

Eye – Pathology

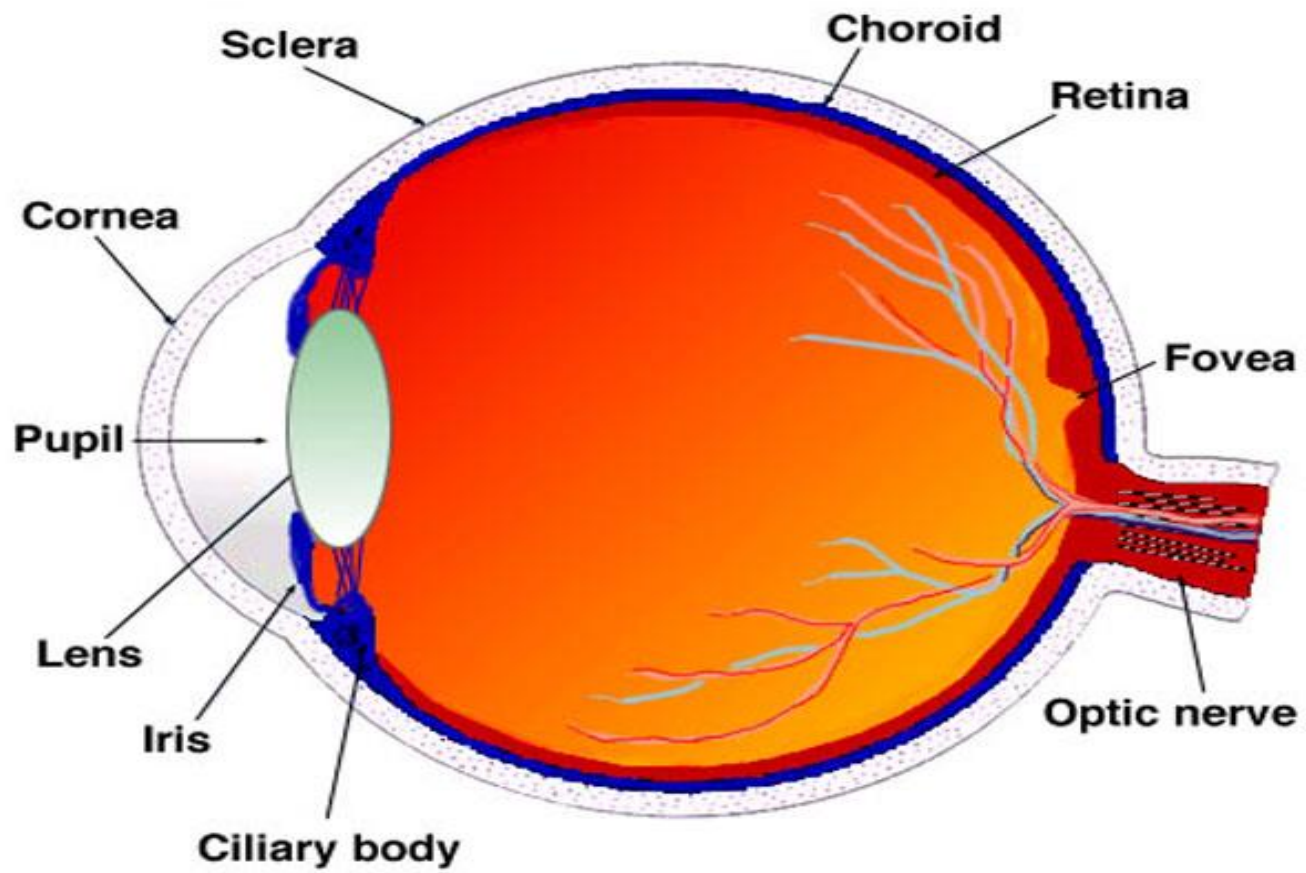
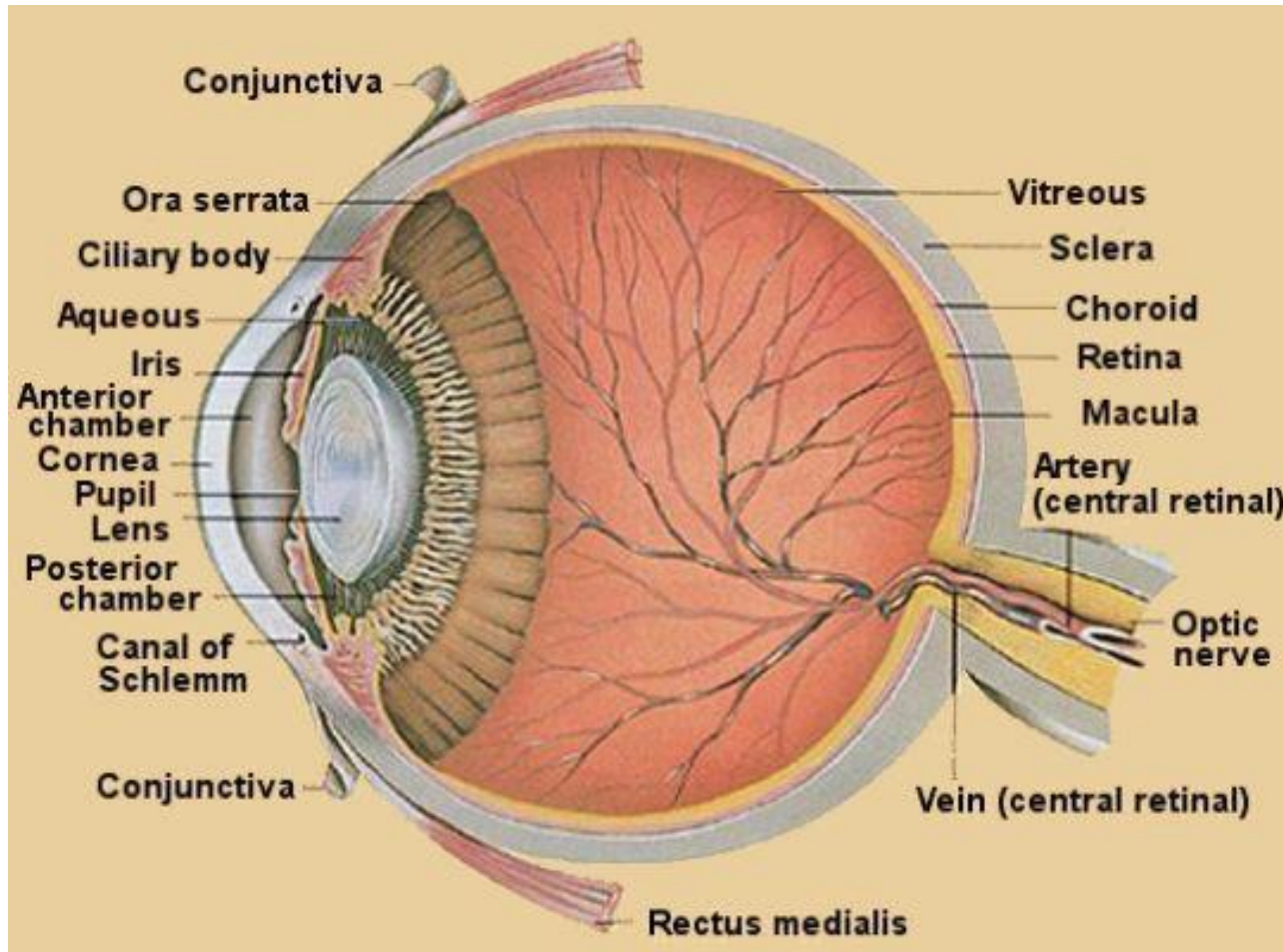


Fig. 6. Vertical sagittal section of the adult human eye.

Eye



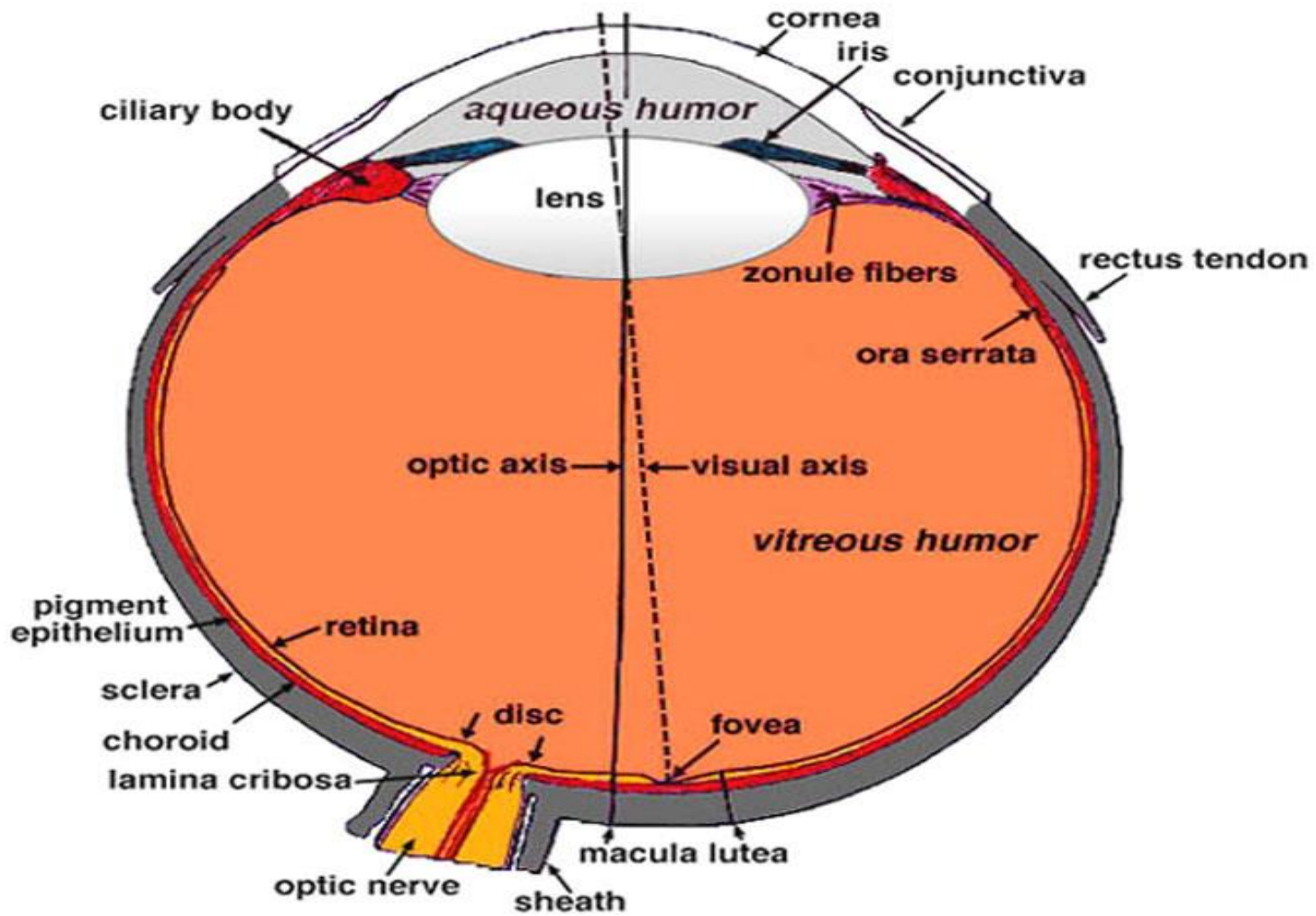


Fig. 2. Sagittal horizontal section of the adult human eye.

Anatomical features

- The eye ball is located in the bony cavity of the skull known as the orbit. It is protected by eyelids, which have skin on the outside and stratified squamous epithelium (the conjunctiva) lining the surface that comes into contact with the eyeball.
- The borders of the eyelids have eyelashes containing hair. Just behind the eyelashes are a row of tiny sebaceous glands, the meibomian glands, the secretion of which serves to lubricate the eyelashes, preventing their adhesion.
- The lens is a peculiar structure composed entirely of epithelium. It has neither stroma nor vascular tissue. In front it is bathed by the aqueous humor and is nourished by it.
- Actually the anterior surface of the lens forms the posterior boundary of the anterior chamber. Its anterior surface is in contact partly with the iris. Its posterior surface fits into the depression of the vitreous- the hyaloid fossa.
- Physiological considerations
- Usually, the conjunctival mucosa is free of bacteria either due to the flushing action of the tears or to the bacteriostatic property of the lysozyme.

CONGENITAL ANOMALIES OF THE EYE



Anophthalmia congenitus- Complete absence of one or both eyes.

- This condition was reported in foals, pups, calves and piglets. Histological examination may reveal remnants of some ocular structures.

Microphthalmia - Microphthalmia is a condition in which one or both eyes are small. The condition was reported in swine and dogs

Cyclops- Condition in which there is only one eye due to fusion of the orbits and is seen in monsters.

Ankyloblepharon - condition in which both the eyelids are fused together

Strabismus - **Squint** of human beings. In animals this condition is seen with the two eye globules turning inwards.

- Squint is seen in Siamese cats in which it is congenital. This has also been reported in calves of beef breed and in **collie dogs**.



Entropion -Turning in of the eyelids and is hereditary congenital condition seen in sheep, dogs and foals.

Ectropion - turning out of eyelids. Usually the lower eyelid is affected. This is also a hereditary condition.

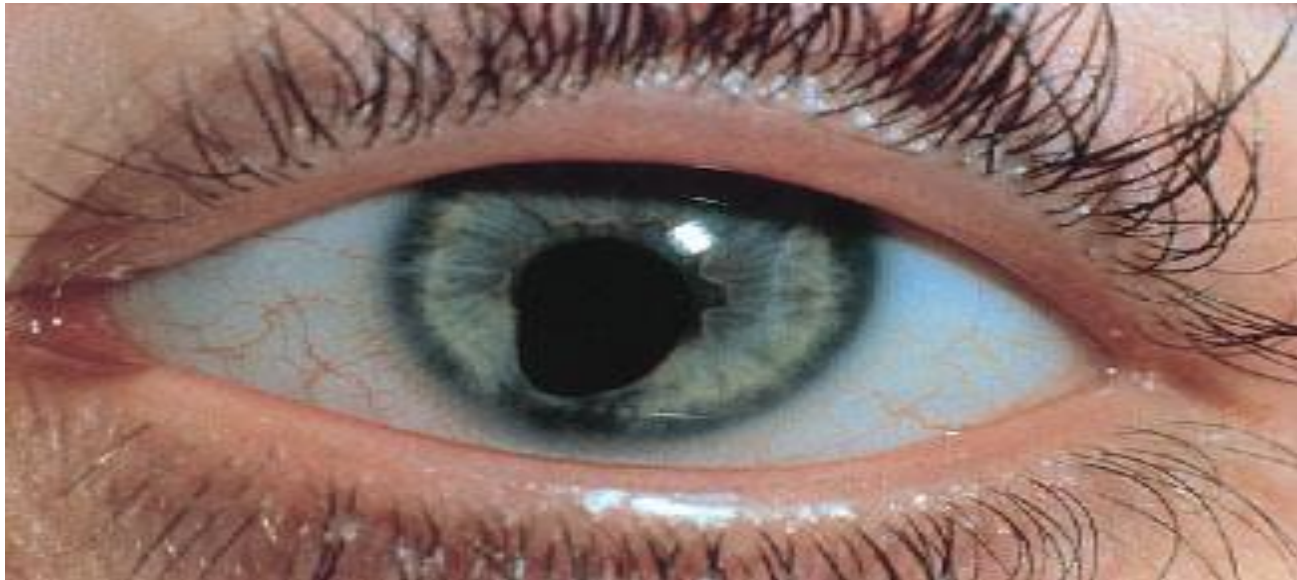
Entropion



Ectropion of the lower lids

Picture courtesy of Sally Turner, MA,
VetMB, DVOphthal, MRCVS

Coloboma- A congenital anomaly due to failure of the closure of embryonic ocular cleft. Here the eyelids, ciliary body, lens or iris may be affected showing fissures or gaps in their continuity. In the eyelids a small wedge shaped portion may be missing or even larger area may be lacking. Similarly small areas of iris and lens may be absent.

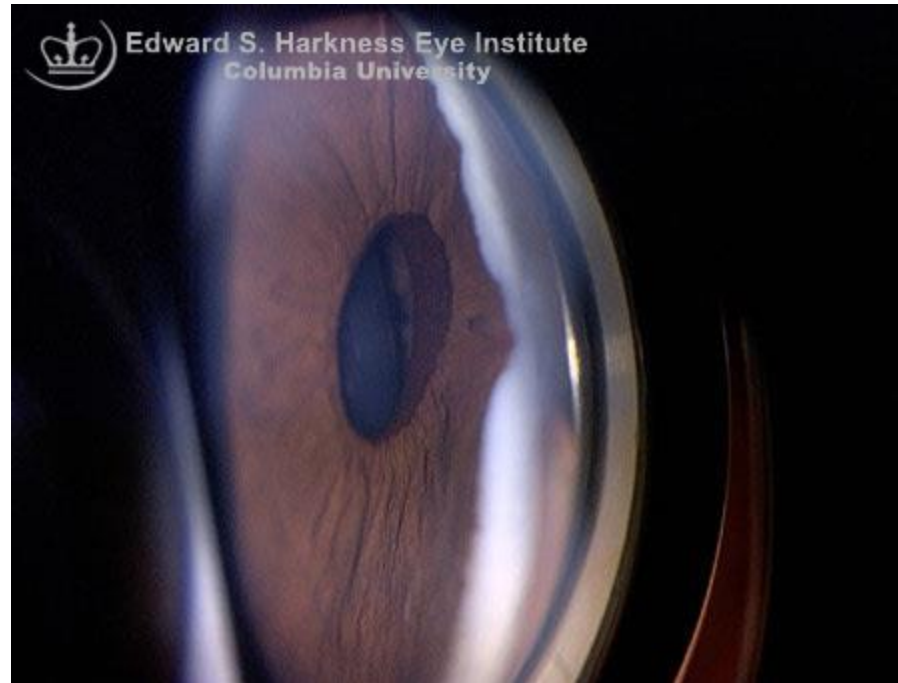


Dermoids of cornea -

- These tumours occur as congenital condition probably due to the sublethal factor.
- The cornea of one or both eyes is partly covered by skin. Because of constant friction and irritation by hair conjunctivitis, pannus formation, keratitis or ulceration may result.



Congenital anterior synechia - Congenital anterior synechia is a condition in which there is adhesion between the iris and the posterior surface of the cornea.



Congenital opacity of cornea- Congenital opacity of cornea may be met with, sometimes, as a result of anterior synechia. In certain breeds of cattle hereditary opacity of cornea has been reported.

Microphakia- lens is small and is spherical. It may be opaque or transparent.

Luxation of the lens- Displacement of the lens or luxation of the lens may be met with in some animals. The dislocated lens is opaque. In certain breeds of dogs, it is a developmental defect.

Cataract- A condition in which the lens becomes opaque. In some animals it is a congenital condition.

Congenital aplasia of retina and hypoplasia of the optic nerve- may be met with in calves and they are born blind.

PATHOLOGY OF THE EYELIDS

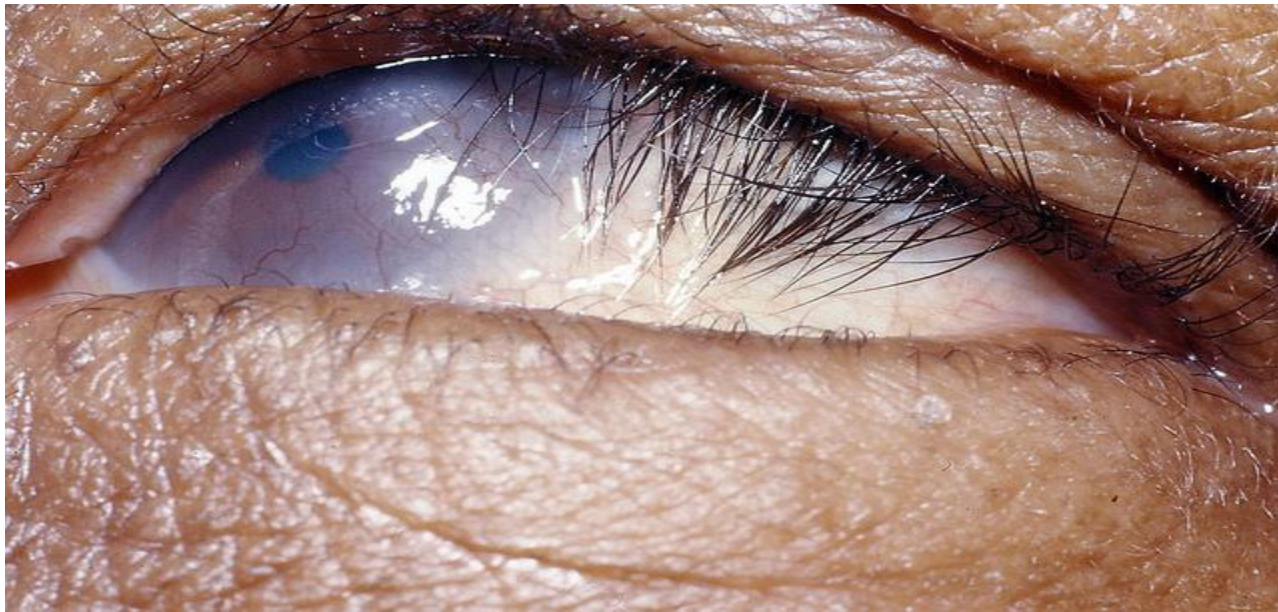
Trichiasis- *Turning in* of the eyelashes and therefore cornea is irritated by the hair.

- Keratitis and attendant lesions may be encountered.

Blepharitis- inflammation of eyelids.

Etiology- This may be a part of generalised dermatitis. But it is usually a complication of

- a) distemper in dogs and cats
- b) trauma,
- c) conjunctivitis or
- d) inflammation of the lachrymal glands.



- **Sequelae**

- Complications of blepharitis are

- i) **Ankyloblepharon**, when adhesion between eyelids takes place,



- ii) **Symblepharon**, where there is union between the conjunctiva lining the eyelids and that covering the eyeballs.



- **Hordeolum or stye** - is the inflammation or even abscess formation of the follicles of an eyelid and is very painful condition.



- **Chalazion** - is the abscess formation of the meibomian glands. Sometimes a cyst may form in these glands.



Edema of the eyelids

- This usually results due to i) trauma, ii) infection, iii) conjunctivitis, iv) allergy and v) fracture of the orbital ring.
- The following conditions are accompanied by edema of eyelids.
 - Horse: Influenza, pink eye, purpura and allergic condition.
 - Cattle: Malignant catarrhal fever, distomiasis, stomach worm affection, traumatic pericarditis and penetration of a foreign body into eye like husks etc.
 - Pig: Gut edema, chronic hog cholera.
 - Dog and cat: Distemper, allergy, stings by nettles and ants.

Neoplasm

- Papilloma, basal-cell carcinoma and angioma may be found. Adenoma of the Meibomian glands may also be met with.
- Squamous cell carcinoma which may arise from the conjunctiva or the skin of eyelid or from the membrane nictitans is very common among cattle.

PATHOLOGY OF ORBIT

Exophthalmos- means protrusion of the eyeball.

Enophthalmos- sinking of the eyeball into the orbit.

Orbital cellulitis- Inflammation of the orbit is called orbital cellulitis.

- ***Occurrence-*** Rare
- ***Etiology***
 - Trauma by foreign bodies
 - Extension from periodontitis of posterior molars in dogs.
 - Orbital contusion complicated by fracture of the ring of the orbit.
 - Extension of ophthalmitis
 - Nutritional deficiency in cats
 - Non-inflammatory edema with sight exophthalmos occurs in edema disease and mulberry heart disease of swine, congestive edema of head, purpura hemorrhagica and urticaria.
 - This condition is usually suppurative in nature.

Xerophthalmia- Dryness of the eye ball.

- It is due to vitamin A deficiency.

PATHOLOGY OF LACHRYMAL GLAND

Dacryoadenitis - inflammation of the lachrymal glands.

- **Occurrence**
 - It is rarely met with as a complication of conjunctivitis or trauma.
- **Gross pathology**
 - There is diffuse congestion and enlargement of the gland, causing protrusion of the membrana nictitans.
 - The ducts are dilated with inflammatory exudates
 - An abscess may form rupturing on the upper eyelid.

Occlusion of lachrymal canal

- **Etiology**
 - Occlusion of lachrymal canal may be congenital or acquired. In dogs of certain breeds (Sealyheams and Poodles) there may be congenital absence of the puncta.
 - The canal may be occluded in the following conditions. a) entropion, b) inflammatory swellings found in conjunctivitis and rhinitis, c) atrophic rhinitis of swine, d) miller's disease in horses and e) neoplasms of the nasal passage.

Neoplasm of the lachrymal gland

- Adenoma of the lachrymal gland is very rare.

PATHOLOGY OF THE CONJUNCTIVA

- **Conjunctivitis** - Inflammation of the conjunctiva is called conjunctivitis.
- commonly met with in animals.
- *Etiology*
 - The causes of conjunctivitis are
 - Bacteria: Some bacteria can penetrate the intact conjunctival mucosa- Brucella, Listeria and Pasteurella tularensis. Secondary infection by *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *E. coli* may occur following trauma or debilitating viral diseases.
 - Chemicals: Disinfecting fluids, lime in white washing material, irritant gases such as formalin vapour, sulphur, smoke, acids, alkalies, sheep dips, parasiticides, skin dressing, iodism.
 - Foreign bodies: Awns, oak husks, mud, dust and sand
 - Parasites: *Thelazia lachrymalis* in horse, *T. rhodesii* in the ox, *T. callipeda* in dog and *T. leesi* in camel. Allergy to pollen, horse serum etc.

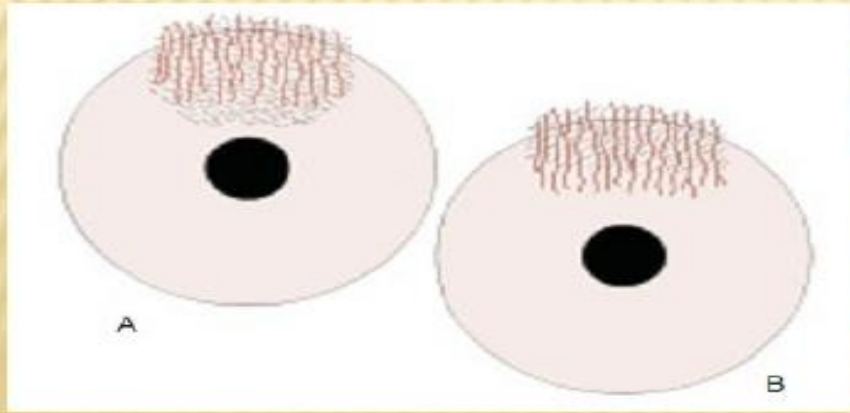
- *Clinical signs*
 - There is congestion of the conjunctiva and increased production of tears which flow over the face as the lachrymal canal may be closed due to the swelling of the membrane .
 - The tears are clear at first but soon become turbid and thick due to the presence of leucocytes and mucoid material. It may also contain flecks.
 - The eyelids may be glued by the sticky material.
- *Gross pathology*
 - Infections by pyrogenic organisms as occurring in distemper of dogs and periodic ophthalmia of horses produce purulent conjunctivitis.
 - Croupous or diphtheritic conjunctivitis is mostly encountered in fowls. In cattle infection by *S. necrophorous* causes croupous conjunctivitis. In this condition there is gray or chocolate colored membrane covering the eyeball.
- *Sequelae*
 - Infection may spread to the cornea and keratitis may result.
 - In the purulent and croupous varieties, keratitis and ulceration of the cornea are very commonly seen.

PATHOLOGY OF THE CORNEA

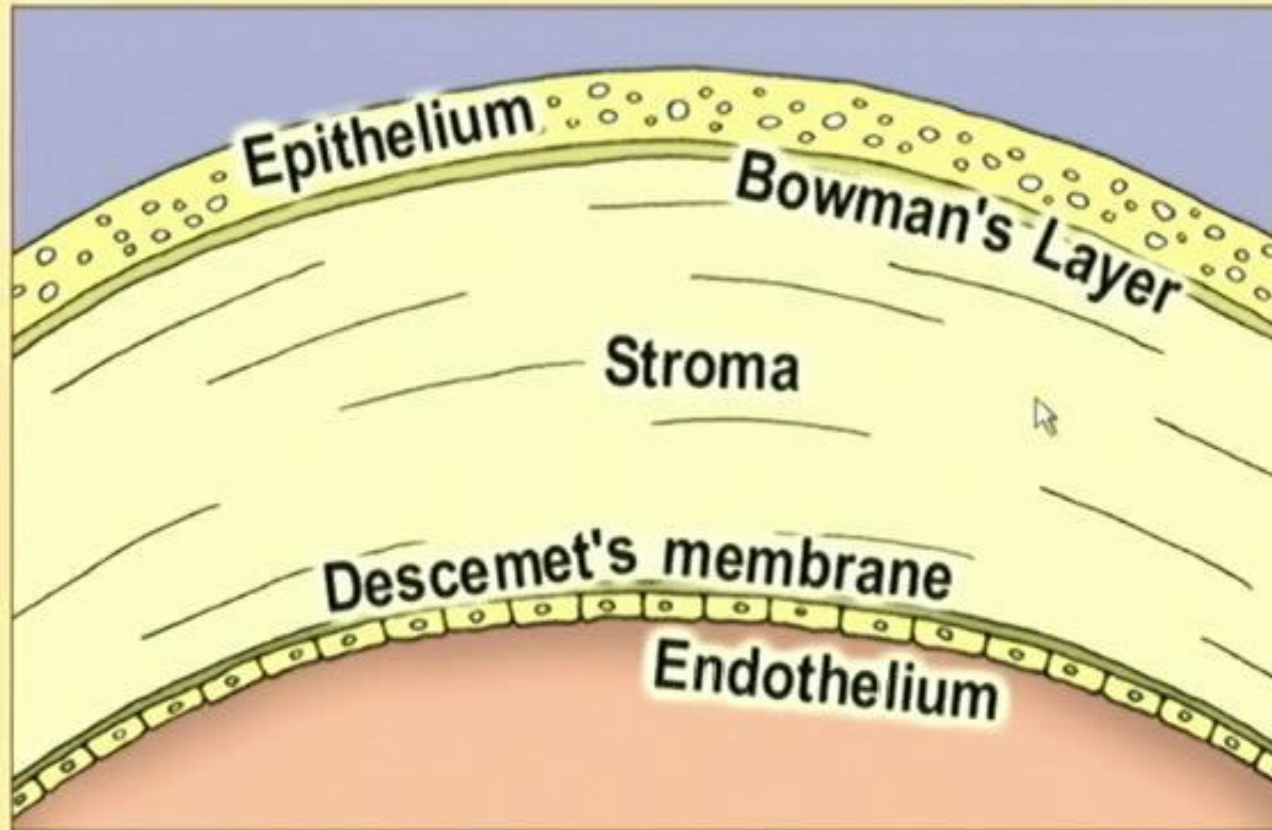
- Pannus-** A condition in which vascular granulation tissue is found between the corneal epithelium and the Bowman's membrane.
- Calcification of the granulation tissue may sometimes occur.

✦ PANNUS:

- ✦ Infiltration of cornea associated with vascularization in the upper limbal area
- ✦ Vessels lie between the epithelium & Bowman's layer
- ✦ Types:
 - ✦ Progressive: infiltration ahead of vascularization
 - ✦ Regressive: vessels extend short distance beyond infiltration



Corneal Layers



Keratitis

– Inflammation of the cornea.

- *Etiology*

- The causes of keratitis are the same as detailed for conjunctivitis.

- a) Bacteria: Brucella, Listeria and Pasteurella tularensis.
 - Secondary infection by *Staphylococcus aureus*, *Pseudomonas aeruginosa* and *E. coli* may occur following trauma or debilitating viral diseases.
 - b) Chemicals: Disinfecting fluids, lime in white washing material, irritant gases such as formalin vapour, sulphur, smoke, acids, alkalies, sheep dips, parasiticides, skin dressing, iodism.
 - c) Foreign bodies: Awns, oak husks, mud, dust and sand
 - d) Parasites: *Thelazia lachrymalis* in horse, *T. rhodesii* in the ox, *T. callipeda* in dog and *T. leesi* in camel.
 - e) Allergy to pollen, horse serum etc.

Clinical signs

- Symptoms include
 - Photophobia and blepharospasm (in which eyelids are tightly closed).
 - Vascularization of cornea
 - Corneal opacity
 - Corneal ulceration
- ***Histopathology***
 - Cornea
 - Congestion and edema
 - Infiltration by leucocytes.
 - Ulceration

Corneal ulceration

- ***Etiology***

- Corneal ulceration occurs during acute or chronic conjunctivitis.
 - It may also occur as a result of suppurative conjunctivitis or due to trauma (thorns, nails, barbed wire, cat scratches, horn gores).
 - Nutritional imbalance due to deficient proteins and vitamins
 - Impaired nerve supply
 - Virulent organisms can cause ulcers due to the activity of their toxins.

- ***Sequelae***

- Healing of a corneal ulcer is slow and is similar to healing of an open wound. The scar tissue contracts and a tiny scar, which is opaque, is left, which never completely disappears. Depending on its density, the corneal scar is known as nebula, macula or leucoma.
- If the Descemet's membrane is also perforated, aqueous humor is lost.
- There may be prolapse of the iris through the rupture (**Staphyloma**), followed by dislocation of the lens.
- Secondary infection of an ulcerated cornea can infect the whole globe (**panophthalmia**) and the eye will be completely lost.

Infectious keratoconjunctivitis in cattle (Pink eye)

- *Epizootiology*
 - This condition may occur as an epizootic in many parts of the world
 - It is common in summer and autumn
 - Probably flies transmit the disease from animal to animal.
- *Etiology*
 - The causative organism is *Moraxella bovis* which is gram negative and is found in the tears. An endotoxin that causes necrosis of the skin is produced by this organism.
 - A mild conjunctivitis is also caused by the virus of infectious bovine rhinotracheitis.

- *Clinical signs*
 - Symptoms include
 - Conjunctivitis
 - Copious lachrymation
 - Photophobia
 - Blepharospasm
 - A slight elevation of temperature accompanied by anorexia
 - Within one or two days following the onset of the above symptoms, corneal opacity develops in the centre followed by ulceration in two more days. Ulceration in the young expands and vascularization may occur.
 - The cornea may become completely opaque.
 - There may be purulent discharge from the eyes.
 - A mild conjunctivitis is also caused by the virus of infectious bovine rhinotracheitis and is characterized by congestion of the conjunctiva with increased lachrymation which is serious.
 - Cornea may become slightly cloudy.
- *Sequelae*
 - As the condition subsides, opacity decreases and completely recovery occurs in three to five weeks.
 - Recovery is followed by immunity which lasts for a year. Immunity is local and may be due to persistence of the organism in the conjunctivitis sac.

Infectious keratoconjunctivitis in sheep – Contagious ophthalmia

Synonym

- Pink eye

Occurrence

- Occurs as outbreaks in various parts of the world in summer.
- Among goats, the condition is mild.

• **Etiology**

- Infectious keratoconjunctivitis in sheep is caused by *Rickettsia conjunctiva*

• **Clinical signs**

- Symptoms include
 - Conjunctivitis
 - Keratitis
 - Increased lachrymation
 - Blepharospasm
 - Opacity of the cornea with vascularization
 - The discharge which is watery at first becomes purulent subsequently.
- Though the condition is mild and not fatal, animals become temporarily blind and become weak and undernourished as they cannot graze properly and adequately.

• **Sequelae**

- Recovery starts within three to four days and by the tenth day is complete.
- In some animals, certain amount of opacity of the cornea remains.
- Recovery followed by partial immunity and the recovered animals are carriers for a year.

PATHOLOGY OF THE LENS

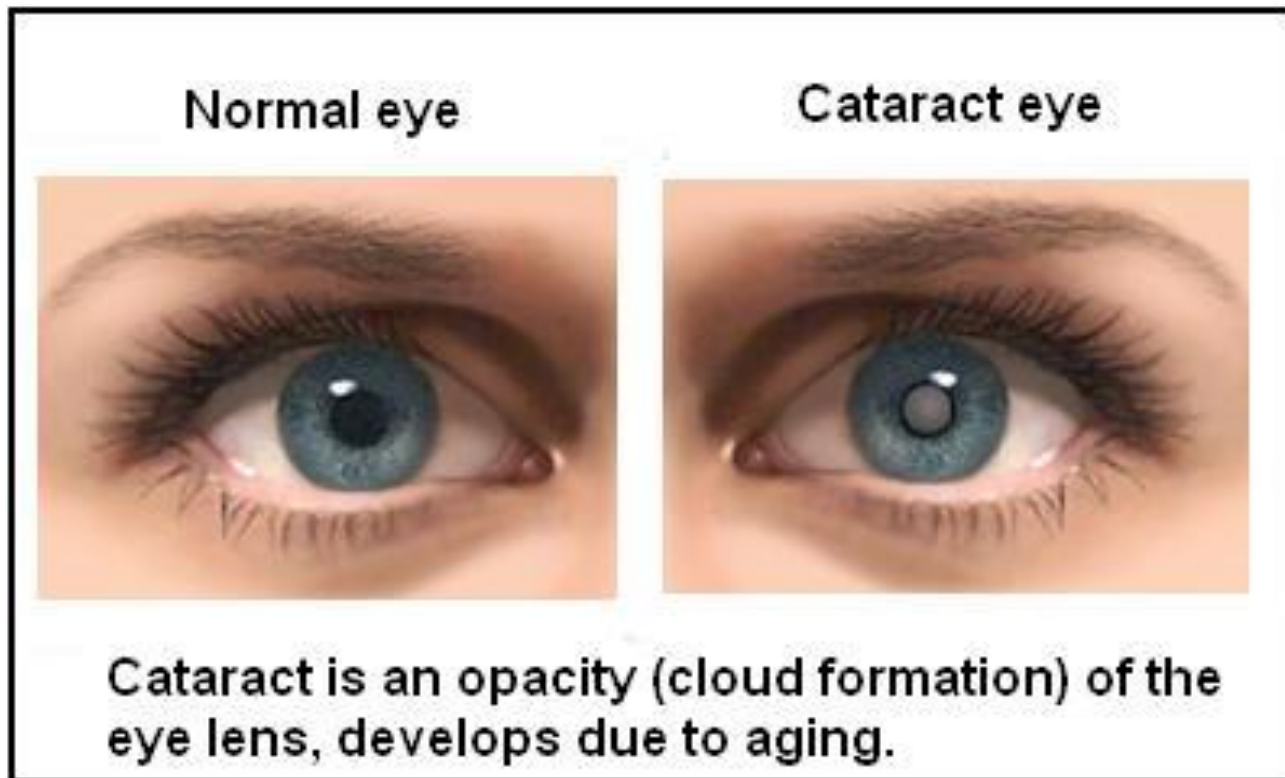
- Because of the peculiar structure of the lens, the changes that could occur in this structure are of limited range. These are
 - changes in its position and
 - degenerative or metabolic changes in which the transparency of the structure is altered.

Luxation of the lens

- The lens is anchored by the suspensory ligaments to the ciliary body.
- If these ligaments are ruptured, the lens may be displaced into the anterior chamber or into the hyaloid fossa or into the vitreous.
- *Etiology*
 - Luxation of the lens may occur in the following conditions
 - The condition may be a congenital anomaly.
 - Trauma is the most important cause in the acquired variety and found mostly in dogs, especially in sealyheam and terrier breeds. Excessive barking may traumatize the ligaments.
 - Since this condition occurs in older dogs (after the age 3 years) degenerative changes (causes unknown) in the suspensory ligaments may be a cause.
 - A predisposing genetical factor may play a part.
 - Glaucoma which may be the result of cyclitis, may cause secondary luxation.
- *Sequelae*
 - If it is displaced into the anterior chamber, opacity of the cornea occurs due to the pressure of the lens on the endothelium. In such a situation, the nutrition of the lens is altered and it becomes opaque.
 - Glaucoma may develop due to hindrance in the filtration of the aqueous humor (consequent on the abnormal position)
 - Inflammatory changes may be produced by the unnatural position of the lens and so adhesion between the cornea, lens and iris may be brought about.
 - When the capsule of the lens is ruptured, the lens may be liquefied

Cataract

- Opacity of the lens
- Cataract is common in dogs and rare in other animals. Among dogs, there is hereditary and breed susceptibility.



- ***Etiology***

- Cataract may be due to the following causes

- Congenital

- Failure of the hyaloid artery (which is present in the embryo entering at the optic papilla and extending to the posterior surface of the lens and nourishing the vitreous humor) to regress and disappear completely, leaving remnants of its wall or its small branches.
 - Impairment of translucence of the lens due to abnormal arrangements of the lens fibres or there may be fluid or droplets of fluid between the nucleus and cortex of the lens.
 - A hereditary predisposition may precipitate the occurrence of cataract in later life.
 - Deficiency of vitamin E: Cataracts are found in chicks born of fowls fed vitamin E deficient diets.

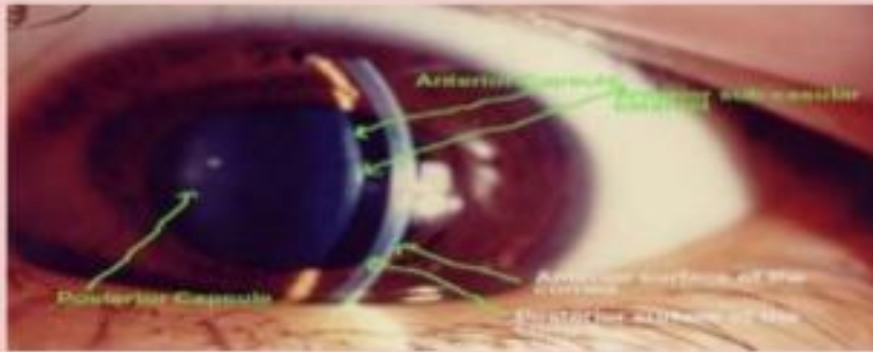
- Acquired
- Degeneration of the lens due to
 - Trauma
 - Luxation
 - Degenerative ocular disease as in retinopathies and retinal detachment in dogs, as found in Pekingese.
 - Senility- common in old stallions
 - Diabetes mellitus: This is seen occasionally in dogs. Probably increased sugar content alters the osmosis in the aqueous humor.
 - Impaired nutrition, as occurs in ophthalmitis and affections of the uveal tract
 - Nutritional disease – deficiency of vitamin D; deficiency of vitamin C in the lens; deficiency of cystein
 - Toxins
 - toxins circulating in diseases like influenza and periodic ophthalmia in horses and distemper in dogs may cause degeneration of the lens,
 - toxins of uremia as occurs in chronic interstitial nephritis.
 - Poisons: Ergot in cattle and pigs
 - Absorbed radiation

- *Pathogenesis*
 - The lenticular tissue is capable of the following changes:
 - proliferation of the capsular epithelium
 - necrosis of the fibre of the lens and
 - increased sclerosis of the fibres forming the nucleus.
- *Types*
 - Cataract may be partial or complete depending on its situation.
 - It may be congenital or acquired, the former being the most common.
 - Depending on the nature of the lesion, cataract is classified as follows:
 - Subcapsular cataract
 - Cortical cataract
 - Lamellar cataract
 - Nuclear cataract

Classification

Cataract location

Capsular cataract



Small opacification of the lens EP and anterior lens capsule

Lamellar cataract

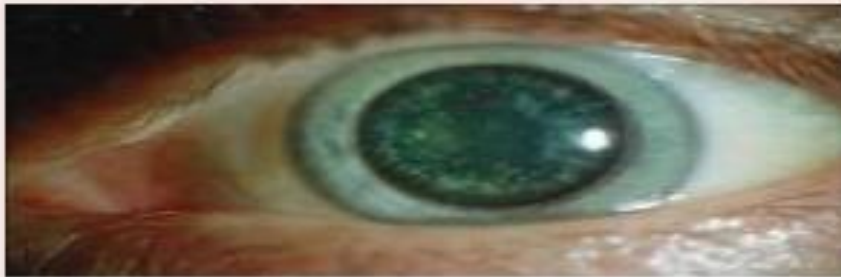


Fig. 3 Lamellar cataract.

Most common type of congenital cataracts, occur from the opacification of specific layers or zones of the lens fibers

Complete cataract



Complete opacification of the lens, Retina cannot be viewed

(1). Subcapsular cataract



- This is seen in horses, dogs and birds.
- In this condition there is abnormal proliferation of the lens epithelium.
- **Anterior polar cataract** - proliferation occurs at the front surface of the lens.
- **Posterior polar cataract** - Sometimes the proliferation of the cells may extend beyond to the posterior surface due to the degeneration of the lens.
- The cells, because of proliferation become disorganized and form thicker layers producing opacity. This condition may be a result of posterior synechia or due to repeated attacks of periodic ophthalmia in horses and is usually associated with cortical cataract.

(2). **Cortical cataract**

- This is the most common form and involves the lens fibres, either at the front (anterior cortical cataract) or at the back (posterior cataract).
- Usually this type follows a corneal ulcer.
- Due to accumulation of interstitial fluid consequent on the altered metabolism of the epithelial cells, the fibres become disintegrated and disorganized.
- The cataract is stellate spreading from the centre to the periphery.
- It is a progressive condition.



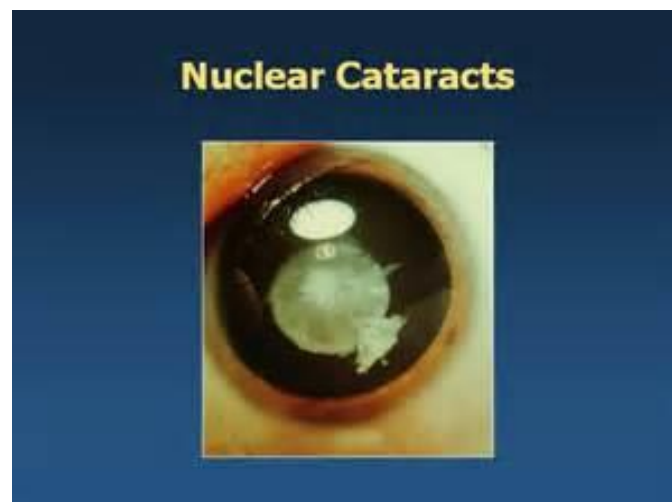
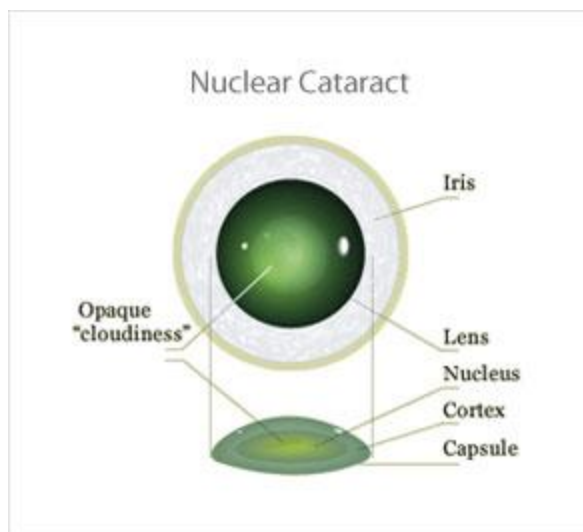
(3). Lamellar cataract

- This occurs in young animals.
- It may be congenital or acquired and results due to some injury during development and is seen in puppies following an attack of distemper or in those that have suffered from rickets (due to vitamin D deficiency).
- It is non-progressive and is located between the nucleus and the cortex.



(4). Nuclear cataract

- Nuclear cataracts are probably the results of senile changes in which the fibres at the centre become denser thereby making the nucleus dull or hazy.
- Sequelae
 - Blindness or impairment of vision develops.



Pathology of Iris

Mydriasis

- Dilatation of the pupil is known as mydriasis.
- This can be brought about by various drugs like atropine, hyocyamine and stramonium, cocaine, adrenaline and amphetamine.
- Mydriasis may be seen in hypertension, injury to the third cranial nerve, strychnine poisoning and in the later stages of chloroform anesthesia.

Myasis

- Constriction of the pupil is known as myasis.
- This can be brought about by pilocarpine, physocarpine and ergotamine.
- Myasis may also be met with in keratitis, ulceration of the cornea, inflammatory conditions of the uveal tract and meningitis.

Glaucoma

- Glaucoma is a condition in which there is increased intraocular pressure leading to secondary changes in the eyeball.

Etiology

- Increased intraocular pressure may result from a) too excessive a secretion of the aqueous humor or b) hindrance in its drainage.
- It is obstruction to drainage is the most common cause of glaucoma among animals.
- Primary glaucoma
- If the causes that give rise to obstruction of the flow, leading to glaucoma cannot be determined with certainty, the condition is known as **primary glaucoma**.
- Probably congenital glaucoma is of this category.
- Secondary glaucoma
- If the causes for such obstruction can be determined, the condition is known as **secondary glaucoma** .

- The pathological lesions causing obstruction may be due to
 - Occlusion of the pupil, which may occur as a result of posterior synechia. In this condition due to organization of the inflammatory products, the iris becomes adherent to the lens and so fluid accumulates in the posterior chamber, iris is pressed forward and filtration triangle and the spaces of Fontana are blocked by this protruding iris.
 - Occlusion of the filtration angle by the products of inflammation, which may be acute or chronic. Majority of secondary glaucoma occur this way. So obstruction may occur in iridocyclitis in which anterior synechia occurs; inflammation following trauma of the eyeball - luxation of the lens, intraocular hemorrhages, detachment of the retina and intraocular neoplasms.

Clinical signs

- Glaucoma may be unilateral or bilateral.
- The globe is enlarged
- Exophthalmos may be noticed (buphthalmos)
- Cornea may be edematous and opaque.
- Corneal vascularisation and pannus may result due to chronic corneal edema.

Histopathology

- The cornea is flattened
- There is opacity of the cornea, the lens and vitreous humor.
- The iris is displaced anteriorly.
- Anterior synechia may occur.
- Degeneration of the lens may occur.
- Blood vessels become sclerosed.
- Atrophy of the choroids to a thin membrane may occur.
- Due to pressure a depression is excavated in the optic disc, which assumes the shape of the cup (cupping of disc).
- The nerve fibres become atrophied. Due to atrophy of the nerve fibres, retina becomes degenerated and atrophied.
- Ganglion cell layer disappears and blindness results.

Neoplasm

Primary neoplasms

- Squamous cell carcinoma, especially in the bovines, is the most common neoplasm.
- Adenomas and adenocarcinomas of the lachrymal gland and Harderian glands may be met with.
- Adenoma and Adenocarcinoma of the ciliary epithelium and iris may occur.

Secondary matastases

- Secondary matastases of carcinoma, sarcomas, melanoma, lymphosarcoma, meningioma and the venereal tumor may be met with

EAR

External ear

- The external ear consists of the concha, the external auditory meatus and the ceruminous glands.
- Otitis externa
- *Definition*
 - Inflammation of the external ear is called otitis externa.
- *Etiology*
 - Foreign bodies like awns may lodge in the ears of dogs and cause irritation and inflammation. The foreign body may sometimes rupture the tympanum.
 - Ectoparasites
 - *Psoroptes communis* – causes profuse exudation in to the meatus, which thus contain tenacious brown material. This is seen in sheep more often.
 - *Otodectes cynotis* causes otitis in dogs and cats. Due to irritation the dogs may shake their heads often and this leads, in the long-ear breeds (Dachshand) to hematomas. Secondary infection by bacteria may produce profuse exudates and tympanum may be ruptured.
 - *Otobius megnini* or the spinose ear tick causes otitis in cattle. Though only lymph is sucked by the larvae and the nymphs, secondary bacterial infection of the wounds results in otitis.
 - Fungi that produce dermatomycosis may also cause otitis.
 - *Stephanofilaria zaheeri* causes dermatitis of the ears in buffaloes and may cause otitis.
 - Specific disease
 - In swine, *Actinomyces bovis* causes a typical actinomycotic granulomatous condition of the ears, which become thick and indurated. The characteristic symptoms are the presence of thick pus in the external auditory meatus (Otorrhoea) and the thickening of the lining of the meatus.
 - Shaking of the head is an important symptom of the presence of pus in the meatus. Stagnant pus may lead to rupture of the tympanum with subsequent occurrence of otitis media and even otitis interna.
- *Histopathology*
 - The skin becomes much thickened and the sebaceous glands contain eosinophilic material.
 - This is a chronic condition in which there is hyperplasia of the epidermis, hyperkeratosis of the hair follicles and the infiltration of the inflammatory cells.
- *Neoplasms*
 - Neoplasms of the ear are rare
 - Adenoma of the ceruminous glands may occur. Sarcoid in the equines and chondroma and chondrosarcoma may rarely be met with.

Middle ear

- Middle ear consists of the tympanic cavity, the ossicles and the eustachian tubes. In horse, guttural pouches are diverticula of the eustachian tubes.
- The epithelium lining the tympanic cavity is continuous with the nasal mucosa through the eustachian tubes and so infection from the nose and pharynx can extend into the middle ear.
- Otitis media
- *Definition*
 - Inflammation of the middle ear is called otitis media.
- *Etiology*
 - Infection can occur through the external auditory meatus through the eustachian tubes. Normally, there is no communication between the external and middle chambers as, the tympanum seals the passage. But in condition in which there is profuse exudate in the external auditory meatus, ear drum can be ruptured by pressure and infection of the middle ear occurs.
 - Infection can occur via the eustachian tubes from the nasal passages and the pharynx. The organisms found in such cases are *Corynebacterium pyogenes* in calves, swine and sheep; *Pseudomonas aeruginosa* and Streptococci in swine; *Pasteurella* in cats and staphylococci and *Mycobacterium tuberculosis* in different animals.
- *Sequelae*
 - The inflammatory exudate that accumulates in otitis media, unless drained becomes inspissated and organized, especially around the ossicles, immobilizing them and so deafness may ensue.
 - Other sequelae of otitis media are extension of infection into the inner ear (otitis interna), deafness, paralysis of the 7th cranial nerve, meningitis and encephalitis due to extension of infection into the cranial cavity through the 8th cranial nerve with resultant death.