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INTERVIEW OF  
DR. JOHN PHILLIPS

October 18, 2013

Conducted by Troy Cline

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

2                   DR. PHILLIPS: Hello?

3                   MR. CLINE: Hello, John?

4                   DR. PHILLIPS: Yeah. Is this Troy?

5                   MR. CLINE: Yeah, this is Troy. Can you  
6 hear me all right?

7                   DR. PHILLIPS: Yeah, I can hear you fine.

8                   MR. CLINE: Awesome. Well, thanks for your  
9 time. You're coming through loud and clear, and we're  
10 recording -- started the recording session now. And  
11 then --

12                  DR. PHILLIPS: Okay.

13                  MR. CLINE: -- of course, we'll edit  
14 everything out that we need to with the "uhs" and the  
15 "ands" and my explanation.

16                  DR. PHILLIPS: Okay.

17                  MR. CLINE: But, yeah, with the shutdown,  
18 I'm really glad you're able to still do this and pull  
19 it together. This is going to --

20                  DR. PHILLIPS: The shutdown doesn't really  
21 have anything to do with me.

22                  MR. CLINE: Oh, is that right?

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1 DR. PHILLIPS: I'm retired. So I'm sitting  
2 here in my house in North Idaho.

3 MR. CLINE: Oh, nice. All right.

4 DR. PHILLIPS: Yeah.

5 MR. CLINE: I'm in --

6 DR. PHILLIPS: Yeah, I retired from --

7 MR. CLINE: -- Pasadena, Maryland.

8 DR. PHILLIPS: Oh. I retired from NASA in  
9 2011.

10 MR. CLINE: Oh, okay. All righty. Nice.  
11 Well, congratulations on that.

12 DR. PHILLIPS: Oh, thank you.

13 MR. CLINE: Well, I think the questions that  
14 we have -- what we do with the interviews, just to  
15 kind of recap, unless -- I think Carolyn mentioned it  
16 in the emails -- is for the Space Weather Living  
17 History Project, it's pretty much done kind of like an  
18 NPR interview. We -- I will just introduce the  
19 question, and then -- as a way to get the conversation  
20 started. And then --

21 DR. PHILLIPS: Okay.

22 MR. CLINE: -- if you wouldn't mind, just

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1 kind of, in your answer, just repeat the question in a  
2 way, you know, just as you get started, like you  
3 typically would with any interview that you've done,  
4 I'm sure. And then go on with your explanation. And  
5 I will likely not say much, because what we'll try to  
6 do for the purpose of this tool that they're creating  
7 with the interviews and all this is to -- they'll edit  
8 me out as much as possible so we get the majority of  
9 the people being interviewed.

10           And then every once in a while, though, I  
11 will interject. I keep notes, or if something comes  
12 up and I really want to bring something out or ask a  
13 question, I'll go ahead and do that, and we can have a  
14 conversation around that if we decide to. But so it's  
15 pretty open-ended. And --

16           DR. PHILLIPS: Okay.

17           MR. CLINE: And this is -- generally, we're  
18 shooting for about an eighth grade-ish audience, just  
19 general public audience.

20           DR. PHILLIPS: Okay. I got the impression  
21 from the emails that you guys didn't really know much  
22 about my background. Is that a --

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1           MR. CLINE: Right.

2           DR. PHILLIPS: -- true statement?

3           MR. CLINE: That's true for me. I don't  
4 know about Carolyn, so ...

5           DR. PHILLIPS: Okay. Let me just tell you  
6 what it is. It might help you with the questioning a  
7 little bit.

8           MR. CLINE: Okay.

9           DR. PHILLIPS: I was a Navy pilot for ten  
10 years; had nothing to do with space weather. And then  
11 I went to grad school at UCLA and got a PhD in physics  
12 with a specialty in space plasma physics.

13          MR. CLINE: Uh-huh.

14          DR. PHILLIPS: And my research work involved  
15 the planet Venus.

16          MR. CLINE: Oh, wow.

17          DR. PHILLIPS: It didn't really have much to  
18 do with space weather on Earth, although I had to be  
19 aware of that sort of subject, but my research work  
20 didn't involve it much. And then I went to Los Alamos  
21 National Lab as a postdoctoral fellow and then as a  
22 staff member. And I worked with a variety of

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1 spacecraft observations. Most -- a lot of my work had  
2 to do with the Ulysses satellite, which went --  
3 launched in 1990 and went out to Jupiter and then went  
4 over the poles of the Sun. So we were studying the  
5 Sun and the solar wind, but in an -- in an area far  
6 from Earth. Okay?

7 MR. CLINE: Uh-huh.

8 DR. PHILLIPS: And I was somewhat involved  
9 with space weather in the sense that I did some  
10 research with satellites called the International  
11 Sun/Earth Explorer, which were orbiting Earth, and so  
12 I cared about that subject, but the focus of my  
13 research was much further out in the solar system.

14 And then I got hired by NASA as an astronaut  
15 and went to NASA in -- from 1996 to 2011 and flew in  
16 space three times, including a six-month flight in  
17 2005, and that's kind of -- that six-month flight is  
18 probably the period under which I could -- the time  
19 under which I could say most about space weather that  
20 people might find interesting.

21 MR. CLINE: No, that sounds perfect,  
22 actually.

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1 DR. PHILLIPS: Okay. So but in general, the  
2 focus of my career has not been space weather.  
3 However, I have some maybe unique outlooks on it.

4 MR. CLINE: That sounds great, and one of  
5 the questions somewhere, unless we already -- you  
6 interject it just because it's what you're talking  
7 about, when you're talking about your work in space  
8 and then you bring in that space weather aspect,  
9 anything that ties that in would be great. Maybe -- I  
10 don't know if it had to do with effects on humans in  
11 space by any chance or ...

12 DR. PHILLIPS: A little bit. I can talk  
13 about my dosage, radiation dose and --

14 MR. CLINE: Oh, that's a great one.

15 DR. PHILLIPS: -- its context in the solar  
16 cycle and that sort of thing.

17 MR. CLINE: Yeah, that sounds great. I'm  
18 typing a few notes here as we talk.

19 DR. PHILLIPS: What might be the thing  
20 that's most interesting to -- for your purpose is a  
21 few little tidbits of information about my six-month  
22 flight in space --

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1           MR. CLINE: That would be great.

2           DR. PHILLIPS: -- and our dosimetry and what  
3 I saw and what I witnessed and what my dose was.

4           MR. CLINE: What you saw and witnessed.

5 Okay. You know, what I'll do -- that actually sounds  
6 fantastic for this. It's perfect because what we're  
7 trying to do in a lot of this is let people  
8 understand, like your experience in space and with  
9 space weather, what influences that actually has on  
10 people's knowledge of space weather and why it's so  
11 important, what impact it has on humans, and why  
12 that's important for us as we explore space, and all  
13 of those kinds of aspects come into this, so that  
14 sounds absolutely perfect.

15           DR. PHILLIPS: By the way, do you consider  
16 space debris as part of space weather?

17           MR. CLINE: In -- I have never heard -- I've  
18 never been asked that before. In what way would it  
19 be? That sounds really interesting.

20           DR. PHILLIPS: Well, it's like satellites,  
21 for example. Satellites get hit by space debris.  
22 We've got -- and, in fact, on the International Space

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1 Station, a couple times a year, they have to maneuver  
2 the space station because it's threatened by  
3 something. It could be a natural thing, like a  
4 micrometeorite, or it could be a piece that came off  
5 of another spacecraft. And, in fact, in my six-month  
6 flight, we maneuvered the spacecraft once to avoid  
7 debris.

8 MR. CLINE: No kidding? So --

9 DR. PHILLIPS: I could tell --

10 MR. CLINE: -- there is a little bit of  
11 truth to *Gravity*.

12 DR. PHILLIPS: Yeah.

13 MR. CLINE: To the --

14 DR. PHILLIPS: Yeah, well --

15 MR. CLINE: -- the movie *Gravity*.

16 DR. PHILLIPS: A little bit, yeah.

17 MR. CLINE: Only a tad. Well, so it's --

18 DR. PHILLIPS: I actually thought that it --

19 MR. CLINE: -- actually been moved.

20 DR. PHILLIPS: I thought it was a pretty  
21 good movie, but there were a whole lot of real wild  
22 inaccuracies.

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1           MR. CLINE: I actually did want to ask you  
2 about that. It wouldn't necessarily be part of the  
3 interview, but, you know, what some of those  
4 inaccuracies were. I mean, everybody focused on the  
5 hair, of course, that wasn't moving, but then I'm sure  
6 that --

7           DR. PHILLIPS: Oh, no.

8           MR. CLINE: Yeah.

9           DR. PHILLIPS: But if you think about the --  
10 well, first off, all those -- there are basically four  
11 spacecraft involved in the Hubble Space Telescope: the  
12 space shuttle, the International Space Station, and  
13 the Chinese Space Station. And those are in -- the  
14 Hubble and the two space stations are all in three  
15 different orbits. You can't get to one from another.  
16 So that's a really fundamental thing that was wrong.

17                   And another thing that was wrong that most  
18 people wouldn't even realize is toward the end, Sandra  
19 Bullock does two spacewalks from a Russian Soyuz  
20 capsule. The exits -- she goes out through a hatch  
21 that doesn't even exist in the real vehicle, and she's  
22 wearing a suit -- I don't know if you'd know this, but

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1 her suit doesn't look like a spacewalk suit. It's  
2 very sleek.

3 MR. CLINE: Yeah, it didn't. Yeah.

4 DR. PHILLIPS: It doesn't have a backpack on  
5 it. She doesn't have a source of oxygen.

6 MR. CLINE: Oh, my --

7 DR. PHILLIPS: She'd be dead in a minute. I  
8 mean ...

9 MR. CLINE: Oh, that's perfect. So she's  
10 apparently just using the oxygen in her suit, which  
11 would go for about 30 seconds.

12 DR. PHILLIPS: Yeah. So, I mean, that's --  
13 those are a couple examples of some pretty wild  
14 inaccuracies. But nevertheless, I thought it was a  
15 pretty good movie.

16 MR. CLINE: It really did, it kept me -- I  
17 gripped the seat the entire time when I was watching  
18 it. There was one scene a friend of mine asked about,  
19 and he said (inaudible) capsule it was she left, but  
20 she didn't have propulsion to get from one capsule to  
21 the next or one vehicle to the next, so she used a  
22 canister, like a fire hydrant. And he said --

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1 DR. PHILLIPS: Oh, it was a --

2 MR. CLINE: Wouldn't that explode?

3 DR. PHILLIPS: It was a -- it was a fire  
4 extinguisher, yeah.

5 MR. CLINE: That's it.

6 DR. PHILLIPS: CO2 fire --

7 MR. CLINE: A fire extinguisher. That's  
8 what it was. And I knew that that could give thrust,  
9 but the question was wouldn't that explode as soon as  
10 it went out into space and the pressure difference? I  
11 didn't know.

12 DR. PHILLIPS: No, I don't think so. I  
13 mean, think about a scuba tank. A scuba tank contains  
14 three -- let's see. Two hundred atmospheres of  
15 pressure. So why was a -- why would -- if he can hold  
16 200 atmospheres of pressure in one atmosphere that  
17 it's normally in, and then you take it to zero  
18 atmospheres, I mean, that's just a one-atmosphere  
19 difference in something that holds --

20 MR. CLINE: Oh, that's a good point.

21 DR. PHILLIPS: -- that holds 200  
22 atmospheres. So I -- no, I don't think it would

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1 explode. The fire extinguisher, I think, is similar  
2 kind of pressure. I can't remember for sure. But,  
3 no, I think changing -- this is something with a lot  
4 of pressure inside, and then you take the outside  
5 pressure from one atmosphere to zero. You've only  
6 changed it by one atmosphere. I think it would hold  
7 it just fine.

8 MR. CLINE: Oh, great, we have a telephone  
9 ringing in the background. Hold on just a second.

10 DR. PHILLIPS: Okay.

11 MR. CLINE: Make sure he can edit that out.

12 DR. PHILLIPS: Okay.

13 MR. CLINE: But, yeah, there's actually  
14 parts of the conversation that you've already  
15 mentioned that, if need, they could go back into and  
16 pick out pieces and parts of that --

17 DR. PHILLIPS: Okay.

18 MR. CLINE: -- which will be -- which will  
19 be just great. So that makes sense, yeah.

20 DR. PHILLIPS: I'm choking on -- I'm choking  
21 on my coffee here, so give it a minute before -- I  
22 won't sound very good on a ...

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1 MR. CLINE: It'll give you --

2 DR. PHILLIPS: -- on the --

3 MR. CLINE: -- that deep, husky voice, yeah.

4 DR. PHILLIPS: Okay. Well, I guess -- I  
5 guess I'm ready to get started again.

6 MR. CLINE: Okay. I'll just -- I'll start  
7 with the questions, and then I'll keep an eye on some  
8 of the notes that I've been taking. And if --

9 DR. PHILLIPS: Okay.

10 MR. CLINE: If I haven't heard you say it, I  
11 might bring it up in a question, depending on where we  
12 are in the conversation. So we'll just kind of play  
13 it by ear. And then at the end, if there's anything  
14 else you need to add, we can certainly do that, and  
15 that won't be a problem.

16 DR. PHILLIPS: Sure.

17 MR. CLINE: All right. So the -- so, John,  
18 I really appreciate your time here with us today.  
19 Thanks so much for working with us on Space Weather  
20 Living History. And, first of all, I'd for you just  
21 to tell us who you are, just a little bit about  
22 yourself, and then we'll get started with the first

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1 question about your primary research interest.

2 DR. PHILLIPS: Okay. My name is John  
3 Phillips. I was a NASA astronaut from 1996 to 2011.  
4 I had three space flights. Before that, long before,  
5 I was a Navy pilot. Then I went to grad school at  
6 UCLA, got a PhD in space plasma physics, and then  
7 worked at nine years -- worked nine years at Los  
8 Alamos National Lab in New Mexico, working on  
9 spacecraft instrumentation and observations from a  
10 variety of spacecraft.

11 MR. CLINE: Now, what area now and -- or  
12 most recently and that you would like to talk about  
13 would you consider to be your primary research  
14 interest?

15 DR. PHILLIPS: My primary research interest  
16 were the Sun and the solar wind, which is a charged  
17 gas, an ionized gas that flows continuously, but  
18 variably, out from the Sun and which envelops the  
19 Earth and is the main driving -- or one of the main  
20 driving factors in what we call space weather.

21 MR. CLINE: And what is it that you believe  
22 that influenced you most to actually be drawn to this

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1 area? What is it that you like so much about it that  
2 it became such a primary focus?

3 DR. PHILLIPS: You know, actually, it was  
4 kind of serendipity. I picked my program at UCLA out  
5 of a catalog. This was before the Internet, and you  
6 looked up university information in a catalog. And I  
7 went to the San Diego Public Library one day. I was  
8 in the Navy in San Diego and read this description of  
9 a program called space physics. And I didn't exactly  
10 know what it was, and I applied for it and got  
11 accepted.

12 So I went to UCLA without really knowing  
13 what I was getting myself into. My interests really  
14 were more in remote sensing of the Earth, but as it  
15 turned out, I liked it once I started studying it;  
16 space physics, that is, which had to do basically with  
17 plasmas and electric and magnetic fields and the  
18 various regimes that are in and around the Sun and  
19 planets and Earth, the moon.

20 And I just found it very interesting. I  
21 like my physics on a big scale; kilometers, not  
22 nanometers. I thought it was very interesting, and

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1 all the courses that I took were good. And then I got  
2 a job at Los Alamos National Lab and kept working in  
3 that field.

4 MR. CLINE: And then what's really  
5 interesting is that you are involved in, you know,  
6 some of the beginnings, really, of what we are calling  
7 space weather research today. And that actually led  
8 towards your career as an astronaut?

9 DR. PHILLIPS: Well, first off, we've been  
10 studying space physics since the International  
11 Geophysical Year in 1957-58, and so I wasn't in on the  
12 ground floor. I started in that business in the  
13 1980s. But nevertheless, I got to -- I got involved  
14 in some fairly groundbreaking spacecraft missions,  
15 particularly the Ulysses mission over the poles of the  
16 Sun.

17 Whether or not it helped me get -- to start  
18 a career as an astronaut, I will probably never know.  
19 The fact that I was working on NASA-based programs  
20 probably worked in my favor when I applied to be an  
21 astronaut. But nevertheless, it took me a long time.  
22 I took the scenic route to the launch pad. I put in

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1 my first application in 1976 and finally got hired in  
2 1996.

3 MR. CLINE: Now, what -- during that time  
4 that you were -- you were working with space weather  
5 -- and you were talking -- let me get the right  
6 terminology here. It was plasma physics, correct,  
7 space plasma physics?

8 DR. PHILLIPS: That's correct.

9 MR. CLINE: What were some of the key events  
10 or turning points during your time in that type of  
11 research that you think were pretty significant?

12 DR. PHILLIPS: The biggest turning point for  
13 me was the launch and the flight of the spacecraft  
14 Ulysses. Ulysses was a -- actually a European  
15 spacecraft launched on the U.S. space shuttle and  
16 containing instruments from both the United States and  
17 Europe, launched in 1990, and first went out to  
18 Jupiter and went over the poles and then used the  
19 gravity deflection to turn south and then went over  
20 the poles and continued operating, basically, for  
21 about another -- well, nearly 20 years, and it went  
22 over the poles of the Sun -- well, it was on its third

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1 lap over the poles of the Sun when they finally turned  
2 it off.

3           And I was fortunate enough to be on the  
4 launch and initial data return from that mission, and  
5 eventually, when the original principal investigator  
6 of our instruments retired, I became the principal  
7 investigator. I didn't help build the instruments. I  
8 came in a little later.

9           But what was very nice about it was every  
10 time I would get a new week's worth of data -- we  
11 would get data a week at a time, and I would see  
12 observations that no one had ever seen before in a  
13 place where no one had ever taken measurements before.  
14 And that was very exciting. It's a form of  
15 exploration, that even though I'm just sitting in my  
16 office, looking at new results, for me, it was every  
17 bit as exciting as something where I was doing it  
18 physically, like going on the South Pole or going to  
19 space.

20           MR. CLINE: So this is -- this is research  
21 that's being done -- and you said this earlier -- Sun  
22 and solar wind research far, far away from Earth, but

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1 yet it clearly has a direct connection with what we  
2 know about space weather and how -- the impacts on  
3 Earth.

4 DR. PHILLIPS: That's correct. What was  
5 unique about Ulysses was that it went over the poles  
6 of the Sun, so we were able to measure the -- not only  
7 the solar wind, but energetic particles and  
8 electromagnetic fields with a solar origin, basically,  
9 in the complete environment surrounding the Sun, and  
10 not real close, but not just from the vantage point of  
11 Earth, which is where every other spacecraft had  
12 measured these phenomena.

13 So we were able to kind of make a global map  
14 of how the Sun produces the plasma and electromagnetic  
15 field environment that we are enveloped in, but we --  
16 but we were able to produce this global map that  
17 helped us understand the entire process.

18 MR. CLINE: That sounds amazing. I mean,  
19 what an addition to add to all the research -- the  
20 ongoing research that's been going on with space  
21 weather. And do you think in the future, as we  
22 venture further into space, if we do additional

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1 exploration, can you imagine that -- I'm also  
2 answering my own question, but the type of research  
3 and data that we can get from those remote regions far  
4 away from Earth that -- the type of impact that might  
5 have on our understanding of the solar system and  
6 space weather. I mean, I can imagine that there are  
7 questions out there that remain unanswered that  
8 students today and people who are listening to this  
9 will be able to be part of one day.

10 DR. PHILLIPS: Absolutely. Every new  
11 spacecraft or every new observatory produces  
12 observations that have -- that are unique, whether  
13 it's because a spacecraft's in a different place or  
14 because it has a better instrument than the -- than  
15 the last spacecraft. And there are still major  
16 questions about the Sun.

17 I mean, for example, one of the real  
18 fundamental questions about space weather is how does  
19 a solar corona that's a region distant from the  
20 surface of the Sun, how does it get heated, because  
21 it's actually much hotter than the surface of the Sun?  
22 So it would be like if you put a pan of cold water on

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1 a barely warm hotplate, and then the water started  
2 boiling. It doesn't make any sense from a -- from a  
3 thermodynamic standpoint, so you have to understand it  
4 from the standpoint of conversion of electromagnetic  
5 energy.

6           And as we -- every time we launch a new  
7 solar observatory or a new spacecraft into the inner  
8 (ph) solar system, we learn more and more about that  
9 really fundamental process.

10           MR. CLINE: Now, earlier, you also talked  
11 about your experience in space as an astronaut. Can  
12 you tell us a little bit about that? Because you  
13 mentioned earlier that, you know, you were there for  
14 quite a prolonged period of time at one point, so your  
15 dosage rates would have been high. Can you walk us  
16 through some of your experience?

17           DR. PHILLIPS: Sure. Sure. Well, my second  
18 space flight, my second of three, was in 2005. We  
19 launched and landed on a Russian Soyuz spacecraft, and  
20 there were only two of us, myself and a Russian  
21 fellow, and we were aboard the International Space  
22 Station for six months.

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1           Now, this was -- to put it into context of  
2 space weather, we were, during the declining part of  
3 the sunspot cycle, almost as sunspot minimum. Sunspot  
4 activity was very, very low. And this is a period  
5 under which you don't get much radiation from  
6 impulsive solar events, but your background radiation  
7 from cosmic rays is actually high.

8           And in six months on space -- in space, I  
9 didn't worry about space weather at all. I did, in  
10 fact, have a place on the space station where I could  
11 take shelter, where it was lined with polyethylene  
12 bricks, but we never had to do that. I did have a  
13 personal dosimeter, and there was also sort of a -- a  
14 spacecraft-wide dosimeter with an alarm capability  
15 that was installed aboard the ISS. It never alarmed  
16 while we were -- while we were on board.

17           But after I got back in October 2005, I  
18 found out my radiation dose, and it turned out that in  
19 six months, I had absorbed a radiation dose of 8 REMs.  
20 REM is a Roentgen Equivalent Man. Eight REMs. Now,  
21 this was -- compare this with the OSHA dose of 5 REMs  
22 per year for a person who, say, works at a nuclear

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1 power plant or works in some sort of radiation  
2 environment. I had 8 REMs. The OSHA limit was 5  
3 REMs. So if I had been a nuclear plant worker, they  
4 would have had to send me home.

5 MR. CLINE: Oh, wow.

6 DR. PHILLIPS: But the NASA limit, in fact,  
7 is considerably higher than the OSHA limit. It's 50  
8 REMs per year, plus they have an additional lifetime  
9 limit based on an enhanced cancer risk. So I was over  
10 the OSHA limit in six months, but well under the NASA  
11 limit. And I found that out after I got back.

12 But so it is what it is. I can't worry  
13 about it too much. And it's also interesting that in  
14 my 11 -- excuse me, my 15-year career as an astronaut,  
15 about half of my radiation dose came from space  
16 flight. The other half came from medical procedures  
17 and experiments.

18 MR. CLINE: Oh, okay. That makes -- that's  
19 amazing to hear that. Wow.

20 DR. PHILLIPS: Yeah. And a couple other  
21 aspects of space weather when I was in space was  
22 looking at the aurora, for one thing. And because I

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1 was personally interested in space weather, much more  
2 so than typical astronauts -- or much more -- every  
3 astronaut has their own interest, and most of them are  
4 not space physicists. I am, and so I was interested  
5 in the subject.

6           So I had mission control, every day when I  
7 was in space, send me up the NOAA space weather report  
8 for that day. And so I was kind of aware of what was  
9 going on in terms of solar flares and sunspots, which  
10 were -- and there wasn't much of that during our time.

11           And I was particularly interested in it  
12 because it would help me pick out times to look at the  
13 aurora borealis and aurora australis, or the northern  
14 and southern lights. Now, we were in space in  
15 Northern Hemisphere summer, so it was hard to see the  
16 northern lights. It was just too bright in the  
17 Northern Hemisphere.

18           So most of the time what we would see is the  
19 aurora australis, or southern lights, typically down  
20 around Tasmania or New Zealand. And we took some  
21 pictures, and we got to -- got to look at it a lot.  
22 And in the -- in the International Space Station,

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1 you're generally going over, or sometimes through, the  
2 aurora.

3 MR. CLINE: No kidding.

4 DR. PHILLIPS: And it was really, really --  
5 it was really spectacular.

6 MR. CLINE: So as you were traveling  
7 through, your perspective, you're literally -- as you  
8 look out your viewing window or port, you're able to  
9 actually see the aurora just all around you?

10 DR. PHILLIPS: Yes, you can, occasionally.  
11 More often than not, we're above it, but sometimes  
12 we're sort of in it, and once you're in it, it appears  
13 very, very diffuse. The lights are not really bright,  
14 whereas from a distance, you can see structure. Once  
15 you get really close to it, what you're seeing is sort  
16 of a vague feeling that you're going through areas  
17 that are slightly illuminated in either blue or green.

18 But we would see that quite often. And my  
19 crewmate, Sergei Krikalev, who was a very good  
20 photographer, took a lot of very nice pictures of the  
21 aurora australis, which is hard to do with a handheld  
22 camera, because you need like a two-second exposure to

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1 get a good image, and you're just holding the camera  
2 with your hand. And after getting some pictures that  
3 were not so good, I finally gave up and just said,  
4 "I'm just going to enjoy this. I'm just going to  
5 watch it go by and not even -- and not spoil the  
6 experience by trying to get a picture."

7 MR. CLINE: Now, I have seen some footage of  
8 the aurora australis from -- on YouTube and different  
9 places and through some NASA videos that have been  
10 released. Those were, I think, you know, taken from  
11 the space station. Were you part of that, some of the  
12 release of some of the video footage in any way?

13 DR. PHILLIPS: No, I wasn't, and I think --  
14 I was on the station in 2005, and those images were  
15 taken a little bit later, when they had, one, better  
16 video cameras on board, and, two, better windows. It  
17 would have been very difficult for us to have taken  
18 that kind of image. But I've watched them, and they  
19 can be really spectacular as you see the cities go by  
20 and occasional thunderstorms flashing, and then in the  
21 background, you can see a faint aurora. I think  
22 they're really spectacular.

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1           MR. CLINE: I just can't even imagine the  
2 change that you would experience in your life after  
3 being part of something like that and witnessing  
4 something like that.

5           DR. PHILLIPS: Sure.

6           MR. CLINE: You also mentioned something  
7 about various things that you saw and witnessed while  
8 you were in space, one being clearly, you know, the  
9 aurora. What were some of the other things that you  
10 noticed and witnessed while you were there?

11          DR. PHILLIPS: Well, the other things that I  
12 -- that I witnessed while I was there that involved  
13 space weather were primarily noctilucent clouds.  
14 Noctilucent means, basically, they'll glow at night.  
15 And these are thin -- very thin, very high-altitude  
16 clouds that mostly appear over the polar areas. And  
17 we -- I can actually look at -- the spacecraft -- the  
18 International Space Station doesn't go over the poles,  
19 but we've got a couple windows that look out on the  
20 horizon, so when we're near our peak northern and  
21 southern latitude, which is 51.6 degrees, we can look  
22 out one of those windows and see further toward the

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1 poles. And quite often, I would see these noctilucent  
2 clouds, which are extremely high-altitude clouds, that  
3 are part of the -- sort of the lowest altitude part of  
4 the space weather, if you will. and I found it kind  
5 of interesting, because I've never seen it from the  
6 ground.

7           And let me tell you one other experience I  
8 had which involves yet another part of space weather,  
9 and this has to do with ozone. As you probably know,  
10 ozone in the upper atmosphere screens out much of the  
11 ultraviolet radiation that would otherwise hit Earth.

12           And all the windows on the International  
13 Space Station are coated with an ultraviolet  
14 protective layer except one particular window on the  
15 Russian segment. And most of the time, we were flying  
16 with that window facing Earth, not facing the Sun, so  
17 I wasn't worried about ultraviolet light, and I got a  
18 little complacent.

19           And then one day, I opened the shutter on  
20 this big window in the Russian segment, not realizing  
21 that the spacecraft had maneuvered, and that window  
22 was actually facing somewhat toward the Sun. And I

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1 opened the shutter, and I got a big blast of sunlight  
2 on one side of my face. And I closed the shutter.  
3 And I estimate that I had sunlight on my face for  
4 about four seconds. And the next day, half of my face  
5 was red, so I got sunburned in four seconds --

6 MR. CLINE: That's amazing.

7 DR. PHILLIPS: -- by opening the shutter on  
8 this window that didn't have an ultraviolet coating.  
9 And --

10 MR. CLINE: Wow.

11 DR. PHILLIPS: I -- yeah. And I'd never  
12 been very much any kind of an expert on atmospheric  
13 chemistry or the way the ozone layer works, but I had  
14 a computer-based encyclopedia on board, so I looked it  
15 up that night, and it turned out that the ozone layer  
16 screens out something like all but one part in several  
17 thousands of the flux of ultraviolet light in certain  
18 wavelengths to the Earth. So my four seconds of  
19 exposure was like several -- perhaps like four hours  
20 on the surface of the Earth.

21 MR. CLINE: Well --

22 DR. PHILLIPS: Anyway, I managed to get

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1 sunburned in four seconds.

2 MR. CLINE: That really makes you appreciate  
3 our atmosphere that much more, and the ozone layer in  
4 particular, yeah.

5 DR. PHILLIPS: Absolutely, and it sort of  
6 made me appreciate the shutter on that window too, and  
7 it made me much more careful about it for the rest of  
8 the flight.

9 MR. CLINE: Whoa.

10 DR. PHILLIPS: Fortunately, I did -- I did  
11 not actually look at the Sun. I just got sunlight --

12 MR. CLINE: Yeah.

13 DR. PHILLIPS: -- on my face.

14 MR. CLINE: Well, plus it would be a great  
15 way to cook a steak in no time flat, I would assume.

16 DR. PHILLIPS: Yeah, I'm not so sure about  
17 that.

18 MR. CLINE: Maybe it wouldn't be edible, but  
19 it could burn it.

20 DR. PHILLIPS: Yeah.

21 MR. CLINE: Now, you had mentioned a little  
22 -- and I'm sure this is something that you were often

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1    aware of -- would be debris in space.  And could you  
2    tell us a little bit more about your experience with  
3    that?

4                   DR. PHILLIPS:  Yeah.  There are natural  
5    objects in space in orbits similar to the space  
6    station orbit, and then there are manmade objects from  
7    spacecraft launches and from collisions of spacecraft  
8    and deliberate shoot-downs of spacecraft, which have  
9    been done by China and by the United States.

10                   And, actually, I was in space a little  
11    before those events, but there was still natural and  
12    manmade debris in space, and it's tracked, basically,  
13    by the U.S. Air Force, who sends out alerts when  
14    something -- when we're in danger of hitting a piece  
15    of debris.

16                   And NASA evaluates it and then decides what  
17    are the odds that we're going to -- we're going to  
18    strike this piece of debris?  And if they -- if the  
19    odds go above a certain threshold, then they maneuver  
20    the spacecraft.

21                   Now, during my six-month flight, we  
22    maneuvered the International Space Station one time

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1 for debris avoidance, and it's done very, very gently.  
2 The crew hardly even notices it. Small rocket engines  
3 are fired by command from the ground, and if they  
4 hadn't have told us we were going to maneuver, Sergei  
5 and I, my crewmate and I, probably wouldn't have even  
6 known it, because it's a very gentle acceleration.  
7 But they -- we changed orbits once in six months.

8           By the way, Phase 2 of this -- what the crew  
9 does in response to -- in response to a debris alert  
10 is that they can go to their Russian Soyuz capsule,  
11 which is basically their lifeboat, and so they'll  
12 hunker down there and wait for the debris to pass. We  
13 never had to do that. In fact, I think it's only been  
14 done once or twice in the whole life of the space  
15 station, but we did maneuver one time.

16           MR. CLINE: Now, out of all of the  
17 experiences that you had in -- particularly in space,  
18 the launch, your stay in space for an extraordinary  
19 amount of time, and then return, reentry, and all of  
20 that, what do you think was the most either exciting  
21 or part of it that made your -- maybe the most  
22 memorable part or part that made your heart nearly

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1 pound out of your chest? What would that be, what  
2 part of your experience?

3 DR. PHILLIPS: For me, the most exciting  
4 part was landing in a Russian Soyuz capsule. This is  
5 very different from landing on a shuttle. On a  
6 shuttle, you only pull about one and a half G's, and  
7 then you end up rolling out on a -- on a runway.  
8 Landing on a Russian Soyuz capsule, you parachute in  
9 in a grassland of Kazakhstan. You pull something like  
10 5 G's on the way in. And parts of it are pretty  
11 intense, like, in particular, when the parachute first  
12 opens.

13 I don't know exactly what it looks like from  
14 outside. I've never seen film of it. But what it  
15 feels like from inside -- and remember that I've been  
16 in zero G. I've been in weightless -- weightless for  
17 six months, so my body's used to weightlessness, and  
18 suddenly, the forces that come on -- but after we get  
19 through the upper part of the atmosphere and the  
20 spacecraft slows a bit, then a parachute opens, and  
21 when the parachute opens, it feels like you're  
22 spinning down a drain. That's what it feels like for

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1 about three or four seconds.

2           If I hadn't been warned about it, if I  
3 didn't know it was a pretty violent few seconds, it  
4 would have been really scary. But my -- basically, my  
5 vision blacked out, and I felt like I was spinning  
6 down a drain for a few seconds.

7           MR. CLINE: And, of course --

8           DR. PHILLIPS: And then --

9           MR. CLINE: -- was it spinning actually, or  
10 was that just a sensation?

11           DR. PHILLIPS: No, actually -- I don't think  
12 so. I think -- and I -- as I mentioned, I've never  
13 seen video of this event. I don't know what it looks  
14 like from outside, and I don't think anyone has ever  
15 taken video of it. But from inside, it feels like  
16 you're spinning down a drain.

17           MR. CLINE: Uh-huh.

18           DR. PHILLIPS: I think what it really is is  
19 the spacecraft is just shaking really violently, and  
20 because your body's sensors are used to being  
21 weightless and haven't had to work very hard for six  
22 months, basically, it confuses your body's attitude

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1 receptors.

2 MR. CLINE: Sure. Sort of like a sense of  
3 vertigo.

4 DR. PHILLIPS: Yeah, it's -- but it goes way  
5 beyond vertigo. I mean, it's really extreme.

6 MR. CLINE: Well, that's amazing. Wow. Do  
7 you have anything else? We've gone over the --  
8 several of the notes that we talked about earlier, and  
9 you've hit every single point.

10 DR. PHILLIPS: Oh, okay.

11 MR. CLINE: And you've done a great job with  
12 that, and I'm wondering is there anything else that  
13 you'd like to add to this that we could include or --

14 DR. PHILLIPS: Well --

15 MR. CLINE: -- anything you'd like to maybe  
16 say to the people listening?

17 DR. PHILLIPS: Well, first off, one of the  
18 little events that happened when I was up there -- two  
19 -- can I mention two other little events?

20 MR. CLINE: Sure.

21 DR. PHILLIPS: First off -- first off, I got  
22 -- I got word that there was going to be a solar

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1 eclipse. And I asked the people on the ground to send  
2 me up information about the solar eclipse while I was  
3 up there. And it turned out we were going to fly  
4 through the shadow of the moon. And, yeah, I got the  
5 exact --

6 MR. CLINE: Which eclipse was this?

7 DR. PHILLIPS: -- time and everything.  
8 Yeah. And as it turned out, we flew through the  
9 shadow of the moon while we were over the Indian  
10 Ocean, and I thought it was going to be very, very  
11 dramatic, like it's suddenly going to go from bright  
12 to dark, and, actually, it was rather subdued.

13 I could barely tell that we were in the  
14 shadow of the moon. We didn't go from, you know,  
15 bright sky to the -- well, the sky is always black in  
16 space, but we didn't go from bright sunlight to  
17 darkness. We went from bright sunlight to slightly  
18 less bright sunlight. So but we did fly through at  
19 least a piece of the -- of the solar eclipse, of the  
20 shadow of the moon.

21 And then one other thing that happened while  
22 I was up there was there was a comet, and I wish I

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1    could remember the name of the comet, but I can't. It  
2    was predicted to impact Jupiter. And so I managed to  
3    find a place on the spacecraft where I could see  
4    Jupiter, and I positioned myself right when the comet  
5    impact was going to happen, and just in case something  
6    really spectacular happened, like a big exposure on  
7    Jupiter -- but, no, Jupiter's a very big planet. The  
8    comet's not very big. Comet crashed into Jupiter, and  
9    I didn't see a thing. I tried.

10           MR. CLINE: Which year was the eclipse? Was  
11    it, by any chance, the 2006?

12           DR. PHILLIPS: No, it was 2005.

13           MR. CLINE: 2005.

14           DR. PHILLIPS: If I remember right, it was  
15    fairly late in the mission. It was --

16           MR. CLINE: Okay.

17           DR. PHILLIPS: -- perhaps -- I'm taking a  
18    guess now -- August of 2006 -- 2005, excuse me. It  
19    was August 2005, and it -- we went through it over the  
20    Indian Ocean. I remember that part.

21           MR. CLINE: And were there, by any chance,  
22    any types of cameras or recording equipment that were

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1 pointed towards the Sun to capture the eclipse as seen  
2 from space that you remember?

3 DR. PHILLIPS: No, there were not. And --

4 MR. CLINE: Okay.

5 DR. PHILLIPS: And, quite frankly, I was a  
6 little bit surprised that nobody but me seemed very  
7 interested in it when I called mission control about  
8 it. I had gotten an email from a friend on the ground  
9 saying, "Are you going to see the solar eclipse  
10 tomorrow?" And that was the first I'd heard of it.

11 And I called down to mission control, and they didn't  
12 really -- I mean, they sent me the information, but I  
13 didn't get the feeling they were even very aware of  
14 it, so --

15 MR. CLINE: That's amazing, isn't it?

16 DR. PHILLIPS: You know, it seemed -- well,  
17 first off, they don't really want to point their  
18 cameras at the Sun. I can understand --

19 MR. CLINE: Right. It would have to be  
20 bright without --

21 DR. PHILLIPS: Yeah. They're --

22 MR. CLINE: -- a H-alpha --

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1 DR. PHILLIPS: They're --

2 MR. CLINE: -- or some sort of filter.

3 DR. PHILLIPS: I mean, these are external  
4 cameras that have to last, basically, the life of the  
5 space station, or at least many years. And they can  
6 point them just about any direction, but they really  
7 don't want to point them at the Sun, so I can  
8 understand why they weren't too interested in taking  
9 images of it. And I didn't look at the Sun either. I  
10 didn't --

11 MR. CLINE: Right.

12 DR. PHILLIPS: -- have any instrument with a  
13 solar filter. I was looking at the surface of the  
14 Earth to see if the shadow of the moon would be really  
15 distinct when they flew through it, and it was less  
16 distinct than I thought.

17 MR. CLINE: But it was noticeable? You  
18 could actually see the difference?

19 DR. PHILLIPS: Yes. Yes, it was noticeable.

20 MR. CLINE: Now, have you ever witnessed a  
21 total solar eclipse from the ground?

22 DR. PHILLIPS: Yes, I have. Just -- not in

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1 any professional capacity.

2 MR. CLINE: Uh-huh.

3 DR. PHILLIPS: I've been in places where  
4 people would set up a couple of amateur telescopes  
5 with Sun filters. And once I watched it on a pinhole  
6 camera.

7 MR. CLINE: Uh-huh.

8 DR. PHILLIPS: But, yeah, I've seen several  
9 solar eclipses in my lifetime.

10 MR. CLINE: I was going to say it would be  
11 really funny, in some way, had -- if the only place  
12 you'd actually witnessed a total solar eclipse had  
13 been in space, which is the most --

14 DR. PHILLIPS: Oh, no.

15 MR. CLINE: -- unique experience you can  
16 imagine.

17 DR. PHILLIPS: Yeah. No, I've seen better  
18 ones on Earth than I have in space.

19 MR. CLINE: I remember we had the  
20 opportunity to be in Side, Turkey with a crew of  
21 people filming the 2006 total solar eclipse, and I  
22 think one of the -- apart from the temperature change

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1 and the temperature shift, that -- we had a whole crew  
2 of students from Side who were monitoring the  
3 temperature shifts and wind and all of that.

4 I thought what was really fascinating was  
5 when you would hold up a colander or anything that had  
6 holes in it or crisscross your fingers and let the  
7 sunlight shoot through your fingers, and then all you  
8 would -- you would just see hundreds of solar eclipses  
9 all over the ground or under trees. We just all found  
10 that incredibly fascinating.

11 DR. PHILLIPS: I actually never thought  
12 about looking at it with a -- through a colander.  
13 That sounds like a good idea. I've done a pinhole  
14 camera, which is -- and I guess a colander's like a  
15 hundred pinhole -- or a thousand pinhole cameras.

16 MR. CLINE: It really creates an amazing  
17 effect. And I know we have an eclipse coming across  
18 the United States in 2017, so we'll have our colanders  
19 out then. And we also noticed under trees, you know,  
20 with the Sun that came through the trees, the way the  
21 light was bending, refracting, you saw just thousands  
22 of images of the -- of the solar eclipse as it was

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1 going on.

2 DR. PHILLIPS: Yeah. Well, Troy, you asked  
3 me if I had anything else I wanted to tell people, and  
4 it's just that space weather is real, it affects not  
5 only life in space, but life on Earth, and I think  
6 it's really important that we continue our efforts to  
7 understand it, to produce warning capability for  
8 destructive events. And as we become more and more of  
9 a high-tech society, we are becoming more and more  
10 vulnerable to space weather. So we really have to  
11 understand it as well as we understand weather on  
12 Earth.

13 MR. CLINE: Well, John, this has been an  
14 amazing interview. Thank you so much for your time.  
15 And I think the very next part of this process will be  
16 they will edit the interview down and then create a  
17 transcript, and then that transcript will be edited  
18 somewhat, and then we'll send that transcript --  
19 Carolyn Ng will likely send that to you, and then you  
20 can read through it, strike anything, make any edits,  
21 suggest any -- if you need us to move something  
22 around, we can --

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1 DR. PHILLIPS: Okay.

2 MR. CLINE: -- certainly do that. And then  
3 after that, we'll have it in the queue and ready to go  
4 up on the Space Weather Living History tool that we're  
5 creating. And then we'll let you know --

6 DR. PHILLIPS: Very good.

7 MR. CLINE: -- when that's happening. All  
8 right?

9 DR. PHILLIPS: Okay. Well, I look forward  
10 to the next step and to the finished product, and it  
11 was a pleasure talking to you today.

12 MR. CLINE: Thank you very much. And you  
13 have a -- have a great -- have a great afternoon.

14 DR. PHILLIPS: Okay. Thanks very much.

15 MR. CLINE: Uh-huh.

16 DR. PHILLIPS: Bye-bye.

17 MR. CLINE: Bye.

18 (Whereupon, the interview of Dr. John  
19 Phillips 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