

**Extraction of hard cataract - death on the fifth day - examination of the eye  
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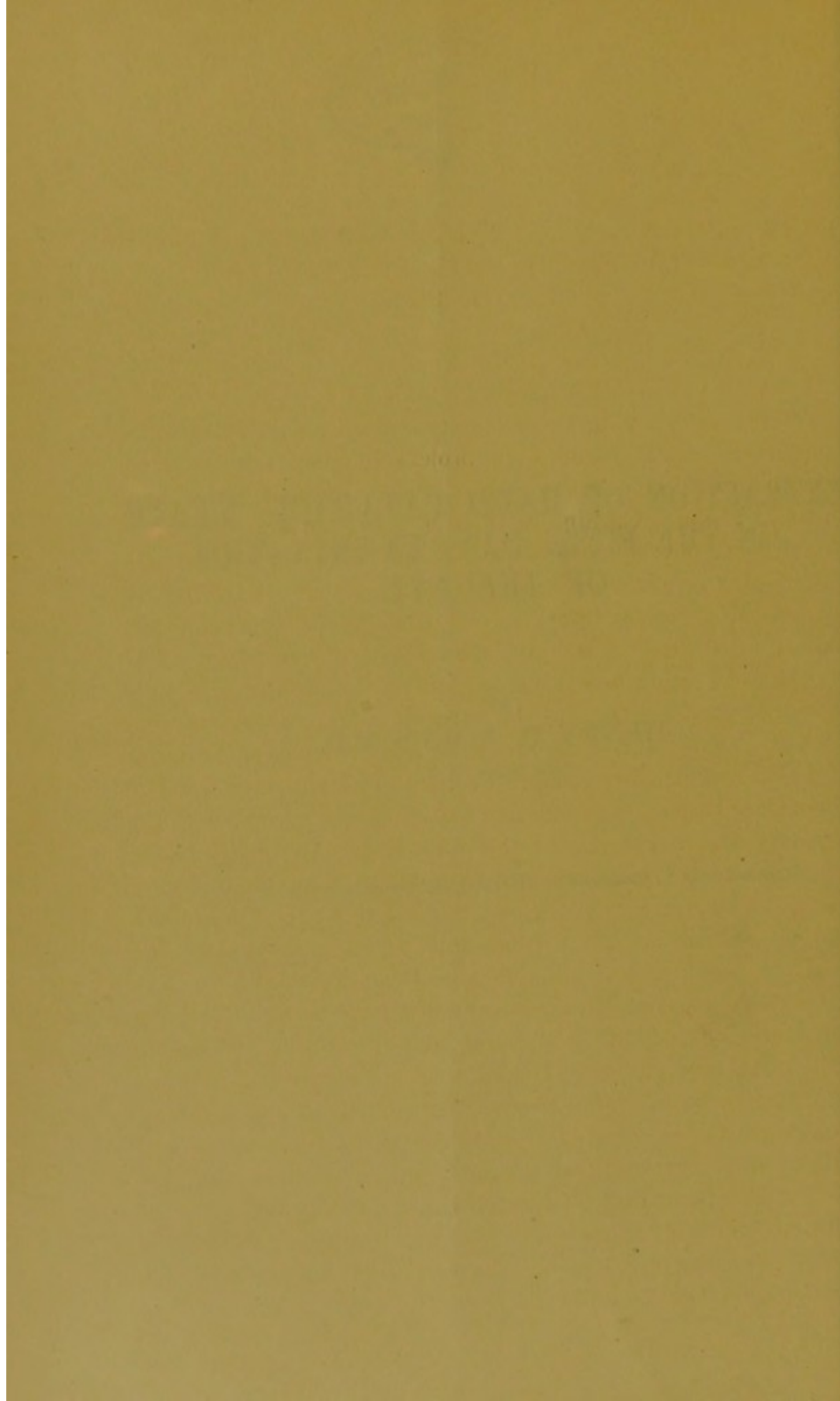
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EXTRACTION OF HARD CATARACT—DEATH  
ON THE FIFTH DAY—EXAMINATION  
OF THE EYE.

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## EXTRACTION OF HARD CATARACT—DEATH ON THE FIFTH DAY—EXAMINATION OF THE EYE.

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*History.*—Mrs. S. S. T., aged sixty-two, with cataract in O. S. complete, in O. D. incomplete, projection good, pupils active, was operated upon on the 25th of April, 1886, at ten o'clock in the morning. Cocaine instilled to complete anæsthesia and dilatation of pupil, lids separated by speculum, section through the upper  $\frac{2}{5}$  of the cornea, strictly in the limbus, iridectomy of medium size, capsule freely opened in the middle by cystotome, expulsion of the lens by pressure and counter-pressure. The conjunctival sac was washed out with a solution of biniodide of mercury, 1 : 25,000, and the anterior chamber was irrigated with the same solution by means of a bulb syringe, the point of which was not introduced into the anterior chamber. The cortical substance appeared to be completely removed, the bleeding was moderate and the pupil became perfectly black. The iris was carefully replaced by a spatula and the action of the pupil was perfectly restored. The operation was smooth and without accident. Patient able to count fingers at one foot. A bandage was applied, and the patient put to bed. After three days the eye was for the first time briefly inspected. The anterior chamber was found to be restored, the wound united, the reaction very moderate. Patient had had no pain. Bandage re-applied and patient continued in bed. At 6 o'clock on the morning of the 5th day the patient was seized with great prostration and syncope, and, notwithstanding the use of stimulants and restoratives, she died in half an hour without pain or convulsion. At the autopsy, twenty-four hours later, the only lesion discovered was dilatation of the heart without hypertrophy.



The contents of the left orbit were removed en masse, and in so doing the wound in the cornea gave way. The specimen was at once placed in Müller's fluid, subsequently treated by alcohol, stained and sections prepared by Dr. H. Gifford with Thoma's microtome. The sections were made on a plane parallel with the vertical meridian, and out of a large number ten were selected and numbered in order, commencing from the nasal side and going over to the temporal side of the cut. Consequently the sections at the extremities of the cut pass through the cornea in planes oblique to its radii, and these sections go through the intact iris, while the middle sections go through the coloboma.

*Description of the Sections.*—Sections 3, 4 and 5, which come from the nasal side of the wound, exhibit an entanglement of the iris; sections 6 and 7 pass through the coloboma, while in sections 8, 9 and 10, on the temporal side, the wound is free from the iris. In other words, a prolapse of the iris took place on the nasal side of the coloboma which was not detected and it is believed did not exist at the time when the operation was finished, and to prevent which the spatula was carefully used. In section 4 the opening through the anterior capsule is displayed, and it is seen that the upper portion of it has been turned down and folded over so as to lie behind the iris; in section 6 the anterior capsule is seen to be loosely folded and wrinkled up. The posterior capsule is in all the sections intact. In the sections at the extremities of the wound a very small amount of lens matter is entangled within the capsule; in the middle sections no lens matter is to be found in the pupillary area, and in only one section, viz., 8, is any lens matter found in the anterior chamber, and in extremely small quantity. This indicates how perfectly cortical matter was removed by manipulation and irrigation. The hyaline membrane is everywhere intact. Sections 1 and 10 exhibit the extremities of the cut where the cornea was not completely divided; in section 2 one half of the corneal wound remains undisturbed with the material of union in situ; in all the other sections, viz., 3, 4, 5, 6, 7, 8 and 9, the lips of the wound have been separated and override or touch each



other at an irregular angle. At the middle of the cut it is evident that the blade of the knife was turned, because the line of the cut is curved. At the summit of the cut, as seen in section 7, the iris is divided very close to the ciliary processes, and the section through the cornea is 2 mm. from the angle of the anterior chamber, and the stump of the iris left, is 1 mm. in length, seen by a low magnifying power. Section 6 shows the stump of the same length. In section 5 the iris is caught in the wound. The thickness of the cornea on the proximal side is greater than on the distal side of the cut. This is especially noteworthy in all the sections except those at the extreme ends of the cut, and the proximal side of the cornea is looser in texture as shown by the spreading apart of the lamellæ and by the display of inter-lamellar spaces. The cornea itself has a slightly wavy outline, especially on the posterior aspect, and its middle is thinner than its extremities. The epithelium of the posterior elastic lamina has in almost all the sections disappeared. The epithelium of the anterior surface of the cornea, on the proximal side, exhibits great activity, on the distal side it shows but little proliferation.

In section 3, where the wound has not been entirely torn asunder, and where the iris is prolapsed into it for half its depth, the anterior epithelium of the cornea is in a state of active proliferation on the *distal* side of the wound, and to a higher degree than on its proximal side. On both sides of the cut the corneal tissue is crowded with lymphoid cells. Those on the proximal side form a stratum of marked density at a little distance below the epithelium, and they are found along a plane occupied by blood-vessels whose sections are seen in the tissue. The intercalated material in section 3 seems to consist of lymphoid cells imbedded in a homogeneous plasma, and similar cells crowd toward it from the adjacent corneal structure, more especially from the proximal side, and the intercalated material approaches the anterior surface of the cornea. The lymphoid cells, where they can be isolated, seem to be surrounded by a body which is more or less elongated, sometimes caudate, and the lymphoid cells then appear



as if they were nuclei. When the epithelial surface of the distal side of the cornea is inspected, the layer of cells is from 7 to 10 cells deep near the wound, and they lie not only flat-wise, but obliquely, and in some cases almost perpendicularly to the surface of the cornea, and cannot be distinguished in form from those which occupy the intercalary plasma or callus of the wound. That portion of the cut of section 3 into which the iris penetrates has been opened by the slight withdrawal of the iris from contact with the borders of the cut, and the tip of the prolapse is covered by a pointed mass of rounded, oval, elongated and variously shaped cells imbedded in a homogeneous material. At this region the substance of the cornea is spongy, opened out by the separation of the laminae, and very few lymphoid cells appear, while the corneal corpuscles are rather numerous. At this point, too, a small quantity of lens matter is found between the iris and the corneal cut. On the posterior surface of the proximal portion of the cornea, in section 3, the epithelial cells of the posterior elastic lamina are numerous and distinct.

In sections 4, 5, 6, 7, 8 and 9, it is on the proximal side of the cut that the epithelium takes on special activity. In section 10 it is pretty equally divided between both sides. In section 1 the epithelial activity is decidedly greater upon the distal side of the cut, and the cut itself is filled with a large mass of new-formed material apparently composed of lymphoid cells exclusively, and at one point these cells break through the epithelium just below the cut. In section 2 the epithelial activity is also greater upon the distal side of the cut, and lymphoid cells seem to be forcing their way through the epithelium of the surface, and the cornea below the epithelium on both sides of the cut is dotted with lymphoid cells. These grow less numerous as one approaches the posterior surface of the cornea. In section 4 the intense activity of epithelium is found on the proximal side of the cut, and in this region the corneal activity is especially noteworthy on this side and deficient on the other side. In section 5 the epithelial activity is very great on the proximal side and almost wanting on the distal side, and the same is true of the cornea. In section 6 the condition



is the same, and in this section the appearance is as if the epithelium had poured itself down into the cut and constituted the chief medium of connection between its opposite sides. The corneal substance is, however, permeated by numerous cells, all pointing toward the cut. In section 7 epithelial and corneal activity are by far the greater on the proximal side, and the appearances in this section favor very strongly the idea of epithelium having thrust itself into the cut. Section 8 shows the same appearance as regards the epithelium and the relative activity of the cornea on the two sides of the cut. In section 9 the epithelium of the proximal side is more abundant, while that on the distal side begins to show an increased activity as compared with the other sections; the cornea on the proximal side is in greater activity than on the distal. In section 10, where the cut through the cornea is incomplete, not reaching the posterior elastic lamina, the epithelium on the distal side exceeds in activity that on the proximal side; while on the proximal side the epithelium is in active proliferation, the distal side of the cut in this section overrides the proximal, and the intercalated material appears to be continuous with the epithelium of the proximal side.

A notable feature of the healing process is found in the great abundance of lymphoid cells in the layers of the cornea which lie some distance below the epithelium of the anterior surface of the proximal side, viz., the region in which blood-vessels can be traced. In every section saving those at the extreme ends of the cut this portion of the cornea is packed with an abundance of lymphoid cells forming a very conspicuous stratum. As we go back from the cut toward the sclera, along this stratum, the lymphoid corpuscles are found to be concentrically grouped around sections of blood-vessels, and they evidently have proceeded from these vessels, and are pressing forward toward the wound. In no portion of either the proximal or distal side of the cut is there such an abundance of lymphoid bodies as in this particular region, and their presence suggests the explanation of the well-known appearance to be seen in the early days after a cataract extraction which is known under the name of striped or striated keratitis.



A study of all the sections makes it evident that by far the larger portion of lymphoid cells which find their way into the wound come from this region and therefore proceed from the circulation. The deeper parts of the cut, lying next to the posterior surface, in all instances contain very few lymphoid cells, either in the cornea or in the cut itself, saving in those regions where the iris had prolapsed. Here the lymphoid cells proceed from the iris itself. In certain sections the lymphoid cells appear to be imbedded in a homogeneous, unorganized plasma.

In some sections a considerable quantity of molecular pigment appears in what may be termed the callus, and it is found also in the adjacent cornea; when in the cornea it appears as if it had entered it from the cut, except in its anterior layer where the blood-vessels are found. The pigment seems to be derived from the blood, although where the iris is prolapsed it might perhaps come from that. (It is proper to observe that this patient had taken nitrate of silver for some disease of the stomach, enough to discolor her skin and give the face and the conjunctiva the well-known dusky blue hue, but not to an intense degree—*i. e.* the condition known as argyrosis.)

In conclusion, it would appear that the healing process goes on with greatest activity in regions nearest to the blood-vessels, and that the healing is effected in large measure by proliferation of the epithelium of the anterior surface of the cornea, and that the activity of this epithelium is in direct ratio to its proximity to the circulation; while a second factor in the healing process is the proliferation of lymphoid cells, which make their way through the corneal structure most abundantly in its vascular parts, and therefore that this process is most active on the proximal side of the wound. The epithelium of the posterior elastic lamina takes no part in the healing process. Besides the new cells, a homogeneous, transparent, unorganized substance forms the plasma in which the cells are imbedded. Lymphoid cells and epithelium become mingled together, both in the callus and, in certain instances, upon the surface of the cornea, especially within the cut. In section 1, where the cut has passed through



only about one-fourth the thickness of the cornea, it is impossible to distinguish between lymphoid and epithelial cells, which are commingled together in the mass of callus. At a little distance from the cut lymphoid cells have pressed forward so vigorously as to force their way through the epithelium and to press it out in a papillary form. To the right and left of this spot the epithelium has been pushed aside. With regard to the fixed corpuscles of the cornea, they do not appear to be specially increased. In a few instances two are found situated in one cavity, but very seldom do they arrest attention. The activity of the healing process is found in the epithelium and in the lymphoid (wandering) cells, which in certain places mingle together so as to be indistinguishable.

*Description of the Plates.*—The illustrations are from photographs kindly made for me by Dr. Randall, of Philadelphia, and to preserve their absolute truthfulness the unavoidable blemishes of the original negatives have been allowed to remain. It will be easy to recognize them. The printing has been most skilfully done by Mr. Edward Bierstadt, of New York. Fig. 1 is taken from section 8, near the temporal side of the cut. The continuity of the epithelium with the callus and its wrinkled appearance are conspicuous. The deeper shading of the superficial half of the cornea is produced by the abundance of lymphoid cells, which come from the vessels situated in this region; one of them is seen in section. The great increase in the thickness of the cornea on the proximal side will arrest attention, especially when compared with the distal side, of which only the tip is shown. Some cortical matter is seen within the capsule.

In Fig. 2, taken from the middle, and being section 6 of the series, the print is less intense but the same general characteristics appear—viz., the increased thickness of the proximal portion of the cornea; the noteworthy proliferation of the epithelium; the shaded streak corresponding to the vascular region of the cornea; also the irregular curve of the posterior surface and the cell proliferation near the canal of Schlemm. The callus has, after the fracture of the edges, remained upon the proximal side, and the membrane of Descemet can be



traced around the angle almost to it. But there is no sign of cell activity in the vicinity of this membrane. The stump of the iris is conspicuous.

Fig. 3 corresponds to section 5 and shows the incarceration of the iris, which had been again pulled out when the wound was opened at the removal of the eye from the cadaver. The picture is quite free from technical blemishes, and shows well the pathological conditions of the cornea.

Figures 4 and 5 approach still nearer to the nasal extremity of the wound and correspond to sections 3 and 2. In fig. 4 the spreading out of the corneal substance, as indicated by the spaces between its fibres, evidences the oedema and swelling of the tissue. The prolapse of the iris is deeper, and the tip of the iris seems to have been pulled away from the intruding epithelium of the anterior surface. Fig. 5 shows the wound not broken open on its outer or superficial portion, and well displays the wavy and irregular line of the corneal epithelium, both on the proximal and distal sides of the cut. Proliferation has taken place in the distal part of the cornea more abundantly than in the other sections. It is also seen that the iris entered to a very slight degree into the cut at this point. The sphincter, or rather the pupillary margin, was nowhere incarcerated. This was seen during the patient's life when the eye was viewed on the 3d day, and at this time the anterior chamber was full. The sections demonstrate that the healing process occurs with greatest activity upon the outer or external surface of the cut, by the agency of the epithelium and of the vessels not far below Bowman's membrane. It may happen that an open space may for some time remain upon the inner (posterior) edge of the cut, and should any leakage occur of aqueous humor during the period when union of the superficial part of the wound has been incompletely established, the iris may find its way into the open space and there remain and grow adherent. It seems necessary to frame some such explanation of the prolapse, because when the eye was first bandaged the restoration of the iris was perfect, so far as could be judged. There can be no doubt that a corneal wound does not unite simultaneously throughout the whole extent of the opposing



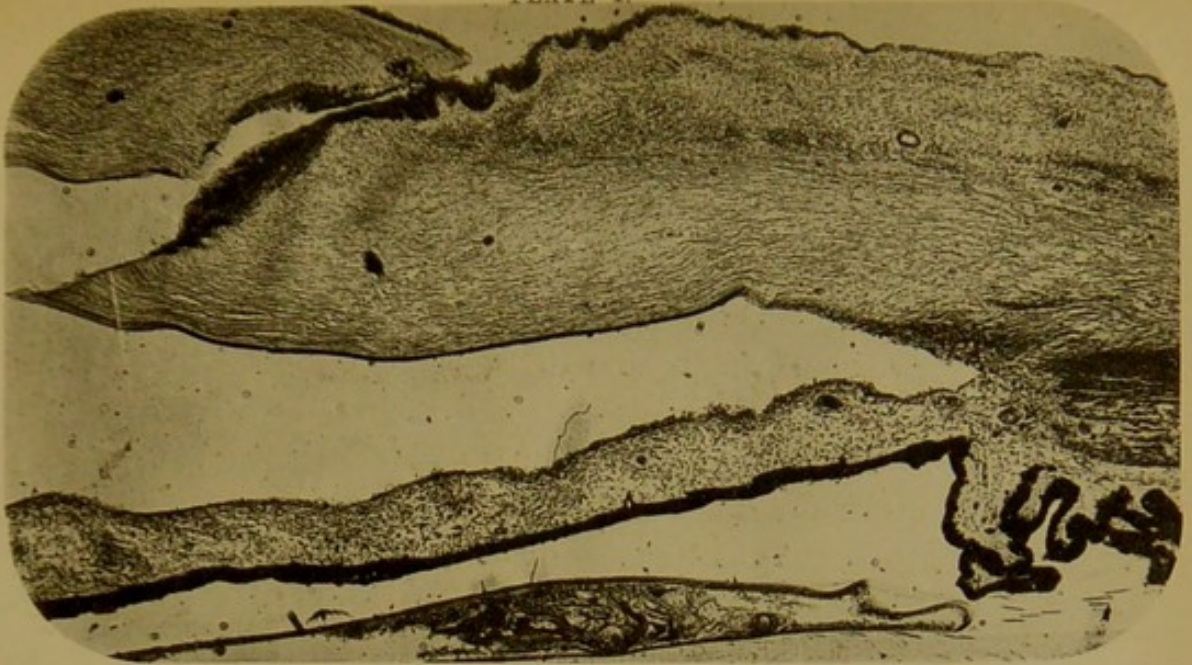


Fig. 1. Section 9. x 35



Fig. 2. Section 6. x 35



Fig. 3. Section 5. x 35





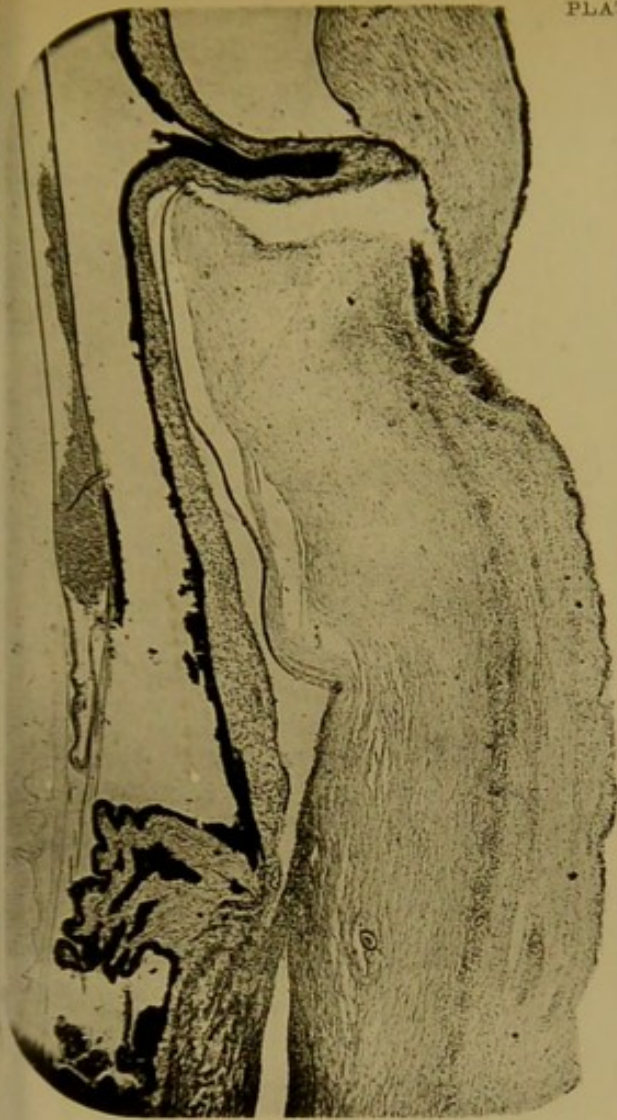


Fig. 4. Section 3. x 35

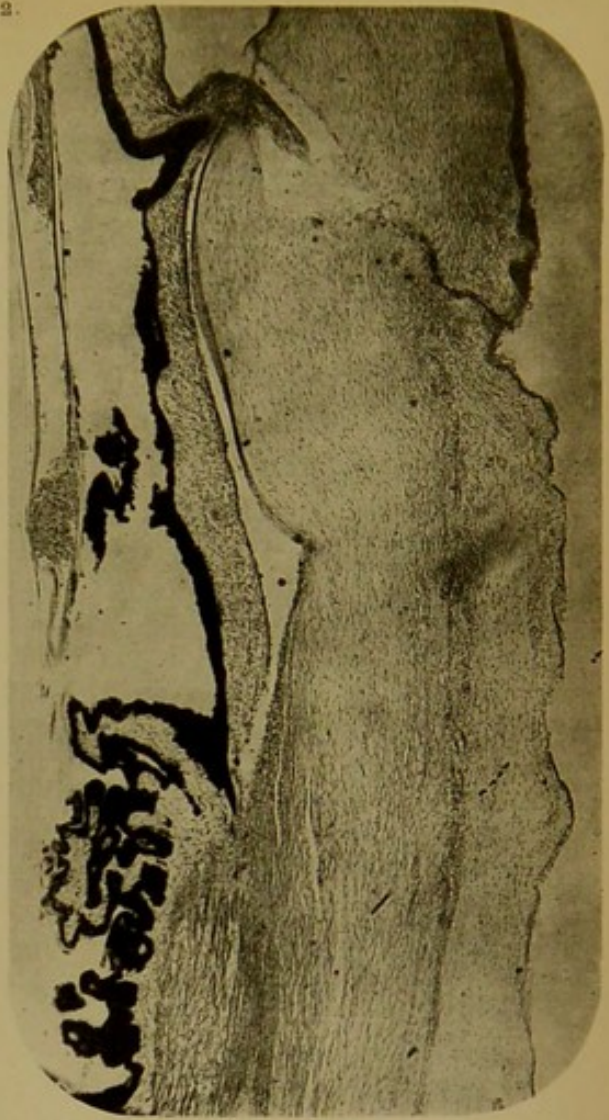


Fig. 5. Section 2. x 35

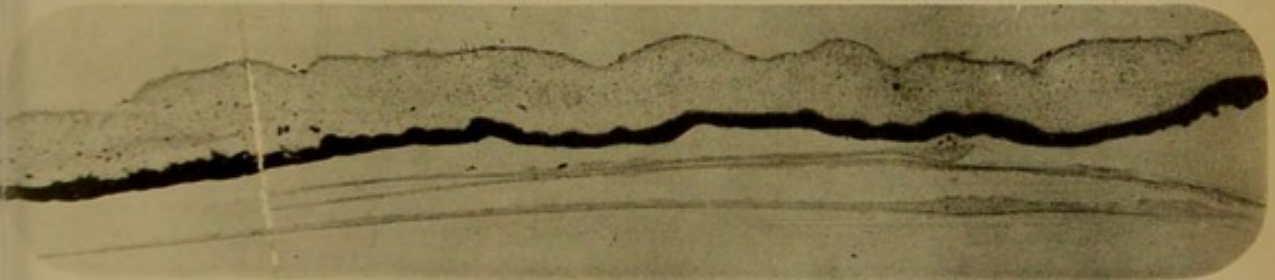


Fig. 6. x 35

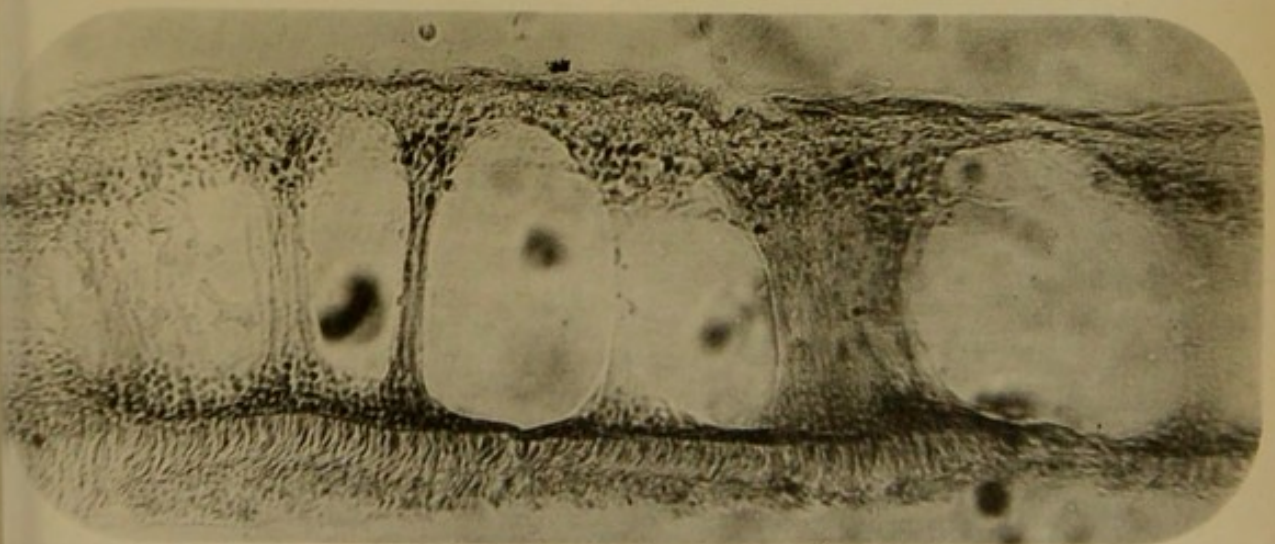
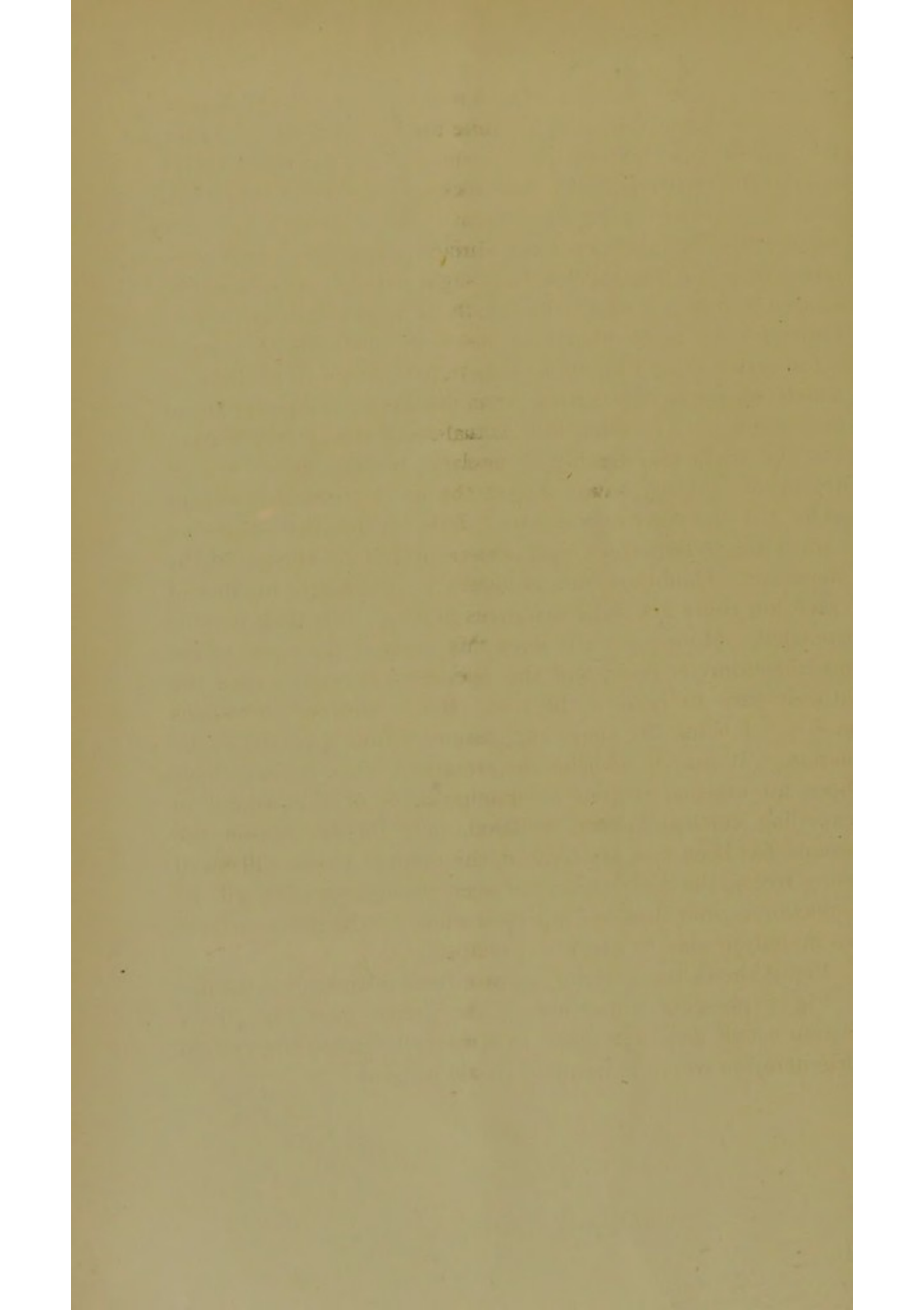


Fig. 7. x 80





surfaces ; on the contrary, this case exhibits a marked disposition of the superficial part to unite the most quickly. Again, the swelling of the proximal portion of the cornea and the notable difference between the thickness of the opposed edges seen in this case upon the 5th day make it evident that the edges of the cut upon the deep surface cannot come into accurate co-aptation, but must form a slight ridge. This is demonstrated in figs. 4, 3, 2, 1. Evidently an opportunity is thus afforded for the iris to intrude, in case some small leakage permits it for only a short time to float up to the cornea. The distance which separates the cornea from the iris at the periphery of the chamber is so trifling that actual contact is extremely easy, and the parts may readily by prolapse become adherent. A degree of mystery hangs about the mechanism of prolapsus iridis after cataract extractions. It is certain that it is not always due to imperfect replacement at the conclusion of the operation. Doubtless this accounts for the larger number of cases, but there are some instances in which this fault may be excluded. More especially does this apply to the cases where no iridectomy is done, and the operator necessarily uses the utmost care to restore the iris. But sometimes prolapsus occurs. I think the above suggestions afford a partial explanation. It may in addition be remarked, that if there have been an unusual degree of manipulation of the wound in expelling cortical matter or blood, or if for any reason the wound has been roughly treated, the corneal tissue will swell more freely, the discrepancy between the opposed lips will be a maximum, and thus by imperfect union of the deep surfaces an invitation may be given to prolapse.

Fig. 6 shows the anterior capsule turned back upon itself.

Fig. 7 presents a portion of the retina near the ciliary region which had undergone in a marked degree the cystoid degeneration which is frequent in old persons.



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