The American Association of Immunologists
Oral History Project

Transcript

Katherine L. Knight, Ph.D.
July 19, 2012
Maywood, IL

Interview conducted by
Brien Williams, Ph.D.

Transcription: TechniType Transcripts
Transcript copy editors: Bryan D. Peery and Elizabeth R. Walsh
Final edit by: John S. Emrich

To cite an interview, please use the following general format: [Name of interviewee], interview by [name of interviewer], [date], The American Association of Immunologists Oral History Project. http://www.aai.org/OHP (accessed [date]).

Williams: This is an interview with Dr. Katherine L. Knight for The American Association of Immunologists Centennial Oral History Project. Dr. Knight is a professor and chair of the Department of Microbiology and Immunology at the Loyola University Chicago Stritch School of Medicine. She's also the cofounder and co-director of the Infectious Disease and Immunology Institute at Loyola University. Dr. Knight was the president of the American Association of Immunologists from 1996 to 1997 and served as an AAI Council member from '91 to '96. We are in Dr. Knight's facility at the Stritch School of Medicine. Today is Thursday, July 19, 2012, and I am Brien Williams.

Dr. Knight, let's start with a little bit of your family background.

Knight: Sure. I grew up on a farm, on a strawberry farm, actually, and so I spent my childhood picking strawberries and weeding strawberry rows, rows of strawberries. Actually, I went to a one-room schoolhouse. That was probably one of the major things. That's probably one of the last one-room schoolhouses in the country. I had actually one classmate. See, we were only two students all the way through sixth grade, so for almost my whole primary school I had just one classmate, and then we were shipped off to the city school, where there were now a hundred people or something.

Williams: So where was this?

Knight: This was in lower Michigan, downstate Michigan, about thirty miles from Ann Arbor. Jackson, Michigan, actually, thirty miles from Ann Arbor and Lansing. So we lived in the country and it was quite an interesting time.

Then when I was looking to go to college, the question was where would I go. Of course, University of Michigan would have been kind of what one would think about, but I needed scholarships, and Elmira College in New York offered me scholarships and work aid and so on. So I ended up there and so went to school there, and I fell in love with chemistry, actually, and had a wonderful chemistry professor, Dr. Spurmuli [phonetic]. So she was fabulous.

Then it came time, then what are you going to do afterwards, and it seemed like, well, chemistry, I guess you should go to graduate school. So then I went to Indiana University in the Chemistry Department there, and that was quite enlightening because I actually worked with Felix Haurowitz. Haurowitz discovered fetal hemoglobin. He was from Prague originally and had moved to the United States in Bloomington, Indiana, and was interested in the chemistry of antibody molecules. So I worked with him, and that was really quite a fabulous time with him. His wife was not a scientist, but she was really a delightful person, loved the outdoors. Indiana, Bloomington, is a fabulous area where there are all kinds of state parks and areas to walk in. So we would go hiking a lot. So it was a wonderful time.

It was a time when chemistry—I think we were only two women in the whole department, basically, students, and there were no women, of course, on the faculty at that time. It's, I think, started to change there. But I didn't really quite realize it, and I just enjoyed what I was doing and kept doing it.

Williams: Tell me a little bit about your parents then.

Knight: Well, my mother was a stay-at-home housewife, so to speak, and my father, actually, he had a job but he really mostly did farming. Well, he did farming on the side, but he kind of worked in some sort of a factory kind of place, but did the farming.

Williams: So what town or city did you go to high school?

Knight: It was Jackson. We lived about five, ten miles outside of Jackson, so that's why we had a one-room schoolhouse, and then they bused us in to Jackson High School.

Williams: Was chemistry on your radar in high school, or was it really when you got to Elmira?

Knight: Actually, chemistry was the first class actually that I ever really enjoyed in school, of all things, yes, right. So I had a wonderful teacher, and I thought, gee, this is really fun. So it was the first time I really studied for an exam or for whatever. So then when I went to college, to Elmira, I thought, well, chemistry's kind of fun, but I like math too, so I decided to do math and chemistry. Then finally the chemistry [ed. math] professor said, "You know, you're spending too much time in the chemistry lab," and so I decided then to major in chemistry. [laughs] I had a wonderful instructor there.

Williams: Then when you looked at possible graduate schools, what did draw you to Indiana?

Knight: Well, actually it was an organic chemist by the name of Eugene Cordes came through. The American Chemical Society had a program where they would send people around from various institutions to give lectures in various places. We were very near the Corning Glass Works, and so he was invited to give a lecture there, and I got to show slides for him. These are the days when you still had slides to show with a slide projector. So I got to show slides for him, and he had these fabulous pictures of Bloomington, because it's a gorgeous area, Bloomington, Indiana. So I looked at the program and he encouraged me to apply, and so I applied a few places but decided to go there.

Williams: At the time, was Indiana a powerhouse in chemistry?

Knight: Yes. Indiana's kind of always been a really strong Chemistry Department.

Williams: So you received your Ph.D.?

Knight: Right.

Williams: That was in ’66?

Knight: Yes. Right.

Williams: Then what was your next step?

Knight: Well, the thing was, you know, working with Felix Haurowitz, nobody understood antibodies, and antibodies are what protect us from all kinds of infectious agents. But at the time, no, we didn’t understand how you could have these huge numbers of different antibodies that we knew you needed to react with all the different infectious agents that we would come across. So we were trying to understand the heterogeneity of these and genetically where it came from. This was before you could do recombinant DNA, so any DNA cloning.

So the closest we could do was to try and get to genetics, because you needed to understand something about the genes, but you couldn’t do DNA. We were dreaming at the time of how you might ever work with DNA and clone it, for example. So in the meantime, what we did have is you had animal genetics, and so I thought that the way to get at this problem was through using animals and the genetics that you could use within individual animals.

So at the time, Sheldon Dray was at University of Illinois in Chicago at the Medical Center, and he was very big on these genetic markers. We call them allotypes, but, anyway, they’re just genetic markers for antibody molecules. So I thought, well, this is really the way to go to try and figure out how is this huge antibody diversity is generated. So that’s how I decided to come to Chicago for my postdoc.

When I talked to Sheldon and said that I agreed to come, then somebody told me the University of Illinois was not in a very good neighborhood, the medical school, and so I said, well, maybe I would only go for a year. So, anyway, we ended up agreeing on a couple years, but then obviously I stayed there at the university for over twenty years, so it was a great place to be. So I went with Sheldon to do antibody genetics and then stayed there for a long time.

Williams: How did you orchestrate that transition from I.U. to Chicago? Did you apply or was he aware of your work?

Knight: Well, actually, these were the days when the AAI meetings and the whole FASEB [Federation of American Societies for Experimental Biology] meetings were in—oh, dear, what’s the name of the boardwalk? New Jersey.

Williams: Atlantic City.

Knight: Atlantic City. Thank you. So there's a big boardwalk there, and so you would be walking down the boardwalk and that's where you would meet everybody, because there were the meetings but then the boardwalk was where all the action was. I was there with Felix Haurowitz, and he knew Sheldon, so we met on the boardwalk. So Felix told Sheldon what I was interested in, and Sheldon said, "Well, wonderful. Why don't you come work with us."

So I thought, well, yeah. So that's kind of how it happened. You just meet people in the—

Williams: Were you in bathing costumes?

Knight: No, no. It was just where the action was. Those days were really wonderful. You'd meet everybody on the boardwalk. If you wanted to find somebody, you'd just go out on the boardwalk and walk between the hotels there. This, of course, was long before there was gambling. It was all gambling. So that's where everybody met.

Williams: So at some point that policy changed, didn't it?

Knight: Yes. We outgrew, basically. I don't remember when it happened, but certainly once it became a gambling place, it wasn't a place we wanted to be.

And then it seemed like that it made sense to start having the meeting in different places, and also the other thing that happened is that we always met with the whole FASEB, which there were at the time, I think, five societies before FASEB expanded considerably, but at the time I think there were just five societies. So we would meet there. For me, one of the major ones was the American Society of Biochemists also were part of that, and so they always met with us, too, and that was wonderful because you could go back and forth to the biochemistry meetings as well as the immunology meetings. Then the biochemists started to break off and have their own meetings, and the FASEB meetings became so huge. They were like 20,000, 25,000 people, I think, and so you got so you really couldn't find the people that you wanted to see.

So eventually AAI started trying their own meetings, splitting off for one year, but you have to schedule these meetings so far in advance that we couldn't be sure that we could have our own standalone meeting for years on end, so we kind of interspersed them, and then it became very clear that it worked and that people were very happy having their own meeting, because then everybody you run into is an immunologist. So that was the progression.

Williams: So describe the Medical Center at University of Illinois. What was it like as an environment to work in?

Knight: Oh, well, I was really kind of a bit sheltered because Sheldon Dray was really just a terrific mentor, and he had just brought on Al Nisonoff, who was from the University of Illinois downstate, who was a fabulous biochemist and immunochemist. So we were right next door to them, and Al had a lot of postdocs and Sheldon had some and a lot of students, so the interaction between these two groups was really astounding.

Al always had his lab meeting on Saturday morning, and so I often would join them on Saturday mornings at his lab meeting. So it was just a really robust kind of environment. Sheldon was wonderful because he really allowed me to kind of do what I wanted to do and really helped my career enormously. So he was a wonderful mentor. So we didn't have to do a lot of other things. We could just stay in the lab and do our things, and we had all the support that we needed. I would say especially with Al Nisonoff there and all his fellows, it was a wonderful environment.

Williams: So when did you publish your first paper?

Knight: Well, the first paper, of course, was with Haurowitz as a graduate student. I can actually remember the first presentation I gave at the American Chemical Society meeting. It was before I joined AAI, because I was in chemistry. So I still remember the first sentence of that presentation, because we worked so hard to—you're a little nervous the first time you're going to present to a big audience. So that was the first one, and then, of course, the manuscripts came right after that.

Williams: So what were the high points of your work at University of Chicago?

Knight: At University of Illinois.

Williams: I'm sorry, yes.

Knight: Well, I think the highlights were really kind of starting to learn to develop—I'm just trying to think of the timing. So it was really learning, expanding, learning more about genetics and learning more about biology, because I had been in a Chemistry Department mostly, even though we were biochemistry. Now, Sheldon was an M.D./Ph.D., so he was much more on an animal model system and more cellular kind of things, still molecules but more from a cellular point of view. So it really expanded my whole horizon.

Williams: I don't understand why it's significant that he's an M.D./Ph.D.

Knight: Well, because I often think of M.D./Ph.D.'s often because once you have the M.D. degree, you think about the whole individual. So as a chemist you think

about a molecule somewhere. So you need both, and so that was really, I think, the part that Sheldon brought, even though he was very molecular in the scheme of things, but he thought about the whole system, which as a chemist you don't really learn so easily to do that. So it was really broadening the horizons.

One of the highlights there was I had the opportunity to take a sabbatical. I had what was called a Research Career Development Award, and on that you could take a year and go anywhere you wanted. So I actually chose to go to Basel, to the Basel Institute of Immunology, which was a just absolutely fabulous place.

Williams: Then after Basel you came back to—

Knight: Yes, to Illinois, and I was there for a long time.

Williams: But then you went to Caltech [California Institute of Technology] too.

Knight: Yes, right. That was the next. I think I can explain that.

Williams: Was Lee Hood there at that time?

Knight: Yes. Right.

So I had the opportunity to go to Basel, and actually there I had a year and I worked with Ben Pernis, Benvenuto [G.] Pernis, a really well-known Italian immunologist, who, again, he was really an M.D., so he was really thinking about the big picture and he was very much into a technique that we call immunofluorescence. What immunofluorescence does is it allows you—this was really kind of the early stages of it—it allowed you to stain an antibody with a fluorescent molecule and then you could put it on cells, and then these cells would fluoresce and so you could look at them under a microscope and you'd see these fluorescent cells. So that was kind of the beginning of trying to understand cellular sorts of things, and I had not done much cellular work at all prior to this time, so that was really an eye-opening experience.

The Basel Institute, it's such a shame that it closed, but for everybody who had the opportunity to work there, it was just an unbelievable situation. You know, Roche put huge amounts of dollar into it, and there were no stipulations. You didn't have to do anything that was relevant to Roche. It was just pure science. The best part was so it was mostly young people. There were like a dozen full members, and then lots of young people who had short, like, five-year contracts and a few people like me who were there for a year.

All the science was done—there was a wonderful little space. They have a coffee shop, and the coffee shop was right when you walked in the entrance, and the coffee shop was open from early morning until, like, three in the afternoon. You could go there anytime and you would meet everybody there, and that's where so

much of the science was done. It was quite remarkable. It was a relatively small institute, but everybody knew everybody, knew what was going on, and the interactions between the scientists there was quite extraordinary.

Williams: What was the cause of its closing?

Knight: Well, I think that the person who was on top of Roche that had supported this, died, and I think the next generation decided that they didn't want to support this any longer.

Williams: And it didn't move elsewhere or take a new form?

Knight: No. It was totally Roche. I don't know of any institute quite like it, certainly not in this country. It was run totally by a pharmaceutical company, but purely research without any need or without any requirement for doing something for them.

Williams: I can see the title for your autobiography is going to be *From Boardwalks to Coffee Shops*. [laughter]

Knight: Yes, right. Yes, exactly.

Williams: So then you came back to the University of Illinois.

Knight: Yes, I came back to Illinois. So having learned a little bit about cells and certainly the technique of immunofluorescence and how to use it, but we were still plagued by this problem of antibodies and how you generate the heterogeneity, so to speak, so many different kinds of antibodies.

It was just about that time, 1976, I was in Basel in '75, so in '76 was when [Susumu] Tonegawa published the paper basically describing genetically how antibodies are generated. So it was really remarkable. Well, he got the Nobel Prize for that work.

We'd been interested in a problem. I was working in rabbit, and there was a genetic problem in the rabbit that it had an impact on these theories of antibody formations and how this diversity was generated, but we still couldn't answer it. But it became clear to me that this new technique of recombinant DNA was the direction we had to go.

So Lee Hood, who was at Caltech at the time, I talked to him and I said, "I've got to learn this technique." Of course, he was one of the early people using it.

So I had just come back from Basel or something. Anyway, I didn't have very long. I only had like three months.

Lee said, "No, you can't do this in three months. You've got to have at least six months."

I said I didn't have six months. I only had three months. So he said, "Fine. Come and do what you can."

So the Hood lab was 24/7, so four o'clock in the morning we'd go out for doughnuts when the bakery opened, and it was fabulous because you really could work totally full-time. So in the three months I learned an awful lot and was able to bring that technology then back to the lab. So then that was a really whole new dimension of being able to really understand the genetics of the antibodies.

Williams: Talk a little bit about what I'm going to call paradigm shifts here, which may not be quite the right word for it, but, I mean, you were pursuing one line with the antibodies and then this new technique arrived, so it sort of makes a lot of your work—you have to move in a different direction.

Knight: Oh, absolutely.

Williams: So as a scientist, how do you incorporate and adjust and transition?

Knight: Well, that's a great question. I think that's the thing that one has to do, is you have to go wherever the field is going, wherever the field takes you. When it takes you into a new technology like this was, it was totally new for me, you just have to make a commitment to do it and figure out how to make it work.

In this case, I went to the Hood lab, which couldn't have been better. It was a fabulous place. They were always very helpful, and so when I would come back and start trying to do things that didn't work, I could call them. No email at that time, but you could call them and get more help with it.

So you just have to seek out those possibilities and just figure out—you have to change with the technology, and you just have to find out how to do it. But, you know, the beautiful thing about the field, the science is that generally, especially in academics, people want to help each other, so they're more than happy. If they've developed a technology, they're generally very happy to help people.

Williams: So there isn't a lot of lab envy or competition, you're telling me.

Knight: Well, I think there wasn't, I don't think. I certainly didn't experience it so much early on. I think now it's much more so because as the competition for grant dollars gets tougher, I think people feel like they somehow have to have an edge. So I think, in general, the field has gone, so it's probably not as open. Well, it's just open and free, that people don't feel free to talk sometimes about things, which I think is a real tragedy because the whole beauty of science, I think, is

doing science together. Whether you're in this lab or a lab at Illinois or at Loyola or at Santa Barbara or Bethesda, it's that interaction among colleagues, and you like this totally open access if you can.

Williams: But you say it is different today?

Knight: Well, it is changing, and it's one of the things that I worry a lot about because I think we're training young people sometimes to keep secrets, and science really should not be secretive. I mean, you can understand the difficulties on the side of if you're going to go for grants, and, of course, patents come into play too. So I think the challenge is to keep things open, communications, as much as possible.

Williams: So when you came back from Caltech, you were the resident expert in this new technique, right, and shared it with your colleagues here, right?

Knight: Well, I guess that's right, yes. Fortunately, I had a postdoc at the time who had been to the Hood lab for a month before I could go, so she had already learned a variety of things, and her husband actually was at the University of Chicago. He was a virologist and happened to be doing some molecular virology. And there was one other lab, virology lab, at Illinois that was doing some molecular biology. So we had some help. But you just have to keep doing it until—mostly you just have to make it work. You just have to figure out how to get it to work. If you're committed to it, you can do it.

Williams: So you came to the University of Illinois in '66 and then left in '89.

Knight: Right. Yes.

Williams: So what were the high points of those years for you?

Knight: Well, I would say some of the high points were, in a way, the time I spent in Basel, because that was such a unique opportunity. Also the way the Basel Institute was built was the floors were connected by a stairwell in the laboratories. So it was really fabulous. You could call down to your colleague downstairs and say, "It's teatime," or, "Gee, can I borrow this reagent?" or something. So the communication was so wonderful, so you got to know a lot of really good people and all interested in immunology. So that was a wonderful time, and plus I enjoyed my time in Basel. It was very different than being in the city of Chicago.

I would say that the time at Lee Hood was really transformative at Caltech because it was such an intellectual place, but really hard working, people really interested in what they were doing and committed to doing it well, and still in the space of having a good time, really enjoying being together and doing things together. So those kinds of things.

Plus I would say throughout my career, not only in Illinois but also since I've come here, I would say the highlights for me are really about training students. As a scientist, as an academic scientist especially, to me the real fun and enjoyment of this is working with young students, especially graduate students, because they come in and they're bright-eyed, bushy-tailed, really excited, wanting to do things, don't have a clue how to do it, but it's fine because that's what you do, is you help them learn and develop what I like to call a scientific mind. So I think that in watching these students grow and then going into their postdocs and then to their getting their own careers, whatever it might be, whether it's in academics or industry, I would say is probably really the highlight for me.

Williams: Were there important benchmarks scientifically in your tenure at Illinois?

Knight: Well, there were probably two things that I feel that were the most rewarding and fun, I would say, for me. One was there was an old genetic problem in rabbits. I talked to you a little bit about this. There were genetic markers, so you could identify different rabbit genes and so on, but there was a problem that the rabbit genetics posed in terms of this antibody formation. Once it became clear from the genetics, molecular genetics, as to how antibodies were made, we couldn't understand how rabbits were making their antibodies, because it was a problem that just didn't make any sense.

So at the time most people went into mice, starting to work with mice because you could have inbred mice and there were all kinds of reagents, antibody reagents, with the discovery of monoclonal antibodies, so there were many reagents in mice. There were many advantages to using mice.

But I liked this problem, I was interested in it, and I didn't want to let it go until I solved it. So we did finally solve it. Once we had the molecular genetic tools, then we actually solved the problem. So now the fun of that is it wasn't a dead-end story at all, but when we solved that problem, then it raised, of course, a whole series of new issues, so then you got all new—that's the way science goes. You make a discovery and then you answer one question, but then you open up five more. So that was one.

The other one actually happened after I came here at Loyola. I don't know if you're familiar with monoclonal antibodies, but they're antibodies that are homogeneous. They're not heterogeneous. It's a single kind of antibody that reacts with a single kind of antigen, and they had proven to be extraordinarily valuable, but they were made in mice. So that technology was out there.

Rabbits always actually make, in my view, better antibodies than mice do, and they're often higher affinity. You can get a lot of different specificities that you can't get in mouse so easily. So I always thought it would be great to be able to make rabbit monoclonal antibodies. So we spent actually ten years developing rabbits that could be used and eventually to get what's known as a cell line, it's

called. We call it a fusion partner. So that means that you can take this fusion partner and mix it with cells from an animal that's been immunized, and you can get out, then, immortalized cells that produce any particular antibody you want forever in life. That's what a monoclonal antibody is. So we actually developed that technology for the rabbit so that now you can make rabbit monoclonal antibodies.

Williams: The same process was not successful with mice?

Knight: No, there are mouse monoclonal antibodies. That was the original set of monoclonal antibodies, was mouse. But rabbits make such good antibodies that we wanted to—

Williams: Good in what sense?

Knight: Well, they have what we call a high affinity, which means they bind the antigen very strongly, which is good, depending on what kinds of tests you want to do with it, or if you want to use it clinically, often you want a high-affinity antibody. High affinity means it's just going to bind that antigen very strongly. For whatever reason we still don't understand that the rabbits make antibodies against antigens that the mouse doesn't do easily, so you actually have more opportunities sometimes to make antibodies. Plus, in the mouse situation you can't make a mouse monoclonal antibody to a mouse, because mice, they don't make anti-self antibodies. So you can use rabbit then to make monoclonal antibodies against mouse proteins, and since so many people use mouse as their major animal species in their experiments, the rabbit antibodies would be very useful for that.

Williams: So were there clinical consequences of this work?

Knight: Well, there are. It's still early, but if you see what's happening with the mouse monoclonals, there are many of them that are being used clinically now, not only in assays, but also they're being given to patients, and the same will happen for rabbit. It's not there yet, but it will happen.

Williams: So what motivated you to come here?

Knight: Yes, that's a good question. So I knew some of the faculty at Loyola for some years, and they had said that the chair was open. I didn't think I particularly wanted to be a chair of a department. I was very happy just doing my science. But then they said, "Why don't you just come and visit us." Once I came to visit, I realized that this was really a wonderful opportunity, and so I decided to take it. At the time I came, the faculty was quite senior, and the dean was prepared to make a big investment in recruiting new faculty, so I had the opportunity to basically recruit the vast majority of new faculty, and so I really had a chance to develop a department really with people who I really wanted to work with and who had a lot of the same values as I did. So it's been fabulous.

Williams: And you accepted the fact that you were going to be drawn away from having a lot of time for science or not?

Knight: Well, actually, one of the things I did was I knew I needed somebody to run the office while I was in the lab because I was still working in a lab myself, and that I needed somebody to run the lab when I was in the office. So I kind of had these two people. One came with me and one I recruited to do those two jobs. So with the two of them, it made it really easy. I actually still worked in the lab for many years, for more than ten years after that. It was really only the last five years that I stopped working in the lab.

So, you know, if you really like it, if you really love it, nothing's too much is work. And when you start thinking about it, because what I did to build the department was I recruited junior faculty right out of their postdocs, and so that's just wonderful because, again, you have the chance to mentor them and help them develop their careers. So it takes time, but, you know, it's all so rewarding.

Williams: So what words would you use to describe the kind of community, scientific community you wanted to create here?

Knight: Because we were a small department, we were only going to be like maximum of probably ten people, and we had to cover immunology, virology, and bacteriology, so that doesn't leave very many people for each discipline, because we were teaching medical students, so we had to have these. So what I needed was in a small department I wanted everybody to be able to work together, and so I couldn't afford to have anybody who was interested only in their own research and was going to go off and sit in a lab somewhere by themselves and not communicate with anybody else, because that was not going to work.

So really the criteria were people who were obviously very smart and did really excellent research, could communicate well, because I think there are people who do really good science but they have difficulty communicating it very well. At some point you've got to teach, especially if you're going to be in an academic institution, and especially a small institution like Loyola. You need to teach. So I need people who could teach and talk well and wanted to work together and wanted to communicate with people.

Actually, we've done what I think is a wonderful event. Every Friday we have what we call a Friday lab meeting, a department lab meeting. So it's the whole department, and so everybody in the department, their name goes on a list, technicians and students, postdocs, faculty, and when your name comes up, you're moderator for the Friday meeting, and you have two jobs. One is to find three people who want to talk, hopefully informally, although now it's PowerPoint and it's hard to get people to do informal shoptalk. But, anyway, find three people who want to talk about their latest experiments and bring cookies.

So that has gone on, and it's really wonderful because you go every Friday. You have no idea who's talking. There's going to be three people. There might be three immunologists, there might be two virologists and a bacteriologist. But you learn what's going on in the department, so you can basically, I think, ask anybody who's doing what, or if you name any one person, they can probably tell you what they're doing. So that's the kind of environment that I had hoped for.

Williams: Just from a practical standpoint, how do you go about that kind of recruitment? Because you're looking for kind of a whole person.

Knight: Yes.

Williams: How do you assess people in how their communication skills—

Knight: No, that's a really good question. Well, of course, we bring them in and they give a seminar, and it's pretty standard. So they give a seminar and then you listen to how their seminar goes, and then we have them, of course, meet with faculty and with students. Then you get feedback from everybody, who they think would fit in. You know, part of it is do they show any interest in what you're doing. A lot of those, you can usually find out pretty easily whether they're really interested only in what they're doing or whether they want also to know about other people's.

One of the key people, you met Debbie, our department secretary, and so when we organize the day for people to come in to visit, she walks them from office to office, and some of them are in different buildings, and so she gets to talk to them quite a bit. So she learns an amazing number of things that are helpful.

Williams: Your agent.

Knight: Our agent, yes. Right. We didn't know it ahead of time, but it turns out that—but basically everybody pretty much ends up, has the same experience.

Williams: But, of course, the ones you invite, that's sort of the second stage of the selection process.

Knight: Yes, absolutely right.

Williams: So how do you know whom to invite?

Knight: Different institutions and departments take a different tack. Our tack has always been we want to get the best person we could get, and we didn't worry too much about what science they were doing, as long as it was in micro/immunology. So we didn't build a consensus on any particular topic. So the downside of all this is that we really haven't been able to go for a program project yet, because the

department is small, we don't have so many people and people who are doing the same sort of thing.

That was kind of the price we paid, but on the other hand, the diversity is so fabulous. We have Karen Visick, who works with squid and bacterial interaction with squid, host micro interaction. When you hear their presentations, it's just so fascinating, and you always find things that relate to what you're doing out of it. So it kind of depends on what you're looking for. We like diversity. Then figure that people are going to—for the needs they have to talk to people that are really doing more precisely the kinds of things they're doing, they have colleagues all around the country.

Williams: So has the department grown over the years?

Knight: Well, not really. I mean, we were ten, but then, in fact, the institution closed the Department of Cell Biology, and they distributed over fifteen faculty there and they distributed them. So, actually, five of those former came here, actually several of which were immunologists, so that was really good for us. So we're now fifteen.

Williams: Are you training mainly M.D.'s or Ph.D.'s, or what's the—

Knight: No, we train mostly Ph.D.'s. We're at a medical school, so of course we're involved in the medical student teaching, but most of us are graduate-student trainers, so we have Ph.D.'s.

Now, one of the interesting things that we did, because the NIH [National Institutes of Health] is going so translational, meaning that they want people to do research that's related to some health problem or certainly to human, and so my department, because I recruited people not so much based on what actually they were working on, but on kind of how good a scientist they were, we ended up being what I call a very basic science kind of department, where most everybody's doing rather molecular kinds of things and without thinking about translational or clinical applications. So given where the NIH is going and where my institution is going, I thought we needed to do something.

So there's a pretty strong infectious disease group who is also very interested in talking with us, and so we organized with David Hecht, who was director of the infectious disease group at that time. He's now chair of medicine, but at the time he was infectious disease. He was funded by VA [Veterans Administration] and NIH, and so we got together and decided that we would start an institute. So we started the Institute of Infectious Disease and Immunology to bring the infectious disease and the basic sciences together. That has been really wonderful, still in its early stages. We're in like year four or five.

But I think one of the best things we did was to develop a master's program. The infectious disease faculty didn't have a lot of experience training students or Ph.D.'s, so we couldn't go for a Ph.D. program, so we started with a master's program. So the unique thing is that these are all translational projects, so these are really cool clinically relevant projects in some form or another. Every student has two mentors. They have a basic science mentor and a clinician scientist mentor. So it's really quite unusual. So we are just taking in either our third or fourth class this fall.

The whole point of doing the master's was when you have clinicians, scientists, and basic scientists, how do you get faculty to talk to each other? There's nothing like students. So now in this case because the students have both a clinician scientist and a basic scientist, they have to end up talking to each other.

Williams: So where are the master's students going after they leave the program?

Knight: Well, we don't know yet. It's still young enough and we haven't taken so many students yet, but many of them actually want to go to medical school and a lot of them want to be M.D./Ph.D.'s. So, many will go that route, and others want to go into research but maybe into industry. We had one who was in the Air Force and got her master's and went back into the Air Force. So it's quite diverse. We're still learning what the goals of all of these young people are.

Williams: Have you experienced NIH support in this?

Knight: Well, we haven't sought NIH support for that yet, for the master's program. Loyola just recruited several infectious disease people from the University of Illinois, my old stomping grounds, and they're fabulous. Many of them are also clinician scientists and have trained students before, so I can foresee that down the road not too far that we might be able to make this master's program into a Ph.D. program, in which case then we could go for an NIH training grant maybe.

Williams: But in your own department, what kind of grant support have you gotten and from whom?

Knight: Mostly we're NIH funded. That's mainly. One of the goals I had here when I came was to develop a training grant—they're called T-32s—from the NIH. So was to generate a training grant, and so we got one and we've had it now for several years. So that's really a wonderful way of supporting the Ph.D. students. Otherwise, you end up supporting them usually off your NIH monies that goes directly to the principal investigator.

Williams: So what are the high points then of your scientific work in the department?

Knight: You mean of the whole department?.

Williams: What you're responsible for.

Knight: Oh, that I'm responsible for. Well, it's interesting, because I don't think of it as being my accomplishments at all. What I do is I try to provide the environment for all these young people, who started out as young people now, who are now almost all of them full professors, to be able to develop their careers. So most all of them are funded, they're still very active, and so what I take a lot of pride in is that I feel these are all really good people who are contributing to science both in terms of their own science but in terms of national organizations and, of course, to the institution, service to the institution too.

Williams: You mean nonscientific activities?

Knight: Yes. I mean, that's a given. Well, you want to do that, but mostly it's about their science, and they've all done really quite well and a variety of them are in different national organizations.

Williams: So what are the scientific high points? What would have been the exciting things that have occurred here?

Knight: Can we stop for a second? I'm not sure how to answer that.

Williams: Well, you were very clear on the accomplishments of your work at Illinois. Now I guess what I'm seeking is, is the exciting research squid or is it still on rabbits or where is the department going?

Knight: Oh, okay, yes.

Williams: Okay. Let's roll again.

Knight: Well, as I said, everybody has their own research project, and there's a lot of collaboration in the department, but it's not always recognized in coauthored publications because a lot of it just goes on in the hallways, the interactions. But we have, for example, Karen Visick, who I mentioned before, is doing squid model, has an absolutely fascinating model where the squid interacts with a particular bacterium. So the whole purpose of this is the bacterium comes into the squid and then it grows, so to speak, and then when it gets to a particular density, it emits light. The whole idea is that this happens, like, in the night, and so it probably casts a shadow and protects the squid from predators. So the next morning then, all of this spits out and they start all over again. So it's this whole twenty-four cycle. So Dr. Visick's really looking at really the molecular mechanisms for all of that. So that's fascinating.

Then we have Dr. Driks. Actually, he's a bacterial spore person, like clostridium difficile makes spores, and that's why *Clostridium difficile, C. difficile*, we call it, is now one of the major hospital-acquired infections. So he's a spore expert who

actually started with *Bacillus subtilis*, which is just an organism that is found everywhere in the ground and so on. But they also make spores, and so he's taking his work on *Bacillus subtilis* spores and is now transferring it to the *C. difficile* spores to try to understand how you can either manipulate those spores or get rid of them, find new ways to get rid of them.

One of the themes I would say of the department has become, to a large extent, host microbe interactions. It's certainly happening with the virologists who are looking at how viruses enter cells and all the molecular parameters of that. We've actually become interested because I start out by saying that we were interested in antibodies, but it turns out that there's what we call mucosal-associated lymphoid tissue, so the GI tract is filled with it, the lungs, the lacrimal glands, the eye, the salivary glands, so on. There are these mucosal tissues that have a lot of lymphoid cells and activities going on there.

It turns out that the bacteria that we have in us all the time are instrumental in developing the immune system. So if you look, for example, at the GI tract, there are a lot of lymphoid cells there. But if you don't have any bacteria, you have a germ-free animal, for example, those lymphoid tissues never develop. So we have become very interested in how these microbes, especially intestinal microbes, drive the development of the secondary lymphoid tissues.

So that turned out to be a lot of fun, because after we've kind of solved the problem in the rabbit, this genetic problem that I mentioned earlier, what happened was, well, where is all this antibody diversity being generated? It turned out that it's being generated in what we call the GALT, which is the gut-associated lymphoid tissue, and it's this interaction between the bacteria and the host that is driving this huge repertoire in the rabbit. So now we're trying to understand that whole host-microbe interaction.

That's kind of what draws many of the members of the department together, I would say, because whether it's bacteria like Karen Visick with the squid and that bacterium, or whether it's Adam Driks in terms of the *C. difficile* and the interactions with human, or we've got several virologists who are doing similar sorts of things, and then it's all pretty basic scientists, but you can see that it's going to be very relevant down the road.

One of the projects is Kawasaki disease. I don't know if you know. Kawasaki is a disease is very small children, and the etiology is thought to be some microbe, but it hasn't been identified yet. So one of our virologists, Susan Baker, is very interested in trying to track down that organism, so she's working with Anne Rowley at Northwestern and trying to find this. They're on a hunt for this organism.

Williams: You're painting a very diverse picture here, but with commonalities.

Knight: Yes, right. I think the one thing that makes the whole department rather common, coalesce, is we're all very molecular, so we use a lot of the same techniques but for very different questions. So it's wonderful when you go to this Friday meeting. You'll have maybe a microbiologist who's talking and a student or a postdoc, but from the audience you often can't tell who's asking questions, because it might be well from an immunologist or a virologist who has ideas coming at it from a totally different perspective. So it's a wonderful way to keep this diversity, because I think, for me, being in a Department of Microbiology and Immunology is wonderful. I like it a lot because I love the diversity of having the bacteriologists and the virologists.

Williams: So you said that five years ago you sort of left the lab yourself.

Knight: Yes, about that time.

Williams: What was that like, and why did you do that?

Knight: Oh, that was hard, actually, you know, because I like working in a lab. I love working in a lab, actually. When you're in the lab, it's amazing. You talk to people, but even though you may not be talking to them, you're doing your own work, you hear things. So you're able to interrupt so many processes that are going on, especially by young students who don't really quite know the best way to do things. So you can help them right then and there, because you hear what's going on and you say, "Well, I think, no, that you don't want to really add this reagent. I think you really mean to add this reagent first," whereas if you're sitting over in your office and they come to you once a week or however often they come and talk to you, you miss all of that.

So that was a real change for me, because I like being over there in the lab, but it came time where I had to spend more time writing grants because it's gotten more and more difficult getting grants. So I really had to spend more time focused on the grant writing. You know, in the early years, you would write a grant and it would get funded, so it's changed now considerably.

I think that's actually one of the things with young faculty. I try to help young faculty stay in the laboratory, because once you get out of the laboratory, it's very hard to go back because technology changes. You can, but it's harder if you go back. So even if you just do one or two things a day to just keep your hands in there and your mind in there, I think it's really helpful. It's difficult now because so many faculty, young faculty especially, it's not easy to get funding, and so they end up feeling like they have to write grants all the time, which is, in part, true. So they spend time writing their manuscripts and writing grants, so they don't have, I think, quite the pleasure that we had the opportunity to have.

Williams: So when is it their responsibility to write the grant, and when is it your responsibility to do it, or is a collaborative effort?

Knight: Well, if we're talking about young faculty, that's their responsibility. That's what they do, because they are developing into young investigators, independent investigators, which means that they're going to have their own grants. So when you have students as predoctoral students or as postdoctoral students, they can write for their own grants, but that's always done in collaboration with you because you're the mentor and so you're helping them learn how to write a good grant. But once they get an independent faculty position, then, in general, if they're recruited into a department like mine where everybody is independent, then they are expected to get their own grants. Nowadays with kind of the big-science approach, people can be recruited into a huge group of people, and then they may not have to write their own grants, but at some point, it's really good for them to know how to do it, because you never know when you might need to.

Williams: So then what are the grants that you're writing?

Knight: Well, I'm writing grants for my own. Well, one I write, I'm director of the training grant, so I write the training grant. Then I have to write grants for my own lab, just like everybody else.

Williams: I got the impression a moment ago that it can be extramural, you can have people from various facilities or various institutions collaborating on a grant.

Knight: Oh, yes, absolutely. Yes. Yes, that's right, you can, and that's the trend nowadays is you find somebody who's doing something very similar which synergizes with what you're doing and you sometimes will write a grant together with them. So, yes.

Williams: That leads me to another question I'm curious about. What is Chicagoland like as a community for scientists in your field?

Knight: That's really a great question. For many years, I think thirty-five years, we had what was known as the Chicago Association of Immunologists, and we started at the University of Chicago. Actually, we met down there, actually at a hospital associated with them, Michael Reese. It was wonderful because we would meet down there for dinner and somebody would make a presentation based on their work, and there were probably, I don't remember, twenty people or something, maybe twenty-five.

Then, of course, the field started to grow, and so the meeting changed over the time and ended up in different places, but still people came, and it was wonderful environment for students because they could come and they'd learn what senior people in the city were doing. So everybody pretty much knew what everybody else in the city was doing.

Now Chicago is a really wonderful place for this. We are six medical schools in the city of Chicago. So there's a lot of research. For us at Loyola, we're just nine miles down the expressway to University of Illinois and to Rush University and then another three miles to Northwestern, to the Medical Center. So these four institutions are really quite close together, and, of course, University of Chicago isn't very far away.

So everybody, I think, in the immunology community pretty much knows what everybody is doing, and certainly all of my interactions, especially because I was at Illinois and, of course, I knew all the people at Rush who were right there quite well. So we all get along really well. And also from University of Chicago and Northwestern also, so you can call any of them on the phone and ask, and everybody's really very helpful.

Plus we have what used to be called the Midwest Immunology, it's now called the Autumn Immunology because they didn't want to localize it to the Midwest, but it is mostly midwesterners who come to this. But it's always held in Chicago in the fall, and so it's immunologists from all over the Midwest and other people now have started coming, but it's mostly midwesterners. It's a wonderful meeting because every student and postdoc who does a poster—well, anybody who does a poster automatically gives an oral presentation. I think, you know, now one of the things that's happening with graduate education is that people are getting so focused on their research, bench research, so fast, and that they don't always have the chance to present their work and learn how to present it. So their mentors need to take time to help them present it. So here's a case where every student and fellow, everybody who presents their poster automatically does an oral presentation in a workshop. It's fabulous because now you really get a chance. Students, you know, they're scared to death the first time they do it, but it's invaluable.

Williams: Repeat the name of the organization now.

Knight: It's the Autumn Immunology Conference, AIC, is now the name of it, Autumn Immunology Conference.

Williams: Let's talk about AAI for a little while. You joined in 1968.

Knight: Right.

Williams: So you've had a forty-four-year association with the organization.

Knight: I guess that's true, right.

Williams: And over those years, how has it changed?

Knight: Well, when I joined, it was a very small organization, actually. Of course, the number of immunologists has risen enormously. My postdoc mentor, Sheldon Dray, was very involved in the AAI in the early days. He was secretary/treasurer for many, many years. So the AAI at that time was kind of a small, intimate group that just was promoting science, promoting immunology. Then it's really grown enormously over the years, and now to think that, for example, we are doing these oral histories of these former presidents is quite remarkable.

I mean, AAI has now diversified, and probably one of the most important things that they've done over the last several years and continue to do is public affairs, because everybody recognizes the need to be educating the public and helping, especially Congress, most of all Congress. And AAI has done a wonderful job with that, often in conjunction with FASEB, the Federation of American Societies of Experimental Biology. So that's an extraordinarily important role that AAI has played, and they do it really very well.

Williams: What about the number and role of women in the organization over those years?

Knight: Of women, you say? Oh, it has grown enormously. Now there's probably, starting about maybe twenty years ago—where are we now, 2012? Maybe about twenty years ago that there were enough women in the field that there were choices to make in terms of having women as presidents there, I mean on the council and eventually to be president.

So before that, for many years there just weren't many people, many women in the field, but now that's changed dramatically. So, no, women are very prominent in the society. I think now if you look at the content or the makeup of the council over the last, say, ten years, it's probably close to fifty-fifty. So AAI has made, I think, a concerted effort to make that happen.

Williams: But in the early days, the women in the organization didn't feel like they needed to coalesce for protection or—

Knight: I may not speak for most women, but because I had two mentors, Felix Haurowitz at Bloomington and Sheldon Dray at Illinois, that were really extraordinarily helpful, and I never had the feeling that I was any different than anybody else, so I never thought about it too much. I would hear it sometimes from other women, but I didn't really experience that so much myself.

Williams: In '91 you went on the council at AAI.

Knight: Right. Yes.

Williams: So talk a little bit about council service.

Knight: Well, council, basically it's really to help make the organization work, so we had to make decisions. One of the major things that the organization did, especially at that time, was *The Journal of Immunology*. *The Journal of Immunology* has been a fabulous vehicle for immunologists to publish their work, and it's a very high-rated ranked g-index. So the council was responsible for *The Journal of Immunology*, so that was a large part of what we did, and then thinking about the finances and how to pay for everything that we needed. Plus I would say it was kind of the time that the AAI was really growing and diversifying, became really very active in public affairs, and Michele Hogan came on and has really enhanced the whole AAI process and helped make all of the systems work, and especially, I would say, public affairs to a large extent.

In addition, now AAI has enormous numbers of awards, which is quite remarkable. So they're all financial awards, so it gives AAI a lot of visibility. They got money from a lot of corporate organizations who contribute, and so it gives a lot of visibility to immunology. I think for young people it's really good, so when they come to the AAI meetings they see these really senior people—not all senior people, actually many of them junior, but who have done extraordinarily well, and so they give lectures. So it's really enhanced immunology as a discipline, as well as really reaching out to try to take care of young immunologists, which is, I think, what a society should do. You don't want the society for the senior people; you want it for the young people.

Williams: So you became president in '96, from '96 to '97.

Knight: Yes.

Williams: What were your aspirations when you came into office?

Knight: Well, I think there was a time where—it's always the case, but right where it's about money and are you going to have enough money to do what you wanted to do. One of the things that I really wanted was to try to make a push to get people involved in public, because I thought it was really important that—you know, most people in our society don't know very much about biology, much about science really at all, and especially probably biology. So I really was trying to see if we couldn't find ways to get people engaged in public presentations and trying to find ways we could help with K-through-12 education, so really trying to get people to think more about how to communicate more with the public, because it's become so clear that it's Congress that pays for our having fun in a lab, and Congress is the public. So I think we all have a responsibility to try to help facilitate people learning about the importance of what we do.

Actually, in our graduate program here, all our Ph.D. students do two public presentations. They do one in their first year. Often now they're attracted to schoolchildren, so they go out and give a presentation. They find a school and go out and give a presentation on any topic they want and to whatever grade school,

whatever level it is, sometimes it's high school. Each person does that, and then before they finish their Ph.D. thesis, so before they graduate, then they go out and give another presentation, usually on some aspect of their thesis to a different group.

I feel very strong that we need to be doing more of that. We actually had started—I had started here a mini medical school, which was actually like one that had been going on for Congress. So we had, like, eight weeks of lecture once a week for the public to come. So we would have maybe 100, 150 people come every week for eight weeks to a lecture, either basic science, clinical, something, but with the goal of trying to educate them about science. So that was one of the things that I had in mind.

Williams: Were your arguments persuasive generally across the membership of the organization?

Knight: Well, it's hard to know, you know. I think the difficulty is that as scientists, and especially now writing grants and all the things that you have to do, when you think about that you're teaching formally in classrooms, if it's in medical school, you're teaching medical students, or undergraduates if it's undergraduate, you've got students in your laboratory, you've got postdocs in your laboratory, you have all the papers to write, the grants to review, to review and write, plus the reviewing of manuscripts. So there are so many different things that people have to do, that you really have to make choices. You'd like for everybody to want to go out and do some of this public education, but not everybody is going to be able to find the time to do it. So what you hope is that you find some people, interest some people in doing it.

Williams: Do you have some memorable moments of association with AAI, things that occurred or exciting or unusual or happy-happy?

Knight: I think the main thing for me with the society, with AAI, is you know everybody's there. Everybody who's doing anything that's of interest to the kinds of things you are in science and immunology is there. You know how to find them. You walk down the hall at the meetings, for the annual meetings, for example, and so most of the business, so to speak, at meetings, I think takes place outside the lecture rooms. You see somebody's abstract or whatever, and you see them in the hallway or at the cafeteria or at the restaurant, over coffee, and then you start to talk to them.

So those are the kinds of things, and that's really through the annual meeting, I think. Plus the annual meeting is so important for junior, for students and postdoctoral fellows, because that's where they have this moment of, "Oh, that's Dr. So-and-so?" So it's an extraordinarily valuable undertaking.

Williams: Now, you were AAI's representative to FASEB for quite a while.

Knight: Yes. Right.

Williams: Talk about the two organizations an entities.

Knight: Well, the FASEB is really a much bigger organization, and now FASEB has become even larger because they've taken on a lot more. It used to be, I think I said, five organizations. Now it's many, which makes sense, because they need to be the voice for biological research, biomedical research, and the bigger the voice they are, the better.

Their main thing has been really about educating Congress and the public, and one cannot underestimate the importance of that. Most of us think, well, we write our NIH grants, and we get money, and then we stay in our lab, but people have to understand, scientists have to understand what that goes through, how you get Congress to give a budget to the NIH. The wonderful thing is that it is the one part of the government that both sides of the aisle agree on, is supporting the National Institutes of Health. Maybe they could understand a little more an opportunity that they could be taking advantage of right now if they paid more attention to it, but, still, it is a wonderful thing that we have them supporting the NIH. And FASEB is a huge voice in trying to help Congress understand and reach out to Congress members from all over the country.

Williams: Do they do that by hiring professional lobbyists or by using—

Knight: Yes. Well, they do both. I mean, it's like with AAI, we have professional now education people, I mean public affairs people, and there's a Public Affairs Committee, which is extraordinarily important and do a wonderful job. So each society has it, but FASEB also has it.

Williams: In-house people, or they go to Patton Boggs or any of the other—

Knight: No, mostly they have in-house. They have their own people who do the public affairs.

Williams: Did you make visits to the Capitol Hill at any point?

Knight: Yes, yes, I did. Right.

Williams: What was that experience like?

Knight: Well, it's very interesting because, you know, you meet the assistants and they're very smart young people. They're all young people. They're very smart. So you go in, and we always went with the public affairs person from AAI, but you can go certainly on your own. But I think initially it's probably nice to go with somebody who knows the ropes and how to introduce you. But I have found

them to be really very helpful, very interested. You never get anything too definitive from them, but you're educating them. So I think that's the key point, and they hopefully will relay the information to the appropriate congressperson. But it's really a very wonderful environment because these are very smart people who are interested.

Williams: Would you go, just you and an AAI person, or was it a team, a group of people?

Knight: No, I usually went just with the AAI person, but you certainly can do either, and there are all formats to do it. And what you do, too, is you always encourage people to write your congressperson especially when there's an important issue. That's what both FASEB and AAI do really well now, is they send out an email to the whole constituency and say, "Here's an issue you probably ought to be addressing," and they give you ideas about what to say and how to say it and so on. So it's extraordinarily important, I think, that people do that.

Williams: You mentioned Representative John Porter at one point.

Knight: Yes.

Williams: I've heard his name come up other times. Talk about his support.

Knight: Oh, John was remarkable. He was just on the North Shore up here in Illinois, north of Chicago, and he was so much in favor of the NIH and of putting money into the NIH budget. So he was a major driving force for that. And the AAI then sometimes will pick out people like John Porter who are such strong supporters of the NIH and give them awards, give them some announcement of appreciation for their contribution. No, unfortunately, John is no longer there. He was a major supporter.

Williams: Are there other members that come to mind in his category, or is he pretty special?

Knight: Well, he was really, I think, quite unusual, but there are others, certainly. I can't come up with their names right at the moment.

Williams: Then you also were representative to IUIS, the International Union [of Immunological Societies].

Knight: Yes. That was quite a long time ago. Right.

Williams: But any remembrances or thoughts about that?

Knight: Well, I think the IUIS, it's an important organization also, because it's the International Union of Immunological Societies. What it does is they have a meeting every three years, and it's distributed around the globe, different places.

It's so valuable, I think, because you get to meet colleagues from countries where you might not usually meet them. One year we were in Hungary, for example, and so you got to meet lots of the Hungarian scientists. So no matter where you go, you meet people that are doing science, that don't have all the money and the equipment and things, resources that we have here, but it's so moving to see how they are actually able to do such good science, I think, in some of these environments, and so you're always happy to see how you can help them, what you can do to make it better for them.

Williams: Was the experience of attending their meetings at all redolent of your years at Basel, sort of back in that atmosphere, or no?

Knight: Well, not quite, because Basel was something really unique. Basel was this group of, say, maybe, I don't remember, twenty or thirty scientists, or forty, I've forgotten, and everybody with their own technician, research technician working with them. So it was just everybody was just free to be thinking. When you got to the International Congress, everybody's presenting their work, so it's quite a different environment.

It's wonderful in its own way because you have a chance to meet these other people who just don't have the kind of resources that you do and opportunities that you do, and so you really can be more trying to be helpful to them as well as certainly learn from them, because they come with whole different kinds of problems and issues that you don't think about, but can be actually very helpful to us.

Williams: Now, of course, another trend in medicine is that foreign students or faculty people are becoming so much more prevalent in this country.

Knight: Yes. Right.

Williams: Talk about that a little bit.

Knight: Well, that's a very interesting issue, you know. Of course, the NIH, in the training grants, we cannot put foreign students on the training grants. They have to be a green card or an American citizen. So, I mean, you can understand that because NIH is public money. There are many, many wonderful foreign students who want to come here to be trained, and some of them, they are fabulous. So it's really essential, I would say, to our economy and to our research process here, because they come, they're highly motivated, they work hard, they're just wonderful, and they bring such a diversity. So I think it's a terrific thing.

Now, sometimes the difficulty is you want to be sure that you're getting somebody who you think can do well, because if they come here and then they have academic difficulties, it becomes difficult. So you would like to choose students who you think are really going to make it, and, boy, they are wonderful

when you find them, and they are essential. I mean, there's a lot of talk about right now they have to go back, most of them have to go back if they come on a J, on a student visa. So really we're losing. Now it's the brain drain, and we need to be keeping some of those people.

Williams: Looking at some of the pictures from your site online, it seems like you have quite an international group of people here.

Knight: Yes, right. Yes. I've always had. I have had four either technicians or one's a physician, actually, a surgeon, who's worked with me now for twenty-five years. Two of them are Chinese and one is Indian. One's American. Of the students, it's quite a mixture.

Williams: Let's do some general summing-up here.

Knight: Sure.

Williams: Looking back over your career to this day, have you been happy with the choices you made or have you second-guessed some things you've done?

Knight: No. I can't imagine having a better career, actually. I can't imagine having more fun. The idea that you can go into a lab and that you get money, go into a lab and to do the kinds of things that you enjoy and just the everyday intellectual exercise, however small it might be. You go home and you're in the shower in the morning or night or whatever, and you're just always thinking about, what does this little immunofluorescent cell mean?

Then when you have the opportunity to combine that with working with young people and helping them develop their scientific minds and end up to be an independent scientist, I mean, it's just a wonderful career. So, no, I can't imagine doing anything differently.

Williams: Now, what about dead ends that you experienced in your career? Did you have any of those, and how did you adjust?

Knight: You always have dead ends, because that's the way science goes. You have an idea, you try it, you test it, and it doesn't work, so you move on to the—you learn what you can learn. So I don't think there is such a thing as a dead end, because you always learn something. I mean, if you're really trying to set up a technique that never works, well, that I guess you could argue is a dead end. But, again, it depends on what you're trying to do, so you find another way to go at the question. So in science, I don't think there are really dead ends as such; they're opportunities.

Williams: Can you give an example?

Knight: Well, let's say you might be looking—this is not an example of mine; I'm just thinking about it. But say you're trying to make a vaccine against some new disease or whatever, and every one you make, it has defects in it. The animal gets sick or it doesn't really cure it or doesn't whatever. You can go on this way for twenty years. Have you hit a dead end? I don't think so, because you always learn something. You say, "Well, this method doesn't work. I'd better try a different one," or a different antigen or a different whatever. So it's just about choosing your question that you're really interested in and then finding ways to pursue it.

Williams: In your '97 presidential address, you called that moment in time an epical moment.

Knight: Yes.

Williams: Did it pass, or are we still in that, or where are we?

Knight: Well, one of the things I talked about there was my concern over what I mentioned earlier, about the kind of secrecy in science. I think, unfortunately, it's a little even worse than it was. That was kind of the beginning. I don't know the beginning, but it was early on. But it's gotten a little worse now, and I think part of it is because of the grant situation where people don't really want to tell everything, for fear that somebody else will—I don't know what, it won't get funded. Anyhow, they somehow feel that, so it's this secrecy in science, which I think it changes the field enormously because you don't have this free communication.

We had an interesting issue right in this room, actually, some years ago where a postdoc came and was talking about his research, and he came to a place and he said, "We did this, but I can't talk about it."

So he went on, and for a second I thought, "Wait a minute." I waited a minute, and then I said, "Excuse me, can we come back to this? What do you mean you can't talk about it?"

"No," he says, "I can't talk about it because we're thinking of writing it up as a patent," and whatever.

I said, "No, you've got this wrong. This is here, you have to be open and you have to be able to talk about this." There are always issues that maybe some details you can't give, you don't have to spill all the beans, but in terms of talking about science and what it means and so on, you have to have that kind of openness to be able to do that. So everybody here knows that's there's nothing that—

Williams: Were you successful in springing the information or did he resist?

Knight: Well, that's a good question. I don't even remember, because what it ended up being was I thought it was a moment, because it was a room filled with students, and I thought, "This is really a time and we need to set the standards of what science should be like." I don't remember what his response was.

Williams: You also mentioned way back then the incursion of venture capitalists into the field. Has that grown?

Knight: Oh, sure. Yes, right, because anytime you get a venture capitalism, again, it goes with secrecy. So I think that it's always something, and now, you know, with being more and more difficulty getting grants, people are kind of seeking money from wherever. As an investigator, I think what you have to try to do is there are certainly some things that you're not going to be able to—until they're patented or whatever, until they're protected, you have to be careful. But I think a lot of it is, too, think that if you're a company versus an academic, the company is there to protect their assets, and they're the ones who are usually driving the papers to be signed. So I think as an academic, we have a responsibility to be very careful about what we sign on for and that there are certain things that we have to have, say that they can be open access. So we have a responsibility to help that process because I think industry, understandably, would want to have everything secretive. So that's a responsibility we have as academic scientists, is to try to make it as open as possible.

Williams: What do you see for the road ahead for immunology?

Knight: Oh, gee, it's exploding. When you think about what's happening now, I think in the end—I don't know in the end, but I think vaccines are now kind of—there are new avenues for trying to make vaccines, and vaccines for a lot of different diseases. It's not so many years ago we didn't understand what—we used to talk about an innate immune system and an adaptive immune system. Innate means just what we have, and adaptive means what we generate in response to the microorganisms. But we didn't know anything about the innate system, and we used to talk about it and we'd teach it to students in, like, five minutes and say, "Well, it's tears. It's a few things that somehow help somehow prevent bacteria from growth."

But now we know so much about the innate immune system and how it directly interacts with the adaptive immune system and how this innate system is becoming so essential in a lot of different diseases. So I think now that understanding, as well as the understanding—the other major piece, I would say, is with the microbes. Of course, I'm a little biased about the microbes, but I think it's becoming so clear that the microbes that we have at any one time in our gut, for example, probably they are responsible or at least contribute to a lot of different diseases that we never thought about, I mean, obesity, probably maybe even some cardiovascular diseases, a variety of things.

Now we're beginning, we can do the sequence, the microbiome, so to speak, so we can know about all the bacteria that are in our gut or in any other area and start correlating that with different diseases. I think you're going to see a major impact of that on the immune system, because those bacteria certainly affect the immune system. The whole thing is, one major thing is we have bacteria. We have what some people call good bacteria and bad bacteria, or we call good bacterias commensals or sometimes beneficial microbes, versus the pathogens.

So I think one of the most important questions is how does the host know, when it sees a microorganism, when it sees a bacterium, how does it know whether it's a good one or a bad one? So we still don't understand, but that's all intimately involved with the immune system. So I think we're going to end up being able to treat probably a lot of these kind of chronic diseases that have really not been able to treat before.

Williams: How important have technological developments been to the pursuit of science in your area?

Knight: Oh, lord, it's huge. I sometimes think back and kind of the three major techniques were of, I would say, the developmental monoclonal antibodies, because that has revolutionized not only immunology but all biomedical fields now, biological fields, because you can make very specific antibodies against very defined antigenic epitopes, we call them. So that has revolutionized the field.

The other, of course, molecular biology, that's an absolute essential. But I mean, once we had molecular biology, the tools of molecular biology, immunology as well as all the biological sciences has just exploded. And the other one that I often think about is the ability to clone. Certainly for immunologists it was the ability to clone T cells. So T cells, you know, are really important lymphocytes in the immune system, and every T cell has a specificity for a different kind of antigen, so to speak.

So if you wanted to study those, let's say you wanted to study the T cells that are involved in some particular autoimmune disease, you have to sort those out from the thousands and thousands or millions of other kinds of T cells. So how can you do that? Well, now it turns out that you can clone. This is not DNA cloning, but you can take a cell and you can clone it. So you can get a large cell of one coming from a single kind of cell. Then it allows you to study those cells.

So those are, I think, and now, more recently, of course, with all the confocal with the high-level microscopy is now you can actually see live cells and you can introduce molecules into them and watch where they go. So it's revolutionizing cell biology in addition to immunology.

Williams: Do you ever on occasion talk to people in the manufacturing industries about what you need or consult with them? What's the crossover between academic and—?

Knight: Well, there's a lot. It depends. I have not gone the route so much of industry, but mostly because I'm really much more kind of basic science, although we have Abbott Laboratories right here in Chicago, and so I've had a lot of contacts with them. So I would say it's variable. It kind of depends on the work that people are doing and what they need, but certainly in immunology as a whole, the interaction with industry has been wonderful and really very growth-promoting, I would say, for both parties.

Williams: You used the term quite a while ago, "scientific mind," development of a scientific mind. So talk about what that is.

Knight: Well, yes, I like to think about that that's what we're doing with all our students. The student comes in you and can teach them to do a few techniques, and they can get data, but they're acting then like a technician, and so what you want to help them do then is to start to have their own mind and being able to think creatively about designing an experiment, thinking about the controls that go with it, then obviously doing the experiment, but then that's technical. But then once you get the results, what do they mean and how does it relate to the question that you originally asked, and what does it mean in terms of what you're going to do next?

So it's really having this whole process, thought process about this evolving thing of what you do with data, how do you go after data, what does it mean, what's the real question that you're asking, how does the context of the bigger question? So it's being able to think about all of that. So I think that is a job as a mentor of students. That's what we have, is to develop a scientific mind.

If you talk about what I think the challenges are to the field, I think now there's a lot of interest in getting students to get data and to get publications, because it's publications that get you your postdoc or your academic position or whatever. But you want to be sure that you aren't losing this development of the academic mind, because publications are one thing, and they're extraordinarily important, obviously, but it's much more than that. So you want to be sure that you're giving the students really the kind of education, kind of broad education, I think, that allows them to really develop this mind that's going to be creative and think in depth about a particular project and be able to come to it from many different points of view.

Williams: I mentioned offline a while ago that one of themes of this interview is the social aspects of being a scientist. Summarize your views on that.

Knight: Well, to me science is about relationships. It's really relationship-driven, I think. It's very hard anymore to have your own little lab and be in there and do science in a vacuum. I mean, for me, it wouldn't be much fun. For some people it might be, but for me it wouldn't be much fun. I think the greatest pleasure is actually talking to people and learning about what they're doing and thinking about how what they're doing can influence you and maybe what you're doing can influence them. So it's all about these relationships, and the relationships are priceless. For me, it's what makes science what it is because it's all about interactions and learning from each other and contributing to the whole knowledge base of everybody. So it's just not done in a vacuum.

Williams: One question I've been asking everyone is what does a scientist do for fun. I think you've just explained it, but, I mean, do you have extracurricular interests?

Knight: Well, outside of here, yes, I would say probably the main thing is the opera, is the opera and then the symphony. Of course, in Chicago we have a world-class symphony and we have a world-class opera. So I have season tickets to both of those and take full advantage of that. Then, otherwise, it's trying to stay healthy with exercise and entertaining at home and visiting friends, visiting with friends, and doing just those kinds of social things.

Williams: Are most of the friends scientists?

Knight: No, actually, most are not. [laughs] I live downtown Chicago and so they're mostly people who live—they're in all different walks of life. They're artists, social workers, bankers, investment people, hospital people.

Williams: Not a former senator and now president?

Knight: No, no, I have not met him [Barack Obama]. [laughs] He lived on the South Side.

Williams: Have we left anything unsaid today, anything you'd like to explore a little bit more in this opportunity?

Knight: No, I don't think so. I think that if I think about the future, I would really come back to this idea—in a way, it relates to your question about the scientific mind, because I think the the challenge for the future, and especially with the funding difficult, young people, students, they see their mentors struggling to get funding, so they can sometimes get a little worried about whether or not they're going to be able to make it.

I think that we want to be careful not to go on the side of getting students—the idea is that if they have a lot of publications, they're going to do well. That's partly true, but there's this other aspect of really giving students—to me, to get a Ph.D., to generate and develop a scientific mind takes time. You can't just walk

into the lab and do a bunch of experiments and get a bunch of papers and then you've got a scientific mind. It is going to go on. It may get you a good postdoc and it may even get you a good faculty position, but it's not going to give you what you need in terms of the long run, because, as you said, you have to change your tactics.

What happens when get a, quote, "dead end"? What do you do? You can't get a dead end. You've got to keep going. You've got to figure out another way to try and approach this. So you want to make sure that people who are coming out with their Ph.D.'s really have that background, because, for me, I always tell my students that the clock starts the day they walk to their postdoc, because up until that time they should be trained with a scientific mind to know how to do science. That's what they should come out.

Once they goes to postdoc, then the clock starts. Now you've got to be productive. Before then, you've got to learn how to do science, but then you've got to be productive. So my concern is that this productivity is getting pushed back into the early graduate-student years, and so that they don't have this time to make mistakes. They've got to try things.

Williams: What about nonacademic careers for your students?

Knight: Oh, there are many now, of course, and, as a matter of fact, there are many fewer academic possibilities than there are nonacademic. In our program, one of the things we do is we put a lot of emphasis on communication skills. So I, for example, have being doing it now for twenty-plus years since I've been here. We have a what we call first-year journal club. So all the first-year students come and they take turns. It's like five or six of them. They take turns. So every week one of them chooses an article, any scientific article, any discipline they want, and they present it. They present it in just a synopsis, fifteen, maximum of twenty minutes. We videotape it, and then we sit and watch the videotape together and talk about what works and what could work better with the audience, does it connect with the audience, what doesn't. So I think this is one of the things that students really need, is to learn to be able to present their work.

Now, I forgot what your question was, though. [laughs]

Williams: Alternative careers in science.

Knight: So that's part of training them, no matter what they're going to do. They've got to learn to talk, and talk in a public forum. We do it so it's really rigorous scientifically, but if they can do that and do it in a way that people can understand no matter what discipline they're doing it, talking about, then they'll be fine, whether they go into academics or into industry or into government or whatever it might be. Communication skills are so extraordinarily important.

Even though I always think, well, we're training them. Of course, we train them to be like us, but, of course, there aren't that many jobs like us. But I happen to think that if we train them to do what we need to do, in terms of being able to communicate, in terms of being able to do good science and to think clearly, rationally, then I think they're prepared to go out and do any of these other kinds of scientific jobs that they might want to do.

Williams: Like, for example?

Knight: Like in industry, for example, if they're going to go and be a project leader there, they're certainly going to have to write, they're going to have to communicate, they're going to have to work with people, which I think is also essential that you help them learn to work as colleagues with people as part of the graduate school. Say, if you're going to be a program officer at the NIH, you've got to have scientific background, you've got to have good interpersonal skills, good communication skills. So I think for most things you would do, those are the kinds of skills that you want to help people develop.

Williams: Are we done?

Knight: I think so.

Williams: Thank you very much. This has been wonderful.

Knight: Thank you. Thank you.

[End of interview]