PETROLEUM INDUSTRY ORAL HISTORY PROJECT
TRANSCRIPT

INTERVIEWEE: W. D. Bill Evans - Career

INTERVIEWER: David Finch

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DF: Today is the 24th day of May, in the year 2000 and we are with Mr. Bill Evans at the offices of the Canadian Society of Exploration Geophysicists in Calgary. My name is David Finch. We'd like you to start by telling us right where it all started, when and where were you born?

BE: I was born in Unity, Saskatchewan and brought up on a farm there, attended country schools until high school at Unity, Saskatchewan.

DF: And what year were you born?

BE: 1936.

DF: What got you interested in the sciences?

BE: I think that just evolved. I was good at it. I was good at math and science and social studies and all those good things and it was just assumed that I'd pursue something that was easy to me. And you probably don't know, but Unity had one of the earliest gas fields in the province of Saskatchewan, in fact I guess in western Canada and it had a major gas powered generating system there for years. I don't know if that had anything to do with my interest in geology and geophysics but it kind of put it on the map for awhile.

DF: When did that Unity gas field become productive?

BE: I can't remember exactly but I was a kid so it must have been in the early 50's probably or late 40's. From the Viking formation which was kind of interesting.

DF: The background of being a farm boy, that story comes up time and time again in Canadian oil patch history, anything there that particularly set you up for being good in the field and so on?

BE: No, I don't think so. It was just that the opportunities seemed greater elsewhere so rather than pursue farming I pursued something else. That's probably the main connection.

DF: Tell us about your education at the university level?

BE: I took Geological Engineering at the University of Saskatchewan, which was one of the few universities that gave an engineering degree in geology. After I graduated there I worked for a year with Imperial Oil and following that year's work, which was in fact in geophysics, in seismic, I decided geophysics was what I was mainly interested in and I needed more background to be proficient at it. So at that time there was only 2 or 3 universities, in fact, on the continent, that gave the kind of degree I wanted. None really in Canada, although Toronto gave a degree which was a combination of physics and geology, somewhat oriented towards hard rock but perhaps a little more theoretical than I was interested in and McGill had a program. Then we were at Stanford, MIT and the Colorado School of Mines. Because I was interested in the practical side primarily, I chose the Colorado School of Mines and it turned out fine.

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#032 DF: Before we get you to Colorado, tell us about that year that you worked for Imperial, that field year. You'd been at university and then you got into the field, what did you do there?

BE: It was on a seismic crew and I did everything, from helping load shot holes to jug hustling and assisting in interpretation or in computing as they called it in those days. Generally it was a training program as most of the major companies provided. As long as you had the background they could provide the particulars of the job so the training program for the first year involved pretty much all aspects of the geophysical side of the business as it was done in the field.

DF: So what year was that?

BE: That would have been, I actually had the summer of '57 and then '58 was my first year, full year after graduation.

DF: Now why did they put you on a geophysical crew instead of use your geological background?

BE: I can't remember exactly, I probably indicated some interest in that. At that time there were very few trained geophysicists. The seismic business was sort of considered part of the geological exploration and if you were going to be a geophysicist, generally you had to get training in order to do it. So it wasn't quite as strange as it might sound today that geologists ended up doing seismic but that was the assignment I got and I was happy for it.

DF: Any stories of working in the field that year, any surprises to you?

BE: No. During the third summer when I was first working we worked southern Saskatchewan and that was typical southern Saskatchewan field operation where we would be based in one small town for a few weeks and then move off to another one for a few weeks. Sort of what you'd call hot shooting around the country. The first full year I had which was in '59 I went on a seismic crew, then I sort of knew what I wanted to do. I was assigned to a crew that was working primarily in northern Alberta, which was the hot spot at the time. Some of the initial work was over the Swan Hills field which had just recently been discovered and then we moved on to shooting long major lines of seismic across a lot of Imperial's acreage, which they had in the Judy Creek and Virginia Hills area which ultimately led to the discovery of those fields. Detecting that particular type of prospect on seismic was not particularly easy, it required pretty detailed work and at the time we did the preliminary interpretation in the field which is what I was involved in, along with a more senior person. And we developed a technique whereby we could, at least we were pretty sure, we could see where the reef edge was. That data was then taken into the office and played to a more sophisticated type of display for more senior interpreters to work with and ultimately we did find Judy Creek about a year later. It was really quite amazing I guess. We worked partly out of Whitecourt at that time and we'd be shooting these lines through the bush using tracked equipment in the summer. When it was frozen we could use wheeled equipment in some of these areas. And we'd shoot these lines and six months later there were rigs all over the place and Judy Creek was there, so it was kind of exciting.

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#076 DF: When you did that work in the field, compared to now, then you were actually doing some of the interpretation right on the site . . and it was exciting, did you see things that you thought might be. . .?

BE: Yes. We saw what we thought was the reef edge and we could control some of the future program based on that and have lines located in such a way that we could confirm or otherwise that the edge was going through there.

DF: So you had a plan from the head office as to what you were going to do but based on what you were . . .I mean this was discovery wasn't it, you were there?

BE: Yes, it was fun. It was kind of exciting. Unfortunately I wasn't on the rig that discovered it but of course, geophysicists are in the forefront anyway right. We found it and then they can drill it up. But yes, I can't claim to have discovered it but I was pretty much involved in the early work up of that field.

DF: When you say exciting were there actual moments when you and the people you were working with, you know, you pinpointed something and. . .?

BE: It doesn't work quite that way. We thought we knew how to see the edge and what type of mapping would define the edge. At that time. . . it required very detailed work and at that time the supervisor or I guess we called him the Chief Interpreter was Mickey Hijash and Mickey Hijash is still in Canada, he's retired of course now. He was very instrumental in finding a lot of the fields in Saskatchewan. It was a completely different geological setting but the kind of detailed application of seismic was somewhat similar in that it was very subtle changes in the seismic signal. So he had that kind of background that he was able to sort of mentor us in looking for and I think that probably helped a lot. So it isn't like drilling and then having a test and oil all over the lease, but in geophysics when you think you see it and you shoot another line and it occurs again and you shoot another line and it occurs again and it starts to make some geological sense in an aerial perspective and you think you've got something and you start to think in terms of where should we locate this, where's the up dip edge and that kind of thing. So it is a pretty exciting time and of course the test is with the drill.

DF: How do you spell Mickey's last name?

BE: H-I-J-A-S-H I believe it is. He would be a good man to talk to. He happens to be in Victoria now but he had a great reputation in the business, I guess it would have been in the early 50's when fields in Saskatchewan were being discovered and he was pretty instrumental in Imperial's sort of, sequence of discoveries that they made, because once they realized how to find them, they were able to find them in pretty quick succession.

#113 DF: Were you working directly with him in the field?

BE: No, he was in the office and I was in the field. But because of the high profile of that particular exploration program he was out in the field quite often.

DF: Was that a regional survey until you started finding some of these features?

BE: Yes, it was quite a regional survey. Imperial Oil had a very large land position at the time. Swan Hills had been discovered and we were expecting that there should be similar types of reefs through that area. We knew the general geological picture, the aerial distribution

of where reefs should occur and we had the land that should cover some reefs and it did.

DF: How much credit would you give to the geologists for that discovery or was it all geophysical?

BE: No, it's pretty much a team effort in that the geophysics surveys are generally located on concepts that are based on the available geological information. At that time there was quite a number of wells available, some of which, it was somewhat apparent that they weren't far from reef. Given that information, of course, we had a general picture as to what we might expect. We just hadn't seen the build ups and it was the seismic that had to be used. Now, at the same time just in case we didn't know what we were doing, Imperial did have a drilling program that basically drilled wells, based pretty much on the geological picture and the locations weren't necessarily based on seismic, they were based on geology strictly and therefore they were not ideally located. But each bit of information provided I guess a refinement in interpretation so that we would know better where to put the seismic. Some of the wells that were drilled, essentially on a regional picture, were pretty close and we were just able to refine it enough that we were able to locate them better.

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#139 DF: Okay, we sort of jumped ahead here, tell us about Colorado School of Mines, what years were you there?

BE: I worked a year so I went the fall of '59 and because I was changing faculties in a sense in that I was going from Geological Engineering to Geophysical Engineering and at the same time going for an advanced degree, the first year was pretty interesting. It was not easy. I didn't find it easy and I had to pick up quite a lot of physics and math that I hadn't had at undergraduate levels and then moved forward to graduate level courses to get a Masters degree. It was kind of funny I guess. At the time we didn't really understand the semester system in Canada that was in place there. It seemed normal to begin in the fall and I was accepted, in fact I had a scholarship to take that, I got a scholarship. So I went in the fall and lo and behold I found that the courses that I required, I required pre-requisites to take those courses in the fall that weren't given until the following spring. So I was in a bit of a bind, I had to take courses in physics and math in the fall, for which I did not have the prerequisites. So come Christmas time which was when we had a couple or three weeks off before final exams, we decided, I'd just better buckle down and cram as much as I could possibly do to pass these exams to get my first set of courses. Then the next semester of course, it was somewhat easier because they were prerequisites to the courses I'd already passed. So I weathered that storm but it wasn't a lot of fun, that first bit.

DF: How long were you at Colorado?

BE: 2 ½ years. I was finished in February, that's when I left and came back to Dawson Creek with Imperial Oil as it turned out. I was married at the time, I married just before going to Colorado. . well, just after graduating with my bachelor's degree in late '58. But we were expecting our first child when we left Colorado and so she was born in Dawson Creek. So it was quite a change. Driving in February to Dawson Creek was kind of an interesting

exercise. When we went to Dawson Creek, by that time now, I was a full fledged geophysical interpreter and I was working on the Rainbow area, which had not been discovered yet. So that was probably where I had my best successes as a geophysicist in locating the Rainbow reefs, which we were able to do quite successfully. We started to advance the technology of seismic in those years and this was 1962. So I was interpreter there and we were starting to use fairly. . for that day it was fairly advanced technologies, we could find the reefs very easily.

#181 DF: Still analogue though.

BE: Yes, it was still analogue but by that time we were using what was known then and now as CDP, Common Depth Point shooting. At that time also, of course, Imperial was affiliated with Exxon and Exxon was beginning to do a lot of research, not just in Common Depth Point shooting, they modified some of the Common Depth Point shooting techniques, but they also started to use 3 dimensional seismic there, not for the first time, but for the first time in Canada. It was pretty elementary type of 3 dimensional seismic and it was analogue, although it was on magnetic tape. But the technology that we pursued there in many cases, was to shoot along a line and have the geophones along another line perpendicular to that line. So that provided a 3 dimensional set of data. Then it was still analogue so Exxon began. . that was sort of one of the early tests of some of their thoughts on 3 dimensional shooting and at that time they started to use a technique where they could in fact display the returned seismic energy in an analogue sense. But they put it on a type of movie projector, whereby they could see the returning waves, which would return as a spherical wave. They could slice that wave and of course, if it was returning from something that was flat it would come back simply as a spherical wave. But if it was returning from something that wasn't a flat surface then it would have distortions, so I enjoyed . . .it was sort of research in a sense, in locating some of these reefs, using that very, very early concept of 3 dimensional shooting. It did work although the capability was pretty limited because it was not a quantified type of presentation where. . . you had to look at this projection of the returned waves as it was shown on a sort of a movie screen and see these waves returning and you'd see the distortions in the waves and from that, combining that with the regular 2 dimensional data we could start to see how we could develop 3 dimensional capabilities. And I think it was just last year that Exxon was acknowledged as the company that developed the first 3 dimensional shooting technology. But it worked but only in conjunction with the 2 dimensional data.

Video #19:23.10.19

#223 DF: Was this, Swan Hills and the other fields that you were working on, was this a speculative venture or did they. . .I mean I know there was a discovery at Rainbow Lake and it sounds like you were involved with that. Was this again, a regional survey?

BE: No, at that stage the geological information we had. . now, Rainbow is different than Swan Hills and Judy Creek. Different setting completely and different types of reefs. In that case there was an awful lot of data that had been shot before my time and there was

interpretations, geological and geophysical interpretations that recognized that there was a basin there that had salt in it and had reefs around it and in it, pinnacle type reefs in it. One of the big questions I guess was whether or not it would contain hydro-carbons, because similar reefs had been discovered in Saskatchewan in the same age, same environment and they were not oil bearing or hydro-carbon bearing. Simple extrapolation of that information would suggest that these would not be either. So it was recognized that . . . by now, we could map these reefs very definitely and there was no question what was there but the big question was, would they contain oil or gas, but probably oil if anything other than salt water or be plugged with salt. As it turned out . . this was the days of Banff- Aquitaine and they were involved . . .Imperial Oil had a lot of land, Mobil had a lot of land and there was, at that time, we recognized most of the reefs but it turned out that it was Banff Company, which later became Aquitaine, they made a farm in from Mobil on some of the reefs. And I think if I recall correctly, they in fact, made the initial discovery. Once that was done then any of the companies who were active in there pretty much knew where a high percentage of the reefs were and that indeed they did contain oil. So from that point on it was a matter of exploiting the technology. It wasn't particularly difficult to find and explore for the early ones, the definite ones. Once they're discovered you have to start pursuing the more subtle anomalies and they're probably still discovering reefs up there that have a little bit of oil in them.

#263 DF: Was there any other new technology that you were applying at this period?

BE: No, those were the two main things. The CDP, Common Depth Point shooting was coming into its own and one of the reasons that . . which I forgot about until you mentioned that but. . .was in that particular area, because of the layering near the surface and the spacing of some of the reflecting horizons, the zone that had the reefs in it was always partially masked by what we call multiple reflections. So sometimes edges were difficult to be confident in because you would have these extraneous reflections that weren't representing the true sub-surface. That was the reason that Common Depth Point shooting was originally developed, was because if you shot it properly and designed your program properly, you could mix certain traces or certain data sets that were coming from the same depth point in a way that the primary energy, the true energy you wanted to see would be enhanced and the non-primary energy, or multiple energy would be diminished or tenuated. That particular technology really, was I guess, probably what contributed most to the capability of seismic in the Rainbow Zama area, which turned out to have, I guess, probably, several hundred million barrels of oil in it in total. So that was the key technology that made a big difference was Common Depth Point shooting.

DF: No, I'm not familiar with the geography of that part of Alberta. Was there any challenges as far as the field work?

BE: Yes, it's all muskeg. So the challenges were you had to do most of your work in the winter if you possibly could. You had to use largely tracked equipment and certainly if you did any work in the summer, if it was dry enough and you had tracked equipment, which most people did at that time, you could do some summer shooting. But the hectic time was in the winter because that's when you would do everything you possibly could

because it was much cheaper and much faster and not as many problems. So it's all muskeg in that country and the tracked equipment was almost imperative.

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Side 2
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DF: The tracked vehicles, who made those for you?

BE: At that time Imperial had all their own crews basically. We had, I think as many as 7 or 8 proprietary crews of our own and much of that tracked equipment, I don't remember what the engines were and who made the tracked component, perhaps Foremost was one of them because they were big in the tracked equipment business, but I honestly can't remember who made the basic frames and the track equipment. We made pretty much all of the rest of the . . the body. . . the instrument equipment was designed and housed in specially designed and made by our research people, using fabricators, contracting fabrication. Our instruments were in many cases, designed and developed, amplifiers and so, by Imperial in conjunction with Exxon. . . or Carter, Carter in those days. They would provide a lot of the back up support in our research centre, which at that time was fairly large, out in Manchester, in Calgary here, we had a fairly large geophysical facility along with an engineering facility as well. But that's where equipment was manufactured and a lot of it was proprietary. In fact, it was, by that time, rather than try to interpret data from what we called analogue records, which you'd have the wiggly trace analogue records, which I used initially in the Swan Hills days, which would have been 1958 and 9. By 1961-62 we were using a display capability which was pretty much at that time, exclusive to Imperial Oil and Standard of New Jersey at that time and we called it Variable Density, VDF, Variable Density Film, which meant that we could display an entire section or an entire line, maybe 5, 6 10 miles long on a film that was perhaps 12" wide. With that we felt it was one of the better displays because the human eye, we concluded at that time, was more capable of detecting changes of density of a signal, translating an analogue signal to shades of white and black, through all the shades of grey, we could line those traces up and all it would be is continuous correlatable pieces of signal, sections of signal which would go across the whole section and they would be in shades of white and black. So we used that extensively and then with the common depth point shooting, we were able to take those data and still, we were using analogue techniques but we were able to add the, the traces together electronically, and then display the result. Which, with any luck, if we had done things rights, the signal that we would see would be primarily, primary signal as compared to the extraneous multiple signal which was the big problem in those days, particularly in the Rainbow area. So all of this time, I guess, from the very beginning of my experience, we were building, developing new technologies. I guess none of them would be called breakthroughs, although I suppose CDP was definitely a breakthrough. And 3 dimensional seismic was certainly a breakthrough. But more often than not they're incremental improvements that you just, because of necessity you say, we've got to do something better and so you fine tune your techniques and it turns out it's

better. Eventually, if you compare the results from one year to another year there's an immense improvement.

Video #20:05.54.00

#047 DF: Was this a two way street, were you people in the field and the people who were doing interpretation, demanding more from the people who were building instruments and the people building instruments were offering you more? Was it going back and forth?

BE: For sure. Yes. And as new problems arose, by this time I was primarily in the office and doing interpretation and participating in the design of processing of the data. The interpreters and the people doing the processing worked very closely together. The interpreter, strange as it may seem, an interpreter. . .often an interpretation is based on what the interpreter thinks he should be able to see. Lo and behold if what he sees in his mind as being the way the seismic should look, if it occurs on the seismic data then it just jumps out at you. If your idea is wrong, is not the way it really is, then it's usually very difficult to see it, then you try to make sure you don't manufacture something that. . . because you know, you can interpret things that aren't there. It's a pitfall you can get into if you start to think you know what the answer is before you see it. But interpretation, that's the nature of it, you have a geological picture in mind. And a geophysicist, knowing the science of geophysics and seismic, can then, if he knows the correct geological model, then a geophysicist will know what that should look like on the seismic. It's a bit of an interative??? process, whereby okay, that's what I expect what I should see, oh, oh, that's what I see, so therefore I better change my geological model because there isn't a good fit and it's an interation of a geophysical and a geological model that's going on in the geophysicists mind. And when the two come together it's usually the right answer.

DF: But you're also explaining some of the tension between the geologists and the geophysicists, aren't you?

BE: Well, there's a lot of discussion and sometimes we do have some disagreements as to . . .you know, a geophysicist will conclude that the geological model has to be changed because it just isn't fitting with the information. Then a geologist maybe has to revise the mapping or the picking of the geological markers or change the concept that seems to be coming out of it. It's difficult and probably should be impossible to work one without the other. That's why most geophysicists. . .well, they all have a very strong geological background. It's just that because of the immense amount of data that a geophysicist works with, that the actual conceptualization of the geology has to be done by somebody who's pretty much focused and dedicated to that. Because to try to do both, you just can't do both so you need a good team of geologists and geophysicists to work both sides of it and bring it together. I think in recent years there becomes less and less of a distinction between the two. I suspect that a geologist today wouldn't be worth their salt if they can't understand the geophysics that's required to define their geological model and vice versa, a geophysicist that is not interested in being very active in understanding the sub-surface geological picture wouldn't do very well either. It just has to be done and I think most would call themselves earth scientists now and there'll be a slight emphasis on one or the

other. More so than in those days, when there was not as much geological information as there is now and not nearly the degree of integration that there is now.

Video #20:10.54.22

#095 DF: What was your next major step in your career?

BE: With that, when I came back to Imperial Oil, after the School of Mines, my main reason for choosing that was because Imperial had a research department at the time and I wanted to get into. . geophysical research was one of my goals at the time. So after four years of interpretation I was then transferred into research in Calgary. I spent the next, I guess about 4 or 5 years actually in research. Those were exciting times too. The main thrust at that time at Imperial Oil at the research function in geophysics was . . .when I moved there they were pursuing optical processing of seismic data, using lasers. That type of processing, literally taking a section of seismic data that was printed in a variable density form. If you were to photograph that into a sort of 35 mm. size photograph of a seismic section and with a sequence of lenses, which have particular characteristics, and laser light, you could transform that section into a display that showed its frequency characteristics. Which would show what . . when you shoot seismic at that time it was primarily using dynamite but also Vibroseis. . you dynamite and Vibroseis pulse is made up of a fairly wide band of different frequencies and the information that's returned in the form of a wavelet or a seismic signal contains a spectrum of frequencies. Well, if you take that information, a series of seismic pulses, which is what you receive on the surface, and shine through a series of lenses and through that section, you will transform that into a display that shows what frequencies are in that and what amplitudes they are. Then you can take that information and simply exclude, by blocking them out with an opaque piece of film, you can exclude some of the frequencies and you can look at some of the frequency information and you can determine which of those frequencies are not signal, are not energy that you're interested in, in other words, they're noise. You can simply block those out with an opaque piece of film, and going through another lens you can recreate your section, which now only has the signal on it. So that's what I was involved in, in my early time in research. At that time one of the universities that was very active, this was the early days of lasers, was very active in signal processing using laser light, was the University of Michigan. So that was one of the places I went for a 3 or 4 week course, not on seismic processing but on general processing of signals with laser light. So at that stage we were in a position where we could play these data out on sections and then we could transform that into the frequency domain and then we could filter, in the frequency domain . . .and we could detect in the frequency domain, the presentation, which was signal, which was noise. Then we could block out the noise frequencies and recreate the section which had, what you thought at least, was only signal. So that was the stepping stone into digital processing. It was quite a wonderful way to be introduced into the digital world. At that point there wasn't the capability to do this sort of thing digitally. But. . .

#148 DF: Yes, I was going to ask you, that is digital but that's a transition from the

analogue?

BE: We're still analogue, it's all analogue.

DF: You're trying to figure out another way to read it, right?

BE: We're doing it analogue but we're doing a lot of things that later became simple digitally. In fact, what we often did in the next couple of years, we would simply. . .

DF: So the techniques were transferred?

BE: Yes. We simply would . . now, come 1963 or something, I can't remember exactly when we first had our capability to process digitally, but we could then, in many cases, we would simply take that procedure, that process and write the digital programs that would do the same thing. So we went through a period of about four years I guess where we were moving from sort of normal processing, developing these optical techniques, and then by that time, digital capabilities started to develop. We had in the research centre. . .well first we used the mainframe computer but we had our own computer that would fill this room. And we would program on cards, you know, the punch cards and . . .what programming I did, I did in Fortran???, which I don't even know if people use anymore but I suspect some do. And we would develop digital programs and we would try to replicate the ideas we developed optically and do it digitally because optics had problems. Vibrations had to be minimal and you had to be a specialist to run some of those things. It was just sort of a poor man's digital processing. We learned a lot however and were able to transfer that knowledge to the digital world via punch cards and Fortran programming. So it was a good time to be involved in the research segment. Then following that, a lot of. . . I guess we were in the forefront of that as far as the Exxon organization was concerned. I was primarily in the interpretation application end of optical technology. So there was a number of affiliates around the world would send us data and say, we're having trouble getting rid of this noise or these multiples or whatever, would you try your hand at optically processing this and interpreting it. So I ended up doing that for a few things. Like, they had concessions in Libya where they had major reef prospects. So at Imperial Oil we would get involved in some of the Exxon initiatives around the world, because we happened to have this capability on . . .it was still a research stage basically. But we eventually did transfer these capabilities into operations and most of our operations in fact, had the capability to do some routine optical processing. And about that stage, digital started to supercede that technology. By the time I guess, about 1969 or so, we were fully digital.

Video #20:20.30.15

#193 DF: Was this optical processing, was that very proprietary, did anybody else have it?

BE: Yes, it was quite proprietary and I don't believe anybody else every used it. They skipped that stage. So we had that sort of intermediary stage between the strictly analogue processing and digital processing we went through. I don't believe. . I mean, there were papers, there were technical papers at conventions and so on by, say, University of Michigan people and so on but I don't know of any other company that actually used it in operating.

DF: Yes, Imperial and Exxon were big enough that it seems to me and correct me if I'm

wrong, but several times over the years created their own instruments or their own techniques and they used them in house and if they hired a contract crew they required them to use that kind of technology and they were sometimes not commonly used elsewhere in the industry.

BE: Yes. And before that, there was a man who passed away a long time ago, a man by the name of Hank Glazier, but he. . .this was before the optical and we had a major capability in house that. . . We were doing analogue but he developed the capability whereby. . and it was developed here in Calgary by him, he was a very smart physicist and he would take . . . it was a little bit like optics in a sense but he would take a seismic signal, seismic record and we had a piece of equipment that contained several dozens, I can't remember how many but maybe as many as 60 or 70 or 100 even, of tuning forks. Simple tuning forks, you've seen them in physics labs. These tuning forks are very specific, depending on their size and their construction, they respond very specifically to only a narrow band of signal. You know, they used to tune pianos I think using them, you hit the tuning fork on there and it will only ring one frequency or at least a very narrow band of frequencies and I think they used them in piano tuning. Well, he had 100 of these, say, built into equipment, whereby he would take the seismic signal and drive it, in other words, excite those tuning forks with the seismic signal, electronically. So the signal would come in, it would excite these tuning forks and the degree of excitement would be determined by how much of that particular frequency was in the signal. So if you had a great big tuning fork that was a very low frequency and that was the major component of the signal that was received in the ground, then that tuning fork would ring very strongly and as you get to higher and higher frequencies, which were weaker and weaker then those little tuning forks, which were generally smaller that are excited by high frequencies, they'd only ring a little bit. So he would get all these tuning forks ringing by impacting them with the signal. Then using other information and data, you could say, well, those really strong, low frequencies are not signal, they're not wanted signal, they're noise. They might be surface noise, they might be wind noise that are impacting the geophones. So he would take these and turn them off, then he would leave the ones that were on and recreate the seismic signal, which if we're right in everything, then that would contain wanted signal as compared to the noise. So that was a technique that was used for several years, I think as many as 10 years, to enhance our seismic data and it did a wonderful job.

Video #20:25.09.28

#245 DF: And these are just more ways of filtering out information?

BE: Exactly. Glazier passed away while I was in research, I think about 1967 or '68. I think that capability at the time, was probably one of the major competitive edges, if we had any, that certainly contributed to having a competitive advantage. The other thing he could do with that, he could not only exclude energy that was considered to be noise, and we had ways of assessing what kind of signal was noise and what was not, but he could also . . . and a seismic signal is wide, but if you take those higher frequency ones in particular and amplify them, then it will make the seismic signal much narrower. So that you can, if the seismic signal is narrow, you have the capability to distinguish between

two very closely spaced reflectors. Whereas if it's a big looping wide signal, the two are so close together, you can't tell one from another. He had that capability, where he could, first of all get rid of the noise, then he could amplify the low amplitude signals, which were usually the high frequency ones, amplify them so you have quite a flat spectrum and that would create a very narrow signal. And so two signals that were previously undistinguishable from one another, would now become two separate signals because the returned energy was very narrow and compact. I guess that was the beginning of another breakthrough, which we did not discover, but we were using it, was deconvolution, which is used to this day as a major technology that enables. . . The more you can deconvolve a signal, the more you distinguish closely paced signals, because it compresses the signal, so it's a very tiny. . . ideally it would be a spike and then you could detect every little layer in the earth that's there. But we haven't reached the ideal but that was another capability that I didn't have much to do with developing but I certainly applied it.

DF: There's just a couple of minutes left at this point. Is there any other major thing that happened in your career?

BE: No, I guess it's just an evolution of things. I was in research and then I went to Exxon Production to study. . not to study, to evaluate 3 dimensional capabilities that were being developed. . . 3 dimensional modeling actually, using seismic and that's why I went to EPR for a short time.

DF: EPR being.

BE: Exxon Production Research, or Esso Production Research, in Houston. And then following that special assignment, where I was assessing the 3 dimensional technology that had been developed at EPR, I returned and at that point I went out of research into operations. In operations I was first responsible for supervision of exploration in western Canada and then ultimately I was General Manager of Imperial Oil's exploration. Following that we then merged with Texaco and that was during my last couple of years and I went back into research for my last two years, where I managed what was then the exploitation and exploration research function at Imperial Oil. It's out of that department that I retired.

DF: In what year?

BE: '91.

DF: We're just about out of time so I'd like to take this opportunity on behalf of the CSEG and the Petroleum Industry Oral History Project to thank you so very much for taking the time to talk with us today and allow us to record your recollections. Thank you very much.

BE: You're welcome, I've enjoyed it. More than I thought I would.