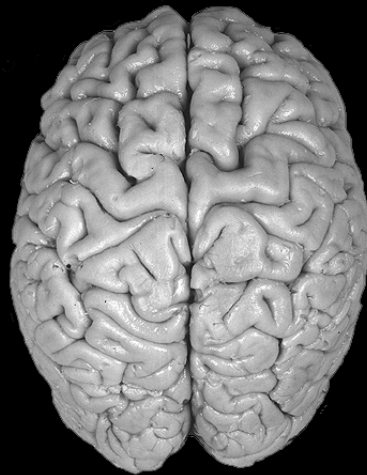


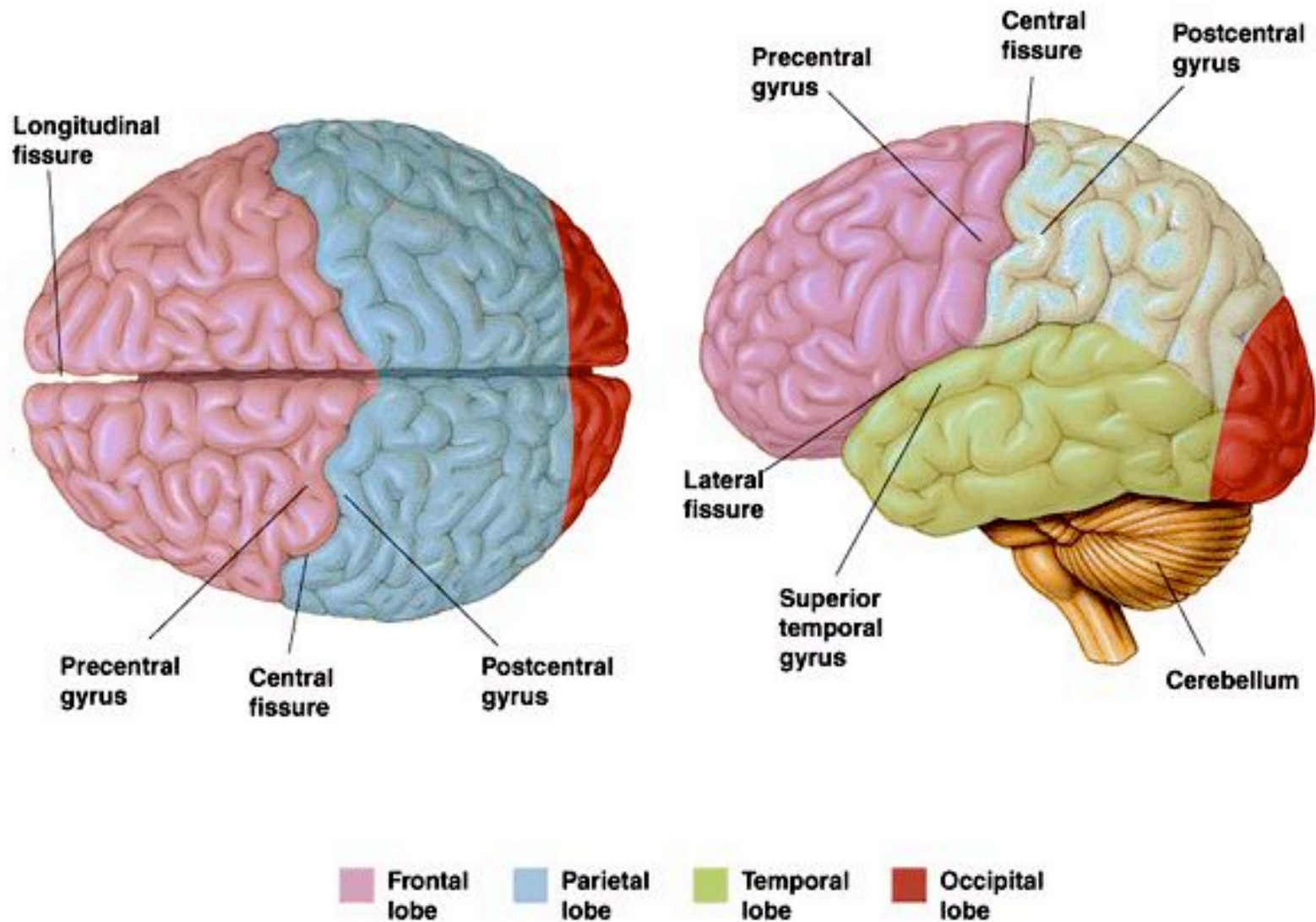
V. Natural & Analog Computation

A Very Brief Tour of Real Neurons



(and Real Brains)

► The Lobes of the Cerebral Hemispheres

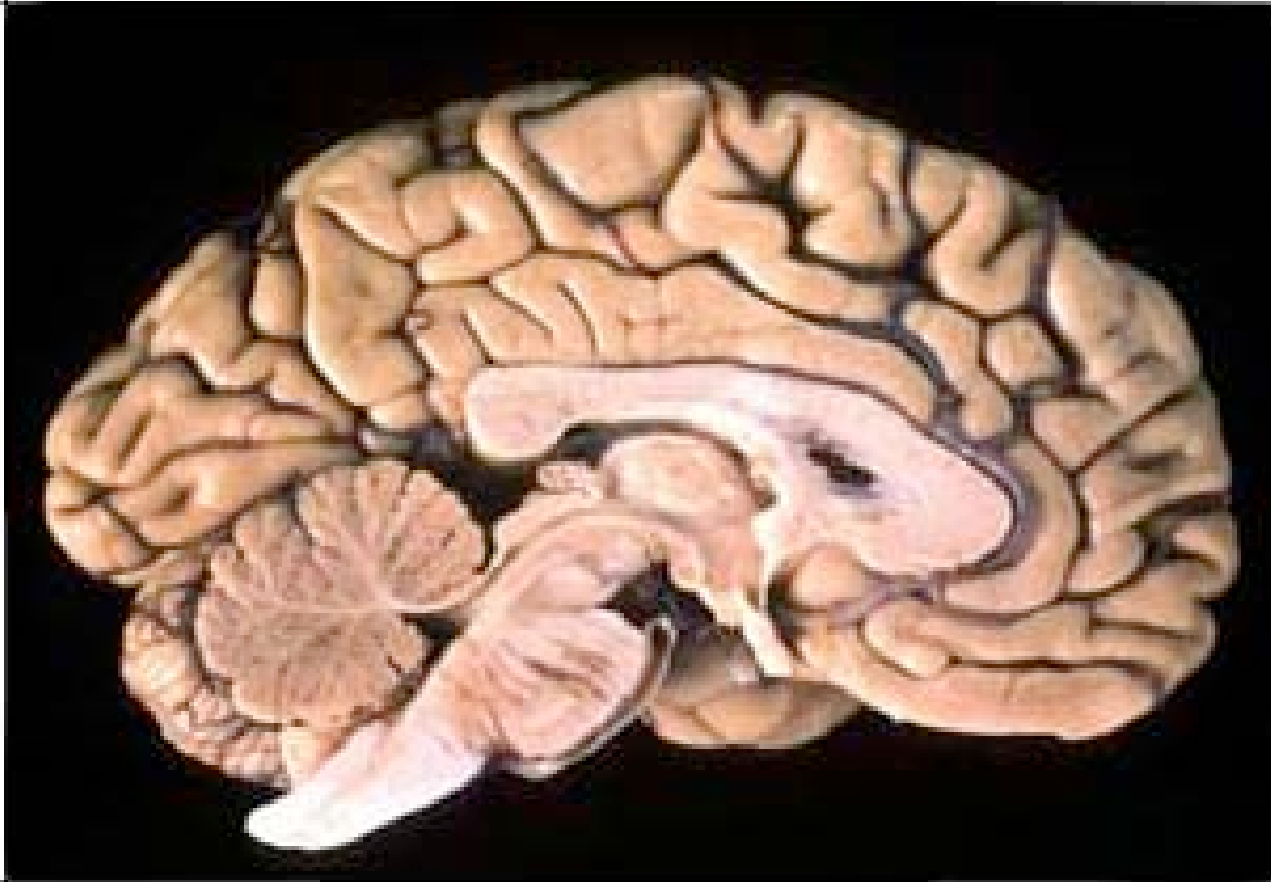


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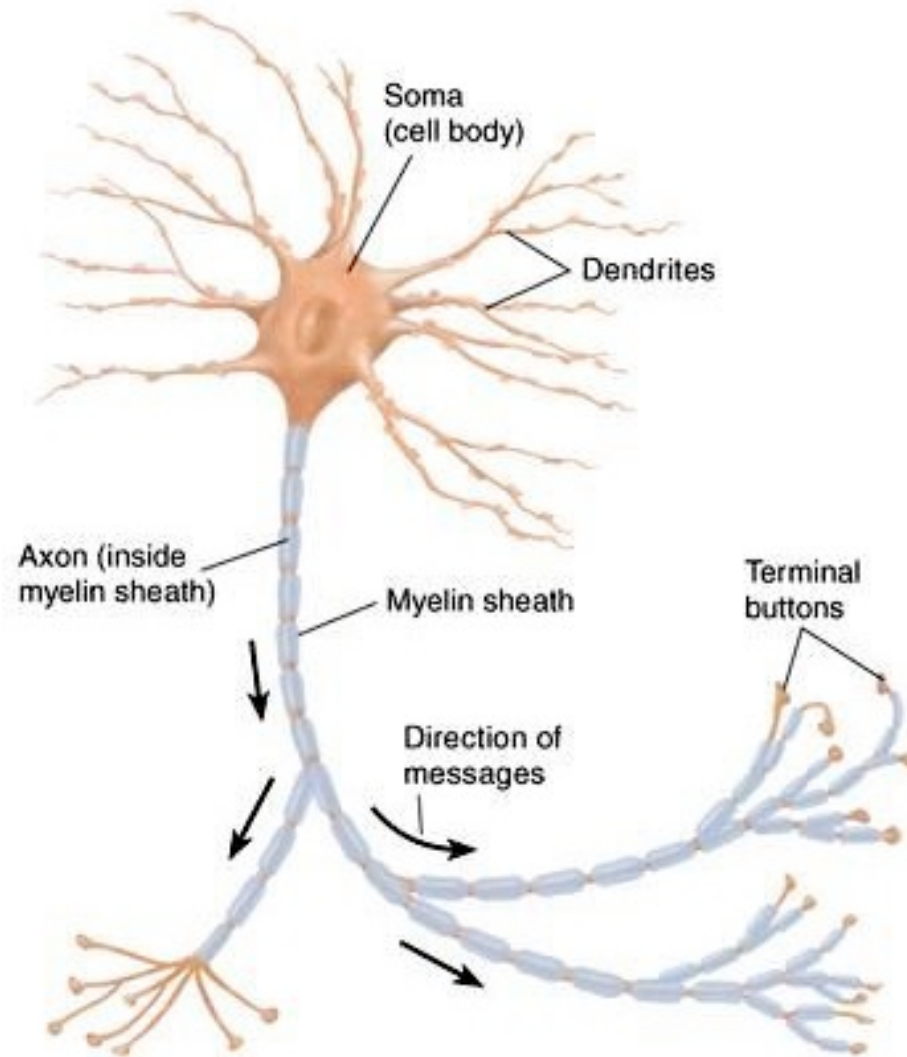
(fig. from internet)

3

Left Hemisphere



Typical Neuron



Grey Matter vs. White Matter

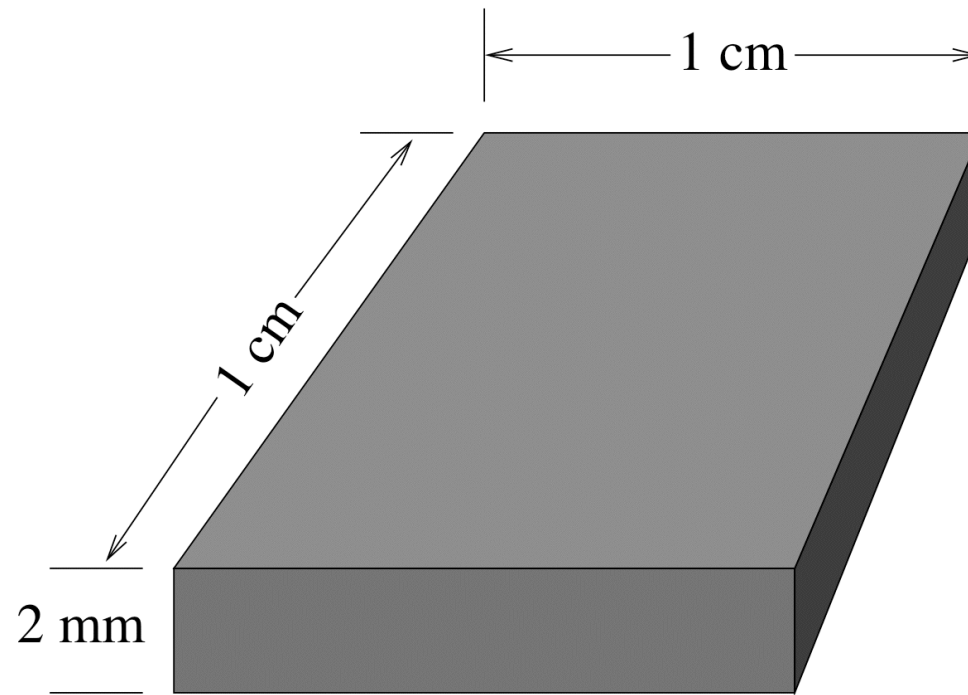


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(fig. from Carter 1998)

6

Neural Density in Cortex



- 148 000 neurons / sq. mm
- Hence, about 15 million / sq. cm

Cortical Areas

human
(2200 sq. cm)

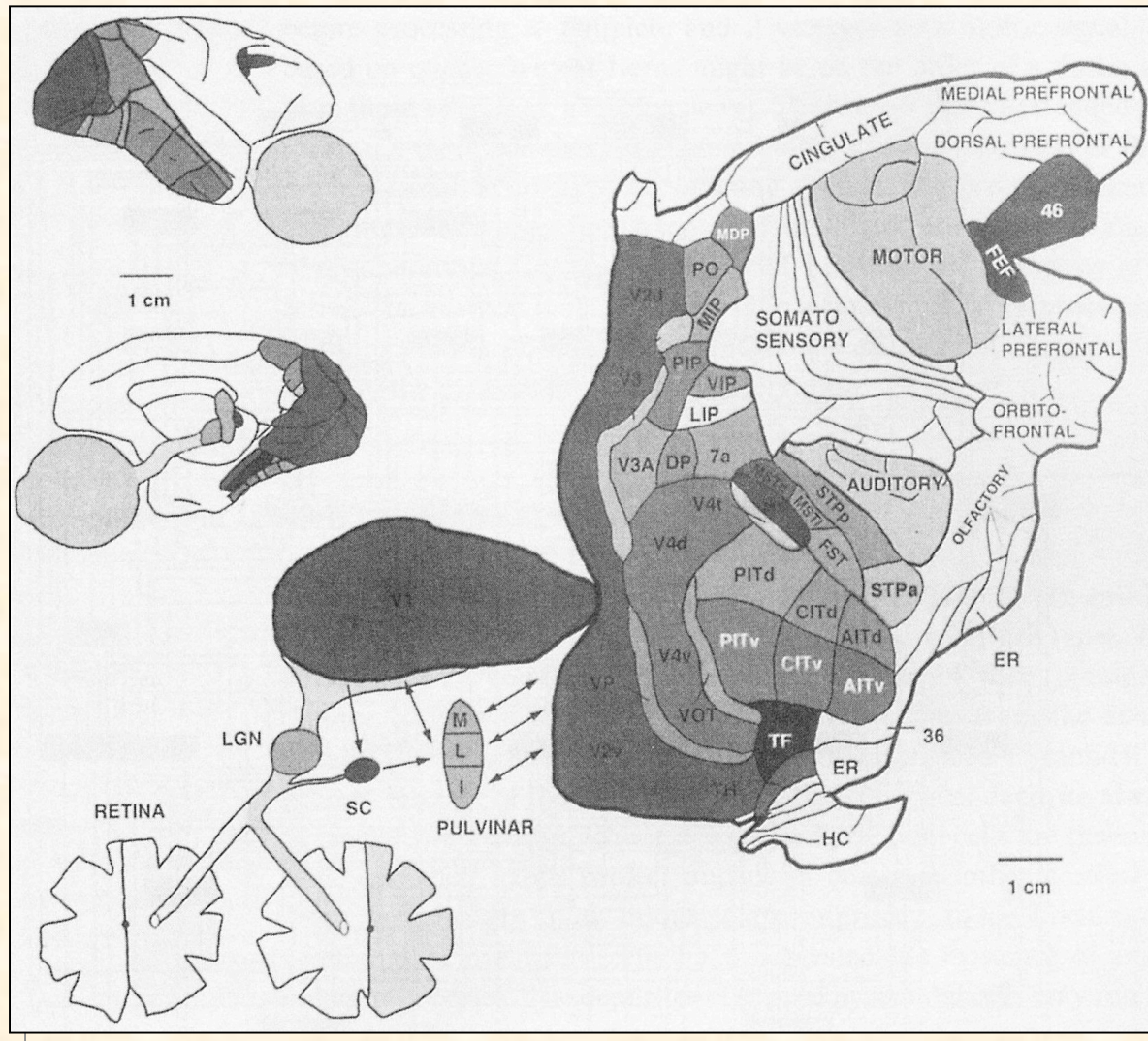
ape

**cat or
monkey**

rat → ●

Neural Representations

Macaque Visual System

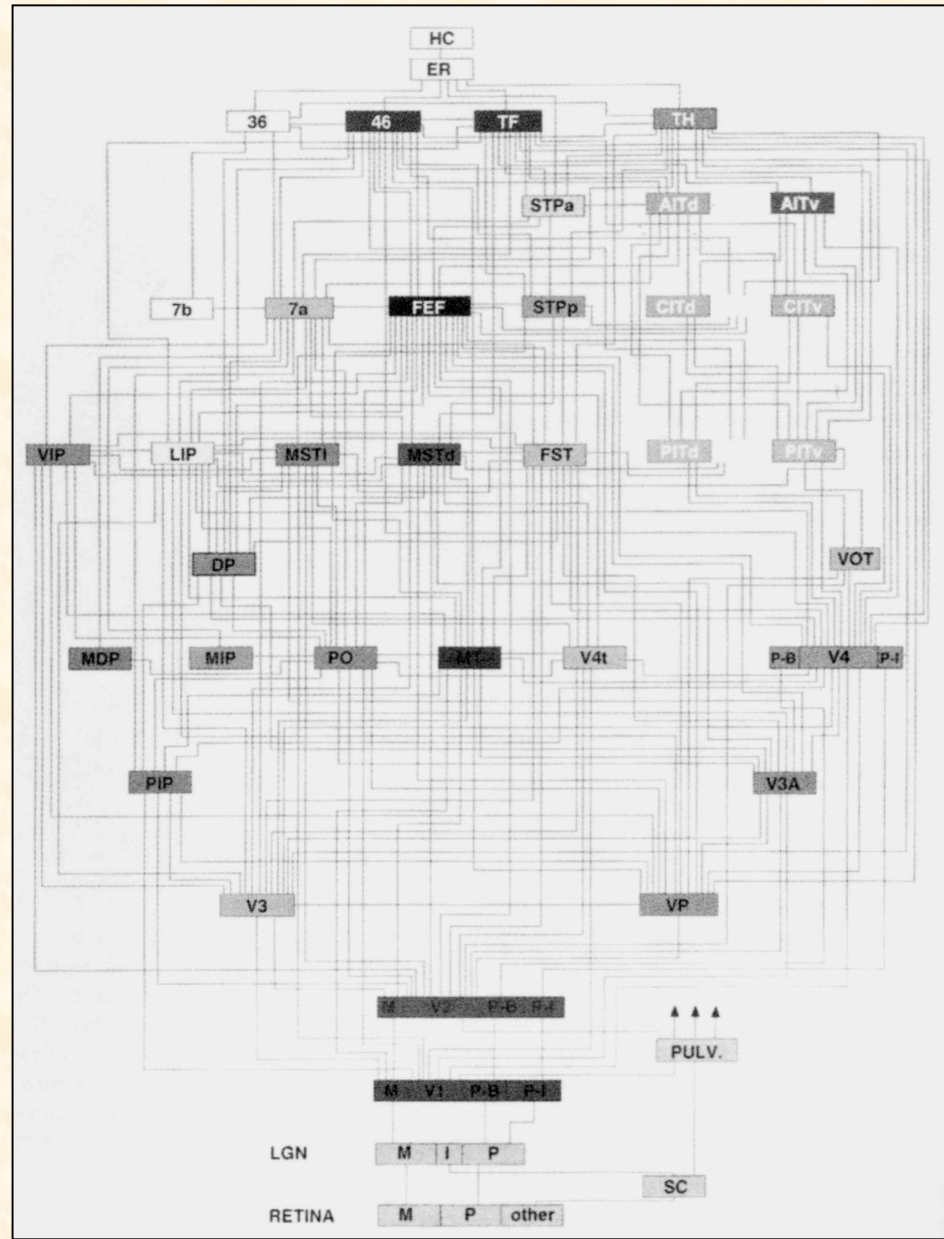


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(fig. from Van Essen & al. 1992)

10

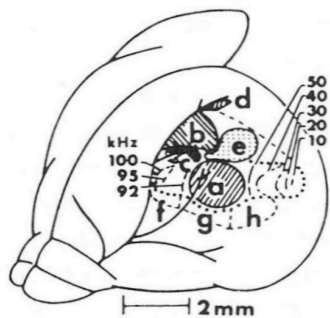
Hierarchy of Macaque Visual Areas



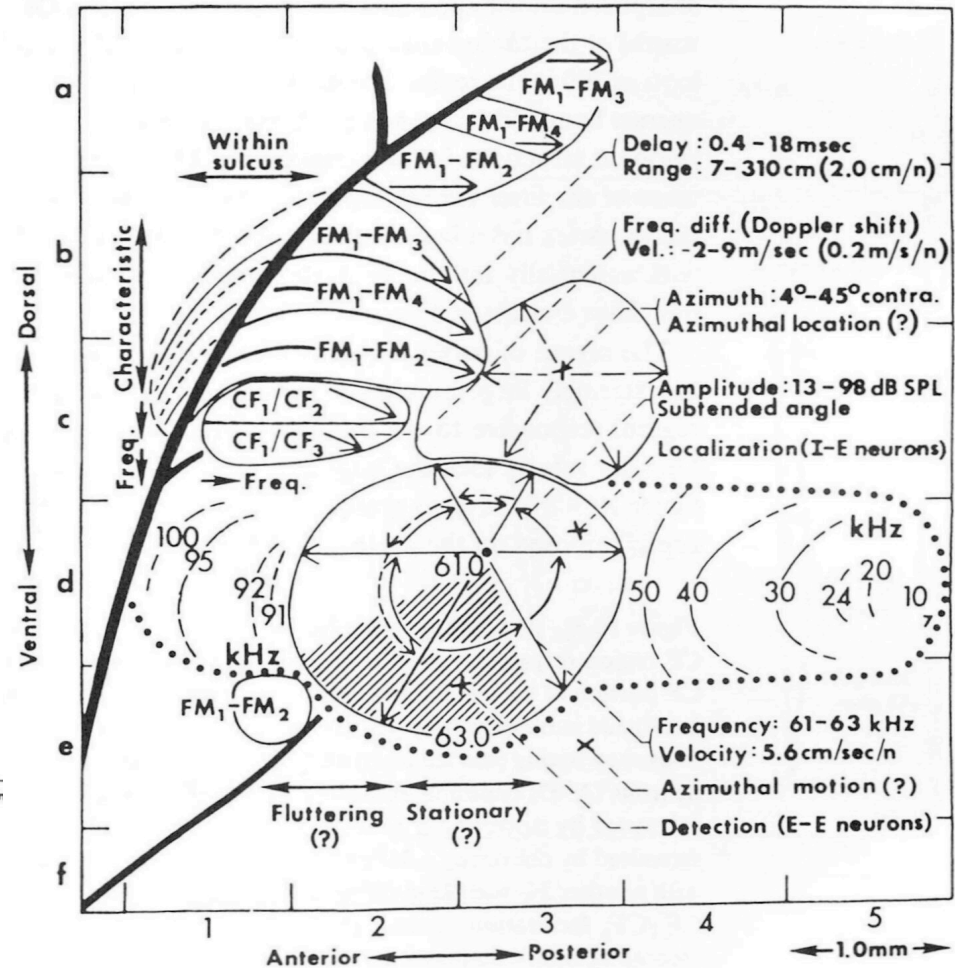
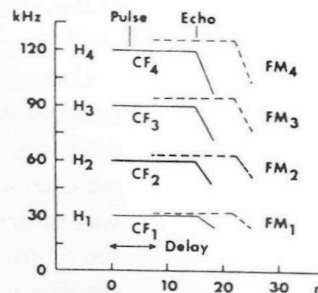
10/27/03

(fig. from Van Essen & al. 1992)

Bat Auditory Cortex

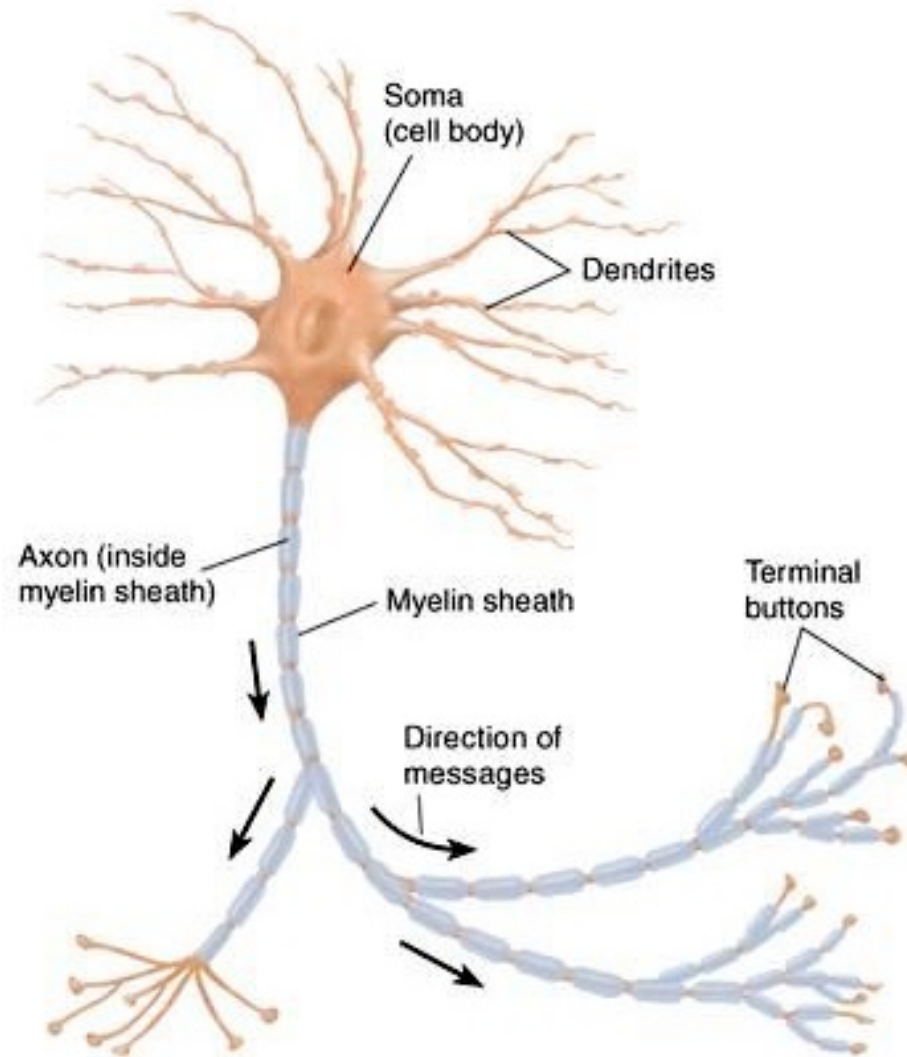


- a: DSCF
- b: FM-FM
- c: CF/CF
- d: DF
- e: DM
- f: AV
- g: VL
- h: VP

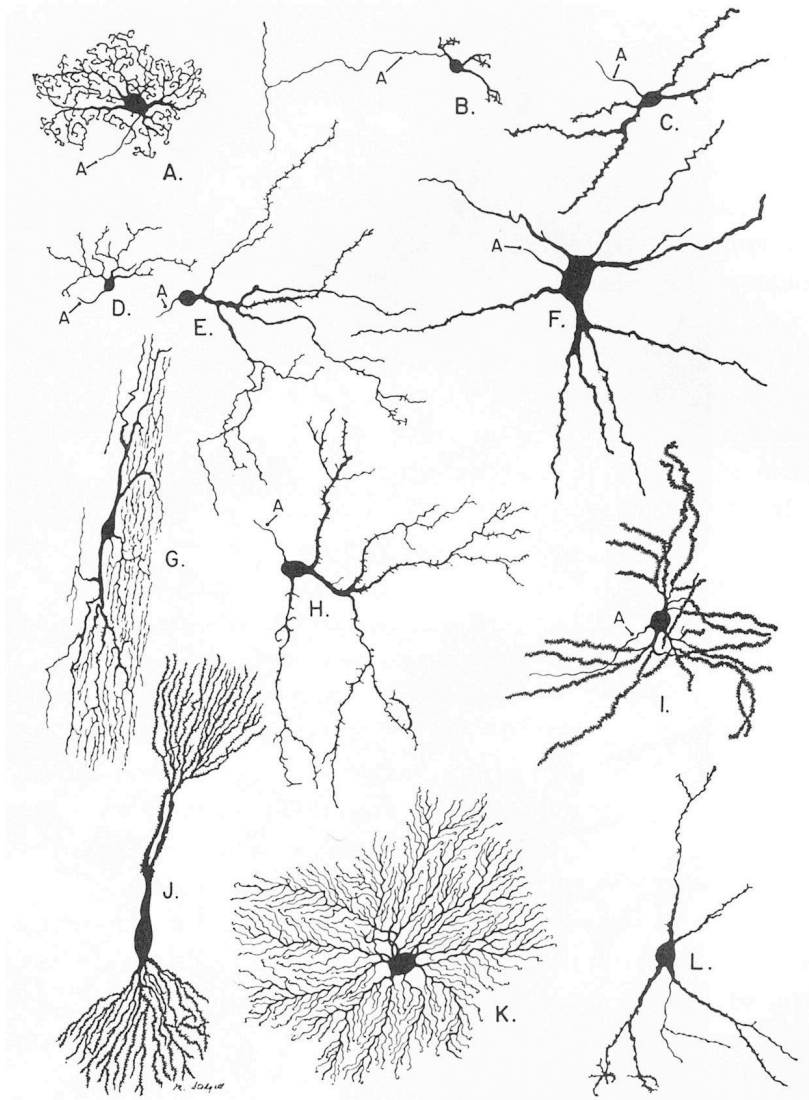


Neurons

Typical Neuron



Dendritic Trees of Some Neurons



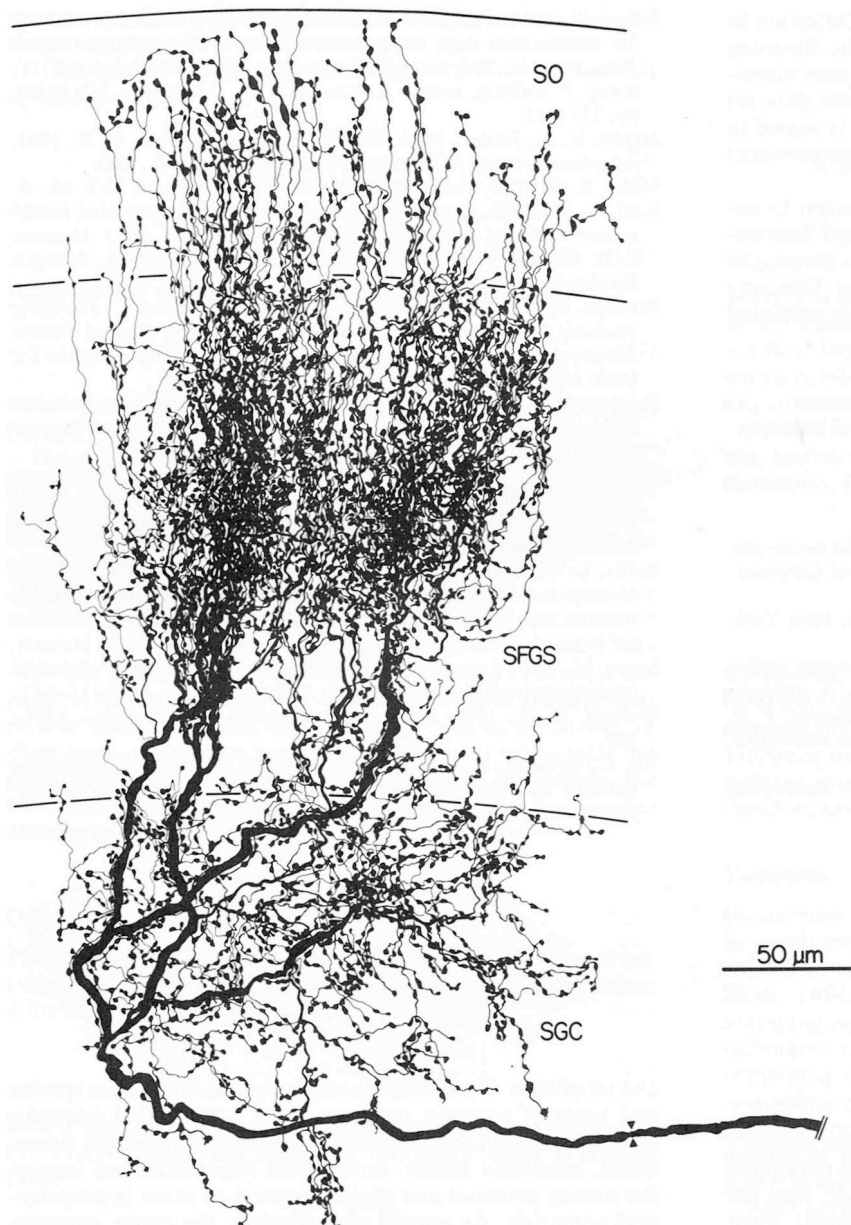
- A. inferior olivary nucleus
- B. granule cell of cerebellar cortex
- C. small cell of reticular formation
- D. small gelatinosa cell of spinal trigeminal nucleus
- E. ovoid cell, nucleus of tractus solitarius
- F. large cell of reticular formation
- G. spindle-shaped cell, substantia gelatinosa of spinal chord
- H. large cell of spinal trigeminal nucleus
- I. putamen of lenticular nucleus
- J. double pyramidal cell, Ammon's horn of hippocampal cortex
- K. thalamic nucleus
- L. globus pallidus of lenticular nucleus

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(fig. from Trues & Carpenter, 1964)

15

Axonal Terminations (Tectum of Turtle)

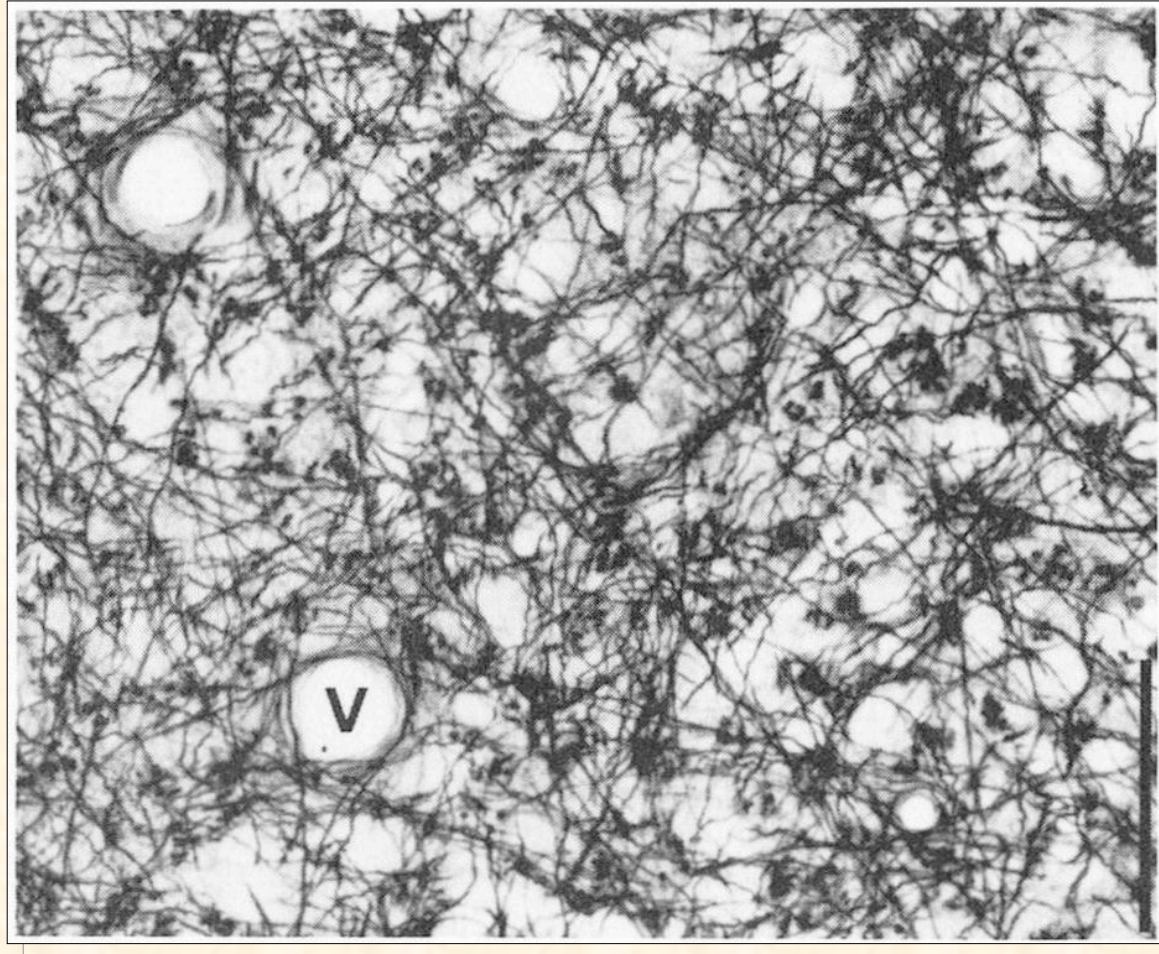


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(fig. from Sereno & Ulinski 1987)

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Axonal Net

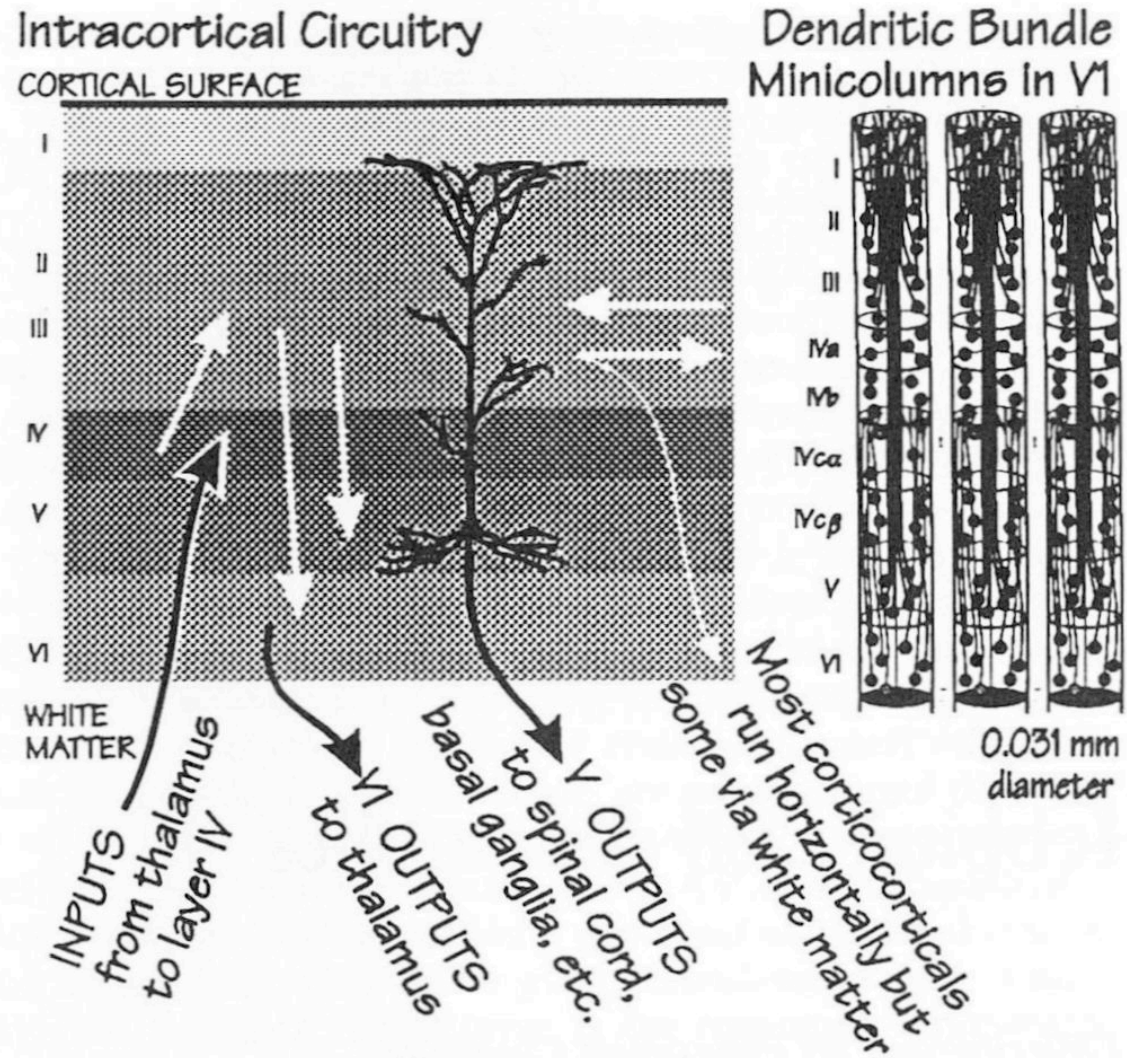


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(fig. from Arbib 1995)

17

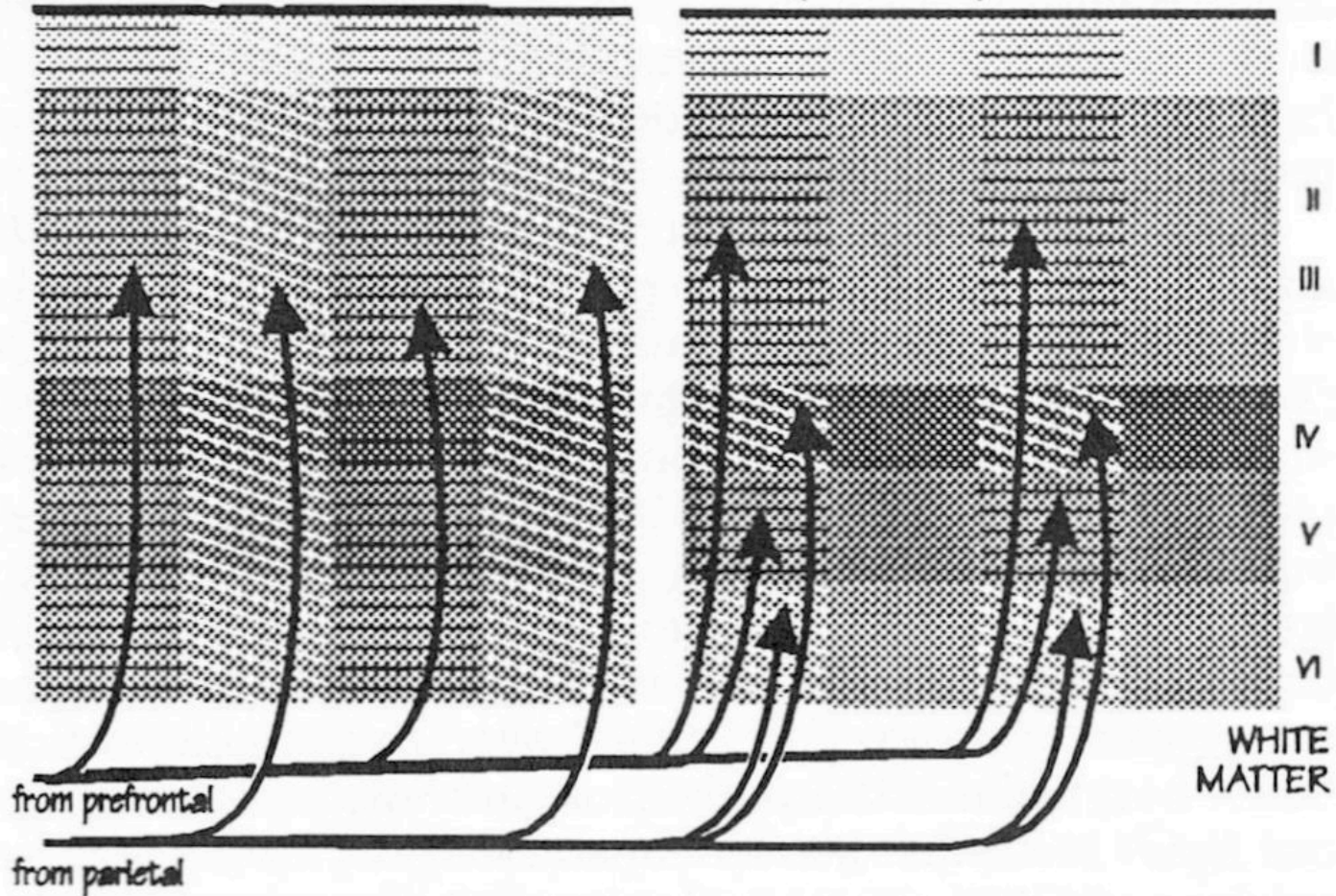
Layers and Minicolumns



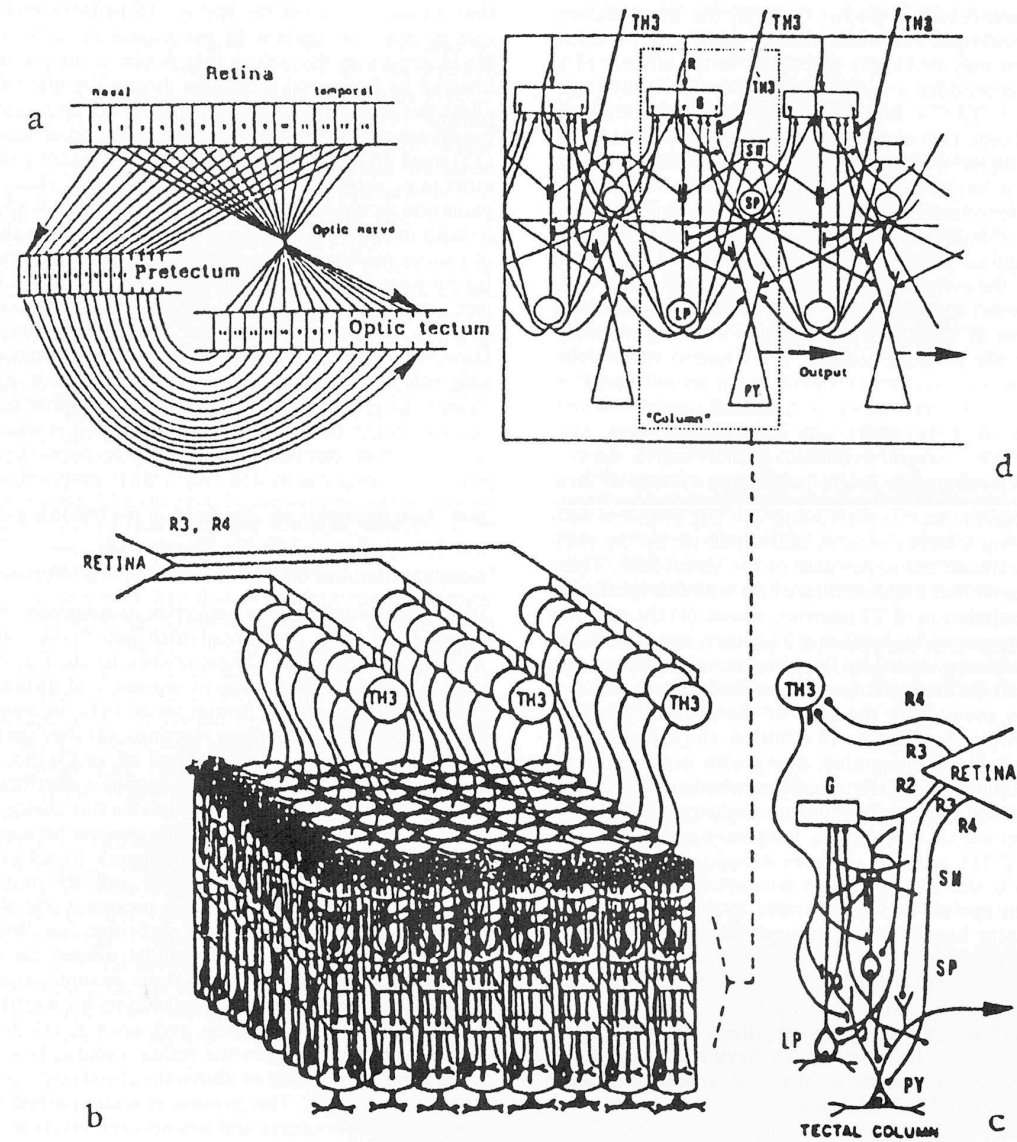
Projection Macrocolums 0.5-1.0mm wide

Interdigitating Columns In Anterior Cingulate Gyrus

Interleaving Input Columns in Superior Temporal Sulcus



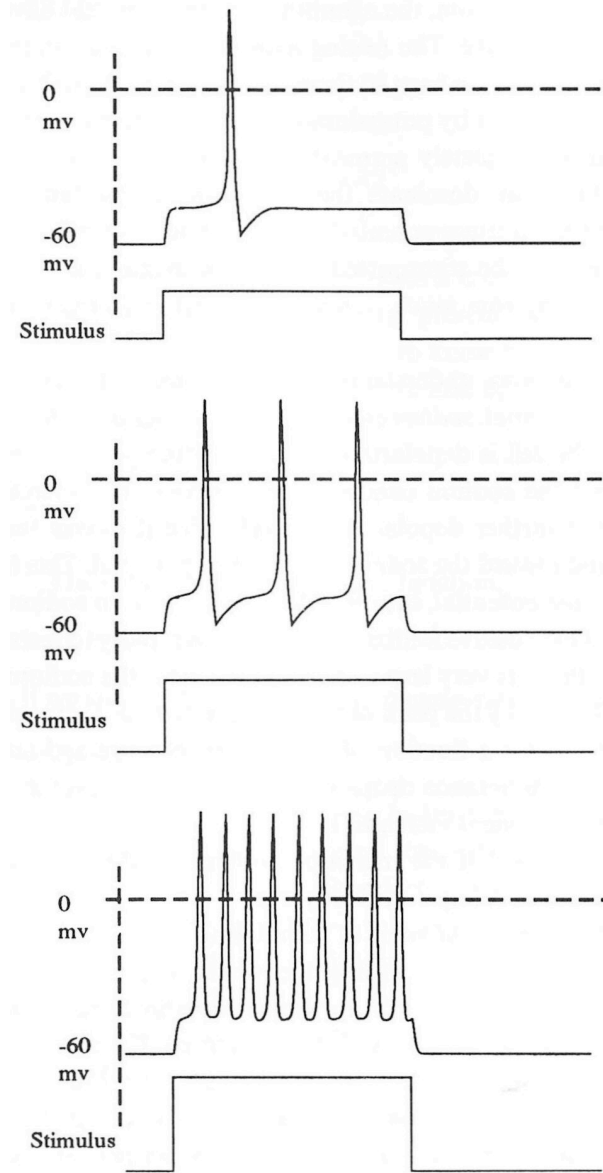
Neural Networks in Visual System of Frog



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(fig. from Arbib 1995, p. 1039)

Frequency Coding

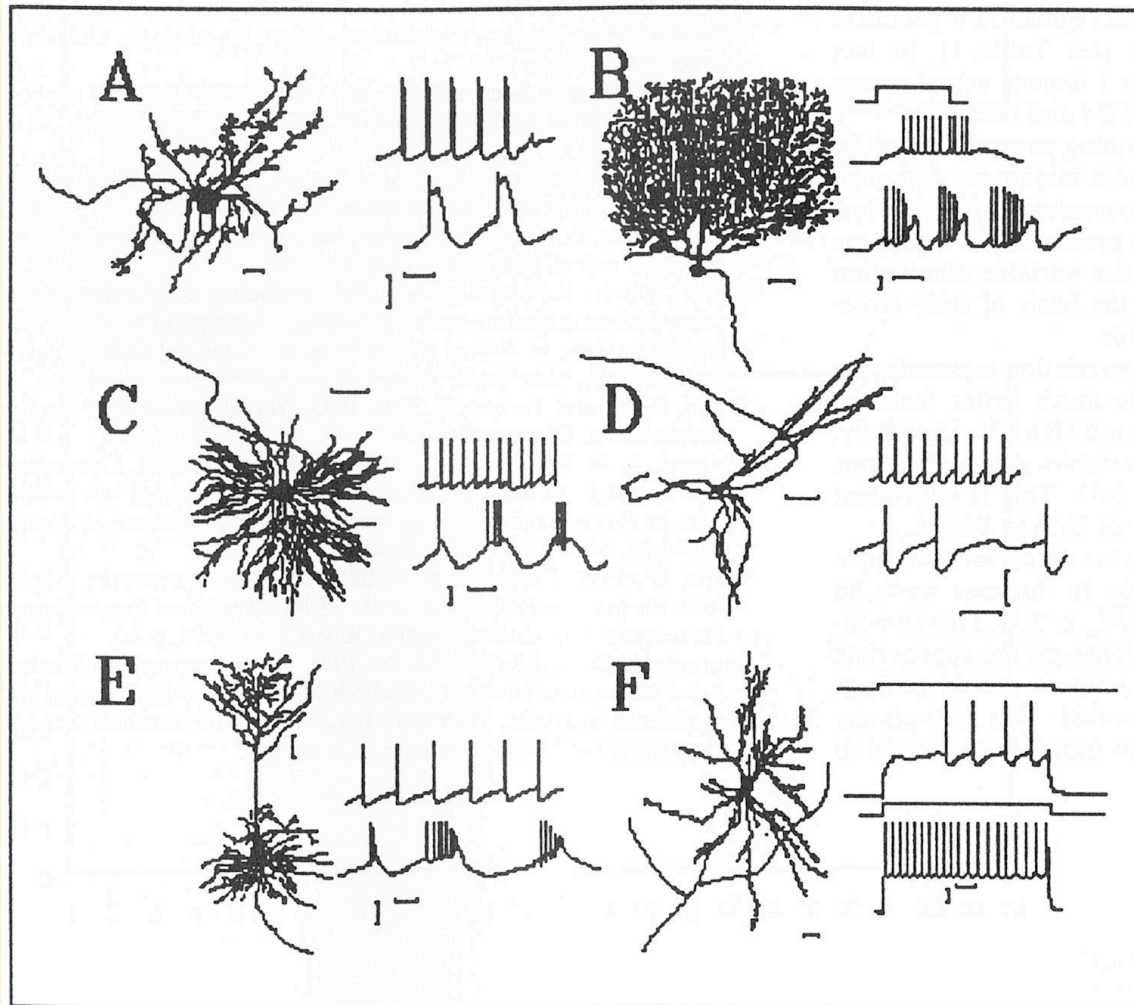


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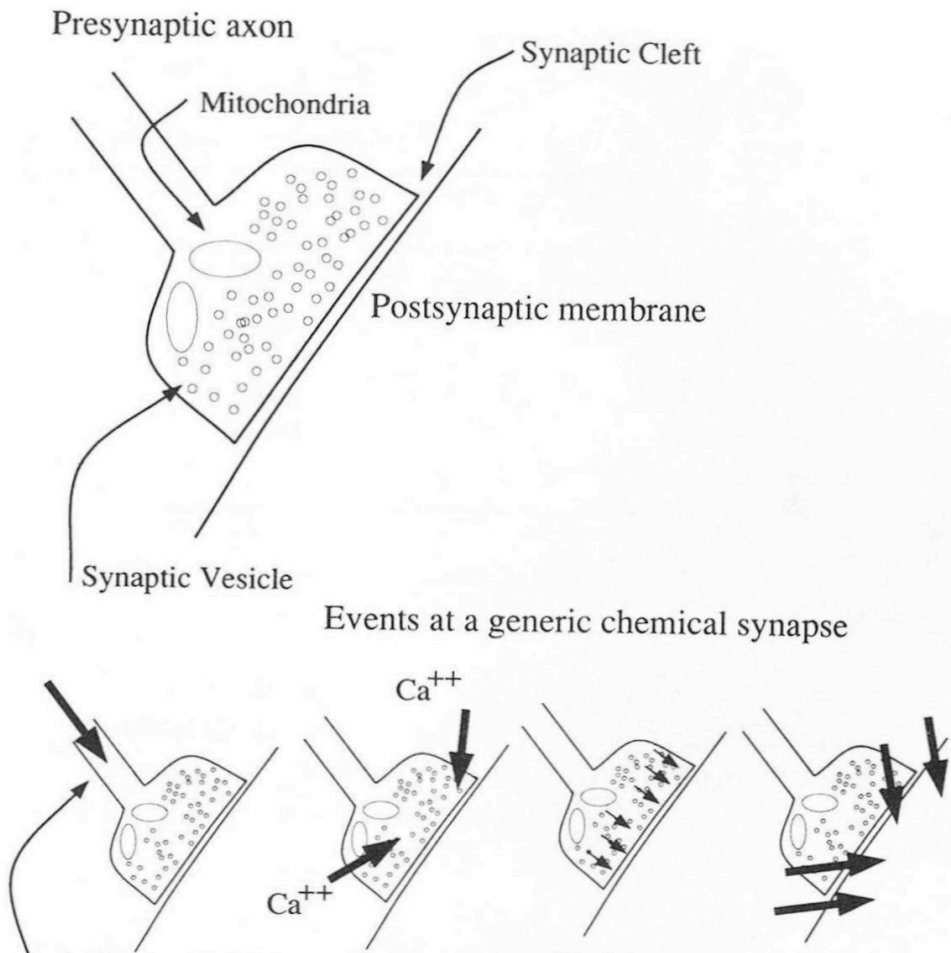
(fig. from Anderson, *Intr. Neur. Nets*)

21

Variations in Spiking Behavior

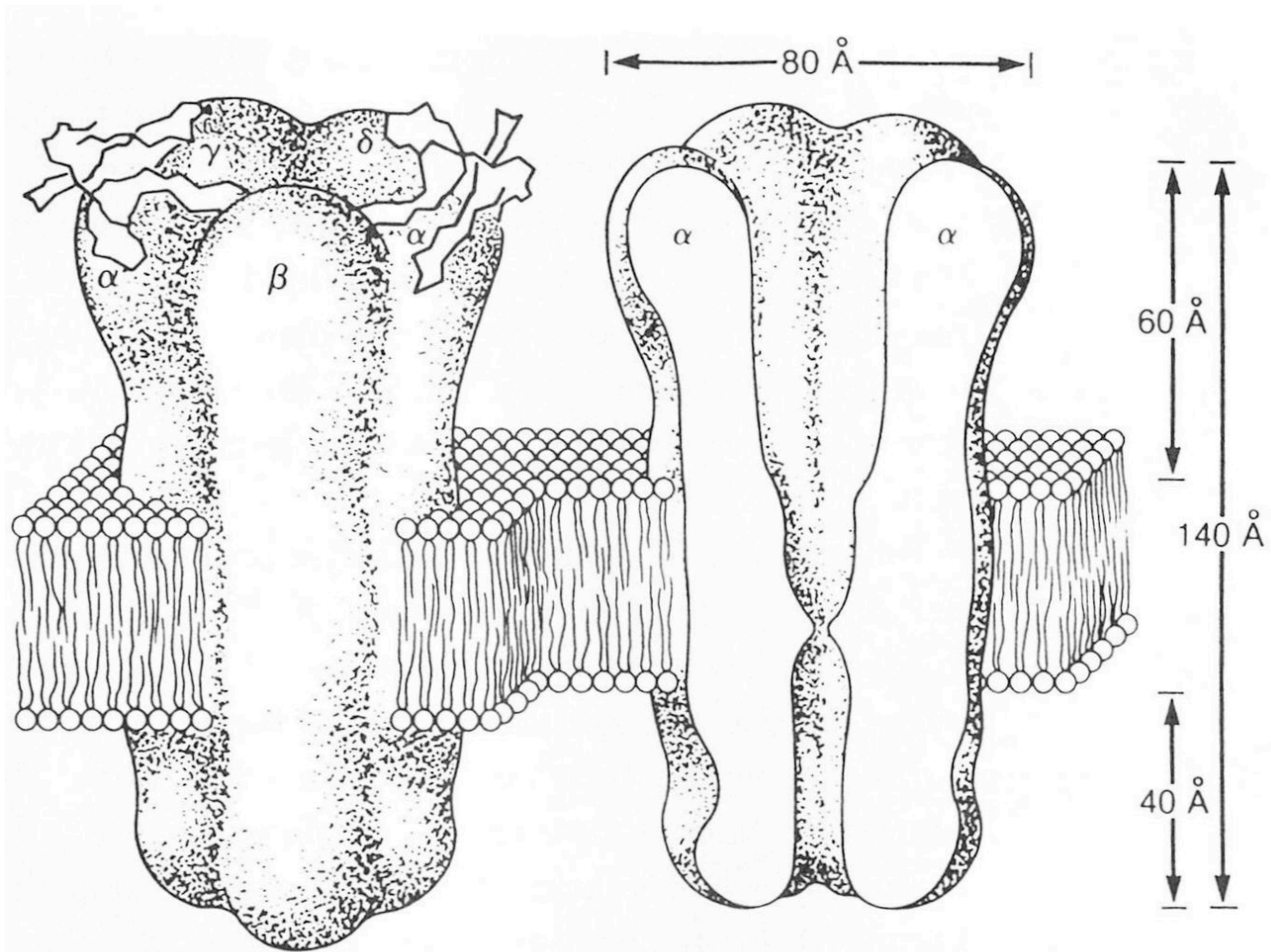


Chemical Synapse



1. Action potential arrives at synapse
2. Ca ions enter cell
3. Vesicles move to membrane, release neurotransmitter
4. Transmitter crosses cleft, causes postsynaptic voltage change

Typical Receptor



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(fig. from Anderson, *Intr. Neur. Nets*)

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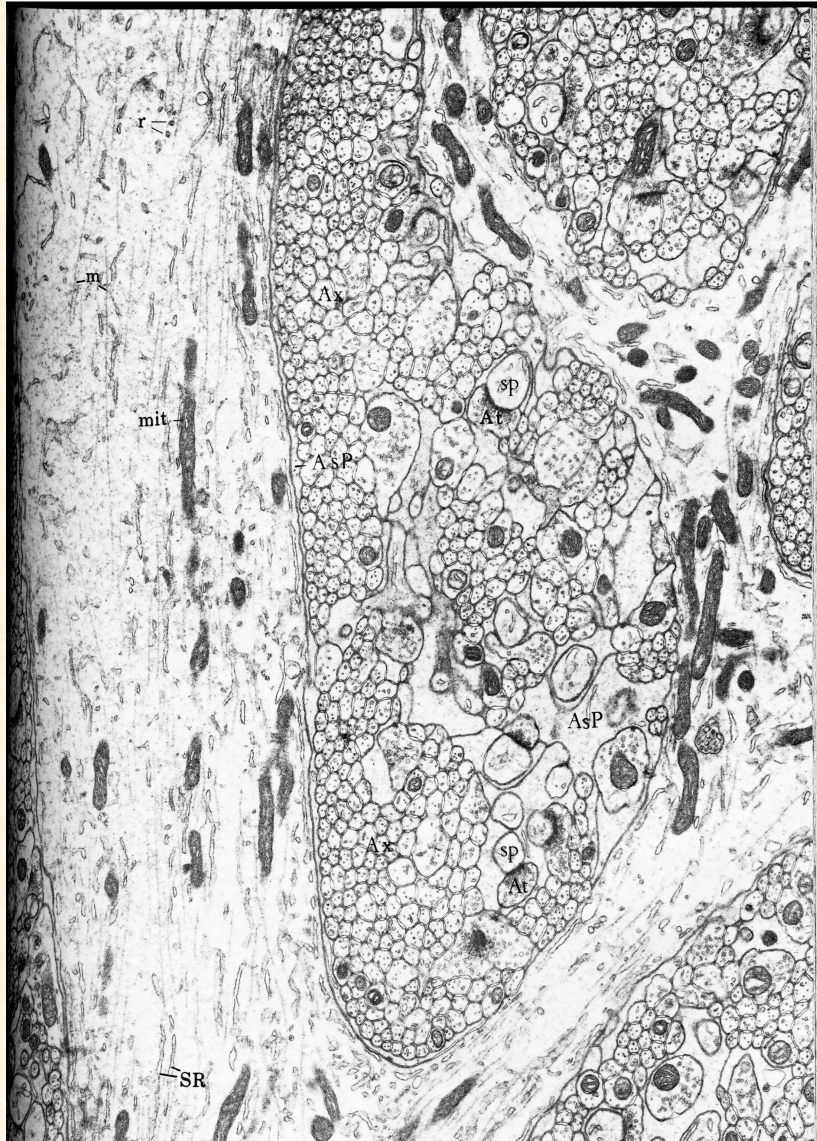
Axon Hillock



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(fig. from Peters, Palay & Webster)

25



Dendrite & Dendritic Branches

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(fig. from Peters, Palay & Webster)

26

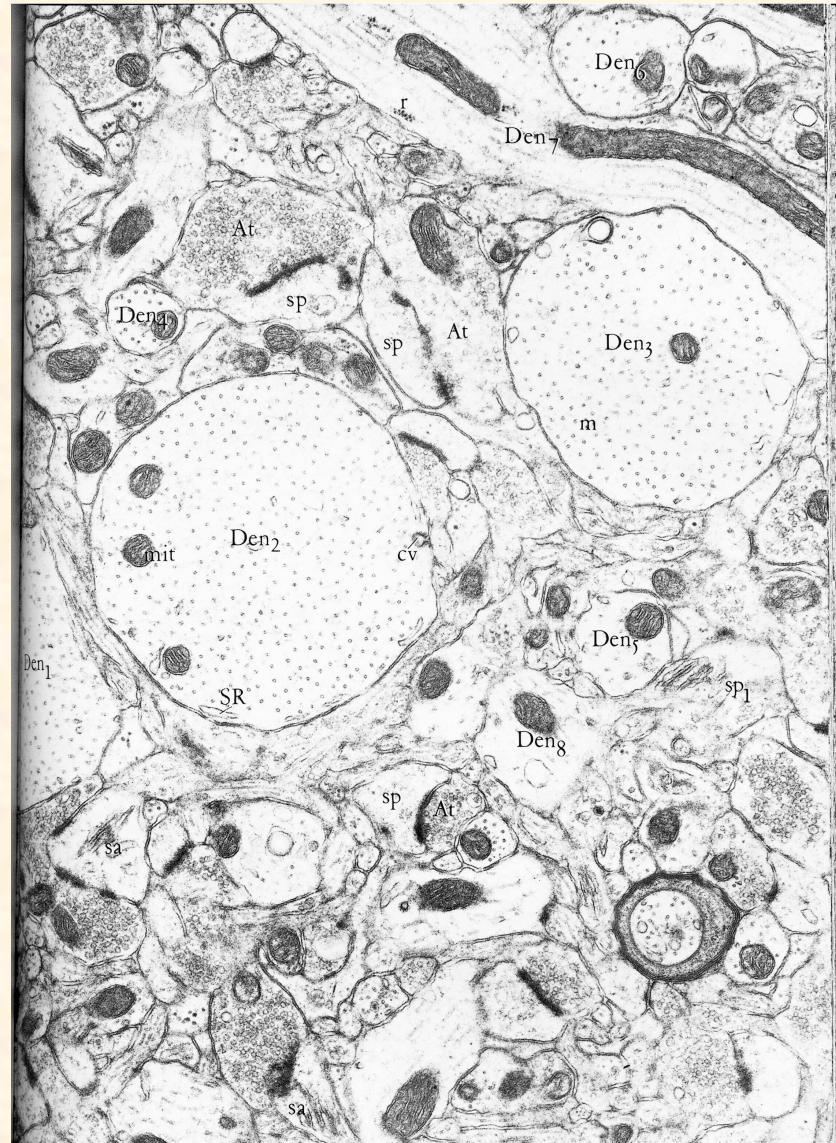


Dendrite & Dendritic Spine

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(fig. from Peters, Palay & Webster)

Neuropil

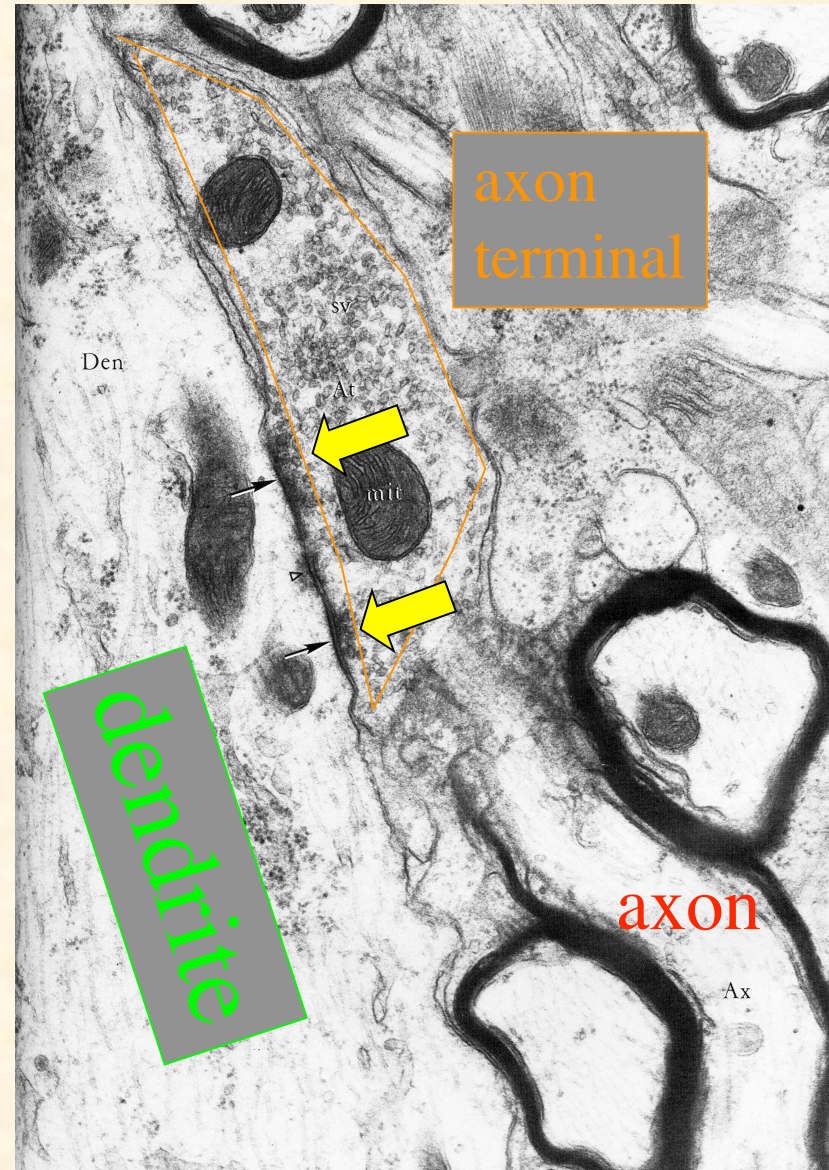


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(fig. from Peters, Palay & Webster)

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Myelinated Axon Making Synapse on Dendrite



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(fig. from Peters, Palay & Webster)

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Various Synapses

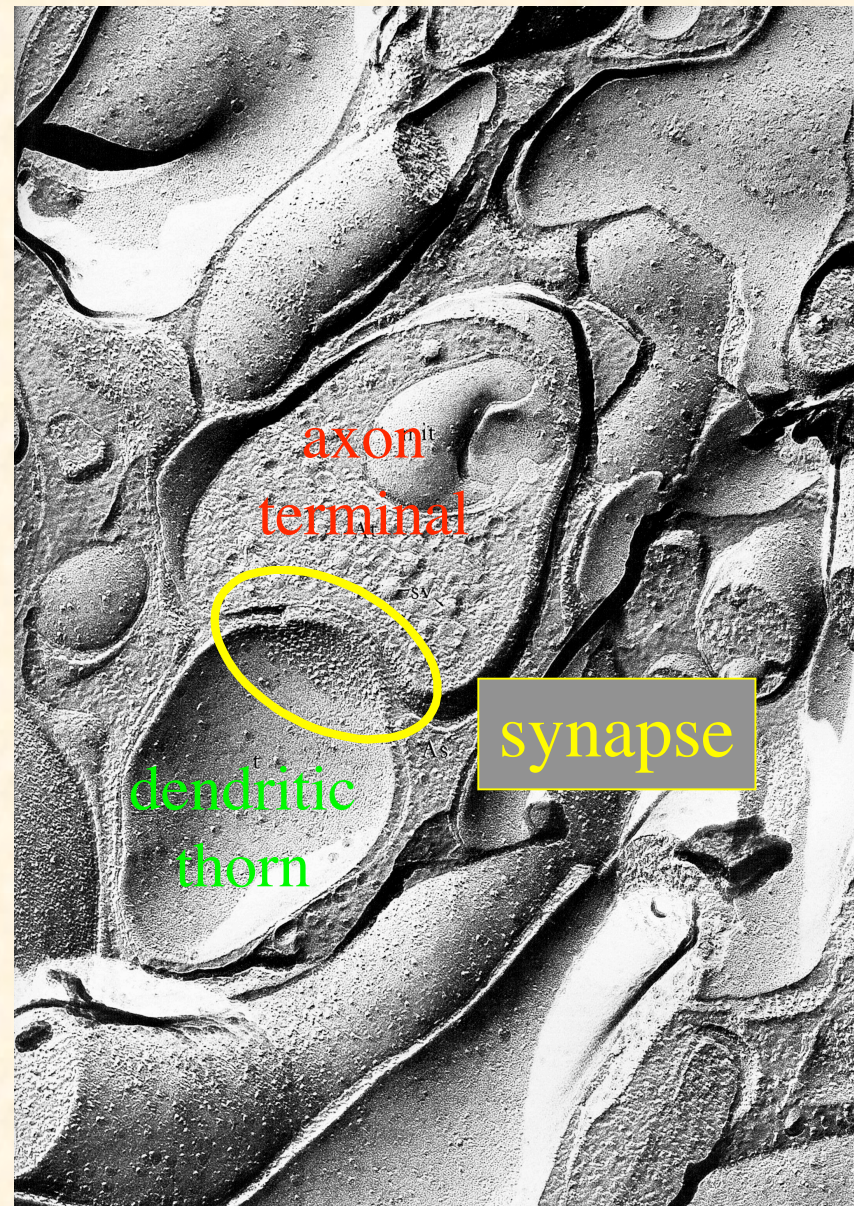


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(fig. from Peters, Palay & Webster)

30

Excitatory
Synapse
Between
Axon
Terminal and
Dendritic
Thorn

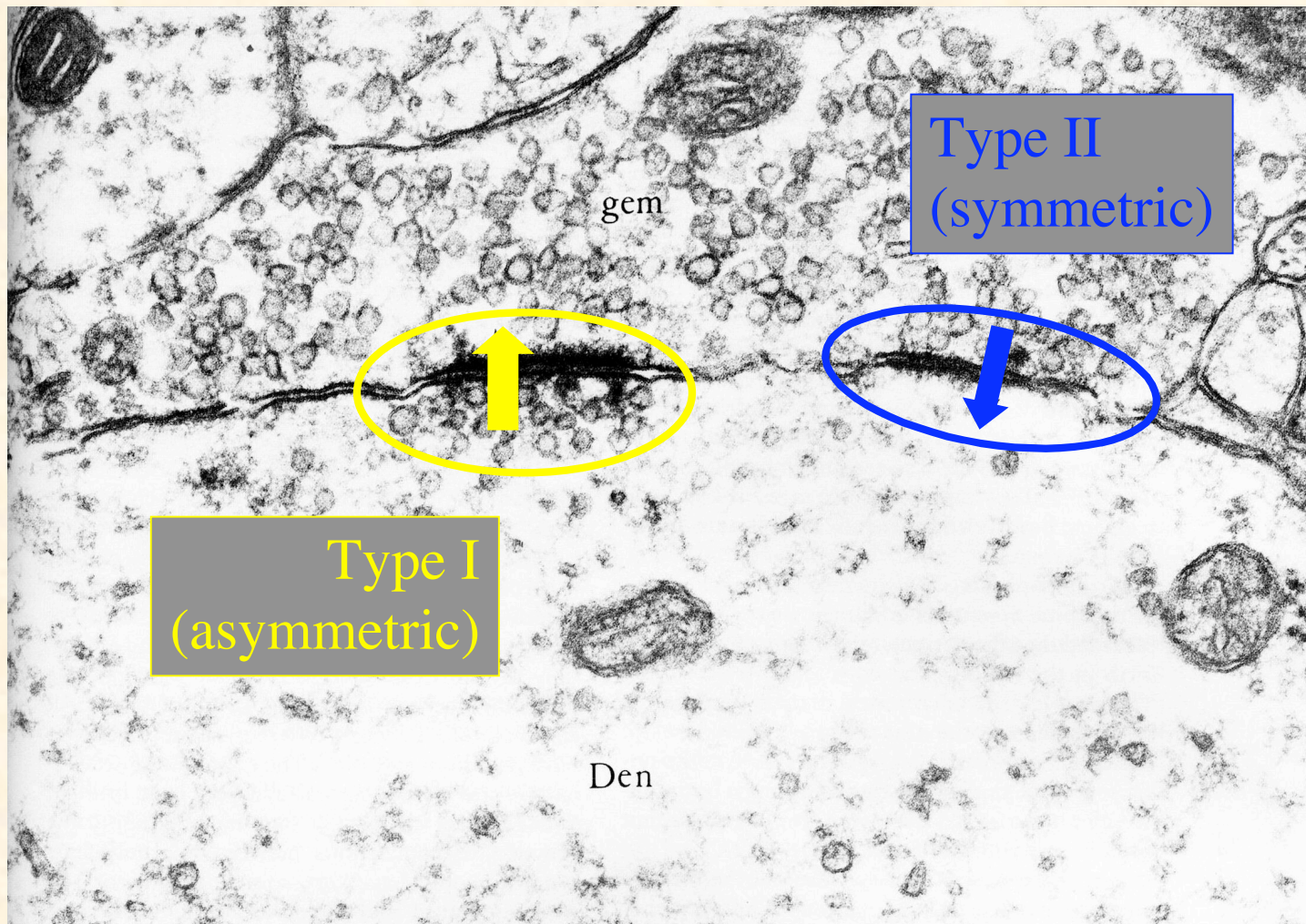


10/27/03

(fig. from Peters, Palay & Webster)

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Dendro-dendritic Synapses

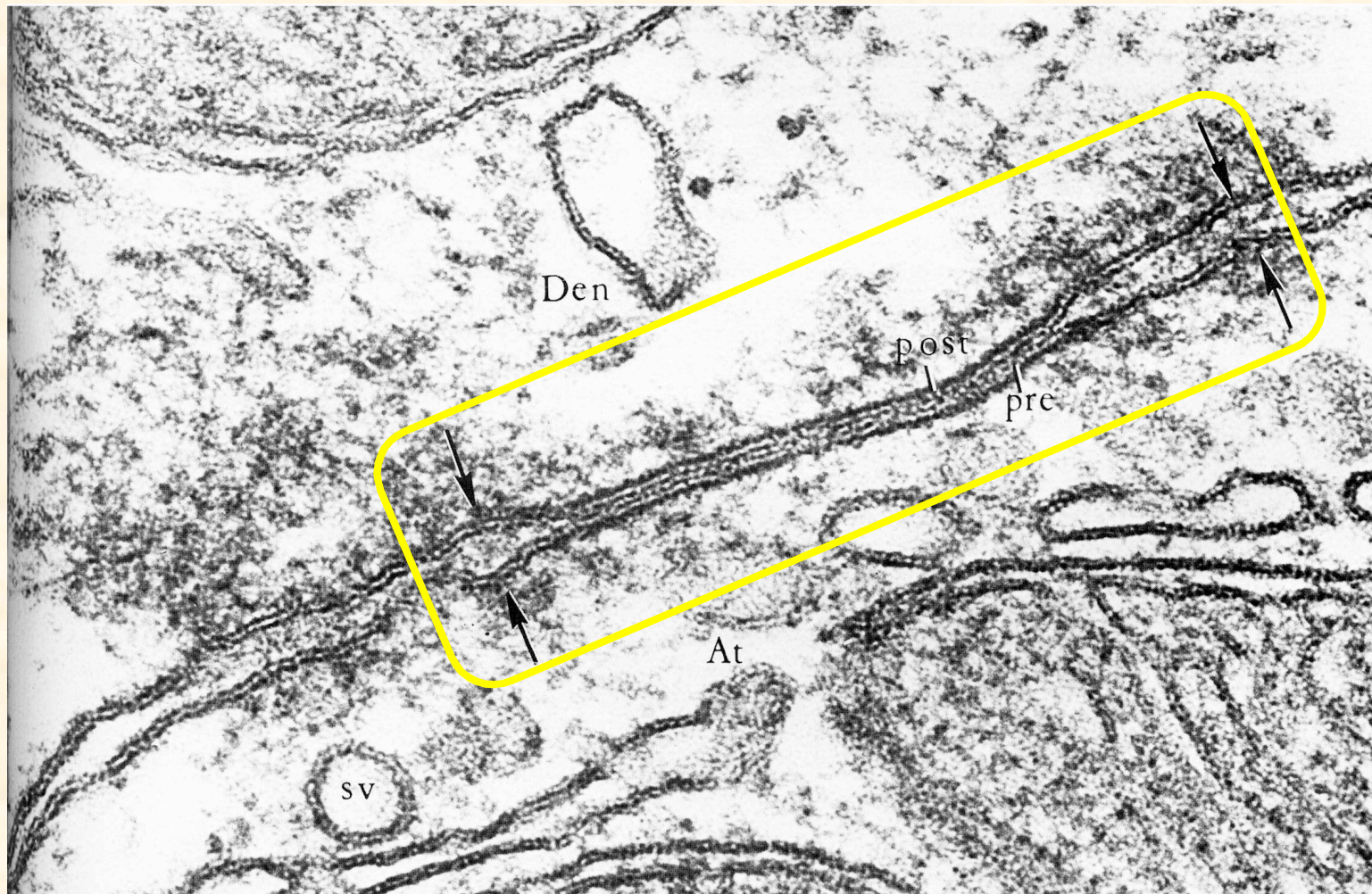


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(fig. from Peters, Palay & Webster)

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Electrotonic Synapse



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(fig. from Peters, Palay & Webster)

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