Historical Role of Lauriston S. Taylor in American Radiation Safety and Protection

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Abstract

What do we need to know about radiation, especially 60 years after the Atomic Bombing in Hiroshima and Nagasaki? It is a great honor and pleasure for me to introduce Dr. Lauriston Sale Taylor on this special occasion, who was a leader in American radiation safety and health protection before and after the Second World War. We can learn a lot from Dr. Taylor as well as from our own experience and knowledge on Atomic Bomb Survivors (Hibakusha): how to protect ourselves, how to protect our families and how to make reasonable social and political choices on unpredictable accidents that may happen at nuclear power stations and nuclear terrorism, and also about medical radiological devices. I had the rare opportunity to listen to “A Tribute to the Life and Scientific Accomplishments of Lauriston S Taylor” at the Forty-First Annual Meeting of the National Council on Radiation Protection and Measurements (NCRP) on March 31, 2005 at the Crystal City Marriott conference center in Arlington, Virginia. With the kind permission of the President of NCRP, Dr. Thomas Tenforde and the speaker, Dr. Robert Gorson, I have summarized the accomplishments and spirit of a pioneer in American radiation safety and protection as accurately as possible, although at first glimpse it may seem unrelated to this special editorial comment.

Introduction

There are many international and national committees that provide information and recommendations to federal agencies and states concerning radiation protection standards. The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) summarizes and analyzes pertinent data on radiation-induced cancer and genetic effects and suggests risk estimates for use by international organizations concerned with radiation protection. In the United States, the Biological Effects of Ionizing Radiation (BEIR) Committee serves a similar role to UNSCEAR. These two committees do not make specific recommendations on radiation dose limits based on health effects.

In contrast, the International Commission on Radiological Protection (ICRP) and NCRP in the United States develop the concepts that underlie radiation protection and recommend maximum permissible dose limits for different population groups. There are many recommended dose limits for different organs and tissues and also different population groups such as embryos and fetuses.

Cancer risk assessment for ionizing radiation relies heavily on the tumor data obtained from the Hibakusha in Hiroshima and Nagasaki. Based on the data gathered from the Hibakusha, the best overall fit for risk estimation is in the form of a linear dose-response curve for solid tumors and a quadratic response curve for leukemias; this conclusion is broadly supported by other human cohort studies. The linear non-threshold (LNT) response at low doses of X-ray and gammarays has been supported by in vitro and animal experimental data at dose levels down to about 0.1 Sv, as recently confirmed by the BEIR VII report of the U.S. National Academy of Sciences.

Based on risk estimates from human tumor data with linear extrapolation to low dose, therefore, a maximum permissible annual effective dose of 5 mSv is recommended as the a limit for infrequent exposure of members of the general population. The natural background radiation level is about 1mSv/year. It is recommended that the annual effective dose should not exceed an additional 1 mSv but medical exposures are excluded from this limitation because of their known beneficial effects. The radiation exposure from an average CT scan examination reaches or exceeds 4 to 10 mSv. The medical radiological exposure also finds significance because of a recent unscientific practice which is cancer screening of healthy adults.

To understand the current radiation safety and protection recommendations, it would be beneficial to learn about Dr. Lauriston S. Taylor, of Mitchellville, Maryland; a pioneer in the field of radiation protection and measurement and the founder of the U.S. Advisory Committee on X-Ray and Radium Protection in 1929, which became the National Committee on Radiation Protection in 1946 and was chartered by Congress as the National Council on Radiation
Protection and Measurements (NCRP) in 1964. He died peacefully in his sleep on November 26, 2004, at the age of 102.

Now everyone can easily access the NCRP website, http://NCRPonline.org, to read about the late Dr. Taylor’s achievements, but there is no report so far written from the standpoint of the effects of atomic bomb radiation on Hibakusha.

Personal history of Dr. Lauriston Taylor

Dr. Taylor (his nickname was Laurie) was born in Brooklyn but his family moved to Maplewood, near South Orange, New Jersey soon after his birth. His attraction to science began in early childhood motivated by his father, who was a metallurgist with a broad interest in physics, chemistry, engineering, mining, geology and botany. It was particularly exciting for Laurie as a grade school student to visit Thomas Edison in his laboratory. When the young Taylor expressed an interest in vacuum tubes, Edison promptly gave him a cold-cathode X-ray tube. Laurie's father, however, forbade his son from experimenting with the X-ray tube because his dad he had already heard about the dangers of X-ray exposure. During childhood, Laurie lived in Maplewood, NJ (Figure 1).

As a youth Dr. Taylor explored wireless telegraphy and later became a licensed amateur radio operator. His first love, however, was plumbing. He often walked the three and a half miles distance to school in order to save the nickel carfare to buy plumbing tools. He studied the National Electric Safety Code to take on electrical wiring jobs after school. He even bid on electric wiring contracts. He studied his father's college physics text to learn about electronics.

Dr. Taylor attended Stevens Institute for a year to study engineering, but had to drop out to earn money for tuition. He worked for a year at Western Electric Company, which later became the Bell Laboratories where his interest in electronics led to his decision to drop engineering at Stevens and to enroll in physics at Cornell University. There he studied for five years, completing the requirements for a doctorate except for the residency requirement. His last year of research was in X-ray technology and spectroscopy. One of his professors directed him to a one-year position in X-ray work relating to radiology at the National Bureau of Standards [NBS (now known as the National Institute of Standards and Technology)].

When he returned in 1927, his supervisor had departed unexpectedly so Laurie was left on his own to learn about the medical uses of radiation. After studying much of the radiology literature, he spent time with Dr. Faila at the Memorial Center in New York City where Laurie led a team to develop free-air ionization chambers for the accurate measurement of X-rays and established the first national standards laboratory for medical radiation dosimetry. During this period, Dr. Taylor worked together with Dr. Binks in London to intercompare their X-ray standards (Figure 2).

![Figure 1. The house in Maplewood, NJ where Lauri grew up.](image)

![Figure 2. L. S. Taylor (left) and W. Binks intercomparing the British and American X-ray standards (1931).](image)

Dr. Taylor led the development of X-ray standards at NBS until 1943. Most of his papers in this period dealt with X-ray measurements and early radiation protection recommendations. The "Roentgen" had become the official unit of X-ray exposure in 1928 and he established the roentgen as a basis for X-ray measurements for the first time. Nevertheless, there were many problems remaining, especially in the measurement of gamma rays from radium which had a wide use in radiotherapy at that time. Consequently, there was a period of great activity in the measurement field, and the challenges were further compounded as super-voltage radiations entered the scene later in the 1930s. By the mid-1930s, NCRP had developed the first U.S. radiation protection standards, which were in place for use by the Atomic Energy Project when it was established in 1943.

In 1940, with war clouds on the horizon, Dr. Taylor was asked by the National Defense Research Committee and the NBS Director to organize another totally new program for the development of the proximity fuse for the defense of Britain against the German bomb attacks. As this program developed he was in charge of all field-
test and proof operations and became the Assistant Director of the greatly expanded program. For this work he received the Gold Medal of the Department of Commerce.

In 1943 the U.S. Army Air Force asked Dr. Taylor to organize a program of operations research for the Army's Eighth Air Force Fighter Command in England. The group consisted of civilian scientists and was attached as a special unit to the Commanding General. When Dr. Taylor returned to the United States in late 1943 to recruit some additional professional personnel, the Ninth Tactical Air Force was just being organized. He put together Operations Research Programs for the Army Ninth Air Force, its Bomber Command, and three Tactical Air Commands. During the war period, he received two Presidential Citations, the Medal of Freedom, and the Bronze Star (Presidential), which at that time was the highest military award that could be given to a civilian. After the war he was made Director of the Operations Research Division of the U.S. Continental Air Command. In 1946, Laurie returned to his first love, radiation dosimetry, at NBS as the Chief of the X-Ray Section.

Dr. Taylor took a leave from NBS for a year from 1948 to 1949, to organize and serve as chief of the Biophysics Branch in the Division of Biology and Medicine of the Atomic Energy Division. It was during this period that he organized "Project Gabriel" to evaluate the long-range implications of strontium-90 in radioactive fallout.

In 1962, Dr. Taylor became Associate Director of the Bureau of Standards where he remained until his retirement in 1965.

His career, however, was by no means over. He began a new one at the National Academy of Sciences (NAS) where he spent six years as Special Assistant to the President of the Academy and as Executive Director of the Academy's Advisory Committee on Emergency Planning.

Dr. Taylor departed from the Academy in 1971 at the mandatory retirement age of 70. After that time, he devoted essentially all of his energies to NCRP, the structure of which he had reorganized in 1964 into the Congressionally-chartered National Council on Radiation Protection and Measurements. With the support of the Joint Congressional Committee on Atomic Energy, Lauriston Taylor accomplished several important changes in the status of NCRP. Dr. Taylor was elected as the first president of the new Council, a position he held until his retirement in 1977. After his third retirement Laurie continued to work in his beloved field of radiation protection for another 21 years, volunteering his time to NCRP, writing books, and serving as an expert witness for the Department of Justice.

In an interview in 1995, Laurie related how in 1929 he was accidentally exposed to a large amount of whole-body radiation from an X-ray machine at NBS. That exposure, in addition to medical radiation treatment for bursitis and other benign conditions and from many radiation experiments, resulted in a large whole-body dose. He experienced no discernible adverse health effects. He described that experience to juries with great effectiveness while testifying in cases of alleged radiation injury involving small radiation exposures.

Dr. Taylor's career has been one of extraordinary diversity. He wrote or contributed to 20 books and published over 160 scientific papers, many of which were on radiation dosimetry, an area in which he commanded the respect of all his colleagues and peers.

He also was a superb administrator and diplomat and the most influential person to get scientists from many disciplines to freely volunteer their time and effort through which the production of valuable scientific reports was made possible for the benefit of practitioners in all fields of radiation usage as well as for the general public. His success at this activity led to the completion of no less than 56 publications.

Lauriston Taylor was awarded honorary doctorates from the University of Pennsylvania in 1960, and St. Procopius College (Illinois) in 1965. He received at least 25 other honors, including the Gold Medal of the XIIIth International Congress of Radiology, the Gold Medal of the Royal Swedish Academy of Sciences, the Gold Medal of the American Roentgen Ray Society, and the distinguished Service Award from the Executive Office of the President.

On the occasion of Laurie's 100th birthday, Senator Domenici rose in the U.S. Senate to pay tribute to a "truly great American," an honor duly recorded in the June 5, 2002 Congressional Record.

Dr. Taylor was involved in no less than 75 committees of 37 different organizations of amazing diversity, including the American Medical Association, the Atomic Energy Commission, the Civil Service Commission, and the International Labor Organization, as well as scientific peer review committees at various institutions including Argonne National Laboratory. He belonged to 16 scientific societies and served as president of two.

In his rich and varied career, nothing has been more constant than Laurie's devotion to NCRP, and his steady development of its objectives. On the international scene, he was a major contributor to ICRP, for which he served as secretary from 1937 to 1950, continued as a member until 1969, and as an emeritus member until his death. He was also a member of the International Commission on Radiation Units and Measurements, for which he served as Secretary from 1934 to 1950, as Chairman from 1953 to 1969, and as the Honorary Chairman and Member Emeritus thereafter.

In addition to his many professional achievements, Laurie Taylor was also a licensed plumber, electrician and carpenter, and a master at woodworking. He also enjoyed hiking and camping along the Appalachian Trail with his sons. On one such trip they became snowbound for a week.

It was a measure of Dr. Taylor's great talent that he was able to get so many people to devote so much of their time voluntarily to the public interest. A portrait of Dr. Taylor painted by Kenneth L. Miller was widely distributed to all the participants during the NCRP Annual Meeting in March, 2005 in commemoration of his wonderful scientific contributions (Figure 3). In the field of radiation protection, he was the "man for all seasons" and second to none. His legacy will live for generations to come.
Conclusion

It must now be clear why I have decided to introduce Dr. Lauriston Taylor as the historical leader of NRCP at the commemoration of the 60th anniversary of the atomic bombings in Japan. The good will of American radiation safety and health protection should be acknowledged not only by the American people, but also by the Japanese, especially the people in Hiroshima and Nagasaki. As you all know, in contrast, the planning of an exhibition of the atomic bombing at the Smithsonian Museum in Washington DC was unfortunately and regretfully rejected at the 50th anniversary in 1995 of the atomic bombing. This year again, in 2005, the same thing happened and the plan for a special contribution to the Smithsonian Journal on the 60th anniversary of the atomic bombing has been rejected and failed to go to the press. The situation has never changed since the Second World War, even after the termination of the Cold War in western societies. It may be true that the former U.S. President Harry Truman once said that the atomic bombs dropped on Hiroshima and Nagasaki were just another type of bomb; he never felt that his decision was wrong.

This is exactly why we need to appeal to the world about the necessity of World Peace and not forgetting about the victims of Hiroshima and Nagasaki’s atomic bombings, especially from the standpoint of health and medical care. Very unfortunately, Americans do not know exactly what happened just below the atomic bombing clouds over Hiroshima and Nagasaki on August 6 and 9, 1945, respectively. They do not know or never try to realize the true catastrophe of atomic bombing. As a result, we have felt challenged to publish books in English on the records of the Nagasaki atomic bombing as a message from Nagasaki to the world.

In cooperation with the Nagasaki Association for Hibakusha’s Medical Care (NASHIM) established in 1992, we have succeeded in publishing three English translations of the records of Nagasaki; a city that was devastated by the second atomic bombing at 11:02 am on August 9, 1945, three days after the first atomic bombing in Hiroshima. The first one is the English translation of “Atomic Bomb Rescue and Relief Report” by the late Dr. Takashi Nagai, who rang the bell of Nagasaki as a saint of Urakami. The second is "A Physician's Diary of the Atomic Bombing and its Aftermath” by the late Raisuke Shirabe, former Nagasaki Medical University professor who made heroic efforts to give medical care in the chaos after the Nagasaki tragedy. And recently in August 2005, The third English translation has just been published of the "Collection of Memoirs of the Atomic Bombardment of Nagasaki, 1945-1955" by the late Dr. Kodo Yasuyama, director of Omura Naval Hospital before and after the atomic bombing in Nagasaki. Numerous witness materials have been collected in all these books, and all of them ring a bell for peace and especially for banning experimentation of any atomic and hydrogen bomb weapons anywhere in the world.

Finally health and medical care/science are totally dependent on peaceful societies. Therefore there is no issue as significant as peace in preservation of health of people throughout the world.

In both developed and developing countries, we all need to use and apply medical technology and equipment carefully, with particular attention to both risks and benefits of radiological and nuclear diagnostic and therapeutic modalities and their effects on humans. Therefore on this occasion, the good will and a well balanced and harmonized dedication to medical science has been exemplified by the late Dr. Lauriston S. Taylor.

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