Oral History of

Victor C. Anderson

Interview conducted by Laura Harkewicz

4 October 2006

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ABSTRACT:

Victor Charles Anderson was interviewed in his home in Alpine, California on October 6, 2006. Anderson was born on March 31, 1922 in Shanghai, China, where his father was principal of the Shanghai-American School. He received his AB from the University of Redlands in 1943. During World War II, he worked at the Radiation Laboratory at the University of California, Berkeley and at Los Alamos as part of the Manhattan Project (1943 – 1947). He received his Master's Degree, in 1950, and his Ph.D., in 1953, both from the University of California at Los Angeles (Scripps Institution of Oceanography) in physics with an emphasis in underwater acoustics. His doctoral dissertation was titled, "Wide Band Sound Scattering in the Deep Scattering Layer." After completing his doctoral degree, he continued his research at Scripps working his way up from an assistant research physicist to a research physicist (1947 – 1968). He was acting director of the Marine Physical Laboratory (MPL) at Scripps in 1964, 1968, and 1974 as well as associate director of MPL and professor of applied physics and mathematics at the University of California, San Diego (UCSD) from 1968 – 1990. While working at MPL, he designed the Digital Multibeam Steering System (DIMUS), an instrument capable of distinguishing between large numbers of sound sources beneath the ocean's surface, which became part of all ships' sonar systems. In 1986, Anderson was named as the recipient of the Admiral Charles B. Martell Technical Excellence Award for outstanding achievement in scientific research and development and in recognition of his many years of work designing technologies for use by the U.S. Navy. The interview addressed Anderson's many years working at MPL, particularly in relation to oceanographic equipment he developed through his research. We also discussed his tenure as a professor at UCSD and his work producing instruments at his own company, Anderson Undersea.

INTERVIEW HISTORY: The interview took place on a sunny fall morning in the home of Victor Anderson on October 6, 2006. Anderson's home is in Alpine, California and is located in a rural area surrounded by horses' corrals and pine scrub. We were joined for the interview by Anderson's two cats, "P.C." and "Ginger" who often entertained us with their antics. Most of our on-audio references to the cats have been deleted from the transcript. We talked for approximately one hour and forty minutes. The recording was paused once for a short break.

Laura Harkewicz
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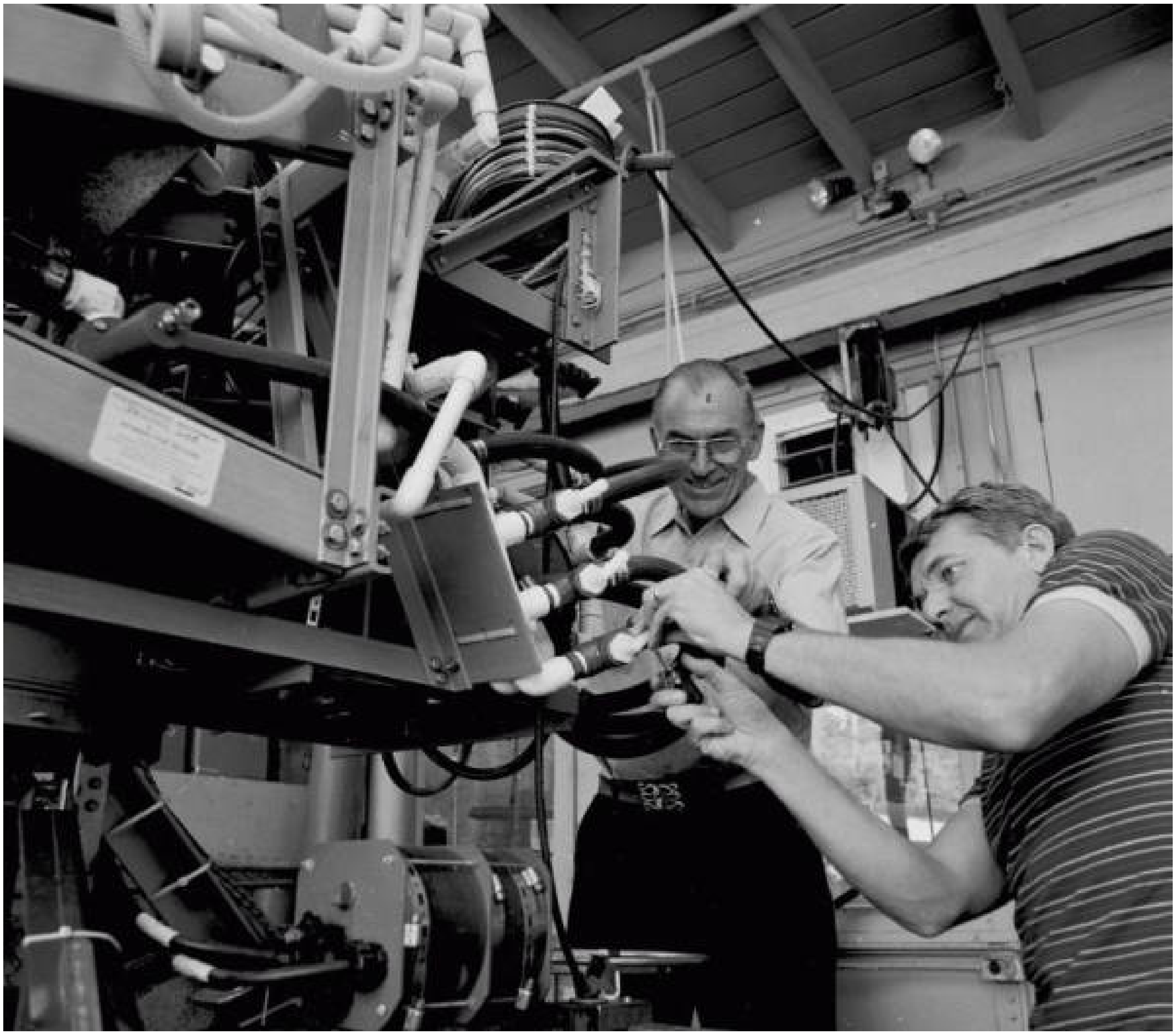
July 31, 2007



Victor C. Anderson (left) and Fred Uhlman (right) with instrumentation, 1989.
Scripps Institution of Oceanography Archives, UC San Diego

Harkewicz: It is October 4, 2006 and I am in the home of Dr. Victor Anderson in Alpine, California. Good morning Dr. Anderson.

Anderson: Well, good morning to you. I'm glad to see you here.

Harkewicz: Thank you. I'm glad to be here.

Harkewicz: The first question I have for you Dr. Anderson, I know that you were born in China and that you had missionary parents, and I wondered what that was like for you growing up with your parents in China. Briefly.

Anderson: Briefly? Well, I was there, I guess, until I was about nine years old or so. I remember the situation there quite well. We lived first at the Shanghai-American College, Shanghai University I guess it was, which was out near the river. And it was, essentially, a campus in itself. We were in a protected compound. Then, when my father became principal of the Shanghai-American School, which was in the French Quarter in Shanghai, right on Avenue Petain, we lived across the street from the school. So, we no longer were in a compound. Our house was fenced but we were in the City of Shanghai.

Harkewicz: So, was it different for you being outside the compound? I mean, when you were in the compound did you ever venture out very much?

Anderson: Well, we were pretty well contained within our fenced yard. When we were at the school we were pretty much restricted to where we went. We weren't free to roam around. Back on the campus, we could go anywhere we wanted within the compound.

Harkewicz: Why was there that containment? Was it dangerous to go outside of the fence?

Anderson: Yes. Yes, it was. I mean, there were people around and it was hazardous. You were always careful, you didn't let little kids run around free.

Harkewicz: Did you learn Chinese?

Anderson: I was starting to learn it. My sister learned it and actually learned it quite well. We were taking courses in it in school. I left in sixth grade and I wasn't into it that much. So, I never really learned very much Chinese.

Harkewicz: That's too bad.

Anderson: Yes

Harkewicz: Was it hard for you when you came to the United States then?

Anderson: No. No. Not particularly. The transition was pretty easy. One of the problems I had was that when I was in the sixth grade there I fell out of a tree and I broke both my arms. My mother always liked to tell that story.

Harkewicz: And, why is that?

Anderson: We had one of these little putt putt boats and there was a big well. Well, the well in that place was sort of like a pond - it was about ten feet across and maybe ten feet deep and we were playing in there and mother was watching, and she didn’t want to let us play there. She said, "I'd rather you went up and climbed a tree and broke your arm as opposed to play here and drown." So, we had to go back, and I climbed the tree and I managed to fall out and break both arms. [*Laughter*]

Harkewicz: Oh gosh. No wonder she likes to tell that story.

Anderson: She thought I was a very obedient child. [*Laughter*]

Harkewicz: You did just what she told you to do.

Anderson: Yes.

Harkewicz: That's pretty good.

Anderson: As a result I really didn't finish the sixth grade.

Harkewicz: This was when you're still in China?

Anderson: I was in China, yes, and it was in the middle of the school year, almost the middle of the school year, and I was out for two weeks with broken arms and I couldn't do anything. So, when I came back here I took sixth grade over again, which was probably an easy thing to do. I mean, that made it a lot easier for me, I think, coming into the States because I didn't have to jump right in at a higher grade.

Harkewicz: Well, that makes sense.

Anderson: So, it was an easy transition.

Harkewicz: And, that was when you moved to Oregon?

Anderson: That was into Oregon, yes.

Harkewicz: So, was your father still involved in the same kind of work at that point?

Anderson: Well, he was then the president of Linfield College. He took the presidency there, and he was there for about six years.

Harkewicz: So, what was it like to be – I don't want to go into this too much, but if you lived in sort of a restricted compound at one time, and then you moved to the United States, was it more wide open to you at that point?

Anderson: Oh yes. We kept wondering, "Where were the boundaries?" you know. "Where were the fences?" And, it was very different. Freedom was something that was very noticeable for us, that we could go down the street to a friend's house and nobody worried. It was quite different. Yes.

Harkewicz: That must have taken a little getting used to, I suppose?

Anderson: Yes.

Harkewicz: Well then, we can jump ahead, way ahead, and talk about other restrictions I guess. I mean, I was wondering about your work with the Manhattan Project. I mean, that was a contained facility also, at least at Los Alamos. You were at Los Alamos, correct?

Anderson: Well, actually that work started at Berkeley. In fact, that's where I first got involved with the University of California. That situation was an interesting one. It was kind of a fluke that I got into it, because what had happened, I was in college at the University of Redlands at the time, I was in my junior year when the war broke out, and by taking a summer course at UCLA, I managed to complete my courses early. We wound up taking twenty-three units in one semester, three of us in the Physics Department, to get it done. And so, we managed to finish a semester early. At the time I was going with Anne, who became my wife, and she had moved up to St. Luke's Hospital in San Francisco, for nurse's training, in her sophomore year, I think it was. I was a senior. So, that Thanksgiving I managed to arrange to exchange Thanksgivings with a friend of mine, Hugh Thomas, who was at the campus there at Redlands. I was going to Redlands at the time. And, his family lived in Oakland. So, I went up to Oakland for Thanksgiving dinner and we got Anne to come over for that. And then Hugh had Thanksgiving dinner with my folks in Redlands.

Harkewicz: Oh. I see. That's what you meant by "exchange"? I wondered.

Anderson: That was a fair exchange. So, that was kind of nice. Well, while we were at Thanksgiving dinner up there Mr. Thomas says, "Hey, you ought to go over to the campus there on Berkeley and check because I hear they're hiring at the Radiation Lab." And so, I went over there and managed an interview and they said, "When can you start?" I said, "Well, I've got to finish college first." [*Laugh*] But, I was able to come up in January then and start. And, that was with the University of California. That was my first link with the University. We worked on what is now called the Calutron, which is what they called the magnetic separation process. I was sent to Oak Ridge as part of the pilot group there to start training and working with the systems and getting them into service and all. And, when that training period ended I moved on to Los Alamos, still under the University of California, and took a position up there and actually managed to be at the site in Alamogordo on the first test.

Harkewicz: Really?

Anderson: Yes, with my interest in acoustics, I worked on the blast gauges for the system and installed them in different locations to measure the blast energy.

Harkewicz: I see. So you were involved in acoustics even at that time?

Anderson: Yes, that was when I got started in it. And then after the war we came back. I left the University and moved to the town of Mentone in the Redlands area and I started working independently. After a while, I decided I had to get back to graduate school. I checked with USC and UCLA, and UCLA offered $10 more a month for teaching assistantships, so I went to UCLA. [*Laugh*]

Harkewicz: You have to go where the money is, right?

Anderson: So, I got back in the University of California system again.

Harkewicz: I see. Can I ask you a question about the Trinity test?

Anderson: Yes. Go ahead.

Harkewicz: You actually saw the test then?

Anderson: Oh yes.

Harkewicz: What did you think about it? What was it like to see it?

Anderson: It was just unbelievable. It really was. We may have been ten miles away when the test went off.

Harkewicz: So, did you feel the heat and the vibration, and all that?

Anderson: The heat, and the light and all, and the shockwave. Yes.

Harkewicz: Was it scary?

Anderson: Oh, it really was. And then I was able to go back to the site later on and saw the green glass and the fusion of the ground. It was very impressive.

Harkewicz: Having been involved with that, do you have any different feelings related to atomic weapons?

Anderson: Well, that's been a concern, but I know that at the time we had been attacked and we were at war, and this was an opportunity to get an advantage. And, I didn't see any other course. We had to do it. And, I think that there's a lot of concern about whether or not it was necessary to do it, but I think that what happened was that we cut the war short with the bomb, because – in fact, some interesting comments came out about the surrender that some of the Japanese officers had attempted to destroy the tape, the surrender tape of the Premier, and they didn't get it. But, the feeling in Japan was that they were going to fight to the finish.

Harkewicz: So, you think without the bomb there would have still been an invasion?

Anderson: Without the bomb it would have been a long extended war. There would have been an invasion of Japan. There would have been millions – the estimated loss of troops were in the millions. To say nothing of the civilian casualties. So, it was unfortunate but I think it was necessary.

Harkewicz: Well, I didn't mean to take us off track here. You were talking about going to graduate school at UCLA.

Anderson: Yes, I was going to graduate school at UCLA, and while I was there we had a visit

from some of the people from the Marine Physical Lab. They came up and gave us a rundown on their acoustic research projects. In fact, we actually had a course in acoustics. I took a course in acoustics, I was in the graduate school and – I was trying to -- I'm fuzzy. So, let me think about it.

Harkewicz: Take your time. I'm not going anywhere.

Anderson: Well, I'm just trying to recollect the situation there because it was linked to my experience at Berkeley…When I had taken the job up at Berkeley earlier I had had a chance, for some reason, I had had a chance to uhm . . . I'm sorry it's so confusing here. But, I had a chance to come down here but went to Berkeley instead. Let me back up a minute.

Harkewicz: All right.

Anderson: One of the reasons I was able to finish early was that I was able to take that summer course and get twelve units of course in electroacoustics.

Harkewicz: I see.

Anderson: Which was my initial input into both electronics and acoustics with any meaningful input. And, at that time, during that summer course we had people from MPL come up and give some lectures and all, and they actually interviewed some of us. And so, after that Thanksgiving, when I was up in Berkeley, I had second thoughts about going to Berkeley, you know go to Radiation Lab there, because there was this contact down here. And, I called down here and nobody knew about me. So I went to the Radiation Lab instead. [*Laugh*]

Harkewicz: Oh no. And, your wife was up in Berkeley too?

Anderson: Yes. She was up in Berkeley. But, she originally came from La Jolla.

Harkewicz: Oh really?

Anderson: That was another reason to come down here.

Harkewicz: So, you could have gone either way?

Anderson: Yes. Either way it would work. I had to fill that information in. I'm sorry if I took us off track.

Harkewicz: That's all right because I know it was bothering you that you couldn't figure out where the connection was – so I'm glad you figured it out then.

Anderson: All right. Finally got it sorted out. So anyhow, the connection was there. But, when I started to go to UCLA for my graduate work then I had a second contact with MPL and I took on a position at MPL and continued my UCLA work through the Scripps faculty.

Harkewicz: I see.

Anderson: Dr. Liebermann[1] and Russ Raitt[2] were able to serve on my committee and I got my degree from UCLA.

Harkewicz: So, you were still in school while you were working at MPL then?

Anderson: Yes. I was still enrolled in the graduate school there.

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[1] Leonard Norman Liebermann (1915-) was appointed Professor of Physics at UCSD from 1959 until his retirement but also held a research appointment at the Marine Physical Laboratory at the Scripps Institution of Oceanography.
[2] Russell Watson Raitt (1907-1995) was a geophysicist who worked at the wartime University of California Division of War Research (UCDWR) in San Diegoand then moved to the Marine Physical Laboratory where he worked until his retirement.

Harkewicz: I see. And was the war over at this time?

Anderson: Yes. Yes. The war was over then.

Harkewicz: But, they were still doing work with the Navy on submarines and things like that?

Anderson: Oh yes. Basically what MPL was involved in was underwater acoustics, at that point. Most of my work ended up in that area, almost everything I did.

Harkewicz: Do you remember what year that was

Anderson: Forty-seven, I think it was. I think it was forty-seven when I came down to Scripps – MPL.

Harkewicz: And you got your doctorate in physics then, or was it some sort of branch of . . .

Anderson: It was in physics. In acoustics, which was in physics.

Harkewicz: What got you interested in acoustics in the first place? Is there some story from your childhood or something that . . .

Anderson: I had been interested in acoustics. Actually, I'd built pre-amplifiers and stuff, and electronics like that, and I'd been interested in acoustics but I think that that summer course at UCLA was the one that really got me interested.

Harkewicz: Did anybody from Scripps come up and teach there at that time?

Anderson: No. Dr. Delsasso[3] of UCLA was the one who taught that course, but people from Scripps came up. I think Russ Raitt came up there and talked about some of the underwater stuff.

Harkewicz: I had a question about the way MPL was set up. I have read that it was established by an agreement between the Navy and the University of California to study purely scientific problems in underwater physics, without concern for its application to the Navy. But, I was wondering if you thought that's how it really worked?

Anderson: Well, basically yes. The problems we worked on were acoustic problems. They were supported by the Navy. I mean, a lot of the support came out of the Navy, the Office of Naval Research. And, in fact that was our primary support. But, the

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[3] Leo P. Delsasso (1896-1971) was associated with the Department of Physics at UCLA from 1919 until his retirement in 1963 as a student, professor, chair and dean. He worked at the U.S. Navy Radio and Sound Laboratory at San Diego during World War II and was an expert on acoustics.

problems were essentially acoustic problems, instrumentation problems that were of that nature. Okay? And, in fact, I did my thesis work as work under the ONR contract. I built the equipment and all there. And, that took quite a while.

Harkewicz: I know some historians have written about the fact that Scripps designed their research to meet the Navy's needs. It was a mutual support network, but some of them suggest that research was done more for Navy applications than some scientists might want to actually admit. And, I just wondered if you felt at any time that the Navy was pushing you to do certain kinds of things that didn't meet your interests?

Anderson: No. No. No. I wouldn't say so. I would say that we were pushing the Navy to do things we wanted to do. In fact, one of the first contracts that I ever got from the Navy, Naval officers were out here visiting NEL[4] at the time. They came down to talk with us and they said, "We've got about $50,000 that we want to put into a project and NEL won't talk to us for less than a hundred. If it isn't $100,000 they don't want to do it." And I said, "I can write you a proposal." So, I wrote a proposal and I got it. And, that started me doing some things. Well, the proposal was to build an ambient noise array to study ambient noise in the ocean. And, that's what got me started on a lot of instrumentation and that turned out to be Navy oriented. Because, they were interested in using arrays for listening, not necessarily for studying the background.

Harkewicz: So, there really isn't any way to separate out scientific interests from Navy interests?

Anderson: No. I was interested in the processing because it was an acoustic problem, and it was instrumentation for acoustic measurements. My thesis project had no particular value to the Navy.

Harkewicz: Right. But they still supported it?

Anderson: But they supported it.

Harkewicz: Okay.

Anderson: And, that was an interesting project. I look back on it and I had to do some very innovative instrumentation to be able to do it. I can remember that one of the first things that I did when I came down to work at MPL, I was still thinking about the thesis project, of course, but I got set to work to calculate the scattering from a fluid sphere. In those days there were no computers. That was before computers. And, we had two girls that ran Marchant calculators and they calculated for

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[4] U.S. Naval Electronics Laboratory (NEL) was established in San Diego in 1945 and undergone several name changes and is currently the Navy Space and Warfare systems Center (SSCSD).

months to generate the characteristic curves for the sound scattering from a fluid sphere. That was one of the first papers I wrote. Later on one of my graduate students said, "You know that paper you wrote? Well, I just did it on the computer and it took me about twenty minutes." [*Laughter*] Oh man. Oh. Yes, we were working back before computers. What I was interested in looking at for the thesis came out of some of the work that Russ Raitt had been working on, which was this scattering from the deep scattering layer. I was interested in trying to understand what was scattering the sound. So, and because I had done this work with a fluid sphere I had some idea of the fact that there's a frequency dependence in there and so I was interested in getting a wide-band, a broad acoustic band scattering. And, in order to do that what I did was I developed a spark source, which is now used for acoustic stuff, and for seismic surveys. But, I was the first one to generate a spark source. I designed one that would work over 2000 feet of cable so I could get down to the scattering layer, and then developed a hydrophone system that would be a wide-band receiving system, and then I had to be able to record it. And, we didn't have digital recorders. We had tape recorders but I was interested in a very short pulse in the broadband. So, I designed and had the machine shop build a rotating drum camera which took 35mm film wrapped around a drum and we would get this spinning at 3600 rpm and I could trigger a cathode ray scope to record the waveform for 30 milliseconds.

Harkewicz: So, you had a visual rather than an audio recording?

Anderson: Well . . .

Harkewicz: Is that right?

Anderson: Well, you use the hydrophone output with the electrical signal and are able to record it on the film and see the actual wave form.

Harkewicz: I see.

Anderson: And then the question was, "What do I do with that?" Well then I had to build a flying-spot scanner that could take that film and scan it, and convert it into an electrical signal, and then put it through a spectrum analyzer so I could measure the frequency. This equipment was something you had to build from scratch. I mean you didn't go out and buy one. You bought a cathode ray tube and got a power supply.

Harkewicz: Now are we still talking about for your . . .

Anderson: That was my thesis.

Harkewicz: I was going to ask you about that later but since you brought it up, I know you built a lot of this stuff. I mean, you said it right now. You said you designed it or you built it. I know that some people do that but is that rather unusual from a scientist's perspective? Do other people just say, "This is my idea"? My impression, from what I've read about you, is it seems like you have a good way of taking your ideas and making them into physical things.

Anderson: Basically that's right.

Harkewicz: That seems unusual to me. Did you feel that at the time?

Anderson: Oh, I don't think that's particularly unusual. An experimental physicist does that. That's what you do in acoustics - you don't get very far if you just use off-the-shelf equipment. If that's the case, then you're a theoretical physicist..

Harkewicz: Okay.

Anderson: If you're experimental you have to build the equipment.

Harkewicz: I understand. So, most experimental physicists actually do build their own equipment then?

Anderson: Pretty much. Well, nowadays, you don't build an awful lot of the stuff. I mean, we were back in the days when you had to build it. It didn't exist. You had to build things that didn't exist. And the interesting thing about the cable - the problem was I had to get the energy down there so I built a 20,000-volt power supply and a big capacitor bank and then had to design an arc gap to trigger that. And then, you'd fire that down this cable and down at the end I had a spark source that I put together that would allow you to, you know, explode it, explode the water. And, the problem was that I had no problem while testing it but when I got a length of cable, 2,000 feet of cable and tried to run it, why we spent most of our time fixing blowouts in the cable. Twenty thousand volts was a lot of voltage, you know. And, I would order more cable from the Navy supply house and I'd get this stuff and I'd put it in there but it just wouldn't go, you know. And I said, "Look, I'd like to get some fresh cable." They said, "We can't do that. We've got 20,000 feet of this cable in stock, and when it's gone we can order some more." So, I said,"Okay, I'd like to have 20,000 feet of cable." So, they shipped me 20,000 feet of cable. "And, backorder for me 2,000 feet." I got the good cable and it worked fine. Well, you know, the thing that happened was, years later, several years later I remember, I needed some coax cable and called up and said, "You got a hundred feet of RG8U?" and he says, "Yeah. We've got 20,000 feet. I don't know why we got that much, but we got 20,000 feet in stock. You can have some." And, it turns out that's the Navy's ordering system. [*Laugh*]

Harkewicz: I see.

Anderson: If you run out of anything in the Navy, for a month, you're in trouble because they won't order it. Because what they do is they look at what was purchased the previous month and they order for the next month. "Okay, well we got 20,000 feet out," they order 20,000 feet of cable, and it sat there for twenty years. [*Laughter*]

Harkewicz: that's pretty funny.

Anderson: We had that trouble with the Navy's supply system. If you went to a resistor bin and it was empty it stayed empty.

Harkewicz: For over a month?

Anderson: Because if it was empty for a month nothing got reordered.

Harkewicz: Gees. Well then how did you ever get it reordered then? I mean, it's almost like you'd have to put some in there in order for somebody to . . .

Anderson: Almost. Well, that's why it was helpful to work with the university. You could order things.

Harkewicz: Earlier you'd mentioned the Navy Electronics Lab. And, I know that I read somewhere that MPL and NEL actually shared equipment and things like that.

Anderson: We did. Yes. We had access to the Navy supply system and to the university purchasing. We had both. And we could get equipment out of the Navy Electronics Lab and use it and we also could buy it through Scripps, through the University contract. So, we had that joint use for quite a while and it was very helpful.

Harkewicz: Did you have to justify that you were going to use it for some sort of Navy thing if you got it from the Navy Electronics Lab?

Anderson: No. We had a contract, basically a contract that was a research contract.

Harkewicz: Okay.

Anderson: It was available.

Harkewicz: So, if you needed your 20,000 cable, feet of cable, and it wasn't there could you have gone to the university or would that not have . . .

Anderson: Probably could have. But, we'd have to tell them why we didn't have it.

Harkewicz: Was there any budget difference, I mean, cost wise?

Anderson: Well yes. The cost-wise difference was it either came out of the Navy budget or it came out of the Office of Naval Research contract.

Harkewicz: At MPL?

Anderson: MPL.

Harkewicz: But, they didn't hike up the price at one place more than . . .

Anderson: No. No.

Harkewicz: I was just curious.

Anderson: Well, we didn't have to pay for it.

Harkewicz: But, somebody did though.

Anderson: Oh yes. Well, the Navy. The Navy paid for it. Excuse me.

Harkewicz: Oh, let's pause here for a minute.[5] So, we were just talking about equipment ordering . .

Anderson: Yes.

Harkewicz: I understand that you did some classified work, or a lot of your work was classified? Is that true?

Anderson: I did some. Some of the work was classified. I was trying to think what it was. It's hard to remember because I don't have those reports here. We did a lot of the work was with the Artemis Program and that was classified. The Artemis Program was a study of, basically a study of looking at a very large sea floor surveillance system. We were involved in that. Actually, I was involved in, and basically did the design for, the subarrays which were installed. And, looked at some of the problems of beam forming with the array. So, that work was classified. But, the basic instrumentation that we did was not. So, the Artemis reports – and I was on the Artemis committee and we had committee meetings and all the rest of the stuff and things that went on, and those were classified reports.

Harkewicz: But, it wasn't a huge part of your work then, to do classified stuff?

Anderson: No. Well, I spent a fair amount of time on it. Yes, it took time. But, I wasn't

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[5] The recording was paused briefly in order for Anderson to respond to a phone call.

solely involved in classified work.

Harkewicz: Okay. I just wondered if you ever felt that doing any kind of classified work restricted your being able to publish something that you really thought was worthwhile to publish, or if you ever came up against that kind of thing?

Anderson: No. I never felt that limitation. The reason was that the things that I did, the ideas and things that I projected into it were not classified. Okay?

Harkewicz: Okay.

Anderson: But, the things that we did, the studies that we did, now those were classified, but those weren't things that would just be published in the open literature anyhow. They were very specific sorts of things.

Harkewicz: For a specific reason?

Anderson: Yes.

Harkewicz: We were talking about the equipment you designed and I know you designed this digital multi-beam steering system, the DIMUS?

Anderson: DIMUS. Well, that grew out of this first contract actually, you know.

Harkewicz: The one you did with your thesis?

Anderson: The one which we talked about. They had some money and we wanted to do it, to build this array. And, I had to decide what to do with it. Well, obviously if I'm going to use the array for listening, for studying, I have to be able to steer it into a direction. What you have to do is look at this spatial array and say, “I want a sound coming in from a particular direction." Well, if I want that sound to add to this hydrophone that's over here behind it I have to delay that sound and add it to this at the right time so they'll reinforce for a particular direction. Well, this was a thirty-two element array, and it turns out that what I did was I chose the largest regular polyhedron that I could find, the great stellated icosahedron.

Harkewicz: My.

Anderson: And, that's a regular geometry that says that you've got essentially thirty-two different directions where the array looks just the same. And, it's symmetrical, see? So, the beams that look in different directions are going to all have the same characteristic. They're not going to be fatter in one direction and not in another. Okay. So, here's thirty-two elements and what I have to do is to be able to delay those signals. I have to put in thirty-two delays for every look direction I want and I want thirty-two look directions so I've got to have a thousand different signals mixed up in here in all different time delays. Well, in order to do that you have to be able to record it on something and play it back. And, I looked at magnetic tape recording, and magnetic drums, and they are very involved. Recording heads are pretty tricky, you know. And, I figured "Well, you know, I don't have to store it very long. I bet I could record it on a dielectric medium." Store a charge on a surface and erase it, you know. Instead of a magnetic field just this electric, electrostatic charge. And so, I worked on it and sure enough I could do that. And so, the first multiple-beam former I built was a dielectric recorder. And, what I had was about a one-foot diameter drum, about a foot long, running on a shaft of a motor running at 3600 rpm, spinning around there at a great rate. And I had built some ion sources where I checked out different gases for their performance. It turns out the nitrogen is pretty good. It has a good ionization potential. Air is a good medium for it and it was just handy, you know. So, I built a little RF discharge, a little arc and put a baffle in it to control it so I could get electrons to flow out onto this drum. And then, they'd stay on there and they'd go around. What I needed then were little pickups. Well, those pickups turned out to be very simple. Very small coaxial cable just cut off and just the end of the wire, the capacitance from the end of the wire to the drum was enough to pick up that charge. These were little, little things. They were about an eighth-inch size or so, very small, and I had mounting racks around the drum, thirty-two racks, and you could position these pickups around there. And then to combine them, all I had to do was tie them together. I could just connect them together and put them into an amplifier. So, it became a very simple, relatively simple thing to build, this 1,000-element, thousand-receiving-head array. And, I did that and it worked.

Harkewicz: Now, let me understand this. First of all, the recording thing that you're describing, that was . . .

Anderson: The dielectric recorder.

Harkewicz: Okay. And that was above the surface – that was out in the air you're saying, right?

Anderson: Oh yes. Just exposed in the air.

Harkewicz: But, your array was . . .

Anderson: Was down in the water.

Harkewicz: Right.

Anderson: Yes.

Harkewicz: We were talking about with the cathode ray tube. Those are all different parts of the same . . .

Anderson: That was a different one. No, that was a different one.

Harkewicz: Okay.

Anderson: Totally different.

Harkewicz: This is all different components for you to find out what you wanted to find, isn't that correct?

Anderson: Oh yes, except it was totally different from the spark source.

Harkewicz: Right. But your . . .

Anderson: Totally different.

Harkewicz: These are different pieces of equipment that you designed, and made, in order to have one big project, right? Is that correct?

Anderson: Well . . .

Harkewicz: This was all the different equipment you needed to use to figure out what you wrote your thesis on?

Anderson: No. They were different projects.

Harkewicz: Oh, they were different projects. I see.

Anderson: The spark source was a totally different project.

Harkewicz: All right.

Anderson: Totally different.

Harkewicz: I thought these were all components of one thing that you were trying to figure out. And I was thinking, "My, how long did it take you to do all this?"

Anderson: No. No. That was the array, for my thesis. This is trying to find out how to use the array. And the array didn't have . . .

Harkewicz: Which you did not use for your thesis project?

Anderson: No. I didn't. That had nothing to do with it.

Harkewicz: I'm sorry. I misunderstood you then.

Anderson: It had nothing to do with the thesis project. That was separate. Okay?

Harkewicz: I misunderstood you then.

Anderson: Okay.

Harkewicz: Okay. I thought you were designing all these different things for one project and I was . . .

Anderson: No. No.

Harkewicz: I was wondering. "All these different pieces of equipment for this one experiment."

Anderson: No. Well, anyhow, I built this dielectric recorder. It turns out that the dielectric recorder, that was one of the things I invented. I got a patent on that. And that's the only patent I ever got any money for. And, I got $1,000 from some weird company named Xerox or something like that. [*Laugh*] They went around and bought a license for every patent they could find that had anything to do with electrostatic recording, because that's how their system works.

Harkewicz: I see.

Anderson: It's a totally different technique but . . .

Harkewicz: Well, since you mentioned the patent though – you're working at MPL at this time, right? So, was there a problem with you having your own patent and then actually getting money for it, because you were working at MPL?

Anderson: No, MPL had a regular patent agreement with the University and with the Navy, and the agreement was that the university had free license to the patent and the Navy had free license to the patent, but a commercial license patent they could buy it from me.

Harkewicz: So, it depended on how you filed for the patent?

Anderson: No, it was the basis of the agreement. I don't know the details on how it was done, but a company can't file for a patent. An individual has to file a patent. I don't think a company can have a patent. It's an individual that owns a patent. What the University policy and the Navy policy was that they had a right to use that patent. They have the right to freely use the patent. But, with the commercial rights, a commercial company could pay the inventor for rights. The rights had to come from the inventor.

Harkewicz: Do you still own the patent?

Anderson: I still own the patent.

Harkewicz: And anything you developed was still yours then? It didn't automatically go to the University or the Navy then?

Anderson: No. No.

Harkewicz: Okay. I understand. All right. I thought that, that maybe there was some sort of intellectual property type thing where anything you developed while you were at the university went to them, or something like that. I wasn't sure how that worked.

Anderson: No. They didn't have that. It was a, it was the rights that went. Yeah. Yeah.

Harkewicz: And so . . .

Anderson: And the patent, I think that's basically true for patents. There may be other things that aren't that way, but for patents I think that's the situation.

Harkewicz: Okay. All right. Well then I'm . . .

Anderson: Just because patents are owned by individuals.

Harkewicz: Right. Okay.

Anderson: Okay.

Harkewicz: Well that's good to know because I wasn’t sure how that really worked anyway. So, thank you for clearing that up. But, you're saying though that the thing that Xerox bought from you was just a little part of your DIMUS system then?

Anderson: No. It was just the right for dielectric recording.

Harkewicz: I see.

Anderson: That's all the patent was, dielectric recording.

Harkewicz: I know you've got this National Security Industrial Association Award for DIMUS.

Anderson: Yes. We haven't even talked about DIMUS yet.

Harkewicz: Well, let's talk about it then.

Anderson: Okay. Well I was getting to that.

Harkewicz: Because I want to know why you got an award for this particular piece of equipment then? What was so special about it?

Anderson: Well, I was getting to that. There's a route to get there and we've got to go through that process.

Harkewicz: All right, lead on.

Anderson: All right. So, I built this dielectric recorder and that got me into the multiple-beam former. That was a real-time multi-beam former where you looked at all directions all at the same time. Now, that particular capability is of interest to the Navy because with the Navy sonar system, a passive sonar system, you basically looked in a particular direction and then you compared that with something in another direction to see if it's louder or less, and if it's louder you say, "There must be something out there." Well, the longer you can look the smaller signal you can observe. You average it. And, the longer you can average the better your detection is. Well, at that time the Navy systems had arrays that they used and this came from the German U-boats. They took the technique from there and they used basically a time delay map, an electrical one and one with brushes on it that rotated that steered the time delays for all the elements in the circular array. And so, they could train this around and look in a particular direction. Well, to use that they would sort of scan, slowly scan around and average it and look at it, but if you can look in one direction all the time you can average maybe fifty times longer, you can gain about 10 dB of gain, which means you can see a signal one-tenth as loud out there as you would otherwise be able to detect. Okay? That's why multi-beam steering is important, simultaneously look in all directions. Okay?

Harkewicz: All right.

Anderson: Okay. And this great stellated icosahedron array that we built, and the beam former, was the first time anybody had done real-time beam forming, multiple beam forming in real time. So, that was an important thing. Well, that didn't get me to the DIMUS system, but what did get me to the DIMUS system was another idea I had and this was the DELTIC correlator that preceded the DIMUS. And, the DELTIC correlator came around because at, about that time the computers were using ultrasonic delay-line memories and that means you have a little block of quartz and you put a acoustic signal into it and then it runs around and comes back out again. And so, what you can do is put a whole series of pulses in there and just keep looking and feeding them back in. So, you can store a thousand pulses in there and that becomes the memory. All right, well I looked at that and I said, "You know, that's interesting but what I'd like to do is to do a correlator by taking two of these things. And, now you've got a signal that's spinning around real fast, and you've got that signal there and you'd like to either do a spectrum analysis of that and see what the spectral content is or you'd like to do a correlation, which means to compare the time delays of two signals." So, this was a technique that I thought would be good to develop. And, one of the things that was important in this was that the length of signal that you have isn't all that long and you have to be able to average it. Well, one of the problems with the dielectric recorder was that it didn't record perfectly. You had a hard time erasing it. Well, it turns out that if you just backed off on that recording head a bit that it wouldn't erase as fast and you get an averager. In other words, a signal will build up and you can have it store for ten seconds. And, it may take ten seconds to change that signal, and it's synchronous with the rotation. Well, an ultrasonic delay line is synchronous. It's just going around the same time all the time. So, if you take a dielectric recorder and combine it with one of these rotating ultrasonic line signals you can build a correlator that will allow you to correlate in real time. Previously what they did was they'd take tapes and they'd record two tapes, and then they'd play it through, and then slip the two tapes in time a bit and play it through, and finally you'll build up a correlation function. Well, here you could build one in real time. So, I took that into the boss. It was Eckart at the time, Carl Eckart. I took it to him and said, "You know, here's an idea," and he says, "Well, it sounds good. Why don't you write a paper on it?" You know, "Give it at the Navy Electronics Symposium." So, I wrote a paper and I worked with the people up at NEL and we built a little movie film of it, you know, to show how the thing operated. And so, I get to the symposium and I give this paper. Well, before I gave the paper a couple people got up and gave papers at the same instrumentation session. One of them was from NEL. It was Bob Isaacs. He gave a paper on a secure communications system. The secure communicating system allowed you to transmit a random signal, and then receive it with a correlator and pull the information back out. And, they ran tests at sea with it and showed that it would really work. The only problem was they didn't have a real-time correlator, they had to do this offline. They'd do tapes and slip them and show they'd get a correlation function. And, then the other one that got up was John Munson from NOL, Naval Ordnance Lab in Washington and he talked about a passive ranging system that had three hydrophones on the submarine, and you correlate the two signals from this one and the two signals from that and you can look at the time difference of the arrival and get a range, by the time difference, but you had to have a correlator to do it. They had run tests at sea and showed how it would work and they just did offline correlation. So, I gave the next paper and told them about a real-time correlator.

Harkewicz: And, did they all cheer?

Anderson: Oh, they said, "Hey, we've got to talk." [*Laughter*] And, we did. See this is all involved. And, at the same session Ted Hunt from the Acoustics Lab, Harvard Acoustics Lab, was there.[6] So, I got an offer from Harvard for a postgraduate position– I just had finished my doctoral degree. I got a postdoc appointment at Harvard. Spent a year at Harvard. I built the DELTIC correlator there. And, John Munson built a DELTIC correlator at NOL. And, Bob Isaacs built one at NEL, and we collaborated on it. I did mine. Mine was unclassified, but theirs had classified applications. And, and we talked back and forth and they used the same technology. The dielectric recorder was a key to it. Nowadays, it's no problem. You do it in a computer, you know, but that was what was key to being able to develop that thing, to make it work. So anyhow that's how I got into the DELTIC correlator. And, I did get a patent on that.

Harkewicz: You did?

Anderson: Got a patent on that one.

Harkewicz: But, nobody wanted to buy that one from you?

Anderson: Hmm?

Harkewicz: But, nobody wanted to buy that one from you?

Anderson: Nobody wanted to – well, the people that wanted it had it. The Navy had it. The university had it. But, when I was working on that at Harvard what we did was we did clipped processing. Just the polarity processing is what we used. And, this came out of work that had been done by one of the people at Woods Hole, that showed that in a random noise background all you have to look at is the polarity of the signal, the plus or minus. Don't worry about the amplitude, just how it changes, and that you lose about three decibels in processing gain, but it's much simpler. Instead of ten bits you can use one bit, one bit data. And so, as I was looking at that in the, in building, in doing this DELTIC correlator at Harvard I thought, "You know, that's something that you can do for beam forming too, and you should be able to just use the clipped output, the polarity of the signals, and be able to combine them with the right time delays to build up the signal." Okay? And, you don't have to use all that amplitude. It turns out that a shift register is a time delay. You put one bit in and you step it and it goes down the line and comes out the other end, okay? Well, if you have taps on that, you can take them off. So, I figured that we should be able to build a beam former that way. And so, I took the same thirty-two element array that we had, after I got back from Harvard, and we built a DIMUS beam former. Instead of delay lines, where I had used a rotating drum we used shift register, a digital shift register, which in those days you could build with transistors. There were no integrated circuits yet. But,

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[6] Frederick Vinton ("Ted") Hunt (1905-1972) Harvard Professor of Physics and founder of the Acoustics Research Laboratory at Harvard.

there were shift registers. I mean transistors. You could buy flip-flops and they were about $4 a bit. Well, that's too much. So, we built our own shift registers, and built a DIMUS beam former for the, the thirty-two element array, which worked well. And, that was the forerunner of a lot of things. Well, what we did at MPL we built a DIMUS beam former. We built two of them, two identical beam formers, relays and all. We shipped one of them off to the Naval Underwater Sound Lab in New London, because the Underwater Sound Lab was the laboratory that developed fleet equipment. Anything that goes into the Navy ships has to come from that place. So, we shipped them one of ours, and said, "Here. Make one." And, they go in to work and they build a unit that goes onboard the subs for their arrays.

Harkewicz: And, what did you do with the other one?

Anderson: Hmm?

Harkewicz: What did you do with the other one then?

Anderson: We used it. We went on submarines with ours.

Harkewicz: Okay.

Anderson: And, we did some studies of the background noise using the sonar arrays, some background noise studies. Yeah.

Harkewicz: And, obviously that was successful?

Anderson: Yeah. That's fleet equipment.

Harkewicz: You had mentioned before when you were talking about the other people building a similar piece of equipment that you built, after you gave your talk at the conference, once you make something like that, are other people still trying to – I can see improving on a piece of equipment, but, was there often duplications with people building the same kind of thing? I mean, once you had this, the DIMUS, somebody else wouldn't have to build it other than make a copy like of what you built?

Anderson: Oh no. No. They'd have to build it. The technology was what was patented.

Harkewicz: I guess I'm trying to ask if laboratories worked together. Once a piece of equipment was manufactured that would be useful for everybody would they just try to improve upon that? Or, would they try to make the same thing that you made?

Anderson: Well, I can explain that a little bit. One of the companies – oh, what was that? I forget the name of the company, but they were involved in one of the big geophysical arrays that was set up to measure explosions around the world. They took the DIMUS design, concept, and built a DIMUS system for that. That wasn't the thing I built, but they took DIMUS, the process, the technique and built a system.

Harkewicz: Okay.

Anderson: It isn't a matter of copying it. It's using that technology, that approach to things, and designing that way.

Harkewicz: I understand.

Anderson: Yes.

Harkewicz: Let me see. I feel like I've gotten us too involved with equipment talk and I guess I wondered more about maybe people or the organization. I don't know if I can just ask the question like, "How did MPL work? Or, how did you interact with the rest of the Scripps organization?" I mean, you're sort of off by yourself here.

Anderson: Well, in the early days we didn't react too much with the Scripps people, mainly because of the distance, of course. Also, there weren't any people in Scripps at that time that were interested in acoustics, except for Russ Raitt, and of course we interacted with Russ a lot. He was on my thesis committee, and well aware of what we did. And, they were doing different things. Basically, he was using geophysical survey work, but they used some arrays and all too. But, mainly they were looking at individual returns. A different type of technique, but it was underwater acoustics. We didn't have an occasion, particularly, to relate to the biologists because the things we did weren't that sort of thing.

Harkewicz: So, the whole thing with Martin Johnson and the snapping shrimp, or whatever, that really didn't affect your work at all?

Anderson: Well, it didn't affect my work, no, not particularly. What I found out on my thesis was that the scattering was coming from sound bladders, from air bladders. And, they confirmed that they were getting myctophids from those deep trawls. And, the myctophids have swim bladders, and I was seeing them. I was seeing those with my wideband sound scattering problem.

Harkewicz: So, there was a little biological connection there?

Anderson: Oh, there was a relationship there. Yes. We sort of confirmed and had an idea of the density of those from our measurements, because we were seeing individual returns, not just the general scattering, you know. So . . .

Harkewicz: So, did you feel like the things that were going on – I don't know, what would you call Scripps? You talk about UCSD being the upper campus, did you have a name for Scripps, when you were down at MPL? Like "over there," or something like that. Was there any . . .

Anderson: No. It was Scripps. I mean, we were part of Scripps.

Harkewicz: Oh, I know. But, with changes in command or things like that, did you feel that as much being at MPL?

Anderson: Not really. Didn't really feel much there. We were pretty much separate. Now, we operated out at the campus. We had a lab out there, and did work there. We had a pressure tank and did some high pressure stuff. And, we built the remote underwater manipulator out there. And, worked with that. So, when I say "we didn't interact with them," we were at Scripps but we didn't really interact with the faculty, particularly. Okay?

Harkewicz: Okay. Now, that you brought up the remote underwater manipulator. I was wondering, and maybe you answered this already when we were talking about the different patent stuff, but I know you started your own company that manufactured oceanographic and environmental equipment. Was that still when you were working at Scripps. . .

Anderson: Oh yes.

Harkewicz: So, was there ever any conflict between the work that you did for your own company and the work that you did for MPL? I just read brief descriptions of this Anderson Undersea Crawler that you did and also the Remote Underwater Manipulator and I wondered what the difference because to me they sounded sort of similar. I guess I'm just trying to ask if there was ever any tension between the work you were doing for your own company and the work you were doing for MPL? Was there every any conflict, even in your mind or anything like that?

Anderson: No. Well, for example, hydrophones. One of the things we did at the company was we built hydrophones for people that wanted them. Well, the hydrophones we built were ones that I had built at MPL, with basically the design I used for the array. People would see that and say, "Where can I get one of those?" Well, we'd build them for them, the company.

Harkewicz: Who would be looking for that sort of thing?

Anderson: Well, mainly research people were looking for it. Woods Hole people, for example. They needed some hydrophones for their acoustic work. And, the ones we built would go to deep pressure and they had preamplifiers, and they worked on a single coaxial cable, and they liked that. And so, we'd build them.

Harkewicz: It was easier for them to buy them from you than to build them their own?

Anderson: Well, yes. They didn't have the people to build them. They had people that wanted to use them, but they didn't have the people that built them.

Harkewicz: I understand.

Anderson: And so, we built those. We built quite a few of those hydrophones.

Harkewicz: Was that your rationale for starting your company, because there were people that wanted some of this equipment but they didn't know where to buy it from? .

Anderson: Basically, yes. We already had the company going, research manufacturing company. Well, not really. I had started a company, up in Mentone when I was living there just after the war, Mentone Laboratory. We built some things. We built some record players and we built some temperature control things. When I came down here to San Diego then, I did some Mentone Lab stuff in the garage. And, one of the fellows, Dan Andrews, worked at the Navy Electronics Laboratory, got together with me and said, "Well, you know, some of the guys here at NEL had a company, Research Manufacturing Corporation, and they were building ham antennas, and they decided that they didn't want to do it anymore." And so, Dan says, "Well, you know, we could get a corporation for nothing." So, we said, "Okay. We'll take it." So, we took “Research Manufacturing Corporation,” and then we had a company, and we didn't have to go through all the corporation stuff. It was already there. And, Dan Andrews was involved in that and we worked out of the garage for a while, finally we had to get a building to work out of, and got some other people involved in it. We built the hydrophones then and built some other things too, basically special purpose projects people wanted. But, that was not involved in the work at MPL.

Harkewicz: You said that the things you were working on in your manufacturing company were different than what you were working on at MPL. But, I wondered about your Anderson Undersea Crawler and the Remote Underwater Manipulator.

Anderson: Oh yes, that. Well, that was one of the things that we did. I had an idea of how to build a smaller one and I just wanted to play around with that. And so, we did that at REMACO.

Harkewicz: So, how did you manage your time?

Anderson: Well, there are weekends and evenings.

Harkewicz: So, it just was a sideline?

Anderson: A sideline sort of thing. Yes.

Harkewicz: All right.

Anderson: Instead of doing it in the garage we actually had a building to work on it. We overgrew the garage.

Harkewicz: I see. Well, that makes sense.

Anderson: Off time.

Harkewicz: Earlier you were talking about Russell Raitt – when you were describing your equipment, and I wondered if you had gone out on research cruises like Raitt did?

Anderson: Oh yes. I'd been on some.

Harkewicz: Can you tell me about your experiences out there?

Anderson: Well, actually I don't think I ever went out on one of the long cruises. Mainly, I'd go out to sea out in the San Diego Trough area, maybe off the Continental Shelf, but no long cruises. I did my thesis work at sea, of course, mainly in the San Diego Trough area and just really fairly local areas.

Harkewicz: Okay.

Anderson: But, with the Remote Underwater Manipulator – that was another project that came about in a strange way. That came out through the Artemis Project. We were faced with the problem of installing a large array and I figured, and looking at the Continental Shelf, I said, "Well, what if we can't just work on the bottom?" And so we tried, we developed a system where basically we borrowed on some of the stuff that Jim Snodgrass[7] had done in working with components under pressure, and oil. So, we built a Remote Underwater Manipulator. The RUM system we built basically used DC motors, operating in oil, and we took the electronics and put them in pressure cases. Basically, it was an ambient pressure device and we used that on several projects. One of the things we did was to go up and work with some of the people at Point Mugu. They had some under subsurface moorings that they needed to get at and we went down there and used the manipulator to actually salvage some of those for them. It would crawl around on the sea floor. The original design was one that would supposedly go out to sea from shore, you could take it out to sea from shore. That was what we had planned on, and then we realized, after we started to get some fine-scale topography, that the ground isn't just sloping out there. It's got some big cliffs and

[7] James Marion Snodgrass (1908-1994) physicist, oceanographic instrument designer and head of Special Developments Division at Scripps Institution of Oceanography.

bumps, and holes, and everything, and it's not going to work. So, we changed it and made it one that can be lowered from a cable, a strain cable.

Harkewicz: Was the manipulation from the ship then?

Anderson: Oh yes. We had a remote control up on the top, and television cameras and all down there, and a manipulator that we could operate from the ship.

Harkewicz: When you were designing these things, were there particular problems? Were you looking to solve a problem and you had to design things in order to solve the problem or investigate the problem?

Anderson: Why did I do it?

Harkewicz: Yes. I'm not sure if you were looking to solve a problem and that's why you designed these things, or if the problem was designing the equipment?

Anderson: Well, I don't know if I can answer it or not. That's asking for a lot.

Harkewicz: Okay.

Anderson: Usually there was some need that I tried to meet with the things I designed.

Harkewicz: Your need or somebody else's need?

Anderson: Oh, something I was interested in.

Harkewicz: Okay.

Anderson: Primarily it was something I was interested in doing or looking at.

Harkewicz: Okay.

Anderson: And, it may have been things that other people were interested in too but mainly it was my interests involved.

Harkewicz: Okay.

Anderson: Basically, that was the stimulus for it. So, I don't know how, how far you can go beyond that.

Harkewicz: Can you tell me anything about some of the people you worked with over at MPL, anybody that had a big impact on you?

Anderson: One of the things we had was a real good research team. Dan Gibson[8] was the one that worked with me for many years. He had a crew of about twenty people that worked under him, and he did a lot of the work and I would basically have the ideas and they'd implement the stuff, do a lot of the actual hardware work. He and I got along very well, worked well together, and he'd always say that – there was something about when I'd walk in, why they'd have a problem and I'd go over and look at it a little bit and fix it, you know.

Harkewicz: Sort of like, "You can come in and solve the problem for us?"

Anderson: Oh yes. They'd have a problem with a circuit and I'd go in and – I told them the things you have to do, you have to think like an electron, see, and then it works all right? [*Laugh*]

Harkewicz: That sounds like a very Zen way of looking at it. "Think like an electron."

Anderson: Yes. Well, I was able to do that for some reason. I don't know. I didn't have a massive education in electronics, or anything like that. But, working with components and systems and all, I could get the picture of what they're supposed to do and figure out why they weren't doing it.

Harkewicz: Sort of troubleshooting type things?

Anderson: Yes. Yes.

Harkewicz: Earlier, before we started recording, we were talking about when you became a professor of applied physics and information science at UCSD. Can you tell me a little bit about that?

Anderson: Well, one day the director came in, I think it was Fred Spiess[9], and Fred came in and he said, "Vic, we got you an appointment." I said, "What?" He said, "We got you an appointment, a professor appointment at Scripps in the electrical engineering department." I said, "Oh? "How come?" He said, "Well, we needed one." The reason was that the University of California had decided that they wanted to get into the Sea Grant Program, and get government funding out of that. But, in order to do that they had to provide FTEs, two FTEs, in the area of Sea Grant. So, what they did was they sort of split those up. I think they were thirty percent appointments or something like that. So, they were able to spread it among several people. And, they needed one in sort of the applied science area and they picked me because I was employed by the university through Scripps. So, I became a professor of applied science with an appointment at both Scripps

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[8] Daniel K. Gibson.

[9] Fred Noel Spiess (1919-2006) Director of the Marine Physical Laboratory from 1958-1980 and Director of Scripps Institution of Oceanography from 1964-1965.

and the electrical engineering department at UCSD. So, I went up to the electrical engineering department and said, "Well, what am I supposed to do?" And they said, “You're supposed to teach a course." I said, "Oh?" [*Laughter*] "In what?" And they said, "I don't know. You just teach a course."

Harkewicz: You'd never taught before then? Is that correct?

Anderson: No, I hadn't taught anything. This was about the time when I had a sabbatical. So, I sat down during my sabbatical and I designed an electronics lab course, an electroacoustics lab course. I designed a set of experiments for the year, and the actual experimental design, you know, the equipment part. And, about that time what had happened was that - we were in the new electrical engineering building - and what happens when the university puts up a new building is they provide ten percent of the cost for equipping the building. Well, I was in the new electrical engineering department, and they had money for equipment. Most of the people in the department were theoretical scientists so I put together a whole list of things. I came up with $150,000 worth of equipment, I think it was. So, they turned the list over to one of the secretaries and she combined the equipment requests from all the people into a single, major list. And, it was too much money. So, they came back to me and said, "Here, you'll have to cut some things out." So, I looked at the list and they had entered my list twice. [*Laugh*]

Harkewicz: Oh, my gosh.

Anderson: So, I crossed out one item of everything I ordered and I cut $150,000 out and turned the new list in. And they said, "Good. We're all set." [*Laughter]*

Harkewicz: Oh, that's good.

Anderson: So, we got the equipment and I set up the acoustics lab and taught it for several years.

Harkewicz: Do you remember what year that was?

Anderson: I don't recall exactly when. I taught it for several years.

Harkewicz: What was that like not having taught before and then being in this position?

Anderson: Oh, it wasn't too bad. No problem. I had done some stuff. I had been a teaching assistant. But, it was different.

Harkewicz: Was it more hands-on? Did you have lecture and laboratory class?

Anderson: I had both. I had a graduate acoustics course and an undergraduate laboratory. So, the undergraduate laboratory was basically a lab course. I don't know that we had any lecture with it or not. I don't recall.

Harkewicz: I was going to ask you if there was any teaching involved at MPL, but I guess there wouldn't be, would there?

Anderson: Not really. No.

Harkewicz: How long were you at MPL? Twenty, thirty years?

Anderson: More than that.

Harkewicz: How do you feel the experience changed over the years? Did it? I'll give you a little bit of something to go on and you can respond. Many of the other people I've interviewed have complained about how difficult funding has become, how they have to spend so much time writing proposals and things like that rather than doing research and how it was different when there was more support from the Navy or other places. And, I know that maybe that doesn't really apply here, but did you notice it getting more difficult over the years to get funding or anything like that?

Anderson: Yes. It got more difficult. It got more difficult as we went along.

Harkewicz: Was MPL still funded through Navy cooperation? Or did you have to go through NSF or anything like that?

Anderson: It pretty much was ONR.[10]

Harkewicz: ONR?

Anderson: Most of the stuff we did was still ONR, yes. It got to be more paperwork. One of the first proposals I did was a one-page proposal. And, there's a lot more than that now, you know.

Harkewicz: What about changes in society? Did that have any effect on your work? I mean, things like the Civil Rights Movement, and the Women's Movement?

Anderson: No.

Harkewicz: Or the environmental movement. Did any of those things have any affect on the kind of work done at MPL?

Anderson: Not while I was there. No.

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[10] Office of Naval Research.

Harkewicz: So, I asked you about funding at MPL over the years but I really didn't give you a chance to answer about if your job had changed. So, I just wanted to ask you that again, if you felt like it had changed over the years that you were there, or if you were still doing similar things when you left as you were when you started?

Anderson: Well, that's a good question. Yes. My job . . . Hard to say. Hard to say whether it changed. It did, obviously. But, we were still going strong about the time I retired. May have tapered off a little bit. But, I can't visualize the time that I quit.

Harkewicz: All right.

Anderson: I retired and kept on for a while, and finally just didn't do it anymore.

Harkewicz: Did you still have your company after you left Scripps?

Anderson: Actually, we had sold out the company by then.

Harkewicz: So, as I told you earlier, one of the questions that I like to ask everybody is, "What Scripps meant to you?"

Anderson: What Scripps meant to me? Well, it was my lifeblood. That was my life. I mean, it really was. It occupied me pretty thoroughly. MPL did. That was Scripps, of course.

Harkewicz: Do you see yourself as an oceanographer? I mean, you did work on underwater acoustics but could you have done it – but, could you have seen yourself being in acoustics outside of Scripps?

Anderson: I could have seen that. Yes. I don't see that I was necessarily – well, underwater acoustics was my game.

Harkewicz: Right.

Anderson: And, you had to be near the ocean to do that. It didn't make any sense otherwise.

Harkewicz: Right. But, would you consider yourself an oceanographer?

Anderson: No. No. I consider myself an acoustician, more than anything else.

Harkewicz: Acoustician?

Anderson: Yes. Because acoustics is my game.

Harkewicz: Right.

Harkewicz: In your opinion, what do you think made Scripps successful?

Anderson: Well, I think the thing that made Scripps successful was that it was an organization that allowed the members of the organization to basically do their thing. I think everybody there had an interest in what they were doing, and they directed what they did, and they weren't necessarily pigeonholed. They were free to get involved in what they got involved in. I mean I got involved in a number of different things. I got involved in teaching, not that I made a lot of effort to do it, but it came my way. I think that kind of freedom is an important part, and I felt that atmosphere from Scripps, from the people there.

Harkewicz: What kind of things do you think may have threatened its success?

Anderson: Well, I think basically the funding problem is the major problem. That's a problem, particularly for an oceanographic institution because it's expensive. It's costly stuff. And, it costs money to run ships and without ships you don't do much oceanography.

Harkewicz: So, you're not from that camp that thinks that computer modeling and satellites is sufficient?

Anderson: No.

Harkewicz: Okay.

Anderson: No. I think that they're very helpful but I don't think that they answer the problem. They're part of the tool package but not the whole package.

Harkewicz: Do you think that there's something that scientists in oceanography should do in order to let the public know why it's so expensive to do science in oceanography, to promote it more?

Anderson: I don't know. I haven't thought about that. I don't know what you could do. There are a lot of lines of science that are expensive, not just oceanography. I think maybe the costs in oceanography that dominate are the shipboard costs and they are unique to it but the funding just isn't the way it used to be for all science. It's a problem.

Harkewicz: Is there anything that you might have wanted to talk about that I neglected to bring up?

Anderson: No, I probably talked about a lot of things that you didn't have in mind. [*Laughter*]

Harkewicz: I feel like there are other questions I have, but because we already talked about the fact that you were sort of removed from the way things were working at Scripps itself, I'm not sure that I can even, that any of those questions would have any relevance, you know. I mean, I know that there are a lot of things that have changed over the years at the main campus of Scripps, but I'm not sure if they really affected you.

Anderson: Well, it didn't really because my association on the campus was primarily up at the electrical engineering department. I was the chairman twice for two years, mainly because they couldn’t find anyone else to do it. Actually, I think the reason I was made chair twice was because I was an outsider. I mean, I really was. Nobody else in that department was involved in the sorts of things I was involved in, or in the funding I was involved in. So, I was independent. And, I think that's probably the reason that I got to serve a couple of terms

Harkewicz: Otherwise, you think there would have been . . .

Anderson: Otherwise someone else would have an interest in an area in the department that was not universal.

Harkewicz: Okay.

Anderson: And, they'd be in a position that might influence decisions on funding and all.

Harkewicz: So, you were seen as an independent entity that could . . .

Anderson: I was an independent entity. I didn't compete for funding with any of the people that were there.

Harkewicz: I understand.

Anderson: Okay?

Harkewicz: All right.

Anderson: Yes.

Harkewicz: That makes sense. Okay.

Anderson: Yes.

Harkewicz: Well, I guess I have run out of things to ask you at this point. But, if you think of anything else you'd like to talk about we can always discuss it further at a later date.. So, thank you very much for speaking with me today.

Anderson: Very good. Thank you.