Course Name: I think Biology

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W1L5_A Tale of Forgotten Scientists - Part I

Hello everyone, and welcome back to NPTEL course, I Think Biology. My name is Prachi Gupta and I am a postdoctoral fellow at Azim Premji University. So this course that you are taking is called I Think Biology. And in the previous sessions, you have already explored what is biology? We say that biology is the study of life, but what does it even mean to be alive in biological context? And you also explored the pillars of biology.

Other than that, you also learned a very interesting metaphor, with city being treated as an organism. How cool is that? So we have such cool things planned for you throughout this course. And you also learned, what is the scientific process that goes behind a scientific discovery. So what do even biologists do? They are like the nature's detective, from decoding the language of DNA to embark on expeditions to study ecosystems.

Biologists, they study life at different levels. So before you move on to learning different topics in this course, I would like to introduce you to two lesser known biologists who have made significant contributions to science. So you will learn about these two biologists and their scientific journey. Some of you might recognize their names, but some of you might be introduced to them for the very first time. These two prominent scientists, these two prominent biologists, they have made significant contributions for humankind.

And yet, most of our textbooks, they fail to mention them. So let's learn more about these scientists. So before I move on to telling you about the scientist, let's start with this picture of a sugarcane. So I'm pretty sure you all must have had sugarcane at some point of your life. If not directly, then you must have had sugar in the form of maybe cakes or the cookies or sweets that you all love.

So you might have had sugar in one form or the other. And we, as we know, this sugar comes from sugarcane, the table sugar that we eat in our everyday life, it is produced from sugarcane.

And on the right hand side, you have the picture of the Silent Valley National Park, which is home to rare species of flora and fauna. What is the link that connects them both? So before you say that maybe sugarcane is grown in Silent Valley National Park, let me stop you right there. That's not right.

What is the other link you can think of that connects these two? So if you don't know, then there is, let me tell you what connects these two, there is this person, there is a scientist behind these two. So this scientist, she made the sugarcane sweeter for us as we know it today. And this scientist is also responsible in contributing to save Silent Valley from a hydroelectric project.

So who is the scientist that I'm talking about? Can you guess the name of the scientist? If not, let me introduce you to this scientist. I'm talking about Dr. Janaki Ammal . He was the botanist, conservationist ,who broke through the barriers of gender, caste and colonialism. This is the picture of Janaki Ammal. But who was she? Who was Janaki Ammal? She was a renowned Botanist and plant cytologist who made significant contributions to genetics, evolution, phytogeography, ethnobotany. So let's embark on this journey to learn more about her life and her scientific contributions.

So in November 1897, a girl child was born in Tellicherry to the EK family. She was the 10th child of this family. And they belong to a middle class and lower caste family. So Janaki Ammal's father was Kakat Krishnan and mother was Devaki Amma. Her father was a Sub-judge at Madras presidency and he was an avid naturalist.

He himself published two books on birds in North Malabar and he also maintained a lovely home garden. So you can see this love towards the natural world. It was sowed in the mind of Janaki Ammal from a very young age. From the very early childhood, she was exposed to the natural sciences. And her father was also the person who encouraged his kids to study.

She was doing well in her studies and she chose education over matrimony. So just remember, we are talking about 1915. It's almost one century earlier we are talking about this time. And she walked on the path of literacy when in India, there were less than 1% of women who, who were enrolled in classes above 10th grade. So the literacy rate for women was very, very low at that time.

As you can imagine, it was pre-Independence era, it was 1900's. So the girls mostly were married off at a very young age. At that time, she had the courage to choose education over marriage. So her decision was not a very usual one at that time. So she did her intermediate course from Queen Mary's College, Madras. And then she went on to pursue honors in Botany from Presidency college. After getting honors in Botany, she taught at Women's Christian College for some time. So even at that time, she wanted to be a Scientist. And it was an unusual decision at that time. First of all, as I already told you, there was very less percentage of women

who decided to study or who chose the path to study.

And for those who usually chose the path to study, their career options were either in Medicine or Nursing or social reformer. But she was determined to become a scientist rather than to study medicine. After her honors and her teaching in Christian College, she won the prestigious Barber Scholarship to study masters in Botany in University of Michigan.

So there is a very small interesting story during that period also. So when she went to America, she was detained in Ellis Island upon arrival. That was because of some immigration issues or some immigration approval. But due to her long, dark hair and her traditional dresses of Indian silk, she was mistaken as an Indian princess and she was led through. She finally landed in America, in University of Michigan, and she did her masters in Botany from there. During that period, she learned plant cytology and she specialized in breeding interspecific and inter-generic hybrids. She joined to study natural sciences and she was inspired by H. H. Bartlett, a renowned Botanist at the University of Michigan. Bartlett's adventurous spirit and pioneering work in plant genetics inspired her to pursue this course. So after her master, she came back to India and she started teaching at Women's Christian College. So at that time in Madras, there was hardly any staff or any educators in the department of Zoology or Botany who were familiar with the fields of cytology or genetics. They were mostly classical taxonomists.

But Janaki Ammal, she introduced the ideas of Mendel and Darwin in her lectures. Along with teaching, she was also collecting the *Nicandra physalodes* for her doctoral research. So she wanted to pursue PhD and she was finally awarded a Barber fellowship in 1928, to go back to University of Michigan and continue or pursue her doctoral studies. Finally, she went back to University in Michigan and she worked on the chromosome studies of *Nicandra physolades*. She worked under the supervision of Dr. Bradley Moore Davis. As you know that chromosomes are present inside the nucleus, they are like the thread-like structures which are present inside the nucleus. So she mastered cytological techniques for her research and she learned about fixation, staining, smear preparation which allowed her to observe the entire cells during meiosis. She experimented with various fixatives and staining methods to achieve their test results. So to study this Nicandra, she obtained the seeds from two races. One she chose was the was an Indian race, Immaculata and other was American race, Typica.

So she collected seeds from different sources and it included Wayanad in India and Tennessee in USA. The results of her research, they showed that Nicandra has a haploid chromosome number of 10 and as you know as I mentioned that she studied Indian and American race of Nicandra and they did not show any cytological differences. One of the interesting results of her research was, she demonstrated Parasynaptic pairing of chromosomes, which means that chromosomes they conjugate side by side during meiosis. So before that the idea that was prevalent was that there is end to end pairing of chromosomes. She debunked that theory and she was finally awarded doctorate in 1931 and so you know that she was the first Indian woman

to receive a doctorate in Botany from America.

So she was the first Indian woman to receive a PhD in Botany. Finally after her PhD, she returned to India and she did multiple jobs, I mean she continued to do different jobs after that. She was a research fellow at Presidency college in Madras, then she was a professor of natural sciences in Maharaja college of sciences and after that she joined sugarcane breeding station as sugarcane cytologist, that was in 1934 when she joined Imperial sugarcane institute in Coimbatore.

So at that time the variety that we had of sugarcane, it was not as sweet as we were importing. So at that time we were importing *Saccharum officinarum*, which is a sugarcane variety from island of Java from Southeast Asia. So the variety that we had in India was not as sweet as this particular variety that we were importing. This institute was trying to, you know increase the India's native sugarcane crop. So we needed to have a crop which was sweeter than this variety or at least equivalent to the sweet of this variety.

So for that sugarcane institute they employed Janaki Ammal to do some to do cytological research on sugarcane. So she crossed, so after joining this institute she crossed dozens of plants to determine which Saccharum hybrids yield higher sugarcane content. She identified native plant varieties to crossbred with Saccharum so that it is better suited to Indian tropical conditions. She developed various hybrids such as *Saccharum zea, Saccharum imperata, Saccharum sorghum*. So this finally reduced our dependency on the Indonesian import and it also promoted India's sugarcane self-sufficiency.

Apart from that, apart from making the sugarcane sweet as we know it, her research also helped in analyzing the geographical distribution of sugarcane across India and she also helped to establish that *Saccharum spontianum* the variety of sugarcane it had originated in India. After that, after her research on sugarcane she started she moved to England and she started working at John Innes Institute in 1940. She co-authored chromosome atlas of cultivated plants with Cyril Darlington. This was a pioneering work. This was a work on breeding and evolution of plants and they recorded the chromosome number of about 10,000 plant species.

This book it was like a Bible to cytogeneticists and horticulturists. Even now, even today this it is still an important book for plant scientists. After John Innes Institute she moved to Royal Horticultural Society in Wisley, England and she joined there as a cytologist. At that time, just imagine in 1946 she was the first woman, first salaried woman which will who was employed in the society.

So just take a moment and think about it. So in this society her focus was on the botanical uses of Colchicine. So colchicine if you do not know, let me tell you it is a compound which is widely

used in plant breeding for inducing polyploidy in plants. So it basically means you can double the plant chromosome number and this helps in having larger plants and more robust plants with thicker stem, bigger leaves or larger flowers, fruits and seeds. So her area of research in that institute was basically to use Colchicine to double chromosome number in different varieties or different types of plants. So in that institute she also developed a Magnolia hybrid which was eventually named after her.

It was called *Magnolia Cobus Janaki Ammal*. India had gained Independence in 1947 as you all know. So post independence the then Prime Minister of India Pandit Jawaharlal Nehru, he requested Janaki Ammal to come back to India and be director of agriculture. So at that time there was a determination to develop botanical foundation of Indian agriculture. It was especially after the series of famines that had hit India like the Bengal famine of 1943. So after that the focus was on to improving India's agriculture.

Hence there was the request to Janaki Ammal to come back to India and join as director. In 1954, Jawaharlal Nehru made her the director of Central Botanical laboratory in Lucknow. And finally she was the special duty officer to Botanical survey of India. However, even returning back to India it was not easy and she was offered these jobs but it was not easy even then, because she had to fight bureaucracy and India was still under the effect of colonialism. So BSI was first originally established in 1890 and it was established under the supervision of Britain's Kew Gardens.

So when Janaki joined BSI after independence she wanted to manage BSI by Indian scientist and kept for India. Her aim was to ensure that modern systematic research on Indian flora can be revitalized and it will be free of any colonial influence. But it was not that easy. Despite her qualifications government appointed a European person as director of BSI. So colonialism was still plaguing the bureaucratic systems of India.

So the plants collected in India were still studied by foreign scientists. Even today the largest collection of indigenous plant specimens, it is housed in Kew and Natural History Museum. So even after independence her journey was not easy. During all this period, during her research she was also not satisfied with some of the government plans.

At this point her work it took a different turn. So just think about it. She was a plant cytologist. She spent decades to apply her skills to improving the commercial use of plants, but then she also moved to use her influence to preserve indigenous plants under threat. So at that time, government wanted to introduce a hydroelectric project in the Silent Valley Forest. So this project was supposed to flood all the Silent Valley area.

So at that time, she joined the protesters and activists. She used her influence to establish a

voice in Indian sciences, to help save the Silent Valley. She raised her voice to environmental movement called Save Silent Valley. She even wrote to Darlington, that I have made up my mind to take a chromosome survey of the forest trees of Silent Valley, which is about to be made into a lake by letting in the waters of the river Kunti. She was very distressed with this project, where she wanted to save Silent Valley and she was one of the prominent voices which helped or which was a part of this movement to save Silent Valley.

So finally government abandoned this project and the forest was finally declared a National park in November 15th, 1984. Unfortunately Ammal was no longer with us to see this victory. She had died nine months earlier. She had died on 7th February 1984 and she was 87 years old at that time. So this lecture was to give you a glimpse in the Janaki Ammal's life, a woman who spent her life in the pursuit of science.

You can read this biography by Savithri Preetha Nair. It is called Chromosome Woman, Nomad Scientist E.K. Janaki Ammal, a life. I would also like to acknowledge that for this lecture most of the material and most of the images that I have taken is from this particular book. So I would urge you to go and read this book which is very interesting and you will learn a lot more about Janaki Ammal's life.

Janaki Ammal also believed that it is through her work that she should be remembered. So I hope you enjoyed learning about Janaki Ammal. She was this prominent scientist and maybe the next time you have your sugar or your cakes and dessert you will remember that Janaki Ammal was the person who made sugarcane sweet. So I hope you liked this lecture. In the next lecture we will be talking about another prominent scientist who is again lesser known in scientific community or to humankind.

So I hope you enjoyed learning about her. See you next time. Thank you.