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TAPE RECORDED INTERVIEW PROJECT

Interview of Loren Crow

April 21, 1992
Interviewer: Julius London

London: This is a taped interview with Loren Crow, on April 21, 1992. The interview is being done in his home in Denver, Colorado.

Loren, let's start with a few items on your vitae. First, when and where were you born?

Crow: In Iowa, Lenox, Iowa, on a farm, 1916.

London: 1916. That means you're 76 years old.

Crow: Yes.

London: You went to college where?

Crow: At Simpson College, Indianola, Iowa.

London: And what was your major?

Crow: My major was in chemistry, minor in physics. I took enough math to cover that field and I took enough physics and chemistry to be pre-doctoral. And I took enough education to be a teacher, and I was president of the student body in my senior year.

London: You had a good, distinguished undergraduate experience. Then you studied meteorology and you went into a cadet class at Caltech?

Crow: Yes. I assume that the University of Chicago was filled because living in Iowa, why I was assigned to Caltech I don't know. But I'm delighted that I was.

London: Well, as I remember, at that time, there were only five cadet programs.

Crow: That's correct.

London: Caltech, UCLA, Washington, MIT and NYU.

Crow: All required that you be a college graduate before you got there. Our group, which I'm sure was similar to others, was a very wonderful group. They were professional, they had college degrees, they weren't doing anything except studying meteorology in the daytime and having a reasonably good time in the evening.

London: Yes, I know how that was. And then your course began when?

Crow: In March, 1942.

London: That was the third war course?

Crow: I believe so, yes. I think you were a class ahead of me at NYU. You finished as I began.

London: Right. Then you were there for nine months.

Crow: And then was picked as an instructor, I'm not sure why, but they had a selection of the people that they thought could handle things and I was chosen as a lab instructor and they had a group of officers of both the Navy and the Air Force who were assigned and I was assigned to take them as my class, all of them essentially outranking me, but I only had one obnoxious guy. All the others were willing...but this one captain thought I should not grade him on anything.

London: We won't ask about his name.

Crow: No.

London: Who were your instructors at Caltech?

Crow: The chief instructors at that time were Paul Ruch, Newton Stone, Dr. Irving Krick was head of the department but he was not there very much at the time, so he would only give a talk when he came in, but the rest of the time he was not there.

London: Do you remember any of the fellow students who are around now?

Crow: Oh yes, I remember a good many of them. Those instructors, the ones that are in meteorology now are very few. One of the fellow instructors stayed and went with the National Weather Service for a long time. Another went back to Washington and worked in the Weather Service. Another one became an insurance man, etc. So it

goes. This man was a class member under me as instructor that I later met on Saipan when I was there. One little interesting thing: one time I had gone to practice for gunnery and I did not make it; I made a 102 instead of 120, and the next morning I gave the 7:30 lecture and on the blackboard when I rolled it up was a sign that said, "102," and in the zero was a little target symbol. Everybody laughed.

London: You stayed then at Caltech in Pasadena for how long?

Crow: I began in March of '42, and I didn't leave until July of '44. Two more classes as an instructor.

London: And then after that...

Crow: I received my assignment to go to Saipan, and Guam, to become a part of what they later called a "brain trust" because we were superimposed on the Army Air Force Weather people who were already there. We had been picked as prior instructors from the various five schools to fill specific jobs. While I was at Caltech, I had been exposed to the weather types and how you would use them in making forecasts, and the logic of identifying repeatable synoptic weather patterns. This experience was particularly useful subsequently when I was on Saipan and Guam and trying to guess the next day's weather.

London: So you went to Saipan and Guam. You didn't stop off at Weather Central in Hawaii?

Crow: Yes, I did. And they checked us out as to whether we were capable weather briefers. We had to be exposed to a critical review colonel to see if we had some savvy of meteorology and were able to talk about the subject in understandable terms.

London: That was 20th Weather Central?

Crow: Yes.

London: Tell me, in your own words, about your experiences, your meteorological experiences, particularly on Saipan and Guam. You knew a number of notable people.

Crow: The people who worked there plus the people who came through visiting the place were--I couldn't have picked a better assignment. And Jim Seaver, (Colonel James T. Seaver (USAF)), who was the staff weather officer for Curtis E. LeMay, the head of the bombing mission against Japan with the B-29s--Jim Seaver and I worked seven days a week. And I, because I was responsible for the day after tomorrow as compared with tomorrow, always had to coordinate what I thought by reviewing everything with the people in the short-range surface section, the upper air section,

the tropical section. Part of that, I would guess, was because I had been sent to Puerto Rico in winter of '43 to take courses in tropical meteorology, and had come back to teach it at Caltech.

London: Was Herbert Riehl in Puerto Rico at that time?

Crow: Herbert Riehl, that's where I first met him, that's where I met Bryson, that's where I met several other people and the staff there was an international group. That was a part of the University of Chicago, so my certificate is from the University of Chicago. So I had this linkage with tropical meteorology already, which helped quite a bit in understanding what went on in that part of the world.

London: And then you were in Saipan and Guam?

Crow: First we landed in Saipan. I was able to see the largest individual flame I've ever seen: a B-29 totally loaded with gasoline hit by a Japanese Zero and went up in flames, and our tent was about, I would say, 200 yards from the flame. It was a big fire.

London: Boy, yes. Were there many injuries with that?

Crow: No. No one was in the plane, it was during the night, no one was in the plane and there were no injuries. Now we did have an occasion of significant meteorology. In this case, Bill Plumley, Captain Bill Plumley at that time, from the University of Chicago, had forecast very strong winds over the target, which was to be near Tokyo, a factory area. And so about eleven o'clock at night, after the original briefing had taken place about six p.m., they came down to our tent. "Where's Plumley? Where's Plumley? The general wants to see him." So he went back to the Weather Central. They had noticed that these strong winds were forecast. So they said, "Are you sure of this?"

"Well, that's my opinion, sir." So they called all of the crews out, and did a different briefing. Instead of their going in from the northeast over Tokyo and bucking a very strong wind so that they would be traveling less than 100 miles per hour, and get that much more exposure to flak, they turned it around. When you add 300 miles per hour to 168 knots, you get a condition where you cannot hit any part of a factory unless the bombardier pushed the button at exactly the right second.

London: Because the speed was so great that the accuracy of the bombing...

Crow: We hit a lot of rice paddies. Subsequently, with looking at no results essentially, everybody got disturbed about this and finally General LeMay and the people working with him had nerve enough to decide that he would order some napalm, which would burn things, and most Japanese cities were ready to burn because of the

way they built their buildings. And so the first raid over Tokyo was a devastating success. They later struck several of the smaller cities. Individual pilots began calling in sick until the decision makers agreed that they would notify the cities that they were on the hit list, and tell the people to get out of there. And then the fire raids resumed. It was that period in March-April-May, 1945, that really ended the capacity of Japan to produce war material.

London: You said the original pilots reported sick. That's an interesting comment.

Crow: Well, they thought it was unfair to the public that they were being killed by these fires. But then they were warned.

London: So that there was even then during the war a little bit of a humane feeling among the...

Crow: Sure. These are people like you and me. We have feelings for people around the world.

London: But the later bombings were successful.

Crow: They were tremendously successful and as a result, on the days they went, we had a big batting average. So LeMay was so impressed that when he came back, he formed what became the Offutt Air Force Base Weather Central. He wanted a big weather central, and he wanted Seaver--

London: At Omaha, Nebraska.

Crow: Right, just south of Omaha. So the general called Seaver, and Seaver was in the advertising business. The general said, "Gee, I'd sure like to have you come back and help me."

London: This was from out of reserve, back into the Air Force.

Crow: He was out of the military at that time. General LeMay said, "What if I made you a permanent 'bird' colonel instead of your official rank. On a permanent basis, you would be a colonel."

"Well, that would be interesting, General, but I really don't want to do that."
About three weeks later, LeMay called Seaver again and said, "How about if I let you pick anybody you want within the whole Air Weather Service to be your staff?"
Well, that's hard to turn down, so Seaver gave in and it became the operational World Weather Center for the U.S. Air Force Strategic Air Command very quickly.

London: Right. And that, as it existed, it still is--

Crow: It still is. So we got a big boost for that relatively short period that our forecasts were very good. Meteorology moved up in the applied side and in the U.S. Air Force.

London: And of course over the years, the Offutt operation has provided a tremendous amount of reconnaissance...they were responsible for these worldwide net analyses--cloud analyses that are being used even now to verify satellite observations.

Crow: I spent one period of my reserve time, two-week tour, at Offutt by request of Seaver to have me come work there, and I did an analysis of how to fill in on the computer the normal average wind conditions over the Pacific when data were missing to make a complete map.

London: Could we now get back again to Saipan and the bombing missions? It was at that time and in that area where the actual verification of an upper-level jet stream was made. Can you fill in a little bit more?

Crow: They assigned two top navigators to make the flight to Japan the night that Plumley and all in the upper air section forecasted strong winds, and they were verified, as written up--as acknowledged by the people who went, including General O'Donnell. And, in this case, suddenly, suddenly people arrived from Washington, D.C., sent there to see what was going on, what was this peculiar meteorology and these strong winds. It didn't seem peculiar to us, working with it day after day. And Ed Lorenz, people like Ed Lorenz, were there, John Bookston from the University of Chicago, and Reid Bryson was there and Ed Buxton was there, and of course Seaver was there. We had top-notch people who also turned out to like each other generally, so we had a good team. There were no secrets among ourselves with anybody trying to hold back one from the other.

So we moved from Saipan down to Guam on Christmas weekend, and we had a better Weather Central down there to work in, but we were still living in tents. One of the assignments I had, I was assigned--

London: This was Christmas, 1944?

Crow: 1944, that is correct. One of the assignments they were then planning to do was a photographic flight over all of Okinawa. I was to pick the weather and give them a forecast as to when they could make a good aerial photo run and get all of Okinawa in one flight. Well, for that I turned to the Northern Hemisphere maps, which I had, and picked the kind of weather that I was looking for. Then when it came up, I said, "Now's the time. Get the hell out of here. Go tomorrow." Which they did. They got excellent pictures as a result of some understanding of how the Northern Hemisphere

maps worked, and you can go from one to two days ahead.

London: These were the Northern Hemisphere sea level maps.

Crow: That's correct. These maps were plotted and analyzed using frontal analysis at NYU and Caltech. They were produced in a period of approximately one year, from 1898 to 1938. So we had forty years of this sequence and I had a complete set of daily maps.

London: Right. You had to then extrapolate from sea level to upper levels and that was a little bit of a problem, wasn't it?

Crow: Sure, but you had to have--the upper air had to be with a high coming out over Okinawa, because most of the time it's in a trough, forming new waves to go up the west side of the Pacific, so it was an unusual event you had to have.

London: This would also occur with a very cold outbreak.

Crow: That's right. So you had two things against you. You had to pick the right one. Now the other interesting thing was that we had one B-29 assigned as a reconnaissance aircraft, and it was my job--generally, I talked to Jim Seaver about where we wanted good information--to pick where this poor devil would fly seven hours up and seven hours back to give us a little bit of what he saw. This was long before the days of satellite imagery. We wanted a little bit in a given area based on what we knew would be the targets, and it was my assignment to pick that and give it in written form to where we wanted them to go.

London: What other things happened on the tour around Saipan and Guam that were of particular interest?

Crow: Oh, I think that the interesting thing of living in tents and we had one interesting side thing--doesn't have anything to do with meteorology, but we asked the Navy to "lose" a refrigerator to store our beer in. They "lost" a refrigerator and we traded some booze for that. And it was decided that a good place to put that--since Crow didn't drink--was to put it at the foot of his bed. I was delighted because it kept my feet cool.

London: Were you in that area at the time of the atomic bomb?

Crow: I actually had been put on rest leave to go back to the island of Hawaii, the big island, when the bomb was dropped. But I was involved in making the training forecast and picking the practice runs they wanted. All we knew was they wanted partly cloudy to clear over a picked target and we had several of them and we could not pick where

they were going to go based on the variety of places that we had to make forecasts.

London: You didn't know what the run was for?

Crow: No, no. The bomb wing was up on Tinian, and a fellow officer from Caltech was their staff weather officer and he didn't know either, but he was the guy asking for the forecasts so we could communicate easily as to what they wanted.

London: Were you surprised when the bombs went off?

Crow: Yes. Yes. But I am one of those who believes that the war was over so far as the capacity of Japan to generate equipment to destroy any enemy by that time.

London: OK, you went back to Hawaii and then what happened?

Crow: Well, I did take a trip to Japan in September about two weeks after the signing of surrender--as an officer visiting there. And my assignment was to ask if I could find any information about the release of the balloons that were to start fires in forests in North America. I failed at finding any such information. Subsequently, it was written up about five years later. But I did not find anything. The interesting thing about Japan at that time that I saw was the devastation, the rusted cars still in the street where they were burned in April. They were still there in September.

London: This was in Tokyo?

Crow: Yes. And the interesting other part is above the debris scattered through all that area were safes that had been dug out of the debris, because somebody remembered that there were important papers or money or something. So as you looked over this big vast area of debris, here were these many safes that had been dug up to the top. An interesting thing to see.

London: After that how long did you stay in the Air Force?

Crow: I stayed there, got out, got home early 1946 and arrived home in March. I was released from the service in 1946. And then I didn't have a job for awhile and I was finally offered a job by Dr. Krick to go help in a company he had set up in England known as IMCOS, the International Meteorological Consulting Service, and it was my job to represent Dr. Krick there and to help sell applied meteorology to various people for various companies. Four different quick things that happened there: one was the meeting with the Central Electricity Board, who had their facility six floors down from the street level to protect it from bombing, and a man by the name of Butterly, an engineer, came with a three-year chart of their load and their ability to forecast the next day's requirement for energy. He then showed us that he was having

a score for that three-year period of approximately 92% of hitting the energy requirement on the nose for the following day. He was a very intelligent engineer because he recognized right away that we should not expect it to get to 100%. No way! Geoff Spurr, an English meteorologist, became the guy assigned in our forecasting office who worked with them. He later was hired by the Central Electricity Board, worked for them for twenty-some years before he died of cancer in 1983, I think.

The two or three other things that were involved: one was to make forecasts for pigeon races. I've never done that before or since, but one of the forecasts was for the release of many hundreds of pigeons that were taken by train and a boat up to Stornaway, Scotland, which was 500 miles to the north-northwest. No pigeon can fly that far back in the daylight hours of one day.

London: Northwest of London.

Crow: Northwest of London. Most of the pigeon fanciers live in and around London, and they had most of their life savings involved in that hobby. They would buy a pair of pigeons for thousands of pounds if they thought they were the right kind. They would bet up to a third of an annual income on their pigeon winning. So they won or lost large amounts of money, and if they got into a storm, they wouldn't make it. So the storm at Stornaway delayed for twenty-four hours the release of the pigeons.

The other one was another flight from Bordeaux, France, 470 miles away from the London area. The previous year they had had a big storm coming in from the Atlantic that sent a lot of pigeons to visit their friends and relatives somewhere else and they didn't get back to London. So these two forecasts worked and whether they're still doing it, I have no idea. It was a very interesting episode.

London: That is the most interesting application of meteorology that I have ever heard of before.

Crow: Another one was over in Ireland. They had a big setup to harvest peat in a big flat area and they had machines that could scrape about a quarter of an inch of the peat to rough it up so that the sun would dry it enough to take it in and compress it. They used the bricks that they made to generate power in a power plant. This is at Tullamore, west-southwest of Dublin. I went over and arranged to get the thing started, and we did it for quite some time.

London: Loren, tell me how large was Krick's outfit in England?

Crow: We had, I think, about eight people in the forecast office. We were copying the data by radio because we couldn't get permission for a drop on the teletype even though

the line went right by where our office was.

London: How long did you stay in England?

Crow: I was there a little over a year. And in that year I also went up to Scotland and over to France and Switzerland and did a bit of traveling in addition to being there. But the interesting assignments were finding new things that meteorology could be applied to. One of the easiest ones was talking to the people who operated commuter trains that came up from Portsmouth. They had problems in the wintertime--this was an electric train--and if frost got on the third rail, it would arc out and it would stop them if the frost was, let's say, a quarter of an inch thick. There was no meteorologist that I know who couldn't pick by 11:00 at night whether they had a lot of moisture and clear skies and a thick layer of frost was going to form. So our simple recommendation was to take an engine only and run it up the hill to the high ground between London and Portsmouth about every two hours between one and six so that when the commuter load of people became available to get to London at six a.m., there was only a very thin layer of ice on the track and they had no problem.

Unfortunately, to me, having developed that by an easy application, then that rail company went to the Met Office--they called it the Met Office, the National Service--and said, "Why couldn't you do this for us, for free?" And they did. I didn't like that, I admit.

London: I guess that happens though, very frequently, doesn't it?

Crow: It does, it does.

London: We'll get to a little bit of that later when we talk about the difficulties, or perhaps not difficulties, but the cooperation or sometimes lack of cooperation between industrial and government meteorological services.

Crow: That has dissipated tremendously in my lifetime. When I first got into the business, everybody thought that I might steal something if I came into a Weather Bureau office. I was the outsider and I obviously had an attitude toward meteorology that money was the only thing involved. That was not true! It was the interesting use of meteorology that was involved.

London: Let's get back to that trip. You came back then from England, and you were still working with--

Crow: Irv Krick. I worked for Irv for nine years, including the one that I was in England. Coming back, he then got into weather modification and he would tend to go sell a project and then send Crow out to work out the details. What would we do at what

time, and what kind of weather would be involved, etc., etc., etc. So this involved investigations not only throughout the United States, but some foreign assignments as well, to go talk to people about this.

London: At the beginning, maybe you can verify a story that goes around about the weather modification of Krick and Associates. The story goes roughly as follows: Krick or a representative--it might have been you, I don't know--would go up to a large group of farmers who were assembled, and there would be a pitch about modification, with the following guarantee to the farmers: that if there is a forecast where they're going to modify the precipitation pattern, then they would be paying for the services. But if it turns out that the forecast was incorrect, then they didn't have to pay. Now of course that is a moneymaker, in a sense. I just wondered whether that apocryphal, or seeming apocryphal, story was so.

Crow: I don't think that's quite right. It's true that the people wanted to hear that they could have an overhead irrigation system--that's what they wanted to hear. And probably Dr. Krick in his enthusiasm for meteorology would tell them that it might happen. This then got interpreted by the people who wanted it to happen to "it will happen." I personally made a visit to Lloyd's of London, and that was a very interesting assignment, to see if we could get some kind of coverage for assuring them and get it as a part of the contract. I was not able to do that. But it has related to that--

Having worked with Irv for nine years, I thought I could get out on my own and apply meteorology to interesting assignments that I could sell to somebody, very few of them having to do with weather modification, but I wasn't averse to having experimental work done because it was still needed to be done in that field.

London: You spent nine years with that and that exposed you to many industrial types of problems. You could be very useful in supplying information.

Crow: I resigned without knowing where I was going. I then went to the Carrier Corporation in Syracuse, New York, with a fixed appointment with the vice-president to see if they could hire me full-time to work on what I was sure was a relationship of weather to air conditioning.

London: It's not very pertinent, but would you care to comment on why you resigned?

Crow: Because there was a tendency for Irv to be so enthusiastic in his salesmanship, there were cases where some overselling may have been done. I was the guy who had the assignment to go out and explain the real world, as I thought it would occur. I decided that life was too short to have me on a different wavelength than Irv, so I resigned. He held a big party in my honor and we still are friends.

London: Where is he now?
Crow: He's in Pasadena, California.

London: He's back home.

Crow: Yes, he's been there for quite some time.

The weather modification was at one time in the early fifties, 1950 and 1951, more centered in the Central U.S. than in California, which has dry sunny summers, no clouds at all. So it was decided to move the whole company to Denver. I was on assignment in El Salvador, and when I came back, the move had been made to Denver and Professor Lou Grant, a good friend of mine, drove our car--his wife drove our car and he drove their own car--from California to here, so it would be ready when we got back. We got back from there in March, 1951.

London: So then you resigned and went over to another company, what company?

Crow: Mine. I was on my own, I did not have a job, but I thought I could sell somebody on doing work on a consulting basis. So I went to the Carrier Corporation in Syracuse, New York, and tried to get a full-time job there, but the vice-president said, "Crow, you seem to have some capacity for applying meteorology. We would like to hire you as a consultant to study a problem, and give us a report on the applications thereof." So I did and back in 1956, I did a study of the weather factors related to the sales of room air conditioners, and self-contained air conditioners, which led me then into the whole field of the applied side of data related to air conditioning.

I came back through Kansas City and talked to a pipeline company and got a second assignment, which was to study the variability caused by weather of the pumping of fuel oil to Chicago, Minneapolis, Des Moines. There were five cities that they pumped fuel oil to from Oklahoma up to those areas, and they had varying requirements because of the variability of the weather. So I worked on that, and gave them ways to estimate the variability that they would expect using climatological data to estimate the odds that the weather the next year would be like the previous one. It so happened that in the winter of 1955, they had a very warm winter. I was explaining that just from the history of climatic odds, the odds were 55 to 1 that it would be colder than that the following winter. I didn't say how much colder--actually the winter of 1956 was near the median, slightly above in coldness.

But this was then the same sort of thing that I had taught the people in air conditioning to use. They kept assuming that the change toward higher sales numbers was due to the salesmanship, but it was the weather in June. And June is far more important than August because people are going to spend $200-300 for room air conditioners in those days. And the time for doing the advertising was different in

different cities. So I made up a schedule as to what they should do for advertising, and then I went to see G.E. and Whirlpool and got similar assignments, and Chrysler Corporation, who was making them at that time. And so I got assignments and had their sales data. They all knew I had the other people's sales data, but they couldn't get it from me. But I was using the combination of sales from several companies to estimate the changes that they should expect in various months of the following year.

This later led to my helping Arlo Gambell to get a job at Sears Roebuck to do that, in Chicago, selling room air conditioners.

London: This was when you were on your own, in your own company.

Crow: And I kept telling people that if only I could move the wolf a little farther away from the door each six months, then I was succeeding. And I've been able to do that ever since.

London: This is interesting; the essential method that you used in terms of applications was to look through the climatological statistics and on the basis of the knowledge that was available to you but also the interpretation of the climatological statistics, you could bring your insight to a meteorological application to their problem.

Crow: It was worth money. They were carrying over several thousand room units, so if you had, let's say, five million dollars worth of room units that you didn't sell this summer, just the interest on that amount of money carried over for next year is pretty sizable. I admit that I have looked for people or industries that have million dollar problems that I can do something about.

London: What do you mean, you "admit"? That would be natural--there's no point in doing something like that for--

Crow: For twenty cents. It just is not economically feasible.

Now that then led into my knowing that the wet bulb temperature, which has to do with the design of industrial cooling towers, was very much needed. They had been going on with only fifteen stations that they had reasonable data collected for, and I knew that the punch cards, which started in the forties, were going to reach a ten-year set.

London: The which?

Crow: The punch cards for hourly observations from many airports were going to become available with a ten-year sample in the late fifties. So I tried to sell this to the leading marketer of industrial cooling towers in Kansas City, and they said, "Well, if you make the book, we'll buy one." I said, "That wasn't what I had in mind. I had in

mind doing this for the whole country, and for some 400 locations across the country, where data would exist and on punch cards." I then went to a competitor in Southern California, the Fluor Corporation--their subsidiary made cooling towers in Santa Rosa, California. Fortunately, I ran into an engineer who was also a Rhodes Scholar, a smart cookie. When I took my booklet out to show him what I had in mind--we were going through the pages--I had spent maybe a day per page working up this model--and he said, "Let's go to the next page, Loren, I understand that." And I had spent a long time on it, but his perception level was good. So they then supported the publication of this book for which they set the price at $35.00. It cost them $13,000. The check went from them to Asheville to the Climate Data Center for running these through the punch card coding system to get the data for putting together these tables at all of these stations. I went to the Jeppson map company in Denver, which had most of the maps in the airline magazines and I wanted it done in color. And the people at the Fluor Corporation thought that was a fine thing, so they supported that. So the cost of this book was pretty high. But we had in it tables for all of these places throughout the country that had the wet bulb temperature.

Now if you're building a big refinery, it makes a whale of a difference whether you have the right design data, and build it big enough to do the problem. If you have a chemical process, and you're liable to lose the whole batch if it gets too damn hot, then you better be on the safe side, so this was put together for the engineer to make a risk decision, based on the percentage of hours that would be equal to or greater than a given amount of wet bulb temperatures. Then when it was done, they sent me around the country as kind of a bookseller to visit with the engineers of power companies and engineering companies designing that design cooling towers. So I became, fairly shortly after this publication, known as the "wet bulb god" of the United States.

London: So these were data you had worked with and suggested as to how the organization would use them.

Crow: I went to people who were familiar with engineering of that equipment--one was at Penn State--and other people to check the way I was presenting it so that it would have usefulness.
I defy an engineer dealing with large industrial cooling towers to throw this away. They can't throw this away--it's got too much information in it. So they put the high price tag on them to keep professors from asking for enough to pass out to all the students. That's it. And they gave them away to the engineers that had the chance of buying $1,000,000 per each or more cooling tower.

So this started me with the American Society of Heating, Refrigerating and Air Cooling Engineers, Inc. (ASHRAE). After carrying out several research projects under contract with ASHRAE, I was designated as a Fellow of that Society in 1980.

One of the research contracts was to take the data from all the cooperative stations around the country and to study the comparison it had with the data that I had from the hourly data from all the airports, and to estimate therefore to the nearest one or two degrees what the design value would be for lots of other places. Actually, there are over 2400 locations where once-per-day cooperative data are recorded throughout this country. So I worked on that, and here you can have a copy of that to read when you get time, and that led to a secondary addendum also sponsored by Fluor--it was now 1964, and the other one was probably from 1958--and they wanted a fresh cut at selling cooling towers, so they authorized me to expand this into a book into which I can cover many, many stations in all the states, and gave the design temperature for summer and winter air conditioning of homes and buildings of all kinds, in categories of percentile levels for the engineer to choose the design responsible for the risk level he faced.

END OF SIDE ONE

INTERVIEW WITH LOREN CROW

SIDE TWO

Crow: This publishing of design data for many small towns and middle-sized cities without airports was then taken as a way of promoting local chapters of ASHRAE. In the Rocky Mountain chapter, which covers Montana, New Mexico, Colorado, and Wyoming, we published a 44-page booklet of climate data on air-conditioning design. This was published in 1976 with the cooperation of NCAR people in Boulder, we showed the high wind situation for the Boulder and Denver area, as to how it decreases with distance away from the Front Range. I also put in the heat island pattern for Denver, which I had derived from studies of Denver air pollution. That led to also doing a similar thing for California and then a second edition of that, published in 1982, covers Arizona, California, Hawaii and Nevada, and has a very large set of design data for even little towns. The first one sort of cut it off at towns of 1,000 or more; this went down to far greater than that, and finally, there was a need for going back to Fluor Products Company. They then wanted another output that they were going to do, but they were in somewhat financial trouble when they got to where they were ready to publish it, and we had included another study of the coincidence of high dry-bulb with the coincident wet-bulb temperatures. The coincident dry-bulb with high wet-bulbs were also published. There are big contrasts in different parts of the country. So this was an added thing, and we then re-published, but not in color as that initial one was, the sets of data and the maps that went with the original book.

London: Could we switch over to another, somewhat allied subject but another area of your work experience. At one time in 1964, I think it was, when you became a special assistant for industrial meteorology to Bob White, who at that time was the head of ESSA, wasn't it? It was not yet NOAA.

Crow: It was still the Weather Bureau when Bob White took the assignment. After Reichelderfer retired, Bob White was selected. He had been working for Travelers' for some time and appreciated the applied side of meteorology. At an AMS meeting at UCLA, in the winter meeting Morrie Neiburger announced in New York the previous year that "I am hereby announcing that the New York meeting next year will be held in Los Angeles."

London: I remember that.

Crow: It was a vivid change in letting the people in the East know that there is something west of the Mississippi.

London: And since then the AMS meetings have been all over the country.

Crow: Anyhow, at that meeting, Bob came up to me and said, "Loren, I want to talk to you. I think that the Weather Bureau that I am now at the head of has very little appreciation for the applied side of meteorology. How would you like to come and fill a job as my special assistant for industrial meteorology?"

Well, that sounded kind of interesting; maybe I could spread the word a little. He wanted me for two years. I didn't want to close my business and go there, and I certainly didn't want to join the government on an indefinite basis, because I was having too much fun working with various clients that I sold the idea to. But he twisted my arm enough, and so it was sort of agreed that I would come for something between one and two years. He wanted me for two years, I wanted it to be one. I left in September, 1964, left my family in Colorado. They went through that school year and then my wife, who was a librarian in the Denver school system, took a sabbatical and came back to Washington. And we traveled around every weekend to show the two boys and ourselves all of the sights to see within "x" miles of Washington. She went to American University and I worked for Bob White.

London: What specifically were your duties?

Crow: My duties--this was like working for Krick in that Bob would never give me a detailed assignment. I was to list some of the specific assignments that should be covered, but within a week of when I got to Washington, D.C., there was a hurricane approaching Galveston. Well, the Galveston flood of 1900 with "x" number of people killed was vivid in memory, but it had developed that the many TV and radio stations had all wanted prior and preferential treatment by the forecasters of any hurricanes. They wanted to put them in voice on their show. Well, that was a ridiculous idea--these guys were busy. So Dr. Robert Simpson said, "Loren, you can go down and get this straightened out so that we pool what they can cover with only one camera in the forecast office and they can't talk to anybody. But there will be briefings on a fixed schedule like the Hurricane Center down in Miami had done before. But we will not permit "x" number of cameras, "x" number of people inside the forecast office."

So I boarded an airplane at Dulles and flew down there to Houston, then on down to Galveston. There were some people already there with cameras, and I called a little short meeting and said, "The logic of this, gentlemen, is that you can have one camera in there and everybody else has to stay outside that room. You can make up your mind who's going to put the camera in there among yourselves, and that can be the best one if you can, but the rest of you people are not going to be in there." This established a relationship between the Weather Bureau and the TV stations which has prevailed ever since then.

Later, I went around giving talks primarily to the regional offices saying to them, essentially, "We have these airplanes flying around and we have lots of data that they fly through--why don't we update this and get that information into the forecast office in detail, and in numbers?"

London: These are the commercial airlines.

Crow: Yes. Nothing happened. Because the FAA runs that. Even though they get the data collection and they pay for it by a transfer of funds from the FAA to the National Weather Service for collecting all its data, they don't collect good real-time data. I think it's so simple that you ought to be able to, as soon as the first flight goes on a jet plane from Chicago to New York eastbound, you have the nearest minute with a setting on the automatic pilot of Mach .82 or whatever each plane type needs. Now a needle up on a clock device, and the westbound flight has a different needle right beside it, because it's going against the wind. And we know that, after the first flight every day, we could have updated information every hour till midnight. But it still isn't done.

The biggest sale I made while I was there was to George Cressman, who was head of a whole lot of meteorologists who had limited training in meteorology. They were the "MICs", meteorologists-in-charge. They had a degree in science of some kind, and they were honest people. They were trying to do the best they could with what they had, but he was stuck with the problem of having well-trained people to fill those jobs. Dr. Reichelderfer had merely promoted by scale of time and service. So I kept preaching that no better use can be made of all the data that we collect other than having it go through the hands of a professional meteorologist to the business company that is going to apply it. Two things were awfully important: the guy using it needs to have a time period to learn how to use it. And the guy furnishing the data needs to learn what and how the business operates. And that cannot be done with the separation of the people in a room at the airport, where they never see the applied side in detail. So that you've got to accept the consulting side of meteorology as a useful tool to expand the uses of all this data you're collecting. Cressman thought that was a good idea, and Cressman was the boss of the forecasting section. So that was one of the things that happened at that time.

One of the things that happened while I worked for Bob White--there was a meeting in Chicago of the TV people from all over the country. I found out that the Chicago Weather Bureau office had killed any prospect of his getting on the program to meet these people and give a talk. I thought that was absurd. So I got a hold of Clint Ewell, whom I didn't know, in Chicago--you know the famous TV weatherman who was accepted by the public in a big way--and asked, "Can you get this back on the track? I'll come out and meet with you and anyone else we need to." He called me

back two days later and said Dr. White was on. Now Bob White is a good salesman, himself. Bob White was talking to the users as the link to the public. This was an important thing that had in the past been avoided. So that was a notch on the rifle.

OK, I did the trip to Galveston, selling Cressman, and, oh, in Baltimore, the Baltimore power company had the guys at the National Weather Service punching the hourly data for them to use where they had historical records. So I found the people out at the weather station punching out the hourly data for them free of charge and they also were furnishing detailed forecasts to the power company. That was, I didn't think, their job. So I went up to Baltimore and confirmed that that was going on. And had Bob White tell them that that was not supposed to go any further, for them to cease it as soon as possible. I happened to be in his office when a call came from the power company in Baltimore. And he waved to me, he said, "Loren, this is from the power company in Baltimore. They don't like it because they're not going to get [the data]. Would you like to take the call?" I said, "No, you're the boss." So he told them that this was supposed to cease and desist.

Subsequently, I found out that in Baltimore, the phone company had illegally placed a tape recorder into the weather station--one of the radio stations had illegally put one in there too. This was to get special treatment for the television station. And that got stopped pretty fast. But this was what I was finding all around the country at places where admittedly, the men--people--in the weather station were trying to do the best they could for all of their community, but they weren't including any private sector in which there was a dollar sign on it that could be handled another way.

So the period in Washington was an interesting one. But as school ended on a Friday, we had the movers pick up the furniture we had on Saturday in early June, 1966, and we were on an Aer Lingus flight to Ireland on Saturday evening. We drove to Newark--I left my car with an old college buddy, Bob Sampson--and we spent eleven weeks driving around while I didn't have any job and the boys were at an age that they could understand what we were seeing. So we had a wonderful trip that summer.

London: So that was the experience in Washington. Before I get back to your re-setting up your company here, let me get on to another interesting aspect of your experience and input. You did a lot of work with the AMS in a number of ways, in helping with the certified meteorological program, CCM. When was that actually set up, do you remember?

Crow: Yes, I remember quite well. I was the first--CCM is the program for producing certifying consulting meteorologists through a testing procedure set up by the professional group of the American Meteorological Society. The numbers of people dealing in the private sector of meteorology are far too few to have this as a

continuing state review session in each state. So I applied, and was furnished a test--Henry Harrison, Bob Elliott, Alfred Glen, Joe George, Woody Jacobson, Wendell Hewson were the six-member review committee. They sent me a test which was put together primarily by Henry Harrison. By asking a lot of people to send in questions, he organized this and pulled out a bunch for me.

London: I remember that. I sent in some questions to Henry Harrison; I hoped they would be important, but not too hard to answer.

Crow: I hoped they were not, too. Loren Crow was the first guy to go through that testing procedure and holds no. 7. The first six were granted to the review board for doing what they did and so in 1959, I had my certificate, which is hanging over on the wall. Then there was a lull; there wasn't much going on. The other persons who went through the testing procedure were Dr. Wally Howell, Norm Hallinger, Bernie Charles and Jack Reed. And all of them received their certification in 1959. Then, because there weren't very many applications coming in...quite a few in 1960 and 1961 were granted to people who this committee thought were working in the applied science and/or some professors. By 1963, we were back in the business of people going through all the testing procedures, both written and oral. And then I became a chairman of the review committee. It gradually has shifted with other people taking on the testing assignment over the years, and now as of August 1992, there are 507 certified consulting meteorologists in the United States.

London: How about that? That's a lot. Now is it just the United States?

Crow: No. There are some foreign people, but very few. But it is not limited to the United States. Bill Haggard, Jerry Hill, Gale Hofnagel, Charlie Bristor--now Charlie Bristor who worked at the NMC, National Meteorological Center out in Suitland, kept saying to his compatriots about the same thing as George Cressman did: "We've got to serve these people to help them do a better job for the people who pay taxes. We've got to get this meteorology as a part of the applied science to as many people as possible." So he pushed the program even though he was a government employee. Dr. Helmut Landsberg was another one.

London: Right, right. I know a number of professors who--

Crow: That's right. Because they liked to talk about it in their classes. And now we have a big demand, I get all kinds of solicitation letters from people who are students. Could I please employ them? Well, I'm semi-retired, so I'm not going to be able to do it. Related thereto, I wrote an article which was in the **Bulletin** way back in 1959 about what are some of the economic possibilities for younger meteorologists, which went in the **Bulletin** for people to read to think about the applied science. I was requested by Ken Spengler to do this and I did it.

London: Ken is another certified--

Crow: Ken Spengler is not only that, but he is also a member of this National Council of Industrial Meteorologists. These are essentially--they're pretty well, I think, the cream of the experienced consultants around the United States. We have forty-some members, and we are located, as this map shows, around the U.S.

London: Were you involved in starting this?

Crow: Yes. We had a meeting in San Francisco along with an AMS meeting. And we had a separate meeting at a hotel and we decided to form it. It was decided that we would put it in Colorado as a non-profit organization. So it is chartered in the state of Colorado. We hold annual meetings in June. If you'd like to come and visit us, we will be holding forth at the hotel by the airport on the first and second of June, 1993. And the people who are in this (I'll only mention a few): Keith Brown, North American Weather Consultants--the organizer of that company was, of course, Bob Elliott, one of the people on the first review committee of the AMS. Another member of the NCIM is Dick Cale.

London: Cale is somebody I worked with back in 1943 or so, and a wonderful person. I haven't seen him since then.

Crow: He primarily works on aviation cases and then here's Arlo Gambell who did work for Sears for a long time, now works for WSI Corporation, selling applied side of stuff for all kinds of TV services. Jack Murray and Dennis Trettle are charter members. I bring out another thing. I have done two different assignments with North American Weather Consultants as an outside consultant. Called in to evaluate what they did, paid for by the client to have a second opinion. I've done two different ones of that. In the case of Murray and Trettle, they had a job that was primarily a climatology problem for the gas company in Chicago; they had me do the job. Recommended by them, paid for by the gas company directly to me. This business of linking our professional talents is a good idea.

London: Is that a rare thing?

Crow: Thus far, it's fairly rare.

London: In industrial groups, I mean, in general.

Crow: Oh, that's not exclusive, a good many engineering companies that tend to do joint things together.

So that's not unusual in other fields. I am twice-honored by having done this several

times in different fields. Bill Haggard and I worked on various projects together, so that these are the people. And Johnny Wallace and Pete Leavitt, in Boston, I've worked with them jointly on some stuff. So that the professional people have boosted cooperation, I've gotten only one job directly by somebody looking me up in this, NCIM Directory. But it does spread the word that there is an applied side.

London: And an organization.

Crow: That's right. Now we do sponsor some scholarships for people to have in-house training in the summertime to our students of meteorology to get a boost. I have hired temporary people to work on problems here in Denver, they're down at Metro State, and there's no doubt it gives them a plus when they go out to look for some other job. It gives them the exposure of seeing someone making a good living by applying what they're studying.

That's the end of that pretty much.

I did want to mention the National Science Foundation assignments that I've had. I did two different things: one is a review of weather modification for the Bureau of Reclamation when they were beginning their analysis of whether or not to do any weather modification in the high Rockies. And that was paid for directly to me. I did some stuff also for Shorty Orville when he was head of that section. This one was a separate study; it was sponsored by the National Science Foundation, having to do with the relationship between hail and rain in Kansas, Nebraska and Eastern Colorado. This led also to an analysis for the hail people in Chicago, the association of hail insurers. This was an interesting assignment, the way we used a computer which at that time filled a big old room in Chicago, and I have an IBM XT sitting right over there in that little closet that I use which has the same capacity that they had in this huge tube-type thing, that we ran the data through at that time. Which led to this analysis, the patterns of crop-hail damage and the path of the storms during the night that go across Kansas and Nebraska that have their impulse begin in Colorado east of the mountains. They progress along with a wave action, generating during the night thunderstorms, getting to Omaha about six a.m. So that, I think, may be a useful input to weather modification.

London: One of the things I would like to look at--we've gone through a good deal of the history, not only of your involvement not only during the war, but as a beginning, really, of the application of meteorology to industrial purposes. It really started after World War II, I guess. There was very little before that; some, but very little.

Crow: Well, Krick had sold the film studios on getting forecasts for their outdoor work. That was what generated his idea to go to see the people in England to get more of their filmmaking done outside, but they needed to have clear to partly cloudy. Now

when you forecast in England, you learn quickly that you use different terms. You say, "Tomorrow will have a few bright periods. Or tomorrow we'll have an afternoon with two to four hours of sunshine."

London: Well, of course, that brings up another interesting point and that is the important role of industrial meteorologists to interpret weather for people who are using it to tell them what things mean and don't mean.

Crow: Sure. How would you like to hire an outdoors scene with 500 extras? You're going to pay them $10 an hour for the time they work. You're not paying them a big amount of money. They're happy to get the $10 an hour, that's $80 for an eight-hour day. Even though the camera may be on them only for 25 minutes. Now how would you like to hire them, get them all out there and then it's bad weather? So it is a support proportional to the money involved.

London: But it's not only the fact that they could read the forecast, but it means interpreting the forecast for time of day, etc.

We've come up to now, and I think very well, what with all the various diverse problems that you've been dealing with--what do you now see as a future for industrial meteorology and where is it going, where should it go?

Crow: I think it will continue to grow slowly. The chance of--see if I'm introduced at a meeting as a chemist, 90% of the people in the audience will think I probably know more about chemistry than they do. But if I'm introduced as a meteorologist and they know what that word means (which many don't), they assume that they know more about **their weather** than this guy up front who's from Denver. How could he know about **their weather**? They have a possessive feeling about **their weather**.

Anyway, that has gradually changed. When I now go to a National Weather Service office, and they may or may not know who I am, but if I'm there getting some data to advise some industrial company on a given problem, they look at me and ask: "How do you get paid for this?! Boy, you get in on interesting things! How could I do that?" Well, you could if you're willing to spend one-quarter of your income for keeping up with training in meteorology. And spreading the seeds that will not mature in any assignment for two to ten years. And keeping your feet oiled to keep moving around and selling ideas. Now not too many meteorologists are in that category, and neither are too many people good at TV meteorology. And you don't have to be a meteorologist to do a pretty good job at representing the weather to the public. With the aids we have now that are furnished by SRI and other similar companies.

London: Actually, a relatively small part of industrial meteorologists--what we call certified

consulting meteorologists--are involved in TV work.

Crow: That's true, that's true. There are many meteorologists that are involved in air pollution problems, and I've done a lot of that work myself. There are others who are involved in forensic meteorology, going to court to say what the weather was when a particular accident took place. And I'm involved with a higher percentage of forensic work now, and many of those are very interesting. The forensic thing--I did a study on the Phoenix floods, and it is interesting how this happened. The guy who was the head of the meteorology department for the Salt River Project in Phoenix told his lawyer that he ought to get in touch with me. But a meteorologist from Milwaukee, who was a TV weatherman, visiting his lawyer daughter in Phoenix, about three weeks earlier went to lunch with her law firm employers who said they were on the plaintiff's side and he said to them, "Whom do you have as a consulting meteorologist?"

"Well," they said, "We don't have any."

"Well, you better get one." And he called me on the phone to relay what he told them at lunch, to "call Loren Crow in Denver." So they did, and I was already working for the plaintiff's side when the defense lawyer working for the Salt River Project contacted me.

London: What do you do in that case?

Crow: Well, I take the first one that calls me. They have a right to request my services and I have a right to serve them.

London: But you don't change your testimony.

Crow: Oh, no, no. My testimony is what was the weather. So then Don Moon, the professional meteorologist working full-time for the Salt River Project, not only knows me, he knew Ted Smith, who was a fellow instructor in the meteorology group at Caltech in the early 1940's. So Don had the company hire Ted as their expert witness. The three of us got on the phone together and said, "Look, we ought to be able to go and look at the historical weather data related to this, and stipulate that we're both using the same data." So a meeting was arranged in which Ted came from Southern California and I came from Denver. The lawyers sat there to watch us so we wouldn't talk too much as friends that the three of us are, as we sorted through the company's historical weather data file.

Then I got involved with trials also related to the Phoenix flooding by other people. And finally, I had so much information that the Salt River Project people settled out of court. But on the Salt River case, we did pool our resources and got the lawyers to

stipulate that the weather data being used was the same thing for both sides.

London: Right. So you think that one of the areas of continued work in consulting meteorology is in air pollution and continued forensic meteorology.

Crow: Oh, forensics will be needed as long as you've got 10,000 lawyers suing everybody, there's got to be a need for that.

London: One other question that would be of interest, or your response would be of interest, is that my recollection is that, in the beginning, there was or might have been some type of government, not interference really, but competition between what the industrial meteorologists would supply and what it was expected that the government would supply. You certainly resolved a good part of that when, in the year or more that you spent with Bob White, and it seems to me now that the whole attitude of the government is quite different from what it was in the early days. Is that true?

Crow: That's true. A new publication's about to come out written by Ed Gross at the National Weather Service, concerning their official attitude toward the consulting side. And it's as I told you, they're fascinated by the things we get in on. And they can help us by being of service of some kind.

London: Well, is there anything else? We have just a few more minutes.

Crow: I'd like to cover some fascinating things around the world, so to speak. I had gotten involved in one case where the wind blew away a train between here and Boulder, blew over a train on the circular segment of track that comes down the hill some five miles north of Golden. As of now they have cars loaded with slag and so forth sitting permanently around that circle to prevent the strong winds from blowing over their trains there. The chief engineer for Denver, Rio Grande & Western was Mr. Jack Ayer, a member of our church. So when this happened, he called me to go out and look at it, and I did. They had been hauling automobiles which were loaded three tiers high, so they had a higher than usual exposure to strong side winds as they went around that curve. They also had the turning moment of going around and swinging the top part of each loaded rail car outward a little bit. There was, I estimate, a speed range of between ninety and ninety-five mile an hour wind, based on Boulder wind data and the recovered data I had from the meteorological tower operating at Rocky Flats at the time. So that I was sure that the strong winds had caused the accident. It was a very extensive wreck.

So Jack asked me to put a wind unit out there and get some records. I wrote up a report and told them that I wanted them to record it so that I could look at the frequency involved in such strong winds. But which they didn't do. The other thing that they did wrong was to connect a wire into the control station in Denver, but they

set the threshold when the warning buzzer went off at only thirty miles an hour. Well, these guys in the control station got fed up with that because that could happen so frequently due to Boulder winds that they yanked the thing out of the wall. So about four years later, there was another accident at this same place. How they kept that out of the paper, I'll never know! They were really concerned at that time, because the customer companies might stop shipping via the D & RGW Railroad. It was after that second accident that they installed the heavily-loaded cars sitting around that circle to prevent wind-blown damage.

Now the other wind story has to do with a forensic case. The wind blew an empty grain car from Arriba, Colorado, toward the east and went downhill toward the east during nighttime darkness and ran into the front of a westbound train, killing the engineer. My investigation found that the downslope winds came from a thunderstorm. The Limon radar had a strong storm echo right there near Arriba--Arriba, in Spanish, means "high"--and so it's the highest point for many miles along this railroad. This car had been left sitting there without good brakes locked in place. Unfortunately, the guy who got killed was the guy was the same man who left that empty car there earlier in the week.

Now a side wind won't do it. An end wind only has the exposure toward the end of the car. A cornering wind gives you more total pressure on the car to move along the track than either side wind or end wind, and this was where the wind was coming from, from the northwest. The wind got that car started and then going downhill--they figured it was going more than twenty-five miles an hour.

I've got more of these, but...

I'm just going to mention a few of these. I have enjoyed preparing the 300 reports, technical reports for companies or on accident cases and so on and so forth, I'm up to number 337, I think now. And the file is right over there, we won't go through that. The UFO studies of the Condon Committee were contracted from the Boulder office several years ago--

London: Were you on that committee?

Crow: I wasn't on the committee. I was hired by them to look at nine cases of UFO's; mostly those were all interesting because they had to do with people not understanding how radar echoes give you false echoes of something. Mostly that was the problem.

I did the climatology of Nicaragua as an AID project several years ago. And then that crook that was running the country at the time--Somoza--he didn't even print the thing. They furnished him a printing press to do the printing, which he never did.

I have put together a report on Colorado's attractive climate, which I did for the University of Denver to put with a "popularity of Colorado." I finished just last year a big project for EPRI, Electrical Power Research Institute, to bring reality into the precipitation amounts we might expect in the high country and Colorado. That's what I mentioned to you a little earlier.

I've made two trips to Peru, one of which had to do with the bad smell that the city of Lima thought was from fish drying.

London: This was on the western coast?

Crow: Yes, on the western coast, and they had been drying fish there. Paul McCready had received this request and the money ahead of time to examine the causes of the bad smell. He knew I was going to Panama and he said, "Loren, why don't you go down and see what these people are doing in Lima?" I went down there and they had a little bit of data that they had on the wind direction during bad smell episodes. Those data clearly showed that it wasn't coming from where the fish were drying, it was coming from ninety degrees difference from that. And that's where Lima was dumping its raw sewage into the ocean. I left town, I don't know what they did about it, but I had easily identified the problem.

I have enjoyed visiting a lot of countries, including assignments in Hawaii and two trips to Thailand. I've done a lot on Denver's air pollution, and studies that I did as a reserve officer including the climatology of the upper winds which I already mentioned, and the failure of microwave of the wrong size in our telephone companies in getting information from the DEW Line stations; they just had the wrong equipment. I will tell you more about it later, but I don't have time today.

So the microwave was the wrong size, it was near a 3 cm. wave length, which was interrupted a lot by weather.

So I've enjoyed a heck of a lot of assignments around the world, and continue to like doing what I do.

London: And you're going to keep on doing it?

Crow: Well, until they put me six foot under, probably.

London: Thanks very much, Loren. This has been a very good interview.

END OF INTERVIEW