ORAL HISTORY INTERVIEWS

Robert Trefzger

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STATUS OF INTERVIEWS:
OPEN FOR RESEARCH

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Robert E. Trefzger

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Editorial Convention

A note on editorial conventions. In the text of these interviews, information in parentheses, ( ), is actually on the tape. Information in brackets, [ ], has been added to the tape either by the editor to clarify meaning or at the request of the interviewee in order to correct, enlarge, or clarify the interview as it was originally spoken. Words have sometimes been struck out by editor or interviewee in order to clarify meaning or eliminate repetition. In the case of strikeouts, that material has been printed at 50% density to aid in reading the interviews but assuring that the struckout material is readable.

The transcriber and editor also have removed some extraneous words such as false starts and repetitions without indicating their removal. The meaning of the interview has not been changed by this editing.

While we attempt to conform to most standard academic rules of usage (see *The Chicago Manual of Style*), we do not conform to those standards in this interview for individual's titles which then would only be capitalized in the text when they are specifically used as a title connected to a name, e.g., "Secretary of the Interior Gale Norton" as opposed to "Gale Norton, the secretary of the interior;" or "Commissioner John Keys" as opposed to "the commissioner, who was John Keys at the time." The convention in the Federal government is to capitalize titles always. Likewise formal titles of acts and offices are capitalized but abbreviated usages are not, e.g., Division of Planning as opposed to "planning;" the Reclamation

Projects Authorization and Adjustment Act of 1992, as opposed to "the 1992 act."

The convention with acronyms is that if they are pronounced as a word then they are treated as if they are a word. If they are spelled out by the speaker then they have a hyphen between each letter. An example is the Agency for International Development's acronym: said as a word, it appears as AID but spelled out it appears as A-I-D; another example is the acronym for State Historic Preservation Officer: SHPO when said as a word, but S-H-P-O when spelled out.

Introduction

In 1988, Reclamation created a history program. While headquartered in Denver, the history program was developed as a bureau-wide program.

One component of Reclamation's history program is its oral history activity. The primary objectives of Reclamation's oral history activities are: preservation of historical data not normally available through Reclamation records (supplementing already available data on the whole range of Reclamation's history); making the preserved data available to researchers inside and outside Reclamation.

A note on the nature of oral histories is in order for readers and researchers who have not worked with oral histories in the past. We attempt to process Reclamation's oral histories so that speech patterns and verbiage are preserved. Speech and formal written text vary greatly in most individuals, and we do not attempt to turn Reclamation's oral histories into polished formal discourse. Rather, the objective during editing of interviews is to convey the information as it was spoken during the interview. However, editorial changes often are made to clarify or expand meaning, and those are shown in the text.

Questions, comments, and suggestions may be addressed:

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For additional information about Reclamation's history program see:

www.usbr.gov/history

Oral History Interview
Robert Trefzger

Petershagen: This is George Petershagen conducting an interview of Bob Trefzger for the U.S. Bureau of Reclamation's Oral History Program. Mr. Trefzger was a geologist for the Bureau of Reclamation throughout his career and has retired from the Bureau of Reclamation. Today's date is July 12, 1994, this is tape one, side A.

Bob, before we get into real details of your career with the Bureau of Reclamation, I would like you to acknowledge that you've consented to tape recording this interview.

Trefzger: Yes, I've consented.

Petershagen: And that you understand that the Deed of Gift you signed makes this interview the property of the United States.

Trefzger: I understand.

Petershagen: And it will be open for researchers, historians and so forth as they attempt to explore the history of Bureau of Reclamation.

Trefzger: Yes, I understand that.

Petershagen: Thank you! Let's start with your birth and childhood if we could. Where and when were you born?

Early Life

Trefzger: You mean you want the date?

Petershagen: If you know it! (laughs)

Trefzger: Yeah, I know it.

Petershagen: If you remember it.

Trefzger: Oh, I don't remember it, but I know it. I was born February 19, 1925, in Rochester, New York. The reason I was born there is because that's where my dad had a job. Within a few months, he was transferred to Pasadena, California. So he and my mother and I came to California, via my mother's relatives in Colorado, and settled down in Pasadena, and they spent the rest of their lives there, virtually.

Petershagen: So you're not technically a native Californian, but almost a life-long Californian.

Trefzger: Right. Yeah, I must have been on the order of maybe six or seven months when I got here to California.

Petershagen: And then you were raised in Pasadena?

Trefzger: I was raised in Pasadena.

Petershagen: You went to Pasadena schools?

Trefzger: Right.

Petershagen: What high school did you go to?

Trefzger: Well Pasadena had a funny system there–they call it a six-four-four system, where you went six elementary grades, and then you went in seventh grade to junior high school, which lasted through tenth grade, and then all the tenth grade graduates–and there were five junior high schools–went to Pasadena Junior College to take the last two years of high school, and if they wanted, the first two years of college. That's the last four of the six-four-four.

Petershagen: I see.

Trefzger: And they don't do it that way any more, but that's the way they did it when I was there.

Petershagen: Interesting. So you went through that entire program?

Army Experience

Trefzger: Well, I went through until the Army grabbed me in 1943. Then I went in the service and went down to Fort Benning for basic training, and then they transferred a bunch of us to the 94th Infantry Division down in Camp McKay, Mississippi. And from there we went through the P-O-E [Port of Embarkation] and we were sent over to Europe on the Queen Elizabeth, which was quite an experience, because we didn't know about sonar and things like that, so

we were all watching for subs. But the Queen Elizabeth zig-zagged every three minutes going across the North Atlantic, and we arrived off the north coast of Ireland in about four days. They unloaded us in the Firth of Clyde, offshore from a town called Grenagh. But we don't want to talk about my military history.

Petershagen: Oh yeah, we do!

Trefzger: Oh, you do?

Petershagen: We do. Continue, please.

Trefzger: Well we just spent a few weeks in England. We landed in the middle of August in '44, so it was well after D day [June 6, 1944]. We landed on Utah Beach on D+94, and then they sent our division down to Brittany where the Germans were penned up in the Saint Nazaire and Lorient submarine bases. So we were there all fall of '44, and we were there when the Battle of the Bulge started, of course.

And then something happened that changed our fate, because a German submarine torpedoed a troop ship coming across the English Channel. It had a couple of regiments of the 66th Division on it, and an awful lot of those fellows were killed in this torpedoing. And so the 66th, in its weakened condition, relieved us, and we were sent to help General [George] Patton.

We got into the German border area in early January of '45, and proceeded to start attacking the fortifications along the German border, which was a very frustrating experience because they were made out of concrete several feet thick, and that's hard to tackle with a rifle. So after . . . It was a very cold winter and we had a lot of casualties from frostbite as well as from the normal warfare things. So I think our division ended up with over 10,000 casualties altogether–about half were combat-related and half were frozen feet, basically.

Petershagen: My!

Trefzger: And this was just a couple months of action, really. So we were involved in crossing the Saar River, our division was, and our regiment was with the 10th Armored Division, and the 10th Armored Division went charging into the German city of Trier on the Moselle River. Since our regiment was attached to them we had to come along behind them and pick up the German *zoldottens* [phonetic spelling] who wanted to surrender. And if they didn't want to surrender, we had to persuade them. So this was in about early March. And a couple of weeks later, they had a big push to the Rhine River, and then they pulled us back. We went up and held down the west side of the Rhine River while big pinchers

were closing off and reducing the whole Ruhr area. So we stayed. Then we went over *in* the Ruhr area to a place called Wuppertal, which is on the Lüder River, and we were there for several weeks. We were there when the war ended in May, and then they sent us to Czechoslovakia. And I guess John Turner was in Czechoslovakia too. I don't know if he told you about that. We must have been in the same area.

Anyway, we were along the Line of Demarcation between the Russian-occupied zone, which was about ninety percent of the country, and the American-occupied zone, which was kind of the southwestern ten percent. So the highlight of the stay in Czechoslovakia was getting to march in a parade in Prague, because Prague was in the Russian-occupied zone, and the Czech people were very enthusiastic in their greetings of these American G.I.s marching down their thoroughfares. They sort of had organized cheering sections where they'd say things like, "Hip, hip, hooray for USA!" And then other cheering sections would say, "*Nazda, nazda, nazda*," [phonetic spelling] which is a Czech word for "hello." Anyway, that was great.

Well then on Thanksgiving Day, my point number came up and I left the 94th Division and went to another outfit that was coming home, and we shipped out about December 20 and had a very rough three or

four days where we made up to fifty miles a day on the ship. Finally the waves calmed down and we pulled into New York harbor on New Year's Eve.

Petershagen: Pretty joyous New Year's for you!

Trefzger: Oh, that was the greatest New Year's Eve I've ever had, coming up New York Harbor. Anyway, so as soon as I got out of the Army I went back to school.

Petershagen: Where was that then?

College Education

Trefzger: That was at Pasadena–still called Junior College–it's City College now. Some buddies of mine were taking geology class as an elective, and every spring break the geology classes at P-J-C [Pasadena Junior College] would go on field trip someplace for the whole week. And this particular year, which would be the spring of '46, they were going to Yosemite. And so I said to myself, "Gee, that sounds like fun." So I asked these guys, "Well, I'm not taking geology, but do you think I could go along?" So they asked the teacher and the teacher said, "Oh, if you've got room in your car, sure." So they had room, so I went. And this geology teacher was incredible. He was so interesting the way he described the geology, and of course

Yosemite is a particularly good place to talk about geology anyway.

So by the time the week was up, I decided I wanted to take geology the next year as an elective. I thought I wanted to be a chemist at that time. So I took a geology course, and as the year went on, I got less and less interested in chemistry and more and more interested in geology. So that's how I happened to end up majoring in geology–because I'm sort of an outdoor nut to begin with. And geology is fascinating to me at that time–still is. So I switched majors and spent another year at what was now Pasadena City College, and then I transferred to Stanford in September of '48. Went there two years, including 1949 summer geology classes, which were partly in the Santa Ana Mountains, and partly in Nevada. So I got my bachelor's degree in June of 1950.

Petershagen: I see. Now, before you went in the Army, if I followed this correctly, you had no great love for geology, you were nowhere near a geology major prior to that time?

Trefzger: No way, right. I hadn't be really exposed to any geology–that was the problem, I guess.

Petershagen: Do you remember the instructor's name at Pasadena College that got you interested?

Trefzger: Sure! His name was Van Emeredge [phonetic spelling], a Dutch name. And he was a wizard, you know, the way he'd describe things and make it so that us neophytes could understand it. So everybody called him "Van," and I'm sure he influenced a lot of people the way he did me.

Petershagen: Alright. If we could return to the Army for just one minute, what rank did you hold in the Army?

Trefzger: Well, ah . . . Of course everybody starts out as a private–well maybe not everybody, but *I* did. And when we got overseas in France they promoted a lot of us to Private First Class. And then as we got into combat and people started dropping out because of being killed or being injured or having their feet frozen off, the attrition was pretty bad. So I got promoted to Sergeant. I was an assistant squad leader in an infantry platoon. As the attrition continued I became a squad leader, so I ended up as a Staff Sergeant–not because of any talent, but because of desperation.

Petershagen: So you were an infantryman all the time you were in the Army?

Trefzger: That's right.

Petershagen: You must have a combat infantry badge then.

Trefzger: That's right.

Petershagen: Okay, let's get you back out of the Army then, and back into geology.

Trefzger: Yeah, right.

Petershagen: Then did you go to work for the Bureau of Reclamation straight from Stanford?

Pre-Reclamation Experience

Trefzger: Well, when I was a senior in my last quarter at Stanford, there'd been an awful lot of ex-G-Is had gotten their geology degrees the year before, and there were a lot more like me getting their degrees in 1950. And so there really wasn't a big stampede to hire geologists at that time. And a few people around were interviewing, but not very many. So I was toying with the idea of doing graduate studies in geology, and then decided I didn't want to do that. And so my first job out of school after a couple of months of various mountain trips was to go to work for a geophysical exploration company called United Geophysical, which had its headquarters in Pasadena. And so they hired a bunch of guys fresh out of school with geology degrees, kind of as trainees. They'd have them work at

different jobs on the geophysical exploration crew.

So I worked as a driller's helper. A driller crew drills the hole to put the dynamite in. And I worked as a shooter's helper. He's the fellow that puts the dynamite in the hole and gets it wired up to shoot. And then let's see, I didn't work with a surveyor, but the surveyor lays out the shot lines. And I worked a lot as what they call a "jug hustler," which are the fellows that move the geophones from set-up to set-up and hook them up onto the cable which goes to the recording truck. And then they had us working in the office some, plotting up the data and that sort of thing. So it was very good training.

Petershagen: About how long was that?

Going to Work For the Bureau of Reclamation

Trefzger: Well, just a few months. Then I'd been working long enough, and seeing the sort of nomadic, gypsy-like life that these guys had, just because of the nature of their work, so I had about decided I wasn't really planning to make a career out of this, when I got an offer from the Bureau in Santa Barbara to come to work for them doing geology. So I jumped at the chance! I didn't know anything about the project, I didn't know anything about what they were

doing there, but I went there and found out that it was the Cachuma Project.[1] And they had a project geologist and they hired me to be his assistant. We had this six-and-a-half-mile-long tunnel going underneath the Santa Ynez Mountains. It's called the Tecolote Tunnel. Should I spell it?

Petershagen: If you'd like.

Trefzger: Well it's T-E-C-O-L-O-T-E. It means "owl" in Spanish. Anyway, this project geologist, had done a lot of the preconstruction geology work there. You try to go into each end of the tunnel each day, and since it took about an hour-and-a-half or so to drive from one end of the tunnel, around and over San Marcos Pass to the other end, it was getting to be, as the tunnel got further into the mountain from each portal, it got to be more and more of a burden on him–in fact, it got to be impossible. So he was able to persuade his boss that he needed an assistant, so I was that. So I got to go in one end of the tunnel every day, and of course the dams were being built then–especially Cachuma Dam,

1 The Cachuma project provides supply water for the historically water deficient communities of the South Coast area, including the venerable, old Spanish mission city of Santa Barbara, its smaller, urban neighbors, and 38,000 acres of outlying agricultural lands. The project stores floodwaters of the nearby Santa Ynez River. For more information see, Thomas A. Latousek, "Cachuma Project," Denver: Bureau of Reclamation History Program, 1995, www.usbr.gov/projects/pdf.php?id=91.

now called Bradbury Dam, and that was interesting. Had some interesting geologic problems there that had not been anticipated, and that always makes things more interesting.

Tecolote Tunnel

Petershagen: Did you have a particular end of the tunnel that was yours? Or did the two of you swap off periodically?

Trefzger: No, we kind of would take turns going to each end. I was familiar with each end. And the really climactic thing . . . See, I started to work for the Bureau on November 6, 1950. And the really climactic thing, I think, happened, oh, gee, it was almost just about two months when my boss, whose name was Harold, and I were in at the north heading of the tunnel where it was very interesting, because the rock was hardly even rock. It was like a loose, white sand. And although we didn't know it, there was a lot of methane gas in it. And later that same night, there was an explosion that injured the crew that was in there. It burned guys hands if they didn't have gloves on, burned their faces, it burned their chests if they had their shirt open. And fortunately nobody was killed or anything, but that really scared Harold because he had a large family of cute little kids. And I think in a few months, he left. And I think this was

one of the factors, the hazards of working in this tunnel. So everything was going fine until then. After then, things got worse. (laughs)

Petershagen: Now, when he left, did you move up then to take his position as project geologist?

Trefzger: Yes, it was decided that since everything was going so well, that they didn't really need to replace him, and that I could fumble along and get the job done. And so within a couple of months of the time he left, the south heading hit a difficult area where a bunch of ground-up rock, shale, came washing into the tunnel with a large flow of water. And of course the specifications that the Bureau had issued were kind of specific, and it said that the Bureau will direct the contractor on routing off excess water flows. And so the contractor said to the Bureau, "Okay, what do I do?" (laughter) The first thing he tried to do is, he said, "Well, I'm just going to go in and muck this ground-up shale out." It was hard little fragments, but it was really crushed.

And so they hauled three or four trainloads of this stuff out. As fast as they'd dig it out, it would come back in, or keep coming in, washing in. Of course nobody could figure out *why*, until much later when we figured out what was going on. So they decided jointly, I think, between the contractor and the Bureau, that they should

come back about fifty feet from where this happened and over-excavate around the tunnel and build a big concrete bulkhead with pipes going through it, and then they'd hook onto these pipes and they'd pump grout in.

Well, so what they did is, they filled the tunnel with loose sand to keep from having to fill it all with cement. Built the bulkhead, hooked onto the grout pipes, started pumping, and the bulkhead broke or slipped or something. Anyway, so they went back eighty feet *more*. What's that, about a hundred and thirty feet from the trouble area. And the rock was better back there, and they built a better bulkhead. And again they filled the inner space with sand, and they pumped a lot of grout in. They carried the pipes back so they could pump from down below the bulkhead, through the pipes, through the bulkhead and on up to where the water was coming from. So they pumped and they pumped and they said, "Well, that's all it's going to take, so now we'll dig all this stuff out and go resume tunneling."

Well they got back up to where the original problem had been, and the grouting had cemented together a lot of these rock fragments, but it had not cemented them *all* together. So the same condition existed of the water flows and the ground-up rock

coming in. So then the contractor got the idea, okay, the problem is two-fold: one is the ground-up rock and one is the water. Well, if we can dig little drifts out to the side of the tunnel up ahead of the heading, we can pull the water away from it, and then we can get through this ground-up stuff, by normal tunneling–driving spiles is what they call it, and breastboard and things.

So that's what they did. They came back, oh, maybe fifty feet from the face–or no, thirty feet back. And they went out forty-five degrees and then forward on both sides, with little wood timbered drifts about three-by-five, so you kind of had to hunch over to walk in the darn thing. And then they got up beyond where the bad place was in the main tunnel, they turned them in and intercept[ed] the water, and that way they finally got through it. Well, they'd gone about . . . oh, let's see, ("scats" while thinking) almost forty feet, and it seemed to be getting a little better down near the floor, but the contractor was getting very discouraged and so he wanted to stop until the Bureau could figure out what to do.

So they set up a drill in there and drilled holes up ahead, and sure enough, there was good rock up ahead. And the three-man consulting board said, "Well, you're doing just fine, just keep doing what you're doing. You got it made!" And so

they did, and sure enough, they got to good rock and then they had to decide, "Well, what shall we do now? We've still got all this water coming in, even though we have a tunnel through it." So they decided, "Well, we're going to enlarge the tunnel and line it with concrete, this part of it." And the reason they're going to enlarge the tunnel is so the concrete can be two feet thick, and that way it will withstand the pressure of the water. "And we'll put a drain in the floor with a valve on the downstream end. And if we get all this concreting done, keyed-in on both ends, then we can turn off the valve and the water will be contained."

So that's what they did, and it took months and months and months. And came the great day to turn off the valve, and it worked! The concrete lining had been grouted-in on both ends, so they did a good job. And so I said, "Oh, okay, full speed ahead." And so they resumed tunnelling. Well, they got the idea of grouting the flows ahead of excavation, which slowed everything down a lot.

Am I giving you too much "gory details" with this stupid tunnel?

Petershagen: No, no! Proceed, proceed!

Trefzger: I could talk three weeks about just the tunnel. Anyway, they were grouting ahead, they drilled holes about–a pattern of six holes at the tunnel face, kind of radiating outward and forward–mostly forward–about thirty-five feet deep. If they hit more than a few gallons of water, they'd put the grout pipes in these holes, and they were caulked-in there with lead wool, because they were pumping at pretty high pressures. And then they'd hook onto the pipe one at a time and pump grout in. And that was helping. It cut down the water flow a lot, but it was very slow and time-consuming. And all this was on negotiated prices because there wasn't anything in the original tunnel spec [specification] for all this high-pressured grouting.

And as this painfully slow excavation progressed, the temperature of the water gradually started inching upward–that is, the natural water coming out of the rock. It was about eighty-seven degrees, I guess, back where the concrete-lined section was. And by the time we'd gone another 2,000 feet, it had risen twenty degrees. It was up almost a hundred degrees. So we went another thousand feet and the contractor–by this time it was about a hundred and twelve degrees–and the contractor tried to get the Bureau to go cost-plus because he said, "Good grief, you didn't expect this, I didn't expect this, this is ridiculous! And I'm going bankrupt if you

just pay me unit prices for all this stuff." And the Bureau said, "Aw, we can't go cost-plus. We've got to get some more consultants in here to look at this." So they had another consulting board, and these guys were even wilder than the first ones, because one of them wanted to drill a parallel tunnel underneath, to serve as a drainage tunnel, and we were in about three miles from the portal. And so that didn't–nobody wanted to do *that*.

New Contractor for Telecote Tunnel

And finally the Bureau had an experience with a tunnel contractor who was a very dynamic guy. This was in Alaska on the Eklutna Tunnel. This fellow's name was Al Coker, C-O-K-E-R. And he was a good tunnel man, and he said, "Oh, come on, I'll finish your tunnel for you. All you have to do is pay me a hundred and forty-four dollars a cubic yard," or whatever it was. Those aren't the right numbers. Anyway, for a price he would take all the responsibility up to the point where the total flow coming out of the tunnel was 10,000 gallons a minute, or the temperature got over a hundred and twenty degrees I think it was. Then if it got worse than that, in either respect, he'd want to get more money. So he came in, the Bureau said, "Fine, we'll do it." So this change order–it was very expensive. Anyway, he

ran big heavy-duty electric cables in there for two miles to run pumps to get the water into pipes. And he bought a bunch of great big new compressors, so he pumped a lot of compressed air in there for cooling as well as running the equipment. And his concept was to dry this tunnel without doing any pre-excavation grouting ahead. He said, "Aw, just go!"

So he started off and started going. Well, he hit about five hundred feet (chuckles) and then he hit a real big flow of water coming out of open fractures and joints in the sandstone. All these flows were coming out of open fractures and joints in this hard sandstone. And this flow peaked out at a total of 9,100 gallons a minute, as measured out the portal. So we were still under 10,000. And the peak temperature was a hundred and seventeen degrees Fahrenheit, which is pretty hot. So the Bureau lucked-out in that regard too, in that we were just three degrees shy of his break-over point.

Anyway, so he put *more* pumps in, more power, got it under control, continued, and pretty soon things started getting better. And the thing I didn't mention was . . . Oh, heavens, this is awful. The other end of the tunnel had been stopped when it was in about three miles because the Bureau was concerned that the Santa Ynez River would fill Cachuma Reservoir and flood the portal.

So they stopped the contractor and had him line that end of the tunnel, three miles, with concrete. So when Mr. Coker took over, let's see, there was about five thousand feet to go, 4,800 feet, from where the north end of the tunnel, all lined with concrete, ended, and where Mr. Coker was going to start working on the south end. Okay, so by the time he got about two thousand–no, less than that–about fifteen hundred feet, things were really good from there on. So it was all really gravy in the sense that the water flows almost stopped, and the temperature dropped, and it was normal tunneling, and yet he was getting paid these inflated prices that he told the Bureau he would finish the tunnel for–which is great for him, but cost-plus would have been a much better way to go, looking at it with crystal-clear hindsight.

Petershagen: Yeah! Let me interrupt you right here, because we need to turn this tape over.

Trefzger: Yes, okay.

END SIDE A, TAPE 1
BEGIN SIDE B, TAPE 1

Petershagen: This a continuation of the interview with Bob Trefzger, tape 1, side B. Bob, would you please continue with your description of the building of the Tecolote Tunnel?

Trefzger: On January 15 of 1945[2] came the great holing-through where the two ends met, and strange to say, they did meet, right there in the middle of the mountain. So everybody was overjoyed about that. And since Mr. Coker had done very well financially on this job, he threw a very wonderful holing-through party for all of the Bureau people and all of his employees. We'll all remember that for a long time. It was in Santa Barbara at what was then called the Miramonte [phonetic spelling] Hotel. Well, let's see . . .

Petershagen: Now, this whole thing went on with you almost by accident becoming the project geologist part-way through.

Project Geologist

Trefzger: Exactly.

Petershagen: By my calculation, maybe it's generous to give you two years of experience as a field geologist by this time?

Trefzger: Oh, no, six months!

Petershagen: Six months?! (laughs) So I was more than generous!

2 Mr. Trefzger misstated the date of the hole-through, which occured on January 15, 1955.

Trefzger: Yeah! (laughs) It was on-the-job training. I had to learn fast!

Petershagen: And I guess the question is, where were you all this time? It seems to me that people were probably looking for the Bureau's geologist just one minute after the other with new problems coming up.

Trefzger: Well, I was trying to cover all the other things on the project as well as the tunnel, which included Cachuma Dam, now called Bradbury, and a couple of smaller dams on the Santa Barbara side of the mountains that are called "balancing reservoirs." And so I was trying to keep abreast of them as well as what was going on in the tunnel. And the contractor had his own geologic consultants that he referred to. Of course, from time-to-time, geologists from Sacramento would come and visit. And when we had consulting boards, the geologists from Denver came out to make sure they were getting all the information that was possible to give them. That was very helpful, rubbing shoulders with these more experienced people.

Petershagen: At the time, was that the attitude you had about it that you were learning while you were "rubbing shoulders with these more experience people"?

Trefzger: Oh yeah.

Petershagen: Or were you going off the job every afternoon saying, "If one more thing goes wrong, I'm going to quit!"

Trefzger: Well, no, I was sort of fascinated by the whole scenario, really. But I was kind of disappointed with the attitude of some of the Bureau engineers in Denver. When they came out with the tunnel spec to begin with, they didn't put any geologic information in there. They said that geology is what you can see by going out and looking at the site. Of course my predecessor as project geologist had struggled and worked very, very hard mapping the surface geology in the preceding years, before final design. And so I really thought the least they could have done was put his geologic map into the specs, or at least made it available.

Petershagen: Was that pretty much standard Bureau practice at that time, was to include those things in specs or to kind of ignore it?

Trefzger: Oh, I don't know. It *became* standard practice, but I don't know what the practice was beforehand. Actually, the bid that was accepted on the tunnel construction was the second time around for it, because the first set of bids were rejected as being too high. And then they modified the spec in some way, which I'm not fully aware of–maybe to put more responsibility on the Bureau, and did it again. And the low bidder, as it happened, was not an experienced tunnel

company. It was some people whose claim to fame was building subdivisions up in the Pacific Northwest. But their father knew a tunnel expert who helped them with the bid and helped them during construction too.

Petershagen: Does that then pretty much close the tunnel story?

Trefzger: Well, I think so. We could go on talking about details. (chuckles) Oh, one thing I might add, that there was a hot spring within a mile-and-a-quarter of the tunnel alignment that showed on almost every map, including the Automobile Club of Southern California map, and it not only was a hot spring, but it was at an elevation considerably above the level of the tunnel. And so looking at that piece of hard evidence, it's not astounding that the tunnel hit some hot water. And the tunnel did dry the hot spring up.

Petershagen: So the hot spring is no longer there?

Trefzger: It's kaput! And the hot water is still coming in the tunnel.

Petershagen: Uh-huh! So from there where did you go?

Regional Geologist

Trefzger: Well, I was transferred to the Regional Office in Sacramento, because with the

completion of the tunnel, the project office was kind of winding down and the regional geologist and his staff were concerned that I would get RIFed[3] and be lost to posterity if they didn't transfer me. So I transferred to Sacramento on July 1 of '55.

Petershagen: And what was your reaction to that at the time?

Trefzger: Oh, I was looking forward to it, because I knew they did a–from visits from different people from the Regional Office, I think maybe three different people had visited me: the regional geologist, his assistant, and one of the staff, over the years. In fact, when I went on vacation, they sent a staff geologist down to take my place, kind of hold down the fort geologically on the project. So I was able to have a nice vacation in the summer of '51 and '52, '53. In '54, I think I just took short breaks.

Petershagen: And were you married during these early years with the Bureau of Reclamation?

Trefzger: Well, no, I was married to a nice lady I met in Santa Barbara just before I was transferred to Sacramento. So we came up to Sacramento as newlyweds and settled down up here.

3 Reduction in Force.

Petershagen: And where did you live when you were in Santa Barbara?

Trefzger: Oh, different parts of the city, really, in Santa Barbara, but usually up on the hill.

Petershagen: Back up into the Santa Ynez Mountains?

Trefzger: No, there's a hill immediately above Santa Barbara they call the Riviera.

Petershagen: Oh yeah.

Trefzger: Are you familiar with that?

Petershagen: Uh-huh.

Trefzger: Anyway, to start out with, I lived down on Victoria Street and then I met a chap and we decided to have an apartment up on the Riviera. And then I moved back down to the lower levels.

Petershagen: So it wasn't construction camp living? (chuckles)

Trefzger: Oh, no, no, no, it was *nice*.

Petershagen: What did your wife think of this idea of moving to Sacramento? Did she look forward to it as much as you did?

Trefzger: Well she was interested. She was raised in Ventura County, and went to nurses school

in Colorado and had a couple of nursing jobs in Santa Barbara when I met her. So she has an adventuresome spirit.

Petershagen: So she had seen a little bit of the world too.

Trefzger: Oh yeah, right.

Petershagen: Then you came to Sacramento as part of the regional geologist's staff?

Trefzger: Right.

Petershagen: What was your position title at that time?

Region's Geology Branch

Trefzger: Well, I was just an engineering geologist. The workload of the Geology Branch seemed to be kind of split between engineering, geology, and groundwater studies. And there were a couple of other people there already who did the groundwater studies, and so I was put in the very small engineering geology group. And the thing I did that first summer was I worked on Monticello Dam.[4] You know

4 Monticello Dam is the primary feature of the Solano Project in Napa County California. Monticello Dam is located on Putah Creek where the stream crosses the eastern boundary of Napa County. It regulates flows along the lower reaches of Putah Creek and stores surplus water. The dam is a concrete, medium-thick arch structure with a height of 304 feet above the foundation and a crest length of 1,023 feet. For more information on the Solano Project, see Zachary

(continued...)

where Monticello Dam is? That's on Putah Creek west of Winters.

Petershagen: On Lake Berryessa.

Trefzger: Yeah, Lake Berryessa. It's a beautiful concrete arch dam, a couple hundred feet high. And the foundation excavation was opened up that summer of '55. Right? Yeah. And so we were mapping in considerable detail, so we'd know what was under the dam in case of any future problems. So of course with the hot weather and not being accustomed to that, having been a Santa Barbarian for four-and-half-years, I'd get up very early in the morning and get my work done over at Monticello before it got too hot. That worked great.

Petershagen: And about how long were you there?

Trefzger: We would commute back and forth from Sacramento, throughout the summer, really–not every day. I got to do other things. I got to reconnoiter some dam sites, small dam sites up in the Sierra, so that was interesting, because I'd never been up there before. Just in the American River

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4(...continued)
Redmond, "Solano Project," Denver: Bureau of Reclamation History Program, 2000, www.usbr.gov/projects/pdf.php?id=195.

drainage. Some of these were subsequently built, but not by the Bureau.

Petershagen: Being pretty much and outdoors-oriented person, you must have enjoyed that sort of work, I'm sure.

Trefzger: Oh, I loved it! Yeah, I loved it.

Petershagen: It's hard to imagine that it was work in your case. (laughs)

Trefzger: No, it was fun! It was a way of getting familiar with the area, the American River drainage area. All the roads in those days were dirt roads–they didn't have the nice paved roads going around like they do now.

Petershagen: Who was the regional geologist at the time?

Trefzger: Well, the regional geologist was a fellow by the name of Bill Gardner. And he had been the original regional geologist in the region when they set up the regions, and he had also been the project geologist at Shasta Dam, so he was very helpful.

Petershagen: And you were, in this particular branch you worked in, you were certainly dedicated more to the planning aspect of Reclamation activities. Were you a part of a planning group, or were you an autonomous kind of a group? Where would you fit on an organization chart?

Trefzger: Well, we were a service agency, or service branch, I'd say. If a planning engineer wanted to know about the groundwater resources of a proposed service area, he would come talk to the groundwater geologist. If he was developing water storage and/or diversion plans, even the most preliminary things based on quatchie-topo he would come and talk to the dam designers and the geologists. And often the planning engineer, the dam designer, and a geologist would go on field trips to look at these possible dam sites that the planner had spotted just on the basis of the topo [topographical] maps. And so there was a lot of this "team effort" sort of thing–especially the three head of the props [pronounced with a long "o"–short for proposals?], the planner, designer, and geologist.

Another thing I got to do even before I transferred, they asked for me to come up to Sacramento and help them out because they were short-handed in February of '55, and they drilled a deep test hole up near Chico for groundwater. So one of the Sacramento geologists and I sat on that thing for a week or so, working twelve hours a day, because the drillers were drilling around the clock. So that was interesting. I'd never done anything like that. I worked some at Monticello then, too, in that diversion tunnel, geology.

Trinity Division

So then the Trinity River Division[5] was authorized, I believe, in 1955 and I got some work up there, but not very much. They hired another geologist to be the project geologist up there full-time, so he took care of most of the work.

Petershagen: So you were here in Sacramento, and really free of any Trinity responsibilities?

Trefzger: Basically, that's right, yeah.

Petershagen: So the project geologist there on the Trinity was the rough equivalent of the position *you* had down in Santa Barbara.

Trefzger: That's right.

Petershagen: Tunnel project?

Trefzger: That's exactly right, except that the Trinity work was just really getting started, the

5 The Trinity River Division on the Trinity River about 25 miles northwest of Redding is a trans-basin diversion feature of the Central Valley Project. Surplus water from the Trinity River Basin is stored, regulated, and diverted through a system of dams, reservoirs, tunnels, and powerplants into the Sacramento River for use in water-deficient areas of the Central Valley Basin. Water is used for irrigation, power generation, navigation flows, environmental and wildlife conservation, and municipal and industrial needs. For more information on the Trinity Division, see Eric A. Stene, "Trinity Division, Central Valley Project," Denver: Bureau of Reclamation History Program, 1996. www.usbr.gov/projects/pdf.php?id=108.

preconstruction explorations, which took an awful lot of work before they could make the final design. And then when the project was under construction at Trinity, the original project geologist had left and so they had to hire another one. And he had full responsibility and had quite a staff of geologists who keep on top of things, because it was a big project.

Petershagen: Well that's a much longer tunnel than the one you were associated with at down south.

Trefzger: Oh yes! Well, there's actually two of them: the big long Clear Creek Tunnel and the shorter Spring Creek thing which has a big pipe in between two shorter tunnels, and Whiskeytown Dam[6] and Lewiston Dam.[7] So there was a lot of complexities. So I had very little to do with Trinity, actually.

Petershagen: So what projects were you associated with during that period of time? say '55 to '65.

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6 Whiskeytown Dam is a feature of the Shasta/Trinity Division of the Central Valley Project. Constructed in 1963, the 282-foot high structure is located is located in the Clear Creek drainage basin within the extreme southeastern foothills of the Klamath Mountains.

7 Lewiston Dam, of the Shasta/Trinity Division, was built from 1960-1963 about 7 miles downstream from Trinity Dam. The dam creates an afterbay to the Trinity Powerplant and diverts water by means of Clear Creek Tunnel to Whiskeytown Lake. It is an earthfill structure 91 feet high and 754 feet long, forming a reservoir with a capacity of 14,660 acre feet.

Trefzger: Well, in about 1959, we lost a couple of supervisory geologists. One fellow transferred and he went to Ethiopia on some kind of a project they had over there as an investigation. And then the other chap retired in 1959 and there was no formalized filling of his position. The organization was a little vague–"unstructured" I guess would be the best way to put it.

Petershagen: When you say "the organization," what do you mean? Just the Geology Branch?

Trefzger: Yeah. It was only later that it was specifically set up as sections with a section head: an Engineer Geology Section Head, and then the Groundwater Section Head, and an Exploration Section Head.

San Luis Dam

So when this chap left in '59 I was sort of a supervisor, but it wasn't spelled out very clearly. And when things really started humming again was when the San Luis Unit[8] was authorized, because it was so big that they couldn't hire enough geologists on the project down at Los Banos to do all the

8 The San Luis Unit is located in California's Central Valley and is part of Reclamation's Central Valley and the California State Water Project. Authorized in 1960, the unit supplies irrigation water to roughly one million acres. For more information, see Robert Autobee, "San Luis Unit, West San Joaquin Division, Central Valley Project," Denver: Bureau of Reclamation History Program, www.usbr.gov/projects/pdf.php?id=109.

preconstruction work. So it was sort of split up: the Regional Office did *most* of the preconstruction work on San Luis Dam and the Forebay Dam; and the Project Office did *most* of the work along the canal and the pumping plants, although there was cross-fertilization between the two offices, and a lot of cooperation. So that was very interesting because the Bureau had its own drill crews. And in order to get all this drilling done, especially at San Luis Dam, the drill crews were mushroomed with additional employees. We had up to about seventy-five drillers altogether at the peak of that work.

Petershagen: Wow!

Trefzger: And then of course as the work trails off, you have to start RIFing people. And so the fellow who was assistant regional director said, "This really isn't the best way to do things, you know. We should have sort of a baseload drill crew and supplement with contract drilling or supplement with temporary employees so you don't have to RIF them, you can let them go with the drop of a hat." Well then before all this was done . . . Well, about the time the San Luis work was done, Bill Gardner transferred to the Denver Office. And this was in November of '63, and at his recommendation they made me acting regional geologist while they were going

through all the procedures of getting a permanent replacement. And by about February of '64, they jumped through all the hoops they have to jump through, and decided that I was it. So I was regional geologist from then on, officially. So by that time we were more structured with the sections I mentioned, and so I was a section head and I had to chose a replacement for myself. And when the groundwater section head retired, of course, we advertised all over the Bureau for replacements and had to make a selection. So that cut down a lot on my field work! (laughter)

Petershagen: And the position of regional geologist is the position you held when you retired, correct?

Trefzger: Right.

Petershagen: So how long are we talking about that you held that position, altogether?

Trefzger: Well, from February of '64 to July of '88–long time.

Petershagen: And when you say that cut down on your field work, let me say that it was largely an office job, supervisory job, policy-making job?

Auburn Dam

Trefzger: Well, it's policy-making and coordinating, programming, trying to fight any fires that

come up, trying to balance the demands versus the needs for things. Like when we got going on the Auburn Dam Project[9] –which I'll have to think about when that was–but anyway, there was a terrific demand for drilling there, and we had to balance *their* needs with the needs in the rest of the region. And so they ended up doing some contract drilling up here, since we couldn't do all of their work for them–just very intensive. The Auburn Dam foundation turned out to be much more complex than any of us supposed it was going to. And of course at that time they were talking about building a thin, double-curvature, concrete arch dam there, where you've *got* to know what's in the foundation in order to design the dam correctly.

Petershagen: I've heard that referred to as an "eggshell" kind of a structure.

Trefzger: Yeah, because it curves both ways, although it's not eggshell in the sense it's very thin.

9 The proposed Auburn Dam was located on the north fork of the American River upstream from Folsom Dam and Reservoir. Auburn Reservoir would control flows of the north and middle forks of the American River, while releases from the reservoir would operate the Auburn Powerplant and supply water to the Folsom South Canal. For more information, see Jedidiah S. Rogers, "Auburn Dam, Auburn-Folsom Unit, American River Division, Central Valley Project," Denver: Bureau of Reclamation History Program, 2009, www.usbr.gov/history/ProjectHistories/Central%20Valley%20Project-Auburn%20Dam%20D2.pdf.

But it's the shape. So this was fascinating too, because at Monticello, which is a concrete arch dam also, but it's not thin–it's a massive arch dam. And the design techniques between the time Monticello was designed and the time Auburn was designed advanced incredibly.

Petershagen: So what is it that makes Auburn so complex, besides the kind of dam, or the design of the dam?

Trefzger: Well, there's a lot of faulting. There's a lot of old, ancient faulting that breaks the rock up into these discrete blocks. And if you don't know about a particular fault in the arch dam foundation, which of course is applying a great deal of stress to the foundation rocks, it could cause real trouble. The Mal Passe Dam in France is one that's always cited as an arch dam where the foundation caused it to fail, with very bad results. So an awful lot of work was done on the Auburn Dam foundation.

Do you think we're jumping ahead too far?

Petershagen: No, no, that's fine. Maybe now is the time to talk about things in detail.

Geology in Dam Design

Trefzger: Well there's a lot of things in San Luis [Dam] that are interesting, but at San Luis

it's a big, broad valley. Have you ever been down there?

Petershagen: Yes, but of course only (laughing) since the dam was built!

Trefzger: You can see what the profile [is], though, from downstream. It's not in a canyon, it's a big, broad valley–the dam is three miles long. And out in the center of this valley, the alluvial materials are a hundred and sixty feet deep. Not only are they a hundred and sixty feet deep, but there's some lake-deposited clays out there that are pretty soft and compressible, and so the design was tricky in the sense that you had to make a design that would allow for the compression of the embankment on these lakebed clays. So the foundation trenches going across the valley do not go all the way to bedrock. They go down about a hundred feet to the top of a basal clay gravel alluvial sequence that's underneath.

Petershagen: So there's almost a cushion under the dam?

Trefzger: Yes, exactly. It's a cushion, and I think that's why they designed, why there are two parallel foundation trenches, each about a hundred feet deep, because of this soft clay material. So that was interesting. And then there were faults in the rock down there that are interesting, and the main problem they

caused was in the outlet works, tunnels–there are four big tunnels.

Petershagen: Now, from the geologist's perspective, you *know* where some faults are, because some are mapped for you already.

Trefzger: Right.

Petershagen: But then in the course of drilling and so forth, do you find more?

Trefzger: Yes, definitely.

Petershagen: And that's a frequent occurrence, I take it, from the way you answered that?

Trefzger: Yes. Almost without exception you find faults where you don't think there are any. But you have to be careful that we don't confuse faults with something that's going to cause an earthquake.

Petershagen: Oh, I understand! (laughs)

Trefzger: [inaudible], you know. Because all faults are not seismogenic. And that's another problem that we can get into. But at San Luis, I'll have to give Bill Gardner a lot of credit. About the first thing he had done was, he had about a thousand-foot-long [bull]dozer cut made up on the left abutment where there was a convenient place to do it, and where it exposed a sequence of the rocks there. And it also, as

it turned out, uncovered one of the biggest faults in the whole dam foundation, in that initial dozer cut. So we got our eye on it right from the start. And this was immediately north of where these four big tunnels were going to go through the abutment from the pumping-generating plant to the trashrack towers. And so it turned out there were four or *five* faults in this tunnel area, especially on the upstream end, that had to be considered when designing the tunnel portals and the trashrack foundation.

Subsidence

So there were a lot of other interesting things at San Luis besides the dam: The subsidence problems on the canal were something that had to be dealt with. So they came to the geologists and said . . . Well, there are two kinds of subsidence in the first place: one is caused by pumping groundwater out from beneath these very extensive clay layers that are formed by old lakes out under the valley. And it works like a huge hydraulic jack where you reduce the pressure below the clay and everything below it consolidates,

and so the ground surface goes down. And there are places near Mendota where the ground surface has gone down over thirty feet, but it's all very gradual and very regional in extent.

Then the other kind of what used to be called "subsidence" is caused by the collapse of some porous soils when they get saturated with water. And this used to be called shallow subsidence, and we sort of developed a better term, we think, called "hydrocompaction," which means the soils compact when they get wet. And about twenty-five miles of the San Luis Canal crossed these old mudflow deposits that were susceptible to hydrocompaction. So this all had to be defined, because it's very expensive to deal with in construction. And so they were drilling a lot of holes down there, some under contract, some with our crews, and ended up using a technique where they built these big ponds as part of the spec and soaked these soils for months and months and months to get them all collapsed and consolidated by saturating them.

And so there's one stretch about five miles, and the other stretch about twenty

miles, of the canal alignment that had to be treated this way. And these ponds were hundreds of feet wide, and of course five miles and twenty miles long, with dikes, and they had to pump the water up in there from Delta-Mendota Canal, because there was no source up above. But that really seemed to work. Over the years since the canal has been in operation, there have been very little problems in these areas that were preconsolidated by soaking and saturation. So the engineers did a good job on that, and we were just the "data gatherers," you might say, getting them the soil conditions and the densities and the moistures. And they figured out where it needed it, and it worked great.

Petershagen: Okay!

Trefzger: So this was a big cooperative thing between the people in the lab in Denver, the Soils Lab, the geologists in the field, the design people in the Canal Design Section–it was a real team effort.

Petershagen: An exemplary team effort?

Trefzger: Well, it worked! (chuckles)

Petershagen: Or was this the way business went on every day?

Trefzger: Well, nobody agreed with everything that everybody was doing, but the bottom line is, How does the thing work when you build it and operate it? And it's been working fine.

Petershagen: Okay, this is probably a good place to stop and put a new tape in, I think.

Trefzger: Okay. This probably a good place to stop and put a new tape in.

END SIDE B, TAPE 1.
BEGIN SIDE A, TAPE 2

Petershagen: This continues the interview of Bob Trefzger on July the 12th, this tape 2, side A. Bob we finished, I think, San Luis on the previous tape. Let me ask, though, about Auburn. In my view, most of the Auburn Dam problems, I'll say for lack of better word, are really the political things that have gone on around the Auburn Dam. But every once an a while I'll hear somebody say that some of your foundation work really made that much more complex than the original design concept. That you

discovered much more faulting in the area than what you expected. Is that correct?

Earthquake Problem at Auburn Dam

Trefzger: Yes, bit that's not atypical. The faults, of course, are the . . . where a rock has been faulted, broken then its more susceptible to be weathered, more suseptible to having soil form on it, and therefore, its not always very obvious. So, I can think of only a very few dam foundations where we haven't discovered faults that we didn't know where there. When their opened up for the eye to see. So, what we have to do in the exploration is temper the amount we might like to do to discover every last one with what is really necessary, in order to reasonable assure a safe design. Then when the foundation is finally opened up, of course , you come down to the nitty-gritty and if there is something there that is drastically different then you have to face it and evaluate it.

Peterhagen: I see.

Trefzger: Of course the big problem at Auburn was the earthquake question.

Peterhagen: So, there are faults, and there are *faults*.

Trefzger: Right. Exactly. Now until the earthquake up near Oroville in 1975, almost nobody had thought much about the foothills being potentially active. And the consultants at that time were doing studies for P-G-&E, because P-G-&E was interested in siting a nuclear plant in the valley, east side of the valley where there was water available. And there consultants were looking up and down the eastern foothills, kind of getting a feeling for what the potential might be. There were these regional faults that had been mapped a long time, since the 1950s, in the Sierra foothills and nobody understood them, nobody considered them to be potentially active faults.

Then came along the Oroville earthquake, and so the P-G-&E consultants did a lot of trenching up there and it showed that there had been earlier earthquakes that had broken the pretty young soil. And then they did some more work down near Sonora where there's a lava flow that comes down from the Sierra that's several million years old, called the Table Mountain Lava Flow. Interestingly, they actually had the P-G-&E surveyors run levels down this lava flow to

see if there were any physical offsets. And, by gosh, it turned out there was. So the lava flow had been offset by faulting since it came down over the river valley. And so the consultant naturally went on the north side of the lava flow down where there was some soils and dug some trenched and found some recent movement there. Young movement so they would classify that fault as a potential earthquake generator.

Petershagen: In geologist term, what do you mean by recent movement or young movement?

Trefzger: Well, that's hard. There are different definitions of what's an active fault. And the Bureau had one definition, and other people have other ones. So, I really don't know what the current state-of-the-art definition is, if there is one. But at that time, it seemed to me that Bureau said that anything that has moved in the last 100,000 years, we don't want to put a dam on it, we want to consider it to be active. At first, the Bureau tried to kind of stonewall this issue of fault at Auburn and do we really have to take a look at it from seismic standpoint, or do really have to hire somebody to this.

Well, there were various geologic reasons advanced for saying that the faults at Auburn are not related to the fault that caused the earthquake at Oroville. But finally, some representatives from a very large consulting company went to Denver and convinced them that they should be hired to do this investigation that the Bureau had not even decided to do. Or, maybe they were thinking of doing it in house. But these people convinced the Bureau managers that they had the expertise the Bureau needed, so the Bureau hired them. And after many, many months of very intensive studies over the whole area, not just a local study, they concluded, I think their famous phrase was, "one cannot preclude that some of these faults in the dam foundation would move hypothetically to an earthquake on a nearby more active fault." "One cannot preclude this" was enough to, I think, destroy the concept of putting up thin concrete arch dam anywhere in the Auburn area, not just at the site.

The Bureau was really in a horrible spot then because it had already stated the foundation excavation for the dam. And the concept was to have two humongous big contracts; one was to excavate and treat the

dam foundation all ready to build a dam, and the second contract was envisioned to be, to come and build the dam per specs on the prepared foundation. So, the first contract was well underway when the Oroville earthquake hit, and the Bureau was faced with making a horrible decision: "do we pay through the nose by shutting this contract down while we investigate this thing, or this idea of a potential hazard, or . . .[phone interruption]

We were talking about the thorny decision the Bureau had to make whether continue the excavation and foundation treatment contract while the potential earthquake investigation was going on, or whether to suspend it pending the result. Well, the decision was made to continue with the contract and the earthquake investigation contract concurrently. And so about the time the foundation excavation and foundation treatment was all completed, was about the same time, in round numbers, that the seismic investigation was completed. And I've already said that the results of that were one cannot preclude the movement on one of

these faults, which would be very bad for a thin concrete dam.

Petershagen: So that's at least a partial explanation of why we have an extensive dam foundation on the other side of Auburn from us and no more work going on.

Trefzger: Right. Well, at about not too long after that when Reagan became president, they kind of changed the ground rules about where the money was coming from for these large expensive projects. And that made things even worse.

Petershagen: And that rule change, I think, in effect meant the Bureau had to go find a customer.

Trefzger: Yeah, I'm not sure about the details, but anyway the Bureau concept was we won't build a large dam here, we have enough concrete out here we'll build a gravity dam. A gravity dam, sort of like Shasta, would sit there, faults or no faults, because its sitting there by its shear weight and its not pushing upon the abutments except weigh-wise. But of course its going to cost a lot more because you have a heck of a lot more concrete to make and form and place. And so the price kept going up and up and up.

Anyway, I don't think there's anything more to be said about Auburn.

Petershagen: Alright. Now that we've scared ourselves with these faults and dam foundations and so forth, that makes an excellent lead in, I think, to talk about the Dam Safety Program.

Dam Safety Program

Trefzger: Right. Well the Dam Safety program got a humongous kick when the Teton Dam up in Idaho washed out.[10] It was a brand new dam that was supposed to have been designed and built to the state-of-art, and I don't know what happened exactly but it washed out. It was a foundation problem. There were big open fissures in these volcanic rocks in the foundation and the fissures were not seal off the way they

10 Teton Dam was planned as the major feature of the Teton Basin Project in eastern Idaho. On June 5, 1976, shortly after construction was completed, the dam suffered a catastrophic failure, causing over billion dollars worth of property damage and 11 casualties. For more information, see Andrew H. Gahan and William D. Rowley, *The Bureau of Reclamation: From Developing to Managing Water, 1945-2000*, Volume 2 (Denver: Bureau of Reclamation, United States Department of the Interior, 2012), 820-832.

might have been. And there may be other reasons it failed.

But anyway, this unfortunate event gave the Congress some incentive to give the Bureau money to really getting into the safety of dams study. So, the problem from the geologist point of view is with a lot of these old dams there were absolutely no geologic records made during their construction. And so the only way we had was to go out to these dams and start drilling holes through it. And sample both the dam itself and its foundation. And so we did a lot of studies.

In fact, one of the dams that got a lot of attention was San Luis Dam. And of course there was a stimulus there in the sense that there was a large slide on the upstream side of the dam which was caused by a very simple thing. The hill on the upstream side on the left abutment sloped upstream, the hill under the dam, and the hill covered some very fat clayey soil. And to put it simply, when theses flat clayey soils have been soaked there for many years and have gotten softer and softer and weaker and weaker, the dam actually slid on these saturated soft clay soils in an

upstream direction that is part of dam. And the creep of the slide came up almost to the dam crest.

So there again, the geologist and the drillers have to spring to it and find out what's happening. So we were out there . . . we had to build a road out to the slide. The upstream side of San Luis Dam is covered by these big angular extremely hard basalt solid blocks that was part of a big lava flow. So we had to build a road out there, drill through these rocks into the embankment, into the foundation sampling and testing, getting all the information. And finally before it was done, we had investigated three or four other places in the foundation where similar conditions had existed without a slide having occurred, but where there seemed to be some potential.

And they ended up doing remedial, I call them buttresses, there just embankments that buttress the existing embankment. And their often called berms, but to me that's not a berm, these are big embankment buttresses that enhance the stability of the dam wherever their placed because there's more weight to hold the

thing in place. So they ended up building four of these in different places; one where the slide was and three other ones. So this was very interesting.

Then we did work at the San Luis Forebay Dam which has subsequently been . . . [phone interruption] Well, we right in the middle of the Forebay Dam when I retired, and as I understand it, since that time there have been extensive repairs on the buttress placed down there. The problem there was typical with a lot of these dams where you have saturated sand bed under the toe of the dam and their concerned about seismic liquefaction of sand, if that happened during a big earthquake the whole downstream side of the dam at least would slide on the liquefide material and it would be goodbye dam. So they had to excavate this saturated sand out of there and replace it with something more stable.

Petershagen: Are there other dams that saw this extensive kind of a retrofit?

Trefzger: No, those are the two main ones in the region. And also at the time I retired, they were looking at Cachuma Dam in relation

to both its seismic stability and to raising it, and to increasing the flood handling capability. And I don't know what has happened in that study.

Spring Creek

Petershagen: Okay. One of the projects that I had indicated to you that I thought was especially apropos to discuss with a geologist is the whole Spring Creek situation in the up in the Trinity Division with the Iron Mountain Mine and the runoff problems. Just recently, the E-P-A, well of course its been a superfund site for some time, but the E-P-A is now proposing that the debris dam there should be raised considerably. And of course the mine owner is fighting that recommendation or proposal. You said earlier that the regional, not the regional geologist, but the project geologist for the Trinity pretty much took care of that whole area and you were largely divorced from it. But later on did any of this Spring Creek debris problem become part of your daily job?

Trefzger: Oh yes. The project geologist up there was only there during construction. So once the

project went into operation, he was gone. His staff was gone and they finished their reports, which described the geology of each of the structures during construction, including the long tunnel. So when the E-P-A Iron Mountain question came up, the E-P-A, as I recall, hired the Bureau to help them evaluate the problem. They had already hired a consultant and had reports from the consultant there in Redding. They had done a lot of work; taking samples from of all the different creeks, running the lab test, and proposing different ways to improving the situation. So . . .

Petershagen: And that was Clair Hill, or C-H-T.

Trefzger: Right. So when we got onboard the E-P-A was kind of locked in to some of these solutions, or I should say these problem solutions. They wanted to divert upper Spring Creek away from the debris dam so that good water from upper Spring Creek would get into Keswick Reservoir[11] a

11 Keswick Dam is a 157-foot-high concrete gravity dam, with a crest length of 1,046 feet, constructed 9 miles downstream from Shasta Dam on the Sacramento River. Keswick Dam acts as an afterbay dam controlling river fluctuations from the Shasta Powerplant. Water released from Shasta Dam downstream to the Keswick Reservoir is

(continued...)

different way. And they wanted to divert some of the other creeks around places where they were thought they were picking up pollutants. And I don't know how much of that's been done. Because if any of that was done, it was subsequent to my retirement. I did hear that instead of putting a tunnel through the upper Spring Creek diversion, they put an open cut, which was fine and should be somewhat effective. Well at least it would decrease the amount of water going into the reservoir the Spring Creek Reservoir.

Of course, one of the problems is that the rains fall on that mountain up there and percolate down through the rock and the water reacts with pyrite and forms sulfuric acid, which dissolves the other copper, zinc, cadmuim-bearing minerals and then the water drains out the open mine tunnels down below. Its called acid mine drainage, A-M-D. And this material is

11(...continued)
stored for release through Keswick Dam and Powerplant. With steady releases from Keswick Dam, managers are able to regulate the flows of the Sacramento River downstream. Keswick Powerplant has three generators with a rated capacity of 105 megawatts.

extremely toxic to fish; the fish are very sensitive to it. And so what has happened in the past, is that there would be a big rain storm and not just the A-M-D but all the pollutants that get eroded by the rain would wash down into Spring Creek Reservoir. And Sping Creek Reservoir would spill and dump this stuff into Keswick. And as I understood it, the operators at Shasta Dam were unable to let out enough water to dilute these toxic flows because of flooding downstream. And therefore you ended up with a big fish kill.

Petershagen: I think as I understand the problem; the real problem is that everything is collected behind Keswick and . . .

Trefzger: Behind Keswick or Spring Creek?

Petershagen: Well, I think from Spring Creek it flows into Keswick Reservoir. Does it not? And I think its that collection right there that they've really been unable to deal with.

Trefzger: Yeah, well I'm not sure. Anyway, it was a big mess. When the regional office did the investigation for Spring Creek Dam when it was constructed and that whole Spring Creek arm of Keswick Reservoir was full of

sediments that had eroded from the mine dump. And in fact a lot of those sediments are what ended up in the dam. Because the powerplant, in order for it to function, into Keswick Reservoir had to have an open arm of the reservoir that couldn't be clogged up with sediments or the powerplant wouldn't work. So the Bureau was faced with a problem, "How do we keep these sediments out of the Spring Creek arm of the reservoir?" Answer was, "Well we could build a dam up here and catch the sediments." And thereby reasonably assure that the tail race arm of the reservoir wouldn't get plugged up.

So the Bureau investigated and designed and built the debris dam as it now sits there. And it was called a debris dam, it wasn't . . . any thought of controlling pollution was at least secondary, if not less than secondary. So the debris dam was built, it caught the debris. It kept the tail race open. And as long as it didn't spill, it gave a method of releasing the A-M-D and whatever other God-awful things were pooled there gradually into Keswick Reservoir. So the justification for making the dam bigger, of course so it could hold

more water, so there are fewer times when you lose control and have it go unimpeded over the spillway. That's part of my understanding.

Petershagen: Part of the debate now is whether the debris should withstand the one hundred year storm, or a three hundred year storm, and on and on and on.

Trefzger: Yeah that was the question. Well, how *high* is high enough. The consequences of the thing washing out are pretty ghastly.

Petershagen: Right. At some point it becomes a Keswick concern. Now Bob, in thinking about the Spring Creek situation and Keswick and all that, this certainly doesn't come about as the result of a deliberate act of anybody in the Bureau of Reclamation to kill fish, and it certainly doesn't come about as a result of negligence. The thing was built I think it could be said state-of-the-art, or the level of knowledge of the day, but I think we still have to face the fact that Reclamation does effect the environment, and I guess take our lumps for what may have been done in the past. Are there other areas that you know of where maybe the Bureau wasn't quite as concerned for environmental considerations

as perhaps they could have been, or in hindsight I should say, should have been?

Kesterson Reservoir

Trefzger: Well, I would like to talk about Kesterson Reservoir.[12] The Bureau sort of had a tiger by the tail with this whole question of drainage from the San Joaquin Valley. And with fact, I believe, that the San Luis authorization act did provide for a drain being constructed without specifying any details whatsoever. So the poor planning engineers were stuck with trying to figure out some reasonable ways of handling the drainage from the huge acreages that were being irrigated and leached the salt.

12 "Completed in 1971 by the Bureau of Reclamation, Kesterson included 12 evaporation ponds for irrigation drainage water. The reservoir, a part of the San Luis National Wildlife Refuge, was an important stopping point for waterfowl. In the 1960s officials proposed a 290-mile drainage canal to the ocean known as the San Luis Drain. Only 85 miles were completed, however, and work on the drain halted in 1986 after scientists discovered bird deformities due to drainage at Kesterson." For more information, see Water Education Foundation, "Kesterson Reservoir," www.watereducation.org/aquapedia/kesterson-reservoir. (Accessed 5/2016).

And so one of there ideas was to have a storage facility and they were thinking of one at a place called Dos Palos, which is sort of southeast of Los Banos. And they were also looking at this Kesterson site which is kind of northeast of Los Banos. And the geologists and the designers were working on both of them trying to see which was the better, if one was better than the other. And the idea of having a reservoir was to store the polluted water until such time in the future when we had such flood flows in the delta and the polluted water could then be dribbled into the flood flows and passed out to the ocean without causing any great increase in concentrations of any bad elements.

Well, it was finally decided that Kesterson was the better choice. We, in geology, were always concerned about the reservoir being made watertight so it wouldn't leak, because we were very concerned about the potential effect of pesticides, of fertilizers, of all the stuff used in agricultural production that would inevitably make its way into this water. We certainly did not know about selenium. We didn't dream that there was an element in the soil that would cause problems, but we

did think about other things that would cause problem.

And therefore when it was decided to make a wildlife refuge out of this reservoir, what we knew would be absolutely lousy water we thought from pesticides and everything, we were astounded. We couldn't believe that anybody would do anything so stupid, as to make a wildlife refuge out of these ponds just because they had water in them. We knew the water was going to be bad. And let me emphasize that we did not know about selenium or that it would be the selenium that would be the culprit that made it bad. We fully expected it to be bad. So I think the Bureau has taken a bum rap on that because it wasn't their idea to make the thing a wildlife refuge. It was Fish and Wildlife guys. Why they couldn't realize the water wasn't going to be good water is beyond me. Anyway, I think that's all I care to say about Kesterson.

Petershagen: Any other environmental problems that you would like to address?

Trefzger: I don't think so. I think the Bureau, in my experience, has always responded to

somebody's needs. Like the San Felipe Division is another good example where you have another water deficient part of the state that just wasn't able to get enough water to get by. So the Bureau devised a scheme to supplement their water supply and bail them out of a bad situation.

Petershagen: How, as a bureau employee, perhaps you could speak for other Bureau employees at the same time too, when you see the Bureau getting a bum rap, like over at Kesterson, how does that make you feel? Does that have a big morale impact?

Trefzger: Well in view of these concerns we've had before about the nature of the water that was going into the reservoir and have someone decide, "My gosh, let's make this a wildlife refuge and make it attractive for birds," that really made us pretty unhappy because it was so irrational. And the fact that the Bureau got the blame for it made us even more unhappy. Because nobody said it wasn't the Bureau's idea that these ponds were not supposed to be anything but storage ponds for lousy water. So, [inaudible]

Petershagen: I think besides hearing it, I see some resentment on your face as you talk about it.

Trefzger: Well, yeah its frustrating. I mean, you know . . .

END SIDE A, TAPE 2
BEGIN SIDE A, TAPE 2.

Petershagen: This continues the interview with Bob Trefzger, this tape 2, side B, on July the 12th, 1994. Bob, in your day-to-day work at the Bureau, you must have interfaced with countless other agencies: the State Department of Water Resources, the Corps of Engineers, probably dozens of agencies I could name if I had to, and dozens more I couldn't even begin to [name]. How did the Bureau get along with other agencies, in your view?

Reclamation's Relationships with Other Agencies

Trefzger: Well, in my situation, I was usually working with geologists for the state or the Corps, and we got along fine. On the San Luis Safety of Dams Study, of course, the state paid fifty-five percent of all the costs for San Luis Dam, you know. And so they

were very much interested in everything that was going on in the repairs, but it was a very . . . It was handled very well. The Bureau engineers from our Denver Office were doing the analytical work to evaluate, to test the samples we got, and then to use the test results in these sophisticated evaluations of the stability under seismic loading. And I think they were very highly-respected by the state engineers who did similar things for state dams, as being very, very talented, competent people. And there was an absolute minimum of any friction or hardship, and we had many meetings down at the San Luis Dam Field Office about this work as it was going on, so I was involved, you know, in all of these.

Petershagen: In any of this work, were you ever called upon to address public meetings or speak to interested groups?

Trefzger: Mmm (thinking). Not that I can recall. I've given talks to local geology groups on the Tecolote Tunnel project, which was a long time ago I did that.

Petershagen: To professional groups and hobbyists both, I assume?

Trefzger: It was an engineering-geology group they had.

Petershagen: I see. How about relationships with Denver amongst geologists?

Region's Relationship with Denver Office

Trefzger: Well, by and large I'd say they were pretty good. There were some characters that I would just as soon have not had to deal with, but they had their responsibilities and we had ours, and sometimes we didn't see eye-to-eye about certain things. We wanted to . . . Oh, as an example, we wanted to put some information in some of our geologic logs up at the Stampede Power Plant[13], and they said, "Well, if you put that in there,

13 A feature of the Washoe Project, the Stampede Powerplant is a run-of-the-river plant. The power generated is dedicated first to meeting the requirements of the project facilities. The remaining energy is marketed to various preference customers in northern California. The dam is a zoned earthfill structure with a height of 239 feet, a crest length of 1,511 feet, and an embankment volume of 4.5 million cubic yards. The dam is 40 feet wide at the crest. The reservoir, with a capacity of 226,500 acre-feet, provides flood control, recreation, a new reservoir fishery, and other fishery improvements on the main Truckee River, Little Truckee River, and Boca Reservoir. The powerplant was placed on-line in 1988.

these logs won't conform to *our* standards, because there's too much information. And therefore, you'll either delete this information from your geologic logs, or you will delay the issuance of the specifications, which your regional director will get very mad about." And there was complete frustration on our part, because we were trying to supply what we thought was adequate information without being overdoing it. But they hadn't changed their standards. Since that time, they've updated their standards and our logs would have been fine, but we were "ahead of the game," so to speak.

Petershagen: Did you ever have the sense that maybe Denver was kind of a "big brother" looking over your shoulder?

Trefzger: Mmm (thinking). Well, I think there were some people in Denver who were sort of over-awed with their own brilliance.

Petershagen: (chuckles) That's an interesting way to describe them! (chuckles)

Trefzger: But I didn't get the "big brother" feeling, it's more, you know, this being over-awed with

one's brilliance ends up causing a sort of a pomposity that is almost indescribable.

Petershagen: How about, oh, various public organizations? I'll toss out the [name] Sierra Club as one, or Chambers of Commerce. Anybody like that ever approach the regional geologist, and did you have to deal with any of those sorts of groups?

Trefzger: No, I don't think so.

Petershagen: So you really weren't out there in the forefront, representing the Bureau to the public, I guess.

Trefzger: Oh no, we were kind of behind the scenes. Our main function was to work with primarily design engineers, to get them the geologic and soils information and samples that they needed, to discuss with them the significance of these things, and to help assure that they didn't misunderstand something or misinterpret something, so that we're all looking at the physical parameters the same way. And the whole point, of course, is to end up with a design

that's as economical as possible, and yet as safe as possible.

Petershagen: In your climb up the ladder from the 50s on into the 60s and into the 70s, as you began to take on a supervisory role, did you feel the Bureau had adequately prepared you for that? Did you receive any training in the supervision of people?

Supervisory Training

Trefzger: Oh, I think I could have received more than I did. They had an organizational development training that was helpful, but it was not about how to function as a supervisor. I should have been given more than I was. I wasn't given very much at all. I think they regarded . . . Well, it worked both ways: some of my supervisors would criticize me for being too technically-oriented and not spending enough time managing, and yet I was given no . . . training in management per se, or supervision per se. So I kind of resented that, you know.

One time my supervisor was an economist, if you can believe that. This was because we used to be in the Planning

Division, in which one of the assistant planning engineers turned out to be an economist. I mean, he was a former Chief of the Economics Branch, and he was in charge of the various service branches in the division, [like] economics and hydrology, and water rights and geology. And the other assistant worked with the planning engineers directly, so it was kind of this division. That was not one of my happier times. (chuckles)

Petershagen: (chuckles) I see. I take it that overall you think the Bureau of Reclamation was a pretty good outfit to work for?

Reflections on Reclamation

Trefzger: Well, I enjoyed it a lot, and although I didn't always agree with some of the political things, I really thought that most of the people in the Bureau are really devoted and committed to providing the public a service, and to filling a *stated* need, not some hypothetical pie-in-the-sky need. And with that end in mind, they were extremely expert at doing their job, at filling these needs. So I have nothing but good feelings

for having spent my career working, contributing what I could.

Petershagen: So your perception of yourself is that you're another one of these people that was oriented towards fulfilling this need?

Trefzger: Right, but as part of a team. It's a multifaceted team with all kinds of specialties. And of course there are a lot of planning engineers and there are a lot of design engineers, but then there are all these other specialties that have their part to play.

Petershagen: Did you notice, over your career, was there any point in time you might identify that you thought maybe that the collective attitude started to change?

Trefzger: The attitude of the employees? Oh, I don't think so.

Petershagen: Or the attitude of the Bureau, it's corporate attitude.

Trefzger: I don't think so. You know, it sort of grew with the times, I think. It certainly didn't stay the same over all those years. You know, the times changed drastically from the 50s and 60s when the Bureau was

building projects like mad and things have really tapered off in the past twenty years or so.

Petershagen: When you went to work for the Bureau of Reclamation, all of the engineers, all of the professional people, I'm sure, were male. And if the Bureau had female employees, they were office workers, clerks and secretaries.

Trefzger: Right.

Petershagen: As women started to come in and fill professional roles, did that come as a shock to your system?

Trefzger: Oh, no!

Petershagen: Or was that just another part of life?

Trefzger: We kind of got a jump-start by having a lady geologist on board as early as about . . . oh, in the late 1950s.

Petershagen: That would have been fairly unusual, I think.

Trefzger: Yes. She had graduated from the University of California and had worked some for the Department of Water Resources and some for the State Division of Oil and Gas, and she came to work for us for a few years and she did pretty well. And, you know, we were flexible. You got to be flexible to be a geologist! And later on we had other lady geologists come on board too, but the first one was a long time ago.

Petershagen: Interesting. Most of your professional associates at the Bureau are local people? University of California? Stanford?

Trefzger: Oh, no, the engineers came from all over–well, and the geologists did too, that we hired over the years. Had fellows from Dartmouth and fellows from Arizona, fellows from Colorado.

Petershagen: Did we experience, oh, say, football season, all the little Stanford-U-C rivalry in the office or any of that kind of stuff go on?

Trefzger: Oh, of course! Of course, you got to have all this attitude going on. Got to have a cheer for the old alma mater. But nobody took it very seriously.

Petershagen: Okay. I think I've reached the end of *my* agenda. Is there anything that you'd like to address?

Trefzger: Well, maybe you could help me think of something.

Petershagen: It looks like I'm drawing a blank.

Trefzger: Yeah, I think you are–Mr. Blank.

Petershagen: Well, I think we've covered a lot of ground in this interview, and I want to thank you a lot for your time and for undertaking this endeavor. Before we close, I do need to have you repeat the acknowledgement that you understand that this interview does become the property of the United States.

Trefzger: I understand.

Petershagen: Alright, and with that I'll say thank you very much, and that concludes this interview.

Trefzger: Fine.

END SIDE B, TAPE 2
END OF INTERVIEW