

Why this Webpage?

Radioactivity

In general radioactivity – as long as it occurs naturally – is an interesting and thrilling physical phenomenon. Natural radioactivity is generated during decay of some chemical elements that still occur in nature in a chemical bond to some molecules in small concentration. Often only a small percentage of atoms is radioactive (the isotopes) as for example with carbon or potassium. Some people just are interested in natural radioactivity as for any other natural phenomenon. Or they try to provide for some risks related to radioactivity simply with acquisition of knowledge on it.

However, most people are afraid of radioactivity and associate a threat to life with it. This is because radioactivity also occurs artificially with man made nuclear technology in such quantities that aren't comparable at all with natural radioactivity. Nuclear technology is used in power plants and military weapons. As is known, both contain a severe risk to life such that fear is absolutely justified. In nuclear plants and with nuclear weapons atomic nuclei are either fissioned or fused together. This would never happen in such a way on earth. During such a fission or fusion process nuclear radiation is produced in a totally different order of magnitude and additionally substances are generated with extremely high radioactivity. These substances (fission or fusion products) may also contain elements that never existed before on earth in a natural way.

On the other hand the natural radioactivity can be found in the human body. Just as an example potassium is a vitally important element for the muscles and in particular for the heart, ingested by the human with many mineral salts. The natural potassium contains the radioactive isotope potassium-40 to 0.012%. This means, each human emits natural radiation. Similarly, during a flight on regular cruising altitudes of airplanes or in the high mountains the human absorbs a non-negligible extra dose of high energy particle radiation, caused by cosmic radiation.

The purely natural radiation on earth can be compared in its dangerousness most closely to UV radiation of the sun. Since the human has no sensory organ for it, there is a risk for a radiation sickness ("sunburn") whenever the exposure is too extensive. Repeated and strong overexposure is considered to induce cancer in the same way. However, the human can at least recognize the visible portion of the radiation emitted by the sun and therefore he can guess the simultaneous invisible UV radiation more easily compared to the nuclear radiation.

An overdose of natural radioactive radiation (for example caused by an excessively long stay at the thorium-containing beach of Guararapi in Brazil) must not be confused with the dose that may be absorbed from artificially generated nuclear reaction or substances generated by nuclear

technology. This difference immediately becomes evident when comparing the irradiation of the earth surface by the sun with the radiation in immediate vicinity of the sun's surface where a nuclear fusion reaction is constantly ongoing (similar to what occurs in a hydrogen fusion bomb). Whereas the sun's radiation is even good for health when consumed in an appropriate dose on the earth's surface, no life at all is imaginable in the vicinity of the nuclear reactions on the sun.

When judging the dangerousness of radioactivity it also has to be considered that a smoker who consumes a packet of cigarettes for his whole life accumulates an aggregated dose of the most dangerous alpha radiation that would not be tolerated in a nuclear plant even in the control area. It is also the current assumption that this radioactive dose is responsible for a significant increase in risk to induce lung cancer. This is related to the ability of the tobacco plant to accumulate the substances with natural radiation in particular the polonium in the surface of its leaves. There are medical specialists who believe that the risk of lung cancer is even dominantly related to the radioactivity of the tobacco aerosols than to the toxicity of nicotine and tar.

Interestingly there are also medical scientists, supporting the hormesis hypothesis (toxins in weak doses may help healing) and prescribe a treatment in a radon bath or radon adit (e.g. as you can find it in Menzenschwand in the Black Forest or in Bad Gastein in Austria) where the radioactive gas radon is inhaled. In fact, it was possible to show that lab mice that was fractionally irradiated with weak nuclear radiation survived a subsequent irradiation with a normally lethal dose with higher probability than without this „training“. It is assumed that the immune system comprises mechanisms to repair radiation induced damages to a certain degree and that can be adapted to a changing environment (training effect).

This theory is also supported by the fact that human embryos are most sensitive to radiation between the second and the sixth week of pregnancy to radiation damages because during this stage of maturation the organs just start to be formed and no redundancy is available for repair by the immune system.

Geiger counter

Since the human has no sensory organ for radioactive radiation he can't sense it. Only the consequences may allow a conclusion on the exposure to such a radiation. A Geiger counter is an instrument that allows the detection of radioactive radiation with technical means. For the one who is interested to work with and understand natural radioactivity, such a detection instrument is very helpful and recommendable, especially when it is cheap.

Another reason for an interest in a Geiger counter is the precaution for potential danger. Even though someone might not be interested in the exact nature of radioactivity a detection of it in terms of a Geiger counter may still be very desirable. A serious risk is indeed given when the probability of a dangerous accident on one hand is pretty small but on the other hand the consequences are extremely fatal. Unfortunately in many countries nuclear plants are operated, supposedly with a small risk, but with fatal consequences in an emergency case. In contrary to vaccination of the population against pox or polio many countries do not prepare much for an appropriate civil protection against radioactive radiation. In case of an emergency the consequences can be expected to be really catastrophic as it could be seen in Fukushima 2011.

The most severe danger for the survivors of a nuclear catastrophe is mainly the ingestion of radioactivity with food accompanied with the erroneous integration of substances into the body cells that emit much, much more radiation than the natural substances. Once integrated in the body cells, these substances permanently emit radiation causing internal "sunburn". Therefore it may be helpful after a nuclear emergency to check the food before eating it with a Geiger counter.

However, right after a nuclear emergency, when needed most, no Geiger counters are available for sale. This was proven to be true several times for the cases in history. Similarly, most people do not know at all how to deal with radioactivity and the respective detection and measurement instruments. They also don't know how to effectively protect themselves. In general there is also no time for an extensive study of the radioactivity phenomenon. The politicians and the emergency management will mostly fail in those cases too, historic cases have proved this. Therefore the majority of the population in the near surroundings of a nuclear disaster and in the regions concerned with the fallout of the artificial and excessive radiation will be exposed fairly defenseless.

Even though someone wants to buy a measurement instrument for radioactivity outside the times of emergency he will be challenged a bit. Such instrumentation will not be available in the drugstore around the corner as it is the case for a thermometer. And such instrumentation is much more expensive than a thermometer, currently several hundred Euros for a very simple instrument.

The meaning of this webpage

This webpage has the idea, to convey knowledge to interested and somewhat skilled people how to construct a Geiger counter on their owns. This counter will not cost more than a few tens of Euros. With it one can get familiar with natural radioactivity and the Geiger counter instrument in general, either because of an interest in the natural phenomenon of radioactivity or to protect against radiation during catastrophes. The do-it-yourself instrument will be capable to detect for example the radiation

emitted from an old wrist watch with a radium containing luminous dial or from a uranium containing stone (e.g. from the black forest area). The do-it-yourself Geiger counter however will not be able to detect the natural radioactivity in the human body or the air. Without special precautions the instrument will also not be able to detect the dangerous alpha radiation appropriately. However, since in the decay chain there is always accompanying beta and gamma radiation, the radioactivity will be detected in general.

For the construction of a do-it-yourself Geiger counter certain knowledge of electronics is required however. For the Geiger counter described on this webpage one should be particularly familiar with a fine tip soldering iron and the assembly of surface mount electronic components.

I also hope that this webpage inspires others to fiddle about this subject and a communication on this subject is initiated. Perhaps it is possible together with the large Internet community to collect a bunch of construction manuals, to test and compare them and to publish it openly to everybody in alignment with the open source idea for software. By this means it may be possible to develop a "counter for the people" that is not subjected to copyright and patent infringement and that works perfectly well, available at a price that everyone can afford.

When this „counter for the people“ indeed is manufactured or bought by many then I would not only have transferred valuable knowledge but also contributed to civil protection a lot (what our governments unfortunately failed to do so far).

In this respect: Have fun and good success.