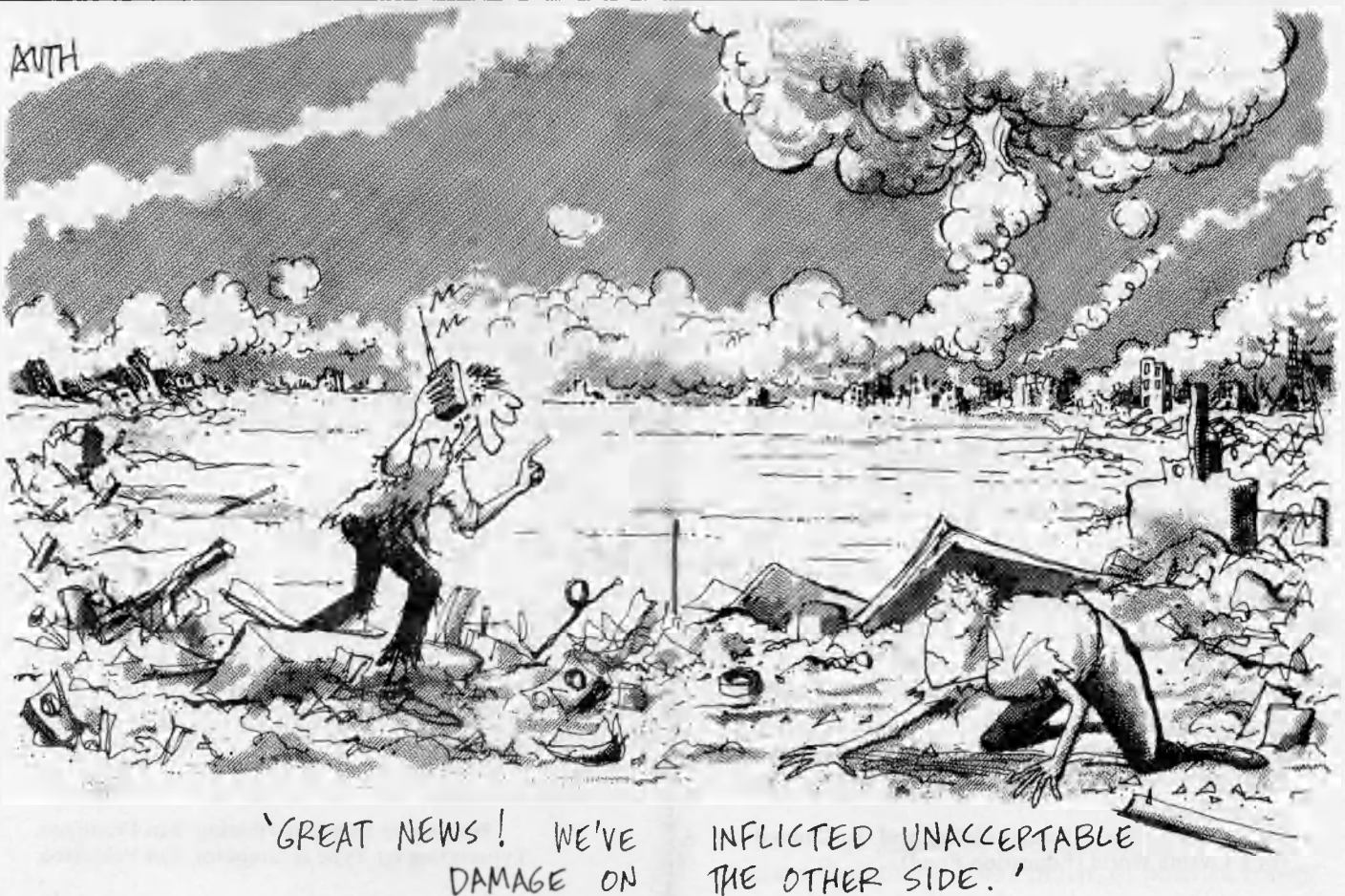


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# Some Medical Causes and Consequences of Nuclear War:

## How Physicians Might Help to Prevent Nuclear War

By John W. Gofman, M.D., Ph.D.



*About the author:*

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In earlier years, he worked on the Manhattan Project; developed ways to separate Plutonium from fission products and unfissioned Uranium; co-discovered Uranium-233 and proved its fissionability; did extensive research in the 1950's on atherosclerosis and lipoproteins, and later on cancer and chromosomes, the biological effects of ionizing radiation, and the toxicity of Plutonium.

It is my opinion that there may well be a *medical cause* of the nuclear arms race, and of the likely occurrence of nuclear war. Further, it is my opinion that the way in which the medical profession treats the issue of the health effects of ionizing radiation may well make the difference between nuclear war and no nuclear war. Let me explain both points of view.



*Possible Medical Cause of Nuclear Arms and Nuclear War*

Medicine and medical research have focused on two, great life-limiting diseases: atherosclerosis and its sequelae, and malignancy. There is no doubt that today these are the major limitations upon life-span in Western Society. But it is highly likely that another medical disorder will soon become the major limiter of life-span for the human species, and for other species coincidentally. That medical disorder is what I refer to as the *power-lust syndrome*, or simply *power-disease* (Gofman, 1979a). While some might insist that this disease has a genetic basis, I would simply list it as a major disease of unknown etiology. There is no doubt in my mind it is a far more important disease than coronary heart disease and cancer put together.

It should be abundantly clear to physicians that there is *not* much, of positive conse-

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quence, which medicine can do after a war which either releases a fair share of our inventory of radioactive waste, or which uses nuclear bombs, or both. So I think medicine should be far more interested in what it can do to prevent nuclear holocaust than in the treatment of its victims. And for this reason, I think medicine should be in the forefront of efforts to control the disease, power-lust syndrome, before that disease eliminates a large part of the human species.

A word about time scales for the effort. Power-disease has been with us at least for a few thousand years. We probably have a decade, or a few decades if we use our time wisely, to quarantine those with the disease, and to prevent nuclear war or worse.

Nuclear weapons represent only one modality in a long line of historical devices employed by those individuals who routinely have used force and coercion to achieve power over other humans. It is ludicrous, in my opinion, to think that agreements, treaties, and exhortations are going to eliminate the threat of nuclear force. I say this because I consider it naive to expect that the type of individuals who have brought us to our present plight, are going to take action to reverse the situation.

We are facing the probability of nuclear war not by accident and blunder and misunderstandings, but rather as the natural consequence of an *idea*: the age-old idea that certain power-lusting individuals called rulers have the right to use force on the bulk of humanity in order to resolve conflicts—conflicts which have been created by the rulers themselves. In order to get rid of nuclear weapons from this Earth, humans must also get rid of the idea that the use of force of ANY sort is an acceptable way to resolve conflicts.

The disease, power-lust syndrome, is associated with a serious companion phenomenon: the acceptance by people that there

should even *exist* positions of coercive power, positions in which the sickest members of society have supra-lethal hardware at their disposal. Medicine ought to give a great deal of effort to learning how to enable people worldwide, and essentially simultaneously, to eliminate all positions of coercive power, and to learn how *never* to allow those afflicted with power-lust syndrome to restore such positions of power. This, in my opinion, is the only non-temporary, enduring solution for the nuclear arms/nuclear war problem.

Is it not a truly amazing situation that 3 to 4 billion people now find themselves hostage, for the very existence of their species, to a relative *handful* of power-lusters? Surely medicine can help find a way to quarantine those afflicted worldwide with this serious disease—and that way is *not* going to be by worthless paper agreements between the world's power-lusters themselves! It is not essential that medicine discover the etiology of the disease in the next two decades or so: quarantine of all sufferers from the disease will do very well.

## ■ 2 ■

### The Health Effects of Ionizing Radiation: Why Indifference in the Medical Profession to this Question Can Help Facilitate the Occurrence of Nuclear War

#### ■ Radiation Induction of Cancer and Leukemia ■

Over the past fifteen years, I have been upgrading my estimates of the cancer and leukemia risk per unit of ionizing radiation, as the newer epidemiological data have become available. We are now quite able to make a very sound assessment of the medical consequences of radiation exposure at all dose levels. Recent-

ly, in the preparation of a detailed book, "Radiation and Human Health", I have analyzed all the world epidemiological studies and have used techniques which permit integration of all the human data into a single, consistent analysis of the diverse sources of data.

Let me quote the results (from Table 2) of my analysis and compare them with the results presented by quasi-official bodies. The results are presented as the expected number of cancer fatalities for the administration of one rad of whole-body radiation to each person in a mixed population of one million people. My estimate is that there will be 3,771 cancer deaths, the BEIR-III Draft Report shows between 70 and 353 cancer deaths, and the United Nations Scientific Committee Report shows 100 cancer deaths.

In "Radiation and Human Health", I have shown *in extenso* the egregious errors of analysis which lead to the absurdly low estimates of the BEIR and United Nations Committees. My point here is simply that the BEIR Committee has underestimated the radiation-induced cancer risk by between 11 and 54-fold, and the error is even larger in the BEIR-III *final* report. The United Nations Committee has underestimated the cancer risk by approximately 38 times.

■

Since it is the output of such quasi-official Committees which is used by military planners and scenario designers for nuclear war, I wish to advise you that the military estimates will be at least 11 to 54 times too low. I shall return to this issue after a bit more consideration of the medical implications of the radiation-cancer estimates.

### ■ Several Myths Which Need to be Abolished ■

- 1.) The first myth involves the linear hypothesis, which holds that the risk of cancer is proportional to the dose of radiation, and that there is no such thing as a safe, or "permissible" dose of radiation with respect to cancer induction. It is a myth that the linear hypothesis overestimates the cancer risk of ionizing radiation. The evidence indicates that quite the opposite of the myth is the truth. The relationship is *supra-linear*, meaning that the cancer risk *per unit of radiation* is higher at low total radiation doses than at high doses, and that the linear model *underestimates* the cancer-risk.

- 2.) It is a myth that the cancer consequences are lessened by slow delivery of ionizing radiation. Both the analyses of Mancuso, Stewart, and Kneale (1977, 1978), and my own independent analysis of the Hanford worker data (Gofman, 1979b), show that radiation delivered slowly (approximately one rad whole-body radiation per year), produced a *larger* effect per unit dose than radiation delivered acutely. The myth-promoters had suggested a diminished effect for slow delivery of radiation.

- 3.) It is a myth that fractionation of ionizing radiation will help reduce the cancer risk of radiation. Careful studies of breast cancer induction by ionizing radiation have shown no protection whatever from breaking a big dose into a series of little doses (Boice and co-workers, 1977, 1979). Even worse, in the studies of induction of bone sarcoma from <sup>224</sup>Radium, fractionation of the dose of <sup>224</sup>Radium was actually associated with an *increase* in the number of bone cancers per unit of alpha particle irradiation (Mays and co-workers, 1978).

The most recent example of this myth is a paper by Linos and co-workers of the Mayo Clinic. Since this paper was featured in the *New England Journal of Medicine* (May 15, 1980), I presume most of you may well have seen it. The paper suggests that *fractionation*

of medical radiation-dose prevents leukemia-induction below 300 rads of total dose. It is rare indeed that journal editors permit publication of papers so totally lacking in the crucial data upon which the conclusions are based. Within the little information which the authors do provide, there are so many flagrant errors of method that any one of them is more than sufficient, on a scientific basis, to discount their conclusions as any serious contribution to the literature of radiation-induced leukemia.

### ■ *The Use of the Data on Cancer Induction by Radiation* ■

Only two concepts are needed to make medical use of the cancer evidence.

The first is the concept of the **Person-Rad**. This is a unit obtained by multiplying each person's dose by one (for one person), and then adding up all the person-rads. A person exposed to 10 rads represents a dose of 10 person-rads, just as a dose of 10 persons each exposed to one rad represents a dose of 10 person-rads. So long as we are in the dose-region where the risk-versus-dose relationship is close to linear, we can calculate directly how many fatal cancers will occur from a population-exposure if we know the total number of person-rads delivered, even if all sorts of doses, high and low, were received by individuals.

The second concept is that of the **Cancer Dose**. The Cancer Dose is defined as that number of person-rads which must be delivered to a population sample (no matter how many persons are in the sample) to guarantee *one* fatal cancer. The Cancer Dose is based upon the human epidemiological evidence and its analysis. In Table 1 are presented my estimates for the Cancer Dose for males and females of varying ages at irradiation (U.S.A.). Also presented in Table 1 are the Cancer Doses for males and females in a population of mixed ages, if we assume equilibrium in the population.

Let us illustrate the use of these Cancer Doses of Table 1 in consideration of some of the *consequences of nuclear war*. You will see, in this Symposium and elsewhere, some charts which speak of survivorship for various acute doses of radiation. Thus one might find that the LD<sub>50</sub> (the lethal dose for 50% of recipients) is given as 350 rads of whole-body radiation for a particular age. The impression might be gained that those who receive a dose below 350 rads are "in the clear". That is simply not so. Let us examine Table 1, in this listing for males. We find, for 10 year old children of the male sex, that 88 rads of whole-body radiation is the Cancer Dose. For every male child *under* 10 years of age, the Cancer Dose is even lower than 88 rads.

Therefore, for every male child at 10 years of age or less who receives 88 rads of whole-body radiation or more than 88 rads, death of cancer is essentially guaranteed, with an average loss of life-span of 18 to 22 years. **NOTE that this need *not* be acute radiation from a nuclear explosion—accumulation of such dose in the aftermath would do just as well to guarantee the cancer death.** For females, any female child at ten years of age or younger who accumulates 104 rads of whole-body radiation is essentially guaranteed to die of cancer prematurely, unless death from other cause supervenes first. The average loss of life-span would be approximately 24 to 29 years.

Of course, there is nothing which limits our consideration to children. For 25 year old males, we find the Cancer Dose to be 201 person-rads. This is well below the LD<sub>50</sub> for acute radiation. But males under 25 years of age of exposure who receive 201 rads of whole-body radiation or more, are essentially guaranteed to develop a fatal cancer, and to lose between 12.8 and 22.3 years of lifespan, on the average, unless other death-causes supervene first.

### ■ *What Are the Effects of Doses Less than the Cancer Dose?* ■

For doses less than a full Cancer Dose, the calculations of cancer consequences are straightforward. Let us consider males at 25 years of age, for whom the Cancer Dose is 201 person-rads. Suppose a particular male received 40 rads in a nuclear war or from fallout. He will experience very little likelihood of any serious radiation sickness. But what of his cancer risk in the future? For one person, a dose of 40 rads means 40 person-rads. Since 201 person-rads guarantees one fatal cancer, that is, a risk of 1.0 of development of a fatal cancer, it follows that 40 person-rads gives a risk of  $\frac{40}{201}$ , or 0.199. Let us round this off to 0.2.

The interpretation is that this man has a probability of 0.2 of developing a fatal cancer from radiation. Stated otherwise, one out of every five men so exposed will die of radiation-induced cancer, and the average life-span reduction of those who do die of such cancer will be about 13 years.

#### ■ Genetic and Chromosomal Injuries by Ionizing Radiation ■

It is very likely that you may have already heard the first distortion of the evidence from Hiroshima and Nagasaki concerning genetic and chromosomal injuries from ionizing radiation. That distortion states, "There were no genetic injuries as a result of the atomic bombing of Hiroshima and Nagasaki". A second distortion, common among apologists for nuclear polluters, is "If you can't find a genetic effect in a whole couple of cities which were bombed, the effect sure must be small".

Let us now look at the *actual* conclusion of Neel, Kato, and Schull (1974), who did the only large-scale search for genetic effects of radiation in the survivors of Hiroshima-Nagasaki. Their study sought out radiation-induced lethal effects manifested by death before the age of 17 years. Let me first point out that grave difficulties face such a study. The investigator is searching for genetic deaths

before age 17 years superimposed upon a very much larger number of deaths from a variety of causes wholly unrelated to those based upon new dominant mutations. In view of the difficulties of such a study, it is impressive that Neel, Kato, and Schull did find a positive relationship between paternal radiation exposure and an offspring's death before 17 years of age. The exact statement of Neel, Kato, and Schull is as follows:

"The regression of proportion of death on mother's exposure is non-significant, as is the regression on father's exposure, but the latter term is just below the 5% level. One might in this situation elect to apply a one-tailed test of significance. In this case, the regression (on father's exposure) becomes significant at the 5% level".

*I certainly hope everyone in this audience realizes that nothing mystical or magical happens at exactly the 5% level of statistical significance, even if many scientists and journal editors are so brain-washed as to think so.*

The actual numbers in the Neel, Kato, and Schull study would lead to an estimate of between 31 and 52 rads as the doubling dose for genetic-chromosomal injury. This is far, far from "no genetic effect of radiation in the Japanese". Inspiration for the distortions of the Japanese findings rests in an ill-considered statement in the Neel, Kato, and Schull paper, reflecting the fact that the findings met only the 5% level of statistical significance. We quote Neel and co-workers:

"In a question of this importance, we believe a finding should be unequivocally significant before being trumpeted as such".

Some have lost no time in saying, "No genetic effects were found in the survivors of Hiro-

shima and Nagasaki”, a statement in no way derived from the actual findings of Neel, Kato, and Schull.

### ■ 3 ■

#### Why the reaction of the Medical Profession to the Estimates of Radiation-Induced Cancer and Genetic Injury Can Change the Prospects of Having A Nuclear War

I am sure that some physicians who have noted press or other comments concerning the arguments about the health effects per unit of ionizing radiation have said, “Ho, hum, some day they’ll figure it out”, and with *that*, they dismissed the issue. Let me tell you why this is sad indeed, and may facilitate nuclear war.

There are numerous factors taken into account by the planners for nuclear war, especially those working for a first-strike capability. I remind you that first-strike does *not* mean the ability to attack and receive *no* damage in return; it means the ability to attack and receive only “*acceptable damage*” in return. In evaluating “*acceptable damage*”, nuclear-war strategists consider economic recovery potential, capital equipment destruction, numbers of acute megadeaths, and other factors. And there is no doubt that health effects must figure into their various scenarios.

It should not require any simple drawings to make it evident that, the lower the estimate of the cancer and genetic effects of radiation exposure is, the more attractive the use of nuclear weapons will become to a military planner, for he will consider the aftermath-effect for “his” side to be less, the lower the cancer and genetic effects of radia-

tion are. I am not suggesting that persons with power-disease really care, in terms of *compassion*, how many people die during or after a nuclear war. But it has to be obvious that the lower the cancer and genetic effects are estimated to be, the easier it is for such people to decide that they *have* achieved a first-strike capability—meaning only “*acceptable damage*” from starting a nuclear war.

The very same rulers who might consider starting a nuclear war if “*only*” 10% of their own subjects would die, might *reject* the same scenario if the average dose to their subjects were of the order of 85 rads and would condemn *everyone* under ten years of age to die prematurely, and of cancer. After all, survivors who are either totally demoralized or enraged would present a *practical* problem.

So, the present, semi-official estimates of radiation-effects, which are too low by 11- to 54-fold and more, *help to increase the likelihood of nuclear war*, simply because the military planners are more aggressive with respect to use of nuclear weapons, the lower they think the consequences to “their side” will be.

Unfortunately, there are some powerful commercial and political interests who prefer the underestimates of the cancer and genetic risks of radiation. And there are always scientists available to accommodate such desired underestimates. It may seem, even to a few physicians, that a low estimate of the risk from radiation exposure is good, since the medical profession uses radiation and radionuclides so much. These few physicians should think again—about nuclear war and the considerations which help induce it.

Because low estimates of radiation effects *encourage* nuclear war, it would not surprise me to discover some well-meaning scientists ready to provide *falsely high* estimates of the cancer and genetic effects of

radiation exposure. I could only express my profound contempt for anyone who would corrupt the profession of science by deliberately providing false estimates of any type, whether too high or too low. Confucius expressed the motives of real scientists very well when he said, "Those who *know* the truth, are not the same as those who *love* it."

■ "When Experts Disagree . . ." ■

As you well know, scientists are said to disagree about the effects of radiation. And let me tell you that the so-called radiation controversy is not going to resolve *itself* conveniently for you! It is as resolved now, among the full-time experts, as it is ever going to be, because there will *always* be scientifically correct and scientifically incorrect ways to analyze existing data. Thus, no matter how much additional data are generated, incorrect ways of analyzing these data will also be generated.

"When experts disagree" on a matter you care about, on a matter with life-and-death implications for millions or even billions of people, on a matter which you have the education and natural ability to comprehend well, I invite you to do your own evaluation. I invite you to compare *the scientific merits* of my own estimates, and the estimates by Dr. Karl Z. Morgan, and the estimates by Dr. Arthur Tamplin and Elizabeth Shafer, and by others, with the estimates published by the quasi-official committees, whose figures are 11-, 54-, and even more times lower.

Physicians are in a position to criticize the estimates made, and if enough physicians get into the fray and express their disgust and contempt for pseudo-analyses of scientific

information, there will be an important effect which the military planners will not overlook. The correct analysis of radiation-effects will help lower the probability of nuclear war, during these crucial decades while we are learning to control the *cause* of war.

Your finding out, as physicians, what you can believe and state with confidence about radiation effects, would be one positive and meaningful contribution which you can make *now* to the people's effort to prevent nuclear war.

The medical centers with which you are associated could and should organize in-depth courses on this very subject.





Table 1\*

The "Cancer Dose" and Loss of Life Expectancy for Radiation Cancer Victims, for Radiation at Various Ages and for Both Sexes

	Age in Years at Irradiation	Cancer Dose in Person-rads	Life-span Loss in Years
<i>Males</i>	0	64	22.3
	5	71	20.1
	10	88	17.9
	15	178	15.9
	20	200	14.2
	25	201	12.8
	30	234	11.6
	35	328	10.6
	40	538	9.6
	45	1233	8.7
	50	13400	8.0
<i>Females</i>	0	68	28.9
	5	80	26.3
	10	104	23.6
	15	217	21.0
	20	249	18.6
	25	252	16.6
	30	285	14.8
	35	399	13.0
	40	636	11.5
	45	1412	10.2
	50	14600	9.3

The **Cancer Dose** is that dose of whole-body radiation exposure, received by a population or by an individual, which guarantees the occurrence of *one* fatal cancer. The **Life-span Loss** is the average number of years of life lost by those who do die of radiation-induced cancer.

The Cancer Dose For An Equilibrium Population of Mixed Ages

<i>For Males:</i>	235 person-rads of whole-body radiation per fatal cancer.
<i>For Females:</i>	300 person-rads of whole-body radiation per fatal cancer.
<i>Average:</i>	268 person-rads of whole-body radiation per fatal cancer.

\* This table is adapted from Chapter 8, **Radiation and Human Health**, John W. Gofman. Sierra Club Books, Inc.: San Francisco, 1981. In press.

Table 2

Estimated Number of Cancer Fatalities from the Delivery of One Rad of Whole Body Radiation to Each Person in a Mixed Population of One Million Persons

Source of Estimate	Number of Cancer Deaths
Gofman, John W., Chapter 9, <i>Radiation and Human Health</i> (1981)	3771*
BEIR Committee of National Academy of Sciences, BEIR-III, <i>Draft Report</i> (May, 1979)	70 to 353
United Nations Scientific Committee on Effects of Atomic Radiation (1977)	100

\* This estimate does not include the leukemia cases which will be induced. The leukemias would add 100-333 additional deaths for this radiation dose.

Table 3

Final Equilibrium "Cost" in Genetic-Chromosomal Diseases or Defects for One Rad per Person per Generation, Expressed Per Million Live-Births

Source of Estimate	Total of All Genetic and Chromosomal Diseases or Defects
Gofman, John W., Chapter 22, <i>Radiation and Human Health</i> (1981)	198 to more than 21,000
BEIR Committee of National Academy of Sciences, BEIR-III, <i>Draft Report</i> (May, 1979)	74 to 1,132
United Nations Scientific Committee on Effects of Atomic Radiation (1977)	196

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