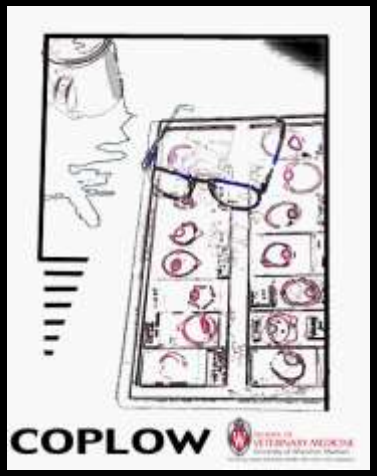
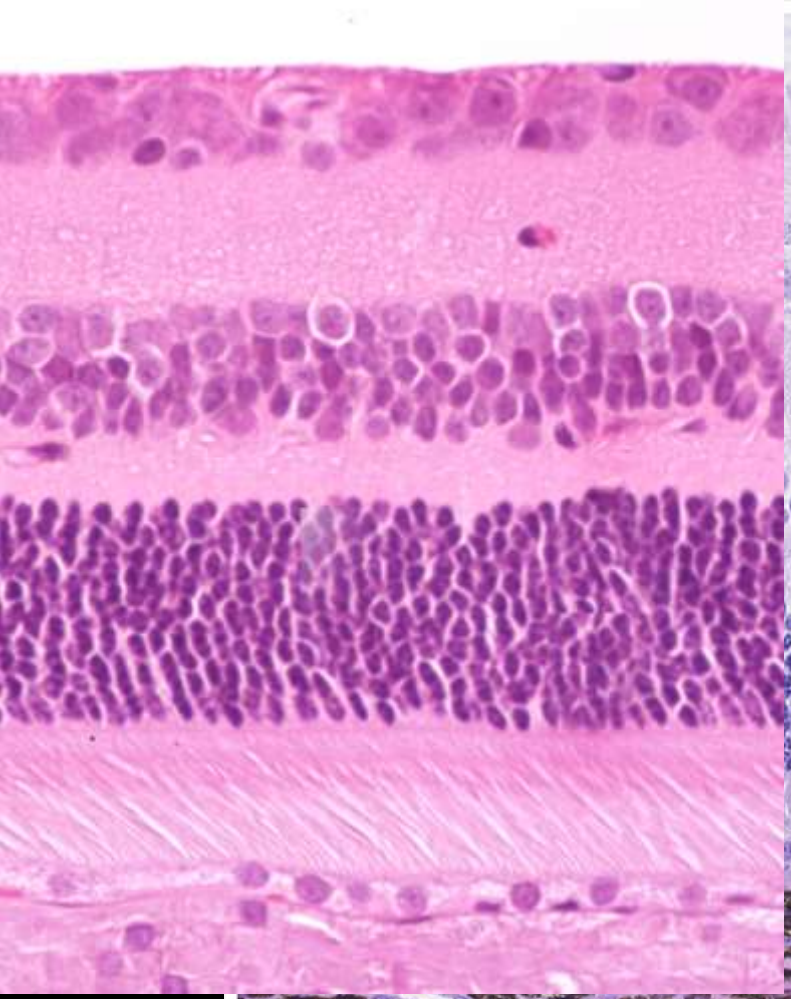


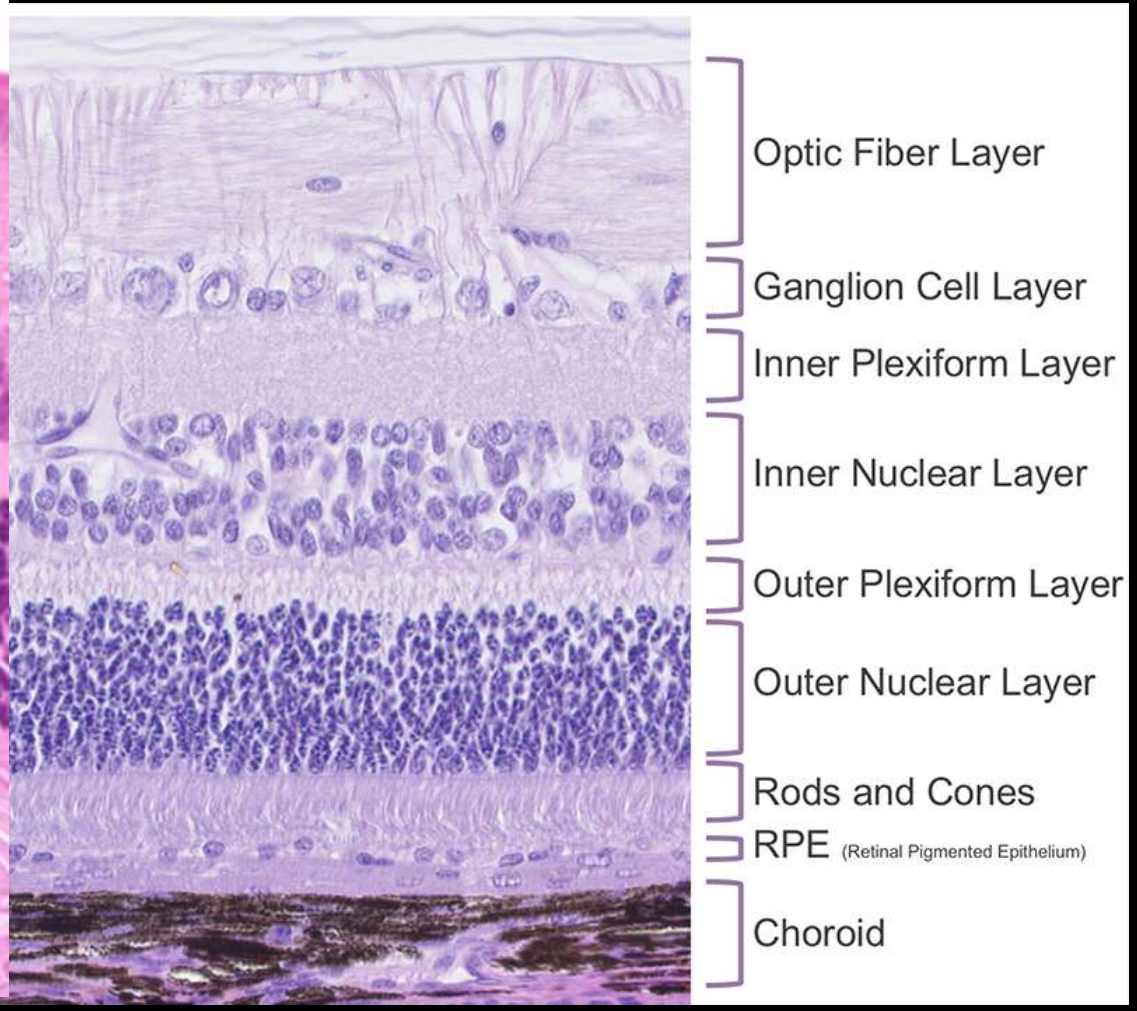
Retinal Pathology

Dick Dubielzig

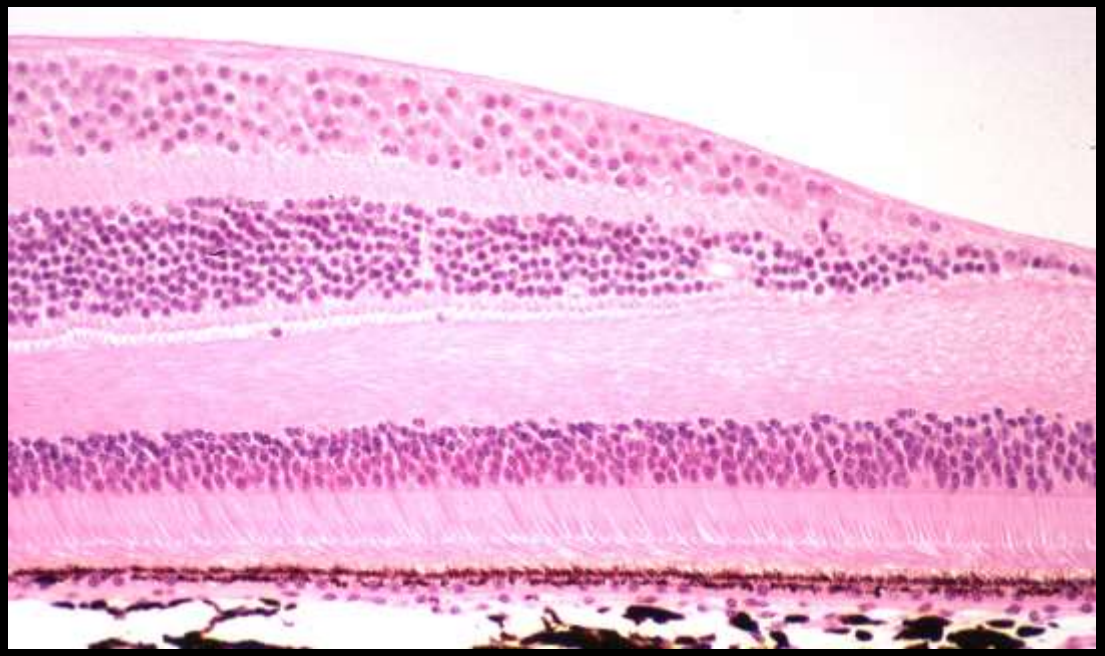
Normal Feline Retina

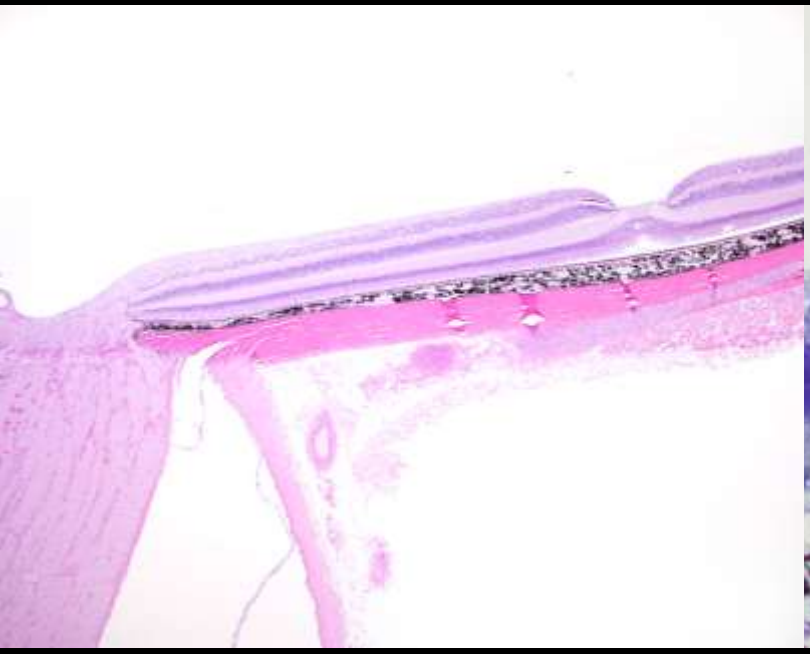
Visual Streak

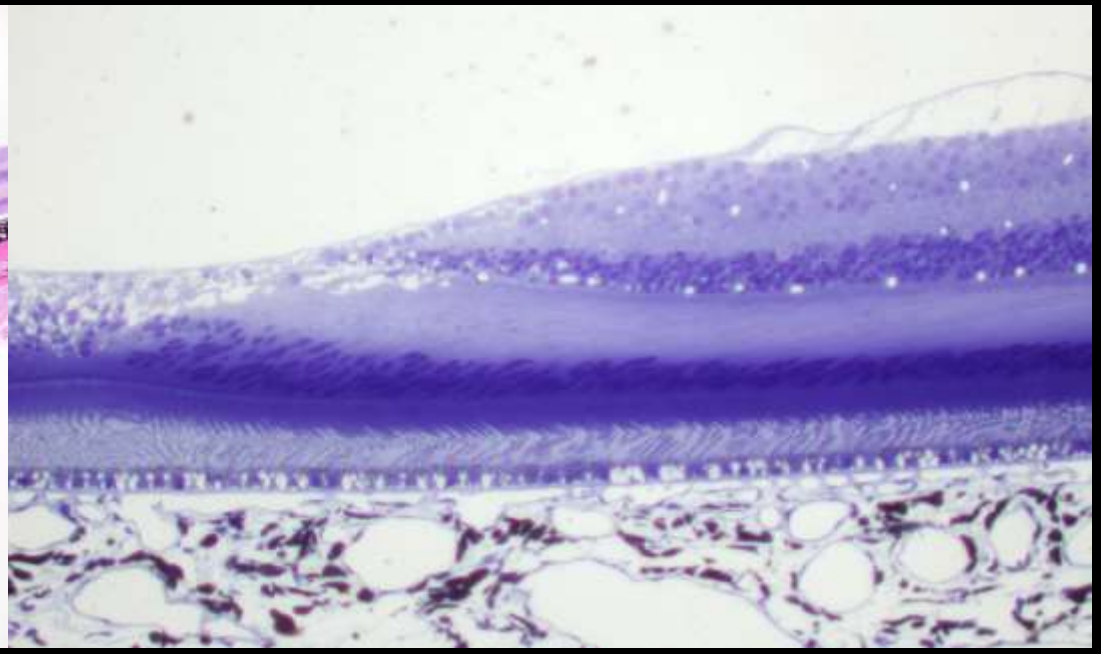




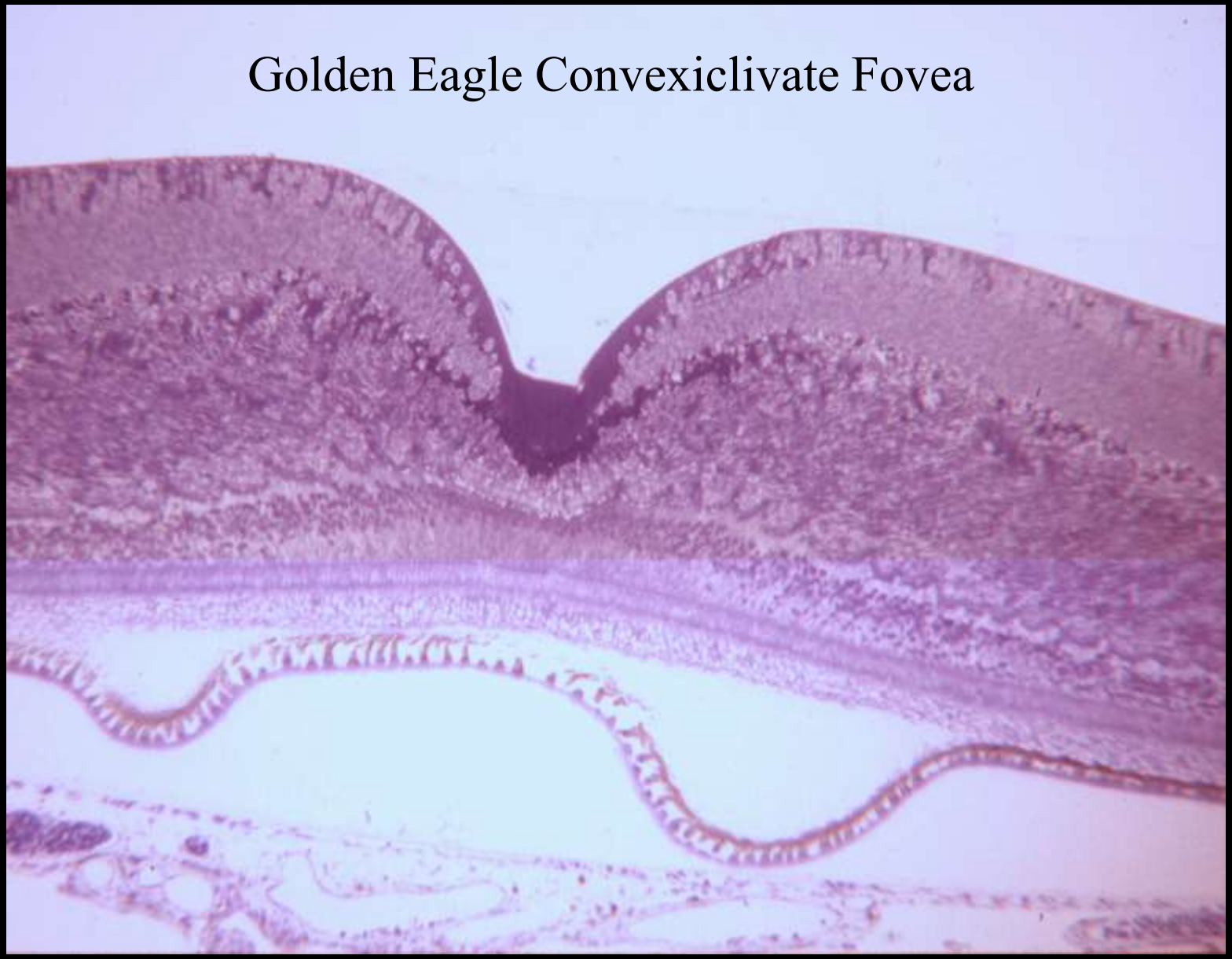
Normal Primate Fovea



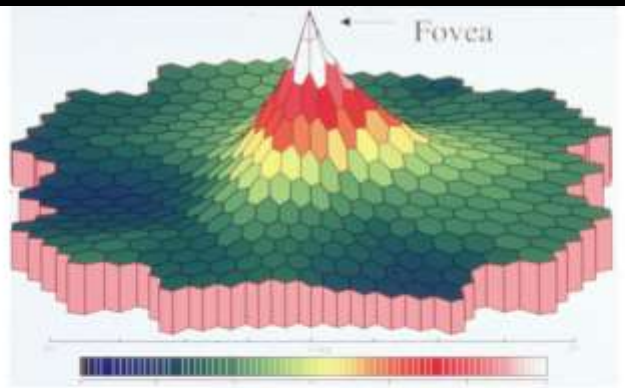




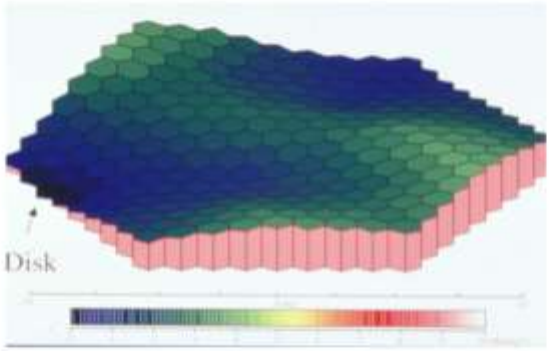
Golden Eagle Convexiclivate Fovea



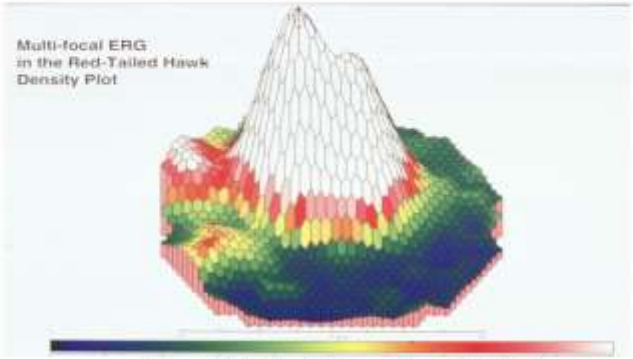
Multi-focal ERG



Human mERG

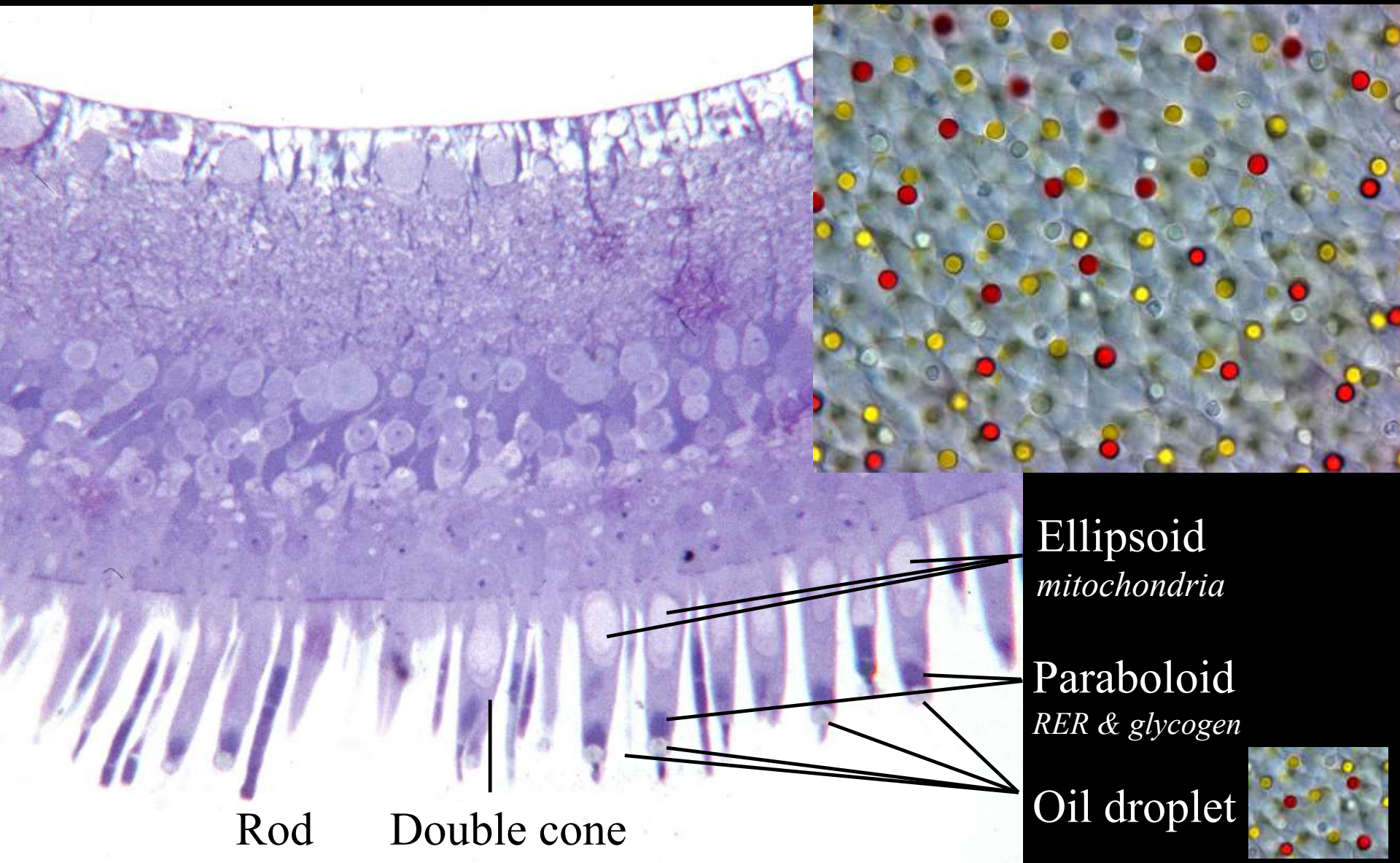


Equine mERG



Red Tailed Hawk mERG

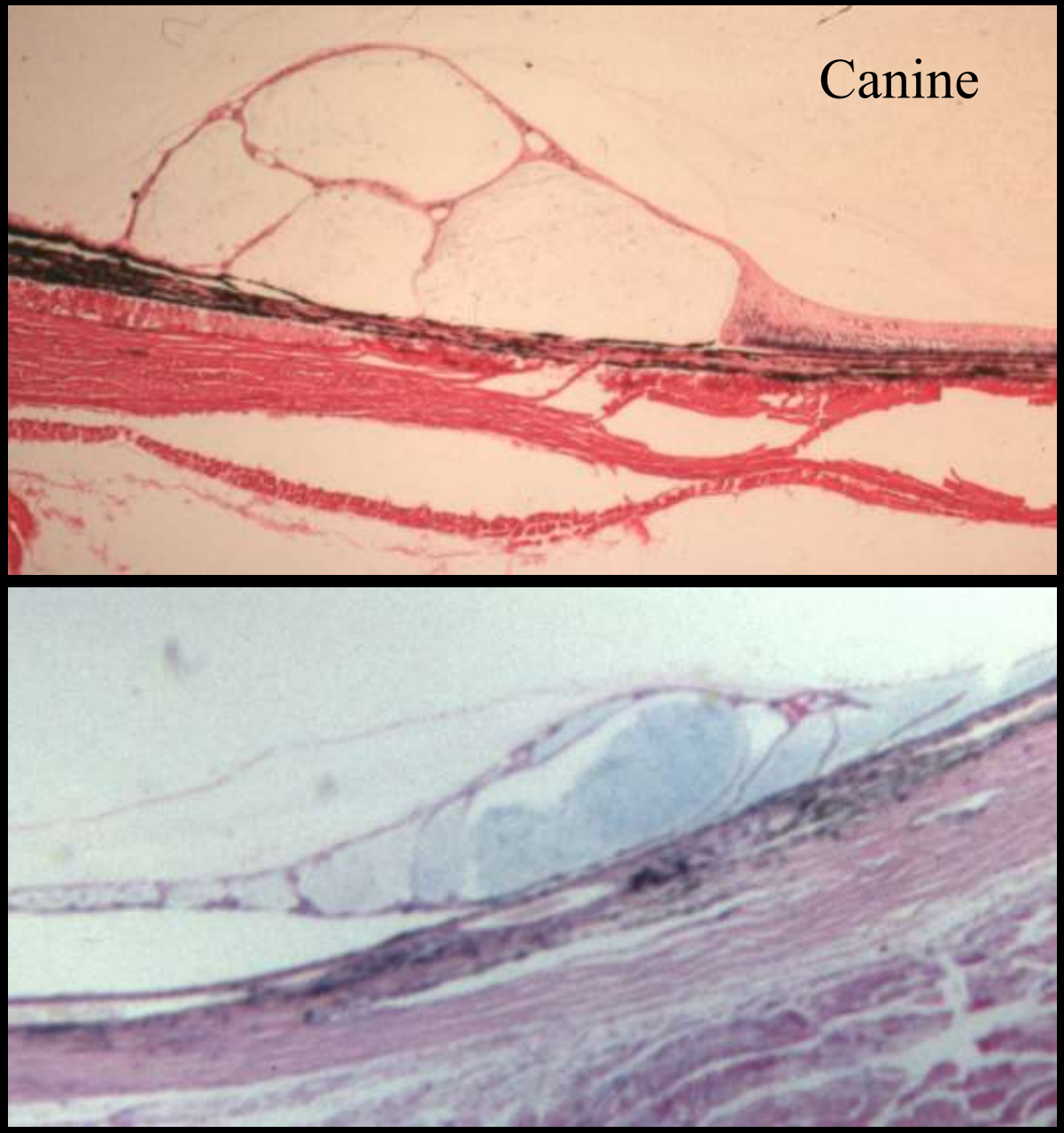
Bird Retina


Ellipsoid
mitochondria
Paraboloid
RER & glycogen
Oil droplet
Rod
Double cone

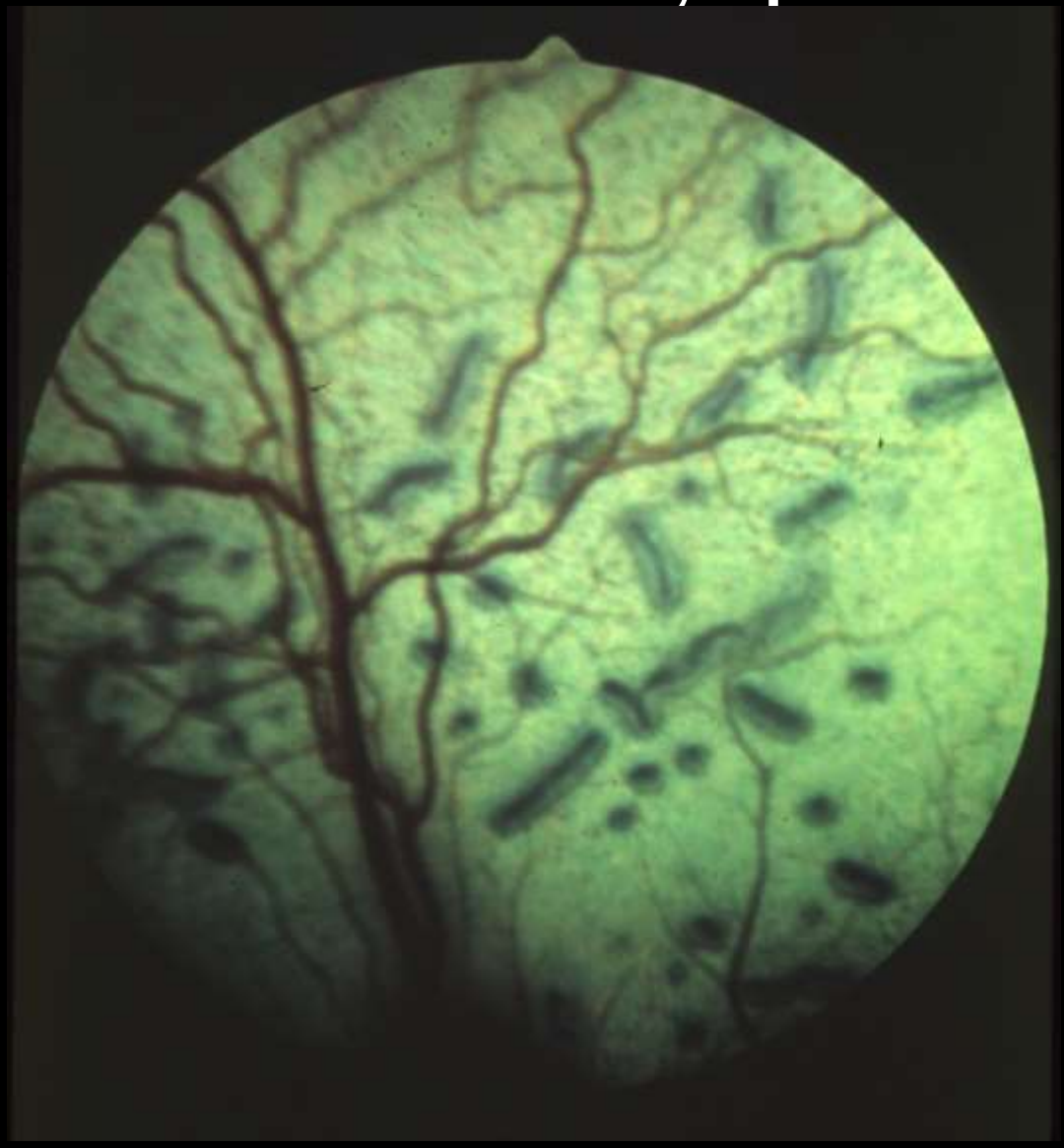
Cystoid Change in Dogs and Cats

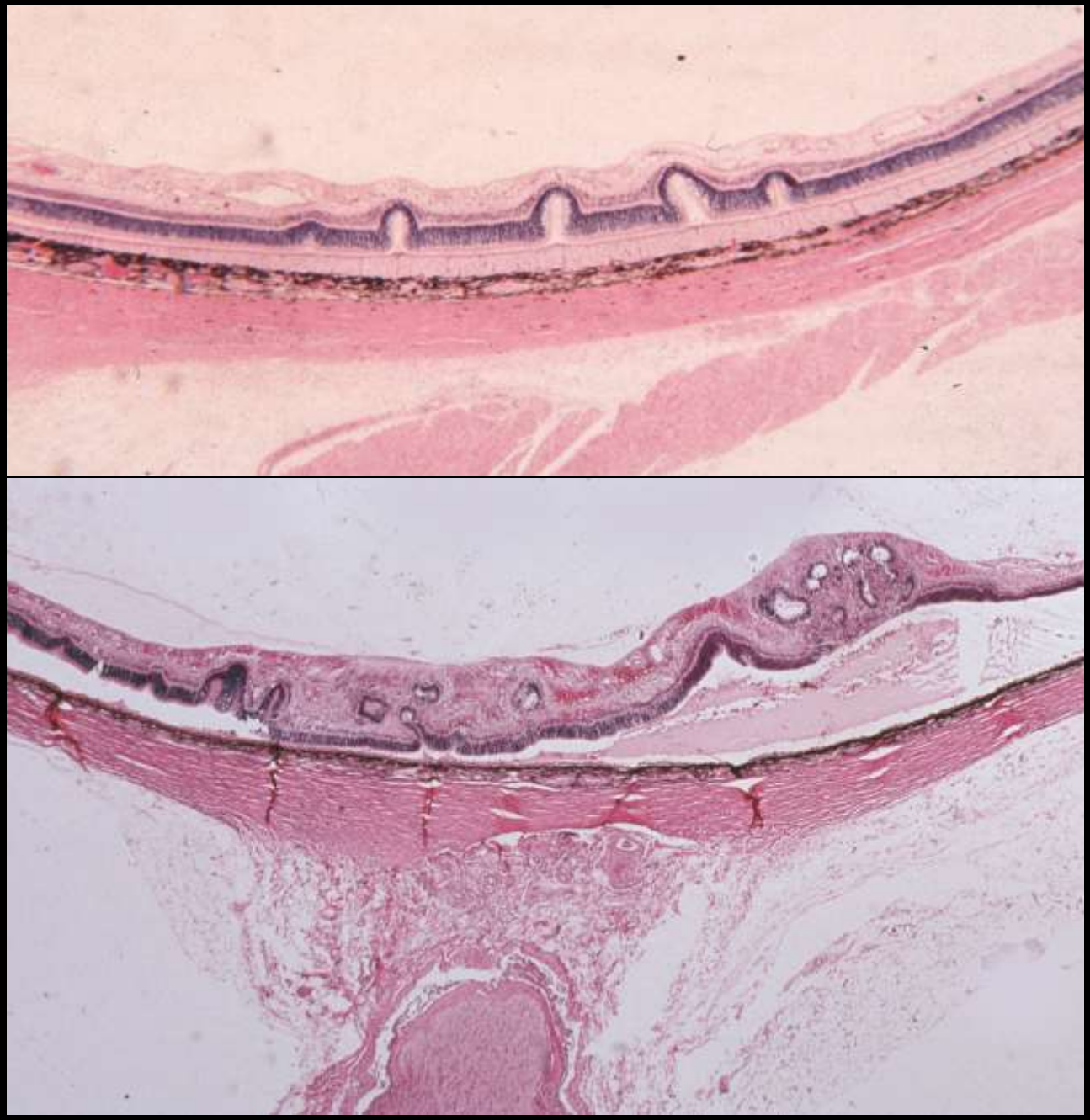
- Dogs
  - Cystic degeneration in the retinal neuropil
  - Cystic spaces have hyaluronic acid
  - Age related
- Cats
  - Cystic changes are in the pars plana epithelium
  - Cystic spaces filled with hyaluronic acid
  - Age related

Feline


Canine

Retinal Folds/Dysplasia

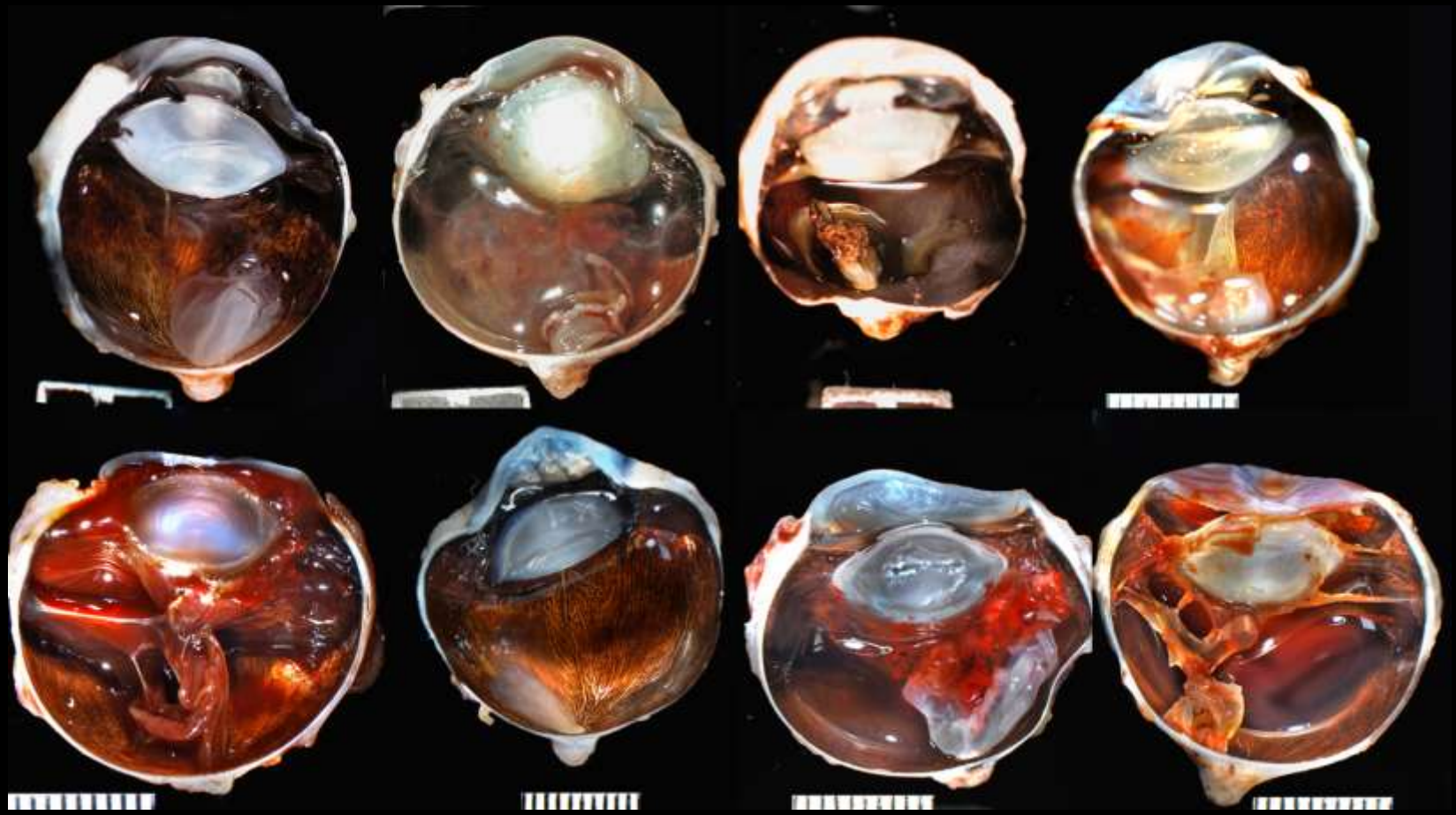




Vitreoretinal dysplasia

- General characteristics
  - Retinal detachment and giant tear in severe cases
  - Liquid vitreous or vitreous strands
  - Disorganized retina, rarely
- Shih Tzu vitreoretinopathy
- Feline vasoproliferative vitreoretinopathy

Shih Tzu Vitreoretinopathy



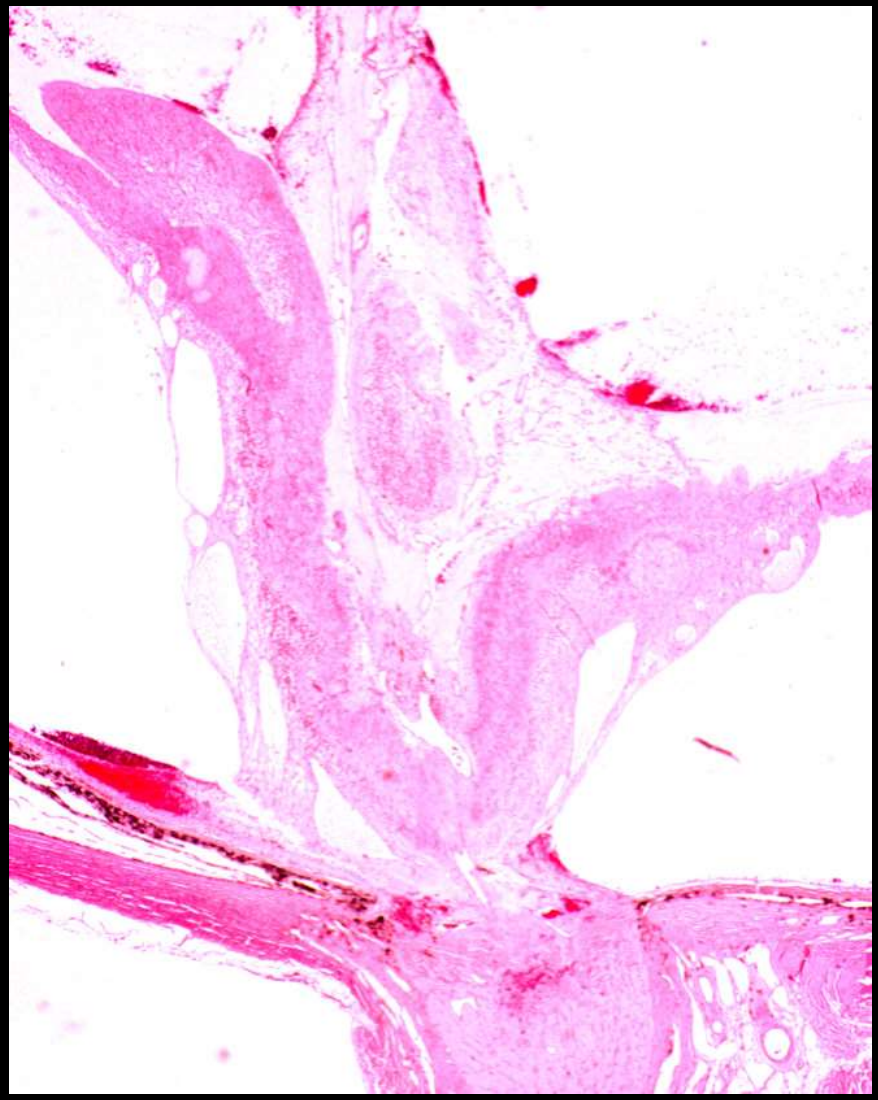
Shih Tzu Vitreoretinopathy

Shih Tzu Vitreoretinopathy

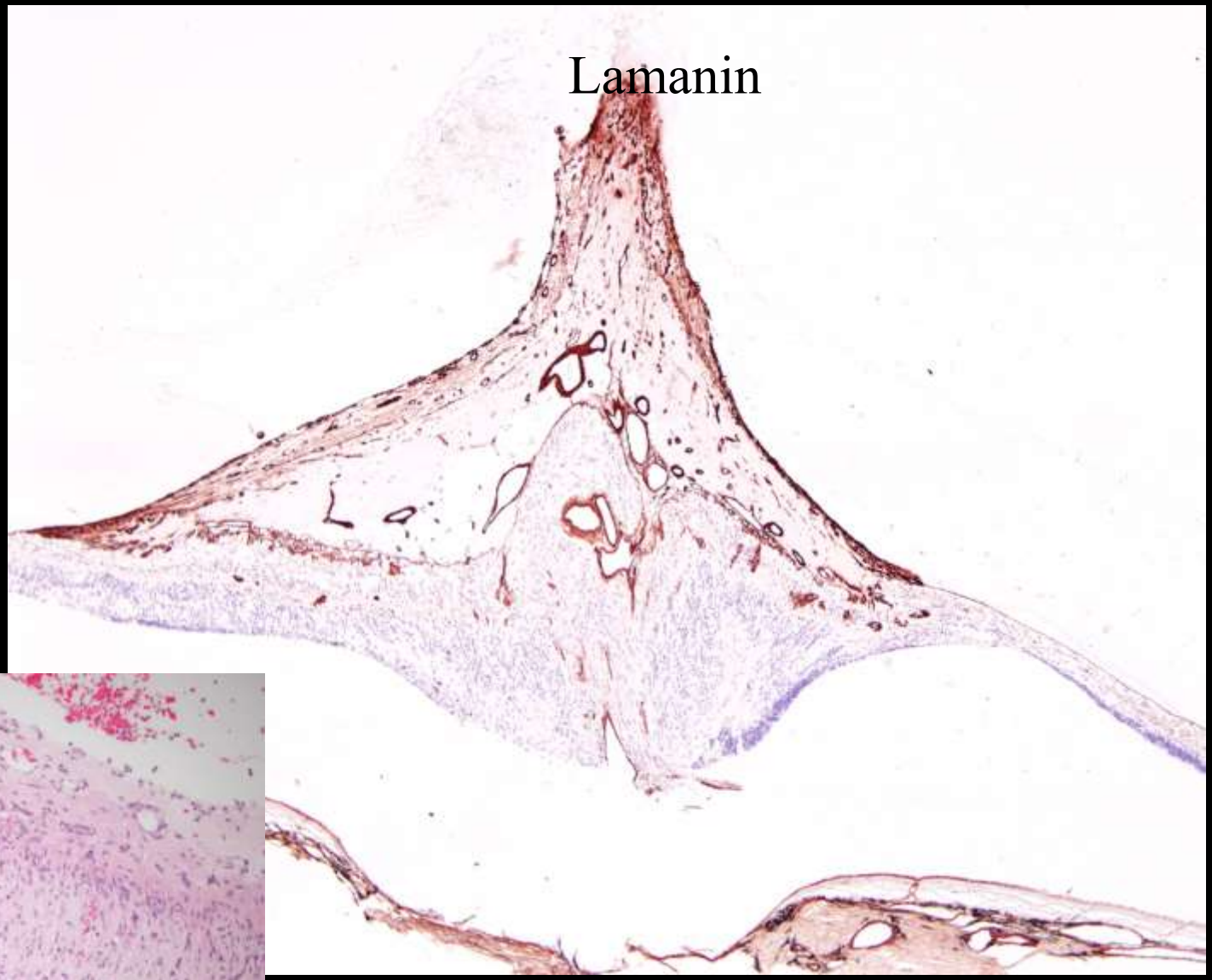
Feline neovascular vitreoretinopathy

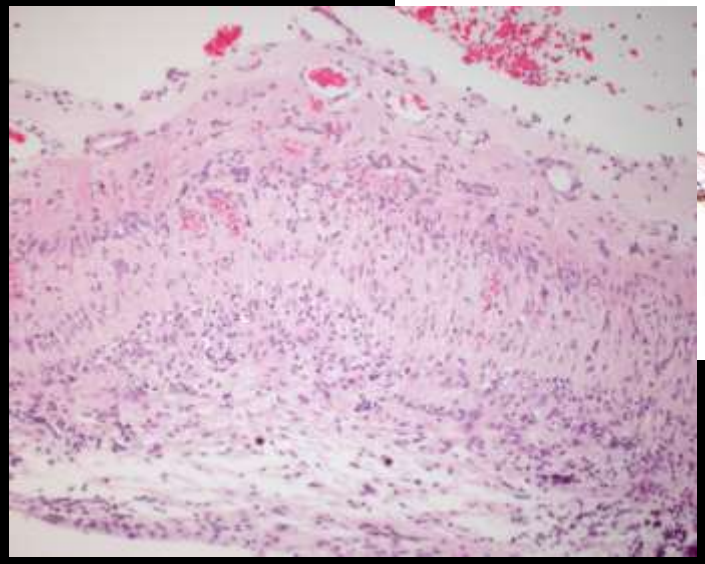
- 25 cases in the COPLOW database
- Seen as a developmental disorder in young cats
- Avascular and gliotic peripheral retina and vascularized vitreous in the area of the central retina
- Anterior segment dysplasia
- Features other than the primary lesions
  - Retinal detachment
  - PIFM and PAS
  - Glaucoma
  - Hemorrhage

Feline Neovascular Vitreoretinopathy

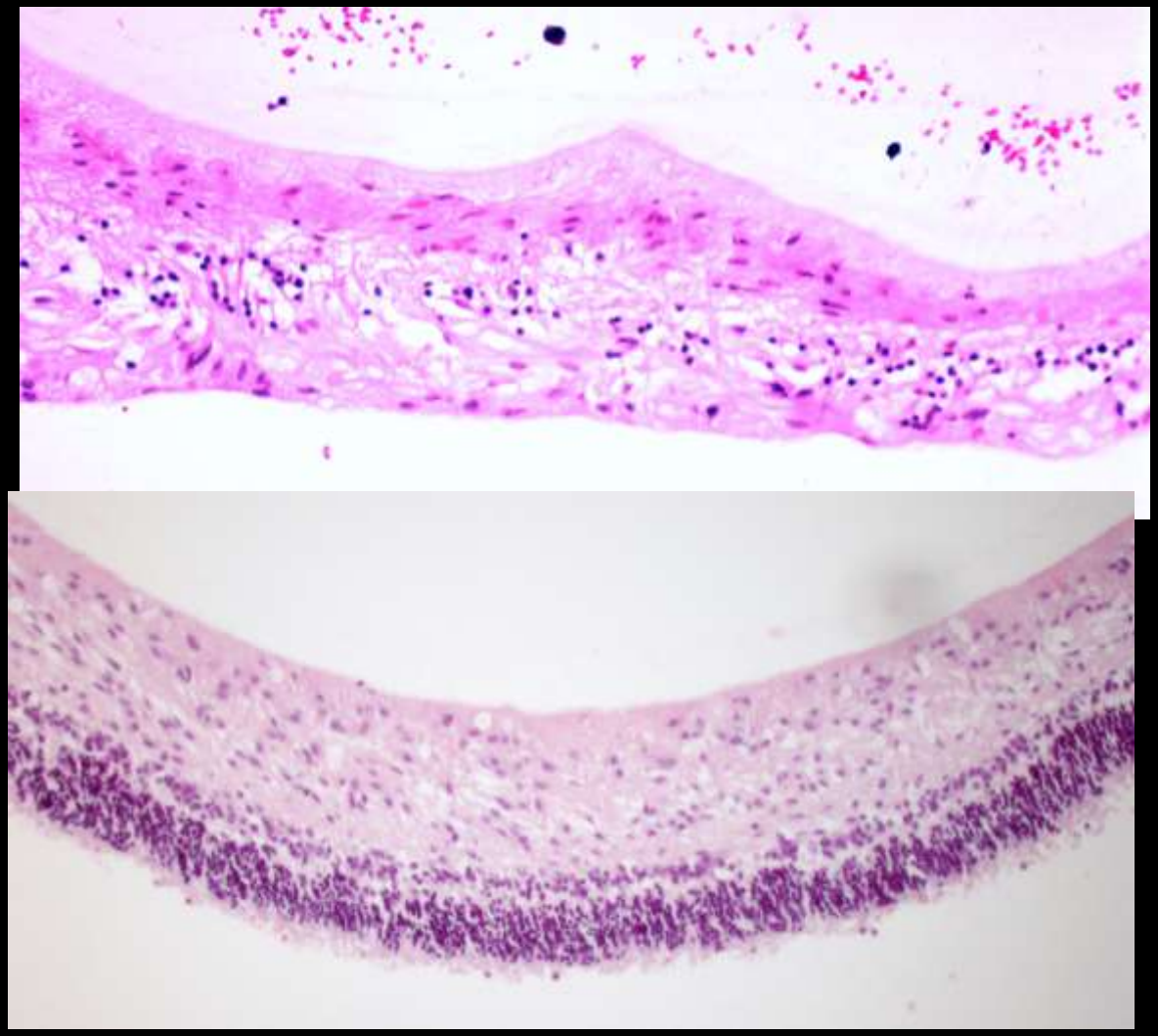


Feline Neovascular Vitreoretinopathy



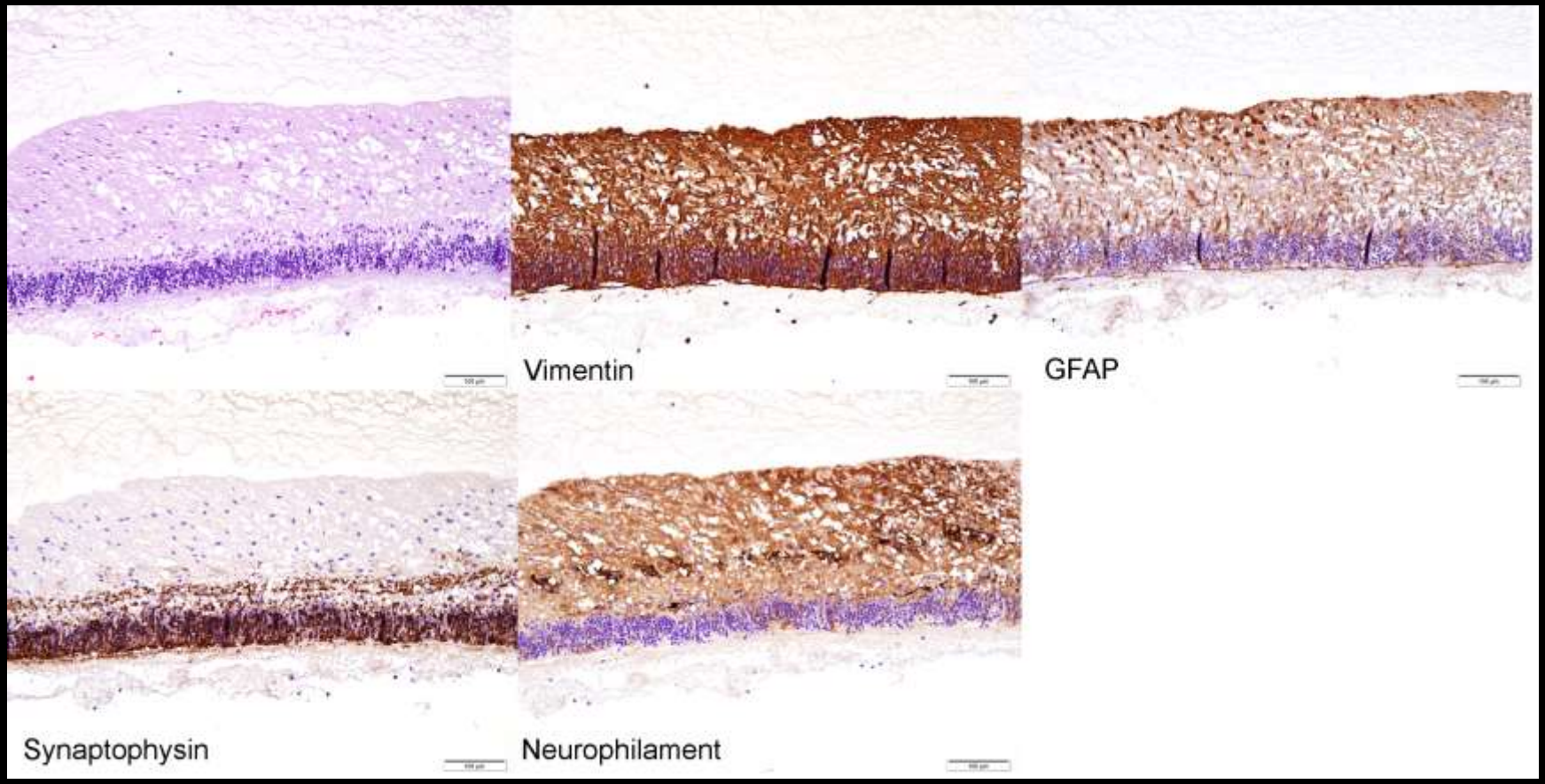


Feline Neovascular Vitreoretinopathy



Feline Neovascular Vitreoretinopathy

Avascular Peripheral Retina

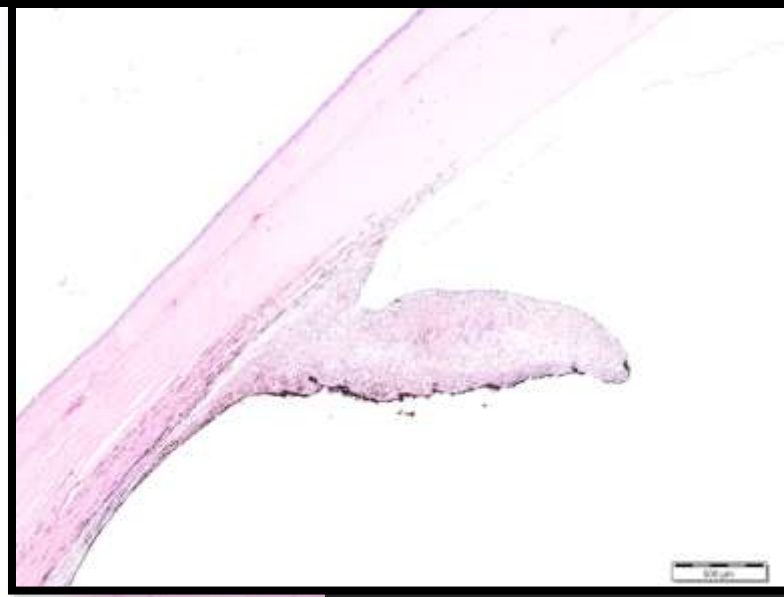


Feline Neovascular Vitreoretinopathy

Avascular Peripheral Retina

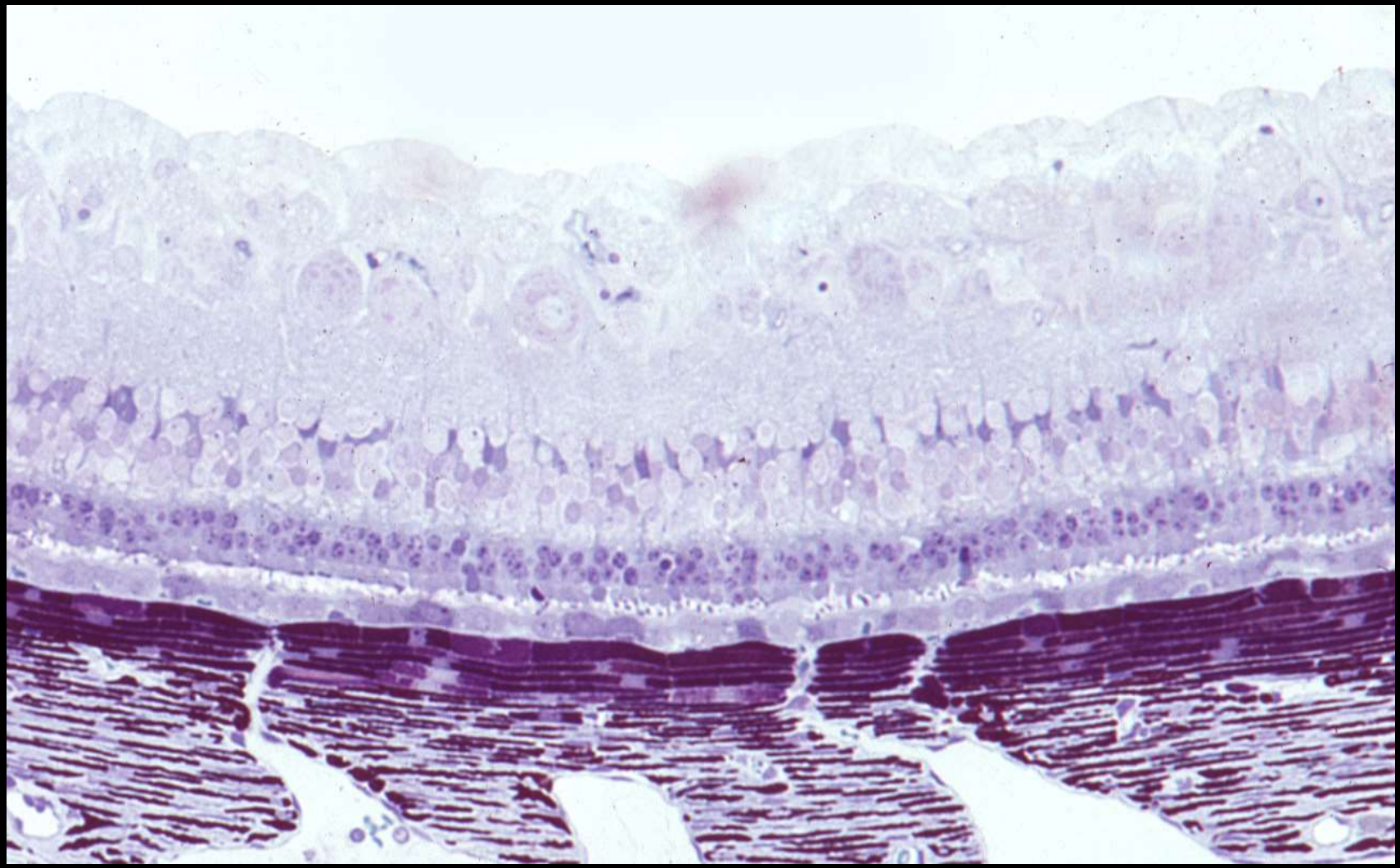
Feline Neovascular Vitreoretinopathy

Anterior Segment Dysgenesis

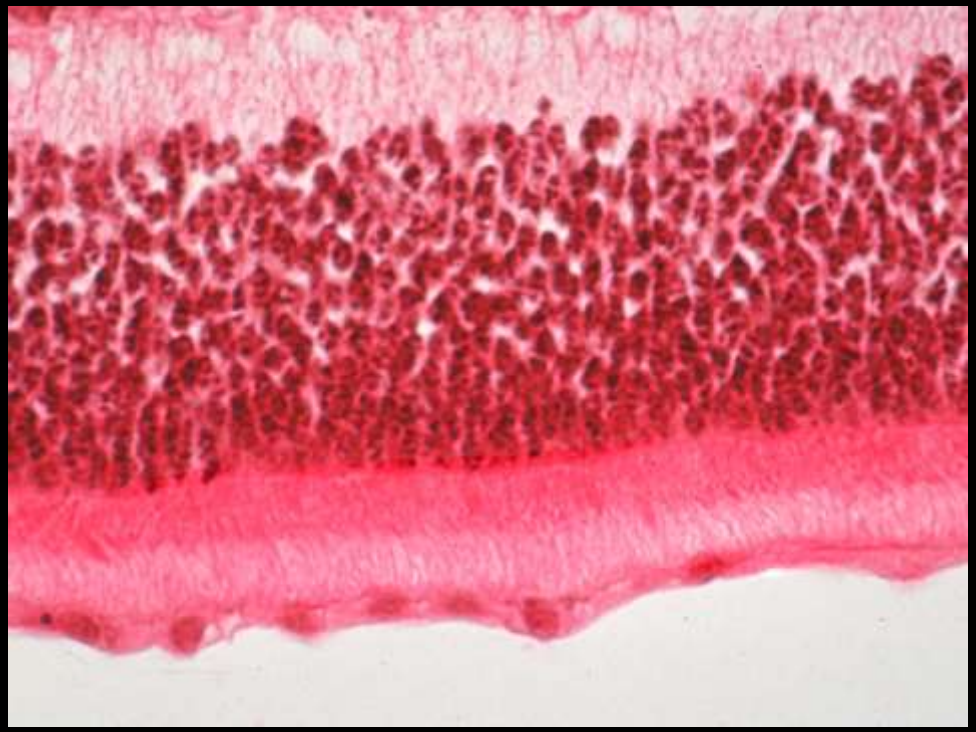


Photoreceptor Loss

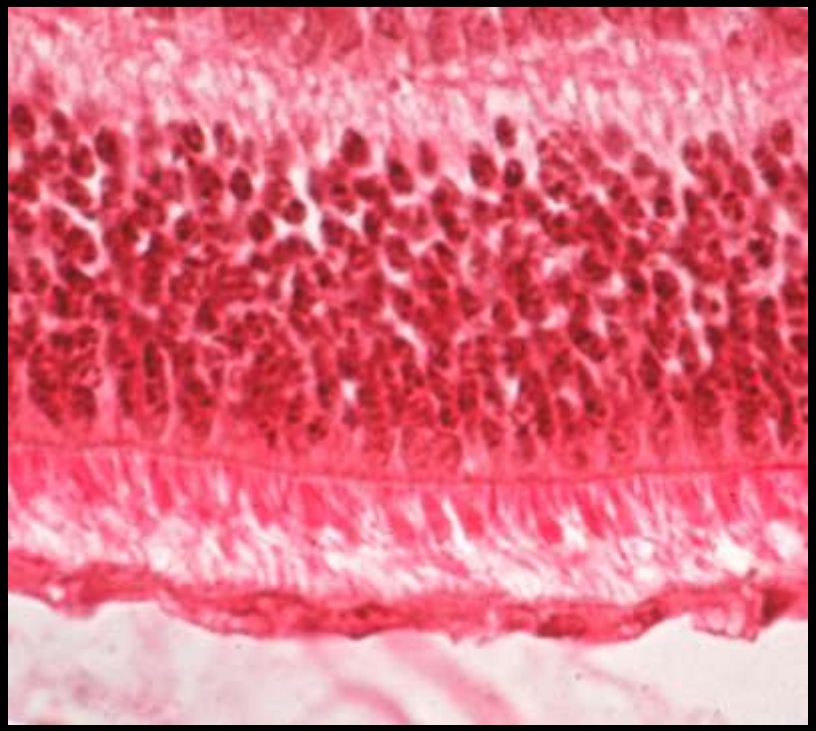
- Progressive Retinal Atrophy (PRA)
- Phototoxic Retinopathy
- Fluoroquinolone Toxicity in Cats
- Taurine Deficiency in Cats
- Oxidative Stress &/or Vit E Selenium Def.
- Vascular Perfusion Problems, Hypertension
- SARDS
- Phototoxicity
- Other Toxic Reactions



PRA

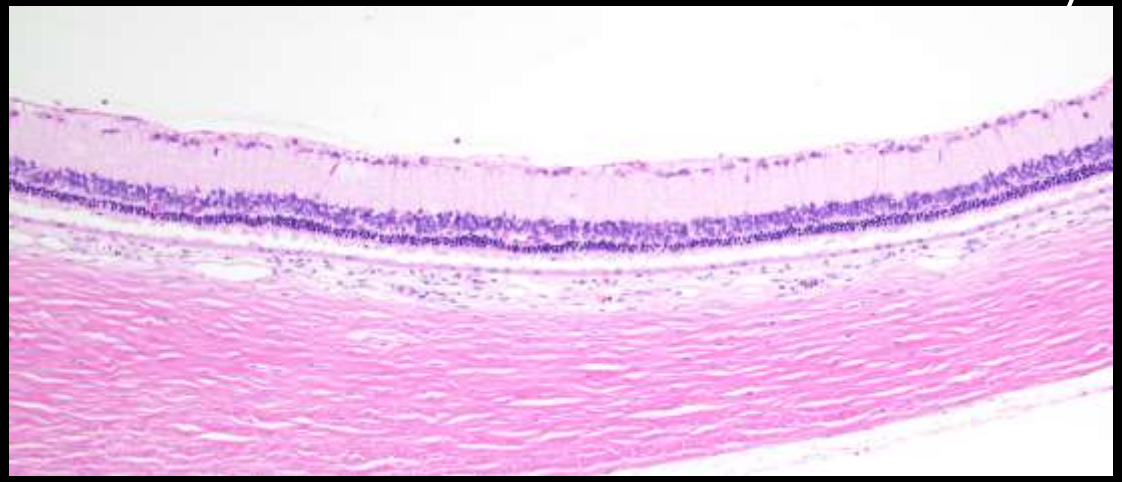


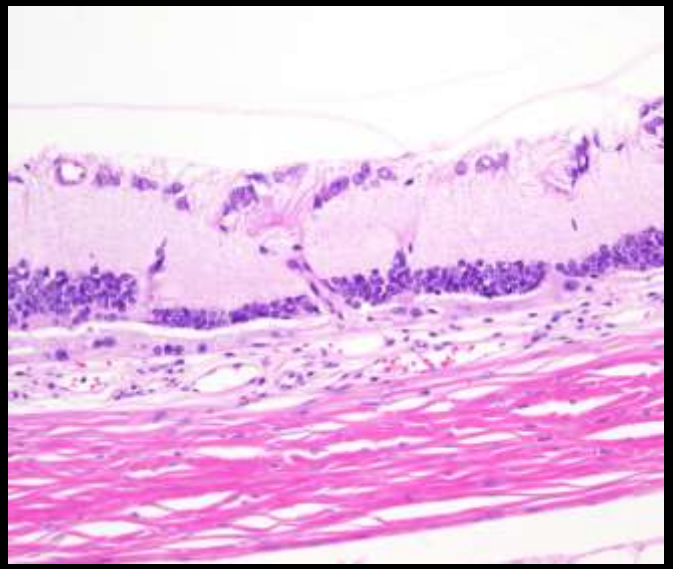
Normal Irish Setter

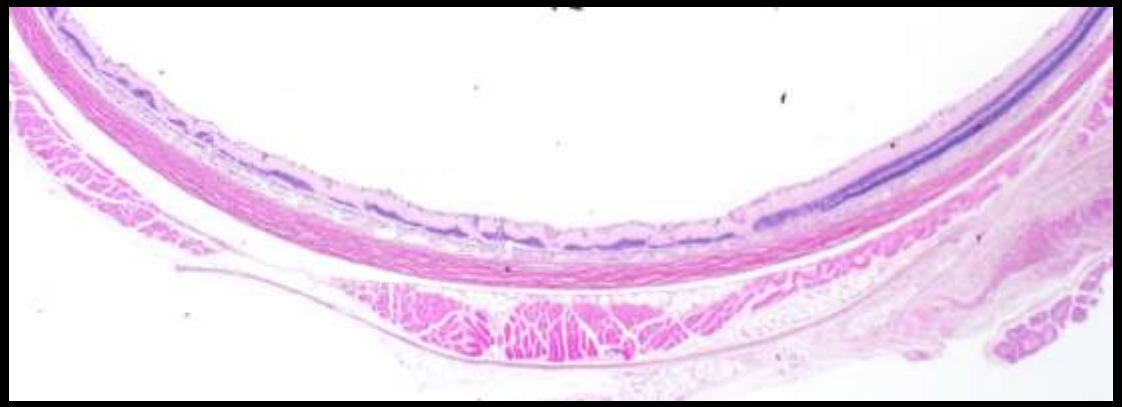


Early PRA Irish Setter

Phototoxic Retinopathy
Albino Laboratory Rodents

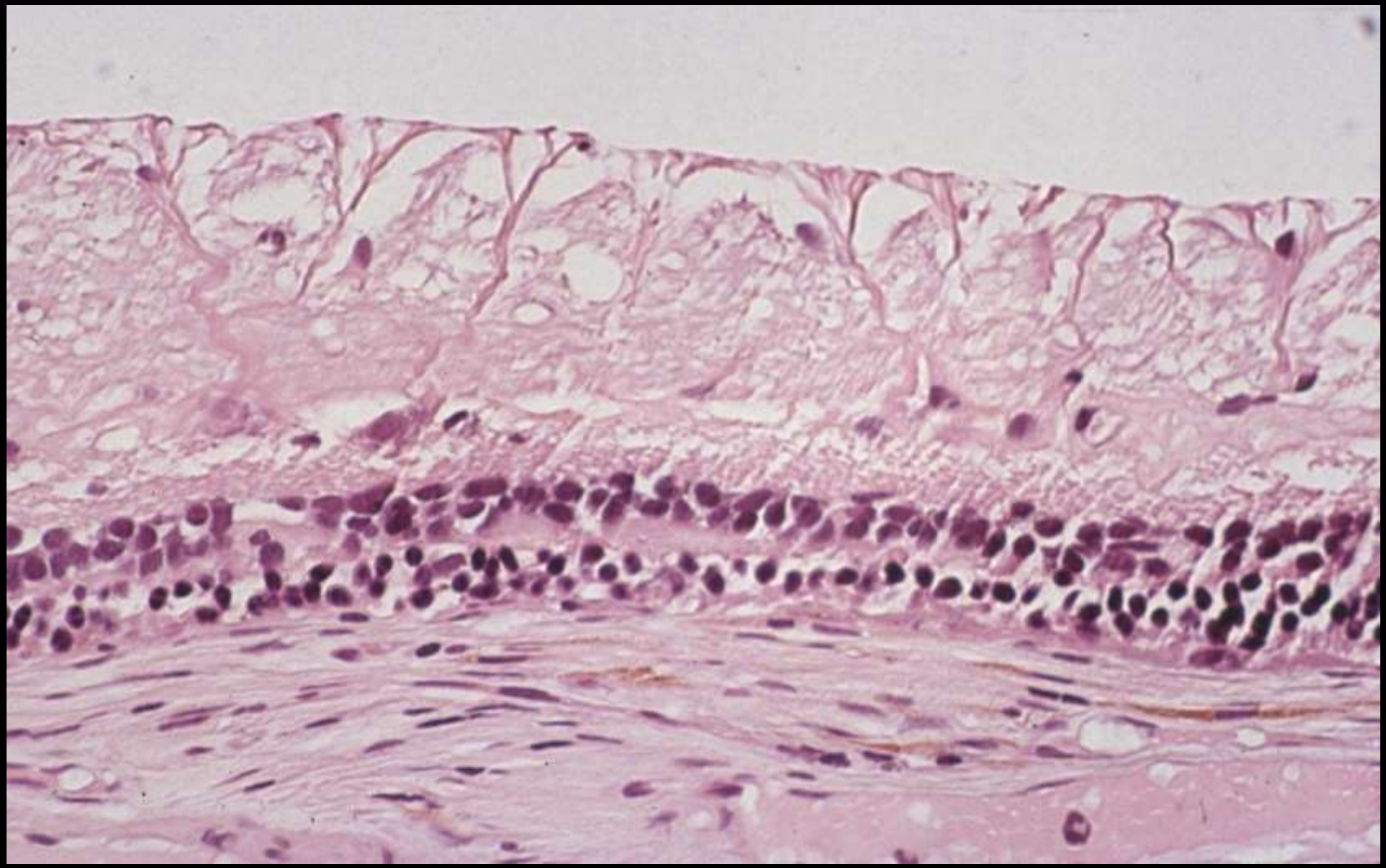






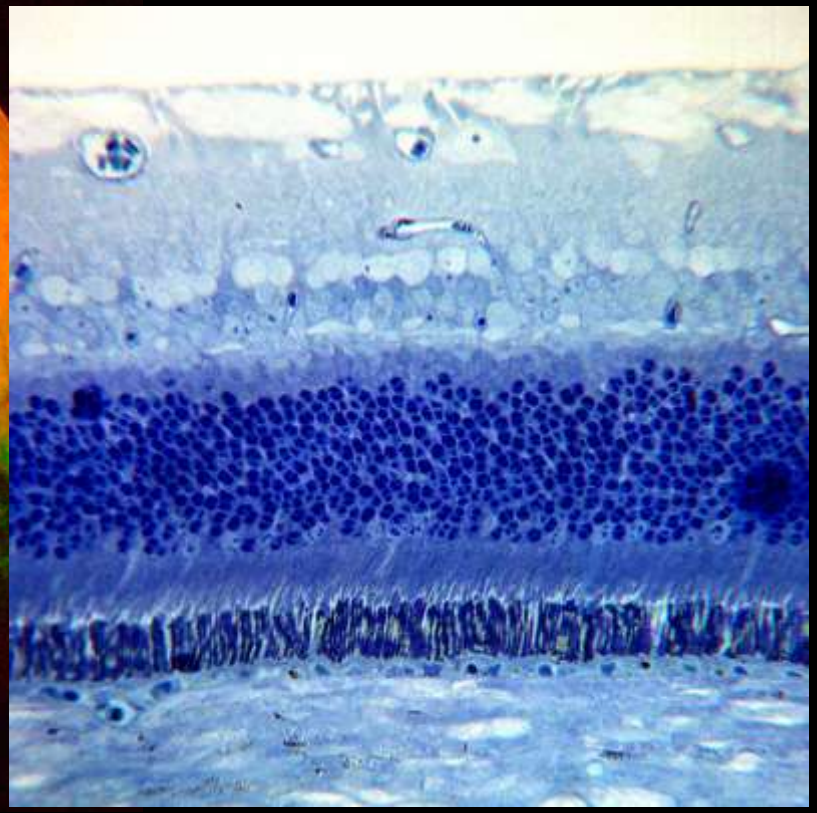
Fluoroquinolone retinal toxicity in cats

- Baytril™ (Enrofloxacin)
  - Discovered after Bayer was allowed to switch from 2.5 mg/kg to 5 to 20 mg/kg
  - Disappeared after the dose was dropped to no more than 5 mg/kg
- Orbifloxacin™ (Orbax)
  - Discovered in a safety evaluation after the Baytril issue became public



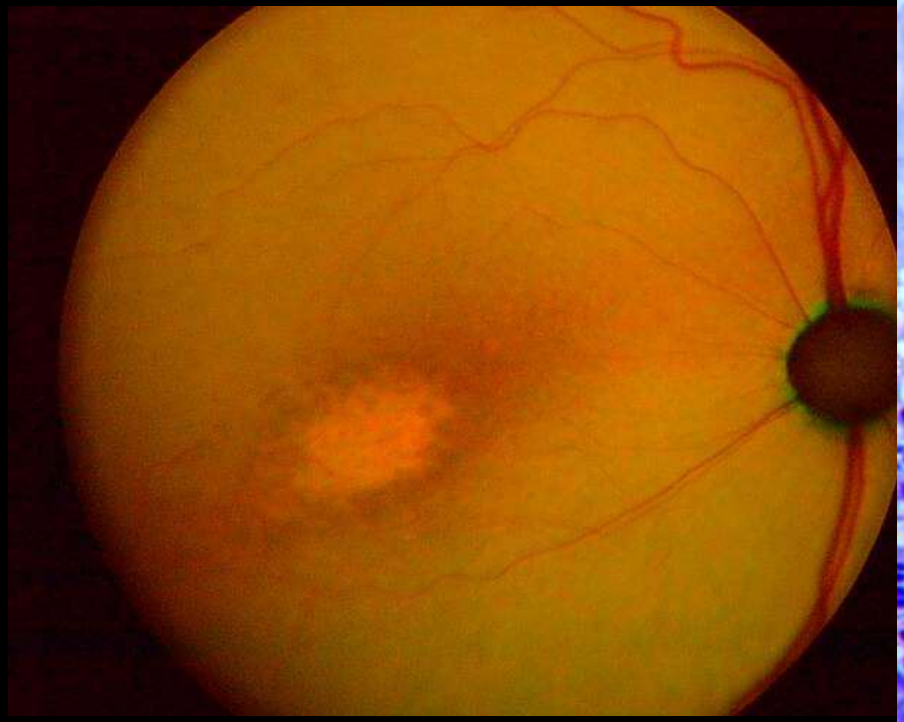
Fluoroquinolone retinal toxicity

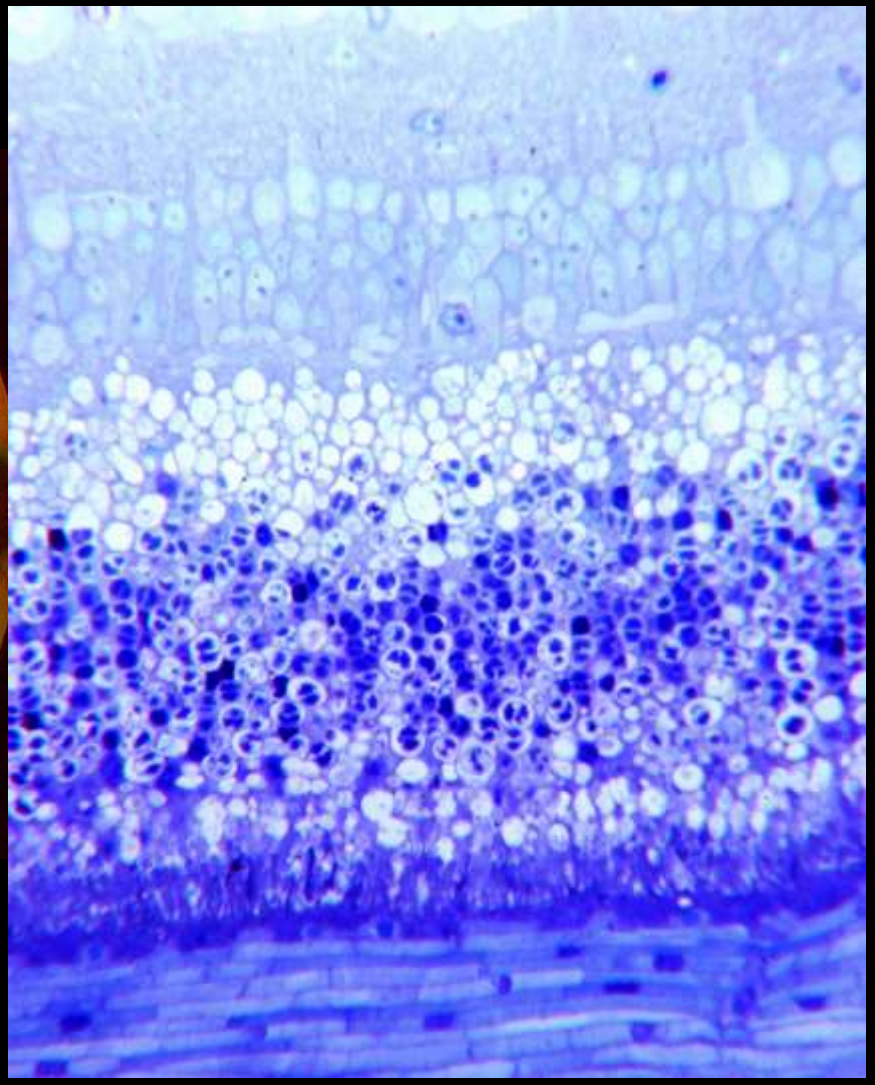
Acute Baytril™ Toxicity



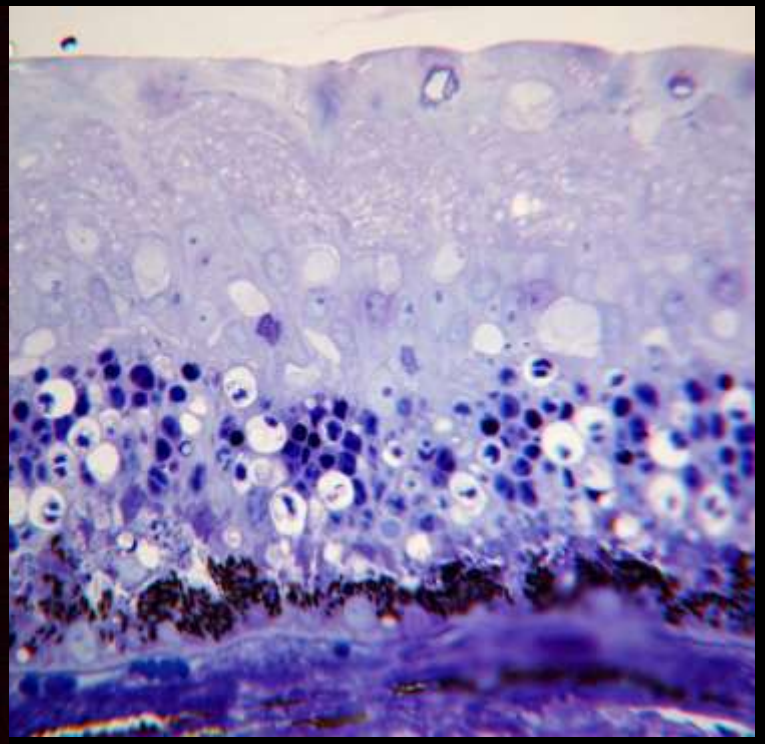
Control

Three Day Toxicity

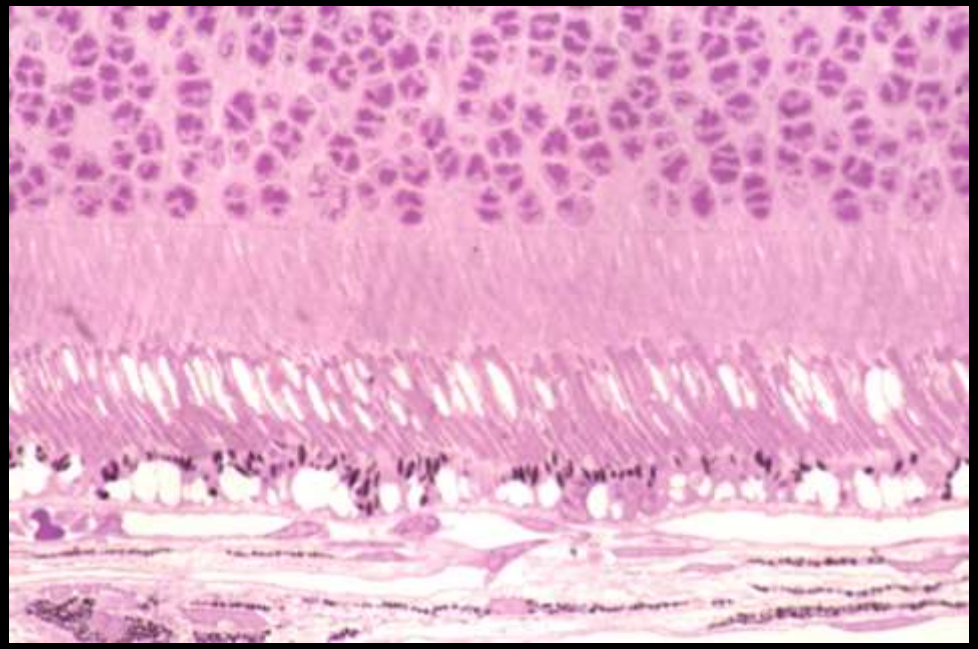


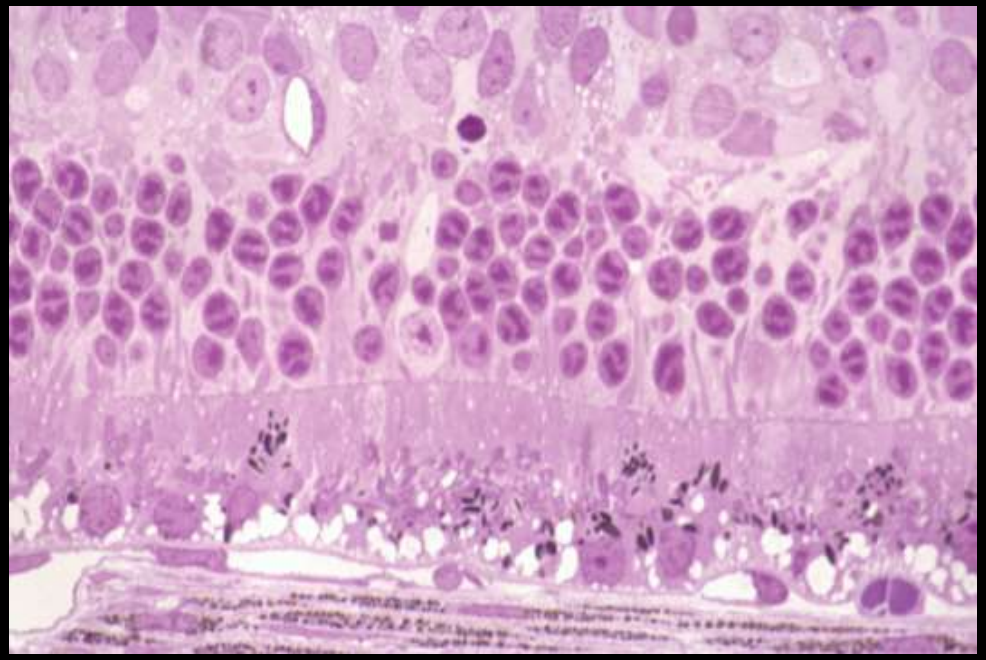


Five Day Toxicity

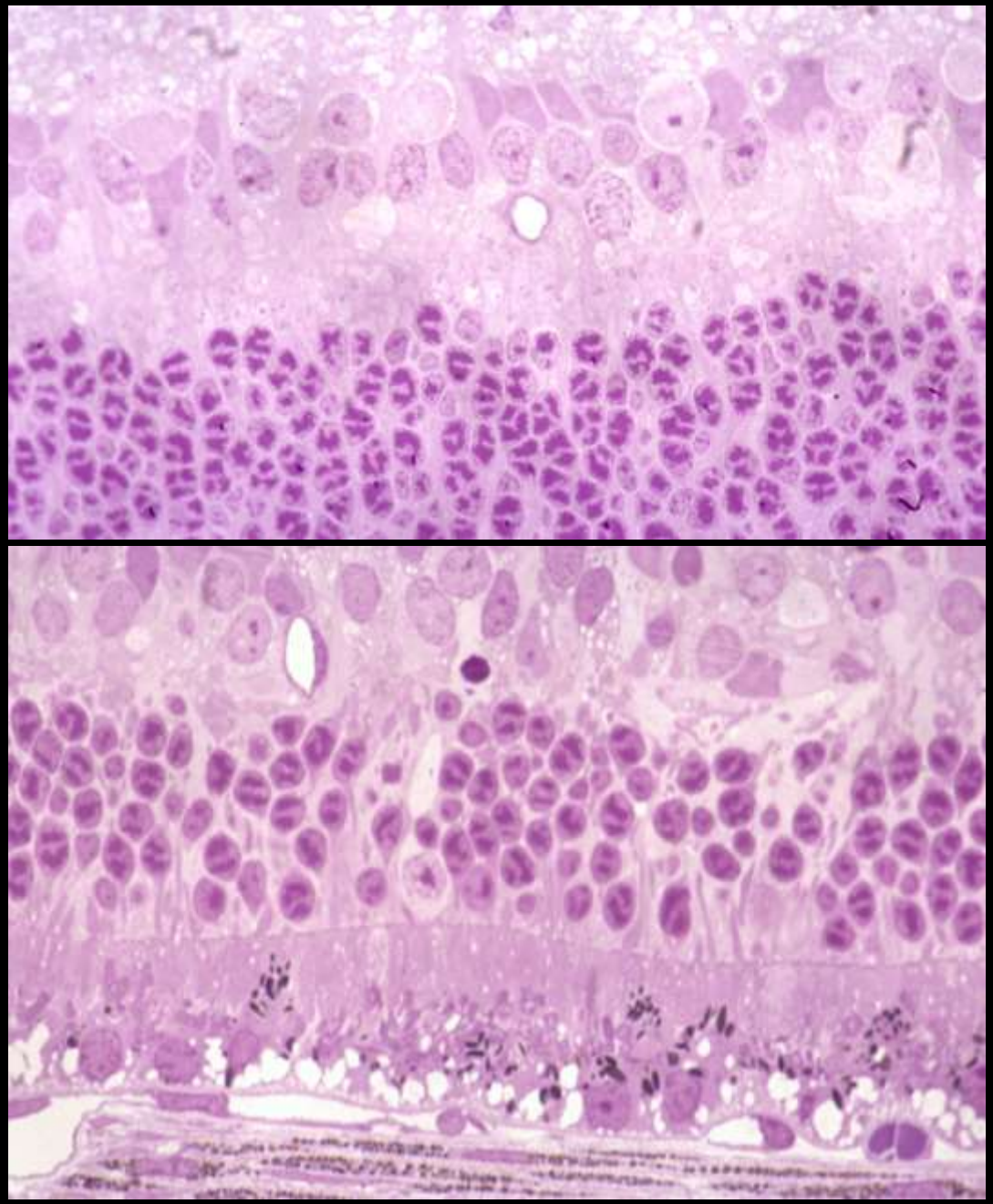


Seven Day Toxicity

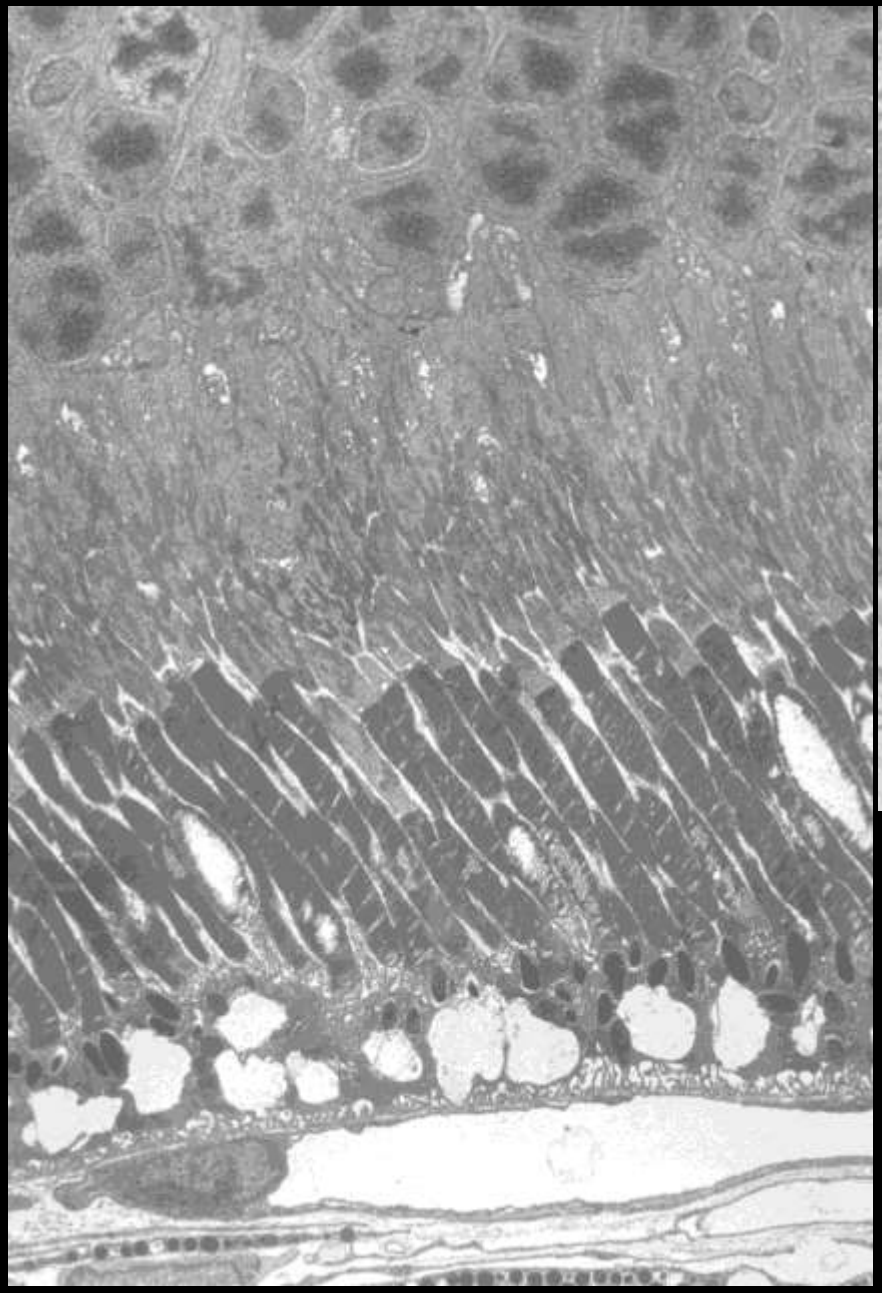


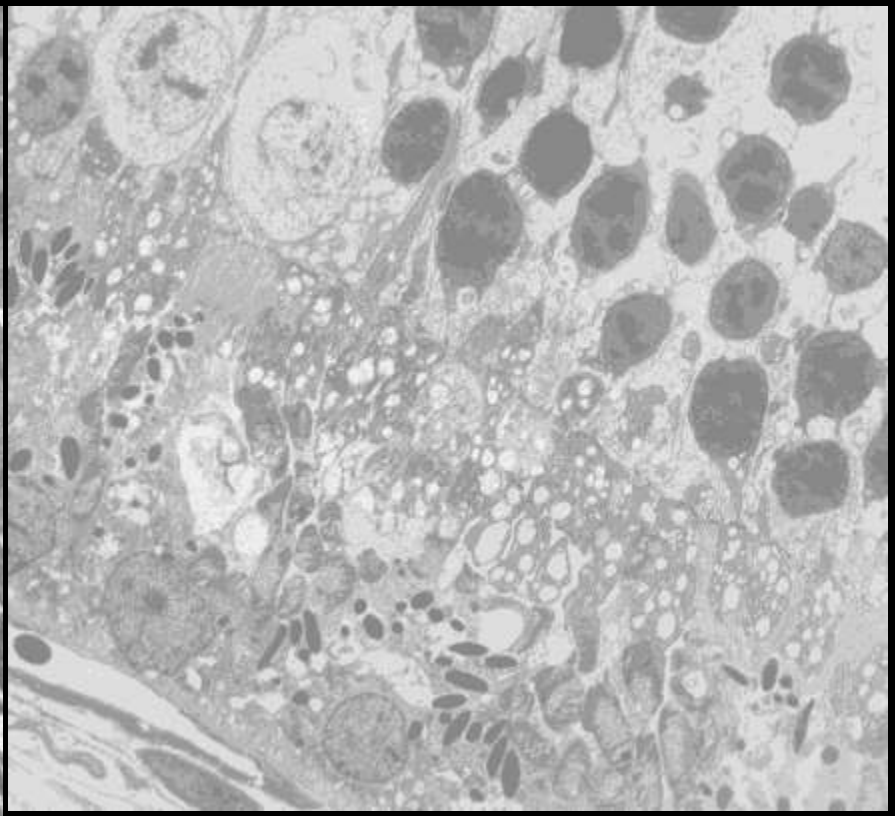


Thirty Day Chronic Retinopathy, Orbax ™



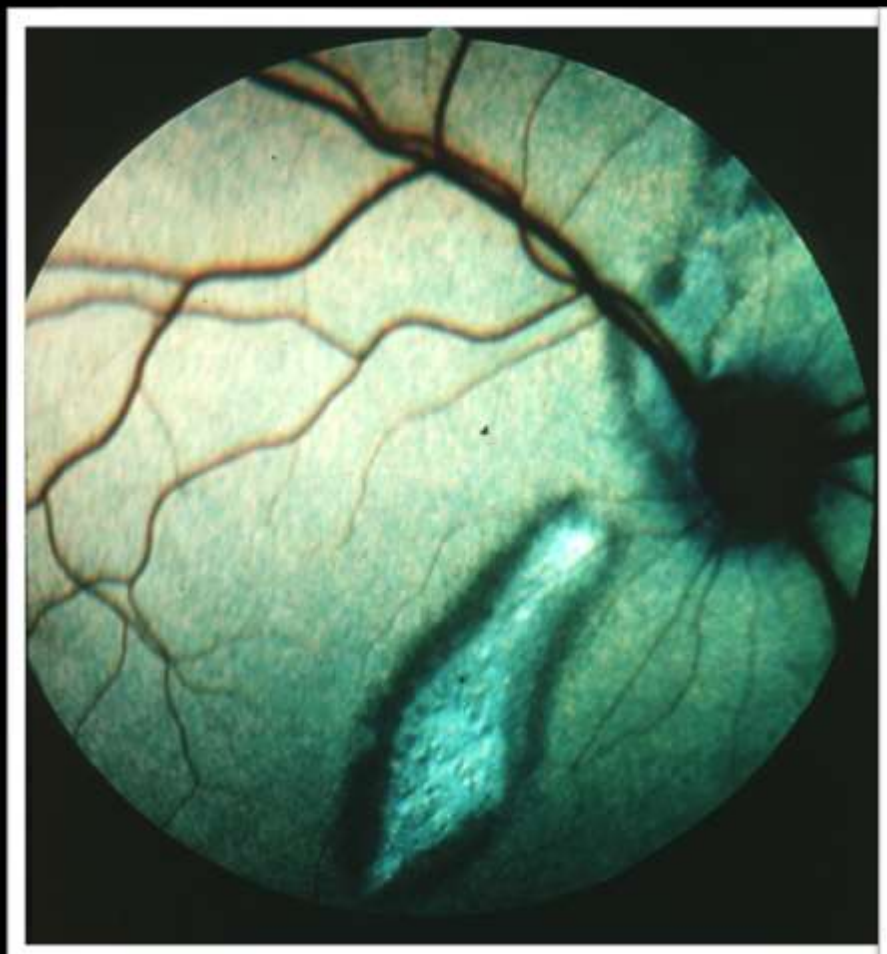
Thirty Day Chronic Retinopathy, Orbax™

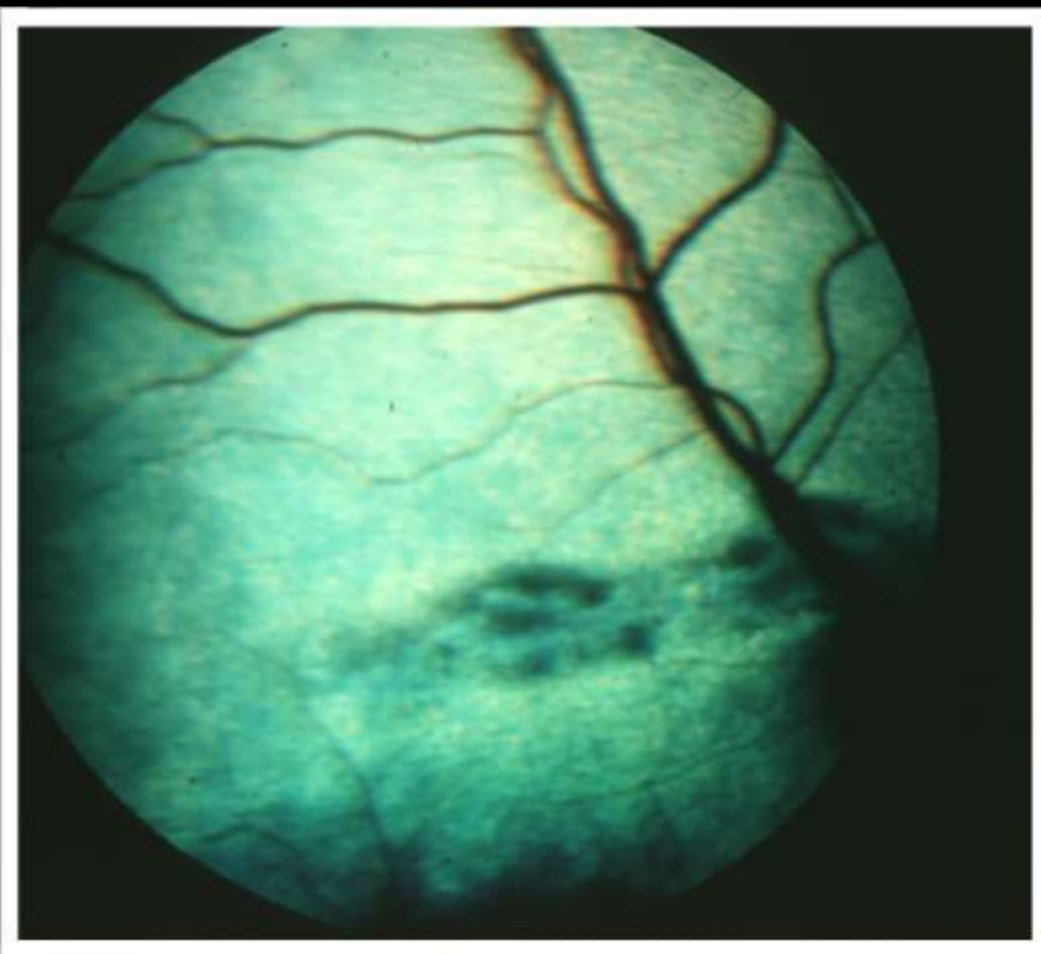


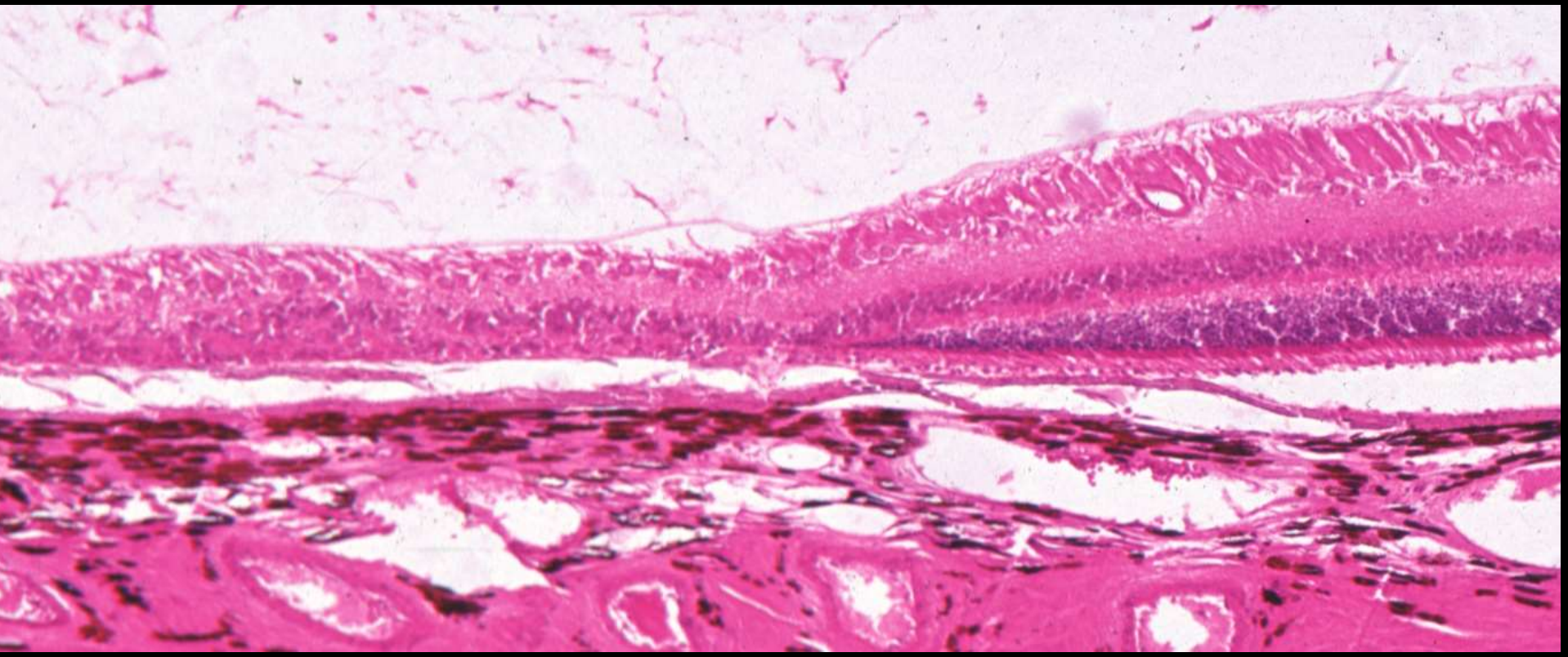


Baytril™

Feline Central Progressive Retinal Degeneration (Taurine Deficiency)



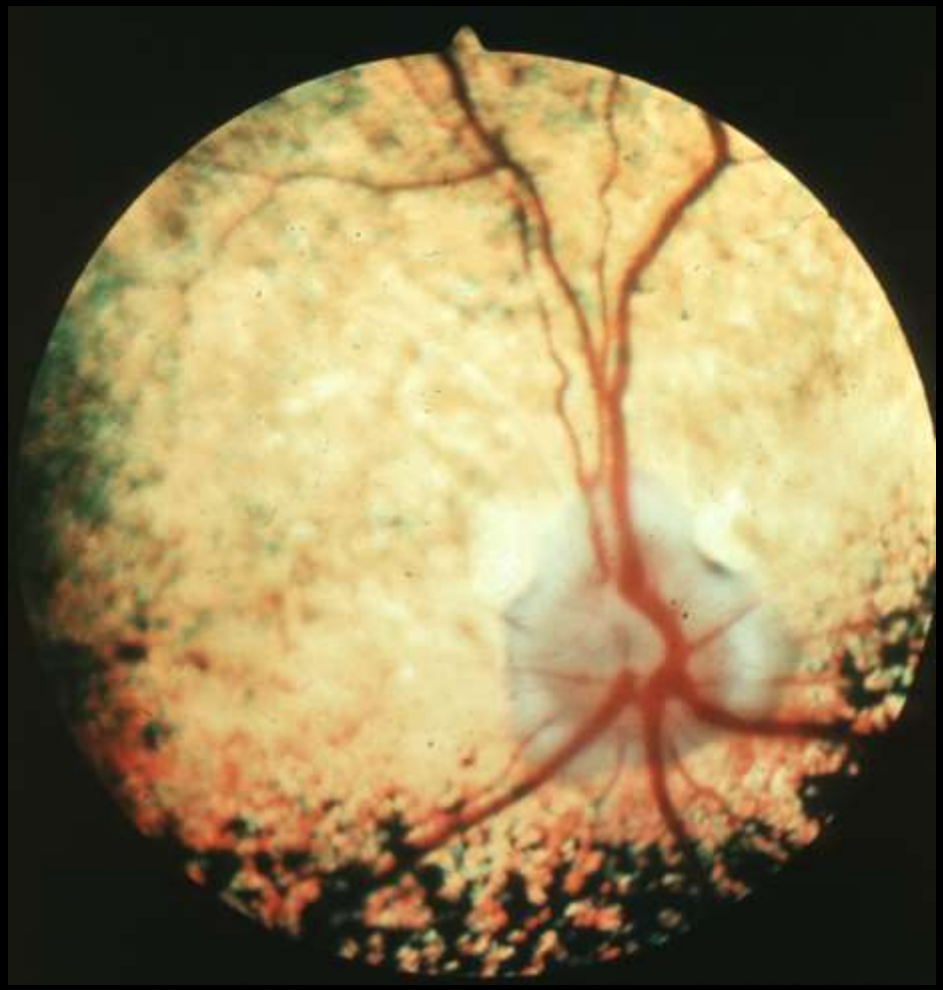




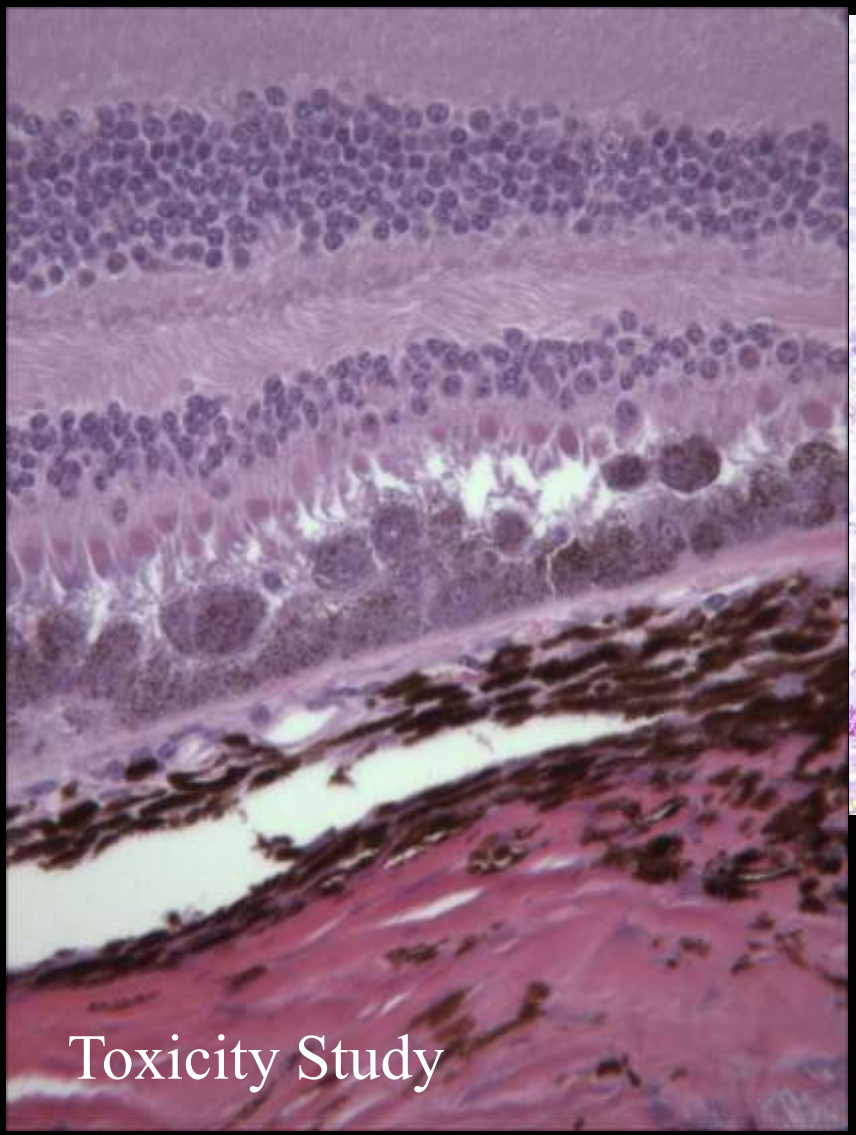
Feline Central Progressive Retinal Degeneration

Canine Central Progressive Retinal Atrophy

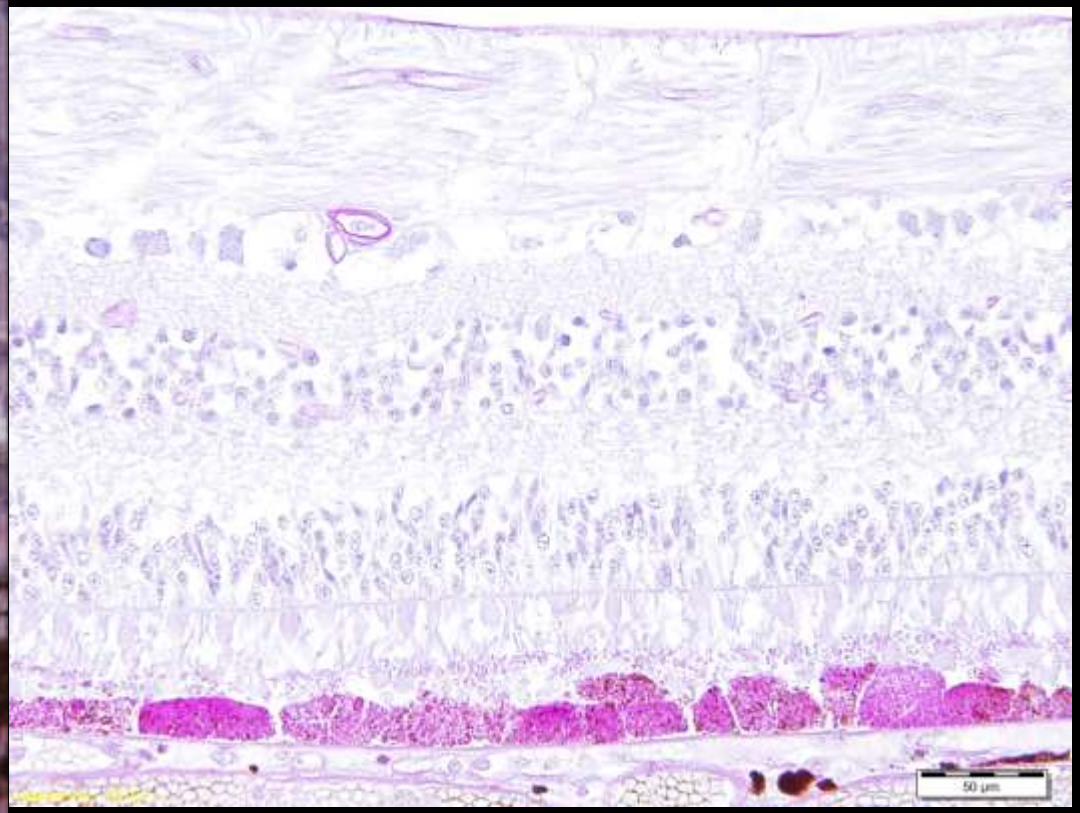
Retinal Lipofuscinosis



Retinal Toxicity & Lipofuscinosis



Toxicity Study



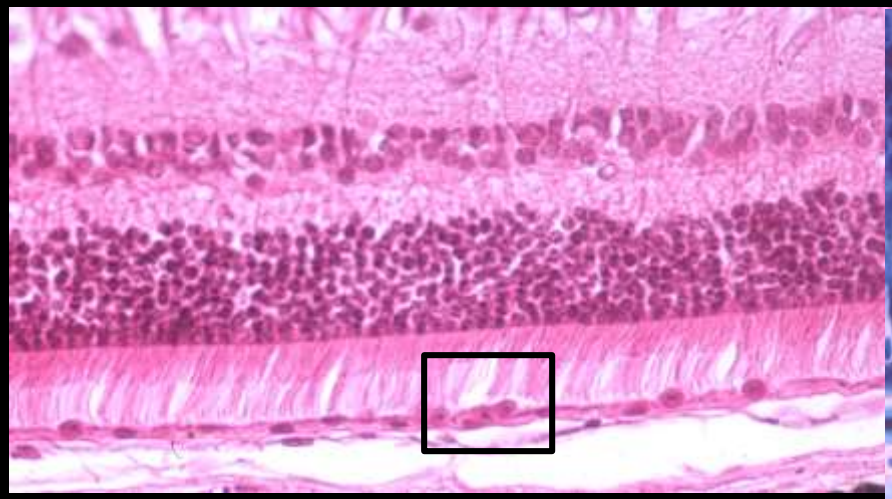
Captive Gorilla

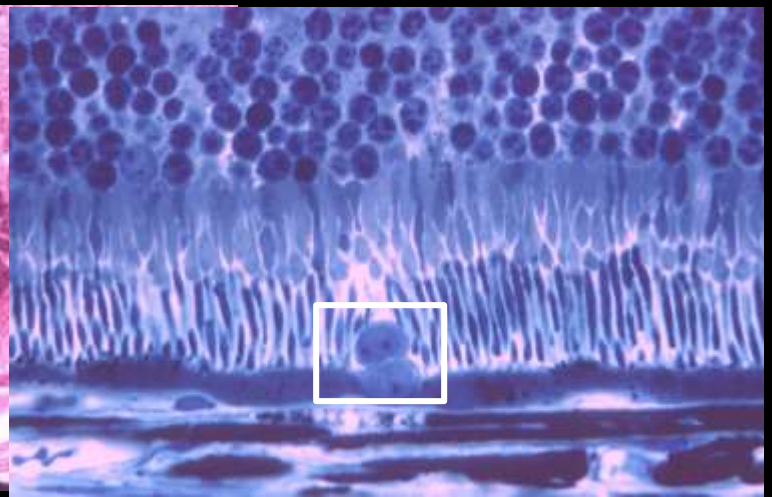
Canine Hemeralopia

Definition (Millodot's *Dictionary of Optometry and Visual Science*)

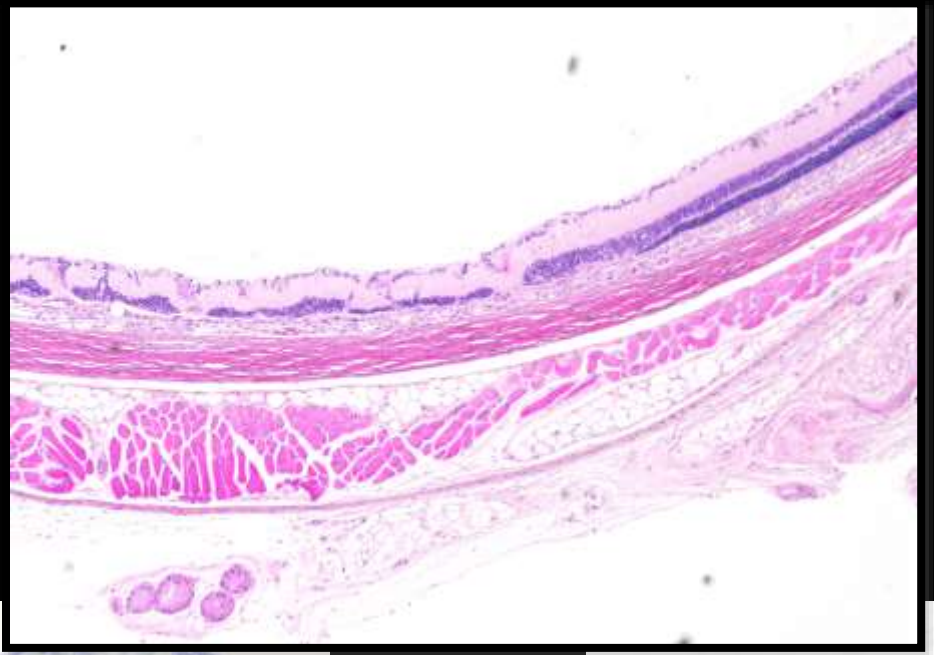
- A term used to mean either **night blindness …** or **Day blindness…**
- European definition … night blindness

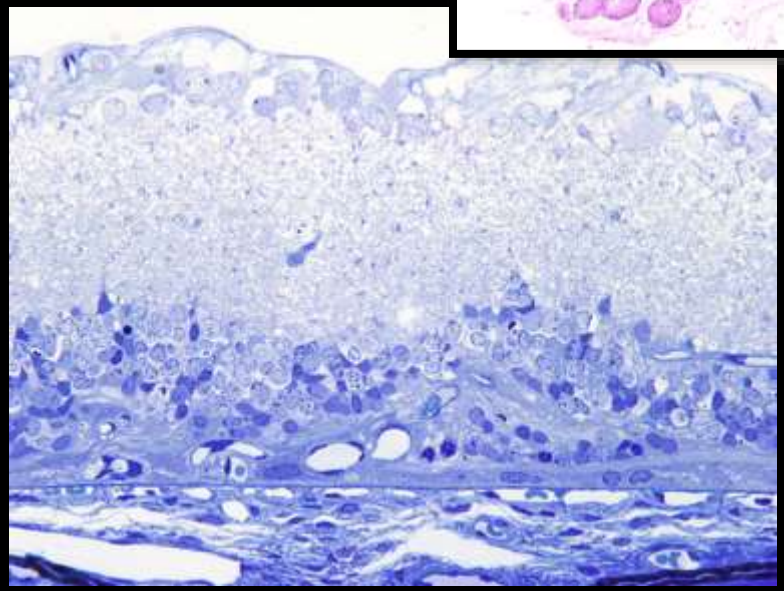
- Day Blindness in Alaskan Malamute
- Achromatopsia

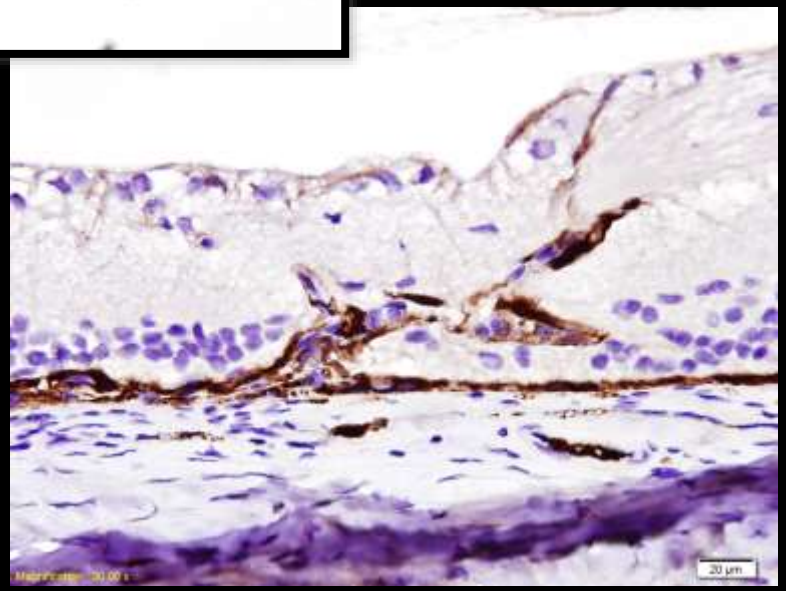




Phototoxicity in Albino Rodents



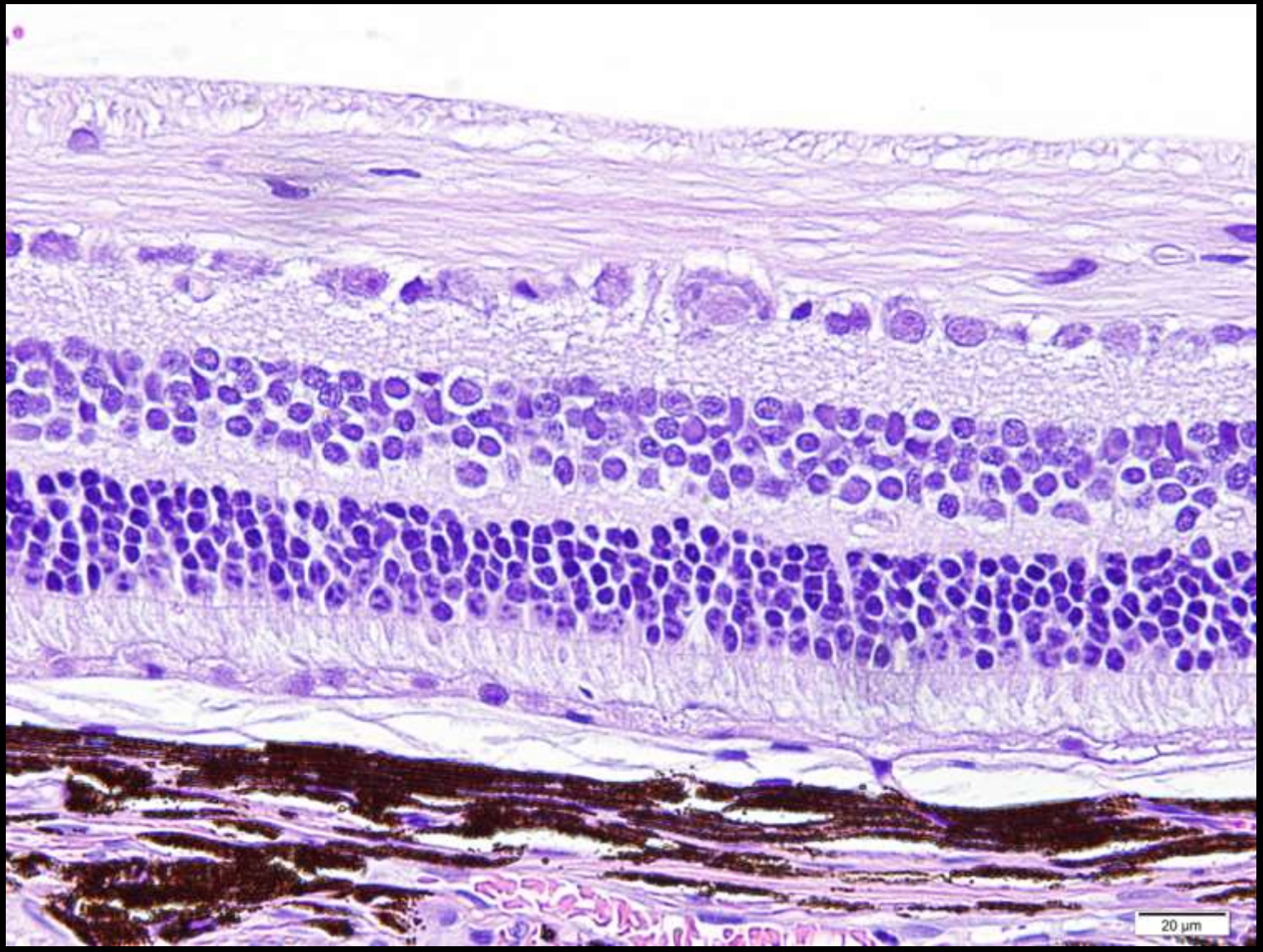




Sudden Acquired Retinal Degeneration Syndrome (SARDS)

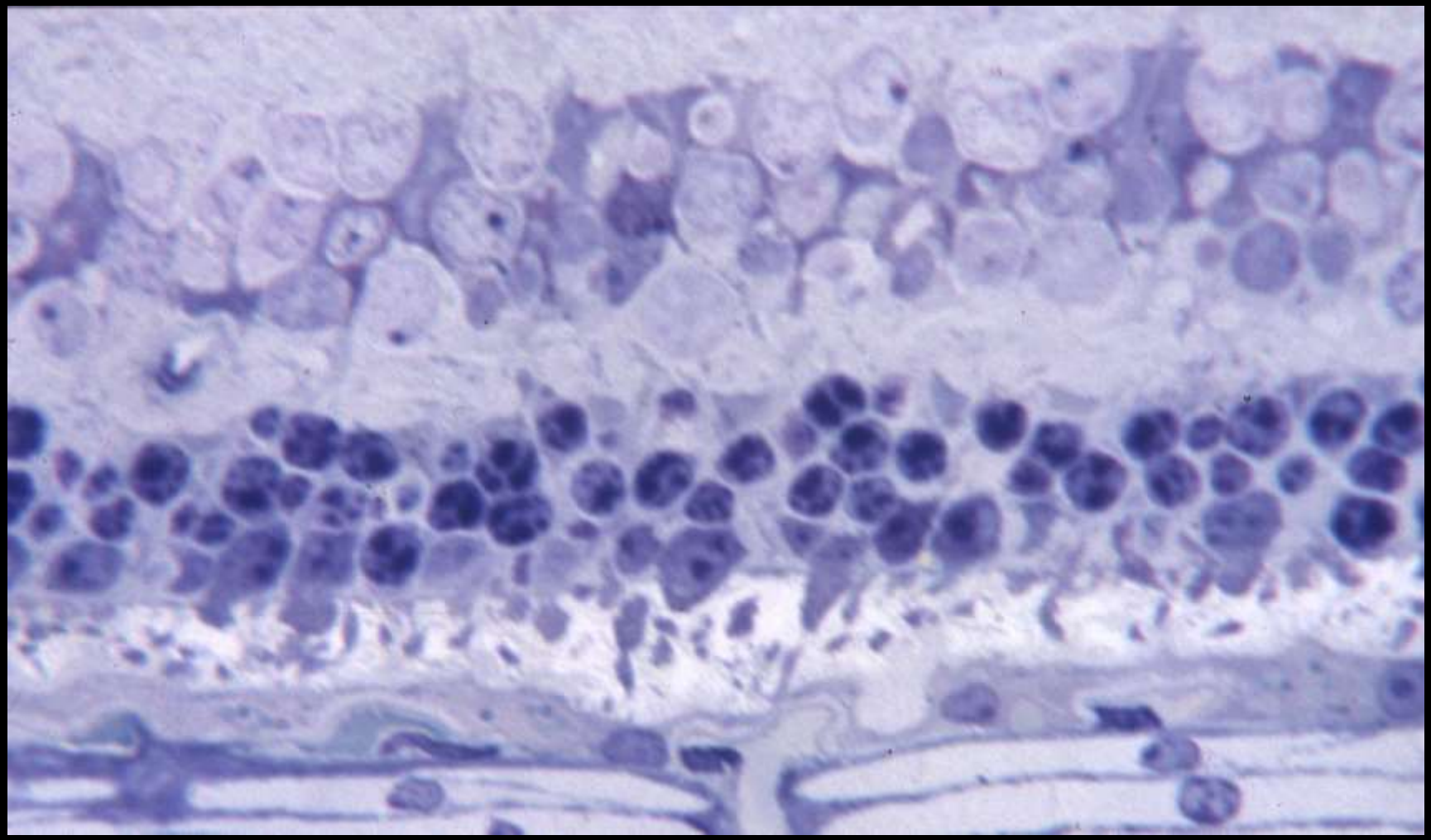
- 36 cases in the COPLOW database
- Sudden blindness
- Flat ERG, indicative of photoreceptor damage
- Affected dogs have
  - PU/PD
  - Obese
  - Polyphagia

SARDS



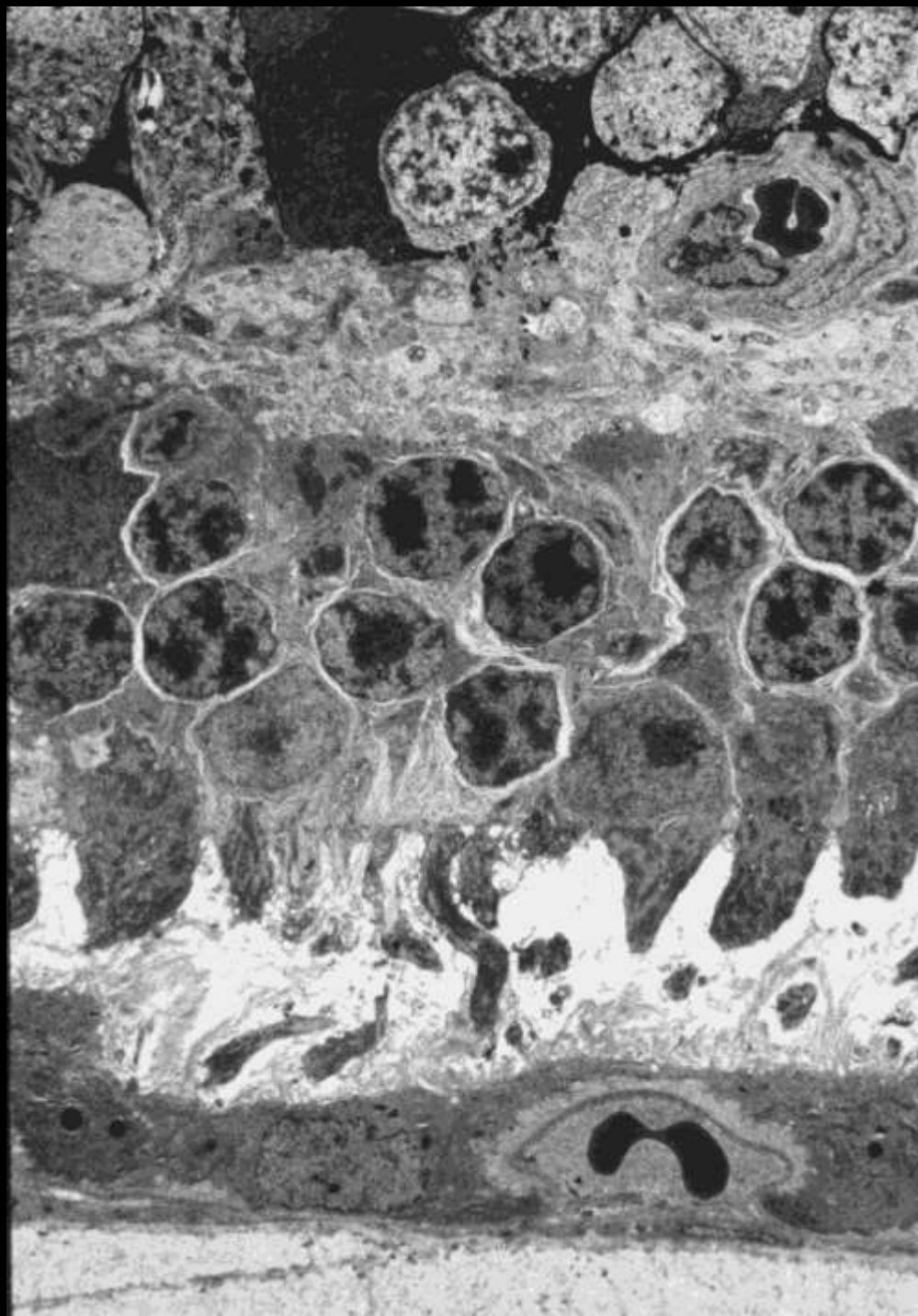
Near Normal

SARDS

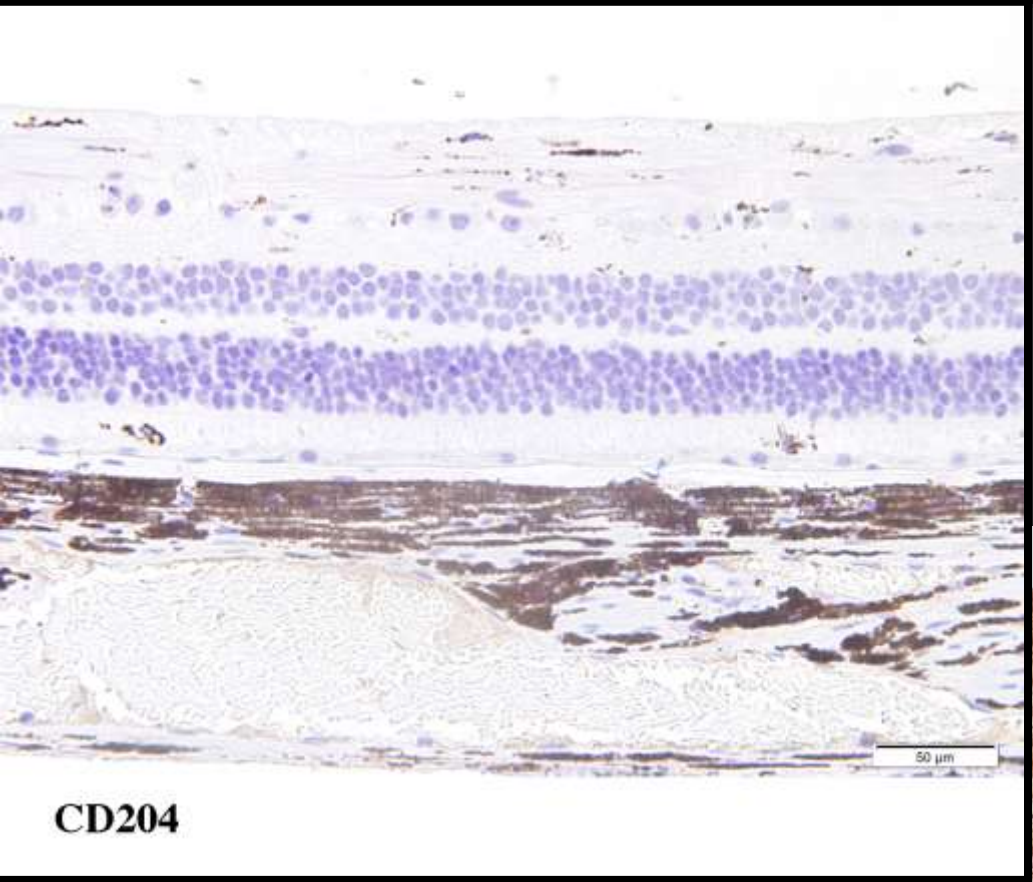


Outer Retinal Atrophy

SARDS

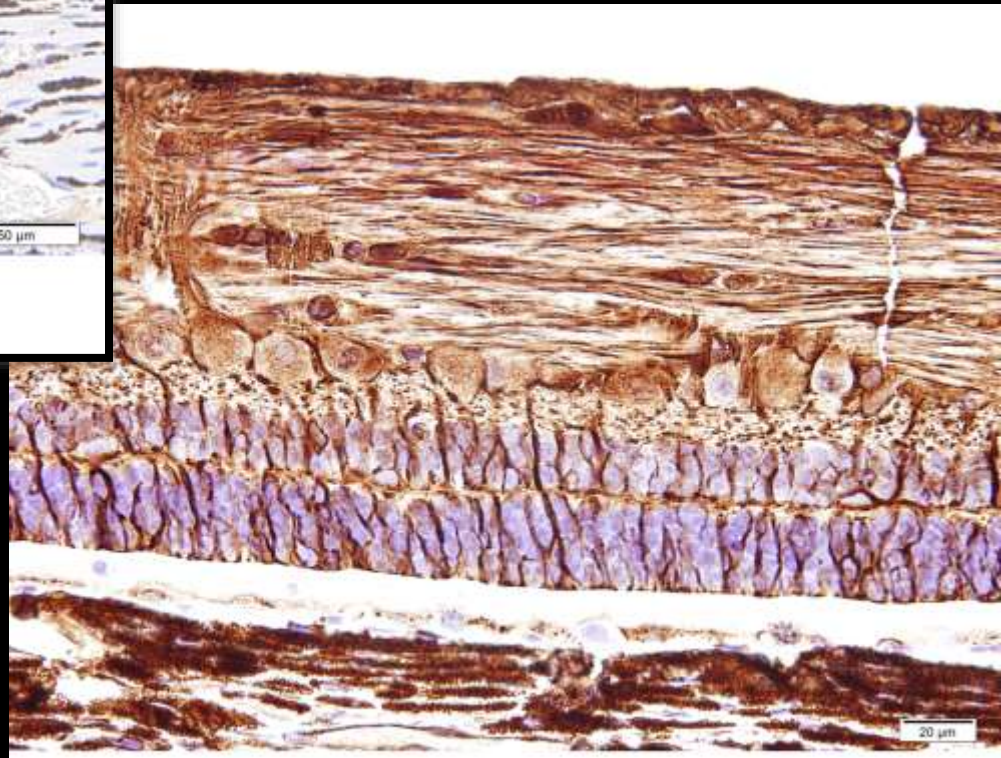


SARDS



CD204

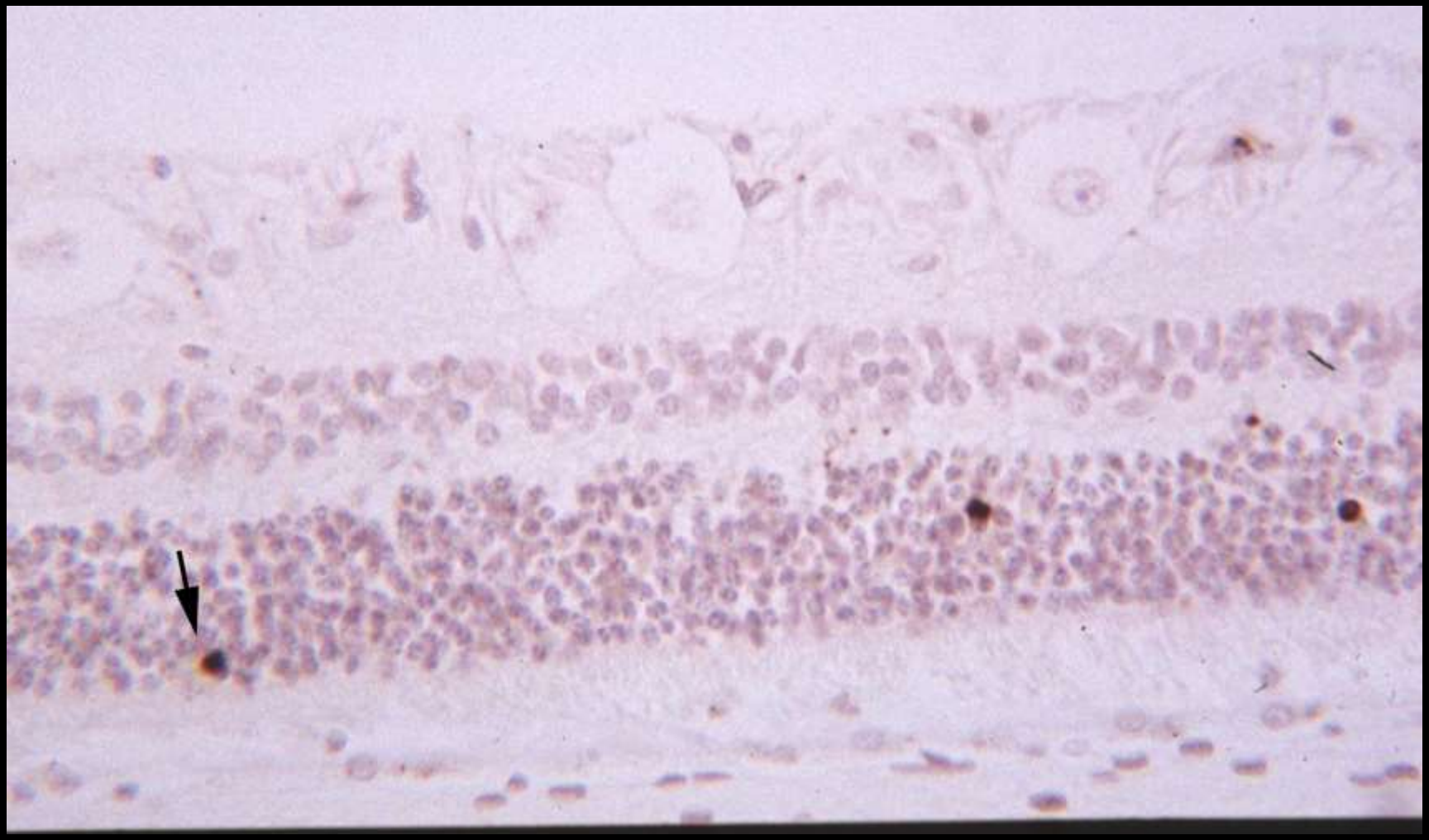
Increased phagocytic cells



Vimentin

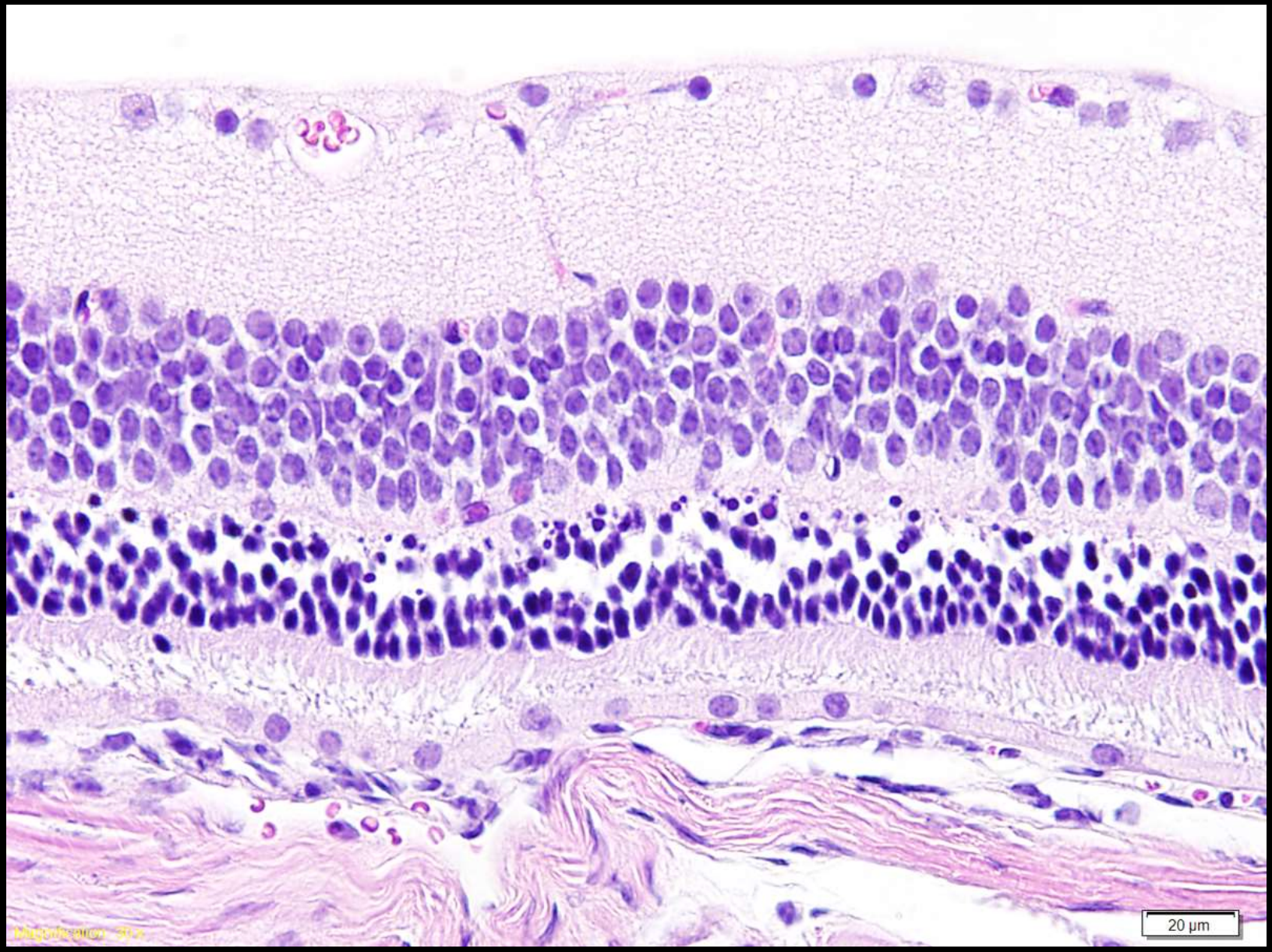
Increased Vimentin Expression

SARDS



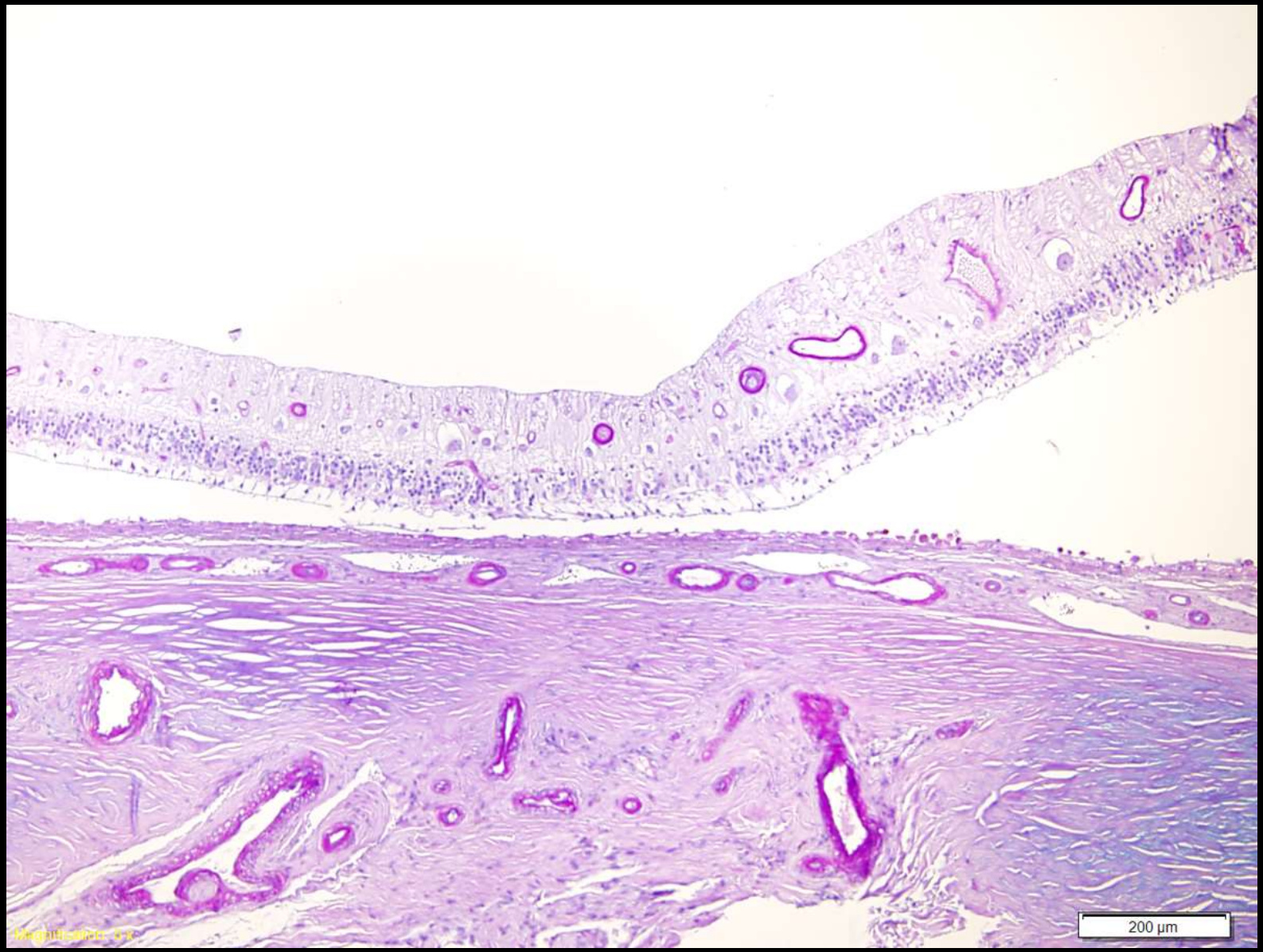
Apoptosis by TUNEL assay

Acute Phototoxicity in Albino Mice



Hypertensive Vasculopathy

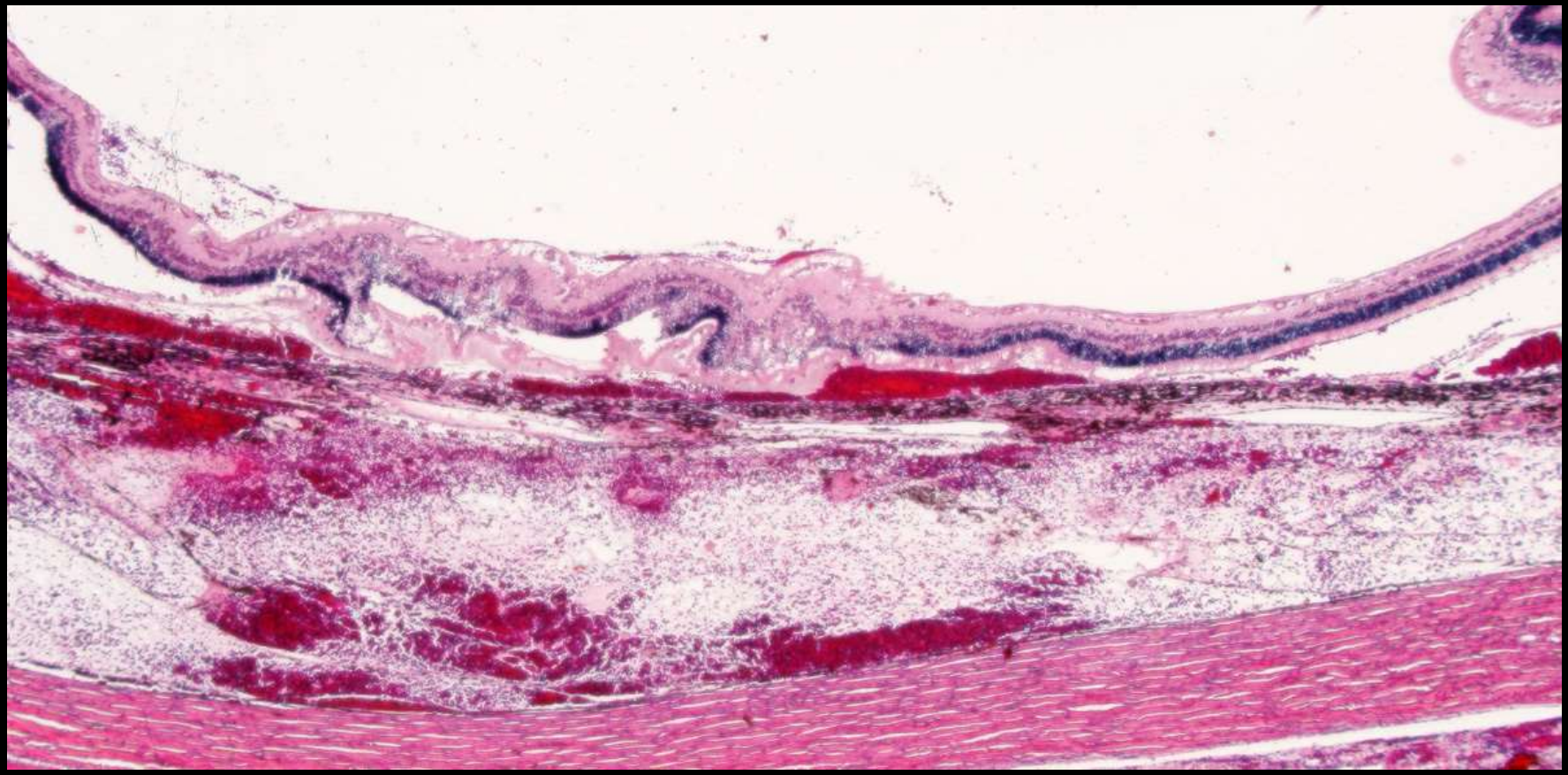
Feline

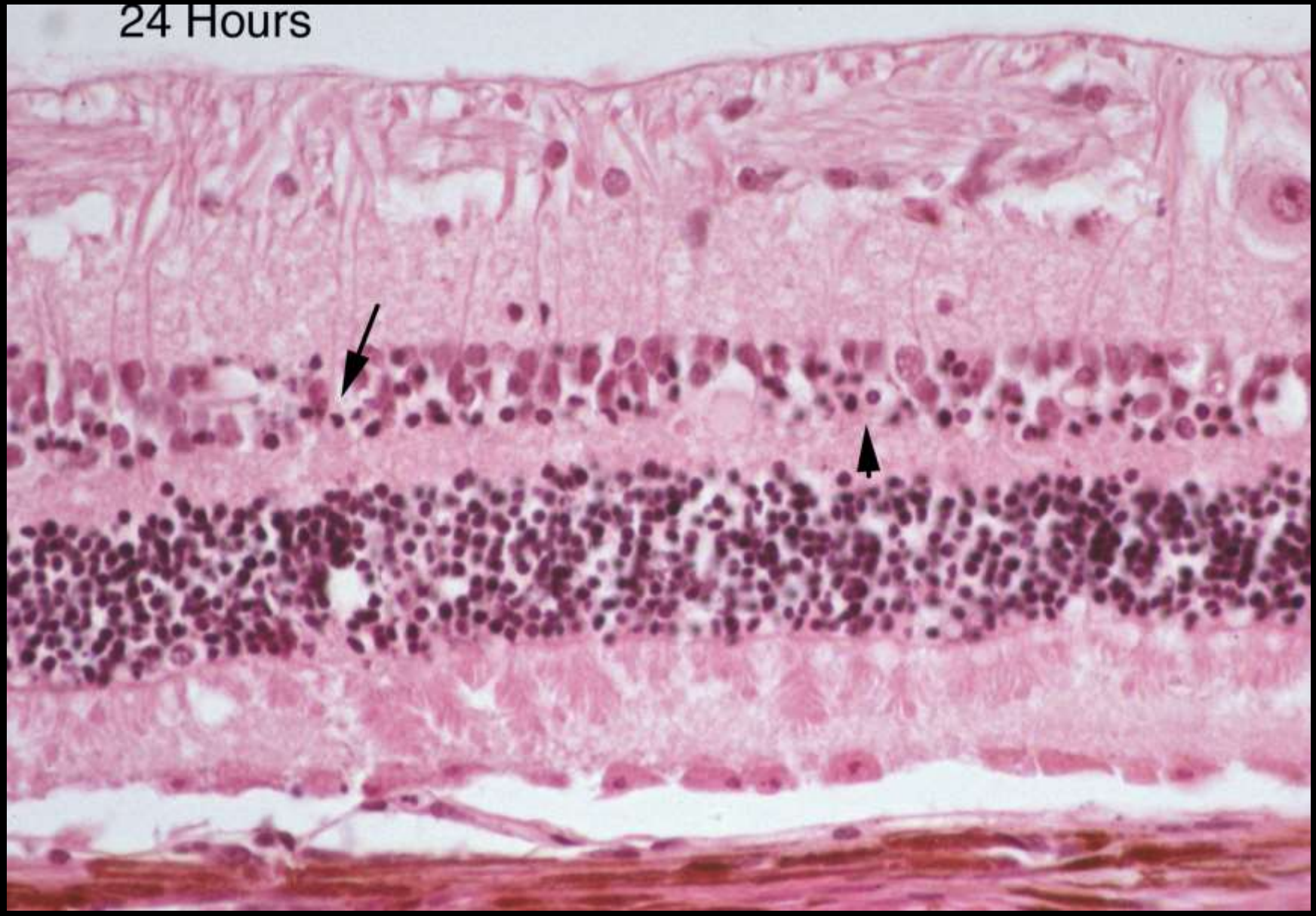


Retinal Trauma/Contusion

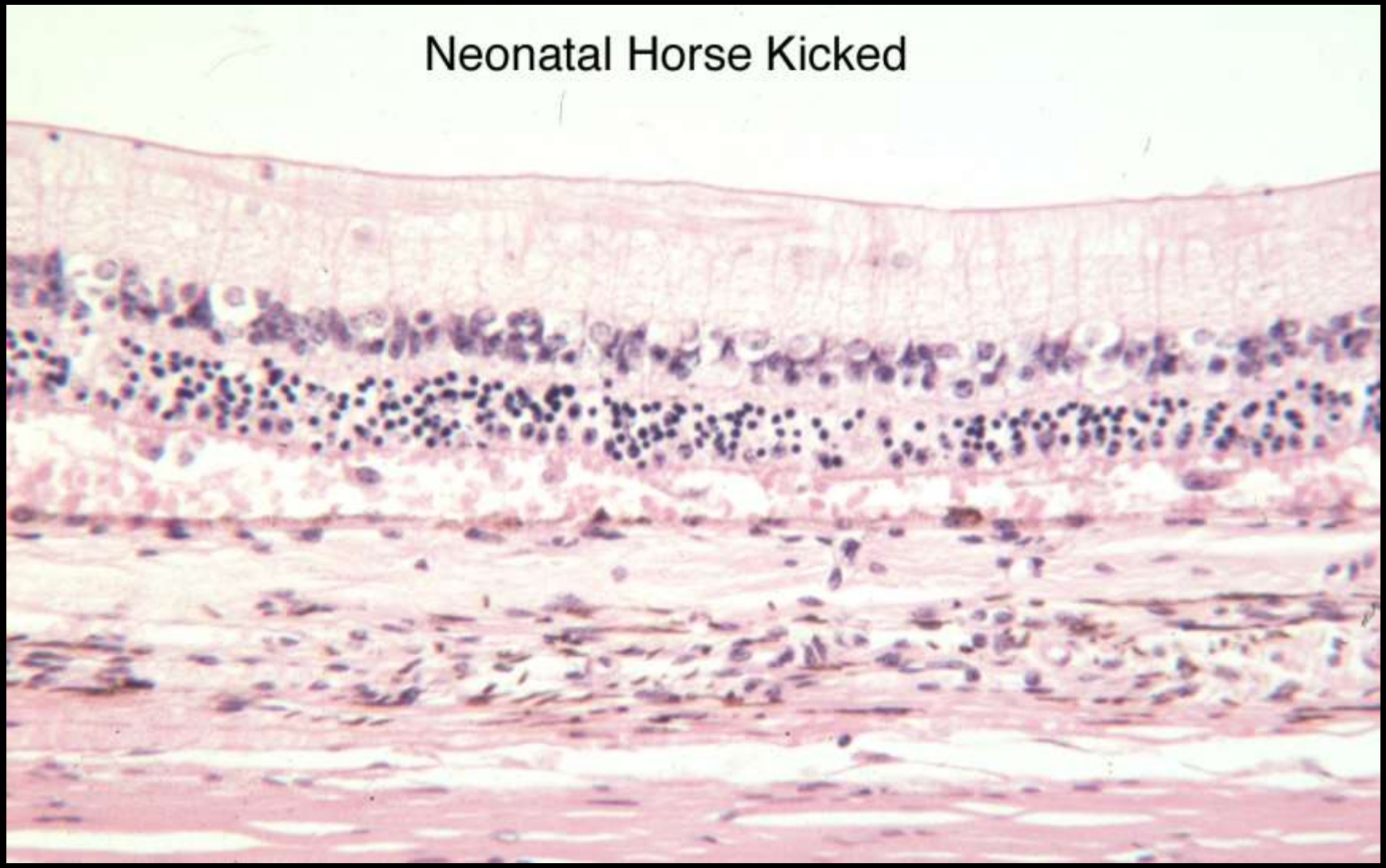
- A blunt blow to the eye at just the right force sets up an energy wave which propagates through the retina and fragments the tissue.
- A more powerful force will tear the retina, but not propagate as a wave.
- A less powerful force can cause reversible damage with no detectable structural damage.

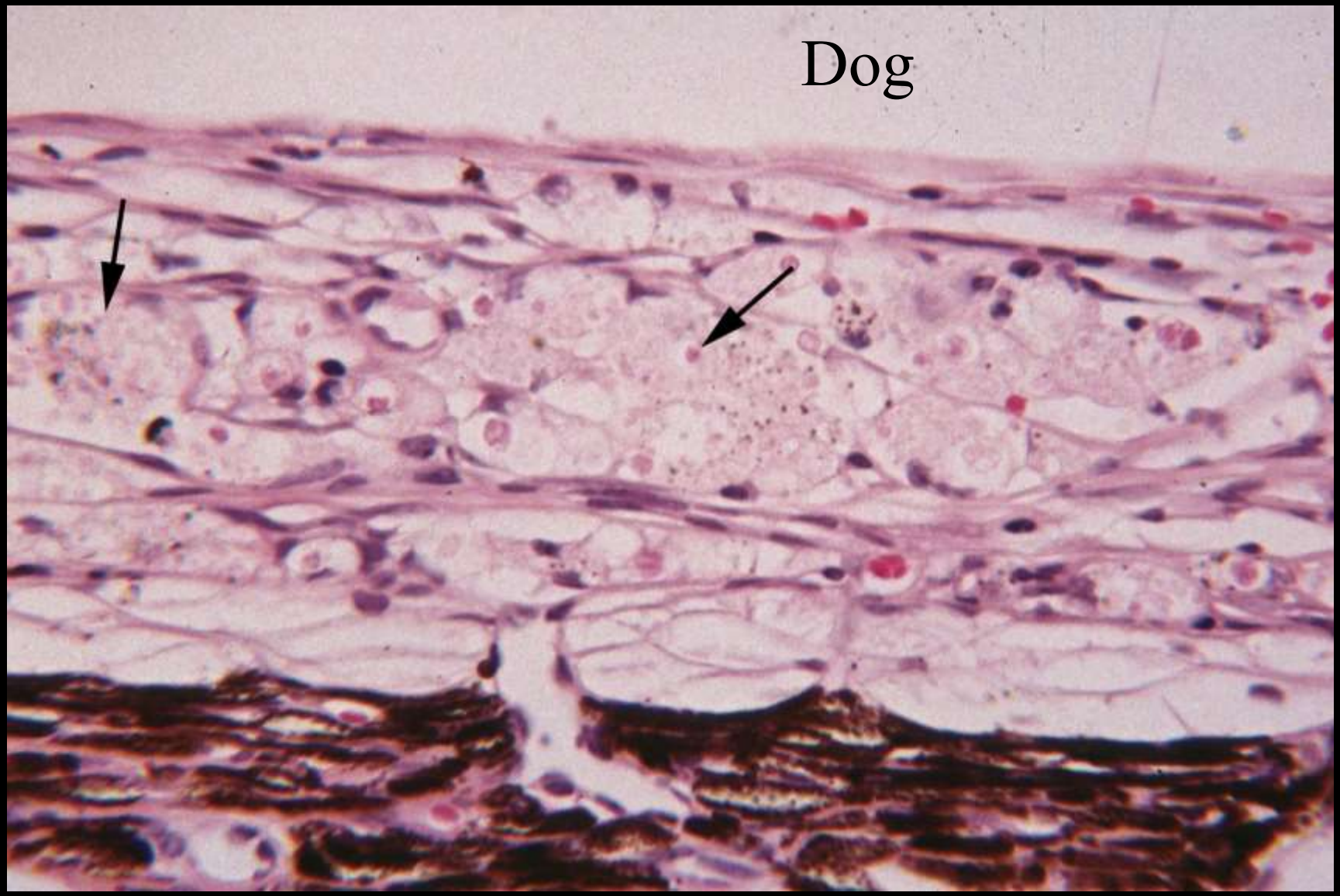
Acute Severe Trauma



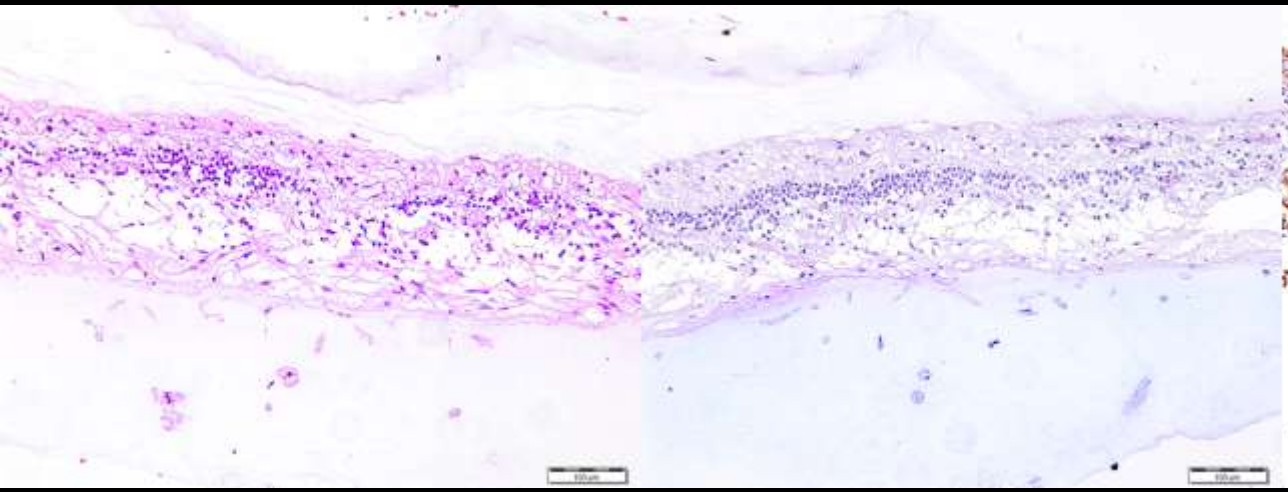

24 Hours

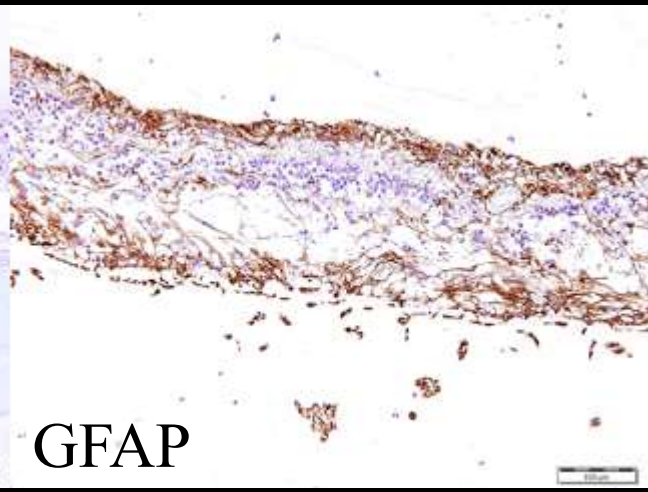
Neonatal Horse Kicked




Dog

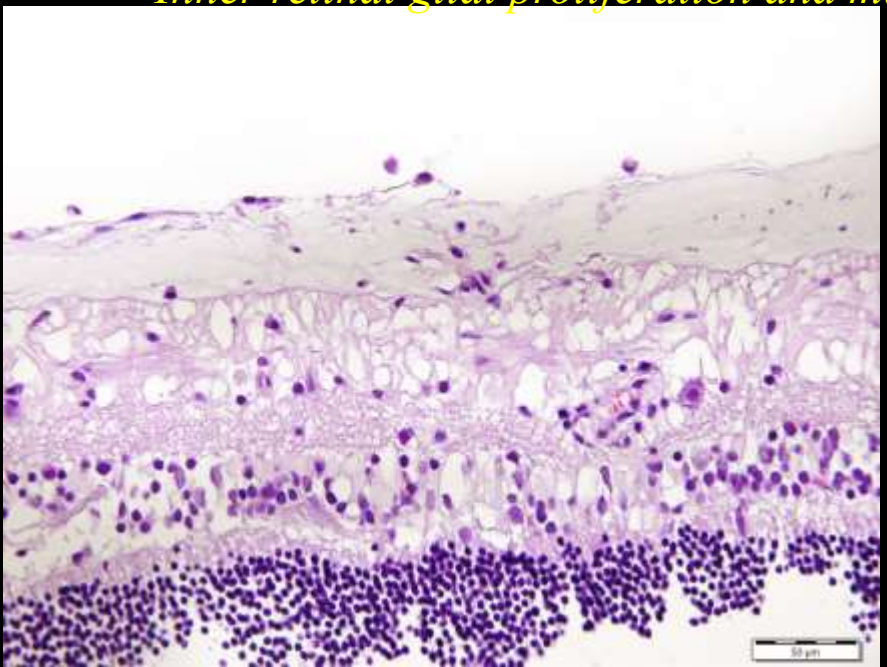
Chronic Traumatic Retinal Atrophy

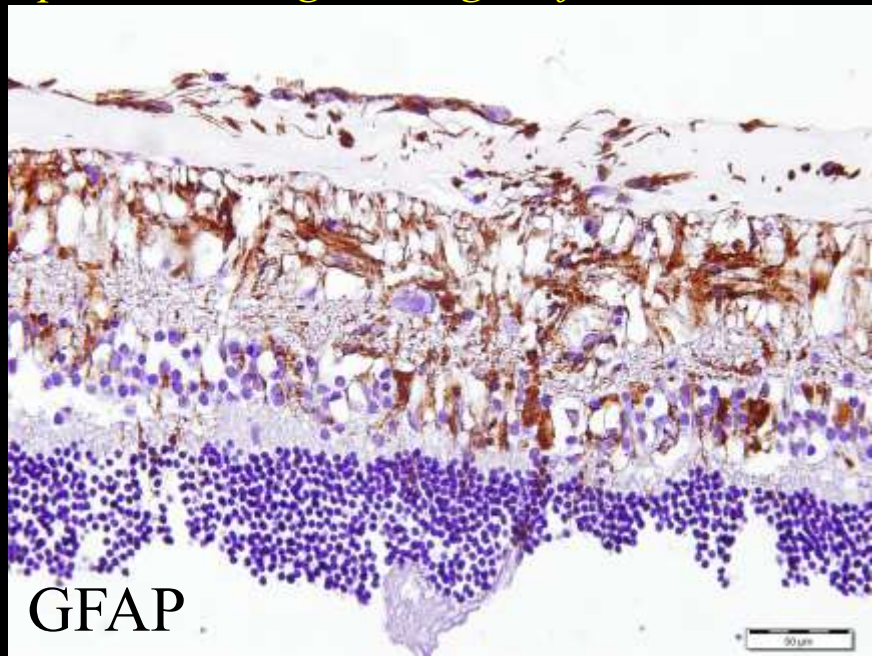




Outer retinal glial proliferation and mucinous deposits in a cat with scleral rupture

Inner retinal glial proliferation and mucinous deposits in a dog with signs of trauma






Owl

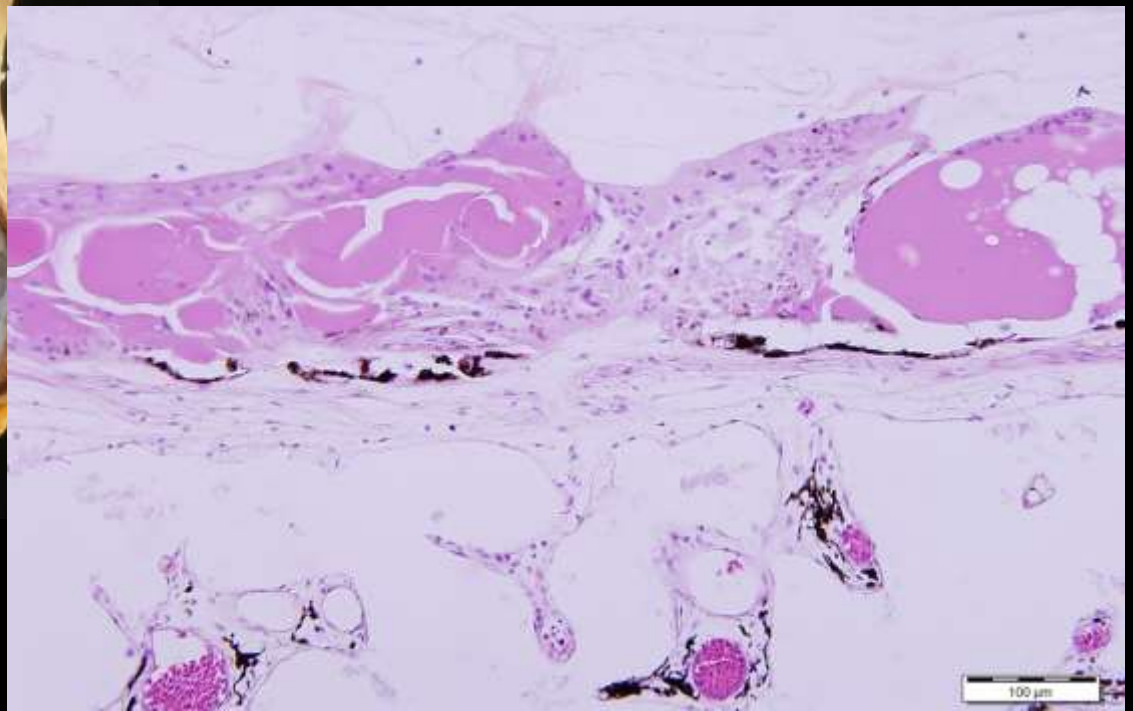
Lenticular metaplasia in the traumatized bird retina

- Lenticular metaplasia can be induced in vitro in the chick embryo, but not the hatched bird retina (Research that was popular until the mid-80s)
- Müller cells switch from GFAP to αA-crystallin
- Cells become phenotypical lens balloon cells

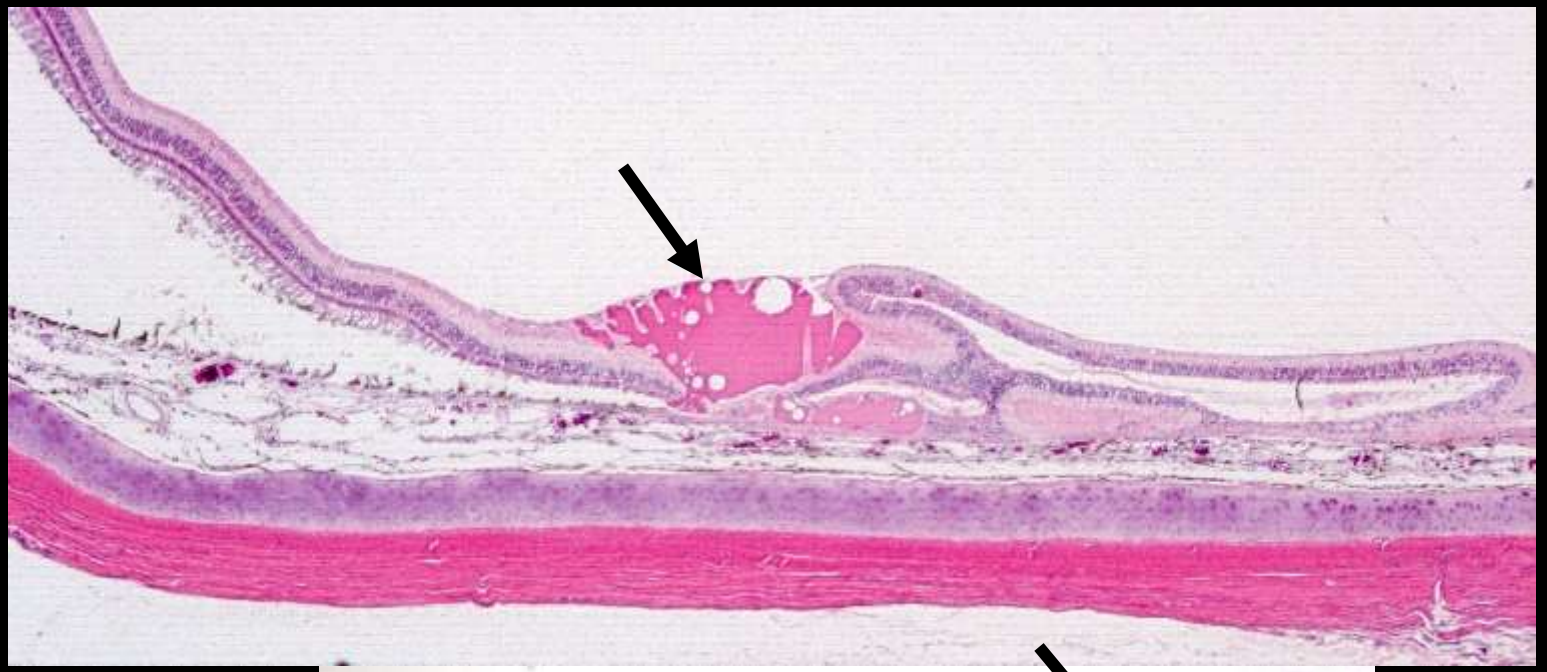
Lenticular Metaplasia

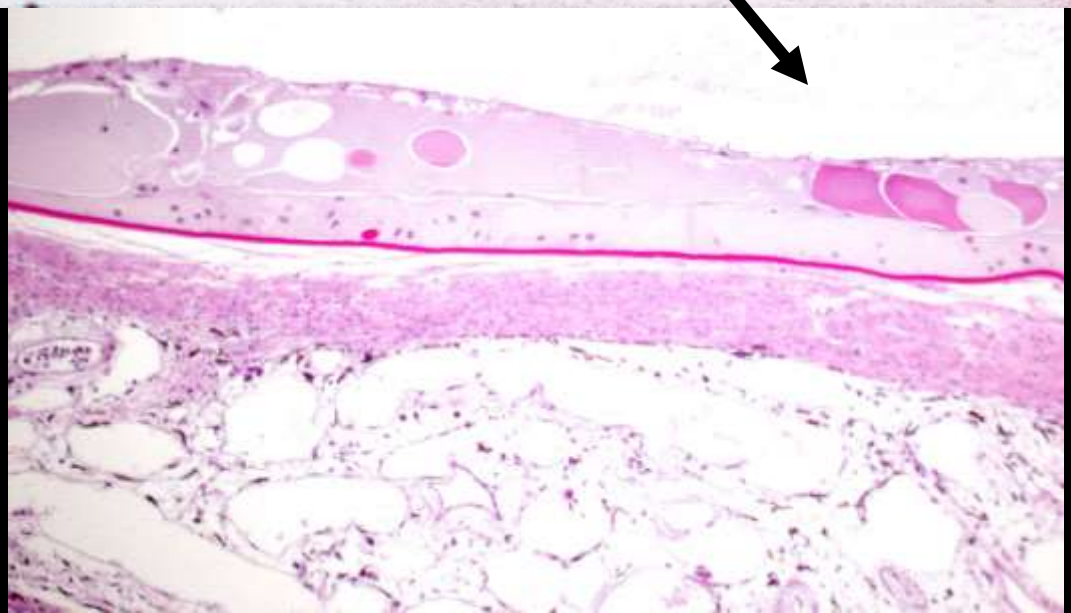
Lenticular Metaplasia

Lenticular Metaplasia

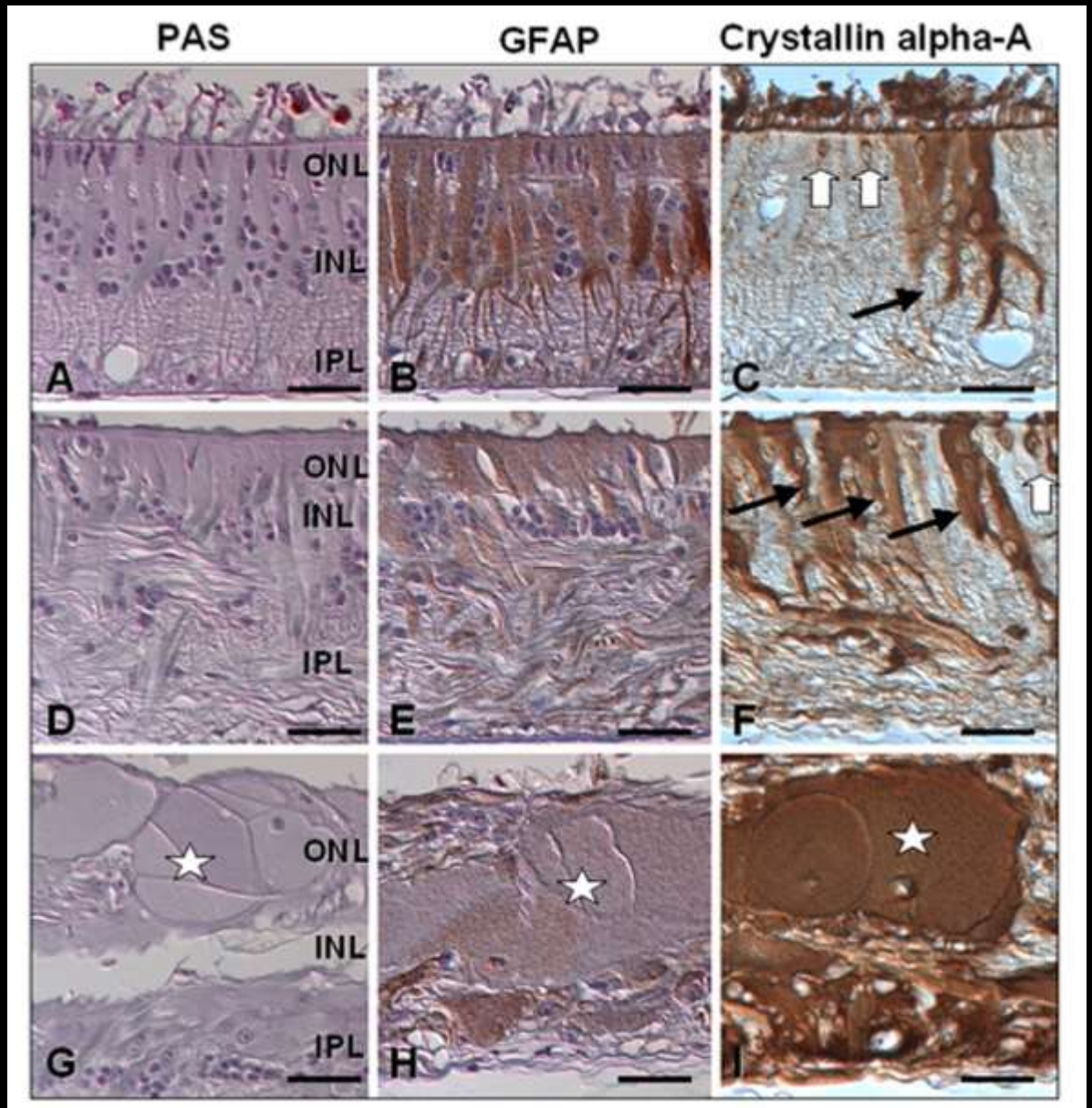


Lenticular Metaplasia





Lenticular Metaplasia

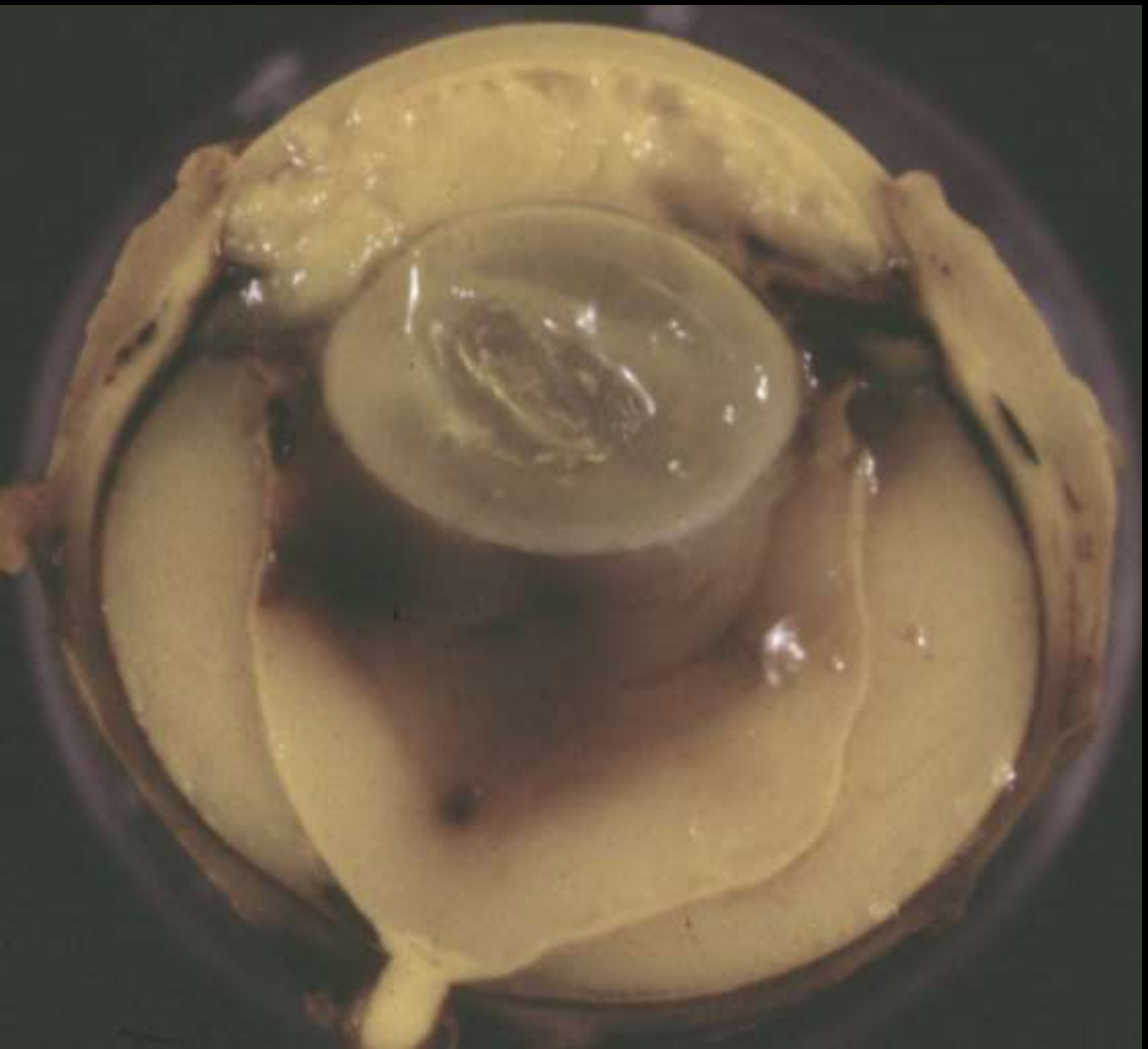


Zeiss & Dubielzig
Acquired Lenticular Metaplasia of Müller Cells in the Damaged Avian Retina. ARVO 2005

Retinal Detachment

- Normal retina prevented from detaching because of the tight junctions of the Müller cells and tight junctions at the apex of the RPE cells
- Vitreous body provides gentle support
- Morphologic features
  - Material in subretinal space
  - Hypertrophy of RPE cells
  - No outer segment fragments still attached to RPE
- Risk Factors for Detachment
  - Trauma
  - Vascular leakage
  - Retinal traction
  - Retinal holes

Retinal Detachment

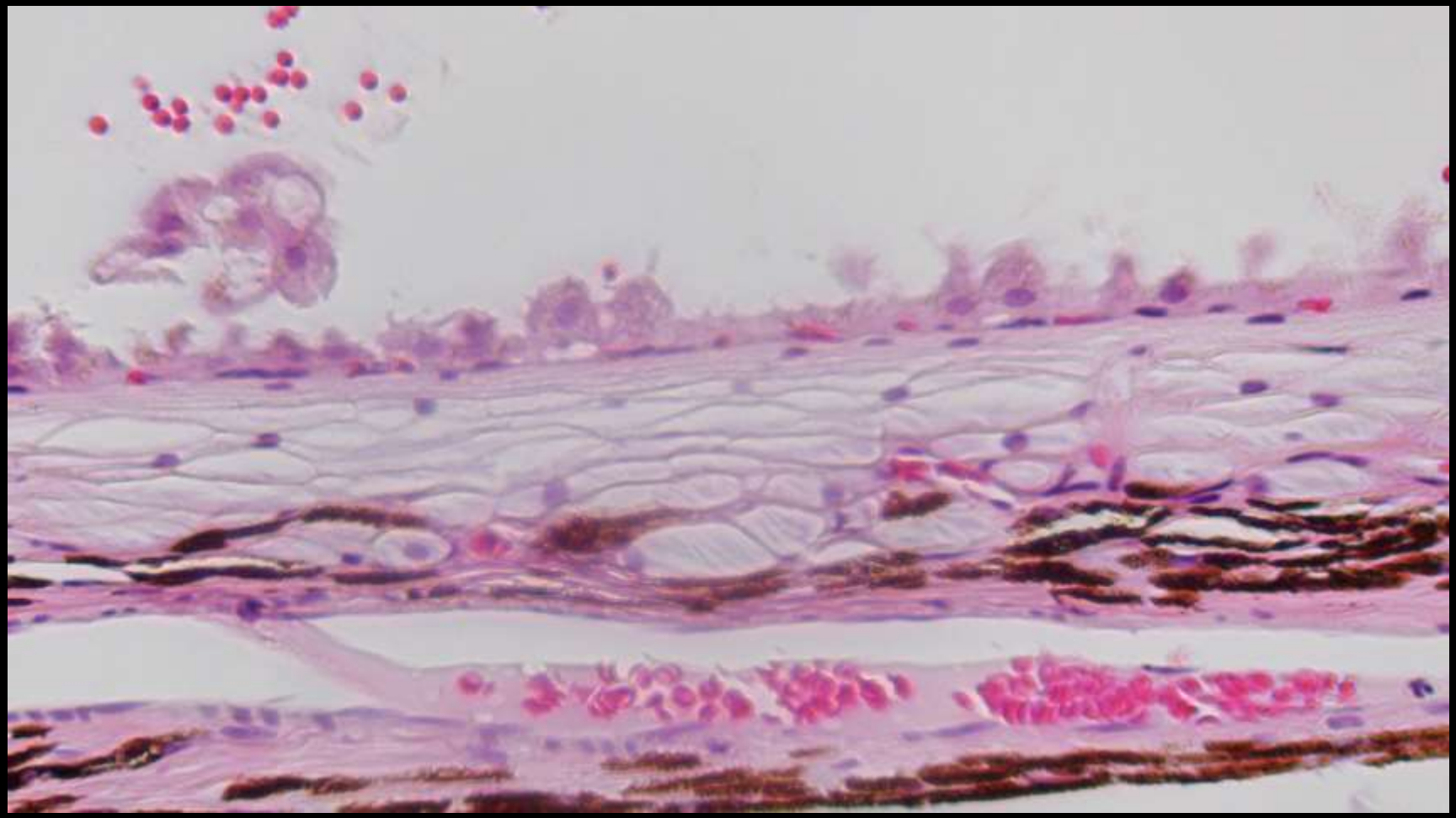


Subretinal fluid

Retinal Detachment

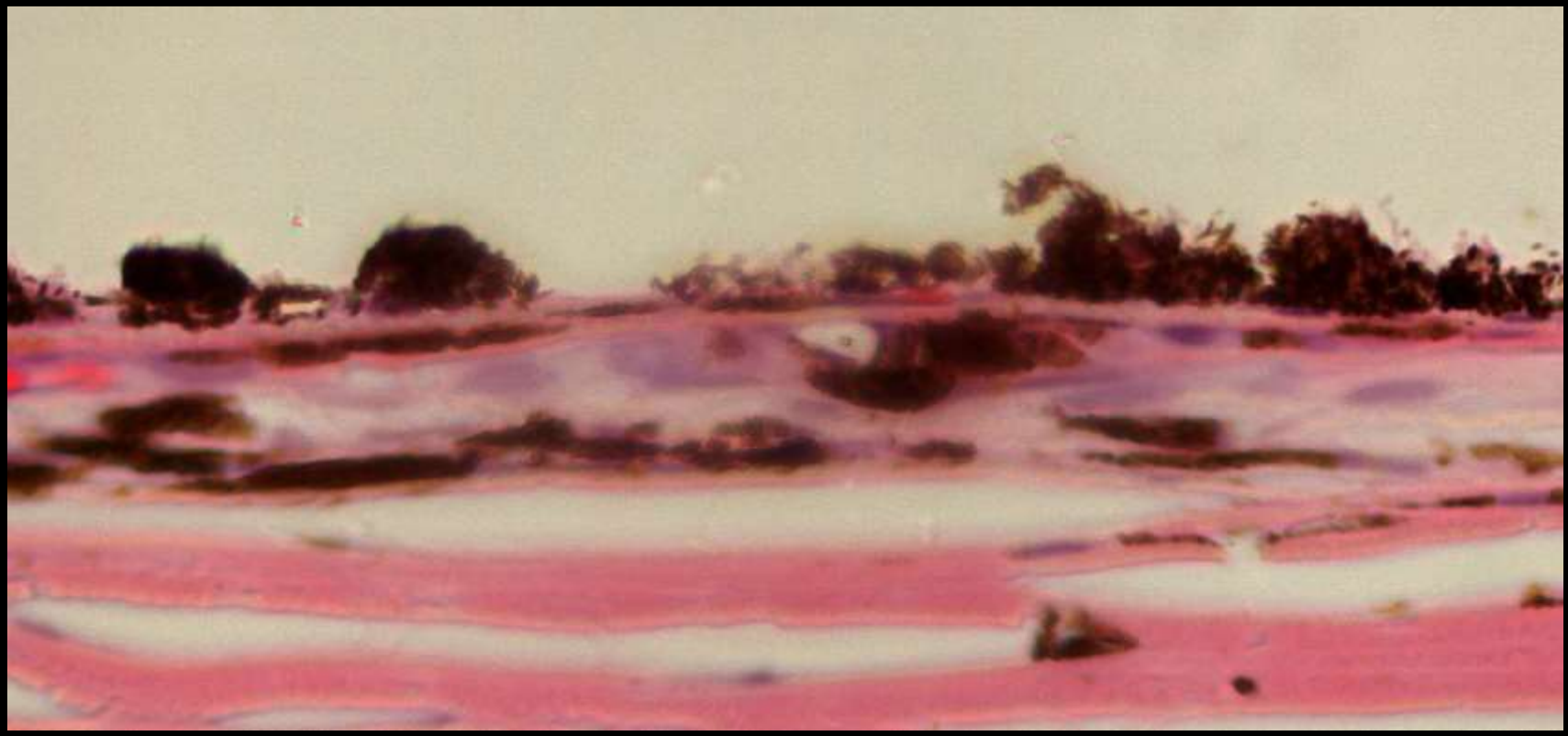
Giant Retinal Tear
(Equine)

Retinal Detachment



RPE hypertrophy, “tombstoning”

Retinal Detachment

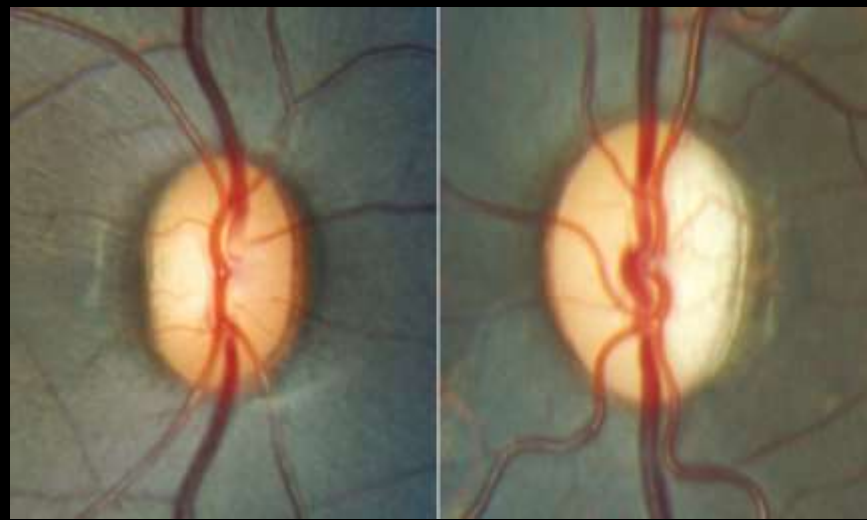


Not likely to be Retinal Detachment

Bilateral Optic Atrophy of Macaques

- Variable decrease in ganglion cells in the macula with NO OTHER changes in the retina
- Decreased axons in the temporal aspect of the optic nerve and NO OTHER changes
- No behavioral changes noted
- Severe changes can be picked up on fundoscopy but the mild changes are difficult to recognize
- Not detected on standard ERG
- Severe changes associated with VEP
- Southeast Asian origin???

Affected



Bilateral Optic Atrophy of Macaques

Normal Male

Bilateral Optic Atrophy of Macaques

Normal Male

Bilateral Optic Atrophy of Macaques

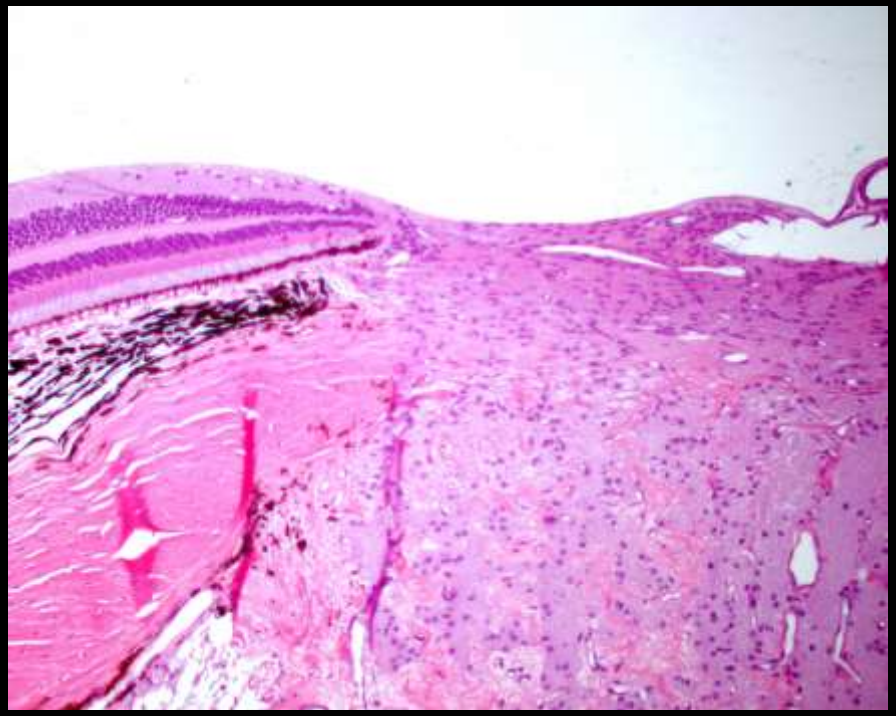
Severely Affected Female

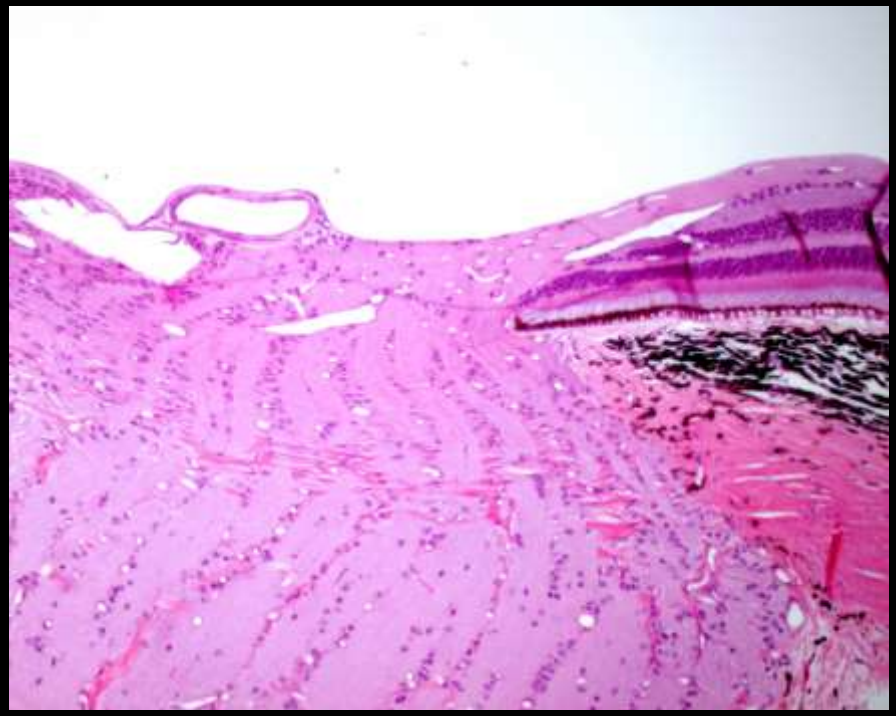
Bilateral Optic Atrophy of Macaques

Severely Affected Female

Temporal

Nasal





Bilateral Optic Atrophy of Macaques

Severely Affected Female

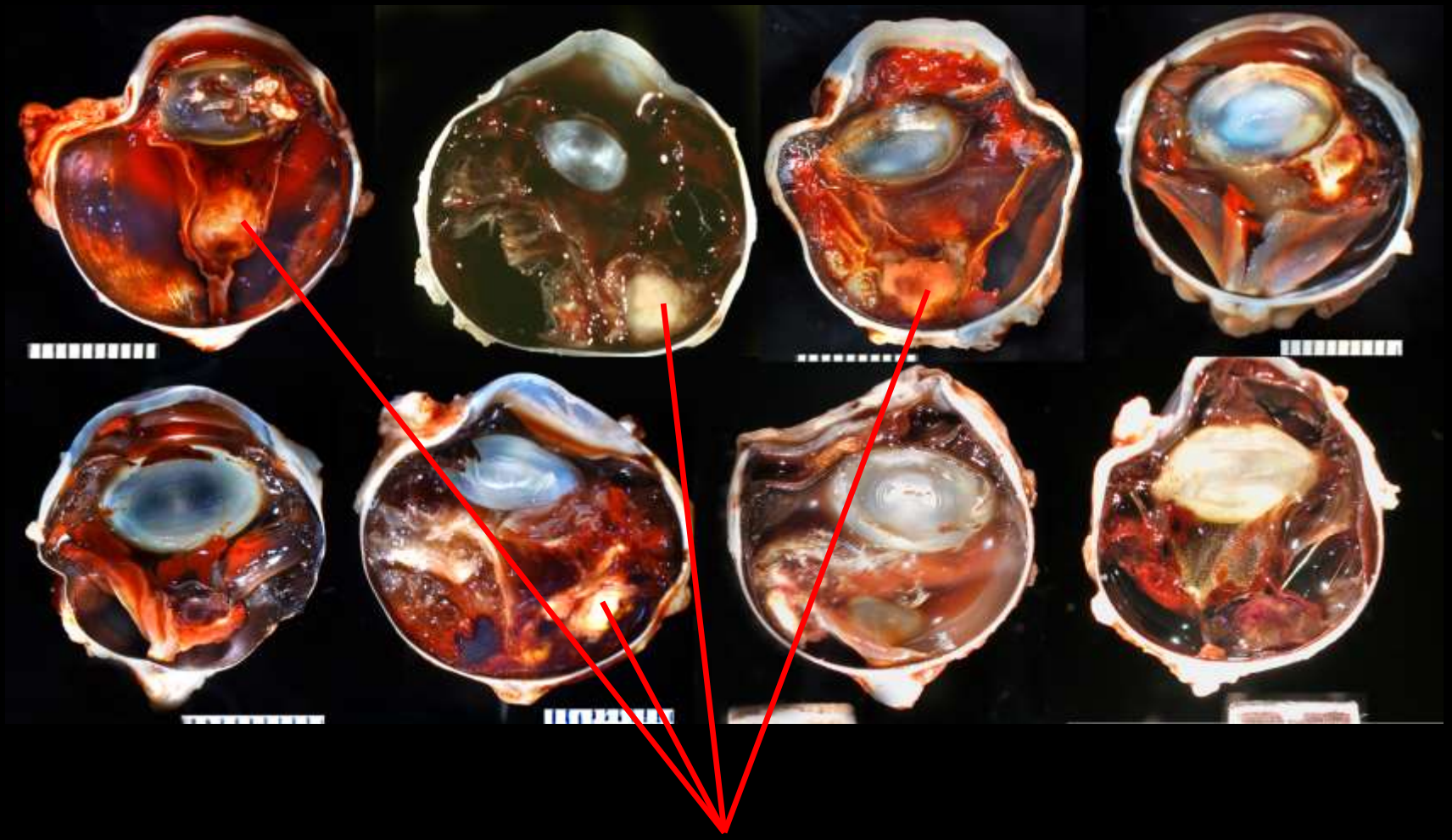
Bilateral Optic Atrophy of Macaques

Moderately Affected Female

Hypertensive Choroidal and Retinal Vasculopathy

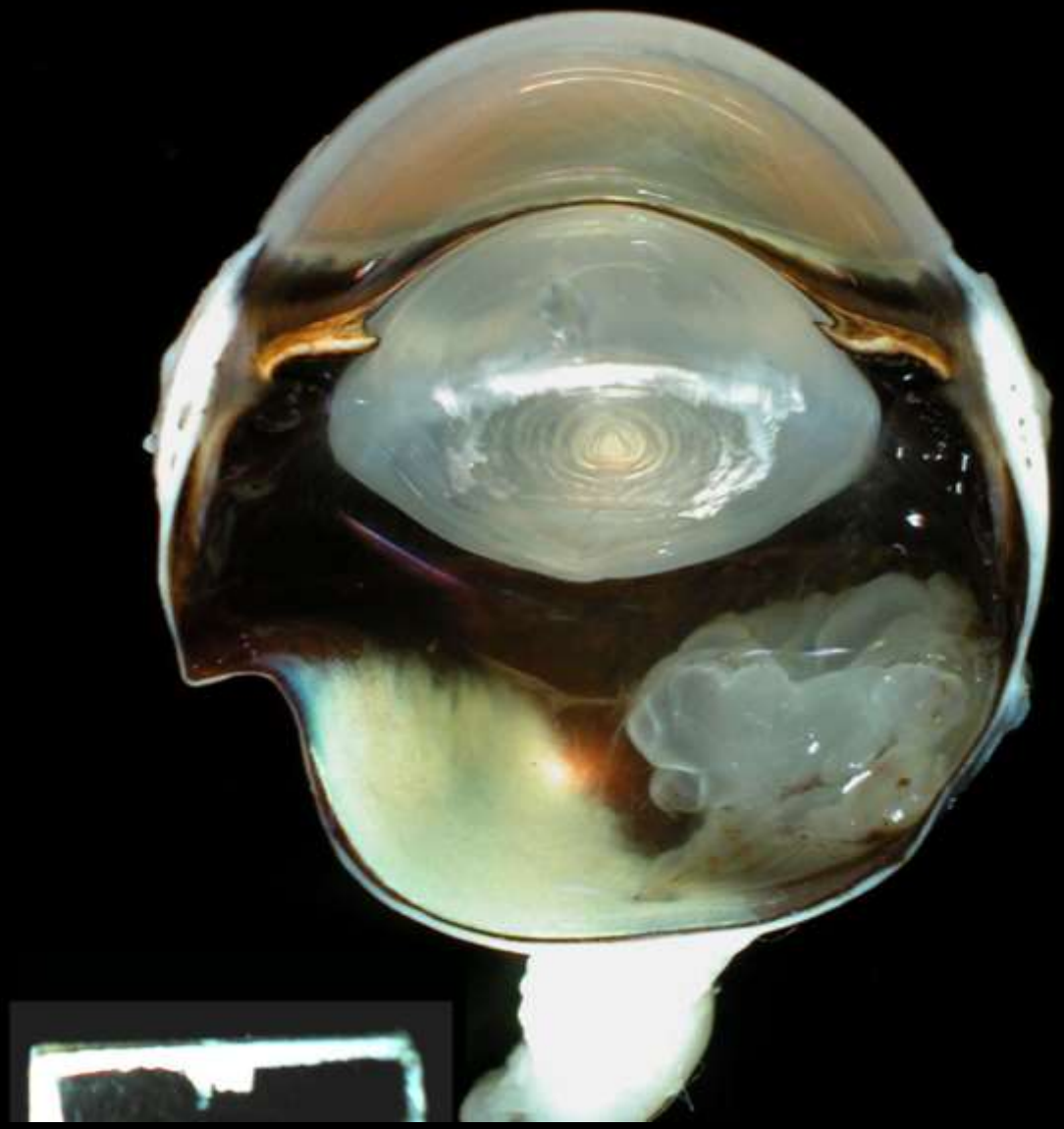
- Affects both dogs and cats
- Vascular disease can be localized and needs to be searched for with a PAS stain
- Hemorrhage, retinal detachment
- Can see iris hemorrhage in cats only

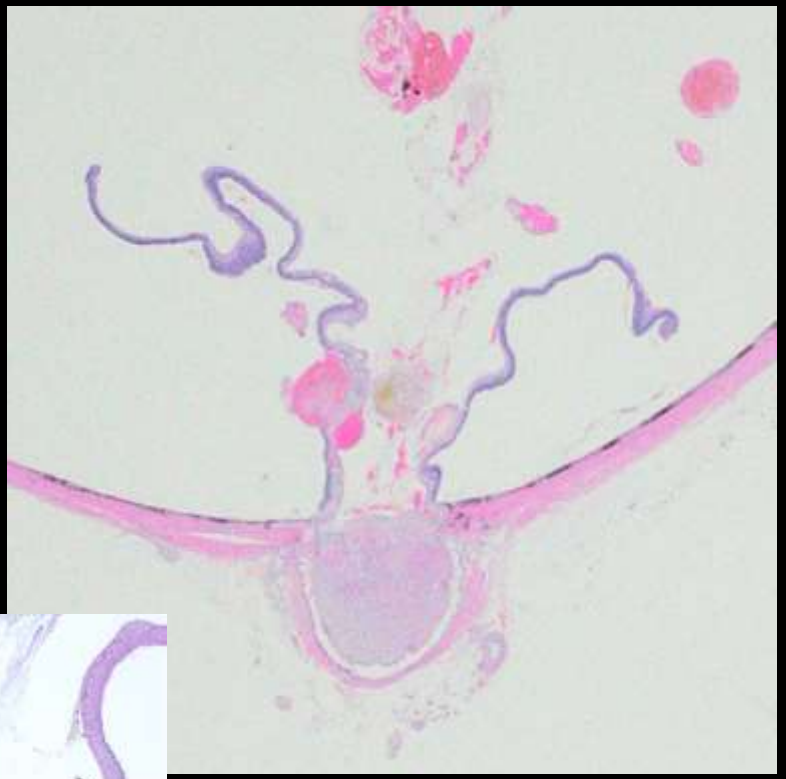
Hypertensive Vasculopathy

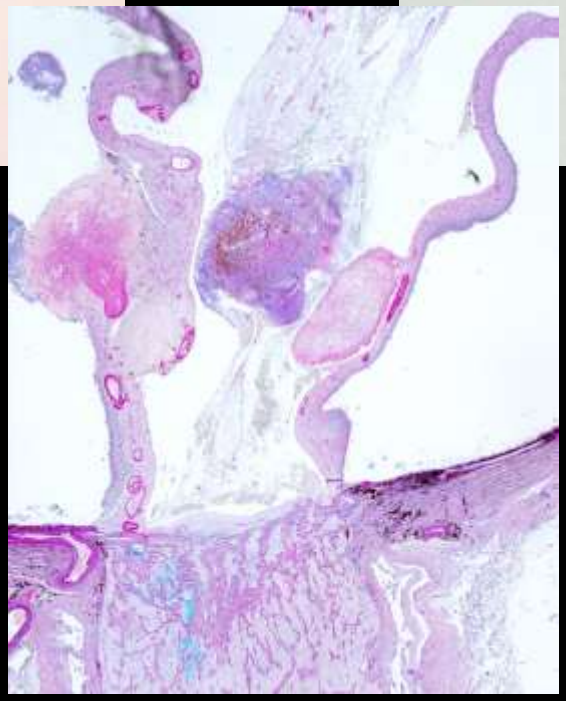


Fibrinoproliferative Lesions

Hypertensive Vasculopathy





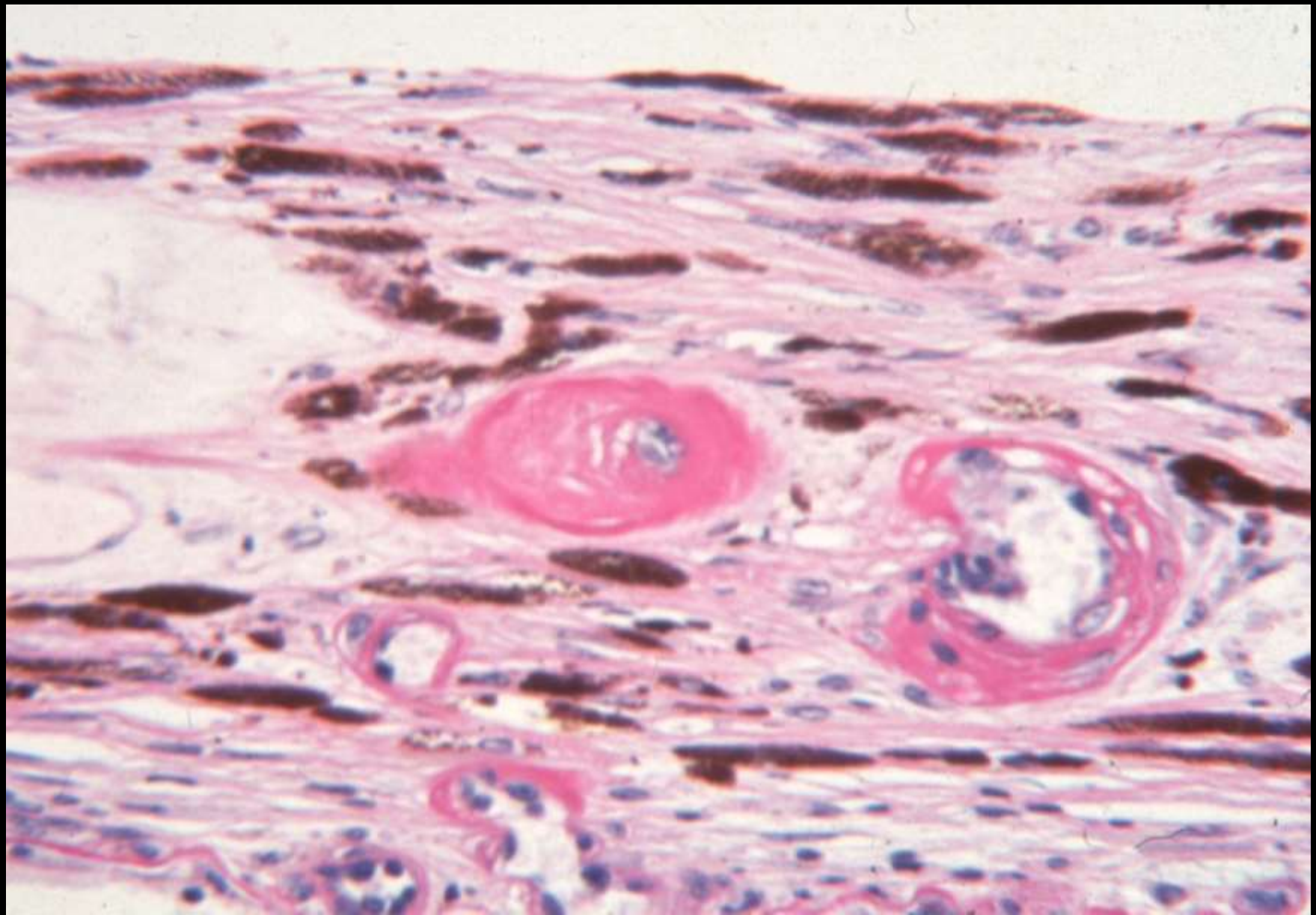


Hypertension

Fibrinoproliferative Lesion

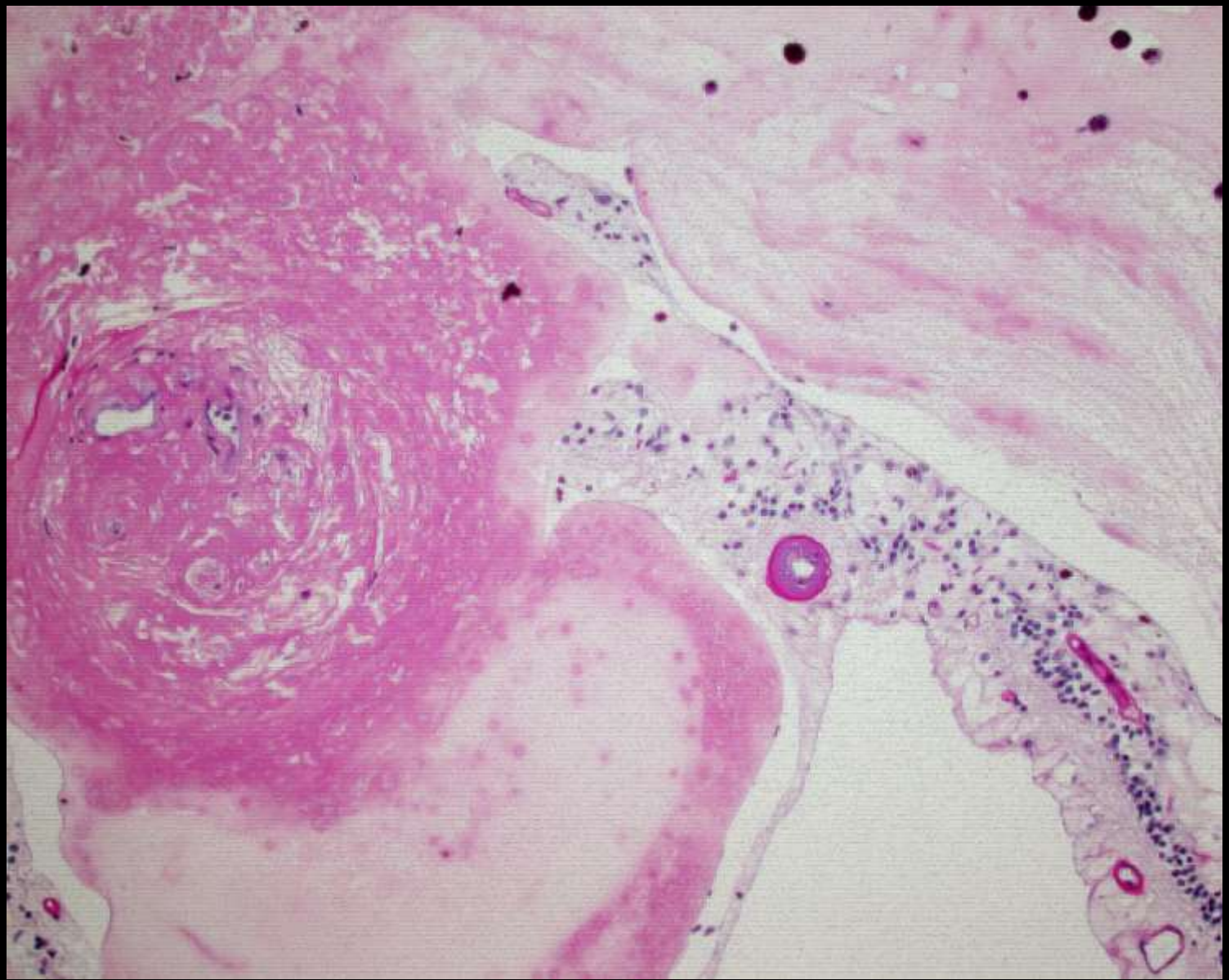
Hypertensive Vasculopathy

Hypertensive Vasculopathy



Systemic Hypertension

Fibrinoproliferative Lesion

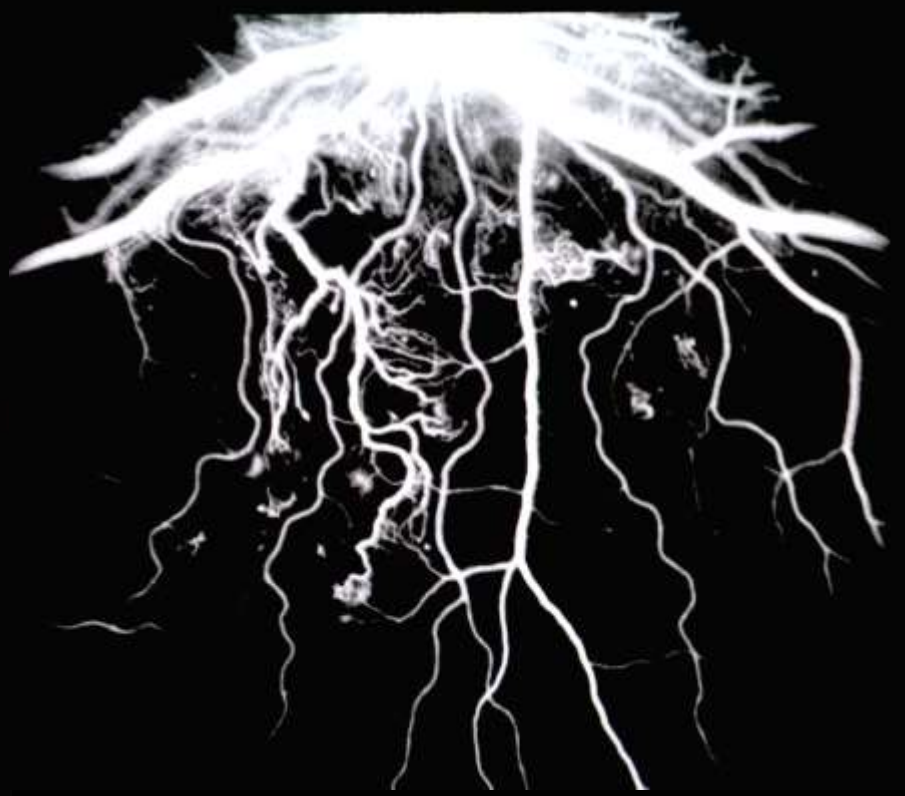


Experimental Diabetic Retinopathy in Dogs

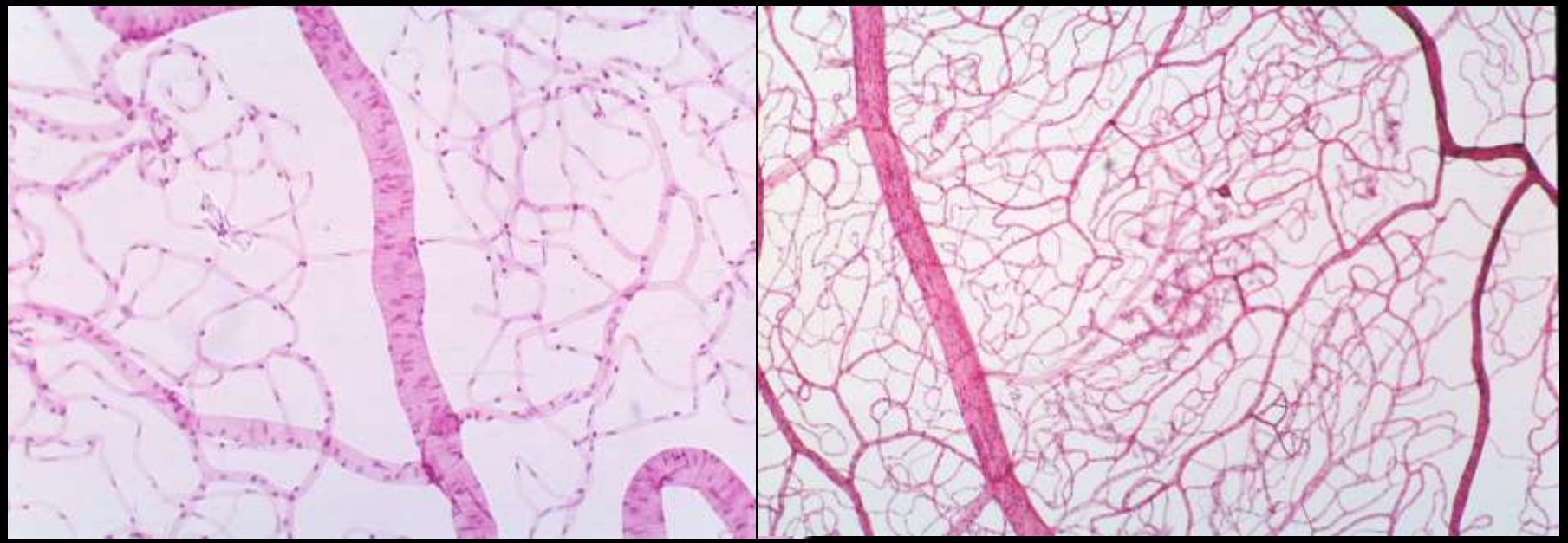
Dr. Ron L Engerman

- Although clinical complications of spontaneous diabetic retinopathy in dogs are extremely rare, the dog has successfully been used experimentally to induce diabetic retinopathy.
- Proliferative neovascularization and retinal detachment are the only features which cannot be induced.

Canine Experimental Diabetic Retinopathy



Canine Trypsin Digest



Normal

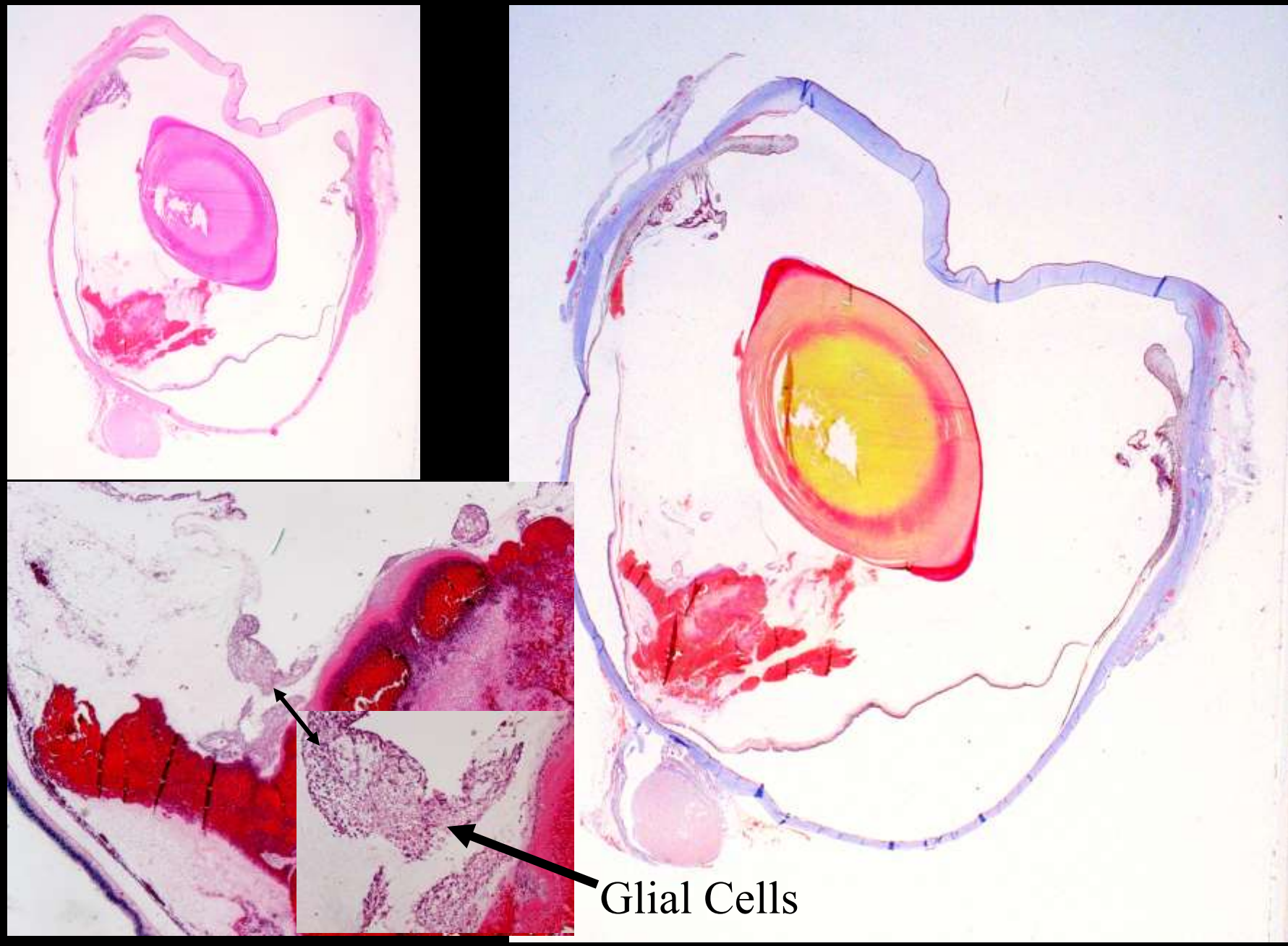
Diabetic

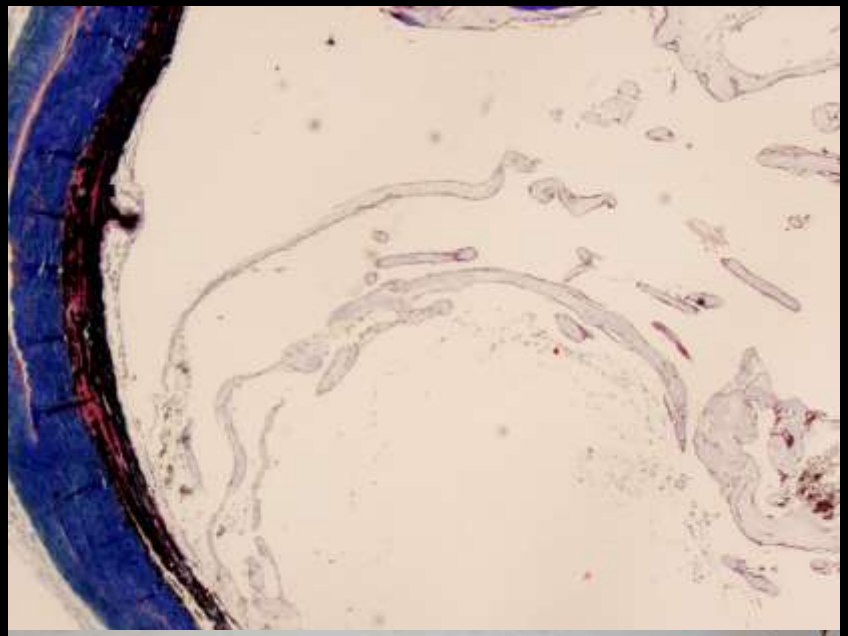
Canine ocular gliovascular syndrome

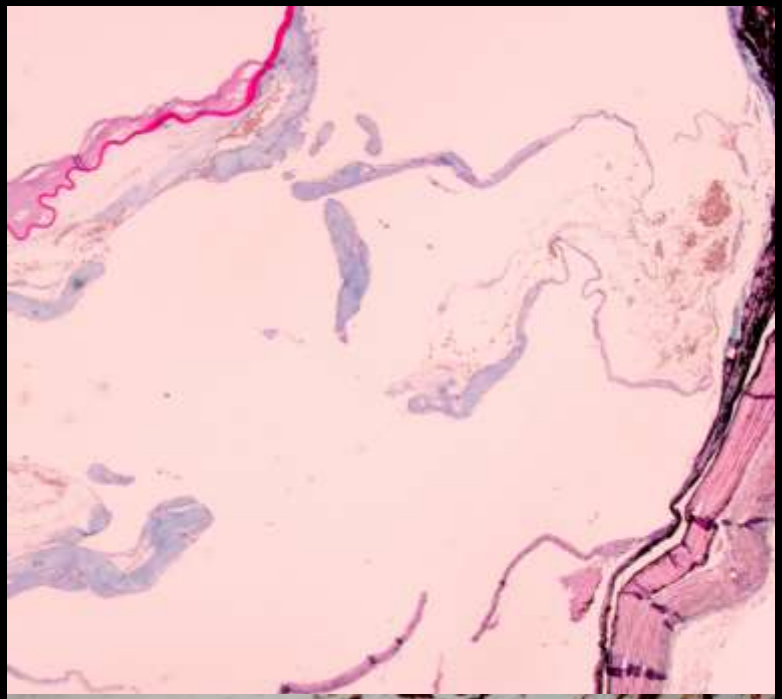
- The syndrome consists of the following:
  - About half the cases are Labrador Retirievers
  - Intraocular hemorrhage
  - Neovascular glaucoma
  - Retinal detachment
  - Clusters of GFAP+ cells in the vitreous behind the lens
  - Neovascular proliferation extending into the vitreous from the retina or optic nerve head
    - Glassy hyalin collagen surrounds the neovascular proliferation

Canine ocular gliovascular syndrome

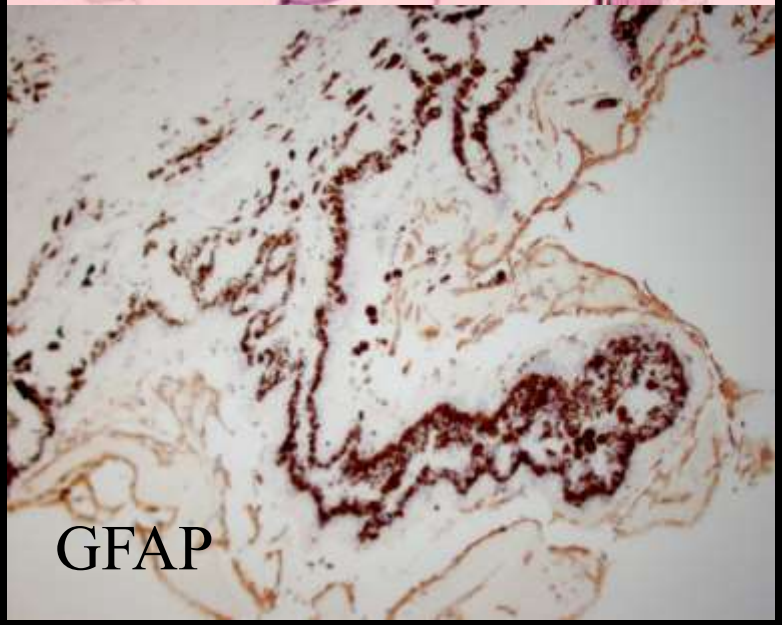
Canine ocular gliovascular syndrome


Glial Cells



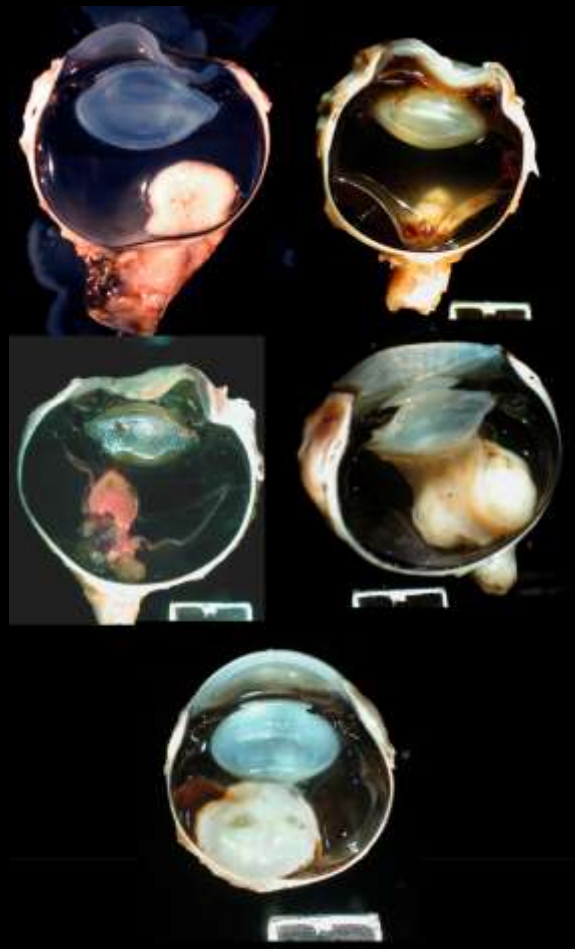



GFAP

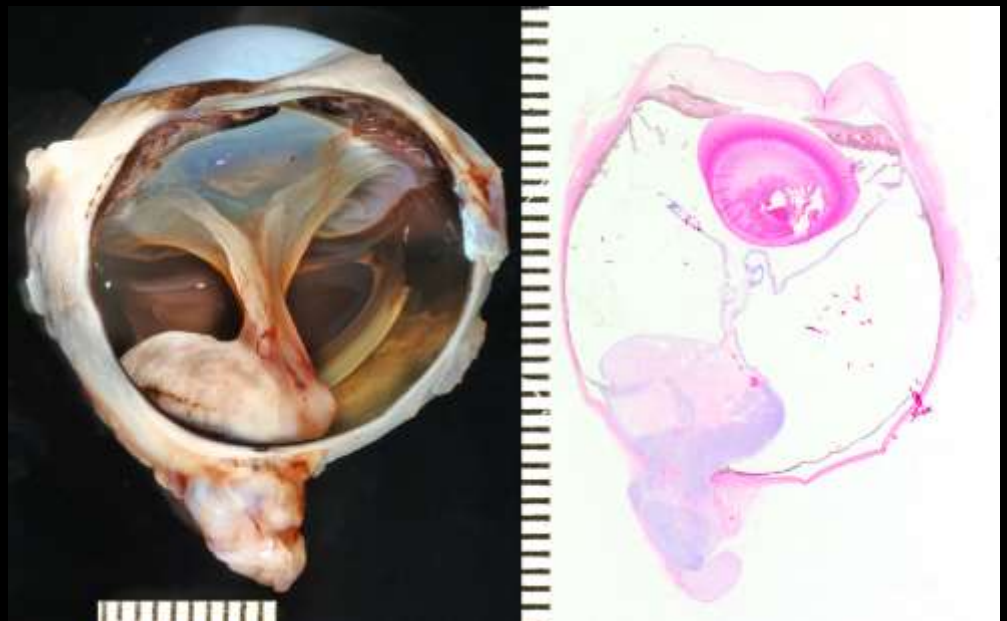

GFAP

Retinal Tumors in dogs

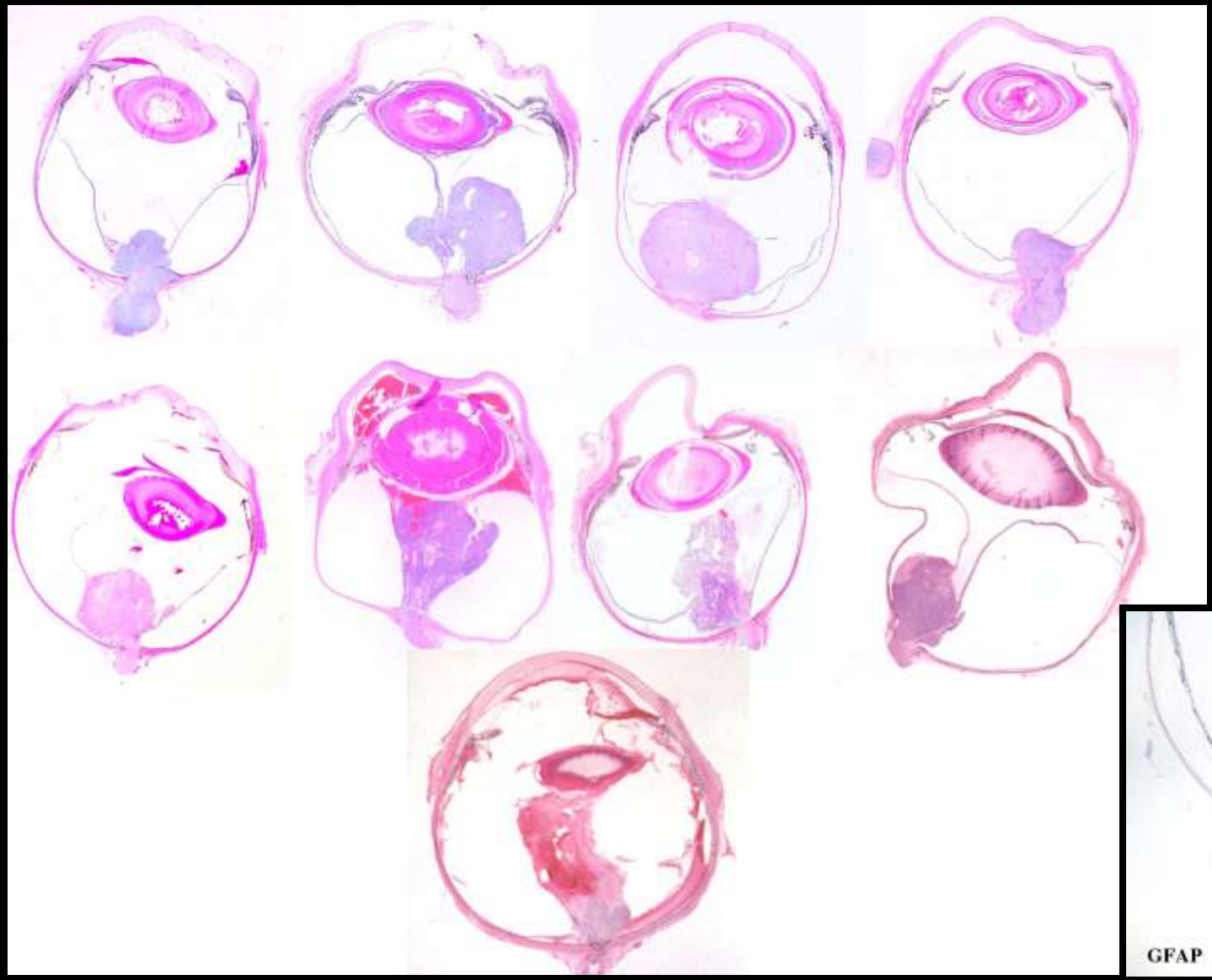
22 cases in COPLOW/5964 total tumors



- **Glioma (astrocytoma)**
  - GFAP+
  - Usually central +/- extension into the optic nerve
  - Optic nerve extension determines prognosis

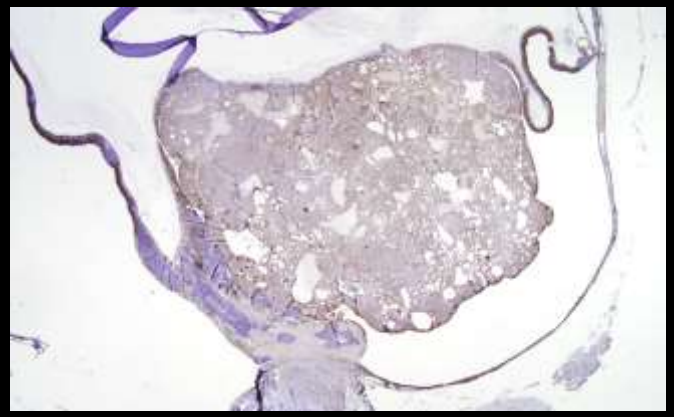


Retinal Tumors in dogs



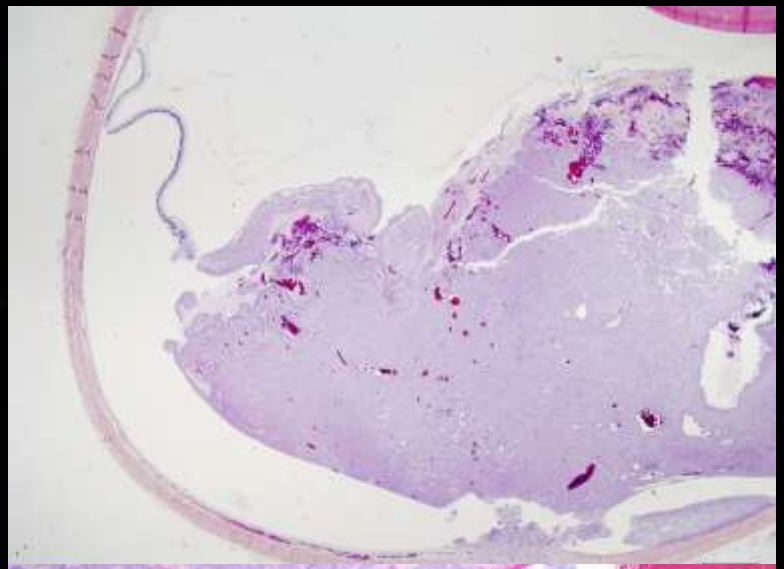
Neuroretinal Tumors
PNET

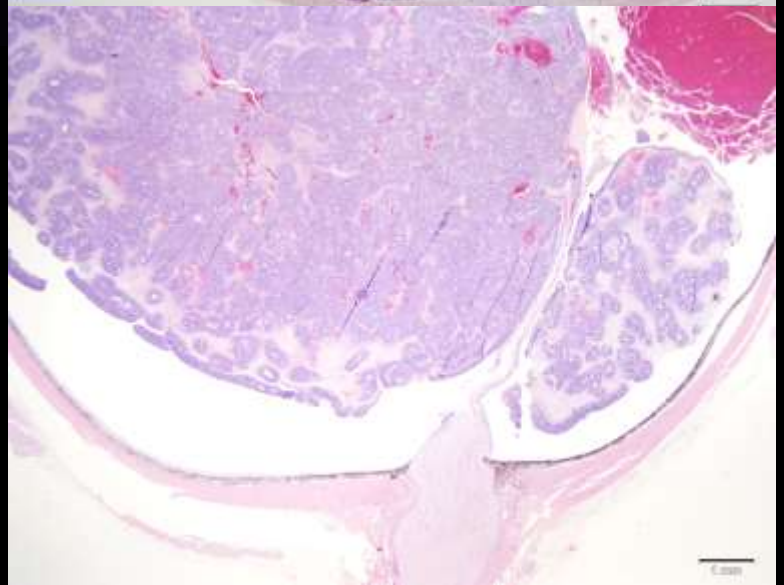
GFAP



Synaptophysin

Neuroretinal Tumors
PNET





Retinoblastoma, human