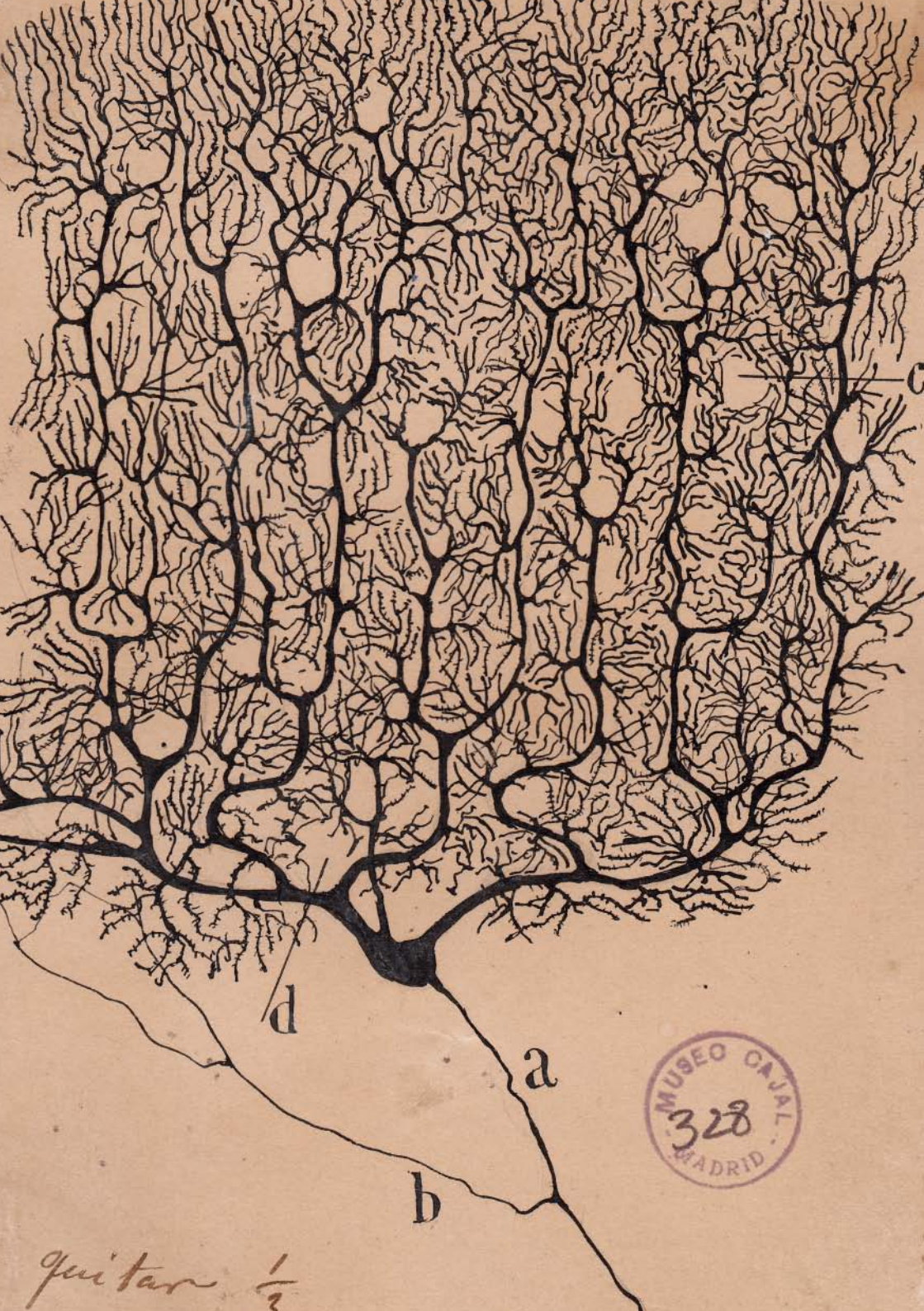


Santiago
Ramón
y Cajal





MUSEO CAJAL
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“As far as possible, I have sought to lead my life in keeping with the philosopher’s advice, as a living poem of intense action and tacit heroism, for the sake of scientific culture.”

On 28 May 1928, Ignacio Bolívar, Director of the Spanish National Museum of Natural Sciences, was awarded the Echegaray Medal by the Royal Academy of Exact, Physical and Natural Sciences. During the tribute speeches, he was dubbed the “Prince of Spanish Naturalists”, to which Bolívar replied that only Cajal was worthy of such a title, for the great body of work he produced in the field of Natural Sciences.

Santiago Ramón y Cajal needs no introduction. He is one of the great figures of universal science. Breaking away from prevailing doctrines, he unravelled (and produced drawings of) the mysteries of the brain. But his greatness went beyond the realms of science. His intelligence, determination and endeavours were qualities that made him a genius, revealing that brilliance in many ways throughout his life.

The Museum is taking up the baton from Bolívar and wishes, once again, to pay tribute to Cajal in this exhibition. We invite you to join us on a journey through the amazing life of a man whose tenacity and perseverance brought about a quantum leap for Spanish science and was eventually recognised by the international scientific community. Our journey will bring us face to face with the man behind the scientist, his passions and the path that led him to becoming one of the most significant figures in the Spanish history.

“I consider it certain, indeed desirable, that my own insignificant personage will be forgotten in the flow of time (...).”

He was wrong. Ramón y Cajal helped us understand the brain, and there, where the art of remembering resides – in our memory – he will always have a place.



Cajal

the man

Little Santiagué, as he was known at home, was a child with a “precocious intelligence, wilful and original, irresistibly attracted to difficult and dangerous adventures; wildly obstinate, unindustrious and wayward, who rebelled against any kind of discipline in his early years”. This is how his brother Pedro, his best friend and confidant, remembered him.

Santiago’s father tried to mould him in his own image, but his son was determined to go his own way. His teachers were no more successful. He hated the rote learning methods they used. He fought with his classmates and instigated epic battles with slings. His belligerent behaviour occasionally had him running away from police officers and even spending a few days in the jail in Ayerbe for breaking down a neighbour’s door with a homemade cannon.

Although his father was against it, he married Silveria Fañanás, and had seven children with her. She was his “most precious balm and support”. He always cared deeply about his family and the loss of his children Enriqueta and Santiago was a heavy blow. He always disliked fame and crowds, but he did not shun good company. In Valencia, he founded the Gaster Club, a society for friends who enjoyed going on trips and eating paella. Sometimes considered surly by the press, which he sought to avoid, he was in fact an enthusiastic conversationalist at social gatherings, like those he was part of at Madrid’s Café Suizo.

But his greatest quality was his unwavering willpower. The trials and tribulations he underwent to get his work recognised are a case in point. Tired of endless waiting, he turned up at the German Anatomical Society congress in Berlin. One eye-witness recalled: “It’s as if I can still see him now, taking aside Köelliker—the undisputed leading histology expert in Germany at that time—dragging him into a corner of a demonstration room to show him his magnificent slides under a microscope and convincing him that what he claimed to have discovered was indeed real”. That tenacious act was to change everything. Köelliker was to become his most fervent supporter and the rest is history.

“The story of my accomplishments is quite straightforward: it is the relentless resolve to succeed, come what may.”



Cajal

the artist

Cajal is estimated to have produced more than 25,000 drawings in the course of his lifetime. It was an interest that would always stay with him and one which he managed to combine with his main vocation of scientific research. As Fernando de Castro put it: “Cajal’s drawings turn science into art”.

It all started in Ayerbe, where he began to develop a passion for painting at the tender age of eight. Not only did he draw on paper, but on walls and doors as well, making the paints himself if needed. As a teenager, he wanted to be an artist and learn to paint by himself, despite his father’s disapproval.

In return for promising to pass all his subjects at baccalaureate, his father agreed to pay for drawing classes at an academy run by painter León Abadías. It was the only time he would study the discipline. His tutor suggested he enrol in Fine Arts, but his father again refused. Instead, drawing would become a way of studying anatomy, as he proved at the University of Zaragoza’s Faculty of Medicine, where he trained to be a physician.

When he was appointed to the Chair of Anatomy, he would use drawing in his lessons. When he became interested in histology, he used it as a way of depicting his observations under the microscope –in particular the nervous system– in the most intricate detail.

“...only artists go into science. (...) It is to my artistic interests as a child, to which my father was so strongly opposed, that I owe what I am today.”



Cajal

the photographer

Photography means “light drawing” and that is precisely how Cajal started out: drawing light. Once, detained as punishment in a dark classroom at school, he saw a small beam of light filtering in from the outside through a hole. It was to be his first contact with photography. The light projected outdoor scenes on to the wall, and the young Santiago enthusiastically traced around them. This was how the camera obscura began.

In Huesca, he became acquainted with the wet-plate collodion process. Amazed, he started using it when he was 18 years old. While still living in Zaragoza, he learned the gelatin silver bromide technique, which was far quicker. Cajal even improved the process, and made and sold his own plates in Valencia.

During his complicated stay in Cuba, he set up a small improvised photography lab. Alongside painting, photography was his great consolation. On his return to Spain, when he was recovering from malaria in the spa town of Panticosa, walking -camera in hand- was to be his medicine: “...more than the odd bout of chronic sadness was overcome and all but appreciated on the culmination of a felicitous photographic trip”.

He was keen on stereoscopic photographs which he took mainly when travelling. He was also a pioneer of colour photography in Spain, and was always up to date on the latest techniques. In 1900, he became the honorary president of Spain’s Royal Photographic Society. He wrote many articles and in 1912 published his book *La fotografía de los colores*.

Cajal left us thousands of photographs on the most diverse themes. Particularly interesting are his self-portraits, genuine ‘selfies’ offering a glimpse into different facets of his private life. Alone in his laboratory, together with his family, relaxing with friends... he was fascinated by the idea of being able to immortalise those everyday moments and make them last for ever: “because life passes, but the image remains”.

“I owe untold satisfaction and consolation to photography”



Cajal

the Physician and Teacher

Santiago studied medicine to please his father, a country doctor keen for his son to follow in his own footsteps. But despite his admiration for the human body, Santiago did not enjoy clinical practice or dealing with patients, and did not direct his life towards that discipline.

He worked as a doctor on three occasions. First, as a military physician in Cuba soon after completing his degree. A year later, on the verge of death from dysentery and malaria, he was awarded his full licence from the army and returned to Spain.

The following year, he gained a place as a practitioner in the Hospital Nuestra Señora de Gracia and helped his father when he was on call with operations and treatments. But he would soon leave that position to devote himself to his doctorate, which is when he became interested in histology.

His father found him a post as a physician in Castejón de Valdejasa, which he would occupy for several months while he was studying for competitive public exams for a professorship.

That was the last time he practised medicine. The rest of his life was devoted to teaching at his laboratory, where he set up a school, and to University, where he would be appointed to three different Chairs in medical faculties: General and Descriptive Anatomy at the University of Valencia (1884-1887); Normal and Pathological Histology at the University of Barcelona (1888-1891) and Normal Histology and Histochemistry, and Pathological Anatomy at the Central University of Madrid (1892-1922).

He always considered himself an academic and was grateful to the institution: "I am the son of University: I owe it what I know and everything I am worth...". He loved teaching, one aspect in which he took after his father, of whom he would say: "...for him, ignorance was the greatest of misfortunes, and teaching the noblest of duties".

When the time came for him to retire, on 1 May 1922, the day he turned 70, he decided not to teach his final class: "...I lost my nerve when I thought of the outburst of emotion that might have caused fatal physical consequences..." .

"I have not said farewell to my professorship or my students, and I never will; I refuse to give up that contact for as long as I live ... that would be more than I could bear!"



Cajal's

early work on the nervous system

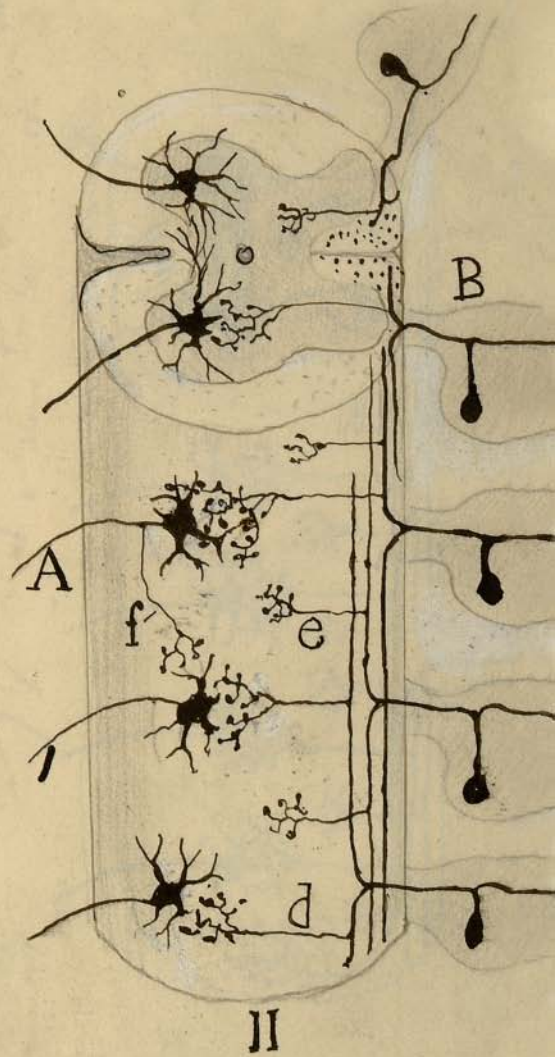
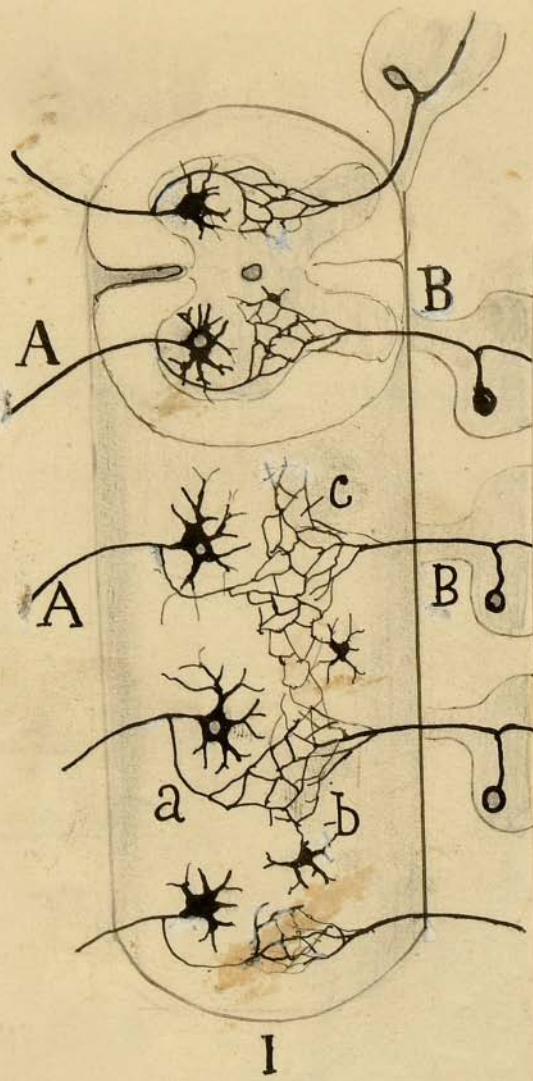
Cajal studied medicine in Zaragoza and devoted his life to the University and to scientific research. Keen to understand the functioning of living beings, he focused on anatomy and histology, which led to his fascination with the brain.

While pursuing his doctoral studies, he met Aureliano Maestre de San Juan, Chair of Anatomy in Madrid, who showed him histological preparations under a microscope that so impressed him, he decided to study histology. He paid for a Verick microscope in instalments and set to work in his own home. He presented his first piece of work on “The Pathogenesis of Inflammation” as his thesis and was awarded his doctorate on 3 July 1877.

Cajal studied all the tissues, including the nervous system, the composition of which – without the knowledge of good staining dyes – was a mystery at that time. Any attempt to study it produced cell tangles that were difficult to interpret.

Consequently, the scientists of the day believed the nervous system was made up of a mass of cells with extensions that were fused together into a vast network covering all the brain's structures and the spinal cord, along which nerve impulses travelled. This was known as Reticular Theory.

**“...what dense forests they revealed,
and how difficult it was to discover
the endings among those intricate
branches!...”**



Cajal

and the discovery of the neuron

In late 1887 in Madrid, Cajal met the neurologist Luis Simarro, who first showed him a nerve tissue preparation impregnated using the Golgi method, with a few neurons stained black to reveal their form. When he went home, he started practising the method with Bartual, a student who attended his private classes, and tried to improve the technique. He not only speeded up the process but also obtained better cellular impregnation and, by using very young animals and even embryos, was able to individualise the stained cells: “As the adult jungle proves impenetrable and indefinable, why not resort to the study of a young forest in what we might call its nursery state?”

Having modified the Golgi method, he studied all kinds of brains: chicks, hens, cats... and realised that the nerve cells (neurons) were independent and had different forms in a relationship of contiguity but not of continuity, as had previously been thought. Consequently, the nerve impulses were transferred by contact, not because they were fused together. This was the birth of Neuron Doctrine.

These and other observations refuting Reticular Theory pushed him to make himself known to the scientific world at the annual congress of the German Anatomical Society in Berlin in 1889. There he so impressed Kölliker that the famous Swiss histologist exclaimed, “I have discovered you and I wish to publicise my discovery in Germany”.

From that point on, Santiago Ramón y Cajal, the man unravelling the secrets of the neuronal forest, embarked on a journey that would change the paradigm of neuroscience forever.

“Like an entomologist chasing butterflies in colourful hues, my attention was drawn, in this garden of grey matter, to cells in delicately elegant shapes, the mysterious butterflies of the soul...”

*ascendente del tuberculo cuadrigenus posterior, H, foco
 del motor ocular comun; O, colateral de las
 raices motoras cerebrales.*

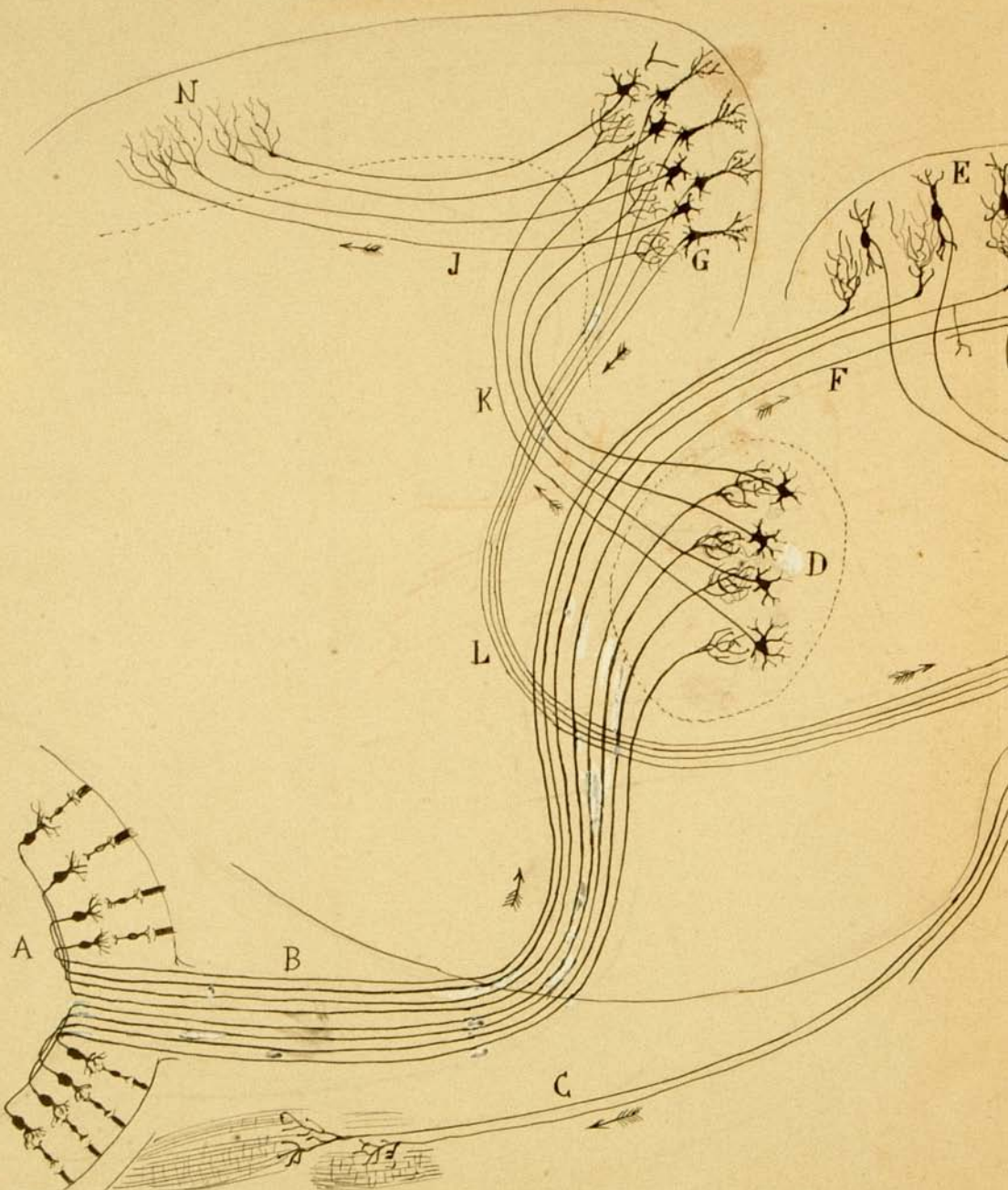


Fig. 63. Esquema general de las relaciones de los
 centros opticos y de la manda de las cordones,
 A, retina; B, nervio optico; C, nervio motor ocular comun;
 D, cuerpo geniculado externo; E, tuberculo cuadrigenus
 posterior; F, fibra optica; G, centro motor; H, foco
 del motor ocular comun; I, centro motor; J, centro motor; K, centro motor; L, centro motor; M, centro motor; N, centro motor; O, centro motor.

Cajal

painter of the brain

Not only did Cajal discover the workings of the brain, he also showed them to the world in his drawings. Extraordinary spatial vision and artistic talent enabled him to condense his observations into diagrams and illustrations which added greater clarity to work which combined his creative skills with his interpretations of microscopic images. And he did it all without the benefit of modern-day optics.

How the eyes could transmit information to the brain, the neurons of the human cerebellum or the representation of the flow of information through the hippocampus... Nothing escaped Cajal. In 1891, he presented one of his most iconic laws at the Medical Congress in Valencia, stating that nerve cells were polarised. From that point onwards, most of his histological drawings included a series of Indian arrows which indicated the direction taken by the nerve impulse in his representations. In this way, he spent hours bending over a microscope, producing freehand histological drawings, not only on the basis of what his eyes could see, but also of what his brain was interpreting.

“It is not enough to examine. We also need to contemplate. Let us infuse the things we observe with emotion and affection; let us make them our own with both our hearts and our intellects. Only then will they hand over their secrets; because enthusiasm enhances and fine-tunes our perceptive capabilities and anyone who contemplates an object lovingly will eventually distinguish within it interesting details and extraordinary properties that will escape the less focused attention of the ordinary researcher.”

Cajal's drawings contain exceptional scientific information and marked the start of modern neuroscience. His illustrations met with scepticism in some quarters where they were considered “artistic” interpretations rather than precise copies of his preparations. But later, as microscopic techniques advanced, they were validated. In the words of histologist Washington Buño, “They are of an unparalleled precision, elegance and veracity”.

“Good drawings, like good microscopic preparations, are pieces of reality. They are scientific documents that will keep their value indefinitely and reviewing them will always be of benefit, whatever the interpretations they may have had.”



Cajal

the humanist

Cajal's great enthusiasm for reading began in Ayerbe when he was a teenager. His father was not in favour of it since he saw it as a frivolous pastime that would distract his son from his studies. Santiago had to make do with secretly reading novels his mother lent him, until one day he came across the extensive library owned by the local pâtissier. Without the owner noticing, Cajal began to discover the great Romance authors who would inspire him in his youth.

A disagreement with classmates in Huesca, who had made fun of the long coat passed down to him by his father, triggered Cajal's passion for physical exercise. After a showdown with the ringleader, who trounced him, Santiago trained rigorously until he was fit enough to overcome his adversary. That physical strength was to save his life in Cuba.

Once in Zaragoza, during a fight over a girl, he was on the verge of seriously injuring his opponent. At that point he toned down his training sessions and decided to overcome his rivals with rhetoric instead, for which the study of philosophy was to prove more useful. He assiduously read Berkeley, Hume, Fichte, Kant, Balmes, Baltasar Gracián... It was perhaps this fondness for philosophy which led him to play an active role in a masonic lodge in 1877 and study psychological phenomena like hypnosis in Valencia.

Cajal's passion for reading made him cultured in a broad sense that went far beyond the confines of his scientific research. As well as being a great reader, he was also a writer, and his works led to his appointment as a member of the Royal Spanish Academy of Language in 1905. Apart from his prolific scientific works, Cajal left us several strictly literary pieces, in addition to plenty of essays and writings of a fundamentally humanist nature.

“...apart from the particular discipline cultivated, the scholar who does not wish to lapse into mediocrity, is under an obligation to know something about everything.”



Cajal

the Nobel Prize Winner

On 25 October 1906, the Royal Karolinska Institute in Stockholm awarded Santiago Ramón y Cajal the Nobel Prize for Physiology or Medicine “in recognition of his work on the structure of the nervous system”. A few days earlier, the communiqué caused “a feeling of distress and almost dread” in Cajal who, fearing the predictable onslaught of congratulations and tributes, was tempted to reject the prize. Finally he put aside his fears and boarded a train at Madrid’s North Station, arriving in Stockholm on 6 December.

On 10 December, he was awarded the Nobel Prize, which he shared with Camillo Golgi, an Italian neurologist and professor at the University of Pavia. Although Golgi invented the staining technique Cajal had used, he supported Reticular Theory, advocating a structure of the nervous system unlike the Neuron Doctrine backed by Cajal.

Their differences were illustrated in their respective acceptance speeches, where Golgi sought to dismantle Cajal’s theory, despite it having been recognised by most of the scientific community. Cajal, for his part, defended his own theory, but also recognised the work done previously by other scientists, including Golgi.

Although the Nobel prizes were already highly prestigious at the time, the Helmholtz Gold Medal, which Cajal had received one year earlier from the Imperial Academy of Sciences in Berlin, was considered the most highly-respected accolade of the day. It was awarded every two years to the person considered to have made the most important discoveries in a branch of human knowledge.

“And to think that, for my spiritual wellbeing and to shun popularity of any kind, I deliberately chose the most obscure, arcane and unpopular of the sciences!”

The Cajal School

Cajal was passionate about teaching. His first disciples were young people who frequented his house for private histology classes while he was living in Valencia and Barcelona. Particularly noteworthy during this period were Juan Bartual Moret, with whom he began testing the Golgi method, and Claudio Sala Pons, the first student to start work at the Biological Research Laboratory after its foundation. This was where the Spanish Histological School would be created.

“... I was always keen, especially after the State placed in my hands a respectable and well-equipped laboratory, to found a true Spanish school of histologists and biologists”.



Pedro Ramón y Cajal. Santiago's younger brother was always passionate about neurohistology and assisted his brother throughout his life, eventually specialising in Comparative Neuroanatomy.



Domingo Sanchez. To him we owe the theory of “reciprocal action between the organism and the environment”, which today serves as the basis for the biological interpretation of behaviour.



Jorge Francisco Tello Muñoz. Friend and right-hand man to Cajal who appointed him director of the Cajal Institute when he himself retired. Together they co-authored *Manual de Histología* (Handbook of Histology) and *Manual de Anatomía Patológica* (Handbook of Patological Anatomy).



Nicolás Achúcarro Lund. The JAE (Board for Further Studies and Scientific Research) created the Institute of Normal and Pathological Histology for him at the Natural History Museum. Sadly, his early death, by which Cajal was deeply affected, put an end to his career.



Pío del Río Hortega. After Achúcarro's death, Río Hortega took charge of the laboratory. His contributions to the histology of the nervous system were very important, particularly in the field of neurologia, and he was nominated for the Nobel Prize on two occasions.



Gonzalo Rodríguez Lafora described a type of epilepsy known today as Lafora Disease. He directed the JAE's Laboratory of Physiology of the Nervous System and created the Laboratory of Experimental Physiology of the Nervous System.



Fernando de Castro Rodríguez was highly recognised for his work on the sensory innervation of the aortic and carotid region and the first description of a chemoreceptor. He was very close to Cajal and together they wrote "Elementos de técnica micrográfica del Sistema Nervioso".



José María Villaverde y Larraz. A highly reputed neurologist, he occupied the chair in the Royal National Academy of Medicine in Madrid left vacant when Cajal died.



Rafael Lorente de Nó can be considered the most brilliant disciple of Cajal's Histological School and was nominated six times for the Nobel Prize. We owe him major anatomical descriptions, and a number of the most important neuroscientific achievements of the last century can be attributed to him.



The Cajal Institute

In 1900, the International Medical Congress in Paris awarded Cajal the Moscow Prize. Seeing the repercussions of this event, in 1901 the Spanish government set up a laboratory where Cajal could work in comfort and provide guidance for others. The result was the Biological Research Laboratory beside the Dr Velasco Museum of Anthropology.

The constant stream of national and global accolades recognising Cajal's work made many students keen to train with him. Soon the laboratory became too small and 1920 saw the creation of the Cajal Institute which was to house the Laboratories of Physiology, Neuropathology and Histology of the JAE (Board for Further Studies and Scientific Research). It was also to accommodate the staff working in the Botanical and Zoological laboratories of the National Museum of Natural Sciences. Run by Cajal himself, its aim would be to conduct research into the different branches of Biology, instruct students from home and abroad, produce scientific publications and foster links with other laboratories. However, building of the new premises on the southern side of the Buen Retiro Park was delayed until 1933, and Cajal, who died a year later, would himself never actually work there.

The new government in power after the Civil War abolished the JAE and replaced it with the CSIC (Spanish National Research Council), a body which absorbed the Institute. Cajal's material legacy was conserved here in keeping with his wishes. After a new site was built on the corner of Calle Velázquez and Calle Joaquín Costa, the Institute moved to its current location in Avenida del Doctor Arce.

Today, 100 years after its creation, the Cajal Institute is a key research centre for neuroscience in Spain.

“They will live there side by side, and those of us dedicated to similar research will trade spiritually with one other. I hope that the community created in this location will be conducive to the solidarity of aspirations and emotions [...].”



Cajal

and the National Museum of Natural Sciences

The ties between Cajal and the Museum were largely thanks to Ignacio Bolívar y Urrutia, its director from 1901 to 1939, and to two different institutions, the RSEHN (Spanish Royal Society of Natural History) and the JAE (Board for Further Studies and Scientific Research).

The RSEHN was founded in 1871 to study, classify and disseminate the flora, fauna and geological features of Spain; it shared premises with the Museum throughout its various site changes, and a very young Bolívar was one of its founding members. Cajal joined later when he was appointed to the Chair of Anatomy at the University of Madrid. Bolívar, who was in charge of the Society's publications, published some of Cajal's early works and later those of his disciples. The RSEHN also set up a Permanent Commission for the Exploration of Northwest Africa (1901-1915) with a view to studying natural resources in Spain's West African possessions. Once again, both scientists were involved, Cajal as one of its vice-presidents and Bolívar as secretary.

In 1985, the MNCN had to leave its original site at 13, Calle Alcalá and move to the Palacio de Bibliotecas y Museos on Paseo de Recoletos. The Anthropological Collections and Entomology Section, managed by Bolívar, were housed in the Doctor Velasco Museum (now known as the National Museum of Anthropology), because they could not be accommodated on the new premises. This was also the location of the Biological Research Laboratory where Cajal worked. This Section was moved, with the rest of the Museum, to Altos del Hipódromo in 1910.

The JAE was founded in 1907 to promote Spanish science, supporting the training of researchers by means of bursaries, overseas placements, and the creation and renovation of research centres. Cajal was its first president and Bolívar a member of its steering committee. The Museum and Laboratory run by Cajal were reunited when, in 1910, the Board created the Institute of Physical and Natural Sciences which included both centres. After Cajal's death, Bolívar succeeded him as the JAE's second and final president.

“...we can see certain parallels between the scientific lives of Bolívar and Cajal. Both appeared on the scholarly stage at about the same time; for both of them, handling a microscope kindled a passion for the study of life's hidden phenomena; [...]; both selflessly devoted themselves to the Sciences; in both of them the same qualities shone out: perseverance, austerity, lucidity and reflection.”

Ricardo García Mercet

Speech given on the presentation of the Echegaray Medal to Ignacio Bolívar
28 May 1928 at the Spanish Royal Academy of Exact, Physical and Natural Sciences

Cajal

timeline

- 1852** Born on 1 May in Petilla de Aragón. Son of Justo Ramón and Antonia Cajal
- 1860** The family moves to Ayerbe
- 1864** Studies for his baccalaureate in Huesca
- 1870** Begins his degree in medicine in Zaragoza, where his family moves
- 1872** Passes a public examination and is appointed assistant professor of anatomy at the Faculty of Medicine
- 1873** Joins the army as military doctor during the Third Carlist War
- 1874** Posted to Cuba where he contracts malaria and dysentery
- 1875** Returns to Spain very ill
- 1877** Doctor of Medicine. Aureliano Maestre introduces him to histology
- 1878** Recovers from a lung condition in the spa town of Panticosa and Jaca
- 1879** Marries Silveria Fañanás
- 1880** Publishes his first scientific work. His first daughter is born
- 1883** Appointed to the Chair of General and Descriptive Anatomy at the University of Valencia
- 1885** Conducts research into the cholera epidemic that hit Valencia
- 1887** Luis Simarro shows him Golgi's staining method. He is appointed to the Chair of Normal and Pathological Histology at the University of Barcelona
- 1888** His "peak year". He uses Golgi's method to study the nervous system. He demonstrates the individuality of nerve cells
- His daughter Enriqueta dies
- 1889** Makes himself known in Europe, at the Berlin Congress
- 1892** Appointed to the Chair of Normal Histology and Histochemistry, and Pathological Anatomy at Madrid's Central University
- 1895** Elected member of the Royal Academy of Sciences

- 1897** President of the Spanish Society of Natural History
- 1898** His mother dies
- 1899** Travels to the United States, Germany, Britain, France and Italy
- 1900** Awarded the Moscow Prize. He is appointed Director of the Alfonso XIII National Institute of Hygiene
- 1901** Receives the Order of Isabella the Catholic. The Biological Research Laboratory is founded
- 1903** His father dies
- 1904** Publishes *Texture of the Nervous System of Man and the Vertebrates*
- 1905** Receives the Helmholtz Medal
- 1906** Awarded the Nobel Prize for Physiology or Medicine
- 1907** President of the JAE (Board for Further Studies and Scientific Research)
- 1911** His son Santiago dies. He publishes his book on colour photography *La fotografía de los colores*
- 1915** Awarded the Great Cross of Merit in Germany
- 1918** Publishes the handbook *Manual Técnico de Anatomía Patológica* with Francisco Tello
- 1920** Foundational decree of the Cajal Institute
- 1922** Awarded the Echegaray Medal by the Royal Academy of Sciences
- 1924** Given an Honorary Doctorate by the Sorbonne University
- 1930** His wife Silveria dies
- 1932** Inauguration of the Cajal Institute. He publishes *Técnica Micrográfica del Sistema Nervioso* with Fernando de Castro
- 1934** He dies on 17 October in Madrid.