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Ionizing Radiation in Context 1

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(transcribed by L-I-G-H-T, verified by Giraffe and Burtlancast)

JB - John Barkhausen

RP - Ray Peat

JB: *Good afternoon everyone and welcome to another edition of Politics and Science. This is the 20th of April, and it kicks off a new series in Politics and Science about radiation, and we'll be discussing nuclear ionizing radiation, focusing on its use in our culture, and weighing its potential usefulness in relation to its cause to our health and environment. And I'm very happy to have on the show again today, Dr. Raymond Peat, who is an endocrinologist and physiologist and science historian from Eugene, Oregon. And you can find more information about Ray Peat on his website raypeat.com. Ray, are you there?*

RP: Yes.

JB: *Good. Welcome back and I know you have quite a bit to say about radiation. And I was wondering, first of all, I think it's a confusing subject for people, because often when people talk about radiation, at the dentist or at the doctor's, they're always trying to make you feel safe about using it, and they always compare it to other kinds of radiations. For instance, they say bone scans equal to no more than two hours in the sun; or I think you've used the example of a flight to Denver to New York, comparing it to cosmic radiation. And I was just hoping to start off, you could just address the different kinds of radiation that exist and, and how do they compare.*

RP: The medical profession, the government and the nuclear industry made up a lot of stories to convince people that radiation doesn't hurt them. And the sunlight is probably the basic, oldest story, that if it doesn't kill you to absorb so much energy of sunlight, then why should it kill you to absorb the equivalent of an hour or something of, in the form of radiation. They've known really for close to 200 years, already in 1800, that there are very different kinds of radiations, and that the one beyond the blue end of the spectrum, the invisible light, was chemically active. For a long time, they called them the “chemical rays”, because changes in silver nitrate (and later, in photographic emulsions, and so on) could be produced with the ultraviolet end of the spectrum (beyond the blue). And so, they knew that the warm rays and the colored visible rays were harmless compared to these chemical burning rays, which can sunburn you. At the end of the 19th century, the Curies, Becquerel and others were exploring radium. Becquerel carried a vial of it in his pocket and got a horrible burn on his chest. And immediately, the medical profession saw that as something even more fun than surgery and cautery; when they saw it caused a horrible burn, they decided that it was good for medical purposes, like burning off warts and, and so on.

But at the same time, in 1904, Thomas Edison's main assistant died of x-ray radiation poisoning, after years of amputations and burns and surgery, and so on. So by 1904, Thomas Edison was already an opponent of the use of ionizing radiation in any form. But the medical profession was just starting to see that it was a profitable tool. And so, even though they knew very well the differences in types of radiation, they just sell it. They had 100 years to invent stories to convince people that they wouldn't get lethal burns. And so, they invented the story that there was a threshold below which no damage at all was done. And that was greatly expanded on by the government when they wanted to show that they could explode atomic bombs in Nevada, and no one would be harmed. Forty years later, Congress investigated and concluded that about 15,000 people minimum in the United States alone were killed as a result of this atmospheric test. But the government had its agents out convincing people that below the threshold, there was no harm at all, and that the amounts were similar to what you get when you live in Denver [1600 meters high in altitude], or when flying in an airplane, or sit in the sun. Even Linus Pauling, who opposed exposing a population to radiation, was convinced that it was worse to live in Denver than at sea level, because, supposedly, cosmic rays were more intense in Denver. And sunlight too was more intense. But the facts showed that cancer of all kinds is less common the higher you go in altitude. [And sadly,] someone who's as sophisticated as Linus Pauling neglected that property of radiation; it's called "the linear energy transfer". At high altitude, it happens that cosmic rays don't deliver much energy or damage to your tissues. But at lower altitude where they're less intense, they're more able to react with your tissues and cause damage. So, cosmic rays are harmful. And when you're in a skyscraper, for example, it's even worse than being at a low altitude, because the cosmic rays are slowed down and produce secondary and tertiary particles. So you get much more intense radiation at low altitude [if you're additionally] sheltered by massive structures.

JB: *Ray, the cosmic ray example you just used confuses me because it seems at lower altitudes, they should be weaker, as they're going slower, which to me implies less energy. So why is that the case? What's actually happening that it's causing damage?*

RP: The ordinary photon-type of radiation (which includes infrared, visible light and ultraviolet) is an electromagnetic vibration. [But] the nuclear particles are actual protons, or nuclei, or whole atoms, minus the electrons. Cosmic rays are typically iron atoms without their electrons. So they're very massive particles; but going at a very high speed, they pass through the body without doing anything except a trail of ionization that you can see when they go through an atmosphere that is saturated with water. The ionization causes a streamer of particles to appear.

JB: *Who can see that?*

RP: In a cloud chamber, you have humid air; when you adjust the pressure, it's just about to start condensing into rain; and [right] at that point, the particles going through it ionize it, causing nucleation that condenses droplets of rain-water; a streamer of fog appears. And any ionization will do that; but cosmic rays are constantly going through, so you can visualize [them] using a cloud chamber. At lower energies, the particles will even stop in your tissue rather than passing through. And I don't think anyone really understands why the faster ones interact less; but it's put to use in linear accelerators, for example. They can adjust the voltage of protons, or other particles, and shoot them into your body at a given energy, designing it so that they all slow down and stop near a tumor. And where they're slowing down and stopping, they're causing the most damage. When they go through quickly, like a

cosmic ray at high altitude, they just leave a slight trail of ionization, rather than a very intense cloud of secondary reactions. And a typical physics professor's explanation for it is, if you imagine the substance as a meteor swarm, and a spaceship traveling through that, if the spaceship goes very slowly, it surely gets hit by a swarming meteor. But if it zooms right through, it has a chance of getting passed without interactions. The trouble is that [this explanation] doesn't apply to photon absorption, because all photons go at the same speed. The fact is the higher energy photons penetrate more deeply without interacting so much.

JB: *So the cosmic rays are worse in a skyscraper because of these rays being slowed down by hitting the walls of the skyscraper?*

RP: Yes. And they cause nuclei to disintegrate into secondary particles; and those particles cause other disintegrations in the tertiary particles. So it's like a more intense shower of lower energy, but still lethal particles. The Chinese did experiments with rabbits putting them under cages with a lead roof of different thicknesses; and around half an inch to an inch thickness of lead on the roof caused the rabbits to fairly quickly become sterile and miscarry. If they were pregnant when they put them under the roof, they would miscarry just like you're giving them a birth control pill. And if you kept them under it, they didn't conceive at all.

JB: *And why was that?*

RP: Radiation poisoning [caused by] tertiary or secondary cosmic rays.

JB: *So the cosmic rays are getting through the lead? I was assuming for some reason it would be blocking them.*

RP: Well, at a certain thickness, you maximize the tertiary and secondary particles. As the lead gets thicker, there's a certain probability that there will be a direct hit on a lead's nuclei, causing it to split into more particles.

JB: *I see. And then it's making them sterile because it's adding stress.*

RP: Yes. With a shorter dose, the litter would simply be reduced in weight, and some of the animals would be dead, and others would survive. And when the lead nuclei splits, you get particles, as well as some gamma rays and x-rays [being] produced. And a study of dentistry in Seattle looked at a large population of people getting different types of dental work, and they used lead shields to cover their body, so that nothing but their face was getting the x-ray directly. But when they looked back at the results of their treatments, a pregnant woman who would get a full set of oral x-rays (as a result of this systemic poisoning produced by x-raying [of] just her head), would expect to have a lighter birth weight baby. So the lead roof experiments in China were exposing the whole animal, [and yet] just exposing one part creates enough stress to reduce fertility [in a similar manner], to the extent of having a smaller baby.

JB: *Well, that's to my mind making the cosmic rays and x-rays sound somewhat equivalent, aren't they?*

RP: Well, in biological effect, yeah, they're equivalent to poisoning and stress. In my dissertation work, I looked through the biological effects of different kinds of radiations, and found that I couldn't distinguish the biological damage caused by overdosing estrogen from the radiation poisoning effects. So it's a very general type of biological damage. In fact, many biologists thought that radiation was causing the pituitary gland to make the ovaries overproduce estrogen, because [the effects] the radiation was so identical to estrogen poisoning. But people made control experiments and irradiated just the head; and the whole animal would show an

estrogenic effect, as in the dental x-rays. And others x-rayed only a foot, or an arm, and so on, and still the whole body went into an estrogenic state, showing that [estrogen is] a toxin produced by any tissue interacting with radiation.

JB: *So you don't have to just target an area. It's actually going to have an effect on the whole animal.*

RP: Yes. It spreads through the bloodstream, and probably in other ways.

JB: *Now, going back to comparing the different kinds of radiations. Is it fair to say, in terms of cosmic radiation exposure, that a single bone scan is equivalent to flying from Denver to New York?*

RP: No. Living in Denver gives you less cancer than living in New Orleans; and living at 10,000 feet (in Columbia or Bolivia) gives you even less cancer than in Denver; if you could spend your life flying around in an airplane, you'd be even better off with less cancer. [That's because] the higher altitudes have been known since 1900s insurance statistics to correspond to a lower cancer incidence. So the whole story, even though it fooled Linus Pauling, has been known to be contrary to the fact, since 1900 at least.

JB: *Now, x-rays are widely used medically, as well as dental x-rays and CAT scans and bone scans. Doctors say they're invaluable for diagnosing and treating different diseases. Do you find that they are sometimes useful? And what else do they do to your tissues, besides the estrogenic effect ?*

RP: Well, the estrogenic effect is just part of a general type of tissue excitation that involves a chronic inflammation being set up. And that, depending on the dose and length of time involved, leads to tissue atrophy and fibrosis. And the atrophy and fibrosis are what predisposes you eventually to cancerization. At first the U.S. government sponsored interpretations of the exposure to atomic bomb radiation in Japan. What they did was draw circles around the bomb, and look at people at one mile, and 10 miles, and so on, out in the circle from the bomb. But in fact, the radiation went with the wind. And when they took the people who really got the radiation in one part of the radius, an averaged it out with [the rest of] the people [inside the same radius in all the other] directions, they made the radiation damage disappear. So it seemed that it wasn't causing any cancer at all. But when experts looked more honestly at the data, and got the actual exposure, they saw that, for example, 20 years later, looking at people who had been exposed as babies or fetuses, their brains were much smaller than normal. The same effect is seen in the Chinese rabbit studies.

JB: *And with the women in the study in the dental offices.*

RP: The Japanese, they actually measured their heads, and their whole head was smaller if they were exposed in utero. And that amount of radiation was being used medically for a long time in the U.S. And Alice Stewart was the one that showed that it was causing leukemia and other childhood cancers. But no one has traced U.S. brain damage to medical x-rays yet, even though it has been established in other countries.

JB: *Now, you spoke of a nuclear atmospheric test. X-rays are actually waves, is that right? They're not actually particles. But I imagine anything that's being carried by the wind is actually a radioactive particle?*

RP: Yes. And those particles get ingested. It isn't that they radiate at you from the dust outside you, but they get into your food, water and air, and enter your [body] as

a food atom; and then they still follow the same course of nuclear decay, and breakdown into radiation and particles inside your tissues. And in that situation, really emit an alpha particle or a helium nucleus. If it is emitted right inside the cell, it's going to cause total damage and be absorbed within just a few cell diameters from where the radioactive particle decayed. The nuclear industry said "Why worry about alpha particles leaking out of our power plants, or coming out of the bomb test fallout?"; and they would have an alpha emitter and an amplified detector, and [in between them] they would put a sheet of typing paper, and the sputtering of the detector would stop. And they said, "See, it just takes a sheet of paper to stop the beam". But the difference is, when you have ingested the particle that emits those beams, there is no paper between the particle and the cell that gets poisoned.

JB: *I see. So every time a nuclear facility has a leak, particles are actually being emitted.*

RP: And people breathe them in; and then they disintegrate in the body, the reaction happens. Just two or three years ago, someone compared the blood serum of Japanese who were still alive, but who had been exposed to the atomic bomb, and they showed that they could demonstrate lingering photochemical emission differences in their blood serum 60 years after the exposure.

JB: *So it lingers that long. Are there still radioactive particles in them?*

RP: No. It's still unstable biochemical material which spreads an influence, and persists unless something intervenes to correct the whole process. But these people 60 years later still were different from unexposed people. And this is something that has been coming up in the last 10 years or so, that if you irradiate cells in a dish to produce mutations, and then put those cells [together] with unexposed cells in another dish, those unexposed cells keep mutating long after, from something emitted by the irradiated cells. And if you irradiate fish, they will emit into the water some of the toxic materials that [will then] cause biochemical disturbances in the other fish. And the genetic instability is really the most horrifying part of the exposure. The bystander effect is transmitted as some kind of signal from the injured cells, which then injures the cells that receive this material. And that transmitted effect destabilizes the chromosomes generations later; and no one really knows how long that can go on. But in the lab situation it can be passed through many generations of cells as a tendency to mutate and produce defects in cells that were many generations removed.

JB: *Now, what about – there was this study done, I think in Germany and a fellow was here around central Vermont speaking about it. His name was Eisenstein, I believe, and I don't actually know the details of the study, except that it did show that around nuclear power plants, there was definitely a higher leukemia rate among children. Why is it that children and young beings are more susceptible to damage from radiation?*

RP: [That's] where the genetics dogma was conveniently used by the physics dogma to say that if it didn't mutate your DNA, then it didn't cause any damage, because DNA controls everything.[They claimed] growth is played out like a genetic blueprint getting literally read out to form each stage of development. But the bystander effect is produced by doses in the microgray region. [Originally,] they used to call a 50 gray exposure (or [5000] rems) the dangerous toxic dose. [Nowadays,] a millionth of a gray is known to produce these bystander effects. And the developing organism is never simply a matter of a blueprint in the DNA being played out step-by-step. Doctors used to say what a mother ate had no influence on the quality of the baby

being developed, that as long as the mother ate enough to live, to give birth, the baby was not going to be affected by the mother's poverty or starvation. And that was because of this doctrine that environment has nothing to do with it: the genes totally determine what the organism [becomes]. [In reality, the environment and the mother's experience determines and modifies the way the cytoplasm of the oocyte is assembled even before there's a fertilized egg]. And then once the fertilized egg starts developing, it's still progressively modified at every stage by its environment. And so, if estrogen is introduced during the pregnancy, and the dose is small enough that the pregnancy can survive, the change in the environment, for example, the reduction of available glucose causes the brain to develop differently. And for example, the cortex of the brain is thinner in proportion to estrogen exposure. And the radiation exposure causes the whole brain to be considerably smaller. But [even] just a fairly seemingly insignificant imbalance towards estrogen causes the cortex to be thinner than normal. It's because the young organism is in a developmental stage, it hasn't decided exactly what it can become because the environment at every stage is part of what it can become. And so, if you introduce inflammation and stress anywhere along the line, the younger the organism the more deviation from its ideal possibilities there will be.

JB: *If that's the effect on younger beings, human and otherwise, it sounds like it's a good idea to avoid any kind of radiation exposure, including x-rays, dental x-rays and things like that.*

RP: Yes. But even the time of day can influence your ability to tolerate stresses, including x-ray. And, for example, if you go for a jog before breakfast, your chromosomes are going to be more susceptible to breakage than if you have had some [fruit] juice before you went for [this] jog; [that's because] the low blood sugar makes your chromosomes break more easily. And so, having your radiation injury in the late afternoon, you're going to have much less risk of damage.

JB: *I see. [There's less danger] when your body is basically fortified against different stresses. I'd like to have you talk about the efficacy of using medical radiation for diagnostic and treatment.*

RP: One article published in JAMA about 10 years ago criticized the use of the bone scans, because they showed that they were thrown off by any consistent change in the ratio of fat and water. Fat doesn't absorb x-rays as much as water does. And so if you reduce the amount of fat in your bone marrow- bone marrow is normally extremely fat- rich -, and if you exchange that for water, and make a sort of sick, anemic, waterlogged bone marrow (which estrogen can do), you're going to seem to have more dense bones. So especially for measuring the effects of estrogen, x-ray bone scans are simply not scientific. And there are ultrasound bone measuring devices that can actually determine the strength of the bone from the elastic sound transmission through the bone. It doesn't just measure the density. You can have soft, but highly calcified bones. And so, the ultrasound really measures the bone quality. And incidentally, each ultrasound treatment is likely to make your bone stronger because it stimulates healing and regeneration, wherever each exposure to x-ray is going to increase your stress, and make your bones weaker.

JB: *Well, it sounds like x-rays are probably not a good idea, especially for bone scans.*

RP: Yes. And ultrasound technology has existed for many years, [enabling] dentists to see cavities and have nice pictures of the insides of teeth, without any x-rays at all.

JB: *I've looked into that without much luck of finding anybody (at least in this country) who's doing that.*

RP: No. It's just the technology that no one wants to use because they have x-rays and believe they're safe.

JB: *Newsweek came out with an article not too long ago about CAT scans. And actually was quite cautionary about people having too many of them. How do CAT scans fit into the scale of exposure?*

RP: Well, one is too many.[chuckles]

JB: *One CAT scan is too many?*

RP: Yes.

JB: *Why is that?*

RP: It's a lot of radiation. It's the equivalent of many, many chest x-rays. It's making an x-ray picture from many different angles, so that you can look at it in the computer and see many different perspectives.

JB: *Is there any time when you think an x-ray would be a useful tool?*

RP: No. Because the other technologies are better. Magnetic resonance and ultrasound. The technology is there, and it would be improved if people would start using it more. [But] they're invested in their present machines.

JB: *So you're basically saying, it's irresponsible that the medical authorities at this point are advocating continued use of x-rays?*

RP: Well, it was irresponsible in 1920; and continuing for a hundred years beyond, when they knew it was harmful, is worse than irresponsible.

JB: *Can you say a few words about John Goffman, somebody who did work for the nuclear regulatory agency (or the atomic energy commission, I think).*

RP: Yes. I was aware of him from 1940s on as one of the main government devils. For 30 years, he said: "How wonderful x-rays and other radiation forms are; they're not known to be harmful. You can't prove that they're going to kill 15,000 people just by exploding some bombs in Nevada". For 30 years, he was a government spokesman and said that people like Linus Pauling were irresponsible fear mongers. And later (around 1968 or so), in the middle of one of his speeches, while claiming "it hasn't been proved that these bomb tests are going to result in 20 years in death and disease" he suddenly realized what he was saying. He admitted he realized he was stupid or crazy to be saying such stuff. It took him 30 years to come to that realization. But once he did, then he became the government's greatest enemy.[chuckles]

JB: *You mean he started to campaign against the use of nuclear technology.*

RP: Yes. And of medical technology. His last big book was demonstrating that breast cancer and heart disease are caused in the United States mainly by medical x-rays. Breast cancer is lowest in West Virginia, where there are the fewest doctor visits by patients per capita; and highest in the rich areas of California, where there are most doctors and most chest exams per patient.

JB: *That's very similar to what Samuel Epstein says about mammography.*

RP: Oh yes, have you talked to him, yet?

JB: *Just on the phone briefly. We're going to have an interview with him on May 4th, I believe.*

RP: Oh yeah. There was a study in Scandinavia a few years ago that showed that total mortality was higher in the women who got their breast scans.

JB: *That's kind of alarming because I know they're being recommended all the time to people. I recently heard an example of not only was that done to somebody, but then a metal pellet was implanted without their knowledge in the place that they'd performed a biopsy on. And they left that pellet in there so they could mark the spot where they had been looking at. How does that strike you as a technique?*

RP: Well, it's not an abnormal medical technique. Did you hear the MVR program a couple of days ago broadcasting a segment from Columbia Medical Schools, [called the] blessing of the "White Coat Ceremony"?

JB: *No, I didn't know they were so religious.*

RP: Yah. They bless the white coats, and then have the students put them on as they call them up, like they're getting a diploma. And it's an attitude that physicians are sanctified by their profession. And so, they really feel that they can't do any harm, if they're sincerely being positioned. And what I hear are mostly horror stories. Women who are told that they're just going to have an exploratory surgery, and then their ovaries are removed. And it just seems like the people I talk to have been really seriously abused by their doctors.

JB: *In a previous show, long time ago, we talked about some of the history of the use of radiation by the medical and military. It's a horrendous story which I don't actually like to talk about because it's so depressing. But I think it is good to know where the technology came from, and how the professionals that developed it basically used it in a completely immoral fashion. And I don't think that Code of Ethics has changed much. Ray, one of the things they're using now ionizing radiation technology for, they radiate food to preserve it. And they irradiate meat; and they also irradiate fruit; and maybe other vegetables as well. What's your opinion on it?*

RP: Sometimes it does spoil it to some extent, [on occasions] almost instantly. But it stops other enzyme and bacterial changes. It'll kill enough microorganisms that it stops some type of rotting; but it also stops natural defense processes. So apples, for example, will instantly turn color from the radiation and get soft and sour, and become susceptible to certain types of decay later, because the natural defense processes of the cells have been destroyed. And it activates some of the aging processes in meat and other tissues, that increase the toxicity. Proteins are degraded into toxic compounds. Fats are made rancid and toxic. Every component in proportion to its oxidizability is affected. And when they fed these processed foods to experimental animals, the animal show the effects of poisoning and malnutrition. The most susceptible components to damage are things like vitamin B2, folic acid, and vitamin A, which is almost totally destroyed by this irradiation, so it becomes nutritionally a deficient food. At the same time the destruction of these compounds converts them into toxic reactive compounds that further reduce the nutritional value, and increase the toxic effects of the rest of the food. And prolonged feeding consistently causes damage in the lab animals. A lot of people have been devising techniques to test food, to show whether it's been irradiated or not. The same tests showing that radiation damages food also show people [getting similarly damaged from] lingering radiation. The photochemical luminescence they saw [by testing] the

Japanese blood serum, [will show up too in the degraded food product, due to] the breakdown of the fats, in particular. If animals [were irradiated], chickens, fish, or oysters, their bones will capture the excited electrons. And all you have to do is dissolve the bone in a dark photo light detecting device, and it will luminesce, because electrons were trapped in an excited state in them. And that [photochemical luminescence test] has been used in people. You can show where you've had dental x-rays by heating a piece of the tooth that was exposed, and [they] therefore [will] luminesce, as the trapped excited electrons are released.

JB: *You spoke earlier that you could detect the oxidized fats in irradiated meat. Does that mean oxidation is just one of the side effects of radiation? Is that really what's going on when you shoot a bunch of protons that don't have electrons attached to them?*

RP: Yes. To the extent that there is something present to receive the excited electrons, they will react, and you'll have oxidation happening, in which the electrons are going into a lower state. And even ultraviolet can cause some processes like that. If you get too much ultraviolet light from the sun, the vitamin B2 in your skin can get into an excited state; and then if you have eaten a lot of polyunsaturated fats, the excited vitamin B2 can extract electrons from the exposed double bonds on the fats and create breakage in the fats; the fats will spread an oxidizing process and attack the DNA, and so on.

JB: *So, that's how you get skin cancer from ultraviolet..?*

RP: Yes. And the wrinkles and cancerization process from sunlight highly corresponds to the amount of polyunsaturated fat that has been previously in your diet. The wrinkles occur very quickly when you've been eating a lot of vegetable oil.

JB: *You're describing there how the medical authorities and the nuclear atomic agency authorities start comparing sunlight with the x-rays and the environmental nuclear pollution. Because you can get a cancer from both types of radiation.*

RP: Yes. It's such a flimsy connection though, because you have to be predisposed to it, and then you have to get an intense sunburn and not have the anti-oxidants in your diet and so on, before it becomes a carcinogenic...

JB: *I see. Whereas with the other radiation, there's really not much protection that you can have against it.*

RP: Yes, especially when isotopes are injected/ingested; the penetrating x-rays and gamma rays will affect tissues all the way through your system.

JB: *Ray, could you just sum up what people can do to protect themselves, if they have to go to the dentist and have to get an x-ray?*

RP: Well, the first thing is to really reconsider why you need it. Dentists will tell you need an x-ray just because they think their insurance requires that they protect themselves while having the x-ray record. And endodontists will tell you that you can't do a root canal without having an x-ray. But I have talked to some endodontists who were very proud of the fact that they didn't need x-rays; but they would later do x-rays to prove to their doubtful colleagues that they have done it perfectly. It's a matter of skill and judgment. You don't have to necessarily get it just because the doctor wants you to. And more and more dentists are willing to have the patient sign a paper that they refuse x-rays; then the dentist has to use their skill and judgment. And it's often the same situation; a lot of medical x-rays are really useless and pointless. And anyone before they get a mammogram should look into the research

on it, and maybe listen to Sam Epstein. But what you can do if you are determined to get an x-ray is to try to schedule it in the late afternoon, in the summer, and have your blood sugar steady and high enough; have some gelatinous soup, orange juice and milk ahead of time, and make sure your hormonal situation is adequate. Because you don't want estrogen effects interacting with radiation effects. Progesterone treatment has been found to protect against x-ray damage to some tissues. Thyroid is probably the most protective single thing. Having lots of magnesium in your cells [is protective]. You need to have your blood sugar steady to keep the magnesium in your cells. Have a magnesium rich food before and after the x-ray. Coffee is protective against all kinds of radiations. The caffeine is the main thing in the coffee. But the coffee is also a good source of magnesium and niacin, both of which are radiation protectors. Niacinamide is a general tissue protector against stress, including radiation. The anti-oxidants vitamin E and vitamin K, and ubiquinone or coenzyme Q10 are protective.

JB: *All right. We have about one minute left. If you have anything else to add to that.*

RP: No.

JB: *Okay. Well, I think that's a good place to stop then, and we'll leave it there for now and maybe pick it up next week, and I want to thank you very much, Dr. Peat for coming on again.*

RP: Okay.

JB: *And thank you for all your information and for your work, and I'll give out your website again.*

RP: Okay. Very good.

JB: *All right. Thank you, Dr. Peat.*

RP: Bye.