After x-rays were discovered in 1896, medical doctors immediately saw the potential benefits and began experimenting with The Ray using home-made equipment. (See REHW #691.) Just 3 weeks after the discovery of x-rays was announced, the first of many experimenters complained that their hands had received painful x-ray burns.

In addition to x-rays, by 1910 the medical community was using radioactive radium extensively for therapy. Radium was also used industrially, to make glow-in-the-dark watch dials, dolls' eyes, fish bait, gun sights and other items. However, in the mid-1920s, it became clear that many young women painting radium onto watch dials were dying. Their employer, U.S. Radium in West Orange, N.J., insisted the young women were dying because of poor personal hygiene, but studies of the workplace concluded in 1924 and 1925 that all workers were being exposed to excessive radiation. Thus humans learned by trial and error that alpha and gamma radiation from radium can be extremely dangerous even in small quantities.

On December 2, 1942, the first human-created nuclear reactor began operating in a secret laboratory beneath the bleachers at Stagg Field, University of Chicago. The purpose of this reactor was, first, to demonstrate that nuclear fission could be achieved (and controlled) and, second, to manufacture plutonium for a bomb. Dr. Arthur Compton headed this "Manhattan Project," the code name for the U.S. effort to make an A-bomb.

At that time, the world inventory of radium totaled about two pounds. The nuclear reactors built in Chicago, then in Clinton, Tennessee and Hanford, Washington would inventory with the radioactive equivalent of thousands of tons of radium. Many of the radioactive elements in these nuclear reactors were new, with unknown characteristics. Arthur Compton and his colleagues insisted that safety standards had to be developed to protect workers from the harms of radiation.

Early in 1943, Compton hired a radiologist, a chemist and three physicists to set radiation safety standards and to develop measuring equipment to assure that the standards were met. These 5 scientists were called "health physicists" meaning physicists concerned about health. To this day, scientists studying the health effects of radiation call themselves health physicists. X-ray specialists are called radiologists.

In September 1943, the initial group of health physicists moved to Clinton, Tennessee where an enormous industrial facility was being built to process uranium; this became known as the Oak Ridge National Laboratory (ORNL). In 1944, one of the original five health physicists -- Karl Z. Morgan -- was named director of the Health Physics Division at Oak Ridge, a position he held for 29 years until 1972 when he reached retirement age. [1, pg.33]

Morgan played a central role in the development of the health physics profession, and in setting radiation standards worldwide. The Health Physics Society was organized in 1955 with Morgan as its president pro tem; he then served as the society's first elected president in 1956-57. From 1955 to 1977 Morgan served as editor-in-chief of the society's professional journal, HEALTH PHYSICS. In 1966 an International Radiation Protection Association was established, representing professionals in 30 countries, and Karl Morgan was elected its first president.

Most radiation standards are set by the International Commission on Radiological Protection (ICRP), which in 1950 grew out of an earlier standards-setting group, the International X-ray and Radium Protection Committee. Karl Morgan served as one of the ICRP's 13 members from 1950 to 1971, and during that time he chaired the ICRP's committee on internal doses, setting radiation standards which were then adopted worldwide. It seems clear why Karl Morgan is often described as "the father of health physics."

In recent years, Karl Morgan has described and criticized the work of the ICRP. Morgan says the ICRP has suffered from two major blind spots: the Committee has never focused on harm to the public from excessive exposure to medical x-rays, and by the mid-1960s, the ICRP began setting standards for radioactivity that protected the nuclear industry rather than the public, Morgan says.

According to Morgan (who is still an emeritus member of the ICRP), the ICRP began ignoring serious radiation hazards in the early 1960s. He writes, "The period of atmospheric testing of nuclear weapons by the United States, the United Kingdom, France and the U.S.S.R is a sad page in the history of civilized man. Without question, it was the cause of hundreds of thousands of cancer deaths. Yet there was complete silence on the part of the ICRP. During these years (1960-1965), most members of the ICRP either worked directly with the nuclear weapons industry or indirectly received most of their funding for their research from this industry. Perhaps they were reluctant to bite the hand that feeds them?" [2]

In the 1970s, the situation grew worse after a series of studies revealed that radiation was even more dangerous than previously believed. In 1974, Baruch Modan showed that a woman's chances of breast cancer were increased by x-ray doses as low as 1.6 rem.[3] In 1977 Thomas Mancuso and others reported that workers at the Hanford plutonium facility were dying of cancers from radiation doses as low as 3 rem accumulated over many years.[4] (The worker safety standard at the time was 5 rem per year.) Karl Morgan says these studies threw the nuclear industry into a panic: "Concerned that its very existence was threatened if the public believed that there was an increased risk of cancer at these low levels of exposure, the nuclear-industrial complex determined that it would respond vigorously to all challengers," Morgan reports in his autobiography.[1, pg.112] As a result, Morgan believes, "...[h]ealth physics in recent decades has sacrificed its integrity. Certainly there remain some true professionals who will not shake the truth to appease their employers, but they are in the minority," Morgan said in 1999.[1, pg.113]

The ICRP turned a blind eye to other problems affecting public health(2,6),(997,990). It ignored excessive exposures from medical and dental x-rays. Early in the 1950s, a series of studies had shown that x-rays were more dangerous than previously known. In 1950, H.C. March showed that radiologists were nine times as likely as other physicians to die of leukemia.[5] In 1956, Alice Stewart showed that a single x-ray of a fetus in the womb would double the likelihood of childhood leukemia.[6]

In his 1999 autobiography, Morgan describes the ICRP's failure to concern itself with excessive and unnecessary x-ray exposures from diagnostic procedures: "...[I]t was like running into a brick wall every time I raised the question of excessive and unnecessary x-ray diagnostic exposures," Morgan wrote in 1994.[2] "I soon became convinced that the subject of excessive medical exposure was a no, no with ICRP because ICRP was founded under the auspices of the International Congress of Radiology (ICR) and radiologists did not want any restraints or interference in their use of diagnostic x-rays. I had the uncomfortable feeling that there was a serious conflict of interest with ICR sponsorship of ICRP. Without question, it was the cause of hundreds of thousands of cancer deaths. Yet there was complete silence on the part of the ICRP. During these years (1960-1965), most members of the ICRP either worked directly with the nuclear weapons industry or indirectly received most of their funding for their research from this industry. Perhaps they were reluctant to bite the hand that feeds them?"

In the mid-1960s, Morgan's division of the Oak Ridge Laboratory studied the x-ray doses being received by U.S. children as a result of a mass chest x-ray program. Starting in the 1950s, portable x-ray machines in special trucks were brought to schools and hundreds of thousands of U.S. children were given chest x-rays. The Oak Ridge study found that each of these children was receiving an x-ray dose of 2 to 3 rem; Morgan knew this was excessive because workers at the Oak Ridge Laboratory were getting a dose of only 0.015 rem from a chest x-ray. In other words, children were getting a dose of x-rays 130 to 200 times as high as the dose needed to produce an
adequate x-ray film -- not to mention that most of the children did not need a chest x-ray at all. (The mass x- raying of U.S. children was stopped by a campaign led by Morgan, Rosalie Bertell, Irwin Bross and others.)[2]

In the 1940s and 1950s, many shoe stores installed fluoroscopic (x-ray) shoe-fitting machines. By 1949 a study had shown that shoe-fitting machines were giving children high doses of radiation. Again, the ICRP showed no interest in the subject.

Morgan and his colleagues calculated that medical x-rays accounted for 90% of all radiation from human-created sources.[7,8] Morgan showed in 1963 that the average U.S. citizen was receiving each year about as much radiation from medical x-rays as from natural background sources. In other words, the use of medical x-rays was doubling the average person's exposure to radiation in the U.S. Morgan's point was that the same benefits could be achieved at much lower doses by using up-to-date equipment and techniques. The medical community, for the most part, turned a deaf ear.

For many years, Morgan and others wrote about the hazards of excessive and unnecessary radiation exposures from medicine and dentistry -- an effort he describes as "twenty years of frustrating failures." In his autobiography (p. 121), Morgan says it was "a highlight of my life's work" when President Lyndon Johnson signed Public Law 90-602, the "Radiation Control for Health and Safety Act of 1968" which set minimum federal standards for x-ray equipment. (See www.fda.gov/cdrh/radhlth/- summary.html.) However, the law can do nothing to curb unnecessary and excessive x-ray exposures, which still occur routinely.

For the past 20 years, another important scientist concerned about excessive exposure to x-rays has been Dr. John Gofman. In his autobiography, Morgan describes Gofman this way:

"...John Gofman, a scientist who [holds] degrees in both chemistry and medicine. Along with Glenn Seaborg, Gofman co-discovered uranium-233, and he also was the first one to isolate plutonium. In spite of these achievements, Gofman has yet to receive the recognition due him; in my opinion, he is one of the leading scientists of the twentieth century," Morgan writes.

For 20 years or more, Gofman has been publishing studies of the hazards of low-level radiation. His latest book fills 700 pages addressing this hypothesis: "Medical radiation is a highly important cause (probably the principle cause) of cancer mortality in the United States during the Twentieth Century."[9] In other words, Gofman believes that medical x-rays are the major cause of cancer (including breast cancer) and heart disease in the U.S. Gofman's work is careful, thorough, and clearly-written, so most of the health physicists of this world probably cannot be expected to take it lying down. More next week.

--Peter Montague (National Writers Union, UAW Local 1981/AFL-CIO)


Descriptor terms: radiation; x-rays; cancer; karl z. morgan; john gofman; heart disease;