Santiago Ramón y Cajal, the ultimate scientist?

Santiago Ramón y Cajal (1852–1934) was a family man, a ground-breaking photographer, an artist, an accomplished writer, a hypnotist, an avid chess player and many other things but, above all, he was a scientist. Science was his job, his passion, his obsession and his refuge. When his daughter Enriqueta caught a serious fever, probably a meningeal tuberculosis, and the limited medical resources of the time were not enough to offer a cure, his wife Silveria stood guard by her bed all night, while Santiago escaped to his study, unable to cope with the situation, where he could isolate himself of the troubles that plagued the real world. There, in his private domain, he would normally spend every free minute he had using his microscope to explore new horizons and solve the questions that intrigued him the most. It was his stubbornness, patience and immense powers of observation that led him to become one of the most accomplished scientists of his and perhaps all time.

The Nobel Prize in Physiology or Medicine for 1906 was shared by two scientists that set the basis for understanding how the brain works: Camillo Golgi and Santiago Ramón y Cajal were awarded the honour "in recognition of their work on the structure of the nervous system". Yet, contrary to what usually happens in these situations, one of them was wrong and tried to sabotage the theories of the other one, refusing to admit his mistakes even when he gave his acceptance speech. How did Santiago Ramón y Cajal, a humble Spanish doctor, manage to upstage the legendary Italian pathologist and change forever the way we see the brain?

There, he discovered that things at the university were not as bad as he thought. There were plenty of opportunities to quench his never-ending curiosity. His new awareness of the puzzle-solving dimension of medicine really excited him. He also came to realize that his passion for art was actually an asset when studying anatomy. He eventually joined the department, where his father also worked. Thus, his career as a scientist began by dissecting cadavers and drawing what he saw, as well as teaching the basics to the new students. Very early on he realized that it was understanding how the human body works that truly interested him, not being the one that deals with it when the patient gets sick. Having assisted his father, under duress, on many occasions when he was a child, Santiago knew that he was going to be happier working in a laboratory than at the hospital or visiting sick people from town to town. And this is exactly what he did for the rest of his life.

Already a married man and with a growing family, Santiago moved to Valencia, where his name quickly became linked to the study of infectious diseases, the topic he had to teach at the university there. He gained notoriety (and a few lifelong enemies) when he used scientific reasoning to discredit a vaccine that was being given to quell the cholera epidemic that was ravaging the city in 1885. But microorganisms were not what really interested him and he soon turned his attention to the most mysterious of the organs in the human body: the brain.

It was in Barcelona, where he moved to in 1888, that Santiago made his most famous discoveries. He arrived with the idea of perfecting his burgeoning studies on nervous tissues, excited because Barcelona was then a thriving city where some of the best doctors and scientists...
of the country were working. 1888 has been considered his 
\textit{annus mirabilis}, the year that all the pieces of the 
puzzle started fitting together. Santiago was 35 years old 
when he realized that the mess of fibres that one could see 
when looking at a stained cut of the brain was actually a 
forest of neurons. His intricate drawings, still useful and 
amazing to look at 130 years later, describe what he was 
seeing in as much detail and accuracy as a photograph 
would do today. They are a testament to his ability to 
observe nature, as well of his artistic prowess, being put to 
use in ways that his father would never have dreamed of 
when he was trying to dissuade Santiago from becoming a 
professional painter.

The turning point of Santiago’s career came when he 
took advantage of knowledge gained from photography, 
one of his enduring hobbies, and applied it to his 
science. He used understanding of the chemistry of 
photograph developing to improve a famous technique 
devised by Camillo Golgi. The Italian biologist was 
already legendary when Santiago started studying 
samples under his cheap microscope. It was thanks to 
Golgi’s special silver staining that Santiago could begin 
his work. But the young Spaniard was clever enough to 
tweak the method to achieve a clarity and resolution that 
no one had seen before. It was this, plus the many hours 
that he spent on the microscope, that allow him to see 
the nervous system in a different way. Santiago was the 
first to propose that neurons were individual cells that 
communicated with the others through long arms that 
looked like branches in a forest full of trees, instead of a 
single continuous network like Golgi and everyone else 
believed at the time.

The contributions of Golgi to histology and the study 
of the brain are numerous and essential, making him a 
worthy recipient of any prize. However, he failed to 
recognize how Santiago’s theory worked much better than 
his when describing how neurons are organized. Despite 
his opposition, the rest of the world caught on to the 
new discoveries pretty fast, and soon Santiago became a 
celebrity. It happened first in scientific circles, but his fame 
quickly expanded everywhere else, especially after the 
Nobel Prize, the first for a Spanish scientist, pushed him 
into the spotlight that he disliked so much.

In 1892, Santiago left Barcelona for Madrid, where he lived 
the rest of his life trying to shun the sudden recognition 
that he had acquired. Even for a country that, historically, 
had never been too interested in science, it was difficult 
to ignore the revolution that Santiago’s discoveries had 
brought to medicine and thus to society. He continued his 
research until the very last day, at the same time training 
a new generation of Spanish histologists and scientists 
that took his legacy even further. Part of this legacy also 
includes a cluster of highly entertaining books for all 
audiences. Still read regularly in Spain, the books offer 
a mix of autobiographical writings with thoughts on the 
most diverse topics, culled from his experiences of years 
of being an avid observer. They are often related to science 
but also include politics, history and all the other topics 
that concerned him.

Despite his wide array of interests, Santiago will be 
remembered above all as a man devoted to science. The 
evening his daughter Enriqueta was fighting for her life, 
Silveria was unable to draw Santiago’s attention, even when 
she realized the girl was getting worse. Locked in his study, 
planted against the microscope, like many other nights, Santiago 
was oblivious of what was happening outside his kingdom. 
When he eventually came out of the room, many hours 
later, he found his wife nursing the dead body of Enriqueta. 
She had not wanted to disturb him, so she just remained 
alone in her room, crying in silence. This is one of the many 
examples which show that, for Santiago Ramón y Cajal, 
science always came first. Thanks to his unconditional 
devoition, he managed to change the world.

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\caption{Salvador Macip is a scientist and writer. He 
attended medical school at the University 
of Barcelona, where he also obtained a PhD in Molecular Genetics. He is an 
Associate Professor at the Department 
of Molecular and Cell Biology of the 
University of Leicester, where he heads the 
Mechanisms of Cancer and Ageing Laboratory. He has published 
over 30 books in Spain, many of which have been translated. 
These include popular science books such as \textit{Where Science and} 
Ethics Meet (with Chris Willmott, winner of the XIX European 
Price for the Popularization of Science) and a biography of 
Santiago Ramón y Cajal. Email: sm460@le.ac.uk}
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