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THE SCINTILLATING SCOTOMA OR TRANSIENT FUNCTIONAL HEMIOPIA.*

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The phenomenon of scintillating scotoma is well known, though it is not always described in the textbooks on diseases of the eye. My interest in this affection dates back many years, when I became more intimately acquainted with it through *personal experience.* Since then I have talked with many physicians, and especially ophthalmologists, who also had knowledge of it from personal experience, and what I have thus gathered is recorded here. It should be of particular interest to the general practitioner because patients suffering from this disturbance for the first time are greatly alarmed and apply to their family physician for relief. This condition was first described, so far as I know, in a dissertation by Vater and Heinecke,[1] in 1723. Since then many men eminent in medicine and in the natural sciences have described this condition as they have observed it. Various names have been applied to this phenomenon: Scintillating scotoma,[2] teichopsie,[3] *amaurosis partialis fugax,*[4] ophthalmic migraine,[5] and transient functional hemianopia.[6] The

* Read before the Newark Medical and Surgical Society.

1. Vater u. Heinecke: Dissertatio, qua visus duo vitia variissima, alterum diplocati alterum dimidiati physiologice et pathologice considerati exponuntur; Wittenberg, 1723, quoted from Schmidt-Rimpler, Die Erkrankungen des Auges im Zusammenhang mit anderen Krankheiten, Wien, 1898, p. 104.

2. Listing: Nervoeses Scotom, Monatsbl. f. Augenheilkunde, v, 1867, p. 335.

3. Airy, Sir George: On a Distinct Form of Transient Hemiopia, Phil. Trans., London, v, 140, 1870.

4. Foerster: Ueber Amaurosis partiales fugax, Klinische Monatsbl. f. Augenheilkunde, 1869, p. 422.

5. Galezowskie: Recueil d'Ophthalmologie, 1883, p. 536.

6. Gowers, Sir W. R.: A Manual of Diseases of the Nervous System, vol. ii, pp. 157, 839, 2d edition, Philadelphia.

last name seems to me to be the most appropriate, though in many cases the defect occupies only a part of the half of the field.

SYMPTOMS.

The attack commonly begins with a disturbance of vision, which often greatly frightens the patient. If asked to describe the nature of the disturbance he can not do it; he is conscious, however, that there is something wrong with his sight. If he remains sufficiently calm to observe the phases of the phenomenon, he will notice if, for instance, he is looking at a printed page, that some of the letters or words either to the left or to the right, or perhaps also a little above or below the right or left of the point of fixation, are blurred, in a minute or two later they have entirely disappeared and are obliterated to his sight. Or, if he happens to be looking in the face of a person a few feet away from him, he will see only the left or the right eye, or only the right or left lower half of the face; or, if he is looking at a sign with the word Thompson on it, he will be able to see one-half of the word only, either the son or the Thomp; at the same time, his attention will be attracted by the appearance of a luminous disc at or near the place where the scotoma was first noticed. This disc is usually bounded by a far brighter and sometimes serrated outline. Very soon the disc is changed into a ring which in a short time breaks near the fixing point; the ends separate more and more, so that soon he sees a luminous arc instead of a ring. The arc gradually becomes larger and at the same time floats slowly on to the periphery of the field of vision, its convexity being directed either out, up or down. One of the ends of this arc often comes close to the point of fixation; it rarely reaches over the median line. With the enlargement of the luminous arc there is also an increase in the size of the defect towards the periphery, but it very rarely, if ever, reaches the fixing point. Sometimes the defect includes the entire half of the field of vision, and there is a complete hemiopia. The luminous arc or crescent gradually becomes fainter and then disappears entirely, in the outer periphery of the field of vision. The defect usually continues for a few minutes longer and then also disappears entirely, leaving a sensation of dazzling, which also vanishes after a few minutes.

The duration of the whole attack lasts from a few minutes to an hour or more. It leaves the eyes in the same condition in which they were previous to the attack, and, so far as I have been able to observe, never leaves a permanent defect. In a few of my cases the phenomenon was followed by a slight headache, and in a very few instances by a tingling in the extremities of the side in which the defect in the field was observed.

Some writers state that a slight vertigo often precedes the attack, but this I have never noticed. Gowers says that in 50 per cent. of the attacks of migraine the phenomena here described are the first symptoms of the attack, and other writers have made similar statements. This discrepancy between my experience and that of the writers mentioned is doubtless due to the fact that patients in whom symptoms of migraine follow the visual disturbance consult a general practitioner or a neurologist, while those without these symptoms seek the advice of an oculist.

While in my experience the sudden development of a scotoma, that is, a defect in either the right or the left half of the field of vision, always was the first phase, other writers report cases in which the appearance of a cloud preceded the scotoma, while others state that sudden darkness in one-half of the field ushered in the attack. I have never seen this nor heard others mention it. Several of my patients who have attacks now and then, have come to me, at my request, shortly after the attack had begun, and in every one I was able to assure myself of the presence of the defect, although it was small in some cases. Some people speak of this scotoma as a darkness or a shaded darkness, but in all my cases it was a real defect, a blank or a void; whatever had been in this spot on the printed page was entirely obliterated. This defect exists in identical parts of either the left or right half of the field of vision; it may closely approach the vertical dividing line of the two halves of the field, it rarely reaches the fixation point, and very rarely, if ever, crosses the vertical dividing line of the two halves. At the height of the attack there is occasionally, for a moment or two only, an obscuration of the entire field, and very rarely there are for a moment on a printed page a few letters missing next to the fixing point in the unaffected half of the field. Sometimes, in the

same persons, the left half of the field will be affected in one attack and the right half in another. In other patients, in different attacks, sometimes only a quadrant of the field and at other times the whole half of the field will be defective.

METHOD OF EXAMINING PATIENT.

As the defect is always, or nearly always, in only one-half of the field, patients subject to these attacks will say that only the eye on the side of the defect is involved, but this is a mistake, as can be proved by examining the field of each eye.

Place the patient a foot away, with his back toward a large window. Have him close one of his eyes, and with the open one look at the physician's eye opposite his open one. Now the physician closes one eye, moves his fingers from the periphery toward the center from various directions. If the patient's field is of normal dimensions he will see the tips of the fingers as soon as the physician sees them.

SPECTRAL APPEARANCE.

It is difficult to give a satisfactory description of the spectral appearance, as the light phenomenon in these cases is called by Gower. The fleeting character of the phenomenon and the mental state of the observer at the time are probably responsible for the discrepancy in the published descriptions. The most common form and the only form that I have any personal knowledge of is the following: A luminous disc appears at or near the place where the defect in the field of vision first developed, the outer edge of which is much more brilliant than the central part. It is serrated, or it may assume a zigzag shape with prominent and re-entrant angles like the ground plan of a fortification and hence "fortification spectrum."

Inside the circle there may be luminous points in constant motion. In the zigzag outline there are at times indications of color, blue and red predominating, but I have never seen any such high colors as are seen on the drawings made by Airy.[7] The luminosity of the periphery is in marked contrast with the body of the disc. Very soon the part of the ring nearest the vertical dividing line of the halves of the visual field dis-

7. Transactions of Ophthalmological Society of United Kingdom, vol. xv, plates I and II.

appears, and there remains only an arc-shaped or crescentic line of very bright light. The ends of this arc may closely approach the fixation point at first, but they soon separate more and more, while the whole arc very gradually floats outward, downward or upward toward the periphery of the field. The convexity of the arc is always directed toward the outer periphery of the field and its outer edge is usually serrated as described above. The more brilliant middle part of the whole outer line in all the serrations appears to be bounded, outside and inside, by a dark line. Sometimes the angular projections of the outline are very irregular, and at times it looks as if two or several such outlines were intermingled. This brilliant arc is in continuous and tremulous motion. In persons subject to these attacks, not unfrequently an arc-shaped, brilliant line, like the above-described, will appear suddenly in the upper or lower portion of one of the halves of the field of vision; it seems to float in the air five or six feet away, will last for some minutes and then will gradually float out of the periphery of the field.

In several such cases which I have had an opportunity to examine while their phenomena continued, I was able to make out a defect in the field corresponding to the apparent location of the floating brilliant line. These spectral appearances, I think, are always present in both eyes, though it is stated by some writers that in some of their cases it was confined to one eye. The light phenomenon is seen with the eyes closed as well, if not better, than when they are open, and this makes it difficult to determine whether it is present in one or in both eyes. To most persons subject to this affection the spectral phenomenon here described is most startling, especially in their first attacks, and their attention is so completely absorbed by it that they are unaware of this simultaneous presence of the scotoma. In a few cases I have been able to examine the pupillary reactions, and found them normal. The attacks were almost over when they were examined. The ophthalmoscopic examination made during the attack revealed always a normal fundus.

FREQUENCY OF ATTACKS.

In most persons subject to these attacks familiarity soon breeds indifference toward the disturbance and they pay but little attention to it. Some are able to go

on with the work in hand, especially if the left half of the field is involved, while a few find it necessary to sit down and keep their eyes closed until the attack is over. Some people begin to have such attacks early in life, and have them of varying severity at irregular intervals as long as they live. Others have only one or two attacks during their whole existence, while still others have them only during a certain period of their lives, at more or less frequent intervals. I know of one person who has had an attack daily for a period of ten years, and of another who for a limited period had two attacks a day. It is said that these attacks diminish in frequency as the patients advance in years, but I know of cases in which this was not true.

GENERAL HEALTH OF THE PATIENTS.

The great majority of the patients who have consulted me with regard to these attacks claimed to be in excellent health. Many of them admitted suffering occasionally from indigestion, some admitted being children of gouty parents, while others were afflicted with various morbid conditions. In many of these people there was present an oversensitive condition of the eyes; they disliked a glare; they were troubled with muscæ volitantes, and had unusually vivid after-images, which often lasted much longer than normally. These patients were annoyed by the distortion of objects, produced by flaws and imperfections in the window pane of glass through which they were seeing them; they were poor sleepers and had many of the disorders of sleep. Some had so-called explosions in their ears just before falling asleep; others were often awakened by a feeling of numbness and tingling, mostly in their hands or arms, and others had rheumatic pains in their limbs at night only or, at least, much more frequently at night than during the day. Most of these patients were so-called nervous individuals.

Most of the persons so afflicted had normal acuity of vision, normal fields of vision, and no visible disease of the eyes between the attacks. In others diseases of the lids and of the conjunctiva, cornea or sclera were present and caused the patient to consult me, and the occurrence of these phenomena under consideration was mentioned by them only incidentally.

ETIOLOGY.

Dr. Geo. M. Gould[8] would have us believe that uncorrected errors of refraction in 99 per cent. of the cases are the cause of migraine and, I suppose, of the phenomena under consideration also, but, considering how very many people have these attacks at times, and the great number of people who have uncorrected errors of refraction, it is not at all to be wondered at if the two conditions are sometimes found in the same person; any more than that the phenomena have occurred in persons having preputial adhesions or in persons having gonorrhea or syphilis. I have examined the eyes of many persons having such attacks, under atropin, and have found many of them free from refractive errors; weakness of the external and internal muscles of the eye also was absent in most of these cases.

Among the exciting causes given in the text-books are named faintness from fasting, fullness of the stomach after eating, excessive mental work, sleeplessness, overindulgence in tobacco, and many other things; but, after all, we know little or nothing about the exciting causes. I have known people to have attacks immediately on awakening after ten hours of sound sleep in a moderately dark room. I know that some of my patients had attacks at times while the stomach was quite empty and at other times immediately after a meal. Some of my patients, professional men, had attacks as frequently while they were spending their vacations in the woods as before they went there, and one man who had not had an attack for a year, during which he did an unusual amount of work, had an attack on the voyage home after a two-months' vacation spent in the mountains. I have had among my patients with this affection men and women, boys and girls, some engaged in intellectual work, while others were factory hands or farm laborers who rarely touched a book or even read a newspaper. Some of my women patients are confident that they have their attacks more frequently at the beginning of their menstrual period than at other times.

PATHOLOGY.

With regard to the pathology of migraine, Gowers[6] says: "No anatomic changes are known to underlie

8. Gould, Geo. M.: Amer. Med., Jan. 21, 1905, p. 103.

the phenomena of migraine and, from the character of the symptoms and the analogies of the disease, it is unlikely that any will ever be discovered. Two chief theories have been held regarding the origin of the attacks; one is based on the alteration in the state of the vessel that is so conspicuous in the aspect of the patient. The pallor of the surface must be due to contraction of the arteries, and the blushing of the skin to their dilatation, and it is assumed that a corresponding condition of the vessels of the brain is the cause of the derangement of function. The suggestion that spasm of the central arteries is the cause of the symptoms was first made by Whytt, and the evidence in favor of this opinion afforded by the state of the accessible vessel was pointed out by Du Bois-Reymond. Mollendorf urged that vascular dilatation rather than spasm caused the symptoms, and the fact that the condition varies in different cases has led to the theory extensively held in Germany (by Eulenberg and most other writers) that there are two varieties of the disease already mentioned, the 'sympathetico-tonic' and the 'sympathetico-paralytic' form, as they are sometimes termed. According to these theories the disease is essentially one of the sympathetic nerves.

"Another theory is that the primary derangement is of the nerve cells of the brain. Their function from time to time is disturbed in a peculiar manner and the visible vasomotor disturbance is of secondary origin. The sensory symptoms must depend on deranged action of the sensory center of the brain. They indicate a combination of arrest of action and of overaction in the nerve cells concerned. In the language of modern pathology, there is a combination of inhibition and discharge. The loss of sight, for instance, must be due to inhibitory arrest of action, the visual spectrum to discharge. The peculiarities in the disturbance of migraine are its special, often uniform features, deliberate course, and its limitation to sensory structures. To explain them on the vasomotor hypothesis we must assume, first, an initial spasm of the arteries in a small region of the brain; second, that the contraction always begins at the same place, and third, that it can give rise to a definite, uniform and very peculiar disturbance of function. There is no evidence of the truth of any one of these assumptions, and we are not justified in assuming that the

state of the surface vessels and accessible arteries is an indication of the condition of those internal organs. Last, that the vasomotor spasm can cause a deliberate uniform and peculiar discharge is not only unproved, but is in the highest degree impossible. In short, the difficulties in accepting the vasomotor explanation of the sensory symptom is so great that it would only be admitted as a tenable hypothesis if there were no other explanation of the coincidence of the two phenomena. We know that the vascular system is in a special way under the influence of the cerebral centers. An emotional blush and the pallor of fear are conspicuous examples of this fact. It is at least as easy to believe that the vascular changes are the result of the disturbance in the nerve elements as it is to regard them as its cause. The vasomotor nerves are peculiarly sensitive to sensory impressions that are felt as pain. No symptoms at all resembling those of migraine have been observed when the sympathetic system is distinctively diseased or deranged.

"The peculiar character of the visual impression affords strong reason for regarding it as the result of a tendency to functional derangement in the cells themselves. This opinion is supported by the fact that it may occur as an isolated symptom, and that it may be related to an actual visual impression, as is shown by the facts mentioned. Such an occurrence can have been due only to a primary functional disturbance of the cells themselves, and that which exists in one case probably exists in all.

"The hemiopia also is best explained by the assumption of deranged function in the occipital lobe, especiallysince right hemiopia may correspond to almost simultaneous aphasia, and the opinion is supported by the fact mentioned above that hemiopia is fixed by a lesion in the cuneus. When all has been said, mystery still envelops the mechanism of migraine."

Jolly,[9] whose clinical experience with this affection is similar to mine, thinks: (1) That the seat of scintillating scotoma in its most frequent, hemiopic form in all probability is located in the primary optic channels and more particularly in the optic tract or in the region of the external geniculate body; (2) that the binocular

9. Jolley: Berliner klin. Wochft., No. 42, 1904, quoted from Nagel's Jahresbericht, 1902, p. 459.

central, and the hemiopic scotomata which cross over the median line have their place of origin in the more peripheral part of the channel, probably in the region of the chiasm; and (3) that the purely monocular scotoma originates in the optic nerve or the retina.

TREATMENT.

Gowers says in reference to the treatment of migraine: "If any errors in mode of life or defects in general health can be traced, their removal is the first and most essential step in treatment; of special importance is increased rest, regularity in meals and attention to diet; whatever is known to induce a paroxysm should be carefully avoided. Hot, crowded rooms are especially injurious. If inherited gout is probable, the regimen suitable for this should be adopted. In cases with conspicuous pallor in the early stage the drug that has most influence is nitroglycerin given regularly in the interval (migraine) twice or three times a day after food, beginning with a small dose 1/150, 1/180, 1/200 of a grain in 1 per cent. solution of alcohol."

During the attack absolute rest is essential; the recumbent posture is generally that in which the patient is most comfortable.

Some of my patients think that the attack is shortened by drinking iced water; others believe that spirits, coffee, tea and other beverages, taken immediately at the beginning of the attack produce a similar result. Others attribute the same result to taking from 10 to 20 drops of valerianate of menthol on a lump of sugar; while others, following the advice of Manz,[10] believe they have shortened the attack by gently pressing the eyeballs and rubbing the lids over the balls for a few seconds. In view of the great difference in the severity and in the duration of the attack at different times in the same person, it is impossible to say how much benefit was derived from any of the measures employed.

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10. Manz: Quoted by Schmidt-Rimpler, Die Erkrankungen des Auges im Zusammenhang mit anderen Krankheiten, p. 108.