Inventors, pioneers and environmental activists

Extraordinary women who changed the world.

Generalitat de Catalunya

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Editor and consultant: Sònia Marta Garcia Giménez

Illustrator and designer: Marta Bellvehí Suñer

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“Let us choose for ourselves our path in life, and let us try to strew that path with flowers.”

Emilie du Châtelet, mathematician and physicist

Prologue

The slim volume you are holding in your hands is an initiative by the Gender Team of the Secretariat of Climate Action, belonging to the Department of Climate Action, Food and Rural Agenda of the Generalitat de Catalunya (Government of Catalonia). The Gender Team seeks to ensure the full participation of women and integrate the gender perspective in environmental policies. To achieve this, it proposes to generate knowledge, share initiatives and raise awareness about gender and environmental issues.

Within the framework of the activities promoted by the Gender Team, the aim of this slim book is to publicise the biographies of different women who, throughout history, have made relevant contributions in the fields of work of this Secretariat. Among others, you will find prominent researchers in the study of solar, electrical and nuclear energy, meteorologists, engineers, environmental activists and precursors of sustainable development. Despite the fact that talent or intelligence does not distinguish between genders, the official narrative has generally ignored the contributions of extraordinary women like the ones we are showing you here. This initiative aims to provide female role models in areas that have traditionally been considered more “masculine”.

With the selection of women presented here, an attempt has been made to cover as broad a temporal, geographical and social framework as possible: from the 3rd century to the present day, covering Asian, African, American and European women, coming from wealthy or more modest families alike. Due to space limitations, the selection had to be adjusted to only 12 women, but many others would have been equally deserving of being part of it. Although most have been admired and celebrated in their field, almost all are completely unknown to the general public.

The lives of the women described in this collection have certain interesting common features. In general, their vocation tended to appear to them when they were young girls and, in most cases, their parents encouraged them to pursue their dreams. Having a good level of family education and a certain level of economic comfort was generally essential. At this point, a question arises: how many brilliant minds have been lost along the way because they did not enjoy the right environment and support? On the other hand, practically all of these women had to fight against gender stereotypes at some

point in their careers. Because they were women, they were not allowed to enter scientific societies - the majority of which were exclusively male until well into the 20th century - as in the case of Hertha Ayrton or Irène Joliot-Curie. Much more preparation was required of them and they were not taken seriously, as happened with Rachel Carson. Likewise, they were denied well-deserved prizes: the case of Chien-Shiung Wu was paradigmatic, because she was unjustly excluded from the Nobel Prize. Despite the fact that some gave up having a family of their own in order to devote themselves to their work or because it simply did not interest them, the majority did have children. In times not so distant, when women's priority was expected to be the domestic and family sphere, many of them had to juggle in order to balance their personal and professional lives; frankly, it can be said that, here, not much progress has been made yet. Lynn Margulis came to recognise that it was "not humanly possible to be a good wife, a good mother and a first-class scientist at the same time...: something had to go". Rarely has a similar statement been heard from a man. As a result of having experienced sexist attitudes or conventions in their own skin, many of them - such as Hertha Ayrton, Irène Joliot-Curie or Wangari Muta Maathai - developed an awareness in favour of women's rights and, insofar as they could, they fought to make women visible and create a more egalitarian society. Finally, most were "the first" to do something: from Mary the Jewess, the first alchemist in history, to Creu Casas, the first professor of Botany in Spain.

Marta Bellvehí, with her personal style and feminist perspective, has captured the essence of these pioneers through her illustrations. We invite you to enjoy the beautiful drawings she has made of these women at different stages of their lives and accompanied by some of their most distinctive details.

The historian and feminist activist Gerda Lerner, the first person to introduce the study of women's history to the university, said that "unawareness of their own history of struggle and achievement has been one of the major means of keeping women subordinate," and, therefore, "women's history is the primary tool for women's emancipation". We hope that this collection of biographies of extraordinary women contributes to the dissemination of role models in the aforementioned fields, which, even today, we believe is so necessary.

Sònia Garcia

SÒNIA GARCIA - Editor and consultant

Sònia Garcia holds a degree and Ph.D in Pharmacy (specialising in Botany) from the University of Barcelona. She is a Senior Scientist at the Botanical Institute of Barcelona, a joint centre between the Higher Council of Scientific Research (CSIC) and the Consortium of the Museum of Natural Sciences of Barcelona (CMCNB). Currently, her research focuses on the study of repetitive elements in plant genomes and applies this knowledge to understanding why a plant becomes invasive, a problem closely linked to globalisation and climate change. As part of her outreach work, and after realising the lack of female referents in research, for some time now she has been interested in publicising the lives and achievements of women in fields related to her research area. On this topic, she has written dissemination articles, given talks and organised colloquiums, both in Catalonia and in other European countries. She also participates in programmes to encourage the so-called STEAM subjects (acronym for Science, Technology, Engineering, Arts and Mathematics), especially among secondary school girls at schools in Barcelona.

MARTA BELLVEHÍ - Illustrator and graphic designer

Marta Bellvehí studied her Design degree at Eina (Autonomous University of Barcelona) and her Postgraduate degree in Illustration at Bau (University of Vic). She has been working as a freelance illustrator since 2014, and is committed to projects linked to culture, education and feminism. She has illustrated and designed book covers, posters, institutional campaigns and exhibitions, among others. In recent years, she has specialised in the field of murals and has painted her illustrations in more than twenty municipalities in Catalonia. Most of these murals, bearing a message against gender violence, have been accompanied by courses on creativity and talks.
In 2019, she made the leap as an author, and published the work *Casa soc jo* (Edicions Tremendes), followed by the novel *Bruna Brown* (Fanbooks, 2022) and the illustrated novel *A partir d'ara* (Fanbooks, 2024). Since the summer of 2022, she has also coordinated and presented the podcast in Catalan *Braves Il·lustrades*, where she interviews women from different creative sectors. You can see her portfolio on the website martabellvehi.com.


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Índex

MARY THE JEWESS · The first alchemist in history

Surely sometime you have used, or heard of, the bain-marie. But, you may have wondered who this Marie or Mary was and what does she have to do with this procedure? Well, Mary the Jewess is woman in question.

Mary the Jewess was one of the first scientists in history. Although her place of birth is unknown, it is known that she lived between the 1st and 3rd centuries A.D. in Alexandria (Egypt). She was also known as Mary the Hebrew or Miriam the Prophetess, and the Arabs called her Plato's daughter. She is the first known female alchemist and is even considered one of the founders of alchemy. **Alchemy is an ancient doctrine that studies chemical phenomena** and it was developed with more or less outlandish goals, but of great interest at the time: to transform metals (especially to turn common metals into gold), to discover the elixir of immortality, to find the philosopher's stone and to explore all kinds of secrets of nature. Despite being a proto-science, with often symbolic goals, **many of the ideas, practices and instruments of alchemy were later adopted by modern science**. Although it is known that Mary wrote several texts on alchemy, unfortunately none of them survive, and they are believed to have disappeared in the famous fire of the Library of Alexandria. We know her work through the testimony of other later scholars, among them, the also-alchemist Zòsimus de Panòpolis (c. 3rd-4th century A.D.), who considered her a member of the "ancient sages".

Mary excelled in the development of laboratory instruments linked to alchemical practice. Thanks to her fertile imagination, she invented instruments and conceived procedures or experiments that were strongly linked to *alchemical processes*, such as distillation, evaporation or sublimation. She is credited with the invention of the *tribikos*, a kind of distillation still, and also of the *kerotakis* (known as "Mary's oven"), a reflux device to heat substances such as sulphur, mercury or arsenic, whose vapours, applied to a metal plate and with prolonged heat, gave a material similar to gold. Later, the *kerotakis* would also be used to extract essential oils from plants such as the rose. It is believed that this device was the basis for the German chemist Franz von Soxhlet to create, at the end of the 19th century, the famous extractor that bears his name and is still found in today's analytical chemistry laboratories.

"With alchemy we transform the ordinary into the extraordinary, darkness into light"

However, if Mary the Jewess has gone down in history for something, it is because of her famous water bath – as we pointed out at the beginning – which, almost 2,000 years after it was conceived, is still being used. **The bain-marie is a technique used to heat substances gently and evenly**, and consists in inserting a container into another larger one containing very hot or boiling water. In the first container we need to place the substance to be heated and, through the transmission of heat through the liquid, it will do so smoothly and uniformly. So, for example, you can melt chocolate to prepare the topping of a cake, or gently heat a baby bottle. Today it is a common procedure in gastronomy, but it has also been used to distill volatile or aromatic substances, or to evaporate extracts. The original bain-marie, however, was a little more complex: it was a sand and ash bath that heated a container, which, in turn, heated another container. Apart from inventing the bain-marie, it is believed that it was she who named it after herself.

Beyond her prominence as an alchemist and her inventions, not much else is known about Mary's life. What is known is that, unlike most known women scientists, even many much more recent ones, **Mary the Jewess enjoyed great recognition and reputation in her circle of alchemists, both during her life and long after her death**.

The next time you make a cake, remember Mary the Jewess and her water bath to ensure the chocolate has a perfect texture!

HYPATIA OF ALEXANDRIA • Discover the power of thought

Among the hundreds of scrolls in the library is a little girl who, concentrating hard, is reading one of them closely. It is a work on astronomy, about the position of the stars. She begins to do some mental calculations to understand what she is reading and smiles: "mathematics never lie", as her father had explained to her.

Hypatia was born in Alexandria, a city in Egypt, between the years 355 and 370 and died in the same place in the year 415. Alexandria was an intellectual and commercial centre located on the Nile Delta although in administrative terms it belonged to the Roman Empire. Even so, it could be considered a Hellenic metropolis that, to a certain extent, had replaced classical Athens, already in decline. H**ypatia was the daughter of Theon, a famous mathematician and astronomer, director of the important library of the Serapeum**. Theon was her first teacher, and his liberal character – exceptional for that time – was fundamental in the development of his daughter's extraordinary abilities. Hypatia was educated intellectually, but also physically, and learned horse riding and rowing. In his own words, Theon wanted Hypatia to be "a perfect human being". **It must be remembered that, in those days, women were always bound by paternal or marital authority and did not usually have education or economic independence**.

Hypatia made important contributions in mathematics, astronomy and, especially, philosophy. **A lesser known facet of hers was as an inventor**, as her studies also included mechanics. She is believed to have invented an **improved version of the astrolabe** and also come up with the **densimeter, an instrument used to determine the relative density of liquids** (that is, the ratio between the density of the liquid and that of water); some writings point out that she may also have invented the **first water distiller with the purpose of purifying it**.

She collaborated with her father on commentaries regarding arithmetical texts, such as the *Elements* by Euclid, and revised the astronomical tables of Ptolemy. Well ahead of her time, she was one of the pioneers of heliocentrism, contrary to the prevailing geocentrism of the period. **In addition, she had exceptional oratory skills and a great ability to explain concepts**. She founded her own school, which received many students. These were mainly young men belonging to the most powerful elites, who came from all over the Mediterranean. Hypatia taught the works of Plato and Aristotle, and her students gained positions of power within the Empire after passing through her classrooms. Considered a wise and exemplary woman, she was often consulted on various matters by the city authorities.

"Reserve the right to think, because even thinking wrongly is better than not thinking at all"

(Theon to Hypatia)

Unfortunately for her, Hypatia lived in a time of transition between the fall of paganism and the rise of Christianity. Despite being a pagan, she had always professed an attitude of tolerance and respect for other people's beliefs, and among her students there were many Christians. Her relationship with the political elites of Alexandria and her prestige, however, made her a target for groups defending the most radical Christian orthodoxy, groups that struggled for power and knew of Hypatia's ability to influence others. **In this context, she was accused of practicing witchcraft and magical arts**. It should be noted that, in the past, astronomy – one of the disciplines studied by Hypatia – was not so far removed from astrology and the divination arts, and it was easy to draw parallels with witchcraft. **Thus, one day in March 415, after accusing her of being a witch, a crowd of Christians running amok brutally murdered her**.

The memory of Hypatia has endured over time and as part of the literary tradition. It is believed that Saint Catherine of Alexandria - a Christian martyr of the 4th century – never existed and was, in reality, an adaptation of the figure of Hypatia by the Catholic religion. This fact does not cease to be ironic because, precisely, the most emotional form of Christianity that was responsible for her tragic death. During the Enlightenment (the 18th century), her figure was vindicated as she was considered a "martyr for philosophy" and a symbol of the opposition to Catholicism. **Nowadays, Hypatia has become an icon of women's rights and is considered a forerunner of the feminist movement**. Her figure has been portrayed in television series, films and plays. In tribute to her, Hypatia is the name given to, among others, a lunar crater, a satellite, an asteroid and a prestigious 2023 mission to the Mars Desert Research Station (a simulated environment of the planet Mars) made up exclusively of women.

HERTHA AYRTON • The spark of creativity

We are at the end of the Victorian era, in the 19th century, in a London street. It is cold and the night is very dark. The streetlights are electric arc lamps and, although they give a lot of light, this light is unstable and they generate a constant hum. Under these streetlights walks a thickset woman, with black and curly hair, who, looking up, thinks to herself: "These streetlights are very annoying, surely they could be improved... How could I do that?".

Hertha Ayrton (1854-1923), born Phoebe Sarah Marks, was born in Portsea (United Kingdom) and was an engineer, mathematician, physicist and inventor. She belonged to a modest Jewish family and was the third of eight siblings. Her father died when she was seven years old, so very early on she had to take on responsibilities to help her family. She was a restless girl, with initiative and possessing an undeniable intelligence; faced with this, her aunts, who ran a school in London, proposed to her mother to take charge of her guardianship and education. She still continued to help with the family economy, giving private lessons and working at embroidery. During her adolescence and after having read a poem dedicated to Hertha, the Teutonic goddess of the earth, she decided to change her name, renounce the Jewish religion and declare herself agnostic. **Thanks to financial support from the feminist Barbara Bodichon, Hertha studied mathematics at the University of Cambridge**. However, given that at that time Cambridge did not allow women to graduate, she had to validate her studies at the University of London where she obtained a Bachelor of Science degree.

"Errors are notoriously hard to kill, but an error that ascribes to a man what was actually the work of a woman has more lives than a cat!"

Hertha made her way into science through her fabulous inventiveness and would publish as many as 26 patents in her lifetime, including a sphygmomanometer, calipers, mathematical dividers, arc lights, electrodes and air thrusters. She was particularly interested in electrical engineering and, in 1884, began training in it at Finsbury Technical College. It is here that she received lessons from Professor William Edward Ayrton, whom she would marry a year later. Professor Ayrton, without much success, had investigated the technical problems of the electric arc that we mentioned in the introduction. He had even written an (unfinished) work on the subject, which was accidentally used by a servant to light a fireplace, and no further record of it remained. This accident motivated Hertha to resume the investigation started by her husband. **She showed that problems with the electric arc lamp occurred when the carbon rods to create the arc came into contact with oxygen, and proposed certain changes that greatly improved its operation**. In 1899, she was the first woman to present a paper at the Institute of Electrical Engineers, and, in 1900, the first woman to be admitted as a member of this institution. She also expanded her research into the field of hydrodynamics, improving the understanding of the vortex in water and air. In 1902, she was proposed as a member of the Royal Society, but her request was initially denied because "a married woman could not be admitted as a member". Despite this, four years later, the same institution would award her the Hugues medal, its most prestigious recognition.

Apart from being a brilliant researcher and inventor, Hertha had a strong feminist profile and was committed to social causes. She participated in the suffragette movements and attended many of the demonstrations called in 1910 to demand the right to vote for women. Hertha was also an **example of sisterhood**: she took her friend Marie Curie into her home so she could recover from illness and stress. Hertha herself taught mathematics to one of Curie's daughters, fellow researcher Irène Joliot-Curie (see next chapter). When the discovery of radium was single-handedly attributed to Marie Curie's husband, Hertha advocated on behalf of her friend so she could be given the recognition she deserved. She participated in the foundation of the International Federation of University Women in 1919 and the National Union of Scientific Workers in 1920. She died in 1923 at the age of 69 in Bexhill-on-Sea, United Kingdom, after entering into anaphylactic shock following an insect bite.

IRÈNE JOLIOT-CURIE · A new radioactivity

We are in a field hospital in Belgium, during the First World War. Among a multitude of casualties, a surgeon tries to locate the fragment of shrapnel that is causing unbearable pain in the leg of a poor soldier. He is helped by a young woman who has just turned 18, using a portable X-ray machine, which she handles calmly and expertly. Thanks to this, the metal is quickly located and it can be extracted and the wound healed (based on Merle-Béral, 2018).

This girl is Irène Joliot-Curie (Paris 1897-Paris 1956), and the episode already shows us her exceptional personality. **Irène, daughter of Marie and Pierre Curie, was a physicist, chemist, politician and activist**. She was born in an environment particularly conducive to science, given the profession and celebrity of her parents, who were awarded Nobel prizes for the discovery of radioactivity and several radioactive elements.

The arrival of the First World War in Irène's mid-teens caused her to interrupt her studies in Physics. During the war, together with her mother, the "**Little Curies" developed several ambulances with portable radiological equipment that saved thousands of lives**. At the end of the war, she resumed her studies and graduated in Physics from the Sorbonne University (Paris). She began her research in alpha rays and the radioactivity of polonium, while continuing the research of her parents. Shortly after presenting her doctoral thesis, Irène married Frédéric Joliot, a research assistant working for Marie Curie. At his request, they both adopted the surname Joliot-Curie. The couple had two children, Helène and Pierre, who would also become scientists.

Frédéric and Irène reproduced the passion for research experienced by Marie and Pierre and formed a true team. Their most important milestone was the **discovery of artificial radioactivity**. Through experiments in which they subjected aluminium to alpha particle radiation, this became a new element, in this case, radioactive phosphorus. Later, they would produce radioactive nitrogen from boron, thus realising the alchemists' old dream of transforming metals (see the chapter on Mary the Jewess), and they would also achieve this with many other elements. Artificial radioactivity would end up having applications in areas as diverse as cancer therapies, diagnostic procedures, isotopic dating in geology or the production of nuclear energy. **For this discovery, Irène and Frédéric received the Nobel Prize for Chemistry in 1935**. The Curie family became the most award-winning family in history, with five Nobel Prizes in total.

The time in which Irène lived bore witness to the most important European wars, the rise and fall of fascism, the rise of communism and the Cold War, as well as a multitude of social movements. Despite her dedication to science, Irène was far from indifferent to these convulsions. From a very young age, she had been marked by the left-wing values of her grandfather, Eugène Curie, and the circle of intellectuals close to her parents. In 1934, Irène and Frédéric joined the French Socialist Party and both supported the Government of the Spanish Republic after Franco's coup. In 1936, Irène accepted the position of Secretary of State for Scientific Research and managed to increase the few resources allocated to research; also contributed to the creation of the National Centre for Scientific Research (CNRS) in 1939. In addition, **she used the visibility afforded her by the Nobel Prize to argue for women's rights**: she championed greater legal independence and shone a light on the high unemployment rates and the need to demand the right to vote. She was ahead of her time in declaring herself in favour of the concept of birth control. Despite the recognition that Irène obtained on an international scale throughout her career, she was rejected no fewer than four times as a member of the Academy of Sciences simply for being a woman In fact, she decided to present herself at each opportunity to denounce the exclusion of women from this institution.

Irène and Frédéric collaborated in the French Resistance during the Second World War, wholly committed to the anti-fascist struggle. However, with the bombings of Hiroshima and Nagasaki in 1945, an intense sense of guilt became apparent in the couple and other researchers involved in the development of nuclear technology. **In 1949, they would participate in the creation of the World Peace Council** which, a year later, would inspire the **Stockholm Appeal against the military use of atomic energy** which was signed by more than 150 million people. In 1956, at the age of 58, Irène died of leukemia caused by years of continuous exposure to radiation.

"She always knew what she wanted and carried it out, without haste, without ostentation, with patient courage"

(Ève Curie, about her sister Irène Joliot-Curie)

JANAKI AMMAL • The Sugar Cane Queen

In Kerala, a state on the tropical coast of India, there are long beaches and large expanses of mangroves. In the mountains, we can find tea, coffee and spice plantations, surrounded by exuberant wildlife. Living in this setting was a woman who was passionate about expanding our knowledge of plants. An imposing presence, tall and with glossy black hair, Janaki exuded a majestic aura, accentuated by the yellow silk sarees she used to wear. Behind the saris was a tireless researcher and a great defender of the environment.

Janaki Ammal (1897-1984), born in Thalassery (Kerala, India), was the daughter of a judge and a housewife. She had eighteen siblings, six of whom were half-siblings from her father's previous marriage. Her family could be considered middle class with a high level of education. **Between 1858 and 1947, India was under British rule (the so-called British Raj) and, at that time, most Indian girls did not go to school. More than 99% of them were illiterate**. However, she was able to attend the Sacred Heart Convent. She continued her studies at Queen Mary's College from Madras, as she watched her sisters accept arranged marriages.

Her father was an avid ornithologist and had a keen interest in nature, which he passed on to Janaki. In 1921, she obtained her degree in Botany at Presidency College in Madras and, in 1924, through a scholarship, she moved to the United States. **At the University of Michigan, she would earn a Master of Science degree in 1926 and a Ph.D in 1931, making her one of the first - if not the first - female holders of a doctorate in Botany in the United States**. She returned to India as a teacher at Maharaja's College of Science (1932-1934), but soon moved to the Sugarcane Breeding Institute, a centre dedicated to the research and improvement of sugarcane cultivation. With microscopic observation of the chromosomes of various populations of wild sugar cane and related species, she was able to establish the hybrid origin of many of its varieties. Her work contributed to creating high-yielding cultivars better adapted to India's climatic conditions. Hence the nickname of *sugarcane queen,* which would accompany her for the rest of her life.

In 1939, she attended a genetics congress in Edinburgh, which coincided with the start of the Second World War. This circumstance forced her to remain in the United Kingdom, where **she entered the John Innes Horticultural Institution as a research assistant to Cyril Dean Darlington**, a renowned botanist and geneticist. There she studied the chromosomes of many other species such as aubergine and citronella, often polyploid. **Polyploidy is a phenomenon whereby cells originate with three or more complete sets of chromosomes** and sometimes this higher number of chromosomes corresponds with a higher yield, for example, in a larger fruit size or a higher concentration of sugars.

Over the years, Janaki would contribute to identifying the number of chromosomes of many species for the first time, connecting genetic aspects with the diversification and evolution of plants. **Her most outstanding work would be the book *Chromosome Atlas of Cultivated Plants***, written in collaboration with Darlington in 1945, with information for over 100,000 species!

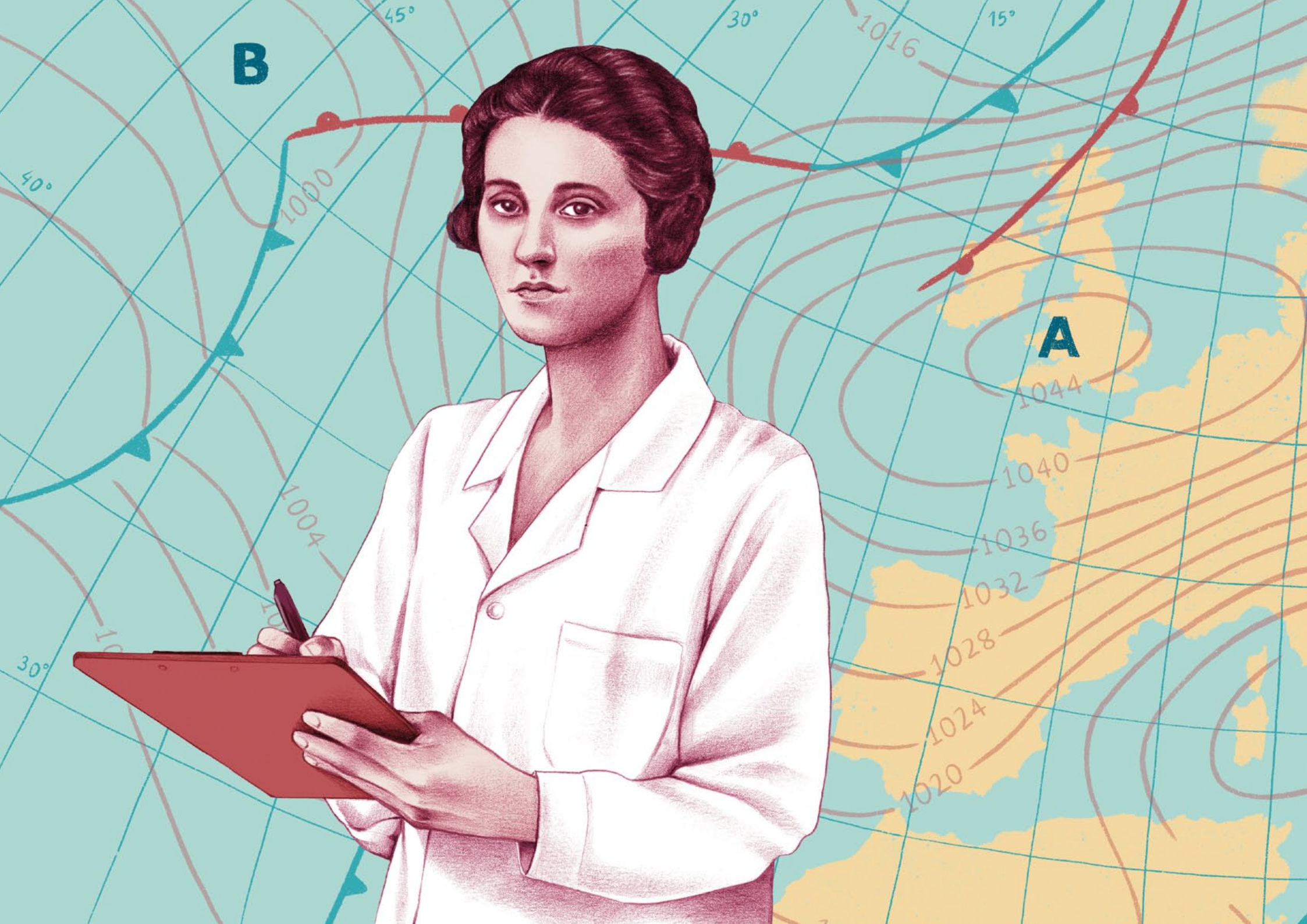
Janaki was also a woman fully committed to her land and the environment. In response to the recent famine epidemics that had hit the country, the Indian government promoted the deforestation of huge areas of land to plant cereals, with the consequent loss of biodiversity. It was at this point that Janaki became aware of the importance of preserving native plants. In 1955, she was the only woman attending the symposium *Man's Role in Changing the Face of the Earth* and, in a room full of white men, she laid out the problems of India's subsistence economy. She talked about the **importance of the matrilineal tradition in her country**, where women were usually the ones who managed the land and the crops, at that time threatened by the mass production of cereals.

At over 80 years of age, Janaki became involved **in the opposition to the construction of a hydroelectric plant** that the Indian government wanted to build and that would lead to the complete flooding of the Silent Valley, an area of tropical forests of great natural richness. She joined the citizen movement to stop the construction of the dam and contributed to the project being stopped. This area is now one of the best-preserved forest areas in India. It plays host to more than a thousand exotic plants and animals, such as the silent macaque, a species of primate in danger of extinction. Unfortunately, Janaki would not live to see this victory, as she would die just a few months before the Silent Valley was declared a nature park in 1984.

Throughout her career, Janaki received numerous accolades, including the Birbal Sahni medal (1961), for her contributions in the field of botany, and the Padma Shri (1971), one of the highest civilian distinctions granted by the Government of India. In tribute to her contributions, that same Government established the Janaki Ammal National Taxonomy Award in 2000.

The next time you put a teaspoon of (cane!) sugar in your coffee, take a moment to think about the incredible Janaki Ammal, whose research contributed to its sweetness.

"My work is what will survive"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FELISA MARTÍN BRAVO · A life between lightning, storms and galernas

We are in the midst of the Spanish Civil War. Meteorological observatories are strategic places from a military point of view in a conflict context like this, but they also continue to engage in their usual activity. Specifically, at the meteorological observatory of Igeldo, in Gipuzkoa, they try to predict phenomena such as galernas, very strong wind storms that have taken many lives of fishermen and seafarers throughout history. While studying complex maps full of isobars, a female meteorologist tries to decipher when the next dreaded galerna will take place on the Basque coast. This meteorologist is also the director of the observatory and has a great responsibility. In the historical and political moment in which we find ourselves - between the 1930s and 1940s - it was unusual for a woman to work outside the home, but for that same woman to lead a public centre was practically unheard-of. The tenacity and determination of our protagonist made it possible.

"They all spent time abroad. They mastered several languages and wanted to have a professional life that would make them autonomous and independent. They were committed to the advancement of women."

(María José Barral, in *Tras las huellas de científicas españolas del xx* (Following the footsteps of female Spanish scientists of the 20th century))

Felisa Martín Bravo was born in San Sebastian in 1898. The daughter of teachers, the family's educational level undoubtedly influenced her subsequent scientific vocation. She was also very lucky that Gipuzkoa contained the General and Technical Institute, one of the few schools that admitted girls to study high school. The possibility of completing the baccalaureate used to be the first major – and often insurmountable – obstacle for women to access university education in those days. After finishing high school, Felisa moved to Madrid to study Physics. During her time in Madrid, she stayed at the Ladies' Residence (*Residencia de Señoritas*), a centre founded in 1915 by the Board for the Extension of Studies and Scientific Research (*Junta para la Ampliación de Estudios*, JAE), giving physics and mathematics classes to finance part of her living costs. The JAE, created in 1907 and chaired by Santiago Ramón y Cajal, was fundamental in promoting scientific research and education in Spain. After its disappearance in 1939, it gave way to the creation of the *Consejo Superior de Investigaciones Científicas* (CSIC), the Spanish Research Council. The Ladies' Residence offered accommodation, a laboratory, a library and a programme of academic and artistic activities to its guests. For example, thanks to the conferences organised around the Residence, Felisa had the opportunity to meet Marie Curie and Albert Einstein.

But let's return to our protagonist. At the end of her course, Felisa started as an intern at the **Laboratory of Physical Investigations** to work on the study of crystalline structures **using X-rays**. Although she intended to expand her knowledge of X-ray spectrography and finish her thesis abroad, in 1925 she decided to enter the official examinations for high school teaching positions, possibly to try to secure options for a stable job in the future. Felisa was not sure that she would prosper in her scientific career because of the difficulties women had in accessing research positions – and, in general, any position of responsibility. Even so, **in 1926 she presented her thesis and became the first female Ph.D in Physics in Spain**. In 1929, she passed the examinations to join the National Weather Service, and was also the first woman to do so. She combined this work with her participation in the X-ray section of the National Institute of Physics and Chemistry. During a research stay at Cambridge in 1932, she expanded her knowledge of X-ray spectroscopy and of atmospheric electricity and storm formation. During the Spanish Civil War, she continued working for a time for the Republican part of the Meteorological Service. Between 1937 and 1940, she moved to the meteorological observatory of Igeldo, in Gipuzkoa. Until 1960, she was the only female meteorologist in the Meteorological Service, where she continued to research atmospheric electricity and storm formation until her retirement. Her research would have application in the protection of commercial flights. During the 1973-1974 biennium, she was the first woman to preside over the Spanish Meteorological Association.

In the personal sphere, not too much is known about her life. She was known to be very devoted to her work and considered any distraction, such as going to the movies or going out for a walk, indeed anything that was not strictly related to scientific research, to be a waste of time. She had no children, but she did marry José Vallejo Sánchez, Professor of Latin at the University of Seville, whom she would outlive by 30 years. Upon her death, at the age of 81, Felisa bequeathed her assets to the University of Seville so it could award prizes to the best records in classical philology and to be added to the library's collections on this subject.

Felisa stood out in a discipline, physics, which, like mathematics or many engineering fields, is still fundamentally male-dominated today. Why is this statement still true despite all the work being done, in terms of equality, to enhance the disciplines called STEM (Science, Technology, Engineering and Mathematics) among girls?

MÁRIA TELKES • The Sun Queen

At the end of 1980, the United States Department of Energy began the construction of a revolutionary house prototype. The first signs of global warming and the oil crisis of the 1970s had pushed the idea forward. The Carlisle House, in Massachusetts, would have solar-powered heating, hot water and appliances. To achieve this, they had to consult an 80-year-old retiree: Mária Telkes. Decades earlier, Mária, known as the *Sun Queen*, had begun to show the world the potential of solar energy.

Mária Telkes (1900-1995) was born in Budapest into a wealthy family, and was the eldest of eight children of Aladar and Mária Laban de Telkes, bankers of Jewish origin. It was a time when there began to be some concern about fuel shortages. Reading a book about the future of energy stimulated Mária's interest in the power of solar energy. She learned four languages to read everything that was being published on the subject and, by 1920, she had graduated in Physical Chemistry from the University of Budapest. In 1924, she would obtain her doctorate at the same university, at the age of only 24. The same year, after visiting an uncle of hers, the Hungarian consul in Cleveland, she decided to move to the United States. In those days it was not at all easy for a woman to become a scientist, and she thought she would have more opportunities on the new continent.

In 1925, she landed her first job at Cleveland Clinic Foundation, where she was able to show, for the first time, her extraordinary inventive capacity. Specifically, **she would invent a photoelectric device for recording brain waves**. However, her real interest was everything related to solar energy and, in 1937 – the same year she obtained US citizenship – she began working as an engineer for the company Westinghouse Electric. In 1939, she became part of the Solar Energy Conversion Project at the Massachusetts Institute of Technology (MIT) and that is when she was able to really delve into solar energy research. The aim of the project was **to achieve a home heating system that depends only on solar energy, without the need for fossil fuels**. The project, however, had to wait a little, due to the arrival of the Second World War.

However, Mária did not have much time to get bored. She had gained a certain reputation as an ingenious person, a reputation that had reached the ears of high officials of the US Government. She was asked if she could create a desalinator. Mária accepted the challenge, and designed a **portable solar water evaporator**. The instrument removed the salt from the sea water through evaporation, then cooled the water again, having already converted it into fresh water. The device was included in the first aid kit of US soldiers and would lead to many lives being saved. Later, it was used to obtain drinking water in places like the Virgin Islands, where there is little availability of fresh water. She would obtain the patent for this gadget in 1968.

At the end of the war, Mária resumed her research as an engineer at MIT and developed a new solar heating system for homes, which would be her great experiment. **We are talking about the *Dover Sun House* (1948), a project based on the collaboration between three women: the architect Eleanor Raymond, the sculptor and philanthropist Amelia Peabody – who financed the project – and Mária herself**. The heating of this house, located in Massachusetts, was achieved by storing solar energy via a **chemical reaction with Glauber's salts**. These salts capture energy by melting it with heat and release it by recrystallising with cold, so the home heats up as the salt, which is located within the walls, cools. Initially it was a great success, but by the third winter corrosion and leakage problems appeared and the system ceased to work.

Partly due to this failure, Mária was fired from MIT, but she immediately found a job at New York University, where thanks to a scholarship from the Ford Foundation **she would develop the first oven based on solar energy**. Again, this is a simple and functional device, capable of reaching 205°C, a temperature sufficient to pasteurise and sterilise food – while improving its safety and durability. This design still endures and many of today's solar ovens are essential in cooperation projects and humanitarian aid in disadvantaged areas. From 1958, Mária would continue working in private companies that promoted the use of solar energy or its technological development. Later, she would continue to express her creativity and invent, among others, a system so that farmers could dry crops more quickly, materials capable of withstanding extreme temperatures underwater or travelling in space, and air conditioning systems. **In her career, Mária registered 20 patents and received a dozen awards**, among them one from the Society of Women Engineers in recognition of her career achievements. She was a scientist completely dedicated to her research. After living in the United States for 70 years, she returned only once to her native Hungary, in 1995, and she would die during this visit, at the age of 94.

Following the recent energy crisis of 2022, the need to bet on renewable energies is now more evident than ever. It is worth remembering the role of Mária Telkes, an idealistic scientist determined to change the world and who, as early as 1942, was ahead of her time with this sentence: **"Sunlight will be used as a source of energy sooner or later anyway. Why wait?".**

"It is the things supposed to be impossible that interest me"

RACHEL CARSON • The Pen of Environmental Awareness

It can be said that the marine biologist, ecologist and writer Rachel Carson (Springdale, United States, 1907) was the founder of the ecological movement. Born in a rural area, she lived on a farm with her family, and from a very young age she loved exploring the nature around her. She also loved to devour books and wrote a lot, encouraged by her mother. She was very fond of animals and, in her first stories, they were almost always the protagonists. She immediately started winning writing competitions and, at the age of 11, she published her first story.

Rachel was a brilliant student and took up an English Literature major because of her ease with writing. However, she decided to switch to Biology, her other passion. She graduated with honours in 1929. Three years later, she would earn a Master's degree in Zoology from Johns Hopkins University. She went on to study for a doctorate, but her father died suddenly and she had to drop out of school to support her family and care for her elderly mother. Thanks to a teacher's recommendation, she joined the United States Government's Fish and Wildlife Service. There her job was as a scriptwriter for an informative radio programme about aquatic life (called *Romance Under the Waters*). Subsequently, **she obtained a position as a marine biologist in this Service, with which she became the first woman of her class and the second woman overall to achieve this in the history of the institution**. She combined this work with writing informative articles for newspapers. Professional successes, however, were paralleled by family misfortunes and, in 1937, her sister died and she took care of her two orphaned nieces. Despite her family responsibilities and work, Rachel always found time to write, and in 1941 she published the first book in a trilogy about marine life. One of them, *The Sea Around Us*, would be a bestseller and **she would receive the National Book Award in 1952**. It would also provide her with the financial security to be able to quit her job and devote herself full-time to writing and independent scientific research.

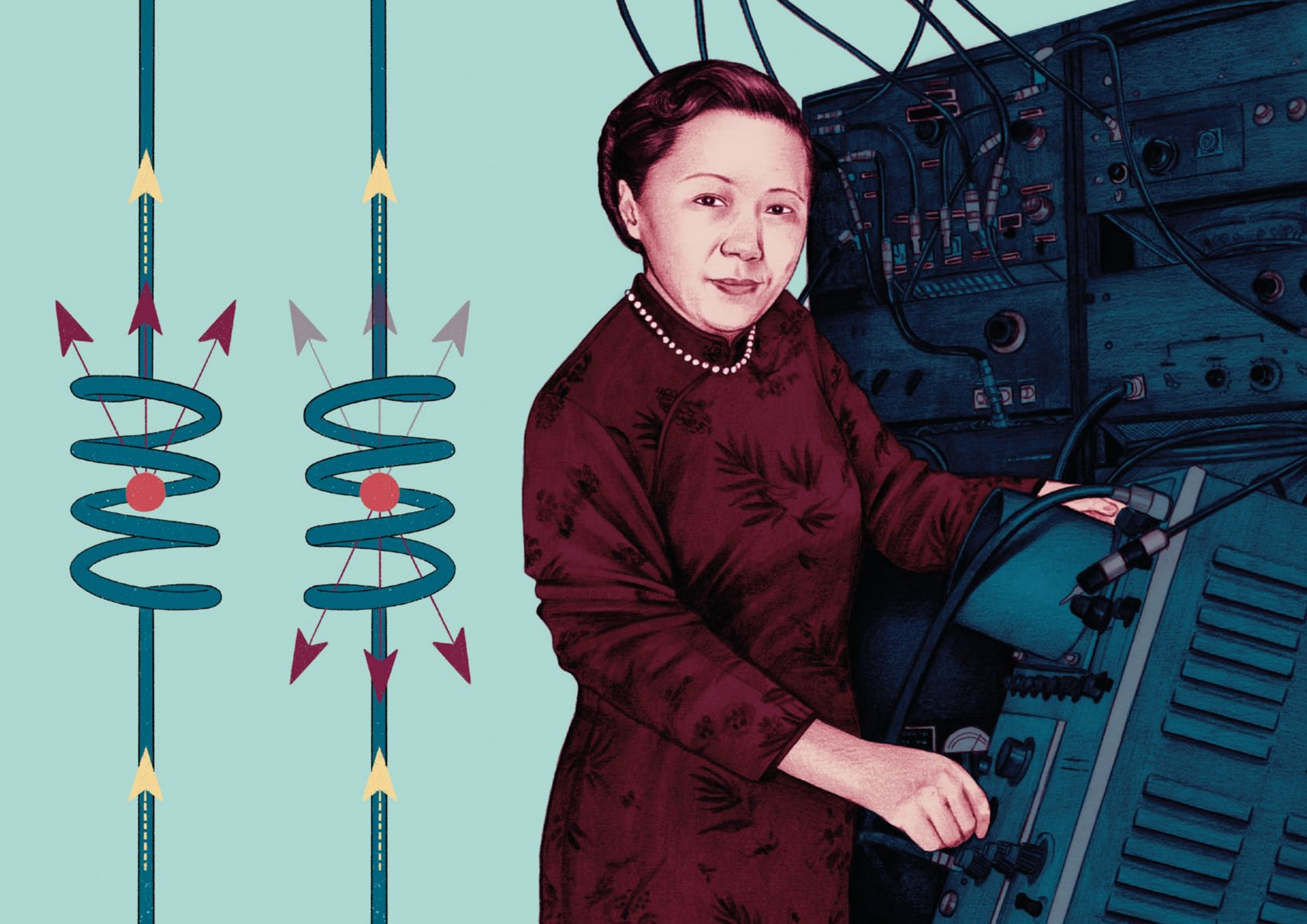
Rachel had the gift of communicating with sufficient scientific rigour, but also with the necessary clarity and beauty of style, to be able to seduce the general public. **The culmination of her expressive ability combined with her love and commitment to nature was her book *Silent Spring***. Published in 1962, it is considered one of the most influential books of the 20th century and the seed of the ecological movement. After delving into the marine theme for a few years, Rachel **began investigating the pernicious effects of a relatively new insecticide: dichlorodiphenyltrichloroethane (DDT)**. This product had been used during the Second World War to control the transmission of diseases caused by mosquitoes, such as malaria. After the war, DDT became widely used, both in the domestic and agricultural fields. In the United States alone, its production went from about 4,300 tonnes in 1944 to more than 81,000 in 1963. This would have disastrous consequences for biodiversity and environmental health, such as the disappearance of many insects that were not the target of insecticide treatments, or the accumulation of DDT in many other species – especially birds and fish, but also in humans – which caused poisoning, illness or directly death. The name of the book, *Silent Spring*, alludes to the absence of birdsong in the fields of Ohio due to the mass death of many birds in this area, due to the use of the insecticide.

***Silent Spring* was an extraordinary sales success**. Suddenly, people were becoming aware of some of the disadvantages of progress and the impact of human actions on the environment. **The work, however, came into direct conflict with the economic interests of the agrochemical industry**. Rachel received classist and misogynistic criticism: because she did not have a doctorate and did not have sufficient scientific judgment, because "despite being quite a buffoon she was single and therefore possibly a communist", or because she was "a hysterical woman", and a "priestess of nature", among other accusations. Curiously, in the book there is no outright opposition to the use of DDT, but a call to control its use.

Rachel's book had a great impact on public opinion, but also in the political and social sphere. In 1963, a report of the Presidential Scientific Advisory Committee on pesticides promoted the limitation of their use and research on the harmful effects. It is considered that *Silent Spring* inspired the ecological movement that began in the 1960s, and **prompted the creation of the United States Environmental Protection Agency, founded in 1970**. Later, environmental protection laws appeared, among them the Law of 1972 that prohibited the domestic use of DDT. Unfortunately, Rachel would not live to see these successes, as she died in 1964 of breast cancer, aged just 56.

Rachel Carson's legacy, however, goes much further than that. **She placed on the table the idea - at that time revolutionary - that humanity is not the owner of nature or the most important thing in it, but is part of it like any other living being**, and made that idea reach a lot of people. When you go out into the countryside, enjoy the noises of nature and remember that "those who contemplate the beauty of the Earth find reserves of strength that will endure as long as life lasts", as Rachel herself recommended!

"Man is a part of nature, and his war against nature is inevitably a war against himself"



CHIEN-SHIUNG WU · Experiments in nuclear physics

In early 20th century China, women had very few rights and a retrograde mentality prevailed in many ways. For example, the tradition of binding women's feet to prevent them from growing was still followed, because small feet were considered attractive and a symbol of femininity. Nevertheless, Chien-Shiung – whose feet were thankfully not bandaged – was born into a family where it was believed that girls had the same abilities and should have the same opportunities as boys.

Chien-Shiung Wu was born in 1912 in Liu Ho, a town near Shanghai. **Her father founded the first school for girls in China** and it was there that Chien-Shiung began her love for maths and science. She immediately excelled and, in 1923, managed to enter the prestigious Normal School for Women in Suzhou – she was ranked ninth out of 10,000 applicants. In 1929, she finished high school as one of the best in her class, and for the next five years she would study mathematics and physics at the Central National University. In 1936, she moved to the United States to study physics at the University of California, Berkeley, after rejecting the University of Michigan because women were not allowed in the front door - they had to enter through the back. **In 1940, she obtained her doctorate in Physics from the University of California, focusing on nuclear energy**, and, two years later, married a labmate, physicist Luke Chia-Lu Yuan. At that time, in the midst of the Second World War, there was a growing feeling of antipathy towards Asian people. Because of this, she had difficulty finding a job, in addition to being a woman in a very male-dominated field. After working for a while at Smith College, a women's college, she obtained a contract at Princeton University, making her the first female professor in that institution's history.

The first half of the 1940s was a turbulent period on a global scale, and scientific knowledge was revealed as a real tool for geopolitical defense. In this context, the Manhattan Project appeared, whose goal was to develop the atomic bomb before Nazi Germany did. Many expert scientists in different disciplines would collaborate in this top-secret project. In 1944, Chien-Shiung became part of it; she participated in the design of a method to enrich uranium and helped create radioactive leak detectors. After the war ended, she got a job as a research professor at Columbia University. In 1947, she had her first and only son, Vincent Yuan, who would become a physicist, like his parents. In 1952, she became a fully tenured teacher and, in 1958, professor. **During much of this time, the focus of her research was beta decay**. This is a physics phenomenon, proposed by Enrico Fermi, by which unstable atoms are transformed into more stable atoms, releasing small particles (electrons). However, from a practical point of view, the phenomenon was problematic and difficult to demonstrate. **Chien-Shiung devised an experiment that confirmed the theory of beta decay.**

In 1956, aware of her experience, theoretical physicists Tsung Dao Lee and Chen Ning Yang asked her to design another experiment to show that the "law of conservation of parity" was not fulfilled during beta decay. This principle states that all particles and their mirror images (reflections) behave in the same way, but in reversed directions. This experiment, of great technical complexity and that **would go down in history as "the Wu experiment"**, showed that although they are identical, nuclear particles do not always act in the same way. She therefore proved Lee and Yang right, and only a year later they would both receive the Nobel Prize in Physics. Chien-Shiung Wu, who had demonstrated the phenomenon empirically, was excluded, but she did not allow this injustice to take away her desire to continue her research. **In 1965, she published *Beta decay*, one of the benchmark books in nuclear physics**. In subsequent decades, she received the recognition that the Nobel Prize had denied her. She won many awards, among them the **National Science Medal in 1975** and the **Wolf Prize in Physics in 1978**. At the same time, she also developed a political conscience. She publicly protested the imprisonment in Taiwan of prominent scientists and journalists, and much later would be one of the public voices against the repression in China after the Tiananmen Square massacre. Already retired, she dedicated herself to helping young researchers pursue a scientific career. She participated in many educational programmes, where she was invited to explain her own personal struggles in research. In 1997, she died in New York at the age of 84, the victim of a stroke. At her express wish, her ashes were buried in the yard of the school that her father had founded in China.

We close here with a sentence spoken by Chien-Shiung during a symposium at Massachusetts Institute of Technology (MIT): **"I wonder whether the tiny atoms and nuclei, or the mathematical symbols, or the DNA molecules have any preference for either masculine or feminine treatment"**. As a scientist in the world of physics, a field still very much dominated by men, she also denounced the gender discrimination she had experienced first hand.

"There is only one thing worse than coming home from the lab to a sink full of dirty dishes, and that is not going to the lab at all!"

CREU CASAS I SICART • "The Doctor"

According to a family anecdote, told by her daughter, when Creu was two or three years old she pulled out a plant by the stem and damaged it a little. Her father, a gardener by profession, was very angry because he considered this to be abuse, and he made her kneel before the plant to ask for forgiveness. Certainly, from a very young age, our protagonist grew up in an environment of admiration and respect for nature.

Creu Casas i Sicart was born in 1913 in Horta, a neighbourhood of Barcelona. She belonged to a working class family: her father was a gardener and her mother a housewife. The father was hired at the residence of Rafael Patxot i Jubert, one of the great cultural patrons of Catalonia. Patxot's financial support would be fundamental in Creu continuing with her studies, a possibility that would normally not have been within the reach of a modest family like hers. On the other hand, the knowledge and appreciation for plants that she had learned from her father from a very young age was key to cultivating her vocation as a naturalist. She received her secondary education at the *Institut Tècnic Eulàlia*. When it was time to go to university, Creu decided to study natural sciences. Her father was not on board, because he believed that she would not make a good living; so she chose a Pharmacy degree - because she knew there was "a lot of botany in it". She started it in 1931 and, in the same period, studied and obtained a Nursing degree at the *Escola Santa Madrona*, a degree she would never put to use. **During her time at university, she attended classes by Pius Font i Quer**, illustrious botanist and founder of the Botanical Institute of Barcelona (1935), whose personality and teaching methods she admired. The classes given by Dr. Font stimulated – even more markedly – her passion for botany.

In 1936 she obtained her Bachelor's degree and worked in a pharmacy in her neighbourhood for a while. She then entered the *Clínica de l'Aliança* pharmacy, where she would meet her future husband. During all this time, however, she remained in touch with her former classmates and botany professors at the university, and participated in small expeditions and field trips. As a result of the contacts made on these trips, an opportunity arose for her to work at the university, as a part-time Assistant Professor in Botany (1947). Thus, Creu came to be **the first female professor at the Faculty of Pharmacy (1949)**, a job she combined with that of director of the clinic's pharmacy for a long time.

Shortly afterwards, she would begin her doctoral thesis and her real research career. **Her subject of study would be bryophytes, generally very small and simple plants that grow in humid places - most of them belonging to the group of mosses**. Bryophytes help retain water in the soil and provide moist habitats for other organisms. They can serve as bioindicators of air quality, as they are highly sensitive to changes in atmospheric pollution levels. Because of their apparent simplicity and small size, however, bryophytes had not been studied very much. Creu made a great contribution to knowledge of them, and in her thesis alone she offered a list of 366 mosses and 102 liverworts from the Montseny massif.

After eighteen long years of internship, she finally obtained a position as assistant professor at the University of Barcelona (1967). **Four years later, she was appointed to the Botany chair at the Autonomous University of Barcelona, making her the first Botany professor in Spain**. Thanks to the work of Creu Casas and her team, Catalonia is, even today, one of the areas, on a global scale, where bryophytes have been most studied. She became a great specialist in bryophytes, and founded a Catalan bryological school, with international projection. During her career, she was the author of more than 200 works on this subject. But she was not only an excellent scientist and passionate about field work: **she also stood out as a teacher, always willing to attend to the students and make the classes rigorous and enjoyable**. She had an extensive knowledge of all plants, in addition to a prodigious memory and a great work ethic. When an emeritus, she continued to go to her department every day, accompanied by her cane, and immediately started looking under the microscope or determining herbarium sheets. Despite her modest temperament, she radiated a special presence, and was known, simply, as "the doctor". She continued to go to work until a few months before she died in 2007, at the age of 94.

Creu Casas was a pioneer in many things: as has already been said, she was the first female professor in the Faculty of Pharmacy and the first professor of Botany in Spain, **but also the first woman to enter the Institute of Catalan Studies (1978), the first woman to preside over the Catalan Institute of Natural History (1980) and the first female president of the Spanish Society of Bryology (1989)**. In 2017, the Creu Casas award was created by the IEC, in recognition of women who promote the interest and participation of women in any field, through dissemination and empowerment. The ICHN was dedicated to the first Grant for Naturalist Women that was announced in 2021.

"The classes were rigorous and well informed; she was very well-prepared when giving them (...) and had an exceptional ability to know about many groups of organisms beyond bryophytes"

(Jordina Belmonte, former student of Dr. Creu Casas and president of the Catalan Institute of Natural History)

LYNN MARGULIS · The Rebel Scientist

Lynn Margulis was born in Chicago in 1938 and was the eldest of four daughters in a wealthy family of Jewish origin. Although she described herself as a poor student and a rebel, at the age of 16 she was accepted into the advanced student programme at the University of Chicago and at the age of only 19 she obtained her degree in Biology.

Shortly after receiving her degree, she married a fellow university student, the well-known astrophysicist and scientific communicator Carl Sagan. In 1958, she joined the University of Wisconsin as an assistant professor and pursued a Master's degree in Zoology and Genetics under the supervision of Professor James F. Crow. Of him, Lynn would say: **"He changed my life. When I left the University of Chicago, I knew I wanted to study genetics, but after his classes I knew I only wanted to study genetics"**. In 1965, she obtained her Ph.D in Genetics from the University of Berkeley, and then joined the Department of Genetics at Boston University, where she would work as a professor and researcher for more than 20 years. In 1967, she remarried, this time to the chemist Thomas N. Margulis, whose surname she took. Thirteen years later, at the age of 42, she already had four children and had been divorced twice. Some time later, she would comment that "it is not humanly possible to be a good wife, a good mother and a first-class scientist. No one can do it, something has to go."

Lynn had always been very curious about bacteria, even though back then they were basically considered germs and did not usually attract much interest. She was also intrigued by the apparent similarity of mitochondria and chloroplasts to these microorganisms. She was starting to conceive the endosymbiotic theory, her most important contribution. **This theory establishes the appearance of the eukaryotic cell as a result of the incorporation of other bacteria, which become an indissociable part of it**. She compared bacteria, mitochondria and chloroplasts, noting very significant commonalities. For example, she noticed that they were all relatively similar in size and all contained DNA and their own ribosomes. The evidence seemed to indicate that mitochondria and chloroplasts had been bacteria at an earlier time. **It was a paradigm shift in evolutionary biology**.

Although the endosymbiotic theory elegantly solved the mystery of the emergence of the eukaryotic cell from the prokaryote — an evolutionary leap that was difficult to understand – her work found strong opposition within the scientific community. **The article presenting it was rejected by 15 scientific journals before it was finally published in 1967**. Lynn, however, defended her revolutionary theory tenaciously and continued to develop it in the book *Origin of Eukaryotic Cells*, published in 1970. In 1978, it was experimentally shown that mitochondria came from bacteria and chloroplasts, specifically, from cyanobacteria, which supported the idea of endosymbiosis. In subsequent decades, especially from the explosion of genomics and bioinformatics, more studies and discoveries have been made that have confirmed this theory.

Somehow as a consequence of the endosymbiotic theory, Lynn argued that cooperation, rather than competition, was the engine of evolution. This was very much in line with the ideas about "global cooperation" on a planetary scale by the **British scientist James Lovelock**, who proposed the **Gaia hypothesis** at the end of the 1960s (Gaia is the name of the Greek goddess of the Earth). Lynn would enthusiastically participate in the development of this theory in collaboration with Lovelock. **It is a view of planet Earth as a complex and self-regulating system, similar to a living organism**. According to this idea, all components of the biosphere – which includes all living things on the planet and non-living elements such as the atmosphere, land surface and oceans – interact ("cooperate") to regulate environmental conditions and maintain a favourable balance in life. The Gaia hypothesis has been widely questioned, with radical views considering it a kind of pseudoscience. Even so, the importance of interactions between the living part and the inert part of the Earth is now accepted and, despite criticism, **the hypothesis has contributed to raising awareness of the importance of taking care of our planet in a sustainable way**.

Lynn went on to make many other interesting contributions to evolutionary biology during her career; she contributed to the classification of living things and further investigated bacteria and other symbiotic life forms. She received prestigious recognitions, such as the **National Science Medal**, presented to her by Bill Clinton in 1999. She collaborated with researchers from the Universitat Autònoma de Barcelona - where she was a visiting professor during the 1980s - through the study of microorganisms in the Ebro delta. She was the author of hundreds of scientific articles and also of many books, including textbooks and popular science books. In 2011, aged 73 but still working at full capacity, she suffered a stroke and died five days later at her home in Massachusetts.

The legacy of the "rebel" Lynn Margulis has inspired - and will continue to inspire - generations. Her provocative ideas, determination and passion for understanding the complexity of life make her one of the most influential scientists of our time..

"The dream of any scientist is to rewrite the school textbooks. Lynn Margulis achieved it"

(Niles Eldredge, American paleontologist)

WANGARI MUTA MAATHAI • The Power of Women and Trees

The Kikuyu are the largest ethnic group in Kenya; they have their own language and traditions, and their economy has historically been based on agriculture. In a village in rural Kenya, a Kikuyu girl stood out for her intelligence and determination. Although her most likely destiny as a woman who was poor and black, would have been to work in the fields, she was able to study. This was the seed of the change that would lead, years later, a change that combined environmental awareness with female empowerment.

Wangari Muta Maathai was born in 1940 in Ihithe, a town in Kenya, which was a British colony at the time. Her mother noticed right away that Wangari was very smart and ensured that she went to school with her brothers. In 1960, she was one of 300 young Kenyans who won a scholarship to study in the United States, where she would graduate with a degree in biology in 1964. Two years later, she was given a job at University College in Nairobi. In 1967, she packed her bags again and travelled to Germany to begin her Ph.D. In 1969, she married Mwangi Mathai, another who had taken up a study scholarship in the United States, and, **in 1971, she would become the first woman from East Africa to earn a Ph.D**, in her case, in Veterinary Anatomy. In December of the same year, she had her first daughter: Wanjira. Wangari also became **the first woman in Nairobi to be Senior Lecturer (1975), Head of Department (1976) and University Professor (1977)**. During this time, she had two more children: Waweru and Muta. It was at this time that she began to develop a sense of social awareness about women's rights, and campaigned for equal pay and opportunities between men and women at the university.

In 1976, she joined the National Council of Women of Kenya (NCWK), which she would preside over from 1981 to 1987. Thanks to her involvement in the NCWK, Wangari heard, at first-hand, the testimony of many women who told her that the rivers were drying up or were polluted, that they had to go farther and farther in search of the water and wood, or that there was less and less food to eat. She realised that environmental degradation was the cause of many of these problems and also that an ecological and women-based approach could be the solution. On 5 June 1977, on World Environment Day, she led a march from downtown Nairobi to the outskirts of the city where seven trees were planted in commemoration of historic community leaders. This would be the first public act of the **Green Belt Movement**. The movement encouraged Kenyan women to plant trees, with indigenous seeds being collected from nearby forests and small tree nurseries being set up all over the place. In return, the women would receive a small salary and basic training in forestry, food processing, beekeeping and other related subjects. In this way, community work to care for the environment was promoted and women were empowered to lead it.

1977 was also a difficult year for Wangari, as she was involved in a separation from her husband. At that time, she was already quite popular, and the divorce had a certain resonance. Her ex-husband made sexist accusations against her, and said that "for a woman, she was too determined" and that it was "difficult to control her". He accused her of adultery, a fact that prompted the judge to be more favourable to him over her. Wangari publicly criticised the judge for his incompetence and as a result she was sentenced to six months in prison, although she spent only three days there. The ex-husband requested that her last name be removed, and she agreed to a solution all by adding an extra "a" (from Mathai to Maathai).

The Green Belt Movement would be a huge success and would receive a lot of international attention. At the same time, however, Wangari realised that the hunger, poverty and environmental problems that plagued Kenya had, above all, a political basis. In the 1980s, Kenya had a government with authoritarian overtones. Wangari would now become an activist in defence of human rights and democracy. In 1989, she would lead the opposition to the construction of a huge building in the middle of Uhuru Park in Nairobi, and thanks to her popularity and media coverage, the investors abandoned the project. From that moment on, she was considered an enemy of the government's interests, despite growing popular and international recognition, and she was subjected to arrests and political harassment. Even so, in 1992 the first multi-party elections were held in Kenya and, in 2002, she became a Member of Parliament. In 2004, she received the **Nobel Peace Prize, for "her contribution to sustainable development, democracy and peace", and in doing so became the first African woman to win it**. The award contributed to providing even more popularity for the Green Belt Movement, which is still active today. Today, as a result of this project, more than 51 million trees have been planted and more than 30,000 women have learned a profession which, while providing them with economic means, helps preserve natural resources.

Wangari died in 2011 at the age of 71, a victim of ovarian cancer. She was an intelligent woman, resolute and much loved by her family and the people of her country. Dr. Maathai is a role model for all women, especially for those who have had to feel, many times, that they are "too smart" or "too sure of themselves"... given they are women.

"Change starts with a seed, so let's start sowing"

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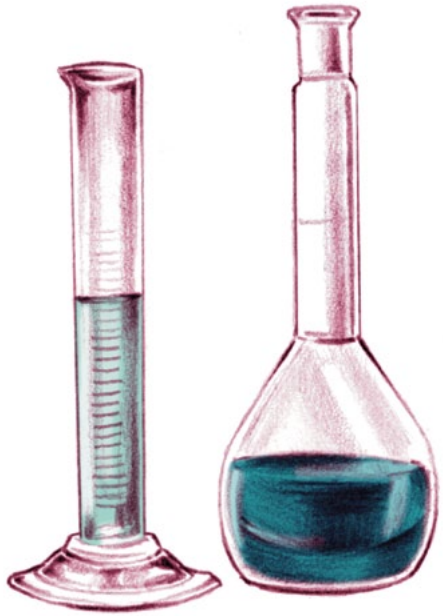

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This slim volume is an invitation to learn about the lives and achievements of **twelve extraordinary women** in fields related to energy, ecology, meteorology, **sustainable development or natural resources**, among others. Despite the importance of their contributions, most of them are still largely unknown. However, behind the invention of the bain-marie, the discovery of artificial radioactivity or the start of the ecological movement, there is an exceptional woman. In addition to understanding what they invented, found or starred in, you will also discover what they were like and the challenges – and some disappointments – they had to face, many times, simply because they were women.