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Nuclear Radiation, Kierkegaard, and the Philosophy of Denial

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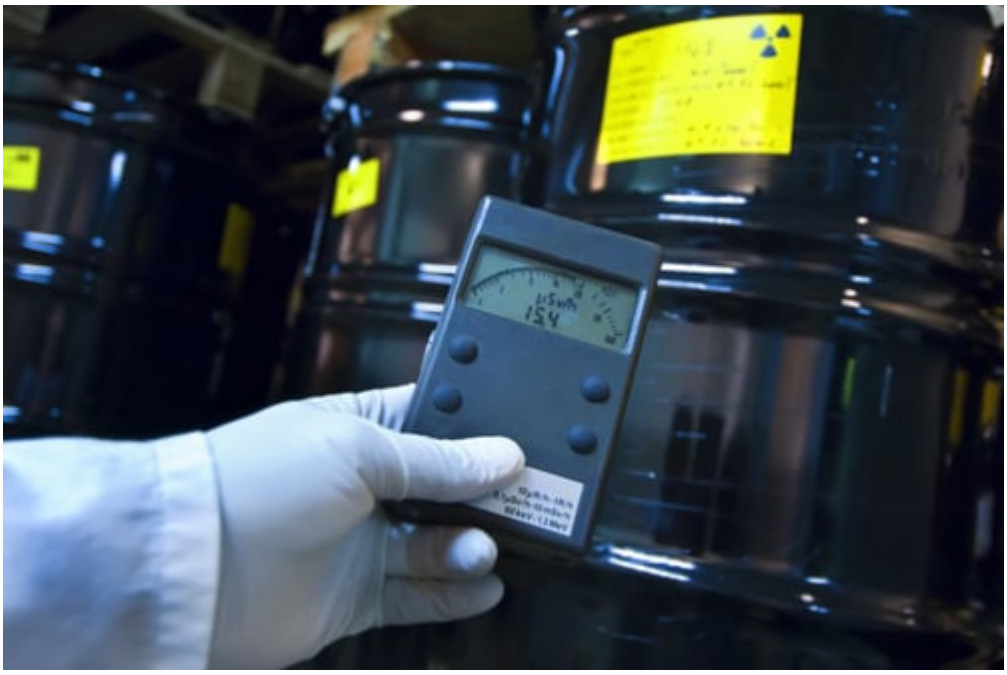
It used to be, and indeed *children are still taught in schools, that the advances that have been made in the last five hundred years (antibiotics, electricity, computers etc) resulted from the application of Science and its overthrow of dogmatic belief.*

All ideas are put to the question in the *auto da fe* of experiment: Galileo's observations versus the Inquistion's biblical earth-centric world view and so forth. But over the same period, the power of belief (in Jesus, Marxism, Allah, perhaps 'Economics') has continued to flourish alongside the supposedly observation- based, empirical philosophy that we call Science.

Belief is strictly about what we cannot know but I am not going down the Dawkins black hole on this one since there are certainly some very odd things that science cannot explain. But I want to apply the philosopher Soren Kierkegaard's approach to something that Science can explain and has: the health effects of ionising radiation.



Kierkegaard said of belief that it becomes stronger the more impossible and threatened it is. And this seems to be rapidly coming true in the case of nuclear energy. The torture imposed on logic, reason and observational data by the advocates of nuclear power has now reached the level of clinical psychosis.

A psychosis is a thought disorder in which reality testing is grossly impaired. There is so

much evidence that nuclear power kills, causes cancer, mutates populations, reduces fertility and kills babies that only a mad person would continue with the belief that it is a good thing and should be pursued no matter what the cost in money and death.

And as they move to even greater levels of psychotic delusion they present two new survival strategies which make it brilliantly clear that the proponents of nuclear are off their heads.

First the recent move to petition the US nuclear regulators to accept the idea that small amounts of radiation are actually good for you (Yes!); we should all be forced to be irradiated like food, maybe at birth in the equivalent of a mass vaccination. *In you go, Jimmy: BZZZZZ, there you are, that didn't hurt did it?*

And the second, as I wrote about recently, is to cancel the US nation-wide study of cancer near nuclear plants.

Are these two moves related? You bet! If the National Academy of Sciences Cancer Study found that people are dying because of the 'low doses' received from the emissions, then obviously low doses of radiation can't be good for you. We are back to the Dark Ages.

Hormesis, or 'radiation is good for you'

I am regularly asked to comment on Hormesis, the idea that small amounts of radiation are good for you.

Several animal experiments seem to have shown that if you deliver a low dose of radiation and then later follow it up with a big dose, those groups that are primed with the low dose have a resistance to developing cancer from the big dose compared with controls which have not.

The explanation is that cells adjust their DNA repair levels, the concentrations of cellular anti-oxidants and radiation repair systems is altered in proportion to the perceived radiation stress. I accept that this is the case, and indeed it seems intuitively likely that such a system would have developed.

We protect against ultraviolet damage to skin cells by sun-tanning, and we have haemoglobin modulators that can be induced by low oxygen levels at altitude. For radiation the process is termed hormesis and is entirely dependent on the induction of cell repair.

But there is clearly a limit to this process: above a certain dose it is overwhelmed: the cell just can't mobilise enough defences and the castle is taken; by which I mean the DNA is mutated and off we go.

The alternative position, the probabilistic one, which is where we are now with radiation protection models, NCRP, ICRP all those people, is that radiation creates its effects by causing tracks of charged particles, mostly electrons.

Every ionization causes damage to the cell, and therefore even at the smallest dose, one ionisation, there is damage to the cell and hence a finite probability that this will lead to cancer. These are the armies facing each other in the petition to assume a threshold, based on the hormesis model versus the Linear No Threshold model.

Actually, as far as human cancer and genetic damage is concerned, both are wrong. I met the hormesis brigade, Myron Pollycove and Ludwig Feinendegen at the CERRIE conference in Oxford in 2004. They were quite sympathetic with what I was arguing (maybe they hadn't thought it through), but they both seemed like nice guys. Scientists anyway. Not psychotic. Because their arguments were based on observation.

Sadly, it's not true

So what is wrong with hormesis. Is radiation good for you? The answer, of course, is no it isn't. There are two alternative, not mutually exclusive reasons. The first is due to Elena Burlakova, Head of Radiation Biology at the Russian Academy of Sciences. Her groups have carried out dozens of experiments on the effects of radiation on different systems.

The dose response they find is biphasic. The effects (including a plot she made for childhood leukemia near nuclear sites) go up then down then up again.

She ascribes this to a combination of the basic dose response which is like a hogs back, going up then flattening, and the induction of repair systems (the hormesis effect) resulting in a falling of the response, which is then overwhelmed at some point, at which the response rises. So the largest effect is at very low doses indeed.

The second is my idea and it is very simple [1]. In the body there are many differentiated types of cell, but what they all (except a few which do not replicate and which you are stuck with all your life, heart muscle, brain) have in common is that at any single time there are two classes: those that are functioning, and those that, because of age (and DNA damage) or fresh DNA damage, make the decision to replicate and provide a daughter cell to take over the job that the parent can no longer do properly.

Replication begins with a 12 hour period in which the cell checks the DNA strands against one another, repairs any repairable mistakes (mis-matches) and then divides. This period is known from experiments to be extraordinarily sensitive to radiation damage to the DNA, ten to hundreds of times more sensitive.

So as the dose to the cell and specifically the DNA is increased, mutation increases for these sensitive minority sub-class of cells which are in repair-replication phase. Thus the cancer rates (or whatever genetic end point is used) rises sharply at these very low doses.

But then the dose reaches the point where these cells are so damaged they cannot survive. At this point, the cancer effect falls (a dead cell doesn't represent a cancer hazard, it cannot create a genetically damaged clone).

This reduction appears to the hormesis crew as a good thing, but note it doesn't operate from the lowest dose, only from some intermediate low dose, and this position is different for different cells.

As the dose increases, after all the sensitive replicating cells are wiped out, the insensitive cells begin to be affected (region B) and the cancer excess risk rises again until these also are overwhelmed and you die (region C). The effect is clearly seen in the results of the huge Cardis et al. 15-country nuclear workers study data which is presented at different doses.

Injecting dogs with plutonium – to prove what?

Some years ago I was up against one of these hormesis geezers, a certain Dr Otto Raabe, in a court case in America. He was the expert for the defence. Raabe was in charge of the Beagle dog studies in New Mexico.

They injected these poor creatures with Plutonium, Radium or Strontium-90 and watched them develop bone cancer and leukemia. The doses were enormous, the number of dogs was small (cost). The whole place was contaminated with Plutonium, the particles hanging in the air like fairy dust. The burial site for the dogs is so radioactive it is fenced off as a US superfund site for decontamination.

Raabe's thing was that he had mathematically converted beagle dogs into humans: you should just see his amazing three dimensional graphs (these guys love all that stuff). Well you can probably find them somewhere on the internet.

The best thing was that in one of his papers he discussed how difficult it was to do these beagle studies. He wrote that 12 (yes 12) of his control dogs (no injections of Plutonium) had unfortunately died of lung cancer and had to be removed from the analysis. What!!?

I checked out the rates of lung cancer in dogs (you can find everything on the web) and that was the end of Raabe. Low dose, you see. Fairy dust.

Anyway, as far as nuclear sites are concerned, none of this is really relevant, except as an excuse to increase the limits of exposure. This is because the cancers near the nuclear sites are caused by internal exposures, to Plutonium, Uranium, Tritium, Strontium-90, Caesium-137, Iodine-131, Carbon-14, particles and huge amounts of radioactive noble gases Krypton-85 and Argon-41. There are more nasty isotopes but that will do.

And internal exposures can deliver doses to the cell and to the DNA which are far above the small doses that the hormesis people are citing. They are talking about low external doses around external natural background, up to 10 mSv.

The alpha particle track in a cell delivers about 400mSv. The alpha decay of a Uranium atom bound to DNA delivers several thousand mSv to the DNA, and also amplifies natural background though secondary photoelectron effects. Different game altogether.

So whats the conclusion? It is this: there is no threshold from zero dose. There is an apparent reduction in the response over some variable intermediate low dose region (the right hand side of the A region peak in Fig 1) which varies depending on the cell type.

Since we don't know what this is, and anyway it varies, we cannot allow for the effect in legislation. And of course, we don't know what other downsides there are to induced repair: one clear likelihood is that you die earlier.

You only get a limited number of replications before you run out of the ability to replace cells. If you use them up with induced repair systems that's the end of the road. Otherwise why haven't we all got these repair systems zinging and spinning at maximum rpm all the time? We all die. And that is why.

The Sweden nuclear waste repository at Forsmark

Hormesis is about misinterpreting some results to obtain what you want. If the hormesis issue seems jaw-dropping, here is a better one where there are no results to interpret, only

mathematical modelling.

On 3rd November I was in Stockholm at the Royal Swedish Academy of Sciences. The meeting was to present to the public and concerned individuals the safety case for the proposed high level nuclear waste repository at Forsmark on the shore of the Baltic Sea just north of Uppsala.

In this perfect example of rational calculation gone mad, the Swedes are proposing to bury the waste in copper canisters which they have mathematically persuaded themselves will keep the stuff from the environment for 100,000 years (Yes!).

The State, in the form of the Environment Council, requires proof that the death toll as a result of this Kierkegaard insanity will be less than 1 in 1,000,000 per year for that period. These deaths are calculated using environmental dose modelling based on the famous ICRP risk model.

I had already written two reports for the Swedish Environment Council [2] and Ditta and I had even presented a complaint to the Swedish Justice Minister in 2012 on this issue [3] [4]. The meeting was in Swedish, and they would not allow me to make a presentation from the stage.

These soothing powerpoints were naturally made by ten or so of the scientific luminaries associated with the ICRP and the presentations verged on criminal misdirection.

Luckily the moderator, a woman, gave me space to jump up at each question time and make clear what was really going on. At the end, she gave me about 15 minutes to present the truth *(see video embed, below)* [5]. This was also reported in the *Osthammar Nyheter*newspaper which gave several pages to these arguments. [6]

There was a predictable response from the men in suits the following week and I get to reply. Carry out a cancer study, I say: let's look at cancer near the present Forsmark reactors, which are among the dirtiest in the world. Lets look at the real world rather than modelling it. Of course they will not: just as the NAS in the USA will not.

My main argument was about the Fukushima thyroid cancers [7]. The average thyroid doses from radio-Iodine at Fukushima were reported to be less than 10mSv. At this dose the current risk model predicts less than 0.05 extra cancers in the 300,000 screened 0-18 year olds.

But in a paper published last October it was reported that there were discovered about 110 extra cancers in Fukushima and none in a control screened group in Nagasaki. This shows an error in the model of about 2,500 times. Our studies and the child leukemia studies suggest the error is bigger.

Kierkegaard was from Denmark. Sweden had Ibsen, whose play, An Enemy of the People, focuses on the attacks by the establishment (out to make money) on the messenger who points out that their nasty tricks are killing everyone. *Plus ca change …*

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3. Busby & Ditta deliver Complaint to Justice Chancelor of Sweden

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