

Jean Deken: [00:00:00] Let me just say that It's Tuesday October 2nd, 2018, and this is Jean Deken interviewing Marty Breidenbach. We can start sort of at the beginning. [00:00:19] Where were you born?

Breidenbach: [00:00:22] I was born in the Bronx [New York] in '43.

Deken: [00:00:26] OK, and where did you go to school?

Breidenbach: [00:00:30] The family moved to northern New Jersey when I was tiny. I went to high school and grade school in a small bedroom community near Manhattan called Hillsdale. Then I was at MIT for both undergraduate and graduate school, and there's a little bit of a story about graduate school.

Breidenbach: [00:00:49] I thought I was going to Berkeley and Henry Kendall and Jerry Friedman broke my arm and said stay with MIT because there's this wonderful experiment that's going to happen at SLAC and you'll like it. And if you want to spend time in both California and Cambridge, well here's an MIT travel card.

Deken: [00:01:15] Wow. So, let's back up a little bit though. How did you decide what high school to go to?

Breidenbach: [00:01:25] I didn't have any choice. You went to the local high school, no choice at all.

Deken: [00:01:30] So how did you find out, or how did you discover that you were interested in science? How did that come about?

Breidenbach: [00:01:38] I think it was obvious from probably age 5 or even earlier that I was interested in how things worked. I got from my father that if something wasn't working - well just fix it - and that stuck. Essentially you know you're not going to make it any worse. It's not entirely true now with modern cell phones, but basically it is with many things. Scoping out a problem yourself, learning how to fix it, and understanding what it's doing is how I grew up.

Deken: [00:02:19] What did your father do for a living?

Breidenbach: [00:02:22] He started out as a machinist, and he was a machinist during the war. Then after the war there was enough anti-Semitism around that he couldn't find work as a machinist and wound up with my grandfather, my mother's father, in the garment industry. So he was a pattern cutter for the rest of his life.

Deken: [00:02:50] In New York?

Breidenbach: [00:02:52] Yes, in Manhattan.

Deken: [00:02:54] In Manhattan.

Breidenbach: [00:02:56] We lived about 17 miles from Manhattan. So, it wasn't a terrible commute.

Deken: [00:03:04] And what did your mother do, was she a stay-at-home mom?

Breidenbach: [00:03:09] For the most part. She was trained as a commercial artist. And she got into all kinds of art. Not as a "professional" professional, but she was a pretty damn talented amateur.

Deken: [00:03:30] Did she have a particular medium that she favored?

Breidenbach: [00:03:35] No. That was one of the things that used to drive me crazy. She was very versatile. Then, when she would get good enough in something, her friends would pressure her for a show. She did not like the idea of that stress at all and that would be the end of that medium.

Deken: [00:03:56] Oh, gosh!

Breidenbach: [00:03:58] And then she would go on to something entirely different. Actually, it's interesting. Perhaps a genetic thing. I think quite inheritable, and I'm afraid I have some of that too..

Deken: [00:04:16] So do you think that she was really doing the art just to please herself and didn't want to have to please other people?

Breidenbach: [00:04:27] No. I think she was happy to do it to give it away to friends. That was wonderful. But then when other friends said 'you know this is really good - you should have a show, boy, she didn't like that.

Deken: [00:04:44] Well interesting. So commercializing it wasn't appealing?

Breidenbach: [00:04:56] I don't even know if you would call it commercializing it. But having a broader and perhaps critical audience was not appealing.

Deken: [00:05:06] OK. So was there a particular teacher in grade school, junior high, or high school who encouraged you in your scientific efforts?

Breidenbach: [00:05:28] I think there was always a reasonable level of encouragement. In grade school there was a wonderful shop teacher where a small number of students, I being one of them, got to build a gasoline-powered little car as a full year project. So that was fun. It was something that could be used to ride around the neighborhood totally unlicensed. It was a really nice learning activity to do things yourself and combine design with construction, but not making a huge production of it and just getting it done in a year. In high school, there was some homogeneous grouping, Advanced Placement didn't exist yet... There were, I think, two of us who were 'encouraged' to go someplace else during math classes and study more math, rather than be disruptive at the back of the room. So that was good. Senior year physics we had a rather enlightened teacher and I got to teach the class. It was PSSC physics, which was new.

Deken: [00:07:15] What kind of physics?

Breidenbach: [00:07:21] The Physical Sciences Study Commission out of MIT. They had just produced a new book on how to present physics coherently. At a high school level, maybe it was too advanced. I don't know if it's still around but it was a nice book. And the teacher, who was a retired Army colonel, was a good sport, and he would take the exams with everyone else. There were exams that came as part of course. So that was fun.

Deken: [00:07:54] So did you, did you teach just certain modules of it? How did that work?

Breidenbach: [00:08:01] I don't really remember in detail, but I think I helped with topics where the Colonel was not comfortable.

Deken: [00:08:15] So how did you...

Breidenbach: [00:08:16] Actually there was another interesting story.

Deken: [00:08:18] Okay.

Breidenbach: [00:08:18] Columbia University ran a "Saturday Science Honors Program" for local high school juniors and seniors ... And this was really terrific. The Faculty at Columbia, the young faculty, essentially gave up all their Saturdays during the school year to introduce kids to real experimental physics. We took a fairly classic experiment, in my case, it was the Stern-Gerlach experiment that demonstrated that you can separate beams of atoms of different spin and built it essentially from scratch. We did things that would be utterly unheard of today in our "hyper safety" world, and it was just absolutely wonderful. I'm still in contact with a fair number of people from those days, and essentially everyone went on to become a professional scientist.

Deken: [00:09:38] Oh wow.

Breidenbach: [00:09:40] It was a great experience. It's very hard to think about how to recreate it. These were 16-year-olds in the lab, often alone, doing things, on occasion, that were ... probably not brilliant. For example, the material that we used in this experiment for the atomic beam was an alkali metal, sodium or potassium. I needed to get some clean potassium to put in this little oven, so I wanted to get half a gram or so. Potassium came in an oil-filled jar and the procedure, which I had been told, was to take it out of the jar, handle it with forceps, use a scalpel (it's very soft), to slice off all the crud on the outside, and then really wash it well with acetone... I was even told this should be reagent-grade acetone but they neglected to tell me that it had to be a brand-new fresh bottle of the reagent-grade acetone which hadn't absorbed any water yet...since the acetone is hygroscopic. So the potassium reacted with the water when I was scrubbing it with a toothbrush, and it goes bubble, bubble, bubble... And this clearly wasn't good. I stepped back and it more or less gently explodes into fire and so there is now this flaming acetone falling onto the wooden floor of the seventh floor of the Columbia Physics building...

Deken: [00:11:32] Oh my!

Breidenbach: [00:11:35] Yes. I went for a fire extinguisher to put it out and that was the end of the story, except for a slightly charred floor. Now what would happen if you did that today at SLAC?

Deken: [00:11:43] Oh, my gosh, they'd shut the lab down, of course.

Breidenbach: [00:11:47] Of course!

Deken: [00:11:48] Yeah.

Breidenbach: [00:11:51] The attitude there was, 'Well, that's a sort of teaching moment...' Now I know I have to get really brand-new acetone to do this. And so, I did go to the lab stores and get a brand-new acetone bottle and kept going. They don't do it like that with students anymore!

Deken: [00:12:06] No. No. And then they wonder why we call them "snowflakes," or they've turned into snowflakes.

Breidenbach: [00:12:17] Yes, the Columbia program was absolutely wonderful. I don't think it still exists. I keep wondering about trying to do it at SLAC, but it seems so impossible. I mean the whole point is you've got to get kids to the stage where you think you're not being stupid to leave them in the lab, but nevertheless the goal is to have sixteen-year-olds in the lab!

Deken: [00:12:45] Was there a professor with you the whole time or did they leave you?

Breidenbach: [00:12:54] He was there, but he was not watching over you the whole time. So there'd be some discussion of what we're doing and how to do it, but was there continual "adult supervision"? No. But we weren't entirely alone - there were a couple of us working on the one project and there were others in the lab.

Deken: [00:13:16] Right.. So, you did that for a year?

Breidenbach: [00:13:25] I think it was for almost two years.

Deken: [00:13:26] Almost two school years.

Breidenbach: [00:13:28] Yes, it was wonderful.

Deken: [00:13:28] And when you were done, did you do a demonstration of your experiment to someone?

Breidenbach: [00:13:36] No. I don't remember that.

Deken: [00:13:37] No. OK. Did you write anything?

Breidenbach: [00:13:40] Yes, I recently was digging through an old box of papers, and there was a report.

Deken: [00:13:43] You didn't keep a log notebook? Did they talk to you about that?

Breidenbach: [00:13:53] We might have had logs. I wouldn't have a where clue they are now.

Deken: [00:13:58] I just wondered if part of what they were telling you about was how to how to take notes about what you were doing and what you're seeing. That was part of the learning?

Breidenbach: [00:14:10] I hate to tell you how long ago that was, Jean. I don't really remember much about any instruction for keeping notes. I'm pretty sure we did have notebooks but, how professional were we? I have no idea.

Deken: [00:14:41] So you did that for two years, 16, 17 years old. And then how did you prepare for going to college and how did you decide what college you wanted to go to?

Breidenbach: [00:15:01] I was almost 100 percent convinced that I wanted to do physics and I applied to MIT and Caltech... and, someplace else...

Deken: [00:15:22] Not Columbia? Not Columbia?

Breidenbach: [00:15:31] No, not Columbia, because I wanted to get away from home.

Deken: [00:15:37] Okay.

Breidenbach: [00:15:41] I thought I wanted to be perhaps within vacation range but not within weekend range.

Deken: [00:15:52] Okay.

Breidenbach: [00:15:52] I got effectively a full scholarship to MIT which was important because the family didn't have much money and I think that's what decided it.

Deken: [00:16:08] So, how was the transition to M.I.T.?

Breidenbach: [00:16:18] I really liked undergraduate life. They go through all the talk about how incredibly tough it would be, but the undergraduate physics and the math at MIT was not hard. I certainly did not skip classes but I enjoyed it.

Deken: [00:16:59] Uh huh.

Breidenbach: [00:16:59] We had a literature professor, probably during freshman year. He was already a well-known young playwright... Edward Albee or was it somebody else, a rather New York type? There was no desk for the lecturer. There was a simple table in the front of the room. He has this habit of putting his foot up on the table and more or less leaning his chin on his knee and lecturing. So being smart-ass MIT students we started raising this table with blocks under the legs. Well-hidden blocks. We raised it a quarter inch at a time and we observed his behavior. His leg would go up, and his leg would come down, and his leg would go up, and his leg would come down and he's very, very confused. And then he would just carry on with his feet on the floor until next time. Finally, he figured it out, gave the table a big shove and it came crashing down. And he was really very, very good-natured about it. He invited us all over for a party that weekend.

Deken: [00:18:26] (Laughs) That's great. So that's what you remember from that literature class?

Breidenbach: [00:18:30] That's what would stand out. And I think there's plenty of stuff that's part of deep background. But memory is very selective, as you've heard in recent testimony.

Deken: [00:18:46] Indeed, indeed.

Deken: [00:18:53] Your physics and math: was there any instructor who stood out? Who kind of mentored you or who you felt like you got more from than others?

Breidenbach: [00:19:07] So I started in with Henry Kendall and Jerry Friedman and by my junior year they were quite wonderful. Yes, they were quite special.

Deken: [00:19:25] Did you work in the lab with them?

Breidenbach: [00:19:29] I think in junior year it wasn't so much... the students had desks in the lab....and so it was an environment that they had created which was really very nice, and you could learn a lot from discussions with the other students.

Deken: [00:19:52] ... So they were special to work with and they're the ones who said 'no you have to stay with MIT because there is this great experiment starting up at Stanford?'

Breidenbach: [00:20:07] That's right.

Deken: [00:20:07] Okay...

Breidenbach: [00:20:09] I was utterly convinced I wanted to go to Berkeley and I would have survived Berkeley just fine. But going to SLAC at the beginning of SLAC was such a nice launching pad, the experiments were so wonderful and so productive that it's been sort of downhill ever since...

Deken: [00:20:38] So, what do you remember about your first impressions of SLAC in your first visits to SLAC? How did you enter the SLAC environment?

Breidenbach: [00:20:49] The collaboration was with SLAC Group A, Dick Taylor. I remember Dick trying to project this image of a really tough guy but in reality he was a pussycat. One of the bigger impressions on me was that as a graduate student you could go in and talk to Pief [W. K. H. Panofsky]. The signal was very simple: if his door was closed then leave him alone, if his door was open, you could poke your head in, he would wave you in, and ask him about anything. He had infinite interest in talking to students about anything.

Deken: [00:21:43] Wow.

Breidenbach: [00:21:43] One of the games I started playing in some way, more-or-less with myself, was: could I study up on any tiny, tiny, little area of physics until I really thought I got it and then go ask Pief about it and see if I knew more than he did? The answer was uniformly... never.

Deken: [00:22:04] [Laughs]

Breidenbach: [00:22:07] It's impossible for a mere human to approach Panofsky. There could be an obscure bit of technology, sure, I mean, but...

Deken: [00:22:17] Yeah.

Breidenbach: [00:22:18] But in terms of what is science. There was no getting to him. It was just utterly amazing. And we were friends, basically for the rest of his life. It was wonderful. My biggest memory is certainly Pief. And, you know Burton [Richter] and Jonathan [Dorfan] were fine directors but Burton would go nuts if I implied that Pief was a better director... It was always a way to drive him nuts...

Deken: [00:23:04] [Laughs].

Breidenbach: [00:23:04] The only possible competition for Pief was the founder of Fermilab.

Deken: [00:23:20] Oh: Wilson.

Breidenbach: [00:23:23] Yes, Bob Wilson

Deken: [00:23:24]

Breidenbach: [00:23:27] It's a riot to hear Adele [Panofsky] talk about Pief in the early days and his interactions with Wilson, because they really disagreed on how to set up and staff their labs. Both Wilson and Panofsky were products of Los Alamos and the war and the Manhattan Project, and that made people grow up really fast.

Deken: [00:23:57] Yeah.

Breidenbach: [00:24:00] They had a kind of clout in Washington which is utterly unknown today. Burton had some of it, and after that no one does. I mean now the lab directors are basically customers ...

Deken: [00:24:26] Yeah.

Breidenbach: [00:24:27] "Customers" may be the wrong word. They're providers of a product for DOE

Breidenbach: [00:24:39] 'The customer is always right' and they say 'jump' and the answer is 'how high?'

Deken: [00:24:44] Yeah.

Breidenbach: [00:24:46] I can assure you that Panofsky would never have done that.

Deken: [00:24:50] Right. And he talked about that when we were working on his memoir. And I didn't know Wilson at all. But I know that Pief had a stature that allowed him to go around even the head of the Atomic Energy Commission or directly to the head of the Atomic Energy Commission and the head of the AEC had to listen because it was Pief Panofsky.

Breidenbach: [00:25:25] That's right. One of Pief's sayings was, 'yeah, we need them, but they need us.'

Deken: [00:25:34] Yeah.

Breidenbach: [00:25:36] And that's no longer true. They at least behave as if they don't need us.

Deken: [00:25:43] Right. And then depending upon your politics these days, you may believe that they're completely wrong, but science advice is treated as just another interest group.

Breidenbach: [00:26:08] I think that's a piece of it. The other thing that has become so prevalent is that all bureaucrats are afraid of their shadows. The folks at the agencies are afraid of Congress. The folks at the labs are afraid of the agencies and everything is about avoiding risk, and they have silly ideas about avoiding risk. They think they can hide behind reviews and committees to make decisions, and in some sense it's an effective method of avoiding risk when something goes wrong. They point the finger and say 'Well, the committee advised us to do that. So we did.' As you know in the Panofsky days, they bet on the person, not on a project. They bet on Panofsky to generally lead, I emphasize "lead" rather than "manage" the lab. He's the one who decided, with some advice, but nevertheless, he's the one who decided where the full budget of the laboratory would go. Those days are over.

Deken: [00:27:29] Right. Right.

Breidenbach: [00:27:32] And so part of the change in risk avoidance, I think, is the shift from making bets on people and that they would do good, to specific projects which are reviewable in perhaps a more concrete sense than people are. But, Panofsky made his bets on people: he picked up Richter and Taylor and Perl to name an explicit three, and you know I think they did amazingly well, and I believe Pief's attitude was that it was the lab's job to provide this environment for good science not to try to pick and choose specifics in advance.

Deken: [00:28:30] Yeah, and Pief was pretty candid when he and I talked about the environment just after the war... When Sputnik had gone live and there was a lot of federal interest in science and a lot of money, and that environment allowed certain behaviors and activities to take place, but the whole political environment has changed.

Breidenbach: [00:29:13] That's certainly true and the importance of science certainly went down a lot towards the end of the Cold War, and with the realization that if it turned "hot" the physicists were not going to save them this time. And then, as you're well aware, we have a fairly anti-intellectual bent in Congress these days...and in government...

Deken: [00:29:47] Yes. Yes.

Breidenbach: [00:29:50] Actually the Congress is doing better. I believe the latest bill that passed is actually quite good for physics, for DOE...

Deken: [00:30:04] I think Pief actually quoted a study to me and I looked it up... that if you look historically, federal science tends to get better funding under Republicans than Democrats, which is really kind of strange. I mean sort of counterintuitive.

Breidenbach: [00:30:35] I suspect that's historical. Pief had said that, I remember Pief saying that and I suspect it was true, but I don't think it's still true.

Deken: [00:30:46] Different Republican Party?

Breidenbach: [00:30:49] Well, of course! It's unclear to me what this Republican Party has to do with the party of Eisenhower or Rockefeller.

Deken: [00:30:59] Good point.

Breidenbach: [00:31:06] I think they're unrelated.

Deken: [00:31:06] In name only maybe.

Breidenbach: [00:31:13] The name is there. But look back and see what even Nixon did... and Nixon doesn't look so bad at all.

Deken: [00:31:27] [Laughs] Yeah. Yeah.

Breidenbach: [00:31:36] You've seen the bumper stickers that were around, "I never thought I'd miss Nixon?"

Deken: [00:31:40] No I haven't seen that. [laughs] I haven't seen that one. I've seen a few of that ilk but not that particular one...

Breidenbach: [00:31:56]

Deken: [00:31:56] When you were in grad school and coming to SLAC, how much time were you spending at SLAC and how much time were you spending actually onsite at M.I.T.? How did that work out?

Breidenbach: [00:32:09] So I started coming out in '66. The first year I managed to pay attention to

classes at MIT and the second year was probably not so great... But I don't remember the exact split, but it was probably roughly half and half for the first three years. I certainly remember that I went back to Cambridge and spent a couple of months studying for the general exams which were no great fun at M.I.T. but I wanted to get through that... And then I started spending a lot of time here. One of the things was that my thesis was the first deep inelastic experiment, and I got that almost completely written and finished when I was 25. But I didn't want to graduate for obvious political reasons until I was 26. So, I actually got to do other experiments here while waiting to turn in a thesis, and so that was great.

Deken: [00:33:59] So, what other experiments did you work on?

Breidenbach: [00:34:02] There were a couple experiments before the deep inelastic. I certainly worked on the elastic scattering, E4A, which was fun, and extremely educational. I remember pretty clearly that we went out to very high momentum transfers, where the counting rate gets extremely low and my rough recollection is that the expected count rate was probably two events a day, and on the first day of running we probably had ten events, so I was getting very excited and Pief came by and said 'well statistics.. just wait, we gotta get more data. Just wait.' And, of course as always, Panofsky was absolutely right. The next two days no events came in and, in the end, it came in statistically a little bit low. Not at all high. So that was the experimental education in counting statistics! That experiment was done with MIT and Caltech. And, in hindsight, it was the start of serious collaborations, of collaborations among a couple of universities and the lab and it enabled you to do things that just could not have been done by a smaller group. So, of course I didn't realize it at the time, but these collaborations have become the utter lifeblood of particle physics. I thought the group that was doing deep inelastic, which was probably 10 or 12, was very big. But today there's always Atlas or CMS at three thousand...

Deken: [00:36:13] Yeah.

Breidenbach: [00:36:15] Okay, so there was the elastic scattering and that got done, and then Caltech wanted to do an experiment comparing elastic scattering of electrons and of positrons on protons. I don't really remember why, but neither MIT (Henry [Kendall] and Jerry [Friedman]) wanted to work on it particularly, and Taylor didn't want to either. So in reality it was the Caltech guys and me. We did it, and it was fun- I really knew how to run the spectrometers and all the end station gear. And that's when I met Barry Barish, who has been another life-long friend. It's really a wonderful way to get acquainted with someone. So, Barry and Jerry Pine... Jerry is still at Caltech but moved pretty much into biology where he can bring his instrumentation skills to biology. That was a long time ago and it's amusing because I'm now sort of doing that with some of the folks on campus.

Deken: [00:37:36] Oh interesting.

Breidenbach: [00:37:38] Using those instrumentation skills when we're waiting for the ILC to happen. So that was a very nice, clean, no interesting results experiment, and then deep inelastic... bj [James Bjorken] had this idea about the data "scaling." I think bj started the work but he got at it through current algebra, and you know there might be another half a dozen theorists who understood it, what he was arguing. Certainly, I think none of the experimentalists understood it at all...

Deken: [00:38:38] How was bj involved with your experiments, or with the experimentalists?

Breidenbach: [00:38:47] bj and Henry were mountain climbing buddies, so that was the connection. Henry and Jerry were originally at Stanford before they went to MIT. I think they

certainly knew Dick at Stanford.

Deken: [00:39:08] OK.

Breidenbach: [00:39:10] That was before my time, and bj was part of that gang. Henry did some very serious climbing, toting a huge view camera around, which made I believe a four by five negative, and Henry's pictures are still on the walls by the Theory Group [Building 40, 3rd floor](not anymore!).

Deken: [00:39:31] Yes, I've seen those.

Breidenbach: [00:39:33] That's the connection. They were good friends and Hobey DeStaebler and Dave Coward were part of that gang. I believe also with the climbing. And so that was a pretty natural connection.

Deken: [00:39:53] You were saying bj had ideas about scaling?

Breidenbach: [00:40:02] Yes. He had the idea to plot the measured cross sections in a relatively simple way. But the argument for that was opaque: it was a very, very formal theoretical argument. I didn't understand a word of it. Nevertheless, I can remember as the data was coming in, bj and Henry would be off in a corner plotting it and getting very excited.

Deken: [00:40:43] Mm-hm.

Breidenbach: [00:40:45] It was all wonderful, and then Feynman showed up on the scene ... and we described what we were doing to Feynman who got amazingly excited and said 'I understand what's going on.' And then he explained it to us in terms of his "partons." This was a simple physical idea and it was pretty obvious what it meant. Scaling came easily from Feynman's partons in a way that was clear. It was well motivated, it made sense and even experimentalists could understand it. It was very exciting that we were finding real point-like structure inside the proton.

Deken: [00:41:43] What was Feynman's relationship to Henry and Jerry? Did they work together formally or informally?

Breidenbach: [00:41:58] No, the real connection, I think, was through Dick. Dick was friends with Murray Gell-Mann and at least there was some connection, I guess, mostly competitive with Feynman through Dick. But Feynman was famous enough in those days, that if he said he wanted to come by and talk about an experiment, he was incredibly welcome.

Deken: [00:42:36] Okay. So, and he would just periodically sort of wander by to see what you were doing?

Breidenbach: [00:42:45] It wasn't so much periodically! I think there was the one time in the late 60s, he came by and just talked to everyone and talked to us about partons. But he didn't give a talk here.. And then a few months later he put it together in an elegant way and gave a talk about partons here.

Deken: [00:43:19] I do have in the archives... I do have a photograph from the talk that he gave, and bj is helping him put on the microphone in the old auditorium... I have a date for that.

Breidenbach: [00:43:34] Yes, that was after his first visit.

Deken: [00:43:36] So that was when you were a graduate student. You had already finished your dissertation..

Breidenbach: [00:43:51] No. My dissertation was on the deep inelastic, so it certainly wasn't done yet at all.

Deken: [00:43:58] Okay. I've got my chronology backwards here.

Breidenbach: [00:44:03] Yes. I had to work a little bit on the chronology but the thesis was deep inelastic and Feynman was contemporaneous with deep inelastic so, no, I wasn't done yet.

Deken: [00:44:16] Okay.

Breidenbach: [00:44:18] Afterwards, I was on more extensive experiments on deep inelastic scattering of protons and then we started on the neutrons using deuterium gas. I was involved in that for a year or two...

Deken: [00:44:37] And who was the... Who was the leader on that experiment?

Breidenbach: [00:44:43] Well it was SLAC - MIT, so there must have been a formal spokesperson but I have no idea....

Deken: [00:44:56] Okay.

Breidenbach: [00:45:00] Dick was probably effectively "the leader" and at some time or other there was friction between Henry and Jerry on the one side and Dick on the other ... And it mostly flew over the head of a graduate student. I don't remember what caused it.

Deken: [00:45:20] Okay.

Breidenbach: [00:45:22] It was a sort of funny thing. I believe that Henry always used to stay at Dick's house when he was out here. I don't think that stopped, even though they were mad at each other.

Deken: [00:45:31] Oh interesting. (laughs) That brings up an interesting question: when you were out, where did you stay?

Breidenbach: [00:45:41] I remember the first place I had was in Whiskey Gulch of East Palo Alto, except on the west side of [Highway] 101 and a trivial walk into the real Whiskey Gulch. That was a nice place --fine...

Deken: [00:46:05] An apartment? So, you just kept it?

Breidenbach: [00:46:08] Things changed. That was a tiny little house, and then I had a shared house with a couple of other graduate students in what was technically Atherton, but it was on the east side of the tracks, so that was the seedy part of Atherton.

Deken: [00:46:34] I didn't know there was a seedy part of Atherton.

Breidenbach: [00:46:39] I don't know if there still is, but there was.

Deken: [00:46:42] Yeah.

Breidenbach: [00:46:46] There were crummy little houses that they'd rent to students. There was a time I went back to MIT long enough to have an apartment in Cambridge. That probably was when I was studying for General Exams... which is, of course, tough... And then, I think it must have been in early '71, I went to CERN for a year.

Deken: [00:47:30] OK.

Breidenbach: [00:47:34] And it was, as usual, from my point of view, utterly indefinite. I essentially condensed what I wanted to bring into two suitcases, sent everything else to my parents in New Jersey, and drained my bank account, got to CERN put it all into Swiss francs in the CERN Bank there. Eventually that was a very good move. The Swiss franc was four to a dollar when it went in and it was about par when it came out.

Deken: [00:48:19] Oh wow.

Breidenbach: [00:48:21] So that's my tale of currency speculation.

Deken: [00:48:27] I see. So, what, who did you work with and what did you work on when you were at CERN?

Breidenbach: [00:48:33] I worked on the intersecting storage rings, the ISR, and it was with Jack Steinberger

Deken: [00:48:59] Oh Jack Steinberger. OK. I've met him.

Breidenbach: [00:49:02] , It was sort of a loose kind of operation. I wound up with a couple of other folks my age doing a very simple but nevertheless the first experiment at the ISR and it was fun. I had a one-year appointment at CERN as a "Junior Visiting Scientist," and it was renewed and I was planning on staying, but Mr. Richter came after me.

Deken: [00:49:56] Oh!

Breidenbach: [00:49:56] About SPEAR.

Deken: [00:49:57] You've already completed your PhD?

Breidenbach: [00:50:12] Yes.

Deken: [00:50:13] OK.

Breidenbach: [00:50:13] I completed the PhD, then became an MIT postdoc for roughly a year, working on more detailed studies with neutrons and protons inelastic scattering...

Deken: [00:50:30] And so when you went to CERN you were a research associate. But you were "Dr. Breidenbach" at that point?

Breidenbach: [00:50:44] Even for a year before that.

Deken: [00:50:48] So how did Richter contact you?

Breidenbach: [00:50:54] I knew Burt [Richter] somewhat from before, from the years at SLAC...I

had never worked for him, but I certainly knew him. This was pre-internet, and what existed for rapid communication was telex. You had to write the words of what you wanted on the telex and bring it to the telex operator to do it. That's probably what it was, or perhaps he was visiting [CERN]. That I just don't remember.

Deken: [00:51:35] Okay.

Breidenbach: [00:51:39] Nevertheless, whatever it was, I became an RA [Research Associate] or a postdoc at SLAC. I remember getting sort of a formal offer letter from Joe Ballam [Director of Research Division] and being a smart ass at that time, I just scribbled "sure" on the bottom of it, "Marty" and sent it back: no interviews, no nothing. It was just very, very nice. Different world.

Deken: [00:52:16] Then when did you actually come back to SLAC?

Breidenbach: [00:52:24] It must have been '72 sometime.

Deken: [00:52:25] Okay, and what was the state of Richter's SPEAR program at that point when you came back?

Breidenbach: [00:52:44] The detector was conceptually done, but still being worked on, and SPEAR was well along but certainly not finished.

Deken: [00:52:58] So what was your first role then?

Breidenbach: We worked a lot on the detector . It probably was on electronics data acquisition and computing. That's sort of where I dug in at first.

Deken: [00:53:21] I'm getting beeped at by my phone that I've got no power and maybe we should wrap up today?

Deken: [00:53:46] OK well this is great. I'm so glad you're interested in doing this.

Breidenbach: [00:53:53] I'm happy to. I'm surprised you're so interested in my early history, but all right.

Deken: [00:53:55] Well that that's... that's also something that the American Institute of Physics is encouraging people doing oral histories to do. I guess because they're trying to get some longitudinal demographic information about, you know why people go into science and how they get started.

Breidenbach: [00:54:14] I certainly enjoy this approach where you ask questions and I'll try to answer them.

Deken: [00:54:18]

Breidenbach: [00:54:23] Rather than trying to invent a coherent story....