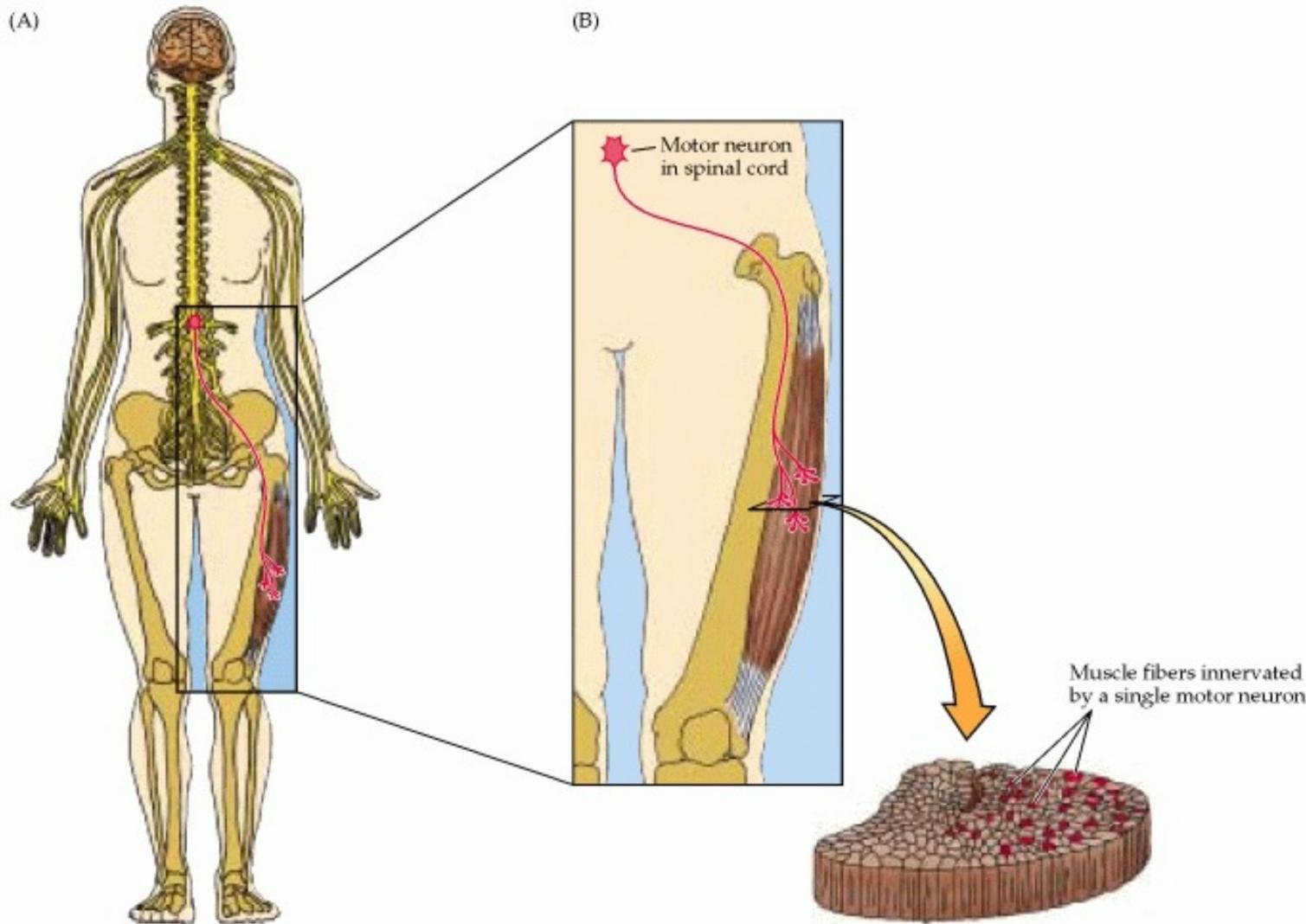


BMD ENG 301 Quantitative Systems Physiology (Nervous System)

Cortex
2022_v1

Professor Malcolm A. MacIver



Motor unit, from Neuroscience 2nd edition

Approximately 4 million touch receptors

Approx. 30,000—82,000 golgi tendon organs

Approx. 50,000 muscle spindles in the body

(320 pairs of muscles, for 640 muscles total)

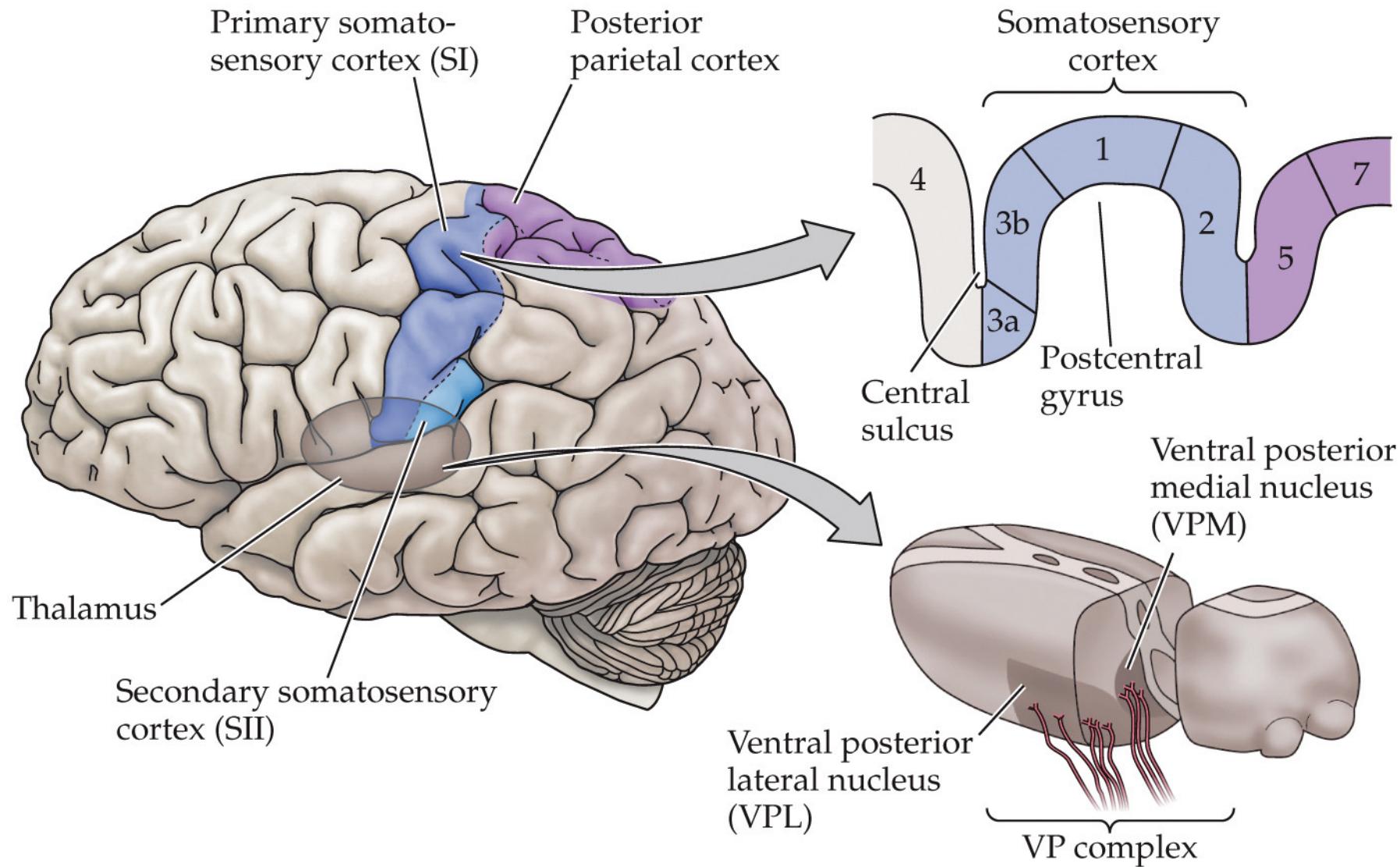
(206 bones: 88 pairs – 176 – and 30 unpaired)

Approximately 200,000 motor units (one motor unit: a motor axon and all the muscle fibers it controls)

Muscle	Number of Motor Axons	Number of Muscle Fibers	Innervation Ratio	Reference
Biceps	774	580,000	750	Buchthal, 1961
Brachioradialis	315	129,000	410	Feinstein <i>et al</i>
First dorsal interosseous	119	40,500	340	Feinstein <i>et al</i>
Medial gastrocnemius	579	1,120,000	1,934	Feinstein <i>et al</i>
Tibialis anterior	445	250,200	562	Feinstein <i>et al</i>

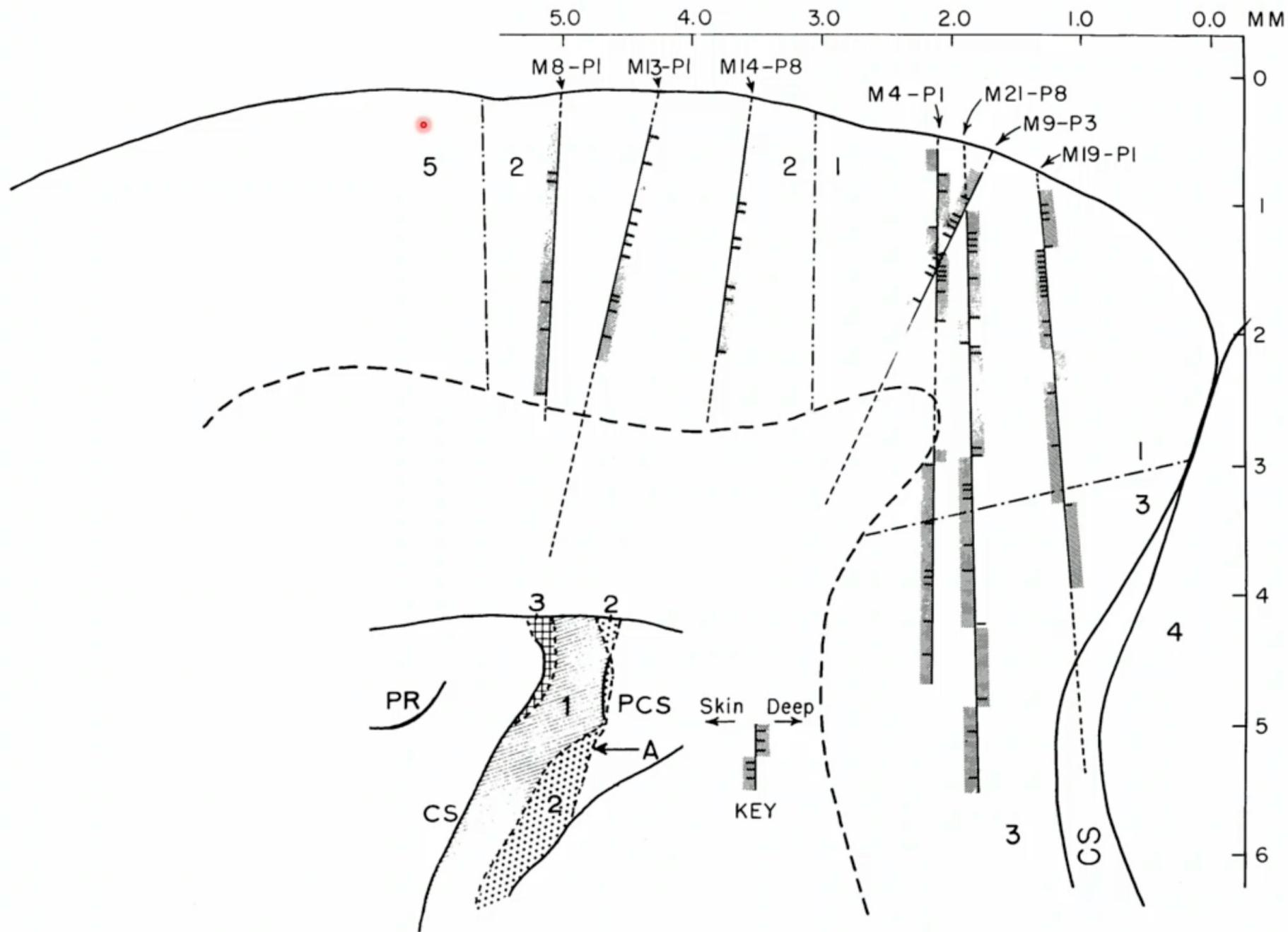
Wikipedia
'Motor unit'
Accessed
Nov 2 2022

FIGURE 9.10 Somatosensory portions of the thalamus and their cortical targets in the postcentral gyrus



After Brodal (1992) and Jones et al. (1982).

Powell and Mountcastle (1959)



Powell and Mountcastle (1959)

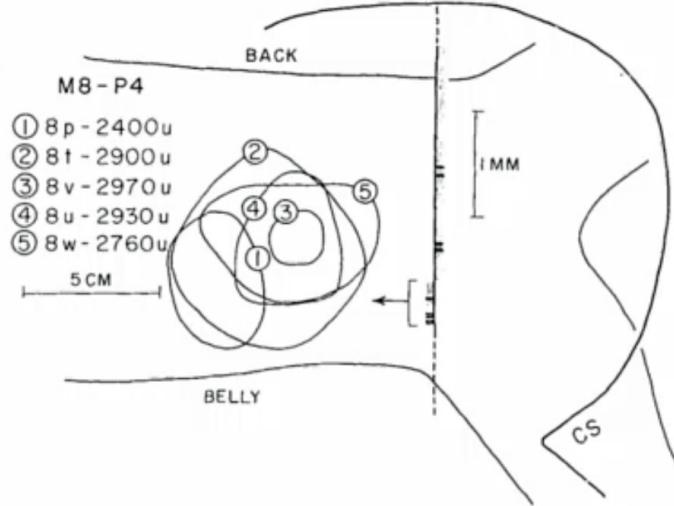
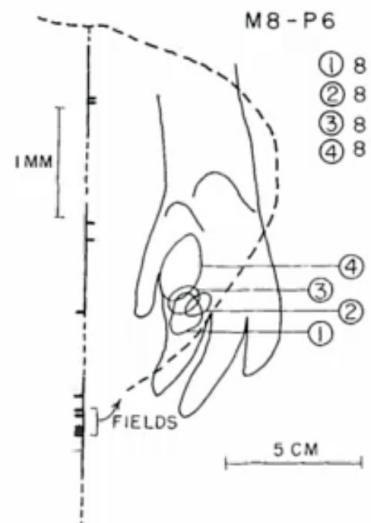
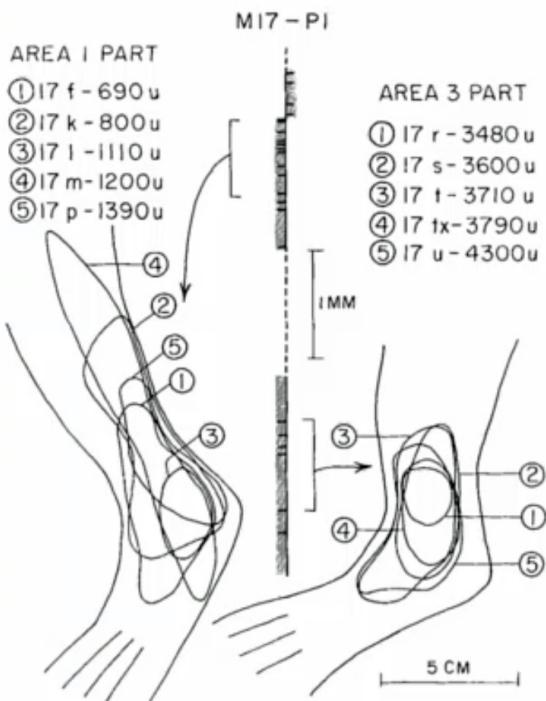
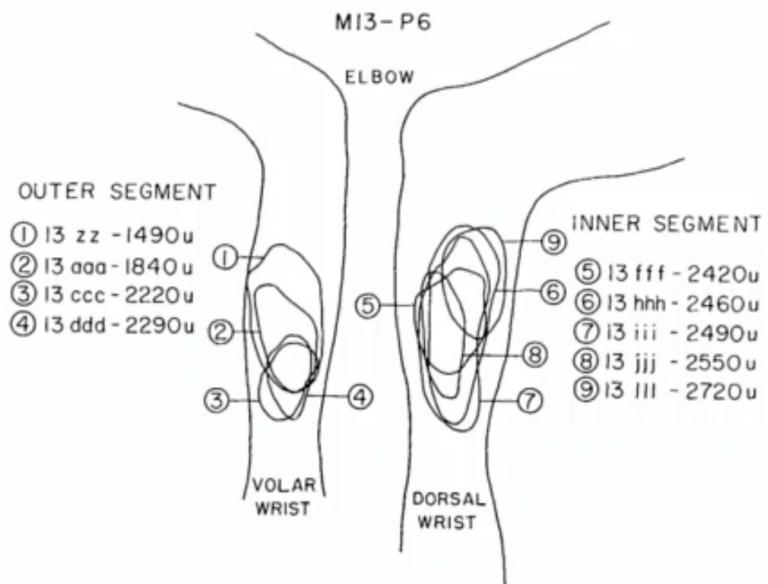
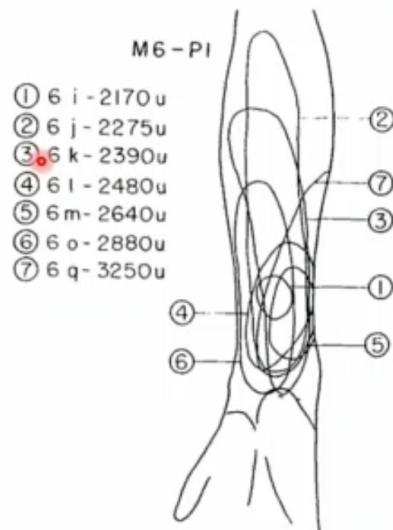
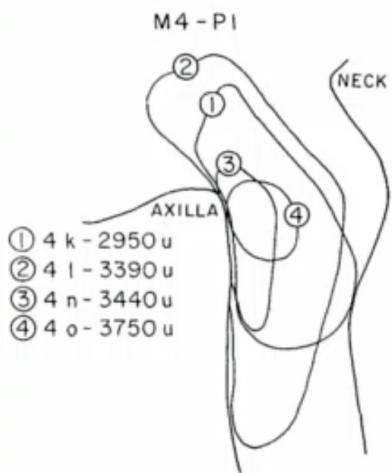


FIGURE 9.11 Somatotopic order in the human primary somatosensory cortex

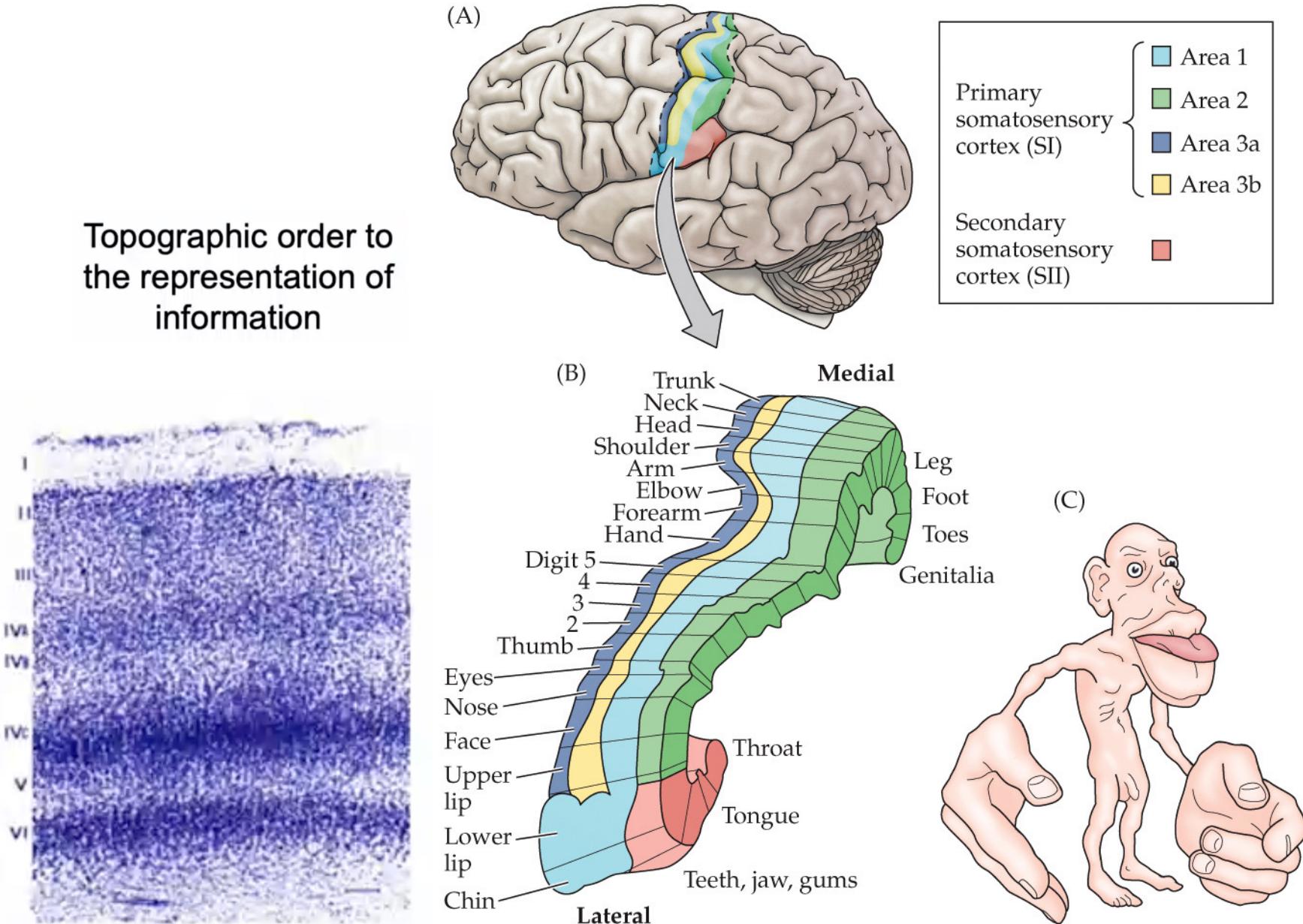


FIGURE 9.8 The main touch pathways

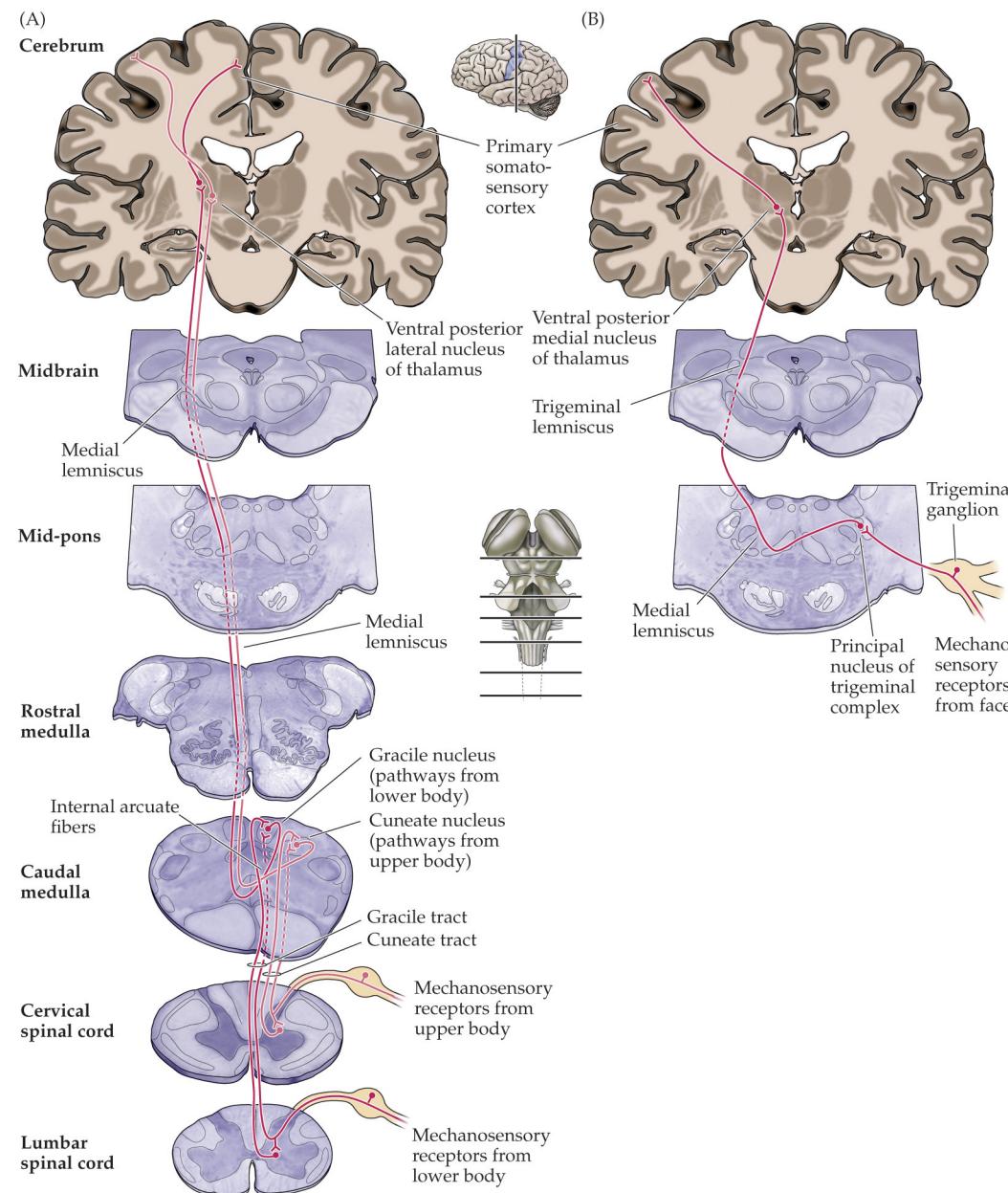


FIGURE 9.11 Somatotopic order in the human primary somatosensory cortex

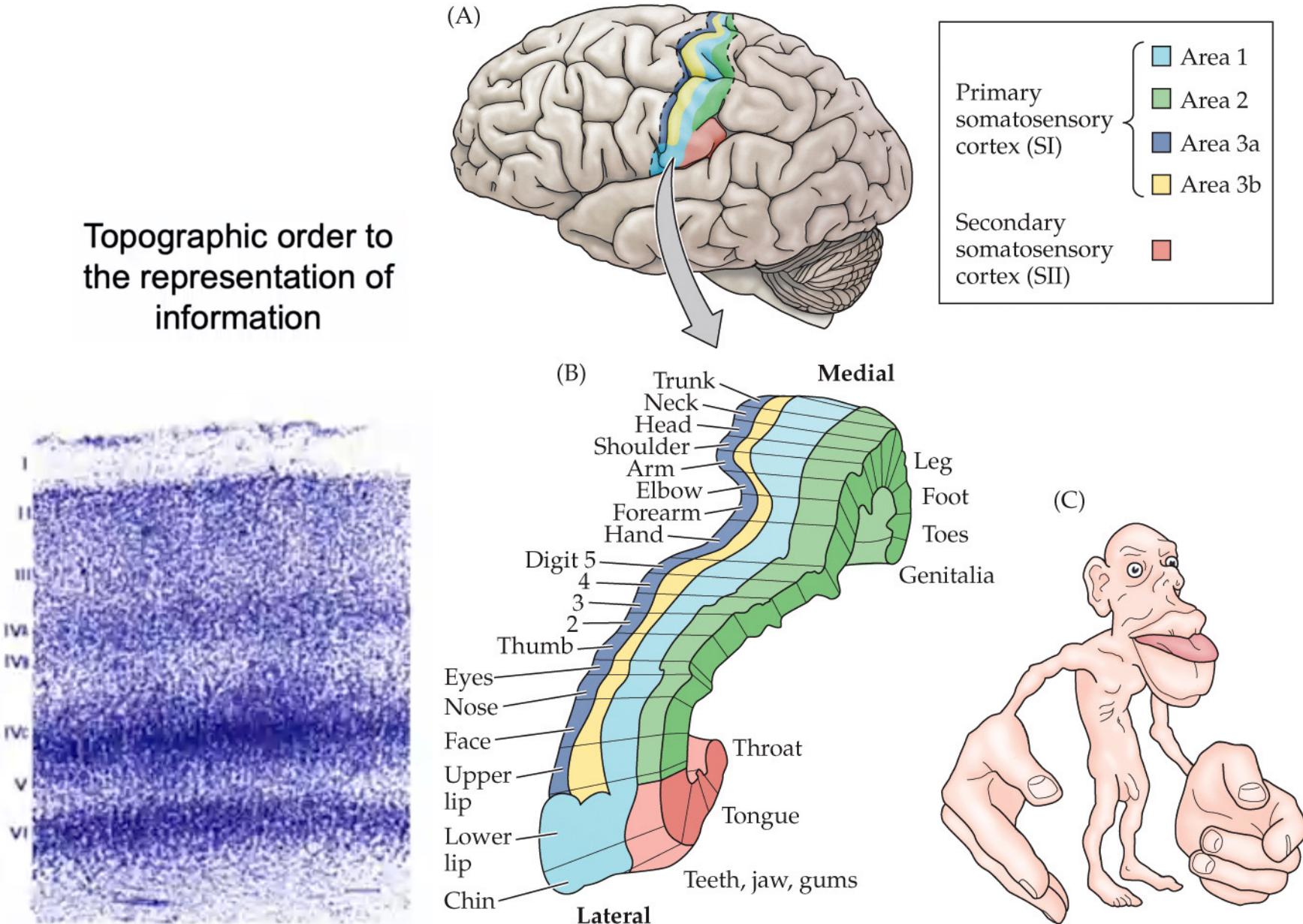
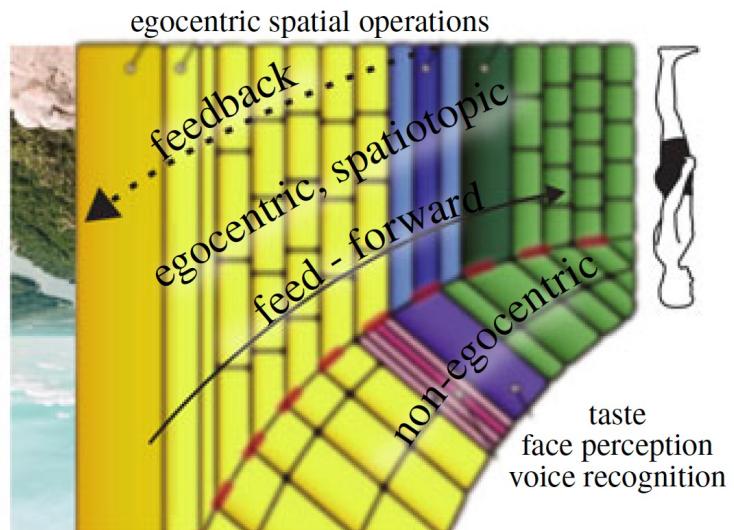
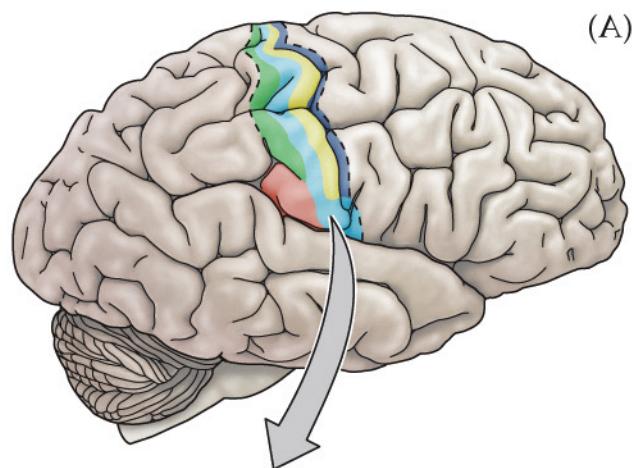


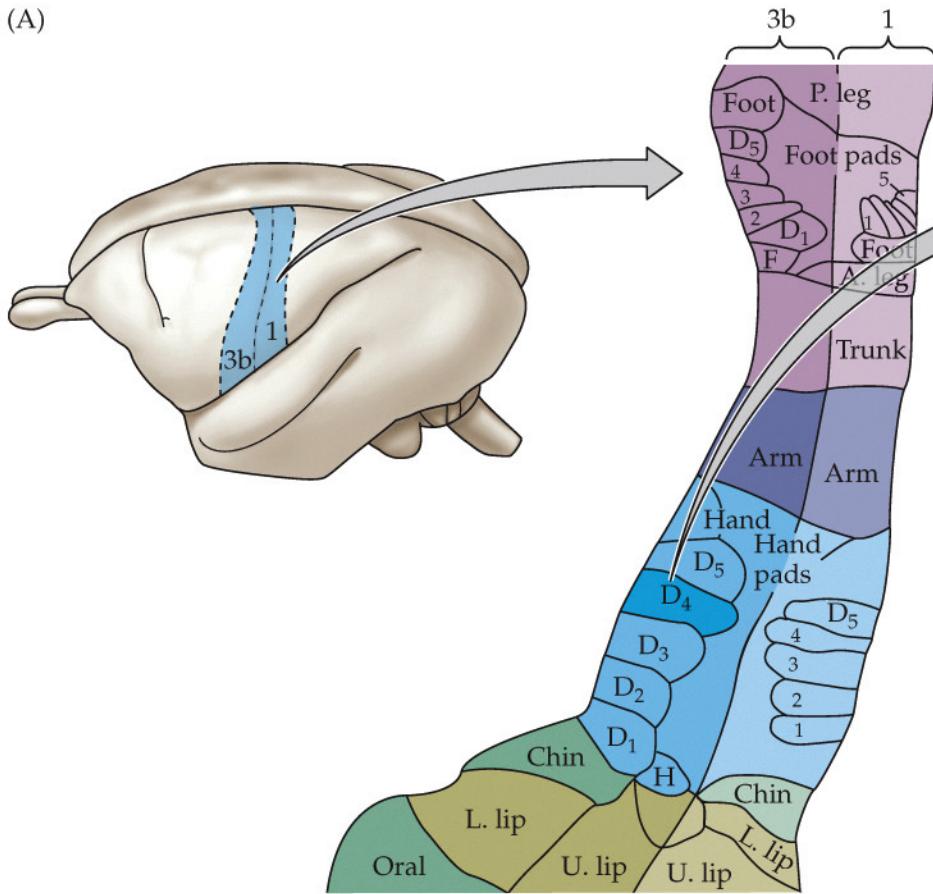
FIGURE 9.11 Somatotopic order in the human primary somatosensory cortex



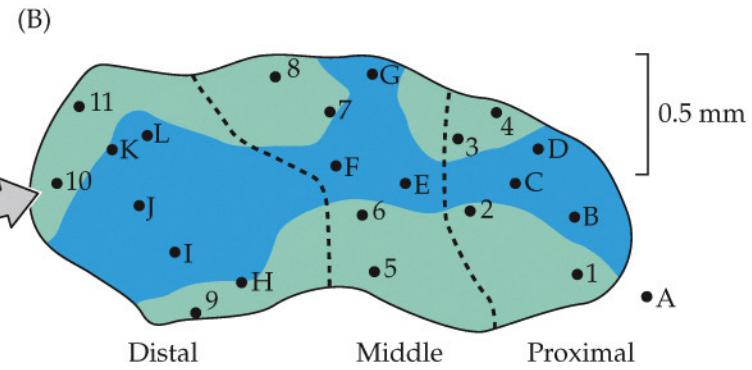
Topographic order to
the representation of
information

FIGURE 9.13 Neurons in the primary somatosensory cortex form functionally distinct columns

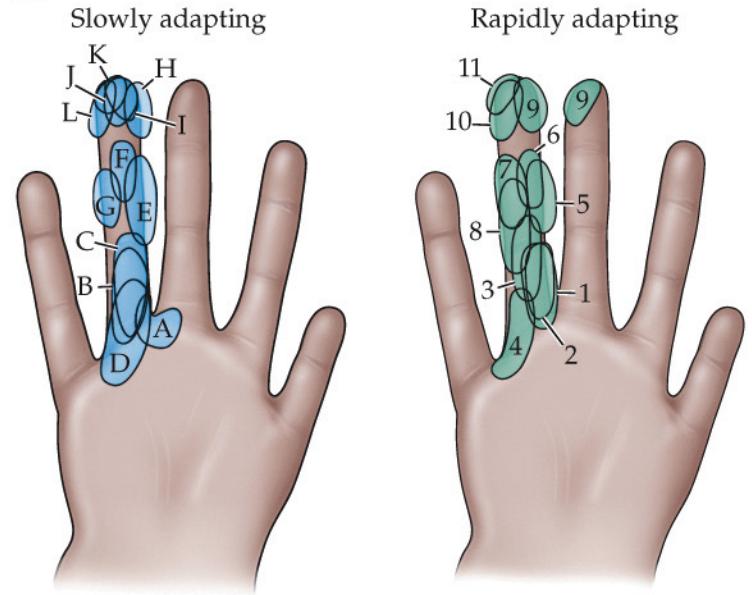
(A)



(B)



(C)

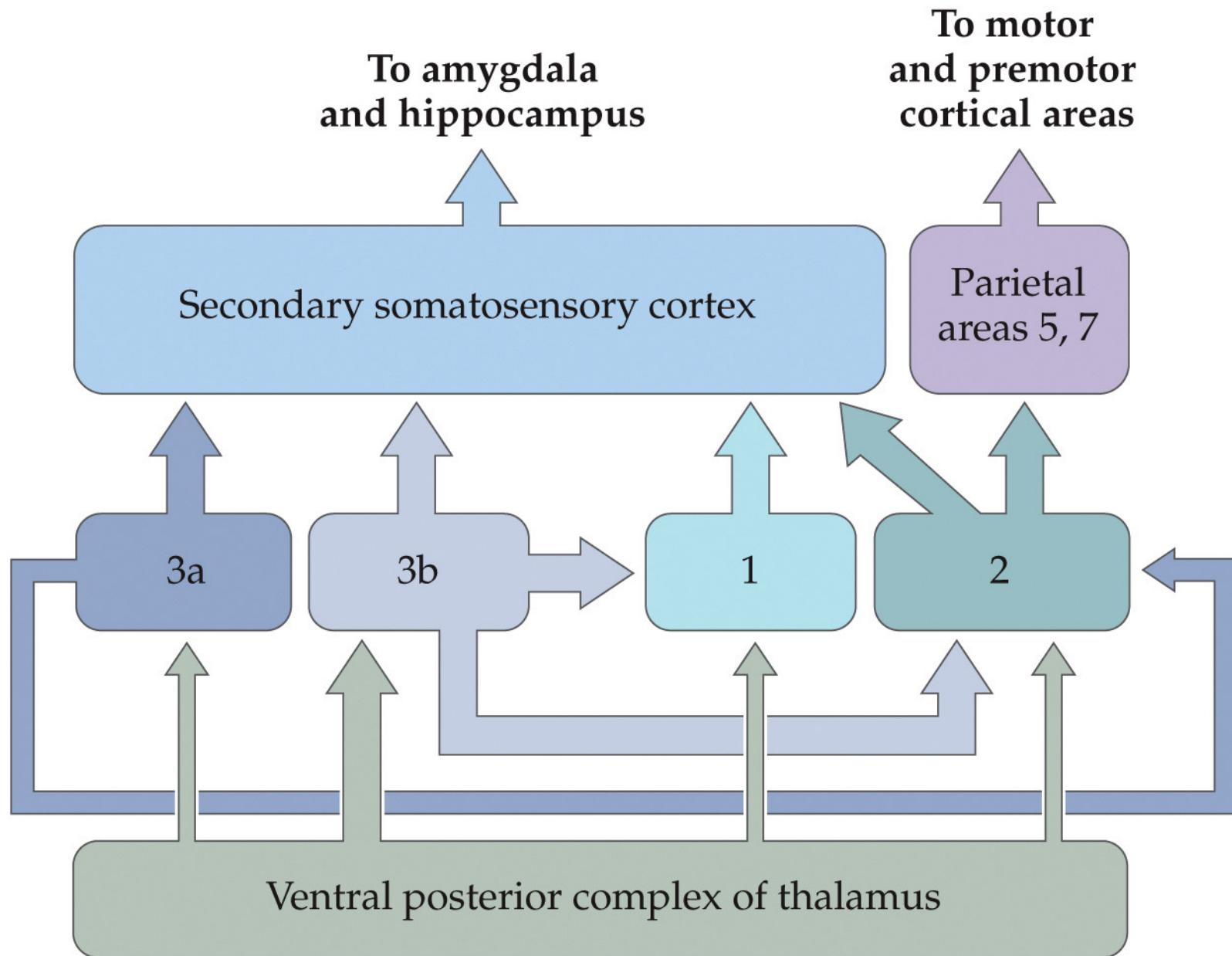


A after Kaas (1993) *Ann. Anat.* 175: 509–518. C after Sur et al. (1980) *Brain Res.* 198: 465–471.

NEUROSCIENCE 6e, Figure 9.13

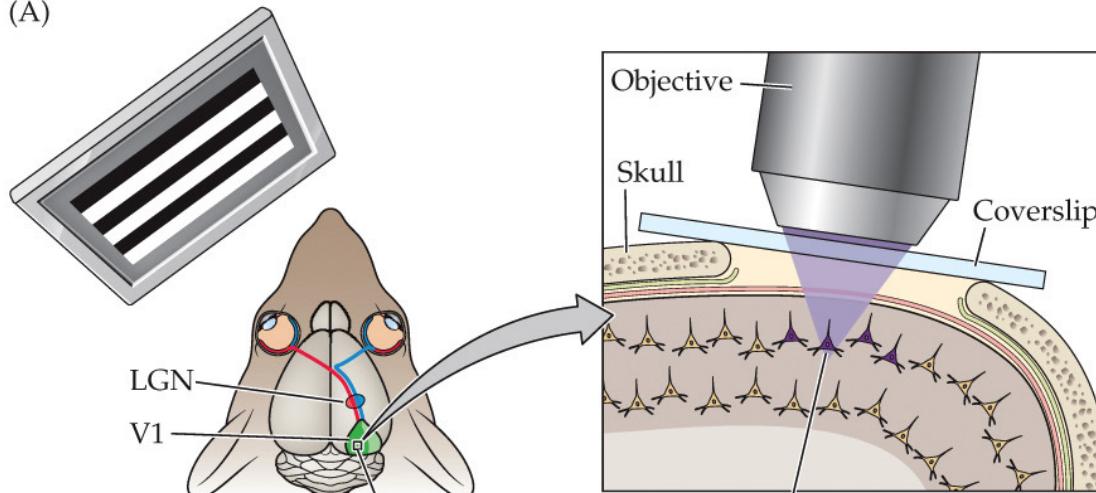
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FIGURE 9.12 Connections within the somatosensory cortex establish functional hierarchies

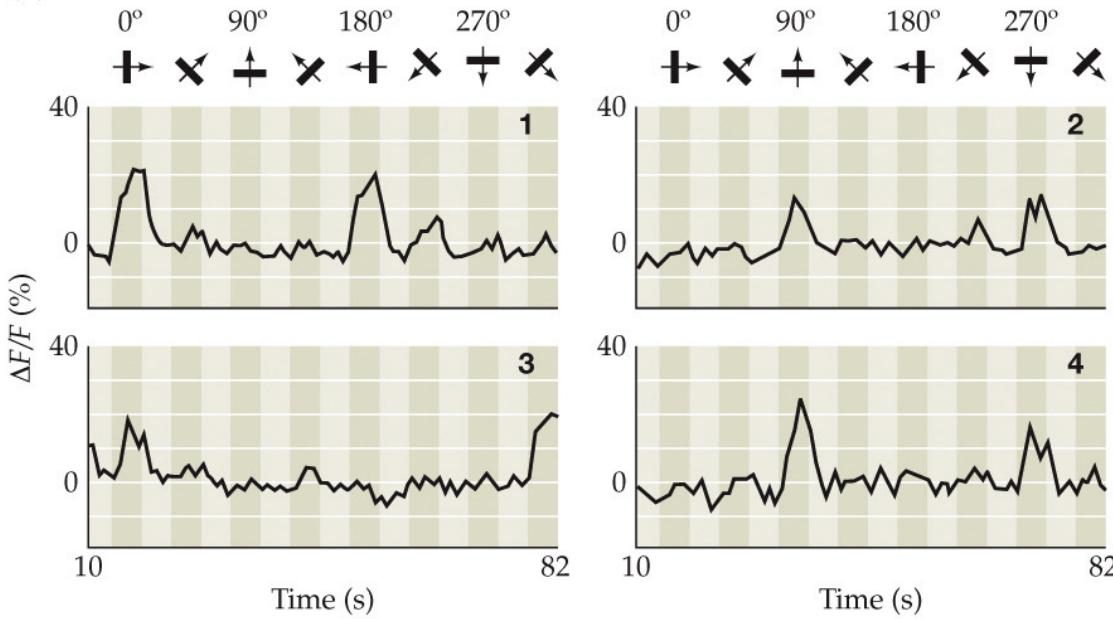


Imaging cortical neurons responding to visual stimuli using calcium-sensitive dyes

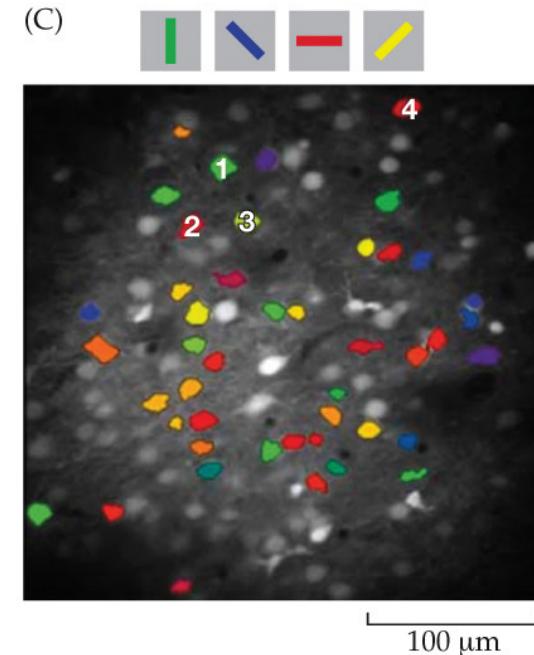
(A)



(B)

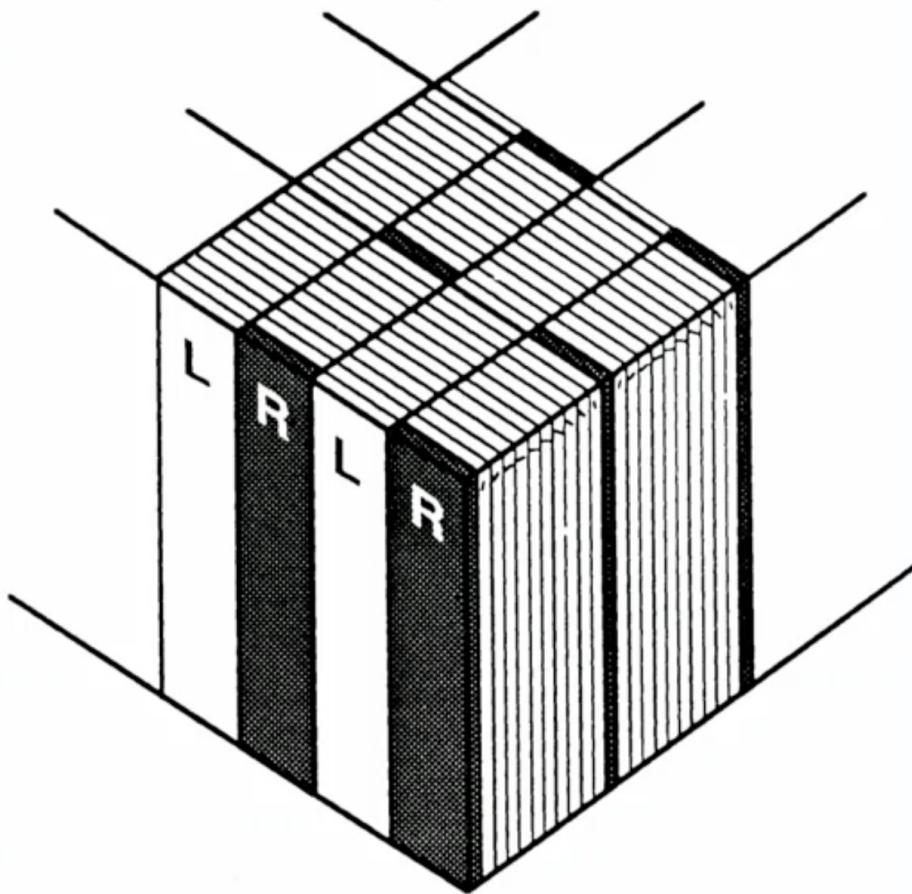
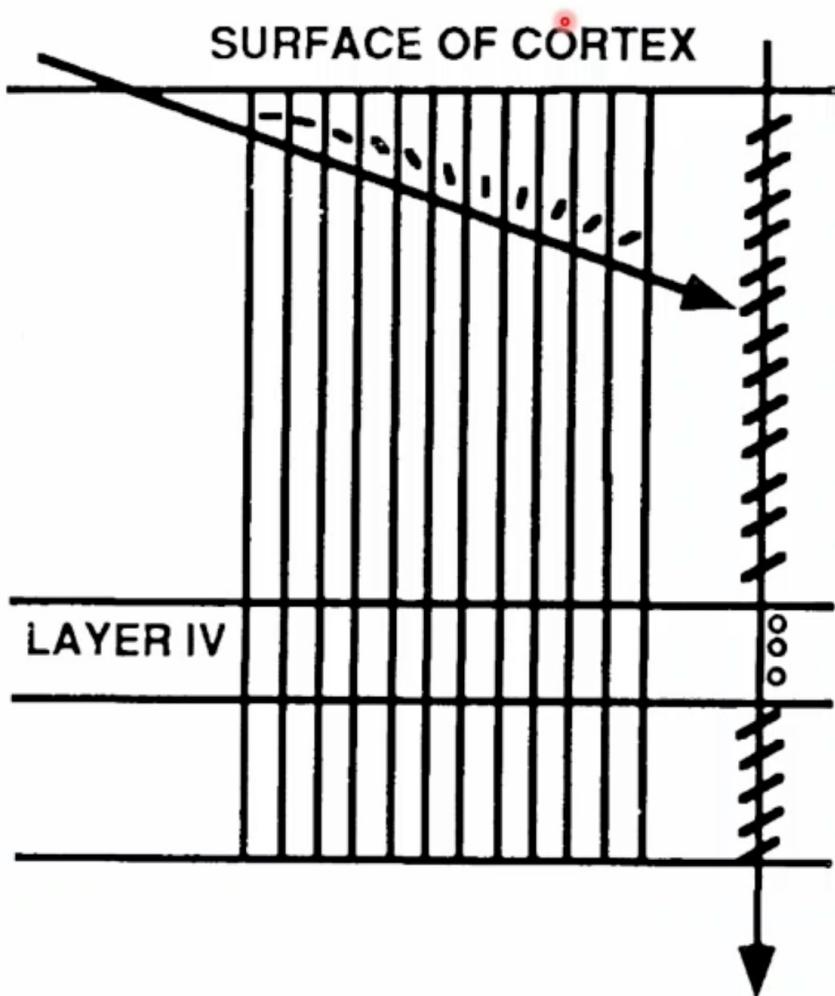


(C)

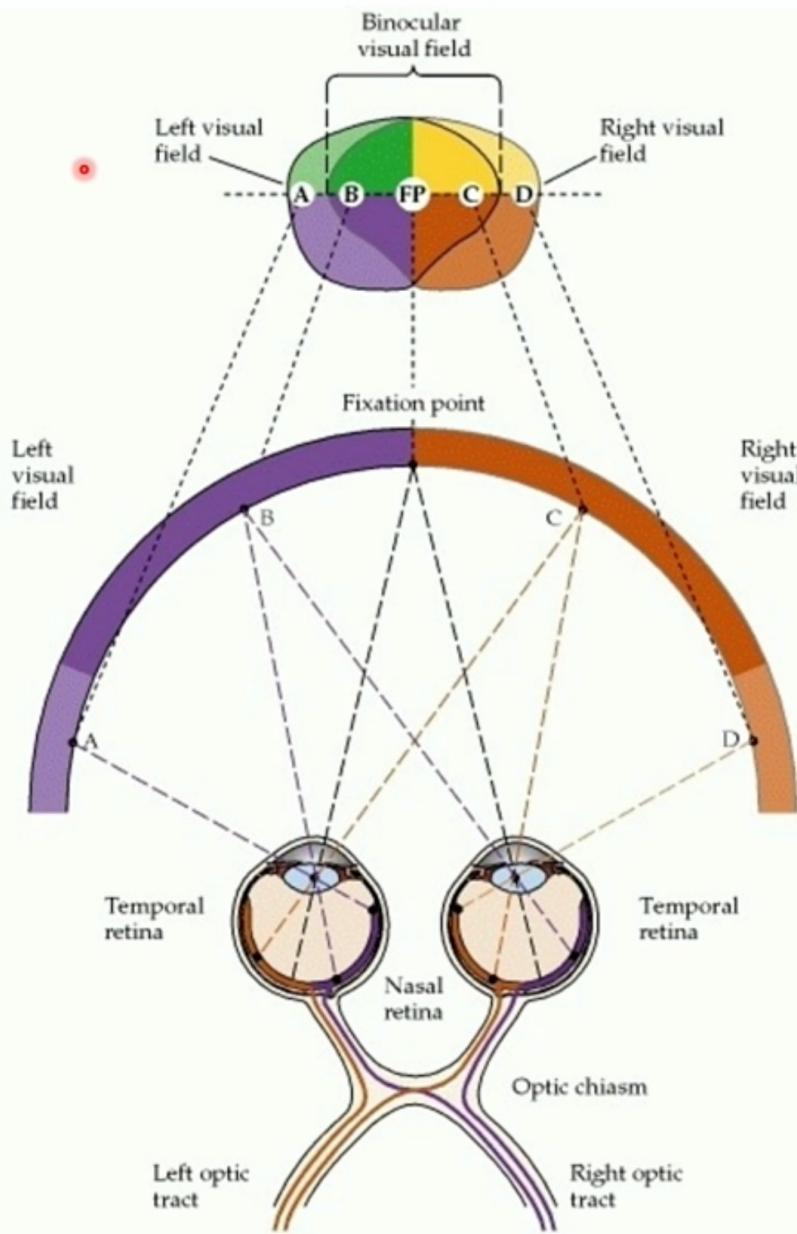


A from Mank et al. (2008) *Nat. Meth.* 5: 805–811. B,C from Ohki et al. (2005) *Nature* 433: 597–603.

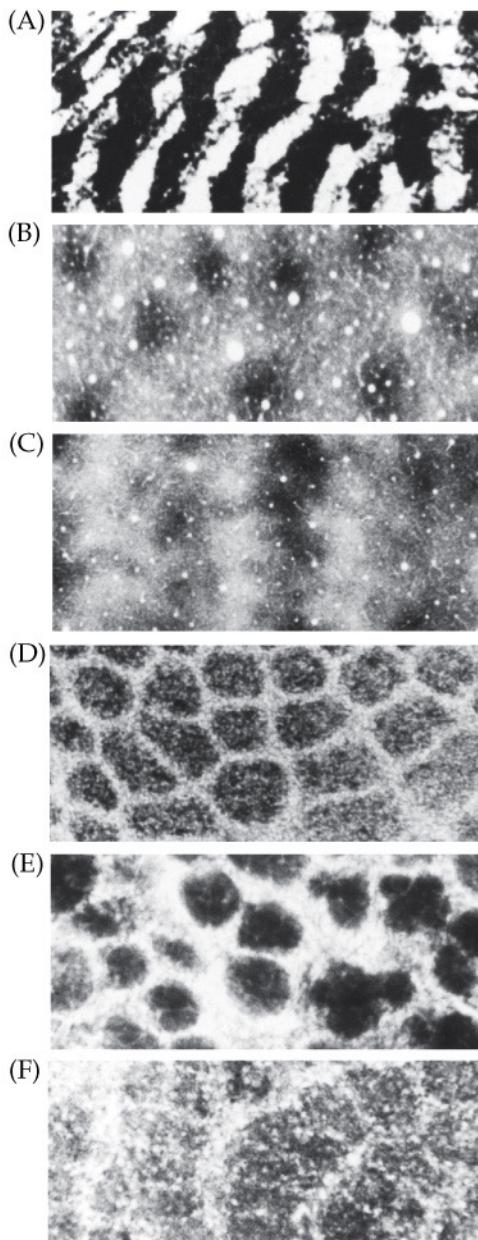
Cortical Columns



Visual Field



Box 9A Patterns of Organization within the Sensory Cortices: Brain Modules



Ocular Dominance, Layer 4, V1

Blobs, Layers 2 and 3, V1

Stripes, Layers 2 and 3, V2

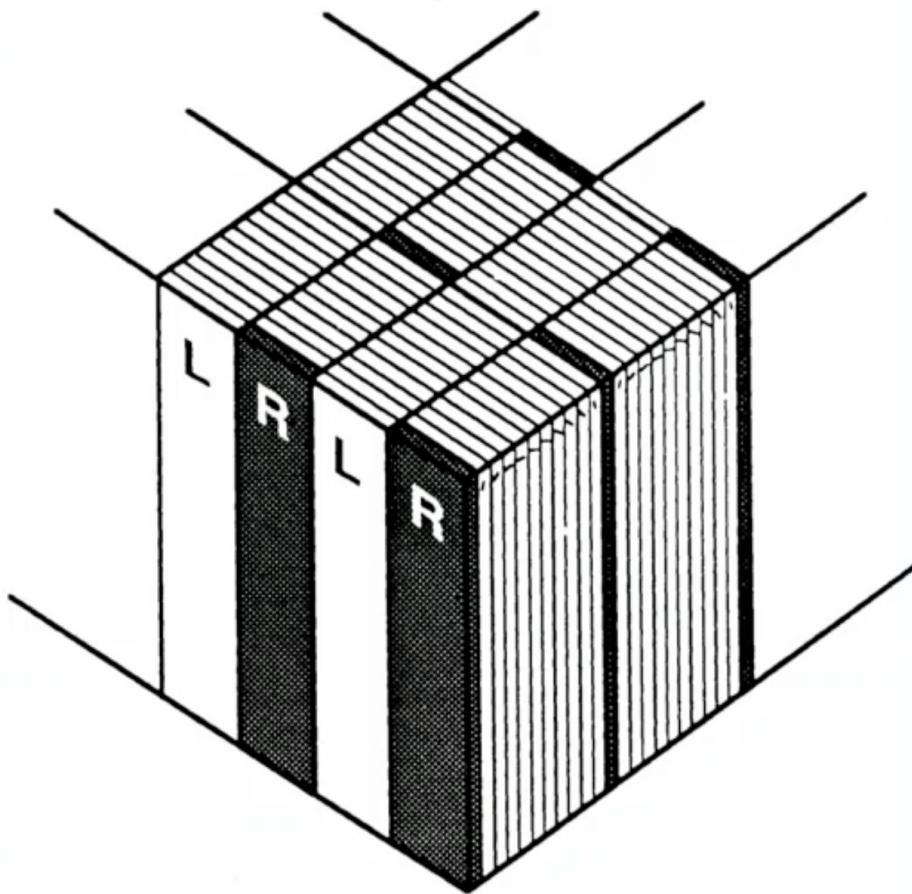
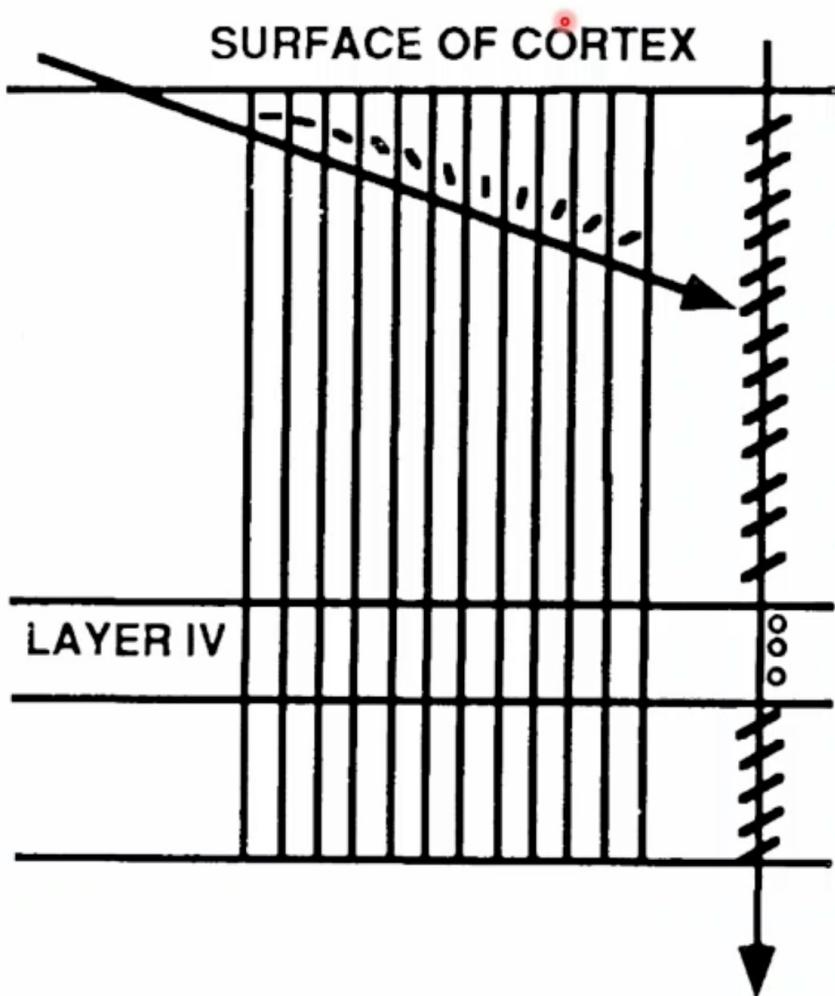
Barrels, Layer 4, S1

Glomeruli, Olfactory Bulb

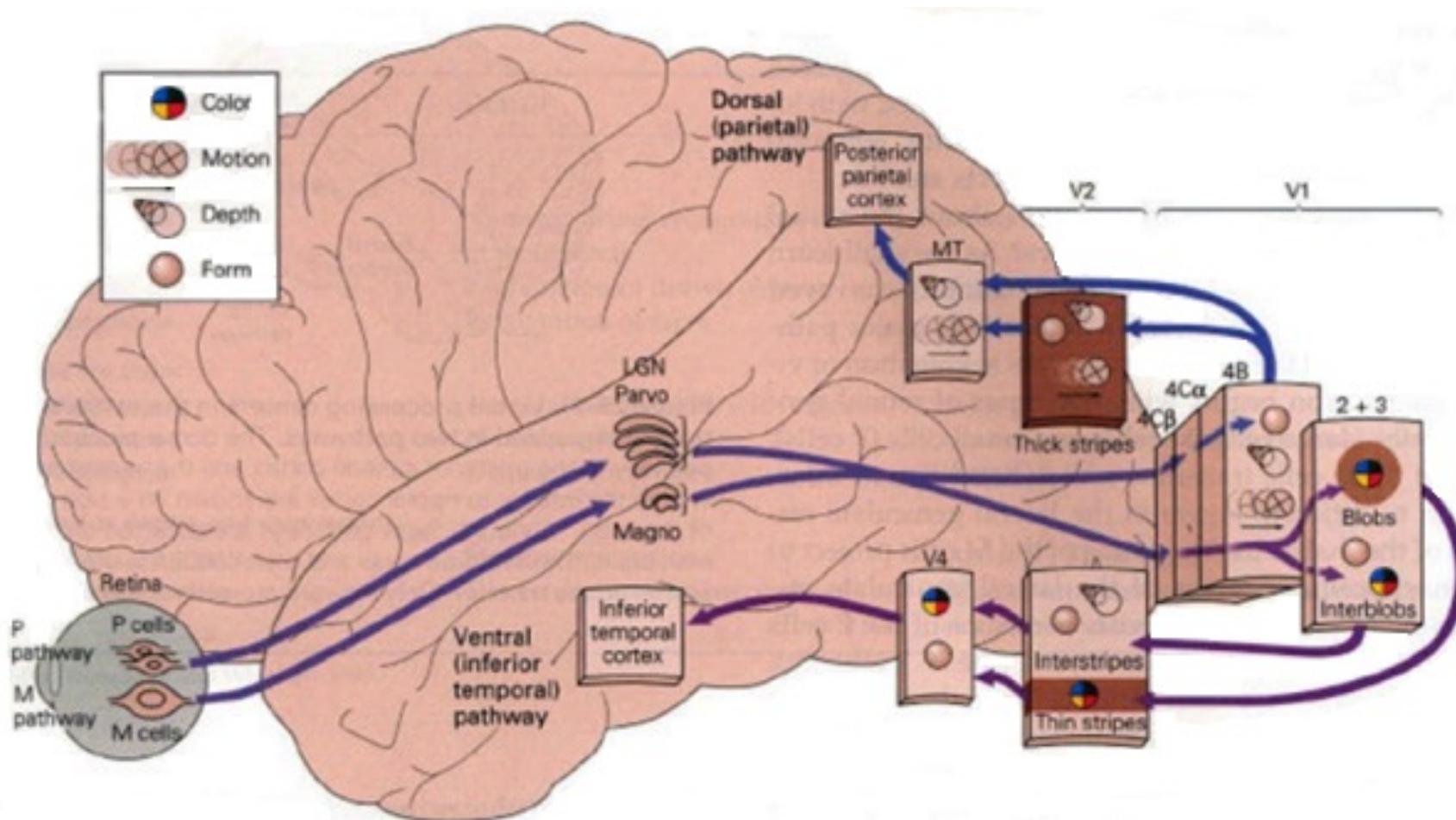
Barreloids, Thalamus

From Purves et al. (1992) *Trends Neurosci.* 15: 362–369.

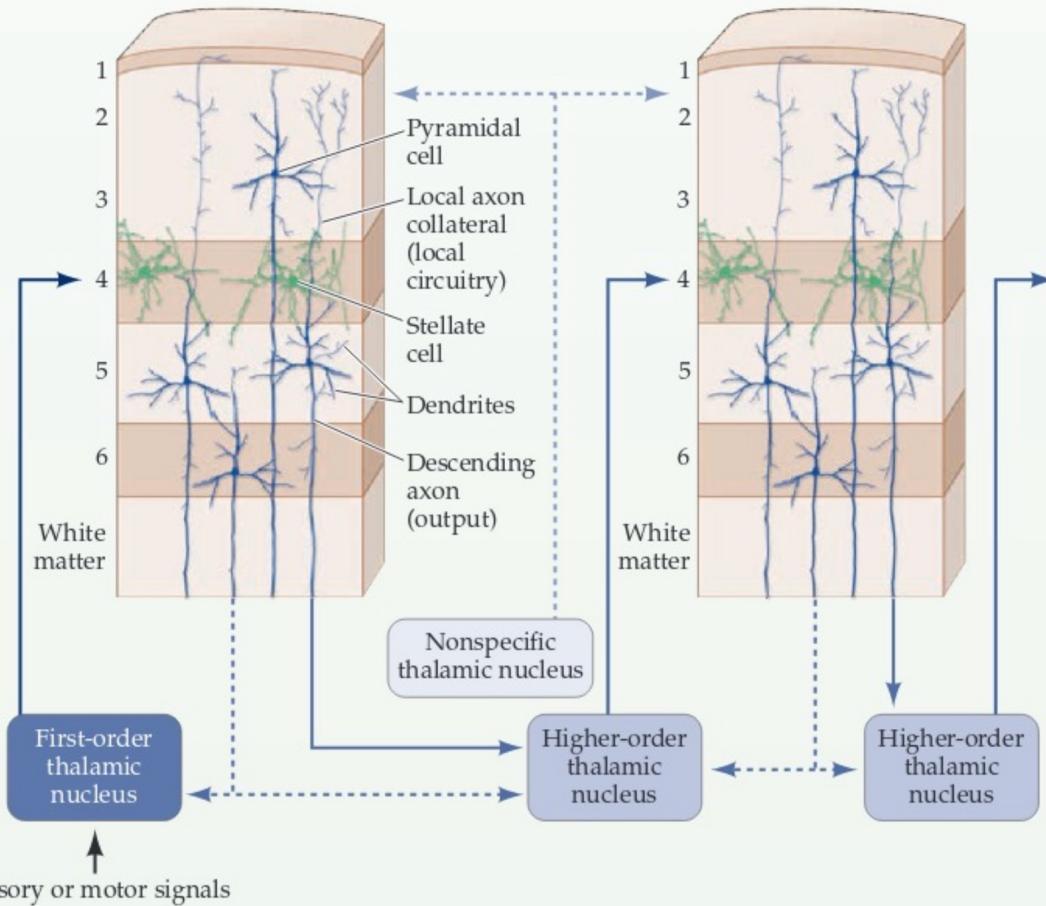
Cortical Columns



Visual Cortical Areas



(B)



(B) Thalamocortical relations. Some specific thalamic nuclei are "first-order" relays of sensory or motor signals to the middle layers of primary cortex; other, "higher-order" nuclei distribute output signals via cortico-thalamocortical circuits (solid arrows). The thalamus also receives and distributes modulatory signals (dashed lines). (After Sherman and Guillery, 2011.)

- Different cortical areas segregated according to modality
- Different cortical areas for a single modality
 - Increasing complexity
 - Sparse coding
 - Cell responds to a more specific stimulus
 - More informative
 - Change in receptive field properties
- Layer specific roles
- Columnar organization
- Topographic map
- Number of neurons