RESULTS

(A) HUMAN MODELS

The ethmoid bone is situated at the anterior part of the base of the cranium between the orbits laterally, the frontal bone anteriorly, the sphenoid bone posteriorly, the cranial cavity superiorly, and the nasal cavity inferiorly. It is cuboidal in shape, and its central portion is cross shaped. The vertical part of the cross consists of an upper segment which is the crista galli, and lower segment which is the perpendicular plate, while the horizontal part of the cross is a perforated lamina which is the cribiform plate. There is one pyramidal mass attached to the arm of the cross on each side, this mass is the ethmoid labyrinth.

- The crista galli :

Is a triangular thick smooth bony process, (Figs. 1 and 5) projecting upwards from the cribriform plate in a median plane occupying the entire length of the cribriform plate. The posterior limb of the crista galli extends from the heighest point of the triangle downward and backward to its posterior point. This border is long thin and curved, it is the site of the attachment of the falx cerebri. The anterior border of the crista galli is short, thick and attached to the frontal bone by two small alae. The sides of the crista galli are smooth and bulgy due to the presence of air cells.

- The cribriform plate :

Is elongated in shape, (Figs. 1 and 6) it forms the horizontal limbs of the cross and forms the roof of the nasal cavity. It has numerous perforations of variable sizes, their number ranging from 21 to 27 foramen in each side, through which the filaments of the olfactory nerve pass to the nasal cavity. The length of the cribriform plate is about 1.6 cm. to 2.1 cm. and its width is about 0.4 to 0.5 cm.

The cribriform plate, or lamina cribrosa, is narrow and depressed on each side of the crista galli. Anterior to this depression, there is a small fissure and just lateral to it there is a small foramen.

- The perpendicular plate :

Is a thin rectangular plate of bone, descending nearly vertical from the cribriform plate (Fig. 3). It articulates anteriorly with the nasal spine of the frontal bone and the crest of nasal bone, posteriorly with the sphenoid crest above, and the vomer below, superiorly it is attached to the cribriform plate, and its inferior border is free, but in the cadaver it is attached to the septal cartilage. The sides of the perpendicular plate are smooth.

- The ethmoidal labyrinth :

Is the lateral mass of the ethmoid bone. It is pyramidal in shape, (Figs. 2,3 and 4) with the long axis running anteroposteriorly and the base of the pyramid facing backwards. The ethmoid bone has two labyrinths, one on each side. After the ethmoid bone has been disarticulated, we found that each labyrinth has three incomplete surfaces :

1- The Superior surface has a row of incomplete cells which are completed by the frontal bone.

2- Anterior part of the lateral surface which is completed by the lachrymal bone.

3- The posterior surface - base of the pyramid - which is completed by the sphenoid bone because there is a common surface between them.

Each ethmoidal labyrinth is about 4 to 5 cm. in length, and its width is about 0.5 cm anteriorly and 1.5 cm. posteriorly with a volume of about 7 to 10 cm.

The upper surface of the labyrinth shows two grooves, one anterior and the other is posterior, these are converted into anterior and posterior ethmoidal canals by articulation of the ethmoid bone with the frontal bone.

After removal of the roof of the labyrinth (Fig. 1') we can see that the ground lamella of the middle turbinate divides the labyrinth into anterior and posterior ethmoid cells. We can see also that the posterior ethmoid cells are larger than the anterior ones.

The medial surface of the ethmoid labyrinth can be seen as a part of the lateral nasal wall after resection of the middle turbinate. This surface shows two distinct bony structures. These are the uncinate process and the ethmoidal bulla (Fig. 7).

The uncinate process is a curved bony leaflet resembles a bent hook and runs from anterosuperior to postero-inferior position. Its posterosuperior margin is sharp and concave running parallel to the anterior surface of the ethmoidal bulla and separated from it by the hiatus semilunaris which is a sickle shaped cleft, its width is about 1 to 2 mm.

The ethmoidal bulla is a bulgy bony structure, which can be seen under the edge of resected middle turbinate, i.e. in the middle meatus, fusing posteriorly with the ground lamella of the middle turbinate.

Looking to the medial surface we can also see the edges of the resected superior and middle turbinates. The anterosuperior insertion of the middle turbinate is adjacent to the crista ethmoidalis of the maxilla producing a bulge which is the agger nasi.

The lateral surface of the labyrinth is thin, smooth and oblong plate of bone, covers the middle and posterior ethmoid air cells and forms a part the medial orbital wall, it is known as the lamina papyracea. Its posterior part lies in close relation to the optic nerve especially when the most posterior ethmoid cells extend into the anterior wall of the sphenoid sinus. The latter cells are known as Onodi cells.

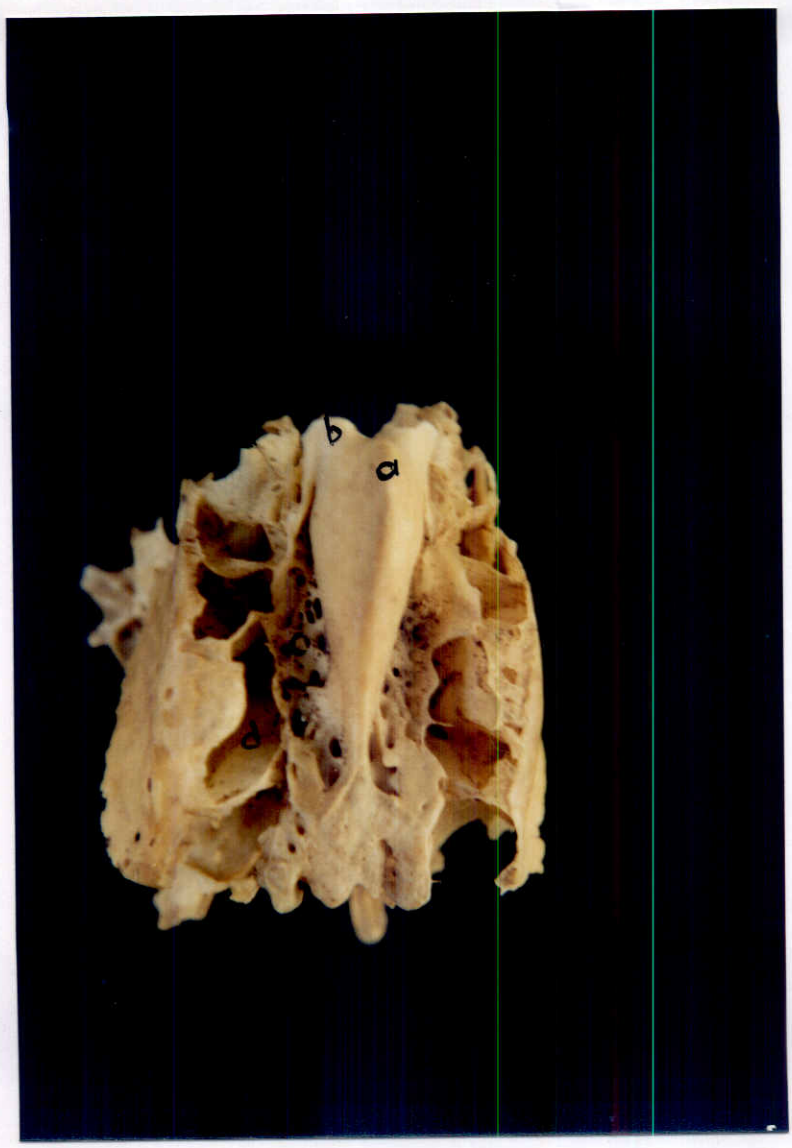

Fig. 1: Superior surface of the ethmoid bone of man

a = Crista galli.
b = Alar process.
c = Cribriform plate.
d = Ethmoid air cells.

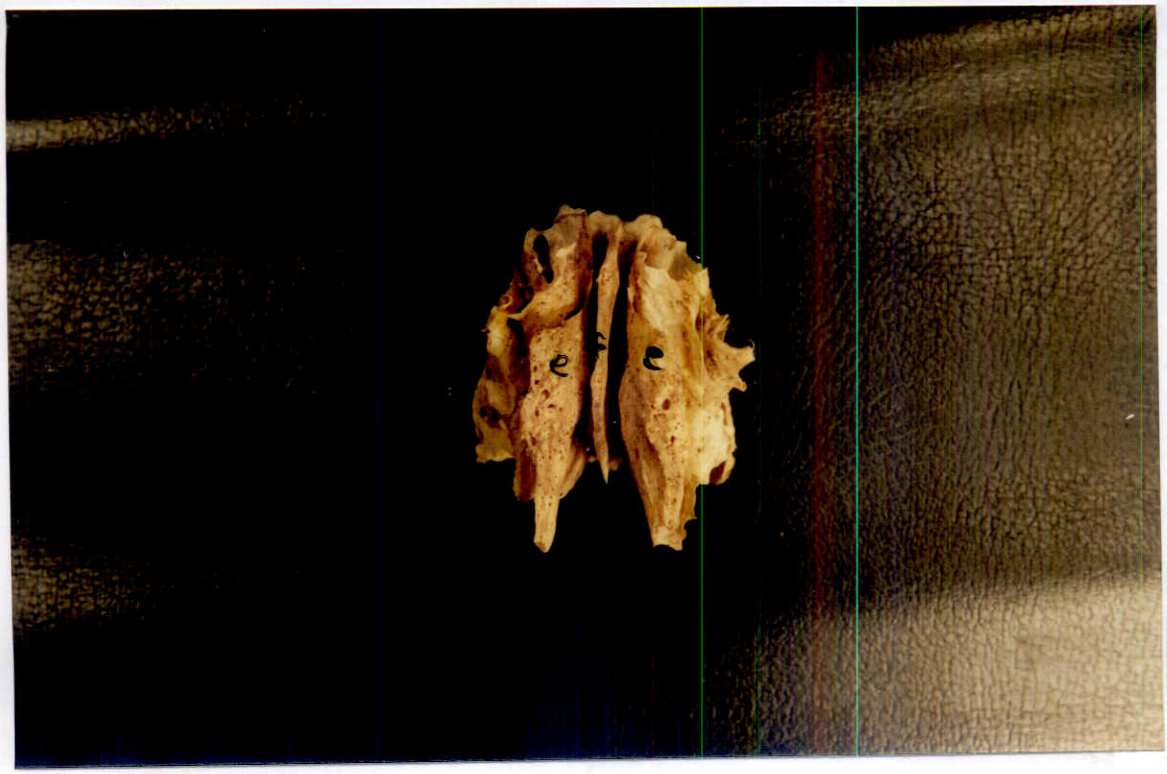

Fig. (2) : Inferior surface of the Ethmoid bone of man.
e = ethmoid labyrinth.
f = Perpendicular plate.

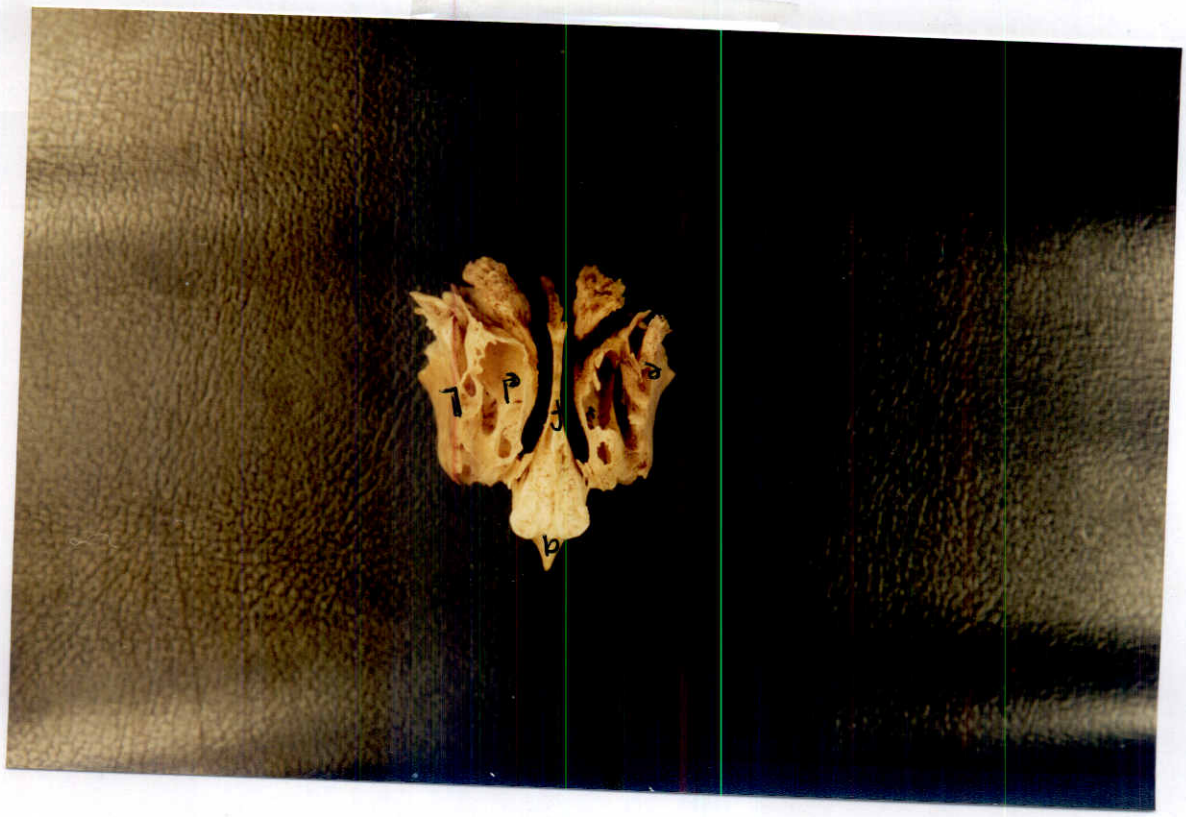

Fig. (3) : Anterior surface of the Ethmoid bone of man.

a = Crista galli

f = Perpendicular plate.

e = Ethmoid labyrinth.

d = Ethmoid air cell.

l = Lamina papyracea.

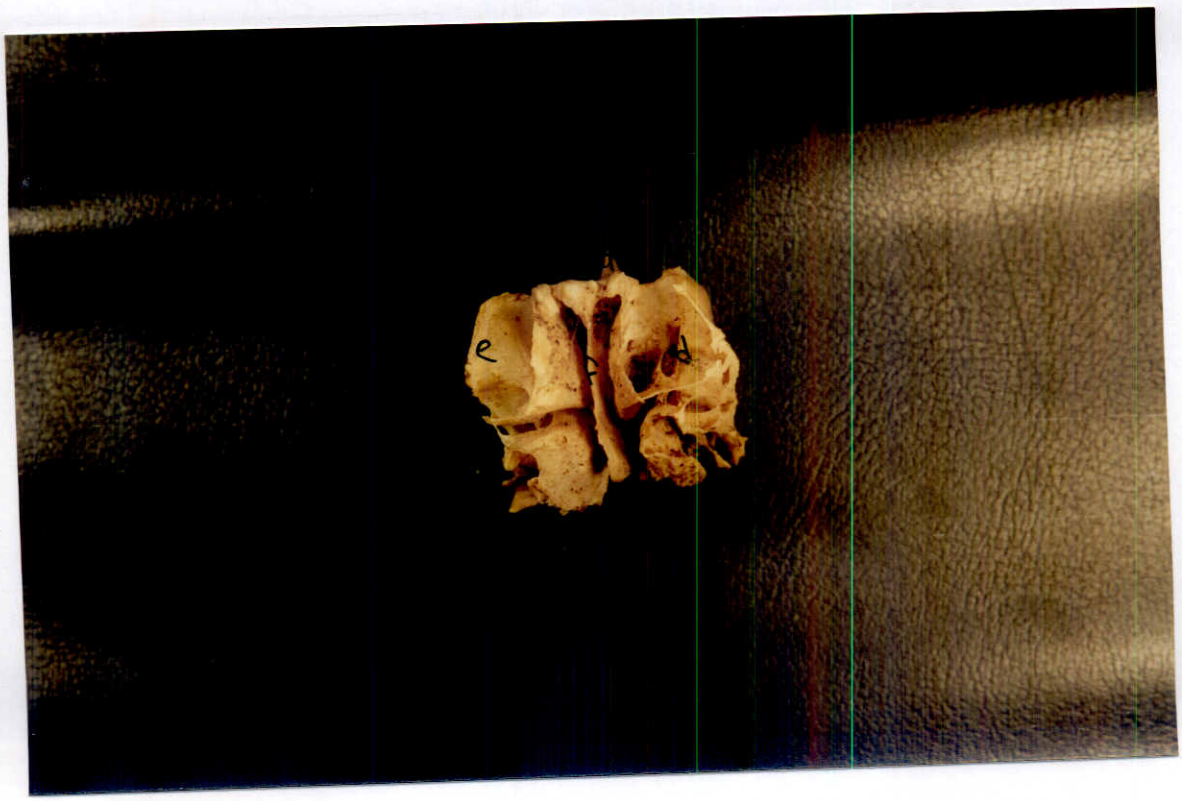

Fig. (4): Posterior surface of the ethmoid bone of man.

a = Crista galli.
f = Perpendiculer plate.
d = Ethmoid air cells.
e = ethmoid labyrinth.

Fig. (5) : Lateral surface of the ethmoid bone of man.
a = Crista galli
l = lamina papyracea

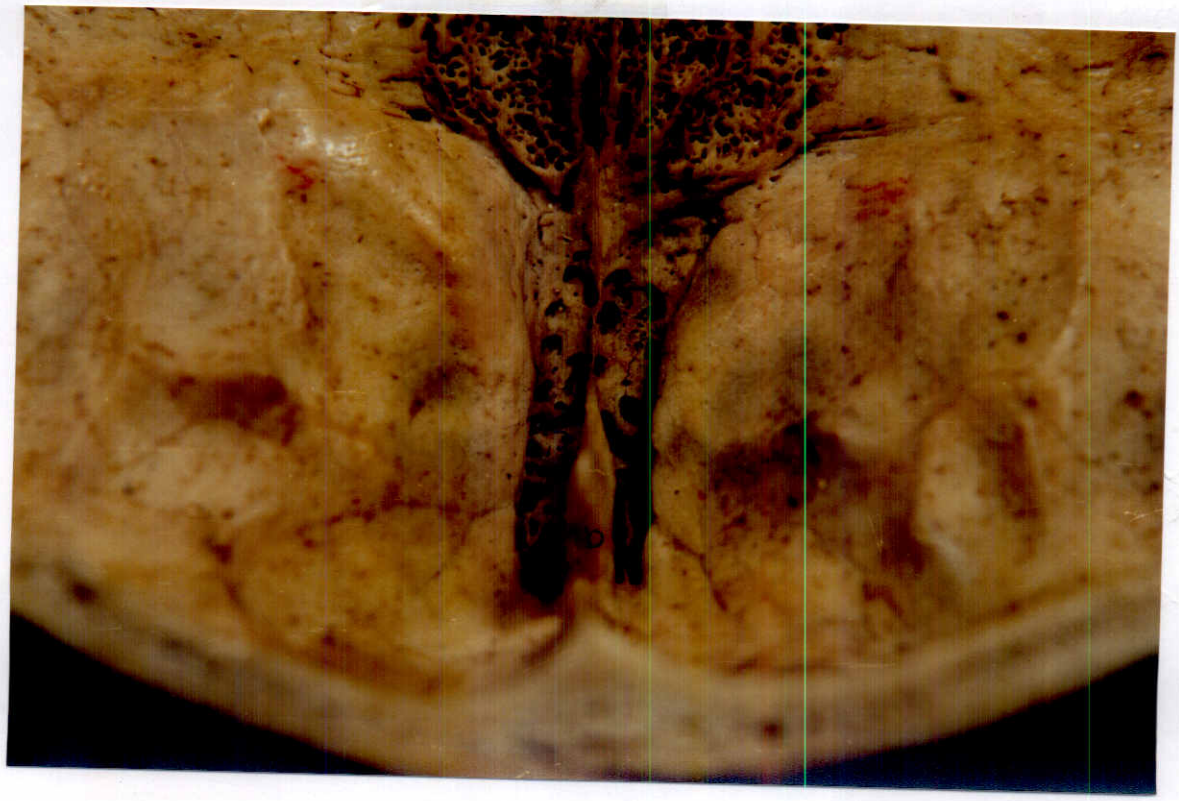

Fig. (6) : Superior surface of the ethmoid bone in intact skull of man.
a = Crista galli
c = Cribriform plate

Fig. (7): Lateral nasal wall after resection of the turbinates in man :

1- edge of resected superior turbinate.
2- edge of resected middle turbinate.
3- edge of resected inferior turbinate.
4- Ethmoidal bulla.
5- Hiatus semilunaris.
6- Uncinate process.
7- Agger nasi.
8- Lacrimal bone.
9- Processus fontanlis of the maxilla.
10- Anterior nasal fontanelle.
11- Posterior nasal fontanelle.
12- Spheno palatine foramen.
13- Frontal sinus.

(B) ANIMAL MODELS

The ethmoid bone of the dog is unpaired elongated bone, Y shaped in cross section and situated between the cranial and facial bones of the skull. It is related dorsally to the frontal, laterally to the maxillary and ventrally to the vomer and palatine bones.

- The crista galli :

Is a short bone, appears as a low crest. It is rudimentary ill developed in small subjects and constitutes the intracranial projection of the perpendicular plate.

- The cribriform plate (Figs. 9, 10 and 13) :

Consists of right and left portions, each portion lies in nearly sagittal plane, forming an angle of 45 degree with horizon, and meeting at right angle with the other portion. The lamina cribrosa is deep and concave extending anteriorly. Dorsally it articulates with the frontal bone and ventrolaterally with the presphenoid bone. It is perforated lamina between the cranial and nasal cavities, containing about 125 to 250 foramen. The larger foramina lie at the periphery of the plate, while the smaller ones localized at its center.

- The perpendicular plate :

It is median in position, triangular in shape, its anterior end is convex (Fig. 10) . It articulates with the frontal and nasal bones superiorly, and the vomer inferiorly. It forms the osseous nasal septum. It fuses with the mid-line between the right and left parts of the cribriform plate.

- The lamina papyracea (Fig. 8):

Is a thin plate of bone which partly coats the ethmoturbinates. It is formed of three parts : roof plate, floor plate, and lateral plate. The roof plate extends from the perpendicular plate of the ethmoid bone in close relation with the frontal and nasal bones and curves laterally to continue as the lateral plate which covers the lateral parts of the ethmoid labyrinth. The antrodorsal part of the lateral lamina forms a sharp curved process, named the uncinate process (Fig. 8) which fuses with the endoturbinates of the ethmoid labyrinth by a thin plate of bone. The uncinate notch is a rounded depression at the ventrocaudal part of the uncinate process, and is found between the first and second endoturbinates. The lateral lamina (Fig. 8) forms a deep concavity which is the medial wall of the maxillary sinus.

The floor of the lamina papyracea is a very thin plate of bone, forming a partition between the ethmoid labyrinth and the nasopharynx.

- Ethmoidal labyrinths :

Each labyrinth is very complex structure formed from a number of delicate, scroll-like bones, named the ethmoturbinates which are covered dorsally, laterally, and ventrally by the lamina papyracea.

The ethmoturbinates are originated from the internal surface of the lamina papyracea. The ethmoturbinates are divided into two groups according to their location; endoturbinates, and ectoturinates .

The endoturbinates (Figs. 8,9 and 10) are four in number. The first one is the longest and originates from the antrodorsal part of the cribriform plate. It scrolls one and half times dorso-medially. The second

endoturbinate arises from the middle part of the lateral lamina, it consists of two scrolls which turn ventrally one and half times.

The third and fourth endoturbinates are short and wide. The fourth one extends posteriorly to the cavity of the presphenoid bone.

The ectoturbinates (Figs. 8,9 and 10) are two large scrolls which originate from the posterodorsal part of the lamina papyracea. They form two and half scrolls which turn ventrally towards itself and then toward their attachment.

The posterior part of the first ectoturbinate projects from the medial part of the frontal sinus, while that of the second ectoturbinate projects from the lateral part of the frontal sinus, so there is a communication between the nasal fossa and the frontal sinuses.

Fig. (8): Lateral aspect of the lamina papyracea of the dog.
1- Lateral lamina.
2- Uncinate process.
3- Uncinate notch.
4- Endoturbinate No. 1.
5- Endoturbinate No. 2. With its two components a and b.

Fig. (9): Lateral nasal wall of the dog.

1- Ectoturbinates.

2- Endoturbinats :

- a- endoturbinate No. 1
- b- endoturbinate No. 2
- c- endoturbinate No. 3
- d- endoturbinate No. 4

3- Cribriform plate.

4- Frontal sinus.

5- Presphenoid bone.

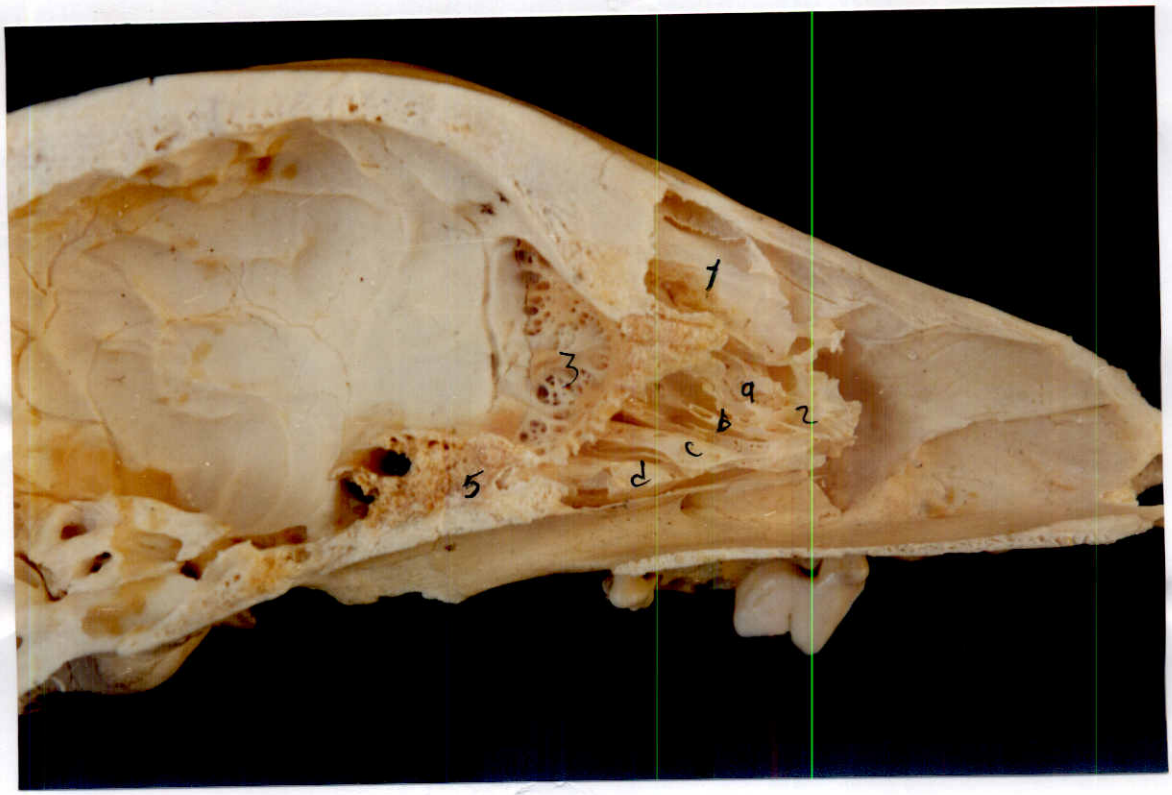

Fig. (10): Lateral nasal wall of the dog.

1- Ectoturbinates.

2- Endoturbinates:

- a- endoturbinate No. 1.
- b- endoturbinate No. 2.
- c- endoturbinate No. 3.
- d- endoturbinate No. 4.

3- Cribriform plate.

4- Perpendicular plate.

5- Presphenoid bone.

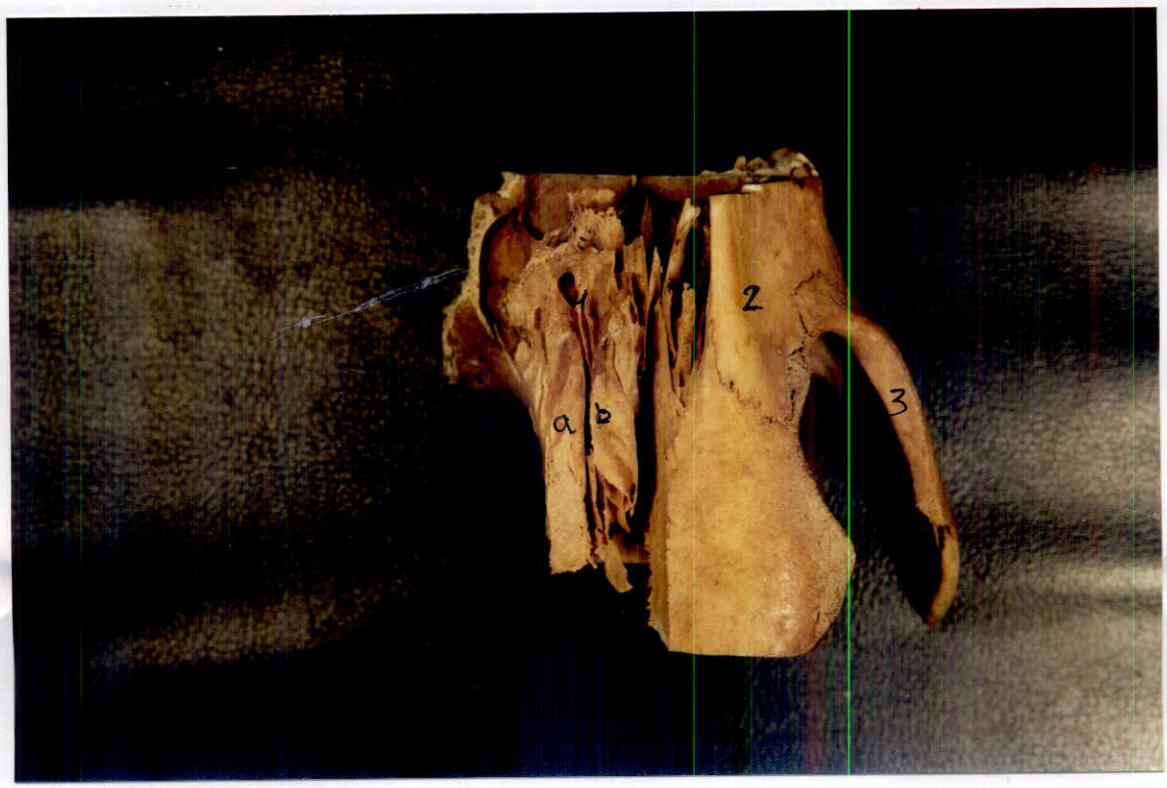

Fig. (11): Superior surface of the ethmoid bone of the dog.

1- Ectoturbinates.

a - Ectoturbinate No. 1

b- Ectoturbinate No.2.

2- Frontal bone.

3- Zygomatic bone.

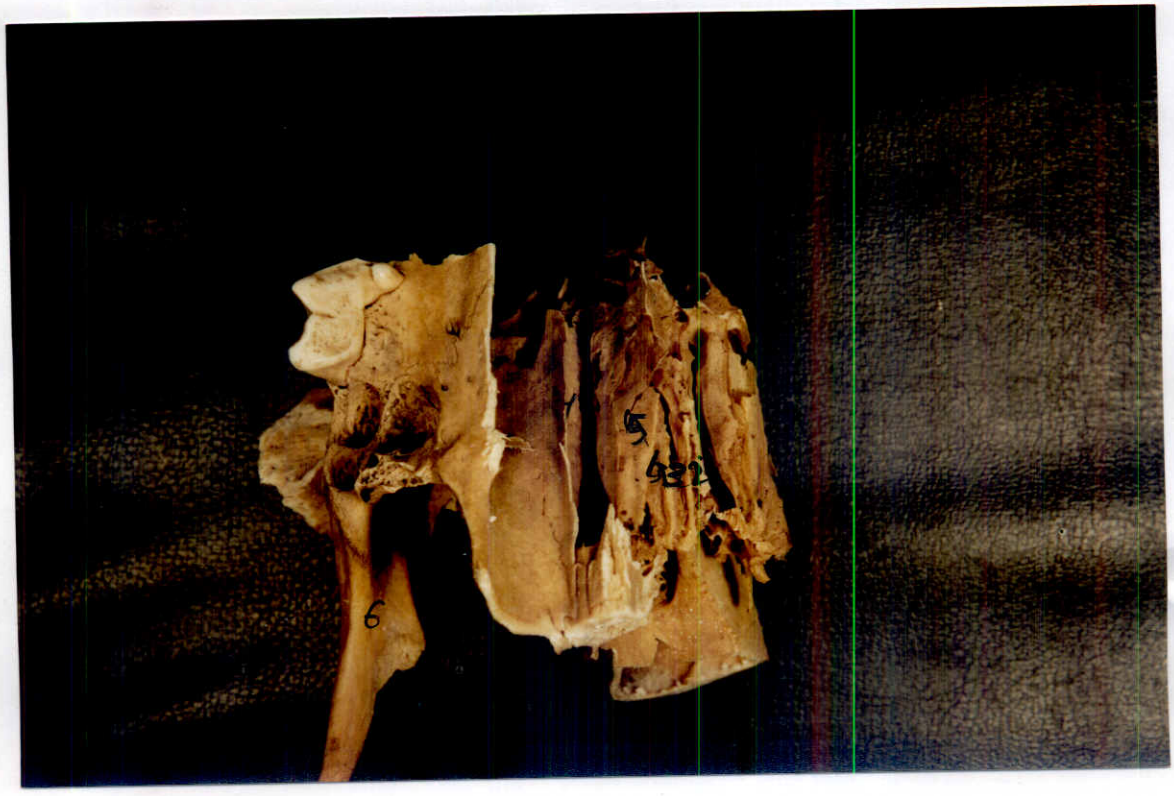

Fig. (12): Inferior surface of the ethmoid bone of the dog.

1- Perpendiculat plate.
2- Endoturbinate No. 4
3- Endoturbinate No. 3
4- Endoturbinate No. 2
5- Endoturbinate No. 1
6- Zygomatic bone.

Fig. (13): Cross section of the skull of the dog posterior to the cribriform plate.

1- Cribriform plate.
2- Crista galli.
3- Frontal sinus.
4- Ectoturbinates.
5- Zygomatic process of maxilla.
6- Presphenoid bone.
7- Endoturbinate No. 4.

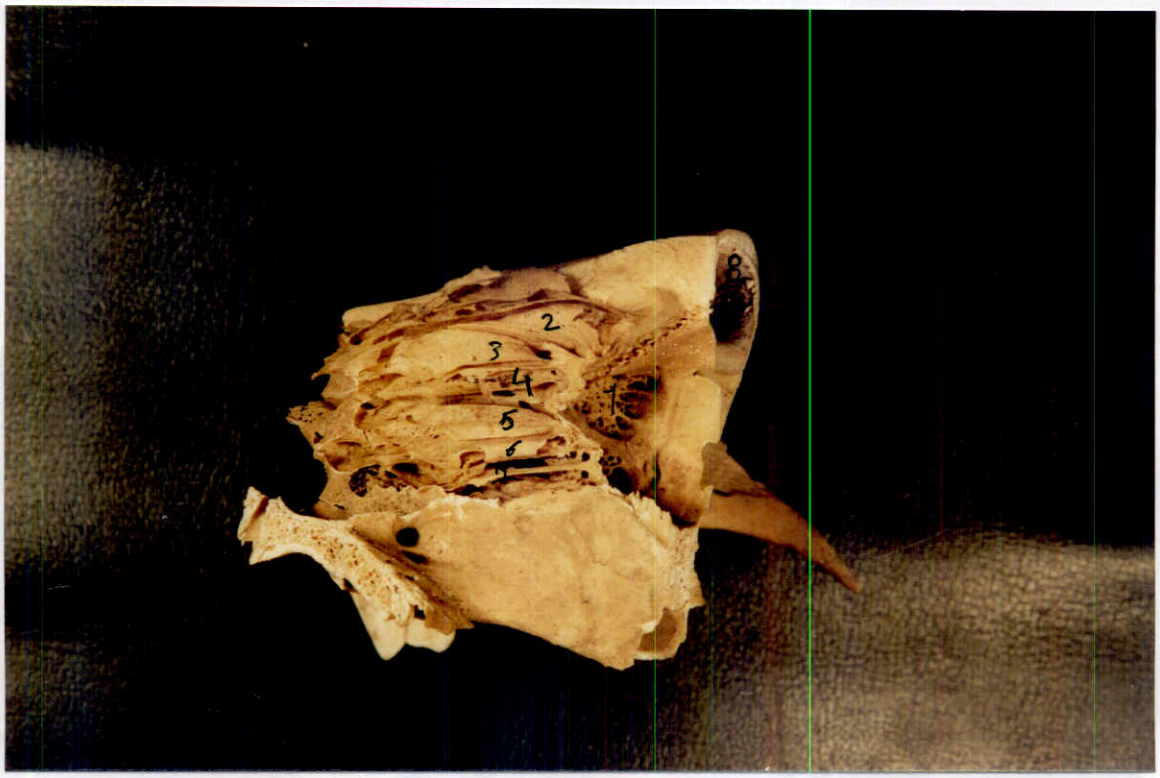

Fig. (14): Lateral aspect of the ethmoid bone. of the dog.

1- Cribriform plate.
2- Ectoturbinate No. 1
3- Ectoturbinate No. 2
4- EndoturbinateNo. 1
5- EndoturbinateNo. 2
6- Endoturbinate No. 3
7- EndoturbinateNo. 4
8- Frontal sinus.

2- Ectoturbinate No. 1