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INTERVIEW OF

DR. ROBERT BENSON

Conducted by Troy Cline

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1 P R O C E E D I N G S

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

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

13 MR. CLINE: That's pretty amazing.

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

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1 Arnold Landow (ph) performed.

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

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

9 DR. BENSON: Seven.

10 MR. CLINE: Yeah.

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

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

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

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

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

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

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

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

6 And then I developed the film, because it
7 was a little oscilloscope that would have the radar
8 display of the ionospheric echoes coming back, and a
9 35-millimeter camera would run to produce ionograms,
10 and then we'd develop these 35-millimeter film reels
11 to produce the ionograms and then scale them manually
12 on the viewer and then send the information back to
13 the viewer and then send the information back to the
14 National Bureau of Standards at that time, giving them
15 some of the information about what the ionosphere was.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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1 spacecraft.

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

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

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

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

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

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

22 And then the other work that I've been doing

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

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

13 DR. BENSON: Yeah.

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

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

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

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

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

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

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1 element in 1957 for them. So -- excuse me, not -- in
2 1962, when they put that up.

3 So that launch was very important for
4 Canada, but then India is also a very large country
5 dependent on radio communication, so the Indians were
6 interested in it. The Australians came in, Japan,
7 England, and pretty soon we had, you know -- over 20
8 countries were involved in the data from the Alouette
9 1 and Alouette 2 satellite.

10 And many times the program -- the Alouette 1
11 was launched in '62. Alouette 2 was launched in '65,
12 and then there was an ISIS 1. Then they changed the
13 name to ISIS for International Satellites for
14 Ionosphere Studies. And the ISIS 1 was launched in
15 '69, and ISIS 2 in '71.

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

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1 and pulled in the data.

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

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

14 DR. BENSON: Yeah.

15 MR. CLINE: That is amazing.

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

20 (Off the record.)

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

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1 main three questions --

2 MS. NG: Yeah.

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

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

8 MR. CLINE: Okay. Okay.

9 MS. NG: -- off the record.

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

11 So ...

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

15 DR. BENSON: Yeah.

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

19 DR. BENSON: Right.

20 MR. CLINE: It was really pretty awesome.

21 Well, thank you very much --

22 DR. BENSON: Well, you're welcome.

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1 MR. CLINE: -- for your time.

2 DR. BENSON: Okay.

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

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CERTIFICATE OF TRANSCRIPTION

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.

_____	_____
Date	Mary E. Young
	Transcriptionist