

Ramón y Cajal: Man and Myth

I remember seeing him often in the early nineteen-thirties, a pale, pensive, silver-bearded old man, slowly crossing the cool green shades of the patio at the Medical School of San Carlos in Madrid. Thanks to him, Spain, which had slowly declined to a state of scientific indigence in sad contrast with the Golden Age of Spanish medicine of the fifteenth and sixteenth centuries, again joined the vanguard of medical progress. Antonio de Gimbernat and Gaspar Casal in the eighteenth century had partly redeemed Spain from her scientific sterility, but it was Santiago Ramón y Cajal who put her back in the scientific hall of fame.

A Humble Beginning

Ramón y Cajal was born to the gloomy untamed earth of a dusty village in the province of Navarre, on May 1, 1852. His father was a rural doctor. An indifferent, even poor, student, the youth gave up school to work as apprentice first to a barber and then to a shoemaker. "Reforming," he resumed his studies and gravitated toward medicine. Ramón y Cajal began his career as a physician, became interested in anatomy, then in histology, and finally concentrated on the study of nerve tissues. His efforts won for him the post of Professor of Anatomy, and later of Histology, in Saragossa, Valencia, Barcelona, and Madrid.

Ramón y Cajal's work is still a source of true knowledge. When we review those works on pathology, therapeutics, and psychiatry which nearly a century ago—when Ramón y Cajal was first beginning—were the medical bibles, we are amazed at the great number of facts that were then considered solidly established and that today have become obsolete. But Ramón y Cajal's works have endured. Their basic structures are still valid, and his discoveries in the field of neuronal anatomicophysiology are constantly reconfirmed by new advances in neurology and psychiatry. Experimental thought in medicine will always have the supreme advantage over discursive and dogmatic thought, since it is based on facts and not on speculations. Ramón y Cajal refused to accept dogmatic authority, which he replaced with observation and experimentation. That is why the luster of youth still clings to his work. This esteemed and outstanding man published nearly three hundred scientific works and innumerable literary works, ranging from short stories to philosophical treatises. By the end of his life, in addition to the Nobel Prize, he had accumulated hundreds of decorations, prizes, honorary awards, and academic titles from all over the world.

Ramón y Cajal was a poor man. His only capital was ideas. Unable to find channels through which to reveal his discoveries, he created his own journal, the quarterly *Revista trimestral de histología normal y patológica*, which, when it first appeared in 1888, was entirely written and illustrated by himself. He could publish only sixty copies

per issue, which he sent to scientists in other countries, perhaps because nobody is a prophet in his own land. With a yearly salary of about thirty-five hundred pesetas (then about fifty-two dollars a month) plus a small income derived from private teaching, he managed to support his family, his journal, and his research laboratory; in addition, he created a school and made an outstanding place for himself in the fields of philosophy and literature! But his *Revista* did not secure him the recognition he deserved. Only when Ramón y Cajal was made a member of the Anatomical Society of Germany did he start the climb to immortality.

Monumental Work

Ramón y Cajal established the anatomical individuality of the neuron and promulgated the neuron doctrine. He described for the first time the true relation of the nerve fiber to the nerve cell, illustrating it with his description of basket structures around the Purkinje cells. His technique made possible the definition of isolated nerve elements in detail, their ramifications, arborizations, fibril nets, and synapses. His work neatly rounded out the anatomical arch running from the impression-receiving organ to the effect-producing organ. His chromo-silver and reduced silver nitrate staining methods made him a true miniaturist of the nervous system, a watercolorist of the neurons. Not content with lighting up the night of the nervous system, he colored its component parts with dyes and engraved its cells into the history of medicine. In 1906, he was awarded the well-merited Nobel Prize, which he shared with Camillo Golgi. The anatomical discoveries of Vesalius and his followers were succeeded in the history of medicine by the physiological discoveries of Harvey and his successors. Ramón y Cajal, however, was able to succeed *himself* and to proceed from his morphological preoccupation with the *what* of the nervous system to the *why* of its physiological functions. His contributions to the knowledge of neuroanatomy form the permanent basis for present-day concepts in neurology and psychiatry. He belongs with His and Forel, Nissl and Weigert, Alzheimer and Bielschowsky, Vogt, Spielmeyer, and Jakob. His chapter on the doctrine of the neuron in the *Handbuch der Neurologie* of Bumke and Foerster (published posthumously as a sort of scientific last will and testament) was eulogized by Bielschowsky as a marvel. In that essay he objectively demonstrated his doctrine of neuronism, which was the supreme historical rectification of the Galenic doctrine of a morphologic-functional continuity in the nervous tissues. He also added the conclusive proof to the cell doctrine of Schleiden, Schwann, and Virchow when he demonstrated the anatomical, genetic, functional, and trophic unity of the neuron, along with the unity of pathological reaction and the polarization of nervous stimulation.

Adolf Meyer, commenting on Ramón y Cajal's lectures on his investigations into the visual and other regions of the cortex, said: "The very remarkable accuracy of description and the sober, critical presentation, free from hypothetical flights, displayed principles of work which unfortunately are abandoned by too many today; it was not an attempt to prove a preconceived hypothesis, but primarily work for the accumulation of data. That patient and steady work will as it has in the past lead to more valuable results than a mere elaboration of ideas is strongly proved by the entire history of Cajal's career. It is, however, nothing but fair to say that Ramón y Cajal was the greatest champion of neurology that Spain has ever produced. . . ."

"Cajal demonstrated that: (1) There is no substantial continuity between the processes of different nerve cells. The nerve elements represent cell units, for which he accepts Waldeyer's term 'neuron.' (2) The protoplasmic processes are those parts of a neuron with which the arborizations of other neurons come most likely in contact and that the contact with the cell body itself is exceptional, being found only in those cells where there are no protoplasmic processes (spinal ganglion, retina). (3) The spreading of impulses received is cellulipetal in the protoplasmic processes and centrifugal in the axis cylinder (law of dynamic polarization).

"In his work, Cajal maintained three 'laws' he himself established: (1) The law of economy of time. In the spinal ganglia the cells are attached to the fibers so as to form a T. The conductors are thereby placed in the very axis of the ganglion and in the direction of the shortest way between periphery and posterior root; and the current need not pass through the eccentric cell. (2) The law of economy of matter. In the midbrain of fish, batrachians, reptiles, and birds, there are certain fusiform cells, the axon of which originates from a dendrite. In this way the axon spares the whole distance between the *cell body* and the point of the dendrite from which it originates. (3) The law of economy of space. The body, the most voluminous part of certain neurons is occasionally placed in regions poor in dendrites of final arborizations of axons: for instance, Dogiel's cells of the internal granular layers of the cortex. The cell body presents the convergence of the protoplasmic expansion towards the origin of the axon, enlarged by the presence of the nucleus."

Philosopher of the Nervous System

Ramón y Cajal's popularity is an interesting historical phenomenon. In Spain, during his lifetime, "Don Santiago" had already become a legendary figure, and when he died, his myth continued. The fame of this man, who was as modest as he was humble, rests on his way of life. His entire existence was made up of study and research at the university and long nights of work at his home until he would fall asleep from sheer exhaustion. All those who knew how he lived admired this learned and good man, who had a goal in life and never swerved from the path he had chosen. Even when famous, he had no wish to be minister or ambassador; he would not accept any public post. Like Pindar, Ramón y Cajal wished only "to become what he was." This consecrated authenticity of Ramón y Cajal's life, this fidelity to himself, is the secret of his legend.

His vocation derived from romantic inclinations of his boyhood when he wanted to be a painter. Psychologically,

Ramón y Cajal was a visual type. His thought was of chromatic texture, which stimulated his interest in coloring the drab gray structure of the nervous system. His works are written with the pen of a man who had the eyes of a painter, the mind of a colorist, and the soul of a romantic. His early frustrated desires to be an explorer of unknown lands prompted him to explore the human brain. But he was not satisfied with examining the brain under the microscope; he also wished to scrutinize its most recondite structures. Psychologically, he sublimated his desires to explore the earth's jungles (this explains the romantic vegetable terminology he always used when describing the structures of nerve centers) by exploring the anatomical jungles of the nervous system.

Ramón y Cajal was a great teacher. For him the university was not simply a means of obtaining a diploma, whose yellow creases years later hide the lost illusions of an ambitious student. For him the university was a true *civitas hippocratica*, where technique must be subordinated to thought. On his lecture platform, he dedicated his brilliance to clarity and to lucidity. This devoted teacher created a school of Spanish histology that was continued by his disciples, many of whom later did their most important work in exile. After he died, his contribution—which during his lifetime was extolled by the masters of medicine all over the world and by philosophers like Henri Bergson—was continued in the physiology of Pavlov and Sherrington.

Gregorio Marañón, in his speech before the Real Academia de Medicina in Madrid in 1950, said: "We are conscious of the abyss that separates a book on neurology written prior to 1880 and one written today; the contrast between a treatise on psychiatry published in the last decades of the nineteenth century and one published today is even greater. The progress that has been made is due in great part to Ramón y Cajal. Ramón y Cajal, Sherrington, and Pavlov are the three men who have done most to provide a rational explanation for the mystery of the nervous system." Ramón y Cajal, like Sherrington, was a philosopher of the nervous system who did his research with the brain of a scientist and the pen of a poet.

Paul Ehrlich once said that the three fundamental requisites of a scientist are money, patience, and luck. That was not the case with Ramón y Cajal, who always worked in humble attics and basement laboratories. He had instead the three qualities that Pavlov enjoined upon the young people of his country who wanted to devote themselves to science: "First, *consistency*. Study, compare, and accumulate facts. No matter how perfect a bird's wings, they could never raise the bird aloft if it were not supported by air. Facts are the air of the scientist. Second, *modesty*. Never think that you know everything. Third, *passion*. Remember, science requires your whole life. Even if you had two lives to give, it still would not be enough. Science demands of man effort and supreme passion. Be passionate in your work and in your quest."

All that was Ramón y Cajal.

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