INTERVIEW

OF

ART POLAND

P R O C E E D I N G S

MR. CLINE: Okay. We're recording. Okay. If you could just -- it's a pleasure to be here with you today, by the way.

EXAMINATION

BY MR. CLINE:

Q If you could just tell us who you are and what your primary research interest is.

A Okay. I'm Dr. Art Poland. I'm a solar physicist. And I used to work at Goddard, and now I'm a faculty member at George Mason University.

And my primary research interest is the sun. And when I say it that generally, it's kind of exciting in that I've been able to do everything from building hardware to doing theoretical modeling. And so to cover all that, it's -- it's pretty difficult.

But my primary research interest is really how does the sun work, what is making storms on the sun, how does the energy get into the outer atmosphere, into the corona, just a physics problem basically.

And the way I attack it, now at least, is to analyze spectra to get the basic physics parameters -- that's temperature, density, and velocity, and then the magnetic field strength of various places on the sun.

We've gotten to the point in computers, which is very, very exciting, to where we are actually model all this stuff.

When I was a graduate student back in the '60s, you could only dream of this. And now we're actually doing, which is very exciting. And what that means is we need the observations to go into those models and to see, do we really understand what's going on or not.

And in analyzing spectra, we need really good telescopes, spectrometers in space. And we're getting those things, which is, again, really exciting. Something that you could only dream of 30 or 40 years ago.

We're able to measure the temperature, the density, and the velocity of the material on the sun's surface all the way from 5,000 degrees up to 20 million degrees.

We're able to get all that information. And we're able to put it into models and see how good is our physics understanding. And that is indeed my interest is what's going on, do we really understand what's going on.

And what's so exciting about it all now is we don't know. We can make the measurements, we can put it into the models, and in many, many cases we -- you don't get good agreement. You know, in some cases we do. We -- when we do, we say, oh, good, because we do understand that.

But there are other things that we're seeing that we can't match and that's what makes science and what I do so exciting, is that we get some answers and then we say, these answers don't match, we don't know what's going on, we got to figure out. We have to say, how can we get the answer, what is going on on the sun.

And that leads to new physics understanding and that's what makes me so excited about what I'm doing.

Q So when you first started research having to do with solar physics and so forth, you didn't have that much data to work with, or did you? What types of information did you have to start with? And then from there, you had to build and ask for what you needed to learn, you had to learn what you needed to learn apparently.

A Well, what's really funny -- and again, this is the way science works; I mean, all the way from Galileo's time -- when I started out, we had telescopes, we had spectrometers, so we could measure the temperature, we could measure the density, we could measure the velocity but these telescopes had very low resolution. They were on the surface of the earth so that the earth's atmosphere blurred them.

And the technology we had was film. So we were actually taking pictures with a camera basically, and you can't do that very fast. So your time resolution was -- was pretty poor. So and going through the earth's atmosphere, you couldn't look in the ultraviolet and extreme ultraviolet film.

(Off the record.)

MR. CLINE: Okay. Let me start the

interview now.

MR. POLAND: Okay.

MR. CLINE: We had to stop for trash. Oh, hold on. We have another pause.

MR. POLAND: Might as well stop me, we'll do that again.

MR. CLINE: And, Brian, this is Troy. We had to stop because of trash can, so you may have to piece some of this together. It'll be fine. But we'll pick up where we were.

MR. POLAND: Yeah.

MR. CLINE: And keep on going.

MR. POLAND: Yeah.

BY MR. CLINE:

Q Okay, all right.

A Okay. So back in the '50s, we had these telescopes on the ground. But you couldn't look at the ultraviolet and the extreme ultraviolet because the earth's atmosphere doesn't let that go through.

But we were doing the same kind of things. We had computer models. They were really crude in that, you know, the biggest computer in those days wasn't what you have on your cell phone now. So the models were crude, the observations were crude. We were seeing things about the physics that's going on, but there was a lot that we didn't know.

An exciting thing happened after World War II. They had these V-2 rockets. And some guys from NRO were approached and said, is there anything you can use these for? And they said, geez, yeah, we'd like to put a spectrometer up above the atmosphere and see what the sun looks like. They did that. And it was Dick Tousey who did it.

And they got these spectra back and the sun just looked amazing in these ultraviolet spectra. And all of a sudden, we had a whole new set of data information, more temperature information, more density information, more velocity information.

That meant that we could do better modeling. And computers started getting better. And so better observations, better computers, better models. You found more things that didn't match. And this says, boy, I'd sure like to get better spacial resolution and better time resolution. And you just keep -- you build better spectrographs.

And then on Skylab we still had film on spectrographs. So, okay, we could do better because we had better resolution. We had more data because those guys were up for like nine months. And we were doing better modeling in those days.

And Skylab was really exciting because that was the first time we got a really clear look at what's called "coronal mass ejections," the big bubbles of gas and magnetic field that come flying off the sun. And if they're aimed at the earth, they come crashing in the earth and interact with the earth's magnetic field -- space weather.

That was the first really solid inkling we had that the sun was shooting these things off from prominences and big magnetic loops. We did know that flares were a problem. They even knew that during World War II, but they didn't really know about these coronal mass ejections.

But on Skylab, again, we were limited to film, low time resolution, low spacial resolution. But we started to say, okay, we got these things going, they're really interesting.

And it was exciting for me. I was on the Skylab team that was working on them. You know, so some of the first papers on coronal mass ejections I was a co-author on.

And but we started saying, geez, I wish we had better spacial resolution, I wish we had better time resolution. And again, the modeling started coming in.

I got involved with somebody, we were doing a little bit of modeling, computer modeling of these things -- how long do they last, how is the material flowing in them, doing crude models like that.

Then SolarMax came along in 1980. Again, a new coronagraph, better spacial resolution. And in that one, we had electronics instead of film. It was basically TV camera kind of stuff. Better resolution in time, better resolution in space.

Q So this was the '80s. And then Skylab went for how long?

A Skylab was in 1973.

Q Okay.

A So '73, this is, again, what's so exciting in science. Okay. Skylab, new data, new models, new things to look for.

SolarMax 1980, new data, better modeling, new things to look for.

And for me at least, the next biggie was SOHO. And I was the project scientist on SOHO here at Goddard, the U.S.

project scientist. It was a joint European/U.S. mission.

And we had fast detectors, better resolution. We had spectrometers. We had a really good set of instruments to be able to measure, again, the basic physics parameters -- temperature, density, and velocity.

We still have not been able to measure magnetic field out in the outer atmosphere of the sun. That's a very difficult measurement to make.

But with the new data from SOHO, and I guess what I have to say was the most exciting thing about SOHO is we had really good time resolution and good spacial resolution so that you had pretty movies.

We were able to get these movies onto television. And they were being shown on the 6 o'clock news. And all of a sudden, solar physics was exciting to the public because we had these exciting movies. And it was great for us as scientists to be involved in something that the public cared about.

And again, also it was exciting because we were able to do better research on it. And we started to get to the point after SOHO -- I shouldn't say after SOHO because it's still running now in 2013, but -- and SOHO was launched, by the way, in '96. So it's been going for a long time.

All of a sudden, we had what I would have to start calling "space weather." We didn't call it at the time -- we didn't call it "space weather" at the time.

But, you know, all of a sudden, we had a practical use. You know, we had these science instruments and they were able to give a heads-up warning to the power companies, to satellite operators that, hey, there's a storm on the sun and it's coming in two days and it's liable to cause disruptions in the earth's magnetosphere and to systems on the earth.

And NOAA was picking this stuff this up. They were actually taking live feeds from SOHO and putting it into their space forecast. I don't want to use "space weather" yet because space weather wasn't really a term at the time.

What then happened -- and it was kind of interesting, I forget the exact year, but I decided, okay, I don't want to be project scientist on SOHO anymore, I don't want to be a manager anymore, I want to just do research.

And so I quit my management positions and just gathered all the stuff together and started doing research again.

And George Withrow came to me one day from headquarters and he said, Art, we got this new idea, we'd like to start a program in space weather, what do you think. And usually when somebody, from headquarters especially, would approach me with a new idea, I'd say, I don't want anything to do with that.

And what George had to say, said to me, this is exciting and we can really do it, we've got the tools, and if we can get the money to put together a space weather research program, this is going to be exciting, it can be like earth weather, you know, we can put a bunch of space weather buoys out there in space and get really good predictions and do something useful for society.

And so I dropped my research and said, okay, here I go again, back into management. And I worked with George and Dick Fisher and Bill Wagner and several other people to put together what would a space weather research program look like, what satellites do we need, what research do we know, you know, what kind of things we know, what do we need to know to be able to do something that's fun research for scientists and practical for society.

Q And this was part of the "Living With A Star" program?

A Exactly. It developed and Bill Wagner was the one who came up with the "Living With A Star" idea. That's what we were going to call it, "Living With A Star." And everybody said great idea, we're going with -- that's the title, that's what we're going to call space weather, we're going to call it "Living With A Star."

Q In one of our recent interviews, we were laughing about the idea of how we could also have said "living in a star" because we live within the atmosphere of the sun.

A Right.

Q Which is --

A Right.

Q -- pretty interesting.

A Yep. Yep.

But anyway, so I went and started working down at NASA headquarters part of the time to help develop this program.

And I was in the chief scientist's office, which was actually pretty exciting because my idea or position there was to help put the sales package together to make this something that upper management and Congress would want to say, yeah, we should do that and also to try to get the earth science people involved to try to make it a really, what the military calls, "a sun to mud" approach where something happens on the sun, we study it, we understand it, and it has an impact on the soldier on the ground.

And actually space weather does do that because it affects communication and it affects GPS and affects how the -- those guided missiles that they send down somebody's front door, how well are they going to work, that is affected by space weather.

So we became involved with the military, we became involved with NOAA. It became a multi-agency effort. FAA got involved because it's -- in the long-run it was going to affect how airplanes land.

I remember one day landing in -- at Paris Charles de Gaulle Airport and the fog was so thick you couldn't see the end of the wings, but yet, they were anding -- landing this plane at the airport. And if the GPS wasn't working right, it wasn't going to work too good.

And space weather's going to affect that. So here I was thinking, here I'm working on this stuff that's going to impact what we're going to do.

So that's how I became involved in the space weather. And one of the questions that's of interest to everybody is, what are the key events and turning points in space weather research.

And I'd have to say there are two big key turning points. The first one was SOHO, when we were able to get really cool movies and put them on the 6 o'clock news. All of a sudden, the public was aware of this stuff.

And I have to give the NASA public affairs office here at Goddard a lot of credit for that. They helped us put together movies that would sell to the news media. I mean, without that, we're not going to go anywhere.

I remember as a scientist trying to get to the news people and say, hey, we got these really slick movies, and they wouldn't even call back, you know.

And after the public affairs office here started working with them and started sending them movies, as project scientist, I was getting telephone calls from the news media, what do you got that's interesting, you know. So that was a big turning point because all of a sudden we were of interest to the public.

The next big turning point was George Withrow and the group at headquarters saying, we need a special new program within NASA that is space weather, and that that is something that we can get major funding for. And we got like a billion dollars over ten years. And with something like that, you can put together a good set of satellites, you can put together a good research program, and make real progress.

And what's exciting for me now is we did this all ten years ago, ten, 12 years ago. And I'm looking at it now and I'm saying, it worked, we have a great set of satellites up, and we're doing good research, really good research, and NOAA is actually taking our information and using it in a practical way for commercial space weather predictions.

Q It's interesting to listen to at what points the public became engaged in heliophysics and space weather and all of these thoughts. Because as a teacher, even 15 years ago, we taught a little bit about the sun, we had some information about it, but the students weren't as interested in all the mechanics and what's happening with what we call "space weather" now until just in the recent years.

So all of that, I hadn't realized really took off really since in this millennium.

A Yeah. Yeah, and there's a real key to that in my mind. And, you know, being a teacher now, if you just put a bunch of words in front of people, it's in one side and out the other.

If you've got a picture, okay, you can grab their attention. If you've got a movie that has flash boom on it, you've got it, they're really excited by that.

Q We also found out if you tell students their cell phone communication could be --

A Oh, yeah.

Q -- hampered.

A Well, I had an interesting -- I used to go to high schools and talk a lot, and I always tried to make sure that every kid in the class had some interaction with me. And there was one kid that he was looking out the window the whole time.

And I mentioned about the GPS affect. And all of a sudden, the kid lights up, he raises his hand, and he says, you just said GPS, is that like what my dad's got on his boat. All of a sudden, the kid was interested again. And that's because it had an impact on him personally.

Q From the sun to the mud. Right?

A Yep. Yep.

(Whereupon, the interview of ART POLAND was concluded.)

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I, JANET M. RICE, a Transcriber, do hereby certify that I transcribed the audio tapes(s) of the proceedings had upon the hearing of this case, previously captioned herein, that I thereafter had reduced by typewriting the foregoing transcript; and that the foregoing transcript, consisting of Pages 1 to 19 both inclusive, constitutes a true, and accurate record of the proceedings had upon the hearing of said cause, and of the whole thereof.

WITNESS my hand as Transcriber this 26th day of August, 2013.

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JANET M. RICE
Transcriber