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OPHTHALMOSCOPICAL ATLAS

BY

EDUARD von JAEGER.

Revised and Enlarged by

DR. MAXIMILIAN SALZMANN

Assistant in the II. Eye Clinic of the University of Vienna.

English Translation by

DR. WILLIAM A. MARTIN

Cincinnati O. U. S. A.

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Preface.

The advancement made in ophthalmoscopy, since the first appearance of this atlas, has rendered it necessary to increase the number of images of the fundus of the eye in this, the second edition, as certain recognized typical affections do not appear in the first edition.

At the same time, however, the atlas in its present form is not as complete as the present state of ophthalmoscopy would require, and I hope by means of appendices to supply that, which is wanting.

An important alteration consists in the abridgement of the text. Prominent authorities in the field of ophthalmoscopy have expressed themselves as dissatisfied with the long histories found in the text and in accordance with this feeling, I have omitted all that, which has not a direct bearing on the subject illustrated in the plates. The description of the images themselves has undergone little or no important abridgement. I have only retained the somewhat shortened histories of two cases, as they are unique; the parts cited are unchanged.

The introduction to the first edition also contains much that is uninteresting to the reader of to day; for that reason I have only retained the following unchanged passages, which relate to the images and which are necessary for a correct understanding of the same.

»The exactness with which I have produced the pictures may be judged by the fact, that I copied the direct and indirect image in every case, so as to control by the difference any errors, which might arise,

as well as from the fact, that I mostly required twenty to thirty and even thirty to forty sittings, of from two to three hours each, to prepare the sketch of the image alone (i. e. the sketch and not the complete picture).«

»There has not been a line voluntarily added in any of the pictures, nor have any of them been prepared only approximately like the original. Every physiological and pathological appearance, every separate and even the smallest retinal or choroidal vessel, every exudation or extravasation and every separate deposit of pigment etc., which appears in the picture have been reproduced in their natural size, form, color, position, in their mutual relation to each other and with regard to every separate angle and even the smallest detail etc., exactly as I saw them and was capable of reproducing.«

»I have omitted reproducing any thing, which I could not clearly see or which appeared to me indistinct or uncertain, rather than reproduce it, possibly, in a false way; for this reason my pictures may here and there be criticized for the intentional or unintentional omission of certain details, but it cannot be said of them, that they contain the smallest thing, which did not appear in the original.«

»As much as is wanting in my pictures, I feel free in saying that — with few exceptions, — they are truer to nature than any pictures I have seen, and that it will be a long time before more correct and more exact pictures will be produced in such large number. Although there may well be more capable, one can not readily find such, who are willing to sacrifice so much time and pains.«

»One cannot assert that such a minute exactness is superfluous, or that with a less degree of resemblance they would have the same value and above all, that an ingenius conception and reproduction of the separate cases, or the common resemblance in a number of cases would have a higher value.«

»As interesting and attractive as such a manner of reproducing the pictures might be, such productions have relatively little scientific

value and only a passing worth. The only part of them, which is of lasting value, is that which was copied true to nature with or without the knowledge of the artist. All that part, which was voluntarily added, or which was the expression of an individual conception, will disappear sooner or later, either with the change of views, or with the personality of the artist.«

»The accompanying plates have mostly been copied from the direct image and only in a few cases, for apparent resons, have the indirect images been copied.«

»A *weak plane mirror* (Helmholtz i. e. composed of three plane glasses) has been used in copying the direct image and the character of the picture, particularly in regard to the color and the intensity of the light, must be judged accordingly.«

I cannot flatter myself with having devoted the same attention to the production of my pictures; my expertness with the pencil and brush would be overestimated, if it were thought that I had produced them in two or three sittings. At the same time, however, I can affirm that my plates are also true to life. I have neither schematicized nor added to nature.

I have been induced to use the indirect method in the production of my pictures on account of the form and enlargment, and more particularly on account of the tecnique and colorering of the von Jaeger pictures; they are given in the plates, however, as they appear in the direct method. Furthermore, they are copied with a concave mirror, by means of gaslight, as is the general usage of the present day; this will account for the difference in tint and color, and for the frequency of the reproduction of the choroidal arteries, which is apparent at first glance.

It was particularly difficult to reproduce the old pictures from the existing plates, which by reason of their age were often poorly

preserved; many differences in color may have thus arisen, as it was impossible to correct by comparison with the original plates, which unfortunately have been lost to Vienna.

It is hardly necessary to mention, that in the whole work, in the text as well as in the plates, I have endeavoral to act in the spirit and intention of the celebrated ophthalmoscopist. I have retained his style and his terminology, even in my own descriptions, although many of the expressions have been supplanted by others at the present day. The introduction to the first edition contains their explanation.

»In regard to the different expressions, which might be misunderstood, I wish to remark that in the descriptions of the pictures, under the term optic nerve the visible ocular end of the optic nerve together with the scleral ring is understood; likewise I include under central vessels the entire distribution of the vessels, which emerge from the pylorus nervi optici, and which are distributed over the intraocular end of the nerve and in the retina; on the other hand, under the name of retinal vessels, I only include those parts of the vessels, which are distributed in the retina.«

Time has fulfilled all the expectations of Eduard von Jaeger. His book is accepted as the most important authority in the field of ophthalmoscopy and it has been the means, through which numerous young physicians have been introduced in this important branch of the oculist. It would be a boldness, as I well know, to place my self on the same level with Eduard von Jaeger, and I only ask that my colleagues will be indulgent in their judgement.

I can refer to no publications of my own, in the description of my plates, in which an explanation of the appearance pictured may be found and the literature for many of the cases is so voluminous, that it would be impossible to cite it completely. Those readers, who wish to obtain further information in regard to the different anomalies pre-

sented, I would refer to Dimmer's book. »Der Augenspiegel und die ophthalmoskopische Diagnostik«, which comprises not only the present state of ophthalmoscopy, but has especial reference to the plates in this atlas.

In conclusion I wish to thank all those, who have lent me their assistance in the production of the new plates, particularly Dr. Dimmer whom I must thank for advice and encouragement, Professor Fuchs who placed the material in his clinic at my disposal and Theodore Bannwarth, who has most carefully executed the technical portion of the work.

Vienna, May 1890.

The Editor.

The peculiarities in the style of Eduard von Jaeger has rendered it difficult in many places to give a smooth translation, and rather than rewriting in a style of his own the translator has endeavored to follow, as nearly as possible, the original text, sacrificing beauty of style for correctness of the translation.

Vienna, June 1890.

The Translator.

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Plate I. Fig. 1.

Synechiae Posteriores.

The pupil is considerably dilated and irregular in shape, while the pupillary margin of the iris is adherent in many places to the anterior capsule of the lens, and the exudation, which is covered with a dense pigment, projects into the pupil in the shape of delicate, sharply defined cones. The free margin of the pupil extends in arches between the adherent parts. The larger portion of the pupil is clear, with the exception of a slight opacity in the central part of the anterior capsule of the lens.

Plate I. Fig. 2.

Synechiae Posteriores.

The pupil is normal in shape and dilated to its full extent. The peripherical portion is perfectly transparent, the central part however is duller, presenting a slightly grayish opaqueness and is distinctly outlined to a great extent, by tolerably dense deposits of pigment on the anterior capsule of the lens. The pigment spots are partly pointed, partly conical in shape.

Plate I. Fig. 3.

Cataracta Corticalis Centralis Antica.

In the middle of the pupil there is a black saturated opacity $3\frac{1}{2}$ *mm* in extent, and which consists of a long thick and a shorter narrower stripe. They are united in the center of the pupil, the smaller joining the middle of the larger stripe. The rest of the pupil is normally clear, and of a yellowish red color. There is no parallactic deviation noticeable between the opacity and the margin of the pupil.

Plate I. Fig. 4.

Cataracta Corticalis Centralis Antica.

In the middle of the pupil there is a dark blackish opacity, which consists of three arms united at their thickest ends and at equal angles in the middle of the pupil, thus forming a figure like an inverted Λ. It shows no noticeable parallactic deviation with the iris.

Plate I. Fig. 5.

Cataracta Corticalis Antica Centralis et Peripherica.

In the dilated pupil, one sees a sharply defined, saturated opacity of the anterior cortical layers. It consists of a stripe uniform in width, which extends obliquely from downwards and inwards, upwards and outwards about 3*mm* in length, and which is joined ut the ends by four pointed cortical stripes, which come from the equator of the lens; there is also a smaller, isolated, pointed stripe, which extends from the outer-lower periphery towards the middle of the lens. The middle portion of the opacity does not show any parallactic deviation, the periphery however shows a slight parallactic deviation with the margin of the pupil.

Plate I. Fig. 6.

Cataracta Corticalis Postica, Centralis, Striata.

In the posterior pole of the lens, there is a saturated, narrow, ring-shaped opacity, which is surrounded by only a small amount of clouded cortical substance. Projecting from the circumference of the opacity, there are six extremely fine, pointed cortical stripes of unequal length, which extend in different directions toward the periphery. The remaining portion of the lens is perfectly transparent. The opacity is situated considerably behind the plane of the iris, and can not be distinctly seen at the same time with the iris; on movement of the eye, it shows considerable parallactic deviation within the pupil, toward the opposite side.

Plate I. Fig. 7.

Cataracta Corticalis Postica Centralis.

In the generally well iluminated pupil, there are differently shaded grayish and some almost black opacities; there is a central, denser roundish opacity, lying in the posterior pole of the lens, which is marked in the middle by a very dark point and encircled by a dark ring. This central portion is surrounded by a continuous, lighter colored, and irregularly punctated opacity, extending from which toward the periphery are other longer or shorter, irregularly wide, conical and flame-shaped, isolated opacities, which are marked by dark radiating stripes. The opacity presents a con-

cavity corresponding to the posterior surface of the lens; the middle part is most widely removed from the plane of the iris, while the ends of the radiating projections approach nearer the the same. On movement of the eye one sees, particularly in the middle portion of the pupil, a distinct parallactic deviation, where at the same time, apart from their oblique position, noticeable variations in the shapes of the opacities are visible.

Plate I. Fig. 8.

Cataracta Corticalis Centralis Antica et Postica, Iridodialysis Traumatica.

The pupil is widely dilated, and irregular in shape, because the upper portion of the iris is separated from the ciliary margin. From this cause a second iris is formed, shaped like a segment of a circle. Within the latter, there is no opacity observable; on the contrary the margin of the lens, the normally wide Petit's canal, and ciliary process projecting into it are all distinctly visible. In the original pupil however, one sees two opacities, one lying in the anterior, the other in the posterior cortical layers of the lens. The part lying between these opacities, as well as the peripherical part of the lens is transparent. The anterior opacity does not show any parallactic deviation, and consists of four sharply defined, radiating saturated stripes of unequal length, which lie in the region of and extend toward the anterior pole, but do not reach it. The posterior cortical opacity consists of a delicate, extensive opaqueness, which becomes gradually fainter toward the iridodialysis; but on the other hand extending from the upper, inner, and lower sides, there are seven dark, irregular projections with rounded ends, which are hemmed in by a dark line, that runs parallel to and sligthly removed from their borders. The posterior opacity shows considerable parallactic deviation, both with the pupil, and with the anterior opacity.

Plate II. Fig. 9.

Cataracta Corticalis Striata Peripherica. [1])

In the dilated pupil there is a blackish striped opacity, lying in the periphery, which is radiately arranged. The various stripes are triangular in shape, and of different length and width. Their wide bases extend be-

hind the pupil nearly to the margin of the lens, while the larger pointed portion extends into the pupil. The anterior stripes show only a slight parallactic deviation, which comparatively speaking is greatest at the broad ends. A few such stripes lie deeper in the eye, in the posterior cortical layers, and their pointed ends make the most rapid movements in relation to the pupillary margin. The several opacities of the anterior and posterior cortical layers are mostly united at their bases.

Plate II. Fig. 10.

Cataracta Corticalis Striata Peripherica.

In the outer half of the pupil, one sees a delicate indistinctly outlined, grayish black opacity of a triangular shape, which extends from behind the iris toward the center of the pupil. It shows no particular parallactic deviation with the pupillary margin, and consequently lies in the anterior cortical layers.

Plate II. Fig. 11.

Cataracta Corticalis Striata Antica et Postica.

In the pupil, which is mostly normally clear, there are four narrow, sharply defined stripes visible, which show no essential parallactic deviation with the margin of the pupil. The longest one, which ends bluntly, extends beyond the middle of the pupil, the one which lies downwards and inwards extends almost vertically upwards. In the lower part of the pupil there is a shorter, wider, less sharply defined and deeper lying opacity, which is directed towards the posterior pole, and which shows considerable parallactic deviation.

Plate II. Fig. 12.

Cataracta Corticalis Striata Antica et Postica.

The central portion of the pupil is well illuminated, towards the periphery however, it becomes more and more darkened, as a large number of distinctly and indistinctly defined, blackish or more grayish triangular stripes extend towards the middle of the pupil.

The longer, darker stripes stretch slightly convexly, immediately behind the plane of the iris, and show only slight parallactic deviation. Whereas the majority of the delicate, shorter, grayish opacities extend concavely, at a considerable distance from the plane of the iris and show a decided parallactic deviation.

Plate II. Fig. 13.

Cataracta Corticalis Striata Antica et Postica.

In the inner and lower part of the dilated pupil there is a partial striped opacity of the anterior, as well as of the posterior cortical layers, while the outer and upper part of the pupil is clear. The blackish, saturated, narrow, sharply defined opacities, which extend to the pole of the lens, and which send off extremely fine, pointed projections, lie in the posterior cortical layers. The opacities of the anterior layers are grayish, shorter, broader and less sharply outlined.

Plate II. Fig. 14.

Cataracta Corticalis Antica et Postica. [2])

In the dilated pupil a central, posterior cortical opacity is visible, which is in the form of a seven pointed star with blunted tips. It shows a decided concavity, and consists of an innumerable quantity of longer or shorter dark stripes, which lie so closely in the body of the star, that it appears completely opaque; whereas in the peripherical portions the stripes are more isolated, and thus give to the margin a fine dentated appearance. Besides the above there are other peripherical cortical opacities, which also consist of delicate, saturated stripes of different lengths, and which lie, partly isolated, partly united in small triangular groups, and the longest stripes of which extend into the spaces between the branches of the central opacity in the posterior cortical layer. The posterior cortical layers, lying between these two opacities, are clear. The margin of the anterior cortical opacity is not so broken, otherwise it is of the same character as the former, only it is less saturated and sharply defined, so that it appears fog-like and of a smoky gray color.

Plate III. Fig. 15.

Perinuclear Cataract. [3])

There is a round sharply defined opacity visible in the dilated pupil. It measures four millemeters in diameter and is of such a delicate, uniform grayish black color, that the fundus of the eye may be seen shining through. It lies in the middle of the pupil and deep in the lens, and is surrounded in the direction of the equator, as well as in the direction of the axis, by the transparent substance of the lens.

The uniformity of the opacity and the lentiform shape would indicate, that only a few central, connected fibres of the lens are opaque, and that the inclosed substance of the lens is perfectly transparent.

Plate II. Fig. 16.

Perinuclear Cataract.

There is a round opacity, seven and one half millemeters in diameter, lying behind the plane of the iris and almost filling the pupil. It is of a light grayish color clearer in the middle and darker in the periphery, and is surrounded by the transparent portion of the pupil, which appears as a very bright circle of light.

Plate III. Fig. 17.

Perinuclear Cataract with Striped Opacity of the Peripherical cortical Layers.

In the dilated pupil there is a sharply defined, lentiform opacity visible, and on its outer borders there lie other short, striped opacities, which are of different lengths and of a more or less triangular form. The first appears of a reddish gray in the middle, and in the periphery of a darker gray color. The marginal opacities appear of a saturated black, and are radiately arranged, in unequal distances, around the border of the lentiform opacity. They do not touch the perinuclear opacity; their pointed ends extend toward the middle of the pupil, and their wide ends slightly beyond the perinuclear opacity, and curving in conformity to the margin of the lens continue on backwards.

Plate III. Fig. 18.

Perinuclear Cataract with striped Opacity of the Peripherical Cortical Layers. [4])

Lying deeply in the dilated pupil, there is a sharply defined, lentiform opacity 6 ½ *mm* in diameter, and in front of the same, occupying a larger circle, are a number of longer or shorter, striped cortical opacities, which project towards the axis of the lens. The first is in the center of a lighter, in the periphery of a darker smoky gray color, through which the yellowish red fundus of the eye may be seen. Viewing it from the side, one can see that the cortical opacity arches from the posterier into the anterior hemisphere of the lens, and is separated from the deeper opacity by a layer of transparent cortical substance.

Plate III. Fig. 19.

Downward Dislocation of a Transparent Lens.

The dilated pupil cannot be evenly illuminated. The lower and larger part, limited by a convex border, appears in a darker yellowish red light, while the upper, crescent-shaped portion appears of a brighter yellowish red. In the lower part there is a myopia of $^1/_{45}$, in the upper part a hypermetropia of $^1/_4$.

The upper part of the dark margin lies considerably behind, while the lateral portions approach nearer to the iris. Its curvature corresponds to the margin of the lens. The dark portion is bounded above by a sharp linear border, while in the lower portion it fades away without having any distinct margin. On movement of the eye it, as well as the iris, vacillates considerably in an antero-posterior direction.

Plate III. Fig. 20.

Exudation and Extravasation into Petit's Canal. [5])

Lewis R — laborer, 27 yrs. old, percieved suddenly, after he had been working hard in the sun for several days and at the same time indulging freely in spirits, a strange feeling in the left eye. He was partly blinded, not being able to see in near

distances so well as formerly. At first the subjective feelings disappeared, with the exception of bad sight for near distances; but after intervals of 6 weeks and 3 months he experienced similar, but more aggravated attacks. Three weeks have elapsed since the last attack.

The left eye is emmetropic, the accommodation is completely paralyzed, with convex 12″ he can read Jaeger No. 1 at a distance of 7″. In the inner angle of the eye the conjunctiva is slightly swollen, and reddened; the pupil reacts slowly and is some what dilated on account of the retraction of the inner-lower pupillary margin.

On looking into the eye, after a maximal dilatation of the pupil, one can see that the lower margin of the lens is bordered by a yellowish white, ribbon-like opacity, which is mottled with blood-red spots. The surface, which is turned toward the lens is concave in a meridional and equatorial direction, corresponding to the surface of the lens, and is of small breadth in an antero-posterior direction (corresponding in depth to the distance between the points where the anterior and posterior lamina of Petits canal are attached to the capsule of the lens). It is sharply defined anteriorly, as well as posteriorly, and in the direction of the equator of the lens is four lines in length. Consequently this opacity is of considerable thickness, and completely fills the space, between the margin of the lens, and the ciliary process (Petit's Canal). Within its limits therefore, there is no reflex from the fundus through Petit's Canal, and the margin of the lens is not normally distinct; in the remaining portions however, the lens and Petit's canal are normally transparent, and the margin of the lens may be seen with the ordinary dark contour.

In respect to its mass the opacity appears very compact and dense. It reflects the light strongly and shows on its upper ends, only to a slight degree, a saturated, yellowish white color, which is more delicate and some what transparent. The blood-red spots on the concave surface of the ribbon-like opacity are of a long irregular shape, of various sizes, and are only sharply outlined in parts, and appear to be of slight consistency.

According to the foregoing description, this opacity would appear to be not only filling out that portion of Petit's canal surrounding the inner-lower margin of the lens, but to be limited to this canal, and to have its origin in an exudation or extravasation from the ciliary process.

Plate III. Fig. 21.

Opacities in the Vitreous.

When the eye is at rest there is a uniform smoky opacity in the vitreous. On movement of the eye an innumerable quantity of minute particles, mingled with somewhat larger, dark brown and blackish points, are thrown up from below and spread out like a cloud, particularly, in the anterior and middle region of the vitreous. When the eye is again at rest, first the larger, then the smaller particles sink to the bottom of the eye and the vitreous clears from above downward.

Plate III. Fig. 22.

Opacities in the Vitreous.

When the eye is quiet the vitreous is transparent. When the eye is moved the vitreous is permeated with dark flakes of a substance, which appear as compact, opaque bodies of a dark reddish brown, almost blackish color, and of various shapes and sizes. A few of them are almost round and some even globular, while others are longer, branching, thread-like or wedge-shaped. When the eye is again quiet, the movements of the opacities become slower and they gradually settle from the limits of the pupil to the bottom of the eye.

Plate III. Fig. 23.

Opacities in the Vitreous.

The anterior part of the vitreous is of a fluid consistency and contains blackish, floating flakes; the posterior part is not softened and its anterior surface is covered with numerous opacities. This surface is wavy and extends from the outer-lower portion of the ciliary body, upwards and backwards, towards the upper-inner equatorial portion of the eye. On movement of the eye it is also thrown into a wavy motion. The opacities, which lie in this surface, are of a lighter or darker reddish brown and even of an almost black color; some appear delicate and dust-like, others are larger and more compact and form irregular flakes, stripes or lumps. In the peripherical portions the opacities are more scattered; in the central portions more numerous, and form here a large irregular flake of a membranous appearance.

Plate III. Fig. 24.

Cholestearin Chrystals in the Vitreous.

The dilated pupil is not as clear as normal, but seems of a light smoky-gray color and is filled with an innumerable quantity of particles, which glitter like gold and silver, and sparkle like stars. On movement of the eye those, which lie in the middle and lower parts of the vitreous, are thrown into eddies and mingle with each other, while in the peripherical portion there are a number of particles, which remain fixed.

Plate IV. Fig. 25.

Fundus of a Healthy, Normal Eye of an Individual with Light Brown Hair.

The optic disk is nearly round and mostly of a yellowish white color, which is most marked at the point of entrance of the central vessels and in the adjoining portions of the outer segment; towards the periphery this yellowish white color changes, on the outer side to a delicate gray, and in the other directions to a light red. The delicate grayish color is perfectly uniform, darkest on the margin of the optic nerve, by which means the latter is distinctly outlined, though without any sharp contour. Above and below, the grayish color gradually merges with the red. The latter is most distinct in the upper and lower parts of the disk between the large vessels and is less marked on the inner side. It consists of a delicate uniform red, increasing in intensity towards the margins, which lies in the deeper layers, as well as, of a fine, radiated, striped portion, which lies in the superficial layers and which continues on into the yellowish-red fundus of the eye.

The surface of the disk lies in the plane of the retina, with the exception of a small depressed portion at the point of entrance of the vessels.

On focusing for a greater distance, the middle yellowish white portion is seen to be covered by delicate grayish spots. These spots are not sharply outlined, in the center they are roundish, in the periphery more of a longish shape and for the most past are radiately arranged. They correspond to the openings of the lamina cribrosa.

The disk of the optic nerve is completly surrounded by a bright seam, — the scleral ring, which has an average width, that corresponds to that of one of the larger central arteries. The border of the scleral ring towards the disk is less distinctly marked, the outer border towards the yellowish red fundus of the eye is more distinct, especially on the outer side, where it is bordered by a dark brownish red pigmentring. On the outer side it is altogether more distinct, brighter and of a uniform whitish color; on the other sides it is blurred by the superficial, reddish stripes of the optic nerve, which pass over it.

The pigment ring, referred to above, gradually diminishes above and below; on the side of the scleral ring it is sharply defined, but it is not distinctly outlined from the other parts of the fundus. It consists of very delicate, dark granules of pigment, which lie closer together and are more or less blended on the inner side, while on the outer side they are more isolated. It lies some what deeper than the plane of the optic disk.

The central vessels emerge somewhat inwards from the middle of the optic disk; there are three separate veins, but the arteries have only one main trunk in common. The two lower veins emerge obliquely from the optic nerve, and for this reason are at first indistinct and of a lighter color, but gradually they assume their normal color and contour. The upper vein, however, emerges in the direction of the axis of the nerve, on the surface of which it bends almost at a right angle. The angle is of a dark red color and hides the perpendicular portion of the vessel, so that the vein appears to end bluntly at this point.

The arterial trunk also approaches the surface of the disk in a perpendicular direction, where it immediately divides into two branches, which pass upwards and downwards: as they run in diametrically opposite directions, they appear to have a part in common, which completely hides the main trunk. The latter is only marked by a blood-red, quadrangular spot, while at this point there is no reflex from the surface of the vessel.

There are also numerous small vessels, which emerge from the surface of the disk.

In their further course, all the vessels lie in the same plane: the larger branches encircle the macula lutea in large curves, and then, together with the other branches, are distributed evenly to the remaining portions of the fundus of the eye.

All the vessels divide in a simple manner and diminish in size accordingly. They lie principally in the same level, but in the plane of the retina; their course is more or less winding.

All the vessels, in consequence of the reflection [7]) of light, are lighter in the middle and are bounded on each side by a single, darker, ribbon-like contour, which merges gradually with the brighter middle portion, but which is sharply defined on the outer side. There is no noticeable reflex in the middle of the smallest vessels.

The veins are larger in diameter, of a darker color and have wider contours than the arteries; they are also more winding, divide at greater angles and lie somewhat deeper. The arteries are $^1/_4$ to $^1/_3$ narrower than the corresponding veins, they are of a blood-red color and their reflex is wider and brighter: they run in a straighter course, divide at smaller angles, and lie more superficial than the veins.

The retina is everywhere transparent and, only by certain illumination, one is able to notice a glassy-like reflex from its surface.

The macula lutea lies $1\,^3/_4$ diameters of the disk, horizontaly outwards, from the margin of the disk. Vessels converge toward it from all directions, but it itself appears to be devoid of vessels. In its region, the fundus of the eye is of a darker color.

Beyond the disk, in the part of the fundus occupied by the choroid, the fundus of the eye appears of a yellow-red color and punctated in all parts by dark reddish granules. The separate granules are of an angular or branching shape, are fewer in the neighborhood of the disk and more numerous in the region of the macula. They lie perceptibly behind the plane of the retinal vessels.

Plate IV. Fig. 26.

Fundus of a Healthy, Normal Eye of a Dark Haired Person.

In the region of the choroid the fundus of the eye is of a darker, more brownish yellow-red color, the granulation is more distinct, as the separate points of pigment are larger, darker and more numerous. This is particularly the case in the region of the macula lutea, from which cause, it there appears of a darker reddish brown color. In the middle of this re-

gion there is a small, brightly shining, yellowish white point, roundish in shape and having a diameter about the size of one of the smaller retinal vessels. This point is two diameters of the disk from the margin of the opticus and lies somewhat deeper than the middle of the disk.

The optic nerve is surrounded on the outer side by a dark reddish brown, almost blackish ring of pigment of considerable width, and on the inner side by a narrower, lighter colored ring.

The scleral ring is visible all the way around, it is of a bright whitish color, its outer margin is much sharper, while on the other hand its inner border is much less distinct than in the foregoing case.

The optic disk is mostly of a whitish yellow color, the pheripherical portion is of a light bluish gray on the outer side and on the other sides of a faint reddish color.

In other respects it resembles the foregoing case.

Plate IV. Fig. 27.

Fundus of a Healthy, Normal Eye of a Blond Person.

The circumference of the optic nerve is well marked, but not outlined by any pigment ring. The scleral ring is distinctly visible throughout its whole circumference; it is of a whitish yellow color and somewhat widened on the outer side; both margins are about equally well defined.

The optic disk is of a yellowish white color in the middle portions and in the periphery of a faint reddish color.

The fundus of the eye, in the region of the choroid, is of a light reddish yellow color, distinctly, but sparsely granulated; the different granules are very delicate and of a pale red. In the region of the macula alone, they are more numerous and crowded closer together. The larger vessels of the outer layer of the choroid are more or less distinctly visible, as ribbon-like stripes of an orange-yellow color.

Plate IV. Fig. 28.

Fundus of the Eye of an Albino.

The optic nerve is of a reddish yellow in the central part, and in the periphery of a delicate red (Hematin-red) color; its circumference is

not sharply defined and the lamina cribrosa is not visible. The scleral ring presents itself as a wide whitish seam, both borders of which are very indistinct. The central vessels are normal, excepting that the veins are a little tortuous.

The fundus of the eye is, in general, of a yellowish white color and is devoid of the usual granular appearance. In the region of the macula lutea only, there are scattered points of pigment, which within the macula lie closer together and give to this place a faint reddish yellow color.

The outer network of choroidal vessels is plainly visible, excepting in the region of the macula lutea, where it is covered by the granules of pigment, which lie more superficial, and thus rendered indistinct. In the interstices of the network the finer vessels of the middle layer are visible.

The choroidal vessels are distinguishable as lighter or darker orange-yellow, ribbon-like stripes, evenly colored thoroughout their width, which are more or less winding and spread out towards the periphery, and which repeatedly divide and frequently anastomose with each other. By this means a more or less extensive irregular network is formed, which lies considerably behind the retinal vessels.

Plate V. Fig. 29 and 30.

Direct and Indirect Images of a Normally Constructed Eye.

In the indirect image (Fig. 29) the central part of the optic disk appears of a whitish yellow color, towards the outer side of a very delicate reddish gray and in the upper, inner, and lower parts of a faint reddish color, and is marked by delicate radiating stripes. On focusing for the deeper layers, the lamina cribrosa becomes distinctly visible. The margins of the disk, as well as of the yellowish white scleral-ring, are distinctly marked on the inner and outer side, but above and below are not so distinct; on the inner side there is a smaller and on the outer side a larger seam of pigment.

In the center of the macula lutea there is a small brilliant spot of about the diameter of one of the larger veins, which is round, distinctly outlined and of yellowish white color. Within the same there is a small, black, wedge-shaped spot with its base in the upper-outer margin of the

yellow spot and its apex directed towards the center of the same. The yellow spot itself lies in the middle of a brownish red triangle, which is of a darker color towards the spot and of a lighter color towards the periphery. Its boundaries are tolerably distinct and it is more densely granulated than the remaining portions of the fundus.

In the indirect image, (Fig. 30) the optic disk appears of a reddish color, lighter in the middle and considerably darker in the periphery. The scleral ring is indistinct, while on the other hand the pigment ring is more prominent and considerably darker. The background of the eye is of a dark yellow-red color, without any distinguishable granulation; in the periphery the choroidal vessels, to a greater or less extent, are visible as light reddish stripes, and the spaces between them as darker spots of a light reddish brown color. The inner surface of the retina has a distinct glassy like reflex.

On the other hand the macula lutea presents quite a different appearance. One sees there an oral, sharply defined, tolerably evenly colored, dark brownish red spot encircled by a bright yellowish white seam, which is indefinitely bounded on the periphery. In the middle of the oval spot the dark triangle is scarcely and the yellow spot not at all visible. The whole image is vague and indefinite, as the slightest movement of the convex lens causes it to swim about in different directions, and at the same time changes its form and size.

Plate V. Fig. 31 and 32.

Direct and Indirect Image of an Astigmatic Eye.

In the direct image, (Fig. 31) the fundus of the eye appears darker than usual and is distorted in a vertical direction.

The optic nerve, which is distinctly outlined only on the outer and inner sides, is ovaly elongated in an almost vertical direction. In the middle it is excavated and of a yellowish white color; in the bottem of the excavation the lamina cribrosa is visible. The peripherical portions are of a decided reddish color, which is quite uniform on the outer and inner sides, fading away towards the periphery; above and below however, it becomes more intense and passes gradually over into the color of the

remaining portions of the fundus, whereby there arises a delicate, superficial, reddish striation, that is most distinct at the margin of the nerve, and which extends a distance of two or three diameters of the disk into the fundus of the eye. The stripes are radiate and spread out in the shape of a fan above and below the disk; directly above and below the disk they are most numerous and darkest, latterally they are fewer and gradually lose themselves in the reddish yellow color of the outer and inner portions of the fundus of the eye. By means of this striation the upper and lower borders of the disk are completely hidden; while on the other hand the outer and inner margins, the curvatures of which are noticeably flattened, are very plainly outlined by seams of dark brownish red pigment, and here the scleral ring is also visible, although it is not distinctly separated from the trunk of the nerve.

The central vessels are of a dark color; they do not divide so frequently and they are much straighter than in a normal eye. They are crowded together, principally, in two main bundles, which pass upwards and downwards within the limits of the fan-shaped stripes, beyond which, they spread out in a radiate direction in the fundus of the eye. For this reason the outer and inner portions of the fundus appear very devoid of vessels.

In the indirect image the optic disk appears still longer, but is distorted in a horizontal direction. The stripes seen in the direct image are not visible. A greater portion of the margin of the disk is distinctly visible, and is surrounded by a dark brown, almost black seam of pigment, which is widest on the side of the macula lutea. The scleral ring is not visible.

Only the main stems and principal branches of the central vessels are visible, from which cause, the whole fundus seems poorly supplied with vessels. They run also in an entirely different direction; instead of passing upward and downward as in the direct image, the vessels spread apart sooner and run toward the outer and inner parts of the fundus, where they divide into smaller branches. Consequently the upper and lower portions of the fundus seem poorly supplied with vessels, a contrary appearance to that of the direct image.

The inner surface of the retina reflects the light strongly.

Plate VI. Fig. 33.

Division of the Optic Nerve.

Gustav N., son of a peasant, 12 yrs. of age, has not had sharp vision since childhood, otherwise he has not noticed any trouble with his sight.

Externally both eyes appear normal in shape and healthy. The pupils are normal in size and mobility.

With the right eye he can read Jaeger no. 3 at distance of 3", but only with the greatest exertion; with the left eye he reads with difficulty Jaeger no. 4 at a distance of $4^1/_2$".

Both eyes are hypermetropic, the right H $^1/_{30}$ and the left H $^1/_{21}$.

The greater portion of the fundus of the left eye within the limits of the choroid is of a normal yellow-red color and granular appearance; but above and below the disk to an extent of two or three diameters of the disk, it is of a darker color caused by an extremely delicate reddish striation. The reddish stripes commence at a line in the optic nerve, which extends obliquely from the inner-upper to the outer-lower portion of the nerve, and which divides the nerve into two almost equal parts; they spread out in the same direction over the margin of the disk, upward and outwards, as well as, downwards and inwards into the fundus of the eye. They are so delicate and indistinctly marked, that they can only be seen by the most exact focusing and close examination. The separate stripes, at their commencement in the optic nerve, are curved slightly inwards and backwards, as though they came out of the nerve like the central vessels, and like them curved over into the retina. In the rest of their extent they run mostly straight and parallel with each other, until they reach a distance of one and one half or two diameters of the disk from the margin of the opticus, where they spread out somewhat in the shape of a fan. The striation is most distinct in the periphery of the nerve and near the margin of the disk, the latter being thereby completely hidden; it is most dense in the middle part of the disk, in the region of the central vessels. On the outer and inner sides it is not so dense and more interrupted, and the tissues are more transparent; towards the periphery it becomes less dense and distinct and is finally lost, having no distinguishable margin. This striated appearance corresponds in position to the surface of the optic nerve and to its division in the retina; the different stripes are not so radiately

arranged (as mentioned above) and are not so uniformly distributed, as is the case with the opticus, and they also hide more or less completely portions of the central vessels, most particularly the smaller branches.

The optic disk, which is distinctly outlined only on the outer and inner side, appears to be normal in size, but is oval in the direction of the reddish striation *viz.* from upwards and outwards, downwards and inwards. The trunk of the optic nerve is of a dirty reddish color throughout, and the yellowish white scleral ring is visible on the inner, but is most distinct on the outer side.

The central vessels, of which the large venous trunks that pass upward and downward are the most prominent, are absolutely irregular in their course and in their manner of division; the division is less frequent and the smaller vessels are noticeably few in number. They are not given off, as is usually the case, from a few main trunks, but emerge separately, side by side, in small curves from the peripherical portions of the optic nerve, and pass upwards and downwards in a noticeably straight course and in the same direction as the striation into the fundus of the eye. They are thus crowded together in the midst of the reddish striation and only spread out in a slight degree, after having passed a considerable distance beyond the margin of the nerve, — where above and below at the same time single branches are given off from the main stems, which encircle the macula lutea in large curves. There is no division of the vessels visible, either on the outer or the inner side of the optic nerve. — On account of this peculiar division of the vessels the upper and lower part of the fundus appears to be well supplied, while the outer (at the point of and surrounding the macula lutea) and particularly the inner part of the fundus appear almost devoid of vessels.

The retina is everywhere normally transparent, except in the portion occupied by the striation, and the macula lutea is not more marked than usual. The appearance of the fundus in general is similar to the direct image of an astigmatic eye, with the long diameter of the disk in a vertical direction; it differs from it however, most particularly from the fact, that the image remains the same, both in the direct and indirect examination.

The examination of the right eye gives the same result, only the details of the image are not so distinct.

Plate VI. Fig. 34.

Medulated Nerve Fibres in the Retina.

The optic disk is of a delicate reddish color and, as well as the scleral ring, is only of a normal shape and sharply defined in the outer-upper and inner-lower circumference. The remaining parts of its periphery are covered by three flame-shaped patches, which spread out into the otherwise normal fundus of the eye.

These patches are partly of a whitish, partly of a reddish yellow color, they have a silky lustre and on the periphery are marked by extremely fine stripes, which correspond to the expansion of the optic nerve. They begin indistinctly in the periphery of the optic disk and become more distinct in the yellow-red fundus of the eye, although they never appear with a sharp contour.

Besides these three patches there is also a fourth one visible, which is slightly removed from the inner and lower border of the optic nerve, so that beween it and the spot there is a narrow ribbon-like portion of the fundus visible.

All the spots lie in the plane of the retina, in front of the choroid and mostly somewhat deeper than the retinal vessels. In some places however, the vessels seem to be more or less deeply imbedded in the white patches and are thus more or less indistinctly hidden.

Plate VI. Fig. 35.

Medulated Nerve Fibres in the Retina.[8])

The middle portion of the optic disk is slightly excavated and of a yellowish white color; in the peripherical portion it is of a reddish color, which is uniform in the inner and outer parts and above and below marked by delicate stripes. The outer and inner margins are distinct, have a normal scleral ring and are sharply defined by a brownish red pigment ring; the upper and lower borders are not visible, while from there yellowish white, bright shining patches spread out, upwards and downwards, for a considerable distance in to the fundus of the eye.

These patches, which have a longish flame-like shape, are indistinctly outlined; they are in parts of a glaring yellowish white color with a silky

lustre, but in the other parts, particularly in the peripherical portions, are delicate, almost transparent and either of a yellowish white or reddish yellow color. They are marked throughout by delicate stripes, which correspond to the expansion of the optic nerve, and which causes a fine dentation on their margins. The central vessels are more or less deeply imbedded in these patches *i. e.* more or less completely covered by them; they are of a lighter color and indistinct and for short spaces are completely hidden.

Plate VI. Fig. 36.

Medulated Nerve Fibres in the Retina.

The optic disk is of a decidedly reddish color, its margins, as well as the scleral ring, are only to be seen on the outer-upper side; the other parts are hidden completely by an intensely white patch, which begins in the peripherical portions of the optic nerve with an indistinct dentated margin, and from here spreads out in every direction, excepting toward the macula lutea. It is least extensive on the inner side of the disk, larger upwards and outwards in the direction of the main vessels, but most extensive downwards and outwards, where it also follows the main vessels and curves around a short distance below the inner and lower side of the macula lutea.

The more delicate retinal vessels disappear almost completely in the white patch, appearing again at the borders. The larger vessels also, either disappear completely for a short distance, gradually reappearing again, having for a short interval a normal appearance and then again disappearing; or they are more or less indistinct without being at any point entirely lost to view.

Plate VII. Fig. 37.

Deposit of Pigment on the Circumference of the Optic Nerve[*])

On the outer circumference of the optic nerve there is a deposit of pigment, the middle part of which coveves the scleral ring. It is of a longish, almost rectilinear shape pointed at both ends, which both project into the surface of the yellow-red fundus; it lies in an almost vertical direction and consists of dark almost black granules, which lie in groups.

Diametrically opposite on the inner circumference of the nerve, there is a similar, though smaller deposit of pigment. It lies in the yellow-red fundus immediately adjoining the scleralring, only a small part projecting into the latter. The central vessels pass a slight distance in front of the masses of pigment.

Plate VII. Fig. 38.

Deposit of Pigment within the Limits of the Optic Disk. [19])

The deposits of pigment are shaped like the segments of a ring, and they are curved in conformity to the contour of the disk. They consist of very dark, in some places almost black, granulated pigment, and are almost of uniform width, but end above and below in fine points. The larger deposit is on the outer side, stretching over almost half the disk. The inner deposit is considerably smaller, but about the same width as the outer. Both lie entirely within the limits of the nerve and extend in some parts quite, in other parts almost to the inner margin of the scleral ring. They lie behind the central vessels.

Plate VII. Fig. 39.

Deposit of Pigment on the Circumference of the Optic Nerve.

The optic nerve is almost completely surrounded by masses of coarsely granulated reddish brown, in some places saturated black pigment, which lie in smaller or larger groups or stripes. Those, which lie on the inner side, are of considerable breadth and consist principally of radiately arranged, longish masses, which completely hide the scleral ring and reach for a considerable distance into the fundus of the eye. The masses, which lie on the outer circumference, are in the form of segments of a circle. Smaller masses of pigment are lying on the inner contour of the scleral ring and larger striped masses of pigment adjoin the outer contour, and are connected below with the masses lying on the inner contour. There are a few other curved stripes of pigment in the fundus of the eye, slightly removed from and surrounding the optic nerve, similar in relation to those, which occur in conus (staphyloma posticum). The remaining part of the background is of a dark, brownish yellow-red color, but otherwise normal. The central vessels, as a rule, pass over the masses of pigment.

Plate VII. Fig. 40.

Congenital bluish Discoloration of the Optic Nerve.

The optic disk is somewhat oval in a vertical direction, it is sharply defined and marked throughout with bluish spots. The different spots begin of a darker color and smaller in the middle and spread out and become lighter toward the periphery of the disk. They appear to consist of fine stripes, crowded closely together, most clearly marked at their commencement in the middle of the opticus, which grow lighter and spread out in the periphery in a manner corresponding to the expansion of the optic nerve. The only exception is a small spot, lying just outward from the origin of the central vessels, which appears to be striped in a vertical direction. The blue stripes end at the inner border of the scleral ring, but there is no sharp line of demarkation; on account of the contrast in color, the yellowish white scleral ring is rendered more prominent.

The blue spots are partly separated by a whitish intermediate substance, which is widest in the middle of the disk and becomes narrower toward the periphery, in most cases not reaching the scleral ring; on the other hand, the spots are separated from the central vessels by narrow, uniformly whitish ribbon-like stripes, which pass into the scleral ring, and which coincide in position and width to the walls of the vessels.

Plate VIII. Fig. 41.

Congenital (Physiological) Excavation of the Optic Nerve. [11])

The peripherical portion of the optic nerve is redder than usual, for which reason the yellowish white scleral ring is everywhere prominent. The outer border of the scleral ring is also distinctly defined by more or less dense deposits of brown-red pigment. On the outer side only, the pigment ring is separated from the scleral ring by a narrow stripe, which is of a somewhat lighter yellowish red than the remaining portions of the fundus.

The reddish color of the disk becomes less intense towards the center, where it gives place to a clear white color. At this point a large number of partly oval, partly irregular shaped spots (openings of the lamina cribrosa) are visible.

The dark reddish peripherical portion of the optic nerve lies in the same plane as the retina. The middle portions sink gradually deeper, the different degrees of depth being marked by the different shades of color, so that the whitest point, where the vessels enter, is also the deepest point. The excavation is consequently of a funnel shape.

In the bottem of the excavation the vessels are ribbon-like, of a uniform pale reddish color and not sharply outlined. As they gradually arise out of the excavation, they become gradually darker and more clearly defined and on reaching the periphery of the disk, have attained their normal color and contour.

Plate VIII. Fig. 42.

Congenital (Physiological) Excavation of the Optic Nerve.

The optic nerve is almost entirely surrounded by a pigment ring, which is most prominent on the outer-lower side, where it is separated from the scleral ring by a small crescent-shaped stripe of the normal fundus. The peripherical portion of the optic nerve is uniformly, but highly reddened, the contrast rendering the whitish yellow scleral ring very prominent. Towards the middle this red color suddenly stops with a sharp margin, and the central roundish portion of the disk is of a yellowish white color. The peripherical portion of the disk lies in the plane of the retina, but the central whitish portion lies considerably deeper, rising with steep walls to the surface, where it has a sharp margin.

In the peripherical portion of the disk the central vessels are normal. At the margin of the disk they lose the central reflex, become considerably darker and appear, either to terminate in a blunt rounded end, or to be connected, by means of an intermediate oblique portion, with the much lighter, uniformly colored vessels, which are visible on the floor of the excavation. By small latteral movement of the eye, either of the examiner or of the one being examined, the vessels on the floor of the excavation show considerable parallactic deviation with the margin, and the intermediate portion becomes more distinct, or disappears entirely.

By the use of stronger concave glasses, one may follow the vessels to the bottem of the excavation, where they appear of normal color and contour, and the grayish spots of the lamina cribrosa become visible.

Plate VIII. Fig. 43.

Congenital (Physiological) Excavation of the Optic Nerve.

The optic nerve is almost entirely surrounded by a dark brown pigment ring, and the scleral ring is visible throughout its circumference. The periphery, to a width corresponding to the outer half of the radii of the disk, presents a decidedly reddish appearance, which increases in intensity toward the center, and is separated by a sharp margin from the central whitish yellow portion of the nerve. The middle portion is marked with delicate grayish blue spots.

The surface of the peripherical portion lies in the plane of the retina, while the central portion is deeply excavated.

The vessels are normal in the outer portions and at the margin of the excavation they are darker, where after bending sharply backward, they appear to end abruptly as though cut off; only a few of them are again visible in the bottem the excavation, where they are indistinctly outlined and of a delicate reddish color. If the course of one of the vessels be followed by the use of stronger concave glasses, one can see that it winds around, more or less behind the margin of the excavation, and curving again passes on to the floor of the excavation. Here it is everywhere of a normal color and contour, so that the difference in distinctness rests in the fact, that the whole course of the vessels cannot be focused at one and the same time.

From the above facts it follows, that the walls of the excavation are bellied outward and that the diameter is greater in the middle than at the mouth.

The macula lutea presents itself as a brilliant point surrounded by a zone of dark pigment.

Plate VIII. Fig. 44.

Congenital (Physiological) Excavation of the Optic Nerve.

The optic disk is not surrounded by any pigment ring, but the scleral ring is well marked all the way around. The narrow ring-like peripherical portion lies in the plane of the retina; it is of a reddish color and surrounds the light colored, extensively excavated middle portion. The

reddish color of the ring-like portion becomes more intense towards the center, and ends in a sharp, in some places, dark line. The middle round portion is of a bright whitish yellow color, mottled with different sized, bluish gray spots, and has a diameter equal to about three fourths that of the disk. Its surface is considerably behind that of the choroid, and forms the floor of an extensive, sharply bordered excavation.

The central vessels are normal in their course, till they reach the margin of the excavation, where they become darker in color and lose their central reflex. Some of them appear to end here, while others, which seem bent or broken in their continuity, continue onward and join with the pale red, indistinctly outlined, ribbon-like vessels, which lie on the floor of the excavation. The portion of the vessels on the margin, and on the floor of the excavation show considerable parallactic deviation with each other.

Plate IX. Fig. 45.

Bluish Discoloration of the Optic Nerve.[12])

The optic disk is of a slightly oval form in an oblique direction; its surface lies in the plane of the retina; its contour, as well as, that of the scleral ring is everywhere distinctly marked; there is a narrow seam of pigment on the inner side. The color of the disk is noticeably pale, in the middle portion more of a yellowish gray, in the periphery some what darker and of a more bluish gray.

Plate IX. Fig. 46.

Bluish Discoloration of the Optic Nerve.

The optic disk is slightly oval in shape and the surface is normal. It is surrounded by a scleral ring, which is particularly distinct on the outer side. On the outer and inner sides there are extensive, though narrow seams of pigment. The disk is of two shades of color; it is on the one hand of diffuse bluish color, lighter in the middle and darker towards the periphery; on the other hand the middle portion is mottled with bluish gray spots. The various spots are tolerably sharply outlined, and are partly of a roundish, partly of an irregular, longish shape, and are arranged radiately.

Plate IX. Fig. 47.

Whitish Discoloration of the Optic Nerve.

The optic disk is round and the surface normal and it is surrounded, particularly on the outer side, by brownish black masses of pigment. It is of a glaring white color devoid of any reddish tint, and at the same time has a silky lustre and shows a radiate striation. The radiating stripes, which appear to be made up of extremely fine, bright fibres pass outward to the margin of the optic nerve, where they are most distinct, and there unite with a small stripe of the same color, which surrounds the disk in the place of the scleral ring. The lamina cribrosa is not visible.

Plate IX. Fig. 48.

Atrophy of the Optic Nerve and Retina.[13])

The scleral ring is only indicated by a lighter, dirty reddish yellow color. It is not distinctly outlined, as it gradually fades away on one side into the yellowish red fundus of the eye, and on the other side into the dirty grayish blue, peripherical portion of the optic disk. The middle of the disk is more of a yellow-red with a slight mixture of light gray.

The surface of the nerve lies somewhat deeper than the retina, showing a shallow bowl-shaped excavation. The depression is very gradual and only recognizable, as there is a slight difference in the focal distance. It begins within the scleral ring, declines more precipilately at the margin of the nerve, but becomes little deeper in the middle of the disk.

The vessels are straighter in their course and reduced to about one third the normal diameter. They lie in the same level as the yellow-red fundus, but above the scleral ring they sink into the excavation, for which reason a slight bend is noticeable in the vessels.

Within the limits of the disk they are somewhat more indistinct, more veiled and not sharply defined.

Plate X. Fig. 49.

Neuroretinitis Regressiva.

The fundus of the eye especially surrounding the optic disk appears of a somewhat darker red, which color is caused by a delicate, radiate, reddish striation, which spreads out in the direction of the principal vessels

and which lies in the superficial layers of the retina partly inclosing and partly passing over the central vessels.

The scleral ring is everywhere visible, though not distinctly outlined; the outer margin only, being marked by a faint seam of pigment The optic nerve is also indistinctly outlined; in the superficial parts it is of a reddish in the deeper central parts of a faint bluish gray color, and on the periphery it is of dirty gray with a mixture of green. The lamina cribrosa is not visible.

The central vessels are decidedly smaller and of a lighter color, the smallest branches are not visible. The arteries at the same time are straighter in their course and are at all points sharply defined. The course of the veins is plainly tortuous; they appear in some places of a darker color and more distinctly outlined, in other places of a lighter color, less distinctly defined, and covered by a reddish fog, while at these places they lie beneath the above described reddish striation.

Plate X. Fig. 50.

Atrophy of the Optic Nerve and Retina.

The fundus of the eye is of a normal color, appearing however somewhat coarsely granulated. The optic disk is slightly oval in a vertical direction. The scleral ring is of a yellowish white color and not sharply marked; on the outer side it appears somewhat widened and is bordered by a seam of pigment.

The optic disk presents a shallow bowl-shaped excavation, its color is almost of a uniform gray-green, somewhat lighter in the middle than in the periphery. The lamina cribrosa is not visible.

The central vessels are slightly curved as they pass out of the excavation into the plane of the retina; they are every where distinctly outlined, of a lighter color and considerably smaller than usual. The majority of the vessels are bounded on either side, by bright white stripes. These stripes are visible beside all the veins and beside the arteries, which pass upwards. They are wider beside the veins than beside the arteries and wider beside the large than beside the small vessels, and they diminish in size proportionately as the vessel, which they accompany diminishes. Their width corresponds to about one third of the diameter of the vessels.

Plate X. Fig. 51.

Atrophy of the Retina and Optic Nerve. [14])

The fundus of the eye is a somewhat lighter yellowish red than normal, and towards the optic nerve it becomes still lighter and less granulated.

On the outer circumference of the disk, hemmed in by a mass of reddish brown pigment, there is a small bright yellow conus, the flattened apex only, being of a reddish yellow color. The scleral ring is of a whitish yellow color, narrow and not sharply defined, excepting on the inner side where there is a small seam of pigment.

The optic disk is somewhat irregular in shape, but the surface is normal; the middle portion is of a bright whitish yellow; the peripherical portion is more of a greenish blue color and is marked in places by indistinct spots.

The veins and accompanying arteries, which pass directly upwards are normal, while those, which pass in an outward-upward direction, are straighter and considerably paler than normal, and they are lined on both sides by yellowish white stripes. The column of blood in the large vein, which passes downwards, appears almost as a line, and can only be traced a short distance beyond the disk. The trunk and branches of this vein are also accompained by yellowish white stripes, which may be traced considerably further than the column of blood, as the further course of the vessel is marked by a narrow stripe, which gradually diminishes in size and distinctness. The corresponding artery is only visible within the limits of the disk, and then only by focusing very sharply. In general the proportion between the size of the veins and arteries is normal.

Plate X. Fig. 52.

Glaucomatose Excavation of the Optic Nerve. [15])

The optic disk is of a greenish blue color throughout; in the central part it is lighter with an admixture of yellow; in the outer part it is marked with darker and bluish green spots, and by means of a sharp margin is separated from a yellowish white zone, which gradually fades away into the fundus of the eye, and which is widest on the outer-inner side of the disk where it is also hemmed in by a seam of pigment.

The optic nerve is deeply excavated throughout its whole extent, as one may determine by the difference in the focal distance of the vessels visible in the disk, and by the parallactic deviation of the same.

A pulsation may be seen in all the retinal arteries within, as well as immediately beyond the limits of the disk, which is somewhat postponed from the diastole in the radial artery.

Plate XI. Fig. 53 and 54.

Glaucomatose Excavation of the Optic Nerve.

When the plane of the retinal vessels (Fig. 53) is in focus the back ground appears mostly normal, with the exception of the immediate neighborhood of the optic disk. This ring-shaped space, which surrounds the disk, is irregular in shape and indistinctly outlined on its outer side. There are two small, oval, indistinctly outlined, yellow spots, which lie to the outer side of the ring-like zone. The optic disk is of a somewhat irregular oval shape; it is sharply defined, in the periphery it is of a darker, in the central part of a bright greenish gray color, and only delicately mottled in isolated spots. Inwards and upwards from the center there is an indistinctly outlined, oval spot of a reddish black color, reaching from which to the margin of the disk, there are ribbon-like stripes of a uniform color.

The retinal vessels appear normal until they reach the margin of the disk, where they seem to terminate, some with rounded and some with pointed darker colored ends.

On bringing the floor of the excavation into focus (Fig. 54), the fundus of the eye seems darker and uniformly colored; the yellow zone is indistinct and faded, and all the retinal vessels appear indistinct, of a darker color and without the central reflex. The optic disk is not so bright and the periphery is sharply defined by a dark line. Within the disk the central vessels have a dark contour, and are distinctly outlined; the different branches of the same join the retinal vessels at more or less acute angles.

Plate XI. Fig. 55.

Glaucomatose Excavation of the Optic Nerve.

Surrounding the optic disk there is a narrow, bright whitish yellow zone, which gradually fades away into the normal fundus of the eye. The

optic disk is of a roundish shape; it is somewhat smaller in diameter than usual and is excavated throughout is extent; in the middle part it is of greenish white, in the periphery it is more of a dark green color, and it is distinctly separated from the yellow zone by a sharp line.

Faded, ribbon-like vessels are visible in the deeper portions, which do not seem to be connected with the vessels lying outside the disk. The latter appear to bend aside, or to be obliquely cut off at the margin of the excavation. The rest of their course, with the exception of an increased winding of the veins, is normal.

There is considerable parallactic deviation, as well as difference in refraction, between the retinal vessels and those in the bottem of the excavation; therefore the excavation is quite deep. The outer wall of the same forms an obtuse angle with the floor, while the inner wall is very much curved and forms an acute angle with the floor.

Plate XI. Fig. 56.

Glaucomatose Excavation of the Optic Nerve.

The optic disk is surrounded by a narrow, whitish yellow zone, which quickly fades away into the normal back ground of the eye, without leaving any sharp boundary line. The disk is of an irregular, oval shape and is bounded by a distinct almost black line; in the central part it is of a yellowish white, in the periphery more of a bluish green color, and it is mottled with irregular, longish spots, which are concentrically arranged, principally in the direction of their longest axis. The main vessels are visible in the inner half of the disk, as indistinct ribbon-like stripes, which seem shoved to one side of the corresponding retinal vessels. The latter are normal and appear to terminate suddenly at the margin of the excavation.

Plate XII. Fig. 57.

Glaucomatose Excavation of the Optic Nerve.

The optic disk is surrounded by an extensive yellowish zone, having a reddish granular appearance, which is from one half to one diameter of the disk in width and which gradually fades into the normal color of the fundus.

The optic nerve is sharply defined, in the middle it is of a yellowish white, in the periphery of a yellow-greenish gray color. Near the inner margin the ribbon-like, large vessels are indistinctly visible; they do not correspond in their course with that of the retinal vessels, which seem to end abruptly at the margin of the excavation. The disk is excavated throughout its whole extent.

Plate XII. Fig. 58.

Glaucomatose Excavation of the Optic Nerve and Atrophy of the Pigmented Epithelium of the Choroid. [14])

The optic nerve is deeply excavated throughout its whole extent, and is of a greenish color and spotted, particularly in the periphery. It is distinctly separated, from the surrounding yellowish white zone, by a sharp line.

Within its limits only small and indistinct portions of the central vessels are visible; in the retina, however, the vessels, aside from their abrupt termination at the margin of the excavation are normal.

On the inner and upper side the surrounding zone gradually fades into the normal color of the fundus; it is covered in places with delicate deposits of pigment and is lined on its inner and outer periphery by seams of dark brown pigment. In the rest of the fundus the coarser network of choroidal vessels is very distinct; the separate vessels appear as winding, ribbon-like, red stripes of an irregular width, which frequently divide and anastomose with each other; the interspaces are filled with a grayish reddish brown pigment.

Plate XII. Fig. 59.

Glaucomatose Excavation of the Optic Nerve and Staphyloma posticum.

The fundus of the eye is darker colored and more coarsely granulated than normal; bordering on the optic nerve, there is a large conus, of a longish, irregular shape, which is narrowest above and below, and wider on the inner side where it terminates in a blunt point. Its greatest extent however is on the outer side, where it is in the shape of a triangle with a rounded apex, and extends towards the macula lutea, a distance corresponding to three fourths of the diameter of the disk. Immediately sur-

rounding the optic disk, it is of a uniformly bright yellow color, mottled with extremely delicate, longish spots of a reddish gray color. On the outer side it is bounded by a seam of irregularly intense masses of pigment, of a dark reddish brown and in places of an almost black color. A large number of extremely delicate, sharply defined retinal vessels are visible within the conus, and lying deeper, isolated, indistinctly defined, reddish yellow choroidal vessels may be seen.

The optic disk is slightly oval in a vertical direction, and is deeply excavated; it is of a bright yellowish white color in the middle, and of a greenish yellow color in the periphery. The margin is every-where sharply marked. The ribbon-like trunks of the central vessels are visible in the middle of the disk, where they appear shoved somewhat to the inner side of the retinal vessels. The latter appear to terminate bluntly, or to be cut off at the margin of the excavation.

Plate XIII. Fig. 60.

Congenital (Physiological) and glaucomatose Excavation of the Optic Nerve.

The optic disk is surrounded on all sides by a yellowish white zone, which is narrow, like a seam, on the inner and lower sides, and which is much wider on the upper and particularly on the outer sides, where it is delicately pigmented, and resembles a shallow conus.

In the outer parts, the somewhat irregularly shaped disk, is of a greenish gray-red color and in the middle is of a yellowish white color with a faint greenish blue tint. The dark ring-like outer portion lies deeper than the plane of the retina; it is narrow on the outer, wider on the inner side, and becomes gradually darker towards the periphery until it reaches the dark margin of the disk; towards the middle it becomes lighter, and though not sharply defined, is still clearly separated from the bright central portion. The bright, central, oval portion is marked by delicate, faint greenish blue spots and lies deeper than the periphery.

The disk thus presents a double excavation; firstly, a total, comparatively shallow excavation with a sharp margin, and secondly, a second excavation, which lies in the floor of the first, occupying the middle portion of the disk, and having also a tolerably distinct margin.

The retinal vessels pursue a normal course until they reach the margin of the disk, where they become darker, lose the central reflex and dip into the excavation. The parts of the vessels lying in the shallow excavation appear shoved a little to one side of the retinal portions, and appear covered by a light veil; on the margin of the second excavation they become again darker, and appear broken in their course and finally on the floor of the same become indistinct and ribbon-like. The portions of the vessels, lying in the three different planes, show considerable parallactic deviation with each other.

Plate XIII. Fig. 61.

Irritation of the Retina. [17])

The parts surrounding the optic disk, particularly above, below, and to the inner side reflect the light more strongly than usual, and are of a light grayish blue or greenish tint, which is most marked at the margin of the disk and disappears gradually in the direction of the periphery. These parts of the fundus are streaked with fine reddish stripes, which lie superficially. The periphery and the macula lutea are of a normal color.

On its outer side the optic disk is normally colored and outlined and the scleral ring is well marked. The remaining portion is of a reddish color and the margin, as well as the corresponding part of the scleral ring, is indistinctly marked. It is also marked with radiating stripes, which connect with the stripes in the fundus of the eye (referred to above) and which gives to the latter a striped appearance, corresponding to the expansion of the optic nerve.

Within the disk the central vessels are accompanied by white seams, otherwise they are perfectly normal.

Plate XIII. Fig. 62.

Retinitis.[18])

The fundus of the eye, particularly in the neighborhood of the disk, is darker and of a more intense red than normal, while it is streaked with delicate radiating reddish stripes, which spread out in the most superficial layers of the retina. The radiated reddish color commences at the point of

entrance of the central vessels, attains its greatest intensity at the margin of the disk, and loses itself in a more uniform red color, about one to one and one half diameters of the disk from the margin of the optic nerve. The uniform reddish color gradually merges with the normal color of the fundus.

This red color covers the optic nerve in such a way, that the upper, inner, and lower part is only indistinctly seen shining through it, as a light reddish disk, and the outer margin alone is distinctly visible, as well as the adjoining portion of the scleral ring.

The distribution of the central vessels is entirely normal. The arteries show no marked changes; the veins, however, are larger and darker colored and their course is more winding, not only in the surface of the retina, but also in a perpendicular direction to the surface; at the places where they lie more superficial, they have a distinct though somewhat widened contour, and the central reflex is not so bright, accordingly however, as they dip into the retina, they lose the central reflex and become darker and ribbon-like.

The place of the macula lutea is only slightly darker.

Plate VIII. Fig. 63.

Retinitis.

The fundus of the eye is of a dark yellowish red, more of a blood-red color, which becomes less intense towards the periphery, and which changes to a light reddish yellow tint in the middle part of the optic disk. Commencing at the point of entrance of the central vessels there is a delicate, radiate superficial striation, which follows the course of the principal vessels two or three diameters of the disk and gradually changes to a dense dark granular appearance. Within the limits of the same there is a weak glassy-like reflex.

This striation partly hides the central vessels, and entirely conceals the margin of the disk, so that the position of the latter is only determined by the figure which the vessels form at this point.

The trunks and main branches of the central vessels are alone visible in the neighborhood of the disk; in the periphery of the fundus however, the smaller branches are also visible. The arteries are narrower, of

a brighter color and straighter than usual; in some places they dip into and are completely hidden by the reddish striation; or the central reflex alone remains visible as a bright stripe. In the superficial layers the veins are larger and decidedly tortuous and broken in their course; they are of a darker color, the contour wider, and the central reflex not so bright as in a normal eye. In the deeper layers the contour is less distinct the reflex is not so bright, but of a dimmer red and in the still deeper layers, the central reflex is entirely lost and the vessel itself is more or less completely hidden. If a vein dips from the superficial into the deeper layers, it loses the central reflex, appears wider, darker and ribbon-like and in its further course takes on the appearances described above; when it approaches the surface from the deeper layers, the changes follow in the reverse order.

In spite of these different appearances, there is no change in the diameters of the vessels, excepting that, which follows as a result of their division.

Finally as may be determined by the different levels, the retina is arched forward, the highest portion being at the margin of the disk, from where it dips back in a funnel-shape towards the point of entrance of the central vessels.

Plate XIII. Fig. 64. [19])

Retinitis Diabetica.

The optic disk, as such, is not visible; its position can only be determined by the character of the vessels. The outer part of the fundus presents a darker red color and coarser granular appearance; the central part is lighter, of a reddish grayish yellow color, and marked by delicate radiating reddish stripes, which begin at the point of entrance of the central vessels. The stripes are most distinct at the margin of the disk and gradually become more indistinct towards the periphery; they are less marked on the inner side, and most extensive on the outer side where they extend to within the limits of the macula lutea. The striped portion of the retina is bulged forward.

There are a great number of longish, blood-red spots (Extravasations) within the discolored part of the retina, which present a delicate striation, particularly on the borders, and which correspond in direction, partly

to the expansion of the optic nerve and partly to the course of the vessels.

There are prominent light yellow to orange-yellow colored, oval and roundish spots, some distance from the point of entrance of the central vessels. The lighter spots are of a uniform color, the darker, are granulated, their borders are indistinct and partly bounded with pigment.

In the neighborhood of the disk only the trunks and larger branches of the central vessels are visible. The veins are wider and more winding; near the point of emergence they are indistinct, as if hidden by a veil; they gradually approach the surface, and the contour becomes plainer and the reflex visible, then again they dip into the retina becoming darker and ribbon-like, after having first lost the central reflex. They appear more or less distinct, and their color is lighter or darker, according to the depth in which they lie in the retina, or they are entirely lost to view. After having passed a greater or less distance in the depth, they appear again in the surface of the retina and pass on to the periphery of the fundus in a perfectly normal manner.

The arteries are almost normal in size and appear sooner in the surface of the retina, where they present a distinct contour and a clear bright reflex; they pass a short distance in a slightly winding course and then dip again into the deeper layers, whereby they lose at first their contour, the reflex remaining visible, or they disappear completely. Finally on reaching the periphery, they assume a normal appearance.

Plate XIV. Fig. 65.

Retinitis Hemorrhagica. [20])

The fundus of the eye is of a tolerably dark, yellowish red, being somewhat lighter around the point of entrance of the central vessels. It is marked by delicate reddish stripes and an innumerable quantity of large and small blood-red spots. The stripes radiate and are most numerous within the limits of the disk, and can be traced from here over the whole fundus of the eye. The spots consist of small points and stripes, which are also radiately arranged and are most dense in the proximity of the veins.

Only the trunks of the central vessels are visible. The arteries are straighter and smaller than normal; in some places they are distinctly outlined, in other places they are only visible as narrow bright stripes. The veins are darker, wider and more tortuous, especially, in a direction perpendicular to the retina; they are visible for such a short distance in some places that they might be mistaken for extravasations.

The surface of the fundus, within the limits of the disk, bulges precipitately foward; it reaches the highest point at the margin of the disk, and from here gradually subsides into the normal plane of the retina.

The deeper parts of the vessels, as well as the optic nerve, are so hidden by the changes described above, that the position of the latter can only be determined by the direction and position of the vessels.

Plate XIV. Fig. 66.

Retinitis Albuminurica.

The fundus of the eye, in the region of and surrounding the macula lutea, is of a darker, more reddish brown-yellow color and is marked by a large number of bright, almost glittering, yellowish white spots.

The larger spots, limited in number, lie immediately around and particularly on the inner side of the macula lutea; they are long in shape, indistinctly outlined and radiately arranged around the macula.

The smaller spots lie adjoining the larger ones, as well as at a greater distance from the macula lutea; they are partly isolated, partly grouped and extend as far as the larger vessels, which curve around the macula. They are partly of a round, partly of an irregular shape; some are clear and distinct; others are less sharply defined and scarcely visible.

The largest spot is on the inner side and slightly removed from the optic disk; it is oval and marked in the middle by a spots of pigment. Similar, but smaller and darker pigment spots are scattered between the bright spots surrounding the macula. Besides the above the retina has an extremely delicate grayish color.

The optic nerve and central vessels are normal.

Plate XIV. Fig. 67.

Retinitis. [21])

The fundus of the eye is of a normal yellowish red color, but appears to be covered by a grayish veil, which is thicker in some places, rendering the retinal vessels indistinct, and completely hiding some of the smaller branches. The optic disk is very red and is only distinguishable, from the other portions of the fundus, by its paler color. It is marked by delicate radiating reddish stripes, which extend over its margin into the fundus of the eye, where they are gradually lost. The scleral ring is not visible.

There is a noticeable difference in the sizes of the central veins and arteries, which have in general the same characteristics as those in Fig. 62—64. Both arteries and veins are hidden in places by the opacity of the retina, but appear plainly in the direction of the periphery.

The opacity of the retina is not so intense in the region of the macula lutea, but in its place there are a large number of deeper lying, light spots and stripes, which are arranged like a mosaic and radiately diverge from each other; between the spots, the fundus of the eye is of a darker, more brownish red color, and contains isolated, almost black deposits of pigment. The spots, mostly of a bright yellowish color, become more of a reddish color towards the periphery and gradually merge into the fundus of the eye; in a few of them the choroidal vessels may be seen.

In the neighborhood of the spots described above, there are numerous irregular, and indistinctly outlined points and spots of a yellowish, or light reddish yellow color. They lie, partly isolated, partly in groups, and their periphery is lost in the grayish opacity of the retina.

Between the macula and the optic disk there is an isolated, sharply defined, triangular patch, in the outer angle of which, there is a pigment spot. It is light in the middle and of a dark greenish blue color in the periphery, and it has a reflecting glass-like surface.

Plate XIV. Fig. 68.

Retinitis.

The fundus of the eye is a darker yellowish red than normal; this color reaches to within the outer margin of the optic disk, so that the

margin is completely hidden, but the middle part is left of a lighter color. The part, immediately surrounding the disk, is marked by fine radiating stripes, which may be traced into the fundus of the eye for a distance, equal to two or three diameters of the disk.

The region of the macula lutea, for a space two diameters of the disk in height, and three in breadth, is filled with numerous longish, light spots and stripes, and the interspaces are colored a dark brownish red. The majority of the spots are radiately arranged around the macula lutea; some of them, particularly the larger ones, which lie above and to the outer-lower side, are of a glistening yellowish white color; the remaining spots vary from a darker yellowish to a reddish yellow color, and have a granular appearance similar to the other portions of the fundus, into which they gradually merge.

The lighter spots are most distinctly and the darker spots most indistinctly outlined. The brownish red color of the interspaces has a granular appearance, and fades away in the periphery.

The arteries, the main branches of which are alone visible, are smaller and straighter than normal, and are of a very light color; on the other hand the veins are larger, darker and more tortuous.

The surface of the optic disk and retina is raised out of its normal level, most so at the margin of the disk, from which place it declines quickly to the point of entrance of the vessels and gradually and slowly towards the periphery of the fundus.

Plate XV. Fig. 69.

Retinochorioditis. [22])

The fundus of the eye appears covered by a reddish gray fog, denser in places, which is marked by delicate reddish stripes in the neighborhood of the disk and, in consequence, the margin of the optic disk is indistinct; the disk itself is highly and diffusely reddened. The smaller retinal vessels are not visible, and the larger ones are only in places distinctly outlined. The arteries are smaller and the veins larger and more tortuous, but the central reflex is nearly everywhere distinctly visible. Pressure on the bulb of the eye produces a pulsation in all the arteries. [23])

In the fundus of the eye, particularly in the neighborhood of the macula lutea and above the disk, [24]) there are quite a number of large whitish yellow spots and stripes, irregular in shape and hidden by the reddish gray fog referred to above.

Plate XV. Fig. 70.

Retinitis (Embolism of the Arteria Centralis Retinae? [25])

The middle portions of the background of the eye appear covered by a delicate grayish opacity, which is most intense in the region of and immediately surrounding the disk, along the course of the retinal vessels, and in the region of the macula lutea; towards the periphery it gradually disappears.

The central vessels appear to be everywhere of a smaller calibre and straighter than normal; the larger vessels, according to their position, appear more or less indistinct, but their contour and central reflex is visible throughout; the smaller vessels are not visible. On the outer sides of the opacity they are of normal color and distinctness.

The principal changes noticeable in the vessels are that the vessels, which approach the macula from above are strikingly prominent, and a small, round, blood-red spot at the point of division in a small artery near the macula.

In the optic nerve there is a small round physiological excavation, with a tolerably sharp margin. The outer and non-excavated part is considerably reddened, but is so veiled by the above mentioned opacity, that its margin is rendered indistinct, and the scleral ring is completely hidden.

Plate XV. Fig. 71.

Retinitis.

The deeper layers of the fundus of the eye have the normal yellowish red color, and granular appearance, but are covered at all points by a veil-like reddish gray-green opacity, which lies in the superficial layers of the retina. It is evenly distributed over the entire fundus; it is of a reddish color marked by fine radiating stripes of a reddish and greenish gray color.

The reddish stripes are darkest and most numerous in the periphery of the disk and in the parts immediately surrounding, and are lost in the retina at a distance corresponding to one or one and a half diameters of the disk. The greenish gray stripes commence in the periphery of the disk, where they are very delicate and scattered, but become more distinct toward the periphery of the fundus, and may be traced throughout their whole extent. They consist of smaller indistinctly outlined stripes, which in turn are made up of rows of points, and are two or three times the diameter of one the larger vessels in length.

The central vessels are somewhat darker than normal. The disk of the optic nerve is of a uniform, delicate hematin-red color; the margin, particularly on the nasal side, is somewhat indistinct; the scleral ring however is everywhere visible. At the point of the macula lutea, there is an extremely small bright yellow spot.

Plate XV. Fig. 72.

Developement of Vessels in the Vitreous.

The region of the fundus surrounding the optic nerve, two to three diameters of the disk in width, is enveloped in an opacity, which varies in intensity, and in its periphery is gradually lost in the normal fundus of the eye. The macula lutea is marked by a bright, shining, whitish yellow point encircled by a darker zone.

The central vessels have mostly a normal appearance, with the exception, that they are not distinct and that the finer branches are not visible within the region of the opacity.

The optic nerve appears as a light, indistinctly outlined disk of a uniform, red color. In the middle, small delicate vessels may be seen branching from the central vessels, and passing into the posterior portions of the vitreous.

They appear veiled in the deeper part of their course, but they advance rapidly and are soon seen as sharply defined lines of a blood-red color, which show a great parallactic deviation with the retinal vessels. Some of them pass, in a diverging direction, towards the equator of the bulb, dividing in a similar manner to the retinal vessels, thus gradually diminishing in size, and finally being lost to view.

The larger number of them however, after passing a certain distance in a winding course, turn and again unite with themselves, and thus form long loops. Others form shorter loops with a coil on the end, which consists of a number of extremely small and close spiral windings; the arms of these loops also run parallel with each other, and unite again, either with the same, or with a neighboring vessel.

Plate XVI. Fig. 73.

Bands of Connective Tissue in the Retina

The fundus of the eye is dark, of a dim yellowish red color, and coarsely granulated. Surrounding the entrance of the central vessels, it is of a lighter color, and streaked with extremely delicate reddish lines.

Only the larger of the central vessels may be followed in their course. The arteries are not so winding, and are of a lighter color and smaller than normal; on the other hand the veins are larger, more tortuous and of a darker color. Both, particularly the veins, are very indistinct or entirely hidden in certain places. There are two bright yellowish white figures in the fundus of the eye, a smaller one to the inner side of the disk, and a larger one lying between it and the macula lutea; the central vessels pass over them without change. They are composed of delicate, sharply defined stripes lined by seams of pigment, and are about the width of a medium sized artery. The stripes form branching and anastomosing figures, on the ends of which, there are deposits of dark reddish brown to blackish pigment, which is darker towards the middle and becomes lighter towards the periphery of the fundus, where it is gradually lost.

Plate XVI. Fig. 74.

Bands Connective Tissue in the Retina.

The scleral ring, as well as the disk, is distinctly outlined; the latter is of a yellowish color in the middle and of a reddish color marked by radiate stripes in the periphery. The central vessels are normal.

In the otherwise normally colored and granulated fundus there are bands of a bright whitish yellow color, which lie behind the retinal vessels, and for the most part correspond in width to one of the medium sized ar-

teries; in some places they are marked by nodes or they spread out in wider bands; they are partly straight, partly curved. Some are single, others are branched and they are distinctly outlined throughout, in some places being bounded by seams of pigment. The most of them are directed toward the optic disk, but the longest sweeps above it in a wide arch.

Plate XVI. Fig. 75.

Atrophy of the Optic Nerve and Retina. Hypertrophy of the Walls of the Vessels.

The optic nerve is sharply outlined on the outer and inner side by a brownish-red pigment ring, above and below it is not so distinctly marked; it is of an irregular, long oval form and the surface is normal. The scleral ring is of a whitish color and visible throughout. The optic nerve is of a whitish gray color, with a greenish tint, which is most distinct in the periphery, while the middle portion is of a more yellowish color. The openings in the lamina cribrosa are visible in all parts of the disk, as greenish gray spots.

The central vessels are straight and the red column of blood is lined on either side by white stripes, which unite, where the column of blood stops, and pass onwards indicating the further course of the vessels. The vessels directed upwards are reduced to about half the normal size and those which pass downwards appear as fine lines, but at the same time, the relative difference in the size of the arteries and veins remains the same. The remaining vessels appear as purely white stripes.

The fundus of the eye is of a light yellowish red color and very delicately granulated. In the region of the macula lutea, also above and below the same, there are yellow figures, which are composed of indistinct ribbon-like stripes of various width, the points of which are gradually lost in the fundus of the eye; they, as well as the masses of pigment, lie beneath the retinal vessels. The pigment spots are of a brownish-red color; some dense and compact, others transparent and finely punctated; some resemble the spots of retinitis pigmentosa, others are irregular and indistinctly outlined.

Plate XVI. Fig. 76.

Retinitis Pigmentosa (First Form).

The optic disk is of an oval form and in the middle there is a moderately deep, physiological excavation; the scleral ring is plainly visible throughout; on the inner side it is bordered by a line of pigment, and on the outer side inclosed by a conus, which is of a yellowish and in the blunt apex of a reddish yellow color and is marked by irregular reddish brown pigment spots.

The fundus of the eye is darker and more coarsely granulated than normal. To the inner side, above an below the disk, there are reddish brown to blackish roundish spots, which lie partly isolated and partly in groups.

The isolated spots of pigment lie in the normal fundus; the groups lie on a darker back ground, while the portion of the fundus between them is darkened by a delicate brownish red pigment.

The pigment spots lie mostly behind the retinal vessels, some however in front and they extend to the equator of the eye.

Plate XVII. Fig. 77.

Retinitis Pigmentosa. (Second Form.)

The optic disk is oval in a vertical direction; it is sharply defined and surrounded by a well marked scleral ring, and on the outer and inner sides by seams of dark reddish brown pigment. The middle portion is of a reddish yellow and the periphery of a somewhat darker reddish color. The central vessels are normal.

The periphery of the fundus, extending to within three or four diameters of the disk of the optic nerve, is filled with unevenly distributed spots of pigment. They are small in size, well defined and appear to lie behind the retinal vessels. Some are mere points and some are in the form of stripes; they lie singly or a number are united and form complicated figures, among which the three pointed star like figures predominate. The largest pigment spots are in the shape of a many pointed star, or of a combination of such figures. Very few spots are quite irregular in shape.

Plate XVII. Fig. 78.

Retinitis Pigmentosa. (Second Form.)

The optic disk is slightly oval in an almost vertical direction. The scleral ring is more on less distinctly visible, and almost surrounded by a seam of pigment, which stands a little apart on the outer side. The middle portion of the optic nerve is somewhat excavated and the color more of a yellowish white, while the periphery is more of a reddish color. The central vessels are normal.

The fundus of the eye, throughout its whole extent, varies from a dark yellowish to a brownish red color and is transversed by very tortuous stripes of a yellowish to a reddish yellow color. The latter, which are the choroidal vessels, are not distinctly outlined in the fundus, but mostly have a light central reflex. The whole appears as if hidden behind a reddish veil, which is thickest at the macula lutea and in the periphery and which causes the faded appearance of the fundus.

Finally there are numerous small pigment spots in the periphery of the fundus. They commence at a distance of two to four diameters of the disk from the posterior pole of the eye, and extend over all the visible portion of the fundus. They are almost evenly distributed in this portion; the greater number lie behind, but a few also lie in front of and conceal the retinal vessels.

The color of the spots varies from a light reddish brown to a black, and they vary in shape; some are mere points, some wedge-shaped, and some are star-shaped, the latter being formed by several of the wedge-shaped being united at their bases. The three pointed star-shaped spots are the most numerous, although there are also many-pointed star-shaped figures with the branches of unequal length. All these different shapes are frequently found joined with each other, while the branches of adjoining spots unite with each other. Thus arise the interlacing figures and the figures, which resemble bone cells.

Plate XVII. Fig. 79.

Atrophy of the Optic Nerve and Retina with Developement of Pigment in the Fundus of the Eye.

The scleral ring is noticeably bright and whitish, and sharply defined on the side of the nerve, but less distinctly defined on the side of the fundus.

The optic disk is of a delicate greenish color somewhat darker in the periphery; it is mottled throughout with small greenish gray spots and presents a shallow bowl-shaped excavation.

The retinal veins, which are few in number, are only visible as very fine reddish bands, and the corresponding arteries can only be seen by exact focusing, as extremely delicate, faint reddish yellow thread-like lines. The vessels are more distinct within the disk, on the margin of which they are slightly curved; they can only be traced a short distance in the fundus.

The choroidal vessels are everywhere visible as ribbon-like bands, while the stroma pigment, lying between, is seen as patches of a more or less dark brownish red color. They have a straighter course and are covered by a delicate reddish veil-like opacity, which renders their outlines indistinct, they present throughout a delicate punctation, which is thinnest in the middle, and gradually becomes denser towards the interstitial spaces.

There are spots of pigment, lying in front of the choroidal vessels, which are unevenly distributed in the fundus from near the disk till near the equator of the eye. They are most numerous in the region of the macula lutea and to the inner-lower side of the optic nerve. They vary in size and in color from a dark brownish-red to a blackish; some are delicate and transparent, others are denser, but they are all composed of small points. Their shape is roundish, long or angular, or they are like stripes, or dentated; or like branches of moss, or of a completly irregular shape. In a few places there are figures like those described in (Fig. 78). In one place such spots of pigment are seen lying to either side of a bright, delicate, stripe (an obliterated retinal vessel.)

Plate XVIII. Fig 80.

Developement of Pigment in the fundus of the Eye with Atrophy of the Pigmented Epithelium of the Choroid.

The optic disk is of a yellowish white color; the bluish gray spots of the lamina cribrosa are visible, and it is surrounded by a distinct scleral ring. The surface of the disk, with the exception of a small central excavation, and the central vessels are normal.

The larger choroidal vessels are noticeably distinct, in the form of bright, yellow, ribbon-like stripes, but they are not sharply outlined. A network of finer vessels may be seen in some of the spaces between the larger vessels. The fundus between the vessels is of a brownish red color and distinctly granulated.

There are also patches of more or less dense blackish pigment of irregular shape, which are composed of smaller granules. They are three or four times the size of a cross section of one of the larger choroidal vessels, and lie principally in the outer-lower portion of the fundus, where they reach to the border of the visible field. They all lie behind the retinal, and in front of the choroidal vessels.

Plate XVIII. Fig. 81.

Detachment of the Retina.

The detached portion of the retina is curved outward towards the center of the bulb, and is thrown into many single or bifurcated folds. The ridges appear of a light gray color and reflect the light strongly, while the grooves vary from a dark to a blackish gray with a slight reddish tint. On movement of the eye, the detached portion is thrown into a wavy motion.

There are very delicate vessels on the detached portion, which divide in a simple manner, cross and recross each other, but never anastomose with each other. They pass on to the posterior fold separately, from backwards, and run forwards in the superficial layers, there spreading out and dividing; their course is tortuous because they follow the wavy surface of the retina.

In consequence of being less magnified, they appear darker and much smaller than the vessels, which lie in the surface of the normal retina, but at the same time the arteries are much brighter than the veins.

Plate XVIII. Fig. 82.

Detachment of the Retina.

The upper and middle portions of the pupil alone appear in a reddish yellow light; the lower part is filled with a reddish gray membrane, lying in folds, and which by movement of the eye is thrown into a wavy motion.

This membrane, which is the detached portion of the retina, presents a convoluted surface of considerable extent. The middle portion projects furthest towards the center of the vitreous, where it lies in two large folds, separated by a deep saggital furrow. The reddish color of the fundus may be seen faintly shining through, but the membrane itself is of a grayish color, the crests of the folds being of a whitish and the floor of the grooves being of a darker and more reddish color.

There are numerous dark colored vessels very much reduced in diameter, but at the same time having the normal proportional difference between arteries and veins, which come partly from backwards, partly from the middle furrow and spread out on the surface of the membrane. They divide in a simple manner and pursue a winding course in the different directions, following the surface of the different folds.

Plate XVIII. Fig. 83.

Cysticercus between the Retina and Choroid.

The lower half of the retina presents a grayish opacity; it is of an irregular shape and is pressed forward a considerable distance into the vitreous. The crests of the ridges are of a whitish gray, and the grooves of a darker gray; the portion, which lies nearest the choroid, having a reddish tint.

There are roundish, tolerably sharply defined, dark gray spots, having lighter borders, which lie in different places, through which the fundus may be seen, although the choroid is indistinct. These spots prove to be holes

in the retina. The vessels divide normally, but are smaller in diameter, devoid of the central reflex and irregular in their course.

At the point where the retina is pressed most forward, a cyst-like structure is visible, which is almost round in shape, of a bluish color, and about three times the size of the disk. The head and neck of the cysticercus are occasionally protruded and moved in various directions. The cyst itself moves more or less extensively in a rhythmical manner, both in a lateral and an antero-posterior direction. All these movements are most distinctly visible through the hole in the retina.

The head moves in various ways, mostly behind the retina, with continous play of the suckers and rostellum; the head is, however, frequently protruded through the hole in the retina, at which time it becomes plainly visible.

The form of the head is continually changing; when the suckers are drawn in it appears thick, and when they are protruded it appears thinner, but the suckers are never all in motion at the same time.

The rostellum moves slowly; it is shorter and wider than the suckers, and when protruded becomes still wider, as the margin, which supports the hooklets, is turned outwards. When seen from the front it presents a cavity in the middle, into which project numerous whitish and gray stripes.

The head when retracted is only visible as a whitish spot, which changes in shape and color, and which causes a motion of the retina corresponding to its own movements.

Plate XVIII. Fig. 84.

Developement of Connective Tissue in the Vitreous.

The posterior part of the vitreous is slightly clouded with a grayish opacity. In the neighborhood of the disk, as well as in the part lying below the same, it is filled with a membranous whitish gray structure, which is dense and compact in some places, and in other places so delicate and transparent, that the fundus of the eye may be seen shining through. In parts the structure is sharply defined and surrounded by brownish red seams of granulated pigment, which is darker on its margin and gradually disappears towards the periphery. In other places the structure is gradually lost in the reddish gray opacity of the fundus. It is composed of thin

layers, which lie in different planes and which give off numerous bands, which unite again, and thus form a laminated network with coarse meshes.

The optic disk is much reddened and the margin is covered by the membranous texture and only the trunks of the central vessels are visible.

The periphery of the fundus is normal; some of the vessels appear immediately adjoining the membranous structure, others at some distance away, but they all emerge from beneath it.

Plate XIX. Fig. 85.

Congenital Pigment-Spot in the Choroid.

There is a patch of pigment lying in the choroid behind the retinal vessels, outwards and upwards from the optic nerve. It is about one and one third diameters of the disk in length and about three fourths of a diameter in width. It is flame-shaped, ending above in flame-like points and tongues, and it is marked longitudinally with light and dark stripes.

It is mostly clearly outlined; its color, depending on the thickness, is a more or less dark reddish brown, excepting in the outermost points, where it is of a delicate light brown color. It appears to be entirely composed of dark points of pigment.

Plate XIX. Fig. 86.

Coloboma of the Choroid.

The disk is surrounded on the outer and inner sides by seams of pigment, and on the outer side by a yellowish conus. In the middle there is a sharply bordered excavation.

In the lower part of the fundus, there is a sharply outlined, irregularly oval spot — The coloboma. In breadth it is about five times the diameter of the disk. The upper margin is about three fourths of the diameter of the disk from the optic nerve and the lower margin is not visible with the opthalmoscope.

The floor of the coloboma is slightly concave and deeper than the inner surface of the choroid, and shows a delicate reflex. The predominating color is a greenish white. On the outer side it is bordered to a greater extent, and on the inner side to a less extent, by a reddish yellow stripe,

which lies in the plane of the choroid. On the other parts of the margin, as well as in the reddish yellow stripe, there are irregular stripes and spots of pigment.

The course of the central vessels is normal, until they reach the border of the coloboma, here they curve and follow around the margin, with the single exception of a fine vein and artery, which pass into the surface of the coloboma where they divide, but one of the arterial branches returns to the yellowish red fundus.

Plate XIX. Fig. 87.

Coloboma of the Choroid.

The optic disk is oval and sharply outlined, and surrounded by two almost complete rings of pigment, the inner of which adjoins the scleral ring, while the outer lies some distance removed in the yellowish red fundus. The scleral ring is everywhere distinct and forms the lower border of a long deep partial excavation of the optic nerve. The excavation is tolerably wide in the lower part, and diminishes in size toward a point outwards from the middle of the disk, where it ends. The floor of the excavation is of a whitish color, while the other parts of the disk are much reddened. The lower vein disappears in a sharp bend at the margin of the scleral ring.

The large, pear-shaped, glaring white coloboma commences one half the diameter of the disk below the optic nerve; it is five and a half diameters of the disk in width, and the anterior border is not visible.

The floor of the coloboma lies deeper than the inner surface of the choroid, and presents three shallow excavations, which border on each other. The upper one is egg-shaped, of a glaring white color, and in the deeper part of a light blue and only in a small upper-outer segment is of a yellowish color. The middle one appears like a bright yellowish white band, bordered in the periphery with a yellowish color. The third and lowest is the most extensive and of a grayish color traversed by whitish stripes.

There are light yellowish red spaces in the outer periphery of the coloboma, in which a coarse network of vessels is visible, which appear like faint reddish, ribbon-like stripes. The coloboma is outlined and sur-

rounded by spots of pigment, which lie partly in the borders, partly in the fundus and some even on the surface of the coloboma itself.

Finally, there appears to be an extremely delicate, shining membrane spread over the surface of the coloboma in which several fine retinal vessels are distributed.

The large retinal vessels are only distributed in the normal portion of the fundus. On the other hand there are several ribbon-like vessels, which lie within the coloboma beneath the retinal vessels; they are very tortuous and make their appearance, partly as isolated vessels from the floor of the coloboma and partly from beneath the adjoining parts. The latter anastomose with the choroidal vessels, visible in the margins of the coloboma and are thus characterized as sclerotico-choroidal vessels.

Plate XIX. Fig. 88.

Coloboma of the Choroid.

A large part of the fundus, extending from the middle to the lower periphery, is of a yellowish white color mixed with gray. This coloboma is oval in shape; it begins about one half diameter of the disk above the optic nerve, and is about seven diameters of the disk in width; the anterior margin is not visible. The floor of the coloboma lies deeper than the inner surface of the choroid, and is marked by numerous depressions and grooves, which are more of a grayish color. Finally it is traversed by whitish stripes, which lie in the same direction as the equator.

The coloboma is sharply defined throughout its periphery and mostly bounded by seams of pigment. The surface is covered with a delicate, slightly shining membrane.

The optic disk, which lies within the coloboma, is smaller than in a normal eye, and is oval in a horizontal direction and of a uniform, faint reddish color. It presents an even surface and on its periphery is surrounded by a very red zone, which is sharply defined on the side next the nerve, and towards the periphery is indistinct.

The most of the central vessels pass upwards into the normal parts of the fundus. Only one large artery and vein and several smaller vessels pass downward, dividing in the upper third of the coloboma, after which they spread apart and pass to the borders. These vessels throw a shadow

on the floor of the coloboma, and show considerable parallactic deviation with the choroidal vessels.

The latter emerge from the yellowish white floor of the coloboma in the neighborhood of the optic disk. They pass on to the normal fundus becoming gradually plainer, and assuming the uniform light reddish color and ribbon-like appearance, finally, join with the characteristic network of ribbon-like, faint reddish stripes in the normal fundus of the eye.

Plate XX. Fig. 89.

Structural Changes at the Point of the Macula Lutea.

The fundus of the eye is normal, excepting at the point of the macula lutea where there is a round spot with a diameter corresponding to about one third that of the disk. The spot is indistinctly outlined, and of a dark reddish brown color. Within the same there are numerous bright yellowish white points, of which the largest lies in the middle and corresponds to the center of the macula lutea; it is also round in shape, while the other points are so small that their shapes are not distinguishable. They all shine and sparkle like stars.

Plate XX. Fig. 90.

Structural Changes at the Point of the Macula Lutea.

At the point of the macula lutea there is a longish, irregularly shaped, greenish blue spot, which is surrounded by a narrow, light yellow zone. It is lighter in the middle and darker in the periphery, and distinctly separated from the surrounding zone by an almost blackish line. The periphery of the surrounding zone is indistinctly outlined.

The spot has a convex, glassy-like, reflecting surface and lies between the retina and choroid, as well as in the superficial layers of the latter.

Plate XX. Fig. 91.

Structural Changes at the Point of the Macula Lutea.

The optic disk appears somewhat pale; in the middle it is of a more whitish and in the periphery of a more reddish color; the fundus of the eye appears darker and more coarsely granulated.

At the point of the macula lutea there is a darker, irregular, oval spot, two diameters of the disk in length and a little more than one in width. It is of a uniform dark reddish brown color, finely and densely granulated, and immediately surrounded by a reddish yellow stripe, which is irregular in width and distinctness and shows a slight deviation when the opthalmoscope is moved. The latter ring is in turn surrounded by a blackish seam, which is composed of small points of pigment.

Plate XX. Fig. 92.

Structural Changes at the Point of the Macula Lutea.

At the point of the macula lutea there is a longish, irregular, sharply defined patch, in which the larger choroidal vessels are visible as reddish yellow, ribbon-like stripes of different sizes, lying in different planes on a whitish back ground. There are large spots and seams of pigment lying on the borders, as well as within the patch, and on the outer side it is bordered by a triangular space of a uniform reddish brown color.

Plate XXI. Fig. 93.

Extravasation at the Point of the Macula Lutea.

At the point of the macula lutea there is an irregular, sharply defined spot, which is of a light blood-red color in the lower part, and in the upper part varies from a blood-red to a dark cherry-red color. It lies on the inner surface of the choroid, presents a convex surface, and is surrounded by a yellowish white, indistinctly outlined zone of irregular width.

Plate XXI. Fig. 94.

Hemorrhagic Patch at the Point of the Macula Lutea.

In the middle of the optic nerve there is a deep excavation with a tolerably sharp margin, in the bottem of which the grayish blue spots of the lamina cribrosa are visible. The disk is surrounded by a narrow pigment ring, which stands somewhat apart, after the manner of a conus, on the outer side.

In the region of the macula lutea the fundus of the eye is of a uniform light yellowish color and is not granulated. This space is surround-

ed and defined by dense masses of blackish pigment, and the surface is partly covered by light reddish brown, irregular pigment spots. Above this space there are two smaller isolated pigment spots. All the spots lie on the inner surface of the choroid, and press the retina more or less forward.

Plate XXI. Fig. 95.

Structural Changes at the Point of the Macula Lutea.

The optic disk is of a striking bluish color throughout and in the middle part is marked by blue spots. It is sharply defined, but there is neither scleral nor pigment ring visible. The central vessels are normal.

There is a longish bright space visible a little downwards and inwards from the macula lutea, and which presents on the lower side an angular projection pointed downwards. The latter portion is of a brilliant white, and the remaining part more of a yellowish white color. The space is surrounded by dark brownish pigment, which forms a blackish seam around the borders of the bright space, and which loses itself gradually towards the periphery. The bright space lies in the plane of the choroid, has a convex surface and projects forwards, especially the lower pointed portion.

Plate XXI. Fig. 96.

Structural Changes at the Point of the Macula Lutea.

In the place of the macula lutea there is a roundish, whitish, irregular spot, the diameter of which equals about one half that of the disk. It is prolonged outwards in a horizontal direction in the form of a stripe one and one fourth diameters of the disk in length, which spreads out at the end like a horn. The whole figure is sharply outlined, partly by fine stripes and partly by scattered masses of pigment, which gradually lose themselves in the periphery. Within the figure there are similar spots of pigment.

In the zone of pigment, surrounding the rounded portion of the figure, there are a number of indistinctly outlined plaques, varying from a whitish to a reddish yellow color, which are mostly finely granulated, and in some cases have a spot of pigment in the middle. Similar plaques are lying to

either side of an artery in the yellowish red fundus, outwards and downwards from the above described figure.

All these spots lie in the superficial layers of the choroid behind the retinal vessels.

The central vessels are normal, excepting a few, which run to the middle of the round spot, where they bend sharply backwards and disappear in the floor of the spot.

Platte XXII. Fig. 97.

Atrophy of the Pigmented Epithelium of the Choroid at the Point of the Macula Lutea. [29])

The optic nerve is of a uniform hematin-red in the deeper parts and there is no scleral ring visible.

At the point of and surrounding the macula lutea for a space more than twice the diameter of the disk in extent, the choroidal vessels are strikingly distinct. They appear as ribbon-like, sharply defined stripes of a uniform orange-yellow color, lying on a dark background, and for the most part have not a granular appearance. The intermediate spaces, however, owe their dark reddish brown color to a thick layer of branching pigment granules.

In two limited places near the borders of the above described space, the network of choroidal vessels is covered by a reddish veil-like opacity, so that the separate vessels are of a reddish color, sparsely granulated and are not so distinctly outlined, and the intermediate spaces appear of a bright reddish brown.

The whole space is sharply defined from the normal portion of the fundus.

Plate XXII. Fig. 98.

Atrophy of the Pigmented Epithelium of the Choroid. [30])

The whole fundus of the eye is traversed by more or less distinct, ribbon-like stripes, varying from a yellowish white to a reddish yellow color, which are covered by a layer of extremely delicate points, in such a manner, that the vessels appear more or less intense in accordance with the thickness of the overlying layer.

The intermediate spaces are mostly of a yellowish red color, except in the region of the macula where it changes to a dark reddish brown.

In this space the deeper choroidal vessels are also of a darker color, while the more superficial ones are of a whitish color and have a sharp contour, but are not granulated.

Plate XXII. Fig. 99.

Node-Like Exudation in the Choroid.

The middle portion of the optic disk is of a faint red and the periphery is of a darker red color, and it is surrounded by a moderately wide yellowish white scleral ring.

The fundus is generally of a normal color and granular appearance. It contains two groups of small bright yellowish white spots; a smaller one inwards and above and a larger one outwards and below the disk. The spots lie in the superficial layers of the choroid, have a roundish to a longish shape, and vary in size upwards to the size of the cross section of one of the large veins. They appear to be of considerable thickness and to have a convex surface, and the borders fade away into the yellowish red background.

Plate XXII. Fig. 100.

Choroiditis.

The optic disk is oval in an oblique direction and presents in the deeper layers a uniform hematin-red color, which is lighter in the middle, but much darker in the periphery. It is surrounded by a narrow, light yellowish scleral ring, which is sharply outlined by a delicate pigment ring.

The fundus, which is generally of a normal color, is filled with yellowish white spots of various sizes. The smaller spots lie in the deeper layers of the choroid, and are partially covered in their periphery by a fine granulation, but the larger number of the spots lie in the superficial layers of the choroid, and many project a considerable distance from its surface. The smallest spots are only indistinctly defined points, varying from a yellowish to a reddish yellow color. The largest spots measure from one half to one diameter of the disk, and the color varys from whitish yellow in the

deeper parts to a whitish on the raised parts; the margins are mostly distinct, in some cases however they are blurred.

Many spots are covered or hemmed in by masses of pigment of a reddish brown color. The smaller are mostly of a roundish, the larger mostly of a longish shape: many seem to be made by the union of several spots and are angular, branching, or lobular in shape.

Plate XXIII. Fig. 101.

Choroiditis.

There is a small funnel shaped excavation in the middle of the optic nerve, which is much reddened, but at the same time sharply defined and surrounded by a yellowish white scleral ring.

The fundus of the eye is covered with large and small spots, between which the normal color and granular appearance is visible. The spots vary in size and are mostly irregular in shape. The smallest are mere points and the largest have a diameter equal to once or twice that of the disk. In some places they are sharply outlined and bordered with seams of pigment, and in other places they gradually fade away into the normal fundus. The smaller spots are less sharply defined.

The greater number of spots lie in the superficial layers of the choroid and only a few in the deeper layers. Their surface is almost plane.

Plate XXIII. Fig. 102.

Choroiditis.

The optic disk is of a uniform reddish color and sharply defined, although there is no scleral ring visible.

The fundus of the eye is generally of a normal color and granular appearance; yet throughout its whole extent reaching to the equator, and particularly in the region of the macula, it is filled with spots and stripes of different sizes, which vary from a yellowish white to a dark yellow and reddish yellow color. In the darker spots there is a delicate granulation, but there is none in the lighter spots.

The large spots lie in the superficial, the smaller in the deeper layers of the choroid. The larger bright spots are quite irregular in shape

and in places are sharply outlined, partly by seams of pigment. In the more narrow stripes the choroidal vessels are visible.

The retinal vessels are normal, but appear of a darker color and very distinct as they pass over the light spots.

Plate XXIII. Fig. 103.

Rupture of the Choroid.

There is an extensive reddish gray opacity in the retina, particularly noticeable near the disk. The optic disk is sharply defined on the outer side, where the scleral ring is also to be recognized by its bright color. In the other directions the margin of the disk is indistinct, and the scleral ring is not visible. The middle part the optic disk is of a light red color and the periphery of a darker red color marked by delicate, radiating, reddish stripes, which are plainest in the upper, outer, and inner parts and which can be traced for a short distance into the retina.

In the limits of the opacity, the central vessels are slightly veiled, and are of a paler and more reddish gray color; the smaller vessels are mostly invisible. The fundus is also more of a reddish gray color and indistinctly granulated.

There are long, straight and curved stripes, lying in the fundus of the eye, a short distance from the optic disk. They are from one to four times the diameter of the disk in length and vary in breadth from the diameter of a large retinal vessel to one fourth the diameter of the disk. In some places they are of a uniform yellowish white, in other places of a yellowish or reddish yellow color with a more or less distinct granular appearance. In some places their margins are distinct and seamed with pigment, but as a rule they are mostly indistinct. Their surface is plane and the retinal vessels pass a stort distance in front of them.

Finally there are a number of extravasations which vary in extent from one half to three fourths the diameter of the disk. They are distinctly outlined and of various shapes. Those, which lie above the disk, are in the choroid and are of a light blood-red color covered by a grayish opacity; those, which lie inwards and above, are more distinct. The one, lying outwards and below the disk, is least concealed by the opacity of the retina; it is mostly of a blood-red color, darker in the lower part and bordered by

a dark line; on its surface there are a number of bright shining points and it extends into the superficial layers of the retina, as it completely hides the retinal vessels at that point.

Plate XXIII. Fig. 104.

Choroiditis.

The optic disk is uniformly reddened, but at the same time sharply defined and surrounded by a distinct scleral ring, as well as by a pigment ring.

The part of the fundus, lying between the outer-upper margin of the disk and the macula lutea, for a space two diameters of the disk in width and three in length, is marked by a yellowish discoloration. It is of a uniform color in the middle portions, but towards the periphery it becomes darker and slightly granular in appearance, and so merges with the normal fundus. The space is covered, particularly in the periphery, by numerous, delicate, longish pigment spots, and in the outer half there is a large, irregularly oval, greenish blue spot, which terminates below in two pointed projections, and is about two diameters of the disk in length and one and one third in width.

The spot is sharply outlined and marked, especially in the periphery, by darker stripes and spots, and the inner lower point is covered with stripes of pigment. The yellow background may be seen through the spot, especially in the middle portion. The margin of the spot lies in the plane of the choroid, but its surface is bulged irregularly forward.

Plate XXIV. Fig. 105.

Choroiditis.

The optic disk is of a reddish yellow in the middle part, and of a darker red color in the periphery, and there is no scleral ring visible.

That portion of the fundus surrounding the disk and the macula lutea is of a bright yellowish white color. This space is four diameters of the disk in length, and two in breath and is mostly sharply defined, and in the greater part of the circumference bounded by spots and seams of pigment; only that portion, lying above the disk, gradually merges into the remaining portion of the fundus.

The whitish color is uniform, without a trace of granulation except around the disk there is a reddish punctation, which becomes stronger above. There are also numerous spots of pigment in the region of the macula lutea, which lie on the white space, but beneath the retinal vessels; they are irregular in shape, only a few approaching a star shape.

The surface of the discolored space coincides with the inner surface of the choroid. The retinal vessels pass over it in a normal manner, and the smaller branches are visible in a larger part of their course than usual.

There are a few, light reddish yellow spots and stripes to the outer side of the large patch; some are indistinctly defined; some are surrounded by spots of pigment. They correspond in position to the course of the larger choroidal vessels.

Plate XXIV. Fig. 106.

Choroiditis. [31])

The optic disk, which is of a yellowish white color in the middle and in the periphery of a uniform reddish color, is not sharply defined, and is surrounded by a yellowish zone, which gradually merges into the surrounding normal color. The central vessels, with the exception of a slight winding of the arteries, are normal and, in consequence of the contrast, appear darker over the light spaces.

A large portion of the outer half of the fundus presents a yellowish white discoloration and is covered with extravasations and masses of pigment. This space is only separated from the disk by a narrow strip of the normal fundus; it is irregular in shape and for the most part sharply defined; it extends beyond the field of vision on the outer side, and from above downwards measures about three or four diameters of the disk. Within its limits there are everywhere visible very tortuous, ribbon-like orange-yellow vessels, which frequently divide and anastomose.

The spots of pigment are medium sized, dense and irregular in shape and of a nearly black color. They all lie in front of the choroidal and mostly behind the retinal vessels, so that they cover the former while the latter pass over them; some, however, lie in the superficial layers of the retina in front of the retinal vessels.

The extravasations are of a blood-red color and have a rounded contour. The course of the choroidal vessels may be followed through them. The most of them lie within the light space, only a few lie on its borders.

Plate XXIV. Fig. 107.

Choroiditis.

The optic disk is of a light yellow color with a dark reddish periphery; the latter color indistinctly distinguishing it from the bright colored fundus. The lamina cribrosa is everywhere marked by long reddish spots, and the scleral ring is not visible.

A large portion of the fundus, surrounding the disk and the macula lutea, is changed to a yellowish white color. This space is irregular in shape and the scalloped border is for the most part sharply outlined; only that portion, lying to the inner side of the disk, merges gradually into the normal color of the fundus.

The plexus of choroidal vessels is plainly visible in the light space, and together with the spots of pigment are similar in character to those in the preceding case.

Plate XXIV. Fig. 108.

Choroiditis and Atrophy of the Retina.

The vitrous presents a uniform smoky opacity and besides this contains numerous, floating, flaky opacities; so that the details of the fundus are rendered very indistinct.

The optic nerve appears as a tolerably sharply defined, uniformly red disk. Only the trunks of the central vessels are visible and these can only be traced for a short distance. They are smaller and straighter than normal, but the physiological relation between arteries and veins remains unchanged.

The fundus of the eye appears of a grayish, reddish brown color and appears to be traversed by lighter reddish gray lines, in which there are traces of the choroidal vessels. This appearance is most marked in the region of the macula lutea and below the disk.

There is a large pear-shaped extravasation visible, outward and below the macula lutea, which is of a dark, grayish blood-red color, and is surrounded by a reddish yellow ribbon-like seam; it appears to be in connection with a large vien, but in consequence of the indistinctness of the image, nothing positive may be said, either in regard to their relation, or in regard to the position of the extravasation.

Plate XXIV. Fig. 109.

Small Conus in a Myopic Eye.[32])

There is a small white crescent on the outer circumference of the optic nerve, with its concave border lying against the scleral ring and with its convex border directed toward the macula lutea. It is somewhat wider than a central vein and is about one fourth a diameter of the disk in length. It is of a light yellowish white color, covered with delicate spots and stripes of pigment and is bounded on the outer portion of the margin by a seam of dark reddish brown pigment, which fades away toward the periphery. It appears to lie in the plane of the choroid.

Plate XXV. Fig. 110.

Medium Sized Conus in an Eye Rendered Myopic by Staphyloma Posticum [33])

There is a crescent-shaped space on the outer side and almost inclosing half the periphery of the optic disk; the greatest breadth, which is one fourth a diameter of the disk, is in an outward and somewhat downward direction.

It is of a whitish yellow color, and is only distinguishable from the whitish scleral ring, against which it lies, by the difference in color. On the outer border it is outlined by a seam of pigment, which in some places is double. There are delicate deposits of pigment on its surface. The finer retinal vessels, which are not visible in the yellowish red fundus, may be seen as they cross the crescent-shaped space, the surface of which lies in the plane of the choroid.

Plate XXV. Fig. 111.

A very large Conus in an Eye Rendered Myopic by Staphyloma Posticum. [34])

The optic disk, which is of a uniform reddish color, is indistinctly outlined and surrounded by a bright whitish scleral ring, which is of normal width on the inner side and which gradually increases in width on the outer side to a point opposite the apex of the conus, where it is one fifth the diameter of the disk in width. The contour of the scleral ring is mostly indistinct.

The wider portion of the scleral ring is inclosed by the somewhat irregular conus, which is one diameter of the disk in width and lies in the plane of the choroid. The conus varys from a whitish to a yellowish color, only in the apex it is of a reddish yellow color. It is covered by delicate, irregular spots of pigment, the disposition of which is similar to the arrangement of the stroma pigment in the meshes of the plexus of larger choroidal vessels. It is further traversed in places by faint ribbon-like stripes, which correspond mostly to the course and arrangement of the choroidal vessels in the outer layers, but they are straighter, smaller and more separated.

The inner margin of the conus is not sharp, but the outer border is sharply defined by a pigment seam of unequal intensity, which is continued along the under side of the scleral ring to the inner side of the disk.

The central vessels are straighter than normal, and the outer branches pass in very long curves above and below the macula lutea.

Plate XXV. Fig. 112.

Double Conus in an Eye Rendered Myopic by Staphyloma Posticum. [35])

The optic disk, which is indistinctly outlined, is of a faint reddish color and lies in a light space, which is longest in a horizontal direction. This space is of a bright whitish color in the immediate vicinity of the optic nerve, but in the greater part of its extent, it is of a dim yellowish white color and covered with spots of pigment. The two colors gradually merge with each other. The pigment spots are arranged similarly to the stroma pigment of the choroid.

Finally, the light space is bounded by numerous spots and stripes of pigment. The surface coincides with that of the choroid.

The central vessels are straighter, and describe larger curves around the macula lutea than in a normal eye.

Plate XXVI. Fig. 113.

Crescent-Shaped Conus in an Eye Rendered Myopic by Staphyloma Posticum. [36])

The optic disk, which is of a uniform, faint reddish color, is surrounded by a normal whitish scleral ring somewhat wider on the outer side, where it is also bordered by two delicate seams of pigment. The scleral ring is bounded on the remaining portion of its margin by a cresent-shaped conus, which has its greatest width inwards and above, where it is one half a diameter of the disk in width.

The conus, which is of a uniform yellowish white color, is covered by delicate, longish pigment spots, which correspond to the interstices of the network of choroidal vessels, and it is bordered by dense, compact spots of pigment. The latter are more frequent and connected on the margin of the conus, and towards the periphery of the fundus they are more scattered; they are most strongly developed at the widest part of the conus.

The course of the central vessels is the same as in the preceding cases.

Plate XXVI Fig. 114.

Conus in an Eye Rendered Myopic by Staphyloma Posticum and Partial Concealment of the Optic Nerve by a Displacement of the Retina. [37])

The optic disk is oval in a vertical direction and no scleral ring is visible. The inner portion of the disk is indistinct, of a reddish color and covered with spots of pigment. This part is crescent-shaped and occupies one fourth the diameter of the disk and appears to be covered by a delicate, transparent membrane. The convex border coincides with the margin of the disk and is marked by a seam of pigment, while the concave border presents itself as a sharp, extremely delicate line, which above and below is continous with the margin of the conus. The inclosed pigment

spots are irregular in shape and position. The remaining part of the optic disk is of a reddish color and distinctly visible.

There is a crescent-shaped conus, adjoining the outer side of the disk one half the diameter of the disk in width, which is of a light yellowish color, covered with spots of pigment and surrounded by seams of pigment. Its surface coincides with that of the choroid.

The central vessels present the same peculiarities in their course as in the foregoing cases. Their trunks emerge obliquely from the optic nerve, from a backward and inward direction, so that their branches must make a sharp bend to reach the inner side of the retina.

Plate XXVI. Fig. 115.

Dark Conus in an Eye Rendered Myopic by Staphyloma Posticum.

The optic disk is of a uniform reddish color. The scleral ring is distinct, somewhat widened on its outer side and surrounded by a pigment ring.

Adjoining the scleral ring on the upper, outer and inner sides, there is a dark crescent-shaped portion of the fundus, which is widest in the outer portion, where it is about one half diameter of the disk in width. The dark color is caused by a large number of longish, reddish brown spots and stripes of pigment, which lie tangentially and which unite at the margin to form a blackish seam. The portion of the fundus between the spots is of a normal color and granular appearance.

Plate XXVI. Fig. 116.

Black Conus in an Eye Rendered Myopic by Staphyloma Posticum.

The scleral ring is broader on the outer side and, in most parts, surrounded by a seam of pigment. More than half the outer circumference is inclosed by a dark colored conus, which terminates in a point, outwards and somewhat downwards. Its surface lies in the plane of the choroid and it is about three fourths the diameter of the disk in width. The prime color of the conus is darker than the remaining portion of the fundus, being more of a reddish brown, and it is more coarsely granulated. It is covered by irregular spots of pigment, varying in color from a reddish brown to

a black, and which on the surface of the conus lie mostly horizontally, but towards the margin are more tangential and denser and so unite and form a wide blackish seam.

The remaining portion of the fundus is also of a darker color and more coarsely granulated than normal. The macula lutea presents itself as a clear bright point surrounded by a zone of a faint reddish brown color. The central vessels are similar in character to those described in the preceding cases.

Plate XXVII. Fig. 117.

Conus in a Hypermetropic Eye.

The optic disk is sharply defined and uniformly reddened. The scleral ring is not clearly defined, as in its periphery it merges with a bright space, which surrounds the optic nerve.

This space is narrowest in the inner and upper part, and broadest in the outer part, where it extends in a point towards the macula lutea. It is of a yellowish white color covered with longish delicate spots of pigment. It is nearly everywhere sharply defined and surrounded, except at the apex, by seams of pigment. At the apex it gradually merges with the normal color of the fundus, and the pigment seams project a short distance into the yellowish red fundus.

Plate XXVII. Fig. 118.

Atrophy of the Pigmented Epithelium in an Eye Rendered Myopic by Staphyloma Posticum.

The optic disk is slightly oval and of a light reddish color. The scleral ring is distinct only on the inner side and is bordered by a delicate seam of pigment on the inner-upper side; in the other parts it is not distinctly outlined.

On the outer side there is a large conus, pointed toward the outer side and one diameter of the disk in width. On the side next the disk it is a light yellowish white, in the middle a more yellowish and in the apex more of a faint reddish yellow color. It is covered with delicate, longish spots of pigment, which correspond to the meshes of the network

of choroidal vessels. The upper and lower borders are partly outlined by seams of pigment.

The remaining portion of the fundus is of a dim yellowish red color, and covered with reddish brown spots, which as a rule are not sharply outlined, and which are of different sizes and mostly of a longish shape. They are lighter in the periphery and darker in the middle portion, and are composed of a layer of granules of dark pigment. They correspond to the meshes of the outer plexus of choroidal vessels.

The spots are separated by reddish yellow, ribbon-like stripes, which are more or less winding, and which form a net with large meshes. The stripes represent the choroidal vessels and are everywhere covered by a layer of delicate pigment granules, which is thinnest over the middle, and thickest over the periphery of the vessels where it is continous with the pigment of the darker spots.

The central vessels are similar in character to those in Fig. 111 and 112.

Plate XXVII. Fig. 119.

Congenital (Physiological) Excavation of the Disk and Atrophy of the Pigmented Epithelium in a Myopic Eye with Staphyloma Posticum. [39])

The optic disk is oval in a horizontal direction. The whitish yellow scleral ring is distinct, particularly on the inner side and it is bordered by a seam of pigment. In the surface of the disk, there is a large funnel shaped physiological excavation, which only leaves a small bordering part of the normal surface. The floor of the excavation is of a yellowish white color marked by grayish spots, corresponding to the lamina cribrosa. The periphery of the disk is of a grayish red color with a greenish tint.

The optic nerve is surrounded, on the outer and inner side, by an irregular crescent-shaped conus, which is more than one third the diameter of the disk in width, and which is sharply defined on the outer side by a seam of pigment.

In the inner and lower portions of the fundus, the choroidal vessels are plainly visible, as ribbon-like, granulated stripes, varying from a yellowish to a reddish yellow color, and between them the stroma pigment is visible as faded, reddish brown spots.

The central vessels present the characteristic appearance as in excavations (Fig. 41 and 44) and in Staphyloma Posticum (Fig. 111 and 112).

Plate XXVII. Fig. 120.

Conus with Distinctly Visible Choroidal Vessels in an Eye Rendered Myopic by Staphyloma Posticum.

The optic disk is somewhat oval but otherwise normal. On the outer side there is a crescent-shaped conus, one half the diameter of the disk in width, the outer border of which is marked by a seam of pigment. The conus lies in the plane of the choroid, and throughout its whole extent the plexus of choroidal vessels is visible; the vessels appear as light yellow, in places reddish yellow, delicately granulated stripes, and the stroma pigment in the interstices appears as coarsely granulated spots of a reddish brown to a blackish color.

In the outer portions of the fundus the choroidal vessels are also strikingly distinct (see Fig. 118); yet at the same time the vessels appear darker and the stroma lighter than within the limits of the conus. This appearance is less distinct in the neighborhood of the disk, there the vessels are more of a yellowish red and the stroma pigment of a more grayish red-brown. Towards the periphery the plexus is more distinct; the vessels are a dark yellow-red to blood-red color and the stroma is a dark red brown. The vessels in the conus may be traced into the other portion of the fundus.

Plate XXVIII. Fig. 121.

Tubercles in the Choroid in an Eye Rendered Myopic by Staphyloma Posticum.

The optic disk is oval in a vertical direction and of a uniform reddish color throughout. The scleral ring is visible only on the inner side, on the outer side it cannot be distinguished from the conus.

The conus is three fourths of the diameter of the disk in width and terminates in the outer side in a rounded apex. Near the disk it is of a whitish color and almost as bright as a tendon; towards the apex it is more of a yellowish color and covered with extremely delicate, indistinct,

longish spots of pigment. The margin is sharply defined by a seam of pigment, and within its limit there are a large number of fine, straight retinal vessels visible.

The remaining portions of the fundus present, in general, a normal color and coarse granular appearance. Extending from the macula lutea nearly to the apex of the conus, there are a large number of spots, mostly round and of a light yellow color. They have a slightly convex surface and lie behind the retina and though not surrounded by pigment, still are sharply defined. Only the smaller ones are less sharply defined, they are of a more reddish color, lightly granulated and lie deeper. On one of the larger spots near the conus, there is a dark, sharply defined spot of pigment visible.

The central vessels present the characteristic appearance as found in staphyloma posticum (see Fig. 111—112.)

Plate XVIII. Fig. 122.

Choroiditis in an Eye Rendered Myopic by Staphyloma Posticum.[46])

The optic disk is of a uniform reddish color. The scleral ring is everywhere distinct, partly bordered by a seam of pigment, and only on the outer side it is not so distinctly defined. On the outer side it is inclosed by a conus, two thirds of the diameter of the disk in width, which is of a yellowish white color and covered with pigment spots. The deeper spots are of a faint reddish brown color, less distinctly outlined, and correspond to the interspaces of the choroidal vessels: the superficial ones are darker, more sharply defined and irregularly arranged. The margin of the conus is formed by a seam of pigment of irregular width.

In the region of the macula lutea there is an irregular, longish yellowish white space, which is one and one half diameters of the disk in length and one in width, and separated by about one fourth a diameter from the outer border of the conus. It lies in the plane of the Choroid and is covered by numerous fine stripes and spots of pigment and surrounded by a seam of pigment. The seam is in places only a line, while in other places it spreads out to a width several times that of a larger vessel; it fades away towards the periphery.

A short distance from the light space, there are short, ribbon-like stripes visible, which vary from a yellowish to a reddish yellow color, and which are bordered by stripes of pigment. They gradually lose themselves in the fundus of the eye, and correspond to the larger choroidal vessels.

Plate XXVIII. Fig. 123.

Choroiditis in an Eye Rendered Myopic by Staphyloma Posticum. [41])

The optic disk is mostly of a uniform reddish color and is surrounded by a wide, whitish scleral ring. On the outer and upper sides it is inclosed by a large conus, which in its widest part, outward and below, measures three fourths the diameter of the disk in width. The larger part, which adjoins the disk, is a light reddish yellow color, while the smaller part, which forms the apex, is of a yellowish white color and has a silky lustre.

The pigment spots within the conus, some of which lie in the deeper, others in the superficial layers, correspond partly to the interspaces of the choroidal vessels, and partly mark the margin of the scleral ring and the line of division between the two parts of the conus. Finally, the conus is surrounded by a seam of pigment of irregular width.

In the region of the macula lutea and in the lower half of the fundus, there are numerous light spots and masses of pigment. The larger more uniform and roundish spots lie superficially, while the long ribbon-like spots with faded ends lie deeper and correspond to the choroidal vessels.

The masses of pigment are also in different planes. They partly correspond to the interspaces of the choroidal vessels and partly outline the light spots. The deeper ones appear finely granular, while the more superficial, which are most numerous, are coarsely granular and of irregular shape, only a few approaching the star shape.

Plate XXVIII. Fig. 124.

Retinochoroiditis with Typical Developement of Pigment in an Eye Rendered Myopic by Staphyloma Posticum.

The optic disk and the parts immediately surrounding are veiled by a diffuse opacity, which is most dense in the neighborhood of the disk and

is lost in a distance of about two or three diameters of the disk. It veils not only the deeper parts, but also the central vessels, which have the characteristics of vessels in staphyloma posticum; the smaller branches are entirely hidden.

The optic disk, which is not sharply defined, is lighter in the middle part and a darker red color in the periphery, and there is no scleral ring visible. The disk is inclosed on the outer side by a conus, about one half diameter of the disk in width, which is of a uniform, dark orange-yellow color and surrounded by a narrow seam of pigment, the latter being more dense at the apex.

The remaining portion of the fundus is covered by a large number of light spots and pigment spots. The former lie in different depths, some even projecting above the surface of the choroid and in these places are of a more yellowish white color.

The pigment spots are partly of a lighter, partly of a darker reddish brown color and lie mostly superficially. They lie either in, or border on the light spots. The greater number have the angular or star shape (see Fig. 77 and 78).

Plate XXIX. Fig. 125.

Choroiditis in an Eye Rendered Myopic by Staphyloma Posticum.

In the middle part of the optic disk there is a small funnel-shaped excavation, where it is also of a light reddish yellow color, while the periphery is of a reddish color. The scleral ring is everywhere distinct.

Surrounding and adjoining the scleral ring there is a ring-shaped conus, which is of unequal breadth, and at its widest part measures about one half a diameter of the disk. It is of a uniform, dirty light orange-yellow color, and covered, particularly in the wider parts, with spots of pigment. The deeper spots correspond to the interspaces of the choroidal vessels; they are delicate and lighter, while the superficial spots are darker, fewer and united in irregular groups. The greater part of the margin of the conus is marked only by a narrow seam of pigment; in the lower part however, it is bordered by large masses of pigment.

There are light spots visible adjoining, as well as some distance from the inner-lower border of the conus; they lie partly isolated and partly in

groups. They lie in the superficial layers of the choroid and are sharply defined, of roundish shape, and of a uniform yellowish white color and they are covered by irregular spots of pigment.

In the remaining portions of the fundus the plexus of choroidal vessels is strikingly distinct (see Fig. 118). The central vessels have the characteristic course as found in staphyloma posticum (see Fig. 111—112).

Plate XXIX. Fig. 126.

Choroiditis in an Eye Rendered Myopic by Staphyloma Posticum.

The optic disk is of a decided red color and in place of the scleral ring is surrounded by a tolerably wide, faint reddish brown pigment ring, which fades away toward the periphery.

A large part of the fundus surrounding the disk presents a yellowish white discoloration. This space is sharply defined on the upper and outer sides by a deposit of pigment; in the lower part, however, it fades away into the normal colored periphery of the fundus.

The portion lying inwards and downwards from the disk has a reddish granular appearance, most marked toward the periphery. The outer portion is covered by heavier deposits, and the inner portion by more delicate and irregular spots of pigment, among which there are few of the wedge and star-shaped figures.

The course of the central vessels is characteristic for staphyloma posticum.

Plate XXIX. Fig. 127.

Sclero-choroiditis in an Eye Rendered Myopic by Staphyloma Posticum.

The deeper part of the optic nerve is of a uniform reddish color and the surface is radiately striped. The scleral ring is everywhere distinct, and somewhat widened on the outer side, where it is inclosed by a conus.

The conus is two thirds of the diameter of the disk in width. It is of a light orange-yellow color and covered with delicate spots of pigment, which correspond to the interspaces of the choroidal vessels, and together with the scleral ring is inclosed by a seam of pigment.

The disk and conus are inclosed in a light whitish ring-shaped patch, which is narrowest on the outer side, and on the other side attains a width, as great as two thirds of the diameter of the disk. There is a similar quadrilateral patch with rounded corners in the region of the macula lutea. Both patches lie in the choroid; they have somewhat irregular surfaces, are mostly sharply defined and surrounded by seams of pigment and they are covered partly by delicate, misty, and partly by darker spots of pigment. There are several other small, yellowish to reddish yellow spots visible, which are indistinctly outlined, and have a delicate granular appearance.

Plate XXIX. Fig. 128.

Retinochoroiditis with Opacities in the Vitreous in an Eye Rendered Myopic by Staphyloma Posticum.

The vitreous presents a grayish opacity in the portion covering and surrounding the disk. This opacity lies immediately in front of the retina, and is most dense in front of and immediately surrounding the optic nerve, and gradually disappears at a distance of one half to one diameter of the disk.

The optic disk is of a uniform reddish color and indistinct, as if covered by a fog; it is encircled, firstly, by a yellowish white zone, then by a ring-shaped conus and finally, by a large, yellowish white portion of the fundus.

The zone resembles the scleral ring only it is much wider and shaped like a ruff, as it has eight tooth-like, radiate projections on its periphery, which are one third to one half of the diameter of the disk in length.

The conus is egg-shaped and attains it greatest width on the outer-lower side, where it is three fourths of the diameter of the disk wide. Its margins are everywhere distinct, and its reddish color is veiled, more towards the middle than in the periphery, by the opacity in the vitreons.

The discolored portion of the fundus lies in the plane of the choroid, and it is about three fourths to one and three fourths of the diameter of the disk in width. It is mostly of a dirty yellowish white color and in the greater part of a granular appearance; in the periphery, however, it is of a more uniform, lighter color; the last mentioned part appears to lie

more superficially than the other parts. It is covered by lighter or darker spots of pigment and it is sharply outlined.

The adjoining parts of the fundus appear to be colored darker and in the neighborhood of the light patch contain numerous light spots, which lie partly isolated, and partly in groups. They are of a roundish to a longish shape and are indistinctly outlined. The smaller spots lie deeper in the choroid and are of a bright reddish color and less granulated than the larger spots, which are more superficial, and which are of a uniform yellowish white color in the central portions. There are scattered spots of pigment in the inner side of the fundus, which are partly of an irregular, partly of a star shape, and which lie in different layers of the retina. The remaining portion of the fundus is of a normal color and granular appearance.

The central vessels are only visible beyond the optic disk and its ruff-like halo and in the vicinity are still veiled by the opacity of the vitreous and are of a reddish gray color and indistinctly outlined; towards the periphery they become perfectly distinct. They have the characteristic course for staphyloma posticum.

Plate XXX. Fig. 129.

Coloboma of the Sheath of the Optic Nerve, Persisting Hyaloid Artery, Retinitis Pigmentosa Atypica.

In the place of the optic disk there is a long elliptical figure visible, which is larger in every direction than a normal disk. The upper half of the same — the real disk — lies in the plane of the retina, it is of a reddish yellow color and is indistinctly outlined. The lower half of the figure — the coloboma — is a deep excavation, having a sharp margin and a slightly uneven, bluish gray shaded floor, but without any traces of the lamina cribrosa.

The central vessels are smaller in calibre and are very irregular in their course; some of them appear separately in the margin of the disk, pass over the floor of the coloboma and appear again on the margin of the coloboma, deviated from their original course, and from here pass on through the plane of the retina in a very straight course. The most of them emerge from the inner side of the disk, passing on into the plane of the retina without any deviation in their course. The point of entrance of the vessels is covered by a bluish gray conical projection, which extends

obliquely outwards and upwards into the vitreous, where it terminates in several fine filaments.

The inner margin of the coloboma is bounded by an intensely white seam, and the outer margin by a seam of pigment, which breaks up below into a number of small spots and above continues a short distance along the margin of the disk. Adjoining the lower border of the coloboma there is a small space in which the choroidal vessels are visible, as narrow, light reddish stripes. This space, however, is very small, soon merging with the other dark brownish red and coarsely granulated portion of the fundus. In the inner and upper parts of the fundus there are numerous black, irregular, sharply defined pigment spots.

Plate XXX. Fig. 130.

Congenital Defect of the Retina in the Region of the Macula Lutea (Macular Coloboma).

The optic disk is of a somewhat long elliptical shape and in the middle there is a funnel-shaped physiological excavation. The scleral ring is somewhat widened on the outer-lower side, and is bounded on the outer side by spots of pigment.

In the region of the macula lutea there is a kidney-shaped space, which measures about three and one half diameters of the disk in a vertical and two diameters in a horizontal direction. Its convex margin is turned toward the optic disk from which it is removed about three fourths of a diameter of the disk. It presents a moderate excavation and is of a light yellowish white color strewn with numerous fine, brownish pigment spots. The inner (convex) border is everywhere sharp, almost overhanging, and is marked near the disk by two shallow indentations. The outer (concave) border is shallower.

The space is surrounded by a seam of pigment, which is narrowest above and below and wider on the inner side where it adjoins a dark colored portion of the fundus; on the outer side, however, it swells into a large dense, dark brown to black mass of pigment, extending from which towards the inner border there are pointed projections and others with parallel margins. The projections correspond to ridges in the floor of the excava-

tion, and serve as an intermediate stage through which the latter gradually rizes to the normal plane of the fundus.

There is a longish grayish white spot, adjoining the outer side of the mass of pigment, which is covered in places by spots of pigment, and which is surrounded by a projection from the mass of pigment.

There are several sharply, defined, narrow, ribbon-like vessels in the excavation, which are not continous with the retinal vessels. The latter pass around the white space with the exception of one artery, which runs across the upper part. The remaining portion of the fundus is of a light yellowish red color and the choroidal vessels are visible, lying on a lighter background.

Plate XXX. Fig. 131.

Engorged Papilla (Neuroretinitis).

The optic disk is enlarged in all its diameters and projects considerably above the plane of the retina. It is mostly of a light reddish color, which gives place on the slanting border to a grayish color; the latter color forming a widened, faded seam in the vicinity of the large vessels. There are several small, longish, indistinctly outlined, whitish spots in the grayish seam, which lie partly near and partly over the larger veins; in the lower expanded portion of the seam there are small blood-red spots. The tissue of the nerve is opaque so that the vessels are indistinct in places, and in some places appear broken in their continuity. The arteries have a normal caliber and course, within the disk they are partly indistinct, partly invisible; the veins are enlarged and tortuous. Within the disk and the grayish seam, the windings of the veins are principally perpendicular to the plane of the retina, so that some of them seem interrupted in their course. From the grayish seam they pass into the plane of the retina in an S-shaped bend, where they are also very winding, but in the plane of the retina. The fundus of the eye beyond the grayish seam is normal.

Plate XXX. Fig. 132.

Tumor Subretinalis.

The optic nerve is of a tolerably dark reddish gray color, the outline is indistinct and the scleral ring is only visible on the outer side.

There is a light gray, discolored space, which commences about one diameter of the disk to the outer side of the optic nerve and extends almost to the limits of the opthalmoscopic field. Within the limits of this space the retina is bulged symmetrically forward to a considerable extent, at the same time, however, it is perfectly smooth. It is of a light gray color, which becomes darker towards the periphery and there merges quickly, though gradually with the yellow red color of the normal fundus; on focusing exactly it presents a marbled appearance, which lies beneath the retinal vessels and which is caused by a system of light and in some cases slightly reddish, indistinct stripes, which in places are united in a network.

The retinal vessels appear somewhat darker over this space, but otherwise are normal, as is also the remaining portion of the fundus.

Plate XXXI. Fig. 133.

Conus below the Optic Disk. [44])

The optic nerve is almost semicircular in shape with the convexity directed upwards; it is of a dark reddish gray color, the margin is indistinct and the scleral ring is alone distinguishable, as a somewhat lighter grayish seam. There is a funnel-shaped physiological excavation, somewhat below the middle of the nerve, which extends obliquely backwards and upwards into the same. The upper wall of the excavation is consequently not visible and the vessels, which extend upwards, appear from beneath the upper margin of the excavation in sharp bends. The lower wall is shelving and the vessels, which pass over it, show only a slight deviation in their course.

There is a semicircular shaped conus adjoining the lower side of the optic nerve, which has almost the same dimensions as the nerve itself; the two together form a disk about the size and shape of a normal optic disk. The conus is of a much lighter color than the nerve; the part adjoining the latter is of a light yellowish white, while the remaining portion is of different shades of gray.

The periphery is clearly outlined in all parts and is surrounded by a seam of blackish pigment, which is somewhat broken on the temporal end.

The distribution of the central vessels is only abnormal in so far as the veins, which come from above, appear in several separate, almost parallel trunks, which dip into the optic nerve.

The fundus of the eye presents two shades of color; the upper half is indistinctly tessellated i. e. the network of choroidal vessels appears on a darker background; the lower half is slightly albinotic. The focal distance of the fundus also varys, the lower half showing a higher refraction than the upper half.

Plate XXXI. Fig. 134.

Conus outwards-below the Disk, Cilioretinal Vessel, Irregular Pigmentation of the Choroid.

The optic disk is somewhat obliquely oval in shape and the temporal margin is not so sharply curved as the nasal margin. In the middle there is an extensive physiological excavation, the nasal margin of which is overhanging, while the temporal side is shallow, passing gradually into the fundus of the eye. The peripherical parts of the disk are of a tolerably dark reddish gray in the upper, inner and lower sides and the outer and outer-lower part is of an almost pure gray color. The outline of the disk is distinct and on the inner side is inclosed by a seam of blackish pigment.

A somewhat irregularly crescent-shaped conus adjoins the outer-lower side of the disk, it is about one third of the diameter of the disk in width. A retinal artery, about third in point of size, has its origin in the periphery of the conus; from its commencement until it almost reaches the outer-lower periphery of the conus, it is only visible as an indistinct reddish stripe, it then appears suddenly in the surface and bends at an acute angle toward the optic nerve. From the angle the contour is sharper, but the reflex is only indistinctly visible. When it almost reaches the middle of the conus it makes another sharp hook-like bend and runs back over the conus into the retina, almost parallel to its original course. At the point of the hook-like bend it is of a dark red color, but before it passes from the conus it has attained the normal color and reflex of the retinal arteries. In its further course it, as well as the other retinal arteries, presents nothing abnormal.

The inner margin of the optic nerve is adjoined by a pale crescent-shaped zone, one sixth of the diameter of the disk in width, the periphery of which merges into the uniform dark brown color of the adjoining portion of the choroid. Above and below this dark brown color extends to the margin of the disk.

The remaining portion of the fundus presents a distinct tesselated appearance in the outer, upper and inner parts, while the lower part is slightly pigmented, so that the red network of choroidal vessels appears on a yellowish background, which is faintly granulated and mottled with brown.

Plate XXXI. Fig. 135.

Discoloration of the Temporal Half of the Optic Nerve.

The optic disk is of a somewhat longish elliptical shape, its borders are sharp and somewhat irregular and the scleral ring is everywhere distinct. The portion of the disk, lying to the inner side of the central artery, is of a pale yellowish gray color, and the outer side presents a physiological excavation, the floor of which is of a bright white covered with grayish spots; towards the outer periphery of the optic disk the color is more of a greenish gray.

The central vessels are perfectly normal and the fundus of the eye is every where distinctly tesselated. In the immediate vicinity of the disk the fundus is of a darker color and on the outer side there is a broken seam of pigment, which incloses several yellowish spots.

Plate XXXI. Fig. 136.

Chrystal Glands on the Border of the Optic Nerve. Retinochoroiditis Occurring with Hereditary Syphilis.

The optic nerve is of a uniform reddish yellow color, its margin is very indistinct and the scleral ring is indicated, only on the outer side, by a more whitish color. The central vessels are reduced to almost half their natural size, but are moderately winding throughout their course.

There are two irregular, longish oval patches on the inner-lower border of the optic nerve, which lie mostly within the limits of the reddish yellow fundus of the eye and only small portions extend over the margin

of the nerve into the limits of the optic disk. They lie somewhat in front of the retina, as may be ascertained from the difference in refraction and from the fact, that they partly cover some of the retinal vessels.

They have a mottled grayish color and a glassy brilliancy and appear, particularly in the direct image, to be filled with glistening granules, similar to cholestearin chrystals. The latter are most numerous in the margins and cause there a whitish color.

All the retinal vessels, which run in an inner-lower direction, pass beneath these patches without suffering any change.

The remaining portion of the fundus is somewhat paler and indistinctly tesselated, besides it is filled with numerous, but tolerably irregularly distributed spots of pigment, which in places extend almost to the optic disk. All the spots lie in front of the choroidal vessels and some even in front of the retinal vessels. The greater number are ring-shaped, some quite round, and some irregularly oval or kidney-shaped. The smaller number are irregularly branching, or are composed of groups of fine points of pigment.

Within the larger, more delicate rings of pigment the choroid appears a shade paler than in the other portions of the fundus.

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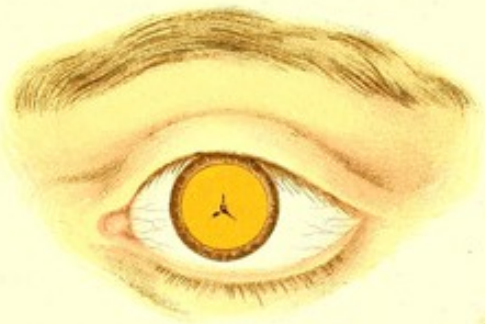
Fig. 2.

Fig. 3.

Fig. 4.



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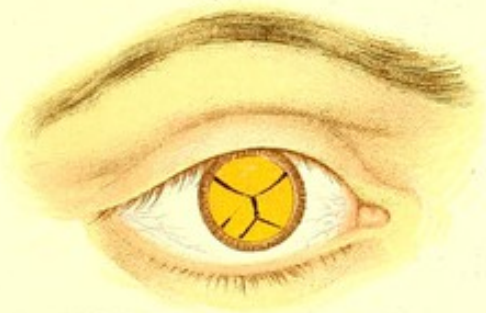

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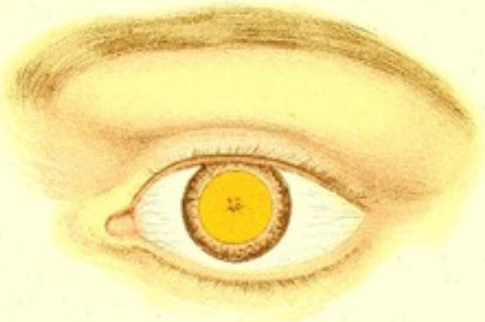

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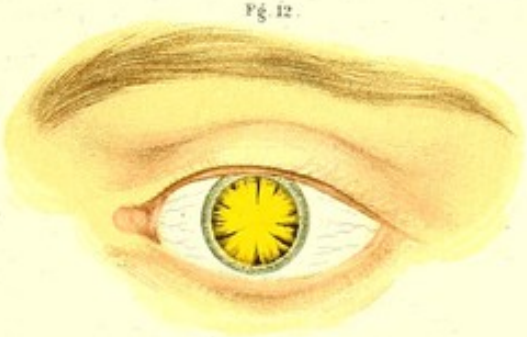

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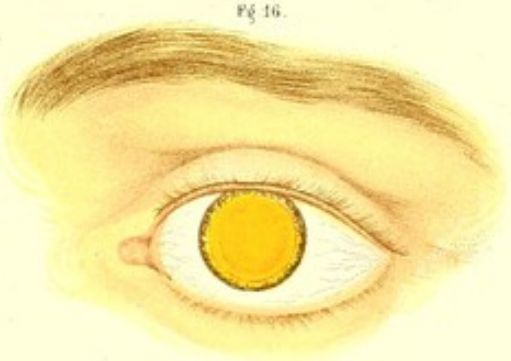

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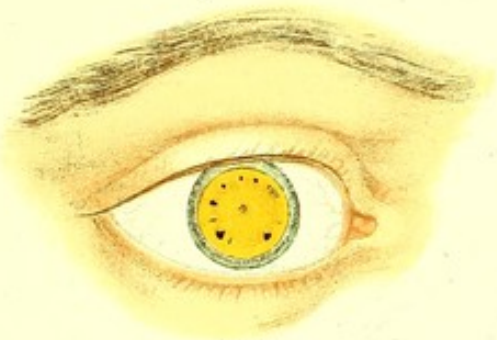

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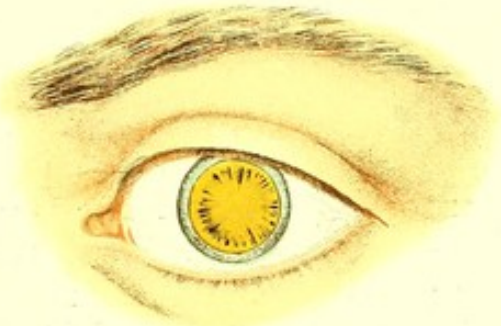

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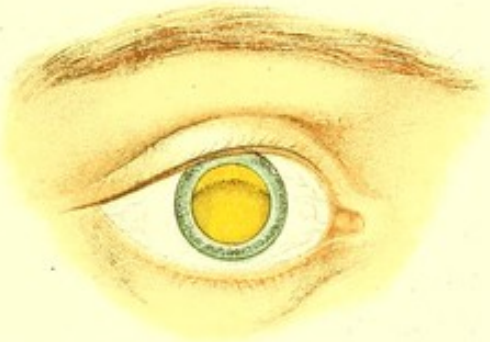

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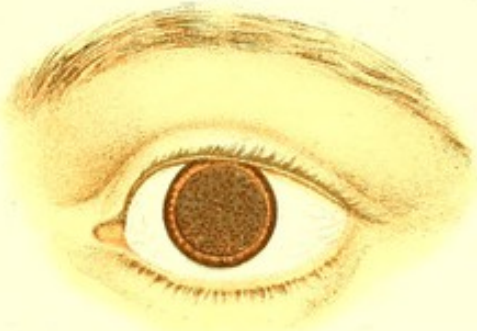

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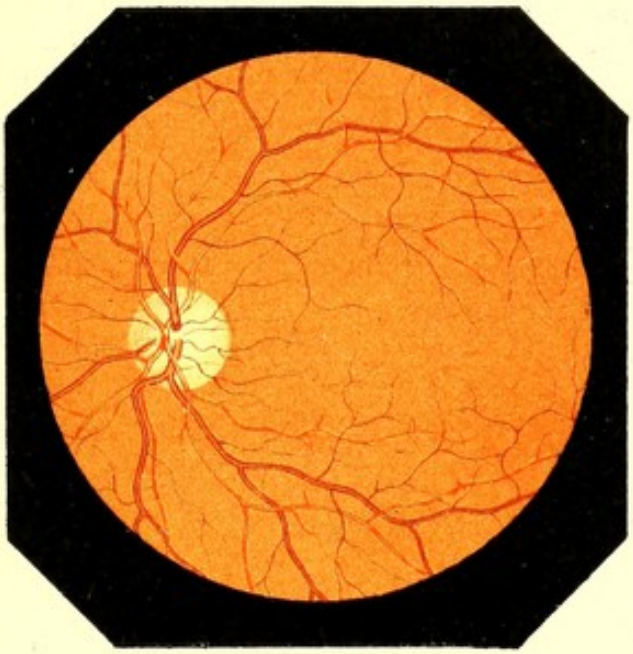

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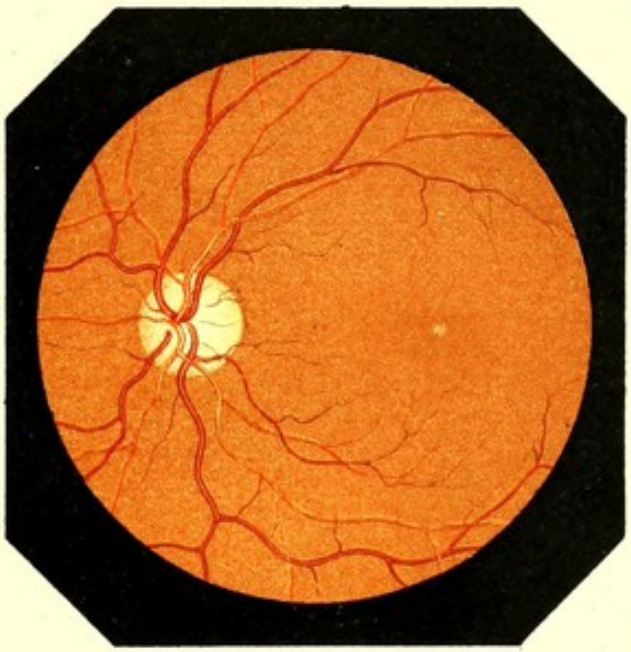
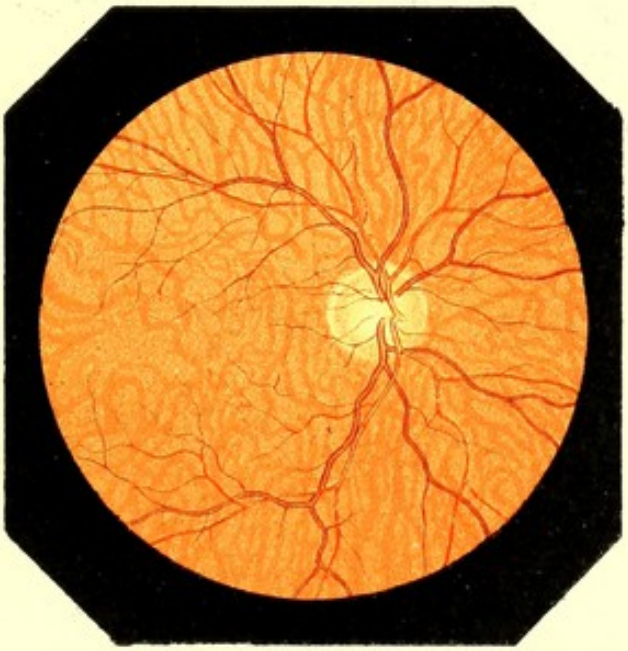


Fg. 27.



Fg. 28.

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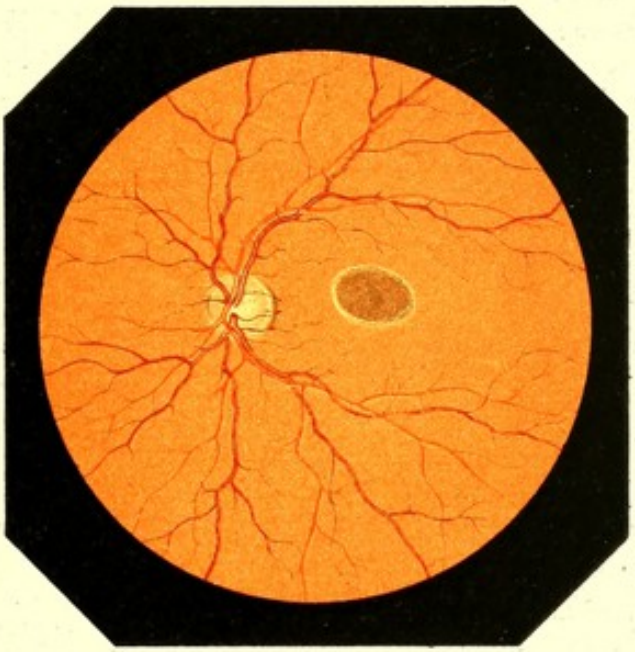
Fg. 29.

Fg. 30.



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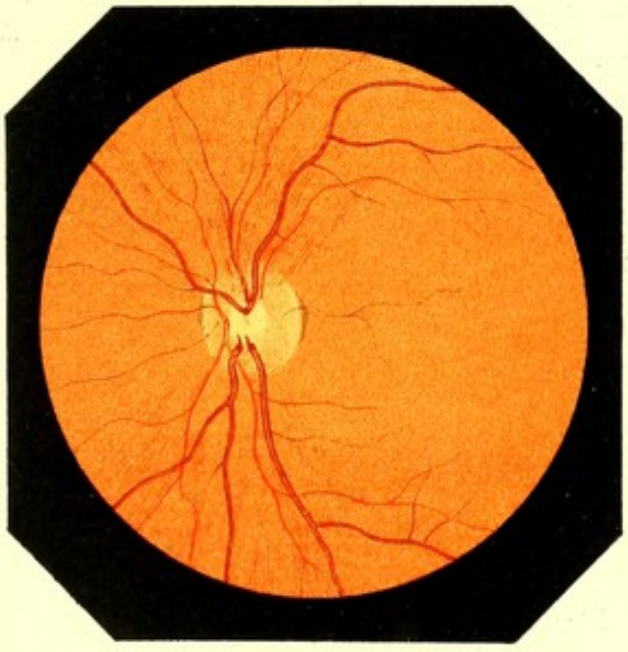

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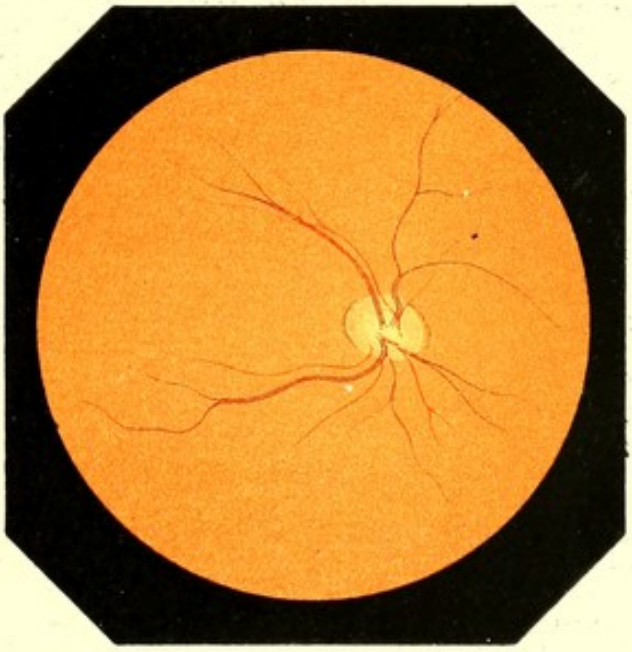

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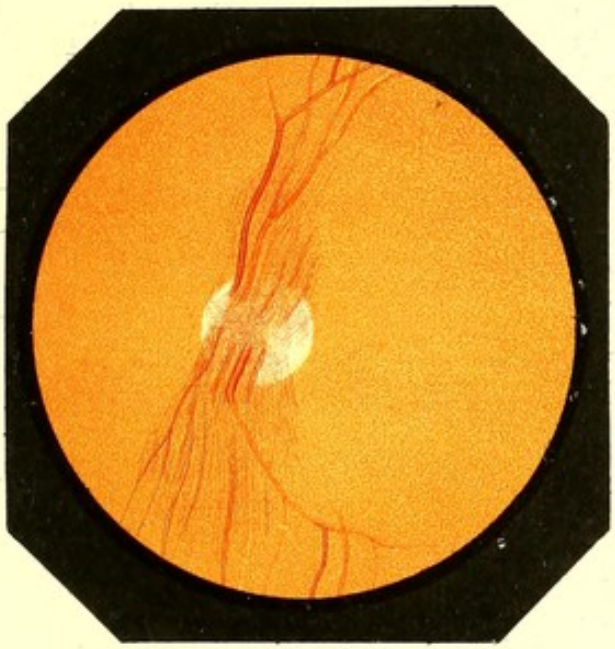
Fig. 33.



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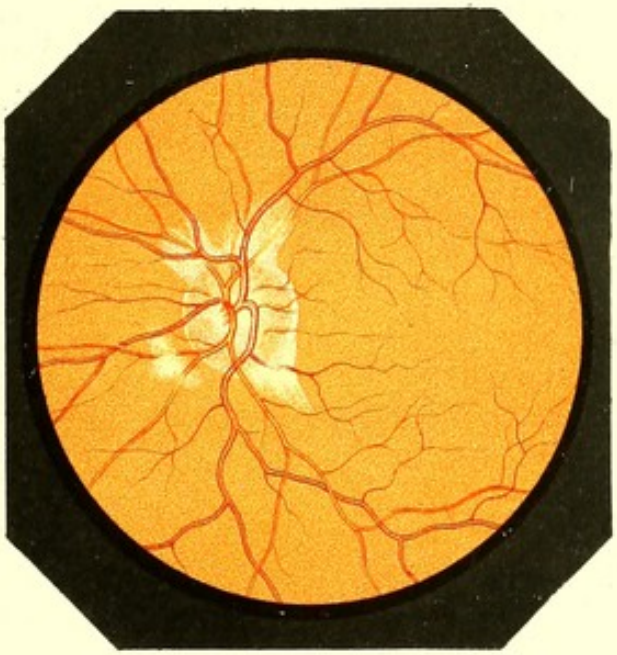

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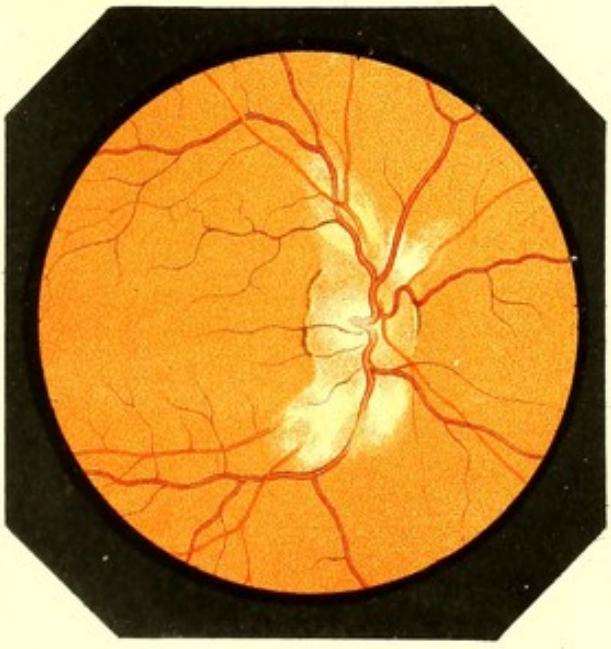

Fig. 36.

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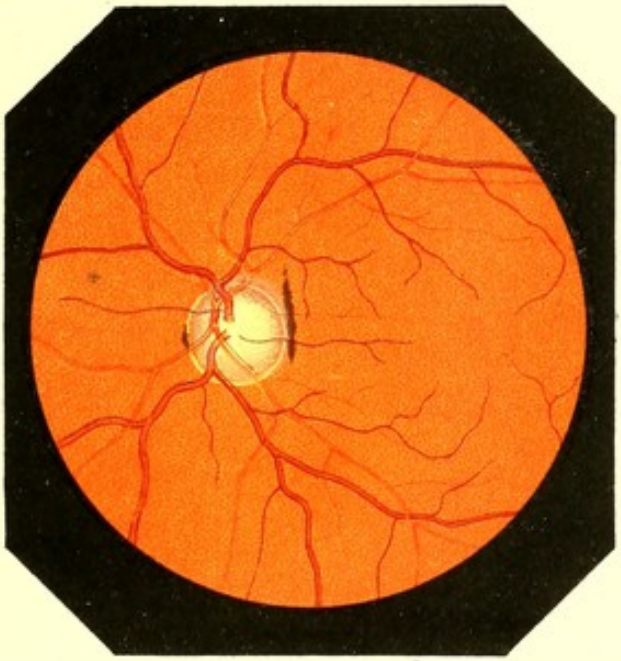
Fig. 37.



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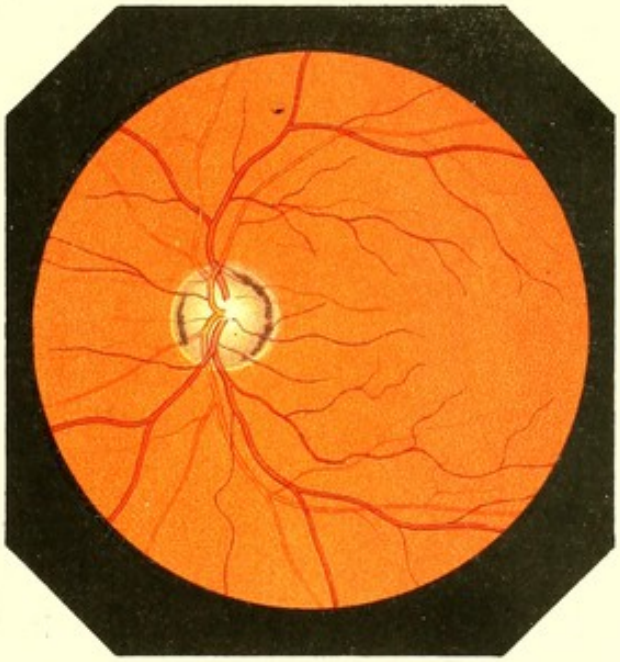

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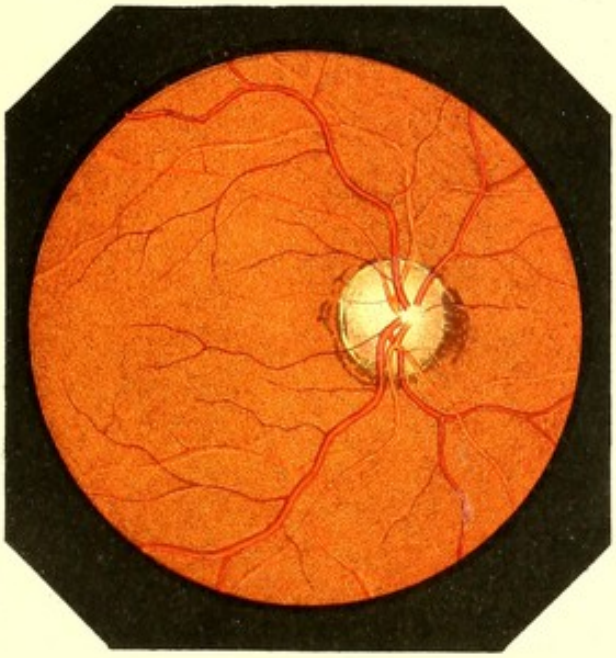

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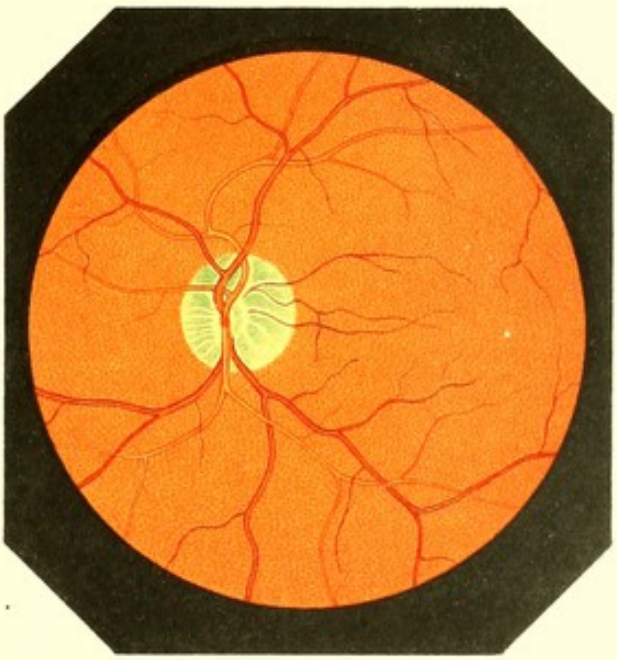

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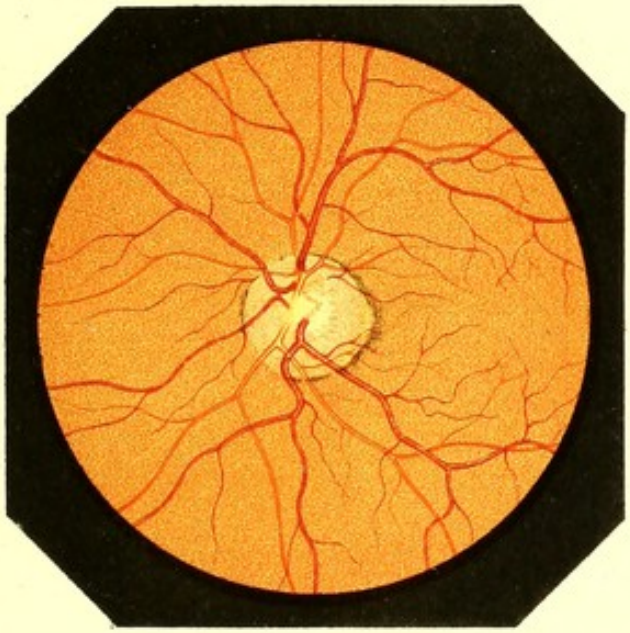
Fig. 51.



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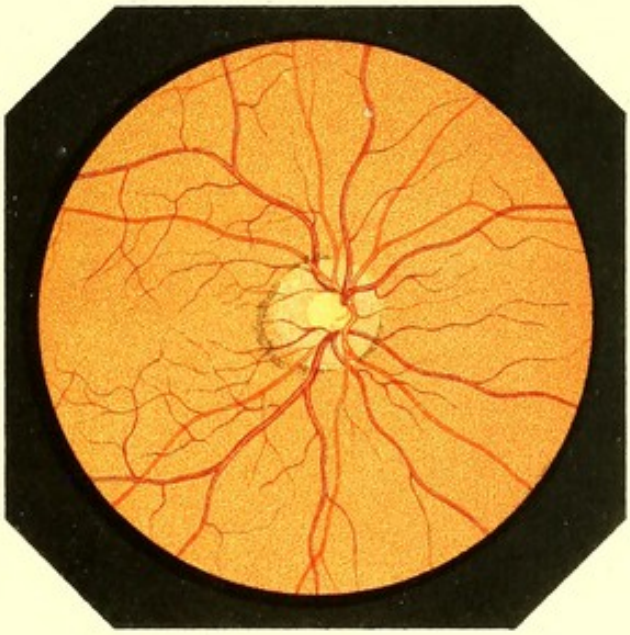

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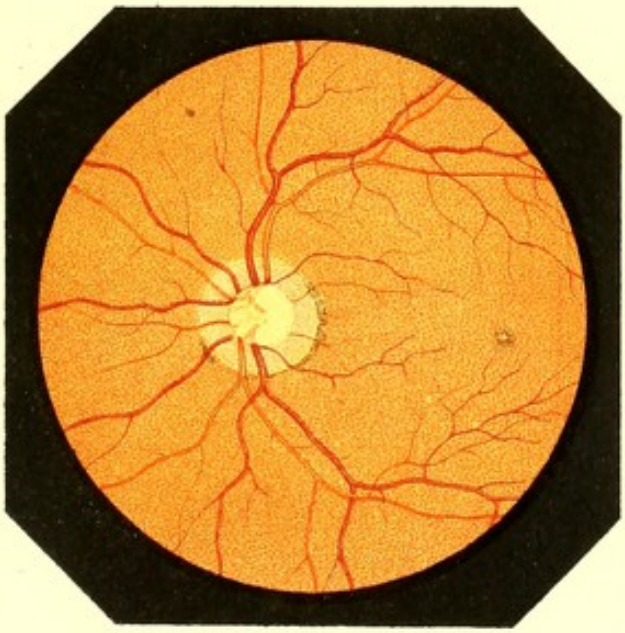

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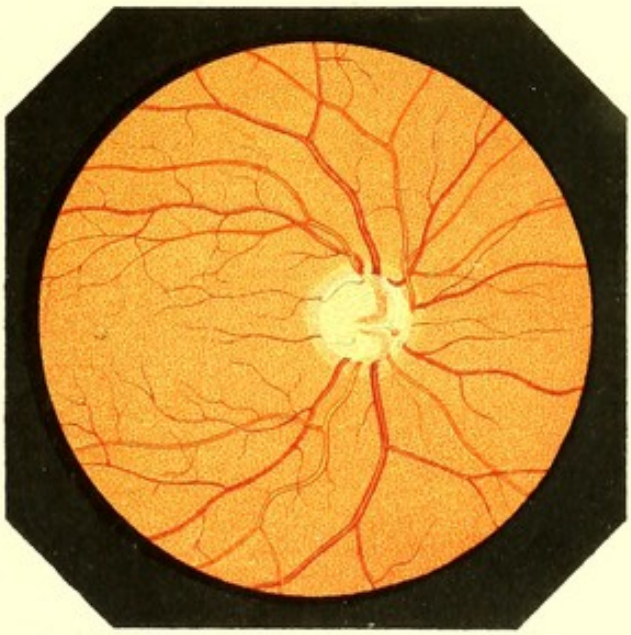

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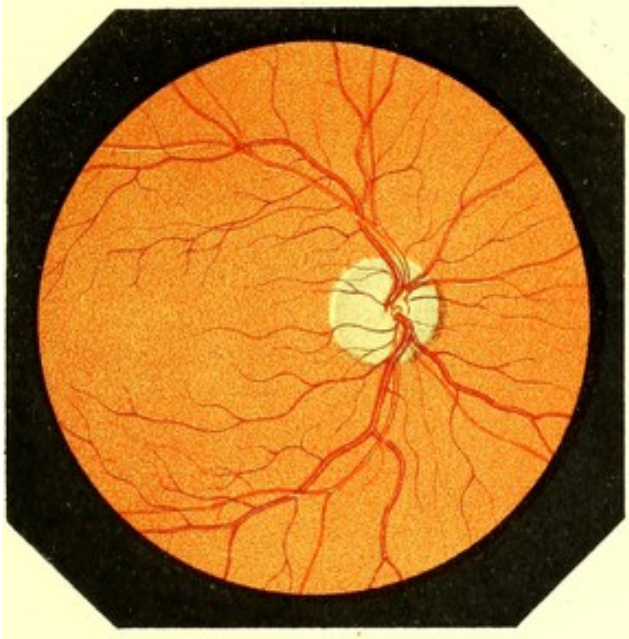
Fig. 45.



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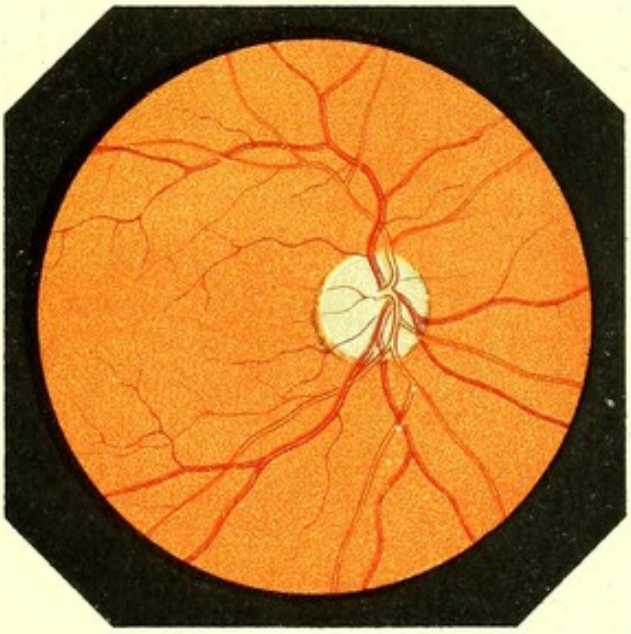

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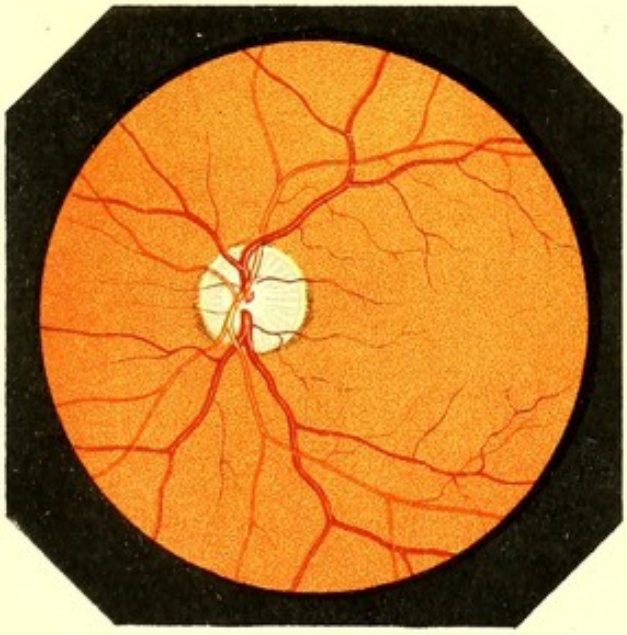

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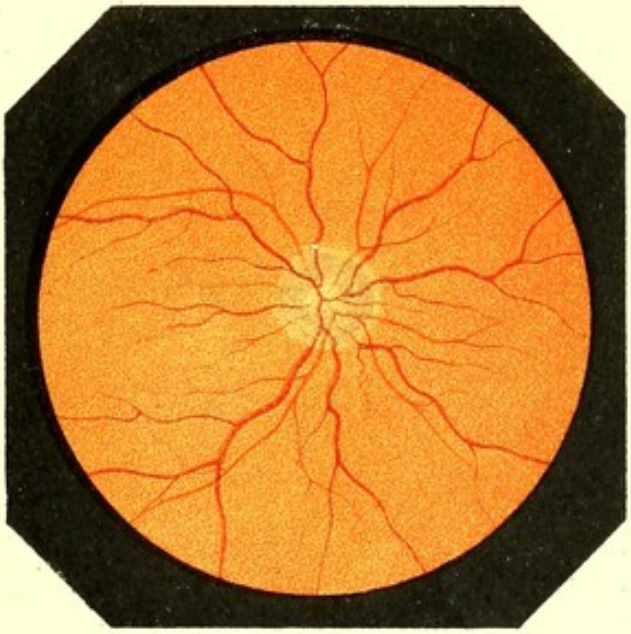

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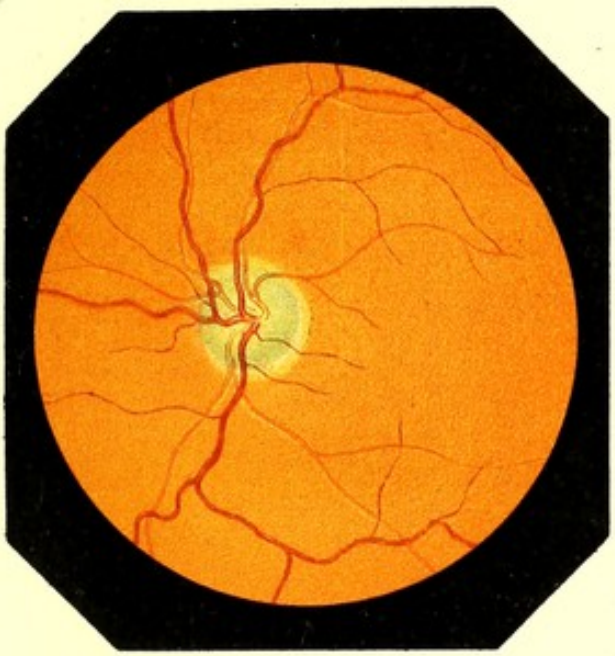
Fig 49.



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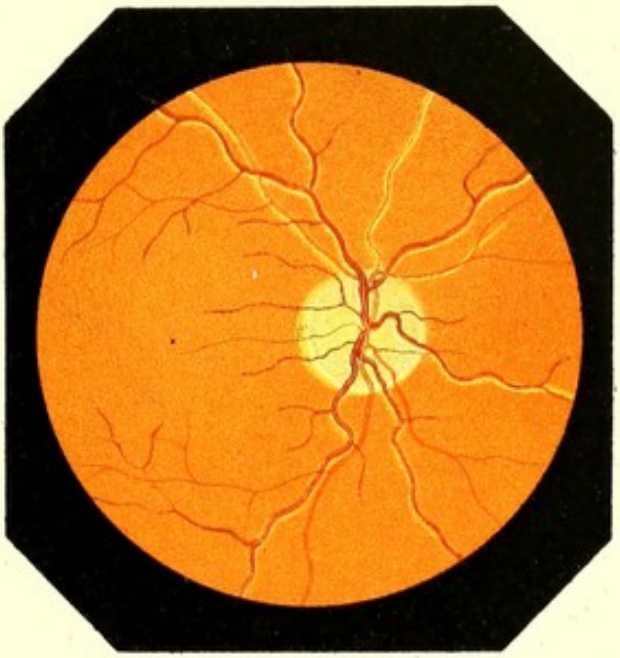

Fig 51.

Fig 52.

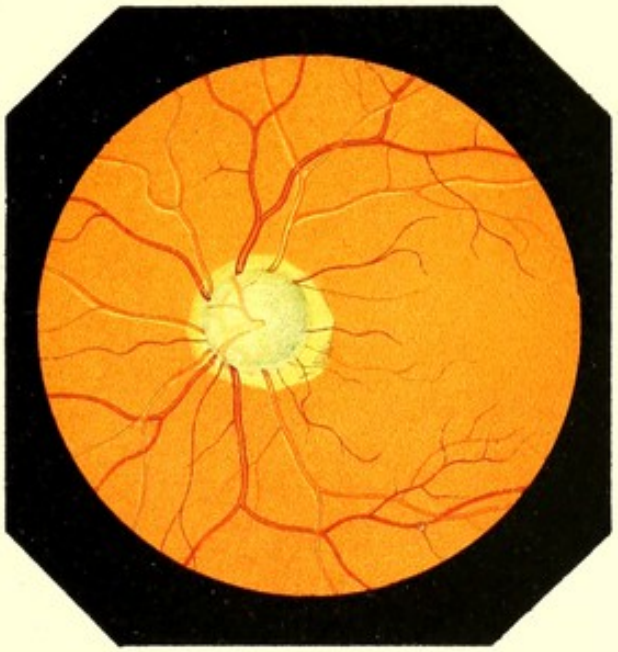

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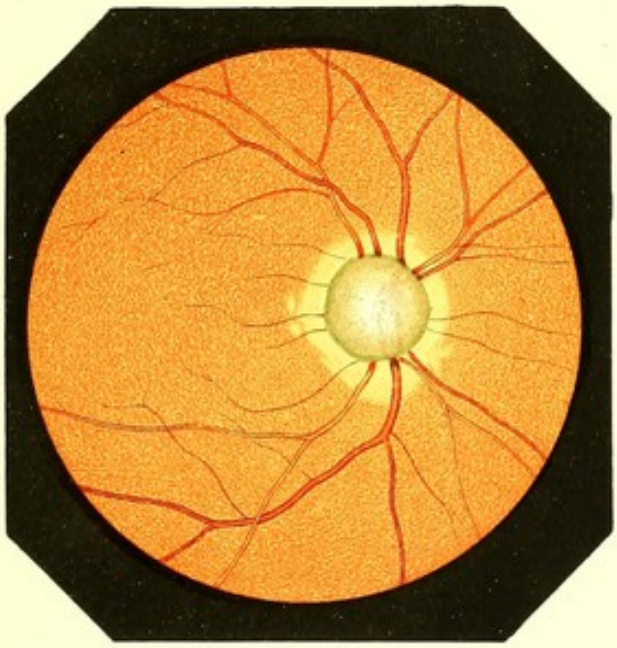
Fig. 53.



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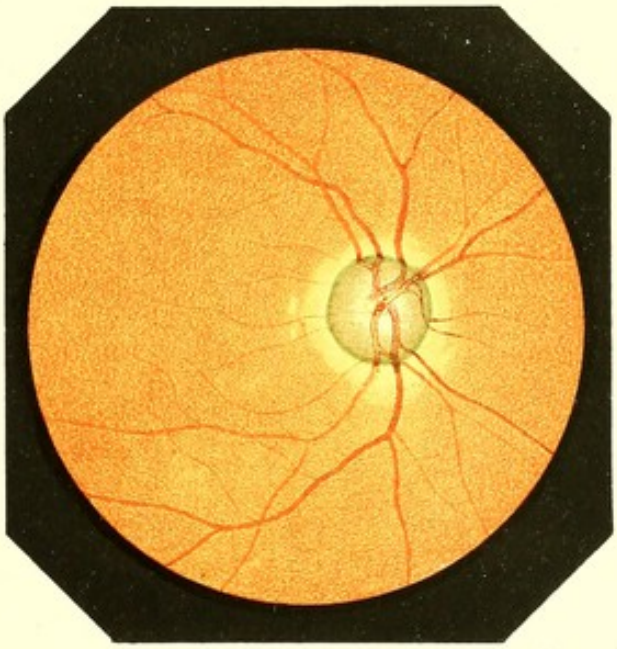

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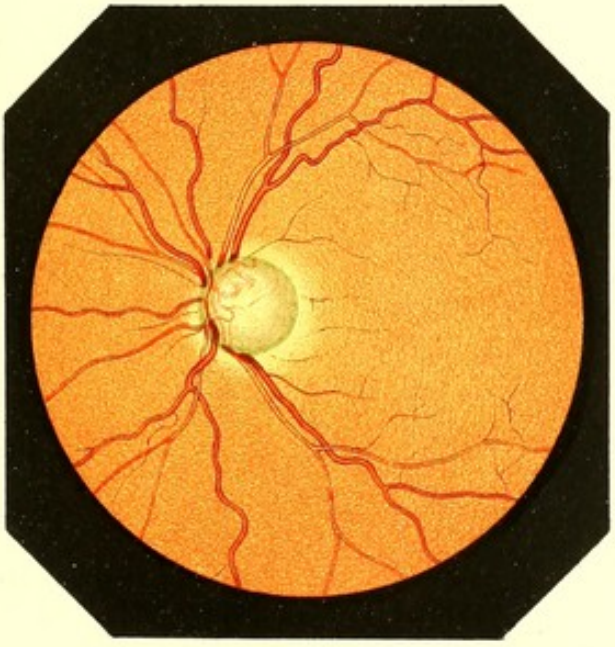

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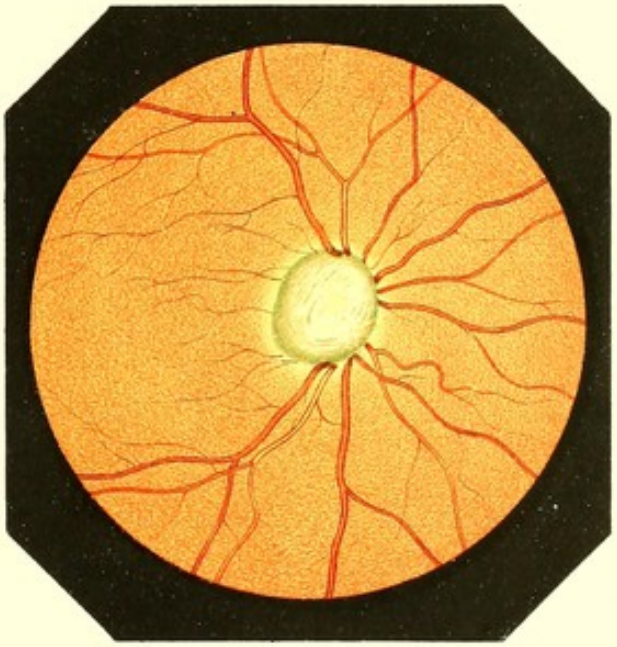

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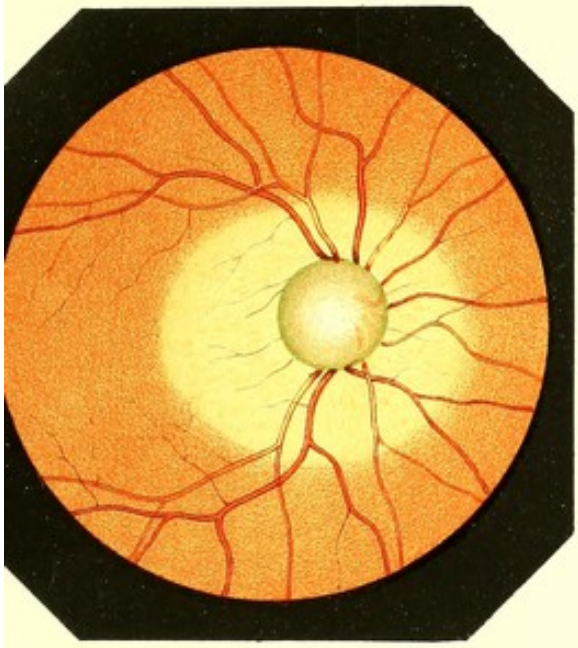
Fig. 57.



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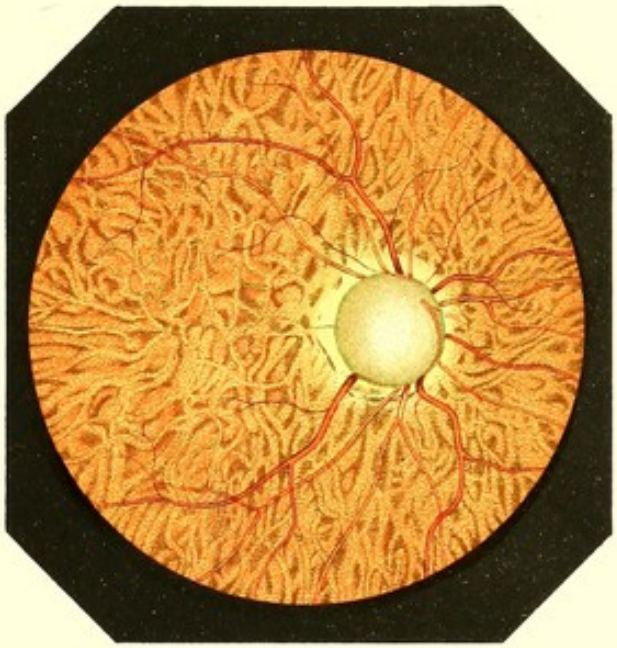

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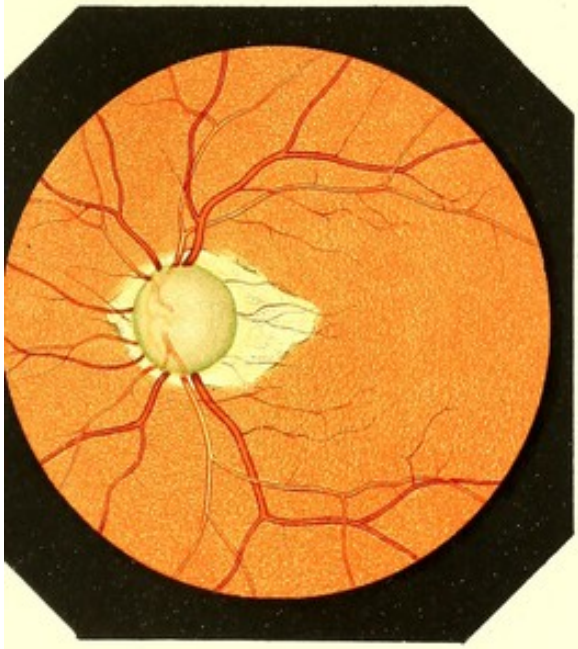

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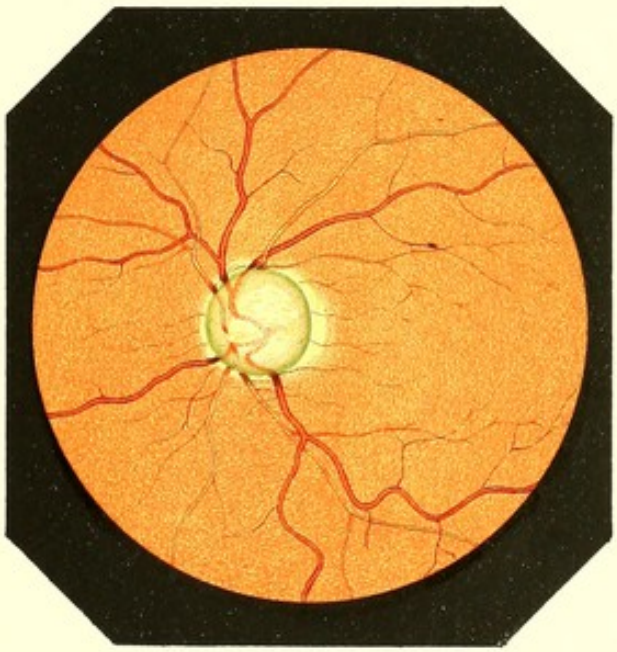

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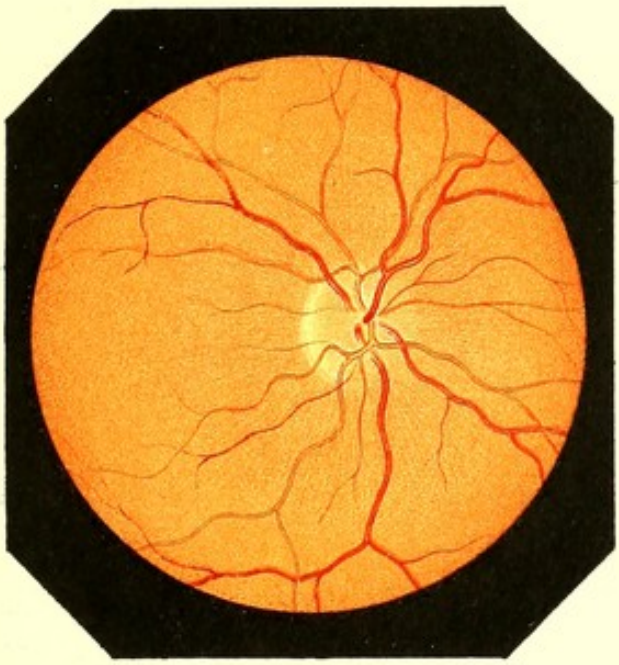
Fg. 61.



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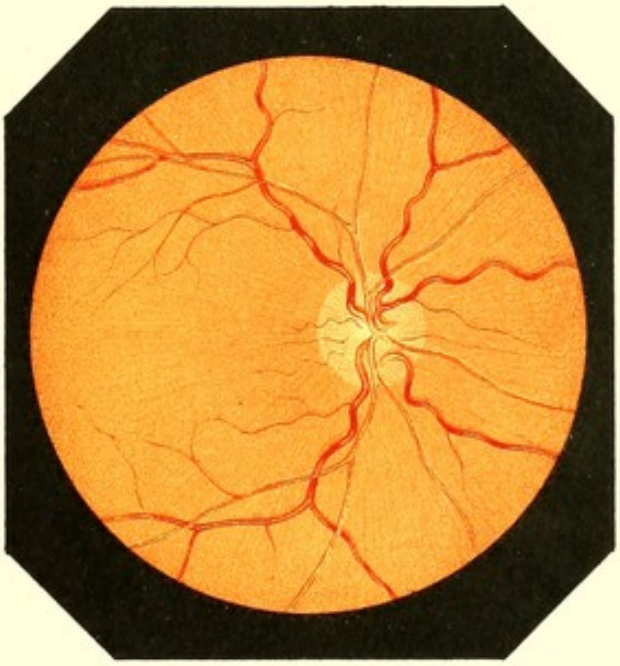
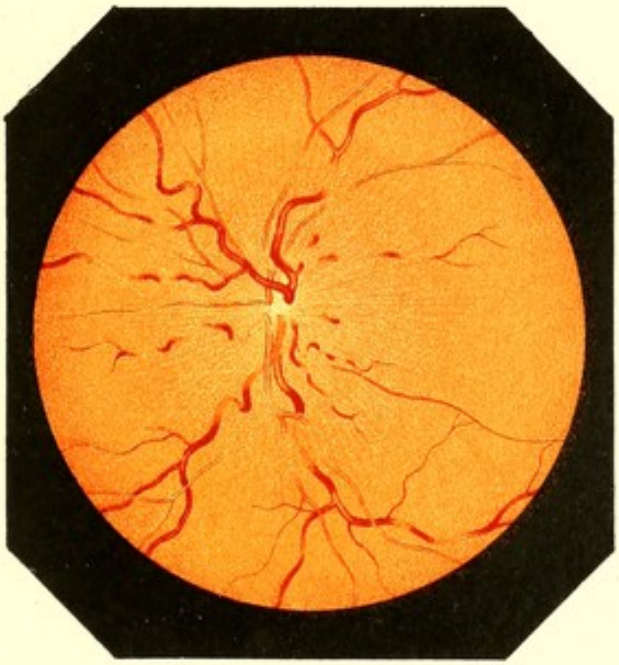


Fg. 63.



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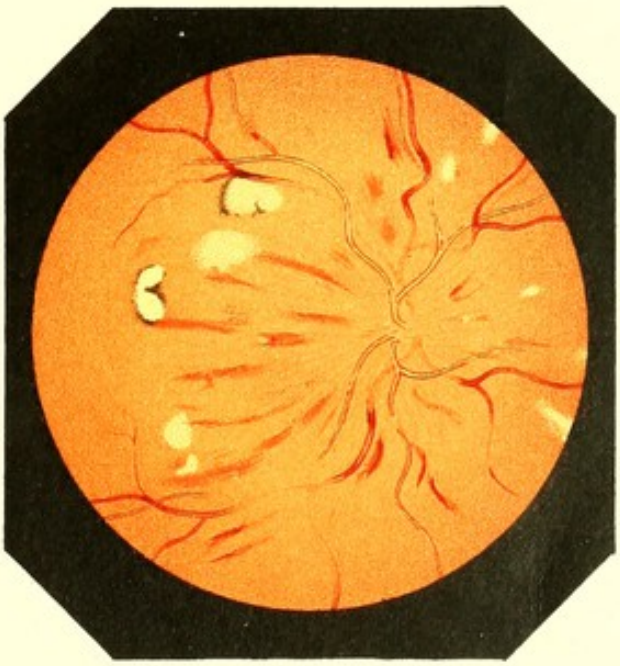

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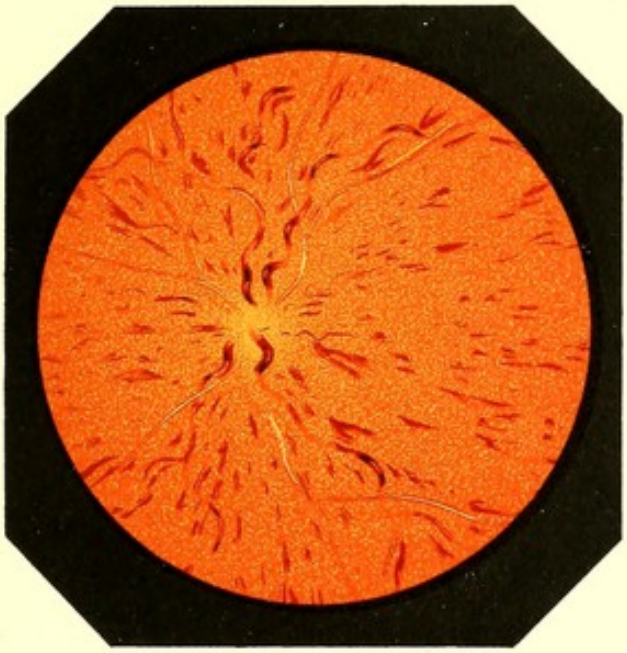
Fg. 65.



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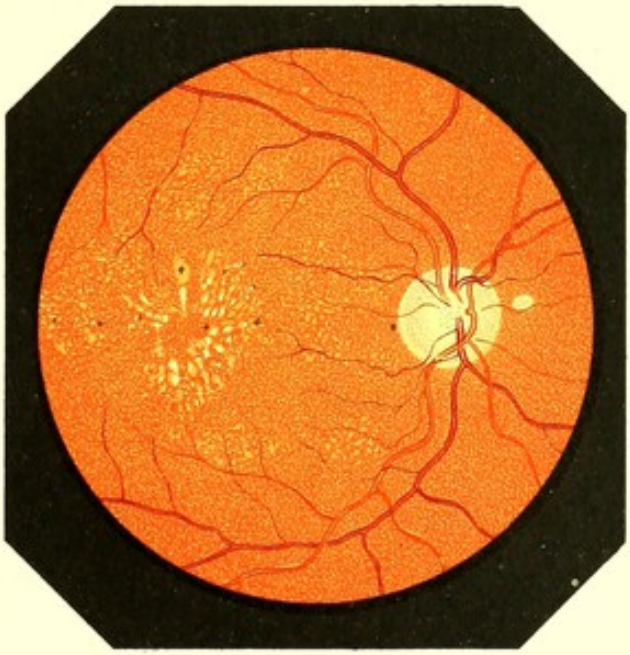
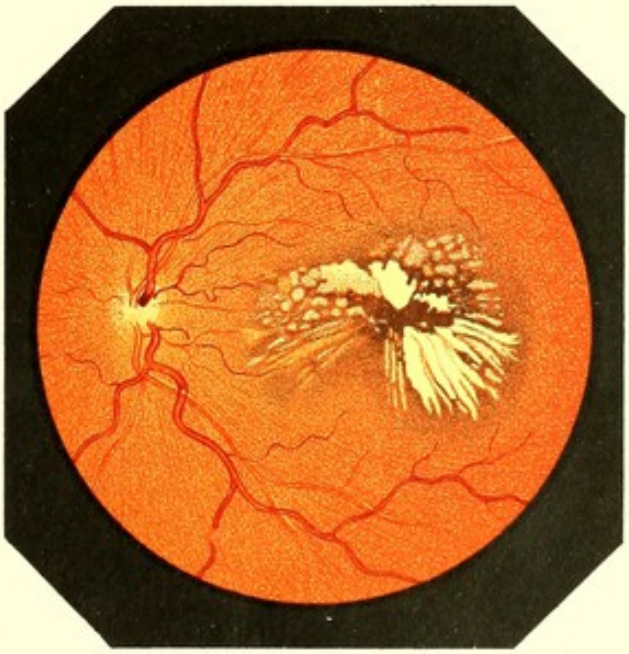


Fg. 67.

Fg. 68.



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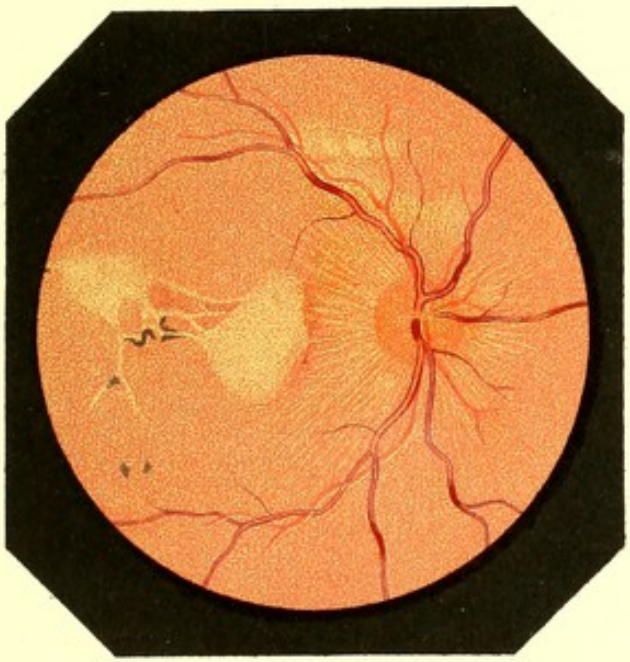
Fg. 69.



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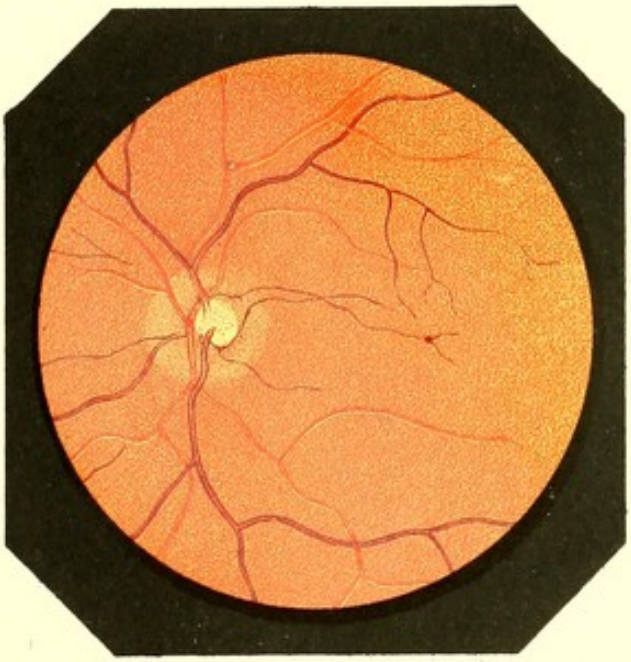

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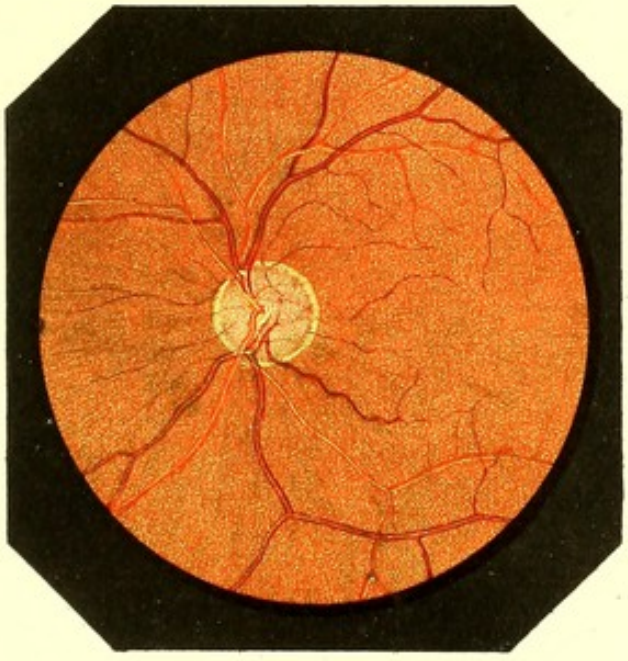

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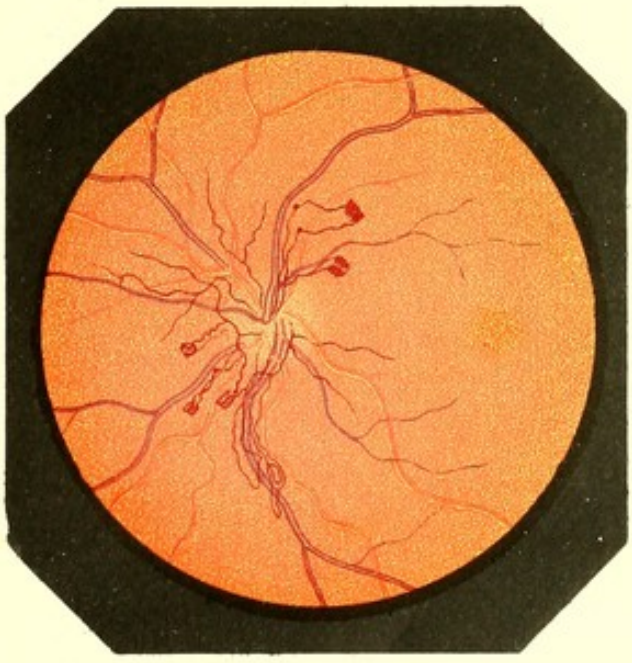

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Fig 73.

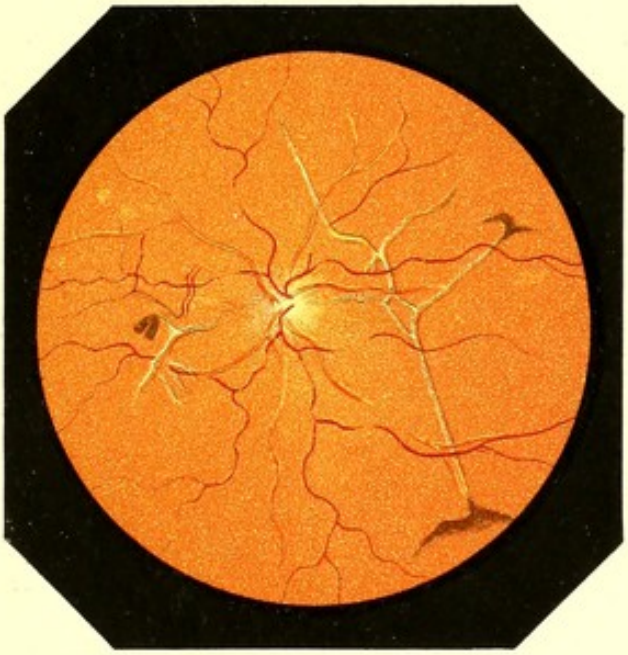

Fig. 74.

Fig 75.

Fig 76.

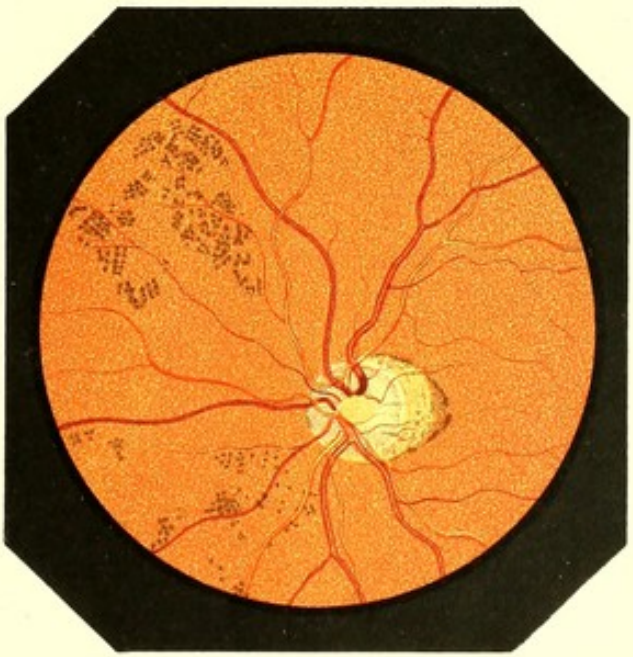

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Fig. 77.

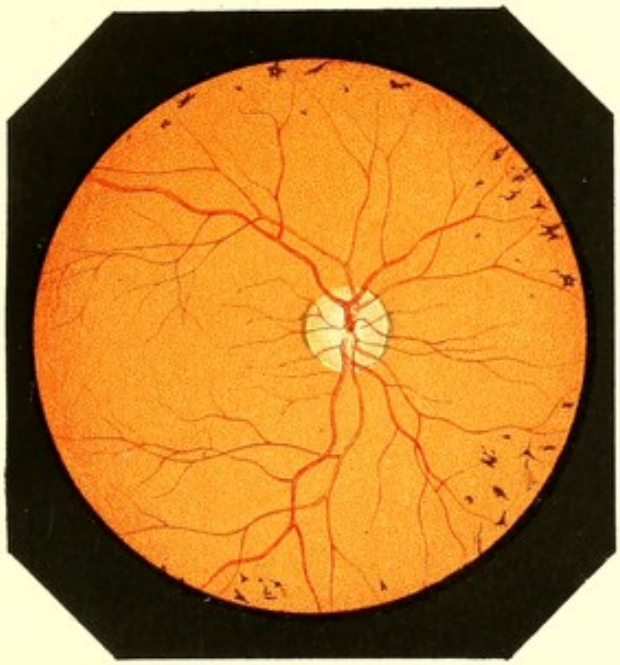

Fig. 78.

Fig. 79.

Fig. 80.

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Fig. 81.

Fig. 82.

Fig. 83.

Fig. 84.

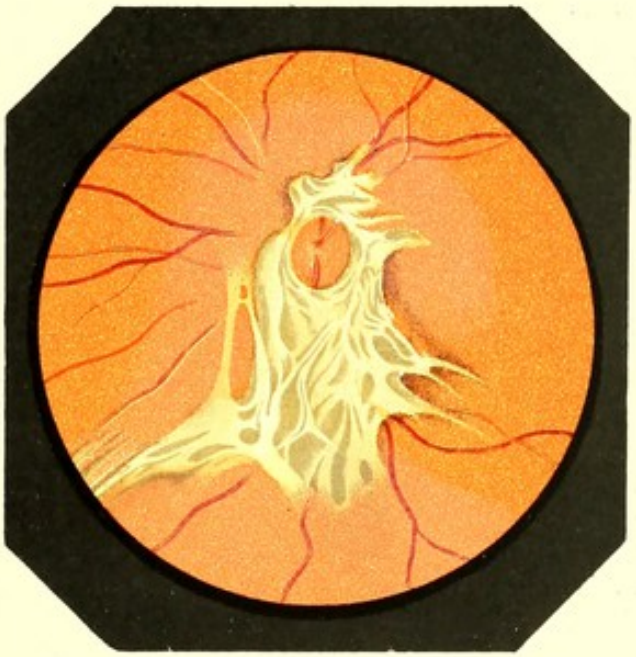

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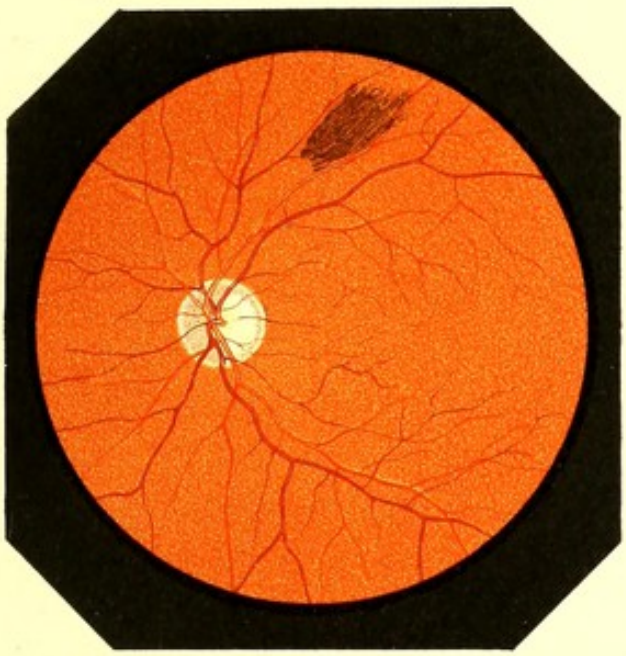
Fig. 85.



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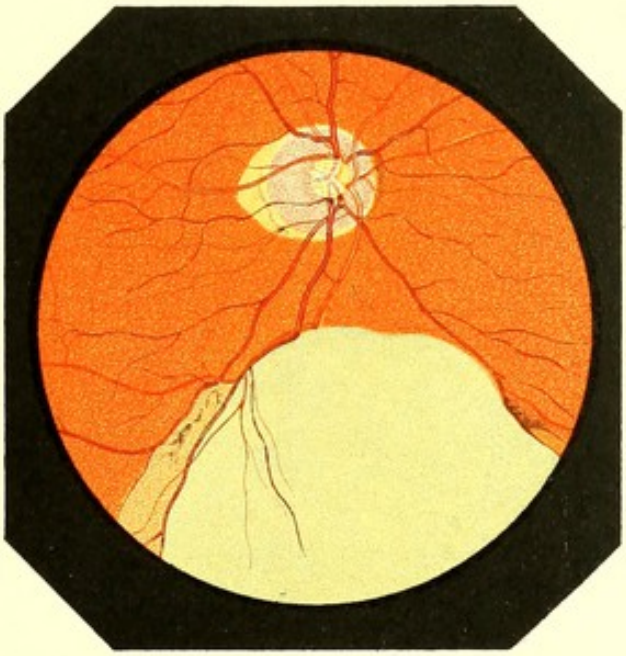

Fig. 87.

Fig. 88.

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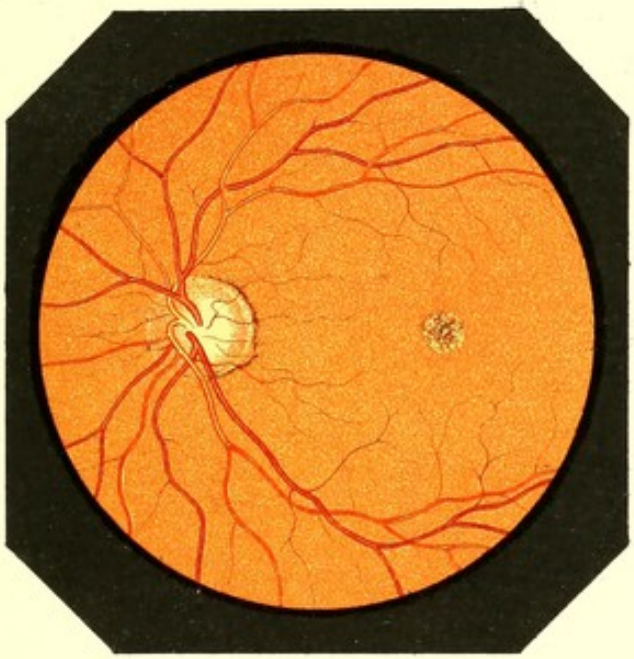
Fig. 89.



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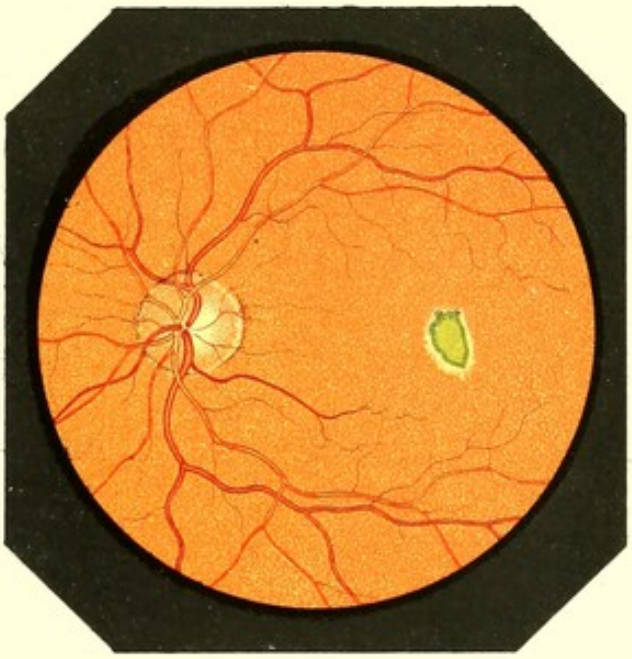

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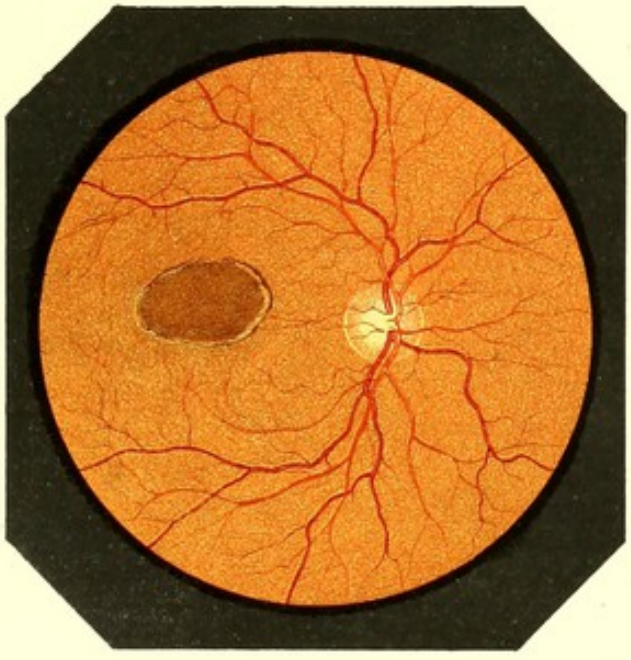

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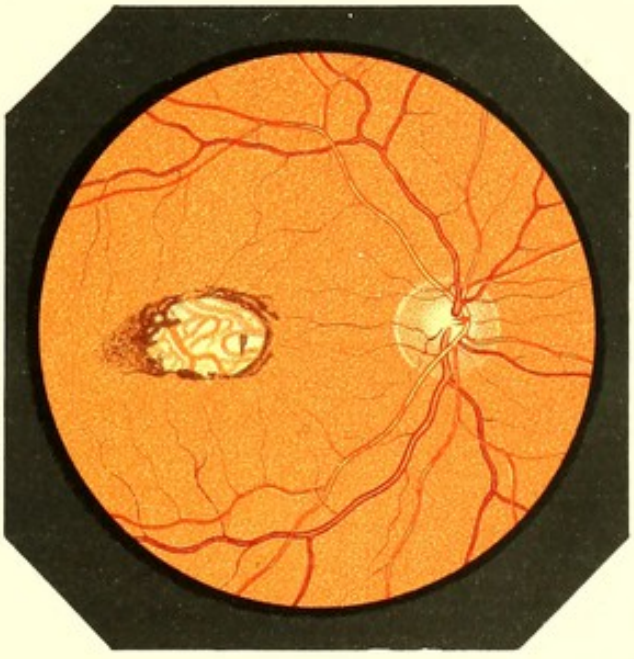

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Fig. 93

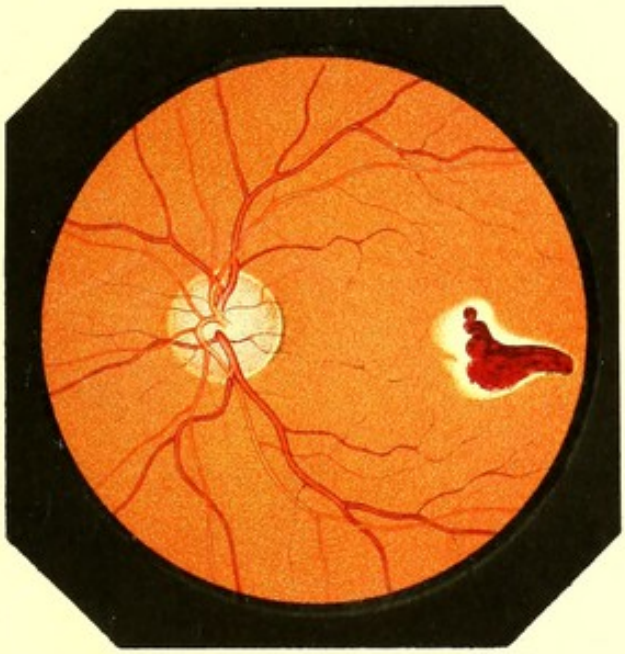
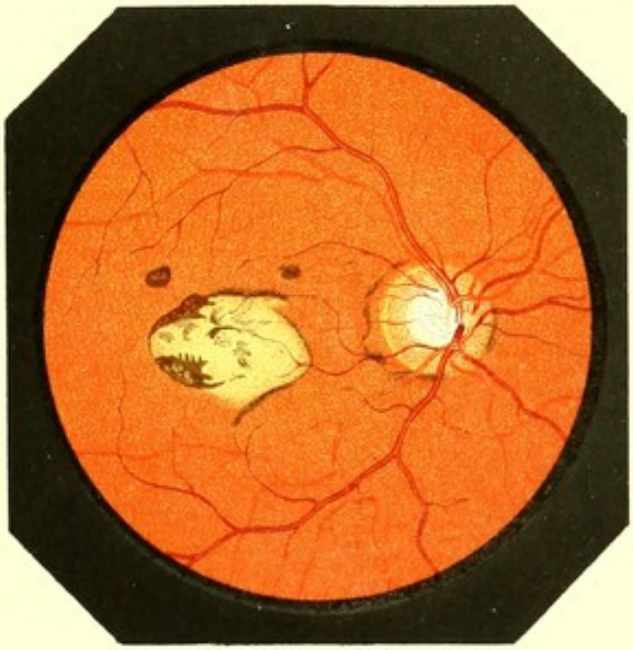


Fig. 94



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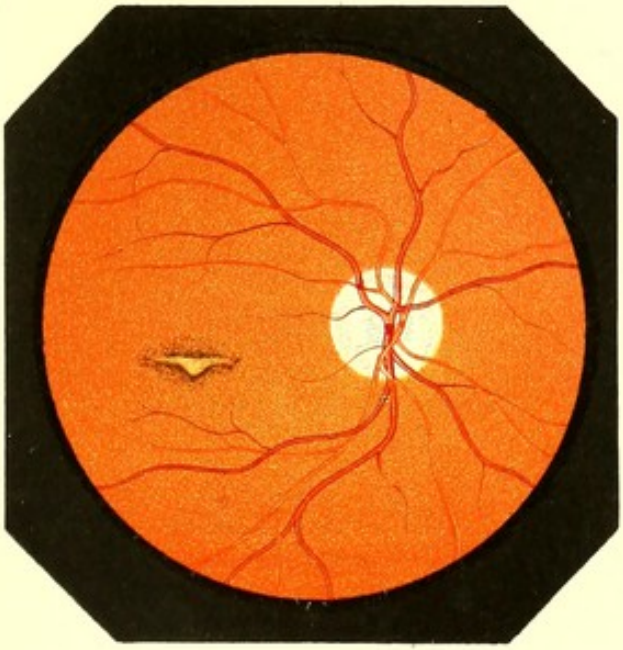

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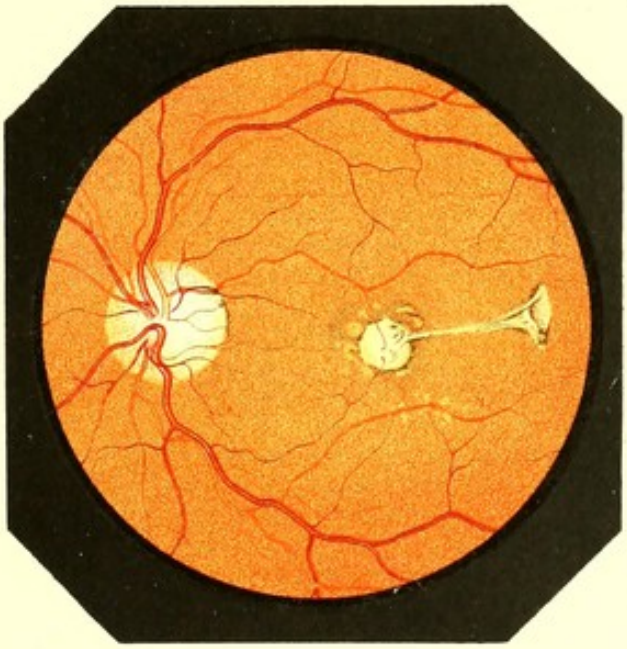

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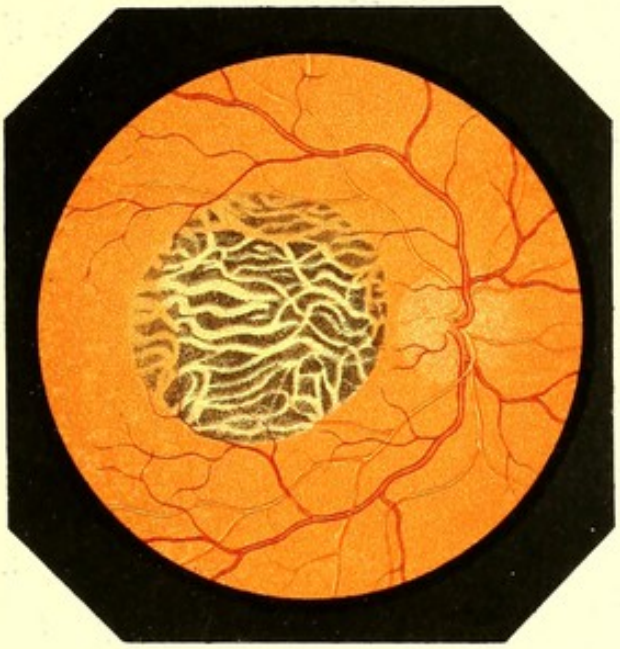
Fig. 97.



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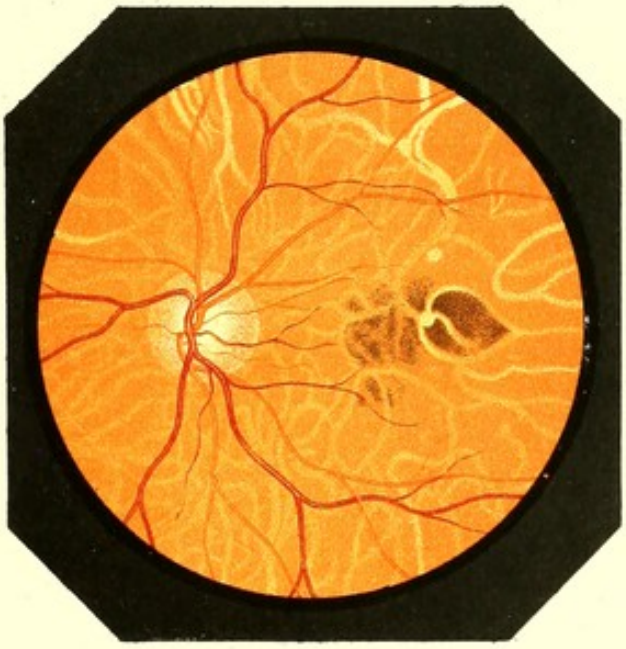

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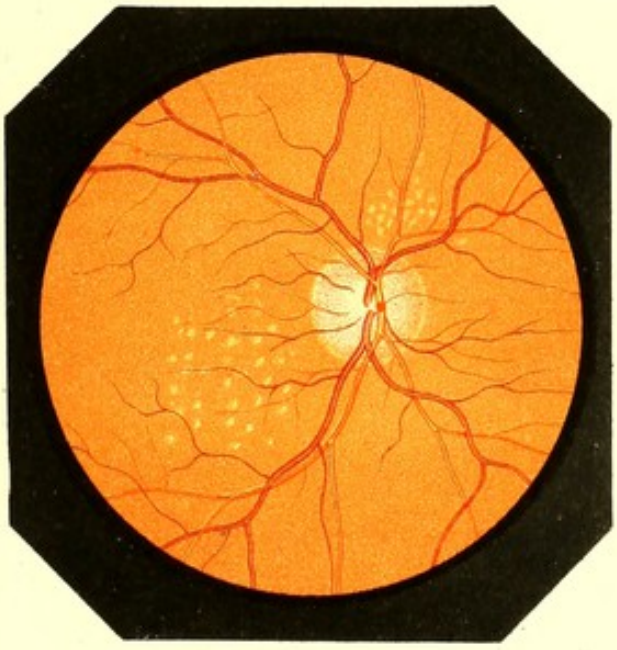

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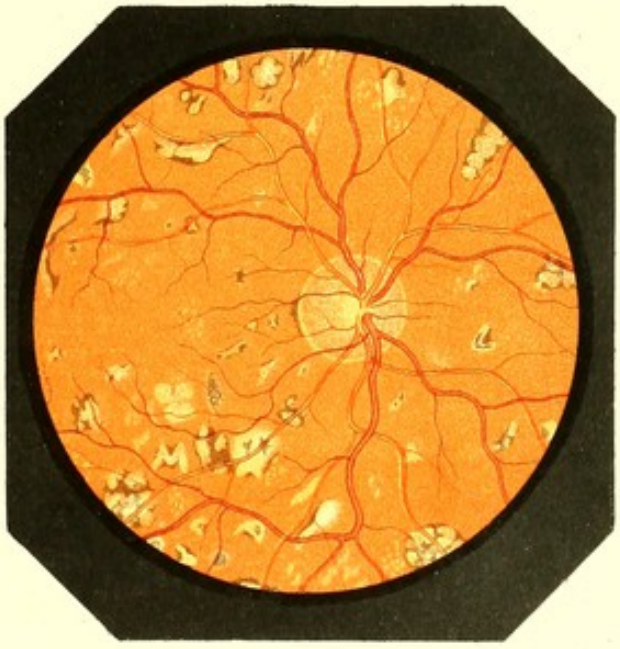

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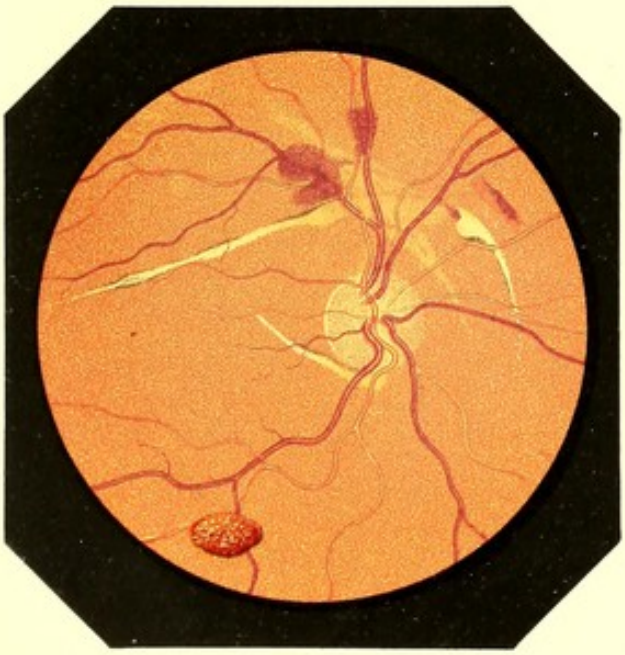
Fg. 101.

Fg. 102.

Fg. 103.



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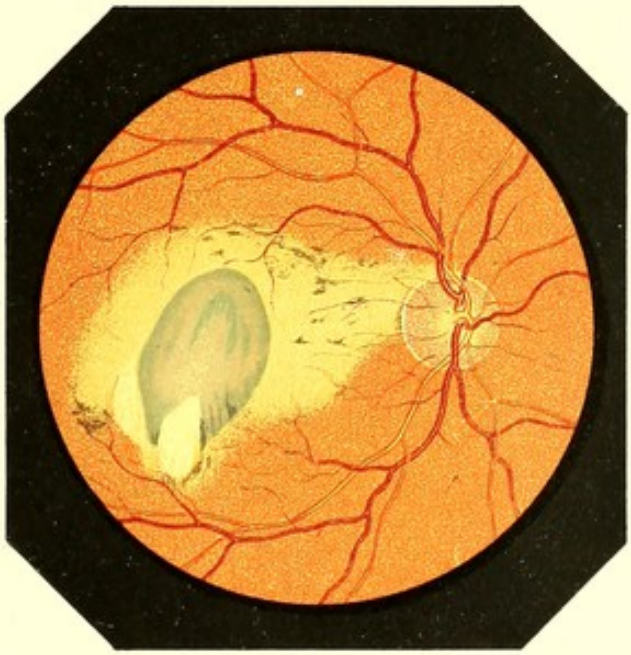

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Fig. 105.

Fig. 106.

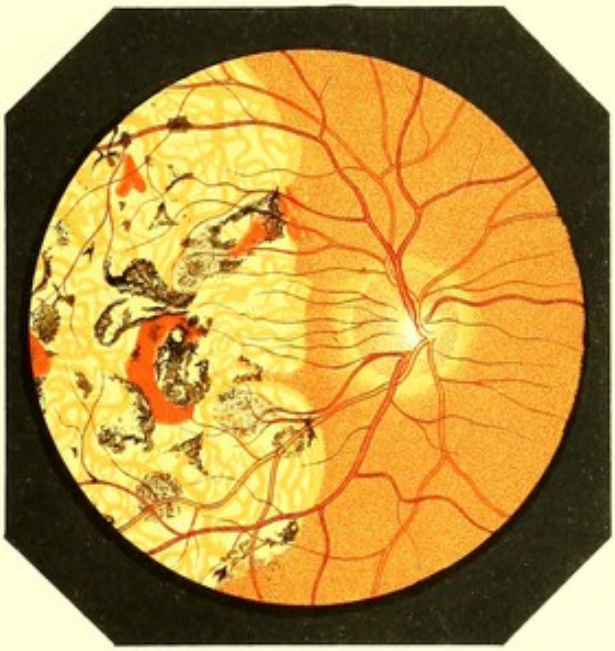

Fig. 107.

Fig. 108.

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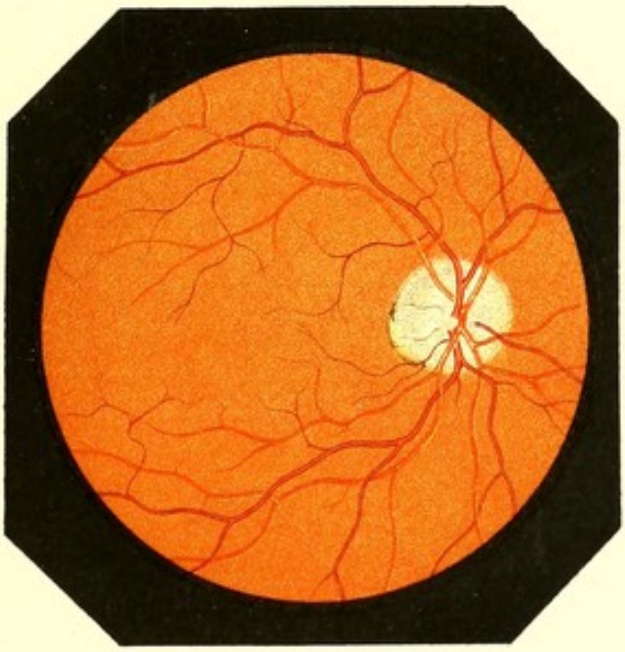
Fig. 109



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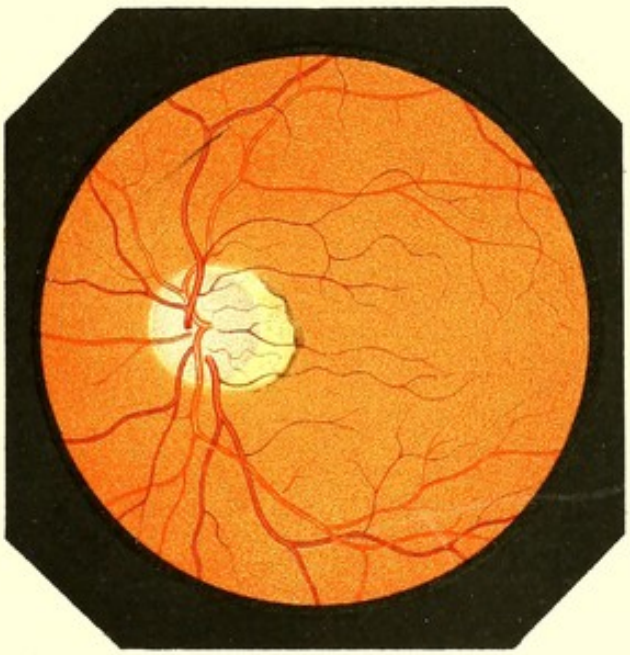

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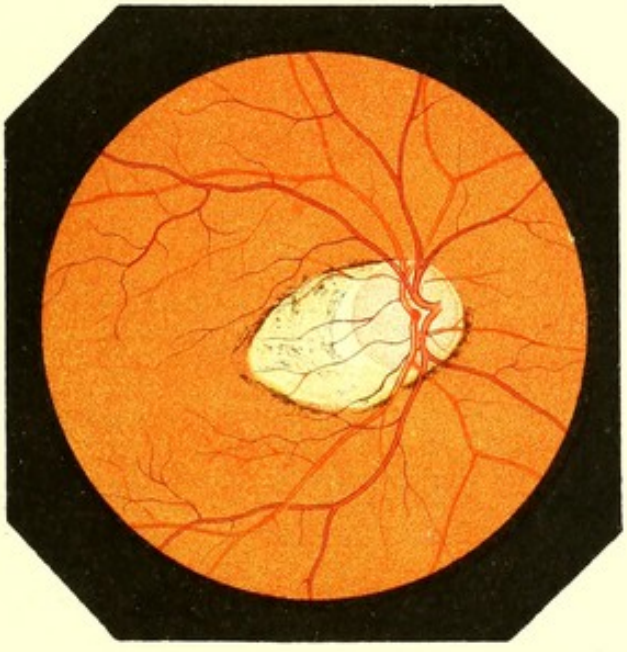

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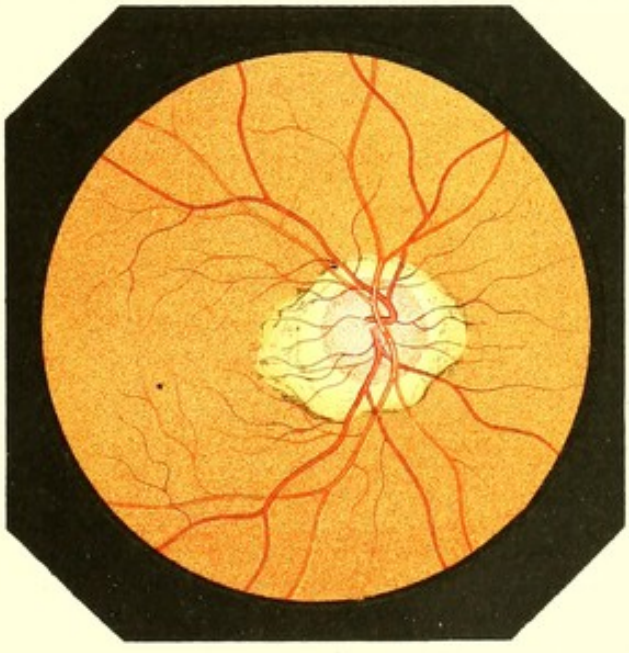

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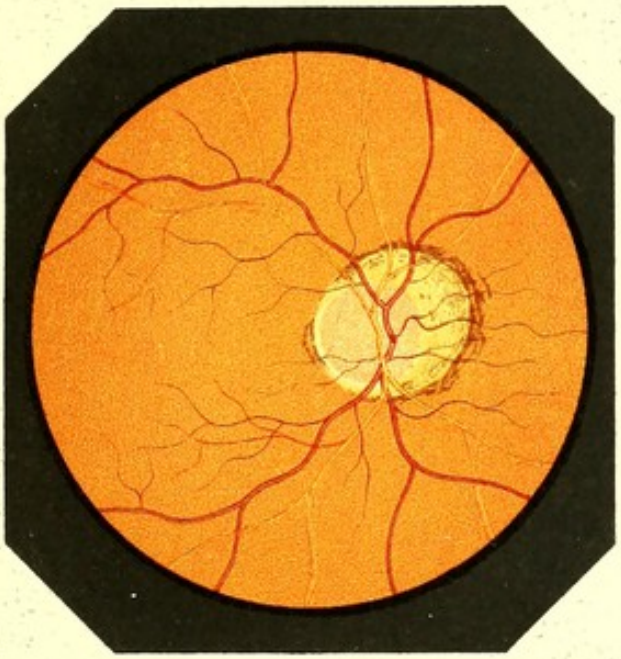
Fig. 113.



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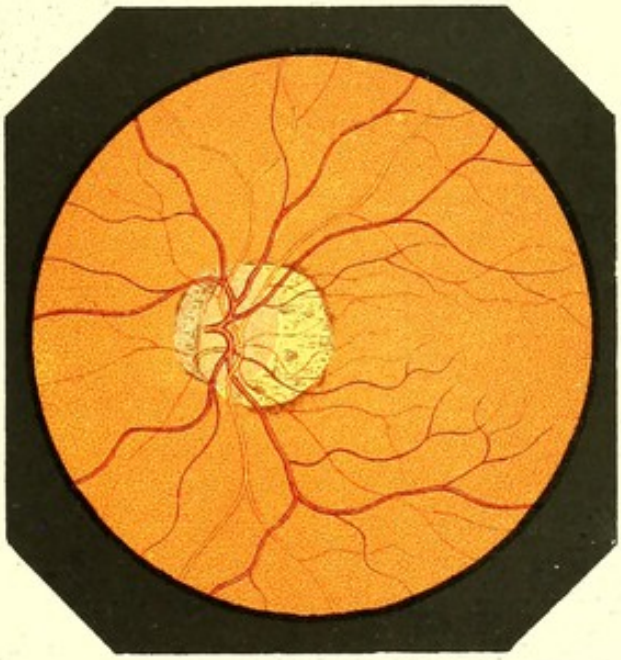

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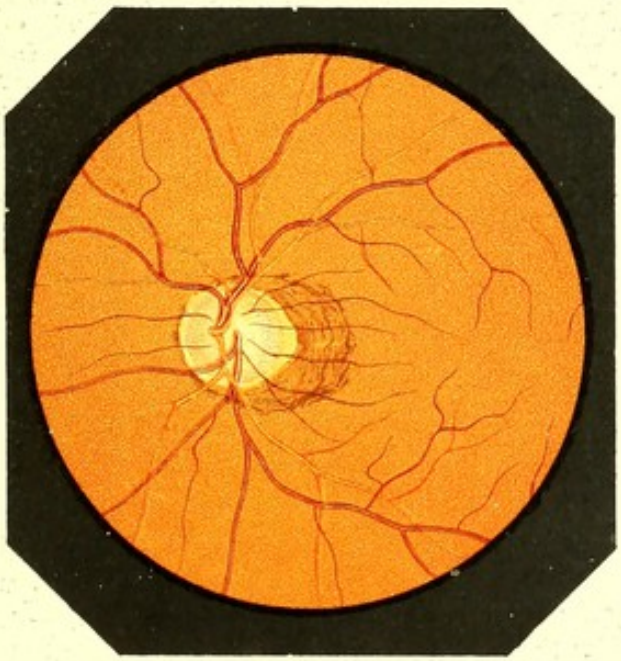

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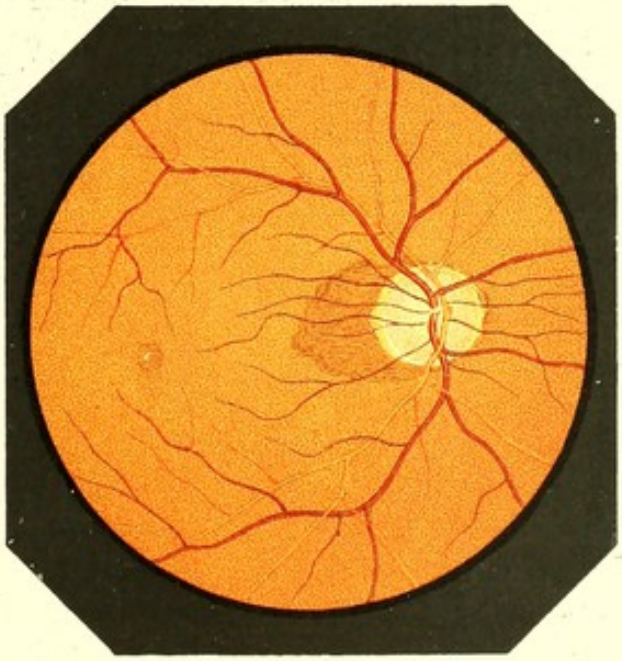

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Fig. 117.

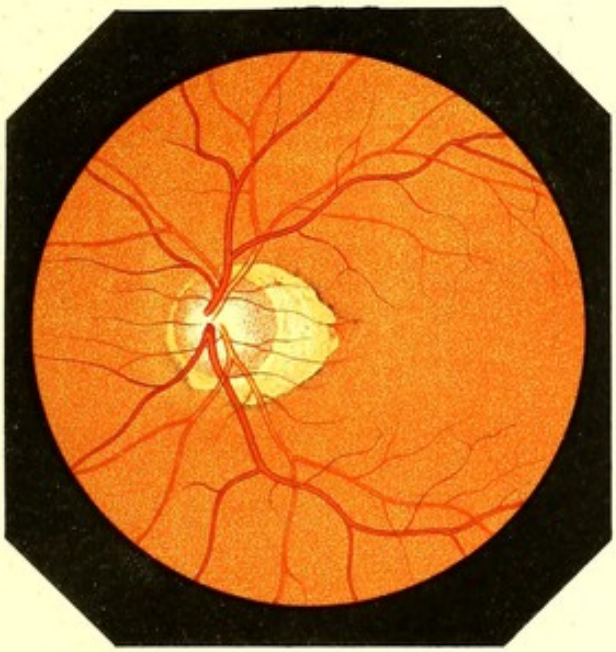
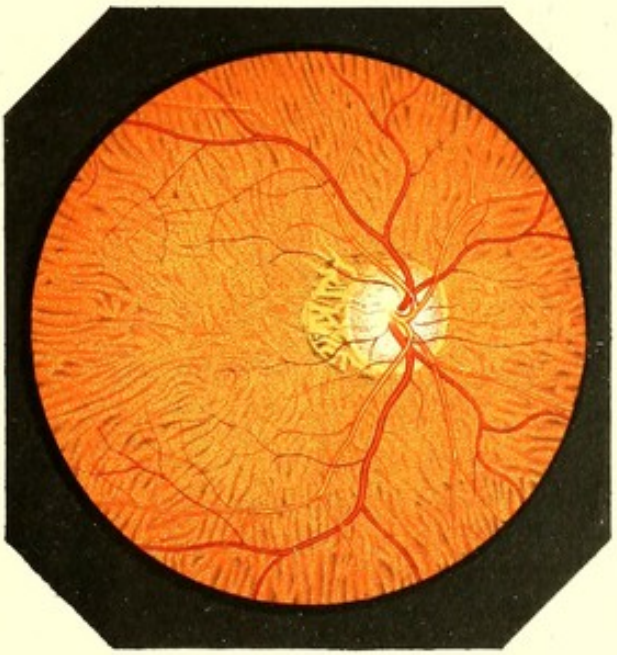


Fig. 118.

Fig. 119.

Fig. 120.



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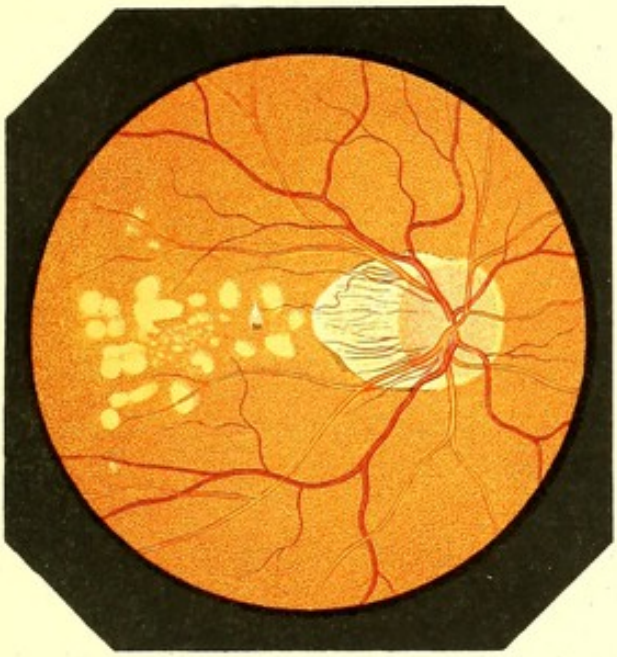

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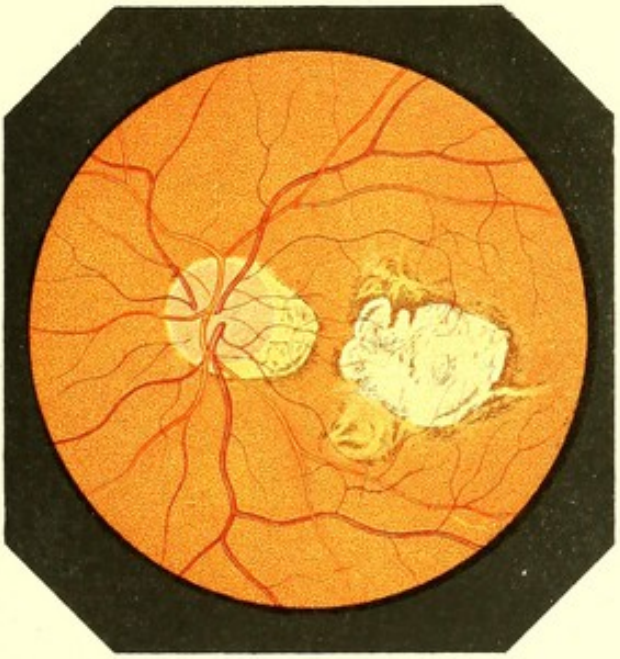

Fig. 123.

Fig. 124.

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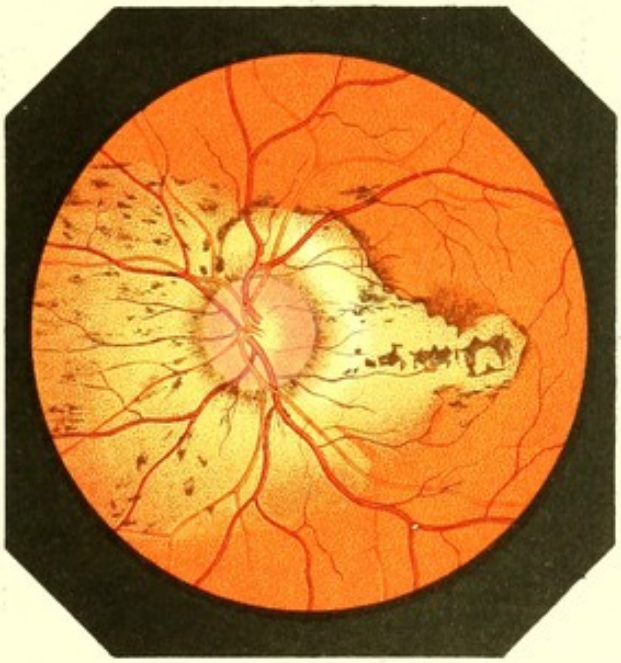
Fg. 125.

Fg. 126.



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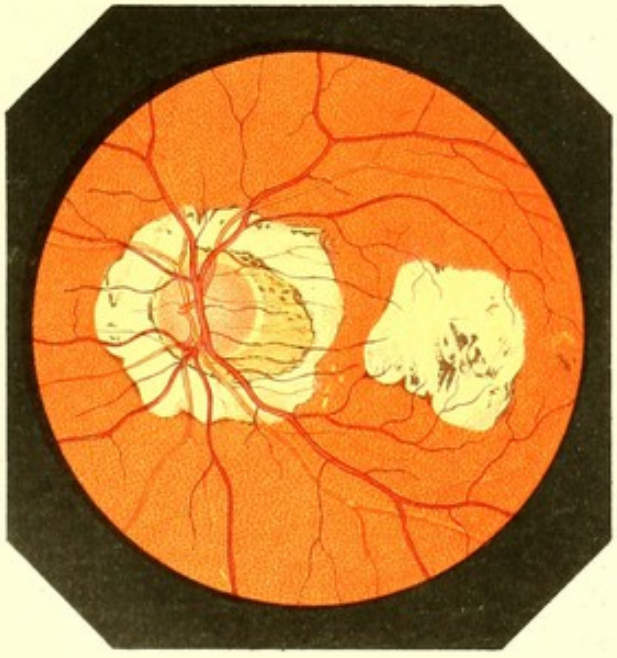

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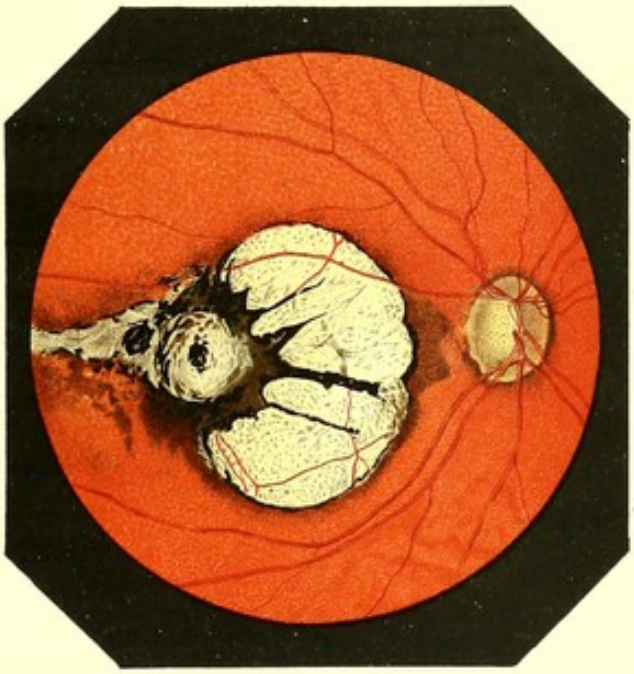
Fig. 129.

Fig. 130.



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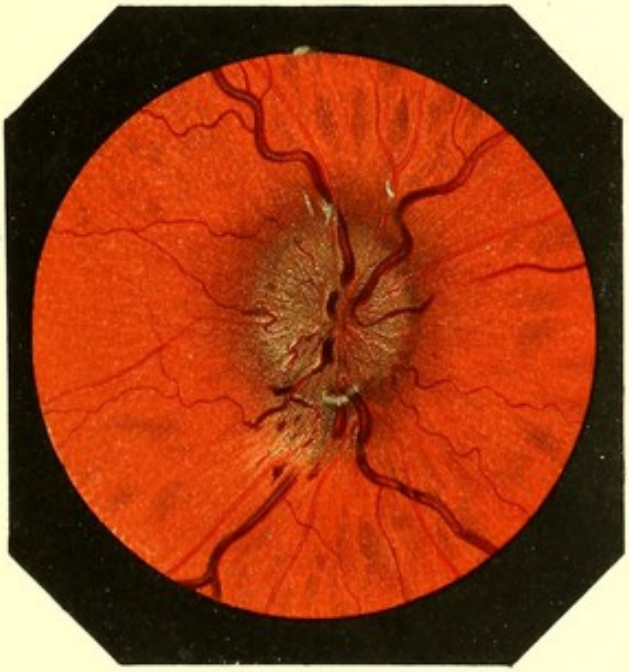

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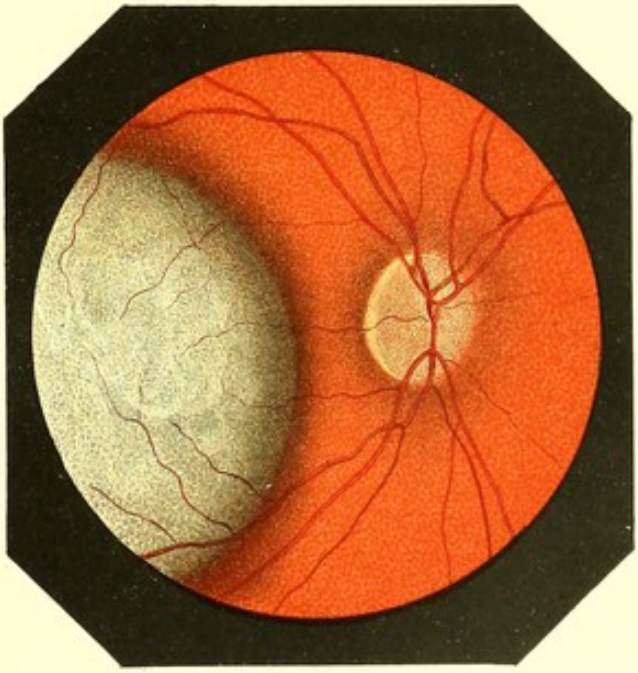

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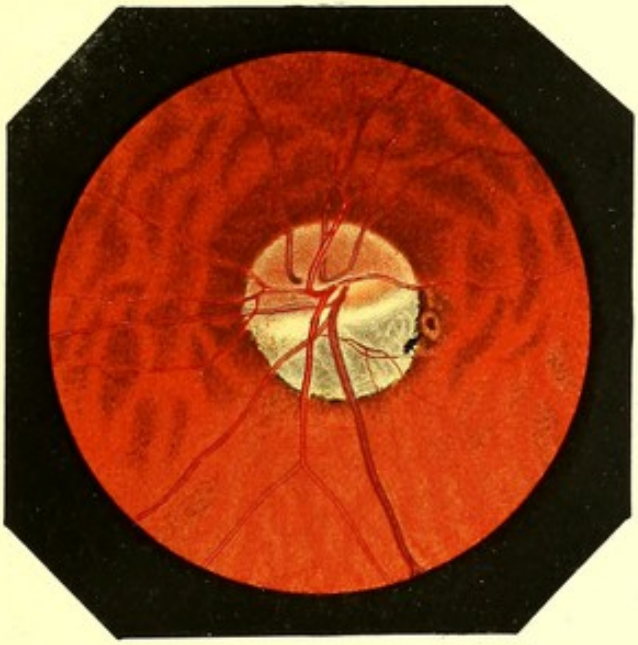

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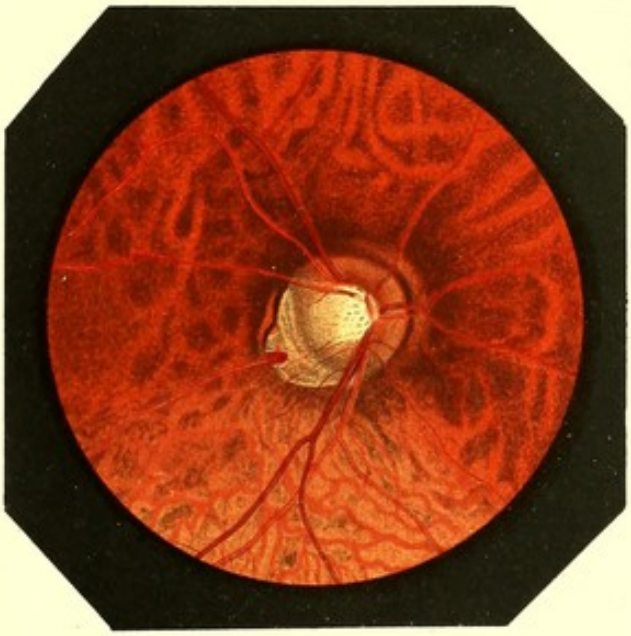

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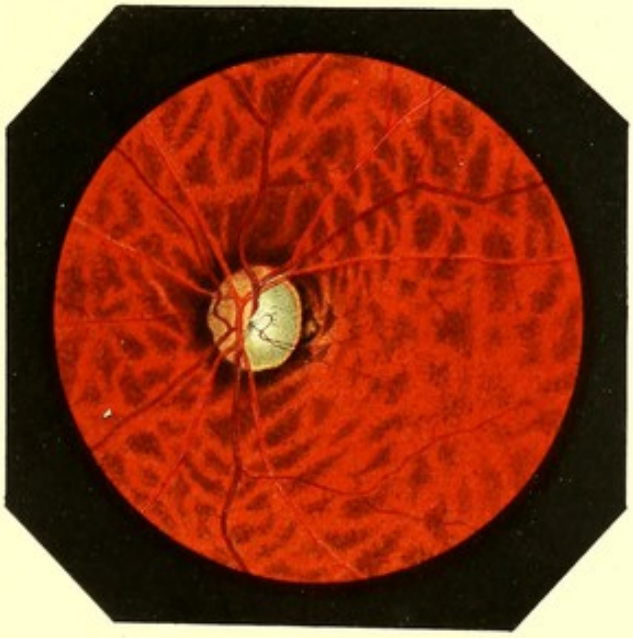

Fig. 136.

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