SHELL OIL COMPANY

ORAL HISTORY PROJECT

Interviewee: Carl Wickizer

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Bio
Wickizer went to work for Shell in 1954 after graduating from Oklahoma State University in 1954. After training, his first assignment was to New Orleans as a production engineer in 1957. He worked in various capacities until 1971 when he first worked with the offshore Gulf of Mexico. In 1973 he became Project manager for the pilot subsea system and he spend the rest of his career developing deep water technology in various management positions. He retired in 1993 after 39 1/2 years of service.

Summary
This interview begins with a discussion of the exploration process including seismic mapping and exploratory drilling. He continues to talk at length about production structures including fixed structures, subsea, and TLPs. Also in this discussion is commentary on the economics behind choosing which technology to implement. It also offers considerable remarks on the move to deep water, large fields in the gulf, hurricanes, and joint ventures. The interview ends with his reflections on the future of the Gulf of Mexico.

Side A

BB: This is an interview with Carl Wickizer with Shell Exploration and Production. We are at One Shell Plaza, Houston, Texas, November 21, 1997. Mr. Wickizer, to get started, I would like to ask you how you came to work for Shell, what have been your positions and your responsibilities?

CW: Well, I graduated from Oklahoma State University in civil engineering in 1954, and the oil industry, of course, was a big industry up in Oklahoma, and so that was one of my primary goals as far as employment, was to look in the oil industry, along with a couple of others. So, I finally picked Shell Oil as having made the best offer and made the best impression upon me at the time. So, I selected Shell immediately after graduation and proceeded to work for them for the next 39-1/2 years until I retired in 1993.

Almost immediately after serving my time in the Army, and then going through Shell's training program, I wound up in Louisiana in 1957, as a young production engineer. But, for the first several years of my life, instead of working in the open Gulf of Mexico, I worked in South Louisiana marsh fields, which were sort of an interesting introduction to the offshore because we had a lot of marine operations, albeit inland water operations, not offshore.

After being a production engineer for a number of years, I worked my way up into

supervisory positions. In the area of production engineering, drilling, production facilities, design, computer-automated control systems for the oil field, and finally, in 1971, was in the area of staff, as we called it at that time, overseeing work in the fields. I began to get exposed more to the open Gulf of Mexico, the part looking forward as to what we were going to do out there . . . doing some studies, economics.

Then, in 1973, I got my first real assignment and I worked in the Gulf as a project manager for a pilot subsea system development program. After getting into that experience, working on this pilot program, which was really aimed at the deepwater of the future, I spent the next 20 years of my life engineering, researching, testing, and actually applying deep water technology, as a supervisor and manager -- engineering manager, technology manager, research manager; finally, projects manager, for all of Shell's deepwater projects in the Gulf of Mexico.

And that is sort of, in a nutshell, my history.

BB: Where in the Gulf did you primarily operate? You see a lot of activity going on in the Central Planning Area, which is mostly offshore Louisiana, but Western as well, perhaps? And there is the MAFLA region - Mississippi, Alabama, which I am not too sure too much goes on there.

CW: Well, the central Gulf was the most active throughout my career, although I did do some work right in the edge of the Western Gulf, you might say, and around the MAFLA area. And then we also did some work off Alabama in the Dolphin Island area. And finally, some of the exploratory wells and some of the deepest production we are doing right now, or, Shell is doing, and the industry is doing, is really east of the river. It is really in what is called the MAFLA area, although it is kind of part of in the borderline between Central and Eastern Gulf. I never did do much over in Florida or on the Texas Gulf.

BB: It seems like Florida does not really promote it as much as Texas and Louisiana do. They often resisted. Did you see that in your time?

CW: Yes. We had acquired a number of leases while I was working off of the west coast of Florida, the eastern part of the Gulf, and did a lot of planning on how we were going to drill it and develop it if we made a discovery, but never got the opportunity to drill it because we could never get permits to drill along that part on the coast. As far as I know, it is still sitting there.

BB: Of course, as you go deeper, you are dealing more and more with the federal government, really, and not the states. I can't remember the line, but it came out to three miles or so, and it varies by state, as I remember.

When and why, and this may have been a little bit before your time but maybe you can speak to it . . . when and why did Shell first begin looking for oil and gas in the Gulf of Mexico? Obviously, the Gulf of Mexico oil and gas development has been ongoing since the 40s, but do you remember when Shell first began to really get involved?

CW: Well, that really was before my time, of course, but I can say that when I was interviewing for a job in 1954, that one of the things we talked about a lot in my interview with Shell was the importance they placed on offshore oil. So that, at least in that point in time, somebody was already well aware that a lot of the future is going to lie offshore and they were looking for people who were interested in the structural engineering offshore, which was my background. So, at least at that point in time, they had already decided that that was the most fertile hunting ground, and I am sure that that was the exploration department who decided that. And the engineering people then were actively at work, mainly in the research lab, but also in the field, on how do we do it, how do we extend what we have been doing on land and marshes into the open Gulf of Mexico.

BB: O.K. Can you talk about the phases of exploration, as we were talking a little bit before the tape was on, during the seismic or other kinds of studies -- magnetic, and there are other ones that I imagine you can do and heard of. And then there is

the exploratory drilling phase. Can you get into that a little bit?

CW: Sure. I am not an expert on exploration technique, so I am not going to talk very much about it but, just to say that in the Gulf of Mexico, I have seen a lot of changes from the time I first started working out there until now. Their exploration phase, of course, starts out with doing seismic mapping, which is the primary tool offshore. It is, I would say, not only primary, but it is about really the only significant tool once you get past basic geology understanding of where traps might lie and the kinds of structure you are looking for, the kinds of source rock that may exist - a lot of basic chemistry and geology that goes into thinking before you start doing seismic mapping. But the real big effort of the exploration phase is to go out with the seismic program and as you get into deeper water, that changes from a small boat doing single lines to what is now done with the very large boats and a lot of streamers, so-called streamers, treading for miles across the Gulf of Mexico, shooting off air pulses basically which reverberate through the rocks and are echoed back up to receivers which are trailed by the boats and captured on massive computer systems which record billions and billions of bits of data. And then they are all massaged and analyzed and mapped, turned into maps, which show subsurface structure and, in some cases, even so-called bright spots which indicate hydrocarbon probability. And it has changed dramatically in the last 10 years. There used to be a case where you would go out and do a lot of mapping, some very simple mapping, if you will, and then go buy a few leases

based on those maps.

In the deep water we are in today, the technique is to do a lot of very detailed mapping because the cost of drilling an exploratory well is so high. Well, essentially detail mapping an entire area, buying all the leases that you can, or at least bidding on them within the area, and then doing even more detailed mapping, seismic mapping, before you drill the first well. And so, we spend a lot more time mapping and analyzing prior to drilling the first well out in the deep water because of the high cost of drilling.

Once you have massaged all that data, then the exploration tries to pinpoint the best place to drill a particular structure to get the first indication of its oil bearing and what size. And then you get into picking a drilling rig, which is suitable to do that kind of exploratory drilling. Of course, in the old days, in the shallow water, in the very shallow water, it was a barge-mounted rig which just sat on the ocean floor in, say, ten feet of water. As you moved that into deeper water, it became the jack-up rig. Keep in mind that all these rigs are mobile. They are all ones you can move from one place to another, which could jack up on its legs to maybe 100 feet of water and then later, up to 200, and finally up to 300 or 350 feet of water. Actually, I think they go up to 450 feet of water today.

Then the rigs changed from jack-up, where you are supporting them on the

bottom and jacking themselves up above the waves for drilling. Then you move into floating drilling operations - either semi-submersible rigs or a shipshape rig which can, today, drill up to about 7,500 feet of water and, with ongoing research and development, to take it even deeper to 10,000 feet and beyond.

BB: And that semi-submersible was something that really helped in deep water and something that Shell came up with, as I remember.

CW: Shell came up with the idea and basically converted an old barge-mounted rig to a semi-submersible back in the early 1960s -- 1961 or 1962, I've forgotten . . .

BB: That sounds about right, yes.

CW: Bruce Collipp was, more or less, the father of that technology. It was extremely important because it gave us the capability to, if you will, decouple the well on the ocean floor from the rig itself which was drilling the well, so we weren't tied together by any legs, and made it possible then to use a floating drilling operation to any water depth; whereas, before, you were limited to the depth of water that you could support a mobile drilling rig on which, at the time, was like 150 feet. So, immediately, we jumped from a system which had to be in very shallow water, and gradually moved from 150 out to 200 or 300 or 400 feet over many years; one which could immediately go from the 150 feet water depth to, at that

time, maybe 1,000 feet, but certainly, now, in the 7,500 feet range. So, that was a giant breakthrough in the ability to, again, put the wellhead, the blowout preventer, and all these things associated with well safety and the ocean floor, have a rig which could float on and float off, without any consequences, and the depth limitation was determined by totally other things other than structure.

BB: When you talked about some of the challenges you and Shell faced in exploratory drilling, are there any other major ones that we should know, like taking soil boarings in deep water? Was that a problem? I understand the issue of how many exploratory wells to drill was sometimes the issue because, as you mentioned, that had become somewhat of an expensive thing . . . I think we talked with Pat Dunn. He mentioned he was with "Boxer" and they drilled just a few. And then with "Cognac," they drilled many . . . maybe some other things like that.

CW: Soil borings, to start with your first question, were very important in jack-up rig deployment because you had to understand the foundation in which you were putting those legs in to hold the rig up, and that was very critical in the early days. Soil borings, as such, became a lot less critical in floating drilling operations. But the ability to map not only the surface of the ocean floor but the subsurface portions of the top 200 or 300 or 400 feet, is very important to the floating drilling operation, so that you knew what you were getting into before you'd penetrate the top part of the ocean, the soil. There had been occasions where you didn't know

that drilled into shallow gas bubbles or shallow water flows or consolidated soils, which allowed your surface casing to collapse. And so, that capability or technique, with side-scan sonar and shallow seismic techniques, became very important as we went into deeper and deeper water. Actually, in the 1980s, we spent a lot of research and development dollars working with some universities in Tulsa and some manufacturers on new technologies to allow us that capability, which became very important in exploratory drilling on the rank wildcats scattered around the deepwater.

As far as the number of wells to drill, in the early days when our seismic mapping techniques were not very refined, we were drilling deltaic sands, which had a way of being sort of hit-and-miss mapping. Yes, it was very important to drill a large number of exploratory wells or, at least what we would call delineation wells or confirmation wells, to try to understand the total reserve in place and its configuration before you set the platform. As we became bolder, in the "Boxer" time that I had talked about, we decided we were smart enough to skip part of those wells and that was a lesson, and a point in time, telling us we needed more wells.

In today's technology, however, we have been able to replace a large number of wells with the 3D seismic technology of today. So, because we just cannot afford to drill a large number of wells to define all of these deepwater reservoirs, you

have to be able to use very precise, 3D seismic technology, along with a minimum number of wells to define the reserve, and that is what is happening in the deepwater today and it is one of the real breakthroughs in deepwater production that is going on. People have the confidence with only two to three wells, and good seismic to know what they are developing. Without that, why, we wouldn't be developed in the deepwater yet.

BB: It is interesting because it reduces cost so much, the 3D seismic, and allows you to know what kind of reserve is there.

CW: Yes, a deepwater well in several thousand feet of water will cost upwards of ten million dollars. You just cannot afford to drill ten deepwater wells or more in order to find out if you want to develop it or not because it just drives the marginal cost for every field up. In contrast, you may spend three, four, five million dollars on 3D seismic, and then drill two wells or three wells maximum. And so, to define a developable reserve, of course, then dramatically cuts down the marginal cost of finding the oil.

BB: You mentioned bright spots, and that was something he mentioned, too. Can you talk about that a little bit? Is that something Shell has come up with?

CW: Bright spot is not a Shell invention. We were on the forefront of developing that

technology but it was being developed by the industry, you might say, all at the same time. Shell Exploration had a lot to do with understanding the bright spot technology and bringing it along, but there were a lot of other companies involved also. But it is a technique which is selective and particular to a particular area of the world. You have to know kind of what is in that area in order to interpret it appropriately. And that is only, say, the bright spot things that we developed in the Gulf of Mexico worked extremely well for us in the Gulf of Mexico, and maybe could not be extrapolated to other areas of the world. But in the Gulf of Mexico, it became very successful at that point in time. And it is simply a seismic technique, which, I cannot describe it technically, but it amplifies reflections from oil in a certain way, which allows you to suspect, with more probability, that there is oil in a particular place. You would have to talk to a seismologist to find out exactly the technique.

BB: And that technology came on about, when did you say?

CW: This bright spot technology was going on, as I recall, in the 1970s. That is when it was being developed. And certainly, in the 1980s, we were using it extensively.

BB: You talked about exploration a good bit. What were some of the challenges faced and technology used on the production side; problems involved in installation of production structures? You mentioned that you were involved in the subsea. Pat

Dunn talked about that a little bit. You might talk about subsea versus TLPs, that sort of thing.

CW: Well, that is a long subject.

BB: Sure.

CW: The challenges that we met as we moved into deeper water, of course, reflected the technical challenges along with the economics of the company. Those technical challenges were what drove the speed with which we actually moved into the deep water and developed it. When we started out offshore with bottom-founded platforms . . . that is something, a structure sitting on the ocean floor which, today, still is where most of the wells have been drilled from, that kind of structure. The problem was being able to go into the deeper water and withstand the ocean forces, the currents, the wind out there, the wave forces, the big waves, and then to solve the foundation problems which became greater as you got into deeper water and had the high forces and weaker soils. All of those problems were compounded by the fact, until we had a need to go out in deeper water, nobody knew much about those forces. There had never been the need to really understand exactly how those forces impacted the structure or how you built a structure under those conditions. So, they were starting from scratch to learn, well, what are the forces of waves on the structure? What are the forces of

winds? What are the forces when exposed to that kind of environment? What does a hurricane really do to a large structure? So, it took a lot of years to just understand how to design and what to design for, and then to actually convert that into a design in steel that we could go out and, say, put in the ocean. It was very evolutionary, from the 1947 start, over the next many years, learning how to take each next step with a bottom-fixed structure.

Early in the game, back in the 1950s, a lot of our technologists realized that there would be a limit to fixed-bottom structures. So, the research started on subsea production in the 1950s -- saying how, when we get to that limit, whatever it is, will we go beyond it for fixed structures? Subsea was the first most obvious thing because it could be all done on the ocean floor; it didn't require anything that penetrated through all the waves and currents of the ocean, and sticking up above the ocean surface where the hurricane winds could get at it. So, it seemed like the obvious thing to do, and that is where the work began.

Subsea technology, however, had a lot of its own obstacles to overcome. First and foremost, if you are going to put a complex set of valves and controls on the ocean floor where you cannot see it and cannot get to it, it had to be very reliable; it had to be designed for that specific purpose, and you had to recognize that although we could make dives about 200 feet of water at that point in time, what we were shooting for was something out beyond 300 feet which was sort of the target for platform death at that point in time. They said, gee, when we get to 300

feet, there is no way you can build a platform that is bigger and deeper water than that. So, we were looking for something that would carry us beyond that 300 feet depth.

Well, that was stretching the limit of diving at that point in technology also. Today, we know that we can do working dives at one thousand feet, and the actual diving limit is about 1500 feet. But back in the 1950s and 1960s, why, the practical diving limit was about 200-300 feet. So, we had to have things that could be done totally remotely or have a way of servicing them on the bottom in lieu of divers. So, we did two things: we were looking for how can you build systems which can be operated without manned intervention totally; totally remotely on the ocean floor, with the well head and all the controls and the valves down there. A pipeline connecting it to a distant place, to the shore or to a shallow water platform, or how could you build something on the ocean floor? If that, we can send a remote vehicle of some kind, which will go down and replace the diver. So, both of those things started back in the 1950s and the early 1960s. We also had to give heavy weight to servicing the internals of the well, because we could not get down there with a pulling unit or a workover unit like we do on land . . .

So, another thrust of technology was the so-called TFL or through-the-flowline technique. That was a matter using wire lines and pipe from above to go down in

the wells and clean out sand, or to perforate them, or to do any one of the number of jobs, such as clean out paraffin. We would have to be able to pump the tools from the platform base through the flow line, down into the well, and then reverse it back out through another line. So that technology began in that same time frame.

In 1961, we put in the first Gulf of Mexico remote underwater well. It was in about 100 feet of water, and it was a test bed. It was designed to be totally installed and operated and maintained without intervention by man. As a matter of fact, it did require some divers because it was the first one.

About the same time on the West Coast, we were experimenting with another approach which was using the remote underwater vehicle or remote robot, and actually, they called it a Mobot out there, for mobile robot, marine robot. And they actually did that back in California in about 1962 or 1963. But the challenge was then to mature those technologies and those techniques to the point that we could use it in any water depth without manned intervention. And then over the next . . . starting of that 1961 well, then over the next, basically, 20 years, those techniques were continually refined, tested, expanded, changed, new technologies employed. So that, as we found ourselves in, basically, the 1980s and 1990s now, it is acceptable, doable technology. So, it becomes a matter not of can you do it, but how much does it cost and is it better than an alternative?

The other alternative we started approaching in the same timeframe, or maybe a little bit later, but in the 1960s and 1970s, was how can you put something on the surface that is floating and have it instead of a fixed, bottom-supported platform, have a floating platform which could serve the same function? That work also began in understanding how you could replace the fixed platform, if you will, with a floating platform, which could do the same things. That took several directions: one was using semi-submersibles which were converted to house the control systems, quarters, and production facilities, tied to a subsea well, which was remote from the particular platform.

Another approach we explored was the so-called tension legged platform which, of course, is a floating platform that tied to a particular spot by tension legs tied to the ocean floor.

There are other configurations for production such as the SPAR. There are a number of hybrid things . . . ships have been converted and used for floating platforms. So, anything that floats can basically be converted to be used for a floating base for production. The real question gets to be, do you want it tied to subsea wells, which then produce through flexible lines back to that floating structure, which is moving around? Or do you want to support a drilling rig and Christmas trees on the platform that you can reenter using conventional

equipment mounted on the TLP, conventional workover units, pearl tubing units, wire line units. It becomes an economic trade-off for any given reservoir and water depth in deciding which one makes the most sense.

BB: Would it be correct to say that the advantage of subsea is, I guess it would be more economical? You don't have the huge platform, the huge, expensive TLPs . . . and I guess, manned operation, or less . . . but with TLPs, yes, they are more expensive, but you can drill more wells off them. Is that correct?

CW: Well, it is close. It is not quite you can drill more wells. The difference is that a subsea well, because of the investment in hardware on the ocean floor, and because of the fact that it is drilled and completed, with a very expensive drilling rig which is the . . . I am talking about deep water now . . . which will be a ship or a semi-submersible, costing, you know, in excess of $100,000 per day, depending on what water depth you are in . . . the cost of each individual well becomes very high. Now, to contrast that to a well completed from a platform which has a rig which is mounted on something else, so it is a very cheap operation -- maybe $15,000 or $20,000 a day, and you have a lot less expensive control and hardware on the ocean floor. So, each well that comes from a TLP or any platform, is much less expensive than a subsea well. So, if you have a lot of wells to drill in a close proximity, then that group of wells will cost a lot more if they are subsea wells than if they were wells drilled from a platform. So, to answer your question:

"Well, how much do I have to invest in a platform to take advantage of it with less cost for the wells as opposed to not investing in the platform and drilling a lot more expensive wells subsea?" It is a basic trade-off. And then you also have the added-on things that, if you have put in subsea wells, somewhere, you have to bring it to the surface to process the production line. So, if that is nearby on the floating platform, well, then you have that cost. If it is a long way away, to shore or a distant platform, then you've got a big investment in flow lines and subsea equipment getting it there. There is also a difference in the cost of workovers and recompletions. If you have a platform that you can put a small leg on to work over a well or recomplete it, that is cheap. If you have a subsea well which requires a large, floating drilling spread to come back and reenter it and work it over, recomplete it, that costs a lot of money. So, you have to look at the overlying cost of an entire field or area of development, to say, "What is the most economic way to develop this field?" You also have to think about other things. You may decide that the TLP is the most economic over-life because of the lower over-life cost in a lot of operations. But you also may decide that I cannot afford the up-front investment, because this up-front investment is a lot higher than putting in two, three subsea wells and gradually adding more on, and letting the production pay for the next wells. So, if you follow that, there is a difference in investment strategy. If you don't have much investment capital, you might opt to go with the subsea approach -- a floating, a converted-semi approach, to minimize the up-front capital. But if you are not short of investment capital and you are

looking more at optimization of cost and return over the next 20 years, then you might opt to go with a TLP because it might give you the best return on your money over that 20-year period. But a lot of people do not have that kind of upbringing. So that it becomes very much a strategic investment decision as well as just saying, "Well, I don't want to spend the money for a platform. It is cheaper to do a subsea." Does that confuse you enough?

BB: Well, it strikes me that there are obviously a number of angles or considerations, and whether you want to decide to go subsea or with a tension leg . . . and you mentioned the cost, what capital you have up front. Pat Dunn mentioned that you may have a 75 million barrel field, something like that, which might not be enough oil to justify putting in an TLP. But you don't want to walk away from it.

With a TLP, you would need a bigger field, a 220 million barrel field, to justify that.

CW: That is absolutely right and, again, that gets back to size of reserves available. You can only afford to spend so much. And it also gets back to how many wells will you need? If you have a 500 million barrel field, it takes a lot of wells to develop it and it is going to be there a long time, doing recompletions and workovers. So, that is a situation that tends to lend itself to a TLP or a SPAR or some kind of floating, on-site structure, where the well is drilled from the

structure.

On the other hand, if you've got a 75 million barrel field, you cannot justify the investment and yes, if the wells are good enough, you can afford to put in three or four or five subsea wells and produce them to some other platform, hopefully.

BB: Any other challenges in production -- under water welding, laying of pipelines, the kind of soils, that sort of thing?

CW: Those are all topics of discussion. Under water welding is not one which I came to think of as of great importance, although some of the people who are engaged in the repairs and so forth think it is very important. It is, in a minute sense. It really doesn't drive what we do in the future as far as offshore development.

The kind of soils you have to lay pipelines through can be a technological challenge. We know there are places out there that you have shifting soils or what you might even visualized as small earthquakes in the soil faults. Those can damage pipelines and so, as we go farther and farther out, we have to do a really good job of mapping the subsurface. I talked earlier about mapping the area around where you want to drill a well in deepwater. Well, when you start to build a pipeline in very deepwater, you have to map the entire route in that same way to know not only what is the surface contour, but what lies immediately under that,

and to try to avoid all of those areas which can cause you pipeline failures in the future. And that is a real expensive process.

Certainly, as you get into deeper water, pipelines have to be heavier and heavier in wall thickness, and stronger to withstand the collapse pressures imposed on the water column above it. Shell recently, as you probably know, completed some subsea wells in 5,400 feet of water. Pipelines in 5,400 feet of water start looking like a gun barrel. They are very thick-walled steel. And yes, as we go in to even deeper waters, the design of those pipelines -- I am talking about after 7,500, 10,000 feet -- will be tricky. And I think we will be looking at some newer high-strength materials which will be needed because steel gets too heavy. So, that is a technical challenge.

A problem that accompanies subsea wells, which is universal in nature and has to be addressed on a site-specific basis, is that all wells, when they produce, contain a lot of things which are not desirable. They produce paraffin. They produce wax. Sometimes they produce sand. If they have gas, they produce hydrates. All of these can plug these very long flow lines. So, one of the challenges that is paramount at this point in time is probably understanding which of those challenges you will face in any given subsea production situation, and how do you take care of it? Certainly, there has been a lot done on insulating flow lines, on providing circulating systems which circulate hot water. All of these are designed

to maintain temperature of the reservoir up to the surface and through a long distance on the ocean floor, which is really a big, cold sink, if you will, that you have to deal with. And the techniques and technologies for dealing with that problem are just as complex and challenging as the mechanical one and how do you deal with the higher pressures of external water columns.

BB: It especially strikes me that most of the activities would be going on off Louisiana area, and that is the area where this soft soil, is at its worse.

CW: Yes, a lot of them result from the outflow of the Mississippi River and what has happened there are very soft soils. That is not to say they are only constrained to that area but it has been a problem area for years.

BB: A more general-type question: what has been Shell's role in making the Gulf of Mexico the predominant US offshore producing region. I think we could say with certainty that the Gulf of Mexico is the predominant US offshore producing region. Certainly, it has been one of the leaders. Has it been the leader in producing oil and gas in the Gulf of Mexico?

CW: Shell has historically and is today the leader in offshore Gulf of Mexico, no doubt about it. And I think what has driven that, in my humble opinion, is a commitment to two things: 1) an exploration program which will not break and

accepts challenges; and 2) just as, or even more importantly, there was a commitment to production technology which allowed us to always be on the cutting edge of what was possible and what could be done. Coupled with those, of course, is a visionary management which we have had for a long time. They said, “I believe in the future and I believe in our technology and our ability to do these things.” So, with that kind of visionary approach and the commitment to employ the people and let them work on the thing, well, we have been able to stay ahead of the competition in both exploring and developing reserves out there.

Another factor is that Shell was a domestic company, basically. Our playground was basically the United States. Most other big US-based oil companies were always dividing their efforts between the Gulf of Mexico and other areas of the world; where our focus was on how do we develop more reserves and production in the domestic scene? In the last few years, we did have a small international company, Pecten, doing some overseas work. But it never did divert our attention from the Gulf of Mexico as our playground. So, back in the 1970s and 1980s, when a lot of the companies were saying, you know, 'the Gulf of Mexico is dead and it is over," and looking elsewhere, we still had a lot of interest in looking seriously at deepwater in the Gulf of Mexico. That is why I spent my career in deepwater because even though we weren't doing anything there actively yet, we were carrying on the development of the techniques and technology that would allow us to do what we are doing today.

BB: Others have mentioned that Mr. Bookout made a move to gather numerous deepwater leases. I guess that was in the 1980s. From a policy angle, I know that Reagan's secretary, James Watt, started the move to aerial-wide leasing. Was that all at the same time?

CW: I have forgotten what year that area-wide leasing took effect, but it did . . .

End of Side A

Side B

BB: We were talking about area-wide leasing.

CW: When that came about, it did give us the ability to go out and lease a lot more acreage without really understanding exactly what was there. We did, with Mr. Bookout's leadership, I guess, go out and acquire great amounts of acreage in deepwater, without knowing very much about what was going to be there. Luckily, it turned out very well because a lot of it, we did make a lot of real nice discoveries. Some of that acreage that we kind of leased blindly, in a way; we knew something about what we were leasing, but we did lease great blocks, and that made a big difference, that change.

BB: It strikes me as taking a really big chance. You knew something about it, but maybe not a whole lot, and maybe the technology wasn't even there yet to develop that acreage.

CW: I can vividly recall a change in strategy that took place in the period of 1980 and 1981, just sort of a personal story. I was, at the time, manager of marine systems engineering, we called it, here in Houston, in our head office. We were diligently still working on design criteria, how you design tension leg platforms, and all that technology, and other floating systems. Somebody had decided that we should not be spending our time on that any longer because we probably were not ever going to make any money out of the deepwater. I was transferred out to our research lab to manage our production technology group out there, and we still had some ongoing work in the technology area, in the scientific area, but we sort of disbanded the engineering group I was managing. We kind of dispersed them around to different jobs. And then, about a year or so later, I got a call, asking if I would head up a study to see if and how we could drill on the east coast in 7,000 feet of water. Our drilling experience at that time was limited to about 2000 feet of water; that's Shell's experience. They wanted to know, well, could we drill out there. This was what exploration said . . . "We are interested in bidding on some leases out there. Can we drill out there?" So, I put together a group, reached out to some of the people I had already assigned elsewhere and brought them back in to the study group. And we did a little study of: 1) could we drill? What would it

take?; 2) if we found some, could we develop it, and what timeframe? What might it cost? We spent several months doing this feasibility study.

Then in 1981, we went out and bought a bunch of those deepwater leases in almost 7,000 feet of water. I was assigned to reassemble the people I dispersed and put together a team to go out and do that work. We did it over the next three-year period. We, unfortunately, did not make any discoveries out on the East Coast, but we developed capabilities that when we got ready to go back to the Gulf of Mexico, when they were talking about leasing the large blocks in real deep water, we had a lot of confidence in our ability to do it and what it would take, because we had that three years of experience. So, we really just moved the team back to working in the Gulf. We moved the drilling team, the drilling rigs, the engineers, and pursued the total exploration. "Let's go by it. We can drill it. We can produce it." That is what we have been doing ever since.

BB: That is interesting. You mentioned the East Coast and, of course, there has been some work going there, and some on the West Coast, and, you would agree, the Gulf of Mexico was the predominant producer for the US offshore. Why is that? It strikes me that it might be three things: geological. That is where the oil is. Geographical: smooth, gradually sloping shelf, relatively calm waters. Or it can be also political. That is where the federal and state governments have allowed development.

CW: Well, certainly, it is geologically the most logical place to explore for large accumulations of oil. It just has the structure we know with to deal with. Geologically, it is just a getter providence to hunt oil in but; and secondly, you are absolutely right. It is more a benign area. It is easier to step away out in the Gulf of Mexico than in the Atlantic Ocean or the Pacific Ocean. The third thing is, politically, this has been the only place we could really drill enough to find out what is out there, because our assessment of geology is oftentimes effective in hindsight by what we find when we drill. So, when politically, you are prevented from going out and drilling and exploring new areas, you may have a view of the area that is totally wrong because we haven't drilled wells out there.

BB: That's interesting.

CW: So, our collective view is that there probably aren't as many hydrocarbons to be found on the West Coast and East Coast. But, on the other hand, if we were allowed to go out and drill some wells, we might find that was wrong.

BB: Right. That's interesting.

CW: I say that, not as an expert in ecology or exploration, but just in hindsight looking at what has happened historically in basins around the world, even the deepwater

Gulf of Mexico. Because, let's face it, it was not too long ago that experts in the industry were telling us there were no hydrocarbons worthwhile in the deepwater of the Gulf of Mexico. That was changed by the drill. The geology is different in deepwater Gulf than in shallow water Gulf.

We understood delta deposits which came from the rivers on the shelf. We didn't understand turbidite deposits, which we were drilling in the deep gulf. There are a lot of experts that didn't believe they would ever give up a lot of oil and gas. So, you know, that is what an expert is. Somebody that makes a guest based on what he knows at the time.

BB: The ability to do more exploratory drilling, as I think you are saying, has really helped.

CW: Well, it's the key. When the federal government opened up the deepwater acreage and allowed us to go bid on it, there wasn't anything stopping us from going and exploring it. When we explored it, what did we find? We found marbles, we found pebbles, and we found all these glorious fields out there, which are extremely productive, much better than we have ever seen on the shelf. Much more productive fields. But the key was that we had been doing the work, we had confidence that we knew how to do it, and we were not scared to do it. Until you explore it, who knows?

BB: You don't know. What have been, and you have mentioned some of the big offshore discoveries, and you hear about them in the paper, such as "Bullwinkle." What have been some of the biggest Gulf of Mexico offshore oil discoveries for Shell? And have there been some big disappointments?

CW: Well, of course there are always disappointments. You don't ever strike 100% when you go exploring for oil. We have drilled some big structures which were certainly disappointments. Well, when you say the biggest ones we have found, I would have to go back and start looking at the numbers to say exactly. All that information is variable as to exactly what the size and various forms we have found. But certainly, the East Bay field in South Pass Block 24 and 27, which was really our star back in the 1940s, was one of the biggies. Eugene Island 331 field was a biggie. The Bay Marchand field was a biggie. Those all occurred in the timeframe of the 1960s, 1970s. Then when we got down to the deepwater, which I am more personally involved with, of course. "Mars" I guess is the biggest we have discovered. Certainly, "Ram-Powell." "Cognac" and "Bullwinkle," where we put big structures, were major finds. The "Ursa" discovery, which we are now getting nearer to building the systems for and drilling the wells, pre-drilling the wells, is a giant field. It may be bigger than "Mars," I am not sure because I am not up-to-date on what they are finding, and all their work. But those are certainly the biggest ones.

We have had a couple of discoveries that we thought maybe would turn into giants in the deep water that, on the subsequent drilling, turned out to be very small, so we haven't been really looking at them. So, there are surprises.

The biggest breakthrough and the biggest surprise of all, in my mind, going in the deep water, Gulf of Mexico, is the change and characteristic of the wells. The move from the deltaic sands, where a good well, an extremely good well, produced 1,500 barrels a day, to the first deepwater well at Auger, which produced 13,000 barrels a day. That difference in well performance, and the fact that these big wells, the individual wells we are completing now, we expect to recover 15 million barrels or more of oil from the individual well. Back in the old days, a million barrels or a million-and-a-half barrels was considered a good well for the Gulf of Mexico. So, what I am saying is that these wells we are completing out there now are producing ten times as well as what we ever saw before. Without that breakthrough, which we had nothing to do with . . . I mean, Mother Nature did that . . . without that breakthrough, I don't know whether we would be developing the deepwater or not.

BB: So, in many ways, deep water is made feasible, well, obviously, because of the huge reserves . . .

CW: Because there are huge reserves and the reservoir components. You can have a huge reserve, but you still can't produce that high a rate. So, it is not the huge reserves, but the fact that it takes a relatively few number of wells to develop those huge reserves.

BB: I would greatly be interested in any kind of visual of all or most of Shell's major Gulf of Mexico offshore production. Do you know of anything like that?

CW: Just in terms of . . .

BB: A map or graphics or something.

CW: Sure. I don't have it but it is available in the company though. It can be acquired.

BB: Yes, I would be interested in that.

CW: Since I am retired, we can . . .

BB: O.K. Just a few more things. Problems associated with weather -- hurricanes, disasters . . . we have talked with some structural engineers. We talked to Griff Lee at McDermott. I don't know if you are familiar with him. He's been there for a long time. So, the height of the deck, the height of the wave, he talks about, as

being really key. The industry came to a consensus on what would be, you know, a good standard for deck height. Can you talk about some of your experiences with weather and hurricanes? Have there been any major problems or disasters because of that?

CW: Well, certainly we have had problems. I don't know whether you would call them major disasters or not. There were equipment failure or human errors. Those kinds of accidents have been the major cause of disasters, not the weather or the environment. But certainly, we have had environmental-related problems and accidents.

One of them, we had . . . well, it has happened more than once. It has happened several times, where hurricanes have come through the Gulf of Mexico, and we had platforms which had failed. Everybody had one or two. And over the years, we learned, as those platforms failed due to a certain hurricane, that our design criteria was not adequate. It is a matter of evolutionary learning: as you go out further and you experience new things, well, you find out what you thought was true to start with, you had to modify a little bit. And this whole area of design criteria is one of just always undergoing a change. And certainly, you know, Griff is absolutely right but, over the years, we have changed our criteria. API working with companies has kind of brought that together so we could change our criteria together. There have always been arguments among the technologists

about what the right one should be. We have sometimes embraced criteria that were probably too stringent, and we overdesigned. Other times, when the hurricane caused the platform to fail, we realized it was underdesigned. So, those things happen. My view is though that I cannot recall any really major catastrophies. We certainly had costs of cleaning up the debris and abandoning platforms which were damaged, but I don't think we have ever, certainly not in the Gulf of Mexico, to my memory, had any permanent environmental kind of things because of underdesign. It is more than a case of costing ourselves money to clean up the wrecks of old platforms, which did not stand the test, and we have had some of that. I don't know what else you can say. You know, you can go through it case by case. Griff would be a lot more familiar with that than I am.

Certainly, the wave heights have increased with time, that we use in design. Right now, the latest rage is to put in a global warming factor in the criteria to allow for the sea to rise next year, the next few years.

BB: That is interesting.

CW: I think the record of the industry is extremely good though considering what we have done.

BB: Right. Griff Lee mentioned that everybody in the 1940s and 1950s was thinking

about a 25-year interval. I think his quote was, "and if it came around, it would happen on your lease, not mine," that sort of thing. Then, a bunch of hurricanes came through. We had Camille, which I think was pretty devastating. And then, maybe I just hadn't tracked it right, but there didn't seem to have been as many in the 1970s. And then, of course, in the 1980s, we had Alicia. But there seems to have not been as many or as much of a problem in more recent years. Does that seem to be your view as far as hurricanes go?

CW: Well, I think, certainly, what we deal with is categories of storms. Certainly, in the 1960s, back in there, it seemed like we had some major category 1 storms. Category 1 or how do they do that?

BB: I think it is worse at it gets to 4.

CW: I have forgotten how to do that now, yes. Category 5. But statistically, I don't know whether it has gotten better or not. But certainly, those statistics are well-documented, either in the Weather Bureau or in the files, probably. But I think, certainly, the damages that the industry has sustained has decreased dramatically over that time period, because of a couple of the big ones back, you know, that you mentioned, weeded out some of the underdesigned structures in shallower water. And so, with the change in criteria in that timeframe, certainly we don't sustain the kind of damage we used to.

BB: The issue of the companies working together and sharing information. One of the things Griff Lee mentioned is that the oil and gas has always been very competitive and very secretive, obviously. Companies are not going to share that. But, as far as sharing information about structures, how to build, there has been more note trading and, of course, you have the Offshore Technology Conference. Has Shell worked with other companies in trading notes and structures and how to build?

CW: Historically, we did not do very much of that. We, and other major companies, considered that kind of information proprietary. I don't know whether it was right or wrong. In hindsight, you know, we may have stifled the speed at which we developed a little bit. On the other hand, the competition may have actually done us a good job in causing us to compete with one another. I can't really assess that, but I do know that up until this last decade, all of the majors historically did not share much of their information with one another, even on structure design. Now, we did go to OTCs and we did present some papers, but we really kept stuff close to the vest as to what we really were doing.

I, for one, in the last ten years, as we got into this deep water business, a couple of three things became very obvious: number one was that we could not go out there alone and do what needed to be done. It was just too expensive. The

infrastructure was too complex. Even though we were "leading the charge," if you will, into deepwater, as we said, we really have to have partners to share the costs, we had to have partners to share technologies, we had to have alliances with manufacturers who know what we are doing and try to work with us. Over a period of a few years, from, I want to say, 1988 to 1993 or 1994, there was a total change in, not only our philosophy, but industry's. So, today, I think it is quite different. I think people are sharing with one another. They have to.

Before "Bullwinkle," which was installed in 1988, up to and including that time, when we had partners in the Gulf of Mexico, in a big project, even though they had some acreage there and were in the project, we kind of said we will run it our way, and if you want to pay your share, feel free to do so. Well, we recognized the hard way, and in the same timeframe, around 1987 or so, in trying to work with partners on some of these deepwater developments that that wouldn't work. We had to sit down as equals. We had teams that were working on solving problems together. But it took a lot of effort and a few years. In the timeframe, I would say 1987-1993, we really turned that around to where people were willing to sit down and openly share their technology, openly work together on how we solve problems.

BB: It seems to be you are saying, for much of Shell's experience, it wasn't so common until more recently.

CW: We had joint ventures but they were not true partnerships, if you will, where everyone is sharing in the thinking and the design and the development procedure. It was more of one company being the leader, being the operator, and making decisions and doing the work, and passing it by the partners as joint ventures for approval. And that is kind of the way it worked throughout the Gulf of Mexico.

It changed overseas before it changed here. In the North Sea, because of the same factors you mentioned -- the high risk, the high cost -- they recognized before we did over here, back in, I'd say, the 1970s and early 1980s, that joint ventures had to be true partnerships and the companies had to work together. They built joint teams of engineers, and that is the way they had to work, because of the high risk and the high cost. the Gulf of Mexico did not pick up on that and follow it until later when we got into this ultra-deepwater stuff.

BB: Do you think that anyone ever ran into any kind of antitrust concerns? Was that ever a concern that you heard about?

CW: Well, it used to be a concern. It was one of the factors. In my early days, I know I was always lectured to be very careful about talking to any competitors about anything we were doing, and antitrust was always one of the things that we were talked to, to be very aware of. In hindsight, I don't know whether that was real or

a figment of somebody's imagination.

BB: Well, it seems to me that the government just has to recognize that to do these things, they are very expensive, and companies are going to have to work together. I can't remember . . . I think it was the 1978 Amendments to the OCS Act that I think said the majors can't work together. I may not have that quite right.

CW: There was a change somewhere, and I don't remember the year either, in that timeframe, that said, as I recall, the majors could not bid together. It didn't say they couldn't work together, but they could not be joint bidders on property. There were a lot of things that happened that came out of Washington that were designed to increase their share of the bid money, frankly, and that is what they were trying to do, is get majors competing against one another instead of joining together and bidding on property. That is the only thing I recall. Now, there might be something else but I don't think we ever had any prohibition against developing, forming joint ventures and working together, but we couldn't bid on leases together.

BB: Of course, that has been a huge source of money for the federal treasury.

CW: Of course, the more recent initiative of the federal government to stimulate the

bidding on deep water was the Deepwater Royalty Relief Act of, when was it, 1995?

BB: I am not familiar with it.

CW: Well, there is a provision, as you go into deeper water, over certain water depths, they will relieve the royalty or reduce the royalty over some period of time. There is a schedule in the federal registry you can read. I guess we talked about it way back in the 1980s, the late 1980s, when we were getting into this stuff, and it finally came to pass in 1995 or 1996. Congress adopted the Royalty Relief Act. I think Bennett Johnston was the leader in that effort.

BB: As far as of the price of oil affecting development and, of course, in the 1970s, we saw the price go very high, and it looks like the 1970s was, in fact, a boom time for offshore oil. Of course, in the early and mid-1980s, the price went very far down . . . paradoxically, it seems, at least to me in looking at it, that development continued, you know, even in the mid and latter 1980s. Can you speak to that? To what extent did price spur activity, and to what extent did activity go on even when price was all the way down in the 1980s?

CW: Well, we went through a very difficult period there. Yes, indeed, when the prices were going straight up there in the 1970s, you know, the economists were

forecasting it was going to keep going. And so, we were investing in things which were basically stupid. And I think everybody will agree to that -- not only Shell but the industry. We were investing in things with bad outlook as to future prices. We were actively investing in all kinds of things, not only development offshore but we were out buying companies and people were diversifying and spending money in all kinds of ways. We had so much money to spend. The result of all that is that we in industry made a whole hell of a lot of foolish investments. When the price came back down to something reasonable, which is basically a historic level, there was a period of years where I know we slowed down in investing. But, like I said, the development went on. Our capital investment was dramatically slowed down while we were reexamining what we could afford to invest in and how we could cover our costs. Because in the late 1980s and early 1990s, we, in fact, cut our costs dramatically, as did everybody else. We also set some new price guidelines for looking at new investments, which were very stringent. So, we had to meet these tests before we invested any money. One of the big arguments, back in the mid-1980s, was whether we should be in this deepwater or not. But, fortunately, we were able to discover the things like "Bullwinkle" and “Auger.” Like I said, yes, at even reduced prices, we are seeing in the future now, we can afford to develop these. But there was a period of two or three years in there where our returns on our investment were inadequate for the company to give enough money to invest. I was actually out spending my time, in the early 1990s, trying to find partners to help us go forward

on some projects, which we could not fund internally.

BB: Oh, that is interesting.

CW: Because of the aftermath of what we had done in the high price time. We had so many investments that were losing money at the lower prie, we no longer had the cash flow which would allow us to invest in some of the projects, profitable projects, we had on the table. Well, fortunately, we got through that period. We got through it. We re-engineered the company. We downsized. We spun off properties. We cut operating costs through a lot of tough decisions. We did a whole hell of a lot of things in that time period which allowed us to become profitable again and get an acceptable return on our investment, which then gave us enough cash flow to invest in the things that we have on the books. That was a very difficult period though.

BB: Yes, it sure was. And it seems like that might have been, from what you are saying . . . might be one of the things that spurred Shell and maybe other companies to get into joint ventures even more.

CW: It has. That is part of it. Part of the answer was we don't have the funds to go it alone. We have to have partners. You know, there were cases, which I know for a fact . . . one very prominent case, so I am not sure I want it to be public . . .

One of our big developments, we actually had decided it was too low priority to drill an exploration well on. We had so many prospects lined up we wanted to drill, we had to prioritize them and say, well, there is one we will put in . . . we had a number of them we sort of put aside and said, we can't afford to drill these because we've got these others which look better. And one of the ones which we decided we couldn't drill, what we did was go out and look for partners. And the strategy then was, well, if you will drill a well on this prospect, you an earn an interest in the prospect. And so, one of our best discoveries, we actually got BP to drill an exploratory well for a one-third interest in the prospect, and they drilled the discovery. So, we are now developing it with us owning two-thirds and them owning one-third. That has changed a little bit. Some other people bought into it and what not but basically, that was one that if we hadn't gone out and gotten a partner to drill the well, we weren't going to drill it.

BB: It might not have happened.

CW: Right. It might never have happened. Not at that time. Probably some time we would have drilled it . . .

But anyway, so your observation that it spurred getting partners, you are absolutely right, because before that time period, there is no way in hell we would

take one of our prospects which we thought was good and get somebody else to drill it for us. We always had enough money to do what we wanted to do.

BB: Interesting.

CW: And so, at that point in time in history, we did not have enough money to do what we wanted to do, and the only way we could get it done was just like I said, was go find somebody else to drill it for us on an interest.

BB: Can you tell me some of the other companies that Shell has worked with on that thing?

CW: Amoco, BP, Exxon, just about all of them. Texaco, Conoco. A number of independents. I don't know if there is anybody out there we haven't worked with.

BB: Who has built Shell's structures? Have you worked with Brown & Root, McDermott, those kinds of companies? Or has Shell done that itself?

CW: Starting with the platforms in the early days?

BB: Yes.

CW: Well, Brown & Root and McDermott were the mainstays in the early days, and built virtually all of them. In later years, the big ones, of course, "Cognac" and "Bullwinkle," McDermott built. There are some smaller companies that have built a few jackets for us like some of the smaller fab companies. But the TLPs, it has been a combination of McDermott, Bellelli, an Italian company, and Aker Gulf Marine down in Corpus. They all have had parts of these big TLPs. Of course, Brown & Root kind of got out of that business several years ago and so, that left the major domestic company being McDermott, in that kind of business. And when we go with the big structures, they are about the only ones really large enough to undertake that kind of project. They've got the bulk of it. Besides, Aker Gulf Marine.

Bellelli, in Italy, was a big part of our TLP construction because of the difficulties in having a deepwater location that you could construct them on. They had the right facilities which were difficult to even acquire in the United States.

BB: The Italian company?

CW: Bellelli, which is another story in itself, because when we started going over to build part of these TLPs in Italy, there was a few complaints from some of the congressmen about why we weren't doing it all domestically.

BB: . . . using domestic companies.

CW: Yes. Technically, it was the right thing to do.

BB: Just a couple of other things. I saw some information that seemed to indicate to me that more natural gas was being produced in the Gulf of Mexico and, in fact, I used to have a chart that showed somewhere in the late 1970s, natural gas production in the Gulf had overtaken crude oil production. So, I guess my question would be, is that your interpretation of what is going on, and if it is, why is it? Is there just more natural gas out there, or are companies responding to environmental concerns, natural gas being a cleaner fuel?

CW: My interpretation of why it has happened, and I think it has, although I don't have the numbers at my disposal, to follow it that closely anymore, but my interpretation of why it is producing more gas is because when you got up and you drilled wells, you don't know what you are going to find - gas or oil. And when both of them are valuable, then you develop what you find. And there is a lot of gas in the Gulf of Mexico. And if there is more produced, it is because we found more.

BB: O.K.

CW: It's that simple.

BB: It is just there? That's what you are finding?

CW: That's right. Now, the marketplace has to be there for it, and so that gets into all the other issues about what is clean . . . why do people burn gas instead of oil and all those other things, but that doesn't really affect the E&P function. As long as a market is out there, we don't care why it is there.

BB: So, you are just finding it more?

CW: That is right, you've got to drill wells and find it and you develop it. Gas is, well, for volume, it has generally been a little bit less valuable than oil, but it is also less expensive to develop than oil. So, the finding cost is generally the same, what it costs to go out and find it, but to develop it, it generally costs you less, on a unit basis theme . . . the same unit as oil. On the other hand, its price may be . . . at various periods in time, it fluctuates a lot more than oil. And sometimes there have been periods where you were selling gas at a loss, too.

BB: Right. It fluctuates more with the season than crude oil does.

CW: Yes.

BB: In 1997, what do you see in the Gulf's future? Will companies continue to go deeper? Will there be more oil and gas found? Will there be more TLPs or SPARS, or subsea play a bigger role?

CW: I have been retired for four years and I do not follow it very closely anymore, but I have seen the newspaper, and occasional conversations . . . there is no doubt in my mind that the answer to all that is yes, there will be more discoveries, we will go deeper in the water in the next 10 years, 20 years. There will be continued expansion of subsea. There will be more TLPs. There will be more SPARS. There will be something new which we have not even talked about come out, some other systems. So, yes, I think there is a right place for all those different kinds of systems, even though people look at them as competing, and they are competing, but they are competing because each of them has a niche, which fits better than something else. So, we are going to continue to see all of them used in different places. There is no doubt in my mind there are more discoveries to be made in existing water depths and in deeper water depths. So, the Gulf of Mexico is going to be alive for a few years, if it doesn't overheat. Right now, if people don't build too many rigs and drive the price of the cost of doing business too high, we won't have another crash. That is always a worry, when you get in one of these boom periods, the cost of everything, of doing business, goes up dramatically, because the drillers raise their rates of the rigs, understandably. The

suppliers of scarce materials, raise the cost of their materials and their equipment. So, all of a sudden, you are looking at a cost that is escalating a lot faster than the cost of inflation. Then suddenly, the price of oil drops. Then you are looking immediately at costs which are too high to justify development. What happens then is you have a bust. You've had a boom and then all of a sudden, people quit drilling and they quit building things; then you have a bust like we had back in the 1980s. And that has happened historically in the oil business.

A lot of managers today in the various companies say they are not going to let that happen again. They are managing their business better this time around. I hope it is true, I don't know.

BB: You do see there is a high demand for rigs. The companies, I think, are waiting on rigs.

CW: That is characteristic with a boom period. It always happens.

BB: Right. Working against that, it seems to me, the costs are so high, but could it really get so overheated? Could more and more companies jump in? I guess, through the joint venture, they could. But it just seems to me costs are so high, could competition really heat up?

CW: Absolutely. You could have, absolutely, a situation in which you are getting a five dollar drop in the price of crude, and a corresponding drop in the price of natural gas, have a great decrease in demand for rigs and people start cutting their prices on rigs. And so, the bottom will drop out of the rig market and all of a sudden, you are going to have a rig sitting idle out there again. And people going bankrupt. Can that happen? Absolutely, it can happen. It has happened before. It can happen again. And I hope it doesn't. I don't know quite how you constrain things so that it doesn't happen. As long as the price is where it is, it is profitable to drill and develop, and people have money to do it with. They are profitable right now . . .

THE END