

Howard Nornes Interview  
Robert Zimdahl, Interviewer  
November 22, 2013

INTERVIEWER: Give us your full name and date of birth.

HOWARD NORNES: Howard Nornes. April 27, 1931.

INTERVIEWER: Where were you born?

HOWARD NORNES: [? Wenger ?] Minnesota, which was a small Norwegian ghetto in northern Minnesota.

INTERVIEWER: A ghetto. Did you grow up there?

HOWARD NORNES: I was born and raised there, yes.

INTERVIEWER: What were your parents' names and occupations?

HOWARD NORNES: My father's name was [? Hulver. ?] And my father was a businessman and a farmer. And a community leader, I would say. President of the bank, mayor of the little village.

INTERVIEWER: And your mother?

HOWARD NORNES: My mother's name was Ida. Her maiden name was Ida Onsgaard. She was a teacher, and of course a homemaker.

INTERVIEWER: You grew up on a farm.

HOWARD NORNES: I actually grew up in the small village. And my mother never wanted to live on the farm. So my father was a grain farmer.

INTERVIEWER: Do you have siblings?

HOWARD NORNES: I do.

INTERVIEWER: Tell us about them.

HOWARD NORNES: I have three brothers. My oldest brother had an apiary, a large apiary, in southern Minnesota. My brother just older than me was a physics professor at Pacific Lutheran University. And my youngest brother, Laverne, he was a high school biology teacher in Minneapolis.

INTERVIEWER: Are they still all alive?

HOWARD NORNES: My two oldest brothers have died.

INTERVIEWER: When you were growing up, Howard, what were your favorite hobbies or pastimes? How did you spend your time?

HOWARD NORNES: Well, first of all, we were really active. It was in a small town, and I really lived out that expression, you know, that a village raises a child. But it was a small village, 375 people. And I had three brothers. So we did a lot of things. Outdoors, mainly.

INTERVIEWER: So you did things outdoors. What kinds of things?

HOWARD NORNES: Well, of course it was all kinds of sports. Sports was the main thing. A sport with each season. And then, in the winter time, it was winter things. We didn't have much money. Whatever we did, we had to create ourselves. So in the springtime, if you had to make kites, you wouldn't go down to Kmart. But you'd go down to the lumberyard and get some sticks and somewhere else to get paper. Somewhere else to get twine.

INTERVIEWER: Your father was the president of the bank in this small village.

HOWARD NORNES: Yes.

INTERVIEWER: The only bank?

HOWARD NORNES: Yep. Oh yes, of course the only bank.

INTERVIEWER: Did you have any particular role models outside your family? People you looked up to?

HOWARD NORNES: Well, I had an uncle who was a teacher. He was quite an articulate man.

INTERVIEWER: In your village?

HOWARD NORNES: In our village. A learned man. And then I had an old man called [? Bess ?] Erickson. He had a big red beard, and I just looked at him as a wisdom figure. Sitting by his woodpile pontificating.

INTERVIEWER: How did these men influence you?

HOWARD NORNES: I'm sorry?

INTERVIEWER: How did these men influence you? What effect did they have on your life? As a young boy?

HOWARD NORNES: Well, it's hard to answer that question specifically, other than just thinking about them as good people. And interesting people. They were interesting to talk to. That was the main thing.

INTERVIEWER: You look back on your life as a young boy, were there any special formative experiences that you remember?

HOWARD NORNES: Well, I think the main thing is that I grew up in the outdoors, in nature. And I've always been kind of fascinated with nature. The cosmos. Where we came from, and where do we go, and so on.

INTERVIEWER: Where did you go to elementary school?

HOWARD NORNES: [? Wenger ?], Minnesota.

INTERVIEWER: Same place.

HOWARD NORNES: Same place.

INTERVIEWER: High school also?

HOWARD NORNES: No, our town didn't have a high school. And so we were bussed to the next town. Which is McIntosh, Minnesota.

INTERVIEWER: A really big town.

HOWARD NORNES: Really big, yeah. There were probably 600 people.

[LAUGHTER]

And my mother told me the reason why we didn't have a high school was because-- probably one of the biggest businessmen in town, he didn't want to have a high school, because it would've increased the taxes. So he had organized a big campaign against building a high school.

INTERVIEWER: How was your education? Elementary, high school?

HOWARD NORNES: I would say that it was very mediocre. The grade school was mediocre, but the high school was bad.

INTERVIEWER: Bad.

HOWARD NORNES: Yes. It was so bad that my dad actually on his own without talking to us too much, set us up to go to a boarding type school, about midway through our high school. Because he recognized it was so bad.

INTERVIEWER: Describe bad. What do you mean?

HOWARD NORNES: Well, let me give you-- let me just give you kind of the circumstance. So it's not really an indictment on the people of that local village. But I think it was just kind of the times. See, I was going to high school during the war, World War II. And it was really difficult

to get teachers at that time. And since our high school was probably one of the smallest high schools in northern Minnesota, it was really hard to get teachers. So I think the reason why the school was bad was not necessarily the leadership in the town, and maybe the leadership of the school, but it was just the circumstance that they were in.

INTERVIEWER: Assuming what you said about what your brothers do, your parents must have had a good attitude about education. Very supportive.

HOWARD NORNES: Oh, they were very supportive. That was what their life was all about, was to improve the quality of their children.

INTERVIEWER: When you were in high school, in this big town, did you have a pretty clear idea of where you were going?

HOWARD NORNES: No. I mean, I just wanted to be a good athlete. I was a pretty good athlete, you know, athletics was really a big thing in the community.

INTERVIEWER: Were you a reader as a young boy?

HOWARD NORNES: No.

INTERVIEWER: Did you have jobs as a young boy, high school student?

HOWARD NORNES: Well, I had jobs all the time, and I worked all the time.

INTERVIEWER: What did you do?

HOWARD NORNES: Because it was in the farming community. So early on, when my father wasn't on the farm, wasn't operating the farm, then I would go out and work for farmers. And then when I was in high school, then my father started farming. And then, of course, we helped him on the farm.

INTERVIEWER: This was a crop farm?

HOWARD NORNES: Yeah.

INTERVIEWER: Not an animal farm.

HOWARD NORNES: No.

INTERVIEWER: When were you married?

HOWARD NORNES: 1958.

INTERVIEWER: To whom?

HOWARD NORNE: I married a student nurse at the University of Minnesota. And her name was Sonia Ann Nornes. Nelson, I should say. Yes.

INTERVIEWER: So, '58, so you've been married, what, 55 years? Tell us about your children.

HOWARD NORNE: Well, I have three amazing children.

[LAUGHTER]

Can I brag?

INTERVIEWER: Yeah, of course!

HOWARD NORNE: Well, first of all, they're-- they're all-- three boys. And they're just solid, good human beings.

INTERVIEWER: Male genes seem to run in your family.

HOWARD NORNE: I love them very, very much. And they're not living with me.

[LAUGHTER]

INTERVIEWER: What do they do?

HOWARD NORNE: Well, my oldest son is a full professor at the University of Michigan in the area of documentary film. He's also chairman of the department. And quite a well-recognized scholar in that field.

INTERVIEWER: And your second son?

HOWARD NORNE: My second son Paul is a chemical engineer. And he works with the Total Petroleum Company, which is a French company. And he's working in the upper levels of management in the corporation. And currently lives in Paris, France with his family. And my middle son, David, he trained as a construction management person. He and his wife are mountain people. They love to ski, and bike, and do mountain activities.

So they live in British Columbia in a ski area. So they're living out their passions.

INTERVIEWER: Uh-huh. You have grandchildren?

HOWARD NORNE: I have five grandchildren.

INTERVIEWER: Five. All boys?

HOWARD NORNES: I have two girls living in Paris. They're in high school. And I have two girls living in British Columbia, and they're still in grade school. And then I have one son, a grandson who's living in Ann Arbor, Michigan.

INTERVIEWER: Oh, you were in the military?

HOWARD NORNES: I was.

INTERVIEWER: When, where?

HOWARD NORNES: Well, after I graduated from college, I didn't exactly have a passion for going into the military, so I was drafted. At that time, they had a draft, and luckily the Korean War was winding down. And so I was very, very fortunate to get an assignment to Heidelberg, Germany and while in Heidelberg, I just worked as a laboratory technician in a hospital.

INTERVIEWER: In the army?

HOWARD NORNES: In the army. So, and it was like living in pretty much like a country club, because it was the hospital that was associated with the headquarters of the army in Europe. And it was a hospital that was mainly for the dependents of the officers, you know, the administrators of the European headquarters.

INTERVIEWER: But this was after your undergraduate?

HOWARD NORNES: After my undergraduate, I was drafted.

INTERVIEWER: You were in two years?

HOWARD NORNES: Two years, yeah. So then I was 18 months in Germany.

INTERVIEWER: So you were enlisted?

HOWARD NORNES: Yeah.

INTERVIEWER: Not officer.

HOWARD NORNES: No, I was--

INTERVIEWER: 18 months. Where did you complete your undergraduate studies?

HOWARD NORNES: Concordia College in Moorhead, Minnesota.

INTERVIEWER: And did you go directly there from high school?

HOWARD NORNES: I did.

INTERVIEWER: Uh-huh. Why? High school wasn't that great?

HOWARD NORNES: Well, as we mentioned earlier, I think it was just implied from the home that I grew up in, you know, we would go to college.

INTERVIEWER: Yeah.

HOWARD NORNES: Because my mother went to college and my dad wanted to go to college. He wanted to be a veterinarian, but he never had enough money to do that. So it was an implied thing. My older brother had gone to college. It was just the thing to do.

INTERVIEWER: Yeah. How did you pick your major in college?

HOWARD NORNES: Well, my major was basically athletics. I was on the varsity basketball team. I was on the varsity track team. I was mainly an athlete, because I didn't have this--

INTERVIEWER: But you must have taken some classes.

HOWARD NORNES: Well, and so I was interested in nature, so I took the physical sciences. I took physics and I took math.

INTERVIEWER: Uh-huh.

HOWARD NORNES: And I took biology. Midway through I was planning on doing math. So I started a math major but that didn't work out very well because I was on the varsity basketball team and in the wintertime we had blocks of time where we'd be off campus, traveling to games and stuff. And so I was also taking biology at the time. So I switched to a biology major.

INTERVIEWER: Uh-huh. Four years undergraduate degree, what year did you graduate?

HOWARD NORNES: 1953.

INTERVIEWER: 1953. So your extracurricular activities were basketball and track?

HOWARD NORNES: They were.

INTERVIEWER: Did you have any jobs while you were there?

HOWARD NORNES: No. I was-- you know, my job was basically athletics.

INTERVIEWER: Yeah.

HOWARD NORNES: Yep.

INTERVIEWER: When did you choose to go on?

HOWARD NORNES: When I graduated, you know, I was drafted. And because athletics was such a big part of my life, I wanted to coach so after I got out of the army, I got a coaching job. And then I taught biology.

INTERVIEWER: In Minnesota?

HOWARD NORNES: In Minnesota. I taught-- I was a basketball and track coach and taught biology.

INTERVIEWER: Where?

HOWARD NORNES: A large, suburban school in Minneapolis.

INTERVIEWER: Uh-huh. How long did you do that?

HOWARD NORNES: I did that for about-- about 9 years.

INTERVIEWER: Nine years, why did you stop? I assume you stopped.

HOWARD NORNES: I stopped because you know it was really an exciting time in the biological sciences because the year I graduated was the year that Watson and Crick discovered, published their paper on DNA helix.

INTERVIEWER: Uh-huh.

HOWARD NORNES: And of course when I started teaching that forced me to really get in touch with what was going on with the subject. I was always interested in studying and learning. I was never bored by any of this, but then it was really an exciting time in the biological sciences. And then the other thing that happened was Sputnik.

And with Sputnik many people in the United States woke up. And that it was time for our country to start doing better in the sciences and start competing technologically and scientifically. And what was kind of amazing is that the leadership at that time, some leadership at that time understood that in order to do this, you also have to invest in teaching, the teaching of science. So the National Science Foundation, they created this amazing program where they created opportunities for high school science teachers to go back to universities during the summer and take courses.

So when I was teaching, I applied for what we-- what was called Summer Institute Program sponsored by the National Science Foundation. I was lucky enough to be accepted in this Summer Institute Program at Purdue University and it was an amazing program.

INTERVIEWER: Where was that?

HOWARD NORNES: Purdue University, Lafayette, Indiana.

INTERVIEWER: Uh-huh.

HOWARD NORNES: So it was a program that was designed so that you could go back four summers and get a master's degree. So during those-- that period that I was teaching high school, I went back to Purdue every summer and studied biology.

INTERVIEWER: Were you married then?

HOWARD NORNES: I was. So it was not easy but it was, you know, we were young at the time. It created kind of an exciting life. It was a quality program.

INTERVIEWER: So you did your master's degree essentially under NSF sponsorship--

HOWARD NORNES: I did.

INTERVIEWER: At Purdue.

HOWARD NORNES: Yes.

INTERVIEWER: What year did you complete that?

HOWARD NORNES: I completed that-- let's see, what year would that have been? Let's-- around '62, 1962.

INTERVIEWER: Was that a non-thesis degree?

HOWARD NORNES: It was a non-thesis degree, but 1/4 of the time was spent doing research.

INTERVIEWER: Mm-hmm.

HOWARD NORNES: As I mentioned earlier, it was an exciting time in the biological sciences. It was at the time that they were working out the expression of the code, of the DNA code.

INTERVIEWER: Yeah, yeah. And I had a project with Arthur Aronson. And Arthur Aronson was a post-doc in the Cavendish Laboratory in England where Watson and Crick had published their work. So I worked with Art Aronson and he was working on-- he had me working on a project that was working on the regulation of the expression of the DNA coding. So it was really exciting.

INTERVIEWER: So you finished that in '62, then what?

HOWARD NORNES: Well, what happened was kind of interesting is that the head of the department, Henry Koffler, he was an amazing guy, he called me into his office and he said, Howard, what are you going to do now that you have your master's? And I said, Well, Doctor Koffler, I'm going to buy a cabin up in northern Minnesota and I'm going to-- instead of coming

down to Purdue, I'm going to teach and coach and will spend the summers up in this cabin. Oh, he said. He interviewed me a little bit more and about three months later, he sent me a letter.

INTERVIEWER: You were back teaching?

HOWARD NORNES: I was back teaching. And he said, Howard, I'd like to have you come down and visit me. So he brought me down to Purdue, talked to me a bit more. And he said, "Howard, how much are you making now?" And I told him.

INTERVIEWER: How much were you making?

HOWARD NORNES: It was probably \$10,000. And then, he said, "Well, if I pay you the same amount of money, would you be interested in going on for a Ph.D.?" So it was like an angel dropping something in your lap. How could you turn it? And it was an exciting place and good people. And I knew them, and they knew me.

INTERVIEWER: How long was your doctoral program?

HOWARD NORNES: So yeah, so he offered me a job and fellowships and so on. So while I was there, part of the time, I was basically working-- or at least, half-time, up to full-time, sometimes.

INTERVIEWER: Working as in doing what?

HOWARD NORNES: Well, I was doing some teaching, and I was doing administrative work. Actually, I ran their entire graduate program, the management of their graduate program. They had over 200 graduate students in the department.

And I was involved in managing all the PR, and the recruitment, and the applications, and the acceptance process, and offering fellowships. So it was a big administrative job, for part of it.

INTERVIEWER: Then, you did a dissertation.

HOWARD NORNES: And I did a dissertation. So it took me-- I left Purdue and came here in 1972, the summer of 1972.

INTERVIEWER: When did you go to Purdue to do this?

HOWARD NORNES: I started there probably in 1965.

INTERVIEWER: And what was your dissertation on?

HOWARD NORNES: I did a dissertation on-- it was in the general area of the development of the nervous system. And what we were studying at the time is-- you see at that time, there were very few definitive markers that you could use for studying. There was no immunocytic chemistry, and there were very few molecules that were isolated.

So the techniques that were available for studying the brain at that time were mainly radioactive molecules.

So we were studying the development of the nervous system. And at that time, there were techniques available so that you could study the timing that cells are born. So what I did was to study the birth dates of when nerve cells are born into spinal cord.

And the neat thing about the nervous system in this respect is that you get only one set of cells. And the cells that we are living with right now in our brain, they are the very same cells that are born once. You get one set.

So because of that, you could use a precursor of a DNA molecule, which is the molecule that's incorporated with the chromosomes during cell division. So we had a technique where you could radioactively label a cell when it was in its last division.

So with that technique, I could get the birth dates of nerves in the spinal cord. So what I did was to get the time and the spatial patterns of where these cells were born. And because the spinal cord is a three-dimensional system, I could see some patterns in how the birthing process of cells in the coordinates.

So I had that information. And then, I correlated that with the pattern in growth of the axons. So with the time and spatial parameters of the site origin of cells, and then the pattern of their axon growth, I put together for my Ph.D. thesis the time and the spatial pattern of the development of the spinal cord. And it was just a beautiful experience.

INTERVIEWER: You said when you finished that, you came to CSU.

HOWARD NORNES: I did.

INTERVIEWER: How did you hear about CSU?

HOWARD NORNES: Well, when I graduated-- finished my Ph.D. at Purdue, I was looking for a job. And the way to do that is go to meetings. And I presented a paper. And Glen Epling was chairman of the anatomy department here at CSU-- was looking for somebody that was working on the nervous system, because CSU wanted to develop a program in neuroscience way back then.

And so they were looking for a person who was in neuroscience, and also in embryology. So I presented this paper, and Glen Epling happened to see the presentation. And he invited me up for an interview.

INTERVIEWER: How did your interview go?

HOWARD NORNES: Well, it must have gone pretty well, because they hired me.

INTERVIEWER: What positive and negative things, good and bad, first impressions about CSU?

HOWARD NORNES: Well, I'd been at a really good university, first-class university. And the Department of Biological Sciences at Purdue was one of the top biological sciences in the country at the time, because it's Henry Koffler who was the chairman, and who offered me the job, was such an amazing leader. He went on to become the president at the University of Arizona. That was his caliber.

But at any rate, Purdue was really a good school, and that's what I was comparing CSU to. And at that time, the graduate program at CSU was in its early stages, because, as I recall, the president of the university, Chamberlain, was the first Ph.D. student at CSU. Is that correct?

So in 1972, the research program here was in its early stages. And they had no neurobiology program. They wanted to create a neurobiology program. And so it was a place where it wasn't necessarily the best place for me to come if I wanted to continue my research-- which I wanted to do.

And at the time, I had three children. And I was ready to move onto a permanent job. It is unheard of to go on into a tenure-track, professorial process without a post-doc.

INTERVIEWER: Was CSU the only place you worked?

HOWARD NORNES: No, I looked at other places. Actually, in that same interview period, I was interviewing at Duke, and also at the University of Arkansas.

INTERVIEWER: Why CSU then?

HOWARD NORNES: Well, I was not only looking at-- should we pause until this?

[MAN ON PHONE]

INTERVIEWER: Where were we? Oh, [INAUDIBLE] issues.

HOWARD NORNES: Well, as I recall I was-- a couple of reasons. One was that in terms of the job I felt like it was a little better fit. Because the other two jobs were in departments of anatomy, where I would have heavy primary teaching of medical school in anatomy.

And since I was trained in biological sciences, both at Duke and at the University of Arkansas, they were in departments of anatomy. And they were departments of anatomy that were really hardcore, exclusive anatomy departments.

Now here at CSU, the position was in the Department of Anatomy, but it was also bio-medical sciences. So the college was more connected, I think, to the natural sciences college here, than in the other universities.

INTERVIEWER: You were in the College of Veterinary Medicine then?

HOWARD NORNES: I was in the College of Veterinary Medicine. So you see it was the College of Veterinary Medicine and Biological Sciences. And because they had this biological sciences component, it was, from that perspective, I thought it was a better fit. So from an academic perspective, that was the reason. And secondly, you know, I love the outdoors, and I love to ski.

INTERVIEWER: Yeah. Who were the colleagues you had the most influence on you when you first came?

HOWARD NORNES: Oh, Glen Ackerman, you know, was the chairman of the department. And he was very supportive. And I respected him very much. And of course, Bill Keats was Chairman of the Physiology. And perhaps, by that time, he'd become the dean. I think he was the Dean of Veterinary Sciences, at the time.

And it was Bill Keats, I think, that was the driving force that developed the neuroscience project. So both of those people were, you know, were very supportive of me.

INTERVIEWER: You said-- who was president when you came?

HOWARD NORNES: Well, Chamberlain, I think, was president.

INTERVIEWER: Any comments about Ray?

HOWARD NORNES: You know, I was just a young, struggling, assistant professor. And the higher levels of administration were so remote from me that I didn't really get, in a sense, what was going on at the upper levels.

INTERVIEWER: How many years did you work at CSU?

HOWARD NORNES: I'm sorry?

INTERVIEWER: How many years?

HOWARD NORNES: I worked over 30 years.

INTERVIEWER: Over 30 years. And you progressed-- you became full professor.

HOWARD NORNES: I did become full professor.

INTERVIEWER: You never went into administration?

HOWARD NORNES: Well, not by choice. But you'll remember, back in the days, when there was sort of musical chairs going on in the administration, and in my younger days of being in the

department, it was the period of time when Phemister was dean. And I think, was Austin the president at the time?

INTERVIEWER: Uh, huh.

HOWARD NORNES: And Austin, all of a sudden, left. And then Phemister moved on up to become the interim president. And then my chairman, John Venable, he became the dean. And then I was appointed to be the interim chairman of the department.

INTERVIEWER: How long did you do that?

HOWARD NORNES: I did that for two years.

INTERVIEWER: Two years?

HOWARD NORNES: Two years.

INTERVIEWER: And you didn't choose to be-- continue in that position?

HOWARD NORNES: I didn't. No, obviously.

INTERVIEWER: Good decision. Ha, ha.

HOWARD NORNES: You know, at that time, the neurosciences was really an exciting place to be, and, of course, the biological sciences. And it was a good place to be. And there were a lot of exciting things going on. And I wanted to stay in my research program.

INTERVIEWER: When you came to CSU, you were assistant professor. What were your professional goals? What did you hope to accomplish?

HOWARD NORNES: Well, I thought that with my Ph.D. thesis, I really had a nice perspective on the overall kind of a macro development of the nervous system.

And because of the nature of my work, this perspective gave me a lot of help in doing the more precise things in localizing some of the underlying mechanisms that were operating, and regulating what turns on the cell to stop growing, and starting to differentiate. What are the mechanisms that are involved in guiding axons to growth, and so on? So your question was what did you hope to accomplish?

INTERVIEWER: Yeah, what were your goals?

HOWARD NORNES: I hoped that I could look at some of underlying mechanisms that were triggering the regulation of development of the nervous system, just to get some insights, you know?

How does the cell know when to be born? What's the trigger for that? And how does it know where to go, to settle in and get its final position?

And then the amazing thing is, in terms of the nervous system, that you have a cell that's born, say, in the lower part of my spinal cord, and yet it has to find the specific cell type up in the brain stem to carry that precise information.

So what are the cues that it gets? So with my Ph.D. thesis, I knew when these triggers needed to come into play. And I had some perspective of when and where to look at these things. So I was hoping, you know, that I could solve some of those problems.

INTERVIEWER: Did you?

HOWARD NORNES: Well, I hope I contributed in a little way.

INTERVIEWER: So you had certain goals when you arrived. Did they change over time?

HOWARD NORNES: The big issues didn't change, but it was my research career sort of, could be categorized as falling into three different periods, or the directions of research.

The first phase was following up on my Ph.D. thesis. And I was basically doing experiments, where we were testing the idea of how the time and the position of birth of a particular cell could determine the position of its axon growth.

So we were doing some experiments to test this idea, and in vivo, in the animal, in the adult animal. Our model at the time was a rat. And to do those experiments, we were transplanting cells.

Let's say, we were taking a cell from the upper part of the spinal cord, and we put it into a foreign place, the lower part of the spinal cord. And then we had ways of finding out if that cell could find its own way in a foreign place.

And then we would get at a question, you know? That just the position would determine its pattern of growth, rather than the identity of a specific cell. So we did those kinds of experiments. They were very difficult experiments.

And that lead me, then, into the second phase of my experiment. And about this time, see we were doing transplantation experiments in the embryo, extremely difficult, fine experimental work. And at that time, the Swedes were doing some experiments where they transplanting stem cells into the adult spinal cord.

And they were very interesting. It was the beginning of stem cell research. And you know, this fit into my interests, and especially, you know, you're always kind of interested in doing things that have some direct application. And of course, implanting stem cells into the adult brain have extremely powerful, therapeutic possibilities.

So we were doing these experiments, transplanting in embryos and studying embryonic developmental issues. But then, when we discovered that they were beginning to do transplants into adult animals for therapeutic consequence, it was kind of intriguing to do that possibility.

So in the middle part of my career, I began to apply my developmental background into turning on development, so to speak, in the adult animal. And work on problems of regeneration of the adult brain.

And so at that phase, I was lucky enough to get a sabbatical. And I went to Sweden and worked with the pioneer in stem cell biology, Andres Bjorklund at the University of Lund. So in the middle part of my career, we were working mainly on implanting stem cells into the adult brain and spinal cord.

INTERVIEWER: Then at the first, the middle, what about the last?

HOWARD NORNES: Can we pause for a moment?

INTERVIEWER: Yeah.

HOWARD NORNES: So I can have a drink of coffee?

INTERVIEWER: Sure.

HOWARD NORNES: Are you ready to go again?

INTERVIEWER: Yeah.

HOWARD NORNES: OK.

INTERVIEWER: So the last the last part of your career.

HOWARD NORNES: Well, in the last part of my career I was still working in development. And in the early on it was a development of the embryo. And then in the middle of the career it was really working on turning on development in the adult brain, because that's what regeneration is about.

And when we were doing the stem cell experiments, early on we were just asking simple questions. If you put a stem cell, and by stem cell, what I'm talking about here, is that we would take, we would dissect out specific cells in a rat embryo. And, in particular, we were implanting noradrenalin cells.

And we knew where the noradrenaline cells were located in the embryonic brain. And, of course, because of the steady timing of birthing and so on, I knew when these cells were born. So I could go into the embryo, the brain embryo, and I could dissect out these embryonic noradrenaline producing cells. And I would implant them into the spinal cord.

And, at that time, the Swedes had techniques that you could immunocytochemically, localize a noradrenaline producing cell. So the neat part about these experiments, is that I could dissect a noradrenaline embryonic cell, implant it into a part of the spinal cord that didn't have noradrenaline cells.

And you could immunocytochemically, localize these cells. So you can find out if they survive. You can find out how much they grow. How far they grow. And then you could find out, for example, when you put an embryonic cell in to the adult brain, does it actually do anything? Does it do what it's supposed to do?

INTERVIEWER: Howard, you kept saying we? Who else was working with you?

HOWARD NORNES: Well, I was working with Anders Bjorklund who is the Swedish scientist. And then I worked with my graduate students. At that time the primary graduate student that did this earlier stem cell work, was James Buchanan. He was post-doc. And then I had Michael Carey, who was in my lab about that time. I was working on the development of the chick spinal cord.

INTERVIEWER: A goal of research is publication.

HOWARD NORNES: I'm sorry?

INTERVIEWER: A goal of research is publication.

HOWARD NORNES: Yes.

INTERVIEWER: Tell us about your publication record.

HOWARD NORNES: Well, we published, for example, in the early phases-- did you want me to finish my research program?

INTERVIEWER: Oh, I'm sorry. Sure.

HOWARD NORNES: I guess I was rambling a little bit too much, huh?

INTERVIEWER: I interrupt well.

HOWARD NORNES: Well, in the stem cell work, and it's kind of related to your question, too. Now I think one of the key publications that came out of our lab, is that we were transplanting. We asked the question, if you take an embryonic stem cell and you put it in to the adult brain, does it survive? Does it grow? And does it do what it's supposed to do?

So we had an experimental model where we could selectively destroy the noradrenaline cells in the spinal cord. And then you could find that when you do that, you've get a behavioral deficit in the flexion reflects of an animal. It becomes very weak.

So here we had a nice model. We could implant these noradrenaline in to the spinal cord, and we could find out if that function came back.

INTERVIEWER: You published this?

HOWARD NORNES: We published this. And it was one of the key, one of my major publications.

INTERVIEWER: Your publications were mostly journal articles.

HOWARD NORNES: Yeah. And review articles.

INTERVIEWER: Did you write a book?

HOWARD NORNES: I never wrote a book, but I wrote review articles. And then, in the final phase of my research, at that time the tools of molecular biology had come into play. And it was possible for somebody that wasn't a hardcore chemist to do molecular biology. Because there were cookbook methods that you could use.

INTERVIEWER: Well, if you think back on your career, are there particular highlights? Particular--

HOWARD NORNES: Well, I think one of the highlights of my career was doing this work. Well, doing the work on the spinal cord. And that was sort of fundamental. Very fundamental research work on the birthing cells in the spinal cord. And I think that's a paper that has some long-term values. People cite it and so on. And then, the second paper, that I just told you about on stem work. That was, I think, the work that showed, you know, that you put a stem cell in an adult brain, it survives. It grows fibers. And it can restore function.

INTERVIEWER: How many papers did you publish over your career?

HOWARD NORNES: You know, I don't know for-- probably 30, 40 papers. Something like that.

INTERVIEWER: When you came to CSU, you already described it as not quite Purdue. And what sort of facilities did you have to do your research?

HOWARD NORNES: Well, the facilities that I got-- at that time, I was in the Department of Anatomy. And in the Department of Anatomy they had a room for me to move into, and an office.

INTERVIEWER: That's about it?

HOWARD NORNES: They had a histology laboratory. And they also had an electron microscopy laboratory. And a histology laboratory was very helpful to me, but, of course, I didn't do electron microscopy. The light microscopy was a program that they had.

INTERVIEWER: Could you depend a lot on external funding?

HOWARD NORNES: I did. And I got some internal start-up funds.

INTERVIEWER: How much teaching did you do when you came?

HOWARD NORNES: Well, I did some teaching in the veterinary program, but that was minimal. Because I didn't have a tradition in the veterinary sciences. I was more in the biomedical sciences. So I spent most of my teaching in the biomedical science department program. And I taught in their large course in physiology. The introductory anatomy physiology course.

INTERVIEWER: How many students?

HOWARD NORNES: Well, that was a big course, because it served a lot of people on campus. That course had an enrollment of up to, over 400 students some semesters.

INTERVIEWER: Once a year, twice a year?

HOWARD NORNES: It was three times a year, actually.

INTERVIEWER: Three times a year.

HOWARD NORNES: During summer and both semesters.

INTERVIEWER: So your teaching experience was not your primary responsibility?

HOWARD NORNES: Well, I would say that it was a primary responsibility. And my research was a primary responsibility. I was hired to develop a research program. And I think I was hired to develop the neuroscience program at CSU.

And, you know, I was probably one of the first hired. Jim Bamburg in biochemistry was a neuroscientist. And Jim Bowman was also a neuroscientist. And I was probably the third hire in the area of neuroscience. And, which, evolved into a significant program at CSU.

INTERVIEWER: How many graduate students have you advised?

HOWARD NORNES: About 8 to 10 graduate students. And then I had about as many postdocs.

INTERVIEWER: Any comments on your teaching experience. Is it good? Did you accomplish what you set out to accomplish?

HOWARD NORNES: Well, I enjoyed teaching. And teaching this undergraduate course was a good experience. And I think the students-- it was a course that served a lot of majors and minors in the university. And I was the coordinator of the course for several years. And I taught the section on cell biology and neurobiology.

And I think the students and people in other departments were quite satisfied with this course. It was a team taught course. And I taught only the section on the nervous system, cell biology.

INTERVIEWER: Did your teaching technique change over the years?

HOWARD NORNES: Well, I'd hope so. I hope I became a better teacher.

INTERVIEWER: How did it change?

HOWARD NORNES: How did I change? Well, I hope that I was able to teach in a way so I wasn't just transferring information, but presenting key experimental work. And presenting it in a context of a scientific process. Giving them somewhat of an idea of the original studies that were done.

INTERVIEWER: You mentioned your sabbatical in Sweden. Did you have other international professional experience?

HOWARD NORNES: Yeah. And the third phase of my research, I, actually, by that time they were beginning to develop techniques for a non-hard core chemist to do molecular biology. And at that time, our research had evolved to the point where we were interested in asking questions at the genetic level, at the gene level.

Where what is it that's regulating gene expression in the development of the nervous system. Which genes are involved in activating growth, for example. And so I was lucky enough in 1979 and in 1980 to get a sabbatical. And I was also offered Fellowship at the Max Planck Institute in Gottingen, Germany, where I learned the techniques of molecular biology.

INTERVIEWER: So that international experience was good?

HOWARD NORNES: It was amazing.

INTERVIEWER: Did it influence your teaching?

HOWARD NORNES: It influenced my teaching. It influenced my research. And so in the last phase of our research, we were actually studying, at that time we were studying both the development of the nervous system, and also the regeneration. And we began to ask questions of what are some of the gene regulation systems that are operating during the development of the nervous system.

Like we had studied when cells were born, for example. Now we wanted to look at this question in the molecular level. So we ask questions. What kinds of molecular triggers are used that turn on cells, so that it stops proliferating when it's born? So when I was at the Max Planck in Germany, we were looking at some of the transcription factors that were involved in turning on the birth of a cell.

So we did that work. And then in terms of the regeneration work, what we discovered when we implanted stem cells, is that it's fine to put in an embryonic stem cell. But in order for the stem cell to really do something, you have to turn on the growth of the host.

You know, it doesn't make any sense to just have a growing system in a non-growing system. They don't interact with each other. So in the latter part, in terms of a regeneration work, then we began to look at the genetic level on how you could turn out growth. So that experience in Germany was a wonderful experience.

INTERVIEWER: You came in '72.

HOWARD NORNES: Yes.

INTERVIEWER: What year did you retire?

HOWARD NORNES: '02.

INTERVIEWER: If you look back over those years, what were the biggest challenges?

HOWARD NORNES: I think the biggest challenge was, for me, was that my condition was in the biological sciences. And I came into the culture a professional veterinary medicine. And I was, basically, a fish out of water. And the cultures were very different. It wasn't that one culture was better than the other one. But they were different. And that was a big challenge for me.

INTERVIEWER: What were the biggest rewards?

HOWARD NORNES: The biggest rewards were being able to get the support. And they have mentoring and have opportunities for continuing to support what I wanted to do. I had some great, idealistic, big dreams about the development, studying the development of the nervous system. And I was able to continue growing, developing the field. And so that was satisfying. And then just working with undergraduate students was amazing.

INTERVIEWER: The 30 years, you look back on that, are there things that you have learned, that you think that young faculty ought to know now?

HOWARD NORNES: Well, don't take yourself too seriously, have some fun. You know, life should be a joy. And we get so serious about producing and about standards. And even though I was able to get tenure and get promotions. And the whole tenure promotion process, it was a difficult process for everybody.

Like we were a growing department at the time. We wanted to develop a research program. And you'd bring people in, young, exciting people. And they would work towards tenure and they wouldn't get tenure. As a more-senior person, you'd be on a salary and promotion committee, and you'd have to turn these people down, because they weren't living up to your standards. That whole process is difficult. So in answer to your question, you need a more substantial mentoring program for young faculty members.

INTERVIEWER: Do you think the professorial role was changed?

HOWARD NORNES: I don't know. I'm kind of a traditionalist. And I've always felt that the flagship university in a state should be a place where your research has to be really good, and well supported. In, at least, one or two institutions in a state, like in the state of Colorado. So I always felt, as a young professor, and I feel now, that in terms of this higher education hierarchy, it's very important for Colorado State University to maintain a very high profile and support for original research.

INTERVIEWER: How about teaching?

HOWARD NORNES: Of course, teaching. And from my own experience as a graduate student, it was my sense that your better researchers are also your better teachers. And I think it's really important that you have undergraduates exposed to cutting edge research. And I think that in the flagship university, I think it's essential that you maintain this, that one maintains this tradition of a professorial rank being an individual who does both original research and teaching.

INTERVIEWER: So you are going to tell this new, young faculty member, lighten up. Have some fun. Does that person face different challenges that you faced?

HOWARD NORNES: Well, it's hard to answer that question. Because I think in order-- a research professor of the sciences, there are two basic things you have to do. Number one, you have to generate your own money. And, number two, hopefully you learned to be an effective communicator and teacher.

And I don't see that that's changed today. And I see the process of writing grants, and getting money. And a commitment, a scholarly commitment is, basically, the same. As a matter of fact, I think nowadays, I see these young professors come in and I see they have a huge advantage over us.

Number one, the first big advantage, is that they have the internet available. And that's a huge advantage. Because, in terms of doing your scholarship, everything is right there at your fingertips. And when we were doing research, it was really difficult, contrast-wise. We didn't know anything.

[INTERPOSING VOICES]

HOWARD NORNES: Well, we'll pause for now.

[INTERPOSING VOICES]

HOWARD NORNES: So we were talking about "you seeing any difference."

INTERVIEWER: Yeah.

HOWARD NORNE: I see a huge difference. And I continue to teach--you know, I'm teaching in the Osher program-- and I continue to write.

INTERVIEWER: What's the huge difference?

HOWARD NORNE: The huge difference is that I have all this information available to me from my desk.

INTERVIEWER: Does that make it easier or more difficult?

HOWARD NORNE: Oh, quantumly easier. It's all right there. And the access and the efficiency of it. And then using all these tools, you know, to put together documents, write grants.

And you know how it was in our day. You'd go to the library, you'd have index cards. And then you would write something long-handed, and you bring it down to the secretary and then have to type it and retype it. So I would say that they have an enormous advantage.

And in terms of funding, there's-- it's still hard to get funding. It's always been hard to get funding. You know, back in the days when I was writing NIH and NSR grants, they were funding less than 10% of the grants. It was very competitive. And nowadays it's still competitive. But there's more money available. There's more private money available. And then there are so many more resources that are available to the young faculty nowadays.

INTERVIEWER: Do you have any general comments about your career at CSU?

HOWARD NORNE: Well, I felt very blessed to have been given the support and the opportunity to grow and develop at a place. My coming into a research professorial position without a postdoc is something that's not a strong recommendation for anybody.

And I feel blessed that I had colleagues that were able to give me the support and the mentoring to survive. And I was able to follow the intellectual track and follow my dream of studying the brain.

INTERVIEWER: How do you see the role of the land grant university?

HOWARD NORNE: I'm sorry, the role--

INTERVIEWER: How do you see the role of the land grant university going into the future? What's their task?

HOWARD NORNE: Well, I mentioned earlier about the role of the vision, the flagship university in the state, where it is the center of learning new things and so on. And of course, I think one of the wisest things that has ever happened in our country was is the legislation of Lincoln to create the land grant universities.

And I grew up in Minnesota, and I saw how the University of Minnesota, which was kind of the classic model for the role of a land grant university in a developing country. And I was very much involved in the Extension program growing up as a child. I was in 4H programs, which were supported by the Extension program at university.

So I think that the land grant concept is amazing, and I think the land grant concept is something that still is alive and should continue to be alive at Colorado State University.

INTERVIEWER: Through your time in education, back when you were a high school teacher, were there any truly significant national, international occurrences that influenced you?

HOWARD NORNES: Well, I mentioned earlier-- well, besides just the amazing development of the biological sciences during the period that I was active, the discovery of the DNA molecule, and all the subsequent things that went along with it.

And then, of course, the corollary developed research that was done on the brain during this period of time. And several Nobel Prizes were given in brain research during this period of time. It was an amazing period of time to be active intellectually in those areas.

And in terms of teaching, the significant thing that happened, as I mentioned earlier, was Sputnik. And that's the reason why I'm here, is because the federal government decided they wanted to improve the quality of teaching of high school science, secondary school science.

INTERVIEWER: What's been the most significant changes in the university during your career?

HOWARD NORNES: Significant changes in the university. Well, of course, the Internet is a huge impact just on the management of the university. And I think at CSU, as I mentioned when I first came here, you know, the research programs were quite young. And there wasn't really a lot of extramural support.

Like in the department that I came from at Purdue, they had a machine shop right in the department, they had a glass shop, they had a store right in the department. They had all the biochemical and analytical systems that were in place. They had all the modern day research equipment that was there.

Well, how has it changed now at CSU? I think CSU is at that point now.

INTERVIEWER: As you look ahead for a place like CSU, what are the big issues that it has to deal with?

HOWARD NORNES: Well, the fundamental question, you know, is how does CSU fit into the delivery of higher education to the people in the state of Colorado? And I think it's really important to spend some time and really integrate how these different programs should evolve in the junior college and the state colleges and in the major universities, and have a clear idea of who should do what, and how do we get the most bang for our buck in delivering higher education to our state.

INTERVIEWER: Two final questions. Did you get the cabin in Northern Minnesota?

HOWARD NORNES: I'm sorry?

INTERVIEWER: Did you get the cabin in Northern Minnesota?

HOWARD NORNES: No, I didn't get the cabin in Northern Minnesota, but I got a very rich and exciting life living on the foothills of the Rocky Mountains here in Fort Collins. And I'm sitting here in my beautiful home looking at the foothills. And it turned out to be a very rich and satisfying and joyful and challenging life.

INTERVIEWER: Any final comments?

HOWARD NORNES: Well, thank you to CSU. Thank you to all my mentors. Particularly thank you to my wife Sonia, who was an amazing support for me. Because as a young, striving professor, we spent a lot of time in the lab. And Sonia was an amazing gift and support raising these three children. And so I have great gratitude to her, and gratitude to my children, who have evolved and turned out to be beautiful, wonderful human beings.

INTERVIEWER: Thank you.