Abstract. An imaginary interview with Joan Feynman, sister of physicist Richard Feynman, is presented, showing her relationship with her brother, her career as a scientist and her scientific contributions, in particular those on the polar aurora.

Keywords: Richard Feynman, polar aurora, Sun-Earth relationship, climate change.

Characters: I: Interviewer, J: Joan Feynman

I: Good morning, Mrs. Feynman.
J: Good morning.
I: Joan Feynman (Fig. 1). First woman to be officially elected member of the American Geophysical Union. In 2000, NASA awarded you the Exceptional Achievement Medal for “your pioneering contributions to the study of solar causes of geomagnetic and climate perturbations”. And, last but not least, sister of Richard Feynman, one of the most famous physicists of the twentieth century. Where would you like to start?
J: Well, with my family. I grew up in the Far Rockaway neighborhood of Queens, New York. My parents were Jews, from Russia and Poland. My father was a businessman and my mother a housewife.

Q: What was it like for your family to have a scientist in the house, besides your brother?

J: My mother didn’t approve of my choice. As a young woman she had been an activist for women’s suffrage. However, when I told her at the age of eight that I was going to be a scientist, she said: “Women’s brains are not made for science.” At that age I believed her and doubted my abilities.

I: Didn’t your brother Richard believe in you either? (Fig. 2)

J: Yes, he did... It was Richard that got me hooked on science. He was my first teacher.

I: In what way?

J: When I was three years old, he taught me to add up numbers. For example, he would say ‘1’ and ‘3’ and I would memorize ‘1+3=4’. When I guessed, the would let me pull his hair as a reward. Or he would make me repeat that the sum of squares built on cathetes is equal to the square of the hypotenuse. I had no idea what it meant, but he recited those words like a poem and I loved imitating him.

I: Did you participate in any of his experiments?

J: When I was five years old, Richard, who was fourteen at the time, hired me as his assistant in the small electronics lab set up in his bedroom. It was my first paid job... Four cents a week. My job was to activate certain switches on command, climbing on a box to reach them.
J: Beh, inizierei dalla mia famiglia. Sono cresciuta nel quartiere Far Rockaway del Queens a New York. I miei genitori erano ebrei e venivano dalla Russia e dalla Polonia. Mio padre era un uomo d’affari e mia madre una casalinga.

I: Come fu per la tua famiglia avere una scienziata in casa, oltre a suo fratello?

J: Mia madre non approvò la mia scelta. Da giovane era stata un’attivista per il suffragio femminile. Nonostante ciò, quando a otto anni le annunciai che sarei diventata una scienziata, disse: “Il cervello delle donne non è fatto per la scienza”. A quell’età le credetti e dubitai delle mie capacità.

I: Anche suo fratello Richard non credeva in lei? (Fig. 2)

J: No, anzi… Richard mi fece appassionare alla scienza. Fu il mio primo insegnante.

I: In che modo?

J: Quando avevo tre anni mi insegnò a sommare i numeri. Mi diceva per esempio ‘1’ e ‘3’ e io memorizzavo ‘1+3=4’. Quando indovinavo potevo tirargli i capelli come premio. Oppure mi faceva ripetere che la somma dei quadrati costruiti sui cateti è uguale al quadrato dell’ipotenusa. Io non avevo idea di cosa significasse, ma lui recitava quelle parole come una poesia e io lo imitavo con piacere.

I: Partecipò a qualche suo esperimento?

J: Quando avevo cinque anni, Richard, che ne aveva quattordici, mi assunse come sua assistente nel piccolo laboratorio di elettronica allestito in camera da letto. Fu il mio primo lavoro retribuito… quattro centesimi a settimana. Il mio compito era attivare determinati interruttori a comando, arrampicandomi su una scatola.

I: Sua madre si ricredette, vedendo che lei imparava tante cose?
J: No. When I learned something, my mother was amazed by Richard’s teaching skills, not by my own in learning.

I: How did you know you wanted to be a scientist?

J: There were two fundamental episodes for me.

I: Would you like to tell us about them?

J: The first was on my fourteenth birthday. My brother gave me an astronomy book from the University. He told me to start reading it until I got to the point where I couldn’t understand it. Then to start over until I got to the point where I didn’t understand it. And then again and again until I finally understood the whole book. I went on like this for months. When I got to page 407, I saw a graph that changed my life. It was an illustration of the spectrum of a star, taken from a work by Cecilia Payne-Gaposchkin. It was an epiphany! If a woman like Payne-Gaposchkin had managed to get her work published in a book, then women really could do science! From then on, I had no more doubts.

I: And the second episode?

J: I was five or six years old. One night Richard dragged me out of bed, took me to a golf course near my home and showed me a rare sight at our latitude: the Northern Lights. I still remember the sky flooded with red, green and golden lights. “No one knows what causes it,” Richard explained.

I: That was where your interest in the polar aurora came from?
I: Yes. Richard and I made a pact. I said, “How about we divide nature into two areas of interest? I’m going to study the polar auroras, while you, Richard, will study everything else.”

J: Did your brother keep to the pact?

J: Yes... Once, in the 80s, he was offered a work on auroras. Before giving his answer, he came home and asked my permission. Of course, I refused. A pact is a pact.

I: Come arrivò lei a studiare le aurore?

J: Beh... la strada non fu facile. Studiai fisica dello stato solido alla Syracuse University. Qui un professore mi consigliò di scegliere le ragnatele come argomento di tesi di laurea perché, in quanto donna, le avrei incontrate nelle pulizie domestiche.

I: Un ambiente pieno di pregiudizi...

J: Comunque nel 1958 ottenni il dottorato in Fisica.

I: Poi continuò a fare ricerca?

J: All’inizio no. A quel tempo ero sposata col mio collega Richard Hirshberg e avevo due bambini. Il preside della Columbia University mi disse che il lavoro migliore per una donna era fare la madre. Per un paio di anni mi dedicai alla vita casalinga. Fu un periodo frustrante.

I: Come superò quel momento?

J: Con l’aiuto di uno psichiatra e di Richard, naturalmente. In una lettera mio fratello mi scrisse: “Se anche non arriverai in cima, alla fine sarai comunque una scienziata migliore che se non ci avessi mai provato”. Ripresi in mano la mia vita e trovai lavoro al Lamont Observatory. Lì cominciai a occuparmi delle aurore.

I: Cosa ci può dire su questo fenomeno?

J: Le aurore polari (Fig. 3) erano studiate già da tempo. Il fisico norvegese Kristian Birkeland, tra il XIX e il XX secolo, spiegò che un flusso di radiazione pro-
I: What can you tell us about this phenomenon?
J: The polar auroras (Fig. 3) had already been studied for some time. Between the nineteenth and twentieth centuries, Norwegian physicist Kristian Birkeland explained that a stream of radiation from the Sun, interacting with the Earth’s magnetic field, allows the formation of these colored lights. But at that time not much existed in the way of measurements.
I: And that’s where you came in?
J: Let’s put it this way... I was at the Jet Propulsion Laboratory in California in 1985. I was analyzing data collected by Explorer 33, a NASA spacecraft launched in the ‘60s. From the analysis of those measurements, I demonstrated the link between geomagnetic activity, such as auroras, and the speed of particles from the Sun, which form the solar wind. The brightest auroras occurred during the most intense periods of solar activity. This confirmed that auroras are caused by the Sun.
I: How are all those colors created?
J: The interaction between the solar wind and the Earth’s magnetic field supplies energy to atoms in the atmosphere. These then release the energy absorbed and emit different colors depending on the atom. For example, oxygen produces green light, the prevailing color in auroras.
I: Was this the only discovery about auroras?
J: No. I used auroras to study the Sun and the cycles of solar activity. Scientists knew that the Sun goes through an eleven-year cycle of high and low activity, caused by a reversal of the magnetic poles. But there seemed to be a longer cycle flowing under the shorter one, an 88-year cycle. For about half of that cycle the maxima and minima of solar activity seemed to

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Figure 3. Aurora borealis over Bear Lake in Alaska. From https://it.wikipedia.org/wiki/Aurora_polare.
increase, for the next half, however, they seemed to decrease. But there was no data on the Sun
dating back hundreds of years; this made it hard to verify the existence of an 88-year cycle.

I: How did you prove it?

J: Given the link between the Sun and auroras, I used historical observations of auroras to derive
solar activity at different times in the past. When the Sun was more active, the auroras were bright-
er and farther from the poles. I used this comparison to prove the existence of the 88-year cycle.

I: Do these researches on the Sun have possible applications?

J: Yes. For example, some of my studies have allowed the design of spacecraft that with-
stand geomagnetic storms caused by the solar wind.

I: What did you do after you retired?

J: I studied climate change and, in particular, the influence of the Sun on a climate model
known as ‘Arctic Oscillation’ or ‘NAM’ (North Annular Mode), discovering that periods of low
solar activity coincided with periods of cooling in some parts of the world, as happened in
the past in the so-called ‘Little Ice Age’. In addition, I discovered a link between solar activity
and historical changes in the level of the Rive Nile.

I: A life dedicated to science! But what is science for you?
J: Science is a game. You notice something in nature and wonder “Why does it work like this?”. Maybe you don’t understand it immediately and you start working for months, looking for an answer, collecting data and information. Eventually, maybe you discover something new and say “Wow, it worked!”. It’s a wonderful thing!

I: Thank you, Mrs. Feynman.

J: Thank you

References

risposta, raccogliendo dati e informazioni. Alla fine, magari scopri qualcosa di nuovo e dici “Wow, ha funzionato!”. È una cosa meravigliosa!
I: La ringrazio signor Feynman
J: Grazie a lei

Referenze
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