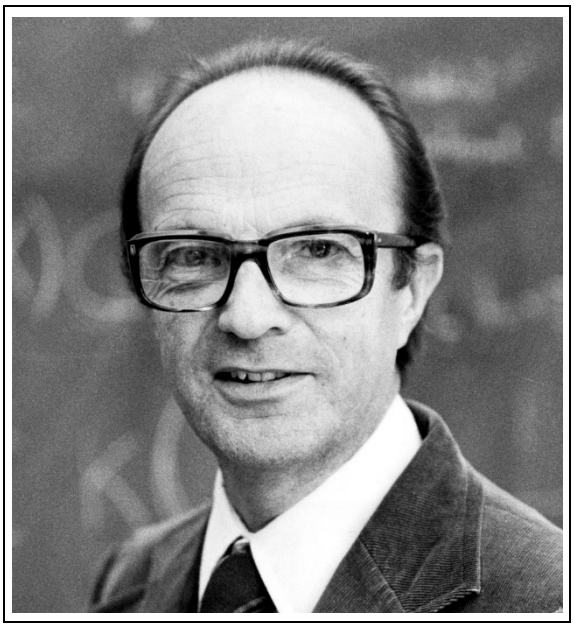

Photo taken in 1979

W. A. J. LUXEMBURG
(b. 1929)

INTERVIEWED BY
SHIRLEY K. COHEN

June 12, 19 & 22, 2001

ARCHIVES
CALIFORNIA INSTITUTE OF TECHNOLOGY
Pasadena, California

Subject area
Mathematics

Abstract
An interview in three sessions, in June 2001, with Wilhelmus Anthonius Josephus (Wim) Luxemburg, professor of mathematics, emeritus, in the Division of Physics, Mathematics, and Astronomy. Dr. Luxemburg received his BA. from the University of Leiden (1950) and his doctorate from the Delft Institute of Technoloy (1955). He and his wife emigrated to Canada, first to Kingston and then to the University of Toronto as a postdoc with Israel Halperin. In 1958, he came to Caltech as an assistant professor in the mathematics department, at the invitation of H. Frederic Bohnenblust. He became a full professor in 1962, served as executive officer for mathematics from 1970 to 1985, and became professor emeritus in 2000.

He recalls his childhood during the First and Second World Wars in Delft, and the deprivations of the postwar period. Discusses his doctorate with Adriaan C. Zaanen at Delft Institute of Technology, on Banach function spaces. Attends

1954 International Congress of Mathematicians in Amsterdam. Invitation from Halperin to come to Canada. His postdoc at the University of Toronto. Travels in Canada. Invited to join Caltech faculty by Bohnenblust.

He comments on the development of mathematics at Caltech, including expansion of applied mathematics and joint appointments with engineering division. Discusses Olga Taussky-Todd as Caltech's first woman full professor; Caltech's abortive attempt to merge with Immaculate Heart College; his membership on Aims and Goals Committee. Recollections of presidencies of Harold Brown, Marvin L. Goldberger, Thomas E. Everhart; support of mathematics by then-current President David Baltimore; travels and life as emeritus professor.

Administrative information

Access

The interview is unrestricted.

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CALIFORNIA INSTITUTE OF TECHNOLOGY ARCHIVES

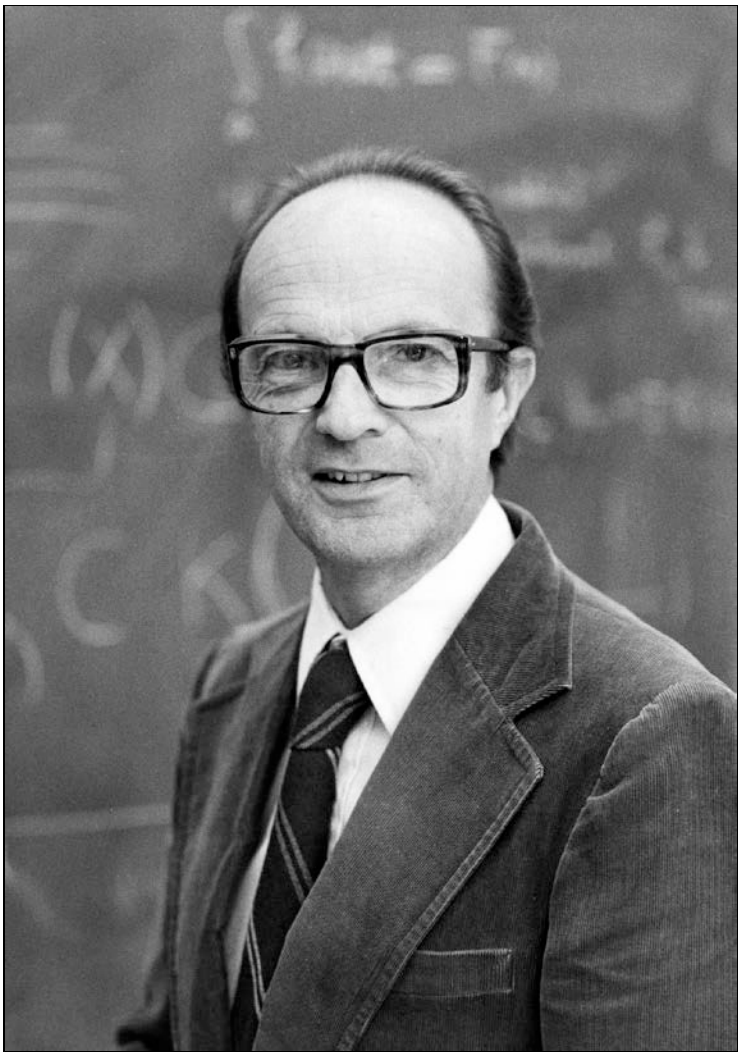
ORAL HISTORY PROJECT

INTERVIEW WITH W. A. J. LUXEMBURG

BY SHIRLEY K. COHEN

PASADENA, CALIFORNIA

http://resolver.caltech.edu/CaltechOH:OH_Luxemburg_W



W. A. J. LUXEMBURG, 1979

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CALIFORNIA INSTITUTE OF TECHNOLOGY ARCHIVES
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Pasadena, California

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Begin Tape 1, Side 1

COHEN: I would like to start with your telling me about your parents—what your parents did—so we know where you came from.

LUXEMBURG: OK. I was born in Delft, in the Netherlands, and my father [Evert Luxemburg] was an architect. He was born in 1886. He had not an easy youth. He never knew his father, who died in an accident; he was a building contractor, and I think he fell from a scaffold. But [my father] never was very explicit about this. He lost his brothers. Through most of the time, of course, he took care of his mother; [he] worked and went to school in the evenings. He worked himself up to become an architect, and he certainly was quite successful. My mother [Digna van Kranendonk] came from an old family in Delft, the Van Kranendonk, and her father [Anton J. van Kranendonk] had a jewelry store. He was a learned man, a very interesting man. We always heard a lot about him; he knew an awful lot about history, literature, and he was an extremely good chess player. She worked with him in the jewelry store. Her older brother was exempt from that, because he was very gifted, and later on he became a professor of English literature and American literature in Amsterdam. She also had a younger sister; they were teachers—my mother and my aunt—when they were young. They were emancipated, in a sense.

COHEN: This was early on for educated women?

LUXEMBURG: Yes. And my mother played the piano very well. She was musical and read an enormous amount—she was really interested in literature. And so we grew up in a— Oh, let me tell you: I had a brother, but he died last year. He was five years older, and I was the youngest; in the middle was my sister. So there were three children at home. We didn't have a lot of family. My father's family—we traced them back; they originally came from Luxemburg, from the province in Belgium.

COHEN: And that's the name, Luxemburg?

LUXEMBURG: Yes. The family was called von Luxemburg, but that "von" meant that you came from that particular area. That was all during the Napoleonic time, and a lot of archives got lost in that period. My brother, particularly, was interested in that. [Laughter] He said, "I can't get farther back than the 19th century and the end of the 18th century." There was a lot of movement in those days—fleeing Napoleon, and then Napoleon, of course, was in the Netherlands as well. So that's where [my father's family] came from. He had lots of relatives in Belgium—the von Kampfs. They lived in the neighborhood of Antwerp. I had only one [paternal] uncle and aunt, whom I never knew, because of the fact that [my parents] married late—I think in 1923 or so, so they were not youngsters. And I never knew my grandparents on either side.

COHEN: So you started out with just your parents and your own family in Delft.

LUXEMBURG: And the First World War, of course—that cut into their lives. The Netherlands was not occupied by Germany at that time; it was neutral. But of course [the war] did affect, a great deal, the country itself. My father was in the Army and my mother worked with the refugees coming from Belgium. And these stories were not very pretty, because even in those early days the Germans behaved in Belgium—

COHEN: Badly.

LUXEMBURG: It's unbelievable. But anyway, my father was, I think, thirty-nine or forty when he married. My mother was two years younger. So they started the family in 1923. And we had a very nice youth—no question about it. We were not rich, but we were always comfortable. My

father built houses, and we lived in a nice house in Delft that he had built—there were some others in the street as well. The Depression was not easy for him, but he managed. But I do remember very well that my parents were very much concerned about what was happening in Germany. They were absolutely certain they would not escape this time—you know, an attack by Germany. And they were definitely completely aware. Even as a child, I remember—in '37, '38—that they were aware that there were concentration camps and [of] all the things that were going on in Germany.

COHEN: You mean everybody knew this?

LUXEMBURG: Well, yes.

COHEN: Because there's this idea that people didn't know.

LUXEMBURG: That perhaps is possible, but there were organizations in the Netherlands. There was an organization of a number of novelists, literary people, and so on, who had taken on the task of informing the rest of the people, through papers and articles, of what was going on in Germany. And my father, but in particular my mother—she read a lot, so she—

COHEN: So she read all this.

LUXEMBURG: So she must have gotten some of this information. And my father had some friends, also, in Germany, some architects, and from them he got some feedback. So they were aware of the things that were going on.

COHEN: No question.

LUXEMBURG: Definitely. Oh, yes. No question about it. And I remember very well that when the war broke out, my father was really [worried]. He said, "It won't be the same as the First World War. The United States will come into the war, and this will be the end of Germany forever." And that's what happened—that's the way it was.

COHEN: Well, they eventually came, but it took a while.

LUXEMBURG: I still remember vividly what happened in the days of the outbreak of the war. When the war broke out, in '39, they were aware that Churchill didn't come in—there was always that fear. And as he said, "England rules the waves. And when the United States comes in, that will be the end." But they did not at all have any idea that Russia would come in later on.

COHEN: Russia never entered into the discussion.

LUXEMBURG: They had no idea that Germany would go into Russia.

COHEN: Holland was occupied very early on.

LUXEMBURG: Yes, very early on. [Fighting] broke out on May 10, 1940, and within five days we were occupied. And then the curtains closed, because that, of course, was a very difficult period.

COHEN: Did your family remain together, in your own home?

LUXEMBURG: Oh, yes. I had three cousins—sons of my mother's brother, who had lived in Amsterdam and had been a professor there at the university. They were older than we were, and they had a very difficult time. The youngest was already studying theoretical physics. There he was picked up by the Germans, and he barely survived—it was a terrible thing. But practically every family, more or less, had something of that sort. My father had a couple of narrow escapes and so had my brother. But I was too young. I always had to talk to the German soldiers when they would come in to pick up people. They had set some particular limits, you see. They wouldn't kill anyone, say, below sixteen, or whatever it was. But that was a very difficult, very awful—

COHEN: Awful time, yes. But your family did survive.

LUXEMBURG: But we survived. We survived. No question about it.

COHEN: Did you continue your schooling at this time?

LUXEMBURG: Well, yes, we did go to school. The German Army had taken over the school, and the troops were in the school, but we had other buildings in Delft that were formerly buildings of the technical university, which was not operating. And we would go into the barracks—as we usually called them—and we had some education in the barracks. But then at the end of the war, with the success of D-Day, the British as well as the Americans and the Canadians, you see, were coming into the southern part of the Netherlands. This was in September 1944; the rumor spread that the next day the British would come in, and the Canadians. But it never happened that way, unfortunately. Then the whole country went on strike, and although [the Allies] were somewhat successful in getting into the southern part of the Netherlands, with this whole campaign to get Arnhem—to get that route into Germany—they didn't succeed. We'd still see the airplanes going over, with the gliders. It was a magnificent, beautiful [sight]. But then the Germans took action, and they starved us to death in the western part of Holland. They drew up a boundary in the southern part of Holland, the northern part, and then going into a little bit of Utrecht, and we were systematically starved to death. We didn't have anything at the end of the war—only water. In the winter—*ooff!* In 1944-45, it was such a cold, terrible winter. We had no heating. But anyway—it's a long story, but we survived it. The end of the war, when it finally came—that was the 5th of May—when finally [we were] the last part of Europe to be liberated—I couldn't walk.

COHEN: You mean you were so weak from hunger?

LUXEMBURG: Oh, yes. Tens of thousands of people, old and young people, died during that particular starvation period. During that time, we didn't go to school. We had a hiding place in the house under the roof. They would cordon off a whole city and put in troops and go into every house, and every able-bodied person had to be shipped off, just like slaves—you know, shipped off to Germany, because [the Germans] were desperate, of course, to try to see whether they would still have a chance. And they tried, of course, as you know, in the Battle of the Bulge. They had to keep the machinery going. Every night we heard planes coming over to bomb parts of Germany. It was day in, day out. Also during that period [the Germans] started to launch the V-1s and V-2s from stations in the western part of Holland, not far from Delft. And

every day the British Air Force would come over to bomb these particular places, the launching pads and so on, every morning at nine o'clock. They came in extremely low, because at that time the Germans didn't have much actually available to really counterattack at all, and you could almost see the pilot sitting in the [cockpit]. [Laughter] But then by accident they bombed away part of The Hague. That was a mistake they made: they thought they were these V-1s. And the V-2s—yes, they were really very bad.

COHEN: So they destroyed part of The Hague, you mean, by mistake?

LUXEMBURG: Oh, yes.

COHEN: That's called friendly fire, I think.

LUXEMBURG: Yes. That was a mistake. But anyway, during that period, the little food that my good father was able to buy on the black market, he did. He lost a lot of stuff during that period. But we played chess, you see. I studied mathematics. I did calculus. Our neighbors lost a son in a concentration camp. There were always some spies within that whole system; we knew some spies. It was really the rough years. Most of the Jews already had been taken out of the country. But [the Germans] needed manpower; and [they would come] early in the morning. We got warned, and so my father and brother would go into the hiding place and sit there.

COHEN: So you mean when the Germans came to get people, they would go up [under the roof]?

LUXEMBURG: Yes. But we had a lot of other things we did, despite all this. We played chess, we studied mathematics and calculus, and so on. So, it's the fear, of course. We lived in fear all day. You never really knew whether you'd be able to survive a day, and that is always something that stays with you.

But then after the war, of course, things quickly changed. The British came in first, and the Canadians. They were very good. They immediately organized places, not only where we lived but in the other cities, particularly Amsterdam—places where the youngsters would come to eat. And then in a couple of weeks—maybe three weeks—we were relatively back to normal.

COHEN: Right. So you were ready to go to university already?

LUXEMBURG: No, I still had to finish high school. Because at that time high school was five years. I was in the fifth year, but we didn't complete that, because we hadn't been in school. So I still had a year to complete. I went to university in Leiden in '47.

COHEN: So you had to live in Leiden then.

LUXEMBURG: Well, because it was almost impossible to get rooms—there was an enormous housing shortage after the war—and since I had my own room in Delft, I could take the train. The distances are so small, you know, that in half an hour I was in Leiden. So I usually took the train back and forth; I would stay [overnight] sometimes if necessary, of course. But at that time I didn't actually have to get a room, because they always said, "If you don't need it, please don't."

COHEN: Because of the shortage.

LUXEMBURG: Yes. So much was destroyed. And nothing could be built. The Germans took away practically everything. Because of the severe cold, you see, wherever people could they would cut down the trees; there were practically no trees left in the cities. And they burned the doors. [Laughter]

COHEN: Just everything they could.

LUXEMBURG: Yes. But in a certain sense we were lucky, because my father had some houses and some property, and he had taken down some of the big trees there. And we'd cut them up, and I sold them, actually, so we were able to get by. We tried to eat—that was not uncommon—tulip bulbs and sugar beets. I couldn't. Tulip bulbs were absolutely impossible. I couldn't keep them down. [Laughter] You have no idea how terrible they are. But sugar beets—that wasn't too bad.

COHEN: I see. So were you already studying mathematics then?

LUXEMBURG: Yes. You see, in Holland in those days was the old system. It was actually a bachelor's degree but it was divided in two parts—the candidate's exam, to actually prepare yourself for the final, your final degree. And for that particular period you had to have two majors and one minor.

COHEN: And did you have a specific professor who guided you?

LUXEMBURG: There were three professors—I took mathematics and physics and I had astronomy as a minor. That lasted about three years. Then you did your candidate's. And then I found myself an assistantship in Delft, at the technical university. You cannot really compare it to Caltech, because it was really an engineering school. But of course there are similarities, there's no question about it.

COHEN: So there was an emphasis on science and math.

LUXEMBURG: I was very lucky to have that, because I learned a lot of different kinds of mathematics and got a lot of experience teaching calculus and doing problems with students. Yes, it was big fun. That had one little advantage also, because of the fact that I didn't have to pay tuition anymore. We got a very small stipend—I think it was ninety guilders a month in those days. You could buy some books, you see, and you could travel and you could do things. Because after the war, my parents told us, "You have to see England. You have to go to France," and so on, so my brother and I, early in 1946 [went]—and we went a couple of times in '47—to England. And then we went to Paris. So we did, actually—

COHEN: Do some traveling.

LUXEMBURG: Oh, yes, in the summer vacations. You see, summer vacations were much shorterr than we have now. We had one month or so; the universities went much longer. I went to school on Saturdays, but that was normal. You had maybe, at most, four weeks' vacation—in elementary school even less.

COHEN: So you had more time to learn.

LUXEMBURG: Yes, but we had to work very hard [in high school], because the final examination was set by the state organization, the Department of Education, in The Hague, and it was the same for the whole country. It was a very, very difficult exam, because we had written exams in all the languages. You had to take French, German, and English. And for mathematics we had to do geometry [and] algebra. And then we had arithmetic. And then we had trigonometry. And then we had mechanics. We had physics, chemistry. All of these required a written examination. It took more than a week, from early in the morning until the evening. And of course with the languages you had to do orals. It was horrible. [Laughter] It was very severe. Just the other day—because I have to get rid of a lot of stuff, you see; when you get old [this happens]—I came across one of these little books with one of the exams in it. When I looked at the physics exam [I thought,] "My god! It's unbelievable that I could do that." [Laughter] The mathematics exams, too—they were very severe, very difficult. But that was the systematic and continuous education you got over five years. You didn't do mathematics, say, in one year. You took mathematics, and it was spread out over five years. You went to school much longer than kids do today.

So you were always busy with that. And particularly for the languages—actually, in retrospect, it was a big advantage. We started with French in elementary school—that was kind of an appendix, you see, from the Napoleonic time. The Germans changed that to German, and so on. Now it is English, of course. [Laughter] But anyway, we started early with French in elementary school, and in high school we took German, French, and English. And of course you learned your own language as well.

COHEN: You enjoyed the teaching in Delft?

LUXEMBURG: Yes, yes, I always enjoyed the teaching. I don't know whether the others enjoyed it. [Laughter] But I certainly enjoyed it; it was really quite interesting, because you had to deal with all kinds of applied mathematical things as well, which we hadn't done in Leiden. You were assigned to one professor, who had several assistants. And that all came about because after the war the Netherlands lost its colonies, which was a blessing [laughter], because the country had to become industrialized.

COHEN: So that's why they strengthened the engineering school.

LUXEMBURG: Engineering became extremely popular. And later on they started another technical university in Eindhoven. So they needed people to teach and to help the students with problems and so on—that's why there were a number of assistantships.

COHEN: So you finished your degree in Leiden.

LUXEMBURG: Yes. But after that first exam, I became an assistant in Delft, in 1950, and I finished it over there. I finished it with Professor [Adriaan Cornelis] Zaanen, in 1954, and since there were no jobs at all, there was a possibility that I could go off to Amsterdam as a postdoc. I was allowed to stay on into 1955, so I got my degree in 1955. But by that time I'd got the attention of some people in Canada and the United States. The first International Congress of Mathematicians was held in Boston in 1950. And then in 1954—it was every four years—it was in Amsterdam. And at that time, of course, all the younger mathematicians who were studying were all helping out there, so I had to clean blackboards and so on. But it was a marvelous thing.

COHEN: You met all these people, then.

LUXEMBURG: Yes. I had finished my thesis ["Banach function spaces"]. And I met there—because I knew his work—I met [Israel] Halperin, from Canada, and a couple of others. And they were very much interested in what I had done. And Halperin said, "Well, I'll get you to go to Canada. You should come and work with me for a couple of years."

COHEN: Now, what was it specifically that they were so interested in? Could you summarize it a little bit?

LUXEMBURG: Yes. In short— Let me put it this way: In the thirties, there was, particularly in analysis, a new era opened up by a group of Polish mathematicians, particularly [Stefan] Banach. And that formed into what is nowadays called functional analysis, although that name is now a little bit old-fashioned. It grew out of work that was done in the late 19th century and the early 20th century—the development of the solutions of, say, particularly integral equations, and the use of the *Veck* integration, which was a new way—actually, a better way—to see how you can see what functions can be given in, say, an area covering [word unclear]. And that led to a new

development that [word unclear] this theory of [word unclear] Banach spaces, Hilbert spaces—which had to do with the theory of operators. A lot of that was also applied in the twenties and the thirties in quantum mechanics. [John] von Neumann was involved in that, and [Francis J.] Murray here in the United States, and a group of people. So I got involved in that particular field in Delft, because I always thought I was going to do geometry. And I wrote a thesis which had to do with these particular kinds of spaces, where you can actually have what they call integral equations and these spaces of measurable functions. And my thesis advisor had asked me to look at this for an abstract collection of what we call norms that you can define. And then you can measure them—you can measure the distance between the two functions and so on. And so I did. First, what I did was work on a class of subspaces which were named after a Polish mathematician, [Wladyslaw] Orlicz, and for the first part of my thesis I developed that theory more systematically. Then, in the second part, we looked at it from a more general point of view. Then a problem came up. I didn't know the problem, but my thesis advisor had learned from [G. G.] Lorentz and Halperin that if you do some operations on the norm, then you'd get the second norm. That seemed to be a hard problem, and I solved that problem. That is why they had that interest in me.

COHEN: Right. Was there anybody from Caltech at this early meeting whom you would have met?

LUXEMBURG: [H. Frederic] Bohnenblust [professor of mathematics, emeritus]. He was very much involved in that particular field.

COHEN: So he already would have noticed you then.

LUXEMBURG: I think that is true, because of the fact that he asked me in '57 whether I was interested in coming to Caltech. I will come to that in a minute. And also Arthur Erdélyi, who was here at Caltech.

COHEN: But it was the work of these Polish people that you originally were involved with.

LUXEMBURG: Yes—particularly the work of Orlicz and Banach.

COHEN: So you had this invitation to come to Canada.

LUXEMBURG: Yes. My wife and I said, "Well, gee, that's an interesting opportunity." [Laughter] So we decided to do that. I also could have gone to Amsterdam at that time; that thing had come through. They needed some younger people, and they asked me to come as what we would call here a postdoc. But we thought, Well— And we had met so many Canadians—first, after the war, that was the contingent of troops that stayed. The British left and the Canadians stayed, because a lot of stuff had to be done, you know. In Delft—also in Amsterdam—before the Germans actually surrendered in the end, they started again fighting the underground. And young people lost their lives, just the day, you know, when it was supposed to be over. And they destroyed our whole school. So [the idea of going to Canada] was, for us, something quite interesting. So I did go to Canada as a postdoc. We stayed one year in Kingston, Ontario, and I got an offer to go to Toronto. One year in Kingston, yes. That's an interesting place. We enjoyed it. The winters were *terribly* cold. [Laughter]

COHEN: I can see why you wanted to come to Caltech. [Laughter]

LUXEMBURG: It was definitely a small town, Kingston. Nowadays I don't think you can call it a small town, but then it was a very provincial, small town. Even Toronto was provincial, in a sense. But it was interesting and beautiful. The winters had an enormous, stark beauty. It was really all so beautiful! And the lake froze over, you see, and we had taken our skates along. [Laughter] We still have them in the basement of the house—these long wooden skates. And I actually skated there at Kingston.

COHEN: On Lake Ontario?

LUXEMBURG: On Lake Ontario, yes.

COHEN: But you don't tell me about the beautiful gardens in Kingston, which I have seen.

LUXEMBURG: Oh, yes, that's true. No question about it. Kingston's very [beautiful]. They also have the penitentiary. [Laughter] They always told us, "You shouldn't go there, because there is

a penitentiary." And from there we went to Toronto. I have to maybe be a little bit more precise, in the following sense. That we went to Canada was to some extent due to the fact that the Dutch government had a program to get as many people to emigrate as possible.

COHEN: Emigrate?

LUXEMBURG: From the Netherlands. There was a whole department. They would pay your way, but we didn't need that, because we got this from the National Research Council in Canada—the trip was paid for. But [in Holland] they had a whole department that did nothing but make it attractive to make contacts over in the United States, Canada, Australia, New Zealand, and South Africa.

COHEN: Was the idea so that the people who emigrated would send something back to the people in Holland?

LUXEMBURG: No. I remember that there was a nice old fellow who was an emigration officer—before I left, because we had to make sure that we told them we were going to Canada and didn't need any money because we had this and that. And he said, "Oh, you'd better make it work. Never come back here again. This country is down the drain." [Laughter]

COHEN: I see. So there was a feeling—

LUXEMBURG: This was sort of the old people; we didn't feel, ourselves, so much that way. But there was so much destroyed. Of course, in Germany itself [there was] even more [destruction]. And of course, for many of the older people, there was the idea that the colonies were gone—that you couldn't go there anymore. [Holland] was overpopulated. They were always getting people to move. They always traveled, always went somewhere.

COHEN: And now there was nowhere to go.

LUXEMBURG: And they made it very attractive for people to go. More than, I think, a half million people left [after the war]. They went all over the world, particularly to Canada. And

large numbers [went] to Australia and New Zealand. Fewer [went] to South Africa; many of them returned from South Africa. That was not such a successful place to go—although there was, in the past, a great connection between South Africa [and the Netherlands]. They speak Afrikaans, and Afrikaans is Dutch—and so there was that connection. But that regime had become so tyrannical, particularly after the war. You see, there were a number of Afrikaans younger people coming home after the war to study. In the past, they would go to England, but they didn't want to go to England to study. They always were terribly anti-British, because of the Boer War. Their parents, too—although they were very much anglophiles. But the Boer War was always a sore point. We were never allowed to go into the Boy Scouts. My mother said, "[Robert] Baden-Powell was a very unsuccessful general, and he built up [the Boy Scouts] in England. All of them had to be these little boys, like the Hitler youth. You're not going into—" We assumed we would never be Boy Scouts. I don't think I lost anything. [Laughter] But that was her opinion. No, he was not such a successful general. Anyway, there was definitely something there that was true.

COHEN: So anyway, you are now in Canada.

LUXEMBURG: Yes, we're in Canada. And that was very interesting. We had, of course, to adjust. We had to learn the language better—in particular, we had trouble reading the comics. [Laughter] But fortunately we had a radio, so we listened to the radio. You learn the colloquial language. Reading wasn't too bad. We could speak [English], but of course very primitively, as still today there's an accent. You learn all these languages. Of course it is very difficult, particularly English. Always, if you want to say something, there are so many different ways that you can select the words. But you always select the wrong one, because you don't have the—

COHEN: You don't have that culture.

LUXEMBURG: Yes. The idiom is very, very difficult. But it's a beautiful language.

COHEN: So what were you doing in Toronto then? Teaching?

LUXEMBURG: Oh, I was there as a postdoctoral fellow from the National Research Council. With Halperin. And I had a little group of students, and we were talking about certain aspects of the field—particularly what I had done in my thesis and so on. So it was really a very nice time. And there—that's why I mentioned the emigration business. Because there, all of a sudden—which we had also already seen in Kingston—we did meet some of the younger people, particularly engineers, who had already emigrated.

COHEN: So there was a Dutch community.

LUXEMBURG: In Toronto it was quite a big group. And in Kingston, too. And there were some people—some families—we met there and got to know; they had left the Netherlands at the time of the Korean War. You see, there was definitely a certain fear during the Korean War that Russia would sweep over the rest of Europe. There was that fear, but it was really—

COHEN: If fear is there, it's there.

LUXEMBURG: And a lot of people left for that reason also. We definitely met some of those families in Canada. I never felt that way—I don't know why.

COHEN: Did you get back to visit in Holland?

LUXEMBURG: Oh, yes. We went back practically every year. There were some meetings that you could go to, so we went back to Holland frequently.

COHEN: OK. So then how did you get to Caltech? How did that happen?

LUXEMBURG: So I moved to Toronto, where I taught and of course did research as well. The University of Toronto is a very good university, and the mathematics department had some very good people, very distinguished mathematicians. The most distinguished one was [H. S. M.] Coxeter. He was originally from England. He's still alive, in his nineties now. He had married, actually, a Dutch woman. [Laughter] [She was] very nice, and my wife got to know her very well. It was very pleasant—and I had all kinds of other contacts there. There were some very

good people. I shared an office, by the way—but this had nothing to do with my coming to Caltech—with an alumnus of Caltech, [Paul G.] Tim Rooney. He was a student of Erdélyi . He got his PhD here at Caltech [1952].

[Tape ends]

Begin Tape 1, Side 2

LUXEMBURG: We had an office in the university towers. It was an old building, a beautiful building. But they hated that fantastically, you see, because you couldn't turn off the radiators. So during the winter, even when it was twenty below zero, we opened the windows, because people were being grilled by the [radiators]. [Laughter] But we had a nice group of people. I taught three courses—that was nine hours. And then we had one afternoon [when] we were doing problems—that was a lab. We did that together with all of the younger people. We were serving the electrical engineers and the physicists; because it was a big university, there were a lot of service courses we had to offer. That was definitely very, very enjoyable. Then, in '57, during the summer, that was the first time we went to the Canadian Mathematical Congress. The Canadian Mathematical Society in those days had just started, and it was called the Canadian Mathematical Congress because the organization would try to get Canadian mathematicians together at regular meetings at intervals of two years—to have a conference. So we went to that. It was in Edmonton. And there, there just happened to be a good friend of mine. He was a civil engineer. He had emigrated to Canada and they lived in Edmonton. It was a coincidence, you know, because they were first in Saskatchewan and then he later went to— He was at the university there, in the engineering department. So it was nice to meet them again. And they also visited us in Toronto once. There I met Erdélyi, but I think there were no other mathematicians from Caltech there. There were lots of Americans.

COHEN: Erdélyi was from Caltech?

LUXEMBURG: Erdélyi was from the Bateman Project, you see. And he stayed on here.

COHEN: Right. Yes. We'll talk about that.

LUXEMBURG: Yes. That was a very enjoyable journey, because we took the train, the National Railroad, and that route went through the more northern part of Ontario, all the way to Winnipeg and all those Canadian provinces. Tim Rooney's mother lived in Edmonton, and we visited her with Tim. It was very, very enjoyable. But Edmonton in those days—though it was a big capital and everything—most of the roads weren't even paved yet. They were just in the oil boom. They were finding oil in Alberta and Edmonton.

COHEN: So it was the Wild West of Canada.

LUXEMBURG: Yes, I suppose so. Edmonton was one of the cities that had all of these oil companies. Tim's father was involved in that.

COHEN: In oil?

LUXEMBURG: In the oil business, yes.

COHEN: So the congress would have lasted one week, two weeks—something like this?

LUXEMBURG: Yes, about two weeks. And then we went with Abraham Robinson. That is a whole other story. He's a very well-known mathematician. That was a Jewish family. They lived in the neighborhood of Waldenburg, near Breslau, which is nowadays Wroclaw. His father died very young, and his mother—you see, they were Zionists and they left Germany in 1933, to [go to] Palestine, and Abraham got his education at the Hebrew University of Jerusalem. He was also in the Haganah. And he got—from the Hebrew University of Jerusalem, through [Adolf A. H.] Fraenkel, his thesis supervisor—an opportunity to go to Paris [in 1939]. That was just before the war. And he and his friend were just able, before the Germans were coming into Paris, to go to Bordeaux. They took a boat to England, and they served, first, in the Free French Army. But then he got picked up by the British and he did a lot of research work [for them] in the area dealing with airplanes, missiles, and all that kind of stuff. He told me that in the particular department he worked in, they got a whole bag of old fragments of a V-1. And he said, "We had to reconstruct it and find out exactly the properties of the thing." And he said that when they got more-or-less finished, the general said, "Well, you have done a very good job. We know,

because we have one which is not." [Laughter] He left England after the war and came to Canada [to the University of Toronto]. And because of the work he had done during the war in applied mathematics particularly—he was very gifted, an unusually gifted man—he was head of the department of [applied] mathematics. I did know about his work in Holland; I had never met him, but I knew about his work. And so we got to know him. The applied mathematics group was in a different part of the university from the mathematicians, but we got together with the other groups at seminars and all that sort of thing. And he was also at this meeting. He took us by car through Edmonton, over to Jasper.

COHEN: Oh, you saw the lakes.

LUXEMBURG: To Banff. That was a beautiful trip. Now it's just a big highway.

COHEN: Yes, but the lakes are still there. It's so beautiful.

LUXEMBURG: Oh, yes. Beautiful. We did that several times afterwards, you see, when we visited our friends.

COHEN: So then you went back to Toronto.

LUXEMBURG: And then back to Toronto. Then, in the fall, I got an offer—I got a letter from Jaap Seidel. He was a mathematician I had known in Delft, and he had the task of building the mathematics department in the new technical university they were going to open in Eindhoven. He told me that if I was interested, he would like me to go back to Holland and be a professor of mathematics. That was interesting, of course. I knew Jaap very well; we did mathematics together. He just died [May 8, 2001]. He was about ten years older than I, and he was already a very well-established mathematician when he came to Delft. So I told him that that sounded marvelous, that we would think about it. And he said there was no hurry—we could let him know. This was maybe the beginning of 1958. But then I got a letter from Bohnenblust asking me if I was interested in coming to Caltech. And to Tim I said, "I got a letter from Bohnenblust." "Oh," he said, "You should definitely go there. It's a marvelous school." Of course, I didn't know a great deal about Caltech.

COHEN: You had never been there?

LUXEMBURG: No, no, no. But I did know something about it, particularly because of Bohnenblust, because Bohnenblust was one of the [stars], for us, in that particular field. In the early days after the war, we had learned more about all this stuff. So he was a kind of hero—he was a great man in that field. So I knew a little bit about Caltech. A friend of mine in Toronto was an aeronautical engineer; he had also emigrated and he was a professor of aeronautics in Toronto. He said, "You know, I have just received *Time* magazine." I didn't have *Time* magazine. He said, "I'll show you. There is an issue—I think I saved it. It's all about Caltech in there. And see, here is Lee DuBridge [Caltech president 1946-1968], on the cover of *Time*." I still see it in front of me. [There was a picture of] Throop Hall and DuBridge and some students. There was a whole story about Caltech. [Laughter] I said, "Oh, that's marvelous." So from those two sources I got all kinds of information. [Laughter] So I talked it over with Trudy.

COHEN: Your wife?

LUXEMBURG: Yes.

COHEN: It stays cold in the winter. [Laughter]

LUXEMBURG: Yes. [We thought,] "It's very pretty, and it was nice that they thought about us. This would be an interesting adventure, and we are still young." So it didn't take us very long to decide. I wrote to Boney—of course I didn't know that his nickname was Boney then—that I was very much interested, and I gave him names of people he could ask for references. And then, shortly after that, I got the offer to come to Caltech. And I got a more official offer from Yale. And then also from the University of Toronto. Because, you see, that was the year of *Sputnik*—that was '57-'58. I remember we saw *Sputnik* in Toronto. We went out late in the night to see it. We lived in a very old part of Toronto, not too far from the university, and we had sort of an attic apartment. In those days, it wasn't very easy to find places to rent, you see—even in Toronto it wasn't easy. But we had a nice place there, and I could walk to school—that was also pleasant. And it was very close to Bloor, the big street. We enjoyed it.

COHEN: So you decided it would be an adventure to go to Caltech.

LUXEMBURG: Yes. It was an assistant-professorship offer, for three years, I believe—that was standard. So I wrote back, "Yes, yes." It would be good experience, and so on. And so we went. Oh, then we had to get the papers.

COHEN: So that's interesting. You were invited to come, but they didn't say, "Come give a lecture first," or "Come and do this."

LUXEMBURG: No, no, no.

COHEN: It was just, "Do you want the offer?"

LUXEMBURG: Yes. I got a letter from the Institute. You just had to sign the letter and then return it.

COHEN: And that was the end of it?

LUXEMBURG: That was all. It was very simple.

COHEN: Simpler days.

LUXEMBURG: Yes. No big forms to fill out, or whatever. But then came, of course, the problem of entering the United States. You see, the Dutch quota was extremely small. Because in that period when they measured and determined that [quota], there were practically no Dutch people coming. Dutch people came much earlier to the United States—I think it was in the twenties, or maybe a little bit earlier. In Orange County, some of the farmers here in the area—they were also from way back; a number of them came from the Netherlands.

So, how to do that? Caltech said, "You can apply as a preferred alien." In those days, a green card. And of course that was completely in accord with the will of the Netherlands, because that meant that they could get rid of you. [Laughter] You see, you would emigrate to the United States. So we went back to Holland, and in Rotterdam there was a consulate, and

there I got the papers. It was all very simple. Because of that visa business, I could not leave Holland so very early. We got out at the end of September, and I came here probably at the beginning of October [1958].

COHEN: And the flowers were blooming?

LUXEMBURG: Yes, but it was also very smoggy. Which we didn't know about. But anyway, it was very warm in '58, I remember. And for the first couple of weeks we stayed at the Athenaeum, because we didn't have an apartment yet.

COHEN: So maybe this is a good place for us to stop.

LUXEMBURG: Oh, yes. Sure.

[Tape is turned off]

WILHELMUS ANTHONIUS JOSEPHUS LUXEMBURG

SESSION 2

June 19, 2001

COHEN: We ended last time when you had already accepted the Caltech offer and now you are just arriving. And you had not seen Caltech yet.

LUXEMBURG: No, no. Actually, except for one trip I made from Toronto to Detroit, we had never been in the United States, except in a few of the towns around the border with Canada, so when we arrived here, this was a completely different world. We were met by Dr. Erdélyi and his wife, Eva.

COHEN: Now, you had met Professor Erdélyi before.

LUXEMBURG: No, no. I had never met him. I had never actually met any of the members of the department personally. They offered the job, I accepted it, and that was it. Then I got the papers ready to get the green cards. We had to go back to Holland from Toronto, and we arranged that, and it took a little bit longer than we had expected. But we arrived here about the beginning of October.

COHEN: There was no problem getting the green cards?

LUXEMBURG: No, no. There were forms you filled out, and you got a particular status—something like a preferred alien. There was a whole group of people that could be so classified if they got a job offer from the United States, and it was clear from the beginning that that would not be any problem. So I took all the papers over to the consulate in Rotterdam, and we had a medical examination and what have you. Of course there were all these details, but that went very easily, very smoothly. And then we took the boat back to Toronto, we picked up some stuff in Toronto that we had left with some friends, and we flew to Los Angeles. That was actually the first time we had made such a long plane trip. We came to Canada by boat, and we went back by boat, and then we came back again by boat. That was normal in those days. But we

flew from Toronto to Los Angeles. That was the first—for us, at least—long plane trip. We had been to London, but that was not a very long trip.

COHEN: Now, did you know anybody at all here?

LUXEMBURG: I knew people by name.

COHEN: I mean in the whole Institute, not just the math part.

LUXEMBURG: Not really, no. I only got information—I told you—from Tim Rooney, who was my roommate, who had been a graduate student here at Caltech and did his work with Erdélyi. He gave me information, of course—very good information.

COHEN: But that was your only real tie.

LUXEMBURG: Yes. I knew about the Todds, particularly the work of Olga [Taussky-Todd, professor of mathematics, emeritus, d. 1995] in matrix theory. She did a lot of that also in Delft with the students. And then, of course, Bohnenblust was one of the pioneers in functional analysis. That was the field I worked in, so I knew his name. And [I knew about] Erdélyi, not only of his work but particularly also— It was well known, of course, that he had organized the whole Bateman Project. And the books were famous in those days—the book of special functions and all kinds of tables for the Bessel function, et cetera, et cetera. That we may come back to, sometime later.

COHEN: I'd like to speak about the Bateman Project, but I think we have to do—

LUXEMBURG: Yes, sure. We may do that a little bit differently. Although I don't really know all that much about it, because when I came here I think it was completed—that particular project of the Office of Naval Research. Erdélyi had been directing it, but he stayed on, fortunately, after that, instead of going back to Edinburgh.

And so when I came here, I met Boney [Bohnenblust]. Of course, at that time, he was running the [mathematics] department, so to speak. It was a little bit less formal, I would say, in

those days than it is today. And he was also dean of graduate studies [1956-1970]. So he had a very big job. At that time, the department didn't have a building; we were housed in the upper floor of Church [Norman W. Church Laboratory for Chemical Biology], which was partitioned off. Everyone had a little cubicle.

COHEN: Mathematicians just need a pencil.

LUXEMBURG: We never had big expectations in those days. [Laughter] If you had a place to sit somewhere, that was nice. I don't think anyone really ever complained, as far as I can remember, for those couple of years. But it didn't last very long, because Bohnenblust and of course the other members of the department—particularly Morgan Ward [professor of mathematics, d. 1963] and Erdélyi and Jack [John] Todd [professor of mathematics, emeritus]—they had gotten from the Sloan Foundation, as you know, the building and so on. They got money to actually rebuild the inside of the high-voltage laboratory. That's the building that now is the Sloan building [Alfred P. Sloan Laboratory of Mathematics and Physics], and apparently it was an empty shell. They brought in floors, and Boney and the architect and Erdélyi and—well, the whole department, except we were not, as assistant professors, so much involved in all that—but anyway, they [decided] how they would divide up the building. A couple of basements and the first floor were assigned to physics. We got what was particularly nice—a big lecture room, Room 151, which is still one of the bigger ones in the whole Institute, although it doesn't hold more than a hundred people, I think—maybe even less, maybe eighty. But it was, of course, perfect. And a couple of smaller classrooms. And that was all on the first floor. And then the second and the third floor were for mathematics.

COHEN: And that was happening just when you came?

LUXEMBURG: No, no. That was being built in '58-'59, and it opened in the summer of 1960. We had a big opening. We had a couple of distinguished visitors, particularly speakers.

COHEN: Now, did you have anything to do with this?

LUXEMBURG: No, no. We were just, as I say, the happy participants in this whole thing. [Laughter] Well, in those days, of course, these things were not so terribly elaborate, you know. The visitors stayed in the Athenaeum, and there were a few parties and so on—that sort of stuff. But anyway, we got that building, which was very nice, because then we also had a couple of rooms on the third floor where we could put some of the duplicates from our library. We had a fairly decent collection of books in there, and also some journals, and everyone contributed some other stuff they no longer needed. Now it's being more-or-less changed, because one of the rooms has been partitioned for graduate students, so now the whole library is one big mess in our building as well. Anyway—

COHEN: Yes. But everybody's library has been moved around.

LUXEMBURG: Yes. But anyway, that was an important thing that Boney accomplished. At that time, I taught sections of Math 2 and Math 108—you had two courses. Math 2 Erdélyi was in charge [of], and Math 108 I did together with Morgan Ward. Math 108 was a very important basic course in analysis for math majors, but it was also a course that was taken by many of the physics majors, too, who were maybe going into the more theoretical angle of physics. So it was always a very interesting class. Bohnenblust at that time would always teach the first-year students—he did it for many years—and that led, incidentally, to a kind of reformulation of what calculus courses ought to be at Caltech. He got together with Tom Apostol [professor of mathematics, emeritus], and Tom and Boney together mapped out a list of topics that had to be covered, and then Tom wrote his famous two-volume book on the calculus for that [*Calculus* (New York: Blaisdell, 1961-1962)].

COHEN: So that directly followed from the course he did with Bohnenblust?

LUXEMBURG: Yes. In the early sixties that started to be completed. But Math 2 we still taught from a very old-fashioned calculus book. I remember that Phillips [H. B. Phillips, *Analytic Geometry and Calculus* (New York: Wiley, 1946)] was the author. But that changed also in a couple of years; I think Erdélyi wanted something else. And Tom had a nice book out on mathematical analysis [*Mathematical Analysis: a Modern Approach to Advanced Calculus* (Reading, MA: Addison-Wesley, 1957)]; we used it in Math 108. That was a very good course

always, and I learned a lot from Morgan Ward teaching that course. We talked about what we were doing, making up exams, making up problems, and so on. Of course, if you're just beginning, you learn a lot from someone else who has done it many times. [Laughter] That was really very, very enjoyable.

So that's the way we started. We found an apartment on El Molino Avenue. Life started to become, say, more normal. In that first year, there was a visitor from Vancouver; he was quite a well-known man in numerical analysis—Tommy Hull. We worked together—he also worked with Jack Todd—and we even wrote a paper together at that time on some aspects of numerical analysis. I thought, Well, I have never really done any particular area of work in numerical analysis myself. But there was some problem there that we got together on, and we worked it out. So that's the way it started to go, and I enjoyed it very much. And my wife, Trudy, liked it very much in Pasadena, too. So that was certainly a very good beginning.

And then Boney, at that time—because that is an important part, actually, of the whole development of our department, of the group for the mathematics option. Boney and Erdélyi, of course—and the Todds and Morgan Ward and [Robert P.] Dilworth [professor of mathematics, ret. 1982, d. 1993] and all of them—they applied for a grant from the Ford Foundation for the further development of mathematics at Caltech. And I have to emphasize here that it included the view of our department that we had to build up something more in applied areas, and particularly statistics. Boney, in general meetings, briefed the whole department, including the assistant professors, about what the main ideas were, and we of course offered some ideas. So that whole thing got going.

Unfortunately—we have a history file, and I had this file on the Ford Foundation in the past, but it seems to have—

COHEN: Disappeared?

LUXEMBURG: It's gone—I don't know where. [Laughter] I looked around in the department. But I may still be able to find the proposal, because it's rather interesting from the point of view of how the math department looked at how they wanted to develop. You see, they felt—particularly Boney and the other full professors—felt strongly that we needed some more people in applied areas to offer, say, a better perspective on mathematics for the math majors and those

who were going into engineering and so on. And that Ford Foundation proposal was approved, for many, many years. Every year they got a fair amount of money. I forget the figure, but when I became executive officer [for mathematics, 1970-1985], it was still going on. I've forgotten now the exact amount, but it became smaller and smaller. One of the important things in that proposal was that we could hire more staff, and particularly mathematicians in more applied areas. So for instance Gary Lorden [professor of mathematics]—he's a statistician, and he was hired [1968]. And Don [Donald S.] Cohen [Charles Lee Powell Professor of Applied Mathematics], who worked in nonlinear analysis. He came on the Ford Foundation [in 1965]. Herb [Herbert B.] Keller [professor of applied mathematics] came on the Ford Foundation [1965]. And so on. We had other young people. They were instructors, the Ford Foundation instructors—the Ford Fellows, I think we called them. I don't know exactly how it went, but a substantial portion of the budget, probably, for those staff members came from the Ford Foundation. And I'm sure that Caltech, of course, integrated that with whatever development they had available for that within our division, you see. So that worked very well. [Robert F.] Bacher [professor of physics, emeritus] was at that time the provost. When I came, it was still [Earnest C.] Watson. He was the provost, but they didn't call him the provost; in those days they called it something else. Yes, I think he was the dean of the faculty—that name changed. And Bacher was [1948-1962] the chairman of the division [Physics, Mathematics, and Astronomy.]

COHEN: Bacher was the one you would have to talk to, to expand the mathematics?

LUXEMBURG: Oh, sure.

COHEN: Of course, that was part of that division.

LUXEMBURG: But there was parallel development in the engineering division, for applied mathematics. When mathematical interest started to grow in the engineering division, with [Paco A.] Lagerstrom [professor of applied mathematics, d. 1989] and [Philip G.] Saffman [Theodore von Kármán Professor of Applied Mathematics and Aeronautics, emeritus]—all those were around the same time—[Donald] Cohen went over fully to the applied mathematics department. I think Herb Keller [was] the only one of that initial group who still [had] a joint appointment [in both divisions].

COHEN: I see. So these applied mathematicians then became part of the engineering division and moved out of the physics division.

LUXEMBURG: Yes, but they kept joint appointments, you see, for a long time.

COHEN: What difference would that have made? Did that make a difference in what they would teach or who would tell them what to teach? Why did they do that?

LUXEMBURG: I think the main reason was that it was felt that it would be—for the group interested in applied mathematics—closer to what was going on in engineering. Already in the engineering division, they had brought in Saffman. And of course Lagerstrom was there. At that time also, in applied mechanics, Charlie DePrima was in that particular group. When Charlie became more interested in other more, say, mathematical aspects of his work, he joined our division later on, but when I came here he was still in the engineering division. And then he got more interested [in our group], so in time he joined us. Keller stayed, but then Cohen went over completely. And statistics, by the way—Gary Lorden stayed in our group. But we were never very successful to further build something in statistics and probability. We always had difficulty in creating an area of mathematical statistics and probability—some kind of a core group. You need some people together. But Gary was happy. He was an undergraduate here [BS, 1962]. He was typically a product of the school, and of course he knew Caltech in and out. [Laughter] He still knows Caltech in and out—maybe even more so. So he was always happy, and he stayed around.

COHEN: Even though he was the only person in statistics.

LUXEMBURG: The only person in statistics. And that was fortunate, because we could then still offer, as we did, courses in statistics, you see. [Laughter]

COHEN: Now, the Todds didn't do statistics?

LUXEMBURG: No. Olga was very much in number theory—algebra.

COHEN: Algebra, that's right.

LUXEMBURG: But of course also during the war they got involved in more applied things. And she got involved more in matrix theory and other kinds of areas which are a little bit more applied than numerical things. Jack Todd was always a numerical analyst. He contributed a lot also to the development of the computer and so on, of course, all the way back to—

COHEN: You know, when I read some of these things about the early math [department], the name Sam Karlin comes up.

LUXEMBURG: Oh, yes. [When I came], he already had left [1956]. He had already gone to Stanford, and from there he later went to Jerusalem. So I never actually—well, I met him, because Sam Karlin sometimes came down to Caltech to give talks here. But we were never really colleagues here. Sam Karlin was also working very much with Boney in those days, the early days, in the area of functional analysis, and they wrote papers together.

Nevertheless, the Ford Foundation grant was, for the mathematics department, a big boost. And at the same time in the sixties—you know, after the *Sputnik* period—the National Science Foundation opened up more possibilities for mathematicians to apply for grants.

COHEN: So this was really the first time there was really money for mathematicians.

LUXEMBURG: Yes, definitely. And most of the schools, of course, were on nine-month [schedules]. The National Science Foundation grants were for summer support. At Caltech it was a little bit different. We applied for the grants and got the grants, and they were usually big grants. Erdélyi on top, Morgan Ward on top, or someone else, and then they had, of course, collaborators—people who would be working [with them]. And that included myself, you know, younger people, or whatever.

COHEN: So you didn't apply for grants yourself?

LUXEMBURG: Right. And it was then usually a proposal that would cover many different areas.

COHEN: Now, I have the impression from some of the things I've read that the Institute itself thought of mathematics as a service department and not necessarily as a department where research is done. Did you have that impression?

LUXEMBURG: That was not so much the case here—at least, the mathematicians didn't think so. [Laughter] Of course we were servicing the Institute with courses, but we have an undergraduate degree in mathematics, so we had a mathematics major. And of course we have graduate students in graduate school for mathematics. And that means that we do have research mathematicians to do this.

COHEN: That was right from the beginning?

LUXEMBURG: Right from the beginning, yes. Going back to Bell—E. T. [Eric Temple] Bell [professor of mathematics 1926-1951, d. 1960], who was a very famous mathematician. And there was [Arisotle] Michal [professor of mathematics, 1929-1952, d.1953]. I never met Michal. Michal had passed away by the time I came here. But he was also a well-known mathematician in his field, also mathematical analysis. I think he did a lot to build it up here. He had a number of students.

And of course E. T. Bell is one of the people in the mathematics group at Caltech who has been known for a long, long time. First of all, he was a very good mathematician, and second, for the [science fiction] books he wrote [under the pen name John Taine]. But I never met him, either. When I came here, he had already moved, I think to Santa Barbara—I've forgotten now. But Tom Apostol knows that very well, because he knew him; Tom came here as an assistant professor in 1950. Tom has been here a long time. We just celebrated last year his fifty years at Caltech—that's a long time. But anyway, so that goes way back to [the early postwar] period. But we then, with the new housing facilities we had, and with the grants we got, the grants supplied money for visitors—short-term, sometimes longer, whatever we were able to negotiate with the people we would like to see come here. And that was largely supported also by the National Science Foundation grants.

COHEN: So there were plenty of grants in mathematics.

LUXEMBURG: Yes. We had an analysis one. And I think numerical analysis always had a grant. Olga [Taussky-Todd] had grants, of course. Practically everyone at that time was somehow partly supported [by the NSF].

COHEN: Why did it take so long for the Institute to appoint Olga to a professorship?

LUXEMBURG: Oh, yes, that is an interesting story. That happened just when I had become executive officer.

COHEN: What year would that have been?

LUXEMBURG: That was in 1970. Yes, we'll get to that in a minute. But, you see, Olga—if I understand it correctly—when Jack and Olga came here [1957], I think Olga wasn't really terribly interested in teaching. I think she wanted very much to be free to do her own research, and so she became what in those days was called a research associate. But within our ranks I always understood that that particular rank corresponded to full professor. I think she also got tenure. But with the build-up in mathematics bringing in more graduate students, she got into contact with more graduate students and actually got students of her own—and that meant, to some extent, that she also had to teach something to them. And she enjoyed that very much. So after a couple of years—from the end of the sixties to the beginning of the seventies—she started to talk about maybe changing from a research associate to a full professor. You see, they had these parallel ranks in research appointments: You had the research fellow and then the research associate. And she felt that that no longer had the same status—that over the years there were some changes made. Because, if I remember correctly, more and more of the research associates came on special contracts. Most of the money, then, probably came out of particular grants, and they would be appointed in that particular rank, but it would no longer, of course, have tenure attached to it. And she felt that this was also a reason she didn't feel too comfortable anymore.

COHEN: So Olga decided there wasn't enough prestige in her appointment.

LUXEMBURG: Yes, that's right. And as naïve as I probably was at that time [laughter], I thought there was probably nothing really to [making that change].

COHEN: That was when you were executive officer?

LUXEMBURG: Yes. You see, that came about because Boney was so busy. He was the dean of graduate studies at that time, and the graduate school exploded. Of course, we don't explode so much at Caltech [laughter], but it was growing as well. And he was probably, later in the sixties, no longer so terribly active with the Ford Foundation grants. They ran fine, everything was going well, but some of the younger members of the department felt that maybe there should be some changes, and they talked to Lee DuBridge. And then Boney decided that maybe it was better perhaps to no longer take on that administrative part of the math. But of course he would still be part of the division's decision-making group. And then Marshall Hall [professor of mathematics 1959-1981, d. 1990] took over.

COHEN: As executive officer?

LUXEMBURG: Yes. Marshall came in '59. So Marshall then took over in the middle sixties or so. [Laughter] I remember when he started talking to me, I had a feeling that he wasn't too happy anymore running the department. There were so many things he had to do. He had to do this and that. He had his own grant, of course, too. He had a whole group of people in combinatorics. And so on and so on. So he wanted, I think, to get rid of that administrative duty. So he said to me, "You're young enough. No one can say anything about you. Why don't you take over?" [Laughter] But I felt a little bit embarrassed about it at that time—that he asked me. Why should I take over? But in the end they convinced me that it would be better if I did it. So I said OK. I was a little bit embarrassed about it, because I was not that senior a person in the department, compared with others. But they felt probably that—

COHEN: You had made no enemies.

LUXEMBURG: No. Maybe [I was] more neutral. Also we didn't have that many—oh, there were some small controversies between two people, but it was not really terribly serious. But anyway, so I became executive officer, and one of the first things that came up was this whole question about Olga wanting to go into the professorial rank, you see—the teaching and all of that. So we wrote up the proposal and I took it to the provost. Well, of course, in those days we first went to

[the chairman of the division]. That was [Carl] Anderson [professor of physics, chairman of PMA 1962-1970, d. 1991]. Well, he said, "It looks good. Go ahead." So we did. But then I got into what was for myself, again, an embarrassing position, because I had to ask for letters of recommendation for her. I hadn't expected that—put it this way.

COHEN: You thought it would just be automatic?

LUXEMBURG: Yes, I thought [it would be] more automatic, because she had tenure. And we understood, at least, that that was a similar rank to the professorial rank. But as it was, we had to get two letters. Of course it was not very difficult to get those letters, and they were, of course, very glowing and everything went very smoothly. And so it became a fact soon after that, you see.

COHEN: She then was the first woman full professor at Caltech.

LUXEMBURG: Yes. I'm not so sensitive to these particular things: this rank, that rank. To me, of course, Olga came here earlier, and she was already in that top rank, and she was always working in the department, except that she didn't have any particular task to teach a particular course regularly. She was always involved with graduate students, and also undergraduates.

COHEN: She'd just advise them—not in formal courses.

LUXEMBURG: Oh yes, definitely. She was definitely involved with undergraduates and undergraduates were seeking her out as well. I remember one of the famous—nowadays famous—logicians, [H. Jerome] Keisler. He was an undergraduate here, and he was just graduating at the time when I came here. I remember that Olga and Keisler worked together. I think there were many of these bright undergraduates majoring in mathematics, who now are major mathematicians throughout the country, in major departments. They definitely always—

COHEN: Came to Olga?

LUXEMBURG: Yes. They talked to Olga. They learned a lot about mathematics from Olga. But it was more in those early days on a personal basis; they would never, say, go to a formal class that she would give, you see. But she would have seminars and then the students would come. And so I thought—particularly because of that, of course—that making a change to her rank shouldn't be so terribly [difficult]. [Laughter] Anyway, we had to go through that process of getting letters, but that all went very smoothly. We submitted the letters, and then I think the proposal was approved by the Institute Council. So that was definitely—as far as the mathematicians were concerned—the sort of thing that was obvious. There were no questions to raise.

COHEN: So it was not some earth-shaking decision, to have a woman mathematician?

LUXEMBURG: No, no, no. But [Robert] Christy [Institute Professor of Theoretical Physics, emeritus], the provost [1970-1980], wanted to do that completely formally—I suppose, correctly, according to the rules. I'm sure that was what was on his mind. So he asked simply for Olga to get letters of recommendation. And we had to write, of course, a supporting letter. Then the division chairman could take it up with him. And that's the way it went. [Laughter] Yes, Olga was always interested to find out who had written those letters. I was not supposed to tell her, you see, but then she'd ask if it was so-and-so. [Laughter] And she guessed correctly, you see. [Laughter]

COHEN: OK. One is always curious—you can't help it. But now, of course, legally you wouldn't be able to prevent her from seeing the letters.

LUXEMBURG: That's correct, yes. In those days the whole appointment procedure became already a little bit more strict and so on. Because the way I came—of course I didn't come here to visit, to look, to have them look me over, or give a talk or whatever. But I had to give them some names that they could write to. And they did, apparently. And then on that basis, whatever came out of it. Of course an assistant professorship is not all that big a deal anyway. [Laughter] But they decided, and you just had to sign a letter, and that was it. It later became far more—

COHEN: Far more formal.

LUXEMBURG: Oh yes, much more formal.

COHEN: Well, it became much more competitive to get a position. So how did you find being executive officer? How did that affect you or your work?

LUXEMBURG: Yes, it did affect me. I had good relations with the rest of the members of the department, but the one thing that was more difficult for me, which I hadn't expected, was the whole—controversy is probably a little bit too strong [a word]—but this split between mathematics and applied mathematics. There were, say, opinions expressed that maybe those mathematicians in our group who were closer to areas of analysis that had to do more with applied mathematics would fold in with the applied mathematicians, and that maybe [they would] even think in terms of discontinuing mathematics altogether in the division.

COHEN: You mean take it out of the Division of Physics, Mathematics, and Astronomy, and just have it in the engineering division?

LUXEMBURG: Yes, move us over, you see. But then the younger people who had no tenure and who were not necessarily, say, really the kind of mathematicians that the applied mathematics group would like to have, you see, would leave.

COHEN: Whose idea was that, to move the mathematicians?

LUXEMBURG: That was in the beginning of the seventies, when it started.

COHEN: And who thought that would be a good idea?

LUXEMBURG: I didn't think it was a good idea.

COHEN: No, you didn't, but who did think it was a good idea?

LUXEMBURG: Oh. I think that came up, to some extent, through Lagerstrom.

COHEN: He wanted to have everybody with him?

LUXEMBURG: Yes. I think that was what was behind it, yes. Although he himself—

COHEN: I should turn this tape over.

[Tape is turned off]

Begin Tape 2, Side 2

COHEN: So you think it was Lagerstrom that wanted all the mathematicians [to come into] engineering with him.

LUXEMBURG: Yes. I don't think that was ever written out explicitly. In those days [Francis] Clauser [Clark Blanchard Millikan Professor of Engineering, emeritus] was the division chairman in engineering [1969-1974], you see. Clauser was very much interested in the role that mathematics played within the Institute. And he, I think, was also involved in this whole question about Olga moving into the rank of full professor.

COHEN: In what way was he concerned?

LUXEMBURG: Well, I think he was interested to see what that would mean for the whole Institute. But it's interesting also that in the seventies, of course, we finally admitted girls to the undergraduate school, and that was not so terribly smooth either, as you may remember, but fortunately that all in the end worked out. But this sort of [thinking] about what the Institute should do about mathematics was not quite clear. And since there was this group that was being formed within the engineering division—which, from our point of view, was something that Boney and Erdélyi started with the Ford Foundation to do within *our* division, as a support group for engineering—what happened in the end was that those particular appointments, like Keller and Cohen, became joint appointments between the two divisions. Then Cohen went over [to engineering] completely. So we felt, "Sure, that was not a bad idea," if they really wanted to do that, but we didn't think it would necessarily mean eliminating mathematics at the Institute. From the early beginnings, there was always an option for mathematics and graduate work in mathematics at the Institute. Even before the war, in the twenties and thirties, there were a number of very well-known mathematicians who were working at Caltech. That there would be

in the engineering division a group in applied mathematics which would support whatever they needed within the engineering division—I think there was no particular quarrel [with that], from our point of view, but we felt that we had a right to exist as well. [Laughter]

COHEN: So there was this attempt to move mathematics into engineering altogether?

LUXEMBURG: Yes—a small part [of it], you know, which would fit. Because the ones who probably were too pure, they would have liked to get rid of, you see. Maybe I put it a little bit too bluntly, but that was a little bit behind it, you see. There was going to be a complete reorganization.

COHEN: Now, was DuBridge president at this time?

LUXEMBURG: No. [Harold] Brown [Caltech president 1969-1977] had come already. But I don't think—at least as I remember—that in the beginning Brown himself took such a strong view. If you remember, in the sixties we also had that huge committee, the Aims and Goals Committee, to map certain particular paths for the future and so on. I was a member of that committee. We were writing up things, but it wasn't really a very coherent sort of thing. And then I think the provost—Christy—decided that it should have a more organized chairman, so Neil [Cornelius J.] Pings [then professor of chemical engineering and chemical physics, and vice-provost] took over. And of course also this whole question about women was part of that Aims and Goals Committee. [There were] all kinds of other ideas, of course, for building up the humanities and making the school become more, say, social—although I don't exactly know how you would put that. And Brown himself was urged on by this well-known psychologist, or sociologist, from Harvard. He wrote a letter to Brown saying that one of the most important things that Brown could do was— This is just the way I remember it, and I still may have a copy of [the letter], because the members of the Aims and Goals Committee got that letter and I still have the old file—I took it out just the other day. But one of the important things that Brown could do was to make Caltech more integrated, not so much in the direction of science but also to go into the humanities. And then they had this idea that instead of just bringing women in as undergraduates, they should bring in a whole women's school, and they set their minds on the Immaculate Heart College. Do you remember that?

COHEN: Oh, of course. Yes, yes.

LUXEMBURG: Immaculate Heart was going bankrupt, I believe—something like that. Anyway, there was this whole thing. But this was the biggest shock I'd ever had in those days—because I couldn't possibly, for myself, not think that this was a complete mismatch. That was a shocking experience, because eventually all the divisions met separately to come to a conclusion. And I remember that Marshall Hall and I went [to the meeting], and we were sitting with the group of mathematicians. Christy, at that time, as the provost, conducted that whole discussion. And we had to vote on it. I think Herb [Herbert J.] Ryser [professor of mathematics 1967-1985] had gone to the Immaculate Heart College. [Laughter] There's nothing wrong with the Immaculate Heart College. He said that, yes, he had met some very smart young women there, sure. [Laughter] He thought perhaps it might not be a bad idea. And there were some others who came forward, you see, saying that was not [such a bad idea]. Oh! Kip Thorne [Richard P. Feynman Professor of Theoretical Physics], too.

COHEN: He thought it was a good idea?

LUXEMBURG: Yes, I think he thought it was a good idea. That it would be interesting at least, that we should certainly investigate more thoroughly, and so on—all that sort of stuff. But I had the feeling that no one was entirely committed. I felt that I'd vote no, because the Immaculate Heart College was something so completely different from our Institute. And then to feel that if you bring a whole group of girls here, it would satisfy the men in our school—to have the girls next door. [Laughter] And then Immaculate Heart's whole view of science and whatever, you see—coming from the Roman Catholic Church. I thought it was complete nonsense. I had already stated that, actually. Because when I became executive officer, in those days the students would interview you for the [school] paper, and I had already made a statement that I thought it was a mismatch. So then it came up for a vote, and first they asked who was against it. And I raised my hand, you see, and Marshall [raised his], and I think also a couple of radio astronomers. But we were a handful. And I thought, "My gosh!"

COHEN: You mean everybody voted for it?

LUXEMBURG: The rest voted for it. [Laughter] There were only a few who [objected]. And then Christy picked on me. He said I should explain why I didn't think it was a very good idea to do this [and] why I voted against it.

COHEN: [Laughter] Right out in the open, in the meeting?

LUXEMBURG: Yes. So I told him I felt it was a mismatch and that I had nothing against Immaculate Heart but I felt that Immaculate Heart had a slightly different sort of opinion or feeling toward the sciences, you see, than what we do here. And then [I said] that just bringing in such a group of girls—not knowing whether they would be happy to be with a whole group of boys next door [laughter]—would not be so very easy, of course. But fortunately it never came about, because Immaculate Heart wanted to build a campus here nearby, and they asked Caltech, if I remember correctly from the Aims and Goals Committee, to donate a large portion of the land. And it became so expensive that I think Brown, in the end, thought it was not a very good idea. So it never went through. But I got a terrible shock, you know.

COHEN: Was Al Moffet one of the [dissenting] radio astronomers?

LUXEMBURG: Yes, that's right. But we had never ever talked to one another about that particular thing. I knew him just as you know other faculty members. We talked in meetings about appointments in mathematics, I talked to him about certain things, but we had never ever talked about this whole Immaculate Heart business. I never really talked to many people about it at all. They had asked Herb [Ryser] to go there. And Herb was not a person who had a very strong opinion about it, but he thought it could do no harm; he was sort of in loose contact, to see whether it would work or not. But we never actually had a discussion about it within the department, and that's probably my mistake, because I didn't think at that time that that whole thing was serious. So when only a few of us voted against it, I thought, "My, gosh!"

COHEN: Christy accepted what you said?

LUXEMBURG: Yes—he said, "OK."

COHEN: Did anything come out of the Aims and Goals Committee that was valuable?

LUXEMBURG: Well, that is difficult to tell. But what definitely did come about was that in the humanities division they brought in what they called the social sciences group, and that meant they were bringing in economists. So the group of economists grew out of that. And there must have been also—that, of course, is difficult for me to say—things that had to do with engineering and biology and the interaction between the groups in chemistry, and so on. But I don't think it ever meant anything to our division. I could be wrong. But certainly for mathematics, I think—as with so many of these things—you know, you have these overseers' committees every four or five years. Of course, these were valuable for us and our thinking, and it was nicely documented and so on, but [the reports] usually are then safely filed. Because what always is the big stumbling block is that the administration at the time, if they were sitting on an enormous pile of money and had extra they could spend, then they could of course look at a particular recommendation. But they [never had any extra money]. [Laughter] You see, the recommendations always involve spending this or spending that, [instead of] "Well, we should give everyone a lower salary," or something of this nature. [Laughter]

COHEN: So without money, it dies.

LUXEMBURG: But these are good exercises, actually, for people to start rethinking, and then later on, of course, slowly, maybe the [ideas] will come into being.

COHEN: Something happens.

LUXEMBURG: Something happens. But it is never a shock kind of thing—where all of a sudden something changes. The Immaculate Heart would have been a shock, if that had ever happened.

COHEN: Well, instead Caltech took in its own girls.

LUXEMBURG: Yes. And that was a more natural way [to do it]. But [there was] one disappointment for us. I had always felt, and so did some other members of the department, that when we got more women to come here, that certainly a number of them would be interested in

taking mathematics as a major. It never really worked out that way. We had a few, but it was not dramatic.

COHEN: Well, this is a very big subject, women and mathematics. And mathematics anxiety, or whatever they call it.

LUXEMBURG: Yes. Although women have done well, actually, in mathematics. There are outstanding women mathematicians. But probably the women we have attracted here have always been more interested in the sciences. I don't know how it was in physics, but I think physics probably did a little better than we did. And of course in biology and chemistry.

COHEN: Geology always has a lot of women.

LUXEMBURG: Geology, yes. Then maybe also, you see, someone who is going to get into mathematics, and who is particularly thinking in terms of a teaching career, [Caltech was not as] attractive as going to a big school, a university, where there was also an education department and so on. But then we did [get women] in the graduate school. I've had three women over the years who got a degree with me.

[Tape is turned off]

WILHELMUS ANTHONIUS JOSEPHUS LUXEMBURG

SESSION 3

June 22, 2001

Begin Tape 3, Side 1

COHEN: Good morning, Professor Luxemburg.

LUXEMBURG: Good morning. Thank you.

COHEN: It's good of you to come in again in this hot weather. This is the first day of summer. And in Pasadena we *know* when it's the first day of summer.

LUXEMBURG: Right. [Laughter]

COHEN: You mentioned something briefly when you came in—that there was an effort to bring in strong people for the department these last few years. And you've had one tragedy [referring to the death of Thomas H. Wolff, professor of mathematics, killed in an automobile accident in July 2000, at age 46—ed.]. So do you want to talk about that a little bit?

LUXEMBURG: Yes. I think when you look particularly at the role that mathematics has played in the Institute during the period I have been here, a lot of the mathematicians always had a little bit of a feeling that things were going OK. There was a certain benign neglect, if I may put it that way. But at certain particular important stages of the development of the department, we had some presidents who took a very active support role in all of it. And I'm thinking particularly about [Marvin L. (Murph)] Goldberger [Caltech president 1978-1987]. When Goldberger came, I think he—knowing the mathematics group in Princeton, which is, of course, a first-rate group—looked at our group in our division and he realized that we had had a period, particularly during the Brown administration, when there was this effort to build up applied mathematics and also mathematical economics and economics in the Humanities and Social Sciences Division. I don't want to say necessarily that [the mathematics department] really made a sacrifice for all that. [Laughter] But for us it definitely left fewer opportunities to bring in people—good people

and young people. That, of course, was when resources were needed for all the other efforts, and that led, to a certain extent, to our losing good people and also being short for some time. And then Christy allowed us to appoint more instructors for a period—instead of two instructors, he would appoint four instructors.

COHEN: Do you mean that he wouldn't even let you appoint another professor?

LUXEMBURG: They were not tenure-track positions at all, and they'd usually have to leave after a couple of years. But when that group in applied mathematics was established, we still kept, of course, the applied mathematicians that had been hired on the Ford Foundation grant. They had joint appointments with our division and the Division of Engineering and Applied Science. And [Gerald B.] Whitham [Charles Lee Powell Professor of Applied Mathematics, emeritus] was added to that as well. He didn't come here on the Ford Foundation grant; that was an appointment that came from the engineering division—they had, of course, their own [appointments] as well. But Keller and Cohen—Cohen left us earlier. There was a little bit of a conflict at that time: Cohen wasn't terribly happy to be among pure mathematicians—I hate the term "pure mathematics"—because from time to time he had to take care of certain courses and aspects of mathematics and courses he wasn't really terribly comfortable with and so on. So he moved over to applied mathematics. But Keller and [Heinz-Otto] Kreiss and also Whitham kept their appointments in the two divisions. And that meant that they had an equal vote, of course, when it came to appointments in mathematics. And we felt, of course, a little bit— We had nothing to say about what was going on in applied mathematics. But that worked out very well. Whitham was, for a long time, executive officer of applied mathematics [1971-1980], and I was executive officer [for mathematics]. And we met regularly and talked about things—how we should arrange things and how to actually make the proposals to the departments. In those days, it was all a little bit different than it is today. The mathematics department would always first meet and then formulate the proposals and ideas that they wanted to pursue and see whether or not they could bring in people to look at.

COHEN: So there was cooperation.

LUXEMBURG: There was cooperation. And then we would bring the proposal to the chairman of the [PMA] division, and the chairman of the division would then meet later with the whole group sometimes. Robert Leighton [William L. Valentine Professor of Physics and chairman of the PMA Division 1970-1975] was certainly very constructive, and he felt that of course mathematics had to play a role. And of course the way mathematics was set up in the past, it had had a place in the division. But he [felt,] as we all felt, that we were somewhat separate, in a corner. That wasn't really what people would have perhaps believed. [You would expect] a big interaction with the theoretical physicists, or anyone in physics who was more interested in mathematics. So we particularly always wanted to get some mathematical physicists to come here who could bridge that particular [gap]. But it did not really materialize during that period. But on the whole, we did OK. Just OK.

And then for a couple of years Maarten Schmidt [Francis L. Moseley Professor of Astronomy, emeritus] became executive officer for astronomy [1972-1975]. But I think he didn't like it—at least that was my impression. I'd have to say immediately that although we met in those days—not often, but socially—we never talked about business. It was completely separate.

COHEN: He was probably having his own problems with the astronomers.

LUXEMBURG: Yes, sure. But I think he wasn't terribly happy in that job. There was a little incident with this whole thing, because Robbie [Rochus E.] Vogt [R. Stanton Avery Distinguished Service Professor and professor of physics] at that time wanted very much to become chairman of our division, and he came to speak to our group in mathematics at one particular point. And when it later came to a vote, I think our group voted for Maarten Schmidt and not for him. When he did become chairman of the division [1978-1983], I was a little bit embarrassed about the whole thing. Because I had to go and see him, and it occurred to me that I had been lobbying for Maarten Schmidt. I had talked to all the members of the department, saying, "You shouldn't vote for him. He's not a good man. You should vote for Maarten Schmidt."

COHEN: Is that what he said to you when you went to see him?

LUXEMBURG: Yes. And he said, "This is complete nonsense." And I said, "You know, you were there, you see. We met with you. You explained your ideas about it. And now this is finally what came out." "Well," he said, "I'm glad that you told me the truth, because I had already checked it with Tom Apostol." [Laughter] I thought, "Oh, god!" But we got along quite well. I told him that if he started to shout, I would leave. Because I wouldn't accept that anymore from Germans, you know. But I think we got along quite well. And he was definitely also a fairly positive force for the mathematics department. Yes. He worked quite well with the whole group. And if he felt a proposal had merits and he was convinced about it himself, then he would really go after it. I cannot really complain about that. But he, as a person, is a very difficult personality. He had these terrible moods and so on, and you have to always be careful. But we got along. That's right. We got along. But I was so much opposed. Yes. I think we got along all right. Yes. [Laughter] But he had some strange ideas. [Laughter]

And then after Vogt, we had Ed [Edward C.] Stone [David Morrisroe Professor of Physics]. And Ed Stone, too—I think you would not say he went all the way out for mathematics. None of them did. They seemed to feel that the students were doing all right. And they looked at how our students did in the Putnam Competition and the prizes they won and so on, the courses we taught, the graduate students we had. I think they were reasonably satisfied—except, of course, during that period there was considerably less interest among young people to go into mathematics. If you compare it with the number of mathematics majors at the time I came—we peaked in the sixties, '62 or '63. We had ninety students majoring in mathematics.

COHEN: That's a lot. Undergraduates?

LUXEMBURG: Undergraduates, yes. Our group of graduate students is rather small compared to, say, such a large group as physics. Astronomy, of course, is also small; they had a similar [situation]. So we could never really accommodate a large number of graduate students, but we always had a fairly decent group, so everyone had opportunity. And they did very well; I think the graduate education worked quite well. But then we had that particular period when the number of majors in mathematics dropped dramatically. It didn't go up very much in applied mathematics either, but applied mathematics didn't have yet any particular interest in starting an option—that took a while. Whitham and I talked about it—[about] what could be done to

support the group. You see, in our group, because of Jack Todd and Kreiss and some other young people, we had a strong group in numerical mathematics. And Jack always taught courses also for our undergraduates—the first-year and second-year students. [He taught] two sequences for calculus. We always set aside a certain amount of time in the second year so that they could do some numerical work, to see really what computing means for solving equations and linear equations and systems of equations and so on. And for that we had a lab, because in those days we didn't yet have Sloan, you see. And that was also, in a certain way, a little bit funny. Because the students, of course, had to use these terminals. We had to pay for that, you see; we got a budget every year for taking care of that. But some of the students were not so terribly careful. They would fall asleep and let the whole thing run for the whole night. And then I would get an angry memo from the provost saying, "What is going on here?" You see, we had overspent the budget. Nevertheless, it was a very interesting laboratory that we ran for the students. But that was not necessarily for the math majors, you see; this was for the whole group, so that they could get a touch of what it means to do computing. And that worked very well. But then, of course, when the PCs came, that all started to disappear. And when they started an option in applied mathematics, the emphasis in the applied mathematics group was also directed more toward numerical work, particularly with Keller, and they took over the courses. But just the other day, when I talked to Herb again, he said, "It's a pity that in applied mathematics we never actually take any role anymore in teaching numerical mathematics and numerical computing"—particularly even nowadays, you see—"to all our undergraduates. That disappeared when we took it over. And that's a pity." Because, as I said before, [these courses were] not really meant for the math majors, who had better courses in numerical analysis, but for the [other] undergraduates, particularly in statistical analysis. We had a little bit of statistics as well—Gary Lorden had his own statistics course and that was quite a popular course. So that was a little bit of a pity. But it was part, I think, of this splitting up of mathematical efforts between our division and the mathematics in the engineering division.

COHEN: Could you speak a little more about when Goldberger came in? He appreciated a strong math department.

LUXEMBURG: Yes.

COHEN: What was his contribution?

LUXEMBURG: When Goldberger came, he was of course very familiar with a strong math department, and he had particularly cooperated a lot also with Barry Simon [International Business Machines Professor of Mathematics and Theoretical Physics]. So he talked to us about certain things we could do, having also in those days still the Fairchild visiting professorship. And he got, among others, Barry Simon [to come here]. He said, "Well, why don't you check with your colleagues about whether they would be happy to have him come first as a Fairchild [scholar] to see whether he likes it here?" I think at that time he more or less knew that Barry was interested, because he mentioned later on that Barry particularly liked the group of Orthodox Jews living here on the Westside of Los Angeles; it seems that Barry felt very comfortable in that particular environment. And so, "I will check," I told him. He said, "But you don't have to worry about it. I think everybody will be very happy with the decision." I said to him, "But you have to check. Everyone has to know." And so I did. So that thing got rolling. And then we had other efforts.

COHEN: So Barry Simon came as a Fairchild [scholar] and then he stayed?

LUXEMBURG: Yes, he stayed.

COHEN: And he had an appointment in both physics and mathematics?

LUXEMBURG: What was important, of course—and that is why I start with him—was that that was the first link we had with physics. They had, in the past—but I of course never had any experience with that—when, you see, [Harry] Bateman was still here. Bateman was, so to speak, the mathematical physicist who at that time—before the war and so on—had that sort of function, as well as [H. P.] Robertson and—

COHEN: These are mathematical physicists?

LUXEMBURG: They were mathematical physicists, yes. Robertson was, I think, a particularly strong man in relativity theory, but he had a great interest in mathematics—and there was that

particular link again. He had an accident later [H. P. Robertson was killed in an auto accident in 1961—ed.]. So there were [these connections] in the past. Also with Mathews, Jon Mathews [professor of physics; d. 1978], there were all these sorts of relations, you see. But now that somehow had evaporated, more or less.

COHEN: You know, this is interesting. You have all these disasters among these young mathematicians.

LUXEMBURG: Yes. Mathews, too, you know. He had this terrible—

COHEN: Yes. That's what suddenly occurred to me. [Jon Mathews was lost at sea while sailing around the world—ed.]

LUXEMBURG: Yes, that's true. That was a pity. But our fundamental course—a course called 108, for our advanced majors—was always a course that was attractive to a fair number of undergraduates in physics. And the interesting part is also that the students who took this—who had this sort of mathematical interest—were doing extremely well. The physics students were always extremely good, and still are. And they also did very well on the Putnam, because some of them thought it was fun to do that, so they joined the Putnam group. So it worked out actually quite well, and it still is, to some extent, happening. They take that particular analysis course as the basis for going from there into new, more sophisticated work. And the physics students sometimes are the best in the class, I have to tell you. [Laughter] I've taught the course many times.

COHEN: And they wouldn't mind telling you, either. [Laughter]

LUXEMBURG: No, no. I've taught the course many, many times, and often some of the physics students are by far the best. That happens—but not always. I find that sometimes also very silly, because you cannot really compare them. But you can see some differences. Also you can see the effort or the interest. And that is always interesting, of course, to see the students who, you can tell, when you ask a question already know the answer. [It's] the way the face looks. But

you also have those students who are maybe not too terribly interested. Probably they don't even register the question, you see. That you may have as well.

But anyway, with the backing of Vogt we brought a former undergraduate here—Hugh Woodin. He was very good; he went to Berkeley for his PhD work. We had brought in at that time—or a little bit earlier, say in the middle seventies—Alex [Alexander S.] Kechris [professor of mathematics]. You see, we gave regularly—practically every year—a course in mathematical logic, but we didn't actually have on the staff anyone that people would call a mathematical logician. But the algebraists, particularly Dick [Richard A.] Dean and some of the others—they liked to give such a course, and it always attracted the best students in our group who were majoring in mathematics. And some of the best mathematical logicians actually came out of Caltech. [Laughter] So the department was very much interested in getting some logicians. We didn't have to have necessarily a whole group, but we wanted to make an effort. And after a couple of attempts that didn't [work out], we finally got Alex Kechris to join us. And he was just the right kind of person for us. He was not originally trained as a logician. He went to the National Technological University in Athens. He had a good overall mathematical background. He was of course at that time still a young man, and he was very much interested [in coming here] and had done beautiful work. So we brought him here as an assistant professor [1974] and he stayed on for this whole period. So we filled that particular gap. And that led to us to see whether we could try to get Woodin. He had already an interest in mathematical logic, and he did his work at Berkeley with a famous logician [Robert M. Solovay]. So we thought we would see whether we could get him here, and Robbie Vogt thought that was a good idea. And I would say that Robbie Vogt did very much his best. And Woodin came here, and that all worked out very well. Vogt supported him later also, in his promotions and so on. But unfortunately Woodin left. He returned to Berkeley after a number of years. But, yes, that happens. It was also something about his wife. She was a chemist, and she wasn't happy in the sort of job she had in this neighborhood. And she got a nice offer from up north, and he could go back to Berkeley anytime he wanted to. But we did very well, despite the fact that we didn't really have a whole group of people who were known as making up the best school in mathematical logic. But Kechris has a decent group, with postdocs and so on. So everything in that particular area is still running very well. But that was a field that you could say for Robbie Vogt—being a

physicist—you could say, "Well, he could have objected—" But, no, that didn't happen. He did see very clearly that this was something worthwhile.

COHEN: He was a positive factor.

LUXEMBURG: Oh, yes, no question about it.

COHEN: Give him his due?

LUXEMBURG: We didn't really collide so much. But the personalities perhaps were a little bit—we were different personalities. But it was OK.

COHEN: You are not alone in that.

LUXEMBURG: Yes, I know. [Laughter] But here I have to admit immediately, you see, that when he finally did become the chairman of the division, he definitely was a constructive force for mathematics. And also at the time, with Goldberger, that worked out very well. We were able to bring in younger people in fields in topology and algebraic number theory. And all through that whole period, we had been steering the department into, again, new directions in mathematics which are now mainstream directions of mathematics. You have to do that; you have to renew. The mathematics also develops and it takes different directions. After the World War, of course, but also in the fifties, the mathematics groups started to bring in people to see whether they remained in some mainstream areas in mathematics. And we had to do this, too. At the moment, we have a good department—there's no question about it. But we lost, in that whole process, some of our best people. Unfortunately, [Anatole] Katok left. He was a Russian mathematician. His wife [Svetlana Katok] is also a mathematician. But we didn't have room. With the restrictions we had in size, we could never make a decent arrangement for her. She taught in the neighborhood, but that never really worked well. Both got an offer from Penn State and they decided to go there. That was a pity, because he is a *very* good man, and a very nice man also—a very good mathematician. But that happens. And [Alexander B.] Givental [professor of mathematics] we brought in. That was a couple of years ago—a very gifted young topologist. I hear from Barry that Givental is going back to Berkeley. But that is a process that

happens, of course, in every group, and it doesn't necessarily reflect that the group is not right, or whatever, or that the administration is not handling the situation correctly. It's just that that's the way it goes. But that means, of course, that we have to continue and try to see whether or not we can get other, say, good [people].

COHEN: Now, when did Wolff come?

LUXEMBURG: I've forgotten the year, but it was in the seventies [Thomas Wolff came to Caltech in 1982 as an assistant professor—ed.]. We learned about Tom through UCLA, and it was obvious to us that if we wanted to get a bright, young, gifted analyst that Tom would certainly be number one on our list. So we made him an offer and he accepted. During [his time here,] he took leaves. He went to New York University, to the Courant Institute [1986-1989]. And then he went to Berkeley [1992-1996]. But [each time] he came back to Caltech. And this was a remarkable sort of situation, because the administration backed us up in this particular situation. They wouldn't say, "He cannot continue doing this." I think maybe the last time he came back, they probably said, "Well, let's hope he will stay now, because it's getting a little monotonous every time he goes and then returns." [Laughter] But that was a very successful appointment. He was certainly one of the gifted mathematicians. And [in the early 1990s] he brought in [Nikolai G.] Makarov [professor of mathematics]. He's still with us.

COHEN: This was a period when you were getting a lot of Russian mathematicians.

LUXEMBURG: Yes. No question about it. And that worked out very well.

COHEN: When was Wolff killed?

LUXEMBURG: That was last year—an automobile accident [near Bakersfield].

COHEN: I know the story. He was passing in a blind spot or something.

LUXEMBURG: Yes. I think he passed a truck. Probably he thought it was a [four-lane highway], but it wasn't. There is a piece of [Highway] 15 there, or a little bit up [Highway] 395, where for

a certain time there is one lane in each direction and then all of a sudden it becomes two again. And he was confused. It was terrible.

COHEN: Yes. So we go on.

LUXEMBURG: Yes.

COHEN: And Goldberger was very good for the department?

LUXEMBURG: Goldberger was very good. He helped us. And when Goldberger left, I think we were in pretty good shape. Then [Thomas E.] Everhart [Caltech president 1987-1997]—I don't think he had any particular interest in mathematics. He didn't obstruct [the development of mathematics], but I don't think he had any real interest [in it]. He'd vote for things if they were not too expensive. [Laughter] But he never really came over to talk to us. I think he was more interested in the engineering division. Now, I think [David] Baltimore [Caltech president 1997-2006] is different. I think he is supporting mathematics. He is more someone—just as Goldberger did, he has a feel for— Although he tells us, of course, that he is not a mathematician. But I think he has a feel for what mathematics means in a school and also at Caltech. And when good proposals come up, and when he can make for himself a good decision on it and get a feel for what it means, then he will support it. I think he is going to be very constructive—certainly for mathematics. Sure, there are infinitely many other areas in the school where his attention is needed, but he definitely doesn't close his eyes regarding mathematics.

COHEN: So he has come around and talked to you?

LUXEMBURG: Oh, yes. You know, when Jack Todd became ninety, we had a little birthday party for him and a conference for a couple of days [May 16-18, 2001]. And Baltimore came to give a little introductory speech, and it was very nice. I think he feels comfortable among mathematicians. I have always had the feeling—but of course I had, at that time, not much to do with it—in particular, that DuBridge was never comfortable among mathematicians.

COHEN: You could sense that?

LUXEMBURG: Oh, yes, no question about it. Jack Todd once asked me, "Have you ever observed that in every official statement that DuBridge makes about the future of Caltech and about what is going on, he has never ever uttered the word 'mathematics'?" I'm sure Todd's recollection must be correct. DuBridge was not *anti*-mathematics, but I don't think he was very comfortable with mathematics and mathematicians as a whole, as a group.

COHEN: Well, maybe it was that Goldberger, coming from a more academic background at Princeton and being with mathematicians and stuff like that—

LUXEMBURG: Yes.

COHEN: And Baltimore certainly seems to be comfortable wherever he is.

LUXEMBURG: That is correct, yes. And Goldberger had also been head of the physics department at Princeton—and he had, of course, around him in the mathematics department a large group of very good analysts and other people.

COHEN: So he felt at home.

LUXEMBURG: He felt at home, yes. He knew what they were doing. I think he felt that definitely we needed some support. He felt that for a school like Caltech, mathematics should have an opportunity to develop, but of course not beyond bounds, because we are much smaller than any other sort of effort in the Institute.

COHEN: OK. Let me take a different tack now. During all these years, when you were very involved with the department and department doings, did you go on any leaves or anything? Did you leave Caltech and go visit anywhere?

LUXEMBURG: For my own work?

COHEN: For your own work.

LUXEMBURG: Oh, yes. Well, practically every summer there were meetings all over the rest of the world, so to speak. And there were international congresses for mathematicians that I went to. I went very frequently and organized meetings with other colleagues for, say, certain areas of mathematics.

COHEN: That was the mathematicians' Aspen, I gather. [Laughter]

LUXEMBURG: Yes, I think you could probably call it that. Yes, definitely it's a wonderful institution. I'm particularly thinking about Jack Todd as being very instrumental in that, you see. It's a beautiful environment, a beautiful library they have there. So that is something I would attend regularly. I also had a couple of colleagues, and we would organize, every so many years, a particular group to, say, have a meeting on a certain area of functional analysis or what have you. So that I did. And then there were, of course, also particular schools that would invite you to give lectures.

COHEN: That was always during the summer that you did that?

LUXEMBURG: Yes. But sometimes also at Carnegie Mellon. I went often to Carnegie Mellon in the earlier years, because I had some colleagues there whom I worked with. I would go there, and they would come here to give talks. And in England and particularly also in Germany I had a group of friends. In fact, they—yes, that came out of the blue. I had no idea, but they must have proposed my name for one of these Humboldt Research Awards. In 1980 I got a Humboldt Award, so for a half year I went to Tübingen. That was very enjoyable.

COHEN: So you took a sabbatic leave?

LUXEMBURG: Yes. Of course, since we don't have sabbaticals, every time, you have to ask to leave. But that means also that if you have a leave this year and in a couple of years something else comes up that is important, you can still ask. I see this from some of my colleagues as well, and particularly also, of course, among the physicists and astronomers. If there is a great need,

and it has to be done this year, not the next or the one after that, well, then, if we can accommodate things, the Institute is going to go for it. It's a little different system, actually. Probably—although I don't know, it's just a guess—it's also because of the fact that the summer we have free.

COHEN: You mean because you are on a twelve-month salary. That's true.

LUXEMBURG: That's right. So things are a little [differently organized.] And I always enjoy that possibility. I mean, if you want to leave for a couple of months and go somewhere else, if that works out, you see, you can apply for that. I've never actually heard, if it's a reasonable case, that they would turn you down. So I went [to Tübingen] for about half a year.

COHEN: You moved your family, or your wife and family?

LUXEMBURG: Well, the kids were in school, of course. I took part of the summer. We could do that, because it was on the Humboldt, not from the university. So they came over in the summer. And I had left a couple, three months before—yes, I took off the spring term and then stayed all the way until the beginning of the fall term. And in 1974 I was appointed a corresponding member of the Royal Academy of Arts and Sciences in the Netherlands, and that was a good opportunity to go over to Holland. With my former thesis advisor, I was writing a book.

COHEN: What does that mean—a corresponding member?

LUXEMBURG: If you are of Dutch nationality and you are not living in the Netherlands—you are working abroad. In the old days, of course, you couldn't go by plane; [everything] was done, of course, by corresponding. So they made you then a corresponding member. They felt, you see—because of the fact that you were so far away—that you could not take an active role in the daily operations of the academy.

The Royal Academy in the Netherlands has an interesting history. It was actually instituted by Napoleon. In Holland, you had all these little clusters, these societies in the cities. We had them in Haarlem. We had them in Amsterdam, in Rotterdam, in Leiden, and in some other places. But when Napoleon's brother came as king [Louis Napoleon, 1806-1810], I think

he—you know, from what you read about him, he was not actually that bad really, in many ways. You see, Napoleon had a completely different view. He wanted all the Netherlands—and that included, of course, Belgium, the whole thing—to make that all part of France and incorporate completely with France. The Dutch language had to be abolished. But his brother didn't like that at all. And put in all kinds of new things which were not at all, say, at that time common in the Netherlands. For instance, when people were born, they had to be registered. They had to [be given] a name, you know, and there were whole lists of names that were acceptable and other names that you couldn't give to your children and so on. He made a whole new civil administration. And he started that academy, you see—the others he left as they were. Some of them still exist.

COHEN: Now, you've retained your Dutch citizenship?

LUXEMBURG: No. I am an American citizen.

COHEN: Oh. But that didn't matter to the academy?

LUXEMBURG: No. Holland is a funny country, too. It is a singularity in all of Western Europe, because of the immigration laws, which they enacted after the Second World War to get as many people out of the country [as they could]. When you would take on the citizenship of the country you had emigrated to, you would automatically lose your Dutch citizenship. So when we became Americans, you see, we lost our Dutch citizenship.

COHEN: But that's the case in most countries.

LUXEMBURG: No. In Germany you can keep it. And the French are extremely attached to their so-called citizens. Robbie Vogt once told me—you see, he's married to—

COHEN: A Frenchwoman?

LUXEMBURG: Yes. His children are French. They also have French citizenship. And he said he was surprised at the French Consulate. You see, they should be registered such that [when]

children are born [they] get passports. In the Netherlands it's quite different, but that doesn't affect the membership in the academy. Nowadays at the academy, of course, I'm not involved at all; I'm already a retired member. Because in most European countries, particularly Holland, everyone in government service or in academic service retires at sixty-five.

COHEN: And that's it? There are no exceptions?

LUXEMBURG: No. Let's see, what else. And then of course there were some visiting professorships. The last one was in 1985, when I went to the University of New South Wales, in Australia. And at that time I also was invited to lecture throughout New Zealand; at all the universities, I gave lectures. That was very interesting. It's a beautiful country.

COHEN: New Zealand. I've not been there.

LUXEMBURG: Oh, it's so beautiful. Australia is also very beautiful. Many Dutch people emigrated to New Zealand and Australia. I looked up in the telephone book "V," for "Van." There was a *long* list of people. I think they did reasonably well in the early days. Australia is an interesting country. One of my brightest students is Australian. They're still coming in. Particularly in the field of mathematics, they come to the United States for graduate work. He married one of my other students when they were here.

COHEN: What was his name?

LUXEMBURG: His name is Peter Dodds. And I had a student from Taiwan, Theresa Chow. And they married. Theresa was very good.

[Tape ends]

Begin Tape 3, Side 2

LUXEMBURG: They were both very successful. They went to Adelaide [to Flinders University]. And he is there at the university.

COHEN: So you've traveled a great deal, always in the summer.

LUXEMBURG: Most of the time in the summer, yes. I've also been to South Africa. That came about because I knew a number of young South African mathematicians when I was a student in Holland; they came over after the war to do their graduate work in the Netherlands, instead of going to Germany or England. They speak Afrikaans; it's Dutch, you see. They were, of course, not terribly popular, but some of them I knew. Fortunately, everything finally—well, it's a completely different world now. I haven't been there since the time, you know, the country actually changed.

COHEN: So the English-speaking people from South Africa would have gone to England.

LUXEMBURG: Oh, yes.

COHEN: And you got the Afrikaans-speaking people.

LUXEMBURG: The Afrikaans-speaking people came, yes. But it's interesting that in mathematics—because that was not a field in South Africa which was very advanced—it was dominated before the war particularly by the English universities and by English mathematicians. But development must have taken place which brought on more Afrikaners to come to mathematics, and so afterward they came. But I understand that there aren't that many [in Holland] anymore; they go to the United States nowadays. One of the best at Princeton, [Peter] Sarnak—he is originally from South Africa. And they usually stay here. That's the way these things go.

COHEN: Right. So now, when actually did you retire officially?

LUXEMBURG: I retired last year at the end of September. But I do the same things I've always been doing.

COHEN: I was going to ask how is your life different, but it isn't.

LUXEMBURG: Yes. The only thing I probably do not miss, you see, is cleaning blackboards. But the rest, of course, I miss. [Laughter]

COHEN: So you haven't taught again? I mean, would you teach if you were asked?

LUXEMBURG: No, no. I haven't taught since September. [I give] seminars. I do not teach regular courses, of course, but I give the analysis seminar with Barry Simon.

COHEN: No responsibilities.

LUXEMBURG: No, no responsibilities. I've become an irresponsible person. [Laughter]

COHEN: An irresponsible person, yes. [Laughter] So I usually ask this question toward the end of an interview: Have you been happy here at Caltech?

LUXEMBURG: Oh, yes.

COHEN: Of course, you have, or you wouldn't have stayed.

LUXEMBURG: Oh, I've been extremely happy. I've always felt that I've been very lucky. I don't think I would have, in those days in the late fifties, even dreamed of applying for a position here at Caltech, you see. But when they approached me we thought, "Well, that is wonderful!" As I told you, I knew a little bit about the Institute. And I liked it right away from the beginning. It was a very nice environment.

COHEN: You were not disappointed.

LUXEMBURG: Oh, no. No, no. Of course, Caltech is a unique institution. I don't think there's anything that compares with it in the dedication to the fields that I represented here and what the school is doing. It's not, of course, a huge place like Berkeley, and so on, so you know everyone, more or less. Of course, when you get older, you don't know as many people

anymore. [Laughter] But I always liked it very much. Very nice colleagues and a very good atmosphere. And you had all kinds of room to move and—

COHEN: Do what you want.

LUXEMBURG: What you want to do. And that is, of course, wonderful—for mathematicians particularly. You have such excellent students, and that makes a big difference. Teaching was a joy.

COHEN: So you envision just enjoying yourself and continuing your work?

LUXEMBURG: Yes. I was lucky. I won the lottery, you see. [Laughter]

COHEN: You won the lottery. [Laughter]

LUXEMBURG: But it's true. When we got offers over all those years, I was never really seriously tempted to leave. Although sometimes you'd start to think about it, because people ask, "Are you interested in doing this or that?" or "Why don't you come here?" or they say, "We have something here that would be interesting for you to develop." But no; in the end I always felt, "No. No. No." It was not only the sunshine. [Laughter]

COHEN: I see. It was the atmosphere at the Institute.

LUXEMBURG: Yes.

[Tape is turned off]