ON A
LUMINOUS APPEARANCE
OF
THE HUMAN EYE,
AND ITS APPLICATION TO THE DETECTION OF DISEASE OF
THE RETINA AND POSTERIOR PART OF THE EYE.

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THE luminous appearance of the eyes of cats, dogs, rabbits, oxen, sheep, and other animals, has been long known, and referred to the reflection of light by the tapetum; as also the reflection from the eye of the Albino, the reflection produced by morbid deposits in, and other changes of, the retina; and from the deficiency of pigment in persons not Albinoes.

Müller, (page 93, by Baly,) in a paragraph on the development of light in the higher animals, says, "The luminous appearance of the eyes of some animals arises from the reflection of the light from a brilliant tapetum which is devoid of black pigment; for which reason the eye of the white rabbit is especially brilliant, and the eyes of the Albino Sachs are said to have been luminous. Prevost was the first to explain the phenomenon: he showed that it could never be seen in complete darkness, and is dependent neither on the will, nor on the passions, but is the effect of the reflection of light which enters the eye from without."

Beer has described a peculiar reflection from the eye accompanying some cases of amaurosis. The cat's-eye amaurosis, "he considers it always confined to old, dwindled, grey-headed subjects, or unhealthy young subjects. When the patient is bereft of vision, a concave, pale grey, bright yellowish, or variegated reddish opacity, is developed. In a half darkened place such an eye presents a shining yellowish or reddish appearance, but only in certain positions of the eyeballs, whence Beer termed it Cat's-eye amaurosis. The disorder is also not accompanied with any other essential morbid appearance, except the decline of vision or complete blindness."—Cooper's *Surgical Dict.*, article Amaurosis.

The late Mr. Tyrrell refers to a brilliant metallic reflection perceived through the pupil in some cases of amaurosis. He says, "Latterly we have observed that the metallic appearance exists in a degree in very many cases of organic amaurosis; but that it is rarely detected unless especially sought for: we have perceived it in cases in which amaurosis has been imperfect, as well as in those in which vision has been perfectly lost. In some instances, in which we have detected this metallic appearance, the patients have experienced muscæ and sparks, or flashes, indicating disease of the choroid or retina; but in some cases the vision has been gradually lost without peculiar symptoms or suffering."—Tyrrell, vol. ii.

These extracts point out the cases in which reflection from the posterior part of the human eye has been observed; none of them mention a reflection from the posterior part of the perfectly-formed and healthy eye of the human subject: nor have I found or heard of any author who has described one. The object of the present paper is to show that the healthy human eye is equally or nearly equally luminous as the eye of the cat, dog, &c., when observed under favourable circumstances, and the application of the abnormal appearance, or want of, this luminosity, to the detection of changes in the retina and posterior part of the eye.

The reflection from the posterior part of the human eye may be seen in the following manner: Let the person whose

eye is to be examined be placed at the distance of ten or twelve feet from a gas or other bright light ; the rays of light must fall directly on his face ; all rays passing laterally of his head must be intercepted by a screen, placed half way between the light and the eye examined. If the reflection be bright, it will be at once seen from any spot between the light and the screen.

The following observations were made in two rooms ; in one of which was a gas-light, the other completely darkened. The person whose eye was to be viewed was placed in the dark room, five feet from a half-closed door opening into this room ; he directly faced the light, also at the distance of four or five feet from the door.

The appearance of the reflection was in most cases extremely brilliant when seen from a position between the door and light. In some it was at once obvious with the door wide open ; in others it was seen with great difficulty, and not till every ray of light passing to the side of the iris was carefully intercepted by the door on one side and the hand or a book on the other. The reflection was always seen much more readily and brilliantly when the eye was turned slightly to the side, and the rays of light passed through the pupil obliquely. On passing to the other side of the door, the luminosity was seen with greater difficulty. In this position it is necessary to have the eye turned to the side, to exclude all rays by the hand except those passing directly to the eye. In this way the reflection may be seen distinctly at the distance of eight inches.

In the majority of cases, however, it may be seen as follows : Let the person under examination sit or stand eight or ten feet from a gas-light, looking a little to the side ; standing near the gas-light, we have only to approach as near as possible to the direct line between it and the eye to be viewed, at once to see the reflection. Or, in a dark room, a candle being placed four or five feet from the eye, if we approach the direct line between them we shall be able at once to see it in many cases. If solar light be admitted through a nearly-closed

shutter into a dark room, the luminosity may be seen when the pupil is tolerably dilated, the patient standing five or six feet from the aperture, and the observer occupying the position before indicated.

These then are the circumstances necessary for seeing the luminosity. a. That the eye must be at some distance from the source of light ; the distance being greater in proportion to the intensity. b. That the rays of light diffused around the patient (and sometimes around the eye itself) should be excluded. c. That the observer should occupy a position as near as possible to the direct line between the source of light and the eye examined ; hence it is sometimes necessary for the observer to stand obliquely, that his eye may approach nearer to the direct line.

The appearance of the reflection itself not only varies much in colour and intensity in different persons, but also from the circumstances under which it is seen, viz. the greater or less intensity of light, the position of the eye examined, and the distance at which it is viewed.

When the reflection is seen under the influence of a dim light, as that from a candle, or a few solar rays, a red lurid glare, like that from a dull coal fire, is observed, evidently proceeding from the bottom of the eye, and, though not distinctly concave, yet conveying the idea of concavity. The character of the reflection thus seen by a faint light, at the distance of two or three feet, is very uniform, and does not present much variety of tint.

When the eye receives rays from a good bright light ten feet distant, and we stand near the light, the reflection is then seen extremely brilliant ; presenting a fine metallic lustre, and varying from a bright silver or golden, to a decided red tint : the latter being the more usual colour. While viewing the reflection at this distance, it sometimes undergoes a distinct change, suddenly altering from a copper or red colour, to a silver tint : this happens sometimes in consequence of a slight movement of the eye, but not unfrequently is observed without any movement having taken place.

Although the reflection is more readily seen in an eye with a large pupil, its lustre does not depend upon this circumstance. In two eyes with pupils of equal diameter, the intensity of the reflection frequently varied greatly. In one case, in which the reflection was very dusky in appearance, and the pupil small, atropine was dropped into the eye. I then observed that, though the extent of luminosity was increased, it still retained the same dusky hue. The greater facility with which the reflection is seen when the eye is directed slightly away from the light, appears to depend on the more patulous condition of the pupil.

On approaching within a few inches of the eye, the reflection is not visible, for, before our eye can be brought within range of the reflected rays, the incident rays of light are excluded. On placing before the eye examined, a black card with an aperture the size of the iris, the intensity of the reflection was observed to be somewhat diminished.

In cases in which the lens had been removed, the reflection was indistinct at a distance, but was rendered somewhat clearer by the aid of a double convex lens placed before the eye examined; but at two or three feet distant, the reflection was as obvious as in cases in which the lens was present.

Among the cases I have examined, I have recorded indiscriminately the appearance of the luminosity in twenty persons with good and perfect vision, whose ages varied from a few months to sixty years. In sixteen cases the reflection was bright and very evident; in four, faint, and seen with difficulty; and in one it was not seen at all; in the last case, the pupils remained small in the shade. If these observations are confirmed by other observers, we may say that the reflection ought to be seen in every healthy eye with a good-sized pupil.

Having pointed out the character of this reflection, and the mode in which it may be seen, we inquire its source or cause.

The retina in the living eye is a perfectly transparent medium in contact with the choroid and vitreous body. The

transparency of the retina is, however, no proof that it does not itself reflect many of the rays of light that impinge upon it, although the greater proportion are transmitted; the transparency of a structure being quite consistent with considerable reflection, but not with absorption of the rays of light: and this reflection would be rendered more obvious by the position of the choroid. The formation of images upon the retina, acknowledged by all, is at once a proof of its reflecting power.

From these considerations, and the fact of the anterior layer of the retina consisting of a vascular plexus, and thinking the choroid with its pigment too dark to give such a reflection, my first impression was that the retina was the reflecting surface.

Mr. Bowman, however, having suggested to me the greater probability of the choroid with the pigment being the reflecting structure, I commenced some experiments to determine this point. The reddish brown colour of the pigment of the human eye has been fully recognised. Mr. Hunter clearly and fully points out the varieties in the depth of tint of the pigment. Entirely or almost wanting in the Albino, it is of a light brown or fawn colour in fair persons, while in persons of swarthy complexion it is proportionably dark, appearing to keep pace with the depth of colour of the rete-mucosum; being still darker in mulattoes and negroes.

The brilliancy of the luminosity of the healthy eye appears to be in proportion to the light colour of the pigment. So evident is the reflection in the Albino, that in ordinary daylight the pupils present a reddish appearance. On placing a middle-aged man, an Albino, ten or twelve feet from a gas-light, the reflection was extremely vivid, and of a pinker colour than ordinary, while the light transmitted through the choroid and iris evidently increased the effect. On placing close to his eye a black card with an aperture a little larger than the pupil, the reflection was little brighter than that from the eye of a fair person examined side by side, but was of a more decided pink colour.

In persons of fair complexion and blue or grey irides, it is generally more brilliant and more readily seen than in those of dark skin and irides. In the mulatto it is also dusky; but in them, as in persons of swarthy complexion, a silvery reflection is sometimes seen, and is most probably a reflection from the retina. In the Albino, this reflection produced by the vascular choroid is most brilliant and lightest in tint, and, in proportion to the darkness of the pigment, its lustre is diminished, and the colour becomes more dusky.

The posterior segment of an eye, the pigment being of the usual brown colour, was exposed to light concentrated by a lens upon it, and a brownish red reflection, of metallic lustre, was observed.

I found, on holding an eye with the optic nerve towards the light, and looking through the pupil, that the light passing through the choroid was of a brilliant red colour, precisely resembling that reflected during life. I therefore obtained seven more eyes, each from a different subject, and found that the same red light was transmitted through the choroid. These cases, taken indiscriminately, leave no doubt that this is an appearance common to the human eye. Some months before, my friend Mr. Dixon showed me an eye in which the same appearance was seen; at that time, however, we both supposed that this was an exception.

This appears to me to be the best proof that the reflection is from the choroid with its pigment, viz., the exact resemblance of the rays transmitted through it to the reflection. But while I regard this as the principal reflecting structure, the light returned from the retina and concavity of the hyaloid body would doubtless increase the effect.

I have not yet seen the luminosity in the dead eye, but the non-injection of the choroid and loss of transparency in the retina sufficiently account for this.

The reflection from these structures would be considerably increased in brilliancy, from the concentrating influence of the concave shape of the retina, and the focal distance of the lens.

The establishment of the fact of a similar reflection from the healthy human eye to that from the eyes of animals, appears to me chiefly important in its adaptation as a mode of examining the posterior part of the eye. The retina and choroid hitherto concealed in the living eye, and little opportunity being afforded of examining their condition after life, in consequence of their diseases not terminating fatally, considerable uncertainty has attended the diseases ascribed to these structures; but the existence of this luminosity having been recognised, its non-existence, or abnormal appearance, may enable us to detect changes in these structures heretofore unknown, or satisfactorily to see those which we only suspected. If we dilate the pupil by atropine, we have a means afforded of seeing the condition of the retina and choroid in every case. The cases I have examined in this way have confirmed the general impression that the retina is not frequently the seat of change in amaurosis; for, out of several cases of amaurosis, in which the non-opacity of the cornea, lens and humours allowed this mode of examination, I found but two in which the retina was so changed that the reflection was not seen. Before, however, relating these cases, I shall make a few observations on the disease called Cat's-eye amaurosis.

Cat's-eye amaurosis.—The recognition of this normal luminosity of the eye will aid us to a clearer understanding of the somewhat contradictory and unsatisfactory statements concerning cat's-eye amaurosis.

First described by Beer, and subsequently by other ophthalmologists, it is confessedly a rare and equivocal disease, and the statements of ophthalmic writers are at variance, not only upon the appearance of the reflection, but upon the progress of the disease, the accompanying symptoms, and the age at which it occurs.

Beer says, that "A pale grey, or whitish yellow opacity, sometimes with a reddish cast in certain lights, is developed in the bottom of the globe far from the pupil; the sight is not merely weak, but in the strictest sense confused, for all ob-

jects, particularly those of smaller size, seem to run together when the patient attempts to survey anything attentively. As the disease proceeds, the bottom of the eye becomes clearer and more visible, and the colour of the iris paler, the latter change being particularly obvious in dark eyes. When the sight is completely extinguished, we may discern, on close inspection of the pupil, a fine vascular network over the opacity, being apparently the ordinary ramification of the *arteria centralis retinae*, rendered visible on the shining opal-like fundus of the globe. Such an eye, when seen in particular directions, has a yellowish or reddish luminous appearance in twilight, resembling in some degree that of the cat, whence I have derived the name.”*

After an attentive perusal of this passage by Beer, and the description of cat's-eye amaurosis by other ophthalmologists, I am inclined to think that two different things have been confused under this name.

First, that in the majority of cases, the normal luminosity of the eye was observed. When Beer says, that an eye seen in particular directions has a yellowish or reddish appearance in twilight, resembling the eye of a cat, he precisely describes the appearance of the healthy human eye in certain positions; the pupil being dilated, and light falling upon it in a certain direction; and the plate he gives of this affection (vol. ii. plate 4, fig. 1) precisely corresponds with the reflection when observed at a distance of two or three feet. Mr. Tyrrell's account, before alluded to, agrees not only in the appearance of the reflection, but the circumstances under which it was seen are necessary to see the normal luminosity. No one can read his case 90, and observe the reflection of the healthy eye, and not be persuaded that they are one and the same. The first case in which I observed this natural brilliant reflection I supposed to be a case of cat's-eye amaurosis, so accurately did it coincide with his description. Carrying the observation further, I found that it existed in all healthy eyes when the pupils were dilated. Most of the

* Lawrence, p. 519.

cases appear then to have been nought but the observance of the natural luminosity; and that it should be seen in cases of amaurosis only is nowise strange: the more minute examination bestowed upon cases of this kind, the probably dilated state of the pupil, and possible absorption or non-secretion of pigment after continued amaurosis, are reasons why it should have been seen in amaurosis alone—thus it has been associated with various symptoms. One author has found it occur in youth, another in old age.

Next; with these another class of cases has been confounded. Thus, Beer says, "When the sight is completely extinguished, we may discern, on close inspection of the pupil, a fine vascular network over the opacity or shining opal-like fundus of the globe." Mr. Lawrence's cases agree nearly with this description. Red vessels were seen in some cases, and the margin of the reflecting surface was distinctly traceable. The facility with which such reflection was seen, the presence of dilated vessels, and the existence of a margin to the reflecting surface, mark them as differing widely from the former cases. These were cases in all probability of deposit of lymph in the retina. A case of this kind is recorded by Mr. Tyrrell (Case 80, page 125); but discriminated from his account of cat's-eye amaurosis. While, therefore, the latter cases afford conclusive evidence of change in the retina or choroid, in the former cases the existence of the normal luminosity warrants the conclusion that these structures were healthy. If this be a correct analysis of these cases, the mystery that hangs about cat's-eye amaurosis vanishes; the first class of cases were cases of amaurosis arising from cerebral and other causes, in which the retina and choroid being perfect, the normal reflection from them was seen; the second division consists of cases of deposit of lymph or other substances in or about the retina. It is then at once evident that a mere luminosity of the eye will in no case be a sign of altered condition. It will be necessary first to become acquainted with the normal reflection—its modifications in different lights and positions, and at various periods of life, and

in persons of a dark or fair skin ; then by the detection of an altered condition of such reflection (and assisted in many cases by contrast with the opposite eye), or by its entire absence, we possess a means of diagnosis in retinal and choroidal disease.

In confirmation of its value, as a means of detecting changes in the retina, I shall now relate a few interesting cases which occurred at the London Ophthalmic Hospital ; which I am permitted to do by the kindness of the surgeons of that institution.

Case 1.—Amelia Flemming, ætat. 57, has had bad health for many years, being afflicted with what she calls rheumatism of the head, but has never suffered from gout. Latterly her health and strength have much improved. After getting wet, she saw numerous black spots and bright sparks, which, she says, were only seen by the left eye, and describes as being all situated in the nasal division of the field of vision. She had no giddiness or unusual pain in the head. When she applied at the hospital in April last, three weeks after the first appearance of these symptoms, this was the state of vision with the left eye, its axis being directed straight forwards. The hand, or any other object, was not at all seen when held to the nasal side of the cornea ; upon carrying it across to the temporal side, it was at once recognized, and, in this position, large printing was distinguished as black lines. The pupils were equal and small. Atropine was dropped upon the conjunctiva of the left eye ; the pupil dilated well, and the following was the state of the reflection when the eyes were examined in the manner before described : upon her looking straight forward, but little light issued from the left eye ; less than from the right, the pupil of which was undilated. When she looked to the right, and the right portions of the retina were brought under view, the reflection was of its usual brightness, and equal in both eyes ; on looking to the left, no reflection was seen from the left eye ; that from the right was of its usual lustre. This observation was made without any recol-

lection of the side on which vision existed. In this case the probability was, that it was an affection of the retina; but there was no other sign on which to rely but the statement of the patient with regard to the appearance of scintillations. The pupils were equally black, and the appearance of the eye normal; by this mode of examination it was rendered clear that the left half of the retina had undergone considerable change, and probably its power of transmitting the influence of rays onwards to the cerebrum.

Case 2.—John O——, ætat. 42, a silk-weaver, has always had indifferent health, and bears a cachectic, worn aspect. Three years and a half ago he had primary, followed by secondary, syphilis; he then had an attack of severe inflammation in the right eye, for which mercury was given, and the vision recovered so far that he could read. One year after, large black spots appeared before the same eye, followed by bright sparks both in the light and darkness; he had no pain, and vision was quickly lost, and has remained the same ever since; he cannot do more than distinguish a bright light, except that if an object be held far to the right, almost out of the range of vision, he can partially see it. The pupils were clear, dark, and readily dilated. Lens perfectly transparent. The reflection from the left retina was perfect and brilliant at a few feet distant; here no reflection could be seen from the right eye; on approaching more closely, and looking very carefully into the eye, when it was turned towards the nose, one spot behind the iris was observed to be luminous, corresponding to the only part of the field of vision in which he had any power of distinguishing an object.

Case 3.—Thomas P——, ætat. 29, a driver, received a blow by a hand upon the right eye and margin of the orbit. Upon blowing his nose ten minutes after, the upper eyelid swelled and closed the eye; he applied a leech, the swelling subsided, and he saw perfectly well with the eye. The accident happened on Wednesday, February 11th. On Friday night, an

attack of severe pain came on, with swelling of the eyelids; the eye was closed; pain became excruciating, situated entirely in the orbit, and unaccompanied with scintillations. He was bled and leeches; an opening was made through the upper lid, and pus escaped. On partial recovery, he applied at the London Ophthalmic Hospital. All pain had then ceased; the globe was much protruded, and vision entirely lost.

March 12th.—The globe had resumed its normal position, and its movements were perfect. The right iris was inactive when the eye was exposed alone to the light, but acted freely when the left was stimulated by light. The pupil was clear and black. There was not the slightest perception of the most vivid flame.

The cause of the total loss of sensation in the retina was, in this case, a most interesting inquiry. If it had resulted from mere concussion of the retina, it should have happened at once; it therefore appeared to depend upon the retina having been impaired and its functions destroyed by the succeeding inflammation, or upon the inflammation of the cellular tissue of the orbit having involved the optic nerve, and so far to have damaged it as to entirely prevent the transmission of nervous influence from the sound retina. The absence of scintillations and circumorbiter pains went far against the presumption that the retina had been inflamed, and this was shown not to be the case, by examining the eye in the manner before described, when the reflection was found to be extremely brilliant and equal in both eyes, clearly showing that the retina and vitreous body were in their normal condition. The only remaining explanation of the case was, that the optic nerve itself had been involved in the inflammation.

Case 4.—P. P——, ætat. 27, a bricklayer's labourer, had a severe attack of inflammation of the eyes two years ago; after recovery from this, which did not affect the sight, the vision began gradually to decline; he had no pain in the head, no *mascæ* or bright sparks before the eyes. He can

now only distinguish light from darkness; the pupils are irregular, and slight opacities on the corneæ give evidence of previous inflammation in the anterior part of the globe. The reflection from each retina is of its normal brightness.

In the first and second cases, the loss of the reflection showed some ocular change; we can suppose this to result from several causes—an extensive change in the choroid; deposits in its structure, of dark matter, or obliteration of its vessels; a slight loss of transparency in the retina, which would not be detected after death, in consequence of this membrane always becoming opalescent shortly after the extinction of life, would destroy the reflection; and this appeared to be the most probable lesion in these cases.

Case 4 is one among several cases of cerebral amaurosis in which the reflection was perfect.