LIPID KERATOPATHY IN THE DOG

VOLUME II

SHEILA CRISPIN,

M.A., Vet.M.B., B.Sc., M.R.C.V.S., D.V.A.

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DEGREE OF DOCTOR OF PHILOSOPHY,

UNIVERSITY OF EDINBURGH.

VOLUME II

PHOTOGRAPHIC FIGURES

1.0/1 - 5.4/4

Figure 1.0 /1

Shetland Sheep Dog: Central/Paracentral Lipid Dystrophy

Figure 1.0/2

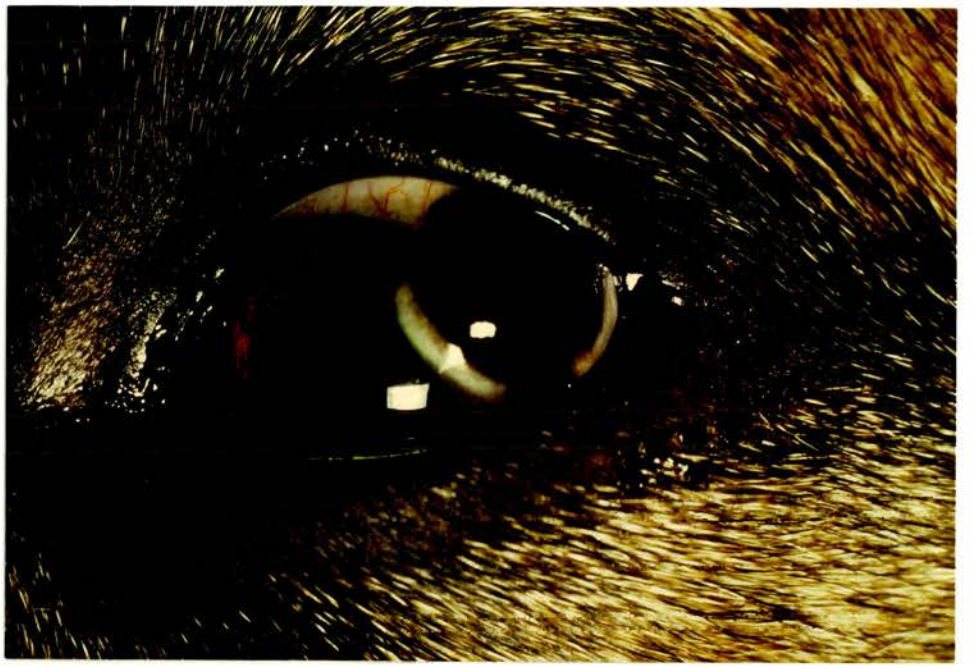
Alsatian: Arcus Lipoides Corneae

Figure 1.0/3

Alsatian: "Arcus" at advancing edge of malignant melanoma

Figure 1.0/4

Rough Collie (149): Lipid Keratopathy and Arcus Lipoides Corneae



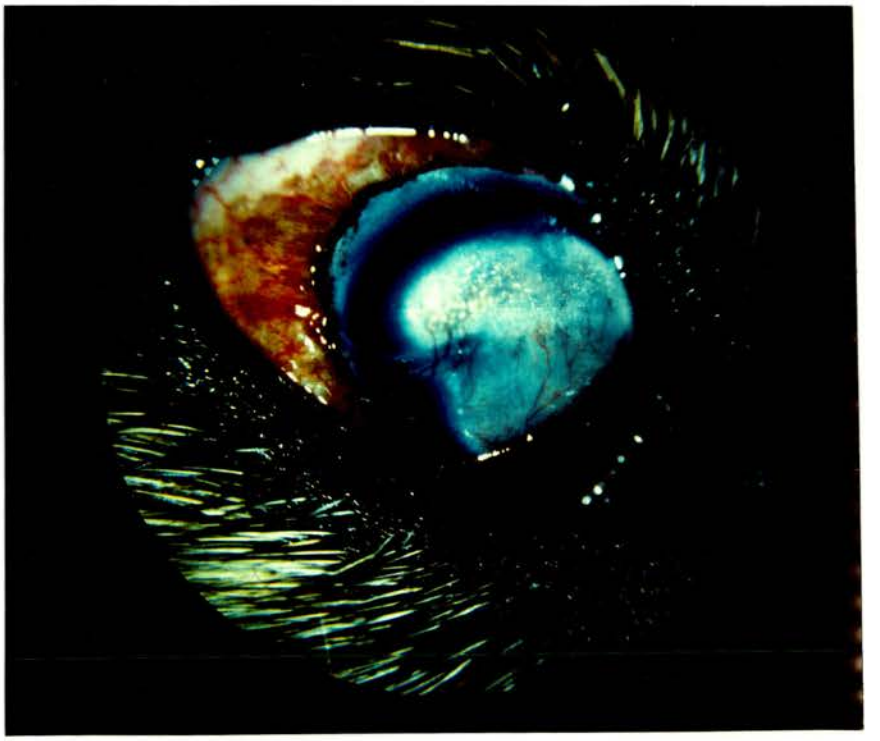
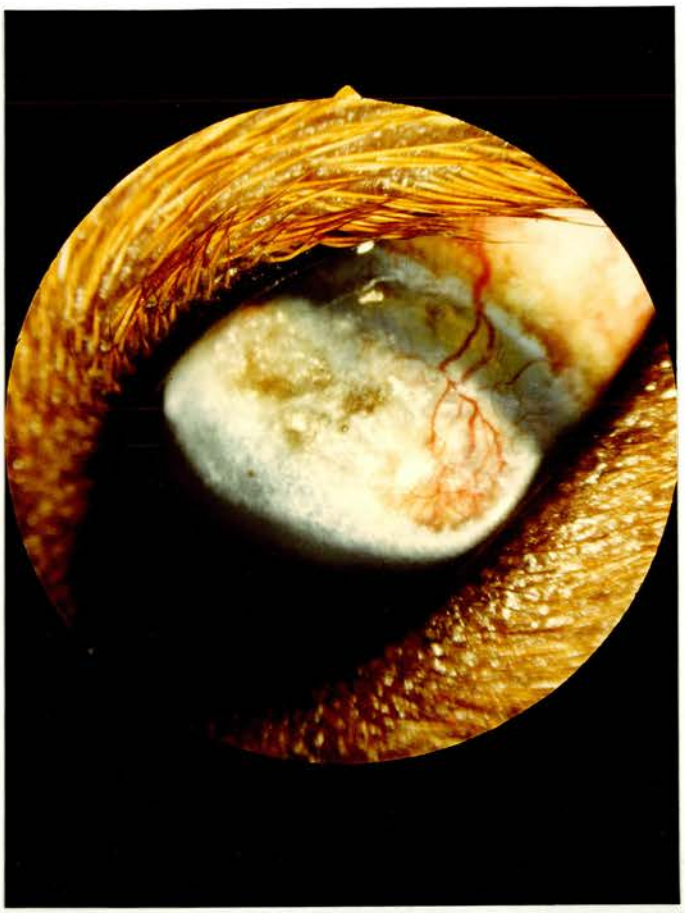


Figure 1.0/5

Jack Russell Terrier (132): Lipid Keratopathy

Figure 1.0/6

Jack Russell Terrier (132): Lipid Keratopathy-natural regression



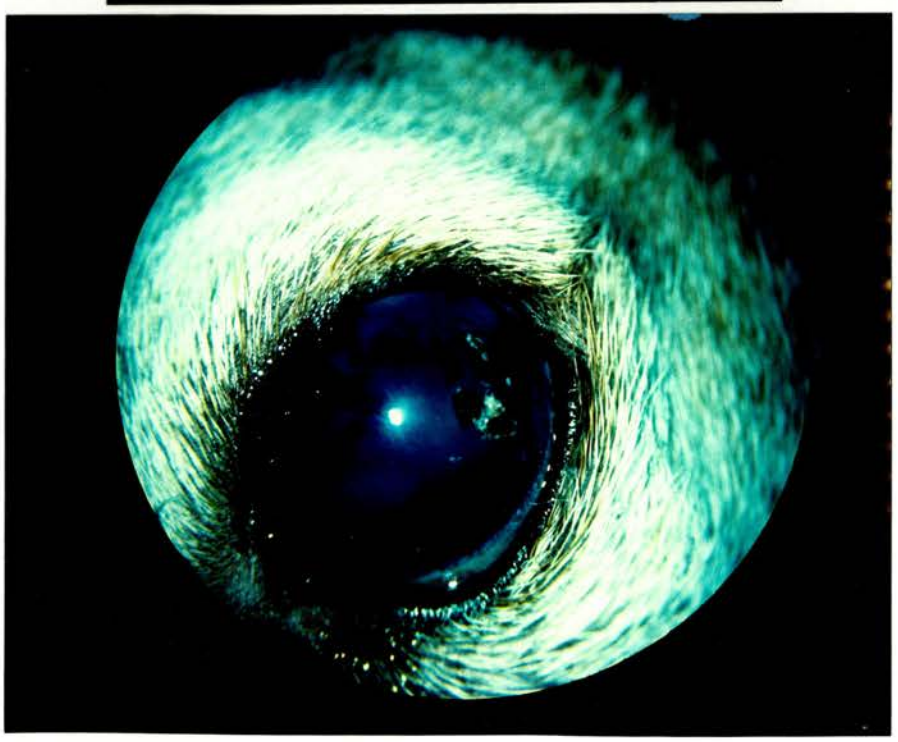


Figure 4.2/1

Normal Limbus (100)

Cornea (A) pigment at limbus (B) bulbar conjunctival plexus (C).


A
B
C

Figure 4.2/2 - 4.2/4

Fluorescein Angiography of the Anterior Segment:

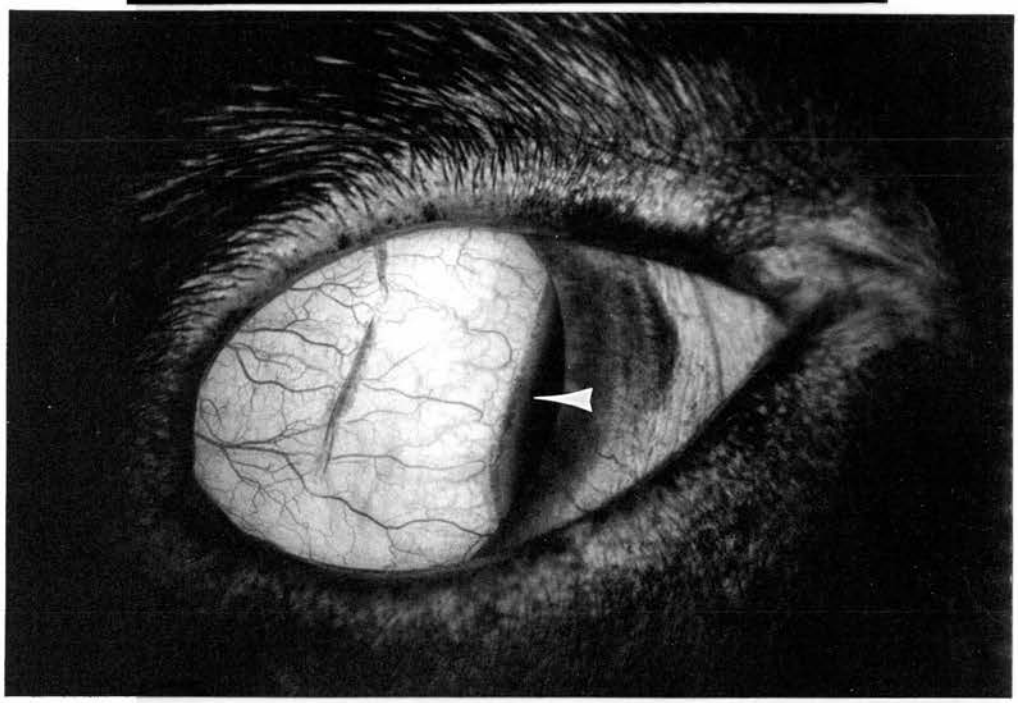
Right Eye, Normal Dog (110)

Figure 4.2/2 10 seconds

Figure 4.2/3 20 seconds

Figure 4.2/4 60 seconds

There is no fluorescence in the normal cornea except for a very narrow annulus at the limbus (arrowed).



The magnifications of photomicrographs are given as original magnification followed by approximate print magnification in parenthesis.

Figure 4.2/5 and Figure 4.2/6

Methyacrylate Luminal Casts of Anterior Segment Vessels:

Right Eye Normal Dog (69)

4.2/5 Viewed from scleral aspect of limbus. SEM X 16 (5)

4.2/6 Viewed from corneal aspect of limbus. SEM X 32 (5)

Choroidal vortex vein (A) anastomising with intrascleral venous plexus (B) and ciliary plexus (C). From the corneal aspect, limbal vessels (D) and iris vessels (E) are also visible. The arrow points towards the irido-corneal angle.

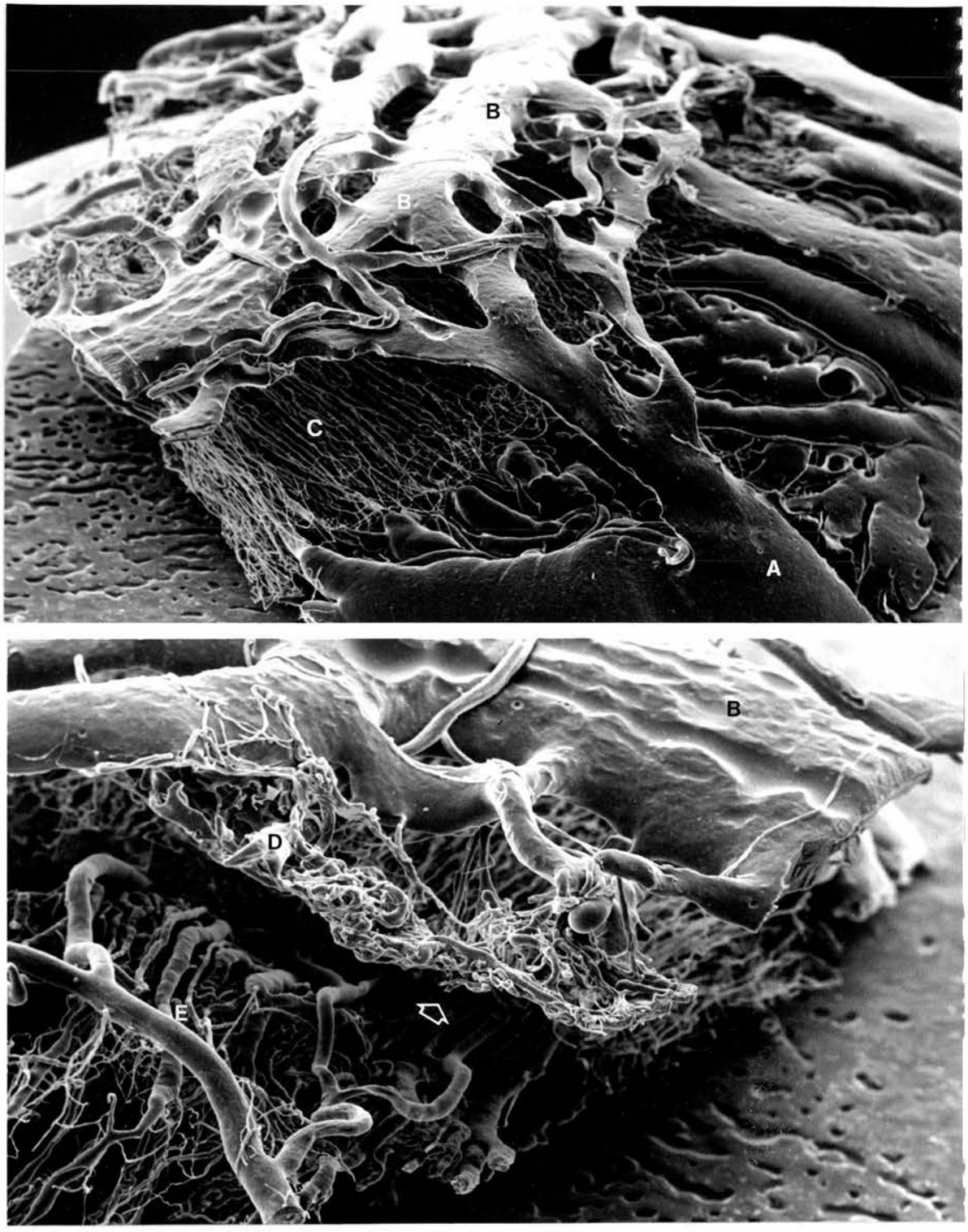
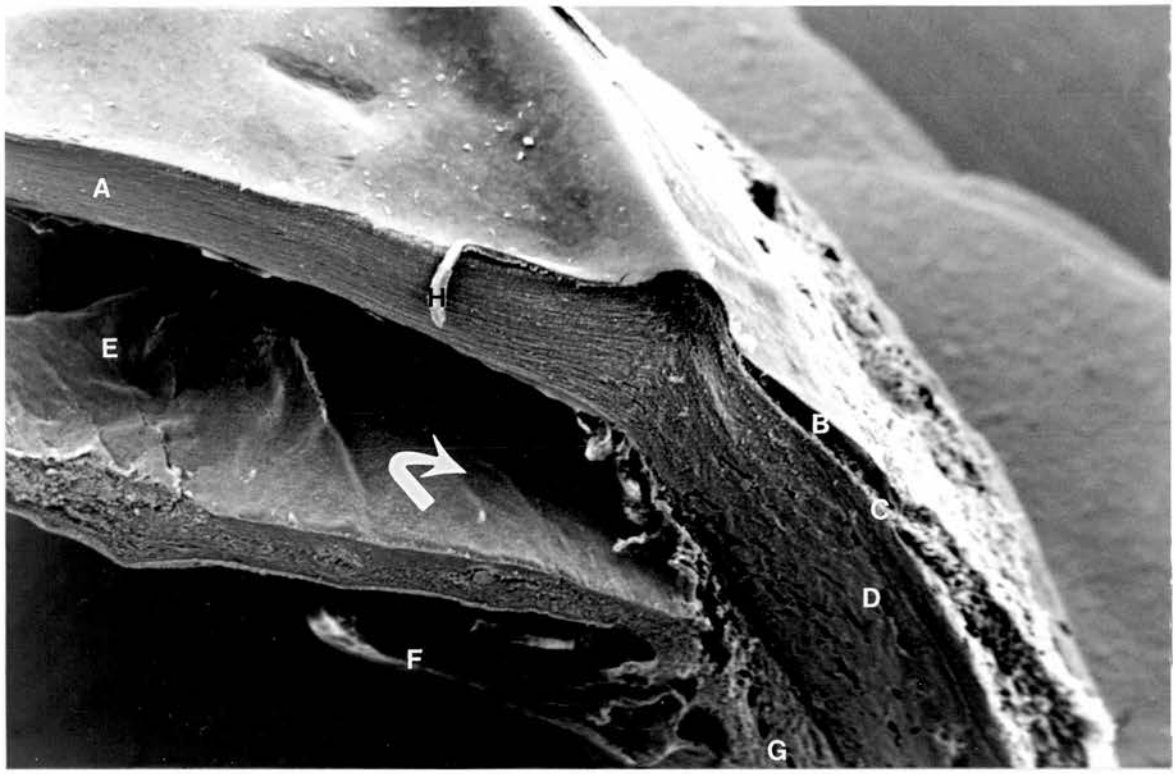

B
B
C
A
B
D
E

Figure 4.2/7

Anterior Segment with Lens Removed: Left Eye Normal Dog (159)

Cornea (A) conjunctiva (B) episclera and Tenon's capsule (C) sclera (D) iris (E) ciliary process of ciliary body (F) choroid (G). Note the overhanging piece of corneal epithelium (H). The arrow points towards the irido-corneal angle.

SEM X 14 (5)


A
H
E
B
C
D
F
G

The following photomicrographs are of the normal adult canine cornea and are meridional sections unless otherwise stated.

Figure 4.6/1

Central and Paracentral Cornea (23)

Epithelium (A) stroma (B) Descemet's Membrane (C) mesothelium (endothelium) (D).

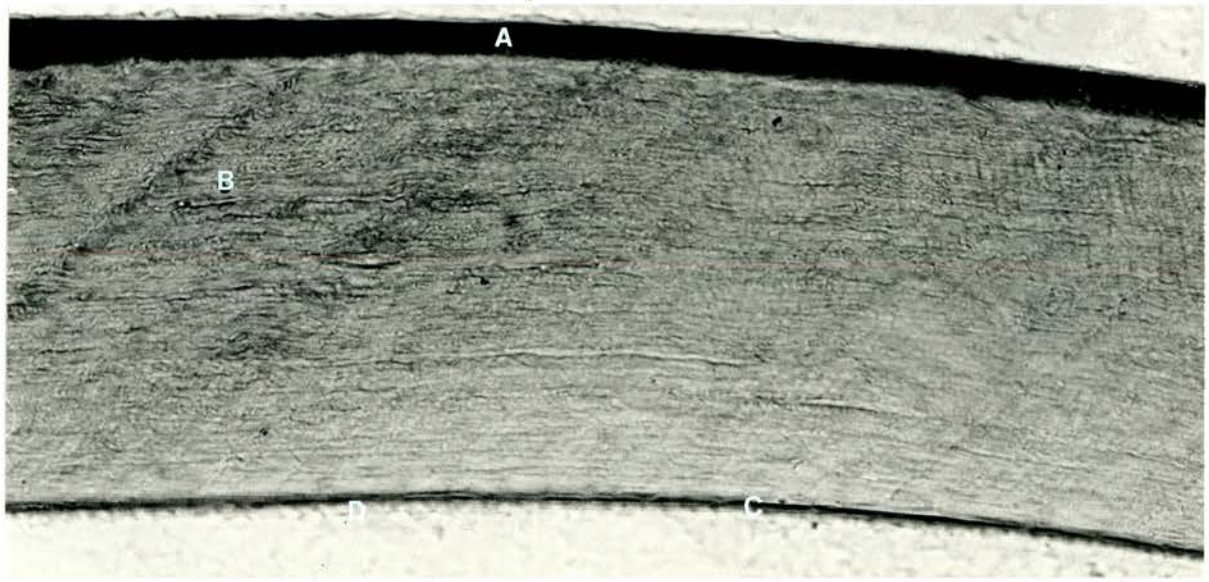
Haematoxylin and Eosin (H and E) X 25 (5)

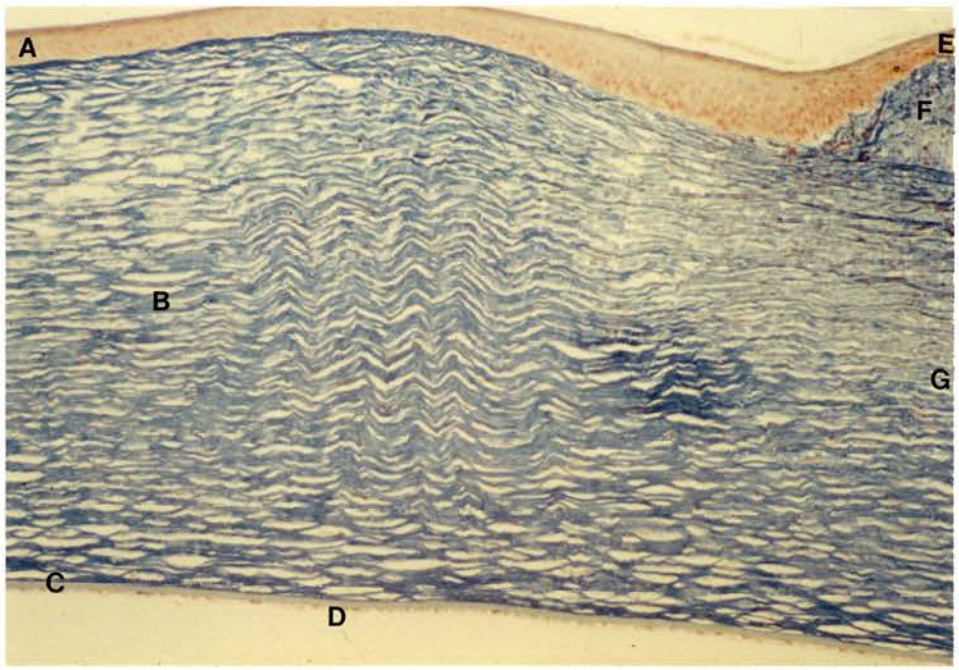
Figure 4.6/2

Corneal Aspect of Limbal Region (21)

Corneal epithelium (A) corneal stroma (B) Descemet's membrane (C) mesothelium (D) conjunctival epithelium (E) conjunctival stroma (F) merging of corneal and scleral stroma at the limbus (G).

PTAH X 28 (4)

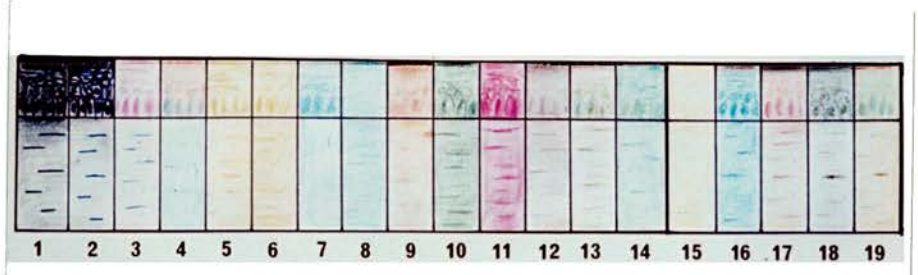

A
B
C
D

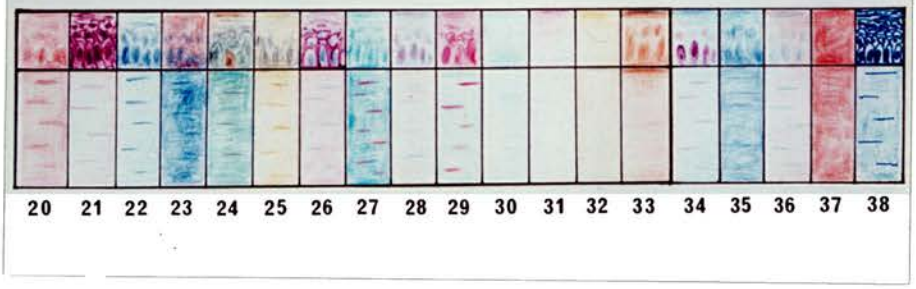

A
B
C
D
E
F
G

Key to Figure 4.6/3

1. Bromine Sudan Black B
2. Sudan Black B
3. Oil Red O counterstained with Haematoxylin
4. OTAN counterstained with Alcian Blue
5. PAN
6. Digitonin - PAN
7. Nile Blue Sulphate
8. Acetone - Nile Blue Sulphate
9. Calcium Lipase - Lead Sulphide
10. Copper Rubeanic Acid counterstained with Carmalum
11. Acetone-Copper Rubeanic Acid counterstained with Carmalum
12. Osmium Tetroxide
13. Acid Haematein counterstained with Methyl Green
14. Acid Haematein - Oil Red O
15. Tween Lipase
16. Alpha Naphthyl Acetate counterstained with Methyl Green
17. Chloracetate Esterase counterstained with Carmalum
18. Gomori Lead counterstained with Methyl Green
19. Naphthol AS-BI Phosphate counterstained with Methyl Green
20. P/W Sudan Black B counterstained with Carmalum
21. Haematoxylin and Eosin
22. Neutral Red - Fast Green FCF
23. PTAH
24. Masson's Trichrome
25. Haemalum - Van Gieson
26. PAS
27. Alcian Blue at pH 2.5 counterstained with Neutral Red
28. Colloidal Ferric Hydroxide
29. Performic Acid - Alcian Blue counterstained with Neutral Red
30. DMAB - Nitrite
31. Glycerol - Ferric Chloride
32. Millon Reaction
33. Modified Sakaguchi Reaction
34. Perls' Prussian Blue counterstained with Neutral Red
35. Schmorl Method
36. Highman's Congo Red counterstained with Haematoxylin
37. Von Kossa
38. Toluidine Blue

MSB Technique stains similarly to 29.


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19


20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38

The photomicrographs from dog 159 include part of the cornea (A) conjunctiva (B) sclera (C) and iris (D).

Figure 4.6/4

Normal (159)

Bromine Sudan Black B X 18 (4)

Figure 4.6/5

Normal (44)

Bromine Sudan Black B X 70 (4)

Figure 4.6/6

Normal (151)

Ciliary body region, myelinated nerves stained blue (A).

Bromine Sudan Black B X 23 (4)

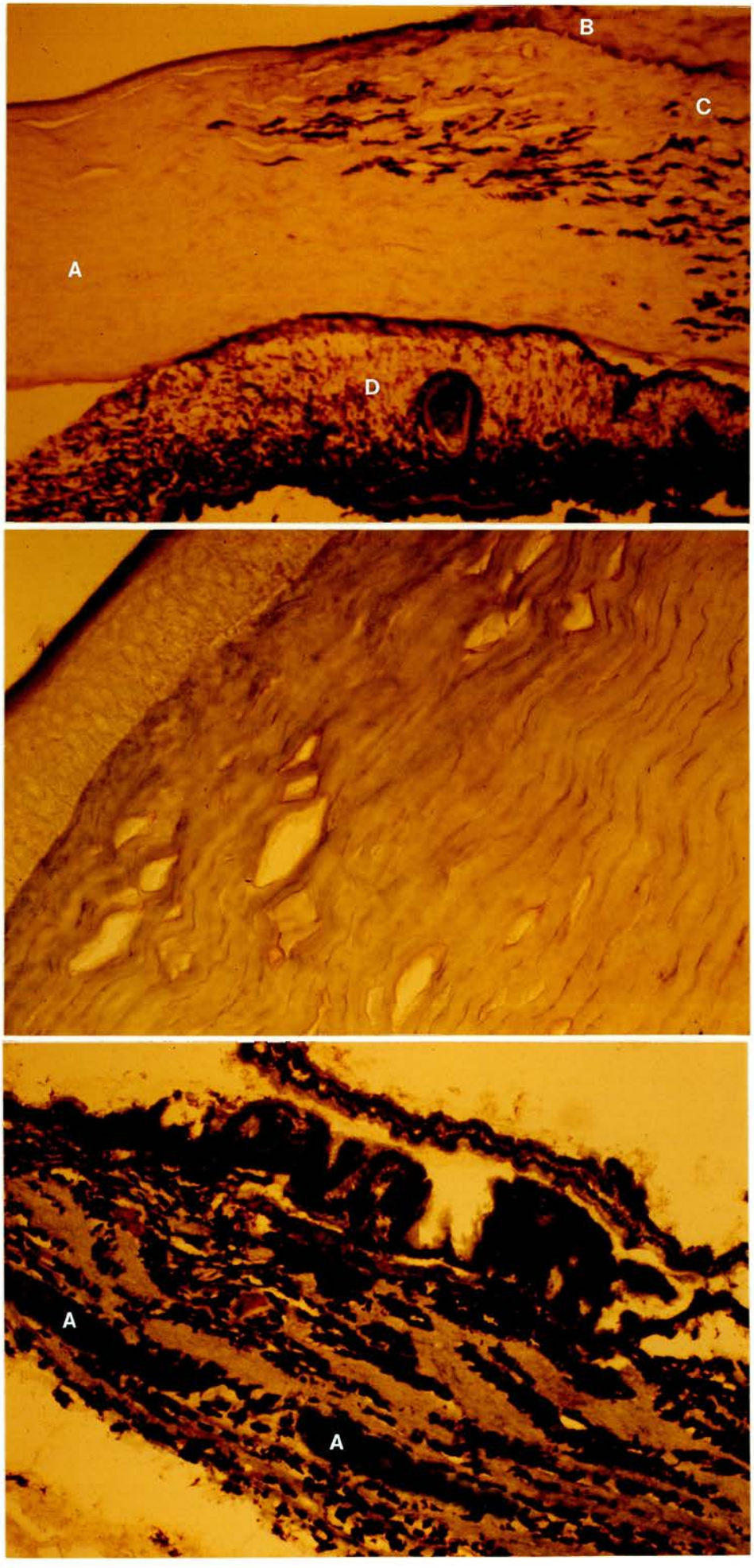

B
C
A
D
A
A

Figure 4.6/7

Normal Limbal Region (55)

Limbal pigment (A) iris (B) ciliary process of ciliary body (C).

Sudan Black B X 40 (5)

Figure 4.6/8

Normal (127)

Acid Haematein X 60 (4)


A
B
C

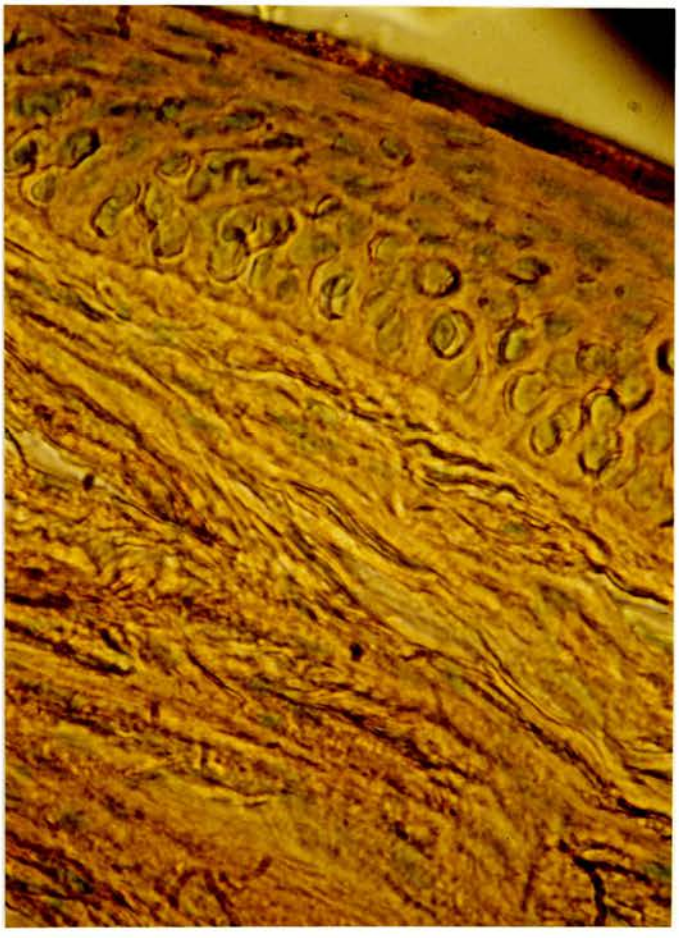


Figure 4.6/9

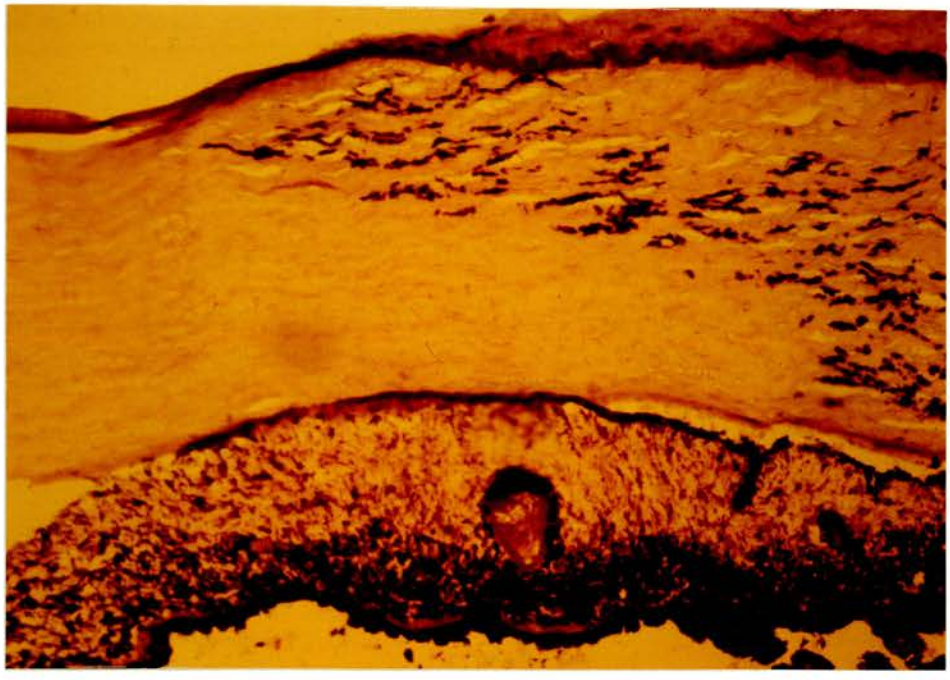
Normal (159)

OTAN X 18 (4)

Figure 4.6/10

Normal Central Cornea (29)

Holczinger Technique X 60 (4)



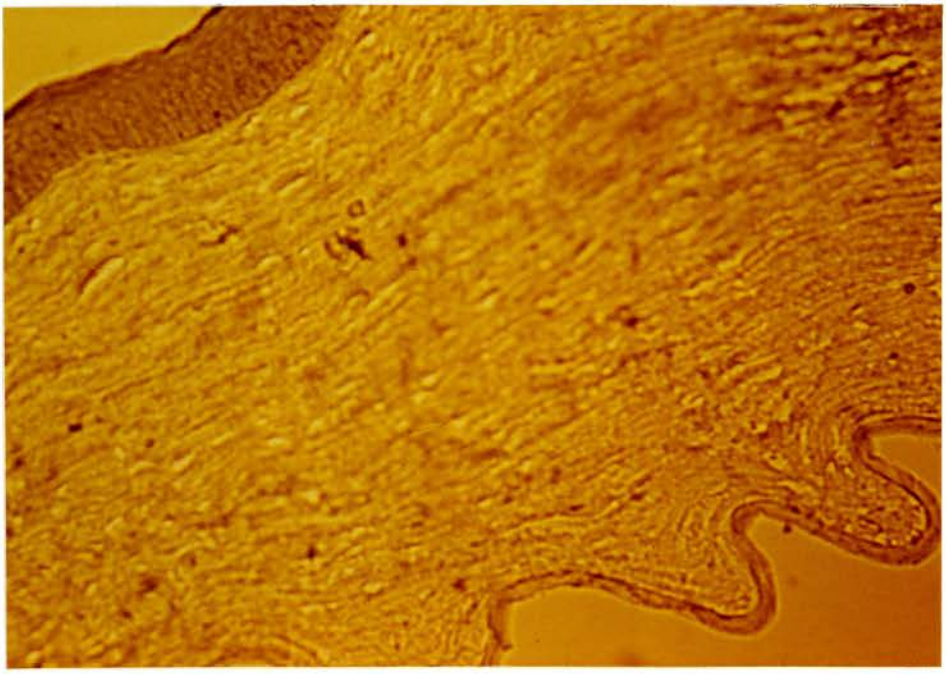


Figure 4.6/11

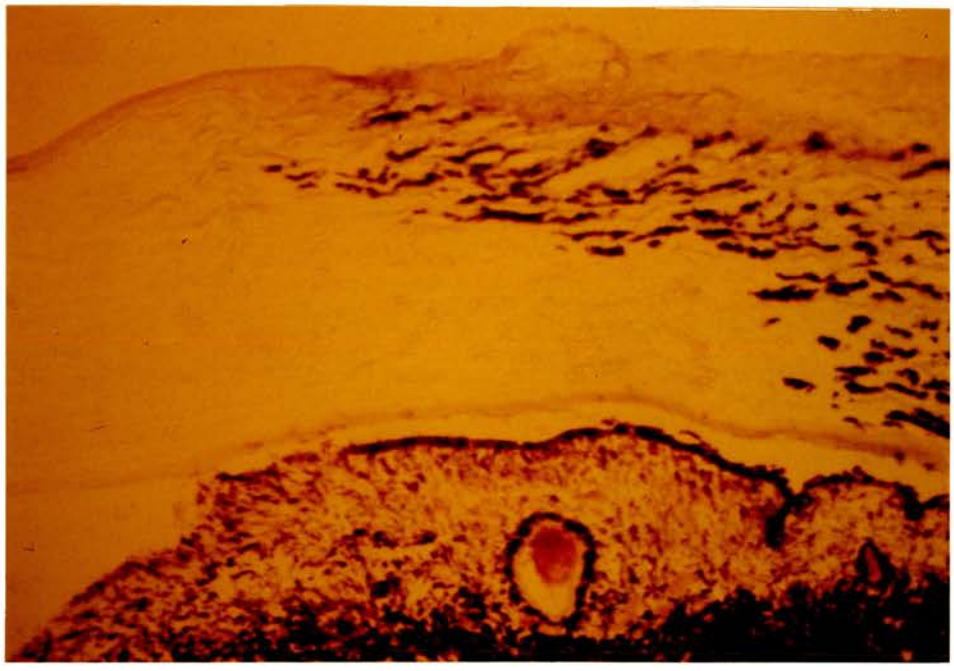
Normal (159)

Oil Red O X 18 (4)

Figure 4.6/12

Normal (159)

Schmorl X 18 (4)



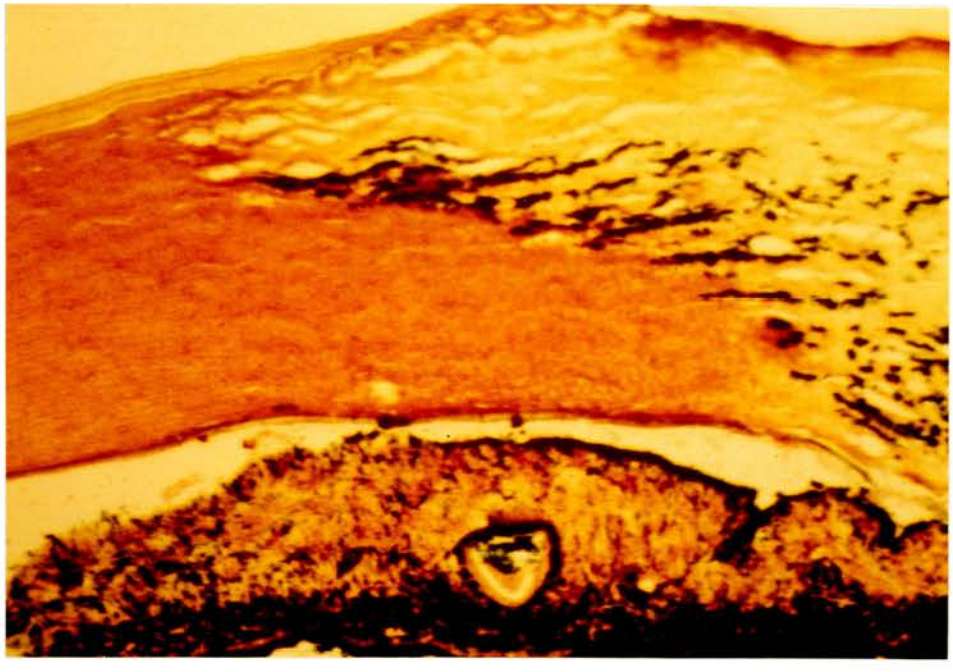


Figure 4.6/13

Normal Central Cornea (29)

Alpha-Naphthyl Acetate Method for Non-Specific Esterase X 70 (4)

Figure 4.6/14

Normal Central Cornea (29)

Arrow points to corneal fibroblast.

Gomori's Lead Method for Acid Phosphatase X 70 (4)

Figure 4.6/15

Normal (159)

Sakaguchi Method X 18 (4)

Figure 4.6/16

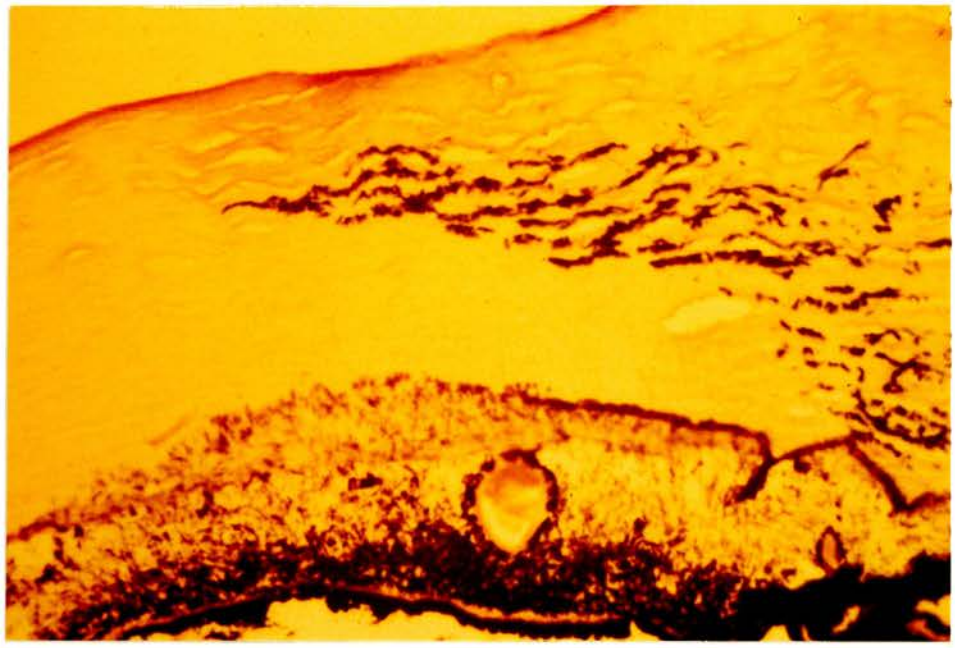
Normal (159)

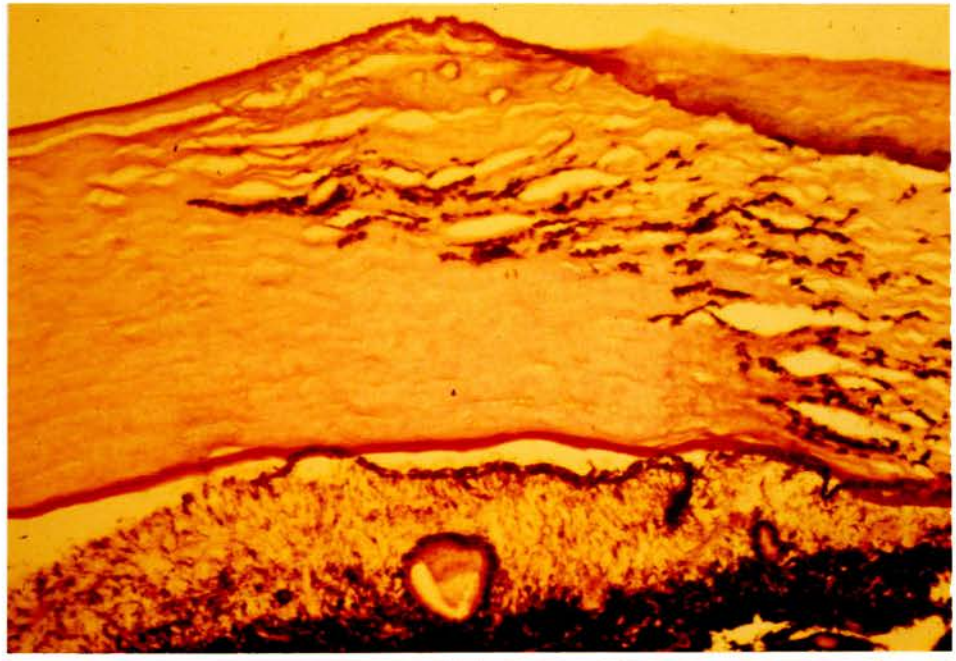
Alcian Blue/PAS X 18 (4)

Figure 4.6/17

Normal (159)

Perls' Prussian blue X 18 (4)





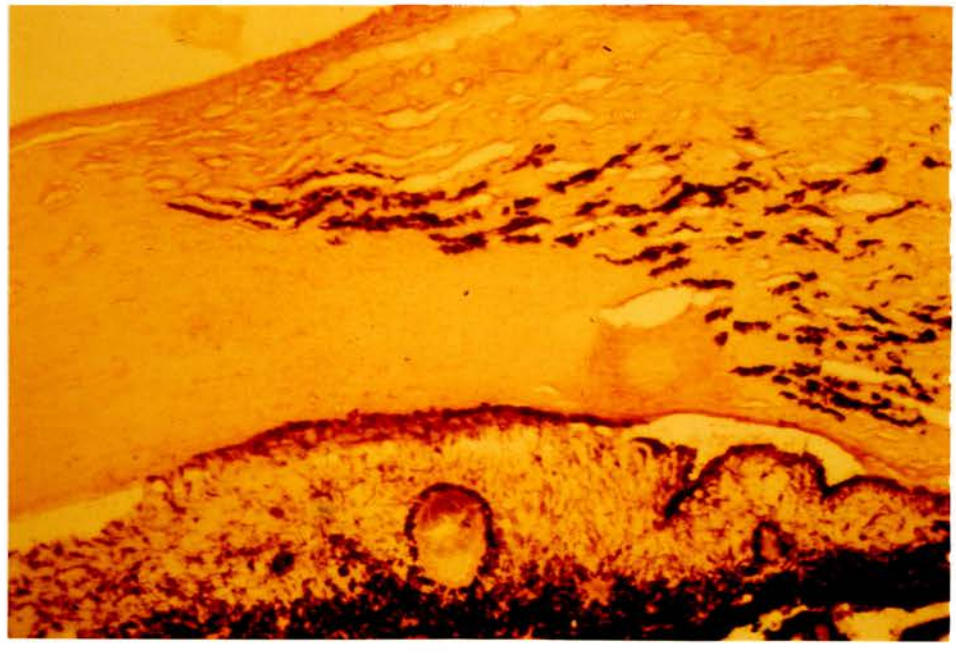


Figure 4.7/1

Normal Paracentral Cornea (32)

Silver, Nomarski Differential Interference
Contrast X 155 (4)

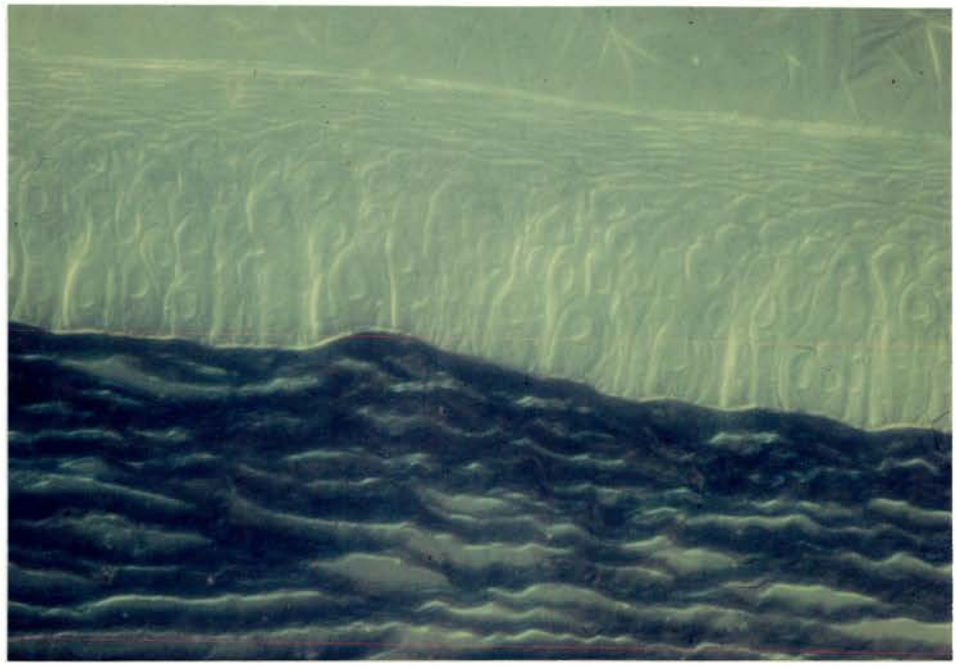
Figure 4.7/2

Scleral Aspect of Limbal Region (21)

Corneal epithelium (A) corneal stroma (B) conjunctival epithelium (C) conjunctival stroma (D) Tenon's capsule and episclera (E) scleral stroma (F) uveal and trabecular meshwork (G).

Numerous blood vessels can be seen in all sites except for cornea. Large thin-walled trabecular veins (H) are particularly obvious. Pigment is prominent in the limbal stroma.

PTAH X 28 (4)



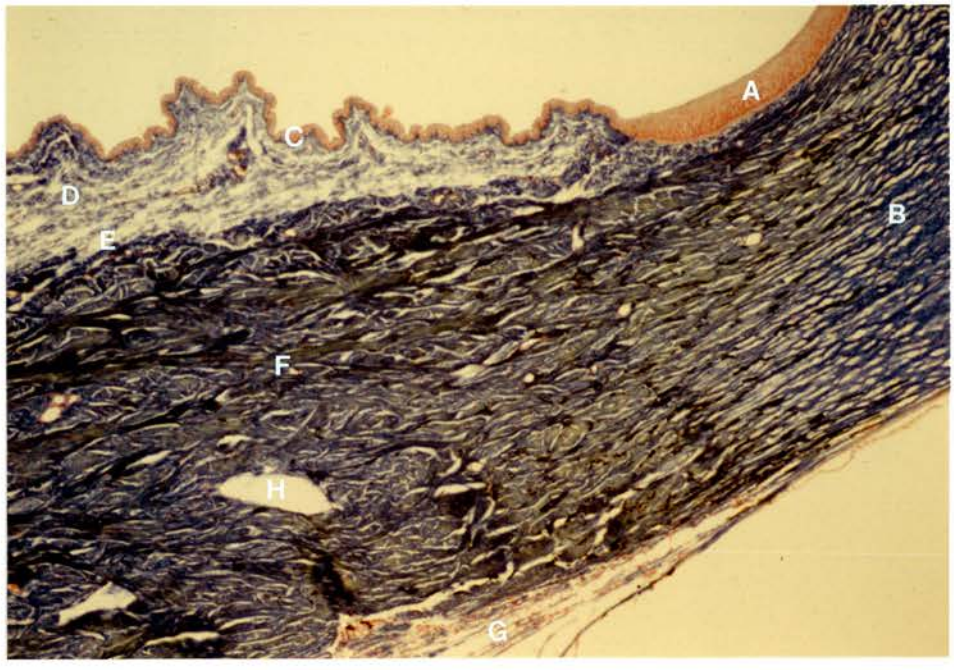

A
B
C
D
E
F
H
G

Figure 4.7/3

Anterior Epithelium, Paracentral Cornea (63)

TEM X 6,000 (2)

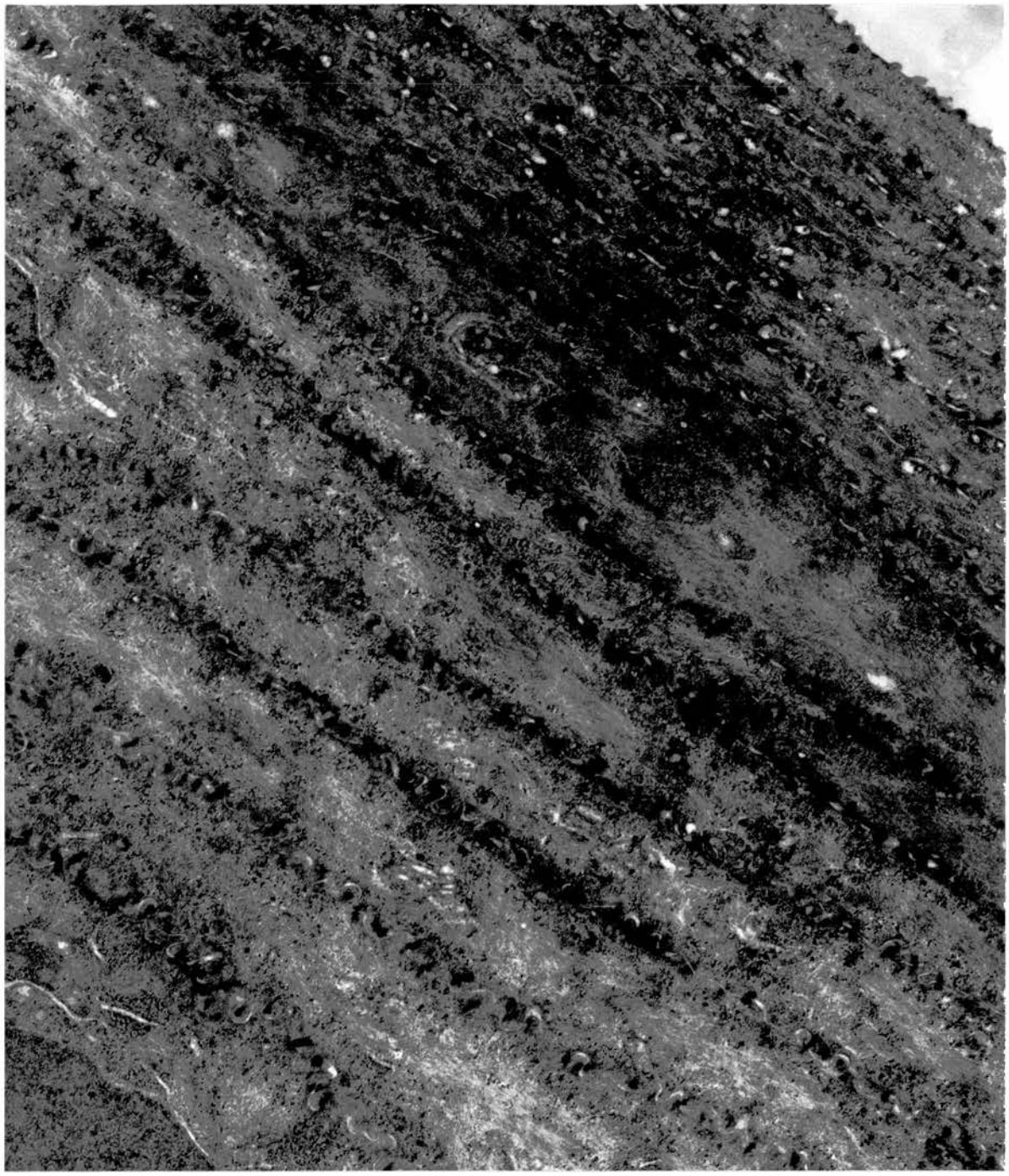


Figure 4.7/4

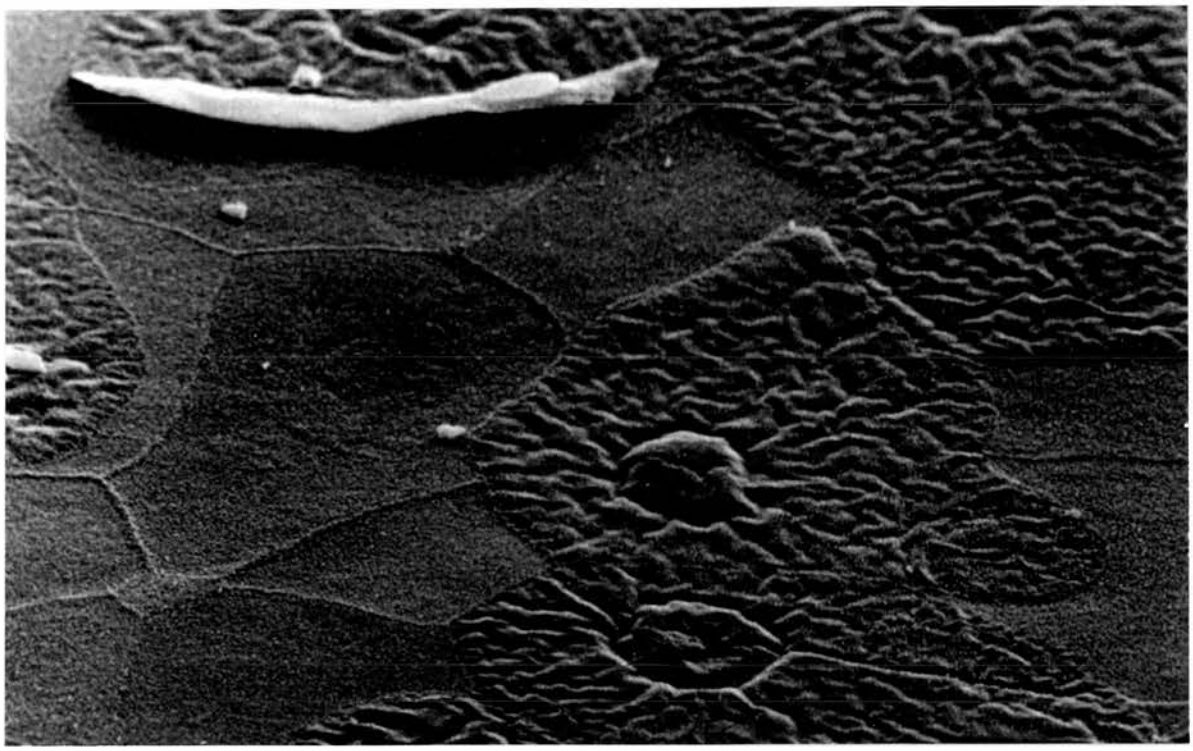
Desquamation of Normal Surface Epithelium (56)

SEM X 37 (3)

Figure 4.7/5

Tangential Section Mid-Corneal Epithelium (32)

TEM X 7,700 (2)



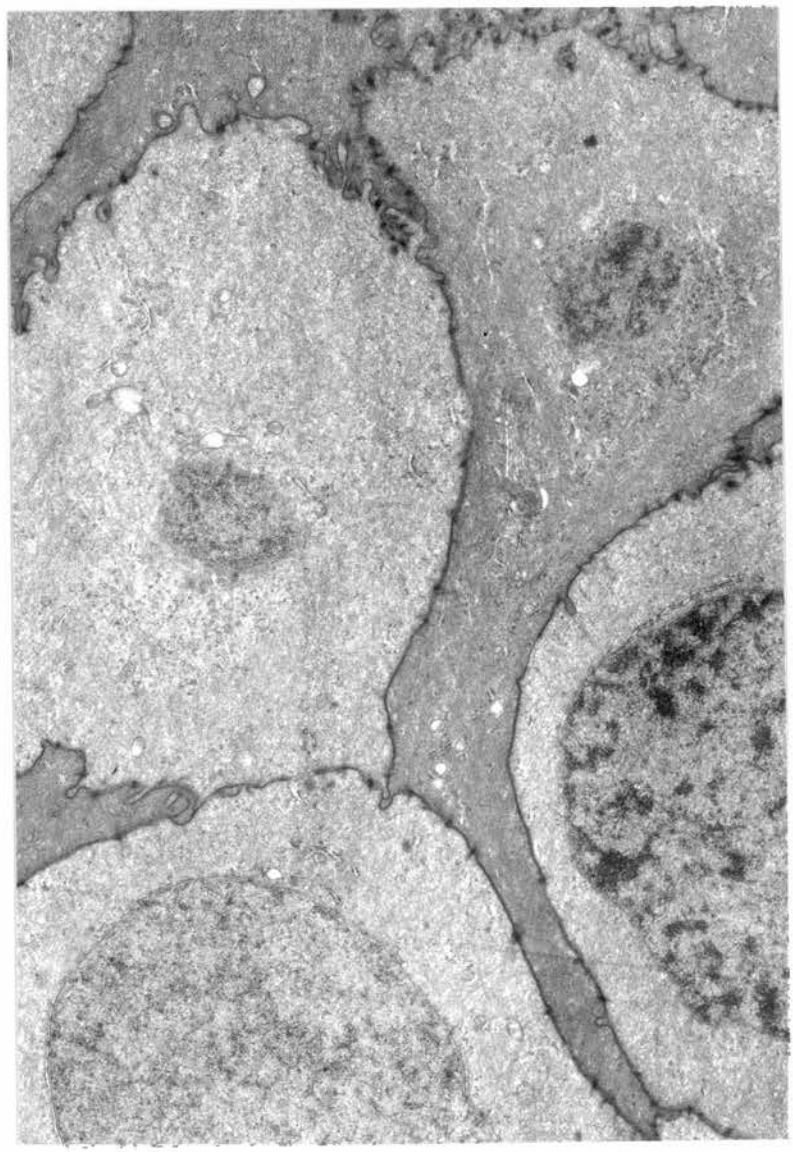


Figure 4.7/6

Basal Lamina and Sub-Epithelial Zone, Paracentral Cornea (51)

Lamina lucida (A) Lamina densa (B). Arrow points to hemidesmosome. Note the anchoring fibrils which extend from the basal lamina into the subepithelial zone. The latter is acellular.

TEM X 27,500 (2)

Figure 4.7/7

Peripheral Cornea (51)

Lymphocyte in basal epithelial cell layer.

TEM X 12,500 (2)

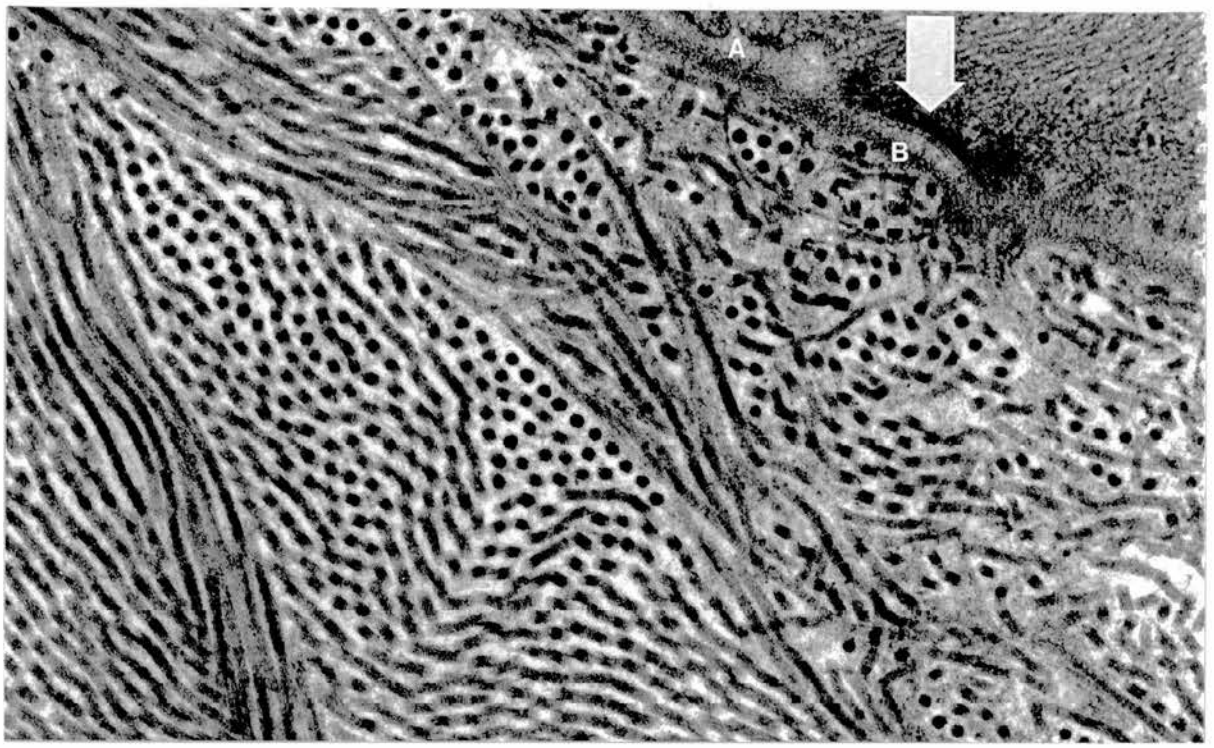

A
B

Figure 4.7/8

Central and Paracentral Cornea (41)

Lamellar arrangement of collagen fibrils.

Toluidine Blue X 60 (5)

Figure 4.7/9

Mid-Stroma, Central Cornea (12)

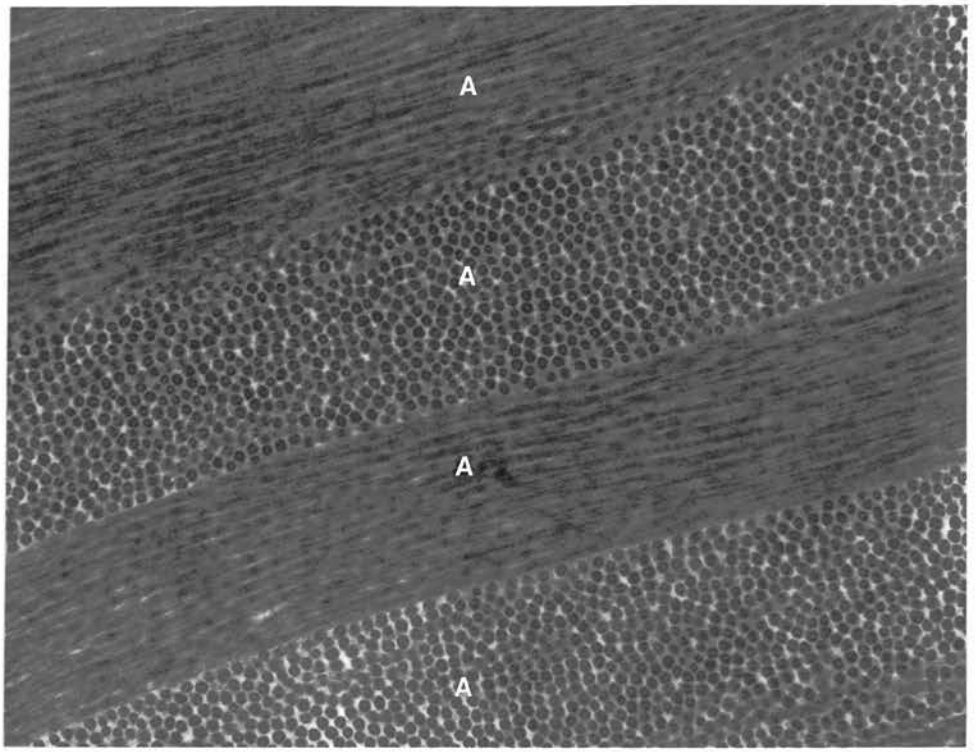
Lamellae (A).

TEM X 35,500 (2)

Figure 4.7/10

Tangential Section, Anterior Stroma near the Limbus (30)

TEM X 12,500 (2)


A
A
A
A

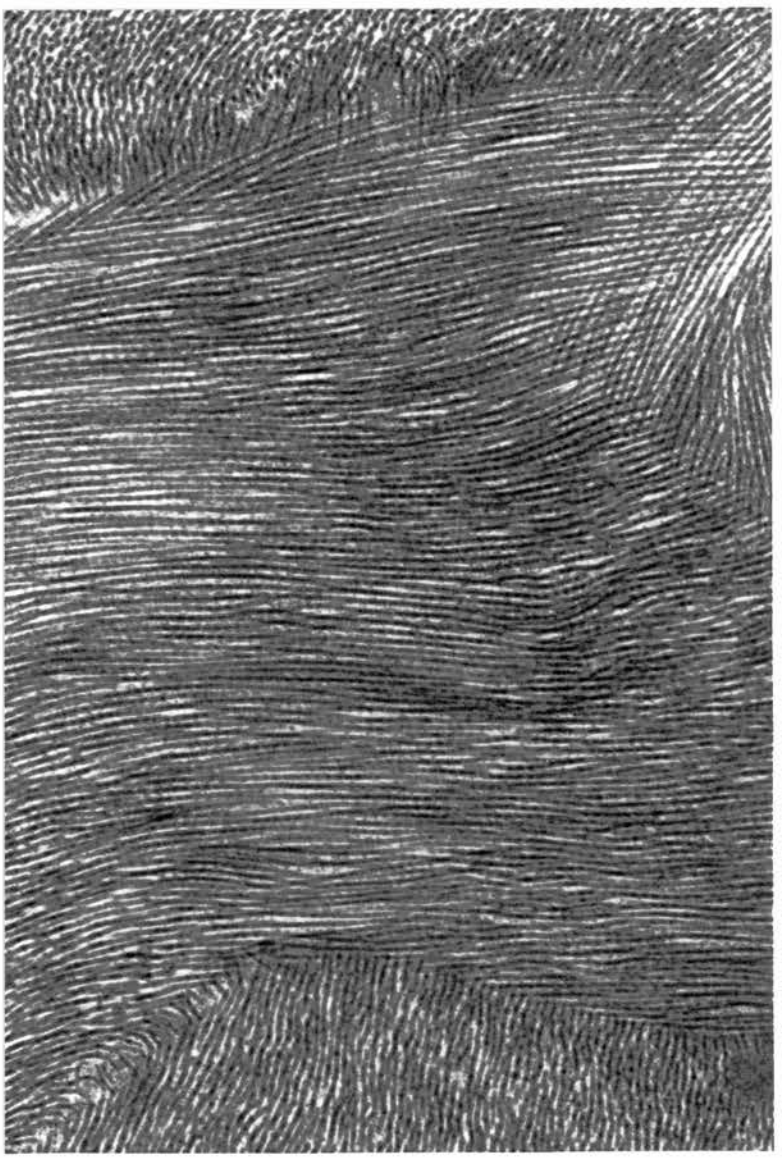


Figure 4.7/11

Posterior Stroma and Descemet's Membrane (58)

Corneal stroma (A) "nests" of Descemet's fibrils (B) and Descemet's membrane (C).

TEM X 35,500 (1.5)

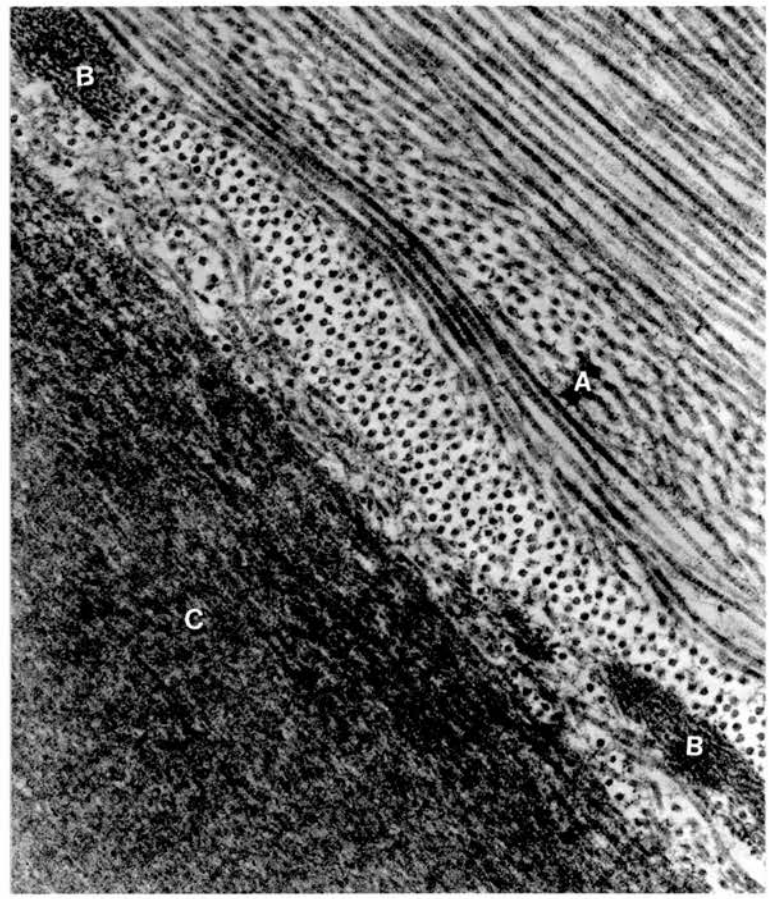

B
A
C
B

Figure 4.7/12

Mid-Stroma, Central Cornea (33)

Normal fibroblasts (A).

Toluidine Blue X 310 (4)

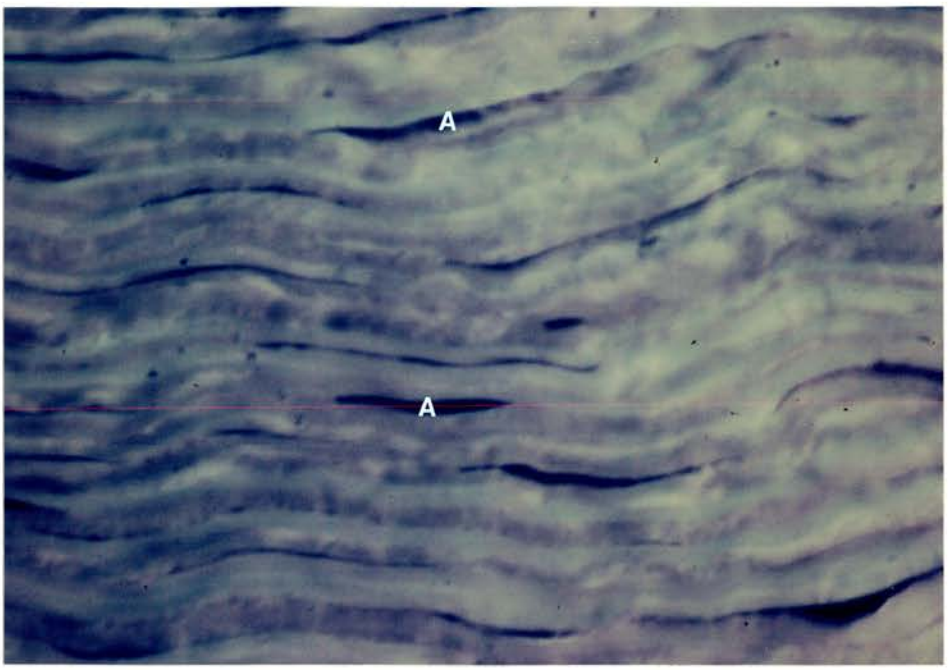

A
A

Figure 4.7/13

Mid-Stroma, Central Cornea (58)

Extensive fibroblast process between lamellae.

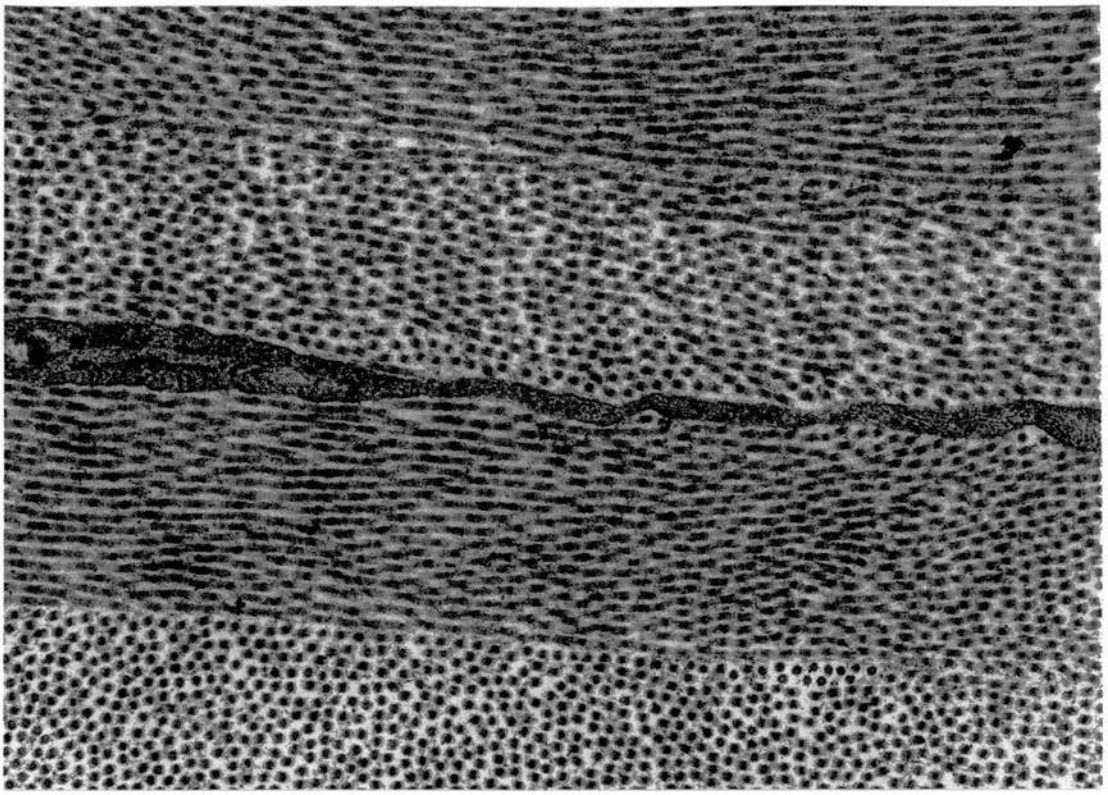
TEM X 21,500 (2)

Figure 4.7/14

Mid-Stroma, Paracentral Cornea (22)

Part of fibroblast nucleus.

TEM X 7,700 (2)



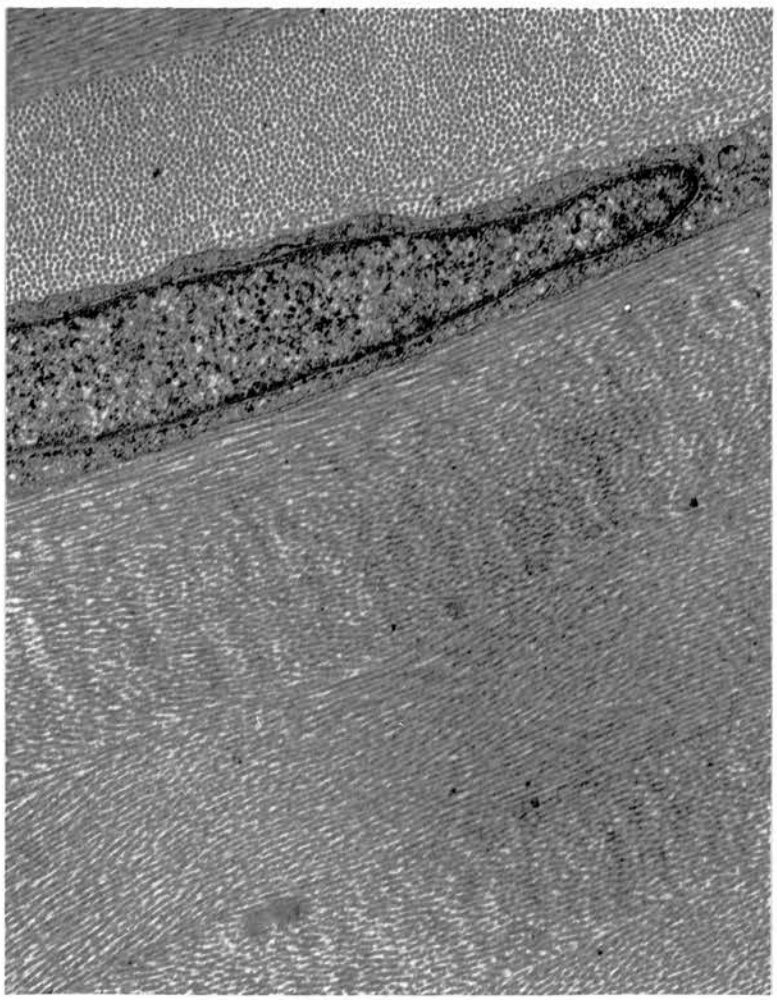


Figure 4.7/15

Mid-Stroma, near the Limbus (68)

Normal fibroblasts (A), whereas (B) is probably a degenerate fibroblast containing lysosomes.

TEM X 4,600 (2)

Figure 4.7/16

Anterior Stroma, near the Limbus (58)

Fibroblast (A) nerve bundle (B).

TEM X 7,700 (2)


A
B
A

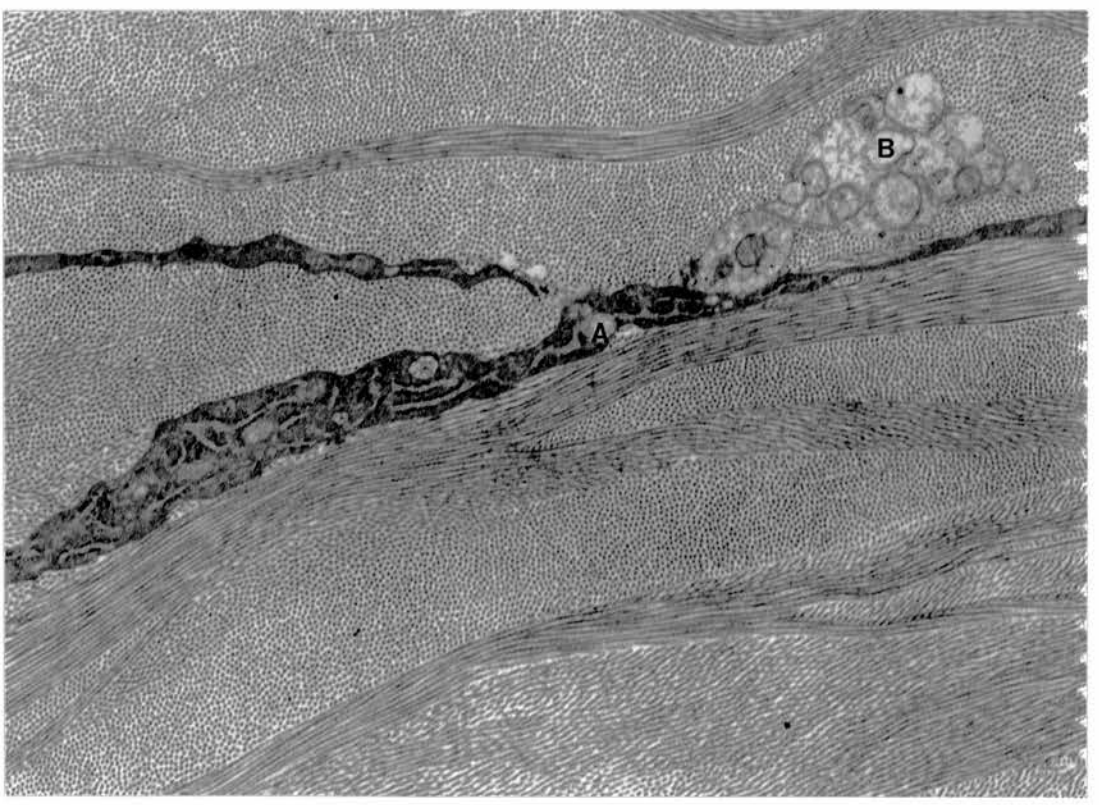

B
A

Figure 4.7/17

Posterior Stroma, Central Cornea (61)

Stroma (A) Descemet's membrane (B) mesothelium (C).

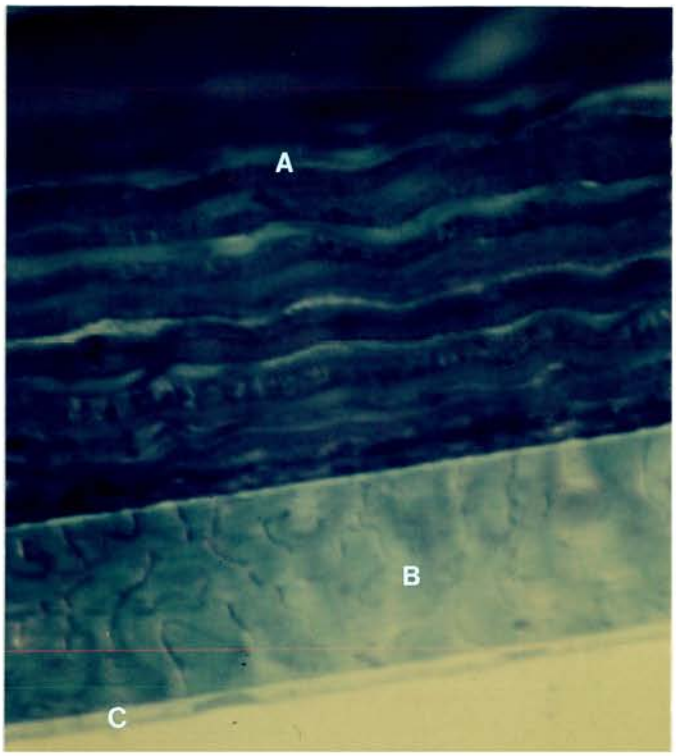
Toluidine Blue X 310 (4)

Figure 4.7/18

Descemet's Membrane, Paracentral Cornea (51)

Stroma (A) Descemet's membrane (B).

TEM X 7,700 (2)


A
B
C

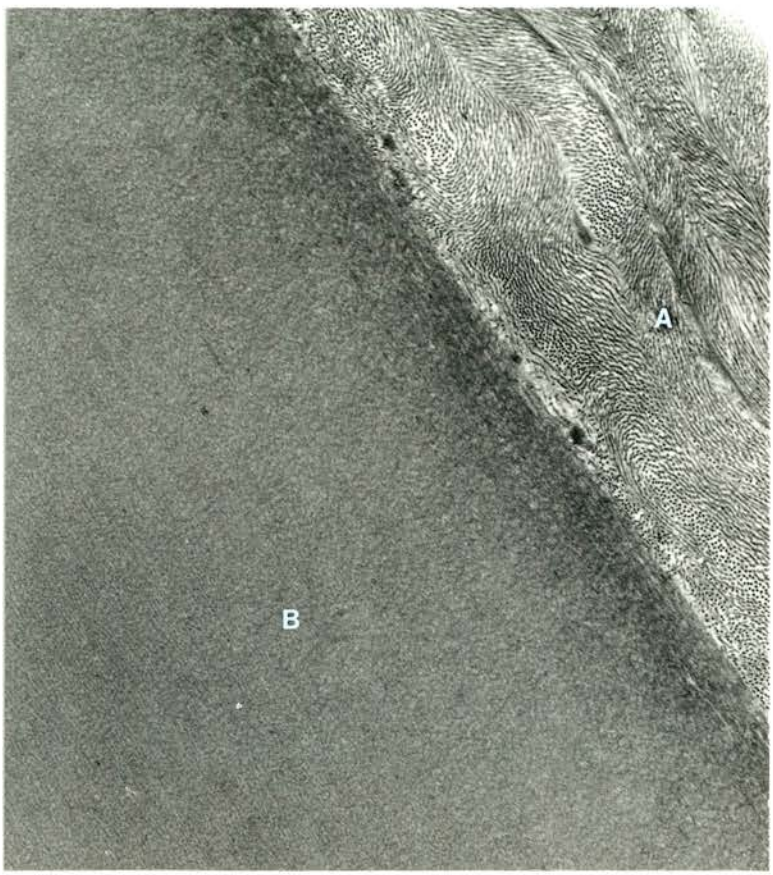

A
B

Figure 4.7/19

Meridional Section, Ciliary Cleft Region (69)

Intrascleral vessels (A) trabecular vein (B) termination of Descemet's membrane (C) primary pectinate fibre (D) base of iris (E) ciliary processes (F) trabecular meshwork (G).

PTAH X 23 (4)

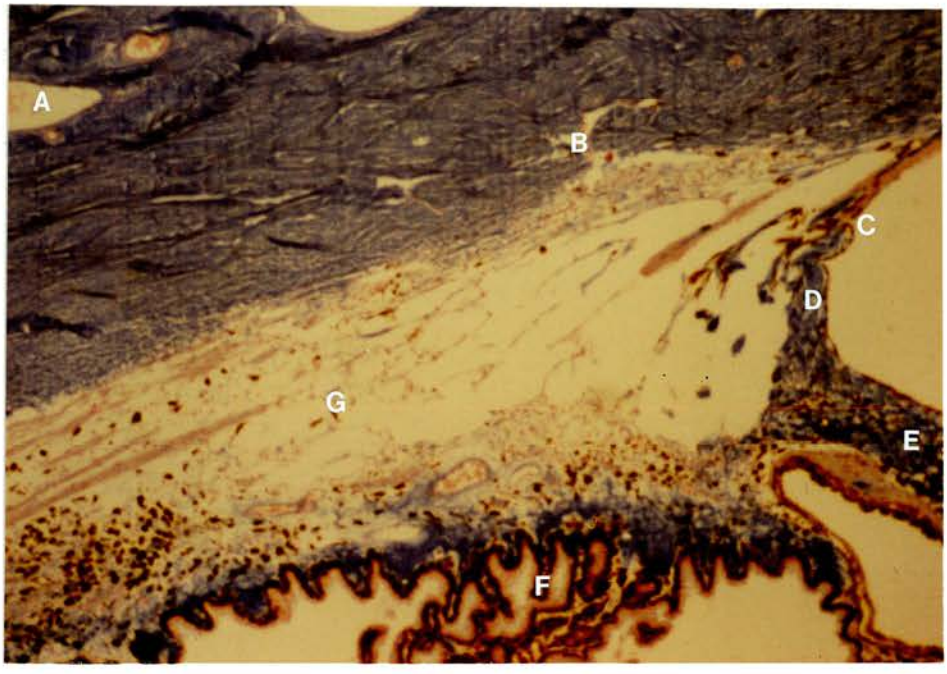

A
B
C
D
E
F
G

Figure 4.7/20

Descemet's Membrane and Mesothelium, Central Cornea (49)

TEM X 6,000 (2)

Figure 4.7/21

Mesothelium, Central Cornea (40)

TEM X 35,500

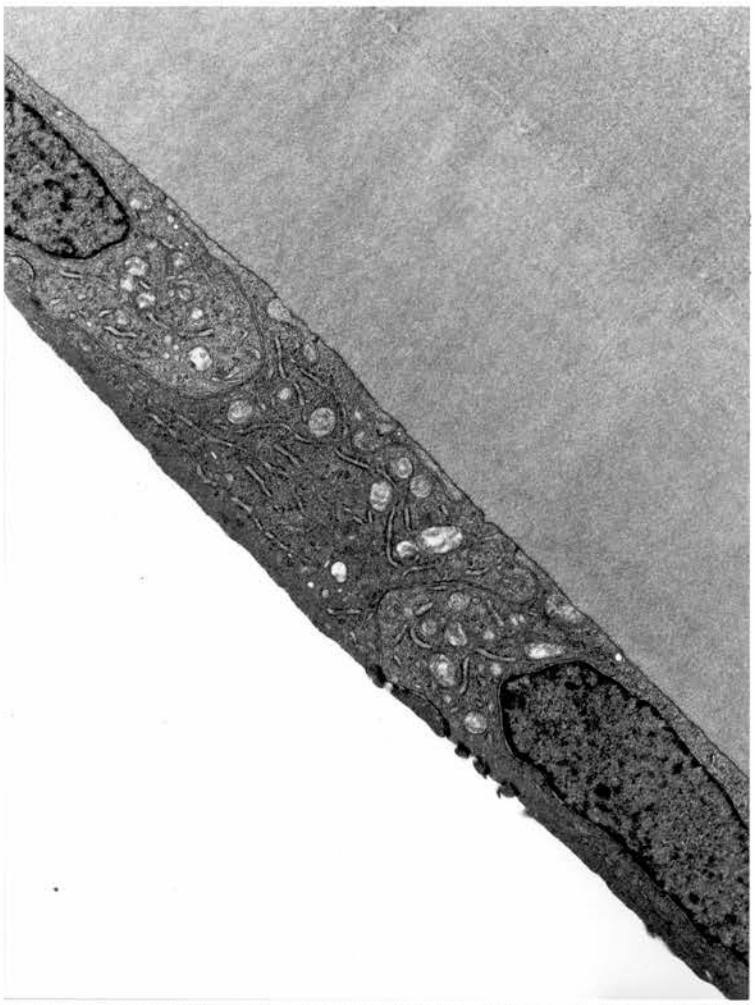


Figure 4.7/22

Perilimbal Region (35)

Palpebral conjunctiva (A) bulbar conjunctiva (B) sclera (C) cornea (D) trabecular meshwork inserting via mesothelium (E).

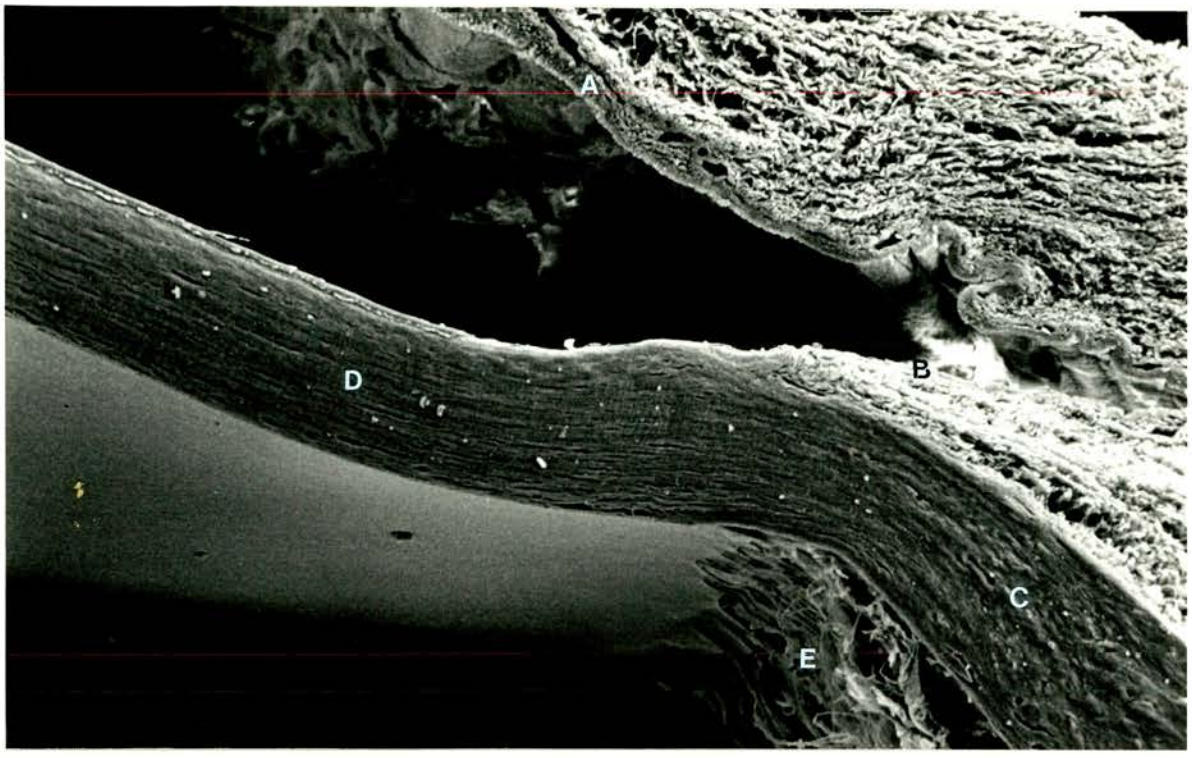
SEM X 28 (5)

Figure 4.7/23

Limbus (63)

Limbal epithelium (A) lymphocyte (B) limbal stroma (C).

Toluidine Blue X 310 (4)


A
B
C
D
E

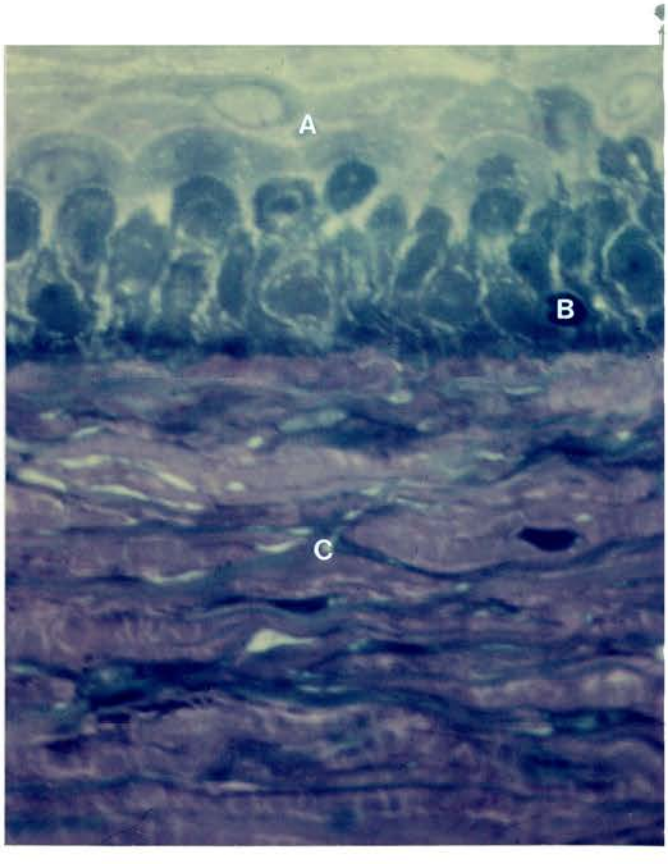

A
B
C

Figure 4.7/24

Tangential Section Conjunctival Epithelium (63)

Numerous, well defined desmosomes (A) Tonofilaments (B).

TEM X 6,000 (2)

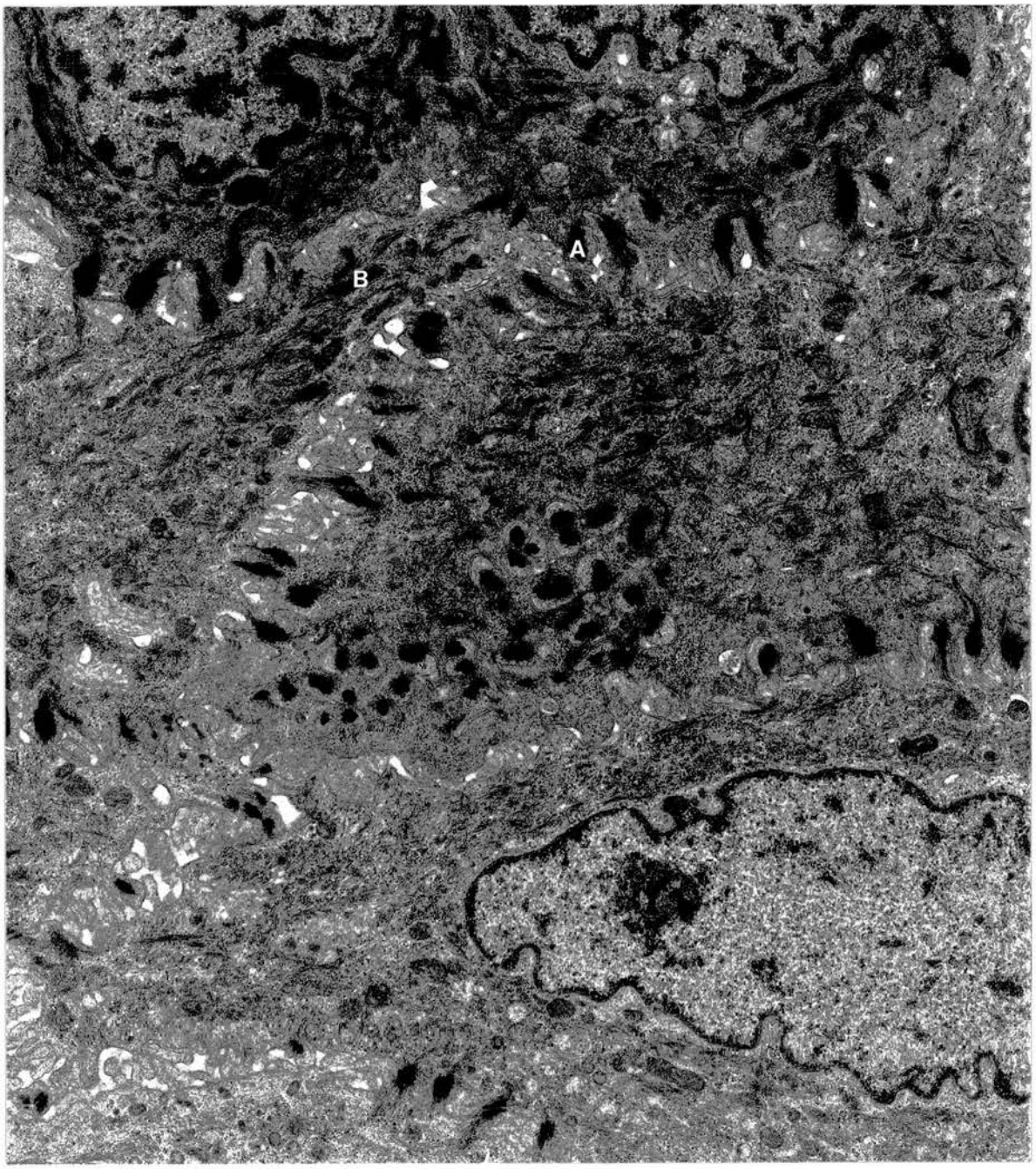

A
B

Figure 4.7/25

Limbal Conjunctiva (63)

Melanin granules (A) Polymorphonuclear leukocyte (B).

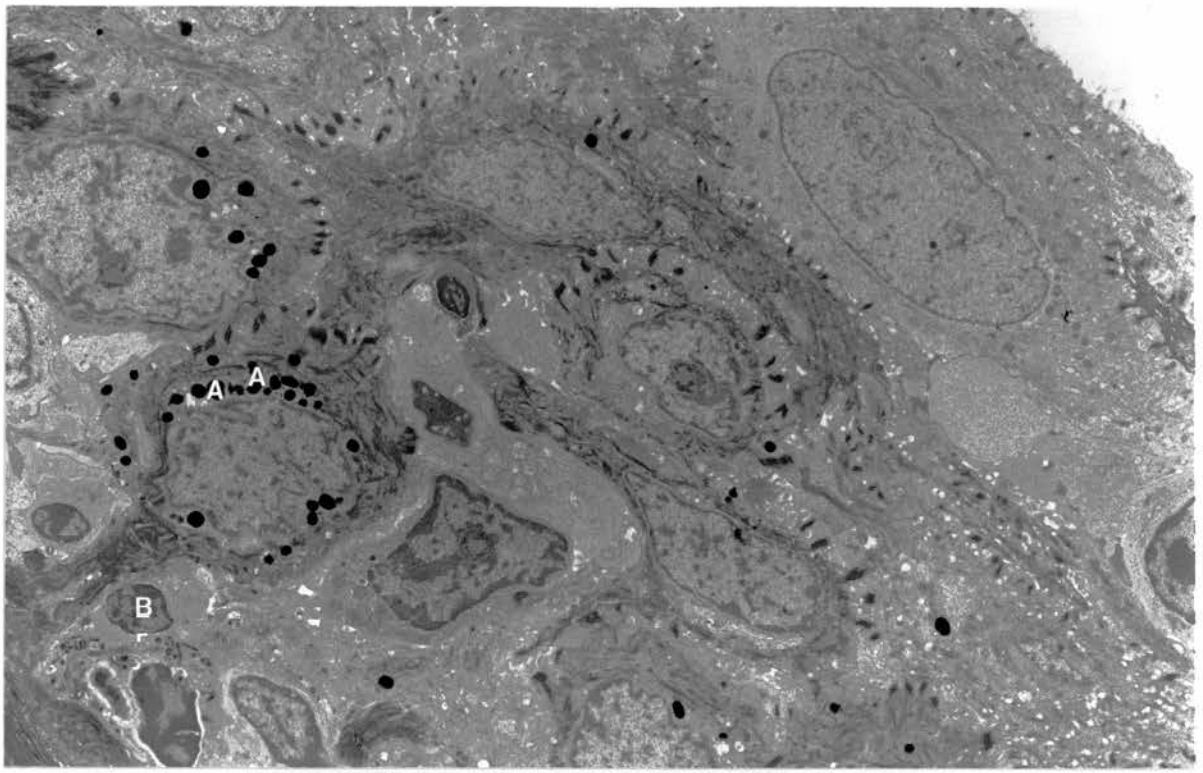
TEM X 2,750 (2)

Figure 4.7/26

Conjunctival Epithelium (68)

Melanin granules (A) lymph vessel (B).

TEM X 2,750 (2)


A
A
B

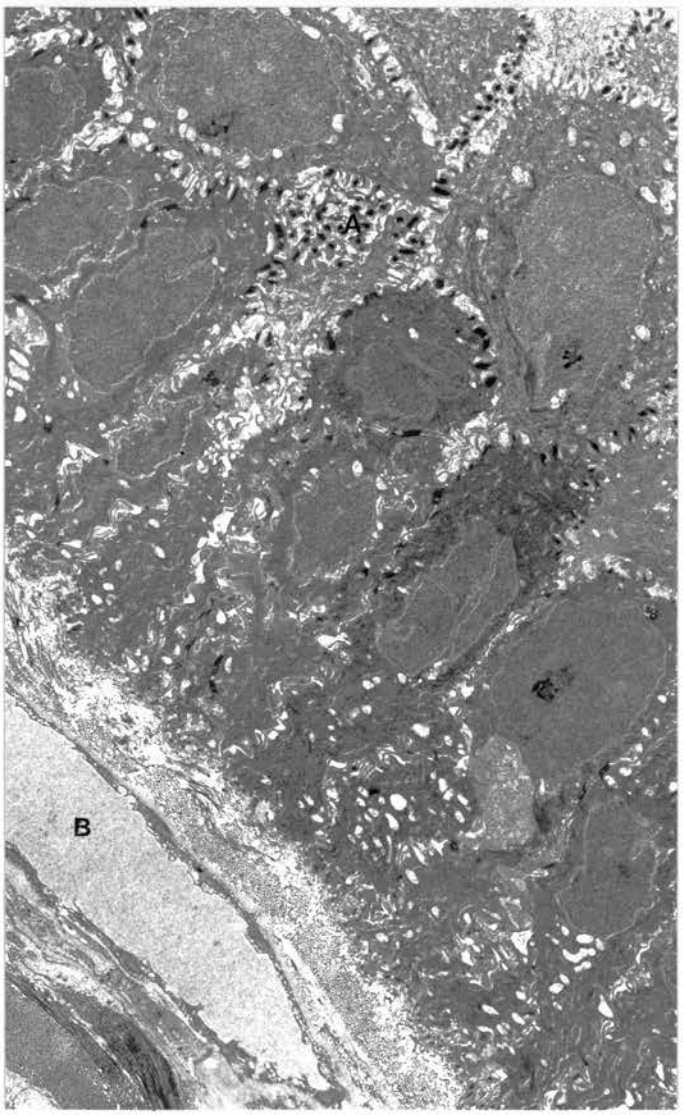

A
B

Figure 4.7/27

Limbus (41)

Conjunctival vessels (A) episcleral vessels (B) scleral vessels (C).

SEM X 140 (5)

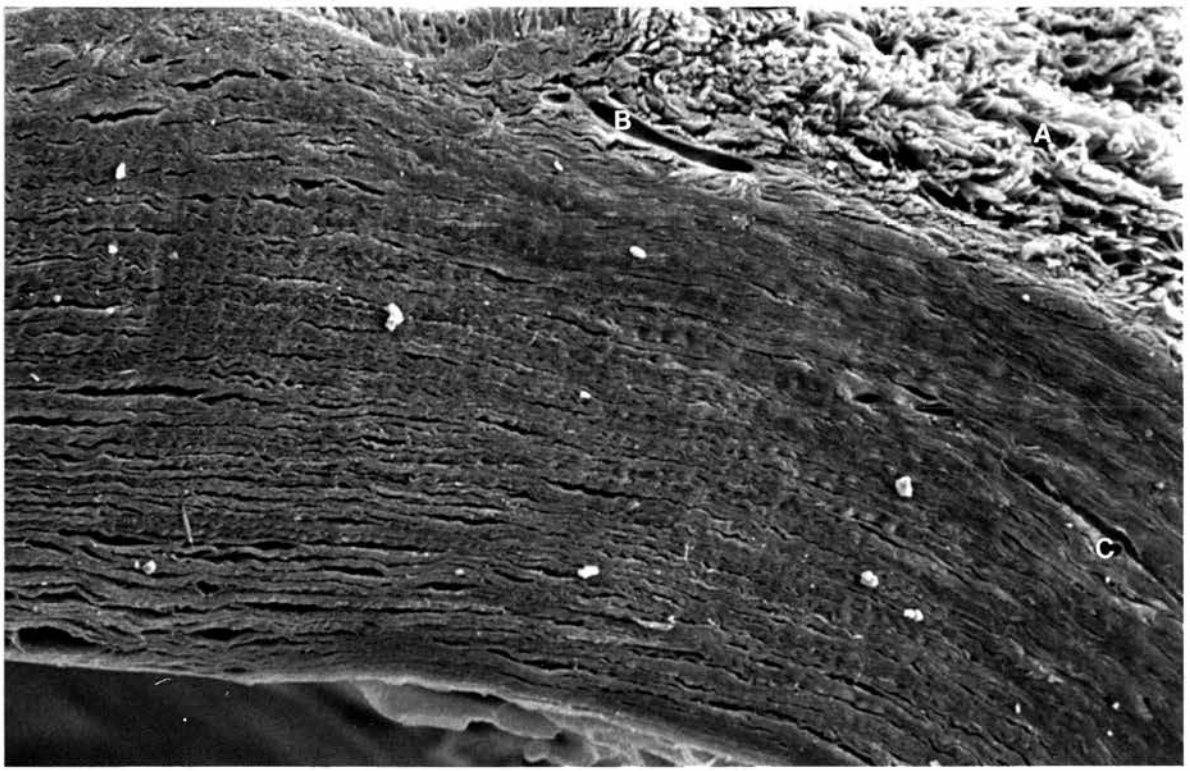

B
A
C

Figure 4.7/28

Episclera (35)

Episcleral vein (A) plasma cell (B) pericyte (C)
Obvious broad spacing collagen fibril (arrowed).

TEM X 7,700 (2.5)

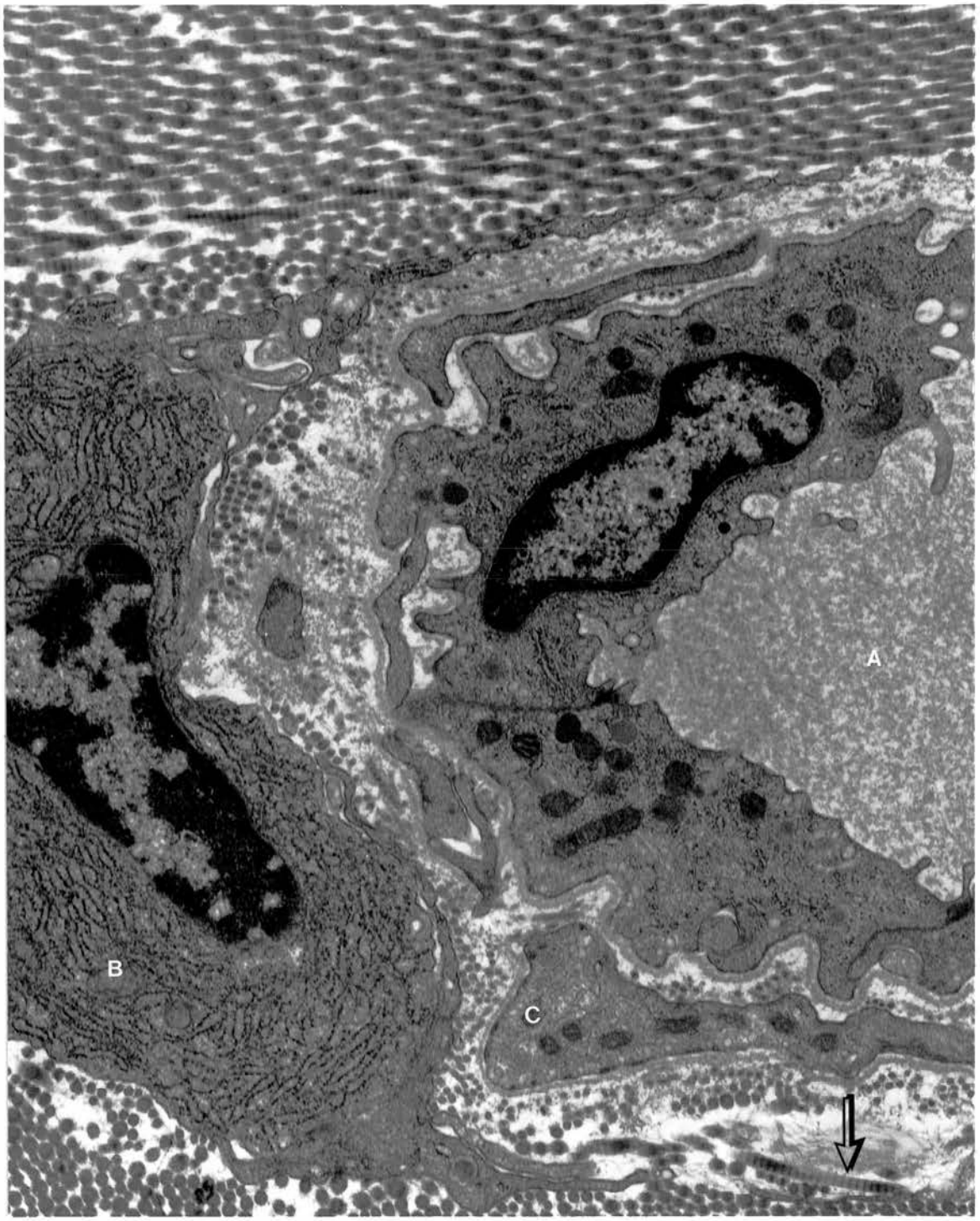

A
B
C

Figure 4.7/29

Sclera (181)

Part of scleral fibroblast (A) with a number of invaginations which may represent both coated and non-coated pits.

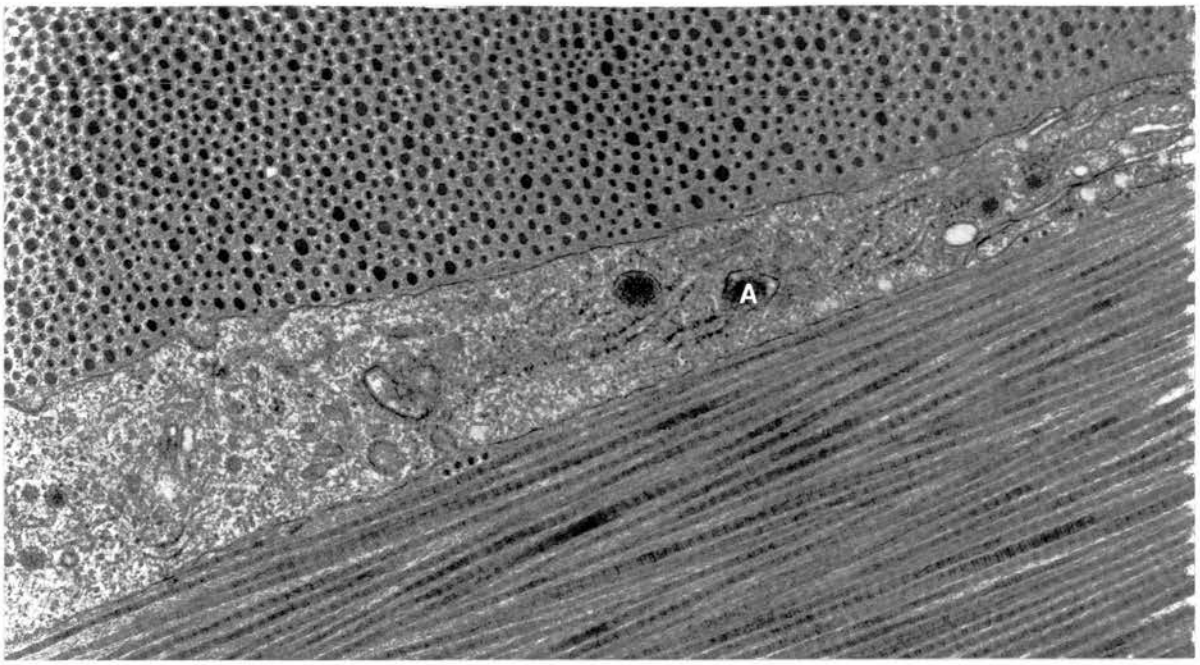
TEM X 16,500 (1.5)

Figure 4.7/30

Sclera (30)

Scleral fibroblast (A) melanocyte (B).

TEM X 1,650 (1.5)


A

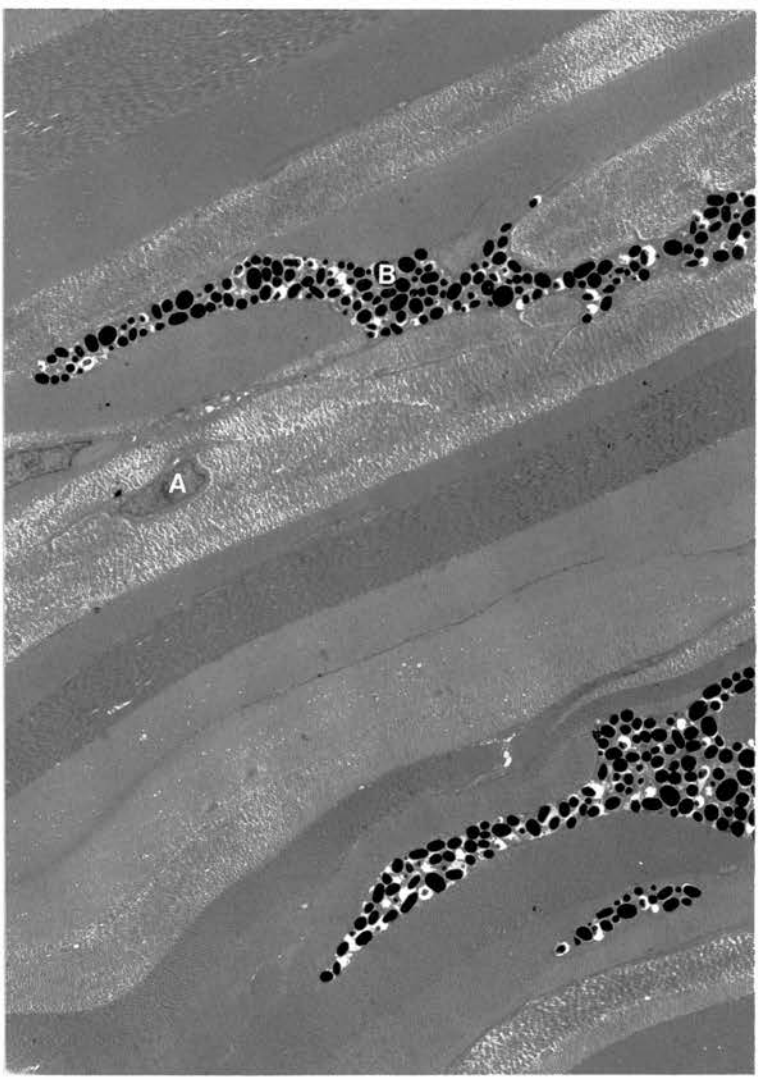

B
A

Figure 4.7/31

Sclera (40)

Nerve-vascular bundle. Lumen of blood vessel (A) with overlapping endothelial processes (B) and gap junction. Nerve bundle with Schwann sheath and part of Schwann cell nucleus (C).

TEM X 35,500 (2)

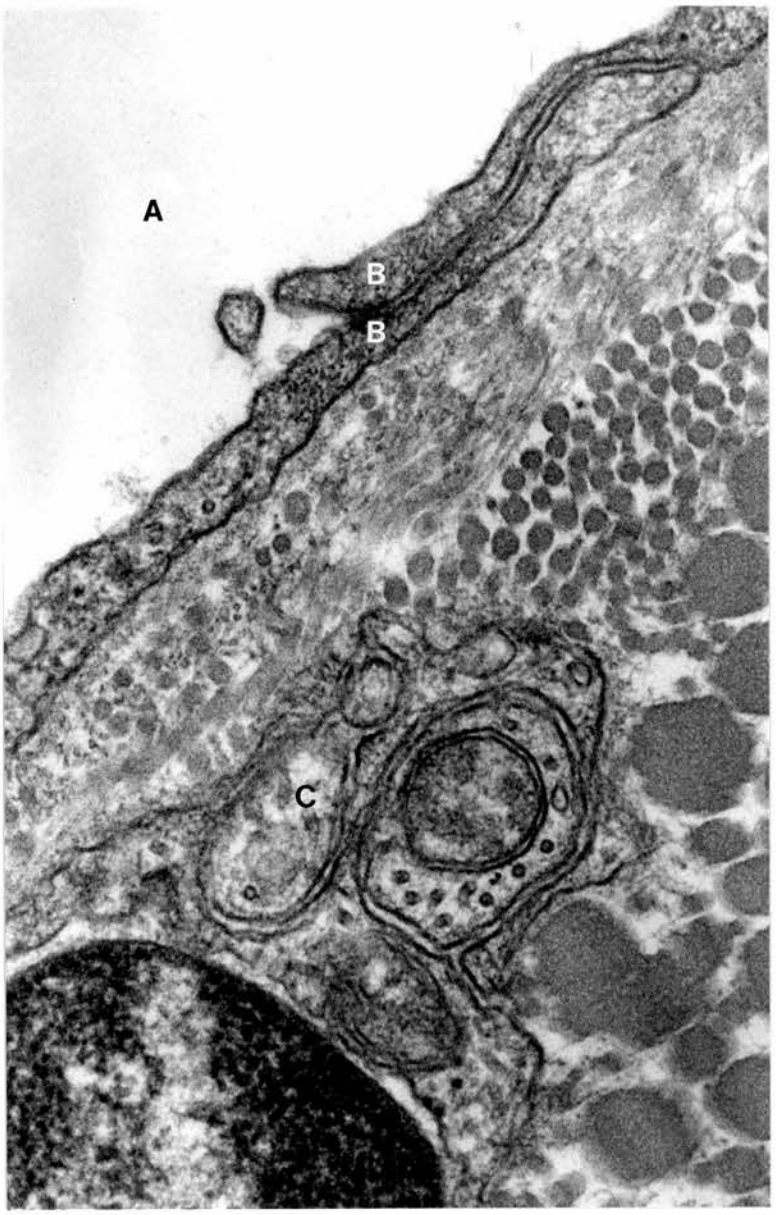
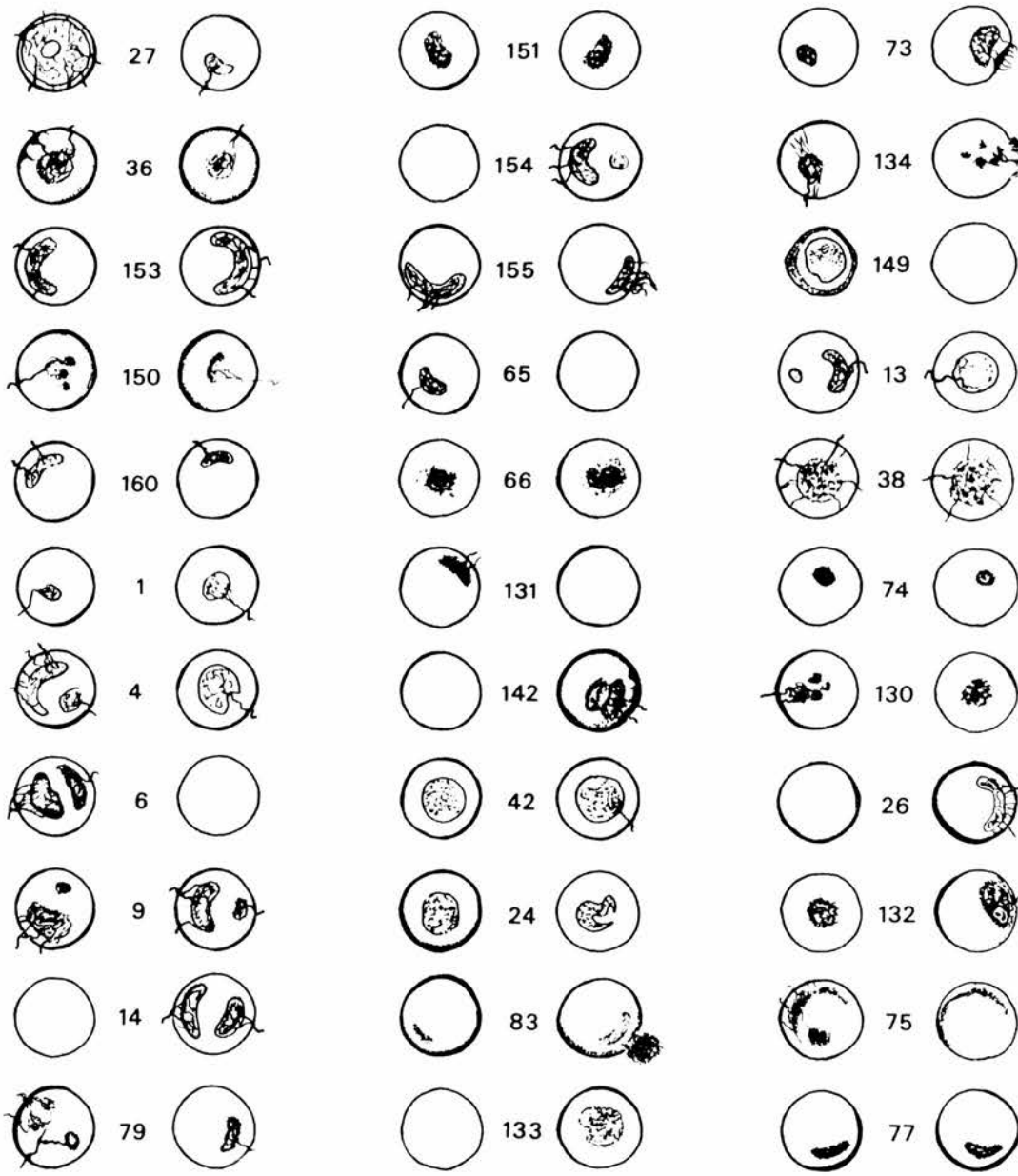

A
B
B
C

Figure 5.1/1

Appearance of Clinical Cases at the Time of First Examination.



Details of the external eye photographs 5.1/2 - 5.1/25 which appear on subsequent pages are given with individual case histories in Appendix 1.

L = Left Eye R = Right Eye

Figure 5.1/2

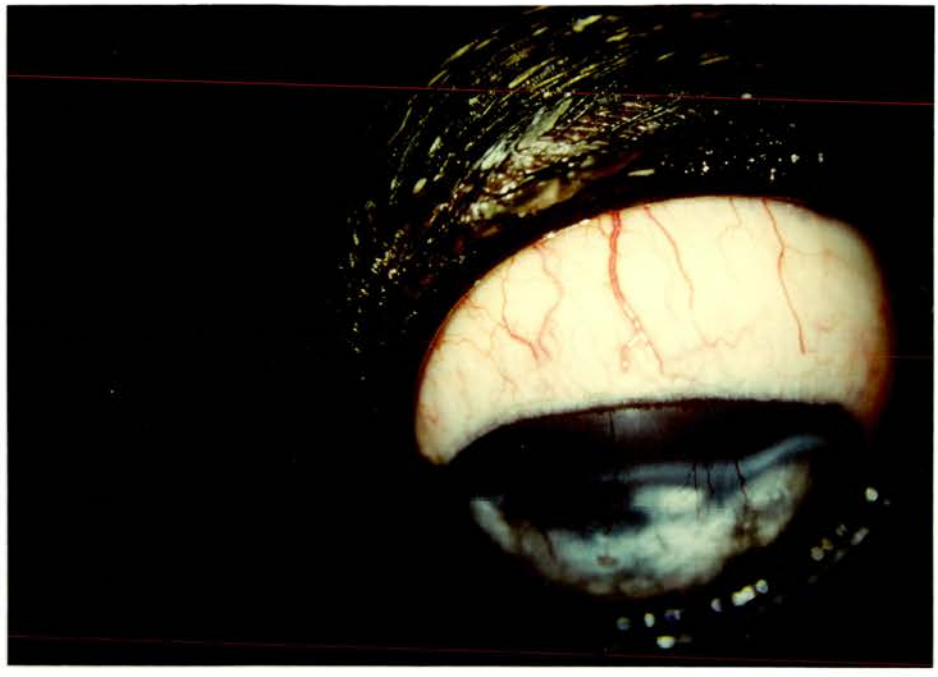
Alsatian (27L)

Prominent globe, engorged, lipaemic, perilimbal vessels and a vascularised corneal opacity. Recurrence of corneal opacity in a hypothyroid animal in which treatment had lapsed.

Figure 5.1/3

Alsatian (27L)

Aggregates of cholesterol crystals are apparent in the cornea with higher magnification.



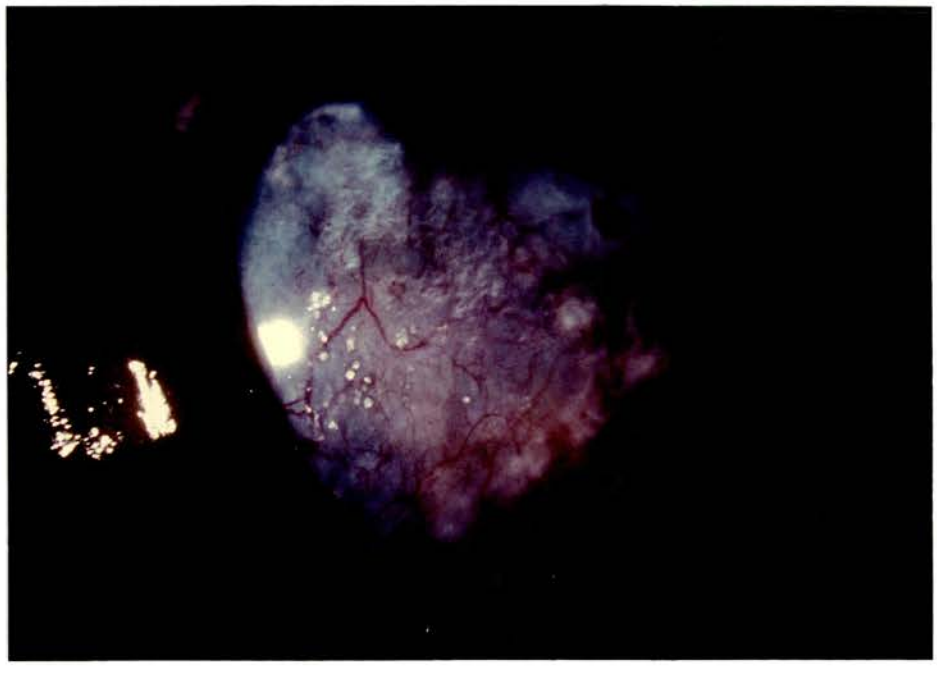


Figure 5.1/4

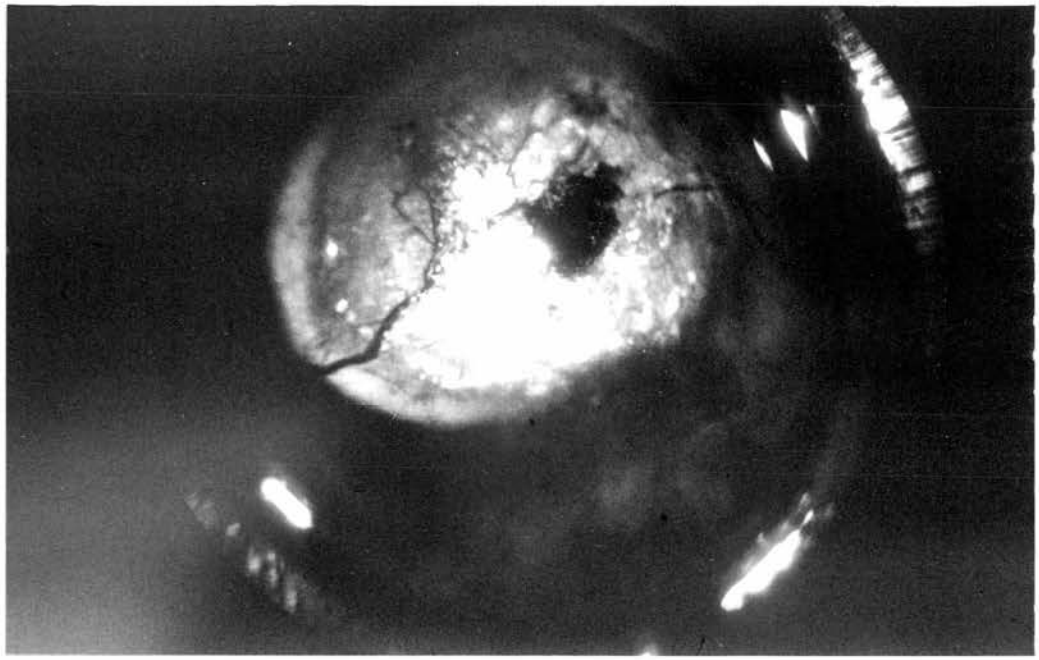
Alsatian (36R)

Free haemorrhage and pigmentation associated with superficial corneal vascularisation prior to treatment for hypothyroidism.

Figure 5.1/5

Golden Retriever (9R)

Regressing opacity following treatment for hypothyroidism, small crystalline aggregates with intervening clear spaces.



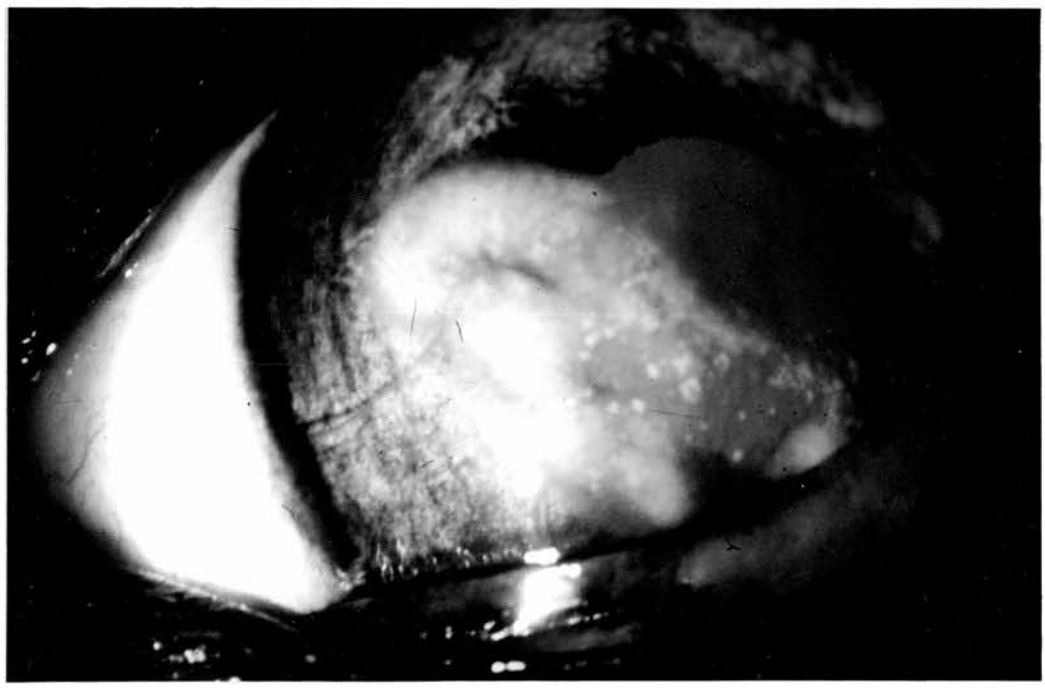


Figure 5.1/6

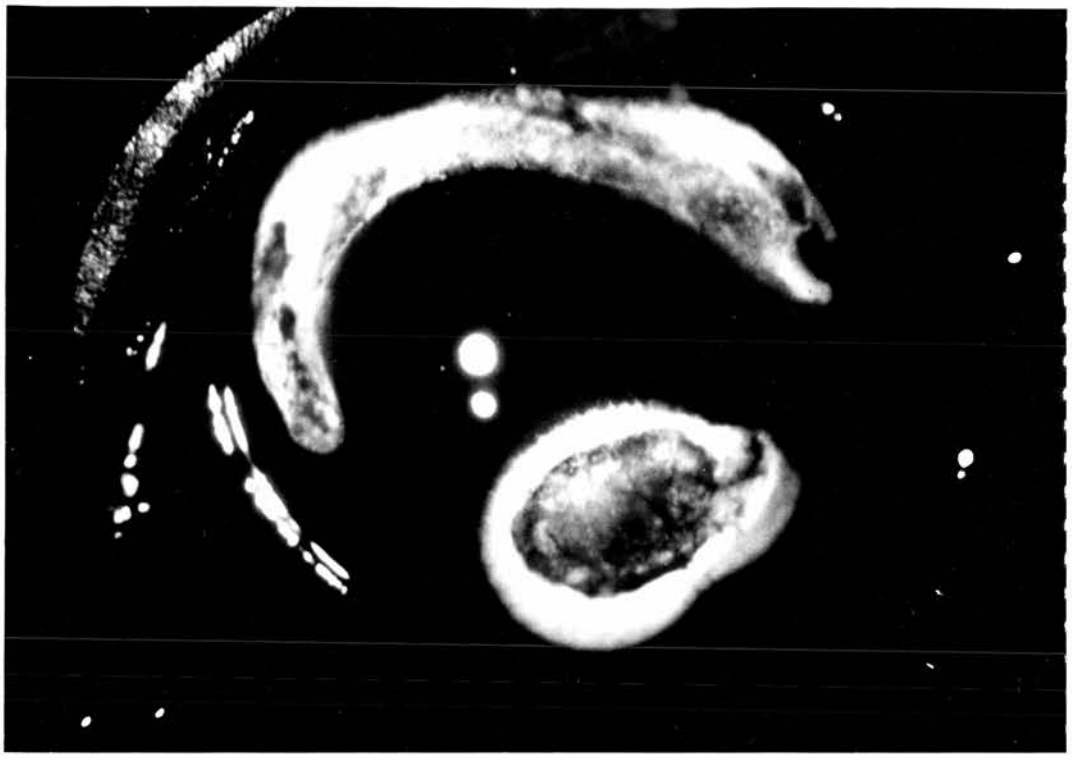
Golden Retriever (4R)

Epithelial erosion is apparent in the inferior lesion.

Figure 5.1/7

Golden Retriever (4L)

Other eye of the same dog at the same time.



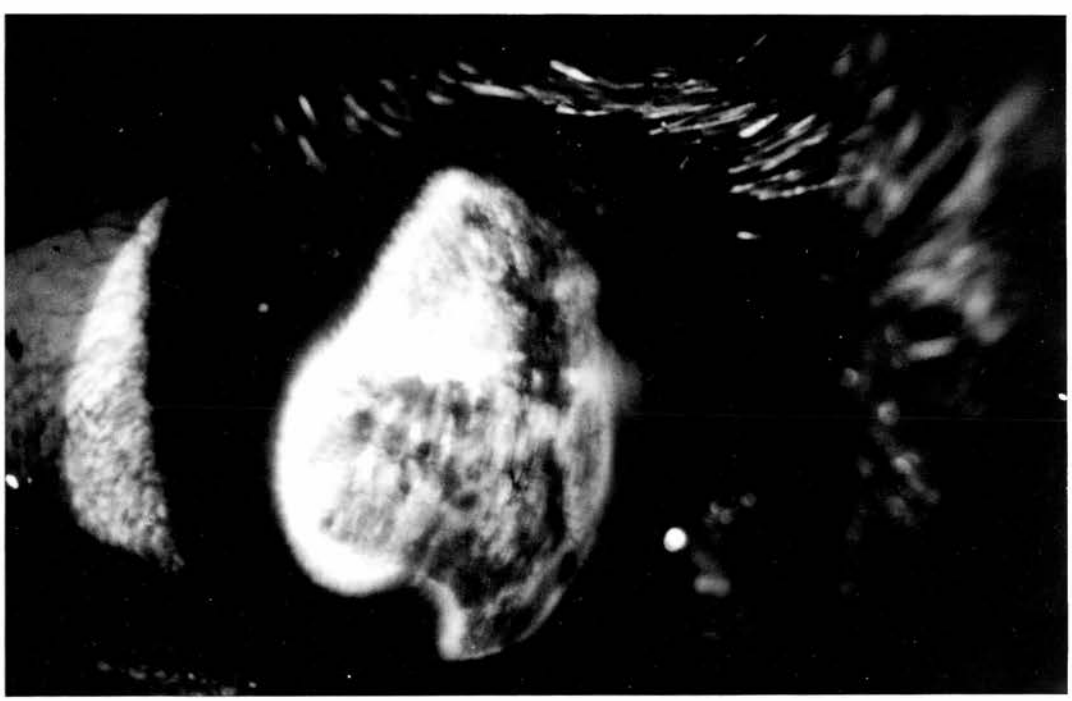


Figure 5.1/8

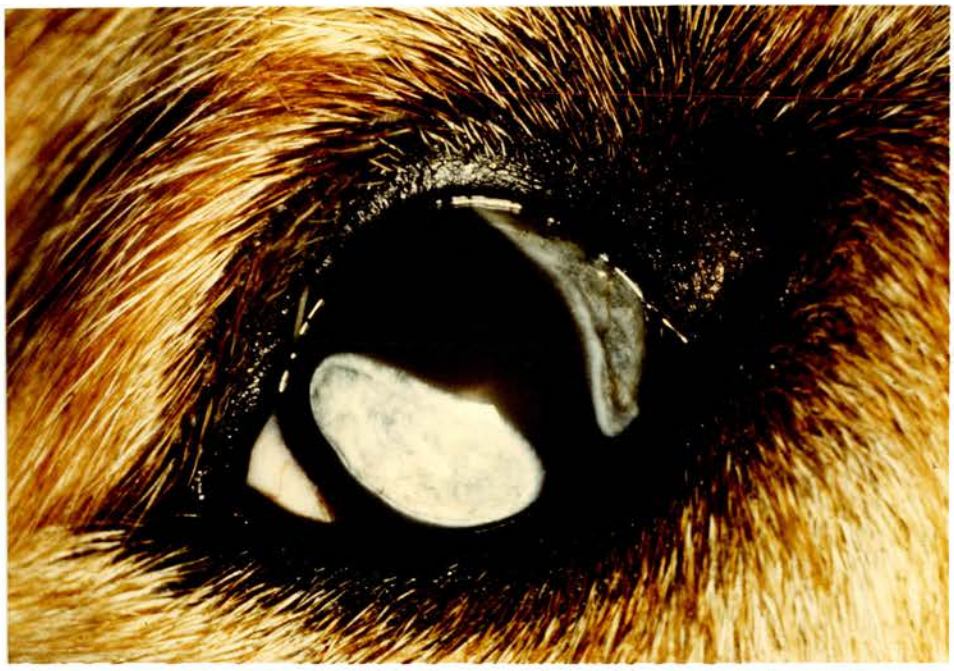
Golden Retriever (6R)

Dense, white, plaques with some epithelial erosion, iris of the right eye is darker than that of the uninvolved left eye.

Figure 5.1/9

Golden Retriever (9L)

Slit lamp photograph demonstrates thickening of the cornea at the periphery of the opacity and thinning towards the centre in a region of corneal erosion. Vascularisation is also present and blood vessels are apparent against a background of the iris.



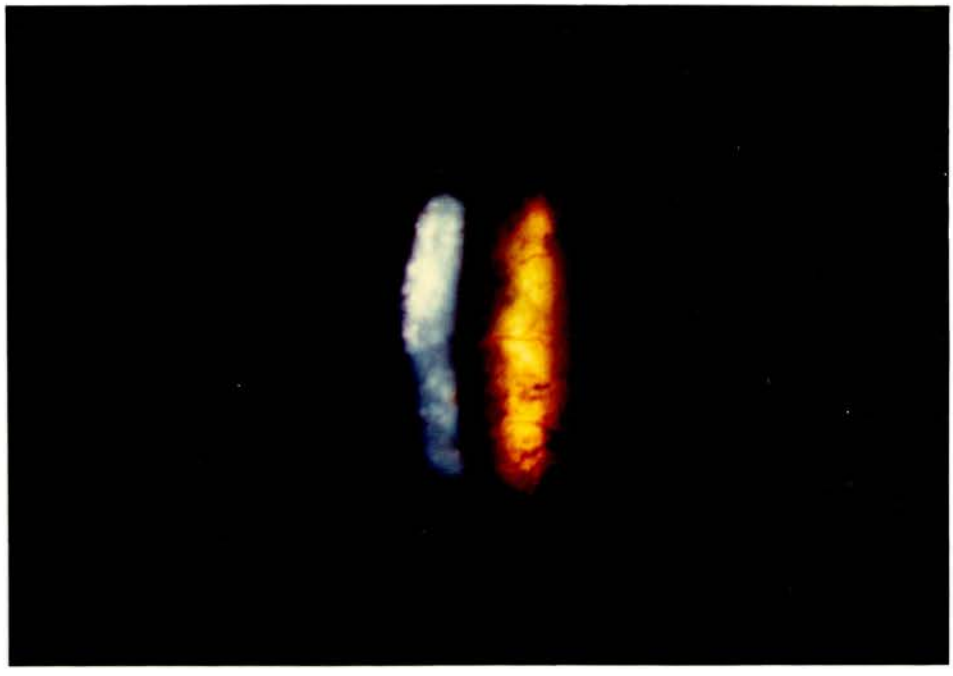


Figure 5.1/10

Golden Retriever (79R)

New lesions in the process of forming in regions of mild corneal oedema. In non-oedematous regions the lesions are discrete and disc-shaped. These is extensive, fine, vascularisation in all the opaque areas.

Figure 5.1/11

Golden Retriever (79L)

The other eye of the same dog at the same time. The irises of both eyes are darker than normal. A fine grey haze is apparent in the supero-nasal cornea at the limbus.

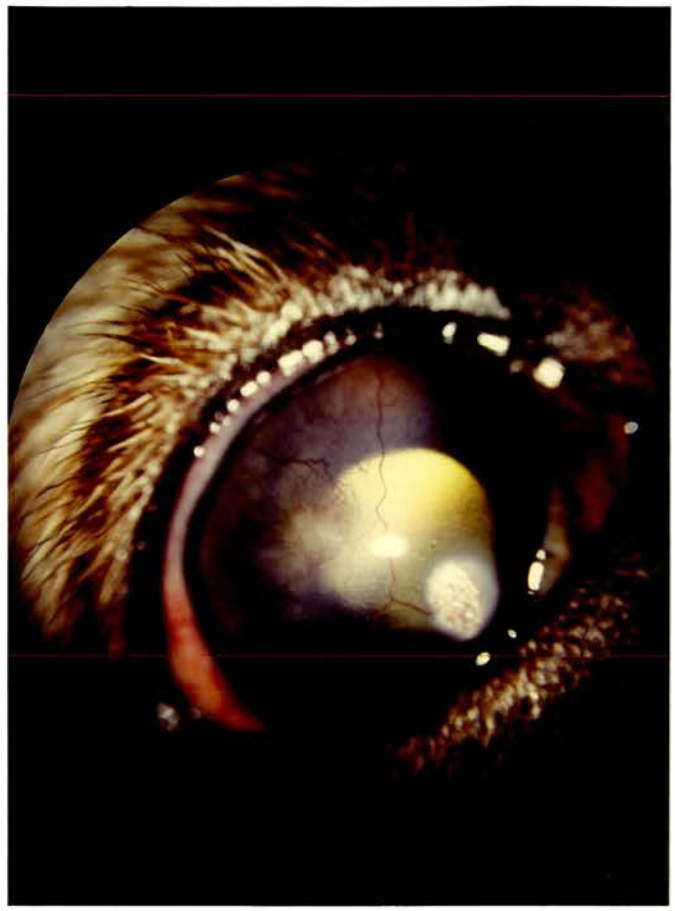


Figure 5.1/12

Welsh Springer Spaniel (42)

Approximately one month after keratectomy of the right cornea and prior to keratectomy of the left. Both eyes quiet.

Figure 5.1/13

Welsh Springer Spaniel (42L)

Recrudescence of anterior segment inflammation has led to recurrence of corneal opacification in the left eye. The fainter outline of the original, larger, lesion removed at first keratectomy can be discerned surrounding the dense new opacity.

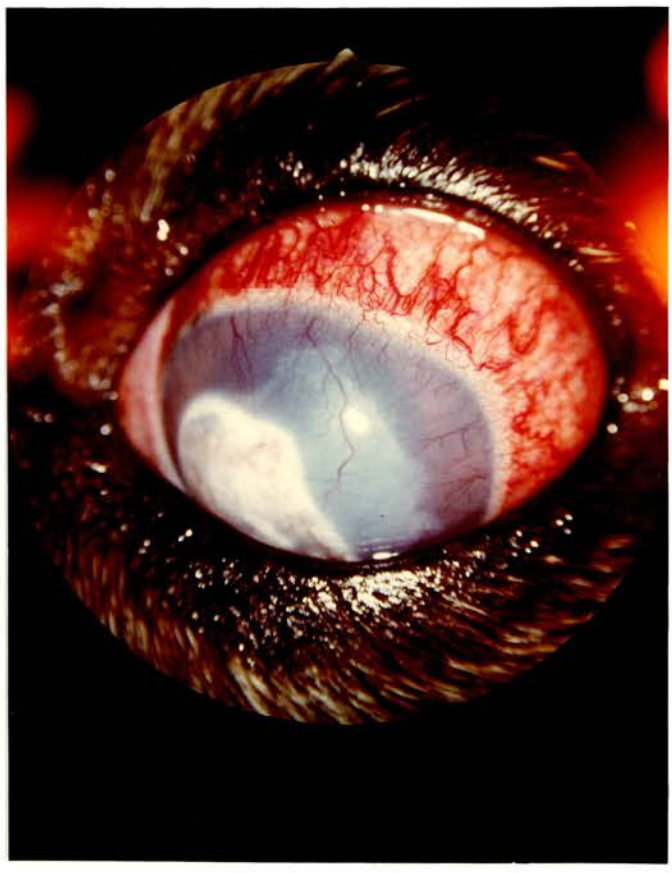


Figure 5.1/14

Welsh Springer Spaniel (42L)

Eye quiet between attacks. There is a small, posterior synechia in the 2 o'clock position.

Figure 5.1/15

Welsh Springer Spaniel (42L)

Regression of the opacity without surgical intervention.

Figure 5.1/16

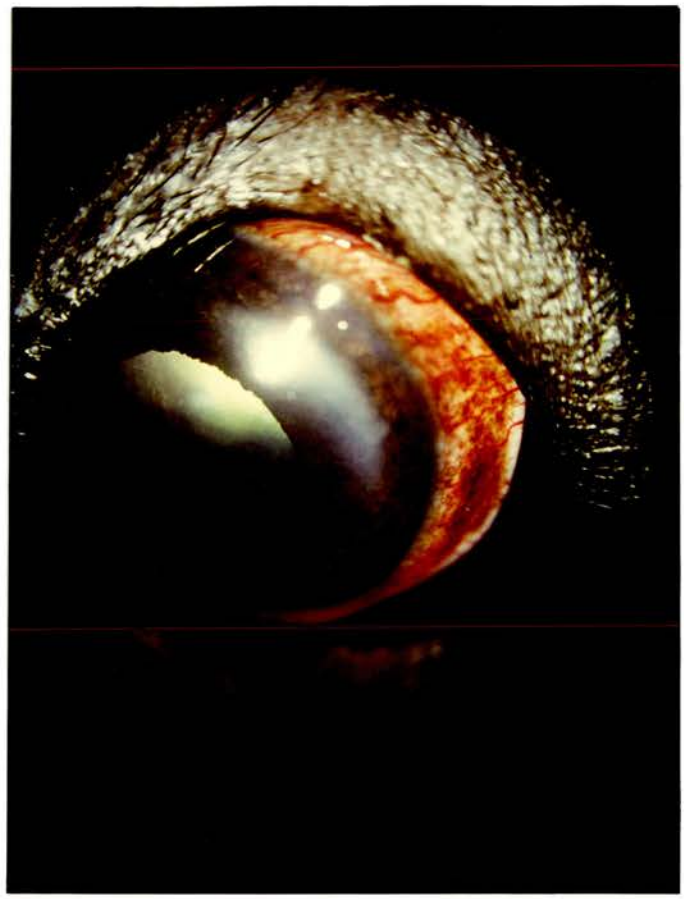
English Cocker Spaniel (83L)

Arcuate corneal opacity following bilateral, diffuse, scleritis; in this eye there was also a discrete, scleral nodule at the time of inflammation.

Figure 5.1/17

English Cocker Spaniel (83L)

Arcuate corneal opacity and a discrete discoidal vascularised opacity. The latter developed quite precipitately in the cornea close to the site of nodular scleritis.



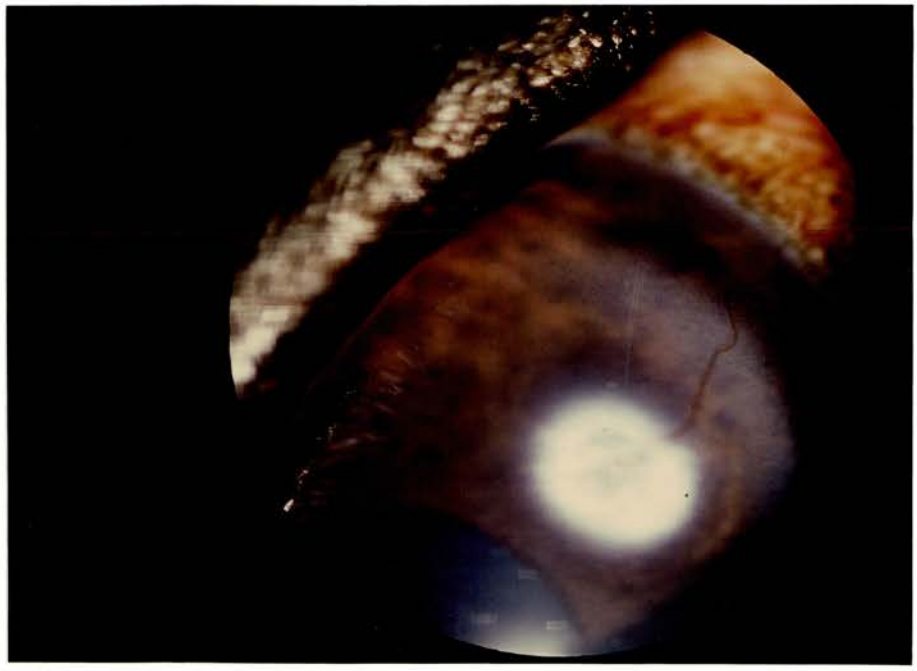


Figure 5.1/18

English Cocker Spaniel (83L)

Appearance of the left eye exactly one week after starting thyroid replacement therapy.

Figure 5.1/19

Rough Collie (73L)

Corneal opacity near the site of previous surgery for scleral nodular fasciitis which was encroaching on the cornea. Crystalline aggregates and vascularisation apparent in the opaque region of cornea.

Figure 5.1/20

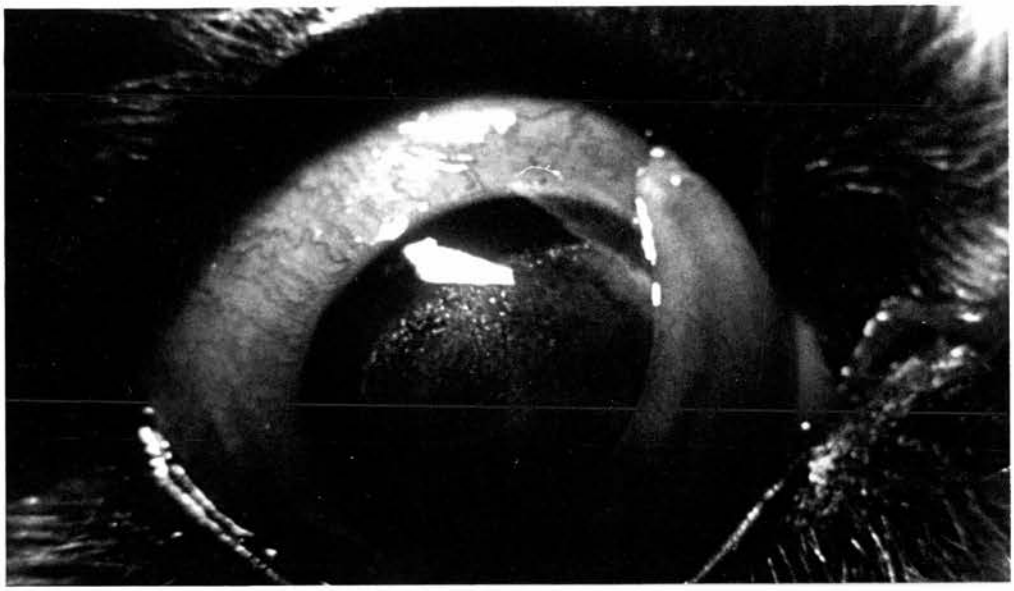
Old English Sheepdog (38R)

Mild chemosis and episcleritis during recrudescence of anterior segment inflammation.

Figure 5.1/21

Bearded Collie (26L)

Vascularised lesion viewed by retro-illumination, note the manner in which the lesion has extended relative to its appearance when the dog was first presented (Fig. 5.1/1).



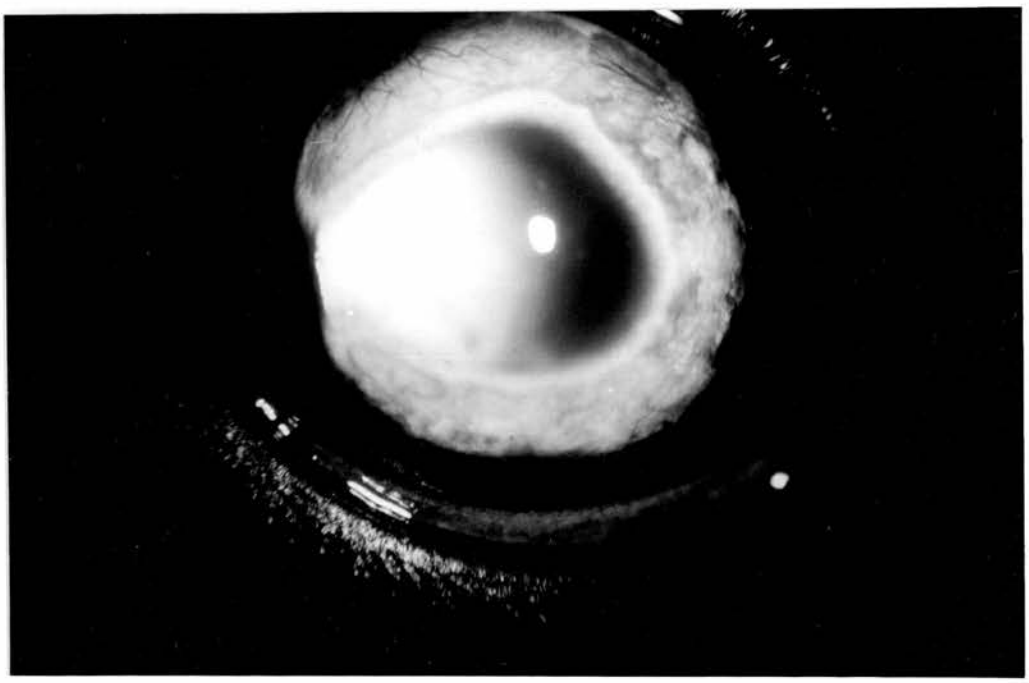


Figure 5.1/22

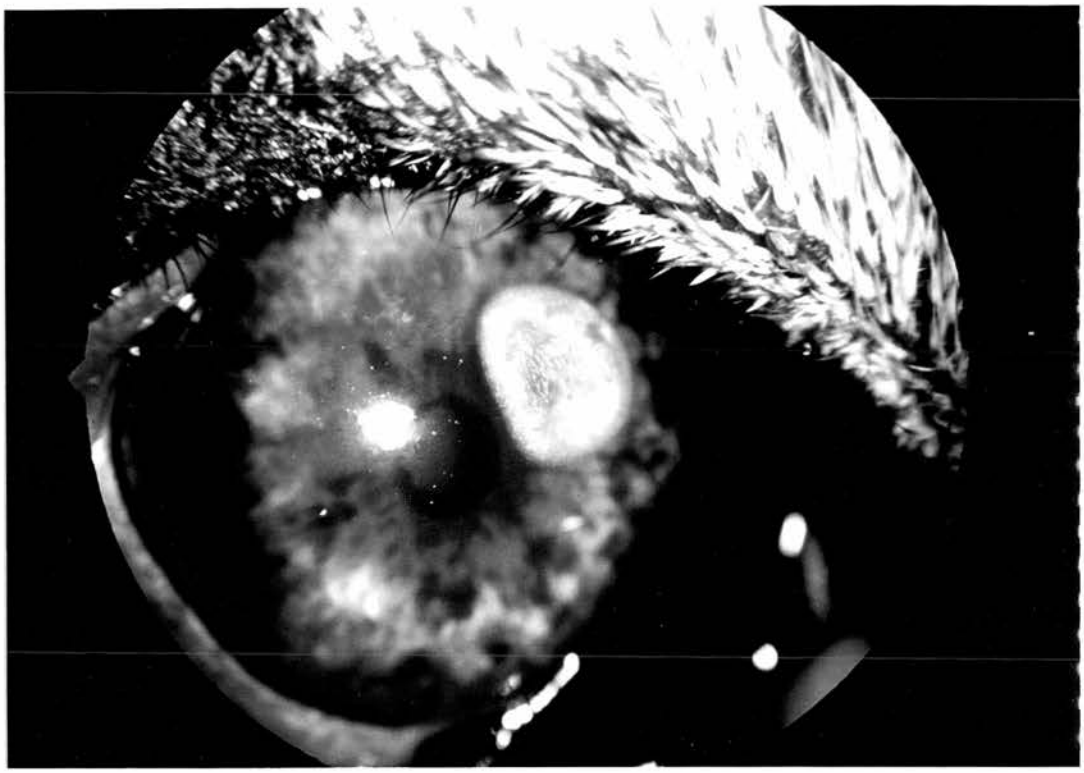
Great Dane (74R)

Acute iritis with reddening of sclera and episclera - sclerouveitis. Mild distichiasis also present.

Figure 5.1/23

Great Dane (74R)

Cataract secondary to previous uveitis, very darkened iris, pigment on anterior lens capsule and a number of post-inflammatory iris cysts.



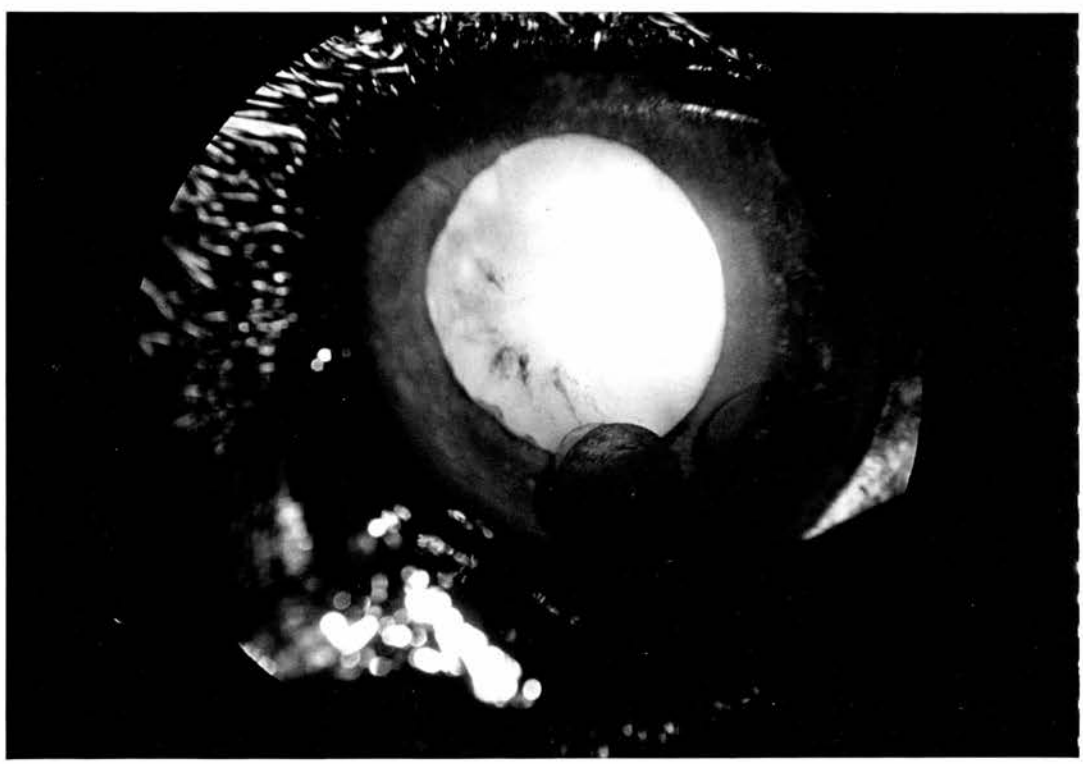


Figure 5.1/24

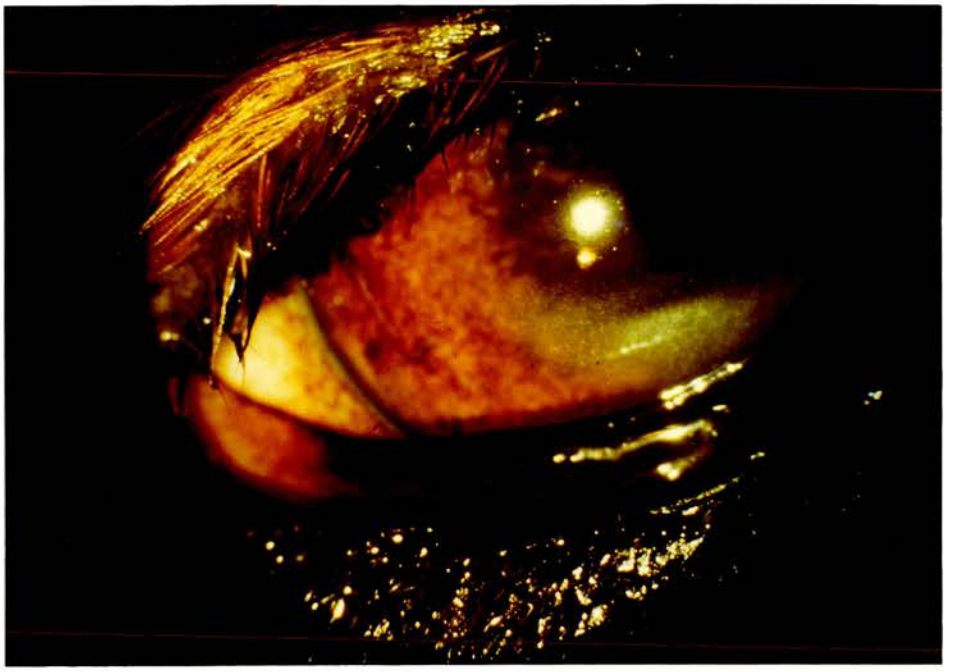
Basset Hound (77R)

Non-vascularised corneal opacity and distichiasis.

Figure 5.1/25

Basset Hound (77R)

Some regression of corneal opacity three hours after removal of irritating eyelashes.



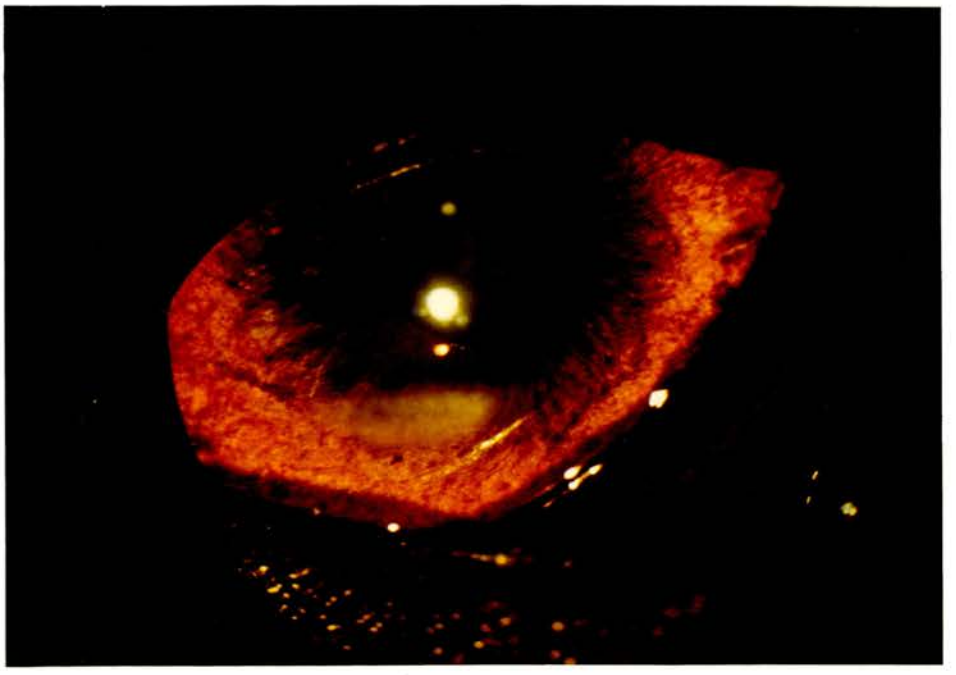


Figure 5.3/1

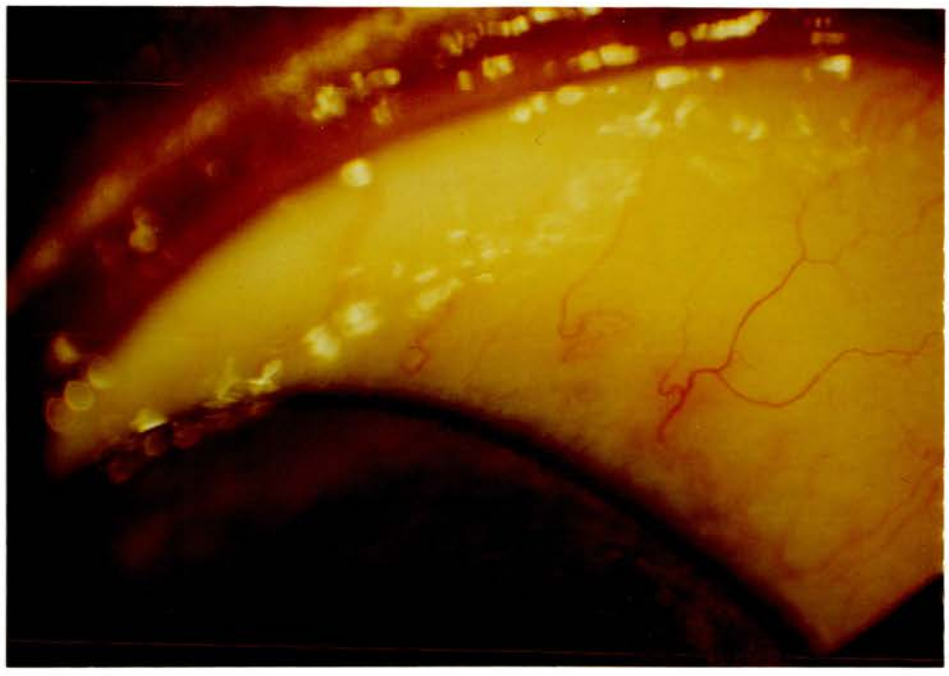
Golden Retriever (1R)

Normal perilimbal vessels.

Figure 5.3/2

Alsatian (27R)

Abnormal, lipaemic, perilimbal vessels showing tortuosity, obliteration and dilatation, indicative of atherosclerosis.



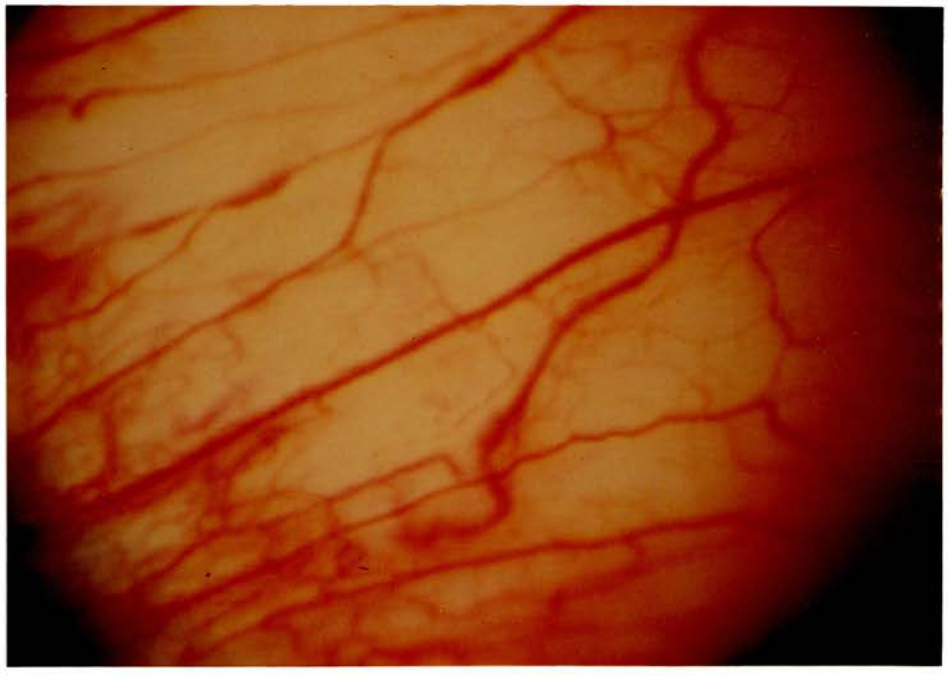


Figure 5.4/1

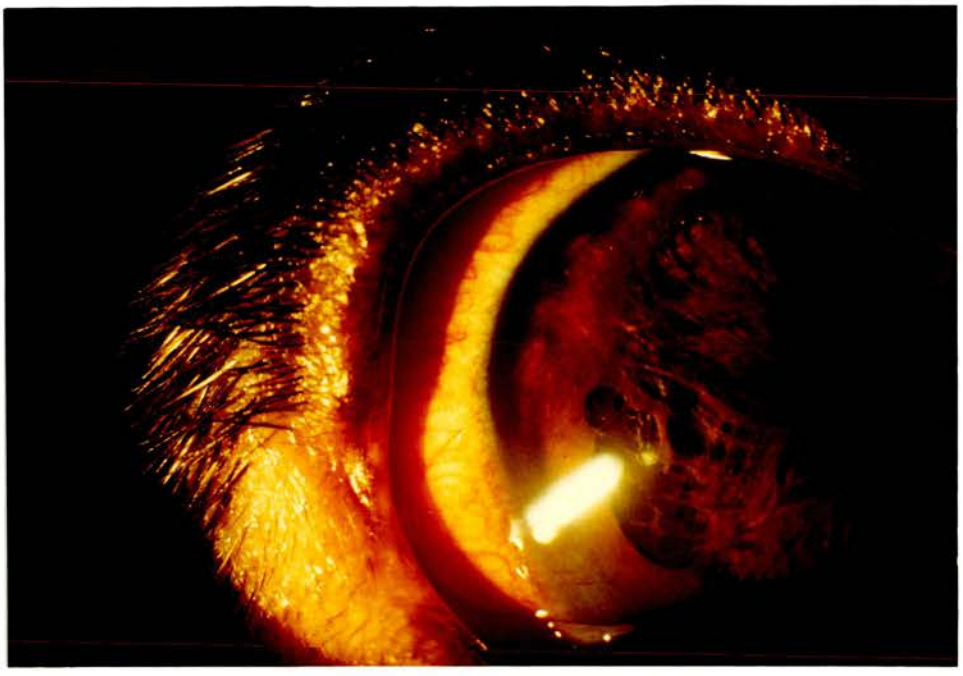
German Short Haired Pointer (75R)

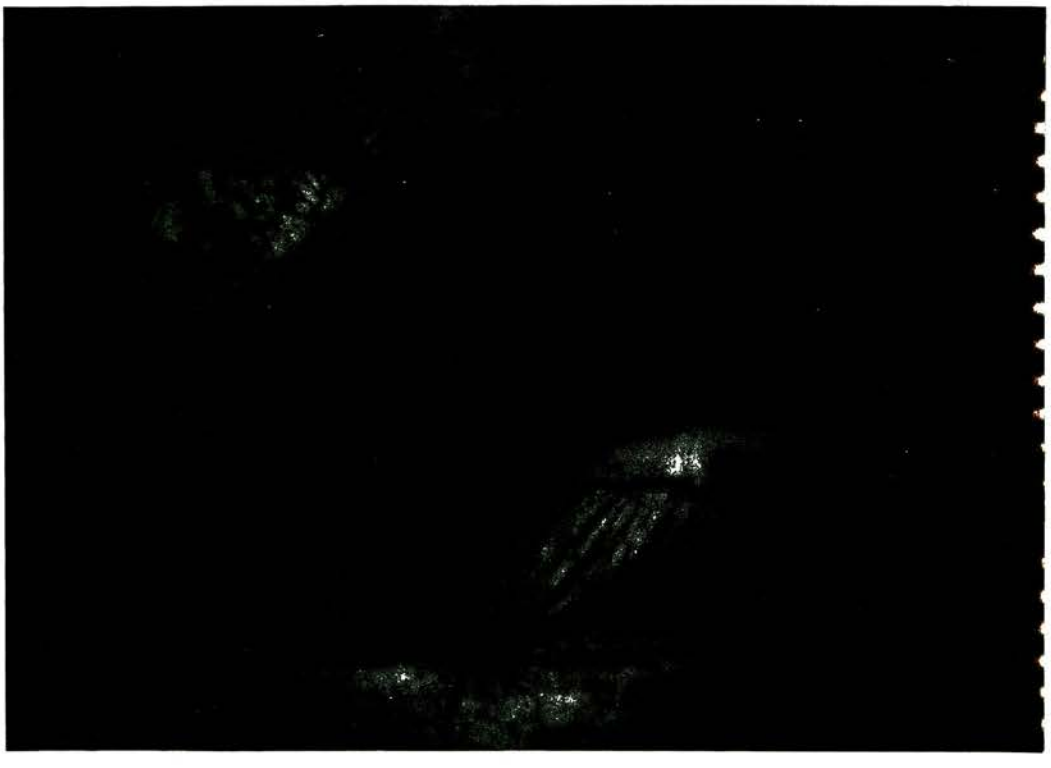
Eye quiet following previous uveitis. Mild corneal opacity in region of slit lamp flash and considerable iris damage from original inflammation.

Figure 5.4/2

German Short Haired Pointer (75R)

Scleral fluorescence some nine seconds after fluorescein injection.





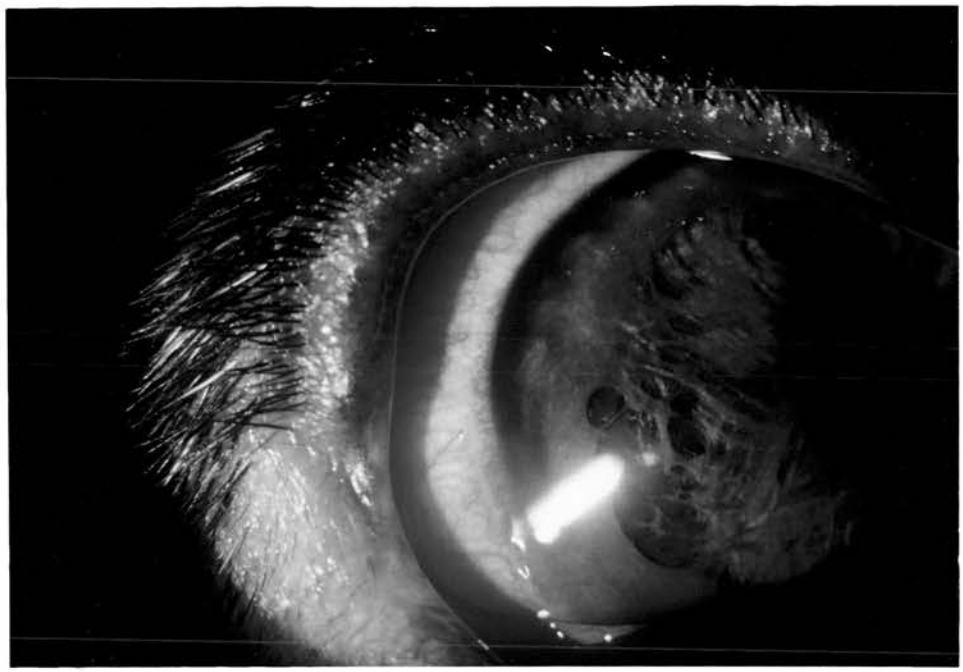


Figure 5.4/3

German Short Haired Pointer (75R)

Scleral fluorescence and corneal fluorescence some fifteen seconds after fluorescein injection. Considerable passage of fluorescein into cornea which had appeared relatively normal. There are also many ghost vessels.

Figure 5.4/4

Welsh Springer Spaniel (42L)

Appearance of eye nine seconds after fluorescein injection. There is considerable leakage from a superficial vessel in the 10 o'clock position and little from a vessel in the 6 o'clock position.