Camillo Golgi (1843–1926) [1]

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Camillo Golgi studied the central nervous system [2] during the late nineteenth and early twentieth centuries in Italy, and he developed a staining technique to visualize brain cells. Called the black reaction, Golgi's staining technique enabled him to see the cellular structure of brain cells, called neurons, with much greater precision. Golgi also used the black reaction to identify structures within animal cells like the internal reticular apparatus that stores, packs, and modifies proteins, later named the Golgi apparatus in his honor. Golgi, along with Santiago Ramón y Cajal [3], received the Nobel Peace Prize in 1906 for their independent work on the structure of the nervous system. Golgi's discovery of the black reaction enabled other scientists to better study the structure of the nervous system and its development.

Golgi, the third of four sons, was born on 7 June 1843 in Corteno, Italy, to Carolina Golgi and Alessandro Golgi. Golgi's father was a physician from Pavia, Italy, who worked in Corteno, later renamed Corteno Golgi. In Corteno, Golgi finished first in his class at the end of primary school. With his mother and siblings, Golgi moved to Pavia to attend secondary school at the Imperial Royal Grammar School in 1856, while his father remained in Corteno until 1858. Golgi next studied medicine at the University of Pavia in Pavia in the early 1860s.

Golgi aimed to practice medicine like his father but became increasingly influenced by the works of Cesare Lombroso, a physician at the University of Pavia who studied diseases that affected the brain and behavior. Golgi was a student of Lombroso, who directed the Institute of Psychiatry at the university. Under Lombroso's supervision, Golgi wrote his thesis for his medical degree on the investigation of mental illnesses. Golgi graduated from the University of Pavia in 1865.

After graduating, Golgi began working at the Ospedale San Matteo (Hospital of St. Matthew) in Pavia, where he continued to research medicine and neurology [4]. When not working in the hospital, Golgi attended the Institute of General Pathology at San Matteo, Italy, led by physician and researcher Giulio Bizzozero, who examined the microscopic structures of tissues and cells, a discipline called histology [5]. Golgi began to use Bizzozero's techniques to analyze brain cells under the microscope [6]. With Bizzozero's guidance, Golgi studied the connective tissues of the nervous system, called neuroglia.

Partly due to pressure from his father, in 1872, Golgi became chief physician at the Pio Luogo degli Incurabili (Pious House of Incurables), a hospital for patients with chronic diseases in Abbiatagrosso, Italy. The position offered a higher salary than Golgi's position at the Hospital of St. Matteo, but it did not offer the same research facilities. As Golgi did not have access to a laboratory, he constructed one with a microscope [6] and a few other instruments in the kitchen of his small apartment. There, Golgi studied methods for better examining brain tissue.

In 1873, Golgi developed a staining method using silver salts to dye neurons. Drawing on previous methods, he applied potassium dichromate to the samples, a chemical that hardened and preserved brain tissue. After hardening the tissue, Golgi submerged the tissue in a silver nitrate solution. The silver nitrate solution reacted with the potassium dichromate to form fragments of silver chromate along the cell membranes, which dyed the outside of the neurons black. Golgi's staining method helped scientists to see an entire neuron [7] under the microscope [6] without damaging the cell. Golgi then hypothesized that the brain worked as an overlapping network of cells connected by extremities that send and receive stimulus, called axons and dendrites, respectively.

Golgi worked with the black reaction to provide support for reticular theory, the theory that the nervous system is composed of a single continuous network of cells, rather than separate nerve cells [8]. In the 1880s in Spain, researcher Santiago Ramón y Cajal [3] used Golgi's black reaction to support the alternative view that the nervous system consisted of individual neurons. Ramón y Cajal detected spaces between the dendrites, which are the branch-like structures at the head of a neuron [7] that receive stimulus from surrounding neurons. His results led scientists to reject Golgi's theory in favor of the neuron [7] doctrine, the theory that the nervous system is composed of distinct cells not connected by a continuous material.

In 1876, after improving his staining technique, Golgi became the professor of histology [5] at the University of Pavia. A year later in 1877, Golgi married Bizzozero's niece, Donna Lina Aletti. In 1879, Golgi became the chair for general pathology at the University of Pavia, a position previously held by Bizzozero.

While at the university, Golgi continued to study the nervous system. In 1878, Golgi described two kinds of cellular structures...
inside the neuron[^7]. The first was the Golgi tendon organs, structures that enable the brain to perceive the body's position and movements. The second was the Golgi-Mazzoni corpuscles, specialized structures in neurons in the fingertips that respond to stimuli or pressure. In addition, by using his black reaction staining technique, Golgi analyzed regions of the nervous system and illustrated his findings. In 1885, Golgi published the compiled images in a book.

From 1885 to 1892, Golgi researched malaria and determined the cycle of development of the malaria parasite. Golgi discovered two forms of malaria. One caused a fever every other day, while another caused a fever every third day. Golgi related the delayed time of the recurring fever to how long it took for a large number of parasites to mature and release into the bloodstream.

In 1897, Golgi discovered a dense body within cells he called an internal reticular apparatus. The structure floated in the cytoplasm of cells, not connected to the cell's nucleus[^9]. Later, that reticulum was re-named the Golgi apparatus, a structure responsible for the sorting, packing, and modifying proteins within the cell. However, at the time of Golgi's discovery, scientists doubted the existence of the internal reticular apparatus. In the 1950s, researchers confirmed the existence of the internal reticular apparatus, or Golgi apparatus, using a powerful microscope[^6].

In 1906, Golgi shared the Nobel Prize in Physiology or Medicine for his work on the nervous system alongside his academic rival, Ramón y Cajal. During World War I[^10], Golgi directed the Military Hospital of Pavia and promoted rehabilitation treatments for injured soldiers. Golgi continued to work in his laboratory until he died on 21 January 1926, at age eighty-two.

### Sources


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