

Ralph DeLong, Ph.D., D.D.S.
Narrator

Lauren Klaffke
Interviewer

ACADEMIC HEALTH CENTER
ORAL HISTORY PROJECT

UNIVERSITY OF MINNESOTA

ACADEMIC HEALTH CENTER ORAL HISTORY PROJECT

In 1970, the University of Minnesota's previously autonomous College of Pharmacy and School of Dentistry were reorganized, together with the Schools of Nursing, Medicine, and Public Health, and the University Hospitals, into a centrally organized and administered Academic Health Center (AHC). The university's College of Veterinary Medicine was also closely aligned with the AHC at this time, becoming formally incorporated into the AHC in 1985.

The development of the AHC made possible the coordination and integration of the education and training of the health care professions and was part of a national trend which saw academic health centers emerge as the dominant institution in American health care in the last third of the 20th century. AHCs became not only the primary sites of health care education, but also critical sites of health sciences research and health care delivery.

The University of Minnesota's Academic Health Center Oral History Project preserves the personal stories of key individuals who were involved with the formation of the university's Academic Health Center, served in leadership roles, or have specific insights into the institution's history. By bringing together a representative group of figures in the history of the University of Minnesota's AHC, this project provides compelling documentation of recent developments in the history of American health care education, practice, and policy.

Biographical Sketch

Ralph DeLong earned his bachelor's in physics and mathematics from the University of Nebraska in 1966. He earned his Ph.D. in Nuclear Physics at the University of Minnesota in 1974. Dr. DeLong then graduated from the University's Dental School in 1978 and earned his master's in fixed and removable prosthodontics in 1981. He became involved in Dr. William Douglas's work on the artificial mouth, took a job in the lab, and became a professor within the Dental School. The lab's work led to the creation of the Minnesota Dental Research Center for Biomaterials and Biomechanics (MDRCBB). His research has included his work on the development on several iterations of the artificial mouth, AnSur software, and the virtual dental patient. He served as chair of Department of Restorative Sciences from 1992 to 1997 and then interim chair from 2003 onward. In 2004, Dr. DeLong became director of the MDRCBB. He continues to serve on the faculty of the Dental School.

Interview Abstract

Ralph DeLong begins his interview by describing his choices regarding his education and early career. He discusses his time in the University of Minnesota's Dental School, his decisions regarding dental research and practice; his master's research; the building of the artificial mouth; the development of AnSur software; and the creation of the virtual dental patient; and the development of ART 5. The interview then turns toward teaching and administration within the school, particularly touching on the teaching of evidence-based dentistry; student-friendly teaching; retrenchment within the Dental School and the University more broadly; and lobbying the Legislature. He then describes the following: relations among departments within the Dental School; relations among different schools and colleges within the AHC; the tenures of Richard Oliver and Richard Elzay as deans; the threatened closure of the Dental School; his time on the Institutional Effectiveness Committee; efforts within the School to admit more minority students; the impact of the Rajender Consent Decree; Michael Till's tenure as dean; and his time with professional organizations. He concludes his interview with his thoughts on the future of dentistry and leadership in the AHC.

Interview with Doctor Ralph DeLong

Interviewed by Lauren Klaffke

**Interviewed for the Academic Health Center, University of Minnesota
Oral History Project**

Interviewed in Moos Tower, University of Minnesota Campus

Interviewed on June 10, 2013

Ralph DeLong - RD
Lauren Klaffke - LK

LK: This is Lauren Klaffke. I'm here today—it's June 10, 2013—in Moos Tower. I'm interviewing Doctor Ralph DeLong.

Thank you for meeting with me today.

My first question I wanted to ask you a little bit about where you were born and raised and your early education and, perhaps, your early interest in dentistry or physics, as I saw you did early on.

RD: I was actually born in Winona, Minnesota. My family moved to Nebraska when I was one year old, so I was raised in Nebraska, in Lincoln, Nebraska. I graduated from high school there, then, attended the University of Nebraska. I graduated with a dual major in math and physics, then, came to the University of Minnesota to pursue a Ph.D. in physics, in particular low energy physics. I was interested in rocket propulsion at that time using ion transportation. I finished my Ph.D. in 1974 and started Dental School that same year.

LK: In Nebraska?

RD: No, here.

LK: Okay. What prompted your early interest in math and physics?

RD: I was just interested in science. Like I said, I was interested in space at the time. If you're in physics, it gets to be all math, so it's natural to have physics and math as dual majors.

LK: What prompted the, I guess, changing interest from math and physics moving into dentistry from there?

RD: Nixon.

LK: Nixon?

RD: Richard Nixon as president had made a statement that the government was no longer going to fund basic research. He didn't think it was important.

Since, physics is all basic research, at that point I decided to look at what kind of job possibility I would have. In education, it was going to be doing post docs, which would be kind of nice for traveling around the world, if you wanted to do that, but they're very low paying jobs and a lot of hours, because you have to produce. If you're really good, you end up getting an offer at a university. The odds of my succeeding compared to those of the people that I was working with in physics, didn't look very good. A lot of the people I worked with were very bright. I was the seat-of-the-pants type of physicist. I could solve problems, but that was about it. I didn't think that was going to work out too well for me.

Industrial jobs were another option; however, if the government was not going to fund basic research, industry was not going to have the funds either.

LK: Right.

RD: I thought, well, my real interest was in research; therefore, I would look into medical research. I also applied for an MBA [Master of Business Administration] because several people that I worked with in physics were getting a master's in business then, taking a position in business to provide communication between administrators and the basic scientist. That was a good way to go.

I decided, instead, to go into medical school. I had to take a lot of prerequisites because I didn't have a lot of biology or any of the required medical school background courses. When I applied for medical school I hadn't completed the analytical chemistry. Of course, at that time, it was the Vietnam War, so there are literally thousands of people applying. I went through the interview process and I did fine. However, they told me because I hadn't completed analytical chemistry and because there's so many other qualified applicants that I should apply next year after I completed analytical chemistry.

Well, at that time, I was living with my cousin, who wanted to be a dentist all his life. He was going to dental school. He told me when I applied for medical school I should apply for dental school, also. I thought, what the heck, you're taking all this stuff. It's roughly

the same test, so I signed up and took both the MCAT [Medical College Admission Test] and the Dental Admission Test [DAT]. I'd gone through the interview with medical school and wasn't impressed with the process...I'm sure the interviewers get bored, when they've got to interview that many applicants.

LK: Yes.

RD: One day, I wasn't thinking much about it when I got a call from Mel [Mellor R.] Holland telling me I had to come over and interview. I thought, this is different. When I got in to talk to him, he sat me down and he said, "What do we have to do to get you into the Dental School?" He said he had never seen DAT scores like mine.

LK: Wow!

RD: I thought, well, this is entirely different. I thought, hey, research is research. So I went into the Dental School.

LK: That's amazing. I'm thinking of that period of time within the Dental School. Was there a lot of retrenchment that you saw going on as a student?

RD: Not as a student. In fact, that was kind of the heyday in Dentistry. I started in 1974, which was the first year this building [Moos Tower] was open.

LK: That's cool.

RD: So I was the first class to go all the way through in Moos Tower. They had students coming over from Owre [Hall], but we were the first class to go through entirely in this building. You didn't notice anything about the administration. As a student, you didn't see much of the inner workings of the school. I don't think they were really having any financial problems, at that time. I didn't notice and probably wouldn't notice anything until I became a chair.

LK: Okay.

RD: They have a Council of Chairs in the School that deals with all the financial issues. At that time, that's when retrenchment really started. That was in the early 1990s.

LK: Okay.

RD: Up until then, as far as I know, things were okay.

LK: I want to say it was in the transition from [Erwin M.] Schaffer to [Richard C.] Oliver is when I started to see the classes being cut down a little bit.

RD: There were 150 students when I entered dental school in 1974, and I think the class size was bumped up when new class started in Moos Tower. The class size was 150

students for quite a while. Funds were given to dental schools to graduate more dentists because of the shortage of dentists or the perceived shortage of dentists. However, soon, there wasn't any shortage. There was a surplus, because they had all these schools pumping out dentists.

I don't remember exactly when the school decreased the class size, but it might have been in 1987. That was kind of a traumatic year, because the governor [Governor Rudy Perpich] decided he wanted to shut down the Dental School.

LK: Right, right.

RD: Of course, there were rumors that he wanted to do it because he didn't get accepted here.

LK: I heard that. [chuckles]

RD: But I don't know if that's true or not. Dental education is one of the most expensive educations on campus, by far...

LK: Wow. Hmmm.

RD: ... because we run our own clinics. It gets to be very expensive. The University at that time was looking to save money, and closing the dental school was one way to do that. We had a big meeting to restructure the Dental School. That may have been when they decided to drop from 150 down to, I don't know, 86 or something like that.

LK: Yes, it was like cutting it in half.

RD: It was an odd number. I think it was dropping back to what it used to be.

LK: Yes.

When you were applying to dental school were you looking at other dental schools?

RD: No.

LK: Just Minnesota, okay.

RD: I applied to multiple medical schools, not many. I applied to Nebraska, because, like I said, that's where I was raised. At the time, most of them were only going to take regional people. So I thought I might have a chance of getting in down there. I applied to a couple others just because it didn't cost you anything.

LK: When you became a student—I'm not quite sure how maybe research as a dental student is structured—did you start to get into more like academic dental research because you already had the Ph.D. in physics.

RD: As a student?

LK: Yes.

RD: No. In fact, I think it's funny, because the school runs a research program during the summer, and they ask for students to come in and volunteer. I didn't find out about it as early as I needed to. I went in and applied for a research position, but they were all filled.

LK: Oh, wow.

RD: So I didn't do anything during that first year.

LK: But you started to do more research in your later dental school career?

RD: Not as a student. When I went into the prosthodontics graduate program, you had to do some research.

LK: You got the M.S. [Master of Science] in fixed and removable prosthodontics?

RD: Yes.

LK: That's when you did the...?

RD: It's an M.S. program so you had to do research.

LK: When you were in Dental School, I saw some in the archives about a push to try and get more dentists into rural areas of Minnesota. I didn't know if you remember any of that from a student's perspective, if there was much of a push having students go out to those rural clinics and work there.

RD: No. The Medical School had this *definite* push for rural medicine. In fact, when I was applying, I was told to write—you have to write an essay why you want to go into medicine—that you wanted to practice as a general practitioner in a rural community.

LK: Hmmm.

RD: I thought, well, that seems highly unethical. That wasn't what I wanted to do, and I didn't write it down that way.

[chuckles]

RD: I wrote down I wanted to go into research. I had some specific interests at that time that I wanted to pursue.

LK: Was your continuing interest in research what prompted you to go for the M.S. after you completed your DDS [Doctor of Dental Surgery]?

RD: Uhhh, not really.

LK: Not really? Okay. [chuckles]

RD: No. When I did my M.S. project, I did it up here with Bill [William H.] Douglas.

LK: Oh, okay.

RD: So I was looking at a process... corrosion fatigue and stuff.

When I graduated from Dental School, I went into one of their first attempts in a GPR [General Practice Residency] program. They didn't have one at the time. So I was hired part time as a dentist to treat some of the patients that were a little more difficult or came back in to have something redone. At that time, I was pursuing a dental practice, so I was interviewing at a lot of places and came in second all the time.

LK: Ohhh.

[chuckles]

RD: It gets demoralizing. In the process, Dick [Richard J.] Goodkind ran the grad pros [graduate prosthodontics] program. He came over and told me that I needed to go into his grad pros program. I think part of the reason he did that is because I had graduated number one in my class. He checks all of those and tries to get them into his program. So when I was in that program, I was still thinking of practicing.

However, I started doing the research and, then, Bill Douglas more or less recruited me to come and work up here with him instead of going into practice.

LK: Had he taught you in any courses?

RD: No.

LK: How did you initially meet him?

RD: Because I came up here to do my master's project. I think he had come here only about a year before that. He didn't teach the dental materials course when I went through. He wasn't here at that time.

LK: It's kind of amazing that you came in second several times being number one in your class. The competition must have been...

RD: No, it's not surprising. There's a lot of other things that people are looking for in their practice, what they want. So it didn't surprise me. I think coming in second isn't always bad.

LK: Yes. [laughter]

RD: At least I didn't get any *don't bother us* type of interviews.

LK: Right, right.

What did you do your master's thesis on?

RD: It's a process called corrosion fatigue. At the time, the price of gold was going way up, so they were looking for other metals to use in dentistry to replace gold. One metal was a nickel chrome alloy. The reason is because when it corrodes, it gets a shiny look to it, so it looks nice. Okay?

LK: Oh, yes.

RD: It would stay polished. My question was if you bonded porcelain to these metals, which is what they were doing, would corrosion affect the bond. I designed an equipment to test that. I needed to use a machine up here, because when doing fatigue, you've got to load and unload the material a lot of times and he had a machine to do it.

LK: Doctor Douglas?

RD: Yes. Then, I got lined up with Art [Arthur G.] Erdman over in Engineering, because he was a corrosion expert. I worked with him and with Douglas on that project. It was a good project. I ended up getting first place in the prosthodontics competition at the American College of Prosthodontics. That was nice, because it had a \$1,000 first prize with it.

LK: Yes. Was that for research?

RD: Yes. It was for research. You present your research at the annual meeting. Doctor Goodkind did pretty good at that meeting. We took first and third that year and I think he took first and second the year before. He's done very well in that competition.

LK: Yes.

Once you completed your master's was it Doctor Douglas who recruited you to stay at the University?

RD: Yes. He actually recruited me while I was doing my master's to come up here and work. He had this idea of developing an artificial mouth to test wear.

LK: Right.

RD: That's why he wanted me to join him. My background is physics and what I had done up here with the other things. He wanted me to help him build the artificial mouth.

LK: Did your physics background play a big role in helping develop that?

RD: It plays a role mainly because when you do physics, you learn a lot about forces, direction of forces. A lot of mathematics helps solve some of these problems. The Ph.D. in physics is mainly learning how to solve problems. So it didn't directly...my physics wasn't directly applicable but what I learned during my Ph.D. had a lot to do with building the machine.

LK: I thought it was really interesting that both you and Doctor Douglas have these basic science backgrounds and were able to come up with the artificial mouth.

RD: The thing that I think was interesting is in my class, there were two Ph.D.s, myself and Larry Wolff, and both of us ended up here, and both of us are currently chairs of departments and doing research.

I've been pushing in recruiting dental students...that we try and recruit a couple people that have advanced degrees. I think there's a higher probability that they will stay in dental education. They talk about the shortage in rural practices, but there's also a real shortage in academics, having enough professors. The last time I heard, there were 300 open positions in dental schools.

LK: Wow! Is that a more recent phenomenon?

RD: It's kind of been there all the time. The main reason is just plain economics. If you go to a dental school, they pay you \$100,000 a year. If you go to private practice, you get \$250,000, \$300,000, \$500,000 depending. Now, with students coming out with huge debts, they can't afford to go into academics.

LK: Right.

When you began research on the artificial mouth, did you all have a lot of external funding, like from the NIH [National Institutes of Health] or the NSF [National Science Foundation]?

RD: Not a lot. When I came in, Bill had written a grant to develop an artificial mouth. The first attempt didn't get funded. I redesigned it and changed some of the aspects and, then, we resubmitted the grant and it got funded. So we had NIH funding to develop with the first grant.

LK: I saw that the artificial mouth is now in its fifth iteration?

RD: Yes.

LK: Each time are you just making improvements on it or are their specific things that you all are looking to change with each generation?

RD: Yes and yes.

LK: Okay. [chuckles]

RD: The ART 1 is the first one, the one we built with the NIH grant. We built that in conjunction with MTS Systems, which is in Eden Prairie [Minnesota]. Working with one of their engineers, I literally built the thing by hand.

LK: Oh, wow!

RD: In fact, the circuit boards, the breadboards, with all the electronics, are still in the machine.

Following that, MTS came out with what they called a Bionic System, so they kind of got a little bit into the health field. The Bionic System, they built was multi-station. So we had one built as a two-station machine. That became called ART 2 because it had two stations. ART 1 has one station.

There were people interested in the machine, but it's too expensive for a dental school to buy. So there were people buying MTS machines and they wanted to know if there was a way of modifying it. We worked on a method to use a Servomotor in conjunction with a hydraulic piston to see if we could make it a bolt-on kit. When we got it done, it was too complex to run, so we kind of abandoned that idea. But that was ART 3. It doesn't really exist.

ART 4... We took a toothbrush machine that had been developed by Maria Pintado...

LK: Yes, I was reading about that.

RD: That was a *very* sophisticated piece of equipment. The demand for using it has dropped off in recent years. A lot of it is very similar to the ART, so we thought, can we convert this over and make it into a chewing machine? Well, that had four stations, so we called it ART 4.

LK: Okay.

[laughter]

LK: It works nicely in sequence.

RD: Well, they do sort of. Not really, but it makes sense. The ones we have make sense. ART 3 didn't fit in and ART 5 won't fit in either.

LK: Okay.

RD: ART 4 works, and we have tested it. But, again, it's very complex, so we're in the process of looking to see if we can rework it to make it simple to use. All of chewing machines have been built more or less on the same principle of operation.

What ART does is reproduce the mechanics and the interaction between surfaces. It does it in a way that's physiologically meaningful. So when you chew, what happens is your brain tells your mouth to open, so your muscles open it. The way your muscles are working is they're moving your jaw from point A to point B. Now, they have a pattern that they follow. But then when you close and you hit the food, you bring in some other sensors around the teeth that are very sensitive to load. So, now, it's paying attention to the load while it's closing. Well, ART 1 does that exactly. It moves from A to B until it hits the surface and, then, it switches over to looking at the load. The shape of the load, the maximum height of the load, the time it's in contact, and the velocity of sliding across the surface to the best of our knowledge, we're reproducing what happens in the mouth. ART 1 is considered to be one of the most sophisticated methods for reproducing wear. We've calibrated it using clinical data to make sure that it's performing the way it should. So that's a very sophisticated type of machine.

LK: Yes.

Did you have a strong background in electronics?

RD: I have a background in electronics because it was part of my physics education. You learn how to do everything. When I was getting my Ph.D. here, I had to run a tandem accelerator, so you learned a lot about electronics. I also had a hobby that I liked to build electronic stuff. I built computers. I built a color organ for Christmas so our lights would go on and off to the music.

LK: Oh!

RD: So I had some background, limited background.

LK: Working with MTS Systems, did you and Doctor Douglas approach them or did they approach you in working together?

RD: You'd have to go way back. I think Bill contacted them. I think that's the way it worked. He would have told you directly.

LK: Yes. Actually, I think he did say that he contacted them. They had something that he wanted to use.

RD: When he came here, in his startup package... You need a load-testing machine. The typical ones in the dental schools are made by Instron. I can't remember if Bill knew about the MTS or if MTS contacted him and told him about their machine, which was much more flexible. So that's what he wanted to get. He ended up purchasing the MTS machine. Then, when we were developing ART 1, he contacted the person that he bought the machine from and that got us in touch with an engineer who thought it was a neat project. He came over, and we worked together on designing this thing and building the circuits. He'd design the circuit and, then, I would build it here. Then, I'd try and test it, and he'd come over to help. It was a good one-on-one relationship building that system.

LK: You mentioned that other dental schools were purchasing the system from MTS and, then, wanting to know how to change it so that they could use it as an artificial mouth? Is that what you were saying?

RD: No. MTS sold the ART 1, but it is very expensive. I think only one school actually bought the system. There were two components to it, actually. One was that it would produce wear and the second thing is you could use it to measure wear. They had developed this system but, like I said, it was \$120,000, and that was back in the 1980s, so it's an expensive piece of equipment.

Now, since then, people have developed all sorts of chewing machines, none of them as sophisticated as this. However, people have been buying MTS machines over Instron's, because it's a much more flexible machine and they cost about the same. The people that had MTS machines were wondering, could we develop a bolt-on that they could buy for \$25,000 or \$30,000 and, then, convert their machine? So that's what we tried to develop. Although, you could build it for that cost, it was too complex to operate because we couldn't get right into their electronics. You effectively had a second unit and you had to get these two units in sync. It was too complex to really make available, so that's why that was dropped.

LK: Did you all do any patenting on the artificial mouth?

RD: We didn't patent the artificial mouth.

LK: Okay.

I know that, eventually, 3M gets involved. Was that in testing materials for teeth?

RD: Before Bill Douglas came here, the school did not have a good relationship with 3M. I don't remember the history of it, but there was something that wasn't too good. When Bill came here, he started working with them, was actually a consultant for them and became very involved in their process. He got them to fund a lot of my work when I was here. He had me on as an RA [research assistant] type of position that was being funded by 3M. Then, he started doing a lot of contract work them. He became very intimately involved in 3M. That was a very strong relationship.

Subsequently, they started working on developing a center, a University industrial center, which would cut out a lot of the red tape and handle a lot of the projects. It would make a very easy working relationship between the two. The center was officially instituted in 1991.

LK: The MDRCBB [[Minnesota Dental Research Center for Biomaterials and Biomechanics]?

RD: Yes.

LK: A long acronym. [chuckles]

In terms of your other research, I saw that you had developed some software. Is it AnSur software?

RD: Yes.

LK: Could you talk a little bit about that?

RD: Well, yes. We had developed this artificial mouth. Okay. So we could produce wear. The problem at the time was how do you measure wear, because the wear areas are very small. At the time, the only thing that people could really use were called surface roughness meters. They were designed to measure the roughness of flat surfaces, but they wouldn't go down very far. In other words, they had a very short range. These wear facets would end up being 500 microns deep but surface roughness could only go, maybe, 100. They were limited.

Bill came up with the idea. A profiler kind of has the same motion as chewing plus stepping. He thought, why not convert the artificial mouth into a profiling system. MTS made a device called an extensometer. What an extensometer is it's a device that has a fixed arm and a movable arm. What you would do is clamp it onto say a rod you're going to stretch and it would measure how much the rod was stretched. Or you could put it the other way and measure if it's getting thinner. The device measured over a small range, but it measured very accurately. The thought was let's suppose we attach the rigid arm to the upper member of ART, which doesn't move. We've got the lower arm that goes back and forth, so let's put a stylus on it. You put a stylus on it, and this thing hangs down. As it's hanging there, it will send out a signal as to how far apart the two arms are. Now, if we bring our sample up, bring it up to touch the stylus and move the arm back up again, we'll have a value for the new arm position, so we know the distance between the two arms.

LK: Yes.

RD: Now, we can tell the machine to hold that distance. One of the control mechanisms on an MTS is to use this extensometer to control its movement. What you have is here

comes our tooth and here's our stylus. The stylus hits the tooth and because of the angle, the tooth tries to push the stylus up. Well, when the stylus moves up, the signal from the extensometer tells this MTS to move the tooth down. So the net effect is... As the stylus crawls over the tooth, what happens is the tooth goes up and down, not the stylus tip. The tip has to move a little bit, but because it's an extensometer, I know how much it moved. So I can take how much the stylus moves up and subtract it from how much the tooth moves down and I can end up getting a digital profile. The nice thing about this is we could measure five to six millimeters in height quite easily, which was a *huge* advantage over the other system. We had to convert the MTS from a chewing machine to a profiler. We'd produce our wear, tear it down, turn it into a profiler, profile the wear, and then tear it down, and go on and chew again, and again, and again. We used to do that.

Well, okay, we collect this data. Now, you've got to put it back into a form that you can see. That's when personal computers [PC] were just starting. This was back in 1983. We had an Apple II[e]. I knew how to program in FORTRAN, but the Apples weren't very good with FORTRAN. They did come out with Pascal programming software. Pascal was actually developed here at the University of Minnesota.

LK: Hmm. Is that the early Internet thing? No?

RD: No, no. This is a programming language.

LK: Okay.

RD: At the time, you had FORTRAN or machine language. Then, came along BASIC and Pascal programming languages. Then, they had different operating systems very early in the system.

I programmed in Pascal to take all these data points and put it back together and draw out an image. You could see the image of the surface. That doesn't help, because you just see the wear. So we wrote it so that you could measure the surface before and after wear and, then, designed an algorithm that put the two together. Then, you could see the wear and calculate the differences between the two surfaces and calculate the volume of material removed. That was the start of the AnSur.

LK: Okay. What a very creative way to calculate these things.

RD: It was fun at the time. Then, computers started advancing and we moved over to the IBM PCs when they out. We brought in other programmers, when the C programming language came out. They took over developing AnSur.

LK: When you were doing the early programming, were you working with computer engineers.

RD: I was a computer engineer.

LK: Okay.

RD: I had learned the Pascal. I'd run over to the computer help office and get help whenever I didn't quite understand. I was, essentially, the software engineer at that time...

LK: Wow.

RD: ...which, then, got turned over to other people as it became more sophisticated, and I started getting into other things.

LK: So, now, you have a lot of computer engineers working within the program who...

RD: Software.

LK: Okay.

I saw that you were involved with the creation of the Virtual Dental Patient.

RD: Yes, that's a take off of what we were doing with just individual wear, AnSur. My idea was that as long as we image one tooth, why can't we do them all? If we can do them all, why can't we put them together in the computer so you can bring the teeth together where they contact the way they do in the patient's mouth? I thought we ought to be able to move one relative to the other so we could see how the teeth interacted while they're in contact. If you got really sophisticated, you could reproduce all the motions and the hard and soft tissue anatomy around the teeth. The idea would be that you could store that and, then, have them come back in six months, a year later, five years later, whatever and do the same process. Then, we can compare two sequential images, and see what kind of changes have occurred over that time period. The whole idea was to do this for, literally, all the patients and have a database where you stored all of this stuff. Then, you could do data mining to look at, well, what is an average wear rate? What would you expect? How much should the gingiva drop down and how much should teeth move on the average? So this becomes like laboratory medicine.

LK: Yes.

RD: Dentists digitize the patient's mouth and send the images in and you calculate all the changes, compare them to what would be considered the normal. Then, you send the results back to the dentist and things that are outside the normal, you point them out. They can use this for making diagnoses and treatment planning. The advantage of this is that one could detect changes long before a dentist would. So if there's abnormal wear, it could pick it up before it really became a problem or if things were dropping unusually fast, you'd know this. It would send you in directions to look for things that would be causing the problem.

LK: Okay.

In creating the baseline to measure wear, did you have to have the same patients come in six years later or did you base average wear on age or...?

RD: To get the actual measurements, you need the same person.

LK: Okay. Was it difficult to get the same people to come back?

RD: No. The test that I had run... I can't remember the study. We had about fifteen patients and had them come back in. It wasn't difficult. It's not a hard job for them. The biggest issue was the fact that you had to take a lot of records. You had to impression the upper arch and the lower arch. To do it without any special equipment, you needed to take about five bite records. This was about an hour chair time for a dentist. That's a lot of time. What we needed to speed it up was digital scanning intraoral, which is now just coming in to play. Now, you could digitize the arch in five minutes, the upper, and five minutes for the lower. The nice thing is you have them bite together and move. So if they move this way, I can capture it. So I can capture the information in a couple of minutes. So, now, you've taken an hour's time down to fifteen minutes, and you've got all the information you need for the diagnosis. We expect this to eventually become the way things are going to be done. There will be a digital image of the mouth.

LK: As part of the routine examinations?

RD: Right, it will be part of a routine exam. We did get a patent for the Virtual Dental Patient, only it's not the patent I wanted.

LK: Oh.

RD: Well, it's a long story.

LK: Okay. [chuckles]

RD: Just to make it short... It took too long to get the patent and when they finally did bring the patent through... Things we wanted in the patent at the time we put it in, were unique. By the time the patent was reviewed, they were no longer considered unique. So they claimed we couldn't get a patent on these things. What I wanted to patent right off the bat—this was back when I got the grant; in 1992 and 1993—was the concept of taking before images and after images aligning those and looking at the changes, and storing that to develop a database. At the time, that was not being done, and nobody had done it. I wanted the patent on that. But we couldn't get it through. If we did, I would now be a multimillionaire.

LK: Oh, wow.

RD: They're doing it for everything now.

LK: Did it not go through because the infrastructure wasn't in place at that time at the University? Were you working with 3M on this?

RD: No, this was totally absent from 3M. We were going through the University patent office. It didn't get handled right, I don't think. The patent got sent in without me even having read the final draft.

LK: Oh, wow.

RD: The patent didn't make sense. There were just a lot of things...inexperience on my part and some other issues, so it didn't work out. It's too bad. It's okay. I've never looked to get rich off any of this stuff anyway. In fact, Douglas gets mad at me because I just give stuff away.

LK: Ohhh.

RD: I'm not so interested in patenting something as I am in just getting it out there to see what it does.

LK: Yes.

I saw that you've done a lot of work with robotics and applications to simulation of an artificial oral environment. I think that's a lot of what we've been talking about, but is there anything specific in your research that I've missed that you want to bring up?

RD: The thing I'm working on right now is ART 5, which we didn't get to.

LK: Okay.

RD: ART 5 is being designed to actually chew food...

LK: Oh, wow!

RD: ...and chew food as closely as possible to the way a human does and react to the food the way a human does, within limits. It's all from a mechanical point of view. We worked with General Mills for a while. When they have new products, they send them out to taste panels. The test panels are supposed to be able to tell changes in texture and define it for them. It's well known that no matter how hard you work to calibrate these panels, there's a lot of variation, because people just interpret things differently. So what they were hoping to do is...can we come up with a mechanical system that will measure these texture parameters of food consistently that correlate with these test panels? They'll never get rid of the test panels, but to go to a test panel is expensive. If you can take different formulations and run them through a machine and the machine says, "Oh, these are going to not be liked by the panel," and "These have a good chance of being

liked,” you can run through a lot more stuff. That was kind of the idea behind trying to develop this new artificial mouth.

LK: Hmmm.

RD: What I’ve done is a lot of reading to see just how we chew. Then, could I design a system that would do the same thing? What I’m interested in is, what happens when you bite through something? I have to state it a little differently, because when you bite something like an apple, it’s determining how much you’re taking into your mouth. When you actually chew food, what do you do? What is it that occurs at the time? Then, if we can develop a system that chews the same way a human does, can we now make measurements that can be translated into texture measurements that they get from the panel?

LK: That’s really interesting. I feel like that brings up questions about people’s texture sensitivities, what foods they like. I don’t know if you guys are going in this direction, but what does it mean when you eat a particular food, not just the chewing motion but what chemical reactions are going on and how does that, maybe, affect the wear?

RD: There’s a lot of stuff along that line.

LK: Yes.

RD: There’s a lot of things where they analyze when you bite into something. They’ll analyze the juice to find what’s coming out, all sorts of different types of tests. If you make it one very specific test, you can probably design a machine to agree with one test panel. It may not agree with the next one. The chances of success are very low. There are a couple of the texture parameters associated with the mechanics of breaking food down, and we’re kind of hoping we can come close on those.

But I have another interest in it. Being a prosthodontist, I’ve always been interested in occlusion, the way teeth come together. I thoroughly believe that dentistry is getting a short stick here, because there’s a growing body of evidence that depending on how good your chewing function is has an effect on how good your systemic health is.

LK: Mmmm.

RD: Now, the argument is the chicken and egg type of thing. Is your chewing function bad because you have a poor diet or do you have a poor diet because your chewing function is bad. I think it’s fairly clear that if your chewing function is bad, you’re going to alter your diet. You don’t alter your diet and then make your chewing function bad. That’s basically a genetic decision about how your teeth are going to come together. There’s an environmental component, obviously, because if you don’t take care of your teeth, you lose them and, obviously, your function gets worse. My interest is, is there an optimal design for teeth that will improve chewing function? It becomes quite important now because of implants. For most people, if you keep more or less a full set of teeth,

it's good enough. You're going to be okay. You can eat the food you want to eat and you're not going to alter your diet because of your chewing function. Where it becomes important are people that have these partial dentures or have full dentures. If they're not working absolutely properly, then people change their diet, but with implant supported dentures and implant supported partials, it's now almost like having teeth.

LK: Yes.

RD: So there's the possibility of improving the function, but because they're not live teeth... Your teeth move. They're supported in a periodontal ligament and it allows them to move slightly so it will correct for errors. Denture teeth won't. What's there is there. It's stiff. So the question is, is there an optimum design of how to make rigidly implanted reconstructions come together that makes them more efficient than, say, if we just put in the normal denture teeth? So that, I think, is an interesting topic to look at.

LK: Yes.

RD: I have that interest and that's another reason for making this artificial mouth. The motions are very close to how one actually chews. What I can do is as you chew through food, we can now start measuring the efficiency using any standard technique. From that, we can modify occlusions and see if there's a better way. Is there one that requires less effort but produces the same results so that people now don't have to alter their diet? That's one of the big aspects that I'm into.

There's also a subtle little thing... When you chew food, what we know... Well, we don't know for sure. They frown on doing tests on humans that they've done on animals. The general idea is, you see something, you've got a past history with that food. If you pick up a banana, you kind of know what it's going to be like. You know what it's going to taste like, or you think you know. You've got a history that you've built up with it. Now, you bite into it, and you bite off a chunk. Now, you've got a little more information. You think you know what it is. You have what they call a central pattern generator that sits in your mid brain back here.

LK: Hmmm.

RD: It says, "I know what this food is. I'm preloaded. Here's the way to chew it." And away I go.

LK: Oh, wow.

RD: Now, that's very nice, except sometimes you're wrong. There are sensors in your muscles that tell how fast the jaw is moving and where it is and there are sensors around the teeth that say what kind of forces are being applied and in what direction they're being applied. When you bite through the food, you have an expectation. We know the first time you bite through something, it's slower than the rest of the time when you bite through. Subconsciously you are telling yourself I'm pretty confident this is what's

going to happen, but I'm not sure because I remember in the past biting through something and hitting a rock and having a response.

LK: Yes.

RD: So, you want to make sure. As you first contact the food, we know that the sensors around the teeth come in and they can modify this chewing pattern. They can change the velocity and how much force you're going to put on, but what's not known is how do they do that? What mostly likely what doesn't happen is subconsciously you think, I know this historically and I'm just going to slow down and come to it at a little slower rate than normal and if everything is okay, then I'll change my next pattern. It's preloaded and you go through the food. That's one way that we could be doing it. The second way is, could be at contact of the food. Subconsciously I measure its stiffness as I'm going through it. Just how stiff is it? Does it meet my expectations? Am I going to get to the point I need to get to in the amount of time required? If not, I adjust the force and, then, continue on. It is a onetime adjustment for each chewing cycle. That's the second way. The third way is I don't trust anything...

LK: [chuckles]

RD: ...so I'm going to modify the force all the way through the food until I get to where I need to be. There are three possible ways to control chewing. With the artificial mouth that I have in here, I'm going to test those three methods.

LK: Oh, wow.

RD: I do have data from people biting through food. So you take the same foods and use these three different methods of control and see which one comes the closest to reproducing the actual forces. That's the second thing I kind of hope to accomplish with this.

LK: That's really, really interesting.

RD: It is interesting looking at chewing. You have a rhythm to your chewing and that usually doesn't get distorted. If you look at people's chewing patterns, it's all over the place when they chew. It's crazy, but the cycle time remains relatively constant.

LK: Do people have individual chewing patterns?

RD: Well, in general, there is a kind of an average chewing pattern, but there's a lot of variability. If you go from person to person, you'll see a similar path, but one may open wider. They may go further laterally, and they may take longer, so there are variations in there. But the variabilities for a lot of things are greater within a person than they are between people.

LK: Do you do much collaboration with, say, the physiologists or neurologists in studying these connections?

RD: Not like I should.

LK: Okay. [laughter]

RD: I generally work on my own. If I need expert advice, I will get it if I can find somebody of interest. It's always better working with multiple people. I haven't done it a lot.

I've done some when we're looking at developing new equipment. One thing I would like to develop is a very inexpensive easy-to-use jaw tracking system. There was a grad student here who was interested in doing that at the time, so we were working with Engineering, but the student graduated, and they lost interest. There are systems out there. The medical devices center isn't all that interested in these dental devices. They need stuff they're going to make money off of. The devices out there are too expensive so dentists won't buy them. The cost of equipment for a tracking device has gotten down to where I think one could build one very inexpensively. I think there's a design where one could hook it up and calibrate it and have the jaw tracking done in a matter of a few minutes. Then, you could track the way people are generally chewing and see if there is any problem with the way they chew. You could record it, and it would go with my jaw tracking...

LK: Yes.

RD: ...because you could use that to pick up any joint problems. If you get problems in your joint, your pattern of chewing is going to change. There are reasons for having a jaw tracking system. It would be something I'd have to probably do on my own as a hobby, because of the cost of development versus the profit for marketing it. There aren't that many dentists out there. A practice might buy one. Are they going to sell 50,000 units worldwide? It's hardly worth it. The profit isn't there. But I like playing around with that stuff.

LK: Yes.

Moving on a little bit... I know when you said after you had graduated from the Dental School, you were looking to join a practice. Have you specifically been focusing on research since then or have you had any kind of a clinical practice?

RD: I practiced in a faculty practice for about fifteen years. When I got the NIH grant to develop the virtual dental patient, at that time I was chair of a department and doing the grant work. I didn't have enough time to do the practice. My practice, I thought, was quite stressful for two reasons. One, the patients I got were extremely difficult and the second thing is, I'm a perfectionist by habit, and you don't want to be a perfectionist when you're dentist. It's okay if you're doing it as a hobby.

LK: Hmm.

RD: Nothing in dentistry comes out perfect. There are too many things that can go wrong and you have to compromise. You have to understand this is the best that can be done under these circumstances. Well, nahhh, it could always be better. You can't practice profitably if you keep saying, "I can do better." And patients don't like you to do that.

[laughter]

RD: They don't like to be in the dentist's office in the first place. I thought it's not a big deal. I decided, at that point, to go all into research.

LK: When you say challenging, do you mean that you were getting the more difficult cases?

RD: They were very difficult.

LK: Okay.

RD: Difficult either because the patients were very difficult or difficult because of complexity, in either case there's stress. The one patient I always remember is a woman that was referred to me for dentures, but she had no short-term memory.

LK: Oh, no.

RD: She came down because her dentures wouldn't work. She didn't like them. They didn't look right. There were obvious things wrong. I told her, "Okay. There are things we do. We can make this for you." Every time she came back, it was for the same thing and she didn't remember what was said at the previous visit. I told her, "Give me a picture. We'll adjust the dentures to look like they would fit for your age, for what your teeth looked like before." So I made a try-in wax denture. I had them all done, but she wanted me to modify them. "Oh, it doesn't feel like my old denture." "Of course, it doesn't feel like your old dentures because your old denture didn't work, and we have to make changes." "It doesn't look right. It doesn't look like my old denture." It just got to the point where I refunded her money and said, "I can't do it for you. It's just too hard." Her husband was there. He was empathizing.

[chuckles]

RD: He saw it. He was sitting there trying to tell her, "No." Then, the sad thing is six months later, I got a call, and she wanted to come down again and do it again. Nobody could make dentures for her. It's a sad case.

LK: Right.

Once you were hired onto the faculty, I assume that you started teaching within the Dental School, as well?

RD: I did some teaching, not a lot when I initially came in, because I came in more as a research person. I did teach in the pre-clinic courses and in the clinics. All that teaching is normal. I did teach a class in... We had a literature seminar series, which was to teach students how to read dental literature.

LK: Oh.

RD: It was kind of the forerunner of evidence-based dentistry, teaching them how to critique papers, how to decide what was good and what was bad, and how to look at it. So I did that for quite a while. Then, when evidence-based dentistry did come in, I switched over to teach evidence-based dentistry. I did that one semester and the timing was wrong, because they weren't quite into clinic, at the time, so it was premature. We wanted to switch, make a change, move it to a different time...we actually were on quarters at that time ...that would be more appropriate. Well, then, we had to skip a year and in the process, they switched academic directors, and things got all screwed up, and it got dropped as a course.

LK: The evidence...?

RD: Evidence-based type of course. They, now, have it back in, ten years later.

LK: What was the difference between the initial course you were teaching, the literature review, and, then, the evidence-based dentistry?

RD: The evidence-based dentistry was more organized. What we did in the review of current literature is we would pull out papers based on the materials that they were working with. It was in association with the dental materials class. They would read the papers. It was a small group. We would come in, and we would go through critiquing things on the papers. In other words, simple things like how many patients were there? Was it a good representation of a population? Looking for things like, was there a bias in paper? Was the product being tested sponsored by a manufacturer? Did it come out better? We would try to find two papers on the same subject with different outcomes. Why are they different? Which one would you believe? The reason they switched over to evidence-based dentistry is because it was a much more formal process on how to do it. It had a nice structure. Even though it accomplished the same thing, it did it in a method that I think was better for students to understand. They'd put a lot of thought into how to go about doing this.

LK: Do you feel like the style of teaching at the Dental School has changed over the years in terms of becoming more student-friendly?

RD: Uhhh... Okay.

LK: [chuckles]

RD: You're on a touchy subject here.

LK: Okay.

RD: First of all, has it become more student-friendly? Yes. There's a concerted effort to get students involved. Has the education improved? I'd say mixed. What I see happening here is... We're always talking about the millennium generation. They have a different way of learning. They're much more attuned to the Internet, getting data online, going on an iPad, doing that kind of stuff, which is true. So the thought is then that, well, we need to modify our teaching styles to go along with this new way of learning. To some extent, I think that's true. But I think you start losing something. What I see in the millennium generation is their attitude is tell me what I need to know, and I'll learn it. Dentistry isn't that. Yes, there's basic knowledge you have to have, but dentistry is, given a series of information, draw a conclusion. A person is coming in. They're going to present with a bunch of outcomes that they have and from those, you have to determine why they're in that situation, and what you can do to prevent it in the future, and how to correct what is currently wrong to get them back into a healthy shape. That's not, tell me what I need to know, and I'll learn it.

LK: Right.

RD: One is rote memorization and the other one is analytical thinking.

CODA [Commission of Dental Accreditation], which is what oversees the dental schools, is now coming down and pushing evidence-based and critical thinking.

What I think is funny about it is one of the big complaints we get from students is that you had material on your tests that wasn't covered in lectures. I would say, "So what?" Coming from physics, it's all critical thinking. You memorize these. You memorize this. But here's the problem you've got to solve with these tools. That's what people would put on their tests. "Okay, you've got the basic knowledge. Now, here's something you have to solve." "Well, you didn't cover it in class; therefore, you shouldn't have it on your test." That's called critical thinking.

It will be quite interesting... What has happened over the years and not just in dental schools, in education in general, is you get an A if you're able to reproduce what I gave you in the notes and lecture. That's not the way it should be... That should be a C. You've learned the basic tools you need. The B's and the A's are what determine who can apply that knowledge and how well they can apply that knowledge.

LK: Right.

RD: You get a D if you can't even learn the basics. That's the way it needs to go. I know the University has talked about it, but it gets tied up in committees, and it takes forever to get anything out of them. So, hopefully, with the critical thinking type of stuff, we will get back more into that way of thinking. It's very hard to get teachers to give C's when they've been giving A's.

LK: I brought up the student friendly teaching because I had seen—I'm trying to see if I have the year on this and you might have been here when this happened—there was a protest of one of the student exams for the dental students. It was in the 1970s, I thought. Students were protesting exams. There were problems with behavior and appearance. Part of that, I guess, is that 1970s activism environment. I didn't know if you had any recollection of that kind of attitude.

RD: There have been student protests against specific exams. I can't remember all the details, especially from the 1970s. I don't know that I would remember anything. There are times when students think things are unfair or professors are too hard or their tests are ridiculous. Generally, they're not. The biggest problem came when we had to present a syllabus. The students interpret the syllabus as containing everything they need to know. Again, all it contains is the minimum information. So when you get a lot of questions that are what I would call critical thinking, they don't like it, and they would protest against it. That occurred rarely. Sometimes, there were protests when they thought a group got the test in advance.

LK: Ohhh.

RD: They'd think those scores should be thrown out or they should redo it, something along that line. But I don't remember any big student uprising against exams. That doesn't mean it didn't happen. I just don't remember them.

LK: Okay.

You had mentioned you were chair of a department. I didn't know what department that was.

RD: I was chair of Restorative Sciences from 1992 to 1997. Nineteen ninety-seven is when I got the virtual dental patient grant. So that's when I started shutting down my clinical practice and moved over more into the research. That was a big project and was going to take a lot of effort to get it done.

I've been interim chair of Restorative Sciences since about 2003.

LK: Ohhh, and you still are?

RD: I still am. [chuckles]

LK: Wow.

RD: I'm not the only one.

LK: [laughter] Are those those empty positions you were talking about because of the lack of...?

RD: No. No, no. That goes back to Dean [Patrick] Lloyd. I was actually put in as chair by Bill [William F.] Liljemark when he was the dean, but he was interim dean, so technically he just said, "I'm going to appoint you chair, and it's up to the new dean to decide what he wants to do when he comes in."

LK: When was he interim dean?

RD: Bill Liljemark?

LK: Yes.

RD: I think he was interim for about a year and a half. It was in 2003, April 2004 when Dean Lloyd was selected.

LK: I'm interviewing Doctor Liljemark on Thursday and I hadn't run across that. That's good to know. Thank you.

You had commented on the retrenchment in the 1990s. Do you think you became more aware of that because you were department chair?

RD: I became aware of it because at every Council of Chairs it was: "They're retrenching us. We have to make modifications."

LK: Did that involve like cutting down staff?

RD: Cutting everything.

LK: Okay.

RD: We tried to cut costs wherever we could. It became quite difficult.

We used to have department meetings that would occur over in the Union. They had a Thursday night buffet, which was fairly reasonable. So we would go over there. We'd have a dinner, have a short meeting, and we would go through issues. It was a good social gathering. It kept morale very high. People enjoyed going to those meetings. You got things done. But, then, when there was no money, we couldn't afford to do that anymore. We started cutting things like that.

We used to have retreats, a school-wide retreat where they'd go out to the [Minnesota Landscape] Arboretum for a day. Then, we would review stuff. It was usually right at

the start of the fall quarter. You'd review what you were going to be going through for the year. They were very productive, gets everybody together, you know. It was nice, but they had to go.

Travel had to be cut down. When people retired or left, positions weren't filled. People had to pick up more and more work. They started increasing the class size because you needed the tuition income.

LK: Hmm.

RD: But, you didn't hire faculty. So more people had to cover more stuff. You had to work more. Pay wasn't going up, all sorts of things. That was hard on the morale. That went on for about eleven years, I think, that there were retrenchments.

LK: Wow. Was that specific in the Dental School or University wide?

RD: That's University wide.

LK: Can you identify any of the factors that caused that kind of retrenchment maybe specifically for the Dental School or is it just because it...

RD: It wasn't just the Dental School. What do you look at? What happened in the 1990s? The IT [information technology] bubble burst. The stock market crashed. Income. State budgets. People aren't working, laid off. The state started cutting the support for the University. It's extremely low now compared to what it used to be. That's nice that they cut your dollars, but you don't lay off the faculty or staff. You still have to run the University. You still have salary increases, so your costs keep going up. That's one of the things why tuition has gone up. There are a lot of factors, but the bottom line is as the state dropped support, money had to be made up elsewhere. You don't make money on grants. Even though they go out and get as much grant money as they can, you actually lose money. So they don't pay. You have to rely on where you can get money. You have to get donations from people. That's hard to do.

LK: Have you done any lobbying to the State Legislature at all?

RD: Not really. When I was chair the first time, we used to meet with state legislators. We had a dinner, and we would meet with them and discuss. But, then, the University kind of moved away from that. They got to a point where they knew how to lobby. The Dental School got this building because they went and lobbied the Legislature for it. The University was ticked.

LK: Hmm.

RD: So they decided that they didn't want that. The University was going to do the lobbying—big mistake on their part. They're not very good at it. When you have people that are passionate about what they want, they lobby very well. When you've got

somebody going over there with a whole bunch of stuff they're going to lobby for, and they don't really know the details and they're not passionate about it...

LK: It seems like you can also use personal relationships with the people in the particular programs and...

RD: You know who they are. I try to avoid the legislature. I don't have much of an opinion of any of them. I feel it's best because of my attitude toward them that I don't meet with them. I don't know that I would be a positive influence.

[laughter]

LK: I'm moving a little bit into the broader picture now. Do you have any comment on relations between Dentistry or dental students and the Dental Hygiene and, when it was here, Dental Assisting? What was the power dynamic like or if there were every any problems between the different organizations or anything like that? I know Doctor Douglas had recruited Maria Pintado from Dental Assisting. It seems like there was a strong relationship there.

RD: Maria, yes, she was in... You'd have to ask her, because she was in a lot of stuff. It was kind of a twisted way in the way she ended up with Doctor Douglas. She was in Operative Dentistry at the time.

LK: Okay.

RD: She was an advanced dental hygienist working in Dental Hygiene and, then, she was teaching and took a lot of the dental courses, actually. She was teaching in classes. She was a real good friend with [Doctor Noble]... The name will come to me. [pause] He was the oral anatomist. I have a problem with names.

LK: That's okay.

RD: I go blank whenever I try to think of a name.

When Dental Materials separated from Operative, he [Doctor Douglas] took Maria with him. They've been together like that all the time.

The relationships between dental students and hygienists and the assistants were always very good. Dentists were always looking for the hygiene students. They had lots of parties together. The politics between the schools, I don't know. I don't think there's ever really been a problem with Hygiene and Dentistry getting along. There are some issues that have always come up sometimes with scheduling and some turf issues and stuff. But I don't think any of those have ever been real serious.

I don't know what happened with the [Dental] Assisting part of it. That was dropped. The reason being it's too expensive to go to assisting school here when you can go for a fraction of the cost elsewhere.

LK: Right.

RD: The Hygiene, it's still very expensive to go here as opposed to outside. That's kind of why they pushed the Hygiene more into a bachelor's program with the idea of getting into teaching as opposed to just training hygienists.

As far as I know, they got along okay. They seem to get along now without any real problems.

LK: This was before you came here, the organization of the Academic Health Center, and as you came here, moving into this building. I didn't know if you could comment at all on the health sciences concept of a team teaching approach that was supposed to, I guess, flourish under this new umbrella of the AHC. Do you have any comments on that?

RD: We had more interrelationships when I was a student than they do now.

LK: Oh. Hmm.

RD: We took histology and gross anatomy with the Medical School. We had classes with the Hygiene students. There was quite a bit of intermingling of the two, at least during the first year. Now, they have this special class when they all get together. I don't remember if it's Health 1 or something like that. It's an ethics class because they all need to have the same ethics class. I'm not sure what they're hoping to accomplish. Depending on how you're looking at dentistry in the future, dentists may become more of a primary part of medicine, because people go to the dentist more than they go to a doctor.

LK: Right.

RD: So dentists see them more often. There are certain things which they think maybe should be done by dentists, in which case they need a better or broader background in general health than they're getting right now. So there might be a good reason for making the first year or so medical and dental together, so they can do that.

One of the concepts being initiated essentially here is the dental therapists.

LK: Yes, I've heard a little bit about that.

RD: The idea behind the dental therapists is, they would do all the effective drilling, filling that a dentist would do, which leaves the dentist mainly to do the diagnosis and the

treatment planning. If you do that, and they're not doing the fillings, there's time for them to do some of the systemic health type testing.

LK: Yes.

RD: If you're going to go that way, then there's a good reason for bringing them together. There's always a good reason for having the dentist, the hygienists, dental therapists, and assistants working together, because they will. So that makes sense. Is it important that we work with veterinarians? I don't know. Veterinary school and dental school are very similar. The only difference is we deal with humans, and they deal with animals, but the clinic structure and everything else is set up very similarly. There are good reasons that you might want to be associated with the pharmacists. You might want to be associated with nurses, because you may end up working with a nurse or a nurse practitioner. I'm not sure where it's ultimately going to go. I don't know that anybody has sat down to figure out, well, where are we going to go? Given that, this is what we should be training them to do. Right now I get the impression it's just, let's put them together in a class so they all get to know each other. Ethics was one; that makes sense.

LK: Did you find it helpful as a student to take classes with medical students?

RD: Uhhh... I wouldn't say helpful because the classes were huge.

[laughter]

LK: That's true.

RD: Two hundred and fifty medical students and 150 dental students.

LK: Wow.

RD: We all had the lecture portion together, but the gross anatomy labs were different, because they had to concentrate on the whole body, so theirs ran for two or three quarters. Ours concentrated mainly on head and neck. The lab portion was structured based on where you were, but the general classes were together. Histology was kind of similar.

LK: Did they ultimately separate because of the class size?

RD: Not because of the class size. I think they got separated because Dentistry wanted to concentrate more on specific things that were more important to dentists and less on stuff that was important to medicine, which also makes sense.

LK: Right.

RD: The thing that's hard to figure out is, how do you want to run these things?

LK: I don't know how much interaction you might have had with these different figures. I'm looking a little bit at the vice presidents for the health sciences. I don't know if you had any communication with Lyle French at all. He would have been here earlier in your...

RD: I had none with French.

LK: Okay. Did you have any with others like...? [Robert E.] Anderson was one or [Neal] Vanselow. Cherie [R.] Perlmutter.

RD: No. I knew them. They'd say, "Hi." That was about it. At the time, I was not on anything that would bring me into direct one-on-one contact.

LK: I know that Erwin Schaffer was dean when you came in. Did you have any communication with him when you came onto the faculty, because he stayed on faculty for a few years after he stepped down?

RD: Not a lot. No. Who came after Schaffer?

LK: That was [Richard C.] Oliver.

RD: Oliver, I had some with him—still do. He still comes back every once in a while.

LK: He's in Arizona now.

RD: Yes. He plays golf.

LK: Okay. [chuckles]

RD: He comes here every once in a while.

LK: Do you know if he has any visits scheduled?

RD: No, I don't. He just pops up every once in a while.

LK: Talking about Richard Oliver as dean, do you have any comments on his leadership style or changes he made during his tenure as dean?

RD: He was there when I got hired. He hired me. I always thought I had more interaction after he was dean. I thought he had a fairly decent style. He was also the last dean of money, so it was easier for them to get along doing stuff. They didn't make a lot of enemies. He was a good supporter of research.

LK: [Richard] Elzay came in when there were a lot of money problems. He was the dean who, I guess, oversaw the potential closing and eventual saving of the Dental

School. Do you have any comments on his leadership style or how he dealt with the incredible retrenchments that he faced?

RD: Elzay was fine. He did okay, but he did things I didn't like. One of the things that always bothered me was... We had a group called the Council of Chairs. There were four chairs, and they were actually the only voting members on the Council of Chairs, but you also had the three associate deans, one for education, one for clinics, and, then, one for research. What I didn't like is Elzay would meet with his associate deans and they would come to the conclusions of what they wanted to do, which were then presented to the Council of Chairs.

LK: Ohhh.

RD: We were expected to rubber stamp them. A couple of times, I couldn't do that, and I thought he was going to blow up. He's staring at me saying, literally, "We have consensus here." I'd keep telling him, "I can't support that from my department's point of view." I didn't like that. I didn't like that these things weren't brought for discussion. They were brought as, effectively, edicts of what we were going to do. Otherwise, I think he was fine. He was in a very difficult situation where they were continuously retrenching. I think he got tired of it. He was in good favor with the AHC at the time, even to the point where I think he was...I can't remember if he was an interim position while they were searching. He was in a high position over there so he was doing very well.

The only real critique I have of anything he did... We used to have what we called session equivalents. What session equivalents did is they effectively told the students, "You've got to be in that chair with a patient every appointment you have available that you can get." You had to accumulate so many of these session equivalents in order to graduate. What it did is it kept students in the clinic. Our clinics ran about ninety-five percent full all the time.

LK: Wow.

RD: He came in one day, and because the students didn't like session equivalent... He listened to the students too much. He came in and said, "The session equivalents are gone."

LK: Oh, wow.

RD: We had to get rid of them. Well, we lost control of everything when that happened. If you wanted to get rid of them, fine, but you had to put something in place so that we could keep control. We lost control and ever since that time, our occupancy has been down at sixty, sixty-five percent, because students don't have to be in the clinic. They're supposed to be, and they're supposed to be there with a patient, and they're supposed to be working, but there's no requirement for graduation that depends on it.

LK: Did the clinics generate revenue for the school?

RD: Oh, it generated a lot of revenue, but it costs. In other words, the clinics are expensive to run. They don't support themselves because of the cost of everything involved. The way we run them now, and the way most dental schools run, they can't make a profit. They bring in a lot of income but it costs more than it brings in.

LK: I see.

I don't know if you have any comments on, I guess, strategic planning for the Dental School. This comes with the potential for the Dental School closure and [President] Ken Keller's Commitment to Focus plan. I didn't know if you had any comment on those changes that were going on in the University at large and, then, how they trickled down to the Dental School in the late 1980s.

RD: Uhhh...yes.

[laughter]

RD: It's one of my fun stories.

LK: Okay.

RD: When they were going to close the Dental School, it happened to be the time I was going to go up for promotion and tenure.

LK: Ohhh.

RD: I submitted all my documents and everything. That year was the year they were talking of closing the Dental School. There were three schools [within the AHC, the Dental School and the College of Veterinary Medicine] I think they were going to close. Everything was put forward by the school. It got over to Central Administration. Anyway, I got a letter saying that at this time I could not be promoted. The reason is that I have not been on tenure track long enough. So I kept that letter...

LK: Yes.

RD: ...along with a statement out of the tenure code stating that one cannot be denied tenure because of time on tenure track.

LK: Oh.

RD: So I thought I'm going to keep this because depending on what happens, if I have to I will end up suing the University. I would win to get my tenure, because the letter said everything was fine but you haven't been on long enough. It turns out they didn't close the Dental School, but they did close a couple of the other schools and they did get sued.

I'm assuming those people were in a very similar situation that I was in and they [the University] did lose.

LK: Hmmm.

RD: So I went up the next year and everything was fine. But I keep that. I still have those two letters. I think it's funny. I can't believe they actually did that; although, my opinion of Administration in general is such that it would make sense. They don't know what their own rules are. For somebody to write specifically that line which was exactly opposite of what the rules say you can do, is incredible. Yes, that was an interesting time.

LK: Yes.

Did you do any of the work to try and save the school? I know there were like community education things going on, letters being sent out to people.

RD: I wasn't directly involved in any of that, but we had an all-school meeting, which was probably attended by 110 percent of the people in the school. [chuckles]

LK: Wow.

RD: They were all concerned about the closing of the school. Some of the critiques that were made, I think were legitimate, which is why we did a total restructuring, did some downsizing. One of the big changes was going from thirteen departments to four. It did make the school more efficient in the way it ran. I don't know if it saved anything cost wise. But it was a major change, major things going through. I participated in that, but, then, so did everybody else. I was still one of the lowly faculty members on tenure track.

LK: [chuckles]

RD: My concern was getting the research done and getting promoted.

LK: Did you sense any change overall in the school's morale? After the threat of closure kind of went away, did it take much to kind of bounce back from that or these big changes kind of helped, as you said, make the school more efficient?

RD: Again, I wasn't at a level where I would get right into the nitty gritty. I think there was a big relief when they decided they weren't going to close the Dental School; although, I don't think anybody was really worried about it, because we're a regional school. It affected seven different states to do that. It was a bad statement for them to do without thinking. You were also closing one of the top dental schools, you know, so it didn't make a lot of sense. I don't think people believed that it would actually happen, but there was enough concern that people did agree with making the changes. I don't think there were any major objections. I don't remember a big change in morale one way or the other.

LK: Okay.

RD: The morale started going down with the retrenchments. That's when things started getting bad.

LK: In the 1990s?

RD: Yes.

LK: I don't have a list of the committees that you were a part of. I didn't know if there were any specific committees that you wanted to mention in terms of maybe things that you accomplished through them or that ended up meaning a lot to the Dental School or whatnot.

RD: The only committee that I really have been involved in is what's called the... I have to look at it. This is my going blank. The Institutional Effectiveness Committee. That committee was set up after not our last accreditation but the one prior to that, because we could not document any continuous organized review of the school structure and improvements. So that's what that committee was set up for, to review all the outcomes from the school every year based on objectives and measures that we set. The Committee reviews that we were meeting our objectives, and if we're not why, and if the why is because the objectives are wrong or we can't collect the data, then we make the modifications. If there's a severe structural problem that needs to be changed, then we made recommendations to the dean. I chaired that committee almost from its inception. I didn't do it the very first year, because that was done, more or less, by Judith [A.] Buchanan and Gary Anderson.

At the same time, I ran the Strategic Planning Committee, which, in many ways, I thought was one of the best strategic planning sessions ever done at the school.

LK: Hmmm.

RD: It ran into problems because it was being done right at the same time accreditation came in. So we couldn't get everything done that we needed to get done. Instead of being a process that should have been completed in three months, it actually dragged out for about four years.

LK: Oh, wow!

RD: We ran into the accreditation, which then, more or less, stopped what we were doing.

The Institutional Effectiveness Committee turned out to be the Strategic Planning Committee with some modifications. The one kind of morphed into the other. Now, I

just stepped down, hopefully, from chair of the IEC. Nobody wants to take it over, because... Do you see that line of books?

LK: [chuckles] Is that all for the...?

RD: Those are reports for each year. Nobody wants to do that.

LK: When did the committee start? You said you were chair almost from the inception.

RD: Yes. Two thousand and six I think is the first one that was done. That one was more or less done by Judith Buchanan. Then, I took over after that. It's quite a labor-intensive committee.

LK: I didn't know if you had any comment on cultural changes at the Dental School, what has gone through in the 1970s and, then, into the 1980s with efforts to admit more minority students or admit more women.

RD: I don't remember there being much effort from the 1970s up until probably in the last ten years.

Since Naty [Lopez] has come here, there's been a huge push for getting more minorities in the school. When Judith came, they started the PASS [The University of Minnesota School of Dentistry Program for Advanced Standing Students] program that's run by her husband, Peter Berthold. That went a long way to really change diversity here. Most of those were third world trained dentists brought in.

LK: Okay.

RD: I'm not a fan of diversity. I'm not against it, but my opinion is we need to get the best people in here for what we think make the best dentists, and I don't care who it is. I don't care about their ethnic background. I don't care about religion, their race, sex, whatever. It's unimportant. It's to get the best people in. I understand that we've got minority communities. They would feel better going to somebody of their own race and maybe we need to deal with that. To me, that's fine. That's a lot like we've got this thing with rural dentistry where they can't get people to go into rural communities. Maybe the reason is that we're not bringing in the right people to go into rural dentistry. I would rather decide who we need to be putting out into the community and, then, recruiting those people who would be the best people to go out into that community. We've got different communities.

LK: Yes.

RD: It's one reason diversity has taken on such a big term. All diversity is not good.

LK: Right.

RD: There is a lot to be said for people coming together and working together as a community rather than having separate communities. I think that comes out because separate communities, when they don't agree, sometimes get into fighting. There's a mixture that has to be worked out there. I don't speak a lot when they talk about diversity...

LK: Oh. [chuckles]

RD:...because I don't have the same opinions they do. I think I probably agree with the outcomes they want to get to, but I don't like the way they're doing it. My thought is if you want to get more minorities into the Dental School, then you need to go into the grade schools and you need to go into high schools, and point out what life would be like for you in this type of profession, and get them to think about this, instead of thinking about I want to be a movie star. I want to be an athlete. Or I want to be a Wall Street person. You need to get them focused on reality and say, "Here's a good profession."

LK: That's kind of what I've heard from a lot people on this question, worrying about earlier preparation rather than ultimately recruiting for the professional schools.

RD: You have to get them to think. Who are the best dentists? Most of them are the ones that planned to be a dentist a long time ago.

LK: This was in 1980, so you would have been in the master's program... The Rajender Consent Decree came down. I didn't know what your perception of that was, at that time, and what changes came out of that.

RD: I don't have all the inside information. Basically, what it did was give a salary boost to all the women. Did it bother me? No. I have problems with this trying to say equal pay for equal work. I will agree equal pay for equal work, but now you've got to show me that it's equal work and that's very hard to do. The University says that we're supposed to put our salaries based on performance. Well, there are people that perform much better than others. If you can show that there's been a bias, yes. I think the Rajender case, from what I heard, wasn't really a bias. From court, it said it was, but from what I heard, her performance, basically, was not up to snuff. It wasn't as good. She claimed it was as good as some people that got promoted and maybe it was, but it's hard to say. We've promoted people here that would *never* get promoted today, because standards have changed.

LK: Right.

RD: Back in the 1960s and the very early 1970s, there was a lot of money and you needed people to teach and anybody that wanted to teach was fine. You brought them on and if they put in their six years and did well, they'd get promoted. The requirements weren't stiff, but, then, as money became tight, you couldn't do that. Now, I don't know the case. Everything I heard said at that time by today's standards she wasn't performing and wouldn't have got promoted. Could she have found people she did better than?

Probably. I can pull up people that did nothing, and they got promoted. Somebody wants to say, "I'm better than that." I'd say, "Yes, you are and if you'd been back then, you would have gotten promoted. But you're not. You're here today." I don't know. It passed, and I have no real problem... When you don't know the facts, you don't know the facts, and you can't argue with it. At that time, there probably was some sort of salary adjustment necessary. I see they're talking about it again. At this time, I'm not sure you could justify it.

Everybody we've had in here...we promote women, minorities... That doesn't seem to be the case... I don't look at anything other than who's going to perform the best. They're brought in at the same salaries, and it's up to them to perform, to keep it going. Under Naty, the Dental School classes, the minority component has been going up and up. Is that good? I don't know. [chuckles] I'm not on that committee. I interview the students. I make my opinions of them. The minorities I've interviewed were perfectly fine, so I don't see any reason why they wouldn't get in. They're doing active recruitment, so they're probably getting more minorities to apply. Our class is over half women; although, it's been that in the past. It kind of goes up and down. I know there was a bias a long time ago against women, because it was so expensive to educate and the concern was a woman dentist probably wouldn't practice full time.

LK: Right.

RD: They end up having maternity leave...that type of thing. Was it justified? Probably not. Was it factor? It was when there was a real shortage. But, at the time when people were talking about it, there wasn't any shortage of dentists, so it wouldn't have made any difference. That's gone now. The biases have been there. There probably are still some biases. I'm sure they're not going to take any Al-Qaeda members into the Dental School.

LK: Was it after Richard Elzay that Michael Till came in as dean?

RD: Right.

LK: Do you have any comments on his leadership, the changes he made as dean of the Dental School?

RD: No. That's when I stepped down. Till was in there. I think the best thing Till did that I know people talked about was the school wasn't on good relationships with dentists out in the public.

LK: Hmmm.

RD: Till would go out and he would drive to all of these meetings and meet with them when they had their local little get togethers. So he helped really put the school in a better standing with the outside community.

I didn't know enough. At that time, we were looking at changing the way we ran our clinics. We'd had a retreat called the Riverwood [Resort, Monticello, Minnesota] retreat. That was a two-day retreat to look at how should we restructure our clinics. After that meeting, our department worked on that, how to do it, how to go about it, and came up with a structure for the clinics that I then presented when Till was then dean. I presented what the clinics would be like, how they would work, and what was necessary in order to implement this. It was only done from our department's point of view. There were three other departments that had to fit into this; although, our department, at that time, was responsible for almost all the clinic teaching. The only thing we didn't do was the specialties. That could have been worked in. What I told Till, at the time, was he was going to have find a champion to put this through. I don't think he did anything about it, so it's kind of gone to the wayside. The interesting thing about it now is the latest research shows that the model we were proposing, or one very similar to that, is the only way you can run a dental clinic and run it in the black instead of in the red. It isn't a unique idea. It was essentially running it as a private practice, literally. But he didn't implement it. Part of reason I think at that time was because there was a misconception that we needed ten additional faculty, what we would call group directors now. There's no money to hire ten faculty. Well, we didn't have to hire ten, but you had to find ten. It never went anywhere.

LK: Okay.

RD: Otherwise, I did not deal much with Till. I think he was probably okay. There's nothing outstanding that I know of that he did at the time.

LK: Did you do any work, and maybe you would have because you were chairman during this time, with either William Brody or Frank Cerra as vice presidents of the health sciences?

RD: Oh, not really. I met Brody, but that was when Elzay had a meeting at his house for the chairs as kind of a retreat, and Brody was there. I met him. He was a fan of silos, which nobody liked, so I didn't deal much with him.

Cerra, I knew him reasonably well. I didn't really work a lot with him. He knew me well enough that he would say, "Hi," when he saw me, that type of stuff, but no real direct relationships with him. I met with him a couple times, one-on-one, mainly with Bill. The University was given \$10 million dollars by the government for some research, and I sat on the committee for distributing that money.

LK: The Federal Government or the state?

RD: The state government gave \$10 million for some projects. So I did serve on that committee. Again, he just kind of came in to give guidance for that.

LK: I didn't know what your relationship was with the Minnesota Dental Association [MDA] or the American Dental Association [ADA].

RD: I belonged for a while. When I was first chair, I joined. It's fine. I have no problem with the organization. My problem was it's very expensive and when I wasn't going to be practicing—I only practiced one day a week—the cost at that time was about twelve hundred bucks a year to belong...

LK: Wow!

RD: ...because you had to belong to the ADA and the MDA and, then, your district. That was three organizations you had to belong to and the dues were quite expensive. So when I got done as chair, I dropped it. I tried to get them to modify their dues schedule for faculty who were only practicing one day a week. Faculty got one-fifth the income from practice than full time dentists. Give them a reduced rate, something that was reasonable. But they never would do that.

LK: I hadn't thought about that relationship between those professional organizations and being primarily private practice oriented. Would you say that's kind of how they operate?

RD: The ADA is set up for practicing dentists. That's their idea. The problem I had is not only did I have to belong to that, I had to belong to the IADR [International Association for Dental Research] and the AADR [American Association for Dental Research], which is one. Then, I had to belong to the College of Prosthodontists, which is another one. When you add up all the dues, it gets quite expensive.

LK: Yes.

RD: I just had to start dropping them. If it's not benefiting me, why do I join?

LK: Right.

RD: Elzay tried to push that all faculty should belong but for most faculty, one, you don't have the income that practicing dentists did, but you get to pay the same amount. It's a hard issue. But I support them. The only thing I think they really screwed up on was this infection control stuff.

LK: Hmmm.

RD: It's over the top for dentistry. There was little to no evidence that a lot of it was necessary. They didn't get in there when they should have. Congress sends out a big book telling you all the bills that are going to be discussed, and the ADA didn't pay any attention to it. They got caught and, then, it's too late. Infection control is fine, but it's over the top for dentistry for what you need. Anyway, Dentistry was doing what they needed to do for infection control.

LK: These are kind of two broad questions that I'll end on. I didn't know if you had any comments on major changes in dental education or research or practice that I didn't hit on in my interview questions that you want to comment on further.

RD: Probably not anything that I haven't mentioned. The big thing is dentistry has to decide what direction they're going to go in in the future. We know a lot now on preventive dentistry. If we can come up with tools to identify early decay in regions that you can't see, there are ways to do remineralization and literally stop it in its tracks. We have a very good idea what causes it. You can educate people. If you brush and you floss and you have a reasonable diet, you're not going to get tooth decay.

LK: Right.

RD: So we can take care of it. Unfortunately, you don't get reimbursed for preventing decay.

LK: Right. [chuckles]

RD: You get reimbursed for dealing with it. You have to look...what's going to happen down the line? In medicine, it looks like they're starting to move to pay a flat rate, and you're going to have to cover all the costs from then on. Well, then that means preventive becomes very important. It's cheaper to prevent something than to it is to cure it. In dentistry, we're behind on that. I don't know if we're going to go that way. Then, it becomes, well, what are you going to be doing as a dentist? Are you going to start picking up some more of the initial systemic type of tests for medicine? I don't know.

LK: I thought that was really interesting when you brought that up about dentists maybe taking on more of a GP [general practitioner] role. Do you know how long they have been talking about that or where...?

RD: It's been there at least since the turn of the century.

LK: Oh, wow.

RD: It's been talk for quite a while. There are more and more tools coming out. We were always taught to take blood pressure and pulse. That's an easy thing to pick up. But now there's stuff for picking up diabetes. They're coming with salivary type of diagnosis tools that you put saliva in, and they point out some markers, you know. These are all things that could easily be done in the dental office when the patient comes in. You're not going to be doing full exams or anything like that, but there are simple things you can do to pick up diseases fairly quickly and maybe they'll get done in the dental office and, then, referred if anything shows up. Like I said, it's because people see dentists more often than they'll see the doctor.

LK: Yes.

Do you have any final thoughts on the Dental School or the AHC, as we conclude?

RD: Well, watching the AHC... I think like many people, I don't think the search is right. I don't think that one person can run the AHC and run the Medical School at the same time.

LK: Mmmm.

RD: Medical School is a full time job. To hire one person to do it, I think is... Whoever walks in is a glutton for punishment. I don't think they'll last long at the job. So I'm not thrilled about that.

I don't have any problem with the AHC. I think there are a lot of benefits for having an AHC. I'm very interested to see how the new dean [Leon A. Assael] does here. I was on the search committee for him.

LK: Okay.

RD: I was very impressed, and I think we got a very good candidate. He wants to make a lot of changes. So it will be interesting to see how that turns out. His management style is quite a bit different from the previous Dean Lloyd. Dean Lloyd was a micromanager. This one isn't. So we'll see how it works out.

LK: Yes.

Do you have any suggestions on other people I should speak to within the Dental School for an interview?

RD: Well, you should interview Maria [Pintado].

LK: Yes, I did interview her.

RD: I'd say you have to interview her. She knows everything from way back when.

LK: Yes.

RD: Larry Wolff would be interesting. We were both in the same class and have a very, in many ways, similar track. So from the same time period, it would give you his perspective.

LK: Yes.

RD: Gary Anderson might be a good person to interview. He was senior associate dean.

LK: Okay.

RD: [pause] I think of the people still around...

LK: Those two?

RD: Oh, you'll get an entirely different outlook from Mark [C.] Herzberg.

LK: Is it H-e-r-t-z-b...

RD: I don't remember if he's got the "t." [Doctor DeLong checks a directory] He's got a vocal, definite opinion. Just H-e-r-z...

LK: Okay. Great.

RD: I would have to say he's probably one of the top researchers here. He's done quite a bit. He was actually editor of the *Journal of Dental Research* for quite a while. So he's been high up in that organization. He did run the—I never get the name right—CTSI [Clinical and Translational Science Institute] or whatever it is. He ran that for a while. He's done a lot and he's been here as long as I have, so he's got a perspective, also.

LK: Okay. Great.

Thank you so much for meeting with me today.

[End of the Interview]

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