

**The Optical Society  
Oral History Project  
Interview with Emil Wolf  
Conducted on May 12, 2008 in Rochester, NY by Paul Kelley**

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KELLEY: We're here in Rochester, New York. It's the 12<sup>th</sup> of May, 2008. This interview is being carried out as part of the OSA centennial history project, and the interviewee is Professor Emil Wolf of the University of Rochester. So we would like to talk about your life a little bit, and so we would like you to tell us a bit about it, and also your career as a scientist and your experiences in the Optical Society and the committees of the Society and other events that have occurred that bear on the history of the Society. So Professor Wolf, would you tell us a little bit about yourself.

WOLF: [00:01:06] Well, how do I start? How I got to the United States? Well, it's a long story. I come from Czechoslovakia, and I lived there until 1939, when the Germans occupied Czechoslovakia. I am of Jewish origin, so of course, my parents thought I should get out as quickly as possible. I was very lucky; I managed to get out within a month after the occupation of Czechoslovakia. Prague and Czechoslovakia were invaded the 15<sup>th</sup> of March, '39. I was out exactly a month later. My brother also managed to get out. Unfortunately, my parents didn't make it—the usual, you know what happened to these people; they didn't survive it. From there, from Prague I went to Italy. It was the only country one could get to without a lot of fuss, because the Germans the Italians were, of course, part of the Axis. So I came as a refugee to Italy with practically no money. I managed to get legally to France, where there was a Jewish refugee committee in the South of France that managed to get me a ticket to get to Paris. So I left to Paris in 1939, not being able to speak the language, and actually I went to France with four francs in my pocket, actually.

[00:02:26] But anyway, I was quite fortunate. After some strange jobs of selling newspapers and things like that, I managed to get a job at what is called a provisional Czech Government In Exile. Since I was a Czech, they were quite interested to have a few Czechs. I was essentially an office boy. I was very fortunate, because the person with whom I worked was a famous journalist from Prague and he took a liking to me, and that actually saved my life in the following way. When the Germans were advancing on Paris in June 1940, I got a phone call at 3:00 in the morning in the little hotel where I was staying, this man I worked with said to me, "Emil, if you come here within the next half an hour or so, the Czech Government In Exile is leaving Paris; we'll take you with us." That happened to have saved my life, because, of course, if I had stayed there, I would have been caught by Germans. By the way, I would like to have the man's name here: Emmett Firth. He became a well-known politician. He was in charge of a very famous newspaper in Prague before the war. He was a friend of the first president of the Czech Republic, Masaryk, friend of the writer Chaplin, and if it wasn't for him I would never have been able to get out of France.

[00:03:52] Anyway, I went on a trolley to western France, but by the time we got some hours later, it was obvious that the Germans would overtake us, so the directive was turning to the right and we went all the way to the South of France. I managed to get on a boat there. We brought a lot of Czech refugees, and there was a provisional Czech army in exile there, and later I managed to get to England. So I arrived in England, having only been in London in 1940. At least I spoke a little bit of the language in France; I did speak French a bit.

[00:04:30] I managed to get a scholarship in a Czech school there. I didn't finish high school in Czechoslovakia because I left two years before. But there was a Czech school opened in England mainly for children of the Czech politicians who managed to get to England. So I managed to get a scholarship there, and I finished what they call matriculate, and this is the main exam to finish high school. I did reasonably well and I got a scholarship to Bristol University. That's how my scientific career started. It was all a matter of luck—particularly that phone call at 3:00 in the morning.

KELLEY: That's amazing. That's almost a movie scenario.

WOLF: [00:05:17] Oh, it was an amazing thing. But there are several other things, later pieces of luck in my life. I will tell you another one, how I got to Rochester; that's very similar thing.

So anyway, when I finished the Czech school, I was just under the age when I would have had to join the army, so I had a choice either to enter the College of London or to Bristol University. I didn't want to stay in London. I'd have enough of the Bombe—I was in the Bombe part of it.

[00:05:45] So I went to Bristol. There I studied mathematics first, and when I finished one of the lecturers in mathematics was interested in keeping me on as an assistant. At first, he was a pure mathematician, and had a nervous breakdown and apparently the doctor told him that he should switch to something else, so he started grinding lenses. This is true! He was quite a [inaudible]. So he started grinding lenses, and of course, he got interested in the theory of the lenses and of isometric surfaces, and as his assistant I decided if I wanted to get my PhD, I would have to change to optics from pure mathematics, which I wanted to do. So I finished at Bristol. My thesis was in the field of designing isometric surfaces.

[00:06:32] Now just as I finished, my thesis advisor was offered an appointment as assistant director of Cambridge University Observatory. He offered me the job to come with him to Cambridge. So I went to Cambridge with him. It was quite a enjoyable year then. That actually made possible for me Cambridge, which brought me close to London, so I used to go to London from time to time for meetings of the British Optical Society. That was at the Imperial College of London. I was very lucky. At these meetings, I got to know Dennis Garbor, the inventor of holographic. Garbor didn't have any children, but he liked young people. He was on the faculty of Imperial College.

KELLEY: So he was Hungarian?

WOLF: He was on the faculty of the Imperial College of London. He was actually Hungarian. He was a refugee from Hungary.

KELLEY: He was a little older, so he...

WOLF: [00:07:25] Oh, yes. But it was also roundabout how he got to London. He lived in Germany for years. He worked for Siemens; you know, the company, that one.

Anyway, as I say, Garbor liked me, and sometimes I would give simple papers at these meetings, and he would invite me to his office at Imperial College, and we talked and discussed science. One day he told me Matsmore, a fellow from Germany, would like to bring out an English version of his own book on optics, and he's looking for somebody to help him; would I

be interested? Of course I jumped at that, but the problem was that, of course, I had another commitment in Cambridge to live, so how to do it. So eventually at one point, Garbor arranged that Linfoot and I would both collaborate on the book, but Linfoot wasn't interested very much, so I told Garbor I could not work with a man like Linfoot, so Garbor contacted Born, and one day shortly after this Born came to one, and Garbor invited me to have lunch with him and his wife and Garbor at their apartment.

[00:08:08] Born was a very trusting person, and Garbor said I would be the right person to help. So without much questioning, Born shortly offered me the job. So I went to Edinburgh and started working on the book. It was a most remarkable collaboration. I loved it. I have a lot of stories which I actually scribed in an article; Morris asked about my association with Born, if anybody's interested. It has been published I think in *Optics News*. I stayed with Born...unfortunately I had to retire fairly early after just two or three years after I started with him. But when we collaborated, he was in Germany, and I stayed in Edinburgh for a while, and visited him from time to time. And it was a very, very pleasant collaboration for me. It was a wonderful thing to be able to work with a man like Dennis Garbor.

[00:09:31] There were a few amusing incidents there. When we got an offer for a contract for Principles of Optics, they said they would print 8,000 copies. I still remember Born saying to me, "Wolf, that's crazy. Nobody's going to buy 8,000 copies of this book." I don't want to exaggerate, but we sold roughly about 150,000 copies now, and it's still selling well. Born was still alive when the third or fourth edition came out, and he was absolutely delighted. It was a wonderful collaboration. There's a lot I could tell you about Born, but that would take hours and it's described in the article. He was a remarkable person, and I was extremely fortunate to be able to work with him, not only as a scientist, but a wonderful human being.

KELLEY: Was Oppenheimer a post-doc with him?

WOLF: [00:10:22] Yes, but I must tell you, probably now it's to where one could say it, he didn't particularly like Oppenheimer. He discusses it. Oppenheimer visited us in Gattingham, and apparently he was trying to run everything, and he had a lot of problems with the fellow students. And Born describes in his memoirs some tricks they used to get him to be quiet in seminars, [inaudible]. So although there is a Born-Oppenheimer formula...

KELLEY: Born-Oppenheimer approximation.

WOLF: That's right. Born was not very happy about Oppenheimer, I can tell you. So you want me to continue, just go on and on?

KELLEY: Well, we have plenty of time. I was going to ask you if I could stop you for a minute. One thing you got into, you became a mathematics student. What induced you? Most people would sort of shy away from such a difficult... What induced you originally to do...?

WOLF: [00:11:21] I'll tell you almost exactly why. I thought about it many times. When I was in school in Prague, I had a wonderful math teacher. Wonder teacher. His name was Freever. He's probably not known at all now. He was so clear, he could show the beauty of mathematics, and it impressed me tremendously. The mathematics that I wanted to do was really pure mathematics, and in Bristol I hoped I could work in Sullivan. I was into very abstract things

like theory of sets, theory of numbers. But I told you, my thesis advisor switched then to optics, so I couldn't do it anymore. But I always have a love for mathematics, and even so, now that I have been very successful in optics, even now I'm sorry that I couldn't follow mathematics. When I see some of these popular books with some of these strange mathematical puzzles, I feel sorry that I didn't follow that.

KELLEY: Do you think it's had an impact on Born and Wolf, on the contents? Do you think your interest in mathematics had an impact on Born and Wolf?

WOLF: [00:12:15] Well, I think it had some relation, because people-- I can't comment myself really on this one, but in the reviews it's always mentioned that the mathematics is clear. So presumably my mathematical background helped. You see, before I started working on doing a PhD, I did take courses in mathematics—mainly applied; there weren't many pure ones. But still, I had some pure mathematics teachers and I really enjoyed it.

[00:12:41] The next stage after Born retired was slightly more complicated. The university didn't continue my fellowship, so I had to leave, and I managed to get to Manchester. I was there for a year or two, and then I ought to tell you how I managed to get to Winchester. I was there for a year or two, and then I want to tell you how I managed to get to Rochester from there. That is an interesting story which shows accidents in one's life. The one accident, or luck I should say, is the person informed me in Paris in the middle of the night to get onto the truck to get out of Paris. The one I tell you now is a similar thing.

[00:13:13] I was in Manchester on what was known as the ICI Company Fellowship, and it was coming to an end, and I was not able to find an academic job then. I could have probably gotten something in industry, but I really wanted to stay in an academic job. I was, at that time, correcting the proofs of my book with Born, and I went during some holidays to the South of England with my wife to the home of Dennis and I was working on the proofs there. The proofs were supposed to be forwarded to the publisher in Manchester and from Manchester they were supposed to forward it to me. And as I was correcting the proofs, one section of the proofs was missing. So when I came back to Manchester, I talked to the secretary of the well-known physicist, Rosenfeld—he worked at Neils Bohr; very famous man—and I asked whether she sent me all the proofs which came. She said, "Of course," but she was a very person; I didn't trust her. So when she went to lunch, I looked through her cupboards, and not only did I find the missing proofs, but there was a letter from A. J. Hopkins at the University of Rochester, asking me if I would be interested in a job at the University of Rochester.

KELLEY: She just forgot to...?

WOLF: She just pushed it into the cupboard and closed the door.

KELLEY: It wasn't deliberate, though?

WOLF: [00:14:34] No, it wasn't deliberate; of course not. So I read the letter, and it was from Al Hopkins. You know, he is still alive, but unfortunately he has Alzheimer's now. The letter was said to me that he was coming to England, and they're interested in starting in Rochester work on coleoid steering [inaudible], and they know that I work in coleoid steering; would I consider a job at the University of Rochester? So that was a time when I was desperate for a job,

and here was a tentative offer, but it was almost too late. Hopkins said he was coming to England; he would like to see me. There were no faxes in those days, no emails. Somehow, I managed to contact him and say I would like to meet.

[00:15:22] So we met in Manchester; he offered me the job. And you know, I started publishing coleoid steering at that time that I came to Rochester. Now the reason why they were interested, coleoid steering is interesting, too. We're talking now about 1959 roughly, or 1960. The first laser became operational in 1960, so at the time he made me an offer lasers didn't exist yet. And it so happened that the Air Force knew something about this. They were very interested to support research which would lead to the development of lasers. Of course, everybody knew coleoids had something to do with it. I did research in coleoid steering. So Hopkins, when we got together and talked about me possibly to Rochester, he said, "Your main job would be that when you get there, you come to Rochester to organize a conference on coleoid steering. The Air Force gave money for it, and we're in charge. That was the origin in the conference on coleoid steering in optics now. That's how it started. So that was another piece of luck. There was how I managed to get from France, and how I managed to get to America. So you know, that just shows how much luck also there is in life. Can you imagine if I didn't find that in the cupboard? I don't know where I would have ended.

KELLEY: There's your ability, clearly, in a role. I mean, you were resourceful. Let's put it that way. You did look through that cupboard, right?

WOLF: [00:16:52] But you know, from then on, things were relatively smooth. I had a job and security, which I never had in Europe, and it was really great. But I was also very fortunate to how I managed to get to know Garbor from these meetings at Imperial College. Garbor liked young people—he didn't have children of his own—and he would talk to me and encourage me in work and so on. And you know, my book with Born is the first book which has anything on holography. It was a new subject. [00:17:23] When it came out, I can show you this, Garbor sent me an article on this, and on it he wrote: "To Emil, my chief prophet." What it meant was he was sure that if there wasn't discussion of it already in the book and the credit to Garbor. That would be an argument of priority; you know, you would still get these arguments in those days. And he said since it was in your book, everybody knew that I did it. So anyway, after that, it's a little bit duller what happened after. The excitement was all in having opened the cupboard at the time to find the letter.

KELLEY: [00:17:59] Now one of the things that I found interesting and that I didn't understand it, and I asked Joe Eberly about it, and he didn't have an answer, he said he was confused. You have a PhD from Bristol and Doctor of Sciences from Edinburgh. How come?

WOLF: [00:18:17] That's simply because in the United States, people don't know what these degrees are. There are two doctorates. The normal one is PhD—doctor of philosophy. If you do lots of research and it's successful research, you don't even have to have a big exam for it. You put your papers together with a cover and submit it for a Doctor of science. It's about honorary faculty almost. The main degree for a university is PhD. This is a little bit of [inaudible].

KELLEY: Don't they have a somewhat similar system in Russia?

WOLF: [00:18:58] There are low doctorates and high doctorates, but the high doctorates are not done by examinations. You submit your papers [inaudible].

KELLEY: So you've proven yourself by publishing a substantial amount.

WOLF: Then they ask some expert to look at it. In my case, it was they asked Garbor to look it over, so it was crazy, you know. And it just contains a few of my papers. That doesn't mean anything. The hard work is PhD. Docs, it's fun because we just do the research.

[00:19:30] But you know, there are other types of doctorates. In Germany there are these habilitation works, so that you can become docent—you know, a lecturer at the university. It's just another type of doctor. What I found to be amusing is they are honorary doctorates. You know, I am very proud of them—I have now several, but I'm very proud of them. But people here don't know what it is. They give honorary doctorates if somebody have comments just to give an address to attract them. They give an honorary degree [inaudible]. But in Europe, that cigar is a very serious thing. There are experts who evaluate another person, qualifies to give a degree. As I say, I am very proud of mine. But here nobody knows it, and nobody takes any notice of it.

KELLEY: Have you made contact back with Czechoslovakian physicists?

WOLF: [00:20:22] Very few. There is a Czech university in a city called Armoltz , and there is a man there by the name of Professor Beriman . He was one of the few Czechs who writes also in English. He published three or four books, and he's an expert on coleoid steering process. He arranged that I get an honorary degree from there also. So I have also still a few school friends, but of course not many; they are slowly dying out. I'm 85 years old now, so I only have so many left.

KELLEY: Of course, the Holocaust, I mean, probably most of the Jews your age...

WOLF: [00:21:01] When I talk about friends, I mean the non-Jewish. Of course the Jews [inaudible].

KELLEY: So your brother?

WOLF: [00:21:09] My brother is in Canada, now retired. There were three of us who survived: my brother, myself, and a cousin. My cousin and my brother both live in Canada in the Toronto area. My brother is in and my cousin is in Toronto, and we are the three who survived. There were 17 of my relatives who died in the concentration camps. One uncle survived and came back from concentration camp. The youngest; it was quite interesting. He was probably the strongest. So we still saw him after the war, but he is the only one who survived. He died soon afterwards. But nobody else.

KELLEY: I must say, it was very moving to visit the synagogue in Prague. My wife and I went there. It was very moving. We also went to one at Budapest as well.

WOLF: [00:21:58] You see how much in life-- I mean, hard work is very important, but how much it is luck. That my father could foresee this, to get my brother out in the months after the invasion of Czechoslovakia. And then the way I managed to get out of France, it was a piece of luck. I told you that phone call at three. And then the letter from Hopkins. It surely was lost, you know! So it's nice to plan your life, but occasionally, things take an unexpected turn.

KELLEY: So you've had a very long and distinguished career since you arrived in Rochester. Do you want to tell us some of the highlights? Can you briefly touch on them?

WOLF: [00:22:43] One of the highlights was these conferences, you know. The first one I started alone, but you know, [inaudible] for it in England, and I tried very hard to get him to Rochester, and he came twice or three times for some collaborations, and I eventually managed to get him here. I was a very, very pleasant collaboration. He was a great physicist and a wonderful person.

KELLEY: Yeah, he did experimental work. I remember visiting him in the lab here.

WOLF: [00:23:09] He was an experimentalist. But he had a good feeling for theory. We published one book together called Optical Coherence and Quantum Optics. A very big book. It was a terrible thing that he died, you know. He was a very kind person. I don't know whether you know it; I published another book a few months ago, at Cambridge it was first published, and I dedicated it to . We are still in touch with his in Rochester. [Inaudible]. I knew [inaudible], but if a fellow came here, here I try very hard to get to know him.

KELLEY: [00:23:54] And then I wanted to ask you about—you don't have to discuss it if you don't want—but I wanted to ask you about your paper on laser line widths and theory and the work that you did with Mandel on that.

WOLF: [00:24:07] Well, most of it was connected with colliders. We had, as you know, a controversy with Glouburg [inaudible]. You know about it?

KELLEY: Not really. I was very interested in what people were doing, because I was working on photon counting theory and the statistics, as you probably know. But I mean, I was just nonplussed by the Summerfeld states. The very interesting things, the [inaudible].

WOLF: [00:24:49] Well, you know, actually, that controversy, which was quite a bitter one, reflected more personality than science, you know. I have great respect for Glouburg did, but he's a very aggressive individual, and he has been extremely negative. I remember the first quantum electronics conference was in Paris organized by Bloomberg and Cussler. You can read at the end of the lecture, after the lecture, the discussion which followed is reprinted. You will see that Glouburg, for example, accused me of—and this is his words—having put optics back 100 years by using time arrangements instead of ensemble arrangements. He implied that I had never heard of a priori process, which was nonsense. For a certain purpose, it was more convenient to use one than the other, you know. And he was a relatively new person in the field. Of course, he did great work in it, but he didn't quite appreciate what some other people did, you know, and the controversy was fairly bitter.

KELLEY: Yeah, I thought it was very unkind.

WOLF: Yes, very bitter.

KELLEY: [00:26:05] And I mentioned that I was going to ask you about this, and Boris was telling me he came to Toronto and spent some time there, and he had lunch with Boris, and he brought up the subject, and Boris said it sounded like you really wanted to try to heal the wound.

WOLF: [00:26:27] I don't feel badly about it, but it wasn't entirely fair. Mandel knew quantum optics well. Not me, I'm sort of semi-classical theory or classical theory, but I don't know the quantum part very well. Glouburg suddenly jumped into this full quantization, and yet there is a lot one can learn from the semi-classical treatments, and I still believe that to understand the physics of it; clearly the semi-classical theory helps. I know one of the two well-known papers as well on the subject, they mention polarization. Now it is a subject on which I'm very now, comprehensive polarization. [00:27:09] And he said something like this, that way of defining polarization is discussed in minute details in classical optics book—minute details. This is what was needed to clear up polarization optics, you know. In those days, no one tried to be . You know, so sarcastic remarks like that. But then his personality and all. And I don't feel bad about this, you know. He did all right, but I still think, once on this subject, that one should read Mandel's and not Glouburg's.

KELLEY: [00:27:47] Yeah, I mean, I think if someone had just-- I mean, I would have-- the approach I would have taken, maybe calling him up to tell you, if I had been Glouburg. But I also would have pointed out that the laser is an amplitude-stabilized device.

WOLF: It's more classical in many ways.

KELLEY: You can develop a classical theory of the fluctuations of an amplitude-stabilized device.

WOLF: [00:28:13] But somehow, this aggressiveness of Glouburg actually had to be rethought . He was the old expert, you know.

KELLEY: Well, it opened up a new approach to thinking about lasers. It was a positive thing for the field. So anyway, let's get back to your... [laughter]

WOLF: [00:28:37] Well, I would like to sort of stress again that piece of luck in life—you know, the coincidence which helps sometimes. It's hard to predict that this sort of thing would happen, you know. I must tell you, I enjoyed my career tremendously. I wouldn't have changed it to anything but physics. I'm still writing papers in it and I'm still publishing books. I still have students. I'm enjoying it tremendously. I wouldn't change it for anything.

KELLEY: [00:29:19] Well, the first time I ever saw a sort of rock star event at an optical meeting was, you were signing copies of your book, and you had a very large crowd. You had a new edition, and you had a very large crowd. People around you, it was amazing.

WOLF: [00:29:29] Let me tell you one or two amusing stories, working on the book. When I started working with Born, I was a post-graduate. Born was almost on the point of retiring. He retired three or four years later, but people don't know it, and they somehow think they are the same generation. So I very often get letters or emails from people asking me, and I don't mind this, but they ask me, "Where are [inaudible]," asking about the other book. So I went on holiday to China, and I remember saying, "No, no, I am the genuine product." An email came back saying, "Congratulations, you must be about 135 years old." [Laughter] This really is true.

KELLEY: How old was Born when he retired?

WOLF: [00:30:16] He was seventy. He retired about 1954, '55. I started working with him 1951. Now, of course, you know, this is a historical thing. If I start talking about my time Born, it would take me a whole hour or so, there is so much of it. It's all described—a lot of it—in my article in Optics and Photonics News, [inaudible] article. There are a lot of things, including Olivia Newton-John, certainly [inaudible] very popular. You know the story about that, right?

KELLEY: If you think it's appropriate, you can tell a little bit about Olivia Newton-John and her relationship with Born.

WOLF: [00:31:01] It was very good, you know, because I have this picture from her signed in this nice way. I met her once. I was on a sabbatical. It was after I wrote , of course, and also in ; I had joint appointments there. And it so happened that Olivia was giving a concert in Toronto, so I went up to her. It was difficult to get her address—you know, these stars aren't so easy to get a hold of, but I managed to get a hold of her. I told her that I wrote a book with her grandfather, and if possible, I would like to meet her, and I got a charming letter back, saying, "Let's get together after my concert. Come and see me." So after the concert we got together and talked a little bit. It was very enjoyable. She gave me a very nice picture. I have it in my office, framed. And I'll tell you a story, which is really true. Almost every year at the beginning of the semester, I have new students coming to see me, and they want to discuss things with me, and I see that they have really nothing to say, but I notice all the time they look at the picture. And they heard that I have a picture of Olivia Newton-John and they want to see it, so they come and see because of the picture and not because they want to do any optics.

[00:32:21] But I'll tell you another story about it. A former chairman of the physics of the Physics Department likes to have all sorts of souvenirs on the walls, diplomas of people and so on. So there were two or three pictures of Olivia Newton-John, you know, and they were put high up, and then he noticed. When people came in, they stretching to see Olivia! So the wall was [inaudible] diplomas, for example. [Laughter]

KELLEY: And you were instrumental in getting the Born medal. I think you played a very large role in that.

WOLF: [00:33:01] I didn't press very hard. It was Jarus Quinn, actually. Of course, I supported it, but Jarus Quinn thought it should be done.

KELLEY: That's a very important medal in the Optical Society quiver of medals. Did you get it? You got the first one.

WOLF: I'm not sure I was the first one, but I got it. Maybe it was the first one. I'm not sure.

KELLEY: And there's the Born Endowment?

WOLF: Yes. The endowment, I configured it recently. You know, it's running now [inaudible], so now they were collecting a little bit more for it, because there was not much money coming in. It's a very nice medal.

KELLEY: Yesh, sometimes an angel shows up and somebody in a company will give money.

WOLF: [00:33:53] I tell you one thing which I'm really positive about: the number of medals is increasing. It's nice, but how mixed up! It is impossible to have a session to give all those medals.

KELLEY: Yeah, I think there should be some control over-- there's not that much great that's done to give a medal every year. Maybe they shouldn't give them every year, all these medals.

WOLF: A famous optics person rises now, and they name a medal for him. It goes on and on.

KELLEY: There has to be some limit. Yes, now, they've instituted the Paul Foreman...

WOLF: Yes, but they renamed one.

KELLEY: Oh, they did?

WOLF: [00:34:36] Oh, yes, there was an engineering award which they called . So that's all right.

KELLEY: Yeah, that's fine. I thought that was a new one. You're more with it than I am on these things. So you came to the Institute of Optics in 1959, and that's before you went to the Physics Department.

WOLF: But you know, I have a joint appointment in physics and optics.

KELLEY: Oh, you did?

WOLF: Yes, the Physics Department offered me a job there.

KELLEY: Now there are a lot of old-time practical optics people. How did you get along with them? I mean, like, Kingsley and Hopkins?

WOLF: [00:35:17] Well, Hopkins got me here, of course. I admire him very much, of course.

KELLEY: I mean the people are interesting and your interaction with them, because you're a very high-brow theoretical person.

WOLF: That's why I ended up actually in the Physics Department. I still have a joint appointment with optics, but it is why I'm in the Physics Department.

KELLEY: And these really sort of grew up with Bausch & Lomb and Kodak.

WOLF: Yes. But they're nice people, kind people you know. The Kingsleys I remember distinctly. They offered to help with furniture. We came as very poor people from Europe, you know, and they lent a certain amount. Anybody who came from Europe, if you needed something for their apartment, they had a tremendous amount of old furniture which they would lend out to help. My wife became very good friend with Mrs. Kingsley. They were wonderful people, very kind. You know, it's an amazing thing; they died within a few days of each other. They were very, very nice people.

KELLEY: Were there other people in Rochester? I mean, I don't think people know the history very well of optics in Rochester. Maybe you could just touch upon that in a little bit.

WOLF: [00:36:32] In the earlier days, of course, it was very much tied to Bausch & Lomb and Kodak. Then there were offsprings of it, and Hopkins started a company of his own, and it sprung out much more and more. They started making it a little bit more academic. They started quantum optics—you know, Carl Stroud quantum optics, and was doing quantum optics and lasers. They always had a good, solid part of classical optics design and lenses. You know, they are opening a new center now, the Hopkins Center. Have you heard about it? They got a lot of money recently to start a center: Hopkins Center for Optical Design. It just was announced. So that continuous. [00:37:17] It's a nice balance between more abstract things than physics things about optics. But you know, there's a lot of collaboration between optics and physics. Three or four of the people from optics have joined up with physics. Carl Stroud is one of them and there are others. For conferences and so on, [inaudible]. Joe Eberly and I have joint appointments, and it's good. So the collaboration is very good; there is no problem.

KELLEY: Of course, what drew you to Rochester was the opportunities in optics, and it came from these sort of people with a very different background than yours, and it's just sort of interesting that you added a new dimension to the...

WOLF: [00:38:07] When I came, it was still very much instrument-oriented, dominated essentially by the selected optics. But gradually the laser, the specialists in laser optics running a conference or some sort of thing, gradually they got more into the physics of it. And then there were the joint appointments of Eberly, myself, among others.

KELLEY: There was, of course, the dilaser and Mike Kurtcher. Of course, Kodak contributed in the laser world, too: Ben Snavely, Otis Peterson. So Rochester has always been-- even today it's...

WOLF: But have you seen now, it's expanding now? There's a new building. I've seen it going up.

KELLEY: No I haven't.

WOLF: So it still goes on.

KELLEY: So anyway, let's get on to the Optical Society, if that's okay with you. You were the president...

WOLF: [00:39:01] A long time ago; I don't remember.

KELLEY: Well, actually it was in the '70s. I can tell you the dates when you were in the presidential chain: '76 through '79. So you must have been involved in the Optical Society earlier than that. Can you tell us?

WOLF: [00:39:32] I was on various committees. I remember I was on a at the University of Toronto. Stoicheff came to me and said, "You know, the Society has decided to create a new position." I don't remember if it was president or vice president. He said, "What do you think of it?" I said, "It's great." He said, "Good, because you will be the next one!" [Laughter] It was already settled by then. That's how it started, actually.

KELLEY: So that's when the presidential chain started, you could say.

WOLF: That's right.

KELLEY: Originally they didn't have a vice president and then a president-elect, and then a president and a past president. So it's four years of service if you agree to be president for a year.

WOLF: [00:40]15 But you know, it was very tough, and it's even worse now, because the president-elect was expected to travel around to every section and give a talk. At my time, it may be 14, 15 or so, but it's now many, many dozens, and I know Charlotte was telling me it's impossible to continue like this. But it's still continued, but it's spread now over several years. I had to do it in one year, visiting all these sections. But it's interesting. You meet a lot of people. It's interesting, too. And for the Society, you got many new members.

KELLEY: And now it's travel all over the world because of the internationalization of-- the Society itself, you know, 75% of the papers received come from outside the United States.

WOLF: [00:41:01] But I was quite impressed that the Society is quite happy to elect as presidents people from other countries. Well Canada is obvious, but England and so on. It's very broadminded. I'm not sure that in Europe, a European society would elect somebody from the United States or from Asia, so it's very broad-minded. You know, like Peter Knight from , and there are some other candidates now.

KELLEY: I've gotten to know Peter Knight very well through the Optical Society, and I think he made a wonderful president. I think he was really top-notch, and I suggested that he take over strategic planning for publications, and he's done a wonderful job at that.

WOLF: [00:41:51] But you know, he was involved in so many things. He gave some of his duties up. He's no longer running the journal with optics, but he is still involved a lot of things.

KELLEY: So what were some of the problems you faced when you were president?

WOLF: [00:42:11] Well, the problems, many of them started later, and I see from your remarks about the possible joining of OSA with SPI. I felt very strongly about it, as you know. There were two or three or five were fighting together against it. I have nothing about SPI; in fact they've been very nice to me. I could tell you a lot of nice stories about SPI. But it seems to me, the Society was so different—culturally so different, you know—that I just could not see it. To me, I may be wrong, but to me, SPI was largely a society about making money. I'm not sure they did make the money because it's tax-exempt, but they were spreading at a tremendous rate. I know for certain that there are optics people in Europe who were resenting it, but they were taking over the optical societies' market in Europe all the time, and even now, you know. It doesn't matter where the meeting is, in Europe, they always gripe that SPI is one of the sponsors. [00:43:10] And that didn't seem to me a reasonable thing to do. I mean, to be at cross points or so, fine, but they did it in a very aggressive way, and it disrespected the Optical Society. They looked after the members—there were many in the United States and Canada; if anybody wanted to join from other countries, fine, they were very welcome. But to push running meetings all over the world for them, getting them out through Optics, I just didn't like it. But there were other things. The main thing was it looked to me more like a business organization than anything with real research and academics.

KELLEY: [00:43:47] Well, they say the members run the Optical Society, and SPIE is run by the SPIE staff. There's a good deal of truth in that, and in a way, that sometimes holds back the Optical Society, because the Optical Society has not had, until very recently, any people who-- when the staff who were technical-- people who had been involved in developing meetings. So they had to rely on the meetings bubbling up from the members, and sometimes the members are not paying attention to doing meetings, so having Tom DeLorenzi, who I'm sure you know in this role on the staff, he's trying to do that a little bit; he's taking it very carefully, because he doesn't want to-- you know, he's not going to step on what the members want to do, but he's trying to steer things into new areas, whereas the SPIE has been very aggressive about that. It's the staff of the SPIE that come with the ideas and basically twist the arms to get people to be involved in it.

WOLF: [00:45:04] You know, I've found that felt the same as I did, so we sort of worked together to drive this business. He even got Nickoli Bryce with us, you know, and eventually he managed to change the bylaws of the Society, so it would not be so easy to do this again.

KELLEY: To merge the societies?

WOLF: No, to change the name. We felt very strongly about it; even more so than me.

KELLEY: [00:45:33] Boris, who overlapped with you at roughly the same time in the leadership of the Society, what he told us, and I didn't quite realize this fully, but he said what Jarus ended up offering, which is to basically absorb the SPIE into the Optical Society. And to sort of say that they were in financial trouble—they had a serious financial problem, and they came to the Optical Society and asked for help. Jarus' initial offer was to say, "Well, we'll take you into the Optical Society and you'll become part of the Optical Society." Their board didn't like that idea. But what it ended up was, the board decided that they would help the SPIE, and suggested somebody who was a good financial manager in Perkin-Elmer to go and help them. That's Boris' perspective. [00:46:43] But I'm sure on the other side of the coin, there were people that didn't want to go near SPIE with a ten-foot pole. Obviously, you were in that. Even to merge them as part of the OSA. But it's always been a problem with the OSA, as you know. Steve Vantung and Duncan Moore have had this perspective, that the OSA just doesn't do enough for engineers and practical people, that the OSA is an academic society. I don't know if that's ever going to be resolved. It comes up all the time—constantly.

WOLF: [00:47:26] It's almost two extremes, aren't they? One is very practical. But you know, SPIE is sort of very opportunist. When I see this announcement of Security Defense Symposium, now if that isn't opportunist, then what is? What does that have to do with society defense? But it sounds good, right. Government agencies put up the money for it, you know. That's what I resent a little bit.

KELLEY: [00:47:56] Tony DeMaria was president of SPIE. He's been president of the Optical Society, but in 2003 he was president of SPIE. So I was looking for his biography because he's coming tomorrow. So I went to the SPIE website, and I found a biography there. Then I also just said, "Well, let me see who is involved with the SPIE," and I didn't recognize anybody. Nobody on their board of directors was recognizable, and from companies I never heard of. And there were a couple of academics, but sort of junior people—nobody that I'm aware of who is a serious person in optics.

WOLF: [00:48:41] But you know, they do things which are obviously attractive to industry, submit papers and have them think you are, and it looks good. Look, I have nothing against SPIE; they're really good to me, too. But it's a very different society, and I think the merger would have been a big mistake. I mean, it would have completely killed our...

KELLEY: So Boris and I were on the committee that looked at merging the societies.

WOLF: So he gave you headaches [inaudible].

KELLEY: And Wayne Knox was one of the people that fought extremely hard against that. He was very strong. We just saw Wayne at lunch.

WOLF: [00:49:23] But it surprised me, actually, because Wayne was in industry, right? He was in Bell Labs.

KELLEY: Bell Labs is not really industry; it's more a research institution. I mean, they have changed now or may be changing now because Lucent and Alcatel...it's part of Alcatel now. It's a very different business. When it was part of AT&T, and AT&T had a guaranteed amount of money, you know; some fraction of everybody's phone bill, when they were a monopoly, the government agreed could go to research. That's what funded Bell Labs. Well, when they split up AT&T that ended, and that's been part of the demise. Central research labs of industry have suffered, and the reason for Bell Labs suffering was because AT&T was split up, and it had to be profitable; there couldn't be a deal made-- you know, you could have this organization which would be funded by everybody's phone bill, and there was no-- you know, the public had no say in the matter. Of course, that's sort of against the idea of business in this country.

WOLF: [00:50:57] I don't know how these things are filed, so I would like to remind you that I had an optics [inaudible] in particular about collaboration with Max Bohm. There is no time for us to discuss here, but I would like somehow that it is together. If you have a reference, [inaudible]. I spent a lot of time on that article.

KELLEY: [00:51:19] I'm sure there is a database, and they can find it right away. It'll be no problem. You don't have to worry about it.

Anyway, there were a lot of changes. What was happening in the '70s when you were president was, laser meetings were emerging—CLEO and CLEOS and CLEA. Did you have any feelings about those things?

WOLF: [00:51:51] Not really, about around that time, optics and photonic use was started, you know, and there were some big arguments. Another controversy I was involved in is the word "photonics", as you probably know, and although it was removed from some other things, they managed to get it into the article. I just don't see any reason to have any other name apart from optics. I still don't know what it means, you know. But anyway, they were quite into arguments about that.

KELLEY: [00:52:20] Well, I think the communications guys and the guys who came to optics from the electronics world—the IEEE types—like the idea of this intersection between electronics and optics, and that's really what it is. The people at Bell Laboratories really love that word.

WOLF: What's the difference between optics and photonics? Is there anything?

KELLEY: [00:52:45] No, I mean, other than that photonics can be considered the intersection between optics and electronics—opto-electronics, you know. The idea that you can now make communications devices with optical systems and fiber optics. So that involves a lot of electronics. You know, optics and electronics now, of course, between the CPUs, Intel, and IBM are going to have optical communication devices right on the chips and on the circuit boards and everything. So it's the sort of merging of-- There's nano-photonics and the fact that as you get the ability to make smaller and smaller devices, optics becomes more like electronics. You're going to sub-wavelength devices, and that's what makes electronics different from gigahertz region or the megahertz region different from the terahertz region, and that is because the devices in the megahertz and gigahertz region are smaller than a wavelength, and now, as you get that

ability up into the tens and hundreds of terahertz, you can see that it's going to be quite possible for the optical frequency devices to look more like electronic devices. I mean, you don't have the latency; you don't have the-- You know, it's a very different world. And there are a lot of people working in this area. Now whether it will all pan out, I have no idea, but that sort of gives into this idea, that there's a...

WOLF: [00:54:48] Well, that makes something completely different. You know, in this forthcoming OSA meeting, about 50 have given papers on everything. If you live long enough, you can do that. [Laughter]

KELLEY: You were there when Optics Letters was founded. How did you feel about Letters, Journals...

WOLF: [00:55:10] Well, people were worried whether it would make it, you know. They were saying, "We have already so many journals. Why make more?" Well, it started, and now it's doing extremely well. Now it's a leading journal.

KELLEY: [00:55:24] I was going to mention, Bob Terhune and Joe Eberly were very entrepreneurial people. I mean, to start new journals requires a lot of effort on the part of the editor to get papers. I mean, you probably got phone calls from Bob Terhune asking you to contribute to Optics Letters, as did many of the famous people in optics. I remember Ali Trubaun telling me he had his arm twisted. You know, and a lot of people don't want to publish in these—they don't know whether this is going to be a success or not, so there's a lot of uncertainty. But he got a few people to publish—a few well-known people—and then it just gradually grew over the years. It's enormous, in terms of the number of papers published, and Joe Eberly did the same thing with Optics Express. He basically went out and beat the bushes and got people to publish. You know, now it's a favorite. Physicists love it, because it's fast, Optics Express. Some of the people who have been around publish long journal articles, but you know, these young guys, they're at a point in their...

WOLF: [00:56:45] Oh, older people have a problem with any electronic things, you know, and computing and so on. And I have Wolf's theory that anyone over 50 cannot learn how to use a computer. That's me, too. Very difficult. All I can do is email and nothing else. I'm actually quite unhappy about the complication to submit a paper, so many things to click and do. It's very complicated.

KELLEY: If you miss a button...

WOLF: [00:57:08] That's right. And registration for a conference and so on. And passwords annoy me. I can never remember them, you know. I think Americans are obsessed with passwords and numbers. I have so many different passwords for computers, for bank accounts, for this. How on earth can I remember? And I can't use the same password, because some have letters and some have numbers. I find it very difficult.

KELLEY: Well, I mean, I live with it. I tend to use the same password over and over again.

WOLF: [00:57:48] Well, I try, but it doesn't always work. My bank wants me to have a certain number of letters and a certain number of numbers. These young people can do it all.

KELLEY: My password is the same as my logon to the *New York Times*. It used to be, you had to log onto the *New York Times* to see anything but the front page. You know, I have this one password that I use over and over again, but you're right, some of the time you have to come up with a different formula. Especially with ones you want to dial in a phone dial way. That sometimes requires numbers like a bank account.

[Tape change]

KELLEY: [01:00:27] Okay, so you want to talk about some of the people you knew in the OSA?

WOLF: Well, I was just saying that I think OSA was very fortunate with the staff they had. I knew, of course, Mary Varger . I knew Jarus Quinn, and I'm still in touch with him. We visited him once or twice. He was a wonderful person that really knew how to run things. But the supporting staff was extremely good: Carla Atridge, Barbara Hicks. I think the Society as a whole was also generous with them. I remember Barbara Hicks, meeting her in an optics meeting in Italy. She was sent there by Jarus to do something . So that really helps.

[01:01:06] But when you're still talking about sort of reminiscence, like the one thing that is still clear in my mind was the effort to buy a building for the Society. That was an outright presidents' center. That was just before or during the time; I don't remember. It was a terrific job. It was extremely difficult. And I don't know how Jarus understood all these things. He was in touch with real estate agents, and we met together several times where they produced the plans, or knew how to change the building and what should be added, and that there was tenant damages making it difficult to get out, but we have to work it out. And so I think the Society was extremely fortunate to have people like Jarus who really pushed these things and knew how to do it.

KELLEY: You're talking about Jefferson Place?

WOLF: That's right.

KELLEY: Because of course the Optical Society has now moved into this huge building, which was a second transition. So this was Jefferson Place.

WOLF: [01:02:00] I don't remember the details anymore, but I know that Jarus was extremely efficient, and every time there was a meeting, and all the plans there real estate agents there, and a bunch had worked out how much it would cost and so on. Amazing. I don't know how learned all those things. It is a highly specialized type of job. You would have to be an accountant or something.

KELLEY: Well, he was an entrepreneur, but he was very quiet about it. He could get along...

WOLF: Very modest fellow.

KELLEY: [01:02:31] I mean, one of the ways I described him to other people was his skill at getting the members to go along with him. He was very good at that. He wouldn't interfere with-- he would be in discussion with the committee, and he wouldn't say anything until finally the discussion sort of tended towards where he wanted to go, and then he'd sort of, "Well, so-and-so says..." He'd say how that could work, you know, and he just steered-- he managed to get everything steered in the direction he knew from the beginning he wanted to go.

WOLF: [01:03:10] [Inaudible], you know. But anyway, he's a wonderful person. I visited him once or twice in North Carolina, I think it was. A wonderful person. Don't you think the Society was likely to have so many wonderful people?

KELLEY: Absolutely. If you just look at it in terms of sheer growth, the Society grew from a few thousand in the late 1960s to it's 14,000 today, but the staff grew from six people to 140 people. The staff grew much more than the membership. The reason for that was that Jarus took over management of the technical meetings. He was between the APS and the IEEE. He was in between, and he took advantage of-- The APS didn't have any big meeting skills, big shows, running the show, because the shows were not part of the APS, as you know. The IEEE was just so cumbersome, and from the beginning wasn't interested. And Jarus fit right in the middle there, and he got all these people to go along with his running meetings, and then he saw the opportunity-- he recognized, as Boris did, and you did too, that there was a need for a letters journal, and that led to an expansion of the journal.

WOLF: [01:04:48] There's just a small caution I would like to mention. I know that the Society is preparing for one of the big anniversary which is coming up, a listing of the most important papers which appeared in the journal. And I was sent a list like this, and I wrote actually about this, too. That should be done really very carefully, because if you ask somebody how he finds his favorite papers, [inaudible]. But I saw that some really important papers were missing, and papers which to me are insignificant were there. That should be done seriously. They should get a few experts together and look at that together. [Inaudible] suggestions.

KELLEY: It should be reviewed in a collective way.

WOLF: [01:05:35] I know they are talking about this, because they asked me to collect on it, and I was a little bit horrified at the complete mixture of some important papers and some complete junk. That should be done carefully. And it's not easy. You would need a few experts, you know, to look at different types of optics to look at it. Because it could be a disaster for someone to say these are the most important papers that appeared in the journals.

KELLEY: [01:06:04] I mean, one indication is citations. That's the sort of indication of...

WOLF: Well, that's a very big job.

KELLEY: One of the most cited papers is by...

WOLF: Well quite right, it should be by citation.

KELLEY: [01:06:19] One is by a fellow named Aranka who was at Cornell. He was one of Gaetta's students. You probably know him from Cornell, Alex Gaetta. Genender Aranka was his name, and Genender was at Bell Labs when he did it, and it would have to do with something with, and I'm not sure, using nonlinear phase modulation to make femtosecond pulses, and it's apparently been cited like 10,000 times now. There are a lot of papers on the subject area, and it's been cited just-- I mean, I may be exaggerating the number, but it's a very large number of citations. And it's interesting. I mean, we could tell, you know-- I'm sure some of yours have been cited an enormous number of times, too. So that's a good indication. And sometimes the Optics Society has published most-cited papers without, you know, saying that they're necessarily the best papers. You could just say what they are—the most-cited papers. Publish a list of the hundred most cited, which is an objective criterion.

WOLF: It should be done that way.

KELLEY: Yeah, that's one way. Maybe there are other ways, but it's certainly one way.

WOLF: [01:07:56] I would hope the Society will appoint somebody to take charge of this, because what I was sent was hodgepodge. They should just ask a few people and everybody send something. There should be a proper...

KELLEY: Yeah. So I mean, it was Jarus that really grew the Society through, and of course, the journals are the mainstay, financially, of the Society. The meetings, as you know, from experience either break even or lose money, and the journals make an enormous amount of money—JOSA, Optics Letters, Applied Optics. Optics Express now is a money...

WOLF: It's great.

KELLEY: [01:08:49] Oh, yeah. It's really... it's about 30 or 40% profit across the journals, something like that. I don't know exact numbers, but it brings in millions of dollars, and is used for other things. So you know, the University of Rochester library is paying, as well as other libraries are paying. Of course, that's not true of Optics Express; it's the authors who pay for Optics Express, but it's tremendously profitable, the journal business.

WOLF: Something quite different.

KELLEY: Yes, we're going to do John Howard in Boston and probably Erich Ippin, and maybe Ali Trubaun. Ali has got macular degeneration; he's basically reclusive. Otherwise, he's in pretty good physical health.

WOLF: How old is he?

KELLEY: [01:10:02] He's in his 80s. I think he's roughly your age. But he's got macular degeneration, which limits your ability-- so he can't read. I send him email, and I try to send it in large type. But he will probably-- if we can get him, we would like to interview him. Because you know, we're trying to get the oldest people first—it just makes sense.

WOLF: But you are doing very well. You have been around for a long time and are doing very well.

KELLEY: Yeah, but... [laughs] Well, I'm not as old as most people are. I'm like 73, so that's not...

WOLF: Compared to me you're a youngster. [Laughter]

KELLEY: I don't feel like one, as you probably know! Things start going wrong when you get into your 70s. I keep telling that to Chad: "Stay young."

WOLF: This was quite enjoyable.

KELLEY: [01:11:17] Yes, it was a pleasure. You've contributed a great deal to the Optical Society and to physics and to optics. Somebody said in one of the articles about you, I think when you got the Medal, that nobody says principles of optics; they said Born-Wolf.

WOLF: [Chuckles] [Inaudible] print 8,000 copies.

KELLEY: Well thank you very much.