Uranium, The Shape Shifter

By Gordon Edwards

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I'm very happy to have this opportunity to talk to you today about uranium. It is a complicated subject, for uranium is not just one substance, as it turns out. Actually, uranium is in a certain sense hundreds of hazardous substances. I will explain that.

I'm talking about uranium as a shape shifter. Shape shifting is what makes uranium insidiously dangerous because it's not just one hazardous element, it's many. In fact, this is how it gives rise to literally hundreds of other elements – you might call them avatars of uranium. It's not that they are byproducts so much as they are reincarnations – unrecognizable alterations of identity. Think of a caterpillar morphing into a butterfly, or a blossom turning into a fruit.

According to Google, “Shape shifting is the ability to physically transform oneself through an inherently superhuman ability.”

There are three different shape-shifting transformations of uranium that take place.

When we talk about uranium mining, the primary problem is the radioactive progeny or “decay products” of uranium, all of which are very toxic. In fact, they are much more hazardous than uranium itself. These atoms all actually started off as uranium atoms, but they have all been fundamentally changed. Uranium has magically transformed itself into all of these highly diverse radioactive progeny by a shape-shifting procedure. Scientists call that procedure “radioactive decay” or “radioactive disintegration”.

In nuclear reactors, a different shape shifting transformation takes place. When we split uranium atoms, we produce literally hundreds of brand new radioactive materials. Most of them were never found in nature before 1939. They are called fission products, and they are the broken pieces of the uranium atoms that have been split. In fact, when fission was first discovered, it was the detection of these previously unknown fission products that allowed scientists to recognize that something brand new had happened – that the uranium atom had been split.

When it comes to nuclear weapons, a third type of shape shifting is involved. The first nuclear reactors were actually built for the purpose of transforming uranium atoms into plutonium atoms, and plutonium has been adopted as the primary nuclear explosive material in the world's nuclear arsenals. Plutonium is a human-made element that is heavier than uranium, so it is called a “transuranic” element. It belongs to a group of elements called “transuranic actinides”. There are about 36 different types of these actinides, all heavier than uranium. All of these atoms start off as uranium atoms, but they become heavier by absorbing neutrons, and then transforming themselves – as if by magic – into these new heavier-than-uranium elements.

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These photographs are by my good friend Robert del Tredici. This is a model of the uranium atom. Uranium is the key element in all nuclear fission technology. It's important to understand that there would be no atomic bombs or nuclear weapons of any description, nor would there be any nuclear reactors of any description, if it were not for uranium. Uranium is the key material in all of these technologies.

In 1943, Canada, formalized its participation in the World War II Atomic Bomb program. The Prime Minister of Canada got together with the President of the United States, Roosevent, and the British Prime Minister, Churchill, in Quebec City, where they signed an agreement to cooperate in building the world's first atomic bombs.

Now, why was Canada particularly involved in this? Well, basically, it’s because Canada had the only readily accessible supply of uranium, the key ingredient. The uranium was actually located in the land of the Sahtu Dene tribe, a nomadic Indigenous people who had lived for thousands of years around the shores of Great Bear Lake way up high in the sub Arctic, just about a hundred miles south of the Arctic Circle.

On the eastern shore of Great Bear Lake there was already a mine, and a geological ore body of uranium that we knew about for a reason which I will explain shortly. The photograph shows some of the contaminated burlap bags that the men of the Sahtu Dene tribe used to carry the rich radioactive ore on their backs. The Dene village of Deline is now sometimes referred to as the Village of Widows, because so many of the men died of radiation induced illnesses.

And it's not as if the scientists didn't know about these illnesses ahead of time. As early as 1931, way before the Second World War, there was a Department of Mines document which talked about the deadly diseases – lung cancer, bone cancer, and rapid anemia – which can be caused by very small amounts of radioactive substances deposited in the cell tissue or bone structure of the body.

This knowledge had been gleaned because of tragic events that occurred in the early 20th century, which I'll shortly be talking about. So it was already well known that radioactive exposures are life-threatening. Don't let anybody tell you that the men in charge didn't know the dangers of these materials. They did.

Because of these historical accidents, Canada became the world's first and most important supplier and exporter of uranium in the world. And up until about four or five years ago, it was the number one and had been the number one since since the World War two atomic bomb program.

Here is a map of the “Yellowcake Road” in Canada, showing all of the uranium mines and mills, and the transportation routes. All of this uranium-rich material was transported down to a town called Port Hope Ontario, where it was refined for the atomic bomb project, and also for the Cold War buildup of nuclear weapons – tens of thousands of nuclear weapons, which had

significant amount of Canadian uranium in them, either in the form of uranium or in the form of plutonium.

Deline is way up at the top of the map there, across the Lake from the mine site called Port Radium. The Elliot Lake region is at the top of Lake Huron, you can see the blown-up circles. That's where the home of the Serpent River Indian Band is, at the mouth of the Serpent River. By the 1970s that entire river system had become very contaminated with radioactive and chemical waste byproducts of uranium mining, which Lorraine will be talking about.

Here's a chart showing the utilization of Canadian uranium based upon the location of each uranium mill. You can see that a lot of these mills produced materials only for bombs. In fact, all Canadian uranium was sold for nuclear weapons up until 1965. It was only then that the Canadian government announced that it would no longer sell uranium for weapons purposes, but for peaceful purposes, meaning nuclear reactors.

Now the first example of shapeshifting comes about through a process called radioactivity. It's a form of nuclear energy that cannot be shut off. Nuclear energy refers to energy that comes directly from the nucleus of an atom. And it turns out that the nucleus of the atom is held together by the strongest force in the universe called the strong nuclear force.

This process of radioactivity – sometimes called “radioactive decay” – was discovered 125 years ago by a man named Henri Becquerel in Paris. The unit of radioactivity is therefore called a becquerel, and it refers to one disintegration per second. So here's a picture of Henri Becquerel. He was interested in things that glowed in the dark, and uranium was particularly unusual because no matter how long you put it in a in a dark place for weeks or months, it would still continue to cause glowing in the dark. Some kind of invisible light was being given off by these rocks, making other materials glow in the visible spectrum.

Radioactivity involves the sudden disintegration or explosion of a nucleus giving off subatomic shrapnel, you might say. And the three types that are most common are the alpha particle, the beta particle and a gamma ray. These are all very dangerous to living cells of all kinds. The number of disintegrations per second is measured in becquerels.

The half life of a radioactive material is how long it takes for half of the atoms to disintegrate, that means the other half is still there. And it will take another half life for half of those to disintegrate. And so it goes on and on and on. After 10 half lives, you've reduced the amount of radioactive substance by approximately a factor of 1000.

Radioactivity is dangerous. The people who own the uranium mines aren't really concerned so much about the dangers -- that's just a nuisance to them. What they want is to get the uranium, to use it either as a nuclear fuel or as a nuclear explosive. But the people who are the innocent bystanders, and those who work in the mines, they have to be concerned about the health effects of radioactivity.

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Chronic exposure to radioactive materials increases the incidence of cancer, leukemia, genetic damage, also strokes, heart attacks and other blood diseases such as “rapid anemia” that Marie Curie died of as well as her daughter Irene. Radioactive exposures can even cause low intelligence in young children who have been exposed in the womb.

But for most of these “delayed” effects there is a latency period. The onset of disease may occur years or decades after exposure. It's very similar to cigarette smoking, you don't see people smoke a cigarette and then keel over dead. It takes a while. And the same thing happens with radiation. So the effects are many years later, and consequently, are subtle. They're not easily detected unless you go looking for them very carefully.

You can't see radioactivity. But if you put a chunk of uranium ore in a special device called a cloud chamber, you can actually see the tracks of these particles that are being given off all the time. So it's constantly emitting these invisible projectiles. You can't taste it, you can't see it, you can't smell it. There's nothing you can do except experience the ill effects of it. Unless you have special equipment, you won't even know that radioactivity exists. Aa radioactive material just looks like normal inert material, but it's not.

Now, Marie Curie discovered something very interesting. She crushed up the ore that Becquerel had used just two years earlier, and she took away the uranium. She extracted the uranium chemically, she was a very good chemist. And she found to her amazement that while uranium is indeed radioactive, the residues are much more radioactive. In fact, 85% of the radioactivity is left in the crushed rock from which the uranium has been extracted. And that's true today at every uranium mine in the world. When they extract uranium, they take away the uranium but they leave 85 percent of the radioactivity behind.

So Marie Curie knew that there must be other materials there in the crushed rock, which are even more radioactive than uranium. She discovered two of them: radium and polonium. She named polonium after her homeland of Poland. She did not know it at the time, but these strange new atoms were once uranium atoms, and that’s why they were present in uranium ore.

Each disintegration of a radioactive atom, it turns out, creates a new element called a decay product. So when a uranium atom disintegrates, it doesn't disappear. It transforms itself. That's why I call it a shapeshifter. It turns out that every atom of radium started off as an atom of uranium. And every atom of radon gas started off as an atom of radium, which in turn started off as an atom of uranium. So all of these things are, in my view, they're magical transformations of the uranium atom. They're not produced by the uranium atom, they are new identities, they are new avatars, you might say, of the uranium atom.

Uranium has two long decay chains with about two dozen radioactive progeny. These decay products are much more radioactive than uranium itself. Consider radium, which Marie Curie discovered. By the 1920s, it was already recognized that radium is an extremely dangerous material. In fact, they used the harmfulness of the material -- the fact that it kills tissues so easily

-- to fight cancer, because they could use the deadly rays to burn the cancerous growth and shrink it down.

By 1920, radium has become the most expensive material on earth – over $100,000 dollars per gram, and that's in 1920 dollars! By 1930, the price had dropped to $70,000 per gram, and many people in many countries had died from radium poisoning. That's when the Port Radium. mine started extracting radium and sending it to Port Hope for refining. But wherever there is radium there must have been uranium, so Canada was in a pre-eminent position to fuel the A-Bomb prgram. The other principal sources of radium – Czechslovakia and the Belgian Congo – were under Nazi control and so were not available to the western allies.

But thousands suffered ill consequences of radium without any health benefits. Unfortunately, thousands of young women – who were mostly young teenagers, almost all under the age of 20 – 1000s of them worked, painting luminous dials on watches using a radium-based paint, and they died of a host of diseases. By the 1920s, it was clear that there was an epidemic of bone cancer among these girls, as well as cases of fatal anemia. And many who did got die of anemia or bone cancers, later on in life, they developed head cancers. All of these dreadful diseases were caused by very tiny amounts of radium – so tiny that the chemical methods of the time would have been unable to identify its presence. It was only through the radioactive emissions that they were able to actually find out how much radium was in their body, during autopsies. It was only a few micrograms in each case.

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Radon gas is another thing. Radon is another decay product of uranium that was discovered before 1900. By the 1930s it was already well known that many thousands of miners had been dying for centuries as a result of breathing radon gas in underground mines. And that's been well documented around the world, in the case of uranium miners and other miners too, particularly here in Canada. The tragedy of the Newfoundland fluorspar miners is a case in point.

There have been great improvements made in controlling the radon levels in mines today so that miners are not exposed to such high levels as they used to be, but radon still causes lung cancer in mining populations. And the only reason there have been improvements is because of public action. If the public and the workers, don't speak out, nothing gets done. There are also tens of thousands of people in North America dying every year as a result of radon gas in their own homes.

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Polonium 210 is another decay product of uranium that Marie Curie discovered. It was used to murder Alexander Litvinenko in 2006 – a Russian ex KGB agent living in London, England. Russian assassins put a little polonium in his tea and that did him in.

Polonium, it turns out, is responsible for up to 90% of the deaths currently attributed to tobacco smoking. It turns out that radioactive polonium finds its way into the tobacco that is harvested. And then when the smokers light up their cigarettes, they're breathing polonium into their lungs. And polonium it turns out, weight by weight, is about 250 billion times more toxic than hydrogen cyanide. Cyanide is one of the most toxic chemical poisons that we know o. Imagine something 250 billion times more toxic. That means if you had the same amount of polonium 210 as you did of cyanide, you could kill 250 billion times more people with the polonium than with the cyanide.

By the way, these deadly radionuclides radium, radon and polonium are all alpha emitters. And so are uranium and plutonium; both of them are alpha emitters too. Now alpha particles don't have much penetrating power. They won't go through a sheet of paper, but they can do enormous harm inside the body. This black star shown in the photograph is caused by the tracks of alpha emissions from a tiny speck of plutonium lodged in the lung tissue of an ape. And that happens over 48 hours, those tracks are recorded by a time-lapse photograph..

So when uranium is mined, you only take away the uranium – you leave all the other materials behind. And 85 percent of the radioactivity, as I said before, is left in the uranium tailings. Here's a photograph of a wall of uranium tailings 30 feet high in the Elliott Lake area. There's about 70 million tons of radioactive sand behind that wall, containing all of those byproducts of uranium.

One of the uranium decay products in the voluminous tailings is thorium-230, which has a half life of 76,000 years. That's one of the uranium byproducts. By radioactive disintegrations, it replenishes the supply of radium, radon, and polonium for hundreds of 1000s of years. So this becomes not just a perennial, but an eternal problem for the environment.

The uranium mill tailings hazards are multiple. There's the radon gas that's given off, there's the radium seepage into the groundwater, there's the radioactive dust blowing through the air. And so over the centuries, this stuff spreads and remains steadily poisonous for tens, for hundreds of thousands of years.

Now, I'm just going to mention two other things briefly.

The second example of shapeshifting is in a nuclear reactor, where as I said earlier, when the uranium atoms are split, you get all the broken pieces of uranium atoms. These are more avatars of uranium. So when you hear about a radioactive accident, like Fukushima and Chernobyl, where all this radioactive poison is going into the air, guess what, those are all the broken pieces of uranium atoms that probably came from Saskatchewan.

And the third example of shapeshifting is how plutonium and other transuranics are created.

And I will end up there. I think it's important for people to realize these scientific facts. Don't be bamboozled when people say that uranium is not the most hazardous material, they are right. But uranium spawns hundreds of other materials which are far more hazardous.

How does plutonium get into the tobacco in such high amounts? Is it naturally occurring or is it only due to due to the spread from the nuclear industry? Thank you.

Gordon Edwards 1:21:15
Okay. The polonium gets into the tobacco primarily through the use of radioactive fertilizer. They sell radioactive fertilizer from Florida, and they also sell radioactive fertilizer from Blind River from the blind river refinery. And this radioactive fertilizer gives off radon gas, which builds up under the tobacco leaves with the tobacco has a very thick canopy of leaves. And when the when the radon gas hovers under the leaves, it disintegrates and produces lead 210, radioactive lead 210, which has a 22 year half life that deposits on the seat he hears and the tobacco leaves as harvested with the tobacco. So when you buy the tobacco in the store, you're actually buying some a small amount of led to 10 led to 10 provides a continuous supply of polonium 210 so that as the smoker smokes, he's inhaling polonium 210. And when he's not smoking, the smoke goes into the air as secondhand smoke, which carries the polonium 210 Two others in the room. And so 90% Approximately, and these are not these are not anti nuclear people who are saying this, the Health Physics Society of America is part of the nuclear industry. And they say that up to 90% of the deaths from cigarette smoking, attributed to cigarette smoking are actually from this radioactive polonium, which comes primarily from the radioactive fertilizer. And we're selling it right now from Blind River as a byproduct that they tried to make a buck on. Okay, thank

Susan O'Donnell 1:22:44
you, Gordon. The next question. You also answered it, which is about can you talk about the effects of uranium on Port Hope, Ontario. Thank you.

Gordon Edwards 1:22:57
Yeah. Import hope is a real tragedy for that community because it's a beautiful little town, one of the prettiest towns on the shore of Lake Ontario. But they dumped over two and a half million cubic meters of radioactive waste into open ravines into harbors and two ditches into the public beach. And they also used large quantities of this material to build roads, and to build homes, including schools, hundreds of homes and schools have had to be not, not homes and schools, hundreds of buildings have had to be demolished. Because the radon levels of buildup inside those homes as a result of the use of radioactive building materials is so high. Right now, as Lorraine said, there was a process for eight years there was a federal sighting taskforce which searched all over Ontario, to find a willing host community for the porthole place. And they came up empty handed despite spending millions of dollars in spending all those years, they came up empty handed. Nobody wanted it. And the result is they're now building two giant mounds less than three kilometers from the shore of Lake Ontario, in which they're going to house all this place, which will remain dangerous for 1000s of years. And actually, they're claiming that this is

a wonderful facility. It's actually a booby prize. It's a booby prize, because the reason they were searching for another community, they knew that this is a rotten place to store radioactive waste, and yet that's what they're doing. So and another thing I just like to tack on here is that when you hear people say that background radiation is harmless, or imply that background radiation is harmless. That's crazy. Background radiation is one of the most harmful things there is that radon is killing 10s of 1000s of people every year, polonium is killing hundreds of 1000s of people every single year. So to say that background radiation is harmless is simply ignored.

I wanted to add something to what Tracy was saying about the situation New Brunswick. The upsurge in activity in exploration in New Brunswick was happening all around the world, really. It was happening all around North America. I was told I went to Virginia, we here in Quebec had a public hearings, the Cree Nation was involved to lead in role medical doctors played a meeting role in shooting that resurgence of uranium mining exploration down. It was totally based on a fictitious price rise. The third the price soared up to a very high number. And that's what stimulated all these small companies to want to mine uranium because of the price. But it was all predicated on the idea that there was going to be a nuclear renaissance which turned out to be a fiasco it never happened. And so the price shot right down again and and everybody went back to sleep. But with the talk about small modular reactors, it would not be surprising, with our government, beating the drum about small modular reactors, which probably are not going to work anyway. But it could still stimulate another surge in uranium exploration. So New Brunswick could be in for another surge. Now in Quebec, fortunately, we managed to get a moratorium. In Virginia, they upheld a moratorium. New Brunswick doesn't have a moratorium, but that would be a good thing for people to keep their eye on because this, this monster is going to come back again, even if the small modular reactors are a pipe dream, and turn out to be an economic and unviable, you can still get a lot of damage done to your communities.

Susan O'Donnell 1:32:32
Thank you, Gordon, I have another question for you. You answered it partly about and I've seen some criticism in the chat that we're talking about historical situations. And the question is, have the hazards from uranium mining been mitigated by modern safety methods and equipment?

Gordon Edwards 1:32:52
Yeah, they certainly have. I mean, prior to 1978, there had been 30 uranium tailings dam failures in the Elliot Lake region, there were reported in the press. And there were very sloppy techniques that were used, the radon exposures for the workers were absolutely criminal. But it was only as a result of activists putting their bodies on the line and workers standing up for the rights, that anything got improved. So the industry likes and the government both like to boast about improvements that have been made without saying that they resisted those improvements every step of the way. So the only way improvements get made is if people fight for it. And that's the sad truth of the matter. And so it's not it doesn't pay anybody. It's just people have to feel that it's their civic duty to really fight for this. And only then do you get things done. There have been improvements. There's no doubt that tailings are much better managed now. And the tailings are, but they're going to be around for hundreds of 1000s of years. These people who

pass these legislations are not going to be around. So who's going to look after it? 1000 2000 10,000 years from now.

Susan O'Donnell 1:34:06
Okay, thanks, Gordon. I'm going to just continue on with you here. There's a question about, you know, how can we do an environmentally sound uranium mining? Because the the issue is, don't we still need it for medical use? And shouldn't we do it in Canada rather than doing it in other countries?

Gordon Edwards 1:34:26
Well, the answer the answer is that very, very little uranium has ever been used for medical use. In fact, for example, people say that the most widely used medical isotopes in the world is technetium 99. M. There were only five nuclear reactors in the entire world, they're producing the whole world supply of technetium 99 M. And none of them were power reactors. None of them were large reactors. One of them was the NRU reactor at CHOC river never produced electricity. So you don't need large power reactors at all for nuclear medicine. As a matter of fact, you You don't even need reactors or uranium for a lot of isotopes, because you can produce them without either, you can produce them using cyclotrons, and linear accelerators. And it's not a clear cut and dried case, because some things are difficult to produce without a reactor. But possibly we can do without those things. Even if we phase out nuclear power, the main thing is that it's the amount of uranium that goes into producing medical isotopes is minuscule. It's a very tiny amount. And if you actually wanted to keep a few small reactors running solely for that purpose, you could perhaps do so I don't think it's necessary. I've been advocating. And by the way, this, this advocacy has become government policy in Canada, they've stopped producing isotopes at CHOC river using the NRU reactor, and they're now promoting the use of isotopes and technologies that don't require uranium or nuclear reactors.

Gordon Edwards 1:42:44
I'd like to remind people that the only really fundamentally essential use of uranium is nuclear weapons. Every other use of uranium has alternatives. We don't need uranium to produce electricity. There's many ways of producing electricity. We don't need uranium to produce isotopes, there's many ways of producing isotopes, We do need uranium for nuclear weapons. There's no other way of making nuclear weapons without starting with uranium. You might say, well, the trick there is not to use it for weapons, but to use it for peaceful purposes. Unfortunately, the only significant peaceful use is to fuel nuclear reactors, and that inevitably produces plutonium. The uranium in a reactor is converted to plutonium, and that stays around for hundreds of 1000s of years and will be available for making nuclear weapons again. So we are spreading literally the seeds of our own destruction. By embarking and continuing on this path. It's a very dangerous path. And if we continue to proliferate it, I'm afraid the world is not going to be able to pull back from the brink ever. We all see that the global warming crisis has got to the crisis point. If we don't act now, we're not going to succeed. Nuclear can't help us in that regard, because it's way too slow and way too expensive. We've got a turn to renewables, because that's where we should be headed anyway. But with regard to nuclear weapons, many people forget that that's an equally dangerous situation for the human race. We could destroy

the Earth's environment in a matter of hours, using nuclear weapons. And this is not getting better. This is getting worse right now. Because we now have trillions of dollars earmarked for accelerating the building of nuclear weapons. I urge people to bear this in mind, that it's not worth whatever advantages might be put forward for nuclear power. We have alternatives, we should use those alternatives. We should shut down this stuff until we get a peaceful world with no nuclear weapons. Then perhaps we can renegotiate, but to continue as well business as usual, there's your ceiling, our own doom, I believe.