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SOME ANATOMICAL STUDIES ON THE ORBIT IN MAN, CAT, GOAT AND HORSE

(With 4 Tables and 18 Figures)

By

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بعض الدراسات التشريحية على الحجاج في الإنسان والقطط والماعز والحصان

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لقد تم إجراء هذا البحث بغرض عمل مقارنة بين الحجاج في الإنسان والقطط والماعز والحصان ولقد إتضح من الدراسة ما يلي : يتكون حجاج العين من ست عظام في كل من الإنسان ، القطط ، الماعز بينما من سبعة عظام في الحصان ، تشارك العظمة الجبهية بأكبر مساحة من هذا الحجاج في الإنسان والحيوانات تحت الدراسة ، يمثل حجاج العين مقدارا من الطول الكلي للجمجمة يصل إلى ٢٩ر٠٦٪ في القطط ، ٢١ر٢٦٪ في الماعز و ١٩ر٥٦٪ في الإنسان ، ١١ر٠١٪ في الحصان ، يقع حجاج العين في النصف الخلفي من الجمجمة في الحصان بينما في النصف الأمامي من الجمجمة في القطط والماعز وفي النصف السفلي منها في الإنسان ، يمثل حجاج العين مقدارا من الإرتفاع الكلي للجمجمة يصل إلى ٦٢ر٥٪ في القطط ، ٣٨ر٧٨٪ في الحصان ، ٣٣٪ في الماعز ، ١٧ر٦٤٪ في الإنسان ، تتسع المساحة بين حجاجي العينين بحيث تصل إلى أقصى مداها في الحصان (١٨سم) وإلى أدناها في القطط (٣سم) والإنسان (٨ر١سم) بينما تكون في الماعز (١٠سم) ، تتكون فتحة الحجاج من ثلاث عظام في الإنسان والماعز ومن أربعة في الحصان والقطط وتكون مساحة سطح هذه الفتحة أكبر ما يمكن في الحصان وأصغر ما يمكن في القطط ومتوسطة في الماعز والإنسان وتأخذ شكلا يميل إلى الإستدارة في الماعز والشكل الرباعي في الإنسان والبيضاوي الغير مكتمل في القطط وذو الوجهتين المحدبتين في الحصان ، يتميز الحصان والماعز بإتساع مجال الرؤيا وذلك لإتجاه حجاج العين ناحية الجانبين بالإضافة إلى بروز هذا الحجاج وخاصة في الماعز بينما يقل هذا المجال في الإنسان والقطط وذلك لوقوع حجاج أعينهما متجها للأمام ويقوم الإنسان وتلك الحيوانات بزيادة مجال الرؤيا عن طريق حركة الرأس ذات اليمين وذات اليسار أثناء السير ، يتميز الانسان والقطط بكبر مجال الرؤيا المزدوج بكلتا العينين وبذلك يزيد من قوة تركيزه للأمام بينما يقل ذلك في الماعز والحصان ، توجد منطقة معتمة بين العينين ولكنها تكون صغيرة جدا في القطط وتكاد تتلاشى في الإنسان .

SUMMARY

The orbit of cat and goat lies in the rostral half of the skull while that of horse lies in the caudal half however, the orbit in man lies in the inferior (Ventral) half of the skull. It is formed of 6 bones in man,

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as well as, cat and goat and 7 bones in horse, of which the frontal bone shares by the largest orbital plate. The orbital plate of the palatine bone is prominent in goat. The ethmoid and temporal orbital plates are only recorded in man and horse. The palatine orbital plate is not involved at all in the formation of human bony orbit. The orbit represents about 29.06% in cat, 21.26% in goat, 19.56% in man and 11.01% in horse of the total length of the skull. On the other hand, it represents about 62.5% in cat, 38.78% in horse, 33% in goat and 17.64% in man of the total height of the skull. The distance between the two orbits reaches about (18 cm) in horse, (2 cm) in cat, (1.8 cm in man and (10 cm) in goat. The Rima orbitalis is formed of three bones in man and goat and four bones in horse and cat. The surface area of it is (2765.33 mm^2) in horse, (615.265 mm^2) in cat (1149.955 mm^2) in man and (928.74 mm^2) in goat. Horse and goat have the greater relative field of vision but cat and man have the smaller one. On the contrary, the area of binocular vision and concentration is comparatively greater in man and cat but smaller in goat and horse. This is due to the orbits in man and cat are looked rostrally (anteriorly) but rostrolaterally in goat and horse.

INTRODUCTION

There is considerable variation in the position and the size of the orbits between man and animals. This work continue our study on the orbits of the man and of the different domestic animals to show the main differences between them.

MATERIAL and METHODS

The present study was carried out on ten skulls of each of the man, cat, goat and horse. These animals were of both sexes and of different ages. Different measurements were taken as shown in Fig. 1',1". The surface area of the Rima orbitalis and the bones sharing in the formation of the orbit were calculated by using a computarized set digitizer with special surface area program.

RESULTS

In man as well as the investigated animals, the orbit is formed mainly by the orbital plates of frontal, lacrimal, zygomatic, sphenoid and maxilla. In addition to the ethmoid in man, and the perpendicular plate of palatine bone in cat, goat and horse as well as the zygomatic process of temporal bone in the latter animal. Among the individual bones involved in human orbit Table (1) shows that, frontal bone sends the widest orbital plate (897.455 mm^2) followed by zygomatic (792.825 mm^2) and maxilla (554.255 mm^2), while the lacrimal bone gives the narrowest orbital plate (149.675 mm^2). More or less similar results in cat orbit (Table 1). In goat, the frontal (1476.625 mm^2) and palatine (771.64 mm^2) orbital plates form the major parts of the bony orbit, while maxilla (199.69 mm^2) form the minor part in its formation (Table 1). On the other

Fig.(1', 1") A diagram shows the different measurements on the skull and orbit : (1' Man , 1" Horse).

A) Total length of the skull.
B) Height of the skull.
C) Height of the orbit.
D) Rostrocaudal length of the orbit.

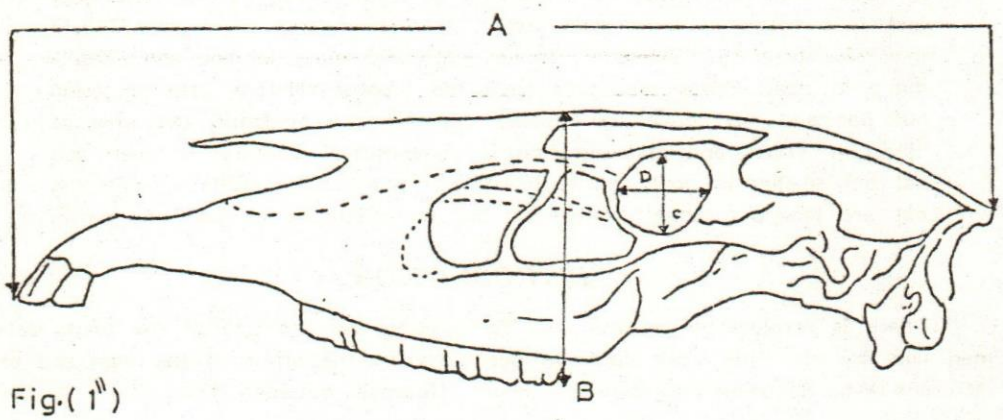

Fig.(1")

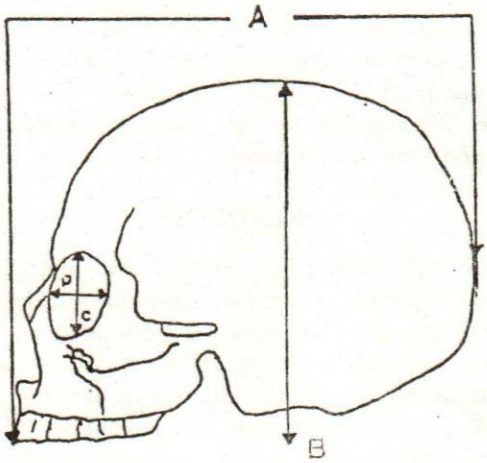

Fig.(1')

hand, the bony orbit of horse is principally composed of a wide orbital plates of frontal (5942.185 mm^2), zygomatic (1352.39 mm^2) and sphenoid bone (1058.255 mm^2) and a narrow plate of temporal bone (238.74 mm^2) (Table 1).

The comparison between the surface area of each orbital plate among the studied mammals (Fig. 1-6) indicates that, the frontal, maxilla, zygomatic, sphenoid and lacrimal plates are manifested in horse. The orbital plate of palatine bone is prominent in goat. The ethmoid and temporal orbital plates are only recorded in man and horse respectively. The palatine orbital plate is not involved at all in the formation of human bony orbit.

In man, the orbits lie entirely in the inferior (ventral) half of the skull away from the mid transverse line by nearly 1.5 cm. In cat and goat the orbits lie in the rostral (anterior) half of the skull but they are more rostrally (anteriorly) situated in cat than goat, while in horse the orbits are situated in the caudal (posterior) half of the skull. In this respect the position of the orbits in cat are more or less as in man (Fig. 7).

Regarding, the position of the orbit in relation to the whole length of the skull (Table 3 and Fig. 7,8) showing that the absolute rostro-caudal (anterio-posterior) extension of the orbit is about 6 cm in horse, 4.5 cm in man, 3.8 cm in goat and 2.6 cm in cat. The relative rostrocaudal (anterio-posterior) extension of the orbit in relation to the length of the skull varies in man as well as the studied animals, as it represents 29.6% in cat, 21.65% in goat, 19.56% in man and 11% in horse from the whole length of the skull (Tables 2,3 and Fig. 8). Consequently the most rostral (anterior) limit of the orbit is observed in man (10.87%) and cat (24.7%) while the most caudal (posterior) one is observed in horse (56.88%) however, goat has an intermediate position (48.97%). Accordingly, the rostral (anterior) limit of the orbit of man, cat and goat situated in the rostral (anterior) half of the skull but it is more advanced in man and cat than in goat. In horse the rostral (anterior) limit of the orbit lies in the caudal (posterior) half of the skull.

Tables (2,3) and (Fig. 9) declaired that the height of the skull is about 17 cm in man, 4 cm in cat, 10 cm in goat and 14.7 cm in horse. It also declaired that, the absolute dorsoventral (superio-inferior) extension of the orbit is about 5.7 cm in horse, 3.3 cm in goat, 3 cm in man and 2.4 cm in cat.

The relative position of the orbital opening in relation to the height of the skull among the investigated mammals Tables (2,3) and Fig. (10) show that; the more dorsal (superior) orbital opening is observed in cat (52.5-95%), horse (53.6-91.48%) followed by goat (55-88%), however the most ventral (inferior) one is observed in man (17.6-38.23%). Consequently, the more extensive orbital opening is represented in cat (62.5%) followed by horse (38.78%), goat (33%) and man (17.64%) as shown in Table (3).

The orbital index (orbital height X 100/orbital width) was calculated in man as well as the investigated animals. Its relative value is about 95%, 92.30%, 86.84% and 66.66% in horse, cat goat and man respectively (Table 2).

By studying the line extending between the two orbits table (2) and Fig. (11) show that; the width is (18 cm) in horse, (10 cm) in goat, (2 cm) in cat and (1.8 cm) in man. Relatively, this line is the most widest in goat in relation to the length of the skull (51.55%) while it is the most narrowest in man (7.82%) however, that of cat (21.51%) and horse (33.03%) lie in between. On the other hand, as shown in Fig. (11) this line begins concave at the median plane only in man then it becomes gradually convex towards the dorsal (superior) part of Rima orbitalis. A reverse results was observed in cat and goat but in horse the line is nerly straight and only convex at the Rima orbitalis.

Regarding the study of the base and apex of the orbit in man and studied animals, it was observed that, the base of the orbit is represented by Rima orbitalis which is quadrilateral in man, incomplete oval in cat, semicircular in goat and biconvex in horse (Fig. 12-15). The circumference of this orbital rim is completely bony in man, goat and horse while in cat a small caudal gap was observed (Fig. 13 B/1). This gap is completed in the fresh state by the orbital ligament.

In this study, the bony rims are formed mainly by the zygomatic process of frontal and zygomatic bones (Fig. 12 A, 13 B, 14 C, 15 D/2, 4) in addition to the lacrimal bone in cat, goat and horse (Fig. 13 B, 14 C, 15 D/3). Moreover, the zygomatic process of temporal bone in the latter animal (Fig. 15 D/5). The maxilla share only in the circumference of Rima orbitalis in man and cat (Fig. 12 A, 13 B/6).

Table (4) shows that, the absolute value of this circumference reaches (20 cm) in horse, (14 cm) in man, (11.65 cm) in goat and (7-8 cm) in cat. Table (4) and Fig. (17) revealed also that, the zygomatic process of frontal bone sharing in the formation of the orbital rim is (9.5 cm) in horse, (2.9 cm) in cat while in man and goat is (5.8 cm). The zygomatic bone is (6 cm) in horse, (4.5 cm) in man, (4.35 cm) in goat and (2.5 cm) in cat. The lacrimal bone is about (3 cm) in horse (1.5 cm) in goat and (1 cm) in cat and it is absent in man. The maxilla is (4 cm) in man and (0.5 cm) in cat. It is not sharing in the circumference of goat and horse. The temporal bones shares in the formation of Rima orbitalis only in horse.

Among the individual bone involved in the formation of the circumference of Rima orbitalis concerning goat, horse, man and cat Table (4) and Fig. (17) showing that, the frontal sends the longest part sharing in the formation of the circumference (49-78%, 47.5%, 41.42% and 37.18%) respectively. The relative value of the zygomatic bone represents about (37.34%) in goat, (42.14%) in man, (32.05%) in cat and (30%) in horse. The relative value of lacrimal bone is about 15%, 12.87% and 12.82% in horse, goat and cat respectively but it is not involved in man. The maxillary part represents about 28.5% and 11.54% in man and cat but not involved in the formation of the circumference in goat and horse. In horse, the temporal bone form about 7.5% of the total circumference but it is not contributed in the circumference of man, cat and goat. Only in cat, a small gap is observed in the caudal (posterior) half of the orbit and representing about 6.4% from its total circumference.

In this study, the points of attachments of the two palpebral canthi to the orbital rim were determined. The long axis of the palpebral fissure of both eyes (i.e the line extending between the two angles of the eye) are met together behind the most rostral (anterior) point of the skull in man as well as the other studied animals forming an angle of about 170-180° in man, 130° in horse, 120° in cat and 140° in goat (table 3 and Fig. 18).

The location of the bony orbit in the skull largely determines the extent of the visual field. In man and cat the orbital opening is directed anteriorly but anterio-laterally in goat and horse. Consequently, horse and goat have a comparatively largest relative field of vision (Fig. 18) as it can see well anterio-laterally than in man and cat. This investigation suggests that, the movement of the head of man and cat increase this field and aids them to see the objects from behind. Also as the eyes of man and cat are looked anteriorly, the area of binocular vision and concentration are much greater but are much smaller in other studied animals (Fig. 18) as the eyes of these animals looked laterally. The depth of the orbit contributes to both the protection of the globe and the prominence of the eye in the living animals. The line extending between the optic foramen and the center of the orbital opening is the orbital depth. It measures about 8.5 cm in horse, 5 cm in man, 4.9 cm in goat and 3 cm in cat (Table 3).

DISCUSSION

The present study showed that; the orbit of man, cat and goat consists of six bones and seven in horse of which the orbital plates of frontal, lacrimal, zygomatic, sphenoid and maxilla share in the formation of this orbit. In addition to ethmoid in man, perpendicular plate of palatine in cat, goat and horse as well as the zygomatic process of temporal bone in the latter animal. More or less similar results were recorded by WARWICK and WILLIAMS (1989) in man and PRINCE, DIESEM, EGLITIS and RUSKULL (1960) as well as GELLAT (1981) in the studied animals. According to IBRAHIM, TAHA, MANSOUR and AHMED (under press) the orbit of sheep is formed of six bones but of seven bones in dog and cattle while of eight bones in rabbit. Of these bones, the frontal, lacrimal, maxilla, zygomatic, sphenoid and lacrimal plates are manifested in horse. The orbital plate of palatine bone is prominent in goat and the ethmoid and temporal orbital plates are only recorded in man and horse respectively. The palatine orbital plate is not involved at all in the formation of the human bony orbit. Relatively in this study, the most rostral (anterior) orbit in relation to the relative length of the skull is represented in man (10.87-30.43%), cat (24.7-53.67%) and goat (48.97-70.62%). Consequently the orbit lies completely in the ventral (inferior) half of the skull in man and the rostral (anterior) half of it in cat and goat. On the contrary, the orbit in horse is situated in the caudal half of the skull (56.88% - 67.89%). IBRAHIM et al. (under press) revealed that, relatively the rabbit orbit is most rostral (42.35-76.48%) while the cattle orbit is most caudal (46.51-67.44%) than the orbit of sheep (52.22-68.66%). TAHA (1990) recorded that, comparatively, the orbit of camel is more rostral (51-28-63.8%) and that of buffalo (57-4-71%) and donkey (56.4-65.8%) are

caudally situated. Therefore, comparing between among the domesticated animals and man, the most rostral (anterior) orbit is found in man, cat, rabbit, dog, goat and cattle while the most caudal is found in buffalo, horse, donkey, sheep and camel.

This investigation, showed that, the eyelids of man, goat and horse are attached to complete bony orbital rim a result which is similar to that mentioned in sheep and cattle (IBRAHIM et al., under press), horse (HILLMAN, 1975), Camel (SMUTS and BENZUIDENHOUT, 1987) and in buffalo and camel (TAHA, 1990). In this study the orbital rim has a small caudal gap in cat. A similar result was mentioned by PRINCE et al. (1960) in dog and NICKEL, SCHUMMER and SEIFERLE (1986) in pig and carnivores as well as in dog and rabbit (IBRAHIM et al., under press).

This work declaired that, the orbital opening is quadrilateral in man, incompletely oval in cat, semicircular in goat and biconvex in horse. This opening is nearly circular in sheep, quadrilateral in cattle and incomplete oval in dog and rabbit (IBRAHIM et al., under press) while it is quadrilateral in buffalo, nearly circular in camel but biconvex in donkey as mentioned by TAHA (1990). HILMANN (1975) described this opening circular in outline in horse.

As mentioned in this study, the circumference of the Rima orbitalis consists of zygomatic process of frontal bone, zygomatic bone in man and the studied animals in addition to lacrimal bone in cat, goat and horse as well as maxilla in man and cat and the zygomatic process of temporal bone in horse. In dog, sheep, cattle and rabbit as mentioned by IBRAHIM et al. (under press) the circumference of the Rima orbitalis consists of zygomatic process of frontal, lacrimal and zygomtic bones, in addition to the zygomatic process of temporal bone in dog and rabbit and the zygomatic process of maxilla in the latter animal. TAHA (1990) recorded that, Rima orbitalis is formed of frontal, lacrimal and zygomatic bones in buffalo and camel in addition to the temporal bone in donkey. The value of the frontal bone in relation to the total circumference is the highest in goat, followed by horse, man and cat. However, the relative value of zygomatic bone is the highest in man, followed by goat, cat and horse but the lacrimal is more in horse followed by goat and cat while it is not involved in man. The maxillary bone relative value is the highest in man but the lowest in cat and is not involved in the formation of the circumference of goat and horse. The temporal bone shares only in horse Rima orbitalis. According to IBRAHIM et al. (under press) thevalue of the frontal bone is the highest in dog, sheep and cattle followed by zygomatic and lacrimal bones. On the other hand, in rabbit, the frontal bone comes first followed by maxilla, zygomatic and temporal bones. However, the temporal bone in dog and the lacrimal bone in rabbit represent the lowest value.

The more dorsal orbit in the specimens of the studied mammals is observed in cat (32.5-95%) followed by horse (53.06-91.84%) and goat (55-98%), but is the more ventral (inferior) in man (20.6-38.23%) in relation to the height of the skull. IBRAHIM et al. (under press) observerd that cattle orbit (63.39-100%) is more dorsal than rabbit (39.4-100%), dog (56-92%) and sheep (40.95-82.60%). TAHA (1990) recorded that, buffalo

orbit is more dorsal (65.5-100%) than that of camel (41-82%) and donkey (58.3-100%). Consequently, among the mammals the buffalo orbit is the more dorsal, followed by cattle, donkey, cat, horse, dog, goat, camel sheep rabbit and man.

The relative width of the orbit in this study represents about 62.5%, 38.78%, 33% and 17.64% in cat, horse, goat and man respectively from the total height of the skull. It represents about 35.65% in sheep, 36% in dog, 36.61% in cattle and 60.60 in rabbit (IBRAHIM et al., under press). On the other hand, it represents about 34.53% in buffalo, 41% in camel and 41.7% in donkey (TAHA, 1990). Consequently, the more extensive orbital width in relation to the height of the skull among the domesticated animals is found in cat followed by rabbit, donkey, camel, horse, cattle, dog, sheep, buffalo, goat and then man.

In this work, the line between the two orbits in relation to the total length of the skull is the longest in goat and the shortest in man however, that of cat and horse lies in between. Therefore, the goat orbit is more projected laterally followed by horse but the orbit is less projected in cat and man. This line begins concave at the median plane only in man then becomes gradually convex towards the dorsal part of Rima orbitalis. A reverse result was noticd in cat and goat, but in horse the line is nearly straight and is only convex at the Rima orbitalis. According to IBRAHIM et al. (under press) this line begins concave in cattle and rabbit at the median plane then becomes gradually convex towards the Rima orbitalis but reverse result in dog and sheep. The line between the two orbits is convex in camel, concave in buffalo but straight in donkey (TAHA, 1990). So among the mammals, the line between the two orbits is concave in rabbit, large ruminants (catte, buffalo) and man, however it is convex in cat, dog, small ruminants (sheep and goat) and camel but it is straight in equines (donkey and horse).

The point of meeting of the two palpebral axes in man and the studied animals lies behind the most rostral point of the head. A narrow blind area is formed between the eyes of these mammals. This blind area is the most narrowest in cat and is nearly absent in man.

This investigation indicated that, the relative field of vision depends upon the position and direction of the orbit as well as the movements of the animal head. Accordingly, goat and horse have the greater relative field of vision but cat and man have the smaller one. This result agree with that mentioned by PRINCE et al. (1960) and IBRAHIM et al. (under press) as this field is the largest in rabbit followed by cattle, horse, sheep, goat, dog, pig and cat. The result of rabbit mentioned by the afore mentioned authors is similar to that stated by TAHA (1990) in camel. Consequently, the relative total field of vision among the domesticated animals and man is the largest in rabbit and camel and the smallest in man, carnivores and pig but intermediate in ruminants and equines. On the contrary, the area of binocular vision and concentration is comparatively greater in man and cat but smaller in goat and horse. This is due to that, the man and cat orbits are looked rostrally (anteriorly) but anterio-laterally in goat and horse. IBRAHIM et al. (under press), mentioned that, the area of binocular

vision and concentration is comparatively greater in dog than sheep and cattle while it is nearly absent in rabbit. On the other hand, PRINCE et al. (1960) stated that, the binocular field is large in cat, small above the prominent snout of pig, small in cattle and very small in sheep. WARWICK and WILLIAMS (1989) added that, in most vertebrates the lateral position of paired eyes permits an almost panoramic vision, in which the eyes notate reflexly towards the objectives. While in man, who adapted for bipedal gait associated with co-ordination of eye and hand movements with other sense organs. So, eyes array of modalities sensetive to minute changes in luminosity particularly in dark and light by binocular vision.

According to DIESEM (1968, 1975), three classes of orbit are recognized taking as a standard: Magaseme (large) in which the orbital index is 89 or over and the orbital opening is round; Mesoseme (intermediate) in which the orbital index between 89, 83; Microseme (small) in which the orbital index 83 or less and the opening is rectangular. Accordingly, the orbital index in horse (95%) and cat (92.30%) of megaseme type but in goat (86.84%) of mesoseme type while of microseme type in man (66.66%).

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Table (1): The mean of total surface area of the Rima orbitalis and the bones sharing in the formation of the bony orbit in the man, cat, goat and horse in mm^2.

Animal	Rima orbitalis	Maxilla bone	Frontal bone	Zygomatic bone	Palatine bone	Lacrimal bone	Ethmoid bone	Sphenoid bone	Temporal bone
Man	1149.955	554.255	894.455	792.825	-	149.675	340.10	469.6	-
Cat	615.265	775.355	854.51	484.655	326.55	234.70	-	244.37	-
Goat	928.74	199.69	1476.525	644.32	771.64	515.23	-	668.535	-
Horse	2765.33	787.475	5942.185	1352.39	596.945	784.87	-	1058.255	288.94

Table (2): Showing the measurements of the height and length of the skull and orbit and the position of the latter along the former in man, cat, goat and horse.

Animal	The absolute height of the skull without mandible at the level of the orbit	The position of the orbit along the height of the skull		The length of the skull	The position of the orbit along the whole length of the skull		Measurement of the line between the 2 orbits in relation to the length of the skull		Index of the orbit
	in cm	in cm	%	in cm	in cm	%	in cm	%	
Man	17	3.5- 6.5	20.6 -38.23	2.3	2.5-7	10.87-30.43	1.8	7.82	66.66
Cat	4	1.3- 3.8	32.5 - 95	9.3	2.3-5	24.7 -53.76	2	21.51	92.30
Goat	10	5.5-8.8	55-88	19.4	9.5-13.7	42.47-70.62	10	51.55	86.84
Horse	14.7	7.8-13.5	53,06-91.24	54.5	31-37	56.88-67.89	18	33.07	95

Table (3): Showing the extension of the orbit along the length and height of the skull, depth of the orbit, angle between the two palpebral axes and the position of the line of meeting of the two axes in relation to the most rostral part of the head in Man, cat, goat and horse.

Animal	Rostro-caudal extension of the orbit in cm	Its percentage in relation to the length of the skull %	Dorsoventral extension of the orbit in cm	Its percentage in relation to the height of the skull %	Depth of orbit	Angle	Position
Man	4.5	19.56	3	17.64	5	180	Behind
Cat	2.6	29.06	2.4	62.5	3	120	Behind
Goat	3.8	21.26	3.3	33	4.9	104	Behind
Horse	6	11.01	5.7	38.78	8.5	130	Behind

Table (4): Showing t[redacted]e measurements of the circumference of the Rima orbitalis and the bones sharing i[redacted] its formation.

Animal	Circumferen[redacted]e in cm	Frontal part		Lacrimal part		Zygomatic part		Temporal part		Maxillary part		Gap	
		cm	%	cm	%	cm	%	cm	%	cm	%	cm	½
Man	14	5.8	41.42	-	-	4.5	23.19	-	-	4	28.5	-	-
Cat	7.8	2.9	37.18	1	12.82	2.5	32.05	-	-	0.9	11.54	0.5	6.41
Goat	11.5	5.8	49.78	1.5	12.87	4.35	37.34	-	-	-	-	-	-
Horse	20	9.5	47.5	3	15	6	30.00	1.5	7.5	-	-	-	-

Fig. 1 to 3: Histograms show the surface area (in mm^2) of the orbital plates of frontal, lacrimalm wygomatic, sphenoid, Maxilla and palatine bones in man, cat, goat and horse.

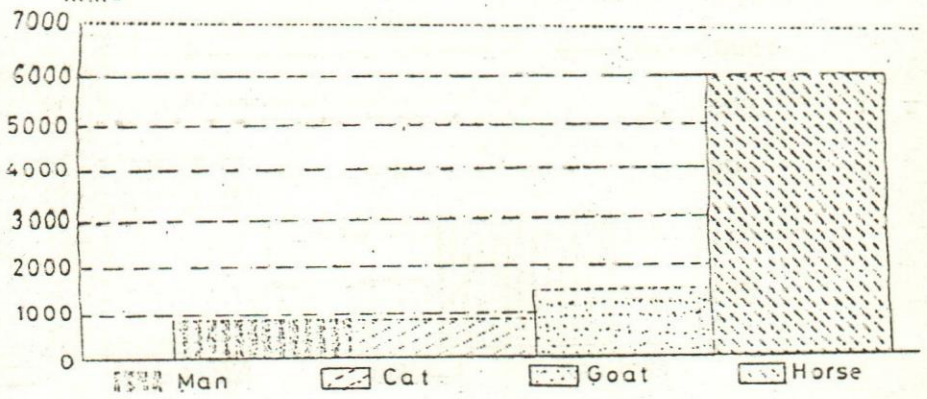


Fig.(1)

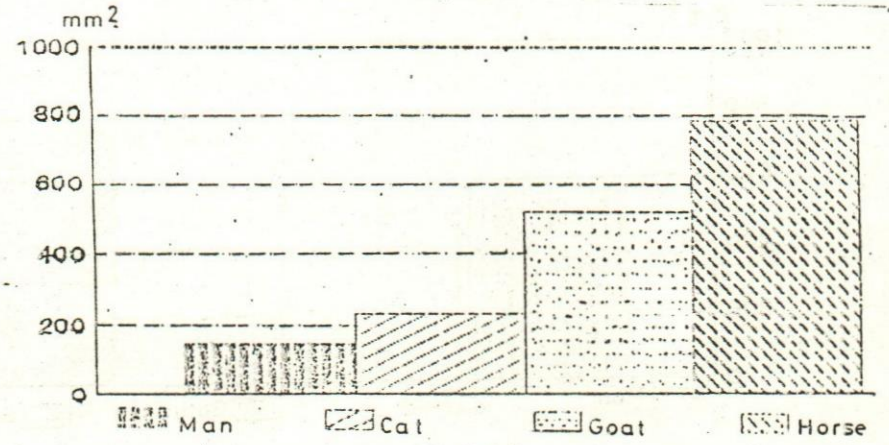


Fig.(2)

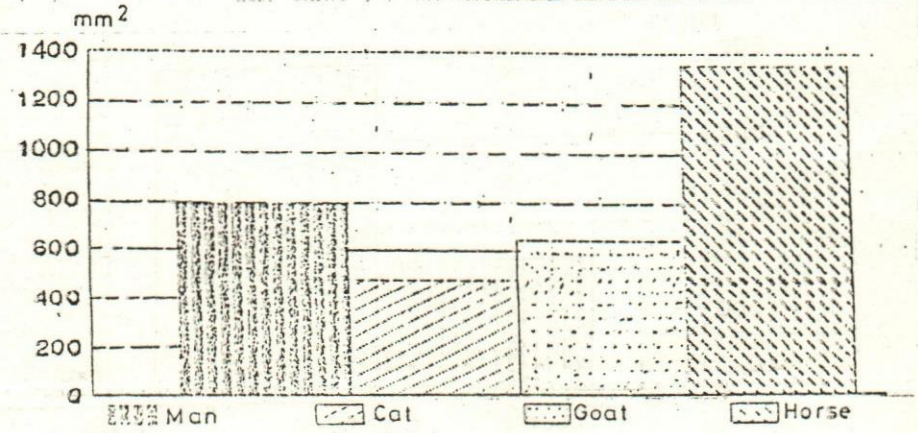


Fig.(3)

ORBIT IN MAN, CAT, GOAT AND HORSE

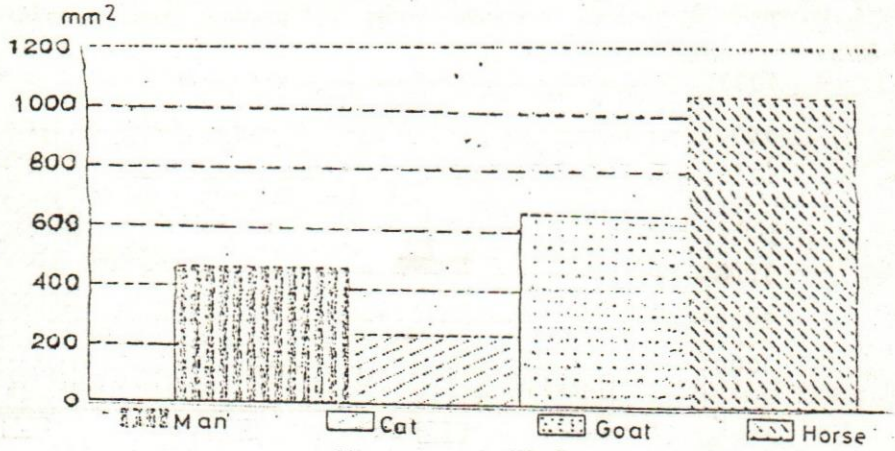


Fig.(4)

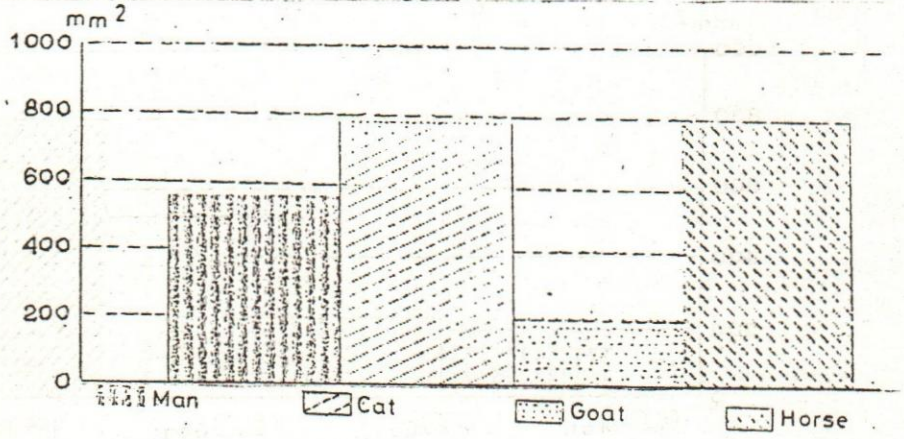


Fig.(5)

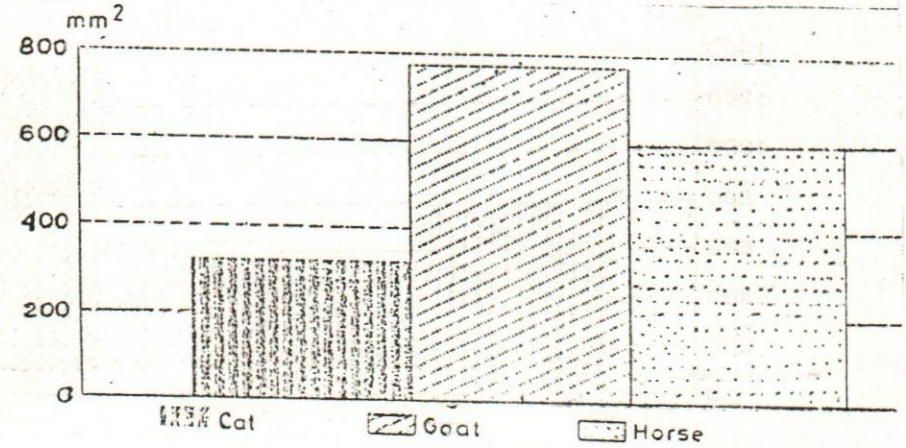


Fig.(6)

Fig. (7, 8) Histograms show the absolute and relative position of the orbit along the whole length of the skull in man, cat, goat and horse.

* Stripped area represent the length and position of the orbit.

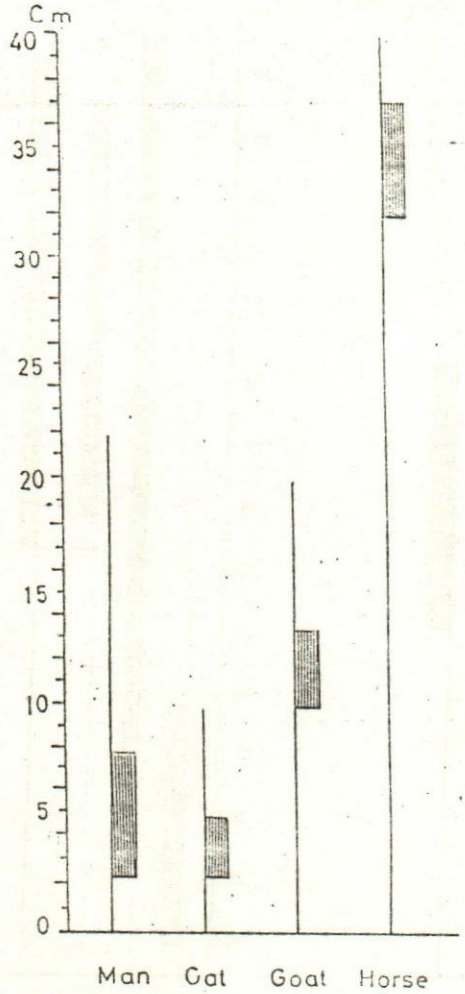


Fig.(7)

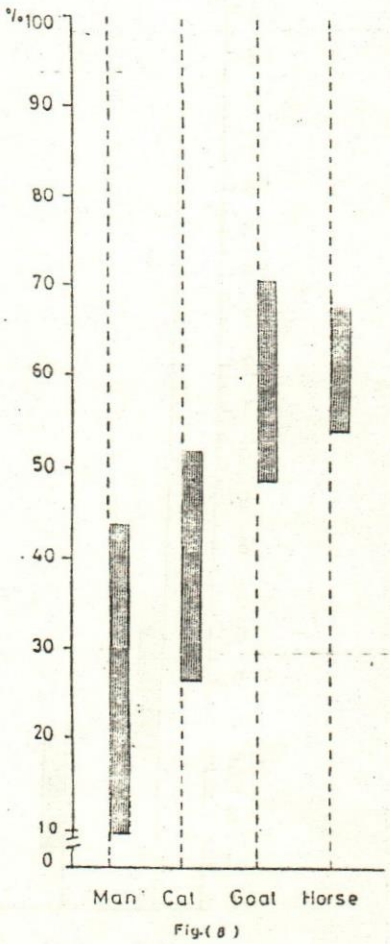


Fig.(8)

ORBIT IN MAN, CAT, GOAT AND HORSE

Fig. (9, 10) Histograms show the absolute and relative position of the orbit along the whole height of the skull in man, cat, goat and horse.

* Stripped area represent the height and position of the orbit.

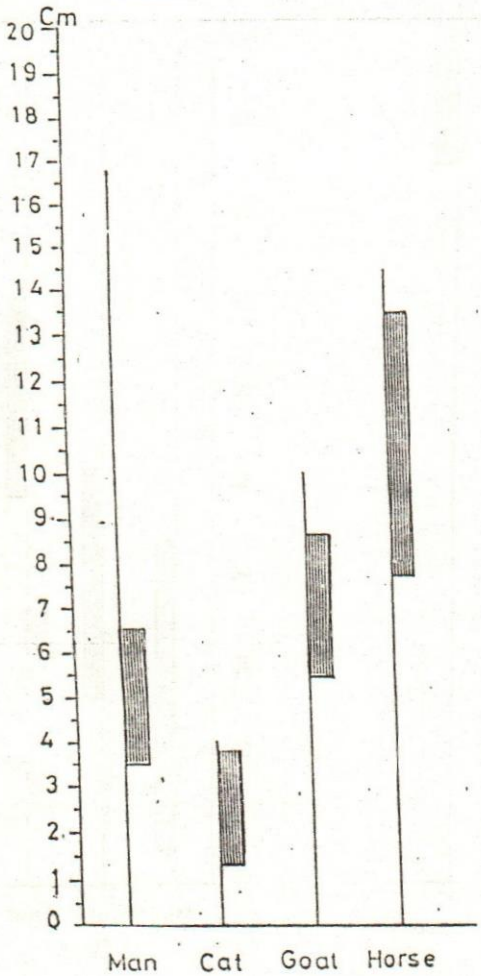
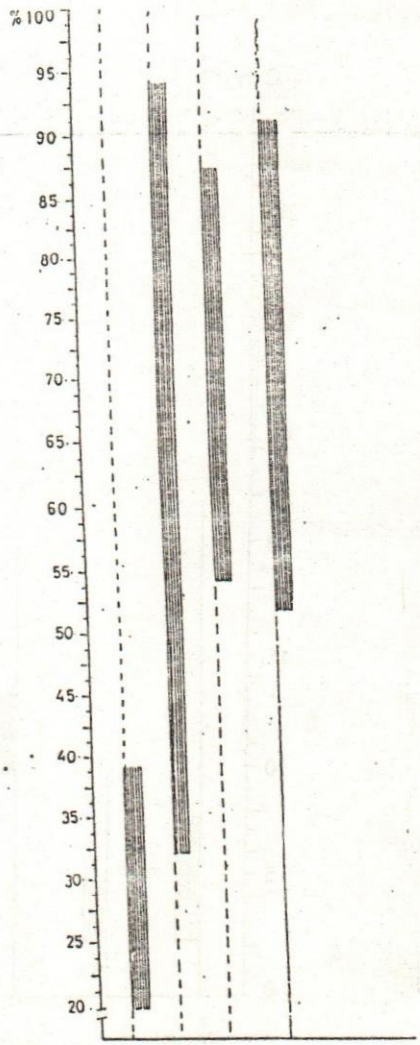


Fig.(9)



Fig(10)

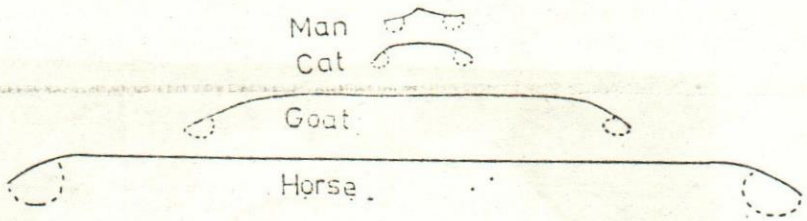
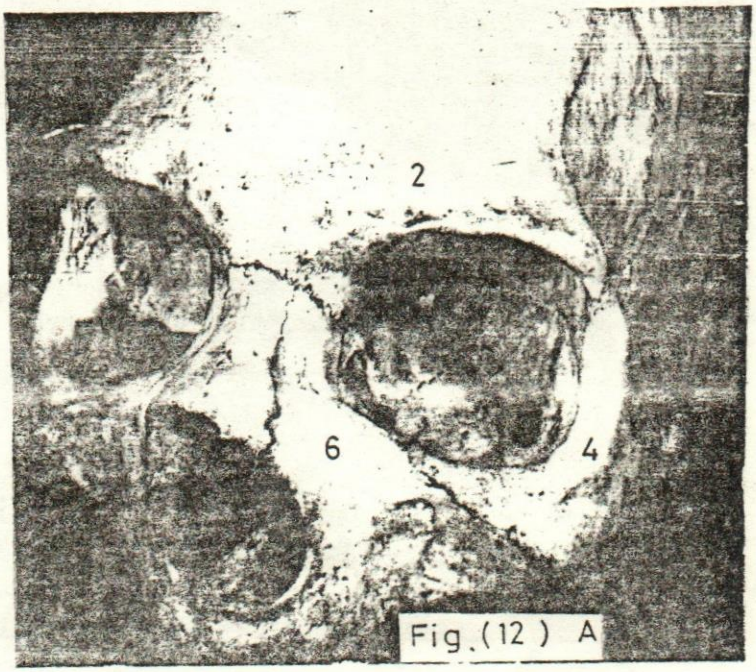


Fig.(11) A diagram shows the shape of the line between the two orbital rims in man, cat, goat and horse.

Fig.(12-15) Photographs show the bones forming the orbital rim.
A) Man B) Cat C) Goat D) Horse.
1- Gap 2- Frontal bone 3- Lacrimal bone
4- Zygomatic bone 5- Temporal bone 6- Maxilla.



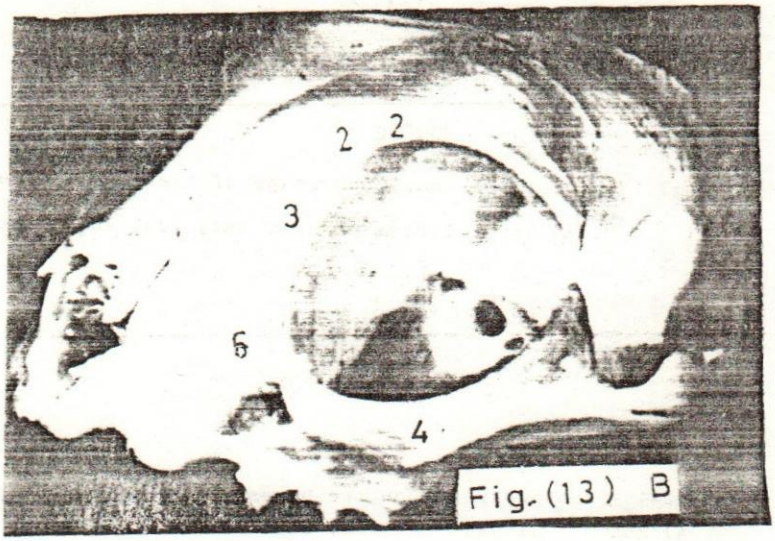


Fig.(13) B

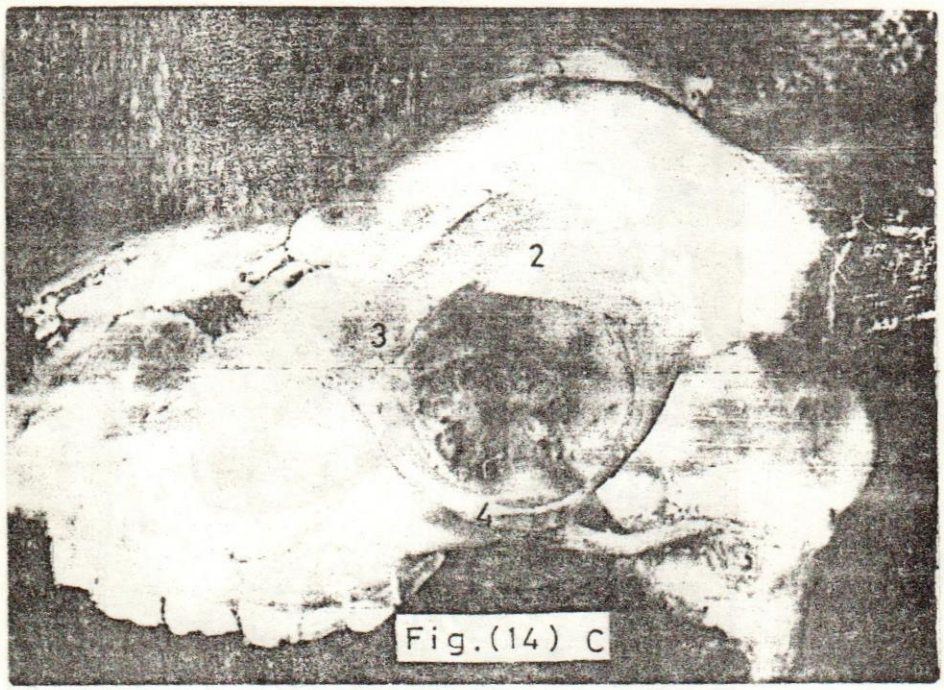


Fig.(14) C

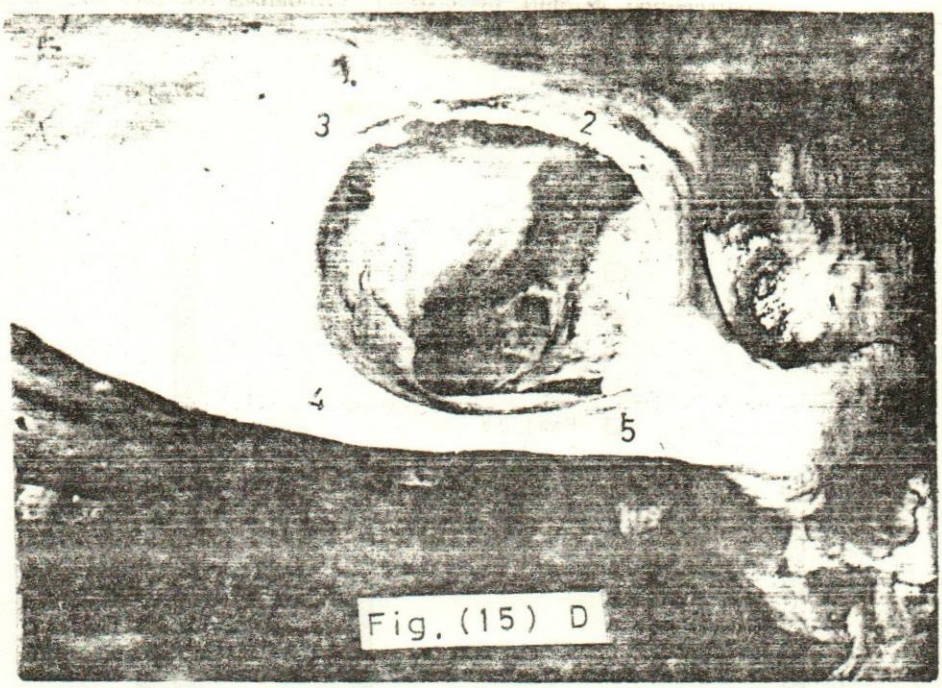


Fig. (15) D

Fig. (16, 17) Histograms showing the surface area of Rima orbitalis and the measurements of its circumference as wall as the bones forming it in man, cat, goat and horse.

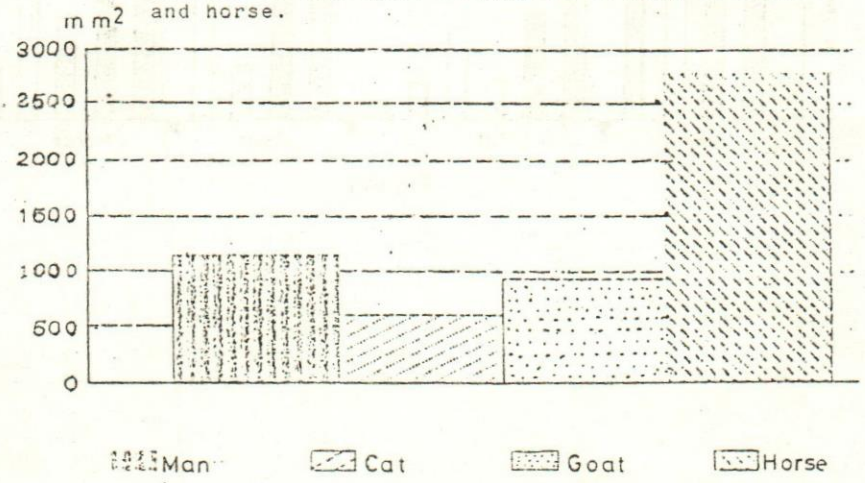


Fig. (16)

ORBIT IN MAN, CAT, GOAT AND HORSE

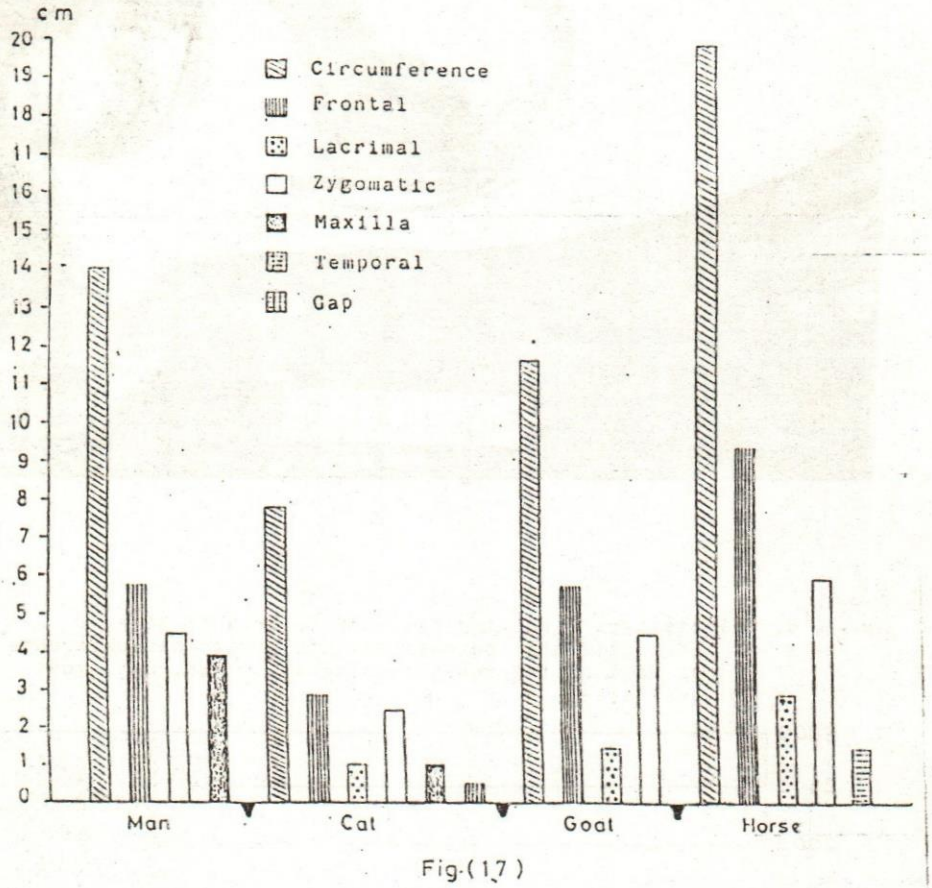


Fig.(17)

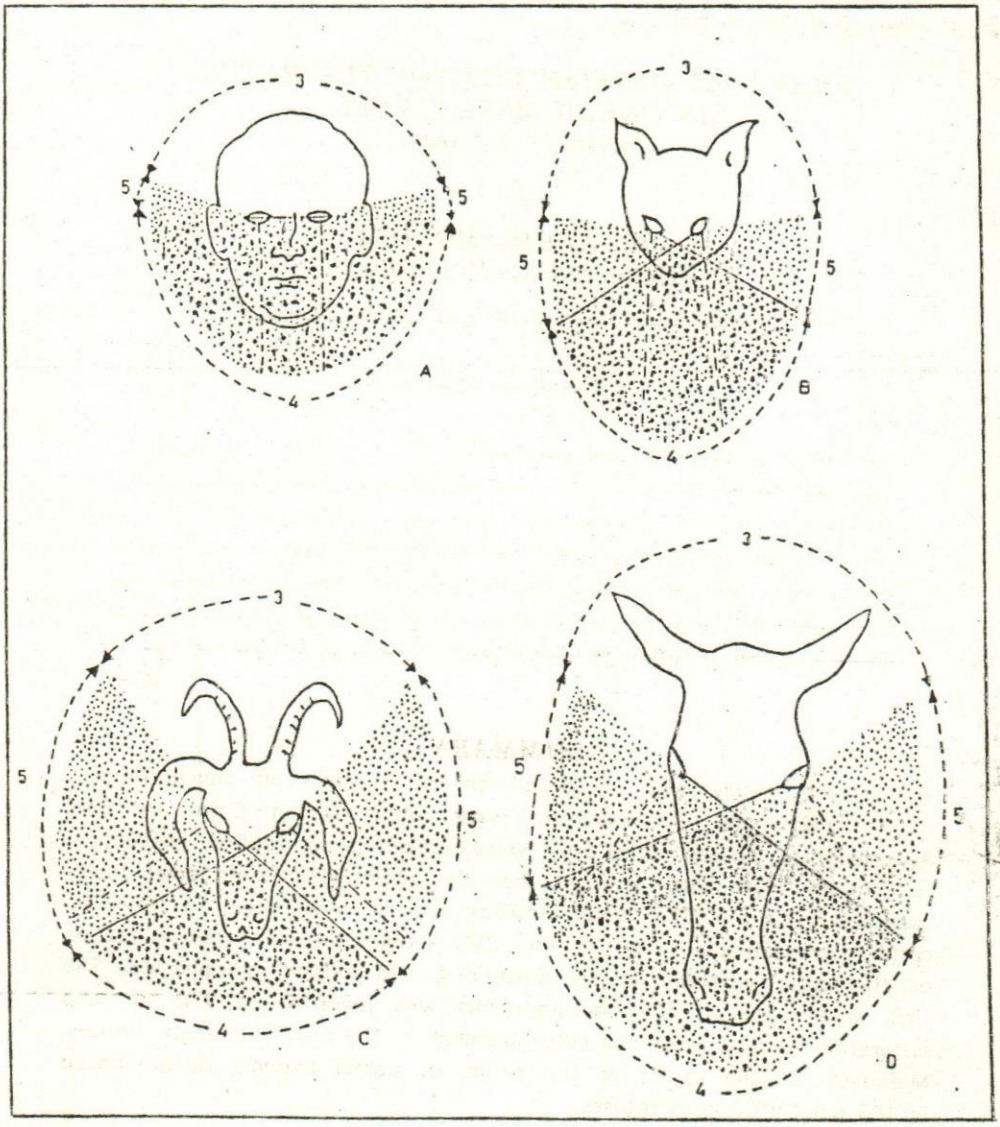


Fig. (18) A diagram showing : The point of meeting of the palpebral axes, angles between them, blind area as well as the visual field of both eyes in:
a- Man b- Cat c- Goat d- Horse
1- Point of meeting of palpebral axes.
2- Angles between them.
3- Blind area.
4- Binocular vision.
5- Monocular vision.