#NOMOREMATILDAS PRESENTS THE HYPOTHETICAL LIFE OF

MATILDA SCHRÖDINGER

#NO MORE MATILDAS

An idea of GETTINGBETTER
for AMIT (Association of Women Researchers and Technologists)
with the collaboration of DOS PASSOS

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TO ALL THOSE GIRLS WHOM WE HAVE MADE BELIEVE THAT "SCIENCE IS A MAN'S THING."

Prólogo de Adela Muñoz Páez

Professor of Inorganic Chemistry
and president of AMIT-Andalucía

There was a time when we believed that science was an activity free from the prejudice that permeate our entire life. But in the late 1990s, Swedish researchers revealed irrefutably that, like all human activity, science was not immune to prejudices, including those that consider women less intelligent, tenacious and brilliant than men[1]. A huge stir was organized and in the European Community, committees were created and actions were designed to eradicate gender biases which said women were less skilled than men for science.

More than twenty years have passed and the prejudice is still there[2]. Not only has the problem not been resolved yet, but many people, including some scientists, still don't see it. We hope that the story of what would certainly have been Schrödinger's life if he had been born a woman, helps them understand the importance of eradicating prejudices so that no other genius is lost to the world, so that there are no more Matildas.

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[1] Weneras, C. y A. Wold (1997), *"Sexism and Nepotism in Peer Review"*, Nature, 387:321-343.

[2] Moss-Racusin, Corinne A.; Dovidio, John F.; Brescoll, Victoria L.; Graham, Mark J.; Handelsman, Jo (2012). *«Science faculty's subtle gender biases favor male students.»*. PNAS (in english) **109** (41): 16474-16479. doi:10.1073/pnas.1211286109.

#NO MORE MATILDAS

It is likely that if Schrödinger had been born a woman, today, that last name would hardly sound familiar to us. And the merits of her discoveries would have been taken by a fellow male researcher or even by her husband. This phenomenon, which is known as the Matilda Effect, points out the injustice that has consciously and systematically relegated to oblivion the findings of brilliant scientists such as **Hildegarda de Bingen, Nettie Stevens, Lise Meitner, Marietta Blau or Rosalind Franklin** among many others. It was the science historian **Margaret W. Rossiter** who named this injustice in honour of **Matilda Joslyn Gage**, a womens' rights activist, and it is the name that we have decided to give the protagonist of this illustrated uchronia.

A story that joins the actions raised from the No More Matildas campaign to report this fact and to recover all these scientists. Women who could have become role models for all the girls whom we have made believe that science is only for men by depriving them of female examples.

THE LARGEST STUDY ON THE PRESENCE OF WOMEN IN EDUCATIONAL MATERIAL, CARRIED OUT BY ANA LÓPEZ-NAVAJAS, REVEALS

AN AVERAGE FEMALE REPRESENTATION OF 7.5%

IN ALL SUBJECTS IN THE SPANISH COMPULSORY SECONDARY EDUCATION CURRICULUM.

ACCORDING TO UNIVERSITY STATISTICS PUBLISHED BY THE MINISTRY OF EDUCATION DURING THE 2019 SCHOOL YEAR,

THE NUMBER OF FEMALE ENROLMENTS IN SCIENCE DEGREES STANDS AT 28.5%

AT AMIT WE BELIEVE **THAT TALENT HAS NO GENDER**, AND TO IGNORE THE ONE THAT COULD EMERGE IN GIRLS AND TEENAGERS WHO DO NOT CHOOSE A SCIENCE DEGREE BECAUSE THEY DO NOT HAVE MIRRORS IN WHICH TO SEE THEMSELVES REFLECTED, IS A CULTURAL LEGACY THAT WE SHOULD STOP PERPETUATING.

#NOMOREMATILDAS PRESENTS THE HYPOTHETICAL LIFE OF

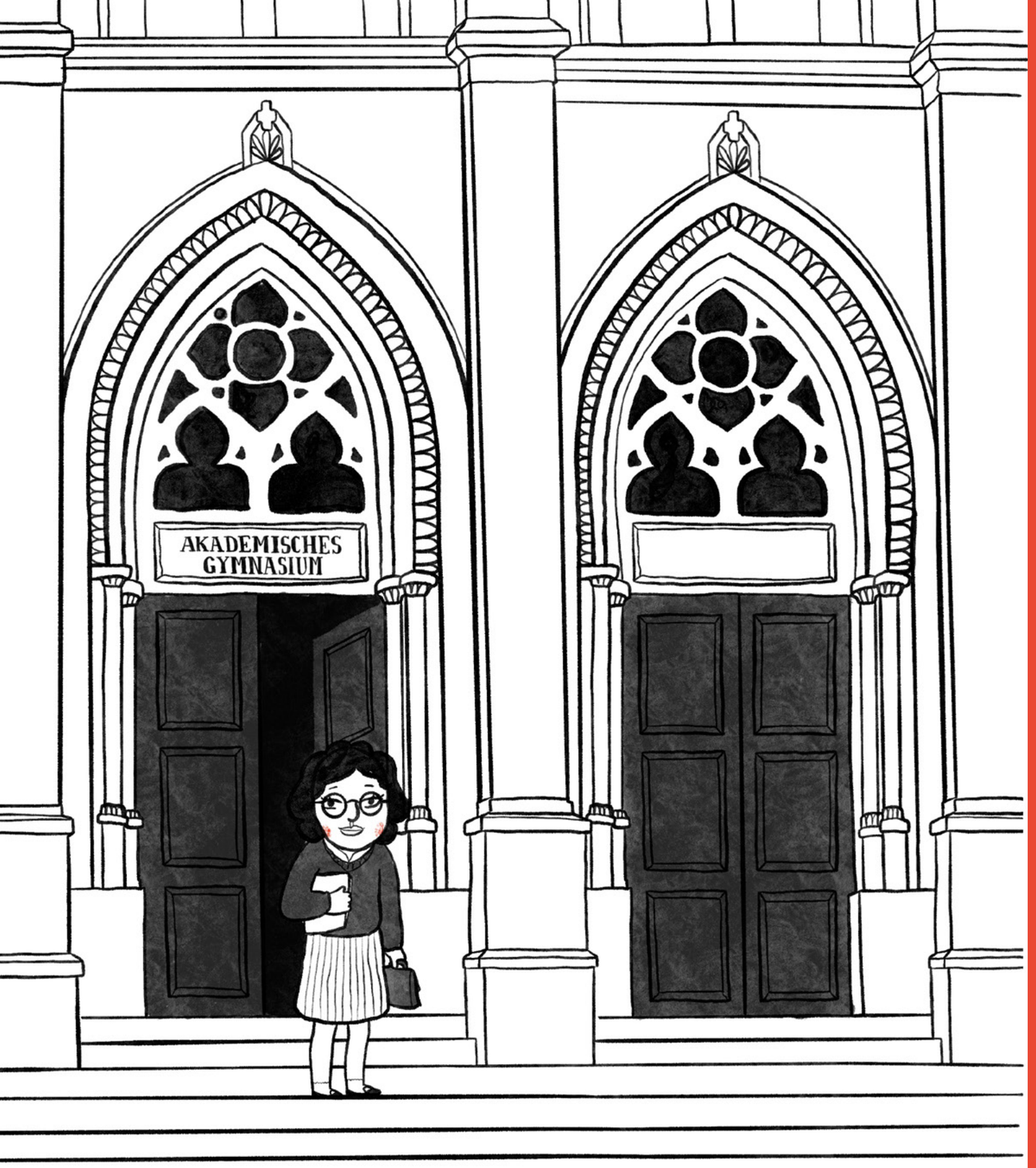
MATILDA SCHRÖDINGER

An old saying goes, as old as absurd it is, that curiosity killed the cat. In fact, it is not true. The cat would be killed by the senselessness. Or recklessness. But never curiosity! This was what Rudolf Schrödinger thought, and he refused to accept such warnings from popular culture to dissuade those who have a natural inclination to enter the unknown. Maybe that's why, to protect the childish curiosity of his daughter, he preferred to adhere to another old saying about cats: they have seven lives.

It's pretty paradoxical, but the big questions often come up when we are little. And to our curious Matilda Schrödinger, the smallest things were the most intriguing to her. How were those invisible atoms his father was always talking about? How did they behave? How to know where they were if they weren't visible? How tiny would something have to be to not be seen?

One day, her father told her a trick to conceive the infinitesimal size of atoms that Matilda would never forget. Imagine you have a glass of water, Matilda. Imagine you could mark all its particles. Now imagine that you pour it into the sea and stir it. Do you know what would happen if you used that same glass to collect water at any other point of any sea or ocean on the planet, Matilda? Well, in that new glass of water you would find thousands of the labeled molecules!

Far from quenching her thirst for knowledge, the famous analogy of the glass of water formulated a century ago by the British mathematician Lord Kelvin, pushed Matilda to search answers at the very sources of quantum physics.



When Matilda enrolled in the *Akademisches Gymnasium* of her native Vienna, women were still banned from university. It was not until a few years later, already entered the 20th century, when the Austrian government allowed young women students to continue with their higher cycles in bachelor's degrees of science. Matilda did not miss the historical moment and soon became one of the first female students to graduate in Physics from the University of Vienna.

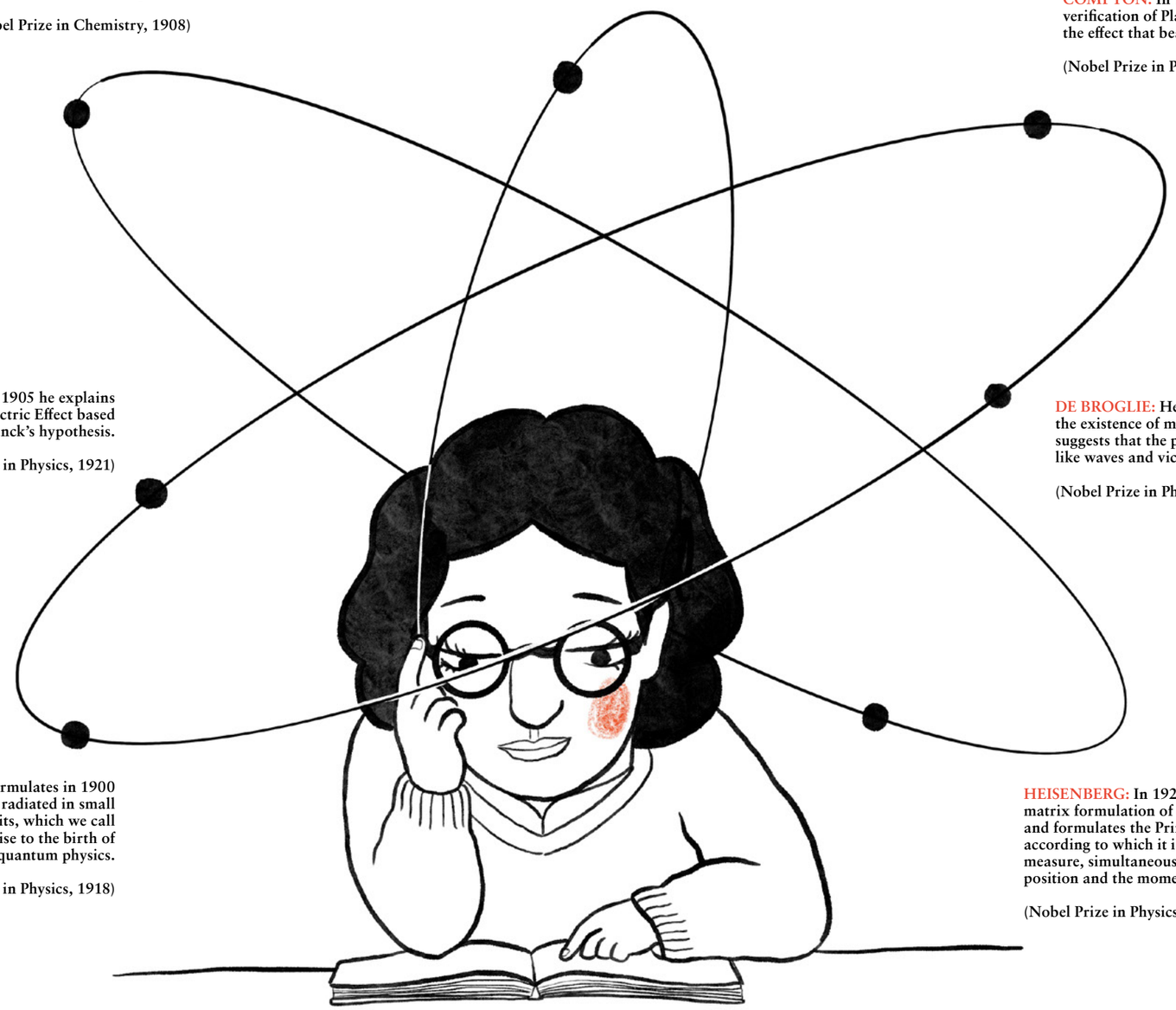
RUTHERFORD: In 1911 he establishes the planetary model of the atom, with nucleus (containing protons and neutrons, similar to the sun) and electrons orbiting like planets.

(Nobel Prize in Chemistry, 1908)

BOHR: He adds Planck's quantum hypothesis to the model proposed by Rutherford and suggests that electrons can only occupy one discontinuous set of orbits and energy levels.
(Nobel Prize in Physics, 1921)

COMPTON: In 1923 he presents a new verification of Planck's hypothesis, through the effect that bears his name.

(Nobel Prize in Physics, 1926)



EINSTEIN: In 1905 he explains the Photoelectric Effect based on the Planck's hypothesis.

(Nobel Prize in Physics, 1921)

DE BROGLIE: He proposes in 1924 the existence of matter waves and suggests that the particles can behave like waves and vice versa.

(Nobel Prize in Physics, 1929)

PLANCK: He formulates in 1900 that energy is radiated in small separate units, which we call quanta, giving rise to the birth of quantum physics.

(Nobel Prize in Physics, 1918)

HEISENBERG: In 1925 he invents the matrix formulation of quantum mechanics and formulates the Principle of Uncertainty according to which it is impossible to measure, simultaneously and precisely, the position and the momentum of a particle.

(Nobel Prize in Physics, 1932)

Those were years of true scientific effervescence, with the emergence of branches like relativity or quantum physics that would end up leading to modern physics.

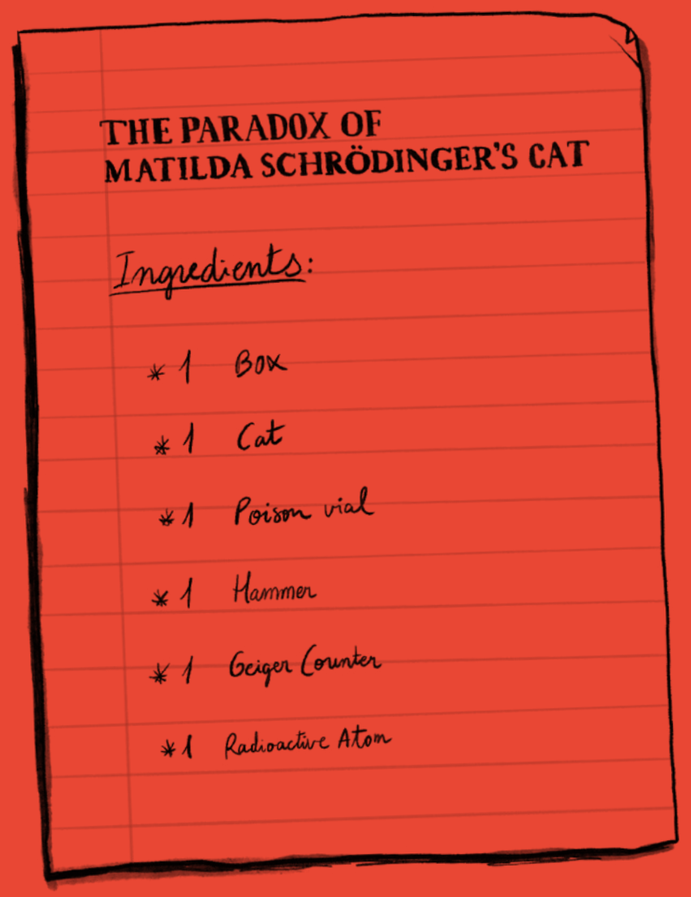
Matilda could barely sleep thinking about all those theories with which the most prestigious physicists were questioning the nature of reality.

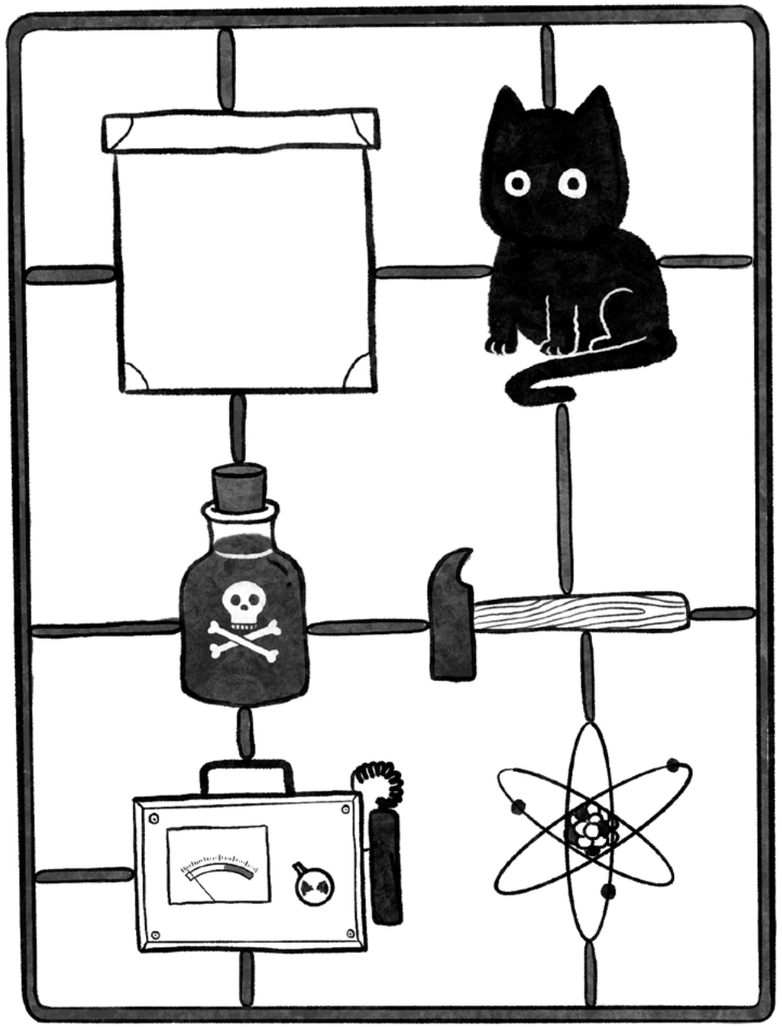
It is said that if you think you understand quantum physics, you have not understood it. And no one in 1926 understood how our curious young lady had been able to describe, with an equation, the way in which a particle changes over time.

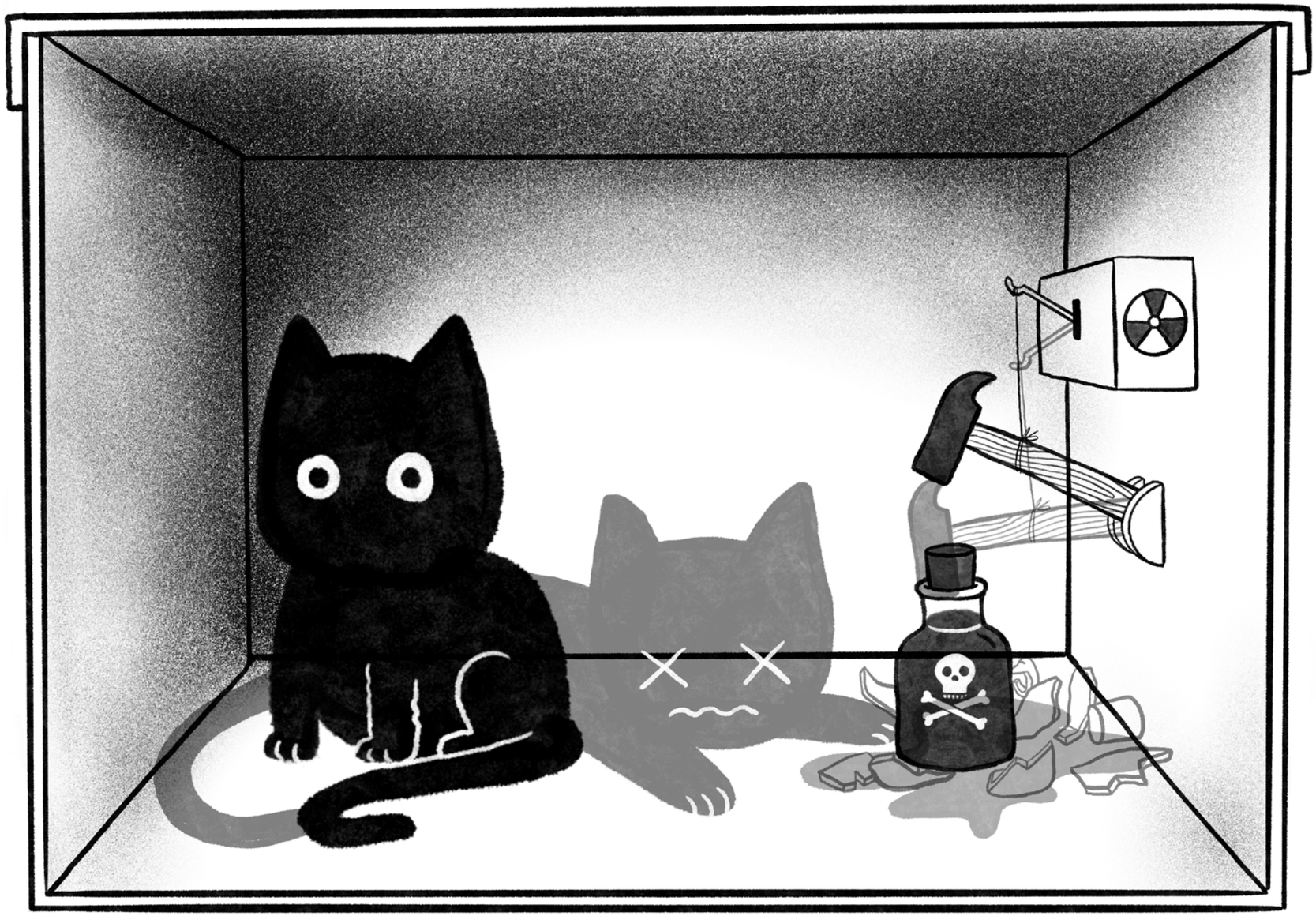
Matilda thought that if, as de Broglie implied, the matter behaved both as a body and as a wave, it might make sense to study particles as the rest of waves are studied, such as sound waves or those that are produced in the water. Matilda was establishing the foundations of the wave mechanics, and its equation would allow us to establish mathematically the probability of space occupation by electrons.

In our macroscopic world, things are relatively easy to locate: they are here or there. Inside or outside. Up or down. For that reason, and although throughout the day Matilda seemed able to be in more than one place at the same time, the rules that governed the newly discovered subatomic world did not stop representing for her a disturbing intellectual challenge. Challenging enough to find it absurd to try to apply the quantum theory to our everyday reality. But there was something that did not fit. Matilda thought something was wrong.

And that's how Matilda came up with a mental experiment to demonstrate the irrational nature of that physic interpretation of quantum theory that, however, renowned scientists like Bohr or Heisenberg seemed to defend.







"STEPS"

- Lock in a box a cat with a deadly poison vial and a radioactive particle detector able to drop a hammer and break it.

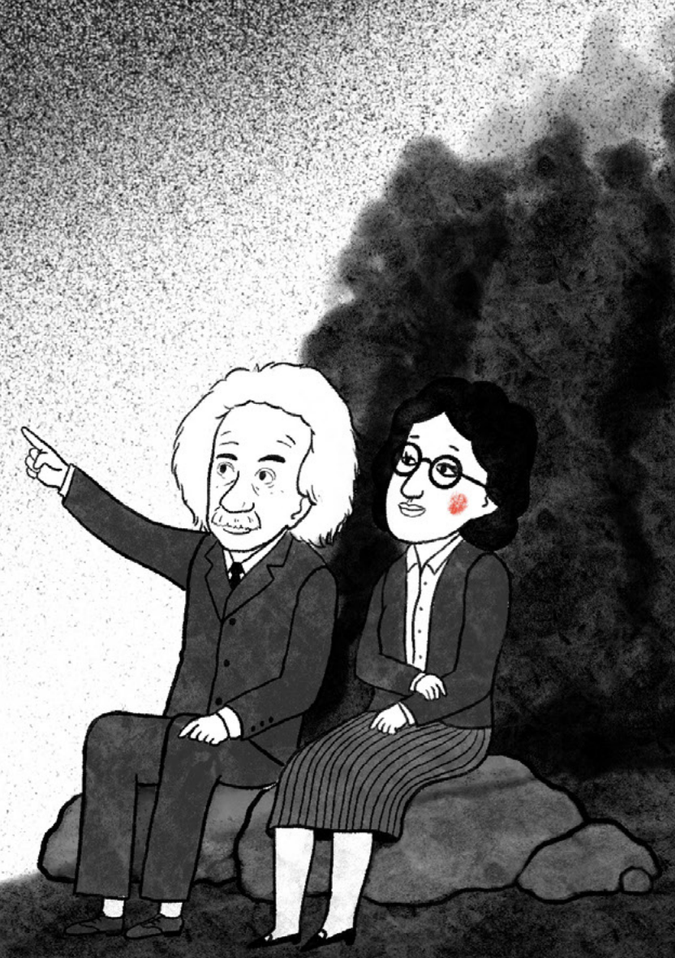
- Deposit inside the box an atom with 50% of probability to disintegrate.

- According to quantum theory, there is 50% probability that the atom disintegrates and is detected by the device, and 50% that does not disintegrate. That is, they can overlap both events.

- So, in the quantum world, the cat would be poisoned and would not be poisoned. He would be alive and dead at once. Both states would be equally probable until someone opens the box and, discovering the status of the cat, modifies it.

Matilda was delighted to hear that her admired Einstein subscribed to her cat paradox. He had positioned himself against that recent idea that reality was modified by the simple observation, suggesting sarcastically that it might even be possible that the moon would not be there when no one was looking at it.

But it is useless that the greatest genius of the 20th century supports you if he's the only one who does...



Matilda, who had never hidden her rejection of the growing anti-Semitism of the Nazi party, was soon harassed by the regime. It was not difficult for the defenders of Aryan purity promulgated by the Deutsche Physik, to accuse “that crazy cat lady” of founding theories incompatible with reality, and Matilda had no choice but to leave the country.

Matilda abandoned her scientific career to retire to a quiet home in the English countryside. And although nobody ever knew about her, her paradox of the cat did not stop awakening the curiosity of the most notable physicists of the following generations. Some theories, such as Everett's, even proposed the existence of parallel universes to solve her cat enigma, holding that both the living and the dead cats existed, but in different branches of the universe.

And Matilda found it funny, although she was also thrilled to think that, perhaps in another parallel reality, that year 1933, Paul Dirac was not the only awarded Nobel Prize in Physics.

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The hypothetical life of Matilda Schrödinger is an illustrated story that joins the actions launched to denounce the consequences of the Matilda Effect through the No More Matildas campaign. An initiative that seeks the recovery of feminine references to inspire and promote the scientific vocation in all those girls whom we have made believe that science is only for men.

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