Original Communications.

ENTOPTICS:

OBSERVATIONS ON THE RELATIVELY GREATER FREQUENCY OF MYODESOPIA IN THE MYOPIC EYE.

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ON the continent and in this country, entoptical observations have received a considerable share of attention from men of science both in and out of the profession. The increased care with which the internal eye has been studied since the introduction of that invaluable instrument the ophthalmoscope, has led to a far better explanation, and a fuller appreciation of the value of such inquiries.

Myodesopia, whether investigated by the philosopher purely in its relation to optical phenomena, or by the medical man as a symptom of some value in the treatment of certain derangements of vision, is, I venture to say, of sufficient importance to warrant a careful record of such facts as may from time to time fall under the observation of the ophthalmologist.

It is well known to most practitioners, that few symptoms in connection with derangement of vision prove more alarming to persons of a nervous temperament than the constantly recurring *muscæ volitantes*;* but fortunately it is quite an easy matter to convince the well informed mind, by direct experiment, that the seat of the phenomena is mostly situated in the humours and secretions of the eye, and not in its nervous or sentient structure.

Entoptical phantoms are principally due: 1, to the passage of muco-lacrymal secretions over the surface of the cornea; 2, to corpuscles moving between the cornea and focal centres, or to corpuscles moving between the focal centre and the retina.

The increased occurrence of *visio phantasmatum*, under certain circumstances, offers an extensive field for experiment and research. When the eye is in a normal condition, the lacrymal fluids, as they float across the cornea, may be quite visible in the diffused light of day. Images of the deeper fibres, moving between the cornea and focal centre, may also be seen without the use of a pencil of light, whether convergent or divergent. And the number of apparent separate beads is apt to incline the observer to the opinion that there are loose beads in the vitreous humour. But all other entoptical objects require the aid of small pencils of light, to enable the observer to perceive and accurately describe them. Such aids are of course necessary before we can determine either the situation, extent, or precise nature, of any entoptical phenomenon. But when the eyes, whether from fatigue of the muscles, or any other disturbing cause, assume a morbid condition, the field of vision becomes peopled with images of all kinds; the number and distinctness of which—however painful to the sufferer—renders their investigation comparatively easy.

"To view entoptical apparitions with precision, and to determine their situation and dimensions—or rather to obtain data for determining them—we must

view them in a bright light of limited extent." (*Entoptics; with its Uses in Physiology and Medicine*. By J. Jago, M.D.) It is true that images of fibres in the vitreous humour, as well as certain spectra arising from eyelashes and conjunctival fluids, are frequently visible in the diffused light of day. Nay, in a diseased state of the internal eye, other entoptical objects obtrude themselves on the field of vision, as represented in the annexed diagram. (Fig. 1.)

Fig. 1.

These, with numerous other spectra, were always visibly floating in the right eye of a myopic patient, when that organ was weakened, and he was suffering from the effects of overwork. But no exact information can be obtained concerning these spectra, unless we follow certain particular methods of investigation; which I shall endeavour to make clear before proceeding to give the results.

However, first, let me say a word or two about a supposed test of the danger or harmlessness of entoptical apparitions mentioned by Dr. Watson; viz., "the simple and easy criterion is this, those *muscæ* which are motionless when the eye is at rest, and move with it when in motion, are signs of danger to vision; those which sink gently downward when the eye is fixed are innocent." This supposed test I have found utterly valueless; and mainly so, because patients, having no scientific knowledge of the subject, will content themselves with applying such a test and acting upon the result; frequently permit great mischief to go on in the eyes unchecked and unheeded; and need, again and again, to be reminded of the danger to which they thus expose themselves.

Now, the result of my experience is this, that blind or insensible spots in the retina do appear "to sink gently downward" when the eye is directed steadily towards some bright object. And Dr. Jago accounts for this when he says: "If the eyes be brought to bear, as is commonly done, on the top of some object, so that the suspected image may be viewed against the sky, they have an almost irresistible tendency to drop, and thus to cause the blind spot to drop also." And even if the object toward which the eyes are directed be not high above the level of the organs themselves, they yet have a tendency to sink downward or to move in some direction or other, thus causing the insensible spot to move also. Moreover, the force of imagination is such, that it is easy to fancy we detect a slight motion in an object when we know that such a motion is an assurance of safety; and even the most cool and collected observer can hardly be certain that the result of his observation will be entirely uninfluenced by his feelings and his imagination.

There are other, and more complicated, causes which render this test, supposing it were a true one, difficult of application. The more deeply situated fibres in the vitreous humour frequently cannot be detected to move along the retina; and, in diseases of the nervous system, *muscæ* occur, which, "like

* Myodesopia (*muscæ volitantes*), usually defined "as any spectrum or visual appearance, which imposes on the patient, and leads him to think that flies are moving about before him in the air." (Dr. Mackenzie, "On the Vision of Objects on and in the Eye."—*Edinburgh Medical and Surgical Journal*, July 1845.) The symptom has also been very appropriately called *visio phantasmatum*; and, in my opinion, no better designation could be found.

dreams, are merely the result of efforts by a suffering brain to realise impressions made upon it."

Having thus premised, that accurate and scientific investigations are necessary to ascertain the nature of entoptical apparitions, the next step will be to describe some of the methods by which such investigations may be made. And here let me say, by way of caution, that care should be taken to ascertain that the lens we are about to experiment with is perfectly clean and free from dust. By looking at the flame of a steady-burning lamp or candle, and at the same time turning the lens on its axis, any particle of dust adhering to it will be seen to revolve, and must be carefully removed. Other imperfections, as scratches, etc., may be detected in the same way.

The first point of importance in making observations will necessarily be, how to obtain such pencils of rays, either convergent or divergent, as may conveniently, and without injury, be thrown upon the retina. I have found that light reflected from water, walls, roads, and other such-like objects, is far too dazzling to be at all agreeable or convenient; and should, therefore, recommend light drawn from a pure white cloud or the clear sky, as both convenient and trustworthy for entoptical experiments. By the aid of a convex lens, we may reflect into the eye, from such a clear sky, very fine divergent pencils of light. "If we look through a convex lens of one inch focal length towards a gas- or lamp-flame situated at the end of a moderately long room (say twenty feet), so that the image may be formed at or near the principal focus of the lens, that there may be produced a rapidly convergent and therefrom divergent pencil, the eye may receive.....a divergent or convergent pencil at pleasure." (*Entoptics*.)

If we use artificial light, care must be taken that the flame does not flicker—a steady light being indispensable for accuracy. With such pencils as those just enumerated, all the following experiments have been made.

A clergyman, of some scientific acquirements, myopic, in whose eyes *muscæ volitantes* have for years been most annoying and distressing, having been requested to furnish me with particulars of his case, says:

"I have not found any results worth noting in the apparitions arising from eyelashes and the movement of the lids; indeed, such can scarcely be called 'entoptical'—*ectoptical* seems a more suitable term for them, since their originating causes are external. In my case, the lubricating fluids do not appear to be as equably diffused over the corneæ and conjunctivæ as they should be, and probably are not in their normal condition; hence, numerous tears, both convex and concave, arise; two of which, as seen through a divergent pencil, are shown in the annexed figure 2. These are evidently convex tears, since they 'brighten the image, and give shade to the areola'; one, however, has a dark central spot. Figure 3 re-

Fig. 2.

Fig. 3.

presents a concave tear, seen through a divergent pencil, the image dark, the areola surrounding it lighter.

"Throughout the crystalline lens are scattered numerous bodies, opaque or semi-opaque, having a round or oval outline, and always presenting a central brightness. The annexed figure 4 will give you

Fig. 4.

some idea of the appearance of these bodies. I am unable, even after careful investigation, absolutely to confirm the statement made regarding similar bodies, 'that the whole wide black ring is constituted of suitable internal fringes.' The shading of the areola around the objects is purposely given roughly, partly to imitate its actual appearance, partly to render the lucid band and central brightness of the opaque bodies more prominent; and, from whatever cause, these bright portions are invariably much more light than the surrounding areola; and they are, also, accompanied with prismatic bands, or circles of colour, which play about them, but which it is impossible to represent in a diagram, inasmuch as they are in constant motion, and present no definite outline. Fig. 5 is intended to represent the irregular outline of

Fig. 6.

coloured bands which surrounded a central spot of brightness upon a ground work of minute grey dots.

"It may, perhaps, not be out of place to detail the peculiarities of focal adjustment in my own eyes, as Dr. Jago has done in his. The power of accommodation, from a distance of only an inch and a half to the horizon itself, is possessed by both eyes when in their normal condition. But when a single horizontal straight line is viewed at a given distance—say twelve inches—and turned round in a plane perpendicular to the optic axis, it is seen more clearly in some positions than in others. A vertical line appears perfectly erect; but one sloping at an angle of 45° appears double. A horizontal line appears double with the left eye; but lately, and when the eyes are suffering from the effects of overstrain, on looking at a distant point, all nearer placed objects appear double, each eye having its own image, and not, as in Dr. Jago's case, one eye possessing two images. Moreover, this gentleman's double images 'become more widely apart as the objects become more remote.' My own case is precisely the converse of this; the nearer the object, supposing the eye to be directed to a distant point, the further apart are the two images.*

* My patient's myopia is probably associated with *astigmatism*, due to some irregularity in the refracting surfaces of the eye, which I have had no opportunity of investigating. That distinguished philosopher, Dr. Thomas Young, first observed this asymmetry of the dioptric system in his own eyes. He was himself myopic; he saw in his optometer double images of the thread intersect one another at seven inches from the eye. "The optician Cary, to whom Dr. Young communicated his discovery, stated to him that he had often found that near-sighted people distinguished objects more accurately, when the glasses suited to them were held in a particular oblique direction before the eye. Now, by this means—at least, when strong

"With regard to the inspection of the fibres in the vitreous humour, I find that while observing intra-vitreous bodies, it is necessary to look downwards; and, indeed, if I fix the eye during such investigations upon an object above, or even parallel to, the axis of vision, I find that the images of intra-ocular bodies move about, so as to render their examination difficult. I have, by careful investigations, arrived at the conclusion, that all the seemingly loose beads in the vitreous humour are, in reality, parts of a series of filaments or fibres. The annexed figure 6

Fig. 6.

represents a portion of the net-work of fibres, and some loose beads visible in the vitreous humour, seen by means of a divergent pencil of light. In place of Dr. Jago's experiment, by which he appears to have arrived at this conclusion, I had an experience of a very different kind, but which led me to exactly the same opinion. When first I commenced these entoptical studies for you, the numerous apparently loose beads in the vitreous humours seemed totally unconnected; and when in motion, it was impossible to detect that they were in the condition of objects connected together, so far as similarity of movement and uniformity of direction were concerned. The annexed diagram (Fig. 7) represents some of these

Fig. 7.

Fig. 8.

loose globules, seen through a divergent pencil, when the eye was in a tolerably healthy condition. But soon after I had noted these, a period of close reading caused rapid deterioration of my sight; and one of the first of my annoying symptoms was the greater visibility of the beads in the vitreous humour. These daily increased, both in number and prominence; and I soon found that several (which, from their larger size or more conspicuous position, I

glasses are necessary—a certain degree of astigmatism may be corrected. Young also studied and delineated the form of the diffused spots. The source of astigmatism he sought in the crystalline lens, because it continued when he plunged his cornea into water, and replaced its action by that of a convex lens. He now assumed an oblique position of the crystalline lens as the cause, and even thought that from the diffusion-images of a point of light it might be deduced, that the two surfaces of his lens were not centred. In a double point of view, therefore, Young's eye, says Donders, 'presented an exception; the refraction was stronger in the horizontal than in the vertical meridian, and the cause lay principally in the lens.' (Phil. Trans., vol. lxxxi; Young's *Miscellaneous Works*, edited by Peacock, vol. i, p. 26; Donders, *On the Anomalies of Accommodation and Refraction of the Eye*, p. 426.)

could easily recognise) were becoming united into a series of connecting links. In process of time, a regular network of fibres became visible; and in the diffused light of day, each fibre or filament was converted into a connected chain of beads (shown in fig. 8.) But, after a series of observations and experiments, I have come to the conclusion, that every bead which is visible in the vitreous humour, whether in the diffused light of day or by means of a divergent pencil, is in reality a portion of a fibre. 'I can at once locate in the tissue any thread that comes into view; and any globule that trembles upon the sight, I can restore to its place among the meshes of the web with facility.'

"To proceed to the entoptical investigation of the retina. At each contraction of the left ventricle of the heart, I can discern a corresponding movement in the arteries of the retina. These produce phantoms in the form of greyish elongated bodies, sometimes, though not invariably, phosphorescent. That the sentient surface of the retina lies behind the arteries seems most probable, when we consider in what way these phantoms are produced. But the experiments by which we investigate these phenomena are somewhat uncertain in their results; and consequently the data obtained from them are liable to many sources of error. As the result of careful observation, I may state that I can detect a very subtle black ring round most, if not all, of the capillary dots which fall upon the more sensitive portions of my retina; and I believe that, in some rare instances, I can observe a very slight central brightness. That the capillaries do not actually touch the sentient surface, although they approach it very nearly, appears certain. In my own eyes, as also in those of some other observers, a few excessively minute dots are just perceptible across the whole of the foramen centrale; but so minute as to be barely discernible. These small dots somewhat resemble the capillaries which lie around that region; although, of course, they must be very much smaller. These dots 'should be regarded as undoubted shadows; and, until the microscope shall have discovered another cause, it will be hard for me to persuade myself that they are not vessels.' The result of my investigations has led me to agree entirely with this view; and, consequently, to acquiesce in the presumption that this spot (i.e., the foramen centrale, which many say is without vessels) is really penetrated by excessively fine capillaries.

"With regard to the detection of bloodless portions of the retina, it is not always possible to discover them, or, at least, to distinguish them from mere harmless muscæ volitantes, by the uncertain test of their immobility; for—as I have before stated when the eye is directed towards an elevated object—they will sink gently downwards; and the observer will often rest satisfied with a cursory observation, shrinking from the possible discovery of danger to vision which a more carefully instituted examination might lead to. And when a more accurate series of entoptical experiments shall have been made and recorded, I think there will be little or no difficulty in detecting anæmic portions of the retina. It is true that they sink gently down, or at least appear to do so; but they will be found invariably stationary when the eye is directed to any spot on a level with, or lower, than its own elevation. You also have the ophthalmoscope to aid you in all such investigations; and can detect, by means of this instrument, other, and perhaps more decided, changes, not only in the retina, but throughout the fundus of the internal eye.

"Then, although the common harmless muscæ will still be seen to sink gently downward—occasionally

returning and then again descending—the phantoms from the lacrimal fluids move either laterally or longitudinally; at such times, the anæmic portions of the retina remain firmly fixed. And I fancy that I can now detect them by a peculiar colour, or rather shade, by which they are distinguishable from all other entoptical images; namely, a pearly brightness, difficult to depict without the aid of a skilful pencil; but when once seen, not to be forgotten. I need scarcely add that, as they are the most alarming, so they are also the most obtrusive of entoptical objects, being visible with as well as without pencils, and visible alike in daylight and by artificial light. They are more affected than any other spectres by overwork of the eyes; and I have invariably found them disappear after a sufficient period of rest, and return when the eyes were fatigued by much work; and, like all the other appearances I have mentioned, to be by far less annoying in the clear and brilliant sunshine of the South, than in the twilight of an English winter's day.

“It has been quite a source of employment for spare moments, to note the effects of external circumstances upon my *muscæ volitantes*. In the first place, reading or writing always causes with me some muscular contraction (a spasm of the voluntary muscles of the eye). This renders all apparitions very much more conspicuously visible. I have noticed that painting does not produce the same unpleasant effects, although pencil- or chalk-drawing does, but still in a far less degree than reading or writing. In fact, I have found it to be an invariable rule, one which may prove of use to others similarly affected, or suffering from weak sight (either associated with anæmia or hyperæmia of the retina), that any kind of employment which involves the looking at coloured objects, or the varied landscape, is not only far less trying than when the sight is exercised on black or white objects; but after the fatigue of reading, if I turn to my painting, or walk out for a while, the retina very quickly recovers itself. I may mention, however, that my retina appears to be at all times morbidly sensitive to light; and that any unusual printed characters, such as Hebrew, Greek, or German, are very trying to my sight. Entoptical objects also become most numerous after reading Hebrew. I append a portion of my field of vision, seen by the aid of a divergent pencil of light, after

Fig. 9.

an hour's reading. A A, portions of fibre; B B, clusters of spectra, probably beads, in the vitreous humour, forming parts of larger fibres; C C, anæmic portions of the retina; D D, deeper fibres in the vitreous body. The background is shaded merely to give prominence to the spectra; and the oval indicates that the central part of the field is more thickly covered. All the images sink gently downwards when the eye returns to rest.”

[To be continued.]

ON IMPAIRED NERVOUS POWER, FROM ALTERATIONS IN THE QUANTITY OF THE BLOOD CIRCULATING IN THE BRAIN.

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[Read before the Northumberland and Durham Medical Society at Newcastle-upon-Tyne, January 12th, 1865.]

THE morbid processes which influence the functions of the brain are various and widely different. Whatever the alteration, the effect is manifested by some loss of power or force, the extent varying, according as the mischief is simple or severe, implicating a portion of the nervous tissue of small consequence or absolutely needful for the continuance of life.

The mental power alone may be diminished. To this there may be superadded a suspension of ideas; the individual halting in a conversation, in the middle of a sentence, or of a word, not from a difficulty in articulation, but from losing the string of ideas owned at the time by his mind. The discoverable effect may be thus constituted; or, in addition, there may be a loss of one or more of the special senses, ordinary sensation or motion, with or without muscular contractions, diminished nutrition, reflex actions, and perverted sensations. Even life itself may be suddenly or more gradually terminated, external impressions previously producing no effect, the semblance being that of death, but with the continuance of the circulation and respiration. How gradual and regular is this progress. The signs are very distinct. Their coexistence is agreeable to order, and guides us to the portion of the nervous centre implicated, and to the nature of the lesion, whether it be due simply to functional disturbance, to alterations in the quantity or quality of the blood circulating, to effusion of this fluid into the substance or cavities of the encephalon, to softening, slowly generated, or to inflammatory or some other condition.

These states are each suggestive, and deserving of distinct notice. Nevertheless, the present inquiry will be limited to the consideration of the various conditions productive of alterations in the quantity of the blood circulating in the brain, the effects arising therefrom being specially referred to.

The quantity of blood may be augmented or diminished.

1. The increase may arise from general or partial hyperæmia. In general hyperæmia or plethora—that bodily condition in which the blood is either in excessive quantity, or not increased, but more rich in fibrine and red corpuscles—the circulation is easily quickened by any sudden excitement. The blood-vessels in every part of the body are over-distended; they contain an excess of blood. Those in the brain are very liable to suffer, and frequently rupture, solely from this cause. In a measure, they are ready prepared for this, from the delicate nature of their structure, and their nearness to the heart. This state may be the forerunner of congestion, or of that variety of partial hyperæmia characterised by sluggishness of the flow, and an increase in the actual amount of blood in the vessels. The veins are principally affected; before long they are over-distended, and finally loaded. Thus the blood accumulates, and by degrees the capillaries dilate, and, by reason of their thin coat, readily yield to the pressure, if the onward current be not re-established.

Any obstacle preventing the return of blood from the brain is the most frequent cause of congestion.