Chernobyl's Legacy: Black Prophecies' Bubble

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Abstract

On April 26, 1986, the Chernobyl nuclear accident occurred. Thirty people died within several weeks, while the accident's scale was unprecedented—and probably about the largest theoretically possible. Many predictions were then made, including rumors concerning up to million cancer deaths. Most of those predictions were *a priori* unobservable and therefore unscientific. The reality turned out to be absolutely different. According to solid scientific data gained over one quarter of a century, 15 cancer deaths at most may be directly attributed to fallout radiation. In particularly, no conclusion could be drawn concerning the presence or absence of a radiation-related excess of cancer—including leukemia—among Chernobyl accident recovery workers, who received rather high (and well-documented) radiation doses. The number of radiation-related mutations (congenital malformations) is zero.

Two popular myths challenge the above scientific evidence: (a) the raw medical data is filtered by local governments; (b) the international agencies that summarize the data (like IAEA, UNSCEAR and WHO) are pro-nuclear biased. Both arguments are, speaking politically-correct, alternatively convincing.

On the other hand it should be stressed that the myths and misperceptions about the threat of radiation themselves caused enormous human suffering. In addition to the socio-economic problems associated with relocation (mostly unjustified), people have suffered a paralyzing fatalism, which has contributed to a culture of chronic dependency. Mental health problems, leading to and coupled with smoking and alcohol abuse, proved to be a very much greater problem than radiation. Similar problems should be avoided in future accidents by means of proper transparency.

1. Introduction

The Chernobyl nuclear accident occurred on April 26, 1986. It killed two employees outright, and 28 more died within several weeks after receiving lethal doses of radiation. The scale of the accident was unprecedented—and probably about the largest theoretically possible. As formulated by Zbigniew Jaworowski [2010],

> *Chernobyl was the worst possible catastrophe. It happened in a dangerously constructed nuclear power reactor with a total meltdown of the core and 10 days of free emission of radionuclides into the atmosphere. Probably nothing worse could happen.*

And really, the 2011 Fukushima accident, caused by an unprecedented natural disaster, with the total meltdown of three reactors, was of a lower order-of-magnitude. In the wake of the Chernobyl accident, many black predictions were made. It was claimed that 53,000 people (pay attention to the accuracy!) will die of Chernobyl-

induced cancer over the next 50 years [Goldman et al. 1987]. The author personally remembers rumors circulating in Moscow in 1986 about a million cancer deaths. These predictions and the overall hysteria led to enormous human suffering, including that associated with the permanent relocation of more than 300,000 people (evacuation for the majority was unjustified [Jaworowski 2010]).

The reality, however, turned out to be completely different. As in the old joke, "in spite of the best efforts of the doctors, the patient recovered." In our case, in spite of the best efforts of statisticians and epidemiologists, the Chernobyl-induced cancers and mutations have yet to manifest themselves.

2. Discussion of the estimates

Let us begin with the frightening estimate of 53,000 deaths as a result of Chernobyl [Goldman et al. 1987]. This death toll calculation was derived simply by multiplying the estimated Chernobyl doses by the vast number of people living in the northern hemisphere and by a cancer risk factor, which is based on epidemiological studies of the atomic bomb survivors in Japan according to the widely accepted (but seriously questioned and debated) Linear No-Threshold (LNT) model of radiation carcinogenesis. Not accounted for is the uncertainty in determining the doses over the northern hemisphere. Annual cancer mortality varies by about 110 per 100,000 persons in the developed countries [Jemal et al. 2011]. Therefore, roughly speaking, of the 1 billion population of the developed countries, 1.1 million people die annually from cancer. Over 50 years, this yields about 50,000,000 cancer deaths (the approximation is extremely crude but gives the correct order of magnitude). The uncertainty of the above figure should be taken as about 5% or 2,500,000 since the cancer mortality rate differs within ±5% between different developed countries (e.g. 1.05 per 1000 in North America but 1.145 per 1000 in northern Europe). We must conclude that there is absolutely no way to verify or disprove that undistinguishable 53 out of 50,000 ± 2500 (thousands cancer deaths) were caused by Chernobyl! The principle of refutability demands that any scientific statement should contain information about how to disprove it. As formulated by Karl Popper [1963],

> "*A theory which is not refutable by any conceivable event is non-scientific. Irrefutability is not a virtue of a theory (as people often think) but a vice*."

Therefore, a positive statement based on the above estimate is simply not scientific. Lauriston Taylor, the late president of the U.S. National Council on Radiological Protection and Measurements, deemed such LNT-based estimates to be "*deeply immoral uses of our scientific heritage*" [Taylor 1980]. Let us mention, by the way, that Taylor himself received a whole-body dose estimated to be more than 10,000 mSv – corresponding to 100% cancer risk according to the LNT model – when he was 27 years old [Taylor et al. 2004]. Nevertheless, he died peacefully at the age of 102.

Next, approximately 200,000 "liquidators," also referred to as "cleanup workers," labored in the 30 km zone in 1986–1987 ([BEIR 2006], Table 8-9, p. 202). Their average dose is estimated to be 100 mSv. According to the LNT model, taking into account that the liquidators were mainly males around 30 years of age, 100 mSv should cause about a 0.6% life-time cancer incidence ([BEIR 2006], Table 12-6, p. 281) on top of the natural 42% ([BEIR 2006] Fig. PS-4, p. 7). Namely, 1200 cancers should be diagnosed on top of 80,000 ±300 (1σ) natural cancers. Such an excess, if

not masked by systematic errors, could be statistically significant. However, the systematic errors are high. As mentioned just above, within the developed countries, the cancer mortality varies by ±5%. The same uncertainty may be with reasonable justification applied to the cancer rate of the affected regions with their highly volatile socio-economic situation, making observation of cancer excess among liquidators a formidable task. Similar conclusions are probably valid for the population of the "strict control zone" (270,000 people, who received an average dose below 60 mSv [BEIR 2006]).

Finally, about 3,700,000 people lived in the territories that were officially declared as "contaminated." The average dose for this population was below 15 mSv [BEIR 2006], yielding according to the LNT model 0.1% cancer excess. Such excess cannot be observed given the uncertainties of the natural cancer incidence rate.

We should conclude, therefore, that even according to the officially-"conservative" (i.e. actually overestimating) LNT model, Chernobyl radiation consequences would be *a priori* hardly detectable. The *a posteriori* scientific evidence is described below.

3. Scientific evidence

In 2006, the US National Research Council published the extensive 424-page BEIR-VII report dedicated to the effects of low levels of ionizing radiation [BEIR 2006]. This report is typical in reviewing findings regarding Chernobyl (see also e.g. [Chernobyl Forum 2005], [WHO 2006]).

1) In most of the studies of the liquidators from Belarus, Russia, and Ukraine, increases (doubling or tripling) in the incidence of leukemia and thyroid cancer have been observed. However, "these results are difficult to interpret" (BEIR-VII, p. 203) since the follow-up of the liquidators is much more active than that of the general population in the three countries, and since *no increase in cancer or general mortality* among the liquidators was reported. To make things easier to interpret, we shall cite that "no increase in the incidence of leukemia or thyroid cancer has been reported among Baltic country liquidators" (p. 204). BEIR-VII claims that this "does not contradict the findings reported in Belarus, Russia, and Ukraine in that the number of liquidators in the Baltic countries is small." However, another explanation, based on cultural differences, seems to us no less plausible.

In a case-control study based on the limited dosimetric data, no significant association was seen between the risk of leukemia and radiation dose among the Russian liquidators (p. 203). BEIR-VII summarizes:

"*At this time (2006), no conclusion can be drawn concerning the presence or absence of a radiation-related excess of cancer—particularly leukemia—among Chernobyl accident recovery workers*."

2) As for the population of the contaminated area, the only traceable direct health effect of the radiation is the increase in the incidence of thyroid cancer in children. Those children consumed milk contaminated by radioactive iodine just after the accident, and that consumption could easily have been avoided by issuing proper instructions. According to the Chernobyl Forum [2005], a total of about 4,000 thyroid cancers were observed; 15 died. The increase was first reported in Belarus and Ukraine in 1990 ([BEIR 2006] p. 215). There was immediate skepticism that such an

increase was related directly to radiation exposure from Chernobyl. This very early onset of the disease, only 4 years after the exposure, was unexpected based on the knowledge that the latent period for radiation-related thyroid cancer is much longer. Hence, there was doubt about the validity of the pathologic diagnoses, and the opinion was given that the apparent increase was largely the result of the widespread population screening. In general, 15 lethal cases among a population of millions is not convincing evidence. The very credible criticism of the Chernobyl Forum Report, submitted by the Polish delegation to UNSCEAR [Jaworowski 2006], was ignored. Studies of hyperthyroidism patients treated with radioiodine suggest that a lower incidence of cancer mortality can be expected [Franklyn et al. 1999]. Despite all of these questions, BEIR-VII considers it probable that the thyroid cancer were really caused by the radioiodine. However, the above number of 15 should be considered as the upper limit of the Chernobyl cancer death toll.

Regarding other types of cancer, BEIR-VII summarizes that "*there is no convincing evidence that the incidence of leukemia has increased in adult residents of the exposed populations that have been studied in Russia and Ukraine*" (p. 227), and also that "*there is no evidence of an increase in any solid cancer type to date*" (p. 228).

3) As for highly dreaded congenital malformations (in simple terms, mutations) and the popular myths of two-headed animals and children, it should be mentioned that such mutants were born before the Chernobyl accident and are not expected not to be born after it. For example, a 300-year-old child's skeleton with two heads and three arms is exhibited in the Kunstkamera Museum (St. Petersburg, inventory number: № 4070-914). The two-headed calf, shown in Figure 1, was born in Israel in 1976, so its connection to the Chernobyl accident is not credible. There has in reality been a modest but steady increase in reported congenital malformations in Belarus since 1986. However, this increase occurred in both contaminated and uncontaminated areas! This is most probably the result of increased registration, rather than being radiation-related ([Chernobyl Forum 2005] p. 20).

Fig.1. Two-headed calf, born dead in Kfar Yehezkel, Israel in 1976. On permanent exhibition at Beit Haim Sturman Museum, Ein Harod, Israel, along with several similar mutants. Any connection to Chernobyl is the sole responsibility of the reader.

4. Criticism and counter-criticism

Two kinds of arguments are often made against the above facts.

- The medical data were and still are filtered by the governments of the USSR, Ukraine, Russia and Belarus to draw attention away from their misconduct and to reduce their responsibilities.
- The data are analyzed by agencies that are somehow connected to nuclear energy and are therefore pro-nuclear biased and also interested in diminishing the Chernobyl accident consequences.

Both arguments are, speaking politically-correct, alternatively convincing.

Regarding the filtering of data by the host countries—while this was really so during the first years, the situation is just opposite since the collapse of the USSR. The Ukrainian government, a bitter rival of Russia, has zero—or rather, negative—interest in covering up the misconduct of the USSR authorities 25 years ago. The same is likely true, though probably to lesser extent, for Russia and Belarus. Just the opposite. All the affected countries are keenly interested in *exaggerating* the medical consequences, taking into account the extensive Western investment in the relief of Chernobyl victims and in dealing with the still-problematic damaged reactor.

Regarding the pro-nuclear bias of the international scientific bodies to under-estimate cancer mortality etc., two statements should be made.

a) The data cited above is freely available to the scientific community. Profoundly anti-nuclear circles (green parties, fossil fuels industry, renewable energy, etc.) have significant influence in many developed countries (including Germany with its considerable weight in the EU)—and, therefore, a significant budget to fund researchers that would challenge any pro-nuclear bias, if it really existed.

b) The pro-nuclear bias hypothesis is in contradiction with the simple fact that the above-mentioned respected organizations (including the BEIR-VII committee) promote the Linear No-Threshold (LNT) model of radiation carcinogenesis, to the discomfort of the nuclear industry. In addition, much of the cited evidence (e.g. that cancer mortality of nuclear workers is generally lower than in reference populations) contradicts the LNT model, and the best that can be said is that "*there is no compelling evidence to indicate a dose threshold below which the risk of tumor induction is zero*" ([BEIR 2006], p. 10). Therefore the cited evidence should be trusted.

4. Victims of radiophobia

As we have shown above, the direct health consequences of Chernobyl radiation, besides the acute effects, are at most questionable. However, at least 4,000,000 people living in the "contaminated" areas were declared victims. And, truth to be told, after being declared thus they became very real victims. Radiophobia—irrational fear of radiation hazards—led to extremely traumatic decisions and results.

The World Health Organization mentioned: "*Evacuation and relocation proved a deeply traumatic experience to many people because of the disruption to social networks and having no possibility to return to their homes. For many there was a social stigma associated with being an 'exposed' person …*" [WHO 2006].

According to the Chernobyl Forum [2005], "*The most pressing health concerns for the affected areas thus lie in poor diet and lifestyle factors such as alcohol and tobacco use, as well as poverty and limited access to health care*". The Forum concludes that "*the mental health impact of Chernobyl is the largest public health problem unleashed by the accident to date*."

It can be summarized thus: that misconceptions and myths about the threat of radiation led to heightened anxiety and tendency to associate every observed health effect with Chernobyl. These factors promoted increased suicides and paralyzing fatalism among residents. All the above, coupled with smoking and alcohol abuse, proved to be much greater problems than radiation.

Unfortunately, these lessons have not been learned, and the same kind of suffering is occurring in Fukushima. Here radiophobia collected directly accountable death toll: more than 50 patients of evacuated hospitals died within several days as a direct consequence of the unfounded evacuation [Tanigawa 2012], and more than 1000 people within the following year owing to various evacuation-related non-radiogenic (mainly psycho-somatic) problems [Saji 2013]. A recent memorandum of the International Commission on Radiological Protection [Gonzalez 2013] admits that the LNT model yields "*speculative, unproven, undetectable and 'phantom' numbers*," but nevertheless finds the model "*prudent for radiological protection*." Additional ethical issues are considered in our recent paper [Socol et al.2014]. For a historical review and economical analysis see [Socol et al.2013].

Radiological hazards should be put into proportion in order to mitigate the present suffering and to avoid such suffering in future.

5. Conclusions

It should be concluded that, unlike the widespread myths and misperceptions, there is little scientific evidence for carcinogenic, mutagenic or other detrimental health effects caused by the radiation in the Chernobyl-affected area. On the other hand, it should be stressed that the above-mentioned myths and misperceptions about the threat of radiation caused, by themselves, enormous human suffering. In addition to the socio-economic problems associated with (mostly unjustified) relocation, people have suffered a paralyzing fatalism, which has contributed to a culture of chronic dependency. Mental health problems, leading to (and coupled with) smoking and alcohol abuse, proved to be a very great problem. The authorities did not learn this lesson from Chernobyl, and the same kind of suffering is occurring in Fukushima. The lessons should finally be learned and the radiological hazards should be put in proportion in order to mitigate the present suffering and to avoid such suffering in future.

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