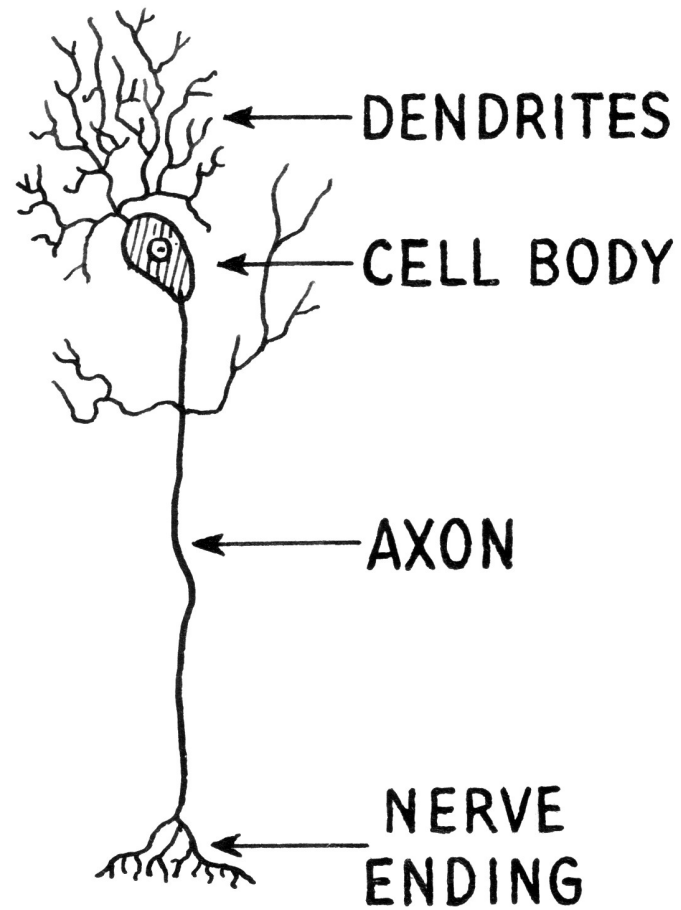
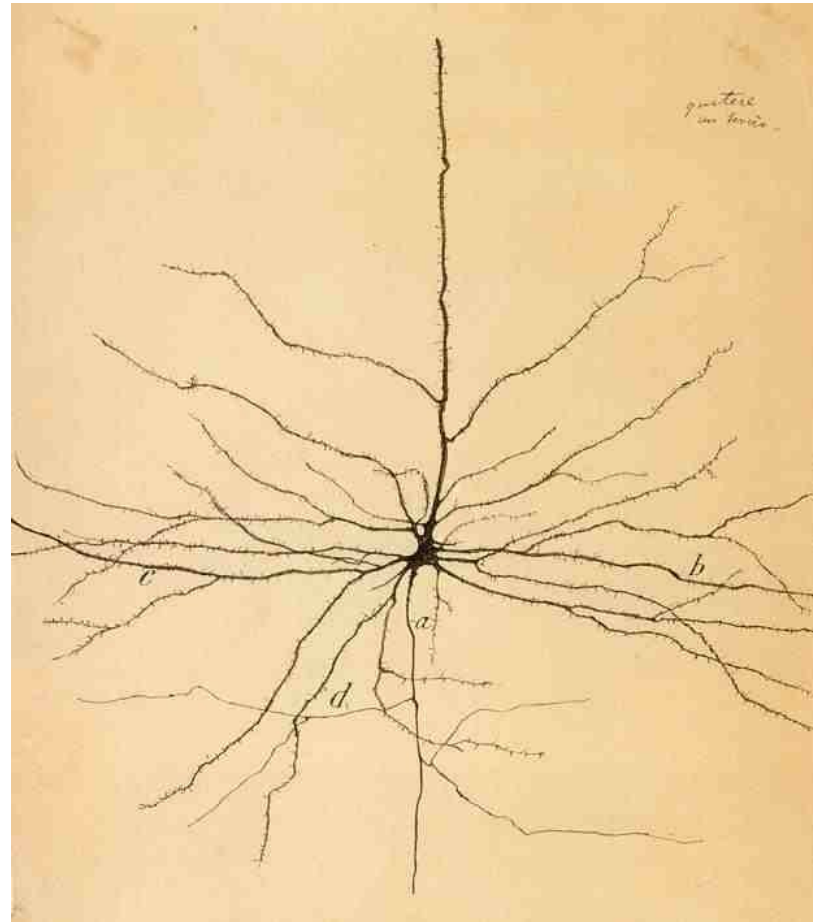


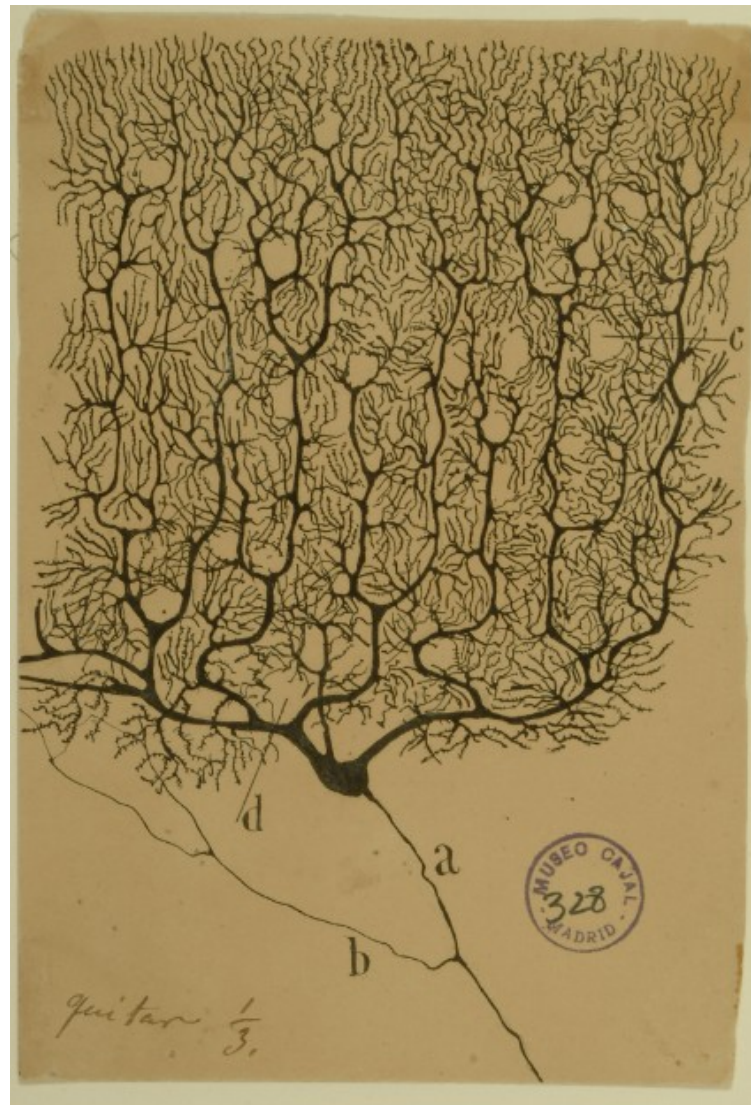
# NEURON



# Cajal – Pyramidal Neuron



# Cajal – Purkinje Cell



# Action Potential

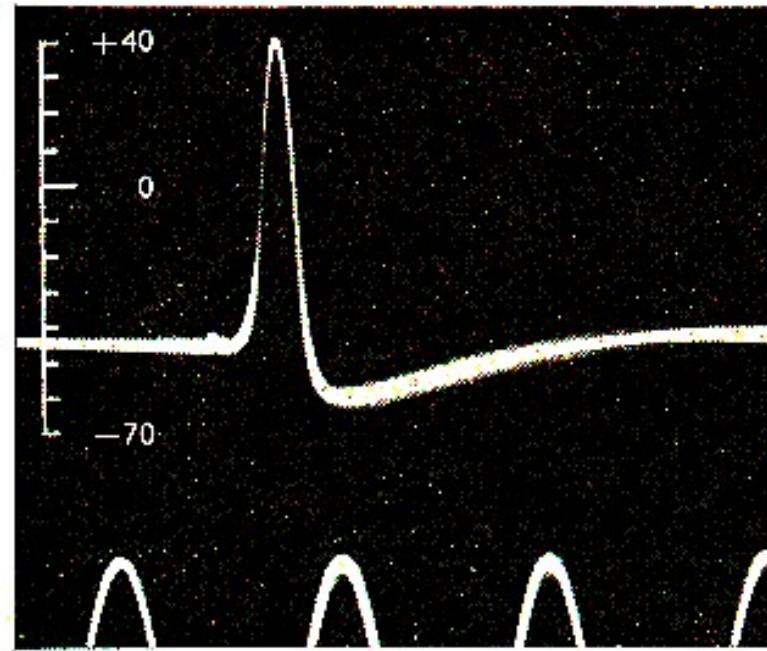


Fig. 6. Action potential and resting potential recorded between inside and outside of axon with capillary filled with sea water. Time marker 500 Hz. The vertical scale indicates the potential of the internal electrode in millivolts, the sea water outside being taken as at zero potential (from Hodgkin & Huxley, 1939; see also Hodgkin & Huxley, 1945; Curtis & Cole, 1940).

Hodgkin, A.L., and Huxley, A.F. (1939).  
Action potentials recorded from inside a nerve fiber  
Nature, 144:710

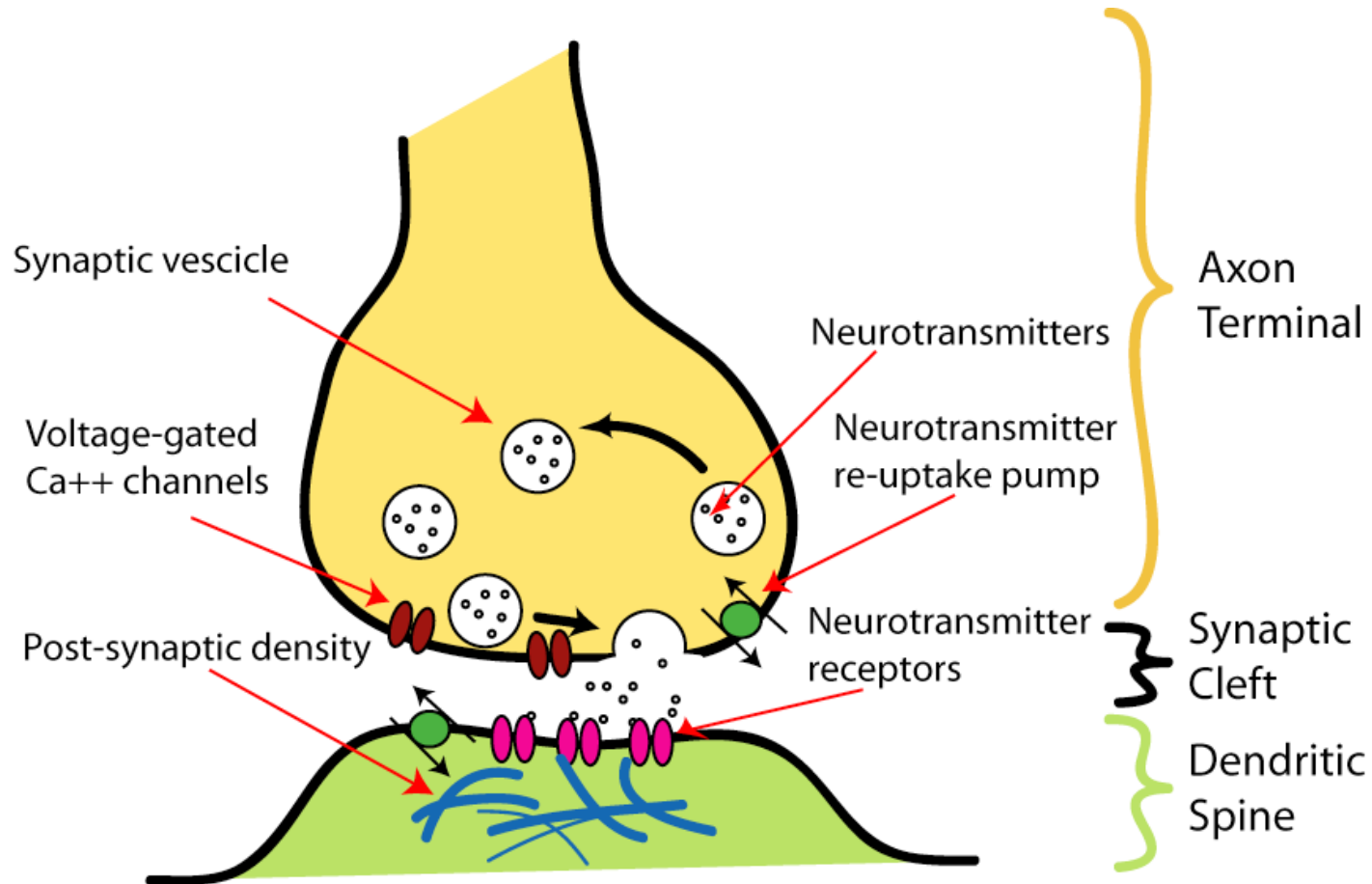
# Voltage dynamics

- The voltage inside the cell lower than outside, this is called the **membrane potential**, between -70mV and -55mV.
- Inputs from other cells change the voltage, **inhibitory cells** decrease it, **excitatory cells** increase it.
- If the voltage exceeds a threshold the neuron sends out a spike.

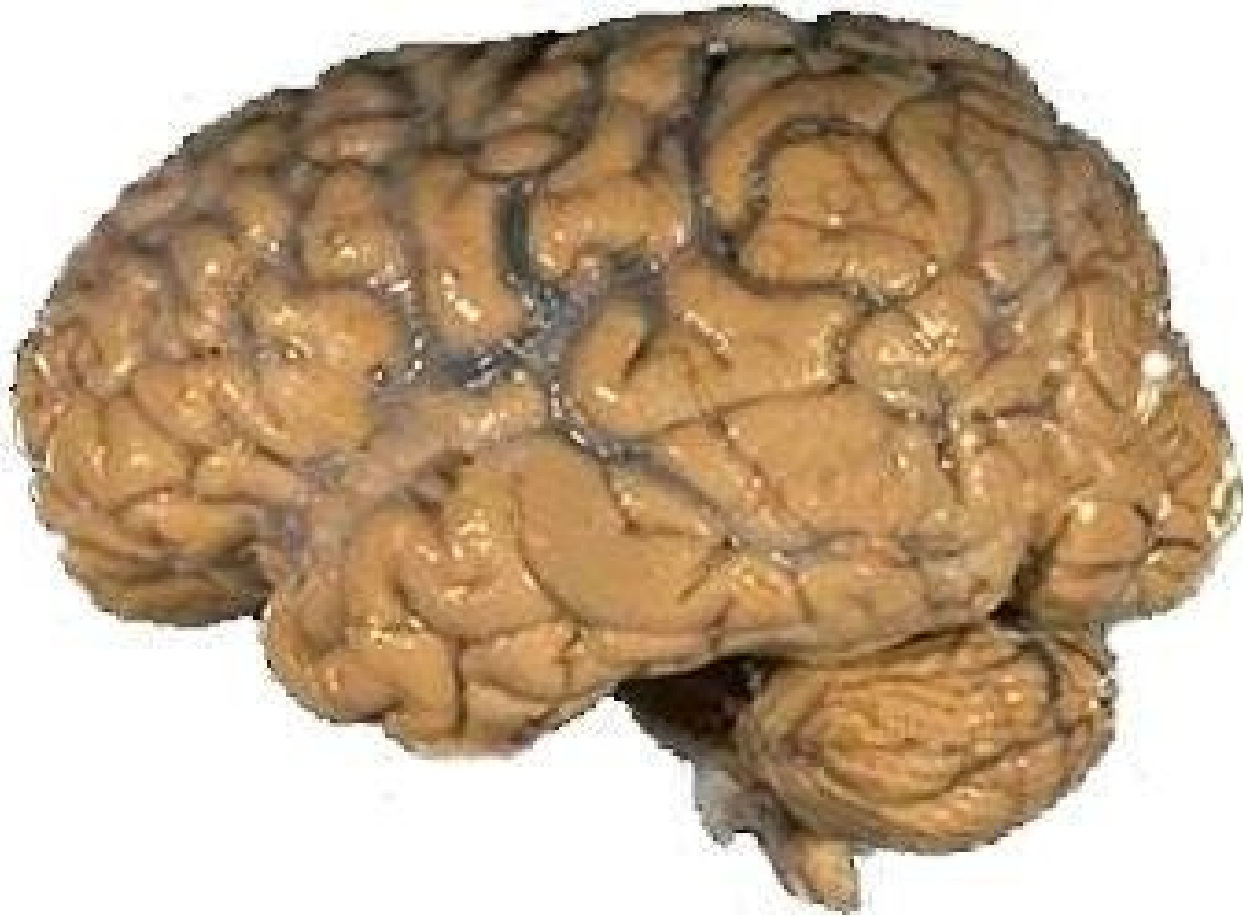
# A retinal ganglion cell spiking



# Synapse

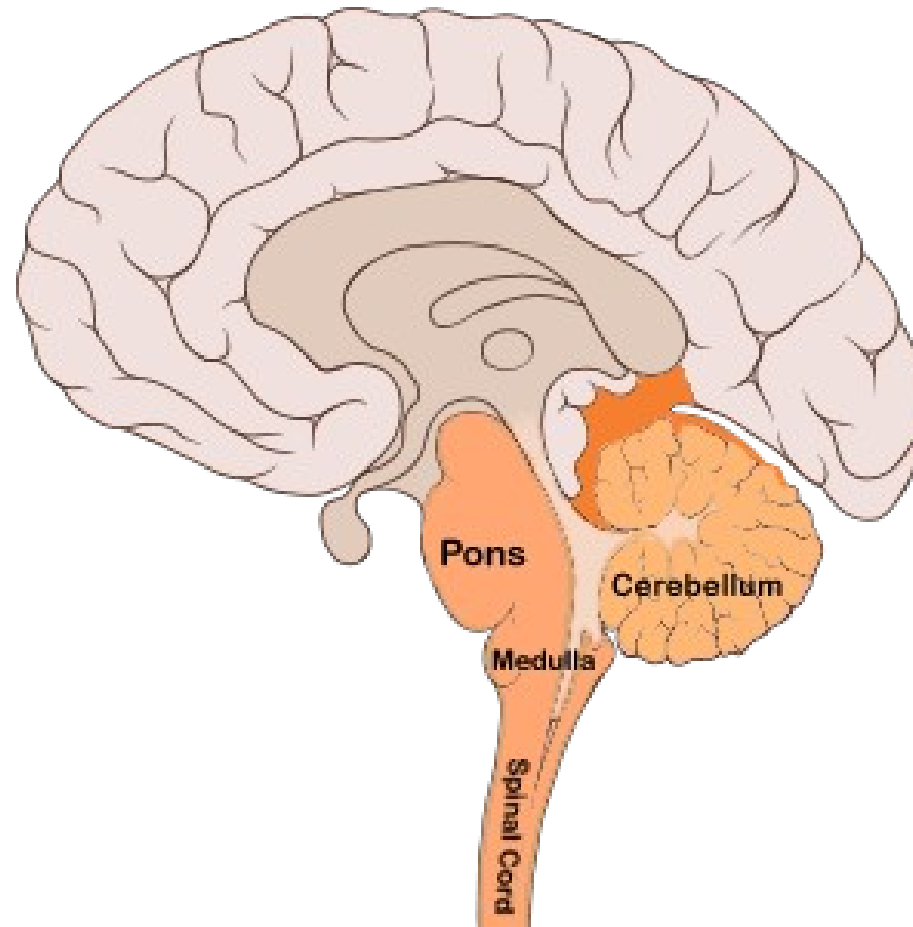


# A brain

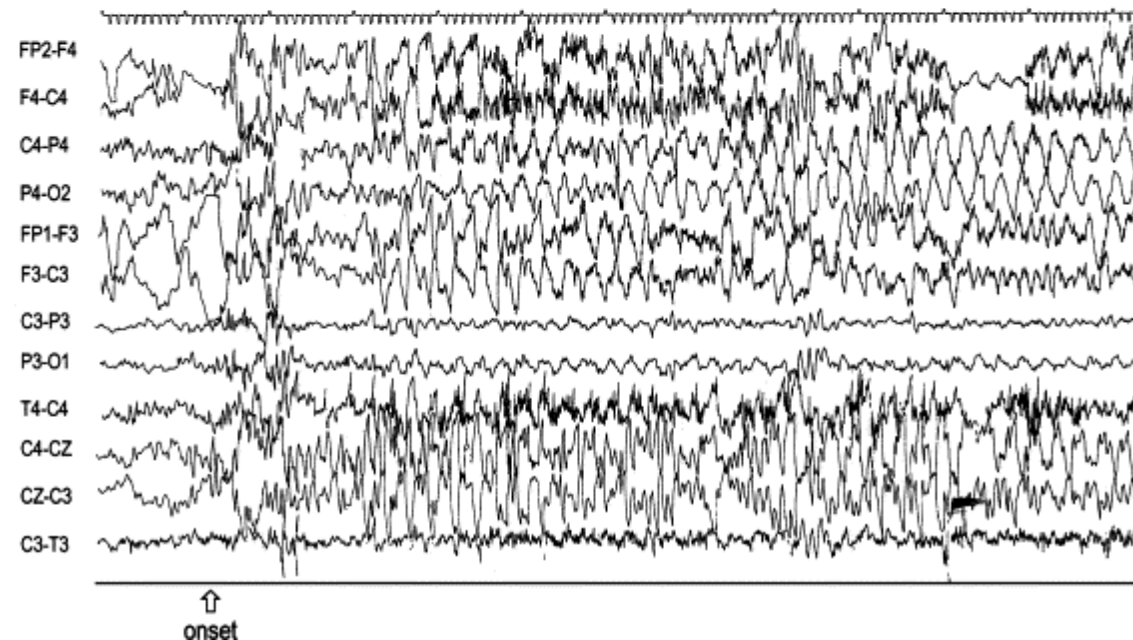
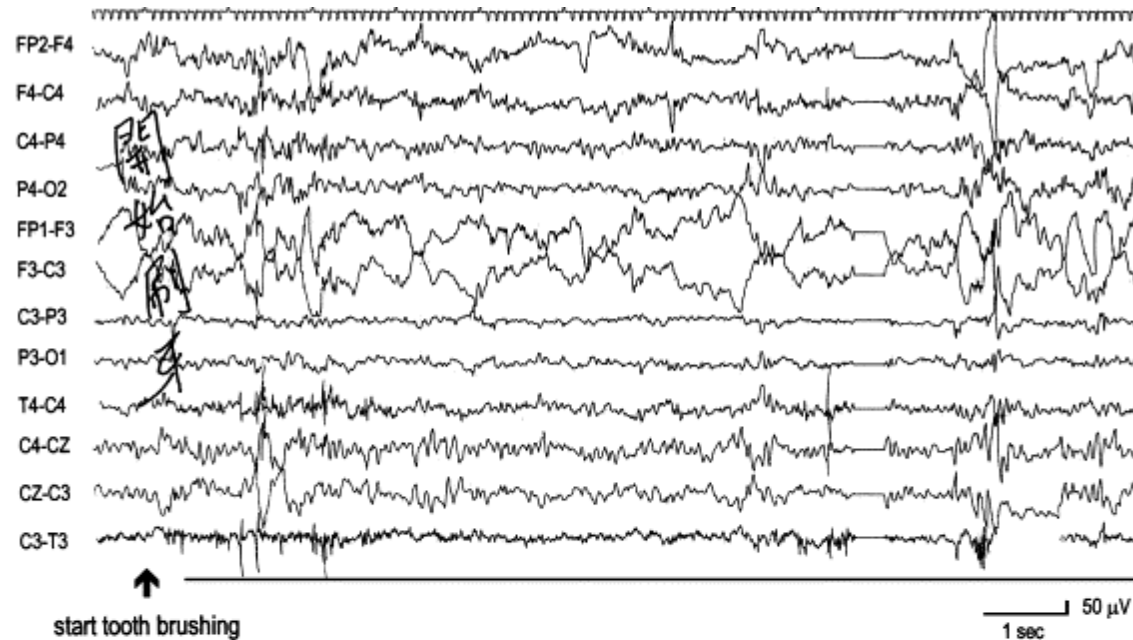




# Sagittal view



# EEG



Chuang et al. 2004. Tooth-brushing epilepsy with ictal orgasms

# fMRI

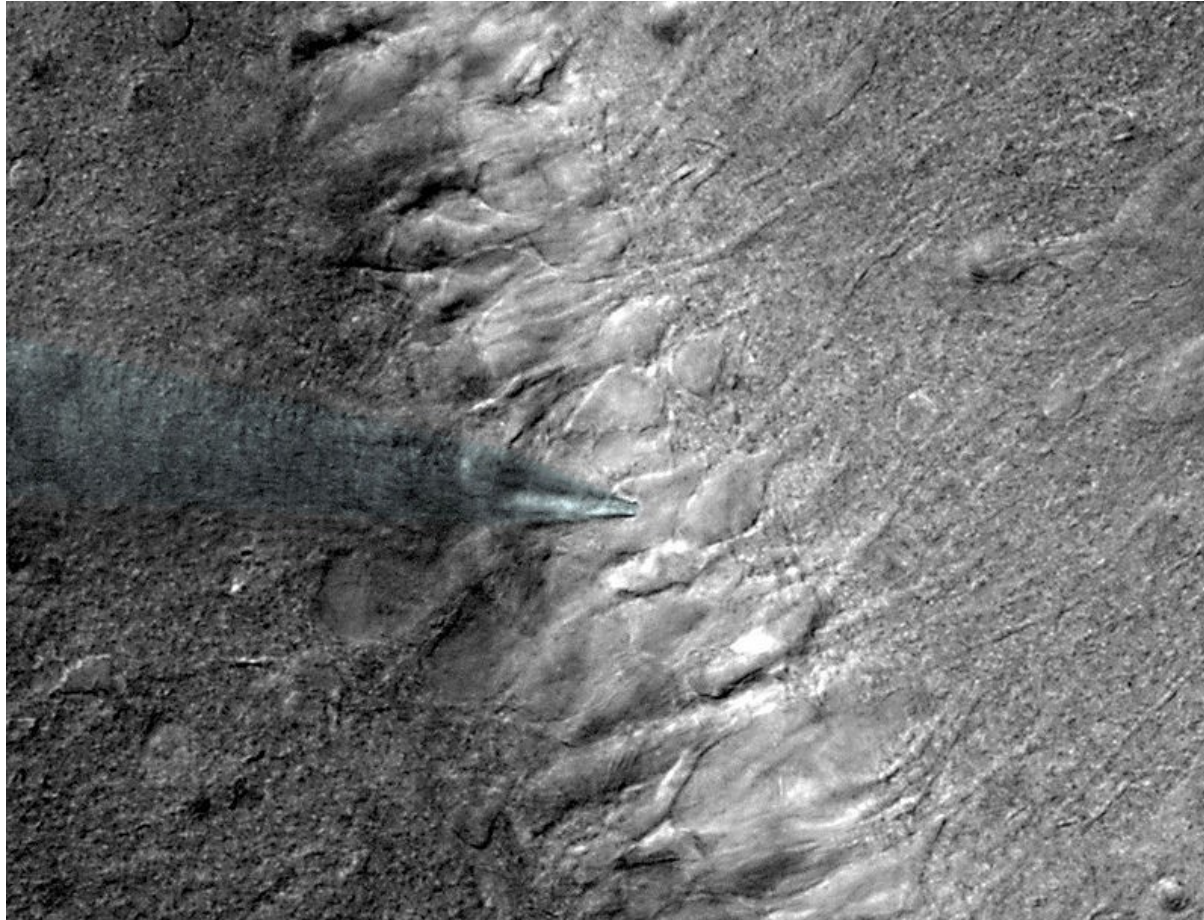


# *In vivo* electrophysiology



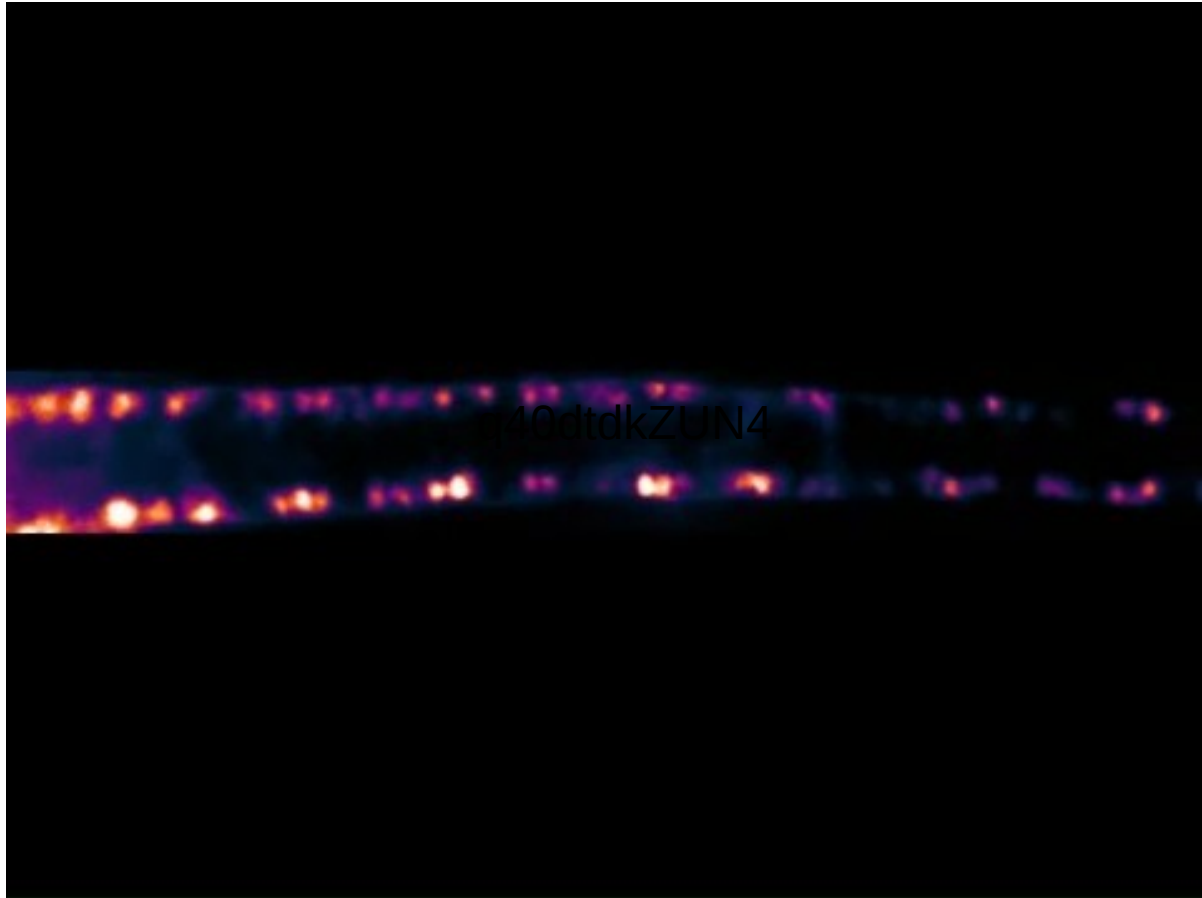
From: <http://neuroscience.cornell.edu/faculty.html>

# ***In vitro* electrophysiology – patch clamping**



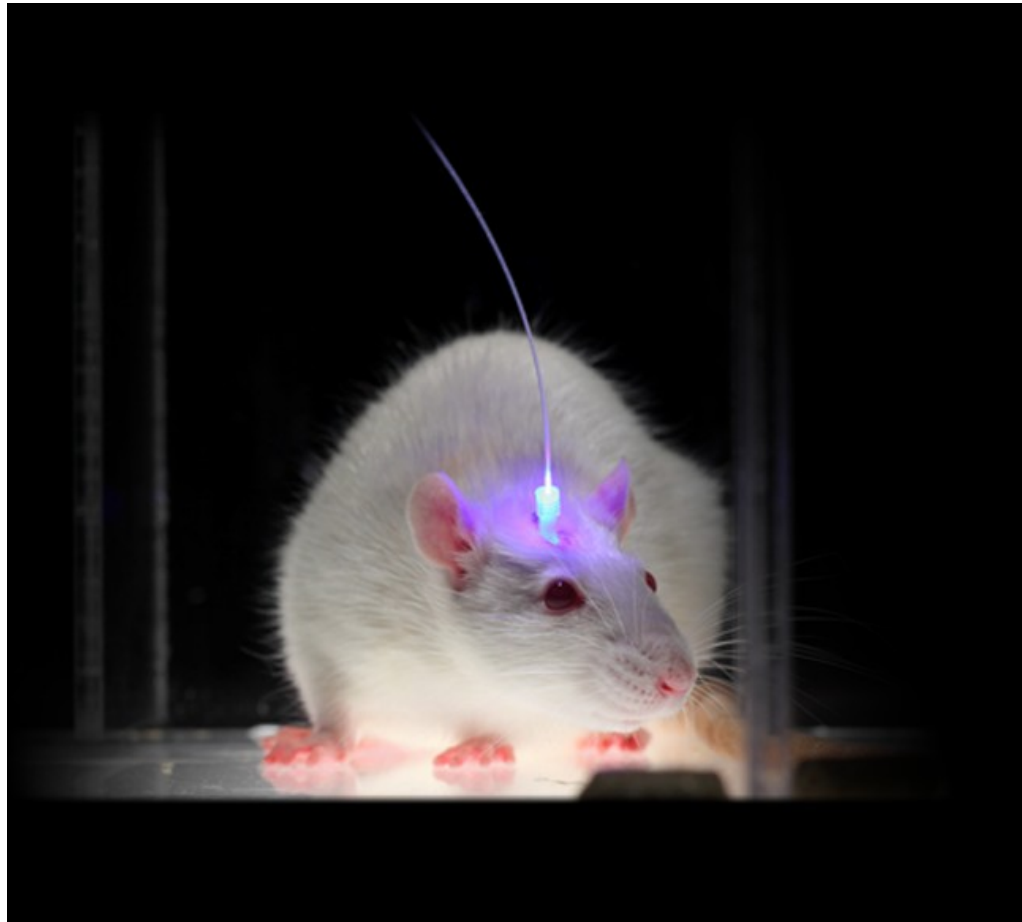
From: [https://en.wikipedia.org/wiki/Patch\\_clamp](https://en.wikipedia.org/wiki/Patch_clamp)

# Calcium imaging – Zebra fish



<https://www.youtube.com/watch?v=q40dtdkZUN4>

# Optogenetics



From: <http://web.stanford.edu/group/dlab/optogenetics/>

# Cerebellar ataxia.

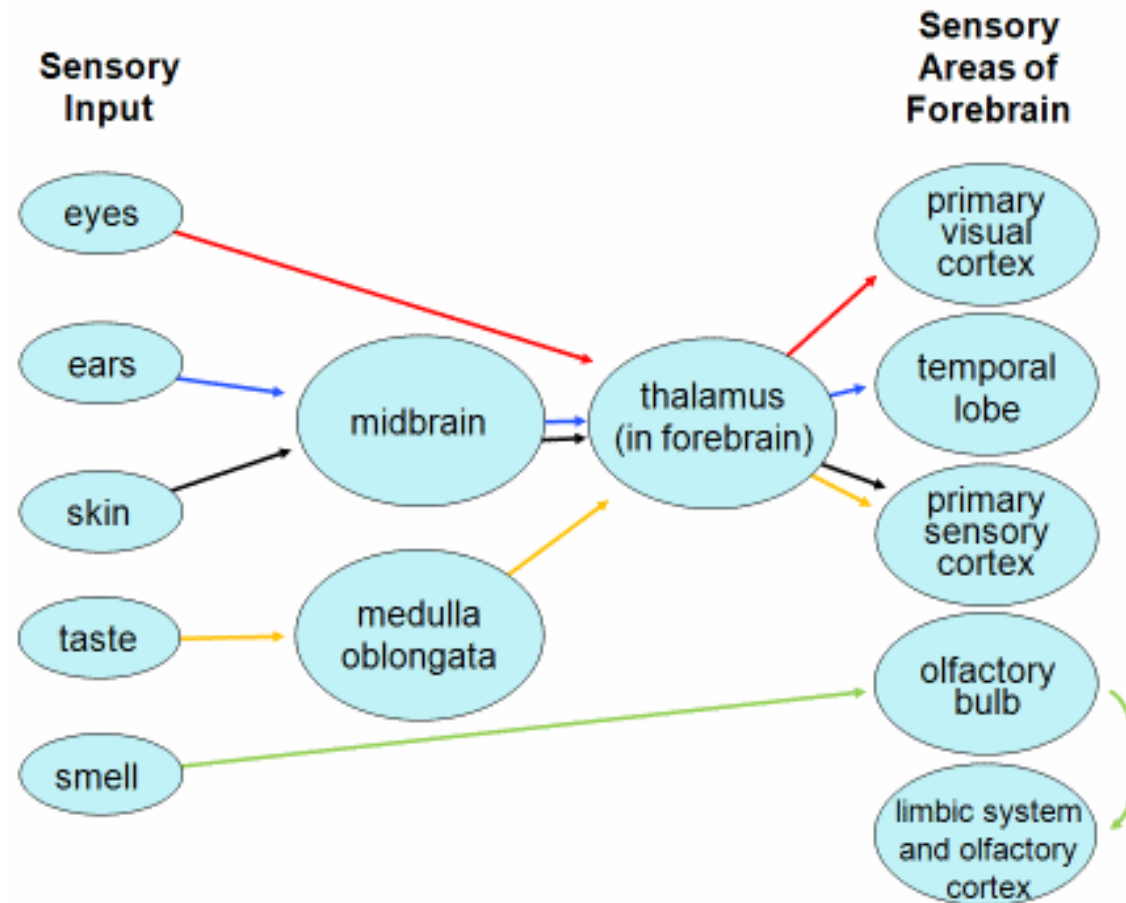




# Thalamus



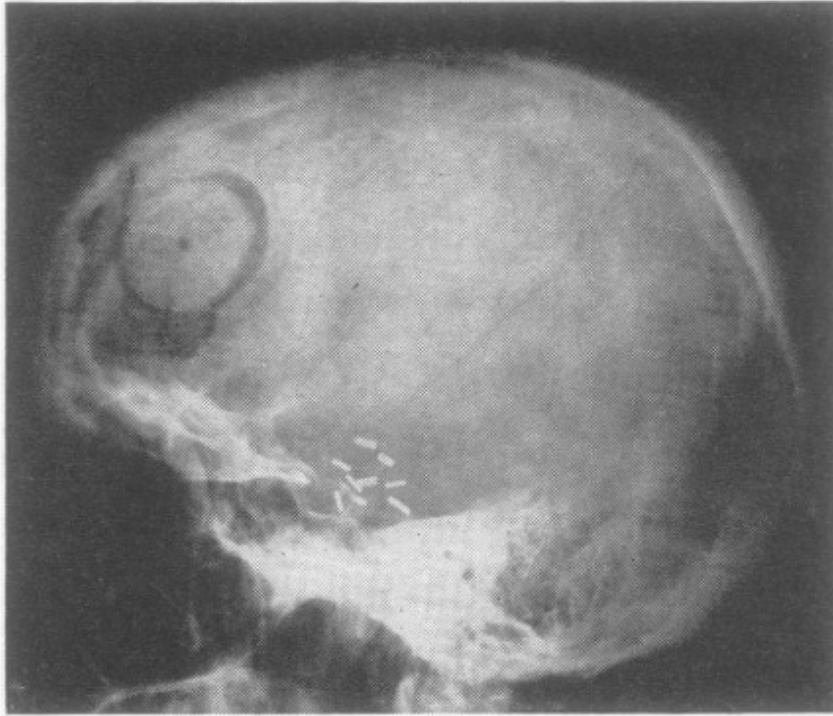
# Thalamus - routing



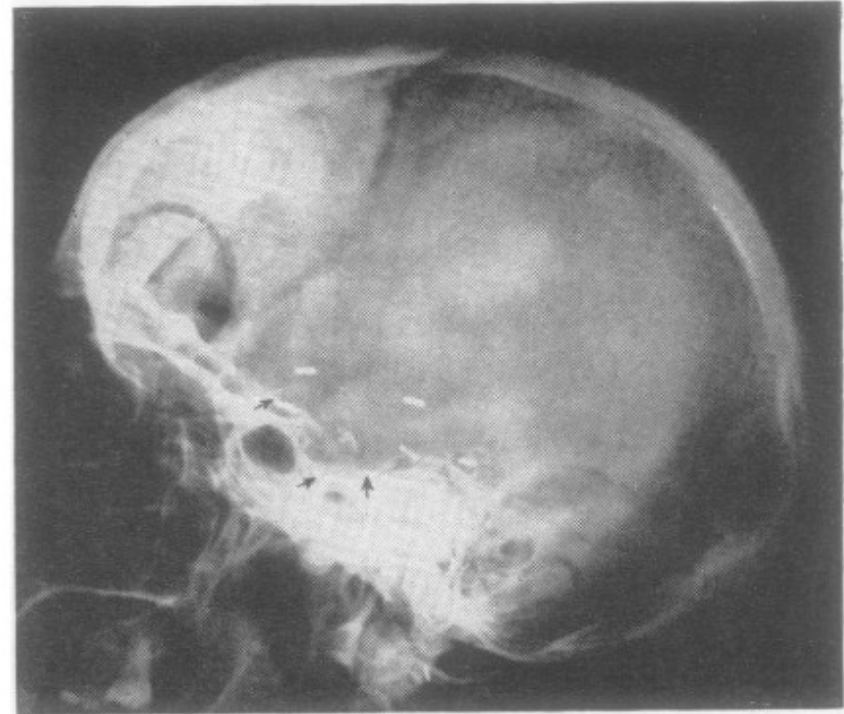
# Hippocampus



# H.M. - Henry Molaison



**FIG. 3.**—Post-operative skull radiograph with silver clip markers outlining extent of bilateral resections limited to the uncus and amygdala.



**FIG. 4.**—Post-operative skull radiograph with silver clip markers outlining the extent of the bilateral resections including the anterior hippocampal complex (approximately 6 cm. posterior to the tip of the anterior temporal fossa).

Scoville, W. B., & Milner, B. (1957).  
Loss of recent memory after bilateral hippocampal lesions.  
*Journal of neurology, neurosurgery, and psychiatry*, 20(1), 11.

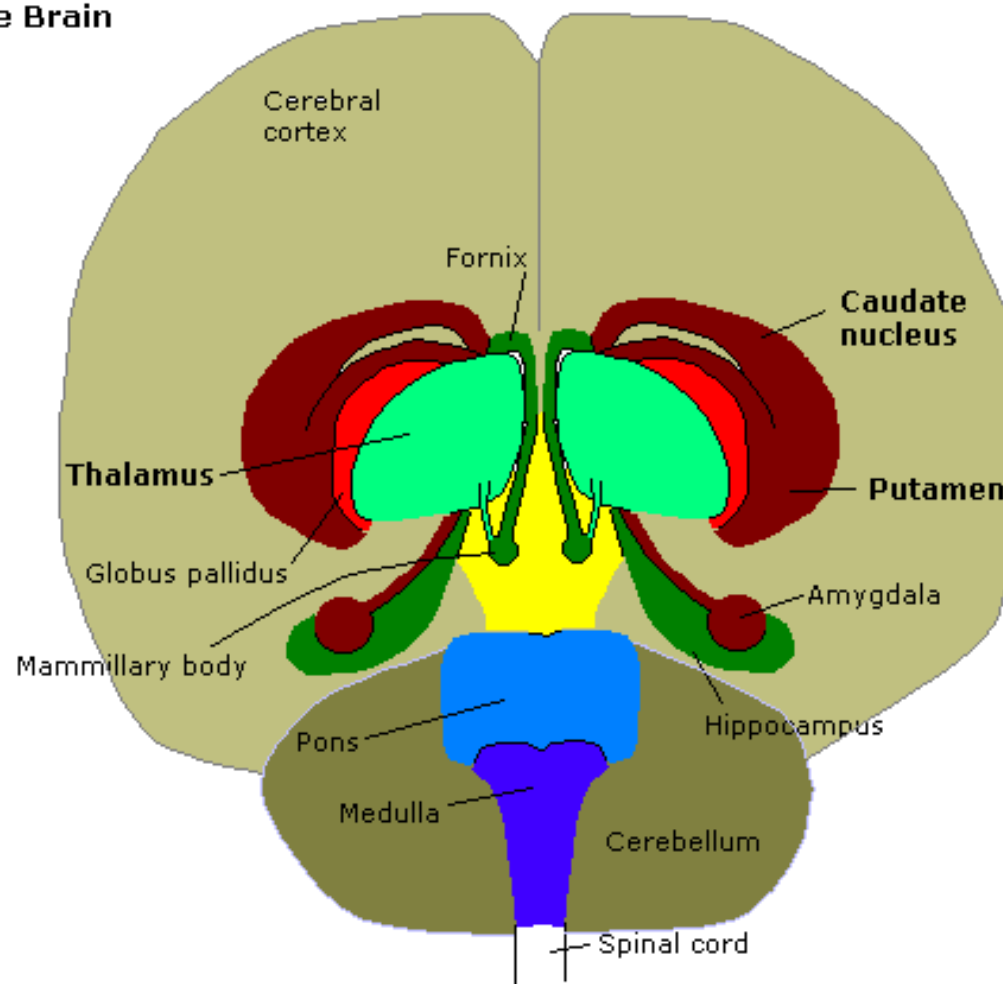
# Clive Wearing



<https://www.youtube.com/watch?v=Vwigmktix2Y>

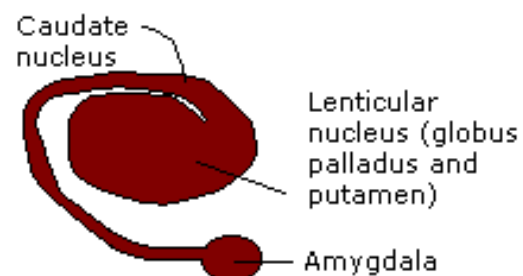
# Amygdala

## The Brain



The brain as viewed from the underside and front. The thalamus and Corpus Striatum (Putamen, caudate and amygdala) have been splayed out to show detail.

## Corpus Striatum



# Drawing by S.M.



**HAPPY**



**SAD**



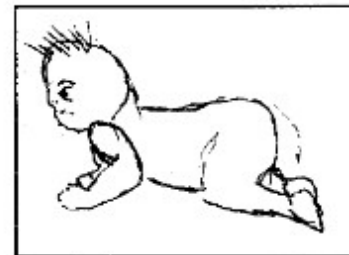
**SURPRISED**



**DISGUSTED**



**ANGRY**

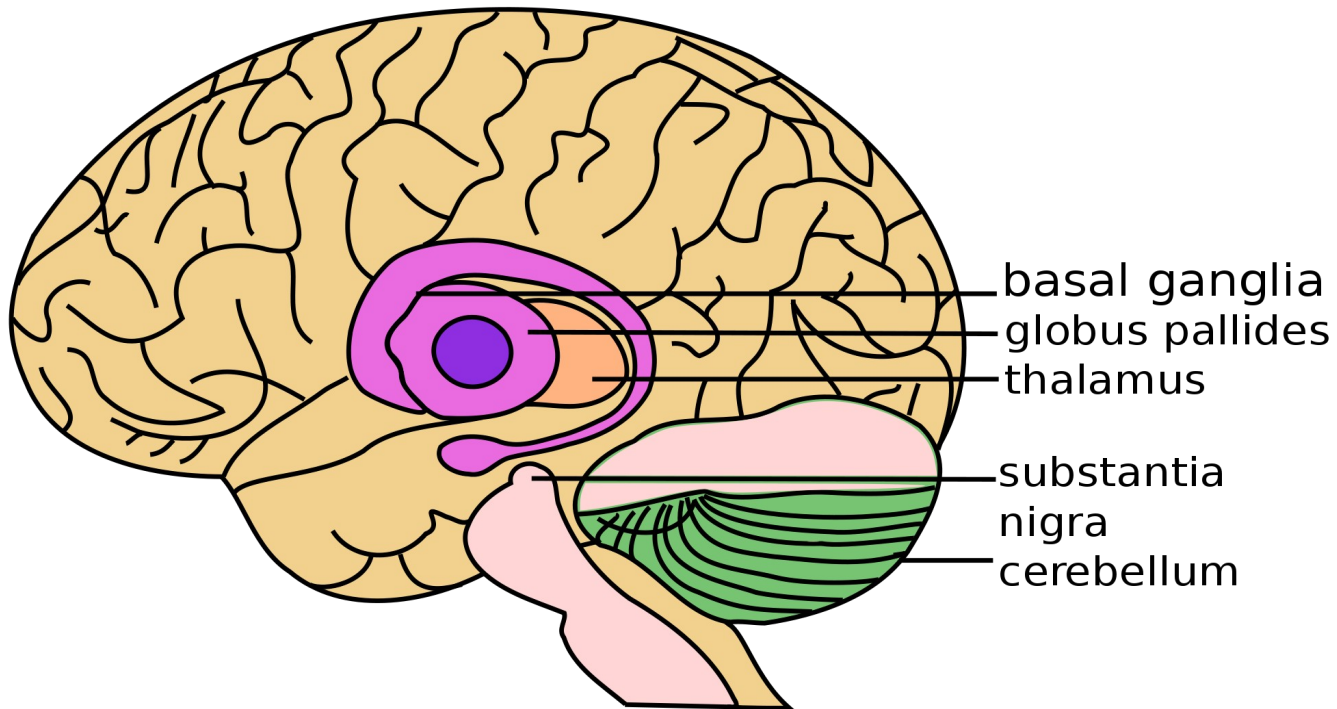


**AFRAID**

Adolphs, R., Tranel, D., Damasio, H., & Damasio, A. R. (1995).  
Fear and the human amygdala.  
The Journal of neuroscience, 15(9), 5879-5891.

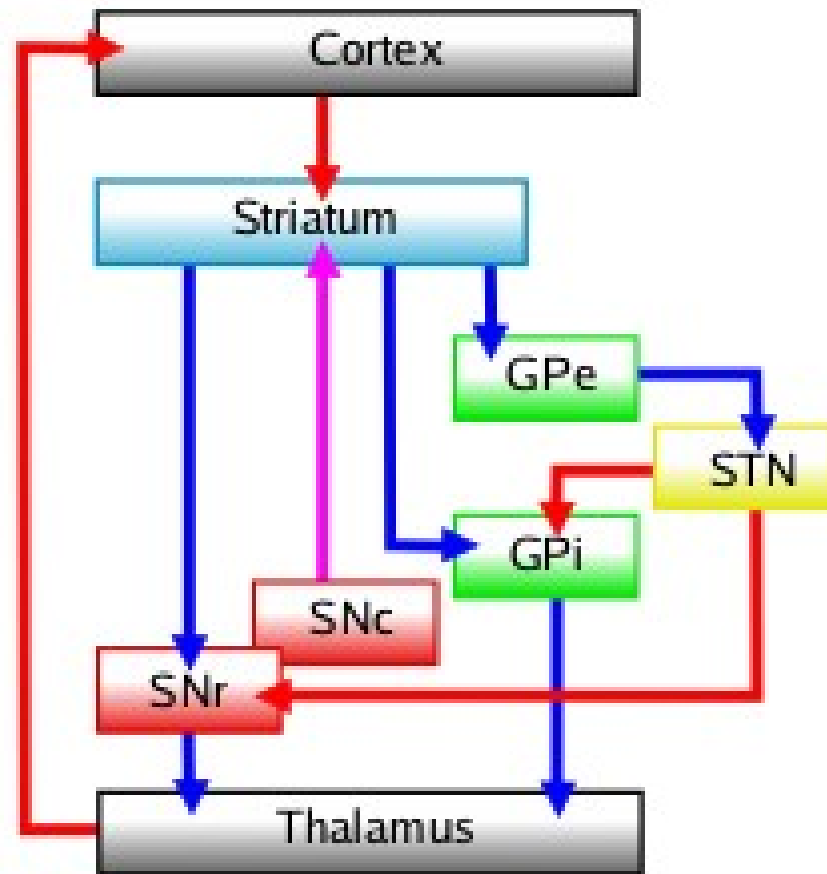
# Basal Ganglia

## Basal Ganglia and Related Structures of the Brain





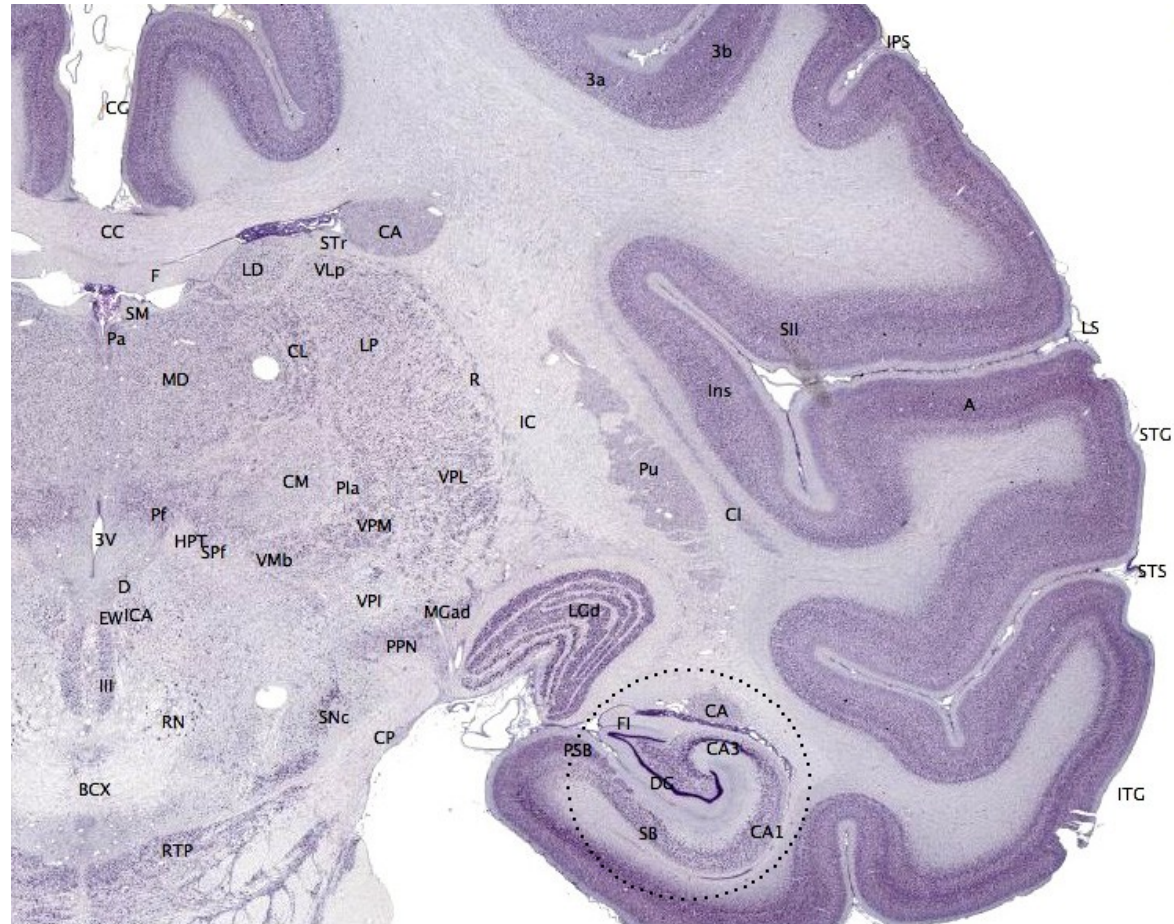
**Basal ganglia – decides between cortical areas competing for motor control.**



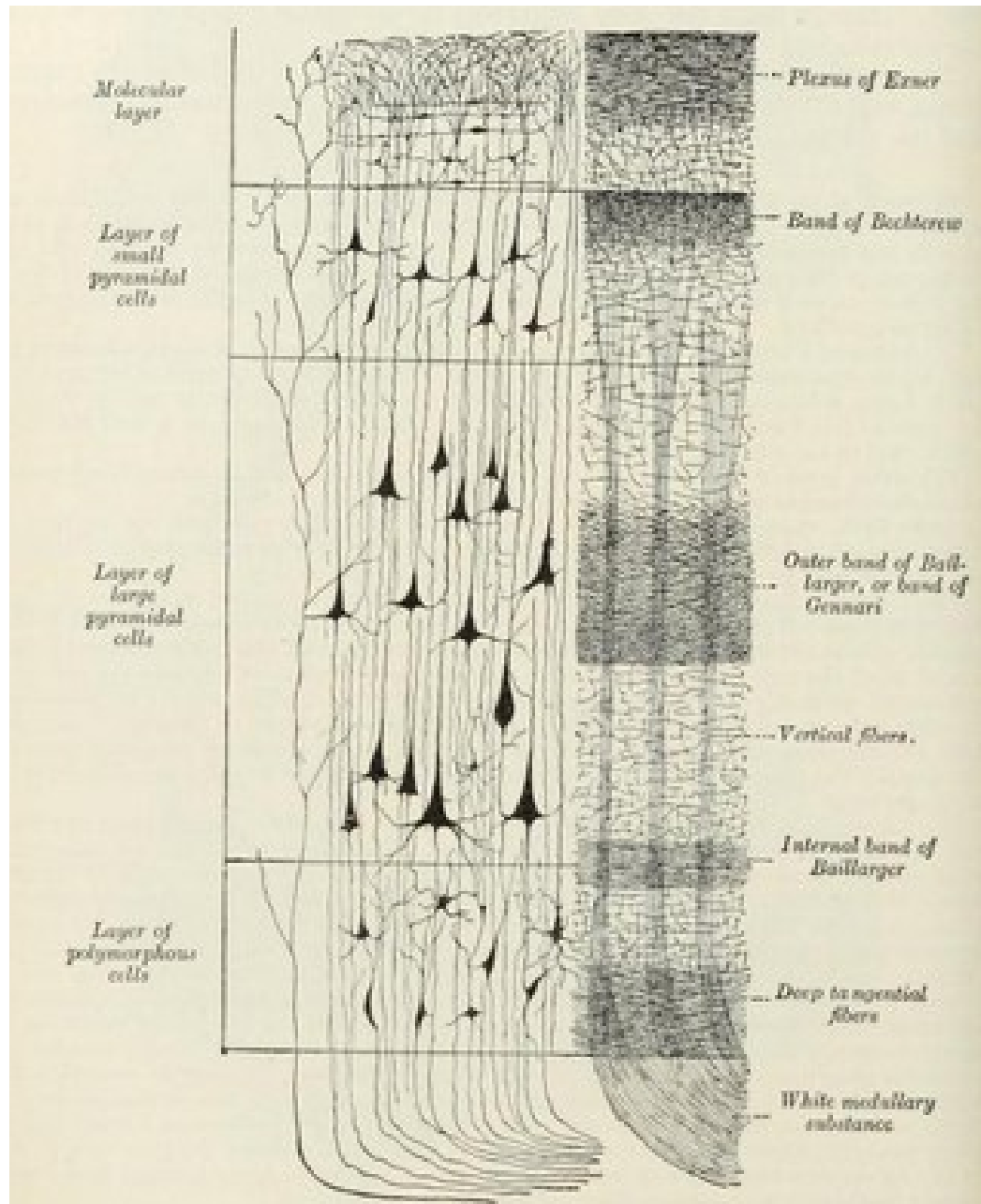
# Parkinsonian gait



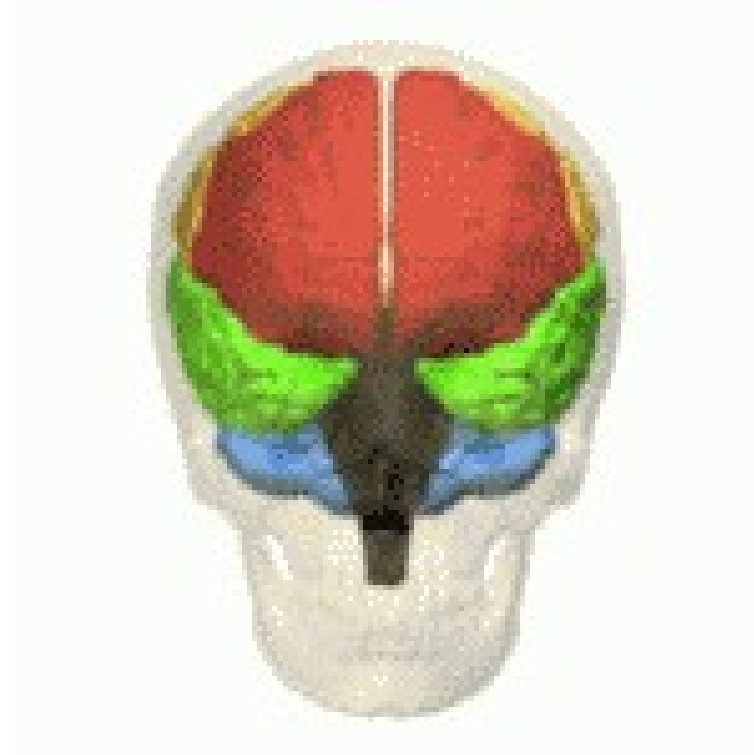
# Macaque cortex



# Layers of the neocortex



# Lobes of the cortex



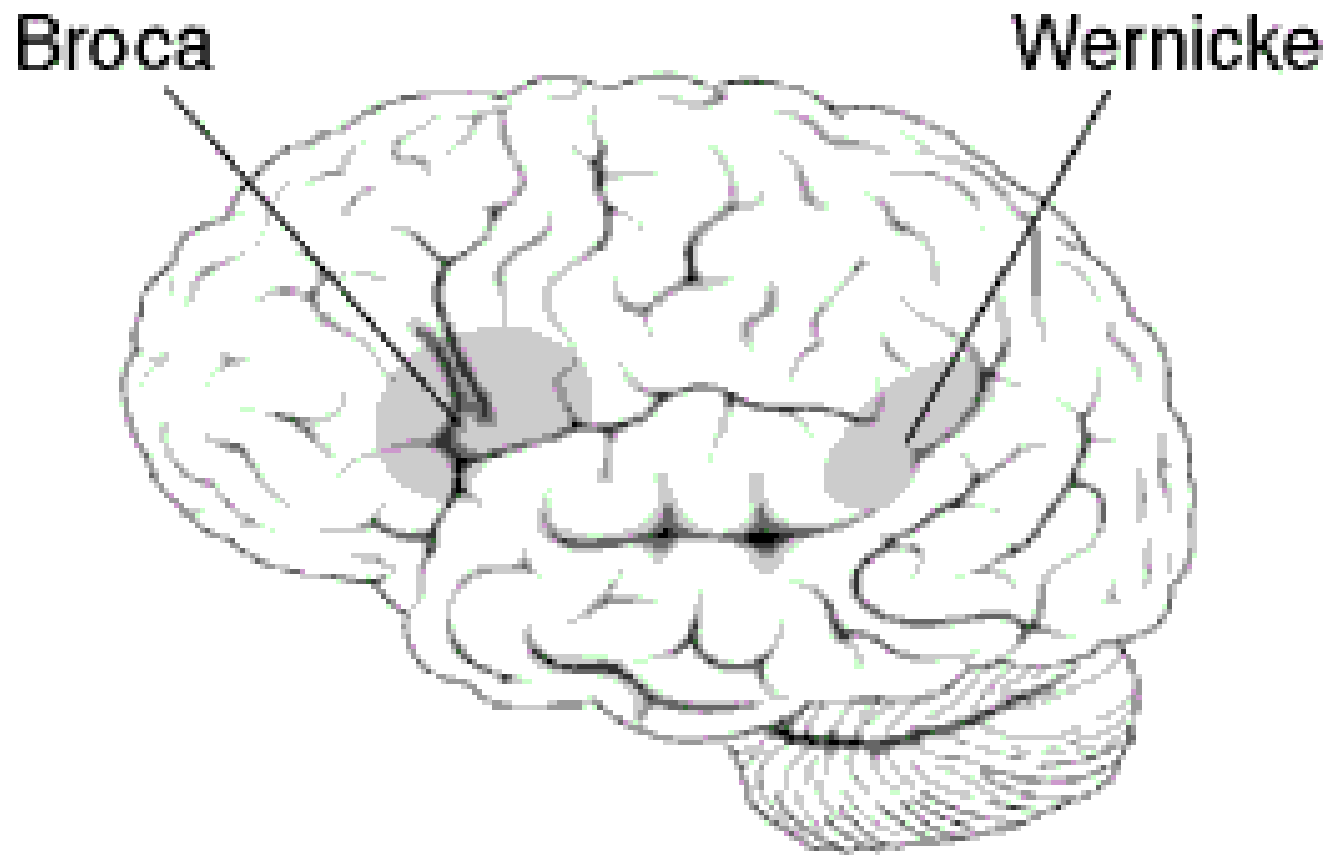
Orange – Frontal Lobe, Yellow – Parietal Lobe  
Green – Temporal Lobe, Pink – Occipital Lobe

# Tan / Hodor



<https://www.youtube.com/watch?v=h5X6Qn9hQHk>

# Broca and Wernicke areas



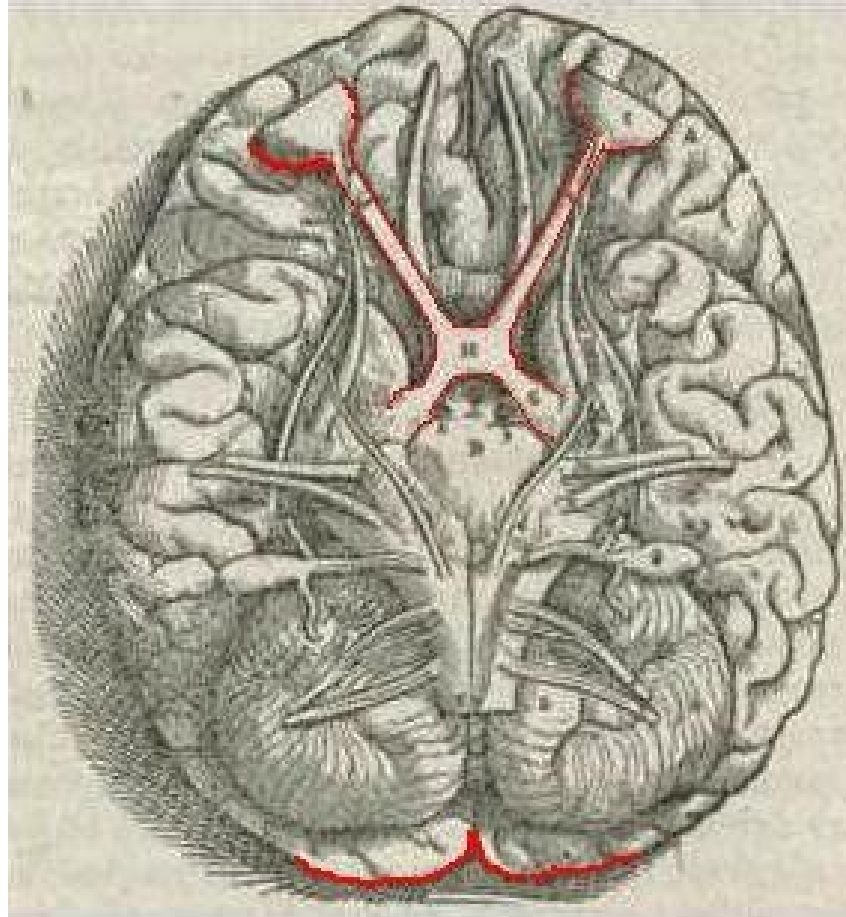


# Secondary zone of left temporal region

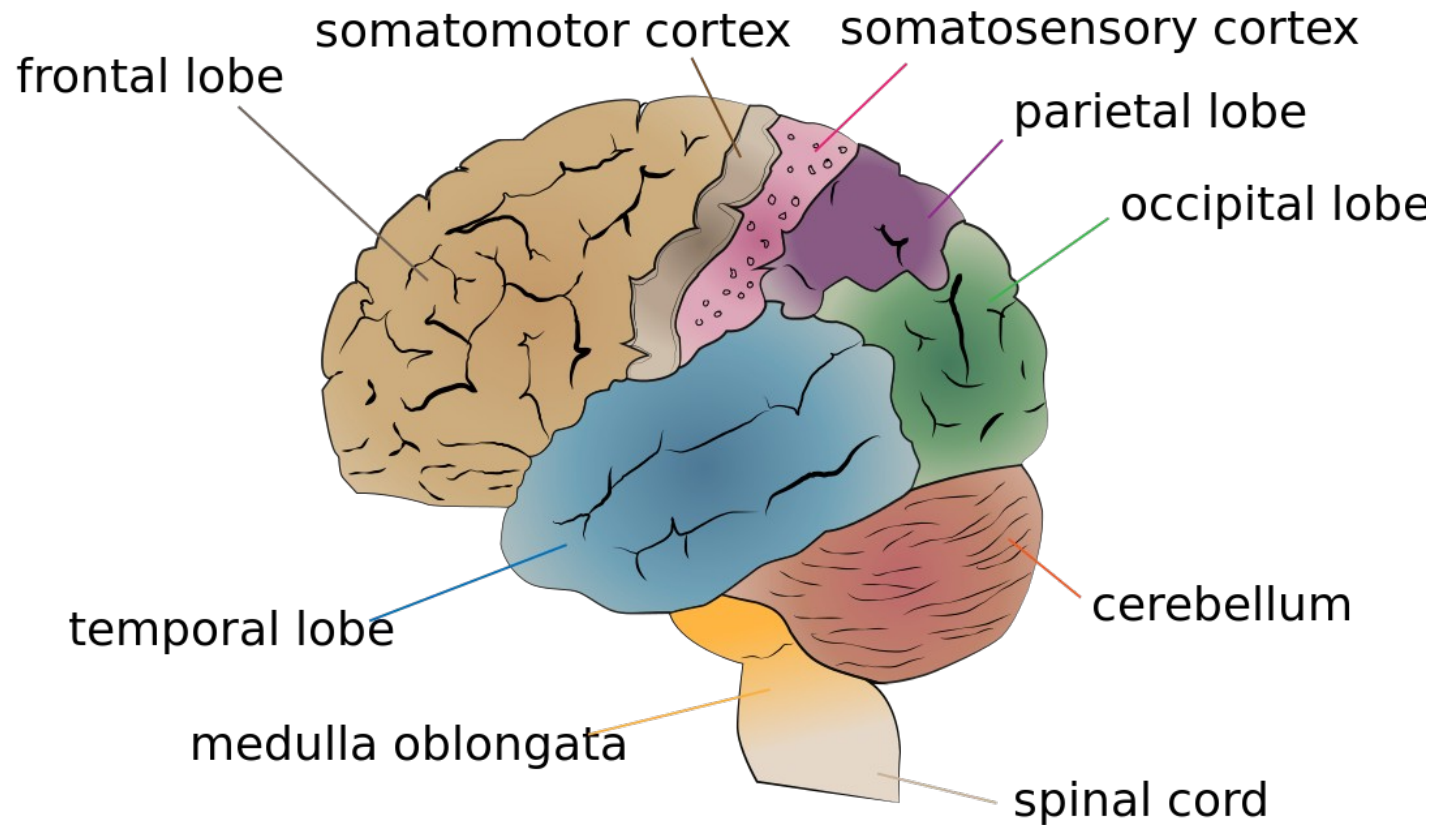
Finally, although the phonemic and lexical aspects of the coherent speech of these patients are grossly disturbed, characteristically the *intonational and melodic aspect of their speech as a rule remains intact*, and by its aid the listener can understand the meaning of the patient's apparently incoherent speech. Who, listening to a flow of words such as 'well now... I mean... so... we... now... went... went... suddenly... now this... like this... bang!... and then - nothing... nothing... and since... little by little... better still... quite... and now... do you see?' - completely devoid of substantives, could guess that a person wounded in the temporal region was describing how they were going, how the exploding shell stunned him, how he lost consciousness, and how his consciousness gradually returned, although his speech still remained difficult?



# Andreas Vesalius' sketch of the visual pathway from 1543.



# Somatomotor and somatosensory cortex



# The motor homunculus



# The sensory homunculus



<http://commons.wikimedia.org/wiki/File:Homunculus.jpg>

# Brodmann areas



# Names of brain areas.

Names often reflect shape not function

Abbreviations are often used – see the list on the website.

