speech by Otha W. Linton, MSJ to ISHRAD 3 March 2012 at European Congress of Radiology, Vienna, Austria

It is a delight to talk and write about radiology. That is how I spent my occupation for the past 50 years. For the first of those years, I labored to learn about the specialty of diagnostic and therapeutic radiology so that I could perform public relations efforts for the American College of Radiology. I retired from that organization 15 years ago. Since then, I have been flunking retirement and now I write more than ever.

In 1960, the American College of Radiology committed to a vigorous effort to tell the American public about the values and achievements of the medical specialty called radiology. At that time, and even to this date, American doctors in other specialties performed much of their own patient imaging. While private health insurance was growing in the United States, radiology was not covered like internal medicine or surgery.

Five years later, when the American government enacted the first national health program---Medicare---with coverage for the elderly and poor, we had a tremendous challenge to persuade the government to recognize radiology as a physician specialty and not simply as a form of hospital service. So we went about telling anyone about x-ray imaging. And we were able to persuade the US

congress to favor us. Then I was sent from Chicago to Washington to defend our role with Medicare and other public health programs. For many years, we would persuade medical administrators to come with us to an academic radiology department, where we would give them a white coat and spend a day watching every part of radiology practice. We invited newspaper and television reporters to visit our groups. About the same time, we recruited medical students to opt for specialization in radiology.

In those years, I began to dig into radiology history. Several hundred radiologists were very senior and some of whom dated back to the early part of the 20th century. They called themselves the Gas Tube Gang. They pushed the major societies for projects to collect early pieces of equipment, books, old films and to record everyone's memories.

Years later, some of the surviving Gas Tube gang insisted that we plan a centennial radiology celebration in 1995, an exact century after Wilhelm Conrad Roentgen had discovered x-rays. I was given the task to organize the effort. We involved more than 50 societies and most of the companies that sold radiology equipment and products. That centennial celebration contained three books describing the development of diagnostic radiology, the growth of radiation treatment of cancer, the advent of radioisotopes, ultrasound, physics, and by then, computed tomography and

magnetic resonance. We had sets of slides, videotapes, a learning file about ionizing radiation for science teachers. To our delight, we shared our projects with radiology in several other countries, notably Britain, Australia and Japan.

For one of our books, I wrote a chapter tracing the economics and politics on how radiology had grown in the United States. Then, as I was nearing retirement, I took on the task of writing a history of the American College of Radiology, almost 75 years old. The college was founded in 1923. I was hired in 1961 and there we were in 1995. I had been involved in the growth of all of the major radiology societies. In 1997, the book was published.

Just before the College history was finished, Stanley Baum, the emeritus chairman of radiology at the University of Pennsylvania, asked me to write a history of that department. I agreed and dived in. The U of Pennsylvania physicist, Arthur Goodspeed, not knowing what he had done, had made x-rays before 1890. So that was real radiology history.

Another friend asked me to write a history of radiology at Boston University in Boston. That involved the earliest clinical experimentation of Francis Williams, author of the first comprehensive radiology books in the USA---and his scientific brother-in-law, William Rollins, who drastically improved the type of

gas tubes that Roentgen had used and many others used with no controls and no protective shielding.

Then came an offer for a history at Massachusetts General Hospital, the oldest one in Boston, and the inventor of their own first x-ray machines in early 1896. Next, I moved toward Harvard Medical School to write about radiology at the Brigham and Women's Hospital, also one of the great x-ray pioneers.

From there, I traveled to San Francisco to record the University of California medical school's development of radiology and its growth into the use of cyclotrons and later CT and MRI. When I finished there, I moved down the road to Stanford University and recorded its radiology from about 1900 to 2005. I took a request from the Dotter Institute at the University of Oregon. Charles Dotter was one of the early and very dynamic developers of angiography and the use of catheter studies to visualize and even unclog vascular systems. Then came books from diagnostic radiology at the two most dominant American cancer hospitals, MD Anderson in Houston, Texas, and Memorial Sloan-Kettering at New York City. Then, I was engaged in a book about the University of Maryland.

By then, I started books at Johns Hopkins Hospital in Baltimore and the combined Beth Israel and Deaconess hospital in Boston. Just after I began both of them, I was asked to write a 75th year history

of the American Board of Radiology. So by the end of last year, all 14 of my books had been published and I have shared some of them with many others. Now I will be into two more histories in coming months.

In tackling all of those books, I visited the academic centers so that I could dig into the annual reports of the medical schools, hospitals and radiology structures. I would also interview members of the faculty, retired radiologists, other physicians and write each book with nearly a century or slightly more historic progress.

By the time I was into my Boston books, I realized that I had very little knowledge about the early development of radiology in Germany, Britain and other parts of Europe. Likewise, I had little depth about the development of radium and other radioactive substances in France with Henri Becquerel and Pierre and Marie Curie. But, in our centennial books, most of the authors had tied the development of various x-ray specialties with American and European doctors who helped make radiology grow.

I became aware that in the first decade after Roentgen's announcement, many of the American aspiring radiologists spent a year or more in Europe visiting pioneers in Germany and England and France. Many of them learned French or German and wrote

papers in those languages. In the book about Memorial Cancer Center, I dug into the creation of radium in the United States.

I learned that the first journal discussing medical x-ray use was started in 1897---English Skiagraphie---supported by the organized London Roentgen Society. A year earlier, in 1896, Henri Becquerel had written a series of monographs in a publication entitled "Applications de la Radiologie a la Medicine." The journal of the American Medical Association published its first x-ray article in 1896. An American doctor, Heber Raberts, also started a radiology journal in 1897. And societies in England and Germany preceded the first United States society, the American Roentgen Ray Society, founded in 1900. Also in 1900, there came the Congres Internationale d'Electrologie et de Radiologic Medicales organized in Paris, France.

Most of you are aware that Roentgen made his first discovery of an invisible x-ray beam from electric current in a vacuum tube on 8 November, 1895, in his laboratory in Wurzberg. We all were aware that he wrote his first paper a month later and got it published in the Wurzberg college journal at the end of 1895. He mailed about 50 copies to his friends and competitive physicists in Europe. A week later, on 5 January 1896, a brief news article about Roentgen's discovery appeared in a Vienna newspaper. By the next day,

newspapers in Europe and in the United States carried copies of the brief news story.

Other physicists who had been working with electric currents and vacuums realized that they also had been generating x-rays. So in February 1896, the first medical x-ray images were produced in Dartmouth College, by Arthur Goodspeed at Philadelphia, and by physicists at Harvard and Yale Colleges. By the same time, Emil Grubbe, a cranky physicist in Chicago, claimed that he had treated a woman with cancer by means of radiation energy. And he set up a business to teach any American doctor about how to produce and look at x-ray images in a matter of just a few weeks.

Otto Glasser, a German physicist who had emigrated to the United States, and who wrote the major Roentgen biography, worked with doctors trying x-ray treatment and wrote many other essays about the growth of x-rays from Roentgen and his European competitors to American scientists. Otto Glasser asserted that in 1896, more than 1000 papers about x-rays appeared in various American scientific publications. Also, in February 1896, the first medical x-ray ever produced in Canada was introduced into a court action in Montreal where the x-ray image displayed a bullet lodged in the leg of the plaintiff and the defendant was convicted of shooting him.

Most of us know about the contribution of the first hot cathode x-ray tool devised by 1913 as the product of William D. Coolidge, a scientist working in the General Electric Company . The Coolidge tube was much stronger and safer than the gas tubes used by Roentgen and everyone else. The tube was built within a metal housing with an adjustable aperture to allow an energy beam to be limited to the patient's area of concern. Coolidge went on to develop stronger x-ray tubes to be used for treating cancers. And because of the tube shielding, the radiologists and their technologists were spared the exposure all of them had suffered earlier.

Because of my involvement in the International Society of Radiology, I had asserted the first international convention in London in 1925. But I found the existence of the Brussels Congress of Radiology and Electricity in 1910 in Belgium. And that was the time and place that some radiologists began to define measurements of radiation, particularly with the use of radium. I had been aware that the biggest effort for the development of radiation measurements and protection standards had taken place in 1928 at the second international congress in Stockholm, Sweden. That was the time and place where the International Commission on Radiologic Protection and the International Commission on Radiation Units and Measurements got started with the sponsorship of the International Society of Radiology.

In most American academic medical centers, the early news about x-ray applications prompted the institutions to obtain an x-ray unit and assign some young doctor to learn how to operate it. Because there were not any organized training structures, x-ray operations were assigned to surgery or internal medicine departments. The young doctor got paid by the medical school or institution. In a few months, some of those x-ray specialists would open a private office, where they could receive ambulatory patients and collect a fee for performing and interpreting patient examinations. I did not do any digging in other countries. I learned that a lot of American surgeons and internists chose to interpret examinations of their patients and bill the patients an extra fee.

Within two decades of x-ray discovery, American medical specialists, ophthalmologists and otolaryngologists, organized the first medical specialty. That led to establishment of various residency training programs and a specialty board which defined disciplines and gave examinations to those who wished to be certified. In 1934, the American Board of Radiology was created with sponsorship by major radiology societies. That board first grandfathered several hundred self-styled senior radiologists and then began oral examinations of younger candidates. The board also defined the development of residency training and gradually required

completion of an approved training program before a young doctor could take the examination.

I have been told that specialty qualifications were provoked in other countries. Last year, I learned that the European Society of Radiology adopted a specialty certification program with some advice from the American Board of Radiology. The third session of the European examinations took place during this 2012 meeting .

On several occasions, I came across the very early x-ray studies for soldiers who were wounded in wars. The first one, purportedly, was used by the Italian army in 1896. The British used x-rays with their troops doing battle with the Dutch Boers in South Africain 1898. The Americans used x-rays in their war with Spain in 1898. By the beginning of World War I, all of the army medical teams involved x-rays to find bullets and define fractures and other damage. All of this, before formal training, meant that military doctors had to teach themselves how to use diagnostic x-rays. And, interestingly, some of those who were assigned to x-rays in army hospitals, chose to continue in radiology when they got back home.

In the USA, until the mid 1970s, the radiology resident qualifications and specifications of the American Board of Radiology, required training, experience and examination of candidates for both diagnostic and therapeutic treatment. Then the American Board

separated requirements and examinations for diagnosis and therapy. By then, the therapists had fairly well abandoned the use of radium. They had obtained million-volt x-ray generators, cobalt-60 devices and linear accelerators which are now the major workhorses in most countries.

In the 1920s, a few scientists were experimenting with artificial isotopes. In France, Marie Curie's daughter and son-in-law developed artificial isotopes in 1934. In California, physics professor Ernest Lawrence developed cyclotrons and began to produce radioisotopes for medical uses in the mid 1930s. Also, a few radioactive isotopes were developed in Boston and were used for studies and treatment of thyroid problems. But the isotopes were scarce and expensive.

In the beginning of 1942, the United States, with help from Canada and England, secretly began developing atomic bombs. Two of them were dropped in Japan in the summer of 1945 and caused Japan's surrender and the end of World War II. The next year, the American government created the Atomic Energy Commission to continue producing artificial isotopes and to make them available to doctors and other scientists. The radiologists and their board asserted that isotope use was part of radiology. Some other doctors, principally internists, asserted that medical isotope uses should be recognized as a separate medical discipline. The Atomic Energy Commission

developed qualifications as the condition for letting doctors use isotopes. In the 1960s, the dominant artificial isotope was molydenum 99 and its refined technetium 99. Some of the isotopes were used for treatment, but not widely.

Most of a decade later, a few doctors took versions of the sonar systems developed in World War II for radar detection of aircraft and navy vessels, and began to use ultrasound techology for detection of various human ailments. One of those changes was the use of ultrasound instead of x-rays to study advanced fetuses. The ultrasound did not provoke any harm to patients or medical operators and it continued to spread. In another story I can tell how I succeeded in persuading our government to define ultrasound as part of radiology.

All or most of you are familiar with the revolutions in radiology that came in the 1950s with the development of image intensification. This brightened the development of angiography and stimulated the use of catheter techniques to correct problems.

But then, in 1972, came the British invention of computed axial tomography, or CAT scanners. Unlike isotopes and ultrasound, CT scanning was adopted in radiology and regarded by all of the health care insurers as part of our specialty. A decade later, when

magnetic resonance imaging was developed for medical use, that, too, was accepted as part of diagnostic radiology.

All of this has been a matter of racing through the growth of radiology and mentioning concepts and events that impacted the increase of the specialty, particularly for diagnosis. With my admission, you can conclude that I learned more about American radiology than I have learned about the developments in your countries.

My own career with radiology has been in efforts to define and develop the specialty, to expand subspecialties, to obtain compensation for radiologists, to help recruit bright medical students to opt into the specialty, and to tell politicians, reporters and educators about the achievements and advances of that modern and well established specialty---radiology. I have been into these activities for a half century. It is my hope that I can keep on for another decade and more.

Thank you for letting me share these items with you. Many of you have probably contributed far more than I have. And I hope that this organization will be of benefit to all of us.