

PETROLEUM INDUSTRY ORAL HISTORY PROJECT
TRANSCRIPT

INTERVIEWEE: Norm Christie

INTERVIEWER: Betty Cooper

DATE: March 1982

Betty: This is Betty Cooper and I'm talking to Mr. Norman J. Christie, who lives at 3824 - 10th Street S.W. in Calgary and it's March 25, 1982. Mr. Christie could we start first by getting a few of your statistics, where you were born and when?

Norm: I was born in Regina, Saskatchewan on August 1st, 1914 and moved to Calgary in 1919, where I spent about 4 ½ years before my father was transferred to Winnipeg and I completed my high school training in Winnipeg at Daniel McIntyre High School.

Betty: What did you father do for a living?

Norm: He was a Veterinary Surgeon with the federal government and subject to periodic transfers. I imagine that the family moved a half dozen times during my father's career. When I graduated from high school I became aware that the Colorado School of Mines offered a scholarship to each province in Canada to a high school graduate, which at that time was the completion of grade 11. I applied for it during the latter part of grade 11 and was awarded the scholarship but since I was only 15 years old at the time, my folks thought I better stay on and complete grade 12 and reapply for the scholarship the following year, which I did and which I was again successful.

#016 Betty: What made you decide to go into the University of Mines?

Norm: Essentially prior to becoming aware of the scholarship, I'd intended to go to the University of Manitoba and take either mining geology or mining engineering. Since the scholarship at the Colorado School of Mines covered tuition only, I still felt that it was probably a better school to attend and went down there with the intention of getting into hard rock rather than petroleum.

Betty: How much money did the scholarship encompass?

Norm: In those days, it was \$250 a year, \$125 a semester and as a matter of interest the tuition fees now are either just over or just under \$5,000 a year.

Betty: Quite a difference.

Norm: Yes, indeed. To residents of Colorado, I think the tuition was only \$50 a semester. Although it didn't sound much, in those days, particularly with the reputation the school had it was something I thought I'd take advantage of.

Betty: What year was this that you went down to the university?

Norm: 1931. And it wasn't until I arrived there. . I joined a fraternity and another man from Winnipeg who had proceeded me down there had joined and a large number of members of the fraternity were taking geophysics and it probably just rubbed off on me and I decided that was a good way to go. It was a new and growing industry. I had till the end

of my second year to choose my option and I decided to go the geophysics route. Actually I graduated with a degree in Geological Engineering with a geophysics major.

#034 Betty: Just before we go on into that area, if we could just back track, I want to fill in a bit of your family history. Are you an only child?

Norm: No, I'm the oldest of five children. Two brothers and two sisters.

Betty: Are any of them involved in the oil industry in any way?

Norm: The two boys are, one of them has passed away but both my brothers are in land department work. One was with Pembina pipeline here until he was forced to retire due to health and the other one is still with Mobil Oil here, has been with them for 30 years now.

Betty: And he's a landman with them?

Norm: Yes. On their east coast operations.

Betty: Let's look at your geophysical training when you were at this mining school. You say, at the end of your second year. . .

Norm: Yes. Most engineering degrees, the first two years are the basic science courses, physics, math, chemistry. You generally make your choice at the end of your second year, whether you're going into civil engineering or chemical engineering or electrical engineering or geological engineering.

#047 Betty: But you chose to do none of those. You really ended up as a geophysicist which is quite different again.

Norm: No, the degree in geophysics, at that time at the Colorado School of Mines, the geophysical course was a part of the geology course. So what you did was get a degree in Geological engineering with a major in geophysics.

Betty: You mentioned several people who were in that same field, were there many of those that were Canadians when you were studying down there?

Norm: None that I know of.

Betty: The man from Winnipeg who was. . .

Norm: No, he took Mining Engineering and he preceded me by a couple of years and became the General Manager of the Hudson Bay Mining operation up in Flin Flon.

Betty: And his name?

Norm: David Robertson. In that regard there was three Robertson boys went down to Mines, all graduated, one of them took geophysics.

Betty: And is he. . .?

Norm: No. He was up here in the early 50's but he's living in Tulsa now. Kenneth Robertson.

#058 Betty: Let's talk about geophysics at the time that you graduated, which would be about 1935.

Norm: That's right.

Betty: Midst of the Depression. A hard time to be going to school. Perhaps we should dwell on how you got through school on \$125 a semester.

Norm: No that just paid for the tuition.

Betty: I realize that, how did you eat?

Norm: My folks contributed but in those days room and board at the fraternity house was about between \$50 and \$60 a month and everything else was relatively cheap in those days too but my folks did have to make some sacrifice to put me through there.

Betty: Did you work part time?

Norm: The last couple of years I did wait tables and corrected some junior papers to help pay my way through. I think really the out of pocket expense, in addition to the tuition for the four years was something less than \$3,000. That was for 10 months out of the year so it would be about \$75 a month is what it cost essentially to attend the school.

Betty: When you say 10 months out of the year, that's a little different than university if today.

Norm: Yes it is. The Colorado School of Mines gave an engineering degree in four years where in a lot of the other schools at that time, engineering was a five year course. So actually I said it averaged 10 months and that's about right, we were off for about 3 months in the summer but 3 out of the 4 years, you had to take a summer course of six weeks duration. So the average attendance was about 10 months out of the year.

#081 Betty: Were you able to get summer jobs in the mining industry?

Norm: Not in the mining industry. I did have an uncle in the coal and ice business in Winnipeg and I'd work part time for him while I was attending school.

Betty: Was that just delivering the coal and ice, was that what it was.

Norm: Yes. Well, in the summer time, it was ice. In those days of course, there weren't that many refrigerators and they had the trucks traveling around and in some cases even horse drawn wagons with the ice on them.

Betty: Did you drive any of the horse drawn wagons?

Norm: Oh yes. And learned to cut those big blocks of ice. There was quite a trick to it.

Betty: Quite a trick to driving the team of horses too.

Norm: Most of the time the horses knew the route better than I did.

Betty: When you graduated in 1935, where did you go?

Norm: I came to Lethbridge, Alberta. At the time I graduated the professor of geophysics at the Colorado School of Mines had organized his own contracting firm.

Betty: What was his name?

Norm: Dr. Carl Heiland, he was a German that came over here originally to sell magnetometer equipment and was approached by the Colorado School of Mines to head up the Department of Geophysics. Which by the way, was the first one in the United States and it was organized in 1927 I believe. Of course, seismic is the big exploration tool now but in those days there was magnetometer and torsion balance and gravity work and not too much in the way of electrical surveying. Magnetometer and gravity and seismic and by the time I graduated of course, seismic was the main subject that was being taught there. And most of the people that graduated went into the seismic business, either with contractors or with oil companies.

#106 Betty: Perhaps before we talk about what you did in Lethbridge, we could talk about these various areas of geophysics. Magnetometer, what was that?

Norm: It measures the magnetic field of the earth and high magnetic intensity would indicate

there's a high mineral content in the ground. It was used primarily as a mining exploration tool.

Betty: Not too much in the petroleum industry?

Norm: No, that's true, although there were some discoveries based on magnetometer where you have a dome that's built up by being forced up by say, some magnetic material in the basement rocks that would force it up. Since it was closer to the surface it would have a higher magnetic influence.

Betty: So it would really be used more in discovering shallow fields?

Norm: Yes. As I say, I only know of one field that was discovered and that was the Hobbes??? field in New Mexico that was discovered allegedly by magnetometer.

Betty: The other one, torsion balance.

Norm: Well, that measures the gravity pull of the earth and . . .

Betty: What do you measure it with?

Norm: With a torsion balance, which is an instrument or a gravity meter. Torsion balance was the first type of gravity tool and it was developed in Europe by Baron von Entrophos??? who was Hungarian and it was brought over here around the time of World War I and it was used to discover salt domes along the Gulf Coast with a fair degree of success. But it was a fairly cumbersome instrument.

#128 Betty: How big would it be?

Norm: It would stand probably 6' tall and I guess about 2' in diameter. They gradually became smaller and then the gravity meter of course, measured relative gravity whereas the torsion balance was more absolute in its readings.

Betty: I imagine there would have been quite a lot of discussion among geophysicists and engineers as to which was the best one to use or were any of them considered very good?

Norm: No, the seismograph was quite widely accepted at a very early stage. And you mentioned the Depression, actually it was a growing industry during the depths of the Depression which was rather fortuitous for people like myself who had opted to take geophysics. Because we had several interviewers coming around to the school offering. . . at the time I graduated in 1935 I was offered 4 jobs, which during the depths of the Depression was rather unique.

Betty: It was four jobs more than many people had. What were the other jobs, do you remember?

Norm: I had the chance to go with Seismograph Service or Phillips Petroleum and there was one other one which I can't recall right now and the one from Dr. Heiland back here, he had a contract up here in Canada.

#147 Betty: And what was the name of that company?

Norm: Heiland Exploration. He had an associate, Dr. John Hollister, who was Vice-President of the company and who had taken graduate work when I was a freshman and John offered me the position. Dr. Heiland had left the school early that year to help start up a seismic contracting company in Poland with one of the fellows that had taken post-graduate work. So he left early and John finished teaching us the last part of our senior courses, also ran a

field operation where we spent time in the field doing the various jobs of a seismic crew.

Betty: Was he a Canadian?

Norm: No. He's an American and he later became the head of the Geophysical Department when it became a separate department from the Geology Department. He's retired now but still a very close friend of mine.

Betty: But he was at the Colorado School of Mines, he stayed with them?

Norm: Actually he stayed in the seismic contracting business until Dr. Heiland retired and then John took over as head of the Geophysics Department.

#165 Betty: When you came to the Heiland Exploration Company in 1935, what did you do?

Norm: I was a computer on the crew.

Betty: So what was a computer on a crew in 1935?

Norm: Essentially the same. We counted the records, worked the weathering corrections. I didn't pick many reflections because the data was so terrible it was almost impossible to get any resultstandards for various fields. They were also getting gas from the Bow Island area and I've forgotten where else.

End of tape.

Tape 1 Side 2

Norm: [in mid-sentence]. . . .identification on it.

Betty: And you would just give those in.

Norm: lay it on the counter. And they didn't wait until the next day or anything, as each block came up, they opened all the envelopes that were submitted and then they'd point to the one that had bid the most. Well, I ended up with I guess, about half the acreage in the north end of Turner Valley and nobody knew who I was.

Betty: I'm sure they were wanting to know.

Norm: I went back to the gas company and they gave me the rest of the day off, in case anybody stopped by to check with them and tell them about this young kid that had bought up all

this land. The follow-up to the story is, I left in January to go down to the States to get back into geophysics and the gas company neglected to have me sign over these leases. It was just about 2 months after the north end of Turner Valley came in and naturally the gas company was rather anxious to get title to this land so they sent me down some forms in Oklahoma and I was on what was called a hot shot crew that was jumping all over the country so it took awhile for this correspondence to catch up with me. But I had to have the papers notarized and at that time we were working in southern Oklahoma for an independent who I think was a bit of a fly by night operator but he was also a notary public. And when I asked him to witness these papers for me, he told me I was crazy. However I did go ahead and sign them over to the gas company.

#017 Betty: So for a short time you were the owner of a pretty lucrative piece of land.

Norm: That's right, exactly.

Betty: Did they indeed get producing wells out of it?

Norm: Oh yes indeed. But it was really humorous because I understand that people were calling up that afternoon telling Mr. Slipper about the land sale. There weren't that many people in town you know, that were involved in the oil and gas business so they were calling him to know if they knew who this kid was. Of course, he denied knowing me. It was a lot of fun.

Betty: They must have thought you were the young son of some millionaire just coming up to try his luck.

Norm: I don't know what they thought but I sure got the stares from a lot of people that day.

Betty: You were in California for how long with United?

Norm: Almost 10 years. Well, I was interrupted a little bit. I started with them in the spring of 1936 and spent most of that time, except for 1942, I was back here in Canada for 6 months and I was in west Texas for almost a year out of that period and then was over in the U.K. for a year in 1944 and 45. We were doing seismic, we were looking for oil over there. They had discovered a little oil and during the war they were quite anxious to develop some more production.

#033 Betty: This would be a rather interesting experience to be looking for oil in the United Kingdom when the war was on?

Norm: Yes. They figured at that time, when normally the price of oil was \$2-\$2 a barrel that oil in England during that period was worth about \$14 a barrel which doesn't sound too much in these times but that was a lot of money in those days. And they had come up with a little production and they were trying to expand it. We weren't too successful although years later they found some small fields on the work we did.

Betty: where were you working?

Norm: We worked out of Docaster??? in Yorkshire and out of Nottingham in Sherwood Forest. They also sent us on kind of an experimental trip. We went up near Blackpool just to see if we could get results at a place called Etham St. Ann??? which is quite a resort area near Blackpool. And down in Chester and we were based just on the outskirts of the city of Chester and then in Southport where they'd had some production from about 100'

underground at the base of the glacial drift and they didn't know where the oil was coming from. And they were drilling a well at that time to see if they could tap the reservoir without any success. On that particular well we ran a velocity survey and the shotholes we drilled on the survey, we let stand overnight and there was about a foot of oil on the tops of those holes when we came back the next morning. But as far as I know they've never found the source of it.

#051 Betty: But it certainly seeps in there from somewhere.

Norm: Yes.

Betty: What a fascinating story and a challenge for someone to find. You mentioned velocity. . . ?

Norm: That's to measure the velocity through the ground, they lower an instrument into the well and in those days, they set off a charge, they do it differently now and get closer interval velocities. In those days you dropped this geophone into the well and took the shots with the geophone at various depths in the well. And this way it told you the velocity of the rocks that the sound was traveling through.

Betty: When you were up in Canada in 1942, where were you. . . ?

Norm: We started in High River and worked out east towards Blackie and those areas.

Betty: Who were you working for?

Norm: In those days, Shell. United had this contract with Shell. And there again, there was no work in the winter time, we came here at the end of March and we left here at the end of September to go back. After we had done some work east of High River we came up here to Calgary and we started a line just out close to Broadcast Hill and headed west along the old Banff Coach Road and ran about a 20 mile line and we picked up the first indications of what later turned out to be the Jumping Pound field. Our work in High River wasn't too rewarding but of course, Jumping Pound came in. Shell had taken an option on that from Bobby Brown's company, I've forgotten, I think it was called Federated in those days.

#070 Betty: Who worked with you when you were up here at that time, do you remember?

Norm: Yes. One of them is here in town now. The Chief Geophysicist for Shell was originally a fellow by the name of Joe Waterman who came up with us from California but he only stayed a couple of months and turned over the job to Cec Cheshire, who later formed his own contracting company here. He passed away about 3, 4, 5 years ago. And also by the way, did a spec survey on Redwater after it came in and instead of selling the data, he took an option of participation with the various people that bought the land on his data and made a fortune out of it. Then the Assistant Geophysicist with shell was a fellow by the name of Gordon Hess???, who is still a consultant here in town. Oh, and Alex Clark, who just died last week, was the Manager for Shell up here. Alex later went with Home Oil Company but that was in 1942. And one of the boys that was with me as my Chief Computer is Bob Gileskie???, who still runs Airborne Geophysics here. He came back to Canada later on and is the owner of Airborne Geophysics here.

Betty: And he was with you in this preliminary which led to the Jumping Pound?

Norm: Yes.

#085 Betty: Did you realize that it was that favourable?

Norm: No we didn't. We knew we had an anomaly and it wasn't the best data in the world.

That's one thing about geophysics, it can't tell you whether there's oil or gas there, all it can tell you is the best place to make a drilling location.

Betty: When you say that the data wasn't the best, again, why was that?

Norm: It's a very complex area, you couldn't. . .

Betty: In what way?

Norm: Well faulted and bent and folded. So that it was almost impossible to get a reflection that ran across an entire record. You had to pick what we call partial reflections that just maybe covered a . . . if you had a 12 trace recording truck, which was a good sized truck in those days, if it had anywhere between 4 and 6 traces that appeared to represent a reflection you picked it and just plotted the partial data.

Betty: How many geophones would you be using in those days?

Norm: We just used per trace. And they were pretty big ones too, they weighed about 10 pounds or so and were oil damped. They probably stood about 10" high and were about 5" in diameter.

Betty: Very different from what is used today?

Norm: Oh yes now a geophone just weighs a few ounces.

#105 Betty: And how many do they use?

Norm: Now? Per trace, up to 9, 16. But they don't weigh as much as one of the old type.

Betty: What has that enabled you the data to become?

Norm: Well, it eliminates a lot of the background noise because it's random and with a series of these things, they're not all in play so they cancel each other out. And it allows the reflected data to be more visible.

Betty: At one point in the geophysical history of exploration there have been people who talked about refraction, people who talked about reflection. Now could we perhaps talk a little about that. It was really two battle lines, weren't they at times.

Norm: They had different uses. Actually refraction was the first seismic exploration tool, and it developed actually as an outcome of World War I, where they used to have these sound ranging units to locate the German gun placements. They had recording stations and depending on the length of time it took for the . . . they could see the flash and depending on the length of time that it took to reach these recording stations, they knew how fast sound traveled in air. And they could swing a series of arcs and where they intersected, that's where the gun was. So that was horizontal traverse of sound. Where they began to use it after the war, was in locating salt domes that penetrated, came up to the surface down in the Gulf Coast. And sound travels much faster in salt than in does in the other areas. They used this a little differently, they knew how far away the explosion was from the recording units, and let's say they put an arc where they had an explosion and then on the circle they'd all be the same distances away. If the recording showed that they came into various stations sooner in one location than it did on the others, they knew that there was something there that was faster.

#133 Betty: Something was bouncing it back quicker.

Norm: Not bouncing it back but it was traveling through it faster. So they'd move around this thing and they'd get kind of a shadow effect of this fast material and that's generally where a salt dome was. And it wasn't until several years later that they tried the reflection technique.

Betty: Now how is it different?

Norm: They sound of the explosion goes down, is reflected off various layers and bounces back. It's almost a vertical. Of course, they're spread out so it is a diagonal thing but it's a vertical measurement whereas refraction by and large is a horizontal although it can be used as a vertical tool as well and it has been used considerably here in the foothills.

Betty: Because of the particular strata?

Norm: That's right.

Betty: Which were you using when you were going along west of the city?

Norm: I'd say 98% of the work I've done has been reflection. And with reflection out here west of Calgary too.

Betty: Is this really what is done mostly today?

Norm: Oh yes. I'd say there's very little refraction work done.

Betty: You'd probably find it difficult to find people who could work in that area both in the interpretation and the setting it off perhaps if it isn't used that much.

Norm: Most of the major companies now have very well trained people in both reflection and refraction and the computers have helped a lot.

#152 Betty: You say it has been used in the foothills here, can you think of particular places?

Norm: Not particular areas but I'd say a vast . . . there's a belt in the foothills, the front range of the foothills and the front range of the mountains where they've used it. I'm pretty sure Shell used it down in the Waterton field and I know Gulf used it there in the early days. They sometimes use both tools. And I'm sure that in the work along the foothills here there's been a lot of it done. I can't think of some of the names of the fields now but the one that Husky came up with down west of Turner Valley, I think it was used there. But I'm sure. . . BP was very strong on it because as an English company they'd used refraction almost exclusively over in the Middle East for some of their big discoveries and Shell has used a lot of it.

#166 Betty: You mentioned Turner Valley a moment ago, did you work at all with Mr. Tom Hicks?

Norm: Not directly. We had done some work with the company that he was with, I don't know whether it was Anglo. I've forgotten the name.

Betty: Anglo Canadian.

Norm: When Jack Webb was with them we had done some work for them.

Betty: Did you work with Jack Webb too, did you know him well?

Norm: Yes. Not well but I knew him reasonably well.

Betty: Can you remember any stories about his early days here, did you cross paths?

Norm: No, I didn't meet Jack until I came back here again in 1950. But he was around. Actually

in 1935 they had a geological society here I think that was composed of not over a dozen people. There was Ted Link with Imperial, I think Ivan Vern??? was a member band Mr. Slipper and Mr. Hunter, Joe Irwin Sr., Russell Johnson and . . .oh, I've forgotten. It was a very small exploration group. . . oh, Grant Spratt??? was another one.

Betty: Did you work with Mr. Spratt at all?

Norm: No, Mr. Spratt had just gone with the Conservation Board at that time in 1935.

Betty: Did you have any dealings with Mr. Spratt at all?

Norm: Not business dealings, no.

Betty: Did you know him socially?

Norm: I knew him socially, yes.

Betty: What was your impression of him?

Norm: He was a real gentleman, a fine fellow. The first time I met him I was with Mr. Vanderlinden, we were walking down 8th Avenue and the Spratt's had just had their first child and had him out in the baby carriage.

#189 Betty: And you were introduced to him at that time?

Norm: Yes.

Betty: Did your paths cross very much?

Norm: Not really that much. But we knew the Spratt's when we came back here again. I was trying to think of another man who later became quite successful down in Long Beach in the Signal Hill area, Robin Willis??? was a geologist up here and Myron Zanmer??? was another one. They were all essentially. . . well, a few of them like Ted Link and Mr. Slipper and I guess to some degree Grant Spratt worked for the Conservation Board but the others were with oil companies but the others were just independents, they were up here essentially operating on a shoestring.

Betty: Did you know Mr. Link very well?

Norm: Yes, I did quite well. Because he used to come down and visit the crew in Lethbridge. We were essentially working directly under him. So I did know him.

Betty: Tell me about him and your association with him?

Norm: He was a character, I don't think he had inhibition one. He didn't care what he said or whose toes he stepped on. But nothing malicious, I think he liked to shock people.

Betty: Can you think of some instances where he almost succeeded or did?

Norm: Well I could but I don't know whether I'd want to preserve it for posterity. I remember one time he had come down to Lethbridge, we were based in a bank that had ben closed down. It was a Bank of Commerce in downtown Lethbridge and we had our offices and our living quarters in this building. I think it later became a Department of Mines and Resource Building, but he came by to spend a couple of days down there. And he stopped by at the office building, I think the only reason he did was to get somebody to carry his suitcases into the Marquis Hotel. So he tapped me to go along down to the hotel with him and he had Mrs. Link, the first Mrs. Link with him. Of course, he had been in and out of the Marquis Hotel many times doing geologic work down there and the clerk knew him quite well. I was following him carrying the suitcases and the clerk said to him, Dr. Link, do you want double or twin beds and Link said, twin beds, this one's really my wife.

Well, I don't know who was the most embarrassed, the clerk or myself, it didn't seem to phase Mrs. Link at all. She must have been used to it. Those are the kind of remarks he used to love to make. He was a real character, and a very, very brilliant explorationist.

#233 Betty: Yes, in line with his work as an explorationist, can you think of some of the history of the petroleum industry that should be linked directly to him?

Norm: That's difficult. You know, he was just a kid when he went up to Norman Wells and was in on the discovery and development of Norman Wells. I think he was only 19 or 20 years old. And of course, that was long before my time. I didn't even know about Norman Wells. He was very highly regarded as an explorationist and when he left Imperial and formed his own consulting firm and later a little independent oil company, he was very successful in his career. I can't really name a specific of what. . . of course, he was a Chief Geologist and Manager of Exploration at the time of the Leduc discovery, so. . .

Betty: So you feel that certainly is a very close association isn't it?

Norm: Yes.

#249 Betty: You were just up for a short time and then you down back in the States until '46?

Norm: Yes, except for a period up here in '42 and about a year in west Texas and a year in the U.K. West Texas I was there '43 and '44 and then I was in the U.K. from '44-'45 and then I went back to California.

Betty: Right. Now when you were in the United Kingdom, what was it like trying to do geophysical work in wartime with restrictions on everything including a truck to carry your equipment.

Norm: Well, we sent those trucks over from the U.S. the recording truck, the shooting truck, the drills and the water trucks, all were shipped over. We did leave the drills there when we came back, they could be used. But the recording truck came back. We left the drills and the water trucks and the shooting truck there. There was people that were interested in acquiring the drills because they were good for drilling test holes as well as shot holes, you know, foundation studies and things like that.

#268 Betty: How big would the drill be?

Norm: The average shot hole drill, it probably weighed about 20,000 pounds and had a mast of about 30' tall was all.

Betty: what did you do for gas?

Norm: Oh, we had no problem. We essentially had our own gas pump. Like, in Nottingham we had a place where it was stored out on a farm where all of our equipment was stored and we pumped our own. And then when we moved to Nottingham there was a gas station there that had a pump reserved for us. Our biggest problem was trying to get repairs done because all trucks in those days were supposed to be under what was called the pool. And you were supposed to go through the pool to get any repairs. Well it took forever to get anything done and we used to do our own or bribe a mechanic to work overtime on them. And the people that managed the pool operations would get very upset with us but otherwise we'd have been down for days waiting for repairs.

End of tape.

Tape 2 Side 1

Betty: Mr. Christie, after the United Kingdom you came back to California?

Norm: That's correct. And I was assigned to an offshore crew at that time working out of Santa Barbara. It was one of the first offshore seismic exploration operations that had been conducted on the west coast.

Betty: Had there been this sort of exploration in the Gulf of Mexico before?

Norm: Oh yes. I guess the first offshore work was done in the Gulf of Mexico and from there it spread throughout the world.

Betty: What is the difference between offshore and land exploration from a geophysical point of view?

Norm: Well, of course, you're operating on water. The cables and geophones are floated. The ideal situation is to get them just under the surface of the water so that you get away from a lot of the wave noise. In those early days the dynamite charges were placed underwater too. We found in California that by using a 50 pound charge at about 5', the bubble caused by the explosion would break the surface of the water and allow the gases to escape. If you got the charge too deep it would blow a bubble in the water which would collapse, expand again, collapse and expand again.

#016 Betty: Like a wave.

Norm: Yes. And with the result that you'd get what appeared to be several shots fired in sequence and about the time that a deep reflection would be coming in you'd get a pulse from a shallow reflecting bed that would hit the record at about the same time. So it was very difficult to interpret the data. This is one of the reason why they like to have the bubble break the surface of the water.

Betty: So this really was a scientific equation, it would be, to see how much dynamite you needed to just make it do that.

Norm: Yes, well, we found it took about 50 pounds to break a bubble at 5' depth. As a result of experiments, I'm sure they could have calculated it but it was more or less trial and error at that time.

Betty: When you were working offshore you had a rather particular boat I believe.

Norm: Yes, our crew boat was John Barrymore's old yacht, the Infanta??? that had been converted during the war to a sub chaser, a mine sweeper and had a magazine in the hold which we used for our dynamite and it was reasonable well suited for our needs except a little fancier than we required. Some of the fixtures for instance in the bathroom and in the bedrooms were sterling silver. The bathrooms were all tile, a beautiful walnut dining table.

#034 Betty: Was it still in pretty repair despite being a mine chaser?

Norm: Probably in better repair because I'm sure that the military would have kept the thing right up to scratch.

Betty: Was that leased from somebody?

Norm: It was purchased by a construction company in Los Angeles and then leased to our group.

Betty: One thing we didn't get down and that is your marriage. You were married in Lethbridge to a Lethbridge girl.

Norm: No, I was not married in Lethbridge. I was married in San Francisco but to a Lethbridge girl who I had met on the first job I had out of college. Actually when I left to go back down to the States we thought I'd be in the mid-continent area but prior to our marriage I had changed positions and gone with United Geophysical on the west coast. So I drove up from Porterville where the crew was based and she took the train down from Lethbridge which was rather a circuitous route, she had to go to a little community in British Columbia called Yak, and then across on, I've forgotten the name of the railway line and then over to Seattle and down from Seattle.

Betty: Not the Kettle Valley Line?

Norm: It could have been the Kettle Valley Line, I'm not sure. And we met in San Francisco and were married in the biggest church at that time in San Francisco, there were four people in the church, the minister, the secretary and Marion and I.

Betty: And Marion's name before she was married?

Norm: Johnson. Her family lived in Lethbridge since about 1910. Prior to that they had lived in Calgary where 3 of the 4 boys were born. Marion's mother was a pioneer here, she came out to Calgary in 1885 and her father just a little later, not much but a little later.

Betty: So real native Albertans.

Norm: Very much so.

#057 Betty: After your stint with California, then where did you go?

Norm: In 1946, early '46, I was transferred to Tulsa in a supervisory capacity. United had a division office there and I was responsible for crews operating in west Texas, Oklahoma, Louisiana and later, about 1948, we had a couple of crews operating in Indiana which was kind of being reactivated at that time. I was also involved in some offshore work in the Gulf Coast, just out of Gulfport which we used as our base. That was an interesting point, in the fall of 1947, there was a severe hurricane hit the Gulfport area and one of our ships, at the time we were working closer to the Delta of the Mississippi, one of our ships was washed up on the levee and marooned there on the levee of the Mississippi River. The other one fought it out in the harbor in Gulfport and managed to survive without any damage.

Betty: The crew was still on the ship when it. . .?

Norm: Oh yes. Actually we were fortunate. The only injury that any of the crew members sustained was one boy, after the hurricane had passed, the ship that was on the levee, he jumped down from the ship onto the levee and broke his ankle. So as I say we were quite fortunate, there was very severe damage done to houses and things like that all the way from Gulfport to New Orleans. The airport in New Orleans was completely flooded and we had to land in a little airport across the river when I went down to investigate what

damage might have been done.

#081 Betty: While you were in Tulsa, you did come up to Alberta though.

Norm: Oh yes. As I say, I went back to Tulsa in '46 and in February of '47, Leduc was discovered and starting in the summertime I started to make a series of trips up here.

Betty: Did you have crews up here to check out?

Norm: Not at that time. Actually I was negotiating with some of the oil companies trying to get crews into Canada because it looked like it was going to be an expanding proposition, we wanted to get in on some of the action.

Betty: Who were you negotiating with at that time?

Norm: At that time, we talked to people like British American and California Standard which is now Chevron. We eventually put a crew out for British American in February of '48 and one for California Standard in Verdun in the spring or early summer of '48. That was a rather interesting situation because on that crew in Verdun the first day we were in the field to begin our seismic survey we picked up the lead that eventually led to the drilling and discovery of the Verdun field. And that doesn't happen very often.

#096 Betty: Very exciting. Were you with the crew at that time?

Norm: I was there because as I say we were just starting up and part of my responsibility's at that time were to see the crews got kicked off and operating properly. And I happened to be in the field at that time.

Betty: Who was the Party Chief at that time, do you remember?

Norm: Yes. A boy by the name of Leon Patterson who was a brother of Arleigh Patterson, who later became associated with me when I started my own company.

Betty: Did you know him at the time, did you know Arleigh at the time?

Norm: Oh yes. He and I, I first met him when United had a crew up here in 1942, I met him in Shelby, Montana. He had come from Oklahoma. The rest of the crew had come from California and we met just before we came up here in 1942.

Betty: So you really were in and out of Alberta from '42 on?

Norm: Oh yes. And besides, both Mrs. Christie's family and my own family were living here so most of our vacation time was spent coming up here.

#111 Betty: I have a couple of names here, Jerry Smith and ???.

Norm: I first met them when I came back from England and United had started a crew up again, for Shell I believe in 1945.

Betty: In Alberta.

Norm: That's right, they had their offices here in Calgary. And as I say, I had never met any of them before, Linsith??? was in the field at the time but Jerry Smith was the Party Chief in the Calgary office. And I remember when I came into the office, there was very few of the crew that I knew because prior to going to Britain I had been in west Texas for over a year so I didn't know too many of the people from the California end at that time. So I thought I'd, as a prank, I'd go in and ask if I could find a job with them and I went in and told these two computers in the office I was looking for employment. They handed me an

application form which I filled out except I didn't tell them the name of the company that I'd had prior experience with so they took it in to Jerry Smith and he looked it over and he said, well, I don't think you're qualified. And I'd already had about 10 years in the field and I finally told him who I was. He was most embarrassed, I don't think he's forgiven me to this day.

Betty: You hadn't put down your experience?

Norm: Yes. But not the company. And as I say at that time I had about 10 years, 9 years experience.

Betty: So a lot more than most geophysicist because it was such a new field. You were a pioneer at a young age.

Norm: I wouldn't classify myself as a pioneer but I was fortunate in knowing some of the real pioneers in the industry. And I feel that was a real reward in itself.

#137 Betty: In looking at those real pioneers, are there any that really stand out in your mind that influenced you in your career?

Norm: I don't know how much of an influence they've had on my career. As I say, when I started at the Colorado School of Mines I didn't even know there was such a thing as geophysics. It was primarily because of my fraternity bothers, some of them were taking it and seemed to be enthusiastic and that's why I made my choice. But I'd say in my early career probably the fellow that influenced me most was Thomas Manhart??? who still lives in Tulsa. He had graduated in 1930 I believe from the School of Mines. I met him first when he was taking graduate work there and was seen quite frequently and he was the one that offered me employment with this Seismograph Service Corporation, which I left. . . I was only with them about 3 months until I went with United in April of 1936. There were others that . . . Jerry Wespey??? with Seismograph Service Corporation who just recently, I say recently, he probably retired about 10 years ago. I'm trying to think of the people in Houston that I met, Bob Duty??? and Paul Nash??? who were with Magnolia which is now Mobil Oil Company in Dallas.

#161 Betty: Did many of these people move into Alberta at all?

Norm: No, not the. . . no, none of them I would say, but the company's they were with did but no, they never came up here. Except maybe on a short visit.

Betty: Roy Linsith.

Norm: As I say, I met him in '45 when I came back from England and then he went to South America for quite a period of time and has had a very successful career. He's a past President of the Association of Professional Engineers and Geologists and Geophysicist of Alberta. He's a past President of the local CSEG section. He's a past President of the International Society of Exploration Geophysicists. He's had an honorary degree from the university here and has contributed really, a great deal, primarily and more recently in the development and processing of seismic data.

Betty: And he was on a 1945 crew that I was supervising?

Norm: No I wasn't supervising, that's the one I visited and tried to get a job with.

Betty: That's the one that he was on.

Norm: Yes.

#178 Betty: The geologists and geophysicist, you mentioned the different organizations, at one time there seemed to be, maybe there still is, sort of like, two camps.

Norm: Well, there's still some friction existing but I think it's more a good natured exchange between the two groups. But I think in the early days, it could be regarded as somewhat serious. When the Society of Exploration Geophysicists was first organized in Houston in 1930 it was more an affiliated society kind of under the arm of American Association of Petroleum Geologists, the AAPG, and until about 1955 I believe it was, they held their annual meetings jointly. Well, eventually it got to the point that most of the exhibits which generated any profits from a convention were geophysical in nature but when the profits came to be split it was based on memberships of the societies and at that time the AAPG outnumbered the SEG by a factor of maybe 3 to 1. So that the geophysicist were contributing most of the financial success of these conventions but they weren't getting what they felt was their share of the profits. And in 1955 they decided to hold their conventions independently. The geophysicists hold theirs in the fall and the geologist hold theirs in the spring. Actually I don't think the AAPG suffered that much really because most of the suppliers, exhibitors ended up patronizing both conventions. And of course, as they grew it got to the point where they couldn't have held joint meetings in maybe not more than one or two cities in the U.S.

#210 Betty: Even now, when they are separated, it's very difficult for them to find places where they can all meet.

Norm: Very much so. By the way this year, the AAPG is holding. . .it's either this year or next year that the AAPG is holding their international meeting here. They have had it in Toronto once before but even the SEG, Calgary can't hold it anymore, they just don't have the capacity for it. And other places like Tulsa which used to have it's turn, it's confined more or less to Houston, Los Angeles, I don't think Denver can have it anymore nor New Orleans, although New Orleans did have it 2 or 3 years ago. But hopefully with these new convention developments here Calgary will get back on the circuit again.

Betty: Besides the animosity because of the distribution of funds, within the workings of the companies there has been friction between geologists and geophysicists.

Norm: Well, I think in the early days, what happened was that maybe, some geologists, let's say the insecure ones, felt that this was a challenge to their profession. Since, particularly seismic exploration is a reasonably exact tool, as compared to geology, which normally you take data and extrapolate it to cover your areas of interest. Actually the best solution to an exploration problem is to use the two tools jointly and that has by far been the most successful route to follow. But as I say, I think that's by the boards now.

#236 Betty: But it certainly was in the 40's and 50's, there was this. . . .

Norm: Oh there was some friction yes. But it never got to anything nasty or anything like that.

Betty: No sort of coming to almost daggers drawn as to where they were going to drill because of interpretation.

Norm: No, at least I never encountered that kind of a situation. Now, what might have happened in the Board rooms of some of the oil companies is something I'm not familiar with.

Betty: With all the improvement of the processing of the data, are they drilling fewer dry holes?

Norm: No they're not. And the reason for that is that oil and gas are becoming a lot more difficult to find. Actually in the early days of geophysics, what we thought were the easier things to discover and what really were the more easy to interpret, things like salt domes, and also structures that even had some expression on the surface. Those were the first things that were investigated and even with the more or less primitive instruments that we had, they were a lot more easy to resolve and interpret. And actually the developments in techniques, instrumentation, processing just barely I'd say, have been able to keep up with the difficulties we've encountered with these more subtle oil and gas reservoirs.

#264 Betty: Do you feel then that as the instruments become more sophisticated that the ground will be worked again and there is still oil underneath or around?

Norm: Oh yes. There certainly could be. For instance, a good example of that is west Pembina which was I think in 1952, Mobil Oil drilled the discovery well and actually their target was the Devonian reef. Unfortunately either it wasn't there or it was water filled. But in the shallower horizon. . . is it the Viking, I've forgotten the name of the shallower horizon. . . they found oil in substantial quantities. Not per well but it covered a tremendous area and it's now and has been since it's discovery, the biggest field in Alberta. It wasn't until about 5 or 6 years ago that they went in there with new instrumentation, the new techniques which is multiple coverage and they were able to pinpoint the reefs in the Devonian and have developed some rather substantial fields at a greater depth.

Betty: It was there, it just wasn't discoverable with the old instruments.

Norm: The old instruments and the old field techniques, that's exactly right. So really the advent of tape recording and things like that has revolutionized the industry. First the analogue tape recording and then the digital tape has allowed us to do some fantastic things.

Betty: In 1950 you formed your own company and I'd like to stop the tape and turn it over and we can talk about that if we could.

End of tape.

Tape 2 Side 2

Norm: [in mid-sentence]. . . and my fraternity brother George Reed, Mr. Manhart was also a fraternity brother of mine, was asked to organize a crew and bring it to Canada because they just weren't available up here, there was just such an expansion going on. And one of the things that Phillips had requested, I'd known a lot of the Phillips people, Mr. Hinsey???, their Chief Geophysicist was also a fraternity brother and Mr. Hyre???, who was already up here as the Canadian Chief Geophysicist, was another one. They had suggested to George Reed that he contact me and see if I'd be interested in getting involved. I thought about it for maybe a couple of days and decided to make the move,

particularly from the fact that Phillips had guaranteed us a one year contract, which was much longer than any contract that we'd been able to get in the U.S. because there had been a little down turn in geophysics at that time. Another reason was that I hadn't been making as many trips to Canada over the past couple of years because United had set up a division up here and moved another Canadian boy up here as manager.

#013 Betty: Who was that?

Norm: A boy by the name of Kenny Robertson who was also a fraternity brother of mine. It sounds like we almost had a corner on the industry.

Betty: Well, there weren't that many geophysicists at that time and there's where they were being turned out.

Norm: Right. So it offered an opportunity to get back up here. And I think primarily the fact that I wanted to try it on my own and also the fact that my wife and I both like Calgary. We figured it was an opportunity we couldn't pass up.

Betty: What's the difference between starting a company in 1950 and if you wanted to start one in 1982.

Norm: Well, the biggest difference is money. At the time, we started we were able to rent a recording truck, a shooting truck and survey pick-ups and a Party Manager's vehicle for something in the magnitude of \$1,000 a month for those four trucks including the instruments. And then the drills were paid for by the client and we were able to hire some drills. Later on we had an option to purchase these units and I think we were able to purchase our first set, although they weren't new, our first set of instruments cost us about I think, 47,000 or \$8,000. Now a recording unit, you're looking at, a recording unit, including geophones and cables, you're probably looking at anywhere from \$300,000 to \$1,000,000 to field just that one unit. You can rent them but I think the rental for. . . I just don't know what it is for a recording unit now but I know prior to my retirement that they were costing in the nature of \$10,000-\$20,000 a month.

#034 Betty: And that's just one part of it.

Norm: Yes. Now there is a big difference of course, they're a lot more sophisticated, it's not just inflation. For instance, our recording truck had, I think it was 12 traces, whereas now they're up to 120 traces, 10 times as much and there is a relatively new development which has over 1,000 traces in the field. In the 1950's you used 1 or 2 geophones per trace, now you use up to 50. But it hasn't slowed things down. As a matter of fact, the coverage that you get nowadays is, I'd say substantially greater than it was 30-35 years ago.

Betty: So this is perhaps why, when people go out as consultants now, it's themselves they hire out. The instruments have to come from the company.

Norm: That's true. Another big change of course, is that nowadays contracting firms are primarily just data acquisition groups. Whereas 30-35, as much as 45 years ago, a seismic contractor not only acquired the data but he did the interpretation and drew contour maps and hand plotted cross sections. There were no data processing centres that did that. And you could. . . the Party Chief on a crew was capable of filling almost any position on that

crew.

#052 Betty: This is really the geophysical training was in that direction wasn't it, so that they could?

Norm: Exactly. Whereas now, contractors as I say, in 95% of the cases would just acquire the data and then hand it either over to their client or over to a consultant that the client has hired, sometimes for the processing, sometimes just for the interpretation.

Betty: And the instruments are all owned by the companies pretty well now.

Norm: No. Not the oil companies, the contracting companies. Out of let's say 100 crews that work in Alberta in the wintertime at this period, I'd say only about 4 of them are oil company crews. Now there is the odd circumstance where an oil company will own the instruments, more or less on a labour contract to furnish the personnel to operate them and maybe furnish some of the peripheral vehicles like the shooting unit and the survey pick-ups, things like that. But there's not too many that do that, normally the contractors own all of the equipment.

#066 Betty: So the contractor has to have a lot of backing now to go out into business, there won't be too many new contracting companies.

Norm: Well, with the recent boom. . .there was a boom following 1973, there were a number of new contractors started up but under the new regulations some of them are beginning to feel the pinch. And there hasn't been that much expansion in the last two years. Four or five years ago there was tremendous expansion in the number of contractors here in Canada. And the States has been, up until the first of 1982, it was on a rising curve too but it's tapered off too as well. Primarily I would say because of the world oil glut and the softening of prices.

Betty: I have a couple of other notes here that I want to get to before we finish our taping today. Royalite in the Fawcett area?

Norm: I guess that was the second crew that we put out, our first crew was for Phillips.

Betty: And that was in what area?

Norm: That was over in Saskatchewan. Out of Kindersley. At that time in Kindersley, I don't know whether I mentioned this before or not but we were doing what was called correlation shooting, not continuous profiling. And on the way up to a well location near Kerrobert, we ran a series of shot points just a mile apart and picked up what looked like a rather substantial lead on the block just north of where Phillips had their block. At the time it was owned by either Canada Southern or United Canso??? and I suggested to Phillips that they go and see if they could make a deal with them but their management said, no, they had enough acreage of their own to look after. Well, as it turned out, later on Royalite made a deal with them and drilled a discovery well, what is known as the Coleville??? field. And that productivity, you could almost draw a line between the Royalite acreage and the Phillips acreage. Phillips had practically nothing on it and Royalite had a rather substantial field. That may have been one of the reasons why Royalite came to us to put out a second crew and we started up in the Fawcett area.

#095 Betty: Can you pinpoint the Fawcett area?

Norm: Yes, it's north of Westlock and it hasn't been a very successful area. But from there we went down into the Brazeau area west of Red Deer and did an exploration program for British American that up until recently hadn't been too successful. With the new techniques, I think there has been some, particularly gas discoveries there. Then we went over with that same crew, they forgot to cancel our contract at the end of the winter and they had a month to go and they went over to the Alex area near Stettler. It's a program that they hadn't planned on but as it turned out we ended up discovering a rather substantial gas field. So it was a bit of serendipity there.

Betty: I have a name here in connection with the Fawcett area and that's Fred McInnis???

Norm: Oh yes. He was the Vice-President of Exploration for Royalite at that time. I had met him before. He subsequently went with British Petroleum here and is now, I believe retired.

Betty: Did you work with him at all, did you know him well?

Norm: Just in passing on the information as a result of the work we had done up there.

Betty: You didn't have any other dealings with him though?

Norm: No.

#111 Betty: the other thing that I wanted to ask you about, you weren't here when Leduc came in but you were here in '48 and there was quite a problem, I believe there was a flood.

Norm: The first crew we put out. . no, I was with United at the time, they put out, was operating out of Wetaskiwin and in the peripheral area around Leduc and it had been a rather severe winter with lots of snow and come spring the whole area started to flood. The town of Wetaskiwin, I guess it's a city now, the railway track acted more or less as a dam precluding any substantial runoff and some of the bridges and things like that got jammed with debris. I believe the crew, in addition to using the drills to pump out the garage where the trucks were stored, they used some of the dynamite to kind of clear out the debris under some of the runoff passages.

Betty: That would be quite an exciting time.

Norm: Yes. As a matter of fact, it was a coincidence actually but in 1942 when we were based in High River, they had a flood there and we had to use our drills to keep our garage dry where we had our equipment stored and also some new cars that the dealer had. He was most grateful for us at that time, threw a big party for us after the flood had passed.

#131 Betty: I have two other names here that I think you worked with at that time, a Doug Hyre?

Norm: Yes. Doug was the Chief Geophysicist. That was when we first started our ECI up here, he was the Chief Geophysicist for Phillips and a friend of very long standing. I had known him since the early 1930's. He had graduated before I had but I had met him quite frequently at the Colorado School of mines. And another one about the same vintage as Doug was Al Hinsey??? who was the Chief Geophysicist for Phillips for the entire company. And he came up here just on short visits, when we were first getting started. We've maintained our association.

#142 Betty: Can you remember any anecdotes of either of them and their contribution into the oil patch?

Norm: I know that Doug as a result of his work came up with the first discovery of gas in Saskatchewan and that was a little field just southeast of Kindersley called the Brock field. There was enough there that they were able to run a line from Brock up to Saskatoon to furnish the first natural gas there. And Al Hinsey has been, as I say, one of the pioneers in the business and I believe became an officer in Phillips in their exploration department. He's still active now with Tom Manhart, they have an office in Tulsa. Primarily devoted to appearing in public forums trying to explain the oil industry to people whose ideas about it aren't what we feel they should be.

#156 Betty: Well, it certainly does need a lot of explaining, even when you talk about pools of oil, people really think you have a big hollow hole underneath the ground.

Norm: That's true. A lot of them certainly do that. It needs a lot of explaining and it's unfortunate because I feel that the oil industry has probably got the poorest public relations effort of any major industry. And it's worked to the disadvantage of the people that are involved.

Betty: They're starting to turn around a bit now I think.

Norm: Aside from drilling and exploration and refining and marketing, there's a lot of spin off that affects a substantially greater number of people. And when the oil industry begins to hurt and it begins to affect them then they start becoming more aware.

End of tape.

Tape 3 Side 1

Betty: In looking at the development of the geophysics from those early days and say, well looking even from 1950 up to the present time, what do you think has been the most significant development?

Norm: I would say, the development of the digital recording systems and the digital processing systems using computers. Prior to that we recorded the data analogue on. . . the early records of course, were photographic records with a stylus on smoked paper. Then you got to recording them magnetically but it was an analogue system but that allows us to

sum the data or remove an effect called the normal move-on??? effect where a geophone removed from the shot point that had a diagonal reflection path could be converted into a vertical reflection path by subtracting a certain time from it. So that was the first step, those magnetic recording that allowed this treatment. But it took the biggest jump when they started to use digital systems.

#013 Betty: Do you remember when that was?

Norm: Well, the magnetic analogue ones, I would say, I know a group of contractors got together here, I think it was in 1956 or '57 to form an analogue data processing company. So it must have been '54 or '55 when they first came in. And it wasn't too long after that before the digital systems came, I'd say maybe 5 or 6 years after that.

Betty: So into the early 60's.

Norm: Yes. But of course, I'm sure, there's been a lot research gone into it prior to that.

Betty: Computers are so important in the industry today.

Norm: Oh yes. Without them you'd be back to the pioneer days. I'd say that is by far the biggest step that has been made.

Betty: With the advances, did you find that you started going over and resurveying.

Norm: Oh yes. There's been areas here that have been resurveyed a half dozen times I imagine. As new improvements have come along.

Betty: You mentioned this in Pembina, which they found something different many years later, was it because of the instrumentation?

Norm: Yes they did. Because with the early instrumentation in '52, there was no such thing as what we call multiple coverage. That's where you shoot, take several records over essentially the same area and you couldn't do it. As a result you couldn't spot those reefs. Now, with the different processing techniques they have, this is what led to the discovery of the reefs in Pembina which had been the original target but as I say, ended up with production from a much shallower zone.

#032 Betty: Were you involved yourself, have you been in the time that you were in the industry, of finding new discoveries where they had sort of given up, can you recall any particular. . . ?

Norm: I can't remember finding anything that had been passed up. Well, there may be one instance. In 1942 when I was up here, I believe I mentioned that we'd started a seismic line just out near Broadcast Hill and headed west along the old Banff Coach Road and we picked up a lead that led to the discovery of the Jumping Pound field, which I think had probably been surveyed prior to that because at the time we were doing that survey Shell was drilling a well west of Jumping Pound on some seismic data. That well turned out to be dry but the Jumping pound came in as a discovery.

Betty: When you were first working with Heiland you were working in Lethbridge and I remember you saying there was no winter work. Now when you came back and indeed when you formed your own company, there was winter work. When did winter work start, can you recall that for us?

Norm: Now I really don't know whether there was any winter work before the discovery of

Leduc or not. There probably may have been because outfits like Heiland were here off and on from 1933 on. But I would say. . .no, in 1942, we were working along side a Heiland crew for Shell and we were only allowed to come up here for six months because we were a U.S. company and most of our employees were U.S. And the Heiland crew was allowed to stay on. Now whether they worked all through the winter, I don't know but we went back in September and they stayed on and I know they worked beyond when we were there. But I know that they were working in the winter in 1948 because I was with United at that time and in February we moved a crew up here for British American, in February of 1948. And there was several crews already here then, so I would guess it's possible from say, '42 on but I know they were working in '47.

#059 Betty: Why were they not working in the winter earlier.

Norm: Well, for one thing the equipment would freeze up, they weren't adapted to winter work. It's just like sometimes, you can't bring a car from Florida up here without anti-freeze in it and things like that. The pumps had to be designed and protected in different ways. It was primarily that the equipment wasn't in a position to cope with the severe weather.

Betty: And by 1948 it was?

Norm: Yes.

Betty: What did they do to the equipment?

Norm: For one thing, I think they enclosed the pumps and the drills. That was primarily the main problem with these little portable rotary drills, they'd freeze up and you could crack the pumps just like a radiator or a lock on a car would crack. It really didn't affect the seismic instruments that much. It was primarily a drilling problem. And of course, a lot of people didn't think you were supposed to work in that type of weather but I've seen work in 60 below weather. We don't enjoy it but if you can keep getting in and out of a warm vehicle you can survive all right.

#073 Betty: When we talk about working north now, we're talking about north. North of the Arctic Circle, way up there but in the 50's, north was not that far north was it?

Norm: Oh no. I know that in the early 50's there was a group formed to work a belt between Edmonton and Fort McMurray, up Edmonton to Athabasca. It was called Bear Petroleum and Dr. Link was one of the guiding lights behind it and that was considered a pretty northerly operation at that time. Of course, Norman Wells had been here many years prior to that, it was discovered I believe in 1919 but not on seismic work, that was a geological discovery. And by the way, Dr. Link was the geologist on that development.

Betty: Dr. Link had quite a lot to do then with the northern development of exploration areas.

Norm: Yes I would say so.

Betty: Did you work with him at all?

Norm: Yes I did, in 1935, he was the geologist for Imperial at that time when I was on a Heiland crew. But I had known him well over the years. No, it wasn't until considerably later that the far north. . .I know we did some work up in the Eagle Plains area, north of Dawson City, Yukon in 1959 but we weren't the first. There had been a GSI crew up there a year or two prior to that. And the result of our work, they had a non-commercial oil discovery

in the Eagle Plains area. But it was a relative. . . .

#097 Betty: What were the conditions?

Norm: Well, it was. . . and we worked in the winter time because the ground was frozen and there was a lot of muskeg and tundra in that area. We did do a job a few years alter in the summertime using helicopter borne instruments and drills.

Betty: When was that?

Norm: I would guess in the early 60's and we flew into an airstrip that had been built there and we had a little dog house with our instruments that could be carried by a helicopter and the drills could be broken down and carried by a . . . it was a good sized helicopter, it was a Sikorsky I believe, it could carry up to 4,000 pounds and we worked there in the summertime but the results in the summertime are much poorer than they are in the wintertime because in the wintertime the ground's frozen. In the summertime you've got water running all over the place.

Betty: Does it interfere with the records?

Norm: Yes it would. And it wasn't nearly as acceptable results. But they had a time commitment on this and so that's why we were in there. Sometimes you are not in a position to take advantage of the best weather. And I've seen it . . . I don't believe we worked but I remember one day just prior to one of my visits up there it was 72 below farenheight and I know the boys worked in 60 below weather up there.

#116 Betty: What would they where?

Norm: Parkas, normal Arctic gear and very thick pants. Cumbersome to move around in but you could get the job done.

Betty: And how many people would you have in a crew at that time?

Norm: I imagine counting the drillers, surveyors, recorders, I would guess about 15 on the field crew plus camp support you know, cooks, swampers, a pilot for air support, so I imagine there would be somewhere between 20 and 25 people in the camp.

Betty: Quite different from the early crews, when you would go out with 3 or 4?

Norm: Well, there would be more than that really, I know the first crew we started with, in the field there was two surveyors, a shooter and his helper, 3 on the recording truck, that would be 7. I guess that would be it in the field. . .and a Party Manager, 8, and then we'd have 3 in the office to handle the interpretive end of things so it would be an 11 man crew.

#132 Betty: Let's look at the 50's, some of the areas that you worked in then that were particularly significant to you that you can remember, special jobs?

Norm: As I say, the first job that we had was working for Phillips out at Kindersley Saskatchewan and I remember it was correlation work as opposed to continuous profiling where you would make a cross section from a continuous line of data. And we were doing correlation work which meant that we would shoot data a mile apart and try and identify the same reflections but instead of making up a profile of the survey we would make up a contoured map or the data. It's much less expensive but it's not nearly as conclusive as

the continuous profiling. But we were working out of Kindersley and the closest well was about 40 miles away and we wanted to run a survey up to that well so we could identify some of the geologic horizons. And in the course of running this correlation up to this well near Kerrobert we picked up a lead on what was later proved to be a discovery and I went to our client and said, if I were you I'd see if I could pick up this acreage or make a deal with the people who already had it and it was near Coleville, Saskatchewan. But they said that they had and they did have a very substantial block of acreage. They said, no, we'll go and evaluate our own acreage instead and they didn't pursue it any further. As it turned out the Coleville field was a rather substantial oil discovery whereas the work we did down on their block, the only thing that came in was a little gas. It was the first gas field in Saskatchewan at a town called Brock but if they'd have made a deal with the . . . I think it was one of the affiliated companies of what is now Canada Southern, I think Royalite made the deal with them and did very well as a result of it. But the Brock field, I think they ran a pipeline into Saskatoon, it may be part of the Saskatoon supply of gas. But that's a long time ago and the field may be depleted by now, I really don't know.

#165 Betty: What was some of the other work that you did in the 50's that . . . ?

Norm: We went from . . . we did some work as I said up around Melville and then stayed on there and worked for Hudson Bay Oil and Gas and we were able to identify reefs in that area but none of them were productive. And then I think our 3rd crew we put out was for Mobil Oil and it started first up in the Buffalo Head Hills, north of Peace River, about 200 miles. Then at the end of the winter we were transferred to Saskatchewan and we were over in that country, Mobil had about 100 townships to evaluate and so we spent the next four years, the summertime in Saskatchewan and the wintertime in some of the northern areas.

#178 Betty: Were you out with the crews at this time?

Norm: Not consistently no. I would visit them, try and hit each one at least once a month. But in southeast Saskatchewan we ran across some very interesting features and also some recording techniques. Now it wouldn't be a problem but in the old days of the analogue systems, we had what was called an automatic volume control on our instruments. So that when a strong pulse hit, it would reduce the amplification factor of the data immediately following. That area had been badly overshot in the past and we found out we could actually get all the data we needed shooting about 3 ounces of dynamite. And by doing that we didn't overload the system and we were able to see additional reflections on the records that had been completely overridden by overshooting. And this led to the discovery of several features over there because one particular reflection that wasn't too strong was the key to accumulation at the top of the Mississippian. And it was being overridden by a very strong reflection from immediately above. Once we developed that technique we found a series of small fields but rather substantial and very high gravity oil

#200 Betty: Were you the first to use less to find out more?

Norm: I would say yes. I think we probably were at that time and I think it was probably more by

good management than good planning.

Betty: What would make you decide to not. . . ?

Norm: We just tried to see how little dynamite we could use to record the full geologic section and then when we got to studying the records we found that there were things appearing on the low energy records that weren't on the ones that were using a lot of energy.

Betty: In the petroleum industry, exploration information and expertise is pretty closely guarded. Did you let anyone else in on the fact that this is how you did it?

Norm: It eventually becomes pretty much public knowledge. For instance we were using that technique and we were working for Mobil Oil and they had a couple of other crews. Well, immediately we came up with this, they told the other crew to cut back. So that type of information doesn't remain proprietary very long.

Betty: Did you ever give papers on some of these types of discoveries to your annual meetings of the Geophysical Association.

Norm: Not to the SEG. I did give papers. . . I remember I gave a talk in Billings, Montana and one in Regina but they were primarily meetings that covered the whole spectrum of the industry, exploration and production and things like that. But not to the . . . I did give one paper here in Calgary to the SEG on a short course they had set up for younger people and it was primarily devoted to some of the interpretive pitfalls that you could encounter in some of the work.

#228 Betty: What are some of the pitfalls that one would have to watch for?

Norm: They're fairly technical. I don't know whether I can describe them in words. For instance, you have a weathering layer near the surface of the ground and then a series of normally, generally increasing beds, the velocity increasing in the beds as you go deeper and you can get some rather strange contrasts where by shooting certain types of weathering corrections, you'll never see the one particular bed on a cross section. We encountered that in the northern part of the country, where we were also working for Mobil and I did give a paper on that. It's hard to explain it unless you have plates and graphs on it.

#242 Betty: Can you recall anything else before we leave the 50's of some of the particular jobs that you undertook that again led to some of these discoveries that obviously you were part of many discoveries, were you not?

Norm: I guess I've had my shore, both here in Canada and the United States. Of course, I had a bit of a jump on some of these other people too by being among the first in some of these areas. Really, we've had discoveries on little reefs in Ontario right in the same counties where oil was first discovered in this country over 100 years ago. And they're still working back there by the way. Teledyne is not back there anymore but some of our ex-employees decided to move back there on a permanent basis and they started their own little company and I think have been quite successful. But there was a case of serendipity to a certain degree, we first went back there at least 15 years ago, maybe more, to do some work for Union Gas Company who were looking for old reefs or any kind of reefs where they could stock pile their gas, put it back into the ground and then be able to draw on it during periods of peak demand. The first year we were back there, we found two

reefs. Of course, Union then immediately drilled them in order to stockpile the gas but when they drilled them they found both of them were full of gas. So they really, they had their reservoir already filled. At the time they never expected to find gas in them but both of them were loaded with gas.

#276 Betty: That would be quite an exciting thing to happen.

Norm: Yes indeed. They thought pretty highly of us at the time. We stayed. . .

Betty: Whereabouts was this?

Norm: In southern Ontario, near Petrolia.

Betty: About 1960 would it be?

Norm: '65, '66, '67, I'm not exactly sure of the date.

Betty: Did you even find some empty reefs that they could. . .?

Norm: Oh, there's lots.

Betty: You did find some for the storage tanks?

Norm: Yes.

Betty: Do they use that system today?

Norm: I imagine they do because the demand for gas is increasing so they probably need a stockpile to be able to draw down on.

Betty: Rather interesting to be using the natural sub-surface terrain to. . .

Norm: Oh, this is happening in several parts of the world now. They're using old reservoirs to stockpile for peak periods.

Betty: Keep the earth from collapsing after it's emptied. Now you stayed with your own company for how long.

Norm: 15 years, from '50 to '65.

Betty: Then what happened?

Norm: I sold it to Independent Exploration, which is an international company in the States and stayed on to operate the new organization which was made up of Exploration consultants, my company, Farney Exploration and Nance Exploration??? and Canadian Magnetic Reductions, which was the data processing centre.

#302 Betty: Why did you decide to sell, Mr. Christie?

Norm: It had taken me 15 years to build up the organization, pay off all the equipment, generate a reasonable return and with the advent of the new systems it meant a whole new investment and essentially for me starting over again to pay off. . . .

Betty: This would be with the computer business coming?

Norm: Exactly, with the advent of digital systems. And I was over 50 at the time and I had some excellent people and I guess out of sheer egotism you wonder what's going to happen to these people if you decide to retire. And this offered an opportunity for them to be placed in an ongoing situation and so it kind of eased my conscience a little bit to be taken over at that time.

Betty: Had people tried to before that, to come to you. There's much of that today.

Norm: Oh yes. We had been approached several times.

Betty: But in the earlier days there was more people starting new companies than doing take

overs. So it came at a very good time perhaps.

Norm: Yes it did and it's worked out very well.

#329 Betty: You mentioned you had some excellent people working for you. Could we talk about some of those people that were working for you in the 50's and 60's?

Norm: Yes. I believe I mentioned this before that the company was actually started by a fraternity brother and roommate of mine from Colorado School of Mines, George Reed, who then went back to run a stateside operation we had developed.

Betty: You continued as partners though throughout, did you?

Norm: Oh yes. And then he went down to Brazil and got into the diamond mining business and has been reasonable successful down there. I had a very close associate with United Geophysical who was in Indiana at the time and when we put out our first crew in the States, he left them and came with us to start that operation and eventually came up here. His name is Arleigh Patterson and to me he was about the best all round geophysicist I had ever encountered. He'd never had any formal training beyond high school but he had taught himself calculus and geology.

End of tape.

Tape 3 Side 2

Norm: [in mid sentence]. . . it was acquired by some other contractor and their client wanted a separate opinion and they would come to us and we would do our own interpretation on the data.

Betty: Were there some companies that were simply engaged in gathering the geophysical information without any interpretation?

Norm: There would be very few. Some of them were formed in the boom periods of the late 40's and early 50's were Canadian companies. And the people there had maybe worked a short period of time for some of the major oil companies and left to form their own data acquisition group but I'd say 90% of the data that was acquired was interpreted by the people that did the acquisition. But there were very few individuals that set themselves up as purely consultants. That probably didn't occur until possibly 1951, '52.

#013 Betty: Why did they not?

Norm: For one thing most of the people with any experience in geophysics at that time, had come up from the states with the major oil companies or who had formed data acquisition groups on which they did their own interpretation. And there were mostly Americans at that time. And it took I'd say five years before native Canadians were in a position to act as consultants.

Betty: So you were really a little ahead of your time, opening up your company in 1950?

Norm: Yes, but actually we were formed primarily to acquire the data. And I think one of the things that allowed us to do consulting was that the principals had probably had substantial experience. By 1950 I'd been in geophysics for 15 years.

Betty: that would be quite a long time.

Norm: By those standards it was a long time. I'd say that there were Canadians that had experience but a lot of them had got it through working in the United States for some of the oil companies and contracting companies.

#026 Betty: Can you remember the names of any of the early companies that were formed, consulting firms that were formed at that time, as yours was, which was primarily for gathering the data but also did some interpretation.

Norm: The ones that were formed here were Farney Exploration, Harold Farney had had experience with Phillips Petroleum and with Heiland Exploration and had been in the business for a considerable length of time. And I think he formed his own company, I believe it was 1948 or '49. He was an American but had worked a fair amount of time in Canada for Heiland so he was in a good position to start on his own.

Betty: Did you work with him at all in Heiland?

Norm: No. He came to Heiland after I had been with them but he had worked for Phillips prior to that. I believe he actually started in geophysics in 1933 or '34. Then there was Northwest Seismic which was formed by Jack Macmillan and oh dear. . .I can't think of the other man's name at the present time, it will probably come to me. They had been with Imperial in South America before they started their own outfit and they had an excellent interpreter, who was a Canadian by the way, George Blunden, who had been with Gulf prior to going with Northwest. And then there was a number of American outfits that came up here after Leduc. The industry was a little slow in the States in 1947 when Leduc was discovered so. . . .

#046 Betty: This was really fortuitous then for Canada, was it not?

Norm: Yes, it was. Because there were crews available to come up here at that time from the

States. Most of the major companies began operations up here. In '47 when I used to visit here, I was representing United Geophysical and made contacts with the various oil companies at that time and I believe our first contract was with British American. Then United got another crew with Standard of California to work in Verdun.

Betty: Yes, I think you mentioned that.

Norm: I believe I mentioned that the first day on the field they came up with the lead that led to the discovery of the Verdun oil field. But GSI was here, Western and . . .

Betty: Had the oil business been booming in the United States. . . .

Norm: Well, it had been during the war.

Betty: Yes, but if it had been at the same time as Leduc, do you think there would have been quite a difference in the history of the Canadian oil, exploitation of the discoveries?

Norm: I really am not sure. Normally in a boom period they generally find ways to expand. Sometimes the quality of the work suffers, for instance, when Rainbow in, I believe it was somewhere between 1967 and 1969, there was a tremendous expansion in the number of seismic crews because it required a lot of detail. Those were small features up at Rainbow Lake and it required a lot of detail. And there was a tremendous number of crews, some of which should never have been organized but due to the demands of the clients the contractors were primarily more of less obliged to put crews in the field for some of their old time clients. And as I say, that rapid expansion, the quality of the work did suffer.

#070 Betty: How many crews were there in the field, do you think in 1950 when you organized?

Norm: By 1950 there would be close to 100 crews in the field. I've forgotten how long they've been keeping records, I don't know whether they go back that far but they have a record of the crew activity that is posted once a month in the daily oil bulletin. But I don't know whether it goes back that far. But it got up to around 180 crews about 1954 and then started to taper off.

Betty: Where were you working?

Norm: The first contract that Exploration Consultants had when we came up here in 1950 was our of Kindersley, Saskatchewan. We had a one year contract with Phillips Petroleum Company. We worked there out of Kindersley for about six months I guess and then moved up to Melfort, Saskatchewan and did some work up there for them. Then in the fall of 1950 we put out a second crew for Federated Petroleum and British American Oil Company and we worked out of . . . it was a camp crew, we lived in a camp not too far from Nordegg and worked on a prospect near the Brazeau River. We worked there throughout the winter and following that we moved to Alex and it was rather a strange circumstance because the work was supposed to have just gone on for the winter months but they neglected to give us our one month's notice at the termination of the contract and since they had a month coming to them, they moved the crew over to Alex on a rather nebulous lead that the John Carr of Federated Petroleum had come up with. And we did some work in there and that led to the discovery of the Alex gas field which is a rather substantial field. So it was ver fortuitous that they had neglected because otherwise I

don't think they had done enough geology at that time to really justify a program but as it turned out it worked out very well. By that time, just south of that Gulf had made a discovery, primarily oil but with some gas in the same area so the area was warming up and I guess we were lucky to get in there at the time we did.

#107 Betty: Was there much of this that happened during your time where you just sort of by happenstance just happened to be there?

Norm: Most of the work was done, no I wouldn't say most of it but a substantial part of it was done on leads that had been developed by geologists. A lot of it though at that time, was done by virtue of commitments that the oil companies had made at the time they acquired the land, in other words commitments to do a certain amount of geophysical work and probably even commitments to follow up with some drilling. So it wasn't really what you'd call a dart board approach, where you threw darts at a map, no there was some good reasoning behind most of it anyway.

Betty: Was there any parts of the exploration in those early days, in the 50's, 60's, that was the dart board approach.

Norm: Everyone at that time was trying to pick up as much land as they possibly could and it's conceivable that in the course of acquiring the acreage they made commitments that probably weren't based on good technical data but if they had to drill a well, even if they had gone in there and developed a geophysical picture that didn't show anything, they were still obliged to drill and what they'd do is they'd make a location at the least poor location not the best location. This happened in the stampede to acquire acreage.

#126 Betty: In doing that then did they get adjoining acreage that might be good, is this what they were looking for.

Norm: Well, there was always the possibility of that, it could give them leads that would help them acquire acreage that might look a little more favourable.

Betty: How deep would they drill in the least poor commitment?

Norm: In those days of course, Leduc was a reef discovery, into the Devonian and in most cases that was the target that they were going for. For instance, I've forgot now, I think it was about 1952 that Mobil had acquired acreage in Pembina and their target for the location they made was the Devonian, they were looking for Devonian reef. They didn't find productive reef but they found the Pembina sands which made Pembina the largest field in the province. That was a bit of serendipity because that was not their target, the Pembina sands are much shallower than the Devonian reef that was their target. And it wasn't until just a few years ago that they did find reef in that area, the west Pembina field and that created another stampede. And that was 25 years after the Pembina field based on the production from the sands was discovered. So sometimes. . .and by the way, the Pembina sands are not governed by structure, they're primarily a stratigraphic trap, where structure had very little to do with the accumulation of oil and gas.

#146 Betty: Could you explain that a little more?

Norm: Yes. Normally well in most cases, oil being lighter than water, always rises to the top of a

structure, in other words an anticline, first if there are reservoir rocks and also source rocks, the oil and the gas come up dip on the flanks of that anticline and the gas is at the crest and the oil a little lower down and then you get water. You can either have an anticline as such, you can have a monocline which is a slope in one direction that might be transected by a fault and that acts as being the reverse dip. Whereas with a stratigraphic trap the productive bed, let's say it's enclosed between two non-porous. . . .let's say shale for example and if that productive bed tapers out to nothing then you have a seal at the end where it tapers off. And it doesn't have to be a structure at all. It might have say. . .it has to have some regional dip but you don't get a structure. And up until recently they've been extremely difficult to find because the resolution of your seismic data wouldn't allow you to pick where that particular productive bed pinched out completely.

#167 Betty: Why is it easier to find them today?

Norm: Because of the instrumentation, the techniques we have that allow us to do that. We get better resolution on our data.

Betty: Everything is more sensitive?

Norm: It's not so much the sensitivity although they are much more powerful instruments but you can get, by data processing and also with field techniques that allow you to record higher frequency data, this also increases the resolution of the data. And there's other things that help too, what is called the bright spot technique that came into effect primarily down in the Gulf Coast where if you ran over a gas field, you had quite a contrast in the velocity of the data and that affected the reflection coefficient of the seismic waves that were being reflected back and they would come back with a very, very high amplitude and this was a lead that was used, it began about 10 or 15 years ago on the Gulf Coast and there was millions of dollars bid, particularly offshore, just on the basis of these high amplitude reflections that would appear on records. And it's been a very good tool. It hasn't been perfect but it's been a pretty good lead.

#187 Betty: With all this sophistication of the data gathering instruments that you have, has this meant that the ratio of finds and dry holes has changed?

Norm: Not really because in the old days with the primitive techniques you had easier types of structures to discover and once those become productive or are discovered then you start looking for the ones that are a little tougher. And actually all we have done in geophysics is developed techniques that try to keep us even with the problems that have developed in discovering these more subtle producing fields.

Betty: So all the easy work has been done really, is that. . .

Norm: A good part of it yes. So really all the industry has done is try to keep pace with the problems that have developed in finding these more subtle reservoirs.

Betty: This has certainly changed the work of the geophysicist.

Norm: By all means. In the old days, the Party Chief on the crew could do almost any job on the crew, survey. . . .

Betty: By the old days, you're looking at 35, 45, 55. . . ?

Norm: Yes. I'd say primarily until the development of the more sophisticated analogue type recording and digital recording. The Party Chief was all things to all people on the crew, he could do or should have been able to do almost every job on the crew from surveying and drilling the holes to taking the records to interpretation. With the advent of these more sophisticated techniques you've got. . . the only thing that was different at that time was the manufacture of the instruments was separate the actual field survey. But aside from that now you've got people to operate these very sophisticated recording instruments which a Party Chief might be able to do but now the data acquisition is almost completely separate from the interpretation. For instance very few of the contracting companies now go beyond just acquiring the data. They will do some of the processing but the bulk of the processing now is done by the client and the interpretation is done almost exclusively by the client or by a consultant. And the number of interpretive consultants has increased materially. As I say, the work has become highly specialized. You've got people to design the instruments, you've got people developing energy sources like vibrasize and dynasize as opposed to dynamite.

#233 Betty: What are those, can you just. . . ?

Norm: Well, they're surface energy sources. Dynasize, the energy is developed by exploding propane which drives a plate onto the ground. And it's a series of these explosions with the plate hitting the ground and they sum this data. And the vibrasize, instead of an explosion, it has a plate that shakes the ground. Here again, it's summed. One of the advantages is that the reflections are always the same but the background noise is different and by summing this particular series you build up the reflection data and essentially carry out the background noise. And there's others of course, there's an air gun too, that uses compressed air to drive a plate or in the water it creates kind of an explosive source. Most marine work is done with other sources of energy besides dynamite. On land I'd say at least half of the work is done still with dynamite as the energy source.

Betty: These newer methods, would they mean that you didn't have to take the hand auger of the old days and drill holes, you just use the surface.

Norm: That's right.

Betty: This would make quite a difference to the environmental disturbance in areas.

Norm: Yes it would. Although some of these things still can make quite a cavity in the ground if you continues in one place with the energy source, so they generally move along maybe just a few feet when they're running a series of developing the energy.

#266 Betty: When you say a cavity, are you looking at a foot, five feet. . . ?

Norm: Depending on the size of the plat you use, it's only a few inches deep but it's surprising how much data you can get from creating even that kind of a. . .

Betty: What a difference from the first time you went out and put 50 pounds of dynamite down a hole and blew a great big hole.

Norm: Yes. It is.

Betty: With them not having bulldozers at that time I guess it was pretty backbreaking to fill those holes back in.

Norm: That's right because it was mostly done by hand and occasionally they would use, I don't know whether you are familiar with the tool, it's a fresno???, they used to more dirt when they were building roads. It's a bucket that kind of operates on the same principal as a plow. It's dragged along by a team of horses and scoops up the ground and then you dump it when you get to where you want to put the dirt that you picked up.

#281 Betty: In those first days then did you use horses.

Norm: No we never did. Most of it we did by hand, filling in the . . .

Betty: So today you don't have to be quite as brawny as you had to be then?

Norm: That's right. Another thing that was substantially larger in the earlier days was the geophones. Some geophones weighed up to 15 pounds, now they weigh a couple of ounces. But instead of using one of the big ones, now you use anywhere from 6 to 48 of the smaller ones.

Betty: With better data or similar data?

Norm: Oh yes, much better data, because you get. . . here again, you're picking up the reflection data, it's always consistent. And the background noise hitting these various assemblies of phones is not consistent and tends to cancel things out so you get a much better record.

Betty: So as some of the other industries have developed, so the geophysical industry has developed because this would be the use of condensers and things like that. . .?

Norm: Oh well, they always had those, the geophysical instruments were electronic but they're a good deal more sophisticated and of course, the advent of the digital systems allowed you to sum the data and also process it in a few seconds what would take an individual months to do.

#307 Betty: How did you find this reflected on the geophysicists who were in the business?

Norm: That were already in the . . .? Well, personally speaking I found it difficult to keep up with it all. And the industry became highly specialized, you had the data processing group, some of whom have never even seen a crew operate and are completely unfamiliar with geology. And yet they are developing programs, computing programs that are revolutionary in the industry. But they probably couldn't tell a lava rock from sandstone or limestone but they're excellent mathematicians and eventually some of the geology rubs off on them and some of them become excellent interpreters as well. But as I say, you have. . . the man on the field now is seldom a geologist, or with a geological background, he's primarily a foreman, helping to acquire the data. And then it goes to the data processing centre and from there it goes to in the old days, what we would call the geophysicist, the Party Chief, the interpreter for interpretation. But I don't believe there's a man in the world today that could be all things in the geophysical industry. There's just too much specialization.

End of tape.

Betty: Mr. Christie, I'd like to, looking at the formative years, as we still are doing, I'd like to talk about the SEG, the Society of Exploration Geophysicists and CSEG because you were very active as the President of the SEG, I think 1963 but were. . .

Norm: '63, '64 yes.

Betty: And were there at the beginning of the CSEG formation too although you hadn't moved up to Canada. What do you think, first of all let's look at the role that the professional society such as the Society of Exploration Geophysicists has played in the oil patch.

Norm: Well, the SEG was organized in 1930 in Houston and I think it had a charter membership of about 30 people and it was organized primarily to have a society that would promote the exchange of technical information. And they came out with short papers, they'd have meetings, not on any scheduled basis but they would have meetings and even in those days, Houston was the headquarters of the oil industry. But when it was organized, it was actually an affiliate of the AAPG, which was the American Association of Petroleum Geologists, who at that time had their headquarters in Tulsa and still do for the that matter. So that any of the clerical work that had to be done was handled by the AAPG. And that affiliation continued until about. . . I'm trying to think, it was the year that O. C. Clifford was the President of the SEG, which I think would be in the late 1950's and there was a bit of friction developed between the two societies at that time primarily because at the annual conventions of the AAPG, which of course meant the SEG as well, most of the exhibitors were geophysical exhibitors, the equipment and things like that. And the funds generated were mostly from the exhibits of geophysical manufacturers, but when the time came to divide the profits of the convention they based it on the membership of the two societies and it ended up that the geologists ended up with most of the money. And this was I would say, the primary reason why, the geophysical society, when it got to be a certain size decided we'll go it on our own and it represented quite a difference and an improvement in their financial status as well. Because that was about the only thing that generated any money for the society beyond the dues paid by the members.

#032 Betty: Going to the annual conferences, if most of the members were geologists, there perhaps would be more papers of interest to them too, than to the geophysicists.

Norm: Yes. Although they did break it down into sections, there'd be geology sections and geophysical sections. As I say, that was one of the reasons for the separation but it hasn't been complete, they still work very closely together. And there is an organization based in Washington, D.C. that is called the American Geological Institute that is made up of, I imagine a bout half a dozen earth science societies that represent. . . there's an exchange of information on, let's say, points of interest that might affect other societies beside the one that originally submits the data. And when the SEG was formed, it was primarily, exclusively I would say, almost an organization for the exchange of information and new developments.

Betty: Has it continued to do that, is that . . . ?

Norm: That is still it's primary thing. But at the time it was organized they were almost adamant in stating that they would never get involved politically but that has changed with

restrictions on where they can work and some of the safety regulations, they've found that they've been obliged to make representations to governments at all levels. So there is some . . .

#052 Betty: This is in Canada and the United States?

Norm: With the SEG it's primarily in the U.S. but in Canada, most of the work is done through the CSEG, those kind of representations.

Betty: Do they have a lobby in Ottawa?

Norm: No, they do not. They don't have an individual who is lobbying exclusively for them. Normally if they have a representation to make either to the provincial or federal government, they will appoint a committee, and I'm speaking now of the CSEG, composed of the members here and those people make the representation on behalf of the society and industry. Well, for instance, this is not political but the CSEG was responsible for establishing a new chair in geophysics here at the University of Calgary and raised about half a million dollars which the Alberta government matched to establish this chair and they just recently have appointed the professor that will take that chair at the university. And they've had scholarship awards for 20 years at least. And the SEG by the way has a substantial foundation for awarding scholarships, they must award between 50 and 100 scholarships a year.

Betty: Are Canadians and Americans eligible?

Norm: Canadian are eligible for those scholarships and there have been some that have gone to universities in the States but they can go to Canadian universities as well under the SEG scholarships.

#070 Betty: When the CSEG was formed in Calgary and that's where the major portion of your membership would be, in Alberta. . .

Norm: Oh yes. The CSEG, I'd say 95% of the people are Calgarians and. . .

Betty: It was formed in 1949. You were in and out at that time but you did have some input into the founding did you not?

Norm: Yes, I did. The moving lights behind the thing were a man by the name of Wayne Phares and John Galloway who was a very well know geologist and had been the President of Standard Oil of California here in Canada and later became an independent operator. And he died by the way, last year.

Betty: Is Wayne Phares still alive?

Norm: I'm not sure, I believe so, he went back to the States 25 years ago. Other people involved were Lindy Richards, who at that time was the Chief Geophysicist for Hudson Bay Oil and Gas and later became the President of the company and he is retired and living in Tucson. I've forgotten who the other first officers were, John Galloway was the President, Lindy was the Secretary-Treasurer and Charlie Moore who was the Manager for GSI, which is Geophysical Service Incorporated, it's one of the largest, if not the largest seismic contracting company in the world. I'm sorry, I can't think of who the other officers were.

#090 Betty: When this was formed, you at that time, were with the branch of the SEG in Tulsa and it was rather an interesting sidelight too, on it being a branch.

Norm: Right. Well as I say, it was the first local section to be formed. I think it was 1947, it might have been 1948 and I became an officer of it in 1949, as a matter of fact I had to give up my office when I came up here to start my own company.

Betty: Did they help with the founding of this other branch, was that one of the things that you did when you. . . . ?

Norm: By virtue of the fact that I was a member of that organization I was able to give them a few hints when they were establishing their constitution and they had correspondence but you see, it's chartered by the SEG and so I was in a position to provide a little liaison when they were being organized. But I was not here for the organization meeting.

Betty: Besides using it as a means of exchanging information and new techniques and new technology, was it used as an arbiter on standards of who could call themselves a geophysicist for example.

Norm: No it didn't. Although for membership in the SEG, the parent company, you had to have a certain amount of experience in geophysics to qualify for full membership, for associate membership that was not really necessary. More or less just an interest in geophysics or let's say, if you happened to be a dynamite salesman selling dynamite to the crews, you could be an associate membership of the SEG but you could not be a full member so you had no voting privileges. Here in Canada, the CSEG, all that it requires is an interest in geophysics and I don't think that's changed. That was part of the constitution and bylaws.

#118 Betty: And where is the decision made as to whether you can call yourself. . . is this through the Professional Engineers?

Norm: It's through APEGGA and up until, I think it was 1957, anyone, a geophysicist could register but he was registered as a professional engineer then . . . and Alberta is the only province that does this, they developed registration for geologists and geophysicists as well.

Betty: What was the advantage of doing that?

Norm: One of the reasons was because of the tremendous influx of geologists and geophysicists following the discovery of Leduc. For instance I was first registered in 1942 as a professional engineer but I had a geological engineering degree so there was no academic problem there. Under the rules and regulations of APEGGA at that time, it was very difficult for a geologist or a geophysicist to register because a lot of them did not have engineering degrees. So they modified the bylaws of APEGGA to allow a person with a degree in geology or a degree in geophysics, it was primarily geology to register without an engineering degree. That situation still prevails but with the overspecialization where now you're getting math majors with computer backgrounds and no geology or geophysics at all, it's become a bone of contention whether they are really geophysicists and yet some of them are trying to be registered.

#140 Betty: This would cause quite a problem to the . . . ?

Norm: Primarily in geophysics and to a certain degree in geology.

Betty: As I think we mentioned earlier, this has always been a problem with geophysicists.

Norm: Well, they come from so many different walks of life and you find also that a fellow that's been a good geophysicist that he can also take on a lot of other things outside the geophysical field and be successful at them too.

Betty: Could we look at your role of the President of the SEG, that's the parent company, in '63, '63? You were the first Canadian.

Norm: That's right. And Roy Linsith subsequently has been president of the SEG as well. As I say, I first got involved in association work in Tulsa when I was involved in the organization of the local section and also became an officer the second year of it's operation. I had been doing a lot of traveling, I had worked in California, the mid-continent, the Gulf Coast and in Indiana and Illinois and I had come in contact with quite a number of people. Then I was involved as I say, in some of the early meetings prior to the founding of the CSEG and finally we got to the position that we felt we could host a national convention of the parent society, the SEG. And we extended an invitation to have them hold a convention here. And the Jubilee Auditorium had been built at that time so we felt we could hold our technical sessions there as well as use some of the halls for the exhibit area which we were able to do. Anyway I ended as chairman of that meeting which was held here in 1962 and it set a record for attendance up to that time. People, primarily from the States, had heard about Calgary and it was quite a tourist drawing card as well. Anyway it was an extremely successful meeting, we developed techniques there as far as getting the equipment for exhibits back and forth across the border. We had to set up a transportation committee to handle the buses between the downtown area and the auditorium and subsequent to that time of course, they've held meetings outside the U.S., one in Mexico City and a second one back here. I think it was a result of that meeting. We had a bit of a problem at that time between one of the executives of the SEG and the program chairman, which I had to get involved in. Anyway I resolved it to the satisfaction of the then President of the SEG.

#182 Betty: Who was he?

Norm: At that time, Larry Faust???, with Amerata??? in Tulsa. And I think it was for that reason only that they asked me to stand of the Presidency. Because I think I've been one of maybe 3 people that had never been an officer in the SEG prior to assuming the Presidency.

Betty: You didn't come up through the ranks at all?

Norm: No. The only, as I say, that put me before the public eye was this. . .

Betty: What happened to the first Vice-President who normally would take over?

Norm: That was not the situation. As a matter of fact, I think they had a by-law at that time, we only had one Vice-President and he had to wait, he couldn't be nominated for the office of Presidency the year after he was Vice-President. I don't know what the reason, it's been changed.

Betty: Isn't that interesting because usually that's where you find out about. . .

Norm: Nor here in the local section, the first Vice-President is an automatic and almost an exclusive nominee, unanimous nominee for President.

#199 Betty: Were there any special things that happened during your time as President?

Norm: Yes there were as a matter of fact. We made the plans and started construction on a new SEG headquarters building in Tulsa and in order to finance it we developed a corporate membership in which some of the oil companies made a contribution to the building fund, which entitled them to an extra copy of Geophysics, which is the journal of the society. And that was new. We also became affiliated with the Mexican Society of Exploration Geophysics and I made a couple of trips down there. . . .

Betty: To make it more international.

Norm: Yes. Which allowed for an exchange. . . if necessary the translation and exchange of papers from various publications. And although it didn't transpire until a couple of years later, I was traveling to Japan at that time and we became affiliated with the Japanese Geophysical Society. And those I'd say were the major. . .

#219 Betty: The Society of Exploration Geophysicists today would embrace geophysicist throughout the world.

Norm: Oh yes. There's, I would say, close to 100 countries represented in the membership.

Betty: So that's quite a change from 1963-64. Mexico would be the first that. . . .

Norm: No actually first one was the European Association and now. . . I think I was one of the first Presidents to speak to their association at their annual meeting but now it's a custom for the President of the SEG to address the annual meeting of the EAEG which is the European Association and vice versa. I spoke to them and I think I may have been the first, I'm not sure, that spoke to them at the meeting in Belgium and that was in June of 1964.

#233 Betty: Now in 1965 you sold your company?

Norm: Yes.

Betty: And what position did you hold with the new one?

Norm: I was President of the new group, Independent Exploration. Which was a combination of Farney, Nance and Exploration Consultants. We kept the processing centre under the same name, Canadian Magnetic Reductions, we didn't change that name.

Betty: Now when you become President of a company that is made up of 3 companies, that must have caused certain problems because there were 2 other presidents.

Norm: That's true but really it didn't. The 3 of us had worked together in the founding of Canadian Magnetic Reductions, we were the 3 directors of that company. We had other business interests together and not only that, both of them were a little older than I am and they weren't too interested in carrying on. They figured it was a good opportunity. They did stay on for a few months but at the time of the amalgamation they had announced their intent of packing it up. So really there was nothing. A year later when Teledyne acquired us, they also had acquired National Geophysical and Bob Bulware??? was heading that operation up and I ended up as Chairman and he ended up as President and he stayed until he organized his own exploration company. He stayed on for a couple of years and when he left I assumed both positions. So, no actually I've been very fortunate in the people that I've been associated with. We all seem to have got along very

well.

#262 Betty: And the heads of the other too, there was Farney Exploration . . .

Norm: And John Fuller was the President of Nance.

Betty: That's right. In addition to yourself and the position you took up, one of the reasons that you had mentioned that you wanted to amalgamate was because of all the new technology and that you wanted to give your people an opportunity.

Norm: For continuity.

Betty: How many of them stayed with you in the bigger organization.

Norm: Quite a few to start with. There's not that many now but I'd say there's more from my outfit than any of the others that are still with the company.

Betty: The person that is the head of it now, was. . . .

Norm: No, he came from the Nance group and Canadian Magnetic Reductions.

Betty: His name?

Norm: He's called Bud St. Clair. It's R. D. St. Clair but everyone knows him as Bud.

Betty: The other problem I would think, being as you were the president and there were the other two companies, they might feel you're going to favour the people from your own organization, how did you handle that?

Norm: I don't think it ever was a problem really. As I say, during the transition period, Mr. Fuller and Mr. Farney were there in the building. We were fortunate in one respect, it was just prior to the discovery of Rainbow and a tremendous expansion, as a matter of fact it was really an overexpansion in the industry. So that everyone was really as busy as they could be and I don't think they had time to think about any problems as far as their stature in the organization was concerned. Everyone was busy. As a matter of fact, people had to really assume responsibilities beyond what their prior activities had involved.

#302 Betty: So it was an expansion time for all?

Norm: It certainly was. No I don't think I had a cross word with anyone.

Betty: That's a very fine record.

Norm: Well, I was fortunate as I say.

Betty: Perhaps fortunate in the people that you had employed in the beginning. Teledyne then took over the company a year later?

Norm: Yes. In 1966. And they had taken over National just prior to that.

Betty: So just to go back one step, when you all amalgamated, what building were you in?

Norm: We had built. . . .at the time IX acquired us we were essentially going our separate ways. We had our offices but we decided we'd build a building primarily for our data processing centre, CMR, and we had bought some property and by the time Teledyne had acquired us the building was almost complete. National had their own office but eventually, about a year later, they moved into the building we had built.

Betty: What building was it?

Norm: We have 4 acres on the corner, just east of Centre St. on 62nd Avenue. Not so much now, but at that time, there's probably half a dozen geophysical companies with offices in the immediate area.

Betty: Quite different from most offices who want to be on 8th Avenue and 1st Street..

Norm: That's right. But with a processing centre we felt that this would be a better location and it's turned out very well.

End of tape.

Tape 4 Side 2

Norm: [in mid sentence]. . . CMR, they had a data processing centre there, so we made one trip and then gradually I took over the supervision of the Australian deal as well as keeping involved with the domestic activities which Mr. Bulware actually got more involved in. So I made a couple of trips a year to Australia and in the process I would visit Japan and also Taiwan and occasionally I would go to Bangkok and Singapore and visit some of the clients there as well. So there was a period there until about 1970 when I was doing a fair amount of traveling.

Betty: The crews that you were using in Australia, would they be Canadian to begin with or . . . ?

Norm: They originated out of Canada. Because it was easier by virtue of being part of the Commonwealth, it was easier to move people and equipment between the two countries. Yes, I would say most of them were Canadians although there were some Americans over there as well.

#012 Betty: Did you train Australians also?

Norm: Oh yes. Eventually we had quite a number of Australians on the payroll. One of the people had been born there, had worked here and then went back there again so things worked out quite well.

Betty: Doing geophysical exploration in Australia, how was it different from here?

Norm: The land operation really wasn't that much different or the processing. Some of the more remote areas, we had to use camps just like we do here in the northern part of the country. But it really wasn't that much different.

Betty: Can you think of any particular incidents that you were involved in or were you just in a supervisory position?

Norm: I was just in a supervisory position. In addition to the land crews that had been established there, we did do some offshore work off the north coast, out of Darwin in the latter part of the 1960's and worked in the Timor Sea. That was an interesting venture because there hadn't been that much work done and Darwin itself kind of reminds me of a frontier western town, except instead of Indians you had Aborigines all over the place. But that was the only thing that was relatively different, that land work I would say, it was the same.

#029 Betty: Did you stay with Teledyne until you retired?

Norm: Yes I did.

Betty: And what year did you retire?

Norm: 1980.

Betty: So you haven't been retired very long.

Norm: A little over two years.

Betty: So your work with Teledyne really encompassed another 15 years?

Norm: That's right.

Betty: And what were some of the areas or companies that you were involved with particularly?

Norm: I'd say primarily the majors, Gulf, Imperial, some work for Shell, Hudson Bay Oil and Gas, Standard of California.

Betty: Where were you working during this period?

Norm: All over, from the Territories over, as I say, into Saskatchewan. We worked for independents in Ontario as well primarily.

Betty: How many crew would you have then?

Norm: At one time during the heyday of Rainbow we had 24 which was far too many. And not only that but in those days, they were 12, 24 trace crews. Now I think Teledyne has either 4 or 5, 96 and 120 trace crews. So they have more capital and equipment invested although the number of bodies isn't as high. You used to be able to buy a set of good analogue seismic equipment for \$35,000 - \$50,000, now it's \$350,000 - \$500,000.

#049 Betty: How long ago would it have been the least expensive?

Norm: Of the analogue tape recording? 10-12 years ago.

Betty: And it's increased that much.

Norm: Yes. But as I say, the capacity has increased also.

Betty: But if you have fewer crews, you aren't covering as much of the land are you?

Norm: Yes, we are because with the new developments and equipment and recording techniques you can get over the ground just as fast . . . I mean a current crew can probably do 3 times as much work as one of those crews.

Betty: I'd like to just explore this for a moment with you, the fact that you can do more with fewer crews and I presume get better records.

Norm: That's true. Well, as I say, the number of traces on a recording unit have jumped from an average of 24 ten years ago, some of them as few as 12, they're now up to, I'd say the average is 96, some of them have 120 and there's one new system that has been developed the past few years in California that has 1,000 traces on it.

#064 Betty: What is the advantage of all these traces?

Norm: The one with 1,000 traces allows the development of what is called the 3D technique, the third dimensional technique and you can come up with, rather than just a profile you can come up with a 3D picture. And this can be done too with the 120 trace systems except it takes more shooting and more moving around of the data. But it allows for expanded multiple coverage, instead of going over the same area 4 - 6 times, now they're going over, recording essentially the same data 12, 24, 48 times, which enhances the reflection data and cancels the background noise.

Betty: Would thin mean that a crew today would move over an area and they would catch the things that were not being caught at other times?

Norm: By virtue of . . . any time you expand the degree of coverage you enhance the quality of the data and there's less risk of missing something. As I say, a good example was the west Pembina area which never could have been found with the techniques being used 30 years ago. By the same token Rainbow could never have been found with the techniques, it was active mostly from '67 through to '69. It couldn't have been found without these multiple coverage techniques because one of the bugaboos in Rainbow were multiple reflections, in other words, reflections going from the surface down to a strong reflecting bed, back to the surface, down to that same reflecting bed and back again. And you couldn't differentiate between them and bonafide primary reflections. But with the multiple coverage and processing the data you could eliminate those multiple reflections and you would see the primary data that you were interested in. So that's been one of the prime advantages of multiple coverage.

#090 Betty: So when you came out of your university career and started in geophysics in 1935, you really came out with a geophysics major in an engineering course. Someone coming out in 1982, what would they have to have that you didn't have to have?

Norm: That I didn't have to have. . . . Well, to be a good all round geophysicist I think you'd have to have a much more substantial background in data processing which never existed when I was in school and which has become a very important part of geophysics today. We had good math courses. . . . I would say that would be the only thing you'd need an expanded background in would be data processing. The rest hasn't changed that much.

Betty: But if you went out as a Party Chief, you could do it all, toady a Party Chief couldn't.

Norm: No way. He couldn't be an electronics engineer with data processing and geology. . . . well, it would take him years to develop that and in the years it would take him, he's want to be much further on in the business than it would take him to develop that type of expertise.

#109 Betty: So the geophysicist now works much more in coordination with other disciplines?

Norm: That's true. Because the data processing people, they're primarily mathematicians, as I say, some of them with very little geological background. The people that are developing these new instruments, they're primarily electronic engineers. They wouldn't be able to tell one rock from another. So it's become an exceptionally specialized industry.

Betty: Do you think it's as exciting as it was when you started out in 1935?

Norm: I don't think it appeals to me as much because when I started out you could see everything. You could see the land you were working over, you could interpret the data, you could make recommendations and you were in a position to see if they drilled a well, whether you were a hero or a bum. It has to go through so many channels now that I don't see how they could feel that they've contributed fully to that type of development.

Betty: Did you find this in the years before you retired, that you were feeling more and more remote from. . . ?

Norm: Well, before I retired I wasn't that involved in the technical aspects.

Betty: You were more in the administration, you had gone past. . .

Norm: It was more administration. But we never saw. . . I won't say never, we seldom saw the end results of our efforts unless we were doing some work for a relatively small operator

and generally those people had their own consultants so that we didn't do a great deal of interpretation. Contractors today are primarily just data acquisition groups.

#132 Betty: There's been a great growth in consulting.

Norm: Oh yes. Tremendous growth.

Betty: Why do you think that has come about?

Norm: The reason is. . . of course, things have tapered off a bit now but during the expansion years all companies were short of competent personnel. Naturally there was a lot of raiding, proselyting, and I think the average fellow saw that this demand did exist and rather than switch as an employee from one firm to another he decided to go on his own where the rewards are even more substantial than being offered a salary increase to make a change. In addition as the industry grew more mature here it produced more people who were capable of doing this type of work.

Betty: When you started you were paid a handsome sum of \$250.

Norm: No, I started out with \$150.

Betty: With \$150, that's right and your board. A geophysicist starting out today could expect to start at what salary. Say even in 1980, when you were hiring, if you were hiring a geophysicist out of university, how much could he think of starting at?

Norm: I would say, somewhere between \$1,800 and \$2,000 a month. I think APEGGA puts out booklets with that information in them, I think they come out annually. They run a survey of the members.

#156 Betty: A consultant going out today, he would of course, be making much more than that.

Norm: Yes he could. He could be demanding at least \$200 a day for his services. If he works 20 days a month. . . .and sometimes the work is based on the value of the project they're being consulted about.

Betty: So times have changed for certainly financially, but the responsibility had increased too for the geophysicist. . . .or the recognition of the responsibility.

Norm: Yes, I would say that may be. I don't think the responsibility has really increased that much because as I say in the old days, the Party Chief on a geophysical crew was responsible for every aspect of the business, from data acquisition to interpretation to writing a report to making recommendations and now it's a committee that makes those decisions.

#170 Betty: Looking back over your career in the oil patch, what would you think would be the highlight or the highlights in your career as a geophysicist?

Norm: The first one probably occurred when I was involved in the first Devonian production in west Texas, where I went against the opinions of some of my peers and some of my superiors and it ended up a very significant discovery. I was in England at the time they drilled the discovery well and it was dry in the upper sediments but came in in the deeper zones very substantially and really sparked a fair amount of activity through the west Texas area.

Betty: That was early in your career.

Norm: No, that was '43, '44. Oh I was involved in some minor discoveries in California and I guess at the time I was pretty thrilled but long range picture, I think that. . .my successor in west Texas, when the upper sediments were dry said, you better see about taking out your British citizenship, I don't know whether it's safe to come home and then he came back with a follow up letter and said, all is forgiven, come home, the well had come in at about 4,000 barrels a day. I think that was probably one of the most gratifying things and the other thing of course, was the Presidency of the SEG. I think those were the two.

#198 Betty: What about in your Canadian exploration days, what is the highlight of your work there?

Norm: I think probably the work we did in southeast Saskatchewan mapping those small fields. I don't think we . . . that and Jumping Pound in 1942, when we had to argue with some of the people that the front fold of the foothills there was a bonafide feature. The shooting techniques in southeast Saskatchewan. We've had some other discoveries to our credit. But these are things that are rather a long time ago because as I say, nowadays you don't get involved in interpretation or recommendations.

Betty: What about the people that you have met, who among your associates has stood out in your mind through your career? The people that you worked with or worked for you because I think there's the two sides, the ones that you worked for and the ones that you could see coming up that you sort of crossed paths with who have gone on to greater glory?

Norm: I'd have to think about that. I've been fortunate in meeting and knowing the real giants in the industry. Some of them have made extreme contributions to. . .some of them I haven't worked for, some of them I've just know, some of them have been competitors.

#224 Betty: Such as?

Norm: Well, Harry Mains??? for one, who developed what they call the multiple coverage shooting technique. Cecil Green who was a past president of Geophysical Services and Texas Instruments and who has contributed millions of dollars to institutes like the University of British Columbia, he was raised in Canada, he was born in England but has lived in the States for the last 50 years I guess. But he was a graduate of the University of British Columbia and always made tremendous contributions, in the millions of dollars, to MIT and Cal Tech and the Colorado School of Mines. I'd guess the most outstanding geophysicist, he's had every award that can be bestowed by the geophysical industry. Still quite active and sharp.

Betty: What about any Canadians, can you think of any Canadians?

Norm: Yes. I always had a great deal of admiration for Ted Link who had an extremely brilliant mind, although he was a real character, he was a great humorist, a man with few inhibitions, he didn't care what he said to who, but generally what he said was pretty much to the point. I think as far as explorationists. . .he was the real pioneer explorationists. Cam Sproule was another one but he spent a fair amount of his career in South America. Of the current people I would say Roy Linsith has probably contributed

as much to the profession and to the societies as anyone I know.

#257 Betty: And you worked with him at one stage did you not?

Norm: Yes. Not closely but

Betty: When you look back on your years, when you did have crews, are there any of the young beginners there that you've seen grow?

Norm: Yes there have been. Two of my old associates, one of them came up as the shooter on the first crew we put out in Canada, his name is Bob Castens??? and he doesn't have too much of a technical background but he was a very personable and industrious young man and now he is heading up the Denver office of Cary??? Data Exchange and has had a very, very successful career. And another one is a young man still. . . .well, he's not young anymore, he got off the boat at 18 years old in 1950, a young Englishman and he's been associated with my organization and Teledyne ever since and is one of the better data programmers in the country.

Betty: And what is his name?

Norm: Vernon Fitzer???

#278 Betty: Just as we wind up the interview Mr. Christie, is there anything that you'd like to say about geophysics and your career that I haven't touched on?

Norm: No. It's been an interesting and rewarding experience as far as I've been concerned. I think I was very fortunate in getting into it when I did and more by accident than intent. I'm not sure I'd feel the same way about it now because I don't think the present individual going into geophysics is going to have the broad exposure that you had 30-40 years ago where you were involved in almost every aspect of the industry. And I don't think I'd enjoy this over specialization that seems to be creeping into the industry and with some justification too I might add because I don't think there's an individual that's capable of being competent in all aspects. But maybe I don't learn as fast as I used to but I'm not sure I'd be capable of facing all the things these younger people have to take into account nowadays.

Betty: Thank you very much for a most interesting interview, it was very kind of you.

Norm: I've enjoyed it, it's brought back a lot of memories.