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FRANK OPPENHEIMER (1912-1985)

**INTERVIEWED BY
JUDITH R. GOODSTEIN**

November 16, 1984

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Subject area

Physics

Abstract

The younger brother of J. Robert Oppenheimer, Frank Friedman Oppenheimer was born in 1912 in New York City. After graduating as a bachelor of science in physics from Johns Hopkins in 1933, Oppenheimer traveled to Europe where he studied at Cambridge's Cavendish Laboratory and Florence's Istituto di Arceti from 1933-35. He then entered the California Institute of Technology from where he received his doctoral degree in physics in 1939. Before joining his brother in Los Alamos in 1943, Oppenheimer held positions at Stanford, Berkeley's Radiation Laboratory and the Y-12 Plant in Oak Ridge, Tennessee. Following the

War, Oppenheimer returned to Berkeley but then moved to the University of Minnesota where he embarked on studies of cosmic radiation. His research ended abruptly in 1949 after he was required to give testimony to the House Committee on Un-American Activities regarding his communist activities as a graduate student at Caltech. Not until 1961 did he return to university life at the University of Colorado. There he developed a variety of innovative teaching techniques, many of which were later incorporated in his design of the Exploratorium in San Francisco where Oppenheimer served as director. He died in Sausalito, California, in 1985.

Conducted at the Exploratorium, this interview focuses on Oppenheimer's years at the California Institute of Technology. Oppenheimer describes his work on beta- and gamma-ray spectroscopy and reminisces about C. C. Lauritsen, his supervisor. He recollects the relationships he formed while working at Caltech's Kellogg Laboratory, including his memories of Willy Fowler, Richard and Ruth Tolman, Hsue-Shen Tsien, Robert Millikan, Henry Borsook, Thomas Hunt Morgan, Fritz Zwicky and Frank Malina. He also discusses his time at Cambridge's Cavendish Laboratory and his recollections of Peter L. Kapitsa, John D. Cockcroft, Ernest T. S. Walton, George Gamow and Ernest Rutherford. In addition to a discussion of Oppenheimer's communist activities in pre-war Pasadena, he recounts his memories of fascism while he was studying in Florence in 1935.

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CALIFORNIA INSTITUTE OF TECHNOLOGY

ORAL HISTORY PROJECT

INTERVIEW WITH FRANK OPPENHEIMER

BY JUDITH R. GOODSTEIN

“THE EXPLORATORIUM,” SAN FRANCISCO

Caltech Archives, 1985

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Interview with Frank Oppenheimer
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Begin Tape 1, Side 1

OPPENHEIMER: I had met Charlie [Charles C. Lauritsen] before I came to Caltech, because he used to come to the place that my brother and my family rented in New Mexico, Perro Caliente. So, when I got to Caltech that fall [1935], he recognized me as I walked into the building. He happened to be right at the door. And he said, “Frank, do you want to smell a vacuum?” [Laughter] He had just taken the X-ray tube apart. In those days, you used shellac to stop leaks, and that sort of decomposed. And it had a real foul smell, even though it was full of air at the time.

GOODSTEIN: Did Lauritsen bring his wife when he would come to New Mexico?

OPPENHEIMER: I don't think so. My recollection is that he was there without Sigrid.

GOODSTEIN: You knew when you came to Caltech that your subject was going to be nuclear physics?

OPPENHEIMER: Yes. I had worked in Cambridge on beta—and gamma—ray spectroscopy, using internal conversion and the photo-electric effect, to develop energy level systems for those heavy nuclei, which was sort of ridiculous, because it was too complicated. So I sort of knew what I wanted to go on with, which was a wonderful thing for a graduate student, because most graduates just take courses, and then somewhere along the way somebody tells them what to do or they get interested in something. So, almost immediately, I told Charlie that I would like to

make a beta-ray spectrograph, since they didn't have one.

GOODSTEIN: Had you made one?

OPPENHEIMER: No, but I'd used one. I used the one developed by [C. D.] Ellis. That seemed a good thing because it was a hole in the Caltech nuclear physics facility.

GOODSTEIN: How long did it take to build it?

OPPENHEIMER: Well, I didn't get it put together until about half way through my second year, I think.

GOODSTEIN: You were taking courses at the same time.

OPPENHEIMER: Yes. I had to build the amplifiers and design the magnet. There was a local place where we could get crescent-shaped magnets because they gave a somewhat better field. They were made in a forging place down south of Pasadena.

GOODSTEIN: Did you actually go into the foundry?

OPPENHEIMER: Yes. That's why I know it was in my second year, because my wife and I went and watched him, and they had lots of ovens all along with a little cart that went along, and a man with a fork would go over and open the door and take out the forging as he would a cake or something, look at it, and see if it was ready. If not, he'd put it back. It was beautiful to see that.
[Laughter]

The research I did was not terribly good.

GOODSTEIN: Why do you say that?

OPPENHEIMER: Well, because I thought I had licked the problem of scattered electrons in this by

various veins.¹ I was looking for a gamma ray from nitrogen 13 that somebody had found, and didn't find it, but I found a broad energy peak in the electron energy spectrum which said that my apparatus was scattering electrons. The spectra were good at the higher energies. I looked at the shape at higher energies and it agreed with other people's conclusion that the neutrino had very little mass.

GOODSTEIN: So the rest of the lab, if I understand correctly, was really into doing these cross-sections.

OPPENHEIMER: Yes.

GOODSTEIN: But your work was not doing cross-sections.

OPPENHEIMER: It was not doing cross-sections. I was looking for gamma rays and looking to see if there were simple or multiple beta spectra from nitrogen and phosphorus.

GOODSTEIN: Did you have much contact with the other graduate students? I think Charlie Lauritsen's son, Thomas, was a graduate student at the same time you were.

OPPENHEIMER: He was an undergraduate, I think, when I first started, and then was a graduate student after that.

As I remember, you'd come into the building from an alleyway, and then over here was the X-ray facility. My office was the second one along there, looking out into that courtyard just in front of the Kellogg Lab. So I was right where everybody else was. Then, Charlie at that time, as I remember, had his students over to his house every Friday evening or maybe every other.

GOODSTEIN: Is that really where most of the seminars took place, at his house?

OPPENHEIMER: There were other seminars, but [on Friday nights] there was always a discussion of the work that was being done. They would talk about that, and then it would gradually

¹ The veins form channels that permit electrons to move from source to collector, but they stop scattered electrons.

develop into a party of some sort.

GOODSTEIN: Was it the sort of party where you might be expected to present something formally?

OPPENHEIMER: No, I think not.

GOODSTEIN: Just everybody went around and said what they were doing?

OPPENHEIMER: What they were doing, or talked and argued about things. I remember one time Jackie, my wife, listening to this, asked a question. It was something about nuclei, and everybody just stopped talking and stared at her for a moment, and then without answering, just went back to talking. [Laughter] They were just so astonished that some stranger would interrupt them. In addition to this, I saw them an awful lot—Willy Fowler and [Lewis A.] Delsasso also. It was a very nice group. Tom Bonner was working mostly with neutrons, almost exclusively with neutrons. And Charlie and Willy were looking at energy levels of light nuclei.

GOODSTEIN: Did you ever find yourself attracted to that? To going into working with the nuclei of the light elements?

OPPENHEIMER: Well, in a way I was, but doing it indirectly through the gamma rays.

GOODSTEIN: Do you remember any interest in nuclear astrophysics on the part of the Kellogg group before World War II? Bethe's paper would have come out in '38, '39. And of course, then the war intervened. But I was wondering if they made the connection?

OPPENHEIMER: I think they did, and I think the groundwork [was laid] for saying "We ought to find out how to measure some of these cross-sections," but the technique for measuring the cross-sections—the sensitivity—wasn't there.

GOODSTEIN: That's why, apparently, they decided to build an electrostatic generator.

OPPENHEIMER: Well, the Van de Graaff was already built when I arrived. Then they built a second one, the tandem one.

GOODSTEIN: This is the one that Fowler and Tommy Lauritsen built.

OPPENHEIMER: Yes. That was after the war.

GOODSTEIN: No, it was before, in '38.

OPPENHEIMER: I left there in '39.

GOODSTEIN: And they started building this in '38.

OPPENHEIMER: Okay, they started this. But they had one that was already working on which they did most of the work. But it was a single one; it wasn't a tandem.

GOODSTEIN: I was wondering if you had given them any help with the building of that?

OPPENHEIMER: No.

GOODSTEIN: When you left, what happened to your apparatus that you had built?

OPPENHEIMER: Well, another man, E. P. Tomlinson, took it over, another graduate student.

GOODSTEIN: Was it used for a long time afterwards?

OPPENHEIMER: I think for a while. I don't know when it got to be disused. It probably wasn't used much during the war.

GOODSTEIN: No, I think they essentially shut down the lab. I noticed, in reflecting on the

experimental approach at the Cavendish Lab, that you told Charlie that you weren't really learning much about nuclei from the approach at the Cavendish. What was different about it?

OPPENHEIMER: Well, I think what I was doing was different. Because [John D.] Cockcroft and [Ernest T. S.] Walton were learning a lot about deuterium and whatnot. But I had done a nuclear level system for radium C, and it broke up, for some reason, into two groups each with about twelve levels, and I couldn't give assigned quantum numbers to these levels from the transition rates. But it was like looking at the iron spectrum rather than at the hydrogen spectrum.

GOODSTEIN: So your comment was more about your own work.

OPPENHEIMER: Yes. We did learn—and corroborated by making the level system—that the radium C has two branches. One is an alpha emitter, and then goes to radium D. And the other's a beta emitter, and then it goes with an alpha emission. And so there's these two ways around that end up with the same product, and one had to find out whether the energy emitted is equal for both cases. In one case, the energy was emitted through a gamma ray, and this I corroborated by developing the level system that showed that that had to be so.

GOODSTEIN: Tell me, just physically, how big is the instrument you built? Was it as big as a desk top?

OPPENHEIMER: It was smaller. The magnet started here and went up to here and then there were Geiger counters at one end of it.

GOODSTEIN: About the size of your desk?

OPPENHEIMER: Just about, a little smaller.

GOODSTEIN: But not exactly portable.

OPPENHEIMER: No, because it was heavy. You could lift it with a forklift. But I didn't move it

around.

GOODSTEIN: So where did you actually do your experiments?

OPPENHEIMER: In that office. Because they would rush radioactive material, even if short-lived, over from Kellogg. But also, at that time, I checked the apparatus because they had a radon source which could put down radium [RaA] that just gave alpha particles, and decayed to radium C, and C¹, which I was familiar with, so I could check the gamma rays from those radioactive nuclei which I was familiar with, and they really gave nice curves, so I knew the thing was working all right.

GOODSTEIN: Who made the radioactive sources for you?

OPPENHEIMER: Well, they had a little facility in which you could go in yourself and collect them on the little buttons you were going to put in the apparatus.

GOODSTEIN: So it was a do-it-yourself operation. Once you made it, you had to rush right over and use it.

OPPENHEIMER: Well, those had fairly long lives. But the ones that were artificially made, Willy would make for me.

GOODSTEIN: You used both, both the natural and the artificial?

OPPENHEIMER: Yes. The natural radionuclides, mostly to test the apparatus, and the artificial to learn something new.

GOODSTEIN: Did you get involved at all in the cancer work?

OPPENHEIMER: No. I knew about it, but I wasn't doing any of it. [Sinclair] Smith had been treated, just as I arrived there, and he was really in pretty bad shape.

GOODSTEIN: He himself was treated at the facility?

OPPENHEIMER: Yes.

GOODSTEIN: Well, someone like Willy, when he came, didn't receive any graduate stipend in money. He received it in services. So he had to do some work on the cancer therapy project. Then he received his room and board in the Athenaeum. Now you were different from him in that sense.

OPPENHEIMER: Yes. Because I didn't have to pay any tuition, but I used family money to live on.

GOODSTEIN: They gave you a tuition scholarship, and then you used your own money. Yes, well, they were very short on cash in those days.

OPPENHEIMER: Yes. I finally made some money there. I made a huge, eight-channel coincidence amplifier. You could measure anything you wanted. You could put some in anti-coincidence, and some in coincidence. The biologists used it; Borsook, for example.

GOODSTEIN: Henry Borsook, the biochemist, he used it?

OPPENHEIMER: Yes, I think so. And paid me for making it.

GOODSTEIN: So that raises the question of what your contacts were with other people at Caltech.

OPPENHEIMER: Well, quite general in a way. Through my brother, probably in part. But I got to know the Tolmans very well. Ruth [Tolman] and I played piano and flute over at Ruth Valentine's house almost every Friday. The first year Jackie and I were married, the Tolmans came to dinner at our house.

GOODSTEIN: Did you live near the campus?

OPPENHEIMER: Not the first two years. But then the last two years, we lived at Cordova Street. I don't know how I got to know Borsook, but he was a great vitamin B enthusiast at that time.

GOODSTEIN: Had he developed it, worked on the chemistry?

OPPENHEIMER: Yes.

GOODSTEIN: Did he advocate taking it?

OPPENHEIMER: Yes. Well, my wife had stomach aches. He told her she should eat wheat germ. And we treated it as a cold cereal. He finally told us it wasn't doing any good; we had to cook it to break down the wheat germ to make the vitamin B available. [Laughter]

GOODSTEIN: Did it work when you cooked the wheat germ?

OPPENHEIMER: No.

GOODSTEIN: Did you know Thomas Hunt Morgan?

OPPENHEIMER: Yes. I didn't know him well. But then, von Kármán was there, and I knew one of his students, the Chinese fellow, [Hsue-Shen] Tsien, very well. Then there were other people.

GOODSTEIN: Did you know Frank Malina?

OPPENHEIMER: I knew Frank Malina very well, and Sidney Weinbaum. What happened with the Communist Party was, I had been close to sort of slightly left-wing things starting in high school. I remember once I went with some friends to hear a concert at Carnegie Hall that didn't have a conductor. It was a kind of "down with the bosses" movement. [Laughter]

GOODSTEIN: Just the musicians played.

OPPENHEIMER: Yes. But then I was also doing the Al Smith campaign during my high school years. So I was sort of aware. Then when I went to Hopkins, I knew quite a few people who I didn't know whether they were party members or not, but they were interested in left-wing politics, and I learned about it. And then a little more on the fringe of it when I was in England, and then I went to Italy, and there were people there of varying degrees of leftness. Occhialini was quite left. Fascism was in Italy when I was there. It was the year before the Abyssinian War. There was a brigade of soldiers just below the lab there, who were always singing and cheering.

GOODSTEIN: Were they dressed in their black uniforms?

OPPENHEIMER: Yes. But they weren't threatening like the people in Germany somehow. I asked one of my colleagues, like Bernardini, about Italian fascism. And I think it was Bernardini who said that he didn't think it was a dangerous thing or that it would have any serious effect on repression in Italy.

GOODSTEIN: Do you remember what Occhialini said about it?

OPPENHEIMER: Occhialini was pretty clear on what it most likely would do.

GOODSTEIN: Did you know Bruno Rossi then?

OPPENHEIMER: Not there, not in Florence. He wasn't there when I was there. But Bernardini felt that because of fascist-organized little discussion groups among the populace, that the populace was finally getting educated about political things.

GOODSTEIN: Which in itself was a good thing, in other words, regardless of who was doing it.

OPPENHEIMER: Yes, that's right. [Laughter]

GOODSTEIN: Did you go to any of those discussion groups?

OPPENHEIMER: No.

GOODSTEIN: Did he?

OPPENHEIMER: No, I don't think so.

GOODSTEIN: Did they ever discuss with you the fact that they had to belong to the party to rise in the academic world?

OPPENHEIMER: No, I think they didn't mind. They didn't see any terrible implications from that. But then the next year, of course, there was Abyssinia.

GOODSTEIN: Did you detect, then, within the year that you were there, a change in people's attitude toward Mussolini?

OPPENHEIMER: No, because it didn't happen until after that.

GOODSTEIN: Because it happened in '36. Did you feel threatened by fascism at all?

OPPENHEIMER: No. Although I had been close to this, I wasn't terribly knowledgeable about what was happening.

GOODSTEIN: So it didn't feel like a menace.

OPPENHEIMER: It did when I was in Germany, very much, where I had been the year before. I had seen people marching down the streets, and really sort of lots of this behavior in the bars, and the whole society seemed corrupt. And then I had some relatives there who could tell me some of the terrible things. But in Italy, the soldiers didn't seem especially aggressive. I never saw any of them marching. The policemen weren't any different, and were probably gentler, than

New York policemen. The towns seemed very relaxed to me.

GOODSTEIN: Did you go to Rome while you were there?

OPPENHEIMER: No, I loved Tuscany so much, I walked all around it and went to Pisa and climbed in the mountains. One time I was climbing and I went to a house up in the hills toward Pisa. And they had a room which was sort of sacrosanct, but they opened the door and I looked in, and it was full of load ropes and climbing gear, and they told me it belonged to the professor at the university; it was Occhialini's gear. But the awe with which the rural population held the academic world really struck me.

GOODSTEIN: Did you find other instances of that?

OPPENHEIMER: Yes.

GOODSTEIN: I think that's still true today. The Italian professor is still somewhat to be respected. Did you ever see any of the Rome physicists in Florence?

OPPENHEIMER: Not then, no. So I never met Fermi until many years later. Occhialini and I got to be very good friends. When I left, he gave me a farewell party in a cave. We walked way back in and came to a huge room and had the party. But Bernardini said something to me at that time that was really surprising. He was twenty-nine and I was twenty-three. And he said, "You know, Frank, I thought I'd reached the age beyond which it was possible to make friends. Now I've learned differently." It was really scary to think you might—at twenty-nine—have reached that end.

GOODSTEIN: Was there any choice of where you might have gone after that?

OPPENHEIMER: Yes, I had a terrible time deciding whether to leave there or not, whether to go to Caltech. I don't know, I think I must have written them about my wanting to come there. And my brother probably did something. But I don't remember any elaborate applications to go to

Caltech.

GOODSTEIN: I think there was less bureaucracy at that time than today.

OPPENHEIMER: The same thing was true with going to Johns Hopkins. I had a friend who suggested I go there, and I probably wrote a letter and got one back. And that had nothing to do with my brother or my friend either.

GOODSTEIN: Overall, in the time that you spent in Florence, did you find that the other physicists were politically minded?

OPPENHEIMER: Some of them. Occhialini especially. Bernardini less so. I don't know about [Julio] Racah. There was another man there, Emil Capo da Lista, who later on came to Pasadena while I was there.

GOODSTEIN: I don't know that name. What kind of a physicist was he?

OPPENHEIMER: He was a nuclear physicist, I think, because he went from there up to Berkeley and worked there.

GOODSTEIN: Did he go back to Italy?

OPPENHEIMER: He died very young. And whether that was in Italy—I don't think so. I think he was in this country when he died.

GOODSTEIN: Did he spend a long time at Caltech, or was it a brief visit?

OPPENHEIMER: He was there, I think, when I left, and he'd been there about a year. So when he went to Berkeley, I'm not sure. Then, he was in Berkeley when Bob Wilson was doing nuclear physics there, which was before the war. So he probably didn't stay at Caltech very long, because there wasn't much time.

GOODSTEIN: Then you came to Caltech. Characterizing discussions there with graduate students and professors, were they aware of what the political climate was like in Europe? Did they care?

OPPENHEIMER: Yes, because of Spain. We were all talking about Spain. Ruth Tolman and I² even gave a benefit concert for Spain. [Laughter] I think they were aware. You see, my wife, also at Berkeley, had been exposed to radical influences and had been a member of the YCL—the Young Communist League—when she was a student there. And we saw an ad in one of the newspapers, asking people to join, and we clipped it and sent it in. It was months before anybody came by. [Laughter] I think we had to send a second one. So it was that kind of a casual thing. But then we became very active.

GOODSTEIN: While you were still a graduate student?

OPPENHEIMER: Yes. First, in the city of Pasadena, in what was called a street unit, in which there were mostly inhabitants and a lot of black people who lived in Pasadena at that time.

GOODSTEIN: What did you do?

OPPENHEIMER: Well, I don't know. We had meetings regularly, and discussion groups. There were various organizations connected with the New Deal. One of them, the Workers' Alliance, was an organization of the unemployed, and many of these people were unemployed.

GOODSTEIN: Did you have this feeling that there was a great deal of unemployment in Pasadena?

OPPENHEIMER: Among the black people there, yes.

GOODSTEIN: Was it visible?

² Oppenheimer was an accomplished flutist.

OPPENHEIMER: They were so poor, but you didn't see them, and it wasn't like New York, where you'd see them out.

GOODSTEIN: There were no bread lines.

OPPENHEIMER: No, I didn't see that. We tried to integrate the city swimming pool there, I remember. It's really hard to imagine, they just allowed blacks in Wednesday afternoon and evening, and then they drained the pool Thursday morning.

GOODSTEIN: So how successful were you?

OPPENHEIMER: It wasn't successful.

GOODSTEIN: I know the schools were also segregated then.

OPPENHEIMER: Yes. But then I was asked by the Party organization to try and organize a Party group with people in Caltech. So Jackie stayed with the street group for a while, and then later on she moved into the other group too.

GOODSTEIN: How much success did you have organizing a group at Caltech?

OPPENHEIMER: Well, I don't know. There were six, or eight, or ten people.

GOODSTEIN: Were all the people who were caught up in the McCarthy period members of your group? I mean, Malina left JPL after the war. Weinbaum went to jail. Tsien left eventually. They're all gone.

OPPENHEIMER: And a few others.

GOODSTEIN: Was it secret?

OPPENHEIMER: It depended on the person. Jackie and I were quite open about it. And I would rent meeting places. Other people were very secretive about it.

GOODSTEIN: I meant were people secret about it on the campus?

OPPENHEIMER: Some of them were. I wasn't. Others were. A lot of people would get into political discussions, and some people avoided all political talk; so there were all kinds of things. But it was essentially a secret group.

GOODSTEIN: Did that bother you?

OPPENHEIMER: Well, it did me, but I wasn't secret about it.

GOODSTEIN: So are you saying the secrecy was imposed by most of the people who belonged to it?

OPPENHEIMER: That's right. Because they were scared of losing their jobs.

GOODSTEIN: Would you often meet on the campus?

OPPENHEIMER: We would meet in people's houses.

GOODSTEIN: If you had to do it all over again, would you have done the same thing?

OPPENHEIMER: I can't say. I know things now. Jackie and I finally left the Party because they had what they called "democratic centralism," in which if there was a policy, the groups were supposed to discuss it and let the leadership know—a back and forth thing. But it really wasn't; there was "centralism," but no "democratic." So we got fairly upset with that. And also, certainly after the war, the Party was not at all concerned with nuclear weapons. And it was pretty much just a duplicate of Soviet policy.

GOODSTEIN: When did you leave the Party?

OPPENHEIMER: We actually left in the spring of '41 or the fall of '40—I think it was the spring of '41.

GOODSTEIN: When you were at Caltech, was Linus Pauling already politically active?

OPPENHEIMER: Yes.

GOODSTEIN: Did he come to any of your groups?

OPPENHEIMER: No.

GOODSTEIN: Because one normally thinks of him only as having become politically vocal after the war.

OPPENHEIMER: Well, I don't think he gave speeches. But in private conversation, he was very interested in what was going on. One of the big issues then was support for the Spanish loyalists. And I don't remember exactly whether he did or didn't support them, but it would seem likely that he was interested.

GOODSTEIN: Was that an issue that polarized the campus in any way?

OPPENHEIMER: I don't think so, not the people I knew.

GOODSTEIN: I noticed that you were friends with Glen Millikan. Politically, he was very liberal compared to his father, Robert. Did he ever discuss that?

OPPENHEIMER: We did a little. We were very good friends. He drove me from England down to Milan through the backside of Europe.

But one of the things about my work in the Party, and I think the only relevant thing to

what you're interested in, is that I would go with my brother to New Mexico in the summer, so I would be gone for two months. Then, the three years that I was there [at Caltech], I was really quite active with the Party, so I didn't work nights as much as I did the first year. With going away in the summer and without working nights, you really don't get enough done. Charlie really didn't object to that; he never chastised me for not being there. He made one of his wonderful cracks one time when he came in and I had just gotten a cigarette holder—I smoked a lot then—and I was soldering away on the amplifier. He remarked on the cigarette holder. And I said, "I had to get it because smoke gets in my eyes." And he said, "Well, if you really have a choice, I'd give up soldering." [Laughter]

GOODSTEIN: He did work night and day, didn't he?

OPPENHEIMER: Yes. I think I did, too, quite often, but not as much as I could have. And I think all the other graduate students knew about Jackie's and my radicalism, and we'd argue about it. But there was never any sense of "you-don't-belong-here" with that community. I'm sure with [Robert] Millikan, it didn't sit very well.

GOODSTEIN: But then, again, you really didn't interact with Millikan.

OPPENHEIMER: No, but I mean he probably knew about it.

GOODSTEIN: Probably. I don't know. Actually, it's very hard to say. I suspect it's not what Charlie would have spoken to him about. After '33 in Germany, and after '38 in Italy, of course there were many scientists who lost their jobs. Was there ever any discussion of bringing some of these people to Caltech?

OPPENHEIMER: Yes, though I can't remember the details.

GOODSTEIN: When you look at the statistics, not all that many émigré scientists really found jobs in the U.S. And there were none at Caltech, nobody came through.

OPPENHEIMER: I wonder why, because I remember talk of it. But I think that may have been something that Millikan wasn't all that enthusiastic to do.

GOODSTEIN: I was wondering, for example, would Charlie Lauritsen have proposed somebody, and did you ever hear anything about it?

OPPENHEIMER: I have a vague recollection that there were talks about it, but whatever was talked about didn't happen. But I don't remember why or who. There were [organizations] in England [to help refugees find jobs]; it was a strange thing, because Rutherford did [help people], and other places did get a lot of German refugees. But there really wasn't any very good way of supporting them. It was still depression times. One of the people I got to know was Kiemperer, who had worked in Germany on Geiger counters and developed counting techniques. He was there the year and a half that I was there; and then they offered him a job in India. And he was really upset with that—I don't blame him.

GOODSTEIN: Did he go?

OPPENHEIMER: No. I think he did find something in London with a commercial firm. But it was a very hard situation because everybody was sort of broke.

GOODSTEIN: Well, apparently Charlie Lauritsen really had a lot of trouble keeping his lab together. He never had enough money. And then, when the cancer therapy program finally ended, because it wasn't a success, there was a real question of where he'd find the money to keep going.

OPPENHEIMER: Well, that was what was so fine about him, I thought. That magnet wasn't very expensive, but still there was no hesitancy in allocating some money for me to get a magnet.

GOODSTEIN: He found the money somehow.

OPPENHEIMER: Yes. You know his own history?

GOODSTEIN: Well, I thought maybe you would tell me some about that.

OPPENHEIMER: Well, I don't know much about it, and in some ways, I could have forgotten. He was an engineering student, and then he was a member of the Royal Danish Sharpshooters. And he rejected the army life and deserted essentially and went first to Florida, and then lived at Lake Okeechobee. I remember the story in which he would catch fish at Lake Okeechobee and take them down and sell them. But the last time I saw Sigrid, she said no, he had a perfectly good job.
[Laughter]

GOODSTEIN: Do you know why he rejected the sharpshooter's life?

OPPENHEIMER: I think he didn't like the military in general. Although, when it came to the war here, I think he saw ...

GOODSTEIN: Certainly he was very involved with the military after the war too.

OPPENHEIMER: Yes, but it was my impression that he just didn't like the regimentation of it or the reason for it; it didn't make any sense to him.

GOODSTEIN: Is that the reason why he emigrated?

OPPENHEIMER: That's what I learned. And then, during the Second World War, he went and did work for the military. It may be that the Danish military was too close to Germany in spirit. That's what I suspected, because as soon as World War I ended, he changed jobs. He had this job during the war of helping launch a Koprorny bomber from a sea sled.

GOODSTEIN: Is that what he did?

OPPENHEIMER: Yes. He had stories about that. The first time it took off, it hit the captain of the sea sled, the tailspin knocked him down. So from then on, it wasn't that the captain learned, but

they had an extra sailor along to pull the captain down. He'd take great delight in that story. And then, after the war, where did he get a job?

GOODSTEIN: He moved to St. Louis.

OPPENHEIMER: Yes. But he also had a job, I thought, with some engineering company that was out of St. Louis. But anyway, he heard Millikan speak.

GOODSTEIN: Did he actually tell you that he came to Caltech because Millikan gave a speech in St. Louis and he was in the audience?

OPPENHEIMER: Yes, that's right.

GOODSTEIN: And he became a convert on the spot?

OPPENHEIMER: Well, I don't know. It didn't happen right away. I don't know how many months it took for that. I think he became a convert on the spot but it took a while before he actually moved.

GOODSTEIN: But he showed up in Pasadena.

OPPENHEIMER: And got his degree.

GOODSTEIN: Was he a good adviser?

OPPENHEIMER: Yes, a very good adviser, and you could talk with him when you wanted to. He didn't come in and ask you what you were doing very much. But, of course, he didn't have to, because of those Friday meetings where you could tell him what you were doing or not doing. I think I discussed what I was doing more often with Willy than Charlie.

GOODSTEIN: He liked what he was doing?

OPPENHEIMER: Oh, yes. Charlie liked what he was doing.

GOODSTEIN: Do you have any sense of what he liked best about it? Did he like the physics as much as building the equipment, making it work?

OPPENHEIMER: Yes. He liked the logic of the physics.

GOODSTEIN: Was he a good lecturer?

OPPENHEIMER: I don't know.

GOODSTEIN: Well, they used to have the Thursday afternoon colloquium in physics.

OPPENHEIMER: Yes, but I don't think Charlie ever gave one. Willy gave one, I gave one; most of the other physicists did. I don't think I ever heard Charlie give a lecture—that may be just lack of memory. Willy was nice. I said, “Are you going to give a colloquium?” and he said, “No, I'm writing it on the board and I'm going to point at it.”

GOODSTEIN: Now, of course, he's famous for laughing when he talks. Did he do that then, the same personality?

OPPENHEIMER: Yes, pretty much. There was a lot of laughter and sort of horseplay with Stuart Harrison.

GOODSTEIN: And Charlie Lauritsen, did he have a good sense of humor, too?

OPPENHEIMER: Oh, yes. I don't remember all the jokes he told, but he could see what was funny.

GOODSTEIN: When you were there, do you remember any of the nuclear physicists from Berkeley? Did [Ernest O.] Lawrence ever come down and give a talk, or any of his boys?

OPPENHEIMER: Well, there was that group from my brother that would come down. I remember Lawrence coming to the Cavendish and giving a talk once, when he was really confused about what was going on, when they first found neutrons from bombarding deuterium. I don't remember his coming down to Pasadena and giving a talk. Who else?

GOODSTEIN: Well, there was [M. Stanley] Livingston.

OPPENHEIMER: Yes. Well, we were doing very different sorts of things really. Who was the cosmic ray expert up at Berkeley at that time?

GOODSTEIN: I don't know. At Caltech it was [Carl] Anderson and [Seth] Neddermeyer and [Ike] Bowen.

OPPENHEIMER: Yes. And then my brother and his group were interested in trying to find out [what cosmic rays were]. Millikan was sure they were gamma rays. And it just didn't work.

GOODSTEIN: Did you ever hear Millikan lecture?

OPPENHEIMER: Yes.

GOODSTEIN: What was he like?

OPPENHEIMER: Very dogmatic! Terribly dogmatic! Pretty clear, but not always believable.

GOODSTEIN: Would people challenge him from the floor?

OPPENHEIMER: No. I don't remember. What else do I know?

GOODSTEIN: Do you remember the discovery of the muon by Anderson and Neddermeyer?

OPPENHEIMER: Yes, but very vaguely. I remember a great sense of excitement, and then wondering almost right away why it didn't interact.

GOODSTEIN: Do you remember any discussion with Fowler about the resonance work, because it was the Kellogg group that discovered the resonance effect.

OPPENHEIMER: I don't remember any particular discussion of it.

GOODSTEIN: Well, I think it's one of those things that looms larger in hindsight than at the time.

OPPENHEIMER: It seemed very familiar to me. It was part of my understanding of what was happening.

GOODSTEIN: Did you do any teaching while you were there as a grad student?

OPPENHEIMER: No.

GOODSTEIN: Would you have liked to?

OPPENHEIMER: Yes.

GOODSTEIN: They didn't take any volunteers?

OPPENHEIMER: I don't know what happened there.

GOODSTEIN: So you really had no contact with the undergraduates.

OPPENHEIMER: Not at all, which is strange, because then when I went to Stanford, I did. I had two laboratory courses with undergraduates.

GOODSTEIN: So, basically, you never really got any teaching until afterwards, after your Ph.D.

OPPENHEIMER: No.

GOODSTEIN: Well, I was going to ask you about some of the professors you had. What was [Fritz] Zwicky like? He's sort of legendary around the campus.

OPPENHEIMER: Well, I had a problem there. My first year in Hopkins, I took a sophomore or junior course in mechanics at the same time I was taking calculus. And I think I must have found it sort of hard. I got good grades in it, but I didn't like the subject. And I tried to make up for that by always, whenever I went to Paris, taking a mechanics book with me and doing some work on it. [Laughter] I must have really hated it. But then Zwicky's course in mechanics came at eight in the morning. It was the first year I was married, and I didn't get there very often. So he was going to give me an F. And I said, "Well, give me a test in it." And he gave me a test in it, and I passed the test and didn't get the F. So I really didn't like Zwicky very much. [Laughter] And I didn't like the way he taught the mechanics course either, especially.

GOODSTEIN: Was he dogmatic?

OPPENHEIMER: Well, I don't know. It wasn't so much dogmatic. It was all in the formalism and he wasn't interested in the meaning or utility of the subject, as I remember it.

GOODSTEIN: Did Lauritsen ever instruct you in the details of nuclear physics right there in the lab? Was he good at that?

OPPENHEIMER: Yes. He'd explain things.

GOODSTEIN: Was he very clear?

OPPENHEIMER: Very clear. That's what I meant, he really loved the logic of the subject.

GOODSTEIN: Did you have any course work from Lauritsen?

OPPENHEIMER: No. I had [William V.] Houston.

GOODSTEIN: He was the mathematical physicist.

OPPENHEIMER: Yes. And [William Ralph] Smythe for electricity and magnetism. [Paul S.] Epstein for thermodynamics.

GOODSTEIN: How was Epstein?

OPPENHEIMER: I liked him, I really did. And I liked the subject.

GOODSTEIN: Was he a good teacher?

OPPENHEIMER: I think so, yes. It's a strange subject. It always seemed like sort of a swindle.

GOODSTEIN: [Laughter] Why did it seem a swindle?

OPPENHEIMER: Well, it's sort of results without any physical input. But I liked the subject. I liked his teaching and I liked his accent. Smythe, I thought, was a little more boring, for a really juicy subject. And he had a real prejudice against vectors. You know, his book has every X, Y, and Z, written out.

GOODSTEIN: And what kind of a teacher was Houston?

OPPENHEIMER: Very good, I think.

GOODSTEIN: He left at the end of the war. He became president of Rice University.

OPPENHEIMER: Yes. I liked Houston, both as a friend and as a teacher.

GOODSTEIN: Was it easier in those days to become friends with professors?

OPPENHEIMER: I found it so. But I'd done that at Hopkins. As an undergraduate, I knew the professors very well.

GOODSTEIN: When you became friends with them, would you go on a first-name basis?

OPPENHEIMER: I suppose. Certainly with Charlie and with Richard Tolman, and with Houston. I don't think with Epstein or Zwicky.

GOODSTEIN: Did you have any mathematics courses with [Harry] Bateman or E. T. Bell?

OPPENHEIMER: Maybe Bell, yes. And then somebody, who was learning it at the same time, taught group theory using Hermann Weyle's book. And it wasn't too satisfactory a course, but it was all right.

GOODSTEIN: So you took your major course work in physics. Did you take any engineering at all?

OPPENHEIMER: No.

GOODSTEIN: And some courses in math.

OPPENHEIMER: I had some in math, yes.

GOODSTEIN: So, you must have had either Bell or Bateman, because they were the two big names.

OPPENHEIMER: I think it was Bell.

GOODSTEIN: What was Tolman like as a person and teacher?

OPPENHEIMER: He commanded respect, very much. And he loved the subject and the beauty of it, and the logical coherence of it.

GOODSTEIN: Did you have him for statistical mechanics or cosmology or relativity?

OPPENHEIMER: Relativity, special and general relativity. I don't know whether I had any statistical mechanics.

GOODSTEIN: That might have been Epstein. So you learned your relativity from Tolman.

OPPENHEIMER: Both special and general, which was wonderful. I don't think I did terribly well in the course.

GOODSTEIN: Did you go to the course that your brother taught? Carl Anderson took it.

OPPENHEIMER: I listened to many of his lectures, but I don't think I took anything for credit. But I think I listened fairly regularly to his lectures. But the course work at Caltech was nice because it came not as something you had to do before you could do any physics. I was really glad that I'd been to the Cavendish.

GOODSTEIN: You had an advantage there.

OPPENHEIMER: Yes, that's right.

GOODSTEIN: You'd really been in two other laboratories before you came. Now, at the Cavendish, had you followed any courses?

OPPENHEIMER: No, I took one course in electrical theory, and one other one—I can't remember what it was. And then I listened to a lot of lectures of a physiologist there.

GOODSTEIN: Why? Were you interested in physiology?

OPPENHEIMER: Yes. I remember one talk he gave, called “Everest in Utero,” which had to do with the lack of oxygen in the uterus.

GOODSTEIN: And then, when you went to Florence, did you follow any courses there?

OPPENHEIMER: No. I was only there for eight months. Bernardini and I did this work on developing proportional counters in coincidence to measure the range of protons.

GOODSTEIN: Of the three labs, which did you enjoy the most?

OPPENHEIMER: They were so different. Probably the Cavendish in some ways because there was so much going on there, and it was all new to me. And they met every day for tea, and you could listen and hit upon what was going on. [Peter L.] Kapitsa was there, Cockcroft and Walton, [George] Gamow would come around. It was a very exciting place.

GOODSTEIN: And you heard, every day, what everybody was doing.

OPPENHEIMER: That’s right. I don’t know why we don’t stop and talk to each other more.

GOODSTEIN: Even at Kellogg, you really only did it on Friday nights.

OPPENHEIMER: Yes, that’s right. Where was the Journal Club started? Was that at Berkeley or at Kellogg?

GOODSTEIN: There was a Journal Club at Caltech.

OPPENHEIMER: Yes. I remember that. We all worked at that.

GOODSTEIN: That’s where you would present a paper that had recently come out.

OPPENHEIMER: That's right, and that was a very good thing. I remember doing that quite often, and all of us did. But it wasn't for the whole physics department, I don't think. I think it was pretty much a nuclear physics or maybe a nuclear physics and cosmic ray journal club.

GOODSTEIN: That was informal, with the professors and the grad students?

OPPENHEIMER: Yes.

GOODSTEIN: Did the undergraduates ever partake of that?

OPPENHEIMER: I wasn't aware of it if they did. They may have. But that was a very fine affair. Then, when I went to Minnesota, I started one up there. And after several months, the FBI came around to ask what we were discussing. [Laughter]

GOODSTEIN: Do you keep up with any of the people that you knew from those days at Caltech?

OPPENHEIMER: Not too many. Willy Fowler I like to see. Delsasso isn't alive. Stevie died. Bonner died. I go to see Sigrid. Tommy died. It's a pretty dismal picture.

GOODSTEIN: Well, it's true. Tommy died young.

OPPENHEIMER: Yes, it's terrible. God, he was wonderful at these journal meetings. He never drank at all in those days. But he would keep up; his mood would change with everybody else's, and he would get more and more outrageous as everybody else did.

GOODSTEIN: Without the benefit of the alcohol?

OPPENHEIMER: Yes, that's right.

GOODSTEIN: Was there ever any problem with a son going into the same field as the father?

OPPENHEIMER: I don't think so. I think they got on famously. I don't know how Tommy felt, because I never had any He didn't act as though there were any problem. And he got his own niche there pretty soon. What was it he did? Tabulating things?

GOODSTEIN: That's right. So it was different from what his father did. He carved out his own niche, that's true.

OPPENHEIMER: Caltech was a lovely place to go to get a degree, partly because of Charlie's group, but partly because of the contacts with other people.

GOODSTEIN: Was the general level of the Institute one of excitement?

OPPENHEIMER: Yes.

GOODSTEIN: It was a very small place then, too.

OPPENHEIMER: It was a small place, but the people in aeronautics were doing interesting things, and I knew them through Malina and Tsien. And Carl and Seth. And then [Jesse] DuMond—I didn't have much contact with him, but enough to know what he was up to.

GOODSTEIN: So there must have been informal ways to know what everybody was doing.

OPPENHEIMER: That's right. I don't know what they were exactly.

GOODSTEIN: Well, did you eat lunch together?

OPPENHEIMER: Sometimes. But there was nothing formal. Let's see, one ate at the Athenaeum occasionally—maybe more regularly. That was one way. I know Jackie and I, when we ran out of money towards the end of the month, we'd always go to the Athenaeum, because you could eat and charge it. [Laughter]

GOODSTEIN: What did your wife do there? Did she work at all?

OPPENHEIMER: No, she went to the junior college in Pasadena and took chemistry. And then she and Willy worked together in the sense that she looked at the pair—formation pictures and then Willy helped her and put her name on a paper that they wrote about pair formation.

Goodstein; Do you need special training to be a scanner?

OPPENHEIMER: She didn't have any previous training.

GOODSTEIN: So Willy instructed her in what to look for.

OPPENHEIMER: Yes.

GOODSTEIN: How many hours a day can you do that?

OPPENHEIMER: Quite a lot. I don't remember how many hours a day she worked. Then she worked also at the radical newspaper, *The People's World*, in Los Angeles, for a year or so.

GOODSTEIN: How long did she work for Willy as a scanner?

OPPENHEIMER: I don't know how long that took—six months maybe.

Begin Tape 1, Side 2

GOODSTEIN: The story is that if you came to campus any season, there would always be work here at Kellogg.

OPPENHEIMER: Yes. And that's why I say, it was very strange for me to go away in the summertime.

GOODSTEIN: Well, in fact it doesn't seem to have held you back. You seemed to have taken your Ph.D. in about the right amount of time.

OPPENHEIMER: Right. But I think I could have done better work if I'd spent more time at it. At the Cavendish Lab, they closed the place down at night unless there was some kind of apparatus or experiment that had to be looked after. And Rutherford—at least I never heard him say it, but the law was that if you haven't done enough in the day to think about it at night it is not worth coming back at night.

GOODSTEIN: Well, what do you think? Now, there you have a study in contrasts, because in Kellogg it was the opposite.

OPPENHEIMER: Yes, it was just the opposite. In most places, it was just the opposite. Well, I think Rutherford's idea came from doing somewhat more straightforward experiments with radioactivity. I thought Rutherford was never really interested in theory. But when you read his works, he really was always trying to think, "What does this mean?"

GOODSTEIN: So he was more subtle than he appeared.

OPPENHEIMER: That's right.

GOODSTEIN: What about Lauritsen? Was he also interested in theory?

OPPENHEIMER: Not so much, I don't think. I think he wanted to think about what was happening, but the theory had gotten—well, there was lousy theory in those days. And I think he knew it. I wasn't much help.

GOODSTEIN: What did they do in Italy? Did they run late at night there?

OPPENHEIMER: No, not especially. When we were fairly late, maybe six or seven o'clock, a group of us would walk to some place where everybody had to go in different directions, and

they'd stop and sing for a while.

GOODSTEIN: Did you participate?

OPPENHEIMER: No. [Laughter]

GOODSTEIN: Were they traditional songs or were they political songs?

OPPENHEIMER: They were traditional song, I think.