Derry (R. H.)

COLOR-BLINDNESS,

AND ITS

ACQUISITION THROUGH THE ABUSE OF ALCOHOL AND TOBACCO.

BY

RICHARD H. DERBY, M. D.,

LATE ASSISTANT-SURGEON OF PROF. VON GRAEFE, AT BERLIN.

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COLOR-BLINDNESS.

Achromatopsia, akyanopsia (Goethe), anerythropsia, or Daltonism, are but a few of the names that have at various times been applied to color-blindness.

In the text-books we find cases of this affection cited as literary curiosities. It was believed to be nearly always congenital, and not amenable to treatment.

Modern investigators have immensely enriched this previously barren field. Color-blindness has been found an almost constant accompaniment of certain diseases of the optic nerve and retina. Excessive use of alcohol and tobacco is now known to produce color-blindness over a portion or the entire extent of the visual field. Exposure to wet and cold may lead to the same condition.

In many cases of amblyopia, an examination of the perception of color reveals functional changes most marked, and indeed in many cases, where the ordinary tests would indicate no pronounced difference in the acuteness of vision in various portions of the visual field, we find a most clearly-defined central color scotoma.

The question may be asked, If color-blindness is so constant a symptom in certain forms of amblyopia, why is it that patients so rarely complain of it? The explanation is undoubtedly in the fact that "the simultaneous falling off of the

acuteness of vision appears to them relatively a far more grievous affection, and a disturbance in their perception of color seems natural. They are apt too to compare their present amount of vision with what their normal vision was by poor light.

"With deficient illumination at a certain point we lose the power of recognizing not only the outline but the color of objects: we distinguish only light from darkness. Consequently the attention of the patient is only drawn to his color-blindness in those cases where it is very pronounced, and where, on the other hand, the amblyopia is slight.

"The fact that color-blindness and amblyopia are not necessarily associated together is reason enough that the condition of the perception of color should be especially examined in affections of the eye; such an examination may reveal us facts striking and unexpected, of importance for our diagnosis and prognosis."[1]

A brief *résumé* of accepted doctrines with reference to the perception of color may aid us in the appreciation of departures from the normal standard.

According to the theory of Young, the retina contains three varieties of nerve-fibres. Irritation of the first produces the sensation of red, irritation of the second that of green, and irritation of the third that of violet.

Homogeneous light excites these three classes of fibres with an intensity proportioned to the length of its undulations. The one class is particularly impressionable to the most excursive undulations—to the rays which produce the subjective sensation of red.

The second class is impressionable to the less excursive undulations, which cause the subjective sensation of green. Finally, the last class is impressionable to the least excursive undulations, which give the subjective sensation of violet.

Still, every spectral color excites each class of fibres, but with different degrees of intensity.

The simple red excites intensely the red percipient fibres, and weakly both the other classes, the sensation being red.

[1] Leber, Archiv f. Ophth. xv., 3, p. 28.

Simple yellow excites moderately the red and green, and weakly the violet percipient fibres, the sensation being yellow.

Simple green excites strongly the green percipient fibres, and much more weakly the two other classes; the sensation is green.

Simple blue excites moderately the green and violet, and weakly the red percipient fibres; the sensation is blue.

Simple violet excites intensely the percipient and weakly the other classes of fibres, the sensation being violet.

The idea of white is produced by an irritation equally intense of all the varieties of fibres, and that of black by an absence of all irritation.

Benedikt[1] was the first to draw attention to the great frequency of anomalies in the perception of color in amblyopia and amaurosis. Schelske[2] subsequently analyzed a case of atrophy of the optic nerve, and found red-color blindness.

At the last meeting of the Ophthalmological Congress at Heidelberg, Leber presented a paper on the occurrence of anomalies in the perception of color in disease of the eye; and later still, in the *Archiv für Ophthalmologie*,[3] the same author has published a more extended treatise on the subject, with the details of a large number of cases observed at Von Graefe's clinique, at Berlin.

In atrophy of the optic nerve, Leber found color-blindness an almost constant symptom. Out of thirty-six cases the perception of color remained intact in only three.

In simple amblyopia, without limitation of the visual field, where no ophthalmoscopical changes were observed, and where there was absolutely no central scotoma, color-blindness was very rare.

In amblyopia, with clearly-defined central scotoma, Leber found color-blindness a constant symptom, and he gives the following excellent description of this affection:

(It is hardly necessary to say that this is not the form of scotoma caused by changes in the outer layers of the retina in the region of the macula. It is a common form of amblyopia,

[1] Wiener Med. Chir., Rundschau, December, 1862, p. 211.

[2] Archiv f. Ophth. xi., 1, pp. 171–178.

[3] Archiv f. Ophth. xv., 3, p. 26.

and up to the last stage of the affection absolutely no changes are to be seen in the yellow spot.)

In the earliest stage the ophthalmoscope often shows no change in the fundus, or, at the most, hyperæmia of the disk and retina. Not infrequently at this period a slight, somewhat striped cloudiness of the boundaries of the papilla and the circumjacent retinal zone appears, not unlike a specific retinitis; occasionally isolated retinal hæmorrhages in the region of the disk appear. Often there are little bright, white opacities on the papilla or on its edge, which either conceal the point of emergence of the vessels or accompany them, sometimes covering them over, and again extending along the edge of the papilla. These opacities Von Graefe regarded as evidences of a retrobulbar neuritis of the optic nerve, which leaves but its last traces on the papilla.

At a later stage, and in some cases soon after the beginning of the disturbance of vision, the disk has a light-blue atrophic look, which is nearly always limited to its outer half. If hyperæmia and opacity have previously existed, they now both disappear. The inner half of the disk remains of its normal color and appearance and so characteristic is this ophthalmoscopic appearance, that *from it alone the central scotoma may be diagnosed.* [Since my attention was first drawn to this fact I have had frequent occasion, at Berlin and elsewhere, to recognize the truth of Leber's statement, and I have repeatedly traced out upon the blackboard a large central color scotoma in patients where the ophthalmoscope had revealed this partial atrophy of the papilla.] The examination of the perception of color now is a most convenient and sure method of recognizing this central amblyopia. In many cases the ordinary method of examination shows nothing abnormal, whereas the color-test reveals instantly a clearly-defined scotoma.

Leber's method is as follows: The patient is placed before a black-board at a distance of perhaps one foot and a half—one eye closed and the other fixing a white cross, traced upon the centre of the board. From the point of fixation now as a centre a small piece of colored paper (mounted upon a short rod) is moved, and the point at which the patient first recognizes the color is noted upon the board. In this way the region

over which the color is not recognized is mapped out. The most striking results are obtained from bright green and rose-red, the first appearing either white, gray, or yellow, and the last, blue.

In the less severe cases Leber found simple red-color blindness, while in the more advanced cases, as in those of atrophy of the nerve, the ability to distinguish colors diminished from the red to the violet end of the spectrum, and finally ceased altogether.

Leber found, further, if the cases are left to themselves, the affection for a considerable time grows worse, then remains stationary; all the time the partial atrophy of the papilla becomes more pronounced. The degree of the amblyopia varies, but in the majority of cases a moderate vision remains, sufficient to recognize large letters.

Almost always both eyes are affected. This form of amblyopia occurs almost solely in men; out of fifty-six cases only three were women. It is a disease of adults; its frequency increasing from the twentieth to the fortieth year. In a portion of the cases abuse of alcohol was certainly the cause of the affection, and in others the excessive use of tobacco undoubtedly contributed to produce the disease. Förster,[1] in a paper on the injurious action of tobacco on the vision, attaches still greater importance to this agent as a cause of amblyopia, supporting the views of Mackenzie, Sichel, Hutchinson, Lureiro, and others. The author cites twenty cases, in which there was a central scotoma, with a horizontal diameter of 18° to 25°, within which large letters could still be recognized. All of these patients suffered from some affection of the digestive and nervous system. Loss of appetite, constipation, loss of sleep, were common symptoms. Each one of the twenty patients was a strong smoker, and in eleven of these cases a very marked improvement was observed when the use of tobacco was given up.

In other cases, exposure to the cold and damp seemed the efficient cause of the disease. The frequency with which certain professions were affected with central scotoma gives

[1] Ein Jahresber. d. schles. Ges., p. 1868.

support to this theory, for, among the cases that Leber enumerates where an excessive use of alcohol could be proved, were three woodmen, a forest-inspector, a railroad-laborer, an engine-driver, and a turnpike-inspector, all of whom in the discharge of their duties were repeatedly exposed to such injurious influences.

From the absence of any complication with diseases of other organs, this is believed to be an idiopathic affection of the eye. Moreover, there is little or no doubt that the optic nerve, and not the retina or cerebro-spinal system, is the seat of the disease, for in these cases there are no changes observed in the macula as invariably are found in the later stages of chorio-retinal processes. The subsequent constant partial atrophy of the nerve, and especially the signs of inflammation on the papilla, as is found in some cases from the outset, point to an affection of the optic nerve.

"As to the nature of the process. Those cases that present the above-mentioned changes on the papilla are undoubtedly cases of neuritis, which gradually leads to atrophy of the optic-nerve fibres, an inflammation of the optic nerve between the chiasma and the eye. On the intra-ocular end of the optic nerve the last traces of the neuritis appear in form of loss of transparency of the edges of the papilla, signs of exudation along the vessels, and hæmorrhages.

"The partial white coloration, limited to the outer half of the papilla, is evidence of only partial disease of the optic nerve. To be sure, there is the same appearance in the first stages of progressive atrophy where there is no central scotoma, but it is much less pronounced. The explanation of this is that, in the outer portion of the papilla, toward the macula, there are only a small number of nerve-fibres, and therefore the disk at this point is less prominent; and commencing atrophy, even when it affects the entire thickness of the optic nerve, will, for this very reason, appear more marked and at an earlier date on the outer half of the papilla. In the pronounced cases of partial coloration of the papilla, as one almost invariably finds where there is a central scotoma, the difference between the inner and the outer half of the papilla is so great that there is no longer any doubt that the affection

is a partial atrophy of the optic nerve. The nerve-fibres which terminate in the region of the macula and between it and the papilla must lie in the outer half of the disk, for those fibres ending on the other side of the macula curve in the papilla itself obliquely upward and downward, and take a direction in the retina bow-shaped about the macula." . . .

The nerve-fibres going to the macula are the most superficial fibres of the optic, whereas, the nearer the periphery the retinal elements lie, just so much nearer the axis of the optic nerve are the fibres supplying them.

"If we now regard the central scotoma as dependent upon an affection of the superficial layers of the optic nerve or upon a perineuritis, which penetrates only to a limited depth in the nerve, we have an explanation of the precise limitation and central position of the scotoma; this theory would harmonize with the partial or complete recovery from the affection and its infrequent rheumatic origin."

If the periphery of the visual field in these cases has remained a long time intact, there is absolutely no danger of complete blindness; on the other hand, if the scotoma is greater in one direction, and if there is a peripherical defect in the visual field, then the case is one of atrophy of the optic nerve, and there is every reason to fear total loss of sight.

As for the prognosis in these cases of central scotoma, we cannot always hope for a *restitutio ad integrum*. The results attained by treatment are less favorable in general than in cases of simple amblyopia where there is no central scotoma. In the severer cases we can hope for a great improvement, and this may be of various kinds—the patient learns to see eccentrically, or, as we sometimes see, small breaks occur in the scotoma, and it is changed into a "ring scotoma," and this last issue is far better than where the vision is eccentric.

The treatment consists in local bloodletting and diaphoretics. Iodide of potash Leber found of service in cases where other measures had failed. Von Graefe applied a seton to the nape of the neck if there was a congestive disposition, and, when the inflammatory processes were over, the eyes were exercised with convex glasses and prisms.