



Editorial

Some Asian Women Pioneers of Chemistry and Pharmacy

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Abstract: At present, several countries on the Asian continent are still very closed off to the idea of allowing not only the work of women, but also even the fact that they can study university degrees and, after finishing them, go on to practice their professions. In addition, if we go back to the beginning of the 20th century, this situation was even more serious. However, this was not an impediment for some women from these countries to achieve their goals of pursuing higher education and then serving society with their work. This article is dedicated to showing the biographies of three of them, the Indian chemist Asima Chatterjee and Philippine pharmacists Matilde S. Arquiza and Filomena Francisco. The most relevant features of their personal and professional lives are presented and previous biographies about them are completed. The main objective of this work is to show these figures to society and hold them up as references to other people, and the methodology followed has been the search for data about their lives and work that would allow us to complete the previous existing biographies about them. A brief biography on Janaki Ammal, the first Indian woman to obtain a doctorate, is also included.

Keywords: Asian female chemists; Filipino pharmacist women; Asima Chatterjee; Matilde S. Arquiza; Filomena Francisco



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1. Introduction

There is not much information in the literature about Asian scientist women who have stood out in their fields of research in the first decades of the 20th century; however, there have been some among them, very unknown in wider society, who undoubtedly deserve to have that recognition by virtue of the achievements they made or because of the work they carried out in their professions.

This article is dedicated to showing the biographies of three of these women, one of them born in India, Asima Chatterjee, graduate in chemistry, who has the honor of being the first woman doctor in sciences in that country. The other two women are the Philippine pharmacists Matilde S. Arquiza and Filomena Francisco, of whom very little is known regarding their lives and works, yet who, however, are clearly pioneers of the profession in their countries and contributed to opening the door for the that the rest of the women who graduated in that discipline.

The main objective of the article is to complete the literature with novel data from the authors' own research the biographies already existing in the literature, in order to hold them up as references to society and as an example of women who had to overcome numerous difficulties throughout their lives, mainly barriers related to gender, to be able to achieve what they wanted: to study a university career, scientific in the case of the three, and be able to pursue a career in their studied areas upon completion.

2. Materials and Methods

The methodology followed in the article consisted of searching for information on the figures of the Indian female chemist Asima Chatterjee and of Matilde S. Arquiza and Filomena Francisco, two Filipino women pharmacists, using all kinds of sources, fundamentally primary, in archives and records, both bibliographic and digital, with the aim of highlighting all the relevant aspects of their lives that are not contemplated in the scarce existing previous biographies about them.

3. Results

In this section, we present the biographies of several Asian women, one of them from India and the others from the Philippines, who, despite the scientific achievements they reached in chemistry and pharmacy and the importance of their discoveries, are practically unknown in today's society, partly because of the low visibility that the dissemination of knowledge has had on that continent and partly, and above all, because of the scant regard, if not even contempt, that women's work has been given in most of the member countries.

3.1. Asima Chatterjee—Her Biography

Asima Chatterjee (née Azeema Mukherjee) was born in Kolkata (Bengal, India) on 23 September 1917. She was the eldest of the two children of the marriage that was Dr. Indranarayan Mukherjee and his wife, Kamala Dev [1]. Her younger brother, Sarashi Ranjan Mookerjee, also came to be known as a noteworthy surgeon, and collaborated with Asima Chatterjee in her research on medicinal plants. It was her father's love for botany that piqued Asima Chatterjee's interest in their medicinal properties.

Asima Chatterjee grew up in a middle-class household and spent her childhood in Calcutta, the city where she undertook her first studies, in which she obtained brilliant qualifications in all subjects. However, since she was a child, she felt a great inclination for medicinal plants, influenced by her father, who was passionate about botany, although he had not dedicated himself to it [2].

As a young girl, her parents never restricted Asima Chatterjee from pursuing education. When she finished high school in the early 1930s, and although it was completely unusual in India for a woman to go on to higher education, much less science, she enrolled at the Scottish Church College, University of Calcutta, where she graduated in Organic Chemistry, with honors, in 1936, at the age of 19 [3], also receiving the Basanti Das Gold Medal [1].

After graduating, she decided to continue her university education by enrolling in doctoral studies at the Faculty of Sciences of the University of Calcutta, where she had access to highly notable professors, with whom she related a great deal. Among them, who helped her a lot and greatly influenced her career, were Acharya Prafulla Chandra Ray, Prafulla Chandra Mitter, Pulin Behari Sarkar, Jogendra Chandra Bardhan, Prafulla Kumar Bose, Jnanendra Nath Mukherjee, Satyendra Nath Bose and Priyadarshan Ray.

In 1938, she completed a master's degree in Organic Chemistry at the University of Calcutta and two years later, in association with Mr. Anjan Palit, a well-known personality in chemistry, she was one of the founders of the Department of Chemistry of the "Lady Brabourne College", of the University of Calcutta, of which she was appointed director.

In 1944, she became the first woman to receive a doctorate in science from a university in India, defending her doctoral thesis at the University of Calcutta. Her thesis was on the chemistry of plant products and synthetic organic chemistry [4] and was supervised by the professor with whom she had started her research career, Prafulla Kumar Bose, one of India's pioneering natural product chemists. In those years, and always interested in knowing why certain plants were effective in treating diseases, Asima Chatterjee (Figure 1) immersed herself in the field of phytomedicine. Thus, after extracting and purifying the active chemical products of plants, she characterized them and developed techniques to synthesize them in the laboratory. With large quantities of these compounds, she was able to study their mechanisms of action against diseases such as cancer, epilepsy and malaria.

As a result of her work and research, she received several awards and distinctions: the Calcutta University Silver Medal and Prize and the Jogmaya Devi Gold Medal.



Figure 1. Asima Chatterjee. Source: [5].

In 1945, she married Dr. Baradananda Chatterjee, an eminent physical chemist who became Professor and Head of the Department of Chemistry, Geology and Metallurgy and Deputy Director of the Bengal College of Engineering. Figure 2 shows Asima Chatterjee with her daughter, Julia and her husband.



Figure 2. Asima Chatterjee with her daughter and her husband. Source: [6].

Her husband always exerted a great influence on her, inspiring and stimulating her on the one hand and helping her with some of her domestic tasks on the other, which allowed her to also dedicate herself to science and carry out her work. Thanks to the good work of her husband, the members of the laboratory that he directed considered themselves as a family. He also used to meet with them on Saturday nights and holidays, advising them even on personal problems that they mentioned to him [1]. For her part, she always tried to instill in her only daughter, Julia, who had come very soon to the marriage, the same taste and enthusiasm that she had for organic chemistry. Thanks to those efforts of her mother, Julia, who married Professor Avijit Banerji, also from the Department of Chemistry at the same university—and had a son, Aniruddha Banerji—became Head of the Department of Chemistry at the University of Calcutta.

In the 1947–1948 academic year, Asima Chatterjee began a stay of several years in the United States, where she first worked with Professor Parks, from the University of Wisconsin, on natural glycosides. In 1948–1949, she worked with with Professor Zechmeister, of the California Institute of Technology (Caltech) of Pasadena, in carotenoids and provitamin A (in recognition of that work, she was awarded the Watumull Scholarship). In the 1949–1950 academic year, she worked with Professor P. Karrer of the University of Zürich on biologically active alkaloids. All these studies focused on the chemistry of natural products, allowing her to obtain anticonvulsant drugs, malaria drugs and chemotherapy drugs [1,4].

Returning to India in 1954, Asima Chatterjee (Figure 3) worked at the College of Science, University of Calcutta, as a lecturer in Pure Chemistry. and in 1962 joined the prestigious Khaira Professorship of Chemistry at the University of Calcutta, a position she maintained until 1982 [1].



Figure 3. Asima Chatterjee. Source: [1].

Unfortunately, the year 1967 was very sad for Asima. Firstly, she lost her father, and then her husband four months later. These two tragedies caused her to suffer a severe heart attack in the same Faculty of Sciences of the University of Calcutta, which caused her to be hospitalized in a critical condition, in which she remained for several days. It took her almost three months to recover, although eventually the support and affection of her students, colleagues and staff members in the Department of Chemistry helped her return to normal activities [1]. Figure 4 shows Asima Chatterjee with her students in 1997.



Figure 4. Asima Chatterjee with her students in 1997. Source: [1].

One of Asima Chatterjee's passions was learning about the medicinal properties of native Indian plants. She was a very prolific writer, who published around 400 articles in impact national and international journals [7], and all this despite the great economic difficulties she encountered. One of her doctoral students, S.C. Prakash, remembered that [1]:

“Being one of her first doctoral students, I have witnessed her initial difficulties in establishing himself. Those were tough days for research, particularly in a poorly equipped university, laboratories with inadequate chemicals, and little financial assistance. Institutions like the Department of Science and Technology or the Department of Biotechnology under the government were yet to come and the Council for Scientific and Industrial Research (CSIR) was in the formative stage.”

Throughout her academic life and as a result of her work, Asima Chatterjee obtained many awards and distinctions in recognition of her scientific contributions. Among them, she became a Premchand Roychand Scholar at the University of Calcutta and was the second woman to obtain a doctorate from an Indian University, the University of Calcutta, in 1944 (she was the first woman to obtain a Ph.D. in science in India, but the first woman to obtain a doctorate in any discipline from an Indian university was Edavaleth Kakkath Janaki Ammal (1897–1984), an Indian botanist and cytologist who made important contributions to genetics, evolution, phytogeography and ethnobotany [8]). Further information on her can be checked in Appendix A and also on other Asian pioneer scientific women in Appendix B.

Asima Chatterjee (Figure 5) was also made Khaira Professor of Chemistry, one of the most prestigious chairs at the University of Calcutta, from 1962 to 1982. In 1972, she was appointed Honorary Coordinator of the Special Assistance Program to intensify teaching and studies in natural chemistry, sanctioned by the Commission of Indian University Grants. In 1960, she was elected to the Indian National Science Academy, New Delhi. In 1961, received the Shanti Swarup Bhatnagar in Chemical Science, India's most prestigious science award [6], the first woman to do so (even though the award was first introduced in 1958, but it 'was not until 1960, that the “chemical sciences” category was introduced; Asima Chatterjee won the award for her contribution and achievements in phytomedicine: the study of plant extracts for therapy). It took over 14 years for another woman to win the same prize, and over 48 years for a woman to win it in the “chemical sciences” category [9].

In 1975, she was conferred with the prestigious Padma Bhushan, the third highest civilian award from the Government of India. That same year, precisely recognized as International Women's Year, she was honored by the Bengal Chamber of Commerce as Woman of the Year for her scientific contributions. She also won the S. S. Bhatnagar Award, the C. V. Raman Award and the P. C. Ray Award, all considered highly prestigious. She was also the first woman to be elected General President of the Indian Science Congress Association, a premier institution that oversees scientific research in the country, and was appointed Doctor Honoris Causa by several Universities and nominated by the Presidency of India as a Member of the Rajya Sabha from 1982 to 1990 [1].



Figure 5. Asima Chatterjee, one of the Indian women in science. Source: [10].

Her research, framed in the fields of organic chemistry and phytomedicine, focused on studies on *vinca alkaloids* and the development of drugs obtained from plant extracts for the treatment of epilepsy and malaria (*vinca alkaloids*, originally derived from "*Catharanthus roseus*", are antimicrotubule and mitotic inhibitor drugs that block cell growth by preventing mitosis; therefore, they are used in cancer treatment [1]. Some of these alkaloids are efficiently used during chemotherapy to prevent the multiplication of cells in cancer patients. These patented drugs have been widely marketed by several companies.

Asima Chatterjee (Figure 6) also chemically analyzed *coumarins*, which came from the bael tree, a native species in India. It was she who brought to light that the fruits and bark of this tree could treat a variety of gastrointestinal disorders.

She was also the author of a considerable volume of texts, around 400 articles and books, on medicinal plants of the Indian subcontinent. At the request of Professor Satyendra Nath Bose, FRS, she wrote "Sarai Madhyamic Rasayan", a book in Bengali on Chemistry for high school students, which was published by Bangiya Bijan Parishad, an Institute for the Popularization of Science founded by Professor Satyendra Nath Bose. According to the Indian Academy of Sciences, Asima Chatterjee [2]: "(. . .) successfully developed the antiepileptic drug, Ayush-56 from *Marsilia minuta* and the antimalarial drug from *Alstonia scholaris*, *Swrertia chirata*, *Picrorhiza kurroa* and *Cesalpinna crista*".



Figure 6. Asima Chatterjee, giving a lecture. Source: [10].

3.2. Pioneering Filipino Women in Pharmacy

A year after being founded in 1904, the Pharmacy School of the Liceo de Manila, currently the Manila Central University (Figure 7), The Philippines, already more than five years independent from Spanish domination, offered women the opportunity to join the study of pharmacy, a field that until then was forbidden to women, which at that time was a profession with the same prestige as medicine (which was also closed to them). The first women to obtain their degrees, and later their licenses, were Filomena Francisco and Matilde S. Arquiza Arroyo, the only women who took the Pharmacy exams between 1 and 3 July 1908, obtaining two of the first three places, according to the results indicated by the examiners. Only 25 of the 39 presented future pharmacists-to-be passed the exams: Filomena Francisco occupied the first place and Matilde S. Arquiza the third, while a man, Nemesio Dimanlig, occupied the second place [11].



Figure 7. The Central University of Manila in its origins. Source: [12].

That success of Filomena Francisco and Matilde Arquiza was highly publicized in the country's press. The newspaper "Manila Times", in its editorial dated 7 August 1908, congratulated the two Filipino women with the following words [13]:

"It is no small honor for older Filipino women to have two of their representatives in first and third place, respectively, thus beating young doctors who aspired to be pharmacists. (. . .) Another victory for Filipino women. It is another laurel that testifies to the ability of the Filipino woman to face the opposite gender in the intellectual field. This tends to emphasize the generally held opinion that they are completely equal to, if not better than, their male peers."

In addition, for its part, another newspaper, "The Filipino Teacher", asked its readers to support them and asked them: "What do you think? ...Having your recipes prepared with the delicate fingers of Miss Menang".

However, there is a great difference with regard to the information found in the literature on the two Filipino women mentioned above. While there is some information on Filomena Francisco, very scarce data can be found on Matilde S. Arquiza Arroyo (Figure 8), the woman who obtained the third place in the aforementioned exams. This subsection presents the biographies of those first two Filipino women to graduate in Pharmacy.



Figure 8. Matilde S. Arquiza. Source: [14].

As indicated above, Filomena Francisco was the Filipino woman who ranked first in the examinations held in the islands in 1908 for applicants aiming to become future pharmacists.

Filomena Francisco Guerrero (née Filomena Francisco) was born in 1886, somewhere in the Philippines, on day and month still unknown, in the bosom of a large family with limited economic resources, in which the idea that the children would be able to study was considered an unthinkable luxury. Her father was Gabriel Beato Francisco, a downtrodden journalist who had been the manager of “El Comercio”, the main business newspaper during the Spanish regime.

At the age of 15, Filomena Francisco (Figure 9) entered domestic service in the house of a family with a very good economic position and managed to convince the owners of the house to allow her to study at night, to which they agreed, as that way, she was able to get to university. However, at one point, the owners thought that the school of pharmacy was not for girls, so they forced her to choose between continuing her work at home or pursuing her career. She chose the latter and continued studying pharmacy at the university, also obtaining the best qualifications in her class.



Figure 9. Graduation photo of Filomena Francisco in 1903. Source: [15].

To pay for her studies, she began teaching at the Centro Escolar de Señoritas (currently Centro Escolar University) in 1907, graduating in 1908, after which she established her pharmacy in Manila, the “El Carmen Pharmacy”, in 1910 [13].

It is important to note that Filomena Francisco finished her Pharmacy degree after marrying Dr. Alfredo León Guerrero and assuming the role of “*submissive and obedient wife and mother*”, since her in-laws considered that it is “*unethical for a doctor’s wife to have a pharmacy*” [15].

The couple had three children, León, Mario X. and Carmen, two of whom, León and Carmen, would later become very important figures in the Philippines, as would their granddaughter, Gemma Cruz-Araneta Guerrero, daughter of Carmen.

Not much information is known about Filomena Francisco related to her person or her profession as a pharmacist. Regarding her personal characteristics, it is known that in December 1907, the Filipino, American and Spanish communities began to nominate candidates for the queens of the first Manila Carnival. The official list included Josefina Ocampo, Purita Villanueva, Leonarda Limjap and Pilar Reyes Cobarrubias, all of them beautiful and above all wealthy women, but the opinion of the inhabitants of Manila meant that Filomena Francisco ought to be also included, because she was a “*student at the Liceo de Manila, known for its intellect and moral values*”.

Regarding the exercise of her profession, it is known that she researched in chemistry and biology, studying the relationship between pharmacopoeia and bacteria. Together with Ramón Diokno, she was the founder of the “School Association of the Philippines” and also participated in 1905 in the founding of the “Female League for Peace” along with other women, including Concepción Félix (the first Filipino woman who had a university degree), Librada Avelino (founder of the Universidad Centro Escolar) and Judge Natividad Almeda López (the first Filipino woman lawyer).

In addition, Filomena Francisco wrote some successful novels at the time, although no references to the details of these were found. Pedro V. Paterno, from Nacional High School, dedicated to her, among other women, his collection of short novels entitled “Aurora social” [16].

Filomena Francisco died in 1949, presumably in Manila, although no source reports her death.

4. Discussion

This article is dedicated to recalling the figures of some Asian women, specifically from India and the Philippines, who were pioneers of science, specifically of pharmacy and chemistry, with the aim of making them known and holding them up as references to the society, having been able to first face and then overcome all the barriers related to their gender imposed on them to study and practice their professions in countries in which at that time the role of women was not valued. Note that the fact that these women in Asia chose the path of academic learning and that, above all, they did so apart from the maternal discipline expected of them. Higher education simply did not include women, neither in those countries nor in many other countries throughout the world. As an example, in 1913, literacy among women in India was less than 1%, meaning fewer than 1000 women in total across the country were enrolled in school.

The women discussed in this article are the Indian Asima Chatterjee and the Filipinos Matilde S. Arquiza and Filomena Francisco.

As well as being a leader in Phytomedicine, Asima Chatterjee was a pioneer in science for women. As already noted, she founded the department of chemistry at Lady Bradbourne College, University of Calcutta, and her Ph.D. was the first Ph.D. in science awarded to a woman by an Indian university. She was the recipient of the Shanti Swarup Bhatnagar Prize in Chemical Sciences (the first woman to receive the prize), a fellow of the Indian National Academy of Sciences, and the first female General President of the Indian Science Congress Association. She passed on her passion for science, and in particular, for chemistry, to her daughter, Julie, thanks to which she became a successful organic chemist. She also served as an inspiration and mentor to numerous students and colleagues [1].

In her 40-year career, she developed several drugs that were used to treat epilepsy and malaria, among others that were used in chemotherapy. The anti-epilepsy drug Ayush-56, discovered by Asima Chatterjee, is still used. She also wrote many books in English and Bengali.

Asima Chatterjee further presented a great example of the much-desired work-life balance: she enjoyed cooking, spending time with her family and the simple joys of family life. She worked until the end of her life, passing away peacefully at the age of 90. Her daughter followed in her footsteps and also became a chemist [17].

For their part, the first two Filipino women pharmacists, Matilde S. Arquiza and Filomena Francisca, were the ones who first opened the door: after them came many other Filipino women, who also contributed to the development of science in their country.

Although not much information is available about all of them in the literature, overall, in the case of the Filipino women, for the reasons mentioned above alone, they deserve to be remembered and recognized.

Allow us, therefore, to finish the biographies of these exceptional women by showing our admiration and respect towards them.

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Appendix A

Although she has not been dealt with in this article, because she was not a woman who dedicated herself to chemistry or pharmacy, but to botany, the authors believe it is fair to dedicate a few lines of this article to also remember the figure of Edavaleth Kakkath Janaki Ammal (Figure A1), the first Indian woman to obtain a doctor's degree, although she did not obtain it at a university in her country, but at Queen Mary's College of the University of Michigan.



Figure A1. Edavaleth Kakkath Janaki Ammal. Source: [18].

Edavaleth Kakkath Janaki Ammal (4 November 1897–15 February 1984) was the first Indian woman to earn a Ph.D., and in 1931, the first female scientist to become a member of the Indian Academy of Sciences, and probably the first female salary earner at the John Innes Institute and the first to be awarded a Padma Shri in 1977. She was botanist and cytologist and made important contributions to genetics, evolution, phytogeography and ethnobotany.

She was the tenth child in a family of 19 brothers and sisters. Her father was Dewan Bahadur Edavalatt Kakkak, a sub-judge of the Madras Presidency and her mother was Devi. She grew up in Tellicherry (now Thalassery), in the Indian state of Kerala. In the family, girls were encouraged to engage in intellectual pursuits and fine arts, and she chose to study botany. Indeed, her family home had a garden that they cared for and shared, and especially involved was her father, a nature lover who came to write two books about the native birds of the North Malabar region. It was in this environment that Janaki Ammal found her affinity for the natural sciences [18].

As she grew older, Janaki Ammal saw how many of her sisters were destined for arranged marriages. Unprecedented, when the time came, he made three very important decisions that marked her life: the first, to remain single all her life, so as not to be subordinated to those family burdens; the second, to dedicate herself to the study of plants; the third, to leave her country and move to study in the United States.

In this way, after schooling in Tellicery, she moved to Madras, where she obtained the bachelor's degree from Queen Mary's College and an honours degree in Botany from Presidency College in 1921.

Later, her university career took place at Queen Mary's College in the University of Michigan, where she majored in Botany and Cytology. In 1925, she earned a master's in science and six years later she received her Ph.D.

Therefore, she was the first Indian woman to obtain a Ph.D.—in her case, botany, in the U.S., in 1931—and remains one of the few Asian women to be conferred an *Honoris causa* doctorate by her alma mater, the University of Michigan. Her Ph.D. thesis, titled “Chromosome studies in *Nicandra physaloides*”, was published in 1932. During that time, she was living at Ann Arbor, in the Martha Cook building, an all-female residence [17].

In the early 1950s, she returned to India at the request of Jawaharlal Nehru, the country's prime minister after gaining independence from British rule in 1947. Nehru called her because India was recovering from the war that left India suffering famines throughout the country, with millions of people dying from malnutrition. Nehru wanted her to return to her country to organize and improve the botanical foundations of the country's agriculture.

In her work in India, she facilitated the identification of native plant varieties that could be crossed with the so-called “*Saccharum*” to produce a sugarcane crop more suited to the country's tropical environmental conditions. She also crossed dozens of plants to determine which *Saccharum* hybrids produced the highest sucrose content and developed several more hybrids by crossing various grass genera: *Saccharum-Zea*, *Saccharum-Erianthus*, *Saccharum-Imperata* and *Saccharum-Sorghum*. Above all, she began to use her influence to preserve endangered native plants.

Among the works she published, the following deserve to be highlighted:

- 1932: Chromosome studies in *Nicandra physaloides*. No. 358 of Contributions, University of Michigan Dept. of Botany. Ed. A. Uystpruyst.
- 1945: Chromosome atlas of cultivated plants. Ed. G. Allen & Unwin Ltd. Londres. 397 (with Darlington, Cyril Dean).
- 1974: Plants and man. Volume 2 of silver jubilee lecture. Ed. Birbal Sahni Institute of Palaeobotany.

She entered the Indian Academy of Sciences in 1935 and the Indian National Academy of Sciences in 1957.

Throughout her personal career, she received several distinctions and recognitions: the University of Michigan conferred an honorary LLD on her in 1956 and the Government of India awarded her the “Sri Padma” award in 1957. India's Minister of Environment and Forests instituted and used her name for the National Taxonomy Award in 2000, intending to promote work of excellence in taxonomy and encourage young students and academics working in this field.

As an anecdote, which at first could seem humorous, but deep down it is not at all, it can be said that in her eagerness to preserve Indian plants, she was the only woman who in 1955 attended an international symposium in Chicago, ironically entitled “The role of *man* in changing the face of the Earth” [18].

The abbreviation “Jan.Ammal” is used to indicate Edavalath Kakkath Janaki Ammal as the authority on the scientific description and classification of plants.

Appendix B

To finish the article and to contextualize its content and give rise to possible comparisons, we include in this Appendix some references to other women who were either born or worked on the Asian continent in the first decades of the 20th century and who achieved important milestones in the course of their academic careers or in the exercise of their professional practice, although in disciplines other than Pharmacy and Chemistry. Sorted by date of birth, those born in or before 1930 were the following (see [19–21] for further information):

Ogino Ginko (1851–1913) was the first registered female doctor to practise modern medicine in Japan.

Esther Park (1877–1910) was the first female Korean physician to practise modern medicine in Korea.

Kono Yasui (1880–1971) became the first Japanese woman to earn a doctorate in science, studying at the Tokyo Imperial University, in 1927.

Chika Kuroda (1884–1968) became the first Japanese woman to earn a Bachelor of Science degree, studying chemistry at the Tohoku Imperial University, in 1916.

Michiyo Tsujimura (1888–1969) became the first Japanese woman to earn a doctorate in agriculture, at the Tokyo Imperial University, in 1932.

Michiyo Tsujimura (1888–1969) was a Japanese agricultural scientist and biochemist recognized for her research of green tea components. Together with her colleague Seitaro, she was the first to discover that green tea contains vitamin C.

Kathleen Maisey Curtis (1892–1994) became the first New Zealand woman to earn a Doctor of Science degree, in 1919.

Filipina chemist María Orosa (1892–1945) fought malnutrition and food insecurity in the Philippines by devising over 700 culinary creations including Soyalac, a nutrient rich drink made from soybeans, and Darak, rice cookies packed with Vitamin B1, which could prevent beriberi disease caused by Vitamin B1 deficiency.

Filipino pharmaceutical chemist Luz Oliveros-Belardo (1906–1999) focussed her research on essential oils and other chemicals derived from native Philippine plants.

South African naturalist Marjorie Courtenay-Latimer (1907–2004) discovered in 1938 a living coelacanth fish caught near the Chalumna river. The species had been believed to be extinct for over 60 million years. It was named "*latimeria chalumnae*" in her honor.

Tsai-Fan Yu (1911–2007) was a Chinese-American physician and researcher who was the first female full professor at Mount Sinai School of Medicine. She discovered that gout was caused by elevated levels of uric acid in the bloodstream.

Fe Villanueva del Mundo (1911–2011) was a Filipina paediatrician who founded the Philippines' first pediatric hospital.

Chien-Shiung Wu (1912–1997) was an experimental physicist who made several important contributions to nuclear physics. She measured radioactive decay.

Bibha Chowdhuri (1913–1991) was an Indian physicist who researched on particle physics and cosmic rays.

The Turkish archaeologist, sumerologist, assyriologist and writer Muazzez İlmiye Çığ (1914) received her degree in 1940 and began a multi-decade career at the Museum of the Ancient Orient, one of three such institutions comprising the Istanbul Archeology Museums, as a resident specialist in the field of cuneiform tablets. At present, she is 108 years old.

Kamal Jayasing Ranadive (1917–2001), a ground-breaking cancer researcher, advanced the understanding of the causes of leukaemia, breast cancer and oesophageal cancer through the use of animal models.

Lin Lanying (1918–2003) was a Chinese material engineer remembered for her contributions to the field of semiconductor and aerospace materials.

Anna Mani (1918–2001), an Indian meteorologist who greatly contributed to the understanding of solar radiation, ozone and wind energy by developing a wide range of measurement tools.

Japanese geochemist Katsuko Saruhashi (1920–2007) developed the first method and tools for measuring carbon dioxide in seawater, which became known as Saruhashi's Table.

Chinese physicist Xie Xide (1921–2000) was an influential educator and one of China's pioneer researchers of solid-state physics.

Rajeshwari Chatterjee (1922–2010) was the first female engineer from Karnataka in India.

Filipina scientist and educator Clara Lim-Sylianco (1925–2013) is remembered for her extensive research on mutagens—often-carcinogenic agents that permanently alter genetic materials such as DNA—antimutagens and bioorganic mechanisms.

Purnima Sinha (1927–2015), the first Bengali woman to receive a doctorate in physics, analysed clay structures using x-ray equipment that she built from salvaged World War II-era parts.

Tu Youyou (1930) is a Chinese pharmaceutical scientist who was awarded the 2015 Nobel Prize in Physiology or Medicine for her work on extracting artemisinin from sweet wormwood to treat malaria.

Gloria Lim (1930) is a retired mycologist from Singapore who studied tropical fungi.

In addition, finally, although far removed in time from the previous ones, Iranian mathematician Maryam Mirzakhani (12 May 1977–14 July 2017) cannot fail to stand out. She was the first and only woman and Iranian to date to win the Fields Medal (the most important award that can be granted in Mathematics) in 2014 for her work on curved surfaces.

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