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OBSERVATIONS OF BLOOD STAINING OF THE CORNEA.

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This report, from the Pathologist of the Royal London Ophthalmic Hospital, gives an account of four cases seen at that institution, and especially of the microscopic findings in three of the eyes, which required enucleation.

Blood-staining of the cornea was first described by Baumgarten¹ in 1883. It is a discoloration of the cornea resulting from the presence of blood cells in the anterior chamber, which in the majority of cases results from an injury, with or without penetration of the globe, altho it has been known to appear spontaneously after an intraocular hemorrhage in buphthalmos.

The time at which the phenomenon manifests itself clinically, varies from a few days to a few months—its duration may extend over months or even years.

It can be readily understood that it is a comparatively rare condition, when one considers the number of cases with eye injuries seen in ophthalmic practice. According to Römer² it occurred in one case out of 400 severe injuries at the Giessen Clinic. At the Moorfields' Clinic it has been observed in about the same proportion. Treacher Collins³ saw 9 cases in 3 years.

There is some diversity of opinion as to what the coloring matter is and as to how it gains access to the cornea. Treacher Collins,⁴ in his series of cases, considers the discoloration due to fluid passing thru Descemet's membrane by a process of diffusion and depositing hematoïdin crystals in the corneal stroma, associated in some cases with hemosiderin. Weeks⁵ is of the opinion that the pigment enters the cornea thru the spaces of Fontana in the soluble form of hemoglobin, and is there transformed into a salt insoluble in the fluids of the cornea. Vossius⁶ thought

there was direct hemorrhage into the corneal substance, the blood coming from the vessels at the limbus. Baumgarten regarded the refractile bodies, causing the discoloration, as microorganisms. Von Hippel⁷ and Leber⁸ as fibrin coagula. Römer as globulin masses—he at any rate, proved they were not fibrin by the use of Weigert's stain. Gutmann⁹ showed they were not globulin by the fact that they were not acted upon by trypsin.

The refractile bodies are seen principally in the stroma. They vary in size and shape, but are usually rounded or oval. They average approximately 1.5 to 4 microns in diameter. They may be rod-shaped. With hematoxylin-eosin and Mallory's stain, they appear red. Van Gieson's stain gives them an orange color.

It has been demonstrated that hemoglobin is insoluble in water, alcohol, ether, xylol, chloroform, acetic acid, dilute mineral acids and weak alkalies.

Lyle,¹⁰ Manual of Physiology, 1911, page 263, states, "Hematoïdin forms flat lozenge-shaped crystals, and is found in the neighborhood of old blood clots, or hemorrhages which have occurred in the body, particularly in the brain or the lungs. It gives no absorption bands with the spectrum, and is iron free."

Case 1.—Morris D., aged 14 years, had the left eye needled four times at the London Hospital, the last being on May 12, 1908. In March, 1911, the eye became inflamed and painful, and on admission to Moorfields Hospital a

month later, the cornea was found to be hazy, the ciliary vessels injected, and the anterior chamber full of blood. Vision equaled light perception with faulty projection. Tension = minus 1. The eye was enucleated and on pathologic examination, the haziness of the cornea was found to be due to blood staining of the corneal stroma.

Case 2.—William C., aged 43 years, was admitted September 12, 1913, under Mr. Hepburn, with a history of having been struck in the left eye by a piece of iron the day previous. The cornea showed a penetrating injury with iris prolapsed. The anterior chamber was full of blood. Vision equaled hand movements. Tension, minus. The Haab magnet proved negative. The patient was discharged in December and attended the outpatient clinic at regular intervals, vision now being 2/60. The hyphema had become absorbed and a small hypopyon occupied its place. On the 24th of December of the same year a fresh hyphema appeared and the tension became plus 1. January 23, 1914, the cornea showed extensive blood staining. The vision was reduced to fingers and the eye was very painful. The pain continued in spite of treatment and the eye was enucleated on February 7th, 1914. Right eye is normal. Vision equals 6/6.

Pathologic Report.—A healed scar is present in the center of the cornea. Bowman's membrane is intact and normal. The stroma shows dark, small, yellow granules, which are rounded and oval for the most part. These granules lie upon the fibers and between the corneal spaces. Descemet's membrane is not invaded. The anterior chamber contains laminated connective tissue, which is vascularized. Pigment cells are scattered about in this connective tissue. The iris shows atrophic changes and lies in contact with the cornea at places. The lens is forward. Choroid normal. The retina is not very atrophic. Optic nerve is cupped.

Case 3.—Emily H., aged 10 years, was admitted to Moorfields Hospital, January 2, 1915, under Mr. Hepburn,

with a penetrating injury at the temporal side of the limbus of her right eye, the result of a blow with a stick. On admission vitreous was in the wound and the anterior chamber was full of blood. Tension, minus. Vision reduced to hand movements. A conjunctival flap was stitched over the wound and some vitreous escaped during the operation. On the 16th of January it was first noted that the cornea was blood stained. The hyphema was now disappearing, but no details were yet visible of the deeper structures. The eye became painful and was enucleated on February 2nd, 1915. L. eye normal. Vision equaled 6/6.

Pathologic Report.—Only the cornea was embedded. The epithelium is edematous. Bowman's membrane contains fine granules. These granules are coarse and predominate in the anterior part of the stroma. Some are rod-shaped but the majority are rounded and oval. Posteriorly, the granules are dustlike. The endothelial cells on the posterior surface show vacuolation opposite the area that is blood stained. The granules take the eosin stain.

Case 4.—Thomas D., aged 33 years, gunner, 65th R. G. A. Regiment, was in a gas attack for several hours on September 5th, 1918, from which time his eye trouble dates. He was treated at a base hospital in France after the attack with lotion and drops until October 8th, when he was sent to England. On October 10th he was admitted to Moorfields Hospital under Mr. Spicer. Examination at this time showed a burn of the conjunctiva below the cornea with marked conjunctival and ciliary injection. In the substance of the cornea was an area that was dark red in color, measuring about 6 mm. in diameter and occupying the lower and central part. Vision equaled light perception with faulty projection. Tension, minus. Not very painful. Right eye enucleated October 15th, 1918. Left normal, V. = 6/6.

Pathologic Report.—Macroscopic—The globe measures about 23.5 by 23 by 23 mm. The entire cornea is hazy and tends to bulge forward. A me-

ridial section shows the iris to be adherent to the posterior surface of the cornea. Blood clot in anterior chamber. Lens in situ. An exudate fills the vitreous. The retina is not detached. Optic nerve looks normal.

After staining the sections with hematoxylin-eosin and Mallory's stain, the cornea was reembedded and paraffin sections cut.

Microscopic—At the limbus corneae are seen many degenerated blood cells. The cornea is about normal in diameter. In contour it tends to form an anterior staphyloma. The epithelial layers are regular and enclose a mass of blood cells near the periphery. Thruout the stroma are seen areas of blood corpuscles. Small, dark colored, refractile bodies are also present, measuring about 2 microns in diameter on the average. These bodies are rounded and oval and take the eosin stain. Bowman's membrane and the rest of the cornea show nothing pathologic. The iris at the periphery is adherent to the posterior corneal surface. A few small hemorrhages are present in the iris stroma. The vessels are filled with blood. The pigment epithelium on the post-surface is uneven and in many places heaped into clumps. No atrophy or cell infiltration. The ciliary body shows the pigment epithelium covering the processes to be undergoing atrophic changes. The vitreous contains a mass of faintly staining

cells and debris, the individual cells being difficult to describe on account of degenerative changes. The retina is not very atrophic and is not cystic anteriorly. The optic nerve is not cupped. Left eye normal. Vision 6/6.

In case 4, I dissolved the paraffin from the sections with xylol and placed them in the dark for ten days in undiluted peroxid without, however, affecting the refractile bodies.

CONCLUSIONS.

1. The highly refractile bodies seen in the corneal stroma in cases of blood-staining of the cornea are pigment granules transformed from hemoglobin.

2. Hemoglobin gains access to the cornea by diffusion thru Descemet's membrane.

3. The discoloration is due principally to the pigment granules altho blood corpuscles may be associated as shown by the plate. The degree of the discoloration varies according to whether hemosiderin or other hemoglobin derivatives are present.

4. The staining never affects the extreme periphery on account of the efficient lymph circulation at the limbus, nor do we find pigment granules in this area.

5. The presence of an iron reaction seems to depend on the vascularization of the tissue.

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THE X-RAY TREATMENT OF RETINAL GLIOMA.

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This paper reports three cases of glioma of the retina treated with X-rays and radium. In each case the ocular growth was checked, and the eyeball became shrunken; but metastases occurred causing death. The autopsy findings with microscopic examination in one case include a metastasis to the pancreas.

The fact that in a boy suffering from glioma of both eyes and subjected to X-ray treatment, the tumor-tissue had considerably shrunk after several exposures, was reported at length by Professor Komoto and myself at the General Congress of the Japanese Ophthalmological Society, in April, 1917. Since then, two other similar cases have been treated in the same way, but with radium radiations added to insure success. After one year, in all these three cases, a contraction of both eyeballs was witnessed, together with the shrinking of the gliomas.

Axenfeld has expressed himself on this point thus: "The action of radiotherapy is an elective one. It destroys the tumor but leaves the normal tissue undisturbed, as far as can be determined clinically." Altho our cases went on to phthisis bulbi, we were led to imagine at least that we could save the lives of the patients; and so we reported the cases, and continued the treatment.

But, during 1918, all three boy patients met with similar lamentable catastrophes. One began to suffer from meningitis, the second developed metastatic nodules thruout his body, and both these cases terminated in death. The third patient was at-

tacked with metastatic tumors in the parietal region, and he too, died. Altho we were not wholly without fear of some such fatal result, our attention was focused upon the contraction of the eyeballs and involution of the primary tumors, so that, exulting in the local destructive power of the Roentgen rays and hoping to save lives of the patients we did not anticipate the eventful development of the metastatic tumors. The fact that phthisis bulbi may result from the use of X-rays has not yet been recorded by any authority.

This being the case, we hasten to report on the sad outcome as a corrective to our former too hopeful report. As a preliminary let us first of all sketch briefly the pathologic history of each case.

CASE 1. A. H. aged one year and two months; both eyes suffering from retinal glioma in the second stage. Consulted us for the first time on September 12, 1916. Both eyes apparently sound externally, but on examination the pupils somewhat dilated; yellowish white tumor mass, on the surface of which retinal blood-vessels are visible; intraocular tension increased; altogether exhibiting the aspect of the amaurotic "cat's eye."