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AN AMERICAN HIBAKUSHA IN FUKUSHIMA

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Abstract : A magnitude 9.0 earthquake and tsunami originating off the east coast of Japan triggered the explosive release of radioactive isotopes from one of four nuclear power plants in the affected area. This event has been compared with the 1986 nuclear accident at Chernobyl, the 1945 atomic bombing of Hiroshima and Nagasaki, and the intervening era of atmospheric nuclear weapons testing. The credibility of any comparison depends on the source, for which reason various specialists were invited to address an audience of media, healthcare, and disaster response professionals on July 18, 2011 in Fukushima City, Fukushima Prefecture. This article is based on a presentation given July 18, and interprets the Fukushima nuclear crisis from the perspective of an American doctor who grew up downwind of an atomic bomb test site, and who now works at Fukushima Medical University.

Key words : hibakusha, radiation exposure

WORDS ON WORDS

1. *Hibakusha*

Hibakusha has entered the English lexicon, particularly in reference to survivors of the 1945 atomic bombing of Hiroshima and Nagasaki¹. It may surprise English speakers to hear the same word applied to people exposed to radiation from the Fukushima Daiichi nuclear power plant. An important distinction is lost when *hi-baku-sha* is rendered in Roman letters rather than the ideographic *kanji* characters that Japan adopted, and adapted, from Chinese. 被爆者 (subjected to – explode – person)² refers specifically to victims of an A-bomb or H-bomb blast³. 被曝者 (subjected to – expose – person) can be anyone exposed to radiation^{2,3}. Nuclear plant accidents are typically cited in this definition, but laboratory mishaps and medical radiation can also make people 被曝者. The middle *kanji* of each word can be understood as a composite of two simpler elements: either 火 (fire) or 日 (sun, day) on the left, and 暴 (violent) on the right². Thus, A- or H-bomb exposure to radiation is connoted by violent fire, and other exposures to

radiation are connoted by violent light. More rigorous analyses are available, but inordinate attention to linguistics can interfere with practical understanding of language. In everyday Japanese, the distinction between 被爆者 and 被曝者 is often blurred by rendering the *baku* of *hi-baku-sha* with two *hiragana* characters that represent the syllables *ba* (ば) and *ku* (く) without imposing a specific meaning: 被ばく者. Early language learners, Japanese or foreign, might render the entire word in *hiragana*: ひばくしゃ.

2. *Fukushima*

Fukushima, too, has entered the general English lexicon as a name associated with detrimental effects of ionizing radiation. In a specialized English lexicon, Fukushima had previously been associated with a beneficial effect. In 1988, Fukushima Medical University was the first institution worldwide to treat all allogeneic donor blood cell products with ionizing radiation to prevent transfusion-associated graft-versus-host disease⁴. Modern authors continue to cite pioneering articles on graft-versus-host disease from Fukushima Medical University^{5,6}.

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General public knowledge about Fukushima is another matter. The prefecture was renowned as a tourist destination and agricultural center, but most people did not know that two nuclear plants on Fukushima's Pacific coast were dedicated exclusively to Tokyo's massive demand for electricity. These are the Fukushima 1 and 2 Nuclear Power Plants, now known around the world by their Japanese designations, *Fukushima Daiichi* and *Fukushima Daini*.

THE PRICE OF POWER

Per kilowatt-hour, nuclear plants have been promoted as being less expensive than other sources of electricity, but indirect, human costs are once again earning some attention. Recent investigations have suggested that from 2003 through 2008, on the basis of workplace radiation exposure, Fukushima Daiichi was among the world's five highest-risk nuclear plants, the other four being in the United States, Spain, India, and Mexico⁷. Through various safety initiatives by TEPCO, the Tokyo Electric Power Company, working conditions seemed to be improving at Fukushima Daiichi in the years just prior to March 11, 2011⁷.

THE GREAT EAST JAPAN EARTHQUAKE "3.11"

On March 11, 2011, a magnitude 9.0 earthquake originated off the Pacific coast of Japan's Tohoku district. Nuclear power stations Onagawa (Miyagi Prefecture, est. 1984), Fukushima Daiichi and Daini (Fukushima Prefecture, est. 1971 and 1982), and Tokai Daini (Ibaraki Prefecture, est. 1978) went into automatic shutdown⁸. The earthquake and related tsunami have been implicated in subsequent failures, radiation release, and core meltdowns at the oldest of these power stations, Fukushima Daiichi. Remote video images of gas-releasing explosions at Fukushima Daiichi were promptly and repeatedly aired on commercial and public television.

At Fukushima Medical University, 57 kilometers from Fukushima Daiichi, the leading edge of a spike in background radiation was observed on the evening of March 15. In a physics professor's office, a peak value of 9.3 times average was recorded in the early hours of March 16. As of October 11, 2011, the decay curve of this increased background radiation could be resolved into a short half-life of 3.74 days and a long half-life of 242 days. These half-lives do not refer to specific

radioactive isotopes, but are calculated by non-linear regression analysis from actual data to forecast further decreases in radioactivity. As of October 11, background radiation at the office where the March 15-16 spike was detected was down to 1.50 times the average background observed prior to the spike. Although radioactive isotopes of cesium and strontium have half-lives around 30 years, background radiation decreases faster as isotopes are progressively dispersed into the environment. For example, the aforementioned decay curve includes a noticeable dip in background radiation on July 28, corresponding to a day of heavy rain.

AMERICAN PERSPECTIVES

1. *Americans in Japan*

On March 17, the US Department of State announced online and by email that US citizens within 50 miles (80 km) of Fukushima Daiichi should evacuate the area or take shelter indoors if safe evacuation is not possible. This recommendation was attributed to the US Nuclear Regulatory Commission, and said to be in accord with directives that would be issued for a comparable event in the United States. Other governments issued similar advice.

This author, an American citizen employed by Fukushima Medical University since January 2008, subscribes to an advisory service of the United States Embassy in Tokyo. The embassy made a health and welfare inquiry by telephone on March 16, and sent an email with evacuation advice on March 17. Subsequent emails in March included information about travel assistance available to US citizens and their dependents. Through September 18, 2011, the United States Embassy in Tokyo continued to advise, "out of an abundance of caution," that citizens living within 80 km of Fukushima Daiichi "evacuate or shelter in place." The March 17 recommendation was modified on May 16 to say that the risk of travel through the area by bullet train or expressway was low. A July 19 travel alert added that it was deemed a low risk to travel to, from, and through Sendai Airport.

Fully aware of official US recommendations, this author continued working at Fukushima Medical University and living about 2 km away. No coercion was involved; in fact, neighbors and colleagues were rather surprised by what seemed to be an act of defiance against the US government by one of its citizens. However, my advice to others,

including an American journalist and a Congolese graduate student, was for them to heed the advice of their respective governments, both of which recommended being outside of Japan's post-3.11 risk areas.

It is the opinion of this author that one motivation for the US Embassy's evacuation advice and assistance was to prevent American citizens from burdening Japan, and cordial Japanese hosts, where infrastructure was damaged and resources were limited. Americans with emergency response, medical, and/or nuclear safety expertise have, along with other nationals, freely traveled and worked in Japan's disaster-affected areas.

2. *American Hibakusha*

In the early 1970s, a guest speaker visited Hibbing High School in the City of Hibbing, capital of St. Louis County in the State of Minnesota. Students assembled in the Hibbing High School Auditorium to learn about nuclear power and radiation. The guest speaker sought a volunteer. From those in the audience who raised their hands, he invited a high school girl onto the stage and asked her to assist with some task. After the task, the speaker offered her a drink of cola as a small reward. The student politely accepted. A conversation along the following lines ensued :

Speaker : "Refreshing?"

Student : "Yes."

Speaker : "Suppose I said your cola was radioactive?"

Student : [Surprised silence.]

Speaker : "Watch."

The speaker turned on a Geiger counter and started to wand our volunteer. As the detector approached her throat, the occasional clicks became much more frequent. This got everyone's attention.

Speaker : "No, I did not give you radioactive cola. Radioactive substances are tightly regulated, and I am not a medical doctor. Your thyroid gland, at the front of your throat, naturally attracts iodine, some of which is radioactive."

To the best of my recollection, the speaker gave no particular details about the extent to which radioactive iodine might be found in nature. However,

St. Louis County was downwind of an unnatural source of radioactive iodine : the Nevada Test Site, where 100 of America's 210 atmospheric tests of nuclear weapons were conducted between January 1951 and July 1962⁹⁾.

The exposure of Americans to radioactive iodine from the Nevada Test Site was not comprehensively investigated until Public Law 97-414 was enacted in 1993, although smaller investigations had been previously reported¹⁰⁾. As directed by Public Law 97-414, the US National Cancer Institute published results in 1997¹¹⁾. In the 1950s, about 150 million curies – in modern terms 5.6×10^{18} becquerels – of I-131 entered the atmosphere from atomic bombs detonated at the Nevada Test Site. The average *thyroid* dose to 160 million Americans during the 1950s was 20 millisieverts. St. Louis County residents, 2,200 km from the Nevada Test Site, received an average thyroid dose of 60-90 millisieverts. Not only location, but also milk consumption and thyroid size were significant factors in an individual's exposure. Children 3 months to 5 years old exceeded the average thyroid dose by 3-7 times¹¹⁾.

What were citizens were told about radiation in the era of atmospheric testing of nuclear weapons? A woman who grew up in southern Utah, just east of Nevada, recalled that when visitors with Geiger counters came to her primary school, she was told that dental X-rays were the cause of elevated readings when a Geiger counter was aimed at her face¹²⁾. A transfusion medicine colleague who grew up in North Dakota, just west of northern Minnesota, said that as a child she was told not to chew on grass outdoors, because it was tainted with strontium (Anne Kaldun, personal communication). Cows are more frequent consumers of grass than well-fed children, but American literature (e.g., *The Adventures of Huckleberry Finn* by Mark Twain) and art (e.g., illustrations by Norman Rockwell) conjure up images of rural children chewing on straws of hay as they work or play outdoors. In the same decade that Anne Kaldun was admonished not to chew on strontium-tainted grass in North Dakota, Japanese investigators were systematically measuring and reporting strontium-90, cesium-137, and plutonium-239 fallout in the atmosphere, rainwater, soil, and food supply in Japan.¹³⁾

DISCUSSION

This author, born in 1958, and Americans of similar age were hibakusha as a result of growing up

in the era of atmospheric nuclear weapons testing. What we were told about this was limited, perhaps misleading, or at least inconsistent with what is now in the public domain. Retrospectively, the spread of radioactive iodine across the continental United States was the main health consequence of atom bomb detonations at the Nevada Test Site, although other isotopes, such as radioactive cesium, were released as well. Hydrogen bomb detonations around the world fueled a global spread of radioactive strontium¹⁰, so people of every nationality can be counted as hibakusha^{9,10}. Saying so should never diminish the significance of this word as it applies to people of Hiroshima and Nagasaki. Rather, this statement of fact should be a touchstone, through which citizens of the world might empathize with the unique history of Japan: a World War II target of two atomic bombs, a Cold War recipient of radioactive fallout that contaminated the food supply, and the most recent nation to deal with a nuclear power plant meltdown.

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