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# Uranium: The Deadliest Metal

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## Bombs and Radioactive Waste

Canada is the world's largest producer and exporter of uranium, yet most Canadians are entirely unaware of our involvement with this "deadliest of metals."

There are only two commercially important uses for uranium: nuclear weapons and nuclear reactors. The ultimate products of the uranium industry are therefore bombs and radioactive wastes. For this reason alone, uranium merits classification as a deadly metal.

But the lethal nature of uranium was manifested long before the first atomic bombs were built or the first nuclear reactors were fuelled.

### **Dying for a Living**

As early as 1546, and for centuries afterwards, it was reported that underground miners in Schneeberg, Germany, suffered an unusually high incidence of fatal lung disease. In 1879, it was demonstrated both clinically and anatomically that about half of these miners were dying of lung cancer. This was a much higher incidence of lung cancer than that found in the general population. The same grim statistic -- 50 per cent mortality from lung cancer -- was later found among the miners in Joachimsthal, Czechoslovakia. The ores in question were particularly rich in uranium.

Similar excesses in lung cancer incidence have occurred among iron, lead and zinc miners in Sweden, in fluorspar miners in Newfoundland, and especially among uranium miners in all parts of the world. Scientific papers published in the 1930s, even before the outbreak of World War II, clearly indicated that airborne radioactivity in the mines was the most likely cause of this lung cancer. The principal culprits are radon gas and its solid by-products, the so-called "radon daughters."

### **Radioactive Daughters**

Uranium is a naturally-occurring radioactive substance, very widespread in the earth's crust, but concentrated in certain hard rock formations. As the uranium atoms slowly disintegrate over billions of years, a host of radioactive by-products are formed: thorium-230, radium-226, radon-222 and the infamous "radon daughters," including lead-210 and polonium-210.

As the miners dig the uranium-bearing ore, they inevitably release large quantities of radioactive radon gas into the mine atmosphere. Radon has a relatively short half-life (3.8 days); before long, the air in the mine is heavily contaminated with radon daughters. Adhering to microscopic dust particles, these tiny, pernicious particles are breathed into the miners' lungs where they lodge delivering a massive dose of alpha radiation to the sensitive lung tissue. The result is an extraordinarily high incidence of lung cancer, fibrosis of the lungs, and other lung diseases, all of which take decades to become manifest.

### **Irrefutable Evidence**

The carcinogenic effects of radon daughters have been studied for many years. The medical evidence is overwhelming and indisputable: radon (with its daughters) is one of the most potent carcinogens known. A 1982 study published by the Atomic Energy Control Board (Ottawa) revealed that workers exposed to the present maximum permissible levels in Canadian uranium mines for a 30-

year period would experience about four times as much lung cancer as non-miners. Instead of 54 out of every thousand males dying of lung cancer (Ontario statistics for non-miners), we would expect over 200 out of every thousand miners to die of lung cancer -- more than one in five!

In 1974, the Ontario Royal Commission on the Health and Safety of Workers in Mines pointed out that the Elliot Lake uranium miners had already experienced twice as many lung cancers as expected. In 1980, the British Columbia Medical Association published a hard-hitting 470-page report entitled "The Health Dangers of Uranium Mining." The BCMA Report warns of a "gradually flowering crop of radiation-induced cancers" among Canadian uranium miners, adding that "We are aware of no other carcinogen which is permitted at levels close to the doubling dose for humans." A total of 81 Canadian uranium miners had died of lung cancer by October 1974. At the end of 1977, the number was 119; at the end of 1981, 174; at the end of 1984, 274.

### **Radioactive Homes**

At Elliot Lake, about a ton of ore is required to extract two pounds of uranium. Huge quantities of pulverized rock (called uranium tailings) are left over from the milling process. The tailings contain 85 per cent of the original radioactivity in the ore: they contain thorium-230, radium-226, and all the other uranium by-products. The tailings also give off at least 10,000 times as much radon gas as the undisturbed ore. (When radon gas is produced inside hard rock, it has little chance to escape; but when the rock is pulverized, radon escapes easily.)

In the Southwest U.S. and in Port Hope, Ontario, many homes and schools were built using the sand-like uranium tailings as construction material. As a result, some of the buildings ended up with levels of radon gas and radon daughters even higher than those permitted in the mines. Similar (though less severe) problems arose in Florida and Newfoundland when phosphate tailings were used for construction, and in Oka and Varennes (just outside of Montreal) when other mine tailings were used in construction. In each case, the original ore was rich in uranium, so the tailings gave off high amounts of radon.

In 1975, St. Mary's School in Port Hope was evacuated because of extraordinarily high radon levels. Radioactive fill had to be removed, at public expense, from hundreds of homes and gardens. Even today, there are over 200,000 tons of radioactive debris lying about the town of Port Hope in open ravines, easily accessible to children and to pets. Eldorado Nuclear Limited, the crown corporation whose radioactive wastes had been generously donated to the eager townsfolk for construction purposes many years earlier, has recently promised -- under the prodding of the Ontario Environment Department -- to finish cleaning up the mess sometime during the next few years.

## **Acceptable Doses?**

According to all scientific evidence, there is no such thing as a "safe dose" of radiation. Every dose of radiation will cause a corresponding increase in cancers and other diseases. Spreading a given dose out to a larger number of people -- so that each individual dose is smaller -- does not reduce the number of resulting illnesses. In fact, in the case of alpha radiation, there is very strong evidence from many different quarters that spreading a dose out among more people actually increases the total number of cancers and other diseases. Uranium and most of its by-products, including thorium, radium, radon and most of the radon daughters fall into this category of alpha-emitting substances.

Since the town of Port Hope had been thoroughly contaminated with alpha-emitting radioactive substances, the Canadian nuclear authorities had to make a political decision back in 1975: What was an acceptable level for radioactive contamination in a private residence?

And so a standard for an "acceptable level" of radon contamination in a private home was set at about 20 times the normal background levels of radon, to guide the cleanup operations at Port Hope. Before long, that same standard was being used for the construction of whole subdivisions of new homes in Elliot Lake in the late 1970s. Radon levels in these new homes were so unacceptably high that fans had to be installed under the floorboards to blow the radon out of the house. Sometimes two fans had to be installed to bring the contamination levels down to the "acceptable" level.

## **Boosting the Cancer Rate**

In testimony to the Elliot Lake Environmental Assessment Board in 1978, mortality figures published by the Ontario government were used to show that even the "acceptable" levels of radon contamination in homes would result in an extra 17 lung cancer deaths per thousand people chronically exposed to such levels. In other words, instead of 54 lung cancers per thousand, one would expect 71, a 31 per cent increase. In light of this evidence, the Board recommended that the radon standard for homes be reassessed. But no such reassessment has taken place.

Since 1980 the B.C. Medical Association has published a slightly higher risk estimate and has condemned the radon standard for homes "as tantamount to allowing an industrially induced epidemic of cancer." A 1982 report published by the Atomic Energy Control Board concurs, estimating a 40 percent increase in lung cancer among those living in homes contaminated to the "acceptable" radon level.

## **Radioactive Smoke**

Radon gas is also given off by phosphate fertilizers (since phosphate ores are rich in uranium). When tobacco crops are so fertilized, radon gas accumulates under the thick canopy of tobacco leaves, and tiny dust particles impregnated with radon daughters adhere to the sticky, resinous hairs on the underside of each leaf. When harvested, the tobacco contains high concentrations of radioactive lead-210 and polonium-210. Cigarette smokers breathe these radon daughters into their lungs with every inhalation.

Some of these radioactive particles lodge in the lungs of smokers, as confirmed by autopsies. Others enter the bloodstream along with oxygen and carbon monoxide. Radioactive deposits of this kind have been found in plaque removed from sclerotic arteries. Many researchers now believe these excessive concentrations of radon daughters are responsible for most of the 135,000 deaths each year in the U.S. from lung cancer, strokes and heart disease which the American Medical Association attributes to smoking.

### **Fallout from Uranium Mines**

In addition to killing uranium miners and those living in contaminated homes, each uranium mine is, in effect, a "slow bomb" -- spreading deadly radioactive poisons over vast areas of the earth, as surely as the Chernobyl disaster did, as surely as atmospheric tests of nuclear weapons have done, but at an insidiously slower rate. Radon gas can travel a thousand miles in just a few days, with a light breeze. As it travels low to the ground (it is much heavier than air) it deposits its "daughters" -- solid radioactive fallout -- on the vegetation, soil and water below; the resulting radioactive materials enter the food chain, ending up in fruits and berries, the flesh of fish and animals, and ultimately, in the bodies of human beings.

On February 25, 1986, the Wall Street Journal printed a front page story that portrayed the 220 million tons of uranium tailings in the U.S. as an ecological and financial time bomb. (In Canada, we have about 150 million tons of such tailings.) Everyone agrees that these materials are too dangerously radioactive to leave on the surface of the earth, yet no one has devised a satisfactory method for permanently containing them. Even at a very modest rate, say \$10 per ton, it will cost billions of dollars to dispose of these wastes.

### **Uncontained in Time and Space**

The tailings will remain dangerously radioactive for millions of years. Thorium-230, itself a by-product of uranium, is an alpha-emitter with a half-life of almost 80,000 years. It continually replenishes all the other radioactive by-products of uranium in the abandoned tailings piles. Radium-226, a bone-seeking alpha-emitting carcinogen which is at least 20 times as harmful as strontium-90, is blown in the wind, washed by the rain, and leached into the waterways from the

tailings piles, where it re-concentrates by factors of thousands in aquatic plants and by factors of hundreds in land plants. It has a half-life of 1,600 years. When the levels of radium increased in Canadian rivers as a result of uranium mining activities, the nuclear establishment obligingly increased the standard for an "acceptable level" of radium in drinking water by a factor of nine.

(The B.C. Medical Association refers to radium as a "superb carcinogen." It is known to have killed many of the women who patriotically painted radium on the dials of military instruments during World War II so that the readings would glow in the darkness of a cockpit or battlefield.)

In addition, the radon gas emissions from abandoned tailings can cause radioactive contamination on a continental and even on a global basis. The U.S. Nuclear Regulatory Commission has estimated that radon emissions from uranium tailings in the Southwest U.S. can be expected to cause over 3,000 cancer deaths per century over the North American continent. Many researchers believe that this death toll is underestimated by at least a factor of ten, even if we ignore the fallout of solid radon daughters on leafy vegetation as the radon gas passes overhead, and even if we assume that the tailings are not blown by the wind, washed by the rain, or spread through the food chain, thereby distributing the source of contamination over a much wider area.

### **A Deadly Legacy**

The legacy of uranium is truly a devastating one. Miners and smokers dead and dying, vast reservoirs of tailings releasing radioactive poisons into the biosphere, radon daughters accumulating in buildings and in the food chain -- and all for the sake of building more bombs and nuclear reactors. The radioactive fission products that were released into the atmosphere from Chernobyl -- iodine-131, strontium-90, cesium-137, and the rest -- are all the broken pieces of uranium atoms left over from the fission process. Even the extraordinary toxicity of plutonium can be rightfully attributed to uranium, since plutonium is created by transmutation of uranium through the absorption of neutrons.

Because Canada is the world's largest uranium producer and exporter, Canadians have an important role in halting the widespread use of uranium. If we do not come to grips with the Pandora's box of problems which it spawns, and soon, our children and grandchildren may find that we have left them with a burden too great for them to bear.

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