

Capital Reporting Company
Interview of Joan Feynman

1

INTERVIEW
OF
JOAN FEYNMAN

Capital Reporting Company
Interview of Joan Feynman

2

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

2 MS. FEYNMAN: Hello.

3 MR. CLINE: Hello, Joan. This is Troy
4 Cline. How are you?

5 MS. FEYNMAN: Okay. Well, pretty good. I'm
6 trying to beat a cold.

7 MR. CLINE: Oh, is that right?

8 MS. FEYNMAN: So I didn't go to work. Huh?

9 MR. CLINE: You're trying --

10 MS. FEYNMAN: Yeah.

11 MR. CLINE: -- beat the cold?

12 MS. FEYNMAN: Yeah, I'm -- I'm coming down
13 with a cold and I'm trying to --

14 MR. CLINE: Hope not.

15 MS. FEYNMAN: -- I didn't want to go outside
16 because it'll only get worse. Let me turn off my
17 iPad. Okay?

18 MR. CLINE: Okay.

19 MS. FEYNMAN: I'll be right back.

20 MR. CLINE: No problem.

21 Can you hear --

22 UNIDENTIFIED SPEAKER: Uh-huh.

Capital Reporting Company
Interview of Joan Feynman

3

1 MR. CLINE: -- her?

2 (Off the record.)

3 MS. FEYNMAN: Okay.

4 MR. CLINE: Okay. Welcome back.

5 MS. FEYNMAN: I'm back. Yeah. Now, do we
6 want --

7 MR. CLINE: She's --

8 MS. FEYNMAN: Do we want to do an interview
9 now or what?

10 (Off the record.)

11 MR. CLINE: Yeah, we're working -- right now
12 we're working on just the sound. So as you were
13 talking, I was -- we're adjusting the volume. And --

14 MS. FEYNMAN: Okay.

15 MR. CLINE: And I think we're just about
16 ready. Yeah, we can absolutely do the interview right
17 now. And usually --

18 MS. FEYNMAN: Okay.

19 INTERVIEWER: -- how I open that up is in a
20 minute I'll just ask you to tell us, this is for the
21 audio person later on when he's doing the files, but I
22 usually ask the person to just say who they are and

Capital Reporting Company
Interview of Joan Feynman

4

1 what they do or most recently have done and basically
2 your field. And then we start with the first
3 questions.

4 And then I won't speak as much, as I was
5 telling you before, so that they don't have to edit me
6 out. And we'll just start with the primary research
7 interest, what you like about it, and how you're
8 involved in space weather and some of the key events
9 and turning points. And then you can talk about
10 anything --

11 MS. FEYNMAN: You mean, you want me --

12 MR. CLINE: -- that sounds interesting.

13 MS. FEYNMAN: -- to just start talking and
14 you're --

15 MR. CLINE: Uh-huh.

16 MS. FEYNMAN: -- not going to ask me
17 anything?

18 MR. CLINE: I will -- actually, I will pop
19 in here and there as we go through the conversation.
20 I'll --

21 MS. FEYNMAN: Because --

22 MR. CLINE: -- make sure we stay on track

Capital Reporting Company
Interview of Joan Feynman

5

1 with the right questions. And if we do get --

2 MS. FEYNMAN: Okay. So you --

3 MR. CLINE: -- into a conversation, that's
4 fine.

5 MS. FEYNMAN: I think it's a good idea to
6 you -- for you to ask me questions and I'll answer
7 them because --

8 MR. CLINE: Okay.

9 MS. FEYNMAN: You know, one by one, because
10 I don't see -- you know, I don't have a talk --

11 MR. CLINE: Uh-huh.

12 MS. FEYNMAN: -- ready to -- if -- to go on
13 for a few minutes. So it's --

14 MR. CLINE: Okay.

15 MS. FEYNMAN: -- not the way I normally
16 work. So --

17 MR. CLINE: Okay.

18 MS. FEYNMAN: -- if you're going to ask me
19 who I am and --

20 MR. CLINE: Uh-huh.

21 MS. FEYNMAN: -- what I do, please ask me
22 that, then you can edit it out.

Capital Reporting Company
Interview of Joan Feynman

6

1 MR. CLINE: Okay. That's fine. That will
2 be fine. And if I do ask a question, if it makes
3 sense during the conversation, right after I ask the
4 question, you can just restate the question as you
5 talk.

6 Like, if I say, you know, what is your
7 primary area of research; you say, well, actually my
8 primary area of research is, you know, and you just.

9 That way it's easier to edit me out if we
10 need to. Sometimes they keep my voice in, just
11 depending on what I say. I never know what I'll be
12 saying either until the interview starts.

13 MS. FEYNMAN: Okay. This is slow to work
14 with, but I'll do my best.

15 MR. CLINE: Oh, you'll be just fine. And
16 actually, the way we're talking right now is exactly
17 the way to do it. And if there's --

18 MS. FEYNMAN: Okay.

19 MR. CLINE: -- any part that doesn't make
20 sense and you're like, oh, scratch that, let's -- let
21 me start that over, just say that and the --

22 MS. FEYNMAN: Yeah, okay.

Capital Reporting Company
Interview of Joan Feynman

7

1 MR. CLINE: -- editor will know to do that.

2 MS. FEYNMAN: Interrupt me and tell me, you
3 know, if I go off but please --

4 MR. CLINE: Okay.

5 MS. FEYNMAN: -- lead me along, because --

6 MR. CLINE: I sure will.

7 MS. FEYNMAN: -- otherwise, I will be
8 babbling.

9 MR. CLINE: That's no problem. We'll take -
10 -

11 MS. FEYNMAN: Yeah.

12 MR. CLINE: -- care of that.

13 MS. FEYNMAN: Okay.

14 MR. CLINE: Well, we're -- I'm really --
15 we're real excited that you agreed to do this. And
16 it's -- I'm looking forward to talking with you right
17 now about space weather and -- and your influence and
18 what you've -- your part in the space weather research
19 that's been going on over the years.

20 EXAMINATION

21 BY MR. CLINE:

22 Q And why don't we start this interview, Joan,

Capital Reporting Company
Interview of Joan Feynman

8

1 by just -- why don't you tell us who you are and a
2 little bit about what you do with space weather.

3 A Okay. My name is Joan Feynman. I work at
4 the Jet Propulsion Lab at this time. And space
5 weather is something I do from time to time.

6 But the solar terrestrial relationship is
7 what I do all the time. Space weather is a subset of
8 those because it consists of the sun doing something
9 to the solar wind that does something to the earth.
10 And it becomes space weather when it's dangerous to
11 something else, like people or power plants.

12 Q So in large, the greater picture of what
13 you've studied over the years, really has to do with
14 the effects of the sun on the entire solar system. Is
15 that correct?

16 A Well, it's really effects of the sun on the
17 earth

18 --

19 Q Okay.

20 A -- mostly and on the interplanetary medium
21 between the sun and the earth. And it's not just
22 effects of the sun. It's also understanding the sun

Capital Reporting Company Interview of Joan Feynman

9

1 itself. There are lots of problem with the sun; for
2 instance, how does it get its solar cycle and why is
3 the solar wind the way it is, and so on. And so I
4 cover all of those problems.

5 Some years ago, when I first came to JPL,
6 which must be like 30 years now, I was in a group
7 where my boss asked me to -- to make a model for the -
8 - the environment that the Magellan satellite would be
9 -- could be expecting as it flew.

10 And I looked at what had been done, and I
11 thought the person who had done it had done a very
12 good start at devising a method but that there were
13 certain things that needed improvement, so I improved
14 them.

15 One of the things was that it had been
16 considered that each solar energy particle event was
17 independent of another. And if you looked at the
18 data, that wasn't true. They came in groups.

19 And if you do a statistical analysis, which
20 is what I was doing, you have to take account that
21 there are groups, not just individual ones.

22 And that was my major contribution to that

Capital Reporting Company
Interview of Joan Feynman

10

1 for quite a while. There are still arguments about
2 what are the groups. I think it's known but not
3 everybody agrees.

4 Q And when you say "groups," can you explain
5 to us a little bit more of what you mean --

6 A Yeah.

7 Q -- when you say that.

8 A Uh-huh. Yeah. When there's -- the way --
9 the most important thing in space weather, I would
10 say, is that there are events when in the solar wind
11 there are high energy particles accelerated by
12 disturbances in the solar wind.

13 These disturbances are due to phenomena
14 related to solar flares. A big glob of the solar
15 corona comes flying out at enormous velocities like
16 1,000 kilometers per second.

17 And solar wind, which is a -- which is
18 totally ionized, that is, it's a bunch of protons and
19 electrons and some helium doubly -- with charged
20 helium, so on, it acts like a fluid which was a big
21 surprise to the early people. They couldn't see how
22 it acted like a fluid.

Capital Reporting Company
Interview of Joan Feynman

11

1 What it does is -- and the reason is unknown
2 but not for this -- anyway, the -- this big blob,
3 which is called a "coronal mass ejection," goes
4 through the solar wind and like a boat going through
5 an ocean it causes the shock -- a shock.

6 And this shock manages to accelerate
7 particles in the solar wind to very high energies.
8 And those particles come into the earth and can do all
9 sorts of damage to spacecraft, also spacecraft in
10 space.

11 And the whole coronal mass ejections cause
12 great geomagnetic storms. And there are big currents
13 in certain parts of the atmosphere. And those
14 currents cause currents in the flow in the power
15 plants in their, you know anyway, And the result of
16 that can be (inaudible).

17 Q Uh-huh.

18 A You know, like if you have a big surge of
19 current on the -- on your wire at home, you're liable
20 to blow up the toaster.

21 Well, here, there's a big surge of current
22 in the ionosphere, you blow out the power plants. And

Capital Reporting Company
Interview of Joan Feynman

12

1 it's very expensive and very annoying.

2 And so that's one of the things people, if
3 you knew one of these very fast coronal mass ejections
4 was coming, then you could do something to shut down
5 the power plant for a couple of hours and then put it
6 back up again.

7 Q So --

8 A But.

9 Q Uh-huh.

10 A So this is of great importance to power
11 plant people and causes lots of money being lost.

12 Q Now, you mentioned Magellan, the Magellan
13 spacecraft. Can you tell us a little bit about what
14 that spacecraft was and the instrument aboard the
15 spacecraft that

16 --

17 A Of course.

18 Q -- that was connected to the work you did.

19 A No, I can't. Several reasons I can't do
20 that.

21 Q Okay.

22 A One is my -- the only question I was asked

Capital Reporting Company
Interview of Joan Feynman

13

1 was what was the space environment that spacecraft had
2 to be able to operate in. And that does not include -
3 - I mean, I knew where it was going, I don't remember
4 anymore -- but that does not include the particular
5 instruments. It only includes what kind of particles.
6 They will have to be designed so they're not clobbered
7 --

8 Q Uh-huh.

9 A -- by the particles as they're expected. So
10 I don't have to know about the details of the project
11 that Magellan was on.

12 If you want to know, you can look it up.

13 Q Oh, sure.

14 A Actually.

15 Q And then --

16 A Yeah.

17 Q But what you found was very interesting.
18 And it was because of your research that you found out
19 that these particles operated in groups, if I'm
20 understanding properly, and that it --

21 A Yes, right, and so that the expectation, if
22 you got one you got several, was high. And that made

Capital Reporting Company
Interview of Joan Feynman

14

1 a difference in the predictions as to what you may
2 get. That is, we knew there were -- in the time we
3 flew about ten big events, big coronal mass ejections.

4 It makes a big difference in predicting
5 whether those ten came in three groups of three and
6 one separate or was -- which would make -- you'd have
7 to predict four groups or ten separate groups. The
8 statistics are all together different.

9 And the -- that's -- and those models, the
10 models that the spacecraft designed to -- that is to
11 say, I calculate the probability that you couldn't get
12 an event with so -- and so many high energy particles
13 of such -- in such a -- well, the -- the flux --

14 Q Uh-huh.

15 A -- of the particles. And then the designers
16 of the spacecraft have to take that information and
17 say, okay, we have to design our spacecraft and the
18 instruments on it so that it can stand that much
19 radiation without collapsing. And that's what the
20 space environments needs.

21 Q Well, so up until that --

22 A Okay.

Capital Reporting Company
Interview of Joan Feynman

15

1 Q -- point, they weren't -- the spacecraft --

2 A No.

3 Q -- really weren't prepared for that?

4 A No. What happened was that the model that
5 was invented had an error in it. And I corrected the
6 error and the error gave different results for the
7 space environment in the original prediction method.

8 Q Well, that's significant.

9 A And they were important different events.

10 In fact, when Magellan went up, suddenly it
11 -- I got a telephone call from the chief scientist
12 saying, my God, we've had all these sudden events on
13 the sun. He said could it kill us. I said, no, you
14 designed for it. And he was very much relieved.

15 Q I'll bet. I'll bet. Even today, can you
16 imagine people not paying attention to that --

17 A Well --

18 Q -- research.

19 A Huh?

20 Q I mean, even today, can you imagine if they
21 -- if anyone sent spacecraft up without that type of
22 protection or preparation, it wouldn't last that long,

Capital Reporting Company
Interview of Joan Feynman

16

1 I would imagine.

2 A Well, it would be a waste of money, because,
3 I mean, you have to make certain decisions about how
4 to protect the spacecraft. And if you make decisions
5 that are way out of reality --

6 Q Uh-huh.

7 A -- it -- you waste money because you spent
8 too much time or too much money protecting it or it
9 wastes time because you haven't spent -- given it
10 enough protection and it gets clobbered.

11 So it's -- and -- in spacecraft design and
12 so on you have to worry about the possibilities that
13 things get broken or that things don't work. And it's
14 money either way, so it's --

15 Q That's right.

16 A -- a -- it's a give and take on that
17 project.

18 Q And it's also vital to human exploration. I
19 can imagine if we have humans exploring or living in
20 space and even in those days, I mean, we're -- I guess
21 this is --

22 A Well, the human stuff is very important. I

Capital Reporting Company
Interview of Joan Feynman

17

1 mean, if you want to fly to Mars or something, you
2 have to know what the environment is.

3 And if you've got a human being in there,
4 then you have to decide what probability you want that
5 he will not be hurt, he or she will not be hurt by the
6 high energy particles (inaudible).

7 And my job was to predict the probabilities.
8 And the -- there are new models that have been
9 developed since mine, but they were -- all the models
10 were based on the same general principles.

11 And one of the problems is there's a lot of
12 question about the description of if you make
13 something -- if you want to know how many events are
14 going to have fluencies or fluxes above a certain
15 amount, it very much depends on -- when you do it, it
16 very much depends on what you know about coronal mass
17 ejections.

18 And so besides doing this space weather
19 part, I also do things like study what you know about
20 coronal mass ejections. And the sun has a solar
21 cycle, which every 11 years the sun gets more spots
22 and then it starts out for three or four years in the

Capital Reporting Company
Interview of Joan Feynman

18

1 sun increasing the number of sunspots. You know about
2 sunspots?

3 Q Yes, and the sunspot cycle, uh-huh.

4 A Yeah, and then for seven years it decreases
5 the number of sunspots. And the number of events that
6 you expect depends partly on the sunspot number.

7 So it would be nice to be able to predict
8 the sunspot number. And it takes, say, ten, 15, 20
9 years to decide you're going to make a spacecraft, to
10 design the spacecraft, to get it all ready, and to
11 launch it. Okay.

12 Q Uh-huh.

13 A So you have to know what the sunspot cycle
14 is going to be like 20, 30 years from now. And we
15 don't know how to do that. And we don't know how to
16 make those predictions because we don't understand the
17 solar dynamo.

18 Q Uh-huh.

19 A Which is the dynamo is emulsions which cause
20 the sun to have the magnetic field that it does and
21 the sunspots that it does.

22 And so one of the things I do is study the

Capital Reporting Company
Interview of Joan Feynman

19

1 solar cycle and the solar dynamo. And during the last
2 ten years, the sun has been doing something very
3 unexpected, that is to say, it has been much, much
4 calmer than was generally expected.

5 Q Huh.

6 A In my opinion, that's because it's another
7 cycle of the amplitude of the sunspot cycle which is
8 about 90 to 100 years.

9 And so what I'm doing at the moment is
10 seriously looking into that finding whatever I can
11 find out about this 80 to 90, 90 to 100 year cycle,
12 which I call the "Centennial Gleissberg Cycle," and
13 what's its cause on the sun and what's its effect on
14 earth.

15 Now, there's a lot of evidence that during
16 periods at the minimum of at least 88 or a hundred
17 year cycle, Centennial Gleissberg cycle, there's a
18 cooling effect. It's from ultraviolet radiation is
19 apparently -- we don't really know, but there's some
20 evidence that it changes, that it interacts with the
21 earth's atmosphere. This is not agreed to by
22 everybody but there's evidence for it.

Capital Reporting Company
Interview of Joan Feynman

20

1 Q Uh-huh.

2 A That the changes in the solar output
3 interact with the earth's atmosphere to change the
4 climate.

5 Q Ah.

6 A So that when the sun is at the minimum of
7 the Centennial Gleissberg Cycle, it's a little cooler
8 on earth than it would otherwise be.

9 So my guess, because at this point only a
10 guess, is that one reason that the earth isn't hotter
11 than it is is because the sun has been cooling it
12 relatively. That is to say, heating from the sun has
13 been relatively small 2010 -- 20 -- yes.

14 Q Uh-huh.

15 A 2007 to 10 and -- but I don't know how much
16 smaller. And I don't even know if that's true. But
17 you asked me what I'm working on, so I am working to
18 find out if that's true.

19 Q Wow. So --

20 A So that's my present --

21 Q -- that's amazing.

22 A -- present. And if it is true, it would

Capital Reporting Company
Interview of Joan Feynman

21

1 mean that the warming due to the carbon dioxide, which
2 I think people now believe in since it's true and
3 we've known it's true for 15 years or so, but anyway,
4 it would mean that the cooling from the carbon dioxide
5 is partially canceled by this -- I mean, the heating
6 from the carbon dioxide is partially canceled by the
7 cooling from the sun.

8 So that we are probably underestimating the
9 cooling that will happen in 15 years if you just say,
10 okay, it's going to continue whatever it's doing now.

11 Q Uh-huh.

12 A So it's important. I think that the most
13 important problem in the earth for all societies in
14 the earth world today society that we are paying no
15 attention, essentially no attention to the global
16 warming which is going to clobber us. And --

17 Q And -- that's right. And the impact that
18 the sun is having on that.

19 A The impact that the sun is having is minor.

20 Q Huh.

21 A But it is in the direction of currently
22 making the carbon dioxide high warming or looks

Capital Reporting Company
Interview of Joan Feynman

22

1 smaller. If you think it's all due to carbon dioxide,
2 then you think that the warming of the earth is less
3 important than it really is.

4 Q Oh, I see.

5 A Because the -- yeah. So that what the
6 effect of the sun on the earth in this Centennial
7 Gleissberg Cycle is still not agreed to by everyone.

8 And the question you're asking me, what I'm
9 working on, I've got to be working on something that's
10 not agreed to by everybody. If it's agreed to, you
11 don't work on it anymore if you're a scientist.

12 Q That's right. And that's exciting --

13 A Yeah.

14 Q -- to hear you talking about this, because
15 there are many, many young scientists and people who'd
16 like to go into science that will be hearing this.

17 And this is really --

18 A Uh-huh.

19 Q -- an area I think that many people would
20 find interesting to explore.

21 A Well, look there, earth science is a
22 wonderful thing because when we know something, one of

Capital Reporting Company Interview of Joan Feynman

23

1 the side effects is that we realize there's something
2 else we don't understand. Like -- and then you go on
3 from there.

4 So there are always new subjects in science.
5 And for young people it's a good idea to work, if
6 they're interested, on the subject that they find
7 interesting or delightful and that's new. Because
8 it's easier when it's new.

9 What happens is all the easy things get done
10 at the beginning and then it gets harder and harder to
11 make new contributions and they're less and less
12 important.

13 So rather than looking at what's, you know,
14 a 15-year-old kid, boy or girl, who looks and sees
15 what's interesting now may find it, by the time
16 they're ready to get their Ph.D, something else is
17 more exciting and that's where they ought to be
18 studying.

19 But you got to study something that really
20 excites you. Otherwise, you know, it's a matter of
21 personality, what you like to do. But science is
22 something you have to do because you like to do it.

Capital Reporting Company
Interview of Joan Feynman

24

1 Otherwise, it doesn't work.

2 Q Uh-huh. It's all about passion.

3 A So, yeah, you know, scientists are supposed
4 to be such dispassionate people. We're not at all.
5 We're very passionate people.

6 Q Uh-huh.

7 A We spend long hours working on things.
8 We're only paid for part of the time, more or less. I
9 mean, you don't leave the problem when you come home
10 from work. You work on it in your sleep. You know,
11 it's not a job like selling shoes where you may want
12 to forget about it when you come home and think of
13 something else.

14 Q Uh-huh.

15 A It's a passion.

16 Q It's a passion.

17 A For all of us.

18 Q It's a lifestyle.

19 A Huh?

20 Q Yeah, it sounds like science for people who
21 are passionate about it and really pursue it, it
22 becomes an entire lifestyle and a way of being.

Capital Reporting Company
Interview of Joan Feynman

25

1 A Well, yes. And if you're not passionate
2 about it, you shouldn't try it because --

3 Q Uh-huh.

4 A -- it's very -- it's difficult. You have to
5 do a lot of learning and a lot of thinking. And if
6 you don't have a passion for it, you're not going to
7 make any nice -- you know, you're not going to enjoy
8 it. There's no point in going into it if you're not
9 passionate about it. And I've always been passionate
10 about it.

11 The reason I was interested in all of this
12 was because, you know, all of this geomagnetic
13 activity and solar influence on the earth, one of the
14 things that it produces is aurora. It's very
15 beautiful.

16 And when I was a kid, not a terrible lot was
17 known about them except that they came from --
18 something from the sun caused them.

19 And when I was about four years old, my
20 brother got permission from my mom -- it was nighttime
21 and I was in bed asleep -- my brother got permission
22 from my mom to wake me up and take me to see the

Capital Reporting Company
Interview of Joan Feynman

26

1 aurora which was happening on Long Island at that
2 time.

3 And he walked me to a nearby golf course,
4 and I looked up and there were lights turning bluish
5 green -- though they may not have been green but there
6 were lights flashing in the sky and it was very
7 beautiful. And I got hooked. So that's what I've
8 been studying the rest of my life.

9 Q Well, that's amazing.

10 A Things to do with those aurora. Huh?

11 Q I love those stories of what it was that
12 actually ignited the interest or the passion to pursue
13 a particular career.

14 Some people have talked about stories of
15 seeing the aurora. Others have talked about looking
16 up and seeing a comet or shooting stars or the moon
17 and it just totally ignited this entire path in their
18 life from that point on.

19 A Yeah. Well, of course, all my family was
20 very interested in science -- my father, my brother.
21 My mother was interested in the beauty of nature.

22 Q Uh-huh.

Capital Reporting Company
Interview of Joan Feynman

27

1 A But, you know, there I was a little kid and
2 my brother got permission to break all of the rules so
3 that he could show me the aurora. So my mother and
4 father were behind this also. So it was very exciting
5 for a little kid. And it's been fun.

6 Q It's been fun.

7 A That's why I'm still working at this
8 insanelly a long time.

9 Q And still making -- and still exploring new
10 territory. That's what's -- that's really awesome.
11 That's amazing.

12 A Yeah. Well, you know, I still -- quite
13 awhile back I thought I might retire, so I tried it
14 for two weeks. And I decided I didn't like it, so I
15 came back.

16 Q Well, my dad's a minister, and I can totally
17 understand that that certain people --

18 A Yeah.

19 Q -- in certain careers that are passionate
20 about their careers, they --

21 A That's right.

22 Q -- never stop.

Capital Reporting Company
Interview of Joan Feynman

28

1 A You never stop unless somebody forces to you
2 stop but -- and they can't really, because you can
3 always do it at home especially now with the computers
4 where all the data is available and so on.

5 So it's been great fun for my life. And I
6 started at a time when it was not considered
7 reasonable for women to do this, but now it is.

8 And so I think, you know, anybody who finds
9 something, you know, in science or somewhere else that
10 interests them, should choose to do it, you know.

11 Q That's right.

12 A I was told it was impossible. It turned out
13 that was wrong.

14 Q Wow, what a --

15 A Thank goodness.

16 Q -- different time.

17 A Yes. Yes. Yes. That's right. Women
18 didn't make a living when I was a child. And women
19 weren't supposed to be mathematicians and scientists.
20 There was a prejudice against it.

21 But it doesn't make any difference. You
22 just do it anyway. You don't have to get permission

Capital Reporting Company
Interview of Joan Feynman

29

1 from the entire world to decide what you're going to
2 do.

3 Q They will eventually catch up.

4 A Oh, yeah. But I, you know, just think
5 passion takes you a long way.

6 Q It sure does. And you know in the
7 interviews that we've been conducting for Space
8 Weather Living History, it seems that many of the
9 scientists and people being interviewed always come
10 back to that word, that that is really --

11 A Passion.

12 Q Passion, that that really is the torch --

13 A Yes.

14 Q -- that kept them involved.

15 A That is. That is. That is the torch for
16 scientists. And it always strikes me as strange that
17 laymen think we're very serious, very, you know,
18 unpassionate people.

19 Q Uh-huh.

20 A We're not. We're not. So you want more
21 information?

22 Q I -- this has been already, believe it or

Capital Reporting Company
Interview of Joan Feynman

30

1 not, we've been talking for 33 minutes.

2 A Oh, my. That's a long time.

3 Q Yeah, these interviews go very well
4 especially when people start talking about what it is
5 that they're excited about and what they do. It just
6 happens. And it's such a pleasure --

7 A Yeah.

8 Q -- on my end to be able to hear that and to
9 listen to it.

10 A Yeah.

11 Q I think it's a very unique experience for me
12 as well.

13 A Yeah, well, I'm glad you enjoy it. And I
14 hope people really warm up to the idea that science is
15 not a chore, it's a pleasure.

16 Q Well, we'll probably take that statement and
17 make that one of the main statements in your interview
18 that you just said. I'll make sure --

19 A Okay.

20 Q Yeah, that would be wonderful.

21 A Okay.

22 Q Yeah.

Capital Reporting Company
Interview of Joan Feynman

31

1 A Okay. Fine.

2 Q Well, thank you so much.

3 A Okay.

4 Q And do you have anything else that you think
5 you would like to add or are you good with --

6 A No. I think my -- yeah, my main dream has
7 been really to get this preserved.

8 Q And it was very good.

9 A My main idea is that you should find
10 something you're passionate about and do it whether
11 people tell you can or not. And that it's -- that's
12 the message, not the particular thing that you're
13 passionate about, that'll be part of your life
14 somehow.

15 Q Wow.

16 A Yeah.

17 Q Well, thank you --

18 A Okay.

19 Q -- so much, Joan, for your time.

20 And what we'll do from this point on is,
21 Carolyn and Barbara Thompson will take a look --
22 they'll listen to the sound, they'll have it

Capital Reporting Company
Interview of Joan Feynman

32

1 transcribed, and then they will go through and edit
2 out the parts that they know that we don't need or
3 that my voice or whatever it is that they edit out.
4 And then they'll send that final transcript to you and
5 you can take a look --

6 A Okay, great.

7 Q -- at the actual transcript and give input
8 to it. So if there are parts that you'd rather be
9 moved around or changed, that's no problem.

10 A Fine. Fine.

11 Q And then we'll put it up online on Sun-Earth
12 Day and in the Space Weather Living History Project at
13 some point. And we'll let you know when that happens,
14 so.

15 A Okay, fine.

16 Q Well, thank you so much.

17 A It's been nice talking to you.

18 Q I'm glad we finally were able to --

19 A Beautiful --

20 Q -- make it happen.

21 A -- really. Okay.

22 Q All right. You have a wonderful day.

Capital Reporting Company
Interview of Joan Feynman

33

1 A Bye.

2 Q Good-bye.

3 A You, too.

4 (Whereupon, the interview of JOAN
5 FEYNMAN, was concluded.)

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

Capital Reporting Company
Interview of Joan Feynman

34

1 CERTIFICATE OF TRANSCRIBER

2

3 I, JANET M. RICE, a Transcriber for the State of
4 Oregon, do hereby certify that I transcribed the audio
5 tapes(s) of the proceedings had upon the hearing of
6 this case, previously captioned herein, that I
7 thereafter had reduced by typewriting the foregoing
8 transcript; and that the foregoing transcript,
9 consisting of Pages 1 to 34 both inclusive,
10 constitutes a true, and accurate record of the
11 proceedings had upon the hearing of said cause, and of
12 the whole thereof.

13 WITNESS my hand as Transcriber this 27th day of
14 August, 2013.

15

16

17

18

19

JANET M. RICE
Transcriber

20

21

22

Capital Reporting Company
Interview of Joan Feynman
Page 1

1	accurate 34:10	asleep 25:21	boat 11:4
1 34:9	acted 10:22	atmosphere 11:13	boss 9:7
1,000 10:16	activity 25:13	19:21 20:3	boy 23:14
10 20:15	acts 10:20	attention 15:16	break 27:2
100 19:8,11	actual 32:7	21:15	broken 16:13
11 17:21	actually 4:18	audio 3:21 34:4	brother 25:20,21
15 18:8 21:3,9	6:7,16 13:14	August 34:14	26:20 27:2
15-year-old 23:14	26:12	aurora 25:14	bunch 10:18
	add 31:5	26:1,10,15 27:3	Bye 33:1
2	adjusting 3:13	available 28:4	C
20 18:8,14 20:13	against 28:20	awesome 27:10	calculate 14:11
2007 20:15	ago 9:5	awhile 27:13	calmer 19:4
2010 20:13	agreed 7:15 19:21	B	canceled 21:5,6
2013 34:14	22:7,10	babbling 7:8	captioned 34:6
27th 34:13	Ah 20:5	Barbara 31:21	carbon 21:1,4,6,22
	already 29:22	based 17:10	22:1
3	am 5:19 20:17	basically 4:1	care 7:12
30 9:6 18:14	amazing 20:21	beat 2:6,11	career 26:13
33 30:1	26:9 27:11	beautiful 25:15	careers 27:19,20
34 34:9	amount 17:15	26:7 32:19	Carolyn 31:21
	amplitude 19:7	beauty 26:21	case 34:6
8	analysis 9:19	becomes 8:10	catch 29:3
80 19:11	annoying 12:1	24:22	cause 11:11,14
88 19:16	answer 5:6	bed 25:21	18:19 19:13
	anybody 28:8	beginning 23:10	34:11
9	anymore 13:4	behind 27:4	caused 25:18
90 19:8,11	22:11	believe 21:2 29:22	causes 11:5 12:11
A	anyone 15:21	besides 17:18	Centennial
able 13:2 18:7	anything 4:10,17	best 6:14	19:12,17 20:7
30:8 32:18	31:4	bet 15:15	22:6
aboard 12:14	anyway 11:2,15	bit 8:2 10:5 12:13	certain 9:13 11:13
absolutely 3:16	21:3 28:22	blob 11:2	16:3 17:14
accelerate 11:6	apparently 19:19	blow 11:20,22	27:17,19
accelerated 10:11	area 6:7,8 22:19	bluish 26:4	CERTIFICATE
account 9:20	arguments 10:1		34:1

Capital Reporting Company
Interview of Joan Feynman
Page 2

<p>certify 34:4 change 20:3 changed 32:9 changes 19:20 20:2 charged 10:19 chief 15:11 child 28:18 choose 28:10 chore 30:15 climate 20:4 Cline 2:3,4,7,9,11,14,1 8,20 3:1,4,7,11,15 4:12,15,18,22 5:3,8,11,14,17,2 0 6:1,15,19 7:1,4,6,9,12,14,2 1 lobber 21:16 lobbered 13:6 16:10 cold 2:6,11,13 collapsing 14:19 comes 10:15 comet 26:16 coming 2:12 12:4 computers 28:3 concluded 33:5 conducting 29:7 connected 12:18 considered 9:16 28:6 consisting 34:9 consists 8:8</p>	<p>constitutes 34:10 continue 21:10 contribution 9:22 contributions 23:11 conversation 4:19 5:3 6:3 cooler 20:7 cooling 19:18 20:11 21:4,7,9 corona 10:15 coronal 11:3,11 12:3 14:3 17:16,20 correct 8:15 corrected 15:5 couple 12:5 course 12:17 26:3,19 cover 9:4 current 11:19,21 currently 21:21 currents 11:12,14 cycle 9:2 17:21 18:3,13 19:1,7,11,12,17 20:7 22:7</p> <hr/> <p style="text-align: center;">D</p> <hr/> <p>dad's 27:16 damage 11:9 dangerous 8:10 data 9:18 28:4 day 32:12,22 34:13 days 16:20</p>	<p>decide 17:4 18:9 29:1 decided 27:14 decisions 16:3,4 decreases 18:4 delightful 23:7 depending 6:11 depends 17:15,16 18:6 description 17:12 design 14:17 16:11 18:10 designed 13:6 14:10 15:14 designers 14:15 details 13:10 developed 17:9 devising 9:12 difference 14:1,4 28:21 different 14:8 15:6,9 28:16 difficult 25:4 dioxide 21:1,4,6,22 22:1 direction 21:21 dispassionate 24:4 disturbances 10:12,13 done 4:1 9:10,11 23:9 doubly 10:19 dream 31:6 due 10:13 21:1 22:1 during 6:3 19:1,15</p>	<p>dynamo 18:17,19 19:1</p> <hr/> <p style="text-align: center;">E</p> <hr/> <p>early 10:21 earth 8:9,17,21 11:8 19:14 20:8,10 21:13,14 22:2,6,21 25:13 earth's 19:21 20:3 easier 6:9 23:8 easy 23:9 edit 4:5 5:22 6:9 32:1,3 editor 7:1 effect 19:13,18 22:6 effects 8:14,16,22 23:1 either 6:12 16:14 ejection 11:3 ejections 11:11 12:3 14:3 17:17,20 electrons 10:19 else 8:11 23:2,16 24:13 28:9 31:4 emulsions 18:19 energies 11:7 energy 9:16 10:11 14:12 17:6 enjoy 25:7 30:13 enormous 10:15 entire 8:14 24:22 26:17 29:1 environment 9:8 13:1 15:7 17:2</p>
---	---	--	---

Capital Reporting Company
Interview of Joan Feynman
Page 3

<p>environments 14:20</p> <p>error 15:5,6</p> <p>especially 28:3 30:4</p> <p>essentially 21:15</p> <p>event 9:16 14:12</p> <p>events 4:8 10:10 14:3 15:9,12 17:13 18:5</p> <p>eventually 29:3</p> <p>everybody 10:3 19:22 22:10</p> <p>everyone 22:7</p> <p>evidence 19:15,20,22</p> <p>exactly 6:16</p> <p>EXAMINATION 7:20</p> <p>except 25:17</p> <p>excited 7:15 30:5</p> <p>excites 23:20</p> <p>exciting 22:12 23:17 27:4</p> <p>expect 18:6</p> <p>expectation 13:21</p> <p>expected 13:9 19:4</p> <p>expecting 9:9</p> <p>expensive 12:1</p> <p>experience 30:11</p> <p>explain 10:4</p> <p>exploration 16:18</p> <p>explore 22:20</p> <p>exploring 16:19 27:9</p>	<hr/> <p>F</p> <hr/> <p>fact 15:10</p> <p>family 26:19</p> <p>fast 12:3</p> <p>father 26:20 27:4</p> <p>Feynman 1:9 2:2,5,8,10,12,15, 19 3:3,5,8,14,18 4:11,13,16,21 5:2,5,9,12,15,18, 21 6:13,18,22 7:2,5,7,11,13 8:3 33:5</p> <p>field 4:2 18:20</p> <p>files 3:21</p> <p>final 32:4</p> <p>finally 32:18</p> <p>finding 19:10</p> <p>finds 28:8</p> <p>fine 5:4 6:1,2,15 31:1 32:10,15</p> <p>first 4:2 9:5</p> <p>flares 10:14</p> <p>flashing 26:6</p> <p>flew 9:9 14:3</p> <p>flow 11:14</p> <p>fluencies 17:14</p> <p>fluid 10:20,22</p> <p>flux 14:13</p> <p>fluxes 17:14</p> <p>fly 17:1</p> <p>flying 10:15</p> <p>forces 28:1</p> <p>foregoing 34:7,8</p> <p>forget 24:12</p>	<p>forward 7:16</p> <p>fun 27:5,6 28:5</p> <hr/> <p style="text-align: center;">G</p> <hr/> <p>general 17:10</p> <p>generally 19:4</p> <p>geomagnetic 11:12 25:12</p> <p>gets 16:10 17:21 23:10</p> <p>girl 23:14</p> <p>given 16:9</p> <p>glad 30:13 32:18</p> <p>Gleissberg 19:12,17 20:7 22:7</p> <p>glob 10:14</p> <p>global 21:15</p> <p>God 15:12</p> <p>golf 26:3</p> <p>Good-bye 33:2</p> <p>goodness 28:15</p> <p>great 11:12 12:10 28:5 32:6</p> <p>greater 8:12</p> <p>green 26:5</p> <p>group 9:6</p> <p>groups 9:18,21 10:2,4 13:19 14:5,7</p> <p>guess 16:20 20:9,10</p> <hr/> <p style="text-align: center;">H</p> <hr/> <p>hand 34:13</p> <p>happen 21:9 32:20</p>	<p>happened 15:4</p> <p>happens 23:9 30:6 32:13</p> <p>harder 23:10</p> <p>haven't 16:9</p> <p>having 21:18,19</p> <p>hear 2:21 22:14 30:8</p> <p>hearing 22:16 34:5,11</p> <p>heating 20:12 21:5</p> <p>helium 10:19,20</p> <p>Hello 2:2,3</p> <p>hereby 34:4</p> <p>herein 34:6</p> <p>he's 3:21</p> <p>high 10:11 11:7 13:22 14:12 17:6 21:22</p> <p>History 29:8 32:12</p> <p>home 11:19 24:9,12 28:3</p> <p>hooked 26:7</p> <p>hope 2:14 30:14</p> <p>hotter 20:10</p> <p>hours 12:5 24:7</p> <p>Huh 2:8 15:19 19:5 21:20 24:19 26:10</p> <p>human 16:18,22 17:3</p> <p>humans 16:19</p> <p>hundred 19:16</p> <p>hurt 17:5</p> <hr/> <p style="text-align: center;">I</p> <hr/>
--	---	--	--

Capital Reporting Company
Interview of Joan Feynman
Page 4

<p>idea 5:5 23:5 30:14 31:9</p> <p>ignited 26:12,17</p> <p>I'll 2:19 3:20 4:20 5:6 6:11,14 15:15 30:18</p> <p>I'm 2:5,12,13 3:5 7:14,16 13:19 19:9 20:17 22:8 27:7 30:13 32:18</p> <p>imagine 15:16,20 16:1,19</p> <p>impact 21:17,19</p> <p>importance 12:10</p> <p>important 10:9 15:9 16:22 21:12,13 22:3 23:12</p> <p>impossible 28:12</p> <p>improved 9:13</p> <p>improvement 9:13</p> <p>inaudible 11:16 17:6</p> <p>include 13:2,4</p> <p>includes 13:5</p> <p>inclusive 34:9</p> <p>increasing 18:1</p> <p>independent 9:17</p> <p>individual 9:21</p> <p>influence 7:17 25:13</p> <p>information 14:16 29:21</p> <p>input 32:7</p> <p>insanely 27:8</p> <p>instance 9:2</p>	<p>instrument 12:14</p> <p>instruments 13:5 14:18</p> <p>interact 20:3</p> <p>interacts 19:20</p> <p>interest 4:7 26:12</p> <p>interested 23:6 25:11 26:20,21</p> <p>interesting 4:12 13:17 22:20 23:7,15</p> <p>interests 28:10</p> <p>interplanetary 8:20</p> <p>Interrupt 7:2</p> <p>interview 1:7 3:8,16 6:12 7:22 30:17 33:4</p> <p>interviewed 29:9</p> <p>INTERVIEWER 3:19</p> <p>interviews 29:7 30:3</p> <p>invented 15:5</p> <p>involved 4:8 29:14</p> <p>ionized 10:18</p> <p>ionosphere 11:22</p> <p>iPad 2:17</p> <p>Island 26:1</p> <p>isn't 20:10</p> <p>it'll 2:16</p> <p>it's 5:5,13 6:9 7:16 8:10,16,21,22 10:2,18 12:1 16:11,13,14,16,1 8 19:6,18 20:7 21:2,3,10,12</p>	<p>22:1,10 23:5,8,20 24:2,11,15,16,18 25:4,14 27:5,6 28:5 30:6,11,15 31:11 32:17</p> <p>I've 22:9 25:9 26:7</p> <hr/> <p style="text-align: center;">J</p> <hr/> <p>JANET 34:3,19</p> <p>Jet 8:4</p> <p>Joan 1:9 2:3 7:22 8:3 31:19 33:4</p> <p>job 17:7 24:11</p> <p>JPL 9:5</p> <hr/> <p style="text-align: center;">K</p> <hr/> <p>key 4:8</p> <p>kid 23:14 25:16 27:1,5</p> <p>kill 15:13</p> <p>kilometers 10:16</p> <p>knew 12:3 13:3 14:2</p> <p>known 10:2 21:3 25:17</p> <hr/> <p style="text-align: center;">L</p> <hr/> <p>Lab 8:4</p> <p>large 8:12</p> <p>last 15:22 19:1</p> <p>later 3:21</p> <p>launch 18:11</p> <p>laymen 29:17</p> <p>lead 7:5</p> <p>learning 25:5</p> <p>least 19:16</p>	<p>leave 24:9</p> <p>less 22:2 23:11 24:8</p> <p>let's 6:20</p> <p>liable 11:19</p> <p>life 26:8,18 28:5 31:13</p> <p>lifestyle 24:18,22</p> <p>lights 26:4,6</p> <p>listen 30:9 31:22</p> <p>little 8:2 10:5 12:13 20:7 27:1,5</p> <p>living 16:19 28:18 29:8 32:12</p> <p>long 15:22 24:7 26:1 27:8 29:5 30:2</p> <p>lost 12:11</p> <p>lot 17:11 19:15 25:5,16</p> <p>lots 9:1 12:11</p> <p>love 26:11</p> <hr/> <p style="text-align: center;">M</p> <hr/> <p>Magellan 9:8 12:12 13:11 15:10</p> <p>magnetic 18:20</p> <p>main 30:17 31:6,9</p> <p>major 9:22</p> <p>manages 11:6</p> <p>Mars 17:1</p> <p>mass 11:3,11 12:3 14:3 17:16,20</p> <p>mathematicians 28:19</p>
---	---	---	---

Capital Reporting Company
Interview of Joan Feynman
Page 5

<p>matter 23:20</p> <p>may 14:1 23:15 24:11 26:5</p> <p>mean 4:11 10:5 13:3 15:20 16:3,20 17:1 21:1,4,5 24:9</p> <p>medium 8:20</p> <p>mentioned 12:12</p> <p>message 31:12</p> <p>method 9:12 15:7</p> <p>mine 17:9</p> <p>minimum 19:16 20:6</p> <p>minister 27:16</p> <p>minor 21:19</p> <p>minute 3:20</p> <p>minutes 5:13 30:1</p> <p>model 9:7 15:4</p> <p>models 14:9,10 17:8,9</p> <p>mom 25:20,22</p> <p>moment 19:9</p> <p>money 12:11 16:2,7,8,14</p> <p>moon 26:16</p> <p>mostly 8:20</p> <p>mother 26:21 27:3</p> <p>moved 32:9</p> <hr/> <p style="text-align: center;">N</p> <hr/> <p>nature 26:21</p> <p>nearby 26:3</p> <p>nice 18:7 25:7 32:17</p> <p>nighttime 25:20</p>	<p>normally 5:15</p> <hr/> <p style="text-align: center;">O</p> <hr/> <p>ocean 11:5</p> <p>oh 2:7 6:15,20 13:13 22:4 29:4 30:2</p> <p>okay 2:5,17,18 3:3,4,14,18 5:2,8,14,17 6:1,13,18,22 7:4,13 8:3,19 12:21 14:17,22 18:11 21:10 30:19,21 31:1,3,18 32:6,15,21</p> <p>old 25:19</p> <p>ones 9:21</p> <p>online 32:11</p> <p>open 3:19</p> <p>operate 13:2</p> <p>operated 13:19</p> <p>opinion 19:6</p> <p>Oregon 34:4</p> <p>original 15:7</p> <p>Others 26:15</p> <p>otherwise 7:7 20:8 23:20 24:1</p> <p>ought 23:17</p> <p>output 20:2</p> <p>outside 2:15</p> <hr/> <p style="text-align: center;">P</p> <hr/> <p>Pages 34:9</p> <p>paid 24:8</p> <p>partially 21:5,6</p>	<p>particle 9:16</p> <p>particles 10:11 11:7,8 13:5,9,19 14:12,15 17:6</p> <p>particular 13:4 26:13 31:12</p> <p>partly 18:6</p> <p>passion 24:2,15,16 25:6 26:12 29:5,11,12</p> <p>passionate 24:5,21 25:1,9 27:19 31:10,13</p> <p>path 26:17</p> <p>paying 15:16 21:14</p> <p>people 8:11 10:21 12:2,11 15:16 21:2 22:15,19 23:5 24:4,5,20 26:14 27:17 29:9,18 30:4,14 31:11</p> <p>per 10:16</p> <p>periods 19:16</p> <p>permission 25:20,21 27:2 28:22</p> <p>person 3:21,22 9:11</p> <p>personality 23:21</p> <p>Ph.D 23:16</p> <p>phenomena 10:13</p> <p>picture 8:12</p> <p>plant 12:5,11</p> <p>plants 8:11 11:15,22</p> <p>please 5:21 7:3</p>	<p>pleasure 30:6,15</p> <p>point 15:1 20:9 25:8 26:18 31:20 32:13</p> <p>points 4:9</p> <p>pop 4:18</p> <p>possibilities 16:12</p> <p>power 8:11 11:14,22 12:5,10</p> <p>predict 14:7 17:7 18:7</p> <p>predicting 14:4</p> <p>prediction 15:7</p> <p>predictions 14:1 18:16</p> <p>prejudice 28:20</p> <p>preparation 15:22</p> <p>prepared 15:3</p> <p>present 20:20,22</p> <p>preserved 31:7</p> <p>pretty 2:5</p> <p>previously 34:6</p> <p>primary 4:6 6:7,8</p> <p>principles 17:10</p> <p>probabilities 17:7</p> <p>probability 14:11 17:4</p> <p>probably 21:8 30:16</p> <p>problem 2:20 7:9 9:1 21:13 24:9 32:9</p> <p>problems 9:4 17:11</p> <p>proceedings 34:5,11</p>
---	---	---	---

Capital Reporting Company
Interview of Joan Feynman
Page 6

<p>produces 25:14</p> <p>project 13:10 16:17 32:12</p> <p>properly 13:20</p> <p>Propulsion 8:4</p> <p>protect 16:4</p> <p>protecting 16:8</p> <p>protection 15:22 16:10</p> <p>protons 10:18</p> <p>pursue 24:21 26:12</p> <hr/> <p style="text-align: center;">Q</p> <hr/> <p>question 6:2,4 12:22 17:12 22:8</p> <p>questions 4:3 5:1,6</p> <p>quite 10:1 27:12</p> <hr/> <p style="text-align: center;">R</p> <hr/> <p>radiation 14:19 19:18</p> <p>rather 23:13 32:8</p> <p>ready 3:16 5:12 18:10 23:16</p> <p>real 7:15</p> <p>reality 16:5</p> <p>realize 23:1</p> <p>really 7:14 8:13,16 15:3 19:19 22:3,17 23:19 24:21 27:10 28:2 29:10,12 30:14 31:7 32:21</p> <p>reason 11:1 20:10 25:11</p> <p>reasonable 28:7</p>	<p>reasons 12:19</p> <p>recently 4:1</p> <p>record 3:2,10 34:10</p> <p>reduced 34:7</p> <p>related 10:14</p> <p>relationship 8:6</p> <p>relatively 20:12,13</p> <p>relieved 15:14</p> <p>remember 13:3</p> <p>research 4:6 6:7,8 7:18 13:18 15:18</p> <p>rest 26:8</p> <p>restate 6:4</p> <p>result 11:15</p> <p>results 15:6</p> <p>retire 27:13</p> <p>RICE 34:3,19</p> <p>rules 27:2</p> <hr/> <p style="text-align: center;">S</p> <hr/> <p>satellite 9:8</p> <p>science 22:16,21 23:4,21 24:20 26:20 28:9 30:14</p> <p>scientist 15:11 22:11</p> <p>scientists 22:15 24:3 28:19 29:9,16</p> <p>scratch 6:20</p> <p>second 10:16</p> <p>seeing 26:15,16</p> <p>seems 29:8</p> <p>sees 23:14</p>	<p>selling 24:11</p> <p>send 32:4</p> <p>sense 6:3,20</p> <p>sent 15:21</p> <p>separate 14:6,7</p> <p>serious 29:17</p> <p>seriously 19:10</p> <p>seven 18:4</p> <p>several 12:19 13:22</p> <p>She's 3:7</p> <p>shock 11:5,6</p> <p>shoes 24:11</p> <p>shooting 26:16</p> <p>shut 12:4</p> <p>significant 15:8</p> <p>sky 26:6</p> <p>sleep 24:10</p> <p>slow 6:13</p> <p>small 20:13</p> <p>smaller 20:16 22:1</p> <p>societies 21:13</p> <p>society 21:14</p> <p>solar 8:6,9,14 9:2,3,16 10:10,12,14,17 11:4,7 17:20 18:17 19:1 20:2 25:13</p> <p>somebody 28:1</p> <p>somehow 31:14</p> <p>somewhere 28:9</p> <p>sorts 11:9</p> <p>sound 3:12 31:22</p>	<p>sounds 4:12 24:20</p> <p>space 4:8 7:17,18 8:2,4,7,10 10:9 11:10 13:1 14:20 15:7 16:20 17:18 29:7 32:12</p> <p>spacecraft 11:9 12:13,14,15 13:1 14:10,16,17 15:1,21 16:4,11 18:9,10</p> <p>speak 4:4</p> <p>SPEAKER 2:22</p> <p>spend 24:7</p> <p>spent 16:7,9</p> <p>spots 17:21</p> <p>stand 14:18</p> <p>stars 26:16</p> <p>start 4:2,6,13 6:21 7:22 9:12 30:4</p> <p>started 28:6</p> <p>starts 6:12 17:22</p> <p>State 34:3</p> <p>statement 30:16</p> <p>statements 30:17</p> <p>statistical 9:19</p> <p>statistics 14:8</p> <p>stay 4:22</p> <p>stop 27:22 28:1,2</p> <p>stories 26:11,14</p> <p>storms 11:12</p> <p>strange 29:16</p> <p>strikes 29:16</p> <p>studied 8:13</p> <p>studying 23:18 26:8</p>
--	---	--	--

Capital Reporting Company
Interview of Joan Feynman
Page 7

<p>stuff 16:22</p> <p>subject 23:6</p> <p>subjects 23:4</p> <p>subset 8:7</p> <p>sudden 15:12</p> <p>suddenly 15:10</p> <p>sun 8:8,14,16,21,22 9:1 15:13 17:20,21 18:1,20 19:2,13 20:6,11,12 21:7,18,19 22:6 25:18</p> <p>Sun-Earth 32:11</p> <p>sunspot 18:3,6,8,13 19:7</p> <p>sunspots 18:1,2,5,21</p> <p>supposed 24:3 28:19</p> <p>sure 4:22 7:6 13:13 29:6 30:18</p> <p>surge 11:18,21</p> <p>surprise 10:21</p> <p>system 8:14</p> <hr/> <p style="text-align: center;">T</p> <hr/> <p>talk 4:9 5:10 6:5</p> <p>talked 26:14,15</p> <p>talking 3:13 4:13 6:16 7:16 22:14 30:1,4 32:17</p> <p>tapes(s) 34:5</p> <p>telephone 15:11</p> <p>ten 14:3,5,7 18:8 19:2</p>	<p>terrestrial 8:6</p> <p>terrible 25:16</p> <p>territory 27:10</p> <p>thank 28:15 31:2,17 32:16</p> <p>that'll 31:13</p> <p>that's 5:3 6:1 7:9,19 12:2 14:9,19 15:8 16:15 19:6 20:16,18,20,21 21:17 22:9,12 23:7,17 26:7,9 27:7,10,11,21 28:11,17 30:2 31:11 32:9</p> <p>thereafter 34:7</p> <p>thereof 34:12</p> <p>there's 6:17 10:8 11:21 17:11 19:15,17,19,22 23:1 25:8</p> <p>they'll 31:22 32:4</p> <p>they're 13:6,9 23:6,11,16 30:5</p> <p>Thompson 31:21</p> <p>toaster 11:20</p> <p>today 15:15,20 21:14</p> <p>torch 29:12,15</p> <p>totally 10:18 26:17 27:16</p> <p>track 4:22</p> <p>TRANSCIBER 34:1</p> <p>transcribed 32:1 34:4</p> <p>Transcriber</p>	<p>34:3,13,19</p> <p>transcript 32:4,7 34:8</p> <p>tried 27:13</p> <p>Troy 2:3</p> <p>true 9:18 20:16,18,22 21:2,3 34:10</p> <p>try 25:2</p> <p>trying 2:6,9,13</p> <p>turn 2:16</p> <p>turned 28:12</p> <p>turning 4:9 26:4</p> <p>type 15:21</p> <p>typewriting 34:7</p> <hr/> <p style="text-align: center;">U</p> <hr/> <p>uh-huh 2:22 4:15 5:11,20 10:8 11:17 12:9 13:8 14:14 16:6 18:3,12,18 20:1,14 21:11 22:18 24:2,6,14 25:3 26:22 29:19</p> <p>ultraviolet 19:18</p> <p>underestimating 21:8</p> <p>understand 18:16 23:2 27:17</p> <p>understanding 8:22 13:20</p> <p>unexpected 19:3</p> <p>UNIDENTIFIED 2:22</p> <p>unique 30:11</p> <p>unknown 11:1</p>	<p>unless 28:1</p> <p>unpassionate 29:18</p> <p>upon 34:5,11</p> <p>usually 3:17,22</p> <hr/> <p style="text-align: center;">V</p> <hr/> <p>velocities 10:15</p> <p>vital 16:18</p> <p>voice 6:10 32:3</p> <p>volume 3:13</p> <hr/> <p style="text-align: center;">W</p> <hr/> <p>wake 25:22</p> <p>walked 26:3</p> <p>warm 30:14</p> <p>warming 21:1,16,22 22:2</p> <p>wasn't 9:18</p> <p>waste 16:2,7</p> <p>wastes 16:9</p> <p>weather 4:8 7:17,18 8:2,5,7,10 10:9 17:18 29:8 32:12</p> <p>weeks 27:14</p> <p>Welcome 3:4</p> <p>we'll 4:6 7:9 30:16 31:20 32:11,13</p> <p>we're 3:11,12,13,15 6:16 7:14,15 16:20 24:4,5,8 29:17,20</p> <p>we've 15:12 21:3 29:7 30:1</p> <p>whatever 19:10</p>
--	---	--	--

Capital Reporting Company
Interview of Joan Feynman
Page 8

<p>21:10 32:3</p> <p>Whereupon 33:4</p> <p>whether 14:5 31:10</p> <p>whole 11:11 34:12</p> <p>wind 8:9 9:3 10:10,12,17 11:4,7</p> <p>wire 11:19</p> <p>WITNESS 34:13</p> <p>women 28:7,17,18</p> <p>wonderful 22:22 30:20 32:22</p> <p>work 2:8 5:16 6:13 8:3 12:18 16:13 22:11 23:5 24:1,10</p> <p>working 3:11,12 20:17 22:9 24:7 27:7</p> <p>world 21:14 29:1</p> <p>worry 16:12</p> <p>worse 2:16</p> <p>Wow 20:19 28:14 31:15</p> <p>wrong 28:13</p> <hr/> <p>Y</p> <hr/> <p>you'll 6:15</p> <p>young 22:15 23:5</p> <p>you've 7:18 8:13 17:3</p>			
--	--	--	--