American Meteorological Society
University Corporation for Atmospheric Research

TAPE RECORDED INTERVIEW PROJECT

Interview of Gordon D. Cartwright
14 December 1991

Interviewer: Morton J. Rubin

Rubin: This is an interview with Gordon D. Cartwright, meteorologist, resident in Geneva. This is December 14, 1991, in my home in Bethesda, Maryland. The interviewer is Morton J. Rubin.

Gordon, in line with the suggestions we have, you're supposed to identify yourself, your date of birth, where, when, not why of course, tell us something about your early life and how you happened to get into meteorology.

Cartwright: Thank you, Morton. This is a happy occasion to be together, talking about our mutual life history and our careers at the Weather Bureau.

I was born in a small steel town, Newcastle, Pennsylvania, on August 14, 1909. The family at that time--when I came into the family--was four children, but it later grew to seven. I was the middle child and had the advantage of being able to learn from my olders and to teach the youngers. My father came from Wolverhampton, England, as a young boy with his family to seek a better life in America. They settled in Newcastle because it was rather similar to the opportunities they had in Wolverhampton, in that that there was a large steel and tin mill manufacturing in Newcastle. In fact, it was the largest of its kind in the world at that time. My mother was born in Fullerton, Pennsylvania, of Welsh parents. Her mother came as a young widow to Philadelphia at the time of the Centennial. She often told stories about the excitement of that period in Philadelphia when Welsh choirs came there to compete in the music festival. My father worked in the mills, but was determined that his children would never do likewise.

So they were both--my father and mother--keen to afford us a good education as least as far as circumstances permitted. Unfortunately, at the time of my graduation from high school in a very good school, it was just the lead-up years to

the Depression, so there was a very profound slump in work opportunities and a natural curtailment in the family budget. But I was fortunate on my part in growing up in a family where education was considered a great opportunity, reading was almost mandatory--I was a very avid reader of all kinds. I can remember in about my tenth or eleventh year I was given one of the Collier's Magazine's **Books of Knowledge**, which had a wide range of popular stories on science and related matters--science and technology. In fact, I can still remember one of the stories by Sir Oliver Lodge, a famous British physicist, on energy from the atom. There was a picture showing--I even remember the claim that one kilogram of atomic energy would lift all the battleships sunk in the Scapa Flow. Which shows how impressionable I was at the time, and this interest in science had already started. It was a period of enormous scientific and technical development in the United States and in the world generally. I recall very vividly the first flight of Lindbergh across the Atlantic, which we followed with great interest on the radio. I watched avidly to see the presence of the first dirigibles that were flying in the United States. The loss of the Shenandoah, for example, in a thunderstorm in Ohio--these all made very vivid impressions on me.

I worked at odd jobs, partly with my older brother who had a small business of handling and delivering coal. After all, Newcastle was named after Newcastle-upon-Tyne in England, which was also a great coal and steel center. Newcastle did not offer many opportunities outside these great mills, against which my father was very strongly opposed. As the Depression deepened, these mills fell into very bad decline and unemployment was very widespread. Also, these mills were aging now, and not very efficient. It may be an interesting commentary that the mills that were designed and built in Newcastle were made as repetitive operations where each mill--I think there were about forty in this large plant--had its own crew that operated more or less as a unit to produce sheet steel. Sheet steel was used in a wide variety of industries, but the United Steel Corporation decided that this method was out-of-date, and the continuous mill came into use. Rather than re-building the mills in my hometown, they went to Gary, Indiana, and that was the death blow for Newcastle as an industrial center.

Fortunately, I happened to see an advertisement in the post office for two positions. One was an airway tender with the Civil Aviation Agency (CAA) and another with the U.S. Weather Bureau. I made application to both, took the exams and by a stroke of good fortune, the response from the Weather Bureau came first. I received a letter from the Chief of the Weather Bureau for their administrative people instructing me to report to the U.S. Weather Bureau Office in the Oliver Building in Pittsburgh, Pennsylvania, on June 1, 1929, and that continues as one of the great red letter days of my existence.

I was welcomed to the office by a very fine and able meteorologist-in-charge, William S. Brotzman. I later became closely associated with his son, Lloyd, who worked his whole career as a professional in the Weather Bureau. Pittsburgh was obviously under the effects of the Depression already, but it was still a very booming industrial city. It was called by one of its great sons, Andrew Mellon, the "Workshop of the World" because everything of a technical or a material nature was made at that time in Pittsburgh. The mills that operated there were of the older types, also, so there was a tremendous amount of pollution in the atmosphere. In fact, three years before I came to the Weather Bureau in Pittsburgh, the county had formed the Allegheny County Smoke Bureau. This was an attempt, even in those early days, to try to improve the very bad atmospheric pollution.

Rubin: Gordon, at that time was the Weather Bureau at all involved in looking into these problems?

Cartwright: Not in a direct sense, Morton. We, of course, had records of temperature, wind, and all the fundamental features of the atmosphere, but we had not started, really, in the aviation side yet. In fact, I was hired on the basis of an act of the CAA to improve the reporting of weather information for aircraft.

Rubin: What was your specific job, Gordon?

Cartwright: I came in as a junior observer at the handsome salary of $1,440 a year, not a month, but a year. That was considered a reasonable salary and I got along fine on that amount of money.

Rubin: I was married at that salary and lived very well.

Cartwright: Indeed. Well, I said I came in, I was hired under this expansion of the Weather Bureau to provide better service for aviation. But the fact of the matter was that in Pittsburgh there was not an active central airport. At that time in aviation history, it was considered that the air companies themselves had to build the airports and Curtiss Wright, one of the big manufacturers, built a number of airports over the Eastern part of the country. But they were in the process of building an airport at Pittsburgh, and until that became active, I was actually assigned in the city office, where I worked as a normal observer during the day. But later, as the tempo built up on the aviation operations, I began taking observations for aviation in the downtown office.

The observations had to be made three-hourly; I was then assigned to the light duty of making these three-hourly observations and reporting them by telephone either to some communications center in Pittsburgh or Cleveland, Ohio.

Rubin: Was there in fact night flying at the time, Gordon?

Cartwright: It was just actually beginning, Morton. You may remember from your assignment at Cuylertown, Pennsylvania, that you were on one of the great lighted airways where the guiding system was a series of rotating beacons that every ten miles could lay a path to the next part of your route. It turned out that a small company in Pittsburgh had won the bid to carry the airmail from Cleveland and Pittsburgh, and I can even remember the amount they got. They got $16.00/pound for every pound of airmail carried, which was obviously a subsidy because the airmail stamps certainly didn't pay for it even then. But that little company grew, was taken over like happens so many times in aviation and in a sense, the present great U.S.Air, now with the building and based in Pittsburgh, has some of the old elements of that first airline that flew the mail from Pittsburgh and Cleveland.

Rubin: You mentioned Lindbergh. He had been an airmail carrier, too, hadn't he, at one point?

Cartwright: Yes, Lindy had a very wide career in the Navy. He was a barnstorming pilot, but actually came to my hometown after he had made his famous flight to Paris. But the airmail was a separate operation because the passenger service was so uncertain that they couldn't deliver the mail on that basis. Furthermore, the aircraft were all quite small, and if you were a passenger, you were lucky to be able to sit on the mail itself. Even in those days, they had the idea that familiarization flights for meteorologists was gradually taking on and some of our people were able to fly on the mailsacks in these small mail planes.

In contrast to the work that Morton did, I was rarely associated with fundamental research. My career grew around operations, mostly in the aviation side of the Weather Service as it expanded. I was lucky in that early in my career I was assigned to a forecast center in Cleveland, where the science of meteorology, as it was known then, was really practiced. Furthermore, we had not only a pilot balloon station for upper air soundings, which we didn't have in Pittsburgh, and we also had what was called an "aponde" (airplane observation), which sounded the atmosphere up to the modest height of 16,000 feet.

Rubin: Who was the head of that station, Gordon?

Cartwright: When I went there, it was Clarence G. Andress, a very well-known and strong-minded individual, who believed in discipline, but who had a wonderful background in meteorology. He was, in a sense, a principal leader in the development of the Aviation Weather Service. He had been a balloonist during the

First World War, as had Dr. Reichelderfer, the later Chief of the Weather Bureau. When I came into the Weather Service, it was Charles F. Marvin, who was basically an instrumentalist and the developer of the Marvin three-cup anemometer. It may have been a four cup at that time.

But the transfer to Cleveland was a great boost in my view. I can remember when I arrived to report at the first city office, the man in charge there said to me, "Well, and you came clean from Pittsburgh?" Yes, Cleveland was a fine station to be based because it had not only the airplane observations, but a very important aviation forecast center flying between Chicago and Newark. Mr. Andress was a taskmaster, but I was able to get along with him all right, and learned quite a bit under his strict tutelage. The other advantage of being in Cleveland was the fact that it was a major telecommunications center in the aviation system. In those days, we had not teleprinters, yes, they were teleprinters, but they printed only on tape, which you had to clip and stick onto sheets of paper and hang them on the wall under the different routes so that when the pilots came in they could rather easily scan the weather over their whole route.
This was also the beginning in a sense of central analysis; it wasn't central, but everyday at the main synoptic periods, the forecaster on duty would draw on a small base chart that could be fitted into a teletypewriter machine, a printer, and that could be transmitted over the lines so that all the stations on that circuit and other circuits could receive a weather map, an aviation weather map. It soon became clear that the maps--they were designed so that they would overlap and you could put them together and have a wider coverage--that the maps from Kansas City didn't always match up and the analysis for that from Cleveland or from Newark. And so it was decided that they would set up a small analysis center in Washington. That was really the beginning of the trend where the forecaster eventually did not plot his own and analyze his own charts. It was very much looked down upon by the field forecasters, and so to mollify them a bit, they were asked to send in their analysis to the center which would then examine these and come out with a kind of a combination product. But it soon became evident that this was not necessary, and that a good analysis center would be able to do its own analysis.

At that time, the public forecasts in the Weather Service, the general forecasts, were made from four centers.

Rubin: What year was this, Gordon?

Cartwright: This was 1930. Four centers, there originally were three--Washington, Chicago and San Francisco--but then because of the great importance of hurricanes, there was a center established first in New Orleans, under a very well-known

meteorologist. The head forecasters were two persons based in Washington, and their forecasts were considered the major guidance for all forecasters in the service. They were Richard Hanson Wakeman, and Charles L. Mitchell. They were both extremely able people, but Mitchell had something special. The way the system worked then, these men were assigned one month duty on in which they made all the forecasts, and one month of duty off in which they had free time, but in which they were invariably occupied in looking forward to the next month and reviewing all the past weather maps for that period. In other words, they were using what we called later the "analog" system, and I would like to comment a little bit more about that because it became a very important facility during the war for stations that were in the battle zones.

Rubin: I had the pleasure of meeting Mr. Wakeman. He lives not far from here, he lived, rather, not far from here, and at that time, he and I had something to do with each other because he was interested at that point in education for Latin American students. And of course with my experience in Latin America, we had a--he was, as you say, a fine gentleman.

Cartwright: Yes, Mr. Wakeman was a distinguished man, always very appropriately dressed, always very courteous, but a studious man nevertheless. He somehow lacked that very unique property that Mitchell had and which was rare. Mitchell had a photographic memory and an ability to interpret the synoptic picture on the map, which was relatively simple being simply the distribution of highs and lows since there were no fronts at that time. He was able to interpret that into the subsequent weather, which was really only for today and tomorrow.

Rubin: I think Harlan Saylor, who I mentioned in my interview, had that same capability.

Cartwright: Yes. It was a unique quality that you either had or you didn't have. I remember very clearly one of the finest aviation forecasters, Henry Harrison, who was based in Cleveland as the forecaster when I was there--everyday, every time he came on duty, the first thing he would do would be to look at the Washington general forecast. If it was by Mitchell, he would rarely go against it.

The work at Cleveland was extremely interesting, partly because it led to an introduction to the upper air picture. At Pittsburgh, we had no upper air maps and the forecasts were made entirely on the basis of the surface chart. We had another important function in Pittsburgh which later became valuable for me, and that was the recording and forecasting of the river stages on one of the most important rivers in North America, the Ohio. The Ohio feeds into the Mississippi, but it itself is fed by two major rivers, one from the South called the Monongahela and the other from the north, the Allegheny. And those two rivers were very fractious, I must

say. To predict the stage at the point in Pittsburgh, Pennsylvania, was no mean trick, and Brotzman had spent many, many hours studying the progress of flood stages down these two rivers and how they would act when they came as far as Pittsburgh.

The Ohio, and these two tributaries for a certain distance, were also highly navigable streams that at one time carried much more traffic than the Panama Canal did. The Corps of Engineers had devised dams that could be lowered when the water level was sufficient to carry the boats right across. It was a very skillful design, but the river observer had to know when the dam was up or you were in what they called a "pool stage," because that affected the level of the water for some distance upstream. But Brotzman became quite an important forecaster for river stages.

Cleveland led to another move somewhat later. When Marvin left the service, a very fine gentleman, Willis Ray Gray, who had been very active in analyses of upper air data, came in as the chief of the Bureau and that brought a rather new attitude to the work of the service. The aviation side became more and more prominent. The use of "aponds" predated the invention of the radiosonde, which, I guess the Russians had devised their own sonde, but the sonde used by the United States was developed, I believe, at the Diamond Hinman Laboratory of the Bureau of Standards, and it contained a very clever innovation and that is where the switching between the various elements in the sonde was carried out by the barrel switch, the barometer itself. As the sonde rose in the atmosphere and the pressure changed, it switched from humidity to temperature and back again.

Rubin: That was in the early 1930s, I believe, wasn't it?

Cartwright: Yes, I think the sonde came out--we were not using them when I was at Cleveland, and that took us up till 1936, but the sonde was probably under development at that time. As a matter of fact, before the airplane came into use as a sounding instrument, the Weather Bureau had both balloon sounders, not transmitting (you had to wait until the aircraft landed back on Earth to get the data), and kites. There were about eight or ten of these stations over the eastern part of the United States. One of them happened to have been in Texas when I became a colleague of the man who had the highest sounding by any kite--I think 21,000 feet with a kite. Well, a kite--I think there were 18 or 20 kites on the one string to get that altitude.

But having had experience in aponds, I was then assigned to Barksdale Field, which resulted from the agreement by the Army Air Corps to carry out these upper air soundings at a number of their bases over the country.

Rubin: Where is that field located, Gordon?

Cartwright: Barksdale Field was a very modern, large facility at Shreveport, Louisiana. So I moved to Shreveport and took up my duties there which I found extremely interesting. For anyone interested in aviation to be based at a field where there was the most modern military aircraft was really a great thrill. Unfortunately, the soundings had to be started at 2:30 in the morning, so it was night shift again for me the whole time I was there. But in that period I came to meet many pilots who later came into some fame as the Second World War started. In fact, the meteorologist in charge of the base was none other than Arthur F. Merewether, who was then a second lieutenant. So he was in charge of the small meteorological group. I didn't come under his direct supervision, but we became very good friends and he was extremely helpful in assisting me in making arrangements with the base commander and others to have these flights carried out. The Air Corps didn't always take them with great seriousness. And so it was a kind of an individual experience for each pilot. So we rotated through the whole squadron a new pilot everyday, and that often led to some rather remarkable types of flights.

One of the most interesting ones was when a pilot who was accustomed to flying at low levels forgot to notice that his altimeter was going around for the second time, and when he was up at about 22,000 feet, he passed out, not having realized that he was anything more than about 12,000. That was the highest flight we made. Most of them were 16,000 and we were lucky to have that type of a record.

Rubin: Gordon, did you go on those flights?

Cartwright: I made one flight at Cleveland, but I didn't make any with the military. The civil flights were based on a contract arrangement that the Weather Bureau had and it was remarkable how inexpensive they were. When I went there, they were paying $22 for one flight up to 16,000 feet.

Rubin: You couldn't get off the ground for that.

Cartwright: Well, one assignment led to another. I was sent, after a year in Shreveport, I was based in Fort Worth-Dallas, then to New York to start the new operation of the Transatlantic Weather Service at LaGuardia Airport. It isn't well-known that until LaGuardia was built in 1940, the principal airport for New York was Newark. And all the traffic came through there.

Rubin: What year was that, that you started that, Gordon?

Cartwright: That was in 1940. The transatlantic service had begun as a flying boat service,

initially out of Baltimore. But the facilities there were limited and when LaGuardia built its large marine terminal, the flights then were focused there. The development of that service was a precedent to the work that was later taken over by ICAO. The early flights were with flying boats, and went up through Newfoundland and across then to the Azores and from there most of them went on to either Shannon or to Lisbon. Pan American was really the pioneer in that activity, and its very sad to see this famous airline finally disappear from the skies.

Rubin: Did they at that time have their own meteorological group doing their forecasting?

Cartwright: Yes. The airlines had felt that the Weather Service wasn't able to meet their operational needs completely, so many of them--a number of the bigger ones--had their own meteorological service. American Airlines, Eastern Airlines, Pan American, United Airlines and some--

Rubin: United used to fly into Cuylertown when they were flying west and the winds were strong, and United maintained their own weather station there and re-fueling, and we would sometimes see them at the field in Cuylertown.

Cartwright: Well, one of the best-known aviation meteorologists was Henry T. Harrison, who later joined United and became very well-known as the head of their meteorological department. It is true that the airlines had their own meteorologists, but when the war came and security of weather information became a major factor, they were not able to receive the data directly, and so they pooled their specialists in the nearby weather office where the forecasts were being made. And that was a very helpful arrangement, I think. The first meteorologist-in-charge at LaGuardia was a man by the name of Wilson, whose first name I don't remember, but he was replaced during the war by Dr. Ben Holzman. Holzman was not an aviation forecaster; he had come up through the research side with the Soil Conservation Service, where he worked with Thornthwaite and other specialists in this field. But I can remember after a few months at LaGuardia, Ben in his quizzical way said, "Well, there's really nothing esoteric about this aviation forecasting, is there?" He acquired a real knack very quickly as he was such a bright person.

We were just beginning the use of facsimile recorders and the first one I recall being in effect was between the **New York Times**, downtown New York, and our office at the Weather Bureau at LaGuardia. The **New York Times** did actually produce this--It was a very cumbersome and slow machine by comparison, but it enabled an exchange of charts between our city office and the airport. That period also saw the introduction of the copy machine. The first machines were these so-called "Ozalid" machines. No, I take that back, the Ozalid machines came in while I was in New York, but the predecessor was the terrible gelatin strip on which you

used an indelible pencil called the "Ditto" machine, and these were suitable for making fairly small-scale charts. But when the North Atlantic-type chart came into being, we needed a larger base. That led to the Ozalid machine, which was a German invention, I believe. And there was even talk that it had been invented and spread into America so that the Germans could get our technical data where it was used.

But the advent of the war created an enormous expansion in the development of weather services on a global basis. And it was this great expansion that eventually led in 1944 to the signing of the Air Service Agreement, the convention which provided for the International Civil Aviation Organization (ICAO).

The development of trans-Atlantic flying was under what was called "TASO," Trans-Atlantic Air Safety Service Organization, drawn up between Canada, the U.S. and Ireland, and I think, the U.K.--all the players at that time in the trans-Atlantic race. I can remember Austin Nagel, who was then director of the Irish Meteorological Service, and an active participant in these arrangements, came to LaGuardia to discuss the exchange of material and that sort of thing, and with him was H.H. Lamb, who later became quite well-known for his work in the field of climatology. Nagel was a very clever man who made a serious mistake of giving up his European standing and coming over to work in the U.S. That never offered him the real opportunity that he might have had had he remained in Europe.

After a time of going to school at night or working at night and going to school during the day, I had the good fortune to get a scholarship to go to one of the cadet training classes at N.Y.U. That was a great, I must say almost a picnic, after going to school all day and working all night. We had the great good fortune of being under the, the department was under the leadership of Athelstan Spilhaus, who was not only a fine instruments man, but a very skillful man as a dynamicist. He gathered around him quite a good team of people, including Bob Montgomery, Bob Stone, Julius London, Gardner Evans and people of that sort, so that it was really quite a good department, perhaps not as strong as Chicago in a theoretical sense, but from a practical sense, I think it was a very good school.

Rubin: It pre-dated Chicago. M.I.T. was the only other one, and Caltech, I think, at that point.

Cartwright: That's right, Morton, but I thought that Chicago had been organized to accept cadet candidates. Or was it Michigan?

Rubin: Well, Rossby didn't go to Chicago until 1941 or 1942. But anyway, they were almost simultaneous. You may remember that Spilhaus and Harry Wexler were

roommates at M.I.T. when they were graduate students together.

Cartwright: I didn't remember that. The other place I was thinking of was Grand Rapids, where the Air Corps set up a special training school for meteorology.

Rubin: That's where Glaser was--no, Glaser was at Chanute, sorry.

Cartwright: Well, that was a great break for me and I unfortunately lived on the other side of New York, and I tried to do some work on the downtown campus, so I was spending four hours a day on the subway in August. And finally I decided that was not the thing to do, not the way to make a living.

But after graduation, something happened which relates to Morton Rubin's [AMS] interview, and that is the development of a program to analyze forty years of Northern Hemisphere charts, surface charts. That was to be used as a tool in the analog system of forecasting, which was widely prevalent at that time. In fact, I believe Krick used the analog system for many years after that. The trick was to have a sufficient background of analogs that you could draw upon to match as precisely as possible the situation you were confronted with.

Rubin: My recollection is that that was funded primarily by the Department of Agriculture, wasn't it, Gordon?

Cartwright: I don't think so, Morton. The Department of Agriculture was active in weather under the Bankhead-Jones Act, which was an act to provide for longer-term forecasting to avoid the disasters of cold waves and things of that sort.

Rubin: That's the one Jerome Namias was involved in. But didn't he base it on those forty-year maps? They were done in New Orleans, weren't they, with McDonald as the head of it?

Cartwright: They were done initially in Washington, and a friend of mine, George Mitchell, was in charge of the plotting of the maps. The analyses, I think, were done--well, what I started to say was that project came into being while I was still finishing up at N.Y.U. So I was asked to stay on to assist in this project under Joergen Holmboe. Unfortunately, other things came up so that I was only there about two or three months, and never had the advantage of his superb analytical sense. I believe he was one of the greatest of the Norwegian school of analysts, having not only the theoretical background, but also a very keen synoptic approach to things. Because of the paucity of weather data in those early days, you had to learn to get as much as possible out of each particular observation; you looked at every observation with great attention and care.

I would like to go back a little bit to talk about the historical map series and compare it with the maps that were done in connection with the IGY. I think you'll remember, Morton, that one of the programs under the IGY was a global map series covering that period. I don't know whether they did eighteen months or only a year.

Rubin: Eighteen months was the IGY period.

Cartwright: Yes, but I think they did only did the months for the year 1957. And that was divided between Germany doing the tropical part, the U.S. doing the Northern Hemisphere, and South Africa, I think, did the Southern Hemisphere. Am I right?

Rubin: I think so, yes. That was the one Harry van Loon was involved with, with ?Teilyard.

Cartwright: Yes, the question that has come to my mind repeatedly is what use are those excellent analyses today? I'll give you a little example of why the question comes to mind. Several years ago, I came across a weather map that was reported to be the map issued by H. H. Kimble, no James H. Kimble (H. H. was a different man) at the New York office for the Lindbergh flight and the map which he was said to have carried with him. The copy that I had contained his pencilled notations of the weather he encountered as he flew across the Atlantic. Many years later, the WMO decided to use as its--

END OF TAPE 1, SIDE 1

INTERVIEW OF GORDON CARTWRIGHT

TAPE 1, SIDE 2

Cartwright: The question that I wanted to discuss, Morton, and the question that I raised with you: What is the current value of these historical maps that were made at considerable cost and with great care? You described the way in which you gathered the data for the maps that you were working on in South Africa, and I remember that if one reads the introduction to the historical map series, you see the number of contributors to that series, contributors of data. The story that I wanted to mention is that, on this occasion of the World Meteorological Day, when aviation was the theme, I suggested to the Secretariat that they use this Lindbergh chart as a centerpiece in that particular brochure. They did something better than that. They sent the chart to a colleague in U.K., who then produced a program--no, I should back up. We went back to the historical map series and copied the map of that day as it was re-analyzed with all the possible data that could be obtained. That map was then sent to a colleague in U.K., who produced a program from which he derived the 1,000 millibar windfield. I then sent this material to Art Snellman, whom you may remember made the marvelous forecasts for that nonstop, round-the-world flight of the Voyager. Snellman wrote back and said, "It was a damn good forecast." The major difference between Lindbergh's flight and the Voyager is that the Voyager had satellites and communications, so that they were able to update at every stage of the flight, their forecast.

But anyway, I thought this seemed to imply that there was still important information in that series that lies in hundreds of archives all over the world, probably absolutely unused. Now, would it not be in the interest of climate alone to go back and put those maps on tape so that they could be analyzed and summarized and dealt with in a modern sense in our own models today? That's a question, Morton, and you look very glum about it but I wonder what your reaction would be.

Rubin: Well, I'm quizzical in a sense, and I think I'm a bit jaundiced in the sense that each age wants to do its own thing, building, of course, on what went before, but it would be an interesting research activity, I think, from the point of view of a better understanding of the dynamics of climate to go back and put those into a modern format so that our period of data could be extended. It's hard to say, though, how much interest you could elicit for somebody to fund that and for people to spend their time doing it.

Cartwright: Yes, I understand that, Morton, and I know precisely what is behind your thoughts. As I recall, in talking with Pierre Morel, he doesn't look back at the climate data.

He uses the current World Weather Watch data as the basis for any modeling that he intends to do. Nevertheless, I think I might write a letter to the present executive director of the AMS to raise this point. Perhaps he would be willing to publish the letter, and to see what kind of reaction one would get to it from the AMS readers.

But the same argument would apply to that excellent series you worked on, the IGY Global Weather Maps. That was intended, as I understand it, Morton, to provide a meteorological base for any research done in other fields where meteorology was an important factor. Is that correct?

Rubin: Well, I don't know. The Southern Hemisphere series that I did postdated the IGY by quite a number of years. They were used--I mentioned a few people who did use them. I frankly don't know how they were used later on or whether any elements of the IGY series was. The only connection would have been that van Loon, who was in South Africa at the time, had come out of our Southern Hemisphere Map Analysis Project which we had at MIT and carried to South Africa, and ?Teilhard himself--because they were the ones who were doing the IGY series for the Southern Hemisphere at least. So there was a progression from one to the other; I think something was gained thereby.

Cartwright: I think, in fact, there was also a sequel to the basic forty-year historical Northern Hemisphere maps carried out by the Air Force, in which they incorporated upper air data as well. I don't have much information about that, but I will raise this question with the American Meteorological Society, for whom we are now working.

Rubin: Let's get on now with the rest of your story, from after you left NYU.

Cartwright: I was then transferred to the Central Office, as we termed it in those days, in Washington, and worked with the deputy chief, Delbert M. Little. That brought lots of connections of personalities who were really active in the business. As I said at the beginning of the tape, unlike Morton Rubin, I was not personally engaged in research, but I developed and had many, many contacts with people who were carrying out these important developments. For example, I remember very clearly Charles F. _____, who was director of research in the Weather Bureau under Reichelderfer. He was an organizer and a manager more than a researcher. I think he came from the Department of Agriculture.

Rubin: You probably met Ross Gunn, who was director of physical research at the Weather Bureau.

Cartwright: Yes, I can tell you a couple of stories about Ross Gunn that may be of interest. But getting back to the research side, I remember seeing Dr. Irving Langmuir, one of the great Nobel prizewinners in chemistry, coming with Vince Schaefer to the Weather Bureau to tell Reichelderfer about weather modification. They had performed their experiments in New York State where Langmuir was chief scientist with General Electric, and had produced a hole in the cloud system as a result of cloud seeding. Reichelderfer was always a skeptic about weather modification, and even the persuasive powers of as great a scientist as Langmuir did not convince him that it was a practical thing to do. In fact, one of his fine lieutenants, Ivan R. Tannehill, wrote in his early book on drought, that in all history man has not been able to produce enough rain to water a small garden at a time and place of his choosing.

Now I think that's still true. It doesn't discredit all of the weather modification efforts, but that has a long way to go yet. On that point (I'm jumping around a bit), the present chairman of the committee on weather modification of the World Meteorological Organization is a very fine scientist, Dr. Harry Orville. Under his strong urgings, the "official" statement by the Executive Council on Weather Modification now has a much more optimistic tone than it did under previous administrations. I understand from an AMS point of view that Harry also chairs the Commission on Weather Modification for the Society, so I would assume that these two statements would have some reasonable consistency.

Rubin: Let's get on to Montreal.

Cartwright: Well, the war did bring on many remarkable improvements in meteorology. Typical of the military approach, they were confident that they could solve the forecast problem within the next few years. There was this famous saying of the Army Air Corps: "The difficult we do today, the impossible takes a little longer." That has certainly been proven wrong in many cases of human history, and weather modification is one of these. Nevertheless, their efforts were a great assistance in this area. It brings me also to the fact that the Weather Bureau strongly resisted any efforts to make tornado forecasts, in spite of the work of Thornbush and Miller out in Kansas, Tannehill felt it would be misleading to the public to attempt to predict these highly localized and "unpredictable" storms. So he resisted this as long as he had a role to play. But the efforts of the Air Corps and Thornbush and Miller in particular forced the matter. The families of the Air Corps people based in Kansas talked with their neighbors about the fact that the tornado was predicted, and in a very short time, the Weather Bureau was forced to get into the business. They have done a remarkably good job through their Severe Storms Center in Oklahoma City, and the advent of Doppler radar is going to make a tremendous change, already has made a tremendous change, in the predictability of these terrible storms.

(There is a little concern here as to whether the Center was based in Norman or whether it was actually in Oklahoma City--I think it must have been in Norman.)

The war had tremendous impact on meteorology, certainly in the area of better observations. The invention of the radiosonde, the widespread use of aircraft in reconnaissance flights, the installation of weather ships over the Atlantic--which at one time, I think, there were some 27--and the development of similar programs in the Pacific--was a tremendous boost to the expansion of meteorological information and the services based on it. A little interesting anecdote about the war and the classification of weather: I was working with Mr. Tannehill in his office when he brought a letter from the publisher of the Farmer's Almanac. He had been informed of the security measures that no weather information would be given public distribution. So he came back with a rather plaintive letter saying that, "Well, really, Mr. Tannehill, these forecasts aren't all that good." That produced a big grin on Tannehill's face that he acknowledged that the Almanacs had their own particular clientele that didn't interfere with the security of the United States.

But the development and spread of aviation did result in the formation of a new international agency, the International Civil Agency Organization, which grew out of a convention held in Chicago in 1944. I can't remember who chaired that convention; I believe it was an American, but the first head of the president of the organization was Edward P. Warner, an MIT professor in aeronautics and a very keen researcher in this field. Warner had also been Assistant Secretary of Air for the Navy in a period of great development of aviation in the naval service itself. He and Reichelderfer fortunately were very close friends, having worked together on NACA (National Advisory Committee for Aeronautics) projects. In fact, Reichelderfer had many important contacts.

[NACA] was headed at one time by the man who later became the first administrator of NASA. I believe it was Keith Glennon, but he was followed by the former NACA director at a later time. You may remember that NACA had a whole series of administrators, including Jim Webb, who I thought was a very fine administrator and we often saw him in conferences related to the development of the satellite program.

This was a very lively time for a young person in meteorology during the war. One of the projects with which I became involved was meteorological support for the Al-Can Highway Project, and simultaneously for the ferrying of military aircraft between the U.S. and the Soviet Union via Anchorage and via Fairbanks and Nome to Siberia. We had the cooperation of the Canadian Weather Service, who didn't have the means to establish these stations, so I was sent up there by Del Little to

assist them, to take a group of young observers to get the station started. These proved highly valuable to the Canadians, who were then able to carry on the network in furtherance of the war effort. Later, when I came back--well, perhaps I should speak briefly about my period in Montreal in the Met Division, where Norman Hagan organized the first meeting of the Met Division of PICAO, the Provisional International Civil Aviation Organization. Norman Hagan was a very lively and aggressive person who had Reichelderfer's confidence. He was assigned, as the war in Europe was drawing to a close, to establish an office in London from which he would follow the progress of the military forces across Europe. The object was to make quick contact with the civilian side of these weather services in order that the U.S. Weather Bureau could maintain and build its confidence as rapidly as possible. Reichelderfer realized that when the war was over, the military influence would begin to decline, and the civilian influence would have to grow rapidly. And so he sent Norman Hagan to London where he donned an insignia-less uniform, and he set off with a chief and a driver to follow the war across Europe. Norman was exactly the kind of man to do that.

Rubin: Was Art Johnson involved with something like that, too?

Cartwright: Art Johnson was in the military and worked as one of the staff on the quadripartite group that was based in Wiesbaden and later went on to Berlin. Van Solenaar was also on that same team, and Art has written several very interesting stories about his experience. Digressing a bit, in a long, recent tourist trip to Europe, he went back to Berlin and was able to find the house where he had lived during the war.

But Hagan's efforts were extremely valuable because he made a lot of contacts with the emerging civil officials. He went to Moscow to meet with General Fyotroff (?) who was then the wartime head of the Hydrometeorological Service. Russia was not an easy place for an American to move about in, especially since Norman did not have any command of Russian. But being a very persistent man, he kept going back to the Hydrometeorological headquarters but always getting the brushoff. So he one day thought, "Well, I'll just look for him." So he went up through the corridors of the building and sure enough, he ran into Fyotroff. He also had the problem of looking very much like Molotov, so when he walked on the streets of Moscow, people would turn their heads and stare at him, wondering who this Molotov was. Norman was a very valuable man for Reichelderfer, because he had this facility and the gall to go anywhere that Reichelderfer sent him.

Art Johnson became involved in these kinds of things and I will mention later his work in Geneva. But Montreal was a very stimulating experience because we were starting a whole new enterprise, a new international agency to pick up where the military had left off in their global transport system and to build a civil transport on

the basis of that. For example, when the war ended, the military no longer was prepared to fund the North Atlantic weather ships, so ICAO called a conference in London to see what could be done about it. I remember that the principal delegate for the U.S. was Del Little, and it was interesting to see how these great meteorological leaders decided on the distribution of the network of stations.

They had an analyzed weather chart from the London weather office on the table, and Little said, "Anybody got a shilling?" And so out came the various shillings--McTaggart-Cowan was one who had a couple of shillings--they laid them on the chart and began to push them around in what seemed to them to be a reasonable manner. It wasn't purely uniform distribution, because these men knew very well the storm tracks and areas of major interest, but in the end they came out with thirteen shillings on the table and those became the basic network of ocean weather stations that ICAO then supported through joint contributions. You may remember that because of its enormous investment in this system, the U.S. operated half the stations, all on the western side of the Atlantic, and the arrangement for payment was based on benefit. And the benefit was a complicated formula involving the Gross National Product and the contributions to the U.N. and the meteorological factor, which was indeterminate, but nevertheless there. For example, the nearness of the eastern Atlantic stations to Europe obviously made them of more meteorological benefit. So it turned out in the end that the U.S. had a reimbursement for part of its investment in that early ICAO-North Atlantic Ocean station system.

Rubin: Gordon, as an aside to this, I remember sometime possibly in the fifties or the late fifties, there was a study done by Bill Klein to remove a certain number of ships' observations and make a forecast and see at what point it would be degraded to the extent that it wouldn't be a useful forecast, or analysis rather. Do you remember that?

Cartwright: I do remember that. Nels Johnson acquired that report which indicated that the use of the ocean stations was a negative influence. Nels kept the report. And he points out that in meteorology, averages are not the most important thing. It's the extreme events. And the British have shown, from their point of view, even today that the placement of weather stations west of them is of great value in extreme situations. It didn't help them, I don't believe, in the hurricane that went across Southern England and did so much damage.

As we were discussing, the effect of the war, certainly on the meteorological prediction and information, was very profound. The satellite has also been a major factor. But there still is the need for ground truth, as we say, and this development is moving very slowly. The increase in the number of viable upper air stations over

the globe is very small, if not even negative. And so one wonders what it will take to bring that observing system, the World Weather Watch, up to a satisfactory level to support not only the global analyses, but to support the meteorology in their own areas. This brings to mind a recent survey being made by Jim Bruce and Bob Brook in their efforts to improve the support for global climate and global warming. According to Bob Brook, they were often met by the statement that these officials in these tropical countries hardly regarded meteorology as having anything to do with climatology. Which brings to mind the problem of meteorology and oceanography. The coupling between the two is so obvious that it seems tragic that the meteorologists and the oceanographers don't share the same attitude towards their international science. I suppose this is due in part to the fact that in its early days, oceanography was an individual expedition operated by a small institute or a small group of oceanographers who gathered their own data, took it back to their laboratories to work on it for a year or two and published their research results. But that hardly seems the way to go about it now in the days of global warming and the enormous pressure on the oceans as part of the transport system and the advent of pollution in fisheries.

Rubin: I think that's changing, Gordon. Probably, the fact that the war itself had a lot to do with that, and so much of the submarine activity and the need to do acoustic sounding and study the large-scale currents. And we know that there is more cooperation between the meteorologists and the oceanographers. Now it stems to some extent from the need to understand the whole climate system.

At some point, you left Canada, you went to Washington, and I think you were out in the Pacific, were you not?

Cartwright: Yes. I was asked by Dr. Reichelderfer to replace Bob Simpson when Bob came back from the Pacific where he was a supervising meteorologist in Honolulu to organize hurricane research activity. You may remember that: Bob worked in Washington for some months before he finally got the research center going in Miami.

Rubin: That was about the time I first came to Washington, in 1955, I believe. I saw him during that period, not in 1955 necessarily, but some time after that.

Cartwright: Well, I came from ICAO in 1952, and for about two months, Bob and I were working together in the Central Office, he on the preparations for the National Hurricane Research Center. The assignment to the Pacific led to a number of interesting contacts. I traveled over the Pacific quite a bit, had the advantage of meeting Dr. Medachi, who was perhaps the most effective head of the Japanese Weather Service that I have ever known. He was a man of great breadth and vision

and very active in not only his own field, but other fields as well.

Rubin: I met him and he showed me a lot of his card tricks.

Cartwright: Yes, he was a great asset to any party because of them--a very lively person. But I remember going to Australia where I met Taffy Bowen--what was Taffy's real first name? I've forgotten now. I saw the facilities there for their cloud physics work. You may remember that they were some of the most active in this field with Bowen at the head. Bowen worked then for CSIRO, which supported this activity. He came to the United States on a professional visit where he was asked to give a talk to Weather Bureau people. Ross Gunn, who was then head of engineering, I believe--

Rubin: Physical research in the Weather Bureau.

Cartwright: --and had done some work himself in cloud physics listened very attentively to Bowen's lecture on meteoritic dust as a seeding agent for storms. At the end of the lecture Gunn said, "Well, Taffy, what you don't say interests me more than what you did say. I find it still very hard to believe." I was visiting in Australia at the CSIRO headquarters when we met Cluny Ross, who was then the director of CSIRO, at a luncheon that he put on. Several of the Australian meteorologists raised the question about this meteoritic dust theory, to which Cluny Ross replied: "I'm not in that business, but I have confidence that Taffy will fall on his feet on this one." I don't think that proved to be true; I think it was gradually discounted.

The Pacific Science Congress had already been well-started when I was in the Pacific, and I was able to attend one or two of their meetings in the Phillipines. I believe it has continued to be an active agent for the development of science in this area.

One of the strange and remarkable individuals in the Pacific at that time was Father Gertsey. Weather has always been a field of great interest to the Jesuits. I can recall visits from the Jesuit school in Georgetown to the Weather Bureau, asking questions about various opportunities and various programs that we were running. Father Gertsey was a unique individual; he was quite a good musician and a man of great intensity. In his lecture, he demonstrated by physical movements many of the theories he was expounding on--the transmission of atmospheric gravity waves and things of that sort. He later came to Canada where he was installed in Loyola University, which was a Jesuit school in southern Canada.

The work in the Pacific was extremely interesting because of the wide scale of opportunity which one had.

Rubin: What specifically was going on there then?

Cartwright: The atomic tests had been held already, but a major event was the acceptance, or the acquisition by the United States under the U.N. Security Council of authority over the trust territory of the Pacific Islands. It was my job as head of the Weather Service in the Pacific area for the Weather Bureau to rebuild the stations, the upper air stations that had been established on those islands as the Navy gradually moved the Japanese forces westward. And so I made a visit to these stations, a rather remarkable experience because you saw the conflict of the highly advanced societies technologically and the primitive life that these people led. We tried to--as it was very expensive to keep our own observers based on these islands, we began to train the local people. That was a sociological experience of the first order. For example, they had no concept of what a clock stood for. Time--that was something measured by the tide or the sun, but this little device hanging on the wall had absolutely no meaning to them. Furthermore, what was this black cord that you had in your hand and that you plugged it into a strange object in the wall? Completely unknown, in their way of thinking. So it was a fascinating effort on our part to gradually bring these young people in and finally we graduated a class in upper air observations in the Pacific. Some of them have proven to be very good observers, and saved the Weather Service quite a bit of money.

After the Pacific, I came back to head up the observing system for the Weather Service [still the Bureau?], which was a period of great development and change. For example, the introduction of the weather detection radar was now absolutely accepted.

Rubin: What year was it when you came back, Gordon?

Cartwright: This was 1954. We were at that time using the old airborne radars that the Air Force had declared surplus, adapting them for ground-based use. They served for a time, but their limitations were very severe, particularly in the hurricane area. And so we then developed a new Weather Bureau radar; I can't remember the cost, but it was probably on the order of $3 or $4 million, which we thought was enormous. I suppose the new Doppler radar is more on the order of $30 or $40 million. That's probably too high; I think that they're actually lower than that. But these developments in weather observing were moving very rapidly at that time, partly because of the introduction of the satellite system. The first TIROS satellite was launched and began its reporting on April 1, 1960. I had by persuasion, I had Dave Johnson working with me in the old observing system where he ran the little observatory at Silver Hill. But Dave had soon shown that he had talents much beyond that. Wexler, a very clever guy in recognizing talent when he saw it, had

decided that Dave was the kind of a man that they needed in the satellite system. So he was assigned there with Sig Fritz, whose work in solar radiation made him an obvious candidate.

After a time, as the laboratory developed, there were more and more conferences going on about who would do what and how they would relate to one thing and another. And Sig was going to all these conferences. So he finally said to Dave, "You're pretty good at this. I don't like to go to conferences, I'd much rather do research. Why don't you become the head?" So in effect they switched jobs like that, with the agreement of course of the chief and others. And whatever the overall result, it was Sig Fritz who wrote the early papers and will be remembered in the literature for many, many decades where satellite meteorology is discussed. Dave proved to be a very able director and carried the system up to a very high level of efficiency. He was able, with much labor and sweat and blood, to work out this famous memorandum of understanding with NASA, which gave the Weather Service the operational responsibility, but required NASA to continue its development program for future satellites. The fact that that was terminated for awhile has caused a very serious problem for the satellite system, I think, and perhaps this great difficulty they're now facing on the GOES satellite may be partly attributed to that break in the continuity of work with NASA.

Rubin: NASA is still, however, responsible for building the satellites to the Weather Service's specifications, is that not true?

Cartwright: That is true, but no, I don't think that's true. I think they are responsible at the request of the Service to develop new systems, and once these systems have been tried, then the responsibility for funding and watching and operating the operational system falls on the Weather Service, or the Satellite Service, as it's now called. That was one division that, when Bob White developed ESSA and then NOAA, that caused some consternation in the Weather Service when he decided on an atmospheric research laboratory--ERL. He took the research aspects out of the different units of NOAA and put them under one head. And there was considerable complaint about that, that it was true that it intended to isolate the research needs from the operational requirements.

Well, Mort we could probably go on for some time. . .

Rubin: Gordon, it occurs to me at this point that an important next step that you took, when you were back in Washington, was to be involved in the Antarctic program to some extent and you were then going to--you had a new assignment. Would you tell us about that please?

Cartwright: That is certainly true, Mort. My lifestyle changed abruptly following a conference in Paris of the committee on the IGY and the Antarctic program, which was attended on behalf of the U.S by Dr. Wexler and some of the other IGY-U.S. officials. At that conference, they began to lay out the program of the network of stations that would be set up in the Antarctic as part of the IGY effort. When Dr. Wexler came back from that conference. . .

Rubin: The IGY, what was that acronym for?

Cartwright: The International Geophysical Year, which was to take place initially during the 1957 period, a time of maximum solar activity, I recall.

Rubin: Can you give us a little bit of background on that, Gordon? Who were involved, and had there been any precursors or previous worldwide scientific activities like that?

Cartwright: Yes, Mort. You probably remember that this was a followup of the international program started on what they called "Polar Years." The first one was, I believe, was about 100 years before, in 18--

Rubin: I think probably it was later than that--

Cartwright: Yes, it was around the 1870's, and it was organized almost entirely by meteorological scientists to gain better information on the circumstances at the Pole, the North Pole that is. There was a fifty-year later repetition of that, and so the tradition had been established.

Rubin: About the 1930's, I believe, Gordon.

Cartwright: Yes, and I believe it was--

END OF TAPE 1, SIDE 2

TAPE 2, SIDE 1: NOTE: This side of the tape was completely blank. Interview continued on Side 2.

INTERVIEW OF GORDON CARTWRIGHT

TAPE 2, SIDE 2 [Side 1 is blank]

Rubin: You were talking about the Bureau, Gordon, when the tape stopped.

Cartwright: The Bureau of the WMO is not an official body of the Convention, but it has proven to be a very useful body in handling certain administrative and tricky details on behalf of the Executive Council. It is right up with the four officers of the organization plus the Secretary General, and now they have added the directors from the three world meteorological centers--Moscow, Washington and Melbourne. They usually add one or two others selected from the presidents of the regional associations, where there are particular problems that will come up at the Executive Council at the subsequent meeting. But Dr. Friday, as the U.S. government representative, sits on the Bureau and this provides an important access to information that wouldn't normally come to him.

Rubin: How many members are there who adhere to the Convention of the WMO?

Cartwright: I believe the number now is at 160, but expect it to rise as the breakup of the Soviet Union continues. In fact, I understand that the three Baltic countries are expected to apply for membership very soon. It happens that under the previous arrangements in the Soviet Union, both the Ukraine and Byelorussia were separate members. This was a device to give them a little larger voice in U.N. Affairs generally. There is, I found, in talking with people from Eastern Europe--there is already a tendency to look at the principal bodies that will remain as this sorting-out of the countries goes on. I recall talking with the director of the Austrian service in Vienna, and he is now dealing with the regional parts of Hungary and Czechoslovakia when he tries to make arrangements for cooperation and exchange of data.

Rubin: Gordon, can you tell us something about the Secretariat and how it works and the personnel and your interaction with the people there? That might be interesting.

Cartwright: This has been a matter of much satisfaction to be able, over a period of more than twenty years, to maintain a friendly relationship and still a useful one. I have tried to be completely honest with my colleagues in the Secretariat and have always had a friendly working relationship with the Secretary-General, including from the beginning, Dr. Davis, Professor Wiin-Nielsen, and now Professor Obassi. Professor Obassi recalls that he met me in Washington when he was assigned by his government to take part in the first workshop on satellite meteorology.

Rubin: What government did he represent?

Cartwright: He was then based in--working on his degree at MIT, and from Nigeria. When he finished his work in the States, he returned to Nigeria for a period and later then became the head of the WMO International Training Centre in Kenya. After leaving that, he went back to Nigeria as a director of research, and it was in that capacity I believe, that he was hired by the WMO as the head of education and training. And it was from that post that he was elected as the Secretary-General.

Rubin: It seems then that the Secretariat staff is composed of people from many countries. How did you feel in working with these people from many different countries and cultures?

Cartwright: That was no real problem for me, Mort, because I had attended literally dozens of international meetings when I was in ICAO and later when I was the international affairs head in the Weather Service. It is always stimulating to see how these young countries are steadily expanding and becoming better qualified. It is also interesting to see that with each change in the Secretary-General, the character of the Secretariat changes slightly as he brings his favorite people into the organization. But that provides a variety and unique input that makes the Secretariat effective. It is difficult, however, to attain a high level of efficiency when you are under pressure as the head of the organization to hire people from this, that or another country. Their representatives in Geneva, the ambassadors who run their missions, are often seen in the Secretary-General's office pushing one of their candidates for a particular post. We do it, the Russians do it, everybody does it. It's part of the task that he must balance very neatly if he's going to retain an effective Secretariat.

I find that the U.S. has made very important contributions to the work of the Secretariat through the high quality of the people that they have been able to send. I can't think of anyone who hasn't measured up to a very high standard. This is perfectly evident, I think, to Professor Obassi, and he would have even more if it were not for this need to balance with the other countries their membership. After all, there are 160 members and there are only about 100 professional people in the Secretariat altogether. We argue with him that because we pay a quarter of the bill, we should have a quarter of the members in the Secretariat. That is clearly not practical from his point of view, and we accept that fact. Previously, there was always a battle to keep the balance between the number of Russians and the number of Americans on the Secretariat more or less even. I think that has worked out fairly much that way. What will happen now with the breakup of the Soviet Union is rather hard to predict.

At any rate, Mort, the time finally came when it looked desirable for me to retire.

Rubin: I wanted to ask one further question, Gordon, if you don't mind. People of various countries come to the Secretariat to work. Are they able to give up their allegiance to their country and serve the purposes of the organization, or is there is some possibility, some taint perhaps where they may serve the interests of their country rather than that of the Secretariat?

Cartwright: I think it's inevitable, Mort, that a person would refer back to his own native land for help and support. Their agreement, which they signed when they joined the Secretariat, as you well know, requires them to abstain from taking instructions from their government. But it's inevitable that that will happen from time to time.

Rubin: Some of this, of course, can be salutary if your country is a powerful country that can contribute to the WMO.

Cartwright: That is indeed true. And while you come as an international civil servant, you bring with you all the skills and obligations that you had as a member of the National Weather Service. But as I was saying, Mort, the time finally came when I felt it desirable to retire and start off on a different career. Fortunately, I think, Dr. Hallgren was very interested, I think, in seeing me continue in some capacity to help the current rep to the WMO. And so with great effort, he organized and was able to push through a contract jointly between the State Department and NOAA which provides for a certain amount of payment for reports which I make from time to time. And this has been a very pleasant way of continuing my contacts. And as far as I can tell, most people in the WMO feel I'm still doing the same job.

Rubin: So we really can say, Gordon, is that you haven't retired completely, you still maintain your interest in meteorology and in serving your government and 'm trying to work out some mathematics. You started in 1929 in meteorology and here we are in 1991, close on to 1992, you're still involved. How many years does that make, Gordon? Almost seventy years, 1992 will be seventy years, right?

Cartwright: That's true.

Rubin: Well, this has been fascinating for me, Gordon. You and I have been close friends for well over thirty years, thirty-five years, and there are many aspects of your life before that I didn't know about and even up to this time. I'm sure that what you've contributed here is going to be very, very valuable in terms of historical perspective.

Cartwright: Thank you very much, Mort, it's a pleasure to join on this further exercise, to exchange our personal histories and our ideas. And it's an especial pleasure to be

able to do this in your lovely home in Bethesda, Maryland, with Rosa in the background.

Rubin: This concludes the interview with Gordon D. Cartwright. We'll turn it off now and give it to the historians.

END OF INTERVIEW