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Teresa Jiménez*

Whether Chance or Science, Always Chasing Neurons

Despite having begun her career in an era when being a woman scientist was almost impossible, Herminia Pasantes was able to take advantage of the opportunities and voids that presented themselves to be able to slip in among the men of science, using outstanding intelligence and an iron will, with a little help from chance —although she says that she owes it all to chance. She is one of the most highly renowned scientists in Mexico and abroad for her enormous contribution to the molecular study of the brain.

Teresa Jiménez: Is it harder for women to have a career in science?

Herminia Pasantes: The truth is that, yes, it's very hard, and in biomedical research it's even harder because you can't work from home or plan visits to archives or observatories like in other fields. We have to go to the lab every day; so, the challenge for women is different than for men. In my day, it was much, much more difficult because we had to deal with men's suspicions about us: "Let's see how these women are going to do this." We couldn't complain about anything; pregnancies didn't exist: if you were pregnant, you dealt with it as you could. Not even a hint of a word or missing work for half a day; if you had to go out of the building to vomit, you did it with all due discretion. I think this has changed, but not completely. The overall society doing research thinks that women are bad investments because you're going to get married, you're going to have children, you're going to be distracted.

TJ: Was it hard for you to be a woman?

HP: Actually, no, because, since I've always been lucky, I've had it good being a woman. I did my master's after I was already married, and when I finished my master's, my daughter was born. And when I wanted to sign up for the

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doctoral program in the graduate division of biochemistry in the School of Chemistry, one of the professors said to me, directly, "You can't sign up for the doctoral program because your daughter was just born," and he didn't accept me. Of course, if that had been today, it would've been a huge scandal. But at that time, he was very powerful and had created, together with the other researchers, the biochemistry graduate program. He said something to me that, with time, I tend to think is right. He said it inappropriately: "Doctorates and motherhood are incompatible." It's not completely true, but it is true that when children are very small, the mother's mind biologically puts the child as her first priority. So, I didn't sign up for the doctoral program, but I continued working half time in the lab. That's something I always tell young women researchers, that biology is in charge and at that stage, when children are small, very probably they'll experience a certain delay in their research and they have to assimilate that. They shouldn't feel guilty about it because later what has been lost will be recovered in spades.

TJ: Why do you say everything has been luck?
HP: Because, since I couldn't do my doctorate in Mexico, I went to Strasbourg to do it together with my husband and my two children. And that's another thing: the most important thing for young women researchers, particularly in their first stages, is who their partner is going to be. That's fundamental. It has to be someone who understands and respects a woman's individual development as a person and who is proud of her work. That was my case: it was wonderful and I had absolute support.

Besides being an extraordinary personal and family experience, I also found there the topic that was going to be my life's work. So, I have to thank that saintly man who denied me entrance into the doctoral program in Mexico.

From then on, being a woman has brought me nothing but advantages because I became part of the dynamic in which councils and editorial boards had to have women on them; otherwise they weren't well thought of. And on international councils, I had a dual advantage: being a woman and being from an emerging country. So, all the international councils you can imagine called me.

TJ: But your case was an exception, wasn't it?
HP: Yes, my case was exceptional for the time because they hadn't accepted me in the doctoral program, because there had to be women on the councils, and for other reasons. I want to tell young women today that even though, of course, there are difficulties, you can have a successful career that's compatible with a family life. My granddaughter wrote on Instagram that on Women's Day she wanted to celebrate her grandmother, who had taught her the two most important things in her life: to read and that gender wasn't an obstacle for personal development.

TJ: The doctor who performed your medical exam to get into the UNAM said to you, "Why don't you get married instead and forget about studying." What happened to Herminia Pasantes from that time until 2001, when you were awarded the National Prize for Arts and Sciences?
HP: I told that doctor what my mother had said to my father: "With those glasses," —because my eyeglasses, at that time the Coke-bottle variety, have been fundamental characters in my life—, "the girl will never marry. It's better if she studies." And the doctor thought that because I didn't have good eyesight, I wouldn't be able to analyze samples in the lab, to which I responded, "My mother says that because of my glasses, I won't get married and you say that because of my glasses, I can't study." So, the doctor didn't say anything, but he signed my health certificate. I've always been very competitive, and since my mother said I wasn't going to get married and wasn't going to have a boyfriend, you should have seen the number of boyfriends I had! And, as for studying, I had no problem going to the university, because at that time, lots of parents wouldn't let their daughters study. The university was extraordinary because, in high school, I was the strange girl, while my female classmates were cheerleaders and knew all the American songs, I listened to Brahms, Shubert, and had read everything. And I was burdened with being called strange, but then I got to the university, and, above all, among the mathematicians and physicists, I found many strange people like me. Then I went on to study my master's and doctorate and fortunately, I found

a very original topic in Strasbourg, which projected me as a leader in the field very quickly, and I didn't lose that until I decided that it was all going downhill and I didn't want to go further down. This is how far I've gotten and that's that. I would define myself as a vital, competitive woman.

TJ: What have the decisive moments in your research been?
HP: Well, first, having found the famous taurine in Strasbourg, which I spent a lot of time on. Yet again, chance: The Neurochemistry Center, which was the only neurochemical institute in the world, had been given a donation to study the retina. So, the director of the institute, who was also my thesis advisor, said, "Why don't you study the amino acids in the retina?" Well, so, I worked with chicken retinas and I noticed that the chromatograph showed an enormous concentration of taurine. And then I extrapolated that experiment to humans. The papers I published at that time got people to pay attention to this molecule, and for several years, other researchers and I were looking for what taurine did in the human body. It was in the heart, in the brain, in all the cells. So, what does it do? Because, its not one of the proteins; it has no other function than to make bile, taurocholic acid, but what was it doing in the retina or the heart? We spent several years studying this, until one day it occurred to me that it might function as osmolytes, that is, to move liquid inside and outside the cell to prevent it from swelling or shrinking. And the day that I did the experiment about that and when Nature's response was "yes," that was one of the greatest moments of my scientific career, perhaps the most important, because after all those years of trying to find out what it could be there for, all the pieces of the puzzle fit together. It's needed to create a highly concentrated osmolyte that doesn't change the cell's metabolism if it enters or exits the cell. It was the ideal osmolyte, and it's still considered the ideal osmolyte.

Then I did other things: I began to see that the regulation of the volume of neurons and astrocytes in the brain, of the nervous cells, was unknown. And I started studying the regulation of volume and why cells swelled and what happens when the brain's cells swell and push against the cranium, and the brain is covered in all the arteries that take in oxygen and nutrients. If the arteries burst when they push up against the cranium, it causes anoxia and the neurons are incredibly sensitive to the lack of oxygen, and they die. I dedicated a large part of my life to this problem also. These have been very interesting topics that allowed me to play a leading role internationally.

TJ: What is the importance of the neurosciences?
HP: The advances in neurosciences has been absolutely spectacular. You have, for example, the project of the human connectome, or how neurons are connected. I'm a materialist, a reductionist, and I believe without any doubt that everything we do, what we imagine, what we think, what we create, what we feel, is all in the brain. And everything is a result of the connection among the neurons. So, now that the connections are being understood, we'll be able to understand many other things, and in addition, something we knew intuitively has now been demonstrated: no two brains are alike because each person has received different stimuli from his or her surroundings and those are incorporated into the brain. We're born with a piece of hardware, which is how the neurons are connected during development, but even inside the mother, before birth, the brain is already receiving stimuli. That is, "little software programs" that have an impact on how the brain is organized. That's why even identical twins who have the same DNA are different. Their hardware may be the same, the color of their eyes, their sex, but not their personality, because they received different stimuli inside the mother: one was exposed to more light, one received a little more blood through the placenta, etc. All this changes the latticework of the brain. The neuronal connectivity studies being done in the world are very difficult, but they're getting extraordinary results. We're talking about the possibility of having a cerebral print, just like a fingerprint.

Besides that, the neurosciences are having an impact on many other disciplines: economics, philosophy, linguistics. If you consider that the brain is the center of everything, if you review the great philosophers of the twenty-first century, you'll find that many of them do neuroscience. They study what the brain thinks and how

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it thinks, how society is organized and how the thinking that originates in the brain impacts society. And that's how they create their philosophical theories.

TJ: We're all immersed in a specific social and political context. How do you relate to that context?
HP: The advance of technology is extraordinary, but there are issues of neuro-ethics, such as genetic editing, that concern me greatly. With CRISPR Cas9 genetic technology, you can edit genes.[1] It's a very simple technique: you build a ribonucleic acid or RNA molecule and join it to an enzyme that's like a pair of scissors. Then the DNA is joined to the RNA and the short blade of the scissors, because RNA is complementary to DNA. And then you have two options: you either join the pieces of DNA that were cut and that DNA no longer exists, or you add other genetic information, whatever kind you want. The temptation for eugenics is enormous. Why not have stronger human beings? More intelligent human beings, more resistant to diseases? This concerns me enormously and the neurosciences also concern me because we can develop techniques that, with a chip, would be capable of reading our thoughts. And that would put an end to our greatest freedom, because up until now, I can be looking at you and think whatever I want and neither you nor anybody else will know.

TJ: You've also dedicated a great deal of time to dissemination of knowledge.
HP: It's extraordinary to be able to spread knowledge. The brain is so beautiful, and there are so many lovely things to tell about it, that it's a very satisfactory delight to do so. Since I'm in the Seminar of Mexican Culture, where science is also considered culture, a group of us scientists go out to small cities to talk about science. I tell people about what happens in the brain. Some of the topics I talk to them about are the ages of the brain; love and mirror neurons; drugs and addictions; freedom; and depression, among many others. When I talk about depression being a disease, for example, and that you can eliminate it with anti-depressants, it's something that in some cities is well known and accepted. But in some towns and small cities, not so much. So, I think it's very important to disseminate knowledge, and create awareness among people about the importance of scientific work. That's my most important work now, together with teaching. Besides these talks, I'm writing a couple of books, besides the ones I've already published.[2]

Young researchers have a hard time of it because the field of science is very competitive, and in addition, in Mexico we lack resources. That's why I don't think we should also ask them to be disseminators of science; that should be done by professionals of dissemination, who can be an interface between society and both women and men researchers. YM

Notes

1 In 2020, French microbiologist and biochemist Emmanuelle Charpentier and U.S. American biochemist Jennifer Doudna were awarded the Nobel Prize for Chemistry for developing this genetic editing technology. [Editor's Note.]
2 *De neuronas, emociones y motivaciones* (About Neurons, Emotions, and Motivations) was published by the Fondo de Cultura Económica twenty years ago, and four years ago we did a second edition because by that time it was super obsolete. A book jointly authored by the UNAM and the Seminar of Mexican Culture is about to come out, titled *Vida y muerte del cerebro* (Life and Death of the Brain). And I have another that I like a lot: it's for children, called *Mi cerebro y yo* (My Brain and I). It's fully designed now and will be published by the Seminar of Mexican Culture.

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