THE MOTHER OF MODERN BOTANY IN INDIA
A BIOGRAPHICAL JOURNEY OF

DR. EDAVALATH KAKKAT JANAKI-AMMAL

vibha
विज्ञान भारती

VIDYARTHI VIGYAN MANTHAN 2019-20
INDIA'S LARGEST SCIENCE TALENT

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PREFACE

This book is a result of information from several accounts of materials from letters of correspondences of Dr Janaki with her colleagues, details provided by family members and published scientific literature. This book also has benefited by the research work performed by my mother Nirmala James who is an author of the recent book published in Malayalam language on the life of E K Janaki Ammal, the book is titled - *E K Janaki Ammal; Aadya Indian Sasya Sasthranjha* (E K Janaki Ammal; First Indian Botanist).

There are six chapters in this book, that summarizes the life and contribution of E K Janaki Ammal, who can be considered as the mother of the modern botany in India. She gave direction to the Botanical Survey of India and has contributed significantly to the development of scientific research in plant biology. The aim of this book is to give an insight into the life of this great Indian scientist and introduce her contributions, and life situations to be inspirational to the future generations. I hope that you find this book useful to celebrate the life and work of Dr Janaki.

- A. P. James

PREFACE

India has a rich heritage of Science and Technology. Whether it is the invention of Zero long ago or launching of more than 100 satellites in space in the modern era our Scientists have done it successfully. Unfortunately, our glorious past has been long forgotten. Vijnana Bharati, through Vidyarthi Vigyan Manthan (VVM), is trying to inculcate the feeling of national pride, about our Scientific and Technological past, in the future citizens of India.

The objective of Vidyarthi Vigyan Manthan is not just to hunt for the science talent amongst the young minds, but also to develop and nurture the scientific temperament in the younger generation. VVM aims at doing so by making the students aware about the lives and achievements of scientists of Indian origin, who have mostly stayed and worked in India. We hope that reading about these scientists will inspire the young minds and focus their attention towards their motherland and the achievements of the sons and daughters of the country.

This year, we have focused on two scientists who were born and brought up in pre-independent India in poor families and did their studies and most of their work in India. Through this write-up we intend to make the readers go through the ups and downs and various obstacles they had to scale to achieve the great heights in their carrier. Reading about their lives makes us realize that when there is a strong will to succeed and passion for your chosen goal, no adversity can ever stop you.

Team VVM

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CHAPTER – 1

Childhood from India to Higher Education in USA

India has produced several top scientists in the last two centuries, and during this era, science went through a revolution of change from the discovery of quantum physics to artificial intelligence. Our understanding of the world before and after the 19th century has substantially changed. The scientific world during this time faced turbulence and reforms of social changes from two world wars to the recognition of equal rights laws for all, the reforms of change were inevitable and significant.

The early 19th century was a time when the science blossomed through thought-provoking and challenging questions, driven by the mighty endeavors of physicists and mathematicians in understanding the fundamental laws of the universe. Likewise, it was also an era that saw many changes in the way we place our modern thinking about biology and the origins of life.

Born in 1897 at Tellichery, a small town in Kerala, India, Dr. E. K. Janaki Ammal was one of the greatest Indian Botanist of the 19th century who revolutionized the understanding of cytogenetics which is a sub-field of study in botany. She dedicated her entire life for science, questioning and developing the field of botany to immensely understand the cellular mechanisms of plants. Botany is a sub-field of biology that specializes in the science of plant life. It's also widely known as plant science(s), plant biology or phytology. The several advancements in agriculture having new breeds of high yielding crops are a result of the scientific discoveries in this field.

Historically from the genetic studies, people in India is known to be from one of the oldest civilizations, with a highly divergent mixture of human population with mixing of Ancient South Indians, Ancient North Indians, Central Asians, Middle Easterners, Caucasians and Europeans. As such almost every Indian today is mixed in one way or other through their ancestral gene pool. E.K. Janaki-Ammal's ancestral history was also not very different.

E.K. Janaki-Ammal was born into a well-respected family, where her father Dewan Behadur Edavalath Kakkat Krishnan was a sub-judge in Madras Presidency. Her mother was Devi Kuruvayi, who was the daughter of John Child Hannyngton and Kunji Kuruvayi. She had seven brothers and five sisters. It is important to recognize that education for women at that time were limited to women both in India and in the west. And India was still under the British rules

and laws, and Tellicherry was within the Madras Presidency, having limited opportunities for studies.

Dewan Behadur Edavalath Kakkat Krishnan (Janaki's father)

To understand the journey of scientific life, it's also essential to understand the grooming of the individuals in the then social, economic, and educational fabric of the society. Kerala, in the early 19th century, was divided into three major region - Malabar, Cochin, and Travancore. The Malabar region was governed by the British Madras presidency, while Cochin and Travancore were princely states. The education to individuals was institutionalized and was only limited to the privileged. Most people in Kerala by the early 19th century was illiterate and were devoid of universal education opportunities. This was one of the worst periods in the history of Kerala on the fronts of education.

The Malabar District was formed on May 21, 1800 and was managed by the collector appointed by the Madras presidency. The developmental progress in western education under the Madras presidency was much slower than Cochin and Travancore. The government paid very little attention to primary education till 1920, and the literacy levels among Muslims in Malabar in 1930 was only 0.55 percentage, while that of the lower caste Cherumans about 0.01 percentage.

Basel German Evangelical - a Christian mission founded by Dr. Herman Gundert was the pioneer of western education in North Malabar. As part of the Basel Mission program to bring education for all, he started the English Free School at Thalasseri in 1839. After this, Malayalam school at Illikunnu in May 1839, and Kathirur in 1840 another school with a request from Tiya Community. The schools provided education for both boys and girls and cut across religion and castes. The Basel mission officially started its activities in 1847 starting primary school at Kallai, and later shifted to Calicut raised to high school and further to present Malabar Christian College in 1907.

Dr. Janaki's educational journey began in this context at Sacred Heart Girls' School Thalassery. This school was a girls only school, started in the year 1886, initiated by sisters from the Sacred Heart convent. The school in its early days

worked in a rented place called 'Stella Maries' and a Bungalow next to it. The convent and the school had several sisters who were teachers as well to the school - Sr. Leonora, Bernadette, Constance, Carola, Dosithia, Patricia, Gemma, Odilia, and Aime, Mother Theodosia, Srs. Gertrude, Machtilde, Lelia, Elanor, Fidele, Ethelburga, Marie Jose, Josefa, Elaine and Annette Students of Sacred Heart who joined Apostolic Carmel. The school was upgraded to high school in 1909, and the first cohort of students graduated in 1911.

In the Malabar region, there was, and still, there is a significant presence of the Muslim community. The Muslim community was very much against western education and opposed any reforms imposed on them. While, in Cochin and Travancore princely states, the majority was Christian and Hindu who was more in support for western education, which was propagated by Christian missionaries. This also attributed to the low literacy rates in the Malabar region in comparison with Cochin and Travancore states.

This was a period of the long sort after the reform in the Malabar under the Madras presidency. The concern over education was raised much earlier in as recorded by minutes, Sir Thomas Nunro on 25th June 1822:

"*Much has been written, both in England and in this country, about the ignorance of the people of India, and the means of disseminating knowledge among them, but the opinions upon this subject are the mere conjectures of individuals, unsupported by any authentic documents, and differing so widely from each other, as to be entitled to very little attention. Our power in this country, and the nature of its own municipal institutions, have certainly rendered it practicable to collect materials from which a judgment might be formed of the state of the mental cultivation of the people. We have made geographical and agricultural surveys of our provinces ; we have investigated their resources; and endeavoured to ascertain their population; but little or nothing has been done to learn the state of education.*"

The effort on Sir Thomas was genuine to the degree that he commanded a survey on the state of education from Collectors in the Madras presidency, following the principle of "non-interference" and to promote education with the support of the people. Following this, the survey concluded the presence of 12,498 schools containing 188,650 scholars, with 184,110 males and 4,540 females. Out of the 12,498 institutions, 740 were Colleges. Note that these were traditional schools mostly Vedic patasalas, which were very far from the western schools of thought the world is used to now. The entire population in the Presidency was 12,850,941, and from the 188,650 scholars, 13,561 were Mohammadans, 42,502 Brahmins, 19,669 Vyasees, 85,400 Sudras, and 27,518 as belonging to other castes, indicating the disproportionate positive bias towards Brahmins, who were

only 1/20th of the population at that time. The progress in the western world, science, and technology, meant the value of education was inclined towards skill development. These Vedic patasalas were seen as of no practical value to the Madras presidency.

Sir Thomas was conscious driven in his reformist approach to education seeing the poverty and what colonisation had done to deprivement of local industries, replacing the local goods with European ones. He identifies a lack of encouragement for education and poverty as main factors for the poor state of affairs in educational reforms. His views later led to the formation of a committee of public instruction, which was later termed as Board of Public Instruction, who were responsible to bring educational reforms in Madras Presidency. The first step taken by the board was to create a school to train the teachers, who could then later be appointed in schools across the Presidency. This translated to Madras High School and later to Presidency College. The role of the college was to train teachers, starting with 40 students a year, who once trained will serve in the concerned districts. In the early days, Hindus were taught vernacular languages, Muslims were taught Hindustani, Persian, and Arabic. They were also given the option to learn English and elements of European literature and science.

Having undergone such reforms in the Madras presidency gave way for women to experience higher education. After Dr. Janaki completed her school education, she moved on to Queen Mary's College for completing an undergraduate degree. It was started in 1914 by the British Government as the Madras College For Women. Miss Dorothy de la Hey was instrumental in setting up this college. This was the first women's college in India. The college started as a discussion between Miss Dorothy de la Hey with then-Governor Lord Pentland. The college was renamed to Queen Mary's College in 1917 after the Queen Empress. Many students who studied at Queen Mary's College went on to pursue further studies in the prestigious Madras Presidency College.

Dr. Janaki's next natural step was to go for further studies in Madras Presidency College for completing B.A. honors in 1921. Board of Public Instruction, who were responsible to bring educational reforms in Madras Presidency, was responsible for starting Presidency College with an aim to train teachers to reform the education in Madras Presidency. It's believed that it was at Presidency College that Dr. Janaki found encouragement from the teachers to take up studies on Cytogenetics.

After completing Honor's degree, she went on to teach in Women's Christian College Madras that was started in 1915. She worked as a Botany demonstrator

between the period 1921-1923. Dr. Miss Eleanor McDougall was the principal of the college at that time. While she was working at Women's Christian College Madras, she got the prestigious Barbour scholarship. The Barbour scholarship was started in 1917, for supporting women from Asia for graduate studies at the University of Michigan. This scholarship requires a special mention as it was started by Levi Lewis Barbour. While Barbour traveled to Asia in 1914, he met several women graduates from the University of Michigan who went back to their home countries in Japan and China, contributing substantially to the development and welfare. Barbour scholarship was established to train future women leaders who can bridge the gap between the western and eastern cultures. Between 1917 to 1925, the first 57 scholars came from China, India, and Japan. Dr. Janaki was one among these scholars, who later made several contributions to the development of science in India.

While studying at the University of Michigan, Ann-Arbor she lived in Martha Cook Building, a hostel for girl students. She spends most of her graduate studies, from 1917 until 1931, investigating chromosome studies in plants. Her thesis title was "Chromasome Studies in Nicandra Physaloids", completing the DSc in the year 1931. This began a new journey in her life.

"Janaki Ammal Edavalath Kakkat (pictured here with two fellow Barbour Scholars in 1924) was the first woman in the United States to earn a PhD in Botany" - Source - University of Michigan, Ann-Arbor.

During her DSc days, Dr Janaki worked with Professor Harley Harris Bartlett at the Department of Botany. Professor Harley was a well-regarded scientist and was the president of the Botanical Society of America in 1927. He is commemorated in the name of one genus, *Bartlettina*, and many species, including *Anemia bartlettii*, *Buxus bartlettii*, *Rhipsalis bartlettii*, and *Panicum bartlettii*. Working with Prof Harley, Dr Janaki developed a cross known as "Janaki Brengal", brengal is the Indian name for eggplant.

CHAPTER – 2

Early days of Research Career in India

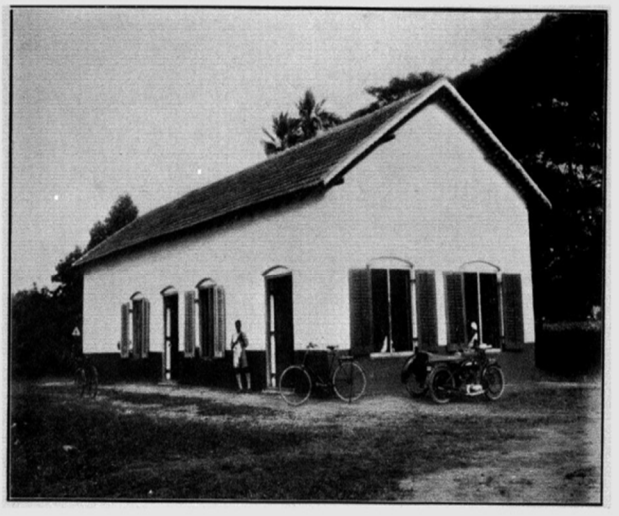
After completing the DSc, Dr. Janaki returned to India. She joined the His Highness Maharaja's College of Science, Trivandrum, as a Professor of Botany. She worked full-time in a temporary position, between the years 1932 to 1934. Maharaja's college was established in 1866 and was one of the oldest institutions in the Travancore region. The college was split into His Highness The Maharaja's College of Science and His Highness The Maharaja's College of Arts in 1924. Unlike the Madras presidency, the Travancore region went to reforms in Education much earlier, and the college was well established by the time Dr. Janaki joined. At that time, the college was affiliated to the University of Madras for the award of B.A. pass course. Later, in 1942 these two colleges were reunited to form the present-day University College which is affiliated to University of Kerala.

The years 1932 to 1934 were the early years of His Highness The Maharaja's College of Science, and the B.A. pass course in Botany was started in 1924. It was during these years that Dr. Janaki got involved in teaching, and possibly helped with getting settled in the scientific life in India. The research facilities in India, during that time, were fragmented and have limited access. Unlike the Western public Universities that were research-focused, the colleges in India were heavily teaching-focused with very little emphasis on research.

The western education and doctoral studies emphasis on quality contributions towards science, and academic careers span across scientific research, teaching and administration. This was not the eastern model of Education at the early 19th century, the scientific rigor was not widespread, and higher Education was seen as a way to help develop the manpower for the British administrative jobs. Being a scientist and teacher were considered two entirely separate tracks of thoughts in university colleges. To an extent, this is a legacy even today in the Indian educational system, with most colleges focusing on teaching rather than an integrated approach of research and Education.

Given that her strong aptitude for research inquiry and discoveries, Dr. Janaki had to move in search of a research position. She took the job as a geneticist in Sugarcane Breeding Institute (SBI), Coimbatore from 1934 to 1939. The British Government established the SBI under the Agriculture department of the Madras Presidency in 1912. The institute focused on the development of hybridization techniques to improve the yield of sugarcane and develop new varieties. Dr. C.A.

Barber is the Founder Director of Sugarcane Breeding Institute which was then known as Sugarcane Research Station. Rao Bahadur Sir Tiruvadi Sambasiva Venkataraman was appointed as assistant to Dr. Barber.



In the first instance, the Imperial Sugarcane Breeding Station at Coimbatore was started only on a temporary basis. This is the small field laboratory—costing Rs. 2,500 in which all laboratory work at the station was done during the first fifteen years. The permanent buildings are now under construction.

During her employment at SBI, she worked closely with Rao Bahadur Sir Tiruvadi Sambasiva Venkataraman (TSV), who was instrumental in developing the Sugarcane varieties in India through different hybridization techniques. His works on intergeneric hybrids of sugarcane and sorghum had inspired Dr. Janaki to develop a sugarcane-maize hybrid. In India, patriarchy was prevalent, and women were not considered equal to men. It is said that on a few occasions that TSV had made attempts to block and in a case ignore the work of Janaki, possibly on accounts of professional jealousy or a patriarchal stance.

In her communication with biologist Reginald Ruggles visit to Coimbatore, she notes her displeasure of TSV and Ruggles. Her work on Saccharum-Zea were faced with brick walls due to the Ruggles visit, were doubts were raised on her work, which delayed her note to Nature to be sent to the Director of Agriculture for necessary permission to publish outside India. She was quite taken aback by the attitude and did not give up, and finally managed to convince TSV the genuineness of the results. The note to Nature was finally published in 1938.

While she was at SBI, she performed studies on cytogenetic analysis of Saccharum spontaneum (or wild sugarcane). Cytogenetics involves the study of chromosomes and related abnormalities. She performed cytogenetic analysis of various intergeneric crosses such as between Saccharum and Zea (i.e. canes and maze), and Saccharum and Sorghum (i.e. canes and grains).

These early efforts in SBI were groundbreaking in recognition of the food sustainability and access for food for all in India. The search was for creating new

varieties of the crops that will help prevent malnutrition. This later led to the development of the SBI as a critical institute in India's post-independence food sustainability story.

Picture of wild sugarcane also known as Kans grass which was the primary focus of Dr Janaki's research in SBI.

Dr. Janaki work's on Saccharum officinarum (sugarcane) involved several interspecific and intergeneric hybrids. The hybrids were done between sugarcane and similar species with genera such as [Bamboo] (bambusa). Her work "Chromosome Numbers in Sugarcane × Bamboo Hybrids" appeared in Nature journal, which is highly regarded publication forum was revolutionary, and established the phylogenetic relationship of the genus Saccharum with other grasses.

During her period in SBI, she published four major papers, two in Nature journals, one in current science, and one in Cytologia. All the works focused on cytogenetic studies on different species of plant. In addition to the work on grasses, she had a keen interest in eggplant originating back from her DSc days which continued on her tenure in His Highness Maharajas College of Science, which is evident from the work titled "Polyploidy in Solanum Melongena Linn" getting published in Cytologia, 1934.

CHAPTER – 3

The world war years and life in UK

Dr. Janaki's career was progressing well in SBI. As part of her research work, she had to travel to Edinburg, the UK to attend the 7th Genetic Conference, which was held on Aug 23-30, 1939. On September 1, 1939, the day after the Genetic Conference ended, the British empire was a global superpower, having direct or indirect control over 25% of the world population. The declaration of war meant to put resources from its colonies, including directing the commercial ships towards the war effort. This meant the colonies were resource stricken in the subsequent years, and traveling overseas was made practically tricky for ordinary citizens. It was a tense period in the world with the start of World War II; the divisions and restrictions were also apparent in the scientific community. The United Kingdom declares war on Nazi Germany at the outset of World War II, creating havoc in the scientific community. Otto Louis Mohr chaired the Genetic conference committee, and due to the world war in a series of letters, several of the Soviet scientists withdrew from the conference and N I Vavilov resigned from being President of the Conference.

J B S Haldane and C D Darlington regarded as some of the leading figures in modern evolutionary synthesis were present during this conference. They both worked at the John Innes Horticultural Institution in London. It is possible that Dr. Janaki had met Dr. Darlington for the first time at this venue. The world war forced Dr. Janaki to stay back in the UK for several more years, where she built a new stage of her career.

She joined as Assistant Cytologist at the John Innes Horticultural Institution in London and worked there between 1940 to 1944. C D Darlington was the director of the institute during this period. Dr. Darlington was an exceptional scientist who invented the "Chromosome." He is termed as "Neuton of cytology" yet his critic's term his works initially as "poison for students."

Darlington himself was not born with a silver spoon, and had several personal struggles from childhood, coming from a less distinguished background. After finishing his degree in Agriculture, he managed to find an unpaid position in John Innes Horticultural Institution in 1923 to work under the famous geneticist William Bastien. It was Batisen who coined the term "genetics" in 1905, and he also founds the genetics society with 34 members in 1916. He passed away in 1926, just three years after Darlington joined the institute.

Darlington rose through the ranks to become the director of the Institute. He was mentored by the sensor colleague J B S Haldane, who encouraged Dr Darlington to pursue theory studies on the then empirically driven field of cytology. He unified the various ideas in generalizing and revolutionizing the field of cytogenetics in his groundbreaking work in the *Recent advances in cytology* (1933). His book "*Recent Advances in Cytology*", published in 1932 created a lot of controversy. He argued for the broader role of chromosome that go beyond the simple mutations and deletions, which we know today that the effects go beyond single genes.

His works were criticized due to the connections he drew between the evolution and chromosomal behavior. In depicting chromosomes as an evolved system, he received severe criticism from mainly American scientist. By the time Janaki met Darlington, he was a world-renowned expert in cytogenetics, having established as a leading authority in evolutionary genetic systems.

British society underwent significant transformation in women's role in the workforce after the world war. The women were given more opportunities; however, the men were almost always considered to take leading roles. Darlington was also not very different in this sense, as he had undermined and downplayed Janaki's contributions on a few accounts. At the same time, they both had an excellent personal and professional relationship, that flourished throughout their lives on various accounts.

During the tenure at the John Innes Institute, she continues to publish and make significant advances in cytology on plant species. Her work on grass "*Sclerostachya fusca*" titled "Chromosome Numbers in *Sclerostachya fusca"* appeared in *Nature* Journal in 1940.

Both Janaki and Darlington had several things in common, apart from the passion for genetics research. In age, Janaki was five years older than Darlington. Their social backgrounds possibly brought them further together to connect the genetics to the society in the later years. They co-authored a book "Chromosome Atlas of Cultivated Plants" in 1945. Bring along the revolutionary ideas of Darlington and groundbreaking findings of Janaki, in creating a Chromosome landscape of Cultivated Plants. This book remains as one of the seminal works and is very well summarized as:

"*The chromosome numbers of some 10, 000 species of the most useful plants, economic, decorative and instructional and of their wild relatives and ancestors have been assembled; it constitutes in effect a world list of the known chromosome numbers of flowering plants. The introduction shows how these discoveries-some original and most published since 1930-reveal*

the origin of cultivated plants and the means that are now available for their improvement. The importance of the chromosome numbers to the systematic botanist is clear from the new classification (undertaken in conjunction with the authorities at Kew Gardens) which has been developed out of them and is now published as the basis of their arrangement. The popular names and economic applications are catalogued and there is a full bibliography. The book will be of service for teaching and research in economic and systematic botany, horticulture and plant breeding."

After the successful tenure at the John Innes Horticultural Institution, she moved to Wisley to take up a position as cytologist at the Royal Horticultural Society from 1946 to 1951. Wisley hosted one of the four significant Gardens of the Royal Horticultural Society in Britain. The research on fruits and vegetables were at the forefront of the Royal Horticultural Society interest. Dr. Janaki's previous works correlated very well with the interest of the Royal Horticultural Society. She further made several critical scientific contributions during this stage.

Her major contributions at Royal Horticultural Society extend to the works on chromosomes studies to trace the understanding of species such as black mulberry, cultivated Narcissi, cultivated Nerines, Philadelphus, Myrtaceae, Kniphofia, and Annonaceae.

It has to be noted that the times were turbulent with World War II putting heaving strains on Britain and its colonies. India was going through the quit-India movement, and while Dr. Janaki tenure in Royal Horticultural Society, India became an independent country in 1947. India was a young country with a rich history and significant social and economic problems. It was no longer the country that Dr. Janaki grew-up knowing.

It can be very well said that Dr. Janaki, by this time, was a well-established researcher. When Darlington proposed to bring out the 2nd edition of the much anticipated "Atlas" book, in a short timeframe, Janaki, however, was not ready to be rushed, and refused to take part in the further writing as she believed that it would affect the quality. This reflected her keen sense of integrity and authority in the area of work.

CHAPTER – 4

Return to India and The Botanical Survey of India

Jawaharlal Nehru was the first prime minister of independent India. He was educated in Trinity College and was one of the leading figures in the independence movement. A lawyer by education, he had seen the eastern and the western education in close. He is considered as the architect of modern India, and a visionary who set up several of the scientific institution in the country post-independence. He wanted all the help he could get to rebuild India and started reaching out for eminent Indians around the world. C.V. Raman, S.S. Bhatnagar, and Meghnad Saha were the stalwarts in India keeping scientific temperament alive, and mainly joining hand with Government to strengthen CSIRO, IISc, BARC, etc.

V.K. Krishna Menon was a close friend of Prime Minister Jawaharlal Nehru and was considered to be one of the most influential people in independent India. Similar to Dr. Janaki, V.K. Krishna Menon also had an illustrious career, not as a scientist but as a politician in Labor party in Britain. He was working as a journalist and as secretary of the India League from 1929 to 1947. Both V.K. Krishna Menon and Dr. Janaki were from Thalassery, Kerala. And interestingly, both of them went to Madras Presidency College. He graduated from Presidency College with a B.A. honors in 1918 and was one year older by age than Dr. Janaki.

J.B.S. Haldane was also a good friend of V.K. Krishna Menon. E.K. Janaki Ammal and Haldane had long-term scientific relation through C.D. Darlington at the John Innes Horticultural Institution. Haldane later moved to India permanently, leaving the job in University College London in 1956 to join Indian Statistical Institute. Janaki and Haldane had several accounts of communications in India, in her effort to bring up scientific rigor and research in Botany in post-independence India.

Prime minister Jawaharlal Nehru's invitation to Dr. Janaki to come back to India should not be seen as a surprise. She was recognized among the best of scientist in the world and was well known among the Indian educational elite. She was one of the leading figures in the area of genetics as applied to fruits, vegetables, and plants. Nehru invited Janaki to reorganize and revive the Botanical Survey of India.

The Botanical Survey of India (BSI) was started in 1890 by the East India Company, and they had created several botanical gardens, following a model

similar to the Royal Horticultural Society. The Botanical Survey of India had made excellent contributions to explore, identify, and document the various plant species in India. After the retirement of C.C. Calder in 1939, the activities were in a quiescent mode of operation till 1953.

As a new country, India was in much need for the inventory of its abundant plant resources, and it was expected that the Botanical Survey of India would provide this for the country. Dr. E.K. Janaki Ammal was appointed in 1952 as a special officer to come up with a reorganization plan. She completed and submitted the reorganization plan to the Government, got it approved in 1954.

The reorganization objectives of BSI was (1) to undertake plant surveys to collect detailed information on the occurrence, distribution, ecology and economic utility of plants, (2) to collect, identify and disseminate information for education and research, and (3) for being the custodian for a well organised herbaria and documentation of plants at local, district, state and national levels.

As India is a large country having a diverse variety of plants, for efficient management, four regions were established: (1) Botanical Survey of India, Southern Circle at Coimbatore on 10 October 1955, (2) Botanical Survey of India, Eastern Circle at Shillong on 1 April 1956, (3) Botanical Survey of India, Western Circle at Pune on 12 December 1955, and (4) Botanical Survey of India, Northern Circle at Dehradun on 1 August 1956.

Dr. Janaki was being swallowed into the Government-led development, where she would take up the administrative role. She moved in 1955 to Lucknow to head the Central botanical laboratory. The Governmental view of building the country included industrialization and developments in all areas of social and economic upliftment.

This development plans of the Government involved a partial disregard to the ethnobotanical knowledge of tribal communities and its preservation. Further, the development focus led to the destruction of forest in the years to come, which Dr. Janaki become increasingly more critic of governmental policies.

In 1955, instead of Dr. Janaki, Rev Fr. Hermenegild Santapau, an old school taxonomist was selected as the director of BSI. The was a major disappointment for Janaki, as she believed that Fr. Hermenegild would not be able to implement the ideas proposed by Janaki to the Government. She felt so bad about it that she took time off by going to Malabar to collect wild yams from the tribes.

Even while Dr. Janaki was invited by the then Prime Minister Jawaharlal Nehru to restructure the BSI, the appointment of Rev Fr. Hermenegild could have been a

reflection of the problem women in science faced. The leadership positions were dominated and held by men, and reflection of the gender ideology in scientific careers.

Dr. Janaki was critical of the administration before 1955 for the systematic decline of the botanical studies. This was attributed to the management by a foreign botanist who moved out most of the research on Indian flora to Europe. This was the result of a culmination of the world wars and the decreasing grip of British in India during the freedom movement.

She was keen on improving the research emphasis on Botanical studies in India, with bringing in collaborations with Indian universities and BSI. The various BSI circles hosted the regional herbarium focusing on the flora within that region. The institutional organization of the BSI had a substantial influence, where she retired from BSI in November 1959.

After this, she was invited by the Council of Scientific and Industrial Research (CSIR) to build new regional laboratories. She directed the Regional Research Laboratory (RRL) in Jammu, where she carried out several research projects and guided number of Ph.D. students, graduating six PhDs.

Dr. Janaki pioneered work in ethnobotany traveling to Nepal and Ladakh. There was no comprehensive study done on this subject and she pioneered developing this are of study. Ethnobotany is a branch of a study looking into the traditional use of plants for medical and other purposes common to the region. In India, much of the use of plants were closely linked to cultural and regional reasons. The prevalence of one plant species over the other is largely reflective of this from one region to another. Given the vast cultural and geographic diversity, compounded with biodiversity made this a popular topic for the botanist to pursue in the years to come.

Although she makes several efforts to bring the research in India to a higher level, she was always disappointed with the research works done in Universities. Her works on ethnobotany revised interested in traditional culture and use of plants. Possibly, this interest she had was from her own ancestral family, who were involved in conventional use of plants, and it was, in fact, a major part of Kerala's ayurvedic traditions.

She and Darlington maintained good working relations, and they communicated the scientific experiments in the '50s to '70s. Darlington had a great interest in cultures and ethnographic details. He had been an advocate for Eugenics, a study for selectively mating people with specific genetic traits to improve human species.

The application of genetics to man as of keen interest to Haldane, R.A. Fisher, and Darlington, and the studies on Eugenics and Genetics at that time was seen inseparable. This was a hugely debated topic in the circles of Haldane and Darlington.

Haldane and Darlington had several disagreements, Haldane supporting the Marxist's and Soviet science, while Darlington where joining the anti-Soviet campaign. Haldane moved to India in 1957, at Indian Statistical Institute denouncing what he thought as the western imperistic views. Haldane ran the *Journal of Genetics*, and maintained a close association with Janaki while in India, inviting her to contribute papers. In her letters to Darlington, she mentions Haldane and his casual approach to meetings. She collaborates with Darlington to provide him with details of tribal communities

Similar to most research-active scientists today, back in her days, networking in science was very important. Unlike the emails today, everything was communicated through letters, which would take days and months to reach. As such science was not hurried - it required patience, and it was slow by today's standards. In addition, being a women scientist, she would not have got a lot of support or forums for the women scientist to interact. The number of women scientists were very few world-wide, and there were not many at the level of Dr Janaki in India.

While scientific progress in Europe was on the rise, the Indian research was in its early years after independence. Most of the well-regarded scientists were busy building institutions and institutional structures, defining and redefining the directions. On several accounts of correspondence of Dr. Janaki with her international peers, it is evident that keeping in pace with terminology, and experienced the changing phases of friendships extending from USA, Europe, UK, and Australia. This had a tremendous influence on the success both as a scientist and a visionary leader.

The high-level networking with some of the best scientists in Botany from a women scientist, especially in a male-dominated scientific world was instead quite uncommon in India. For many who worked with her, the most striking aspect of their memory about Dr. Janaki was her simplistic lifestyle irrespective of the international stature and scientific fame.

Exploring the broader scientific literature, it should also be noted that there were not any women scientist from India who managed to publish their works in the top journals and forums. This sets her apart as a leading role model for women scientists in India.

The last several years after her retirement from CSIR in 1962, she continued to work as an emeritus scientist. She continues to pursue active research even after retirement, publishing several works until her death in 1984.

Even with such contributions in UK and India, she was not given a fellowship from the Royal Society, which is indicative of the male dominance in the scientific societies and decision bodies. She did indicate the displeasure and lack of recognition offered by the then scientific societies that dictated the direction of science in the west. Nonetheless, she managed to outlive those by focusing her life on the search and passion for real science, beyond the fame and recognition which were often are traps, that often kills the real passion of scientific excellence.

CHAPTER – 5

Recognition and Awards

The contribution of Dr. Janaki to Botanical studies in India stands out both as a woman and as a leading international scientist. There has been no comparison for the journey she adhered for from the pre-independence India to post-independence challenges. Not many people have lived through such changes, living across three different continents and even faith holding hands to make things happen.

Her scholarship to USA and her stay in the U.K., whether you call it coincidence or luck favors the dreamers is genuinely nothing but would seem like an act of god. Being board to a mixed background, an outcast by many standards, it would have been a nearly impossible journey only suited for the brave heart. The exposure provided by the early days of her school and college would probably have a lot to do with her strong desire and passion for science. Not many who get into administration can remain a scientist for till the end of their time on the planet.

In her career, she was recognized for her services, an elected fellow of the Indian Academy of Sciences (IAS) in 1935, and Indian National Science Academy in 1957. Sir C V Raman started the Indian Academy of Sciences in 1934, and Dr. Janaki was one of the early members by invitation of Sir CV Raman. The Indian National Science Academy was previously known as National Institute of Science of India (NISI), which was started mainly from the collective effort of Indian Science Congress Association (ISCA) with several governmental bodies and individuals. NISI was modeled to propel scientific research in India similar to the Royal Society in the U.K.

NISI enjoyed support from Government after India's independence and was renamed as Indian National Science Academy (INSA) in February 1970. Dr Janaki remained as an active member of IAS and INSA throughout her life. The Current Science journal started in 1932 is a by-product of the efforts from CV Raman, Birbal Sahni, Meghnad Saha, Martin Foster, and S.S. Bhatnagar. This had stimulated the discussion of science in India. It has to be noted that in 1930, CV Raman was the Nobel Prize winner in Physics "for his work on the scattering of light and for the discovery of the Raman effect" and by 1932 he was at the top of the scientific fame having substantial influence in the development of science in India. Birbal Sahni was paleobotanist who studied fossils in India, Meghnad Saha physicist who is known for Saha ionization equation, Martin Foster a well-known British organic chemist, and S.S. Bhatnagar a physical chemist, all of them were the pioneers in defining the modern scientific discourse of India. This Current Science journal was a primary forum discussing both general science to research

results and was a window into the world of science for the public at large. There have articles about Dr. Janaki in this journal, which is both nostalgic and equally reflective of the era of change in scientific temper and rigor in India.

In 1956, the University of Michigan conferred honorary LL.D. to Dr. Janaki for her contributions to cytogenetics and botany. The highlight of her contributions are mentioned as "Blest with the ability to make painstaking and accurate observations, she and her patient endeavors stand as a model for serious and dedicated scientific workers." She was an alumni that University of Michigan groomed from being a dreamer to a high quality researcher, who benefited tremendously by the Levi Lewis Barbour scholarship, proving Barbour vision as success.

In recognition of her contribution to the John Innes Centre offers Janaki Ammal Scholarships for overseas postgraduate research students from developing countries to study for a Ph.D. program. This scholarship is a testimony of the importance of Dr. Janaki's work in John Innes Centre being one of the early members in the center.

The recognition from the Indian Government came in the form of Padma Shri in 1977. The Padma Shri is the fourth highest civilian honor awarded by the Government of India on the Republic day. The Padma award was started in 1954, with the word "Padma" meaning Lotus and "Shri" honorific equivalent of 'Mr/Ms' in Sanskrit - together meaning 'Noble one in blossom.'

Later in the year 1999, the Government of India from the Ministry of Environment and Forestry honored Dr. Janaki by starting a National Award of Taxonomy in her name. Initially, one Award on Taxonomy covering three fields - Botany, Zoology and study of Microorganisms were presented. Later as of 2019, the scope of this was expanded to (1) E.K. Janaki Ammal National Award on Plant Taxonomy, (2) E.K. Janaki Ammal National Award on Animal Taxonomy, and (3) E.K. Janaki Ammal National Award on Microbial Taxonomy. These awards are considered today as the highest award for scientists working in the field of taxonomy in India.

The importance of these awards cannot be understated based on the degradation of taxonomy research in India. India has a vast biodiversity, and even with that the opportunities in the field were declining and, in a view, to reviving this, for the future of the environmental sustainability, it is essential to develop the biosystematics in India massively. The Government of India recognizes this, while systematically needing to acknowledge the efforts put to fund the research, improve collaboration between the research groups and institutions.

CHAPTER – 6

Interesting facts about her life

One of the most interesting fact that not many people are aware of Dr. Janaki's life is her name. Her original name by birth was Edavalath Kakkat Janaki. She did not have Ammal to her name until when working as a scientist in Sugarcane Institute. Yes, her real name is E.K. Janaki and not E.K. Janaki Ammal.

Then how did it become E.K. Janaki Ammal? In her correspondence with Darlington, she mentions how this becomes. While she was working in Sugarcane Institute, Coimbatore, she was the only woman scientist, and the people used to call Janaki Ammal out of respect. In Tamil, the local language spoken in Coimbatore, Ammal is a respective tone for mother-like. It was at this stage that she officially had it changed to E.K. Janaki Ammal.

It had to be noted that in those days changing a name did not require a lot of formal procedures as today. And the documentation and follow-ups were not that complicated as today. In the official records in school and colleges where she graduated, she is recorded to be E.K. Janaki. Today, it is evident that Ammal is an unusual name to be used for someone from Kerala, while Janaki had been one of the most famous names in Kerala. The origin of the name Janaki comes from the Hindu text "Ramayana," where Janaki is the daughter of King Janak, the wife of Lord Rama, i.e., Janaki is nothing but another name for Sita.

Janaki never married. To make such choice might not have been just tricky, but rather an impossible thing for a woman in those times in a male-dominated society. It is not very clear why she remained to be unmarried. There are, however, various possibilities that led to this. Those days the marriages were done in the early age of 15, and during those times, she wanted to pursue higher studies, which took over for her as a more important choice than getting married. Admission to universities in the USA in those days was restricted to single foreign women or foreign women married to a citizen in the USA. Possibly, her being from the white Tiya community status also made it hard to seek good alliances as there was often an illogical and unwarranted divide between the Tiya communities over their sub-castes. After the demise of her father, the family was in the struggle, and she partly took up the responsibility on her shoulders to support the family in ways she can. Her education made her the independent thinker, from one stage of life to another she remained more focused on her scientific pursuits. From the accounts of the family members, she was always seen to give her wealth and time for her relatives, and everyone close to her in the family enjoyed her company. On

her personal life, there have been some accounts of her emotional involvement with Darlington, however, it was short lived, and she had to take her path that was beyond defining the patriarchal society norms. They maintained a healthy professional relationship throughout their lives. Throughout life, she reflected to be a great mentor, and someone with firm conviction - an iron lady of science.


John Child Hannyngton
(Janaki's Grandfather)

About one fourth of her relatives were from influential British family, many of them whom she did not have much of future connections. Janaki's mother Devi Kuruvayi was born to Kunhi Kurumbi Kuruvayi and John Child Hannyngton. Hannyngton was born in Barrackpore, West Bengal, India, and much of his family stayed in India. Maj. General John Arthur Hannygton was the son of John.

It has to be noted that back in the 18th century, India was part of the British empire. All the citizens of India were in fact the citizens of Britain. In essence, there were several British officers who considered India home, and had never visited Britain in their lifetimes. All of John's kids were born in India - Maj. General John Arthur Hannygton; Patrick Hannyngton; William Onslow Hannyngton; Frank Hannyngton; Agnes Bernice Hannyngton; Devi Kuruvayi and Martha Fewkes.


Devi Kuruvayi
(Janaki's Mother)


Kuruvayi house of Devi Kuruvayi

Her grandmother Kunhi Kurumbi Kuruvayi was a very much a lively character who had three partners in her lifetime. Her partners in her lifetime were an Indian nair (name is not known), John Child Hannyngton and Col Walter Gaven King. They had six kids Devi Kuruvayi; Martha Fewkes; Krishnan King; Kuruvayi Govindan King and Kalyani.

Edavalath Kakkat Krishnan married Devi Kuruvayi who was 23 years younger than EK Krishnan after he becomes a Judge at the age of 42. EK Krishnan had a

first wife Kalyani and with second wife Devi, together they had 15 children, 2 from first wife and 13 from second wife. In addition, Krishnan also supported for 4 children of his first daughter as she became a widow at a young age. Kalyani's son Rao Bahadur E K Govindan grew up as an Agent Governor General of India, and later as Dewan of Pudukottai. Krishnan (1841-1907) entered Government service as English Writer of Civil Court, Thalassery in 1861, Malayalam Translator in Madras High Court in 1864, and Sub Judge in 1883, Deputy Collector of Malabar in 1899, retired in 1901, to become Chairman of the Thalassery Municipality. Probably, a lot of interest that Janaki on the biodiversity came from her father. Krishnan wrote, *Birds of Malabar* and *Birds of Thalassery,* apart from, *Life of Churia Cannan.*

It also interesting to note that Dr Janaki's uncle Frank Hannyngton (1874-1919) was into butterfly research. Frank served as an Assistant Collector in South Arcot and Malabar, and as a Commissioner of Coorg in 1912. He published a paper on the Butterflies in the *Journal of the Bombay Natural History Society*. Further, as Post Master General in Bengal he used collectors to get information on the butterflies in Chumb Valley, where he finds a new species of butterfly. This he sends to Andrey Avinoff, the Russian scientist who named this after Frank as *Parnassius hannyngtoni.*

She traveled to the USA, and the UK. Well, today we have a passport and we do not think much about how it would have been in those days. There was still a passport issued to the Indians, however, as India was part of the British, most of the people residing in India were British citizens by birth. She traveled to these places on a British passport issued by the viceroy of the Empire of India. The passport in those days were handwritten, and often was issued to families, i.e. one passport for the family consisting of father, mother and children.

The stay in the UK was one of the greatest co-incidences of her life. She travels to the conference in Edinburg, UK, for the 7th Genetic Conference which was held on Aug 23-30, 1939, and the day after on September 1, 1939, the war is declared. She is forced to stay back. She also meets up with some of the leading figures in the field such as Darlington, with whom she does some pioneering works.

Perhaps Janaki's best friends for life were cats and kittens. In her various correspondences and letters to friends, she always mentions about them. The kittens were always taken care of irrespective of where she was, and she always adhered kindness and simplicity in life. She used to recognize the differences between them, including often connecting to the genetic traits, and behaviors.

It has to also noted that she was the first woman scientist to be awarded the Padma Shri in 1977, one of the highest civilian honor given by the Government of India.

CHAPTER – 7

Major Scientific Contributions

As the first woman scientist from India in Botany her contributions span from development of cytogenetics to conservation of biodiversity. She was able to manipulate the polyploid cells by cross-breeding of hybrids to develop high yielding strain of the sugarcane that grows in Indian conditions. Various characteristics of this high yielding strain such as the sweetness were a result of her works. Through her works, which was published in journals such as *Nature* she established that the sugarcane variety S. Spontaneum originated in India. This has a profound impact on the usage of sugarcanes in India to this date. She developed several intergeneric hybrids: Saccharum x Zea, Saccharum x Erianthus, Saccharum x Imperata and Saccharum x Sorghum, and spanned a research direction from sugarcanes to Bamboo.

The flower *Magnolia Kobus Janaki Ammal* is named after Dr Janaki. She worked on Magnolia plant in Royal Horticulture Society Wisley garden, and the name of the flower was given in recognition for her work as a cytologist. This is a celebrated flower in Japan and China in their legends, and has fused sepals and petals, which give various genetic basis for study.

One of the biggest contributions came with CD Darlington, who remained Janaki's friend for long, in the form of a book on "Chromosome Atlas of Cultivated Plants" in 1945. The book list 1100 species, with about 1000 of them not having chromosome information. This was the most comprehensive book that listed the chromosome number, along with the cultural and geographical information of the species. This book served as the reference book for environmental scientist and botanist for decades to come.

She was an environmental activist in the later stages of her life in India. He was worried about the biodiversity issues and preservations of the forests. She played a major role in the protest that stood against the plans to setup hydro-power dam in

Kunthipuzha river in Kerala. In 1955, she was the only woman invited to the conference by the Wenner Gren Foundation for Anthropological Research at Princeton.

In her return to India, her focus on polyploidy and evolution of plants led to work in some of the most important works in the genera - Solanum, Datura, Mentha, Cymbopogon and Dioscorea, in addition to several of medicinal plants. She compared the polyploidy effects as a result of climatic conditions in the northeast to northwest Himalayas. She also finds that the natural hybridization was a result of Chinese and Malayan elements in the flora of northeast India. After retirement, the main contributions were in the area of medicinal plants and ethnobotany. Mainly, interacting with the tribal communities in the Himalayas and Western Ghats.

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