CHEMICAL HERITAGE FOUNDATION

LILIANNA SOLNICA-KREZEL

The Pew Scholars Program in the Biomedical Sciences

Transcript of an Interview
Conducted by

William Van Benschoten

at

Vanderbilt University
Nashville, Tennessee

on

19-20 April 2004

(With Subsequent Corrections and Additions)

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LILIANNA SOLNICA-KREZEL

1961	Born in Cieplice-Sląskie, Poland, on 12 May

Education

1985	MS, Molecular Biology, University of Warsaw, Poland
1991	PhD, Oncology, University of Wisconsin-Madison, McArdle Laboratory for Cancer Research

Professional Experience

	Massachusetts General Hospital
1991-1995	Postdoctoral fellow, under Dr. Wolfgang Driever
	Vanderbilt University
1996-2001	Assistant Professor, Department of Molecular Biology
2001-present	Associate Professor, Department of Biological Sciences

Honors

1978-1979	Champion, National Contest in Biology for High School Students, Poland
1986	Distinguished Publication Award, Polish Ministry of Science and Higher Education
1989	Wisconsin Power and Light Foundation Fellowship in Cancer Research, McArdle Laboratory for Cancer Research
1997	Basil O'Connor Starter Scholar Award, March of Dimes Birth Defects Foundation
1998	Pew Scholar in the Biomedical Sciences Award

ABSTRACT

Lilianna Solnica-Krezel was born in Cieplice-Sląskie, a small village in the mountains in the southwestern part of Poland, but grew up in Sandomierz, Poland, at a time when the country was still under the communist regime. Despite some limitations due to the political situation, Solnica-Krezel had a happy and normal childhood: she enjoyed reading and spending time on her grandparents' farm during the summers. Her older brother's interest in medicine (he became a doctor) fostered an interest in science, and an excellent, free educational system provided many opportunities including biology projects in high school.

Solnica-Krezel attended Warsaw University for a master's degree in molecular biology, specifically studying developmental genetics and working on changes in chromatin structure during gene expression; she attended the University during the Polish Solidarity Movement. In the summer of 1985 she took a predoctoral fellowship in Thomas Schreckenbach's laboratory at the Max-Planck-Institute in Martinsried, Germany, and analyzed gene expression during sporulation in *P. polycephalum*; then she became a research associate in the laboratory of Professor Kazimierz Toczko at Warsaw University, working on the characterization of nuclear HMG proteins from *P. polycephalum*. Wanting to receive her doctorate, and after hearing about the University of Wisconsin from a friend who matriculated there, Solnica-Krezel accepted an offer from the university to undertake her doctoral studies in the laboratory of William Dove. Her graduate work continued in the area of genetics, though this time focusing on changes in composition and organization of microtubular structures during the amoebal-plasmodial development in *P. polycephalum*. Solnica-Krezel then moved on to Wolfgang Driever's laboratory at Massachusetts General Hospital for a postdoctoral fellowship, where she researched zebrafish embryo mutagenesis and cytoskeletal structure and gained insight into Driever's laboratory management style and his grant-writing process. She then accepted a position at Vanderbilt University, where her husband, a structural biologist, also accepted a faculty position.

Solnica-Krezel discusses the process of starting up her laboratory, as well as her research on patterning, morphogenesis, and mutant screening in zebrafish. She also describes various aspects of her life as a principal investigator, including her role in the lab, her administrative duties, teaching responsibilities, travel commitments, and the process of writing journal articles and grants. She discusses broader issues related to the science community: the national scientific agenda, the privatization of scientific research, competition and collaboration, and the role of scientists in educating the public about science. Solnica-Krezel's speaks about the gender and ethnic makeup of her own lab, and notes the gender imbalance in her department. She also comments on the environment science provides for women, as well as underrepresented groups. She concludes the interview by discussing the impact the Pew Scholars Program in the Biomedical Sciences has had on her career.

INTERVIEWER

William Van Benschoten, Interviewer, UCLA Oral History Program; BA, History, University of California, Riverside, 1990; MA, History, University of California, Riverside, 1991; C.Phil., History, University of California, Los Angeles, 1995.

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INTERVIEWER: **William Van Benschoten**

LOCATION: **Vanderbilt University**
Nashville, Tennesee

DATE: **19 April 2004**

VAN BENSCHOTEN: I'm going to mangle your name, so I'll let you say it.

SOLNICA-KREZEL: Okay. Lilianna Solnica-Krezel. Or Lila, as my friends call me.

VAN BENSCHOTEN: Where were you born and when?

SOLNICA-KREZEL: I was born on May 12, 1961, in Cieplice-Sląskie, which is a very small village in the mountains in the southwestern part of Poland.

VAN BENSCHOTEN: As you were saying earlier, you actually didn't grow up there. You spent two years there, right?

SOLNICA-KREZEL: That's right. That's where I was born, and when I was two years old, my parents [Mieczysław and Maria Solnica] moved to a small city called Sandomierz, which is located on the Vistula River in Poland in central southern Poland.

VAN BENSCHOTEN: What was it like growing up there? How would describe it to someone who had never seen it?

SOLNICA-KREZEL: It was a very interesting time and place. It was a small and quiet place. It was also a time when the Poland was still under the Socialist or Communist regime, and my choices in terms of entertainment were rather limited. So there was very good public education, but in terms of access to TV, that was very limited to TV programs at the time on Polish TV, very limited access to movies and other types of recreation, so it was very simple growing up.

VAN BENSCHOTEN: You move eventually to Warsaw.

SOLNICA-KREZEL: That's correct. When I was eighteen years old, I entered university at Warsaw University in Warsaw to study biology and eventually receive a master's degree there.

VAN BENSCHOTEN: Let's start with some family background. Maybe if you could start with your mother's parents [Jan and Marianna Regiel]. Talk a little bit about them, maybe about where they were born, what they did, etc.

SOLNICA-KREZEL: My mother's parents were farmers, and they lived in the eastern part of Poland. My grandmother, Marianna Regiel, I knew her. She died only a few years ago. I never knew my grandfather, who died very young when he was thirty years old. So actually, my mother just knew him, has very small memories of him. So my mother was raised practically by her mother and her older siblings, an older sister and a brother. She was born in 1935; therefore, a big part of her childhood happened during the Second World War, so that was a pretty traumatic childhood.

Immediately after the war was over, she was just a teenager. She completed very basic education, and she started to work when she was fifteen years old, sixteen years old. Very soon after that, she moved to the western part of Poland, which was the part of Poland that Poland received after the Second World War previously belonging to Germany, and there she met my father. She started to upgrade her education at the time, and then, finally, as I said, when I was two years old and with my older brother [Bogdan Solnica], they moved to Sandomierz.

VAN BENSCHOTEN: Talk a little bit maybe about your father's parents [Józef and Józefa Solnica].

SOLNICA-KREZEL: They were, on one hand, also farmers. They lived in another very small village called Czerników, very close to Sandomierz, actually. It's just about thirty-five kilometers from where finally my parents moved. They had a small farm, but my grandfather, Józef Solnica, also tended the roads. I don't know what name you would use in English. In Polish, we said it was the person who was responsible for the status of the road and the traffic on the road.

VAN BENSCHOTEN: Interesting.

SOLNICA-KREZEL: Yes, that was. I never heard about these people after my grandfather died, so I don't know if that function still exists. Probably it doesn't. But that was his job.

Again, my father was born in 1933, so a big part of his childhood was also the Second World War, and he completed education after the war, and then he became a teacher. My mother was an accountant by education.

VAN BENSCHOTEN: What about your father's mother? Talk a little bit more about her.

SOLNICA-KREZEL: She mostly tended the farm, because my grandfather was involved in tending the roads. So she was mostly at home and she took care of two sons, my father and his older brother, who eventually was in the Polish army.

So both families were very simple families with rather limited education, because at the time in Poland, possibilities for education were still rather limited. When the Second World War started, it was really just about fifteen, nineteen years after Poland started to exist again on the map.

[tape recorder off]

VAN BENSCHOTEN: How well did you know your grandparents, growing up? I know on your mother's side. Your mother's father, for instance, you didn't know at all.

SOLNICA-KREZEL: I knew them pretty well. Actually, almost every summer I would spend with the family of my mother; it was in a small village in the eastern part of Poland, near Lublin, or I would spend a pretty long time with my both grandparents from father's side. I was actually very fond of being with them.

I spent a lot of time on the farm helping as much as a ten-year-old or eight-year-old can help with the farm business, but I was always fascinated by the life and, in a way, admired the way they lived, a very simple life on the farm. These farms were pretty small farms, and they did not provide big income, but it was a very simple—difficult—but also a happy life. So I spent time with the farmers in the eastern part of Poland and then with my grandparents in Czerników. They had a beautiful garden, and that's what I remember mostly, spending time in that garden, which was always a big mystery to me in terms of the bees and also just the different types of trees. So that was my childhood, not only at school, but just spending time with these families in the country.

VAN BENSCHOTEN: I know in the US [United States] we have a lot of different regional differences, especially from the North and South. I'm wondering, when you talk about West Poland and East Poland, are those distinct differences between the two?

SOLNICA-KREZEL: They are, and they come from several reasons, but one main reason is that—just as I told you—in the twenties Poland started to exist as a single country again, after almost two hundred years of being partitioned and not existing as a country, so there are a lot of differences between the different parts of Poland, depending under which occupation, so to speak, they were.

So, for example, the part of my mother's family, that was in the Russian partition. The family of my father, that was in the Austro-Hungarian partition. There are some differences just in the economy of these regions, but also some influences in terms of language. For example, the eastern part of Poland has a very beautiful accent; you can hear some Russian influence on it. So, yes, there are differences just because of the historic reasons.

VAN BENSCHOTEN: I know, too, that people in the US who grew up during the Great Depression, they have a particular personality. This is generalizing, but there's a certain characteristic that you find: some of them save; they don't throw anything away, probably because of the experience of the Great Depression, having scarcity.

I was wondering, since both of your parents grew up during the World War II, did they speak about World War II very much and the deprivations during that time and the effect of it?

SOLNICA-KREZEL: They didn't, but we often did ask questions, and especially now when I visit Poland, we often, on purpose, ask these questions because we actually are doing our oral history program, because we feel that we really want to know.

We were brought up in the climate of the Second World War, in terms of the movies that we have seen, in terms of the books we have read. That was a very traumatic experience for the whole continent, and even being born in the sixties, the war was over for a very long time, but still the war was in the air, if you will. And that was a little bit influenced by the Russian propaganda as well, because I think the Russians wanted to make a point that they freed Poland from the German occupation. There was this tendency to present Russia as saviors from [Adolf] Hitler, and so there were a lot of Russian movies about the Second World War. But definitely the Polish literature, Polish movies, were very much influenced by that period, and, of course, education at school as well.

Not as much at home, our parents didn't really want to speak about it that much. But then, as I told you, when we now return and even now when my mother visits me, we often ask her questions about that time period, because we are, on the one hand, fascinated and we want to know what happened. I am fascinated: How do you go through your life when you are thrown in these types of circumstances? How do you pick up your life when you are fifteen and you have to start to work; you have no choice, and you have to somehow build your life from not only by your choices, but by simply the reality around you?

I feel extremely lucky in terms of my upbringing, in the sense that I was born at a very peaceful time, and maybe that's something that people here take for granted, but because of this atmosphere in Poland, I very much did not take it for granted. I always feel that I was very lucky being born at the time when I was born, going through life without any war that directly touched me and being able to receive the type of education that I received, and with a really huge effort and support of my parents, not being limited by any outside circumstances.

Of course, there were limitations, because we were under the Communist regime, but in terms of education, I feel that I got the best of both worlds. I got the free education in Poland, which was pretty good, as much as the university could provide education, and then I left Poland and came here and could start the PhD program. So in all of that, I feel that that was a very special type of childhood and growing up.

VAN BENSCHOTEN: I wanted to ask a few more questions about your parents before we move on, and we'll talk a little bit about your education, too, and flesh that out. How about their temperaments? How would you describe your mother, for instance, her character?

SOLNICA-KREZEL: She is very determined person, on one hand, and a perfectionist, on the other hand. Very energetic person, a very positive person as well, and I think this is what allowed her to go through life with the difficulties that she had and succeed in completing her education eventually and rising in the ranks and doing the job that she liked to do. But in everything that she does, she is a perfectionist, and that's something that I think influenced us greatly.

VAN BENSCHOTEN: Why do you say that she's a perfectionist?

SOLNICA-KREZEL: Because she always tries to do everything the best she can, so at work, she was always an extremely driven person in her profession, and the same at home. Just doing anything, from cooking to cleaning to just anything she could touch, she would like to do it the best she could.

VAN BENSCHOTEN: And the same question for your dad. Describe his personality.

SOLNICA-KREZEL: He was a little bit more relaxed than my mom. Not at work, actually. He was very driven at work and very ambitious as well, but maybe at home not as perfectionist in his style.

VAN BENSCHOTEN: Did he have any hobbies, or did either of them have hobbies?

SOLNICA-KREZEL: I would say that my mom did not really have time for hobbies, because at the time when she was working and raising a family of two children, she was also finishing up her education. So actually my timing at home before I left for university, that was at the time when Mom was at the same time going to school, at the same working, and at the same time taking care of the house, so she didn't really have much time for hobbies.

My father read a lot and he was very interested in the Second World War, so that there were a lot of books, and he was fascinated by that period and he read a lot of literature on that subject.

VAN BENSCHOTEN: How did your parents meet?

SOLNICA-KREZEL: They simply met when both of them moved from the place where they lived to this part of Poland that was freed from German occupation. So that was the new land, as we called it. They were starting new jobs. They were very young, about twenty years old, when they met simply in a restaurant when, after work, they were relaxing.

VAN BENSCHOTEN: Did you have other relatives when you were growing up that you were in contact with, that you met, who might be an extended family?

SOLNICA-KREZEL: Both my father and my mother have siblings, and that was my family. So my father's brother was older than he, and he lived in Warsaw. He was in the army, and that was the family that I frequently visited even before starting my education in Warsaw. Then, of course, when I lived in Warsaw as a student, I met them pretty frequently.

Then I already mentioned to you that I spent a lot of time in the eastern part of Poland where my mother was born, and this is where her older sister and, for a while, actually, her older brother also lived, in the same village where she was born. Her sister had a farm, and her brother was a construction worker, and his wife was a teacher, so they had also a little house in the village. Their children were my buddies during my visits there, and we spent a lot of time together. So my family is actually quite big, and I've spent some time with many of them.

VAN BENSCHOTEN: As you were saying off tape, your mom is visiting you now, and you go back to Poland once a year.

SOLNICA-KREZEL: Yes, I go to Poland about twice a year. And now with e-mail, I also keep in touch with my brother by e-mail and some other extended family as well. And, of course, via phone calls.

Before e-mail became very popular and before phone calls became so cheap as they are, we wrote a lot, so I have a huge stack of letters from my mother, a huge stack of letters from my other family, and I keep those. I think I will read them one day.

VAN BENSCHOTEN: This makes my historian's heart happy, because with the advent of e-mail, even though it's very convenient, letters are dying out now. People don't write letters as much.

SOLNICA-KREZEL: That's right. I don't recall when I wrote a letter to my family by hand, but then I also keep all the letters—all the e-mail messages from my brother—so that's a substitute for handwritten.

VAN BENSCHOTEN: How about family activities? What did your family tend to do together? I know you took these summer trips, I assume, then to these relatives.

SOLNICA-KREZEL: That's right. So we would do this together, and with my parents, one of the things we liked to do together besides just going to the movies or watching movies together at home, we liked to play bridge, because my father, my mom, and my brother and myself, that was a natural four. So that's what we used to do in our free time together. We liked to do that a lot.

VAN BENSCHOTEN: Do you still play bridge now when you go back?

SOLNICA-KREZEL: No. Unfortunately, we lost my father, so there's no longer a natural four. He died two years ago. Yes, so no longer that's possible.

VAN BENSCHOTEN: You mentioned movies. Were movies an important part of your life, or was this simply a way of passing the time?

SOLNICA-KREZEL: Movies were always important. I think for me books were more important. As I told you, my choices in entertainment were very limited, so I was definitely a voracious reader at the time. I read literature Polish, Russian, American, British, Latin American, actually. At the time when I was growing up, writers like [Gabriel Garcia] Marquez

and Mario Vargas Llosa became very popular in Poland, and we read them quite a lot. Of course, besides the official literature, there were also some underground libraries of [George] Orwell and others that we could not officially read, but they were circulating among students, especially when I was in Warsaw. So there was a lot of this type of literature that we were reading. As far as my entertainment, definitely books were more important from the very beginning. I started to read when I was five years old, and that never stopped. But movies were important. They were always, of course, limited in terms of what we were shown in the theater, but that was an important window for us.

VAN BENSCHOTEN: This underground circulation of forbidden books, as it were, how easy was it to get ahold of these?

SOLNICA-KREZEL: I think it was not easy if you were not part of university. I think it was mostly connected to people connected to the university. I never heard about anything like it when I was in my little city—Sandomierz—and only when I moved to Warsaw and became a student, at some point this started, and especially after the martial law. I started studying in Warsaw when it was 1980, and that was exactly when the Solidarity Movement first arose and then collapsed when I was studying. And the first year at university really happened in this quite amazing atmosphere of freedom and optimism, and a lot of books, I think, entered Poland at the time, so there was a big supply.

After [Joseph] Stalin died, Poland was a pretty relaxed country compared to, say, eastern Germany or the Soviet Union. As Stalin mentioned, Socialism or Communism fits Poland like a saddle for a cow. It just did not fit, never did. Plus because of the partitions and everything, Poland just, I think, has an inbred gene for disobedience. So we have it in us, and that, of course, doesn't work well for the Polish government right now. But at the time, that was a positive that we always did something to disobey and took every opportunity to do something underground if possible.

VAN BENSCHOTEN: In this reading that you do as a young girl, did it go in any particular direction? Did you specialize in any type of literature, or were you reading all over the place?

SOLNICA-KREZEL: No, I was not reading all over the place. I, for example, was not very fond of science fiction; I read a few books—I tried that—but I did not like that. I was mostly interested in the classic type of literature. I like, for example, crime novels, Agatha Christie. That's how I learned English, actually, by reading Agatha Christie. But otherwise, every now and then I would read a crime story, but I love the classic type of literature. The same with movies; I don't like horrors. I don't like science fiction, every now and then. I like movies just about normal life, actually.

VAN BENSCHOTEN: What was your family's economic circumstances at the time you were growing up before college?

SOLNICA-KREZEL: I wouldn't say that it was very poor, but it was rather modest, just because the whole country was in difficult situation. The country was in complete ruin when the Second World War happened. My parents were from the farm, and these were the poorest people. They entered this new wave of workers who educated themselves and started to work as teachers and as accountants, as my mom, but their salaries were rather low. It was enough to go from the beginning to the end of the month.

Our situation was, on one hand, a little bit more difficult because my brother became ill with diabetes when he was seven years old, and for my parents that was a huge stress because at the time not that much was known about diabetes, definitely not in Poland. So that was a big strain also financially, because they really tried to provide him with sanitoria or hospitals, which were free; however, you had to travel to them, and you had to do all these things that were not cheap. And also in terms of food, they had to provide quality food rather than any type of food. So that was a strain financially on the family.

On the other hand, my grandmother's sister [Rosalia Dyba Regiel] immigrated after the war to Australia, and she was helping the family somewhat. She was sending big packages with clothing. Every now and then, she would also send some money, and that was important at the time for us to live on.

But if you think about certain standards, for example, we never had a car. Sometimes I think it was because my father was a little bit too lazy to drive it if we had one, so I'm not completely sure if that was just financial circumstances. But he was a driver in the army, so I'm not sure. So we didn't have a car, and definitely the financial situation was one of the reasons for it.

I would say definitely we were not rich. We were not poor. I have to tell you that I never felt poor. And when I look at the past, it's actually quite surprising to me, because I think we didn't have many things. But we were a very happy family. I never felt that I really wanted something that I didn't have. Or maybe it was that I simply didn't want things that I knew I couldn't have. And my mom actually points it out to us every now and then: that we were pretty remarkable children, that we didn't ask her for a lot of things she knew she could not provide. And on the other hand, I felt—at the time I felt, and I still feel—that they just went out of their way to make our life happy and give us opportunities.

VAN BENSCHOTEN: You mentioned your brother. How close were you when you were growing up?

SOLNICA-KREZEL: Very close, yes. We were extremely close. It was just two and a half years of age difference, and when he became ill, we were separated for sometimes long periods of time, so that was a difficult moment for both of us, but then when mostly his situation stabilized and he started to spend more time at home, we became very close through reading and just talking constantly about things, spending vacations together. So, yes, we were and we still are very, very close.

VAN BENSCHOTEN: Where does he live?

SOLNICA-KREZEL: He lives in Krakow, which is the first capital of Poland. He's a doctor, a medical doctor. That was the first long separation, actually, that we had when he decided to go to medical school in Krakow and then me, instead of going also to study in Krakow, I decided to go to Warsaw to study biology. But we saw one another pretty frequently, and we were in communication and still are.

So, yes, if you think about people who influenced me, I would say my mother and my brother probably ranked very close on that list.

VAN BENSCHOTEN: Maybe this is a question I should ask later, but I can't because I'll forget, so I'll ask it now. What was that influence? What do you think you got from your brother most?

SOLNICA-KREZEL: I think admiration; that with the difficulties he has with diabetes, he never complains. He never does. He's always very positive and very optimistic, very ambitious in the sense that he wanted a normal life and he wanted to achieve something in life, and he did. He finished medical school and he's a scientist also at Jagiellonian University. He has a family—a wife and a child—and so that I admired in him, that he just wanted a normal life without ever asking for favors or forgiveness for the difficulties that he had.

[tape recorder off]

SOLNICA-KREZEL: So another thing I admired and that actually influenced me was his passion for medicine. He wanted to be a doctor since he was ten years old or so, and he never changed his mind.

I didn't know what I wanted to do when I was a teenager and when I was in grade school. As I told you, I loved literature; I loved poetry. Anything I touched at school, I would be fascinated. Except history, actually; that was not very interesting. Now it changes; I like history, but at the time I didn't. So I actually was planning to focus my education on literature, and my brother, actually, influenced me greatly, first of all telling me that when I was choosing a profile

in high school that I shouldn't go to the humanistic class because that will limit me and I should go to a biological profile because that would give me more possibilities for the future. And he also said that the smartest people go to the biological profile, so I think that was another influence.

But at the time, he was also starting to participate in little competitions in biological sciences, and that involved doing some experiments. He had little fields of peas that he was doing some experiments on, and that was my first encounter of an experiment. At the same time, he was reading a lot about biology, and I was reading a little bit with him or he was just telling me about it. And I became curious and I started to think about biology, not just as a subject, at school. And that's when my fascination with biology started, with him, in a way, pulling me into it.

VAN BENSCHOTEN: I wanted to ask too—you talked about the two most important people being your brother and your mother—about your mother's influence as well. What do you think you received from her? Describe that influence.

SOLNICA-KREZEL: That influence was her own unfulfilled desire for education. Somehow I sensed that in her: that she loved being at school. She loved to learn, and she never really had an opportunity to fulfill that. So by that attitude, somehow I never took school for granted, and I always considered that as a very valuable opportunity. So that was a huge influence, I think. She never pressured me in this way, but that was something that I always sensed: that I'm doing something that she would love to do on her own. And in a way, like very often with parents, it is the children are fulfilling somehow their dreams.

VAN BENSCHOTEN: My other question before we move on: talk a little bit about yourself and your earliest memories, but how politicized would you say your family was, growing up? By politicized, it could be outright activism or just being aware of what was happening politically.

SOLNICA-KREZEL: My father was a member of the Socialistic Party. My mom never was. So the politics was always part of what we talked about. And, of course, especially when the changes in Poland had started and people had started to take sides, we talked a lot about the situation throughout the time when I was growing up, both in Sandomierz and then also when I was studying and coming home, visiting. Then I also had my own views, and we discussed those.

I can characterize, probably, my family as extremely tolerant; the tolerance was a natural thing at home in terms that our parents allowed us to take our own views, and I never felt something was imposed on me in terms of views, and I was allowed to evolve in any type of views that I chose to.

VAN BENSCHOTEN: You talked about your brother's family. You have a family.

SOLNICA-KREZEL: That's correct. I have a husband [Andrzej M. Krezel].

VAN BENSCHOTEN: Could you maybe mention that so we have the picture complete?

SOLNICA-KREZEL: So my husband, Andrzej [Krezel], is also Polish. I met him as a student at Warsaw University. At the time when we were applying to graduate schools, we were just friends. At the time when we were accepted to two different graduate schools, we were more than friends, and we had this notion that, yes, we will finish the PhD's—he, in Maryland and me, in Wisconsin—and then we'll get together. But then we came to US and realized how long it takes to do a PhD in the US, and decided that this idea was not good and we revised this idea, and then Andrzej transferred to [University of] Wisconsin.

But to step back in time and to introduce a picture of Andrzej, who is another huge influence on me: we were very good friends, and also I always admired him during our studies. His interests were always more biophysical than mine. In Poland, university is a little bit different than in the US. You enter not just for four years as here, but you enter for five years, and you finish with a master's degree, and immediately they are very specialized. So we both studied biology, but then we had also an opportunity to do something more. The best students had an opportunity to have an individual course of studies, which at the time was pretty unusual. So I studied biology, but I also studied a little bit of philosophy in certain courses. Andrzej, on the other hand, was studying biophysics, and he is now a structural biologist. So I always admired him as a student and as an intellect, and then we became friends. He's definitely a big influence on me, not just scientifically, but also personality-wise.

VAN BENSCHOTEN: Do you have any children?

SOLNICA-KREZEL: No, we don't.

VAN BENSCHOTEN: Let's turn to you. What are your earliest memories? What do you remember about growing up?

SOLNICA-KREZEL: The earliest memories go to, probably on one hand, to the visits in the country with my grandparents and with my grandparents on the mother's family and also my father's family. If I really reach back for my earliest memory, it would be actually from home—

from Christmas—when magically presents appear under the Christmas tree. I think that's a common one for people to have. So, simply images from home with my family, like Christmas or other type of moments.

VAN BENSCHOTEN: You've already mentioned how important reading was, and we're talking about the period when you're between maybe four and twelve, thirteen, somewhere in there; early girlhood. How did you occupy yourself other than reading? Did you have pets? Did you have hobbies? What else did you do?

SOLNICA-KREZEL: No, we did not have pets. So in the school year, that would be really mostly reading.

VAN BENSCHOTEN: You were quite a reader.

SOLNICA-KREZEL: And the reading could be also just studying, because, especially when I went to high school and I became interested in biology more intensely, then I started to just read about biology quite a lot outside of the curriculum, and so with this and just normal studying and reading, that was most of the time.

I also liked to do work at home and help my mother and grandmother to take care of the house and bake and also just to spend time with my friends, just talk as teenagers do, meet and go for a walk. We mostly would meet at somebody's home for tea or coffee and just have some discussions, so that was also quite a lot of time.

VAN BENSCHOTEN: Let's talk about early memories of schooling. When you start your schooling, do you remember any particular interest? Were you moving in any direction?

SOLNICA-KREZEL: Initially, no, I wouldn't say I was. As I told you, I had pretty broad interests at the time. So I very clearly remember the first years of education, because on one hand, I started in my little city, but later because of some family circumstance, I actually, for several months, was moved to my grandmother's family in the country and went to school there, which was quite an interesting experience to go to a school in the country. But that was just a very basic education without any emphasis on any particular subject, and I would say that through the first eight years of education, I was all over the place. I liked everything, and I was more or less good at everything, mathematics, literature, biology, chemistry, but nothing particularly was interesting.

VAN BENSCHOTEN: Did you happen to have a chemistry set?

SOLNICA-KREZEL: Yes, we did something, but first of all, we wouldn't have like a chemistry set in Poland sold in the shops. It was more homemade types of experiments. Yes, we were doing some experiments with my brother at home.

VAN BENSCHOTEN: You didn't blow anything up, I assume, or did you?

SOLNICA-KREZEL: No, no. We had some little accidents, but nothing of major proportion.

VAN BENSCHOTEN: Did you have any memorable teachers, influential teachers, at that early stage?

SOLNICA-KREZEL: I had actually always very good teachers in biology, both in my grade school and then in high school, and my high school teacher [Ewa Achenbach] helped me quite a lot when I started to take part in these biological competitions, which was part of my getting into biology. So she definitely was very, very helpful and encouraging.

VAN BENSCHOTEN: You mentioned friends. Did you have a large circle of friends, and who did your friends tend to be? What groups did you belong to when you were in school?

SOLNICA-KREZEL: I had pretty big group of friends, and I think I was friendly with more or less everybody. Back then I had some closest friends who would be part of, on one hand, my class in my school, but then when I got engaged in biology, I had also some friends from different schools in my little city with whom we were meeting and studying together, and then that became more social, not just studying, but just meeting and talking on other subjects as well. But they would be people very similar to me in terms of interests and temperament.

VAN BENSCHOTEN: Let me flip this over.

[END OF AUDIO, FILE 1.1]

VAN BENSCHOTEN: This is tape one, side B.

Let's talk a little bit about your junior high and high school. I say "junior high." Is there such a thing in Poland?

SOLNICA-KREZEL: No, there wasn't. There were eight years of the basic school, and then there were four years of high school, so there were twelve years altogether, and so I was eighteen when I went to university.

VAN BENSCHOTEN: What is the general focus when you get into high school? Is it, again, more specialized?

SOLNICA-KREZEL: It became specialized, and at the time we had profiles: mathematics, physics, and biology, and humanistic type of profile. So I was in the biological chemistry type of class, which has all the parts of the basic education with extended hours for biology and chemistry.

VAN BENSCHOTEN: You mentioned already that you were helping your brother [Bogdan Solnica] with his science competition projects, and that really turned you on to the wonder of science, in part at least. When does that happen, more or less?

SOLNICA-KREZEL: When I went to high school, so I was fifteen years old.

VAN BENSCHOTEN: I remember reading, too, in some of the literature that I received from the Pew [Scholars Program in the Biomedical Sciences], you read a book about the physiology of organisms. Is that more or less about the same time?

SOLNICA-KREZEL: That was at the time. So my brother participated in that competition, and I participated in his experiments; we were reading, and he was just telling me about it. That was actually when I entered high school, he was in the last class of high school, and then he left for medical school.

So then I had much more time on my hands, which was pretty unusual when I was a student. I was just finishing my first grade at this high school, and I decided— actually, this teacher [Ewa Achenbach] encouraged me, biology teacher—to enter this competition in which usually people only in the third or fourth grade participate. So to participate in this competition, within one year I had to cover the entire program of biology from this extended biological chemistry profile.

I was, of course, reading our textbook, but then—I don't have this book here— there was a translation of [Claude A.] Villee; I think that's how you pronounce it. It's a pretty well-known book here, and it was a general biology book, one of the books that you would use here in biological sciences—introductory program—at the university, and it covered everything from

a cell through evolution through the physiology of the organism, and it was very well written. And somehow for the first time, I was reading something not just a textbook—not my textbook, at least—but a book which really turned me on to biology. So then practically every chapter of that book was a new fascination for me.

VAN BENSCHOTEN: Is your interest in literature still going on at the same time in high school? Are you still pursuing that?

SOLNICA-KREZEL: Yes, I was still reading at the time quite a lot, and that actually continued and still continues, but a little bit more limited right now. I was continually reading at the time.

VAN BENSCHOTEN: Did you have any plans at some point of pursuing that career option, or was that pretty much foreclosed?

SOLNICA-KREZEL: At the time when biology sparked, I think from that point on, literature just always remained a hobby for me.

VAN BENSCHOTEN: Did you have any extracurricular activities when you were in high school, things that you did outside of schoolwork?

SOLNICA-KREZEL: We had various scientific groups at the time, and besides that, not really. Besides the friends I told you about from my little city, I had also a big circle of friends outside of Sandomierz [Poland], which were friends I picked during vacations. We were going with my brother to a special summer camp, which was for children with various diseases like diabetes and other types of gastrointestinal diseases. It was a fantastic camp organized by a medical school from a different city and some clinicians who were attending these children. I was coming as an accompanying person with my brother, and I met a very nice group of people there. Actually, I was writing to these people throughout the year. During some vacations, we would meet with one another, so I would travel to different cities to meet with those people as well. That was also part of my growing up in childhood, just having a pretty large network of friends and keeping in touch with them.

VAN BENSCHOTEN: You've already mentioned one influential teacher, biology teacher. Were there others in high school?

SOLNICA-KREZEL: I think that was the only teacher that I would mention as having influenced me at the time.

VAN BENSCHOTEN: You were saying that you sped through the biology part of the profile in order to do this project, in order to do this competition. What was that project?

SOLNICA-KREZEL: So the first one that I did was the influence of different pesticides on algae. That involved a trip to catch some algae from nearby ponds and then treating these algae with different doses of pesticides and just reporting what happened to these different algae in terms of how quickly they died. That was probably, in a nutshell, my experiment at the time.

VAN BENSCHOTEN: Did you do other projects, other presentations throughout high school?

SOLNICA-KREZEL: So that was my first time when I was taking part in the competition, and the next year I participated as well. At that time, my project was the influence of environment on the population of a little plant. The Latin name is *Ranunculus acer*. It's just a little yellow flower. And that was actually fun, because during all my travels that I did during that year, including near my little city but also when I went to the sea or in the mountains, I would find the same species of that flower. And on the one hand, I would count the density of the population, which is counting the flowers.

One funny story from that time was that I was in a field nearby Sandomierz, and a farmer with weapons emerged to chase me off to protect his field. [laughs] But otherwise, it was pretty safe. So that was counting the flowers in a certain surface of area. And then I picked up the soil, and I had it analyzed at a biological station in my little city, in terms of acidity, in terms of different types of factors that could influence the plants. So that was the second experiment, which was a little bit more sophisticated.

VAN BENSCHOTEN: How did you fare with these projects?

SOLNICA-KREZEL: Doing the experiment and then writing a report was the first entry point, and then there was just your usual competition of tests and knowledge. Actually, that was pretty amazing for me at the time, because as I was entering my first competition, I was in the first grade, and when the competition ended, I was in the second grade, and I had like a seventh place in Poland, which was extremely good at the time. So from the perspective of a little town and a young teenager, that was a very big thing for me in that maybe I had found something that I was good at, simply.

VAN BENSCHOTEN: What was your understanding of what scientists did?

SOLNICA-KREZEL: Limited at the time. So definitely I did not know any scientists. So as I read about biology, I started to read some literature about scientists, famous scientists. So that was my first glimpse. And then, of course, once I entered the Warsaw University a couple of years later, then, of course, I met real scientists.

VAN BENSCHOTEN: Was that your first experience in a lab when you went to Warsaw University?

SOLNICA-KREZEL: That's right, yes, because otherwise it was just lab in high school.

VAN BENSCHOTEN: What kind of student were you? How would you describe yourself?

SOLNICA-KREZEL: I was a very good student in terms of how I did in different courses. Probably a little bit of perfectionism of my mom [Maria Solnica] got into all of that. But I was simply genuinely interested in all of that stuff, except political economics, which we were treated with as students in the socialistic times. I don't know if you've ever encountered that subject, but that was a little bit of Marxism. It was a very political economy subject, which I never understood.

VAN BENSCHOTEN: So a little bit of Marx, some economic thought, maybe, is that it, and political ideology tossed in as well?

SOLNICA-KREZEL: Yes, exactly.

VAN BENSCHOTEN: Interesting. How would you assess your education, all of it, at this time?

SOLNICA-KREZEL: I often think about it, actually, because now I am here, and I talk to a lot with people who have children or I just observe our students here. How our education compares to the education that is given here: There is a big contrast, and maybe not just Poland but generally in Europe. There is a tendency for the education [to be] more uniform across the entire country in terms of the requirements and then to become specialized—or at least expanded—in a certain area pretty early compared to what is happening here.

I think, when I look back, I'm pretty happy with the type of education that I got until I came here, until my master's degree. At Warsaw University, that was definitely more book-type learning rather than applied learning that you have in graduate schools here, so that was a nice transition that I liked: to come here to graduate school and have a little bit more [of] how you do science, rather than what science can give in terms of information, but I like the idea that there is some uniformity in terms of education. If somebody applies here and they are from some city in Poland, I more or less know what they should know.

VAN BENSCHOTEN: I had a question about religion—we haven't talked about religion—before we move on and get you into the university. What impact did religion have on you and your family, if any?

SOLNICA-KREZEL: Poland is a very religious and Catholic country, even at the time when that was a communistic or socialistic country, so there was this disconnect. Definitely the school, there was no influence of religion whatsoever, no mention of religion. But then everybody went—and also we were going for religious education throughout my high school—to church, basically. Priests and nuns were running this religious education in parallel to your normal education. I went through all of that, and so religion was very much part of my upbringing.

VAN BENSCHOTEN: Is it still important now?

SOLNICA-KREZEL: I am not a religious person anymore.

VAN BENSCHOTEN: As you're about to leave high school and enter the university, what plans did you have? How did you see your future at that point?

SOLNICA-KREZEL: I did not have other plans except that I just wanted to study biology, and so that evolved over time. What I knew was that I really liked biology and I wanted to learn more of it, and going to university was the answer to that. And probably for the first few years, I was happy doing this. Then at the end of my studies, I knew that I really liked doing research, and I wanted to just do more of it and go to the next step. That was the motivation to come here.

VAN BENSCHOTEN: How did you choose Warsaw University? Why Warsaw rather than another?

SOLNICA-KREZEL: Rather than Krakow [Jagiellonian University in Krakow, Poland] where my brother was? It was considered the best university in biological sciences, so I decided to go there.

VAN BENSCHOTEN: Were you tempted to go to Krakow with your brother?

SOLNICA-KREZEL: I was. I was because of my brother being there, and actually Jagiellonian University is the oldest in Poland and also has a nice system. But still, somehow, I think also I simply liked Warsaw [Poland] as the capital. That was also attractive to me: that a lot of important aspects of life of the country were happening there. So I was curious about that as well.

VAN BENSCHOTEN: Had you been to Warsaw before?

SOLNICA-KREZEL: Oh, yes, I'd been many times. My father's family lived in Warsaw, so I visited frequently. And that was also probably part of my decision, because I knew the city a little bit; I liked the city, and so I felt comfortable with the notion of spending the next five years of my life there.

VAN BENSCHOTEN: How would you compare Warsaw to Nashville [Tennessee]? [laughter]

SOLNICA-KREZEL: Warsaw is just a little bit bigger city, and it feels like a bigger city than Nashville is. It's more urban than Nashville.

VAN BENSCHOTEN: It's more built up.

SOLNICA-KREZEL: More built up.

VAN BENSCHOTEN: It's much older.

SOLNICA-KREZEL: And it's European. Actually, many people do not consider Warsaw beautiful. Krakow is beautiful for everybody. Warsaw has different parts. So, of course, for Poles what is extremely important is that the entire old city was completely destroyed during the Second World War, and ninety-five percent did not exist and was completely rebuilt by Poles. So for us, it has a very special meaning. There's this old city.

Then, of course, there are some beautiful parts and some beautiful parks that we like very much, and then there's the more socialistic part of Warsaw, which some people consider ugly, but for me the whole thing is beautiful. I very much enjoyed my time there.

VAN BENSCHOTEN: As you were growing up, do you feel that your parents [Mieczysław and Maria Solnica] had expectations for you, about what you should do with your life?

SOLNICA-KREZEL: So I told you about the tolerance, and they had high expectations in the sense that they wanted us to get education. They wanted us to do very well in life. There was, I would say, not from my parents that much, but from my grandmother [Marianna Regiel] who lived with us, some pressure for me to become a medical doctor, but it was a very tiny pressure, and otherwise they really allowed me to do what I wanted to do. So, as I told you, it was really my brother, maybe a little bit influenced by my father [Mieczystaw Solnica], my parents, who convinced me to pursue the biological profile in high school, rather than the humanistic profile that I was almost determined to do. But if I chose to go that route, no problem.

VAN BENSCHOTEN: They would let you?

SOLNICA-KREZEL: Yes, absolutely.

VAN BENSCHOTEN: Describe that first year at Warsaw University. Describe also the transition. How easy was the transition from going from this rather smallish town?

SOLNICA-KREZEL: It was for me. I was a little bit anticipating the transition, because Sandomierz was a very, very tiny city. I was little bit shy. Having won these contests in biology was somewhat helpful because I met some of the colleagues whom I met eventually at Warsaw University; I met them during these competitions. So on one hand, I knew I probably would not get lost there. But on the other hand, there was some anticipation: How will I fit in all that big-city environment.

But I very quickly met some very good friends. Actually, my best friend during my Warsaw years is not a biologist. She was studying Portuguese, of all things, and I met her because of a very funny system that existed at the time, which does not exist anymore. But the socialistic government at the time had this notion that, before intellectuals become intellectuals, they should know what real physical work is like. So before we would start the university, we had something which we called practical training, which was a month of some physical labor. So we would come to Warsaw before we even started to study.

My friend who was to study Portuguese was working in a perfume factory, and I was working in a zoo for a month. That was at the time when Solidarity Movement was starting, so it was all very interesting. We were living in the dorms, and this is where I met Helena [Morstyn-Kaufman], who became my best friend at the university and even now.

VAN BENSCHOTEN: I take it that the friendship was probably more memorable than the job you had for a month. [laughter]

SOLNICA-KREZEL: The zoo was interesting, but, yes, it was not very memorable.

VAN BENSCHOTEN: Now that you mention the friendship, describe the friendship a little bit. What was the friendship like? What were you receiving? I'm not phrasing that well.

SOLNICA-KREZEL: It's like whatever friendship. On one hand, I think you cannot just express in words why you like somebody. We met one day, and in the evening we already knew we just really liked one another and we were going to be friends. I was almost in love with Helena, if you can say that in all positive aspects of that word, in the sense that she was just delightful, very beautiful and very smart, and she was doing something different than I was doing. That's something that's in my nature: essentially I like people who are different than I. She was studying Portuguese, which was very interesting, but then we shared, also, a lot of interests like literature and theater, and that was some of the things that we would do together. So when we started to study, we were living in different places; we were studying different things, but we would meet every week or every other week and just go to the movies together, go to the theater together, or just meet in cafés. That's what European students do, of course, spend a lot of time in cafés and just talk about politics and life and men and everything.

VAN BENSCHOTEN: Right, what you normally talk about. Of course, now, too, you have a backdrop of the Solidarity Movement beginning. What was that like? In other words, what was the feel of Warsaw at that time?

SOLNICA-KREZEL: I've already alluded to that. There was an enormous feeling of optimism at the time, and a lot of good things happened at university. Many very wise and valuable people got to the top of the departments and to the top of the administration in the university during this year.

What was interesting then, that even after martial law was imposed and some of these people were imprisoned for a time, many of these people were retained in their positions. So we've been very lucky to have these people as our deans and department chairs at the time when

I was studying, even without the Solidarity Movement in power. But that was a very, very interesting time to study in terms of what was happening there.

VAN BENSCHOTEN: Did you become involved in these group activities?

SOLNICA-KREZEL: I was involved with some demonstrations, and also just before martial law was imposed, the whole university went on strike, and I was part of that strike, so we basically moved to the university. It was an occupational strike, so we were living for actually over a month, I think, in the zoology building. People were bringing us food, and we basically stayed there for over a month.

Then on December 12, actually, we ended the strike, and the next day when I woke up, martial law was imposed. So that was a moment that I will never forget, because going outside my apartment and when I went to downtown Warsaw, and there were soldiers and there were tanks in the middle of Warsaw. So that was a pretty memorable experience.

It was [an] amazingly quiet day. The phones did not work. When we turned on TV, you heard General [Wojciech] Jaruzelski speaking to the nation. If you turned on radio, there was again General Jaruzelski speaking why he did what he did. There was this difficult moment for everybody because the phones did not work, so I could not communicate with my parents at least for a day or two. I almost immediately took a train and went to my parents. But it was a very memorable day in the country; the next few months, actually, over a year, I think.

VAN BENSCHOTEN: Were you and your fellow activists aware, too, of the reaction it had in other places around the world, like in the US?

SOLNICA-KREZEL: So that was talked about a lot. What will be the reaction of [the] US? Will the US actually do something? Will the US react to the martial law by actually somehow intervening in a more powerful way than just sanctions? So I think we had a pretty good impression [of] what was happening, in terms of what is the reaction and what's going to happen, and definitely how the West would react to what's happening in Poland. That was an important thing for us, because we knew that what the outcome was going to be was going to very much depend on the international politics of this.

VAN BENSCHOTEN: I'm not an expert—I'm not even close—on Polish history, but what was the relationship, let's say, between academia and Solidarity, the movement itself, the workers?

SOLNICA-KREZEL: Very, very, very big connection between Solidarity, the first Solidarity Movement. Of course, [Lech] Walesa became very quickly the chief of that movement, but some of the people, who later became prime ministers, they were part of the roundtable, which eventually negotiated after 1989 when the system went down and there were so-called roundtable discussions between the opposition and the old government. Many of the professors of Warsaw University were actually part of these discussions—[Bronsáaw] Geremek, who is still part of government—and many of them were very much involved at these stages. And they formed one of the parties which later was a very important part of the politics.

But later there was a rift, but that happened only in the nineties. There was a big rift between Walesa and workers and these intellectuals. But many of them were imprisoned for many years, and they were definitely part of this initial movement and initial establishment of the democratic government.

VAN BENSCHOTEN: So even then at the very beginning, would you say, there was this close relationship between the workers—the people of the union, members of the union—and academia as well?

SOLNICA-KREZEL: Yes, there was a big connection there. I would say that intellectuals probably played a very, very big role in these transitions.

VAN BENSCHOTEN: Getting back to your academic work, at least at the university. Do you believe you were prepared for college-level work? Was it difficult? Were you tackling the subjects fairly easily? What was that like?

SOLNICA-KREZEL: Yes, but education was never an issue. So even in the small city, I felt that education was pretty good. I had some worries about my chemistry when I was going to Warsaw University, because I felt I was not prepared in chemistry very well. I'd never done an experiment on my own. We could only observe our teacher doing something in the front of the class, so that definitely was not very good preparation, but even with that, there was never a problem. The next step was never a problem.

VAN BENSCHOTEN: What was the curriculum there the first couple years at college?

SOLNICA-KREZEL: At college? We had [a] pretty broad curriculum. On one hand, the humanistic curriculum with a lot of Polish language and literature, not only just Polish literature, but world literature, and then history, of course, mathematics, physics, chemistry, the languages. The languages were very specific at the time. We started to learn Russian when we were in fifth grade, and we continued to learn Russian throughout high school and throughout the university.

At some point I was fluent in Russian, and I love that language. It's actually a very beautiful language.

Then when I entered high school, the language that was offered in that high school was German, so I also know some German, and I was learning this. English, actually, I started very late, and that was already the time when I became very interested in biology and I realized that I need English to continue to study biology in the future. Then I just started to take private lessons and then just read as soon as I could, read anything.

VAN BENSCHOTEN: It sounds then that languages came pretty easily for you, then.

SOLNICA-KREZEL: Yes. My brother, I think, has much better talent for language. I am not fluent in English. I will probably never be, and so it's not that I have just a natural talent. They come easy, but I'm not very talented in that direction.

VAN BENSCHOTEN: I should have asked this earlier, but I'll ask it now. When Solidarity is occurring and this political turmoil is happening, what was your parents' reaction to your participation in these various movements?

SOLNICA-KREZEL: They knew that I was part of the strike. I don't recall them either approving or disapproving. Again, this tolerance was in evidence there at the time.

VAN BENSCHOTEN: In the university, describe your first lab work that you started. How did you introduce yourself to that?

SOLNICA-KREZEL: The system works this way, that for the first three years of university we have very much like here. You would have laboratories, which would be just class laboratories, so we would do experiments in biochemistry, in analytical chemistry, which I was afraid, as I told you, because I felt I was not prepared for that.

I was overeager. I remember very well my first experiment in analytical chemistry. We were given a test tube, and we were asked to identify what types of ions are in that. And I did everything that we were asked to, and one of the ways of determining what type of ion is to smell. It happened that I discovered ammonia in my test tube, and I discovered it extremely well. It was swift. There was absolutely no question that it was ammonia in that test tube, right? And we had a little few explosions in the chemistry lab, of course, and things like that, but that was very much just following the book and learning the techniques.

So when we were in the fourth and fifth year, you can compare it a little bit to the honors program here, but then it was really much more extensive and ends with writing a master thesis. This is when I entered the lab and I started to spend most of my time, because the classes or course work is almost over at the time, and then you concentrate on experimental work.

VAN BENSCHOTEN: How did you focus on a particular lab then in your fourth year?

SOLNICA-KREZEL: That was at the time when my biological interests were evolving as I'd been learning about new disciplines of biology. As I mentioned earlier, initially when I became fascinated in biology, everything interested me, every discipline. At the end of high school, I think I was more and more interested in genetics, and that definitely became part of my biological fascination. I was very interested in regulation of gene expression, and I chose the lab that I felt was the best lab to do that type of work, and that was the lab that was working on chromatin structure and regulation of gene expression in this way. So I chose the lab based on this and also just the quality of people in the lab as well.

VAN BENSCHOTEN: I'm assuming, too, all throughout, college is state-funded.

SOLNICA-KREZEL: That's right. There were no worries. Actually, I was getting a small fellowship. For certain standards of certain grades, there was a small fellowship eventually. So that was all for free. Of course, you had to buy books. You had to find a place to live, of course, and you had to eat, and all of that was [supported by your] parents, because we were not allowed to work.

VAN BENSCHOTEN: Oh, really?

SOLNICA-KREZEL: Yes, that was one of the things that probably is my parents' influence. Students could not really work officially at the time when they were studying, but even during summer, my parents were not at all fond of the idea of me working for money. It happens very rarely; very few people have done that, and they did not encourage it at all. I simply view it as probably just trying to protect us from what they were going through, because, as I told you, they started to work when they were very young, and I think they didn't feel that that somehow enriched their life in a significant way. They felt we still had time. So that's why, as I told you, I consider my childhood as a very, very relaxing time where I could just do what I liked doing.

VAN BENSCHOTEN: It sounds as if they gave you a lot of space in order to explore anything you wanted to.

SOLNICA-KREZEL: Yes, they did. They did, yes. My summers, I could spend them whenever, however, I wanted, and I would always spend some time with my family, but during my studies in Warsaw, my friend Helena, whom I mentioned to you already, she went to Portugal for a whole year, and later she invited me for the summer. So that was my really fantastic vacation: to go to Portugal. It was my first trip to the western world at the time, and we had a really great time in Portugal. Before I went, I learned Portuguese just a little bit to be able to delight the natives when they saw this bunch of Polish young women, some of them fluent in Portuguese and some of them at least trying. [laughter]

VAN BENSCHOTEN: They always admire that anyway when you try.

SOLNICA-KREZEL: They do, and Portugal particularly so, because like Poland— well, it's even a smaller country than Poland—a smaller nation, so they really take delight if people make an effort and they try to learn about their country and they want to learn their language.

VAN BENSCHOTEN: Did you take any side trips? Did you get to go into Spain at all?

SOLNICA-KREZEL: No, no. Initially, I think, we were planning and I even had a Spanish visa, which, of course, I needed, but we started in Lisbon, and then we spent a couple of weeks. We rented a little cottage on the ocean, which was very nice, and then we hitchhiked to the northern part. Porto? The name escapes me. There is a modern city to which we basically hitchhiked, which now I'm thinking that maybe that was not a good idea, but it worked fantastic. As I told you, they were so delighted with us speaking Portuguese that the drivers would go literally out of their way to deliver us to wherever we wanted to go. We had a tent, and we would spend a few days in one city and then move to another city.

VAN BENSCHOTEN: You're doing this academic work. You're also partly involved in these political activities. Were you doing any other extracurricular activities, things like clubs? Were sports important, fraternities, anything like that?

SOLNICA-KREZEL: We don't really have fraternities in Poland, or sororities, for that matter.

VAN BENSCHOTEN: Is that mostly an American thing?

SOLNICA-KREZEL: It is. I'm still trying to understand the logic behind it. [laughter]

VAN BENSCHOTEN: Me, too.

SOLNICA-KREZEL: So I started to play tennis with Andrzej [M. Krezel], my current husband, so that was one interesting thing we did. With Helena, my friend, and some other friends, we were also very interested in theater, and there were a number of very good Polish theaters in Warsaw, so that's what we'd do often during the weekends.

Then at university, I told you that I really liked my teachers, my professors, and not only professors, but actually people who were doing their PhD's and who'd already finished their PhD's who were very much involved with us in actually organizing various activities. So we formed—we called it—the Molecular Biology Scientific Club, which was just a group of people who were interested in learning more about molecular biology, and we organized regular meetings. And then once per year, we organized—you would call it a retreat here—a retreat, which was beautifully located in an old forest on the northern eastern part of Poland. There's a place called BialowieÏa and this is a national reserve, national park, where you have still European bison living, and it's a beautiful forest.

Warsaw University has a little outpost there, which is also a conference center, so there was a room for giving talks. That was actually a very nice group of people that we had, students and these TA's [teaching assistants], PhD's who were running our education at the time, and you would go once per year to this place or another place, and we would have a small conference that we organized totally on our own. They were different topics, and, in a way, these different topics from year to year also nicely reflect the evolution of my interest in biology to the point where I am now, because one of the topics of these conferences, which probably I suggested, was developmental genetics, developmental biology.

I read some papers from Janni [Christiane] Nüsslein-Volhard and Eric Wieschaus, who in 1980 published this paper in *Nature* on genetic analysis of fruit fly development, and I was at the time already interested in genetics. But then I saw these papers in which you can use genetics to ask how an embryo develops, and they isolated a number of mutations. Just from these defective embryos—just from these defective phenotypes—they could suggest a model of what type of groups of genes would participate in development. That was something that was the last switch that had to be switched for me in terms of what I want to do in my life.

In preparing for that seminar, we even published little booklets from these seminars, so that was very much involved. We organized the whole thing; we prepared the talks; we went; and then we wrote little papers, and we even published them. Apparently later, after I left Poland, some of these books have been used by later students in their studies. So that was a very nice adventure. BialowieÏa was a beautiful place to go.

One of these retreats actually happened also in the northern part of the Poland where we have beautiful lakes, and we also traveled for about three weeks on boats, and at the same time were talking about oncogenes. At the time, there was only one, one known.

So, yes, that was a big part of these scientific circles that was fun, and then my friends, like Helena, and more humanistic entertainment was another. Then I still had these friends with whom I kept in touch that I met during the camp where I was going with my brother, and so I continued to keep in touch with these people as well throughout these years.

VAN BENSCHOTEN: So these were very important, then, for your scientific development later on, then.

SOLNICA-KREZEL: Yes, yes, so that's definitely where I decided what I want to do, and that was already when this retreat happened and I really became interested in developmental genetics. This is also already after martial law was imposed. As I told you before we started taping, that was a very sad time in Poland. After this huge optimism of the early eighties when Solidarity was in power, when we were so hopeful that things will change, after martial law there was this huge letdown. And especially after a year or two years passed and nothing was changing, we felt that nothing maybe would change for the next twenty years and that the possibility of doing science in Poland would be extremely limited. Because we had a very good education, but my possibilities of doing experiments in Poland were extremely limited. We were practically building our own apparati to run gel electrophoreses.

There was very little money; there was very little equipment. On one hand, you are reading these papers with these really fantastic techniques which you can do, which you can use to ask these questions. I felt that if I stayed in Poland, I would be always limited by the reality by what I can do experimentally, and I felt that I would like to find myself in a situation where I wouldn't be limited this way, that I will have my own limitations as the only limitations on what I want to do.

VAN BENSCHOTEN: We're near the end of this tape.

[END OF AUDIO, FILE 1.2]

VAN BENSCHOTEN: This is tape two, side A.

You were talking about these retreats. This is when, I assume, you're finishing up your master of science?

SOLNICA-KREZEL: That was throughout, actually. We organized three or four of these.

VAN BENSCHOTEN: You were talking, too, about how ominous the future seemed, or it didn't seem very hopeful. What were the paths that you were looking at? You had limited possibilities. What were some of those possibilities, though, that you were looking at?

SOLNICA-KREZEL: I could stay at Warsaw University. It was not easy, but my professor and people at university, they were trying to do everything for me to be able to stay, and at the time when I was leaving Poland, it looked that if I would be staying, I would be able just to work at Warsaw University, so teach and do research. That was the only other option I considered. I did not even think about any other option that I would take at the time. I would not take another option, at least at the time.

VAN BENSCHOTEN: What was your thesis? Is that the proper name for it?

SOLNICA-KREZEL: That's right, it was a master thesis. I mentioned to you that I studied in a lab which was interested in regulation of gene expression, and the lab was studying chromatin structure. Chromatin is just the physical status of the genetic material, which is the DNA and the proteins that package it. At the time, the notion was arising that the physical status of the chromatin of the genetic material very much depends if this material is being expressed or is being silent in any given cell. That's what I'd been trying to address, trying to compare what are the differences between the genetic material—or its physical status—that is currently being expressed, versus the one which is not, which is silent. So that was the topic of my thesis, and I was looking at the properties of how the DNA is packaged in both situations.

VAN BENSCHOTEN: You get your master of science in 1985, and then you become a research assistant. Was that immediately afterward, then, the research assistantship?

SOLNICA-KREZEL: That's right. So I finished my master's degree. At the time, I was simply waiting for people in US to decide to accept me to their program or not.

VAN BENSCHOTEN: Where did you apply?

SOLNICA-KREZEL: I applied to Madison, Wisconsin, [University of Wisconsin, Madison] for two main reasons. One was, as I told you, I was already interested very much in developmental genetics and particularly in animal development, but I thought that I might have better chances of being accepted to a lab which works on a similar subject or on similar model system that I was working during my master's thesis. So I applied to the best lab in the world working also on the system I used for studies of chromatin structure, which was a slime mold. So that lab was in Madison, Wisconsin.

However, it was not an accident that the friend I told you about, Helena [Morstyn-Kaufman], was at the time already married and in US and living in Madison, Wisconsin, so definitely my interest in Madison, Wisconsin, was tripled, if not quadrupled, because for me that was a big step. Leaving when you are just twenty-four, to leave your home country in which I was very much isolated because of the isolation of the whole system, except one trip to Portugal and one trip to Ukraine. So that was a big step, and definitely going to a city where my best friend lives, definitely that helped. That reassured me and my family that I would be okay.

VAN BENSCHOTEN: How about at that point, he wasn't your husband, but your boyfriend at that time, I suppose?

SOLNICA-KREZEL: My boyfriend [Andrzej M. Krezel] at the time was accepted and went to University of Maryland, and he started to study there, and I started to study in Wisconsin. We were calling a lot and we were also writing a lot, and we decided that it might be worthwhile for him to try to transfer, and he did. From that point, we were together.

VAN BENSCHOTEN: I want to back up just a little bit, because in looking over your CV [curriculum vitae], you do summer research, a predoctoral studentship.

SOLNICA-KREZEL: In Germany.

VAN BENSCHOTEN: Talk a little bit about that and how it fit into your evolution as a scientist.

SOLNICA-KREZEL: I was just very curious about the world, and at the time it was possible for us to travel, and I applied for fellowships. It was pretty popular at the time for western Germany to fund just summer work for people from Eastern Europe, so I applied to a lab which was working on the slime mold I was working on in Poland, and I went there just for a couple of months, which was just an experience in terms of using some of the techniques I was reading about and just meeting people from a different country.

That was a very interesting experience for me as well, reinforcing the idea that I like science for the reasons of science and for the reasons of being able to go to interesting places and meet interesting people. It also gave me courage that I can go to a place knowing just a little bit of German. I can survive for two months in a place like that and work in a different lab. It was also helpful because the professor, Thomas Schreckenbach, who was running that lab, he knew my future PhD advisor, and at the end of my stay there—and he was very positive about my stay in the lab, and he was very generous—I came back to Poland with a big stack of books,

and he asked me what he could do to help me. And I simply said, "Why don't you write to Professor [William] Dove and tell him that you know me, that you've met me, and what type of student I am." And he did that, and I think that was very helpful, besides my taking GREs [Graduate Record Examinations], that also helped, because there was anticipation. It was pretty unusual at the time for a student from Poland just to write to the US and say, "I want to study there." And they had absolutely no idea what type of preparation I would have, and so there was some anticipation, I think, on his side: Should he take that risk and accept me. And definitely, besides the GRE tests, the letter from Schreckenbach must have been also just a reassurance and that helped in the decision.

VAN BENSCHOTEN: Your path that you're taking is very interesting. Were other people taking any similar paths along those routes?

SOLNICA-KREZEL: So that's actually quite an interesting question. It was me and my husband—future husband—and just very few people. I'm actually amazed how rarely it happens. Throughout our time here, we've met few Polish students and also from other European countries, actually. It's very rare for people to come here to do a PhD. A lot of scientists come here to do postdoctoral work. Maybe this is because it takes such a long time in the US to do a PhD. In Europe you can do it in three years in some countries, and here you have to do extensive course work, and it takes a long time, so maybe that's a reason, but that was pretty unique.

VAN BENSCHOTEN: When we get further into the interview, I'll ask questions about gender in your lab and in your department, but I was thinking among your cohort at this time in school, how many women were trying to pursue graduate careers, were also doing this? I realize you can't give me hard and fast numbers, but, nevertheless, what was the percentage?

SOLNICA-KREZEL: It's actually a very interesting question that I also think about sometimes, and, again, I think I was raised in somehow a very special circumstance, because in this regard I was indoctrinated in a positive way. I was indoctrinated that I am equal to everybody, and from my family, definitely, that came as well. But we were really raised in the spirit of women being equal to men, even though now when I talk with my mom [Maria Solnica], she was not making as much money as her colleagues, so that was not completely true. But I strongly believed I was equal, and I strongly believed that all the races are equal, and so on and so forth. So I would say that I picked good parts of the indoctrination, if you will, and that helped me and still does, throughout my life, that I have no complexes about being a woman. I don't see being mistreated or sometimes maybe not looked at seriously. So that's the attitude I took with me from Poland. I don't ever recall at school any issues. There are normal issues between girls and boys and then men and women, but I don't think we ever felt discriminated or just looked down by our colleagues.

VAN BENSCHOTEN: I wanted to ask, did you apply at any other places for grad [graduate] school besides Madison?

SOLNICA-KREZEL: Actually, no. So, you see, that was a pretty targeted admission. [laughter]

VAN BENSCHOTEN: That's what it sounds like, too. It sounds like you really did set your sights on it.

SOLNICA-KREZEL: It was such a good school, too.

VAN BENSCHOTEN: Let's talk about that school, because you show up at Madison. You eventually go into William Dove's lab. Describe that transition. What was it like to go from Warsaw [Poland]?

SOLNICA-KREZEL: Warsaw to Wisconsin. In many respects, that was not such a difficult transition. So there were several aspects. One aspect was just the school itself and language, and there was a language barrier in the sense that at the time, I told you, I was mostly learning English on my own by reading, and then for the last few years I also had private conversation lessons, which really helped me to understand and speak a little bit.

My understanding ability was very good, excellent. I had no problem with understanding any lecture. I had no problem with reading. My speaking ability was not that great, and that's what I'd been struggling for the first few years. And that's difficult, because I like to talk. I like to communicate my thoughts, and I felt handcuffed, if you will. I could not express myself. I felt stupid. That was difficult. But people were extremely friendly in this regard. Americans are too friendly; they don't correct you. But I was lucky that for two years, I had a British friend, and she did correct me. That was very helpful.

The lab was international. There were some British people, and there were some foreign students, and there were some Polish people in Madison, as well, and of course there was my friend Helena, and with her and her husband, we would very often meet and spend time together. So, the language, slowly I adjusted to it, and it was not a problem.

Of course, there's the issue of missing your family and there's the issue of missing your country. The first year was very difficult. Especially when I was leaving Poland—that was 1986—I was not really sure if I could come back. I actually left very officially, but we did not know if the system would change, what will happen. So that's why this departure was very

difficult, because I was not sure could I come back after two years. Will it take five years for me to be able to go back?

But fortunately, after two years, I was able to go back, and that was a very memorable, for me, visit. I was so homesick. I was missing Poland so much, and I was coming via train from Germany from some conference. I remember when I saw the first Polish cow that was enough. [laughter] I was just crying.

I'm not mentioning my family, when I saw them at the train station. But, yes, that was a difficult time, just missing the family, and as I told you, I had huge stacks of letters from my family at the time. But from then on, once this first visit happened, I knew I could go back, so that helped a lot. Then soon after, the changes started to happen in Poland, and somehow communication became easier and the distance simply became smaller, and now it is very small. It is still the same physical distance, but they are closer than they used to be in 1986 and 1987.

VAN BENSCHOTEN: How was the system set up in Madison? How did you eventually end up at the William Dove lab?

SOLNICA-KREZEL: I went directly to his lab. In most graduate schools and actually in Madison as well, you can do rotations, and in some departments you have to do rotations; you are not allowed to go directly to a given lab. However, they allowed that. If there was a student who from the very beginning was interested in a particular lab, they had no problems with that student joining their lab. So that's what I'd done.

Already at the time I knew that when I finish the PhD on slime mold, I would do animal genetics, but that was okay with me. I liked the lab very much, and Bill Dove is actually an excellent geneticist. Besides slime molds, he was also doing mouse genetics, so I was exposed all the time to mouse genetics—to vertebrate genetics—and to thinking about the vertebrate system. And of course, I had all the coursework I wanted on the subjects that were interesting to me. So in theory, I could change the lab after arriving there, but I felt it was not needed, that what the PhD is for is to get a good education and good experience, and then I can do a postdoc [postdoctoral fellowship] in the subject that I would decide will be for the rest of my life, and that's what happened.

VAN BENSCHOTEN: Correct me if I'm wrong, but you hadn't met Professor Dove before you came there?

SOLNICA-KREZEL: No, I had not, no.

VAN BENSCHOTEN: So you just had done research on his lab, said, "That's precisely what I want to do," and then applied.

SOLNICA-KREZEL: Actually, the story is even funnier, and that will tell you how naïve and how little I knew about the world of science. A friend of mine brought a book from an international meeting on the slime mold—*Physarum polycephalum* in Latin—and I found this article from that lab in Wisconsin, and the first name, the first author, was Larry Green. Bill Dove was the last author. I did not know that the lab head is usually the last name, so I wrote a letter to Larry Green. "Dear Professor Green." Professor Green turned out to be a graduate student. [laughter]

VAN BENSCHOTEN: He was very flattered.

SOLNICA-KREZEL: He was very flattered. So Larry, whom I met later, Larry turned over this letter to Bill, laughingly telling him, "Look, there's this woman from Poland who wants to study with me." And Bill responded.

So Bill is not the only person I wrote. There was actually another. I don't remember. There was another prize-winning person there to whom I wrote working on ribosomes, and I think I wrote to the person because it was a Nobel Prize-winning person.

And then another person I wrote to was a Polish person, a Professor Wacław Szybalski, who studied bacteria, and that was a Polish connection, of course. Professor Szybalski responded as well, but then I decided to go to Bill's lab. But Professor Szybalski was important, because there was a lab. He was born in Poland. He left Poland much, much earlier; in the fifties. And back then there were usually a number of Polish people in his lab, which was a nice social aspect, and they were just a floor above us, so that was nice.

VAN BENSCHOTEN: Is there much of a Polish community in Madison?

SOLNICA-KREZEL: There is. Polish communities usually have two layers to them. There is so-called the old immigration, and these are people who immigrated, well, anytime up to the Great Depression, because a lot of Poles immigrated at the time. And then there is the immigration from our times. We left to study, but after the martial law was imposed, a lot of intelligentsia were just allowed to leave, and many, or some, were asked to leave. They were not wanted in that country. So many people immigrated at the time all over the world. So there were these two waves, and we interacted with both of them.

VAN BENSCHOTEN: Did you plan, when you came over here, to do both graduate work and postdoc? I assume you were thinking of doing your postdoc here as well in the US.

SOLNICA-KREZEL: No. As I told you, I sort of went from step to step and never had a grand plan for my life. I became interested in biology, so I went to Warsaw to study. Then I fell in love with developmental genetics and science in general, so I decided to go to graduate school in the US. Then I kept all my options open, even though I knew that probably a very likely possibility would be that I will do postdoctoral work and that there will be a likely event that I'll simply stay in this country, but that was never planned. That was "Let's do this," partly because I didn't know how well I will do in graduate school; will I like this country; will I like doing science in this country, so I simply did not make any firm plans.

VAN BENSCHOTEN: Before we get into that work that you do, how about American culture itself? Had you been prepared at all for this? How much of American culture was there in Poland when you were going through the university?

SOLNICA-KREZEL: So when we talked about the transitions, I talked about language and I talked about missing Poland. One of the biggest, say, culture shocks, if you will, is in the relationships with people. Poles—in general, Europeans—are extremely close to one another. We form friendships, and we form very close friendships, and with friends we talk about everything. We become attached to one another, and that may be because we are very stationary in Europe. Now this is changing, with Europe—European Union—people start traveling for jobs.

In Poland the situation was somewhat extreme; it was difficult to move because it was difficult to get an apartment, so you had apartment in that place and you stayed your whole life in that place. That's very simple, right? And once you do this, you form these friendships and you form bonds for your whole life, okay? And then once you leave, if you happen to leave, which happens rarely, you miss your friends. You miss not only your family, but you miss your friends.

What struck me when I came to the US is, on one hand, that everybody is extremely nice. Poles are a little bit gloomy and pessimistic, and they like to complain, and that strikes me especially now when I go back to Poland. So when I came here, what was very nice and striking was how nice everybody was and smiling and "How are you?" and so on. But then there is this realization that everybody is nice but all of this is very shallow, that if somebody asks how are you—say if somebody asked me how are you at the beginning—I would stop, because this is what a Polish person would do and try to explain my condition. [laughter] That's a normal thing for Europeans, and you learn very quickly that "How are you?" is just "Good morning," almost, and you move on.

But then even if you go beyond that and you have some friends in the lab, I felt that there was almost like glass between me and my American colleagues, that there was somehow this barrier that I cannot reach through. There is this perception that Americans like their personal space in terms of do not touch, and, of course, Europeans, you know, we hug; we kiss; we do all these things. I know that Americans do not like these things in everyday life. But then it's, I felt, not only in a physical sense, but also in an emotional sense that there's almost the same type of need of isolation and not getting through. So that at least was my perception at the time.

I have a theory about it as well, and my theory is that this is almost a self-defense against becoming too attached, because if you become attached, then you miss people, so I felt because I went from Madison to Boston, and from Boston I came here, and at every place I met people and I became attached to some of them and then I missed them, so I now know that you cannot get too attached because then you miss people.

But now I also very much appreciate the style of life that science gives in terms of traveling and moving from place to place, which is a very American style of life, is that once you get over missing somebody, you recognize the positive side of it and that I have friends all over the place. And that's what I very much enjoy. Whenever I go to Europe, I have friends in Paris; I have friends in Germany; I have friends in London, in Madrid, and basically everywhere. Of course, it's a very, very big circle of friends, and we don't talk every week. We don't sometimes even speak every month, but we usually see one another every year or every second year. So, yes, that's my theory.

VAN BENSCHOTEN: It's like a defense mechanism for a very highly mobile population.

SOLNICA-KREZEL: Yes. Well, there's another theory, which is age-related. I think that the type of very close friendships that people do form really happen in high school and at university, and later, people become so involved in their own life that these very close friendships are no longer happening.

VAN BENSCHOTEN: At Madison, let's talk a little bit about the work that you do there. How did you and Bill Dove decide upon what your first couple of projects would be? Did you come in already very clearly knowing what you wanted to do?

SOLNICA-KREZEL: Bill Dove was doing many things, but he knew I was interested in development, and as simple as slime mold is, it actually has some developmental aspects. So he allowed me to work on that developmental aspect, and so I did what I wanted to do in terms that I was able to use genetics and I was able to learn molecular biology techniques and cytological techniques as well. So, yes, I was really allowed a choice of what I wanted to do.

VAN BENSCHOTEN: How would you describe his lab management style?

SOLNICA-KREZEL: At the beginning, a mentoring style. In general, a mentoring style in the sense that Bill was not doing experiments on his own—after going on sabbatical, he did start to do some experiments, like one day per week—so that was very much a style of meeting with a student or a postdoc and discussing the strategies, discussing experiments, and that's what eventually we arrived at.

At the very beginning, he was trying to get to know me, and that sometimes was frustrating to me. Sometimes initially I felt that he just didn't realize that my education was much better than the questions he was asking me. But that was just the first few meetings, and after that, I think we got into a very good relationship.

VAN BENSCHOTEN: Was he someone who—I don't want to say micromanaged—tried to keep tabs on progress every day of all of the members of his lab? He had a very small lab, too, didn't he, to begin with?

SOLNICA-KREZEL: That was not a very big lab, but it was about ten people or so, and no, it was not a small lab. He had part of the lab that was working on the slime molds and then the part of the lab that was working on the mouse. At the time when I was there, both parts were still pretty sizeable, so he was not an everyday manager or he was not really pushing me. He was very concerned. He really took seriously our education, so that was his primary, I would say, goal: that he really cared that we learn. And during our conversations, he spent a lot of time on thinking about proper controls for proper understanding of the subject, proper scientific method, so that was very important.

VAN BENSCHOTEN: Describe, if you would, what was the evolution of your research that you did during the five years that you were there, almost six.

SOLNICA-KREZEL: That's right. There is a very simple transition developmental process that happens. *Physarum* can exist as a single-celled organism, which we call amoebae, and then it can become a multinucleated cell which we call *syncytium*. The *syncytium* was interesting for scientists at the time, because all these nuclei can undergo division or mitosis in a synchronous fashion, so it was, in a way, devised as a model for regulation of cell cycle.

I was interested in how the single cell becomes this big cell: single cell with a single nucleus, how does it become this *syncytium*. There are many intracellular changes that happen. The cytoskeleton changes during that transition, and the way the chromosomes divide also changes in a very characteristic fashion. So that was my task. My question was to ask how this

process happens. What are the genes that are involved in regulation of that process? I addressed that at many different levels. So there was one very descriptive aspect of the work in which I used the techniques to basically describe what happens with this skeleton of a cell with the microtubules.

How do they change when there is just a single cell; what are the characteristics of a cell that has already two nuclei in it, and then hundreds, and so on and so forth. So that was a cell biological approach, if you will.

Then we also used a genetic approach. We had a collaboration with a lab in UK [United Kingdom], where they isolated a number of mutants defective in that process. So we were characterizing these mutants in terms of what goes wrong with development, and that, for me, was a strategy that I wanted to use in the future to address animal development: find defective individuals and ask at what point in development are they defective, isolate the gene that is responsible for that defect. So that was another avenue that we were pursuing.

Then finally, the last approach, we decided to use molecular methods and basically isolate, using these molecular methods, genes that would be either turned off or turned on at these specific stages of development.

So all in all, that provided a very nice combination, a very nice educational package, because I was working with genetic methods; I learned cell biological methods; and I also learned molecular biology methods. That was extremely useful even when I came here, because during my postdoctoral work I did a huge project, but the project was very limited in terms of methods we used. So this experience from my graduate school actually was very, very important in terms of my ability to do what we have done here, which is to use many methods, and part of that education from [University of] Wisconsin was invaluable at the time.

VAN BENSCHOTEN: Compare, if you would, the labs, let's say, the lab you were in in Warsaw [University] and the one in Wisconsin. What was the difference?

SOLNICA-KREZEL: There is a huge difference in terms of just equipping the labs. The possibilities of doing experiments in Wisconsin are just completely different than they were in Poland. There is also a difference in terms of how much time scientists can spend—can commit—in Poland to doing science and in US. The difference comes from a very prosaic reason, is that the salaries of scientists in Poland were, and still are, pitiful. So, most of my colleagues even now who are at Warsaw University and became professors, they usually have to do additional jobs to be able to live. So they teach; they translate; they write books. So, effectively, the intensity of work in Poland was smaller, except that you had students like us who, of course, would spend strange hours in the labs. But most of the scientists would be spending smaller number of hours than, of course, in Wisconsin where there was just much, much higher intensity of effort as well.

VAN BENSCHOTEN: You have several publications. What was the journal-writing process in Dove's lab? How did you go about starting a paper and getting it through all of these stages?

SOLNICA-KREZEL: So from the very beginning, I was allowed to write papers on my own, which was a very valuable experience, and Bill was extremely patient in terms of my English. So, writing would be very much starting with a body of work and us thinking about, okay, we have a body of work that can be described in a manuscript, and writing an outline. I think that's exactly what I'm doing with my people right now. That's just sort of the system that we were working with Bill, writing an outline and collecting the images, because in biology, this visual data or numerical data are extremely important.

So we would have the data collected and the outline, and once this was ready, then one could write results based on the data. I would write results, and he would read them, and then I would write the introduction, then discussion, so that was very much back-and-forth effort. I would write and he would read it, and then other colleagues in the lab would read it. So that's a very common technique. In some labs, some PIs [principal investigators] like to write their papers, but, as I told you, for Bill, our education was very important, and he wanted us from the very beginning to learn to write our own papers.

VAN BENSCHOTEN: I know that you said earlier that you were just taking steps and feeling your way. Were you having any thoughts about having your own lab and setting up your own lab, or was that, again, just too far in the future?

SOLNICA-KREZEL: Of course I had thoughts. I'd been feeling my way through, but I knew what the possibilities were at the time. I don't think I ever motivated myself in a sense that I had to do well here because I wanted to have my own lab in the future. Somehow my motivation always was just I want to do great science, and everything else, all these other administrative things—your own lab, the promotions, all of that—is like a byproduct of doing science, of being engaged in science.

VAN BENSCHOTEN: What was the most important discovery that you made in the lab? Important for you.

SOLNICA-KREZEL: Important for me, because it was really the first discovery—almost important discovery—that I had done during the PhD I told you that I was interested in genetic regulation of the developmental process, and we knew from studies in other labs that there is one gene that is turned on, and they had some concept when this gene is turned—this protein, actually, because we had antibodies—when this is turned on, and that was pretty late during this developmental process.

And from my thinking about it, I knew that this protein should be turned on earlier, and I was able to do an experiment. Altogether it was a long experiment, because it started with me optimizing conditions of the culture and being able to enrich in certain developmental stages. But eventually, I was able to show that this protein that others felt showed up only in a pretty late stage of development, I could already identify it when this single nucleus cell became a binucleate cell. So it was a very simple observation, but for me, seeing this spot showing up on this sheet of Western blot, as we call it, was an amazing feeling, and that's what science is all about.

VAN BENSCHOTEN: Especially with regard to your work, how much of your work has relied or depended upon creativity, scientific creativity?

SOLNICA-KREZEL: It always is. I think how much progress you achieve in any given project, that's very much dependent [on creativity], because you will always get somewhere. You will do something. But what you can do with that project is very much dependent on your creativity. In a way, the fact that I told you that detection of that little spot of that protein very much first relied on fooling around with conditions of culture, and that's probably what maybe not everybody would have done. It's maybe creativity or at least curiosity or just thinking a little bit out of the box, is that "What else can I do to address this question?" Or if somebody failed to do something, what could they have missed? What else can I think about to succeed in answering a specific question?

VAN BENSCHOTEN: The question that I often have is what is scientific creativity, and it seems part of it is that urge—that desire—to go beyond paradigms, the models that we've been presented with, or maybe techniques that we know now. What else can we add? But is there anything else? Also hard work, it just seems to me, going that extra.

SOLNICA-KREZEL: Hard work is important, but probably, especially in the type of work I'm doing, is ability to observe nature. Biology, in a way, is describing what nature is and what are the mechanisms of how nature works. I [do] not consider myself an extremely gifted person, but I know that I have some abilities maybe different than some other people have, and if I can point to something is that what some people have in biology is this ability and patience to observe the process that you are studying, really watch it, watch it very carefully, and you will have five different scientists watching, for example, how a cell moves, which now for me is important in my research. Or just watch this process happening, either in motion or simply at a few timed points. Then you will have these five different scientists, and if you ask them what have you seen, they will all tell you different things. Some people have ability to see certain details that maybe other people would ignore, but they actually notice that and they then start asking questions about it. Then that's where sometimes discovery comes from. So it's not mathematics; it's not creating something completely new, but in the discipline of biology that I'm in, the

observation and curiosity and being able to notice something and dwell on it, that's a very important aspect of the discovery.

VAN BENSCHOTEN: Just to see what there is to be seen.

SOLNICA-KREZEL: That's right.

VAN BENSCHOTEN: Although it sounds simple, it's really difficult, it seems. Someone once said that science is mostly trained—and I quote—"mostly trained in organized common sense." Do you agree or disagree with that?

SOLNICA-KREZEL: "Trained in organized common sense." Depending what you consider common sense. [laughter] But, yes, if you consider common sense a belief that biology works by laws of physics, yes.

VAN BENSCHOTEN: Let me flip this over, actually.

[END OF AUDIO, FILE 1.3]

VAN BENSCHOTEN: This is tape two, side B.

What was a typical day like for you in the [William] Dove lab? When would you usually go in? How would you set up and structure your day?

SOLNICA-KREZEL: So the day would start in the Dove lab between eight and nine. In the summer we would walk or bike to the lab, and that was very nice thing because the student housing in which we lived was about a fifteen-minute bike ride along a very nice lake, so it was a nice start of the morning.

In the lab I am a very organized person, so this is organized common sense. To some extent, it's true. I like to do several things at a time. I always did, and I had these different projects that I told you about. Some of these things I would do on my own. Some of these things I would have collaborative projects with some other people in the lab, so always there would be two or three experiments going on any given day, and I would then have a pretty good plan of the day: what I need to do in the morning, what I need to do in the afternoon, and there are always some little things that you can do at any time of the day when you find a moment of time.

Then in free moments, of course, we would be reading. The lab was organized in a sense that there was a lab component where we had benches, and all the experiments were happening there. Then there was an office component where all the postdocs [postdoctoral fellows] and students were, and my colleague on the left was a British postdoc, and we had our Tea Club. So in the afternoon, there would be a tea that Europeans would be drinking, and there would be some political discussions.

Another thing I remember, besides just doing science in this organized manner of culturing and isolating and doing stainings and going to a microscope to have images, I also remember that at 4 p.m. in Wisconsin there would be National Public Radio always on, and we would be listening to the news. We would always bring the *New York Times*, or we would actually even together somehow have a subscription to the *New York Times*. I'm laughing that the *New York Times* and my husband [Andrzej M. Krezel] are my only continuity in my life, so then I would always have a subscription of *New York Times* either in Boston or here as well. So the *New York Times* was always read, and at the time, 1986 and then 1989, practically every day there would be something about Poland, so that was important because things were happening in Poland. Now like once per month there's something about Poland, which is really good news.

So that was life in the lab. The lab was extremely friendly. They'd been very welcoming and very supportive of me throughout these years. I have to say that that was a very positive experience, from very simple things like, of course, birthdays and so on. But when we got married with my husband, they had a big party for us in one of the parks, and, of course, there were presents. And we had a little reception after our wedding. Our wedding was unusual in a sense that our family was not with us. They could not travel at the time; it was just too expensive, but our friends were with us, so that was nice.

But we were talking about the lab, so I'm backtracking. What I was stressing, however, was that there was a lot of discussion in the lab and also outside of the lab, and a lot of meetings and parties and just trips together—bike trips or canoe trips—not only in my lab, but also in the lab of my husband. So that was a very friendly environment in which the science was combined with social and also some culture because there were some movie festivals that we were going to and things like that.

VAN BENSCHOTEN: I know this is mostly about science and your work, and we've taken little digressions here and there, but that's entirely acceptable, given the importance of 1989 and what happened then. What was your response to those events and what was happening in Poland?

SOLNICA-KREZEL: Initially, that was stressful time, even though actually in Poland from the very beginning it was obvious that it's going to happen almost peacefully, and that's probably something that I am very proud of Europeans that it happened this way, and that's why I was later so much shocked by what happened in Yugoslavia when things started to deteriorate

there. But I'm amazed still what happened in Europe at the time, starting with Poland, and then the progression through to Czechoslovakia and through to Romania and still relatively very, very peaceful transition from a system that, if you look back in time, seemed so pervasive and so strong, that later just collapsed like a house of cards, almost, one would think. Yes, Poland, the martial law, it seemed like that was the last strong reaction that communism could yield, and later just collapsed.

VAN BENSCHOTEN: I don't know about you, but it seems as if we're still trying to absorb that. It's almost as if it's hard to believe it happened.

SOLNICA-KREZEL: Yes. On the other hand, if you go to Poland, it's actually amazing that it's almost completely forgotten.

VAN BENSCHOTEN: Really?

SOLNICA-KREZEL: Yes. The reality of everyday life in Poland is now too absorbing for Poles to appreciate what actually happened and to appreciate how for the better life has changed, because there are many aspects of life which are difficult and there are many people who long for the socialistic times.

We were talking about that, about how predictable my life would be in Poland. It would be very predictable in a sense that, yes, I would be working at university; I would be struggling with doing science; I would be not rich, not hungry. However, I would have some medical care. It would be just a very predictable life in which you know that your potential as a person would never be fulfilled, and you will be always wondering what this potential was. But on the other hand, this is a very secure life, if you think about it, because everything is predictable, but nothing really bad is going to happen to you, unless, of course, you get sick or something like that. So there was also enormous security in that system, of everybody having a job, really very few people on the street, and so on and so forth. So that's a transition now when people struggle with becoming a capitalistic country, and it's difficult for people to accept that there are so many hungry people, that there are so many poor people. Some of these numbers existed, but they were sort of hidden. Now they are out in the open. So, yes, 1989, that's such an ancient history in Poland.

VAN BENSCHOTEN: It really is. How soon after the fall did you return to Poland?

SOLNICA-KREZEL: I was actually there in 1989, I believe. I was there in 1988— that was my first trip—and then almost every year or every other year I would go. And then, indeed, every time I would go, after the collapse of the system, it would be a different country. It was

enough to step down from the plane at the Warsaw [Poland] airport, and you would already see some changes happening. I can just give you a taste of it. The first few visits there was just huge inflation; it was like ten times more; money would be losing value. I would be completely confused how much everything costs every time I would go to Poland. Now this is one of the achievements that the zloty became very, very stable in the last several years, but I'm looking forward to the euro in a few years in Poland as well.

But then there would be these transitions. Initially, there was huge explosion of people just doing small business and just trying to sell things. They would go to Western Europe or actually to India, they would bring stuff, and they would be selling. Everybody was selling something and buying something, and that was like the first wave of capitalism in Poland in private enterprise. So that was the first visit. I was completely impressed by just the number of people who were selling and buying on the street and everywhere.

Then I remember another visit where the selling and buying became more organized. There were a lot of little shops, less buying and selling on the street. Of course, the shops were then filled with goods from the West, and then everybody would be watching videos because that was like a completely new Poland. So, transitions like that.

I can tell you that, not the last trip, but the penultimate trip a few years ago, I remember coming to the Warsaw airport. We arrived and in the luggage everybody took their cell phones out and everybody was talking on their cell phones. I thought, okay, this is another phase of Poland.

VAN BENSCHOTEN: Exactly. It had to be amazing.

Let's get back to the chronology here. The chronology has you finishing up then at Madison [University of Wisconsin, Madison]. Before we move on to the [Wolfgang] Driever lab, is there anything that you want to say more about the Madison experience?

SOLNICA-KREZEL: Besides that it was such a positive experience?

VAN BENSCHOTEN: Right.

SOLNICA-KREZEL: Yes. One thing I can mention. One thing I've done with Bill Dove besides the research in the lab: Bill was teaching a course every couple of years on developmental genetics. I took this course first as a student, and then he suggested me being a teaching assistant in that course, and that was a very interesting combination, because it was one of the best courses I ever took, very intense from Bill's perspective. But the idea was to survey developmental systems from phages to human, actually, and discuss a bunch of papers, and he

would ask very, very good questions about these papers, and there would be a discussion about these papers.

He organized it very well, so my role as a TA [teaching assistant] was actually to provide an introduction to every one of these systems that we would be covering. I took that very seriously, and I spent this entire semester when I was doing that. I would spend a lot of time studying every one of these systems. In a way, that was at the time when I was deciding what I want to do in the future.

I told you that I was interested in genetics and development, but my initial love was fruit fly, *Drosophila*, and the studies I read about, but as I was in Madison and I was reading and the science was developing, I became fascinated by the studies in the frog, on gastrulation. This is this process when the embryo is taking shape. There's a very dynamic process of a lot of cell movement. So I became fascinated by this, and I knew I wanted to do this, but I wanted to do it with genetic methods. And then in the frog, you cannot do that. So it looked that the mouse was an obvious choice. In the mouse you can do genetics, and Bill was doing genetics in the mouse. I was going to the mouse rooms and actually watching how experiments were being done, but just at the same time, some papers—very few papers—started to be published about the zebrafish, and Bill Dove is one of these biologists who started with lambda phage, and another scientist who did that was George Streisinger, and he was the founding father of the zebrafish research. So George Streisinger also started as a phage geneticist and then chose zebrafish as a potential model system for studying nervous system development. He died early in life, but he founded this research in Eugene, Oregon, and then there was already a group of people who continued these studies.

The system started to draw some attention, so I was reading about this system. I was curious about this system, and Bill very much encouraged that, actually. He liked the idea of zebrafish as a model system. He encouraged me to read about it. Then during this course that we'd been teaching together, as I was reading about every system and then lecturing about every one of these systems, we played a little game with the students: What are the pros and what are the cons of every one of these model systems to do developmental biology? I don't know if I convinced the students, but I convinced myself in the process that the zebrafish is what I wanted to do, the main reason being that the embryos are transparent, they develop outside of the mother, so you can actually watch. With a camera or time lapse you can document this developmental progression as this dynamic process of gastrulation is starting and you can use genetics at the same time.

VAN BENSCHOTEN: How about teaching? Obviously in doing this course, it leads you to your next step in terms of research, but had you done much teaching before?

SOLNICA-KREZEL: Not really, except being involved in these different scientific circles in Poland. Actually, they didn't teach us too much about writing in Poland, in terms of scientific writing, except writing my master's thesis. They do a much better job here in teaching to write.

But they taught us to talk about science, so that was always easy for me and I gave a lot of seminars in Poland, and I thought that would be something that I would like to do. And definitely this experience of TA-ing with Bill—this course—was also a positive experience, so I knew I can do that and I like that.

VAN BENSCHOTEN: I'm going to throw in this one more question, which is, you know that you're going to move in the direction of zebrafish, I assume, then.

SOLNICA-KREZEL: Yes.

VAN BENSCHOTEN: How did you decide then to go to Driever's lab?

SOLNICA-KREZEL: That was, you see, also Bill Dove's influence. We knew that Janni [Christiane] Nüsslein-Volhard, who is the same person that I read the paper about *Drosophila* development, that she also started to work on zebrafish, and one of her previous students, Wolfgang Driever, was also doing that and that he would be moving to the US. Bill learned this when he met Janni at some meeting in France. He came back and he told me that Wolfgang Driever will be moving to the US and setting up his own lab, working on zebrafish doing genetic screens.

So then I wrote to Wolfgang, even before he came to the US, that I would be interested maybe meeting with him and talking about joining his lab, and he responded positively. He already had a position at Mass [Massachusetts] General Hospital in Boston, but he was not there. He spent some time in Eugene, Oregon, which is the mecca of the zebrafish, the cradle of the zebrafish, if you will. This is where I visited him. This is when I saw the zebrafish embryo for the first time. I'd seen the fish, but I saw the embryo for the first time, and maybe I'll show you sometime tomorrow. Once I saw the embryo, I was absolutely sold.

VAN BENSCHOTEN: That's great. Why don't we end it there on that note.

[END OF AUDIO, FILE 1.4]

[END OF INTERVIEW]

INTERVIEWEE: **Lilianna Solnica-Krezel**

INTERVIEWER: **William Van Benschoten**

LOCATION: **Vanderbilt University**
Nashville, Tennesee

DATE: **20 April 2004**

VAN BENSCHOTEN: This is tape three, side A, and today is April 20th, 2004.

You wanted to add something to the record before we begin.

SOLNICA-KREZEL: Yes, this is just a little bit about my times in Madison [Wisconsin], because we were discussing how we spent time there. One thing that I remember fondly was just one of the ways I'd been spending time with a friend of mine, Helena [Morstyn-Kaufman], was that we were both volunteering at the Civic Center in Madison. For me that was a new concept, because in Poland you either have theater or you have author hour or you have philharmony, and the Civic Center in Madison is this typical—now I know it's typical for the US—stage which can be anything. We'd usher usually two or three times per month, and that really provided an opportunity for me to see a variety of shows, from theater through some performances like Philip Glass or Peter, Paul, and Mary. So it was a very good window for me to enter American culture and have a nice survey. It was just one of the things that I spent many evenings there, and saw a lot of *Nutcracker* performances during the Christmastime as well. [laughter]

VAN BENSCHOTEN: How about here? Do you still do things like that here [Nashville, Tennessee]?

SOLNICA-KREZEL: I still do things like that. I'm not ushering anymore. Vanderbilt [University] has a similar venue, much smaller, but they have a stage, which they use in a similar fashion, so you can have dance. Modern dance is actually something that I enjoy very much, and whenever there is a performance I try to go, but they also have concerts on the stage or sometimes plays or some other type of music. Of course, there is a Tennessee Performing Arts Center in downtown, which also has a number of performances, but there is also School of Music, and they have a very nice concert hall and a concert series by outside and also inside musicians, and that's something that we go [to] quite frequently. And sometimes I'm invited by my students for their performances, which is a unique type of concert, but a very, very nice way of spending time as well.

VAN BENSCHOTEN: When we last spoke, we had left off with you about to join the [Wolfgang] Driever lab, and you talked about the teaching that you had done at Madison [University of Wisconsin, Madison] and how that helped you find the topic that you wanted to focus on in the Driever lab.

SOLNICA-KREZEL: Right.

VAN BENSCHOTEN: How large was the Driever lab when you entered?

SOLNICA-KREZEL: When I arrived, actually, I was the first postdoc [postdoctoral fellow], so there was Wolfgang, who was still very, very young, because he just finished his PhD. He had this amazing series of papers from his work on *Drosophila*, and after a very, very short postdoctoral period, he started his own lab. When I contacted him, he was just putting his group together, so when I arrived in Boston [Massachusetts] in October 1991, there was just one research assistant who came with him from Germany, Lisa [Elisabeth Vogelsang], and Wolfgang himself. A couple of months later, another postdoc, Zehava Rangini arrived from Israel, and that was our lab, actually, for the first year. Then it exploded. Several postdocs came next year and the next year, so eventually, at the end of my stay, the group was over ten people.

VAN BENSCHOTEN: So it grew very, very fast.

SOLNICA-KREZEL: Yes.

VAN BENSCHOTEN: Describe Driever's lab management style. You had never met him before, I take it?

SOLNICA-KREZEL: No, no.

VAN BENSCHOTEN: Then you showed up at his doorstep, as it were.

SOLNICA-KREZEL: I think his management style, he was learning, himself, and that actually was one of my motivations to go to his lab, because I felt that seeing somebody starting his own lab will be a good lesson for me to do it in the future. Sometimes when you are in a lab like Bill [William] Dove's lab, a lab that existed for over twenty years, everything works smoothly like a well-oiled machine that you don't really see the workings of it. And when you see a lab

forming, it's a very educational experience. I've seen it, and the style changed. Initially, I think he was just so excited to have the first postdoc, that for the first three weeks he would just follow me with everything I am doing, trying to figure out if he made a big mistake of hiring me or not. [laughter] But after that, I think he realized, "Okay, she knows what's she's doing," and he got a little bit more relaxed.

Then I think he was overeager, and he tried, for example, to pressure me, but I just told him very plainly, "Wolfgang, the negative incentives do not work with me. I respond with aggression or my response is negative and definitely does not motivate me." So I said, "I work only with positive incentives." So, you see, he was learning, and we could communicate pretty well, actually. Me and the other postdocs, he was very much open to what we were thinking, but he was extremely well organized. That's something that I learned is absolutely essential for the type of projects we did when we were handling really large number of animals and lines of animals, eventually. At the beginning we were establishing methods of mutagenesis, so we did not have that complexity, but at the end of the project we had hundreds of fish crosses set up, hundreds of mutants to handle, so, a big logistic type of operation that needed very good coordination. That's what he was excellent at, setting up databases, making sure that there are people responsible for directing other people so the whole operation goes smoothly.

VAN BENSCHOTEN: Why don't you talk then a little bit about the evolution of your research there. When you went in, did you have a clear idea of what you were going to do?

SOLNICA-KREZEL: That's correct. We discussed this at length, once he decided to accept me. That's actually also a nice story, because initially he said no. He was very eager to take me into the lab, but at the time when I met him, he had already committed himself to this Israeli postdoc [Zehava Rangini]. He said, "I will support you." So when I contacted him, he said, "I don't have any more positions." We decided that I'd write fellowship proposals and just join his lab. So he said initially no, but then I thought about it quite a lot, and then I wrote to him that that's the only lab I wanted to go to, that's the only thing I wanted to do, and if it took for me to wait a year or two, I don't mind. At that point, he said, "Fine. Let's just go ahead." And it turned out that simply he had additional money to accept me into his lab, and so I could start without any delay.

But at the time, once we made this decision—once he made the decision—we talked about the plans of what I was going to do, and from the very beginning there were two projects. One project was to develop methods of fish mutagenesis in zebrafish. Some methods already existed, but we wanted to achieve a special type of mutagenesis which targets spermatogonia in the fish and then would allow a specific type of recovery of mutants in a three-generation breeding scheme.

There were really two basic options to go. We could either use EMS [ethylmethanesulfonate], which is one mutagen, or ENU [*N*-ethyl-*N*-nitrosourea], which is another type of mutagen. I was very much pro ENU, because this is what mouse geneticists

were doing, and Wolfgang was pro EMS, because that's what *Drosophila* geneticists were doing. So we tried both methods, and that was a pretty frustrating period of time, because you are doing experiments and obviously you are putting animals in conditions almost such that many of them, initially, when I was setting the doses, would not survive. So it was difficult for me to go through this. We knew we had to go through this, and eventually we arrived at a very efficient method, deciding that ENU was a much better option. So that was year number one, and it took me half a year to establish these conditions.

Then at the beginning of February I went for a meeting. After five months in the lab, I went to a meeting in UK, and then when I came back, we could test some of the males that I mutagenized with certain conditions, and these tests really showed that the method was working. So that was the first big moment for me that this method works. Then once this method was established, we knew we could now generate large numbers of families and then screen them for the defects we would be interested in.

So that was one project, and parallel to that project, I'd been also working on cytoskeleton, and that's something that I'd been doing in my slime mold work during my PhD, and we thought that that would be a nice avenue for me to pursue in fish. So that project also, just looking at how the cytoskeleton, particularly microtubules, are organized in the zebrafish embryo, and then we discovered that they participate in some of the gastrulation movements that I was very much interested. So that was a very, very nice project for me, and that also allowed me to just spend a lot of time with embryos, and that's what I've been doing throughout, actually, these years, just studying the embryos quite a lot.

In relation to what we were discussing yesterday—what's really an important aspect of discovery—and in biology, especially developmental biology; you need to know your subject. It's like a good physician. You need to know the body and how the body works to be able to figure out what's wrong with a sick body. The same is with developmental biology. You need to know your embryo, because only then, when you look at a defective embryo, you can figure out what's the defect.

So I spent a lot of time on the microscope just doing experiments and just watching the embryos, and that was also very important preparation for the genetic screen, to be able then just to look at the mutant phenotypes. So at the end of the first year, the methods of mutagenesis were established, and we had a lot of lines growing.

Then for the next two years—two and a half years—we'd been discovering this large-scale screen, when we screened over two thousand families of fish by crossing them. So that was, on one hand, as I told you, very complex in terms of organization, and just also a lot of very, very busywork: setting up crosses, collecting embryos, looking at embryos, and finding the mutants, deciding what is interesting, what is not interesting.

At that point we were joined by several really fantastic people, which made the next three years an absolute fantastic experience for me. Some of the postdocs who joined the lab Alex [Alexander F.] Shier, Derek [L.] Stemple, Jarema Malicki, really extremely talented

people and just made it fun to work. Some graduate students also, Salim Abdelilah and Stephen [C.F.] Neuhauss, we had just great time working together and finding these mutants. Nobody had really found many mutants in zebrafish before, so we did not know what we were going to find, and as we were finding them, we were trying to figure out what's interesting, what is not, and trying together to identify some patterns in what we were finding.

VAN BENSCHOTEN: You did that in the last part of your postdoc, I take it.

SOLNICA-KREZEL: Actually, we did it throughout, because at the beginning, after we screened the first two hundred lines, we could not keep all the mutants we had found, because we found hundreds. The way we'd been looking, we'd been looking for everything that somehow affected development of the fish until day five of development. At day five, the little fish can eat, can see, so we were looking for a very broad spectrum of defects, in part to describe the spectrum of defects that the mutagenized fish can give you.

So we had too much to handle, and therefore we had to decide what we were going to keep. To be able to do that, we had to immediately assess what we had. For example, it was pretty obvious that about thirty percent of all mutants we were finding were very early degeneration of central nervous system. There were so many of them that we said, well, even if they are interesting—in some interesting genes—we cannot simply keep them, and most likely they are not in some very interesting genes. They are probably just required for some—what we call in biology—housekeeping genes, very busy genes that are needed for survival of a cell, but they are not involved in specifying where the forebrain and where the midbrain is going to be. So we decided that we are not going to keep these mutants, and then as we were going through, we found new classes of mutants and decided, "Okay, this is interesting, and this is what we are going to keep."

The whole project worked with continuous assessment, and the project was organized in a different manner than a parallel effort by Janni [Christiane] Nüsslein-Volhard in Germany. Our effort was much more individualistic, so everybody had their own lines designated to them, and we were screening on our own. We were finding these mutants, and all the mutants were then presented at the group meeting. It was almost like a little competition. You had to defend your mutant. What's interesting in this mutant that we are going to keep it?

Then once the mutant was accepted, it was given a name, and that was, of course, also a source of entertainment, because some classes of mutants got funny names. For example, when we started to find mutants in which we couldn't see any blood cells, then Alex [F. Shier] decided to call the first one vampire, and then the next one was called nosferatu, and all the vampire names. So we had a lot of fun with that.

VAN BENSCHOTEN: One of the key ones, boz.

SOLNICA-KREZEL: Bozozok.

VAN BENSCHOTEN: Explain that.

SOLNICA-KREZEL: So whoever found the mutant could name it, and actually Jarema Malicki, who was another Polish person in the lab, found most of the mutants that I was interested in, and he named them. Bozozok actually is a Japanese name. So we didn't have a Japanese person in the group, but we had the Japanese-named mutant. In real life, I think it should be pronounced bozozok [bosozoku] , in Japanese, and it means "motorcycle thug" or "a noisy man on motorcycle." Now I have to pay the price for this name because I always have to explain it. But another one he called knypek, which in Polish means short, and that was for a mutant which was much shorter than the wild-type fish, and that affected gastrulation movements. Then there was a whole family of also shorter embryos which we called grumpy and dopey and all the seven dwarfs. Then I found one day another mutant; it was shorter, but not as short as the seven dwarfs and also had problems with pigmentation, so I had to call it snow white.

VAN BENSCHOTEN: You have another one, van Gogh.

SOLNICA-KREZEL: Van Gogh, yes. That one had ear problems.

There was another funny one that I found, which had, on one hand, a problem with the jaw, but then sometimes there was a problem with the heart. Once there was a problem with the heart, very often the embryo develops edema and then the jaw defect is masked by this huge edema. So when I found the first one, I called it doctor jekyll, and then the next similar one was called mister hyde, and there was an entire collection of these mutants found with just a shorter jaw, and we gave them all the literature doctor names: doctor kimble and doctor crusher and so on and so forth.

VAN BENSCHOTEN: That's great. So it sounds like it was an amazing period then. You're finding all of these mutants; you're naming them in very creative ways.

SOLNICA-KREZEL: Well, I think that that really showed our intellectual limitations. [laughter]

VAN BENSCHOTEN: Then, of course—and everyone mentions this—a lot of papers came out of this. How many papers did you have? I think you had eleven, twelve.

SOLNICA-KREZEL: Yes, from this original screen, actually, you probably have not seen that, but we published these papers together with Janni Nüsslein-Volhard's lab, and all the papers, I think eleven from our lab and over twenty from Janni Nüsslein lab, were published bound in a single volume of the journal of *Development*, and that's the description—the initial description—of all the mutants.

At the time when we published these, we knew the mutant phenotypes. We did not know what were the genes that mutations in these mutants affected. And since then, these mutants systematically are being characterized in molecular fashion, and there is a constant publication from my lab, from labs of my colleagues, and other people who simply could take these mutants. Because at the time we published them, we made everything available, so people just could grab these mutants, and they did, and they are using them for their research.

VAN BENSCHOTEN: Just for the record, this is *Development*, volume 123, December 1996, the zebrafish issue.

SOLNICA-KREZEL: It's being called the zebrafish issue.

VAN BENSCHOTEN: Right. It's huge. It's got some amazing photographs in it as well, I should say.

Earlier when we were talking about your graduate work, I asked what a typical day was like. Did you more or less keep the same routine in this postdoc lab?

SOLNICA-KREZEL: There's a little bit different routine, which was driven by the way that fish live in the lab. Fish have a specific day. The light is turned on in the fish facility at eight o'clock in the morning. The fish are rhythmic in a sense that they start mating. If you set up a cross when the light comes on, they will start mating, and then therefore lay eggs. Depending on what you want to do with them, sometimes you want to use them immediately for some injections or for some treatments with chemicals, and then you want to be in the morning at eight o'clock sharp to collect these eggs as they are falling in the mating trap. Then the light is turned off at 10 pm in the evening. So that, in a way, gives you an extent of how long you can work in the fish facility.

Of course, in other rooms the light was not regulated, so you would usually show up, depending on our experimental schedules, sometimes around eight o'clock to do some experiments, because I continued this project on cytoskeletons throughout, and also I continued some other projects just to keep going with learning about the fish and the embryo.

We immediately started to characterize some mutants. So, for example, there was a very interesting mutation that one of the students, Salim Abdelilah, was characterizing, and I helped him with that a little bit. So besides just the screening, we immediately started to analyze some mutants because we felt that it was important to eventually publish these papers, to have some characterization, but also we felt very strongly that we just needed to learn much and as fast as possible as we were going through that process.

So, some mornings we would start very early and just continue to do some experiments, and then in the afternoon we would be collecting the screen crosses. The screen was done in such a way that one of us, usually one day per week, would set up our own crosses, and that would mean setting up over a hundred crosses usually in the evening, and then in the afternoon of the next day we would collect them, and then we'd screened them practically every day. We'd screened them on day zero when we collected them and put them in the dishes, and then on day one we would screen for certain aspects—basically morphology of the embryo—overall morphology and defects from morphogenesis and so on.

Then on day two, that was primarily the screen for heart defects, because the heart starts beginning on day one, and then if something goes wrong, you see it on day two. Then on day three, there was another screen for additional aspects of development, and then the final screen was on day five.

Then as far as the screen goes, we would decide, okay, are there any interesting mutations that we are going to keep, and then the fish would have to be transferred from temporary containment to the permanent containment and then until the next week when we would get another round of screening.

The lab very often went for lunch together. There was a group of people, as I told you, that really liked each other, and either on our own and sometimes Wolfgang would join us. We were doing all of this in a very interesting location. The lab was part of Massachusetts General Hospital and Harvard Medical School, but it was not the central Mass [Massachusetts] General complex, but it was part of this new Mass General location in Charlestown, in Boston, which is in the old Navy Yard, which used to be some industrial huge building which was then completely renovated as a part of a big renovation and recovery of the Navy Yard to the city. They have done a very nice job. I think it was initially planned as a business building, but they couldn't sell it. Mass General bought it, apparently for pretty good money, and made a research building out of it. So it was a beautiful building. Actually, I think the same architects were involved in that building as in this building we are here [Vanderbilt University], right, and there was a Boston firm.

So it was a great building, especially at the beginning, when we needed a lot of space for developing methods of mutagenesis and so on, but there were few places to go for lunch, really. There was a cafeteria downstairs and a couple of cafés, which we quickly discovered, but it was a very nice surrounding, actually, in the Navy Yard. So we would usually go for lunch either out or to the cafeteria downstairs, and spend some time together and just talk about everything.

VAN BENSCHOTEN: I visited Wilma Wasco in that Navy Yard. It's very calm, very quiet. You're right, not a lot of places to eat. There's a bagel shop, I think. But otherwise quite nice. You mentioned that one of the benefits of working in such a small lab was that you could see how a lab is created and how it evolves and what's involved in that process. What were you learning about the culture of science? By "the culture of science" I mean the establishment of the lab, recruiting people, getting funds, getting grants. What were you learning about the culture of science in Driever's lab?

SOLNICA-KREZEL: I've seen Wolfgang interview people. He was interviewing people, and we were interviewing the same people, and he was very much always curious what we thought about any given person who visited. Would this person fit into the lab; how we felt; and, of course, he had his own opinion, but eventually, I think, he decided based on both what he thought and the rest of the lab thought.

He was also very good about making transparent for us grants, and so whenever he would write a grant, he would give it to us to read, which, of course, probably helped him a little bit but mostly helped us, because this is when I could read grants and how they are written, how they are being developed, especially in this new area, because, for me, that was still a very new area of research. I knew that if I start my own lab, that will be one of the most important and most difficult tasks as well.

But the whole group was really good about it in a sense that once we started to go for job interviews, my colleagues were right there for me in terms of when I wrote my little résumé and also research plan and research proposals. All my colleagues whom I asked would read it and comment on it, and vice versa, I would be reading their proposals. So it was really a very supportive group of people.

Wolfgang would read it as well, and he would, for the first seminars that we would be presenting on the forum of Mass General Hospital, or also a little meeting of the zebrafish community we had pretty regularly in Boston—there were already a few labs that started to work on zebrafish at the same time as we did, so there was a small community—want to see our presentations before they were really presented, so that was very nice. In these terms, we were just very much part of everything that was happening, and he allowed us to see these inner workings of the machine.

VAN BENSCHOTEN: How did you take to Boston? How did you adjust there? Because that's quite different from Madison, is it not?

SOLNICA-KREZEL: It is quite different from Madison, but in a way it has an opinion of most European cities, so it was not a problem for me. It actually reminded me of Krakow [Poland] a little bit with its architecture—old parts of Boston—because there's this eighteenth-, nineteenth-

century style of architecture, which, on one hand, I really liked it, and it was a wonderful place to be for a postdoc. That's probably the only city that I would ever consider moving, in terms of a bigger city.

Eventually, I got just tired of that being a big city. Actually, we were living in Charlestown, even though my husband [Andrzej M. Krezel] was working at Harvard Medical School, and he had a long commute. I had a fifteen-minute walk, but we liked our apartment so much that we decided to stay there, because I moved to Boston a few months before my husband. He was still finishing his PhD, but I was so eager to start on fish, that I could not wait. On my way through Charlestown to the Navy Yard, I usually saw one tree. I really love nature, and what I really like about Nashville [Tennessee] right now is how green it is. When I walk from home here, it's just a very pleasant walk. So, big city eventually got to me a little bit. But what I loved about Boston, of course, is everything that comes with it: All the wonderful concerts and just being part of a city like that. And I have to say that I also very much like the White Mountains and the Catskill Mountains, all the surroundings of New England. One of my favorite places still in US to go is Acadia National Park and Mount Desert Island [Maine], where we spent some vacations with my husband, just hiking this mountain back and forth in all possible directions. So this type of nature, which is the mountains—the White Mountains—are similar to the Polish Tatras. At a certain point you go above the tree level and you have these spectacular views, especially in the fall with the foliage. So this I remember very fondly, because we found a few times per year to get out for the weekend and go to some bed-and-breakfasts and hike with friends or just alone. So that was a very nice aspect of being in Boston. And, of course, nice beaches during summer as well.

VAN BENSCHOTEN: How extensive was your knowledge of American history? Because that's another great thing about Boston: You have all these wonderful colonial historical colonial sites.

SOLNICA-KREZEL: That's right. So, yes, we visited many of the places around Boston in terms of history, yes.

VAN BENSCHOTEN: What was the arrangement? Both of you come to Boston. Where did your husband work? What did he do?

SOLNICA-KREZEL: He is structural biologist, so he finished a PhD in Wisconsin with John Markley, doing protein structure using magnetic resonance spectroscopy, and he joined the lab of Gerhard Wagner at Harvard Medical School, which was an excellent lab. So he had a longer commute than I did, but he was very pleased with his lab.

So we would basically say goodbye in the morning and not see one another until evening—late evening usually—and then very often we still went to the labs. In the evening, he

could get there much quicker. By car, that was just about ten minutes in the evening, unless there was some game.

VAN BENSCHOTEN: And the Big Dig.

SOLNICA-KREZEL: The Big Dig actually was only starting when we were leaving.

VAN BENSCHOTEN: It just seems to me, from what I've heard and what I've seen, the Big Dig was always there.

SOLNICA-KREZEL: That's true. There was always something in Boston, and it will probably never end.

VAN BENSCHOTEN: What I found interesting, too, last time I was in Boston, the Big Dig had finished, finally. They had all manner of ceremonies and whatnot, but people were beginning to miss it. They complained about it while it was under way, but now they missed it. I think they were getting nostalgic for it.

SOLNICA-KREZEL: There was no excuse for being late.

VAN BENSCHOTEN: Exactly.

Let's talk a little bit about how you get here at Vanderbilt [University]. You were talking about how people helped you prepare your CV [curriculum vitae]. Where did you apply, and then what made you decide to come here?

SOLNICA-KREZEL: I started to search for a job relatively early; that was just the third year. It was 1994. I arrived in Wolfgang's lab in October of '91. So in January of 1994, I thought, "Well, I'll just send a few applications, just to have practice in writing those, and who knows what will happen." In academia there are very stringent cycles, so to speak. Most openings show up in the fall and then a little later. So when I applied in the spring, there were very few openings, so I sent a few applications.

I got my first interview at Washington University in St. Louis [Missouri], and that was my first interview to which I went, which went very, very well, and immediately I got an offer. Then, of course, because there were the two of us, there's always this two-body problem that has to be dealt with. Unfortunately, in St. Louis at the time, they just hired somebody of the

same specialty as my husband, and so there was no interest. I had this offer standing for over a year, and eventually could not take it because there was no opportunity for him. But it was a great experience for me, and I had very good interactions with people there, and that gave me some confidence for the next cycle.

So the next cycle, we both applied to all possible places. Not all possible places; we were applying only to places that we knew we could go. So, for example, I did not apply to New York. I did not apply to bigger cities, because I knew that it was a time for me to move to a little bit smaller city. As I told you, I was a little bit tired of Boston. So then, of course, I got many interviews and Andrzej got many interviews. There were few interviews in the same place. This place immediately caught our attention because there was an advertisement by this department, for either a developmental biologist or a structural biologist, and, of course, I'm developmental biologist and Andrzej is a structural biologist. And we thought, "Well, we'll ignore "or" and we'll just send our applications."

Later we heard the story that they really needed both, but they thought, "Well, we will hire one or the other this year, and then depending on whom we get one year, we will go after the second specialty next year." They had two separate committees, one dealing with developmental biologists and other with structural biologists, and somehow in both of them independently, they found me in developmental biology and Andrzej in structural biology, and then they realized that it's a couple. So we were invited and we got offers here. We also had another double offer at the University of Houston in Houston [Texas], and then we had some single offers.

We decided to come here, because it seemed for me that it was definitely a very good place. There was a very good group of developmental biologists here in the medical school, so I knew that for me this would be a very, very receptive environment. For my husband, we knew the start would not be as easy because there was no equipment. Not "no," but the equipment was not appropriate, so we knew there might be some time of waiting for the equipment, to either get grants or for the institution to fund the equipment, but we decided to come, because considering the other options, it was still the best option for us as a team.

VAN BENSCHOTEN: I should say I met your husband. I took the wrong floor, and I went one up. So I met him up there. So you're very close, your labs.

What was the startup package here?

SOLNICA-KREZEL: At the time it was a very good startup package, and on one hand, there was money for renovation of a very big room that we found downstairs for a fish facility and setting up a big facility of over fifteen hundred tanks. That's definitely something that was very important for me. And from the very beginning, we decided that we would actually construct it in such a way that we'll be able to hire another zebrafish person in a few years and just expand the existing system. And that's exactly what happened when a few years later—a couple years

later—we hired Bruce [H.] Appel, my very good colleague here. Then over a quarter of million dollars just for the rest, for putting the lab together and for research assistants. So at the time, that was a very, very good package.

So this St. Louis experience and then having the offer in Houston as well, it was very helpful because we could compare the packages, and so we knew that the package here was competitive for the times.

VAN BENSCHOTEN: Is your salary included in your grants?

SOLNICA-KREZEL: The salary, because this is a College of Arts and Science, we have nine months of our salary always connected to teaching. So that was included, and actually the first year of our summer salary was included as well. From then on, the summer salary is up to us. If we have grants, that's what we are bringing in grants, the summer salary.

VAN BENSCHOTEN: How long did it take to get your zebrafish program up and running?

SOLNICA-KREZEL: That happened relatively quickly. So we came here exactly January 1st, 1996, eight years ago, and almost immediately I started ordering things. My lab was not really ready at the time, and, of course, the fish facility was not ready either, so I focused on just ordering things, and I focused on talking with people who would work on this room. I was actually glad that I could be here at the time when they were renovating the room and then oversee construction of the facility.

So I focused immediately on writing the grants, because I could do that. I had this wonderful collection of mutants at hand and partially characterized. I knew exactly what I wanted to do with them, so I submitted my first grant on February 1st, just a month after I arrived, and amazingly enough, it was funded, so that was really good.

But of course, at the time I was writing, I submitted it, and I started to write other grants that I submitted on a different project. From the very beginning, the lab went two routes connected to the two mutants we already mentioned. The bozozok mutant is at the heart of what we call embryonic patterning, which is where the head and where the trunk, where the tail, where the central nervous system are going to be; it's one of the genes which is centrally involved in setting up what we call the organizing center, which then dictates where things are going to be in the embryo.

So I wrote one grant to NSF [National Science Foundation] about bozozok that was not funded, but then almost immediately I was nominated for March of Dimes Birth Defects Foundation Award, and I submitted the bozozok project for that, and that was funded. That was the Basil O'Connor [Starter Scholar Research] Award.

So immediately the two projects were funded in the first year as I'd been setting up the lab. So the grant that I sent to NIH [National Institutes of Health] was related to the knypek mutant and another mutant called trilobite—very similar mutations—and another group, but I think different genes, and other mutations that also affected cell movements during development. So one big project in the lab that was the patterning, and then the other project was morphogenesis, cell movement during development.

So as the grants were submitted, then I focused on just unpacking the boxes. The lab was, at the time, already repainted and renovated. It was in a different building at the time, and the fish facility was ordered, so everything was in place. In March and April, I was able to offer the first rotation to students.

VAN BENSCHOTEN: That's amazing.

SOLNICA-KREZEL: I didn't have live fish at the time. Actually, they saw live fish on the last day of their rotation, because then the quarantine system—which eventually became a quarantine system—was installed in the lab and the first few fish I brought actually with me from a fish meeting in Cold Spring Harbor [Laboratory]. So the first fish arrived, and the students could see the fish. They were working with fixed [in preservative] embryos, because I brought with me a whole collection of mutant embryos which I fixed in Boston, and they could actually do some stainings and some analyses on these fixed embryos. So that was very, very fast progression as the other things were falling in place.

Therefore, in May when one of the students decided to join my lab, and at the time the quarantine system was up and running, and we had fish, she could start to work. Also in the meantime, I interviewed for a research assistant, and I found a very amazing research assistant who later became my graduate student and both this research assistant, Florence Marlow and my first graduate student, Kim Fekany, were part of the success of this group. They were really fantastic people, very nice people, and I think that later encouraged other people to join the lab. So that was a very good first half of a year, and then in the summer, the fish facility was installed, so we had these fifteen hundred tanks that needed to be populated by fish. It was a challenge at the time to raise fish, a little bit, because the baby fish needed very special food like paramecia.

[END OF AUDIO, FILE 2.1]

VAN BENSCHOTEN: This is tape three, side B.

You were talking about setting up the tanks, setting up the fish facility.

SOLNICA-KREZEL: Setting up the tanks and struggling a little bit with just growing the generations of zebrafish. I remember when finally, the fish that we raised, these fish mated it for the first time, and so we had the babies. Florence [Marlow] gave me this big poster, "Lila, congratulations on your first grandchildren," which was hanging on my door for a while. I remember then one of my undergraduate students coming to my office next fall and looking at this and then looking at me and saying, "Hmm. You already have grandchildren?"

I said, "Yes, they are fish grandchildren." [laughter]

So we had our first babies born here and surviving and having their own babies. Then there were some improvements in food—dry food for babies became available—which seems like such a very prosaic and unimportant thing, but actually facilitated our life significantly. Usually in fish labs you need one research assistant to grow this live food for babies. So that's something that a big lab can afford, but in a small lab, I didn't want eighty percent of the time of my research assistant to be spent on food for babies. This dry food, which we can just sprinkle, that saves a lot of time and effort and money.

So that was all that was happening, and the animals were in place. The one student and one research assistant and then some undergraduate students started to join, were interested in the lab and doing some research. At the time same as the grants were being reviewed, I also was in communication with prospective postdocs [postdoctoral fellows]. Both of them, actually, contacted me even before I started my own lab. I still don't know how they found me and how that happened, but one of them I know because he came from Poland, Jacek Topczewski, and was recommended to me by colleagues of mine from the same university, some of the colleagues I told you about yesterday, with whom we organized these scientific retreats. He came from the same department, so I knew exactly what type of education he got, and he came very well recommended by these people, so I was encouraged.

He was working on yeast, so I knew he would have to make a big transition, but the same type of transition I made a few years ago, and at the time finding a postdoc with experience in zebrafish was practically unrealistic. So it was a very, very new discipline. I knew I would have to train people coming to my lab. So that was Jacek who came here. Once I heard about my grant sometime in the summer, we knew that we would have money for him to come here, and he came here in January of 1997. So one year after I came here, there was the first postdoc coming to the lab.

Then just a couple months later a postdoc from Spain, Encina [M.] Gonzalez came with her own funding from Spain, so that was fantastic, because Jacek immediately started to clone knypek. At the time, that was very difficult, because still there was not enough information about the genome of the zebrafish to clone these genes. So it took us eventually about three years to clone, to identify what molecule is defective in this mutant knypek. So Jacek immediately started to work on this project.

Kim Fekany, the first graduate student, and then Encina Gonzalez, who was the postdoc from Spain, started to work on the bozozok project. So these two groups, as I told you, became

immediately established in the lab, and we started to characterize both the mutant phenotypes, generate some double mutant phenotypes, and worked on cloning knypek and also trilobite. What was happening at the same time, we started some collaborations. We started collaboration with Chris [Christopher C.V.E.] Wright's lab, a cell biology department at the time, and that was very fruitful because they actually identified and then we helped to characterize a gene affected in very famous mutant in zebrafish called cyclops. That was not a new mutant for us. We isolated alleles of the same mutation in Boston, but it was one of the first mutations isolated in fish in Chuck [Charles B.] Kimmel's lab in Oregon [University of Oregon, Eugene].

But when Chris Wright's postdoc, Karuna Sampath, identified that in cyclops the gene mutated is a nodal gene, called nodal, which turns out to be a key molecule in patterning from fish to mammals. That was an important one because it linked for the first time the nodal genes to defects like cyclopia in humans. After that work, publications have appeared from the human side that, indeed, this family is involved in some of the clyclopic defects in human. So that was a very nice collaborative work with their lab, which I think was published in 1998.

Then another big thing that happened for us was that as we were characterizing bozozok—we did not, on our own, work towards cloning bozozok; that was actually what Wolfgang Driever was doing—but a lab in Japan, Toshio Hirano's lab, identified a gene which, when overexpressed in the embryo, could induce formation of a secondary axis. We call it twinning. Instead of one embryo, you have two embryos, suggesting that this is a very powerful molecule.

On the other hand, the bozozok mutation had almost an opposite effect on phenotype. They were very defective in axis formation. They didn't have eyes. They didn't have forebrains. They didn't have a lot of midline tissues.

So I heard their talk at the fish meeting. After the talk, I asked them, well, this gene, which they called dharma, which is also Japanese for "god which has two faces," could be bozozok. So we started a collaboration and then, indeed, dharma turned out to be bozozok. So we knew that this is a transcription factor, meaning that this is a gene that regulates expression of other genes. That was an important discovery on one hand, but at the same time it really facilitated our additional analysis of that mutant, because we knew molecularly what it was, and then publishing other papers about it—what it does during development—became much easier, so that project was developing very nicely, and we were publishing actually quite a lot on bozozok. At the time we were very quiet on the morphogenesis area, because, on one hand, Jacek was cloning knypek and trilobite, which took us quite a while. And then I knew that to publish anything in that area we needed to invest a lot of time to answer the basic questions: how cells are moving in zebrafish embryo; what are the patterns of movements. This is actually when Pew [Scholars Program in the Biomedical Sciences] is coming in, because I was nominated for Pew [Scholars Program in the Biomedical Sciences] in 1997. Actually, one of the nicest letters I ever got was this letter from Pew [Scholars Program in the Biomedical Sciences], which is actually interesting because I am not used to letters providing good news about fellowships. When you get the letter from the foundation, it very rarely tells you that you actually got it. Most often it tells you, "We regret to inform you." [laughter]

So when I got this envelope—and that was ’98, right, the spring of 1998—of course, we were doing well. I had an NIH [National Institutes of Health] grant and I had March of Dimes grant still at the time. But we were developing very dynamically, so money is, of course, absolutely essential for that. And I opened the letter, and it stated that I was a Pew [Scholars Program in the Biomedical Sciences] Scholar. That was really a fantastic, fantastic moment, because I knew that we would have this freedom, actually, to ask some questions that probably otherwise I would not be able to ask, and that we have just additional time to ask certain questions in a very thorough manner that I don’t maybe have to hurry and publish something before it’s absolutely ready.

Pew [Scholars Program in the Biomedical Sciences], from the very beginning, funded another postdoc in my lab, Diane Sepich, who became instrumental to all our cell movement analysis, which is a pretty difficult thing to do. You need a lot of patience, and you need to spend a lot of time with a microscope, and later with a computer, tracing the cells, tracing their behaviors. And Diane is really fantastic with doing that.

So that was what Pew [Scholars Program in the Biomedical Sciences grant] had done for us at the time: that we could invest more into this what eventually became the bigger part of the lab. Initially the bozozok project was bigger, and we were developing the morphogenesis project, but eventually the morphogenesis project became much bigger.

Just at the same time, in ’98 I submitted for March of Dimes a three-year grant on bozozok, which was funded; that allowed us to continue that project. Then I think in 1999, I submitted a collaborative grant with Mark [S.] Cooper, who is in Seattle, and he’s an expert in cell imaging and morphogenetic analysis, and we submitted a grant. How to say it best? It’s also on knypek and trilobite, but not on the early stages, on later stages of development when the embryo becomes segmented. So that was a very nice proposal that we put together, and that was also funded, which was very important because later when I sent for the first time to renew my convergence and extension grant, the renewal was not funded.

So actually having Pew [Scholars Program in the Biomedical Sciences] at the time and having these additional grants was absolutely critical that I did not have to contract my research, my research growth. We could continue, and then eventually the grant was renewed. So I was told—and as I observe people around—this moment around five years, that’s the most critical period when the grants have to be renewed and you have to write a lot of papers at the same time and sometimes tenure decisions are being taken. So that’s a very, very critical period in the life of any lab, and we managed to go through this period in relatively smooth fashion.

VAN BENSCHOTEN: You received tenure, right?

SOLNICA-KREZEL: That’s right. It was actually an early tenure, once my department heard about the very good score on the second NIH grant. They are pretty adamant about having two

federally funded grants. So Pew [Scholars Program in the Biomedical Sciences award] was icing on the cake, but the cake had to be there.

VAN BENSCHOTEN: What does tenure mean at this institution, at Vanderbilt [University]?

SOLNICA-KREZEL: It means stability. That's probably the most important thing. It means prestige. That's the stability and freedom then of not, maybe, being so much confined by these time frames that these things have to happen within five years and that you have to publish a certain number of papers, and that sometimes pushes some people to publish maybe a story which is not completely ready. Maybe you would like to ask a few more questions about it and eventually publish a great complete story, but sometimes when tenure decisions are looming, you don't have this luxury, because you know that if you don't publish it right now, simply that might be detrimental.

Fortunately, I did not have this problem. The bozozok project very quickly started to produce numbers of publications, and there were some additional publications still coming from the screen, which were not published together with this group of papers. For example, a group of kidney mutations were published a couple of years later. So we had the luxury to publish when we felt we had a story the way we wanted to say it.

VAN BENSCHOTEN: Why don't you bring us up to date, then. What is the current research that you're doing? What are some of the projects that you have?

SOLNICA-KREZEL: So we continue on both fronts. We continue the organizer project, and we continue the morphogenesis project. Until last year, we've been mostly working with the mutations that I brought here from Boston and we also received from other groups from around the world, so we have not been doing any screening.

Last year, in collaboration with Bruce [H.] Appel, we started to screen again, and that is going to continue probably for a decade or so. These are new types of screens. As I was telling you, in Boston we were screening basically by looking at morphology of the embryos with a very simple dissecting scope without any additional markers, so there was a limit of what we could see. There were some structures in the embryo or some cell types. We couldn't, for example, see specific neurons or specific cells in the retina, specific cell types. We could only see the eye was smaller, for example. We could detect that.

Now there's a new wave of discoveries and genetic screens which is based on the fact that we can generate so-called transgenic embryos in which certain cell types or structures are highlighted by fluorescent tags. So now using a fluorescent [micro]scope, for example, Bruce has this beautiful transgene which highlights all oligodendrocytes eventually forming glia cells that surround the neurons in the central nervous system. So they are screening for that.

We actually decided to screen—and that was funded in my renewal of my grant—for modifiers of knypek, and the idea of this is that we have knypek mutation in the background, and now we are asking for mutations which would modify the phenotype, particularly that would enhance the phenotype. So that's a screen that's already ongoing in the lab.

However, we are just raising another transgene which highlights expression of one of the genes that we work on in the lab, conserved from fish to mammals again, which has a really spectacular expression pattern. It highlights some structures in the developing gastrula at the time when the cells are moving, and we think that will allow us to see very subtle defects in movements of certain cells in the developing central nervous system and in the developing midline. But then it has some expression in the fins, some expression in the eye, some expression in the cloaca. It really highlights a number of structures that we otherwise maybe would not be able to see as clearly. So that's another basis of the genetic screen to be continued next year.

I probably want to say that we are significantly expanding the whole operation at the moment, and that was possible because two years ago we applied internally for something that the new chancellor called Academic Venture [Capital] Fund. He funded a number of grants for the research ongoing at Vanderbilt, and he wanted to invest in areas that can make a difference at Vanderbilt.

At the time, besides me, there was Bruce [H.] Appel and also Tao[-Qi] Zhong, hired by the medical school, and there started to be significant amount of interest in zebrafish, not only by primary fish investigators like myself, but also by physicians, scientists, and people all over medical school who want to use zebrafish in parallel to what they are doing in the human or they are doing in the mouse.

So along with Heidi [E.] Hamm, who is the chair of pharmacology and one of my collaborators, and Al [Alfred L.] George [Jr.], who is head of the Division of Genetic Medicine, we put together this grant for Academic Venture Capital Fund, and it was funded. That provides almost ten million dollars over the next five years—now next three years—to specifically invest in the infrastructure for zebrafish at Vanderbilt and to hire several more faculty.

So we are expecting for Ela [W.] Knapik to join us later this year, and we are currently recruiting another zebrafish person to our department this year. So I was able to hire a number of postdocs [Thomas Wilm] who would develop new technologies. One of the postdocs is involved in the screening that I was telling you about, but there is another very important technique that we are also developing, and let me explain that to you.

The screening that we are doing, the method is called forward genetics, meaning you mutagenize fish and you look for defects. You don't know what the gene is, and you have to clone the gene. So this is forward genetics, looking for phenotype. There is another logic called reverse genetics. You have a gene—and now we know the sequence of the human genome; we know the sequence of the mouse genome; we are almost there with the fish genome—we know

all the genes that are in our body. We know only for a fraction of them what they are doing. So sometimes you have a gene; you have a molecule; you want to know what's the function in the organism. So you would like to disrupt the function of the gene.

There are technologies for that in the mouse. Technologies like that do not exist for fish at the moment, and people are working on it. But methods have been developed that would allow us to find mutations induced by ENU [*N*-ethyl-*N*-nitrosourea], which is this method that I developed in the past, to find mutations by ENU in a specific gene. And that basically uses a lot of busywork in molecular biology, in a nutshell. So Fish Initiative is funding one of the postdocs in my lab to develop the technique at Vanderbilt, and we are very excited about that because for us and for our collaborators, having a mutation in a gene we are studying is a very valuable asset.

Then other technologies are being developed. There's another postdoc [Adi Inbal] who is also developing these technologies which allow us to survey which genes are expressed at different stages of development or allow quickly to compare the repertoire of genes being expressed in the wild-type versus mutant situation. So the lab, on one hand, continues along these two broad schemes of patterning and morphogenesis, but our possibility to use very exciting new technologies is really good. So this is a very exciting but also very busy time for us.

VAN BENSCHOTEN: You've created a mecca of zebrafish research right here in your last few years.

SOLNICA-KREZEL: The mecca is only one, and that will be in Oregon. But we hope that we will create—we are creating—a center of excellence, in a way, a group of good labs with a lot of fish expertise who will be cooperating, providing different types of expertise, and we hope that whoever comes here will be able to use all of the state-of-the-art technologies.

VAN BENSCHOTEN: Where do you see the lab going in five to ten years? It seems to me part of it, of course, is this huge grant that you just spoke about, that's going to play itself out.

SOLNICA-KREZEL: That's right. And so at the moment, I'm definitely committed to all of the collaborations I initiated. Some of these collaborations go beyond my immediate interests, and I hope that with some people that we'll hire, that these people will provide the expertise, which might be even more appropriate than my expertise to support some of these collaborations.

For the next five years I want to continue to build on and expand maybe not horizontally, but rather more deeply into the mechanisms of morphogenesis and patterning, early morphogenesis. One area that I'm thinking about also addressing is morphogenesis of the neural

tissue, so later stages of development, morphogenesis of the brain and more particularly forebrain. But this is something that we will be thinking about as we do genetic screens. I think that's definitely a subject that I want to target: to specifically look for mutants which would be affecting morphogenesis of the anterior central nervous system. So we will be paying a lot of attention to that, because a group of mutations can open—as much as it opened gastrulation for us in patterning—this next question.

But I am not seeing my group expanding to twenty or thirty people in the future, because already I feel very much committed to people in the lab, and there is always a price that you pay if you expand your lab too much, that the attention of the PI [principal investigator] becomes very, very diluted. I think the success of every person in the lab is very important to me, and therefore we're going to put a limit in terms of expansion to make sure that I have enough time to spend with people and make sure that they are succeeding in whatever they want to do.

VAN BENSCHOTEN: Assess your efforts so far in achieving in your goals. Are you more or less where you want to be or further along?

SOLNICA-KREZEL: Sometimes I think I'm farther along than I wanted to be, but in terms of what I'm doing, I'm exactly where I wanted to be. As we were discussing yesterday, I never set goals in terms of where I want to be in terms of position or something like that. These things I treat them almost like a driving license; I need position and tenure just to be able to continue to do science. That's the most important thing for me, and being able to do what I'm doing, that's again the most important thing for me.

At the moment, I see absolutely no inclination of becoming a chair of this or that, but, again, I've been surprised in my own life by wanting something that I didn't want before. So, who knows, maybe that will change. But at the moment, I'm just very happy to be able to continue to just do the research and teach.

VAN BENSCHOTEN: What is the source of your funding now for your lab?

SOLNICA-KREZEL: So at the moment we are funded by two grants from NIH, and there is also the funding from this Academic Venture [Capital] Fund supporting some of the postdocs. And then we have a number of grants pending and some new grants that are being written right now.

VAN BENSCHOTEN: How much does the source of your funding shape what you undertake, say, the projects?

SOLNICA-KREZEL: Without funding, you cannot do biological research. If you are lucky enough to have funding like the Pew [Scholars Program in the Biomedical Sciences] or other sources that allow you this freedom, this is when you can do new things and expand your portfolio and expand your research base. And once you obtain some preliminary data in these areas, then you can write new grants to foundations like NIH or NSF [National Science Foundation].

VAN BENSCHOTEN: A question about applications of your research. What are the potential clinical applications? I realize that some of this is speculation, but where do you see how this stuff could be used and applied?

SOLNICA-KREZEL: There are two major outcomes of that work. One is connecting specific birth defects to specific genes, and that can be important in diagnoses of birth defects and also possibly treatment in the future. There are a huge number of birth defects, either children born with these defects or children basically not born because of different defects, and the numbers are actually extremely soft and they vary. I hear and read in some sources that about 25 percent of human pregnancies fail, up to 50 percent of pregnancies fail due to either environmental or genetic defects. So if that's the case, even if this is just 25 percent, which would be the lower estimate, I think we don't even touch the tip of an iceberg in terms of understanding which genes can give defects like that when mutated.

I think this is where our research is very relevant. I already mentioned to you that our studies' collaborative work on cyclops, which affects nodal signaling, that links for the first time nodal signaling to cyclopia in human. At the moment, actually, I have a very interesting collaboration with Guillermo Oliver at St. Jude [Children's Hospital], and we published one paper together last year on a gene called Six3, which is a transcription factor. In humans, mutations in the gene are connected to the defect called holoprosencephaly, which is very similar to cyclopia. It's a fusion of eyes in the forebrain.

We are doing some very interesting intermodel system work where we are asking what is the activity of exactly these proteins in human individuals—the mutated proteins that can lead to holoprosencephaly—we are studying activity of these proteins in the zebrafish embryo and in the mouse embryo at the same time. So that's exactly what the model systems are on. You can do experiments that you cannot do in humans, because once you are presented with a child with holoprosencephaly, you simply don't know what happened at the time of development. So you want to create a model system like zebrafish or mouse to be able to watch, and in fish this is particularly easy because of the traits of the fish we already discussed. So birth defects is one. But one of the biggest discoveries of the last decade or so is the realization that the genes that cause cancer are exactly the same genes which are either involved in development or regulation of the cell cycle. So some of the genes we are studying, actually—the morphogenetic pathway I told about, knypek and trilobite and downstream components of that pathway—are oncogenes and can be related to tumor formation or metastasis.

I was telling you that yesterday morning I was at the meeting of the local American Cancer Society where people funded were meeting. My lab doesn't have a grant from ACS [American Cancer Society], but actually one of my postdocs, Jason Jessen, his work on trilobite was actually funded by ACS, and that's very nice recognition of the fact that these studies we are doing are important for understanding tumor formation and metastasis.

VAN BENSCHOTEN: Let's change gears a little bit. Let's talk about duties you have as a PI. How big is your lab right now?

SOLNICA-KREZEL: So we have to talk in layers. We have two research assistants and three graduate students; several have already graduated, and we have five postdoctoral fellows who work directly with me. Then I have what I call adopted students, postdoctoral fellows who are our collaborators. Some of these actually live in our lab; some of them are just coming to the fish facility in our lab to do these experiments, and that would be another six or seven people working closely with us.

VAN BENSCHOTEN: So, seventeen, eighteen people, then?

SOLNICA-KREZEL: Yes.

VAN BENSCHOTEN: And do you still do bench work?

SOLNICA-KREZEL: I can tell you what I'm doing. I continue to work with fish. There is a constant need to just maintain mutant lines, and everybody in the lab is responsible for a few mutants, and I'm maintaining some mutants that nobody wants to deal with at any given moment. So I continue to do this. I was very much involved last year when we were doing mutagenesis, because I was training people how to do it. I participate in the screen, so I actually go and look at the embryos myself, and also that's what I'm doing almost every day is to look at embryos. People inject in the morning, either RNAse or different things, or treat embryos with different chemicals, and I spend a significant amount of time, which usually means that I either go to the screening room, as we call it, and just look at embryos myself, what's on the shelves, or people just grab me when they want to show me something. So that's something that I continue to do.

VAN BENSCHOTEN: You have administrative duties as well, things like admission committees, doctoral committees, I assume.

SOLNICA-KREZEL: Last year got totally out of control I was on so many. I always amaze myself with the more things I can handle at the time, but, for example, January and February of this year got to me severely, I have to say, because I was teaching genetics, which is a very demanding course for me. It was almost ninety-one students when we started to teach. When I started to teach, I always, several years ago, tried to learn the students' names, and I continue to do that, try to do that. That's challenging for ninety-one. I think I succeeded in learning maybe seventy-five of them. So I teach that three times per week.

A lot of my responsibilities is reviewing papers and grants, and in recent years it became very, very heavy. At the moment, I'm on editorial board of a number of journals, so I feel obliged to review for these journals, even at the time when I already have like two assignments, and when these journals contact me, I feel I cannot refuse. I have to take that assignment on. But internally at Vanderbilt, I am on the institutional Animal Care Committee. I'm only a temporary member, so I'm called only when they need me, to walk around and to review the situation in different animal facilities, for example. I am on Graduate Recruitment and Graduate Committee. We had a number of meetings in terms of recruiting this year. I was also on so-called Ad Hoc Review Committee, which the dean put together to review—fourth-year review—throughout the college, which also took a significant amount of time in review. I'm probably missing a few, which I'm trying to block in my memory very quickly. [laughter]

VAN BENSCHOTEN: You've already mentioned teaching genetics. What else do you teach? Do you have other teaching responsibilities other than, of course, the people in your lab?

SOLNICA-KREZEL: I also teach developmental biology in the fall, so I teach half of the developmental biology course, which is a smaller course. This year it was about twenty students, seven of them graduate students. And I teach vertebrate development, which for me it's easy. On one hand, it's very easy because that's what I do. On the other hand, developmental biology is changing with such a speed that every year—and this year particularly because I was on sabbatical last year—I completely just change what I was teaching because it would be insane to try to ask students to remember all the genes that we know, because we already know too many for them.

So it's always, no matter how you teach them, that you give them an excitement of this discipline and what is at any given moment the most important knowledge that you would like to relay to them. So even on one hand, that's easy; on the other hand, I put a significant amount of time in preparing these lectures for them.

VAN BENSCHOTEN: How much job-related travel do you do? How much do you travel a year?

SOLNICA-KREZEL: When I'm teaching, I try to avoid travel, for obvious reasons. But altogether, I try to limit my travel to not more than one to two trips per month. So that's actually a significant amount.

As I mentioned to you, last year I was on sabbatical for the entire year, and I used this as a time to travel a little bit. I was invited for a number of meetings and visited some very interesting places, like Singapore, for example, and I spent—I called it microsabbatical—in London. I spent ten days, visited all the zebrafish labs in Cambridge [England] and in Mill Hill [London, England]. So that was a very nice trip.

So, yes, a significant amount of traveling. But there was one year when I overdid that, and when you put together teaching responsibilities and then traveling, then again I felt that took too much of my attention, and so now I have a rule no more than two trips per month are allowed.

VAN BENSCHOTEN: You're right. I do a little bit of that myself, so my heart goes out to you.

SOLNICA-KREZEL: So you know what all that means.

VAN BENSCHOTEN: I wanted to ask to about one of the duties you have is, obviously, managing your lab, just managing people. How much time does that take? Then, also, I know commonly, for many Pew [Scholars Program in the Biomedical Sciences] Scholars, that's not something that they teach you usually, when you're going up through the ranks. How much time does it take to do this, and then, also, what could help people who are starting their labs to manage people better, do you think?

SOLNICA-KREZEL: Right. Our education does not really prepare us for this, and that's one of the many things that we are never taught, but then you have to learn in a hurry, but the way I've been doing that is that initially I was meeting with my lab members on an individual basis every week. Now that would take almost my entire time. So what we are doing is that there are weeks that I meet people individually, and, for example, this week is the week that I have meetings, and my time is blocked significantly.

Then every other week, we don't have individual meetings, but we have meetings in the thematic groups, which sometimes are as broad as the patterning and morphogenesis, but sometimes I redefine the groups, and we talk just about the topics that I want to talk about in a given week, and in different arrangements of people.

My approach is very intuitive. Every person is different. I told you that I don't like negative incentives, and that's the last resort that I try to use. I try to work very much on creating an atmosphere which sometimes just happens naturally, and I've been extremely lucky

with the first group of people that joined the lab, Florence [Marlow] and Kim [Fekany] and Jacek [Topczewski] and Encina [Gonzalez], which all of them were extremely enthusiastic.

Then the new people joining the lab simply just go into that pattern, and that's your best mentoring tool is your own lab. I've seen people come into this lab and just be naturally molded into that pattern, but then every person is individual, and I try to get to know every person at the beginning when they join the lab. What is their style; what's their character? How can I help them to achieve the best they can in this situation, in this work?

VAN BENSCHOTEN: Another duty you have is putting out journal articles. What is the process in your lab for getting journal articles out?

SOLNICA-KREZEL: As we do research, at some point we think, well, we really have an interesting story that is developing here, and it's time to start thinking about preparing a publication, and we start with first putting together the data, so we have all the data—or at least part of the data—in the form of the pictures, because, for us, that's one of the main data, and the numeral data and the type of quantitations about cell behaviors, gene expression patterns that we can have.

The next step is putting an outline of the results where the student or postdoc would prepare an outline, and we look at it and we discuss is it a proper logic of putting out the story. The next step then is writing the results, and they write the first draft, and we start to go back and forth to shape these results. At some point it's pretty obvious what type of introduction do we need. And then depending where the paper's going, is it going to a journal like *Development*, where we have the luxury of pretty long introduction and then long discussion, then the introduction would be prepared accordingly. If we think we have something very, very exciting and we would try to send it to a major journal, then it has to be very much compressed and the introduction will be minimal and then the discussion is part of the results, so you more or less write the results into the discussion at the same time.

From the very beginning, we know what we have. Sometimes, of course, we aim for a high-profile journal, and we have to fight for it and shop around, and sometimes eventually from a short introduction we have to write a longer introduction and send it to a journal which accepts this format. So we start with writing the results, and as the results unfold and we are perfecting them, then we write the introduction, and either the results are expanded by a discussion narrative, or we write a separate discussion. And somewhere in the middle, materials and methods are written, because that's the easiest part to do that.

Eventually, we then have a draft which we circulate first among the people who are very close to the subject in our group, and then we would ask a member of the group who is not directly related: the patterning group, would read the morphogenetic papers, and vice versa. Then we ask our colleagues at Vanderbilt. Very often Bruce Appel for me is a natural colleague to read my papers. Sometimes the most important papers that we have published I would then

often send to some colleagues, my good colleagues in the zebrafish community, to look at them and to give me some critical feedback.

VAN BENSCHOTEN: We're getting low here.

[END OF AUDIO, FILE 2.2]

VAN BENSCHOTEN: This is tape four, side A.

We were talking about duties that you have. Another one, besides writing journal articles and managing people, is also grant-writing. What is the process by which you get grants out? How early do you have to start a grant?

SOLNICA-KREZEL: That varies from grant to grant. On some grants I start with just some ideas, and that can be not even on the computer; that can be just here, just thinking. If this is a continuation of the grant, I start strategizing, seeing where we are right now with our research, what are the most important questions that we need to ask next, and can we ask them, because even if this is a continuation, you have to always demonstrate that you will be able to answer these questions.

So can we do it? We already have preliminary observations to ask these questions, or which questions seem to be too difficult at the moment and I don't have tools—I don't have the means—to answer these questions. So I start to think about some of things half a year in advance or sometimes even more. It almost becomes part of your doing science. As you are putting forward experiments, you think, "Okay, we need to push that because that seems like a very promising avenue," and I would like to have the data at hand when I will be writing the proposal a few months down the road.

Eventually, in terms of just sitting down and writing the proposal itself, I like to give myself usually a couple of months or a month, but then initially that won't be very intense work but just thinking and writing down some ideas. I am a very systematic person, and I don't like to spend one week, as some people do, or two weeks, and then they just close themselves in their office and write a grant. I don't like to do that. I don't want to do that, because I don't want my office to be closed for two weeks. So I try to work out these writing projects around in such a way that people don't feel I'm writing a grant. I'm sure they do. I'm sure they do, but I try to minimize that effect on the lab.

VAN BENSCHOTEN: What do you spend the bulk of your time doing as a PI [principal investigator]? If there were like a pie chart, how would you break up that pie chart among these many duties that we've described so far? Maybe some we haven't described.

SOLNICA-KREZEL: Right, but, yes. In the pie chart, I would be off, probably, because I've never estimated that, but overall, probably 30 percent of my time is just talking to people either in the office or doing different things with them in different venues, in the different screening rooms, so 30 percent just really working on science either directly or indirectly via interaction with my people.

I would say that probably 20 percent of my time is writing different things. Overall throughout the year, probably 20 percent of the total time would be teaching and preparation and everything related to teaching, and then I mean undergraduate teaching and some graduate lecture type of teaching. So I think we are now at about 70 percent, right?

VAN BENSCHOTEN: Yes, I think so.

SOLNICA-KREZEL: Then 10 percent would be reviewing all sorts of things, grants and papers, and then 10 percent would be other types of service. Then if we had an additional 10 percent, unless I'm missing some category, it would be probably added to one of the existing categories.

VAN BENSCHOTEN: Ideally, is this how you would want to divide up this pie chart? In other words, would you rather spend more time doing certain things rather than others?

SOLNICA-KREZEL: I think I would like the remaining 10 percent for reading, and I would have more time to be able to read and sometimes just to be able to think on my own. Sometimes it becomes so intense and so busy that it's difficult to find a moment just to step back [and think about] what you need to do; I mean, to step back and think, "Okay, what we are doing? Where we really want to go?"

In a way, grant-writing provides that, but I always like to do that, to have that little bit of extra time to look at the whole operation, what we are doing, where different projects are going, and I continue to do that. When I walk to work, that's one time which is just for myself. And sometimes just I sneak out for a coffee just on my own and try to get some time to analyze the situation.

VAN BENSCHOTEN: We talked about the lab management styles of your mentors. What is your own lab management style? What kind of boss are you?

SOLNICA-KREZEL: That's such a difficult question to answer, but I think I'm trying to be very close in terms of communication with people. I told you that I try to make every person

individual in terms of trying to understand what are their needs in terms of mentoring, and some students need a lot of support in terms of building their confidence. Some students need a lot of positives and need a lot of positive feedback. Amazingly enough, I realized after many years that some people do need negative feedback. [laughter] So I try to do that. I try to be constructive in terms of trying to guide their research, try to keep them to come [up] with ideas. But then also what I've learned, that giving people total freedom sometimes is not the best, so I try to provide some critical feedback, and sometimes I say strongly, "I really think you should reconsider doing this or that," or, "I think that we need to prioritize this line of experiments, rather than a different type of experiment." So maybe one would call it-not micromanagement-that I do try to influence.

VAN BENSCHOTEN: Sort of proactive.

SOLNICA-KREZEL: Proactive, right, yes.

VAN BENSCHOTEN: How do you balance work and family life?

SOLNICA-KREZEL: Because we [Andrzej M. Krezel and she] have similar interests, that's naturally easy because we understand how much we care about what we are doing, but what we insist on is always having dinner together whenever, unless there are some functions that we have to attend to. So our style is that we usually try to have breakfast together and either walk together to work or drive or bike, or sometimes separately, but we try to either go out or go home for dinner and cook every day, and then often we come back after dinner here. But then during weekends, we also spend a lot of time together, just at home, either cooking or shopping or doing some stuff in the garden. Then we also try to travel together as much as we can. So, of course, there are a lot of trips that we go on separately, but sometimes we try to join these. For example, we will be going to Poland together, and then on our way back, we'll stop in Paris [France] when I'll be giving some talks and then in New York the same. So we will spend this time together.

VAN BENSCHOTEN: If you would, describe a typical workday from the time that you get up in the morning till the time you go to bed at night.

SOLNICA-KREZEL: So the morning varies depending on the needs. Today was early, and I got up at six o'clock in the morning to be at this breakfast with the American Cancer Society. We usually get up between six-thirty and seven and then have either a somewhat longer breakfast at home with coffee and sandwiches or a quick cereal type of thing. Then at this time of the year, I try to walk.

Then I'm here anytime between eight o'clock and nine o'clock, depending how early things happened in the morning. In the morning, at the time when I'm teaching, then I will be preparing for my lectures. This is from October to the end of February. This is when all my teaching happens. So right now I no longer teach. Just one more exam, so the teaching is no longer. I'm not busy with teaching, so in the morning, this is when I try to read and I try to work on my writing assignments. At the moment, I'm working on a big review on gastrulation movements so that all my free time is reading for this and writing that.

This is the week that I'm meeting with people, so actually the whole day is broken with meetings with individual people. We have group meetings today, for example, at noon. So until usually 4:00 p.m., they are different meetings with people in my office. And in the free moments, I will try to do either administrative things like letters of recommendation, to do other things, or just read, answer e-mails. That becomes a big job, because now almost every day there are thirty, sometimes more, e-mails that have to be answered. So the whole day then is talking to people, going to different meetings at all the different functions that I have to serve.

Between four and six, then, is the time when I often would look at embryos and then read and write, and then go home for dinner. Traditionally, we tape the NewsHour [with Jim Lehrer] on National Public Radio, so whenever we get home and whenever we have dinner ready, we would watch it. Now we do it with my mom [Maria Solnica], and so we have to translate it in Polish, what's happening in the world, and we try to bring her some news from what we learn here via computers. Then usually we are home, depending when exactly we got there, until eight or nine, and usually four nights per week we would come back here and do some additional reading and writing.

So at the moment, it's still pretty intense. I think in the future, I would like to spend probably a couple or maybe three days at home and just not come back always. I can work at home, but still somehow there are usually some embryos to look at.

Another thing that I really like to do is go down to the fish facility and check if everything is okay. It's a pretty stable situation, but people make mistakes, and there is always a danger that the water is going from the tank system on the floor, and there are some accidents that can happen. So between me and Bruce [H. Appel], we try to make sure that the fish facility is safe before the light turns off at 10:00 p.m.

VAN BENSCHOTEN: Where is the fish facility? Is that in this building?

SOLNICA-KREZEL: Fish facility is in the old building where I was, but that's just a few steps for us in the basement, yes.

VAN BENSCHOTEN: What time do you usually go to bed?

SOLNICA-KREZEL: Anytime between midnight and 2:00 a.m. I try to read and usually have some novel on my night table that I try to read a few pages.

VAN BENSCHOTEN: Do both of you prepare dinner, or does one of you seem to take that responsibility?

SOLNICA-KREZEL: We both like to cook, and it's actually very funny when my mom is watching us do that, because there's a natural division of labor; Andrzej deals with meat and I do the rest. So meat or fish or whatever. So if we do this together, that's how it naturally falls. Sometimes I will prepare dinner during the weekend and then he comes home. Again, there are some very funny natural divisions of labor, as far as house duties. He does certain things related to the car. I would be doing the laundry and ironing. So it's a very extremely complementary type of arrangement.

VAN BENSCHOTEN: Do both of you like gardening?

SOLNICA-KREZEL: It's probably me more. I think the years on the farm that I told you about I spent as a child, now they are coming back to me. So I have my plot with strawberries right now, and I planted raspberries last year, and I'm checking on them every day. And usually a whole bunch of flowers planted in the little pots, and, of course, my recent collection of orchids.

VAN BENSCHOTEN: Oh yes, you have orchids behind you here.

SOLNICA-KREZEL: Yes.

VAN BENSCHOTEN: Quite nice.

SOLNICA-KREZEL: I take care of them very well, I hope.

VAN BENSCHOTEN: What is the best part of being a PI?

SOLNICA-KREZEL: If you like science, that becomes just the best game you can ever play, I think. Some people ask me if I like to play computer games, and I laugh because for me what

I'm doing is just in a way the best computer game you can have. It can be looked at this way, but this is just being able what you love doing is one thing, but within that frame, what really struck me when I started to be a PI—because I just continued to do science, right, I was doing science for many years as a student and then as a postdoc [postdoctoral fellow]—is the feeling of freedom in what you are doing. Really in this country the science is constructed in such a way that when you become a PI, you really are the boss, in terms of setting up the direction of what's happening in the lab. Nobody tells me what I am to work on, and the only thing I have to do is to convince funding agencies. And, yes, if you cannot get the funding on some of the projects that you want to do, then you become limited. But at the beginning, when you get the startup funds and if you get some grants at the beginning, that gives you the possibility to develop the projects that you want.

This feeling of freedom, on one hand, is almost exhilarating and fantastic. On the other hand, of course, there is a burden coming with it, because you are responsible for the whole operation; you are responsible for successes and failures; and you are then responsible not just for yourself. That's a big transition from the postdoc to the PI. You're responsible for people in the lab and for their success and/or failures.

VAN BENSCHOTEN: We're going to change gears a little bit and move to the public policy question part. We'll start with patents. Do you have any patents?

SOLNICA-KREZEL: No, no. The work in Boston [at Massachusetts General Hospital] was initially funded by Bristol Myers Squibb [Inc.], and initially they owned all the mutations we had. So even for me, one of the first things I had to do when I came here, I had to write and sign a big material transfer agreement, but very quickly they decided that they are not going to own all these mutants, and that became not an issue. So far, I've not been involved in any patents.

VAN BENSCHOTEN: So all of that research then was underwritten by Bristol?

SOLNICA-KREZEL: Part was funded by NIH [National Institutes of Health] and NSF [National Science Foundation].

VAN BENSCHOTEN: Do you believe that patents are generally good for science, your experience of them, at least?

SOLNICA-KREZEL: I think they have a positive effect. I think that, of course, there is also the negative side in terms of bureaucracy and sometimes in terms of slowing down the process through which discovery can become public and available to other people. By the time the

patent is out, all this information is usually not published or not revealed, and then there is basically a delay.

VAN BENSCHOTEN: So that would be just the main drawback of patents then is that?

SOLNICA-KREZEL: That's correct, yes.

VAN BENSCHOTEN: What criteria do you use in determining what projects that you're going to undertake? What is uppermost?

SOLNICA-KREZEL: I'm interested in the whole process of development and in specific, then, processes within it. My priority is to identify what I think are the most important questions at any given moment. So that can be a risky situation if you work on important questions that sometimes there is a lot of competition, but the positive side of it is that you have a chance to make important contributions. There is a lot of interest in the work, and also that helps with funding if you do not ask minutiae questions, but rather really try to identify what are the key questions for the discipline right now.

VAN BENSCHOTEN: Talk a little bit about the US national research agenda. We know that for the most part that's set by the NIH and also by industry. We also know that with certain highly controversial subjects like stem-cell research, human genetics, genetic engineering, or, rather, human cloning, that agenda can be influenced by various groups, groups like PACs [Political Action Committees] and celebrities and the media. Almost everybody can have a say in this. If there were an imaginary ten-person commission, let's say, set up to determine the nation's scientific agenda, who do you believe should rightfully have a place on that panel? Not by name, but generically, who are the people who should be on that commission determining what science is done in the US, what science isn't done?

SOLNICA-KREZEL: What science is done; what science is not done. That should be, in my view, a very interdisciplinary body. Of course you would have some scientists who would have a broad vision, and so the scientists who would represent disciplines. We are talking about biological sciences, I believe, right? You're not talking about physics or astronomy?

VAN BENSCHOTEN: Yes.

SOLNICA-KREZEL: So that would be a group of, on one hand, basic scientists. On the other hand, I would see there physicians and even just clinicists with some connection to basic

research or those who actually do both at the same time. And I would like to see the very people who are related to ethics, and also there should be some people who are dealing with—who know very well—epidemiology, what are the biggest concerns in terms of human health at any given moment, because this is, I think, what can become important in terms of the distribution of money. I think my understanding is that the division of money on certain subjects and certain diseases can be very much influenced by the fact that the interest in certain types of disease—say, for example, cancer or a different type of disease—has simply a very well-organized group of people who are promoting that type of research.

So in terms of deciding what type of research is done, we need to have a very good assessment what really are the risks of the population at this moment, and these risks, are, of course, changing in terms of not only viruses that show up, but I'm actually very concerned with the issue of obesity in this country and almost the epidemic of childhood diabetes, not the Type I, but Type II which usually comes on later in life. I'm seeing what my brother is going through after over forty years almost of diabetes, right. We should not allow these children to suffer from diabetes. We need a very good assessment of what are the risks, real risk in terms of what should be priorities in terms of the research. Then we need a very good group of scientists to have a vision what type of research then should be done to address these issues.

VAN BENSCHOTEN: Given your knowledge of the NIH, do you believe that it does this fairly well, or not? How would you assess its performance in setting the agenda?

SOLNICA-KREZEL: All in all, comparing it to what I know goes on in Europe, for example, and other countries, NIH is the best system we can have, in terms both of setting the agenda and also then executing this agenda and then using the peer-review system to fund individual grants. There are some trends and some specific policies that probably I'm not very happy about. For example, there are some trends in recent years of moving a lot of funding into these very big awards, like program project grants, which take enormous amounts of money and they are really cutting into the RO1 individual-initiated research. And that's what I'm worried about, is that still probably the best research comes from these individual investigator grants.

There is another dangerous trend that people have noticed, that at some point if you look simply at statistics at NIH and you ask how many people had one grant, how many people had two, or more than three grants, at some point the majority of people funded by NIH would have one grant. And at the moment, actually, you have many investigators with two or several grants. But then you're asking what total number of scientists are funded by NIH. This number is actually decreasing. So these are the trends that I'm a little bit worried about. They are trying to monitor themselves. They, for example, noticed a trend in this country that the age of people receiving the first award is increasing. They have this cutoff at thirty-five years, and the number of people who make it before the thirty-five years of age has just really dwindled in the recent two decades. I almost just squeezed in with my first RO1 into that category.

But this is not just NIH. This is actually more broad a change that happened. Twenty years ago, people rarely did postdoctoral work in biological sciences. They very often went into academic positions immediately after receiving PhD. So then there was a postdoc, which initially was two or three years. And now simply the expectations when you look for a job—what type of experience and what type of research program you have at hand to take with you—that really increased significantly, so that very rarely people start looking for jobs after three or four years of postdoc. And very often you have people taking positions after five or six , sometimes seven years, of postdoctoral work.

So we have a shift. We have definitely a shift. One could argue that you are really ready to be a PI when you are just thirty-one if you have enough experience. You still have so much to learn in this position. And as we discussed, there are so many things that you need to learn as a PI that you will never learn as a postdoc, and it's just they are different types of things, different types of responsibilities. So these are some issues, I think, that need to be addressed in terms of the future of biological research.

VAN BENSCHOTEN: And who should be the proper people to assess those?

SOLNICA-KREZEL: I don't think that should be done internally by NIH. I think they need an external panel. They need some people from NIH, but these are things that could be a matter of research, simply. That's very much the sociology of research, and that can be simply a research project. And some of these things can be done as research projects, very much, like, for example, a gender distribution among PIs and the trends in that. That can be simply looked at by numbers and seeing some trends and asking is it moving us as scientists—or science in this country—in a proper direction, or how the system needs to be, maybe, modified to move us in a better direction.

VAN BENSCHOTEN: Two other trends that I want to throw out and get your opinion on, if you would. One of them is the growing rise of industry labs, and therefore also the growing amount of money being put into private labs rather than, let's say, academic or public labs, and then also the growing partnership between the university and these private labs, in many cases pharmaceutical companies. I was wondering what is your view of this? Are these good trends? Are these dangerous trends for science and the conduct of independent research, basic research?

SOLNICA-KREZEL: These are trends that I think only with time are we going to be able to assess what the impact was. I think there might be some good things coming from it in a sense that there are some projects that may be very difficult to obtain money for from NIH. NIH is a little bit conservative in this regard.

I can give you one example of a wonderful genetic screen that Nancy Hopkins has done at MIT [Massachusetts Institute of Technology], not the chemical type of mutagenesis in

zebrafish, but using a retroviral type of mutagenesis. She, for many years, would not get funding for that from NIH. Then, as she said, she had to sell her soul and then obtain funding from companies. Eventually, after she was able to develop that project, she was then able to get money from NIH. But there are circumstances then when very valuable projects, and I mentioned also that our project in Boston also was partially funded [by Bristol Myers Squibb, Inc.]. So I think industry can do a lot of good in terms of jumpstarting some projects that NIH sometimes is too conservative to take on.

However, then I see some problems. I see problems with NIH co-funding some of the research which is also funded by private institutions, especially if patents come from it, and it seems to me that then society pays for the same thing twice or sometimes three times, because then we pay taxes for our research. Then the private foundations or the industry sometimes also raises money from the public, and then if there is a patent, and then we have to pay again for that patent. So that's something that, again, I think can be looked very closely at by some specialists in terms of the money flow and what is the best flow of money in terms of funding science. So in a way, I see a possibility of good and cooperation, but then I think there are some conflicts of interests for the public that arise.

VAN BENSCHOTEN: As we mentioned earlier, the Pew [Charitable Trusts] has the Science and Society Program [Institute]. It addresses some of the questions that we've just looked at. But another one that they're interested in is the public's perception of science and why that perception exists, and what it is that biomedical scientists can do perhaps to better put across what work they do and the possible applications of it and the possible use of it for the public as well. Is it the responsibility, do you believe, of the average PI in science today to be a spokesperson for science and to raise the science literacy of Americans? Do you see that as one of your responsibilities, or do you see your colleagues seeing that as a growing responsibility?

SOLNICA-KREZEL: So my view on this, actually, goes beyond just the ideas. I think we are responsible for that, and we should take opportunities to introduce what we are doing as well as we can to the public audience. Whenever we have the opportunity to present that in a forum of just everyday newspaper or to have websites that are transparent so people can view, this is our responsibility as well.

My view on this is, however, that what really needs to change in this country in that respect is education. You cannot educate society about science if the society does not understand the language you are speaking, if society does not understand basic notions about biological sciences.

If it was up to me, then, everybody should have some genetics in their education. Definitely more than we have in this country. And this is not just for them to understand science. It becomes pretty obvious that biological science has really entered the life of normal people. From the moment you enter the grocery store—and we don't want people to get scared of transgenic food—to the moment when they go to a doctor and they learn that their child

might have a birth defect and they have to make some type of tough decisions, to the issues like cloning. There are so many issues that really impinge on the life of normal people, and there's no way people who did not receive a basic education in this country can understand. We can be doing as much as we can in terms of educating society, but society needs to be prepared for being educated at some point, educated farther or updated on what's going on in science. So my big issue is—and that's actually, in a way, what a great job Pew [Charitable Trusts] is doing—there is still a big disparity between the science done by people like me who are teaching undergraduate students, and the science that can be done or is being done in medical schools, where very little teaching responsibilities are. That really is something that should be looked at, because we are in a way competing to do science with people who are in medical schools or just research institutes with very little teaching responsibilities. We have to basically compete on the same rules. We are applying for the same grants. We have to do everything they have to do, plus we have to teach forty or sixty lectures per year.

I decided to take this job because I think it's really important for us to do this. It's important for scientists who are doing modern research to teach undergraduate students, to give undergraduate students a chance to do research in their labs and to educate society because by educating society, I think this is the first step that happens at undergraduate at college or even at high-school level.

In my mind that really comes to very basic issues. How do you treat teachers in this country? I think this country has a big problem, starting with first-grade teachers through high-school teachers, through college teachers and university teachers as well. Somehow this should be looked at, because there is some method of selection that is happening also at the level of academia in that sometimes the best people choose not to go to college because they know they will have to work extremely hard to be able to teach and compete at the national and international level with their research.

VAN BENSCHOTEN: So what would be the best way? If there was one thing you could do, one wish that could be granted then, in improving this education—the science education—among Americans, what would it be?

SOLNICA-KREZEL: Improving science education, I would start with investing in teachers. We want quality people to be teachers at every level, starting from the grade school through the high school through that level, and that simply requires appreciation. And that's very simple. You need to support these people according to their value and the effort they are putting in.

VAN BENSCHOTEN: So translate appreciation into money, in a way, and salaries.

SOLNICA-KREZEL: It always is. It always is. We've seen very interesting trends in terms of just people interested in doing science. In the mid-nineties when I started, there was a big

decrease in American graduate students' applications. And, of course, we have a lot of foreign students doing research in this country, and that's all very nice, but we need scientists from this country. We need people from this country to do research, right? When the economy started to do less well, we see again renewed interest from the national candidates. What this tells me in a very naïve type of thinking is that the scientific career is not competitive, in the sense that for people in this country, this is a very demanding job for which they have many other more lucrative and attractive options. And that's also something that should be thought about.

VAN BENSCHOTEN: I was wondering, too, does your institution [Vanderbilt University] encourage you to participate in these public policy questions, things like public forums, visiting schools, taking on, let's say, students from other schools and have them visit the lab, any of these things?

SOLNICA-KREZEL: They do. We have a number of programs, and Vanderbilt is structured like a pie which is cut in two different ways. You have departments, which are just the normal pieces of the pie, but then you have layers of the pie, which are different transinstitutional programs.

I belong to the neuroscience program, which goes across institutions through our College of Arts and Science, medical school, and the Peabody College of Education; and the Developmental Biology Program and the Cancer Center, I don't belong, but many people belong. So these programs have a lot of outreach activities. So, for example, the Cancer Center, I just met some people today. They have lectures—public lectures—for people in the community, which are opened completely to the community. They very much encourage people going out and giving lectures.

The neuroscience program here has something—March is the Brain Awareness Month—and they have lots of activities in the local science museum. We have tours for high school students and first graders who come to visit us. We do our best to accommodate high school students who want to do work in the labs. We also have a pretty good set of journalists who are publishing our local newspapers as well as providing outreach to the community in terms of web pages, but also being in communication with the local TV and local newspapers, always trying to pique their interest in what interesting is happening at Vanderbilt, if there is some really important discovery done here—or not necessarily here, but somewhere else—that we can be contacted to comment on that in public venues.

VAN BENSCHOTEN: I wanted to ask about competition. As you know, competition is part of the US system of doing science, whether it's grant-writing or journal articles or what have you. Is competition generally good for doing good science?

SOLNICA-KREZEL: It's difficult to imagine the system working without competition. You need it. How is it executed? That's sometimes a question, and there is, of course, a price to pay for that. So it's necessary. It's a necessary condition. I come from the communistic system. I was raised in the communistic system where many things were done without competition, and I know that this just basically fails.

VAN BENSCHOTEN: Have you ever been scooped?

SOLNICA-KREZEL: Yes, we have been. We've been very lucky to be scooped very few times. There was one paper that we wanted to publish—besides our mutants, which we always manage to publish without any problem and not be scooped, or at least [publish] in parallel—which would introduce the concept of noncanonical signaling being involved in morphogenesis that we were preparing. We were preparing this, but at the same time we were doing different things, and we knew that we would be scooped, and we basically allowed ourselves to be scooped. So we basically decided, okay, we simply cannot do all of these things at the same time. But that was really just one situation, and otherwise we've been very, very lucky with being able to publish what we wanted.

VAN BENSCHOTEN: All right. Let me flip this.

[END OF AUDIO, FILE 2.3]

VAN BENSCHOTEN: This is tape four, side B.

The flip side of competition is collaboration. You've already mentioned a couple of collaborations. How important is collaboration to the doing of your science?

SOLNICA-KREZEL: I am a very collaborative person. For me this is part of science, and maybe that's why I think competition is important, but I don't care about it that much. Since I was a little girl and a student, I don't really try to compare myself to other people but rather scientifically set standards and goals to myself and then compare myself to these goals, so I am very much eager to exchange ideas, collaborate with people. I don't care if I'm the last author or the middle author. I do pay attention to that in the sense that in the reality of science, I know there have to be some papers that are coming primarily from our group. And when I came to Vanderbilt [University], I knew very well that especially as a junior PI [principal investigator], you have to very much pay attention to becoming independent of your former PI and also to publish a significant number of papers which are completely from your own group. So we have done that and will continue to do that, but whenever there is a possibility, if we know that somebody's doing something similar, I will be the person to contact them and say, "Hey, we are

doing something like that, so we can either collaborate or we can just keep in touch in terms of communicating each other," to avoid this scooping issue.

VAN BENSCHOTEN: Exactly.

SOLNICA-KREZEL: If you look at the list of papers, probably more than half of them [are collaborations], and definitely the project we did in Boston [at Massachusetts General Hospital], that's by definition a very collaborative type of enterprise, and we have continued to do that throughout the years.

VAN BENSCHOTEN: Some have argued, too, that for people who wish to get tenure, collaboration sometimes can be risky. Did you find that to be the case, or have you heard of that being the case?

SOLNICA-KREZEL: That is an issue, so that's what I was just alluding to, is that it was very clearly stated to me that I should avoid collaborating with my previous boss [Wolfgang Driever] and that I should not have too many collaborative papers unless I'm the senior author, which clearly tells you that this is primarily from our work. So that's what we did. We did pay attention, and as long as you have a significant number of works which are clearly coming from your lab and then you have these collaborative papers, that's icing on the cake. But the cake has to come from your own lab. So I know that for some people and in some disciplines, that might be more difficult than in others. In biology, still, that is possible.

VAN BENSCHOTEN: I have a few questions about women in science and also underrepresented groups. How many women are in your lab? You've already said more or less you've got maybe seventeen or eighteen people. How many of those are women?

SOLNICA-KREZEL: At the moment, I think it's half and half. Actually, I started with a very female-heavy group, and Jacek was the only male, plus maybe a few undergraduate students here and there. So we were initially all female, almost all female, and then gradually we now shifted. It might fluctuate from time to time, but at least half, with a few more females or sometimes a few more males over these eight years.

VAN BENSCHOTEN: I've heard—you can tell me if I'm wrong—that women tend to be well represented in developmental biology, rather than structural biology.

SOLNICA-KREZEL: That's correct, yes, and there are some wonderful just role models like Janni [Christiane] Nüsslein-Volhard, I mentioned. A very good friend and also a mentor for me, Brigid [L.M.] Hogan, who is a prominent developmental biologist, was here at Vanderbilt, now moved to Duke [University]. So there is really a very nice group of senior developmental biology women who have a lot of respect and probably provided some role model situation.

VAN BENSCHOTEN: You don't have to give me an exact figure, but how many PIs, roughly, are in this department, in the department you're in?

SOLNICA-KREZEL: Twenty-three at the moment.

VAN BENSCHOTEN: How many of those are women?

SOLNICA-KREZEL: Three. [laughter] So we have a problem here. We still have a problem at Vanderbilt in general with women. I've been in this department for eight years. I've been on search committees. We've actually just offered this year a job to two women and they turned us down. So in the zebrafish search we offered a job to a woman, and she turned us down. Then the next candidate is a man, and if he accepts, the statistics won't change.

VAN BENSCHOTEN: May I ask why she turned down the department?

SOLNICA-KREZEL: Her family, because of her family situation. Apparently her husband has a job in Seattle, and because of what he is doing, it would be very difficult for him to work.

VAN BENSCHOTEN: So, the two-body problem.

SOLNICA-KREZEL: Two-body problem is often an issue. While men have it, too, in a way, but if I can do sort of intuitive statistics here, women scientists tend to have men who are scientists, I think, in disproportionate numbers compared to male scientists. The other woman who actually turned us down in the search, her husband is a lawyer, and he had an excellent position somewhere, and that also was the problem. The other body, in the case of female candidates, is much more difficult, statistically, to move than if you consider male scientists and their two-body problems.

VAN BENSCHOTEN: That's interesting. It's more intractable for women.

SOLNICA-KREZEL: That's right.

VAN BENSCHOTEN: Given your experience as a biomedical researcher—given your experience as a woman—is the playing field level in the biomedical sciences between men and women right now?

SOLNICA-KREZEL: I told you about where I'm coming from: that I'm coming with actually no complexes whatsoever; and personally I would say I never felt discriminated in this country as a scientist and as a woman. And if there would be a moment where I felt was treated maybe not as I would want it to be, I would probably first think that may be because I'm Polish and not as a woman.

And I really try to avoid this type of thinking. If I would see a glaring example of being mistreated or not taken seriously or marginalized as being a woman, I would definitely try to act on that, but I don't think I ever experienced something like that. I've been extremely lucky with my advisors, Bill [William] Dove and Wolfgang [Driever], who always treated me like any other student in the lab, male student or postdoc [postdoctoral fellow]. So I had very positive experiences in that.

VAN BENSCHOTEN: Have you had friends, let's say, who have not had those experiences, have experienced sexism, moving up through grad [graduate] school, postdoc, etc.?

SOLNICA-KREZEL: So personally, again, not too much, and maybe because of the discipline I'm in. You just mentioned developmental biology is very good in terms of having large number of females. I told you I had a lot of interviews. I got probably not as many offers as I probably would hope at the time, but was it an issue that the zebrafish was a very risky model system at the time, or was it because I was a woman? Was it because the quality of my work? These are extremely difficult questions. One would have to look at salaries. One would have to look at space. And some of these things, unless you do something as Nancy Hopkins has done at MIT [Massachusetts Institute of Technology] and basically measured the labs, but, again, in terms of space, I definitely cannot complain.

The person who hired me here was extremely forthcoming and generous in terms of the space for me, and when I said I wanted to move to this new building, initially it was not supposed to happen. Eventually, it did happen.

VAN BENSCHOTEN: Do you believe that men and women do science differently? Do they approach it differently? Do they have different ways, habits of thought?

SOLNICA-KREZEL: I wouldn't have any brilliant observations on that subject. [laughs]

VAN BENSCHOTEN: I have a question about underrepresented groups. Whenever I ask this of Pew [Scholars Program in the Biomedical Sciences] Scholars who are not native Americans, I get very different answers sometimes.

SOLNICA-KREZEL: So now you don't know what's going to come back?

VAN BENSCHOTEN: Right. I just interviewed a man who was from Canada, for instance. In any case, let me just throw it out. First of all, we talked a little bit about comparing the systems—the science systems—in the US and in Europe as well. There are certain underrepresented groups in the United States, African Americans for instance, Latinos being another group. What can be done in the biomedical sciences to bring these underrepresented groups into the game, as it were?

SOLNICA-KREZEL: Yes, that's a big problem.

VAN BENSCHOTEN: That's one. And then the second question, while you're thinking about it, is this a problem, say, in Poland? Is this a problem in Europe? I don't know, but I'd be very interested to find out.

SOLNICA-KREZEL: So let's deal with the second question first. Very few minorities are in Poland; it became a very homogeneous country, especially after the Second World War. There were always issues of anti-Semitism in Poland. There are some small minorities, but these are minorities so small that you wouldn't be able to do statistics in terms of their representation. So at least Poland is not really a good example to think about representation of minorities. And probably from the really handful of Jews who are still in Poland, they are probably very well represented in science and politics and journalism. How it would work if we had sizable minorities, that would be a very good question, and maybe that will become some issue when some of the Ukrainians and some of the people who came back from Lithuania—many Poles lived there—would they be considered separate? That wouldn't be race type of minority. That would be all the same race, really.

What to do here? It's probably very much the issue of role models, still. We just need more success. The success that exists needs to be propagated among people in their minorities, and then I would go back to the initial education. That's very, very important, is for people from these minority groups to have broader access to better education, because when bigger numbers do, then bigger numbers will trickle down to the higher levels. I don't know statistics, are we

doing well; how well are we doing on that in terms of the numbers who are afforded a very good education at the basic levels, and then how does that progress.

VAN BENSCHOTEN: I should have asked this earlier, maybe. Where do the people in your lab come from? What countries, in other words.

SOLNICA-KREZEL: All over. All over the place. We have people at the moment from US, and we have people from Canada. We have people from Germany, Israel, China, and Korea. We also used to have people from Spain. Germany, I already mentioned. Some other people, yes.

VAN BENSCHOTEN: Some people have pointed out the prevalence of foreign nationals in US science laboratories. Again, is that a trend that you see any problem with, or is it good, bad, indifferent?

SOLNICA-KREZEL: Being a foreign national myself, I already raised the concern that we should have more native Americans in the labs here. I think it's a positive in a sense that that's the biggest problem for civilization: to become one, to break the barriers. And science provides a wonderful example of that; that can be done. From the perspective of my students from US and also my undergraduate students who often come from Alabama, from Florida, from parts of the country—it's not New York; it's not just Boston or Chicago—where there are few Europeans or Koreans or people of different nationalities, they told me that that was one of the best experiences of their life to do research, but then also to do research in a setting when they have these people from all over the country, all over the world.

So I view that as a positive as long as it is being done in proper proportions. We don't want science to be done exclusively by foreigners, because then I think we will be talking about science shops, very much like you talk about jeans shops, because that means that you are hiring foreigners who are willing to work for the conditions and money that no Americans are willing to do. So if that goes in that direction, that simply means that science is undertreated and underfunded in that country, because definitely there are enough talented people in this country to compete with the foreigners, and then how much interested are they in that competition.

VAN BENSCHOTEN: Again a ballpark figure. What percentage of foreign nationals return to their country out of your lab?

SOLNICA-KREZEL: We had a German postdoc who returned to his country. We had a Spanish postdoc who returned to her country. And we had a Polish postdoc who remained in this country. So from a very small statistic of three, we have sixty-six percent returning to their country.

VAN BENSCHOTEN: I should maybe have asked this earlier, too. Are you a citizen of the US? You're still a Polish citizen?

SOLNICA-KREZEL: I am Polish citizen and permanent resident of that country.

VAN BENSCHOTEN: Do you hope to eventually return to Poland, or do you see yourself here?

SOLNICA-KREZEL: I see myself here. It's been very long, and when I go back to Poland and visit there, it's very difficult still to do the type of science that I like to do, so probably my home and my work are here. I suppose that when I retire, I sort of see myself as a world citizen. I think I will be traveling quite a lot, maybe at the time return to Poland partially, maybe maintain some home here, some there; that's something that remains to be seen, but probably at that point I would like to become more active on the Polish side, maybe in writing and participating more. Actually, one of the jobs for this summer is to write a small review on zebrafish to a Polish educational journal that I promised a colleague of mine. My husband wrote something also over there last year. So we are trying to do a little bit, but we would like to do more.

VAN BENSCHOTEN: Just a few more questions. One was on the Pew [Scholars Program in the Biomedical Sciences]. You've already talked about the impact of the money, that it allowed you to do some independent research. It wasn't earmarked in any particular way. Was there any other impact, any other consequence of the Pew [Scholars Program in the Biomedical Sciences] award on you?

SOLNICA-KREZEL: Yes, there is a very positive one. There's this very, almost intangible, way that you are still the same person, but after this award shows up on CV [curriculum vitae], people think more of you. [laughs] I am always amazed by that, but it's recognized very much like an award, and it's recognized as some evidence that you've been recognized in terms of some qualities or some matter of work. I mean, Pew [Scholars Program in the Biomedical Sciences] is mostly talent and promise for the future, this type of recognition. So, yes, in this regard, that, as you notice, in this part of the country you don't have many Pew [Scholars Program in the Biomedical Sciences] fellows, right?

VAN BENSCHOTEN: That's true.

SOLNICA-KREZEL: And it's not common that, I think, in the history of Vanderbilt. I'm the third Pew [Scholars Program in the Biomedical Sciences] fellow, Pew [Scholars Program in the Biomedical Sciences] Scholar, so that was very much celebrated by this place and recognized.

VAN BENSCHOTEN: My last question is: what would you like to add to the record? Would you like to clarify anything? Anything that we haven't talked about that we should?

SOLNICA-KREZEL: I probably don't remember what I told you.

VAN BENSCHOTEN: It's been long.

SOLNICA-KREZEL: So let me think if there is anything.

VAN BENSCHOTEN: I can pause this, too. Would you like me to?

SOLNICA-KREZEL: Yes.

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