Joan Feynman Transcript

Jayne Guberman: Good morning. My name is Jayne Guberman. I'm here today with Joan Feynman at her home in Pasadena, California. Today is Wednesday, January 16, 2013. We're going to record an interview for the Jewish Women's Archive. So Joan, do I have your permission to record this interview?

Joan Feynman: Indeed.

JG: Great. So, as we've discussed in our conversations to date, we're going to talk today about your experience as an American woman scientist, your dreams of becoming a scientist, your struggles to become one, and ultimately your success in becoming a distinguished physicist. I want to begin by putting your life in some context. So let's start with your telling a little bit about your family background. Go back to your grandparents' generation and just tell us how they first came to the United States.

JF: On mother's side, her father was Henry Phillips, who was born apparently in Poland. The next thing we know about him – he's in an orphanage in London, and his mother is also in London and has remarried and doesn't want the kids, two brothers, from the old marriage. So she put them in a Jewish orphanage. I have gone to Great Britain and looked into the orphanages, but I can't quite find their names, but I'm sure they were the Jewish orphanage that the Rothschilds were supporting. When they were fifteen, they were considered old enough to go on their own. So they were either sent to a relative or something like that. My grandfather, Henry, was sent to join his brother, who was in the United States. Henry arrived with fifty cents in his pocket. His brother had a little apartment, and there was no bed. He slept on the rounded top of a trunk. It was the best they could do with him. He, being fifteen and old enough to work, carried needles and thread to the farmers and rural people who lived in the northern part of the island of

Manhattan, which at the time was rural. So that's what Henry did for a while. I guess his brother was a tailor and eventually became the founder of the [company], which is was Phillips Jones and makes the shirts that are under the name of –

JG: Van Heusen.

JF: Van Heusen, yes. Now, my grandfather married a lady. He had a broken watch, and he went into a watchmaker in the Jewish section of New York, and she had beautiful hands. It was unusual to have a woman who was doing a thing like that. They fell in love. Her name was (Johanna Levinsky?), and they fell in love and married. They opened a millinery business, which apparently was the business that her three sisters were in, too. But Henry and (Johanna?) had their own stores, and Henry invented trimmed hats. Until that time, all of the hats cam with the trim, and what he would do every year – he would go over to Paris and find out what they were wearing, then come back and trim the hats for the person the way they would look the best, and they were very successful. So Henry's brother came to him one day and said, "Look, Henry, why are you in the millinery business? Would you rather be in the shirt business? I have found a collar, which is very good, and I think if we get the patents for that collar, we'll be really able to expand." His place was little at the time. Henry said, "Look, I'm in the millinery business. We're doing fine. I don't know anything about shirts, but I'll give you some money to get to – so that's how his brother, with his own money and with some of Henry's, bought the collar that made (inaudible). So that's my mother's parents.

JG: Right.

JF: My father's parents were a little different. They lived in Poland. My great-grandfather was a patriot, but not for Poland. He thought it would be better – Poland at the time was split between Russia and Germany. He thought it would be better if the Jews were under the Germans (inaudible) the Russians. So he was smuggling guns to the Jewish side when he got caught, and the Russians decided to hang him. So they

had him out there to at their camp, and they were about to hang him and making the preparations when the Germans attacked. In the mess, my great-grandfather got away, and he went to the temple of his town, where anybody in trouble in those days could go to the temple and get help. The town put the money together to get him over to the United States. He came to the United States and opened a watchmaking store. When my grandmother was sixteen, he wrote and said, "Listen," to his wife, "(Johanna?) is old enough to be useful. I need somebody to take care of me, to cook, and act in the store, clean it, and so on. Please send (Johanna?) over. So (Johanna?) was packed up – or rather, they got clothes for her to come, and she had a few clothes with her. They got on the boat, which took a long time to come to the United States.

JG: You can tell me that story more in-depth tomorrow.

JF: Okay.

JG: So she arrives in the United States.

JF: Yes. She arrived in the United States, and her father didn't meet her because he was too busy. He sent a strange man to pick up his sixteen-year-old daughter at the docks. But it worked. The strange man was a person who worked for – so she went to work in the watchmaking, and she learned to fix watches. That's where she met her husband, Henry.

JG: So your mother grew up –? Where did your mother grow up, actually?

JF: Well, as I said before, the business of millinery got very good. So they were in the brownstones of New York in Midtown. It was a very nice area. The brownstones are still there. So my mother, being the youngest child, grew up in the brownstones. Earlier, they had lived in less nice conditions. My mother went to – my grandmother was a very patriotic German. They sent their daughters to a German school for their first school, their grammar school. That should be another story for next –

JG: For tomorrow.

JF: Yes, what a mess it was. Then, they sent her to Ethical Culture School, which was a school which still exists with the highest level of morality and philosophy and so on. My mother took all of that very seriously. I think it's somehow connected to Jews and Judaism. I don't know.

JG: You mean historically? Or in her mind?

JF: No, historically, I think that the people that founded it were Jews, but definitely the concepts of how one should live and what life was about were the Jewish concepts that I learned from Reform Judaism when I was in school. So my mother didn't – my mother, when she got out of high school, which was all people went, started to work in a – there were places in Chicago and in New York, which took care of small children who were being abused. My mother volunteered her work there when she was eighteen, nineteen.

JG: When are we talking about? What year do you think we're talking about?

JF: Well, my mother was born in 1895. So when she was eighteen, it was before the First World War.

JG: 1913, something like that. 1913?

JF: Yeah, something like that. I have a lot of information about that organization. But I don't remember where I put it. [laughter] I had just thought of it at this time.

JG: I see. How did your mother and father meet each other?

JF: Oh, that was fun. My mother had a friend. My mother was seventeen or eighteen. I guess they had phones by those times. Anyway, a friend said she had a friend coming down from a college for the weekend, and they were going to –they had a car, and they were going go out in the car and go to a picnic. But the friend was bringing a friend and

would my mother like to go. So the first picture I have of them is of the two who had made the date, sitting in the front of the car. My mother and the other – I don't know. Anyway, my mother was with one man when she went out, and with the other men when she came back. They fell in [love]. It was love at first sight. She never fell out of love. He never fell out of love with her. It was just wonderful. When she was eighteen, my father proposed to her. Henry Philip said, "She's too young. When she is twenty-one, you may get married." So my mother got married two days after she was twenty-one.

JG: Tell us your father's name.

JF: Melville Feynman.

JG: When did they move to Far Rockaway?

JF: Well, my grandfather, Henry Phillips, built the house in the Rockaways. At those times, the Rockaways on the beach were very fine place. The houses that were built in the town of Arverne were fifteen rooms or something like that. He had built for him the first house by the waterside, by the boardwalk. Other wealthy businessmen had a couple of houses on the side. So before my mother moved to Rockaway, her father was already – she went there for summers – Arverne, parts of Rockaway. My brother was born in New York.

JG: In 1918.

JF: In 1918. Then, I'm not sure – they lived further out on the island. When the Depression came, people began to live in – two families would be in one place. So my mother moved in with her sister Pearl into a fifteen-room house on Cornaga Avenue, which has now been given a new name as Feynman Way quite recently. They lived together. My aunt and uncle had two children. My mother and father had two children. We're all about the same age. I think of it as a wonderful time in my life. I wasn't in school yet. I didn't have anything I had to do. I had all those cousins running around

doing things for me. That was great.

JG: It does sound wonderful, I must say.

JF: Yes.

JG: Let's talk a little bit more about your family. You've said that your family was a wonderful family. Tell us a little bit more about your mother and what she was like as you remember her when you were a young child and what she was involved in?

JF: Well, first of all, she was an awfully good mother. Whenever I got sick, she walked down to the village, and she got books for me and toys for me. She seemed to enjoy it. She would bring me hot tea and state toast because I was always sick to my stomach. She liked nursing people in bringing them to health. She was a very cheerful woman. She had a wonderful sense of humor. She never made a joke that was at somebody's expense. It was always a joke that was in general, or about herself or something like that. That was the tradition in the family. We never made jokes that made fun of anybody, and I hope we still don't. As I say, my mother and father were so much in love. That makes a great deal of difference. They had this wonderful son, who – well, when I was a baby, he used to put me in a carriage, a walker, and take me to his friend's house, where they had a lab. He was nine years old. I would sit and watch the lab. Now, of course, I know more psychology. I think he was trying to get me away from his mother. He was nine years older than I. But everybody was happy with that. Well, life was good. When I was about three or four – my brother had old-fashioned ideas about being on time, eating right, going to bed at the right time, not getting up, and so on. So one day, that was an aurora out on a golf course near our house. My brother asked permission to wake me up. So he did, and I got dressed. We walked down the street to the golf course. I looked up, and there were these green lights moving and white. I thought it was marvelous. That's how I came to study aurora the rest of my life – aurora and things to do with it.

JG: I understand that your brother Richard – what was he called? What did you call your brother?

JF: Richard.

JG: Richard?

JF: Richard.

JG: I understand that he was your first teacher, even from a much younger age than that.

JF: Oh, yes.

JG: There are stories about you in the crib. Can you tell some of them?

JF: Well, yes. We had a dog. My cousin took the dog to shows because the dog would do tricks. My brother decided I was as smart as the dog, and he could teach me some tricks. So the trick he decided to teach me was to add numbers and subtract numbers. I was to do it for the amazement of his friends. He was twelve; I was three – something like that. He had to do something. Of course, when you teach a dog, you give him a cracker; you give him a little snack. When you teach your little sister, what do you do? Well, what does she like to do best? She likes to pull your hair. So I would stand by the rail of the bed or something like that in the crib, and he would get me to add. Every time I got it right, I could take his hair and pull it as hard as I could. He made a face like that. [laughter] I can see his face. I'm sure it didn't hurt. But I always say that the reason he had his hair until he died was because he had such strong roots that I had pulled his hair so often. Yeah.

JG: So there are more stories I know about Richard really being your teacher when you were a child. One of them had to do with being his assistant in his lab.

JF: Oh, yes.

JG: Can you tell us that story?

JF: That was after we moved out of that house to a small apartment because it became difficult for the two families to live together. So we moved to a small apartment a block away. My room was a laundry room or something. He had a small room, and he built himself a lab, electrical lab. He had switches and things like that. I'll tell you two stories about that. The first is that he hired me; it was my first job. I got two cents a week.

JG: How old were you?

JF: Two cents a week to be his lab assistant, and my job was – he'd get everything ready, and then I pulled the switch. Okay. But I had another job. He had spark gaps, two things like this with an open piece there. You put the circuit – you throw the switch, and spark runs across. It was my job – as part of the amazement for his friends, I would stick my hand, my finger in this spark gap. [laughter] And he would throw the switch. So that was – I didn't get any extra for that. That was part of the regular job. Then the other story is my mother used to have people over to play – mahjong they played in those days. They would be in the living room playing mahjong. My brother would be in his lab. So one day, that's going on. My mother says, "Something's wrong. Something's wrong. Would you check, Richard, what he's doing?" So I went into the room with the lab, and there's my dear brother. He has pliers, and he's got a tin wastepaper basket, and he's holding it out the window because he's got a fire in it. [laughter] The fire was burning down. So I came back to my mother and said, "He's all right. There's just a fire." [laughter]

JG: What did she do?

JF: I told her the fire is going out. She said, "Okay." [laughter]

JG: So there was a lot of tolerance within your home for these kinds of experiments?

JF: Oh, yes. Yes. Since he was doing something intellectual like burning the house down, that was fine.

JG: Another story I know you said was very important was the centrifugal force one with the water?

JF: Oh, yes. That was all through my childhood. My parents would leave my brother as the babysitter. As soon as the parents left, I would get an enormous thirst. I just had to have water. He would come in and say, “Now, you know you’re not allowed out of bed. So I’ll get the water.” So he filled the glass half full of water, and he came in twisting the glass like this, upside down. But no water came out because the centrifugal force was holding the water in the glass. Then one night, he got this far, and the glass fell out of his hand, against the wall, water all over the place. I was so pleased. [laughter]

JG: You said that your father really was a lover of science.

JF: What?

JG: Your father really loved science, you told me.

JF: Oh, yes.

JG: Can you tell me a little bit about your father? You started before saying that he sold uniforms. What kind of uniforms?

JF: Yes. Well, before the war, it was of drivers, of nurses of civilian type things. But when the war started, they went into military stuff.

JG: Uniforms, yes.

JF: Yeah. You asked me about?

JG: About what he was like, your father and his love of science?

JF: Yes. Well, he was absolutely crazy about his daughter. [laughter] He thought I was marvelous. So he read me books every night, so I could go to sleep. But they weren't the usual kind of books. One of them he read was a book by [Alfred Lothar] Wegener that was written in 1905 about how the continents were moving. He had the proof that the continents were moving, which comes from looking at South America and Africa; they fit together. There's some rock on Africa that's the same in South America. So he read me this book carefully. He read me about Neanderthal men, and I got terrified of them. [laughter] That was his reading for this little girl. He also read me Alice in Wonderland, which both he and my brother loved because of the crazy – well, in Alice in Wonderland, the Red Queen says, "Tell me what there is to eat." "There's jam every other day." So Alice says, "I would like some jam." She says, "There's no jam today. This is not any other day. There's jam yesterday, and there's jam tomorrow, but there's never jam today." [laughter] That kind of logical thing they liked.

JG: Probably if you were a little girl, this was during the Depression.

JF: I couldn't read yet.

JG: Yeah. But it was also during the Depression. I wonder if that – it was during the Depression. You were a little girl. So there probably were things that were –

JF: There's no jam today was quite reasonable. He eventually got tired of reading me Alice in Wonderland. I was in first or second grade. So he'd read me half a chapter, lay it down, and say, "Finish it yourself." [laughter] That's how I learned to read.

JG: Really?

JF: These pictures on the wall, he painted. I was with him when he painted these pictures.

JG: Where were these pictures set? Where are they?

JF: This is where we used to go to a farm for the summer. This one over here is an estate, which was empty because it was the Depression. It was called the Lord Estate. Just past those trees, there was a pond where we used to go ice skating. This one is a covered bridge in southern New York, one of the last covered bridges. They were covered like that so the horses wouldn't shy. You can see two little kids below that. That's me and a cousin of mine. He painted some other pictures in this room.

JG: It's lovely.

JF: It was his hobby. He died at fifty-three of high blood pressure.

JG: Yes. You said he had been diagnosed some eighteen years or so earlier.

JF: That's right. Yes. At that time, there was no medicine for high blood pressure. When my mother was pregnant with me, he wanted to get more life insurance because he had more children, in case he died. But he flunked the physical because he had high blood pressure. I later found out that the mean lifetime was eighteen years for high blood pressure. He died when I was eighteen. But they were getting medicines that were useful for it at that time. So he was involved in some of the experiments of not eating any salt, for example, just fruit and rice with no salt. That got his blood pressure down, but he was so far gone that he died in a few months.

JG: Let's talk a little bit more about some of the other aspects of the atmosphere in your home. So I want to go back to the ethical culture movement.

JF: The ethical culture.

JB: Because your mother was educated in ethical culture, as you said, what would you say were the most important principles that your mother brought into your family as a

result of that?

JF: Well, it and Reform Judaism brought a concept that there would be a time – because human beings could work towards time – when everything would be good – would be no more wars, everybody would have enough to eat, no more poverty, and so on, but it took human beings to do it. It was called the Messianic Age. The philosophy of my family was working towards a Messianic Age. We all did the best we could. My mother, during the war, folded bandages; she went to see the guys off who were going overseas. She took information to find out – when a person was captured, she would try to find out where they were and contact the family. She was very active in the American Red Cross in our town and was one of the leaders of it at that time. Before that, she had some friends who had something – had a league – I forget the name of it, unfortunately.

JG: The Flora Wald Society?

JF: Flora Wald Society. Now, there was some connection between that society and the one that she'd worked with in Manhattan. But Flora Wald was now a person who lived in the Rockaways. There were about five or six women that met once a week. People that were in real trouble would appeal to them. They would go and see what was going on and what they could do. For example, the Depression was pretty tough. They were kids that didn't have any shoes to go to school in the winter. They got them shoes, secondhand shoes from somewhere or other. There were people who had no coal to heat their homes, and they got them coal. The coal was cheaper than usual because they had a person they had helped, who had a truck, who delivered the coal for free. Those card games that I told you about before, those who were betting games, for maybe a dollar even; they could win or lose a dollar and a half, and they put their winnings in a pot. That pot was used for going to the theater and also for helping people. The theater was somehow involved with helping people, too. I don't remember.

JG: Would you say that your family, when you were growing up, had a relationship with Judaism and with the Jewish community?

JF: That, to me, was Messianic Reform Judaism. Also, Far Rockaway was a place which had Blacks and whites. The Blacks were Protestant. The whites were 95% Jewish. When there was a Jewish holiday in our high school, they sent around a message, "Who was in school," instead of "who wasn't in school." So the whole town – you couldn't miss Judaism in the town. When I was very small, I celebrated Rosh Hashanah and Yom Kippur. The boys that we knew, the little boys, were more religious than us, and they went to one shul, and we went to the Reform shul. We're all little kids, before bar mitzvah, and there were bushes growing; the bushes had little red berries on them. So for Yom Kippur and Rosh Hashanah, the boys would walk over to their shul, and we would walk over to our shul, and we'd throw little red berries at each other. [laughter] So the shul was associated with nice childish things when we were nice children. Then, when we grew up, they had dating things. But we were not a member of a congregation until I was a teenager, when a very excellent rabbi, Rabbi (Kahn?) was his name came out to our Reform Temple and lectured on really current day things. He was a good lecturer, a good speaker. We had a good canter. Being a Reform temple, we had a choir, and we liked it. So we often went to shul then. When I went to college – I told you it was Oberlin College.

JG: Yes. We'll get to that.

JF: You don't want to do that?

JG: You can tell me that story now, but we'll get to that. Go ahead.

JF: I went to college in Oberlin. On the first page of their catalog, it said, "Oberlin is a Christian college." So why was my mother sending me to a Christian college? I'll never know. I don't know now. I didn't know then. Anyway, it was two percent Jewish, and

there were two thousand students at that time. So after the war, when the war was just finished, the Second World War, the president of the school thought it would be a good idea to [let] Jews have a congregation. Maybe somebody else thought of it first. But anyway, he brought together four or five Jews, of whom I was one. We talked about what the Jewish students on campus need. Now, no students on campus were organized socially around religion. We didn't want to be organized socially around religion. So we decided we would have a congregation. Now, Oberlin was a place that graduated ministers, and so they had a chapel, which was empty on Sundays because all the young ministers were going to some church. We figured, "Okay, Saturday, Sunday – we'll have it on Sunday" because it was open. We organized it. The guy said, "Any of us can give the service. We've all been bar mitzvah." Some of the people – Oberlin College has a very large and excellent music school. Some of the young guys in the music school said, "One of the things that we can sometimes get jobs doing is cantering." So we had a cantor. I don't know whether the cantor was Jewish or not, but he was good. So we had everything. I don't know. We must have had prayer books somehow or other, or a few of them. So every Sunday, we went to our chapel. They were ninety-nine Jews on campus. We got about eighty of them. It was very good. And we have our own service. We invited rabbis to come visit us every once in a while. Of course, it being Sunday, they did come. The first rabbi we got was from the nearby town, and we invited him to our service. He was absolutely shocked. First of all, the Christian things were put away for us. So there were no [inaudible] images of any kind. We used a violin for music from the conservatory, one of our guys. We had a cantor. We had the books. We had the service. We had the [inaudible] and the whole thing. [laughter] He was, "Huh?" Also, if somebody in the town or nearby town needed some help on what the Jewish services were, we offered that service to them. For instance, a guy I hardly knew, and I went to somebody's house; they had been in the concentration camps, and they had never had a seder. They wanted help with their seder. So we went to their house and helped them with their seder. So it was nice.

JG: So you really did have an active Jewish life?

JF: Yes, I did. Afterward, my two sons were bar mitzvah. My daughter didn't want to be.

JG: We'll continue with – I want to go back to your childhood again.

JF: Okay. Back to my childhood. What age are we now?

JG: You're still young.

JF: Before grade –?

JG: Let me set the scene here for you. So there's been a lot said in recent years about the impact of socialization on girls, girls' socialization on their interest in science. Right? You said that your family was a real influence. You talked a little bit about your father's influence. I don't know. Is there anything else you want to say about your father's influence in terms of your interest in science?

JF: Yeah. My father and my brother taught me what physics was around, particularly my brother, and there's physics all around. So, when we were walking, where there was a chain on the fence, he'd hit the chain and say, "See how that goes back and forth?" Then he showed me that if you take a tree, a small tree is better than a very large tree, and push it, all of the branches shake a little. If you look very carefully if you push it like that – well, the first push, you look, and you see a branch, which is waving at a nice frequency for you to push the tree, you then push the tree at that frequency, and eventually, all the other branches stop waving, and the only thing that you got waving is this one branch up there, waving bigger and bigger. So I used that once when I wasn't a kid. We were on an island with my kids in the Adirondacks, and there was very little wood. So I looked at the tree, and there was a nice dead-ish looking log. I pushed the tree, and the thing came down, and we had marshmallows, burnt marshmallows.

JG: Your son Chuck says he was very impressed. That was one of the science lessons in his life.

JF: Yes, yes. He was very impressed.

JG: What about your mother? What was your mother's attitude?

JF: My mother? First of all, my mother claimed that she had a small door in her head, a small door, and whenever anything mathematical or scientific came up, the door shut. So she had no knowledge of anything. However, my father brought home a book called Are You a Genius, which had all these riddles in there – not riddles, but hard things to figure out. I looked in the index once and found that the answer was five oranges. So whenever my father read her a problem, my mother would say, "Five oranges." And one day, she was correct. [laughter]

JG: How did she feel about you and your interest in science when you were a little girl.

JF: Well, she thought the interest in science was fun. I seemed to like it. But she did have a problem with it. She said to me when I was eight, "Women, you know, can't be scientists. Their brains can't do it. So you can't be a scientist." So I sat in a chair, which I still remember, and wept because I couldn't be a scientist. However, shall I tell you the story of how I got healed?

JG: Yes. How did you get healed?

JF: When I was fourteen years old, it was my birthday. My brother was home for some reason. He was in Princeton at the time. Is that right? Yeah. He was in graduate school at Princeton. He left a book, a textbook. I picked it up and said, "Mom, Richard left a textbook. We'll have to get it to him." It was called Astronomy by [Robert] Baker. I opened the textbook, and it had my name in it. I said, "Oh, it must be a present for me." So I asked him, "How can I read this? It's got math, and it's got science." He says, "You

start at the beginning, and you read until you're lost. Then you start at the beginning, and you read again until you're lost. Each time, you'll go further until you read the whole book." So I read that that way. After many starting overs, I got to a page where it was talking about the light that comes from the Sun, the spectra; that is, the spectra or the frequencies of the light. There was a little – you know the pictures they have in textbooks, and there was a [picture] with a thing like that, which was the spectra, and it said under it, "The spectrum of magnesium from the Sun. Courtesy of Cecilia Payne-Gaposchkin." Now, Cecilia is a woman's name. Payne-Gaposchkin means she's married. So not only was she a woman, but she was a married woman, which my mother wanted me to be. She was good enough to have her results published in a textbook. So the secret was out. My mother was wrong. You could be a scientist. So that was a very eye-opening thing to be.

JG: Sounds like it was a transformative moment.

JF: It was. It was. So when my brother wanted to make a telescope with me, I thought that was a great idea. He was in Princeton.

JG: You were fourteen, fifteen?

JF: Yes. It was my fourteen birthday that I got the news, the news that Payne-Gaposchkin was now a scientist. My brother wanted to make a telescope with me. He would buy the glass for the telescope. He had his own money. All I would have to do is grind it. Then he would design it. He would take it to Princeton, where he was in graduate school, to be tested. Well, the question was, where would I make the telescope. I couldn't do it in my bedroom because of the little pieces of glass. But there was a storage room down in the cellar. I figured I could do it there because some of the guys in the building had their chemistry labs in there or something like that. So okay, I went down, looked at – "Yes, Mom, I can do it here." My mother said, "No." In my mother's imagination, there were men lurking in the cellar ready to rape a 14-year-old-girl

down there. So my mother would not let me do it. So that telescope was never made. It was too bad.

JG: Yeah. Tell me what the attitude of your teachers was towards girls who were interested in science.

JF: Well, I do want to tell you something else before that. When I thought of being a professional woman, I thought of my grandmother (Johanna?), who made hats and was a professional woman – the grandmother I was named after. That was very important. That also gave me permission to leave my kids and do something else.

JG: Very important.

JF: So I'm thankful to (Johanna?), as well.

JG: I just wanted to talk a little bit about your experience in high school.

JF: In high school.

JG: High school I'm talking about. I'm still going back to the thought of the socialization of young girls.

JF: In the high school I went to, Far Rockaway High School, which is now closed, and no longer exists, the most important thing, I think, in school is the students. Because for the students, you can have fun and make strong relationships. It isn't just the teachers. The high school teachers, in general, were pretty nice and pretty. [laughter] There's a funny story, which I'll tell you later. Pretty nice and encouraged us. And encouraged us in strange ways, like the math teacher would not look at us while we were taking the tests; we were on our honor, which was really nasty of him because we were worried about our honor. So he would sit there with a newspaper in front of him. We would be doing the test, not looking at anybody else, not trying to get the answer from anybody else. That

was a math teacher. The chemistry teacher, however, was very strict, and she was nasty. Some friends of ours, me another friend or two, helped in the lab in the chemistry lab. They were happy to let us do it. One day, it was the final exam of the year, and she left the test next to the window in the lab, and we took it. We took the test. She also [laughter] left the class. She had to go somewhere. So she left the last two classes to a couple of the best students to help the others to get the questions correct. So I forget which friend. It was a guy, and I decided to really help them. So we went over the questions on the test. So everyone in the class knew the right answer. Okay? [laughter] So we all took the tests, and as usual, in her classes, it was a person here, and all those chairs around them were blank, every other chair, and couldn't cheat. Nobody did cheat, except when studying. [laughter] So she came to the class furious, absolutely furious. She said, "I don't know how you did it." [laughter] So we had to take another test. But that was how we took the seriousness of these things in high school. So you were asking me about the high school. The professors were very helpful.

JG: The teachers. Teachers in high school.

JF: We had a professor in physics, an actual professor, who had taught as a graduate student in Columbia in English and English literature. He was writing a book. It was so bad; the only job he could get was in high school English. He was writing a book about something. We had a group of friends, which we referred to as our gang. There were four or five girls and ten boys – very nice. We used to do all sorts of things together. One of the things we did was go over to the professor's house, where we would talk philosophy. The professor smoked and had a collection of pipes. Each of the boys had a pipe – pre-smoking age. They would sit around there, smoking their pipes, discussing philosophy. So you see, we had some good teachers, too.

JG: Sounds like it.

JF: It was wonderful.

JG: Can you say, though, whether there were expectations based on gender about what was appropriate for you as girls to be?

JF: Not in high school. Not in the high school.

JG: The world was open.

JF: The world was open. My best friend got a PhD in chemistry. After she got the PhD, she didn't like it much. She didn't like the chemistry jobs she could get. So she got another PhD in law. I mean, another degree in law. She's now a Justice of the appeals court in Washington, DC, the Honorable Pauline Newman. Many of the boys became doctors. Some of them became physicists.

JG: What did the other girls –? What did you think? What were you interested in at the time?

JF: Physics. My brother and father enjoyed talking about it so much when they were at the table that I thought it must be the most wonderful thing to be. But I didn't think that a girl could become a physicist. When I was in college, if I may go that far along, I wrote my brother a letter and said, "I think I could get a job helping a physicist maybe." What did he think? I knew I would never be a great physicist because I was a girl. What was his advice? He was in graduate school. I also asked him how to break off with the boyfriend, who was trying to get me to say yes to marrying him. He said that answer was very easy. You just tell him no in no uncertain terms as quickly and clearly as possible. But the physics one, that what I should do is not try to be educated to be anybody's assistant – to be educated to be a great physicist, instead of a mediocre physicist. Because if I tried to be a great physicist, even if I didn't make it, I'd be a better physicist than if I wasn't trying for that. However, as I always say, never in the history of human beings did a little sister take the advice of a big brother. So I just tried to be a high-medium physicist, not great. But I always tell this story to girls because anything's open.

So my brother certainly gave me very – well, with giving me the book, with wanting to grind a telescope, we had another thing. We had a book when he was in Princeton. He would send me a math problem, and I would work out the answer. I had any problem in physics at all, I would send him the question, and he would answer it – or in science at all. So that was very encouraging.

JG: I just want to place us in historical time for the moment. So, your high school years really coincided with US involvement in World War Two.

JF: Yeah.

JG: Do you remember Pearl Harbor?

JF: Yes.

JG: Can you just tell us about that for a minute?

JF: Of course I remember Pearl Harbor. It was a Sunday. My mother had gone to the movies. My father was reading or studying something at the table – a little dining room table – and I was doing my French homework. The radio was on. The radio came through with the bombing. My father says, "That means war, that we're at war." I remember that.

JG: Was your family or anybody you knew involved at that point in the military? Was anybody in your family in the armed services during the war?

JF: My brother was at Los Alamos. My cousin, my mother's brother's son, was in the Army, and he was allowed – Army Air Force – and he was allowed to quit the part he was in and join another group, which were the Flying Tigers. My mother's sister's son was enlisted immediately. They all came back. Lots of the boys in my class came towards the very end of the war.

JG: Came?

JF: Joined the Army towards the end of the war, were drafted, and so on.

JG: You graduated high school in ’44, right?

JF: Yeah.

JG: Do you remember becoming aware of what was happening to the Jews in Europe?

JF: I don’t remember becoming aware of it. I remember being aware of it. When I was small, before I was in high school, my grandmother, on my father’s side, Anna Feynman, had a brother who lived in Dusseldorf. He had a nephew who lived with him. Now the guy in Dusseldorf was apparently a great engineer. He had built the bridge at Dusseldorf. He stayed throughout and was never put – he died because he was an old man but was never put in a concentration camp, and neither was the brother. But they came to visit. I remember going out to a restaurant, and my father asking his uncle something or other, and the uncle looking around like that, and he says, “In Germany, there are microphones everywhere. When you go out anywhere, you must never, never speak of anything like that.” So I knew that. I was very aware during the war of the concentration camps because I don’t know if people remember, but Henry Morgenthau, who was the Secretary of the Treasury, was trying to get people out. There were lots of news things about the concentration camps. Then that news got shut down. So there were a lot of people that didn’t know about the concentration camps until the war was over and they were opened up. But I certainly did.

JG: Did it have any effect? I mean, what effect would you say it did have on you and your family to know what was going on there?

JF: Well, a very deep effect. That somebody would want to kill me because of my religion or was threatening the Jews has a very deep effect. That’s why I had religion in

college. It's also why I felt that – although we had my children – when the story was you were only to have two children. Why I had a third child, I figured that I had the right to a third child, at least. Because oh, boy, when I got pregnant with a third child, it was considered – [gasps]. [laughter] I'd say, "Hitler killed my people. I have a right for a third child."

JG: Well, let's talk about another impact of World War Two. That's the impact on women's roles in the workplace, which was a big change.

JF: A big change. Yeah.

JG: I'm curious whether you were aware when you were in high school of these changing roles.

JF: I didn't consider them changing roles because I thought of them as something that would go back as soon as the men came back. But as I say, since my grandmother was a businesswoman, that was never such a – (Johanna?) Phillips. It didn't seem very odd. I understood from what I learned about Judaism that in families with rabbis, it was customary for the woman to make a living so that there was a whole custom of Jewish married women making a living.

JG: Right. So were you aware of that having any effect on your own sense of what you wanted to do with your life at that point?

JF: Sure. My mother thought I couldn't do it and that I didn't see people doing it. But I met [inaudible] (Botkin?), and I figured, "Okay." As a matter of fact, when my brother went to college, he came home to tell me that Madame [Marie] Curie was not a real scientist because she was married to a man who was a physicist, and he must have done all the work.

JG: Your brother told you this?

JF: My brother told me this. Of course, Pierre Curie was killed by horses in Paris, and she did the work. Not only that, but the Nobel Prize was a descendant in the line only of women at that time because her daughter also got the Nobel Prize.

JG: Very interesting. Why don't you tell us a little bit about how you decided on Oberlin College?

JF: How I decided on Oberlin?

JG: Yes.

JF: Well, that was easy. Everybody else was going to Ohio State. My mother went to the person who was in charge of suggesting where kids go – without the kid being there. The catalog opened to O. Then, the first school was Oberlin on the page. My mother didn't like Ohio State because it was too big. She wanted a small school with an excellent reputation. Oberlin was a small school, which had an excellent reputation.

JG: How did she feel about you going so far from New York?

JF: It was sort of expected. Even the other schools I applied to – there was Swarthmore, which I applied to because it had a fellowship for a woman in astronomy. There was Connecticut College of Women because they'd take anybody if I failed in the other two. Oberlin was the one I wanted. I don't remember if I got into Swarthmore, but I know I didn't get the scholarship.

JG: What were you interested in at the time? You told me that you were interested in archaeology and anthropology.

JF: Oh, yes. But my family talked me out of archaeology and anthropology. They said, "Look, all the great anthropologists – Margaret Mead – going all over the place. She marries a man, goes on a trip with him, and divorces him." That was true. That's what she did. She had to have some male protection. So she often married. But it really isn't something that's good for a woman because you're going off to these really dangerous places alone. Also, it's very hard to get support. My father, as I told you, was sick. My mother, as I told you, had no way to make a living. She didn't have any trade. Although she worked very hard in charity, she had no trade. So my father could not quit. In those days, high blood pressure was considered to be caused by stress and business. It was believed that if he had been able to quit, he wouldn't have died so young. So I decided that I would have to have, when I got out of college, a profession that I could support myself on. Then, just before I went to college, my father took me aside and said, "Joan, I want you to have when you get out of college a profession that you can support yourself on," and I agreed with that. I couldn't support myself in anthropology because it was too scary – not much money. I couldn't support myself – they did talk me out of astronomy because astronomy, as they knew it, was somebody who worked all night. Who would want to be married to an astronomer? So that left physics. [laughter] I did also, while I was in college, consider quitting physics and going into medicine because my brother's first wife was dying of tuberculosis. She died at twenty-seven. Then I found out it was very, very difficult, in those days, to get into medical school.

JG: For women, you mean?

JF: Impossible.

JG: So you decided to focus on physics and math while you were at Oberlin?

JF: Yes, yes.

JG: What was it like for you, as a woman, to be studying [inaudible]?

JF: I had some profs [professors], who were very, very nice and took it as perfectly normal. Then, I had a prof who didn't take it as perfectly normal. First of all, he came into the class every day and said – I was the only woman – came into the class and said, "Gentlemen," and then began to lecture. Then he gave me bad grades the whole time I was in his class. Math is a subject where he gives a problem to you and calls on you, and you're supposed to work it out on the board. He never called on me the whole time. Others were perfectly lovely. They took me as – we had a special class in math. There were three of us women and one guy because he thought he could go faster with us than anybody else, and it was a lot of fun. That guy wasn't hired for the faculty.

JG: So, how did you come to the specific topics that you were interested in at that point? What were you interested in, in particular?

JF: What I was studying?

JG: Yes.

JF: I wanted to get the basic physics and the basic math as exactly and as completely as I could. So there were no particular topics. It was just that I wanted to know what I knew, very, very solidly. That's what I did.

JG: Sounds like you were following your brother's advice at that point.

JF: Oh, well, that's the only way I figured you could know anything. You had to know how it was derived, and you had to know what the assumptions were. For math and for physics, you had to know what the observations were. So I just tried to learn everything I could and to be proficient in doing it.

JG: So you graduated in 1948?

JF: Yes.

JG: 1948. At that point, you also –

JF: Got married.

JG: Tell us about that.

JF: Okay. Well, the guy I married was one of the big men on campus that everybody thought was very nice. I wasn't sure. [laughter] We argued a little bit because he wanted me to get engaged to him, and I didn't want to get engaged to him.

JG: You have to tell us his name.

JF: Yes, Richard Hirshberg. So eventually, we did get engaged, and we got married right after graduation, two days later. We went away on a canoe trip for our honeymoon in the Saratoga Lakes in New York. It was great. It was very nice. I enjoyed canoeing – still do. Then we went to work. We had gotten jobs at the Naval Research Labs. I don't remember – I think we just made out applications, and his was accepted. For my applications, they wanted to give me a special – wanted to talk to me and see. Now, that would have been okay if he [had] better grades than I, but I was better in grades than he. So I think it was a separate trip that they took me into the NRL, Naval Research Lab. It was a group on safety with atomic particles. When I came, I was escorted. My name was Hirshberg, so it was no connection with Richard. So I was escorted into this big office, where the secretary escorted me in and then backed out. Apparently, you were not to turn your back on this august man, according to the secretary. I expected [to be asked about] courses, why am I studying it. No, that's not what I got. He said, "Will you please derive such and such for me?" Now, never before or after have I ever been asked to derive anything. So I took a piece of chalk and started deriving it on the board, and I got a little stuck. He says, "That's okay." So they gave me this little special exam to whether I was really a physicist or not – a bachelor's in physics. Then I was assigned to this very nice guy. His name was Faust. I teased him a lot about it, about devils and

things like that. But he was very, very nice. What we were doing was testing shielding from hot radiation. So things would break or something, and we'd have to get it fixed in the engineering lab. He would say to me, "Joan, tomorrow, we need to get such-and-such fixed. Would you please get dressed up?" I said, "Sure." So I'd put on a nice dress and high heels and look really great and take it down to the lab at the beginning of lunch hour – take it down to the lab and ask them to fix it, and instead of the two weeks, it took just lunch hour. It was lovely. It was one of my jobs that I enjoyed very much. [laughter] Another job was designing and running a safety system. He asked me when I came in, would I like to design and run the safety system. I said, "I'd like to design it and test it, but not run it." I want to get it going. Somebody else should run it. I don't want to run. It didn't seem like physics to me to run a system. So it was okay. There were some bad moments because it was right after the war, and nobody knew anything about dangerous particles, and you can't see them. You don't know if they're there. Of course, these brave men thought nothing of walking through my beam. [laughter] We had to keep the door to the lab essentially locked so that nobody would walk in and walk through the beam. Things went okay. Everybody had a little badge. I was getting it straightened out when the – not top of the group, but the guy under him decided he wanted to get some of the radioactive stuff. The safe was down in a hole below the laboratory. In order to get something, you had to bring the machine that picks things up right over it and go down and then pick it up. So this guy goes in there, and he picks it up, and he looks at it. He says, "Oh, this is a pharmacist's bottle." He opens it, and it's filled like a pharmacist would; every inch is covered. The whole thing was so hot that he dropped it; it was so hot. I don't know whatever happened to him. But if he did get radiation disease, it wasn't my fault. He didn't ask me whether he could go in and pull up a source that hot. But I suppose that everything got straightened out. I mean, I complained highly. Then, my husband and I were only working to get salaries to go to graduate school. We applied to many graduate schools. I got into the equivalent of Harvard that is the woman's section. [laughter] He did not get into Harvard. Anyway, he had switched to anthropology. He

was allowed to come into Syracuse University as a graduate student in anthropology on the basis of some sociology work he'd done, and I was accepted to the physics department. Syracuse was fairly close to Cornell, where my brother was at the time, so we thought that would be nice. So you went up there. That's where I took my graduate work.

JG: You were there for about eight years. You graduated in '58? '59, you got your PhD.

JF: Yes. But the reason was he was an – part of the reason was he was an anthropologist, and you can do a PhD in anthropology in Syracuse. So we had to go somewhere to do his PhD in anthropology. We decided the closest place that was really reasonably primitive was in Guatemala, which we went to. Now, we were living mostly on the GI Bill because he had been in the war. He was a Lieutenant First Class, I guess. We got two hundred and fifty dollars a month or something, which was quite a bit larger than the present two hundred and fifty dollars a month, but not enormous. So we had a seventeen-year-old car that I bought from a friend at the Naval Research Lab.

JG: We decided to drive that down to Guatemala. We also had acquired while we were in the first year in graduate school a very beautiful dog, a Dalmatian who was absolutely lovely. I mean, it's this kind of dog that people did stare at in the street – a female. It had only one trouble; it couldn't hear. This is fairly common with Dalmatians. If they're too white, they often can't hear; it's associated with their whiteness. Our dog had one brown eye and one white eye shaped as a keyhole, so we called her Keyhole – very sweet dog. We taught her to follow hand signals. For example, we taught her so we could walk in the woods. We took her into the woods when it was snowing and walked along with her, and then we hid when she wasn't looking. She finally figured out how to trace her way back on her own footsteps until she found us, and she got very good at it, no problem at all. So we could let her run in the woods. It was nice. So we had a dog, and the two of us and a seventeen-year-old car. We also bought a house. Yes. So we bought a house

because it was cheaper than renting.

JG: Where was the house?

JF: In Syracuse. It was not a new house. It was about twenty-five, twenty-six years old. It had two bedrooms, living room, dining room, kitchen with an [eat]-in

area for breakfast, and a front porch, which was a Sun porch. On the second floor, a back porch, which was a Sun porch. It had a nice yard. It was a very nice little house. My mother had come to live with us. Wait a minute. That was the second time we were there. The first time we lived in a tiny apartment with his dog. The dog did go to Guatemala with us.

JG: Did you want to say what you were doing in Guatemala?

JF: Yes. In Guatemala, we were doing a thesis. We had to figure out what the thesis was. But in Guatemala, there were people who were clearly descended from the Indians, and there were people who descended from the Spanish, and there were people who were descended from higher-class people. Part of Guatemala had been invaded by [Pedro de] Alvarado in 1513. What happened when the Spanish invaded is they brought all the illnesses from Europe, all the childhood illnesses, which we get and don't pay much attention to measles, chickenpox, and so on. But they were fatal, so the population was devastated. We have records of that because in the village we eventually went to, the scribe at the village wrote year by year what happened until he died in one of the epidemics. Anyway, there was a class system in which the upper class was descended from the Europeans, and the middle class was descended from the Spanish; it was called Latinos in Guatemala, and the lower class was descended from the Indians and was called Naturales when you were being polite and Indios when you weren't. We went down there, not having much money. We stayed in a nice hotel. Not having much money, we asked the busboy if he knew of a place where we could live, and he said his

wife would let us live in their house. They're in a boarding house. So it was one room, no furniture, but we had sleeping bags and the dog. The bathrooms – there was an open trench, which ran along the back, which had the two holes in boards on it, and all the water from the street ran down there, so it kept it clean pretty good. It had a sink; it was a big sink for everybody. The water ran and ran through it. Then there was the kitchen; the kitchen was a small place about six foot by five foot, which had a counter made of stone. There were four little squares in the counter. How you cooked – you made a fire in those little squares and used the fire to cook on. Now, making the fire was not easy. You cooked in charcoal, and they had little pieces of pine wood that was easy to get the fire from one to another. You started with that and built up a fire by lots of this ¬– fanning. Then, had a big enough fire to put a pot on it and start cooking. In our room, they gave us a small table and two chairs. We slept in the sleeping bag. So it was our first – the street was more or less of a slum street. That is, there were lots of kids in each little house and dogs and relatives and so on. The little kids, up to age three or four, who were not yet toilet trained wore shirts but no pants conveniently. But everybody was very nice. They invited us over to their house for New Year's Eve. Of course, their house didn't have wooden floors; it was just dirt, clay-ish stuff. We danced to a fiddle, and it was great fun. There was no place to park our car in that narrow street. So we parked at the beginning of the street. The adults warned all the children not to steal parts of it. [laughter] Otherwise, it wouldn't have lasted. At the end of the street, there was a wall, and the wall went down to a deep ravine, which was garbage. That was where they threw their garbage. It went down over the wall. It was very deep. It now, I understand, has been completely filled up, capped with a nice piece of dirt, and is now a nice neighborhood as the place grew.

JG: How long were you there in Guatemala?

JF: We were there a year in three months or so. We came down early in spring and stayed until the next fall when we got back to school. Then we decided – that was a city.

We saw people who lived in the country and came into the city first started in places like that. The people in the villages, the Indians, wore their old costumes, which were beautiful handmade cotton skirts and so on. I have some here. I have a loom here, where I eventually learned how to do it – a loom where I learned how to do it. So we went back into the country. The first place we went in the country was a tourist place – Panajachel, and Panajachel was on a very beautiful lake, Atitlán. We stayed there a while until we figured out what we wanted to do. Then we noticed that some of the villages – there were six or seven villages around the lake. Some of the villages were very traditional, and some weren't. We tried to figure out why and what was going on. We finally realized that the way Indian village is organized is there's a group of older men who rule the place, and then there are young men who do civil service called cargos for free, and then there's everybody else. If the older men were conservative, what they did if somebody was not conservative is they made life kind of difficult for him, so he left. So in most of those little towns, they were very conservative. Now, we tried to go to live in one of those towns. In order to get to it, you had to take a boat from Panajachel to San Antonio Palopo. There were no regular boats that went. So we figured, "Okay. We like to canoe. We can rent a canoe and go over." So, there was a wind that came up on the lake in the afternoon called a xocomil. We'd come back before the xocomil. Anyway, we paddled over, and they looked at us as we paddled there. But they let us in. There was a young man who was very not conservative, and he was finishing a house. He said he'd rent it to us if the old men permitted it. So, okay. So we paddled back. Then the next time we met him – we were supposed to come back the next week. So we came back the next week, and he said, "No, they won't let you live here." "Why not?" "Well, there was a movie company that came in and made a movie and made all sorts of trouble for everybody, and they won't let any Americans in anymore." So, with arguing and with talking and so on, we got a little late, but the xocomil was not yet up. So we started paddling back. The xocomil came up, and it's right on the path you want to go. It was very hard to make progress. Now, the Indians did not know how to swim. So when they

got caught in a xocomil, it was extremely dangerous. We weren't near the edge of the lake. If we did get caught, we could swim into the land. But since we got back without any damage, they decided we were witches of some sort. I mean, the very conservative did. So we were out of there; we could not go back to live. However, there was a market in our town, Panajachel, and people came from the towns outside to sell whatever they grew, like apples, or a couple of things of apples, or corn, or something like that. One man had come from the village on top of the mountains called San Andres Semetabaj, and he was a Latino. He said he would rent part of his house to us. So we went up there. That town had a much bigger Latino group in it, but it had a lot of Indians, naturales. We lived there for a year and studied. We found there was a man in the town, an old man who had had several wives. They all started out young wives. The first two died or got divorced or something. The third one he thought was cheating on him, so he went for her with a knife to kill her. As I said, the young men had different – the young Indians had different jobs. So the young Indians had the job of policing the place. So they caught him, and they tricked him into handing in the knife. So he went to prison. While in prison, he met another man who had a daughter. This other man had quite a lot of money because he worked very hard as well as trying to kill his wife. So this lovely man in jail made an agreement that – not our San Andres guy, but the other made an agreement to sell his daughter to Juan for a wife. He paid the fine for the other guy to get out of jail. Then, took this daughter for [a] wife. Can you imagine somebody selling his daughter to a man who's been on trial, been accused of murder? So we were all very sure that when she had a baby, it was actually Juan's because he didn't kill her. That was the kind of place we were living. What we decided was that everybody who tried to break the rules got pushed out of town. So that was the thesis of why they remained so conservative that we wrote and took data for. We also taught English. My husband came in white-faced one day that there were a large number of children that were dead and dying. I said, "What's going on?" We asked people who spoke Spanish – we learned a kind of Spanish, and they told us that was whooping cough. Remember, I told

you they died of European [diseases]. So they were dying. So we, being Americans, had to do something about that. So I went into Guatemala City and got a doctor to come out. In the next town, they could get injections to stop the whooping cough. So those were the sort of things that kept happening there.

JG: So after a year and some, you came back, though, to the States, your husband wrote his dissertation, and where were you at that point in your own studies?

JF: We were all in Syracuse. We're both at Syracuse University.

JG: Where were you in your own PhD process at that point?

JF: In my own education courses?

JG: Yes.

JF: I was [inaudible] two years, first year in graduate school before we went, second year after we went, and continuing taking graduate courses. I had decided there was – I was afraid of – I went around to find a teacher who would take me as a graduate student and the courses he had – I wanted it in theory, not experiment. So, there was a solid-state guy, and there was one who had come over with Einstein, a relativist, and he scared me. I didn't think I could do that. There was another guy who was not theory, but I went to him anyway and asked him – did he have some ideas? He looked at me, and he said, "Yeah, I have an idea. How about the study of cobwebs? Cobwebs, the [inaudible] in the house? He suggested I study that for a PhD in physics. Needless to say, I did not pick that one up. So I went to solid-state material properties and did – the thesis was that diamonds, silicon, and germanium absorb some light, which is a little hard to understand how they do it. That was what I wrote my thesis on. It was quite dull. [laughter]

JG: I guess not for you, though.

JF: What?

JG: Not for you.

JF: Oh, yes, for me. I learned all these techniques, but I didn't give a damn why geranium, silicon – it wasn't me. But by hook or by crook, I got a PhD.

JG: So what happened? Let's just pause there for a minute. So it's 1958 or '59 – we're not clear when you got your PhD. Dick also got his PhD then.

JF: Yes.

JG: You were describing to me that – I want to get into this, the question of motherhood and being a scientist, etc. But tell me what was happening.

JF: Okay. The baby wasn't born until the last year. Right?

JG: The baby, meaning your first child.

JF: My baby Matthew, my first child, was not born until the last year when we were finishing the PhDs.

JG: This was –?

JF: 1958, I think.

JG: 1958, right. You were telling me about when you graduated.

JF: We had bought a house. We bought a house, as I mentioned. It was a row of five houses on a big road, and then behind the five houses was a big field. Then there was a cemetery, and then there was Syracuse. So I could walk back and forth. I only had to be on campus when there was a class. So, not the next house, but two houses up lived a delightful woman who had five children. She said, "One more won't make any difference

to me." Her children were – her youngest was about a year older than mine. So he joined their family while I went away to the university. That was very nice because she taught me everything I needed to know about taking care of a baby. She was very sweet. So she took him in while I was away studying. I also had the usual job of teaching undergraduates. So it was about half-time I was away. So he was at her house half-time during the week.

JG: This was after? You have your PhD. This is a job we're talking about now, or is this your last year?

JF: No, when I was at Syracuse, I couldn't pay all the tuition and everything, and everybody did it; you taught the undergraduates or some special class. The last year after I got my PhD, we were also there. My husband was teaching anthropology, and I was teaching still beginning physics, actually on a radio course.

JG: So I just want to pause here for a minute and ask you a question because I just want to place us in time a little bit. So this is the period that Betty Friedan described as characterized by a cult of domesticity.

JF: That was about two years into the future.

JG: Yes, when the book was published, but this was the period that she was describing. At the same time, historians have described a backlash against women in the workplace that was happening after the war, after World War Two.

JF: Yes, they wanted to get them all back into the – out of the factories because those were the higher-paying jobs.

JG: Right. From what I understand, this was also a particularly difficult time for women engineers, women in technology, and in the sciences, even though those fields were exploding in the 1950s and 1960s. So can you describe a little bit what the –? What was

the scene for women scientists at this –?

JF: What was the scene? The terror was in ’60, ’64, around then. I was hit by the terror real hard.

JG: The terror meaning?

JF: That they didn’t want women. This was before that. It was mild and depended entirely on the guy you were talking to. But after I got my degree, it was horror.

JG: It was horror?

JF: Horror, yes.

JG: Can you describe that? What was the horror?

JF: Well, take a little jump in time.

JG: Matt was born in 1960. Dick took a job in New Jersey, and you took a job in a lab, which lasted for about three months.

JF: I quit. I quit because I got pregnant. It was a very tough drive. I didn’t think I wanted to go through three months of throwing up on that drive. So now, I’m trying to keep house. The trouble was, we bought a house outside of New York in New Jersey, on the Jersey side. It had four bedrooms, a living room, dining room, kitchen, three baths, and a yard. I don’t like housekeeping. [laughter] So I didn’t like it in that sense. But I would spend my time – you don’t know. There’s something called the specific heat in science. It’s the amount of heat energy you have to put in something to get a particular temperature. It’s not the same for everything. I found myself doing nothing but measuring the specific heat of carrot, ground carrots, and other baby foods, okay? I had worked very hard to get a PhD. It was a beautiful kitchen with huge windows looking out, and I wanted to throw the carrots out the window, but I didn’t. So I went to a shrink.

JG: This was a period where you had three children in relatively short order. Right?

JF: Well, I had one child when I went to the shrink. Two children when I went.

JG: Right. Because Chuck was born in 1962.

JF: Yes, he was born when we were in that house, and I wasn't working. It got worse and worse for me. Finally, I decided that my two children had a choice of having a full-time witch or having a part-time mother, and I made the decision for them. I decided to go to work part-time. So I told you, I was talking to my psychiatrist. I was complaining, "What can I do? I can't find a job up here. There's nothing here." He said, "Have you tried such and such? And have you tried such and such?" I said, "No, they'll never hire me." So he said, "Try it." So I thought, "Oh, well. This is stupid. But for his sake, I'll try it." You know when you want to get to work in a place, you make contact with the people, you write your resume and things like that – not me. I drove across the county. There was this big, beautiful place called Lamont Geological Observatory of Columbia University. I went in, parked at the big, beautiful administration building, and walked in and said, "I have a PhD in physics. I would like a job here." The woman behind the thing said, "Well, I'll tell you what you do. You write our vitae here, and we'll send it around to all the people in all the projects." If anybody is interested, we'll give you a call. So I said, "Yeah." I thought to myself, "Right." So I went home. Two weeks later, I got a telephone call. We have three people who would like to interview you. So, one of them wanted me to calculate the way waves traveled in the moon. We hadn't been to the moon yet. So we'd probably get that wrong. One of them wanted me to interpret what – there are some stones that look like they've been melted by very high temperature – they're all over the world – and what were they and where did they come from, and so on. The third one, there are – if you put a magnetometer on Earth and watch it closely, it has little tiny motions in the magnetic field. When the guy told me this, he said, "We're studying the rapid variations of the Earth's magnetic field," and I said, "Oh, are there any?" [laughter]

He said, “Yes,” and he showed me this data. I thought, “That’s fascinating. That can’t be a light wave. It’s got too slow a period. I wonder what that is?” So I went to work half-time on that. Can you ever hear of anybody getting a job like that?

JG: No, it’s a wonderful story. How usual was it, though, for anybody to be able to find a job part-time in science and be juggling motherhood and science?

JF: Nobody asked for it.

JG: What?

JF: Nobody ever asked for it. There were no women around with babies who were asking for. Men wanted full-time jobs. These were very intelligent, very imaginative people that worked at that lab. It’s an excellent, excellent lab. So they didn’t care about those things. They figured if it worked, it worked. That’s fine. Okay. You want to come work? We have some money. Come work.

JG: So, how did that work for you?

JF: Wonderful. Wonderful. My first paper I wasn’t sure my boss would approve of. I had him read it, and he wanted some changes made. So I made the changes, but I wasn’t sure he would have agreed with it. So he went away on a business trip, and I sent it to the technical magazine, got it published. [laughter] It was early in the space business, very early. That area was growing with great imagination. Anything went. It was exciting. Anything you touched was new and not understood, and you could get clues to it. It was marvelous. It was just so exciting. The place I worked, Lamont, did a lot of stuff in the Arctic. Other people in my group had just been floating on an ice float in the Arctic, gathering data, when the ice melted, and their machine went down, and they were stuck on the ice floe, but they got them off. So you can imagine a woman who was taking care of two babies alone in the house in a totally non-exciting atmosphere, getting a job in a place where the guys are talking about themselves almost being drowned in

the Arctic last week. That was marvelous. That was fantastic. The whole world changed. Anything became possible. That's what that job did for me.

JG: Fantastic.

JF: One day, the people next door came in. They had wonderful new data. They found that the continents were moving. You remember I mentioned my father. They said, "Isn't that exciting?" I said, "When did they stop?" They looked at me, I said, "My father read me Wegener." They said, "Well, nobody but your father believed Wegener at that time." [laughter]. It just became a whole new feeling towards it. It wasn't step by step by step by step, and everybody in a line, and this is your problem, and that's my problem. Don't touch my problem. You do your problem. No. It was anybody do anything.

JG: Did you know other women who were doing this kind of work at that point?

JF: No.

JG: So I wanted to recall that the Dean of Women at Columbia at that time said that sensible motherhood and wifedom, being a wife and a sensible mother was, quote, "The most useful and satisfying of the jobs that women could do." Your son wrote, "My mother tried to be a sensible mother, and it almost killed her."

JF: [laughter] Is that from Chuck?

JG: That's from Chuck.

JF: [laughter] You can see that I had a little trouble being a sensible mother. [inaudible] falling into the ocean in the North Pole.

JG: So it was this psychiatrist who really helped you find your way out of that?

JF: Oh, yes. He saw no reason why I shouldn't be getting a job and taking care of the kids some other way.

JG: So from there, from what I understand, you then had a number of different part-time jobs for a number of years. So let's talk about them. We can talk about them somewhat individually, but also just more – I'm curious what the –

JF: Those were the years when my children were young.

JG: Yes, those were the years when your children were young.

JF: So now, I had to face the idea that women were supposed to take care of children for the children's sake. But I had found by doing the best I could, that that was not good for my children. They had a mother who was miserably unhappy. I didn't blame it on them. That was just a fact of life. But I had to find a way out. Now, my mother worked part-time for all the charities she was working for. She worked as long as I would be working part-time. Her mother was a milliner. So I thought, "Well, how did they do it?" The answer was, they had help. So throughout the period, I had help. When I was being unlucky, I had somebody that came in in the afternoons, took care of them, and did a little dusting, and got the soup started. When I was doing well, I had somebody – I always tried to find a house every time we moved that had a secluded bedroom that I could give to a woman, who would be working in the house, away from the rest of the house with her own bathroom and her own door, if possible, to bring her friends in. So there were companies at that time, where you could get somebody from overseas, for example. You paid for their fare over and their room and board and a small salary for a year, and then they were free. I had one woman, who was perfectly wonderful, named Betty Baker. She was a Scottish woman. I was living on nine acres of Atherton – you know Atherton.

JG: Yes.

JF: The richest city in – on nine acres of land in Atherton in a somewhat decrepit house where the roof leaked, and the water came in on this side [when] the rain came, but we managed to plug it up. I got her to come over from Scotland and be my cook and nursemaid. By this time, the dog was old and decrepit. She had worked for a veterinarian, knew everything to do for the dog. She was wonderful with the children. She had a face on her which would scowl, just the eyes. When they were being bad, noisy, and fighting, I would hear her say, "Now boys, if you boys don't settle down, I will not make a chocolate cake this afternoon." [laughter] Of course, there was no chocolate cake scheduled until that worked. [laughter]. She did speak Scottish with [inaudible], and she was very nice. She was the most marvelous cook. She took such great care of the dog.

JG: You felt you were in good hands, all of you.

JF: I was working part-time. I spent plenty of time with the kids. When they were in nursery school or something, I was out working.

JG: So you were at the Lamont laboratory for how long? Then you went on to a number of other jobs.

JF: Yes. Well, what happened was my husband was transferred – he was at Stanford Research Institute in New Jersey, and he was transferred to the main section, which was in Palo Alto. So I had to move, too. So I went to the head of the lab, and I told him my problem. I had this interesting problem that I was working on, and I wanted to finish it. Was there anything that could be done about it? He said, "Well, we have a lab in Great Britain. We'll have a lab in Menlo Park, and you'll be the only person in it, and we'll do this for [inaudible]." What more can you ask? I mean, these guys were not run-of-the-mill people. So I was the sole person in Lamont West. [laughter] When I got to Palo Alto, I went out to Ames Research Center, where they were doing the same kind of work. I went to their seminars, and I met their people. When it came to the end of the time with

Lamont, they were willing to hire me part-time. After I first walked in the gate of Lamont and weren't dealing with machines, people that were machines, things were great. Now, I do want to tell you the story of my trying to get the job just before I went to Lamont, where I got the job that lasted three months because I got pregnant. I didn't like it anyway. I wanted to put an ad in the newspaper. In those days, people did – "Physicist, bachelor's, Oberlin College 1948, or something. I want some work," and where to call. I wanted to put it under employment-men. I mean, who's going to look under employment-women for a physicist. The New York Times would not let me. They said, "You put it under employment-women, or you don't send it in." I said, "I'd write in it: woman wants." "No." It was obviously somebody at the bottom of the barrel. But that was before I met Lamont, and I was easily discouraged. Now, I wouldn't pay any attention to it. I'd just say John or something – J. I also found out that I was Joan Hirshberg. I also found out that I should publish under J. Hirshberg – it got much better reception – and I should learn to sign my name, J.O. Hirshberg, and that got good reception compared to J-O-A-N. So I hid those little things. The worst thing I ever did on that line was at Lamont, and I wanted to talk to a high-level person. I really wanted to talk to them. So I picked up the phone. He was the head of a big lab for NASA. I picked up the phone, dialed his number, and the secretary said, "Dr. So-and-so's office." I said, "Dr. Feynman for Dr. So-and-so." So yes, I got through. [laughter] He heard my voice. He said, "Who is this?" "Dr. Joan Feynman." [laughter]. But I only did that once. Mostly, I hid it while I was a Hirshberg. Nobody knew it.

JG: That you were Feynman.

JF: That I was Feynman's sister.

JG: Tell us a little bit more about – you had a number of different jobs over this period of time.

JF: They were all on the same subject.

JF: Which was?

JF: Which was solar terrestrial relations. This is a big thing. If something happens on the Sun, what is the relation to that to something that happens on the Earth? Solar terrestrial relations. So, where does an aurora come from, and how does it operate? How do [inaudible] connect to the solar wind, which is between the Sun and the Earth? There are strong particle events, which are produced at the Sun and get to the Earth – a lot of problems about that. That's called space weather. Then, there's variations of the Sun. What do they do to the Earth? That what I'm in now. So it was always the same subject after I got to Lamont. Lamont was what caused these slow waves in the vicinity of Earth – the heliosphere, it's called – where the Earth keeps the solar wind – you know what solar wind is?

JG: Yes, but can you say what it is briefly?

JF: Okay. From the Sun, there's always flowing out from the Sun, continually a stream of particles in all directions. The particles are mostly electrons with their charge, and protons with their charge, and helium with a double charge. Actually, when I was a kid – I think when everybody was a kid, they learned the three states of matter, which were gaseous, liquid, and solids. Well, plasmas are a different state. Because they are charged particles that are traveling, they are affected by magnetic fields. There are magnetic fields every place in the cosmos, around the Earth, in the living room, and so on. So how do these streams of particles and the magnetic fields interact? It depends on the energy in the particles and the strength of the field, and it becomes very complicated. So solar terrestrial relations depend always on the fact that – it's called a magnetohydrodynamic fluid, which is a big thing. The hydro is water. Hydromagnetic is magnetic field. Magneto – magnet. Water – hydro. It flows like water does in a stream. It's mechanics of these things, which would otherwise be gases. They're tied together by the magnetic field that they carry. So it's more like water, the flow around thing. It

confines the Earth's field to a certain area of space about six Earth radii away – or ten Earth radii – six or ten Earth radii is the boundary from the Earth.

JG: I want to get also to your work at the Jet Propulsion Laboratory, which doesn't start until 1985. Is there anything else you want to say about all these different jobs that you held in between?

JF: Yes, they're all the same, is what I want to say. I just went wandering around where I could find available funding or something like that. I had worked on these jobs with some people that were at JPL [Jet Propulsion Laboratory]. One morning, I woke up in February, in Massachusetts, in Boston. I'm sure you can appreciate this. I looked out the window, and it was snowing. I said to myself, "What am I doing here? Why am I here?" My children were all away. I was living alone. "Why am I living in Boston?" I shouldn't say it. Then I said, "Well, where would I rather live?" I said, "Well, I'd rather live where my brother lives, so I won't be so lonely." That's where JPL is. Okay. So I'll call up my friends at JPL and see if they have something, and they did. I came out. That's how I got here. But it's the same problem. That's why I could come so easily. I've always worked on the same problem since I got to Lamont – the same set of problems. Now I've added climate and agriculture to it.

JG: What's the importance of this work in your view?

JF: First of all, I think you never know the importance of something until you finish it – for your work. Now, the aurora, to me, was just a puzzle. But it turns out that these strong fluxes of energetic particles, which knock out parts of the instruments on the spacecraft or cause the large power plants on the surface of the Earth to go blow out – that's the same thing. Those big ones of those – the big particle events in space are the big things that cause spacecraft to collapse. They also injure, or at certain levels, they may kill astronauts going to Mars or something. So you want to be able to say when they're going to happen. Is this one, which is going to be very dangerous, et cetera, et cetera, et

cetera?

JG: So these were very important for safety in the whole space exploration.

JF: In space. Yes, and you need to make every spacecraft so that it's got enough shielding against these events, so it can carry out its mission. So you have to know – we have to be able to calculate – then don't come every twenty minutes. They seem to be very scattered at random – not really. In a ten-year period, there'll maybe be ten of them or less that are really dangerous, but you have to know when and so on. You want to understand why one is dangerous and the other not. Then you can recognize when it's happening. They're called coronal mass ejections. Because if you look at the corona through a telescope and blank out its disk – you know what the corona of the Sun looks like? This hazy white thing. You'll see, all of a sudden, a blob going through it, and that blob causes a shock in the solar wind, which is always coming out. That shock accelerates particles to high energies, particularly if they're two of these, following one on top of the other. So that's the reason that NASA [National Aeronautics and Space Administration] pays for a large number of people to work out of there. Then, the climate stuff is just that – the climate is so complicated. We know that most of the effect is going to be due to the carbon dioxide, methane, and water that we stick up in the atmosphere. But there'll also be an effect of the Sun to some extent, or there seems to be. If you want to know what the effect of the carbon dioxide is, you have to know what the effect of the Sun is because the data that you get back is just the two of them working at the same time. So you have to be able to distinguish them. That's what I'm working on now. The Sun, we used to have a short history of it, but now we have history from very long periods of time. Because the solar system – there's this solar system, and in from the solar system comes high energy cosmic rays. Nobody knows really how they're produced. They're getting it more closely. They come in and produce particles in the Earth's atmosphere. These particles, after a few chemical processes, either lay in the ice in the north or in the tree trees all over the place. And now, it turns out that the solar wind –

where the particles come in from space, the solar wind moves to push it out because it's charged in the solar wind as a field, so it moves to push it out. There's turbulence that lets it come in. So the variation of the solar wind – the cosmic rays don't change because they're from the cosmos; they don't change [inaudible] pieces. But this stuff, this solar wind with its magnetic field, pushes the cosmic rays back out. So you can tell from that, by counting the cosmic rays, how strong the fields of the Sun, the Sun pushing it out, and the turbulence preventing that is, and you get a lot of information about the past history of the Sun, the past history of climate. It's kind of delightful because when people are in a new field like this, the climate field or any new field, you get new sets of data. They're so wild. You're looking at snow that fell on the North Pole 250,000 years ago. But it piles up like tree rings. So you can count down, I'll say, 150,000 easily. You can count down 150,000 years ago, and you can get something about the strength of the plasma, the strength of the Earth's magnetic field, every – I don't know – maybe a ten-year average strength or something like that, or even better of things that happened that long ago.

JG: I want to turn now to discussing just some of the factors that were changing the culture during this period that you had been a scientist. One thing that we've talked about is the 1964 landmark Civil Rights Act, which really became an important tool for allowing women to push for equal treatment in the workplace.

JF: Yes, it did.

JG: So I want to ask you whether you have any memories of when this legislation was passed, and what its impact –?

JF: The Civil Rights Act, Title V?

JG: Yes.

JF: First of all, it was amazing that women got in there because everybody knew Blacks were discriminated against, but people didn't know that women were discriminated against because they thought women were different. I had a friend when I lived in Boulder, Colorado, who was one of the lawyers that wrote part of that. To me, the first reaction was all the big organizations of scientists did something about it. The American Geophysical Union, of which I was an officer at one time but not at this time, had gotten together a group of men who were going to discuss what to do about this, but they had no group of women. So they had big meetings. So I thought, "Okay, I'll just go to the group of men and bring up the fact that women are covered by this, too." So I went to the group, and I said that women were covered by this. They informed me that women did not have any discrimination against them and couldn't be part of this group. No way. So then I went to the head of the – I went around and picked out some women to be part of a group and did not pick myself because I didn't want to be part of it. I wanted these other women to do it. We got a woman's minority anti-discrimination thing for us.

Another kind of amusing event – I was working at the National Science Foundation.

They were interested in some problems or other, but they wanted me to come and talk to them about what I'd seen. They were all men. So they met at the club, which will have to find the name of – a club downtown in Washington. Oh, what a name to forget.

Anyway, it was the club where people who were anybody met for dinner, and so on. All of the people that were anybody were men. So these people had the ground floor and the floors above it. A woman could come into the ground floor but not into the dining rooms. The floors above it, the woman could not go. So I went over to this place. I walked in, and they wouldn't let me up to the floors above. I said, "I'm going up." They said, "No, you're not." I said, "Well, get me an officer to tell me – not you, an officer of this place to tell me." He told me I was not allowed upstairs. I said, "Why?" He said, "Because women are not allowed above the first floor." So I said, "Okay, give me a telephone." I called the guy who was the head of the American Geophysical Union at the time and said, "Hey, I'm stuck here at the bottom floor, and there's a meeting about

women upstairs. I can't get upstairs. Why is the American Geophysical Union holding a meeting of any kind when the entire membership cannot get to that place?" So then the American Geophysical Union, the next time – since I was an officer at that time, a lowly officer, the next meeting of the congress of the people that ran it, I introduced a measure, which said that the American Geophysical Union should not hold any meetings in any facility, which did not permit all of our members to attend all of the rooms, and it passed. I think other organizations also passed these things. So it became always that AGU and other memberships required open rooms for the whole membership. That was very important to them because they earned a lot of money in their fancy rooms that only men could go into. So that's one thing I did.

JG: Another thing I understand was figuring out that there was a tradition not to ask women to give invited papers.

JF: Oh, yes. It occurred to me at one meeting that I didn't see any women giving invited papers, and I didn't see any women chairing sessions in our group anyway. I got the old meeting books, and I discovered that women were never invited to give invited talks or to chair a session. So I said to the guy in our group, "Did you know this?" He said, "No." I said, "Do you know a reason for it?" He said, "No." I said, "Well, what are we going to do about it?" He said, "Well, I'll invite women, and so on." And he did. Now the point that was important to me was that he was not against women. He was not discriminating against women. He was just doing the usual thing. I thought that that's probably what most people were doing. They weren't thinking about it. I impressed on people who organized meetings that this was crazy and please fix it. So he wrote letters to various other people on his level and said, "Hey, guys, look what we're doing by mistake." I felt good about that because it did not involve anybody getting angry at anybody, which would only put their backs up. [inaudible]

JG: So, over this period of time and since then, have you seen tremendous change happen in this organization?

JF: Oh, yes. At this point, I believe the head of the AGU is a woman. The heads of everything are women. I mean, there's no discrimination at all about being members of the upper levels of the politics of the AGU. And it's wonderful. I feel proud to have made some of the first motions in that direction.

JG: Do you remember? Just thinking back – this was in the 1970s that we were describing just now. But when you think back a decade earlier to – as we were mentioning, 1963 was the publication of The Feminine Mystique. Do you remember that? Was that important in your life? Did you read it?

JF: I remember it. I don't mean that it suddenly made a difference. But I remembered it. Also, the fact that it went off into athletics, as well, that women's things be even in athletics, which nobody thought of, but a lot of women have had good experiences in that. It's mostly in the past, but not completely. But it's now individual things, individual men, who are nutty this way or nutty that way, who are nutty about women being where they don't expect to see them. But it's not an institutionalized thing. It's not a legal thing. It's a tremendous difference.

JG: So just to bring your career more up to the present, in 1985, as we said, you began working at the Jet Propulsion Laboratory, continued working on many of these same issues that you've been describing to us.

JF: No, I didn't work on them at – oh, in the same science.

JG: Yes.

JF: The same science, but I dropped the parts about women.

JG: Yes. Same science, I meant. But recently, you and your husband today have been working on – worked on a paper on why it took humans so long to develop agriculture.

JF: That's right. Okay. We go to that. As I said before, I love archaeology. So I was looking through an archaeology book, or rather, I was in the caves in France, the caves where the drawings are. I looked at those drawings. When you look at them, you get an emotional feeling of what – there's four horses, for example, and you look at it, and you know that that man or woman was drawing beautiful pictures of horses and had some emotion towards it. You feel his emotion or her. So this person must have been – this was thirty-three thousand years ago this was drawn. Modern men had developed by a hundred thousand years ago – less than that. Forty thousand years ago, they had left Africa and come in probably through the Middle East into the places in France. Now here were these people that I could feel were human beings like me, who had drawn this beautiful picture. Twenty-two thousand years passed before they began to invent agriculture. Now, that seemed to me to be a simple question: why? I knew these people had to be smart. Why did it take them Twenty-two thousand years? Remember, I think I mentioned the ice cores before, that you could tell what the Sun was doing. You could also tell what the weather was doing, what the temperatures were doing. If you look at that ice core, until 11,300 years ago, it has very fast variations, deep variations, in the weather. Then it suddenly stops within two thousand years of that stopping, which two thousand years is not long in human history when you got twenty-two thousand years, and they didn't accomplish anything in the way of agriculture. Two thousand years after that became flat – that is the beginning of the Holocene. Six agriculture developed independently throughout the world. That is, corn was domesticated in Mexico. Wheat was domesticated in the Middle East. Rice was domesticated in China and India, and so on. These could not have talked to one another. Okay? So something must have happened to their environment, which permitted the development of agriculture. If you think of living in an environment, where every forty or fifty years there's a big change in the weather, you're going to be following the flocks, the animals that get away, but the

plants can't get away so fast. So the plants have to be what caused the fact that they don't move anymore because the climate is flat, is the same, must be the reason that permitted all of the agriculture to develop. So I went and very carefully got the dates of four or five of these agricultures. It took me two years. Since I checked with the biggest people in the – for each of the cases, I worked to really get a convincing scientific description that yes, this is when the agriculture started. So it took me another year to get this thing published. But now I've been informed by one of the major scientists in this field that our paper – the way we told the change in the variation was my husband did some analysis of their variations. It's his field. So this has become part, or a major part of the data, which allows them to make a new explanation of why agriculture is founded at that time. It was delightful to do. It was really delightful to do. It's such a beautiful problem. Twenty-two thousand years – nothing happened. And then, in two thousand years –

JG: So here you are, in your mid-eighties, and you're still at this point, getting a lot of recognition for your work.

JF: I don't care about the recognition. I care about the finding [out] about something, finding something out.

JG: Of course. Yes. But what I wanted to say is that in 1998, you were appointed as senior research scientist at JPL. So can you just describe what does that mean to be a Senior Research Scientist? What does it mean to you?

JF: It's the scientists that the top-level people go to for advice on what to do. It's supposed to be equivalent to a full professor in a university. It's a nice thing. It means recognizing your work. But the other one is more so.

JG: The NASA Exceptional Achievement Medal, which you got in 2002. What did you receive that award for?

JF: For what I did in geomagnetics and climate and climate change. That's a medal given by NASA by the head of NASA. It's not common. There are a lot of senior research scientists at JPL. But that is more honorable, and I'm very proud of it.

JG: How did it feel to you after all those years?

JF: Good, good. As a matter of fact, when they told me I was going to get it, I said, "What do you mean? Are you sure?" [laughter]

JG: So what do you think it means for other women in science or who are thinking about becoming scientists to see you getting an award like that?

JF: Well, I guess, if you look around the sciences now, the number of women who are at the top level is not as large as the number of men, but it's not small. There are women who are heads of big corporations. There is no bar anymore. You may have to work harder, but [inaudible]. You may have to work harder, but there's nothing standing in the way.

JG: Well, in that regard, and by way of some more reflections at the end of this interview, I wanted to mention Larry Summers, who was then president of Harvard – I'm sure you remember this. It was 2005 –

JF: Oh, yes. President of Harvard, yes.

JG: – at the Conference on Diversifying [the Science & Engineering Workforce].

JF: So there are some people who haven't gotten to the modern world yet. There are always going to be some people living in the old world. He isn't the president of all colleges. He isn't somebody you have to listen to. He's only one jerk, if I may use that word. I guess not. He's only one fool. Change that.

JG: So, what do you think it will take for women to continue to make progress?

JF: Keep doing it. It takes a long time. You got to start working when you're in high school. You got to start working hard when you're in college. You got to start working harder than most people imagine when you're in graduate school. When you have a job, you have to devote yourself to it. That's why you have to love it. You can't do it by deciding, "Oh, yeah, I'm going to be great." Because that's not pleasant enough. You have to enjoy it. You have to see the beauty in it. That's what my brother told me about his work, too. So that's not because you're a woman; it's because you're a human. It is very hard work. But it is wonderful. It's exciting to do. It makes your life fun. It's just great. So anybody who is interested should develop that interest, or whose children interested, should develop that gift in them because it's a gift of a happy life. Or it's a part of a happy life, at any rate. No life is altogether happy. But it's an element that through hard work, you can get where you want to go.

JG: So, in that regard, I wanted to read you something that your son Chuck Hirshberg wrote, and I'm thinking about the fact that we all stand on the shoulders of the people who've come before us. So in 2002, your son wrote, "To become a scientist is hard enough, but to become one while running a gauntlet of lies, insults, mockeries, and disapproval – this is what my mother had to do. If such treatment is unthinkable, or at least unusual today, it's largely because my mother and other female scientists of her generation proved equal to every obstacle thrown their way." So you said when you were young, Marie Curie was just a mythical figure for you until you encountered that citation in the astronomy textbook.

JF: Yes.

JG: So I'm wondering, what do you think is the importance of having role models for young women today?

JF: If by role models, you mean that they can see that somebody else did it, it's very important because one of the things which still happens to women is they're very

interested in some field, and they go to their high school guidance counselor, and the guidance counselor says, “No, no.” As a matter of fact, at Stanford University, they were having a meeting – when I was at Stanford University – of what kind of careers women could come to, and they had invited all these people from soft sciences, but they didn’t invite me. So I said, “I’m a woman scientist, and I’d like to come.” The woman pulled up and said, “Our girls are into nurture, not nature.” Women in college [are] getting that kind of nonsense. It becomes very guilty. You’re not a girl if you’re interested in nature. Antelopes hopping over big walls is not for you. The Sun is not for you. But I have a great recipe for gingerbread.

JG: So juggling work-life balance, including motherhood, has been one of the central challenges of your career.

JF: Yes, but my grandmother had women that took care of her children. She didn’t take care of her children. Wealthy people today have people that take care of their children. They don’t have to drive them to every event that comes along; they have somebody who will drive them over. If you’re a scientist, you’re making enough money to pay for that. In fact, you make very little money until your kids don’t need this kind of help because it’s very expensive. But you can’t wait. You can’t take off ten years, twelve years from science, and then come back and say, “I studied science twelve years ago. I want a good job.” So you have to do something, and it’s very bad to dump it on your husband. It’s very bad to dump it on yourself. You’re making money. Pay someone to drive the kids where they need to [go]. Pay someone to clean the house. Pay someone to start supper. When your kids are young – I worked a half-time, which was not good for my career, but I’m not sorry I did it because that is the time you want to be with [your kids] the most. You just work the time when they’re at nursery school, or they’re taking a nap. That’s the time you work – longer than it takes for them to take a nap. But there are times in the day where you can fit it in without much – and you mustn’t feel guilty. If you feel guilty, you can’t decide which house is where you’re supposed to be. That’s up to

you to not feel guilty. Remember, it's only until they're seven that they want you around. By the time [they're] twelve, or fourteen, they don't want you anywhere. [laughter] You're going to be sitting when they're fifteen or sixteen years – you're going to be sitting with nothing to do and nothing to enjoy.

JG: So, to sum up, your advice to young women on how to successfully manage the juggling act?

JF: Yes, pay for it. Don't try to overdo it because you can't do all those things at once; they're big jobs. Pick out the big jobs that you like with the family. I loved to buy clothes for them. So I bought all the clothes for them with them. But I didn't dust the furniture; I don't like that. I didn't scrub the kitchen floor, and so on. I had somebody else do it. Most women I know – most of them do the same thing – they get help. It's important. You're not one and a half people. You're only one person. You can only do one job. I mean, the job part of one job. You can enjoy your kids alright, but the laundry, have somebody else do.

JG: So to switch gears to a much more ethereal plane, I wanted to just spend a minute thinking about your views on religion and the nature of the universe, as a scientist, as you think about it because your daughter said that you think of yourself as highly religious and even traditional, maybe in the ethical, cultural model.

JF: You spoke to my children?

JG: Yes. Do you agree?

JF: I think that the Jewish religion lasting so long under such terrible circumstances must have something. That's one reason that I keep searching in it. I like the idea of the Messianic Age. I think it's a wonderful goal. I enjoy being in shul on the High Holy Days, sometimes on Saturdays, sometimes on Purim.

JG: I'm curious how your religious perspectives come together with what you know about the universe as a scientist?

JF: They have nothing to do with one another, in my mind.

JG: Really?

JF: Yeah. I was brought up in a household where if anybody believed in God, the Creator, I didn't know it. My mother kept her mouth shut. I don't know what she believed. But my father and my brother certainly did not believe in God creating it because dinosaurs weren't done in six days. So to me, this is – every group of people says, "What is the purpose? How did this happen?" A group of people three thousand years ago decided on the creation – three and a half thousand years ago – because their creation is much the same in different books – decided on a system to explain it. They didn't know physics. They didn't know chemistry. They didn't know all sorts of things. So they came for the wrong data, and they made something that made life tolerable – the hope that there was somebody looking after them. But I, unfortunately, lost that hope during the Holocaust. If God was looking after us during the Holocaust – so, I lost it then. But it turns out it's okay. It's okay. There's a lot of Judaism which is good in the morals of the religion, the idea that we should help others. I don't throw that out with the question of who built things. I don't know who built this thing. I don't even know how to describe it yet. So that's your answer to that question. You can leave it out if you want.

JG: I just want to come back one last time to your relationship with your brother. You said he was your first teacher. Your relationship evolved over the course of his whole lifetime and yours.

JF: What?

JG: Your relationship continued to evolve over the course –

JF: Same. It remained quite the same.

JG: Did it? How did you relate to each other as you got older? You became a scientist along with him.

JF: Well, I would say that he gave up trying to teach me what he knew because I figured I was not really interested, and it would keep changing because that science continues. I had a little problem, which I thought was fun. I felt that he would be able to solve that problem very easily. So I went to him and said, “Richard, look, I’ll make a deal with you. I’ll take the aurora, and you can take the rest of the universe.” That’s the deal we made. So he didn’t work on aurora or space science and whatever, and I didn’t work on the rest of the universe. [laughter]

JG: It was a good deal for both of you.

JF: It was a good deal. Yes.

JG: So I wanted to ask you if there’s anything else that you wanted to add before we conclude? Is there anything else you wanted to tell?

JF: That it’s been one of the great fun things that I’ve enjoyed life with is my science and my family.

JG: You told me how wonderful it is to do work that you love.

JF: Yes. Do work that you love. Yeah, it makes work a whole different thing. My brother – they used to ask him, “How many hours a day do you work?” And he wrote he didn’t know because he couldn’t tell the difference between working and playing. [laughter] It was the same feeling.

JG: And for you?

JF: Same.

JG: The same. Well, I want to thank you so much for sharing so many stories with us today and so many reflections.

JF: Well, it's been fun.

JG: For me, too. It's been a real privilege. I want to thank you myself and for the Jewish Women's Archive, as well.

JF: Thank you for thinking of me for this. I hope some little sister will do what my brother told me to do. That is, be great. [laughter]

JG: Thank you, Joan. It's been wonderful.

[END OF INTERVIEW]