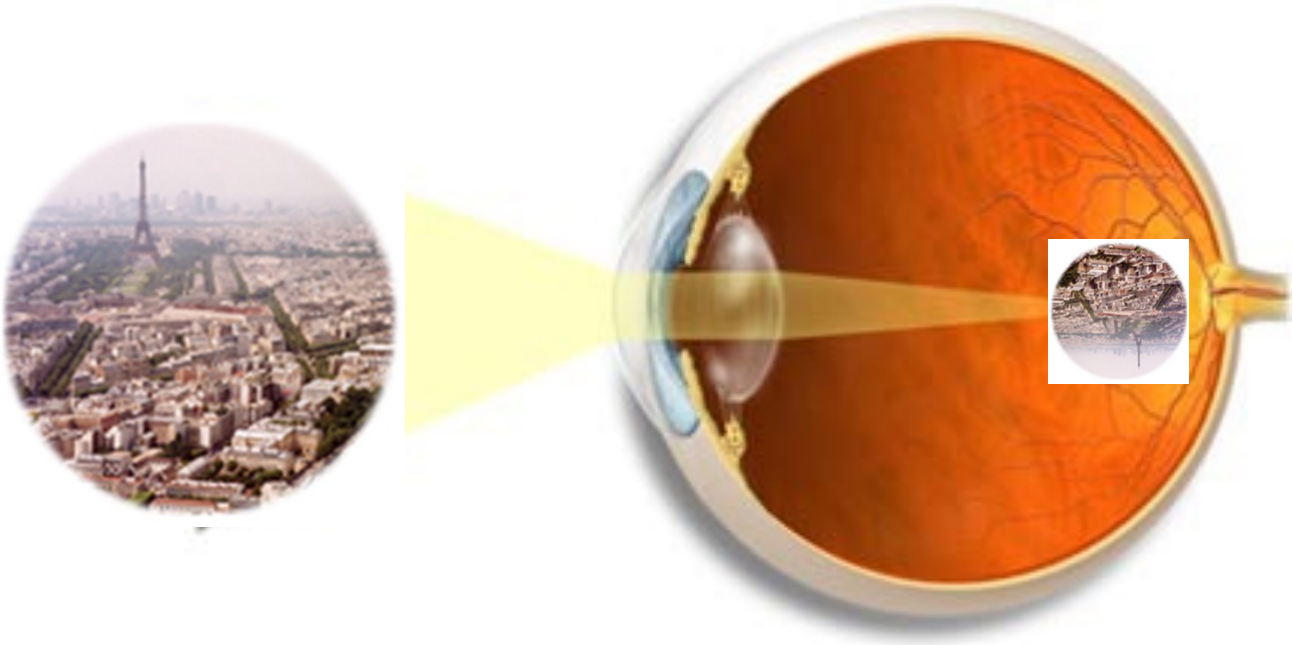
Primary Visual Cortex

MEDS 470 / NRSC 500B

Dr. Olav E. Krigolson



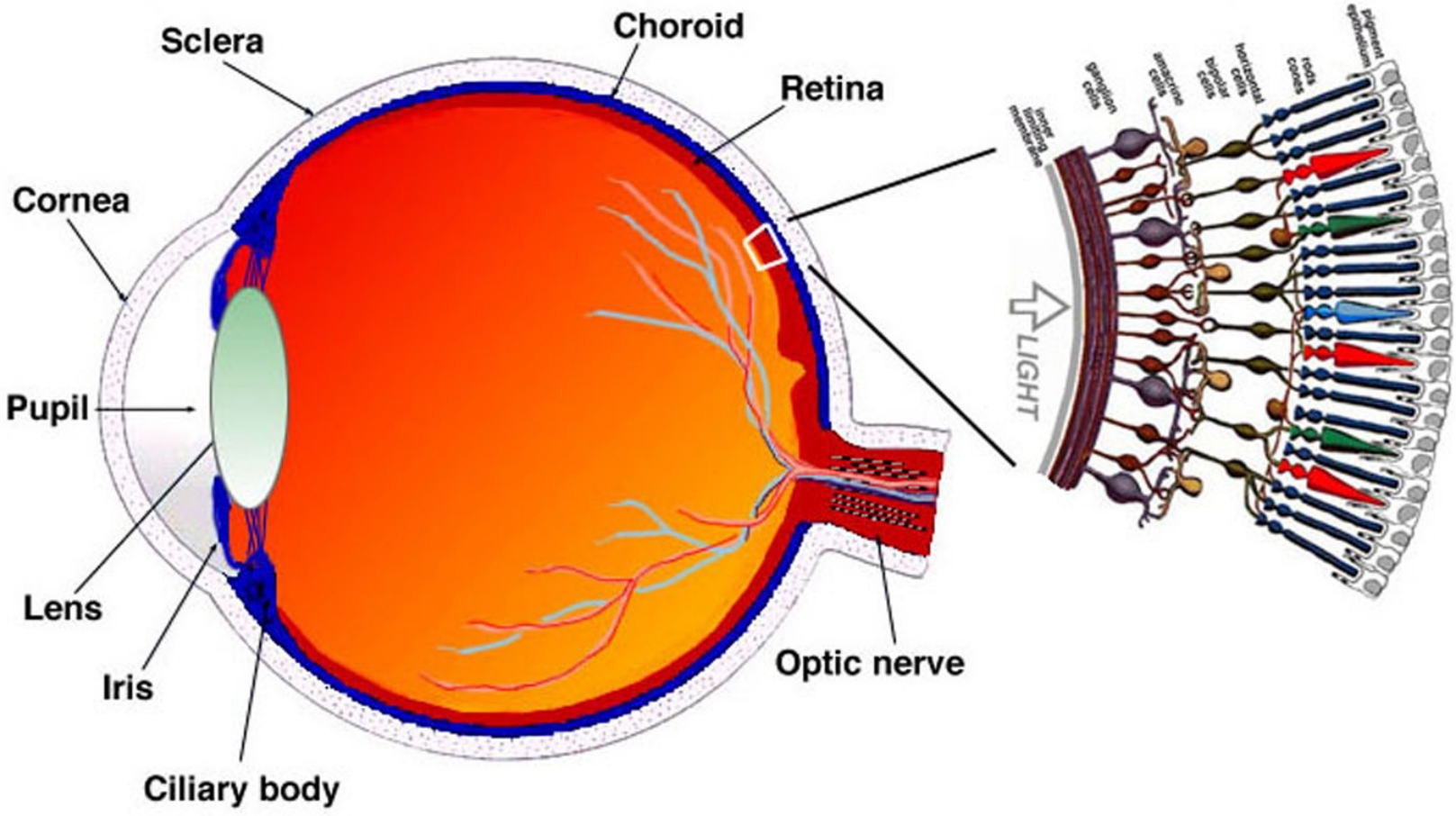
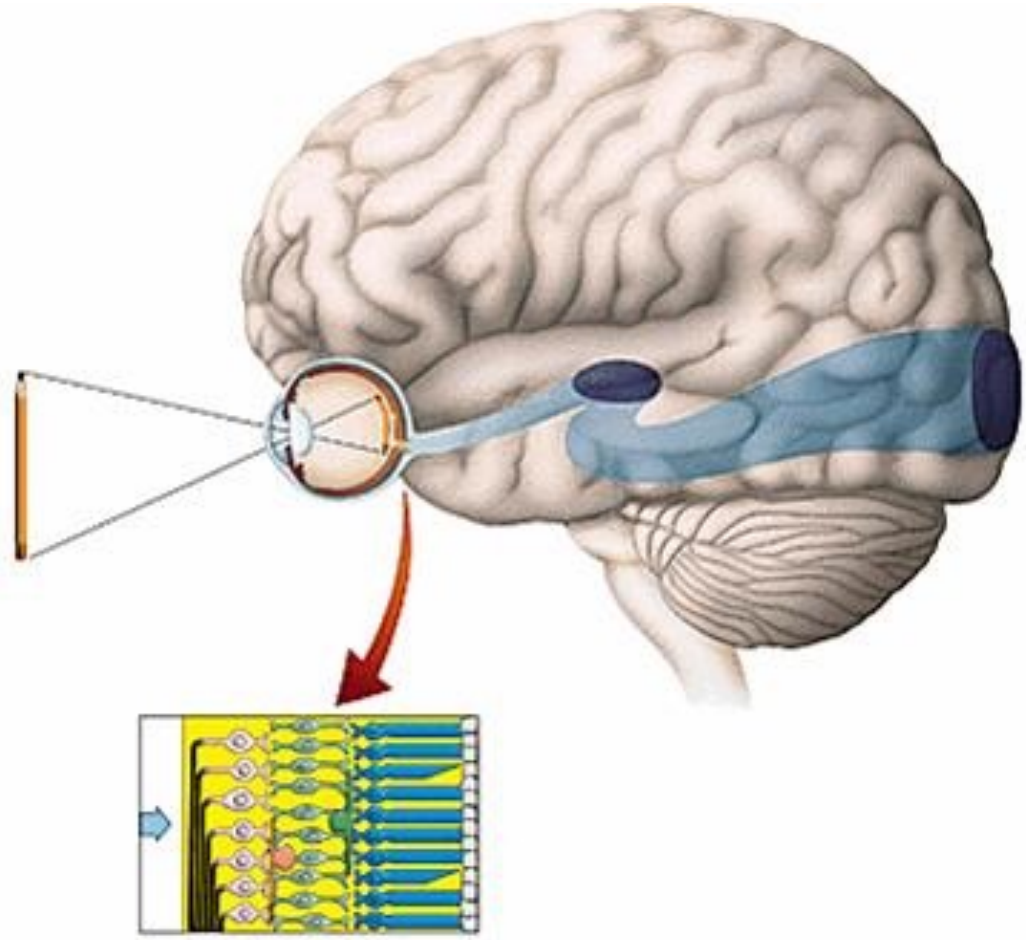
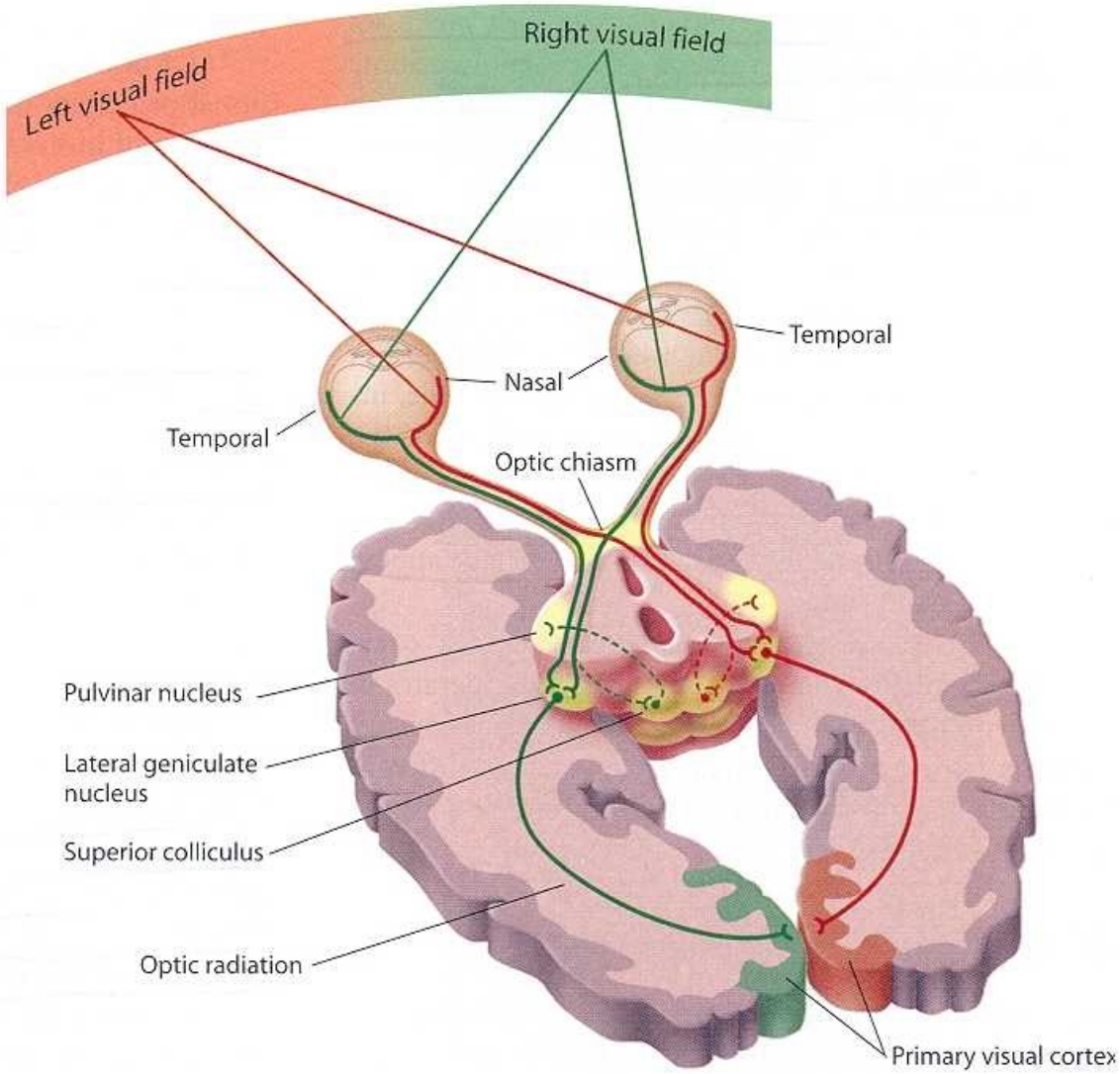
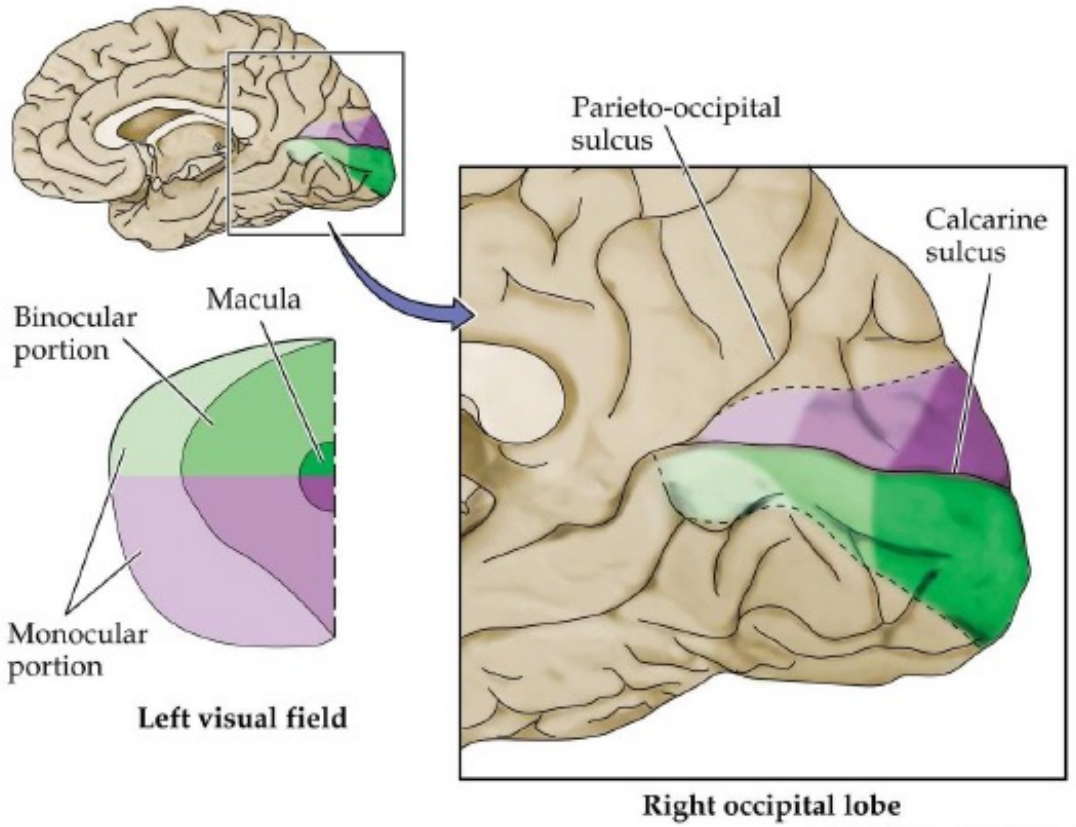


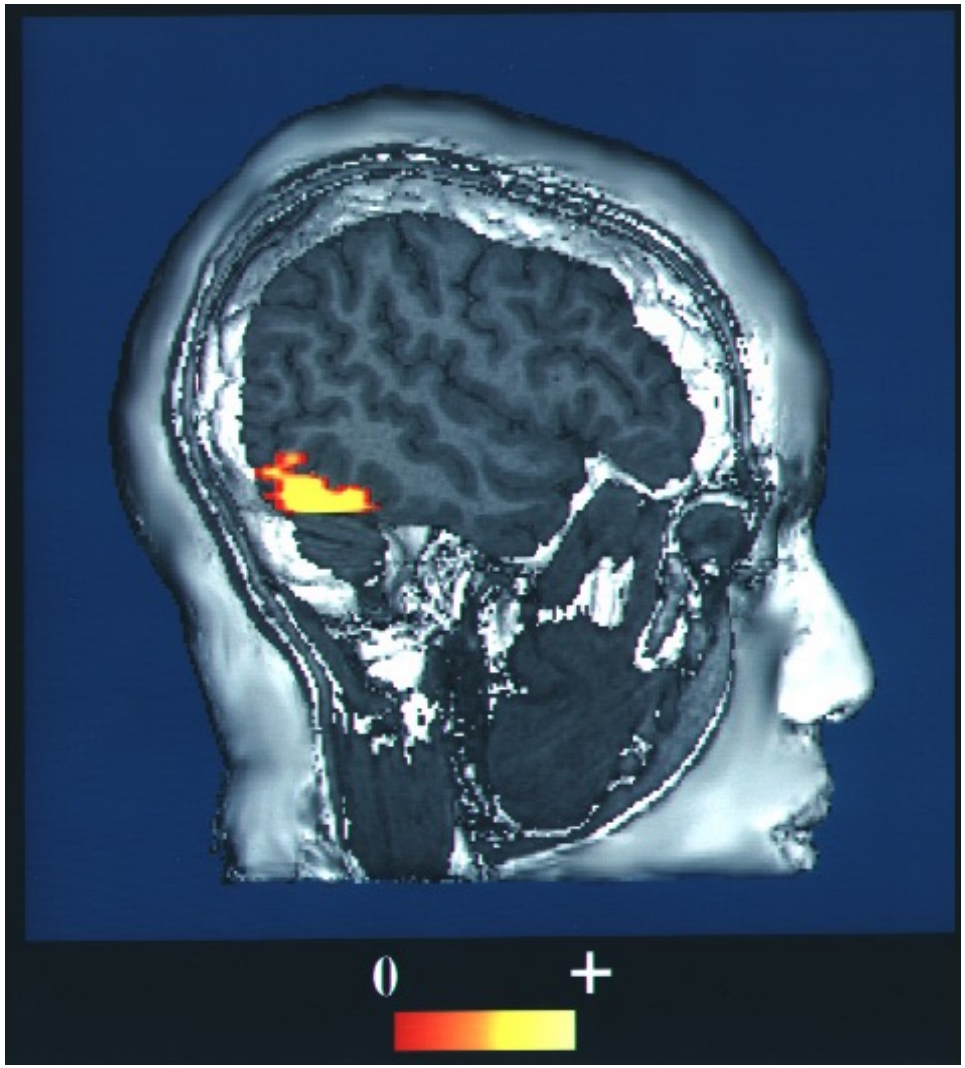
Fig. 1.1. A drawing of a section through the human eye with a schematic enlargement of the retina.




Left visual field
Right visual field
Temporal
Nasal
Temporal
Optic chiasm
Pulvinar nucleus
Lateral geniculate nucleus
Superior colliculus
Optic radiation
Primary visual cortex

The retinotopic map

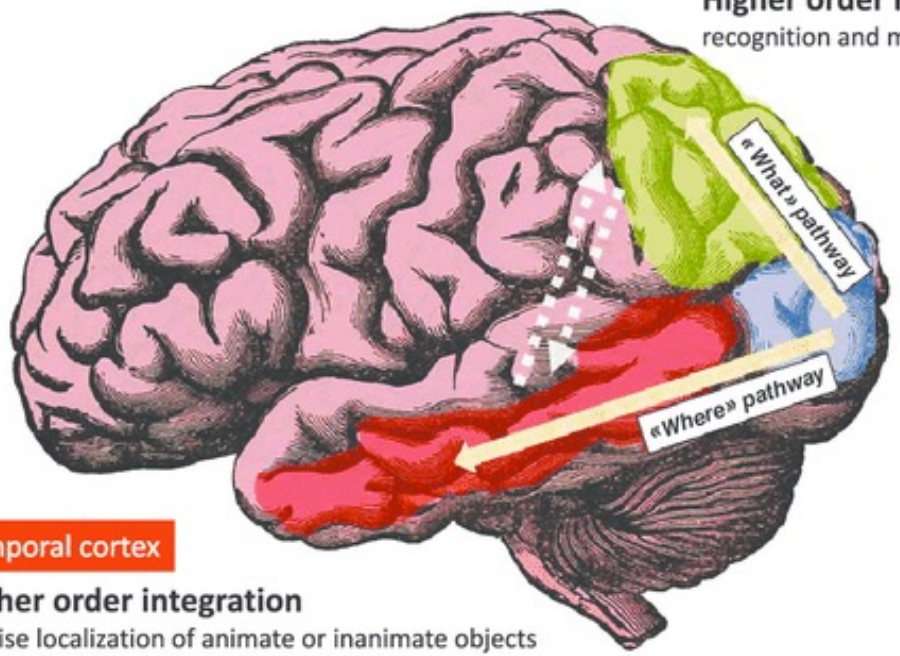



0
+

Parietal cortex

Higher order integration

recognition and memorization of objects and forms



Occipital cortex

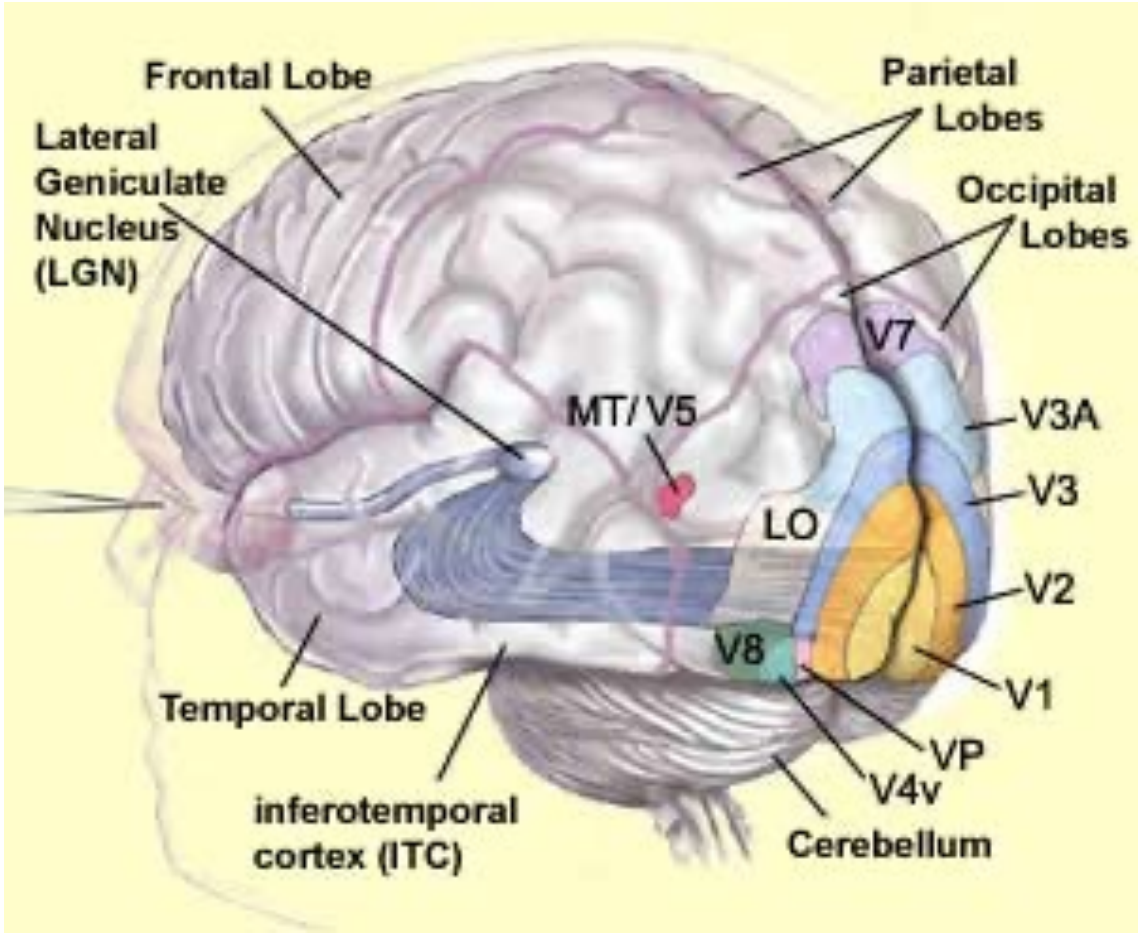
Primary integration

perception of shape, color, motion

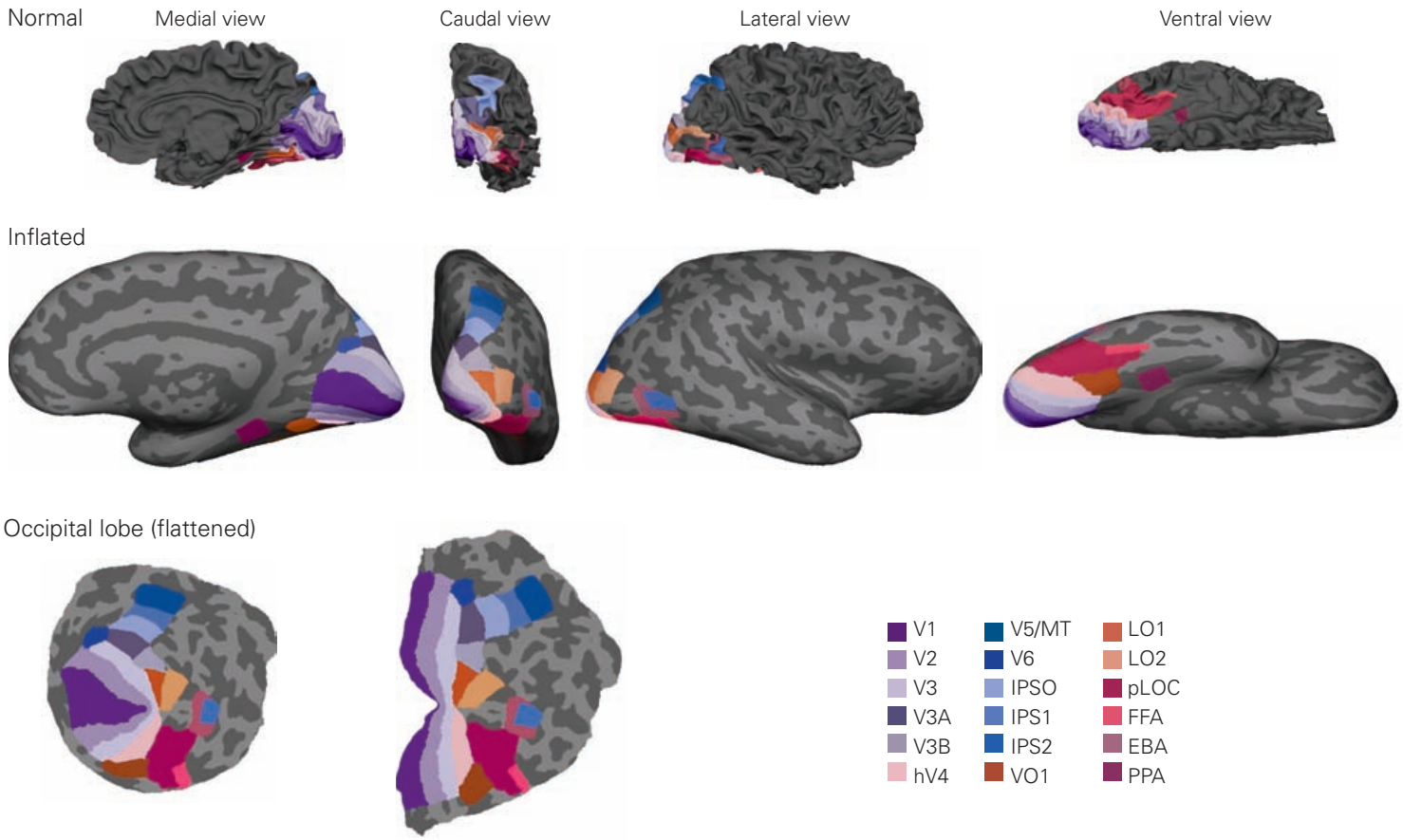
Temporal cortex

Higher order integration

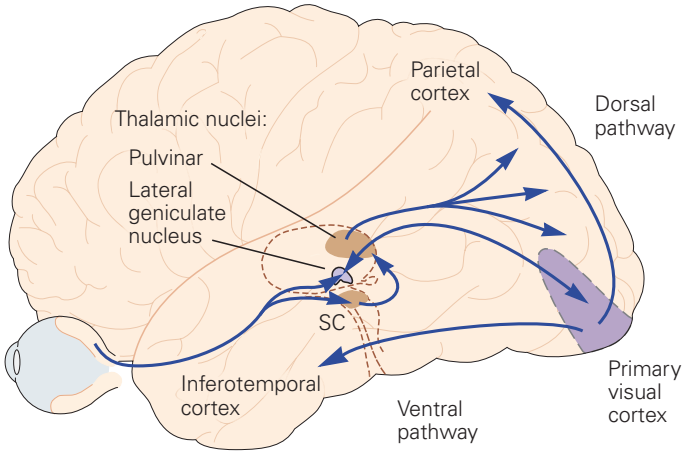
precise localization of animate or inanimate objects


Frontal Lobe
Parietal Lobes
Lateral Geniculate Nucleus (LGN)
Occipital Lobes
V7
MT/ V5
V3A
V3
LO
V2
V8
V1
Temporal Lobe
VP
V4v
inferotemporal cortex (ITC)
Cerebellum

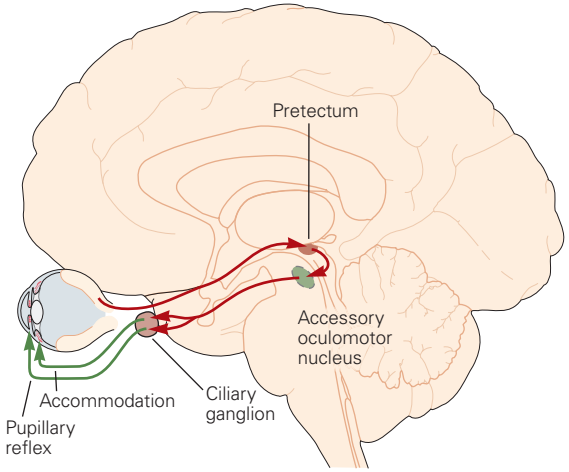
A Cortical visual areas in humans



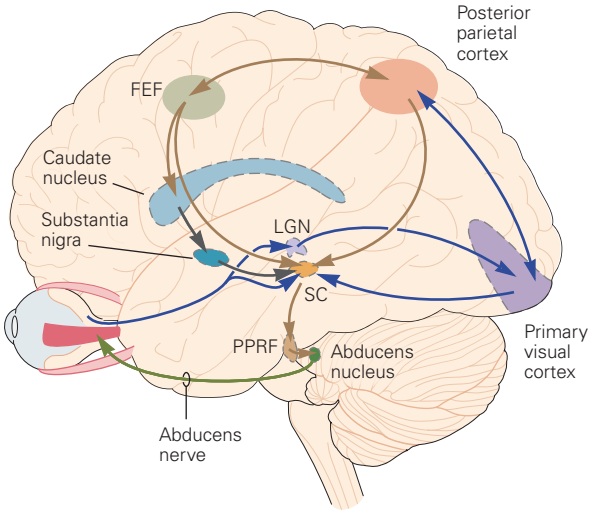
A Visual processing

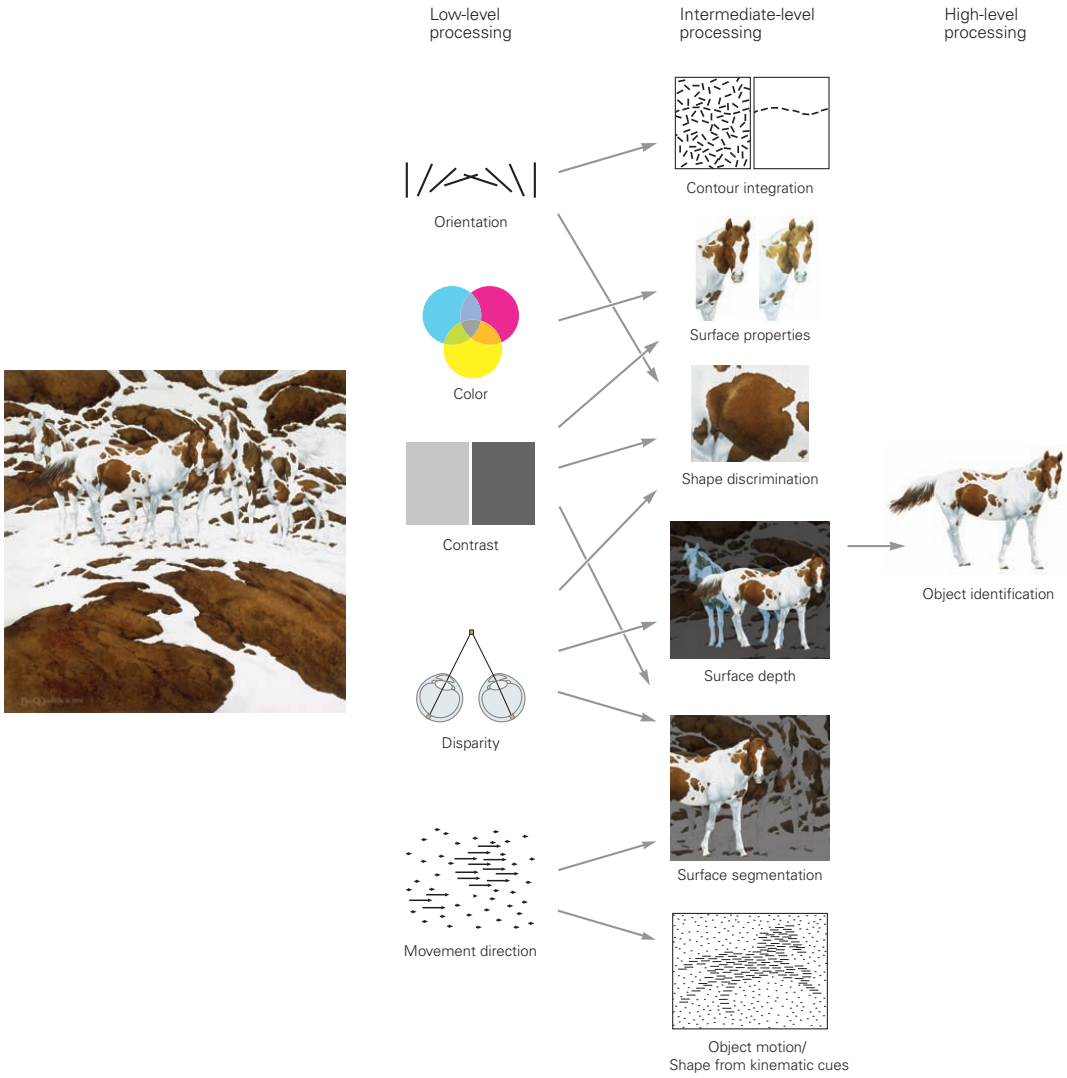


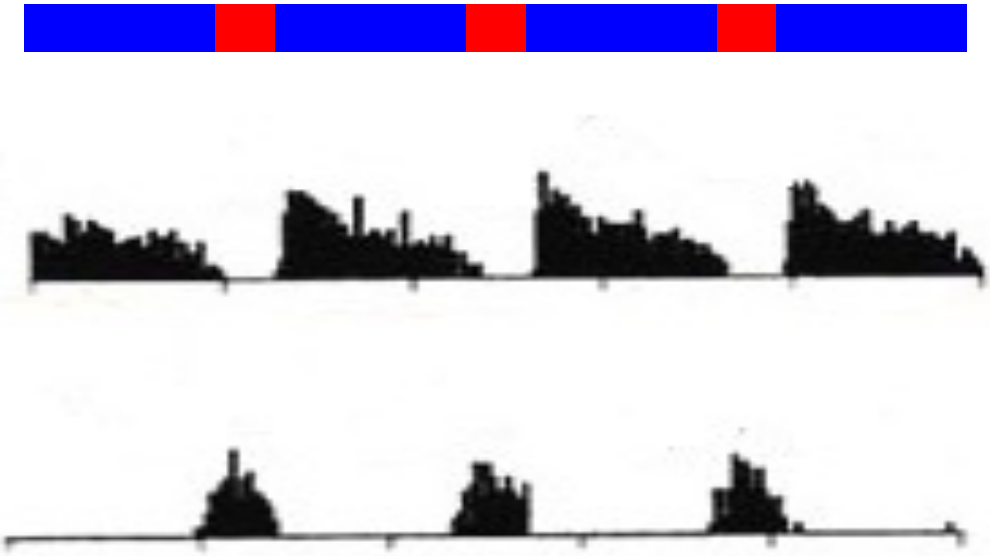
B Pupillary reflex and accommodation

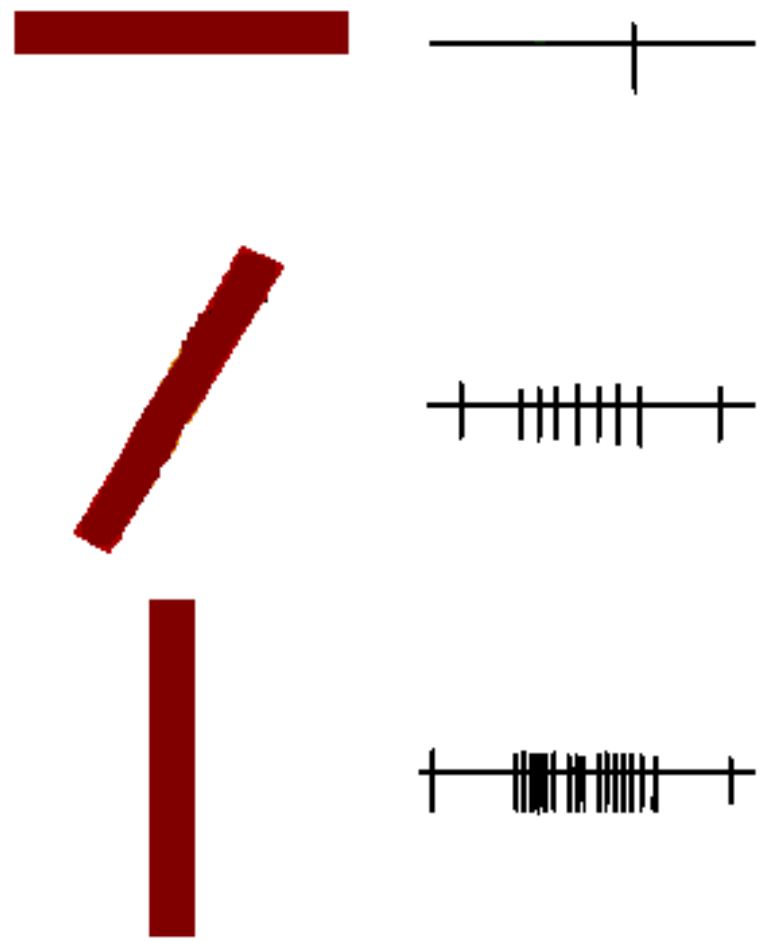


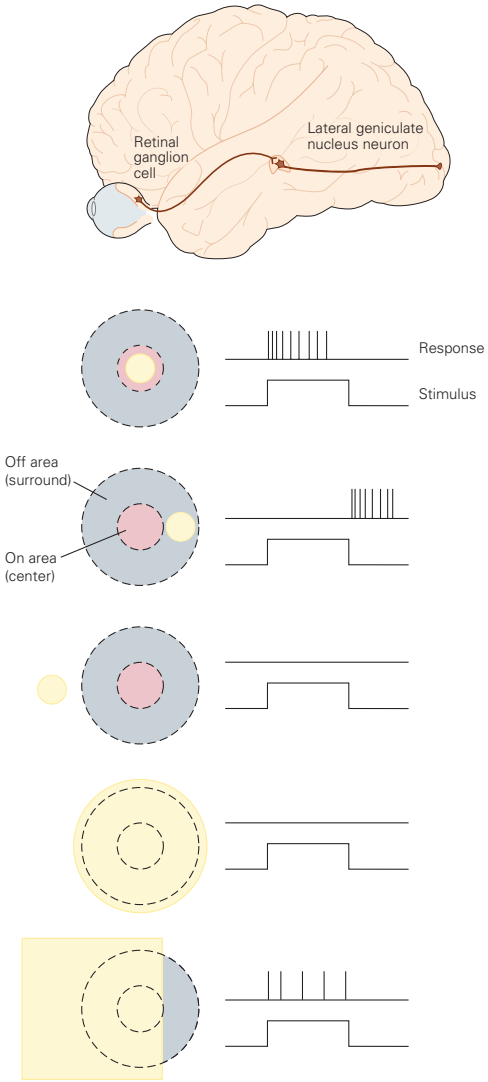
C Eye movement (horizontal)

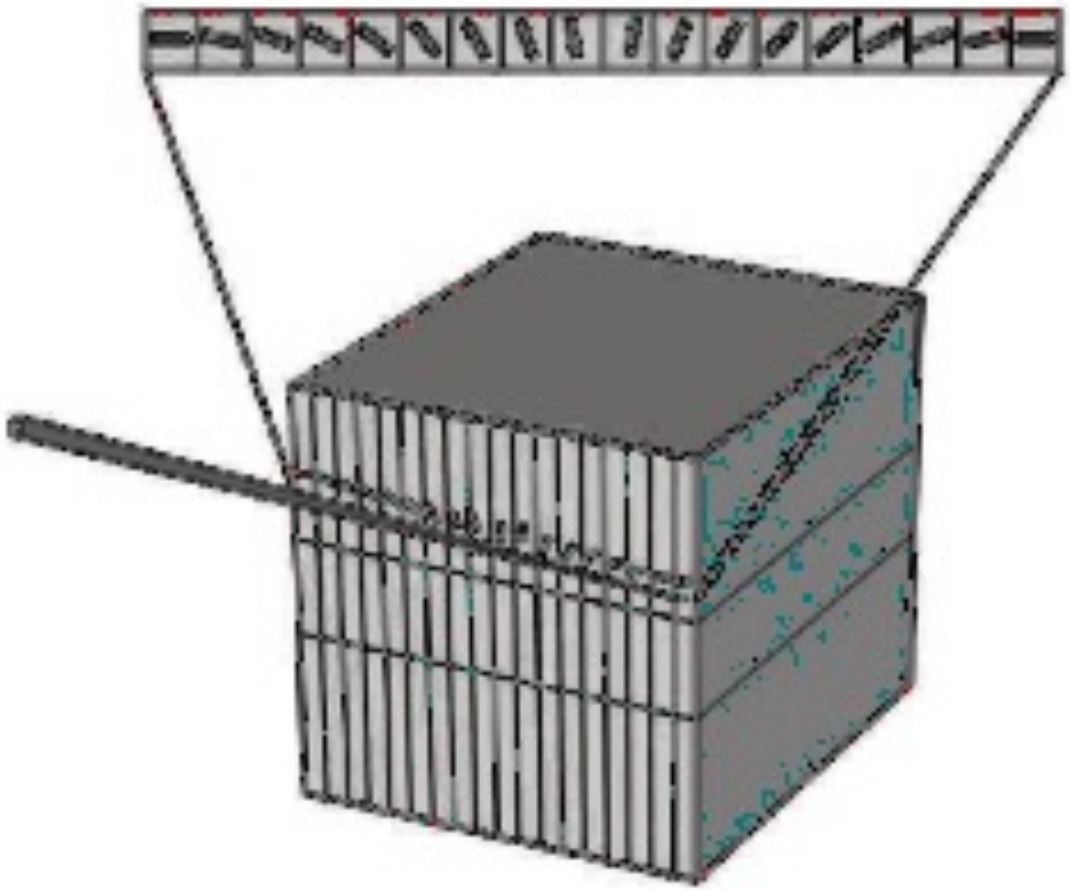



Low-level processing
Intermediate-level processing
High-level processing
Orientation
Color
Contrast
Disparity
Movement direction
Contour integration
Surface properties
Shape discrimination
Surface depth
Surface segmentation
Object motion/
Shape from kinematic cues
Object identification

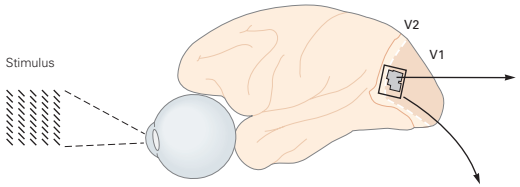


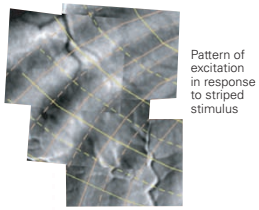



Retinal ganglion cell
Lateral geniculate nucleus neuron
Response
Stimulus
Off area (surround)
On area (center)

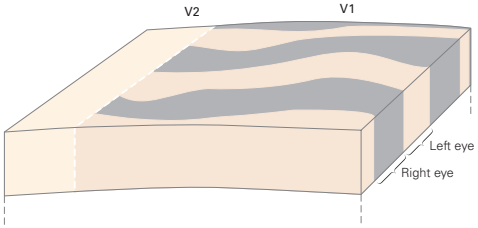


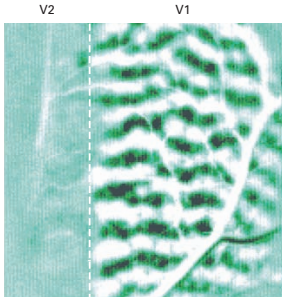
A Visuotopic map



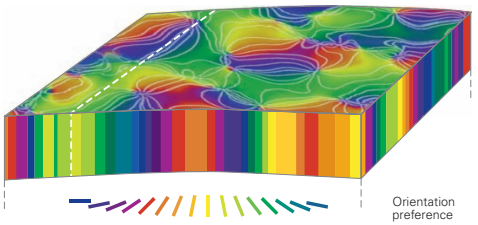


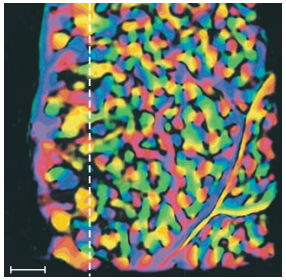
B Ocular dominance columns



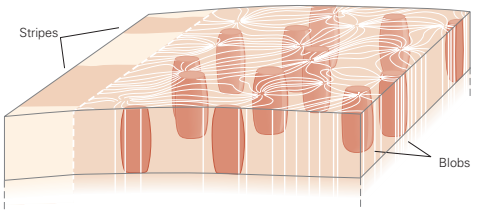


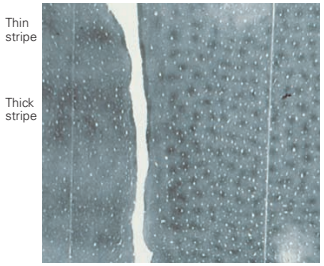
C Orientation columns

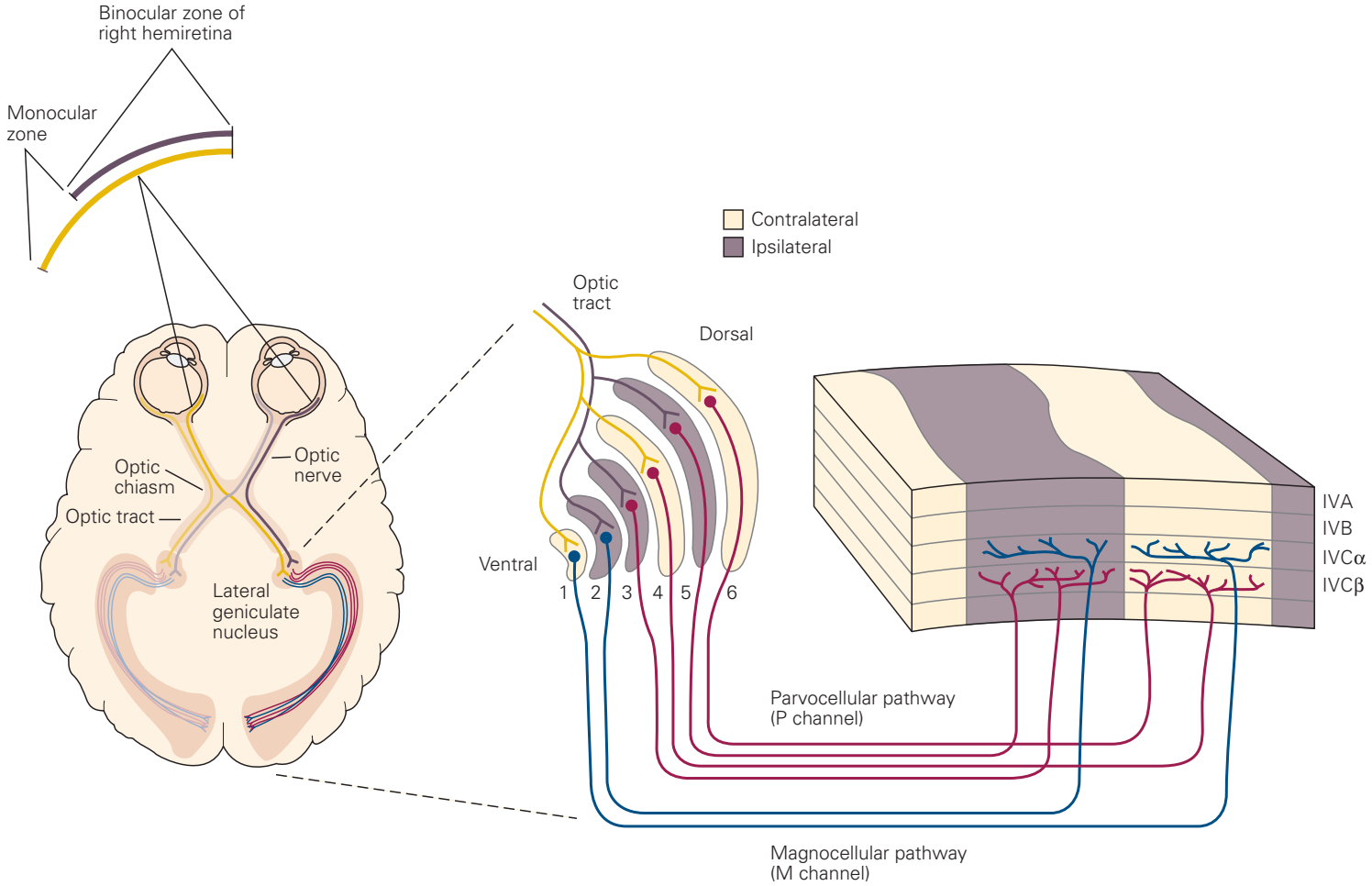




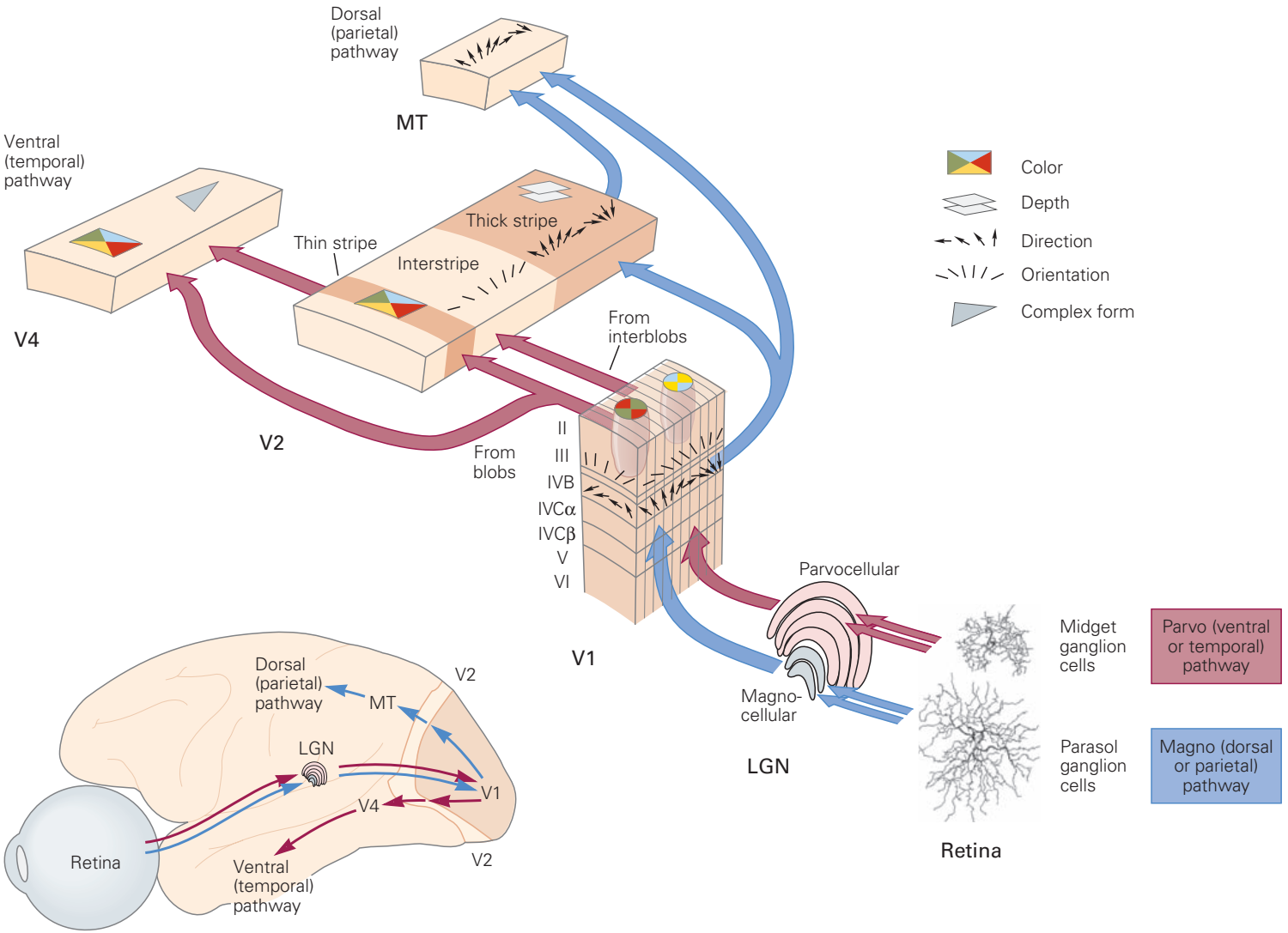
D Blobs, interblobs (V1), and stripes (V2)



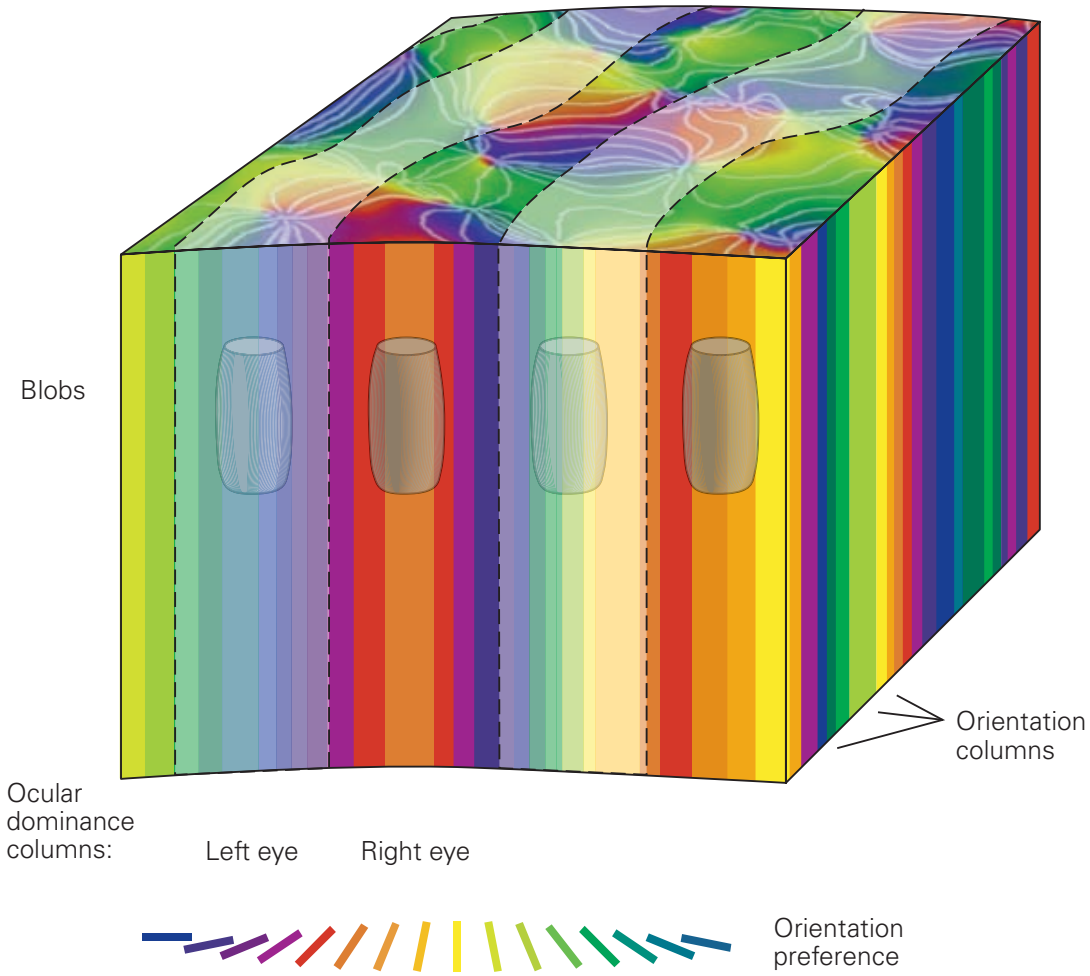



Binocular zone of right hemiretina
Monocular zone
Optic chiasm
Optic nerve
Optic tract
Lateral geniculate nucleus
Contralateral
Ipsilateral
Optic tract
Dorsal
Ventral
1
2
3
4
5
6
IVA
IVB
IVCα
IVCβ
Parvocellular pathway (P channel)
Magnocellular pathway (M channel)

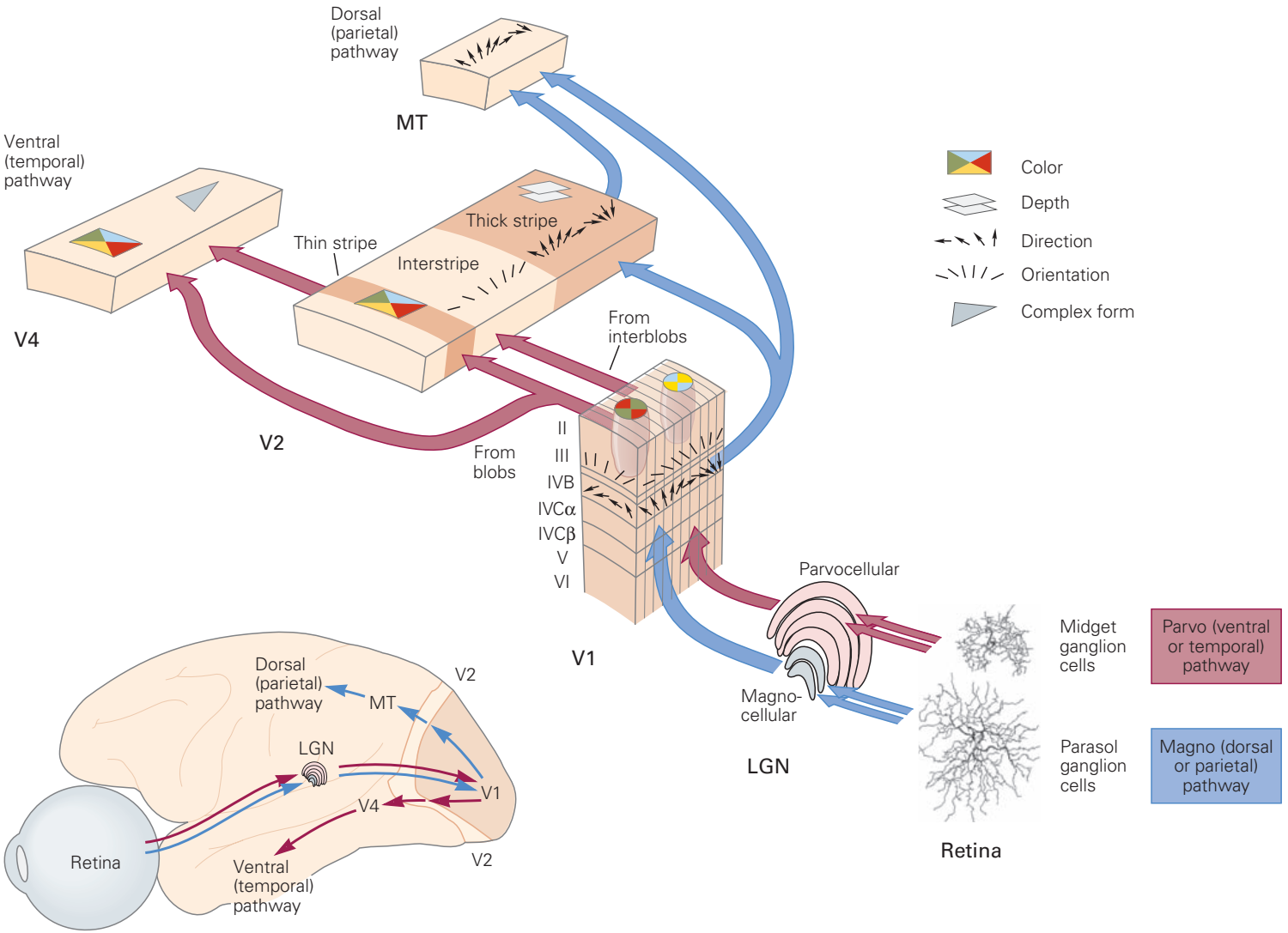
The input(s) to V1 (see Figures 25-6, 25-12, and 25-14).


Dorsal (parietal) pathway
MT
Ventral (temporal) pathway
Thick stripe
Thin stripe
Interstripe
V4
From interblobs
V2
From blobs
II
III
IVB
IVCα
IVCβ
V
VI
V1
Color
Depth
Direction
Orientation
Complex form
Parvocellular
Magno-cellular
LGN
Midget ganglion cells
Parvo (ventral or temporal) pathway
Parasol ganglion cells
Magno (dorsal or parietal) pathway
Retina
Dorsal (parietal) pathway
MT
V2
LGN
V1
V4
Retina
Ventral (temporal) pathway
V2

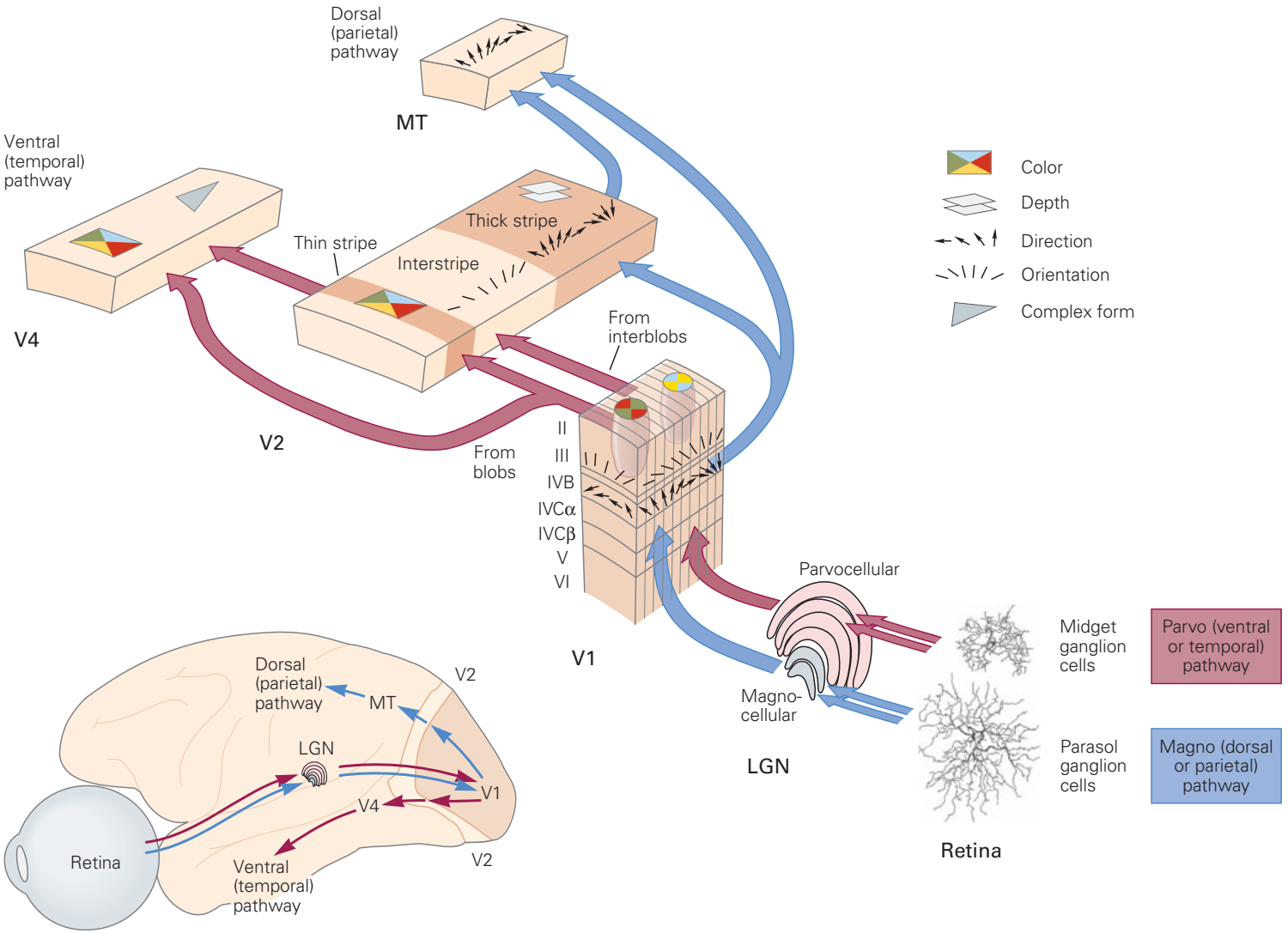
The functional role of neurons in V1 (see Figure 25-13).


Blobs
Orientation columns
Ocular dominance columns:
Left eye
Right eye
Orientation preference

The functional role of neurons in V2 (see Figure 25-14).


Dorsal (parietal) pathway
MT
Ventral (temporal) pathway
Thick stripe
Thin stripe
Interstripe
V4
From interblobs
V2
From blobs
II
III
IVB
IVCα
IVCβ
V
VI
V1
Color
Depth
Direction
Orientation
Complex form
Parvocellular
Magno-cellular
LGN
Midget ganglion cells
Parvo (ventral or temporal) pathway
Parasol ganglion cells
Magno (dorsal or parietal) pathway
Retina
Dorsal (parietal) pathway
MT
V2
LGN
V1
V4
Retina
Ventral (temporal) pathway
V2

Where do areas V1 and V2 project (see Figure 25-14).


Dorsal (parietal) pathway
MT
Ventral (temporal) pathway
Thick stripe
Thin stripe
Interstripe
V4
From interblobs
V2
From blobs
II
III
IVB
IVCα
IVCβ
V
VI
V1
Color
Depth
Direction
Orientation
Complex form
Parvocellular
Magno-cellular
LGN
Midget ganglion cells
Parvo (ventral or temporal) pathway
Parasol ganglion cells
Magno (dorsal or parietal) pathway
Retina
Dorsal (parietal) pathway
MT
V2
LGN
V1
V4
Retina
Ventral (temporal) pathway
V2

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RECEPTIVE FIELDS, BINOCULAR INTERACTION AND FUNCTIONAL ARCHITECTURE IN THE CAT'S VISUAL CORTEX

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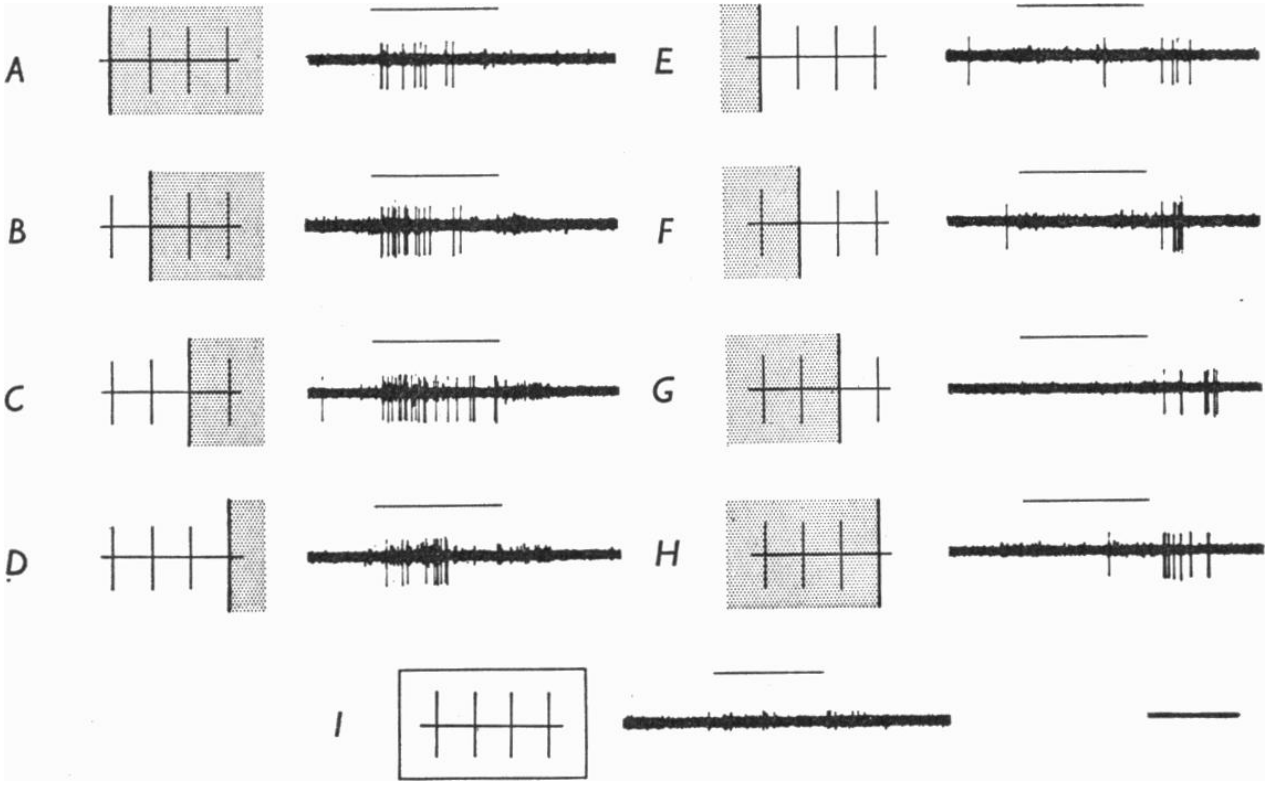
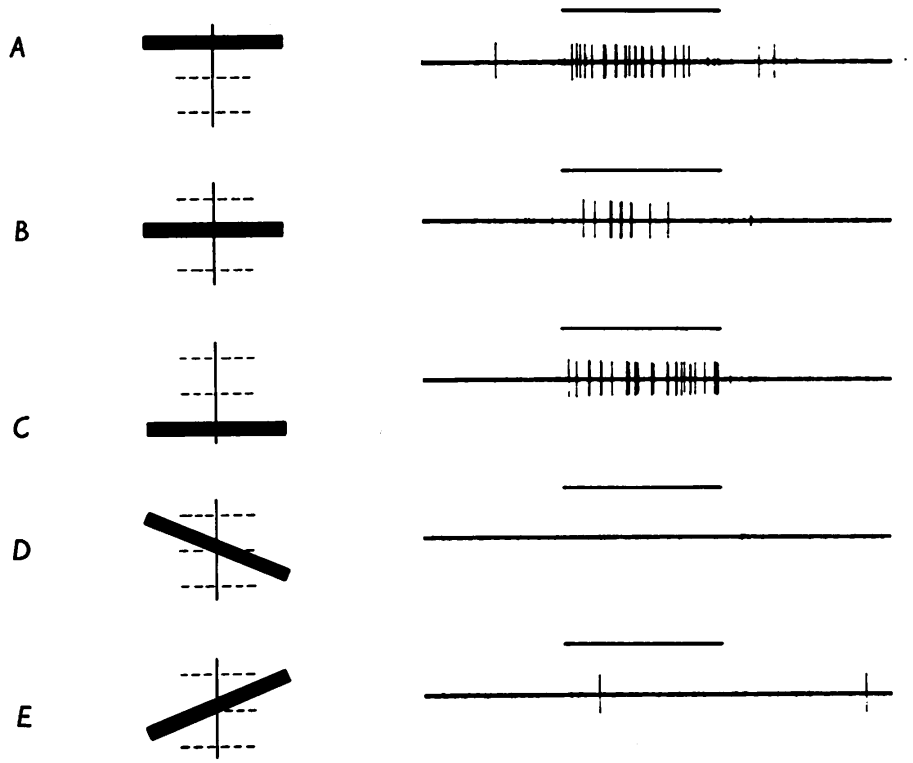
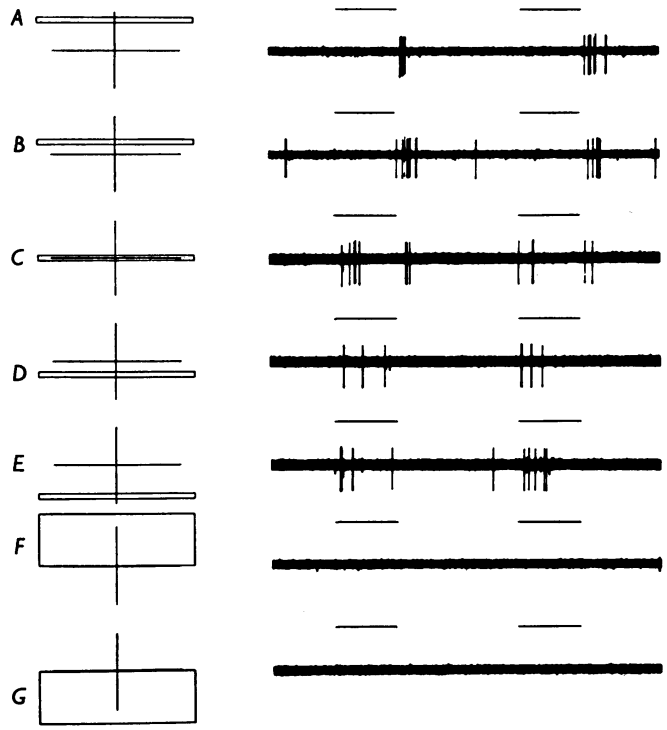


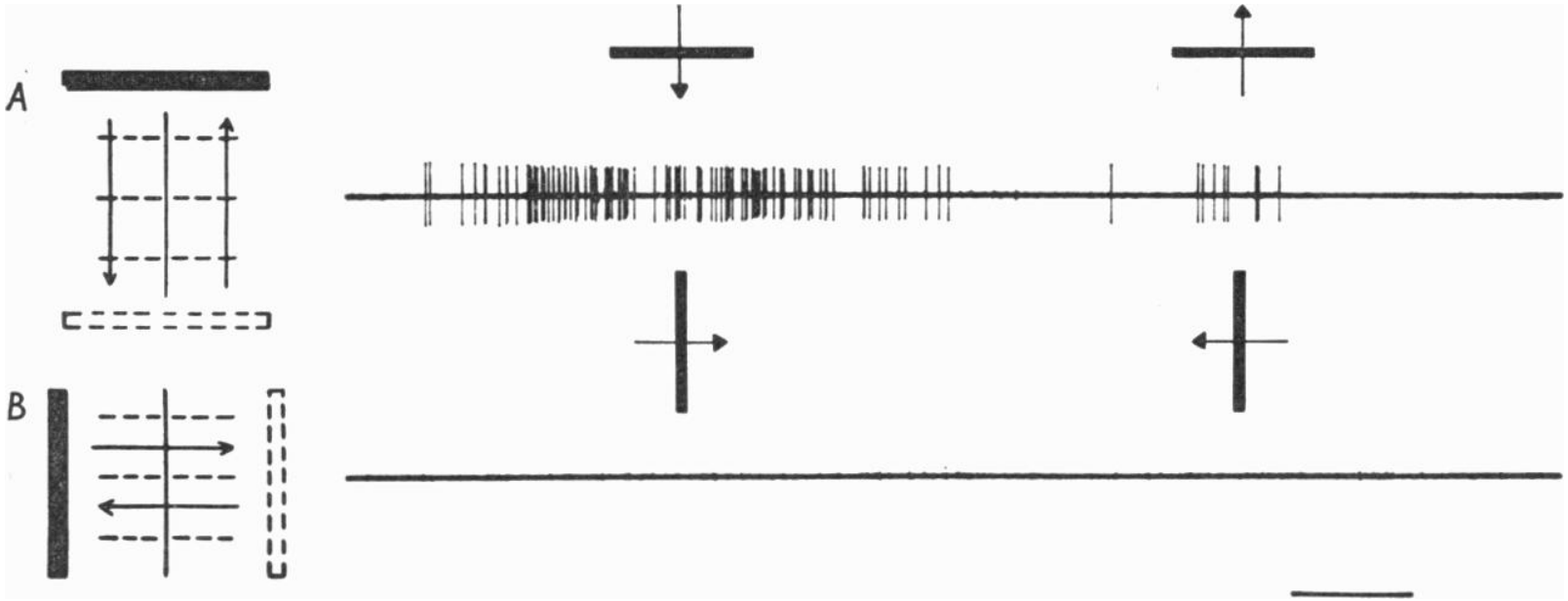
Text-fig. 6. Same cell as in Text-fig. 5. *A–H*, responses to a vertical edge in various parts of the receptive field: *A–D*, brighter light to the left; *E–H*, brighter light to the right; *I*, large rectangle, 10 × 20°, covering entire receptive field. Time, 1 sec.



Text-fig. 7. Cell activated only by left (contralateral) eye over a field approximately $5 \times 5°$, situated 10° above and to the left of the area centralis. The cell responded best to a black horizontal rectangle, $\frac{1}{3} \times 6°$, placed anywhere in the receptive field (*A–C*). Tilting the stimulus rendered it ineffective (*D–E*). The black bar was introduced against a light background during periods of 1 sec, indicated by the upper line in each record. Luminance of white background, 1·0 $\log_{10}$ cd/m^2; luminance of black part, 0·0 $\log_{10}$ cd/m^2. A lesion, made while recording from the cell, was found in layer 2 of apical segment of post-lateral gyrus.



Text-fig. 3. Responses of a cell with a complex receptive field to stimulation of the left (contralateral) eye. Receptive field located in area centralis. The diagrams to the left of each record indicate the position of a horizontal rectangular light stimulus with respect to the receptive field, marked by a cross. In each record the upper line indicates when the stimulus is on. *A–E*, stimulus $\frac{1}{8} \times 3°$, *F–G*, stimulus $1\frac{1}{2} \times 3°$ (4° is equivalent to 1 mm on the cat retina). For background illumination and stimulus intensity see Methods. Cell was activated in the same way from right eye, but less vigorously (ocular-dominance group 2, see Part II). An electrolytic lesion made while recording from this cell was found near the border of layers 5 and 6, in the apical segment of the post-lateral gyrus. Positive deflexions upward; duration of each stimulus 1 sec.



Text-fig. 8. Same cell as in Text-fig. 7. Movement of black rectangle $\frac{1}{3} \times 6°$ back and forth across the receptive field: *A*, horizontally oriented (parallel to receptive-field axis); *B*, vertically oriented. Time required to move across the field, 5 sec. Time, 1 sec.

What do the primary visual cortex (area V1) and area V2 do?