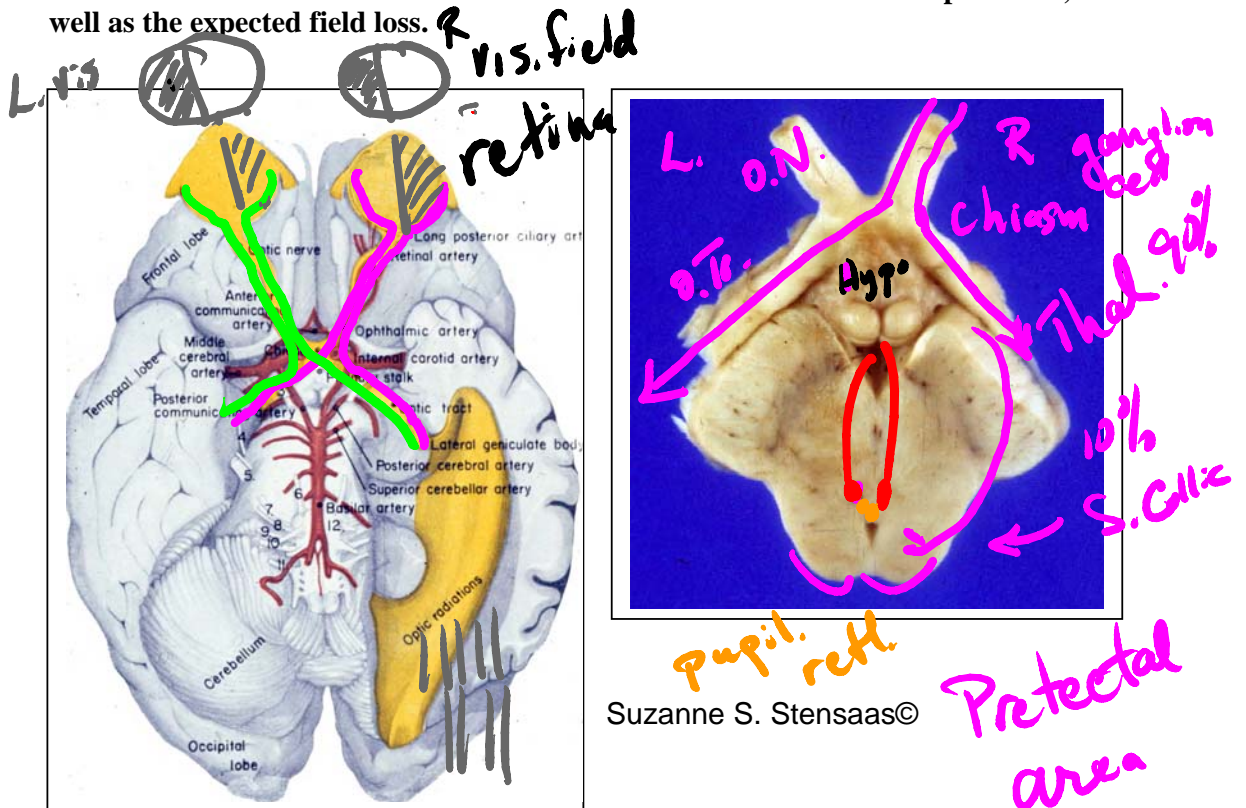


THE VISUAL PATHWAY FOR DENTAL STUDENTS

Objectives:

- A. Draw the expected visual fields seen in classic lesions of the nerve, chiasm, thalamus, optic radiations and cortex.**
- B. Describe the blood vessels that when occluded could lead to visual problems, as well as the expected field loss.**



Source? ©

II. OPTIC TRACT

Ganglion cell axons diverge into multiple pathways. Axons go to:

- ✓ A. 90 % go to Lateral geniculate nucleus (or body) of thalamus (the retino-geniculocalcarine path – today's topic) *perception pathway*
- ✓ B. 10% go to Superior colliculus and pretectum (the retinocollicular path we will discuss with visual reflexes) *only imp't for vis. reflexes*



to vis
cortex



6 layers

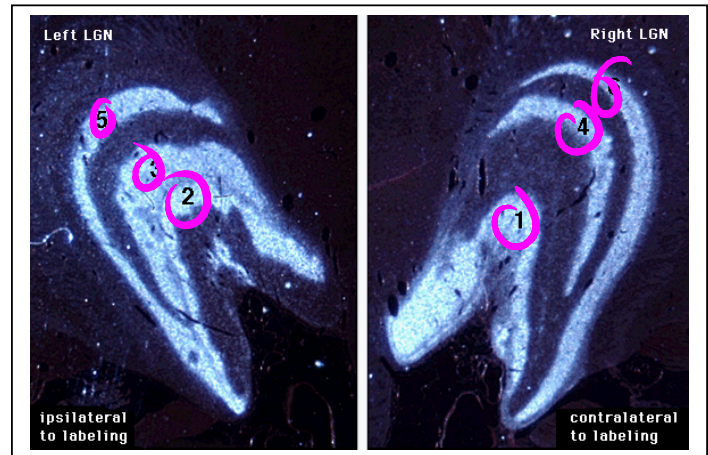
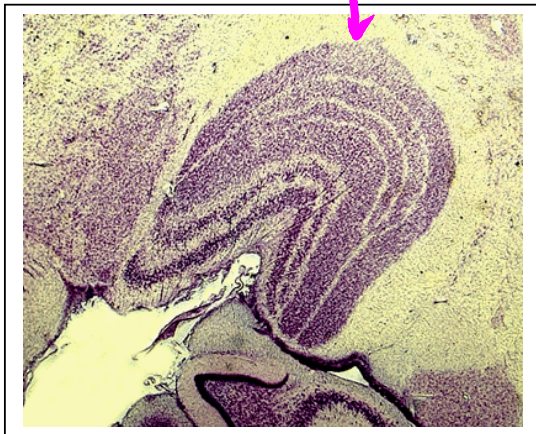
Suzanne S. Stensaas©

ganglion
cell axons
terminate

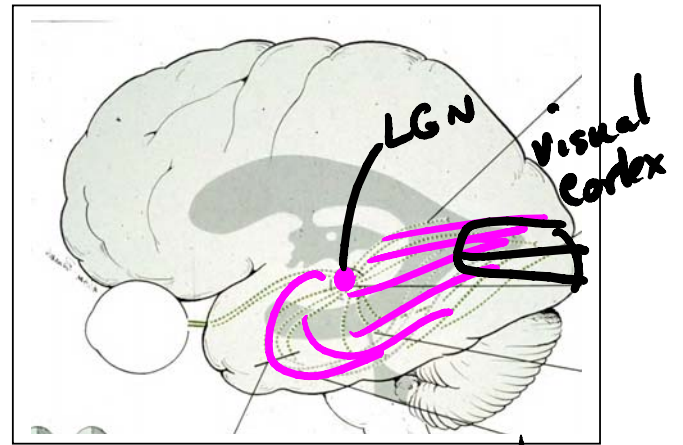
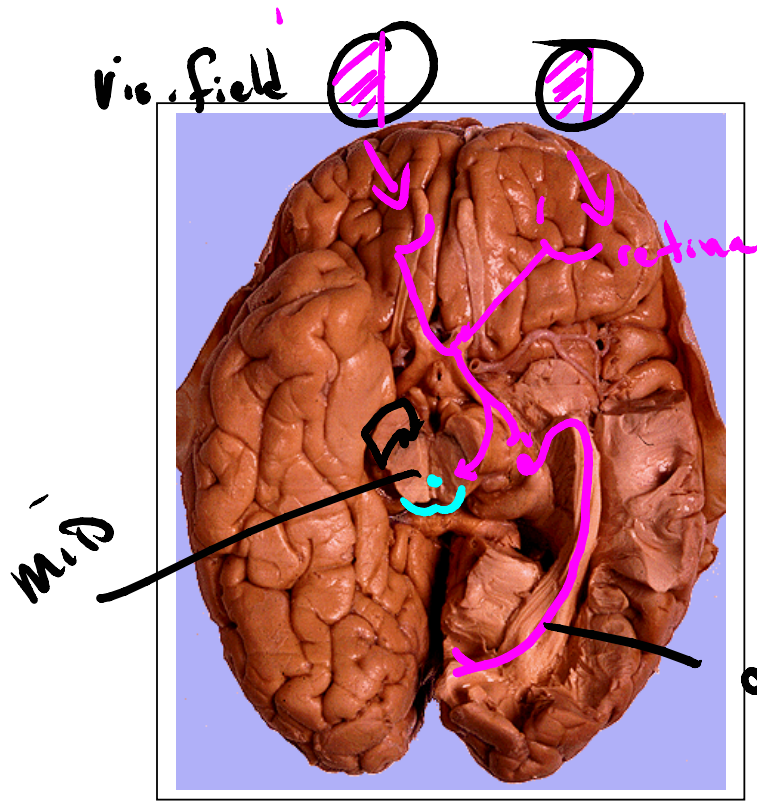
90%

III. THALAMIC RELAY NUCLEUS -- the LATERAL GENICULATE nucleus (or body)

- A. Specific retinotopic projection. The perceptual pathway
- B. Six layers. Three layers get input from each eye (do not memorize)



From The Digital Anatomist Interactive Brain Syllabus. John Sundsten and Kate Mulligan, Univ. Washington School of Medicine. 1998 ©

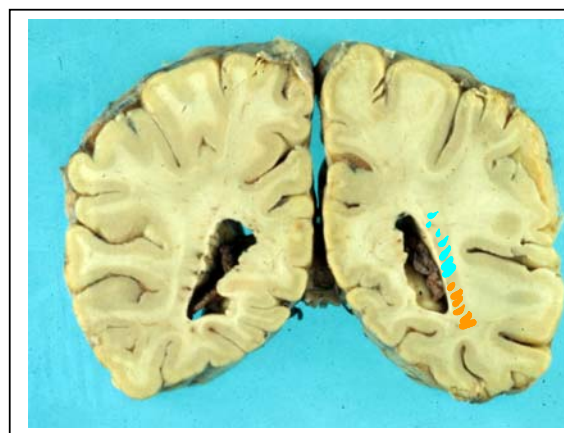
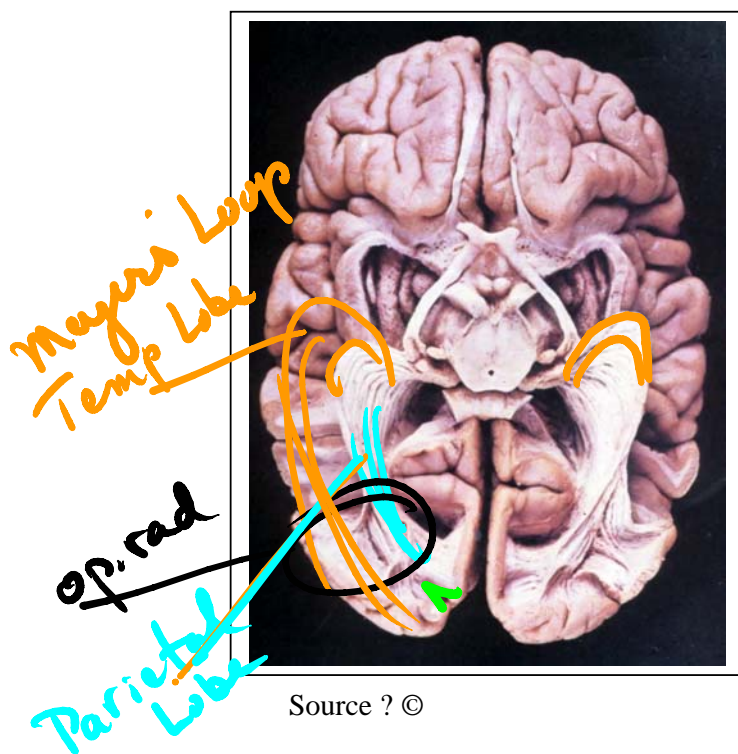


Kandel?©

op. radiation,

optic
radiation
right "world" to left hemisph

From The Digital Anatomist Interactive Brain Syllabus. John Sundsten and Kate Mulligan, Univ. Washington School of Medicine. 1998 ©



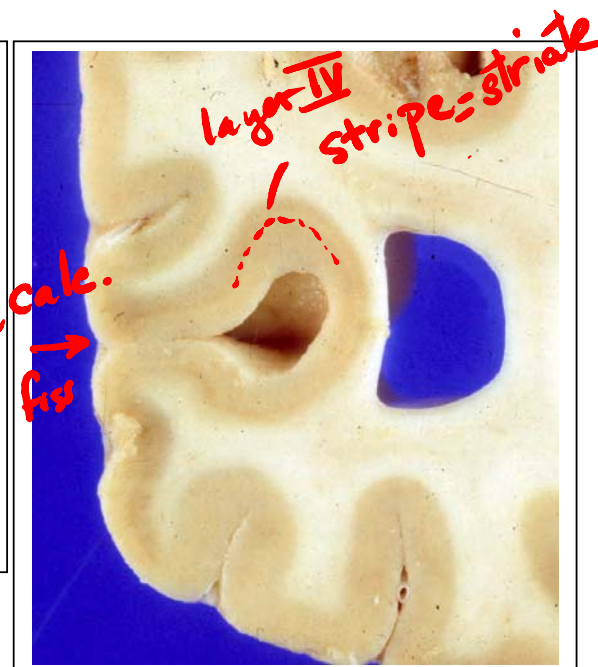
Suzanne S. Stensaas©

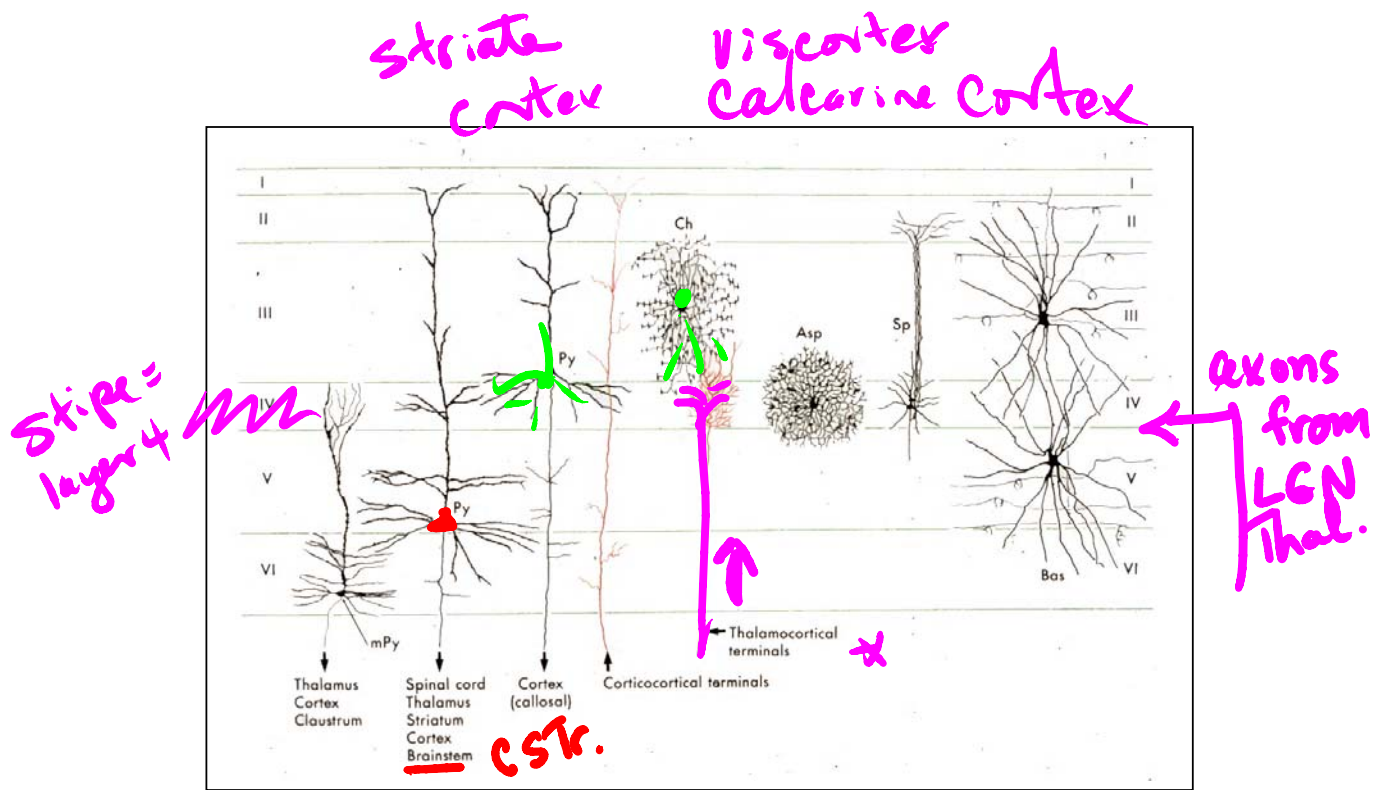
optic radiations

- C. Axons of neurons in the lateral geniculate form the optic or visual radiations = geniculocalcarine tract. The retinotopic organization is maintained.
1. Some loop forward over inferior (or temporal) horn of lateral ventricle = Meyer's Loop. (Contralateral eye upper quadrant fibers of visual field)
 2. Other axons take a more direct posterior course through the deep parietal white matter.
 3. All fibers travel lateral to the lateral ventricle.



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From Fundamental Neuroscience, Duane E. Haines, Churchill Livingstone, 1997 ©

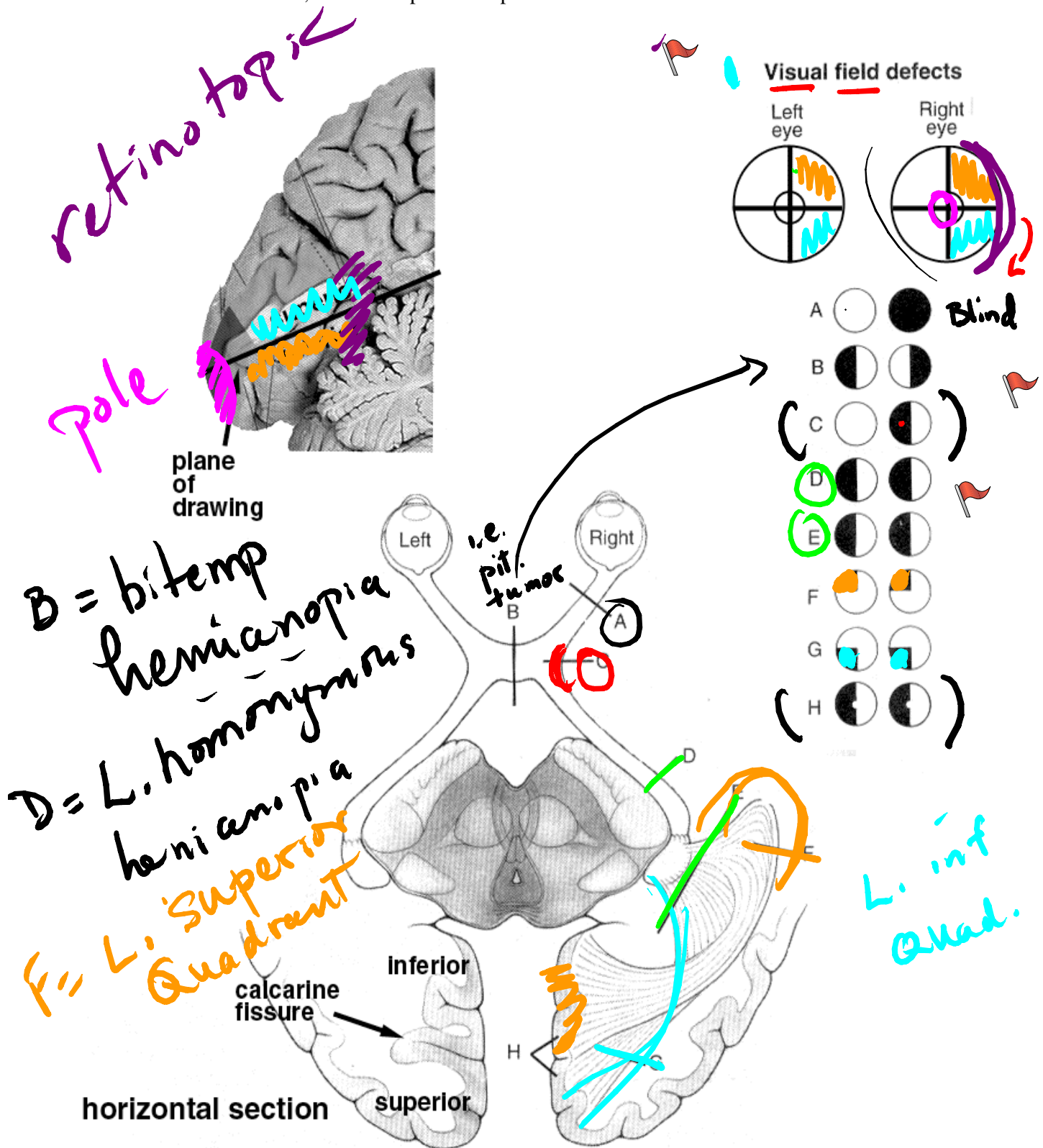
IV. PRIMARY VISUAL CORTEX = CALCARINE OR STRIATE CORTEX. ALSO KNOWN AS BRODMANN'S AREA 17, (VI=primary visual cortex just like SI is primary somatosensory cortex)



1. Stripe or line of Gennari- massive termination of myelinated axons in layer IV = striate cortex in our typical 6 layered cortex. from LGN

2. Ocular dominance columns, orientation, color, retinal disparity columns. Concept of columns introduced in early lecture on orientation to forebrain has been further elaborated in studies of visual cortex studies.

VI. PRINCIPAL VISUAL FIELD DEFECTS. Lesions of the visual pathway and resultant visual field losses (Circles represent visual field of each eye tested separately and viewed as if physician is standing **behind** the subject). From Basic Clinical Neuroanatomy, P.A. Young and P.H. Young, Williams and Wilkins, 1997©Adapted from p. 160



V. **EXTRASTRIATE CORTEX** - There are over 30 different visual representations of visual world in cortex of primates. Parallel processing of information concept.

A. Parietal Association Cortex connections for motion and visuospatial relations.

B. Temporal Association cortex connections for processing information from the P channel for object and face recognition. Some cells are called "grandmother" cells. Respond to faces, hands, objects. Damage results in **agnosias** for form, pattern, faces, color, and words **alexia**



Vasc.
Supply

Clinical Neurology p. 130 (4th edition) Simon, P, Aminoff, M.J. and D.A. Greenberg, Appleton and Lange.1999 ©

VI. VASCULAR SUPPLY TO THE VISUAL PATHWAY

A. **Ophthalmic Artery** - the first branch off the internal carotid as it emerges from the cavernous sinus.



1. **Central retinal** artery - ganglion cells, bipolar cells, inner part of receptors. Sole supply of retina inner surface.

2. Ciliary arteries - outer segment of receptors.



*B. **Middle cerebral artery** – (MCA) deep branches vascularize optic radiation in parietal lobe.



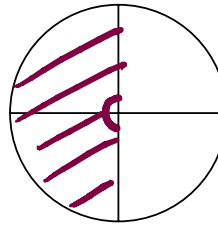
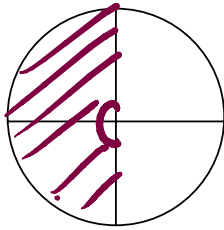
*C. **Posterior cerebral artery** (PCA) branches and forms calcarine artery. The PCA is easily compressed during herniation of the temporal lobe over the lateral edge of the tentorium. Also supplies LGN and other regions of posterior thalamus.

VIII. VISUAL FIELD SELF-EVALUATION TEST

- A. A 52-year-old man was struck in the back of the head. Total collapse occurred, but eventually he completely recovered and except for a visual field loss. He had 20/20 vision in both eyes. The cause was a transient arterial occlusion with the diagrammed permanent visual field defect. **Occlusion of which vessel most likely caused this visual field finding?**

macular sparing = spared the pole

Left Eye



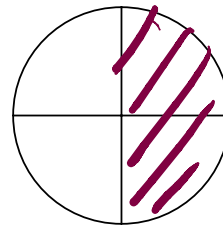
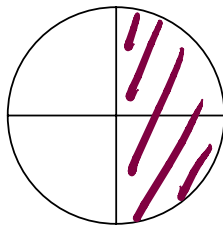
Right Eye

Right Post. Cereb. Art

- B. A 37-year-old was in a car accident in which he sustained a compressed skull fracture and unconsciousness. Many bone spicules were removed from his parietal cortex. Moderate aphasia was present after recovery. He had 20/20 vision in both eyes. Testing showed the visual field defect pictured below. **Which hemisphere was involved, right of left?** He was unconscious because blood on the surface of his brain was compressing the brain stem. **Which vessel was most likely traumatized? Explain the large visual field defect and yet his vision was reported as 20/20.**

L. =

Left Eye

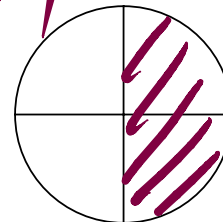
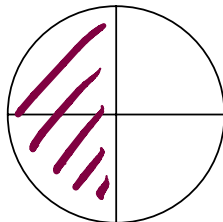


Right Eye

L. PCA

- C. A 30-year-old white female complained of headaches (due to increased intracranial pressure). Headaches persisted with amenorrhea. Careful visual field testing showed the following deficits. **A probable site for the lesion is? The lack of menstruation can indicate involvement of what brain area?**

Left Eye



Right Eye

Pituitary Chiasm Bitemporal hemianopia

Patchy Demyelination optic n. = Multiple Sclerosis

- D. A 23-year-old woman with marked loss of vision in the **right eye only**. A similar episode occurred three years previously. She was tested 4 months later with significant loss of acuity in her right eye and no pain. Vision improved to 20/40 after a year. The lesion or damage is in the optic n.? From your reading This history is typical of a disease that is present more often in women of northern latitudes.

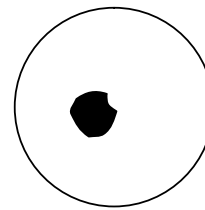
O.D. Right Eye



O.D. First visit



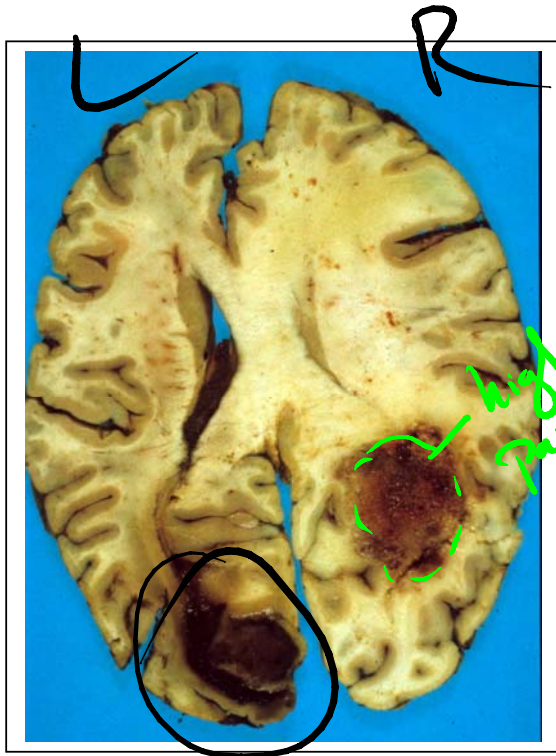
O.D. 4 months later



O.D. one year later

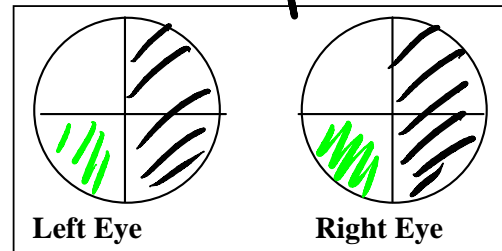
enlarged Blind spot

For Fun: Some pathology pictures: Predict the visual field deficits

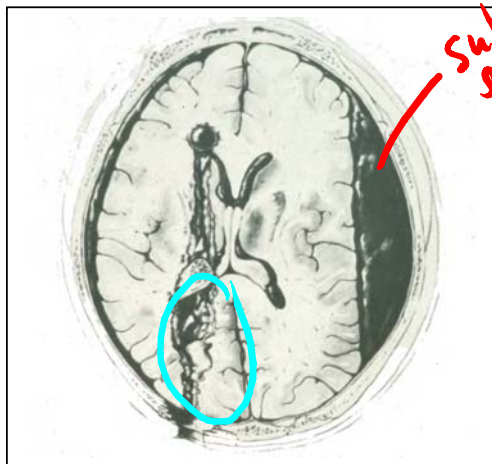


This is an axial or horizontal section at the level of the corpus callosum. Two sites of metastatic cancer are seen. Rostral is up, as is the convention. Predict the visual field loss.

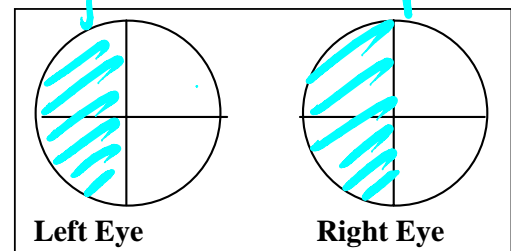
Hard to know without seeing multiple cuts.



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L homonymous hemianopia

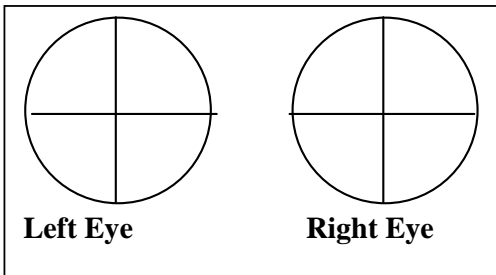
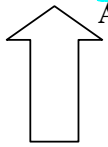


R Autopsy of Abraham Lincoln L Source?

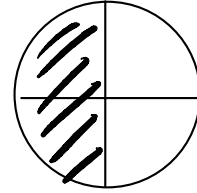


Primary
vis.
cortex
not
involved.
(you can
see
stripe)

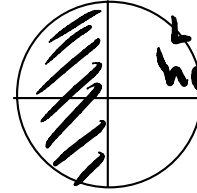
Left Hemisphere Multiple Breast Mets
Axial Section (Suzanne S. Stensaas©)



patient would have no
defect

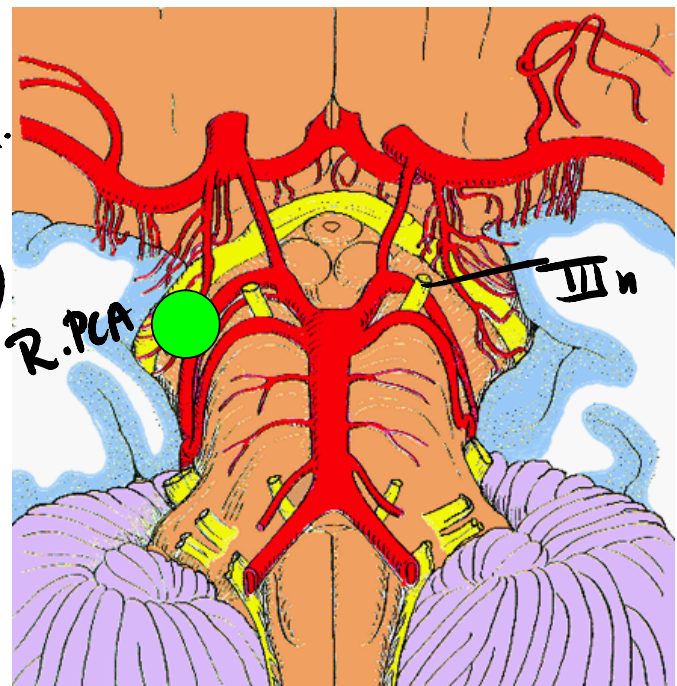
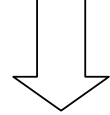


Left Eye



Right Eye

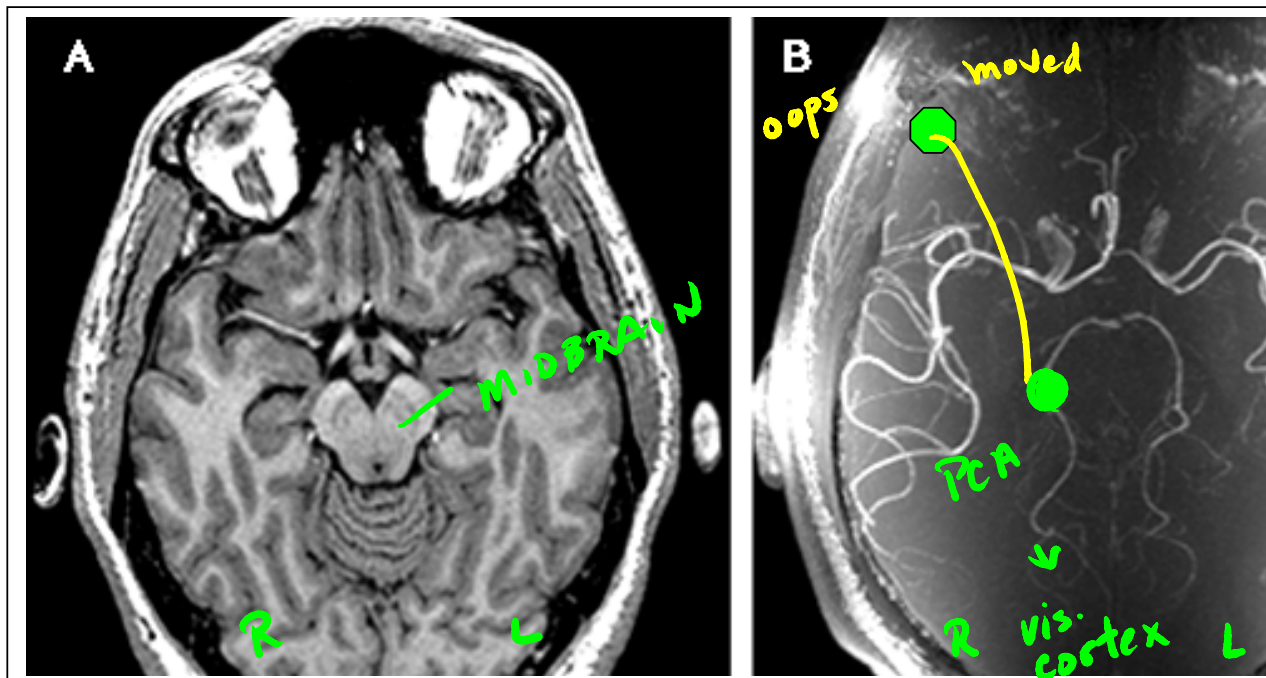
L. homonymous
hemianopia



RIGHT

LEFT

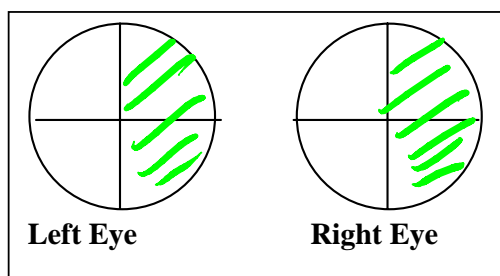
From The Digital Anatomist Interactive Brain
Syllabus. John Sundsten and Kate Mulligan,
Univ. Washington School of Medicine. 1998 ©



From The Digital Anatomist Interactive Brain Syllabus. John Sundsten and Kate Mulligan, Univ. Washington School of Medicine. 1998 ©

Axial Section through the Midbrain seen on left and MRAngiogram on Right

IF the vessel marked by the green dot was occluded predict the visual field defect and fill in the circles with the visual field defect. Radiology Convention R L



Right homonymous hemianopia