

**Discovering the Basic  
Components of the Brain:  
Mapping the Neocortex**

# Maps

- You arrive at Earth in your spaceship in 1700
  - previous explorers have reported the presence of a semi-intelligent life form
  - your mission is to compile a detailed report on this life form
  - you are equipped with a transporter so you can move about freely to collect information
- As a basis for your continuing study, you decide to create a map
  - What do you show on the map?
  - How do you divide the map up into regions?

# What Are the Steps in Constructing a Map?

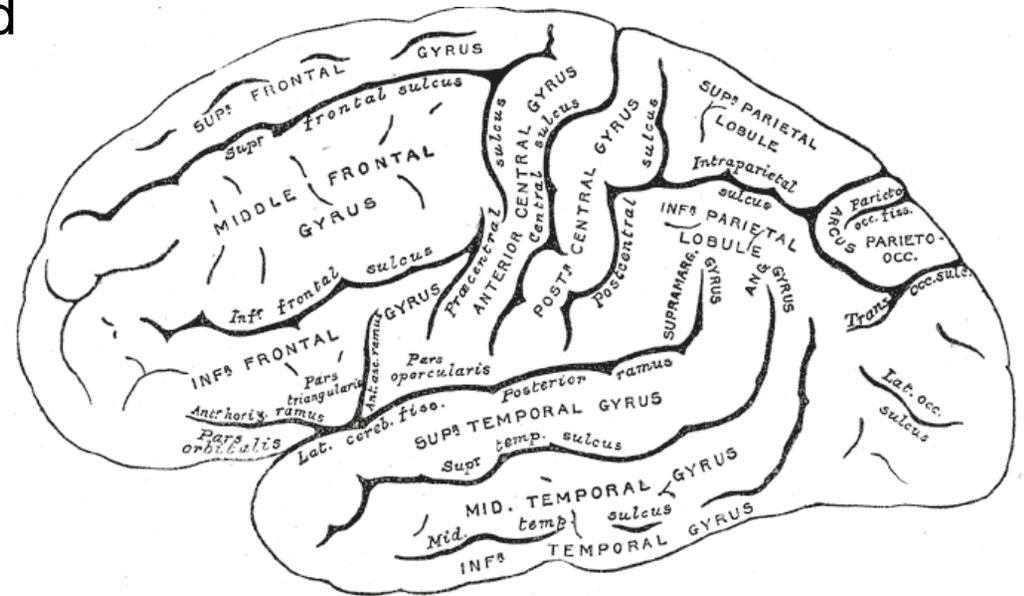
- From space you can identify the major features of the geology—oceans, lakes, rivers, mountains, valleys, etc.
- What other information might you want to collect (remember, you have a transporter so travel is not an issue)?

# Mapping Languages



# Mapping the Neocortex

- One of the most notable features of the cerebral cortex is the pattern of folding
  - Which turns out to be quite regular from person to person
- Major sulci supported dividing the neocortex into four lobes
- Major project in the 19<sup>th</sup> century: delineating and naming sulci and gyri, which were hypothesized to be the relevant units of the brain
- With the identification of neurons, researchers began to focus on how different types of neurons are found in different tissues



# Discussion Question

Is the Map of Sulci and Gyri sufficient for neuroscience?

- A. Yes, it provides a way of referencing every place
- B. Yes, it picks out clear physical structures
- C. No, it doesn't take differences in neurons into account
- D. No, it doesn't pick out units we care about in the brain? (be prepared to explain)

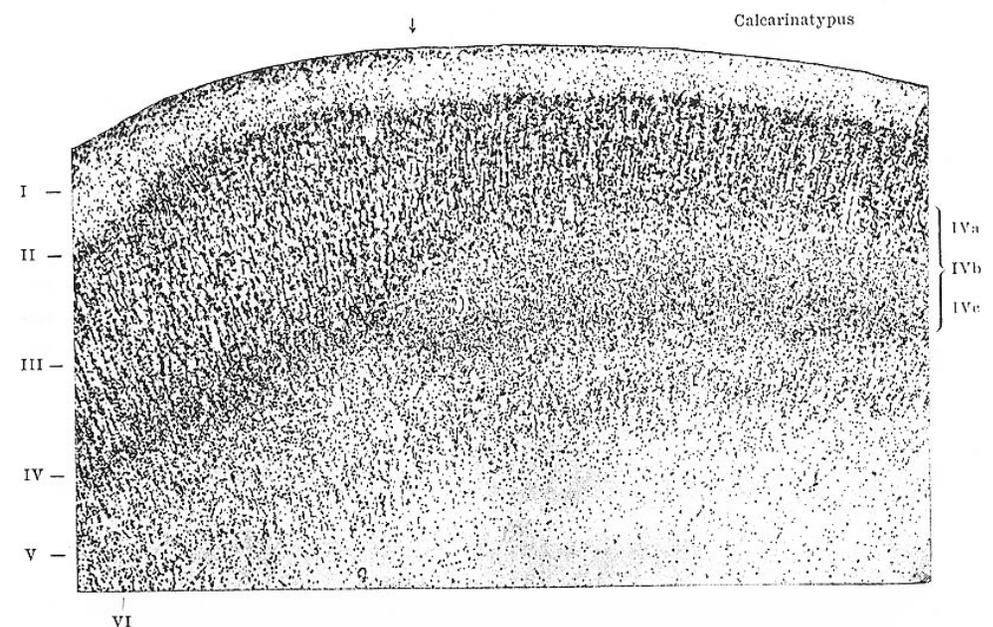
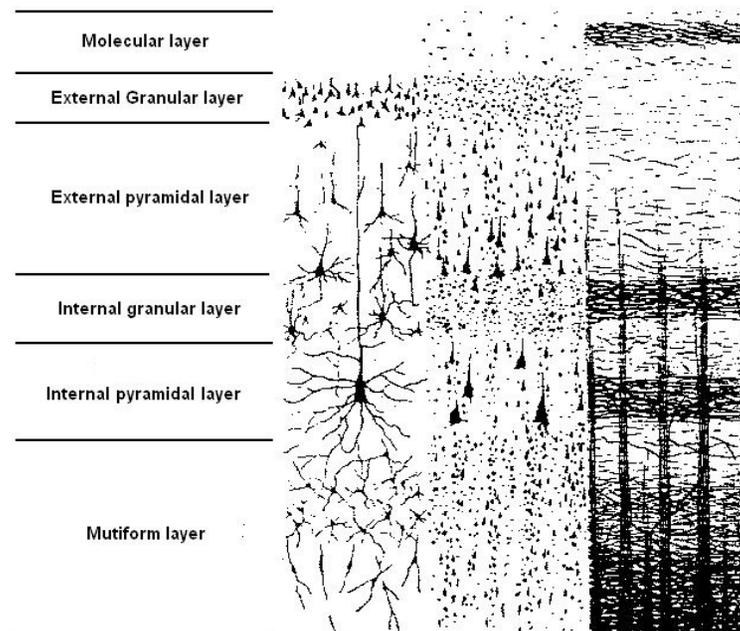
# Clicker Question

What did Brodmann use to mark off regions of the neocortex

- A. Sulci
- B. Recordings of electrical activity in the brain
- C. Measurements of the concentrations of chemicals in parts of the brain
- D. Differences in layers within the neocortex

# Layers of Cortex

- In viewing cortical slices from many organisms under the microscope, Korbinian Brodmann found a common pattern of six layers distinguished by the types of cells they contained, and hence how they appeared when stained
- The thickness of these layers often varied across cortex, and this provided Brodmann's chief tool for distinguishing brain regions



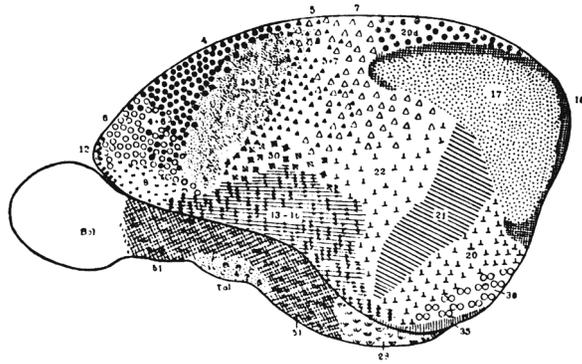
# Discussion Question

What would support Brodmann's interpretation that the thickness of layers across the cortex indicated that the different areas perform different cognitive functions

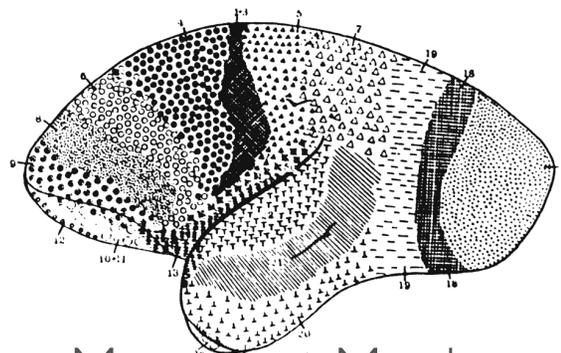
- A. Such an major difference in thickness of the layers must reflect something about how the neocortex works
- B. It is reasonable to assume that different types of neurons which appeared in different layers would perform different functions
- C. It is reasonable to issue that neurons in different layers do different things and if in one region one layer was thicker, that would explain what the region could do
- D. He assumed that if regions of the neocortex performed the same function, they should all look the same
- E. Other

# Mapping Neocortical Regions

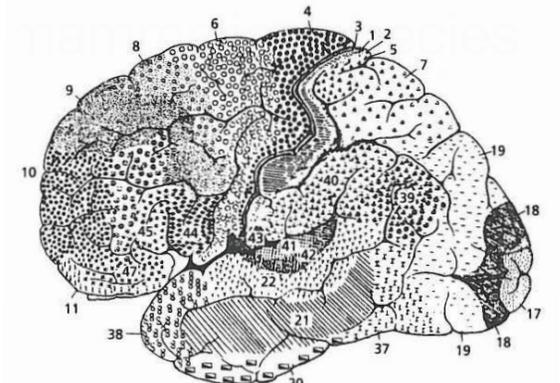
- Brodmann mapped out brain areas on the basis of the cytoarchitecture
  - He numbered areas in the order in which he investigated them



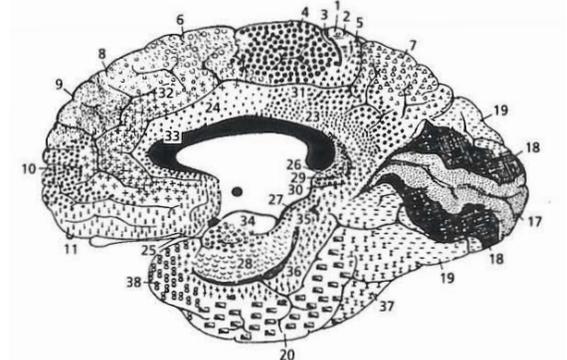
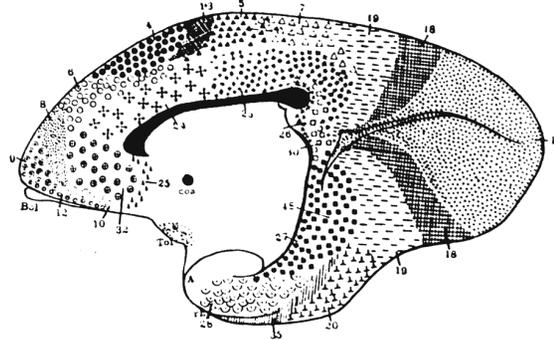
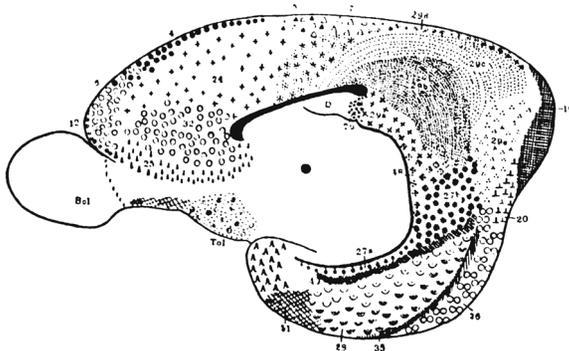
Ground Squirrel



Marmoset Monkey



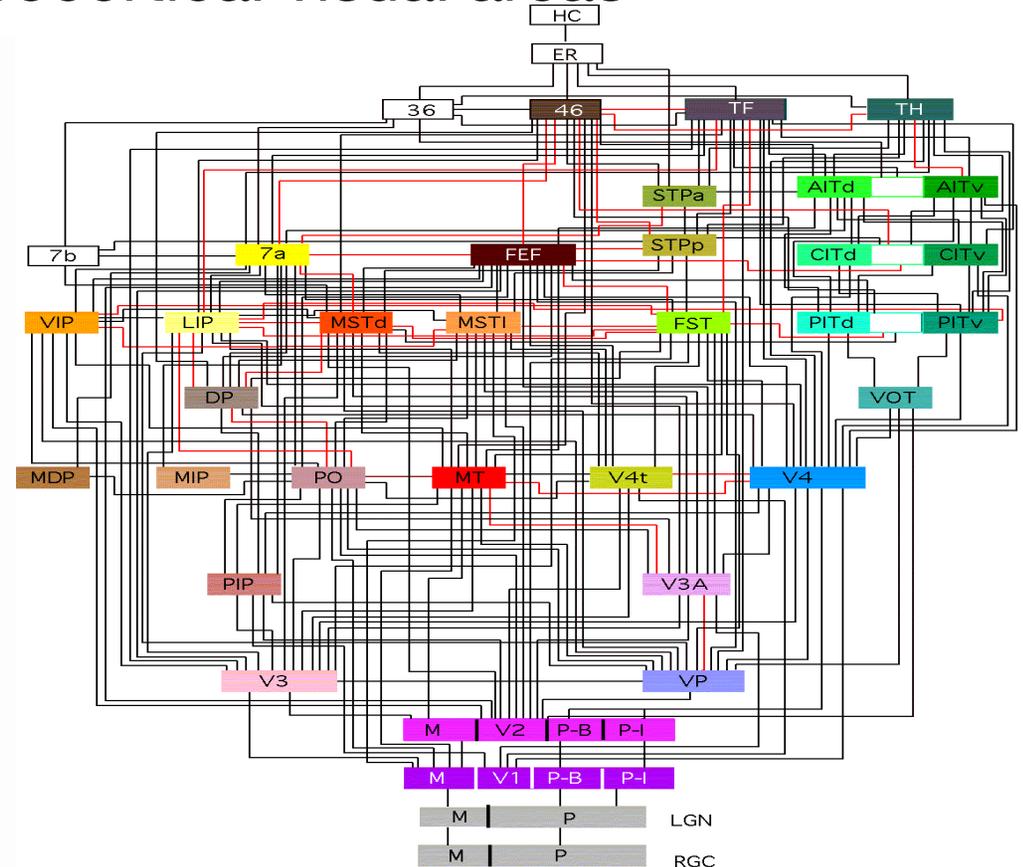
Human



# What Else to Base a Map On?

- What are you most likely to look to Google Maps for?
- What in the brain corresponds to roads?
  - Connections between neocortical visual areas

To:	OCCIPITAL										TEMPORAL					PARIETAL										FRONTAL								
	V1	V2	V3	V3A	V4	V4t	MT	FST	PTd	PTv	CTd	CTv	AITd	AITv	STPa	STPp	STPa	TF	TH	MSTd	MSTl	PO	PIP	LIP	VIP	MIP	MDP	DP	Tx	FEF	46			
V1	+	+	+	+	+	+	+	+	+																									
V2	+	+	+	+	+	+	+	+	+																									
V3	+	+	+	+	+	+	+	+	+																									
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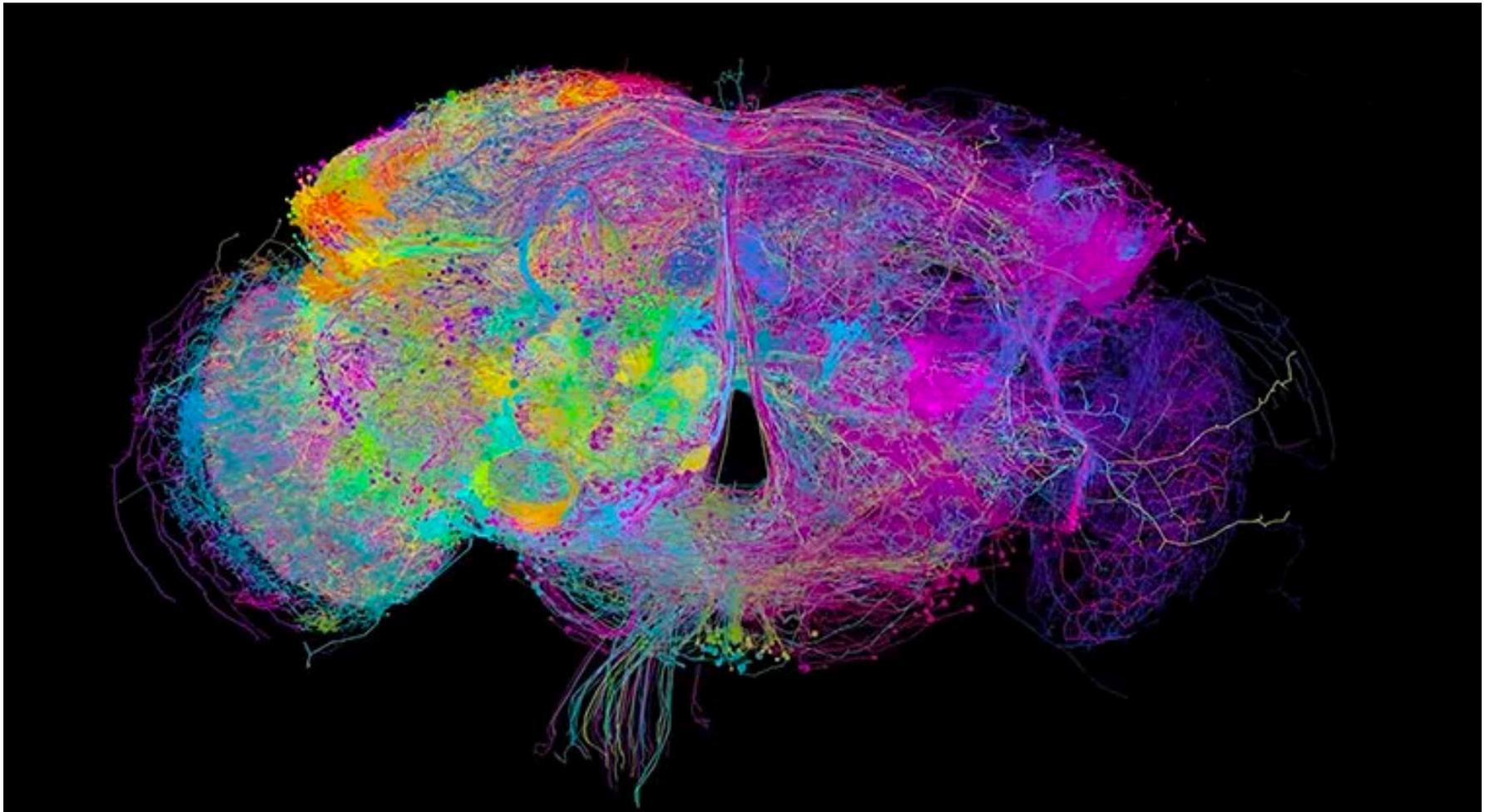






# Mapping the Fruit Fly Brain

- ~100,000 neurons



# Discussion Question

What might one learn from knowing how neurons (brain regions) are connected?

- A. Determine which neurons (brain regions) work together
- B. Follow how information is processed in the brain
- C. Provide a guide for building artificial brains
- D. Other

# Forget the Map!?

- If all one wants to do is identify where something is in space, one can forget the map and just specify the coordinates
  - Right now I am at  $32.88^{\circ}$  N and  $117.24^{\circ}$  W
- What would be the comparable thing with the brain?
  - Talairach Coordinates

