Neural networks and population coding

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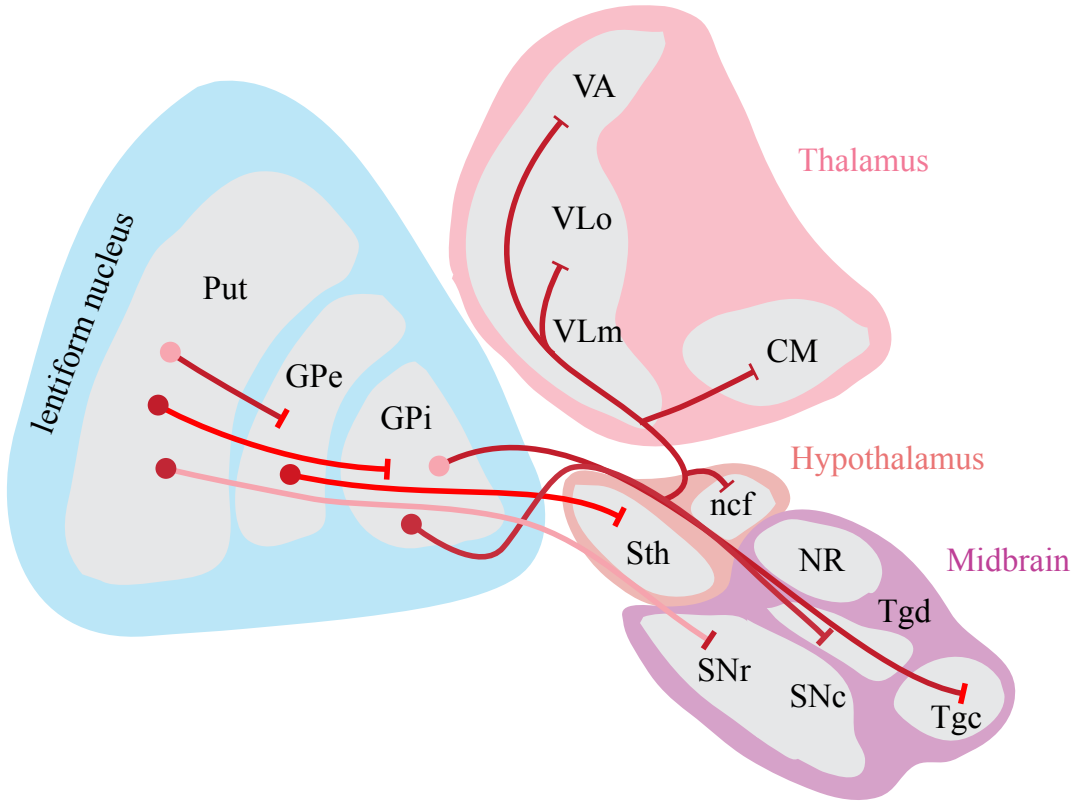
🧠 Topics

- 📡🖇️ Networks and population coding
- 🛠️🧰 Methods for large-scale neuroscience

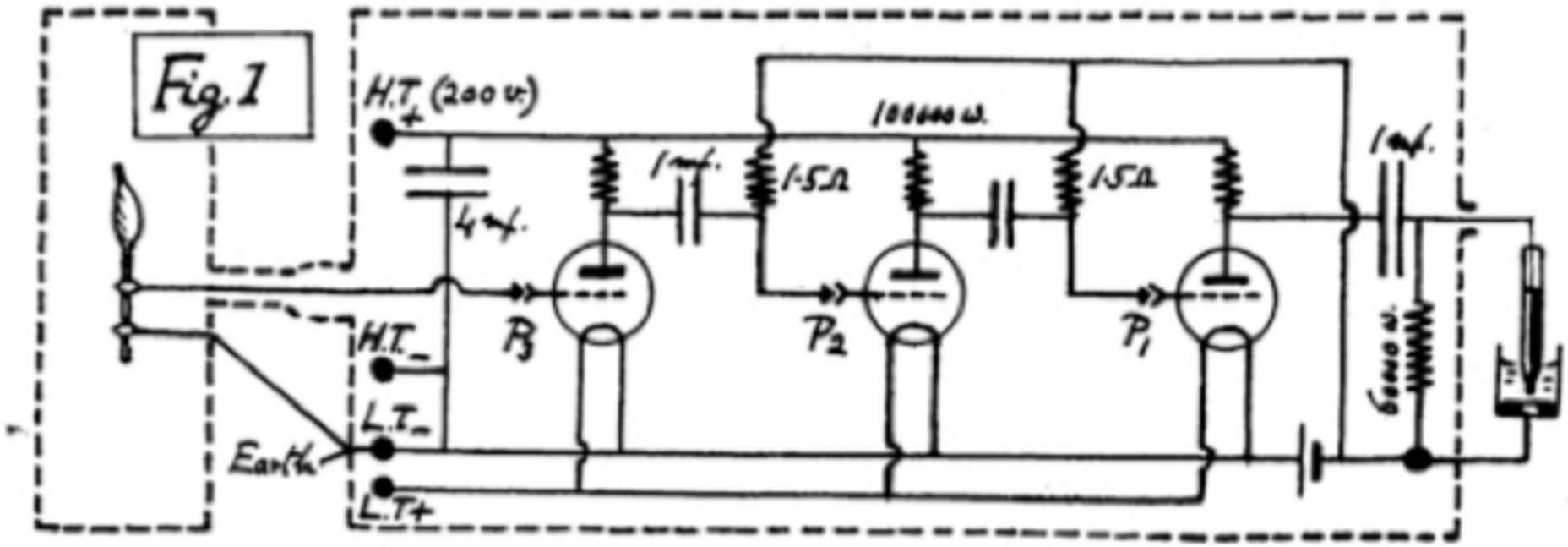
Networks



Nauta & Mehler (1966)

🥁 Rate coding

Edgar Adrian and Yngve Zotterman.



Rate coding

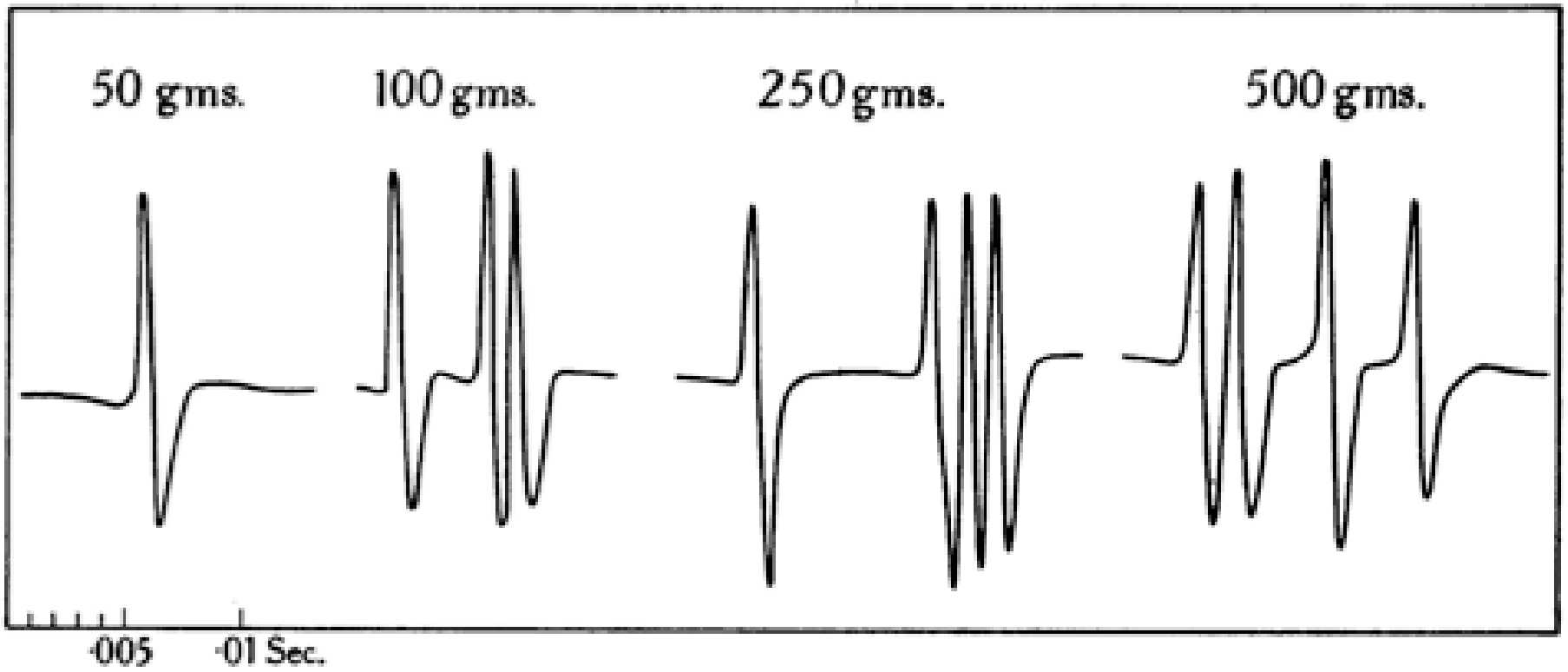
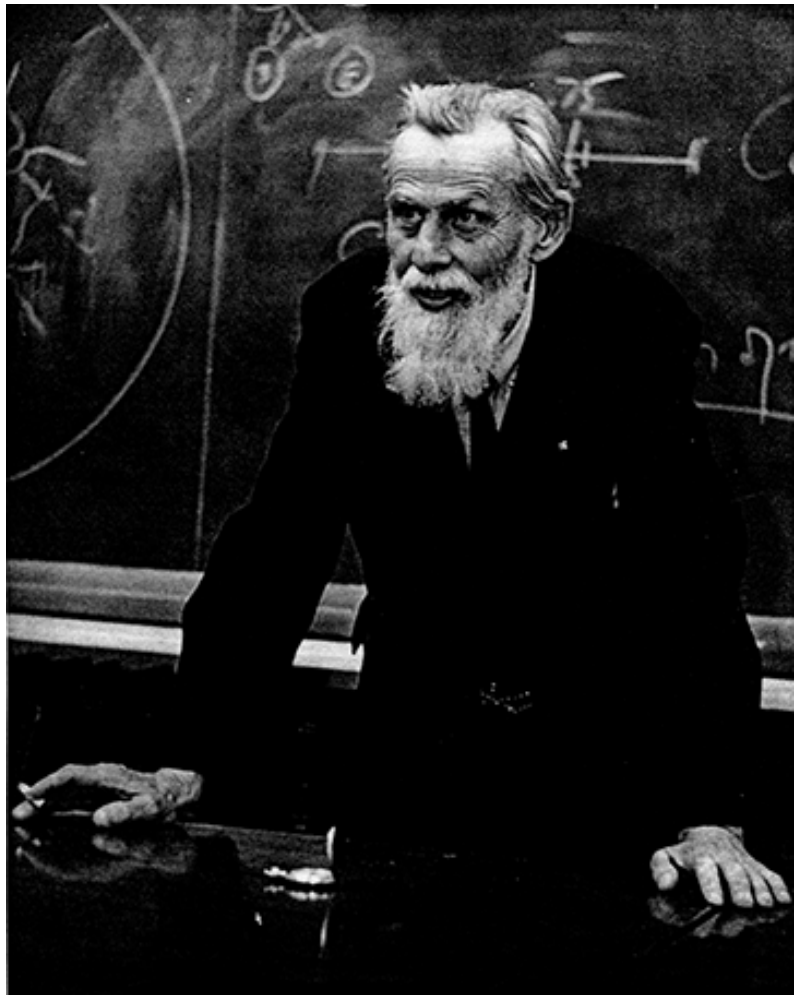


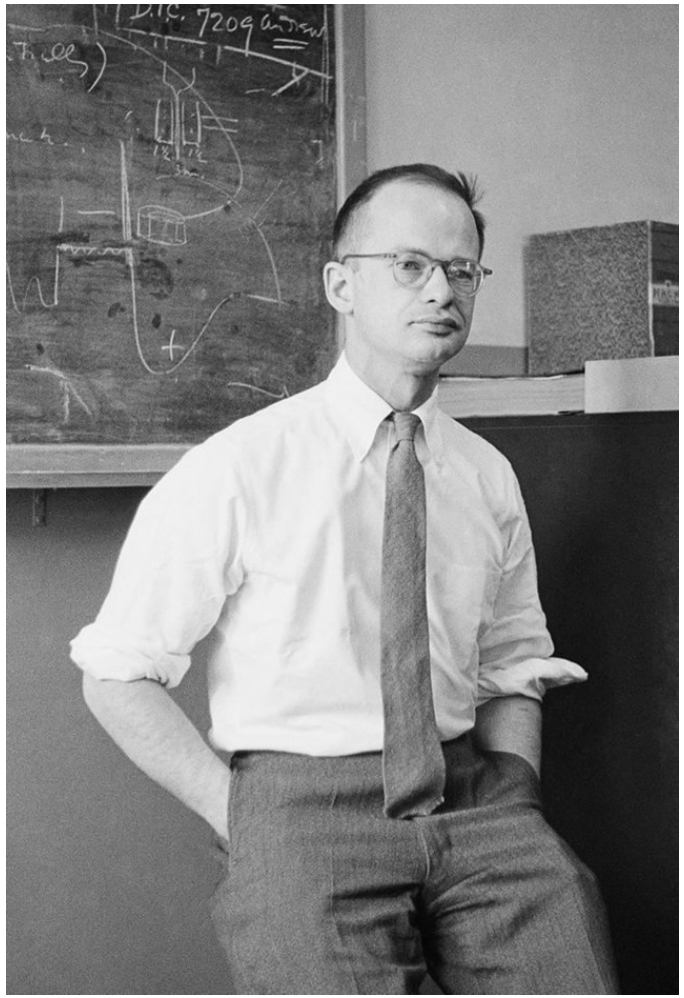
Fig. 5. Analysis of electrometer records, *Exp.* 2, showing that the size of individual impulses does not vary with the stimulus.

Adrian & Zotterman (1926)

A Logical Calculus of Ideas Immanent in Nervous Activity

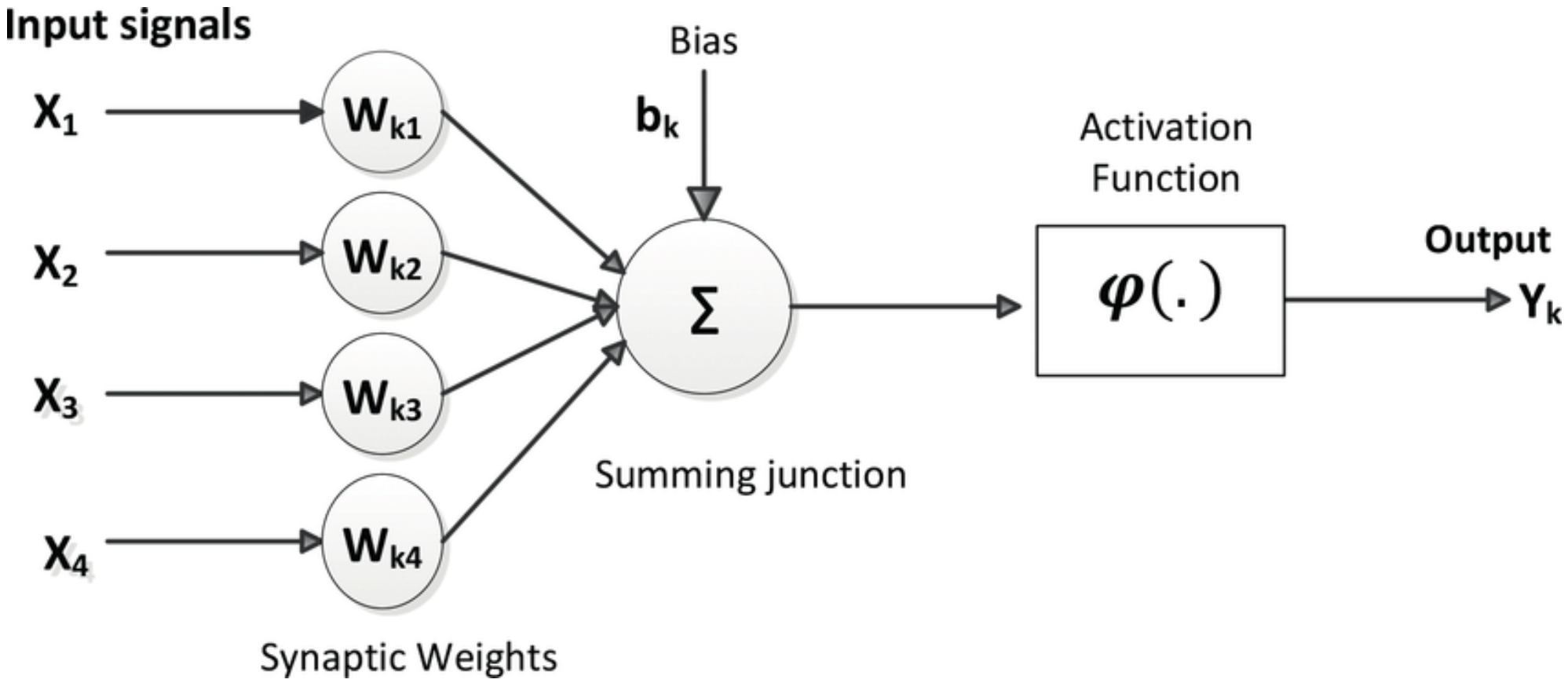


Warren McCulloch (MIT)



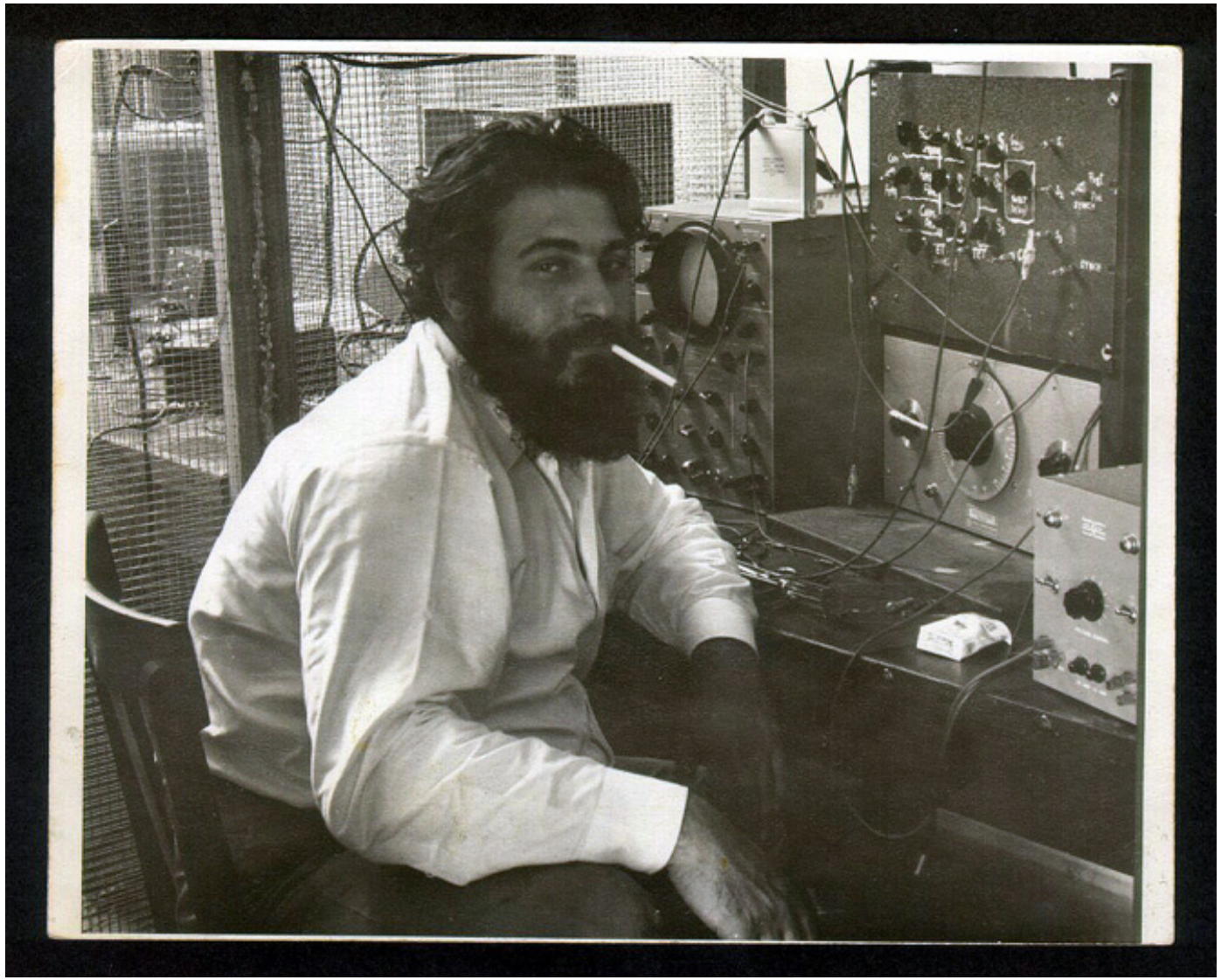
Walter Pitts (MIT)

McCulloch-Pitts model



🧠 **Perceptron**

What the Frog's Eye Tells the Frog's Brain



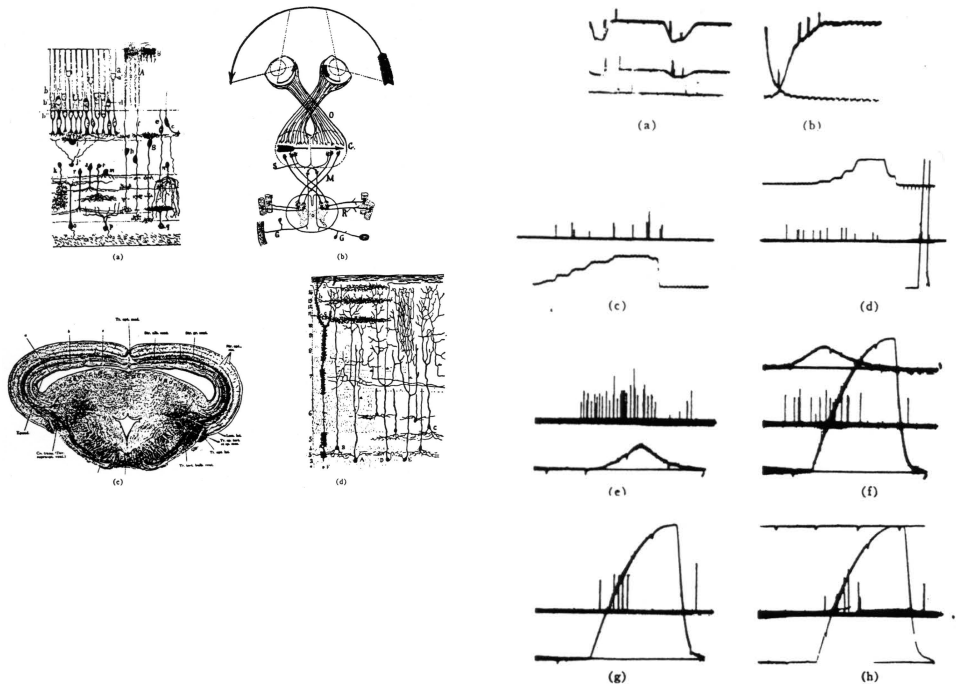
Lettvin, Maturana, McCulloch, Pitts (1959) *Proceddings of the IRE*

What the Frog's Eye Tells the Frog's Brain

Retinal ganglion cells in the frog's eye are specialized to detect specific types of visual information:

- movement
- contrast
- light intensity

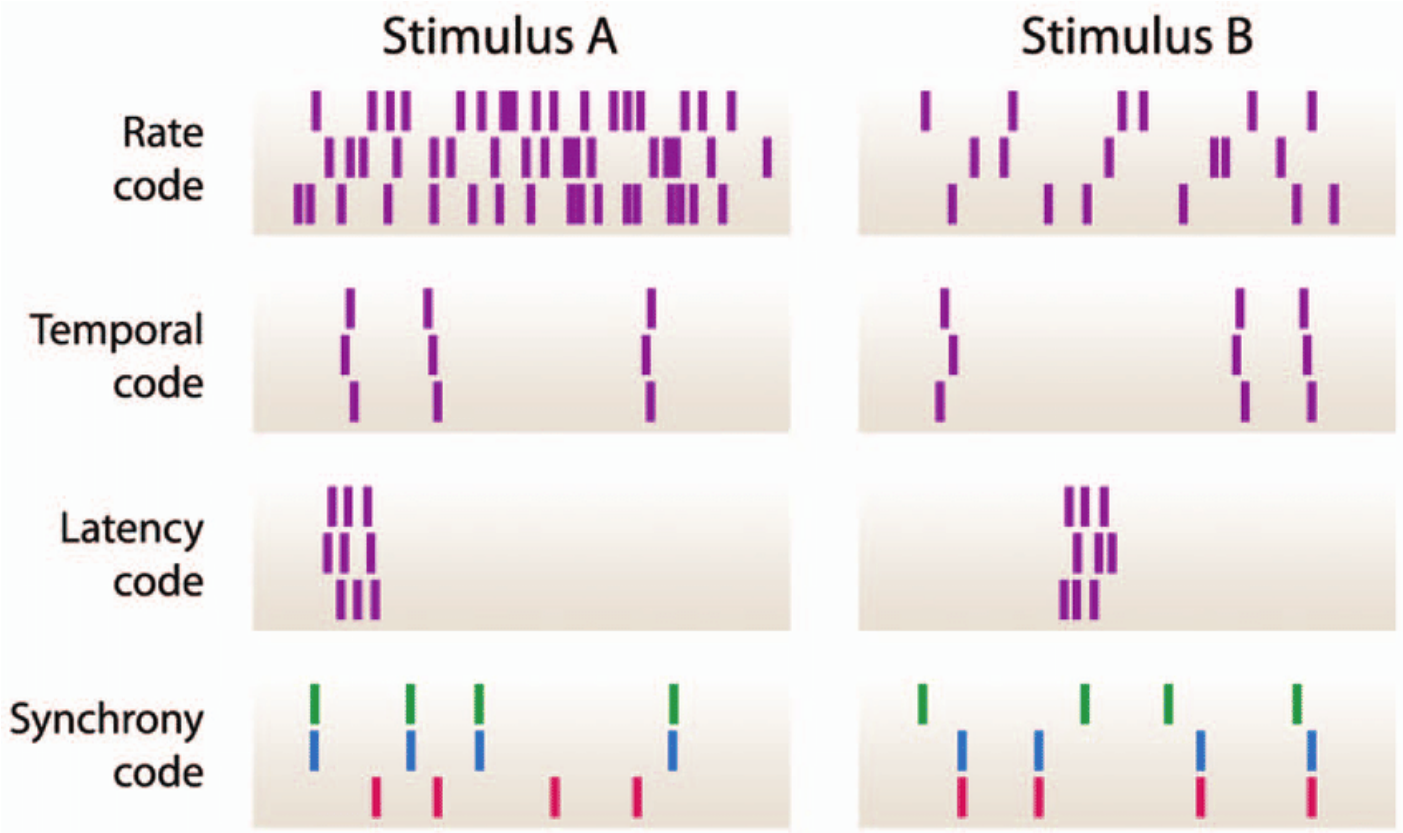
Features, rather than forming a complete image by representing parts of the image.



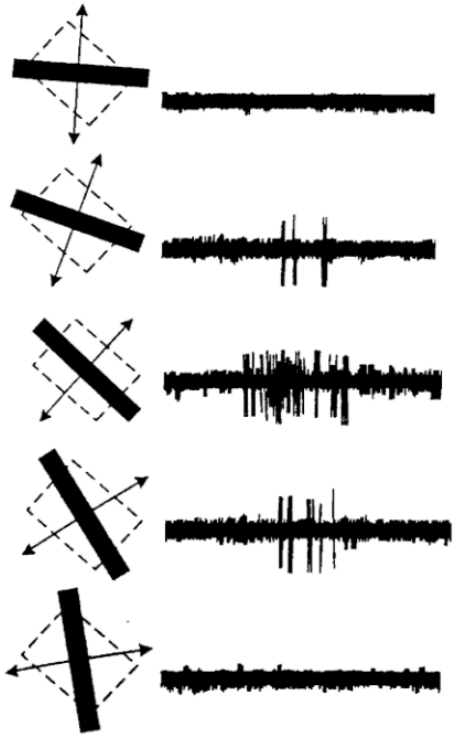
Lettvin, Maturana, McCulloch, Pitts (1959) *Proceddings of the IRE*

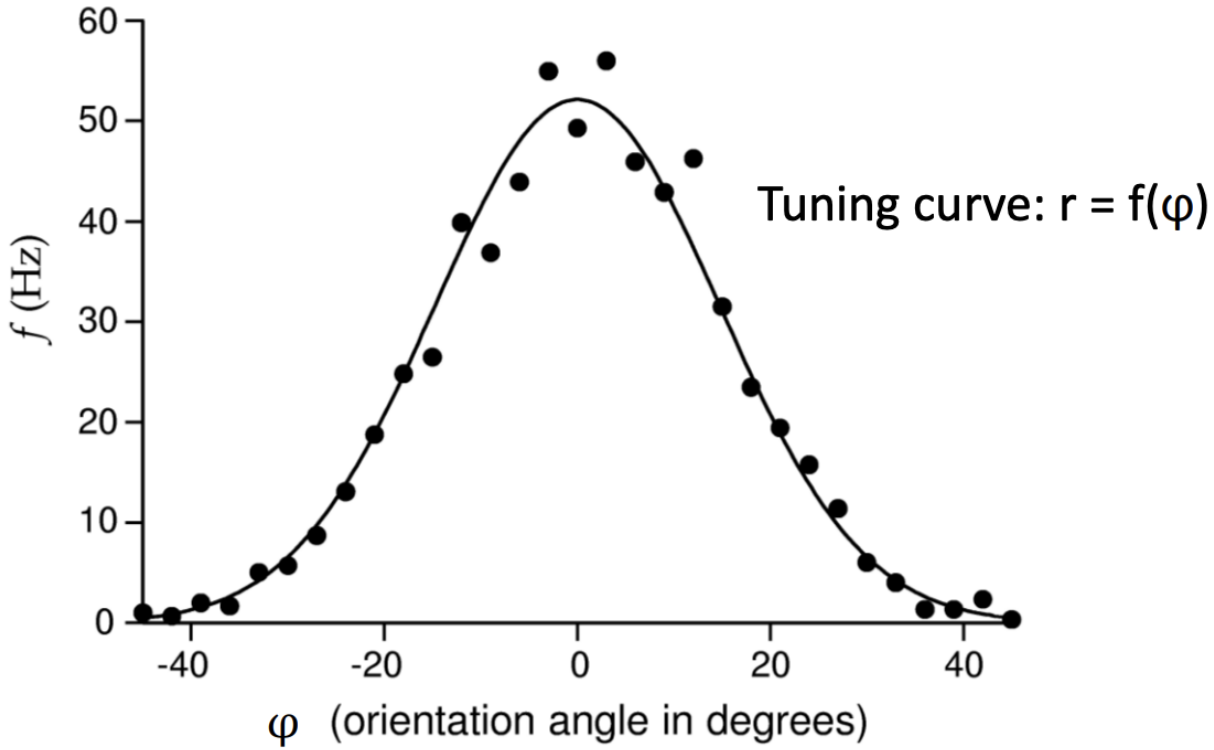
Neural coding

- Rate coding
- Temporal coding
- Population coding



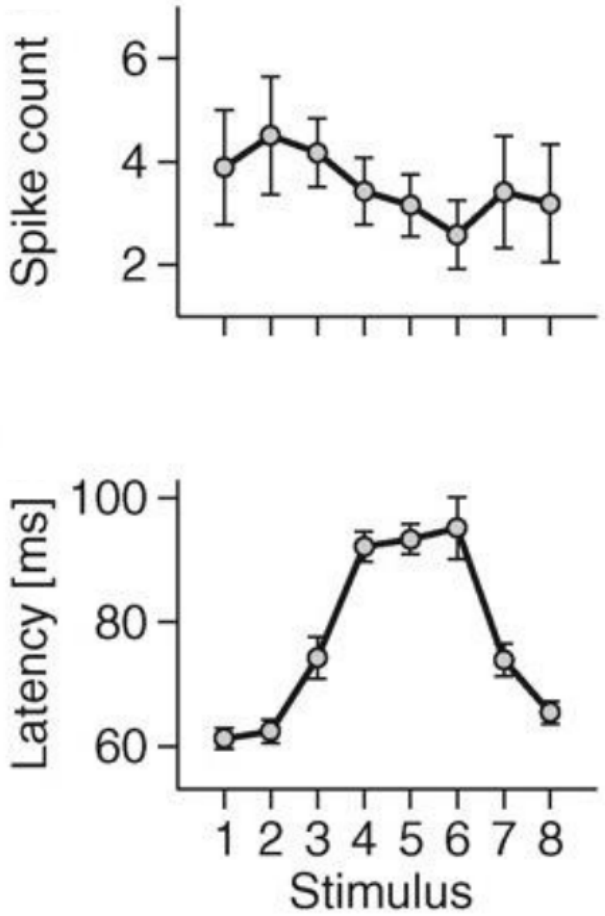
Tuning curves





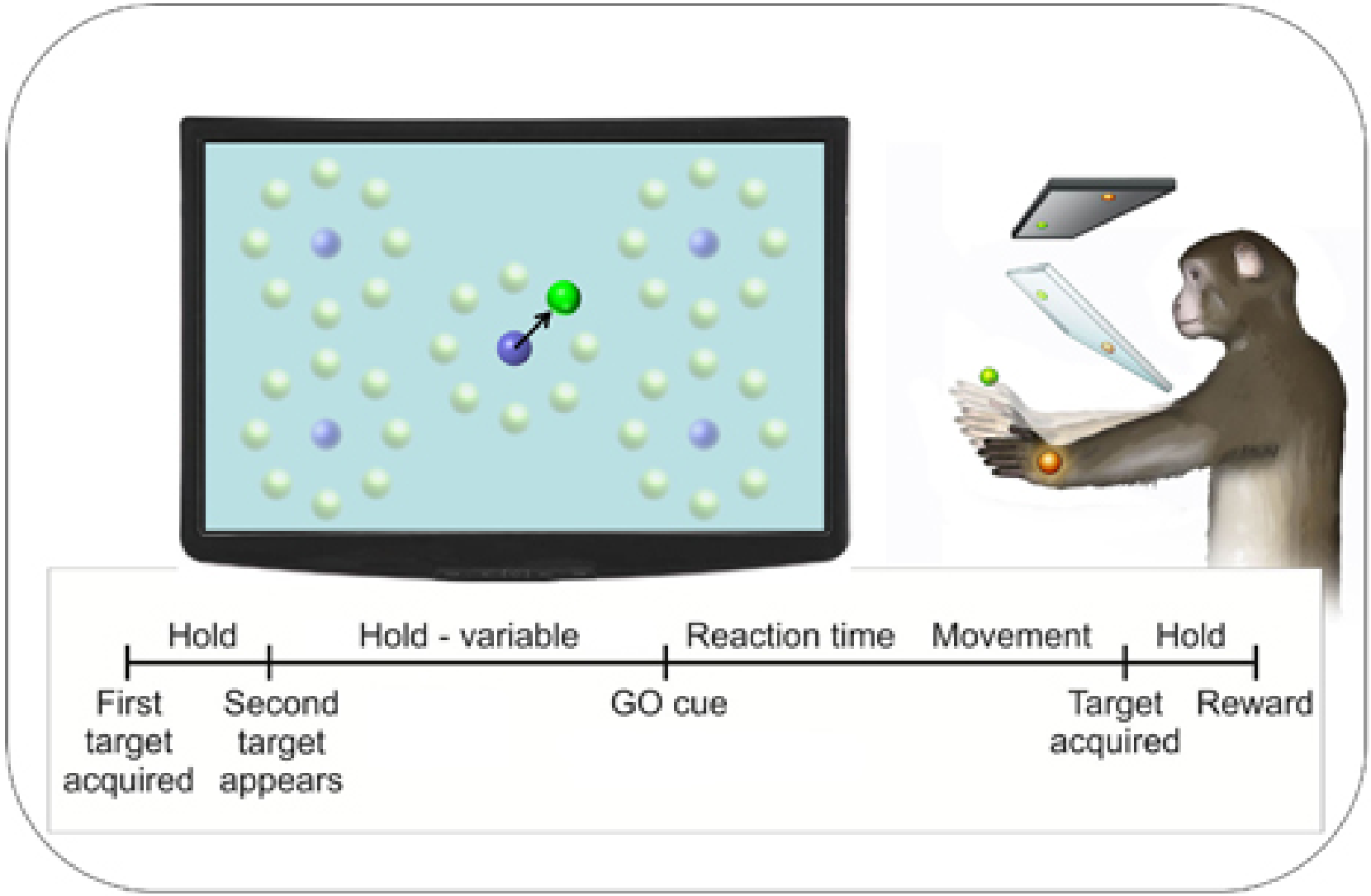
Hubel & Wiesel, 1968 *Journal of Physiology*

Temporal code



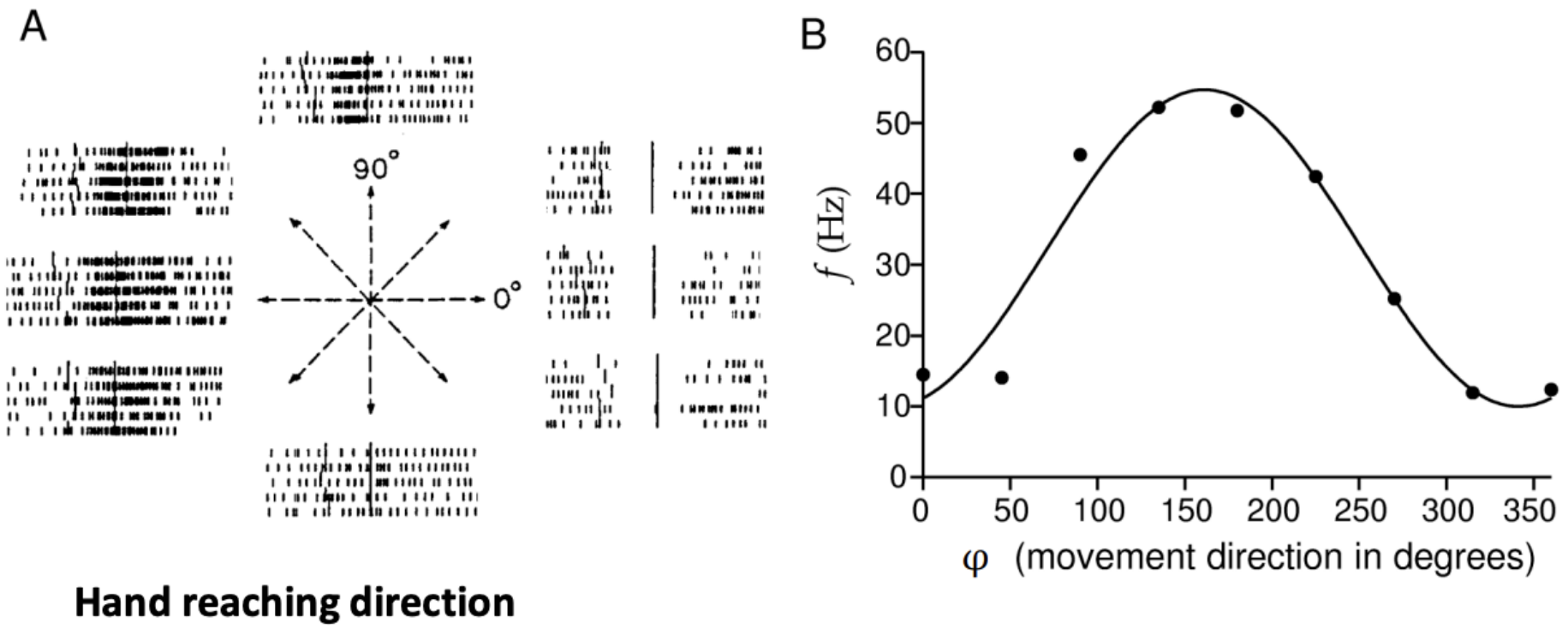
Gollisch & Mesister 2008

Population coding



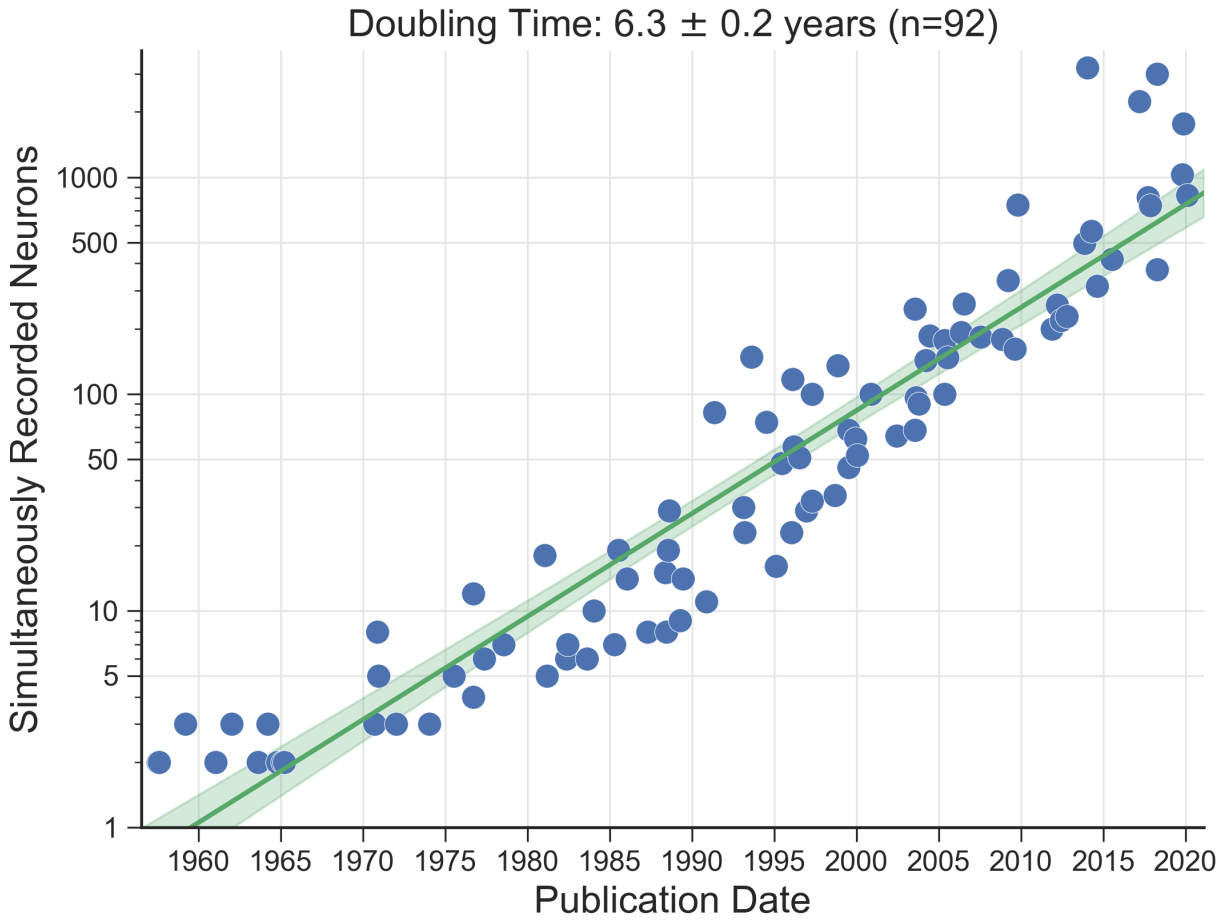
Georgopoulos (1982) *Science*

Population coding



Georgopoulos (1982) *Science*

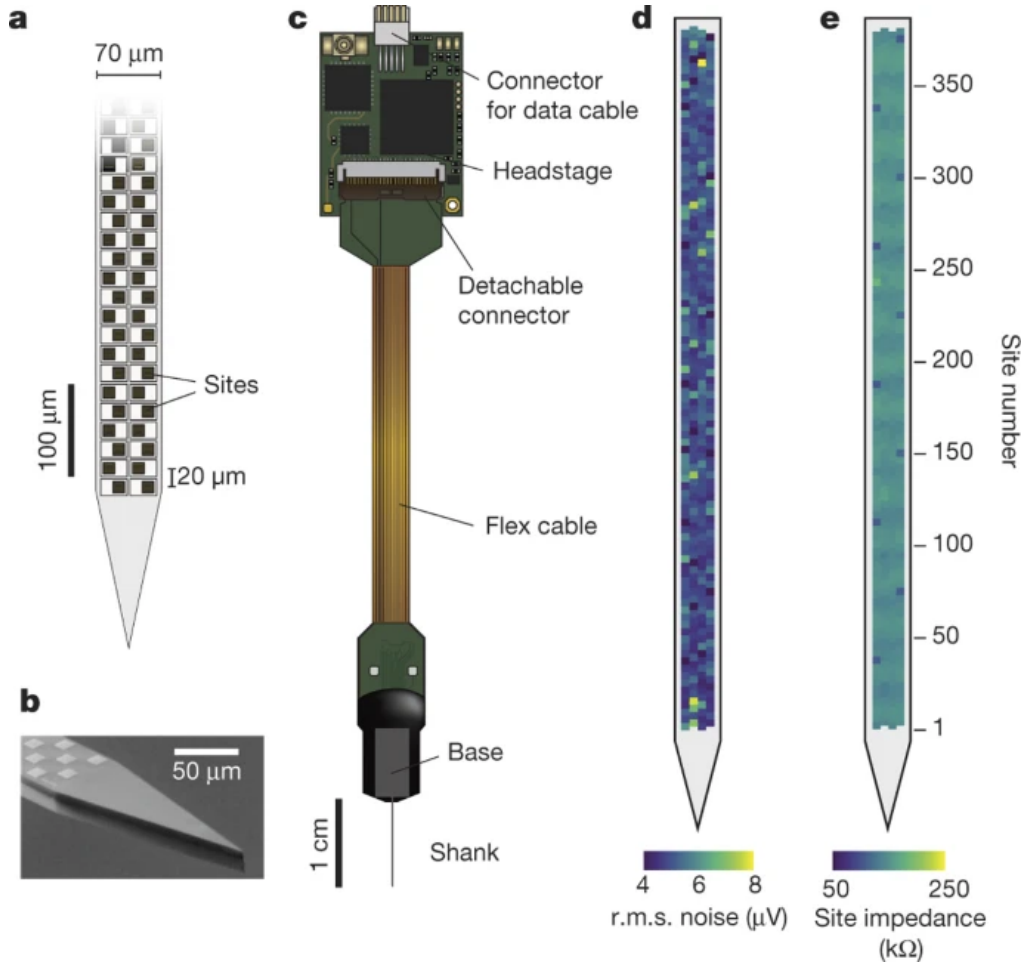
Recording multiple neurons at the same time



For updated list: https://stevenson.lab.uconn.edu/scaling/

Stevenson and Kording (2011) *Nature Neuroscience*

Neuropixels



Ju et al. (2017) *Nature*

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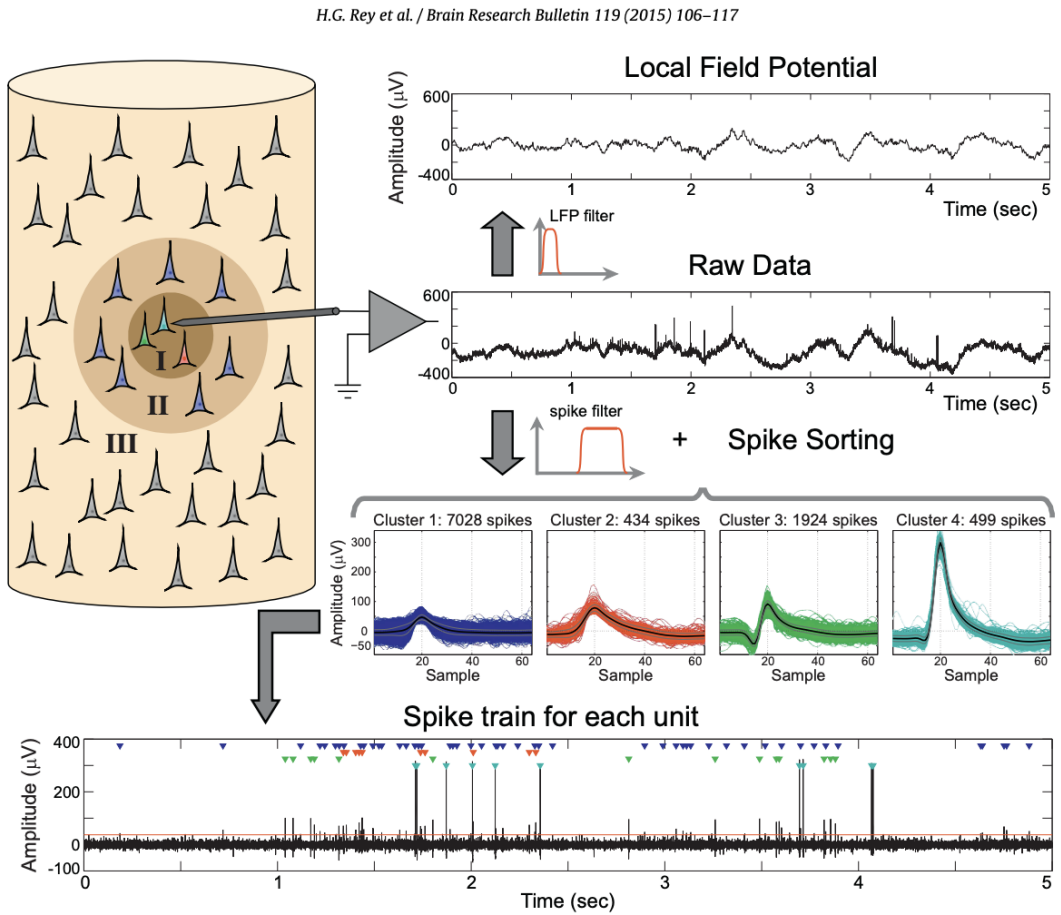
Detecting individual neurons through their spike shape



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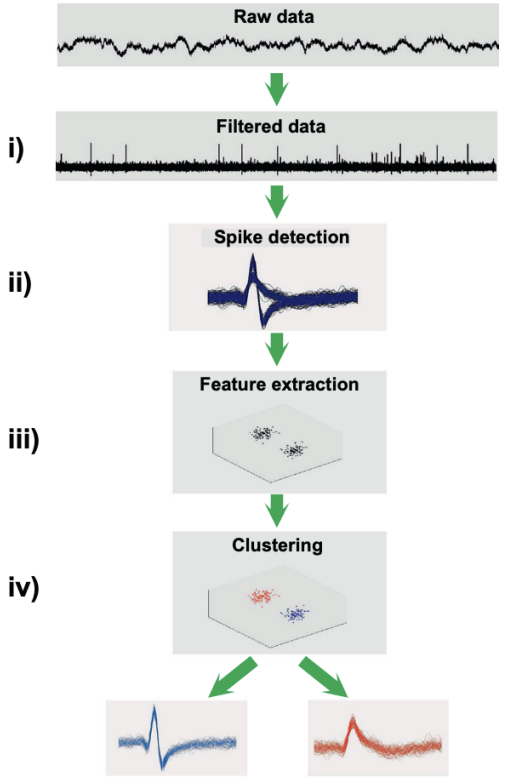
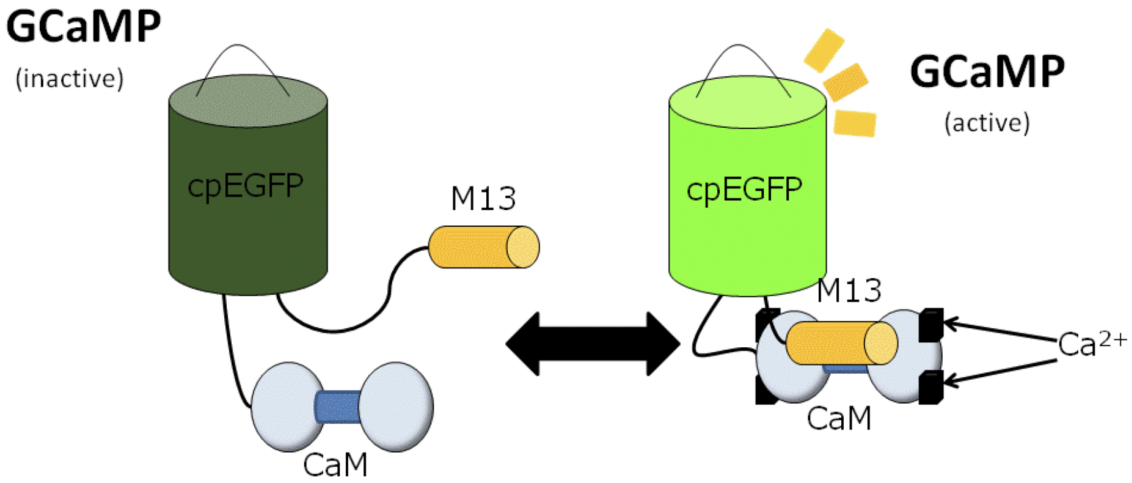
Spike sorting

Spike sorting is the process of isolating and classifying electrical signals from individual neurons recorded by electrodes, enabling the analysis of neural activity at the single-cell level.



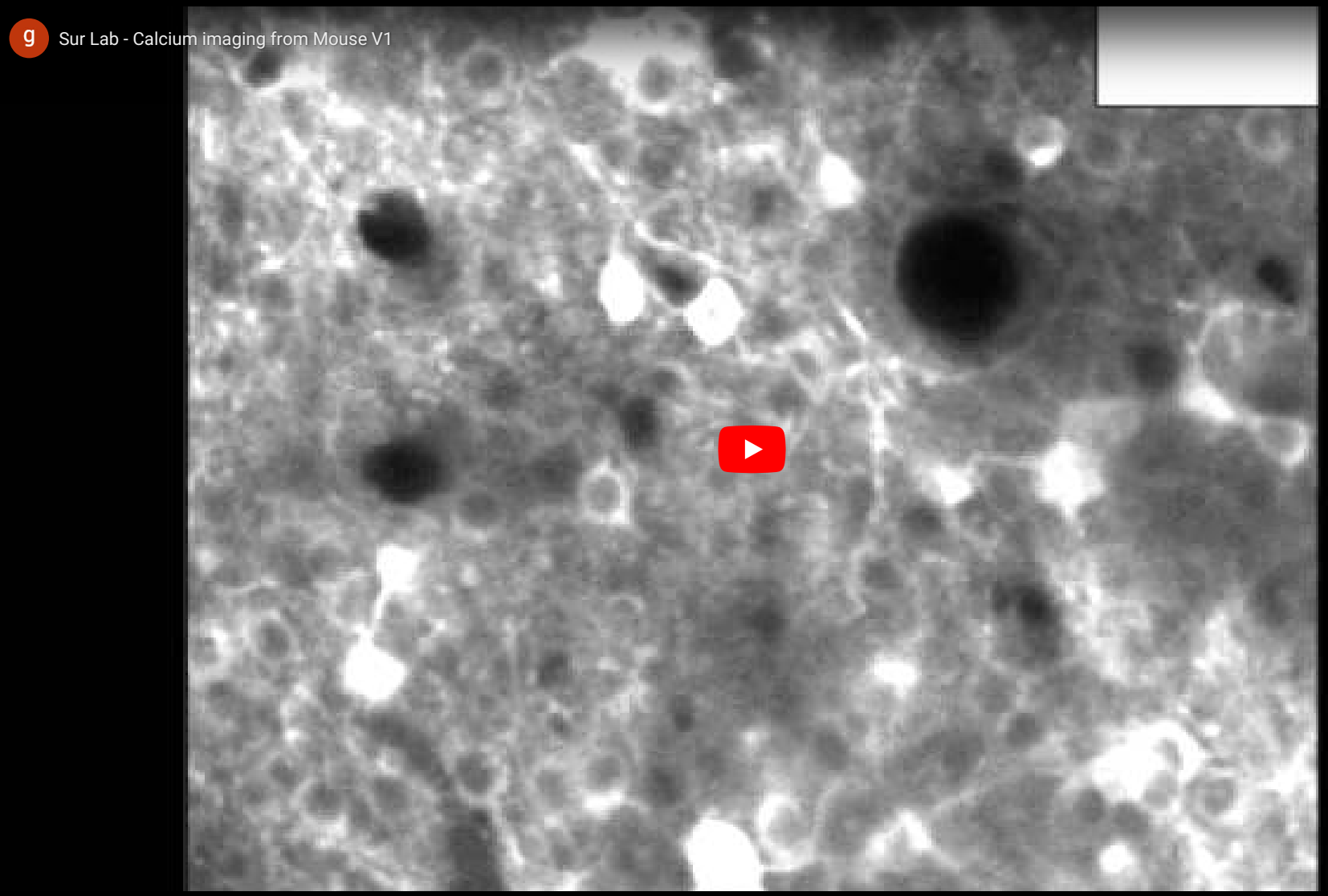
Calcium imaging: Genetically encoded calcium indicators



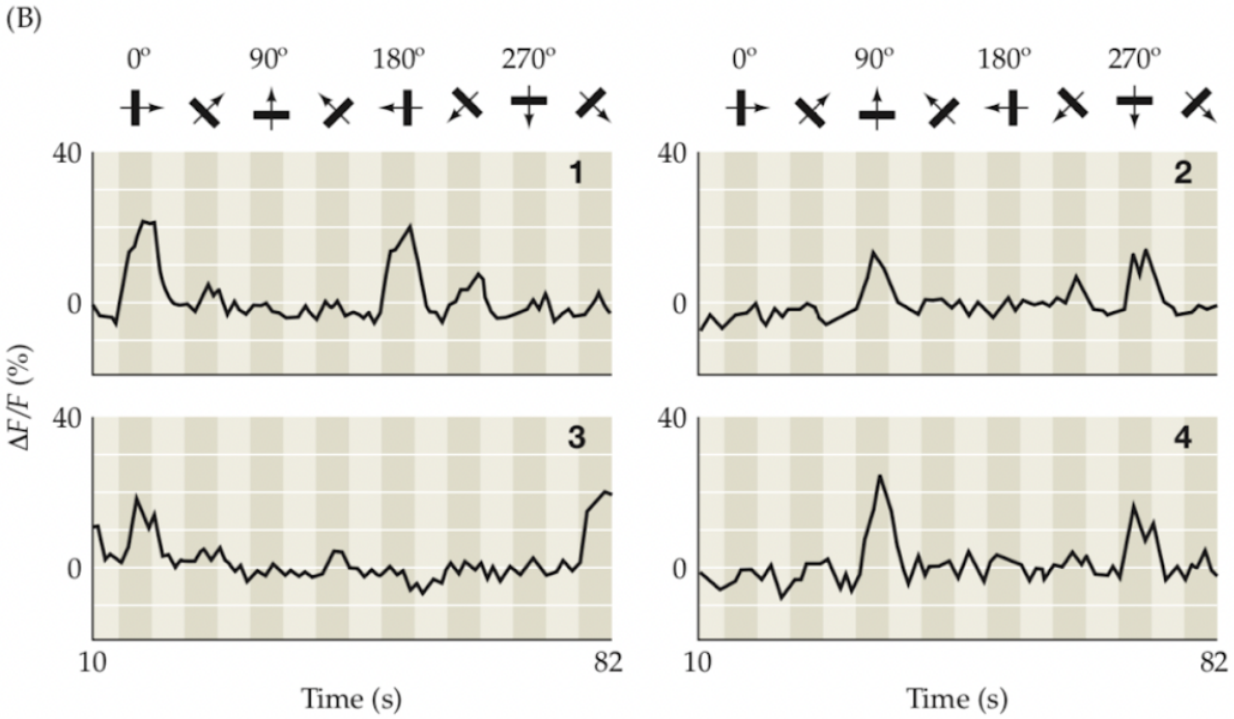
- genetically encoded calcium indicator (GECI)

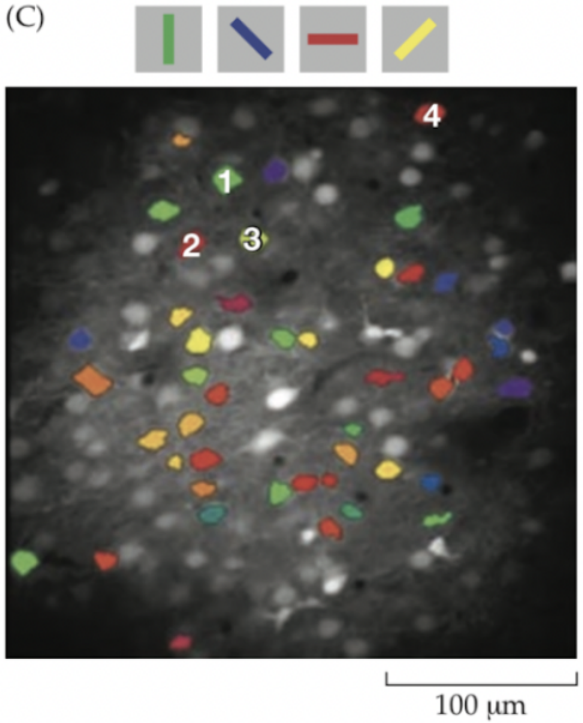
Nakai, Ohkura, Imoto (2001) *Nature Biotechnology*

Direction sensitivity in vision cortex

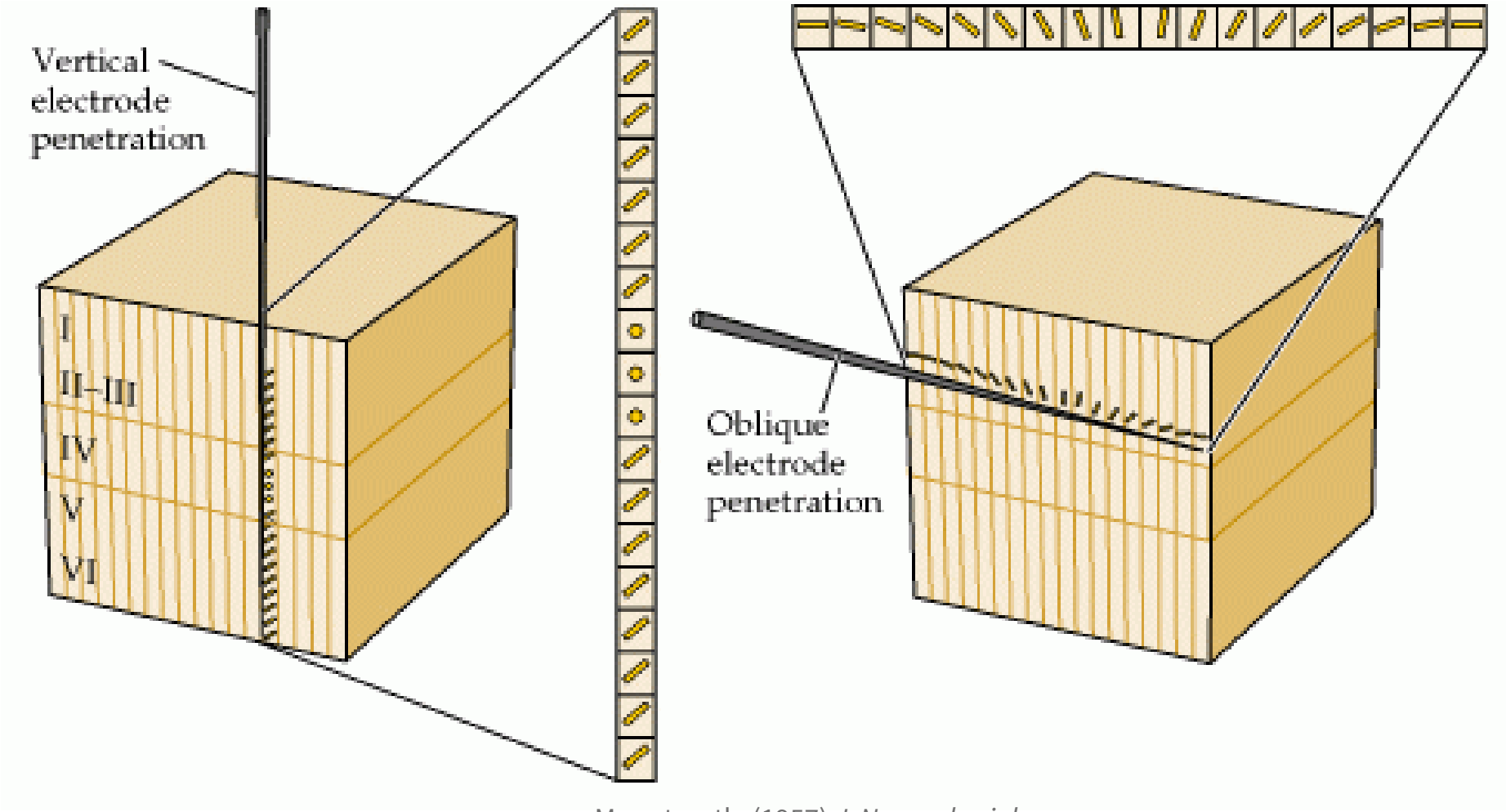


Direction sensitivity in vision cortex





Direction sensitivity in vision cortex



Mountcastle (1957) *J. Neurophysiol.*