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

Interview with Benjamin C. Diven

March 10, 2004
Los Alamos, New Mexico

Interview Conducted By
Mary Palevsky

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Mary Palevsky: *Maybe you could start by just talking a little bit about your background, where you were born, when you were born.*

Ben Diven: Yes. I was born in northern California on a farm near Chico in 1919, and so I grew up there, went to school in the Chico schools. And then for two-and-a-half years I went to Chico State College, which was close enough to home that I could live at home while going there. I took all of the physics and mathematics that they taught there in that two-and-a-half years and then wanted to transfer to Berkeley to finish up. But lacking money for that I made a deal with an organization that was starting a lumber business, and so for a year or two I worked there without pay with the agreement they would send me through Berkeley for the other year-and-a-half I would have left. That worked very well and so I went to Berkeley. I forget the exact year I graduated, but at any rate then I started graduate school there after I got my bachelor's degree. And as a teaching assistant I had enough money to live on from then on. I had it made once I got that far.

Well, during that period, well, the war had already started in Europe. We got into the war **[00:05:00]** then when I had just finished up my first semester of graduate work. That was in December of 1941 when Pearl Harbor came along, and I continued there working for the physics department. Well, I finished up that school year, and then in the fall of 1942, I had decided that I would have to get into the military service. Since all of my friends were in that was the thing to do. But the chairman of the physics department immediately told me to go talk to [J. Robert] Oppenheimer.

And who was the chairman at that time?

Raymond T. Birge. Yes. So anyway I went up to Oppenheimer's office and he told me that he was going to have a military project. It was going to be run by the Army and the people who were going to be there would all be *in* the Army, and that I would be a second lieutenant in the Army and would I agree to go. And well, I said yes.

Now, did you know Oppenheimer? Had he been one of your teachers?

Oppenheimer had not been one of my teachers. I would see him, of course, and he would give lectures of a general nature, but no, I didn't know him before that. I got to know him quite well.

I bet you did, yes.

Then sometime later, probably around the beginning of 1943, he stopped me on the stairs of the physics building, said that things had changed, that the place was not going to be completely militarized, and that I would *not* be in the Army if I went. Would I still go? Well, by then I was of course intrigued, had some idea about what was surely going on, and so I said I would.

Let me stop you for a second. When you say "some idea," this was from your knowledge of what had been happening in physics, or were people sort of talking about it?

The rumors about what was going on with the 180-inch cyclotron that had been started before the war, but suddenly everything was closed up there, and it didn't take very much guessing to guess what sort of thing was happening.

Well, it kept being postponed. Everything was late, but in early March Oppenheimer called me up to his office and there were John Williams and Hugh Bradner. And he said he was sending them out to Los Alamos to find out what was going on, that everything kept being delayed and he only got information from General [Leslie R.] Groves who got it, you know, down through the chain of command. It was always obsolete by the time he [Oppenheimer] heard what was happening, so he wanted someone on the site, and so he said I would go out with them.

And I got here [Los Alamos] then on March 13 [1943] in Santa Fe, New Mexico, and Hugh and John had arrived the day before. This was on a Saturday; I got in Saturday night. That was my first airplane flight; that was from Oakland out here.

You flew*?*

Yes, we flew out.

Wow! So many people tell the story of coming in on the train.

Yes, it took a special kind of priority to get on an airplane then.

Yes.

[00:10:00] Yes. But anyway I got here. And one other person who was a resident of Santa Fe was Joe Stephenson, and he was called the project manager to start with. He was a local person, had local contacts, and could help with whatever local arrangements had to be made. I don't know what happened between him and Oppenheimer. They had a falling out and Joe kind of disappeared after a few months.

But anyway there was no housing and yet people from various projects—for instance, the project at Princeton to separate U-235 was cancelled and all those people were to pick up the Harvard cyclotron and bring it to Los Alamos. Well, the project was over, they had packed up the cyclotron and they were on their way, but there was no housing, and that was true for everybody else. They had the whole group of people who were going to come here and figure out how to build this thing and there was no place to put them. So Hugh Bradner's job was to go around, along with Joe Stephenson, and take over whatever housing they could find. They took over dude ranches and some of the houses down at Frijoles Canyon, and, well, that was his job. John Williams had the job of finding out exactly when to expect housing to be finished, laboratory buildings finished. There was not a single laboratory building finished and not a single apartment house ready to be occupied, nor any dormitories. There was a few houses of the schoolmasters and there was the big house that housed the students and Fuller Lodge [of Los Alamos Ranch School], of course.

Well, what they did then was to essentially confiscate dude ranches and any housing they could find that was in the general direction of Los Alamos, a little closer than Santa Fe. But John Williams and I then spent every day talking to the construction people. You would find the carpenter foreman and ask him when that building was going to be finished, you talked to the plumber foreman, and so on, and the electricians. The idea then was that these people really knew what was a reasonable schedule.

Right. And these people were working then for the Army Corps of Engineers?

They were working for the Corps of Engineers, private contractors.

OK.

Well, there were no telephones in Los Alamos and so we stayed in a hotel in Santa Fe.

Do you remember which one—?

Yes, it was El Fidel. And every evening we would come back to Santa Fe and, you know, John would call Oppenheimer. I would've been taking notes all day, like a little boy following John Williams, who was an important professor, but making notes about when one building or another might be ready for occupancy. And then John would call Oppenheimer on the telephone and report. Well, it wasn't only when a building might be finished but there were deficiencies. These plans had been drawn up in a great hurry, of course. People who were bringing their equipment here would have given very crude specifications of what they needed in the way of a building, but then by the time that was put on paper, made into drawings, and it was getting built, why there would be glaring discrepancies. We found there was no control room for the cyclotron. You couldn't have the control room in the building with the cyclotron; it had to be some distance **[00:15:00]** away. We found such things as chemistry laboratories which were to have an acid drain in the back of the work benches, that got interpreted as a little groove in the hardwood bench top, and that would hold pencils nicely but had no relation to an acid drain. So these were things that we would refer to Oppenheimer and he could get a hold of the appropriate people who were going to occupy these sites and have them take care of getting corrections in.

Well, that went on for a couple of weeks, I guess. I don't remember when Oppenheimer arrived but it had to be a couple of weeks after the fifteenth. I know the laboratory official history by [David] Hawkins says he arrived the fifteenth of March, but he certainly didn't. [See Hawkins, *Project Y: The Los Alamos Story. 1983, Tomash]*.

Great! That's a great little fact. Yes.

But I don't know exactly when he got here.

No, but that's interesting, just that you can say that Hawkins is off by probably a week or two, I would say. Yes.

Yes. Right. Well, first we lived in a hotel, then as the other people began to arrive I moved to Rancho del Monte, a dude ranch outside of Santa Fé in the Tesuque area, for a little while. And Oppenheimer must have been here by then too. And I was no longer doing this job, running around behind John Williams, but Oppy asked me to do something about all of this equipment that was arriving. The man who was to be in charge of supply and property, Dana Mitchell, was a physics professor but he had become an expert in supply and property and how to get things in a hurry. I think he was on the radar project at MIT [Massachusetts Institute of Technology]. And he came here, actually ended up being an associate director.

But there was no one here to do anything about all the equipment, the truckload after truckload of equipment pouring in. There wasn't even a warehouse to put it in. The first building that was finished was the building that was to be a cryogenics building to liquefy hydrogen to make a hydrogen bomb, and of course there was no conceivable use for such a building so that became temporarily a warehouse. It was just a great big empty building, was just a shell essentially. So these truckloads of things came in and Oppy said, `Well, do something about it.` And so we just had this huge pile of boxes and such things and so we would try and sort them out to go to the various groups, but then these people just had to come and get their own. We did have an army dump truck that we could use for hauling these things around but if Bob Wilson wanted the equipment that was coming in for the cyclotron, he could get his people to come there with him and load up that truck and take it down themselves.

So anyway that's what we did. I just tried to get the things that were pouring in to go to the appropriate people. And I did some other jobs, little gofer-type jobs Oppenheimer, if he wanted something and didn't want to disturb an important person, I could go do it for him. And he promised if I would do this for a few months, that then he would put me in the best possible group so I would learn the most.

And he did that. After Dana Mitchell had been here awhile and I had still then been **[00:20:00]** working for Mitchell to try and get this supply and property confusion sorted out, he gradually got people who knew how to do these things to come in. And finally Oppenheimer said now I could go into a scientific job. He put me in Bruno Rossi's group. Rossi and Hans Staub were co-group leaders. Originally I think it had been intended to be two separate groups. But it was a group whose job at that time was to develop instrumentation for other people to make the kind of measurements that were desperately needed. And so I was assigned to learn how proportional counters worked and then work up a system such that if somebody wanted to build a proportional counter, that we had charts and various sorts of data that would, given the kind of conditions the counter had to work under, that they would know how to build one, put it together. And other people were studying ionization chambers and whatever instrumentation that was needed. So I learned a lot about instrumentation until about the end of that year, I suppose, is when [Emilio] Segrè discovered that plutonium-240 was spontaneously fissioned and put out lots and lots of neutrons all by itself and that the plutonium that was going to be available was going to have a lot of plutonium-240 in it. And that made it impossible to use a gun weapon because assembly was too slow. Already Seth Neddermeyer was working on implosion systems.

But anyway obviously, well, the uranium-235 device would work clearly with a gun-type weapon and we had Captain [William S.] Parsons—a Navy captain, who was an expert on guns—had that well under way, and clearly we were going to be ready to have the gun-type weapon when they found out they couldn't use plutonium. And of course it turned out that there was hardly any U-235 and there was going to be buckets of plutonium, so—

You said "buckets of plutonium"?

Well, it was going to be measured in lots of pounds [laughing]. There would be plenty of it.

So anyway, the lab was reorganized and everyone pushed towards finding out how to make an implosion device. And so Rossi's group was assigned to help out with the RaLa [Radio Lanthanum] experiment. This was an experiment in which they would use an extremely intensely radioactive source of radiolanthenum to study an implosion: to put this very intense radioactive source in the center of an implosion system, set off the high explosive. And well, let's say, this is a shell of something to mock up plutonium that was going to collapse and by putting ionization chambers to measure the current from the radioactivity, as the shell collapsed it would thicken and the current would decrease and that way you could study the progress of the implosion.

All right, so Rossi first was asked to supply the detectors to do this, and Luis Alvarez was in charge of the experiment. I'm afraid he made a horrible mess out of his first trial, and **[00:25:00]** Rossi said he wouldn't work with that man. Either Rossi would take over or Alvarez did it himself.

In layperson's terms, what was the mess that he made, can you—?

Well, he just was unprepared. He didn't have any proper way to get the radioactive source from the radiochemists and put it inside of the bomb. He had some ridiculous scheme, using a fishing pole or something. Anyway, it was all right for a trivial little practice source but when the real ones came, why, you couldn't do it that way. And there were other things about the electronics Rossi didn't approve of. It just had been too casually done. It wasn't carefully prepared and Rossi was a person who was meticulous with everything, and he expected things to work the first time.

So anyway he was given the job of taking over the RaLa experiment, the whole thing. So at that point then, he called all the members of the group together and said this is what they were going to do and he hoped everybody would join him but if anyone didn't want to, why then they could find themselves a place in the physics division. But he was going into the new division that would study implosions.

OK, so I started learning things about explosives. I had the job of getting the source from the chemists, removing it from the big lead pig it would arrive in—

"Big lead pig"?

Pig. Just a cylinder of lead several feet in diameter with a hole down in the center where this tiny little extremely hot source would be located, with another plug of lead on top of it. And so I'd take it out of that. Well, I guess I should back up and say first, of course we had to supply the chemists with the piece of equipment that the source was to go in because it had to fit inside of a bomb. So this would be on a very thin stainless steel metal cone that they place at the bottom for this small volume of this radioactive material, probably a fraction of a centimeter in diameter.

Now, did that plutonium come down from Hanford or was that—?

Oh no, this—

This plutonium was made here?

We're not talking plutonium. This is radiolanthenum that came from Oak Ridge.

From Oak Ridge.

Yes. It had a half-life of a matter of hours, I forget, maybe twelve hours, something like that.

OK. So it would come by train or something from Oak Ridge or—?

No, I don't know how it came.

A car or something like this.

It probably came by either truck or train.

OK. Don't let me get you off-track. I'm just curious about that.

OK. So anyway then we first had to know what the implosion system was going to be. I had the job of handling the explosives too. And so the explosives people would have a new system that they thought would be better than the last one. And these were to be roughly, I think, half-scale bombs, half as big as the real one was going to be, because you had to have something small enough that you could get—the gamma rays from the source had to penetrate and still have enough intensity to get a good current in your detectors. So we mocked up plutonium using cadmium. It was very much less dense than plutonium. They hoped that it would bear a little resemblance, as far as its hydrodynamics was concerned, to plutonium. But anyway **[00:30:00]** uranium would have been a good mock-up for plutonium, for instance, as far as density goes, but it's so dense that you couldn't get enough current, couldn't get enough radiation through it. So we had to study mock-ups. Not a very satisfactory way of doing it, but that's all we could do.

So we would then, knowing what the implosion system was going to be, then we would have to arrange that a conical section would be cut out—of course it would come in pieces, it wouldn't be a complete cast sphere, and these pieces would all fit together to make a sphere. So one of them, the one right at the top, had to have a conical hole cut in it that would accept a very thin metal cone that at the tip would have the radioactive source that would end up then at the center of this sphere of explosive.

So that was my job, then, to handle the explosive, get the source located in the center. And then other people in the group did the electronics and so on, and built the detectors. Well, they would have a large number of detectors all around the outside of this sphere and they from the very beginning could tell that the implosion was not simultaneous enough. Some pieces of explosives would go off before other pieces and the result was that you would just get a useless mess in the center. You couldn't make a bomb that way. It had to have much better simultaneity and a better shape to the shock front that was going to accelerate the metal. And they were able to tell just at first that things weren't good enough, and later to make real measurements about how much compression you got in the metal.

Now, I shouldn't pretend that we were the only people studying implosions. The whole laboratory had been turned into a study of implosion systems using all different kinds of schemes for doing it. This was just one. It turned out to be a very important one because it could make a quite respectable measurement of the compression of the metal. Not real plutonium, just cadmium, but still they could tell that it had a good chance at working, at least.

All right, so we did that until it was fairly clear, I suppose around early in 1945, that there was a system that would work. And of course it was going to be tested at Trinity. And one of the important measurements was the alpha measurement. That was studying how fast the reaction rate would take place. It would be an exponential reaction and you needed to measure that with the time constant of that exponential. It would be in the neighborhood of a small fraction of a microsecond, and at that time we didn't have electronics that was fast enough to quite do that. And if the bomb failed, then that would be an important measure to know why it failed, and so they wanted to have a good measure of this let's call it the time constant. And Bob Wilson had the job of making that measurement and he had something that actually worked but **[00:35:00]** but didn't give a very accurate answer, but Rossi thought he had a way of doing it and getting a more precise answer. Wilson nicely agreed that Rossi could share his recording station and gave him some help too. And so I quit the RaLa experiment then and the soldiers who had been working with us—by then we had a whole lot of these SEDs (special engineer detachment) and they were doing very well on the RaLa experiment. And so we moved to Trinity to make this measurement.

So were you then with Wilson's group or you—?

No, with Rossi.

You were with Rossi at Trinity.

Strictly with Rossi, but Rossi couldn't have squeezed in at this late date without Wilson's help. Wilson was a good guy and he gave Rossi all the help that you could imagine.

Anyway, Rossi's experiment worked very nicely. Just barely, but nicely. So that was sort of the end.

So just for a chronology, you move out to Trinity how soon before the test, would you say?

Oh, a month I suppose.

A month, and you're living out there?

Oh yes.

Yes. That must have been an interesting experience. I haven't been there in the middle of the summer. They don't let you go if you're a tourist. I was there in October and in March and it was hot enough then.

Yes, it was very warm.

Yes. And you lived in—?

Barracks.

Barracks?

Yes.

And I saw the McDonald House there. Were you working—?

We had a room in the McDonald House where they could assemble the detector that was going to follow the nuclear explosion.

And where were you when Trinity actually went off? Were you in this recording place or—?

No. No, I was about twenty miles away where all the onlookers were, people who weren't really needed in the—well, nobody was—where the data were all recorded in underground bunkers and nobody was there. The timing and firing system was in another bunker quite far away, I don't remember how far. Anyway, all the people who were essential for that were there, and then—

And was Rossi there or—?

Rossi was up on the mountain where I was. There would be people, for instance, I suppose it was Dave Nicodemus who was in charge of the detector and—well no, it wouldn't have been Dave. Whoever it was who was to go in and recover the photographic film and take it to Los Alamos and develop it and so on. That person would have been at the base camp, which was still farther away than where the bomb was set off. So there were a few, of course Oppenheimer and Groves and various important people were right there where the timing and firing was done. But otherwise the people who were essential for recovering equipment would be at the base camp, and then those who had no real use there anymore were—I think I was about twenty miles away. But anyway, there were *lots* of people there.

Yes. And what was that like when you saw it? What did you think?

Well, we thought, `Oh boy, it worked.` Well, of course, there was a flash of light and simultaneously heat, suddenly like the sun shining on you, and then nothing for quite a while **[00:40:00]** until the shock arrived, and then you had the loud *boom!* and then the reverberations as the sound reflected off the surrounding mountains, and just a whole long series of *booms!* and this really impressive cloud. Well, so we knew it worked. And well, I was with Rossi and he had an Army car and we drove back to Los Alamos and the car was full. I don't remember who all was in it.

By then the job was done and soon after Trinity we were allowed to go home. So for the first time I went home, visited relatives. I had a pretty good idea of when the bomb was going to be dropped because, well, of course the uranium bomb was already over there or on the way.

And we knew that the plutonium parts were coming out at a sensible rate and that it was going to take just a reasonable amount of time to get the core over to Tinian and then for the Army Air Force to do their things. So we didn't know when the day was going to be but knew approximately about the earliest it could be, so from then on I started wanting to see the newspaper every day as soon as it came off the press.

Yes. And this is when you're home visiting.

Yes, when I was home.

Yes. Yes. And you were single at the time, is that right?

Yes.

So you were visiting your parents?

Yes, and friends.

Yes. So were you still at home when Hiroshima happened or were you back here?

I was there when Hiroshima happened, I was home, and so I immediately came back because I knew there were going to be all kinds of celebrations. So I hopped on a bus and came back.

Yes. So then you were here for the second bomb.

No, I don't' remember. Yes, I'm almost sure I was. Yes, I was. That's right because I knew that they hadn't hit the target squarely, you know. I had to have been here.

Yes. Oh, they hadn't hit the target squarely?

Well, you know, it was a cloud cover and they couldn't do the first target. They took a second target and it was partly obscured. It was a difficult job but it still worked well.

Yes. Just sort of a detail question that it never occurred to ask but you sort of raised it in my mind. You're working on the implosion. Are you simultaneously making duplicate sets in case it works so that you have that whole setup to ship out to the Pacific?

Well now, remember we were working on a scale model that didn't apply to a real bomb, and not only a scale model but we of course weren't using plutonium. But we were studying various schemes of implosion. What was finally used of course was the explosive lenses that created a pretty good spherical shock wave. For them to work, maybe the most important thing was to have electric detonators that were extremely precise and that all go off at exactly the same time. Until those were developed—and incidentally it was Luis Alvarez mostly developed those, and I maybe made some nasty comments about him—

[00:45:00] *They weren't nasty.*

Anyway, the most important thing of all I think was getting simultaneous detonators, a whole lot of detonators, all to go off at the same time.

Right. But when you're doing the Trinity test and it works, then you have this other—

That's right, the conditions of making these explosive systems were somewhat primitive, I suppose, and there were elaborate schemes for studying whether there might be bubbles or any imperfections in the explosives. So there were lots of methods of nondestructive testing, so every one of these pieces would have been just studied to death and the very most perfect ones picked out, the ones they had the most confidence in. And yes, of course, there would have been duplicates and duplicates.

OK. So once you have the success of Trinity you can duplicate it within a reasonable period of time.

Right. Right. Of course, once Trinity worked, why we knew we could've done a lot better. Just the system I had been working on, the RaLa experiment, by the time of Trinity we were already testing much more sophisticated implosion systems. Once you knew Trinity worked, it was a shame in a sense to use such a super conservative design that was not as efficient, not nearly as efficient, as it could have been. But the Trinity shot, everything was aimed at something that for sure would work, and it was very, very conservative, and it could have been much more efficient. Actually as soon as Trinity went, a matter of it could only have been days, maybe even before it went, people knew that if it worked you could make it better and you could use the fissionable material that was available to better advantage.

So when you say "conservative" let me see if I'm understanding you correctly. You're saying things are going to behave in a certain way and we give ourselves a wider range which makes it maybe less efficient and then you see that you can narrow it down in some sense?

Yes, we started out—there were design parameters, for instance, for the gun gadget. It was going to be a long skinny thing and the length of the gun would be the longest that a B-29 could carry—even though you modify the bomb bay—and so the B-29 was modified to take the longest, skinniest thing that it could carry. All right, then the fission bomb was going to look like a sphere and there the diameter of the sphere that we could use was the biggest diameter that a B-29 could be modified to drop through a bomb bay.

All right, so that fixed that, and that nobody would've modified. You might as well use all the explosive you can. But you could configure the solid material much more efficiently. A real bugaboo was that you knew you would get the maximum compression—and therefore the most efficiency—if you would just accelerate a thin shell, because as a shell collapses it goes faster **[00:50:00]** and faster and faster. So it really in principle—well, ideally would reach an infinite compression. Of course nothing is perfect, so it wouldn't do that, and imperfections were what would happen if every detonator didn't go off exactly the same time, if every lens didn't make a perfect spherical shape, and so on. And that kind of a system is unstable. If you try to implode a shell, it's not a stable system. It tends to make jets and it just doesn't want to stay a beautiful collapsing sphere. It wants to just turn into a jumble. And so the way out of that was to just use a solid ball of plutonium and just squeeze it so hard that you made that metal even more dense. OK, now there you don't have any chance for jets to develop. You know, if say one detonator goes off a little too early, there would be extra high pressure pushing that would start a movement before the rest of the sphere. Well, that imperfection would just grow until you had a jet of material squirting in there, and that would destroy all of the symmetry. It just wouldn't work very well. And then of course once you know that the Trinity device worked, then the gun assembly was going to be very much less efficient and it would have been better to use that. We had only had enough U-235 for one bomb and you could have used a little bit of that in a bunch of plutonium bombs and stretched that plutonium because the implosion is much more efficient than just in an assembly in which there's no pressure involved.

But that's knowledge, isn't it, that only comes once you've done your experiment. I mean I guess you can guess about those things but—

Yes, well, you could have been quite certain you could have built a better bomb, but of course there wasn't any need to, and so the exact bombs—the Nagasaki bomb was identical in every way to the Trinity bomb. The strange thing is that the Russians of course, once they knew that the Trinity bomb worked, they had no need to duplicate that and they already wanted to make their first bomb an improvement and their security people wouldn't let them. They were forced to make an absolute identical replica of the Trinity bomb. But their scientists already knew how to do it better.

Sure. That's an interesting fact. So there's the conservatism among the security military types and the scientists are ready to go forward with the next step.

Yes, and you have to have these people who know it all tell you how to do it.

Right.

Well, we got nowhere near [we have not discussed the Nevada] the test site.

Well, that's all right. This is interesting—

This *is* the test site. Trinity was the test site [during Manhattan Project].

Well yes, exactly, this was the first test and I mean it's the early history of nuclear testing in the United States. So you come back. You're still officially working for Los Alamos. You come back and there are these celebrations, you say, going on.

Yes, and then it's time to start writing up things, so there was a lot of history to get written up.

Yes. And you were involved in that?

Well, to a limited extent.

Yes. Yes. Now I'm imagining some of this history, does some of this remain classified till today, some of this history, of the implosion and things?

I don't really know.

I'm just curious.

I'm pretty sure nothing I said was at all classified. **[00:55:00]** Classification is a strange thing because if something could be classified, then it's an effort to declassify, so we have all kinds of things that are classified with no reason to except that it takes so much manpower to declassify them. Declassification is a tricky business and it's easy to make a mistake. Some of the things that we tried to keep as secret as possible about the thermonuclear devices accidentally slipped through a crack and a document was declassified and it left a key design element for thermonuclear devices. So there's always a reluctance to declassify things just to have them declassified.

Right. Well, just for a sense of it, when did this with the thermonuclear—this has to have been, what, the early 1950s that this mistake was made?

Oh, it was much later than that.

Later. The 1960s?

It didn't matter much. Everybody had figured out how to do this by then, but it still was a scandal.

Yes. Oh, OK, I think I know the scandal you're talking about then, yes. OK, so we've gotten through Trinity. That's the first test.

And so then I came back. And of course in this period the professors were all negotiating for better jobs in bigger universities and so on, and the students were wondering where they were going to go. I sounded out the physics department at Berkeley, did I want to go back there. They were looking for all the best students they could find and I didn't know many professors there real well. And Rossi was going to go to Illinois and said I could go with him, so I decided I'd just stick with Rossi. It's good to have a protector, and I knew a lot of the other people who would be assistant professors and so on at Illinois, plus several students that I knew well here were going to go there. It would be more familiar. And then I had a letter from [the University of] Illinois saying they'd give me a research assistant job with a reasonable amount of pay. It was more than I could have got at Berkeley, and so I accepted. And then Rossi got a better job at MIT and went to MIT. Except I stayed; I went on to Illinois.

Oh, OK. Yes. And I wanted to ask you just a little bit, and maybe this is an appropriate time since you and Rossi are parting company, what was he like as a person and to work with? What kind of guy was he?

He was a very, very mild-spoken, very gentle person, very kind to people. He must've been very good to his students, and he liked to teach, he liked to explain things. He was just ideal to have as a boss when you aren't studying theoretical things but you're learning practical things. It was always amazing that his language was never anything violent. Now Hans Staub was a volatile person. Of course he had been in the Swiss army and learned how to swear appropriately in *Schweitzer Deutsch*, and he studied appropriate foul language among the GIs because he wanted to know just how to express yourself perfectly.

He made a study of it, eh?

[01:00:00] Right. Well, when our first RaLa experiment before we had earth-covered bunkers they just took an Army tank and lined it with lead and used it for the recording station, and I remember that—well, it was just a little hatch to climb up out of this tank, and I remember one time Rossi coming out of the tank and he whacked his head on a sharp metal edge and blood was running down and he looked at his blood on his hand and said, Oh my. That was so different from what you would have heard from Staub. A very, very considerate person, but he was also just a wonderful experimenter. He was extremely inventive.

Yes. Now someone else I met back at Cornell, if I remember correctly, also worked with Rossi at some point, and that was Ken Greisen.

Yes.

So I'm remembering correctly. He was in your group?

No.

He wasn't.

No.

I remember he talked about explosives, Greisen did.

Greisen was heavily involved in Trinity. Before Trinity he was in the physics division like most people were, and I don't remember what experiments he was working on now.

Doesn't matter. I have it from him. I remember him talking a little. My memory was, and this was several years ago, that he also worked with Rossi.

Well, I'm pretty sure that Rossi was at Cornell before he came here [Los Alamos]. Now Rossi was one of these European Jews escaping when it was obvious that they had to get out, and of course he was in Rome, but still the Italians weren't quite as bad as the Germans maybe but it wasn't good. So he emigrated and I think—the people got, oh, instructors' jobs even though they were important people, they would come here and look for anyplace they could make a living, and of course universities were fully staffed according to their budgets and so there were great scientists who were taking very low-level jobs when they arrived here. I trust you've read Segrè's book. [Emilio Segrè, *A Mind Always in Motion*, University of California Press, 1993]

I haven't read Segrè's book, and I will.

You'd better. His story of taking the family fortune out of Italy and skiing over the mountains with it to Switzerland, because he was the only family member who skied, it's a fascinating book.

I'll get it when I get back.

And he has all kinds of sly digs at other famous people, that it's just fun to read.

I will definitely on your recommendation get that book.

Oh yes.

I think what I'll do now since we're sort of at an end of an era with Trinity is change this CD.

[01:03:47] End Track 2, Disk 1.

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

OK, so we can get you back to Los Alamos.

OK, and then I guess I said that I got myself to Illinois and into graduate school and ground away there for four years and came back. So I came back in 1950.

OK. So you're at Illinois, you get your degree, then have you always been thinking that you would come back to work at the lab or did someone ask you to come or how did that work?

Oh yes. Well, I wasn't so sure I wanted to come back to the lab when I first went to Illinois because it was not a very pleasant place here. It was dusty or muddy, the wind was blowing dust in your face or whatever it was, and ramshackle temporary buildings. But then after a year, I guess, anyway a fairly short time and when I would come back to visit, it was beginning to change into a more normal community and really a pleasant place. And the work was interesting. And yes, I had job offers, people saying, When you get your degree, will you come back? And the one that was most interesting to me was Dick [Richard] Taschek in the Van de Graaf group, and I agreed, I guess, a couple of years before I was through that I'd come back to that group. And so I did.

And at this point you're still single or had you—?

No, I was still single. But that didn't last long, and Beckie and I were married a year later but we were seriously involved much earlier.

So she was here.

She was here. She came very early. Sometime late 1943 she signed on to the project but she worked at Berkeley for a while. She was given the job of building a quartz fiber microbalance to weigh the first plutonium that was weighable. She was working on a project for making oxygen meters for submarines at Cal Tech and this was a Linus Pauling project. I don't think she ever knew until much later how it was that somebody tapped her for building a quartz fiber balance.

But she was working with quartz fibers for building oxygen meters, and it was much later that somebody sent her a declassified minutes of a meeting in Chicago in which [Glenn T.] Seaborg mentioned that there was a Becky Bradford at Cal Tech in Linus Pauling's group who was an expert with quartz fiber and maybe they should get her to build the balance. So they tried that and she agreed. She didn't know anything about mechanical drawing or how to design things but she was just told, `Design a microbalance.` [laughter] And so she did. She had the letter she wrote home describing her problems at Berkeley. There was no housing, she couldn't get a dormitory room. And she was shuffled from a room in a rooming house that some employee of the radiation lab had, and they'd go on vacation and she could have that room, and she kept being shuffled around until she finally got this thing designed, and then came here in early 1944.

[00:05:00] *So she stayed here and then you'd come back?*

And she stayed after the war. By the time I came back she was in the test division and was doing radio assay. The key job in analyzing data from radioactive debris from what's left over in the atmosphere would be [in a test], first, to know what fraction of the bomb you have in the sample. So she would determine the amount, for instance, of uranium-235, do this radiochemically. They'd have a sample, she would take and measure an aliquot of the sample and—

"Measured an aliquot"?

Anyway, say you have a bucket of this stuff, all right, then you take and accurately measure a small volume of that. And then she would from that volume determine how much U-235 was in this. She would plate it out onto a platinum disk and then go through various radiochemical things you would do to determine how much U-235 there was, and that would say what fraction of that bomb you had. And then you could look at the decay products and tell how much fission had taken place. If you know how much of the bomb you have, well then now you know what the total yield was. So that's kind of the nutshell idea but that's the kind of thing she was doing. She had learned all these skills here, just like she'd learned how to work with quartz fiber and then she learned how to make a microbalance, and then she was taught, you know, how to do various chemical things, even though she was not a chemist. Yet she was very good at what she did.

So had you known her during the war or—?

Oh yes. Not so well though. So anyway I came back to Dick Taschek's group, the Van de Graaf group, and went to work, first re-measuring the U-235 fission cross-section with more accuracy than it had been done. And then in 1953 sometime I got sort of drafted into a job at the director's office for the big push to get the first thermonuclear devices going, the first weapons. In 1951, I guess, they came up with the idea of how to build a thermonuclear device. Nineteen fifty-two, I think it was, they fired the first one [Mike test, 10/31/52]. It was a building-size object. And so then it was a push to get a weaponized version, and so we had settled on several different versions of a weaponized thermonuclear device. And then one person would be assigned as what you might call a project manager or something. You didn't design weapons but you were supposed to pull together all the information. Essentially it was a matter of getting the official word from the theoretical division of just what these dimensions were and then translating that to the engineers to turn it into a real object. So it's kind of a go-between the theoretical people and American Car and Foundry **[00:10:00]** who were actually building these devices.

They were building them—they're here?

In Albuquerque.

In Albuquerque. So you were this project manager, is that what you're saying?

Just for one type, yes.

For this thing. And then, OK, explain this to me a little bit because this is just an area I don't really understand. You've got the science of this particular thermonuclear device. Then you're asked to be able to create a weapon. But you are all actually then building that weapons or is someone else—?

The theoretical people will design it. Now separately the fission bomb that will set it off, it's being worked on by other people. That pretty much came to us as a package. But then the theoretical people did the design job for the thermonuclear part. There were several, quite very different designs. And it almost started out, well, what's the biggest thing you can do? What's the biggest thing that some airplane's going to carry? And then can you make that smaller, and so on.

Right. OK. And so all along also, I guess, the fission weapon is being perfected also.

Right. Instead of this great huge thing, now you really want a very tiny efficient fission weapon to set this off, and that had been going on, well, as I said, before the war was over we were working on better designs.

But you're still using this implosion concept then at that point or—?

Oh yes.

That's the way to go then.

That's the way to go.

Yes. So then you have to figure out how to get these things into some form that is a weapon, is what you're saying.

Yes, and that was primarily a theoretical job. They had something that would work, this great huge, enormous thing, and their job was to scale this down to something that was usable. And so of course they would scale it down starting reasonably conservative, then as time goes on get smaller and smaller.

Miniaturized.

Yes.

And so this work you were doing resulted in some tests that—?

Yes. Well, the particular device I worked on ended up being the first one in the test series at Castle [Operation]. So yes, I was in charge of course of the assembly and getting it put together in Albuquerque, and then we went overseas the first of January in 1954, and the test was March first, I think, in 1954.

And which test was it?

That was one they named Bravo. Maybe it's the biggest bomb we ever tested, I'm not sure, but anyway it was a big one. And once the test was over I went back to the physics division.

Now Bravo, the whole thing about Bravo being bigger than had been expected, what was that about?

Well yes, the theoreticians always calculated the expected yield, predicted yield, and then the maximum credible yield. It would be unbelievable that it should be greater than, and that you could then design. So, you know, you're designing underground bunkers to protect your recording equipment, why, you would use the maximum credible yield. All right, so this went more than **[00:15:00]** the maximum credible because the physics division had missed a crucial nuclear reaction.

Oh, OK. And so you see Bravo.

Yes.

Must be a whole heck of a lot bigger than Trinity—the effects—I mean to you the personally?

Yes. Well, it was a thousand times bigger than Trinity, approximately. The shot was fired from another island on the same atoll. The bomb was on one little island of the atoll and then off on a different island more or less as far away as you could get was where they fired it from. And so there was just a handful of people there and everybody else was off on a ship. I remember too the rituals for guarding these things. You can't trust scientists to have common sense. They are notoriously stupid about lots of things. And so the rule was that once we had that bomb assembled, one of our group—and we took turns, the project leaders for the different bombs would take turns. One of our group had to be there twenty-four hours a day watching because you couldn't tell who was going to do what.

What would they do?

Well, I had a cot under the bomb where it was set up on Bikini ready to be fired, and I slept there. And one morning early I woke up to the sound of a drill motor. Somebody was drilling onto the bomb case. Some test division person wanted to fasten a sample on it and so he just started to drill a hole on it. Anyway—

So you say, `What are you doing?` *or—*

`Get out.`

Whose language do you use, Staub's or Rossi's?

Well, he would've known that I would just have the MP [military police] come and get rid of him. Well anyway, and then finally the last thing I did was—everybody was evacuated almost, except the firing party, and the firing party then would be hooking up their firing cable to a place underneath the bomb case that had a little lid, just screwed down with ordinary screws. So I just took a screwdriver, took the lid off, and said, `There, you can plug in your firing cable now`. And then I got on a helicopter and went to the ship out in the ocean. And except for the firing party everybody was many miles away out in the ocean. And then this bomb went off and it just seemed like that cloud grew and grew and grew until finally it was coming overhead, and then they had to send everybody down below and start the wash-down system for emergencies. These ships all had a spray system that would pump ocean water out and keep just water pouring over the outside of the ship to wash radioactive stuff away. And so we were holed up down in this hot ship for some time.

Approximately how long, would you say? Are we talking minutes or hours or—?

Well, it was a matter of hours. At first they had to decide what are we going to do—on the command ship, the *Estes* I think, where all the admirals and generals and such people were on. Fortunately the test division people had a little kind of a personalized radio system that they **[00:20:00]** could talk to each other on. And so we had on the *Curtiss* where we were, we had a little hole down in the ship where we had a radio room and we could talk to the other J-Division people, including the people on the command ship. So as soon as they knew what they were going to do, they decided, well, the whole fleet would steam back to Enewetak. And they had determined by then that the base camp on another island in the atoll had been swept away and all the tents knocked down and there was too much radioactivity to hang around there anyway. They did have to pull out the arming party and rescue them. They were safe as long as they stayed underneath all their shelter, of course. But anyway we knew long before the captain of our ship knew what we were going to do, you know, and we went back to Enewetak. And my job was over. I really should've hung around and helped the other fellows by sleeping under their bomb when necessary, but I came home.

Yes. Yes. So the Castle series continued.

It continued.

Despite the fact that this was something bigger than expected?

Yes. Well, it changed everything. They didn't fire all the bombs they planned to. Well, the second one was to be a Livermore bomb but it failed and it was obvious that all their bombs were going to fail so they didn't shoot anymore.

Yes, I remember that.

But they didn't shoot all of our [Los Alamos] bombs. The clumsiest ones, the least convenient to weaponize, was not fired, and they did some modifications. They kind of on the spur of the moment and with spare parts built what they thought would be some improvements.

Was the design of the Bravo bomb unique in a sense? I mean was that error not going to be duplicated in the rest of the bombs that were tested? Were the other bombs also thermonuclear bombs?

Oh yes, and they would all work better than expected, yes.

But I'm saying, whatever that flaw was or mistake was, obviously you weren't worried that it was duplicated in the other ones, I would imagine, or—

Well, you'd be glad that it was because they were going to work so well.

OK, so it was a good thing that it worked better than expected but a bad thing that you hadn't expected it to work that well?

Yes.

So it was dangerous?

Well, it delayed the whole program quite a while once they had to wait for radioactivity to die down and rebuild a lot of stuff. It damaged a lot of recording stations. It wasn't such a *huge* over-yield. Maybe it was double what expected, I don't remember. But it was one big bomb all right.

Had you seen any other explosions since Trinity?

No.

So you saw Trinity and then you saw this.

Right.

It was a thousand times bigger.

It was the only two atmospheric test I was ever at. And I never got to the test site until long, long later, back in the 1960s.

Yes, you told me about those experiments on the phone. I had one other question about Bravo. You said you were on a ship named the Curtiss.

Yes, the *Curtiss* was a converted submarine tender, converted to handle bombs, to assemble bombs and such things.

I'm not specifically clear on this, and it may not be a good question for you, but you read stories about how maybe some of the sailors weren't apprised of **[00:25:00]** *the danger after Bravo, that they were allowed to be out longer than they should have been in this radioactivity. Do you know anything about that?*

All I can remember is that nobody was allowed above deck until they were out from under the cloud. Some ships could've been run differently, I suppose.

Yes. And then you've got this salt water being sprayed.

Yes. And conceivably some ships didn't have that.

Yes. Were you personally worried about radioactivity yourself, personal harm?

No. I'd been working with RaLa.

Yes. OK, so you come back and then you were saying this was the only test stuff you did till much later.

That's right. Well, when I came back to work at the test site with making *scientific* measurements using neutrons out of a bomb, but instead of using an accelerator as a neutron source, we used a bomb. Very commonly on accelerator work you use a pulsed source, get a pulse of neutrons of all energies, and then you go far away to study some reaction. And the length of time it takes the neutron to get there tells you its energy, so you can study some nuclear reaction as a function of energy over a big energy range. Well, a bomb gives you a nice big blast of neutrons in a very short period of time and then you can go far away and do the same thing.

So you work with, what, people at the test site to be able to put your instruments, or how does that work?

Well, if there's going to be some experiment—let's see, maybe I should mention that it isn't very attractive to try and make such measurements with an atmospheric test.

Great point. OK.

Because neutrons scatter around off the atmosphere, off the oxygen and nitrogen, and come at you from all directions. The backgrounds are terrible. But once they went underground, and then you could have a little skinny pipe all the way from the surface down to the bomb. Now neutrons can go up this pipe. So then you can be a thousand feet away right at the surface and do the same kinds of experiments except that it's such an enormously more intense source than you get out of a single pulse from an accelerator that you can overwhelm all kinds of backgrounds. So you can make measurements of nuclear cross-sections of extremely radioactive materials. So once they went underground, then soon after we got interested in some of these things and it was great fun. We would just piggyback a regular weapon shot that's going to take place and it looked like it was a kind of a bomb that would be good for us to work on and we would just ask them for a line-of-sight, which is really a pretty big deal but the test division people would accommodate these things.

Now just to back up a little bit. You're in what division and group here now in Los Alamos?

I'm in the Physics Division and only as a guest at the test site.

OK. Now this notion that you can use the underground test mechanism as a neutron source, does this occur to you as underground tests are being developed or is this something you've thought about before or how does it sort of come that you want to use this as an experiment?

Oh, strangely I forgot his name, but some guy at Brookhaven [National Laboratory] who was involved with nuclear data long, long ago, probably soon after Trinity, suggested using it as a pulse neutron source.

OK, I can maybe find that out.

[00:30:00] Don Somebody. Oh well, it doesn't matter.

Wasn't Don Hughes, was it?

Yes. Right.

All right. I knew Don Hughes. He was my dad's [Harry Palevsky] *best friend. OK, that's an interesting thing. So he imagines that this would be a use.*

Yes, long before it was practical, but yes. It's obviously a pulse source of neutrons and so why not use it? And so once they went underground it was fairly obvious. Another good friend of your father was Art [Arthur] Hemmendinger.

Yes, I'm seeing them in a couple of days.

Art was the one who suggested to me that we might join him on such experiments. He was in the Weapons Division. And it hadn't been very common for people outside the J-Division to get involved in the test site. For one thing they didn't know how. But I don't know why Art got interested but anyway he thought that we had some instrumentation techniques that would be useful. And so Art and I went at this together—very informal. I started going to all of the weapons working group meetings where I could keep track of what bomb was going to be tested when that might be interesting to get on, and I went to all the J-Division scheduling meetings, and then we could just kind of informally—well, George Cowan was heavily involved in all this.

Cowan?

Yes. He did the first line-of-sight experiments from the bomb, using time of flight. So he was always heavily involved. Sometimes we worked from the same shots, sometimes we did them separately. And then later, I went to a cocktail party at one of my daughter's boyfriend's house and it turned out that the host was in the division that makes detonators and explosives and does that kind of work. And he had there a consultant from the University of Chicago who was a geophysicist who asked me what we were doing and I told him we were working at the test site just using neutrons. And he said he'd been trying to persuade the GMX Division, the ones that work with explosives, to do some work on high pressure equations of state, because the bomb would be just the right pressure range for where these things are poorest known. But they assured him it was impossible, you can't interfere with another division's work. But here we were happily working out there with no problem at all. So what I did then was to have this fellow who had been the host come and give my group a lecture—you know—what do you have to do to measure a point on the high pressure equation-of-state of some metal? And so he told us the kinds of things that you can do to do this, you just get the right pressures. And it turned out it was pretty formidable but still could be done. And so we proposed to Duncan McDougall who was deputy director for weapons at the time that we do some of these equation-of-state experiments. So he just wrote a nice little memo to all the divisions that could be involved, not offering them any money but it would be nice if they could help. And so we got started and before we **[00:35:00]** *really* got started on this we thought we had a scheme that would work. I got somebody in the Weapons Division, a designer said that they kept having an uncertainty about some kinds of things and not at all in the pressure range we were going to look at but maybe we could do something there. And so we looked into that too and yes, we could do that in a hurry, that was simple. So we got kind of involved there and pretty soon we were doing not just neutron measurements but measuring things concerning the equation-of-state of metals. And you understand equation-of-state?

I was just going to ask you. This means you're talking now of solids?

Yes. Usually you think of equation-of-state of a perfect gas as being pressure times volume as it's proportional to temperature. Well, when we're talking about a metal under these temperatures and pressures, it's not exactly a perfect gas but it's closer to a perfect gas than a familiar metal. That is, it is compressible. Now I mentioned that the first implosion bomb, you actually took a solid ball of plutonium and you just squished it together as though it were a sponge. OK, well, that is really the sort of pressure range that was of most interest because if you go much higher to pressures that you have in a thermonuclear bomb, for instance, there they really are getting back to being almost a perfect gas. It's just a sea of charged particles but something that's calculable. But this intermediate range where it's neither solid nor gas is a tricky one and it's pretty difficult to measure. But we never really got to making super-good measurements on this because testing stopped. Besides, I retired.

Oh. OK. Interesting. So do you recall the names of the tests or the series of the tests that you were putting your experiments in?

Oh, a few of them. And sometimes you couldn't mention the name of the test, the stupid security reasons, so we might call them Physics-1, Physics-2, or something silly like that. And a lot of these really worked well and some didn't work very well.

But you got data that was useful to you?

We got some usable data.

And give me again the sort of the year range on this work? From you said the early 1960s?

Yes, sometime in the 1960s, and until testing stopped.

All the way up until—?

Well, we had quit doing cross-section work. We were still involved in equation-of-state work. Also in there somewhere I retired and John Hopkins persuaded me to become a scientific advisor for test shots. And so there I was working in the test division as a consultant, and this is kind of a very pleasant retirement job.

OK, and what year did you retire?

Nineteen seventy-seven.

OK. You know it's now eleven thirty-five, so you're waiting for your guest?

Yes, we could just wait till he gets here.

OK. So you do that all the way up until 1992, until testing stops, is that what you're saying?

Almost anyway but I don't remember when I quit. A little before testing stopped.

[00:40:00] *OK. Just a sort of mundane question, you'd be working here, then you would go out to the test site for a particular period of time? Would you live out there, stay—?*

You mean as a scientific advisor?

No, when you're first doing these experiments.

All right then yes, we'd go out for a week at a time.

Would you fly over or would you drive?

No, we'd fly.

And you'd stay out at Mercury?

Well, for instance we'd have a trailer set up here that would have all of our recording equipment. And then the detectors that we're going to use, it would stand over the line-of-sight and probably be destroyed when the shock hit them, but we'd build all of that here [Los Alamos]. And so then we'd have our recording trailer, our detector system, and all of that and various ways of calibrating things, we'd do all that before we shipped it out there. Then we'd ship it out and then the detecting equipment would be mounted on a tower above the ground zero and then you'd have the same recording station but it would be a thousand feet away or more. And then we would be there for a few weeks, just going out for three or four days at a time and coming back.

You know I'm just beginning to think about this whole issue of underground tests and how that instrumentation works. You're putting all sorts of stuff in there that—this is a layperson's question, this is a question I'm asking you—you put stuff in there that will give you the measurements and then immediately very soon thereafter be destroyed, is that right? Is that how it works?

Yes.

So the instrumentation piece of that must've been difficult as well or—?

Well, you know, the measurements we were making, we would have the detectors above ground and a vacuum pipe down to near the bomb. OK, but all the measurements would be made above the ground. Now, you would have maybe as long as a millisecond or so to make these measurements, and the shock would come even later than that. And actually the shock wouldn't really damage anything much. It's far enough away and not such a huge shock. We started putting all of our detectors—of course they would be in a big vacuum system, maybe as high as this room, and mounted on a sled. And when the bomb went off the shock hits and then everything is quiet for a long time until finally—well, down underneath the ground you have a huge bubble of high pressure gas, of course. And eventually that cools and when it cools the whole thing collapses. OK, now that's where the damage occurs, so we just pull our sled with all the instruments away.

Wow. And the sled is what, it's mounted on—how does it slide?

It was just like a sled on ice except it's just on steel that you put something slippery on so it slides easily. And eventually the last one we did actually had an entire tower, I don't know how high, seventy-five or eighty feet high, with experiments all the way up and the entire tower was on rails and was pulled away. The idea was to use it over and over again. And we never did any more.

So the whole tower was on a sliding thing that pulled it away before the shock?

Yes. Maybe I have some pictures that would show you a little better.

OK.

[00:44:39] End Track 2, Disk 2.

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

[Showing photographs] These are all cameras taking pictures of an oscilloscope screen.

So this is at the test site?

Yes, it's at the test site. Now let's go through some of these. Here's one where this was the physics division and weapons division people who worked on these. There's Art Hemmendinger [right]. [B.Diven 2004 1] And so this was the crew from Los Alamos. [B.Diven 2004 2]

Where are you here? [Front row, fourth from right]

Oh, somewhere in there. I don't see me. Another one of the same thing.

Yes. In your hard hats.

And there's Art and I. OK, here is a shot. Obviously it was named Petrel. Here's our sled, and this would just be pulled down this ramp and pulled away. And other experiments by the test division are on up. [B,Diven 2004 3]

Interesting. And there's your staircase up there.

OK, here is a sled and our experimental package on it. [B.Diven 2004 4]This is here in Los Alamos, and this would be the recording station in that trailer. Here again a package on a sled and that's the trailer behind it. So these are just amplifiers. Nothing very exciting.

No, it's interesting though because it lets me understand better what you're talking about.

Here's again a sled. They tended to get bigger and bigger.

Oh, there you are looking into—

Inside a vacuum chamber. It's had the lid pulled off. And that looks like Art there and that's I. A tower. Art and I again. [Insert photo reference]

These are great pictures.

Somewhere we'll have some showing the general layout. OK, here the tower has grown. These are the recording cables laid out on the ground. [B.Diven 2004 5] The bomb is down under the tower, six hundred to a thousand feet down. [B.Diven 2004 6]Same thing here. Most of these will be the test division's recording cables but some batch of them will be ours. These will be all the cables going to various instrument levels. [B.Diven 2004 7]

Amazing. Now this is a good one. Now what are these things?

Something J-Division is doing. And I know who's doing them but I don't know why.

That's a great shot, with the distance. And where is this at the site?

Mostly these would be in Area 3.

Area 3. Great. Thank you.

This is a drum that will pull the cable that will pull the sled out.

Wow!

Here is an after-the-shot. This is where the tower—it wasn't a big tower, just a small one at ground zero, and this is after it's fallen in.

Yes. Oh, here's another one.

It really messes things up.

Sometimes would you get a deeper crater than this?

Oh yes. Yes, sometimes quite deep. That must be an after-the-shot and the tower is still standing but it just chunked down. A movie of this is really interesting. You see that tower sitting there on the flat and all of a sudden it just falls straight down and if it's just a good sturdy tower it holds together like this.

Now, this was the outer casing. They used to have, say, a four-foot diameter steel casing and they would put that down, then the bomb would go down inside of it. And then there would be a smaller pipe as a line-of-sight and it would all be filled with concrete or something. So the ground zero was really up here.

Oh. Explain that to me a little better. So this would have been underground here, is what you're saying?

Yes, and the ground had just fallen away.

Oh, the ground had fallen away. I see. Oh, and you see that here too. That looks like it would've been on the surface. Oh my God!

Yes.

I know they all have numbers on the back. Are they available?

Yes, those are lab photos.

Would the lab give those to me?

Oh, I would think so. Yes, you could probably get those. I could probably find better ones.

[00:06:54] End Track 3, Disk 2.

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

[Continuing with photographs] Now, this is going to be part of a line-of-sight. So you have two cranes. They'll just be laid out horizontally on the ground. They will have been assembled in Los Alamos. They will have collimating apertures in them. Anyway, then you pick them up one at a time, put them up vertical, and put them down the hole. [B.Diven 2004 8]

I want to note the number of that one. OK, so that's the line-of-sight.

So here now it's hanging vertically and starting down the hole, and the cables that test division people will have near—detectors near the bomb are going down the hole here. They'll be stretched out on the ground. [B.Diven 2004 9]

OK. OK. Oh, this is from way up. Is this from a tower that this is taken?

[Laughing] Darned if I know.

Or an airplane.

I have no idea. Now this is a familiar experiment that you've seen before. If you come back again you can do some of this more easily.

Yes. Yes. Maybe that's what we'll do. We'll come back and look at these. Oh, what's this?

All right, the thing has collapsed. This was the four-foot diameter pipe that the bomb went down, and it didn't fall away with all the dirt and somebody is wanting to do something there so he's had a crane—He's hanging from a crane. [B.Diven 2004 10]

That's an amazing shot. Look at that, and there's just nothing. It's the flat desert in the background.

Yes.

That's incredible.

Oh, the test division people could get you all kinds of interesting things.

Yes. Yes. But this is interesting because it connects to what we're talking about.

This is on the way down hole. This is the bomb rack and this is probably four feet in diameter and is sliding down into— [B.Diven 2004 11]

It's going to go into that concrete casing, is that—?

It'll go into that steel casing.

Steel casing. Excuse me.

Things change. They quit using those casings and they just go down in a dirt hole.

Well, this is a bomb rack, fairly near where the bomb is, and as a matter of fact it was the Pliers shot. That was a big deal physics shot with nothing but physics experiments on it. Now recognize this as a security barrier so you can't see what's going on and I'm almost certain that they're inserting the bomb down here. [B.Diven 2004 12]

OK. So anyone standing above ground would not be able to see what's going on in the hole, is that what you're saying, with the security?

Well, anyone who's on the ground wouldn't be able to see in.

Oh, I see, this is a security barrier.

Yes.

And you're on the ground.

Just a plywood fence they put around it. Now, the bomb would be delivered in a covered case and be put down inside here and then uncovered so people couldn't see. And of course they wouldn't encourage anybody to be up high around nearby. This is just a bomb rack with all kinds of experiments. [B.Diven 2004 13] Now, have you gone to the museum downtown?

Yes.

And so don't they have one of these?

They do. They have a miniature one sitting in the middle of one of the exhibits, but you're just seeing a lot of the metalwork and then where the device would sit. At the Nevada Test Site, they have left one—I think it was a British test, Icecap—intact, and so we got to see that as well. It was the test that was going to happen when the moratorium happened, so it just got left there.

[00:05:00] These get very repetitious [referring to photographs]. A lot of this is just documentation that if something didn't work you could go get your magnifying glass and see where every knob was set and did somebody make a mistake. [B.Diven 2004 14, 15]

Interesting. Oh, that's interesting.

Now, that same thing applies even more so with the bomb itself. I remember one time when John Hopkins was a test director, a bomb didn't go off.

Oh, I've heard about that.

But before the shot everything that goes on with inserting the bomb and hooking it up, everything is photographed. There's a photographer there taking picture after picture after picture. And so the bomb didn't go off and so then you wonder why. They went back, looking at those pictures, and they found a firing cable went very close to an explosive device that was supposed to open a valve or do something and it had obviously been hit by the shock wave from that device, and so it crushed the firing cable and the bomb didn't go off. In the meantime it's down there buried, covered in tons of concrete and epoxy and you don't know what all, essentially almost impossible to get at.

Well, so what do they do?

You drill a hole right alongside it and set off another bomb.

Do you. OK. Yes, obviously you can't leave that thing sitting there.

No. So you take a bomb that ought to be buried at about that depth that you're going to have to fire anyway and you fire it there. You just drill real close.

Thank you for showing this. This is so helpful to me as a non-scientist, non-experimenter, to see what those things are. It'll be useful for us to put those selectively with things.

The one question, since your guest isn't here yet I'm going to take advantage of this time You're doing science experiments, they're doing weapons tests. Were there any cultural issues or were there problems at the test site ever with who?

Well, obviously we're using their resources and so we're stealing money from weapons testing to some extent. Now, we're using physics division and weapons division resources also but we aren't paying for everything, and so it costs money. That means it hits their budget. That means fewer tests or something. So yes, it affects them and you'd better not do anything that interferes with the weapons data. One time I did get scolded a little bit because we were doing, I guess it had to have been our equation-of-state experiment which would have been interesting to the weapons people, so that' s not wicked. But [we] failed to mention that we had a lot of depleted uranium

[Interruption as friend comes by to visit]

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

—[which] interfered with their radiochemical analysis.

OK, so the depleted uranium interfered with their stuff.

Yes.

OK. We'll stop right there. Thank you very much.

[00:00:11] End Track 5, Disk 2.

[End of interview]

B.Diven 2004 2

B.Diven 2004 2

B.Diven 2004 3

B.Diven 2004 4

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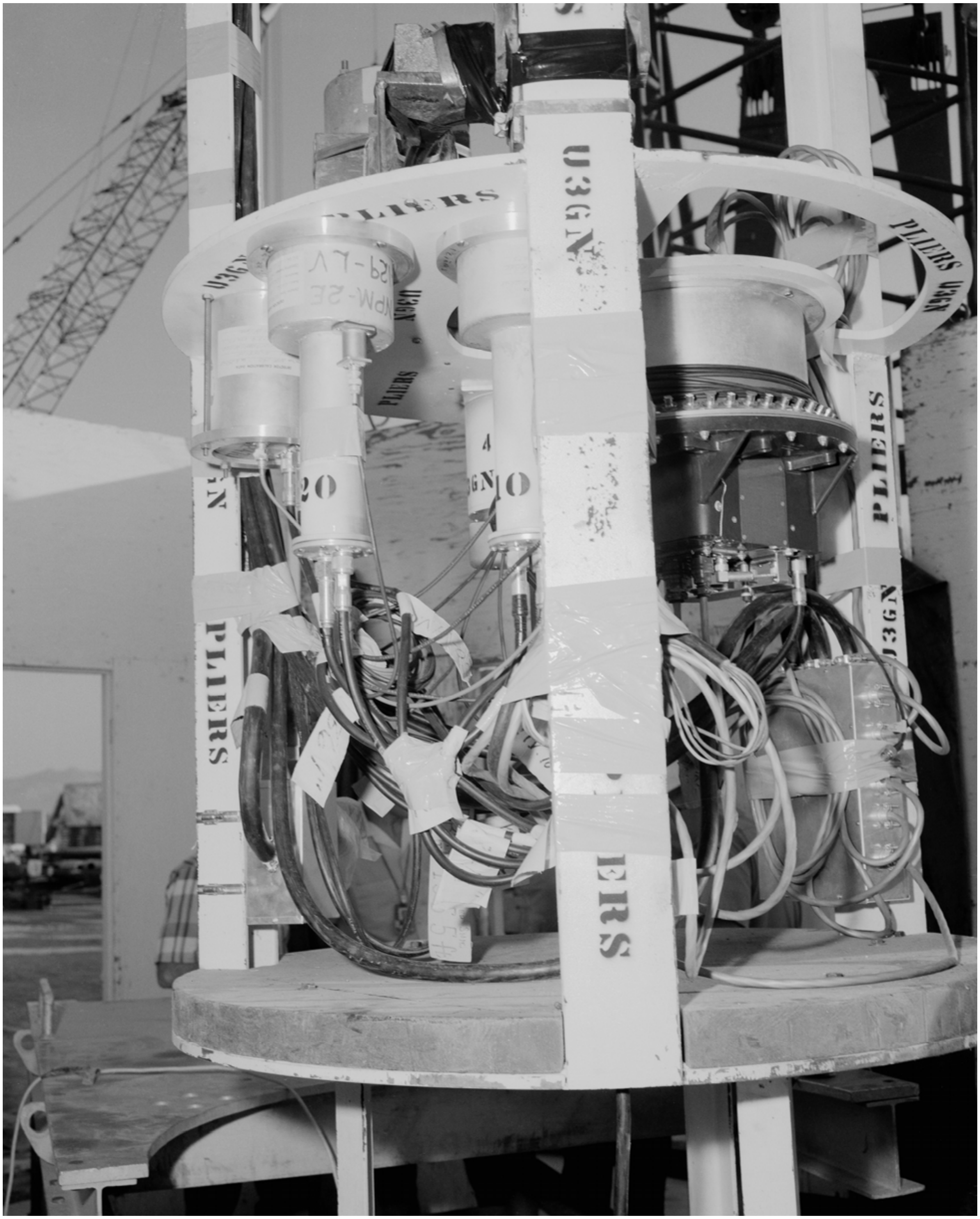

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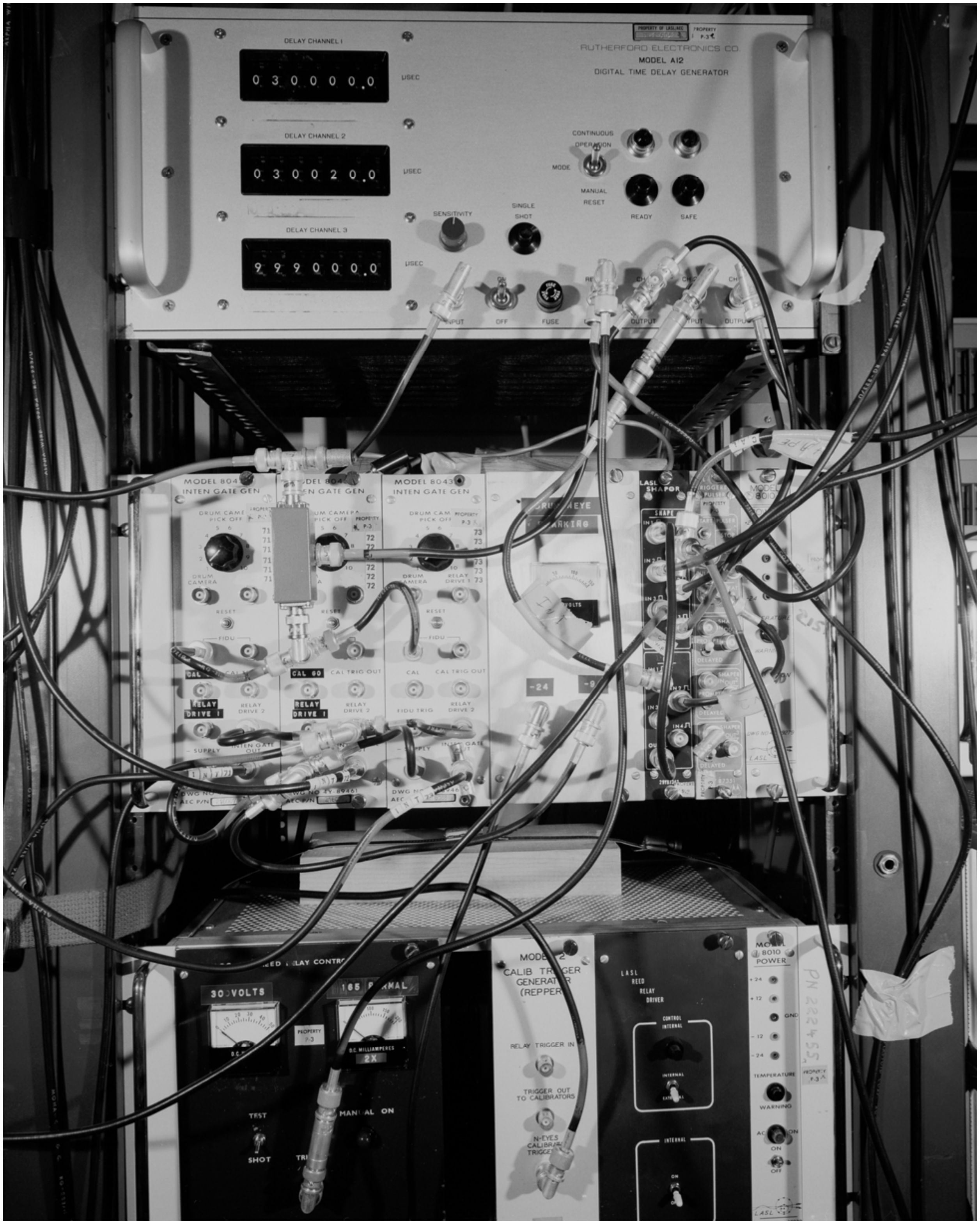

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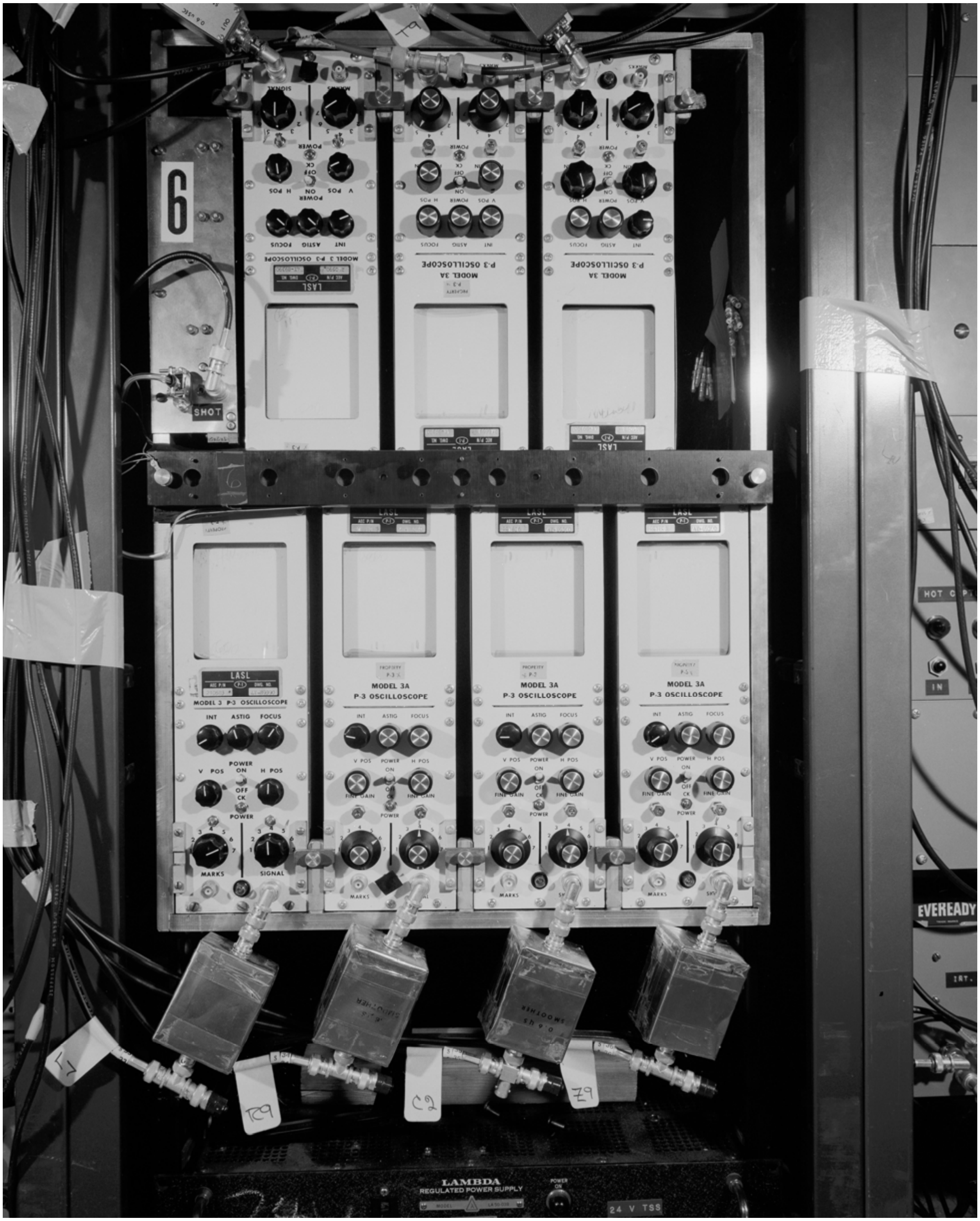

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