RESULTS

I. Rabbit:

A) Histological observations:

1. Nasal cavity:

a) The nasal vestibule of the nasal cavity was represented by the most anterior portions of the nasal cavities (right and left). It was lined by keratinized stratified squamous epithelium (Fig. 1). At the vestibular floor and the anterior extension of the dorsal concha (straight fold) the epithelium appeared relatively thick. At the ventral surface of the anterior extension of the ventral concha (alar fold), it was highly keratinized showing depressions (Fig. 2).

However, posteriorly the epithelium appeared thin and at the summits of the alar and the straight folds it changed into stratified cuboidal epithelium (Fig. 3). In spite, the stratified squamous epithelium was still keratinized at the vestibular floor and the ventral portions of the lateral nasal wall and the nasal septum. The epithelium rested on a basement membrane showing PAS positive basal lamina and argyrophilic reticular lamina.

Beneath the lining epithelium, there was connective tissue which appeared dense with papillary body at which

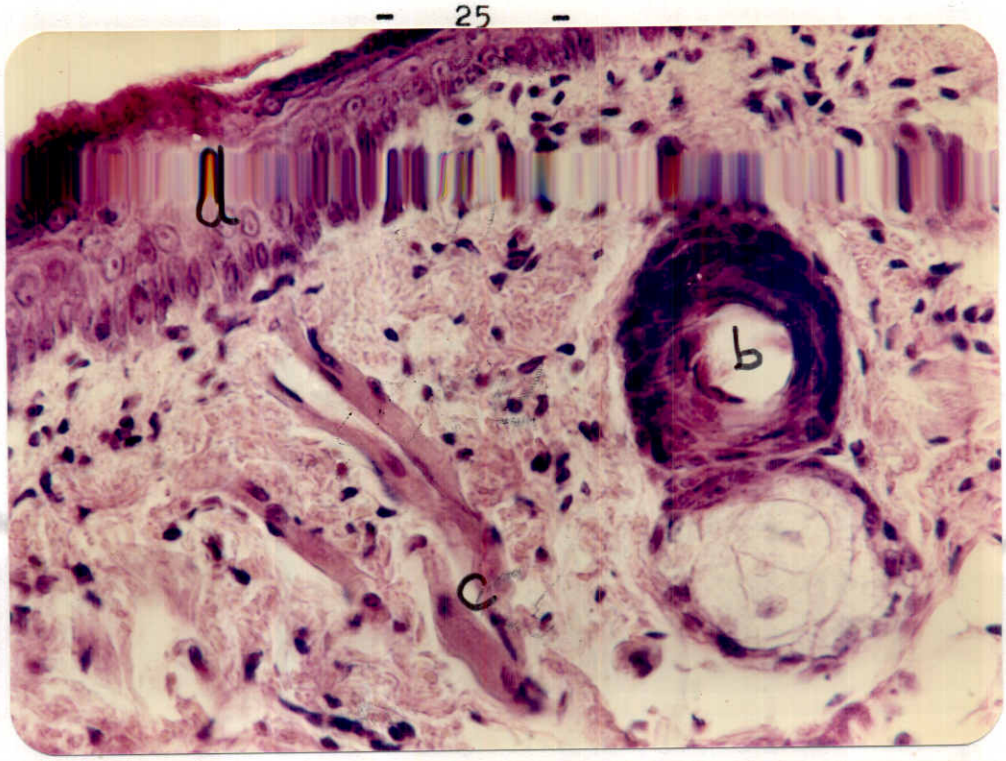


Fig.(1): A photomicrograph of a section in the nasal vestibule of a rabbit showing:
a) Stratified squamous keratinized epithelium.
b) Hair follicles besides sebaceous glands.
c) Striated muscle fibers.
(Hx & E stains. Obj. X 40, Proj. X 10).

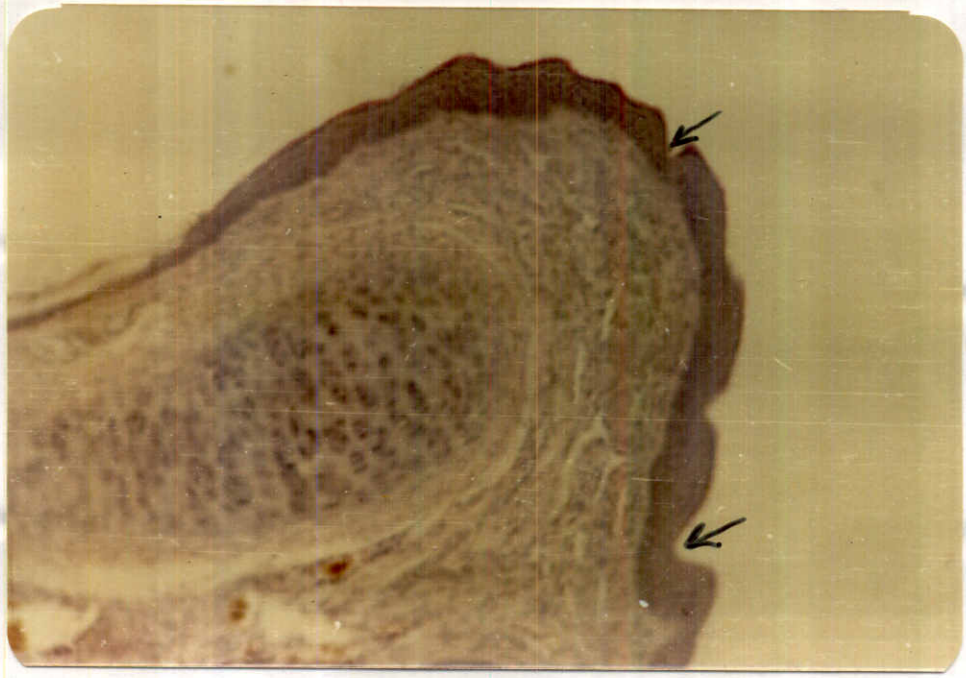


Fig.(2): A photomicrograph of a section in the anterior extension of the alar fold of a rabbit showing depressions (arrows) in it's keratinized stratified squamous epithelium.
(Hx & E stains. Obj. X 10, Proj. X 10).

the epithelium was thick and corrugated. The subepithelial tissue was vascular containing wide irregular blood spaces. As well, there were few glandular elements scattered inbetween the wide irregular blood spaces of the subepithelial tissue of the medial part of the nasal roof (Fig.4). These glandular elements became numerous along the medial surface of the alar fold. Posteriorly, these elements were lined with cubical cells containing spherical nuclei. These elements were PAS positive and AB negative.

At the most anterior portion of the vestibule, the floor showed hair follicles, sebaceous glands and striated muscle fibers in the subepithelial tissue (Fig. 1).

b) The nasal respiratory region.

It was lined by a ciliated pseudostratified columnar epithelium with goblet cells (Fig. 5), except the scrolls of the ventral concha, where, the concave and convex surfaces were lined with two layers of flattened cells and it's rounded free ends were covered by 2-3 layers of cuboidal cells (Fig. 6). The goblet cells were increased towards the floor of the nasal cavity (Fig. 7). The subepithelial tissue layer was made of fibroelastic tissue

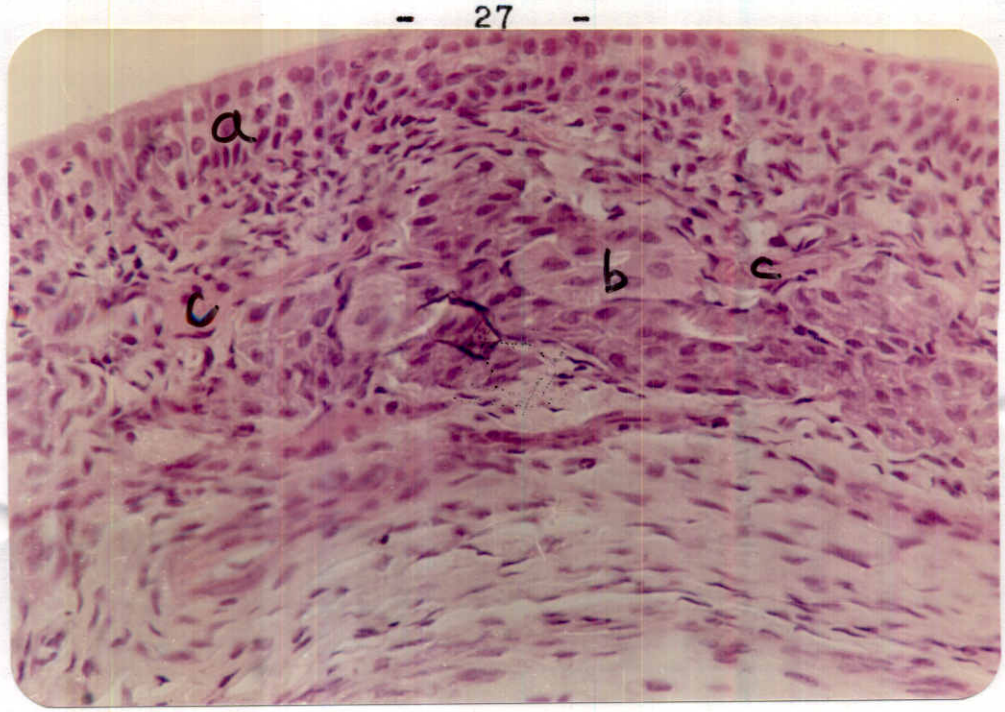


Fig.(3): A photomicrograph of a section in the alar fold of a rabbit's vestibule showing:
a) stratified cuboidal epithelium.
b) glandular elements
c) a blood vessel.
(Hx & E stains. Obj. x 40 , Proj. x 10)

Fig.(4): A photomicrograph of a section in the rool of the nasal vestibule of a rabbit showing:
a) Stratified cuboidal epithelium.
b) Wide irregular blood spaces.
c) Glandular elements .
(Hx & E stains. Obj. x 10, Proj. x 10).

containing blood spaces, capillaries and nerves. The glandular elements were absent from the scrolls of the ventral concha (Fig. 8), and were present only in the subepithelial layer of the attached part of the ventral concha lateral to the osseous plate (Fig. 9). However, numerous glandular acini were present in the nasal septum, the lateral mucosal surface of the dorsal concha, and the floor of this region(Fig. 8). These acini were formed of one layer of cubical acidophilic cells with spherical nuclei.

Subepithelially, the ventral portion of the nasal septum showed few superficial glandular acini of negative PAS reaction and deep closely packed one with PAS-positive supranuclear vacuoles, reaching the perichondrium of the septal cartilage (Fig. 10).

c) Olfactory region of the nasal cavity:

The olfactory region appeared to be localised at the most posteriodorsal portion of the nasal cavity. It was characterized by a special type of epithelium known as olfactory epithelium. The change from respiratory epithelium to olfactory one was gradual with respect to it's thickness. The olfactory epithelium

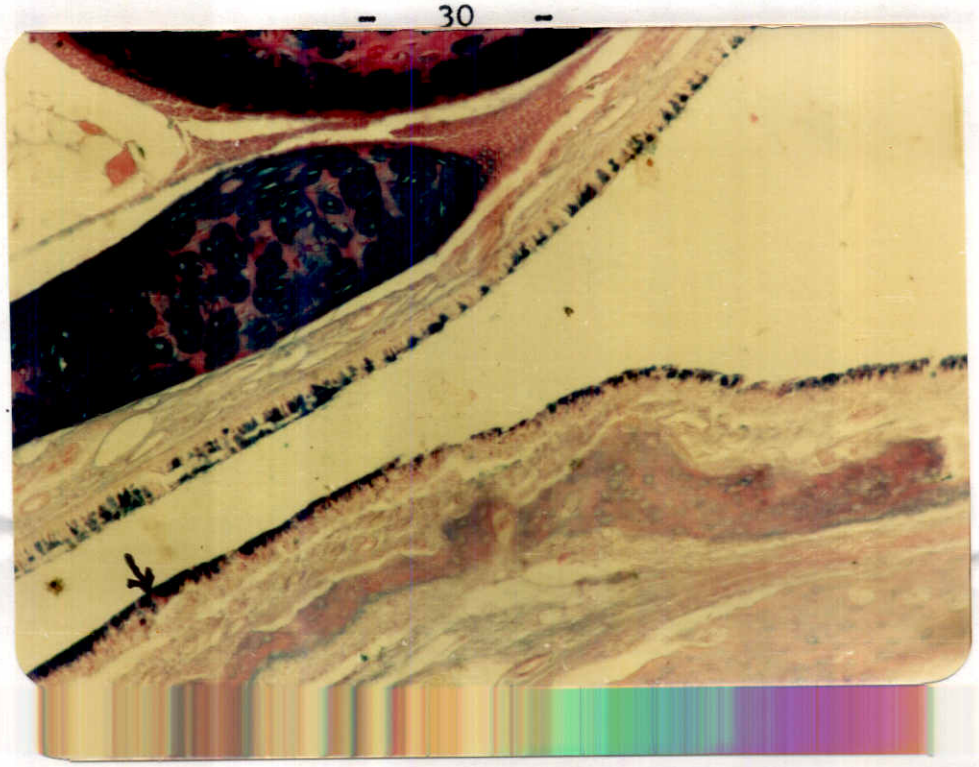


Fig.(7): A photomicrograph of a section near the floor of a rabbit's respiratory region showing numerous goblet cells.
(AB-PAS reaction. Obj. x 10, Proj. x 10).

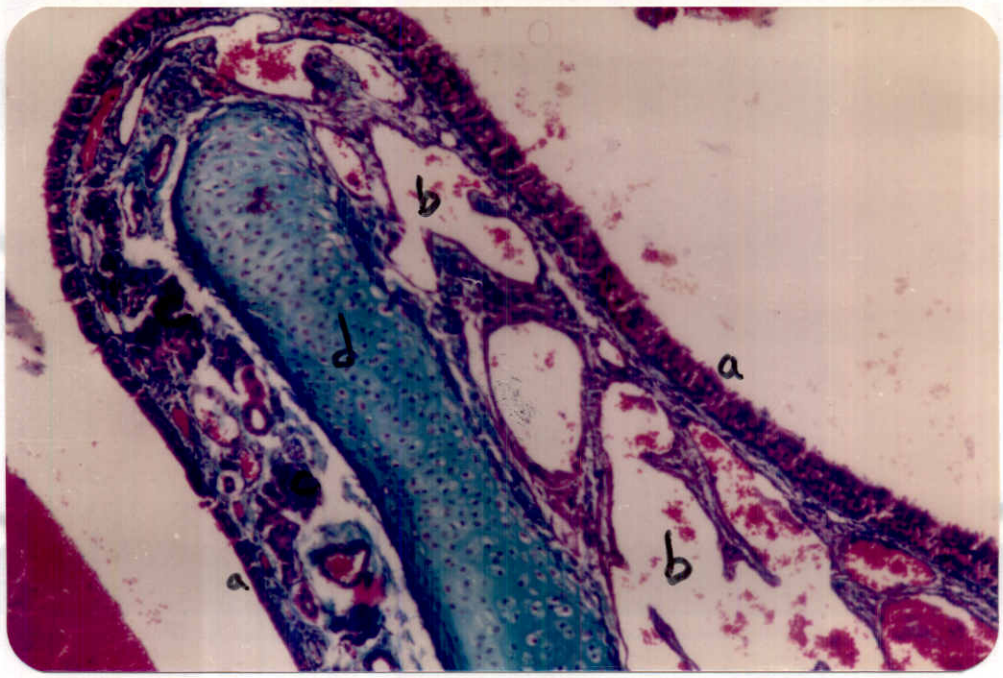


Fig.(8): A photomicrograph of a section in rabbit's dorsal concha showing:
a) Ciliated pseudostratified columnar epithelium with goblet cells b) blood spaces.
c) glandular elements d) hyaline cartilage.
(Crossmon's trichrome stain. Obj. x 10, Proj.x10).

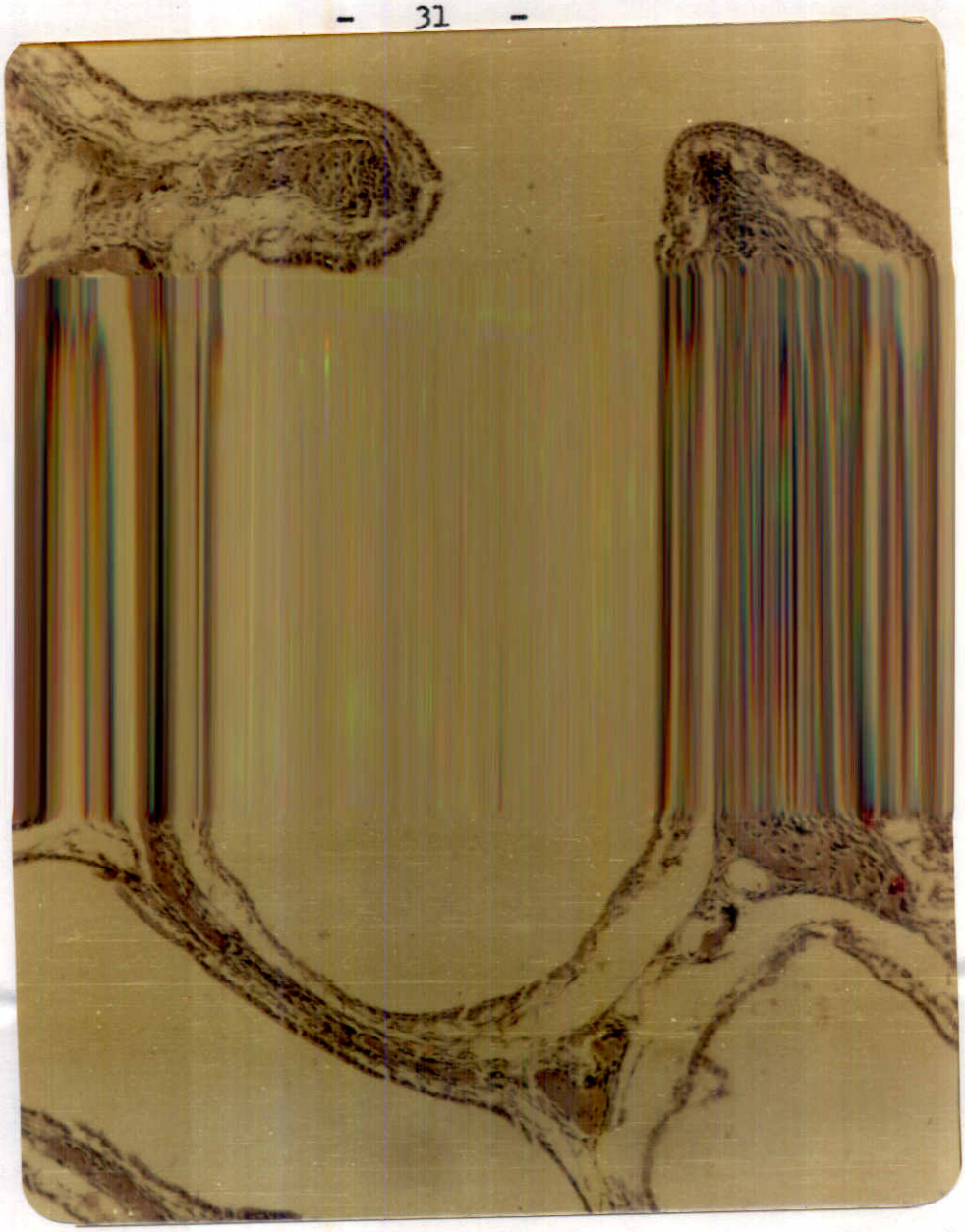
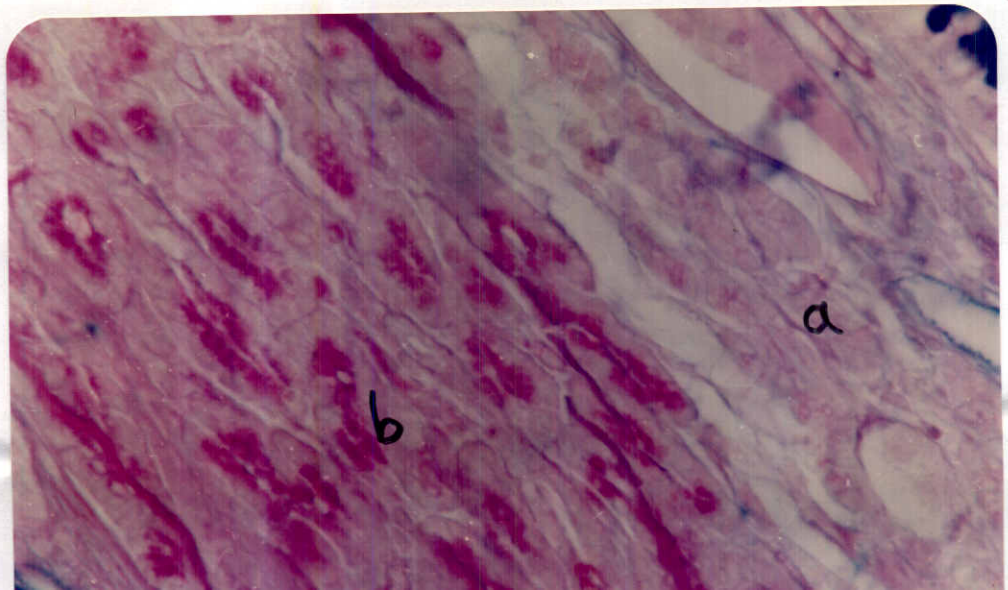


Fig.(9): A photomicrograph of a section in scrolls of the ventral concha in a rabbit showing absence of glandular elements.
(Hx & E stains. Obj. x 10, Proj. x 10).



was distributed on the most posterior part of the nasal septum at the convex surfaces of the scrolls of the ethmoturbinals and on the dorsal concha. This epithelium appeared as a tall pseudostratified columnar type (Fig. 11). It was composed of several zones:

i- a delicate brush-like free border which was formed of the microvilli of the supporting cells together with the distal extentions of the olfactory cells. This border was both AB and PAS positive (Fig. 12).

ii- a wide supranuclear eosinophilic cytoplasmic zone mostly free of nuclei except those of some free lymphocytes. These zone was formed of the broad supranuclear parts of the supporting cells and the dendritic part of the olfactory cells.

iii- a nuclear zone which appeared crowded with muclei of 5-8 layers of supporting, olfactory and basal cells. Three types of cells could be distingwished:

* The supporting cells which were tall columnar with broad apical borders and thin basal ones. From their broader ends microrilli arose.

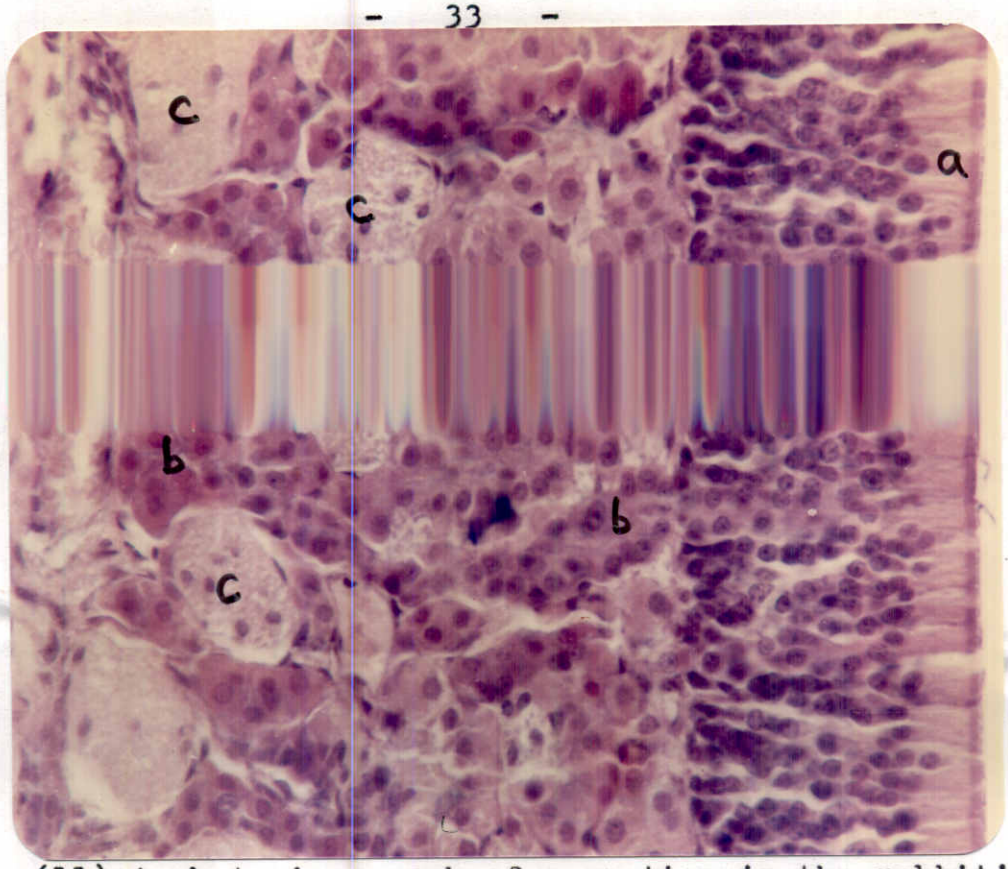


Fig.(11):A photomicrograph of a section in the rabbit's nasal olfactory region:
a) tall pseudostratified columnar epithelium without goblet cells. b) Bowmann's glands.
c) bundles of the olfactory nervas.
(Hx & E stains. Obj. x 40, Proj. x 10).

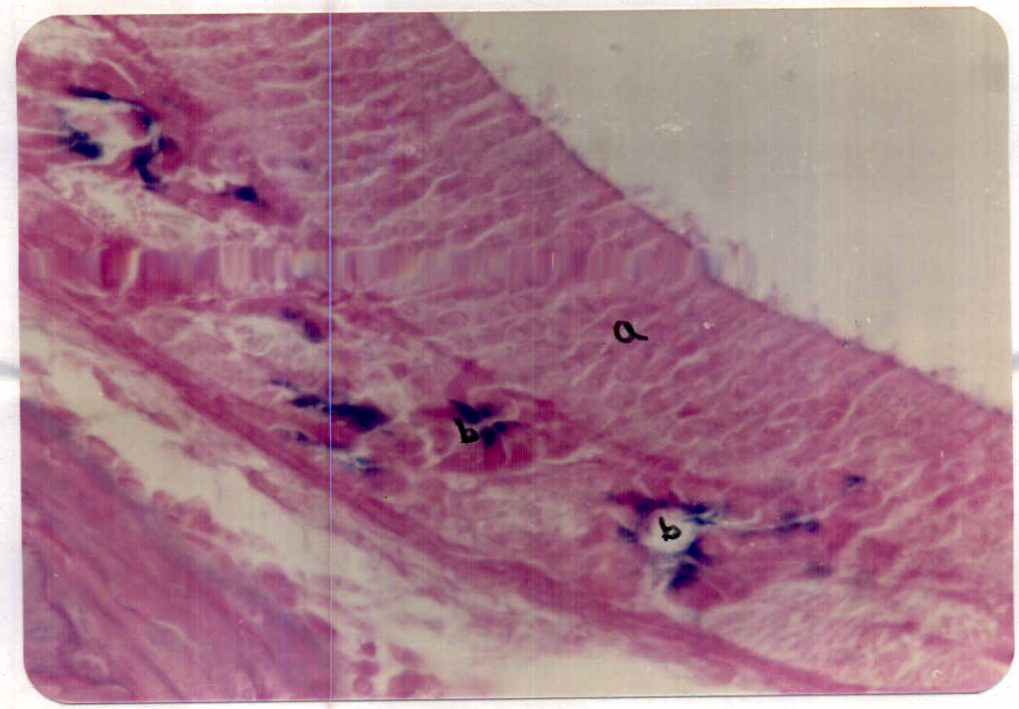


Fig.(12): A photomicrograph of a section in rabbit's olfactory region showing:
a) free border of the olfactory epithelium.
b) Bowmann's glands.
(AB-PAS combined reaction. Obj. x 40,Proj.x10).

* The supporting cells which contained ovoid nuclei occupying a superficial position in the nuclear zone.

* The olfactory cells which were true bipolar neuro-epithelial cells. The nuclei were rounded containing 1-3 nucleoli and located at different levels giving the characteristic appearance of the nuclear zone. The nuclei were surrounded by a thin rim of cytoplasm forming the cell bodies or perikarya from the perikarya, long thin cytoplasmic (dendritic) processes extended distally to the free olfactory surface ending in minute bulbous like projections slightly raised above the olfactory surface.

A thread like process (axon) arose from the infranuclear cytoplasm of the perikarya and passed to perforate the basal lamina to the sulbepithelial tissue. These axons aggregated with each other forming bundles of the olfactory nerves.

* The basal cells: were small, few in number and arranged in one row of low cuboidal cells on a clear basal lamina with PAS positive reaction. The basement membrane of the olfactory epithelium on the convex surfaces of the ethmoidal conchal scrolls, was interrupted. Through

these interruptions, the ducts of Bowmann's glands passed to the free surface. However on the nasal septum, the interruptions of the basement membrane were not clear as those on the convex surfaces of the ethmoidal conchal scrolls.

The subepithelial layer beneath the olfactory epithelium showed closely packed glandular structures (Fig. 13). The acini of these glands were lined by one layer of cuboidal cells with central spherical nuclei. The apical cytoplasmic parts of the acinar and the duct cells appeared bluish purple, while the basal parts of these cells appeared magenta red in combined AB-PAS stained sections (Fig. 12). Meanwhile, the deep layer of the subepithelial tissue contained numerous bundles of the olfactory nerves (Fig. 11).

2. Larynx:

The most anterior portion of the larynx was covered by stratified squamous epithelium (Fig. 14). On the posterior surface of the epiglottis, especially towards it's attached end, the epithelium was ciliated pseudostratified columnar with goblet cells (Fig. 15). As well, the latter cells were dorsally located among the ciliated epithelium of the larynx. However, their were absent

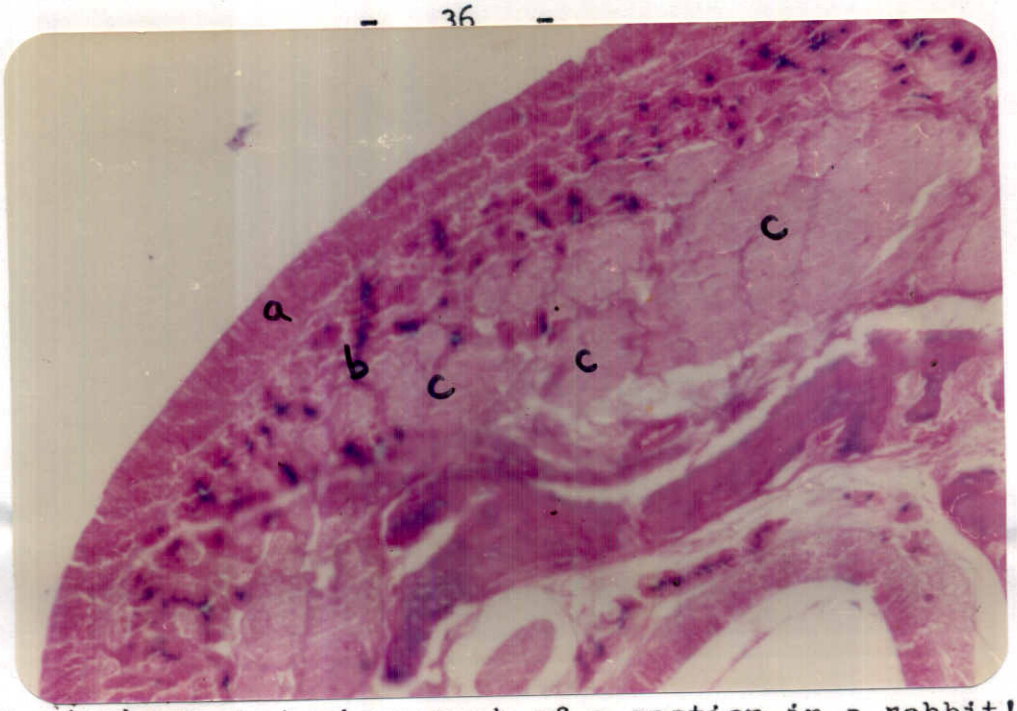


Fig.(13): A photomicrograph of a section in a rabbit's nasal olfactory region showing:
a) olfactory epithelium. b) Bowmann's glands.
c) nerve bundles.
(AB-PAS combined reaction. Obj. x 10, Proj.x10).

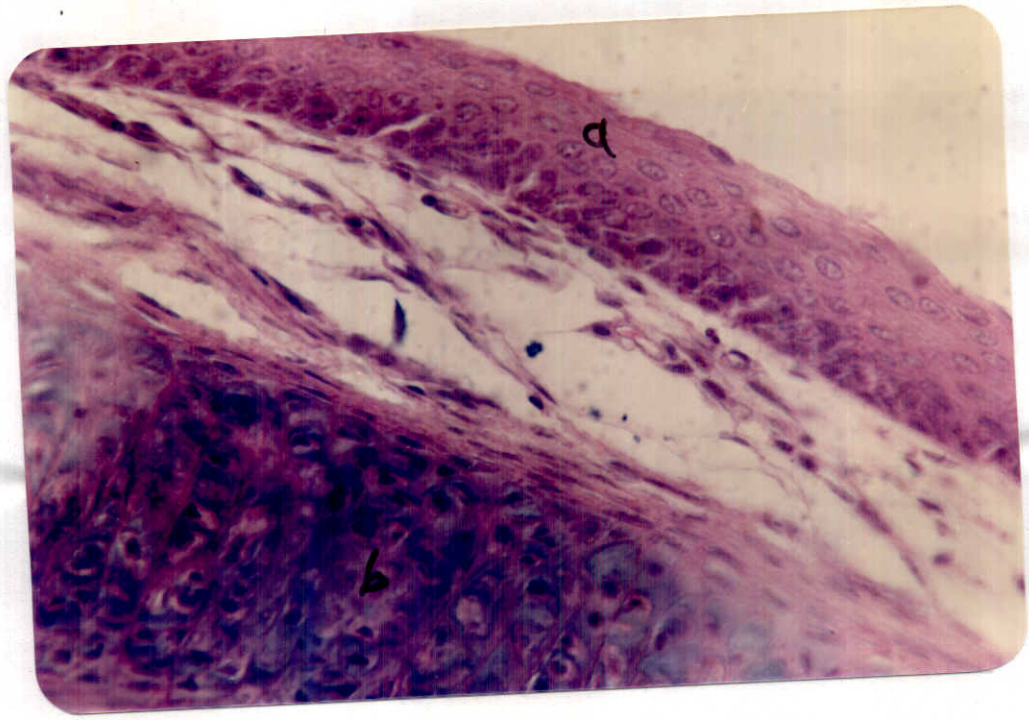


Fig.(14): A photomicrograph of a sagittal section in the posterior surface of epiglottis of a rabbit showing:
a) stratified squamous epithelium.
b) elastic cartilage.
(Hx & E stains. Obj. x 40, Proj. x 10).

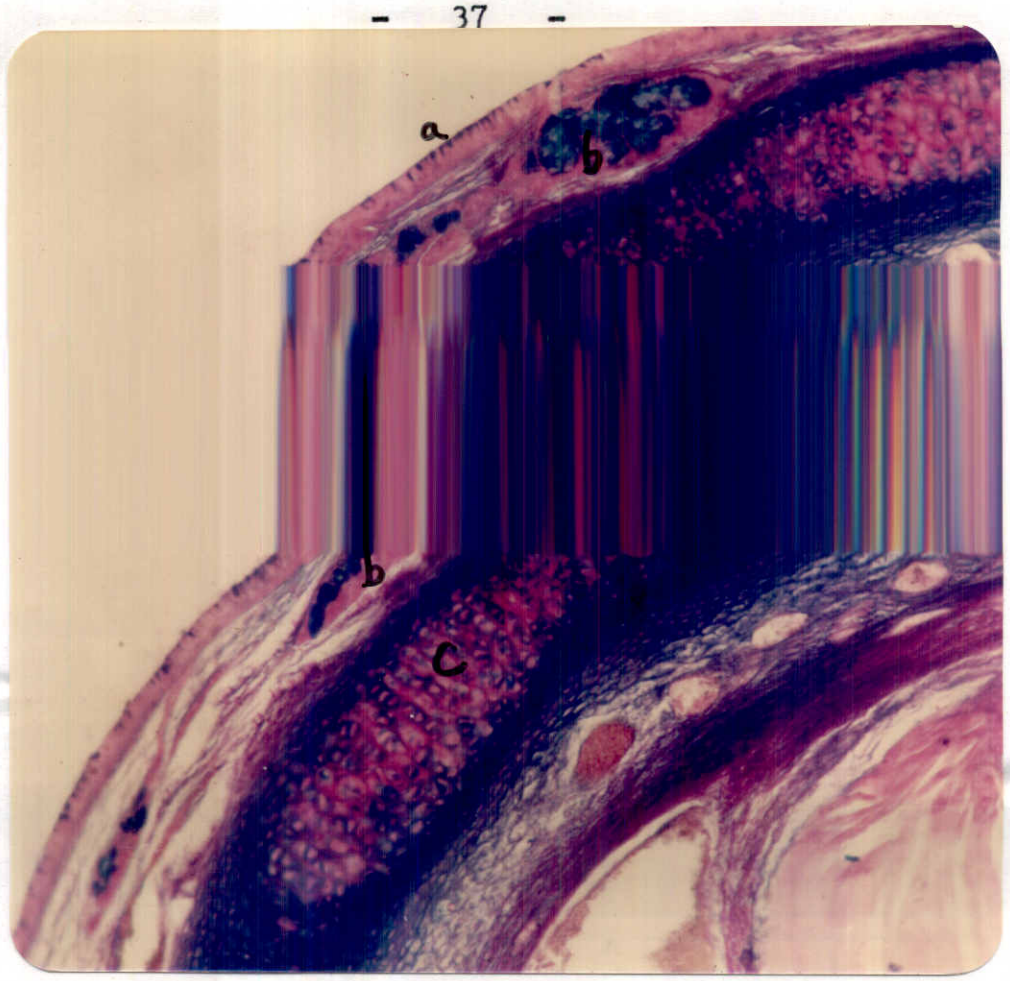


Fig.(15): A photomicrograph of a sagittal section in the posterior surface of epiglottis of a rabbit showing:
a) ciliated pseudostratified columnar epithelium with goblet cells.
b) glandular elements.
c) a plate of elastic cartilage.
(AB-PAS combined reaction. Obj. x 10, Proj.x10).

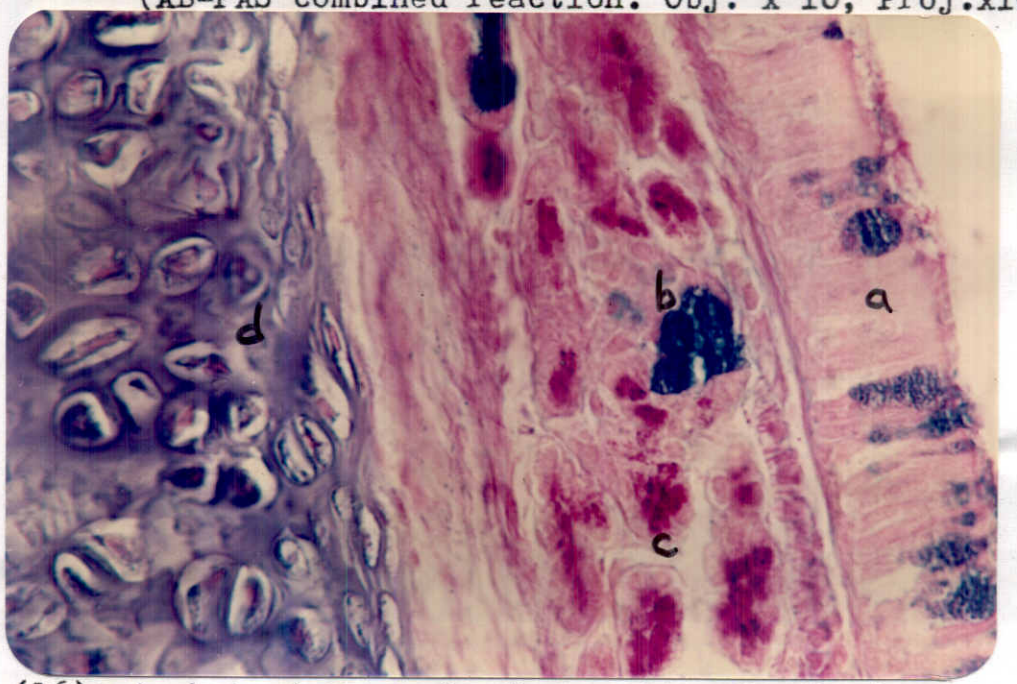


Fig.(16): A photomicrograph of a section in the larynx of a rabbit showing:
a) respiratory epithelium with goblet cells.
b) AB- +ve acini c) PAS+ve acini d)cartilage.

from the rest of the epithelium at the same level.

The fibro-elastic subepithelial tissue contained few scattered collections of AB positive glandular acini inbetween wide blood spaces and blood capillaries. Besides, other glandular acini were PAS positive (Fig.16). The vocal cord was covered with stratified squamous epithelium and was lacking the glandular elements. The cartilagenous support of the epiglottis was of the elastic type (Fig. 17). The core of which was PAS-positive while it's periphery was AB positive (Fig. 15).

The caudal portion of the larynx was lined with ciliated pseudostratified columnar epithelium with goblet cells. The latter cells were numerous and distributed among the whole ciliated epithelium. These goblet cells were stained blusih-purple in combined AB-PAS stained sections (Fig. 18). The collections of the glandular acini and the lymphatic infiltrations were increased (Fig. 19). Some of these acini were AB-positive while the others were PAS-positive (Fig. 20).

3. Trachea

The trachea of the rabbit was lined by ciliated pseudostratified columnar epithelium with few goblet

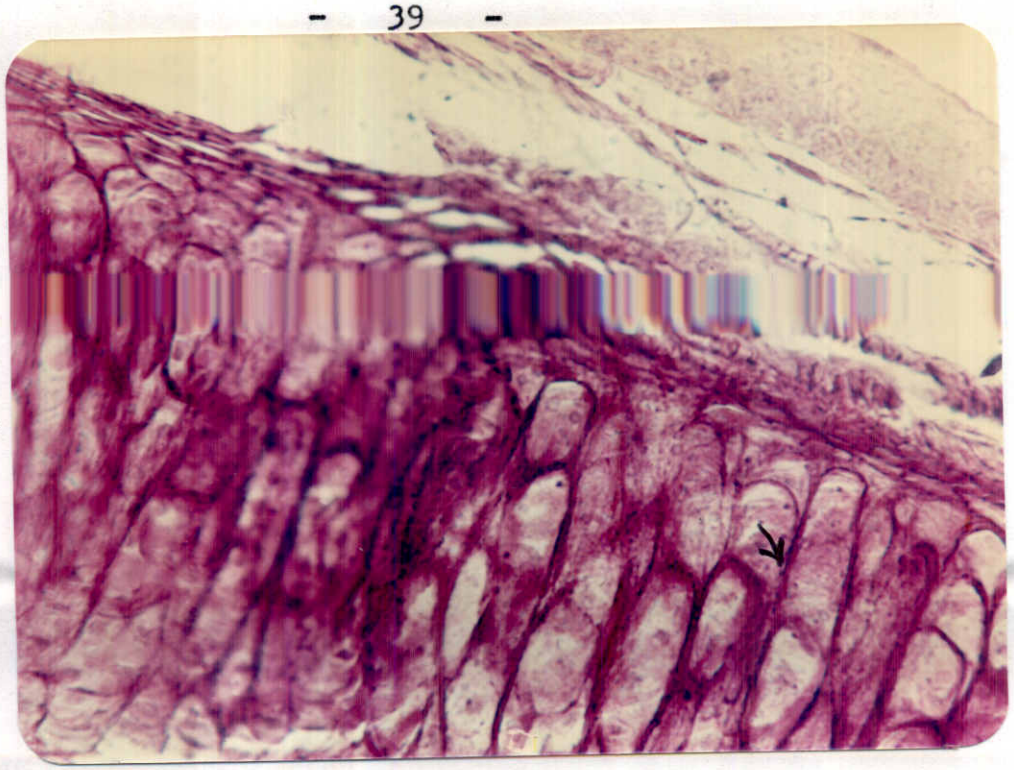


Fig.(17): A photomicrograph of a section in the epiglottis of a rabbit showing elastic type of cartilage. (Resorcin fuchsin stain. Obj.x10, Proj.x10).

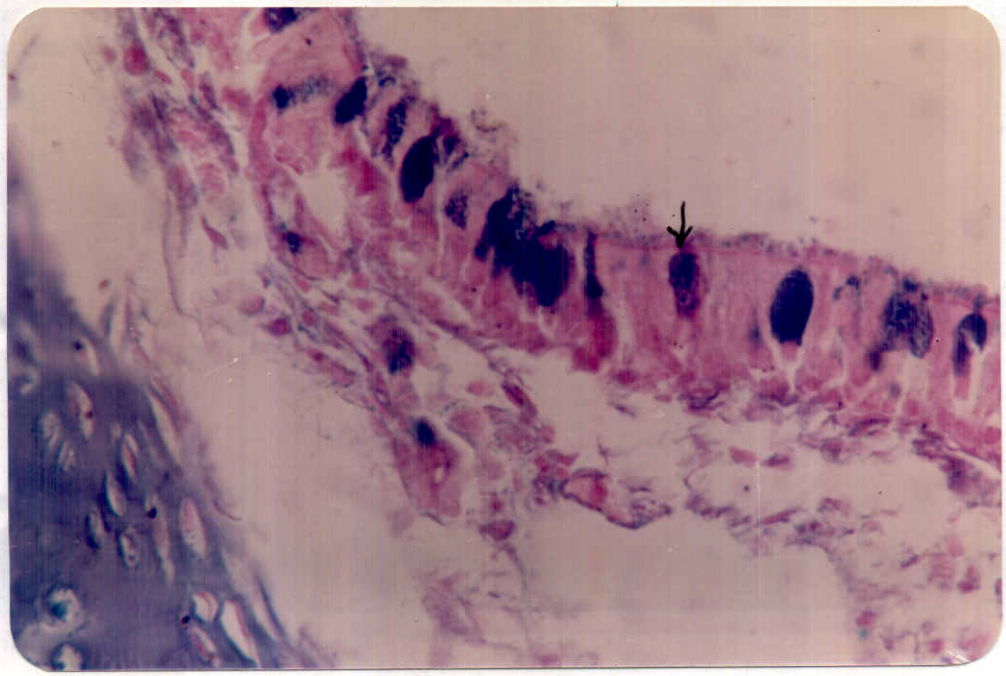


Fig.(18): A photomicrograph of a section in the caudal portion of the larynx of a rabbit showing the respiratory epithelium with goblet cells (arrow).
(AB-PAS combined reaction. Obj. x10, Proj.x10).

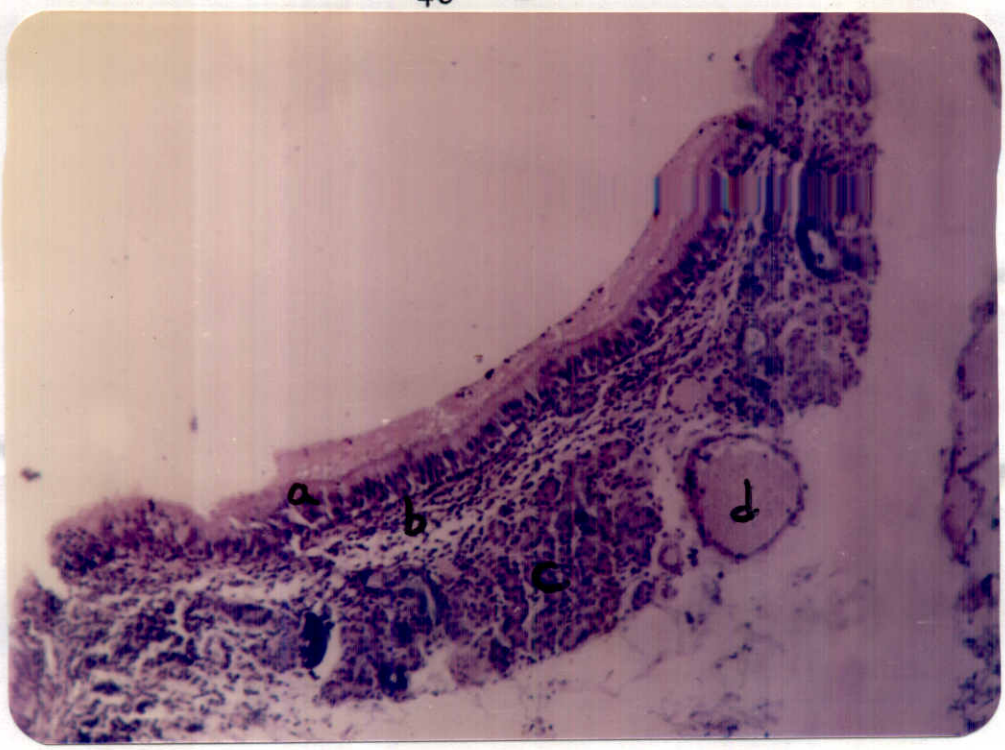


Fig.(19): A photomicrograph of a section in the larynx of a rabbit showing:
a) respiratory epithelium. b) lymphocytic infiltration.c)glandular acini d)blood vessels.
(Hx & E stains. Obj. x 10, Proj. x 10).

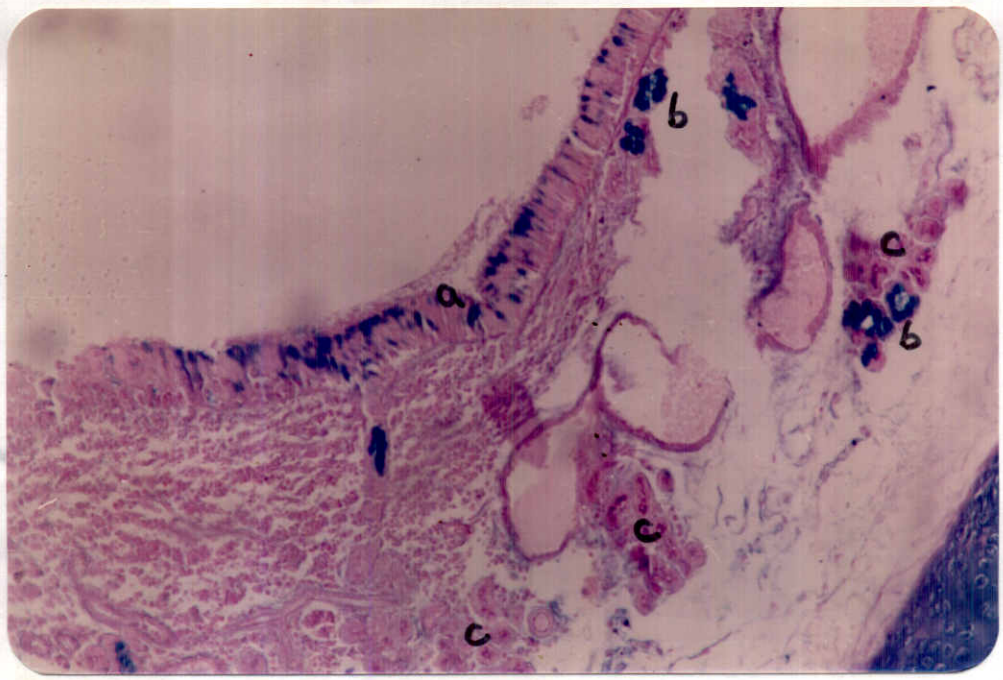


Fig.(20): A photomicrograph of a section in the larynx of a rabbit showing:
a)respiratory epithelium with goblet cells.
b)AB-positive acini.c)PAS-positive acini.
(AB-PAS combined reaction. Obj. x 40, Proj.x10).

cells which bluish purple by AB-PAS technique (Fig. 21 & 22). The free border of the epithelial cells was sharply demarcated and eosinophilic.

Beneath the epithelium, there were closely packed elastic fibers. These fibers, were longitudinally arranged (Fig. 23). The epithelium and subepithelial tissue were infiltrated with lymphocytes. Also, there were numerous wide blood spaces and capillaries (Fig. 24). In the subepithelial layer,few glandular acini could be seen just beneath the surface epithelium especially anteriorly in the spaces between the cartilagenous rings (Fig. 25 & 26). Some glandular acini were strongly AB-Positive and other acini were weakly stained with PAS technique. The cartilage which supported the trachea was C-shaped and of the hyaline type. The smooth muscle band capping the opened side of the C-shaped cartilage was thin.

B) Histochemical observations:

* Alkaline phosphatase:

The epithelium of the nasal cavity revealed traces of the alkaline phosphatase reaction. A weak reaction was detected in the respiratory, olfactory, laryngeal and tracheal epithelia. However an increased reaction to

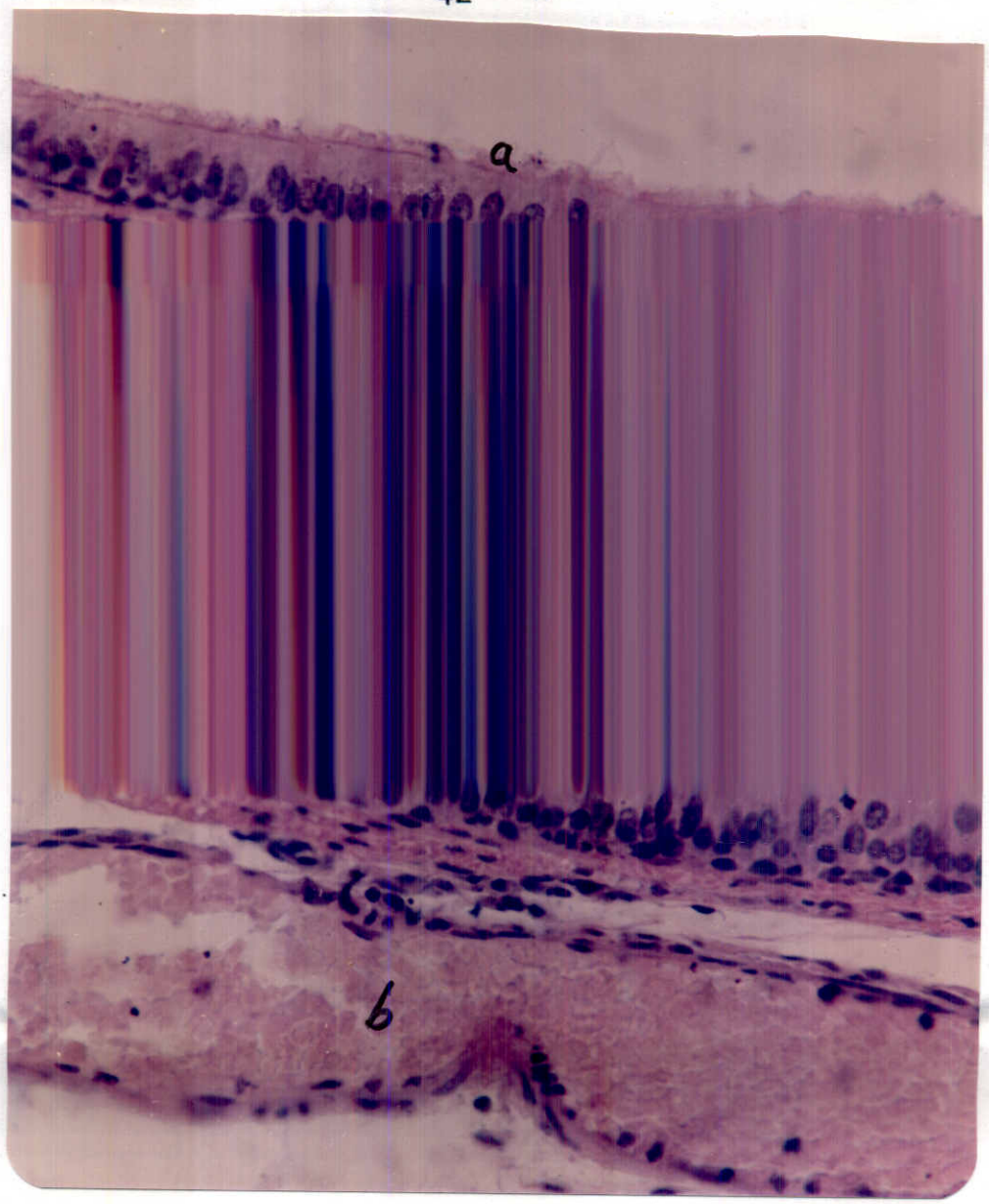
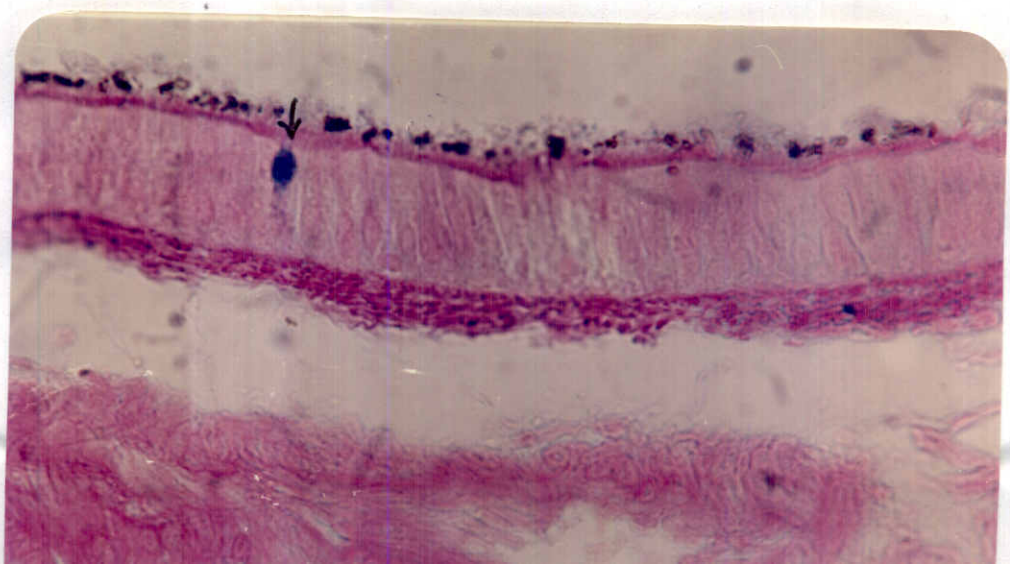


Fig.(21):A photomicrograph of a section in the trachea of a rabbit showing:
a) ciliated pseudostratified columnar epithelium with few goblet cells.
b) blood vessels.
(Hx&E stains. Obj. x 40, Proj. x 10).



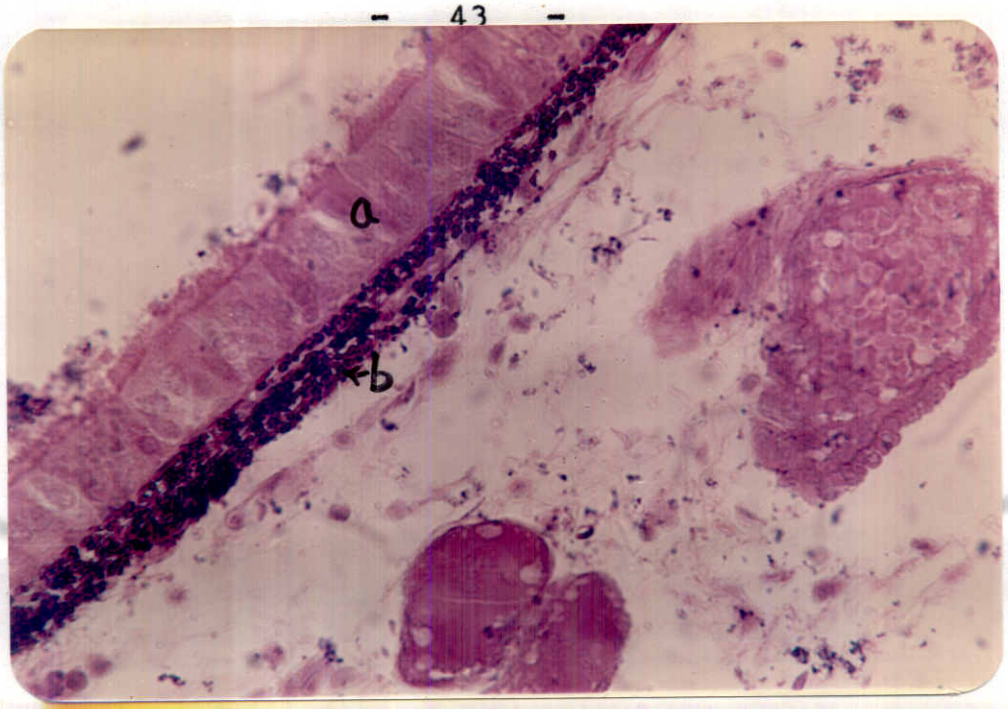


Fig.(23):A photomicrograph of a section in a rabbit's trachea showing:
a) pseudostratified columnar ciliated epithelium. (b) elastic fibers.
(Resorcin fuchsin stain. Obj. x 40, Proj. x10).

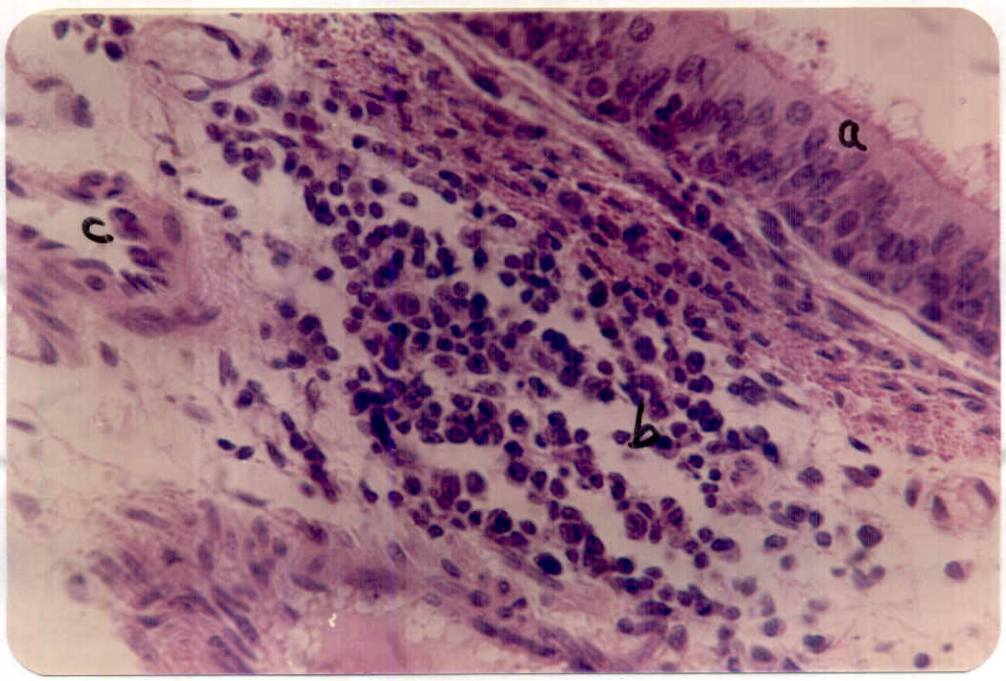


Fig.(24): A photomicrograph of a section in a rabbit's trachea showing:
a) pseudostratified columnar diliated epithelium with few goblet cells.
b) lymphocytic infiltration.c)blood spaces.
(Hx & E stains. Obj. x 40, Proj. x 10).

Fig.(25): A photomicrograph of a section in a rabbit's trachea showing:
a) few glandular acini. b) cartalige.
(Hx & E stains. Obj. x 10, Proj. x 10).

Fig.(26): A photomicrograph of a section in a rabbit's trachea showing: a)respiratory epithelium. b)non vacuolated acinar cells. c)few vacuolated acinar cells. d) blood spaces.
(Hx & E stains. Obj. x 40, Proj. x 10).

a moderate level was observed at the basal border of the respiratory, laryngeal, and tracheal epithelia and to a strong level in that the basal cell layer of olfactory one (Figs. 27 & 28). The laryngeal and tracheal glands had a moderate activity of the enzyme.

* Acid phosphatase:

The acid phosphatase activity was weak in the vestibular and nasal respiratory epithelia. The activity increased to become moderate at the free border and basal area of these epithelia respectively. The glandular acini in the nasal septum showed an intense reaction, while their ducts revealed a weak one (Fig. 29).

The olfactory epithelium and Bowmann's glands gave a moderate reaction with a strong one at the supranuclear region of the epithelial cells (Fig. 30). As well, the laryngeal epithelium had a moderate reaction with a strong one at the free cellular border together with the acini of the laryngeal glands (Fig. 31). However, the tracheal epithelium showed a moderate activity at the free cellular border.

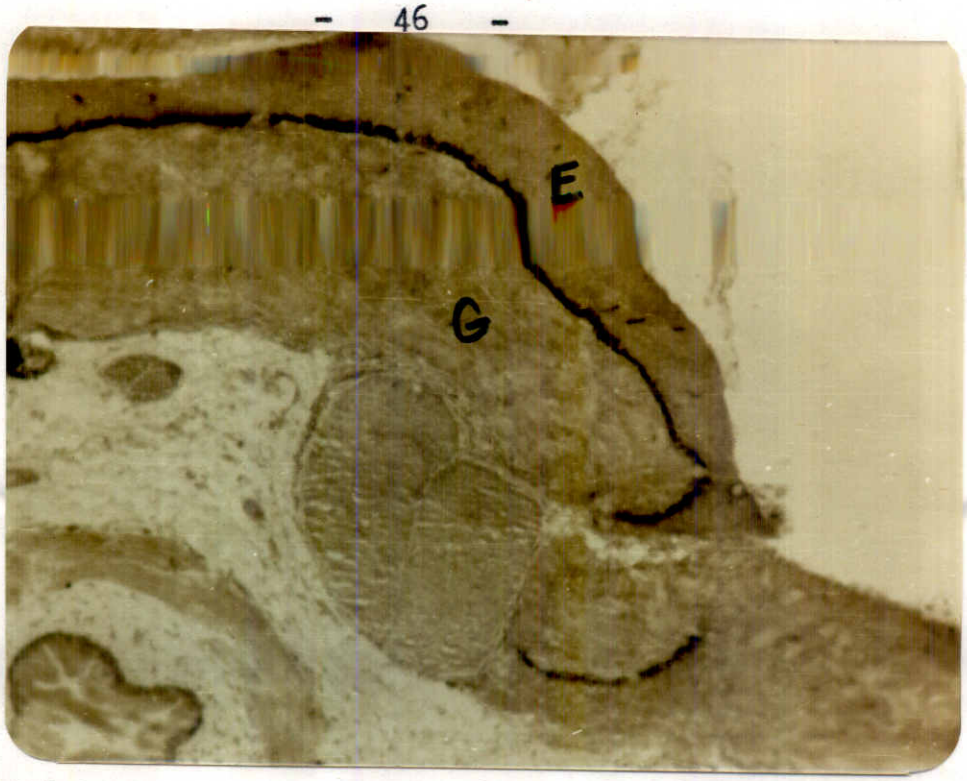


Fig.(27): A photomicrograph of a cryostat section showing alkaline phosphatase activity in the olfactory mucosa of a rabbit in the lining epithelium (E) and glands (G) .
(Azo-dye coupling method. Obj.10, Proj. x 10).

Fig.(28): A photomicrograph of a cryostat section in the laryngeal mucosa of the rabbit showing alkaline phosphatase reaction in the lining epithelium (E) glands (G).
(Azo-dye coupling method. Obj. x 10, proj. x10).

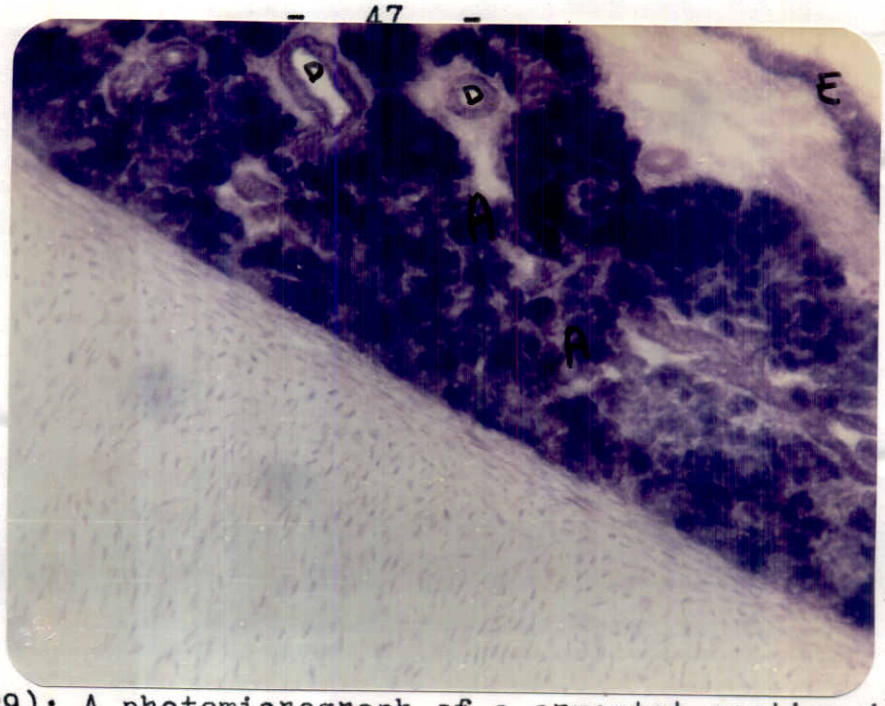


Fig.(29): A photomicrograph of a cryostat section in the septal glands of the respiratory region of a rabbit showing acid phosphatase activity in the acini (A), ducts (D) and lining epithelium (E). (Azo-dye coupling method. Obj.x10, Proj. x10).

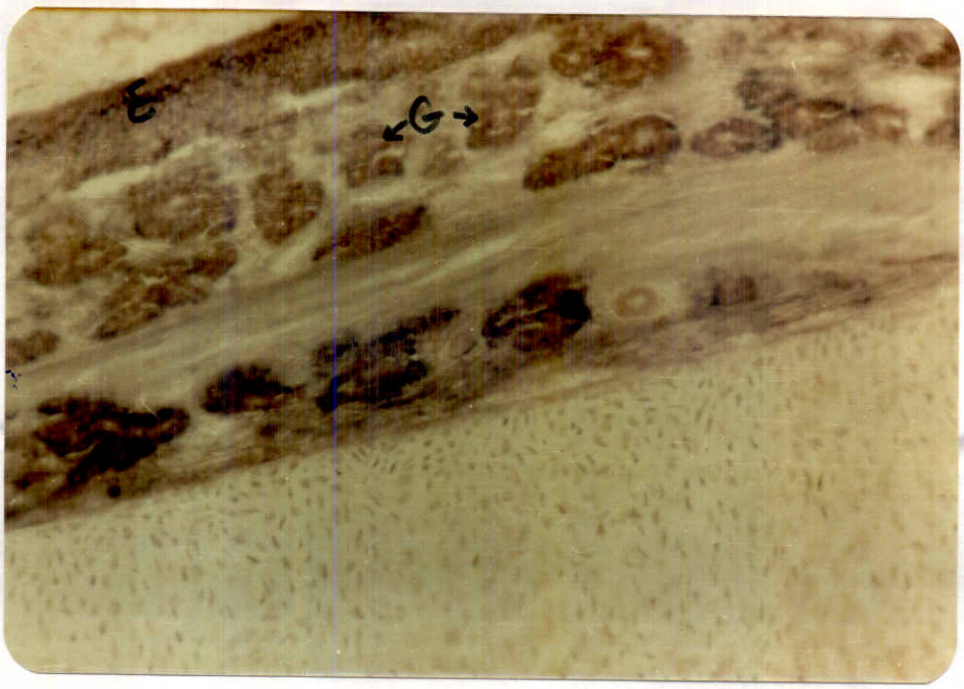


Fig.(30): A photomicrograph of a cryostat section of the olfactory region of a rabbit showing acid phosphatase reaction in the lining epithelium (E), glands (G).
(Azo-dye coupling method. Obj. x 10, Proj. x10).

* Adenosine triphosphatase

Generally speaking, the reaction in the endothelium of blood vessels was strong (Fig.32). However, traces of the enzymatic reaction were revealed in the nasal vestibular epithelium, olfactory epithelium and glands (Fig. 32). A weak reaction was observed in the respiratory, laryngeal and tracheal epithelia which increased to a moderate level at the free cellular borders (Fig. 33). The glandular elements in the larynx and trachea showed a weak reaction of the enzyme, while the reaction in the wall of the blood vessels and muscle was strong.

* Non sepecific esterase:

Traces of the enzyme activity were observed in the nasal vestibular, respiratory, and olfactory epithelia however the free cellular borders of the latter epithelia showed a strong reaction (Fig. 34). On the other hand, most of the glandular acini revealed an intense reaction of the enzyme. However a few number of them together with the underlying glands showed a moderate activity (Fig. 35). As well the olfactory glands of Bowmann and their ducts revealed a strong reaction (Fig. 34).

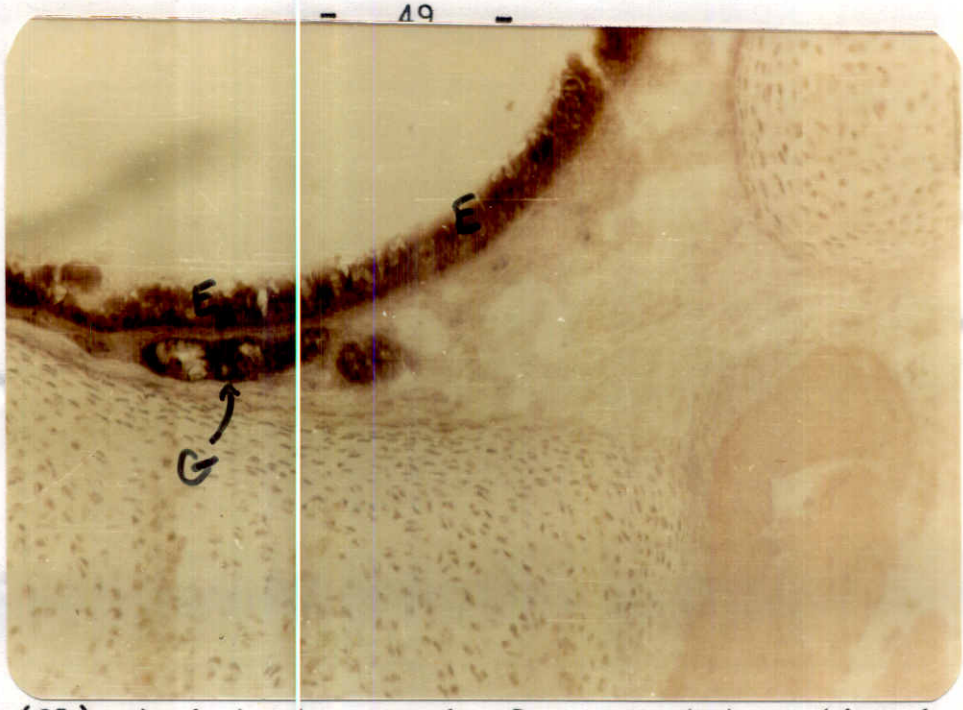


Fig. (31): A photomicrograph of a cryostat section in the larynx of a rabbit illustrating acid phosphatase activity in the lining epithelium (E), glands (G).
(Azo-dye coupling method. Obj. x10, Proj. x10)

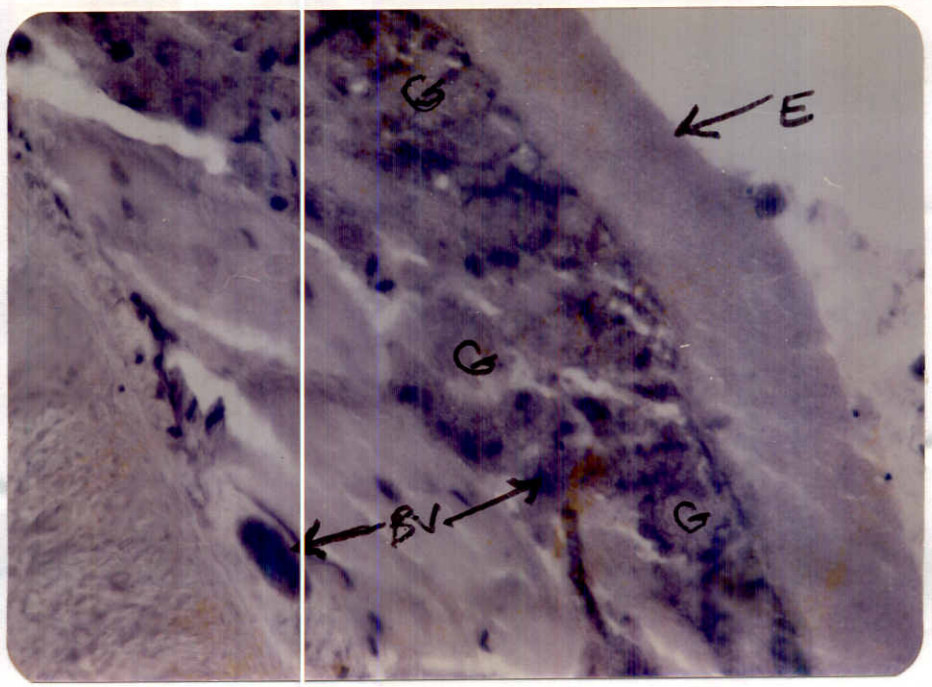


Fig. (32): A photomicrograph of a cryostat section in the olfactory region of a rabbit showing adenosine triphosphatase reaction in the lining epithelium (E), blood vessels (BV) and glands (G)
(Calcium method. Obj. x10, Proj. x 10).

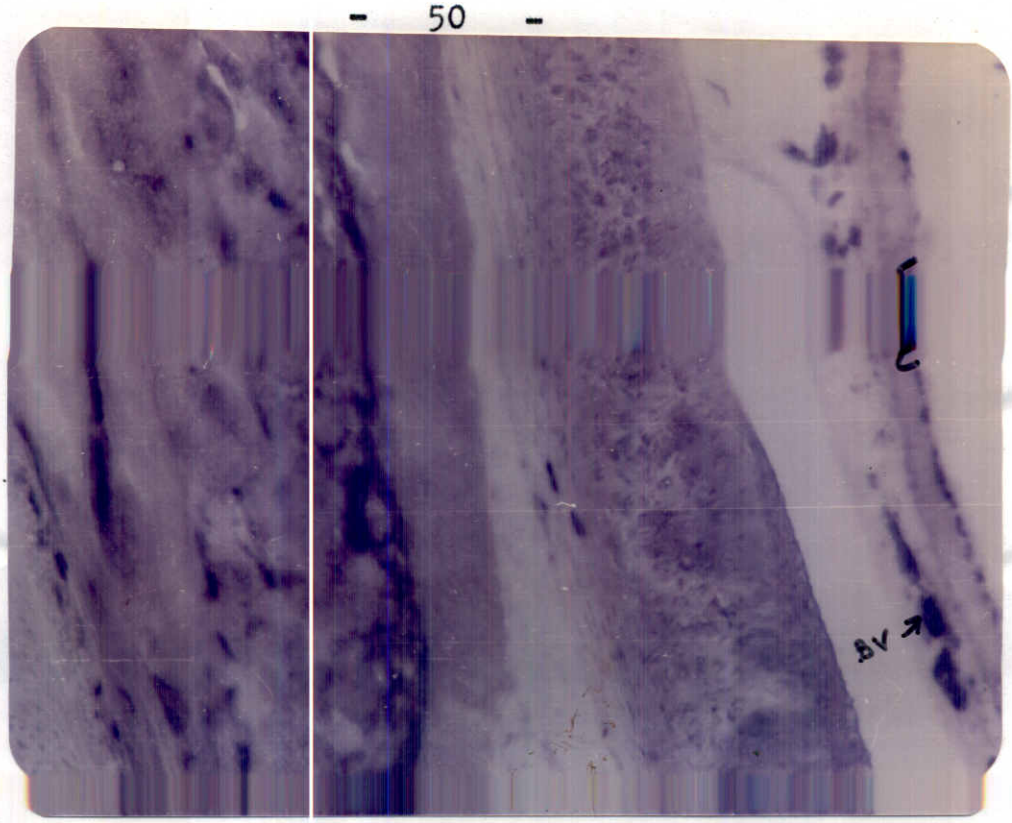


Fig.(33):A photomicrograph of a cryostat section in the trachea of a rabbit showing adenosine triphosphatase activity in the lining epithelium (E) blood vessels (BV).
(Calcium method.Obj. x10, Proj. x10).

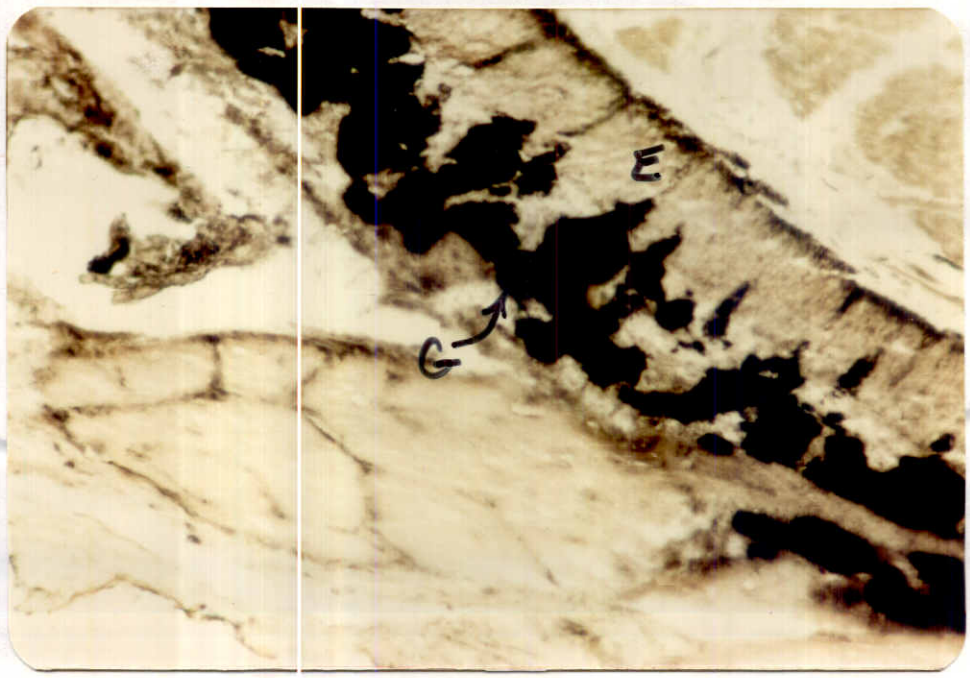


Fig.(34): A photomicrograph of a cryostat section in the olfactory nasal mucosa of a rabbit showing non-specific esterase activity in the epithelium (E) glands (G).
(Alpha-naphthyl acetate method.Obj.x10,Proj.x10).

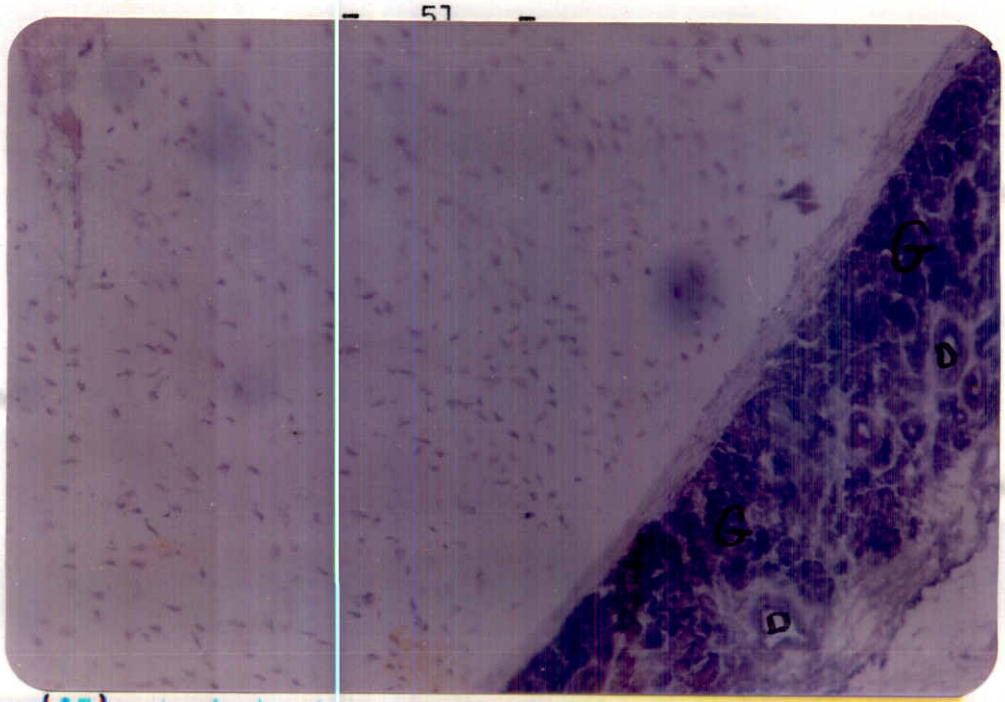


Fig.(35): A photomicrograph of a cryostat section in the septal glands of the respiratory region of a rabbit showing non-specific esterase reaction in glands (G) & duct (D).
(Alpha-naphthyl acetate method. Obj.x10, Proj.x10)

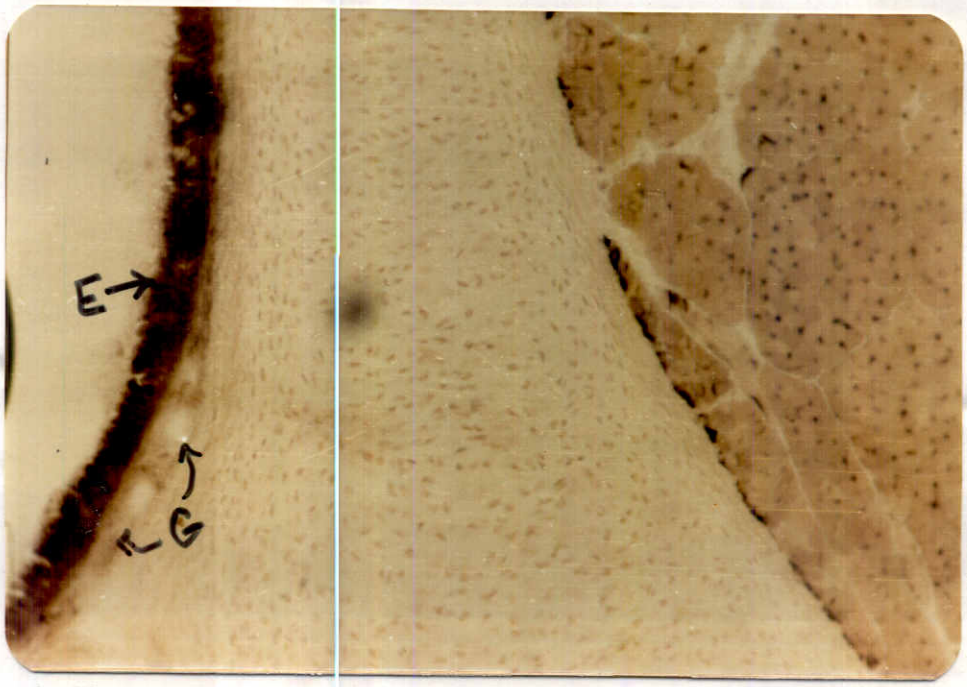


Fig.(36): A photomicrograph of a cryostat section in the larynx of a rabbit showing non-specific esterase activity in the epithelium (E), and gland.
(Alpha-naphthyl acetate method. Obj.x10,Proj.x10).

In both of the larynx and trachea, the lining epithelium showed a strong activity, while the glands showed a weak one (Fig. 36).

* Succinic dehydrogenase:

The reaction was weak in the nasal respiratory epithelium, olfactory epithelium, respiratory glands, tracheal glands and muscles. This reaction was moderate in the vestibular epithelium, the free borders of respiratory and olfactory epithelia and cells, olfactory glands and their ducts, laryngeal epithelium and glands. However, a strong reaction was observed in few of the glands of nasal cavity and the tracheal epithelium (Figs. 37, 38, 39, 40).

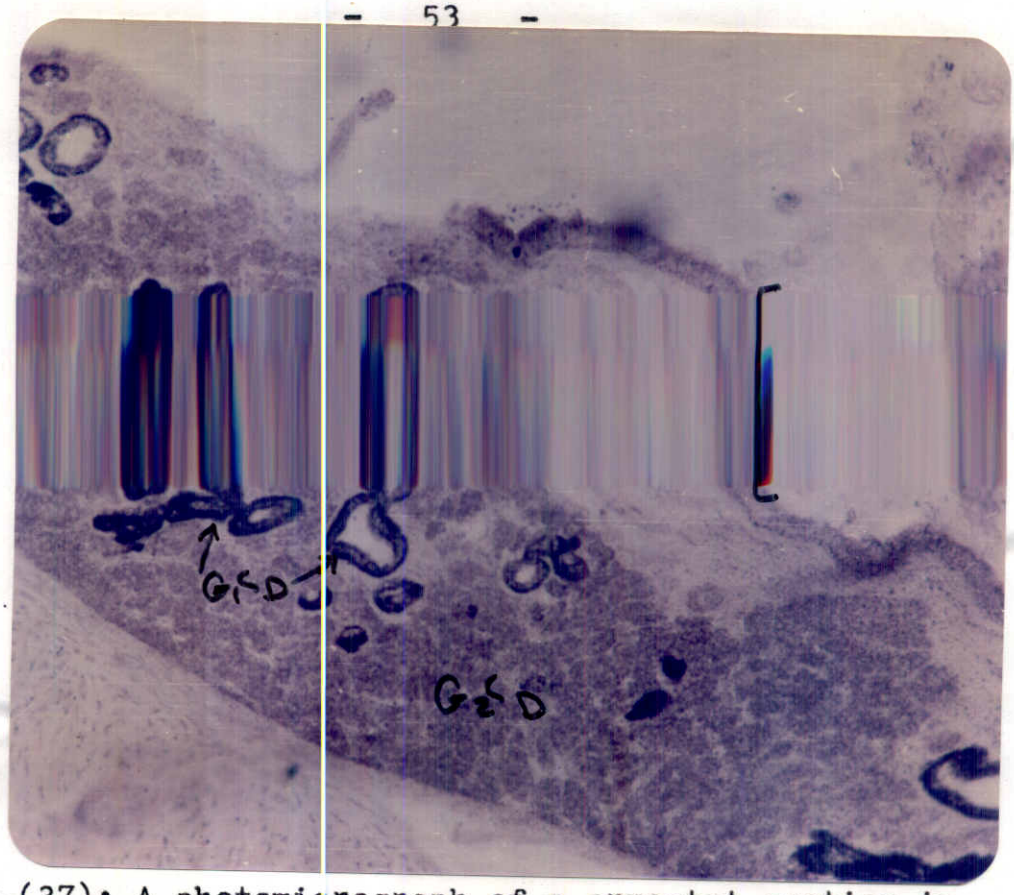


Fig.(37): A photomicrograph of a cryostat section in the septal glands of respiratory part of a rabbit illustrating succinic dehydrogenase activity in glands and their duct having strong reaction (G_1 & D), glands and their ducts having weak reaction (G_2&D) and lining epithelium (E).
(Nitro-blue tetrazolium method. Obj.x10,Proj.x10).

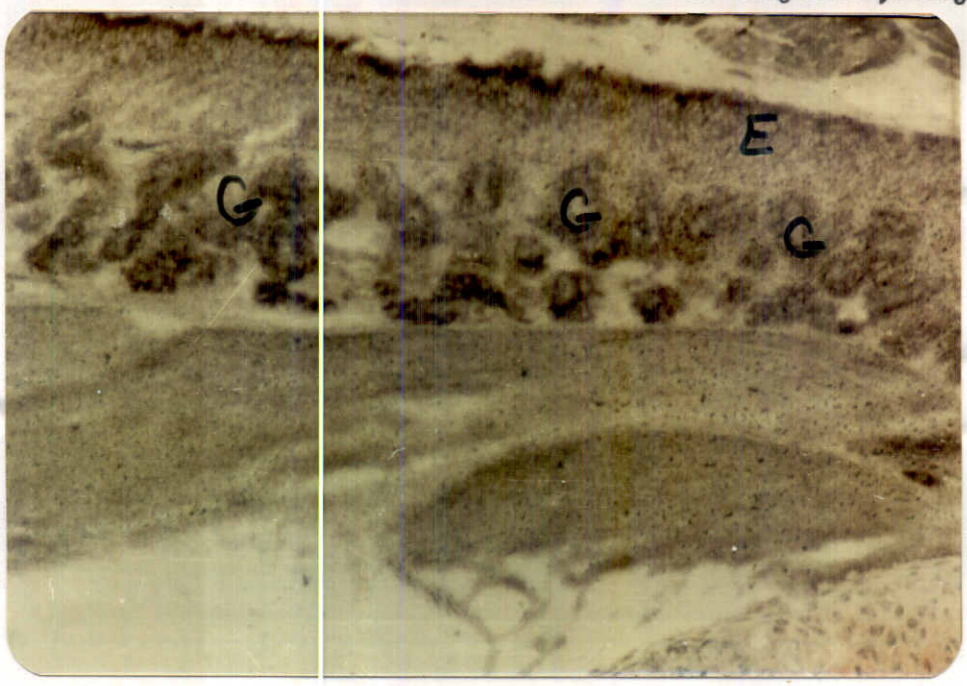


Fig.(38):A photomicrograph of a cryostat section in the olfactory nasal mucosa of arabbit showing succinic dehydrogenase activity in the lining epithelium (E) & glands (G).
(Nitro-blue tetrazolium method. Obj. x 10,Proj.x10).

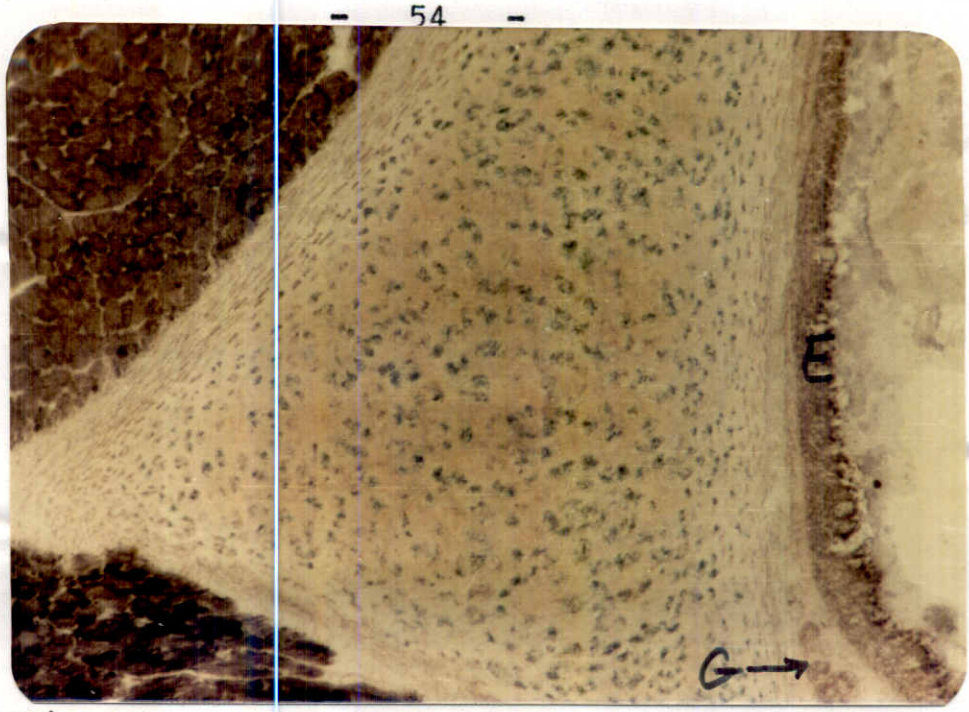


Fig.(39): A photomicrograph of a cryostat section in the larynx of a rabbit showing succinic dehydrogenase reaction in the lining epithelium (E) & glands (G).
(Nitro-blue tetrazolium method. Obj.x10, Proj.x10).

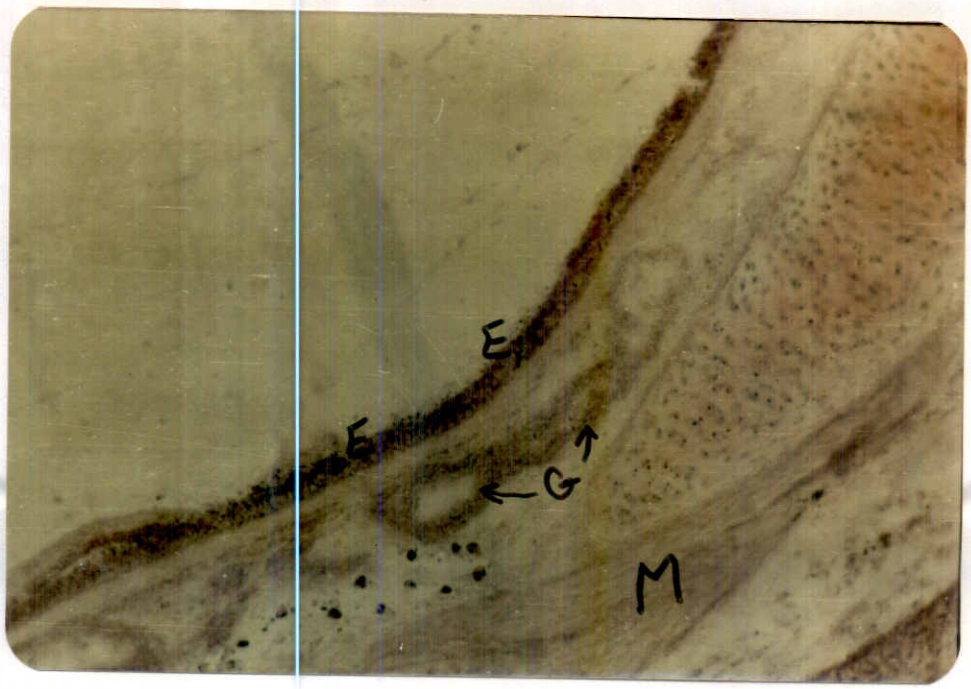


Fig.(40): A photomicrograph of a cryostat section in the trachea of a rabbit showing succinie dehydrogenase activity in the lining epithelium (E) & glands(G), and muscles (M).
(Nitro-blue tetrazolium method. Obj.x10,Proj.x10).

II. Guinea pig

A) Histological observations

1. Nasal cavity

a) Nasal vestibule

The vestibular epithelium was keratinized stratified squamous epithelium (Fig. 41). This epithelium extended posteriorly to line the dorsolateral portion of the nasal vestibule which was situated between the dorsal and ventral conchae (Fig. 42). The epithelium became thin and extended to line the anterior portion of the midle nasal meatus (The ventral surface of the dorsal concha , the lateral nasal wall, and the dorsal surface of the ventral concha).

At the nasal opening, the subepithelial layer of the anterior portion of the vestibule contained numerous hair follicles, sebaceous glands, and deeply situated striated muscle fibers (Fig. 41). The anterior portion of the middle nasal meatus was lined with thin keratinized epithelium which became stratified cuboidal and ciliated pseudostratified columnar epithelium (at the medial surfaces of the dorsal and ventral conchae) (Fig. 42 & 43). Beneath the keratinized and the stratified cuboidal epithelium of the posterior portion of the vestibule, there were

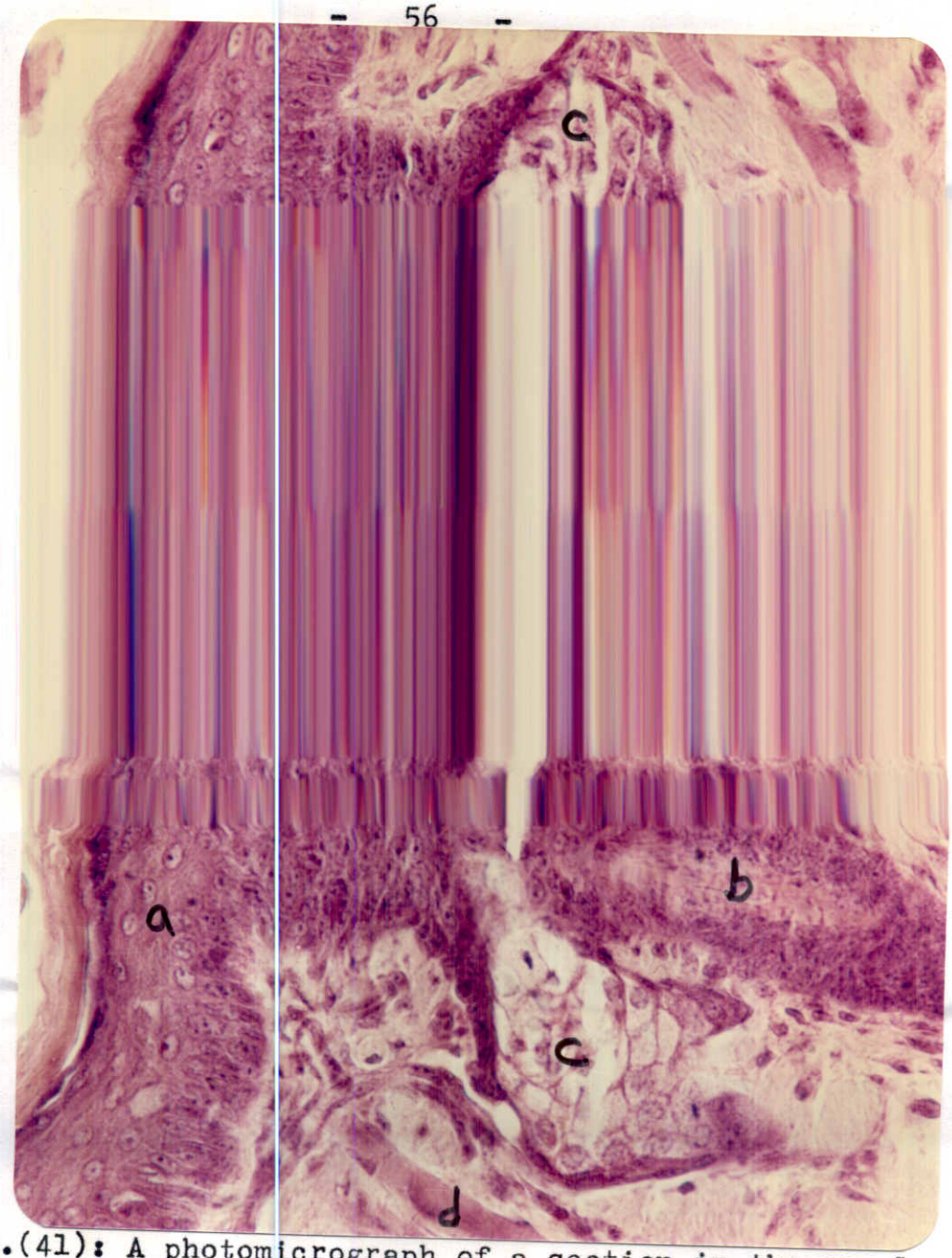


Fig.(41): A photomicrograph of a section in the nasal vestibule of a guinea pig showing:
a) Keratinized strtified squamous epithelium
b) a hair follicle.
c) a sebecous glands d) striated muscle fibers.
(H x & E stains. Obj.x40, Proj.x10).

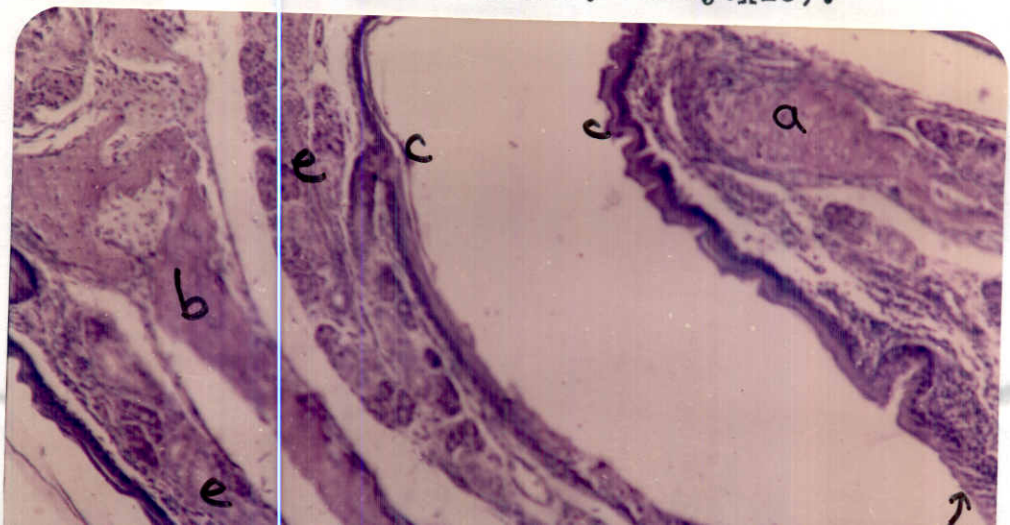


Fig.(43): A photomicrograph of a section in the dorsal concha of a guinea pig's nasal cavity showing stratified cuboidal epithelium (arrow) (Hx & E stains. Obj.x40, Proj.x10).

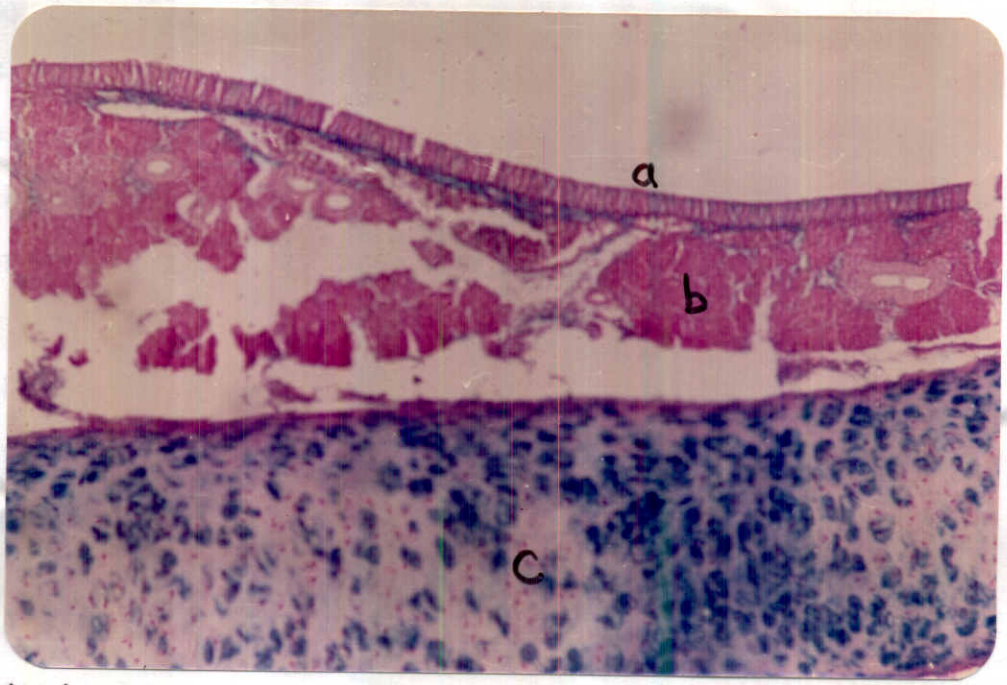


Fig.(44): A photomicrograph of a section in the nasal respiratory region of a guinea pig showing: a) respiratory epithelium. b)glandular acini. c) hyaline cartilage.

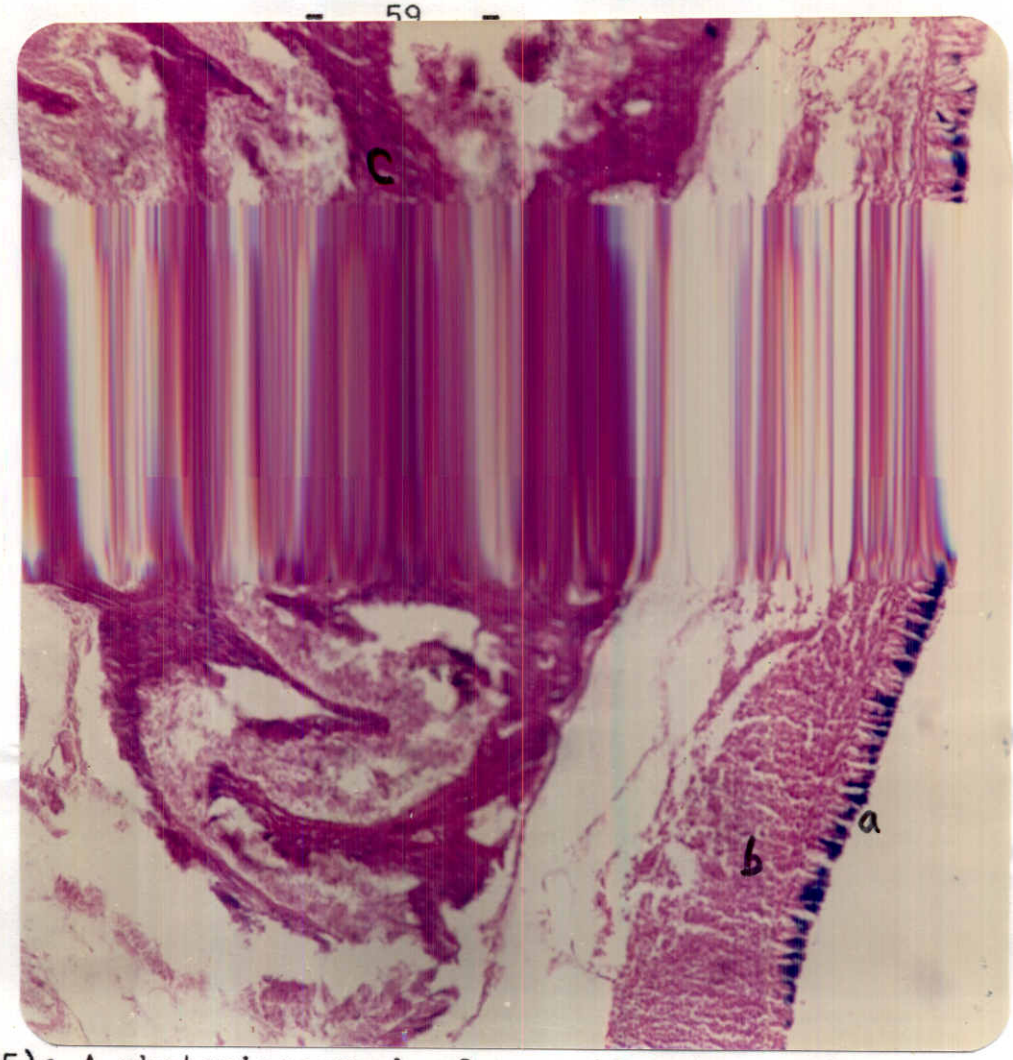


Fig.(45): A photomicrograph of a section in a guinea pig's nasal respiratory region showing:
a) numerous goblet cells.
b) lymphocytic infiltration c) bony plates.
(AB-PAS combined reaction. Obj. x 10-Proj. x10).

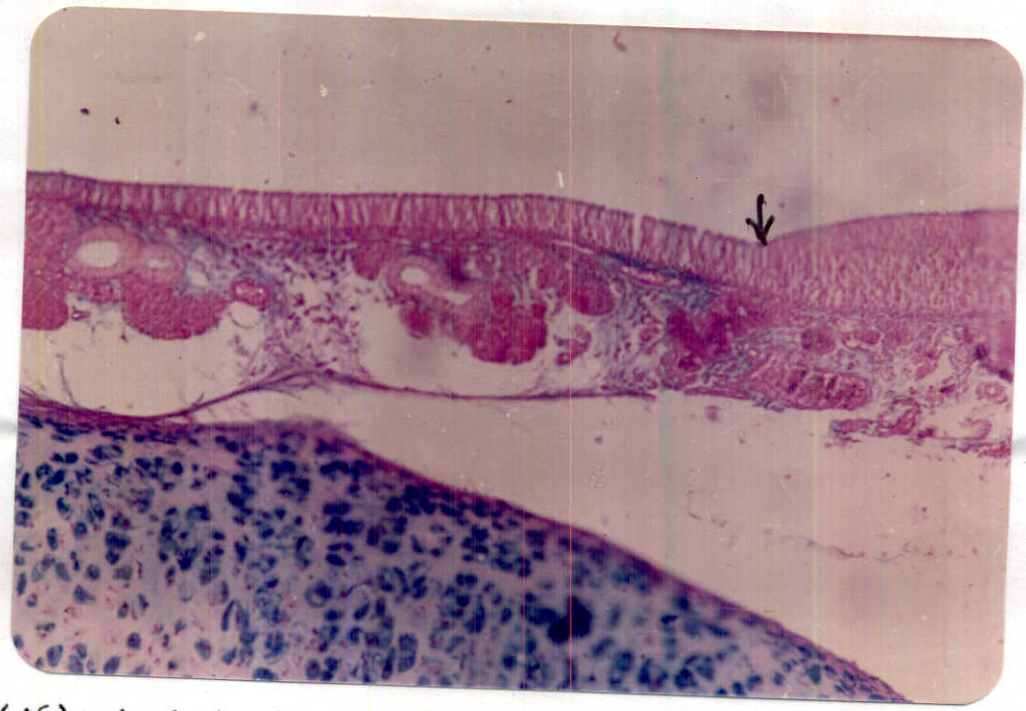


Fig.(46): A photomicrograph of a section in a guinea pig's nasal olfactory region showing the

Fig.(47): A photomicrograph of a section in the olfactory nasal mucosa of a guinea pig showing:
a) olfactory epithelium.
b) glandular elements (olfactory).
c) olfactory nerve bundle.
(Hx&E stains. Obj. x 40, Proj. x 10).

Fig.(48): A photomicrograph of a section in the olfactory nasal mucosa of a guinea pig showing:
a) olfactory epithelium. b)olfactory glands.
c) olfactory nerve bundles.
(AB-PAS combined reaction. Obj. x10, Proj.x10).

Also, the glandular and their ducts exhibited AB-PAS reaction as those in the rabbit (Fig. 48).

2. Larynx

The guinea pig laryngeal mucosa simulated that of the rabbit except that the goblet cells were numerous among the laryngeal epithelium of the dorsal and ventral portions.

In the combined AB-PAS stained sections, there were magenta red colouration in the goblet cells of the dorsal portion (Fig. 49) and bluish-purple colouration in those of the ventral portion (Fig. 50). The glandular elements in the anterior portion of the laryngeal mucosa appeared as cord-like arrangements consisting of some small sized acini and others large sized ones (Fig. 51). The small acini possessed cubical cells with acidophilic cytoplasm and centerally located spherical nuclei. There was a moderate AB and PAS positive material in the supranuelear region. However, the large acini were formed of one layer of vacuolated cells with compressed basal nuclei (Fig. 51). The vacuolated cells had intense AB and PAS positive material (Fig. 50).

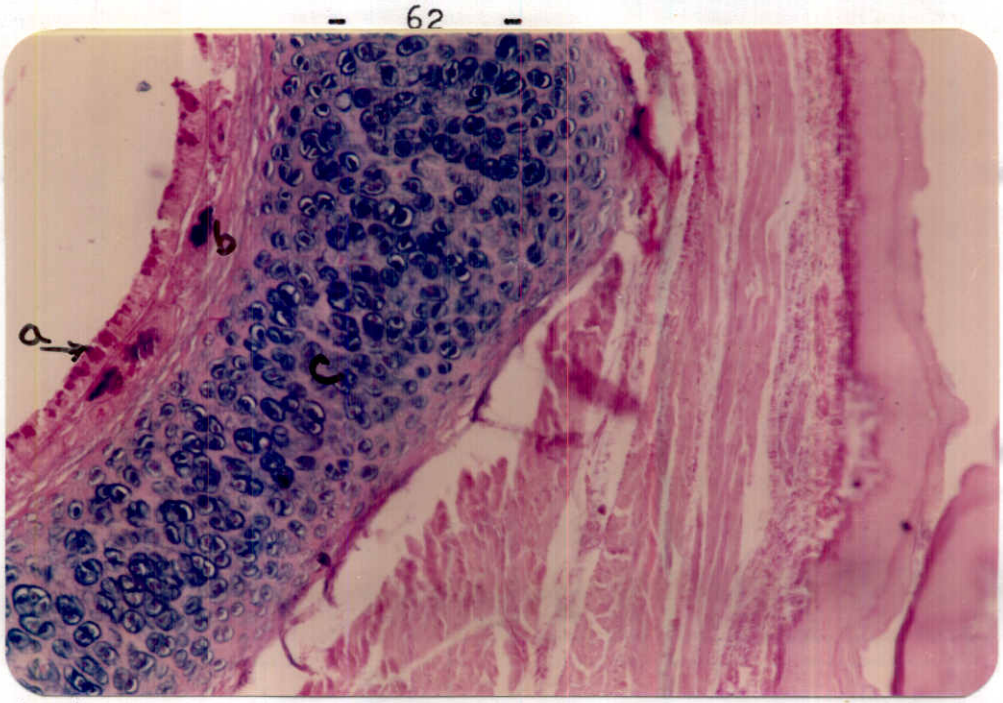


Fig.(49): A photomicrograph of a section in the dorsal portion of the larynx of a guinea pig showing:
a) magenta red stained goblet cells(PAS.Positive).
b) AB-PAS positive acini c)hyaline cartilage.
(AB-PAS combined reaction. Obj.x10-Proj.x10).

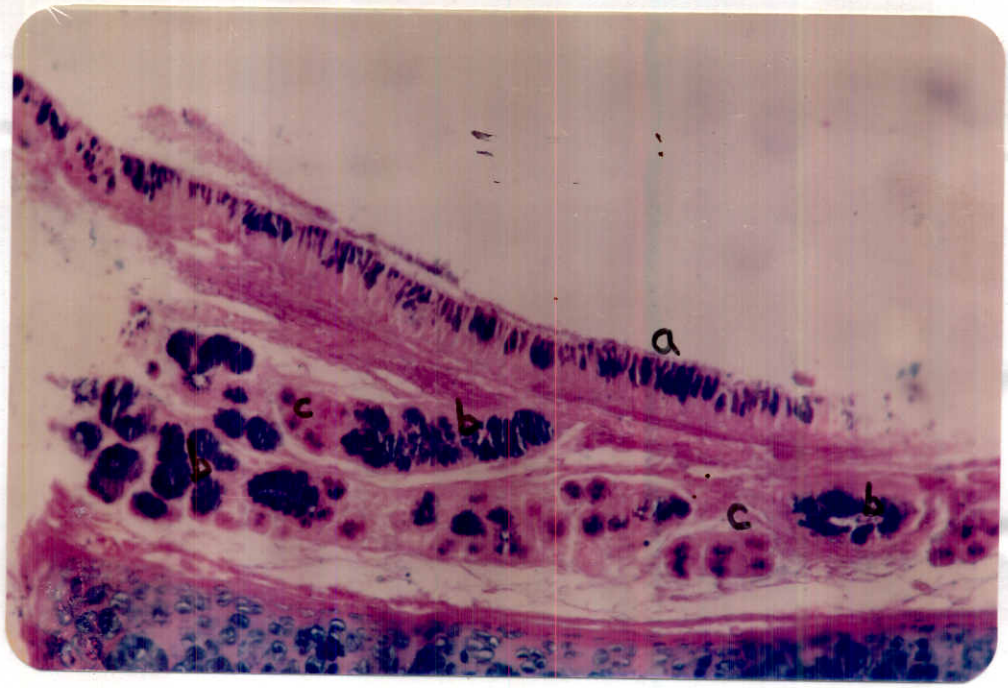


Fig.(50):A photomicrograph of a section in the posterior portion of the larynx of a guinea pig showing:
a)bluish purple colouration of goblet cells.
b)AB-PAS-positive acini c) PAS-Positive small acini
(AB-PAS combined reaction. Obj.x10, Proj.x10).

3. Trachea:

The trachea of the guinea pig resembled that of the rabbit, but the surface epithelium beneath the muscle band was folded (Fig. 52). The goblet cells were numerous especially in the epithelium which covering the folds. They were stained magenta red in the combined AB-PAS stained sections (Fig. 53). However, the rest of the goblet cells were stained bluish. As well, few of the goblet cells in the lateral wall were bluish purple with the combined AB-PAS stain (Fig. 54). The subepithelial tissue was highly cellular. The hyaline cartilage was fragmented. The smooth muscular band was thick than that of the rabbit (Fig. 52).

B) Histochemical observations:

* Alkaline phosphatase:

The picture of the enzymatic activity resembled that in the rabbit in the nasal cavity and trachea. (Fig. 27).

However, the larynegeal epithelium revealed a moderate reaction which increased to become a strong basally, but the glandular acini showed a weak activity with a moderate reaction in the basal border of their cells (Fig. 55).

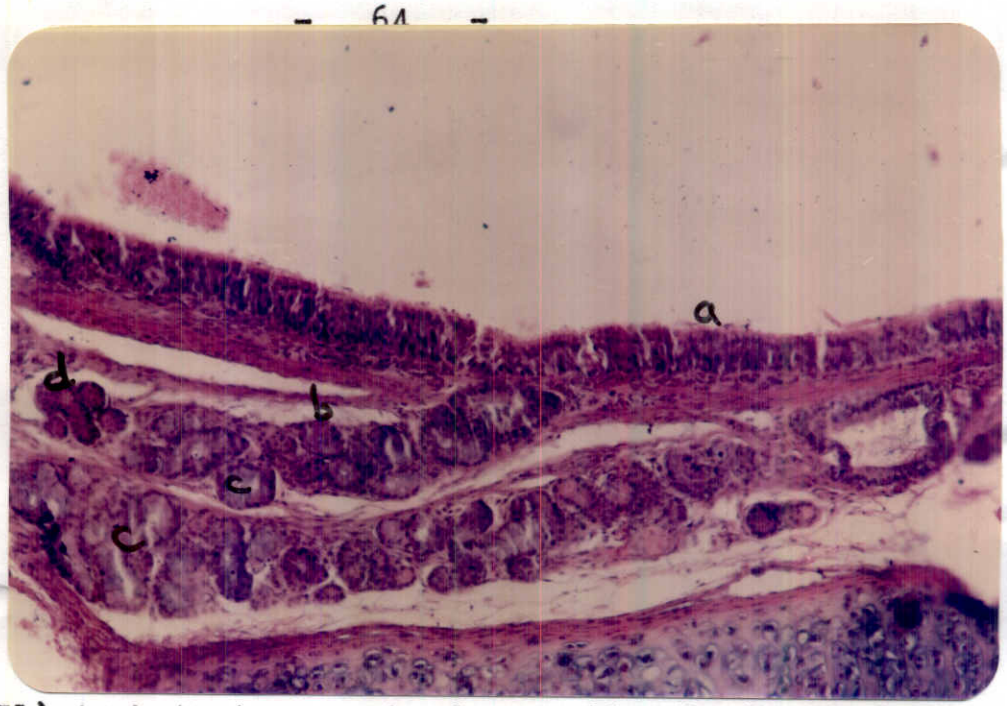


Fig.(51): A photomicrograph of a section in the posterior portion of the larynx of a guinea pig showing:
a)respiratory epithelium.
b) glandular elements in cord like arrangement.
c) Vacuolated acinar cells.
d) esinophilic acinar cells.
(Hx & E stains. Obj. x10. ,Proj. x 10).

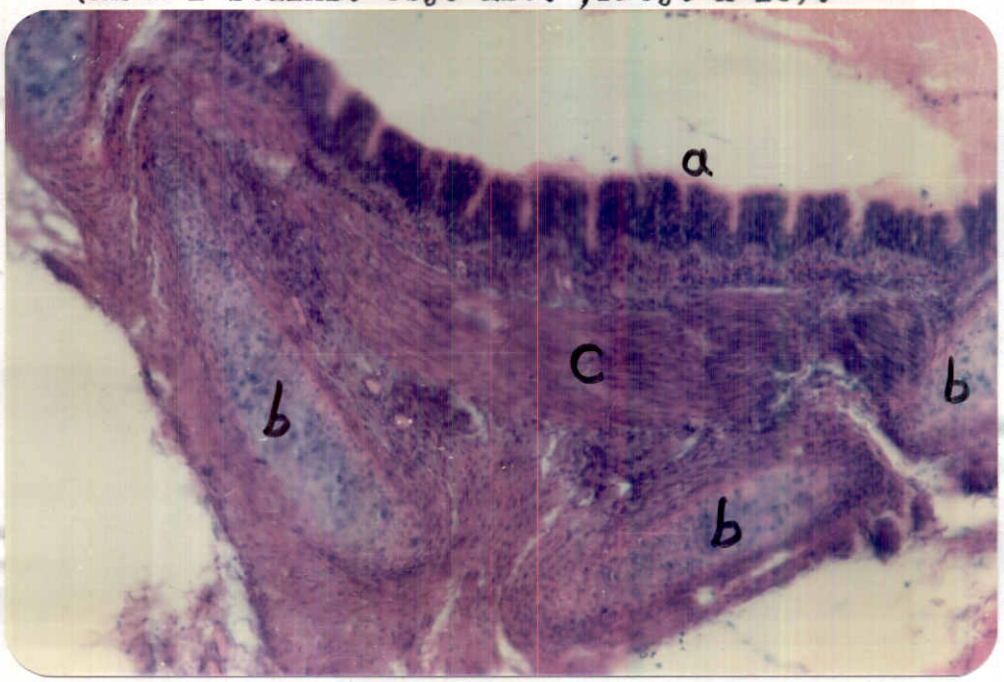


Fig.(52): A photomicrograph of a section in a guinea pig's trachea showing:
a) folded epithelium b)cartilage plate of hyaline type. c)thick smooth muscular band.
(Hx & E stains. Obj.x10, Proj. x 10).

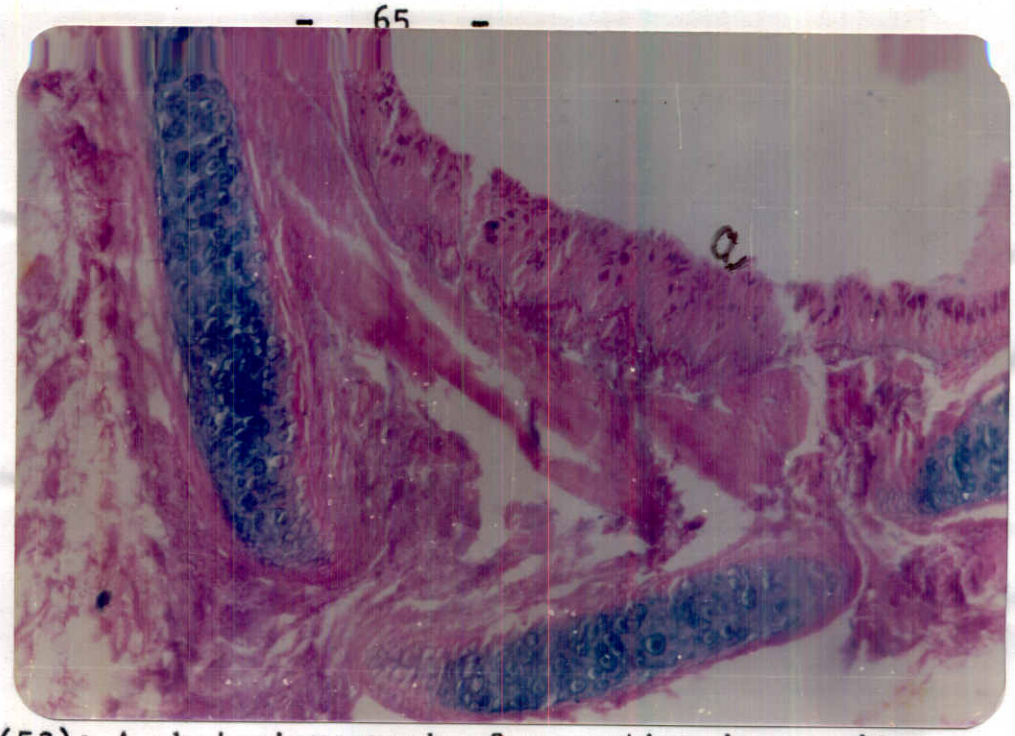


Fig.(53): A photomicrograph of a section in a guinea pig's trachea showing PAS. Positive goblet cells (a).
(PAS reaction. Obj.x10, Proj. x 10).

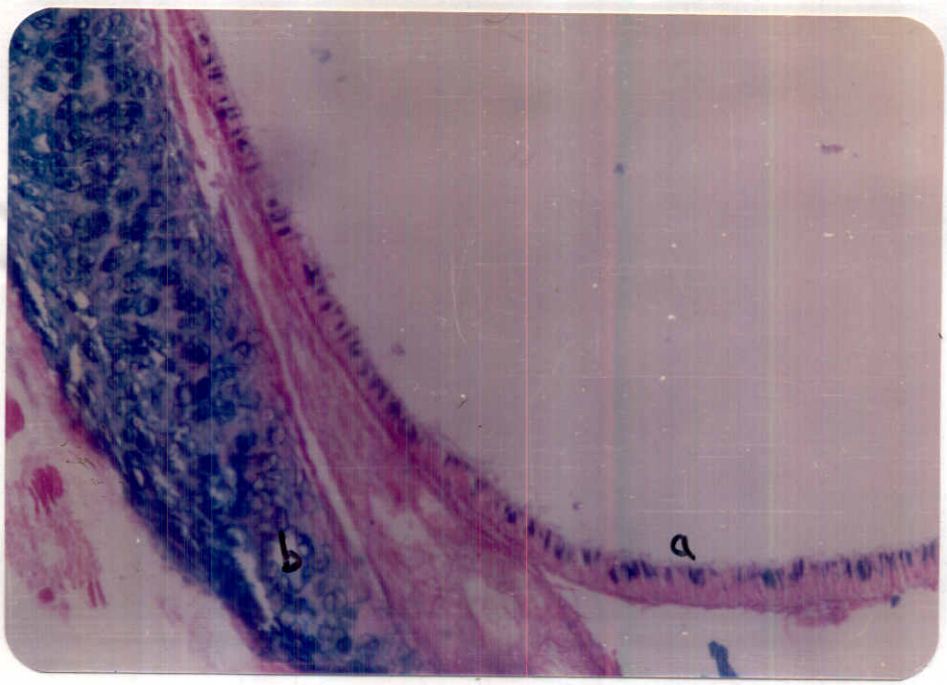


Fig.(54):A photomicrograph of a section in the trachea of a guinea pig showing:
a) goblet cells (AB and PAS positive).
b) a cartilage plate.
(AB-PAS combined reaction. Obj. x 10, Proj.x10).

Fig(55): A photomicrograph of a cryostat section in a guinea pig's larynx demonstrating the alkaline phosphatase reaction in the lining epithelium (E) and gland (G).
(Azo-dye coupling method. Obj. x 10, Proj. x 10).

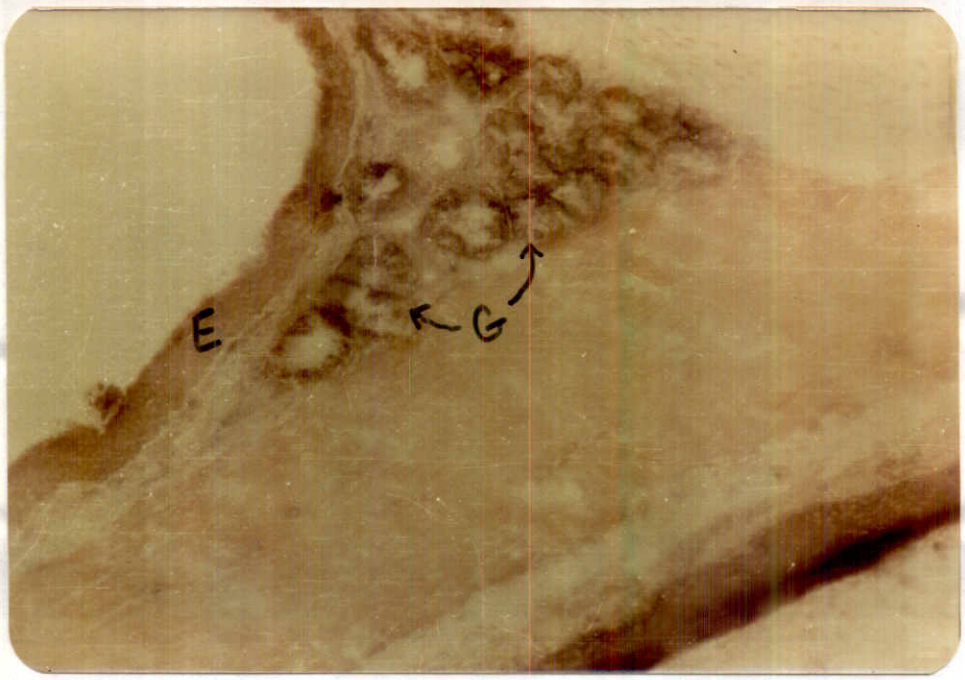


Fig.56): A photomicrograph of a cryostat section in the larynx of a guinea pig showing acid phosphatase activity in the lining epithelium (E) glands (G).
(Azo-dye coupling method. Obj. x 10, Proj.x10).

* Acid phosphatase:

The picture in the vestibular and respiratory region was like that described in the rabbit. However, the glandular acini showed a moderate activity.

The olfactory epithelium gave a picture resembling that in rabbit (Fig. 30). On the other hand, the olfactory glands of Bowmann showed a weak activity.

The laryngeal epithelium revealed a weak reaction with a moderate activity at the free border (Fig. 56). While, the laryngeal glands showed a moderate reaction (Fig. 56).

Again, the picture in the trachea resembled that in the rabbit.

* Adenosine triphosphatase:

The enzymatic reaction in nasal vestibular epithelium, respiratory epithelium, and olfactory epithelium and their glands was similar to that in the rabbit. As well, was that in the blood vessels and the larynx, except for the basal border of the epithelium of the latter which was moderate (Fig. 57).

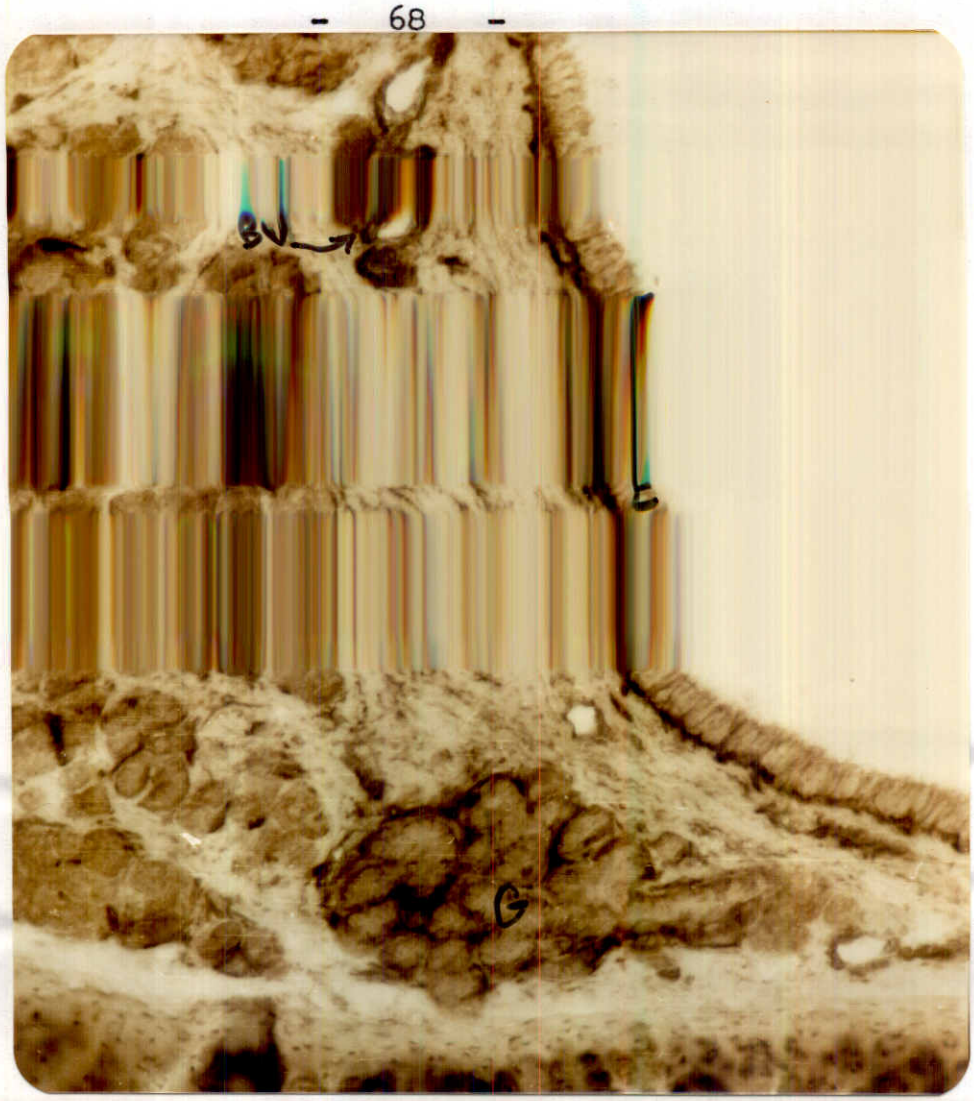
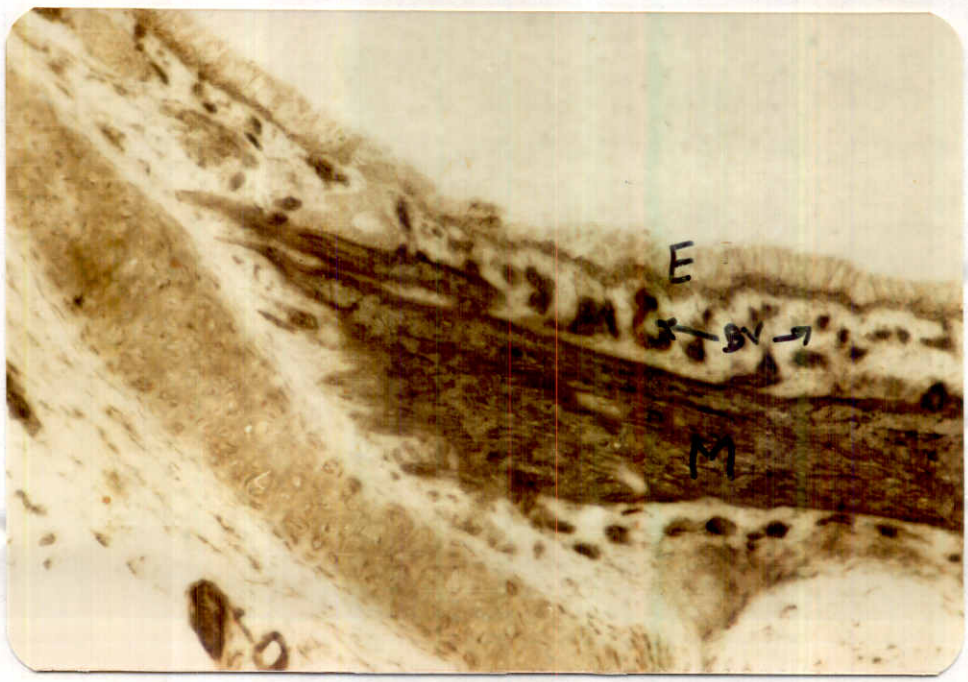


Fig.57): A photomicrograph of a cryostat section in the larynx of a guinea pig illustrating adenosine triphosphatase reaction in the lining epithelium (E), glands (G) and blood vessels (BV). (Calcium method. Obj. x 10, Proj. x 10).



Again, the trachea presented similar reactions to those of the rabbit except for the basal border of epithelium which presented a moderate reaction (Fig. 58).

* Non_sepecific_esterase:

reaction of this enzyme in the nasal vestibular and respiratory epithelia, together with the glandular elements and the nasal olfactory epithelium except the free border which increased to become a moderate in activity. As well, the olfactory glands of Bowmann and their ducts rerealed a moderate reaction.

In the larynx, the lining epithelium showed a moderate reaction, while the glands showed a strong one (Fig. 59).

The lining epithelium of the trachea revealed a strong activity of the enzyme, on the other hand, the glands showed a moderate one (Fig. 60).

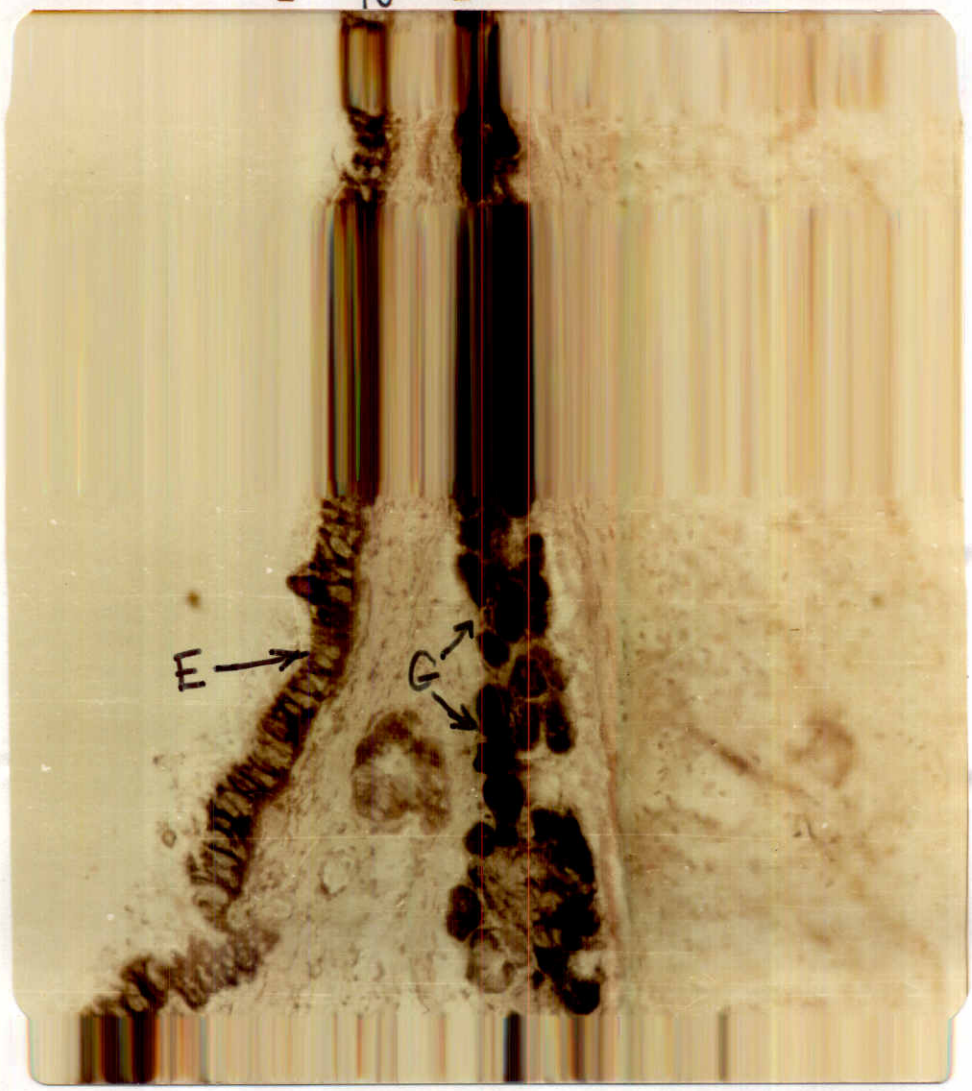


Fig.(59): A photomicrograph of a cryostat section in the larynx of a guinea pig demonstrating non-specific esterase activity in the lining epithelium (E) glands (G).
(Alpha-naphthyl acetate method. Obj.x10, Proj.x10).

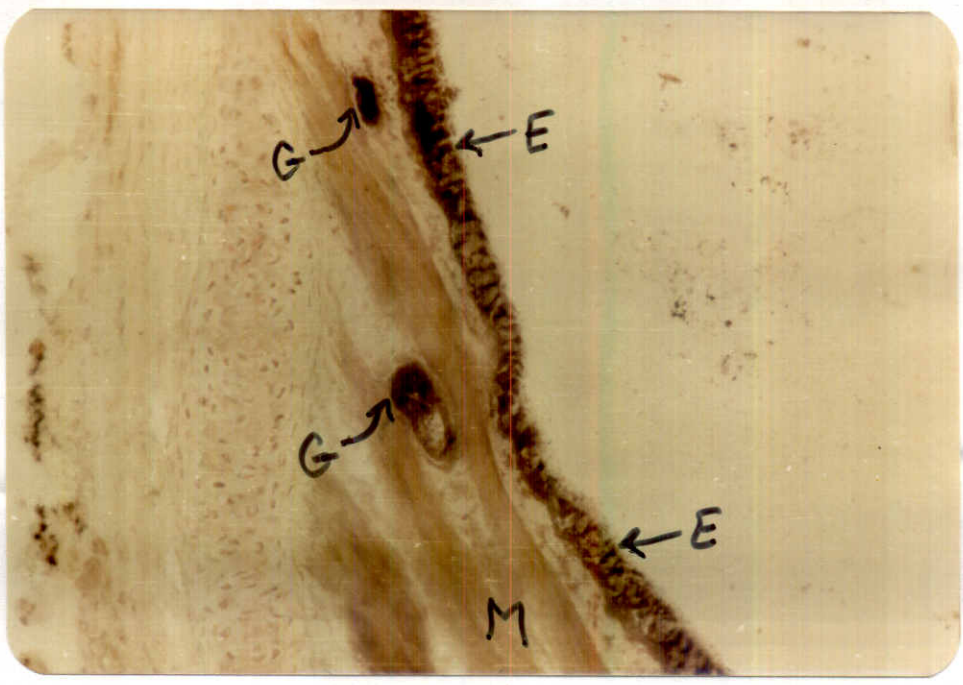


Fig.(60): A photomicrograph of a cryostat section in

* Succinic dehydrogenase:

The nasal vestibular and nasal respiratory epithelia and glands showed a similar reaction as in the rabbit (Fig. 37). However, the nasal olfactory epithelium showed a moderate reaction which increased to a strong level at the apical portions. The olfactory glands showed a moderate activity which increased at the free border (Fig.38).

The laryngeal epithelium showed a weak reaction while the laryngeal glands showed a moderate activity (Fig. 61).

In the trachea, the epithelium, glands and, muscles showed a moderate reaction with the enzyme.

III. Rat

A) Histological observations

1. Nasal cavity

a) Nasal vestibule

The anterior portion of the vestibule was lined with stratified squamous keratinized epithelium. Few rounded structures seen subepithelially in contact with the surface epithelium of the alar fold were lined by this type of epithelium. In this region there were no glandular elements. The vestibular floor showed plates of hyaline cartilage beneath the epithelium, few hair follicles, and striated muscle fibers. The latter fibers were deeply located in the subepithelial layer. The keratinized epithelium was still covering the posterior portion of the vestibule and even extending to cover the dorsal concha . As well, few PAS-positive and negative glandular acini were detected subepithelialy in the lateral nasal wall(Fig. 62). The dorsal concha showed a duct in it's lateral subepithelial layer (Fig. 63).

b) Nasal respiratory region:

The nasal respiratory region of the rat was lined by ciliated pseudostratified columnar epithelium with

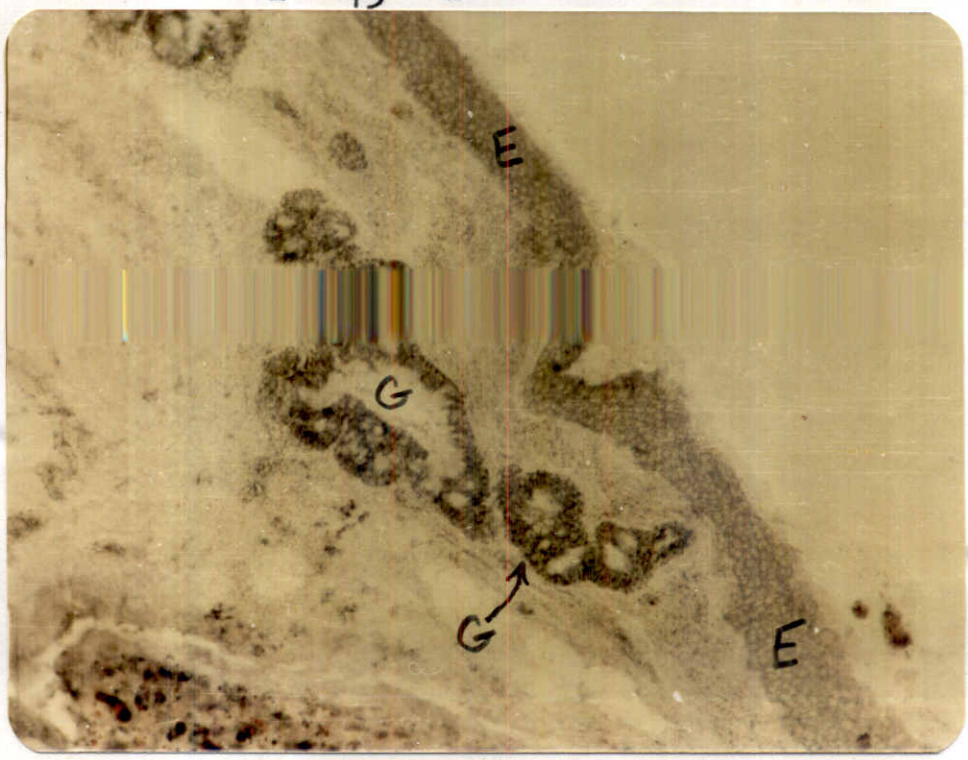


Fig.(61): A photomicrograph of a cryostat section in the succinic dehydrogenase activity in the lining epithelium (E) and the glands (G).
(Nitro-blue tetra-zolium method. Obj.x10,Proj.x10).

Fig.(62): A photomicrograph of a section in the lateral nasal wall of a rat's nasal vestibule showing:
a) keratinized stratified squamous epithelium.
b) strong PAS positive acini.
c) Weak PAS stained acini.
(PAS reaction. Obj. x10-Proj.x10).

goblet cells (Fig. 64). However, the distal free surface of the dorsal concha and the dorsal portion of the ventral concha were lined by stratified columnar non ciliated epithelium (Fig. 65). The goblet cells were few and present particularily towards the floor (Fig. 66). However, mucous cells were aggregated among the epithelial sheat forming what is known as intraepithelial glands. The latter glands were present either alone or arranged beside each other forming a row of about 4-5 glands (Fig. 66). These glands were particularily located in the membranous part of the nasal septum. As well, some individual glands could be detected dorsally in the cartilagenous part of the nasal septum.

The subepithelial tissue of the respiratory mucosa was extremely cellular and vascular. The glandular acini together with blood spaces were present in the subepithelial layer of the lateral nasal mucosa (extending from the attached and the ventral concha to the dorsal concha) and the cartilagenous parts of the nasal septum (dorsal and ventral) (Fig. 66). These glands were weakly PAS positive (Fig. 67). The ventral conchae and the middle third of the nasal septum were free of the glands.

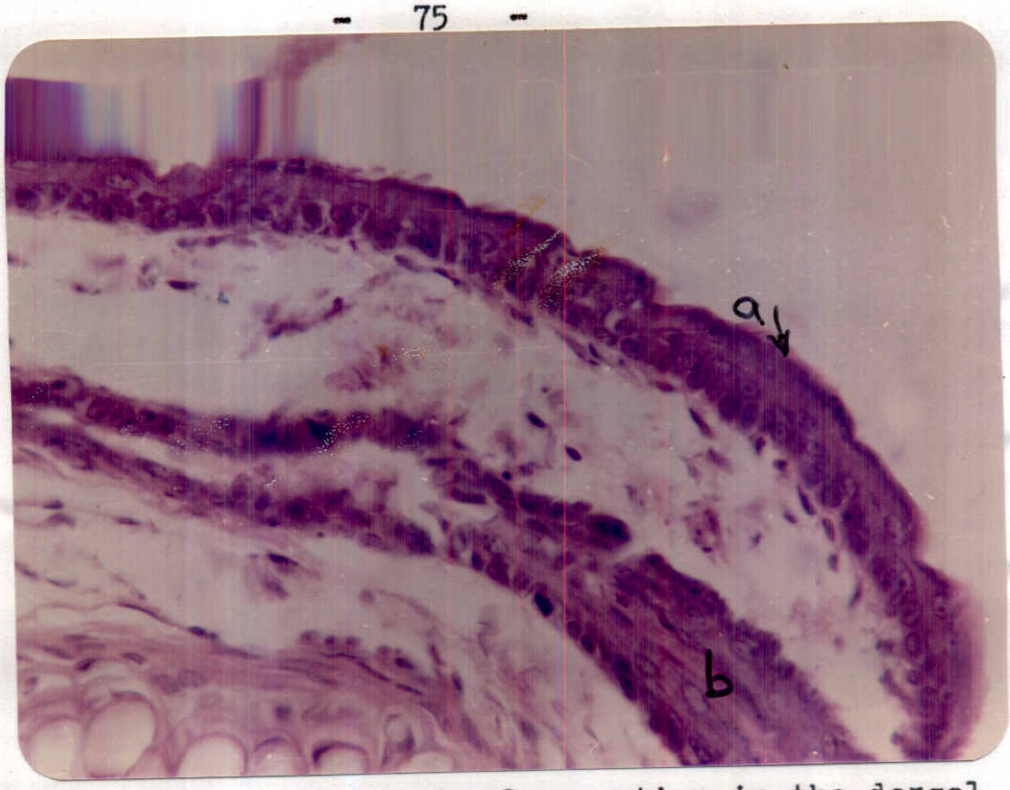


Fig.(63): A photomicrograph of a section in the dorsal concha of a rat showing:
a) keratinized stratified squamous epithelium.
b) a duct lined by stratified squamous keratinized epithelium near it's opening.
(Hx & E stains. Obj. x 40, Proj. x 10).

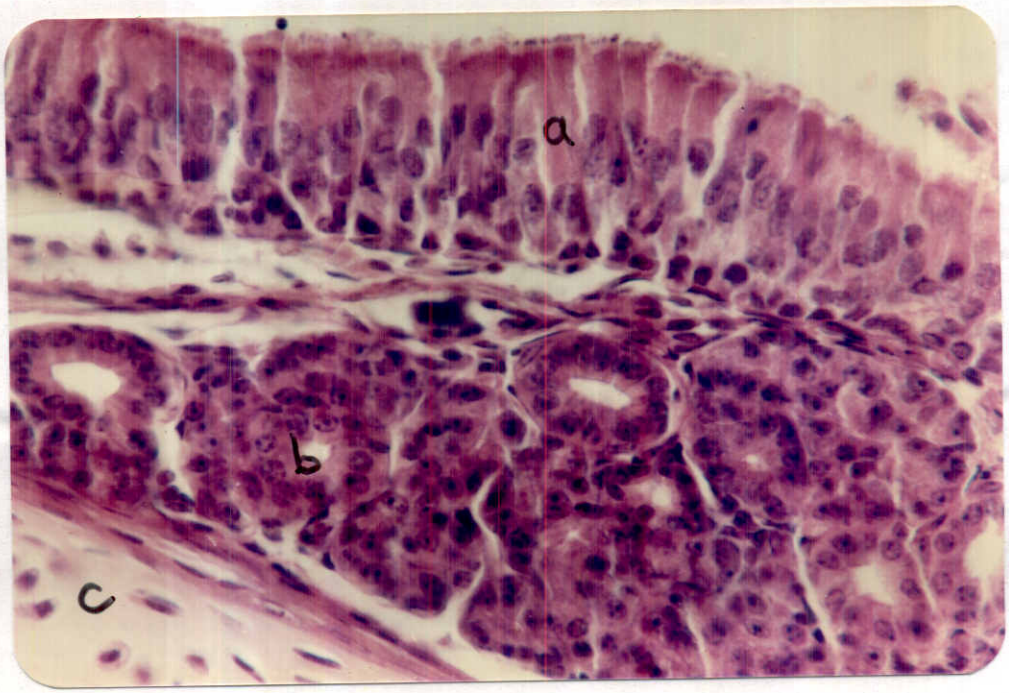


Fig.(64): A photomicrograph of a section in a rat's nasal respiratory region showing:
a) ciliated pseudostratified columnar epithelium with goblet cells.
b) glandular acini and their ducts.
c) hyaline cartilage.
(Hx & E stains. Obj. x 40, Proj. x 10).

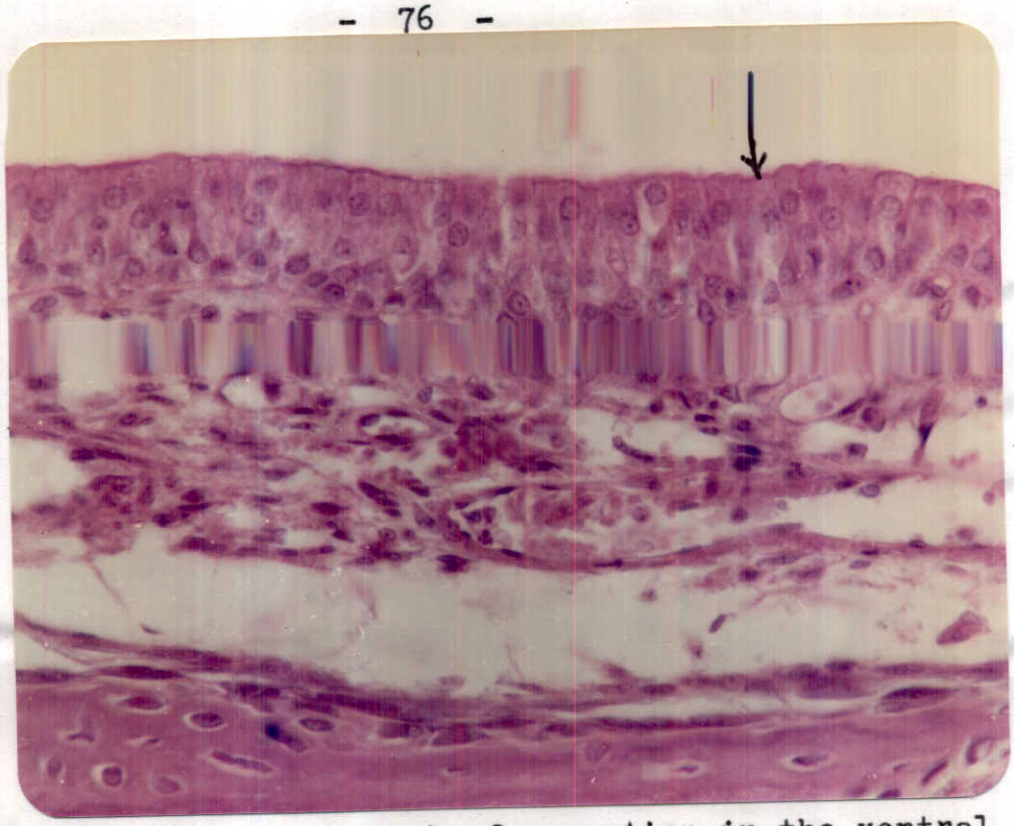


Fig.(65):A photomicrograph of a section in the ventral concha of a rat showing non-ciliated stratified columnar epithelium (arrow). (Hx, E stains. Obj. x 40, Proj. x 10).

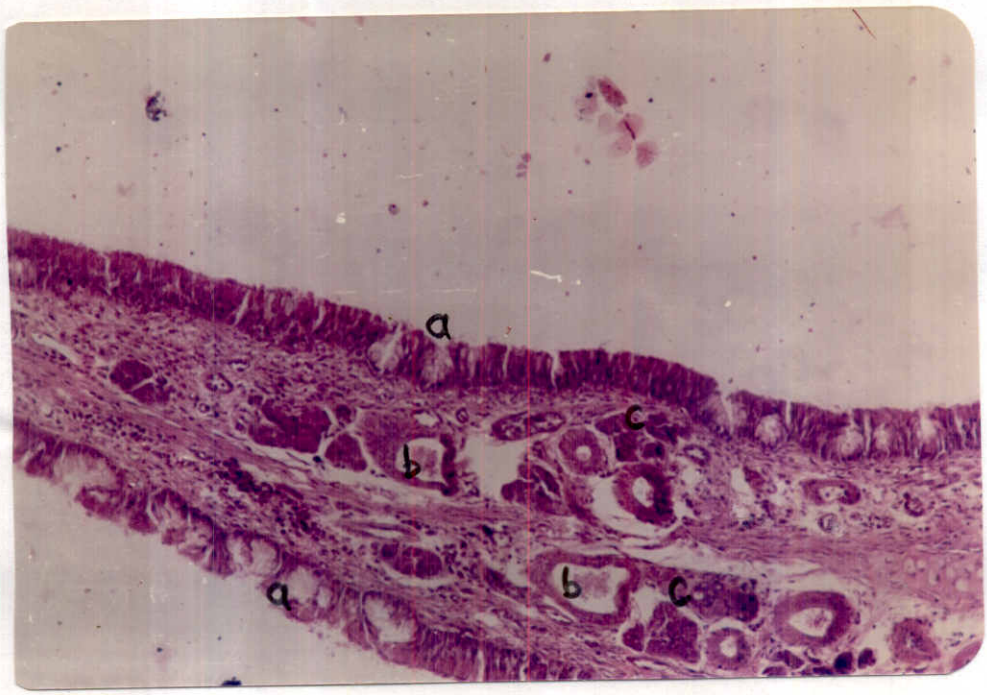


Fig.(66): A photomicrograph of a section in rat's respiratory region showing:
a) intra-epithelial glands among the respiratory epithelium.
b) blood vessels.
c) glandular elements.
(H x & E stains. Obj. x 10 , Proj. x 10).

c) Nasal olfactory region

The olfactory epithelium of the rat's nasal cavity was similar to that of the rabbit and guinea pig. However beneath this epithelium, there were olfactory glands and blood capillaries. Meanwhile, in the deep layer of the subepithelial tissue, there were numerous and closely packed bundles of the olfactory nerves (Fig. 68). Sometimes, the latter bundles were embrassing the glands between them. These glands were AB and PAS positive (Fig. 69).

2. Larynx

The laryngeal mucosa of the rat resembled that of the rabbit but the goblet cells were hardly detected (Fig. 70). There were a vast number of migrating lymphocytes among the ciliated pseudostratified epithelium. The collections of the glandular acini were more than those in the larynx of the rabbit. The number of the glands in the mucosa of the anterior portion of the larynx was greater than caudally (Fig. 70). Few acini of these were small-sized and formed of one layer of cells with spherical central nuclei and acidophilic cytoplasm which reacted negatively with AB and PAS. Meanwhile, most of the acini were of the large size & lined with

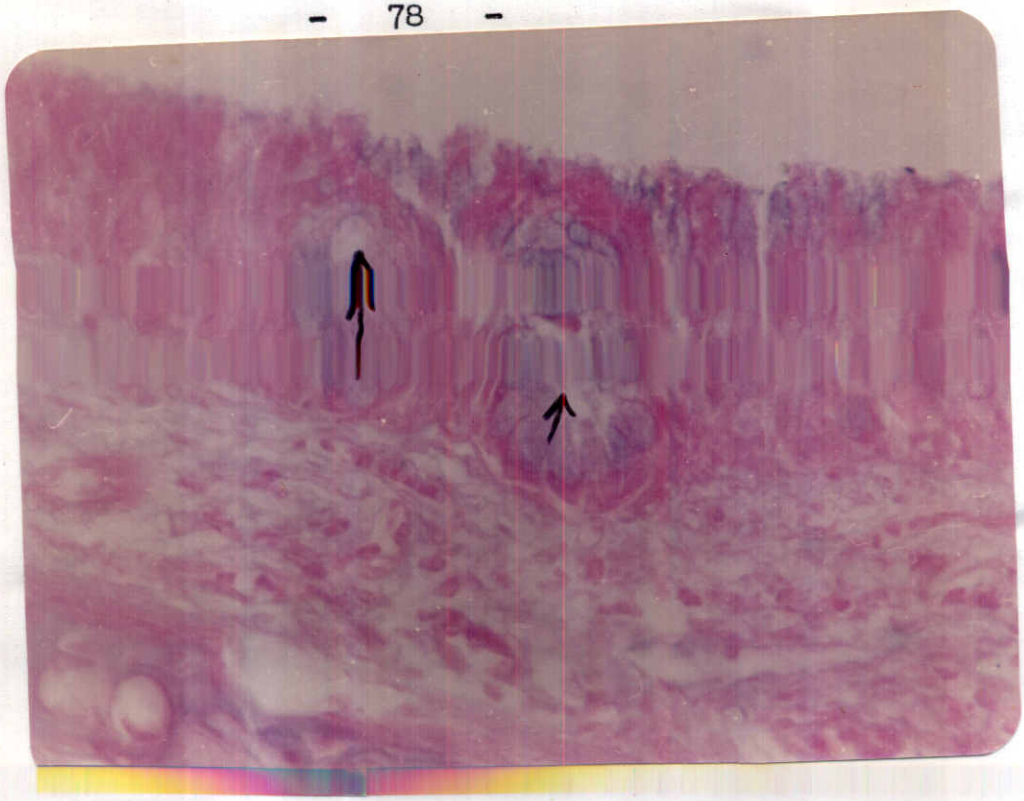


Fig.(67): A photomicrograph of a section in a rat's respiratory region showing intra-epithelial glands (arrow. a)
(AB-PAS combined reaction. Obj. x 40 , Proj.x10).

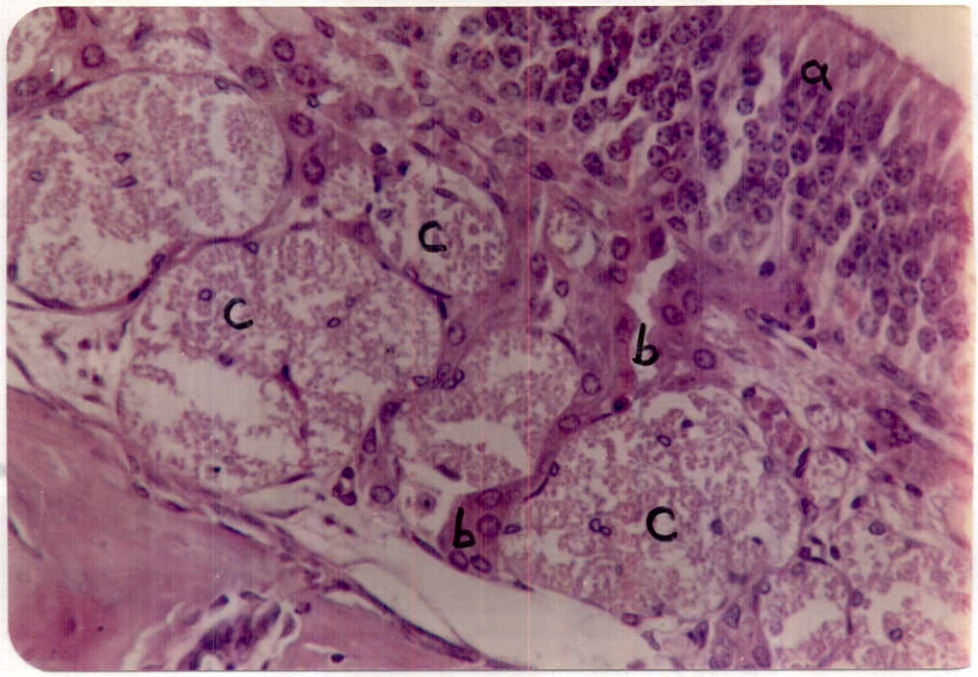


Fig.(68): A photomicrograph of a section in the rat's olfactory nasal mucosa showing:
a) olfactory epithelium.
b) glandular elements.
c) olfactory nerve bundles.
(Hx & E stains. Obj. x 40, Proj. x 10).

Fig.(69): A photomicrograph of a section in the olfactory region of a rat's nasal mucosa showing
a) olfactory epithelium.
b) olfactory glands. c) olfactory nerve bundles.
(AB-PAS combined reaction. Obj. x 40, Proj.x10).

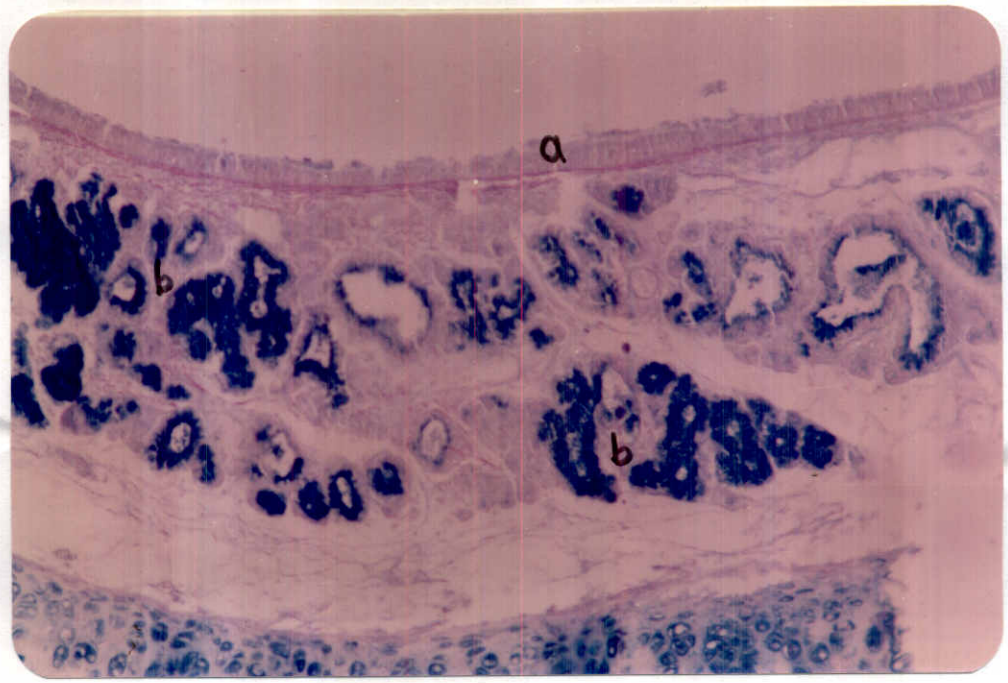


Fig.(70): A photomicrograph of a section in the larynx of a rat showing:
a) respiratory epithelium free of goblet cells.
b) glandular elements (AB-positive).
(AB-reaction. Obj.x10 , Proj. x 10).

one layer of cubical vacuolated cells with compressed basal nuclei (Fig. 71). The ducts of these vacuolated glandular acini were very wide and lined with large cubical cells possessing a strongly AB-positive reaction and a moderately PAS positive. The vacuolated acinar cells had strong AB-PAS positive reaction (Fig. 72).

3. Trachea

The trachea of the rat was lined by ciliated pseudostratified columnar epithelium with few goblet cells which reacted positively with AB and PAS. There were, few glandular acini together with lymphocytic infiltration forming the bulk of the subepithelial layer (Fig. 73). The glands were PAS and AB negative. The smooth muscle band was thick. Sometimes the hyaline cartilagenous ring appeared fragmented (Fig. 74).

B) Histochemical observations

* Alkaline phosphatase

As in both of the previous two animals (rabbit and guinea pig). The vestibular epithelium of the nasal cavity revealed traces of the alkaline phosphatase reaction. However, the nasal respiratory epithelium presented a moderate level of activity and the acini

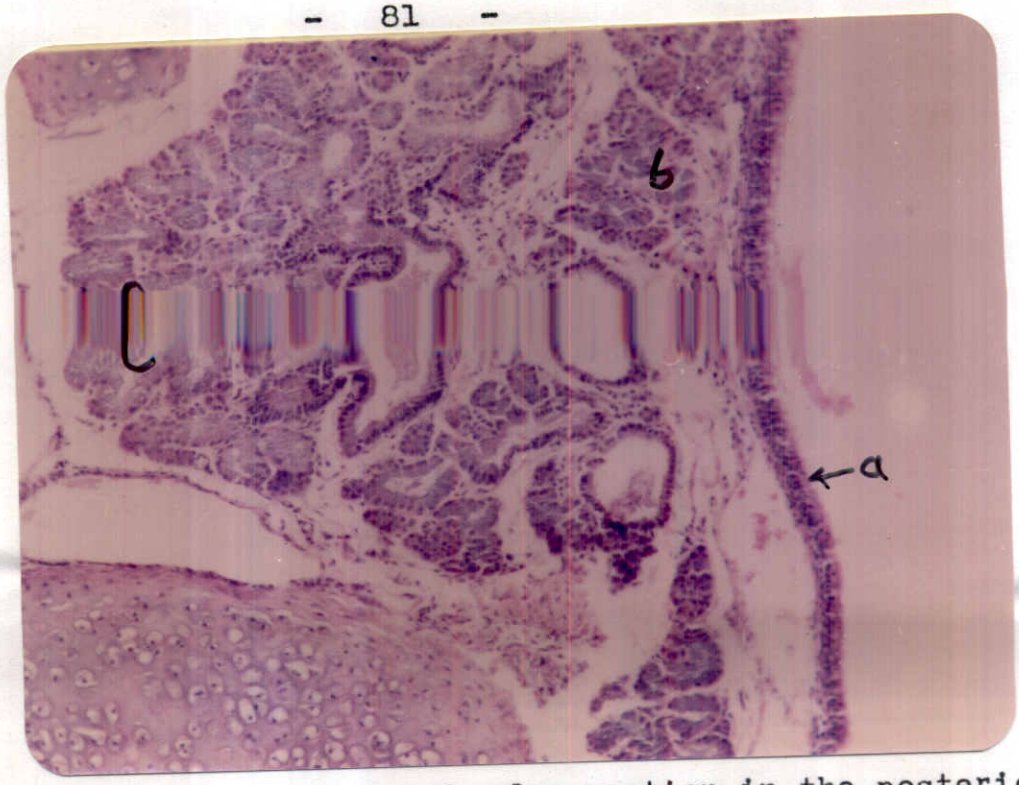


Fig.(71): A photomicrograph of a section in the posterior portion of the larynx of a rat showing:
a) respiratory epithelium.
b) numerous, glandular elements.
c) vacuolated cells of large acini.
(Hx & E stains. Obj. x 10, Proj. x 10).

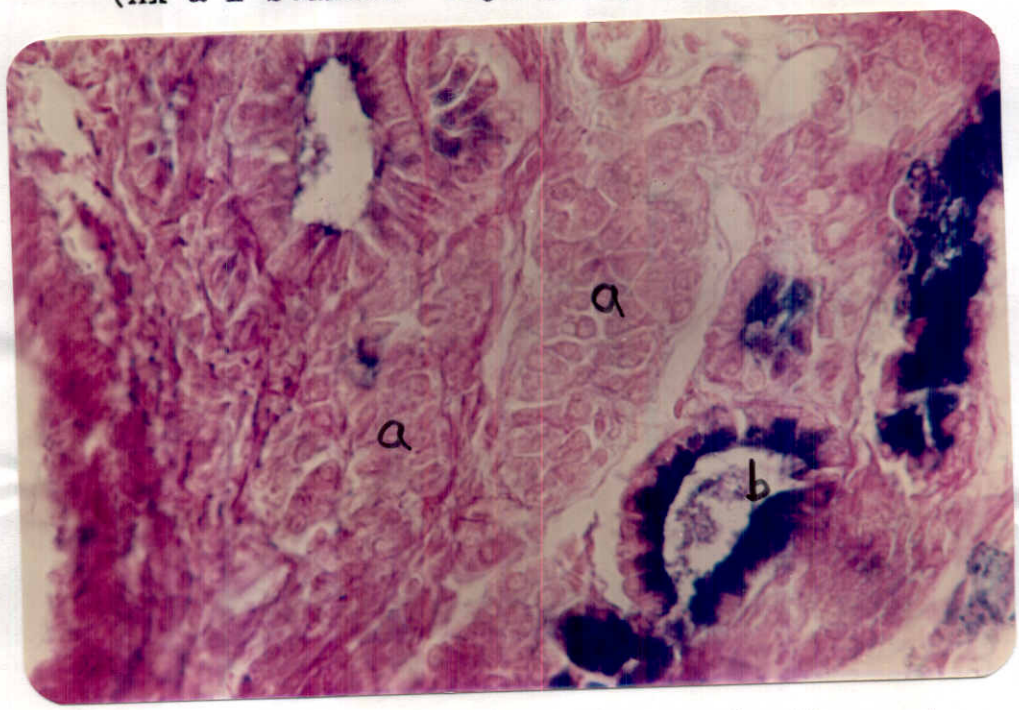


Fig.(72): A photomicrograph of a section in the posterior portion of the larynx of a rat showing:
a) AB-PAS negative glandular acini.
b) AB-PAS positive glandular acini.
(AB-PAS combined reaction. Obj. x 40, Proj.x10).

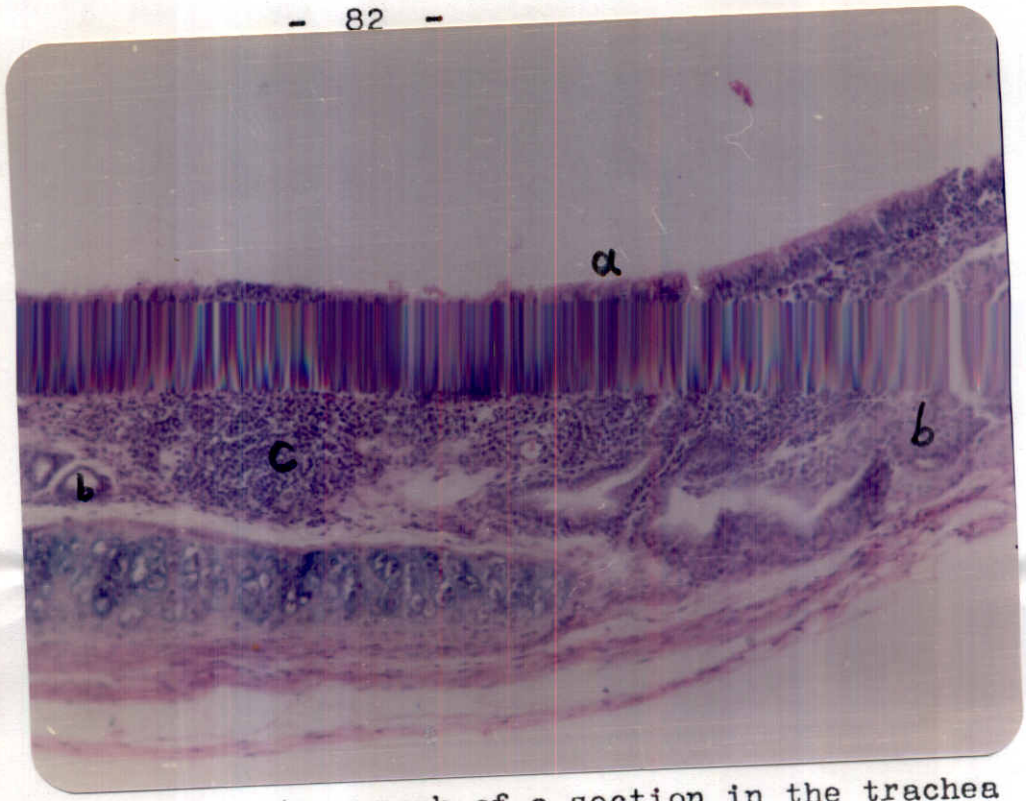


Fig.(73): A photomicrograph of a section in the trachea of a rat showing:
a) respiratory epithelium.
b) few glandular acini.
c) lymphocytic infiltration.
(H x & E stains. Obj. x 10, Proj. x 10).

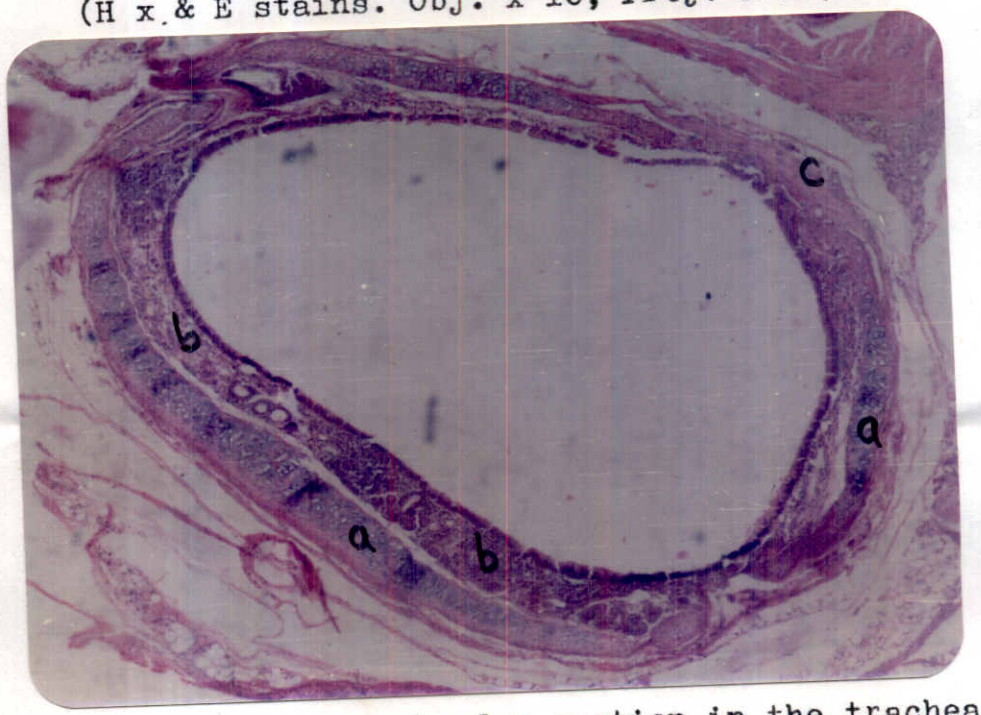


Fig.(74): A photomicrograph of a section in the trachea of a rat showing:
a) fragmented cartilage plates.
b) subepithelial layer containing lymphocytic infiltration and some glandular acini.
c) smooth muscle band.
(H x & E stains. Obj.x10 , Proj. x 10).

and their ducts presented an intense reaction (Fig. 75).

The picture in the olfactory epithelium resembled that in the rabbit (Fig. 27).

The largngeal epithelium showed a weak activity with an apical moderate reaction. Again, the superficial laryngeal glands had a weak reaction, while the deep glandular acini showed a strong activity (Fig. 76).

In the trachea, the epithelium and the glands revealed a moderate reaction with a basal strong activity in the former (Fig. 77).

* Acid phosphatase

The picture in the vestibular and respiratory parts of the nasal cavity resembled that in the rabbit and guinea pig. However, the picture in the glandular acini resembled that in the guinea pig.

As regards the olfactory epithelium and glands they showed a picture similar to that in the rabbit (Fig. 30).

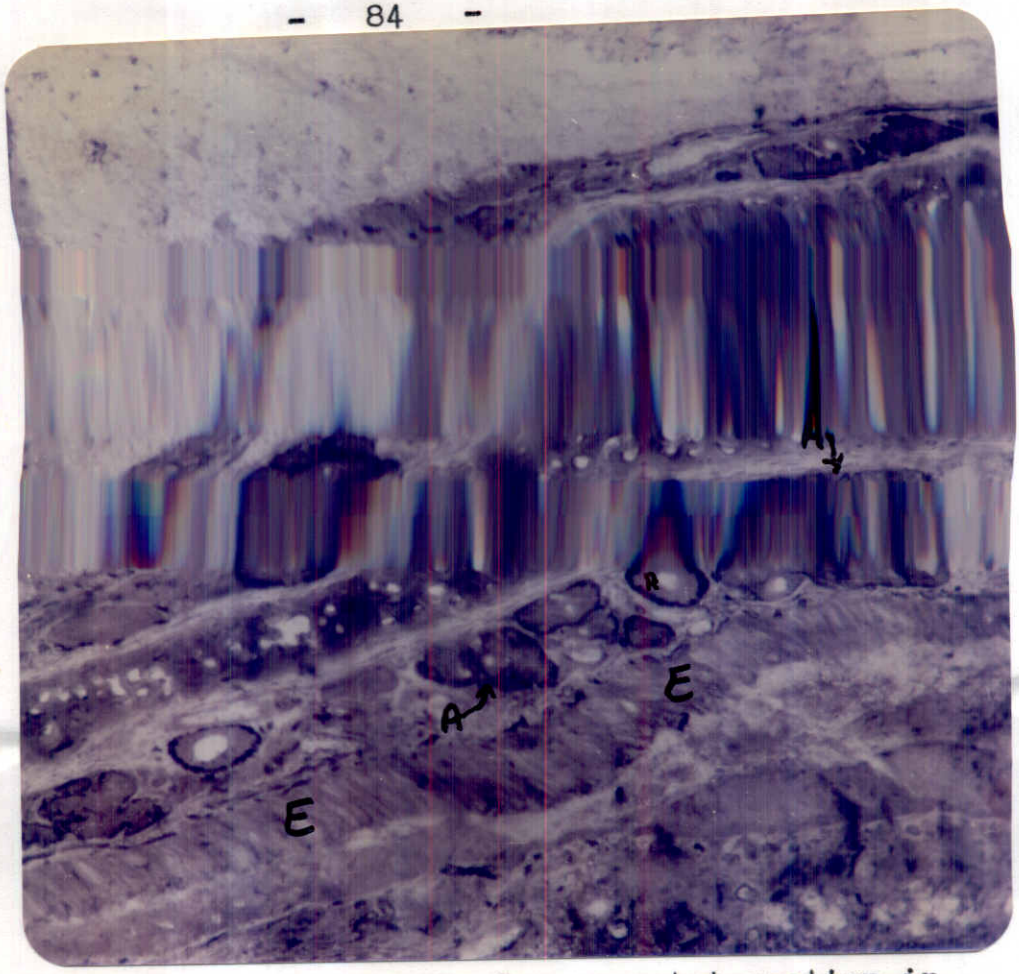


Fig. (75): A photomicrograph of a cryostat section in a rat's nasal septum demonstrating a basal intense reaction of alkaline phosphatase in acinar & duct cells (A) and weak reaction in the lining epithelium (E).
(Azo-dye coupling method. Obj. x10, Proj.x10).

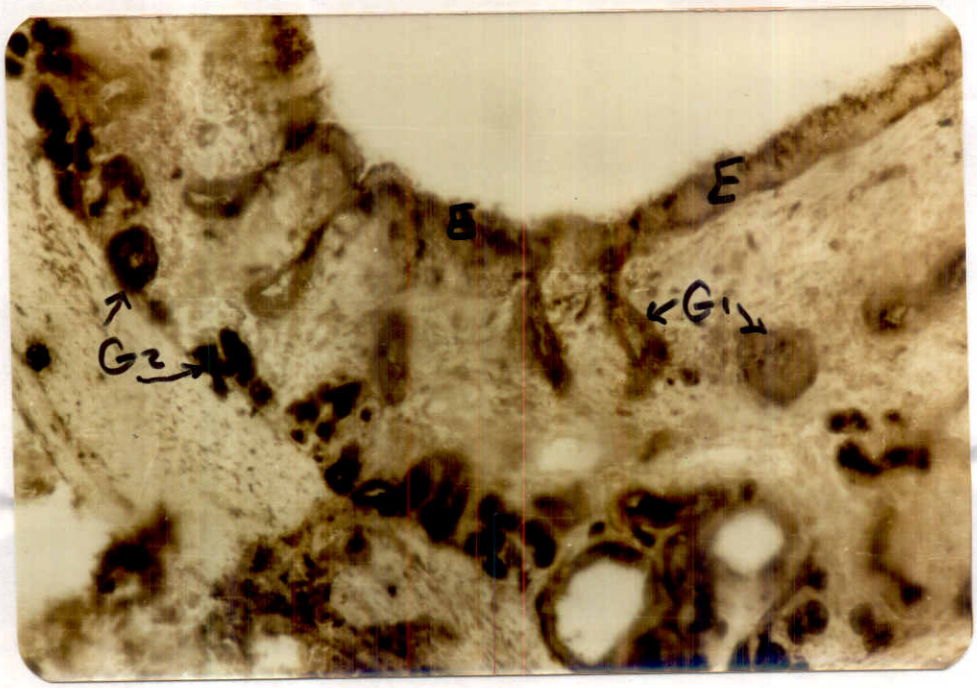


Fig.(76) A photomicrograph of a cryostat section of a rat laryngeal mucosa showing alkaline phosphatase reaction in the lining epithelium (E), weak reaction in superficial glands (G_1) and strong reaction in deep ones (G_2).

The picture in the larynx and trachea resembled that in the guinea pig (Fig. 56).

* Adenosine triphosphatase:

All the reactions of this enzyme in the nasal vestibular epithelium, respiratory epithelium, olfactory epithelium and glands, laryngeal epithelium and glands and tracheal elements were similar to those in the rabbit (Figs. 78, 58, 32).

* Nonspecific esterase:

In both, the nasal vestibular and respiratory epithelium, the activity of the enzyme was found as a trace. However, there was a moderate reaction in few glandular acini and a weak reaction in most of them.

As well, the nasal olfactory epithelium showed trace of activity, while the olfactory glands of Bowmann and their ducts showed a moderate reaction (Fig. 79).

In larynx, the lining epithelium and the glands showed a weak reaction. However, the epithelium and the gland of trachea revealed a moderate reaction.

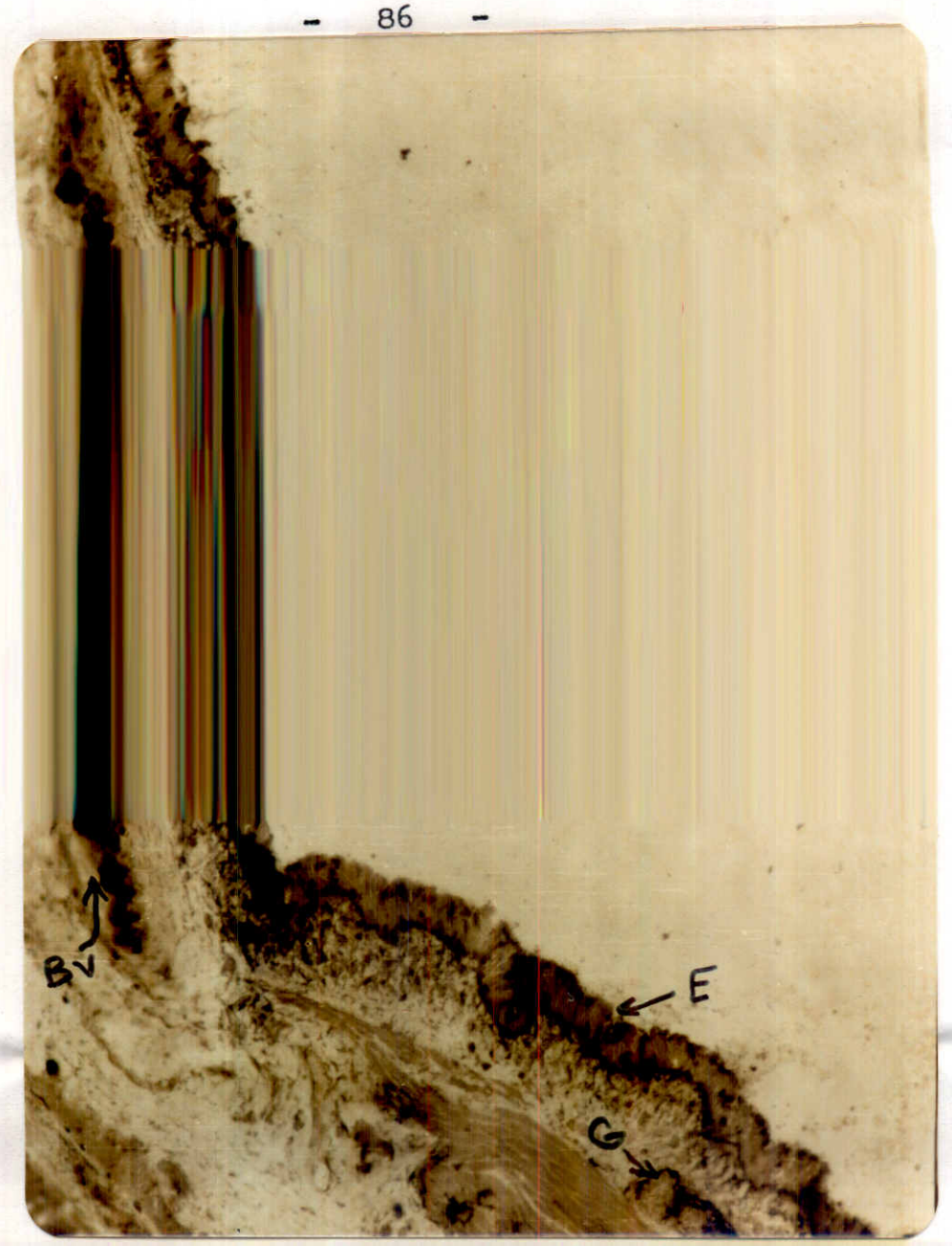
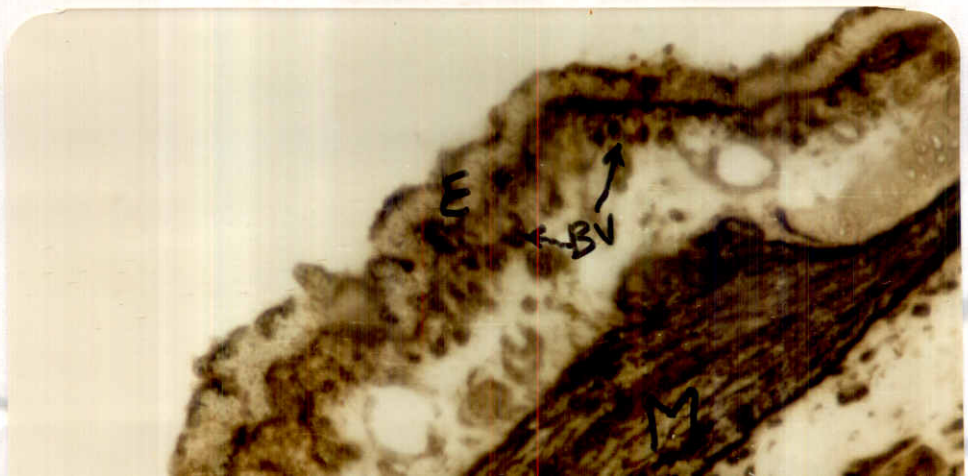


Fig.(77): A photomicrograph of a cryostate section in the trachea of a rat demonstrating alkaline phosphatase activity in the lining epithelium (E), gland (G) and blood vessels (BV). (Azo-dye coupling method. Obj. x 10,Proj.x10).



* Succinic dehydrogenase:

Again the reaction in the nasal vestibular and respiratory epithelia together with the respiratory glands was similar to that in both rabbit and guinea pig. (Fig. 37).

However, the nasal olfactory epithelium showed a moderate activity which increased to become strong at the free border, as well, the olfactory glands and their ducts showed a moderate activity which increased at the free border (Fig. 38).

The laryngeal epithelium and glands revealed a moderate reaction (Fig. 61).

The epithelium of trachea revealed a moderate activity (Fig. 80). However, the tracheal glands and muscles showed a weak reaction (Fig. 40).

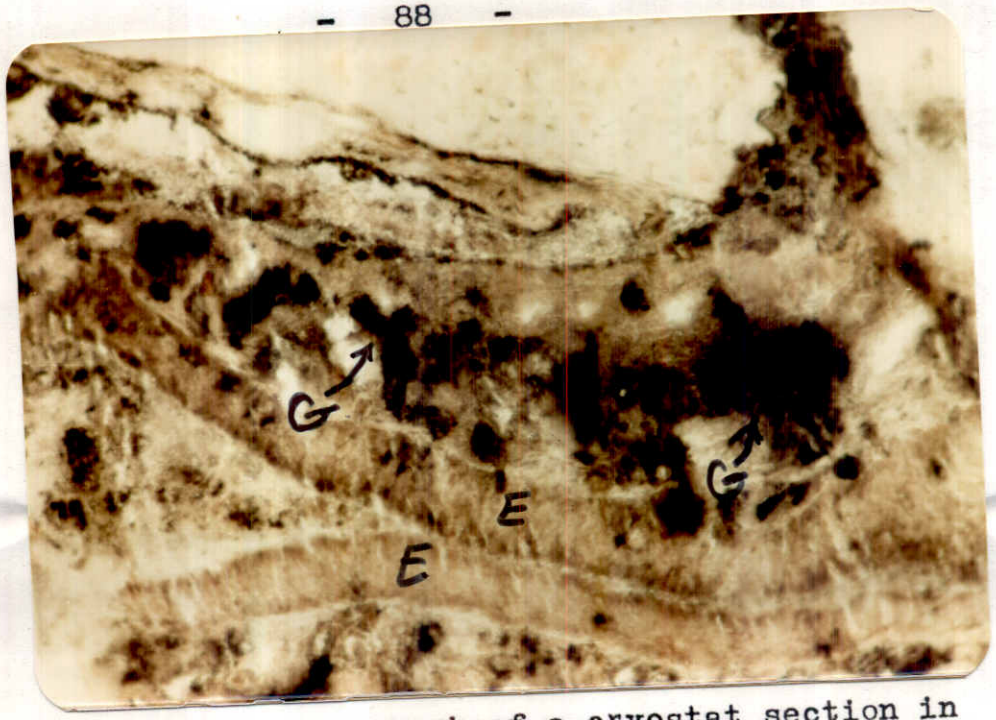


Fig.(79): A photomicrograph of a cryostat section in the olfactory nasal mucosa of a rat showing non-sepecific esterase reaction in the lining epithelium (E) and gland (G).
(Alpha-naphthyl acetate method. Obj. x 10, Proj. x10).

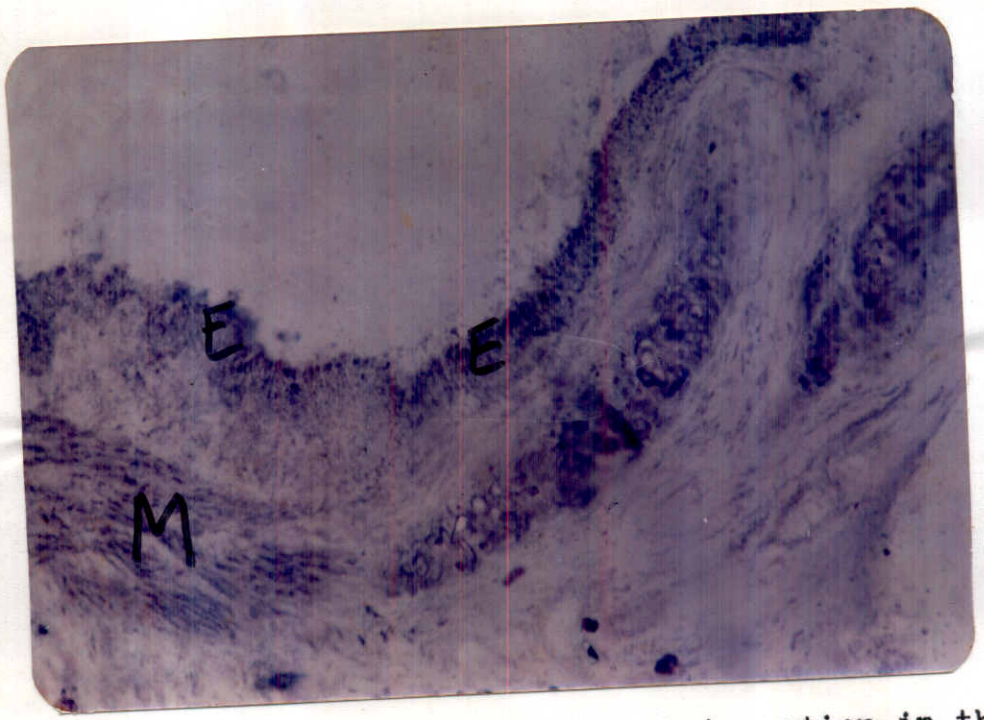


Fig.(80): A photomicrograph of a cryostat section in the trachea of a rat illustrating the succinic dehydrogenase activity in the lining epithelium (E) and muscle (M).
(Nitro-blue tetrazolium method.Obj. x 10,Proj.x10).

DISCUSSION

DISCUSSION

The present work showed that the nasal vestibule was lined by a keratinized stratified squamous epithelium in all of the investigated animals. This epithelium had some hair follicles, sebaceous glands and striated muscle fibers which were more numerous in guinea pig. A picture which resembled that in many other animals and man (Trautmann, and Fiebiger, 1957; Adams and, McFarland, 1972, Badawy and Fath El-Bab, 1974; Loo, 1974; Krajina et al., 1975 and El-Sayed, 1982).

The distribution of the protective epithelium in the vestibule of the rabbit, guinea pig, and rat varied and this may be attributed to a relation between the depth of stratified squamous epithelium to the air flow. The thickness increased where there was a great impact of respired air (Hidling, 1963). Thus these variations in the thickness can be attributed to species variations.

The glandular and vascular elements play an important role in the entering air (Plannel, 1951; Bojson - Moller, 1964).

The floor of the most anterior portion of the vestibule in the rabbit, guinea pig, and rat revealed striated muscle fibers which were numerous in guinea

pig than in both of rabbit, and rat. The presence of the striated muscle fibers here may attribute to the mobility of the oral part of the nasal vestibule in rodents.

Again the structure of the nasal respiratory region of the rabbit, rat, and guinea pig resembles to a great extent that in many other animals (Trautmann and Fiebiger, 1957; Badawy and Fath El-Bab, 1974; Bloom and Fawcett, 1975; Tandler and Bojson Moller, 1978; Ham and Cormack, 1979; and El-Sayed, 1982).

The presence of lymphocytes in the respiratory epithelium supports the idea that the lining epithelium had a vital role as a defense mechanism of the body (Kent, 1966; Jeffery and Reid, 1975; Dellmann and Brown, 1976 and El-Sayed, 1982).

As in the dog (Dempsy, 1946), the rabbit possessed ventral concha of high complexity which, however, was absent in guinea pig and rat. This was refred to the high activity for a long period of time.

The nasal respiratory mucosa in the rabbit, rat and guinea pig was highly vascular. This may aid in the temperature regulatory mechanism as evidenced by Scott (1954). The mucous secretion of both goblet cells and the glands entraped foreign particles from the inspired air. Consequently, the nasal respiratory mucosa made the inspired air conditioned; purified with suitable warmth and moisture (Scott, 1952; Hidling, 1963 and El-Sayed, 1982).

The change from the respiratory to the olfactory epithelium was gradual in the rabbit, and rat while in the guinea pig, the change was abrupt. Similar observations were reported in man, cat, and dog by Read (1908) who added that the olfactory mucosa was thick and the transitions from respiratory to offactory epithelium was sharp in manner.

The activity of the alklaine phosphatase enzyme detected in the nasal epithelium and glands ranged from traces to a strong reaction. However, the activity ranged from a moderate to a strong one at the basal border of the epithelium (nasal respiratory and olfactory, laryngeal and tracheal) and the acini of the glands and their ducts in the rabbit, rat and guinea pig. These

findings were in accordance with Tylor (1958), and El-Enany et al., (1980b). Meanwhile in the rat, there was a weak activity of the enzyme in the superficial laryngeal glands and strong reaction in the deep ones.

The increasing activity at the basal border of the respiratory and olfactory epithelia indicated that the short cells of the ciliated pseudostratified columnar epithelium and the basal border of the olfactory epithelium may be involved in the synthesis of some secretory material as these cells were the original sites of mitotic figures (Choudhury and Lurdy, 1970). The alkaline phosphatase activity seemed to be concerned with the phosphorlyation processes as a step in metabolism and transport of a large number of phosphate containing compounds including glucose entery to tissues (Johonson and Bavelandar, 1964).

The nasal epithelium of the rabbit, rat and guinea pig possessed acid phosphatase reaction ranging from a moderate activity along the whole epithelium to strong one at the free it's border. These results were in agreement with El-Enany et al. (1980 b). The sites of increasing activity indicated that there was a metabolic activity as reported by Ogawa, Mizuno and Okamato,

(1961) who suggested that the acid phosphatase in the nasal mucosa may be concerned with phospholipid metabolism. The increased activity of the enzyme at the free border may be attributed to the secretory activity at this part of the cell as evidanced by Smith and Farquhar, (1966).

The present study revealed that the adenosine triphosphatase activity ranged from traces to a moderate level in the nasal epithelium and glands of the rabbit, rat, and guinea pig, in addition to the respiratory epithelium of larynx and trachea. There was an apical increase of its activity in the ciliated respiratory epithelium.Comparable findings were described by Cress et al. (1965) who studied the role of adenosine triphosphatase using a culture of the rabbit's tracheal epithelium and who found that the beating cilia were positive with the enzyme, while the non-beating cilia were negatively reacting or weakly positive in few small scattered areas. The presence of the adenosine triphosphatase in the beating cilia and its absence from the non-beating ones agreed with the biochemical and physiological studies which suggested an association between adenosine triphosphatase and ciliary activity. This enzyme is the end product of a major energy -