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HUMAN RADIATION STUDIES: REMEMBERING THE EARLY YEARS

Oral History of Health Physicist Carl C. Gamertsfelder, Ph.D.

Conducted January 19, 1995

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FOREWORD

In December 1993, U.S. Secretary of Energy Hazel R. O'Leary announced her Openness Initiative. As part of this initiative, the Department of Energy undertook an effort to identify and catalog historical documents on radiation experiments that had used human subjects. The Office of Human Radiation Experiments coordinated the Department's search for records about these experiments. An enormous volume of historical records has been located. Many of these records were disorganized; often poorly cataloged, if at all; and scattered across the country in holding areas, archives, and records centers.

The Department has produced a roadmap to the large universe of pertinent information: *Human Radiation Experiments: The Department of Energy Roadmap to the Story and the Records* (DOE/EH-0445, February 1995). The collected documents are also accessible through the Internet World Wide Web under http://www.ohre.doe.gov. The passage of time, the state of existing records, and the fact that some decisionmaking processes were never documented in written form, caused the Department to consider other means to supplement the documentary record.

In September 1994, the Office of Human Radiation Experiments, in collaboration with Lawrence Berkeley Laboratory, began an oral history project to fulfill this goal. The project involved interviewing researchers and others with firsthand knowledge of either the human radiation experimentation that occurred during the Cold War or the institutional context in which such experimentation took place. The purpose of this project was to enrich the documentary record, provide missing information, and allow the researchers an opportunity to provide their perspective.

Thirty audiotaped interviews were conducted from September 1994 through January 1995. Interviewees were permitted to review the transcripts of their oral histories. Their comments were incorporated into the final version of the transcript if those comments supplemented, clarified, or corrected the contents of the interviews.

The Department of Energy is grateful to the scientists and researchers who agreed to participate in this project, many of whom were pioneers in the development of nuclear medicine.

DISCLAIMER

The opinions expressed by the interviewee are his own and do not necessarily reflect those of the U.S. Department of Energy. The Department neither endorses nor disagrees with such views. Moreover, the Department of Energy makes no representations as to the accuracy or completeness of the information provided by the interviewee.

ORAL HISTORY OF HEALTH PHYSICIST CARL C. GAMERTSFELDER, Ph.D.

The interview was conducted on January 19, 1995, in Knoxville, *Tennessee, by Thomas J. Fisher, Jr. and Michael A. Yuffee from the Office of Human Radiation Experiments (OHRE), U. S. Department of Energy.*

Carl C. Gamertsfelder was selected for the oral history project because of his more-than-40 years of practical experience in the general field of radiological sciences and health physics. The oral history covers Dr. Gamertsfelder's long career, focusing on the years spent pioneering the development of radiation instruments and measurement techniques during the Manhattan Project, continuing through the expansion of research aspects following World War II, and concluding with his later work as a consulting radiological scientist.

Short Biography

Dr. Gamertsfelder was born in Decorah, Iowa, on June 6, 1913. In 1935, he received his B.A. (Mathematics and Physics, double major) from North Central College in Naperville, Illinois. From 1938 to 1941, Dr. Gamertsfelder studied at the University of Missouri. During this time, he received both an M.A. and a Ph.D. in Physics. Dr. Gamertsfelder is married and has three children.

Dr. Gamertsfelder began his career as an Associate Physicist at the Armour Research Foundation from 1941 to 1942. In 1942, he joined the Manhattan Project as an Associate Physicist in the University of Chicago's Metallurgical Laboratory. While in Chicago, Dr. Gamertsfelder developed radiation monitoring instruments and techniques, including the first practical neutron monitor. In addition, he was one of 49 individuals who witnessed the first self-sustained nuclear chain reaction, on December 2, 1942.

In 1943, while still on the University of Chicago payroll, Dr. Gamertsfelder was transferred to the Clinton Laboratories in Oak Ridge, Tennessee, where he conducted health physics instrument development. During the startup and operation of the X-10 graphite reactor, he was in charge of monitoring. He also trained Du Pont personnel for work at the Manhattan Project site at Hanford, Washington.

In 1944, Dr. Gamertsfelder went to Hanford, where he served as Senior Supervisor of the Medical Department, a position he held until 1946. During this period, he trained engineers and supervisors in the basic elements of health physics, and developed surveying techniques. In 1946, Dr. Gamertsfelder was appointed Manager of the Biophysics Section of the Radiological Sciences Department at Hanford. He left Hanford in 1952 and joined General Electric's Aircraft Nuclear Propulsion Department as a Consulting Physicist, where his work focused on determining the hazards associated with all powerplants designed by the Department.

In 1961, Dr. Gamertsfelder returned to the Hanford Laboratories, where he became responsible for the planning, advancement, and appraisal of major research and development programs. Dr. Gamertsfelder eventually left Hanford a second time, to work with the General Electric group that was making a power supply (using plutonium-238 as the source of heat to generate electricity) for the Apollo space missions. Dr. Gamertsfelder retired in 1975.

In addition to holding the title of Certified Health Physicist, Dr. Gamertsfelder is a member of the following organizations:

- Pi Mu Epsilon,
- Sigma Xi,
- Gamma Alpha,
- American Physical Society,
- American Institute of Physics,
- Health Physics Society, and
- Inhalation Hazards Subcommittee of the Committee on Pathological Effects of Atomic Radiation of the National Academy of Sciences, National Research Council.

Dr. Gamertsfelder has published many times on radiological sciences research, radiation protection issues, and dosimetry investigation.

Education and Early Employment

FISHER: Good morning, Dr. Gamertsfelder. My name is Tom Fisher. I'm from the Department of Energy's Office of Human Radiation Experiments, and I'm here this morning with my colleague, Michael Yuffee. It's Thursday, January 19th[, 1995].

I would like to take a moment to thank you for taking time out of your day to visit with us for our oral history program.

I was wondering if we might begin this morning by talking a little bit about your early education and your background, and [about] what brought you into the Manhattan Project, and ultimately, to health physics.

GAMERTSFELDER: How far back do you want to go?

FISHER: Start with your school[ing].

GAMERTSFELDER: I didn't start from kindergarten. We didn't have it.

FISHER: Okay—that's fair.

GAMERTSFELDER: I started in first grade in Elkader, Iowa. I went through the first two grades there, and then moved to Decorah, Iowa, where my dad had been a teacher, sometime [prior] to my birth. And my dad was superintendent of schools in Elkader for the two years. And then he was superintendent of schools in Decorah, where I finished my high school education.

FISHER: And then, where did you go on to college?

GAMERTSFELDER: I went to college at the North Central College in Naperville, Illinois. It was a relatively small college. It had been called Northwestern [College]. And then Northwestern University [in Evanston, Illinois] came along, so they changed it to North Central. I guess there were, maybe, 400 or 500 students at the time I was there.

FISHER: And what was your major? What did you study?

GAMERTSFELDER: Oh, I had a double major; in Physics and Math. And I was close to having one in Chemistry.

YUFFEE: What year did you graduate college?

GAMERTSFELDER: Nineteen thirty-five.

YUFFEE: And from there, you went on to—

GAMERTSFELDER: And I then took some Education courses and tried to find a job teaching. And thank goodness, I didn't find one.

[In the summer of 1936, Dr. Newell S. Gingrich, who earned his bachelor's degree from North Central, visited Dr. Clifford Wall, who was the Physics professor at North Central. Dr. Gingrich was interested in talking with potential students for the graduate school at the University of Missouri, where he was to be one of the Physics professors. I was interviewed by Dr. Gingrich. And a few weeks later, I received an offer to be a research assistant for Dr. Fred Uber, who was involved in a genetic research program with biologists who were irradiating corn pollen with ultraviolet radiation.[1] I had a lot of practical laboratory experience; built some equipment, helped in some experiments, and did some of my own.]

And the next year, I was given a job as a graduate assistant in Physics, in which the assistants were the ones who ran the laboratories for the Physics courses that were being given.

YUFFEE: And that was at Mizzou?[2]

GAMERTSFELDER: That was at Missouri. And that meant that we didn't have full time to work on graduate things. I got a master's degree by testing the linearity response of the [x-ray] film, when augmented with a fluorescent screen. [The nonlinearity was probably useful for enhancing some x-ray pictures, but it was not useful for our purposes.]

GAMERTSFELDER: And so—and then, for my doctorate, I did a lot of analyses of diffraction patterns of liquids to determine the arrangement of atoms around another atom, in various liquid elements.

YUFFEE: And where did you get your Ph.D.?

GAMERTSFELDER: I got the Ph.D. at Missouri in 1941. Getting a job was done by getting letters of recommendation from my professor, who wrote to several different places. I had ended up with two offers, [each for] $200 a month.

YUFFEE: Wow!

GAMERTSFELDER: That's a good one. There were a few 225-dollar [opening]s, that I heard about. And I ended up at Armour Research Foundation in Chicago. That was an interesting place. [Two other Ph.D.s from Missouri, Dr. Frank Trimble and Dr. Ernest Landen, were already on the staff before I got there.]

FISHER: What did you do there, what type of work?

GAMERTSFELDER: Oh, all kinds of things. Mostly—to start in with, I worked with the people who were running various projects. And the projects ran from tearing [worn rubber] off tank treads to put new rubber on them, to watch-springs for Elgin Watch Company [in Elgin, Illinois]. And I was included in the conversations they were having when that contract almost died. Their problem was making a hairspring out of a nonmagnetic [alloy].

[The normal hairsprings are made, five or six at a time, from slightly flattened wires spirally wound, in contact with two other wires over most of their length. The normal, magnetically susceptible springs are easily separated. The nonmagnetic springs, in about 50 percent of the time, are stuck to neighbor springs, making them unfit for use. A meeting was arranged for the purpose of canceling the contract.]

The guy working on it had tried all kinds of things, and nothing worked. He put different atmospheres in an annealing oven, and vacuums, and powders. And he had stayed up all night the night before the meeting. And he changed from ac [(alternating current)] to dc [(direct current)], or the other way around, in an oven he was using to treat the thing with.

When the meeting was called to order, the researcher was asked to report on his most recent work. And without saying anything, he took a small bottle out of his pocket, shook it vigorously a few times, removed the cork, and dumped the contents on the table. And there were hairsprings—

FISHER: Everywhere?

GAMERTSFELDER: All over. So that changed the whole tenor of the meeting. They ended up hiring him.

YUFFEE: *(laughs)* Not surprising.

GAMERTSFELDER:

[Dr. Ernest Landen, whom I mentioned earlier, had contracts to study the spectra of combustion gases in diesel engines. He had a single-cylinder engine directly coupled to an electric motor, which served as a starter for the engine and as generator to dump power back into power lines. Light from the combustion chamber was conducted through a pipe with quartz windows and lenses, which was inserted into a hole drilled in the wall of the combustion chamber. It took careful design and construction to get the quartz hot enough to stay clean [by burning off deposits], and the metal tube to be cool enough to maintain its strength [by staying within its elastic limit]. A successful design was obtained and used. Dr. Landen eventually went to the Caterpillar Tractor Company.

I did get a small contract of my own with a company which was making photograph needle tips with an osmium-ruthenium alloy which, when worn with use, developed an extremely smooth surface, thus slowing the rate of wear. The company was investigating the use of these materials as bearings in very sensitive meters. X-ray diffraction patterns proved the needle tips were true alloys, and not just a compacted mixture. [The contract came to an abrupt end when the owner and major experimenter died].

And, while I was [at Armour], I went to a[n American] Physical Society meeting that was [held in] Chicago. A lot of people were at the meeting, and there was a lot of talk about things that were possibly going on down [on the south side of town,] at the University of Chicago. They were collecting [many of] the nuclear scientists in the country, and these people at the meeting included some. They were—they knew, generally, that what they were working on was, essentially, getting power out of the [atomic] nucleus.[3]

And there was a story going around about that it was being encouraged by the Russians, because it got the good scientists away from doing something else that bothered them more.

[While I was a graduate student, I went with Dr. Gingrich (my thesis adviser) to visit Dr. Ernest [Omar] Wollan, who was at Washington University in St. Louis. When I found out that Dr. Wollan was then at the University of Chicago, I made contact with him and arranged for an interview.

The interview with Dr. Wollan was interesting and useful, and ended with a nonofficial offer of a position, pending a security clearance. At that time, I and my management were not satisfied with my position at Armour, and there seemed to be no prospects for the near future, so I was terminated. A few days later, my security clearance for a position at the University of Chicago arrived[, and I started work there].[4]

YUFFEE: Did he make an overture to you about a job?

GAMERTSFELDER: Yes.

FISHER: And this would have been in the spring, or in the fall, of 1942?

GAMERTSFELDER: This would have been in the fall of '42.

FISHER: I see.

Position at the University of Chicago

GAMERTSFELDER: And he made an offer that I accepted. And I was given to understand that when I got there, I would be working under H.M. Parker,[5] who was, at the time, working at the Swedish Tumor Institute [at Swedish Hospital, Seattle, Washington] with Dr. Simeon T. Cantril. And they were using radiation to treat people with cancers, things of that type.

FISHER: It's interesting, Doctor, that you say that there was discussion, among your colleagues at the meeting, that there was something going on involving radiation.

GAMERTSFELDER: Oh, yes. Well, what they knew was: nuclear scientists were going to the University of Chicago. They didn't know any more than that.

FISHER: Oh. So the rest of you were all speculating, gossiping?

GAMERTSFELDER: Yes. Well, that's what those meetings are for.

(laughter)

FISHER: Well, I guess you're right about that. So what were you hired to do, in the fall of 1942?

GAMERTSFELDER: Well, I was hired to work on instrumentation, and what other things that were coming up. The instruments that were available in the lab that I was working in, were things which were suitable for measuring radiation in a place where you irradiated people [for cancer treatment (using x rays)]. And there was a survey instrument that was calibrated in R [(Roentgen)][6] per minute, and our general area of work is milli-R [(thousandths of an R)] per hour.

YUFFEE: That's right.

GAMERTSFELDER: So there was a big difference. There was some really good instrumentation for making precision measurements of doses and Roentgens; an R meter which would read up to a total dose of 50. Well, this was Roentgens at that time.[7]

FISHER: Right.

GAMERTSFELDER: And then they had some pocket chambers of the kinds which, I think, are still being used.

FISHER: Like the pencils [(pencil dosimeters)]?[8]

GAMERTSFELDER: Yes. And they're sensitive and fairly accurate.

YUFFEE: So you were—were you designing—trying to help them design something?

GAMERTSFELDER: Well, I don't know that "designing" was right. [We were] trying to find some things that could be used to do other things. And then [we sought to learn], "How do you take care of doing it for lots-and-lots of people?"

And we had Geiger counters.[9] That was one of my early jobs—calculating what kind of a dose you got from neutrons.[10] It's a simple calculation to find out what the collision cross-sections for neutrons of various energies were, with hydrogen.

YUFFEE: How many people were in this group with you, working on this?

GAMERTSFELDER: Well, at that time, there were: [an Englishman who had been working in Seattle,] Herb Parker; Karl Morgan[, a physicist and mathematician from North Carolina];[11] [Du Pont chemist] Jim Hart, and Robert Coveyou *(phonetic)*, who I think was a mathematician without any physics training.

FISHER: Who were some of the folks that you were working with in the early days back there?

GAMERTSFELDER: Well—

FISHER: —other than Parker and Cantril.

GAMERTSFELDER: Let's see. I—there wasn't anybody, really, for a little while. Then they started bringing in some people from Du Pont[12] for, essentially, getting them some experience.

Jim Hart, I think, was the earliest one. And he was the one that ended up running personnel meters down at Oak Ridge.[13] Somewhere along the line—oh, my brain ain't working.

FISHER: That's all right. I can't remember what I had for dinner last night, Doctor.

(*laughter*)

GAMERTSFELDER: No, he was a physicist from the University of Kentucky. Why can't I think of his name? [Dr. Pardue].

FISHER: Well, it will come, it will come. We're just trying to get a flavor for some of this stuff.

The First Reactor, December 2, 1942

GAMERTSFELDER: Yeah. And then a guy by the name of Landsverck got there. He invented the Landsverck[-Wollan] electrometer, which was an improvement over the Lauritsen electro[scope (for measuring gamma exposures)] we had.

Besides working in the lab, I was present when they ran the first reactor.

FISHER: Well, we want to talk to you about that.

GAMERTSFELDER: I was monitoring gamma radiation[14] with an ionization chamber that

Compton[15] had used in some balloon flights all over the world.It was arranged so that it had a compensating little chamber in it with a bit of radioactive material in it to cancel the normal radioactivity readings from the brass that the chamber was made of.

It seemed to work reasonably well when they first got the first criticality,[16] and when they made a prolonged run at some low power, the things started going backwards. It turned out, the bit of radioactive material was uranium.

FISHER: Can you tell us a little bit about what it was like; December second, 1942?

GAMERTSFELDER: Well, it's about the way people tell it. There was—the squash court was—I hadn't seen a squash court before in my life, and inside it was this pile of graphite blocks.[17]

There was canvas arranged around the sides of the thing and, I think underneath. That was intended to evacuate air from the system, because they knew that [nitrogen] had a fairly good neutron cross-section and figured they might have to get rid of the air in the reactor to make it operate.

But as they were taking readings with—on some counters[18] that were stuck in the pile,[19] they would pull out a control rod [used to regulate the rate of fission]. This control rod was a wooden stick with strips of cadmium stuck on it. And move it out a few inches and the counting rate would go up and then level off. Move it a little bit more, the counting rate would go up and level off.

And somewhere, getting near noon, [Dr. Enrico] Fermi[20] was around. And they called things off and went and had lunch.

FISHER: Mm-hmm. Well, that's fair.

GAMERTSFELDER: Then they came back about 1:00 [p.m.], started in on again, quickly got up to that point that they had been, started in doing it. And Fermi [is doing calculations] with his little six-inch slide rule, and he says, "It ought to go."

And it [(the rate of radioactive decays per minute)] went, and it went up, and it went up, and it went up, went up, went up, went up. And they decided they were there [(they had achieved a self-sustained nuclear chain reaction)] and turned it off.[21]

Dr. [Eugene] Wigner[22] had been standing around the edge of the group with his hands behind his back; [he] brought forth a bottle of wine with a kind of a straw-basket–type thing around it. And they had some little tiny [paper] cups, and everybody present got a sip of wine.

FISHER: Was there a presence, or the feeling that something extraordinary had happened?

GAMERTSFELDER: Yes. That was—they were celebrating. They knew it worked. The pile wasn't finished [(construction wasn't fully completed)].

Oh, on the back, on the other wall away from the balcony, was another door looking in on the squash court. And there was a kind of a gangway over to the top of the pile, and that's where the "suicide squad" was

	located. They had some bottles of neutron poisons,[23] solutions they were going to run in and pour down into the pile if necessary.
FISHER:	I see.
YUFFEE:	And how did they get the name, "suicide squad"?
GAMERTSFELDER:	Well, they would be going towards the place you wanted to get away from.
	(laughter)
FISHER:	And they knew that? I mean, there was that danger, that element of danger?
GAMERTSFELDER:	Well, that was a possibility, yes. They recognized things might have gotten out of hand, or that they didn't know about all of the parameters necessary for really running a reactor. They had run—they had a lot of test piles which were, maybe something like that; square.
FISHER:	It's a couple of feet across.
GAMERTSFELDER:	Maybe eight feet tall, or something. They had a radium-beryllium source, which was being used in experiments all over. I think everybody who had some measurement or other to make, that wanted some source of neutrons, would get that.
	And the guy who was running the elevator also ran a car around if people wanted to go to the store to buy something, or go to another building. He said [that] he knew when the thing was in the lead pot, and when it wasn't.
FISHER:	Mm-hmm.

GAMERTSFELDER:	He *didn't*, because they never told him.
FISHER:	What kind of security was there, under the stands there?
GAMERTSFELDER:	Well, they had guards. You had to wear a badge. And your badge—I don't know whether they had films in the badges yet or not.[24] If they didn't, you were carrying a film (a dental film) in your pocket. And we had personnel meters; the pencils. One of the early experiments was the one [in which] we were trying to measure neutrons with a pocket chamber. We had made some special chambers. And we coated the inside with paraffin, and then put as thin a layer as we could on top; getting something so it would conduct a little bit of electricity. I took them over. I was going to use cyclotron[25] neutrons on the things. [The electrodes were supposedly made out of aluminum. Well, evidently they were not: When I took them into the cyclotron, those things flew out of the box and were standing at attention inside the magnetic field of the cyclotron.]
FISHER:	Wow.
GAMERTSFELDER:	We did the experiment later, after we got some real aluminum [electrodes for] the chambers. But that wasn't a good enough way of measuring things.