THE LACRIMAL APPARATUS

The lacrimal apparatus consists of (a) the lacrimal gland, which secretes a complex fluid, known as the tears, and its excretory ducts which convey the fluid to the surface of the eye; (b) the lacrimal canaliculi, lacrimal sac, and nasolacrimal duct, by which the fluid is conveyed into the nasal cavity.

The lacrimal gland is probably homologous with the Harderian gland of lower mammals, and is derived from a serous secreting element and a gland secreting an oily material. In primates the lacrimal (serous) element has migrated from its original position in the lower lid to the upper. The human lacrimal gland consists of a larger upper orbital part and a lower smaller palpebral part, the two parts being continuous with each other postero-laterally around the lateral concave edge of the aponeurosis of the levator palpebrae superioris. The orbital part is about the size and shape of an almond and is lodged in the lacrimal fossa on the medial side of the zygomatic process of the frontal bone, just within the margin of the orbit. It lies above the levator (and, further laterally, above the lateral rectus); its lower surface is connected to the sheath of the levator, its upper surface is connected to the orbital periosteum, its anterior border is in contact with the orbital septum.
and its posterior border is attached to the orbital fat. The palpebral part, which is about one-third of the size of the orbital part, is subdivided into two or three lobules and extends below the aponeurosis of the levator into the lateral part of the upper eyelid, where it is attached to the superior fornix of the conjunctiva, through which it can be seen when the eyelid is everted. The ducts of the gland, about twelve in number, open into the superior conjunctival fornix. Those from the orbital part (four or five in number) pass through the palpebral part and are joined by some of the ducts from this latter part, while other ducts of the palpebral part (six to eight in number) open independently. Thus all the ducts pass through the palpebral part, so that excision of this part of the gland is functionally equivalent to removal of the entire gland.

Many small accessory lacrimal glands are present in and near the conjunctival fornices; they are more numerous in the upper lid than in the lower. Their existence may explain why the conjunctiva does not dry up after extirpation of the lacrimal gland proper.

**Structure of the lacrimal gland**: The gland consists of very small lobules and is a compound tubulo-alveolar gland. The acini are lined by a layer of columnar cells which rest on a basement membrane and contain secretion granules and fat droplets. Outside these there are flattened
myoepithelial (contractile) cells. The ducts are lined by a layer of columnar cells, outside which are a few myoepithelial cells. The secretion fluid (tears) contains various salts and an enzyme (lysozyme) which is bacteriocidal. No account of the primate lacrimal gland in terms of its ultrastructure appears to be available. Published accounts are so far chiefly concerned with rodents. Mucinogen and zymogen granules have been observed in the secretory cells. The plasma membrane of these cells is extensively infolded on their basal aspects.

The Lacrimal canaliculi, one in each eyelid, are about 10 mm long; they commence at the puncta lacrimalia. The superior canaliculus, smaller and shorter than the inferior, at first ascends, and then bends at an acute angle, and passes medially and downwards to the lacrimal sac. The inferior canaliculus at first descends, and then runs almost horizontally to the lacrimal sac. At the angles they are dilated into ampullae. The mucous lining of the ducts is covered with stratified squamous epithelium, placed on a basement membrane; outside the latter there is a corium rich in elastic fibres (rendering the ducts easily dilatable during the passage of a probe) and a layer of striped muscular fibres which is continuous with the lacrimal part of the orbicularis oculi. At the base of each lacrimal papilla the muscular fibres are circularly arranged and form a kind of sphincter.
The lacrimal sac is the upper blind end of the naso-lacrimal duct, and is lodged in a fossa formed by the lacrimal bone, the frontal process of the maxilla and the lacrimal fascia. It measures about 12 mm in length, its upper, closed end is flattened from side to side, but its lower part is rounded and is continued into the naso-lacrimal duct; the openings of the lacrimal canaliculi are situated in its lateral wall slightly below its upper end.

A layer of fascia, continuous with the periosteum of the orbit and named the lacrimal fascia, passes from the lacrimal crest of the maxilla to the crest of the lacrimal bone, and forms the roof and lateral wall of the fossa in which the lacrimal sac is sited; between the fascia and the lacrimal sac there is a plexus of minute veins. The lacrimal fascia separates the sac from the medial palpebral ligament in front, and from the lacrimal part of the orbicularis oculi behind. The lower half of the fossa which lodges the lacrimal sac is related medially to the anterior part of the middle meatus of the nasal cavity; the upper half is related to the anterior ethmoidal sinuses.
The lacrimal sac consists of a fibro-elastic coat, lined internally by mucous membrane; the latter is continuous through the lacrimal canaliculi, with the conjunctiva, and through the nasolacrimal duct with the mucous membrane of the nasal cavity.

The nasolacrimal duct is a membranous canal about 18 mm long, which extends from the lower part of the lacrimal sac to the anterior part of the inferior meatus of the nose, where it ends in a somewhat expanded orifice. A fold of the mucous membrane forms an imperfect valve just above the opening and is known as the lacrimal fold. The duct is contained in an osseous canal, formed by the maxilla, the lacrimal bone and the inferior nasal concha; it is narrower in the middle than at either end, and is directed downwards, backwards and a little laterally. The mucous lining of the lacrimal sac and nasolacrimal duct is covered with two layers of columnar epithelium which in places is ciliated. Around the duct there is a rich plexus of veins, forming an erectile tissue, engorgement of which may obstruct the duct. (Quoted from Gray's Anatomy).

VALVES

The lacrimal passages consist of lacrimal puncta, lacrimal canaliculi, lacrimal sac and naso-lacrimal duct. Each eye lid has one punctum near the inner canthus and beginning from the punctum each canaliculus travels first
in a vertical direction and then horizontally towards the middle to enter a small diverticulum of the lacrimal sac called the sinus of Maier, either together or separately through flaps of mucosa called - the valve of Rosenmuller and the valve of Huschke. The lacrimal sac lies in the lacrimal fossa, the upper end of which is blind while the lower end is continuous with the nasolacrimal duct. The junction of two is marked by a constriction due to indentation by the split fascia of orbiculosis oculi and also due to mucosal folds the valve of Krause. The nasolacrimal duct passes downwards and slightly outwards to open in the inferior meatus of nose. The nasolacrimal duct is marked by numerous mucosal folds called valves, out of which two are more constant - one near the middle called valve of Taillefer and other at its lower end called Valve of Hasner.