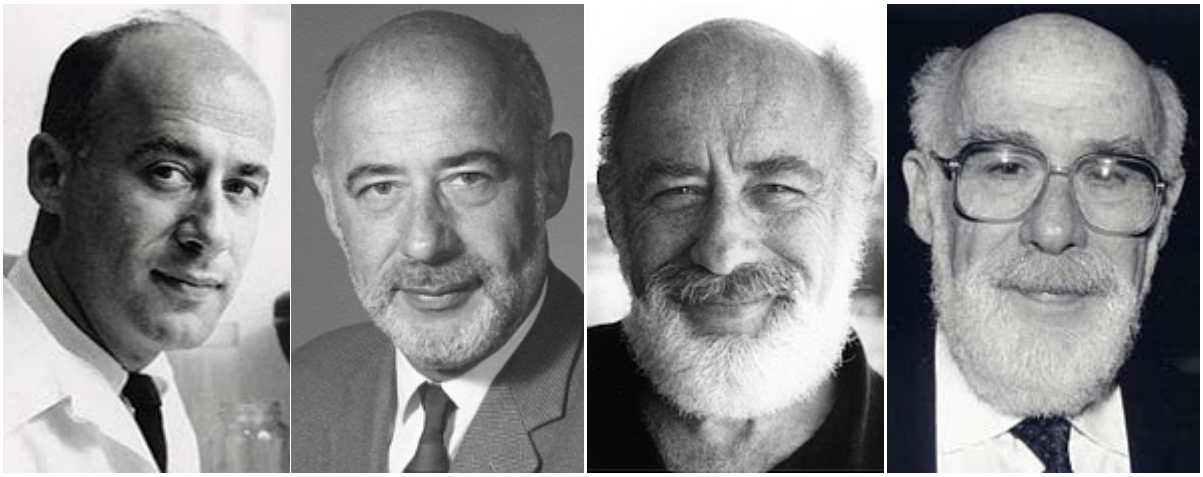
ratitor's corner
23 September 2015

September Equinox, 4:22am EDT

prior moments

rat haus reality: celebrating 20 years wide

Dr. John W. Gofman



His Life, and Research on the Health Effects of Exposure to Ionizing Radiation

by David T. Ratcliffe

Today, the Sun, appearing to travel along the ecliptic, reaches the point where it crosses the equator into the southern celestial hemisphere. Today day and night are of equal length.

Today rat haus reality completes its 20th revolution around the Sun and begins its 21st cycle. Gratitude abounds having this ratical venue from which to publish materials worthy of note and emphasis. In this past circle of the Sun I am re-connecting with two primary interests that have compelled my attention on the journey: the critical necessity of mending the sacred hoop created by our collective indigenous ancestors and the consequences of playing with the mountains of poison fire generated from man-made radioactive matter.

I, David Ratcliffe, cannot help but feel grateful for John Gofman's decades of unpaid work in the service of protecting health for you and for future generations. Regarding exposure to ionizing radiation, Dr. Gofman reluctantly became a very prominent whistleblower from 1969 to 2002, with the ethical choices and dangers and emotional ups and downs which go with whistleblower territory.

> "Gofman is a prime example of the unusual man who straddles two fields and as a result is able to see novel ways of applying methods and ideas from one field to the other."
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> —Daniel Steinberg, "The Pathogenesis of Atherosclerosis. An interpretive history of the cholesterol controversy," *Journal of Lipid Research*, 2004

Contents

> "The author knows that it is just by chance, in the random shuffling of mankind's genes, that he did not receive the damaged genes and chromosomes that produce very low intelligence, severe emotional disorders, early death, or major physical disorders. Luck, not merit. Those of us who were lucky may express our gratitude not only by helping those who were unlucky, but also by working to protect the integrity of the species' genetic materials from unnecessary injury."
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> —John Gofman, M.D., *Radiation & Human Health*, Sierra Club Books, 1981, p.8.

A striking feature of our culture includes the specific set of illusions presented by commercial print and broadcast media which promote a representation of reality through omission, distortion, lack of contextual analysis, and disinforming opinion stated as obvious, incontestable fact. It is always our choice what lens we adopt to view the world and our place in it. Here the focus is on two facts which concern the further evolution of life on Earth and which were studied and explained in extraordinary detail by the late John W. Gofman, Ph.D., M.D.:

1. There is no risk-free dose of or exposure to radiation.
2. It is not humanly possible to achieve 100% containment of these man-made radioactive particles that burn at the atomic level.

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Nuclear Witness

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I became aware of Dr. John Gofman in the 1980s from reading the 1982 paperback edition of Leslie Freeman's fascinating and frightening book, *Nuclear Witnesses: Insiders Speak Out*[1] In the Author's Note, Ms. Freeman (Ph.D. from Columbia University and in 1981 a teacher at the New York Institute of Technology) explained, "It is the premise of this book that if the American people knew the truth about radiation there would be no nuclear issue."

Along with *Nuclear Witnesses* I also absorbed Rosalie Bertell's incisive and profound 1985 book, *No Immediate Danger: Prognosis For a Radioactive Earth*.[2] This extended my concern and understanding of the complexities and dangers I initially read about in *Nuclear Witnesses*. Reading Leslie Freeman's interview of Dr. Gofman, I was especially struck by, and have never forgotten, his observation and warning about how nuclear power creates a mountain of radioactivity. From pages 110-111: (Note: all footnotes within *Nuclear Witnesses* are denoted with "nw" following the footnote number.)

Nuclear Power: A Simple Question

> Many people think nuclear power is so complicated it requires discussion at a high level of technicality. That's pure nonsense. Because the issue is simple and straightforward.
>
> There are only two things about nuclear power that you need to know. One, why do you want nuclear power? So you can boil water. That's all it does. It boils water. And any way of boiling water will give you steam to turn turbines. That's the useful part.

> The other thing to know is, it creates a mountain of radioactivity, and I mean a *mountain:* astronomical quantities of strontium-90 and cesium-137 and plutonium—toxic substances that will last—strontium-90 and cesium for 300 to 600 years, plutonium for 250,000 to 500,000 years—and still be deadly toxic. And the whole thing about nuclear power is this simple: can you or can't you keep it all contained? If you can't, then you're creating a human disaster.
>
> You not only need to control it from the public, you also need to control it from the workers. Because the dose that federal regulations allow workers to get is sufficient to create a genetic hazard to the whole human species. You see, those workers are allowed to procreate, and if you damage their genes by radiation, and they intermarry with the rest of the population, for genetic purposes it's just the same as if you irradiate the population directly.[27nw]
>
> So I find nuclear power this simple: do you believe they're going to do the miracle of containment that they predict? The answer is they're not going to accomplish it. It's outside the realm of human prospects.
>
> You don't need to discuss each valve and each transportation cask and each burial site. The point is, if you lose a little bit of it—a terribly little bit of it—you're going to contaminate the earth, and people are going to suffer for thousands of generations. You have two choices: either you believe that engineers are going to achieve a perfection that's never been achieved, and you go ahead; or you believe with common sense that such a containment is never going to be achieved, and you give it up.
>
> If people really understood how simple a problem it is—that they've got to accomplish a miracle—no puffs like Three Mile Island—can't afford those puffs of radioactivity, or the squirts and the spills that they always tell you won't harm the public—if people understood that, they'd say, "This is ridiculous. You don't create this astronomical quantity of garbage and pray that somehow a miracle will happen to contain it. You just don't do such stupid things!"

Fukushima is the latest instance of mountains of deadly toxic radioactivity released into the biosphere that humans are incapable of containing.[3] In addition to the astronomical releases of radioactive isotopes from such calamities there are also the medical and public health consequences of the entire nuclear fuel cycle: from the mining and enrichment of uranium, its transport, operations in nuclear reactors and routine standard operating procedures that release radioactive isotopes in both gaseous and liquid forms, as well as reprocessing of so-called spent fuel, disposal of radioactive trash, and the proliferation of fissile materials employed to produce nuclear weapons. To appreciate the magnitude we are dealing with concerning man-made radioactive pollution, it is essential to learn about a whistleblower who made significant contributions towards ushering in the nuclear age and then devoted himself for over 30 years to point out the dangers of further nuclear contamination to present and future generations.

↑ Ph.D. Candidate at UC Berkeley, Studying Under Glenn Seaborg ↑

John William Gofman, the son of David and Sarah Gofman, was born in Cleveland, Ohio on September 21, 1918. His parents immigrated from czarist Russia in about 1905. John Gofman graduated from Oberlin College in 1939 with a B.A. in chemistry. After entering Western Reserve University Medical School he decided he was not getting the background depth in physical sciences he would need for medical research. In 1940 he enrolled as a Ph.D. candidate in chemistry at UC Berkeley. There he decided to work with Glenn Seaborg, then an assistant professor, who was working with artificial radioactivity. In February 1941 Seaborg co-discovered Plutonium, the man-made radioactive element

used in the 1945 atomic bomb detonated over Nagasaki. Gofman described beginning to work with Seaborg as his faculty advisor in *Nuclear Witnesses*:

> I thought, probably all kinds of biochemical problems in medicine are going to be solved by the application of radioactive tracers.[3nw] How better could I prepare myself for a future medical career than to work on a problem involving artificial radioactivity?
>
> So I elected to work with Glenn Seaborg. He assigned me a problem—there was a possibility from thorium you might be able to make a substance called uranium-233, provided it existed, and we didn't know whether it would exist or not. He said, "Why don't you see if you can find out whether it exists or not?"
>
> It was just an interesting problem in nuclear physical chemistry—an unknown part of a whole systematics of the heavy elements. So I started to look, and the work went quite well, and in about a year and a half I had discovered uranium-233....
>
> It was possible that uranium-233, which I had discovered, might be one of the substances used to make a bomb. It depended on whether it fissioned more easily or less easily than plutonium, which had been discovered by Seaborg, or than uranium-235, which exists naturally. These were the three candidates to make a bomb, and certain physics measurements on the fissionability would determine which was the best.
>
> So I started to work on trying to find out if uranium-233 was fissionable, and I proved that it was, using what's called both slow- and fast- moving neutrons. In fact, I proved that it was even better in many respects than plutonium for this purpose.[4nw] All that was connected with my Ph.D. thesis which I finished in 1942.[4]

↑ Working on Plutonium in the Manhattan Project ↑

In 1941, while a graduate student, Gofman began working in the Plutonium Project sector of the Manhattan Project. In February 1942 Seaborg left UCB to go to Chicago to head the plutonium section of the Metallurgical Laboratory. Following this, Gofman became the leader of the group Seaborg had directed at Berkeley. Seaborg and Edwin McMillan were the first two chemists to work with plutonium. As Gofman recalled this period,

> When I finished the work on 233U, I became the fourth chemist in the world to work with plutonium.... The guy who really did the only chemistry that was worth talking about before I got in was Arthur Wahl. He was a graduate student one year ahead of me. He knew everything in the world there was to be known about plutonium, and he taught me. And I got started at the same time.[5]
>
> In order to make a bomb out of plutonium, we had to learn a hell of a lot of chemistry of plutonium, at a time when practically no plutonium was available. We had never even seen it. We were tracing its radioactivity around by its alpha radioactivity. But we learned quite a bit about the chemistry of plutonium in the year that followed.[6]

Dr. Robert Oppenheimer was a nuclear physicist involved in the Manhattan Project and headed the Los Alamos Laboratory to build and test the first atomic bomb. In the fall of 1943 he came to see John Gofman with an urgent need.

I remember when J. Robert Oppenheimer came back from Los Alamos and came to see me and said he absolutely needed a miligram of plutonium in a hurry. At that time the total world stock was about a tenth of a miligram—yet a year later we were going to have *grams* of it—and asked if we would prepare it. And we agreed to do it. So we bombarded a ton uranium nitrate on the Berkeley Cyclotron night and day for two months and then we set up a little chemical factory in Gilman Hall in the chemistry department on the campus and we worked night and day around the clock to separate that plutonium out of that ton of uranium and deliver it to Dr. Oppenheimer and Dr. Kennedy: one point two miligrams of plutonium. So it was the world's largest factor of increase in plutonium production at that moment. The world's first miligram. I don't know whether I'm proud of that or sad about it now.[7]

It was a big, dirty job, and dangerous, because uranium gets hot as a firecracker with radioactivity from all the fission products that accumulate—all the strontium-90 and all the cesium-137 and the radio-iodine, and everything else. I didn't know enough to have good sense, but I knew that it was dangerous....

So I was the first chemist in the world to isolate milligram quantities of plutonium ... We knew nothing of its biological problems.

I got a good radiation dose in doing that work. I feel that since that time, with each year that's passed, I consider myself among the lucky, because some of the people who worked closely with me in the Lawrence Radiation Lab died quite prematurely of leukemia and cancer. I'm still at a very high risk, compared to other people because of the dose I got. I probably got a hundred, hundred and fifty rems in all my work. That's a lot of radiation. And damn stupid, but nobody was thinking about biology and medicine at that point. We were thinking of the war. So we did it.[8]

↑ 1943: Ph.D. in Nuclear/Physical Chemistry, Discoveries & Patents ↑

John Gofman received his Ph.D. from UC Berkeley in 1943 in Nuclear/Physical Chemistry. His Dissertation was titled, "The discovery of Pa-232, U-232, Pa-233, and U-233. The slow and fast neutron fissionability of U-233." As a result of his work on the Plutonium Project Dr. Gofman co-discovered protactinium-232, uranium-232, protactinium-233, and uranium-233.

With Robert E. Connick and Arthur C. Wahl, he shares *patent #2,671,251* on *The sodium uranyl acetate process for the separation of plutonium in irradiated fuel from uranium and fission products*. With Robert E. Connick and George C. Pimentel, he shares *patent #2,912,302* on *The columbium oxide process for the separation of plutonium in irradiated fuel from uranium and fission products*. And with Glenn Seaborg and Raymond Stoughton he shares *patent #3,123,535* on *The slow and fast neutron fissionability of uranium-233, with its application to production of nuclear power or nuclear weapons*. The work conducted with Glenn Seaborg, for separating plutonium from uranium and other fission products of irradiated nuclear fuel, was the precursor to full-scale plutonium production at the Hanford Nuclear Site in Washington. The plutonium that was separated and produced at Hanford using the techniques Gofman helped develop was used to make the Nagasaki atom bomb.

↑ 1946: M.D. from UCSF, Discoveries in Lipoprotein Chemistry ↑

After the plutonium work, Gofman was accepted into the second-year class accelerated program for his M.D. degree at UC Medical School in San Francisco. He graduated in 1946 with the faculty and his

classmates choosing him to receive the annual Gold-Headed Cane Award for personifying the qualities of "a true physician." After his internship in 1947, Gofman joined the faculty at UC Berkeley as assistant professor in the Division of Medical Physics and also held the position of lecturer/instructor in medicine at the UCSF. In 1954 he was promoted to professor at Berkeley. Beginning in 1947 Gofman

> began his research on coronary heart disease and, by developing special flotation ultracentrifugal techniques, he and his colleagues demonstrated the existence of diverse low-density lipoproteins (LDL) and high-density lipoproteins (HDL). Their work on lipoprotein chemistry and health consequences included the first prospective studies demonstrating that high LDL levels represent a risk-factor for coronary heart disease and that low HDL levels represent a risk-factor for coronary heart disease. His principal book on the heart disease research is *Coronary Heart Disease* (Springfield, Ill: Charles C. Thomas, 1959).[9]

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Significant Contributions in the Field of Heart Disease Research

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From 1947 to 1951 Dr. Gofman was a physician in radioisotope therapy at the UCB Donner Clinic. During these years through his research he became more and more engaged in studying heart disease, lipoproteins, and how the blood transports cholesterol. Through the ensuing decades there followed acknowledgements from the medical establishment of the significant contributions made by Dr. Gofman to the field of heart disease.

- **1954**: received the Modern Medicine Award "for distinguished achievement ... in recognition of outstanding contributions to the progress of medicine as exemplified by his original contributions to the investigation of cholesterol-bearing lipoproteins".
- **1965**: received the Lyman Duff Lectureship Award of the American Heart Association, for his research in atherosclerosis and Coronary Heart Disease.[10]
- **1972**: shared the Stouffer Prize for research in prevention, understanding and treatment of arteriosclerosis. The prize committee was chaired by Professor Ulf S. von Euler, a former chairman of the Nobel Prize Committee for Physiology and Medicine. The Committee cited Dr. Gofman "for pioneering work on the isolation, characterization and measurement of plasma lipoproteins, and on their relationship to arteriosclerosis. His methods and concepts have profoundly stimulated and influenced further research on the cause, treatment, and prevention of arteriosclerosis."[11]
- **1974**: the American College of Cardiology selected Dr. Gofman as one of twenty-five leading researchers in cardiology of the past quarter-century to participate in the documentary titled, "An Oral History of Twenty-Five Years of American Cardiology: 1949 - 1974".
- **2004**: the *Journal of Lipid Research*, Volume 45, "*Thematic review series: The Pathogenesis of Atherosclerosis*. An interpretive history of the cholesterol controversy: part I" delineated how, "John W. Gofman was not the first to try to characterize the full spectrum of lipoproteins in the blood, but he was the first to do so successfully. Gofman is a prime example of the unusual man who straddles two fields and as a result is able to see novel ways of applying methods and ideas from one field to the other." The article concluded with: "In a 5- or 6-year period beginning in 1949, Gofman and his collaborators turned out a prodigious amount of new information about the lipoproteins in human plasma, their metabolism, and their correlation with atherosclerosis" (p.1591). "The impact of Gofman's work on the field was of great and lasting importance." (p.1592).[12]

2007: the *Journal of Clinical Lipidology* re-published his quintessential 1954 work and named Dr. Gofman "The Father of Clinical Lipidology".[13] W. Virgil Brown, M.D, the Editor-in-Chief of the *JCL*, introduced the paper as "both a scientific tour de force and an historically important presentation of concepts that underpin our field ... [Gofman] not only discovered relationships previously unknown but defined important questions that remain unanswered even today ... [Many of his findings] were rediscovered later without credit to this work ... Once you have finished this paper ... you will understand why the name of 'Father of Clinical Lipidology' is fitting" (p.98).

↑ 1954: Organizing a Medical Dept at Lawrence Livermore Nat'l Lab (LLNL) ↑

While engaged in the Plutonium Project during his graduate work at UCB, John Gofman met Ernest Lawrence. Lawrence had received the 1939 Nobel Prize for Physics, "for the invention and development of the cyclotron and for results obtained with it, especially with regard to artificial radioactive elements". In 1931 as part of the UCB Physics Department, Ernest Lawrence founded the Radiation Laboratory. The research it conducted revolved around his invention, the cyclotron. Lawrence was very involved in the Manhattan Project during the war. In 1946 the Atomic Energy Commission (AEC) was created which transferred the control of atomic energy from military to civilian authorities. In 1952, Lawrence successfully lobbied the AEC to establish the UC Radiation Laboratory in Livermore, California. In 1954 Ernest Lawrence called Dr. Gofman into his office.

> We were good personal friends. "I'm worried about the guys out at Livermore," he said. "I think they may do some things to harm themselves. You're the only person who knows the chemistry and the medicine and the lab structure. Could you do me a favor and go out there a day or two a week and just roam around and see what the hell they're doing, and see that they do it safely? If you don't like anything they're doing, you can tell them that your word is my word, that either they change, or they can leave the lab."
>
> So I decided to do it.
>
> While I was out there—to have something to do between times of roaming around—I organized a Medical Department at the Livermore Lab. It was then a lab of about fifteen hundred people. It's now about seven thousand. I organized the Medical Department and served as the medical director. But I was there only a day or two a week. The rest of the time I was in Berkeley teaching.
>
> In the course of my wandering around I got to know all the weaponeers who were working there. I worked with them, helped them with some of their calculations on health effects and problems of nuclear war, and so forth. They were making bombs, new bombs, hydrogen bombs, designing all the bombs within the nuclear subs, for missiles and so forth.[14]

In 1957 Dr. Gofman decided he was finished with what he had set out to establish at Lawrence Livermore Lab regarding radiation safety, turned the Medical Department there over to Max Biggs, a former Ph.D. student, and went back to Berkeley full time to teach and return to his heart disease research.

By 1960 Gofman felt he needed to re-focus his energies into something beyond heart disease research that would again engage his attention and creative curiosity.

> I decided that, although there was still a lot left to do in heart disease, the excitement of my early discoveries, the night and day work, wasn't there any more. I'm not very good at dotting I's and crossing T's. If it's not something really new and unknown, it's not something I want to do.

By then, two of my students were on the faculty and were doing very nice work. So I said, "I'm going to get out of the heart disease work totally. You take over." They did, and they're still there, doing fine work. I shifted my major emphasis to the study of trace elements in biology and worked hard on that from about 1959 to 1962.[15]

1963: Founding the Bio-Medical Research Division at LLNL

In 1962 a new situation began to develop that would fundamentally alter how the health effects of all types of nuclear activities are evaluated. Gofman received a call from John Foster, then-Director of the Lawrence Livermore Lab. The two men knew each other from the 1954-57 period when Foster was in the Weapons Division at Livermore and Gofman had helped him with his calculations. The AEC was on the hot seat trying to diffuse public outcry from Downwinders in Utah who had been hit especially hard by very heavy fallout from bomb tests in Nevada. Foster said the AEC wanted to set up a Biomedical Research Division: "They think that maybe if we had a biology group working with the weaponeers at Livermore such things could be averted in some way—like you'd advise us not to do this or to do this different."[16]

Initially Gofman was resistant to the proposal because he did not trust the AEC. As he recounted telling Foster, "I don't think they really want to know the hazards of radiation. I think it's important to know, but I don't think *they* want to know." The footnote to this statement quotes Gofman as saying, the AEC "had tried to ridicule Linus Pauling's calculations about strontium-90 and carbon-14 in the late fifties—for which Pauling got the Nobel Peace Prize. They said his calculations were wrong. I even got caught up in that mythology—thinking that Pauling might be wrong about the low-radiation doses causing all these diseases. I took the wrong position in 1957 on Pauling's work, saying, 'Since we don't know the answer for sure, we should not impede progress'"[17]

In the end, acknowledging that fallout is important, Gofman recounted how he decided to accept the proposal:

> I thought about [it] and there were some really attractive features. A three-and-a-half-million-dollar budget each year, [a] new building, and not having to worry about grant applications over and over. So, what [can] I say, somewhere along the line, I had a lapse of cerebration. I said, 'I will do it.'[18]

One of Nine Associate Directors at LLNL

In 1963 Dr. Gofman went to Washington to sign the papers formalizing his appointment. His former mentor and Ph.D. advisor, Glen Seaborg, had been appointed Chairman of the Atomic Energy Commission by President Kennedy in 1961. The signing established that Gofman was to become head of this new Biomedical Division and an Associate Director of the Livermore Lab. Years later he recounted making a very clear statement during the signing:

> I said, "I would like to say I don't really give a damn about the Atomic Energy Commission's programs. I care about the public health. And so, what I want you know is, you're asking me to set up a division to consider the health effects of atomic bomb tests, uses in nuclear war, nuclear power, peaceful uses of explosives. We'll investigate these problems, but you're not going to get me to be silent and use the secrecy stamp to keep something from surfacing that I think the public ought to know."

> So I said, "having said that, I think you should think twice about whether I'm the right person to head this program." I made [it] very clear exactly how I feel about it.
>
> Glenn Seaborg said in memorable words, "Jack, all we want is the truth." If I'd ever seen the opposite of reality, this was it.[19]

An indication of how Gofman did not trust the AEC is his requesting and receiving from the President and Regents of UC Berkeley a signed letter stating that at any time and for whatever reason he was unhappy about the Livermore arrangement, he could return to Berkeley and resume his fulltime professorship with no questions asked.

The title of the project he was asked by the AEC to found and be the first Director of was "Implications of All Nuclear Energy Programs upon Man in the Biosphere." Asked later about how he would explain the fact that the AEC went ahead and hired him after his stating unequivocally that he placed the public health above any other concerns, Gofman said:

> I think they felt they could always control it. It's really complex. They probably figured people around me, like Johnny Foster, might very well remind me of what is appropriate behavior and so forth. I don't think it was smart of them to give me that job.... I think they made a mistake in choosing me.... I think [Seaborg] had a high regard for my ability and work. I had done a good job at Berkeley when I was working with him in the war years. So I think that had some bearing. We were friendly all during the period from '47 to '60, when he went off to head the Atomic Energy Commission, but not terribly close at all.[20]

As head of the new bio-medical division, Dr. Gofman built up a group of 150 people, including about 35 senior scientists whom he had worked with before as well as others outside, along with engineers and technicians. Their exact mission was "to calculate and do the experimentation needed to evaluate the health effects of radiation and radionuclide release from weapons testing, nuclear war, radioactivity in medicine, nuclear power, etc.—all of the atomic energy programs."[21]

Along with heading up the new Bio-Medical Division, Gofman became one of nine associate directors of the entire lab. His general area was anything in biology or medicine. And as an associate director he described attending weekly "directors' meetings that concerned all lab matters. So I was involved in the bomb testing and everything else."[22]

↑ AEC Tries to Suppress & Whitewash Evidence of Radiation's Harm ↑

Within weeks of beginning his tenure as Director Dr. Gofman was asked to suppress evidence of fallout levels in Utah that were orders of magnitude above what was claimed to be permissable by the AEC at that time. He was called to Washington where he met with five other scientists from AEC-funded labs around the country. There they were told by an AEC official that another AEC scientist, Dr. Harold Knapp, had conducted a study that showed fallout in southern Utah from bomb tests in the 1950s produced levels of radio-iodine 100 or more times higher than the AEC had publicly acknowledged. The group was told by the AEC man, "We must stop that publication ... If we don't stop that publication, the credibility of the AEC will just disappear, because it will be stated that we've been lying."[23]

Years later Dr. Knapp, who in 1962 had been a member of the AEC fallout studies branch, described his own experience of this situation:

> When I told them in ’62 how high the dosage levels were, the deputy director of the Division of Operational Safety had this pitch: ‘Well, look, we’ve told these people all along that it’s safe and we can’t change our story now, we’ll be in trouble.’ And I told him, ‘Well, I know you guys have been telling them that, but I haven’t, and I’m supposed to be studying fallout. So don’t tell me what answers I have to get.’[24]

Dr. Gofman and the five other AEC scientists looked at Knapp’s data and concluded that his study was sound and ought to be published. The AEC man was very disappointed but could do nothing to override Gofman’s and the others authority to make the call to not suppress scientific truth. After returning to Livermore, Gofman described how quickly, after his appointment to the Lab, “within a matter of a few weeks one of [Seaborg’s] chief men at the AEC is asking us to help suppress the truth. So I came back to the lab and I told Johnny Foster, ‘Well, the first encounter with Washington was to help with a coverup.’... there was no further flap from that. But it taught me something about the Washington office —that they would lie, coverup, minimize hazards. My worst suspicions were confirmed.”[25] Following this things went relatively quietly until 1969.

In 1965 Dr. Gofman appointed one of his junior associates to chairman of the division so he could go back to the lab “to have more time for his own laboratory research on cancer and chromosomes (the Boveri Hypothesis), on radiation-induced chromosomal mutations and genomic instability, and for his analytical work on the epidemiologic data from the Japanese atomic-bomb survivors and other irradiated human populations.”[26]

In 1969 Dr. Ernest Sternglass, a physicist who had been studying infant mortality, published estimates that 400,000 children may have died from radioactive fallout from atmospheric nuclear bomb testing. His calculations were cited in a September 1969 article in *Esquire* magazine called “The Death of All Children.” At this time the AEC was trying to get the antiballistic missile program through Congress and they were afraid that if Sternglass’s estimates were seen as valid this could sink getting the ABM passed in the Senate.

The Washington office sent Sternglass’s paper to Dr. Gofman and directors of other AEC laboratories. Gofman asked Dr. Arthur Tamplin to evaluate the paper. Tamplin figured the number of deaths was about 4,000, not 400,000 and at Gofman’s urging, he wrote a paper with his determination and submitted it to the AEC for approval to publish in the *Bulletin of Atomic Scientists*. Word came back from Washington that the AEC was very concerned about Tamplin’s paper and did not want him to publish it the way he had written it. Gofman and Tamplin got on the phone with John Totter, the head of Biology and Medicine, and another AEC official, Spofford English. Gofman asked what the problem was with Tamplin’s paper and his wanting to publish it in the *Bulletin*. As described in *Nuclear Witnesses* the conversation proceeded with Totter responding, followed by Gofman:

> “Tamplin has proved that Sternglass is wrong, and that four hundred thousand children did not die from the fallout. But he’s decided to put in that paper that four thousand did die. And we think that his refutation of Sternglass ought to be in one article—like the *Bulletin of the Atomic Scientists,* which is widely read—and that his four thousand estimate ought to be in a much more sophisticated journal.”
>
> “Well,” I said, “I’ve talked to Arthur about this, and he says that doesn’t make sense, because if you publish an article saying Sternglass is wrong, the first thing anyone will ask you is what do you think the *right* number is?”
>
> “No, the two things are just separate,” he said.
>
> Arthur Tamplin was on the phone. I said, “Art, I don’t think it makes sense.”
>
> “No, it doesn’t make sense to me.”

I said, "What in the world is the sense in separating these two things?"

And this AEC fellow said, "Well, one ought to be in a scientific journal."

I said, "What you're fundamentally asking for is a whitewash. And for my money, you can go to hell."

At this point the conversation ended. Nothing further ever came back from Washington and Dr. Tamplin published his paper in the *Bulletin*. Gofman did acknowledge in *Nuclear Witnesses* that 10 years after this the new evidence coming out suggested to him that Sternglass may have been right.[27]

1969: IEEE Conference Presentation:
"Low Dose Radiation, Chromosomes, and Cancer"

In 1969 Dr. Gofman was invited to be one of two featured speakers in the Plenary Session at the Institute of Electrical and Electronics Engineers (IEEE) conference held in San Francisco. On October 29 he presented a paper he and Dr. Tamplin had prepared titled, "Low Dose Radiation, Chromosomes, and Cancer."[28] Gofman summarized the paper's talking point as, "One, there would be twenty times as many cancers per unit of radiation as anyone had predicted before, and two, we could find no evidence of a safe amount of radiation—you should assume it's proportional to dose all the way up and down the dose scale."[29] Other than one article written in the *San Francisco Chronicle* the paper did not receive any national press.

> "This nuclear thing, it was a stone that fell in my path, and so before I could go on I had to kick it out of the way."
>
> —John Gofman reply to Anna Mayo after her asking why he had not kept quiet. Interview appeared in *The Village Voice* after his IEEE talk.

"The Entire Nuclear Power Program Was Based on a Fraud"

On November 18, 1969 Dr. Gofman was invited by Senator Edmund Muskie to address the Senate Committee on Public Works. Muskie was holding hearings on nuclear energy. He was not aware of Gofman's IEEE paper and invited him to speak because he was associate director at Lawrence Livermore Laboratory. Gofman prepared a paper for the Senate Committee titled, "Federal Radiation Guidelines: Protection or Disaster?"[30] that expanded on the IEEE paper. This time Gofman's findings were picked up by the Washington press.

While he was testifying in Senator Muskie's hearing room, Gofman was asked by Ed Bowser, the Secretary on the Joint Committee on Atomic Energy (JCAE), to come see its Chairman. Bowser took Gofman and Tamplin to the JCAE Headquarters in the Congressional Building where they were ushered into a secret Green Room and confronted by Representative Chet Holifield, one of the Committee's Chairs. Rep. Holifield complained that Gofman and Tamplin were hurting the atomic energy program and at one point said to Gofman, "There are people like you who have tried to hurt the Atomic Energy Commission program before. We got them, and we'll get you." Gofman felt that Holifield, "didn't mean

to kill us, but he meant they could take care of our reputation."[31]

In short order Gofman and Tamplin came under vicious attack from the AEC and the nuclear power industry. Dr. John Totter, the head of biology and medicine at the AEC, was one of the people who endeavored to slander and smear Gofman's and Tamplin's credibility.[32] In 1980, Dr. Gofman reflected on the contradictory nature of the attacks coming from within the AEC:

> What happened when we came out with some facts about cancer and radiation: Within two weeks certain officials of the AEC, not Glenn Seaborg, were denigrating our work publicly, saying to reporters that we were wrong, that we were incompetent. It was a most interesting situation. Here is the department of the AEC that had just awarded seven years of $3-to-3.5-million budgets to be used under my general guidance, since I was the associate director for biology and medicine at Livermore. And two weeks after we'd come out with a paper on radiation, cancer, and chromosomes — By the way, it was an invited paper from the Institute of Electrical and Electronics Engineers. In two weeks we became incompetent. Here's somebody that for seven years gave me $3.5 million a year and couldn't detect my incompetence; in two weeks I was incompetent.[33]

In 1973 Gofman recounted how

> it seemed somewhat strange to us that these people who ostensibly had a grave concern about the hazard of radiation—indeed we had been commissioned by the Atomic Energy Commission to find out the hazard of radiation—should be so vehement in their immediate attack upon us. And the fact that the attack came from the electric utility industry and the manufacturers of nuclear reactors made us wonder if there wasn't something that the nuclear power industry had to hide....
>
> And, of course, they were trying to hide a great deal. Namely, trying to sell the idea of nuclear power as being cheap, clean, and safe. And our subsequent investigations directly went into the question of nuclear power and we've concluded that this industry is far, far from safe; far, far from clean; and the word cheap is really a joke because it is the most expensive imaginable way when you consider all the hidden subsidies and the costs that don't show in the actual operation of the plant—namely your government subsidies—this is the most expensive way to produce power.
>
> The biggest subsidy of all that they have is to take away your right to redress if you are ever injured through the courtesy of the U.S. Congress passing a law called the Price Anderson [Act] Law which virtually removes the requirement of any responsibility for damage caused by nuclear power."[34]

After their November visit to Washington, both men were invited to testify before the Joint Committee on Atomic Energy in January 1970. In the middle of 1969, Dr. Gofman had resigned his position as associate director at Lawrence Livermore while remaining a research associate. He was now spending half his time at Livermore doing cancer and chromosome research and teaching part-time at Berkeley. Dr Gofman recounts what developed next.

> [A] lot of people from the electric utility industry ... were saying our cancer calculations from radiation were ridiculous, that they were poorly based scientifically, that there was plenty of evidence that we were wrong. Things like that. So I wondered what was going on there. At that point—January 1970—I hadn't said anything about nuclear power itself. In fact, I hadn't even thought about it. It was stupid not to have thought about it. I just wondered, Why is the electric utility industry attacking us?
>
> I began to look at all the ads that I had just cursorily seen in *Newsweek* and *Time* and *Life,* two-page spreads from the utilities, talking about their wonderful nuclear power program. And it was all

going to be done "safely," because they were never going to give radiation above the safe threshold.

And I realized that the entire nuclear power program was based on a fraud—namely, that there was a "safe" amount of radiation, a permissible dose that wouldn't hurt anybody. I talked to Art Tamplin. "They have to destroy us, Art. Because they can't live with our argument that there's no safe threshold." He said, "Yeah, I gathered that."

"So," I said, "we have a couple of choices. We can back off, which I'm not interested in doing and you're not interested in doing, or we can leave the lab and I go back to my professorship and you get a job elsewhere, or we can fight them. My choice is to fight them." He said, "I agree."

Congress Hears the Evidence

The system used to discredit scientists like us is usually to call you before the Joint Committee on Atomic Energy—it's a Congressional committee—and they let you present your evidence, and then they get all their lackey scientists, the ones who are heavily supported, to come in and say why you're wrong.

So I got the call just like I expected to from the Joint Committee. Would I come in on January 18, 1970 to testify?

I said, "Art, just as expected, they're ready to slice our throats at a Congressional hearing. We've got a lot more evidence that's sort of undigested than we had when you gave your paper and we gave the one at the Muskie hearings."

In about three weeks we wrote fourteen scientific papers. I'd never done anything like that in my life. And we learned new things. Stuff was falling together. We took on the radium workers. We took some data on breast cancer. There was a whole study of radium workers and their deaths. A guy at MIT had said they wouldn't get cancer below the safe threshold. We pointed out his papers were wrong. There were the uranium miners, who were getting lung cancer. And we analysed that and showed how it also supported the idea that there was no safe dose. We studied the dog data. Studies were being done at the Utah laboratory and sponsored by the AEC—they were irradiating dogs and studying how many cancers appeared. We took a whole bunch of new human and animal data and wrote fourteen additional papers that buttressed our position, that indicated, as a matter of fact, that we'd underestimated the hazard of radiation when we'd given the Muskie testimony.[35]

The Gofman-Tamplin Reports

In all, Gofman and Tamplin wrote 24 technical reports, which came to be known as "The G-T Series." They documented "in detail the much larger association of ionizing radiation with cancer-causation than had been previously estimated [and examined] all the major sources of data from known, human exposures (including certain medical therapies, the Hiroshima-Nagasaki data, the uranium miners, the radium dial-painters) as well as relevant data from animal exposures." All 24 reports were submitted to two Congressional Committees: the *Environmental Effects Of Producing Electric Power*, Hearings before the Joint Committee on Atomic Energy, 91st Congress in October and November 1969; and the *Underground Uses of Nuclear Energy*, Hearings before the Subcommittee on Air and Water Pollution of the of the Committee on Public Works, U.S. Senate 91st Congress, Part 1, November 1969, and Part 2, August 1970. As was explained in the published listing of these reports, "It is no error ... that the date given to an entire volume may be earlier than the dates on materials included in that volume. Congress can operate that way."[36] Gofman's and Tamplin's strategy was well conceived, as in this manner the

papers were given wide distribution by being published in their entirety in the Congressional Record and are available at large libraries which keep collections of Congressional Hearings.

As preparation for testifying, Gofman and Tamplin had produced 178 pages of testimony. Dr. Gofman next described how he intended to address the challenges he knew they would be facing from the Joint Committee.

> We were going to take all this as evidence before the Joint Committee. But I wanted to be sure that our material got out to about a hundred key scientists in the country in case the AEC tried to prevent us access via the journals.
>
> —That's always something you have to worry about. The journals can easily not publish what you want to say. It's a simple technique. If the journals have editors and staffs supported by an industry or government agency, you can be blocked from getting your things published.[37]
>
> [I took the] 178 pages of scientific stuff ... over to the Information Division at Livermore Lab. They nearly had a conniption fit. They had heard all the flack about this. Roger Batzel came running over to see me. We've always maintained a open dialog in spite of everything. He said, "What's going on here? Why do you need this 178 pages of stuff and you want 250 copies?" I said, "Yes, Roger. Chet Holifield has invited me to speak at a hearing of the Joint Committee," and I said, "If you don't want to do it, I'll call Holifield's office and tell him the Lab has decided not to permit me to prepare this material for you, Mr. Holifield." He said, "Oh no, no, don't do that. We'll do it." So I got the 250 [copies], of which I sent 100 to scientists around the country, thinking it might be a good idea to have a copy out in some other people's hands.
>
> We went in and I presented the thing. I thought they were going to just tear it apart. Holifield said, "Well, you submitted so much material. We haven't had time to go over it. We'll call you back. Do nothing until you hear from me." So we never heard again from Holifield.[38]

After the preparation for and appearance before the Joint Committee on Atomic Energy, Dr. Gofman began to experience the chilling effects resulting from challenging the influence and reach of the political and corporate interests driving the atomic energy programs of the United States. The nuclear juggernaut Gofman and Tamplin began to confront head-on in this time period was a consequence of more than a half-century of disaster creep since Roentgen's discovery of the X-ray in 1895 (see Disaster Creep - "Safe Doses" Belief Began Post-1895, below) followed by the confluence of further scientific innovation to make the atom bomb, Cold War politics, and the pursuit of profit. Beginning at the end of the 19th century, the dangers of looking only at the short time span for recognizing the health consequences of exposure to low dose ionizing radiation would lead to tragic and endemic denial of its true health effects by official bodies beginning in the 1940s through the remainder of the 20th century and beyond.

↑

Ostracizing Gofman and Tamplin

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After testifying before the JCAE, Dr. Gofman returned to the lab at Livermore and continued his research on chromosomes and cancer. Years later he recounted how his morning office hours prior to January 1970 were like Grand Central Station. Then his office changed into an empty space that no one else inhabited.

> During the period where I had been head of the department and Associate Director of the Lab, I had mornings open to anyone who wanted to come into my office: had all kinds of problems, needed another technician or their wife was sick, they needed this, or [one] needed that, or they

wanted to talk about their research. It was Grand Central Station [un]til noon. Twelve o'clock noon, I went into the lab to work and I never would see people. I wanted to work.

During those several weeks, both Tamplin and I were working until 11, 12, or 1 in the morning every night to try to get these papers ready for the Joint Committee. I noticed the most interesting thing during those weeks. Nobody ever came into my office again, nobody. From Grand Central Station to a desert. Nobody needed to see me at all.

So, I just worked in the lab. I worked on this preparation. But on two occasions in the evening, two different scientists stuck their head in my office. I can paraphrase only what they said, not exactly: "Look John, I looked over your calculations on this whole flack about radiation. I agree with you. I don't see anything wrong with your calculations." I'd said, "Great. Tamplin and I have a lot to do. How about you doing this or that on some other part of it?" And the answer from them was essentially this, "Look, you're a professor in the University, you don't have anything to worry about. If I help you, they'll slice my throat."

I said (to myself), "Look, this is a slave empire. If you never find radiation harmful, [or if] you can find huge doses harmful, nobody worries you. That doesn't worry [the] Commission. They can see that. But start to find that low doses are harmful and they're going to fight you every step of the way. They don't give two hoots in hell that it kills millions of people or billions. They're going to fight to preserve the empire. The bureaucratic empire and the bureaucrats cannot tolerate radiation to be harmful."[39]

The AEC: We Need to Destroy Gofman and Tamplin

A revealing example of how truly desperate the Atomic Energy Commission was to destroy the credibility of Drs. Gofman and Tamplin—and maintain the lies and deceptions it had been making with the false claim that there was a "safe" level of exposure to radiation—came in this time period of January 1970. Gofman recounts how none other than Dr. John Totter visited a member of the Public Health Service who had received a copy of the G-T Series papers Gofman had mailed out.

One of the guys we had mailed the papers to called me up. He was in the Public Health Service, in a division separate from AEC. It was on a weekend.

"I've got something disturbing to tell you," he said, "but if I tell you and you ever want to use it legally, I'll deny that I told you."

"That sounds like terribly useful information," I said. "I can't use it, but you think I ought to know it. Well, go ahead."

"Someone from the AEC came to my house last weekend," he said. "He lives near me. And he said, 'We need you to help destroy Gofman and Tamplin.' And I told him you'd sent me a copy of your paper, and I didn't necessarily agree with every number you'd put in, but I didn't have any major difficulties with it either. It looked like sound science. And—you won't believe this—but do you know what he said to me? He said, 'I don't care whether Gofman and Tamplin are *right* or not, scientifically. It's necessary to destroy them. The reason is,' he said, 'by the time those people get the cancer and the leukemia, you'll be retired and I'll be retired, so what the hell difference does it make *right now*? We need our nuclear power program, and unless we destroy Gofman and Tamplin, the nuclear power program is in real hazard from what they say.' And I told him no. I refused. I just want you to know if you ever mention this, I'll deny it. I'll deny that I ever told you this, and I'll

deny that he said it to me."

"Well," I said, "it's nice to know. We realized that we were in a war to the death, and that there was no honor, no honesty in the whole thing, but that's the way it is. You're not going to stand behind what you found out. That's okay with me too."[40]

↑ Oct 1969 to Nov 1972: Evolution in Thinking on Radiation Exposure ↑

Between October 1969 and August 1970, Dr. Gofman gave many invited talks, including "Can We Survive the Peaceful Atom?" in Minnesota on April 22, 1970, the first Earth Day. In that speech, he addressed the ethical aspects, and launched the radical concept that a "tolerance", i.e. legally permissible dose of pollutants should be outlawed, since exposing humans without their consent to health hazards should be a privilege which must be awarded only after the polluter produces concrete *evidence* of both the benefits *and hazards* from the polluting activities at a specific limit. Only after such public hearings, and public comments, should legal permission even be considered by government agencies. His proposal contained the following:

1. Outlaw the concept of a "tolerance" [permissible] dose of any by-product poison.
2. Abolish the dual role of promoter and protector for any agency, governmental or otherwise.
3. Establish the principle that the only proper tolerance dose of any poison is zero.
4. Instead of halting all technological advancement, require that the current or prospective polluters *prove* their cases in favor of specific levels of pollution above zero.[41]

On August 20, 1970 Drs. Gofman and Tamplin testified before the Pennsylvania State Senate calling for "a 5-year moratorium on the planning, construction, and operation of nuclear power plants above ground anywhere in Pennsylvania ... a first step toward the safe consideration of nuclear energy in the future."[42] This idea was further developed in a November 1972 article written by Dr. Gofman and published in *Environmental Action*: "Reacting to reactors—The 'peaceful atom': Time for a moratorium." Quoting the first and last paragraphs:

> This is a recommendation for a moratorium on the construction and licensing of any new nuclear power plants, breeder and non-breeder, plus a termination of licensing of all nuclear power plants now in operation....
>
> The energy industry has no place in its ledgers marked "health and welfare of future generations." Therefore, the task of accomplishing a moratorium and providing a sane energy economy cannot be entrusted to that industry. But individuals in society do have a moral obligation to avoid recklessness and extremism in dealing with the future of living creatures on earth. Given the nature of the real problem of nuclear power, a problem admitted by proponents and opponents of nuclear power, it is difficult to understand the position of anyone who is not insistent upon an immediate moratorium on all nuclear fission power generation.

From this one can see the evolution of Dr. Gofman's thinking—from a *reduced* permissible radiation dose (Oct 1969) to *zero* dose as the default level (April 1970), to a 5-year *moratorium* on licensing any more nuclear plants until the potential consequences for *human health* is better understood (August 1970), to terminating the licenses of *all operating* nuclear power plants (November 1972). In 1970 Gofman and Tamplin proposed establishing an "Adversary Science" program where governments and polluters would be required to provide the funds for experts whose *duty* would be to uncover and publicly present the case *against* a proposed or existing activity.[43]

↑ 1971: The Committee For Nuclear Responsibility (CNR) is formed ↑

In May 1971, Dr. Gofman became Chairman of the newly formed nonprofit research and educational group, the Committee for Nuclear Responsibility (CNR). Established by Lenore Marshall, a poet concerned about nuclear issues, it was the first national anti nuclear group. CNR's Mission was "to provide independent analyses of sources and health effects of xrays and other ionizing radiations." Others who joined Gofman on CNR's Board of Directors included: Prof. Lewis Mumford, and Nobel Laureates Linus Pauling, Harold Urey, and George Wald.

As expressed in its Mission Statement, The Two Main Goals of CNR were:

1. One of CNR's priorities is to make *actual progress* in preventing cancer, by helping other groups and individuals to eliminate the careless xray overdosing which occurs today in medicine. Xray dosage can be cut in half (or more) without interfering with good diagnostic information. CNR supplies the evidence for such action, and regards "getting the job done" as an ethical imperative—because every action which reduces unnecessary irradiation is guaranteed to prevent a share of future cancers which would otherwise occur.
2. A second function of CNR is helping other groups and individuals to prevent additional nuclear pollution of the planet. The importance of such prevention is supported by CNR's detailed proof that there is no safe dose (threshold dose) of ionizing radiation with respect to causing mutations and human cancer.

Following these Goals, a more detailed and specific purpose was expressed that is as necessary to pursue, and as relevant today, as it was in 1971.

> **The Real Reason For Our Existence**
>
> The real reason for our existence is to counter the unrealistic information provided by some other sources.
>
> Radiation from xrays, nuclear pollution, and other sources of ionizing radiation, can injure our genetic molecules—DNA and chromosomes. Radiation-induced damage cannot always be successfully repaired by our cells because damage from ionizing radiation can be especially complex. Cancer and inherited afflictions are caused by damaged genetic molecules. Ionizing radiation is a proven cause of human cancer. None of this is in dispute, none of this is speculative.
>
> Nevertheless, exposure to ionizing radiation is seldom listed as a "risk factor" for cancer and inherited problems—even though it may well be the single most important cause to which everyone is exposed. Today, the largest sources of willful radiation exposure are diagnostic medical irradiation and work-related doses. In the future, nuclear pollution may exceed those sources, if citizens become lazy watchdogs.
>
> The powerful medical and nuclear industries do not educate people realistically, in our opinion, about the aggregate consequences of 200 million xray procedures per year in the USA, and about the aggregate consequences of low-level nuclear pollution. The tobacco industry was not the leader in warning people about the health consequences of smoking, either.

In 1971 the AEC began to push the Administration at Livermore Lab to phase out Gofman's program of laboratory research on chromosomes and cancer. This situation culminated with his resigning from the Lab in February 1973. He then returned to teaching full-time at Berkeley, and chose an early and active

"retirement" in 1974 as Professor Emeritus of Molecular and Cellular Biology in order to fully devote his time on pro-bono research into human health-effects from radiation.

↑ **1971-1979:** *Poisoned Power: The Case Against Nuclear Power Plants* ↑

While still research associates at Lawrence Livermore, Drs. Gofman and Tamplin wrote a book for lay people that summarized their research into the grave dangers posed by man-made nuclear pollution. It was published in 1971 under the title, *Poisoned Power: The Case Against Nuclear Power Plants*. It explained how atomic radiation created in the operation of nuclear power plants will result in many more deaths from cancer and leukemia than had ever been acknowledged by the AEC, government officials, or the nuclear power industry and how the potential injury to future generations from genetic damage was even more grossly underestimated.

The book was reprinted in 1979 with the extension to the subtitle: *The Case Against Nuclear Power Plants Before and After Three Mile Island*.[44] The 1979 edition is available online in its entirety. More than 40 years later, the facts, comparisons, and insights presented are as relevant today as they were when first published. Two examples illustrate the book's value in educating the public about the dangers posed by nuclear power and its advocates that previously were simply omitted from government and commercial media claims and pronouncements.

1. Calculating from first principles of nuclear fission[45], the book explains how,

> One year of operation of a single, large nuclear power plant, generates as much of long-persisting radioactive poisons as *one thousand* Hiroshima-type atomic bombs.... Once any of these radioactive poisons are released to the environment, and this we believe is likely to occur, the pollution of our environment is irreversible. They will be with us for centuries. It is important that people learn *how* they are likely to be exposed to such poisons and *how* death-dealing injury is thereby produced in the individual and in all future generations.[46]

2. The insurance industry gave nuclear power a "No Confidence" evaluation by inserting exclusion clauses into most Homeowners' policies if homes and property suffered damage from radioactivity and nuclear plant accidents. The electric utility would not have ventured into nuclear power if they could be held liable for possible disastrous accidents.

> A bill was proposed, known as the Price-Anderson Act, which simply eliminated individual liability in the event of a major accident in a nuclear electricity plant.... The key point, over and above the lack of confidence of the insurance industry in nuclear electricity plants, is the utter disregard of personal rights the Price-Anderson Act represents for the average citizen. Since the maximum coverage is 560 million dollars per nuclear electricity accident, and since the damage can run to 7 billion dollars, in a serious accident, the individual might recover only 7 cents out of every dollar lost, assuming he is lucky enough to emerge from such an accident with his life.[47]

The concluding section of the 1979 Foreward to *Poisoned Power* emphasizes the primary issue present throughout the history of nuclear power. It is not about the technical issues from those who propose employing and advancing this technology throughout society. It is the ethical and moral considerations that form the basis of any rational dialogue concerning pursuing this extremely hazardous technology for the purpose of boiling water to run a turbine to generate electricity.

Summary: The Important Questions

There has been much press and TV coverage devoted to the technical aspects of the Three Mile Island accident, but very little to its moral aspects. Yet the really important questions about nuclear power are ethical:

- The use of lies and deception by the nuclear industry in order to manipulate public opinion, and in order to *use* people, even kill people, for the benefit of that industry.
- The experimentation on people without their knowledge or consent.
- The acceptance of random murder and denial of the inalienable right to life as the cost of "progress."
- The genetic degradation of the human species, vs. our minimum responsibility to protect our species' genes from injury.
- The need to hold bureaucrats and industry employees personally accountable and responsible for implementing hazardous and even murderous policies, even if such policies are advocated by Congress and the President.

Yes, *Poisoned Power* is a sad story about the absence of ethics and morals in men. But it is not too late to jolt society into realization of what is going on, and what is in the future if humans do not improve in the very basic and minimum principles of morality. Either we improve, or the future is dismal indeed. We hope that *Poisoned Power* upsets you enough to make you work toward such improvement.

—John W. Gofman
San Francisco
June 1979

The Question Which Demands An Answer

"After [losing government funding for lab research at Livermore and] returning full-time to my professorship at the University of California, I have been thinking about the implications for humanity of the conflict-of-interest problem. How can humanity have even the remotest chance of protecting its own health, when an agent of poisoning the population is also the sponsor of virtually all the health research concerning the pollutant?"

—John Gofman, "Bio-Medical 'Un-Knowledge' And Nuclear Pollution: A Common-Sense Proposal," the Right Livelihood Award, Stockholm, December 9, 1992.

↑ **1981:** *Radiation and Human Health* ↑

In 1981, Dr. Gofman had gathered and analysed the data from every valid existing study of low-level radiation to demonstrate that official estimates of radiation health hazards had been seriously underestimated. Published in a 908-page compendium entitled, *Radiation and Human Health*, the cover's subtitle reads, "A comprehensive investigation of the evidence relating low-level radiation to cancer and other diseases".[48]

The opening of the 1982 review in the *Journal of the American Medical Association* stated, "This remarkable and important book enables any intelligent person with a high school education to understand the complexities involved in assessing the risks to man from low levels of ionizing radiation. Gofman not only demonstrates his mastery of this complex subject but carefully explains the basic concepts of epidemiology, genetics, birth defects, carcinogenesis, radiobiology, physics, chemistry and even mathematics, which are necessary to an understanding of the subject."[49]

The book's purpose was described in the dust jacket.

> This comprehensive source book contains the practical information needed to make personal as well as family decisions about voluntary exposures to medical and dental radiation (of special consequence to young children, who are among the most vulnerable to radiation injury), as well as occupational exposures. This invaluable reference is also available for physicians, public health officials, researchers, scientists, and others who must make knowledgeable risk estimates of radiation hazards. Dr. Gofman explains:
>
> - how to estimate diminished life-expectancy from various radiation exposures;
> - how to evaluate the consequences to an unborn child of irradiation during its mother's pregnancy;
> - how to assess the medical probability that a particular cancer results from a previous radiation exposure;
> - how to compare the likelihood of developing cancer or leukemia with or without various radiation exposures;
> - how to estimate the consequences of exposing the entire body to various doses of radiation;
> - how to estimate the consequences of exposing specific parts of the body to various doses of radiation, including breast exposure from mammography, brain exposure from dental X-rays, and more;
> - how to evaluate the genetic consequences to future generations of our own radiation exposures.
>
> This profoundly important book offers an original and urgently needed evaluation of the risks associated with a wide variety of radiation sources, from the dramatic (such as nuclear accidents and weapons-testing) to the commonplace (exposures from building materials, color televisions, and normal "background" radiation).

In pages 52-53 of the book, Dr. Gofman explains what causes "the enormous effectiveness of ionizing radiation" by comparing it with a fever. This explanation and its expression is representative Gofman's skill in describing highly complex biological and physical processes in a manner accessible to lay people. The same logic—having to do with the unique *physical* properties of ionizing radiation compared with heat—also explains the potency, or "effectiveness" in the jargon of radiation biology, of ionizing radiation compared with chemical toxins and chemical pollutants.[50] In the following, the caret character ^ indicates that the next number is an exponent.

The Enormous Effectiveness of Ionizing Radiation

> Thus far we have not concerned ourselves with the special properties of ionizing radiation except to note that the energy of a beta particle, for example, can be 100,000 or even 1,000,000 or more times greater than the energy required to break even a strong chemical bond in biological tissue. But that does not tell us the whole story about the enormous effectiveness of ionizing radiation energy in producing devastating biological effects such as cancer and even virtually immediate death.

Just how much energy is represented by one rad? And how effective is that energy in producing biological injury compared with other modalities which might deliver energy to tissues? As an interesting comparison, we may compare the biological effectiveness of energy from ionizing radiation with energy from heat (Gofman 1960).

The *calorie* is the familiar unit in chemistry that describes energy transfers involving heat. One calorie is that amount of energy which will raise the temperature of one gram of water by one degree centigrade. (This definition does change some at different temperatures of water, but for our purposes here we can neglect those small changes.)

The best estimates are that approximately 400 rads of whole-body radiation, if delivered rapidly, are sufficient to cause 50% of the exposed humans to die within a period of days to weeks. This is the so-called acute radiation sickness. Is this a great deal of energy in heat terms? Some simple calculations will show that it is not.

Since 1 rad represents the absorption of 100 ergs per gram of tissue, it follows that 400 rads represents the absorption of 40,000 ergs per gram. The conversion factor from ergs to calories is 2.39 × 10^-8. Therefore,

$$\frac{40{,}000 \text{ ergs}}{\text{gram}} \times \frac{2.39 \times 10^{-8} \text{ calories}}{\text{erg}} = 9.56 \times 10^{-4} \frac{\text{calories}}{\text{gram}}$$

We can round this off to approximately 10^-3 calories/gram (or 0.001 calories/gram).

Biological tissue is quite comparable with water in the amount of heat required to raise its temperature by one degree centigrade. So we shall say that the required amount is one calorie per gram for biological tissue too. Therefore, our 10^-3 calories/gram from the absorption of 400 rads of ionizing radiation energy would be enough to raise the temperature of biological tissue by 0.001° centigrade. Not much of a fever! We tolerate fevers of several degrees centigrade (not thousandths of a degree) in a variety of infectious diseases. Yet the amount of ionizing radiation that can kill half of the humans exposed to it, would—if converted first into heat—raise temperatures only by 0.001° centigrade.

This points up the biologically deadly difference between energy in the form of heat versus the same amount of energy in the form of ionizing radiation. Why is the effect of ionizing radiation so much larger?

The difference resides in the fact that the energy of ionizing radiation is not distributed the way the thermal energy of a fever is, the latter being about evenly distributed among all the molecules of a gram of tissue. Instead, the energy of ionizing radiation is transferred from photons to single electrons, which in turn transfer all their energy to *relatively* few electrons in *relatively* few molecules. The transfer occurs in extremely concentrated fashion compared with the even diffusion of heat energy. Therefore, the energy delivered by ionizing radiation is energetic enough to break *any* chemical bond, even the strongest ones in living tissue. We shall learn later that certain chemical bonds in cells are crucial, and breaking just a few of these bonds may set a cell on the path to cancer.

- Gofman, J.W. Medical aspects of radiation. In *Modern Nuclear Technology: A Survey for Industry and Business*, chap. 15. Edited by M.M. Mills, A.T. Biehl, and R. Mainhardt. New York: McGraw-Hill, 1960.

Radiation and Human Health was published in the year after the release of the quasi-official Committee

on the Biological Effects of Ionizing Radiation 1980 BEIR Report. It challenged a number of BEIR's methods and conclusions. From this, the *New York Times* convened a three-way discussion with Dr. Gofman and two members of the BEIR committee, one of whom was its Chairman, Edward Radford. It was titled "With Radiation, How Little Is Too Much?" and appeared in the Sunday "Week in Review" section. Dr. Gofman found it hard to believe that medicine tolerated the administration of x-rays, a powerful, proven carcinogen and mutagen without insisting on measurement.[51]

> [M]y estimate is that in the next 30 years, medicine is going to sign about 1,400,000 death warrants as the result of unnecessary radiation exposure. I'm not talking about therapeutic radiation, just diagnostic. There is nothing on the cancer horizon aside from cessation of smoking that has a much prospect for improving public health as reducing diagnostic exposures. And I'm not speaking of eliminating a single X-ray. When the public starts to say they won't go to a facility that doesn't give a certified lowest dose compatible with getting good diagnostic information, then we are going to see a massive reduction....
>
> Medicine is producing harm and should clean up its act. We've got the competence in the form of health physicists and radiation physicists to show the way.

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1985: *X-Rays: Health Effects of Common Exams*

↑

In 1985, at the request of Sierra Club Books (the publisher of *Radiation and Human Health*), Dr. Gofman and Egan O'Connor produced *X-Rays: Health Effects of Common Exams*.[52] From the book's dust jacket:

> While emphasizing that diagnostic X-rays produce benefits as well as risks, the authors, radiation expert Dr. John Gofman and science writer Egan O'Connor, show how the risks can be dramatically lowered by specific steps which individual readers can take on their own to avoid unnecessarily high X-ray doses. They point to recent research data from the Mayo Clinic and Case Western Reserve, where teams have cut the risk of breast cancer more than 60-fold, from upper spine exams, by developing ways to reduce dose. Similar efforts could prevent 1.5 million cancers among Americans in one generation without eliminating a single X-ray exam.

A review in the *New England Journal of Medicine* described the book's organization:

> It is divided into 22 chapters, including tables based on the authors's data on the risks of future leukemia and cancer resulting from common diagnostic examinations. Such examinations include routine films, fluoroscopy, angiography, mammography, dental x-ray films, and CT scanning. The handbook is clear, succinct, and pedagogically organized. The risk values are tabulated, projections or exposures titled, and in the event the reader believes the authors' numbers to be high, convenient lowering factors are provided with which to calculate reduced risk....
>
> The humanity and concern of the authors as physicians and scientists are expressed in a quotation from the earlier work: "The author knows that it is just by chance that he did not receive the damaged genes and chromosomes that produce very low intelligence, severe emotional disorders, early death, or major physical disorders. Luck, not merit. Those of us who were lucky may express our gratitude ... by working to protect the integrity of the species' genetic materials from unnecessary injury."[53]

Dr. Gofman's concern regarding unnecessarily higher doses received from medical irradiation than are required to produce the same diagnostic benefits would continue to be incorporated into his research and future books.

1986: "Assessing Chernobyl's Cancer Consequences: Application of Four 'Laws' of Radiation Carcinogenisis"

On September 9, 1986, Dr. Gofman presented his estimate of the cancer consequences of the Chernobyl accident, as an invited speaker at the Low-Level Radiation Symposium of the 192nd National Meeting of the American Chemical Society. The title of his presentation was, "Assessing Chernobyl's Cancer Consequences: Application of Four 'Laws' of Radiation Carcinogenisis."[54] His figure, never modified, was a half million undetectable fatal cancers from the cesium fallout alone. Undetectable? Yes. Because the extra cancers would occur over a vast geographical area and over a century, even a half million fatal cases would be undetectable against the much higher "background" cancer rate. He thought Sherlock Holmes would be impressed by the capability to kill a half million people and get off scot free. His estimate was well covered by the press services, to the likely dismay of the nuclear industry which had a significant presence at the meeting.[55]

1990: *Radiation-Induced Cancer from Low-Dose Exposure: An Independent Analysis*

In 1990, the further development and continuing refinement of Dr. Gofman's research was published in *Radiation-Induced Cancer from Low-Dose Exposure: An Independent Analysis*.[56] (A majority of the book is available online.) It included a powerful challenge to the popular "threshold" hypothesis which proposed that, at some unspecified low dose, repair of radiation-injured genes and chromosomes would be perfect, and that below such a "threshold dose," exposure to ionizing radiation would be risk-free. Combining his knowledge of how ionizing radiation delivers its energy along primary ionization tracks, with existing evidence of cancer-induction at low doses, he was able to prove "by any reasonable standard of biomedical proof" that no exposure to ionizing radiation is risk-free with respect to DNA mutations.

The core of this comprehensive proof is presented in Chapter 18, "Disproof of Any Safe Dose or Dose-Rate of Ionizing Radiation, with Respect to Induction of Cancer in Humans," with Chapters 19 through 21 comprising the Auxiliary Chapters on the Threshold Issue. Combined, these chapters form Section 5: Disproof of Any Safe Dose or Dose-Rate.

Within three years, the quasi-official radiation committees (the United Nations committee, the British committee, and two American committees) began gradually but openly to publish the same conclusion.[57]

The book was compared very favorably in the *New England Journal of Medicine* review[58] with the 1990 BEIR Report. It was also translated and published in Russia right after the U.S.S.R. disintegrated. Dr. Gofman soon received e-mail from a Russian geneticist calling it "a masterpiece." A traveling American "activist" reported that he saw this book and also the 1994 one (below) on the desk of every environmentalist he visited in Russia, Belarus, and Ukraine.[59]

1992: Right Livelihood Award

"for his pioneering work in exposing the health effects of low-level radiation"

From the Right Livelihood Foundation in Sweden Dr. Gofman received the Right Livelihood Award in 1992.[60] Dr. Jakob von Uexkull's statement, in presenting the award to John Gofman "for his pioneering work in exposing the health effects of low-level radiation," was: "The Right Livelihood Award for vision and work forming an essential contribution to making life more whole, healing our planet, and uplifting

humanity." Gofman donated the entire award he received to the Committee for Nuclear Responsibility.

Along with Dr. Gofman's speech given at the award ceremony on December 9, 1992, "A Key Step in Protecting the World's Health," he also wrote a paper on the occasion of the award entitled, "Bio-Medical 'Un-Knowledge' And Nuclear Pollution: A Common-Sense Proposal."[61] More than 20 years later, this paper retains its timeliness. A few excerpts convey a sense of the import.

> **The Question Which Demands an Answer**
>
> After [losing government funding for lab research at Livermore and] returning full-time to my professorship at the University of California, I have been thinking about the implications for humanity of the conflict-of-interest problem. How can humanity have even the remotest chance of protecting its own health, when an agent of poisoning the population is also the sponsor of virtually all the health research concerning the pollutant?
>
> ## 4 • Some Basic Rules of Believable Bio-Medical Research
>
> *The key to believable bio-medical research is obedience to the Rules of Research, some of which are listed below. It follows that we can solve our problem if we figure out and establish a mechanism to ensure that the Rules of Research receive real implementation, not mere "lip-service."...*
>
> **Nine Essential Rules of Inquiry in Medical Sciences**
>
> To help prevent production of false databases and false "findings," either through bias or scientific error, medical science has developed some basic Rules of Research. Adherence to these rules is essential for conducting scientifically credible studies of Chernobyl's radiation consequences. For comparing exposed and non-exposed groups in epidemiological studies, some basic rules are abbreviated below.
>
> - First Rule: Comparable Groups....
> - Second Rule: A Real Difference in Dose....
> - Third Rule: A Sufficiently Big Difference in Dose....
> - Fourth Rule: Careful Reconstruction of Dose....
> - Fifth Rule: "Blinding" of Dose-Analysts....
> - Sixth Rule: "Blinding" of Diagnostic Analysts....
> - Seventh Rule: No Changes of Input after Any Results Are Known....
> - Eighth Rule: No Excessive Subdivision of Data....
> - Ninth Rule: No Pre-judgments....

In subsequent sections Dr. Gofman goes on to demonstrate Some Examples of Rule-Breaking in Radiation Research:

- Violation of Rule 7, in the database for the Hiroshima-Nagasaki Atomic-Bomb Survivor Study
- Violation of Rules 2, 3, and 4 in the 1991 IAEA Study of Chernobyl
- Violation of Rule 9 in the 1989 WHO Study of Chernobyl

Following this is a proposal for independent watchdog scientists to work inside the central Chernobyl data base that was under construction at that time. The conclusion distinguished between The Easy and the Difficult:

> Common-sense proposals—like independent "watchdog authorities"—are the easy part. The hard

part is reaching a critical mass of international support sufficient to establish and sustain mechanisms which will cope with the thrust of "concentrated benefit" in all sorts of areas. Since human nature is not going to change its range and distribution, we have to become realistic about controlling its darker aspects.

The concept of independent "watchdoggery" is such a control, needed to offset a great conflict of interest in certain types of research.

The proposal will meet with dedicated opposition beneath the surface, thanks to "concentrated benefit." Even its supporters will call it very difficult to achieve. And they will be correct, because the public is told loudly and often that most injuries from pollution are "just hypothetical—an exceedingly "diffuse harm."...

The Law of Concentrated Benefit over Diffuse Injury

In 1993 Dr. Gofman and Egan O'Connor wrote a paper published by CNR that analyzed what was alluded to in the conclusion above: "What Is Humanity's Most Harmful Law? *The Law of Concentrated Benefit over Diffuse Injury*,"[62] While acknowledging that "[m]any scholars have written about this extremely important axiom before," and "[t]he fact that narrow special interests are always at work for their own benefit *at the expense of others* is not at all surprising, given human nature," the authors point out the "surprising aspect is the failure of so many victims—especially in peaceful democracies—to appreciate the *aggregate* consequences which inevitably accrue, when each small injustice has such a high chance of prevailing."

> We regard Concentrated Benefit as the most harmful law of all humanity. Is this correct? The terrible feature of this law is that each incremental injustice has a very high chance of prevailing. So, even when new injuries or injustices truly are small, the aggregate abuse can accumulate to tragic proportions after the axiom of Concentrated Benefit has operated on behalf of various narrow interests again ... and again ... and again....
>
> The axiom of Concentrated Benefit over Diffuse Injury accounts for the current promotion of a "de minimis" policy toward nuclear (and other) pollution. A de minimis policy asserts that society should not concern itself with trivia. (Latin: De minimis non curat lex. The law does not concern itself with trifles.) A de minimis policy toward *pollution* asserts that poisonous discharges and human exposures below a certain level should be treated as non-existent—because their consequences are allegedly trivial.
>
> Trivial. That is the essence of the axiom. Triumph for each injustice is virtually assured if the advocates succeed in presenting it as trivial....
>
> Even after a nuclear accident as severe as Chernobyl, it is unrealistic for an irradiated population to feel, "We are all doomed," or "The children are all doomed." Although the aggregate number of Chernobyl-induced cancers will be very large—at least a million over all time—this will occur not because everyone in fallout areas has a *high* personal risk of cancer from Chernobyl. It will occur because there is no safe dose, and therefore the accident creates a small extra risk of cancer for *many* people (over 500 million exposed individuals, inside and outside the ex-USSR).
>
> The fact that the enormous health consequences of the Chernobyl accident are diffused among so many people is what allows powerful operation of the law of Concentrated Benefit over Diffuse Injury. Governments which sponsor nuclear power can say that personal cancer-risks even from

Chernobyl are small. This assurance is supposed to inactivate public resistance to "routine" levels of nuclear pollution....

With respect to nuclear pollution and every other type of persistent pollutant which lacks a safe dose, the following point deserves emphasis again and again:

What counts biologically is the sum of all the injuries over time from ALL the combined sources and events which release persistent poisons (radioactive or other) into the biosphere. If the sum matters biologically, then each contribution to the sum matters. Whoever consents to the small releases is consenting automatically to their worldwide sum, whatever it turns out to be.

↑ **1994:** *Chernobyl Accident: Radiation Consequences For This And Future Generations* ↑

In 1994, by request from citizens in Belarus for an independent expert opinion about the probable health consequences from the nearby Chernobyl accident, Dr. Gofman completed *Chernobyl Accident: Radiation Consequences For This And Future Generations*.[63] Published in Russian only, it is a 574-page book in which he provided lessons in radiobiology and explained how he derived his estimates. The book sold out immediately, except for some copies that were reserved as graduation gifts for medical students at the Minsk Medical Institute. Presumably both the 1990 and 1994 books had considerable impact in the former Soviet Union, where people no longer trusted experts employed by any government.

↑ Disaster Creep: "Safe Doses" Belief Began Post-1895 ↑

On March 20, 1995, Dr. Gofman submitted a Supplement—reproduced below in full—to the Oral History he had participated in as part of the Human Radiation Experiments Oral Histories. This program was initiated in December 1993 by U.S. Secretary of Energy Hazel O'Leary. The Supplement provides context regarding how, in the five decades preceding the Manhattan Project, the dominant biomedical community erroneously believed that exposure to low dose ionizing radiation was of no consequence. Once this bias of missing the boat concerning cancer induction had been adopted over decades, the imperative to continue operating with the "no problem from exposure to low-dose radiation" mindset predominated. This overrode all voices urging caution or that the medical community's prior guidance was wrong.

Supplement to the Oral History of John W. Gofman
March 20, 1995
An Overview in Retrospect of the "1945 + Human Radiation Experiments"

It is my opinion based upon some major studies I have accomplished in the past year that it is a grave mistake to consider "human radiation experiments" as a phenomenon peculiar to the advent of large-scale atomic energy.

In fact, the really significant events were in 1895 (Roentgen's discovery of the X-Ray), and 1898 (the Curie's discovery of radium). The true era of massive human radiation experimentation began very shortly after Roentgen's work, and by the 1940-1945 period, all the features were in place that ASSURED we would have precisely what has been found to have been the case in the post-1945 period. But there really was nothing special about the human experiments beginning after 1945.

1. *Humans in recent decades (last couple of hundred years) operate on the technological imperative. Whatever is discovered must be applied immediately. There has been no thought, until recently, about DISASTER CREEP which can occur as a result of looking only at the short span of time for consequences of exposure to new technologies.*

2. *A special example of disaster creep is the inordinately long latent period before the full flowering of cancers following exposure to carcinogens such as ionizing radiation. The time is clearly at least 50 years and it may really be 60 or more years.*

THE RESULT: *The bulk of cancers from x-radiation and radium gamma rays simply were not seen, partly because of the long latency and partly because the idea that long-term follow-up was essential was clearly dismissed in the half-century after the Roentgen discovery.*

THE FALSE CONCLUSION: *Doses of 200, 400, 600, and even over 1000 Roentgens of exposure to partial body radiation were erroneously exonerated as cancer producers. Millions of cancers were set in motion in the populations receiving ionizing radiation in the half-century before the A-bomb.*

And this set the stage for all the events recently receiving notice. How?

Radiation below 500 to 1000 roentgens of exposure was ridiculed as being of no consequence by failure to look at the follow-up of persons exposed.

When the post-Hiroshima era resulted in the massive Atomic Energy Bureaucracy, with all the biases built-in from 50 years of having missed the boat concerning cancer production, WHO WAS PUT IN CHARGE OF THE PROGRAM ON HEALTH EFFECTS? THE VERY PEOPLE WHO HAD A TOTAL BIAS IN FAVOR OF "No Problem from Low-Dose Radiation." Although there should have been more thoughtfulness over the uranium miners and dial painters, somehow the idea became accepted that beta particles and electromagnetic radiation simply had shown themselves not to be a worry. Alpha particles, grudgingly yes.

Not that these people were correct. THEY WERE NOT. But I am describing the atmosphere in which these individuals came to be the dominant forces in setting up the post-war era of biology and medicine of irradiation. The bias was overwhelming, and with their short-sighted look at the problem, it seemed as though they really believed there was no harm.

That was the EARLY phase post-war. But once the bureaucracy was set up and the movers and shakers were told, "No problem with health issues," the door was opened wide for all sorts of proposals from nuclear power, massive uses of radionuclides in medicine and elsewhere, and even all the "Plowshare" ideas.

This set up a new phase. Once the biologists had told the high moguls there was no problem with health effects, all kinds of wheels were in motion and from there on out, the biomedical people had to try to have biology conform to their erroneous view of what the real truth was.

And all hell would break loose if the moguls had been embarrassed by the poor biological guidance from an inept biomedical community. And that community, seeing this golden goose of unlimited funds for research and grants, simply was not in any mood to say, "Go Slow," or that our prior guidance was wrong.

We are now slowly coming off that erroneous mountain—but because so much prestige and so much funding have gone into the enterprise, the easiest path is denial that any problem exists at doses of a few rads. After all these same people just a couple of decades earlier were telling the Congress and the public that 500 to 1000 rads were "Safe" exposures. I have recently found even more evidence that this was the prevailing view at the bureaucratic top.

There is a fundamental rule that exposing persons to a potential poison, with an assurance of safety when that cannot be assured, is fraudulent. At the very least, this constitutes human experimentation, with its Nuremberg connotations. Such experimentation is commonplace today, with so-called safe standards being set for "tolerance" doses. The idea of safe doses was much much more in error for the 50 year period before the atomic bomb.

Now we can go into the Oral History, but I think failure to appreciate the 50 years before the a-bomb completely confuses the persons looking into the ethics of so-called "human experimentation." The outcome WAS CRADLED long before the post-bomb period, and was an inevitable expectation.

End of Prologue

I have felt these conclusions needed to be here. They have resulted from an in-depth year-long investigation of the extent to which ionizing radiation, primarily medical x-rays and radium gamma rays, accounts for the current level of breast-cancers. We estimate that 75 % of all breast-cancers were and are induced primarily by medical irradiation. Most of that was in the horrendous use of fluoroscopy and the equally questionable uses of radiation in the therapy of benign diseases—from dermatologists to rheumatologists. There is some REAL human experimentation.

John W. Gofman, M.D., Ph.D.
March 20, 1995

↑

1995-1996: *Preventing Breast-Cancer: The story of a Major, Proven, Preventable Cause of This Disease*

↑

Also in 1995, the first edition of *Preventing Breast-Cancer: The story of a Major, Proven, Preventable Cause of This Disease* was published. It presented Dr. Gofman's careful estimates of how much breast cancer in the United States was due to earlier medical x-rays during the 1920 to 1960 period. A second edition published in 1996 is available online in its entirety.[64] The following quotes offer starting points into this study.

Bottom line: The recent increase in breast-cancer incidence is not a mystery. About 75 % of annual incidence is caused by earlier exposure to ionizing radiation, primarily medical x-rays.

The task is *not* to reject medical uses of radiation, which are often very beneficial for women. The task is for everyone—most especially women and their physicians—to get busy providing those benefits with *vastly less harm*.

Radiation dose-levels from mammography have already been reduced by 30-fold compared with doses twenty-five years ago. This study makes it clear that it would be criminal not to make the *same* serious effort to reduce unnecessarily high doses in other radiation procedures.[65]

Dr. Gofman has a track-record of being right. For example, he led the group which demonstrated

the existence of diverse low-density lipoproteins (LDL) and high-density lipoproteins (HDL). Their work on lipoprotein chemistry and health consequences included the first prospective studies demonstrating that high LDL levels represent a risk-factor for coronary heart disease and that low HDL levels represent a risk-factor for coronary heart disease.

Although resistance to their findings was fierce at first, their work stood the test of time and became very widely accepted.

Now Dr. Gofman's 1995 book identifies earlier medical irradiation as the major cause of the breast-cancer problem in the USA—and he expects that the finding will be highly unwelcome in *some* circles of medicine and government. A few individuals may promptly deny the finding without even reading the work. By contrast, the book solicits thoughtful peer-review from objective sources who "read first, judge second." It is worth emphasis that Dr. Gofman's book is fully compatible with roles for additional causes of breast-cancer (see Index: "Co-action of cancer-causes").

There are 182,000 women every year (USA), newly diagnosed with breast-cancer, who want to know, "Why me?" This book can provide an explanation for many of them ... and can help numerous women (and their daughters) to avoid this dreaded disease. Many of the cases which will be diagnosed 10 to 50 years from today, are being induced *now*.[66]

1999: *Radiation from Medical Procedures in the Pathogenesis of Cancer and Ischemic Heart Disease*

Preventing Breast Cancer led to Dr. Gofman's final book, not yet well known. He thought only time would tell if it was his most important contribution to human health or not. The 1999 medical monograph is titled: *Radiation from Medical Procedures in the Pathogenesis of Cancer and Ischemic Heart Disease: Dose-Response Studies with Physicians per 100,000 Population*.[67] The complete books is available online in PDF format with "Section One - Orientation, Materials, Methods" also in hypertext.

In his last study, Dr. Gofman tackled an ostensibly impossible scientific problem: How to make a reality check on the comfortable assumption that medical x-rays have been a trivial cause of cancer, when no records exist of accumulated lifetime x-ray doses for even a single person. He considered it a very important task, not only because of the warning from his 1995 investigation, but because medical x-rays are several times more powerful as a mutagen, per unit of energy delivered to human tissue, than such common nuclear pollutants as cesium-137. And medical x-rays had been in very widespread use in the U.S. since 1900.[68]

The book is organized around two hypotheses:

1. Medical radiation is a highly important cause (probably the principal cause) of cancer mortality in the United States during the Twentieth Century. Medical radiation means, primarily, exposure by xrays (including fluoroscopy and CT scans).
2. Medical radiation, received even at very low and moderate doses, is an important cause of death from Ischemic Heart Disease; the probable mechanism is radiation-induction of mutations in the coronary arteries, resulting in dysfunctional clones (mini-tumors) of smooth muscle cells.

Speaking about this in a presentation made to Marin Breast Cancer Watch in 1999, Dr. Gofman clarified the meaning of the word "hypothesis."

People often hear of the term hypothesis and think that, 'Oh it's just hypothetical.' These are totally

different concepts. Hypotheses *are* just speculation if they're not backed up by any evidence. But when hypotheses, such as these, are backed up by the evidence, then that becomes the very *essence* of scientific knowledge and medical progress. And there is a *mountain* of evidence in my new work which supports both of the hypotheses that are on the front cover of this [Executive Summary].

The first hypothesis on the cover is that medical radiation is a highly important *cause* of cancer mortality in the United States. And the new evidence strongly supports the estimate that *over half* of all the cancer deaths in the United States would be absent in the absence of accumulated exposure to medical radiation.[69]

Writing in the year following the book's publication, Dr. Gofman described its method of evaluating Two Totally Trustworthy Databases.[70]

You can hardly imagine my joy when finally I figured out a way to evaluate the impact of medical radiation upon cancer mortality in the USA, from two databases which I could totally *trust* to be unbiased with respect to the topic.

Because medical xray doses were not measured in the past, and are rarely measured today, both past and current dose-estimates are highly uncertain. But we recognized that the problem (of estimating the impact of medical radiation on national age-adjusted cancer mortality-rates) might be solved by using data which *are* available—namely, the number of Physicians per 100,000 Population ("PhysPop") in each of the nation's Nine Census Divisions.

Physicians (not patients) order xray procedures. As the density of physicians goes up per 100,000 population, more xrays will be ordered per 100,000 population. This common-sense premise is supported by surveys reported in 1988. In each Census Division, the population's average per-capita xray dose will be approximately proportional to the Census Division's PhysPop value for the same year.

Thus, the nine PhysPop values are a valid indicator of the *relative* magnitude of annual per-capita xray dosage received by the nine populations of the nation's Nine Census Divisions. However, we had to ascertain that PhysPop would be a valid indicator of *accumulated* per-capita xray doses, not just the doses received in a single year. It turns out that the relative magnitude of PhysPop values was remarkably *stable*, among the Nine Census Divisions, from 1921 to 1990.

Because we were able to use the PhysPop database for dose, we are totally confident that we have been able to use data which are absolutely free from bias with respect to xray dose. After all, the PhysPop values in every state were collected and published from 1921 to the present day by the American Medical Association, for completely different purposes. The AMA statisticians clearly had no idea that anyone would ever use the PhysPop values to evaluate the impact of medical radiation upon cancer mortality, by Census Divisions.

In addition, we are totally confident that the mortality rates by Census Divisions, collected for Vital Statistics by the U.S. Government, *also* are absolutely free from bias with respect to whether medical xrays have a big or a small impact on cancer mortality, by Census Divisions.

These two databases permit our study to begin in 1940, by "enrolling" all 150 million inhabitants of our Nine Census Divisions into the study. (The study ends in 1990, when the combined population was 247 million.) By contrast, the A-Bomb Study has about 90,000 participants—which severely limits its power to discern provable differences between dose-groups.

Our PhysPop study is probably the largest, statistically strongest, prospective study of radiation

health-effects ever done—and it was done with assuredly neutral data. One should go where the trustworthy data are, and we did.

Our PhysPop study revealed not only that medical xrays are an extremely important cause of the nation's past and present cancer mortality, but it produced the first powerful evidence that ionizing radiation is also an extremely important cause of the *other* biggest killer in the nation: Ischemic/Coronary Heart Disease.

To assume that these striking findings are irrelevant to issues of nuclear pollution, because the insights derive from medical xrays, would be a serious mistake (Part 4, above). It would be *self-defeating* to ignore undeniably strong findings from any immense, neutral, highly credible database —in favor of perpetual dependence on marginal findings from the A-Bomb Survivor Database, the nuclear worker databases, and other databases with unreliable dose-estimates, retroactively altered input, and pro-nuclear management.

It would make good sense to avoid an exercise in *self*-defeat. The stakes for posterity are very high.

Dr. Gofman repeatedly emphasized that recognition of the aggregate consequences of individually small risks was critical in assessing the severity of health consequences from the sources of nuclear pollution. The following, from his 1990 monograph, *Radiation-Induced Cancer*, reflects the understanding regarding the de minimis policy expressed in The Law of Concentrated Benefit over Diffuse Injury (above).

"De Minimis" — Beyond Radiation:

Many people have observed that human nature incorporates some contradictory tendencies. It seems contradictory to me that, on the one hand, there is a readiness to inflict cancer-death on undetectable victims who will not be noticed, while there is a competing tendency which causes some people in Oakland, California, to risk their own lives on an unstable structure and work themselves to exhaustion following the October 1989 earthquake, just on the very slim chance that they might *save* one life from under the collapsed freeway.

People of goodwill need to look closely at the aggregate consequences of individually small risks. If pollution sources of all types are regulated individually, and each is allowed under the "de minimis" concept to kill one person in 100,000 (a low individual risk), then only 10,000 sources could kill up to one tenth of the population. And no one would ever be able to prove it.[71]

The awareness that each bit of additional radiation dose, no matter how small, *does* matter, counters the de minimis mindset the majority of medical radiologists are caught in. The contribution *Radiation from Medical Procedures* can yet make to prevention of needless additional cancer induction and heart disease is of great and lasting health potential and significance. From Chapter 1:

10e. A Mountain of Solid Evidence That Each Dose Matters

The fact, that xray doses are so seldom measured, reflects the false assumption that such doses do not matter. This monograph has presented a mountain of solid evidence that they do matter, enormously. And each bit of additional dose matters, because any xray photon may be the one which sets in motion the high-speed high-energy electron which causes a carcinogenic or atherogenic mutation. Such mutations rarely disappear. The higher their accumulated number in a population, the higher will be the population's mortality-rates from radiation-induced Cancer and Ischemic Heart Disease.

> The xray is a proven mutagen and a proven cause of Cancer, and the evidence in this book strongly indicates that it is also a very *important* cause of Cancer and a very important atherogen. From the existing evidence, it is clear that average per patient doses from diagnostic and interventional radiology could be reduced by a great deal without reducing the medical benefits of the procedures in any way (Part 9, above): Same procedures, at lower doses. Unless effective measures are taken, to eliminate uselessly high dosage, medical radiation will continue in the next century to be a leading cause of Cancer and Ischemic Heart Disease in the United States, and will become a leading cause in the "developing" world, too.[72]

Also in the first chapter of this, his final book, Dr. Gofman sums up his enduring commitment to the oath he took as a physician. [73]

> I have spent a lifetime studying the causes of Ischemic Heart Disease, and Cancer, in order to help prevent such diseases. So it would be pure hypocrisy for me to feign a lack of interest in any preventive *action* which would be both safe and benign. And when sources, completely independent from me, set forth their findings that such action is readily feasible—namely, significant dose-reduction in diagnostic and interventional radiology—it would be worse than silly for me to pretend that I have no idea what action should occur. After all, as a physician, I took the Hippocratic Oath: "First, do no harm." Silence would contribute to the harm of millions of people.

↑ A Unique Legacy: To Discover, Understand, Reveal, Educate and Inform ↑

Dr. Gofman produced a wealth of papers, articles, and books on the health effects of exposure to ionizing radiation. Through his independent research he created an invaluable library of facts, cogent analysis, and insights to assist individuals and groups in

- the prevention of cancer, leukemias, genetic mutations, inherited afflictions, genomic instability, birth defects and malformations from ionizing radiation;
- the prevention of additional nuclear pollution of the planet;
- and countering the unrealistic information provided by some other sources.

Beginning as a graduate student in the Plutonium Project, his experiences gave him an applied understanding of the chemistry of artificial radioactivity. His innovative research into lipoproteins, cardiology, atherosclerosis, and coronary heart disease and its causes, treatments, and prevention resulted in the sorts of breakthrough contributions acknowledged above. Beginning in 1963, his second tenure at Lawrence Livermore Laboratory afforded him ideal conditions for the highest quality lab facility from which to pursue research into the health effects of radiation and radionuclide release from weapons testing, nuclear war, radioactivity in medicine, and nuclear power. And when the results of his and Dr. Tamplin's research led them to conclude that radiation was much more dangerous than previously understood, they did what Dr. Gofman had told Glenn Seaborg in 1963: "We'll investigate these problems, but you're not going to get me to be silent and use the secrecy stamp to keep something from surfacing that I think the public ought to know." Gofman's recollection in 1973 about initially going public affirmed his remaining true to announcing what the public ought to know.

> We presented this [1969 paper on "Low Dose Radiation, Chromosomes, and Cancer"] in a totally low-key manner on an invitational paper at the Institute for Electrical and Electronic Engineers just thinking that people involved in the radiation field should know that radiation was much more hazardous with respect to cancer than it had been thought to be.[74]

While the two men did not anticipate the firestorm that would confront them by fulfilling their

commitment to public health and the public's right to know, once the battle was engaged they did not shrink from the ethical duty it required of them.

Dr. Gofman was the most engaged when he was able to conduct research in the laboratory. As he said in *Nuclear Witnesses* when initially asked by John Foster to come back to Livermore in 1963,

> I'm perfectly happy in Berkeley. I've got my research. I'm up to my neck in my trace element research. I've gone down from having to supervise fifty people in my heart disease project to where I now have three people working with me. And it's just the way I like to work. I can be in the lab, and I don't have to think about administrative details.[75]

Egan O'Connor worked with Dr. Gofman as his assistant from 1970 until his death in 2007. Recently she shared the following regarding the duty he felt he had to fulfill.

> JWG confirmed *many* times privately the fact that he would have much preferred to stay in the lab and continue cutting edge research, than to become a crusader and to use the crude tool of epidemiology forevermore. But it was a duty—to check out the claims of "trivial harm" from the permissible dose-level. Before the 1969 IEEE paper, he did *not* dismiss that as possibly being true. His 1969 IEEE paper assessed all the existing but *thin* human evidence, which existed only on a few cancers. It did not exist for heart disease or heritable afflictions at that time. The causes of heritable afflictions were not even well understood. Nor was the role of mutations well understood.[76]

Not long after giving his paper at the IEEE symposium Gofman was interviewed by Anna Mayo of the *Village Voice* in Manhattan. Although others had already written books against nuclear power,[77] she considered October 1969 to be the birth of the movement to stop nuclear power, because of Dr. Gofman's extraordinary scientific credentials. Before 1970, he was already under heavy attack by the Atomic Energy Commission and by many of the other radiation experts it was funding. Anna asked him why he had not kept quiet. She recalled later that he shrugged and replied, "This nuclear thing, it was a stone that fell in my path, and so before I could go on I had to kick it out of the way."[78][79]

Dr. Gofman's legacy of published works is a testament to and confirmation of his receiving the Gold-Headed Cane Award in 1946 for personifying the qualities of "a true physician" upon obtaining his M.D. degree from USCF. At the time he began his early research in 1947 at the Donner Laboratory at UCB, he already had the idea that the two big problems in medicine are cancer and heart disease.[80] As he said to Leslie Freeman, "If it's not something really new and unknown, it's not something I want to do."[81]

Dr. John Gofman's interest in exploring the unknown has contributed much to what we as a species now understand and must address regarding further exposure to low-level ionizing radiation. The following exemplifies this, his dedication to public health protection and the right to know.

- There Is No Safe Dose of Radiation. There Is No Safe Threshold.
- Containment of N-Power Radiation Release and Cancer-Risk From Low-Dose Exposure
- Doubling Background Radiation Dose: Greatest Imaginable Crime Against Humanity
- Nuclear Plant's Radioactive Repository: Equivalent to Thousands of Hiroshima Bombs
- Licensing A Nuclear Power Plant Is Licensing Random Premeditated Murder
- Candidates For Nuremberg Trails Through Our Gross Negligence and Irresponsibility

There Is No Safe Dose of Radiation. There Is No Safe Threshold.

In a 1994 interview with the UCSF student newspaper, *synapse*, Dr. Gofman reviewed what would

constitute a safe level of exposure to radiation.

> How would a safe level of radiation come about? It could come about in theory if the biological repair mechanisms—which exist and which will repair DNA and chromosomes—work perfectly. Then a low dose of radiation might be totally repaired. The problem, though, is that the repair mechanisms don't work perfectly. There are those lesions in DNA and chromosomes that are unrepairable. There are those where the repair mechanisms don't get to the site and so they go unrepaired. And there are those lesions where the repair mechanisms simply cause misrepair. We can say that between 50 and 90 percent of the damage done by ionizing radiation is repaired perfectly. What we are then seeing is harm done by the residual 10 or 40 or 50 percent that is not repaired perfectly.

Gofman is summarizing what he details concerning these three forms of genetic damage in Part 2, "A Troublesome Trio: Unrepaired, Unrepairable, Misrepaired Injuries," of Chapter 18, "Disproof of Any Safe Dose or Dose-Rate of Ionizing Radiation, with Respect to Induction of Cancer in Humans," from *Radiation-Induced Cancer From Low-Dose Exposure*. In the interview he goes on to provide a distillation of how there cannot be a safe dose of radiation.

> [I]onizing radiation is not like a poison out of a bottle where you can dilute it and dilute it. The lowest dose of ionizing radiation is one nuclear track through one cell. You can't have a fraction of a dose of that sort. Either a track goes through the nucleus and affects it, or it doesn't. So I said 'What evidence do we have concerning one, or two or three or four or six or 10 tracks?' And I came up with nine studies of cancer being produced where we're dealing with up to maybe eight or 10 tracks per cell. Four involved breast cancer. With those studies, as far as I'm concerned, it's not a question of 'We don't know.' The DOE has never refuted this evidence. They just ignore it, because it's inconvenient. We can now [in 1994] say, there cannot be a safe dose of radiation. There is no safe threshold. If this truth is known, then any permitted radiation is a permit to commit murder.[82]

Containment of N-Power Radiation Release and Cancer-Risk From Low-Dose Exposure

The following comprises the end of Chapter 25, Main Text: A Closing Statement, Section 7: Practical Impacts on Human Health, from *Radiation-Induced Cancer from Low-Dose Exposure*. The first part is an instance of the simple logic Gofman expressed in his writings. Chernobyl had occurred only 4 years prior to the publication of this monograph. The final segment once more emphasizes the critical necessity to determine "the correct evaluation of cancer-risk from low-dose exposure" and how this "necessarily affects the decisions which will determine the ultimate and aggregate levels of radioactive pollution, everywhere, from current and contemplated nuclear activities worldwide."

Just One Part in a Thousand?

> It may sound like a trifle to put only one part per thousand of a poison into the environment, but we will show what one part per thousand means with respect to radioactive cesium.
>
> The cesium-137 produced each year by a 1000-megawatt (electrical) nuclear power plant amounts to nearly 4 million curies. Since its radioactive half-life is 30.2 years, very little of it decays during a year.
>
> The Chernobyl reactor contained a two-year cesium-inventory of about 8 million curies. Recent estimates are that the Chernobyl reactor released about 2.5 million curies of cesium-137, which is

equivalent to (2.5 / 4.0) or 62.5 % of a *one*-year inventory.

Now let us consider 100 large nuclear power plants each operating in the USA for a lifespan of about 25 years each. Call "A" the yearly cesium-137 production by one plant.

Then 100A = the yearly production by 100 plants. Lifetime production = 25 yrs x 100A/year = 2,500A. 99.9 % containment = release of 1 part per 1,000. With 99.9 % perfect containment, loss = 2.5A. Chernobyl lost 0.625A. The ratio of 2.5A and 0.625A is 4.0.

This ratio, 4, has an enormous meaning. It means that achieving 99.9 % *perfect* containment of the cesium-137 produced by 100 plants during 25 years of operation, through all steps of the cesium's handling up through final burial, would *still* result in cesium-137 contamination equivalent in curies to 4 Chernobyl accidents.

Worldwide, there are about 400 plants underway, so the same scenario (99.9 % perfection in containing cesium) would mean cesium-loss equivalent to 16 Chernobyl accidents per 25 years of operation. And this assault on human health could occur without blowing the roof off any single plant.

Best Estimates ... Semi-Prudence :

The stakes in the correct evaluation of cancer-risk from low-dose exposure extend far beyond one spectacular accident like Chernobyl. Not only do such evaluations affect hundreds of millions of medical and dental patients, and millions of occupationally exposed workers, but correct evaluation necessarily affects the decisions which will determine the ultimate and aggregate levels of radioactive pollution, everywhere, from current and contemplated nuclear activities worldwide.

It is possible that new evidence developing in the future will show that our estimates in this book, of cancer-risk from low-dose, low-LET ionizing radiation, are too high—and it is equally possible that new evidence will show that our estimates are too low. In other words, there is as much chance that sampling variation and forecasting are producing *under*estimates of hazard as *over*estimates.

Pending future evidence, it is scientifically appropriate to produce and disseminate the best risk-estimates which come from the available human epidemiological evidence of good quality.

But we will repeat a warning.

What is scientifically appropriate behavior is only *semi*-prudent with regard to public health protection. True prudence with respect to human health would require the operating assumption that current uncertainties in sampling and forecasting are causing us to *under*estimate the real risk.

Doubling of the Background Dose of Radiation: The Greatest Imaginable Crime Against Humanity

The following, from "*A Wake-Up Call* for Everyone Who Dislikes Cancer and Inherited Afflictions," was published by CNR in 1997.[83] Its continued relevance concerning the dangers from further increases of low dose radiation exposure by official rulings is of concern to all. Raising levels of "permissible" radiation exposure limits, as are now occurring in the U.S. and Japan,[84] is an indicator of how desparate the nuclear industry is to justify further radiological contamination of the biosphere. In this morality play, "the economy" once more trumps health and well-being of all living systems on Earth.

Today, a growing number of people associated with the nuclear and medical industries assert,

falsely, "there is no evidence that exposure to low-dose radiation causes any cancer—the risk is only *theoretical*," or the risk is "utterly *negligible*," or "the accidental exposures were below the *safe* level," and even "there is reasonably good evidence that exposure to low-dose radiation is *beneficial* and lowers the cancer rate."...

We and others have refuted the [above denial group]'s false claims in detail, elsewhere (for example, Gofman 1990, Baverstock 1991, Ward 1991, UNSCEAR 1993, NRPB 1995, Gofman 1996, Pierce 1996—see Reference List). And the work which refutes the claims of the radiation enthusiasts, has *not* been refuted by *them*. They just don't mention it.

By any reasonable standard of scientific proof, the weight of the human evidence shows decisively that cancer is inducible by ionizing radiation even at the lowest *possible* dose and dose-rate—which means that the risk is not "theoretical." Therefore, we know that harm to human health will be immense, if the false claims about safety or benefit prevail and exposures rise....

"Negligible" Personal Risks vs Large National *Rates*

The fact, so seldom explained by radiation enthusiasts and so often stressed in our publications, is that extra exposure of a population to low-dose radiation creates only a small *risk* per individual, but it creates a real *rate* (not a "maybe") of fatal radiation-induced cancer for the *population*.

For example: In 1990, the government-sponsored BEIR Report (p.172) estimated that if the population received an extra 100 milli-rems of dose every year (approximately equivalent to doubling the natural "background" rate), the dose-increment would induce extra cancer fatality in one out of every 400 people per lifetime (details available in Gofman 1995, Pt.3). Per newborn individual, the extra lifetime *risk* would be 1 chance in 400—perhaps a "negligible" personal risk in some people's opinion. The same estimate translates into a lifetime *rate* of 650,000 extra fatal radiation-induced cancers for a population of 260 million persons (USA). Our own 1990 estimate (Gofman 1990, Table 16-C) is about 7.6 times higher: 4,940,000 extra fatal cancers—1 person in every 53.

Nonetheless, many radiation enthusiasts are arguing that the consequences of doubling the "background" dose would be "negligible" or "non-existent" or maybe "beneficial." (For instance, see Billen 1990, or Graham 1996, or Pomeroy 1996, in the Reference List.)

By contrast, we and others find *decisive* evidence that there is no threshold dose for radiation-induced cancer. And this finding very strongly supports the presumption that *inherited* afflictions are also inducible by ionizing radiation, even at the lowest possible dose and dose-rate.

In our own view, it is quite possible that a permanent doubling of the "background" dose of ionizing radiation, worldwide, would very gradually double mankind's burden of inherited afflictions—from mental handicaps to predispositions to emotional disorders, cardio-vascular diseases, cancers, immune-system disorders, and so forth. Such a doubling would be the greatest imaginable crime against humanity.

A Nuclear Power Plant's Radioactive Repository: Equivalent to Thousands of Hiroshima Bombs

In a 1973 radio interview,[85] Dr. Gofman explained in general terms, the scenario of what the world witnessed with the hydrogen explosions and subsequent triple-meltdowns at Fukushima beginning on March 11, 2011. As all six reactors had come online by 1979 and had been operating for three-plus decades, one can only imagine how much radioactive inventory at a minimum was resident—in the spent

fuel pools as well as the reactor cores—when the three reactors overheated and went critical. As described below, within a year or less for a new power plant that started up in the 1970s, it would have had within it, a repository of radioactivity equivalent to a thousand Hiroshima Bombs.

> But what you must understand is that a nuclear plant that's been operating—one of the large ones that's being built now—that's been operating, say, for between three months and a year, has within it, a repository of radioactivity equivalent to that of approximately a thousand Hiroshima bombs, the radioactivity of a thousand Hiroshima bombs.
>
> Now very often the utilities industry in endeavoring to mis-state the position of the critics—that the critics say the nuclear power plant's going to explode like an atomic bomb. That isn't so at all. The nuclear power plant won't explode like an atom bomb. But, unfortunately, it doesn't have to.
>
> If a nuclear power plant should lose its cooling water, through the action say, of a saboteur, an airplane crashing into the cooling water, or failure of the cooling system, the nuclear power plant will shut itself down. That sounds as though everything is fine. But that's where the trouble only begins. Because there is so much contained radioactivity in there that even after the plant shuts itself down the heat generated by that radioactivity will heat up that nuclear power plant at a rate of about 50 degrees per second. So it will very rapidly heat itself up to several thousand degrees and everything in the core of the reactor will melt and it will keep itself hot as a result of the further radioactive decay.
>
> The accident that this could cause has been named, semi-facetiously, the China Syndrome. When asked why this is called that, they said because the darned thing could melt itself all the way through to China. Now in truth it won't melt all the way through to China. It's estimated that it will cool itself down and probably wouldn't melt more than a half a mile into the earth. The trouble is along the way there's water around and molten metal which is generating hydrogen by reacting with water and hydrogen is explosive as you know. So you have the probability of a chemical explosion of the hydrogen and the steam, spewing radioactivity out of this plant.
>
> Remember: the inventory at full operation is something of the order of a thousand Hiroshima bombs-worth of radioactivity. That's such an astronomical amount of radioactivity that it's really just hard to contemplate what the numbers mean.
>
> But I might put it this way. Now that we're going ahead building these nuclear power plants, 10 to 30 miles from major metropolitan centers like New York, Philadelphia, Chicago, and we will in time build them close to Los Angeles, we now have a situation, if one of these accidents occurs and the wind is blowing in the right direction we can blanket a major city like New York, Philadelphia, and Chicago—any one of them—with radiation such that if the people stay there, for 12 hours or more, they're going to accumulate a dose of radiation in the neighborhood of several hundred of the radiation units we call the RAD. That means that what you do in the event of such a nuclear power plant failure is you must organize the evacuation say of a city like Philadelphia or New York and get the people out within say 6 to 10 hours because you can't afford to have them stay there 12 to 24 hours and get this fatal dose.
>
> It's an interesting thing to contemplate how you'd get everybody off the island of Manhattan at a given point when there might be say 6 to 8 million people there and get them all out—these refugees from radioactivity—inside of a few hours. That's in the short term.
>
> Then even for those who get lower doses, perhaps they haven't been right in the cloud of a such a disaster; if they get lower doses they may not show any injury acutely in days, weeks, or months.

As a matter of fact if you ask them how they feel they'll say, I feel fine. And they do. But what they have now built into them is a new risk. Because for every RAD that they accumulate of radiation, they've engendered for themselves a two percent increase in the chance of developing cancer between 5 and 30 years later.

So if you take a group of people, for example, who don't get enough radiation to die of acute radiation sickness, say they get 50 RADs. They're going to have 50 times 2 or 100 percent increase in their cancer occurrence rate between 5 and 30 years later. So that in this group of people for every person who would die of cancer ordinarily, two will die of cancer or leukemia.

The other thing that you do is approximately at the same rate, about a two percent increase per RAD, you increase genetic mutations. So the offspring of these people for generations will suffer from the genetic diseases that can be caused by mutations. So the cancer and genetic hazard are the prominent, important late effects, the acute radiation sickness the early effect.

None of this occurs if everything goes perfectly. And what the nuclear power people would have us believe is that all acts of God will be avoided, no humans will ever make errors because they're infallible, all machinery will work perfectly under all circumstances and there will be no failures of equipment whatsoever, no airplanes will stray and crash, and there will be no psychotics or saboteurs and no conventional, guerrilla, or military activity.

Licensing A Nuclear Power Plant Is Licensing Random Premeditated Murder

Dr. Gofman's 1980 description to Leslie Freeman regarding the consequences of sanctioning nuclear power go to the heart of this technology and its use for the purpose of making electricity.[86] Gofman has acknowledged in many statements, his own culpability, along with "a lot of the atomic energy scientists in the late fifties" of being candidates for Nuremberg trials for the crime of experimentation without prior consent, as well as irrevocably damaging the gene pool of future generations. As of yet I am unaware of others admitting their own connivance in their past promotion of atomic energy. In terms of being complicit, Dr. Gofman did more in his life to warn people of the dangers of radiation than most other scientists.

Licensing Murder

Licensing a nuclear power plant is in my view, licensing random premeditated murder. First of all, when you license a plant, you know what you're doing—so it's premeditated. You can't say, "I didn't know." Second, the evidence on radiation-producing cancer is beyond doubt. [As of 1980] I've worked fifteen years on it, and so have many others. It is not a question any more: radiation produces cancer, and the evidence is good all the way down to the lowest doses.

The only way you could license nuclear power plants and not have murder is if you could guarantee perfect containment. But they admit that they're not going to contain it perfectly. They allow workers to get irradiated, and they have an allowable dose for the population.[28nw] So in essence I can figure out from their allowable amounts how many they are willing to kill per year.

I view this as a disgrace, as a public health disgrace. The idea of anyone saying that it's all right to murder so many in exchange for profits from electricity—or what they call "benefits" from electricity—the idea that it's all right to do that is a new advance in depravity, particularly since it will affect future generations.

You must decide what your views are on this: is it all right to murder people knowingly? If so, why do you worry about homicide? But if you say, "The number won't be too large. We might only kill

fifty thousand—and that's like automobiles"—is that all right?

People have told me they agree with my calculations. One of the associate directors at Livermore actually said to me, "Jack, you have a right to calculate that thirty-two thousand people would die from the standards we have in force. What I don't understand is why you think thirty-two thousand a year is too many."

"Look," I said, "if I didn't think thirty-two thousand were too many I'd give up my medical diploma saying I didn't deserve it."

He didn't understand that.

People like myself and a lot of the atomic energy scientists in the late fifties deserve Nuremberg trials. At Nuremberg we said those who participate in human experimentation are committing a crime. Scientists like myself who said in 1957, "Maybe Linus Pauling is right about radiation causing cancer, but we don't really know, and therefore we shouldn't stop progress," were saying in essence that it's all right to experiment. Since we don't know, let's go ahead. So we were experimenting on humans, weren't we? But once you know that your nuclear power plants are going to release radioactivity and kill a certain number of people, you are no longer committing the crime of experimentation—you are committing a higher crime. Scientists who support these nuclear plants—*knowing* the effects of radiation—don't deserve trials for experimentation; they deserve trials for murder.

Candidates For Nuremberg-Type Trails For Crimes Against Humanity Through Our Gross Negligence and Irresponsibility

In 1978, Dr. Gofman prepared a statement for the Cactus Alliance in opposition to the Palo Verde nuclear power plant in Arizona.[87] His candor in accepting personal responsibility for failure to sound an alarm over atmospheric bomb testing and nuclear power many years sooner than he did is of supreme significance. His efforts to compensate for this lack of understanding—once the sky did fall in on him and Dr. Tamplin from the AEC and the nuclear power and electric utility industries beginning in late 1969—reveal a profoundly more adaptable and engaged intelligence and curiosity than perhaps he knew he possessed before then.

Law vs. Justice

It is said that nuclear power plants can operate *legally* simply because they are licensed to operate by the Nuclear Regulatory Commission. The Nuclear Regulatory Commission is operating *legally* because Congress legislated it into existence to issue such licenses. But what has all this to do with justice and natural rights? Congress has no authority under the Constitution to issue murder licenses. Moreover, Congress could have no such authority, simply because one of the rights protected by the Ninth Amendment is the *natural right to justice and to life*.

That is my opinion, and it would not be altered one whit if there were 100 decisions by the Supreme Court which stated that it is permissible to murder people. There is a higher law.

It amazes me that people don't seem to realize the implications of permitting laws to be passed which violate justice and natural rights. It amazes me especially since it is so soon after the Nazi Holocaust and the Nuremberg Trials. In Nazi Germany the rulers, as evil people as one can imagine, wished to carry out a program of genocide. Because of the recognition that people *might* object to such a gross violation of justice and human rights, even the Nazis decided to make the

process legal, at least in part, by passing laws which permitted judges to send people to their death with no justification at all other than a Nazi-passed law.

At the Nuremberg Trials, the United States declared that this sham of using "*laws*" to subvert *justice* was a heinous crime, and we meted out severe sentences to judges who had used the Nazi "laws" as a shield for the crimes which they (the judges) committed on the bench.

If the Congress of the United States can permit the Nuclear Regulatory Commission to deprive people of life without due process of law, and if the Supreme Court turns its head from realizing this, as it did in declaring the Price-Anderson Act to be Constitutional, where are the guarantees that far worse injustices and violations of human rights will not be carried through in the future?

Personal Responsibility

In the USA, we have already accepted the policy of experimentation on involuntary human subjects. Every year, we introduce new chemical compounds of *uncertain* toxicity into the workplace and the biosphere. In the mid-fifties—when the toxicity of low-dose *radiation* was still uncertain—we were testing nuclear bombs in the atmosphere and launching the Atoms for Peace program.

It should have been clear to me, even then, that both atmospheric bomb-testing and nuclear power constituted experimentation on involuntary human subjects, indeed on all forms of life. Instead, I am on record in 1957 as *not* being worried yet about fallout, and still being optimistic about the benefits of nuclear power.

There is no way I can justify my failure to help sound an alarm over these activities many years sooner than I did.

I feel that at least several hundred scientists trained in the biomedical aspect of atomic energy—myself definitely included—are candidates for Nuremberg-type trails for crimes against humanity through our gross negligence and irresponsibility.

Afterword

I began working with Dr. John Gofman and Egan O'Connor in 1995 to create hypertext copy of a subset of his articles and his books. The experience has been one of the high-water marks in this life. As the work proceeded and more copy became digitally available, I was especially struck by how gratified and appreciative Dr. Gofman was in seeing his research, writings, and conclusions gain a wider exposure through the internet—to anyone anywhere on Earth who had access to a computer—than he had imagined possible before that time.[88]

Dr. Gofman's findings as expressed in his published works have had a significant influence on the medical and nuclear industries, try as they have to ignore his conclusions. As Egan O'Connor shared earlier this month, "Dr. Dan Hirsch of the Committee to Bridge the Gap, says, 'Although the BEIR Committee refused to include Gofman in its deliberations, he was always the 900-pound gorilla in the room whenever they met.'"[89]

Dr. Gofman became more and more focused on the consequences of "average per patient radiation doses from diagnostic and interventional radiology [and how they can] be reduced by a great deal, without reducing the medical *benefits* of the procedures in any way. The same procedures can be done at

substantially lower dose-levels."[90] Implementing standardized, measurable lowered dose levels provides an immense benefit for reducing the chances of cancer induction for millions of people without interfering with a single diagnostic exam. Ms. O'Connor again shared her insights regarding the biggest hurdle to overcome amongst members of the medical community.

> When others do *not* accept Gofman's estimates about medical radiation, it is mostly from their ignorance about the widely acknowledged higher potency of medical x-rays compared with A-bomb gammas, and their ignorance about the kind of doses that were accumulated in the past from medical x-rays. Again and again we hear, "75% cannot be true because we all receive higher doses from natural background radiation than from medical x-rays." They are just plain and seriously and severely wrong about that. The average whole-body accumulated dose grew to many times the natural background dose (Gofman 1999, Appendix K). Acceptance of Gofman's estimates about Chernobyl and medical x-rays would be far greater if the skeptics would just read what he produced.
>
> But physicians certainly don't want him to be correct. They would not like to think how many deaths and miseries have resulted from their ignorance. And the nuclear establishment does not want him to be correct, because it dreadfully interferes with their hopes, past and reviving, for plutonium economies here and abroad.[91]

Dr. John Gofman was a pioneering medical physicist. Beginning in 1969 he became a highly effective and constructive critic of nuclear energy and medical radiation practices. His analysis was based upon his comprehensive understanding of the biological effects of radiation exposure. His conclusion—supported by many written works detailing his research step-by-step—that there is no risk-free dose of exposure to ionizing radiation, has never been refuted by the medical or nuclear industries. The response is to ignore his work. And then there is the rest of humanity. To learn about and share this written legacy, to educate ourselves and others, serves Life's needs here on Earth and gives significance and purpose to our days.

"It is very often said that, if scientists advocate any [citizen] action based on their findings, they undermine their scientific credibility.... I have spent a lifetime studying the causes of Ischemic Heart Disease, and Cancer, in order to help prevent such diseases. So it would be pure hypocrisy for me to feign a lack of interest in any preventive *action* which would be both safe and benign. And when sources, completely independent from me, set forth their findings that such action is readily feasible—namely, significant dose-reduction in diagnostic and interventional radiology—it would be worse than silly for me to pretend that I have no idea what action should occur. After all, as a physician, I took the Hippocratic Oath: "First, do no harm." Silence would contribute to the harm of millions of people."

—John Gofman, M.D., The "Advocacy Issue" and the Hippocratic Oath,
Chapter 1, *Radiation from Medical Procedures*,
CNR Book Division, 1999, pp.19-20.

1918	Born September 21, Cleveland, Ohio
1939	B.A., Oberlin College, Oberlin, Ohio
1939-1940	Western Reserve Medical School
1941-1943	Plutonium Project Group Co-Leader for the Manhattan Project at University of California, Berkeley
1943	Ph.D. Nuclear/Physical Chemistry, University of California, Berkeley
1943-1944	Research Associate in Chemistry, University of California, Berkeley
1946	M.D., University of California, San Francisco
1946-1947	Intern, Department of Medicine, University Hospital, UCSF
1947-1951	Assistant Professor of Medical Physics, UCB
1951-1954	Associate Professor of Medical Physics, UCB
1954-1957	Director, Medical Department, Lawrence Livermore National Laboratory
1954-1974	Professor of Medical Physics, UCB
1963-1965	Founder and First Director of the Biomedical Research Division of the Lawrence Livermore National Laboratory, University of California
1963-1969	Associate Director, Biology and Medicine, Lawrence Livermore National Laboratory, University of California
1971-2007	Chairman, Committee for Nuclear Responsibility
1973-2007	Professor Emeritus of Molecular and Cell Biology, University of California at Berkeley
1974-2007	Professor Emeritus of Medical Physics, Donner Laboratory, Division of Medical Physics, UCB

Patents:

#3,123,535	Glenn T. Seaborg, John W. Gofman, Raymond W. Stoughton: The slow and fast neutron fissionability of uranium-233, with its application to production of nuclear power or nuclear weapons.
#2,671,251	John W. Gofman, Robert E. Connick, Arthur C. Wahl: The sodium uranyl acetate process for the separation of plutonium in irradiated fuel from uranium and fission products.
#2,912,302	Robert E. Connick, John W. Gofman, George C. Pimentel: The columbium oxide process for the separation of plutonium in irradiated fuel from uranium and fission products.

Honors and Awards:

1946	Gold-Headed Cane Award, Presented to Graduating Senior in Medicine, University of California Medical School, for personifying qualities of a true physician.
1954	Modern Medicine Award, for outstanding contributions to heart disease research.
1965	The Lyman Duff Lectureship Award of the American Heart Association for research in atherosclerosis and coronary heart disease.
1972	The Stouffer Prize, shared $50,000 prize and Gold Medal for outstanding contributions to research in arteriosclerosis.

1974 American College of Cardiology, Selection as one of 25 leading cardiology researchers of the past quarter-century.

1992 Right Livelihood Award, "for pioneering work in exposing the health effects of low-level radiation" and "for vision and work forming an essential contribution to making life more whole, healing our planet, and uplifting humanity."

Publications: Approximately 150 scientific publications in leading scientific journals encompassing the following fields;

- Lipoproteins, Atherosclerosis, and Coronary Heart Disease.
- Ultracentrifugal Discovery and Analysis of the Serum Lipoproteins.
- Characterization of Familial Lipoprotein Disorders.
- The Determination of Trace Elements by X-ray Spectrochemical Analysis.
- The Relationship of Human Chromosomes to Cancer.
- The Lung Cancer Hazard of Plutonium.
- Problems Associated with Nuclear Power Production.
- The Biological and Medical Effects of Ionizing Radiation, With Particular Reference to Cancer, Leukemia and Genetic Diseases From Radionuclides and X-ray Sources.

Books:

1. *Dietary Prevention and Treatment of Heart Disease* with Alex V Nichols & E Virginia Dobbin (1958)
2. *What We Do Know About Heart Attacks* (1958)
3. *Coronary Heart Disease* (1959)
4. *A Specific Common Chromosomal Pathway for the Origin of Human Malignancy* with Jason L Minkler; Robert K Tandy; Lawrence Radiation Laboratory. Bio-medical Division (1967)
5. *Population Control Through Nuclear Pollution*, by Arthur R Tamplin & John Gofman (1970)
6. *Poisoned Power, The Case Against Nuclear Power Plants Before and After Three Mile Island*, with Arthur R. Tamplin, Ph.D (1971-1979)
7. *Irrevy: An Irreverent, Illustrated View of Nuclear Power: A Collection of Talks, from Blunderland to Seabrook IV* (1979)
8. *Some Medical Causes And Consequences Of Nuclear War: How Physicians Might Help To Prevent Nuclear War* (1980 or 1981)
9. *Radiation And Human Health* (1981)
10. *X-Rays: Health Effects of Common Exams*, with Egan O'Connor (1985)
11. *Radiation-Induced Cancer From Low-Dose Exposure: A Independent Analysis* (1990)
12. *Chernobyl Accident: Radiation Consequences for This and Future Generations* (in Russian, 1994)
13. *Preventing Breast Cancer: The Story Of A Major, Proven, Preventable Cause Of This Disease* (1995-1996)
14. *Radiation from Medical Procedures in the Pathogenesis of Cancer and Ischemic Heart Disease: Dose-Response Studies with Physicians per 100,000 Population* (1999)

> “I had made one mistake. If the Department of Energy or the AEC gives you money on a sensitive subject, they don’t mean for you to take the job seriously. They need you—with your scientific prestige—so they can point to you. "We have so and so studying the problem." Studying the problem is marvelous. But if you want the money and the continued support, you should go fishing or play golf. My mistake was I discovered something.”
>
> —John Gofman, in *Nuclear Witnesses: Insiders Speak Out*, by Leslie Freeman, W.W. Norton, 1981, p.106.

References

1. Leslie Freeman, *Nuclear Witnesses: Insiders Speak Out* (New York: W.W. Norton & Co., 1981, 1982). All page numbers listed herein are from the 1982 paperback. The book consists of interviews with nine individuals “who have worked with or around nuclear materials.” In the early 1990s I asked for and received permission from the book’s publisher to make and produce digital representations of three of the nine witnesses. Their names and titles of their chapters are:
   - Rosalie Bertell, Mathematician and Medical Researcher,
   - Dr. Ernest J. Sternglass, Physicist,
   - John W. Gofman, Medical Physicist.

   [↩]

2. Dr Rosalie Bertell, *No Immediate Danger: Prognosis For a Radioactive Earth* (Summertown, TN: The Book Publishing Company, 1985). In the mid 1990s I asked for and received permission from the book’s publisher to make and produce a digital representation of Part One - The Problem: Nuclear Radiation and its Biological Effects. [↩]

3. See for example:
   - “Sr-90 density rose up 155 percent of the previous highest reading in the seaside of Reactor 2,” Iori Mochizuki, *Fukushima Diary*, 09/16/15;
   - “Nuclear waste overflowing into Pacific Ocean at Fukushima – Officials: Impossible to stop the spill anytime soon – Torrential rainfall from approaching typhoon already too much for plant to handle,” *Energy News*, 07/16/15;
   - “Plutonium levels 10,000,000 times normal in water below Fukushima reactors – Plutonium hit record high off coast in 2014 – “Has been transported relatively long distances” – Every sample taken from rivers flowing into Pacific had Pu-239, Pu-240, Pu-241,and Pu-242 from plant,” *Energy News*, 07/10/15;
   - “Plutonium-241 from Fukushima nearly 70,000 times more than atomic bomb fallout in Japan – Gov’t Labs: Large areas of oceans contaminated by plutonium from events such as Fukushima; Build-up in biosphere expected; Considerable hazard to humans – Officials: Molten fuel now ‘particle-like’, contains ‘special’ nuclear materials,” *Energy News*, 03/25/15.

   [↩]

4. *Nuclear Witnesses*, *op. cit.*, pp.82-83. [↩]

5. From: The Manhattan Project, Human Radiation Studies: Remembering The Early Years – Oral Histories: Dr. John W. Gofman, M.D., Ph.D., conducted December 20, 1994, United States Department of Energy, Office of Human Radiation Experiments, June 1995. [↩]

6. *Nuclear Witnesses*, *op. cit.*, p.84. [↩]

7. 1979 Pacifica Radio interview with KPFA news producer Aileen Alfandary. Excerpt from recording reproduced in Maria Gilardin, “Shut Down Nuclear Power Plants; The Life and Work of Dr. John Gofman, Part One,” *TUC Radio*, May 22, 2012.

See Also: From Research to Laboratory Production of Plutonium, 1994 DOE Oral Histories: Dr. John Gofman, *op. cit.* [↩]

8. *Nuclear Witnesses*, *op. cit.*, p.84-85. [↩]

9. Curriculum Vitae of Dr. John W. Gofman, M.D., Ph.D., from *Preventing Breast Cancer: The Story of a Major, Proven, Preventable Cause of this Disease*, by John W. Gofman, M.D., Ph.D., Committee for Nuclear Responsibility, 2nd Edition, 1996, p.379.
See Also: John W. Gofman, Frank T. Lindgren, and Harold Elliott, Ultracentrifugal studies of lipoproteins of human serum. *J. Biol. Chem.*, 1949, **179**: 973-979. [↩]

10. The "George Lyman Duff Memorial Lecture was established in 1956 by the Society for the Study of Arteriosclerosis in memory of Dr. Duff, a founding member and past president of the society. Dr. Duff was one of Canada's most distinguished pathologists and medical educators."
See: John W. Gofman, M.D., Ph.D., Wei Young, Ph.D., and Robert Tandy, "Ischemic Heart Disease, Atherosclerosis, and Longevity," *Circulation*, Vol.34: 679-697, October 1966. This communication was presented at the Lyman Duff Memorial Lecture, entitled "Atherosclerosis, 1965," at the meeting of the Council on Arteriosclerosis, American Heart Association, Bal Harbour, Florida, October 13, 1965. [↩]

11. "The Stouffer Prize consists of a medal, citation and $50,000. It is awarded yearly from funds of the Vernon Stouffer Foundation to the person or persons chosen by an international prize selection committee for achievement in prevention, understanding and treatment of arteriosclerosis and hypertension, the diseases most responsible for heart attacks and strokes.... Sharing the 1972 prize with Dr. Gordon will be Dr. Vincent P. Dole, Jr. of Rockefeller University in New York City, Dr. John W. Gofman of the Lawrence Radiation Laboratory in Livermore, California and Dr. John L. Oncley of the University of Michigan in Ann Arbor. All four are being honored for scientific achievements concerning the blood lipids, or fatty substances, which have become most familiar because of their involvement in arteriosclerosis, diabetes and related diseases." —From the U.S. Dept of Health Education, and Welfare's HEW News National Heart and Lung Institute Press Release, 20 Sep 1972. [↩]

12. "Thematic review series: The Pathogenesis of Atherosclerosis. An interpretive history of the cholesterol controversy: part I," Daniel Steinberg, Department of Medicine, University of California San Diego, La Jolla, CA 92093-0682, September 2004 *The Journal of Lipid Research*, 45, 1583-1593. Complete article online. The full final paragraph reads, "The impact of Gofman's work on the field was of great and lasting importance. He opened the window on the complexity of the lipoproteins and started people thinking about what they do, how they are metabolized, and how they lead to atherosclerosis. The next two decades would see an explosive increase in research on the plasma lipoproteins and their relationship to atherosclerosis. Anitschkow and Gofman played major roles in sparking that explosion." [↩]

13. John W. Gofman, Oliver DeLalla and Frank Glazier, Norman K. Freeman, Frank T. Lindgren, Alex V. Nichols, Beverly Strisower, Arthur R. Tamplin, "The Serum Lipoprotein Transport System in Health, Metabolic Disorders, Atherosclerosis and Coronary Heart Disease," *Plasma* 2, 1954, No.4: 413-484. This paper was re-typeset and fully re-published in May 2007 by the *Journal of Clinical Lipidology*, 1 No.2: 104-141.
In addition: Listen to the podcast, Who Was John Gofman? on "Lipid Luminations," a program of the National Lipid Association. Dr. Larry Kaskel speaks with Dr. William Virgil Brown, Editor-in Chief of the *Journal of Clinical Lipidology*. Covers background on nuclear physicist John Gofman and the major contributions he made to science and how it affects cholesterol work today. Recorded on March 2, 2008, 13 minutes. [↩]

14. *Nuclear Witnesses*, *op. cit.*, pp.86-87. [↩]

15. *Ibid.*, p.87. [↩]

16. *Ibid.*, pp.87-88. [↩]

17. *Ibid.*, p.88. [↩]

18. "Jack, all we want is the truth", 1994 DOE Oral Histories: Dr. John Gofman, *op. cit.* [↩]

19. *Ibid.* [↩]

20. *John Gofman: Medical Research and Radiation Politics, Oral History Interviews, Medical Physics Series*, The Bancroft Library, University of California, Berkeley, History of Science and Technology Program, pp.124-125. The book is a reproduction of the original oral history transcript, conducted by Sally Smith Hughes in 1980. [↩]

21. *Nuclear Witnesses*, *op. cit.*, p.89. [↩]

22. *Ibid.* [↩]

23. *Nuclear Witnesses*, *op. cit.*, p.90.
For information on Dr. Knapp's study, his refusal to back down when pressured by the AEC, and the reactions his work engendered from his AEC colleagues, see: "Harold Knapp and the Geography of Normal Controversy: Radioiodine in the Historical Environment," Scott Kirsch, *Osiris* 2nd Series, Vol. 19, Landscapes of Exposure: Knowledge and Illness in Modern Environments (2004), pp. 167-181. [↩]

24. Dr. Harold Knapp, in Anne Fadiman, "The Downwind People: A Thousand Americans Sue for Damage Brought on by Atomic Fallout," *Life,* June 1980, p. 39. Cited in *Nuclear Witnesses*, fn.11, p. 90.
Dr. Knapp's report came out in the middle of 1963: Harold Knapp, "Iodine-131 in Fresh Milk and Human Thyroids Following a Single Deposition of Nuclear Test Fallout," TLD-19266, Health and Safety, TID-4500, 24th ed. (Washington, D.C., 1 June 1963). [↩]

25. *Nuclear Witnesses*, *op. cit.*, p.91. [↩]

26. Egan O'Connor, The Author's History, p.viii, from John W. Gofman, M.D., Ph.D., *Radiation From Medical Procedures in the Pathogenesis of Cancer and Ischemic Heart Disease: Dose-Response Studies with Physicians per 100,000 Population* (1999). [↩]

27. The Controversy Over Nuclear-Armed Antiballistic Missiles (1969), 1994 DOE Oral Histories: Dr. John Gofman, *op. cit.*; *Nuclear Witnesses*, *op. cit.*, pp.92-94. [↩]

28. John W. Gofman and Arthur R. Tamplin, Division of Medical Physics (Berkeley) and Bio-Medical Research Division Lawrence Radiation Laboratory (Livermore) University of California, "Low Dose Radiation, Chromosomes, and Cancer", The Institute of Electrical and Electronics Engineers (IEEE) 1969 Nuclear Science Symposium, San Francisco, October 29, 1969. The Table of Contents lists Gofman as the first of two speakers in the lead-off Plenary Session (from IEEE Xplore Digital Library). Published February 1970 in IEEE Transactions on Nuclear Science (Volume: 17, Issue: 1), pp.1-9. Reprinted in *Environmental Effects Of Producing Electric Power*, Hearings before the Joint Committee on Atomic Energy, 91st Congress, First session, Part 1, October and November 1969, pp.640-52. [↩]

29. *Nuclear Witnesses*, *op. cit.*, pp.95-96. [↩]

30. John Gofman, "Federal Radiation Council Guidelines for Radiation Exposure of the Population at Large -- Protection or Disaster?" presented to the Senate Committee on Public Works, November, 18 1969, in *Environmental Effects of Producing Electric Power,* pp. 695-706. [↩]

31. Testifying Before Congress on Radiation Effects, 1994 DOE Oral Histories: Dr. John Gofman, *op. cit.* [↩]

32. *Medical Research and Radiation Politics*, *op. cit.*, p.134. [↩]

33. *Ibid.*, p.132. [↩]

34. John W. Gofman, "Poisoned Power," interviewed by KPFA Radio's public affairs producer Elizabeth Eielson, 1973. Excerpt drawn from transcript of recording, reproduced in Maria Gilardin, "Shut Down Nuclear Power Plants; The Life and Work of Dr. John Gofman, Part Two," *TUC Radio*, June 9, 2012. [↩]

35. *Nuclear Witnesses*, *op. cit.*, pp.99-101. [↩]

36. See: The Gofman-Tamplin Reports, from John Gofman, *Irrevy: An Irreverent, Illustrated View of Nuclear Power: A Collection of Talks, from Blunderland to Seabrook IV*, (San Francisco: CNR, 1979), pp.243-245. Both quotes in this paragraph are from page 243. [↩]

37. *Nuclear Witnesses*, *op. cit.*, p.101. [↩]

38. Testifying Before Congress on Radiation Effects, 1994 Oral Histories: Dr. John Gofman, *op. cit.* [↩]

39. Gofman and Tamplin Ostracized, 1994 Oral Histories: Dr. John Gofman, *op. cit.*
See Also: David Ratcliffe, "Atomic Energy: Origins Of The Fallacy In A Risk-Free Radiation Dose," August 2016. [↩]

40. *Nuclear Witnesses*, *op. cit.*, p.102. The identity of John Totter is revealed in *Medical Research and Radiation Politics*, *op. cit.*, p.136. [↩]

41. John Gofman and Arthur Tamplin, "Can We Survive the Peaceful Atom?," presented at the Environmental Teach-In of the First "Earth Day," University of Minnesota, Minneapolis. Gofman-Tamplin Report GT-120-70. Reprinted in *Earth Day—The Beginning; A Guide For Survival*, compiled and edited by the National Staff of Environmental Action, Washington, DC., 1970. Also available in Underground Uses of Nuclear Energy, Part 2 Hearings on Bill S.3042: August 5, 1970 before the Subcommittee on Air and Water Pollution of the Committee on Public Works, U.S. Senate, 91st Congress, second session, pp.1509-1522. [↩]

42. Drs. John Gofman and Arthur Tamplin, “A Proposal for a Five-Year Moratorium on Above Ground Nuclear Power Plants.” Hearings Before the Subcommittee on Air and Water Pollution of the Committee on Public Works, U.S. Senate, 91st Congress, Second Session on S.3042. Presented August 20, 1970, in *Underground Uses of Nuclear Energy*, Part 2, pp. 1368-1382. Gofman-Tamplin Report GT-123-70. [↩]

43. I am grateful to Ms. Egan O’Connor for this description of the many invited talks Dr. Gofman gave and the evolution of his thinking from October 1969 to August 1970. Ms. O’Connor was Dr. Gofman’s editor and assistant from 1970 until his death in 2007. Regarding adversary science, see *Medical Research and Radiation Politics*, *op. cit.*, p.174:

> We had tried to move all of our work to the [UC Berkeley] Boalt School of Law in 1970, to set up a center in the School of Law for the adversary study of science, to provide the other side of the picture on a number of issues of great public concern. The faculty of the School of Law voted unanimously to embrace this project. I went back and saw the Ford Foundation and they said they would probably support it. [Richard M.] Busbaum, the head of the project at Boalt, backed it. And then Ford just dragged their feet and dragged their feet. [↩]

44. John W. Gofman and Arthur R. Tamplin, *Poisoned Power, The Case Against Nuclear Power Plants Before and After Three Mile Island*, (Emmanus, PA: Rodale Press, 1979). A combination of the 1971 and 1979 editions of *Poisoned Power*—since they were not identical—is available online through the above link. [↩]

45. See John Gofman, “The Fission-Product Equivalence between Nuclear Reactors and Nuclear Weapons,” adapted from Vol.117, No. 105, July 8, 1971, of the Congressional Record. [↩]

46. *Poisoned Power*, *op. cit.*, p.4. [↩]

47. *Poisoned Power*, *op. cit.*, pp. 13, 161. [↩]

48. John W. Gofman M.D., *Radiation and Human Health* (San Francisco: Sierra Club Books, 1981).
Chapter Titles:
    1. Introduction to Radiation and Human Health
    2. Energy Interchanges and Health
    3. The Origins of Human Cancer: Implications for Radiation Causation
    4. The Induction of Cancer and Leukemia by Ionizing Radiation
    5. A Systematic Approach to the Quantitative Aspects of Radiation Carcinogenisis, with Personal and Public-Health Risk Estimates
    6. The Human Epidemiological Evidence Concerning Radiation Carcinogenisis: The Studies Involving External Exposure
    7. The Induction of Human Breast Cancer by Ionizing Radiation
    8. From Peak Percents to Whole-Body Cancer Doses, by Age at Irradiation
    9. Practical Applications of the Whole-Body Cancer Dose
    10. Partial-Body Irradiation and Cancer Doses for Specific Kinds of Cancers
    11. The Evidence For A Linear or Supralinear Dose-Effect Relationship and for the Nonexistence of a “Threshold” Dose
    12. Handling the Internal Emitters: Dosimetry and Applications
    13. Internal Alpha-Particle Emitters: Radium and Radon-Daughters
    14. The Biologically-Important, Man-Made Alpha-Particle-Emitting Nuclides: Plutonium and Other Transuranics
    15. Lung Cancers Already Produced by Plutonium Inhalation
    16. Plutonium-Induced Lung Cancers in a Plutonium Energy Economy
    17. Likely Radiation Doses and Their Effects in a Nuclear-Power Economy
    18. Ionizing Radiation Exposures from Natural Sources, Consumer Products, and Particular Occupations
    19. Ionizing Radiation Exposures from Medical Diagnostic and Therapeutic Irradiation
    20. Induction of Human Leukemia by Ionizing Radiation
    21. Congenital (In Utero, Teratogenic) Effects of Ionizing Radiation
    22. The Genetic and Chromosomal Effects of Ionizing Radiation
    23. Appendix: Some Simple Rules for Handling Small and Large Numbers and Units
    24. Bibliography
    25. Index

Highlights of the Index (from page 884)

[↩]

49. Victor E. Archer, "Radiation and Human Health," *JAMA*, 1982;247(11):1637-1643. doi:10.1001 / jama.1982.03320360071051, p.1637. [↩]

50. I am grateful to Ms. Egan O'Connor for highlighting this section and her description of its value which comprises the text for this paragraph. Ms. O'Connor was Dr. Gofman's editor and assistant from 1970 until his death in 2007. [↩]

51. "Ideas and Trends; With Radiation, How Little Is Too Much?" *New York Times*, September 26, 1982. I am grateful to Ms. Egan O'Connor for bringing the *New York Times* article to my attention and for the description which comprises the text for this paragraph. Ms. O'Connor was Dr. Gofman's editor and assistant from 1970 until his death in 2007. [↩]

52. John W. Gofman M.D., Ph.D., and Egan O'Connor, *X-Rays: Health Effects of Common Exams* (San Francisco: Sierra Club Books, 1985). [↩]

53. M.M.Greenfield, M.D., Book Review, X-Rays: Health effects of common exams, *N Engl J Med* 1986; 314:393 February 6, 1986 DOI: 10.1056/NEJM198602063140627. [↩]

54. John W. Gofman, M.D., Ph.D., "Assessing Chernobyl's Cancer Consequences: Application of Four 'Laws' of Radiation Carcinogenesis," presentation as a panelist at the Symposium on Low-Level Radiation, 192nd National Meeting of the American Chemical Society, held in Anaheim, California, September 9, 1986. A copy of the presentation is presented in Chapter 36 of *Radiation-Induced Cancer From Low-Dose Exposure: An Independent Analysis*. The complete text at the beginning of this Chapter reads: "For the reasons given in Chapter 24, our September 1986 estimate of the radiation-induced cancers to come from Chernobyl is reproduced in its original form, exactly as presented. The calculations and estimate were part of a longer paper. Only the sections relating specifically to the Chernobyl accident are reproduced here." [↩]

55. I am grateful to Ms. Egan O'Connor for the description which comprises the bulk of the text for this paragraph. Ms. O'Connor was Dr. Gofman's editor and assistant from 1970 until his death in 2007. [↩]

56. John W. Gofman, M.D., Ph.D., *Radiation-Induced Cancer from Low-Dose Exposure: An Independent Analysis* (San Francisco: Committee for Nuclear Responsibility, Inc., 1990). [↩]

57. See, Appendix B, The Safe-Dose Fallacy: Three Remarkably Similar Reports, from John W. Gofman, M.D., Ph.D., *Radiation From Medical Procedures in the Pathogenesis of Cancer and Ischemic Heart Disease: Dose-Response Studies with Physicians per 100,000 Population* (1999). [↩]

58. G. Theodore Davis, M.D., André J. Bruwer, M.D., "Book Review – Health Effects of Exposure to Low Levels of Ionizing Radiation: BEIR V; Radiation-Induced Cancer from Low-Dose Exposure: An independent analysis" *N Engl J Med* 1991; 324:497-499 February 14, 1991 DOI: 10.1056/NEJM199102143240722. [↩]

59. I am grateful to Ms. Egan O'Connor for the details comprising the bulk of this section's text for the first, third, and fourth paragraphs. [↩]

60. The Right Livelihood Foundation is a registered charity with its office in Stockholm Sweden. Dr. Gofman shared the 1992 Award with Alla Yaroshinskaya: he "...for his pioneering work in exposing the health effects of low-level radiation" and she "...for revealing, against official opposition and persecution, the extent of the damaging effects of the Chernobyl disaster on local people." There are two Laureate listings for Dr. Gofman: the original 1992 issue and the current declaration. [↩]

61. John W. Gofman, M.D., Ph.D., "Bio-Medical 'Un-Knowledge' And Nuclear Pollution: A Common-Sense Proposal," On the occasion of the Right Livelihood Award, Stockholm, December 9, 1992. [↩]

62. John W. Gofman, M.D., Ph.D., and Egan O'Connor, "What Is Humanity's Most Harmful Law? *The Law of Concentrated Benefit over Diffuse Injury*," CNR, November 1993. [↩]

63. John W. Gofman, M.D., Ph.D., *Chernobyl Accident: Radiation Consequences For This And Future Generations* [in Russian]. Translated by Professors Emanuel I. Volmyansky and Olga A. Volmyanskaya. (CNR Books & Vyshėĭshaĭâ Shkola Publishing House, Minsk) 574 p. ISBN 5-339-00869-X. [↩]

64. John W. Gofman, M.D., Ph.D., *Preventing Breast-Cancer: The story of a Major, Proven, Preventable Cause of This Disease* (San Francisco: Committee for Nuclear Responsibility, Inc., 1996), Second Edition. [↩]

65. "Breast-Cancer Study – New Study Identifies Past Medical Irradiation As Major Cause Of The Breast-Cancer Problem" [↩]

66. John W. Gofman, "Resistance to New Ideas: A Relevant Story from the Past." [↩]

67. John W. Gofman, M.D., Ph.D., *Radiation from Medical Procedures in the Pathogenesis of Cancer and Ischemic Heart Disease: Dose-Response Studies with Physicians per 100,000 Population* (San Francisco: Committee for Nuclear Responsibility, Inc., 1999) 708 p. [↩]

68. I am grateful to Ms. Egan O'Connor for the details comprising the bulk of the text for these two paragraphs. Further, Dr. Gofman described this dynamic of medical x-ray energy being being roughly twice as harmful as the radiation exposures released from the Hiroshima and Nagasaki bombs in a 1994 UCSF interview, "Gofman on the health effects of radiation: 'There is no safe threshold'":

> [M]edical radiation, from x-ray machines, is roughly twice as harmful per unit dose as Hiroshima-Nagasaki radiation [because of] the effect of linear energy transfer. When gamma rays or x-rays set electrons in motion, the electrons are traveling at a lower speed than the electrons coming out of

Cesium-137. And as a result, when they're traveling at a lower speed, they interact much more with each micrometer of path they travel. Therefore the local harm is much greater. So medical x-rays set in motion electrons that are traveling at a lower speed and hence producing about twice the linear energy transfer, and hence twice the biological effect. That's why alpha particles from radium or plutonium are so much more devastating than beta rays set in motion from x-rays. The alpha particles, with their heavy mass and plus-2 charge, just rip through tissue so strenuously that they don't go very far. A deception of the crassest sort are the lectures by pro-nuclear people showing a plutonium or radium source and putting up a piece of paper and showing that the alpha-particle radiation on the other side is zero. "You see, a piece of paper will stop those alpha particles, folks, there's no problem with plutonium." Except when that alpha particle is lodged next to an endosteal cell in the bone and producing a horrendous amount of interaction. Or that alpha particle is lodging on the surface of the bronchi — that's why we've got an epidemic of lung cancer among the uranium miners! The fact that they don't travel far is because they interact like hell!

[↩]

69. "Medical X-rays and Breast Cancer," Dr. John Gofman, Part 1, on the connection between breast x-rays and the breast cancer epidemic. Presentation made to Marin Breast Cancer Watch / Zero Breast Cancer in Stinson Beach, California, 1999. Reproduced on The Ecological Options Network youtube channel, the film is 40:07 minutes. This quotation runs from 02:35-3:44. The Question and Answer segment is provided in Part 2 which runs 55:24. [↩]

70. John W. Gofman, M.D., Ph.D., "Preventing an Exercise in Self-Defeat: The Relevance of Medical Radiation to Nuclear Pollution," CNR, April 2000. [↩]

71. *Radiation-Induced Cancer*, *op. cit.*, Chapter 24, "Chernobyl: A Crossroad in the Radiation Health Sciences," p.24-20. [↩]

72. *Radiation from Medical Procedures*, *op. cit.*, p.20. [↩]

73. John W. Gofman, M.D., Ph.D. Chapter 1, Part 10: An Immense Opportunity: All Benefit, No Risk, *Radiation from Medical Procedures*, *op. cit.*, p.19. [↩]

74. John W. Gofman interviewed by KPFA Radio's public affairs producer Elizabeth Eielson, 1973. *op. cit.* [↩]

75. *Nuclear Witnesses*, *op. cit.*, p.88. [↩]

76. E-mail from Egan O'Connor, October 6, 2015. [↩]

77. See Sheldon Novick, *The Careless Atom* (Boston: Houghton Mifflin, 1969), and Richard Curtis and Elizabeth Hogan, *The Perils of the Peaceful Atom: The Myth of Safe Nuclear Power Plants* (Garden City, NY: Doubleday, 1969). [↩]

78. John Gofman to Anna Mayo, interview appeared in *The Village Voice* after his October 1969 talk at the IEEE. [↩]

79. I am grateful to Egan O&Connor for her recollection of this and for the text of this paragraph. [↩]

80. *Medical Research and Radiation Politics*, *op. cit.*, pp.72-73. [↩]

81. *Nuclear Witnesses*, *op. cit.*, p.87. [↩]

82. Shobhit Arora and Fred Gardner, "Gofman on the health effects of radiation: 'There is no safe threshold'," *synapse*, Volume 38 Number 16, January 20, 1994, quotes 1 and 2. [↩]

83. John W. Gofman, M.D., Ph.D. and Egan O'Connor, "*A Wake-Up Call* for Everyone Who Dislikes Cancer and Inherited Afflictions," CNR, Spring 1997. [↩]

84. See for example:
    - "White House Approves Radical Radiation Cleanup Rollback, Civilian Cancer Deaths Expected to Skyrocket Following Radiological Incidents," Public Employees for Environmental Responsibility (PEER), April 8, 2013.
    - "Japan to raise worker emergency radiation exposure limits," *World Nuclear News*, May 21, 2015. "Japan's nuclear regulator is to increase the radiation exposure limit for workers in emergency situations from the current 100 millisieverts (mSv) to 250 mSv. The limit was temporarily raised following the March 2011 accident at the Fukushima Daiichi plant."
    - "Japan: Government to Raise Maximum Annual Radiation Exposure Ahead of Restart of Nuclear Reactors, *Mainichi Shimbum*, June 30, 2015.

    [↩]

85. John W. Gofman, “Poisoned Power,” interviewed by KPFA Radio’s public affairs producer Elizabeth Eielson, 1973. Excerpt from recording reproduced in Maria Gilardin, “Shut Down Nuclear Power Plants; The Life and Work of Dr. John Gofman, Part Two,” *TUC Radio*, June 9, 2012. [↩]

86. *Nuclear Witnesses*, *op. cit.*, pp.111-112. [↩]

87. *Irrevy op. cit*, pp.226-228. [↩]

88. A subset of Dr. Gofman’s works are presented in CNR’s List of Publications Available Electronically. [↩]

89. E-mail from Egan O’Connor, September 9, 2015. [↩]

90. John W. Gofman, M.D., Ph.D. Chapter 1, Part 10: An Immense Opportunity: All Benefit, No Risk, *Radiation from Medical Procedures*, *op. cit.* [↩]

91. E-mail from Egan O’Connor, September 9, 2015. [↩]