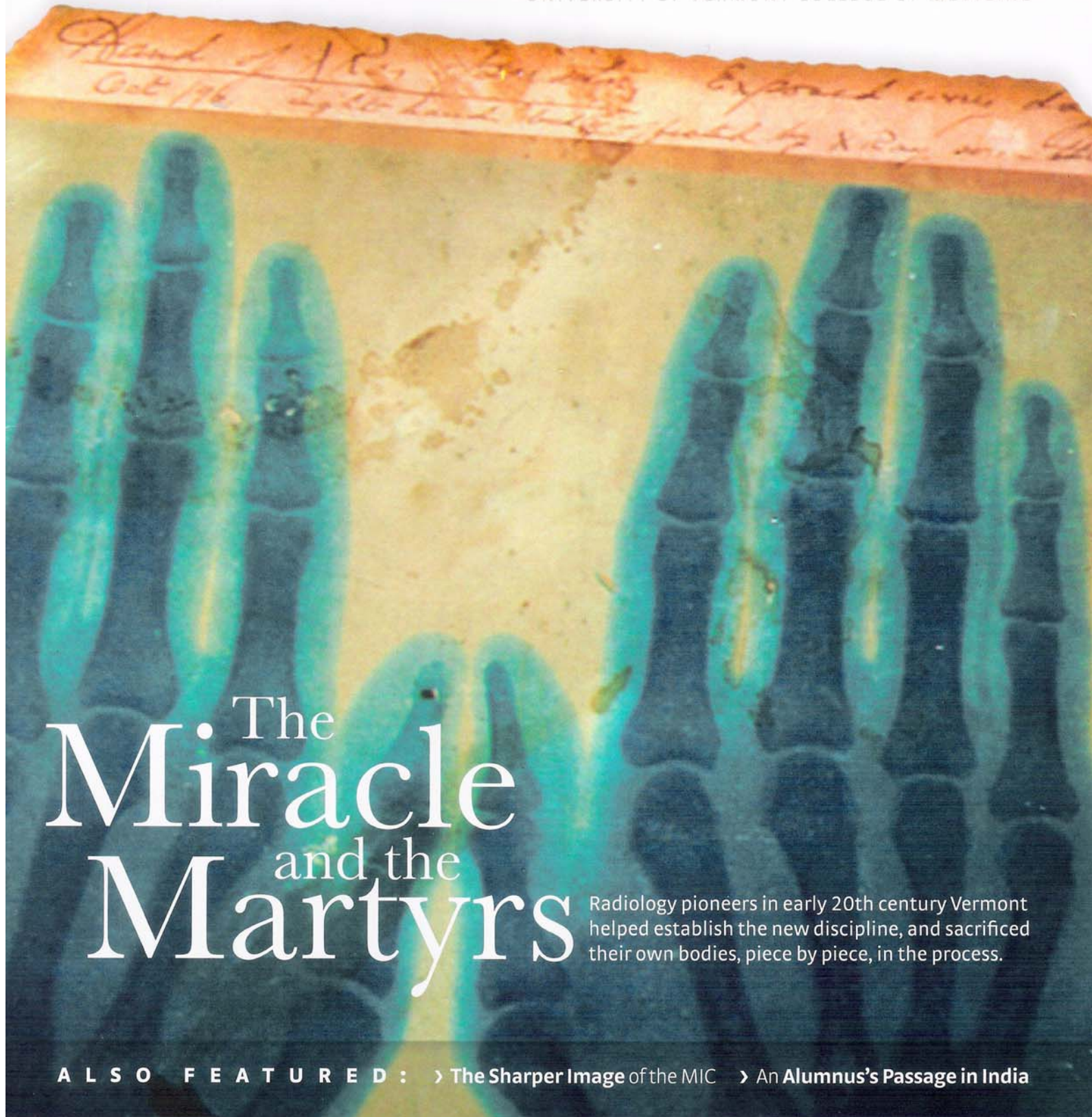


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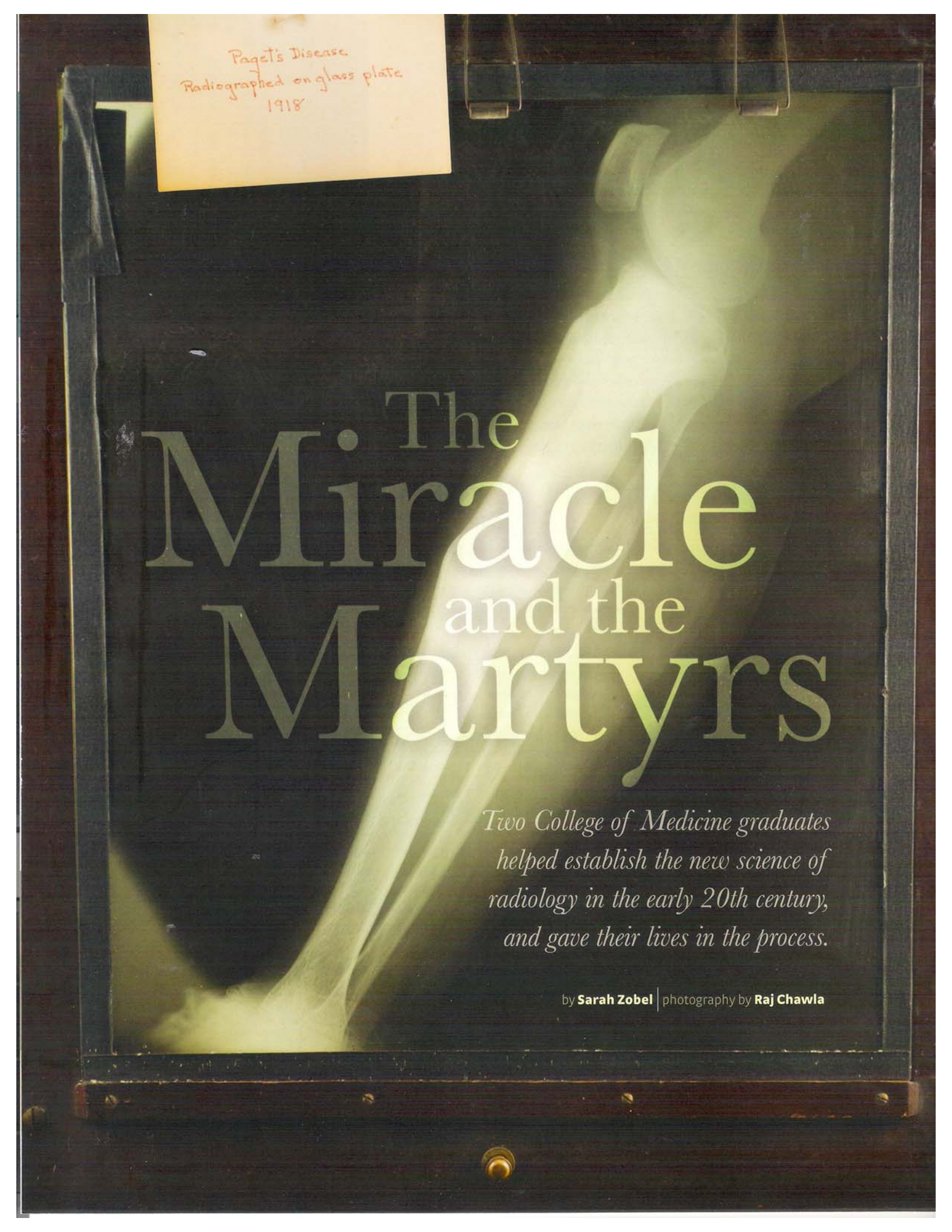


The Miracle and the Martyrs

Radiology pioneers in early 20th century Vermont helped establish the new discipline, and sacrificed their own bodies, piece by piece, in the process.

A L S O F E A T U R E D : › The Sharper Image of the MIC › An Alumnus's Passage in India

Paget's Disease
Radiographed on glass plate
1918



The Miracle and the Martyrs

*Two College of Medicine graduates
helped establish the new science of
radiology in the early 20th century,
and gave their lives in the process.*

by Sarah Zobel | photography by Raj Chawla

At a professional meeting of roentgenologists in 1920, a chicken dinner was served. Soon after the plates were set down, it became apparent that few of the attendees were able to enjoy the meal. After years of working with X-rays, so many had lost fingers or hands to radiation-induced damage that almost no one was able to cut the meat by themselves. Among them, perhaps, were some of the men who would forever be known as radiology martyrs.

Two who earned that unfortunate sobriquet had significant ties to the University of Vermont College of Medicine and in their short lives left a definitive mark on the field of radiology: Walter James Dodd, M.D., of the Class of 1908, and Lawrie Byron Morrison, M.D., who graduated in 1902.

On a Friday afternoon in November 1895, German physicist Wilhelm Roentgen was working in his laboratory with a Crookes tube — a glass bulb with the air evacuated from it and two or more electrodes sealed inside — connected to an electrical induction coil. The room was dark and the tube was covered with black paper because Roentgen hoped to measure the rays coming from it. When Roentgen switched on the electrical current, however, this cathode ray tube cast a glow on a screen coated with barium platino-cyanide that lay a few feet away. Through further investigation, Roentgen would determine that a new kind of radiation was emanating from the tube. In addition, he observed that the rays passed through most substances, including soft tissue, but not certain metals and human bones. He termed this radiation “X-rays” because its source was unknown to him. Days later, Roentgen took his first photographic X-ray: his wife’s hand, her wedding band and bones easily discernible. Though she was horrified by



Above, two rare surviving X-ray tubes used by Lawrie Morrison, M.D., of the Class of 1902 in the early 1900s. Before the full effects of radiation were understood, these powerful, unshielded tubes broadcast X-rays throughout the laboratories and examining rooms of early radiologists.

Below, Walter Dodd from his class photo in 1908. At right, the first clinical radiograph in America, taken by Dodd at Massachusetts General Hospital in 1896, just a few months after the discovery of X-rays by Wilhelm Roentgen, below right.



W. J. Dodd.
Valedictorian

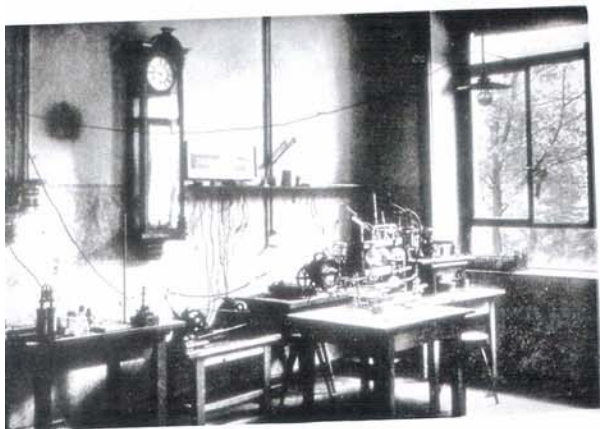
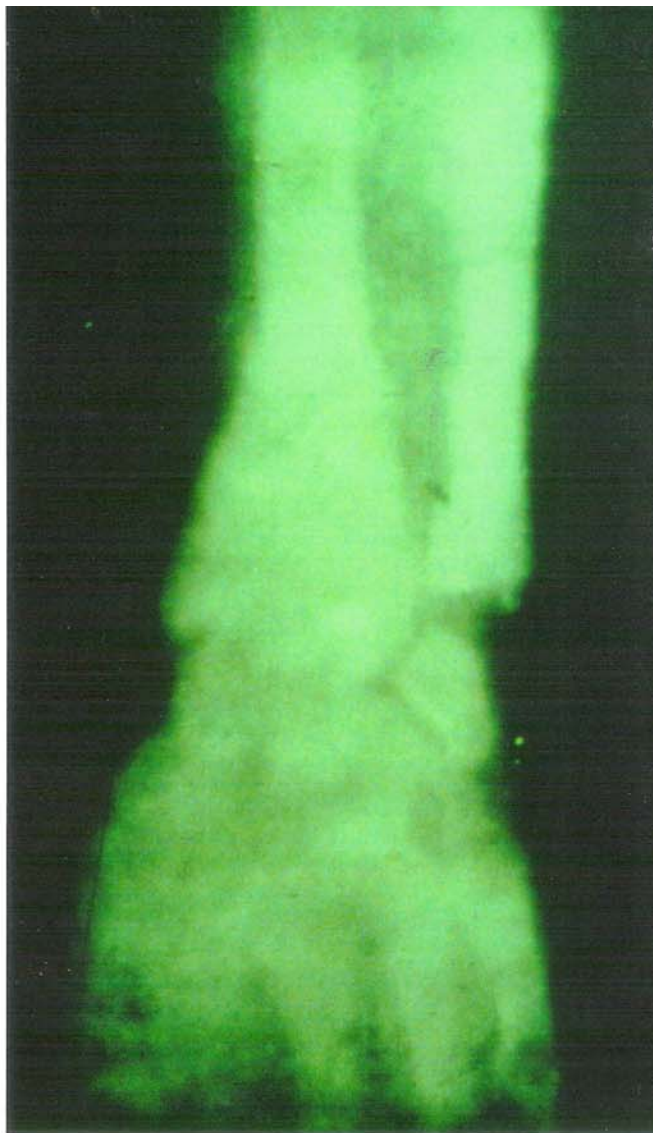
what she saw as a visible reminder of her mortality, others were more appreciative. In a matter of months — before it had been fully tested and understood — the X-ray would become both scientific tool and entertaining curiosity worldwide. To the medical community it seemed a miracle — where definitive internal diagnosis had required risky surgery, a simple machine could now supply the view. For his work, in 1901, Roentgen received the first Nobel prize in physics.

Walter James Dodd, M.D., of the Class of 1908 was sent to Boston from his home in London in 1879 at age ten, soon after his father's death. Dodd was raised by his sister; when he was old enough to work, she made it clear that she thought it a poor choice for him to follow his plan of going to sea as a coffee and tea merchant. So Dodd's Sunday school teacher recommended him to her cousin, Harvard University's President Charles Eliot; Eliot found Dodd a position as assistant janitor in the Boylston Chemical Lab at Harvard, beginning in 1887. In the lab, Dodd was expected to clean, but he asked permission to also be allowed to prepare materials for chemical experiments.

At the same time, Dodd began attending lectures in chemistry and qualitative analysis, and in 1892 he was appointed assistant apothecary at Massachusetts General Hospital (MGH), advancing to the chief's position within two years. The apothecary's work required the filling of prescriptions, but he was also the hospital's official photographer of "interesting" people, whether dead or alive.

In early 1896, reports of Roentgen's discovery reached MGH, and Dodd immediately set about conducting experiments to produce radiation. Within a few months Dodd constructed a machine that took the first X-ray exposure in an American hospital.

Not long after, by the autumn of 1896, Dodd had begun to suffer the effects of radiation exposure.



Class of 1902 member Lawrie Byron Morrison was born in Barnet, Vermont, in 1875, one of 12 children. His path to medicine was less circuitous than Dodd's: he graduated from Peacham Academy and went directly to the University of Vermont, where he earned both undergraduate and medical degrees. After training in Philadelphia and Montreal, Morrison returned to the university as instructor in embryology, histology and pathology. In short order, he was appointed medical director and assistant superintendent of the Mary Fletcher Hospital.

Dodd, meanwhile, had been advised by his colleagues at MGH that he would never enjoy the prestige and respect accorded physicians and surgeons unless he, too, had a medical degree. In short order, he enrolled at Harvard Medical School, but left after one year because he was too distracted, constantly sought out for his expertise in radiography. He transferred to UVM, where he hoped he would be far enough removed to be allowed to focus on his studies. Not one to rest, he continued to serve as pharmacist at MGH during that time, even as he was elected president of his medical school class. After graduating, Dodd was formally appointed roentgenologist at MGH, making official what he had been doing for years. He also joined forces with George Holmes, M.D., to establish a private radiology practice on Beacon Street.

At UVM, Dodd had studied under Morrison. Yet the student was also the teacher: during that time, Dodd ignited Morrison's interest in radiology, and helped him install the first X-ray equipment at Mary Fletcher, where Morrison was then appointed radiologist. After Dodd returned to Boston, he invited his former professor to join him in his practice, and in 1914, Morrison left for Boston. He was one of the few radiology pioneers to enter the field as a physician rather than as a physicist, an engineer, or a photographer.

Dodd is recognized for his importance in the field of early American radiology. Though his name is less familiar, Morrison's contribution to the emerging field was no less significant. After moving to Boston, he went on to establish radiation centers at several Boston-area hospitals, including New England Deaconess (now Beth Israel Deaconess), New England Baptist, Faulkner, Robert Bent Brigham (now part of Brigham and Women's), and Corey Hill. He focused his extensive research career on osteocarcinoma, the calcification of vessels in diabetics, and the role of radiology in the diagnosis of colon cancer and hip disease. Perhaps most important, he was the first radiologist to show a hiatal hernia in the esophagus and stomach through use of an X-ray and contrast medium.

As with so many scientific discoveries, the early reaction to the development of X-rays was exaggerated. Physicians, of course, were eager to use them as both diagnostic and treatment tool, but they weren't the only ones who fell prey to "roentgen mania." Department stores installed machines to show the bones in customers' feet, so that employees could be sure new shoes fit properly. Cranial X-rays were suggested as a means to cure criminal behavior, as well as a way to reform drunkards and smokers. Medical schools talked of using X-rays to reflect diagrams directly onto



Lawrie B. Morrison, M.D.
First Roentgenologist at M.F.H. 1906-12.



Mary Fletcher Hospital and Nurses Home Jan. 1909.

Above, Lawrie B. Morrison graduated with the Class of 1902 from the College of Medicine. He returned to the College to teach and serve as medical director and assistant superintendent of Mary Fletcher Hospital, seen above in an early photograph.



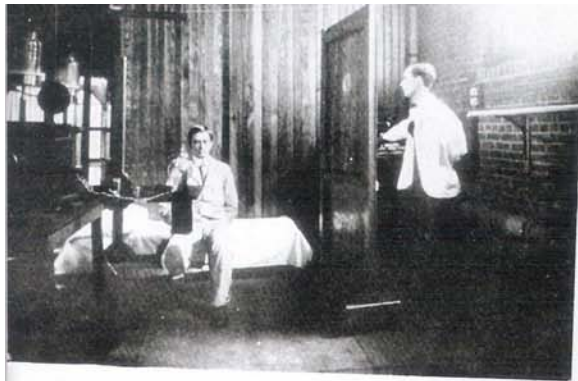
The early device seen above regulated the voltage and the timing for X-ray exposures of different parts of the body, as noted on the chart pasted to its lid.

students' brains, in the hopes of creating a more lasting impression than traditional methods of learning. One experimenter claimed that he had caused a dog to salivate by projecting an X-ray image of a bone on its brain, and there were rumors of someday using X-ray glasses to see through women's clothing. But medicine reclaimed X-rays when the novelty abated, particularly when negative side effects began to be routinely reported.

Complications from X-rays were observed from their earliest use — published reports of hair loss after prolonged exposure to X-rays appeared within weeks of Roentgen's discovery. In 1896, there were nearly two dozen reports of skin damage related to radiology — redness, itching, drying, and blisters on exposed hands, arms, and face. Thomas Edison began experimenting with X-rays shortly after Roentgen's discovery. Most of Edison's lab work was actually performed by his assistant, a former lightbulb glassblower named Clarence Dally. Dally became the first American to die of radiation exposure in 1904, a development that shocked Edison into abandoning all X-ray research. Later that year, the first American radiologist died from related causes. The speed with which burns developed into metastatic epidermoid carcinoma startled the medical community.

Because a great deal of the early X-ray equipment — like Dodd's and Morrison's — was homemade, the dangers of X-rays were magnified. And even those that were not homemade tended to be unreliable, producing radiation that was intermittently too weak to be effective and then strong enough to irradiate people in nearby rooms.

Physicians worked with a variety of tubes, depending on what they needed for a given patient. Gassy tubes had less penetrating rays, and could be used on less dense parts of the body; to look at the abdomen, however, they needed to use better-evacuated tubes, which produced more energy and emitted powerful rays. These tubes were not enclosed when in use, which exposed both doctor and patient to their rays. The seat-of-the-pants approach to the new technology only added to the risk. One early X-ray therapist said that because dosages were uncertain and results capricious, the best one could do was put a patient on a table under the machine and hope for the best. Patients were often burned from inaccurate doses, and occasionally even electrocuted.



Dr. Walter J. Dodd (right) at the controls of one of his early x-ray machines

Radiologists were learning as they went, in many cases unaware of the dangers of their procedures. In calibrating the fluoroscope used in daily practice, for example, they would pass their own hands beneath it, in direct exposure to the X-rays. Early fluoroscopes were worn like masks, and rays passing through or around them fell heavily on the user's face, hands, and upper torso. Sometimes, to calm anxious patients, physicians would personally demonstrate how safe and easy the process was, taking unnecessary X-rays of themselves. Others did the same thing to amuse patients with the novelty of it all. Though there were many who suspected the risks, others operated under a false sense of security, wearing only leather, silk, or rubber surgical gloves as protection. And all kept up the innocent hope that a cure for radiation-related illnesses would soon be discovered.

Dodd suffered his first bout of dermatitis, on his face and hands, in 1896. He reported that the pain was "beyond description"; his skin appeared as though burned. Soon Dodd's hands became so inflamed that he couldn't sleep; instead, he covered them with a salve and gauze and walked the floor of the hospital pharmacy all night, hands held above his head. When the inflammation quieted down, after a couple of weeks, he would get back to work — until it recurred. In 1897, he received his first skin graft, but it was unsuccessful, and within five years, cancer had spread through his fingers. He began a series of what would eventually be 50 operations lasting an hour and a half to three hours each. During these procedures, bits of his fingers were removed, one piece at a time. He sometimes went to the operating table not knowing how much of his hands would be left when he woke up. Decisions were made by Dodd and his surgeon about how much to remove from each lesion-ridden hand, based on a given finger's level of usefulness. Although it was burdened with a cancerous ulcer, Dodd kept his little finger as long as he could so he would have something to press against when using the X-ray equipment.

And still he kept working. In 1915, Dodd volunteered to serve with the Harvard Medical Unit attached to the British Expeditionary Forces in France. He was transported to the train station by ambulance, a wound in his upper arm and chest wall raw from a recent operation. It was reported of Dodd that despite his continued outwardly sunny demeanor, it pained him to go out in public, where people would inevitably stare. He dreaded going to the houses of friends, even, for a meal, since he was certain there would be some mishap with his food. Though he still frequently went to the theater, he would stand in the back, so as to be able to leave without drawing attention. A photograph taken in 1915, before Dodd shipped out from Britain to France, shows him sitting cross-legged, with his hands purposefully hidden behind one knee.

Morrison would suffer the same effects, losing his fingers a knuckle at a time, beginning with his left hand in 1929. In quick succession, his right hand was affected, and by 1931 his entire left arm had been amputated. Like Dodd, Morrison put off as long as possible any amputation that would affect his active practice.



Above left, Walter Dodd X-raying a patient's foot at Massachusetts General Hospital. Above, the hand-held fluoroscope viewer that allowed dangerous amounts of radiation to flood the physician's head and chest. Below, Class of 1908 member Walter Dodd, M.D., during his military service a year before his death. His partially amputated hands are placed discretely behind his crossed legs.



DODD IN LONDON, 1915



A Record of Research and Sacrifice

Above, a cabinet displays just part of the large Morrison collection during its display at the Franklin County Museum. The Morrison Collection is scheduled to be transferred to the Warren Anatomical Museum in 2012. Below, Morrison's red goggles, used to enhance the reading of early radiographs, will remain with the small collection of his artifacts remaining at the College of Medicine.

Lawrie Morrison, M.D., left behind an office's worth of X-ray equipment. His only child, Harvey, also a radiologist, donated it to UVM; there was talk of using it to start a medical museum centered around radiology. When space became tight, Harvey Morrison worked with UVM's Bradley Soule, M.D., to find room for the equipment at the Franklin County Museum, through the auspices of the St. Albans Historical Society, where it has been housed since 1972. At that dedication ceremony, the younger Morrison stated that it was his hope that the exhibit would be considered a memorial to the pioneers in the field of radiology from all over the world.

In the coming year, Lawrie Morrison's early twentieth-century roentgenology equipment will have a new home, as it joins other collections of artifacts honoring the early radiological pioneers at the Warren Anatomical Museum at the Countway Library of Medicine at Harvard University.

"It's a large collection, and it's intact, which is pretty rare," said Warren curator Dominic Hall, listing some of the many pieces that interested him. Those include a two-screen light box, an examination table, a Snook machine (which generated the high-voltages needed for early tubes), a headpiece that directs the X-ray beam to the jaw, a stereocard collection showing the headpiece in use, and several rare glass-plate X-rays. "With this equipment collection, you have a tangible testimony to Morrison's contribution to early twentieth-century radiological science, particularly in the New England area. It's especially important because he didn't leave an extensive published record, and this affords a wonderful way for him to be remembered."

John Tampas, M.D., '54 former chair of radiology at the College of Medicine, has been instrumental in coordinating the donation.



Both men continued to practice medicine until close to their deaths — Dodd's in 1916 at age 47 and Morrison's in 1933 at age 58, of generalized pulmonary metastatic disease.

One might wonder why these men continued to expose themselves to radiation, even when there had been concern as far back as 1896 about doing so. In the first few months of roentgenology, reports of alopecia, erythema, and skin lesions had been shared by doctors who implored practitioners to hold off until the action of the X-rays was better understood. But Dodd and Morrison, and many of their colleagues, were willing to suffer the consequences associated with their specialty in the name of science.

"I think that Dodd and Morrison were just too intrigued by the potential of this specialty to worry about it," said John Tampas, M.D., '54, former chair of radiology at the UVM College of Medicine. "Were they practicing a little self-deception? Probably to a partial degree, yes. There's no question that these men had an utter disdain for any distraction that took them away from their totally fascinating work."

One contemporary said that Dodd had won the respect of the entire MGH staff through his "careful, painstaking work and by his ever-willing self-sacrifice." Some referred to him as a "roentgen saint." Both Dodd and Morrison were willing models for their patients, many of whom were hesitant to undergo diagnostic or therapeutic X-rays until their doctors showed them how easy and painless it was. At the same time, the two men knowingly served as models for their colleagues in what not to do in working with X-rays, and as a reminder to take all available precautions.

They were far from alone. Roentgenology, it is said, was understood to be a field in which certain individuals were willing to suffer pain and disfigurement. Those so-called X-ray martyrs eventually earned international recognition. In 1936, a monument at Saint Georg Hospital in Hamburg, Germany, was dedicated to them. It is inscribed:

To the roentgenologists and radiologists of all nations — doctors, physicists, chemists, technicians, laboratorians, and nurses — who sacrificed their lives in the struggle against the diseases of mankind. They were heroic pioneers who made possible the successful and safe use of roentgen and radium rays in medicine.

The monument's vertical stone shape is said to represent an amputated finger; the names of 350 individuals, including 40 Americans, are listed in alphabetical order on its faces, so as to downplay any one person's importance over another. Walter Dodd's and Lawrie Morrison's names are among them.

It wasn't until 1928 that X-ray safety guidelines would be issued by the International Congress of Radiology (ICR). They specified the amount of lead needed to shield X-ray tubes of varying voltages and even the necessary size, temperature and color scheme for X-ray rooms. But even those guidelines were inadequate, and the justifiable fear of X-ray exposure continued. As he lay dying in 1931, the elderly Thomas Edison provided his doctors with a detailed written list of his symptoms, but the Wizard of Menlo Park, who had watched his assistant die piece-by-piece so many years before, resolutely refused to submit to an X-ray.

By 1934 the ICR was prepared to issue revised guidelines based on decades of research and a better understanding of how even a seemingly small difference in doses could affect radiologists and patients. Those are the direct forebears of the standards that today protect radiologists in their work. In countless ways, two quiet, Vermont-educated doctors played a significant role in their evolution. VM

The editor wishes to thank John Tampas, M.D. '54 and the Morrison family for their assistance in presenting this story.



Above, Lawrie Morrison, M.D., near the end of his life. His malignant left arm was amputated in December 1931, but Morrison continued to fish in the summertime using a special leather harness to hold his fishing rod. Below, the monument to radiological martyrs at St Georg's Hospital in Hamburg, Germany.

