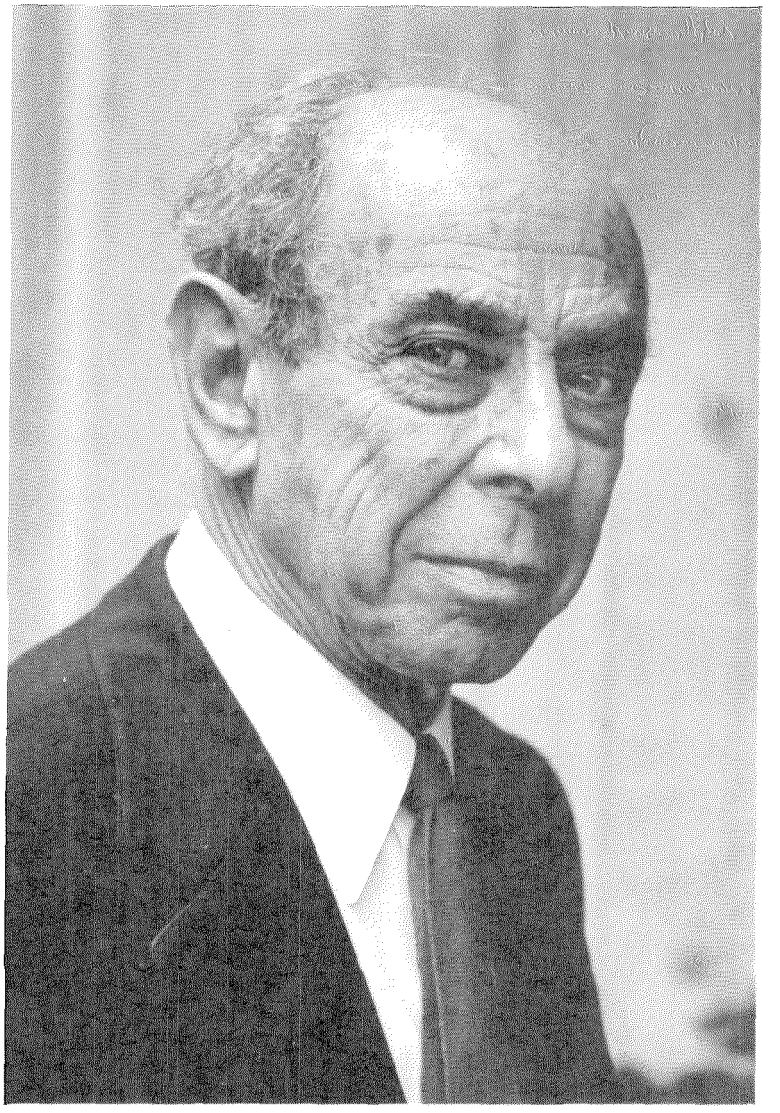
Oral History

Frank Oppenheimer



When he died on February 3 of this year, Frank Oppenheimer was director of San Francisco's Exploratorium, which he also founded (in 1969) and which many have called the best science museum in the world. For his achievements Oppenheimer received, among many other honors, Caltech's Distinguished Alumni Award in 1979.

Oppenheimer was a graduate student at Caltech for four years (in the early days of Kellogg Laboratory), earning his PhD in 1939. Before that he had graduated from Johns Hopkins and spent two years doing research at the Cavendish Laboratory in Cambridge, England, and the Instituto di Arcetri in Florence, Italy. After receiving his PhD, he worked with E. O. Lawrence at UC Berkeley and in 1945 joined his brother Robert at Los Alamos. In 1949 he was forced to resign from the University of Minnesota and banished from academic physics as a result of harassment by the House Un-American Activities Committee. He spent the next ten years as a cattle rancher in Colorado. He was eventually drawn back into teaching at Pagosa Springs High School and from there returned to mainstream academia at the University of Colorado at Boulder, where he directed research in high energy particle physics.

The late 1930s was an exciting time in physics at Caltech. Politically this was also an interesting time, and it was Oppenheimer's political activity in Pasadena that was to have such bitter consequences later on. Caltech Archivist Judith Goodstein talked to Oppenheimer last November about his years at Caltech.

Frank Oppenheimer: I 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. Of course, 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.

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

FO: Yes. I had worked in Cambridge on beta and gamma ray spectroscopy, using internal conversion and the photoelectric effect to develop energy level systems for those heavy nuclei, which was ridiculous and 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 spectograph, since they didn't have one.

JG: Had you made one?

FO: 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 Charlie's nuclear physics facility.

JG: How long did it take to build it?

FO: Well, I didn't get it put together until about halfway through my second year, I think. 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 us a much better field. They were made in a forging place down south of Pasadena.

JG: Did you actually go into the foundry?

FO: 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. [laughter] It was beautiful to see that. The research I did was not terribly good.

JG: Why do you say that?

FO: Well, because I thought I had licked the problem of scattered electrons in this by various veins. I was looking for a gamma ray from nitrogen 13 that somebody had found, and didn't find it, but I found a 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 conclusions that the neutrino had very little mass.

JG: 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.

FO: 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 it 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.

JG: Is that really where most of the seminars took place — at his house?

FO: 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 develop into a party of some sort. They just said 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 a question of 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.

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

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

JG: 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 or '39. And, of course, then the war intervened. But I was wondering if they made the connection.

FO: 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.

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

FO: Well, the Van de Graaff was already built when I arrived. Then they [Fowler and Tommy Lauritsen] built a second one.

JG: When you left, what happened to the apparatus that you built?

FO: Well, another graduate student, [E. P.] Tomlinson took it over.

JG: Was it used for a long time afterwards?

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

JG: No, I think they essentially shut down the lab. I noticed you told Charlie that you weren't really learning much about nuclei from the experimental approach at the Cavendish. What was different about it?

FO: 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 12 levels, and I couldn't give assigned quantum numbers to these levels from the transition rates. But it was like looking at the iron atomic spectrum rather than at the hydrogen spectrum.

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

FO: 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 has to find out whether the energy emitted is equal for both ways around. In one case some of the energy was emitted through a gamma ray, and the level system showed that had to be so.

JG: Where did you actually do your experiments?

FO: 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 [radium A] that just gave alpha particles and decayed to radium C and C', so I could check the gamma rays from those radioactive nuclei that I was familar with, and they really gave nice curves, so I knew the thing was working all right.

JG: Who made the radioactive sources for you?

FO: 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.

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

FO: Well, those had fairly long lives. But the ones that were artificially made, Willy would make for me. The natural radionuclides were used mostly to test the apparatus and the artificial ones to learn something new.

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

FO: No. I knew about it, but I wasn't doing any of it.

JG: 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.

FO: Yes, because I didn't have to pay any tuition, but I used family money to live on. I finally made some money there. I made a huge, eight-channel coincidence analyzer. You could measure anything you wanted. You could put some in anti-coincidence and some in coincidence. You could use it in coincidence with the biology analyzer that belonged to [Henry] Borsook [the biochemist]. He paid me for making it.

JG: What were your contacts with other people at Caltech?

FO: Well, quite general in a way. Through my brother, probably in part. But I got to know the Tolmans very well. And 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. I don't know how I got to know Borsook; he was a great vitamin B enthusiast at that time. My wife had stomach aches. He thought she should eat wheat germ. And we treated it as a cold cereal. And he finally told us it wasn't doing any good. We had to cook it to break down the vitamin B. [laughter]

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

FO: No.

JG: Did you know Thomas Hunt Morgan?

FO: 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. 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 kind of a "down with the bosses" movement. [laughter] I was also doing the Al Smith campaign during my high school years. Then when I went to Hopkins I knew quite a few people who I didn't know whether they were party members at all, 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 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 — the year before the Abyssinia war. There was a brigade of soldiers just below the lab there who were always singing and cheering.

JG: Were they dressed in their black uniforms?

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

Frank Oppenheimer at Pagosa Springs High School in Colorado, 1959.

JG: Did you feel threatened by fascism at all?

FO: No. Although I had been close to this, I wasn't terribly knowledgeable about what was happening. I did when I was in Germany, very much. The year before I had gone to see people marching down the streets, and really sort of lashed out at 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 town seemed very relaxed.

JG: Did you ever see any of the Rome physicists in Florence?

FO: Not then, no. So I never met Fermi until many years later. One of the nice, interesting things was that 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 in that time that was really surprising. He was 29 and I was 23. 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 29, have reached that end.

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

FO: Yes, I had a terrible time deciding whether to leave there or not, or 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. 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.

JG: So 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?

FO: Yes, because of Spain. We were all talking about Spain. Ruth Tolman and I even gave a benefit concert for Spain. [laughter] I think they were aware. You see, my wife, when she was a student at Berkeley, had been exposed to radical influences and had been a member of the Young Communist League. And we saw an ad in one of the newspapers, asking people to join, and we clipped it and sent it in. And 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.

JG: While you were still a graduate student?

FO: Yes, first in the city, 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. We had meetings regularly and discussion groups. There were various organizations connected with the New Deal. One of them, the Worker's Alliance, was an organization of the unemployed, and many of these people were unemployed.

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

FO: Among the black people there, yes. They were so poor, but you didn't see them, and it wasn't like New York, where you'd see them out in bread lines. We tried to integrate the Pasadena city swimming pool, I remember. And it's really hard to imagine — they just allowed blacks in Wednesday afternoon and evening, and then they drained the pool Thursday morning.

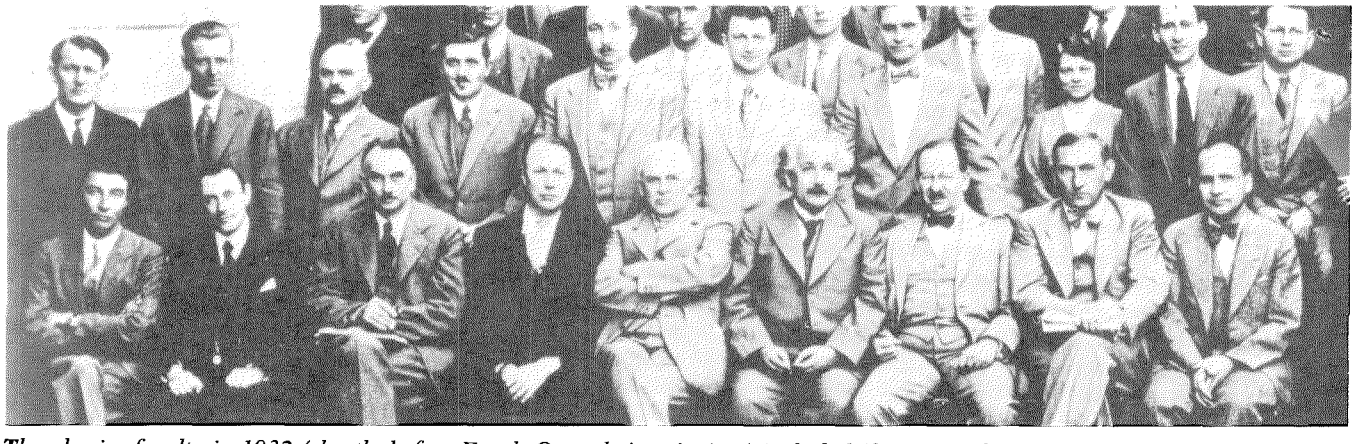
JG: How successful were you?

FO: It wasn't successful. But then I was asked by the Party organization to try and organize a Party group with people at Caltech. So Jackie stayed with the street group for a while, and then later on she moved into the other group.

JG: So, how much success did you have organizing a group at Caltech?

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

JG: All the people who were caught up in the McCarthy period, were they all members of your group? I mean, Malina left JPL after the war. Weinbaum went to jail. Tsien left eventu-



The physics faculty in 1932 (shortly before Frank Oppenheimer's time) included (front row, from left) Robert Oppenheimer, Harry Bateman, Richard Chace Tolman, William Houston, Robert Millikan, Albert Einstein, Paul Epstein, Fritz Zwicky, and Earnest Watson. Charles Lauritsen stands directly behind Oppenheimer.

ally. They're all gone.

FO: And a few others.

JG: Was it secret?

FO: It depended on the person. Jackie and I were quite open about it. And I would rent meeting places. Other people on campus were very secretive about it. A lot of people would get into political discussions, and some avoided anything political. So there were all kinds of things. But it was essentially a secret group.

JG: Did that bother you?

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

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

FO: That's right. Because they were scared of jobs.

JG: Would you often meet on the campus?

FO: We would meet in people's houses.

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

FO: I can't say. I know things now. Jackie and I finally left the Party because they had something that they called "democratic centralism," in which, if there was a policy, the groups were supposed to discuss it, to 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 attitude of the Party was not at all concerned with nuclear weapons. And it was pretty much just a duplicate of the Soviet policy.

JG: When did you leave the Party?

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

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

FO: Yes.

JG: Did he come to any of your groups?

FO: No. 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.

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

FO: I don't think so — not the people I knew. One of the things about my work in the Party 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 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 didn't object to that, 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]

JG: *He* did work night and day?

FO: 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.

JG: 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?

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

JG: 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.

FO: 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.

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

FO: I have a vague recollection of yes, that there were talks about it, that whatever was talked about didn't happen. But I don't remember why or who.

JG: Was Lauritsen a good adviser?

FO: 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 the Friday meetings where you told what you were doing or not doing. I think I discussed what I was doing more often with Willy than Charlie.

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

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

JG: Was he a good lecturer?

FO: I don't know.

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

FO: Yes, but I don't think Charlie ever gave one. Willy gave one, I gave one — mostly other physicists. I don't think I ever heard Charlie give a lecture — maybe it's just a 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."

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

FO: 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 the neutrons from deuterons, but I don't remember his coming down to Pasadena and giving a talk.

JG: Did you ever hear Millikan lecture?

FO: Yes. Very dogmatic! Terribly dogmatic! Pretty clear, but not always believable. [laughter]

JG: 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.

FO: 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, I'd take my mechanics work with me and do 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 course, the mechanics, either.

JG: Was he dogmatic?

FO: Well, I don't know. It wasn't so much dogmatic. It was all in the formulas and not in the meaning or utility of the subject, as I remember it.

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

FO: Yes. He'd explain things. He was very clear. That's what I meant — he really loved the logic of the subject.

JG: How was Epstein for thermodynamics?

FO: I liked him, I really did. And I liked the subject. It's a strange subject; it always seemed like sort of a swindle — sort of results without any physical input. But I liked the subject, I liked his teaching, and I liked his accent. [William Ralph] Smythe, I thought, was a little more boring, for a really juicy subject [electricity and magnetism]. And he had a real prejudice against vectors. [laughter] You know, his book is all X, Y, and Z written out.

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

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

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

FO: 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 hint at what was going on. [Petr L.] Kapitsa was there, [Sergey P.] Karpoff, [James G.] Mauldon, [George] Gamow would come around. It was a very exciting place.

JG: And you heard every day what everybody was doing.

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

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.

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

FO: Yes. It was a small place, but aeronautics was doing interesting things, and I knew them through Malina and Tsien. And Carl [Anderson] and Seth [Neddermeyer]. And then [Jesse] DuMond — I didn't have much contact, but enough to know what he was up to.

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

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

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

FO: Yes. And that's why I say it was very strange to be away in the summertime.

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

FO: Right. But I think I could have done better work. 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. Rutherford's law (at least I never heard him say it differently) 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.

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

FO: Yes, it was just the opposite. In most places it was just the opposite. 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 was always trying to think, "What does this mean?"

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

FO: 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. [laughter] I wasn't much help.

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

FO: 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.

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

FO: They were traditional songs, I think. □