7-25-2007

Bette and Will White oral history interview with Spencer Fleury and Todd Chavez, July 25, 2007

Elizabeth L. White (Interviewee)

William B. White (Interviewee)

Spencer Fleury (Interviewer)

Todd Chavez (Interviewer)
University of South Florida, tchavez@usf.edu

COPYRIGHT NOTICE

Karst Oral History Project
Oral History Program
Florida Studies Center
University of South Florida, Tampa Library

Digital Object Identifier:	K20-00005
Interviewees:	Bette White (BW) and Will White (WW)
Interviewers:	Spencer Fleury (SF) and Todd Chavez (TC)
Interview date:	July 25, 2007
Interview location:	Marengo, Indiana
Transcribed by:	Nicole Cox
Transcription date:	February 05, 2008
Audit Edit by:	Ian Howard
Audit Edit date:	April 3, 2008
Final Edit by:	Nicole Cox
Final Edit date:	May 20, 2008

Spencer Fleury: Okay, (clears throat) excuse me. My name is Spencer Fleury. I am here at the 2007 National Speleological Society meeting in Marengo, Indiana. I have with me here the Whites—Dr. Will White and wife, Bette White, Dr. Bette White. And we're going to be talking about their lives and experiences and the world of karst. Welcome, and thank you both for coming.

Will White: All right. Glad to be here.

SF: Well, why don't we start at the beginning? Um—(laughs) Where were you both born?

WW: Well, I was born in Huntingdon, Pennsylvania—a town right in the central part. [I] grew up on a farm ten miles south of there, way out in the brush, no electricity, no running water—the whole primitive bit.

SF: (laughs)

Bette White: I was born outside of Pittsburgh, in McKees Rocks, Pennsylvania—with electricity and running—

(all laugh)

Todd Chavez: You were lucky!

SF: (laughs) So, I guess it sounds like you both probably had very different childhoods, very different experiences of growing up in those environments. Why don't you tell us a little bit about what you remember from your earliest years?

WW: All right, well, I went to a one-room country school, one of the last of the ones with all eight grades in one room. I guess I must have learned to read there. I learn[ed] basic arithmetic. I can't remember much else I might have learned.

And [I] went to high school, in a real high school, I guess, in the town of Huntingdon. And then went to Juniata College which is a small liberal arts school located in Huntingdon. [I] received a bachelor's degree in chemistry in 1954, after which I took a job at the Mellon Institute of Industrial Research in Pittsburgh, which is how I got to be a little closer to meeting Bette. So—

(long pause and laughter)

BW: I started kindergarten in the Pittsburgh schools, and then our family moved. Then I took a year off after kindergarten and then went to kindergarten in McKees Rocks. And went to Stowe High School and then went on to the University of Pittsburgh, where I studied civil engineering, and met Will in Pittsburgh, and then he and I continued—moved to State College. I received my master's degree and my Ph.D., both in civil engineering.

TC: A lot of people have told us that we need to ask you two how you met. Tell us how you met.

WW: Well, okay, that's a story! When I was in Pittsburgh—can I back my story off a little bit?

TC: Sure.

WW: We should probably talk about caving at some point, because that predates when Bette and I met. People have asked me when I got interested in caving and I have to tell them that I cannot remember when I got interested in caving, because as a child in grade school I was prowling around in the woods looking for caves. And when I went to

college, I worked as a cave guide at Lincoln Caverns, a little show cave there in central Pennsylvania. And I got acquainted with other caves, real caves. Went caving, did a lot of caving when I was in college. Went to Pittsburgh, I got involved with the Pittsburgh Grotto, the Pittsburgh chapter of the NSS.

And also got into what is these days called project caving, where you have some area you keep working on and working. And one of these was a place called Swago Creek drainage basin in Pocahontas County, West Virginia. We had a number of caves that we had been surveying; you know, in order to lay out the whole pattern, we needed to connect the entrances, which are half a mile or a mile apart, so we could see how the caves interrelated.

And so what I was primarily looking for was not really a girlfriend; it was somebody who knew how to run a transit, so we could do [these surveys]. And I learned about this female civil engineering student at the University of Pittsburgh who might be interested in such a thing, and we dragged her off to the wilds of West Virginia and did a transit survey across, up this valley connecting cave entrances together. And that's how we met!

(all laugh)

SF: Bette, did you have any interest in caving before that experience, or even thought of it?

BW: I had no idea even what a cave was!

(all laugh)

BW: All I knew was I was going down to do this survey, and there was actually another civil engineering student who came along with us. And—well, why don't you tell the story about Overholt Blowing Cave.

WW: Well, that's really your story. You better tell that one.

BW: They said, "Let's go in the cave." The people who were experienced in caving went on ahead and this other civil engineer and I were supposed to come in afterwards. Well, we had never been in a cave, and so what we did is, we started to go in and realized we had to get wet. And so we went through this wet part, and those guys all knew how to get

through the dry part. As we're coming around a corner, these guys all yell. (makes yelling noise)

(all laugh)

BW: Scared us half out of our wits!

TC: So did you get paid?

BW: No!

TC: Aw! (all laugh)

SF: (to Will White) So you're from Huntingdon, right? Right there in central—that's right in karst country in central Pennsylvania.

WW: Yeah, it's in the limestone area of central Pennsylvania.

SF: As you mentioned, you spent some time as a child wandering through the woods trying to find caves. What do you remember most about those experiences? Did you find anything good?

WW: Well, you know, later on I discovered, learned some geology and I learned that the hills out there near my father's farm were all underlain by shale, which is not a good place to look for caves. However, there are a few places where the land has slipped and opened up crevices even in these insoluble shale rocks. So we, in fact, did succeed in finding some caves, most of which were maybe ten yards long if we were lucky. But we were scouring around. We were looking for anything.

(SF and TC talk at the same time)

SF: No, go right ahead.

TC: Bette, why did you choose civil engineering? That was an unusual career choice for a

woman at that time.

BW: When I was in tenth grade, we hired [a new teacher]. Our school was not one of the better schools in western Pennsylvania. And so they were in the process of hiring a physics teacher and a chemistry teacher and an engineering person. And this person came in and he had this [sign in front of the] class and it said, "Engineering Needs Women." And I thought, "Hmm, that sounds like an interesting career," and so I took all of his courses that he had and went into engineering at Pitt and found that was just my thing, and had no problems with the classes and had a wonderful time. I was in a [freshman] class of 200, which is 199 guys and me.

(all laugh)

BW: I graduated in a class of twelve. Only twelve of us made it.

SF: Wow! So, you moved to State College from there and you were pursuing a master's at—

BW: No, no, no.

SF: Did I get that wrong? Okay.

WW: Well, there was—yeah, there was a little more history in between. What had happened or what happened in there—and, let's say, we were doing a lot of extensive caving and cave mapping and beginning to shift from just cave exploring into cave science, actually.

But the job that I had at Mellon Institute was one that would be appropriate for just a bachelor's degree level person. And [I] discovered that my job was being downgraded. The original thought was that these junior members of the staff were essentially graduate students and they would be working on an advanced degree at Pitt or something like that. New management came in and [they] decided that now these people were hired as technicians, and that's what they're going to be is technicians. And I said, "Okay, this is now a dead end."

And so, after scouting around various places, I went to Penn State to work on a Ph.D. and figured if I'm going to do anything in science, I've got to have the necessary union cards.

So, [I] went up and was working there on a degree, but then—

BW: In the meantime, I graduated.

WW: Bette graduated.

BW: And I went to work in Harrisburg.

WW: She went to work as a civil engineer for the highway department in Harrisburg, designing bridges. Somewhere in this time frame we got married, and then in due course, probably something having to do with a baby being on the way, she decided to give up the job in Harrisburg and move up to State College. So, that's where we've been ever since.

SF: So you were both on the faculty at Penn State, right?

BW: I was research faculty.

WW: Yeah.

SF: Okay, okay. So did you—did the two of you have any opportunity to work together, or were you more or less on your separate wings of the campus?

WW: Oh, it worked out in kind of a peculiar way, like such things [do]. I finished my Ph.D. in geochemistry in 1962, at a time when my advisor, my boss—a fellow named Rustum Roy—decided to build a Materials Research Laboratory at Penn State. And I was invited to stay on on the faculty, which was nice. I didn't have to go job hunting. So I stayed on. Bette, as the kids grew up a bit, decided she'd better get an advanced degree, and then she started her graduate work a little bit later. But I have been a faculty member there since 1962 until I formally retired in 2002.

BW: What do you want me to talk about?

(all laugh)

SF: So what did you like about the academics, the academic career at Penn State in particular? I mean, did you—did you actually enjoy the teaching aspect? Because I know a lot of professors look at teaching as more of a necessary evil so that they can do research. Is that the way you looked at it, or were you more teaching oriented? What were your thoughts on that?

WW: Well, in principle, I was split down the middle, in that half of me was in the department of geophysics [and geochemistry], what today [is] the department of geological sciences. The thing has changed its name two or three times along the way. And there, my responsibilities were primarily teaching, both undergraduate and graduate courses, which I very much enjoy doing. And I don't have much sympathy for people who—you know, if you don't want to teach, why are you at a university? You know? Go work for industry, you get paid more.

But the other half of me was in this [newly] formed Materials Research Laboratory in an entirely different field from geology as material science. And a lot of which is high temperature, high pressure chemistry, condensed matter physics and a whole bunch of stuff that, you know, is fairly remote from geology, certainly remote from hydrogeology. But that's the way it worked out, and I have no problem sort of standing with one leg in each field.

SF: (to BW) And you were on the research faculty, you just said—

BW: Right, well—

SF: Did you have—

BW: Let's back up that a little bit, too, because what I did was I decided to write a master's degree, and there was a new faculty member at Penn State and I chose him as my advisor. And he was really interested in surface water hydrology. And so I was going to do this surface water hydrology, looking at all of the watersheds in Pennsylvania. And so I got to the end of my research and I plotted up all the data and found all of the data followed a trend, except [for] these five watersheds.

And I thought, "Why are these five watersheds so weird?" Instead of looking like a curve, which would have been in the (using hands to show the type of shape the curve made) this kind of a shape, the limestone basins looked like this (draws in the air with hands). And so they—I discovered that those were five carbonate basins, and [I] wrote [a

technical] paper. This paper has been sent all over the world and there are something like two thousand or three thousand copies of this thing all over the world. And we did some traveling after this, and realized that—[when] we went to England and somebody said, "Can I have an original of one of those things [reprints]?"

(all laugh)

BW: It's like [I] gave out original copies of this thing, and used that as a basis for working on my Ph.D. And essentially, that was—my Ph.D. was an extension of that [study]. And actually then [I] applied for a highly competitive American Association of University Women scholarship and received one of—I forget the numbers. Very few [were] awarded. And that was, well, what I worked on for my Ph.D.

TC: So your findings flew in the face of conventional wisdom?

BW: Right.

TC: In that particular case.

BW: Right.

TC: What was the impact of the paper in terms of—beyond the fact that it flew against—in the face of conventional wisdom? What was the impact? What did it mean to the people in that area?

BW: That floods in carbonate areas are damped, meaning that the water goes into the groundwater into the sinkholes; and it is only then, if all of the sinkholes get filled, then you can get a more severe flood than you would have received had it been a non-carbonate basin.

TC: So it altered the way that people predicted flooding?

BW: Right. And so it's actually [a paper] in one of Will's benchmark series book—it's a paper in one of Will's benchmark papers.

SF: So you continue to do karst related research with your civil engineering background across your careers. That's how it works?

BW: Well, sort of. Because then, when I graduated, I was looking for a job in civil engineering, and at that point in time, most of the men would not allow me—would not hire me. And I almost got one job, and the one fellow's wife said she didn't want to have a woman working in their engineering company because she was afraid that some shenanigans would be going on.

(all laugh)

BW: And so I actually lost that job. I had an opportunity to go to MIT after I graduated, but I didn't want to leave my family. But I worked in—what I ended up doing is I had two half-time jobs: one in the department of civil engineering, where I was doing hydrology, and I worked in [the] Materials Research Lab in a completely different field in cement and concrete research. And through the cement and concrete research, then we did—had separate grants with another person, and actually had a trip to India to talk about some of the research that I had done.

TC: And did you get a chance to do any caving in India? Did you—

BW: (laughs) No, no.

TC: (laughs) Okay.

SF: That explains how you got into karst, but I'm not sure about—(to WW) I'm not sure about your story. I know that you studied geochemistry, which at least is related. How did you sort of make that transition into or develop your specialty in karst?

WW: Well, researching karst—remember, we're talking about the late 1950s, 1960s. And nobody who was in any way professionally respectable would work on this subject. I mean, if you wanted to get a paper rejected, the easiest way to do it was to write it and put the words *cave* or *karst* in the title. It would come back from the editor saying, "Well, this isn't going to be of interest to our readers."

And it was really, really fairly (inaudible). So this was all work sort of under the table, in the closet. But I had—I was doing a lot of other things at the same time. And my Ph.D.

thesis has nothing whatsoever to do with karst. I can tell you a lot about the high pressure-high temperature chemistry of the oxides of lead, for instance, (all laugh) which is what the thesis was about. And I've written over the years a pretty lengthy string of papers, and probably in round numbers no more than a quarter of them deal with karst. So —

SF: And yet those seem to be the most influential, at least. Well, from my perspective, of course, because I'm coming from the karst—

WW: Well, it's—you know, it's nice the subject has become respectable. I can go to a Geological Society of America meeting and entire symposia [will be] dealing with karst. The University of South Florida has seen fit to sink a fair amount of money into doing things like the Karst Portal. It's a really booming subject at the moment, but it has really come in out of obscurity. And there is only a handful of people that ever really tried to make it their main professional activity up until maybe twenty, twenty five years ago.

Derek Ford could get away with it in Canada, because there was a tradition among the British physical geographers to do this kind of work. And one of the grand dame[s] of karst science, a woman named Marjorie Sweeting, who wrote a very influential book, back about 1972. I'm not sure. So Derek was fine, he could deal with it in Canada. But south of the border, you will find, if you look, that the earlier karst workers were either people who were in schools where they weren't really expected to do a whole lot of research, and so that if they did anything it helped a lot. Or they were people like me who did it but did it quietly and never made much of an issue of it. I certainly never got tenure at Penn State on the basis of karst research. (laughs)

TC: People outside of this community don't understand that problem of the marginalization of karst early on. From your perspectives, what caused that? And why has that changed?

WW: Well, let's suppose—let's talk about the hydrology and hydrogeology, which is where probably where the biggest transition took place. In the early years of the twentieth century, there were people—a few people—looking at karst areas, including the late Clyde Malott, who was looking at the lost river system here in southern Indiana. And they talked about sinking streams and underground rivers and things like that and had a pretty reasonable understanding, in a rough qualitative way, of how these things worked.

There came, within the general area of groundwater hydrology, a major revolution in the 1940s in which the mathematical basis for the flow of water for porous media was developed by several people, but notably by M. King Hubbert, who was known in the

petroleum business for Hubbert's Peak and the maximum of the petroleum production. He was a towering figure in the earth sciences, and there's this incredible paper, written in 1940, in which he lays out all the mathematics of how water moves through rock.

And so people found they could drill wells, they could run pump tests on wells. They could predict yields, they could predict water supplies. And the whole subject became very quantitative, very mathematical. This is in pre-computer days, and when the computers came on scene, they turned these things into mathematical models for the thing.

Well, karst doesn't behave like that. The water is running along through conduits and pipes and you can drill a well one place and get a good supply of water out of it. You can move fifty feet away and drill a dry hole. So, it didn't really fit, and their way of dealing with it was to ignore it.

SF: (laughs)

WW: And if you read—I mean, this is experimentally—can be experimentally demonstrated if you just get any of the textbooks on hydrogeology—was becoming a very important science in the fifties [1950s], sixties [1960s], thereabouts. You'll find that either the subject is not mentioned at all, in some of them. Or if it's mentioned, there's sort of some few pages stuck away somewhere. And it says, "Oh, yeah, on limestone terrain you've got sinkholes and you've got big springs and stuff like that." But it just never enters into those [the main discussion].

So a lot of the effort that was put forth, probably in about the 1960s time frame, was trying to convince the professional hydrologists that there was some point to looking at karst from this perspective of actually determining flow paths, exploring the caves, making quantitative measurements on springs, things like that. I mean, I wrote a paper with a fellow at the University of Pittsburgh in about 1966, the purpose of which was to demonstrate most of the water was running through a big pipe. I mean, it seems so incredibly self-evident, and yet at the time—gee, you know; you mean you really mean it's going, running through a pipe? Yeah.

BW: Even my advisor, who—he was my advisor for my master's degree and my Ph.D. And he said, "What does this look like?" and he was drawing a photograph, drawing pictures of the karst conduit, and he had a little hole in here and a little hole over here and he didn't realize that they were connected.

SF: Interesting.

WW: Well, if we're putting this here, I'll give you the stories as we go along. These are the ones I'd like to have recorded anyway. Because I got abused by no less a personage than M. King Hubbert himself, in that I gave a talk at a meeting of the American Geophysical Union about 1965, in which I was laying out this idea, how does water move and the flow rates, and some of the semi-quantitative aspects of the subject. And there is Hubbert, getting fairly elderly by that time, sitting in the front row glaring at me, and as soon as I finished, he leaped to his feet and turned around. He didn't address me; he addressed the audience and announced that everything I said was nonsense. (all laugh)

TC: And that makes it hard to respond.

WW: It does make it hard to respond.

TC: (laughs)

SF: So these stories are coming from the days when karst was first starting to establish itself as more of an independent, stand alone discipline?

WW: Yeah, there's—let's see. I would have sort of divided—the evolution of the science in North America and the story in Europe is a little different. The story in Russia and the story in China are also different. But there was a period along about the late 1800s, early 1900s, when people were accepting cave streams and things more or less for what they were. Okay, and it wasn't quantitative, but it was descriptive.

In the time frame of about 1930 to about 1942, there was a series of papers written: a very famous one by the father of geomorphology, William Morris Davis, that essentially used this developing theory of groundwater flow and porous media to apply to the origin of caves. The caves are very old objects. They're related to deep groundwater circulation beneath old erosion surfaces that the ages date well back into geologic time. And what we see today are just fragments, remnants of—as erosion has exposed these things and there they are. And there was a big debate about whether caves form deep below the water table or somewhere near the water table, or even occasional voices that said, "Maybe they form above the water table."

And this argument went on, and I think the rest of the geological community simply got bored. Best explanation I can think of, at any rate. And the textbooks repeated it, so the

next twenty or thirty years, when the textbooks would talk about caves, they'd quote these old papers and this old water table argument. And in a couple of paragraphs, the subject was, you know, you'd taken care of it.

And my date for the beginning of the modern period of karst science is about 1957 when there were a couple papers [that] appeared that attempted to address the flow of water through carbonate rocks, quantitatively, and [attempted to] figure out, okay, how long does it take a cave to form? How fast can you really dissolve this stuff? And a couple more papers that said, wait a minute, there's good geologic evidence that says that most of the caves, and we're talking about eastern United States here, are really related to contemporary drainage basins. They evolve with the drainage basin. And it's a whole different mindset and a whole different perspective on this subject, and that has developed more or less continuously since then.

So really, I think it was probably hydrology that was the science that carried it along. We've added other things as time has gone on, and it's a fairly complicated subject and a very diverse subject today. But—

TC: One of the things that, as a person from a library perspective looking in to your community, is the interdisciplinary nature of what you all do, and it just—it seems almost impossible that to pursue any karst subject without having multiple disciplines of expertise. Do you find that to be the case?

WW: It is. The French, in particular, back in—all the way back in the 1800s—decided that there was a science that they called speleology, which was the science of caves, and it included everything: you know, the water, the minerals, the biota, archeological remains found in caves. It just covered the entire subject. And then scientifically it started to say, wait a minute, you know, what these things all have in common is they involve caves, but maybe they don't. And so the subject kind of split apart, and now it's been reassembled again. And we've discovered that, particularly, a missing component of the whole business had been the microbiologists and microbial processes that go on underground, which turned out to be much more important than anybody would have guessed as little as ten years ago.

SF: So, Bette, what's your take on the interdisciplinary nature of the discipline? You've certainly—you're certainly an example of that, coming from civil engineering.

BW: Well, what Will and I have done is, I think, we're one of the first to tie surface water hydrology and groundwater hydrology together. And actually, some of the early conduit flow hydraulics in civil engineering was applied to groundwater flow, and I think we—

WW: Well, this is where some of our early work came from, you know. There's a back [story]. You also have to realize that geology itself has evolved over the same forty or fifty year timeframe. And there was a time, about the time I was moving from chemistry into geology and merging these things together, that, you know, if you can't handle the math and you can't handle the quantitative concepts and if you can't handle the physics and if you can't handle the chemistry, be a geologist when you don't have to know any of those things.

BW: And actually, remember, I did my Ph.D. thesis, which was on the sixty-two carbonate basins in the Appalachians. Will was my field assistant.

WW: (laughs)

BW: And so—

WW: She got even, you see! (all laugh)

BW: So I was looking at flood flow and low flow. Well, the low flows were really controlled by what's going on in the groundwater system, and the peak flows were controlled by really what's going on on the surface. And so he and I then published a lot more papers about the interrelationships between these two criteria.

TC: Tell us about some of your students that you've had over time.

WW: I presume you want to know about the students who [worked]—

BW: In karst.

WW: In karst.

SF: Right.

TC: Yeah.

WW: Okay. Well, we can kind of chug down the line. There's been an assortment of people.

One of the first karst Ph.D. students, I guess, is a fellow named Henry Rauch, who is presently on the faculty at West Virginia University in Morgantown. I put Henry to work trying to figure out whether development of solution cavities and caves really prefers certain paths through the rock, certain rocks. It looked superficially like looking at the caves at—the caves pick out certain rocks that they dissolve more readily than others.

So, we put Henry to work going through all the caves in central Pennsylvania and estimating their volume, which is much more difficult than estimating their length, and also figuring out which carbonate rock unit—we've got a very complicated series of carbonate rocks there, and they're all broken up into little groups and names by the stratigraphers—and figure out which rock it was in and work out the results. And the result of this was a bar graph which shows that predominantly all the caves in the valley, in spite of equal access to the rocks, picked out about two rock types out of that. He spent a lot more time trying to figure out what was unique about those rocks than just distinguishing the others; but it was a study of that particular figure in his paper [that] has been borrowed by a lot of people since then.

And [there was] a master's student by the name of Evan Shuster, who went on to go to work for the Pennsylvania Department of Environmental Protection in their mining program, actually. But we decided to look at the chemistry of the springs there in central Pennsylvania, and he had a collection there of about fourteen springs in one direction and another dozen or fourteen in the other direction, and he would go by about every two weeks and measure the sample of water and analyze it. And we discovered that the springs fell into two neat groups. There were those where the chemistry bounced around all over the place, and there were those in which the chemistry was essentially constant, which later turned out to be springs that are fed by conduits, by cave systems—even though there's no evidence of a cave system; it's just water coming out of the ground—and springs that are fed predominantly by fractures.

[Evan and] I wrote a lengthy paper. Poor Evan: coursework was not his strong suit, unfortunately, because his master's thesis would have earned him a Ph.D. in a number of places. It was really an outstanding piece of work, and the paper that was written from it is still being cited thirty-five years later, and I've always felt kind of bad about that. I mean, he did far more work than would really have been expected from a master's student. But—

TC: Did you expect your textbook to have the effect that it did?

WW: You know, I really don't know. I struggled along for a long time trying to write that book and I eventually got it done, and we sort of floated it out there, and what amazes me is that the bloody thing is still in print! I mean, you can't say that about many books published in 1988.

TC: Well, you know, when I was trying to learn a little bit about karst to be more effective at this project, I asked Len Vacher at University of South Florida, you know, "Len, give me a couple of books that I can go and read," and he gave me yours—I think there were three, and yours was the first one he mentioned. He said, "You got to read Will White's book."

WW: (laughs)

TC: So I said, "Okay." I will tell you that the math is above my level, but I'm working my way through it. (all laugh)

SF: That was the first one that I read, actually. My advisor had said, "You need to read White's book from 1988, and you need to get Ford and Williams as well." And of course, the Ford and Williams book was only available in hardcover for about three hundred dollars every place I looked; and yours was a comparative bargain, for about seventy or eighty.

WW: (laughs) That's because the bigger publishers keep ratcheting up the price all the time. But it was written as a textbook; it was intended to—and I had thought about it as my—the audience—and I'm sitting there at the keyboard looking out and imagining people sitting out there would have been seniors and beginning graduate students at about that level, which is why there's some chemistry and a little bit of mathematics. Not very much, actually. (laughs)

TC: Well, librarians are not known for mathematical acumen.

WW: But trying to write it in such a way that would be useful to these sorts of folks, and I guess it must have been; but I don't make any pretense that I can predict things like that.

SF: (to BW) I know that—I heard from someplace that you wrote a book on optics, was

it?

BW: No.

SF: No, that wasn't you? Okay. Then Lee Florea's lying to me.

BW: Oh. (all laugh)

SF: He told me I should ask you about your optics book. So much for that. But you've—you have written books, though, haven't you?

BW: No, I've just co-edited books with Will.

WW: We have one joint book on karst hydrology of the Mammoth Cave area that Bette and I put together.

SF: Right, okay. So, I know that you've worked in various places throughout the United States. I know that you've worked—you did some exploration of Crystal Cave. I know that you worked—you did some work at the central Kentucky karst; I know that because I have cited that paper in my own dissertation. So where—what were your most interesting locations for research in caves with karst?

WW: I get asked that question.

SF: Do you?

WW: And I don't have an answer because, you know, I've never seen a cave I didn't like and I've never seen a karst area I didn't like. Some people will do—predominantly will do field work and that's their thing; and some folks work in the lab and that's their thing. And I do both. And some people have certain field areas. They say it's their favorite place and they go there summer after summer after summer. I've always said, "Well, where are the field areas that could teach us something new?"

So, we looked at, obviously, the limestone valleys of central Pennsylvania. They're right outside the door. There's been a mention of Evan Shuster's thesis. There was another

master's thesis on nitrate contamination in groundwater, and there's Rauch's thesis—well, the field part was. Okay, that's convenient, that's okay, but [I] was interested in Kentucky because it's the Mammoth Cave area. It's the longest cave in the world, and I put a lot of time ourselves—Bette and I were down there extensively and we've written a fair amount about it, including the book that I mentioned.

And there was a graduate student named Jack Hess, who did his Ph.D. thesis doing quantitative chemistry and things like that; and I was closely involved with another student. Another person was the advisor, but the other person was only there once. [It was] on the structural controls on cave development and so on. Hess, incidentally, is currently the executive director of the Geological Society of America. So, I guess having a karst background didn't do much [to harm] his career. That's sort of the evolving state of things.

But I was interested in tropical areas, and so I sent a student off to Puerto Rico to work on the Rio Camuy drainage system. He never came back. He really liked Puerto Rico and did his degree, but he got a job at the USGS in Puerto Rico and was there for—

BW: Jamaica and Isla de Mona—

WW: George Veni did his thesis out in the hill country of Texas, because that's where he wanted to work. That was his country. He said, "Can't we do that?" (response) "Okay, we can, where do you want to work? We can work up something that—we can do something."

Did a little bit in the Black Hills with the mineralogy at Wind Cave and—I don't know. Here, a lot in the work—a lot of work up and down through the Appalachians. A student named Ira Sasowsky did his Ph.D. thesis in the Obey River gorge in the Cumberland River drainage in Tennessee.

BW: One of my watersheds.

WW: (laughs)

SF: One of your watersheds?

WW: Oh, yeah, she owns personally the watersheds she worked on for her thesis.

TC: Oh!

WW: She decided they're her personal property. She keeps track of them. (laughs)

TC: The best way to preserve it is to take it.

WW: But, no, so it was always a question of going where there was something interesting to be done. It wasn't dictated by much of anything else.

TC: You said that you never met a cave you didn't like. Explain that to people. What is it that you see, both of you, what is it that you see when you see a cave?

WW: You know, that's this unanswerable question. It's like there's a little kid out there wandering around in the woods looking for caves. You know, why in the heck would I do that? All the other kids were playing baseball or something, and I go in a cave. I like show caves. I'll happily walk through a show cave and look at it. I've gone through some caves that are beaten up and trashed that have been used by, you know, local kids for years and years and years and are busted up, and you know, graffiti all over the walls and trash strewn all over the floors. I look at that and I still find the cave very interesting. But I can't explain it; I can't give you an explanation for it.

TC: Bette, what is it for you?

BW: Well, there's two things. One is that I think they're beautiful. They've got such beautiful formations and—but also, we've found that they're really an interesting phenomenon of, why is there breakdown in the cave? And so we have done a lot of research on the strength of the limestone and why is this limestone stronger than this one. In fact, in Isla de Mona, the limestones are not the same as they are in the United States. In Isla de Mona, they're tough rather than—what's the other word?

WW: Limestones around here are strong, but brittle.

BW: Right, strong and brittle, and the other ones are tough and non-brittle. And we've written a couple of papers on that. They're mostly just interesting and fascinating.

SF: So, I mentioned Crystal Cave. I saw something on the Internet about you having explored Crystal Cave, and from what I understand, that's no longer open to the general public anymore.

WW: Which Crystal Cave are we—

SF: In Wisconsin.

WW: Nope.

SF: No, it wasn't you? Okay.

WW: [You've] got to watch what you get off the Internet.

SF: Yeah, well, that's—I was going to ask you for some details of—

WW: That's in the same category with her book on optics.

SF: Yeah, apparently so.

BW: Crystal Cave in Kentucky.

SF: In Kentucky? Okay. I might be confusing—

WW: Every state has got a Crystal Cave, but—

BW: At Glacier.

WW: The Mammoth Cave, as it is known today, is actually from stringing together about five or six big caves, one of which, one of the first ones, was Floyd Collins's crystal cave, which is north of Mammoth Cave. And for a long time the caves under Mammoth Cave Ridge and the caves under Flint Ridge, the next ridge to the north, were completely

independent, but there were Great Salts [Cave], Colossal [Cave], and Crystal [Cave]. The three big caves on Flint Ridge were strung together back in the sixties [1960s] into a single integrated system, and often it was referred to as Crystal Cave in a lot of the work that we did in Kentucky in the sixties [1960s], that may be where the Crystal Cave came from.

SF: That could be.

WW: But it wasn't Wisconsin.

SF: Okay. But tied to that same story—and again, it's online, so the veracity is naturally in question until you can confirm it. But there was a story about you exploring this cave and something about a haunted telephone.

BW: (laughs)

WW: Oh, boy! Yes, that was Crystal Cave in Kentucky.

BW: Yes.

WW: It really was.

SF: Okay, what can you tell us about that? I'd like to hear that story. (laughs)

WW: I don't know where—let's see, this is supposed to be a historical record, isn't it? That tale has really gotten passed around. It's in—Colleen Olson, [who] works at Mammoth Cave National Park, wrote a little book about scary stories in Mammoth Cave and she's got it in there; and somebody else wrote a book on, you know, supernatural phenomena in national parks, and I got a phone call from this guy one night wanting to know about it.

Okay, well, why not? Crystal Cave is an old show cave. It was discovered by Floyd Collins himself back in 1917 and opened up as a show cave to compete with Mammoth Cave. I mean, the Collins family were poverty ridden central Kentuckians living on this scrubby farm back on the ridge, on Flint Ridge. And to go in the cave, the old show cave, you walked through the entrance and there was a nice long very tubular passage, nice

comfortable walking height passage, and for a couple—maybe a hundred and fifty yards or so, and then it came intersected with a big canyon and you drop down this hill. The trail just zigzagged down, dropped about a hundred feet in elevation to the bottom of the canyon, and there was a big cross passage at the bottom of the canyon.

Okay, so Floyd Collins died in Sand Cave in 1925—that's another long complex story. But at any rate, in the early sixties [1960s], Floyd was interred in a coffin sitting there at this intersection between this big canyon and the cross passage at the bottom. And I always thought putting a granite tombstone in a limestone cave was kind of weird, but at any rate—

TC: (laughs)

WW: There's his tombstone. There's his coffin, and the tourist trail went right by it, and then the tourist trail went across and went up the other side of the canyon to one part of the cave. But the trail forked, and at the fork there was a passage. [It] went up the big bottom lower passage off to the right, and that was the one that went fairly deep down into the cave system.

So when they were doing this thing as a show cave, they had an old army telephone laying there just on a ledge, about a yard from the coffin, just on the other side of the trail. And they would—the guide would take tourists in, and then they would ring up the ticket office and they'd say, "Well, okay, we're going to send a couple more people down to go on this much longer walk back through the cave." And it was still laying there. The cave had been closed, but in 19—oh, I have that exact date some place in my notebook. But at any rate, around 1962, the phone was still laying there, although the cave was no longer a show cave. It had been bought out, bought by the park several years earlier, and was now part of Mammoth Cave National Park.

So, we were going into the cave with the idea of going down to the lower levels to do some geological work. There's the grad student I mentioned who was working on the cave, a guy named George Deike. He and I walk on in there and we start down this windy trail down into the canyon, and we hear this ringing noise. Okay?

I look at George, George looks at me. You know, okay. And while we're doing that, it rings again, and it's very definitely coming from the bottom of the hill down there. So, it's one of those things you gotta know. So we both took off at a dead run down the trail. You've got to find out what's going on. And so we get down to this trail junction. Here's the coffin on one side of the trail. There's the telephone on the ledge, and the phone rings for a third time. It was the phone, it wasn't the coffin. That we considered good.

So I pick up the phone, an old army telephone, [with a] little butterfly switch on it. You know, you can listen and you can talk but not at the same time. You've got to click the switch. So I click the switch and I say—and the phone's alive, I can hear. I say, "Hello. Is somebody trying to call Crystal Cave?" And I hear this—you know, if you've ever listened on a phone and somebody that you're talking to has laid the phone down and gone off somewhere but there's people in the room, you kind of hear voices in the background. You can't quite make it out, but there's kind of background babble going. That's what I could hear.

So then I hear some noise that sounds like somebody has picked up the phone, a phone, somewhere. And so I say again, "Hello. Is somebody trying to call Crystal Cave?" and there's this startled gasp and the line goes dead.

(all laugh)

TC: And that's it?

WW: And that's it. Okay. I put the phone down. George and I continued, went down, worked our way down to the water levels, did whatever it was we were doing. Coming back out of the cave, you know, four or five hours later, we were approaching this junction with a certain amount of trepidation, but everything is quiet. And we walk on, and we climb up out of the canyon and walk out the upper passage and out the entrance. But we're tracing the phone wires as we go, and we get to the surface and we're going up the trail to the old ticket office, and we found the phone wires dangling from the pole where they'd been cut. (laughs) That's the story.

TC: No explanation?

WW: No explanation for it at all.

SF: (laughs) Very unusual.

WW: But that was the story, and that's—essentially, what I just told you has been published twice by somebody or another. So, you can have it in the record here.

SF: Well, we set the record straight, at the very least.

TC: Right.

SF: Okay, well, I'd like to talk a little bit about—I guess more [about] how you see the relationship between professional karst scientists and the amateur or recreational caving community. I'd like you to offer your perspective as well, Bette. How do you see those two groups relating to each other or interacting with each other? What do you think that's —

WW: Well, you know, you've got to understand that I was one, right. I came out of that particular community, and so I'm—you know, I feel very good towards all this gang that's around here. These are all, in some sense, friends of mine.

SF: Sure.

WW: But from a professional point of view, the cavers are absolutely indispensable. I mean, leaving aside the fact that, you know, I empathize with them very well. Because there's no way that any individual research type could possibly map, explore, map, and collect the amount of detail on caves that these folks have generated.

And the quality of the maps that are being made these days are just incredible. Which—you can just simply walk through the map salon upstairs in the gym there, you know. And those things have taken—some of those maps have taken thousands of man hours, person hours, to do. And there's all this data, and it's there. And I've—Bette and I have written a couple of papers where we've just taken cave data and, you know, basically measured off things and plotted it up and found out relationships about caves. And there's no way we could have done it without the database.

And I think one of the reasons why the old timers of the 1930s, very famous guys like William Morris Davis and J. Harlan Bretz [and] so on, got so far off the rails was [that] they didn't have any real data! The cave maps of the day were very, very crude and not very accurate, and I think they misled them. So, yeah.

SF: Bette, would you agree? How do you see it?

BW: Oh, no, I just agree. There's no way even now—the caving that's being done is these

horrendous trips into caves where they have, you know, four inches of air space, and they go for miles and [they are] really difficult caves, and there's no way that Will and I could ever do any of that. And so now, they are publishing all of this data and we're using it.

SF: Do you think this relationship has changed or evolved over the course of your time spent working in karst areas?

BW: What people are doing now is far more difficult than what they did many years ago.

WW: Yeah, that part has changed. The standards have changed. The cavers have now had this "map as you go" sort of philosophy. [When] you discover a new cave, you don't just go romping off down to see where it goes. You pull out your tape and compass and start surveying your way down the passage; and it's considered kind of in bad taste to do what they call "scooping," which is just sort of running off through the cave without first making a map of it.

But in terms of the professional relationships, I think, you know, the modern era of karst science really did sort of evolve from the cavers. If you look at the people who have done most of the work, you find that, whether in the closet or not, they were cavers somewhere along the line. And professionals had, you know, no interest whatsoever in caves, thought caves were completely irrelevant to what they were doing, have come around. And they're saying, "Hey!" You know, this is particularly true with one of the current hot topics in the subject, which is caves as paleoclimatic archives. Where, you know, wow! There's this thing that used to be a stalagmite to show to the tourists in a show cave, maybe. Turns out there's a nice climatic record, if you can figure out how to read it.

And so they—it's all gotten blurred, now. You know, we don't—we can't really say there's the caver related and there's the others. The boundary's disappearing.

BW: And also, take for instance what's going on in Hawaii, where Will has been asked, "You've got to come to Hawaii," for years and years, you know, you've got to see the minerals in the Hawaiian Caves, and it's all the amateur cavers who are saying, "Come see this, and tell us what it is." So—

TC: So you need to make a trip!

BW and WW: (both speaking at once) We did!

TC: Oh, okay.

WW: Oh, and, uh, we've got an article on lava tube mineralogy, which is coming through the pipeline.

TC: Okay, okay.

WW: (laughs)

TC: So, we'll be able to read it.

BW: Yeah.

WW: Yeah, yeah.

TC: What is the—as we are dealing with this issue of climate change, what—do you think this is going to help raise the profile of karst—

WW: Yeah.

TC: —research and karst science?

WW: Yeah, it—

TC: How?

WW: It already has. And that's got a certain amount of downside to it, too, in the sense that a lot of people who are interested in paleoclimate say, "Okay, there's a—you know, we can get a record from a stalagmite," with no notion about what caves are, no notion of conservation ethics. And there's a certain amount of concern about some of these folks who are coming in from the outside. Not that I object to them coming in from the outside, but I've got a certain objection, a very large objection, to them coming in and just sort of —"Well, you know, we don't know which one of these we're going to use, so let's bust

out all twelve of them and take them back to the lab and then we'll pick and choose," and that kind of thing. And so there needs to be some cross education, which is what some folks are trying to do at the moment.

But no, as far as caves as objects, you know, interesting objects to study, there's no—it's spreading, all through the community. And you can also document that if you look at the programs of the Geological Society of America, which is probably, you know, the largest gathering of geologists in the country and go back twenty years. And you might find, oh, three or four talks being given on some karst subject, maybe. And, you know, by that time they would have been accepted for the program, but there weren't very many of them. Now, if you look at the programs of, say, the last five years, you'll find that every year, there's anywhere from one or two to four or five complete symposia dealing with aspects of karst related thinking.

One of the things I've been meaning, if I go back through, if I had the time to do it, is just to plot this up. I think we would find ourselves with an exponential growth curve of the sort that you see in many other fields.

TC: Tell us a little bit about your relationships with international groups and individuals.

BW: (to WW) Talk about our invitation to go to China.

WW: Well, there's—yeah, let me get to that. They, uh—

TC: Do you want to take a break?

WW: No.

TC: You okay?

WW: I'm okay. You okay?

TC: Okay, that's fine.

BW: I'd like standing, though.

TC: Okay, that's fine.

(all speaking at once)

WW: The main international contact has been with the—through the International Union of Speleology and the International Speleological Congresses. And as far as contributing to the Congresses—I think the first one was clear back in 1961, but [I] wasn't able to go to the Congresses. They were held in Europe, basically; I couldn't afford it. But I sent papers and had papers read at the meetings and prepared [published] in the Congress proceedings and so on like that.

So, the 1981 Congress was in the United States and Bette and I attended that, and after that, we've gone to most of them since then, the most recent one being one held in Greece, in 2005. We've also had a certain number of people from overseas who come to work at Penn State and work with me, people from—well, Julia James from Australia; and, well, Bogdan Onac, one of your own guys there, got in because he came in on a Fulbright and spent six months at Penn State.

BW: Michael Hauns—

WW: Yeah, a grad student—the laboratory [a colleague university] of Neuchâtel in Switzerland sent one of their grad students over to, you know, hang out with my grad students for a while; And so, yeah, there's been a fair amount of contact. When I think over the last ten or fifteen years, it's been pretty extensive.

And Bette was mentioning China. The Chinese are developing what they call geoparks around some of their very spectacular karst features, and they would like to have these—they'd like to have them better known, they would like to have them listed as a World Heritage Site. Basically, it's a matter—at least to the politicians, it's a matter of drumming up trade. And Professor Zhu at the Karst Institute in Guilin came up with this scheme, convincing the provincial governments and several of the karst provinces in China to ante up the money to bring in an international team of experts to look over these features and offer their considered opinion from a more world point of view—whether these things are as great as they think they are and, you know, the rest.

And we were invited, and Art Palmer and his wife were invited. We were the two American sets of delegates to that thing, and we spent a couple weeks being treated as

VIPs and touring around China and being shown all kinds of things. We had a fellow from the Ukraine and we had our friend Julia James from Australia, and we had a couple of Brits. [We had] a couple from Slovenia. It really was an international group, and I can say that we were mightily impressed by what we saw.

So yeah, there's been a—I'd say that over the last ten or twenty years, and this, I think, is probably true with most of the karst researchers in the United States, the international connections are pretty well sewed in place. There's—[in] the very early days, again, as we move from the 1957 time frame forward, the people working in the U.S. tend[ed] to be pretty isolated, because they were mostly, after all, at that time mostly young grad students, faculty members. [They were] people that didn't have a whole lot in the way of resources [so] that they couldn't go stomping off to meetings in Europe and things like that. So—

TC: As you look at the karst terrains as you travel, what is the condition of these terrains? What's going on from your perspective over the time that you've been working in this area?

WW: Well, like most of the rest of the planet, it's getting overrun with people, and this has been true in the south central Kentucky karst. There's an area that at one time was mostly rural and mostly farming communities, and caves and sinkholes and things like this that [were] kind of a nuisance to farmers, but they just leave the sinkholes grow up in a clump of trees and, you know, farm around it, and it's not a big deal. But whenever a developer comes in and decides to put in a housing project in this same terrain, the fact that the basements are sagging and falling in and sinkholes flood and all the rest of it, well, it's a major problem and it causes a lot of trouble. And the—what the people refer to as geo-hazards in karst areas, a lot of attention being given to that subject these days. But people are certainly aware of it, but [it's] not at all obvious what you can do about it.

TC: Right.

WW: Except go somewhere else.

TC: Right.

BW: In one of the most expensive places to live in State College, where we lived up until a few years ago, there was a sinkhole, and that's where they dumped the old refrigerators and everything that they could think of, and they just lined it sort of with trees. (all laugh) And this is "The Greenbrier," which is, you know, the place to live.

TC: We visited Lost River Cave on the way up—I drove up from Florida—and they pointed out that that was a dumping zone for many, many years.

WW: The one there near Bowling Green, yeah. Bowling Green, Kentucky, is the poster child for just about every karst problem you can imagine. We don't have quite the sinkhole problem of Florida.

TC: Right.

WW: The sinkhole [problems go] up through the Appalachians, through the interior low lands. Those generally don't eat entire houses or take big chunks out of shopping malls or something, but they also do some things.

TC: (inaudible)

(all laugh)

SF: BMW dealerships. I've seen that happen.

TC: Oh, yeah.

SF: (laughs) So you mentioned—you talked a little bit about paleoclimatology and caves and how that can be one of the future, I guess, productive future avenue of research in karst science. What other directions do you see karst science taking in the future that might turn out to be particularly productive?

WW: I'd better answer that question carefully, because the Karst Waters Institute sponsored a meeting out in San Antonio in early May in which the whole purpose of the meeting was to talk about frontiers in karst research and where is the field going and what kind of advice could we collectively—about a hundred people who showed up for this workshop—what advice could we give to people at the National Science Foundation and the EPA and other agencies as to what was worth spending money on and what wasn't.

So, yeah, hydrology is in there, nobody was going to throw it out; and paleoclimate is in

there big time, and microbiology. It turns out caves are of considerable interest these days as the habitat for extremophiles, and so we have NASA, of all the unlikely people, putting money into cave related research, particularly by the microbiologists. Penny Boston at New Mexico Tech comes immediately to mind, because they're looking for environments which might mimic the prototypes or give some insight into environments that you might find on other planets—on Mars, or maybe you're going to drill into that, under the ice lake on Europa or whatever it is they've got in mind doing.

And so, all of a sudden, caves have come up again, in an entirely different scientific context. And it's because of the microorganism; in fact, the little buggers seem to be just about everywhere, and living in environments where you would guess that nothing would be able to live. The biologists like caves because they're—they've been used for years as laboratories for studying evolution, because you've got much simpler populations and much less complicated interrelationships between the organisms that live in caves. And so, studying biodiversity and such is another of the topics that was flagged out by the biologists as something of interest.

And one of the third biological topics, since I can only speak as an observer from the sidelines, is that—what they call lineages. You know, [this topic includes] when species are splitting into new species and what's the timescale of which this kind of thing happens, and the cave as a habitat for one isolated population and when did it become isolated and how does it relate to some adjacent cave, whether it may be a different species of the same organism. So that's considered something of considerable value to biology at large, not just the very specialized subject of the biology of caves.

Let's see, other than that, we of course said—well, there's the whole subject of applied issues: geo-hazards, sinkholes, floods, soil piping failures, waste disposal, [and] water supply. You can make a long list of ways in which humans and karst interact, and trying to understand this with more scientific precision than we have at the moment, something definitely we're doing.

So that's a synopsis of the report that I'm in the process of trying to edit, right—as soon as I get back from this meeting. (all laugh)

SF: Okay, that's all I got.

TC: All right. Is there anything you'd like to add? Any stories that you feel like we need to document? They're in your head.

WW: (laughs) Yeah. I don't know, what all are you trying to capture with these interviews? I mean, I was—

TC: Let me go ahead and I'll turn it off and then—

End of interview