

A PORTRAIT OF THE SCIENTIST AS A YOUNG ARTIST

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This is the story of how an artistic son grew up to become the father of modern neuroscience. In 1873, an Italian pathologist named Camilo Golgi stirred the scientific community by managing to expose the brain in a new light—or darkness. Golgi found that by immersing nervous tissue first in a potassium dichromate solution and then in a silver nitrate solution, one could show a small number of cells—randomly—in a naked, black entirety. The stain—which Golgi named *la reazione nera* ("the black reaction")—was hugely and internationally influential. From his inky-looking data, Golgi induced that our brain is composed of a *syncytium*, or a physically continuous nervous net. The new conclusion supported an already prominent hypothesis: the "reticular theory," which was proposed by the German anatomist Joseph von Gerlach in 1871. (Imagine a structure similar to the enmeshed fingers of your two hands). But this turns out to be incorrect, an explanation destined to fall flat atop the scrap heap of once-received wisdom.



Drawing of a Purkinje cell in the cerebellar cortex done by Cajal, after using the Golgi stain.

Camilo Golgi was awarded a share of the Nobel Prize in 1906 for his spectacular stain, which is still used by investigators today.

In fact, the most important result of *la reazione nera* occurred half a generation after its invention when an unknown Spanish academic saw some expert preparations in the private laboratory of a colleague. The sight incited an insatiable need to see more. At that moment the ambitious scientist became excited—and started firing. After Charles Darwin, Santiago Ramón y Cajal—though far less well-known than the founder of evolutionary theory—is the second greatest biologist of his era. He was the first of two Spanish scientists to receive a Nobel Prize, which he strangely shared in 1906 with his wrongheaded rival. The most famous and important discovery of Cajal was the neuron, a cellular entity proven to be the basic anatomical, physiological, genetic, and metabolic unit of the nervous system [DeFelipe 2006]. In the 1890s, Cajal provided indisputable evidence of distinct cerebral individuality in the form of his portraits of neurons, which finely—finally—revealed the composition of our mysterious mental matter. As profoundly true as great science and as truly creative as great art, the investigations of Cajal offer rare and precious insights into life and its infinitely small secrets.

Cajal's great insight came in 1888, the most progressive year of his scientific career. He describes the solution as frankly commonsensical. Frustrated by the unpredictability and inscrutability of *la reazione nera*—which seemed to hide the forest among tangled trees of fully grown processes—Cajal sought a way to represent his cellular subjects in a truer light. In his memoirs *Recuerdos de mi vida* (*Recollections of My Life*) he explains his thought process:

'Since the silver chromate yields more instructive and more constant pictures in embryos than in the adult, why,' I asked myself, 'should I not explore how the nerve

cell develops its form and complexity by degrees, from its germinal phase without processes . . . to its adult or definitive condition? In this developmental course, will there not, perhaps, be revealed something like an echo or recapitulation of the dramatic history lived through by the neuron in its millennial progress through the animal series?"

With this thought in mind, I took the work in hand, first in chick embryos and later in those of mammals. And I had the satisfaction of discovering the first changes in the neuron, from the timid efforts at the formation of processes, frequently altered and even resorbed, up to the definitive organization of the axon and dendrites [Cajal 1989, 365].

Known as the *ontogenetic* or *embryological method*, this type of treatment ultimately unveiled the essential identity of the nerve cell. In the words of Cajal, "Since the full grown forest turns out to be impenetrable and indefinable, why not revert to the study of the young wood, in the nursery stage, as we might say?" [ibid, 324]

Similarly, biography may be viewed as the literary outgrowth of biology. The development of a human being—a multi-cellular organism—retains some of the primordial patterns conserved throughout the evolution of life on earth, discernible at many magnitudes. This fact of modern biology creates a unique poetic symmetry: the scientific genius resembles the cells under his microscope, and by studying their secrets, he sings his own. In the case of Santiago Ramón y Cajal, the best method to examine his life is the one he himself used. "If the stage of development is well chosen," Cajal explains, "the fundamental plan of the histological composition of the gray matter rises before our eyes with admirable clarity and precision" [ibid, 324-5]. A well-wrought portrait of Santiago Ramón y Cajal should reveal the essence of the legendary individual who was to discover individuality in the brain. But once upon a time he was a rebellious boy who loved to draw, and this must guide the first brushstroke.



"La Virgen de Casbas" | 1860-1871. Santiago Ramón y Cajal. Cajal Legacy. Instituto Cajal (CSIC), Madrid, Spain. Reproduced with the permission of the inheritors of Santiago Ramón y Cajal ©.

As a child growing up in small towns across the rustic provinces of northern Spain, Santiago Ramón y Cajal was completely obsessed with drawing. By the age of nine he was incessantly scribbling on paper, sketching in books, and painting walls, gates, doors, and facades. This graphic impulse was strictly forbidden by his formidable father, Justo Ramón. Legend has it that as a young man Don Justo walked over three-hundred-and-fifty miles from tiny and remote Larrés to bustling Barcelona in search of opportunity and prosperity in the field of medicine. Such a migration would have been difficult enough despite even the sturdiest shoes, and yet the determined peasant crossed the Pyrenees mountains on foot. After his journey, Justo Ramón worked to become a well-respected and successful country doctor, and went on to achieve an advanced surgical degree.

To his father's dismay, school did not interest young Santiago. His attention always wandered and his hand had to doodle. Whenever he could, Santiago disappeared into the rich and colorful countryside and there recorded his visual impressions:

Translating my dreams onto paper, with my pencil as a magic wand, I constructed a world according to my own fancy, containing all those things which nourished my dreams. Dantesque countrysides, pleasant and smiling valleys, devastating wars, Greek and Roman heroes, the great events of history all flowed from my restless pencil, which paid little attention to common scenes, to ordinary nature, or to the activities of daily life [ibid, 38].

He indulged his fantasies and sketched avidly. It is, therefore, no surprise that, having experienced such passions, Santiago Ramón y Cajal wanted to be a professional artist. Only his father absolutely forbade this.



"Cabin" | 1860-1871. Santiago Ramón y Cajal. Cajal Legacy. Instituto Cajal (CSIC), Madrid, Spain. Reproduced with the permission of the inheritors of Santiago Ramón y Cajal ©.

Determined to terminate the creative process of his son, Don Justo solicited a professional opinion. In Ayerbe—the town of roughly six-hundred residents in which the family lived—the only qualified expert appears to have been an itinerant house painter, recently hired to whitewash the walls of the local church. The judged piece was a copy of the Apostle Santiago—the boy's birth saint—made with colored paints stolen from the church. Surely eager to appease his furious boss, the house painter condemned the effort of

the eight-year-old. "But does the boy really show no aptitude for art?" Don Justo asked. "None, my friend," replied the house painter. Writing as an adult, Cajal remembers his sense of defeat: "Farewell to the ambitious dreams of glory, illusions of future greatness! I must exchange the magic palette of the painter for the nasty and prosaic bag of surgical instruments [ibid, 40-42]!"

Santiago Ramón y Cajal was ten-years-old when his father, hoping to induce a straightening out, sent him away to Jaca, a small city in the Pyrenees where an uncle lived.

There he attended a strict college of Esculopian fathers who brutally enforced the educational philosophy of "la letra con sangre entra" ("knowledge enters with pain")



"Cabin 2" | 1860-1871. Santiago Ramón y Cajal. Cajal Legacy. Instituto Cajal (CSIC), Madrid, Spain. Reproduced with the permission of the inheritors of Santiago Ramón y Cajal ©.

Santiago had no aptitude for rote memorization; his memory was a visual one. And so he became disruptive and quarrelsome, playing pranks and making mischief. The friars whipped, starved, and locked the disobedient boy in a dark room—but to no avail. In performing one of his frequent escapes, the juvenile prisoner literally used his pencil as a lever to spring himself from a shut-up schoolroom. When he was not so visually deprived, Santiago sought to soothe himself with sights of his picturesque surroundings:

Fortunately, I found great consolation in the cultivation of art and in the contemplation of nature. Before the grandeur of the tremendous mountains which surround the historic city on the Aragon I forgot my humiliations, discouragements, and sorrows [ibid, 60].

The untameable "Ramón" appeared to be a lost cause. (Like many boys, he was addressed at school by the family name of his father).



1860-1871. Santiago Ramón y Cajal. *Cajal Legacy*. Instituto Cajal Madrid, Spain. Reproduced with the permission of the inheritors of Ramón y Cajal ©.

The friars decreed that he would never be a scholar. They threatened him with expulsion. The boy stopped going to school altogether.

At the beginning of 1864, Don Justo at last agreed to transfer his son to the Institute at Huesca, in the ancient historical capital of the kingdom of Aragon. There was an art school there. Not yet a teenager, Santiago was afforded a measure of liberty. Once his father left him, his first free act was to purchase paper and a box of paints. He remembers:

I painted whatever charmed my eyes. The pages of my sketch book were filled with drawings of rocks and trees, sprays of wild flowers, butterflies in showy liveries, and brooks gliding among pebbles, rushes, and white water lilies [ibid, 92].



"Girl" 1860-1871. Santiago Ramón y Cajal. *Cajal Legacy*. Instituto Cajal (CSIC), Madrid, Spain. Reproduced with the permission of the inheritors of Santiago Ramón y Cajal ©.

But Santiago did not always apply his skills so innocently. In the third term of his course at Huesca he circulated devastating caricatures of a detested professor of Greek, earning him the ire of the faculty and of his father.

In 1866, determined to "eradicate [his son's] artistic inclinations entirely" [ibid, 120], Don Justo apprenticed his teenage son to a stern shoemaker in Gurrea de Gállego, where the family was living. Despite the strictest sensory constraints, as soon as he finished supper Santiago "spent [his] time giving form and life to the jumble of stains on the wall and the cobwebs of the ceiling, which [he] transformed, by the power of thought, into the wings of a magic stage, across which filed the cavalcade of my fantasies" [ibid, 121]. His brain generated pictures from faint or even nonexistent stimuli. This visual acuity was one of the special gifts of Santiago Ramón y Cajal. One way or another, he was bound to use it. But even Cajal himself—at fourteen-years-old—would never have imagined what trails he would one day be blazing.

After a year of this harsh vocational punishment, Don Justo believed that his son was finally "cured of [his] artistic madness" [ibid, 129]. Adolescent Santiago

promised to behave as long as he could take a drawing class, and Don Justo finally relented. Always energetic and industrious, Santiago fervently dedicated himself to learning to draw. After three months, he had exhausted the lithographic library at his school. An impressed teacher, Don León, encouraged the boy. The man even tried to convince Don Justo of the ability and potential of his son. But Don Justo would simply not allow it. His son was not to be a professional artist.



"Desnudo" | 1860-1871. Santiago Ramón y Cajal. Cajal Legacy. Instituto Cajal (CSIC), Madrid, Spain. Reproduced with the permission of the inheritors of Santiago Ramón y Cajal ©.

Of course, the great achievements of Santiago Ramón y Cajal do not belong to the category of traditional arts, however arbitrarily defined. But his persistent creative process, which never ceased to develop, was directed and affected elsewhere. Cajal the drawer or the painter would most certainly have been lost to oblivion. But during the summer of 1868—the year of his first romantic love and "The Glorious Revolution" in Spain—something happened to sixteen-year old Santiago. It was then that the fiery teenager was introduced to the study of anatomy by means of contact with his father. Before microscopic advancements, the artful surgeon had to clearly understand the very complicated, very living *thing* he hoped to address with such sharp and decisive instruments. One relied on visual memory to direct the hand, and so direct experience was clearly more beneficial than book learning. Don Justo's skill was renowned and he wished—after all—to transmit the knowledge of his own beloved trade: dissection. This was his key communication to his son. For the sake of science, Don Pedro and Santiago spent summer nights raiding graveyards for human remains.

"If things are looked at in their true light," Cajal explains honestly, "my enthusiasm for anatomy formed one of the many evidences of my tendencies; for my artistic idiosyncrasy, osteology constituted one more subject for pictures"[*ibid*, 145]. For him, bones were just another marvelous material that nature made. He drew them devotedly, as he had drawn all that had caught his eye. But now his father saw that the skill of his son was good and useful. In fact, Don Pedro was so impressed that he pushed to have the drawings published. And so Santiago had found his calling. He took his talent, his personality, and his will to Zaragoza to study medicine, the arena in which he became a legendary hero. But look closely: seeds of his every mature accomplishment were planted during his development. His art grew into his science.

In 1934, the year of Santiago Ramón y Cajal's death, his brother Pedro—a fellow neuroanatomist at the University of Zaragoza and a former rabblero during school days—delivered a eulogy filled with priceless childhood remembrances. He recognized the central conflict between his father and Santiago, and perfectly explained the resolution: "My brother entered into the castle of science and, despite all his honors, never betrayed his artistic inclinations; he entered through the door of art, for it is no coincidence that Minerva is the goddess of both the sciences and the arts." Cajal himself once remarked that "only true artists are attracted to science"[*ibid*, 28. My translation]. His career is proof of the freedom and independence that moves the truest geniuses. His portrait is as distinctly individual as the neuron, which he correctly identified.



"Naufragio" | 1860-1871. Santiago Ramón y Cajal. Cajal Legacy. Instituto Cajal (CSIC), Madrid, Spain. Reproduced with the permission of the inheritors of Santiago Ramón y Cajal ©.

Art may imitate life and life may imitate art, but why not dismiss this chicken-and-egg silliness and observe the simple fact that life imitates life. *Life imitates life*. It reads like a redundant and unremarkable statement until we consider some essential samenesses that it suggests. After all, evolution cannot cook from scratch. What exists is a template for what may come to exist, and time-tested traces of the old are forever conserved in the adapted new. If nothing else, science offers the humanities a vast narrative throughout deep time with recurring patterns and related characters. There are ways in which the story of each life will always imitate every other. Birth will always precede death in the chronology of the individual. Along the winding course of whatever length of time flows in-between those two events, organisms are undergoing constant development. Both Santiago Ramón y Cajal and the neuron he defined are revealed through illustration of their early stages, before increasing complexity confuses the portrait, when each is reaching to achieve its mature—yet still plastic—identity. •

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