SCIENCE HISTORY INSTITUTE

TIMOTHY P. CROUGHAN

Transcript of an Interview
Conducted by

David J. Caruso

at

Science History Institute
Philadelphia, Pennsylvania

on

13-14 June 2023

(With Subsequent Corrections and Additions)

Timothy P. Croughan

SCIENCE HISTORY INSTITUTE
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> Timothy P. Croughan with Suzan Croughan (wife) and Matthew Croughan (brother), interview by David J. Caruso at Science History Institute, Philadelphia, Pennsylvania, 13-14 June 2023 (Philadelphia: Science History Institute, Oral History Transcript # 1147).

Science History Institute

Chemistry · Engineering · Life Sciences

TIMOTHY P. CROUGHAN

1950 Born in Santa Cruz, California on 22 March 1950

Education

1975 BA, Reed College, Biology
1977 MS, University of California, Davis, Agronomy
1981 PhD, University of California, Davis, Plant Physiology

Professional Experience

Louisiana State University Agricultural Center
1981-1984 Assistant Professor, Rice Research Station
1984-1991 Associate Professor, Rice Research Station
1991-2005 Professor, Rice Research Station
1999-2005 American Cyanamid Endowed Professor of Excellence in Plant Biotechnology, Molecular Biology, and Crop Pest Management

Honors

2001 Louisiana State University Agricultural Center Service Award
2006 Rice Technical Working Group Distinguished Service Award
2011 Crowley International Rice Festival Honoree

ABSTRACT

Timothy P. Croughan was born in Santa Cruz, California, in 1950. His parents were from the Midwest, moved to California as children, met and married in college, and moved to Santa Cruz upon graduation. Croughan was one of six children, and he loved being outside as a child. When he was four, the family moved to Marin County, California, so that his father could go to seminary. When his father got his first job as a minister, the family moved to Augusta, Kansas, to start a new Presbyterian church. Croughan remembers retreating to safety in the lower level of the family home during tornado watches. He talks about his parents' high expectations for the children in chores and education. His mother was involved in politics and supported women's rights. She also worked in hospitals as a microbiologist and brought her children to work with her sometimes. When Croughan was eleven, the family moved back to California, and he started getting more interested in science. He participated in the Boy Scouts and went hunting during his free time. He learned about Reed College from his sister Kate and decided to attend. He had originally planned to become a physician, but changed his career trajectory after reading an article in the paper that children around the world were dying from a lack of food. He decided he wanted to help produce food. In college, he enjoyed working on calligraphy and spending time in his garden. He knew his next step was graduate school, and he decided on the University of California, Davis, working with Professor D. William (Bill) Rains in the Department of Agronomy.

Croughan started working on cell culture and salt tolerance in Rains's lab. He learned new techniques and discusses his daily life in the lab where he met his future wife, Sue. In his free time, he continued to garden and also got involved in winemaking and brewing beer. He even established a class at Davis, "Agricultural Science and the World Food Crisis," and invited well-known scientists to come and speak to the class. As Croughan considered his career after earning his PhD, he started becoming more interested in working on rice. He was offered a position at Louisiana State University's Rice Research Station as a faculty member focused exclusively on research with no teaching responsibilities. He talks about setting up his lab, which he would later share with his wife, and hiring technicians. He also traveled around the world to learn more about rice. When Croughan returned to the United States, he began trying different techniques to find herbicide-resistant plants, including spraying plants and studying chemical mutation. When Sue came in 1984 to study soybeans and forage crops, the couple worked side-by-side in the same lab, even checking each other's math. They raised their three children on the Rice Research Station property and speak fondly of their time in Louisiana. In the early 1990s, Croughan discovered an herbicide-resistant plant and tested it, eventually filing a patent in 1994, which he received in 1996. He begins backcrossing seeds and working with companies who want to use his patented technique. For the next ten years, he continued his work, retiring on January 1, 2005. In retirement, Croughan turned his focus again to gardening, this time raising native Louisiana trees. He concludes the interview by discussing his children and how proud he is of them.

INTERVIEWER

David J. Caruso earned a BA in the history of science, medicine, and technology from Johns Hopkins University in 2001 and a PhD in science and technology studies from Cornell University in 2008. Caruso is the director of the Center for Oral History at the Science History Institute, a former president of Oral History in the Mid-Atlantic Region (2012-2019), and served as co-editor for the Oral History Review from 2018-2023. In addition to overseeing all oral history research at the Science History Institute, he also holds several, in-depth oral history training workshops each year, consults on various oral history projects, and is adjunct faculty at the University of Pennsylvania, teaching courses on the history of military medicine and technology and on oral history.

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ALSO PRESENT:	**Suzan (Sue) Croughan (wife) and Matthew (Matt) Croughan (brother)**
LOCATION:	**Science History Institute Philadelphia, Pennsylvania**
DATE:	**13 June 2023**

CARUSO: So today is June 13, 2023. I'm David [J.] Caruso here with Tim Croughan, Sue [Stavarek] Croughan and also Matt Croughan. We're conducting an oral history interview here at the Science History Institute. Thank you again for sitting down with me and telling me a little bit about your life. And like I said, I want to start at the very beginning. So I know you were born in Santa Cruz, California, or I should ask, were you born and raised in Santa Cruz, California?

CROUGHAN: Yes.

CARUSO: Okay. And that was 1950?

CROUGHAN: Yes, exactly.

CARUSO: Can you tell me a little bit about your parents? What were they like? What were their names? Did they work? What were their occupations?

CROUGHAN: Yeah, both my parents worked. So my dad's name was Claire Malloy Croughan. And my mom's name was Mabel Wilson Croughan.

CARUSO: Were they native to the Santa Cruz area, or did they move there at some point?

CROUGHAN: I guess they moved there. I'm not [sure].

MATT CROUGHAN: Yeah, they had both been . . . they were born in the Midwest, Pete in South Dakota and Mabel in Illinois and then had spent their youth in Southern California, and both graduated from UC Berkeley, got married while they were in college, and then moved to Santa Cruz upon graduation.

CARUSO: Okay. Do you know what they were studying in college?

MATT CROUGHAN: Yeah. Pete, mechanical engineering. And Mabel was bacteriology.

CARUSO: Great. So what are some of your earliest memories of growing up in Santa Cruz? What was your neighborhood like? What was your home like?

CROUGHAN: Oh, I guess the earliest memories are going to the beach. The home seemed very large at the time. I don't know. In retrospect now, it may not be that large. It was a nice family. It was a . . . we got along well. I guess that's pretty much covers it unless you want me to try to come up with more.

CARUSO: No, I have some other questions I can ask. So your father was a mechanical engineer, your mother, bacteriology?

MATT CROUGHAN: Yes, she worked ultimately in hospitals as a microbiologist.

CARUSO: Okay. And so that's what I was going to ask. So your parents both worked when you were young?

CROUGHAN: Yes.

CARUSO: Okay. Did you have someone who sat for you while they were at work?

CROUGHAN: Yeah, various people over the time.

CARUSO: So hired nannies and things like that? What . . . do you recall any interests that you had when you were very young? Were you out in the yard looking for bugs? Did you like reading? Were you interested in music? I'm trying to remember when I was given a chemistry

set when I was a kid. I was probably like four or five when they shouldn't have given me a chemistry set. But I mean, did you have . . . what were some of your early interests, if you remember any specifically?

CROUGHAN: Liked to be outdoors. Wasn't into sports very heavily. I did participate, but I wasn't very gung-ho on it. Tried a little bit of piano lessons, that kind of thing when I was younger, but I had an older brother who was a superb pianist, so there was kind of a model there, but I didn't have turned out, didn't have the skills he did. So I'd like to go hiking in the hills around Santa Cruz. So liked the outdoors a lot.

CARUSO: And how much older is your older brother?

CROUGHAN: I mean, how old is Jack?

SUE CROUGHAN: About ten years.

MATT CROUGHAN: Eight years older than Tim.

CROUGHAN: Eight years older.

CARUSO: Eight years older. Okay, so he was already in elementary school when you were born?

CROUGHAN: Right.

CARUSO: So middle school when you were in elementary school?

CROUGHAN: Right.

CARUSO: Roughly, okay. Do you recall doing a lot with your brother when you were young? Was he playing with you or is he one of the "you're my younger brother; stay out of my room"?

CROUGHAN: Probably a compromise between those two. We shared a bedroom, so there was some interaction there.

SUE CROUGHAN: His parents had Jack and then Kate. And then they were having difficulty having more children. And so they adopted Shelley [Booth]. And then she got pregnant with [Tim]. And **<T: 05 min>** so Tim and Shelly were very close in growing up because they were close in age.

CARUSO: What's the age difference?

SUE CROUGHAN: Was it thirteen months or something?

MATT CROUGHAN: Yeah.

SUE CROUGHAN: And then there was another long break before Matt and Mary came.

MATT CROUGHAN: Nine-year gap. And then my sister Mary and me.

CARUSO: Okay. So relatively large family over time.

CROUGHAN: Right.

CARUSO: While growing up in the household when your parents weren't at work, what did you tend to do as a family? Was this when you were going on the hikes outside, or were there other things that your family did together as a group?

CROUGHAN: Well, we regularly took vacations, and so that was kind of a highlight each year. We'd go camping. I guess we must have stayed at a motel once or twice, but in general, it was all camping. Mostly to save money because that was an issue.

CARUSO: And did you stay in California, or did you travel, go on road trips?

CROUGHAN: Mostly in California.

SUE CROUGHAN: When did you move to Marin?

CROUGHAN: What's that?

SUE CROUGHAN: When did you move to Marin?

MATT CROUGHAN: We'll get into the future. I think he stayed in Santa Cruz, too. You were about seven or so.

CARUSO: Yeah, Santa Cruz till seven.

MATT CROUGHAN: Or actually, maybe not that long. Yeah, I know these dates if you want me to state it so . . .

CROUGHAN: Go ahead.

MATT CROUGHAN: So Tim was born in 1950. Then in 1954 about, our dad decided to go to seminary to become a Presbyterian minister and went to San Francisco Theological Seminary, which is in Marin County in San Anselmo, and moved [the] family of he and Mabel plus four kids to there. They lived in married student housing while he spent three years in seminary. And then Mabel, I believe, raised the kids and worked as a medical microbiologist while he studied and [she] kind of got rewired to work pretty much twenty hours a day. So she was sort of this incredible woman of she could sleep four or five hours a day, day after day after day and be completely happy and fine. So interesting gal. And then my dad got his first job as a minister, as essentially a missionary pastor to Kansas, where he moved into a town where there was no Presbyterian church, and he recruited the members and physically built the church. He knew how to do construction.

CROUGHAN: He had an engineering degree.

MATT CROUGHAN: Yeah from his mechanical engineering degree. And then he'd worked for a construction firm in San Diego . . . sorry, in Santa Cruz. And then after three years in Kansas or so—three or four years—couldn't really stand the weather. Loved the people, but the weather drove them crazy. He loved Santa Cruz weather, SoCal weather, and a position opened

up in Novato, California, in Marin County and moved the family there. And so I was born . . . . Mary and I were born in Kansas, but when we were young moved to Novato and were raised in Novato.

CARUSO: Okay. That helps fill in a lot of the history. So you were back in California roughly what year?

MATT CROUGHAN: Sixty-one.

CARUSO: Nineteen sixty-one. Okay. So you were eleven years old when you were back in California. One of the other questions that I was going to ask about your childhood was whether or not and so this . . . . I mean, the answer is pretty obvious at this point, but whether or not your family was religious at all.

CROUGHAN: Yeah, my dad was a minister.

CARUSO: And so before your father decided to become a pastor, was religion a strong component of what you did on a regular basis? Were you going to services? Were you being raised . . . ?

CROUGHAN: I guess so. I haven't really reflected on the very early on, but . . .

MATT CROUGHAN: They were active in the First Presbyterian Church in Santa Cruz.

CROUGHAN: So **<T: 10 min>** I would say religion was a significant part of the family's life.

CARUSO: Did your father ever speak about why he decided to become a minister, why he wanted to move in that direction instead of remaining an engineer?

MATT CROUGHAN: I never heard. I don't remember. He was an excellent pastor. Quite successful at it.

CROUGHAN: Yeah. He was well-liked.

MATT CROUGHAN: Well-liked. And he successfully recruited and started that church. And it was in Augusta, Kansas.

CROUGHAN: A place with many . . . thirteen churches already. I think five thousand people.

MATT CROUGHAN: So they were disappointed when he left. The congregation loved him and then in Novato quite successful, probably doubled or tripled the size of the church in Novato. He was a senior pastor. And we were raised as pastor's kids in Novato, which . . . our dad was very popular. So it was kind of a special way to grow up when the town all loves your dad.

CARUSO: So when you were in Kansas, you were roughly eight years old. Do you recall what life was like for you while your father was literally working to build the church there?

CROUGHAN: Yeah. That open area is how I remember it. And, you know, the weather changes in the winter with the snow.

SUE CROUGHAN: Tell them about the tornado.

CROUGHAN: Oh yeah. We had . . . when a tornado watch would be called, we'd all go down to . . . it was a split level so half of one level was underground, and there was a certain corner of the house we'd kind of all not cram into, but get seated at on the floor, and we'd wait for the activity outside to play out. I don't know if that answered that.

CARUSO: Yeah.

SUE CROUGHAN: Didn't you . . . one time your parents weren't home, and you had to get Matt and Mary down there or something?

CROUGHAN: I'm sure I did, yeah.

CARUSO: Wrangling up the little kids to get them to safety.

CROUGHAN: Younger.

SUE CROUGHAN: And your dad made you work, remember?

CROUGHAN: Oh yeah. Around the house. Yeah.

CARUSO: So your . . .

CROUGHAN: Intense, laboring obligations.

CARUSO: What sort of obligations?

CROUGHAN: Oh, indoors and outdoors. Anything that needed to be done.

SUE CROUGHAN: Setting up chairs in the church.

CROUGHAN: Yeah, yeah. Helping move chairs. Put up chairs for the services every Sunday at the church and then taking them down after the service was over and stacking them up and helping move them back into storage.

CARUSO: In terms of building the church there, did your father have help from anyone else to do the manual labor, or did he involve the kids?

CROUGHAN: It was professionally built. It was built by a contractor. But since he was an engineer, he was pretty heavily involved in the design and the specifics of the construction.

MATT CROUGHAN: He didn't physically build it.

CROUGHAN: He didn't physically build it, but he oversaw . . .

CARUSO: Oversight management. Okay. Were you ever brought to the construction site that you recall to see the church being raised?

CROUGHAN: Oh yeah. Yeah. And I'd go by on my own, you know, as time went by just to see it and play around it, you know, because it was just kind of a fun, ongoing project to see.

CARUSO: You mentioned that you had a number of chores around the house, responsibilities. Did your father or your mother show you what you needed to do? Like, were they . . . . I'm just reflecting on when I was a little kid, and my parents would involve me. And if we needed to build something, even if it was just like—I doubt I was really actually building anything—I had a hammer in my hand or used a pair of pliers. Were your parents showing you how to do these various chores, these life skills, or were you just expected to kind of figure it out?

CROUGHAN: Well, my dad had pretty high expectations. So if you were told to do something, he would check it. And if it wasn't done right, it would be done right before you were finished with it, that's for sure. So in that sense, he brought direction to the project. But I guess essentially, if you weren't going to do it right, you could expect repercussions.

MATT CROUGHAN: He wouldn't necessarily give you a lot of instructions. Yeah, but he had a high standard, so it was a little tricky. Yeah, I had to figure it out. My mom would give us more instruction.

CROUGHAN: I would agree on that. **<T: 15 min>**

SUE CROUGHAN: I think both your parents were . . . had very high standards for all the children.

CROUGHAN: Yeah.

MATT CROUGHAN: Yeah.

CARUSO: And those high standards, did they apply to scholastics as well? Were you expected to do well in school?

CROUGHAN: Yes.

CARUSO: Were there any . . . and I know that you started elementary school in one location, switched schools and switched schools again. In those early years of education, were there any specific subjects that you were more drawn to compared to others?

CROUGHAN: Hmm. I'd have to think about that. Have I ever discussed . . . ?

SUE CROUGHAN: Not really.

CROUGHAN: Life sciences was always of interest to me. So, you know, some biological [science] always drew me to it.

CARUSO: Do you recall any teachers from those early years that stood out as good educators, people that were getting you more interested?

CROUGHAN: I can't remember their names.

SUE CROUGHAN: He was much more involved at the high school level.

CROUGHAN: Yeah, the high school level.

CARUSO: Yeah. Part of the reason why I ask those series of questions is just thinking about 1950s US when they're starting to think more deeply about investing in science education in the United States. And so I'm always curious to know how students at various ages were impacted or not by these changes in education. And sometimes you see or you hear about people who were . . . who had PhDs that were teaching high school science. And so sometimes those individuals stand out. So if there are any teachers as we move along, if there are any teachers that stand out or science classes that really had an impact on you, I'd love to hear about those.

CROUGHAN: Okay, we can talk about that in a little bit.

CARUSO: And in these in these early years, when your parents were home, maybe over dinner, maybe in the evenings when you're all relaxing, did they talk to their kids about things that were going on more broadly in the world? Were you getting into debates about—I mean, this is McCarthy era and after—getting into debates about communism? Were you talking about

religious beliefs or engaging in more discussions about religion or anything that was kind of a contemporary topic of the day?

CROUGHAN: I don't recall that the religion was covered. It was covered on a Sunday because you're going to spend your whole Sunday morning at the church, so you went to the regular church service and you also went to the preceding, you know, child's service.

SUE CROUGHAN: I think again, when you were in high school in the sixties, your mom was very involved in politics.

CROUGHAN: PTA [Parent-Teacher Association].

SUE CROUGHAN: And school board.

MATT CROUGHAN: Yeah, more late sixties, seventies. More after Tim left.

SUE CROUGHAN: Oh okay. I just remembered a story about you had your hair long and your dad stood up for you one time. You went to some naval base for dinner or something.

CROUGHAN: Oh, yeah.

SUE CROUGHAN: And your dad stood up for you because the guy wouldn't . . . didn't want you to come in.

MATT CROUGHAN: Oh, was it Hamilton [Army Airfield]?

CROUGHAN: Yeah. Hamilton. So there was an Air Force base at the edge of the town, and we went to . . . for kind of a tour type thing. And this one guy was jacking me around about having longer hair. And my dad said, "Well, [it] doesn't matter what his hair length is. He's an American citizen." So that was probably 1969 or '70.

MATT CROUGHAN: Because Tim grew his hair quite long when he was a freshman in college, maybe sophomore.

CROUGHAN: It was pushing my waistline by the end.

CARUSO: Yeah. Okay. That is very long. Yeah.

MATT CROUGHAN: And then . . . and our dad was a veteran from the Navy from World War II.

CROUGHAN: I'm not sure he was real pleased about my hair length.

MATT CROUGHAN: Yeah, he probably wasn't thrilled, but . . .

CROUGHAN: But he didn't confront me. He didn't tell me to cut your hair. He was cutting my hair already, so he never said it had to be.

MATT CROUGHAN: What would we . . . over dinner? We blessed every meal. So there was always the, you know, to start every meal. And we had different blessings that we sometimes caused some stress with the boyfriends **<T: 20 min>** or girlfriends of some of the kids because they would memorize one and then we'd throw in a new one.

CROUGHAN: Yeah, it was random.

SUE CROUGHAN: You guys sang after . . .

MATT CROUGHAN: Sang the Doxology. And then to our . . . our parents very much emphasized scholastics, music, and public service and didn't care much about sports. So if we played sports or did well in sports, that didn't really count for much, but . . .

CROUGHAN: I agree.

MATT CROUGHAN: Yeah, we were expected to, you know, maybe be in student government, to be good students, and ideally to be good musicians. But really, only Jack, our oldest brother, was an outstanding musician. [crosstalk]

CARUSO: And I guess he was, I mean, being eight years older . . . so while you were in Kansas, he was getting ready to . . . almost ready to head off to college. I assume that he . . .

MATT CROUGHAN: Yeah, he never moved to Novato. So he went directly from living in Kansas to college. So I was born in November [1960], and he was already in college, so we're eighteen years separated, right? So we were never, strictly speaking, two boys in the same household.

CARUSO: And do you recall what he went to college to study?

MATT CROUGHAN: Chemistry.

CARUSO: Chemistry? Okay.

SUE CROUGHAN: And then he ended up in med school.

MATT CROUGHAN: He ended up as an MD. He went to KU [University of Kansas] med school.

CARUSO: So in addition to discussing religion around the house and your father, a mechanical engineer, expected expectations in terms of being able to do certain chores and work around the house. Did your . . . do you recall your mother ever talking to the kids about the work that she was doing in the life sciences? I don't know what she did in hospitals as a microbiologist. I don't know if she was analyzing slides or anything like that. But I'm wondering if she was introducing any of you to the kind of work that she . . .

SUE CROUGHAN: Mary said that she would rope you guys into going into the lab and helping her.

MATT CROUGHAN: Yeah. Yeah. So for me, I don't know about you, Tim, but we . . . she was working full-time and, you know, kind of watching us when we were little kids. And so she was working actually overtime to help pay for the college of her older kids. So Jack was in college, Kansas State. So she would work, you know, an extra at least ten hours a week, if not more, to try to build up a college fund.

CROUGHAN: It was pretty significant.

MATT CROUGHAN: And so Mary and I would—we were, you know, five or whatever—would go in the lab, and I would do red blood cell counts. So she would analyze patient samples for red blood cell counts, white blood cell counts. You know, try to culture out bacteria to see if they had an infection, that sort of thing. So, yeah, I'm sure it would be considered completely out of line now and inappropriate. You have your kids handle patient samples from potentially infectious diseases? But it was, you know, suburbia, Novato.

CROUGHAN: And you were under her immediate supervision.

MATT CROUGHAN: Yeah. And we never did, as far as I know, got sick from it.

CROUGHAN: Yeah, I didn't.

MATT CROUGHAN: Yeah. So but we all . . .

CARUSO: So there was some knowledge of what the type of work that she was doing?

CROUGHAN: Yes, firsthand knowledge.

CARUSO: One other question about this general time period. Do you recall Sputnik and hearing about the . . . ?

CROUGHAN: Yeah.

CARUSO: Can you tell me a little bit about what you remember from the launch?

CROUGHAN: There was not an arms race, but get into a space race. And actually I wanted to be an astronaut because of all of that for quite a while. Remember that?

MATT CROUGHAN: I didn't know that. But yeah, totally makes sense. Yeah.

CARUSO: Did your family . . . do you recall your family reacting to it in any way? Because this is also the period of time, again, the height of communism, people are starting to build bomb shelters. I don't know if maybe that became part of the culture of your . . . and also being in Kansas, probably not bad to have an underground shelter with the tornadoes. But if there was any sort of political or other broader discussions of Sputnik.

CROUGHAN: That didn't seem to be an overbearing issue in the family.

MATT CROUGHAN: Our parents, our dad was like a moderate Republican, and our mom **<T: 25 min>** was a little more liberal. She was a Democrat, mostly liberal, moderate on some issues. So they differed politically.

CROUGHAN: Yeah.

SUE CROUGHAN: She was pretty liberal when it came to things like the school board and women's rights.

CROUGHAN: And actually she was more liberal with the school board than she was at home.

MATT CROUGHAN: She would have been called kind of an early women's liber.

CROUGHAN: Yeah, she was.

MATT CROUGHAN: Trying to get our dad to do half the housework was good luck with that. But he contributed somewhat. She was a really, really good cook, so her meals were delicious and would be . . . . I mean, he could only cook the most basic. Yeah, he'd cook a hot dog and pour cereal.

CROUGHAN: Yeah, maybe a fried egg.

CARUSO: And so given your mother's liberalism or some [liberalism] . . .

MATT CROUGHAN: Mostly liberalism.

CARUSO: Comparatively to . . .

MATT CROUGHAN: Yeah.

CARUSO: Were the kids introduced to those things as well? Were the children like both boys and girls encouraged to cook and handle the what might have been considered more traditional women's work around the house? Was there . . . and were the girls also doing some of the traditional what might be considered men's work around the house?

MATT CROUGHAN: By my age, they were. I did laundry and dishes.

CROUGHAN: Yeah, we did the whole slew. Whatever needed to be done.

SUE CROUGHAN: You used to bribe Mary to do when you had to do dishes.

CROUGHAN: Yeah, I'd pay her a dime. Yeah, not a penny, but a dime went a long ways. You could get a candy bar for a dime, then.

MATT CROUGHAN: Yeah, definitely. And I think Mabel hoped that her daughters would have careers or go into science possibly.

CROUGHAN: Yeah, I think I think that was an unspoken expectation.

MATT CROUGHAN: The younger, the youngest daughter, Mary, did. So she's now provost at [University of California] Davis.

SUE CROUGHAN: Kate was a philosophy major. She almost got her PhD. She never finished her dissertation, I guess, at UC [University of California] Berkeley. UC Berkeley?

CROUGHAN: Yeah. Yeah. UC Berkeley.

CARUSO: Do you recall how it was transitioning for you going from Kansas back to California, switching school systems and meeting new people? Were there any challenges that you encountered with that?

CROUGHAN: I don't remember any obstacles. I think I really liked California right from the get go.

CARUSO: Better weather.

CROUGHAN: Better weather for sure. You know, a lot of baseball, which I was playing baseball then.

CARUSO: Okay. So were you playing baseball just for fun with kids in the street, at ballparks, or were you joining a team?

CROUGHAN: It was a team.

CARUSO: It was a team.

CROUGHAN: So the rec department organized, you know, the baseball games with other [groups] and set up a schedule and all that for teams to play against each other over the summer.

CARUSO: And so when you came back to California, were you now in what would be the equivalent of junior high school?

SUE CROUGHAN: He was like twelve.

CARUSO: Twelve.

CROUGHAN: Almost. Eleven, twelve.

MATT CROUGHAN: Okay. Do you remember going to an elementary school in Novato?

CROUGHAN: Yeah. There was one close to the house. West Novato, I think. Just for a year or two.

MATT CROUGHAN: Yeah. So you would have been in sixth grade, which was in elementary school.

CARUSO: Elementary school and then seven, eight for middle . . . ?

MATT CROUGHAN: And then ninth at the time.

CARUSO: Seven, eight, nine for middle school. And then high school was ten, eleven, twelve. Okay. So you went to one year in elementary, then started middle school there and then high school. Was the high school . . . how large was your high school?

CROUGHAN: It was big. I think it was two thousand students.

CARUSO: Two thousand students. And do you know roughly how many schools were pulling in for that high school? Like, was it three junior high schools, four junior high schools?

CROUGHAN: It was two.

CARUSO: Two? Okay, but everyone . . . so the town that you were in, did you kind of know the kids that were coming from the other junior high schools? Had you had interactions with them before meeting up in high school?

CROUGHAN: Maybe through sports.

MATT CROUGHAN: He would have played sports against them or with them. And then they built another high school and another junior high. Basically, they were finished about a **<T: 30 min>** little while after you left for college.

CROUGHAN: Right.

MATT CROUGHAN: And that's where I went to school. It was more on the west end of town where we lived.

CARUSO: So when you came back to California, this is the early 1960s JFK [John F. Kennedy] presidency. This is . . . you mentioned the space race, right? This is . . . . I forget what year specifically the Kennedy's "We choose to go to the Moon" speech—"not because it's hard," right?

MATT CROUGHAN: Sixty or '61, right? Pretty early.

CARUSO: Right. And so you're now thinking that you want to be an astronaut. So you have an interest in space. This is also, you know, kind of the beginning of the civil rights era in the United States. So there's a lot that is going on more broadly. With your interest in potentially becoming an astronaut, did this shift your interests in school at all? Were you becoming more heavily interested or heavily invested in science at that time? Or was this just: you want to be an astronaut, you want to go into space like a child?

CROUGHAN: More like that, more I want to be an astronaut because I ended up being pre-med in high school so had to do all the science courses that were associated with that.

CARUSO: Do you recall what any of your science classes were like in middle school?

CROUGHAN: Well, this would have been actually in high school.

CARUSO: Right. I was just wondering if you remembered anything from the middle school era.

CROUGHAN: I don't recall any.

CARUSO: Okay. So what year did you start high school?

CROUGHAN: Nineteen sixty-eight. [crosstalk] No, that was when I graduated.

CARUSO: So 1965 is when you started?

CROUGHAN: Right.

CARUSO: So you're going in . . . so that's tenth grade, right? As we said, tenth, eleventh, twelfth. When you started at your high school, do you recall what your curriculum was like at that point in time? Did you . . . ? I'm just thinking about my experience. I had math, I had English, I had history. I think in my first year we did biology as my science. Was that similar too . . . was that the kind of curriculum that you had?

CROUGHAN: Yes.

CARUSO: And in that first year at high school, do you recall any teachers that stood out in terms of being inspirational [. . .]?

CROUGHAN: I don't remember being really in a position to evaluate them. You know, I think kind of the family values were I don't think you came home and badmouthed your teachers. What do you think?

MATT CROUGHAN: No, no. Novato generally had good teachers. It was not a really wealthy town. It was kind of middle class. So you didn't have, you know, really advanced classes like some of the really wealthy towns in California, but solid but say, it was probably in the 70, 75th percentile for California as a school district. Something like that.

CARUSO: Okay. While you were going to high school, you'd mentioned that your older brother went to college, your older sister went to college. I assume it was an expectation that you were going to be going to college as well.

CROUGHAN: I guess it wasn't a big deal. It wasn't. They weren't in my face about it. I think they just . . . everybody assumed they'd go.

CARUSO: Okay. And when you started, you mentioned earlier that you were pre-med in high school. Did your high school . . . was that an official designation that you had, or is it that you were thinking that you wanted to pursue?

CROUGHAN: Being a doctor seemed like the route to go.

CARUSO: Is there a reason why you wanted to become a physician? Not . . . . I guess you stopped wanting to be an astronaut.

CROUGHAN: No, it was a respectable position. It was sort of like you had your ministers. They were respected. You had your doctors. They were respected. You had the police more or less respected, depending on who you were and judges and stuff like that. So it was a good, respectable endeavor.

CARUSO: And I guess it also related to your family's commitment to service. I mean, being a physician, healing individuals, caring for them.

CROUGHAN: I agree with that.

MATT CROUGHAN: And our **<T: 35 min>** brother Jack was held in very high regard, so . . .

CROUGHAN: In the family.

MATT CROUGHAN: Right. Kind of set up as the model. Eagle Scout. Goes to med school. Marries an heiress.

CARUSO: Yeah. Those are very high standards. Not too many heiresses hanging around.

MATT CROUGHAN: That's a tough competition.

CROUGHAN: That's ticking off.

MATT CROUGHAN: And a concert level pianist, too.

SUE CROUGHAN: Yeah, you were a scout and went to—what is it?—they called Life. But you didn't quite make Eagle. But Jack made Eagle.

CROUGHAN: Yes. Right. Exactly.

CARUSO: So had you been involved in Boy Scouts from a young age? I guess it was . . . it's Cub Scouts, then Boy Scouts.

CROUGHAN: Yeah.

CARUSO: I went through the same process.

CROUGHAN: Yeah, I went through the whole stretch.

CARUSO: And I remember the kerchiefs. I don't remember. I think you got a different color.

CROUGHAN: Yeah.

CARUSO: Like when you moved on to Boy Scouts. You got the new uniform. I think I made it . . . . I'm trying to remember the . . .

MATT CROUGHAN: There's Cub Scouts, Webelos, and then Boy Scouts.

CARUSO: Webelos. I forgot about Webelos and Boy Scouts. And then there was something, then Life, then Eagle. If I remember.

MATT CROUGHAN: Star.

CARUSO: Star. I think I made it to Life, and I didn't make it to [Eagle].

MATT CROUGHAN: That's pretty close.

CARUSO: Yeah, so I started high school and my commute, it was a two-hour commute to get to high school, so it was like that . . .

CROUGHAN: Two hours each way?

CARUSO: Yeah, it was New York City, [New York]. I was on Staten Island, and I had to get to the Upper East Side of Manhattan. So two hours each way. So the Boy Scouts not an option.

SUE CROUGHAN: Our kids had an hour. I thought that was bad. Two hours is horrible.

CARUSO: Yeah. So you were involved in Boy Scouts. Is there a reason why you didn't make it to Eagle Scout? Did you lose interest?

CROUGHAN: I, kind of, lost interest. It started falling by the wayside the older I got.

CARUSO: And while you were in high school, were you still playing team sports? Baseball?

CROUGHAN: I always worked, so I had a newspaper route, and so I couldn't stay around for practices and stuff like that after school. So not much of that.

CARUSO: In high school, did you have any other . . . so you're working, you're studying, you're thinking of becoming a physician. Did you have any other hobbies or interests at that age?

CROUGHAN: Well, I ended up student body president at the school. I don't know if that came up already so that . . . . I had a lot of fun with that, and that worked out very well, I thought, on both for everybody, I think. But I didn't have any real strong other activities, you know, that I was involved in.

MATT CROUGHAN: You liked hunting.

CROUGHAN: I liked hunting and fishing, yeah. More hunting than fishing at that point.

CARUSO: So when had you . . . . I assumed you were using a rifle.

CROUGHAN: Shotgun.

CARUSO: Shotgun? When had you learned how to shoot?

CROUGHAN: Let's see, maybe in Boy Scouts. They . . .

SUE CROUGHAN: Your dad didn't hunt.

CROUGHAN: Yeah. They would teach you shoot a .22 [caliber], which is a very small.

CARUSO: I remember getting my rifle [badge] at Boy Scouts.

CROUGHAN: Yeah, yeah, exactly. And I was a good shot, so that was fun. And then I had friends who were hunters, so I'd just go out, started going out with them hunting. It's probably . . . . I know it wasn't as safe as. A series of events I can remember at one point meeting up with a guy out in the field. I was out hunting by myself. He was hunting by himself. But we recognized each other because I knew he was a hunter and I knew he hunted that area. We got together and he was sitting about from here to the clock on one side of a little creek, and I was on the other side of the creek, and he was, kind of, messing around with his gun. And all of the sudden it went off and right next to me, about this far away. [imitates gun noise] Like this. So he goes, "Ah, ah, ah!" He jumped up. He was quite upset. It was too late for me to be upset. You know, it was over.

CARUSO: And he missed.

CROUGHAN: He missed.

CARUSO: The most important part.

CROUGHAN: Yeah. That was the closest call.

CARUSO: When you went out hunting, how long would you go out for? Was this . . . ?

CROUGHAN: Oh, I loved it. I'd go all morning usually. I really enjoyed it. I don't do it. It was duck hunting.

CARUSO: Duck hunting. Were these ever . . . you had mentioned that your family would go on camping trips. Were you ever, like, out overnight? Like if you had a free weekend or over the summer?

CROUGHAN: Yeah.

CARUSO: Did you go out for days on end on **<T: 40 min>** hunting trips or camping trips?

CROUGHAN: When I was much older, I would do that as an adult. I would go deer hunting some. Never shot a deer, but just for the fun of it, I'd go, I'd get up in the loft and, you know, wait for the deer to come by. But I never got a shot at any of them. I wasn't very gung ho.

CARUSO: And you mentioned fishing as well, right?

CROUGHAN: Yeah, I love fishing. Yeah.

CARUSO: How often would you go out fishing? Same as hunting.

CROUGHAN: Well, we have a pond on our property now, so I still do a lot of fishing. But there was a lake pretty close to the house in Kansas, so I'd go down there, and I'd go down to the lake and go fishing. It was just about three blocks away, so it was very convenient.

CARUSO: Any of your siblings join you?

CROUGHAN: No, that was something I did by myself, I think. I don't remember them ever coming along.

CARUSO: And what about in California? Were you—back in California—were you still going out fishing?

CROUGHAN: Let's see. I think you . . .

MATT CROUGHAN: I would join him sometimes.

CROUGHAN: Yeah, go fishing with you once in a while. Yeah. It wasn't a regular event, but we did get together on that.

MATT CROUGHAN: We shot the shotgun together when I was pretty little. I was like five or six. And Tim would stand behind me or sit. We'd kind of crouched down and fire it off. And you somehow supported me, and it all worked.

CROUGHAN: Got behind you and cushioned you.

MATT CROUGHAN: Yeah. So, anyway, it was pretty unusual to shoot the shotgun when you're five.

CARUSO: So while in high school you're thinking about pursuing medicine as a career. At what point do you start thinking about what colleges you might want to go to?

CROUGHAN: Hmm, it would have been towards the end of high school. There wasn't . . .

SUE CROUGHAN: Kate was up at Reed.

CROUGHAN: Yeah, my sister Kate was at Reed College, so . . . which is where I ended up going. But there wasn't a whole lot of talk around the family table or anything like that like what school are we going to go to and stuff like that. It just didn't seem to be a big point of interest.

CARUSO: But were you aware of any other potential schools that you might want . . . ? I forget where your older brother went.

MATT CROUGHAN: KU [University of Kansas]. He was from . . . he was living in Kansas.

CARUSO: So Kansas, Reed. Your parents were at Berkeley.

CROUGHAN: Right, right.

CARUSO: Were you . . . did you . . . were you aware of other schools that were out there? Were you thinking about even maybe . . . ?

CROUGHAN: Well, I'd visited my sister when she was at Reed, so I was pretty locked in. I thought that was about as cool a place as I'd seen anyway.

CARUSO: Do you recall what made you interested in Reed during that visit?

CROUGHAN: Well, there were . . . it was slightly hippie, which to me was, kind of, cutting edge, you know, especially compared to going to public high school and stuff like that. There were some a little bit hippie guys, but nothing like Reed College had. That was . . . and it just seemed like a different atmosphere.

SUE CROUGHAN: Kate was in philosophy.

CROUGHAN: Yeah, she was in philosophy, my sister.

CARUSO: And this is also when you had long hair?

CROUGHAN: Yeah, I had long hair then.

CARUSO: Do you recall why you wanted to grow your hair out?

CROUGHAN: I guess because it was stylish then for lack of a better description.

CARUSO: So you were familiar with Reed College. Is that the only institution that you applied to then?

CROUGHAN: I don't think so. I think I applied to one or two of the UC campuses, too. But I didn't go there, obviously, but I can't remember whether I got in. I think I got in, but I'm not positive on that.

CARUSO: Okay. In terms of paying for college, was that something that your parents were going to support? You had mentioned that your mom worked extra hours to help.

CROUGHAN: My mom was a big player in that.

CARUSO: Okay, and let's see your sister. She's thirteen months older.

SUE CROUGHAN: Oh, that's a different sister.

CARUSO: Oh sorry.

SUE CROUGHAN: Kate was right behind Jack.

MATT CROUGHAN: Kate was five years older than [Tim].

CARUSO: Five years older. Okay.

CROUGHAN: She's the one who went to Reed.

SUE CROUGHAN: Shelley was the one that was adopted. She went to community college, I think. **<T: 45 min>**

MATT CROUGHAN: Right.

CROUGHAN: Yes.

CARUSO: Okay. All right. So you saw Reed when you were still in . . . so let me start again. So I was asking the question because I thought that you might have overlapped with your sister at Reed, but I guess by the time you started there, she had already graduated?

SUE CROUGHAN: Didn't she transfer to Lewis & Clark [College]?

MATT CROUGHAN: Well, she actually started at Lewis & Clark.

CROUGHAN: Yeah, she started at Lewis & Clark.

MATT CROUGHAN: But she had graduated by the time Tim went there. She finished in '67, and he started there in '68. They almost overlapped.

CARUSO: Okay. So can you tell me a little bit about what it was like starting college for you? Is this the first time that you were living away from home for an extended period of time?

CROUGHAN: Yeah, it would have been.

CARUSO: What was that transition like for you?

CROUGHAN: I was fine. I loved the freedom. Not having to answer to my parents was delightful. I liked the chance to meet they were called Reedies. Interesting people. Various levels of sanity among them. But there was . . . all of them had something to offer, you know, in interesting way. And I was glad to be at a school that I thought was a good school to be attending.

CARUSO: When you started there, do you recall generally how many students were in your entering class?

CROUGHAN: Oh, maybe a hundred.

CARUSO: A hundred. So it's a relatively small college. Okay. Were the individuals that went to Reed College, were they relatively local to the Northwest or to the West Coast?

CROUGHAN: Only a small fraction. They, kind of, stood out, the ones that lived in Portland, [Oregon], and were there. They weren't ostracized or anything like that, but you definitely knew that they were from Portland because most . . . not very much of the school was from Portland. They were mostly from other places.

SUE CROUGHAN: You said mostly the East Coast?

CROUGHAN: Yeah, mostly East Coast.

CARUSO: So mostly people from the East Coast coming to the West Coast. Did you find the students from the East Coast culturally different in any way?

CROUGHAN: Indeed.

CARUSO: How so?

CROUGHAN: To be blunt, they were so rude. I was amazed that people would be that rude to other people in a lot of instances.

CARUSO: Do you recall any specific examples?

CROUGHAN: No, just in general that there was . . . they had a pretty—I don't know if this is what I should be talking about—but they had a strong they were better than the West Coasters attitude. And they weren't hesitant to relay that.

SUE CROUGHAN: I think a lot of them were wealthy and the kids had gone to very private, wealthy high schools. And it was just he was pretty middle class.

CROUGHAN: And I hardly knew . . . . I don't think I knew anybody that had gone go private school at that point.

MATT CROUGHAN: Yeah, they'd gone to the premier high schools. Some were wealthy.

CROUGHAN: Yeah. Yeah.

CARUSO: I mean, I interacted with some of those students. I was not one of those students, but I did interact with those. Yeah. And what was your course load like when you entered? How many classes were you taking? What types of classes?

CROUGHAN: It was a full load. So whatever the core, you know, the number was for that.

CARUSO: And do you remember what subjects you started taking when you . . . ?

CROUGHAN: I started taking philosophy. I started off with that and then switched to biology as I got more interested in the medical stuff.

CARUSO: So philosophy as a major and then switching to biology as a major?

CROUGHAN: Exactly.

CARUSO: What were the college classes like for you compared to what you were experiencing in high school? More challenging, different topics? Were the teachers, the professors there moving you in different directions? What was the educational pedagogy like?

CROUGHAN: Yeah, well, the intensity was probably the biggest difference in how much work was involved in getting what you [were] supposed to get done done. So **<T: 50 min>** it was pretty demanding school as far as what they require from the students. And I really was, I guess, not taken aback by it, but I guess I wasn't really expecting that much rigor going into it. But you just do it. So it worked out.

CARUSO: With the full course load, you'd mentioned that in high school you were working, you had jobs. Were you also working during college?

CROUGHAN: No, so my mom's working and could collect enough money to send us to college, so didn't have to do that. Later on, I did some at the local newspaper because I knew the newspaper business pretty good. Working in the summer and stuff like that to save up money. So as I progressed through college, I got through—I think if I remember correctly—a four-year standard deal, and I didn't feel that my mom should be paying any more money. So I worked until I could save up enough money to finish that last year.

CARUSO: Okay. When you were taking your classes, you mentioned that there was an intensity to them in terms of what was required to get the work done. Did you have time for any other activities when you weren't in class, when you weren't studying?

CROUGHAN: [I] took karate classes, which I enjoyed those. That was pretty fun.

CARUSO: Was that something . . . had you taken karate before?

CROUGHAN: I didn't even know really what it was till I got there. But my [roommates] . . . I had roommates who had taken karate, so they got me started at it.

CARUSO: Any other interests? Were you still going out hunting occasionally? Fishing?

CROUGHAN: No.

SUE CROUGHAN: You did calligraphy.

CROUGHAN: Oh, I did calligraphy. So there was . . . the school was pretty . . . had a pretty strong footprint in calligraphy. Had a guy that was pretty famous. And there's classes in it that I took. I took, I think, three years of calligraphy over the course of school.

CARUSO: Do you know what sparked your interest in calligraphy?

CROUGHAN: Well, my sister could do it. And her writing was so beautiful. I knew I could take the classes there. So I wanted to be able to do it like she could. I never did get that good, but that was probably what spurred me on.

CARUSO: So you did calligraphy for three years. You mentioned you decided to switch from philosophy to biology. Was that switch from philosophy to biology in your first year, or is that something that you did as you progressed?

CROUGHAN: I think that was in the second or . . . . It wasn't in the very first.

CARUSO: Okay. So not the first year, maybe the second year or slightly thereafter.

CROUGHAN: I'm not sure exactly, but it wasn't right away.

CARUSO: And you were still interested in pursuing medicine as a career?

CROUGHAN: Yes.

CARUSO: Okay. When you were . . . when you moved into the biology major, do you recall what the department required in terms of courses that you needed to . . . core courses that you needed to take for your degree? And what—I don't know if it was . . . these were referred to this way at the time, but—distribution credits like courses in other departments?

CROUGHAN: Oh yeah. There was a list of required courses. It wasn't overwhelming. There still was some fair amount of room left for you to take courses outside of the department. But you did have . . . there was . . . . You had to tick off the required courses.

CARUSO: So one of those classes was calligraphy. Do you recall some of the other classes that you were interested in taking in college?

CROUGHAN: Oh wow. It's been so long on that. I don't know. Maybe . . . nothing bounces into the [mind].

CARUSO: Yeah, I mean, I took a fair number of courses. I couldn't tell you. I have to look at my transcript to remember. I just didn't know if maybe you had like, an underlying interest in the history of warfare. So maybe you were taking classes on the history of war or anything that. Yeah, but just general courses?

CROUGHAN: Yeah, I was conscientious objector, so . . .

CARUSO: Right. So that was a bad example for me. But yeah.

SUE CROUGHAN: Well, one of the things I think you took up too is gardening. **<T: 55 min>** You had a vegetable garden.

CARUSO: Oh really?

CROUGHAN: Right.

SUE CROUGHAN: Quite large. Elaborate. I've only seen a couple of pictures. I didn't know him then.

CROUGHAN: It was a few times the size of this room.

CARUSO: Wow. And so how did that start?

CROUGHAN: [I] just got interested in gardening.

MATT CROUGHAN: He lived in an old Victorian style house that had a pretty big yard, so he had the space to do it.

CARUSO: And so you were . . . there wasn't on campus housing for students at Reed?

CROUGHAN: First year.

CARUSO: First year. And then after that you're on your own?

CROUGHAN: After that, I think you could get on campus if you wanted but nobody that was in their right mind wanted to go back to on campus housing.

CARUSO: And so living off campus, in addition to taking your classes, you mentioned a garden. You had other responsibilities then, right? Like you needed to eat. So you had to cook, You needed to do laundry. You needed . . . and if you were in a house, I don't know if someone was maintaining the house for you or you had responsibilities for repair. What other what other things were occupying your time on, sort of, that level while you were in college? And was it difficult for you to become an adult in a certain sense?

CROUGHAN: No. Did a lot of the karate stuff so that filled . . . and some of the other guys that lived in the house were doing karate too. So we all kind of had that in common. And had the big yard, and I was into this gardening so that took up any free time after doing the schoolwork, but mostly focused on getting the classwork and, for lack of a better term, homework done.

SUE CROUGHAN: And his cooking. He had it down to—because money was tight—what was it? About a dollar a day with rice, eggs?

CROUGHAN: Yeah, and two pieces of sausage.

CARUSO: I lived on ramen for quite some time.

CROUGHAN: There you go. You know exactly what I'm talking about.

CARUSO: Yeah, and a friend made me start buying eggs, so it's like you need a little protein. Put the egg in there. It's like, all right, fine. Right. So ramen and eggs was a staple for me for quite some time. Okay. The garden that you started, was this a food garden or . . . ?

CROUGHAN: Yes.

CARUSO: Okay. So what were you . . . what types of foods were you . . . ?

CROUGHAN: A lot of corn. Because that was easy to cook, right?

MATT CROUGHAN: Delicious corn. You would eat it fresh.

CROUGHAN: We would eat it as much corn as we could . . . . I would way over plant so we could eat as much as we wanted during the corn season.

MATT CROUGHAN: Pumpkins. Didn't you grow big pumpkins?

CROUGHAN: Yeah, I grew pumpkins just to see how big a one I could grow.

CARUSO: How did you learn to do the gardening?

CROUGHAN: Mostly trial and error. I actually didn't have anybody that was knowledgeable about it to show me.

MATT CROUGHAN: Did Pete ever or Dad—his nickname was Pete—did he ever show you gardening, or did he ever show . . . ?

CROUGHAN: I can't remember.

MATT CROUGHAN: So at 8 Haverhill in Novato [our family moved there in 1967], he had a little garden. Corn, tomatoes, and stuff.

CROUGHAN: Yeah, I don't remember that.

MATT CROUGHAN: Yeah, he did.

CARUSO: Okay, So as you're pursuing your degree in biology, you're taking classes. You're . . . you had been thinking about becoming a doctor. I do know that you wind up going on to graduate school, but not medical school. So I'm curious to know at what point in your college career your thinking about becoming a physician changes and why.

CROUGHAN: Oh, that's interesting question.

SUE CROUGHAN: Because the article you read in the paper.

CROUGHAN: Oh, why don't you refresh my memory?

SUE CROUGHAN: Remember about the children?

CROUGHAN: Oh, about the children starving to death? Yeah. Happened to see an article in the Oregon daily newspaper on a Sunday morning, and it talked about how many kids were dying from lack of food. So at that point that was actually the switch flip. I said, "Oh, that can't be ignored." So I got involved in that from that standpoint. I wanted to help produce food.

CARUSO: Did you . . . do you recall what year in college?

CROUGHAN: Probably about . . . maybe '68.

SUE CROUGHAN: You graduated in '68. So it had it been **<T: 60 min>** the year . . . either one or two years before that because you had to take plant classes. But at Reed they only had like one or something.

MATT CROUGHAN: No, no. You graduated from high school [in '68].

SUE CROUGHAN: Yeah, yeah.

MATT CROUGHAN: He graduated from Reed in '74, I thought.

CROUGHAN: Right.

SUE CROUGHAN: He started at [University of California] Davis in '74, January of '75.

MATT CROUGHAN: Right.

SUE CROUGHAN: Or '74. Oh shoot. Yeah, let me think about it.

CARUSO: So, I mean . . .

SUE CROUGHAN: Seventy-four.

CARUSO: It would have been ’68. You were eighteen when you started college.

CROUGHAN: Right.

CARUSO: So that would be ’68. And so receiving the degree you think is more . . .

SUE CROUGHAN: [He] did college in five years.

CARUSO: So it took five years because you switched your major?

CROUGHAN: Yeah.

CARUSO: Okay. So yeah. So switching your major then you needed to take different classes.

CROUGHAN: Exactly.

CARUSO: Okay.

MATT CROUGHAN: He probably switched I would guess maybe three.

SUE CROUGHAN: Yeah.

MATT CROUGHAN: If I was to guess, ’70, ’71.

CARUSO: And this is also why you wanted to make money because you were . . . to pay for your last year of college because you were actually staying for five instead of for four?

CROUGHAN: Right.

SUE CROUGHAN: Yeah. January ’74 is when he started at Davis.

CARUSO: Okay. January ’74. Thank you. So you see, you read this article, you decide not to pursue medicine, but you wanted to change your career path in order to address this problem.

CROUGHAN: Right.

CARUSO: I know that you received a [BA] in biology from Reed. That’s correct?

CROUGHAN: Right.

CARUSO: So you mentioned that you needed to . . . you stayed a fifth year to complete your degree. What courses did you need to take at Reed in order to shift in the direction that you wanted to do for your new career?

CROUGHAN: Well, I’d been taking more of the social studies type courses before I made that switch. So I had all the chemistry and I don’t know if I had physics, had a physics class—more scientifically oriented coursework.

SUE CROUGHAN: And you had to do . . .

CROUGHAN: A project.

SUE CROUGHAN: A project, a research project, a senior project, and you did it on chlorophyl? No. It was algae.

CROUGHAN: Algae. It was done with algae. I can’t remember what the project was focused on. [It was the effects of pollutants].

CARUSO: So with this decision to switch career trajectories . . . . I'm trying to think of how to formulate this question, so I apologize if it's a bit cumbersome. When we think of established professions like becoming physicians or engineers, usually there's like a straightforward path to achieving those, right? You go to medical school, you get an engineering degree. Since you wanted to change what it is that you did or what your career was going to be, how did you learn what you needed to [do]? How did you learn what steps you needed to take in order to pursue this new career path?

CROUGHAN: Oh, that's a good question. I guess I just looked up what the required coursework was [. . .].

SUE CROUGHAN: How did you find out about UC Davis? I didn't meet him until I got to UC Davis. How did you find out about UC Davis? I mean, it was an Ag school.

CROUGHAN: It's an Ag school. And that went along with what I wanted to do as far as helping to feed people.

CARUSO: Were you aware or had you known anyone who had pursued a PhD?

CROUGHAN: Kate maybe.

SUE CROUGHAN: Maybe Kate was working on hers.

CROUGHAN: But she . . . . I don't know if she actually . . .

SUE CROUGHAN: She actually went to law school, stopped, and then she started working on a PhD.

CARUSO: So that concept existed as like for these advanced degrees. I know when I was going for my advanced degree, my mother had a lot of doubts or . . . because it's not something that she experienced growing up, right? Like maybe you went to college, but more college, right? That that concept didn't necessarily make sense. And so I was wondering if you had been introduced to anyone or if other **<T: 65 min>** people from Reed College had decided to pursue PhDs or if the professors there when you maybe you spoke to them about your interests, were they saying, "Yeah, you need to go and get a PhD in order to do what it is you wanted to pursue"?

CROUGHAN: Yeah, I don't recall that taking place. I think for whatever reason, I just thought that was necessary for me to do.

CARUSO: And when you were thinking about this new career path, it's . . . . I mean, it's not uncommon for people to pursue a PhD and want to work at a university, right?

CROUGHAN: Right.

CARUSO: Were you . . . do you recall thinking along those lines that you wanted to become a professor in order to educate? Did you want to become a professor so that way you could do research? Did you have . . . do you recall what it was at that time that you were thinking you'd like to do once you completed this next step getting this advanced degree?

CROUGHAN: Yeah, I think it was I wanted to be able to do research.

CARUSO: Okay. So you wanted a research position, and were you thinking that that was something you could only do at an academic institution? Or were you aware of any private companies that you could do that type of research?

CROUGHAN: For whatever reason, I didn't even really look into private companies. I just, kind of, assumed it involved education.

CARUSO: Do you recall what the application process was like for graduate school for you? Did you . . . . I know you went to Davis. Had you looked at . . . do you recall looking at any other schools potentially to pursue the degree?

CROUGHAN: I don't think I applied to any place other than Davis.

SUE CROUGHAN: Yeah, I just . . . . I mean, he showed up one day, and that's when I met him. So I don't know what his process was before.

CROUGHAN: I think I just applied to Davis.

SUE CROUGHAN: But I think somehow you heard about, you know, learning about agriculture and I don't know how you found out about Davis and then how you met Bill [D. William W.] Rains [. . .].

CROUGHAN: Our major professor.

SUE CROUGHAN: And he had funding to bring Tim in as a graduate student.

CARUSO: Okay. So you somehow interacted with Bill Rains.

CROUGHAN: Right.

CARUSO: So when you were applying to graduate school, you already had a professor to work with?

CROUGHAN: Already knew that I wanted to work with him, basically.

CARUSO: Okay. So you're wrapping up your college degree, right? And we settled on '74. Or you start at Davis at the beginning of '74. What was it like for you to move to Davis to begin pursuing your graduate degree? Was there anyone else from Reed that was going to Davis?

CROUGHAN: Not that I knew.

CARUSO: Okay. And how was it moving back to California?

CROUGHAN: It was delightful. I didn't realize that professors could be so nice. I just had this mindset of, you know, this is how higher education is. It's torture. Swords, you know? And here was a place where people were happy. They're doing something that definitely is of value. They aren't worried. It's not you can one up another person by saying something smart ass for lack of a different term, you know, in their conversations with them and stuff like that. So it was just a delightful change in environment.

SUE CROUGHAN: I remember him saying that at Reed, you know, you didn't dare ask a question unless you knew the answer. And everybody was very strict.

CROUGHAN: The professor would actually make fun of you.

CARUSO: Oh wow.

SUE CROUGHAN: When you got to Davis, you know, he was sitting in a classroom and everybody's raising their hands.

CROUGHAN: And I shrank in my seat literally like this at that. I thought, "Oh my God." Actually, in this case, it was just one other guy who was sitting next to me. And I did not want to be sitting next to the guy that was about to get rung over the coals because he went, "Wait a minute. Wait a minute. I have a question. I have a question." At Reed they would dissect him for doing that.

CARUSO: Wow. Okay. When you started at Davis, what was the **<T: 70 min>** . . . what department were you actually in at Davis?

CROUGHAN: Agronomy.

CARUSO: So it was the agronomy department?

CROUGHAN: Yeah.

CARUSO: Okay. How large was the department in terms of both the faculty and also the other graduate students there?

CROUGHAN: Well, that's where I met Sue.

SUE CROUGHAN: So it was a pretty well-known internationally department, the agronomy department. And it had a lot of basic agricultural in terms of planting row crops, breeding, and a lot of the—what's the correct word?—the standard producing crops and maximizing yields and stuff like that. Davis was a really cool campus because you had the agronomy department and

then you had . . . but then you had other departments—soils and stuff like that that specializes in insects and other weed problems and stuff like that. But the agronomy department was, kind of, agriculture, and this is when all the biotech stuff was just . . .

CROUGHAN: Just coming on.

SUE CROUGHAN: Just coming on the scene. So it was where you had traditional agriculture, now all of a sudden you have these weird biotech people coming in and kind of thing. So there was a little bit of the traditional clashing with the non-traditional approaches to agriculture that was happening right at that point.

CROUGHAN: Yeah.

CARUSO: And so you were already in the . . .

SUE CROUGHAN: I was working my way through college, so I was a technician in the lab, and they had just started what was called the Plant Growth Center. So they had faculty from different departments, and they'd kind of put them together, and it was starting to do some of plant cell culture. Recombinant DNA was just kind of being discovered and thought. And then there was a lot of work done on trying to make plants be able to fix nitrogen, you know, taking traits from legumes and putting them into agricultural crops and seeing if we can . . .

CROUGHAN: Like soybeans. Peanuts too.

SUE CROUGHAN: So there was a lot of cutting edge stuff creeping into the traditional agriculture at the time. And Bill Rains was one of the founding people of that. [. . .] And so Bill Rains, who did a lot of interesting traditional stuff, was just starting to get started in this. And had hired me to start his plant cell culture work. And then that's when Tim also then . . . . I had started I guess was it . . . ?

CROUGHAN: About a year before?

SUE CROUGHAN: About a year before then.

CARUSO: Okay. And how many individuals were working with and for Bill?

SUE CROUGHAN: Oh, he had a lot of students at the time, and they were doing more traditional, you know, agricultural research on nitrogen. And he had postdocs. He had quite a crew.

CROUGHAN: Yeah.

CARUSO: Would you . . . . Is this like ten, twenty, fifteen?

SUE CROUGHAN: Yeah, I would say like ten.

CROUGHAN: Ten and twelve.

SUE CROUGHAN: We had a pretty active lab, and there [were] people doing . . .

CROUGHAN: There [were] two professors that shared a lab. So we had about all together probably fifteen people in there.

SUE CROUGHAN: Yeah. And then there was . . . they were doing a lot of modeling at the time. They were trying to, you know, measure and come up with computer programs to if you tweak this, will you get higher yields or whatever. And so there was that component to the lab. And then I was, kind of, the only technician and then I would oversee the student workers.

CARUSO: And when you say student workers, do you mean undergraduate or . . . ?

SUE CROUGHAN: Yes.

CARUSO: Okay.

SUE CROUGHAN: I myself was an undergraduate, but I was the . . .

CROUGHAN: Senior.

SUE CROUGHAN: The head technician, and then the student workers would come in and wash dishes, or they would do measure things or something. We would give them tasks to do.

CARUSO: And you mentioned that Bill hired you as the technician. Had you worked in similar labs previously?

SUE CROUGHAN: So when I was in high school, I knew I wanted to go to college and try to make money. And I got a job working at Salk Institute doing animal cell culture, and I just **<T: 75 min>** fell in love with that. And I was . . . . I had a really good person that I worked for, and he involved me in a lot of the research and actually put my name on a publication. So when I got to Davis, I walked around knocking on doors, trying to find a job. And most incoming jobs into a lab was washing dishes. And I would walk around with my published paper saying, "I know how to do animal cell culture," but I wanted to work in plants. Well, I guess actually I went to other labs too, but I ended up I met Bill and that's how I got the job there because they wanted to start doing plant cell culture and they thought, "Oh well, she knew sterile technique already."

CARUSO: I'm familiar with graduate programs that train people in chemistry and biomedical science and those areas. But I don't think I've interviewed anyone who has focused on agronomy and those types and those related sciences. Can you tell me a little bit about what the structure of the graduate program was like in terms of classes that you needed to take? Did you have to serve as a teaching assistant? What is that type of lab like? I know I've just given you like several questions all at once. I'm just giving you a general idea of what I want to ask about. Let's just start with what was the curriculum like for graduate school? Classes?

CROUGHAN: Yeah, you had . . . . I had to take a lot of classes. You probably had taken some of those as an undergrad.

SUE CROUGHAN: I was an undergrad botany major, and I took every plant course I could where Tim was coming in as a Master's student in agronomy, but he didn't have any of the basic plant classes, so he had to take a lot of undergraduate classes to catch up. And that's so we actually overlapped a little bit in . . . . I was taking the courses, but he had to fulfill his Master's requirement.

CARUSO: Was that a common thing or an uncommon thing for graduate students coming into that program?

SUE CROUGHAN: Kind of a mixed bag, I think. Yeah. People coming in at that time to get a Master's in agronomy; there was a whole range of people and, you know, people were interested in organic farming, and they were coming in with no knowledge of plants and how plants work or farming and how farming worked. And so there was kind of . . .

CROUGHAN: Yeah, ran the spectrum.

SUE CROUGHAN: At Davis, you can be very traditional in agronomy. You could do ecology; you could do plant physiology. So depending on what level you wanted to, whether you wanted to go out and help the farmers or whether you wanted to do basic plant research as to kind of . . .

CROUGHAN: In the lab.

CARUSO: So there are the courses that you had to take. Did you when you first started there, were you put to work in Rains's lab as well?

CROUGHAN: Yeah.

SUE CROUGHAN: We started doing the . . .

CROUGHAN: Cell culture.

SUE CROUGHAN: Cell culture.

CROUGHAN: Yes.

CARUSO: And so was this an assigned project from Rains, or was this something that he . . . did he let his students have . . . pursue their own interests as long as they aligned with the mission of the lab?

CROUGHAN: Pretty assigned, I think.

SUE CROUGHAN: He wanted . . .

CROUGHAN: Salt tolerance.

SUE CROUGHAN: Yeah. So salinity, salt tolerance.

CROUGHAN: Resistance to salt in soil and water.

SUE CROUGHAN: And so this was such at the beginning that people were just learning how to make plant cells grow and then how to regenerate a plant back from the cells. So we had to develop some of those basic techniques. And then the work became . . . he was interested in salt tolerance. So we developed a cell line that was tolerant to salt versus not and would do comparisons between the two: the tolerant and non-tolerant at the cellular level.

CROUGHAN: Studied how it did that at the cellular level.

CARUSO: Can you tell me a little bit about how you developed those? Like what is the process that one goes through to develop these cell lines that are more resistant to salinity?

CROUGHAN: So you . . . when you made the media culture, media that the cells would be grown on, you could **<T: 80 min>** put in a standard series of . . . there's about twenty ingredients you put in that they needed to flourish. And then in addition, you could add salt. And so you could then you had a range of activities you could do with something that was exposed to that salt level in the growth medium. So what we were looking for was things that were resistant to salt and would tolerate—correct me if you disagree—they would tolerate the presence of salt in fields in California especially, there's a lot of fields that are pretty seriously contaminated with salt just because of the evaporation of water. Over time, the water evaporates, the salts left behind, and it accumulates. So it was affecting the crops that the farmers were trying to grow. So the idea was to try to develop through the . . . in the laboratory plants that would survive being exposed to a lot of salt in their surroundings—for lack of a better term—in the culture media and work from there to develop the new plants for the farmers to grow.

SUE CROUGHAN: So I think the ultimate goal was to take a plant—rice and alfalfa—that we worked with, expose . . . develop the cell culture, develop a salt tolerance cell line, and then take that cell line and regenerate a plant and hope that that plant would be salt-tolerant, that you could then grow in a crop. In doing that, we also did some more basic science in terms of . . .

CROUGHAN: Energy consumption.

SUE CROUGHAN: Energy consumption. What it costs the cell to deal with salt and regulation of sodium and potassium and some other little basic things like that.

CARUSO: And so when you were doing these early experiments were . . . like I know there are standard model organisms in biological sciences. Was there a standard cell line that you were working with that you were hoping would change with different exposures and then cultivate, keep cultivating that changing cell line? Or were you like, well, okay, there's this one cell line. Let's see how that cell line responds to this. Then here's another cell line, and it's slightly different. Let's see how that cell line responds to it. And then was it looking at what was out there and trying to figure what survived or was it trying to push something into surviving by modifying the . . . how it was growing and the solutions that was growing in.

SUE CROUGHAN: It was finding.

CROUGHAN: It was finding.

CARUSO: Finding. So just looking for the optimal cell line?

SUE CROUGHAN: And back then a lot of people did work with tobacco because somebody had worked out where you could regenerate tobacco plants very easily. And I think for Bill he was, let's work on crops that are, you know, important crops. Alfalfa is important in California. They grow a lot of it down in the Imperial Valley, and that's where they were having a lot of salt issues. And then, of course, rice is very important in terms of a crop. So I think that's kind of how we approached. But those . . . the correct media to grow cells and get them to regenerate, you know, we had to work on that a little bit, tweak that as we went along.

CARUSO: But Sue, you mentioned that you had some experience with animal cultures. Tim, did you have any experience working with any types of cultures while you were an undergraduate or was this completely new?

CROUGHAN: New. Brand new.

CARUSO: So how did you go about learning the techniques to undertake this work?

CROUGHAN: Well, they have recipes for what to put into the material that's going to go in the petri dish, but that you're going to grow the tissues on. So you just follow that recipe to make that. If you want to expose it to the salt, you'd add salt in that media as an additional component and do your study in the presence of salt or you had a control which has no salt for comparison. So what was the other part of the question?

CARUSO: So I was just wondering how you learned to do these techniques. You mentioned that there were recipes.

CROUGHAN: Yeah, exactly.

CARUSO: But I'm **<T: 85 min>** assuming you also needed . . .

CROUGHAN: Hands on.

CARUSO: Well, I mean, hands on, but also techniques to analyze the cultures that you're developing to see how they were thriving or failing or what was going on. And I'm curious to know what sort of . . . how you went about learning how to do that analysis if you hadn't done it before.

CROUGHAN: Yeah. What do you think? Just practice.

SUE CROUGHAN: Well, yeah. I mean, I had already established some techniques and then, you know, came in . . .

CROUGHAN: So you could, like, grow the tissues in these dishes—petri dishes—that the media contained salt or whatever else you wanted to study. And then you'd usually use weight as the factor, how fast they were growing. So you'd have a control that had no salt. And you use that for comparison for anything that had salt in the experiment. So it's mostly done by weight, if that's the answer.

SUE CROUGHAN: Bill Rains had not done any plant cell culture, so he didn't have . . . his training was not in that. But Bill Rains was an extremely sharp individual. And we would . . .

there were a lot of . . . so we were located in the agronomy department. But across the street in another building was where most of the people doing plant cell culture were. And we would regularly have meetings, and we'd get together and consult with each other and get advice. And I think Tim and I, kind of, worked hand-in-hand with a lot of it. And then we got with Bill and we would have meetings and everyone's like, we got to . . . something that wasn't working. We'd sit around and talk about it. And of course reading the literature about what other people are doing. And it was a lot of trial and error.

CARUSO: And so developing these techniques took time. So this is not a lab that had been doing this for long periods of time. So it's, kind of, brand new to everyone. You mentioned that there are other people at the university that are . . . that might be more familiar with it. So picking up some of the techniques from those individuals. During this period of time when you're beginning this type of laboratory work, it's early in your graduate career, right? What was the overall long-term plan for? Maybe I shouldn't phrase it as long-term plan. What was the overall structure of the graduate program in terms of starting to . . . getting your MS to getting your PhD? What were the steps in addition to taking classes? What were the steps required of you in order to make your way through the program?

CROUGHAN: Well, in conference with a major professor, you would come up with a research plan, and you'd have to have some specific question you were going to ask. So, for example, if you're working with salt, one thing, one question you could ask is could cells perhaps . . . could plants perhaps mutate at the cellular level in dishes that contain gelatin and nutrients but which also contain salt? And could you isolate from those tissues, those pieces of tissue ones that were resistant to salt by their growth or by their weight?

SUE CROUGHAN: So his Master's was . . . so he had to take courses and then he had to do a research project and write up a thesis.[1] And what was the name of your . . . ? I wrote it down so I wouldn't forget. But you did the study between the two cell lines, the salt-tolerant and the non-salt-tolerant in terms of potassium content, sodium content.

CARUSO: And was that a project that you . . . was that something that Bill Rains said, "I need someone to work on this. Are you interested in it?" Or was that an idea that you had and you brought to Rains as a . . .

CROUGHAN: That was already in the works in the laboratory.

CARUSO: So this was more of a . . . in a project that you were assigned?

[1] Timothy P. Croughan, *Selection of a Salt Tolerant Line od Cultured Alfalfa (Medicago Sativa) Cells* (1977).

CROUGHAN: Yes.

CARUSO: And to develop data from.

CROUGHAN: Yeah.

CARUSO: Can you **<T: 90 min>** tell me a little bit about what it was like working in the lab? You mentioned the number of individuals. It was a, kind of, a shared space, right? There were two professors who were in close proximity working in these labs. What were your days like? Were you getting in at eight in the morning and leaving at eight at night? What were you doing in the lab? Was there just a lot of sitting and waiting around for things to grow? Can you tell me a bit about what the day-to-day work was like?

CROUGHAN: You'd do several of those stages that you just mentioned. Not in sequence at the same time. So you'd start a cell line, for example, and you'd set that in an incubator and let it start to flourish. And while it's flourishing, you might start another cell line where you included salt in the media, and you put the same amount of material or take some from that cell line that you're growing in an incubator, take some tissue out of that, put it on in the presence of salt. Now close that up, put it in the incubator. So a lot of it is like weighing things. That's the main parameter you use to measure growth at the cellular level.

SUE CROUGHAN: But on a daily basis, you know, you'd come into work, you would prepare your media, autoclave things, transfer tissue to fresh media because you had to constantly be feeding them. Design an experiment. And we wanted to do . . . grow cells in a liquid culture, and we needed a shaker. So built a shaker, a two-tiered shaker thing. So part of it was going down who turned out to be a very good friend of ours, Dave Paige. He was a person in the department who basically he was the one of the . . . well, he still is a very extremely bright individual. And he would come in, and you'd say, "I need to measure something." And he would come up with a machine to do it, or we needed a shaker. He would, kind of, design it and [say], "Okay, you drill these and do this." And he would help you build things and . . . but so on a daily basis. And then we would have meetings, you'd go to class, and then there was a real good camaraderie. There was a real good group within the department. Had coffee breaks that would meet up. And then there was a lot of us that were, you know, young and single and after work go down to a local bar and have beers together and just would hang out. And then we started where on Fridays we would meet in this [crosstalk] grassy area and play volleyball together and stuff like that. So there was always the controversy between the traditional people. They're getting their PhDs in agriculture and us playing around with our cells, you know.

CROUGHAN: But there was no friction.

SUE CROUGHAN: But we would still get together. And, you know, we had a good camaraderie despite our, you know, ah, that's a waste of time, you know, kind of thing and all that. Some of the older professors were kind of, "What are they doing?"

CROUGHAN: Yeah, our fellow students never criticized us at all. Zero. They were on board with what we were doing.

CARUSO: Were you still sporting the long hair in graduate school or had that . . . ?

CROUGHAN: No, no.

CARUSO: Cut that off?

SUE CROUGHAN: Yeah. You didn't have that when I met you. Longish hair. But no.

CROUGHAN: No ponytail.

CARUSO: No ponytail. How many hours would you spend in the lab each day? Was it a nine to five?

SUE CROUGHAN: Yeah, for Tim, kind of. He was a graduate student, so he had a lot more flexibility. He was really only required to be there for twenty hours. And then of course you had coursework and stuff like that. For me it was a little different. I got . . . it was my job.

CROUGHAN: Yeah, you'd start at eight.

SUE CROUGHAN: I would get there early because I would have to then leave for classes. So I was trying to get my hours in to for work and then I would leave in the middle of the day, go to class, and come back and work.

CARUSO: And so **<T: 95 min>** how many projects did you wind up undertaking in Rains's lab during your tenure there?

CROUGHAN: How many do you think?

CARUSO: I don't know how long any one of these projects would normally take.

SUE CROUGHAN: They would grow on themselves. So, you know, we came up with a line of alfalfa cells that were salt-tolerant. And so we would do some basic studies. But then at the same time, I was working on trying to get them to regenerate into a plant. Well, we finally got that happening. And so then we were babying all these little plants that we were getting, and then we finally got a whole bunch of these plants and then we had to do . . . remember in the greenhouse we would set up and make cuttings from them and grow them and try to do experiments with the plants at different salt levels to see if we actually came up with a salt-tolerant alfalfa plant, which we did not.

CROUGHAN: Pretty tedious work. Yeah.

SUE CROUGHAN: So there [were] a lot of things. And then it was an interesting lab too, because if somebody had a big project, I remember Ed [Edward] Ng, he would do these modeling studies and so he would come in and he would just have tons of plant samples that had to be, you know, get leaf areas. And so everybody would just kind of, "Okay, here's the day everybody's going to join in and help Ed do his thing or whatever."

CROUGHAN: But there was a lot of camaraderie in the lab. People would pitch in, you know.

SUE CROUGHAN: But it was definitely not an eight to five. [crosstalk] It was you kind of stayed when you had to. And if you didn't, you could leave.

CROUGHAN: Yeah.

CARUSO: And you mentioned some of the things that you were doing when you weren't in the lab. Did you have other interests that you were pursuing while you were at Davis? Taking . . . ?

SUE CROUGHAN: So he still had his garden.

CROUGHAN: I still had my garden.

CARUSO: Or it was a new garden?

SUE CROUGHAN: Yeah.

CROUGHAN: But I had a bigger project.

SUE CROUGHAN: So Dave Page is a very good friend. Winemaking became a thing.

CROUGHAN: A hobby of ours.

SUE CROUGHAN: And so there was Bill Rains, Dave Paige, and Tim and I, and I guess Ed Ng helped some to some extent. And we would go to Napa, [California], and there was a UC Davis research facility there. And after the professors would go through and pull all their grapes, we could go in and harvest the [leftover] grapes. And then we took them back to [make wine].

CROUGHAN: So we'd go back and make wine from it.

SUE CROUGHAN: And Dave Page and Bill Rains both dug cellars in their back yards.

CROUGHAN: Yeah, that's sort of the two bosses there.

CARUSO: So winemaking, wine activity, the garden.

SUE CROUGHAN: And then towards a little bit later, Dave and Tim got into beer making and decided to open a [. . .] brewery in Davis. But at that time, the law was such that if you made beer in a facility, you could . . . people could come in and drink the beer and you could sell it there, but you couldn't retail. You couldn't sell your beer at another store like wineries could. You could go in and taste wines and stuff like that and drink, and you could go to a store and buy the wine. But the law was you couldn't do that for a beer. And this was in the early

seventies, mid-seventies. And so basically they bought a bar. Started the process. Had a brew kettle made.

CROUGHAN: Brew kettle.

SUE CROUGHAN: Big copper kettle.

CROUGHAN: In San Francisco, [California].

SUE CROUGHAN: Started this whole process. And then Dave Page got together with this guy, and they got the law changed. But by then Tim was finishing his PhD and going off to Louisiana. But now that's why you have beer in places everywhere.

CROUGHAN: In California anyway.

SUE CROUGHAN: You can brew and sell.

CROUGHAN: Made it legal.

CARUSO: That's impressive getting the law changed.

CROUGHAN: Yeah.

CARUSO: Earlier you had mentioned that the time that you were at Davis, this was also the beginning of the rise of biotechnology, right? So people interested in modifying genomes, genetic material, doing lots of other sorts of work with that. Were you . . . how did you . . . at the time, were you aware of this biotechnology **<T: 100 min>** work going on, or is this something that you realized was going on while you were—like afterwards—that you realized was going on roughly at the same time that you were at Davis.

CROUGHAN: At the same time.

CARUSO: At the same time. And so how were you exposed to the individuals that were developing these new biotechnologies and starting these companies? Were they regular? Did they make their appearances on campus? Were they some students from Davis and the surrounding area or . . .

CROUGHAN: What do you think? We were kind of separated from the heavy duty gene transfers.

SUE CROUGHAN: But part of that plant growth lab, there was an individual, Ray Valentine, and he was big on a lot of that stuff. And he actually started a company at Davis called genetics plant something. Don't remember that name [Calgene].

CARUSO: We can always look it up later.

SUE CROUGHAN: Yeah. So it was happening. You know, you were hearing about it. You'd go to meetings, everybody was talking about it. And then that's when genetic engineering and let's make these crop plants do these amazing things and the traditional breeders were sitting up there, "Oh, that's such a joke. You can't do that." But yeah, I'm going to put these genes in these plants and make them wonderful. And so it was a hotbed at the time.

CROUGHAN: You had the traditional plant breeders which didn't really buy in on it in general. I think there was exception on some; one or two of them did. And then you had people like us that were working on the other end that were completely buying in on that.

CARUSO: And so you counted yourself in the group of the biotech people gene splicing.

CROUGHAN: Yeah.

CARUSO: As you're pursuing your degrees, you decided to go into this area because kids were hungry and you thought that was wrong. While you're pursuing this or while you're doing this work and you're pursuing your degree, did you . . . were you thinking about what your career was going to be once you finished your degree? Were you thinking, "I want to stay at a university and do research"? Or now hearing about these biotech companies, were you thinking, "You know what, I started a brewery, got some laws changed. I'm going to start a biotech company, or I want to join a biotech company because they're the ones that are going to make the difference." So I'm wondering during your graduate school years, what did you . . . when

did you start to think about what your next career steps were going to be and what they were going to be?

CROUGHAN: Well.

SUE CROUGHAN: So there was a group of us that were all coming along about that same time. And that was the topic. Do you go to these new companies or Monsanto or these established companies, or do you go the academic route? And that would be discussed many times over beers as to, "Okay, which way are you going to go? What am I thinking and stuff?" And we knew individuals who would go off to Monsanto and then some vice president over here decided that was done and they'd lose their job like this, you know. And other people were going in academics and barely making tenure and so it was a hard decision.

CROUGHAN: Pluses and minuses on both sides. Yeah.

SUE CROUGHAN: And it was back and forth in terms of which direction we were going to go. I think the . . . . I guess I want to take that back. Tim was becoming more and more interested in rice, and there was the LSU [Louisiana State University] Rice Research Station [H. Rouse Caffey Rice Research Station] doing work on rice, and they were interested in getting involved in biotech. And I think somebody who was at Davis had gone to the LSU Rice Research Station. He was a very traditional agronomist. And they were . . . at LSU they were saying, "You know, we're interested in doing this and stuff." And he says, "Well, I know somebody who's finishing his PhD." You know, that was Marlon.

CROUGHAN: Marlon Brandon.

SUE CROUGHAN: Yeah. And once that connection was made, I think that path then went that way. But something I think we, kind of, skipped over having to do with feeding the children. Tim started a class at Davis. He decided he wanted to expose more people to the world food **<T: 105 min>** crisis, so he established a class. I don't remember the number. Mary was going to look that up for me. And it was called . . .

CROUGHAN: Agricultural Science and the World Food Crisis.

SUE CROUGHAN: And the whole thing was to bring in agronomists, bring in social people, economic people, political people, and look at the world food crisis from all the different angles. So the class was set up to where he would get somebody good in that field, and they would

come and give a lecture and there would be handouts with important points. And the whole class was not, "You know, are you going to get an A or B in this? But do you understand what's going on?" And the tests were open book because the whole point was for everybody to learn the material, not . . .

CROUGHAN: [. . .] To encourage people to cheat on their tests. I'd say, "Get together."

SUE CROUGHAN: And there would be, you know, a hundred, a hundred-fifty students in these classes. And that went on . . . for I think it went on several years after you left. But that was something that Tim, you know, in the back of [his mind] always wanted to do was the world food crisis.

CARUSO: And so when you say that you started this class, was it an undergraduate class, or was it open for graduate . . . ?

CROUGHAN: Undergraduate class. Graduate students attended it, too.

CARUSO: And what was the process at the university for establishing a new class?

CROUGHAN: Let's see.

SUE CROUGHAN: That was something you did on your own. You knocked on doors and had to talk to the dean.

CROUGHAN: Yeah.

CROUGHAN: So I talked to the dean. I talked to the chancellor too. I talked to the chancellor. Of course, I made an appointment with him, and I said, "I want to get these people educated on the food crisis." [. . .] And he said, "Yes. And that would also get them educated to other aspects of agriculture." And I said, "Indeed, yeah, that's the whole deal. We bring in every aspect we could have agriculture." And he says, "That sounds like a very interesting idea. I think I can find a little money to help you start that class." So he backed it, which made it possible to start the class. And then we started it and it was a packed house. We had the largest hall, speaking hall.

SUE CROUGHAN: The [. . .] auditorium.

CROUGHAN: Auditorium, the largest auditorium on campus, got packed full the first day of class, and it stayed that way. So it was very successful.

CARUSO: Had you taught any classes before that one?

CROUGHAN: No.

CARUSO: So teaching a class can be complicated.

CROUGHAN: Yeah.

CARUSO: How did you go about learning how to become an educator?

CROUGHAN: Well, the way this was structured, the guys I asked to give their . . . from their perspective, their take on the world food crisis from, you know, what they're specialized in. It might be grapes, might be wheat, might be whatever they worked on. And so they'd determine what the lecture content was. And then I just helped manage the, you know, nuts and bolts of having the place available and, you know, making sure . . .

SUE CROUGHAN: But you came up with a list of individuals, and you would go and get them to give that . . .

CROUGHAN: Yeah, I'd talk to them. I'd convince them to come to join the effort.

SUE CROUGHAN: And Bill Rains was an excellent mentor. He was an excellent teacher, excellent researcher, very close friend of ours. Other than being our major professor. And he just recently passed. And it was . . .

CROUGHAN: Yeah.

CARUSO: I'm sorry to hear that.

SUE CROUGHAN: He was a good person.

CARUSO: You also mentioned, though, that you had while they may have been open book exams, there were exams.

CROUGHAN: Yes.

CARUSO: Were you grading all the exams?

CROUGHAN: Yes.

CARUSO: So no teaching assistants or anything?

CROUGHAN: Oh, I had teaching assistants, too.

CARUSO: Okay. You had teaching assistants for the course. Were they undergraduates, or were they graduate students?

CROUGHAN: Both.

CARUSO: Both. Okay. Were they from the department or just . . . ?

CROUGHAN: Everybody.

CARUSO: Just everybody?

CROUGHAN: On campus.

CARUSO: So how did you go about teaching **<T: 110 min>** the teaching assistants what it is that you expected of them in terms of grading and other responsibilities for the course?

CROUGHAN: We'd have meetings, and they would have a copy of the test, and it was multiple choice on the test. So it wasn't a big essay.

CARUSO: So it wasn't like writing essays and interpretation. This is an A; this is an A-. It's either right or wrong.

CROUGHAN: Right. And got the head of the—what's it? What was the head of . . .

SUE CROUGHAN: Oh AID, wasn't it? USAID [US Agency for International Development].

CROUGHAN: USAID. I got him to come talk. So we had a big gun as part of that teaching in the course.

CARUSO: So you mentioned that you were able to go out and convince these individuals to come and give talks. I'm curious to know how you were able to. You're graduate student, right? I know you're coming from a well-known . . . you're working with a well-known individual, but you're a graduate student. How are you getting these big name individuals to come?

CROUGHAN: I think . . .

SUE CROUGHAN: He's a persistent Irishman. [laughter]

CROUGHAN: I think when I approached him, it was, kind of, complimentary because they were the one that was picked out in their field of expertise. So, you know, one guy is, kind of, one guy per department. So I'd go to this guy in this department and get him to say okay, I'd go to this guy in this department and get him to say okay. So got the . . . . I would explain that the chancellor is going to be talking. That was, I think, the breakthrough from the beginning—that the chancellor . . .

SUE CROUGHAN: The first year he did give . . .

CROUGHAN: Did the kickoff speech, you know, for the course, and he backed it.

CARUSO: And so when you're asking these individuals to come and give talks, after the course is over or after the talks were over, did you remain in contact with these individuals? Did they become a network of sorts?

CROUGHAN: Not so much. I wouldn't say so. How long did we have the class?

SUE CROUGHAN: Well, after you left . . . yeah, after you left, I think it went on for several more years. I don't think it's taught anymore. His sister [Mary Croughan] is provost there now, and she was going to get that information.

CROUGHAN: Yes, I could ask my sister. She's the provost.

CARUSO: And who—I'm sorry to use this word, but it seems appropriate—who took up the reins when you when you moved on? Who took on the course?

SUE CROUGHAN: I think Bill did.

CROUGHAN: Bill did.

CARUSO: So Rains took the reins.

SUE CROUGHAN: Yeah. Yeah.

CROUGHAN: Rains took the reins. There we go. Full circle.

CARUSO: Now one thing that I haven't asked about, and if you're not comfortable discussing it, I completely understand, but how did you two happen?

CROUGHAN: Let's see. Well, worked together, fell in love, and got married. Now I happened to be married before. So that involved a divorce.

CARUSO: Was this while you were in college?

CROUGHAN: Well, I . . . yeah, while I was in college. Right.

CARUSO: Okay, and how long after meeting each other?

SUE CROUGHAN: When we first met, we didn't particularly care for each other.

CROUGHAN: Yeah, she didn't like me at all.

SUE CROUGHAN: Yeah. And so it took some time, but we had to work together, and there was a lot to get done and stuff. And I was a tough taskmaster. Things had to be done the correct way and all that. But I think just we became good friends. I was one of few women in agronomy and I was, kind of, one of the guys. And so after work, we'd go have beers or whatever and just became close friends.

CROUGHAN: And we were working in the equipment. I mean, you're sitting . . .

SUE CROUGHAN: We were at a transfer hood.

CROUGHAN: You're sitting closer than this.

CARUSO: And working inches apart.

SUE CROUGHAN: And just talking . . .

CROUGHAN: For three or four hours.

CARUSO: Every day.

SUE CROUGHAN: A lot of it was very mundane work, and you're doing the same thing over and over again.

CROUGHAN: And you could talk in the lab in the hood.

SUE CROUGHAN: And **<T: 115 min>** then he was . . . when we'd be in the greenhouse sometimes, it didn't matter what I would say. He would turn it into a song, and he would start singing a song about whatever word it was. And he would go on and on and on. But we just—I don't know—we really became buddies, you know, helping each other out.

CROUGHAN: It was a good time.

SUE CROUGHAN: So we met in '74, but we didn't get married until '84.

CARUSO: Okay. And do you recall when you started dating how long after meeting?

SUE CROUGHAN: Eighty-one when he left. I mean, we kind of hung out. You know, hung out with Dave and Bill and some of the other guys. You know, we'd hung out. We never dated. Everybody would just go hang out.

CROUGHAN: Go have a beer together or something like that.

SUE CROUGHAN: He went off to Louisiana. I went to a meeting. And where did I go? I went to a meeting somewhere, and I was just working then. I wasn't . . . . I had gotten my Master's, and I was just working, and somebody didn't want to talk to me because I didn't have a PhD and it really upset me. So on my way back from the trip, I stopped in Louisiana to visit him, and I said, "What do you think? Do you think I should get a PhD?" And he said, "Yeah, go for it." So I came back and asked Bill if I could get my PhD, and he said yeah. And so I started working on my PhD, but [Tim] was in Louisiana. And then I think we just started a long-distance deal.

CROUGHAN: Yeah.

SUE CROUGHAN: And when I finished my PhD in '84 . . .

CROUGHAN: Then an opening popped up at my job site. And so she applied for it.

SUE CROUGHAN: Well, first he flew out.

CROUGHAN: Yeah. First, [I] flew out to . . .

SUE CROUGHAN: You know, to visit.

CROUGHAN: Yeah.

SUE CROUGHAN: And we went and we were on the Golden Gate Bridge and he proposed. And the rest is history.

CROUGHAN: Irish.

CARUSO: Thank you for sharing that. As you were pursuing your PhD, was there . . . at what point in your time at Davis, did you begin what became your PhD research—your thesis, the main work for your thesis?

CROUGHAN: When did I start?

SUE CROUGHAN: I think it was just a continuation. I mean, I think once you were, kind of, into getting your Master's, you wanted to stay and get your PhD.

CROUGHAN: Exactly.

SUE CROUGHAN: And then it just kind of . . .

CROUGHAN: It just flowed through. So they had the same major professor for the PhD as I did for the Master's.

CARUSO: Okay. And the reason I'm asking the question is because, I mean, obviously at some point you received the PhD. And so I was wondering how you knew when that point was going to happen. I'm trying to think of that sentence if that question really makes sense. Again, relating it to some of the other people I've interviewed, like they had a very specific research project. They started it at one point. They wrapped up the research, They were done. They knew

they were going to move on to their career. It sounds like this was just ongoing work. Maybe I'm misinterpreting what I'm hearing. So how did you know when you were going to have enough? How did you know when you were going to have enough research done that it would be considered a PhD or PhD worthy?

CROUGHAN: That's tough.

SUE CROUGHAN: So you had to have . . . at that time, you had to have like three distinct projects or three distinct publications or three distinct things. And so you, kind of, chiseled those out.

CROUGHAN: Yeah, publishable articles.

CARUSO: And so was it a decision that Rains was like, "Okay, you've done enough. Now you're getting your degree"?

CROUGHAN: Right.

CARUSO: Did you have to . . . was there a thesis defense?

CROUGHAN: Yeah.

CARUSO: And what was . . . were there other individuals that sat for the . . . as a committee assessing your work.

CROUGHAN: Yes.

SUE CROUGHAN: I think it was five, and he blew through his orals.

CARUSO: So **<T: 120 min>** they were oral exams or . . . ?

SUE CROUGHAN: Yeah, he had an oral exam.

CARUSO: Were there . . . was there a written component? Was there a bound thesis?

SUE CROUGHAN: Yeah, you're right. There's a bound dissertation, and that was the sticking point because they . . . once he was . . . they wanted him at LSU, they wanted him to show up by a certain date, and he was, kind of, dragging his feet, getting that last chapter written up and done and . . .

CROUGHAN: Not dragging it too bad, though.

SUE CROUGHAN: No. And they were like, "You better . . . . You have to start." I don't remember what the date was, and it was like . . . and then it came down to, "You be here May 1, or you don't have a job kind of thing." And so towards the end there it was really . . .

CROUGHAN: Hadn't found out the last part.

SUE CROUGHAN: Get it written and approved and all that.

CARUSO: And did you actually publish any of the work from . . . ?

CROUGHAN: Did I? Yeah.

CARUSO: How many papers?

CROUGHAN: I don't know.

SUE CROUGHAN: A bunch. Bill was very good about letting us be on a lot of publications. And there [were] chapters in books. There [were] quite a few. I mean, I could get that list to you, but . . .

CARUSO: I mean, we can include that later. Part of my reason for questioning that is, I mean, scientific publishing—or science—has a specific style to it, right? There's a very specific way of writing. And I mean, I've read some of some of what you published. There's this tendency to use the passive voice. Things happened, but no one's actually doing them. In some ways it's

magical. Because you're not intervening. This is just the evidence, and you're not trying to insert yourself in that type of . . . in those publications. But being that it is I would say it's not a way of writing that you might learn in school generally, I'm always curious to know how people learn how to write scientifically. Were you reading articles, and it's like, "Okay, I just need to mirror this"? And you kind of . . .

CROUGHAN: I think there's a fair amount of that. Yeah.

CARUSO: What about Dr. Rains? Did he work with you on writing articles? Did he . . . ?

CROUGHAN: He reviewed everything.

SUE CROUGHAN: He was really good about . . . yeah. We would write it. He would review it. We would come back. It wasn't like he did it all and just put our name on it. We did it. But he was very good with constructive criticism. But I think it goes back to UC Davis and some of the courses that we took. Ray Huffaker had a great class where you would . . . he would assign so many scientific papers, and you would be in charge of one, and you had to read it and critique it, you know, present it to the class and critique it and stuff. And it was, you know, how do you write a scientific paper?

CROUGHAN: How do you present a scientific paper.

SUE CROUGHAN: You know, what are the loopholes? And I think he was really good at coming up with papers that got published that really shouldn't have been published when you really get down and dissect what it is they did and the science behind it, it's like, oh, wait, he doesn't have a control for this. He didn't really replicate that. And I think I think it was the training at Davis.

CROUGHAN: But a lot of the guys there were on the boards of leading journals. So they were handling papers all the time.

SUE CROUGHAN: They encouraged all the students and even me as a technician to go to national meetings. And you would meet people.

CROUGHAN: Give talks.

SUE CROUGHAN: Give talks and interact. And it was a lot of . . . . I think that was important, you know, going around.

[END OF AUDIO, FILE 1.1]

SUE CROUGHAN: Different national meetings.

CARUSO: And do you know how Dr. Rains funded his lab? Was it through . . . did the university provide all the funds, or were there grants?

CROUGHAN: No, it was grants.

CARUSO: Did he expose you at all to the grant writing process?

CROUGHAN: Yes.

CARUSO: What did he wind up doing?

SUE CROUGHAN: We wrote a lot of the grants.

CARUSO: Okay.

SUE CROUGHAN: Yeah. And down to . . . back then—I'm sure it's all electronic now—but back then you would have to get the grant and twenty copies of the grant by a certain time and date. And I remember many times we'd be there late at night and collating by hand, you know, twenty copies to make sure you had it all together. And then you'd box it up and you'd have to rush it over and get it to the post office so you could get it to the granting agency by a certain date.

CARUSO: Because they would have to distribute the physical copies to potential reviewers. There was no sending [an email]. Well, I mean, okay, so late seventies we did have early electronic systems but definitely not like people just printing out PDFs.

SUE CROUGHAN: No.

CROUGHAN: Right.

SUE CROUGHAN: We did calculations by hand and punched cards.

CROUGHAN: Yeah. Computer cards.

CARUSO: So were you actually using punch card systems while doing your work? And was this to do calculations? What sort of calculations were you using this for in your work?

CROUGHAN: Statistics.

CARUSO: At the university, did they have multiple computer systems, or was it one centralized one that . . . ?

CROUGHAN: One centralized place.

CARUSO: And so you had to sign up for time on the computer?

CROUGHAN: Yeah, that was a big deal. Get used to going down there at ten at night and getting out of there two in the morning.

CARUSO: Yeah, time-sharing.

SUE CROUGHAN: And you would handwrite and give it to the secretary and then you would beg her to, you know, if she wasn't too busy to type up your stuff for you and then she would give it to you and you would literally cut and paste and give it back to her and she would type it up again for you.

CARUSO: Yeah, I remember cutting and pasting. Even in college, I was . . . . I mean, it was just easier to visualize things for me that way. Just a random question. Did you ever . . . since you were working with punch cards, did you ever accidentally drop a batch of punch cards?

SUE CROUGHAN: Yeah. Yeah.

CROUGHAN: You did?

SUE CROUGHAN: Not very often, but yeah.

CARUSO: Yeah. Because, I mean, they have to be put in a specific sequence, and if they're out of sequence, it, kind of, doesn't work.

CROUGHAN: That's got to be a bad feeling.

SUE CROUGHAN: You do that once.

CARUSO: You had mentioned I think the name was Marlon.

SUE CROUGHAN: Marlon Brandon. Yeah.

CARUSO: Marlon Brandon. And so you're finishing up your degree. At that point in time, were you already . . . were you certain that you were going to . . . were you looking for positions in academic institutions? I know there was this opportunity that came up with this one individual, but I was wondering if you had started the job search process before you found out about that specific position.

CROUGHAN: Oh. I don't think so. Do you?

SUE CROUGHAN: I mean, we would get the publications, and you look and see what jobs were available. But I think that one kind of popped up, and that was because . . .

CROUGHAN: It worked on rice.

SUE CROUGHAN: It's right down his alley.

CROUGHAN: It was right down there in Louisiana.

CARUSO: And so what . . . ? So two questions. What attracted you to rice? It was mentioned earlier that you became interested in . . .

CROUGHAN: Main crop that's used to nourish people.

CARUSO: And so this was the feeding the world solution?

CROUGHAN: Feeding the world. Exactly.

CARUSO: And there was no attraction to any other type of . . . . I mean, soybeans. I know that you focused on soybeans for your research, but . . .

SUE CROUGHAN: Rice is something you grow and you eat.

CROUGHAN: And there's so much of it grown that, you know, the impact, a small impact is a huge impact.

SUE CROUGHAN: So much of the world depends on it. And it is a good nutrition. It is lacking in a couple of amino acids. But if you throw some beans in . . .

CROUGHAN: But in general, if you can get enough rice, you're in good shape.

CARUSO: Okay, so there's this one opportunity. Now, I don't believe you'd mentioned traveling east at all, right? So, I mean, it was California. I guess Kansas you had been for a couple of years. A little more . . . a little away from the West Coast. It sounded like, though, when we were talking about this opportunity to go to LSU, it sounded like you, in addition to the type of work and focusing on rice was important, but it also sounded **<T: 05 min>** like you

might have wanted to move away from the West Coast. Is that accurate that you were interested in moving beyond just West Coast life?

CROUGHAN: No, I think I was pretty pleased with just getting to California.

SUE CROUGHAN: I think if a job was available in California, you would have taken it versus go to Louisiana.

CROUGHAN: Oh, I see what you're asking. Oh yeah. Yeah. Yeah.

CARUSO: So you would have preferred being in California over moving to Louisiana?

CROUGHAN: Well, I don't know because rice was such a big crop in Louisiana. And they have a—I don't know if we've mentioned this—a rice festival where we live in Louisiana. The city has a rice festival every year.

SUE CROUGHAN: But there was a rice research station and there was rice research in California, but there [were] no jobs.

CROUGHAN: They didn't have the funding, and they didn't have any openings.

CARUSO: Okay. So it turned out that since Louisiana had the opening and you were interested in rice, that's where you were going to go.

CROUGHAN: And a brand-new lab and money to equip it. It was pretty sweet.

CARUSO: Did you have any concerns about moving to Louisiana?

CROUGHAN: I got more concerned while I was there. People were different from California.

CARUSO: In what way?

CROUGHAN: More traditional. Not very outgoing. In California, you could meet somebody, and they could be friendly immediately. Not so much in the South; it's kind of formal friendship. You know, they were polite, but it was just more manners type thing than, you know, "Hey, nice to meet you, buddy. Want to go get a beer or something like that?" So [it] was different . . .

CARUSO: So a different cultural experience?

CROUGHAN: Yes, right. Because everybody knew everybody except you.

SUE CROUGHAN: Very small town. So even though it was part of LSU, the main campus was in Baton Rouge, [Louisiana]. But this research station is in Crowley, [Louisiana], which was at the time maybe fourteen thousand, fifteen thousand [people], and now it's probably down to twelve [thousand]. Very small rural environment.

CARUSO: Did you visit there before accepting the job?

CROUGHAN: Yeah. So I knew what I was getting into.

CARUSO: You knew what you were getting into.

CROUGHAN: But they also took me through the lab. You know, here's a brand-new lab. Who gets their own brand-new lab, you know, fresh out of grad school? That was part of it.

CARUSO: And so what was the nature of the offer? Was it that you were going to be a research scientist in that specific lab? Were you going to . . . or sorry, were you being hired to be a research scientist? Were you hired to be a faculty member that also had teaching responsibilities? What was the actual nature of the position?

CROUGHAN: I'd be a faculty member, and I would definitely not have teaching responsibilities. They were pretty adamant about that. They didn't really want me splitting off to do . . . they were hiring me to do research, and that's what they expected me to do.

CARUSO: So do you know if there were other positions . . . other individuals who were being interviewed for that position?

CROUGHAN: Yeah, there were. There were. I don't know how many. I think there was about ten other guys, though, that got, kind of, the final cut. And they might have interviewed that group twice or something like that.

CARUSO: And what was the overall process like? I mean, you had a site visit. When you were there, were you presenting on the research that you had done? Were you talking about research that you might want to do? What was part of the application process?

CROUGHAN: Talked about what I had done in my thesis, what I did in my thesis.

CARUSO: So giving like a standard scientific talk?

CROUGHAN: Right. Exactly.

CARUSO: Had you given talks elsewhere during your graduate career? You had mentioned going to meetings and giving presentations.

CROUGHAN: National meetings so had a fair amount of practice in that. So wasn't a big deal to talk.

CARUSO: And I know it's been forty-ish years now. Do you recall what it is . . . so you were talking about the research that you had done. Did you get a sense for what it is that LSU wanted you to do in that research position? Was it a predefined, like "We want you to come here to work on this specifically," or did they just want you to come and you develop a project?

CROUGHAN: Come, and I developed a project. I think they were looking at me, looking to me to come in and establish the project, and **<T: 10 min>** they would supply all my needs in order to do that. But I don't think they had a clear idea of what was needed. And so carve out this, you'll be doing this and [. . .] you'll be doing this too and then if you want to do some more, that'd be up to you. It was pretty much it's up to me when I come down.

CARUSO: And so do you have a general sense or a general understanding of why LSU wanted to open the research station there?

CROUGHAN: It's the oldest one in, I think, in the US.

CARUSO: Oh okay. [crosstalk] So new facility.

CROUGHAN: It's a new building.

CARUSO: New building.

SUE CROUGHAN: It was a very . . . again, traditional agricultural research center, and they had seventeen of them around the state and they focused on certain crops. And this one was internationally known for the rice research it did. And I think . . .

CROUGHAN: It still is.

SUE CROUGHAN: Louisiana at the time had oil money, and they were . . . so they could hire new faculty at starting wages much higher than any other university. You know, they just had this flow of money. And I think biotech all of a sudden was popping up and they said, "Oh, we don't have anybody doing biotech. We need to start some biotech stuff." And that's when I think Marlon, Marlon Brandon, who had come there to be an agricultural . . . agronomist, said, "Well, I know somebody" kind of thing. And at the time . . . had Kent already . . . yeah, Kent Mackenzie had already moved there too. He was a breeder at Davis, a rice breeder, a graduate student at the same time. And he . . . Marlon, I think, got him to come down and be the rice breeder there.

CROUGHAN: Right.

SUE CROUGHAN: So then they said, "Hey, let's get Tim down here." And I think that's how . . . when you applied.

CARUSO: And what did Bill think of your decision?

CROUGHAN: Bill Rains?

CARUSO: Bill Rains, yes.

CROUGHAN: I think he was very pleased with it because it's almost unheard of for somebody to get that kind of funding walking in the door, you know.

CARUSO: Where had some of his other students gone? Were they mostly academics?

SUE CROUGHAN: Both, I think. Yeah, both . . . had gone both ways. And it was funny because I mentioned earlier about we'd all sit around and decide which way we were going to go, and there was two individuals. I remember she was adamant she was going into academics, and he was adamant he was going into industry. And about three years in, boy, they switched. She . . .

CROUGHAN: Who was that? [crosstalk].

SUE CROUGHAN: Carol Meredith. And I'm blanking on the other guy's name.

CROUGHAN: I know who you're talking about. Yeah.

SUE CROUGHAN: And it was just funny, you know, where everybody ended up. But Bill, a lot of . . . . Bob [Robert D.] Wych went into Illinois or Iowa or somewhere?

CROUGHAN: Yeah.

CARUSO: So Bill was very comfortable with students going to industry, going to . . . So he wasn't just like, you need to be an academic, and that's the only true research or anything like that?

CROUGHAN: Yeah.

SUE CROUGHAN: This was also a unique position because most . . . a lot of our friends were getting into academics, and they're scrambling to make tenure. They're teaching, they're trying to do research, they're trying to write grants, they're trying to do publications. And, you know,

here Tim walks in. You know, we built you a facility. Here's money for your research. It's 100 percent research. No teaching. You can have students or postdocs if you want.

CROUGHAN: But you don't have to.

SUE CROUGHAN: Here's a technician, you know, several technicians. And it was just kind of an unheard of thing at that time for all of our friends who were starting out.

CROUGHAN: That's what a senior faculty member at Davis would get. You'd never get that walking in the doors fresh out.

SUE CROUGHAN: It was a nice setup.

CARUSO: Yeah. Sounds like a spectacular opportunity. Yeah. So I know we've been going for almost three hours. And so, from my perspective, this transition seems like a good stopping point for to pick up tomorrow. But before we stop, I want to make sure that there isn't something that I didn't ask about that you were hoping to talk about or to mention or to have be part of this oral history in the . . . you know, again, could be like, "I remember my first bottle when I was a kid." Like whatever it is up to this point in time. Is there something that you want to talk about that we didn't talk about or that you would want to talk about in greater detail before we end for the **<T: 15 min>** day? And if you don't think of anything now, we can always start tomorrow with, "Oh, you know what? Last night I remembered I wanted to talk about this." But I like to give people the opportunity. I've been pushing people.

CROUGHAN: That's very nice of you.

CARUSO: Okay. All right. So should we stop here for today?

CROUGHAN: Yeah, I think so.

CARUSO: All right. [. . .]

[END OF AUDIO, FILE 1.2]

[END OF INTERVIEW]

INTERVIEWEE:	**Timothy P. Croughan**
INTERVIEWER:	**David J. Caruso**
ALSO PRESENT:	**Susan (Sue) Croughan (wife) and Matthew (Matt) Croughan (brother)**
LOCATION:	**Science History Institute Philadelphia, Pennsylvania**
DATE:	**14 June 2023**

CARUSO: Today is June 14, 2023. I'm Dave [David J.] Caruso sitting here for our second session with Tim and Sue Croughan as part of the oral history interview that we're conducting here at the Science History Institute. Yesterday we wrapped up with you finishing graduate school. We heard a little bit about your relationship. I know that you wind up coming out too . . . . Sue, I know you came out to LSU in '84, but Tim, you started there in 1981. After being hired, after . . . you mentioned a little bit what it was like visiting LSU and the change in culture there, what people were like. I am interested to know more what it was like for you getting to the institution and starting up your research there. You mentioned that you're being given your own lab. You were given the freedom to think about the research that you wanted to undertake. So I, kind of, want to know what was it like for you on that first—well, maybe not the first day—but those first days when you are now a member of the LSU [H. Rouse Caffey] Rice Research Station if you could tell me a little bit about that.

CROUGHAN: Yeah. Well, when I arrived, I was pleasantly presented with an opportunity to build this new lab and also equip it. So that was a real opportunity to make things the way I wanted it. And with experience at Davis, I had some pretty solid ideas on what we needed in the facility. And there didn't seem to be any shortage of funding for doing that. And that worked out very well.

CARUSO: So what were some of the things that you felt you needed in order to set up your lab? Were there specific technologies that . . . devices, mass spec devices, chromatographs, anything like that that you felt that the lab needed to be equipped with, that they didn't have that you wanted to purchase?

CROUGHAN: Not elaborate pieces of equipment. Things like sterile transfer hoods to have the opportunity to handle the cultures and not get them contaminated by other organisms. So there wasn't really any really exceptional pieces of equipment.

SUE CROUGHAN: Autoclave?

CROUGHAN: Yeah, autoclave. Yeah, that was sort of standard equipment for this kind of work, though.

SUE CROUGHAN: Incubators.

CROUGHAN: Incubators, right.

CARUSO: Okay. So just the standard basic equipment that you would need.

CROUGHAN: They did have the funding for all of that. So didn't have to wrestle around with them about whether or not we should get it.

CARUSO: And what was the physical size of your lab?

CROUGHAN: It was large.

SUE CROUGHAN: Yeah. Geez.

CROUGHAN: And what would you say that was? I would say it was . . .

SUE CROUGHAN: At one point with twenty people.

CROUGHAN: Yeah, maybe three times the size of this room.

CARUSO: Three times the size of this room. Okay. And how many benches or how many hoods did you wind up having?

CROUGHAN: Three or four.

CARUSO: Three or four hoods. Okay. And when you started setting up your . . . how long did it take you to do that initial setup of your lab? Was it relatively rapid?

CROUGHAN: Well, I communicated with them beforehand. So we, kind of, took that into account that we wanted to hit the ground running. So I would send them a list of what was needed in the facility. And without question, they just went ahead and provided everything I asked for. So that worked well.

CARUSO: And when you showed up, was everything unboxed and placed in various positions around the lab, or did you have to . . . ?

CROUGHAN: Yeah, pretty much.

CARUSO: So the layout was kind of set up for you?

CROUGHAN: Yes.

SUE CROUGHAN: They already had hired him two [technicians], I think.

CROUGHAN: Two technicians.

CARUSO: Okay. That was going to be my next question is who is going to . . . who is staffing your lab when you got there? So you had two technicians coming in.

CROUGHAN: Yeah, they were at ground zero, so they needed to learn everything that we were going to be doing. But that was easy to do. They were enthusiastic.

CARUSO: Do you remember their histories? Had they been technicians before? Were they just people from the community?

CROUGHAN: Do you remember that?

SUE CROUGHAN: I think Mona [M. Meche] had been working there in some other lab, but doing, you know, more traditional . . .

CROUGHAN: Like seed counting things. Not very high tech.

CARUSO: Okay. So you come in, you have the physical **<T: 05 min>** space set up, you have the equipment that you need. You have two technicians. Did you immediately start to develop a specific research project, or did you feel that you needed more people on site? So you mentioned that at some point you had like twenty people in there. So I'm wondering did the lab grow in terms of personnel quickly, or was that a slow growth over time as you were doing more work?

CROUGHAN: Do you remember that?

SUE CROUGHAN: I would say a little bit of a slow growth, but by the time I got there in '84 and brought on my group of people, his was pretty blowing and going because it was three years later. So his was . . . within that first three years, it, kind of, picked up pretty quick.

CROUGHAN: Yeah, it got up to speed for sure.

CARUSO: Okay. So pretty quickly. So three years, you were pretty much up to speed on [the] research project, more people in the lab, more people doing work.

CROUGHAN: Yeah, it was a very active lab.

SUE CROUGHAN: One of the things that they did, though, the individual who hired actually both of us, Duke Faulkner, he was in charge of the Rice Research Station, and he was very internationally known. He had worked . . . was it the Ford Foundation in India?

CROUGHAN: Yeah, he'd gone to India.

SUE CROUGHAN: And he had traveled quite a bit. So one of the first things he did, which I was impressed with, is he told Tim, he says, "You need to get out and see the world and how rice is grown" and sent him literally around the world.

CROUGHAN: Around the world.

SUE CROUGHAN: He, you know, went from Louisiana—I don't remember how many stops—but I know there was India and Thailand and the Philippines and then, kind of, circled around and ended up before he went back to Louisiana stopping in California again. And the reason I remember this so strongly is he had gotten a little black lab, and I took the . . . while he was gone on this month trip, [I] took the lab to California and took care of him while [Tim] was on this whirlwind trip.

CROUGHAN: Yeah, that was a wonderful opportunity to see other parts of the world and how rice was grown and what their needs were and what the people that were working in rice were like, you know, and get to know them.

SUE CROUGHAN: And how poor people were dependent on the rice.

CROUGHAN: Yes, exactly.

CARUSO: So was Duke Faulkner a plant scientist as well, or . . . ?

CROUGHAN: No, he was an engineer.

SUE CROUGHAN: But very bright individual. Very firm, but very honest. And if you could . . . his first comment was usually no, but if you gave a good argument, he would, he would say okay.

CROUGHAN: Yeah.

SUE CROUGHAN: But he made you . . .

CROUGHAN: Yeah, he was, kind of, a tough old guy, but he had good goals.

CARUSO: So in this around-the-world trip, you mentioned India. China?-

SUE CROUGHAN: That was the next trip he took, [he] went to China.

CARUSO: Okay. So let's stay focused on this first trip. You're going around the world. You're meeting individuals who are growers. Or are you also meeting with people who work on breeding rice?

CROUGHAN: Breeding, mostly.

CARUSO: Mostly breeders. And were these [. . .] large commercial farming type of breeders, or was it like [. . .] a decent size?

CROUGHAN: It was major operations. So it was . . . . I'd go to institutes similar to where we were working.

SUE CROUGHAN: Wasn't it . . . . I'm trying to remember all the acronyms, all the different international research centers.

CROUGHAN: Right.

SUE CROUGHAN: And India was actually a conference as well. Some kind of rice conference.

CROUGHAN: Yes.

CARUSO: And so while you're making this trip, do you recall what you were learning from all these different institutes in terms of how they were approaching rice science and how they were approaching problems like feeding individuals?

CROUGHAN: Not so much. I think the real function of the traveling like that was just to get exposed to the role of rice in other countries. And, you know, to talk to the guys who were working on rice in their locations. It was quite eye-opening to me. You know, I didn't know very much about that kind of stuff.

CARUSO: In **<T: 10 min>** terms of the general science that individuals were pursuing at this period of time, was there a broad focus? Was it looking to improve the stalk strength so things don't break? Was it looking to introduce productivity of individual plants? What were people thinking about broadly at the time in terms of rice and its production?

CROUGHAN: Pretty standard. Just to increase the amount of rice that was produced [per acre]. Its main goal was to increase yields. So they weren't so oriented at developing, you know, particularly brand-new kinds of rice. They mostly wanted to just . . .

SUE CROUGHAN: It was, kind of, the green . . . what they called the green revolution.

CROUGHAN: Right.

SUE CROUGHAN: And it was increasing yields . . . but then you realize what are the limitations when you have an acre? You know, is it water, labor, or what are the things that restrict [yield]? The weeds, the pests, and that type of stuff. What's mind-boggling is the percent that weeds actually [impact yield] because you're watering and fertilizing these plants that you're growing, but the weeds are benefiting.

CROUGHAN: Yeah, you're watering and fertilizing the weeds at the same time.

SUE CROUGHAN: And they actually can outcompete a lot of the crops. So those weeds are actually a pretty significant hindrance to increasing yields.

CROUGHAN: I agree with that totally.

CARUSO: And do you know what some of the approaches were at the time for trying to deal with those problems? Like what . . . ?

CROUGHAN: I'd just bend over. Hand pulling. It was . . .

SUE CROUGHAN: Well, you could describe how they did it in Louisiana in terms of controlling the red rice. There was a whole process.

CROUGHAN: You mean like rogueing the fields?

SUE CROUGHAN: Well, so red rice is very similar to commercial rice.

CROUGHAN: Same genus and species.

SUE CROUGHAN: And so there's, you know, say if you were growing a crop of soybeans, there's certain herbicides you could spray that would kill, say, the red rice and other weeds, and the soybeans would be fine. But in a rice field, you couldn't do that. So not only red rice [was] a significant problem, but other weeds. So to control this red rice, they came up with all these things where they would have to [. . .] aerial seed the rice versus drill seeding because you would put the water on that would, kind of, help suppress things. They did—what did they call it?—mudding in.

CROUGHAN: Mudding in, yeah.

SUE CROUGHAN: And then they would always be rotating with soybeans, even though soybeans [. . .] in the rice growing areas of Louisiana were not very profitable. It was the only way you could get on top of controlling that particular weed, which was very . . .

CROUGHAN: So you'd alternate rice and soybeans. And during the soybean crop, you tried to knock the red rice down and hold that in and, kind of, keep that under control. And then you could go back to the rice crop the next year.

SUE CROUGHAN: Red rice [. . .], when it grows, it's very aggressive. But what happens is it . . . they call it shattering. The grains do not stay on the head. They drop into the field, which just replenishes.

CROUGHAN: So they contaminate the field.

SUE CROUGHAN: And they can stay dormant for quite some time. So they can go a couple of years in the soil and then germinate. And then the problem is when you go to harvest your rice, you have this red rice, which is contaminating the rice. Now red rice is actually grown in other parts of the world and eaten, but for the US rice industry, they don't want [it].

CROUGHAN: They don't want the presence of red-colored rice.

SUE CROUGHAN: They want to look at a bag and see all these perfect grains. So if you have this grain that's different in there, the quality is lower and stuff. And then the millers in order to get rid of the red rice have to go through a lot more rigorous cleaning up. And so the quality . . . you bring in a truckload of rice. What you get out at the other end, you've got not as much as you should because there [are] broken [grains].

CROUGHAN: And how much you got paid for the rice was dependent a lot on how much red rice was in the load.

CARUSO: So the red rice itself, you said other countries, other places do eat red rice. Is its nutritional value different significantly from non-red rice?

SUE CROUGHAN: Boy, it's probably similar.

CROUGHAN: That's a good question.

SUE CROUGHAN: Yeah. **<T: 15 min>** I don't remember this.

CROUGHAN: It wasn't like it was inedible or anything like that. It wasn't, you know, bad for you, but it was just the presence of this contaminant in the . . . in your bag of rice, which is eye-catching.

CARUSO: So the contamination . . . so to me, so it sounds like it was more aesthetic than anything else.

CROUGHAN: Yes, exactly.

CARUSO: So it wasn't that it was bad to have the red rice. It was just that you wanted to see a bag of white rice, not of . . . not a bag—what's the candy?—is it Good and Plenty that's the white and . . .

CROUGHAN: Yeah.

CARUSO: So you didn't want like the Good and Plenty version of rice. You just wanted it to be white.

SUE CROUGHAN: And what they call brokens. So if you have a sack of long grain rice, you want each kernel to be there. You don't want it to be what they call broken. They want it to be a whole kernel.

CARUSO: And so the red rice tended to . . .

SUE CROUGHAN: You had to mill it more to get the . . .

CROUGHAN: They tried to get that red coating off by milling it more, and that would break up more of the rice, which lowered the value.

SUE CROUGHAN: And then certain industries, you know, Budweiser and—who's the one does Special K?— people that are using rice in food products also had pretty high standards. I think just the US, the quality of US rice compared to other places in the world. Now I know Japan has very high standards for their rice and stuff, but when you're just producing rice to feed people, they don't care. It's just volume. They don't care the quality.

CARUSO: And just to make sure that I understand the process correctly, so the planting of soybeans, it wasn't about . . . . I mean, you could make some money off the soybeans, but it really wasn't about that. It was planting something that wouldn't die when you sprayed an herbicide to kill essentially the red rice so that way hopefully when you then went and planted the standard commercial rice again, there wouldn't be as much red rice because you might have killed it in the interim. You also mentioned that the red rice could lay dormant for years and then begin sprouting.

CROUGHAN: Ten years, yes.

CARUSO: If you sprayed with an herbicide, was that dormant rice also killed, or is it only . . . ? So I was . . .

SUE CROUGHAN: It depends on the mode of action of the herbicide.

CROUGHAN: Right.

CARUSO: Okay. So it might have killed some of the dormant ones, but it may have just been like, well, you didn't . . . you killed what you killed. But whatever went in-ground and remained dormant, it was going to pop up.

SUE CROUGHAN: Things like Roundup are contact. So they kill what they touch. Other herbicides you would put on the ground would kill germinating seeds. So it just, kind of, again was the mode of action . . .

CROUGHAN: Of the herbicide.

CARUSO: And when you were visiting these various institutes, were they looking for—I'm going to use this word here, I don't know if it's appropriate—but were they looking for natural ways to modify things, to get things to have the rice be more productive? And I'm using the word "natural" here because I know that genetically modified and you were talking about the biotech revolution beginning in the 1970s. So I'm curious to know if people were starting to think about genetically modifying organisms in the early 1980s. And so that's why I was trying to use the word "natural" as compared to genetically modified.

CROUGHAN: Right. Yeah. I don't think that was in the picture yet.

CARUSO: Okay, so no genetically modified.

CROUGHAN: Just traditional method.

SUE CROUGHAN: Traditional breeding.

CROUGHAN: Right.

CARUSO: So you spent a month traveling the world learning about . . . was this your first international travel? Was this the first time you're outside the United States?

CROUGHAN: I guess maybe I'd been to Mexico or something like that. But not to that extent.

CARUSO: Okay. So you got a lot of stamps on your passport?

CROUGHAN: Yeah, that's for sure.

CARUSO: In experiencing or going to these other institutes and being in these other countries, you had mentioned yesterday the fact that you decided to move into this field because, you know, the thought that kids couldn't eat, that people were starving, you felt this desire to address that problem. When you were visiting these other institutes and these other countries, do you recall any experiences with regard to that specific aspect of things like seeing the poverty, seeing starvation internationally that maybe you hadn't been exposed to in the US?

CROUGHAN: Especially like in India and stuff like that, you'd see considerable [poverty]. **<T: 20 min>** That was the predominant thing. People were just skinny people, you know. You could tell they were undernourished, and the worst part was that the babies were the ones they had to sacrifice. The mom and dad couldn't be kept from eating. They had to be out there to do the work on the rice field or everybody died.

CARUSO: And I'm trying to remember. Is it the early 1980s . . . . I'm now flashing back to commercials on television where was it Ethiopia that was going through a food crisis? Because I remember the ads on TV like donating certain amount of money per day helps feed a child. And I remember Ethiopia specifically, but it may have been other countries as well.

CROUGHAN: Yeah, I don't know specifically on that. The answer to that. But I think it was occurring somewhere pretty much every year.

SUE CROUGHAN: Every year.

CARUSO: So you have this month-long trip. I assume you pick up the black lab on your way back to Louisiana. You return to your lab, you have the two technicians, you have the equipment. What project do you decide to focus on in those early years of your time at the LSU Rice Research Station?

SUE CROUGHAN: I knew I should have brought my notes. So I went through our annual reports because every year we had to write an annual report. And so I went by year what he reported on and stuff. So coming up with something weed-resistant was you identified as a number one thing. And then there's a separate project which we can talk about, which was anther culture, which is a way of taking breeding lines. And there's . . . when you come up with a new variety, it takes years to get that variety to the point where you can commercialize it. And anther culture is a way to, kind of, shorten that. But coming back to the herbicide, that was the focus. And what was interesting is based on your annual reports, Tim took several approaches, and one of them was screening the world collection of rice plants. I don't know if you remember all that. And every year there was an individual there, a pathologist who would every year get—I can't remember the number—but say two hundred or two thousand lines. And he would plant them, and he was looking for disease resistance. So Tim was working with him in getting these lines and literally planting rows and rows and rows of the world collection and then spraying them [with] herbicide and looking to see . . .

CROUGHAN: Hoping that one of them would turn out to be resistant to the herbicide.

SUE CROUGHAN: Just a particular world collection. And then you started with doing somaclonal variation so that was your first approach.

CROUGHAN: Yeah. That's in cell culture. Lots of times you would grow the tissues and if you could cause them to regenerate back into a plant, to form a plant, and sometimes those would have novel new characteristics. So that's how I looked for plants that had herbicide resistance as a new characteristic, but that didn't pan out.

SUE CROUGHAN: Yeah. So he would regenerate plants, you know, put them out in the field. You'd look for things that . . . they were looking for varieties that were shorter because you mentioned, you know, about standing up for the. . .

CROUGHAN: Yeah, there's other characteristics.

SUE CROUGHAN: So he was looking for new traits in these somaclones, but one of them was for the herbicide resistance. So he was looking at different approaches to come up with a herbicide-resistant plant. But there was a process too that you went through on trying different herbicides as to what would be the right herbicide to select for.

CROUGHAN: Right, right.

CARUSO: And can you tell me a little bit about that process?

CROUGHAN: Well, there's a lot of herbicides they couldn't use on rice because it would kill the rice. But they were good herbicides. So had to get very familiar with all these other herbicides that normally weren't used in rice production but would be useful if you could go out there and spray it and kill the red rice and not kill **<T: 25 min>** the commercial rice.

CARUSO: And so I have a certain image in my mind of this overall process, and I just want to make sure that I'm understanding it correctly. So you do this work, there is some laboratory work where you're trying to analyze and grow seeds and have them become new plants. You then take these plants, you put them out in a field, you plant them, and then as they're growing, you spray certain sections of the field with certain herbicides. Or is it like you have different fields: "This field, I'm going to spray it with this herbicide. This field, I'm going to spray with that [herbicide]."

CROUGHAN: It was more of this field and that field because the herbicide tends to drift with wind so you wouldn't . . . you didn't want to complicate things with that. So you put them in separate fields.

CARUSO: Separate fields, okay.

SUE CROUGHAN: So one of the interesting things was most of the projects were in the field during the growing season and then they didn't really do much in the wintertime because, you know, it was mostly in the field where Tim's project, it was, say, in the wintertime, you're trying to produce as many sumaclones as you can. You're growing them up in the greenhouse, collecting seeds, and stuff like that. And then the growing season, you're out in the field, planting, spraying, harvesting, and then coming back. So it was a year-round effort.

CROUGHAN: Year-round operation.

SUE CROUGHAN: And then one of the other techniques you were doing was taking seeds and soaking them in herbicides and then planting them. So he had all these different techniques he was trying.

CROUGHAN: Different approaches.

CARUSO: And do you recall what inspired your different approaches? I would never think to myself, "Oh, maybe we should soak some seeds in herbicide and see what happens." Do you recall what made you think of these different ways of experimenting?

CROUGHAN: Just trying to try everything possible. Brainstorm. Maybe we haven't tried this. Let's try this. Let's see if there's anything.

SUE CROUGHAN: One thing. If you're looking for disease resistance, you have to grow a plant, introduce the disease and see if it survives. One thing about herbicide resistance is . . .

CROUGHAN: Is you spray it.

SUE CROUGHAN: You spray it. It either lives or dies.

CROUGHAN: It was pretty black and white.

CARUSO: And so clearly this was . . . things varied by season so when you're in the growing season, you're trying to kill stuff. When you're not in the growing season, you're trying to grow stuff that you could then grow in the growing season. How large were the fields that you were planting in?

CROUGHAN: Large.

SUE CROUGHAN: Twenty acres?

CROUGHAN: Yeah, Twenty acres. Twenty, thirty. Maybe even forty acres.

CARUSO: And were you the one going out and poking holes in the ground and putting in seeds?

CROUGHAN: Well, we had equipment so we could plant with the equipment, and then we could also use the equipment to spray. But I was the one out spraying it.

SUE CROUGHAN: On the tractor.

CROUGHAN: On the tractor, right.

CARUSO: You were on the tractor. And so the technicians that you had, were they just laboratory technicians, or were they out in the field as well?

CROUGHAN: They were more laboratory than . . .

SUE CROUGHAN: But then you got some guys later. Like you had somebody before Ronald Reagan, but you had . . . [knock at the door]

CARUSO: [. . .] All right. So, yeah, I'd like to hear a little bit more about that early work. You mentioned the spraying, and you were out in the field. What I'm curious to know is as you are out in the field and you're doing this work—I know later on you had other people to help you—when you were spraying these herbicides, were you taking . . . were you wearing hazmat suits? Or I think about what I did in the early '80s when we sprayed for like weeds and things like that, we weren't wearing it. It wasn't DDT level spraying myself. But, you know, I was getting hit with herbicides while I was spraying outside. I was wondering if you were taking any precautions to protect yourself or . . .

CROUGHAN: I don't think so.

SUE CROUGHAN: No.

CARUSO: So inhaling, like if the wind was bad that day, you were sniffing some herbicides.

CROUGHAN: Yeah.

SUE CROUGHAN: I mean, he typically would go out real early in the morning before the wind . . .

CROUGHAN: Before the wind picked up.

SUE CROUGHAN: In Louisiana, it's real interesting. You go out at daybreak, and it's real calm and still. And that's always a good time to get out there.

CROUGHAN: Also, you got a uniform spray pattern if the wind wasn't blowing. If it was blowing, it might you might miss a spot. You might get a plant that survived. You'd get all excited about it. Well, it's just because the wind blew the herbicide past **<T: 30 min>** it in a burst of wind.

CARUSO: And so was that a, kind of, standard thing that you did every morning in the growing season? Were you out spraying herbicides every day, or is it that there was you would spray once and then you'd see what happened? What was the overall process like?

CROUGHAN: What do you think? I was spraying pretty regularly.

SUE CROUGHAN: Yeah. I mean, you would plant the rice, you would wait for it to come up, get to a certain size, but then there would be spraying.

CROUGHAN: You know, I thought of it as a numbers game, you know, who knows? It's one in a million. It might be resistant, but you knew the more that you sprayed, the more likely you were to find something.

CARUSO: And the amount of spraying that you were doing, was this similar to what you would find on a commercial farm? Did they spray that frequently?

CROUGHAN: They'd spray for other reasons, of course, but I guess it was I'm just spraying once.

SUE CROUGHAN: Well, farmers have a whole system. You know, the plant, you know, whether they go and add fertilizer later. So they might have a plane fly over and herbicide or they might . . .

CROUGHAN: Might put it [with] a tractor.

SUE CROUGHAN: Fertilizer or herbicide or insecticide or whatever.

CARUSO: Yeah. The reason I'm asking the question is I'm just curious in terms of if you're thinking of developing something that would be resistant compared to the red rice, are you looking for resistance in extreme herbicidal conditions or would you be looking for what you might encounter? Are you looking for something that would survive a minimal amount of spraying that would kill the red rice but not affect those? And so I was wondering if that was a factor, if concentration levels were important.

CROUGHAN: Pretty much just set one concentration—the minimum it would take to kill the rice.

CARUSO: Okay. And during the growing season, when you were out spraying, was there much work going on in the lab at the same time?

CROUGHAN: Yeah, quite a bit.

SUE CROUGHAN: Yeah, [because] they would go out, so that's when they would do a lot of anther cultural work because they'd [dig up] the plants growing in the field. You have to get them at the exact right time to collect the anthers. So that was always going on too. It was pretty year-round.

CARUSO: Pretty year-round, okay. When you were spraying in the field and clearly things were dying from the sprays, you mentioned that there are other factors. Maybe there was a slight wind that day. Maybe something didn't get hit. Other things did get hit. If you had something that survived, how did you know if it survived because it was resisting the herbicide or it survived because just randomly it wasn't actually hit with an herbicide.

CROUGHAN: You could look at the field later on and see how uniform the pattern of death was. And also you just avoided situations where, you know, the wind was blowing that significantly.

SUE CROUGHAN: But if you found a plant, then you would dig it up, put it in a greenhouse.

CROUGHAN: Test it further indoors.

SUE CROUGHAN: But you would grow it up, collect the seed off of it.

CROUGHAN: Right.

SUE CROUGHAN: And then grow those plants and test offspring and see.

CARUSO: So how often did you have . . . again, I know this probably changes over time, but in those early years, how many how many survived your herbicide?

CROUGHAN: Oh.

SUE CROUGHAN: Not many.

CROUGHAN: Not many.

SUE CROUGHAN: I mean, every once in a while you get a false positive.

CROUGHAN: Yeah, false positive, meaning it survived, but it was a puff of wind or something prevented it from getting sprayed.

CARUSO: Okay. As you're doing this work, you have the two technicians to begin with. I know that there are others who came in to help with the maybe the planting, the herbicide work. Were you thinking of growing your lab in any other way in terms of personnel? Were there things that you weren't able to do because you were understaffed in those first few years?

CROUGHAN: Not so much. They funded us generously because it was an important goal we were pursuing. And, you know, the place would be . . . it would add to the success of the overall projects at the location.

SUE CROUGHAN: The Rice Research Station was pretty famous internationally, **<T: 35 min>** and there [were] always people that would want to come and do a postdoc or graduate work, especially out of China. And so in those early years he went—and I'm trying to remember what year it was . . . it was pretty early in the '80s right after China opened up to be able to

travel there—you went and they were starting to do anther culture there, and that's when you brought, I think it was Xi Ren over, and he came into your lab and stuff. So it started expanding pretty quick personnel.

MATT CROUGHAN: Didn't you get funding of a penny for every 100-pound bag out of Louisiana or something like that?

CROUGHAN: That went to the station as a whole, so it would depend on . . .

SUE CROUGHAN: They called it checkoff funds. I see.

CROUGHAN: I would submit proposals and get funding for part of it, but not all of it.

MATT CROUGHAN: From that?

CROUGHAN: Yeah.

MATT CROUGHAN: I see.

CARUSO: And just when you say checkoff because I was also thinking since it's early '80s Russia, I didn't know if there was like Chekhov. So I just wanted to confirm that it wasn't a Russian name . . . [laughter]

SUE CROUGHAN: They would . . . the rice farmers had agreed to—and I can't remember the exact number—but it was pennies per pound or whatever would put money into this fund. They called it the checkoff. Yeah, the rice checkoff funds, and those monies would go to support the Rice Research Station and the research because the whole thing was then you bring all this information back to the farmers and they're benefiting from it. So they had agreed to do this.

CROUGHAN: Yeah, they put together a good system [for] research.

SUE CROUGHAN: It was an additional source of funding that . . . and I think it was LSU administrators had, kind of, come up with this thing.

CROUGHAN: And rice was an important crop in the States.

MATT CROUGHAN: I guess just to add to that, I mean, agricultural research has been supported by the government for hundreds of years, right? A hundred years very consistently with these research centers and colleges. And, you know, if you look and you say, well, it used to take [well] over half of humanity to grow our food and now it takes 1 percent, that's the impact of that.

SUE CROUGHAN: USDA was big. And in fact, there were USDA personnel at the Rice Research Station that was, you know, part of the whole thing with the rice.

MATT CROUGHAN: So yeah, most crops you can—or maybe all crops—you can look at the productivity per acre or productivity per person per year—that kind of thing—and plot it. And it looks a little bit like Moore's Law for semiconductors where it keeps on improving, keeps on improving, keeps on improving. And it's like that like corn and soybeans and everything. Rice. It's pretty impressive. It's still going on. It's not as steep a curve as semiconductors. It's not doubling every year-and-a-half, but it doubles every seven or ten years or fifteen years or something. And you do that over and over again . . .

CARUSO: How many other researchers were at the Rice Research Station when you started there?

CROUGHAN: What do you think? Twenty?

SUE CROUGHAN: We had, I think, at one point at least sixteen faculty. And that was huge. And they all had their programs, and everybody had, you know, their main technician, plus all this help. So when you were talking about pictures in there, there's a great one that we took with Duke, and it's all the staff. It was, kind of, like a year thing. We took this picture of . . .

CROUGHAN: Duke was the head of the station.

SUE CROUGHAN: Yeah, everybody. And it was it was a good group of people. Everybody . . . and I think what was nice is the faculty, it was 100 percent research. So you'd go to campus every once in a while I have to give a talk or whatever. You might be on a committee, but you didn't have that day-to-day teaching classes and all that.

CARUSO: So was there . . . you had mentioned earlier getting some . . . the seed lines from the person who was doing research on disease. Was there a lot of collaboration, other collaboration that was going on at the research station? Were you collaborating with other faculty members there?

CROUGHAN: Well, my project was pretty separate from theirs. Everybody had their own projects, so it wasn't.

SUE CROUGHAN: I know some of your somaclones, he was also working a little bit with wheat. You were giving to Steve Harrison, and he was advancing some of those.

CROUGHAN: Yeah, he was a wheat breeder.

MATT CROUGHAN: Eventually **<T: 40 min>** it would, kind of, move down the line to a breeder. You were . . . he was at the research stage, and Sue was at the research stage. So once they had something that was looked really promising it would go into what maybe you'd call development in the pharmaceutical industry, but, you know, move toward commercialization. And there were staff that were professional at that, formally breeding it. Rules how to do that.

CARUSO: And did the research station have any close connections to commercial farmers at that point, or was it more indirect?

CROUGHAN: Oh yeah. There was a very close relationship.

CARUSO: And what was the relationship like? Were they involved . . . were they funders? Were they . . . ?

CROUGHAN: Yes. There [were] checkoff funds. So the checkoff went to the station.

SUE CROUGHAN: There was a yearly meeting where it was field day, and hundreds of people would come in that day. And everybody would be standing out in the hot sun because it was usually June or July at their research plots, and they would take them on trucks with hay bales and hundreds of farmers would go and get this tour. You would stand there and give the same speech over and over to these different truckloads that would come through, and then

they'd have a big meal, and the chancellor would be there and give a talk and stuff. So the farmers were definitely pro the rice station and always, "What's new? What's coming out?"

CROUGHAN: There was a close relationship with the farmers.

MATT CROUGHAN: There was a category of personnel that were like farmer outreach, like . . .

CROUGHAN: Extension.

MATT CROUGHAN: Extension people that were always working with them, in touch with them. Yeah.

SUE CROUGHAN: And farmers were always coming by, "I got this going on. What do you guys think?" Or whatever, you know. And we were in a rural . . . . I mean, there's literally a farmer right next to the rice station, growing rice, you know. So it was in the heart of all of that.

CROUGHAN: Yeah, the rice region.

CARUSO: And with all the research that you're doing and the work that you're doing, is there also a publishing component to it? Were you taking the data and saying, "Look, none of these seeds worked"?

CROUGHAN: Yeah, we had to write annual reports which were published.

SUE CROUGHAN: They did not encourage you to do scientific publications. They said, "Don't worry about that. We got all this money. You don't need to write grants. You don't need to publish. You know, just do your work, do your work, do your work." And that went on until the oil industry changed. And all of a sudden, you guys need to be writing some grants and you need to be publishing because in order to get funding from a grant, you have to show some record and have to be publishing. So, you know, all of a sudden, it's like, you know, brakes, you know, you got to kind of change what you're doing because what he was doing soaking seeds in herbicides is not something that you would publish in a scientific journal. Now there was popular press things and Louisiana Ag, you know, articles and stuff like that, but not scientific crop science type papers going out.

CARUSO: But there were journals focused on . . . ?

SUE CROUGHAN: Yeah, and there was some publication, but not a lot. There [were] annual meetings. The Rice Technical Working Group had meetings. There was, you know, other meetings, and your anther culture stuff you did publish. In fact, you did, I think, a chapter in a book in that, but it wasn't required. It was . . . you did it, but it wasn't as strict as some.

CROUGHAN: There wasn't a lot of pressure to do it.

CARUSO: So the individuals that were working at the research station, were they thinking of this kind of like a lifetime appointment or hoping for it to be? I know you . . .

CROUGHAN: Pretty much.

CARUSO: Okay. So it was, "I'm going to settle here. This is what I'm going to do for the rest of my life." And so maybe that's why there wasn't too much of a concern for publishing.

CROUGHAN: Yeah.

CARUSO: All right. In your scientific field, it seems like this might have been a considered a dream job, but for other individuals that were working in this form of science, were there . . . so I'm thinking of growth in scientific communities, recognition, things like that. Were you aware of . . . even though you weren't publishing yourself, were you aware of what other people were doing? Were you still engaged with the journals? I think yesterday there was . . . we talked a little bit about you would read an article and **<T: 45 min>** you'd present on it and you'd be like, "All right, you know, this person actually didn't do a good control or things like that." Were you still engaged with the literature that others were publishing? And did you discuss that literature with others at the research station or in your lab or . . . ?

CROUGHAN: Or with her.

SUE CROUGHAN: That was one thing that, you know, since we both had the same kind of training and interest even though we were working on different crops, we try to keep up on the literature, and we'd see some article, "Oh, what about this? What about that?"

CROUGHAN: And so if she saw something she'd tell me. And same with me.

CARUSO: The approach that you decided to take in terms of looking for something that would survive this herbicide spraying, were you aware of any other researchers who had done similar things for different types of plants? Was this a process that was used previously maybe to make sure that soybeans or corn or something else could survive these herbicidal sprayings, or is this kind of a unique thing that you decided to instantiate?

SUE CROUGHAN: There were some other crops. In fact, when I was digging through your box, I came across some journal articles that you had pulled out and marked up. I think one was tobacco and one was . . . . I can't remember what the other crop was, but you had been looking at what other people were doing.

MATT CROUGHAN: And they were mutation and selection approaches.

SUE CROUGHAN: So early on, Tim was not doing any kind of mutation work, more just screening of somaclones, world collection or trying to cause . . . another thing you were doing was putting herbicide in cell cultures, trying to . . . so when you go to regenerate the plants, perhaps those would be resistant. Soaking the seeds and stuff like that. And then I can't remember exactly what year, but at one point then and maybe we'd gone back to Davis and you talked to [J. Neil] Rutger. He was a rice breeder at [U.C.] Davis. He eventually went to Arkansas, I think, had done some . . .

CROUGHAN: He was a geneticist.

SUE CROUGHAN: A geneticist, that's right. You started doing x-ray radiation mutation was one of the first things you started trying.

MATT CROUGHAN: So he recommended that you intentionally speed up the mutation rate?

SUE CROUGHAN: He had done some work with it, yeah. And came up with a short stature rice. And so then that's when Tim started working with radiation and then went to the EMS [ethyl methanesulfonate] chemical.

MATT CROUGHAN: And what year was that?

SUE CROUGHAN: In my notes that I didn't bring today.

CARUSO: Rough time period. I mean, was this still in the '80s? Was it pushing into the '90s?

SUE CROUGHAN: No, it was late '80s.

CARUSO: Late '80s. Okay, so in those first few years you were just focused on this specific process: screening, developing, planting, seeing what worked.

CROUGHAN: Right.

SUE CROUGHAN: And I think at that point they were like, "Tim, you've been doing this for five years. You don't have anything to show. Tim, you've been doing this for six years. You don't . . ." And it's like, but it's out there, you know. And he persisted and kept trying different approaches to coming up with this. And I think that was part of his . . .

CROUGHAN: Stubbornness.

CARUSO: And so that's where I was, sort of, moving towards in terms of your overall project, right? I think some individuals after several years like, "Okay, this hasn't worked. How long am I going to keep on doing this?" I'm wondering why you felt that this was going to be a valuable, a productive way of finding this. Because it's not making this resistant. It's finding this resistance. So do you recall why it is that you wanted to persist, why you were convinced that this was . . . ?

CROUGHAN: Bottom line was I enjoyed doing it. I remember at one point, at the end of the season, I didn't find anything, which was normal, and I went, "Ah, I get to do it next year too." And I went, "What did I just say?" You know, I was surprised I had that reaction to it.

CARUSO: So I know you came out in 1984. You were . . . so I don't remember when you two got engaged. It was while you were still . . .

SUE CROUGHAN: We got engaged in February of ’84, married in July of ’84. And I started August 1 **<T: 50 min>** in ’84.

CARUSO: Okay. So whirlwind. Did you take a honeymoon? Did you . . . ?

SUE CROUGHAN: We did. Pebble Beach, [California].

CARUSO: Okay, great. So there was at least a little time off.

SUE CROUGHAN: Three days.

CARUSO: So you come out to Louisiana in ’84. You have a position at LSU as well, right? And you were focusing on soybeans.

SUE CROUGHAN: And forage crops.

CARUSO: And forage crops.

SUE CROUGHAN: Mainly forage crops initially. Forages was a big thing in Louisiana. You could pretty much grow grass year-round to feed cows. So it was almost every research station had two forage people and an animal scientist [. . .] all over the state doing that stuff.

CROUGHAN: Cattle was an important thing in the state.

SUE CROUGHAN: So they had started Tim’s program, and they said, “Oh, we want to expand the biotech stuff. Let’s bring in a forage person.” Tim says, “Oh, I know somebody.”

CARUSO: So I don’t immediately understand the relationship between forage and biotech. How . . . they wanted to expand biotech, so they wanted to bring in a forage person.

SUE CROUGHAN: They wanted to expand the biotech presence in the field and bring in some other crops. And because forages were important to Louisiana, they said, “Let’s bring somebody in working, you know, in the field of biotech but working on forage crops.”

CARUSO: And so when you started LSU, was your experience similar to Tim's in terms of the size of the lab?

SUE CROUGHAN: So they . . . to have a married couple in one department was a big thing. And they really hemmed and hawed whether they were going to hire me and whether I was going to be located at the Rice Research Station versus on campus or somewhere else. And Duke sat us down and he said, "If I agree to this, you know, you guys have to, you know, keep home at home and work at work. And neither one of you can advance in the ranks and be over the other one. Like somebody couldn't become a department head." And we're like, "That's fine. We don't want to be an administrator and stuff like that." And they said, "Well, can you share the facilities?" And we're like, "Yeah, sure, we can do that."

CROUGHAN: Gladly.

CARUSO: And so where is your lab relative to . . . ?

SUE CROUGHAN: So I used the same lab.

CARUSO: Same lab. Okay. Same general space.

SUE CROUGHAN: Right. Now they separated . . . my office was over here and his office [was down the hall] in the office [. . .] building.

CROUGHAN: We were at opposite ends of the office building. But we shared a lab.

CARUSO: Shared lab, opposite ends of the office building. And so when you came in, in terms of the technologies, the devices, the setup for Tim's lab, did that mesh well with what you needed in terms of the work that you were going to do?

SUE CROUGHAN: Right. The only thing was, you know, he was fully utilizing. So now all of a sudden, here I'm coming in and I need just as much stuff. So they built some more greenhouses for us. They put in some more incubators. They, kind of, expanded the lab and we might even gotten another [transfer] hood at the time, you know. So they did . . .

CROUGHAN: Which was beneficial for both of us.

SUE CROUGHAN: Right. And our groups were real good about, "Okay, I need all this space today, or I need all this space." And we worked through it, or they would have a big push in the field to do something. We'd go help them or vice versa. So it really was a good working group.

CROUGHAN: Good teamwork.

CARUSO: And in terms of staff that you started with, did you bring in . . . or did they hire technicians for you or . . . ?

SUE CROUGHAN: Yeah, I had two technicians and then a lot of student workers and then over the years had a visiting professor, had some graduate students.

CARUSO: And when you say student workers, undergraduates? Graduate students?

SUE CROUGHAN: So the student workers were local kids from high school. They had to be at least sixteen. And every summer it was a big thing to be a student worker at the rice station. And they would work all summer long. And when they would come in, it was like, "Okay, who did you get assigned to?" Because the worst ones were the people that had to go out and work in the field every day and rogue the fields. And a lot of them, you know, wanted to come be in our labs because it was [. . .] air condition[ed]. You did have some field work, but a lot of it was inside and stuff. And then because our work was year-round, we were able to convince the administrators to expand that program. So it wasn't just for the summer, but **<T: 55 min>** we could have student workers year-round. So these would be high school kids or kids going to college, you know, locally, and they would come and work, you know, half-time in the lab. And so that was big, because a lot of what we were doing was just routine, you know, transferring cells and that kind of thing.

CARUSO: So were these student workers . . .

SUE CROUGHAN: They had no knowledge of science.

CARUSO: That was a question that I was about to ask. So they had no knowledge of science?

SUE CROUGHAN: Yeah.

CARUSO: Were you educating them in the science at the same time?

CROUGHAN: Yeah.

CARUSO: What were you trying to convey to them about the work? Like the fundamentals of the work, the broad aspects of it?

SUE CROUGHAN: Yeah. And I think it was interesting because some of them, they could have been flipping hamburgers. It didn't matter. You know, you would teach them a skill, and they could just sit there and do it all day long. But some of them had to be very specific because you said, you know, sometimes it was the look of the callous, okay, if it looks like this, put it on this media. But if it looks like this, put it [on a different medium].

CROUGHAN: It's got little green dots, you know.

SUE CROUGHAN: And it's like, well, how many green dots, you know? Well, is it two, three? And it's like so you had to . . . some of them were real good at getting a feel for what you [wanted]. Others, you had to be very specific. And they did exactly what you said, you know, but they didn't really understand it. And then some of them would get inspired and like, "Oh man, this is like so cool." And they would want to then go on into college and study some things. So every once in a while you'd get that one that would spark and stuff.

CROUGHAN: Get fired up.

SUE CROUGHAN: And then one of the things a lot of the local schools, there was one Carla [Lambousy], she would always every year bring her—was it first graders?—and every year they would come and tour the lab and that was a big thing. We'd set up all this stuff and show them, and they were just fascinated by the science and you would get some dry ice and show them things and we'd put things on a stir plate. And, you know, the kids were just, "Whoa, here's science and stuff." But she was real excellent teacher. And so she would . . .

CROUGHAN: Yeah, she's special.

CARUSO: And how did you find the transition to Louisiana life?

SUE CROUGHAN: It was a culture shock for sure. After growing up in California and then going in to a local grocery store and it's, you know, here's some iceberg lettuce and that's about it in the produce department. It since has changed. But in the early '80s, people were still speaking French in our community. And it was hard to understand people. So there was definitely a transition, and people didn't know . . . there were not a lot of professional women, you know, there were some women doctors, but, you know, nobody knew what a PhD was. And you'd meet somebody and they'd say, "Oh, where'd you go to school?" And I'd say, "UC Davis." And they'd look at me funny. And they said, "No, what high school did you go to?" It's like, "Oh, in San Diego." And they're like, "Oh, you're not from around here.".

CROUGHAN: Yeah, that was the standard saying, "You're not from around here."

CARUSO: More broadly, what was the faculty makeup there in terms of gender? Were you the only . . . ?

SUE CROUGHAN: Oh no. There was a geneticist that came in, but she was not well-liked. Elaine Nowick. And she clashed with the other she was a rice geneticist, and she clashed with a lot of the other rice people. And so she didn't . . .

CROUGHAN: She wasn't a very cooperative person.

SUE CROUGHAN: She didn't last very long. So now on campus, there were some women, not many in the Ag, so a lot of times I'd go to campus and there'd be people there that I could interact with. But in the forages, a lot of meetings I'd go to, I'd be the only woman.

CARUSO: What about at the technician level? Was it predominantly men? Was it women?

SUE CROUGHAN: No. In the lab, it was mostly women.

CROUGHAN: In our lab, it was mostly women.

SUE CROUGHAN: But then we'd have guys to do a lot of the field stuff.

CROUGHAN: But the rest of it was men.

CARUSO: So did you encounter any difficulties?

SUE CROUGHAN: Yeah. I mean, that's part of being a woman in agriculture. You just kind of went along with it, but I'd always been kind of one of the guys hanging out, you know? I wasn't a real girly girl.

CARUSO: Yeah, I mean, you were buddies for seven years.

SUE CROUGHAN: Right. So I guess I was just kind of used to it. I grew up with two brothers.

CARUSO: And so when you came to LSU, you're now both in the same physical lab. You have your research **<T: 60 min>** focus. You have your research focus. Was there any initial actual or plans to do some sort of collaboration since you were sharing the same physical space?

SUE CROUGHAN: Not really collaborating.

CROUGHAN: We never had a formal collaboration.

SUE CROUGHAN: We just would always help each other. I mean, a classic thing was, you know, you'd be doing some calculation and can you double check me? Because he would go through a math process different than my math process. And if we came up with the same number, then we knew we were doing it right. The only thing we did collaborative . . . well, we did little projects collaborative that we have our names on. There was something with protoplasts and stuff, but there was a big grant. We wanted to expand the facility, so this was like when now genetic engineering is happening. People are like getting genes and stuff and we're thinking, "Whoa, maybe this is our next step." So we wrote a grant, and we got a big chunk of money to physically add on to the lab. They busted through one of the walls and attached another lab. And we outfitted with all this just high tech, you know, whatever the latest was back then.

MATT CROUGHAN: Microbiology equipment.

SUE CROUGHAN: And as this process is happening, that's when all the stuff about consumer acceptance started popping up. And by the time the facility was done and ready for us to use, we're starting to put the skids on it. Maybe we don't want to be doing that. I mean, back then initially they would do things like they'd attach an antibiotic to a gene because that's the only way they could trace it. And antibiotics in your plants, you don't want that.

MATT CROUGHAN: Antibiotic resistance so GMO plants were starting to get a lot of attention by industry, but some resistance by consumers.

CROUGHAN: Exactly.

CARUSO: So roughly what time frame are you talking about here?

SUE CROUGHAN: The late '80s, early '90s, maybe.

CARUSO: Because I think you had mentioned that it was the late '80s probably where you were seeing . . . because you had to apply for grants, this is when you needed to start publishing to demonstrate things. So I was wondering if it coincided with . . .

SUE CROUGHAN: Yes, kind of all of that was happening. Right.

CARUSO: So late '80s, early '90s is when you're applying for grants, you're starting to publish because you need the recognition, and you look to expand to think about genetically modifying things. And then people don't want genetically modified things or at least people, I should say people in the US. Some people in the US.

MATT CROUGHAN: A lot of people in Europe.

SUE CROUGHAN: Yeah.

CARUSO: A lot of people in Europe.

MATT CROUGHAN: Right.

CARUSO: How did you become aware of this reaction towards genetically modified organisms?

SUE CROUGHAN: Tomatoes. Do you remember the tomato story?

CROUGHAN: Go ahead.

SUE CROUGHAN: Oh, so they—what was the place in Davis?—they came up with this modified tomato.

MATT CROUGHAN: Flavr Savr tomato.

SUE CROUGHAN: You know, because it was, you know, they put all this work into it because . . . . I can't remember the specifics, but it was meatier or whatever, make better tomato sauce or whatever. And then all of a sudden, they did all this work. The company bought it and then just buried it because [of] consumer acceptance. And then there was something to do with . . . so they had genetically engineered corn for Roundup resistance, I believe. And some of that corn got into taco shells, and they were coming up with GMO-contaminated taco shells. And it was a big recall on taco shells one year I remember.

CROUGHAN: Yeah, big red light.

SUE CROUGHAN: And so it was like, "Okay, wait. We don't want to do this kind of thing." Now we could use the lab for other things. But it was like, we're not going to start plunking genes into stuff. And that's when your stuff really started expanding with the radiation and the chemical approach to things.

CARUSO: And so when you were thinking of moving in this direction in terms of genetically modifying things, did you have . . . because you'd mentioned there was some of that stuff starting when you were in graduate school, did you actually have experience with the techniques that you would need to use in order to do this genetic modification?

CROUGHAN: Not really, no.

CARUSO: So the plan was maybe to hire individuals to handle that type of work?

CROUGHAN: A postdoc.

CARUSO: Okay. You also mentioned that this is roughly the same period of time where you started to expand **<T: 65 min>** the type of research or do different things to try to create a resistant version of rice. What were the things that you were looking to do to modify the organism without genetically modifying the organism?

SUE CROUGHAN: So that was the chemical mutation.

CROUGHAN: Chemical mutation, soaking them in EMS, which causes mutations.

MATT CROUGHAN: What does EMS stand for again?

CROUGHAN: Ethyl Methanesulfonate.

CARUSO: So you're looking to force mutations that are random, or were you trying to control the types of mutations?

CROUGHAN: They were random. There was no way to control it really.

MATT CROUGHAN: Speeding up the rate.

CARUSO: Just speeding up the rate of the actual mutations.

MATT CROUGHAN: Yeah.

CARUSO: Okay. And why is it that you wanted to try that approach? I mean, you had been doing things one way for . . . . I'm going to say seven years. I'm randomly choosing a number.

You'd been doing things in one way for seven years. Why did you want to switch up your methodology for . . . ?

CROUGHAN: I guess, to just explore the potential of new approaches.

CARUSO: Did you have any concerns that this increased rate of mutation could be seen as similar to genetic modification? I know you're not inserting genes from . . . you're not taking a fly gene and putting it into rice. But you're forcing the rice to change more rapidly than it naturally would.

CROUGHAN: There was a pretty clean distinction between the EMS type work and foreign insertion.

SUE CROUGHAN: Just what you said insertion of something foreign versus modifying the [existing DNA]. You weren't moving any antibiotic resistance or anything.

CARUSO: I was just curious. So I'm asking the question because I'm wondering if, like the general population who were rejecting GMOs, would they have would they have thought similarly? Like would they have said, "Well, that's GMO. That's not GMO"? Or was it more about you're trying to rapidly change something in ways that nature didn't intend? So I was just curious if it was like . . .

CROUGHAN: It turned out that there wasn't that concern.

SUE CROUGHAN: I mean, I think once you explained it to people. In fact, I thought I might have sent you that article. There's an article in Louisiana Ag where—and this is after you found your rice—that Tim actually explains that concept. Yeah, I'll send that to you.[2]

CARUSO: Yeah, I've read that. So some of the questions I ask I know the answers to, but I'd like to get them on the recording and to hear if there are further explanations or rationales or things like that.

MATT CROUGHAN: I think it's considered an accelerated natural process, right? I mean, nothing was happening that wouldn't happen naturally. It's just the pace was faster.

[2] Timothy P. Croughan, "Clearfield Rice: It's not a GMO," *Louisiana Agriculture* 46(4) (2003): 24-6.

CARUSO: Though you did also mention using radiation as well?

SUE CROUGHAN: You tried that.

CROUGHAN: Tried it, but we didn't really get too involved in that.

SUE CROUGHAN: I think that's how Neil [Rutger] had come up with his short stature was radiation. And so that's why you started.

CROUGHAN: So there's precedence for it.

CARUSO: So you experimented with it for a little while, but then didn't continue. Is there a reason you decided not to continue with that method?

CROUGHAN: There wasn't any particular . . .

SUE CROUGHAN: You read about EMS, and I think you just decided that was something to do. To do the radiation, he had to go to campus, and he could only take so many pounds of seed at a time. With the EMS, he could ramp that up.

CROUGHAN: I had more control of the quantities and stuff.

CARUSO: Because your facility wasn't built to handle the radiation, right?

SUE CROUGHAN: Right, we didn't have a whatever.

CROUGHAN: We didn't have that facility.

SUE CROUGHAN: The machine.

CARUSO: The machine to do that. Okay. So this is the late 1980s. You're shifting your methodology somewhat to hopefully affect a more rapid change in the genetic sequence naturally using modification. Were you able to expand—let me phrase this question differently—as time progressed, as you were working, did the plots of land that you had access to in order to plant these seeds did those increase or were you still limited to the I think you said it was twenty acres? I'm trying to remember the number from earlier.

CROUGHAN: Twenty acres is a lot, though.

CARUSO: Yeah, but if you wanted to . . . . I didn't know if you had access to more space to try different mutations.

CROUGHAN: I could go in and request more land. And they were cooperative with it. We were **<T: 70 min>** pretty much blowing and going. So they would put some more than what we requested.

CARUSO: Okay. And when you were using these mutated varieties, did you see any that had promise for herbicide resistance in those early years.

CROUGHAN: Well, some of them would appear to have been herbicide resistant, but weren't when you retested them. You found out they weren't genetically anyway.

MATT CROUGHAN: So that's called a false positive.

SUE CROUGHAN: That's where he'd go dig up the plant, bring it into the greenhouse, grow it up, collect the seeds, test that next generation.

CROUGHAN: And it turns out it was just normal rice.

CARUSO: Part of the reason I was asking that is I'm curious to know whether or not you were thinking of trying to . . . if let's say you had some things that seemed to be working or maybe they were false positives, but maybe well, they lasted a little longer than some of the other ones that died immediately. I was curious to know whether or not you had any intention of or if you tried to see what mutations you actually caused in order to see if there's a way to maybe breed for that specifically?

CROUGHAN: Yeah, we weren't really set up for pursuing that kind of work.

CARUSO: Okay. So it was just going to be if it was a random mutation, if it survived, you tried to have it reproduce, right? And so that's how you'd be . . .

CROUGHAN: Testing the offspring.

CARUSO: Test the offspring. Would you ever then try mutating that offspring to see if a further mutation?

CROUGHAN: Well, you generally didn't want to get any additional mutations because it was usually deleterious, so if you got the mutation you wanted, you wanted to just grab that and run.

CARUSO: While you were working on this project, were there any other projects that you wanted to . . . or that you were undertaking while at the facility?

CROUGHAN: High protein.

SUE CROUGHAN: And the marsh.

CROUGHAN: Those were my projects. There were some plants that they could potentially use to control coastal erosion. So I got involved with the guy who wanted to get involved in that business business-wise. So it was all legit. It wasn't behind the scenes or anything like that. So did a little work on that.

CARUSO: So is this someone also at the research station or was this . . . ?

CROUGHAN: No, that was just a businessman in New Orleans, [Louisiana]. He actually found me because I got . . . there was an article in the newspaper about the work. And he got ahold of the newspaper and I all of a sudden I get this phone call and this guy wants to talk to me because he wants to work on doing, protecting erosion areas that were eroding along the coastline. And he thought using some of these coastal plants would be—he had a nursery—and he wanted to get into coastal plants for his nursery operation.

CARUSO: So what was it that was in the newspaper that piqued his interest?

CROUGHAN: What was that? There was an article I guess about just using plants for coastal erosion control.

SUE CROUGHAN: Yeah, but I think you were doing something at the time. And I don't remember specifically what it was that [piqued] his interest.

CROUGHAN: Yeah, it did. You're right.

SUE CROUGHAN: Biotech. And I think part of it was the practice was to go to some area of the marsh, dig up plants, and then take them to another part of the marsh and plant them, you know, and very labor intensive. And it had to do with encapsulating the seed if you could.

CROUGHAN: Oh, that's . . . artificial seeds.

SUE CROUGHAN: Right. So I think what he maybe he saw the thing about regenerating the plants.

CROUGHAN: Right.

SUE CROUGHAN: And I think that's maybe what [piqued] him in terms of if you could take, say, spartina and have all these little plants that you're developing in the lab regenerating or whatever, and then you encapsulate them in a gel, and then you fly them out on the marsh and then they grow. So a way of seeding the marsh.[3]

CROUGHAN: Right.

CARUSO: So was that something that you had been interested before this businessman approached you? Were you playing around **<T: 75 min>** in the marshes?

[3] Timothy P. Croughan and M.D. Materne, "Applications of Biotechnology to Coastal Erosion Control," *Louisiana Agriculture* 37(3) (1994): 25-6.

CROUGHAN: I was, but that's . . .

SUE CROUGHAN: Not really.

CROUGHAN: Not to the biggest extent.

MATT CROUGHAN: You liked to fish. You would crab down there.

CROUGHAN: Yeah. Not crab, but fish.

MATT CROUGHAN: Sometimes catch crabs.

CARUSO: Okay. But you yourself weren't focused on or weren't concerned about erosion issues or . . . ?

CROUGHAN: I was after I met this guy.

CARUSO: After you met the guy?

CROUGHAN: Yeah, exactly.

CARUSO: And so after you met and he proposed or he presented his idea to you, what was it about that that made you want to pursue a relationship, a working relationship with the individual?

CROUGHAN: Because it was a real problem for Louisiana. Coastal erosion was serious.

CARUSO: And so how was he and how were you proposing to fund this work? Was it going to be something that happened through a grant through the university?

CROUGHAN: He had greenhouses so he was willing to and employees. Not very many of them. A handful, but he had employees.

SUE CROUGHAN: But he also had connections.

CROUGHAN: Yeah. He was also, kind of, politically connected.

CARUSO: Okay. But this was still going to be privately funded work?

SUE CROUGHAN: No.

CROUGHAN: Well, no.

SUE CROUGHAN: You went to DC.

CROUGHAN: I went to DC.

SUE CROUGHAN: So he had been a—I don't know what his exact title was—but maybe like a chief of staff or something, but not really chief of staff for a senator from Louisiana. So he knew people in DC pretty intensely. So you went up to the—who was in charge of appropriations for the House?—I want to say somebody like . . . can't remember his last name, Johnson or something like that. Anyway, he was from Louisiana and went . . .

CROUGHAN: I haven't thought about this in a long time.

SUE CROUGHAN: Yeah. And it was . . . so Tim actually took vacation time, and we paid for it ourselves for him to go up to DC because didn't want it to be convoluted and stuff and had this conversation, and they agreed, "Yeah we need to appropriate," and it was several million dollars. Yeah. And then when Tim came back to LSU and said, "Look, we found a source of money." And LSU went, "Whoa, wait. Wait. Whoa! Stop, stop. That's not how we do things." But it all worked out. The money came, and that's when they really started working on that approach to . . .

CROUGHAN: That was a pretty separate project.

CARUSO: But the money ultimately came through LSU?

SUE CROUGHAN: I mean, the federal government provided funding and . . .

CARUSO: So it was a grant to the institution and you were the principal investigator for that grant. Did that mean . . . so did that grant allow you to . . . were you setting up a new research space in order to do this work?

CROUGHAN: No, just do it in the same facility and using some of the same techniques.

CARUSO: And what about staff? Were you increasing the staff to work on that?

SUE CROUGHAN: I want to say he did bring in somebody.

CROUGHAN: Maybe one or two people. It wasn't a great expansion of any sort.

CARUSO: And so can you explain to me what the overall problem was? I mean, I understand the term "coastal erosion." What was causing it? What were your initial ideas about how to address that?

CROUGHAN: Well, it was a plant that could hold the soil. So that was the bottom line. So just needed a way to propagate it and I think the thought at the time was using tissue culture to propagate the plant.

SUE CROUGHAN: Because it didn't produce a lot of viable seed. So if you could again regenerate plants in the lab and then encapsulate them and you guys had played around with that and actually made some and I want to say you took them to DC and so these little regenerated plants encapsulate them. And then, you know, this process worked. But then you also looked for naturally occurring plants that held on to more viable seed and tried to then propagate those and use those as the source.

CROUGHAN: Financial sources.

CARUSO: How would you go about finding these natural . . . [crosstalk] So going out in the field and planting. You were out in a boat and you were just like digging in the marshes.

CROUGHAN: Yes, exactly.

CROUGHAN: Pulling out plants. And how would you go about testing them?

CROUGHAN: Bring them back to the facility and test them.

CARUSO: Just test and try to grow them. See what they would produce.

CROUGHAN: Try to collect seed off of them and see if you could plant those and get them to **<T: 80 min>** sprout.

CARUSO: Why wasn't it . . . so if soil erosion was a concern and having more plants be planted would solve the problem, why weren't people just . . . why wasn't the state investing in having people go out into fields and just plant more plants?

CROUGHAN: I don't know. They just didn't have the foresight, I guess. Wouldn't you say? And I guess the cost, yeah.

MATT CROUGHAN: It probably didn't have the plants available, but who would have provided this? Partly if these guys could figure out how to do this, but to have all these plants.

SUE CROUGHAN: But if you calculate . . . if you do the calculations on how many people to physically go plant an acre, you could fly it on with a plane acres for pennies.

CROUGHAN: In minutes with an airplane.

CARUSO: And so the hope was you would just find a plant that was extremely productive in terms of producing seeds so that way it would be a . . . and so you find that plant, you find the seeds and then you reproduce or you have the plant reproduce so that way you have a lot of seeds to just like toss on an area?

CROUGHAN: Right, right.

CARUSO: Sort of like crop dusting, but with . . .

CROUGHAN: Right, exactly.

MATT CROUGHAN: And with . . . you would also, sort of, crop dust with encapsulated plants. It wasn't the idea . . . not just seeds, but the whole plants would come down and maybe somehow . . .

CARUSO: Some would take.

MATT CROUGHAN: Some would take.

CARUSO: So yeah, yeah. A numbers game essentially. If you throw in a thousand and a hundred take.

CROUGHAN: Then you've got a hundred plants now.

CARUSO: And so the research, how long did it take you overall to find a plant that would work, a plant that you could develop more? Was this a relatively fast turnaround?

SUE CROUGHAN: So I think they found something pretty quick. The process was, kind of, evolved, but at the same time your herbicide stuff was ramping up, and LSU had this federal money coming in and they put other projects, other faculty pulled a lot of it away from Tim and gave it to other researchers. And so LSU started expanding what they were doing on coastal erosion through this process because they hadn't been doing a lot. And so Steve Harrison and some other people took that project over. And you were involved with it a little bit.

CROUGHAN: They were located on campus.

SUE CROUGHAN: But they pretty much took that over. But at that time, you were finding your first plants and things were expanding on that.

CARUSO: And what's the general time frame for this? Is this the early '90s?

SUE CROUGHAN: Yeah.

CARUSO: Early '90s. And so can you tell me a little bit more since you mentioned that things were ramping up. What was going on in your red rice herbicide research at the time that you could classify it as it was ramping up? Were the mutations working?

SUE CROUGHAN: I mean, you were going through hundreds of pounds of seed and putting them out and spraying and stuff, and then you were starting to find that plant. And it's like that day because he would go out early in the morning again before it got too hot and walk the fields and look for that plant. And I remember I was at home, hadn't even gone to work yet. And you came back, and it was like, "There's a plant. There's a plant." And it's like, "Shh. I don't want anybody to go over there and step on it or dig it up or whatever."

MATT CROUGHAN: That's the photo. You have the photo of that plant, right?

CROUGHAN: Yeah.

MATT CROUGHAN: What year was that?

SUE CROUGHAN: I want to say it was '94. It was '92, '93, '94 because our kids were babies. And it was all this was happening and '94 was when I think you came up with the first one and then you ramped it up and came up with the second one that was better because it was in '98 that the license agreement was signed. So it was in that time frame and on these field days Tim would talk about this, and more and more chemical companies would . . . they would come to these field days, too, and they were getting interested in it. And that's when it was American Cyanamid at the time, they would have some—what's the right word?—new herbicides coming out that weren't being used yet. What's the right word? I'm thinking experimental-type things. And they were suggesting to him, you know, "Let's try **<T: 85 min>** this herbicide or this herbicide" because they all had different modes of action. And you pretty much settled on one in particular. And its mode of action was similar to all these other types of herbicides that American Cyanamid produced.

CROUGHAN: I'm going to have to take a quick break.

CARUSO: So your research was ramping up at this point in time. I also wanted to ask a little bit about . . . . I know you have three children. I was guessing their rough ages when I was coming up with my interview protocol. It's the . . . . I was assuming late 1980s, early 1990s is when you start a family. And I'm curious to know how you managed having a family with your scientific work. I know for me I have three children. I still don't sleep that much. But it was . . . . I mean, it's a challenge, right? And so I'm wondering how becoming a parent if it changed the way that you were doing work in any way in those early years. And then as the kids get older, I'm also curious to know and we can talk about it later whether or not you incorporated them into the research that you were doing. I don't know if they were out in the field spraying the herbicide. I mean, it's the '90s. Who needs hazmat suits even then? So I'm just curious, you know, to start with what was it like starting a family and managing that with the work, the scientific work that you were doing?

CROUGHAN: Yeah. How do you answer that?

SUE CROUGHAN: So it was difficult having children. And so we did infertility. And so there was a place in New Orleans. So I would get up at, you know, three or four in the morning, drive to New Orleans, do whatever testing, and get back so that I could be at work at eight or something. So it just fitted in. The rice station was very eight-to-five attitude. They wanted you physically there. It was different than on the campus where as long as you got your work done, it didn't matter what hours you were there. So tried to kind of work around that schedule. And then we were fortunate that we were able to have kids, Pete in '89 and Carolyn in '91, and we lived on the research station. They provided housing for faculty there. That was part of your compensation for the low salaries. It was about a 1,200 square foot house and had one little bathroom, but it had three bedrooms. And you had a one-minute commute to work because it was, you know, you were literally on the property. So you were right there all the time. So we just . . . and one thing about being in a little town like that is you can find somebody local to come to your house and take care of the kids. So we were fortunate that we found somebody that she would come in the morning and we could go off to work. And then.

CROUGHAN: What was her name again?

SUE CROUGHAN: Karen.

CROUGHAN: Karen, yeah. Miss Karen.

SUE CROUGHAN: Miss Karen, yes.

MATT CROUGHAN: And there was . . . Bill came along in ’93.

SUE CROUGHAN: In ’93, yes.

CARUSO: And what was the LSU’s policy on maternity and paternity leave?

SUE CROUGHAN: There wasn’t any. So I had saved up as much vacation time as I could so that when I had Pete, I took, I think, two months off or something like that. But then Carolyn came along pretty quick, so I didn’t have as much time, but I think I probably took a month off. By the time Bill came along, I had no vacation time, so I literally went back to work after a week, but I was able to zip home and feed him and then go back to work and stuff like that because we were physically [there].

CROUGHAN: We were only five minutes from work.

CARUSO: And Tim, did you modify your schedule at all after the kids were born?

CROUGHAN: I don’t recall doing that, no.

MATT CROUGHAN: That’s a Croughan male tradition [. . .].

CARUSO: Now given the research that you were working on—I don’t know all the other research that was happening at the research station—did you have any concerns about raising a family in close proximity to where, you know, lots of chemicals are being sprayed or genetic mutations are now taking place? There’s **<T: 90 min>** . . . . I know the radiation facility was on campus, so maybe it wasn’t real close. But did you have any concerns about raising a family physically in such close proximity to . . . ?

SUE CROUGHAN: My biggest thing was that we didn’t drink . . . we had well water from the station, so I would buy purified water because I didn’t want the kids drinking the well water. That was probably about the only really thing.

CROUGHAN: That's the only precaution we really did.

SUE CROUGHAN: We opened the door and let the kids run and play in the mud outside and it was . . .

MATT CROUGHAN: In your . . . you would use protective gear when you used the EMS, wouldn't you?

SUE CROUGHAN: Oh, definitely.

MATT CROUGHAN: That being a hood and a mask and gloves because that would be another mutagen.

SUE CROUGHAN: And you always did that. You didn't let anybody else handle it because there was a whole process on dealing with the EMS.

CROUGHAN: Didn't want any of the workers to get exposed.

MATT CROUGHAN: And it was not . . . . I mean, it's still controversial over whether herbicides actually have a real issue of . . . there's thousands of studies shows that Roundup is safe and then a few that says it isn't and then ten billion dollars later, these lawsuits. But there's a lot of stuff saying it's safe.

SUE CROUGHAN: But the herbicide that Tim was working with was safe because the enzyme that it works on people, animals, insects don't have; only plants have. And that was one advantage of that particular herbicide is it could be used in very low quantities plus the enzyme was not in human systems.

CARUSO: So there was nothing for it to interact with in humans?

CROUGHAN: Ideally. That we know of.

CARUSO: Just as a quick question and then I'd like to return to the research aspects. As the kids got older yesterday, you had mentioned that at least for the youngest siblings in the family, you know, Mom brought them to the lab to help out and to do things like that. Did your kids ever come to work with you, and if so, what were they . . . ?

SUE CROUGHAN: They would come especially like if something after hours or checking on the weekends and stuff. Yeah, so they were exposed to plants. And I was also working with an entomologist at the time. And she was a character. She didn't have any kids, but she loved our kids. And she would bring them—I don't remember the names for all these—giant grasshoppers or giant beetles and, "Oh, here you need a pet!" And she'd bring in the aquarium and stuff. And then we were doing stuff with fall army worms in the lab and I was having to produce the army worms in the lab, grow them up and stuff. So you had the moths lay the eggs and all. There was a whole process. And I remember one time the kids had to do a science project and I'm like, "Oh, why don't you take these army worms? And you could do this, this, and this." And it was a little bit too much for them at the age that they were, but they ended up doing something else. But yeah, they were definitely exposed to the lab and seeing all the things and science.

CARUSO: Did they ever become some of those summer students or . . . . I know it became the year-round at some point, but no, they were never summer students in the lab or anyone else's lab?

SUE CROUGHAN: No.

CARUSO: Okay. In terms of the research that you started to have success with, were you using . . . so was this work that was just pure mutation, or was it you had been soaking some of the seeds in herbicide to see if those would become resistant? What type of seed were you having success with the mutated or the herbicide-soaked or . . .

SUE CROUGHAN: The mutant.

CROUGHAN: Mutated.

CARUSO: It was the mutated version. And so you describe the, you know, going out one morning and finding this viable plant in a field. What made this one stand out more to you? Just that it existed or that . . . was there something about where it existed in the field that made it seem like this is interesting?

CROUGHAN: What you look for is that there's death and destruction completely surrounding it because there's constantly plants that a puff of wind had happened just as equipment and spraying that spot. So I got very good at looking at it and seeing that it was totally uniform. The response was totally uniform around it. So it wasn't an escape. It was actually sprayed.

CARUSO: So **<T: 95 min>** this was probably something more in the middle than on the margins of the area planted?

CROUGHAN: Not necessarily. Usually in the middle because that's where most of the plants are.

CARUSO: Okay. All right. And so once you discovered that plant, what were the next steps that you took?

CROUGHAN: Go back to the lab, get some containers. I'd get them out of the field pretty quickly because I didn't want some unfortunate event, you know, [they went] missing. Missing. So I'd take them back and get them in a greenhouse to protect them.

CARUSO: And so once in the greenhouse, what was the process then? You just let it continue to grow? Did you . . . ?

CROUGHAN: Yeah, grow it up. So the main interest was to make sure that the progeny was resistant. So what you want to do is get seeds off of it and then test the seeds for the next thing.

SUE CROUGHAN: One thing that's nice about a rice plant is it'll send up a shoot, a seed head. You can collect that seed, but you can then cut the rice back and . . ..

CROUGHAN: It'll regrow.

SUE CROUGHAN: You can collect off this one plant a lot of seed that then he could go back to test.

CARUSO: In the greenhouse, did you expose it to herbicide there as well? Did you keep trying to kill it?

CROUGHAN: I don't think so because it's you hated to kill something that was actually did have some resistance. And then you just you sprayed it twice and that was one time too many.

CARUSO: Okay, so you collected the seeds from this plant, right? And then did those seeds go back into the field?

CROUGHAN: [I] did all that testing I think in the greenhouse.

SUE CROUGHAN: The individual seeds would be planted. And so then he could take all of those and then in the greenhouse grow those up and then you would pull them outside because you didn't want to spray in the greenhouse and then spray. And so then if they all or whichever ones were good, you would grow them up. So now you over the winter time, you would grow those plants and collect as much seeds. So come growing season in the next year, now you had a lot of seed off this original plant that you could then put out in the field and start doing more advanced testing.

CROUGHAN: Yeah, by far the majority of what you found was good. When you retested it, it turned out to be resistant.

MATT CROUGHAN: By that time versus earlier. A lot of false positives.

CROUGHAN: Right.

CARUSO: So you had this one plant that seemed potentially very good or potentially good, right? You grow it a bit more in the greenhouse. You get more seeds. Next growing season, you spread the seeds. Were they isolated to one specific field, these specific seeds, or did you distribute them among different . . . ?

CROUGHAN: Yeah, it'd be in one field.

CARUSO: In one field. Okay. So you plant them in one field, you do your normal spraying process and what happens?

CROUGHAN: You look for damage on the controls. You put in a control that's just normal rice and you compare what the response was after spraying.

CARUSO: And what was the response like with this new . . . ?

CROUGHAN: Wonderful. It didn't look like it had been sprayed.

CARUSO: Didn't look like it. So there were still the control ones that did die?

CROUGHAN: Right. Dead as could be.

CARUSO: And so was this . . . did you have a cluster that survived? I'm just trying to picture the field.

CROUGHAN: You had individual rows, so the way you planted them, you planted them so they each plant would get a full dose from the spray as opposed to, you know, a big clump or something like that where they might protect each other.

CARUSO: And so you have the success with this new planting, right? What was . . . what steps did you take after that? Did you have to go through another cycle?

CROUGHAN: See, I think I dig them up in the field because you didn't want something bad to happen. You know, it could be anything that might get killed in the field in some way and bring them in the greenhouse so they were protected from the weather and stuff.

CARUSO: So you brought this new batch into the greenhouse. You went through the process of growing them, harvesting the seeds. So did you wait for another planting cycle and growing cycle before?

CROUGHAN: Yeah, so we tested the [progeny].

CARUSO: Okay, so you did another cycle and same results?

CROUGHAN: Right.

CARUSO: They all survived; the controls died. And so this is now . . . roughly is this 1993 that you had . . . that the progeny had the success?

CROUGHAN: That sounds right.

MATT CROUGHAN: Ninety-four, ninety-five maybe.

CROUGHAN: Yeah, maybe a little later.

CARUSO: Okay. Yeah. So the patent was filed on November 28, 1994, so . . . **<T: 100 min>**

SUE CROUGHAN: Okay, So yeah, because . . . so you would have had this plant and you would have been working with the attorney to do that patenting, that patent because there's a time lag between when you submit a patent and it gets approved and stuff. So if it was approved in '94, you were . . .

CARUSO: Yeah, it was filed in '94, approved in . . . issued in '96.

SUE CROUGHAN: Okay.

MATT CROUGHAN: So you probably got the original plant in '93.

CROUGHAN: Right.

MATT CROUGHAN: And then would you grow it in the greenhouse over the winter?

CROUGHAN: Yes.

MATT CROUGHAN: And then the next cycle was that spring or summer?

CARUSO: You had success confirmed.

MATT CROUGHAN: Progeny good and now you filed a patent.

CARUSO: And now you filed a patent.

SUE CROUGHAN: But at the same time, he's also doing more EMS [with Rice] and looking. And then you found a second one.

CARUSO: So another just a random mutation that wound up being . . . ? And so there wasn't anything that you were doing in the EMS work, it was, again, just purely random.

SUE CROUGHAN: And I think if I remember correctly, they were slightly different on [where the] mutation occurred. So when they did the DNA analysis—if I remember correctly—one had a modification at one place and one was at the other place.

CROUGHAN: I think so.

MATT CROUGHAN: So they weren't . . . one wasn't derived from the other. It was independent.

SUE CROUGHAN: Right. So he had . . . and they had names and numbers, so then he had these two particular lines and you did studies looking at . . . on a range of herbicides.

CROUGHAN: Rates.

SUE CROUGHAN: And different rates. How these two compared. And then you also did a cross between the two and compared that.

MATT CROUGHAN: And it was a single mutation that provided the resistance in each case versus I believe—I could have this wrong—but Roundup resistance requires two. So the whole technique, if he had gone after Roundup, probably would not have worked because he couldn't

have simultaneously . . . it would have been like one in a million times one in a million or one in a billion times one in a billion. And that wasn't going to work.

CARUSO: Infinitesimal chance.

MATT CROUGHAN: Yeah. Yeah.

CARUSO: So once you determine that this was a viable plant, I know that you filed for the patent. Was that . . . so let me start . . . . I have too many so's in that sentence. Once you realize that this was viable, what were the steps that you took to inform the research station about your results? I'm wondering how things unfolded that relatively soon after that you are filing a patent. Was this standard practice at LSU like you report on a research result and it automatically goes to the patent office? And I'm also curious to know how people responded to the fact that you had this viable . . .

CROUGHAN: That's a good question. Do you remember?

SUE CROUGHAN: So filing patents was not common . . . . I mean, maybe in engineering or something like that, but not in plant sciences. That was pretty unusual. People would . . . there would be PVPs. What are they? Plant variety protection. Yeah, variety when you would release a new variety or something like that. But this was a different type of patent. It wasn't on a particular . . . it was on the utility.

CROUGHAN: It was a utility patent.

SUE CROUGHAN: Right. And so that was something different. But he had a good attorney that was pretty sharp; [. . .] I guess he had a chemistry background. That was part of it. And so in terms of writing out this patent, it was, you know, you'd get it to proofread it. And it's so much lawyer talk, but you realize all the little subtleties. It wasn't just you have a plant; it was spraying the plant and spraying weeds around the plant and all those little wordings that go into making that patent. And then of course the industry was very interested when they found out about it and then that started the whole kind of snowball of now what happens after that? Because this was pretty unique situation.

MATT CROUGHAN: And I'd say, correct me if I'm wrong, but this is my memory of it that, you know, Tim had some notion that money could be made here but wasn't real familiar with that whole system because it wasn't part of the LSU Ag station world. But I come out of

engineering and MIT, and there's license deals all the time. Bob Langer is a friend of mine. So [Tim] called me, a request of how does this work? You know, how do you do this stuff? What's the nature of the deals **<T: 105 min>** that go down? What are the terms? And I have a lot of friends that are business development people and, you know, familiar with faculty that do this stuff all the time. So we talked on the phone, and I called some of my friends and gave him feedback on your questions, really. And then I think you were then confident at that point. I mean, you had some notion that you could do it and then now you knew you could do it. And then held his ground to make sure it would happen. This is not just my crazy idea that we can file patents and license it and make money for the university and make money for me and my family. I mean, you know, other places, there's lots of discoveries by academics that aren't in engineering, not used to licensing things, not used to patenting things that they get nothing. You know, the university gives it away. Nobody figures out you could do some licensing deal. The corporation just makes more money. They charge exactly the same. Whatever the market will bear. It's just the university gets shorted, and the inventor gets shorted.

SUE CROUGHAN: And I think from the information that you, Matt, gave Tim, and then there was a Ken [Kenneth] Koonce. He was, kind of, the development guy over at LSU. And he was a very bright individual.

CROUGHAN: He was a bright guy.

SUE CROUGHAN: And so Tim would go and talk to him and they came up with, yes, okay, this is how we can approach the company and stuff like that. But then you had to go convince the administration of, okay, here's a way to make money for the university and patent this and propose this license to the company. And then that started all, kind of, negotiations.

MATT CROUGHAN: It was pretty amazing. I mean, pretty impressive overall because it wasn't like he was part of a system where this just was a machine cranking out like you're a professor at MIT and you do a big discovery. They just line you up with meetings with all the top venture capitalists in the world. You negotiate the best deal if there's something to be had from it. And he had to get the whole university along and get the whole system going: this is how it can all work.

SUE CROUGHAN: Again, the Croughan persistence

CROUGHAN: They were hesitant.

CARUSO: So that's what I was going to ask about because I wanted to be certain that, again, I'm familiar with MIT. And so you have entire departments that are like, "Okay, can we patent this?" And they're looking for those developments. And it sounded like it wasn't LSU or the Rice Research Station that was like, "Hey, this is a great thing. Let's try to do something with it." You were the one coming up with the suggestion: "This is a great thing. Yeah, we need to do something with it."

CROUGHAN: Yeah, that's true.

MATT CROUGHAN: I think they knew it was a great thing, but they weren't used to . . .

SUE CROUGHAN: They had no clue.

MATT CROUGHAN: The licensing deals or that the university could make money, and they were just, I think, typically going to just give it away.

CROUGHAN: Yeah.

CARUSO: And was there anything in your agreements with the university about rights of ownership over materials created since it was a grant-funded institution you were receiving money from?

CROUGHAN: Yeah.

SUE CROUGHAN: So at that time they had a little policy book you could go through. And one of their policy things was an inventor gets 40 percent, the university gets 60 percent. And that was the policy when this happened. And so that's what we were going into the negotiations with that as part of the policy. They have since changed that policy.

MATT CROUGHAN: On the royalties after expenses. Forty-sixty. Which is pretty generous.

CROUGHAN: Yeah, that's quite good.

CARUSO: So you file in 1994, you used . . . so it was an attorney that you sought out to write the . . . ?

CROUGHAN: He was the university's attorney.

CARUSO: Oh, he was the university's attorney. So he just happened to have a chemistry background. So it wasn't . . . so you were fortunate in that way. So the patent is filed in '94, right? It's issued in 1996. You also have the other variety that you . . . that wound up being a bit better. And I forget the dates for that patent specifically, but what winds up happening or does anything happen between when you file in '94 and when it is issued in '96 or do things only really start happening with companies and companies' interests after it's actually issued?

CROUGHAN: That's a good question.

SUE CROUGHAN: So when you're going to release a variety, it can't have just herbicide resistance. It also has to yield well; it has to have good quality. It has to have it can't be too tall, you know, **<T: 110 min>** so it has to go through a rigorous test. So you can't just take this plant and say, "Oh, it's great. Let's run with it." So typically what's done is you want to move that trait into a variety. And I think one of yours went directly as a variety. But then Tim had the foresight of saying, "We need to get this gene in all these Louisiana varieties, but [also in] all these other varieties in all these other countries." So he contacted breeders all over the world and said, "Send me your emerging best lines and I will move this trait into your lines and then you will end up . . ." and there's a whole process with backcrossing. And, you know, first you make the first cross and then you do a lot of backcrossing to get now basically the original variety that you started with, but now it has this trait that's been moved.

CROUGHAN: You add that trait.

SUE CROUGHAN: And [. . .] it wasn't like just call up and send me some seed. Of course there's a lot of paperwork involved because now you have something that's being patented. You have to have all these licenses and agreements and blah blah blah blah blah. So things really, kind of, ramped up around . . . and then when you're dealing with international things, you have to have all kinds of clearance for quarantine moving, you know, rice seeds back and forth and stuff. And so Tim really then focused on getting that gene into a lot of varieties. And I think that was the key to getting it out there because if you look like the typical sequence of a new variety when it's released, there's such a . . . it could be years, and a patent only lasts twenty years. So you need to get something out there right away in order to capture the benefit of that.

CARUSO: And so just to clarify, so since this was unique in terms of patenting and it's a utility patenting this specific version of rice, the . . . typically varieties like these new varieties, are they patented as well? Like when you have a new variety coming out or a more productive version, are those typically patented?

SUE CROUGHAN: So then you have a plant protection, a plant patent. Yeah, it's a different type of patent. So his gene's patented, but then these individual plant lines can also be patented. And so when their little clock starts ticking, that extends the time out.

MATT CROUGHAN: And I think—correct me if I'm wrong—well, I mean, would for sure credit the patent attorney for the university as did a great job is really he or she . . .

CROUGHAN: He.

MATT CROUGHAN: I mean, really great patent attorney, and I work a lot of expert witness cases and so any weakness in claims you know can cost you a case. And he did a really good job writing the claims, and I think my memory of a utility patent or the patent is that has more to do with spraying, right? Like if you spray this herbicide on, around, then that was what was covered. It wasn't a composition of matter patent on the plant or something. I think that was later. But anyway . . . because what is it? I remember somebody from a company that licensed it. They went through all the claims and tried to figure out could we get around them. And they came to Tim, and they said, "We couldn't figure out how to get around them. So we have to license it from you."

SUE CROUGHAN: Yes, exactly. That's a quote.

MATT CROUGHAN: Yes, exactly what you want. Thank goodness.

CARUSO: And I was asking the question because just thinking about if you're trying to mix what you have with what someone else has because what someone else might have a more productive variety. I didn't understand how that would work legally. So now is it that what you create by crossbreeding is that jointly owned by both parties?

SUE CROUGHAN: Yes.

CARUSO: So when it's when that crossbreed is used, you are a partial owner of that new one because you did the crossbreeding.

SUE CROUGHAN: And what was is that the company which started out as American Cyanamid that got bought by Bayer first and then BASF or BASF. Anyway, BASF has it now.

MATT CROUGHAN: I think BASF bought it. No Bayer.

SUE CROUGHAN: Yeah, that was another one. Licensed and then would make separate license agreements with **<T: 115 min>** these other entities for the seed, and it was tied to the herbicide. Now even though this herbicide already existed and was used in soybeans, they had to re—what's the right term?—approve it for being used on rice. So they had to go through a little bit of thing, which wasn't a big thing since it was already an existing herbicide, but they had to get it approved for using on rice and then they would have these packages that they could go to India and mostly South America and other countries and say, "Okay, here's . . . we'll negotiate this license with you." And then LSU had the thing through BASF where, you know, based on the royalties coming in, then they would get so much and then go from there.

MATT CROUGHAN: If you had a broad utility patent on spraying this herbicide around rice, it would . . . you would have coverage for all plants, right? So even if you crossbred it, you would control that, just that technique. But I remember reading the patent claims years ago. It's been twenty-five years, so I don't remember them, but they'd be interesting to go through. There's a series of patents issued with how the claims evolve. I want to do that at some point.

CARUSO: So how did the crossbreeding go? Was it a relatively easy process to get your variety?

CROUGHAN: Pretty straightforward.

CARUSO: Pretty straightforward.

CROUGHAN: Yeah.

SUE CROUGHAN: Time-consuming.

CROUGHAN: Time-consuming, but fun.

CARUSO: How long did it take to get it to work?

CROUGHAN: Oh.

SUE CROUGHAN: Well, normally they would do it based on the growing season, but Tim amped it up to where he was doing it year-round in the greenhouse, you know, because the whole thing was to . . .

CROUGHAN: Get it going.

SUE CROUGHAN: Get it going and moving it fast. And then do you want to describe your little field tours? That was a huge thing there. Do you remember?

CROUGHAN: No, go ahead.

SUE CROUGHAN: Okay. So once he had all these breeders from all these places involved and they were all excited about it and Tim would take their varieties and move that gene in and get to about a I want to say an F3 level or F4.

CROUGHAN: Third or fourth . . .

SUE CROUGHAN: Generations down. He would plant these in the field in rows, and each one was identified by what its original source of whether it came from Brazil or India or whatever, and then set it up to where the breeders would now come and over a two-day period and I think BASF funded the breeders to come in and then all his crew and my crew, every breeder was matched up with a technician, and they had a book explaining what all the different rows were. And then they could go through and say, "I want seed from this one. I want seed from this one." And the technician would be there to help them if they wanted it from a specific plant in a row or it didn't matter, and they would work together. And then that breeder then now could take his seed back and expand it and developed the variety, you know, further in his country.

CROUGHAN: In his own country.

SUE CROUGHAN: And it just rapidly got the gene out there into a lot of different countries. And it was . . . . I just remember the breeders were pretty excited about it because he did a lot of the initial work of, and it's a process because you make a cross, and you use the variety you want to move it into as the mother plant. And the herbicide-resistant is the father so that when you take the seed off and you spray that seed, you make sure that you're getting actually something that has the pollen from the herbicide-resistant in it. And then it's not just a self because rice is self-pollinating. And so you'd have to spray that and then you would pull the ones up that are herbicide-resistant and do another cross and just keep that process going. It was pretty labor-intensive to get just to that F3, F4. The breeders were like, yeah, come once a year to Crowley and we'd have lunch at our camp for them.

MATT CROUGHAN: And so you never pushed resistance beyond the first two plants you found those two separate mutations. Is that the full level of resistance you needed?

CROUGHAN: I think so, yeah.

SUE CROUGHAN: You did a pretty extensive thing with rates and different herbicides that were all within that same class and they had pretty strong resistance on a lot of . . .

CROUGHAN: Didn't need any increase.

MATT CROUGHAN: And to his earlier question, would you . . . did you spray the plants once with herbicide and that would kill the normal ones and the mutants would survive or would **<T: 120 min>** you spray it repeatedly?

CROUGHAN: Maybe repeatedly at that application time, go twice, make it half-strength, have the mixture be half-strength with herbicide, walk one way, turn around, walk back the other way. So you'd sure you got at least a half a dose right on everything.

CARUSO: So you weren't trying . . .

CROUGHAN: So you could see.

CARUSO: You weren't trying to drown them in herbicide.

CROUGHAN: Yeah.

MATT CROUGHAN: So it was . . . and you did that to try to overcome this occasional wind so you got two shots on goal and then . . . but it was ultimately just one round of spraying that either killed it or didn't kill it.

CROUGHAN: Exactly.

MATT CROUGHAN: So to your point, it wasn't like over and over and over.

CARUSO: I just didn't know if you wanted to really make sure that it was like you're going to go swimming. This is going to become a marshland, right? You're now in a pool of herbicide. Yeah, I was just curious.

CARUSO: So you have the success, you filed a patent, a patent is issued, you developed the second . . . you have the second viable mutation, you have breeders coming in starting to look at your production. At this point . . . and so this is mid- to late 1990s with this success. And you'd spent thirteen years doing this work to find that one mutation, right? Does your research or does the work that you then do from that point change? Are you—because I know that you mentioned like you stopped with the second mutant—are you now just focused on this crossbreeding aspect of things, or are you investigating something else in terms of . . .

CROUGHAN: I don't know. Did I keep searching for . . . ?

SUE CROUGHAN: I don't . . . . I think you did do a few more rounds and then stopped. And so Tim retired January 1, 2005. So you did a few more things. There was some protoplast work you were doing. You had the guy from Ukraine doing some [gene] research and, kind of, winding down on a lot of different projects. But it was mostly, yeah, just getting it bred into the . . . and you had to do a lot of work for the patents like do a lot of other experiments. So he would go in the lab. I remember you had to do some test on a lot of things. I'm trying to remember what that test was because I think I had retired at that point. But you were going into the lab and what were you testing? Anyway, he was doing . . .

CROUGHAN: Additional testing.

SUE CROUGHAN: Yeah, it was a lot of . . . what were you testing for? Shoot. I can't remember.

MATT CROUGHAN: More examples for patents, probably.

SUE CROUGHAN: Yeah, it had something to do with the patents.

MATT CROUGHAN: On enablement or something. Yeah.

CARUSO: And once you found this variety, you had mentioned that starting in the late 1980s, you needed to do more publishing to demonstrate your . . . and for granting and things like that. Did you publish on this work or was the patent the publication?

CROUGHAN: The patent was the publication.

SUE CROUGHAN: You couldn't report on it if you were going to patent it because then it became public.

CROUGHAN: Yeah.

MATT CROUGHAN: Prior . . . after the patent was issued or after you filed it, you could do it right.

CARUSO: And did you publish after you . . . after the patent was issued?

CROUGHAN: I don't remember. I don't think so.

CARUSO: And what about presenting about the work at conferences?

SUE CROUGHAN: There was some of that. Oh, you went a lot to South America multiple times.

CROUGHAN: Yeah.

SUE CROUGHAN: Which was scary because that was . . . he was going to Colombia and that's when all the kidnapping was going on, but the chemical company would bring him down and do presentations and stuff.

MATT CROUGHAN: To that point among academics not everybody knows that he's the inventor of Clearfield rice. If you say, "My brother Tim invented . . ."

[END OF AUDIO, FILE 2.1]

MATT CROUGHAN: ". . . Clearfield rice" versus the leading people at Monsanto that did Roundup-ready crops knew him because they read the patents, and they had actually a pretty good idea of how he did it too because they, kind of, knew what might be involved if you . . . so they were quite familiar with it. "Oh, you're Tim Croughan's brother. And we know about Tim Croughan." But your typical academic because it wasn't in the literature, and they don't read patents usually wouldn't know who did it.

SUE CROUGHAN: And the material ended up with breeders. So now breeders are releasing varieties. They're releasing Clearfield varieties, and it's like, "Oh, you know, so-and-so released the Clearfield for us," but they don't really know who started . . .

CARUSO: The originator.

SUE CROUGHAN: The originator, yeah.

CROUGHAN: Which wasn't that big a deal to me, actually.

CARUSO: Having your name known?

CROUGHAN: Yeah, it wasn't that big.

SUE CROUGHAN: And so another crazy thing is what the company didn't want is for farmers to keep their seed. So normally you would sell your seed, but you would keep some to plant the next year. They wanted the farmer to have to go back and buy seed from them. And it's called brown bagging, I think it's called. And apparently that happened somewhere. And I remember . . .

CARUSO: Where they didn't return the seed?

SUE CROUGHAN: Right. They were brown bagging, and it was like, oooh, is the chemical company going to go after them? Because that was the big threat. We're going to find you and all this bit. And Tim said, you know, that farmer is trying to feed his family, and he's doing what he wants. And that was the whole goal of this is to feed people. Let them keep the brown bag.

MATT CROUGHAN: You certainly don't get a royalty from every acre of that.

CROUGHAN: No.

MATT CROUGHAN: There's a lot of it planted by poor people.

CROUGHAN: Yeah, right, exactly. Especially overseas.

MATT CROUGHAN: It's fine. You guys aren't sure . . .

SUE CROUGHAN: And it ended up in China, and there's no protection for it. But there's nothing to be done.

CARUSO: So after the patent is issued—the first patent—and the second patent is issue, you're still doing some research, but as mentioned, you decided to retire in 2004. Why is it that you decided that it was time to retire?

CROUGHAN: [It was] 2005.

CARUSO: **[**Oh], 2005?

SUE CROUGHAN: Well, January 1, 2005.

CARUSO: So January 1, 2005. Okay. So why did you decide to stop?

CROUGHAN: Oh, that's a good question. Why did I decide to stop?

SUE CROUGHAN: Because I retired.

CROUGHAN: Because she retired. It wasn't fun anymore.

CARUSO: It wasn't fun anymore because . . . did you have to share your lab? How long before . . . ?

CROUGHAN: Oh, yeah. We shared our lab all along.

CARUSO: But how long before he retired did you retire?

SUE CROUGHAN: I retired in 2001.

CARUSO: Okay, so another three years.

SUE CROUGHAN: And he was going to stay another five years to get so many years with the university. I had some time from California that I added to my Louisiana time. That's why I was able to retire. And the kids were young then. And Tim said, "Well, I want to stay five more years." And, you know, you get that extra little blip. And after three years, he said, "Nah, this isn't any fun anymore."

CARUSO: I was just wondering. Did you have to share your space with someone else then?

CROUGHAN: No.

CARUSO: So you just took over the entire space?

CROUGHAN: Right.

CARUSO: And at the time that you retired . . . so with the position at LSU, I can understand when an individual retires. Does that mean that the laboratory and the research happening in that laboratory also shut down, or does the university look for someone to continue on?

CROUGHAN: They didn't look.

SUE CROUGHAN: Well, so you had brought in two individuals from Indonesia. He had brought in a couple.

CROUGHAN: Oh yeah, that's right.

SUE CROUGHAN: And actually brought in one. And then we helped the spouse come and stuff. And you had hired both, and Tim had been working on some protein, high-protein rice. And so he basically took that over. And then they were doing also some other little projects that you had started. They, kind of, took that over, and I think . . . well, actually, she just passed away.

CROUGHAN: She did?

SUE CROUGHAN: Yeah, it was . . . . I never heard why. Something sudden. But I think he's still there.

CROUGHAN: Herry [S.] Utomo.

CARUSO: So the married couple moves on and in comes another married couple. So LSU is probably like, "If **<T: 05 min>** you're married, then, you know, you can't advance." Very fitting though. So you stopped doing your research in 2004, 2005. You are retired. What do you become involved with after that?

CROUGHAN: Oh, what would you say I got involved with?

MATT CROUGHAN: Your estate.

SUE CROUGHAN: Yeah. We have 125 acres, but also, we, kind of, started a little side company, and we thought, "Well, maybe we can do some of this on our own." And we dabbled in it for a few years, but then it just . . .

CROUGHAN: It wasn't going anywhere.

SUE CROUGHAN: It wasn't going anywhere. And it was just hard to work with, you know, different people and stuff. So we just said, "No, we'll just move on, but . . ."

MATT CROUGHAN: They built a beautiful house and bought a bunch of acreage and customized it to their tastes.

CROUGHAN: Landscaped it.

SUE CROUGHAN: We took rice fields and turned it into a park [with] trees.

MATT CROUGHAN: They're going to have a very long oak alley at some point. Like what? A mile long of the oak trees making an arch.

CROUGHAN: Right.

MATT CROUGHAN: Once they all get big enough. And so we have family reunions down there and have a blast. Fifteen-acre pond to fish in and all this other acreage on the edge of bayou country. So part of it is cypress trees and alligators and gorgeous huge bugs and . . .

SUE CROUGHAN: Snakes.

CARUSO: That the kids can have as pets.

SUE CROUGHAN: Oh, yeah, yeah.

MATT CROUGHAN: You put on rubber boots and bug spray and go out there.

CARUSO: One question that I have is so you talked about your garden early on when you were a student and having your garden and you were enjoying that. It's something that you got into. And in some ways I was thinking of your work at the Rice Research station as a bigger garden of sorts. Did you bring . . . are you back into gardening? When you retired, did you feel compelled that you no longer had your fields because you left your fields? Did you want to create a new garden for yourself after you retired?

SUE CROUGHAN: We moved into trees.

CROUGHAN: Yeah.

SUE CROUGHAN: And we're famous for having thousands of trees that we have raised from either little saplings that we bought or acorns that we have collected. And we have thousands of trees.

MATT CROUGHAN: I think your analysis is right on. Yeah, It just changed which plant, but it's all agriculture, farming, gardening.

CROUGHAN: Yes.

CARUSO: So I think those are the major questions that I had. I mean, I don't . . . you know, I'm happy to talk about more if there are other things that you want to discuss or if there are things that we haven't had a chance to speak about more. I know that early on, religion was a significant, you know, a father who's a pastor. That was an important component of your early life. I don't know if religion or other social causes or anything else has been important and we haven't discussed. So I want to make sure that you have an opportunity to raise anything before we end that I haven't covered or that you just like to talk about in greater detail.

CROUGHAN: Yeah. Can you think of anything?

SUE CROUGHAN: I just would like to say that I think for our children, you know, we just . . . the family was important. Education was important. It wasn't so much things as it was just that time spent on the land and stuff like that and learning. And our kids, we were fortunate that there was a school that they went to that really prepared them well, and they went off and were able to accomplish and become very productive adults and do that. And I think that's . . .

CROUGHAN: We're very proud of our kids.

CARUSO: In medicine, veterinary medicine and mathematics?

SUE CROUGHAN: Right. So Pete is an MD, and Carolyn is a vet, and Bill just finished his PhD in neuroscience. So kind of math computers, neuro. And they're all married. [door opens]

CARUSO: So I think we're just wrapping up. And so I just want to thank you for sitting with me for the past couple of days. And as I mentioned, we'll get this transcribed and out to you and whatever you want the final product to look like.

MATT CROUGHAN: I have one little comment.

CARUSO: Please.

MATT CROUGHAN: You know, I mean, we come, you know, Irish immigrants, great-great-grandfather, illiterate, spoke no English, came to the US through New Orleans, **<T: 10 min>** probably dug ditches at risk of getting yellow fever at the time when no Irish need apply for any reasonable job. And then his son worked on the railroads, permanently disabled doing that, no compensation. So this is old-school Irish.

CARUSO: So more late nineteenth century coming over?

MATT CROUGHAN: Yeah. And then our grandfather eventually ran a fish cannery but didn't go to college. And then our dad was the first one to go to college in his whole family. And then now lots of PhDs and MDs coming out of that. But if you looked historically, there was still this Irish laborer, tough guy, stubborn. Don't quit. Can't complain about the conditions, can't complain how hard the work is that has it's part of our family's past. You run into a lot of Mexican immigrants in California that are like this, you know, extremely tough farm laborers. The Irish used to be like that. Maybe a few are. Some can still be. But, you know, if you see the

movie *The Field*, it's one about Ireland, and the guy drags up seaweed to this field on his back for years and years and he's just—[the] movie ends tragically—but he's extremely stubborn tough guy. And I think that's part of how Tim pulled it off is you've got to have this obviously strong science background and education, but most people wouldn't be going into the summer in the middle of Louisiana when it's 99 degrees and 99 percent humidity day after day after day after day, spraying, doing whatever. So that's how we were all raised. It was this weird combo of coming out of the laborer world, and our dad would force us to do lots of hard work when we were like ten. You know, chopping wood or you could barely hold the ax. But then be a very strong scholarly, and we were weird combos. He does it in his work. I do it with sports where I, you know, ski super difficult stuff and mountain bike super difficult stuff but not a productive thing to do. But it's that same toughness, physical toughness.

CARUSO: I mean, a decade-and-a-half doing the same work every day looking for a solution to something that you saw as a major social problem.

CROUGHAN: Indeed, yes.

CARUSO: Feeding people.

MATT CROUGHAN: Yep. Tim and I used to occasionally try to take on the bullies at school. Sometimes we'd win and sometimes we'd lose.

CROUGHAN: You noticed my nose is [pushed] to the side.

MATT CROUGHAN: Mine too. But yeah, that was how we were raised. To not quit, right?

CROUGHAN: Thanks for saying that.

CARUSO: And thank you all.

CROUGHAN: And thank you.

[END OF AUDIO, FILE 2.2]

[END OF INTERVIEW]

SUPPLEMENTAL INTERVIEW VIA CORRESPONDENCE (INTERVIEWER AND DATE UNKNOWN)

INTERVIEWER: How long have you been working in this field?

CROUGHAN: Started working at the LSU Rice Research Station in 1981 upon graduating from UC Davis with a Ph.D. in plant physiology and a M.S. in agronomy.

INTERVIEWER: Is rice research the main focus of your work?

CROUGHAN: Yes - I worked on rice in grad school, too.

INTERVIEWER: Do you work on any other areas?

CROUGHAN: Yes - my favorite project is the rice work, but I also work on developing efficient ways to use native plants to control coastal erosion. This is a pretty big project with several other people involved.

INTERVIEWER: Could you provide a basic summary of the Clearfield system?

CROUGHAN: The Clearfield system is a match-up of imidazolinone herbicides and imidazolinone-resistant rice. Normal rice is very sensitive to imidazolinone herbicides, as is red rice and most other weeds that infest rice fields. While there was no guarantee that a rice plant with resistance to imidazolinone herbicides would ever be found, a 12 year search through about a billion seeds and seedlings finally yielded a resistant plant. This plant is one of the parents of the first two Clearfield rice varieties released - CL 121 and CL 141. Meanwhile I continued searching for higher levels of herbicide resistance, and after 5 more years and another billion seeds, a second plant was found that had a much higher level of resistance. Seed tracing back to this plant was increased in quantity to yield the Clearfield rice variety CL 161. Besides being more resistant, CL 161 is higher yielding and has better grain quality than CL 121 and CL 141.

INTERVIEWER: How big of a problem would you estimate red rice to be, and how widespread?

CROUGHAN: The red rice problem is widespread, but the exact acreage affected is a difficult number to come up with. Most of the rice acreage in SW Louisiana has red rice to a greater or less extent. Some fields have tremendous infestations - so bad that you can hardly see the commercial rice because of all the red. The other rice- producing states in the South also have red rice to varying degrees. California just reported what appears to be red rice on a farm there, so while it's generally stayed red rice free, it's contending with a potential red rice problem, thought on a very limited scale, as we speak.

INTERVIEWER: When was Clearfield introduced?

CROUGHAN: CL121 and CL141 were released for seed production in 2000. There was very limited commercial production in 2001, then about 75,000 acres were planted with these varieties in 2002. CL161 was released for seed production in November of 2001. Seed was increased in 2002, and about 200,000 acres of CL161 were grown in 2003.

INTERVIEWER: How was it discovered, and how long was the research process involved?

CROUGHAN: [see answer above]

INTERVIEWER: Was the research time associated with Clearfield typical of this type of research?

CROUGHAN: I don't think there's a typical timeline for this type of research. After a massive effort, you might find nothing, and with less effort and a lot of luck, it might be possible to find something quickly. I tried the massive scale approach, and it still took 17 years to find the two resistant plants that lead to Clearfield rice varieties.

INTERVIEWER: Dr. Steve Linscombe is a colleague of yours at the LSU AgCenter. What was Dr. Linscombe's contribution to Clearfield?

CROUGHAN: Right after I found the first resistant plant I established a breeding project specifically focused on developing herbicide-resistant varieties from this plant. This was a very concerted effort, and involved over 2,000 crosses a year. By comparison, a large rice breeding program typically makes less than half that many crosses a year. Once I accumulated enough material from this breeding effort I planted each of these new lines as a separate row in the field. This planting consisted of over 2,000 rows. Dr. Linscombe toured this planting and picked several rows as showing promise. He eventually narrowed down these selections to the two that

he felt were best, and released them as CL121 and CL141. CL161 came about in a somewhat different way- it was simply a seed increase from the most resistant plant I found. I provided that seed to Dr. Linscombe, and he released it as CL161.

INTERVIEWER: How do you think Clearfield has changed the rice farming industry?

CROUGHAN: I don't think Clearfield has changed the industry much yet, but I think it probably will over time. Of course, controlling red rice in a commercial rice crop is itself something new. But the Clearfield rice system also allows rice growers to base more of their decisions on what is best for the crop and their farming operation, rather than what is best for suppressing red rice. The practice of "mudding in" is used to suppress red rice, but it's hard on the equipment and I don't think any farmer would do it ifhe didn't have to. Also, the muddy water that's produced sometimes escapes from the field and gets into waterways, which can attract negative attention from the Feds and environmentalists. With Clearfield, mudding in is no longer needed, so that problem becomes non-existent. There are other potential benefits Clearfield offers, but they can pretty much be summed up as increased yields, improved grade, less wear and tear on equipment, and, in simple terms, the headache of dealing with red rice is over.

INTERVIEWER: How did BASF get involved with your work?

CROUGHAN: BASF now produces the imidazolinone herbicides, since they bought the former manufacturer, American Cyanamid. The imidazolinone herbicides are both very effective and very non-toxic. They are exactly the kind of herbicide that I wanted to have rice resistant to. Back in the early 90's I got American Cyanamid to invite me up to their company to give a seminar. The seminar went well, and afterwards I was told that, while Cyanamid had almost no interest in herbicide-resistant rice before my visit, now they did. Things progressed from there, and I've worked very closely with many people at both Cyanamid and BASF on this project.

INTERVIEWER: How does Clearfield differ from products such as RoundupReady Rice or LibertyLink?

CROUGHAN: The basic concept is the same - change the rice plant so that it becomes resistant to an excellent herbicide - but both Roundup Ready and LibertyLink rices are GMO's. They have a gene inserted in them through genetic engineering techniques, whereas Clearfield rice contains nothing but natural rice DNA. This has pretty important consequences as far as marketing rice. Almost half the U.S. rice production is exported to foreign countries, many of which have reservations about GMO foods. Also, U.S. consumers generally accept GMO foods,

but major U.S. food companies typically function internationally as well. A growing list of companies in the U.S. and overseas are banning GMO ingredients in their products to assure consumer acceptance worldwide. This is not so much because of scientific concerns on the part of the companies regarding GMO ingredients, but as a practical approach to an international marketplace that includes consumers who have personal concerns about GMO food.

INTERVIEWER: A lot of countries in the world have consumers who express concerns about GMO food, how would you rate Clearfield's acceptance level?

CROUGHAN: As far as I know, there has been total acceptance of Clearfield rice in the marketplace, including internationally. Regarding growers' acceptance, I think there has understandably been some "wait and see" attitudes at the beginning, but I think that's fading quickly.

INTERVIEWER: Do you see cost as a potential barrier to acceptance?

CROUGHAN: Cost is an obvious factor, but the benefits of the Clearfield system are pretty significant. What would help would be a Clearfield variety that was the highest yielding variety of any of them out there. CL161 yields very well and has excellent milling, but we're working hard on producing even better Clearfield varieties.

INTERVIEWER: Because Clearfield is not a genetically modified (GM) crop, acceptance has perhaps been easier. What are your thoughts on biotechnology and agriculture generally?

CROUGHAN: I think biotech has a tremendous role to play, but I'm not sure it's time has really come yet. I'd hate to see us lose overseas markets because some of the rice the U.S. produced was a GMO. I think nearly every variety of all crops will be GMO's someday, but we've got to get past the current GMO marketing hurdles first. For the U.S. rice industry, which exports so much of its production, a significant loss of overseas markets would be a disaster.

INTERVIEWER: Despite not being a GM crop, Canada was wary of the new system. Do you expect this to be an ongoing issue with the product[1]s acceptance, and other products using similar breeding methods?

CROUGHAN: Actually not. Canada was not really wary of Clearfield rice. They had already readily approved several other Clearfield crops prior to the Clearfield rice application. But Canada has a unique law which states that any commodity that is different in any way from the

standard commodity must be approved before it can be imported into Canada. As the GMO concerns gained momentum, Canada's approval agency came under very tight scrutiny by groups who were anti-GMO, and I think the Clearfield rice application caught some of the backwash from that situation. The approval process slowed down in Canada, not because of health concerns, but more because everything had to be meticulously reviewed and scrutinized from the perspective that a lawsuit might be filed against them down the road. But approval was finally forthcoming, and now Clearfield rice is fully accepted in Canada and everywhere else.

INTERVIEWER: Do you feel that the type of breeding process you used has a better chance of success in the future than GM efforts?

CROUGHAN: A genetically engineered plant might be produced fairly rapidly in the laboratory; however, before a new variety developed from that plant could be released to farmers, approximately $10 million must be spent on testing to gain government approvals. The approach I used is time-consuming, but since more than 1,000 varieties of a wide number of crops have already been developed through this technique and grown worldwide over the last 50 years, consumer acceptance of such crops is not an issue. I'd say there's plenty of room for both approaches in crop improvement.

INTERVIEWER: What is unique about the stewardship program associated with Clearfield?

CROUGHAN: I think the most exclusive part is that it's pro-active. Instead of waiting until problems develop and then trying to solve them afterwards, this program educates growers ahead of time as to the potential pitfalls. That's a new approach, and I think BASF should be commended.

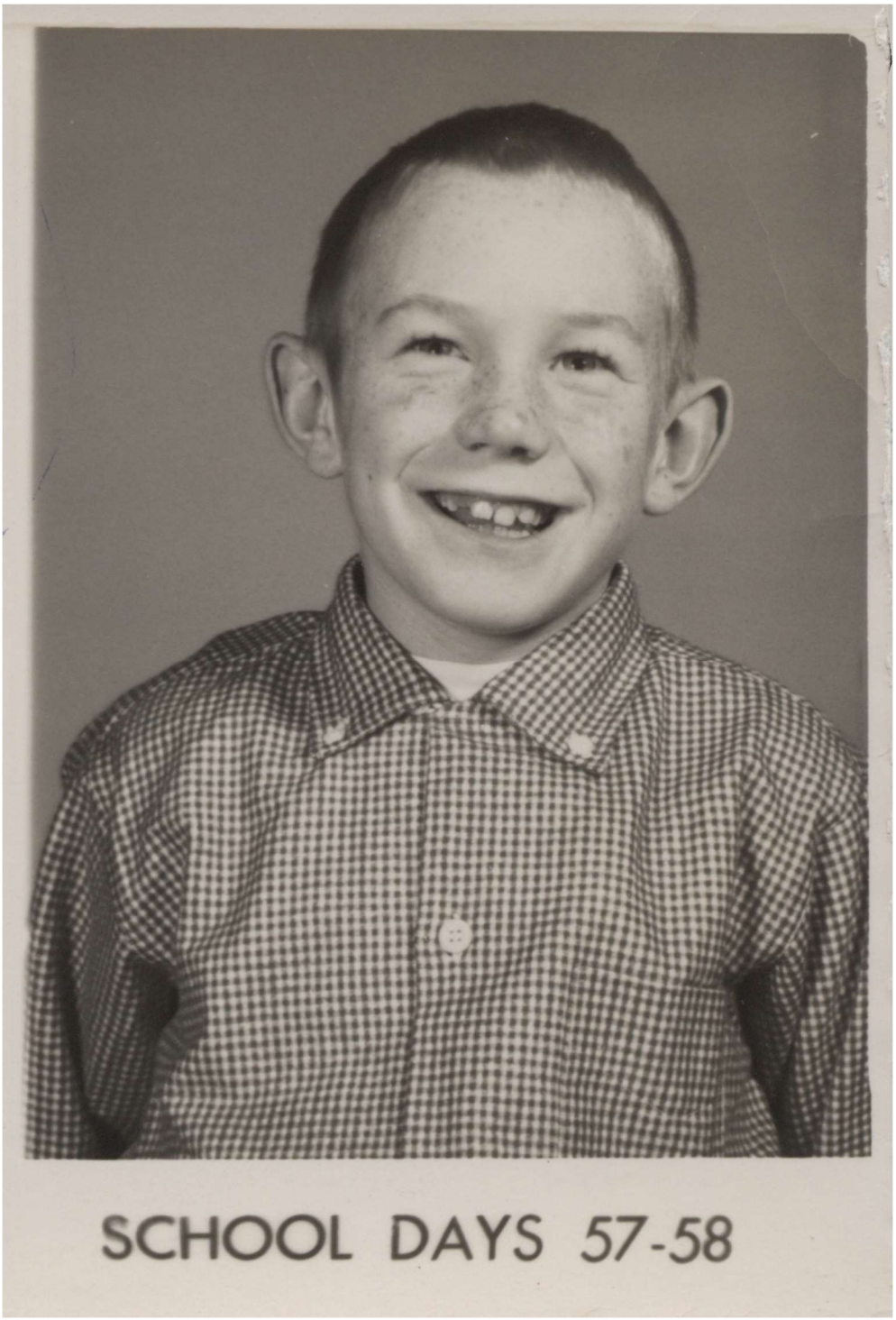
INTERVIEWER: Newpath (the chemical used to kill red rice) is rumored to persist in fields and damage non-Clearfield rice. Does soybean rotation solve this problem, or has it been resolved through other means?

CROUGHAN: Newpath does persist in the soil, and under certain conditions there can still be enough around by the following season to injure non-Clearfield rice. But soybeans are inherently resistant to Newpath, so injury to a soybean rotation crop would not be a problem. What is very important about this rotation is the opportunity to use another chemistry, such as Roundup with Roundup Ready soybeans, to help eliminate any potential outcrossed red rice during the rotation crop. I strongly recommend that growers rotate into Roundup Ready soybeans after Clearfield Rice for at least the first several years. During that time they should dramatically reduce their red rice infestation, since red rice would be controlled every year, and not just during the soybean rotation crop as now occurs.

INTERVIEWER: Implementation of Clearfield is now worldwide. How has its success changed your work?

CROUGHAN: Another research goal I have is the development of more nutritious rice. I've worked on that for almost 20 years as well. Hopefully that will happen eventually as well. This would also be non-GMO rice, and by crossing it with Clearfield, the resulting plant would be non-GMO as well, and both herbicide resistant and more nutritious. But there are no guarantees in research, so we'll just have to see if that whole plan works out.

PHOTOGRAPHS



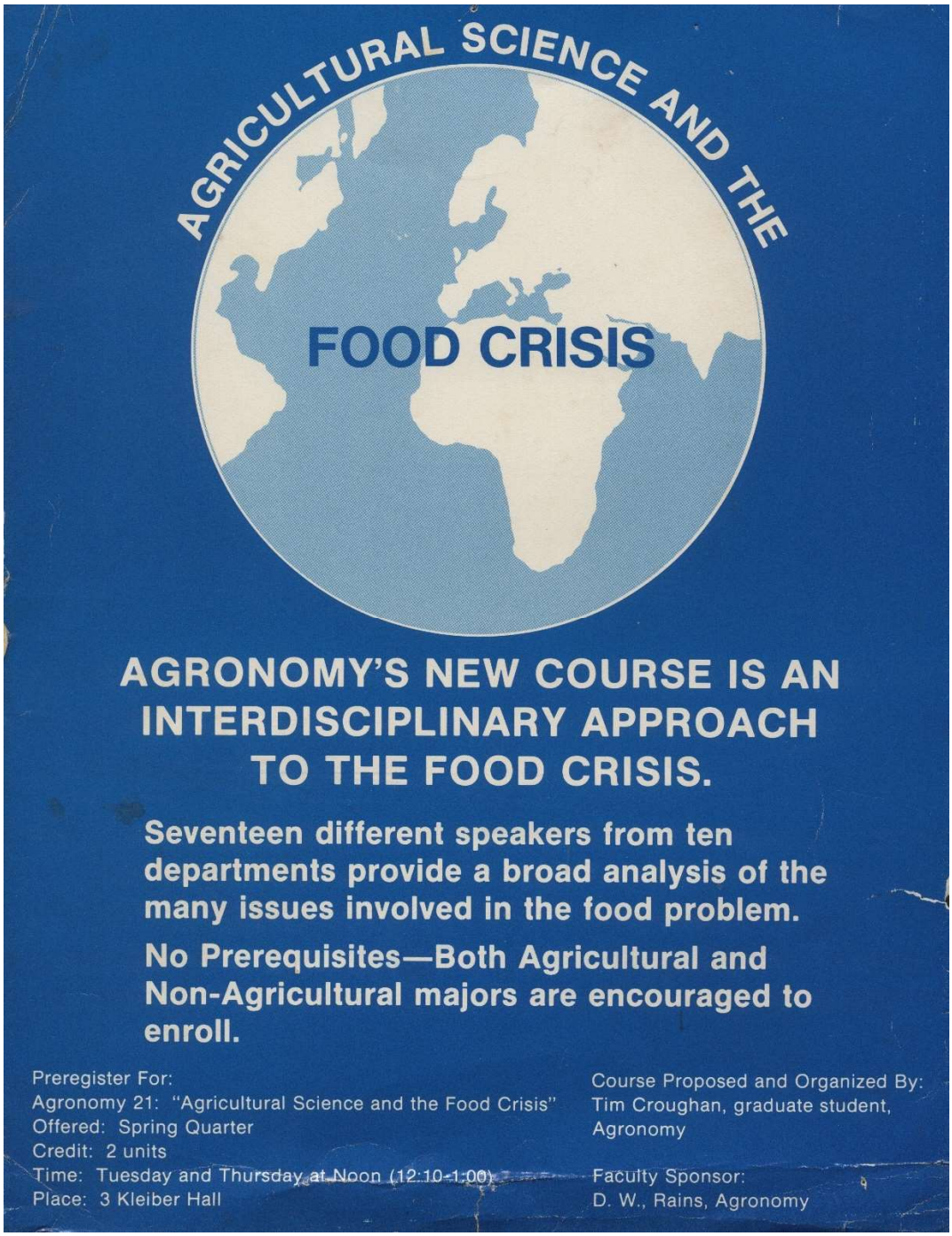
Tim at age 7

Tim as a Boy Scout (third from right)

Tim during his Reed College years

Tim during his Reed College years

Tim at the University of California, Davis, working in his lab



Flyer for Tim's Agricultural Science and the Food Crisis course in the Department of Agronomy at University of California, Davis

Tim's lab when he first arrived at Louisiana State University

Tim (far left, with hat) and others harvesting grapes in 1980

Tim in his car

Tim (second from right) with siblings (except Jack) in 1981

Tim and Sue's wedding on 7 July 1984

Tim spraying herbicide on rice that was treated with EMS; then looking for survivors

First Clearfield rice plant found in field

Test plots showing difference between resistant and non-resistant rice

Louisiana State University
Agricultural Center

ScienceWATCH

New developments from the Louisiana Agricultural Experiment Station

LSU Ag Center researcher develops herbicide-tolerant rice

Dr. Tim Croughan, a researcher at the LSU Agricultural Center's Rice Research Station in Crowley, Louisiana, developed two new rice breeding lines that are resistant to imidazolinones, a family of herbicides that can now be used to control major weed problems in rice, including difficult-to-control weeds such as red rice. Red rice, because it belongs to the same species as cultivated strains of rice, has historically been particularly difficult to control. Improved weed control will increase yields and give farmers greater flexibility in crop rotations, herbicide timing, planting practices and water management.

Croughan's field tests at the Rice Research Station initially identified two rice plants with resistance to imidazolinone herbicides. The culmination of 17 years' of research, the new rice lines are not genetically engineered materials but the result of identifying and developing a natural mutation. No genes were introduced from any other organism.

Beginning in 1989, Tim Croughan looked at literally hundreds of millions of rice seeds to find the ones that had tolerance to imidazolinone herbicides.

Years of field testing at the Rice Research Station produced two rice lines that are resistant to imidazolinone herbicides.

Dr. Steve Linscombe, professor of agronomy at the Rice Research Station, is leading the initiative to incorporate the herbicide resistance characteristic into rice varieties that possess superior agronomic properties.

Four patents that have been issued have been licensed to American Cyanamid Co., which produces and markets the imidazolinone herbicides. The imidazolinones work on an enzyme that is present in plants but not in animals, birds, fish or insects. This selectivity makes the imidazolinones very environmentally compatible to humans and wildlife while providing outstanding weed control.

Louisiana State University
Agricultural Center
Louisiana Agricultural Experiment Station

For information contact the Office of Intellectual Property,
P.O. Box 25055, Baton Rouge, LA 70894-5055
tel 225-388-6030 or fax 225-388-6032.
Produced by Ag Center Communications. 3-99

Louisiana State University Agricultural Center announcement of herbicide-tolerant rice in *Science Watch*

Breeders field day, when breeders from all over the world came to select Clearfield rice lines from Tim's backcrossing program

Tim (fifth from right) on first of three trips to China

Tim with older brother Jack in 2001

**Family Photo (2019) Pete and Allie (pregnant with Isla);
Sue and Tim; Bill and Rebecca;
Patrick, who is holding Olivia, and Carolyn**

Tim with his granddaughter, Olivia

Tim with his granddaughter, Isla

Tim in greenhouse growing trees in retirement

Tim playing bagpipes

Tim with dogs checking trees on “south forty”

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