

Nevada Test Site Oral History Project
University of Nevada, Las Vegas

Interview with
Herbert F. York

January 16, 2004
La Jolla, California

Interview Conducted By
Mary Palevsky

© 2007 by UNLV Libraries

Oral history is a method of collecting historical information through recorded interviews conducted by an interviewer/researcher with an interviewee/narrator who possesses firsthand knowledge of historically significant events. The goal is to create an archive which adds relevant material to the existing historical record. Oral history recordings and transcripts are primary source material and do not represent the final, verified, or complete narrative of the events under discussion. Rather, oral history is a spoken remembrance or dialogue, reflecting the interviewee's memories, points of view and personal opinions about events in response to the interviewer's specific questions. Oral history interviews document each interviewee's personal engagement with the history in question. They are unique records, reflecting the particular meaning the interviewee draws from her/his individual life experience.

Produced by:

The Nevada Test Site Oral History Project

Departments of History and Sociology
University of Nevada, Las Vegas, 89154-5020

Director and Editor

Mary Palevsky

Principal Investigators

Robert Futrell, Dept. of Sociology

Andrew Kirk, Dept. of History

The material in the *Nevada Test Site Oral History Project* archive is based upon work supported by the U.S. Dept. of Energy under award number DEFG52-03NV99203 and the U.S. Dept. of Education under award number P116Z040093.

Any opinions, findings, and conclusions or recommendations expressed in these recordings and transcripts are those of project participants—oral history interviewees and/or oral history interviewers—and do not necessarily reflect the views of the U.S. Department of Energy or the U.S. Department of Education.

Interview with Herbert F. York

January 16, 2004

Conducted by Mary Palevsky

Table of Contents

Introduction: Dr. York discusses involvement with the Manhattan Project and his graduate studies with Ernest O. Lawrence at the University of California at Berkeley.	1
Dr. York compares the personalities and political views of J. Robert Oppenheimer and Ernest Lawrence.	4
In 1943, Lawrence sent Dr. York was part of large team to work at the uranium separation facilities at Oak Ridge, Tennessee, Manhattan Project Site Y-12, which created highly enriched uranium.	5
Explanation of uranium separation process. Recollections of June 1945 when the word came down to stop production and he knew “the end was coming.” What he knew about the significance of his work at the time.	7
Discussion of secrecy on the Manhattan Project what he and other young scientists knew and discussed about the project’s work and achievements, code words used.	8
Local rumors about the work being done at Oak Ridge	14
The working environment at Oak Ridge was shaped by segregation and the presence of women workers, his sensitivity to race issues due to Mohawk ancestry.	15
Dr. York reflects on his family heritage and race issues in the U.S.	16
Discussion of women workers at Oak Ridge.	20
After World War II, Dr. York returned to Berkeley to complete his Ph.D.	22
After the first Soviet atomic test in 1949 E.O. Lawrence sent him and Hugh Bradner to Los Alamos, involvement with Operation Greenhouse diagnostic experiments, witnessed Ranger test (NTS) from top of Berkeley hills. (1951),	24
Dr. York discusses his reactions to viewing Greenhouse atmospheric test, his view of nuclear tests as “spectacle” and that policymakers must understand the weapons’ destructive power by studying photographs of Hiroshima.	28
First discussions with Ernest Lawrence about creating a second nuclear weapons laboratory	30
Ernest Lawrence and Edward Teller debate the merits of creating a second weapons laboratory and York’s preliminary activities in that regard.	32
Dr. York describes setting up Livermore lab in 1952.	34
Norris Bradbury’s early complaints about Livermore activities and Teller’s and Lawrence’s reasons for wanting a second weapons laboratory.	35
Dr. York worked with Duane Sewell on Livermore organization and logistics, his views of Teller at the time and later.	37
Dr. York’s policy of working on extremes at Livermore.	39

Discussion of competition between Livermore and Los Alamos laboratories and nature of some differences in weapons development.	41
Dr. York discusses work at the Nevada Test Site, relationship among the labs, AEC, University of California and contractors.	42
The scientists early concerns about radioactive fallout from atmospheric tests at the NTS	43
Dr. York explains the tasks involved with designing and managing a nuclear test, Gerald Johnson (Livermore) and Jack Clark (Los Alamos).	45
All nuclear testing was subject to President Eisenhower's approval, role military and governmental decision-makers. Dr. York explains this process and describes how the laboratories generally avoided Cold War political issues and focused instead on applied science.	46
Dr. York discusses first Livermore tests at the NTS, Ruth and Ray (1953).	50
Discussion of first Livermore test in the Pacific, Koon (1954).	52
General discussion of various Pacific tests and experiences while there.	55
Nevada tests, Bill Ogle and the "Pogo staff."	58
Dr. York disagrees with the notion that the Nevada Test Site was a "battleground" of the Cold War" rather than an extension of key work carried out at the national laboratories.	60
Discuss fallout from Bravo test and trip with Lawrence to investigate impacts on Wotho Atoll, Marshall Islands.	61
Discussion of the origins of the Plowshare program for peaceful applications of nuclear energy.	63
Dr. York recalls naming the Rover program (later the Nuclear Rocket Development Program) and discusses the Soviet version of Plowshare.	65
Dr. York discusses exchanges between of Soviet and American scientists including the Joint Verification Experiments and his own interactions with Soviet scientists.	69
Visits to Eisenhower in Palm Springs and views on the military-industrial complex	72
1980 visits with Soviet physicist Peter Kapitza in Geneva and views about the coming end of the Cold War.	74
Security concerns, debates about the nuclear test ban, role as Carter's chief negotiator in Geneva.	77
The shock of the first Soviet atomic bomb and of Sputnik.	81
The U2 incident and Eisenhower and Khrushchev at Camp David.	82
Dr. York describes experiences in the defense department	85
Dr. York discusses the postdoctoral fellowship established in his name at Lawrence Livermore National Laboratory.	89
Dr. York shares memories of visiting the Las Vegas Strip while he was working at the Nevada Test Site.	93
Dr. York discusses the early mathematical careers of John von Neumann and Theodore von Kármán, as well as the development of the Jet Propulsion Laboratory.	95
Conclusion: the interview concludes with more personal memories of the Las Vegas Strip and the Nevada Test Site.	99

Interview with Herbert F. York

January 16, 2004 in La Jolla, CA

Conducted by Mary Palevsky

[00:00:00] Begin Track 2, Disk 1.

Mary Palevsky: *You and I have spoken a lot about the Manhattan Project over the years.*

Herbert York: Yes.

I realized, as I was preparing for this interview, that we've never really talked that much about Ernest Lawrence. And when I was thinking and reading in Race to Oblivion [A Participant's View of the Arms Race, by Herbert F. York, Simon and Schuster, 1970] and remembering how Lawrence was your teacher, you refer to yourself in Race to Oblivion as his last student, and how he was so instrumental in many things in your early career.

Yes.

I wondered if you would be interested in talking a little bit about Lawrence, when you met him and just what your remembrances of him are sort of chronologically.

It's important to note that I was twenty years younger and I had this student relation with him, almost a father-son relation. I was a favorite of his, not to be too shy about it, and what he liked about me was my simple side. I came from a simple family and so forth, with no pretensions either bred in or developed, and he liked that sort of thing. But he himself was fairly pompous and was very bossy and it turned off a lot of people. It made for some difficult relations with him and others, but I didn't mind. He would do things like tell me that, You're as good as anybody. I was mentioning Russian scientists and, You're as good as anybody in Russia, he says, but don't let that go to your head. Or if I would ask for something which he thought I shouldn't have, he would say, You know, Herb, if you talk like that, people

will think you're a spoiled brat, so it was that kind of relationship. But of course, the positive part of it was that I worked a lot at night because I could get the big cyclotron at night and the faculty—I was a graduate student—the faculty members preferred to work in the daytime, so I got the odd hours. But Lawrence was one of these people, rare people who just loved to visit his laboratory empire over and over and over again. And so, more or less once a week I'd be there working in the evening or maybe a Saturday or Sunday—also time available—and he would come by and ask, *What are you doing?* And I would talk about what I [was] doing, the mechanics of it, how the counters were working, where the beam was and all of that, and I'd talk about the theoretical basis of the experiments that I was doing, and then he would just beam and go away and then a week later he'd come by again. So the fact I worked at night was important, and then I took the odd hours. But I'd already become quite familiar with him at Oak Ridge.

But anyway the first time I met him I was looking forward to meeting him. I knew about him and I was—one of the odd characteristics of my whole life, including my youth, is that I've always just glommed on to the superlatives—and I knew that Lawrence had a Nobel Prize, he'd invented the cyclotron, and I was just very eager to meet him. And I came to California because they had the redwood trees and the Sierra and, you know, the longest five-foot bookshelves in the world and things like that—

I get it.

—but I was that way as a boy so I was just looking forward to meeting Lawrence and I was awed by him before I ever saw him. Well, he's big, both tall and a little bit heavy. And I remember that we had [a] weekly colloquium, maybe even more often than weekly, at Berkeley, in a room that had—well, it was in an unfinished room. Everything was, you know, you could see all the two-

by-fours and so on, and there were just a bunch of these folding chairs arranged in a geometrical array, blackboard and a podium in front. All of us, maybe thirty or forty people gathered, and after we were all there this big guy came in from the back—the entrance was at the back—and he was heavy, you could feel the floor bounce. And he beamed at everybody as he came in, smiled, and went up to the front, to the right, where there was an easy chair. All the rest of us in these—he sat in this big easy chair and sort of presided, but very gently; he was obviously the presiding officer but he didn't intervene very often. And I remember wondering about the easy chair, but he felt he needed to explain it at some time later to me, and that was he had a bad back, but I mean it's the usual thing.

But that was my first meeting with him and from then on it was—I just enjoyed being there with him. I enjoyed the laboratory and I enjoyed Lawrence.

[00:05:17] *So this was, remind me, this was 19—*

This was May of 1943.

So the war was on.

During the war, we were engaged in separating uranium isotopes by what was called the electromagnetic process.

And you were doing that there at Berkeley.

We had some prototype devices, two of them. There were two of them between what became eventually the one-eighty-four-inch magnet, between the jaws of that magnet. There were two teams. One was headed by Frank Oppenheimer, Robert's younger brother, and that's the team I joined. And that meant a great deal to me too. Frank Oppenheimer was a wonderfully empathetic person. And the other team, as I remember, was headed by Duane Sewell, who we mentioned earlier.

Yes, we'll talk about him later a little bit.

So that's when I first met Duane.

So then—you mentioned the name Oppenheimer. I just want to ask you about this because it sort of fits with something you said. When I interviewed the late Robert Wilson, also a student of Lawrence's, he mentioned that Lawrence was much more down-to-earth and less sort of cerebral—

Yes, comparing the two men, yes.

—and that the students were aware of that. Was that something that was just—Wilson is noticing or was there sort of like camps?

Well, you see, by the time I arrived Oppenheimer was already gone—

That's right.

—so I didn't meet the senior. I did eventually meet the senior Oppenheimer two years later, after the war was over, and I was a student and he was a professor at Berkeley.

Right.

And yes, they were very different that way. You know, Oppenheimer liked music and sophistication and political theories and—whereas Lawrence was very disdainful of political theories. He wasn't too sure about physical theories either and had this—he was from a rural college. Lawrence's father had been the president of a small church-related college in one of the Dakotas. And that showed, and I think that showed in him. He had very different politics. I didn't see a lot of the politics of either of them but what I did see was very different.

Oppenheimer's view, you know, was a sophisticated view. Oppenheimer was proud to be. He knew he was sophisticated and proud of it. And Lawrence, on the other hand, if something—when McCarthy came along and the oath came along, Lawrence's attitude, well, if you have

nothing to hide, you have nothing to worry about, why make such a fuss? And, OK, sign the oath if you don't—if you don't have anything to hide there's no problem. So Lawrence took that kind of an attitude, whereas Oppenheimer would take a much more complicated attitude.

[00:08:16] *Yes. So you were with Lawrence—*

Starting in 1943.

Starting in 1943, and then did he send you to Oak Ridge?

Yes.

How did that work that you got to Oak Ridge?

Well, I went to Oak Ridge during the war as part of a big team, a team of, I don't know, fifty or sixty people; yes, Lawrence sent us there. What had happened, it was an unexpected result—it hadn't been planned originally. What had happened is that they set up these so-called racetracks, which were gangs of big magnets and electromagnetic separators, like a hundred in a group, kind of laid out in an oval called racetracks, and each one operated separately from a big console that controlled the electric power that made the machines work. And they had hired a lot of people from Appalachia, mostly women in their late teens—all the boys were off to war or dodging the draft or whatever—so they hired these squads of young women, all of them wearing blue jumpers, I remember very well—but they couldn't get the units started. I mean, they would do what they were told to do: to turn it on. And it turns out that devices of that type—mixed high voltage and magnetic fields—they're very much subject to breaking down and sparking, and they couldn't get it started. So Lawrence essentially sent sixty of us young people back there to get it started. And so as soon as we arrived we went to these racetracks, these various consoles, power control consoles, and we started turning them on, with these girls watching us, and after a few weeks we had it all running. And then they took it over and then they did better than we did, but

I'm not at all surprised—so utterly strange, these girls had never seen anything like it. I mean, you know, totally novel. Well, the world hadn't seen anything like it. But we'd grown up with it because we were in the development—making the prototypes at Berkeley. So that's why we went. And then we stayed. I don't know why it was we didn't come home. Well, I think some of the older people did. But most of the young people I think were probably all men.

Yes.

A few had wives, but mostly just single men got this thing going. Then we stayed, and then I became involved in improving it. In particular my job had to do with trimming the beam in such a way as to improve the quality of the product, that is, the percentage of U-235. And I determined fairly early that it was a tradeoff between quality and quantity, but I knew it only as a function of making the stuff. I didn't know what the tradeoff was at the other end, I mean, in making bombs.

In using it, yes.

So I remember asking Lawrence, I said, I could do this better if you would tell me what the tradeoff is between quality and quantity; and he went back and forth to Los Alamos, monthly or weekly, very frequently, Berkeley, Los Alamos, and Oak Ridge. And so the next time he came by he had a little tiny piece of paper, like two-by-three from a pad, and on there were two columns of numbers, maybe four numbers in each column—

Wow!

—and they essentially were the purity in one column and the other column, the critical mass. Now whether it was the critical mass really or fudged, I really don't remember anymore. But anyway I took those numbers, turned them into a curve, and then adjusted the way the beam was trimmed in order to—my purpose was to increase the number of critical masses slightly.

[00:12:41] *Right. So just in sort of layperson's terms, you've got this beam going through the cyclotron—*

Yes, through the magnetic field.

Through the magnetic field which causes you—?

Well, the two different isotopes are—the magnetic field—they're ions of uranium—which are going through the magnetic field. And the magnetic field acts on both of them, but one of them is lighter than the other so that it moves in a different way. The lighter one moves in a tighter circle, but it's very little less. I mean the receiver that these all went into was 180 degrees away and that meant, I forget, but four feet or five feet or something. And the U-235 arrived slightly closer to the source than the other one, but they overlapped, I mean, for a lot of reasons, like air, the residual air, and other imperfections in the magnet and so on. They overlapped, so it wasn't pure U-235 here and pure U-238 there. They overlapped. And so the idea was to take out as much U-235 as you could while—and you could get more by the closer you moved towards the U-238, the more you drew from it. But, you know, the question is where do you—how do you do that? So the problem was to adjust the trimming mechanisms that separated the two isotopes at the far end of the machine. And do that in a way that maximized the number of critical masses. I really don't know whether I did any good or not but my purpose was to do what would ultimately make the Hiroshima bomb more powerful, but I don't know whether I did. That was my purpose.

[00:14:48] And one of my memories from that time, special memories, is that in June of 1945, after we'd been there already about fifteen months, sixteen months, the word came down to stop everything. But to go back a little bit, the uranium was processed in batches and it took a few weeks or a month to process a batch. You put it in the machine, you'd run the machine for

about a month till the source material was exhausted. And so stopping and taking everything out at once was inefficient. But it's clear what it meant. I still remember a little shiver. It meant that we were finished. And in some ways—I still didn't know the details but I knew we were finished in June. June of 1945, I knew the end was coming.

I think we've talked about this before but I don't know if I've ever asked you this specific question. How much at that point [did you know?] You knew you were making a bomb?

Oh yes, I knew quite a bit. In fact, I knew more than the typical young physicist at Oak Ridge because of my contacts with Lawrence and because of this particular question of what to do, how to trim it, and because I was involved at the very end of the physical process. I was, so to speak, the last physicist to touch it before it went to Los Alamos. Now there was a chemist in between and he'd take this stuff and convert it into something which they would then ship off to Los Alamos. And then I had several friends that were sort of clued in to—heard that—we gossiped a lot. So I knew very little about Los Alamos. I didn't know what a critical mass was, I mean how much it was. I only knew that by June 1945 we had one or maybe it was two. I didn't know that either, in June of '45. I just knew that somehow we were ready, done. And I knew about the plutonium project.

You did?

Yes. That, though, I figured out—well, not all by myself. But just gossiping. One person had heard—it's like the intelligence people say, you know, *Loose lips sink ships*. It works. We, this small group of us, figured out the plutonium project illicitly, just from things we heard—and were able to put it together. And then when I had somehow put it together, somehow in talking with Lawrence when it was evident that I knew nearly all of it, then he probably told me some more.

So someone had heard about what—had you known—?

No, we just got little bits and pieces at a time.

Had you known—would you have known about the chain reaction and things like that?

No, not—I did eventually.

Eventually.

But no, I was not privy to it at all, even though there was a reactor at Oak Ridge, I didn't know what it was. It was the X-10. I never knew what was there. *X-10*. But the very first thing I heard that started us thinking, this small group, was that Bohr had been briefed about what we were doing at Y-12. I didn't—I never saw him. I don't know if he came or not, but I—but he had been briefed and he said how surprised he was that, They're doing it by the brute force method and I never thought that would work, I didn't think that would work. Now, he could've meant a lot of things.

Right.

But we began [to ask]—what does he mean? And then somebody casually or by accident or somebody over here, somebody mentions “forty-nine.” And it becomes clear somehow in another single sentence that that's an element. Well, there is no element forty-nine. What it—well, there is, but I mean it hadn't anything to do with anything. I don't even know what it is. But it meant ninety-four, element ninety-four, and it wasn't reversed, it was the four from ninety-four and the nine from 239, which was the molecular weight of this—plutonium that made weapons-grade. So we heard that. I don't remember what else we heard, but it just was a sentence at a time. And then, you know, us smart young bucks trying to figure out what it is. And figuring it out.

Yes. Interesting.

Or half figuring it out, and then getting far enough so that somebody confirmed it, somebody who knew. [00:19:47] But it was so little-known that we at Oak Ridge, at Y-12, about six months before the end of the war, the diffusion plant, K-25—we starting working first, then the diffusion plant started working, and it turned out that the most efficient thing to do to get the war ended was to run the diffusion plant up to about 15 percent U-235 concentration and then take that stuff and bring it over to Y-12 and process it through the second—

OK.

See, we had a two-stage process. And to bring it over and put it into our second stage. So I was involved in preparing for that. And the president of Tennessee Eastman Company, whom I'd somehow gotten to know—he knew that I was there and somehow that I knew things—he came and suggested to me, he says, You know, we should get the stuff from this plant in Washington, Hanford, and we should run that through, too. Now that doesn't—that's wrong, you know. I mean, I would never—.

Well, but you see, he thought it was another uranium plant. So the executive head of the Y-12 plant didn't know about plutonium.

Right.

And because it was me—I forgot how I handled it, but I made it clear that wouldn't be a good idea. And he—I didn't say anything about why. I didn't even hint about why. But somehow or other I was persuasive and so he dropped the subject. Of course, maybe he brought it up with Lawrence, I wouldn't know necessarily. But he brought it up with me early on.

Do you remember, or was there a time when Lawrence told you—or who told you what was happening at Oak Ridge or that whole piece of it, that you knew what you were working on, or did you piece that together too?

Well, it was just the normal—at Los Alamos, everybody was clued into everything. At places like Berkeley and Columbia, and there were only a couple of other places.

Right.

Chicago. All the physicists were clued in with respect to the purpose of the project. The general project, and also the specific project. Right from the day I walked in, somebody told me that we are separating uranium isotopes with these electromagnetic devices.

At Berkeley.

Yes, at Berkeley, in order to build an atomic bomb. It was perfectly—for most of us, we knew that before we got there. Again you had to figure it out, nobody told you. But here's Lawrence, the nuclear laboratory at Berkeley, and that's all I knew about him. And then there's these people at Columbia that were recruiting for the same project; and the nuclear physicist Vicki Weisskopf was at Rochester and left a few months before I did. He would go to Chicago all the time. I didn't know he was going to Los Alamos but we—you know, it's just obvious, and furthermore fission was discovered in the open just before the war. So we got fission, we got nuclear physics, we got cyclotrons, we got Weisskopf and Lawrence, I mean, what else? What else?

Yes. Yes.

It would've been amazing if it wasn't an atomic bomb, so we all knew that without talking about it. And then on the secrecy side, one of the first things that was made clear is you don't say the word "uranium" or anything like that. And that was so strong, I mean, this prohibition about saying the word "uranium," we never, never did it.

At Berkeley and at Oak Ridge.

And at Oak Ridge. Never said it. We called it—"R" was the mixture of U-235 and 238 we were producing, and that was made out of "X" and "Y". "X" was U-235, "Y" was U-238—and, you

know, at the laboratory in Berkeley there were some meters that measured the current and said “aluminium,” you know.

Interesting.

So the point is, when at the end of the war, the day after Hiroshima the newspapers published accounts of the project and used the word “uranium,” it made you shudder. Seeing “uranium,” I mean that word had just been forbidden.

That’s interesting.

We called it—if we needed a name for the metal, we called it tube alloy.

Tube alloy.

A name that had been given by Churchill. Winston Churchill named it. Now you call or alloy the stuff that’s produced at Oak Ridge. But we—that wasn’t at that time. But Churchill—

That’s all right, the Brits had that, right.

At the very beginning of the project the question is, what are they doing? And he said, we’re developing alloys for tubes.

That’s where it came from?

Yes. It was—the word “tube” was the operation - “tube” and “alloy.” I mean—

Interesting. Well, “tube” has a “u” in it, I guess.

And the idea somehow that it had to do with tanks, that they needed special tubing for tanks. But it was—we never, just never, said that word. I think even when we were gossiping about what might—what are they doing at Hanford? We still didn’t use any—except for “forty-nine.”

Somehow since we had heard that illicitly it didn’t bother [us]—somehow we didn’t—and since it was a code itself, you know, forty-nine, what’s that?

[00:25:35] *Right. Right. Well, what’s interesting about that, maybe related to a later conversation we’ll have about secrecy, is just how that begins to work on such a simple level;*

groups of people have agreements about what can and can't be said. And just almost your, I don't want to say emotional, but your gut reaction when the secret is finally said it's—how powerful that is.

Yes, and to be perfectly frank, I don't remember anybody objecting. There may have been some older people who did, but I was young and naïve and I didn't object.

Yes. Interesting.

But when we went to Oak Ridge, we had a fake address for our parents to write to. They wrote—before that, when I was in Berkeley, we just had ordinary correspondence, but once I went to Oak Ridge they used a fake address.

Like a P.O. box, like they did at Los Alamos?

Yes, but it was at Berkeley, so the letters went to Berkeley and then to Oak Ridge. And—well, it was a room number in the one where they had “Donner Laboratory.” Like Room 600, which is in a four-story, a three-story building, and then the mail was forwarded. There was never—it was not censored. At Los Alamos it was—but not at Oak Ridge. And people could come visit. My father came and visited me twice.

Really?

At least maybe just once, but I think twice. Yes, he came once and I went to visit him several times.

So what, he visited the town or—?

Yes. It might've been after the war, during a tiny little interval because we sat up on a hill and we looked at the Y-12 plant and I didn't tell him—I didn't violate any rules. But somehow or other—people noticed at Oak Ridge that everything's coming in, nothing's going out, so the question is, what are they doing there?

Yes, that's interesting.

There were these wonderful rumors; They were digging a hole to China, things like that.

Well, that's so interesting though because it's the war and people are producing things for the war and you're not producing anything.

Yes, nothing's coming out. Well, stuff was coming out. They didn't know it was four or five grams at a time and the guy was taking it with him in a railroad car to Los Alamos.

What would it actually be put in, the uranium?

Well, I have—for some reason I remember a thing that looks like an ordinary tin, a round thing this big around [demonstrating size], metal, with a cap on it, but you know, I'm not at all sure that I have that right. The stuff that I saw, I saw it just before that, when they were processing it. That was impressive for a different reason because they had like a cake tin, a container that was rectangular like this [demonstrating] and an inch-and-a-half or so on high, with heavy walls like a sixteenth of an inch or maybe an eighth of an inch, all platinum.

Wow!

Big piece of platinum. [00:28:48] And the coils—this is all well-known but maybe you've forgotten—the coils for the magnets were so big and so heavy and involved so much metal that they made them out of silver instead of copper because copper was in big demand for other electrical machinery and the silver was all lying there backing up the currency in West Point, wasn't doing anything.

Oh, I didn't know that story.

So that they made the coils for the Oak Ridge machines out of pure silver, and the coils were made out of straps and my memory of them is, they're a little over an inch wide and around a

quarter of an inch thick. So that's that kind of heavy stuff. And that's all wound around these cores to make these magnets. And in places it was exposed. You could see this all this silver.

Amazing.

But another thing now that I'm just reminiscing, and one thing reminds me of another—I was very much aware of this big contradiction because here we were doing the most exotic thing in the world. I mean these machines unlike anything that had ever been built before, separating isotopes, never been done before. But on every floor of these factories there were four toilets: colored men, white men, colored women, white women—and there were always at least two drinking fountains, colored water and white water. I always thought the colored water was orange and blue. But there it was. There was the primitive America right there superimposed—and there were black people around the project because Tennessee had a lot. Appalachia had fewer, a smaller percentage, than a lot of the South, but there they were. I remember I knew one girl a little better than the others and we dated once or twice, not much. And I remember in her presence—she invited me home somehow and I referred to a black person as “Mac” and they just didn't—that just went over like a lead balloon.

I don't understand.

Well, they probably called him “Uncle,” you know, I don't know what they would call him—but the use of a familiar sort of name was not accepted.

Oh, that's interesting.

[00:31:12] Well, I accepted it but I was sensitive to it. I was always a little ahead of my family and the crowd on issues like race but—well, partly because I'd been aware since I was a small boy that I was partly Indian. I'm partly Mohawk.

I never knew that.

And—well, people do. Some people do and some people don't but—so I knew from the library and things like that, I knew very early about the evil that had been done to the Indians. It was only a tiny step from that to understanding slavery in a way that none of my neighbors did. So I was much more sensitive to—the family wasn't, it was just me.

I was going to say, it sounds like you—

Just me.

—got the fact and then you read about it—

Yes.

—and then you learned about it.

My grandfather simply said, my mother was a squaw. Actually his—my grandmother was a squaw. Well, they had deliberately—they had done everything they could to assimilate. They just walked in 1845 when it became impossible—around the time of Jackson, who's thought of as a great democrat, but he's the guy who finally stuck it to the Indians. A popular thing to do. Then my people, the men, left. They left the women behind. I always wondered what happened. They were a family of ten, and the two oldest men, my great-grandfather and his father just walked away from it and stopped being Indians. They were half-breeds so they could do that. And furthermore it's always been a contradictory and ambivalent policy that Indians should assimilate, unlike blacks who were forbidden to assimilate. Indians were supposed to assimilate. And so I don't know how—I don't know any of the details, just that they walked away from it in 1845.

And so you knew that and then you went and found out what that was.

I knew it but not very well and so that got me. I read about Indians and I don't know exactly how things—but then that segued immediately into, very quickly into blacks.

And the whole race question.

And so my family was very religious. My mother [was] an avid Episcopalian. And so I thought in those days that God just couldn't allow this. I mean, there was going to be retribution. He wouldn't allow it. And of course I still—now I don't think God would. God's not going to—but there still may be retribution.

Another kind of retribution.

Yes. But anyway—

You mean like social unrest.

Yes, like the kind of turmoil—actually I think that the race problems are going to work out here.

In this country.

Yes, and of course the big change that I was totally unaware of is the really important minority from the point of view of issues, the Chicanos. Here in California it's, you know, every year they vote more. And there are bigger—the reason the University of California is building a campus in Merced and the reason that's not being cut out in this budget crisis is because the Chicanos won't have it. They're behind the campus in Merced. The whole Central Valley is heavily Mexican. So you can see I'm partly Indian, if you look at my nose and eyes.

Your cheekbones.

And also there's my hair, you see. Indians don't get pattern baldness. They keep the color longer, and I suppose that's what—

Yes, when you said it I thought, well, I guess that you do have those really high cheekbones.

Yes, and from—and not just that, my eyes and—I remember driving with a Navajo on the reservation one day and he's looking at me and he says, Your nose is just like mine. You have a small hooked nose.

[00:35:02] *Now, not to get too far off that track, but what were you doing driving with an Indian on the Navajo Reservation?*

Oh, I was just visiting. You know, it does all tie together. My interest involves myself, but in this particular instance he is the representative of the Atomic Energy Commission [AEC] or the Department of Energy [DOE], working with the Navajo, and he's employed by the Livermore Laboratory. I mean, that's how I came to know him.

What's his name?

His name is Gray, Steve Gray.

Is he still involved with the DOE?

Yes, he's actually—he probably is in Washington. He was at least half-time in Washington, and he—it has to do with uranium ore and with mine tailings. But it has a positive side. They've tried to find a way to support research related to science and reservation matters, as in for example health as it might be related to uranium. Or energy.

Like nuclear medicine, you mean?

Energy—yes, maybe. It could be anything that they—it hasn't worked out particularly well but they keep trying. And both Livermore and Los Alamos have a lot of work [they] do take a positive attitude towards trying to work with Indians. And why Steve Gray was at Livermore instead of Los Alamos, I don't quite know. But anyway, I don't know if you know, one of the big family names—the Smiths of the Navajo are the Begays. And his mother-in-law is a Begay. And she never did learn English. We met her when she was about eighty. She says, at least the way—the translation of what she said is that all white men are evil. So I mean they're—anyway, I was visiting. When I got the Fermi Award he was there.

So that was just a couple of years ago.

Yes, I guess it was aught-aught [2000]. I think so.

Two thousand.

I had leukemia in aught-one [2001] so it was the year before that.

That's right, it was before that. "Aught-aught," I haven't heard that in a long time.

So I was lying there just at the very end of my chemo—when—looking at television, it's one of the things for us to do. By that time I was sufficiently sick so that I could read but it was hard.

Energy. It was an energy problem. But I could watch television and there are these airplanes over and over and over and over again, flying into the World Trade Center. It was that day

[September 11, 2001].

It was that day.

That morning. I woke up to it. And Sybil [Dr. York's wife] came in regularly every day after breakfast. But there was already a big deal.

Wow.

The people there knew that I had been involved in the whole national security and nuclear question, so that I became the instant guru in my part of the hospital. I didn't know anything about it but I mean they kept—

You're a guru wherever you go, Herb, so even in the hospital—

—kept asking me about it.

Yes. Well, I have to say, maybe we'll have time today, when I was thinking sort of about the Cold

War and where we are now, I actually did have some questions for you about any relationship you see, but I think we'll move—

Livermore is much involved. Los Alamos too.

[00:39:00] *Yes. You know, so—but I'd like to get there chronologically. The two things that you said that I want just a clarification on. All these women who were working at Oak Ridge, these would've been white women then, though.*

Oh yes.

And were there hundreds of them?

There were, as we said, colored people there, but as always they were cleaning the floor. They wouldn't be used for anything else.

So they would be in the area where the bathrooms were because they were doing the cleaning.

That's why we had these four bathrooms.

Right. Were there hundreds of women?

A matrix.

Pardon?

A matrix of color and sex, a little square matrix.

That's scary.

No, it's life, you know, that's how it is. I remember being in the Pentagon. You know, I was in there for years. And I often went around, and I went—there's a niche where they have all of the names of all the Medal of Honor winners, and several others. And I remember reading through them and there'd be Indian Scout Joe, you know, or there were medals given at times when there was no war except against the Indians. So I was very much aware that in the Pentagon these people were being honored for killing Indians. I never said anything to anybody about it.

But you thought about it.

Yes. I had a different—see, my view is that the Great White Father in Washington is not trustworthy either, but he's more trustworthy than any other Great White Father anywhere else.

In the world.

Including in China where he may not be so white, but you can't trust anybody. Now of course the Founding Fathers had the same view, from a somewhat different perspective. People would say, We're worried about biological warfare.

And they would say that, We would never do that.

And then I'd say, well, they used to give the Indians blankets that had been previously used by people with measles and smallpox. It was the sort of thing I knew in those days. It's the furthest I would ever go with it.

OK, I see what you're saying.

Well, how about—we haven't been to the test site.

We're going to go. We're going to the test site now. We're going to go, but the only little question I had about Oak Ridge was when you said all the women in the blue jumpers.

Yes.

Were these women in the tens, in the hundreds, I mean, how—?

They were in the many hundreds.

Many hundreds.

I suppose for the whole plant there might have been thousands because—well, there had to be thousands.

OK.

There's something like fourteen hundred of these consoles, and there are three shifts. And if you have a three-shift operation it takes four people per shift, because you have all the holidays and weekends and occasions.

Right.

So there had to be six thousand of them running these machines. And they came in by buses. They didn't live—we lived on the site, but these plant operators came in. I know this one particular girl, she was a twin. I have no memory of her name at all, but somehow I went to their house. It was a nice middle-class house. I don't think I'm making this up.

[00:43:30] *No, I'm sure you're not. OK, so how are we going to get to the test site? We've talked a lot about the war and the use of the bomb, so we won't have that conversation here today.*

Then after the war, will you go back to Berkeley?

Yes, with Lawrence. See, he'd made a point of that, that he would take me back to Berkeley with him.

And so you stayed at Oak Ridge a little bit after the war and then—?

Yes, but only weeks. I mean it was just a case of cleaning up, unlike the poor GIs who often stayed for many months. It was just days or weeks. I don't remember exactly.

And then had you—so what happens at Berkeley and then sort of how does that lead to—?

Well, I went to Berkeley. I became a graduate student, one of about two hundred in Physics. Nearly all of them people like me whose education had been interrupted, which made us just a little bit more mature and determined and eager. It was like the—everybody with the GI Bill. We weren't on the GI Bill but we had that same attitude. The opportunity has returned.

Yes.

And I remember specifically, getting back to Lawrence, about politics because we knew that at places like Los Alamos and Chicago, people were talking about the politics of the bomb.

Lawrence would say, Keep your nose to the grindstone, that, Being a graduate student here at this time is the greatest opportunity you could have. You know, Keep your nose to the grindstone. He was very definite about that. So except when Oppenheimer would visit occasionally and give a public talk, I was really pretty much unaware of the FAS [Federation of Atomic Scientists] or any of those things. But anyway I did get my Ph.D. in a timely fashion and I got a good reputation in doing so, and then the Soviet atomic bomb in 1949 came.

Right.

And Lawrence was eager to get back into military science, into war science, because again that's his the simple side. For Lawrence, like millions of other veterans, even with his Nobel Prize and everything he'd done, it was perhaps the most exciting part of his life, was the Manhattan Project.

Right.

And so I knew that, saw that in lots of people. I remember clerks who had been bombardiers or navigators, it was clear the war was the most exciting thing that happened. And it was also clear to me that the problem was that that wasn't true for the dead people, they weren't there, they weren't part of the discussion. For the living it was, a vast number including even a lot of the people on the Manhattan Project. I can feel this myself. Now since I've had so much excitement, I could easily have gone through life thinking that the Manhattan Project was the most exciting thing I'd done. For me it isn't but—

Right.

But anyway Lawrence was determined to get reinvolved—well, also because he felt that there was a real problem that needed to be addressed. The Russians were a threat. A real threat. And so he sent me to Los Alamos with Hugh Bradner, just to see what we could do to help.

Hugh Bradner.

Hugh Bradner, who's still here. We saw him a couple of days ago. He's again about four years older but in good shape. He was during the war at Los Alamos. He wasn't there afterwards. So he's not a test site person. But we went. We met all these exciting people.

Right.

We met especially [Edward] Teller, but in the course of that visit or maybe in some others I met [Enrico] Fermi and [Richard] Garwin and [Hans] Bethe and [John] Von Neumann, George Gamow, and [John] Wheeler. It was great. It really was great, you know, I enjoyed it. I enjoyed it. And that was part of the reason I went.

So what we did is we got involved with the Greenhouse Operation, and Hugh Bradner and I put together a small group of people, about thirty or forty, to do one of the so-called diagnostic experiments. Our job was to try to get as close as we could to measuring the temperature of the little tiny thermonuclear capsule that was part of the George experiment. And just a few grams of tritium and deuterium burned, the first time ever a thermonuclear reaction on the Earth's surface. But that meant I knew a lot about the program.

Then that was finished, then I was back at Berkeley and they started Operation Ranger. And they—I was one of the few people at Berkeley who actually knew—had really working contacts, fresh contacts, with Los Alamos. So probably the first Ranger shot, I'm a little uncertain but one could check the papers, they reported in Los Angeles and elsewhere they had seen it. And people were surprised.

Scientists were surprised.

Yes. So they called me from Los Alamos—it may even have been the test director, Jack Clark, it might've been somebody else—called me to say, Would you go up into the Berkeley hills and see if it's true, see if you can see it? So they gave me a time and a date and I went up there. It was like seven in the morning, maybe earlier, and it was all fog everywhere, I couldn't see anything. And so the time came and went and I didn't see anything. So I called him back and I said, I didn't see anything because it was foggy. They said, We didn't do it. Tomorrow. So I went up the next day. Beautiful clear day, not a cloud in sight. And at the appropriate moment—we and the Russians always fired them on the hour. It's one of the things that helped all the intelligence people everywhere.

That's amazing to me. It's a military thing, I guess.

Well, also you've got data collection all over the world and you've got to tell them, you know. So anyhow—I shouldn't have said that—but I went up the second day and the time came, the sun came up and then it went down again, this thing that covered that many degrees in the sky, this light, maybe it was smaller, but it was clear over the Sierra Nevada and it silhouetted the peaks. I could just see this jagged—you ordinarily would never see them, but there it was, this bright—and the back light was this bright light. So the whole Sierra's there. Because there's a straight line from Oakland to the Nevada Test Site, goes more or less over Mount Whitney. I'm not exactly—we could check it out.

Yes, we'll have to look at the atlas.

It was over the highest mountain. It was a great airplane flight because you went right by Mount Whitney and the little lakes around there. So then I called him back and said, I saw it. And that might have even been the second shot in Ranger, but as I say, the way you find out is that you

check out the Los Angeles papers because it was reported in the papers that they saw it. And then it was after those reports, probably the very next test that I went up to watch. So that's my first contact with the Nevada Test Site, is watching from the Berkeley hills. If you know Berkeley, the place I was, was right over the Caldecott Tunnel, which is the tunnel that goes out to Lafayette and so on.

Yes.

So anyway that was my first contact and it was sort of official; I was up there, Los Alamos asked me to go look. And you see, they could talk to me in adequate code. That's why they picked me. Well, they knew me but also they could say things without—they probably did violate some rule but not really, just formally.

When you said you shouldn't have said that, were you saying—?

I was talking about the timing.

The times. OK.

And its utility for keeping track of. But the world's full of things like that.

Yes. So this is still sort of unofficial but official because you are someone who knows and so you can tell them this.

Yes. And I'm employed at the RAD Lab at Berkeley [University of California Radiation Laboratory].

Right.

What was the date for Ranger? It was in 1951.

It was 1951.

Yes.

It was the beginning of 1951, January or February.

You see, I was already—my status then was postdoc. I was a postdoc. I may even have been a professor. I was an assistant professor, and Mike May was my TA [teaching assistant], and it probably was then.

Really?

Yes, it might've been just then. Mike was just here.

See, when I looked at—oh yes, maybe I'll get a chance to talk to him too. I talked to him for the—
He's at Stanford and he lives in Pleasanton.

Yes. When I looked at the Ranger data, and we can look at it in a minute, I thought maybe the one you saw—a later shot was a lot bigger than the first shot, but I think it's equidistant probably from the test site to Los Angeles and the test site to Berkeley.

Yes, just about. Los Angeles is probably closer.

Yes. We'll check that out. And then we can probably look at the records to see that delay that you're talking about.

I'm quite sure it's closer. People in the Bay Area didn't report it. It would be the other side of the hills.

Right.

I had to be up on top of the hills. And people in the valley wouldn't see it. Because there they were too close to the Sierras.

Yes. Maybe you were the only one up there who saw it.

Maybe.

Yes. So the background history of you getting to Livermore is the whole issue of Teller and Lawrence?

No. I got involved—you see, Lawrence had sent me down to Los Alamos in 1950, two years before Livermore, that's when I went down and the Greenhouse tests were in 1951.

Well, about Greenhouse, just a diversion here, what were those explosions like? I mean, that was your first witnessing of a—what was that like?

Well, it's impressive. I used to argue with [Harold] Agnew and some others; they would say that the world would be better off if the politicians could see these things. And I felt oppositely. I said, No, they're just simply spectacle, because you always see them from a safe distance and nothing ever happens. I said, It's the pictures of Hiroshima, that's what you should have. If you want to impress somebody, that's what you show them, not an enormous orange and blue and purple object. The radiation makes the air purple and you get these—and a big mushroom cloud. So I said, That's all spectacle.

So you didn't experience it as a scary thing in and of itself.

No. It was just a great spectacle. There was that side to it, but it wasn't the explosion in a scary sense, it just—I was always concerned. I was always aware of the fact that these atomic bombs have their downside. They are necessary, people say: In the Cold War and the problems, we have to be ready, have a proper level of preparedness. And I accepted all of that. But of course I hadn't yet met [Dwight D.] Eisenhower, but when I met Eisenhower six years later I learned directly from him, he felt exactly the same way. That nuclear weapons may be the necessary solution to an immediate problem but they can't possibly be the solution to peace and stability, in the long run.

Yes. Now you sort of answered a question I was going to wait chronologically to ask you, but I'll ask it now and we can get back to it. Was it Eisenhower himself—well, it must have been in

combination also with your experience to date that that insight that you just articulated sort of came together?

Yes, that's right. But my knowledge that Eisenhower—who as far as I was concerned knew more about national security than any of my friends who were criticizing him, I mean like Teller and Lawrence—the fact that Eisenhower felt that way, it was the clincher. I mean, it was—before that, I was open to the idea of a test ban, but possibly no one else at Livermore, certainly not Teller or Lawrence or Mills who were involved.

And Mills is who?

Well, Mark Mills was the man who would have been my successor as director, but he was killed at Enewetak.

Yes, I read about that—

His wife's—

—in the Gerry Johnson interview just now, I read about that.

It was one of the religious holidays, it was like Easter, something like that. And I was in Puerto Rico with the President's Science Advisory Committee when it happened.

Wow.

Sybil was in Livermore and she and Duane Sewell somehow got together with the Mills's doctor and drove over to talk to Polly, to tell Polly that it had happened.

Oh my gosh.

So Sybil was right in the middle of that. And Duane.

[00:58:07] *Yes. So then back to—let's skip back from Eisenhower a little bit to the getting from Berkeley and how—you wrote in the book [Race to Oblivion] that Lawrence says to you something like, We're going to start this lab and you're going to run it, or—?*

Well, before that he asked me—it's memorable because it was a New Year's reception, a regular one, at Carl Helmholtz's house in Orinda, or Lafayette.

I have to ask you the spelling: Helmholtz.

He was chairman of the—a known physicist, chairman of the physics department at the University of California at Berkeley, just died a few weeks ago. Very friendly guy. His wife had money, maybe he did too. So they had a real nice house out at Orinda. They had a New Year's reception every year, and us graduate students went. By that time I was a postdoc and an assistant professor. And Lawrence took me, he was there, he said, Herb, come in and see me as soon as you can, at your convenience, or something. And I was always happy to talk with Lawrence, so I went in the next day, I guess, and he told me a little bit, but it ended with a question, Do we need a second laboratory? And he made it clear that Commissioner [Thomas] Murray, who was a man who had marvelous internal conflicts about this—well, he was a very serious Catholic, Murray was. He was also a hawk, but he was concerned about the moral aspects, so that there was a lot of ambivalence in Murray's view.

Commissioner—?

He was a member of the Atomic Energy Commission. And he's the one out at Enewetak who eventually forbade the display of pictures of naked women, because they were all men and these pictures are everywhere and he was offended by it. So Lawrence told me that Murray had asked him—I knew almost none of the rest of the background of that issue, but of course I knew all the people because I had just been through Greenhouse. So I knew Edward [Teller] and I knew [Norris] Bradbury and I knew Carson Mark and everybody, the test directors down there, and this was after this episode with looking to see the bomb in the Berkeley hills. And so I started touring the country, mostly Los Alamos, Chicago, where Teller was, and Fermi too, and then

Washington, D.C. And I spent a lot of time going from one to the other, talking with people. I met a lot of interesting people there: Jimmy Doolittle, I first met in that connection—he was special advisor to the Secretary of the Air Force—and a lot of others.

Now you're not just barely thirty years old, are you?

That's right, I was thirty, yes. November of 1951, I was thirty. Well, that's where Lawrence is key also. No one else would've sent somebody that young, but Lawrence would. That's typical Lawrence and it's something that sets him apart.

Well, explain a little bit why—

That he would have confidence, that he would just disregard questions of age or background, you know, or anything.

Just based on his assessment of you as a person.

Yes, this is, you know, a smart enough guy with—that's all that—Well, I had been working quite hard for quite a long time, and he liked that. So I started visiting all these people on that issue, and at the very same time he [Lawrence] was in one of the periods when his colitis was especially bad, and that's a disease that reacts to tension and worry and busyness. And so he was constantly under a doctor's orders to rest, and he went on a cruise at some point during this period right after he asked me the question. He was always thick with the Standard Oil Company, he was already thick with the Standard Oil Company, and they took him on a tanker, a cruise down in the Arabian Gulf. I remember one of the times when he got back from that trip, he was all full of the fact he'd been to this oasis called "Woof-Woof" and a famous oasis near the Red Sea, near the Arabian Sea, called H-O-F-U-F. It's part of Saudi Arabia. Lawrence was always excited about things like that. That's part of his youth, you know. I can't imagine

Oppenheimer coming and talking about it unless he saw a great concert or something, whereas Lawrence, you know, he went to this oasis, wow! And I appreciated it too.

So anyway I'm making all these visits and thinking about what to do and he's not there most of the time, so I'm not in touch with Lawrence except sporadically. And I'd been talking with Teller and others and I'd come to the conclusion, well, we could use a second laboratory. I don't remember thinking that it was urgent but that yes, it wasn't a bad idea. And after one of these trips fairly late in the spring, General [Kenneth] Fields, who was then the head of the Division of Military Application, was visiting to talk about these things. It was very much in the air. And the Commission was refusing Teller's exhortations because they said it'll take talent and effort away and besides, they didn't want to do it; what it amounted to, especially they didn't want Teller to do it. So they were able to say No—even despite the threat of the Air Force—no to a second lab.

And Fields came out at one point, but Ernest had just gotten home and I hadn't seen him. And he said, Tell General Fields what you're thinking. I said, Well, I haven't talked with you yet. [He said,] Just tell him what you're thinking. And at that time I was thinking about a second laboratory and how you might go about building one and what it might do. And it grewed like topsy. I mean we approached it—it was a problem because Teller wanted a guarantee of a big laboratory working on nuclear weapons from day one, and he wanted it in writing because he didn't trust anybody. Teller really was paranoid. Lawrence, on the other hand, was always relaxed about that. He says, Ah, you know, put a floor under it and we'll see where the ceiling is afterwards. Just go out there and do a good job and things will develop right. And of course Teller didn't agree with that at all. By that time I was anxious to go ahead, so to some extent I was involved in keeping them apart so they didn't screw everything up. And they never really liked each—there was always

tension between Lawrence and Teller. They each admired the fact that the other one was a nuclear hawk but beyond that—and they admired each other’s work in a sense. Teller could see Lawrence as a great physics entrepreneur and Lawrence could see Teller as a very bright guy. And by that time he’d invented the hydrogen bomb and that was a very big, positive thing for Lawrence.

But anyway I described all of this and Lawrence was a little bit taken aback but didn’t say, No, we’re not going to do that. And so within a month or two after that we actually had a meeting, big meeting in Berkeley, at which it all was finalized. Gordon Dean was there, Teller was there. Fields was not there but his deputy Captain Hayward was there.

Do you remember Fields’s first name? It’s OK.

Ken.

Ken. All right. And Gordon Dean was then—?

He was the chairman of the Atomic Energy Commission.

Was he the chairman there? OK.

Teller had a spy in the office because—

In the AEC office?

Yes, because it’s a typical thing. Freddie de Hoffman who was Teller’s amanuensis, sort of his bootblack as well as his assistant—Freddie made all the travel arrangements and everything. I hear Teller just never did any of those things. But anyway he was romancing Dean’s secretary.

Ahhh, OK.

He married her. When Freddie was here at General Atomic and then Salk Institute. This was his only wedding that he had. I think he was only married once. Anyway it was she—I forgot her name but she was here. So when I say “spy in the office”—

I understand.

But when I was in Washington I not only met with people in the Air Force and the Pentagon but people in the Atomic Energy Commission, which at that time was on Constitution Avenue. I think it's Constitution. It's the one parallel to the Mall away from the river. I think Independence is the one on the other side.

I don't know.

But anyway it was right there, something like 19th and Constitution so it was right, I think, probably next door to the National Academy of Sciences. And that building, I think, now is the Federal Reserve, where they meet, but they may have changed again.

But then, you know, the rest is history, as we say. I mean, we started that summer, went out to—opened up Livermore on about the second of September. Extremely hot day!

That's the summer you start, the summer of 1952.

Nineteen fifty-two, yes.

And you open up Livermore January of 1953.

No, it was September of 1952.

Nineteen fifty-two, OK. It was a hot day, you were saying, yes.

It was the hottest day of the year, well over 110 [degrees]. Well, one or two days a year in Livermore it gets above 110. It was 114 or something like that. It was extremely hot, and there was of course no air conditioning, even for years there was none, except for the computer. The computer was air conditioned but the rest of us weren't.

So you had had to build buildings.

We took over a whole bunch of leftover buildings from World War II. It had been a naval air station. And Duane and I set up our office. He was from the beginning the deputy. We set up

adjacent offices in what had been the infirmary, and I think my office—one of us had the ambulance breezeway; we had done a little bit of reconstructing, and the other one had the emergency room next to the ambulance breezeway. And I think you had to virtually go through my office to get to Duane's office, something like that, something unreasonable, but it all worked out at the time.

And the mission at the beginning was simply that a second weapons lab—to do things different from Los Alamos?

Yes, that's what we promised, and Bradbury complained endlessly about the fact, they're not living up to that promise. They said they were going to do things different and they aren't.

What was the rationale?

Well, the rationale was simply technical optimism. We thought—Teller thought for one set of reasons, Lawrence for quite different, and us because we were young and brash, Harold Brown, Johnny Foster, Gerry Johnson, me—that we would find other ways, not necessarily—that the technology was new and that it had many branches. And of course—yes, did have many branches but they were not radically different from each other.

[01:11:26] End Track 2, Disk 1.

[00:00:00] Begin Track 2, Disk 2.

One of the last things you had said before we stopped was that Lawrence and Teller wanted Livermore for different reasons. You talked about that a little but—

Well, they both wanted it for similar reasons in one sense. They wanted to expand the nuclear weapons program, but the big difference was not in what they wanted but how they talked about their relations with Washington and planning and so on. Teller wanted everything in black and white. He was paranoid. He didn't trust anybody. The suspicion came and went, that the whole

business of doing the Livermore Laboratory was just to get him off their back—as soon as they pretend to start the Livermore Lab they'll go off on a tangent or they won't do anything very worthwhile. So he was paranoid about it, suspicious. Lawrence was optimistic nearly always about everything and his view was that, All we need to do is get started and then we'll see what happens. We don't need any guarantees from anybody. And it almost broke up at the beginning over that. There was an incident—I've written about it several places—in which there was a party with drinking and so on at the Claremont Hotel, sort of celebrating the idea of getting started. And Teller suddenly became morose and said that, The whole thing is a fake, it's just to get me off their back, so I'm not coming to Livermore.

Oh wow.

And Lawrence said to me privately, That's all right, we don't really need him. At which point Navy Captain John Hayward, who was then seconded to the Atomic Energy Commission, said, You can't do that, you've got to have Teller, and you've got to butter him up. I mean, you somehow have to persuade him. So I a little, but mainly Lawrence, did get together with Teller and others from Washington. And they actually went off by themselves, I think, Gordon Dean, Teller, and Lawrence—to Lawrence's office which was a couple of miles away. And they worked up a letter that would be satisfactory to Teller, and to Lawrence and Dean too. And so we started.

But that party was somewhere in June of 1952. During the summer, we spent a lot of time having meetings and talking about program, what should we do, what do we do next. Duane Sewell and I talked about buildings and buying a computer. We bought the first UNIVAC to go to anybody that wasn't part of the government.

Wow!

It was the number five UNIVAC, and numbers one and three or whatever never left the factory. And then we talked about the need for an engineering building. We did a lot of that. And about recruiting because there was no staff yet, but Duane and I were already—Duane was key. And then we had a—I'm not sure, Duane started in June, maybe he was later, like August. But then we had some physics groups meetings and we talked about controlled thermonuclear energy, now called magnetic fusion. We thought that'd be a great thing to have in addition, because we wanted to have the laboratory a little broader than just nuclear weapons. Not much broader, just a little, so we were doing something else that people would find attractive and interesting, partly for recruiting reasons but generally our relations with the world. And so we started with fusion. Teller in some of his reminiscences later says, That's the only thing that Herb was interested in. It's just utter nonsense.

I remember reading that.

In all of the things he's written he belittles me. It's always pleasant, Herb's a great guy, good physicist, great husband, but when it comes to something substantive about the lab he never puts it in. And one time he wrote a letter to Lewis Strauss and said, Herb York's a traitor to Ernest Lawrence, so that's the one thing he did that made me angry.

He actually wrote that to Strauss?

Yes. Yes.

Oh wow.

Well, it was when I had made it clear in Washington that I thought the president's goal of having a nuclear test ban was a good idea. Ah, Teller would never have thought that thought. Always thought that was the dumbest thing coming up.

Now what was your—so you're here with the, you know, the brilliant Edward Teller and you've got Lawrence but you're seeing him as the great physicist that he is and he's going to do great things at the lab, or what was your view of him [Teller]?

No, I thought him, I think, from the beginning as a bright idea-type guy. We never gave him any authority. He didn't want any; at least he said he didn't want any. He was director for about a year later on.

I remember, yes.

And I always thought he was content. Harold Brown has told me that Edward did chafe a little bit with me as director, but I thought we got along fine. You know, there were things that I thought he was doing wrong and that bothered me and were difficult to deal with because of his special status. But I remember, and Sybil might remember this, talking with her about the bad—occasionally mentioning to somebody some of the bad side, or somebody else might mention it. And I at that time was very defensive about him. And I said, well, you know, you just can't subdivide him, you just got to take the good with the bad. It comes that way. And it's that way with anybody. I was philosophizing.

And so he had a special role, but it was not an executive role in any way. He inspired young people. Many of the people who came remember their visits with him and were genuinely inspired. He was a charismatic person, and I found him so myself. It was fun to talk with Teller about anything else, about nuclear issues of all kinds. And so he was there with us really only the first year. I mean, nobody realizes that, even people at Livermore. From the second year through the fifth year he was hardly around.

Really?

Well, he was busy, off with the Rockefellers, with the oil companies. He was consulting, and he was politicking. I didn't realize that at the time. He was pushing his own ideas about the world and national security, relating to Livermore but not at all exclusively.

But he was always inspirational. He did almost nothing with regard to recruiting. He had a lot of ideas about who to recruit, and there really was only one person who came of all of those, not a well known person either, a theoretical physicist named Montgomery Johnson. [He] was somebody that—actually I knew him too, so that I'm not sure that Teller was the sole recruiting agent. But I associate him as coming because Teller was—

I remember Teller writes about him in his—memoirs, yes.

Montgomery Johnson. Yes. Well, he liked him and he was the most senior theorist that we had when he first came. There were others. Mark Mills was a theorist and Mark maybe came primarily because he was inspired to come by Teller. But the great majority of the people, not only did Teller not recruit them, but they didn't come because he was there. I'm sure they all found it interesting that Teller was there, and it was a plus, but nearly everybody was recruited by Lawrence and I. Sometimes just me, sometimes just him, but more or less jointly. And I recruited nearly everybody from Berkeley, so they were all Lawrence's people who knew that Lawrence was behind this project. They were early postdocs who didn't know what was going to happen next, so Livermore was a great solution that enabled them to stay in this great laboratory and do something that we all thought was useful.

[00:09:10] *Right. So early on you're thinking you're going to design a weapon that does something different, or what is that about?*

Well, I initiated the policy that I thought was closest to Lawrence's views in pure science, that this policy was the applied science equivalent, and that we would always work on extremes. We

would not wait for Washington or the military to tell us what to do. We would simply from day one work on the largest weapon we could think of, the smallest—smallest meaning physically small or low yield—the smallest diameter and that’s what led to things like Polaris. See, Polaris was half the weight of the ICBM [inter-continental ballistic missile] that preceded it and it was much smaller in diameter. And so we were working on Polaris before the Navy said they wanted Polaris. And that’s why—just because we had this policy of working at the extremes—and as I say I thought, naively or otherwise, that maybe it was just brilliant intuition—that that would substitute for working at the frontiers of pure science, that working at the extremes of the technological envelope.

So as I say we were working on the largest, the smallest, the smallest in many different ways, *et cetera*. And what Bradbury—we talked about this earlier—Bradbury always complained that everything Livermore finally did, he said, *We were thinking of that already*. Some of the things are still nominally secret. I mean, everybody knows them but I’m reluctant to say.

That’s fine.

But we did explore some new territory in primaries that made things like Polaris possible. They really were a big step forward. But Bradbury said, *We were going to do that anyway*.

There’s only so many things you can do and that’s one of the things we would eventually have done for sure.

What do you mean by “in primaries”?

Well, thermonuclear weapons have a primary and a secondary.

Correct.

And Johnny Foster was in charge of primaries—

OK.

—or of course they could be freestanding, and Harold was in charge of secondaries, really. And so Johnny is very aggressive. I don't know if you ever talked with Johnny Foster.

No.

But he's personally an aggressive person. He's very smart but he's personally aggressive, and so that he would find out what's happening at Los Alamos because they were pushing in new primaries also, smaller—that just means smaller, more efficient atomic bombs. Both of those things are important: small and efficient. And he would find out what they're doing at Los Alamos, then he would change it just a little bit, to make it a little bit more daring or a little bit more—and they got annoyed at that, and so I said, *Johnny, you can't do that. We're going to make them different. And actually what I said is, You can't make them round, is what I said.* And that may still be at the borders of classification. So Johnny started working on genuinely new ones and they worked out very well. The idea for non-spherical bombs was in the air already. Von Neumann had ideas about it and George Gamow had ideas about it. To make them fit into artillery pieces, they can't be round, you know.

Oh, OK.

So anyway that's what we did. But even there, when we did something new Bradbury said, we would've done that. We just hadn't got there yet. We were busy doing these other things that Washington says they need. But Bradbury's complaints were almost entirely private, not even to me or to Lawrence. They were complaints internally. [Harold] Agnew reports him saying those things. And the documentary record from the Atomic Energy Commission. But a lot of the stuff that Sybil Francis found were letters by Bradbury complaining about what we were doing at Livermore. The simple fact is that Bradbury was always good to deal with. He was always cooperative. He met every legitimate need when we asked for assistance doing something. And Agnew in fact has said, *Bradbury seemed to like you, I*

don't know why. But personally because there was bad blood between Livermore and Los Alamos all those several years.

Well, in the Gerry Johnson interview, he's talking a little bit about—well, several pages about how I think at the test site that the Los Alamos people were treated better by the AEC and other types of people, treated more as elites, than the Livermore people were.

Well, I don't know about that.

So what's curious to me as I'm reading it is this—

That's news to me.

Well, you'll read it and you can see how you interpret it.

Yes.

So you've got the tests being designed and then you have to test them, so I guess the test site belongs to the labs that want to test there, or—?

Well, we were the primary users, and then there was a completely separate organization for running the test site. I think run by the military. Not even the Atomic Energy Commission, although Holmes and Narver, the contractors may have been AEC contractors, I'm not quite sure. And there was a certain formalism. When they finally fired off a bomb, the University of California transferred it on paper because there was some kind of a belief, I think both in Washington and in Berkeley, that the University of California didn't fire these bombs. I mean, that's not something we did.

Interesting.

So we built them.

You built them.

Designed them and built them, but the government fired them. And they surely had the authority. I mean, not Jack Clark or not Gerry Johnson had any executive authority at the test site other than for the particular events taking place, but not for the maintenance of the property or the operation of the site.

Right. Yes, there's that whole—

And the weather, all the question about fallout. We were acutely aware of fallout. People who sometimes say we were casual about it are wrong. They tried real hard to get it right. It's just that it's so complicated, they couldn't get it right, I mean all the time. And there were surprises. We knew about fallout but we didn't really understand at the beginning about rainout. The stuff gets up in the clouds, it's moving around the world, and some of it somehow gets caught in the rain. Either raindrops form on the radiation or the rain falls through the lower parts and picks it up, takes it to the ground. And we discovered that—or it was discovered, we didn't discover it—when Kodak film started showing that it had radioactive materials in the emulsions. Special emulsions, not your ordinary film. And discovered that some of the organic materials that went into the cellulose, that sort of thing, were in fact radioactive from the tests in Nevada. Stuff that was harvested back East. It wasn't local. Then it was essentially local rainout. There would just be a few acres or a few hundred-acre patches where there was this radioactivity, which was extremely low in level. You would've never found it with counters and things. You found it by these—the films themselves were the delicate detectors.

Yes. I guess that's a question that sort of general public people have about not only the test site itself but the tests that were designed after Hiroshima and Nagasaki and after tests in the Pacific, what was the knowledge of what fallout would be? You know, what the environmental and then health consequences would be, because then later it was a big furor.

Yes, I think both of those things were—

[00:18:37] End Track 2, Disk 2.

[00:00:00] Begin Track 4, Disk 2.

Yes, so the question of how much government people, scientists, were concerned when they started exploding the tests.

Everybody was very concerned, but we only knew so much. There was a certain naiveté but it was perfectly natural. No reorganization of the world at that time would have produced anything substantially better. Fire everybody and hire philosophers, or something. It was good, considering what we knew and what we could've known. But people did know about biological damage, they did know about the way fallout would work. They had ideas about it, but there were a lot of surprises. The rainout was one. The fallout from the first big thermonuclear shot was another because what happened there, and nobody knew this, the stuff went up about a hundred thousand feet, a little more. On the way down the winds blew in opposite directions in different altitudes and no one knew the wind structure was that complex. So that's why the people on those other islands were hit with radiation, almost killed but it happened not. They were lucky they weren't killed. It could've been much worse than it was. But it had to do with the fact that it was unprecedented.

That's the George shot, is that—?

No, that was the Bravo shot.

Excuse me, right. Bravo. But that was the first actual, what, thermonuclear bomb?

Yes. Well—

Or the largest—you tell me.

It was like Mike only it was much lighter and more practical. But it was the same explosive size as Mike. It was actually a little bigger, fifteen megatons instead of ten, but it was the first real prototype.

Of the hydrogen bomb, thermonuclear bomb.

Yes.

So let's talk now—we'll get to the test site finally. So you designed a test at Livermore, you need to test it at Nevada. How does that—will you go down there? What does that work like?

Well, a whole bunch of people go down. Gerry Johnson, who organizes the test for us, and the experiments. There really are two fundamental parts to it. One is the device, the explosive device. And then the other is all the instrumentation you use to observe it.

It's called diagnostics, as in medicine. And the idea is to find out as much about the details of what happened. It's not just go-no go, does it work or doesn't it work. If it doesn't work or doesn't work quite up to snuff or whatever, there's lots of experiments in addition to the explosion itself that are there. We measure X-rays, neutrons, I mean, we measure them underground, above the—there's just lots of measurements. So there's a team of physicists who go down there in order to measure the various aspects of the explosion, as well as another team which puts the bomb together.

And the test director, for a long time—now that you mention Gerry—part of the time I remember some of the people in administration found it just a nuisance to have two test directors, so they favored Los Alamos. They expected us to work through Los Alamos just because it was too much trouble to have two separate—Somebody's got to be in charge, they said. So that's why Gerry had a somewhat secondary position to the Los Alamos people. But they were good friends. The head of the Los Alamos group at that time was Jack Clark, who

retired here. He was retired here about thirty years. He died in his nineties. A lifelong bachelor, so he had plenty of money—good pay and nothing to spend it on, and then good investments—so he just was an inveterate traveler. He was the most traveled person I know. And in between trips to Zaire or Malaysia—kept getting malaria and everything like that—living to ninety-five, he lived in an apartment here. I knew him but Gerry and Mary Kay were closer to him, visited back and forth.

So when you designed, say, the first weapon at Livermore, are you thinking in terms of science or are you thinking in terms of policy?

No, in terms of applied science.

Applied science, but are you thinking in terms of the Cold War and what the government wants and how we need these, or—?

Well, we don't talk about the Cold War because we don't have a foreign policy at the laboratory. We work with the government; it's up to them to decide the foreign policy. Well, there's a formal system of requirements and so on that we know this is what the government says it wants. In addition to that there were certain experiments simply to design the parameters, to investigate these extreme parameters. Now every one of those has to be negotiated. We couldn't do what we wanted to do. Every shot has to be negotiated, and actually at the primitive level it was me. I negotiated with Washington about what kinds of tests we would make and why. I'd provide the rationale, the cost estimates, all of that came out of the director's office. And the president approved every one. They took those things very seriously. The president—and he really did, it wasn't just some nominal thing which he then delegated. Every test went to Eisenhower. This was during that period.

Right.

And he approved them. And at one point I had suggested some tests that would lead to a bomb bigger than any we'd exploded so far, maybe fifty megatons, I'm not sure about that. And the word came back, the president said, *They're too big already*. It was Eisenhower's peacenik side. My first direct contact with him was word coming back, *They're too big already*, or, *They're big enough already*.

Interesting.

You know, something like that. He just said no. So that's the only case where we were going to do something and the word came back no. Otherwise they were very permissive and welcoming. They let us do essentially everything. And some of the things worked out and some didn't. And they were very tolerant of things that didn't work out; they said *Yes, well, OK, you can't make progress without making mistakes, and so on*. But there was this one where the president just said no.

Interesting. So when was the first time you—?

Now I didn't see him, of course. But the then-Director of Military Application did tell me personally. I did deal directly and personally on all of these things, not through staff and not through his staff either. Now it would all be done by staff. But the principals did these things directly in those days. So I would talk with then-General [Alfred] Dodd Starbird about what it is we would do at Livermore and what we thought we ought to do and how that would relate to so-called requirements and how it would relate simply to the general development of nuclear weapons.

OK. So I guess that the way you framed it was my question. There's the question of how are nuclear weapons going to develop, and then there's the question of what particular things do we think we need to do for—

Well, by the time we got into it even in 1952, there was a formal system for working out requirements, involving primarily—well, central to it was something called the Civilian-Military Liaison Committee, sometimes just Military Liaison Committee, based in the Pentagon, and a person with assistant-to-the-secretary-type rank. In later years that office became known as the Assistant to the Secretary for Atomic Energy, and your Troy Wade was one of the—and Gerry, were two of the people who occupied that office over time. The person in that job, he didn't make the decisions but he chaired a fairly complicated decision-making system which formally told the Department of Energy [DOE] what it is they should do. And when they finally gave the requirements, there were lots of things. There was a yield, there was a weight, there were questions of safety, there were questions of reliability. There were ten or fifteen different—at least ten different requirements for any particular bomb.

Wow.

Well, sometimes they were mundane. What kind of aircraft had to be suitable for this aircraft or this missile. The yield and the weight were the drivers but there was always all this stuff too. And that was worked out by this formal system in which we participated just along with a lot of other people. In fact, we were not formally members. It was a government committee because they're deciding what the government wants, and the laboratories never had that function of deciding. However, we were very insistent about telling the government what could be done, and we weren't shy about saying we thought this is a good idea, or something. *Build Polaris.* Don't do this. So we weren't shy about it, but we were input rather than members of the decision-making.

Right.

But every year I wrote a letter to the—every year I was there. I wish I could get these. They're probably still all classified. Sybil Francis knows where some of them are. But every year I wrote a letter, only four or five pages long, about what it is we're going to do, what I thought we should do at Livermore. Dividing it into large weapons, small weapons, and then tests and nuclear chemistry and nuclear physics, a dozen or so topics with estimates of how much money for each one, and the testing one, when we would be ready to test and so on. But it was all a request; it was a statement of plan, but it had to be approved in Washington, but basically by just one guy, the Director of Military Applications. Only when something like the president saying, *It's too big already, did anybody else get into it.*

Yes.

The remarkable thing—it can flatter the ego. See, I wasn't given the title "director" until we'd been going for two years. So I'd write these letters and then just sign it with my name, "Herbert York, UCRL Livermore." No title, just me. And then after two years Lawrence said, you know, *Start calling yourself the director, or, Why don't you start calling yourself the director, something like that.* And so I became the director. From the moment he walked out of my office, I told my secretary, *Next time you answer the phone, say 'director's office.'*

But the AEC published an annual report. In those days it was only like this [demonstrating size], and they always had the laboratories and who was who, and they simply had me listed under Livermore, there I was, no title. But then I told Lawrence, we have to have titles for everybody else, so by then everybody but me had a title. Harold Brown was assistant director for large weapons—"A" Division, we called it, we didn't say "large weapons," "A" Division. Johnny's assistant director of "B" Division. Or maybe just division leader, but they all had titles; working with Los Alamos, they got to know who we are. And in fact in Washington

this same Admiral Hayward, many times more than once I'd be back in Washington and he'd say, Tell me, who is Mr. Livermore? And I'd say, Ernest told me to go out there and run the place, and I'm, you know, I'm Mr. Livermore, but I didn't even say that. Ernest told me to go out there and run the place. That was my answer to the question, who is Mr. Livermore? Then finally after two years I was named the director, Lawrence named me the director. He could just do that. It was the sort of thing he could decide. Now it would take—

This is really so amazing, that he could—

—now it would take all these committees and approvals—

Right. But he was Ernest Lawrence, so he could do that.

Yes, he was very high-handed with the university and they knew it. Some people asked [Robert Gordon] Sproul, who was president when I first got into these things, why do you let him do that? Why do you let him treat you like that? And Sproul said, He made me famous. And actually that's largely true. I was just talking with Dick Atkinson recently and he knew that Sproul felt that way about Lawrence. It was Lawrence who put them on the map, and so they tolerated stuff that nobody else could get away with. And Lawrence did it usually with a smile or with his great sense of enthusiasm that everybody would want to do this, wouldn't they, you know, whatever it is we're doing.

So when did you first go down to Nevada? We talked about this a little before, off tape.

Well, it was very early. It was very early and I don't remember quite when. Duane and I went down just to see how to operate down there, because from the day we opened the laboratory's doors we had in mind that we were going to do these two tests which became known as Ruth and

Ray, are the names of these tests. The so-called hydrides. But we didn't use those words then.

Those are my godparents' names, Ruth and Ray.

You're kidding me.

Ruth and Ray Foos. My mother, when she moved back to Rochester at age 18, the family in Oneida, which is where she was raised, they were Germans and Jews. She lived with Jewish relatives, although she was a staunch Episcopalian because her mother had been. But in Rochester her relatives were all Dutch and they were very specific, that's Holland Dutch.

Not Pennsylvania Dutch.

No, not German.

Not German Dutch.

Because Deutsch, you know, the word was—and they lived by themselves. Everybody was Dutch in the neighborhood. It was self-segregation. And the Fooses, that's a Dutch name, Foos, Ruth Foos had been one of her girlfriends. Actually my sister's godparents were named DeWitt. Everybody was Dutch that was connected with my mother. Not my father but connected with my mother. So Ruth and Ray are my godparents. Or they're my sister's godparents, I'm not quite sure. And the DeWitts were the godparents for the other.

Yes.

But anyway, from when we opened Livermore, this and the first things we did at Enewetak were some ideas that Edward brought with him. They were some ideas that from even before Mike he had in mind about how to do things. And they were bad ideas, but nevertheless they were not a bad way to get started, although they could've discouraged everybody but they didn't. Somehow we were just too young and naïve and the government accepted us—and Lawrence, accepted him—to get things right.

So Ruth and Ray were both smaller than we expected, and we expected small. So they didn't knock the tower down. It's a famous event. The first thing we did in Nevada was on a short tower and the tower was still partly standing. There used to be pictures of that everywhere. We had a big object lesson at Livermore. The director's office for years and decades had a picture of the stump of the tower from either Ruth or Ray, whichever was first. And the Los Alamos people just got great pleasure out of it. Laughed unashamedly, gave us the horse laugh, saying, *You guys at Livermore think you're so hot.*

So it was an embarrassing time. And then unhappily the first thermonuclear one didn't work either. It fizzled, really a very big fizzle, I mean not just a little. Well, only the primary went off in the two-stage weapon—two-stage device, it wasn't a weapon. That was a different idea that Teller had, and we didn't like it. We thought it was kind of doubtful. None of us thought it was all that great but we went ahead and did it.

Yes. Now were you there for the tests or would you be—?

Yes and no. It was right after Bravo. I think it was called Koon. And I was in an airplane with Norris Bradbury and we were getting ready to land at Enewetak. I'd been out there earlier to see it, then I'd gone home and I was coming back now to see the explosion. And we saw the explosion. It was all cloudy. All you saw was reflections in the clouds from this airplane, but both Norris and I thought, that's pretty small. And it missed by a factor of twenty or more from what it was supposed to be.

And then we were on our own. The next tests were locally generated ideas, not ideas that Teller brought, and they all worked out. Ideas that Johnny [Foster] and Harold [Brown] were primarily responsible for, with me, visitors and Teller also playing something of a role. We operated the laboratory very tightly. I was in intimate touch with the weapons designers at that

time. There were so few; there were only a few hundred people, maybe a thousand, five hundred.

And so I was able to do that.

Now you said you first went to Nevada with Duane Sewell. Did you guys fly in, did you drive in, or do you remember?

Well, I'm not absolutely certain but about that time, the normal way to get there was to fly to McCarran, the airport in Las Vegas, and then be driven up. I mean, that was the normal way.

And I think there was one time only when somehow or other I actually took off from either Indian Wells or—there's an Air Force place closer [Indian Springs Air Force Auxiliary Field].

Yes.

Yes, but we didn't go there. Now later that became the normal way, going to this Air Force base that was closer than Las Vegas.

Yes.

[00:21:45] End Track 4, Disk 2.

[00:00:00] Begin Track 5, Disk 2.

I was just looking, while you were out, at these tests here. Yes, so I'm seeing Ruth, Ray, and I see one named Simon.

No, everything else was as Los Alamos.

Did you witness Bravo?

No. I got there just when they were discovering how bad it was. I got there just as the Koon shot went, if we have a date for that.

We do.

That would be in what series?

Let's see.

Redwing. No.

Castle [Operation].

Castle, that's what it was. Do you see Bravo?

Yes, Bravo says February 28.

And what about Koon?

And Koon says April 6.

Well, that's six weeks, so I'm not sure. That doesn't quite fit because my memory is they were still developing an understanding of what Bravo had done. Was Koon the next one after Bravo?

No, there's something called Romeo. Here, I'll show you. These are all at Bikini, it says.

I wonder what Romeo was, whether it's—because they're not otherwise labeled, are they?

Well, they are. I just—

Oh well, Romeo's LANL [Los Alamos National Laboratory], yes, you can see there, it says—you see, there's only one Los Alamos shot. There were supposed to be two.

Koon says LLNL [Lawrence Livermore National Laboratory]—

Yes, and it's the only one.

Right, and so it says Bravo—

Romeo.

Romeo was a barge, it says. Eleven megatons.

Yes. And Koon says what, fifty kilotons?

A hundred ten kilotons.

Does it? Well, maybe it was. It could be. Without that I would have said fifty.

When I met with the DOE people about secrecy, they were saying the yields had been gone over and maybe they were just ranges, they were not going to reveal the actual yields.

Well, Koon was supposed to be a megaton. Just about one.

Yes. So you didn't see Bravo but they're still trying to figure out what happened.

But I arrived there when the turmoil was just sort of building up, in connection with Koon, which then fizzled. I mean everything's a mess. I wasn't there for Bravo but there's six weeks in there and I made more than one trip, so that I could have been there right after Bravo and then come again for Koon. It's quite possible. By that time, as a director I wasn't involved, actually handling equipment and setting things in place. So I could've been out, could've gone home. But I wasn't there for Bravo, and I wasn't there for Mike either. I don't know what's the biggest bomb I ever saw. I'm not sure. I'm sure I saw multi-megaton but not very many. I saw lots of kiloton-size bombs. And that tells whether they were Enewetak or Bikini also.

It tells everything.

Yes. Because I think all three of those—well Koon and Bravo were Bikini. And Mike had been Enewetak. And George was Enewetak.

Correct.

And on Engebi. One of the things that enters into this, and again I'm going to psychological feelings and understanding, there's plenty of evidence of the war in the Pacific at Enewetak. When we went there, there were busted tanks and there were busted ships on the reef. So war was not an abstraction. You know, 1950 was only five years.

So in the sense that you're experiencing this and you're thinking—

Well, we're not thinking that it's peacetime. We're really thinking there's a—dangers everywhere. Two wars already this century and now everybody's worried about more, nuclear this time. So we all took it fairly seriously and didn't do a lot of second guessing.

Yes.

Again, Duane Sewell, for some reason, I don't know why he was there. I know why I was there. I was at Wake Island during an explosion in that very early period; I'm not sure which series. Might've been Greenhouse, but that doesn't seem right. We were up there for that same reason as in the Berkeley hills: Can you measure the yield from five hundred miles away by observing the light curve? There was already a fairly good idea about it. It was just a question of details and demonstrating it. And so we were up in Wake Island in order to observe one of the explosions. I think that's eight hundred miles or six hundred miles, something. And there again Duane and I were just around. Hardly anybody was going to Wake. There were a lot of Americans there, fifty or a hundred. And we drove and found a Japanese bunker. And in this bunker Duane found and kept a little piece of wood about like this [demonstrating size]. And it was obviously the firing instructions, because it was all in Japanese, in the event of an American attack. And in addition to Japanese language it had pictures, you know, sun, moon, sun covered with clouds, and then obviously instructions about what you do. When ships were there, I think there were pictures of ships, about how this battery was supposed to work against an American invasion. Well, it was five years after the war and nobody had yet actually explored this place and taken it away.

Of course. That's amazing.

Duane may still have it but I mean it was a piece of wood and I think it had been burned in, the sort of thing you get with—because I think it was scorched rather than inked, with these firing—what to do when the Americans come.

Wow. And this was Wake Island looking at Enewetak.

We were at Wake in order to look at Enewetak. And we saw it, it was easy. I don't remember whether we—the thing I remember is not seeing the bomb but just a bit of scientific data, and

that is looking east you can tell the sun is coming about one hour before it actually rises. That is, there's enough—the light curve goes flat, then an hour before the sun comes up the light curve starts to turn. And that would be eight hundred miles away or something, maybe a thousand, so that tells you how far away you could see an atomic bomb. I mean about a thousand miles.

Something like that. And measure the yield. And of course the Russians were testing in the atmosphere in Siberia, and so even then we were in bed with the Pakistanis trying to, getting data.

So let me understand this a little better. From the light you measure the yield?

Yes. When a nuclear weapon goes off the light changes with time, and the plot of that is called the light curve. And it looks like this [demonstrating], right side up for me. It rises a little, it falls, and then it rises way up. And that first little rise and fall depends on the yield. By measuring the time from zero light to that dip, you can measure the yield.

Wow.

And that's called a Bhang meter but it's spelled with an "h": B-H-A-N-G. I think it's Agnew's word. It comes from the Hindu, you know. Well, that's what was at issue in connection with this more recent event in the south Atlantic/Indian Ocean. That curve wasn't there, that characteristic wasn't there.

Which explosion?

Well, there was this one—south Atlantic or south Indian Ocean. I mean in something like 1978 there was this explosion that ever since people have said, was it or wasn't it?

Oh, OK.

And maybe it did have a little nick in it, something like that, but not in the right place. I forget exactly what the situation was.

So when it goes up again that's the—

Well, that's the big light that everybody sees.

That's the big light.

The first is just the original gamma rays coming out and making the atmosphere shine. The fireball is just this big [demonstrating], it may be real hot but it's tiny. And it's not producing much light; it's producing X-rays and things like that. And you see the light produced by these gamma rays and X-rays away from the bomb, then you finally come to a point where the shock wave breaks away from that. I'm not quite sure what's happening here anymore. And so it starts to dim and then you get the real bang. But the first rise and the first dimming are due to detail processes that take place within a millisecond after the—it's a very short time. And it's a standard candle, like what's in astronomy. It's a way of measuring the yield.

And someone must have discovered that at some—what was going on with the detection?

Oh yes, well it had to be fresh but it wasn't super fresh; we didn't think of it as a—at the time we just took it as a fact.

OK.

But anyway I used to go to Nevada quite often in the beginning, in connection with Ruth and Ray, and then we always had something, nearly always had something. It started with them. And the firing site, sort of the headquarters for the scientific team and for the team in charge of firing, pushing the button, was called the Pogo. Well, the site was a control site or something up above Frenchman's—

Yes, CP, control point, they seem to refer to this.

Yes, up above Frenchman Flat in a kind of a pass. But the staff was called the Pogo staff, and I don't know truly why, but I believe that Bill Ogle, who was a local test director, was responsible

for that. On the blackboards in the test—there were a lot of—because of academics and scientists, blackboards—these blackboards were always covered with large representations of the comic strip character Pogo and all his friends, about this size or maybe this size, but big. Very well done, and I think Ogle did them, though I'm not quite sure about that.

I can find out.

And of course they had some of the really famous Pogo-isms which were very fresh at the time. Two of them that were on the walls there for lessons for all of us, you know: We have met the enemy and he is us. And the other one is, when in trouble, when in doubt, run in circles, stamp and shout. That was another Pogo-ism.

And that was about six miles away. I'm not [sure], one could check that but about six miles, and so that's part of my story earlier. It's always a spectacle with nothing serious ever happening. You can feel the heat, you get this brilliant fireworks, this mushroom cloud, but nothing ever happens. You know, it's sagebrush out there where the explosion—

They did some experiments down there with buildings, but of course that's what you always see on the specials—but that was the exception. It's easy to believe that was the norm, or the soldiers in the trenches; but you know how many shots there were in Nevada and that's two of them or something like that, so that it made for good documentaries but it just was quite an abnormal situation.

I was going to ask you this later but it sort of fits with what you're saying. The test site book I was showing you, at the end has a phrase about the Nevada Test Site having been the battleground of the Cold War. Someone described it as such.

Yes?

And that if you actually go out there, with the buildings and the holes and the craters and the torn-up train trestles that they blew up, yes, it looks like a battleground. And there's something sort of interesting and odd about that because of course no actual physical battle took place there and yet what was going on there was related to this local battle—

See, if you had asked me, or I think most of the people at Livermore and Los Alamos, I'd have said if—the word “battleground” really isn't appropriate anywhere. If you want to apply this back home at the design labs, Nevada's just someplace we go because we have to go someplace remote. We never thought of Nevada as being a big deal on its own. It was just an extension of our activity. So the whole notion of a Nevada Test Site having its own place in history and time—

Its own identity.

Yes. You know, there's something else that probably—it may not—it may be a diversion for you, but there was a lot of thinking before Nevada about what to do. And Jack Clark looked at all sorts of places, and maybe other people too but I think of Jack Clark, including off the Atlantic coast where the wind normally was out to sea.

Right, they write about that in here.

And in northern Canada. You see, when the Korean War broke out just as we're getting started—we're already testing at Enewetak—but there was a question: Can we continue? I mean, with the Russians and the Chinese, the Koreans, sharing the same ocean, is it really safe to test at Enewetak? So the whole question was reopened. And I remember myself studying maps of the far north of Canada. And the trouble is there isn't any place in the world where nobody lives except the icecaps. That's all there is. There's always somebody, either transient or permanent,

and having had that accident in 1952 at Enewetak—I'm not quite sure I have the time sequence right but we were already getting sensitized about people.

You mean the Japanese ships and the—I mean the fishing boats?

[00:16:40] Well, there was the Japanese ship [*Daigo Fukuryu Maru*—[for] Bravo was the Japanese ship and it was the Marshall Islands at Rongelap and Rongerik. And in the case of—I guess it's Rongelap, the one where most of the people were, it's a big atoll, twenty miles or so across, and the natives were at the north end, and they got a hundred Roentgens. The south end got a lethal dose but they weren't there, they were in the north. It was just the other side of the atoll from where they were living.

So it was a close call. The Bravo thing could've been much worse than it was. And of course our people fought back—they always do—and that's when we had these silly things coming out of Washington about sunshine units and the various kinds of discussions about how fallout's not so bad. It wasn't that we didn't know that it was harmful and that it happened, but the program seemed more important—and these people who are fussing about it [saying], get them off our backs. Not me, I'm not talking about myself, but it was very common that, we can't let something like this stand in the way. It's not very bad and it was an accident besides, you know.

So one of the funny little side trips I took with—I think I may have arranged it or Gerry probably arranged it. We got an airplane, it was easy to do, and we went to another island called Wotho which was nearby, and we took Ernest Lawrence and the regents, just sightseeing. But it was one of the places where there had been a little bit of fallout. There was no commotion there. Well, somebody had gone just before us to find out what the problem was and nobody seemed to understand what the problem might be. Nobody there cared anything. And then there was a schoolteacher—there were only fifty people there—and she was pregnant by an American GI.

We thought, oh, we've got another problem. So people went over trying to explore that problem. That was even tougher. That had no idea: What are they talking about? What is this problem? you know. She's pregnant. What's the problem? That's a good thing. And they knew, intuitively that a population of fifty need a constant stream of outside blood. So they all thought it was a great idea.

But it was really a joy. We spent a day maybe—maybe not; probably we came in the morning and went back in the evening—visiting the school and the schoolteacher. Wonderful tropics, almost—Bali Hai stuff. We met women sitting under trees weaving baskets. There was a ship that came in only a few times a year, and it traded copra and it took out cocoanut and left medicines and things like that. And also by that time they had become accustomed to importing, rice or something, maybe a little more. Not very much. They were really self-sufficient. But they had come to depend on these boats. And because of the boats they made the little baskets and they traded them via these boats to the outside world. And, you know, souvenirs often say, “Made in Japan.”

Right.

Using mercurochrome and gentian violet as the colors, that they got from the medical center, they painted on them, “Made.” You know, not made anywhere, just “Made.” Because they knew that souvenirs had that on them.

That's lovely.

I used to have a couple of them downstairs. The mercurochrome and the gentian violet faded, evaporated I suppose. But anyway I had them for years, just “Made” they said. And I remember—I was always pleased when Lawrence was pleased because, I said, that means that a

fifty-year-old man can enjoy this sort of thing like he was a boy. That's great. And I saw it as a good omen. Because I remember arranging helicopter rides for Lawrence. He just really loved it.

[00:21:37] End Track 5, Disk 2.

[00:00:00] Begin Track 6, Disk 2.

One thing I wanted to talk to you little about before the day gets too far along, because you mentioned it earlier and I was curious about it, was Plowshare. What was the story with that?

Well, I'll tell you the whole story, which I didn't even know at the time, was that Fred Reines, who later got the Nobel Prize for the neutrino when he was at [University of California] Irvine, was one of the top senior people working on testing, or worked anyway at Los Alamos, a physicist. And when the Russians first made the test in 1949 and the Americans announced it— [Harry S.] Truman announced it—the Russians said, We don't know what you're talking about. We told you all along we knew how to make bombs and we've been using them in experiments and moving mountains and maybe that's what you're talking about. They just denied testing a nuclear bomb, or tried to cover it up, and they used this notion that there's some experiments with nuclear bombs that you may have. And Reines thought about it and he then started thinking about ways to use nuclear bombs to move mountains and do other useful things. And he published a little piece in the *Bulletin of the Atomic Scientist*. So that's where it started, but I didn't know any of that. We at Livermore were always looking for extensions. That's why we got in to thermonuclear power, fusion. And so I think independently, although somebody might have talked with somebody at Los Alamos, I think independently we started thinking ourselves about how to use nuclear weapons in a positive way from an economic point of view. And very soon ideas about creating dams, underground reservoirs—mostly we thought in terms of digging, like digging a new Panama Canal, making a big harbor in Alaska at a place whose name was Teller, northern coast, it was somewhere around Nome. And these

peaceful uses, we called them “peaceful uses.” Later we learned the Russians called them “economic uses.” And as I said, I think that Harold [Brown] suggested called it Plowshare because of the biblical injunction: Beat your swords into plowshares and your spears into pruning hooks, or something. [“They shall beat their swords into plowshares, and their spears into pruning hooks: nation shall not lift up their sword against nation, neither shall they learn war anymore.” ISAIAH 2:4.]

Right. Yes.

Later, when I looked it up, there are actually three references like that in the Bible, and the other two are the reverse. You know, “Beat your plowshares into swords,” and they were each of them playing on the words. I mean, one of them was first and then the other, even in the Bible, was somebody who knew about this and making the opposite twist. Because they both appear. I mean, “Beat your swords into plowshares,” and “Beat your plowshares into swords.” They’re both in the Bible. Well, the Bible’s wonderful when it comes to contradictions. [“Beat your plowshares into swords, and your pruning hooks into spears: let the weak say, I am strong.” JOEL 3:10]

Right.

And I think that actually twice you’re supposed to make your weapons and only once you’re supposed to get rid of them. As we say, we could look it up. In my reader that I wrote for *Scientific American* long ago, *Readings [from Scientific American] in Arms Control*, [W.H. Freeman, 1973], in there it actually says, Isaiah, chapter something, chapter something. And I’m not sure that Harold [Brown] named it but I think he did.

[00:04:06]

I named Project Rover, which was our version of the nuclear rocket, and then for quite a while they used it—it was called the Rover Project even after we were out of it, and then that name disappeared and names like Kiwi and whatever else took over.

That was at Nevada, right?

Yes, at Jackass Flats.

Because we saw, when we went on our tour, the remains of whatever had been there.

See, I got back into that. I was in it originally because we were promoting it at Livermore. Then we were taken out. Washington said, and correctly, that really we don't need two laboratories working on nuclear rockets. And since Los Alamos has the technology base for working graphite, it's obvious it should be there. So they just took us out by force, they just said no more. We'd been spending modest amounts of money and they just, NO! They gave us Pluto instead, which I didn't like but Mills did. That was a nuclear engine and I didn't think that was going anywhere either, in the long run. But Mills was very enthused and some others too, so we did it. We took it up as a sort of a booby prize when they took us out of Rover.

I called it Rover because I asked two guys—Biehl was one and I'm not sure who the other would be—I asked them to study the question of a reactor for use as rocket propulsion. And I called them the Rover Boys, that's how it got started.

And was there an allusion there or—?

Oh yes, well, we were certainly naïve. Whether we should have been smart enough to know it was a dumb idea, that's always hard to say.

Oh no, I was saying—OK, but that's a good thing you're answering me, but was there—when you said the "Rover Boys" were you referring to something—?

Oh, something in my youth about some kids that had that name. I really don't know the reference. Unlike Isaiah, I wouldn't know where to look it up.

Yes. Because I was reading yesterday, when I was reviewing Race to Oblivion, your critique of the nuclear-powered airplane.

Airplane.

But obviously with Rover that was a different—that was a rocket.

Of course it was a different era. My involvement with Rover was well ahead of my involvement with the nuclear airplane. And much of what I learned in connection with Rover and with Kiwi and the Los Alamos program is what made me cool to the nuclear airplane. I mean, I already was getting into an understanding of the kind of problems before I ever was involved with the nuclear airplane.

Later on, and it's too bad—this might be in some of Gerry's memoirs somewhere—Gerry was actually in close touch with the people in the Soviet Union who had the Plowshares program there. One or two of those people actually came here on a lecture tour, and I remember Gerry shepherding them around California. I think I actually met them. They were eager to talk about their experiments, and they had a lot of them. They did more than we knew, and their ideas, of course, were well beyond what we knew, about building dams, and they brought us all kinds of blueprints: if you have a valley like this, this is where you put the bombs to blow the stuff to close off the river.

But they never did it, did they?

Yes, they did.

Oh, they did do it.

Once. I think just once, and that one was done by putting the bomb, I believe they put it right in the river or on the river plain and then the crater lip formed the dam.

Oh wow.

So they had the dam upstream blocking the water and another one down and it's not doing anything. I think that's right. But the guys who talked with Gerry talked about, I remember, and I met with them briefly, they were talking about putting them in the canyon walls and blowing the whole canyon wall down into the river.

And I guess the layperson's question right there is what about contamination?

Well, that was always a problem even there. Our people would always say, well yes, that stopped us but since they have no care for human life, it won't stop them. That phrase was just sort of standard in dealing with the Russians. They could do this or they will do that because they have no regard for human life. And of course Stalin didn't have a lot when it comes to treating his prisoners. But they were aware of those things. They tried to take them into account, especially the scientists; but you know Central Asia has a pretty low population level and so they were more careless than we would have been. We would not have done what they did. But they could get away with it. And they also made underground reservoirs and they used it to put out an oil fire. They actually did a number of things. And we never did very much. I mean, the fact that we never did anything practical. We had a lot of experiments like Sedan and other things. But I remember one of the things that made me realize how crazy this is, somebody showed me and it's correct, how you can use a nuclear weapon to stimulate an oil well. You got this oil well, you put the bomb down the shaft, you blow it up, it cracks up all this rock, the oil—the gas starts to—loosens it up.

Right.

And that's true. But we drill something like close to ten thousand new gas wells a year, and in order to make an impact, the number of wells you stimulate with nuclear weapons has to be comparable to the total number of wells you drill. There would've been thousands and thousands of underground nuclear explosions all of them behaving differently, some of them would put a lot of radioactivity in the gas, some of them wouldn't. Lord knows, but it's just a crazy idea. The idea of getting more gas by stimulating the wells with nuclear explosions is just wonderfully crazy. Imagine ten thousand underground nuclear explosions per year scattered throughout the Rocky Mountains or in Texas. But the Russians did do things, and they explored another thing. They explored putting cavities in salt domes that could be used for storage of anything, gas, oil, water. And so the Russians were quite eager about Plowshares for a while. I mean, all the stuff we got in 1949 was phony.

What they said, yes.

It was Foreign Minister Vishinsky who said these things. It was the foreign minister himself who said these crazy things. But the technical people in Russia did become quite enthused about it. That's why we tried to work out in the Ford administration the technique for separating peaceful explosions from military-based explosions. And that's what got the Russians, that's when they started coming to the Nevada Test Site. That's a story that happened when I wasn't looking, mostly. But that's a very important story.

Well, let's stop for a minute and then we'll have that story.

[00:12:05] End Track 6, Disk 2.

[00:00:00] Begin Track 2, Disk 3.

I thought maybe we could talk about—you mentioned the Russians coming to the test site. I know that there's documents over there I've seen about that. But that was in connection with—

Well, it was in connection with observing tests at each other's sites [Joint Verification Experiments 1988]. I'm a little mixed up on exactly what happened because of what—but one of the stimuli about getting to each other's test sites was to somehow or other get greater knowledge of what was happening there so that among other things you could fit peaceful uses in with military uses. You would make sure that there were no experiments going on. See, the fear for people who are paranoid—and people in this business and the intelligence side of it always are—the idea was, We'll agree with them to use peaceful uses. We'll ban all military tests, we'll continue peaceful tests, and the Russians will use them to develop these new ideas that are going upset the strategic balance. The idea was the Russians are always going to discover something that we don't know that's going to upset the strategic balance. And so the idea was to somehow or other, if we're going to allow peaceful uses, and there were people there and here who said, You've got to do that, it's a big economic opportunity you can't forego, you had to get a better handle on what was happening at the test sites. So it was both with respect to arms control, nuclear test bans in general, and it was specifically connected with these questions of distinguishing peaceful uses from military uses. And I remember—I wish I could—[Evgeni N.] Avrorin. Avrorin, he's the first person I ever met from one of the Russian labs. And he was one of the senior physicists at Chelyabinsk or Snezhinsk as they also call it. Sneg means “snow”—and Snezhinsk is just the adjective. Russian is a highly inflected language and letters are always changing, so it goes from Sneg to Snezhinsk to mean “snowy.” And that's the town where the—see, the laboratory was called Chelyabinsk-70 or something. And then it also was called just simply the All Union Laboratory for Pure and Applied Science, had some name like that. Well anyway, Avrorin and Mikhailov, who was the vice minister of nuclear things, and an interpreter came to my hotel in Washington. We had breakfast together and a long talk. I'd never met anybody from their labs before.

And what about era would this be?

Well, I'm not quite sure. It was before the end of the Soviet Union but it was when things were beginning to relax, so I suppose it was the 1980s. And the person who sort of set it up—it was set up from two ends. One of our groups, like FAS or the Union of Concerned Scientists [UCS], had invited them here. The government hadn't invited them at all. But they had been coming—they had previously come to Nevada, so that had broken the ice. The Chinese were dying to get to Nevada. They just so badly wanted an invitation, so they kept inviting our people into their program, in some depth, all aimed at getting an invitation back which never came. Well, our people in Washington said, *we're not dealing with the Chinese, just the Russians.* But anyway somehow these groups, like UCS and FAS, had invited them here. And at that time I don't think they came west, they just came to the East Coast. And one of them invited me to have a meeting. And there was a guy at Livermore who was in the arms control side of things—I can't think of his name, but he was one of the good guys up there—he was involved in helping to set this up too. So I had breakfast with them. I had never met them before, it was a big deal.

[00:05:04] *Yes. And what was your position then? Were you—?*

I was probably a member of the President's council—the then equivalent of the UC [University of California] President's Council on the labs. It was called the Academic Advisory Committee at that time. It had less force behind it than the current—it got into it less deeply. And I probably was that. I've never been completely out of it but there were periods when I wasn't very far in. I was probably also a member of the JASON, so I was still working on the cleared side of things. So there was a certain delicacy in meeting with them but I did it anyway, and nobody scolded me. They just sort of were disdainful: *why would anybody want to do that?* But I did meet with them and we had a marvelous time, and I enjoyed meeting Avrorin. Then it must have been

very close to the end because it was very soon after that that the opportunity for going there actually opened up. Within a few years. And I never went because when it happened is when I was starting to battle prostate cancer and I was not feeling very well—the radiation gives you a lot of problems—and so I was feeling sufficiently unsure of myself that I could've angled an invitation but I didn't. I mean they said, You've got to come, let us know, that sort of thing. But nobody said, There's a meeting on May 5, you've got to be there, you see, that didn't happen. But it's obvious I could've gone but I never went. I haven't been back to the Soviet Union since the end of the Cold War. To Russia. The laboratory's name was changed, so instead of being the All Union Laboratory of, it's now the Russian Laboratory.

Maybe we could go back a little bit because in my mind, from having been reading your 1970 book, which I liked very much, and now that we're out of the Cold War and there's sort of this interesting thing that happens, at least from my observation of history, that all of a sudden we have a break in the time line and we say that was the Cold War era and now we're in this war on terror era. And so you wrote the book almost thirty-five years ago when the Cold War was still going on and you had a big point to make. Was there something that said [to you] "I need to write this book for—?"

Well, there were a couple of special stimuli. I can't say that I would not have written it otherwise but there were two specific stimuli. One was that Harold Brown invited me to come and talk at his inauguration, to talk about anything, and I talked about the nuclear part of the Cold War.

His inauguration as—?

As president of Cal Tech [California Institute of Technology].

All right.

When I was walking out in the procession with my square hat and so forth, one of the ladies leaned over to me and she said, *That speech was written in Moscow*, she said. So I wrote it out. It was not much of a speech. But anyway that's what I turned into the book.

Now I had previously been, during the 1960s, the decade before, after I came here, I visited Eisenhower a number of times at Palm Springs. And we had wonderful talks, just reminiscing about the past and talking some of these things over. And at one point I asked him to expand on his remarks about the military-industrial complex and so forth. You know, it caught everybody's attention.

Right.

It had another thing in there about scientific-technological elite, and I remember Kistiakowsky was pissed off, as they say, about that: *Why did Eisenhower say that about us?* you know. Actually he wasn't talking about us. He was talking about Teller and von Braun when he was talking about this elite going to get us in trouble. I asked him about it.

And he said that—

That's what he told me. I said, *Who'd you have in mind?* And without any hesitation he said, *Teller and Von Braun. Who were always bugging him. They were always coming in and telling him, We've got this great new idea and invention and if the United States doesn't do it, we're doomed. That's what both Von Braun and Teller were constantly saying, and they had a status such that they couldn't get to him easily but they could get to him secondhand and sometimes occasionally firsthand.*

So that's what he had in mind. But anyway, I also asked him about the military-industrial complex, and he said, *well, I didn't have anything in mind much more than what I said. He said, In fact I told my speechwriter—this is a wonderful remark, I wish I*

could get it exact, he said—I told my speechwriter that I wanted to say goodbye to the American people. I wanted him to write my speech, my farewell address, and I want to say goodbye to the American people and I want to get these two warnings in there. A lot of people credit the speechwriter with inventing the warnings. They're Eisenhower's warnings. I don't know which words are his. But he told me directly, without any doubt, the purpose of the speech was to say goodbye and all the rest of it is fluff, put those warnings in and then make the rest of longer. Wonderful for an appropriate end. But the two warnings were the whole point of the speech—it wasn't an afterthought.

Anyway when I asked him what he had in mind, well I didn't have anything more than just what I said. And then he said, why don't you draft up a couple of pages for my memoir, I'm writing my memoir, and draft up a couple of pages about that for me, because he knew I had the same kinds of ideas that he had. I never did, not even word one, I just never did. But I always had that in the back of my mind, I mean the president said I could write this up for him in his book.

And then Harold [Brown] invited me and that was enough—put that all together and we'll—so the date was as you said, it was the 1970s because Harold was president of Cal Tech immediately after he left the Pentagon and that was 1968. He left when Johnson did. So he left in 1969 and he came out here. And so somewhere very, very close to 1969 they had a ceremony up in Pasadena and I went up and talked with them.

And were you chancellor here then or—?

Yes. I was probably acting chancellor. Yes, I was chancellor on my own, as you might say, from 1961 to 1964, when Harold was in the Pentagon. So when he was back out for Cal Tech—as I say, he must've come in 1969 and I was acting chancellor 1970 to 1972, so it fits.

All right. It fits with then. You write about—there's so many interesting things that you write about, just the technical pieces, but the notion of overreactions and then the technological excess that goes with it.

Exuberance. I even used the word. Before Greenspan.

And patriotic zeal.

Yes.

And I guess when you think about how the Cold War actually ended and how people—I mean, what did you think it was going to turn out to be, how we got out of this at that time?

Well, let me tell you, I didn't know but I was confident we would. One of the things that distinguished me, us Cold War liberals I guess, from the Cold War hawks, in my particular case, was the belief that it would end and it would end OK. It would come out all right, somehow to our benefit, but the Cold War would end, and it would end because somehow they [USSR] would get—I didn't think of them collapsing but I mean they will somehow or other stop misbehaving, threatening everybody and otherwise being obnoxious. And so I believed it would end and that it would come out favorably. I can fill in small details but the big thing was just that I was confident it would end and it would end favorably to us. But not with their collapse, they just would finally get their act together and behave right. With respect to their own people, I always thought the way they treated themselves was even more serious than the way they treated us and everybody else.

But then I had a talk, it was probably 1980, with Kapitza, Peter Kapitza. And Peter was very optimistic. I asked him what he felt about the future. It was ten years before the end. But he liked Brezhnev and he said—he knew Stalin. He explained his optimism. He said, At the beginning our leaders were people with no education, meaning Stalin, and we got the kind of government you would expect. Now our leaders are educated in

engineering and it's a lot better. The next generation of leaders will be people educated in the social sciences and law and letters and then you'll see. It will be just as good in my country as in yours. We were meeting in Switzerland on neutral ground.

Wow!

So, he was unduly optimistic but he had the signs all right. It was a good and proper intuition that he was bringing to this. Kapitza did know the facts and he wasn't just wildly guessing.

So I took that home with me; I remember that comment. He was a very old man, the same age as I am now, maybe a year or two younger, and I remember he couldn't keep from drooling, had to wipe his lips with his handkerchief. His wife was there. It was a nice garden somewhere around Lausanne, if you know that part of Switzerland. It's the sunniest side of the lake, looking at the south-facing side. And he was able—he had hard currency, he'd had it for years, I don't know exactly how, so he was able to travel, he was able to subscribe to foreign magazines.

But that was his view. He was optimistic because the next generation of leaders would be better educated, and the present one was better educated than the prior one. But I already had that view, that somehow the Cold War is going to end and the end is going to be favorable to us, but I didn't think they would collapse.

So back to the notion that the ways that—or the activities that were manifested at Nevada, maybe they weren't created there—the weapons labs, the weapons testing and all the things that happened there to build us up and be strong, winning the Cold War, to some degree is that true, or how does that work?

Well, it's just not the way I would say it. What the labs did at Nevada Test Site may be said to have won the Cold War, but the Nevada Test Site can't be said to have won the Cold War.

OK, but what about what the labs did, because you also critique all this overkill.

Yes. You'll never know. We did have overkill, lots and lots of it. Eisenhower, with some help from me and others in the Pentagon that tried to get it under control, we didn't do a very good job. In theory we could've done a lot more. But you see, all during that period the worries about it and the fears of what might happen were so strong and they usually had a kernel of reality. Now there were those that didn't, you know. Teller and others said, They tested the hydrogen bomb before we did and we never observed it. Well, that was just wrong. So Teller told us at one time, he said, we've already lost the Cold War. [Richard] Perle says, They're cheating on the tests. So there were a lot of things that were just plain wrong, in my view. But the general idea that there's a serious problem was basically true. And the only solution that had any political possibilities included nuclear preparedness. And on things like the test ban, I actually have a letter I wrote to Harold Brown which was unclassified, I think, at least I—I don't even know where it is. Harold had asked me, when he was secretary of defense, what I thought about a test ban. Because [Richard] Garwin and Bradbury had both been saying that a test ban is perfectly OK for our national security and it can be monitored adequately, and so people had been saying that in different groupings for some time. Well, I said it when I was a member of PSAC in Eisenhower's days. But Harold said, What do you think about that? I mean, a lot of time had passed. And I said, They're right from a technical point of view. The national security of the United States can be maintained adequately without testing and we can do an adequate job of monitoring. Monitoring didn't have too much to do with it; it was a question of direct effect on American national security. That would've included the potential for significant cheating but—and I said, Bradbury and Garwin are right but it would be unstable. You can't do it in America. If you had a test ban—and I must have said this somewhat better but maybe not more or less clearly—if you had a test ban, I said, the national security establishment will just start thinking about what's wrong, what's

going on, it's just too dangerous, and so on. And I think I even used words like "high strung" or something like that. Even if they accepted in the near term they'll just—it'll make—and I—that was the middle of the Cold War. So I said, *I don't think it'll work*, but, you know, I went—it was shortly after that President Carter appointed me to be the [chief] negotiator [for Comprehensive Test Ban negotiations]. They, in ACDA, didn't like that, and they knew about that letter and the arms control agency didn't like it one little bit. So I was appointed to be negotiator over the dead bodies of the people in the arms control agency, or over the minor objections.

They didn't like it because you said you thought that they—?

Well, I said I didn't think a test ban would work. And I was about to go negotiate one. So in the Pentagon, and working actually with your friend Troy Wade, I tried to work out other limitations, in particular quotas, say three a year. People were saying, *We've got to maintain safety, we've got to maintain reliability, can't go down to zero*. So we talked about quotas and I talked with Troy about them, and with Harold. But the trouble with quotas is that there's nobody for them. With regard to a test ban, you can get a constituency almost big enough, not quite big enough but almost. Regard to quotas, nobody gives a damn. The people who want to continue testing regard them as an equal nuisance, and the people who want a test ban regard them as really pusillanimous partial measures. So there's no constituency at all for things like that. But I did talk with both Troy and with Harold about them at length and I tried to develop some small details with respect to them, just before I was negotiator. But it just—there was no way of doing that. So that when you bring in politics, real politics, and decent people, it just wouldn't have worked. We couldn't get it. And it just was too limiting on the one hand and no confidence that the other side would be following it on the other. And this belief, which I

didn't share but was widely shared, that there are all these breakthroughs just waiting to be discovered. That's what we all believed when we started Livermore, but twenty years later I didn't believe that anymore. It was obvious to me there was nothing to Edward's ideas about third generation weapons. I thought from the beginning that's the dumbest—you know, it's just nonsense. It's just salesmanship. There's no such thing as third generation nuclear weapons that matter.

Yes. Fission—fusion—

Well, something beyond that. And typically they talk about directed energy, but that's what the laser—the nuclear laser was a particular example of something much more general. And they had other ideas, wild ideas, that they never would develop, about how to convert nuclear explosions into something else.

[00:25:18] End Track 2, Disk 3.

[00:00:00] Begin Track 3, Disk 3.

Since I was packing in questions that I could ask you, the other things that were occurring to me as I was reading this thirty-five-year-old book [Race to Oblivion] were general issues that you raise about striving for security making things less secure.

During the long run. But see along that same line—talking about my letter to Harold about the test ban and the political reaction to it under Cold War times—we can't even do it now, but it would be close, we can have a moratorium, kind of unstable; but earlier the question about whether we could've avoided the development of the hydrogen bomb—we now know in retrospect the Russians were already working on it before Truman's 1950 decision, but more seriously than that, if the Russians had done it first the reaction in this country would've been so much more frantic than it was. The arms race would've been much worse if we had not gone

ahead when we did, as a practical matter. Now it's a kind of an awful thing to say but it has to do with the frailness of humanity. I don't think any other country would've done it better or at least wouldn't have done it as well, but nevertheless, I can say we should have tried but it wouldn't have worked.

Well, because in The Advisors, that's your argument. [Herbert F. York, The Advisors: Oppenheimer, Teller, and the Superbomb, W.H. Freeman, 1976]

That's where I discussed this, yes.

Yes. So you're saying—

In retrospect it wouldn't have worked. In fact it would've come out worse.

It would've come out worse because even your point about Sputnik and the reaction to that—you're saying if it had actually been an H-bomb that they'd come up with rather than the Sputnik, the reaction would've been more fear.

Yes. There already was this great fear. You've read those things, and they're in *The Advisors* too, about how people like Senator [Brien] McMahon and others in the Congress really did believe that we were doomed if the Russians did it first. It wasn't just inconvenient.

That they would do it and that they would use it?

They would do it and use it, yes. They would use it for—whether they used it literally or whether they just simply got great political advantage, I don't think anybody thought that through.

Knowing what the people thought about the Russians, the using it was what they had in mind.

Yes. That kind of fear started coming more to the foreground of my consciousness before I was preparing to come see you, reading some of the literature about why certain things were done at the test site. So when they're marching these soldiers and these various things, it's, how close can the units get to the nuclear battlefield that's taking place right here on American soil?

Yes. But you're still putting it in a way that I never would have put it. In my own mind I think of those things as tests and experiments and not the battlefield right here on American soil. I don't think of it that way.

No, but I'm saying that that's how they were describing it.

Yes.

The reason that they had the soldiers do what they did, they had scenarios. I'm not being exact about this. The scenario would be there was an attack off the East Coast and the Russians had made it to the Mississippi River and—

Yes. Well, realize as you're discovering how people can think of it twenty years later, faced with a lot of other facts and information. Think how it was in the Cold War when we didn't have these other facts and information, how much worse it was. People are capable of believing in the worst and acting on it. It's just what people do. When somebody says something despairing about America, including I might say it myself, I always end up saying that they would do it worse in London, Paris, Beijing, Moscow, anywhere else they'd do it worse. You know, in Finland they might do it better. In a small country off at the end of the world, or New Zealand, just four or five million people, fewer layers from the bottom of the society to the prime minister, they might do it better. But there's no big country would do it—as bad as we do, to put a little more cynical twist on it, I used to say the reason the United States intervened in Vietnam and the Canadians didn't is not because Canadians are nicer but because they couldn't. Canadians couldn't imagine intervening in Vietnam. It's one-tenth the size of the United States, and that factor of ten, that's the real difference between us and Canada. Now there's some other differences too. They're both homogeneous societies but in quite a different way. I mean they have this 30 percent French minority and we have a much more complicated minority ratio.

But that's interesting, what you're saying, that the argument that you make in The Advisors, maybe politically was just an impossibility.

Or even that it would've been worse.

And that would've made it worse, yes.

If the Russians had in fact done it first and had been up front about it. Or maybe if they weren't up front but—yes, Sputnik was such a shock and yet—many people saw it as a direct danger because of the ballistic missile connection. But it was not seen as a threat in the same way that the atomic bomb was seen, ten years before. There's only eight years from the first Soviet atomic bomb to Sputnik. You know, that's a really short time. The same people who were surprised in one were surprised by the other. It wasn't a generation apart.

So you're saying the shock of the Russian atomic bomb was greater than the shock of Sputnik.

It was probably greater. Certainly, yes, it wasn't quite so general. Sputnik involved virtually everybody—

That's what I remember even as a child.

—but whereas the atomic bomb had a certain elite emphasis to it. Everybody did know but it was the national security elites that were especially excited, and the Congress. In that case it was just like Sputnik. There were the congressional committees and the congressmen and the press and so on who saw and the top military and so forth. But you know at first the top military was somewhat relaxed. They wanted to know, Exactly why do you want this hydrogen bomb? What's the advantage if it is bigger? So what? [Omar] Bradley was the chairman of the chiefs [Joint Chiefs of Staff] I guess. But these were the real fighting World War II generals and they knew the downside of war, like Eisenhower too. And so that influenced them to some extent.

So they didn't have the same enthusiasm.

Yes, they eventually acquired it but it was the Congress, we know the names of specifics like Brien McMahon and so on.

I think I mentioned that at one of these events in Nevada at the Test Site Historical Foundation, Sergei Khrushchev was there.

Yes. And the granddaughter's even more fun.

He was good, but the impression you got, and it was just a short speech, question/answer, was that his father never, in spite of what he said about burying us or whatever, he never intended to actually use a bomb against us.

Oh, I think that's right.

He was always posturing or something in reaction to what he saw.

You know, I heard the, we will bury you, in real time. I was persuaded essentially immediately that that's a Russian metaphor meaning that, I'll be at your funeral. Not that, I'll kill you, but that, I'm the one who is going to survive.

I think that that is actually what Sergei said, that, I will persist when you are gone.

Yes, somehow people knew that at the time.

Oh, they did?

Somewhere I think it was right away. I read an explanation that said that's what he meant, so I've always known that's what he meant. And I was the kind of person who would believe it.

There were other people who said, it's all a plot, he really does mean it. He really does mean it the other way and he's just pretending.

And the other interesting thing about that day was that the other person they had there was

Francis Gary Powers Jr.

Oh, he's the son.

The son. And they had a little discussion and Khrushchev—

Well, they're both sons.

Right. The two sons.

Yes. Yes.

And Ambassador—what was his name? I'll remember his name in a second—was moderating, but Khrushchev was saying, You know, if we had been such evil, awful people, you know—Francis Gary Powers landed, he ran into some people who were going to a wedding, they didn't know who he was, they said,—Oh, you're an American. But if it had been this—he would have been shot. Why didn't he take his poison? Because everyone was being so nice to him.

Well, he was supposed to take it before he ever met those people.

That's right, but he didn't.

Well, maybe he was supposed to take it after he was—if escape seemed impossible. So maybe he did it all right.

Or if he was going to be interrogated.

I thought he'd taken it. You see, I knew about it.

Oh OK, tell me that story.

Well, when I heard that he'd been shot down, my assumption and that of, I think, the people I was talking with was that Powers will have poisoned—couldn't be—well, when he was missing, see, before they had said anything, we were pretty sure that he had done the whole bit, taken his poison and so on. And felt badly about it for that reason. But I thought he was dead.

Now what was the deal with that? Eisenhower had said we were going to do one thing with the Russians, and then the U-2 went over and there was some—

Well, it's complicated because Eisenhower's view of that was that he never once told a lie about it, and that in fact he took a lot of heat and it might've been better if he did. He never denied that we were flying U-2s—not even that last one, as well as the previous ones—but he let the government deny it and say that it was just a weather plane. But he never said any of those things. And he told me—this must be in the book somewhere—he told me that when he met with Khrushchev at Camp David, that he never brought it up. The Russian government had been protesting because it had been going on several years, but the protests were secret, they didn't want to admit that it was happening. It was an embarrassment that they couldn't do anything about it. And Eisenhower said he never brought it up, and then he said, *And I don't know what I would've done if he did, if he had.* And I think that's perfectly true, that on something like that you really don't know before it actually happens. You know, flying blind is what you do in real life.

But that's what he said; he said he never brought it up. That's what we were discussing at Palm Springs, all kinds of wonderful things like that, we talked about there. And he never brought it up and if he had I don't know what I would have said. And George Kistiakowsky was there, often was doing the interpreting at Camp David.

Yes, at Camp David. I understand.

And he says—George relates this thing, it was typical Khrushchev, he says that they got talking about what they did with leisure time. Khrushchev hunted and Eisenhower says, *I play golf.* Then Eisenhower, just a friendly remark, an innocent remark, he says, *But, you know, you can always reach me on the phone. I'm never out of touch, he says, Right there on the golf course there's always somebody who has a phone and they can get me at any time they want.* And Khrushchev took it as boasting and he said, *I've got a*

telephone too. I think those are George's exact words. He said, I've got a telephone too. You're not the only guy with a telephone.

You know, I had a—the brief time I was interim secretary when I was acting secretary on a number of different days—

Secretary of defense.

Yes, but never—but—they're just out of town for a day or something. So—oh, there was only day when anything at all when I acted as secretary, much to my surprise. That's a separate story. But when I was interim secretary, before McNamara was sworn in, nobody could know for sure how long it was going to take. I mean, things could go wrong. So I was then brought in to the get-ready-for-war loop. And I had a buzzer, and the telephone in my bedroom. It was long before cell phones or anything like that, this is 1961, Kennedy's inauguration. But I had a buzzer and if it buzzed I was supposed to go to the nearest phone, and I had this secret telephone number which I can still remember on how to call the war room.

And you're saying the buzzer was on your body or it was—

Yes, it's a thing like this [demonstrating], it fits in a pocket or something. Maybe I had it, I don't [know]. But it was a buzzer to tell me to go to the phone and call the war room. And then in the bedroom they placed this phone, big red or blue light on it, and of course I called in to check whether it's working, and whenever I called in they would always say, who are you calling, please? Well, they—when this strange phone rings in the war room, well, it's a question of what's going on; you're never quite sure. I never met the guy but anyway it was somebody. Or some group of people. And so after McNamara finally was sworn in, Sybil says, Tell them to come and get their phone. So I did. I mean she never liked this phone in the bedroom. So I said, Come get your phone, and they said, Well, you never know; now that we've gone

to all the trouble of putting it in, maybe while you're still here—so they left it until we moved out of the house. It was three or four months.

What a story.

And of course, it never was used, for anything except checking whether it worked. But they briefed me about how—they did then the only time brief me about what the secretary's role is in releasing nuclear weapons. That was the one thing that couldn't be handled in a routine fashion.

Wow.

And so they had to have people and I was the person. But of course it never happened.

[00:16:58] The very day that—well, the second day after Kennedy's inauguration—the first day I had the Pentagon to myself. The second day McNamara came in and I didn't know he was there. I mean we'd met of course. But Johnny Foster was visiting me and I said, *would you like to see the secretary's office?* He visited me in my own office just a half a corridor down. And Johnny says *Sure*, so we go in the back door, through the secretary's private conference room, and then we burst into the secretary's office and there's McNamara talking with the chief and vice chief of the Army. They look up, startled. I was surprised too. I said *Hi*, you know, *Hello*, and then said, *if anybody calls and asks for the secretary of defense, tell him I'll be at home.* And they all laughed properly.

The one time—the one action I did as secretary was a bold action. I mean not pussyfooting. What had happened was, it was early in the space launching business and the Air Force, in order to get a certain one of these north-south reconnaissance satellite things up, they wanted to shoot it a little bit towards the east because the rotation of the Earth helps. Every little bit helps, it's so marginal. So they wanted to shoot slightly east from a cape in California. And the naval commander of the Pacific missile range says, *It's too dangerous.* And he is the one,

the way the power was set up, it was his authority to prevent it. So he did. Well, the Air Force was eager to get it up and the secretary was out of town, and so was the deputy secretary.

And was Harold Brown the secretary?

No, it was long before Harold.

OK.

I was DDR&E [Department of Defense Research and Engineering], so I was acting secretary sort of. When I first got into my office, there's a call from the secretary of the Navy. I call him back and he says, You're the secretary of defense and we have a problem. Well, his man had said the Air Force couldn't shoot and the Air Force was furious about it. So I spent half a day talking with the principals. Curtis LeMay was the guy who had been running research. And of course the range commander wasn't there, but I talked with the assistant secretary of the Navy and with others about the situation. And then I just hit the simple decision. I said, Shoot.

You did?

So they shot. But it went right over a county park. It's a not very commonly used county park. It's north of the city of Santa Barbara, it was a little county park. Went right over it. And what I remember is it's extremely unlikely to fail there. It would either fall back on the pad or it'd be a thousand miles away, but to be fifty miles away is pretty unlikely.

And then I remembered that even when you deliberately were trying to kill people with missiles, as the Germans did in London, you dropped a one-ton bomb—that's what they were, one metric ton, the V-2—in the middle of the biggest city in the world and most of the time it never kills anybody. Now on the average it killed two people, but that's because in five thousand shots or something, there were three or four of them that killed hundreds. But most of them never killed anybody, by some small majority.

And so I decided this is too improbable, and other thoughts I still remember going through my head, we postponed for one day all the workers going in and out of—an extra trip in and out of the test site from Santa Barbara launch site. The danger on the highway is much, much greater than the danger—now, of course there's a question of who's innocent and all that sort of thing. But anyway I had really no trouble telling them to shoot.

Would that have been from Vandenberg [Air Force Base]?

Yes. And you see the reason for Vandenberg is that they wanted north-south. The satellites work best on north-south orbits. And going out of Florida, you couldn't go straight south. It went over Cuba, and then Brazil and every place else. And you know shooting over the Santa Barbara county park once is one thing. Routinely shooting over Cuba and Brazil, which are much bigger targets, is quite another. So we were constrained about shooting out of Florida, only to go east or with some small angles, and the first land was Africa. And actually we did drop something into Cuba, do you remember that?

No.

Well, it actually was troublesome because it was one of the very few instances in which the payload had a radioactive power source. This radioactive power source somehow fell near a cow and did some kind of damage, I mean the radiation effect, or maybe it was the potential. But anyway, fell into Cuba, as unlikely as that is.

So that's why we had Vandenberg. There were constant spy satellites, they're north and south, it's the right way to shoot them, launch them. But you see the launch velocity is five miles a second. And the rotation of the Earth is a thousand miles an hour. It's a small fraction of a mile per second. But it's like a tenth, I mean the Earth's spin, so if you shoot east it's easier. You get the rotation of the Earth.

You get a little push.

In addition to the rocket you get the boost, and on Earth with no winds it would mean flying east takes less fuel than flying west. It's this very teeny-weeny effect, and the wind is much more important. But the fact that the Earth rotates towards the east matters with rockets. They're out in space, there's no wind.

So that's what the Air Force wanted to do. Instead of shooting straight south, you get just a little bit of English, and it took it right over this county park.

Wow.

So the Navy, the guy said, No, can't do that. And the secretary of the Navy, when I called him, he said, You're the secretary of defense and we have a problem.

Well, we've been talking a long time, and when we took one of our breaks I was looking up at your thing here about Livermore and your postdoctoral [fellowship], and since we started this morning with the origins of Livermore, maybe you could tell me a little bit about what that's about.

Well, what it's about is that they have—the program that you read there, it's a postdoctoral fellowship which pays this guy and he doesn't have to do anything for the lab except study something that's related where the laboratory's an appropriate place. And there is a young man, he's a Vietnamese American, born in Vietnam but he speaks perfect American English. He came here, given how far back the war was, he came here at age one or two, something like that. Did you meet him, Sybil, when he came down to see me?

Sybil York: Yes.

Herbert York: What was his name? Bong or something?

Sybil York: Nguyen.

Herbert York: Oh yes, that was his first name.

Sybil York: With the typical Vietnamese—pronounced “win.”

Oh OK, I never knew that’s how it was pronounced.

Herbert York: Yes, the pronunciation doesn’t fit the spelling.

Sybil York: But since he’s the second Vietnamese who has told us that that is the way it is pronounced Win.

Herbert York: Yes, but that was—I think it was his first name, but anyway like Nguyen Vong.

Sybil York: Yes, I think that was the second.

Herbert York: And so he came here and we visited, you know, nothing of great consequence—
But he’s a physicist.

He’s a physicist. He’s a scientist for sure. I think he’s a physicist. And he was just developing his interests, so it wasn’t really clear, although he was—what the heck? He did have a particular project and I think it involved arms control, but I’m not sure even of that. And then there are two others, on entirely different fellowships with my name on them, for students here.

Oh really?

And one of them is named, oh I guess it’s Sandra but anyway Sandy Weiss, and she came to visit me. Obviously she was Chinese. So we talked and it turns out she was born here and her ability in Chinese is about the same as mine. I mean she’s just learning, and in fact we’re using the same books as primers. There’s a couple of good books for people who know a lot but not enough. So at the end of this thing I said, are you married?

And she said, No.

And so I said, well, I thought maybe you got the name Weiss from your husband.

She said, No, it’s my father. He’s a Polish Jew.

And I said, well, you look all Chinese.

She said, well, he's got dark hair and dark eyes.

And she's from Seattle. Now that was her. And then there was a young man. And I remember what Ms. Weiss wanted to do. She was hoping to get to Washington using the UC—there's a good solid UC [University of California] base with a lot of support back in Washington. And she wanted to go there. That was an additional sort of action. I mean being a Herbert York Fellow didn't get you to Washington, it only got you some money. And now she had to arrange separately to go, so she may even be there. But Susan Shirk whom we saw there this morning asked me that once a month I should meet with her.

And all these fellowships have to do with arms control?

Yes. No, the one at Livermore just has to do with national security issues. Could be any element of national security issues, including arms control. Including why it's not a good thing. The ones here are arms control because they're related to a program. There's a bigger group of about twenty or thirty statewide who are part of a bigger program. The purpose is this very general program of educating a new generation of people interested in these subjects, and people often put it in terms of the fact that us from the first generation are dying off. But they put it kindly, we need a new generation. And they often say complimentary things, or replace you and stuff like that. But they are separate from that but they relate to it because that program, they're also all Fellows but their fellowship money comes from the Science Foundation. And I'm not sure where they get their money for the two—there's a lot of change going on and of course with the state budgets—that's a true crisis there. They're going to cut back on freshman admissions.

They are?

Yes. First time ever, as far as I know. And they're going to reduce faculty spending by 5 percent.

No one says how. But you see we probably spend more than 5 percent of the faculty budget on visitors. We have people of our own on leave or on sabbatical, which releases some money.

Yes.

[Interruption here. Dr. York talking with someone in the background.]

Well, where were we?

[00:30:57] *We were talking about the budget crisis at UC.*

Oh yes. The reduction in faculty expenses by 5 percent probably can be made up entirely out of not filling vacant jobs left by people on leave and things like that. So they won't—it's not the kind of thing—during the Depression they actually were faced with firing people, but that's sixty, seventy years ago. It won't come to that. But all kinds of research will be cut off, and then the saddest thing is that they'll raise tuition and fees and the really big cutbacks are in so-called outreach.

Yes.

Well, it's not part of our historic main mission, sending people to the high schools. We'll still recruit but what outreach had come to mean is special courses and special counseling and lectures at high schools and just as much first year after a minority or difficult student is here, nurse them along with extra—

Right.

That's essentially being wiped out.

Well, I guess the only sort of—

Leave something for next time.

Yes, let's leave it because we've got a lot of talking here today.

Yes. One of the things I—really, when somebody says “test site” to me, one of the things that comes to mind we never talked about at all.

Which is what?

Going there and stopping overnight in Las Vegas at the Strip and staying in the—the first night I always stayed there. I went to the Strip was—this was fifty years ago, so it was a different Strip, but the Flamingo was there, the Frontier was there, the Thunderbird, there were a whole—the Strip was already there in its earliest form. And there was a lot of empty space, empty lots but there were these hotels, and I regularly planned to spend fifty dollars on gambling. Of course, all of it was silver dollars.

Right. What did you play?

I played either blackjack or craps. The difference is that in blackjack you have the illusion of having some control.

Correct.

Well, you do. It usually means you lose worse but I mean—

Right. Yes, you can say whether you want the card or not.

Yes, that’s right. And he has no choice, the dealer. Yes, you can say whether you want the card.

In craps you just have to go with the—

In craps—well, there’s various different ways to play. You can play with the house or with the player. But they’ve got it adjusted so that in each case they change the odds by one in thirty-six.

When you play with the house, the house wins on double-six I think, and if you’re a player playing with the house you don’t win on double-six. And that happens one time in thirty-six.

And that’s where the house wins.

Right.

By including that rule it just makes the odds for the house, you know, one-thirty-sixth bigger than the odds for the player. And but then again in craps, there are lots of side bets. You can bet that the next, you can get—big odds, you can bet that the next will be double-six or something like that. I've forgotten what all those are called. They're called playing the field.

Yes, I played craps years ago.

And then occasionally I went to roulette, where the odds also—it's a question of how many zeros they have but, if they only have one zero the odds are about the same as they are in craps. And there there's no way to change the odds. I mean you can bet all black, all red, but the zeros are green.

Yes. I've never played.

You can bet odd, even, you know. There's all kinds of combination plays. They all had the exact same odds. It's just that, I mean, you know, if it's thirty-six to one against you, then the payoff is thirty-six.

So when you gamble, or gambled, you're thinking about these odds when you go in.

Yes, but only to the extent I know that this game has closer odds than that one. I never had any illusions about winning. You know, the odds are always against you. And these tricks, like some people go and use double-up every time, eventually you'll win. Of course, that way you could lose a billion dollars if you do it thirty times in a row. If you've got a billion dollars.

Got it.

But there are all kinds of illusions about how to change the odds. The one that works, the companies won't allow it, if you're allowed to keep track of the cards in blackjack and if it's a finite deck, then occasions will occur when the odds are in your favor. You know, whatever,

either all the aces are out or all the aces are still in, but you know a few cards left and so forth.

But that's become, you know, they call it counting or something.

Yes, card counting.

And when they see somebody doing it, they won't let them play.

Yes, they kick you out.

But there was a brief period before they were wise to it when people could do that.

And they could make money.

There may have been others but it was the people at RAND Corporation whom I know as being the first who really worked that out. And you know von Neumann got started in mathematics by trying to work out the odds for a European game called *chemin de fer*, which is a variant of blackjack. I don't know the rules for *chemin de fer*. You know it means "railroad," is what it means. But Johnny when he was a young man and maybe a teenager, he just became very interested in calculating the odds.

Is that right?

On that particular game.

That's so interesting.

That's what he told me. I've never read that anywhere.

That's amazing. So all his mathematical—

I don't remember reading it.

Yes, I—

Well, you see it's a complicated thing. His father, I think, was a banker and he wanted Johnny to be a banker. It was a distinguished kind of job, safe job, and it got the "von" in von Neumann, because the family was Neumann originally and then they got this "von" somehow, Hungarians

did that. And it could happen there, quite properly. Everybody knew Johnny was smart, incredibly smart, but they wanted him to be something like that, and Johnny wanted to be a mathematician. They said, well, be an engineer instead, I mean there was that sort of thing. And I may have some things mixed up. But finally the deal was that he would study in two different places. He was a chemistry student at one place and a math student at another one.

Amazing!

Well, people who knew Johnny, people that I knew who knew Johnny, routinely said he's the smartest man they ever knew. And that's what I would say too. You know, just in terms of ordinary IQ. What you call IQ.

So he wanted to figure out how to beat the odds in chemin de fer.

That's what I heard. Well, I don't say that he wanted to figure out how to beat them. He just wanted to figure out what they were. That presumably might give you some advantage—that also might lead to some advantages. So I don't say he didn't have an ulterior purpose. And of course it's just something he told me long ago.

Yes. It's a really interesting little tidbit of information.

You know the Teller story that we sometimes tell, I maybe told you more than once, about how Sybil was putting Rachel, Cynthia, and David to bed and they went very nicely. And Teller was there at the house. And he commented on how well-behaved the children were and how nice, good control Sybil had or something, and then he said, when I was a small boy my grandmother would tell me, if you don't behave the Russians will get you.

Amazing.

So it started out very early, his views about the Russians. And then the Communists besides. He'd gone through the Bela Kuhn period. Do you know the story about von Kármán and Bela Kuhn?

No, I do not.

Well, Bela Kuhn appointed him deputy minister of education because it was an operating government. And von Kármán was perfectly happy to do that. He had been chief scientist of the Austro-Hungarian air force and now the war is over. So he's deputy minister of education. The Bela Kuhn government only lasted six months. And what von Kármán—I'd either read this or again he told me—is that he figured it was easier to leave the country than to explain why he had been part of this government. So he went to Aachen where he became professor of aeronautical engineering or something and where—it was in Germany; Aachen is in Germany. And—between the wars. And they were forbidden to develop military aviation but they were not forbidden to develop gliders. So it was a major center of aerodynamics that focused on the development of gliders. And he told me some of the students and you know it was like Messerschmitt and Fokker and so on, were all students in his classes at Aachen.

Oh my gosh.

Then—not as a refugee, he came here not as a refugee because it was early. He came in about 1928. He found out correctly that Cal Tech was a lot better and so he came in the 1920s. He manipulated himself, maneuvered himself, a job at Pasadena where he then went on to train the first generation of the aerodynamicists who built the American aircraft industry. You know, all the big companies had somebody from von Kármán's classes at Cal Tech.

Amazing.

And then he became chief scientist of the United States Air Force. He was twice Air Force chief scientist, once in Austro-Hungary of all unlikely places. But I think maybe I read that. There is a biography as told to—and I think that's in there, that he decided it was easier just to leave the country than to explain how it was he'd been in the Bela Kuhn government.

That's an amazing story.

Because as far as I know he never was a Socialist. He was an odd person, von Kármán, but he did a lot of remarkable things. Once when I asked Teller, I said I'd heard the rumor that you guys weren't Hungarians at all, you were Martians—you know, that's a well-known story. But I said this to Teller. And he said von Kármán must've talked. See, von Kármán was a full generation older.

Older, right.

But about twenty, twenty-five years. And I got to know von Kármán quite well. Not really well but I got to know him, over a period of about ten years, we saw a lot of each other. He was a big enthusiast for the nuclear rocket. American rocketry owes more to him than to [Robert] Goddard, but the happy story is the other way around. Goddard was a pioneer. Goddard got into rockets way before anybody else. But he became a recluse and he was somewhat paranoid, everybody was trying to steal his ideas. And so when von Kármán started studying rockets at Cal Tech, which led to JPL [Jet Propulsion Laboratory] and all of that, APL, they tried to get in touch with—they knew about Goddard, but he wouldn't deal with them.

Interesting.

[00:44:45] And so the work at Cal Tech went along sponsored by Guggenheim. So Goddard was the first person who launched liquid rockets, only a few and they never worked very well. It's hard to do, you know, the mechanics, it's hard to get it all working right. But they did the same thing at Cal Tech but entirely independently.

Amazing.

Well, at Cal Tech they're near the Air Force base in Riverside and one of the well-known Air Force chiefs, I can't remember his name, the wartime chief, asked—I don't know where the idea

came from but engaged von Kármán in developing the little rockets that are used for jet-assisted takeoff. I mean they're not anymore but for a while they played an important role. And they're rockets, they're not jets, they're rockets. But they didn't call them rockets partly because of Goddard but otherwise too there was a certain amount of derision, the idea that if you're interested in rockets, you're interested in going to the moon, what could be more ridiculous than that. So that's why they called them "jets," and that's why the Jet Propulsion Laboratory is the Jet Propulsion Laboratory instead of the Rocket Propulsion Laboratory.

I always wondered about that.

It's always been rockets from the very start. They shied away from the word.

That's an amazing story.

Yes. And von Kármán was the major factor in getting that started.

Just when you talk about these people—

They were fun.

—and just what happened in the twentieth century as far as both theory and then the applications of these things is really phenomenal, it seems to me, as you describe it. So I think we've—

Yes, probably. Probably.

—we've probably got enough—

Our heads are swimming.

Our heads are swimming but yes, thank you for bringing up the night in Las Vegas before you headed out to the test site, the ritual.

Yes, it was a big part of—you know, it wasn't a long period, it was about five years.

Yes. Did you stay at any particular hotel?

Well, I certainly stayed at the ones I named, like the Thunderbird, the Flamingo, and the Frontier. I don't know whether any of those are still there.

Flamingo is. I don't know if it's the old, but someone was mentioning the Thunderbird in relation to people coming in to the site, so—

Yes. And there may have been others, because it wasn't always the same place. And you mentioned flying. I did once fly out of something—Is it Indian Wells [Springs]?

It might be. I have to look, but when we drove up they were saying sometimes the scientists would come in in the morning and go back at night.

Well, eventually both Los Alamos and Livermore developed regular—I think they hired a contractor. It wasn't their own airplane but they contracted for direct service. Because there's an airport at Livermore too. And so, otherwise you'd go into Oakland, fly to Las Vegas. But eventually most people went direct.

That's what they were telling me.

But that was later. I never—that was not developed when I was there.

Yes. So would you have a car pick you up and drive—or you guys would drive out?

I don't remember how we got up there. Somebody—I didn't drive—I don't think I drove myself. I might've, you know, a rental car, but I think somebody picked me up.

And then you'd stay up there for whatever.

And stay up there, yes, there was a kind of a dormitory arrangement. Pretty primitive at first but perfectly adequate. And then yes, we'd stay, and at first, there were never more than—well, there was just one or two people might go in and out for some reason. Probably when I went it was always to visit our people who were—except for the first time, with Duane, it probably was to visit a team we had there, but I don't remember what I did. All I can remember is being in the

control point and watching the explosions with the rest of the Pogo staff. Herb Grier was the center of that.

Right.

He's the last "G" of EG&G.

Yes. And I know that someone has done an interview with his wife I guess, who lives here.

Yes. He was here and I really—I was always going to make it. He never got in touch with me but I always had this idea that I'd get in touch with him. Gerry was—I don't think he saw him often but Gerry saw him, Gerry knew he was here. And I never got around to it, for the same reason he never got around to getting in touch with me, I guess it didn't seem like a particularly important thing for either of us. I don't really know.

Yes.

He was a little older. But I knew both Edgerton and Germeshausen also, but not well. But Edgerton was the guy who got it all started, and you still sometimes see these extremely short exposures that he developed, pictures of hummingbirds and bullets going through a playing card, milk dropping a sauce—those were made by Edgerton in the prewar years. And one thing led to another.

Right. There's a little pamphlet that, I believe it's by Peter Zavattaro on EG&G and the cover is—it's like a pamphlet almost—is of some weapon in its extremely early stage, looks like a little amoeba.

Yes.

But it's an interesting sort of overview of all that they did.

Well, they're the ones who made sure all the explosions were on the exact hour, because they did the so-called timing circuits. But that included—see, not only the signal going to the—we always

called them “devices,” we didn’t call them “weapons.” A “weapon” was something that was on an airplane, long out there in the future, and what we were doing—what we had in Nevada were “devices” leading to “weapons.”

“Devices.” OK.

It wasn’t a euphemism, it’s just that we didn’t think of them as weapons. The first one was called a “gadget.” I don’t think we called any of the others—I think that name was just one time. But we called them “devices.”

Yes. Well, Herb, I think that that’s a good place to stop.

Yes. But I do remember the gambling, and occasionally I went to shows, not every time but nearly. And I took advantage of the buffets. And I was usually alone, occasionally with some person like Gerry or Duane, but usually alone, without Sybil or without anybody, just on my own over there carousing in Las Vegas.

It’s been a long day.

[00:52:33] End Track 3, Disk 3.

[End of interview]