

Radiation through fresh eyes 1:

Protected by Nature *

Wade Allison, Emeritus Professor of Physics, University of Oxford, UK

In a fresh environment on a new planet every influence and substance is a potential threat to life. To move and act quickly with minimal energy the basic mechanisms of life have to be delicate and sensitive, but that implies they are easily overpowered by any change in the physical or chemical environment. On planet Earth life only became possible when the environment became suitably stable, just over three billion years ago. At that time the first few cells were struggling to survive with their early hit-and-miss design. If some had not stumbled on adequate defences, they would have died quickly, as no doubt most did. This search continued for so long that some extraordinarily clever overlapping solutions were found by chance. In evolution by natural selection many individuals die and whole populations are swept away as the environment changes. But today humans and other forms of life on Earth have established some degree of natural protection, in particular against those agents that change relatively slowly.

In its war game of survival life is faced by threats from two directions: from other life forms and from non living agents. Danger from other life forms range from war to infection, from individuals and other species, to bacteria and viruses. Each form is engaged in its own battle to find a niche and multiply. As such, both sides in the threat are playing a similar game, each changes its strategy of attack so that the effectiveness of any particular defence does not last. We see this in the fight with crime, competition between nations, the challenge of finding effective antibiotics and the ongoing evolution of infections that survive in spite of treatment. There is seldom an outright win for either side, just an ongoing sequence of battles - life against life.

But in the war game with a non-living agent the attack is predictable, it does not evolve, it is not volatile. In over three billion years life has evolved survival strategies to cope with such physical threats as cold, heat, starvation, chemical agents and radiation. In each case a living organism learns to tolerate a certain range or scale of attack. Outside this comfort zone the agent may act as a poison, but within it is tolerated or even beneficial. So it is the environment in which the organism has evolved that sets where the comfort zone should lie. The biology has had to adapt and design itself accordingly. If it failed, the organism died out. The physician, Paracelsus, understood this 500 years ago when he wrote *Poison is in everything and no thing is without poison. The dosage makes it either a poison or a remedy*. Although often accepted in popular culture and supported by medical evidence, this understanding has been written out of safety regulations today as a matter of principle.¹ This is misguided, a mistake that should be reversed.

Oxygen and ionising radiation are two such agents which are significant because they can both break molecules, a process called *oxidation*. In this way, but benignly, oxygen releases energy to life by oxidising sugars and releasing carbon dioxide; in photosynthesis the reverse process occurs with the sun supplying the energy. Consequently oxygen is widely spread in the environment and living tissue, and its ability to oxidise significant biological molecules has been an ever present threat to life. Radiation comes from the Earth's rocks, the Sun and elsewhere in outer space. In fact it was rather more intense when life first appeared than it is today. So protection from oxidative attack by these two agents was a condition of survival right from the start.

A protective suit like the ones pictured on the left below may isolate life from a living danger like a swarm of bees, but is clumsy and awkward, even redundant, seen alongside the all-in-one *Birthday Suit* provided by nature and pictured on the right. The protection this provides was developed by natural biology over billions of years for use in low and moderate radiation exposures. It had to work effectively without conscious intervention or safety regulation when life began long ago.

* More is explained in two accessible books by Wade Allison: [Radiation and Reason](#) and [Nuclear is for Life](#).

Follow [@radiationreason](#) on Twitter. Find [recent articles](#), [videos](#) and lectures at www.radiationandreason.com

1 The well worn saying *You can have too much of a good thing* is at odds with the modern safety dogma that even a little of a harmful agent is harmful in proportion - the Linear No-Threshold (LNT) assertion.



But how is it possible that the human body alone can protect itself effectively, given the enormous energy of a radiation quantum? The answer is three-fold: 1) having a suitable design in the first place; 2) having at hand protective strategies to make good any damage caused; 3) being ready to improve future protection in the light of experience. The basic design of life is protected by redundancy: multiple individuals, each regularly replaced; each individual composed of multiple cells, each frequently replaced. Protective strategies neutralise chemical radicals (anti-oxidants), repair broken molecules, kill errant cells (apoptosis) and police for abnormal behaviour (immune system). Such strategies consume resources - and so fail when these are exhausted. However, by increasing and adapting those resources with experience, the strategy can adapt further with use.²

Unlike a virus or bacterium radiation and oxygen are dead agents not able to evolve. Protection against them is virtually complete unless resources fail - or unless the patient *thinks* they are a real threat. The *nocebo* effect, the opposite of the *placebo* effect, is the well known negative medical effect of a harmless agent to a person who thinks it is harmful. That can generate a basket of actual symptoms and real suffering. An example is the real effect of a religious curse on a believer.³ At a social level it can cause human panic. At Fukushima this was readily amplified by the media, but the wildlife, having no such fear and innocent of their modest contamination, have thrived in the absence of humans both at Chernobyl and Fukushima.⁴

Collective fear is a political force, as potent today as it was in the era of the mediaeval witch hunt. Military weapons have been used throughout history not only as instruments of death and destruction but more effectively to engender fear. Losses to men and materials are least if the enemy loses its nerve and retreats. Nuclear weapons are no exception in principle. If used, they cause blast and fire over several square miles, locally. But it is the fear of global nuclear radiation that has gripped world opinion for 70 years. However, except at the highest doses there is no danger from radiation. In 50 years fewer died of radiation-induced cancer from Hiroshima and Nagasaki than died on the Titanic; less than 50 died from radiation at Chernobyl and no one did at Fukushima. But losses from the *nocebo* effect were more serious.

Panic caused by radiation and the fear of nuclear technology are the greatest avoidable threats to the future of mankind. Avoidable? Yes, by communicating with the public and explaining to them how they already receive high doses of radiation for their personal health - and live much longer as a result. We should scrap safety regulations designed simply to appease the public fear sanctified by the precautionary principle and the Linear No-Threshold assertion, neither of which is based on sound evidence. It is a matter of exorcism, like getting rid of a ghost.

² Further straightforward discussion is given in the book *Nuclear is for Life*, Chapter 5.

³ Pilcher, H (2009). *The science of voodoo: when mind attacks body*. New Scientist. May 2009.

⁴ Nature video of Chernobyl wildlife (2012) Discovery Channel <http://t.co/puM2rwyBMH>, <https://www.youtube.com/watch?v=IEmms6vn-p8> and <http://www.bbc.co.uk/news/science-environment-32452085>