INTERVIEW OF

DR. ROBERT BENSON

Conducted by Troy Cline

P R O C E E D I N G S

MR. CLINE: -- actually turn the recorder on now. What I'd like for you to do is just to introduce yourself for our editor to know who you are and your title and what you do, and then we'll -- I'll ask your first question.

DR. BENSON: Okay. I'm Bob Benson, and I'm presently an emeritus at the Goddard Space Flight Center. I have been working as an employee for 47 years. Prior to that, I was a National Research Council postdoc fellow for a year, so combining those, I've been here approaching 50 years.

MR. CLINE: That's pretty amazing.

DR. BENSON: And my main research interest is in the ionosphere, and I got my first interest in the ionosphere when I was a member of the International Geophysical Year team at the South Pole Station in 1957. And I was fortunate enough to be one of the first wintering-over members at that station, and I was helping Willie Huff (ph) with the ionosphere work, and then I was also in charge of seismology, and then I helped with the auroral (ph) observations that

Arnold Landow (ph) performed.

And that was a very good year. It was the first year of the South Pole Station, and the South Pole Station has been operated ever since, although they're on the third version of the station right now.

MR. CLINE: Can you describe the South Pole Station; what that looked like, what it was, maybe how difficult it was to get there in 1957?

DR. BENSON: Seven.

MR. CLINE: Yeah.

DR. BENSON: Okay. The South Pole Station, at that time -- I landed in February 1957, and it was quite different than, of course, what Amundsen and Scott saw near the turn of the century, when they came. It was 1910, 1911 -- actually, 1911, 1912 when Scott and Amundsen were the first ones there. We should redo that.

MR. CLINE: Okay. Yeah, you can restart that. All right.

DR. BENSON: Yeah. Okay. The -- I arrived at the South Pole Station in February of 1957, and it looked quite different than what it must have looked

like when Amundsen arrived at the first time, because he put up his tent, and then it was nothing. And then -- that was in 1911, December of 1911. Then in 1912, about approximately a month later, Robert Scott arrived there, and what he saw was the one tent that Amundsen had left.

Of course, when I arrived, there was -- quite a bit of the station was already built. The Seabee construction team had been there for several months ahead of time, working on the station, and then our job was to finish it off, put the rest of the station together, and put in all the scientific equipment so we could operate the science.

The International Geophysical Year started in June of 1957 and ran through the end of August -- the end of the calendar year of 1958, so it was an 18-month year. And our job was to get the station ready in 1957 and try to get things operational by June, which would be mid-winter at the South Pole.

And I was in charge of setting up the seismology station primarily and then helping with the ionosphere and the auroral (ph) observations. So I

got my first introduction to ionosphere work there because we had to make sure that the cylinder was operating. It was a huge C3 cylinder with vacuum tubes -- hundreds of vacuum tubes in it, and it took up a good chunk of the room.

And then I developed the film, because it was a little oscilloscope that would have the radar display of the ionospheric echoes coming back, and a 35-millimeter camera would run to produce ionograms, and then we'd develop these 35-millimeter film reels to produce the ionograms and then scale them manually on the viewer and then send the information back to the viewer and then send the information back to the National Bureau of Standards at that time, giving them some of the information about what the ionosphere was.

And the concern, then, of course, was since we were going to go into six months without sunlight, would the ionosphere stay there, and would we have communication? Because that was our means of communication. And we did have an interesting (ph) ionosphere the whole year, and that provided us with communication back to the States.

MR. CLINE: Well, as far as your research, can you explain to our listeners the importance of being in the South Pole? Why did you have to be there to take the measurements you were taking?

DR. BENSON: Well, the South Pole -- the importance of the South Pole Station was, of course, the unique geography of it, being right at the spin pole. And the U.S. set up that station in 1957, at the start of the IGY. Actually, they started working on it in 1956, but it was a result of a agreement in the planning for the International Geophysical Year that different countries would have different stations. There were 13 nations in all that were at the South Pole.

And there's a very interesting story about that in South -- in the book called *90 Degrees South* by Paul Siple, who was our station leader, and he describes the politics that went into this. And the U.S. had not committed to go to the Pole Station, but the -- there was a meeting -- international meeting for the IGY, and the Russians had said that they wanted to go to the Pole and put in a Pole Station,

and the French person who was in charge of the meeting said, "No, we've already promised that to the Americans," when, at the time, they had not really promised it to the Americans. So there were some very frantic phone calls and lots of pressure at the State Department to get them moving fast, and then they agreed that the U.S. would put in the station at the South Pole.

So it started off with a little bit of political gamesmanship at that time to put it in. The U.S. was very active in the IGY or the International Geophysical Year, but that was kind of forcing the hand, and I think that because of this push, the U.S. has stayed there all the time.

See, the United States does not have any territorial claims in Antarctica, and we don't recognize any claims, and if we left that area, very quickly some other station would -- some other country would come in to man that. So we have kept that station going for all these years since then.

MR. CLINE: Now, listening to that story -- not many people have the opportunity to go to the

South Pole and to be there and to do some of these extraordinary things. How does that all fit into the picture of space weather and where eventually research went and where it is now?

DR. BENSON: Okay. The importance of the South Pole, I think, from space weather, first of all, it's a very unique place because you have an entire year compressed into one -- let me reword that. The entire -- one day is stretched out over a whole year. And so you're having six months of daylight, and you're having six months of darkness and so the interesting meteorological phenomenon in that way.

And the Antarctic continent is such a huge continent that the U.S. has several stations around there, and from the South Pole, we have things called unmanned geophysical observatories that are put up at different locations, and so they are outfitted by traverses (ph) from different areas, different stations, and there are several of those near the South Pole.

And the Pole has many scientific disciplines. I mean, as I mentioned, they have the

ionosphere. There's monitoring the aurora. There's the seismology. We have micrometeorology. And there's very big things in astronomy, because with astronomy, during the daytime, you have -- which is six months -- you have continuous observations of the sun from the ground, and at night, you have continuous darkness. So there's some unique things you can do from that point of view.

And the science program has expanded so much since we've been there that it is very amazing. The National Science Foundation is the main agency responsible for the science at the South Pole.

MR. CLINE: And I think you've already started answering this question, and our second major question has been with what and when were you involved in space weather research? And clearly part of this started with the South Pole for you.

DR. BENSON: Right. I think that got my interest in space weather, and the whole IGY was a very important aspect of the space weather phenomenon because it was a sequel to, you know, International Polar Years that they've had before, but now the IGY

cover the entire globe. And there was 66 nations in all that were involved in that. And in the Antarctic, there were 13 that had put up stations either in the Antarctic or the Subantarctic regions.

And the uniqueness of that year -- and people recognize that science doesn't stop at a political boundary, so if you're interested in seismology or aurora or meteorological effects, you have to have observations that are continuous. And even recently, you can still find the importance of that work there because of the continuous chain of stations that they set up around the globe, and that was a very important time.

And as far as the continuing work, I was at an AGU meeting about a year ago, and there, there were several papers in my field where they were using current data from the South Pole, and so it's a very active program in wave emission (ph). In my interest in the ionosphere, I started there because I was interested in ground-based ionosondes, and then when I came to Goddard, I had the opportunity to look at some of the records that were made by the Alouette

spacecraft.

And this was the first satellite that was launched with a sounder. The technology had changed by that time so that they could actually put a complete ionospheric sounder into the satellite. And then they're getting the ionospheric record from the region above the maximum electron density. They call that the topside ionosphere.

So the satellites have two advantages. One is it can measure this region above the peak of the electron density, which is the topside ionosphere, and it can do it globally, whereas otherwise you'll have to depend on stations, which are in fixed locations around the globe, and then they just measure the bottom part of the ionosphere.

So the -- I got my interest in the ionosphere in the South Pole, and then it was continued when I found that there was so much data here. It was a Canadian primary spacecraft, and there were not that many people at NASA that were looking at the data, so I was invited to start looking at it, and I've been looking at it ever since.

MR. CLINE: And that leads you into today and your research with space weather.

DR. BENSON: Right. And we've recently taken some of that old topside sounder data, which was designed as an analog system, and because it was -- it was so successful, there were four satellites in the series, and it really had operations covering 60 years among those four satellites. I mean, the years were overlapping, of course, but they had 60 satellite years of data.

And not all of that data were compressed into ionograms and film because of the cost involved. So we started a program where we could digitize right from the telemetry tapes, and we were able to get a portion of those before they were thrown out to a landfill in Canada. And we've digitized these, and now we're working with the digital data, and it's like a new satellite mission with old data, because nobody's looked at it, because we digitized it right from the telemetry tapes. They were never processed into film.

And then the other work that I've been doing

is with the radio sounders is with the IMAGE mission. They had a radio sounder on that, and that went into the magnetosphere. So that used similar techniques, but in a different medium, and provided a lot of information. And the importance of radio sounding is that you don't only get the information right around the satellite, but you get the remote measurements, so you get a whole profile. And this is the value of that technique.

MR. CLINE: Now, with the experience that you've had over the years, and you said you've been at this for 47 years --

DR. BENSON: Yeah.

MR. CLINE: -- I believe. That leads us right into our third question, which is, you know, what are some of the key events or turning points that you've witnessed or that you believe are the major turning points in space weather research, perhaps even connected directly with what you've done?

DR. BENSON: Well, I think the major turning point in ionosphere research is since the IGY -- I would call IGY probably one of the key points in space

weather because it was such a recognized international effort, and as far as the ionosphere, I think the key element there was, at least from my point of view, the launch of the Alouette 1 satellite in 1962. And that was the first time they put a sounder in a satellite.

There were some rocket shots (ph) before that to test the concept, but the satellite launch by the U.S. -- it was a Canadian-built satellite, and the U.S., if you look back over the records now, there was not a lot of preparation for the data and everything because the lifetime of satellites weren't that long at the time.

This was the Canadians' first satellite, and I think there was a lot of feeling that this program won't go on too long. Well, it went on for one year, and then two years. It was very successful. The lifetime design was one year.

And the international community started getting very interested because they wanted the ionosphere information for communication purposes. Canada, of course, initiated it because as a very large country, radio communication was an important

element in 1957 for them. So -- excuse me, not -- in 1962, when they put that up.

So that launch was very important for Canada, but then India is also a very large country dependent on radio communication, so the Indians were interested in it. The Australians came in, Japan, England, and pretty soon we had, you know -- over 20 countries were involved in the data from the Alouette 1 and Alouette 2 satellite.

And many times the program -- the Alouette 1 was launched in '62. Alouette 2 was launched in '65, and then there was an ISIS 1. Then they changed the name to ISIS for International Satellites for Ionosphere Studies. And the ISIS 1 was launched in '69, and ISIS 2 in '71.

And these satellites were so popular, and they were so much in demand, that NASA tried to cut off the funding on it because they were really only funded for one year after launch on each satellite. But the phone would ring off the hook at the State Department when they tried to cut it down because different countries just put up a telemetry station

and pulled in the data.

They were using it, and they had an agreement, and so that program kept going for many, many years, until finally the Canadians couldn't operate it anymore, and they finally turned it off, but the Japanese had some rocket facilities in Antarctica, and they wanted the satellite data going over, so they took over the keys to the program, and they ran it for several more years, until 1990, and then they turned them off. So it was a very successful program.

MR. CLINE: That's a long time for a satellite to stay up and functional.

DR. BENSON: Yeah.

MR. CLINE: That is amazing.

DR. BENSON: Right. So we went from Alouette 1 in '62, and then that operated for ten years. The Alouette 2 operated for ten years. And then ISIS 1 and 2 each operated for about 20 years.

(Off the record.)

MR. CLINE: -- start recording, just so we can capture it. But I know we've gone through the

main three questions --

MS. NG: Yeah.

MR. CLINE: -- but there are some additional, perhaps, facts and things that you'd like to include?

MS. NG: I have a couple of questions for you --

MR. CLINE: Okay. Okay.

MS. NG: -- off the record.

MR. CLINE: Oh, this is off the record? So …

MS. NG: Oh, no, no, no.

MR. CLINE: Okay. You can ask, and then I'll just record, and then we'll -- you can decide.

MS. NG: Okay. Okay. One is whether there are follow-on spacecraft since the last one ended in the 1990s, whether you need more ionospheric (ph) type of spacecraft to be launched; would that be important to you?

DR. BENSON: The -- yeah, the question is when will we launch another topside sounder satellite. There have been other countries that have put up

satellites. The Japanese had an ionosphere sounding satellite. The Russians have had one. And those satellites were very successful also, but they didn't -- I don't think any of them are operating now. I'm not absolutely a hundred percent certain on that. No, I think that the Russian ones are turned off.

And there have been attempts by Bodo Reinisch and his group up at the University of Massachusetts Lowell to try to put sounders on Air Force satellites. And I think that is still, going forward, that they will have some satellites on that.

The problem that we find is that it's difficult to get an active sounder on a satellite because everybody feels that the interference is going to be too great. Now, the ISIS 2 satellite was a complete observatory. It had the first auroral imagers on ISIS 2. So even though they had the long antennas for the radio sounder, it did not interfere with the positioning of the satellite for the imaging.

And the -- well, yeah, I think the first satellite that went outside of the Earth -- or the first spacecraft outside of the Earth with a sounder

was the Ulysses mission. And that was originally going to be Solar Polar until -- there's quite a story about how one of those got cancelled, and then the satellite -- because one of them turned into -- Ulysses was the name of it.

And that satellite went to -- let's see. That went to Jupiter, and it had a sounder on board, but the sounder they put on there was as a result of Bob Stone adding that sounder after the satellite mission had already been selected.

If they had proposed the sounder on it, they probably never would have been selected because it would be considered too risky, but they had the receiver set up on there, and then at some of the meetings, he said, "Well, it wouldn't take too much to just add a little active element in here," and they slowly got the sounder on that, and that was the first spacecraft with a sounder that left the Earth -- you know, the Earth's orbit.

And now there are sounders on Mars. There's a sounder in orbit around Mars, and there's a sounder that went onto a spacecraft to Saturn, so there have

been several of them -- realizing that. But there's always the fear that the active instrument is going to interfere with the passive ones, and I think that's the difficulty of getting one on …

MR. CLINE: All right. But since you had such a unique experience that you described in South Pole and Antarctica, do you have any stories that were just incredible? It can be bizarre, fun, just something that sticks out in your memory from just your personal experience in such a -- such a extreme environment?

DR. BENSON: Well, at the South Pole, I guess the -- one of the more fun times, we had a picnic at one of the holidays out there. It was a mid-winter, and so we put out the -- put a fire out, and had a fire and hot dogs and ice cream. They weren't all that hot, but that was a different situation. I don't think they could do that now with the environmental protection situation they have with the open fires out there.

Just the overall experience in the Antarctic -- I did a lot of photography down there because the

unique situation of being right at the Pole, you had the horizontal motion of the stars, and the moon slowly spiraling up, so I did time exposures of the moon and things of that sort and found a lot of fun with that.

And I did a lot of pictures, and I had a Canon camera with a -- interchangeable lenses, and Paul Siple had a similar set of lenses for his camera that were provided by the *National Geographic*. And we'd always go out walking together, taking pictures of the station, and sometimes I'd say, "Well, can I borrow this lens or that lens?" So I was taking his lens on there, so I had a very good collection of films because I had a camera that would take all of these lenses.

And after we got back from the trip -- the *National Geographic* had sponsored Siple's photography, to take a lot of pictures there. And so when we got back, the *Geographic* wanted to look at my pictures as well, and they bought ten of those, and some of those were used -- one of them was used in the article that he had published in -- back in 1958.

But the -- just the overall experience there -- and it was a very well-run camp, because Dr. Siple, who was the leader, he went down with Admiral Byrd on Admiral Byrd's first expedition, and he was a Boy Scout with Byrd. Byrd wanted to have one Boy Scout go there. And so there was a competition nationwide among thousands of Scouts, Eagle Scouts, and he -- Paul Siple was the one that was selected.

And his approach was he wanted to always be the best in whatever he chose to do and be prepared. He said he considered himself a fatalist and that didn't mean he was just going to sit under a tree and wait for something to come, but he was going to prepare himself.

He had more merit badges, I think, than any other Scout, and that led him to the point where he was selected, and then he went down to Antarctica, and he got interested in that and majored in geography and eventually went on and -- he was the first scientific attache to Australia and New Zealand, and so he had quite a successful career. And he was our leader at that time, and he had more experience in the Antarctic

than any other living person at that time, and so he was truly a good leader.

And at the Pole at that time, they were -- there was a split command between -- there were nine Navy personnel and nine civilian, and Paul Siple was the leader. He was the civilian leader, and he worked very closely with Lieutenant Tuck, who was the military leader. And there was a very, very harmonious relationship there, and they worked well together, and so if there was any disagreement that came up in the station, usually that could be very well settled. And so we had very little difficulties, even though we were isolated there for -- you know, for almost 12 months. I was there for 10 months at the Pole.

And we'd show movies, and many people wanted to show a movie every night, and Siple argued, "Well, you wouldn't see a movie every night if you were at home." Now, you couldn't make that argument today, see, but he could in 1957. And so they showed movies on about three nights a week, and then other nights, different people would give lectures on what they were

working on and such, or you'd have just kind of an open entertainment night.

And when you'd show movies, you know, everybody would gather together, and it would be just a lot of fun, everybody, you know, chipping in with wise comments and remarks, whereas I think nowadays, it's not that way. Everybody just takes their DVD and goes off to their own room, and so there's a lot of comradeship and, I think, fellowship that we had down there at the Pole as a group at that time that I imagine is not present anymore. It's different anymore, I'm sure, different now.

MR. CLINE: It's different. It reminds me of watching *MASH* --

DR. BENSON: Yeah.

MR. CLINE: -- how they used to have movie night and that would happen. It was just that kind of camaraderie kind of experience.

DR. BENSON: Right.

MR. CLINE: It was really pretty awesome. Well, thank you very much --

DR. BENSON: Well, you're welcome.

MR. CLINE: -- for your time.

DR. BENSON: Okay.

(Whereupon, the interview of Dr. Robert Benson was concluded.)

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I, MARY E. YOUNG, hereby certify that I am not the Court Reporter who reported the following proceeding and that I have typed the transcript of this proceeding using the Court Reporter's notes and recordings. The foregoing/attached transcript is a true, correct, and complete transcription of said proceeding.

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