Dept. of Anatomy and Histology,
Fac. Vet. Med., Assiut University,
Head of Dept. Prof. Dr. A. Hifny.

PRENATAL DEVELOPMENT OF THE RETINA IN ONE HUMPED CAMEL

(With 13 Figures)

By

M.E. ABDEL-MONIEM

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النمو الرحمي للشبكية في الجمل وحيد السنام

محمد المحرزي عبد المنعم

أجري هذا البحث على عدد ٢٦ من أجنة الجمال وحيدة السنام بغرض دراسة النمو الرحمي للشبكية في الجمال . وقد أظهرت الدراسة أن بداية ظهور الحوصلة البصرية يكون في الأجنة التي طولها ٢ سم وتتحول إلى كأس بصري في الأجنة التي طولها ٣٫٨ سم . وقد وجد أن بداية ظهور الخلايا الحساسة للضوء يكون في الأجنة التي طولها ٧٧٫٥ سم حيث يتم تمايزها إلى قطعة داخلية وأخرى خارجية في الأجنة التي طولها ١٠٠سم . وقد أظهرت الدراسة أن كل طبقات الشبكية يتم تمايزها قبل الولادة في الأجنة التي طولها ١٠٠ سم . هذا بالإضافة إلى نتائج أخرى يتم مناقشتها مع مثيلاتها في الحيوانات الأخرى .

SUMMARY

The present study was conducted on 26 one-humped camel fetuses, two of each age. The specimens were collected from Cairo and Bani Adi slaughter houses. The eyes were subjected to routine histological examination. The data revealed that the optic vesicle in camel firstly appeared in 2 cm CVR length fetuses and its invagination to form the optic cup took place in 3.8 cm CVR length fetuses. The oblitration of the optic ventricle begins posteriorly and extends peripheraly. The first appearance of the photoreceptors was recorded at 77.5 cm and differentiated into inner and outer segment in 100 cm CVR length fetuses. Moreover all the layers of the retina of camel become differentiated in 100 cm CVR length fetuses.

INTRODUCTION

Knowledge of the origin and pattern of different cell type of the retina is very important. It can explains the causes of some congenital anomalies, also it helps in identification of cellular differentiation of some tumours. Therefore, the retina was the subject of study by many authors such as EL-RACHKWAY (1984) and EL-BADRY (1991) in albino rat; TOUT, ASHWELL and STONE (1988) in albino rabbit; GOREY and POWELL (1968) in cat; PARRY (1953) in dog; BOYCOTT and HOPKINS (1981) in monkey; MANN (1964) in man and RODIECK (1973) in vertebrates.

Few authors as ABDEL-MONIEM (1980) studied the retina of Camel but the recorded data in this field are still limited. This attracts our attention to lighten the prenatal development of the retina of one humped camel.

MATERIAL and METHODS

The present study was carried out on 26 fetuses of the one humped camel, collected from Cairo slaughter house. The CVR length of these fetuses were: 2, 3.8, 5, 9, 11, 12, 19, 24, 35.5, 49, 77.5, 88, 100 (Two of each age were used).

After slaughtering the mothers, the fetuses were taken and immediately injected through the umblical blood vessels by 10% formaline. The fixtive was injected also into the cavity of the eye ball to be sure that the retina become well fixed. Theeye was extirbated, and the eye ball preserved in 10% formaline and subjected to the subsequent histological preparation.

RESULTS

2 cm CVR length camel fetus (Fig. 1):

The optic vesicles are formed as a result of outward proliferation of the neuroectodermal cells lining the floor of the primitive forebrain. It consists of three to five layers of nuclei.

3.8 cm CVR length camel fetus (Fig. 2):

Invagination of the external surface of the optic vesicle produces twolayered structure, the optic cup (secondary optic vesicle). The inverted wall is formed of 8-14 neurobastic cell layers. Mitotic figure is common within the cells of the inverted wall of the optic cup specially at the surface adjacent to the optic ventricle. The external wall of the optic cup consists of a single layer of pigmented epithlium. The pigment granules of the optic cup increases at its periphery. The thickness of the neuroblastic layers decreased from the posterior to the periphery of the optic cup where it is formed only of about 8 layers only.

The nerve fiber layer appeares at this age covering the innermost layer of the neuroblastic cells.

A primary vitrus body containing mesenchymal cells appears infront of the optic cup, invaded with hyaloid vessels which spread over the nerve cell layer.

The optic ventricle is almost obliterated posteriorly when the inverted wall of the optic cup comes in contact with the external one.

5 cm CVR length camel fetus (Fig. 3):

Condensation of melanin granules in the retinal pigmented epithelium increases specially toward the peripheray of this layer.

The optic ventricle is completly obliterated resulting in contact of the external and inverted layers of the optic cup.

The inverted layer of the optic cup is thickned due to extensive mitotic activity. The nuclei of this layer remain oval or elongated in shape and condensed except those of the inner layers become rounded less condensed and paler.

9 cm CVR length camel fetus (Fig. 4 A,B):

The inner most part of the neuroblastic layers shows several layers of the rounded nuclei, which are the precursors of ganglion cell layer. The differentiation of the ganglion cells as a distinct layer begins peripheraly where it is separated from the neuroblastic cells by newly fomed inner plexiform layer.

The nerve fiber layer becomes more thickened than the previous age specialy at the posterior part of the neuroblastic layer.

11 cm CVR length camel fetus (Fig. 5 A,B):

The retinal pigmented epithelium continues its increase in thickness especially at its peripheral parts.

The neuroblastic layer appears to be formed of two parts an outer part with condensed, dark, elongated nuclei and inner part (the ganglion cell layer) with uncondensed paler rounded nuclei.

The nerve fiber layer becomes well formed specially at the posterior part of the retina where and lined by well disinect inner limiting membraine.

12 cm CVR length camel fetus (Fig. 6 A,B):

The ganglion cells are arranged in a discontinous rows. They are 3-5 rows at the peripheral part of the retina and increases up to 5-10 rows at its posterior part. The cells of the ganglion layer have large rounded lightly stained nuclei.

The ganglon cells begin to move inward away from the main bulk of the neuroblastic layer resulting in complet formation of the inner plexiform layer. The inner plexiform layer appears at first peripheraly then it extends to the posterior part of the retina. Displaced ganglion or amacrine cells are occasionaly seen in the inner plexiform layer.

19 cm CVR lenght camel fetus (Fig. 7 A,B):

There is a marked increase in the thickness of the retina both posteriorly and peripherally.

The gangllion cell layer decreases in its thickness. It becomes 2-3 layers posteriorly and 3-4 layers peripherally. The nuclei of the gnglion cells are paler, spherical and larger than the nuclei of the undifferntiated cells of the neuroblastic layer.

The inner plexiform layer is well defined both posteriorly and peripherally but it still contains few number of migrating cells.

The neuroblastic cell layer appears to be formed of an outer thick, compact, darkly stained nuclei and an inner thin, less condensed with large, pale rounded nuclei.

Hyaloid blood vessels spread over the surface of the nerve cell layer.

24 cm CVR length camel fetus (Fig. 8):

All layers of the retina are thickened except the ganglionc cell layer which is represented on one or two rows of cells.

Appearance of horizontal cells at the junction of the outer third and the inner two thirds of the neuroblastic cell layer. These cells are the precursor of the outer plexiform.

35.5 cm CVR length camel fetus (Fig. 9):

The internal limiting membrane becomes well defined at the inner surface of the retina. Hyaloid vessels spread within the nerve fiber layer.

The ganglinic cell layer consists of single row of condensed relatively large cells with spherical and less stained nuclei.

The inner plexiform layer increased in its thickness with a few nuclei are scattered within it.

49 cm CVR length camel fetus (Fig. 10 A,B):

There is a marked increase in the thickness of the retina which atributed to the increase in the thickness of the nerve fiber layer, the inner plexform layer and the neuroblastic layer.

Retinal capillaries are well evident passing horizontally in the nerve layer specially at its posterior.

The number of ganglionic cells within the ganglion cell layer decreased with a marked increase in its size.

The inner nuclei of the neuroblastic layer become rounded slightly larger in size, less condensed than the outer one which are elongated and condensed.

There are many horizontal cells which are well developed.

At the outer edge of the neuroblastic cell layer appears the outer limiting membrae for the first time.

77.5 cm CVR length camel fetus (Fig. 11 A,B):

The appearance of the outer plexiform layer divides the neuroblastic layer into, internal nuclear layer and outer nuclear one. The internal nuclear layer constitutes approximately the inner one third of the neuroblastic layer. The cells of the internal nuclear layer are less condensed with a large rounded nuclei. The outer nuc-

layer which forms the outer two thirds of the neuroblastic layer. The cells of outer nuclear layer are elongated or ovoid in shape and condensed.

The ganglion cell layer is comosed of single row of large and spherical nuclei which are disposed at intervals.

Photoreceptors starts its development at this age. the outer limiting membrane appears as a thin zone which separates the photorecptors from the outer nuclear layer.

88 cm CVR length camel fetus (Fig. 12 A,B):

The cells of the inner nuclear layer begin its differentiation into more than one cell type. The inner segment of the photoreceptors continue its formation. The outer limiting membrane is well formed. Blood capillaries spread within the nerve cell layer and the ganglionic cell layer. Astrocytes appear within the nerve fiber layer specially around the blood capillaries.

100 cm CVR length camel fetus (Fig. 13 A,B):

At this age the retina reached its maturity complete differentiation by formation of the outer segment of the photreceptor layer. The outer segments are longer and lighter than the inner one.

Capillaries are shown in the inner nuclear layer. It connect with the superficial capillary network in the nerve fiber layer.

The outer plexiform layer increases in thickness. It has a reticular appearance separating the inner and the outer nuclear layers.

The inner nuclear layer is formed of 5 and 7 layers of nuclei in the peripheral and posterior retina respectively.

The outer nuclear layer which is formed of cell bodies of the photoreceptor cells are arranged in 15-17 rows in the peripheral and posterior retina respectively.

DISCUSSION

Complete differentiation of the photoreceptors differs from animal to animal. In some animals it takes place prenatally and in other postnatally.

According to the available literature, complete differentiation of the photoreceptors in albino rat occured at 12 days old rat (EL-BADRY, 1991) and at 80 days post conception in dog (PARRY, 1953). In camel fetuses, as shown in the present work, the differentiation of the photoreceptors takes place at 100 cm CVR length (339 days). In regard to the gestation period in these animals it appeared that complete differentiation of the photorecptor cells takes place so early in camel fetuses.

The retina of human become mature at early stage of gestation (MANN, 1928), while that of some animals such as dog (PARRY, 1953), albino rat (BRAEKEVELT

and HOLLENBERG, 1970) and EL-BADRY (1991) become mature posnatally. The present study investigated that the development of the retina of camel become fully developed at late stage of gestation. This explains why this animal is capable for vision at birth.

The present study showed that the peripheral retina lags behind the posterior retina in development and the layers of the peripheral retina never attain the degree of thickness that they do posteriorly. This come in agreement to that described in human (MANN, 1928), in cat (DONOVAN, 1966) and rt (BAEKEVELT and HOLLENBERG, 1970).

In camel the retinal epithelium was differentiated early than that of the neural retina and the mitotic activeties in the epithelium are restricted to the early stage of gestation. The condensation of the melanine within the retinal epithelium increases with the advancement of age. Similar findings were described in albino rat (EL-BADRY, 1991).

The cell bodies of the photoreceptors form the outer nuclear layer and the external limiting membrane lies between the inner segment of the photoreceptor and that of the outer nuclear layer. In this respect camel resmbles the other animals described in the avilable literature.

In camel the horizontal cells appeared at 24 cm CVR length at the junction of the outer third and inner two thirds of the neuroblastic layer. These cells are the precursor of the outer plexiform layer. CORMACK (1987) added that these cells play an important role in integration and summation of responses.

The nerve fiber layer in camel appeared early at 3.8 cm and become well formed at 11 cm CVR length. At 49 cm marked increase in its thickness was observed. In albino rat this layer started to appear at 13 days prenatally.

The hyaloid vessels spreaded over the nerve fiber layer at 3.8 cm and appeared within the nerve fiber layer at 49 cm and reached the ganglionic cell layer at 88 cm and the inner nuclear layer at 100 cm.

As that described in the current study BRACKEVELT and HOLLENBERG (1970) and EL-BADRY (1984) in albino rat recorded that once all layer of the retina have reached their maximal width they decrease somewhat in thickness.

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LEGENDS

ELM : external limiting membrane
On: outer nuclear layer
H: hyaloid vessels
ILM: internal limiting membrane.
In: inner nuclear layer
PE: pigment epithelium
PVB: primary vitrus body
RC: retinal capillaries.
NF: nerve fiber layer
OC: optic cup
GC: ganglionic cells
OS: outer segment of photoreceptors
OVe: optic ventricle
IS: inner segment of photoreceptors
NB: neuroblastic layer
FB: forebrain
Op: outer plexiform
Ov: optic vesicle
IP: inner plexiform
LV: lens vesicle
I: horizontal cells

Fig. 1: Showing the optic vesicle which is separated from the forebrain in 2 cm CVR length camel fetus. H&E, X 63.

Fig. 2: Showing the formation of the optic cup at 3.8 cm CVR length, X 63 (left), its prepheral part (cpper right inset), its posterior part (lower right inset), H&E, X 250.

Fig. 3: Showing the formation of the optic cup at 5 cm CVR length (left) its peripheral part (upper right inset), its posterior part (lower right inset), H&E, X 250.

Fig. 4: Showing the retina of camel fetus at 9 cm CVR length, 4a (posterior retina), 4b (peripheral retina), H&E, X 250.

Fig. 5: Showing the retina of camel fetus at 11 cm CVR length, 5a (posterior retina), 5b (peripheral retina), H&E, X 250.

Fig. 6: Showing the retina of camel fetus at 12 cm CVR length, 6a (posterior retina), 6b (peripheral retina), H&E, X 250.

Fig. 7: Showing the retina of camel fetus at 19 cm CVR length, 7a (posterior retina), 7b (peripherl retina), H&E, X 250.

Fig. 8: Retina of the 24 cm CVR length camel fetus, H&E, X 250.

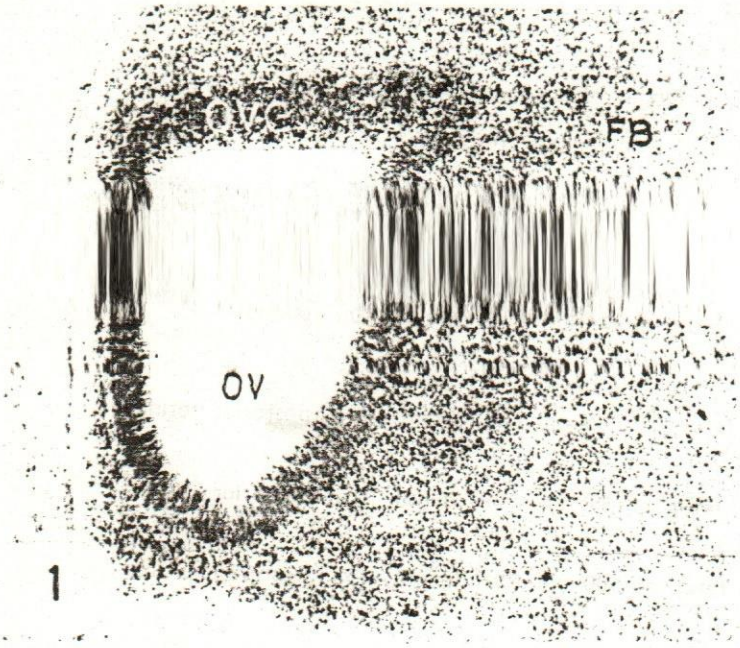
Fig. 9: Retina of the 35.5 cm CVR length camel fetus. H&E, X 250.

Fig. 10: Retina of the camel fetus at 49 cm CVR length, 10a (posterior retina) 10b (peripheral retina). H&E, X 250.

Fig. 11: Retina of the camel fetus at 77.5 cm CVR length, 11a (posterior retina) 11b (peripheral retina). H&E, X 250.

Fig. 12: Retina of the camel fetus at 88 cm CVR length, 12a (posterior retina) 12b (peripheral retina). H&E, X 250.

Fig. 13: Retina of the camel fetus at 100 cm CVR length, 13a (posterior retina) 13b (peripheral retina). H&E, X 250.



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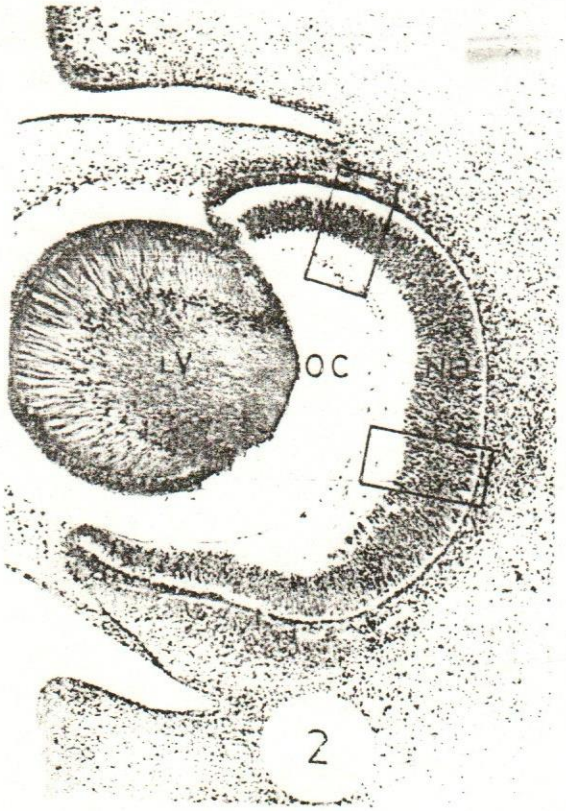

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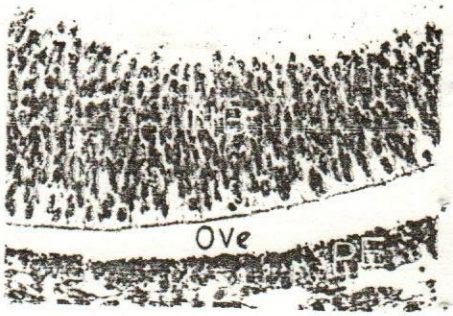

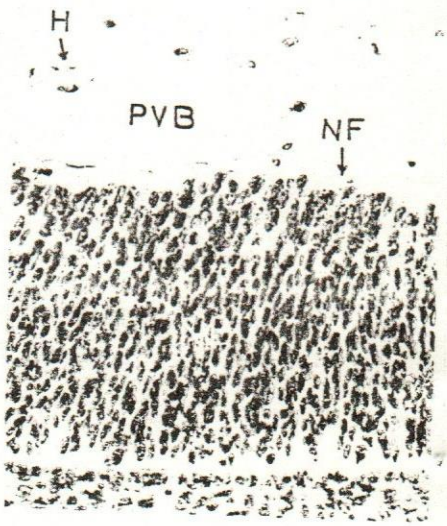

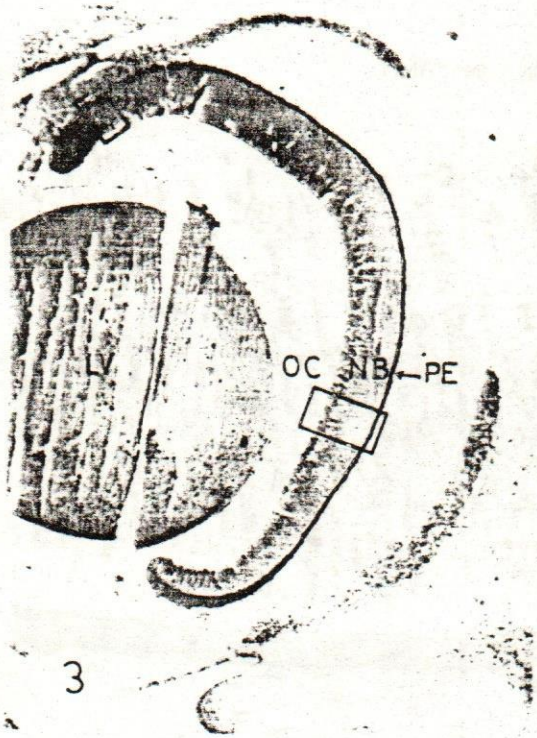

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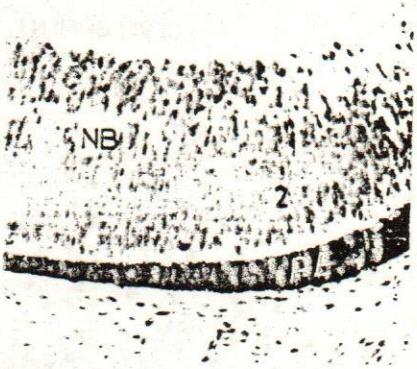

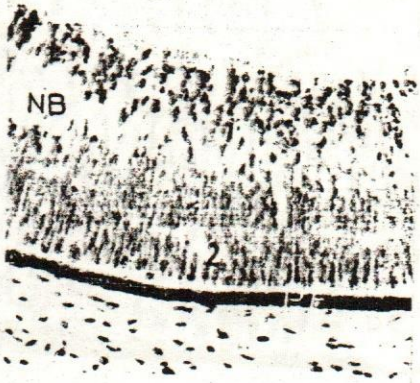

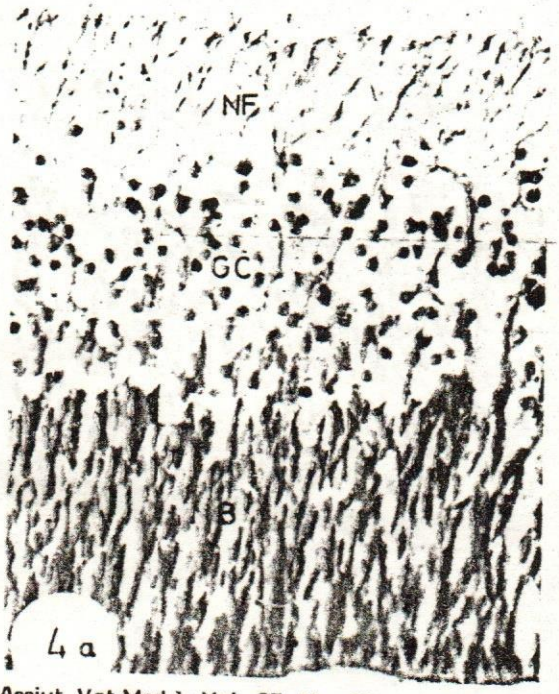

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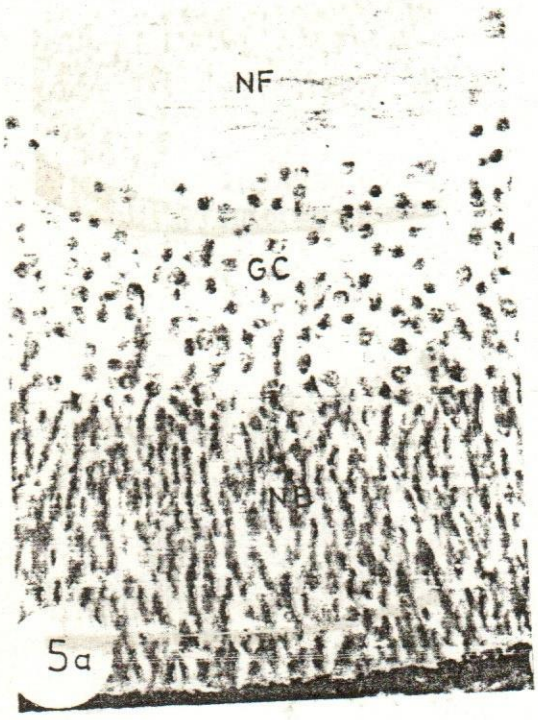
DEVELOPMENT OF THE RETINA IN CAMEL



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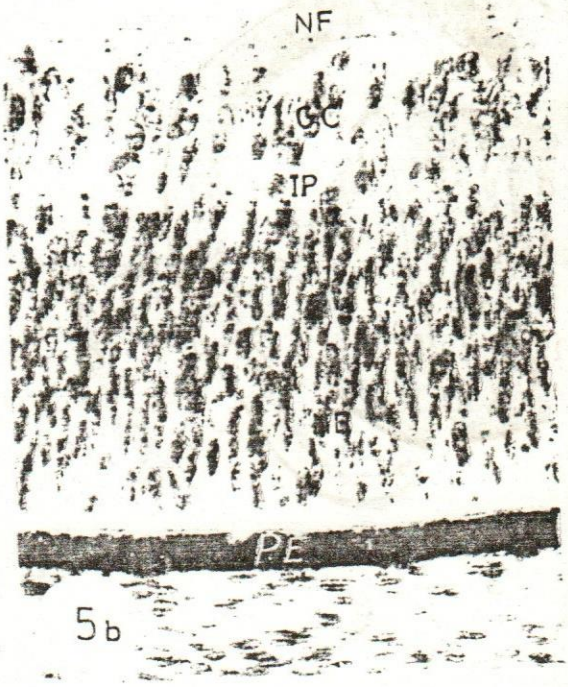

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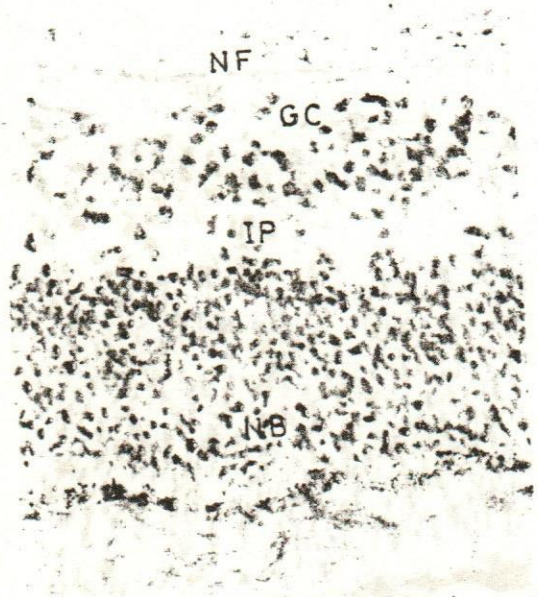

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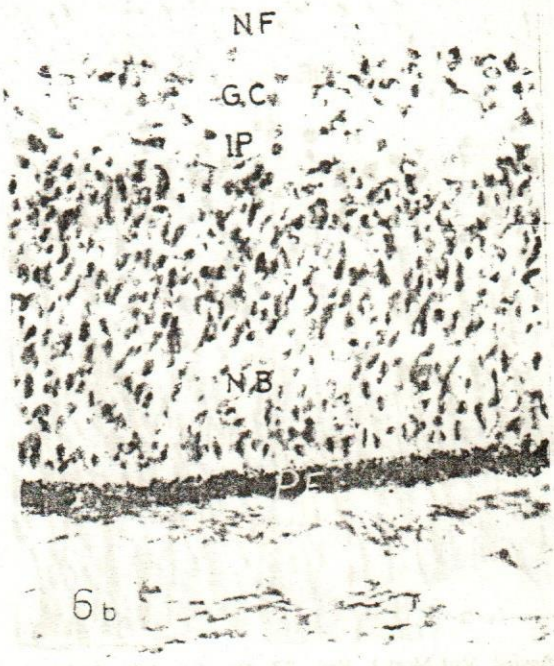

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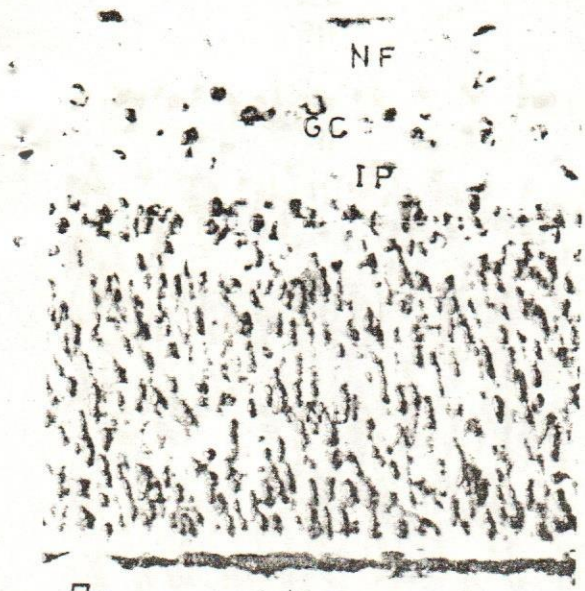

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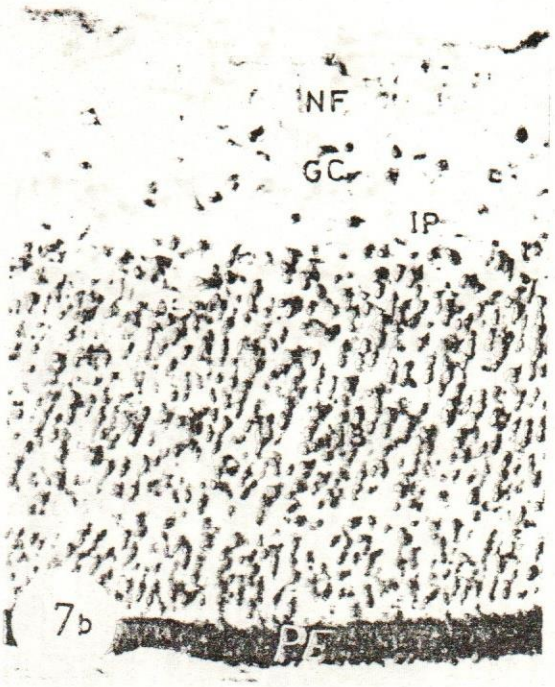

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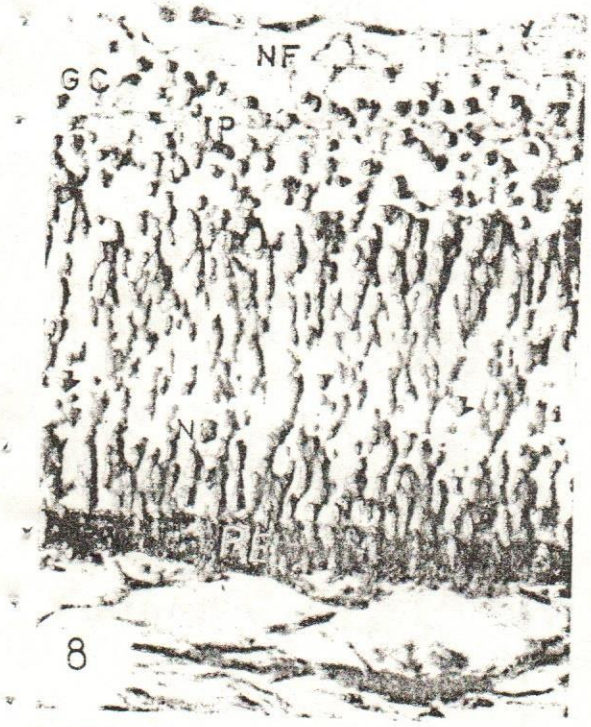

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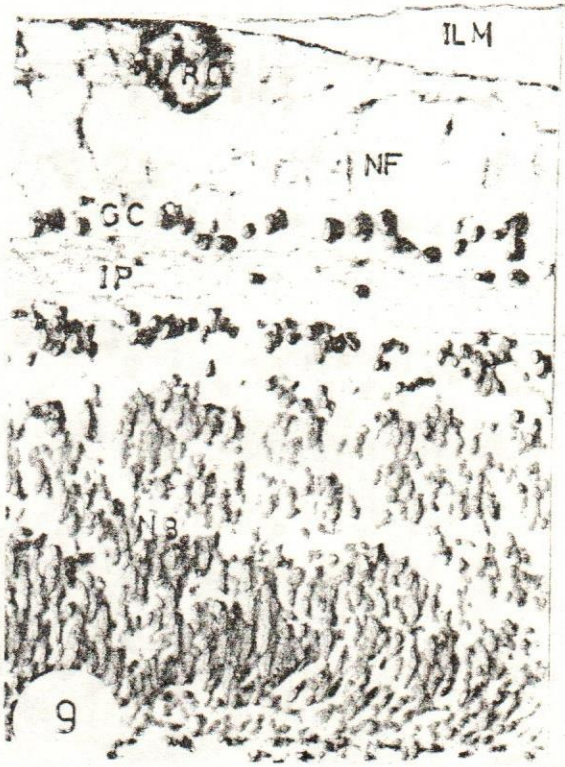

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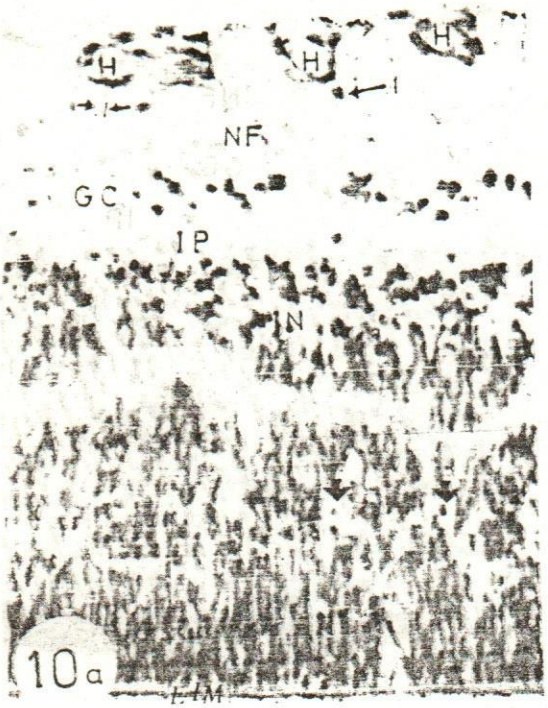
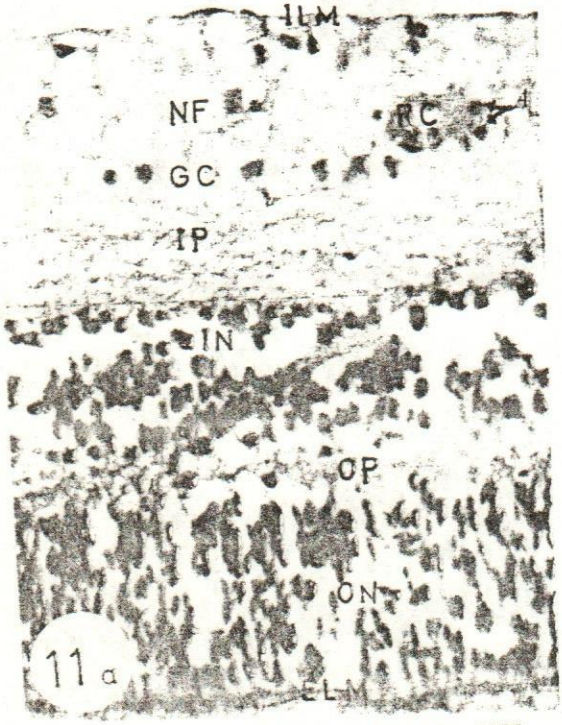
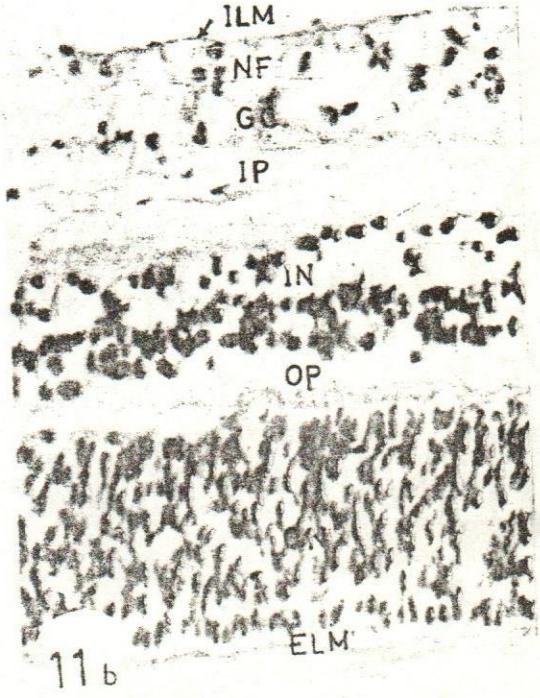
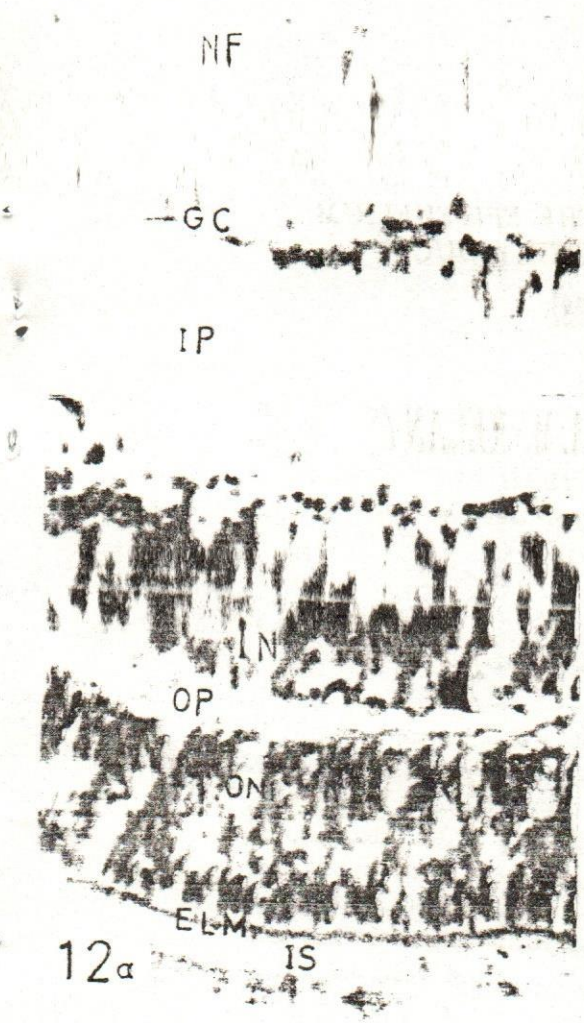
DEVELOPMENT OF THE RETINA IN CAMEL









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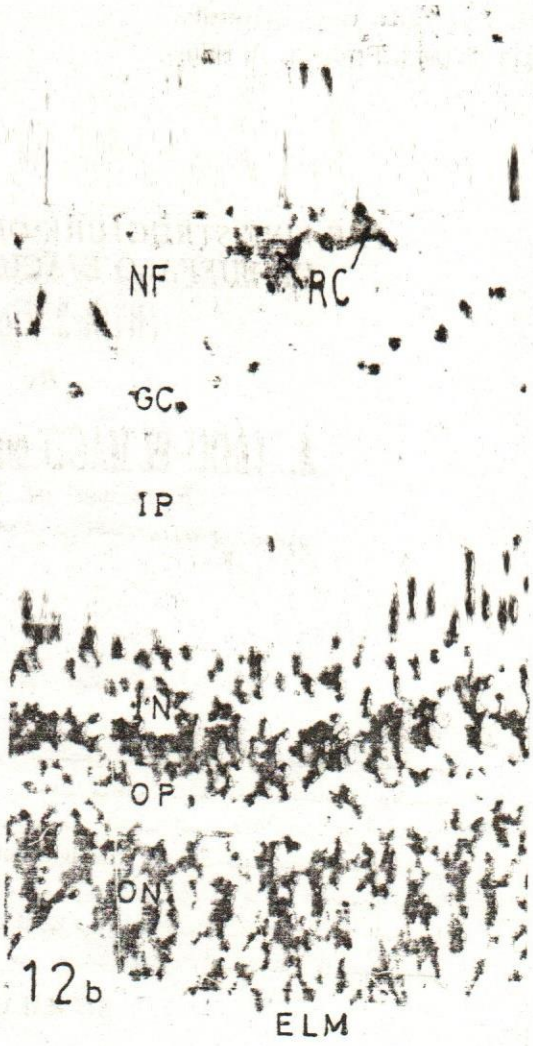

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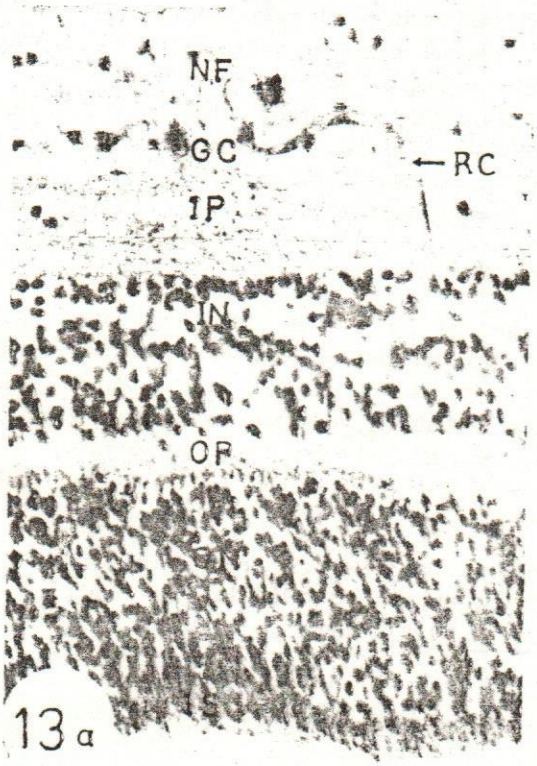

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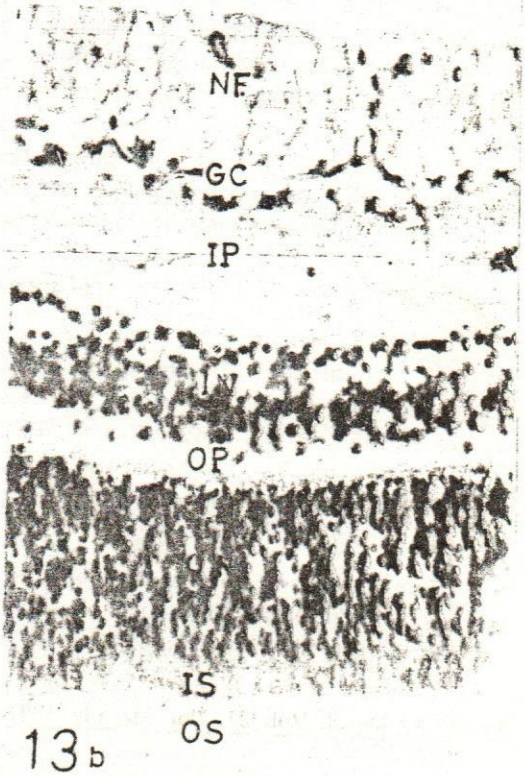

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