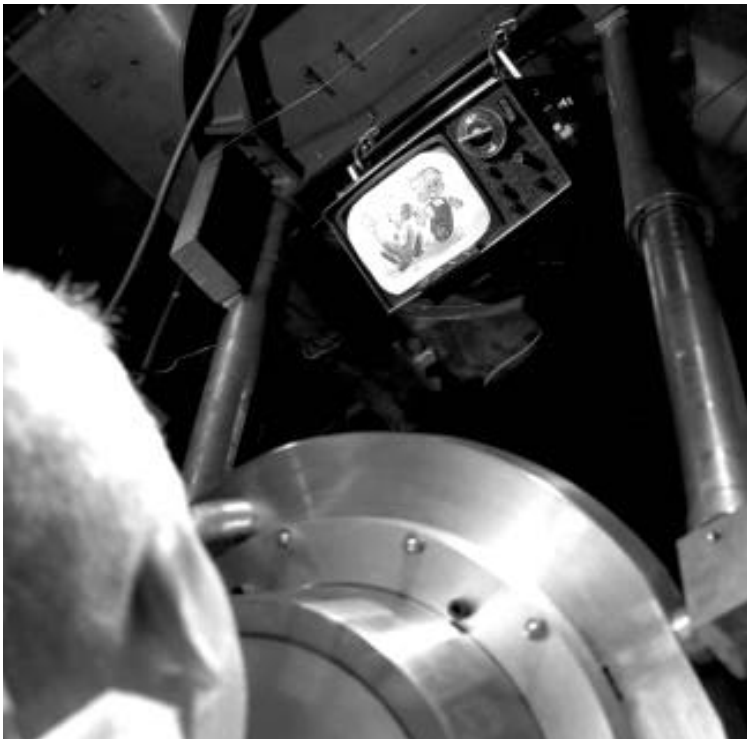
Child Volunteers: One Dad Tells the Story

by Don Petersen

The use of children in human radiation experiments has been a special ethical concern of the President's Advisory Committee on Human Radiation Experiments. At Los Alamos, in 1963, one such experiment was performed in which eight children were given a small amount of radioactive iodine. Responsibility for the children who participated was taken by the parents. Dr. Donald Petersen, a former deputy leader of the Health Division and biochemist at the lab, was one of three parents who invited their children to participate in this experiment. Here is his story.

Almost immediately after the Second World War, the scientific community split into two groups on the issue of radioactive fallout from atmospheric nuclear weapons testing. One said, "We've got to stop. We're going to hurt somebody," while the other said, "We can't afford to stop. We need to test if we are going to survive militarily, even though it might be hazardous." And then there were all shades of opinion in between. The person who really clarified the debate was Willard Libby. Libby realized that neither the people who said, "We've got to stop," nor the people who said, "We've got to do this regardless," had any quantitative information. So, in 1951, as Atomic Energy Commissioner, he started Project Sunshine.



Dennis the Menace provided the incentive for this child to sit still in front of the sodium-iodide detector in Van Dilla's and Fulwyler's radioiodine experiment.

Under Project Sunshine, the Atomic Energy Commission funded the various national laboratories to study fallout. Along with strontium-90 and cesium-137, iodine-131 ended up being one of the most studied fallout radionuclides because it is an abundant fission product, it is highly radioactive, it enters the food chain almost unimpeded, and it concentrates inside the body in a small gland called the thyroid. As the iodine-131 decays, it emits beta particles and gamma rays. The beta particles deposit most of their energy in only a few tenths of a millimeter and so are very effective at damaging the thyroid. On the other hand, the gamma rays are highly penetrating and many of them pass right through the thyroid and surrounding neck tissue. That makes *in vivo* detection of iodine-131 rather easy .

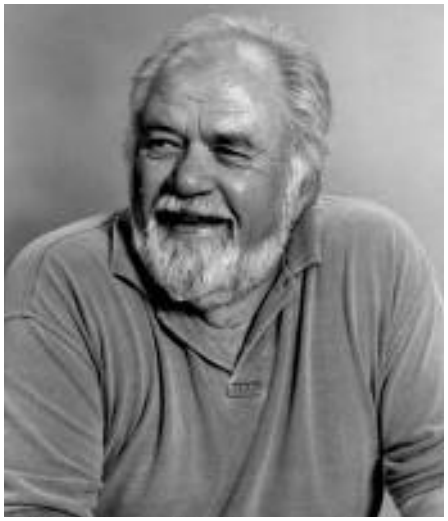
The iodine-131 in fallout was a problem for children in particular. You see, the radioactive iodine produced by nuclear weapons falls on pastures, cows eat the iodine, the iodine is concentrated in the cow's milk, and then people drink the milk. Because the thyroid picks up iodine preferentially, the radioactive iodine in the milk had a straight shot at that tiny organ. Children were potentially at greater risk from iodine-131 fallout than adults because they drink more milk. Also, because they are still growing, it was thought that children's thyroids might take up more iodine per gram than adult's and that they might retain the iodine longer, both of which would enhance the risk for children.

A lot of information had been gathered over the years during the development of medical diagnostic tests on the retention of iodine in the thyroids of adults. But, because the amount of iodine-131 that could be detected by existing techniques was large enough to be of concern, there was little information on children. By 1963, however, measurement techniques had been developed that were able to detect iodine-131 at the level of only 50 picocuries. Therefore, it became safe to perform these

experiments on children, and two Los Alamos researchers, Marv van Dilla and Mack Fulwyler, decided to do so.

To make the absorption and retention measurements, they had to administer the iodine-131 and then measure the intensity of the gamma-rays by placing a large sodium-iodide detector right up close to the thyroid. This measurement was repeated periodically to determine how long the radioactive iodine remained in the thyroid. Of course, holding still in front of a large detector for any period of time without fidgeting is very tough for a small child. But the real uncertainty in this experiment was the depth of the thyroid in the neck. The tissue that overlays the thyroid attenuates the gamma rays. Thus, the thickness of this layer must be known to determine the amount of attenuation and, thereby, the actual amount of iodine-131 present in the thyroid. It doesn't take much of a mistake to make a factor of two difference in the calculated radiation dose to the thyroid, which may be enough to conclude erroneously that the child is or is not at risk.

Van Dilla and Fulwyler came up with a very elegant method for determining the depth of the thyroid in the neck and therefore for making an accurate determination of iodine uptake [see main article, p.264]. It was a very neat measurement that could only be done at a place like Los Alamos. Furthermore, it could be done with essentially zero risk to the children because they needed to be given only a few nanocuries, or billionths of a Curie, of iodine. Of course there was an uncertainty in the dose to the thyroid—that's why the measurement had to be made—but the upper limit on the total dose was very low, about 160 millirem to the thyroid. Once they had worked out the details, Marv van Dilla and Mack Fulwyler approached those of their colleagues who had young children and described the experiment. We were all familiar with radiation because we worked with radioactive materials on a daily basis in our labs. When we saw the size of the dose, we realized that it was far below the level at which we would expect any consequences. Convinced that the radiation risk was negligible, the parents went to their children and asked them if they were interested in participating.



Don Petersen is one of three Los Alamos dads whose children participated in a Los Alamos human radiation experiment.

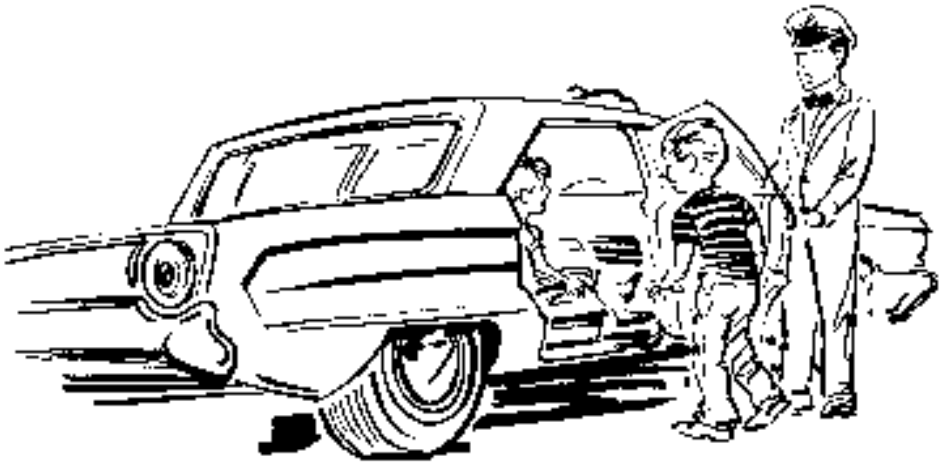
Van Dilla and Fulwyler made sure that the kids who were interested would be available for the length of the study because you wouldn't want the children to leave in the middle of the experiment to go on vacation. In the end, four of one of the investigator's kids, two of my kids, and two of someone else's kids participated. My children were quite young, ages five and seven, so there was no point in trying to explain to them, in physical terms, about radiation. I just described the kind of physical environment they would be in, that they would have to go into a dark room and sit very, very still for a substantial period of time, like 15 or 20 minutes. Because the doses were so low, van Dilla and Fulwyler couldn't get a good count, a statistically significant count, unless the children sat for a fairly protracted period. The children would then come back three or four times, spaced about eight days apart, since eight days is the physical half-time of iodine-131.

Christy

. . . with Sarah

Hans

The experiment showed that the depth of the thyroid in the children's necks ranged from about half a centimeter to nearly one centimeter and, from this measurement, van Dilla and Fulwyler were able to derive an average correction factor for the attenuation. This experiment was a "one time only" deal. Once the correction factor was determined, it could be applied to all future measurements of iodine absorption in children, not only fallout measurements but also measurements involved in children's medical diagnostics. This work also demonstrated that the biological half-time for iodine was similar in children and adults and that the fraction of the administered iodine that was taken up by the thyroid was about the same for children as in adults. Unfortunately, this implies that children, whose thyroids are smaller than those of adults, receive a higher dose for a given amount of iodine-131 intake.



The children who participated were "subjected" to certain amenities. For example, their daddies didn't drive them over to be counted—instead they got picked up at the front door of their house by a Zia taxi. There was also a really neat technique to keep them still—a little Sony television sitting right on top of the sodium-iodide detector. It took no time at all for those kids to figure out that the best counting times were when the best cartoons came on. The children were never physically restrained. But they were told to hold very, very still and the cartoons assisted in that. You could get good counts even from a five year old. Three of my children were the right age for the study, but only the older two, who were 5 and 7 at the time, participated. The youngest one just didn't want to hold still and so she said no. She was kind of an ornery little kid at the time anyway!

Yet, as much as I feel that participation in this experiment was completely safe and appropriate for my children, I am not sure how to deal with the strong feelings of the general public or our Human Studies Committee here at Los Alamos or the President's Advisory Committee. When I testified before the President's Committee, someone in the audience suggested that we, the parents of the children involved, should be incarcerated. What bothers me the most about that kind of statement is that it's completely at odds with my understanding of the concerns that guided our actions. I remember those times, and I remember the attitudes of the people involved in the experiment. As in the Hippocratic Oath, which says do no harm, everybody performing these experiments performed them with ground rules that said, "We're not going to hurt anybody." Everyone was trying to help. In particular, the studies that were performed at Los Alamos were always driven in the direction of reducing doses and minimizing risk.

The children who participated were "subjected" to certain amenities. For example, their daddies didn't drive them over to be counted—instead they got picked up at the front door of their house by a Zia taxi.

I am concerned that in the 1990s people are beginning to equate the kinds of biomedical activities that took place in this country immediately following World War II with the things that Nazi doctors were being tried for at Nuremberg. There have actually been accusations that the experiments were similar. Others have claimed that we should have been much more aware of the Nuremberg Code. As I recall, nobody involved in tracer studies at Los Alamos saw even the remotest connection between our work and the things being discussed at Nuremberg. The Nazi physicians used people against their will and in a harmful manner that included causing horrible deaths. Our work was done from the premise that we would hurt no one, and we never did.

To get back to the issue of child volunteers, obviously, if there had been any radiation hazard to my kids, I wouldn't have allowed them to take part in the iodine experiments. It is true that high radiation doses can cause severe consequences including cancer and subsequent death. But the doses required are thousands of times larger than the tracer doses used in diagnostic medicine, and that's what we're talking about here in the case of the children. ■