Ramon y Cajal

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Santiago Ramón y Cajal (1 May 1852 – 17 October 1934) was a Spanish neuroscientist and pathologist, specializing in neuroanatomy, particularly the histology of the central nervous system.

The Father of Modern Neuroscience
Nerve cells as independent entities

- a continuous network of interconnected fibers (continuity) → axons terminate freely in the cerebellum and retina (contiguity)
- Dendritic spines: sharp thorn-like structures in dendrites
- Axonal growth cone: an amoeboid-like structure at the end of the axon of developing nerve cells
The law of dynamic polarization

- The processes of nervous cells comparable to the dendrites are oriented towards the “external world” and they have evidently conduction of the nervous impulse toward cellular body; meanwhile the axon is oriented towards the nervous centers.

- **Theory of axipetal polarization**: The dendrites and the cellular body have conduction toward the axon; whereas the axon has conduction comes from the dendrites or the cellular body.
- Hypothesis: Oft-used neural pathways would see their connections reinforced
- Speculation: Learning requires the formation of new connections between neurons
Neuron doctrine

1. The neuron is the structural and functional unit of the nervous system.
2. Neurons are individual cells, which are not anatomically continuous to other neurons.
3. The neuron has three parts: dendrites, soma (cell body) and axon. The axon has several terminal arborizations, which make close contact to dendrites or the soma of other neurons.
4. Conduction of nerve impulses is directional and follows the theory of axipetal polarization.

According to Cajal, the polarization of the nerve impulse is due to the pre-established relations between the neurons and the initial position of the excitation.
The neuron doctrine today

- Some neurons are connected by gap junctions
- Action potentials can travel backward from the axon and soma regions into the dendrites
- Two-way communication between neurons and glial cells
Chemotaxis

- Several stages: An ovoid shape and no projections --> thin extensions (axon and dendrites)
- A precise connectivity pattern
- (Propose) Axonal guidance is based on gradients of chemoattractive substances guiding the growth cones toward their final targets
- A same molecule could attract or repel a growth cone depending on the battery of receptors expressed by the neuron or its metabolic state.
Degeneration and regeneration of the neurons and axons

- Damage repair would be more difficult than during normal development
- Both growth and proper guidance were needed to effectively repair severed connections
- Regeneration after injury vs adult neurogenesis
References


- [http://www.scholarpedia.org/article/Santiago_Ram%C3%B3n_y_Cajal](http://www.scholarpedia.org/article/Santiago_Ram%C3%B3n_y_Cajal)