

# PHILOSOPHICAL TRANSACTIONS.

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- I. *The Croonian Lecture. In which some of the morbid Actions of the straight Muscles and Cornea of the Eye are explained, and their Treatment considered. By Everard Home, Esq. F. R. S.*

Read November 17, 1796.

IN two former Lectures, which I have had the honour of communicating to this learned Society, upon the subject of vision, I confined myself to the adjustment of the eye for seeing objects at different distances.

From the attention which in that investigation I necessarily paid to the natural actions of the muscles, and the structure of the cornea, I have been led to consider the effects which a diseased state of these parts will produce on the phænomena of vision. The observations I have made upon this subject, I now lay before this learned Society.

That I may be understood in giving an account of the diseases that arise from morbid actions of the straight muscles of the eye, it will be necessary to explain the effects which their natural actions are intended to produce; for these are

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not confined to the separate, or combined actions of the muscles, but also vary according to the degrees of their contraction.

The first and most simple of these effects is that of moving the eyeballs in different directions.

The second is that of making the motions of the two eyes correspond with such a degree of accuracy, that when an object is viewed with both eyes, the impressions from the object shall be made on corresponding parts of the retina of each eye.

The third is that of compressing the eyeballs laterally, which renders the cornea more convex, and pushes forwards the crystalline lens, to adjust the eye to near distances.

Distinct vision with two eyes depends upon these different actions of the straight muscles; an imperfection in any one of them, as it renders the organ unfit to perform its functions, must be considered as a disease.

Three different diseases occur in practice, which appear to arise from morbid actions of the straight muscles. These are, an inability to see near objects distinctly; double vision; and squinting.

I shall consider each of these separately.

### *Of the inability to see near Objects distinctly.*

As that action of the muscles which produces the adjustment of the eye to near objects, consists of the greatest degree of contraction usually exerted by them, it puts the fibres into a very uneasy state; which while in health they support with the utmost difficulty, and when affected by disease are unable to

sustain: under these last circumstances near objects cannot be seen at all without considerable pain, and never distinctly, the eye not remaining a sufficient time adjusted for that purpose. I cannot better explain the nature of this disease, than by giving an account of the symptoms which occurred in the following case.

A gentleman forty years of age, naturally short-sighted, of a delicate irritable habit from his infancy, never able to bear much bodily fatigue, being always soon tired by walking, or other exercises that required muscular exertion, had the following affection of his eyes.

His sight had been very perfect till he was nineteen years of age; at that time he resided in a part of the country where the ground consisted principally of white chalk, which produced an unpleasant glare; and his constant amusement both by day-light and candle-light was drawing, which he frequently pursued so far as to fatigue his eyes. While thus employed his complaints had their origin. The first symptoms were that of being unable to look long at any object without pain, and feeling uneasiness when exposed to strong light. The eyes to all appearance were free from disease, having no unusual redness, nor any purulent, or watery discharge. The plan that was first adopted for his relief consisted in lowering the system, both constitutionally and locally; but this treatment rendered him more irritable, and made his eyes rather worse than before; he therefore, after a trial of eight years, in different means of this kind, gave them entirely up. For the next five years, in which nothing was done to the eyes, the symptoms appeared to have been stationary; but at the end of that period, his mind suffering from an uncommon degree of anxiety, the

complaints in his eyes were evidently rendered worse; this effect, however, depended solely on the state of mind, for as soon as ever he recovered from his distress, the eyes also returned to their former state. In this condition I first saw him in the year 1795; and, at that time, his eyes had no external mark of disease, and were moved by the muscles in every direction without the smallest uneasiness. He could look at any thing that was at some distance, as the furniture in the room, the passing objects, &c. with perfect ease; but whenever he attempted to adjust the eyes to near objects, the effort gave so much pain, that although he succeeded in seeing them, he was almost immediately obliged to desist. Every attempt to write or read gave so much pain, that he became unable to do either; but as soon as the strain produced by such an effort was taken off, he was at ease. His disease therefore consisted in a want of power to adjust the eyes to near objects for a sufficient length of time to render them distinct, which of course incapacitated him from reading or writing. The cause of this disease appears to me to be a morbid affection of the straight muscles of the eyes, which allows them to perform all their intermediate contractions as usual, but not the extreme degrees of contraction without considerable pain.

As these symptoms have not, I believe, been before accounted for in this way, it may appear to many who have not seen similar affections of other muscles, that the present opinion is rather theoretical than practical; it will therefore be satisfactory to illustrate this disease in the muscles of the eye, by examples of the same kind of morbid action in other muscles, more within the reach of common observation. The following instances all refer to the muscles of the fore-arm and hand, employed in

actions with which every one is familiar, and show that these muscles are liable to be affected in the same manner as the muscles of the eye.

A gentleman, forty-six years of age, naturally of an irritable habit, which had been much increased by a long residence in the East Indies, was, about eight years ago, in a situation of great responsibility in that country. He was much engaged in writing, and previous to the sailing of a vessel for England, had, with a view to finish some dispatches of importance, written incessantly for a great many hours; the immediate effects of this exertion were simply fatigue, and stiffness in the muscles; but when he again attempted to employ the muscles in that action, he felt a nervous pain in the fore-arm, which was so severe as to oblige him to desist. This pain gave him considerable alarm, from the notion of its being of a paralytic nature, and many attempts were made to remove it. Recourse was had to electricity, and several other stimulating applications; but these always aggravated the symptoms, and they still continue. The circumstance in this case which is peculiarly applicable to my present purpose is, that the pain is only felt in the act of writing, the common motions of the fingers and thumb not giving the smallest uneasiness.

A gentleman about forty-six years of age, of a very irritable constitution, who had been in the habit of dealing cards for whole evenings together, was engaged in this employment one night for six hours; the weather was very warm, and he walked home in a state of perspiration, and went to bed. The window of his apartment, which faced the north, and was directly opposite to the foot of the bed, had been left open; the bed curtains were also undrawn. In the course of the night there was

a sudden change in the weather from hot to cold, and the wind having shifted to the north, blew directly upon his right arm, which was accidentally exposed. In the morning when he awoke his arm was in a very uneasy state. This however went off; but there was a pain in the muscles situated between the thumb and fore finger, and those of the fore-arm, which continued, and gave him great uneasiness. As it was supposed to be paralytic, blisters were applied to the origin of the nerves at the shoulder, and a visit to Bath was agreed upon as a necessary measure. The effects of the blister rather increased the complaint, which raised a doubt about its nature; and I found, upon a careful investigation, that particular muscles only were affected, which suggested an inquiry into the use that had been made of them. This inquiry led to a discovery of the real nature of the complaint, as only those muscles used in dealing cards were particularly affected. They were not in pain while at rest, but were unable to bear the least action without considerable uneasiness. This was greater at some times, than others; and although a year has now elapsed since the complaint came on, it is not entirely removed.

One of the principal tavern keepers in London was rendered very uneasy by a pain in the fore-arm, close to the elbow, which at times was very severe. Upon examining the parts, the pain was evidently not in the joint, but appeared to arise from an affection of the supinator brevis muscle, as the motion of that muscle gave pain. This I stated to him, but told him I was at a loss to find out in what way that part could have been injured; this was readily cleared up, when he informed me that the greatest pain he felt was in drawing claret corks, which he did with a jerk or sudden motion of the arm, and it was immediately after an

exertion of this kind that he had first felt the complaint. It was clear from this account that this particular muscle had been strained, and was rendered unfit to bear any violent action.

These cases will be sufficient to explain that a muscle, or set of muscles, may be unable to perform those actions which require the greatest exertion, although capable of performing all the others.

If then we consider the disease which causes the inability to see near objects as a strain upon the muscles, and compare it with the same disease in other muscles, there will be no difficulty in accounting for the bad effects produced by every thing that irritates, or weakens the parts themselves, or the general habit: it will follow, that such a mode of practice should be laid aside, and those means adopted by which the parts can be soothed in their sensations, and quieted and strengthened in their actions, since in that way only the muscular fibres can possibly recover their tone.

### *Of double Vision.*

Many opinions have been advanced to account for the single appearance of objects when seen by both eyes.

Dr. REID of Glasgow, who has taken much pains on this subject, has treated it with ingenuity and a great deal of knowledge; and the opinion he has advanced, of objects appearing single when the impressions from the object are made upon parts of the retina of the two eyes which correspond with each other, and double whenever that is not the case, is very strongly confirmed by the following observations upon double vision.

There are two circumstances under which double vision

takes place; one where the muscles of the eye do not correspond in their action, and therefore the two eyes do not bear equally upon the object; the other, where some change has taken place in the refracting media of one eye which prevents the pencils of light from impressing the corresponding parts of the retina of both eyes. Instances of double vision produced by these two modes have fallen under my notice.

It has been long ascertained by experiments, that when the eyes are not turned equally towards an object, it appears double, and the disease in the muscles which produces this effect is the subject which I now mean to consider. It will, at the same time, be proper to distinguish this kind of double vision from that which is produced by a change in the refracting media of the eye; and this will be best done by explaining the nature of those changes in consequence of which it occurs.

When one eye has had the crystalline lens extracted, the other remaining perfect, objects seen by both eyes will appear double.

This is a fact which was noticed in a former lecture, in treating of the adjustment of the eye. At first it appeared difficult to account for the double vision, particularly as the two images were entirely separate from each other. It could not arise from the absence of the lens, as that would not alter the situation of the images on the retina; and the two images being of different dimensions on similar parts of the retina, would appear to be one before the other. As the operation of extracting the lens in no respect affects the muscles of the eye, the action of the muscles would be the same as before, and therefore could not contribute to produce this effect.

The double vision in this instance appears to arise from the

cornea of the eye which had undergone the operation being rendered flatter than the other, and giving a different direction to the rays of light, so as to form an image on a part of the retina not corresponding with the part impressed in the other eye.

If the crystalline lens be extracted from both eyes, and the person applies a convex glass to one eye only, and looks at an object, it will appear double; but if the convex glass is moved in different directions before the cornea, there will be found one situation in which it makes the object single. In this instance the corneas and muscles of the two eyes are under exactly the same circumstances; and when the centre of the convex glass is directly in the axis of vision, the image on the retina of that eye is formed on parts that correspond with those impressed in the other; but whenever the centre of the convex glass is out of the axis of vision this does not take place, and the object appears double.

The experiments of which these observations are the result, were made upon the eyes of a lady who had lost the sight of both, by opacities in the crystalline lenses; but by submitting to have the lenses extracted recovered her sight, and had afterwards an uncommon degree of distinct vision; which made her a very favourable subject for experiments of this kind.

Having explained the two different modes by which double vision may take place in consequence of operations that render the refracting media of the eye imperfect, I shall now consider it when produced by a morbid action of the muscles.

Several cases of this kind have come within my own knowledge, and I am induced to dwell upon the subject, because some of them had been considered as arising from a defect in

the organ, and erroneously treated. The fact has been long established by philosophers that a defect in the muscles may produce such a disease, but as other causes may likewise do the same, I believe that such a defect has not been practically considered, as one of the diseases of the eye; certainly not as a very common one, which undoubtedly it will be found.

The first case of this kind which led me to pay attention to the subject, was that of a friend, a lieutenant colonel of engineers, who was in perfect health, shooting moor-game upon his own estate in Scotland. He was very much surprised towards the evening of a fatiguing day's sport, to find all at once that every thing appeared double; his gun, his horse, and the road, were all double. This appearance distressed him exceedingly, and he became alarmed lest he should not find his way home; in this, however, he succeeded by giving the reins to his horse.

After a night's rest the double vision was very much gone off; and in two or three days he went again to the moors, when his complaint returned in a more violent degree. He went to Edinburgh for the benefit of medical advice. The disease was referred to the eye itself, and treated accordingly; the head was shaved, blistered, and bled with leeches. He was put under a course of mercury, and kept upon a very spare diet. This plan was found to aggravate the symptoms; he therefore, after giving it a sufficient trial, returned home in despair, and shut himself up in his own house. He gradually left off all medicine, and lived as usual. His sight was during the whole time perfectly clear, and at the same time near objects appeared single; at three yards they became double, and by increasing the distance they separated further from each

other. When he looked at an object, it was perceived by a by-stander, that the two eyes were not equally directed to it. The complaint was most violent in the morning, and became better after dinner, when he had drank a few glasses of wine. It continued for nearly a twelvemonth, and gradually went off.

The above account of the disease was given to me by the patient himself, who is an intelligent man, very soon after his recovery. It was considered as a curious disease, and I had several conversations with Mr. RAMSDEN respecting it. The more we considered it, the more we were convinced that the disease had been entirely in the muscles; and this I explained to the patient at the time as my opinion.

It is now about eight years ago, and the gentleman has had no return of the disease; but for two or three years past has lost in a great measure the use of his lower extremities, being unable to walk alone.

Some time after the recovery of this gentleman, a house-painter, who had worked a good deal in white lead, was admitted a patient in St. George's Hospital, on account of a fever, attended with a violent headach. Upon recovering from the fever, he was very much distressed at seeing every thing double; and as the fever was entirely gone, he was put under my care for this affection of his eyes. Upon an inquiry into his complaints, I found them exactly to correspond with the case I have just described, and therefore treated them as arising entirely from an affection of the muscles. I bound up one eye, and left the other open; he now saw objects single, and very distinctly, but looking at them gave him pain in the eye, and brought on headach. This led me to believe that I had erro-

neously tied up the sound eye; the bandage was therefore removed to the other eye, and that which had been bound up was left open. He now saw objects without pain, or the smallest uneasiness. He was thus kept with one eye confined for a week, after which the bandage was laid aside; the disease proved to be entirely gone, nor did it return in the smallest degree while he remained in the hospital. Rest alone had been sufficient to allow the muscles to recover their strength, and thus produced a cure.

A repetition of cases, I am very sensible, is not the most pleasing mode of conveying information, except to medical men; I have therefore selected those only, which are absolutely necessary to explain the different phænomena of the diseased states of the eye at present under consideration. The cases brought forward with this view, are rather to be looked upon as the detail of so many experiments made in the investigation of the diseases, than as histories of particular patients.

When muscles are strained or over fatigued, to put them in an easy state, and confine them from motion, is the first object of attention; and this practice is no less applicable to the muscles of the eye, than to those of other parts.

### *Of Squinting.*

Whenever the motions of the two eyes differ from one another, whether in a less degree, so as to produce double vision, or in a greater, turning one eye entirely from the object, the disease has been called squinting. What I mean at present to consider under this head is, where the deviation of one of the eyes from the axis of vision is greater than that by which ob-

jects are made to appear double; so that in this view, double vision is an intermediate state between single vision with both eyes, and squinting. Squinting has been very generally believed to arise entirely from an inability in the muscles to direct the eye properly to the object. There is, however, probably no original defect in the muscles; certainly none sufficient to sanction such an opinion; since the muscles of a squinting eye have the power of giving it any direction, but cannot do it without some degree of effort. The defect, therefore, appears to be principally in the eye itself, which is too imperfect to assist the other in producing distinct vision. From this imperfection, the muscles have not the same guide to direct them as those of the other eye; and, therefore, although perfectly formed, cannot make their actions exactly correspond with them.

In a squinting person, both eyes certainly do not see the object looked at. This is evident to a by-stander, who is able to determine, that the direction of one of the eyes differs so much from that of the other, that it is impossible for the rays of light from any object to fall upon the retinas of both; and, therefore, that one eye does not see the object.

The same thing may be proved in another way; for since a small deviation in the direction of either eye from the axis of vision, produces double vision, any greater deviation must have the same effect, only increasing the distance between the two images, till it becomes so great that one eye only is directed to the object. In squinting there is evidently a greater deviation from the axis of vision than in double vision, and the object does not appear double; it is therefore not seen by both eyes.

The circumstance of those who squint having an imperfect eye, is corroborated by all the well authenticated observations

which have been made upon persons who have a confirmed squint, which all agree in stating, that one of the eyes is too imperfect to see distinctly.

From these observations, it would be natural to suppose that the loss of sight in one eye, should produce the appearance of squinting, which is by no means the case; for when that happens, the motions of the two eyes continue to correspond, although not exactly; but the deviation is not equal to that which is met with in squinting; it is nearer to that which occurs in double vision.

The reason why the imperfect eye of a squinting person is directed from the object, while a blind one in its motions follows the other, is, probably, that the indistinct vision of the imperfect eye prevents the muscles from directing it to the object with the same accuracy as those of the other do; this small deviation from the axis of vision renders the object double, and interferes with the vision of the perfect eye; and it is in the effort to get rid of the confused image that the muscles acquire a habit of neglecting to use the imperfect eye. It may also happen, when the eye is so imperfect as not to receive a correct image of any object, that it may have been neglected from the beginning. Distinct vision being at once obtained by the perfect eye, the end is answered, and the mind is never afterwards led to employ the other.

The direction the eye takes under either of these circumstances is inwards, towards the nose, the adductor muscle being stronger, shorter, and its course more in a straight line, than any of the other muscles of the eye.

That the eye, when not accurately directed to the object, produces confused vision, and is for that reason turned away,

appears to be confirmed by the case of a patient, from whom I had extracted the crystalline lens. This man, at first, saw objects double, in a manner which extremely distressed him; but, after some months, acquired the habit of neglecting to employ the imperfect eye, and no longer found any inconvenience.

The different degrees of squinting appear to be in proportion to the imperfection in the vision of the eye, and, in some instances, the person is capable of seeing distant objects with both eyes, and only squints when looking at near ones. The following case is of this kind.

A young lady, twenty-three years of age, has been observed to squint from her infancy; this has not been considered by her friends as the consequence of any defect in her eyes, but as arising from the cradle in which she lay having been so situated, with respect to the light, as to attract her notice in one particular direction, so much as to occasion a cast in one eye. Her eyes are apparently both perfect; when she looks with attention at an object some yards distant she has no squint, but if her eyes are not engaged by any object, or a very near one, she squints to a considerable degree.

Upon being asked if she saw objects distinctly with both eyes, she said certainly, but that one was stronger than the other. To ascertain the truth of this, I covered the strong eye and gave her a book to read; to her astonishment, she found she could not distinguish a letter, or any other near object. More distant objects she could see, but not distinctly. When she looked at a bunch of small keys in the door of a bookcase, about twelve feet from her, she could see the bunch of keys, but could not tell how many there were.

To see how far the two eyes had the same focus, she was desired to look at an object in the field of a microscope, and it was found that she saw most distinctly with both eyes at the same focal distance, although the object was considerably more distinct to the perfect eye than to the other; so that the focuses of the two eyes were the same.

I desired her to cover the perfect eye, and endeavour to acquire an adjustment of the other to near objects, by practising the use of that alone. At first she was unable to see at all with the imperfect eye, but in some weeks she has improved so much as to be able to work at her needle with it; this she cannot do long at any one time, the eye being soon fatigued and requiring rest, though without giving pain. She is unable to read with the imperfect eye. These trials have only been made in the course of two months, for a few hours in the day, and her friends think that she squints less frequently than she did.

In this case it is probable that the imperfect eye never had acquired the power of adjustment to near objects; for as distinct vision seems necessary to direct the muscles in their actions, the perfect eye would require less practice to adjust itself than the other; and as soon as the near object became distinct to one eye, no information being conveyed to the mind of the failure in the other, all efforts to render its adjustment perfect would be at an end, and it would ever after be neglected, while the perfect eye was in use.

Squinting, according to these observations, appears to arise from the vision in one eye being obscure. It may, however, be acquired in degree by children who have the lenses of their eyes of different focuses; or have one eye less perfect in its

vision than the other, living constantly with those who do squint, and, by imitation, acquiring a habit of neglecting to use one eye.

The power of squinting voluntarily may also be acquired at any age. This we find to be true in persons who look much through telescopes; they are led to apply the mind entirely to one eye, not seeing at all with the other. In this case the neglected eye will at first, from habit, follow the other; but in time, if frequently neglected, may lose this restraint, and be moved in another direction. Some astronomers, whose eyes have been much used in this way, are said to be able to squint at pleasure.

From this view of squinting, it takes place under the three following circumstances: where one eye has only an indistinct vision; where both eyes are capable of seeing objects, but the one less perfect in itself than the other; and where the muscles of one eye have acquired from practice a power of moving it independently of the other.

Where squinting arises from an absolute imperfection in the eye there can be no cure.

Where it arises from weakness only in the sight of one eye, it may, in some instances, be got the better of; but to effect the cure there is only one mode, which is that of confining the person to the use of the weak eye by covering the other; in this way the muscles, from constant use, will become perfect in the habit of directing the eye upon the object, gain strength in that action, and acquire a power of adjusting the eye; when these are established in a sufficient degree, the other eye may be set at liberty. The time that will be necessary for the cure must depend upon the degree of weakness of the sight, and

the length of time the muscles have been left to themselves; for it is with difficulty they acquire an increased degree of action after having been long habituated to a more limited contraction.

*Of the Nature of the Cornea, some of its Diseases, and Mode of Treatment.*

The cornea of the eye, as the name implies, has been considered of a cuticular nature. Baron HALLER compares it to the nails in a soft state, and believes that in its regeneration it resembles the epidermis.

This opinion is founded upon its want of sensibility, and having no vessels which carry red blood; the appearance it puts on when preserved in spirits, which is exactly similar to the nails at their roots, probably confirmed this supposition.

As the cuticle is devoid of life, it is only under the influence of disease during its growth; once formed, it continues unchanged. The cornea, were it of the same nature, would be equally incapable of taking on new actions from disease, or any other cause; but we find, on the contrary, that it undergoes many changes, which exactly correspond with those which the living parts of an animal body go through when under the influence of disease, from which I am induced to consider it alive; and I find that many of the present teachers of anatomy are of the same opinion.

To prove that the cornea has life it is necessary, as a previous step, to shew, that being supplied with vessels which carry red blood, and having sensibility, are not essential to the possession of the living principle; for this purpose all that is required is to

demonstrate that there are living parts which have neither the one nor the other. Tendons and ligaments in a natural state are instances of this kind. That these parts are not supplied with red blood is obvious to the eye of a common observer; no illustration will therefore be required to substantiate that proof. That they are not endowed with sensibility was, I believe, first taught by the late Dr. WILLIAM HUNTER,\* who published the following account of it.†

In a case where the last joint of the ring-finger had been torn off, half an inch of the tendon of the flexor muscle projected beyond the stump; this it was thought right to remove; and to ascertain whether it was possessed of sensibility, the following experiment was made: a piece of cord the thickness of the tendon was passed round the wrist and along the side of the finger, so as to project even with the end of the tendon; the man was then told to turn away his head, and tell which of the two were cut through; the tendon was divided, and the man declared it was the string, not having felt the smallest degree of pain.

This proof is satisfactory; but that the cornea is possessed of life, by no means rests upon any negative proofs; which I shall now endeavour to explain.

The cornea in its structure is made up of membranous laminae. One of these appears to be a portion of the tunica conjunctiva, but it is either so extremely thin, or so intimately connected with the lamina next to it, as not to admit of more than a very partial separation from it; another lamina, as I

\* This doctrine was first taught by Dr. HUNTER, in the year 1746. HALLER made experiments proving the same thing in 1750.

† Medical Observ. and Inquir. Vol. IV. page 343.

have shewn in a former lecture, is a continuation of the tendons of the four straight muscles; but as both these laminæ have the same properties as the other parts of the cornea, and are not to be distinguished from them, they must be considered in every respect as a part of it.

The tunica conjunctiva and tendons, a continuation of which forms these anterior laminæ of the cornea, are allowed to be living parts, and the portions that make part of the cornea are not to be distinguished by their structure from the rest; we must therefore suppose them to be also composed of living parts.

When the cornea is wounded it unites, like other living parts, by the first intention. If the wound is made by a clean cutting instrument the cicatrix is small; but if by a blunt instrument it is larger, extending further into the neighbouring parts of the cornea, and a greater quantity of the coagulating lymph of the blood being required to procure the union.

Although the cornea, when divided in the operation for extracting the crystalline lens, commonly unites by the first intention, this union is in some cases attended with inflammation, which produces an opacity of the cornea; in other cases the inflammation exceeds the limits of adhesion, and the whole internal cavity of the eye proceeds to a state of suppuration. These stages of inflammation are only met with in parts possessed of life.

It is true, that an injury may be committed to the cornea, such as a small piece of metal sticking in it, which from the indolent nature of its substance, shall remain there for months without producing inflammation; but an irritation of a less violent kind upon the edge of the cornea, by which the tunica conjunctiva is also affected, will produce inflammation upon

that vascular membrane, which may extend itself upon the cornea; for it is impossible that the vessels of the cornea, which naturally carry only lymph or serum, can be made to carry red blood, unless the irritation extends to some neighbouring part supplied with red blood.

That vessels carrying red blood have been met with upon the cornea in a diseased state, is doubted by HALLER; he does not altogether deny it, but the assertion, he says, requires proof, as he is not satisfied with the authorities of PETIT and others whom he quotes upon that subject.

It is so common a thing in inflammations of the eye to have the branches of the arteries of the tunica conjunctiva continued upon the cornea, that every practical surgeon must have met with it. In some instances of this kind, which have come immediately under my own care, I have examined these vessels with a magnifying glass, and have seen distinctly small arteries from the tunica conjunctiva, uniting upon the cornea into a common trunk larger than any of the branches that supplied it, and this trunk has sent off other branches distributed over the cornea.

These vessels may, by some physiologists, be supposed to be continued upon the lamina of the tunica conjunctiva, which is spread over the cornea; this, however, is not the case, as they pass behind it, and therefore belong as much to the lamina under them as that which is over them; and, in many instances of disease, vessels carrying red blood are met with in the substance of the cornea still deeper seated. This has been seen by Professor RICHTER,\* who says, he has divided a

\* RICHTER *Med. Doctor. et Professor publicus Ordinarius Soc. Reg. Scient. Gotting. et Acad. Reg. Scient. Sueciæ Mem. in Novis Comment. Soc. Reg. Gotting. T. vi. ad annum 1775.*

thickened cornea, and the vessels in its substance have poured out red blood.

The cornea is not only capable of uniting by the first intention, inflaming, and suppurating, but when the inflammation is carried to a great height, a portion of its substance is sometimes removed by ulceration, and the ulcer so formed is filled up by coagulating lymph, which afterwards becomes cornea, acquiring the necessary property of transparency. This new formed part is weaker than the rest of the cornea, and commonly projects beyond it, forming one species of staphyloma; in the substance of the cornea, round the basis of the staphyloma, I have frequently seen vessels carrying red blood.

From the opinion of the cornea being devoid of life, the opacities which are found to take place on it have been considered apart from common surgery, and entrusted to the care of men who are supposed to have made the diseases of the eye their particular study.

According to this theory, the opacity was supposed to arise from a film of inanimate matter laid over the cornea, and upon that idea very acrid and irritating applications were employed with the view of scraping it off, or destroying it, as powdered glass, powdered sugar, &c. and such applications being of service, confirmed the opinion which gave rise to the practice.

Having shown that the cornea is possessed of life, I shall now point out the parts of the body it resembles in structure, and to which it bears the greatest analogy, both in its healthy actions, and those arising from disease; and endeavour, by comparing them, to establish some general principle which will explain the beneficial effects of irritating applications in cases of inflammation and opacity of the cornea.

The cornea, from some experiments and observations mentioned in a former lecture, appears to be similar in structure and use to the elastic ligaments. It has all the common properties of ligaments, those of elasticity and transparency being superadded.

Like other ligaments it can be divided into laminæ, in an healthy state has no vessels carrying red blood, and is devoid of sensibility; when divided it readily admits of union, when inflamed acquires a great degree of sensibility, is slow in its powers of resolution, and when the inflammation subsides, the coagulating lymph deposited in the adhesive stage of the inflammation remains, producing an opacity which it is afterwards found difficult to remove.

All ligamentous parts, of which I consider the cornea to be one, are weak in their vital powers; this arises from their having no vessels carrying red blood; when they inflame, which is a state of increased action, they therefore require a different mode of treatment from the other parts of the body, whose vital powers are strong, in consequence of being largely supplied with red blood.

The truly healthy inflammation requires an increased action in the parts affected; and if this, either from weakness or indolence, is not kept up, the inflammation does not go rapidly through its stages, but remains in a state between resolution and suppuration. In ligamentous structures the actions must therefore be roused and supported when under inflammation, to promote resolution, and prevent the parts from falling into an indolent diseased state. This is, however, attended with difficulty, and they too often become considerably thickened

by a deposition of coagulating lymph during the adhesive state of inflammation, which in the cornea renders it opaque. The thickening of the parts remains after the inflammation is gone, and can only be removed by absorption, which is best effected by the application of very stimulating medicines.

Upon these principles all ligamentous structures require a treatment peculiar to themselves, which may be illustrated both in inflammations of joints and of the cornea of the eye; the applications made use of with the greatest advantage in both cases being of a very stimulating kind.

The advantages attending this mode of treating the cornea were, probably, discovered by accident; and when they were ascertained, it established itself as a very general practice. It must, however, in the hands of those who had no general principle to direct their practice, have been sometimes applied without benefit, and must sometimes have been injurious.

It is an extremely curious circumstance, and probably the most so that can be met with in the history of medicine, that a local application should have been discovered to be of service in a particular disease 2513 years ago, that the same application, or those of a similar kind, should have been in very general use ever since, and in all that time no rational principle on which such medicines produced their beneficial effects should have been ascertained. This appears, from the following account, to have been the case with respect to stimulating applications to the cornea in a diseased state, and can only be accounted for by a want of knowledge of the structure of the parts, which is an argument of uncommon weight in favour of the study of anatomy.

In the Apocrypha we find, in the book of Tobit\*, a very circumstantial account of an opacity of the cornea successfully treated by stimulating applications. It is there stated as a miracle, but we have the authority of JEROME, a father of the church, who wrote in the fourth century, to say, “ the church “ reads the books of Tobit, &c. for examples of life and in- “ struction of manners, but doth not establish any doctrine by “ them.” We shall therefore consider the account which is given in extracts from the book of Tobit in that view.

Tob. chap. vi. ver. 2.

“ When TOBIAS went down to wash himself in the river “ Tigris, a fish leaped out of the river and would have devoured “ him.

“ Ver. 4. The angel of the Lord told him to take out the “ gall, and put it up in safety.

“ Ver. 6. TOBIAS asked the angel what was the use of the “ gall.

“ Ver. 8. As for the gall (said the angel) it is good to anoint “ a man who hath whiteness in his eyes, and he shall be “ healed.”

Chap. xi. ver. 11.

“ TOBIAS took hold of his father, and strake of the gall in “ his father’s eyes, saying, be of good hope, my father.

“ Ver. 12. And when his eyes began to smart he rubbed “ them.

“ Ver. 13. And the whiteness pilled away from the corners

\* TOBIT was of the tribe of Naphtali, in the city of Thisbe, in Upper Galilee; he was carried captive to Nineveh, after the extinction of the kingdom of Israel, by Enemassar, or Salmanassar, about the year of the world 3283.

GRAY’s Key to the Old Testament and Apocrypha, page 554.

“ of his eyes, and when he saw his son he fell upon his  
“ neck.” \*

In conversing with my friend Dr. RUSSELL on the manner in which the Arabians treat inflammations and opacities of the cornea, he very kindly favoured me with the following account.

“ Respecting the practice of the Arabians in disorders of the  
“ eyes, I find nothing of consequence in my papers. An ocu-  
“ list among them is a distinct profession; and the collyria they  
“ apply are secret compositions, which pass hereditarily from  
“ father to son. The Arabian writers give a number of recipes,  
“ most of which are taken from GALEN and the Greek physi-  
“ cians. One composition in AVICENNA contains the gall of a  
“ crow, crane, partridge, goat, &c. At Aleppo, the gall of  
“ the sheet fish, *Silurus Glanis* of LINN. was in particular re-  
“ quest; but it should be remarked, that they always add to the  
“ gall other ingredients, it being a material circumstance in  
“ that country, that a recipe should consist of a multitude of  
“ ingredients. What often struck me in their practice was the  
“ successful application of sharp or acrid remedies, at a time  
“ I should have been induced to make use of the mildest emol-  
“ lient applications.”

\* Since this paper was read before the Royal Society, my friend Dr. WELLS acquainted me with the following case, published in the Annual Register for the year 1768.

“ One of the Paris newspapers gives an account of an extraordinary cure effected by  
“ the gall of a barbel, in a case of blindness, in substance as follows: A journeyman  
“ watchmaker, named CENSIER, having heard that the gall of a barbel was the remedy  
“ which TOBIAS employed to cure his father's blindness, resolved to try its effects on  
“ the widow GERMAIN, his mother-in-law, whose eyes had for six months been af-  
“ flicted with ulcers, and covered with a film, which rendered them totally blind:

From this account given by Dr. RUSSELL there can be no doubt of gall having continued in use, as an application to the eye among the eastern nations, from the time of TOBIT down to the present day.

I have in the course of the last three years made many trials of the effects of gall, as an application to the cornea in a diseased state. I have used it pure, and diluted; and compared its effects with those of the unguentum hydrargyri nitrati, and the solution of the argentum nitratum; and find in old cases of opacity it is, in some instances, the best application. The gall of quadrupeds, in these trials, gave more pain than the gall of fish. The painful sensation was very severe for an hour or two, and then went off. It is proper to observe, that the beneficial effects it produces appear to be in proportion to the local violence at the time of its application.

To enter further into the practical part of the treatment for removing opacities from the cornea, would be foreign to the pursuits of this learned Society, which I consider to be confined

“ CENSIER having obtained the gall of that fish, squeezed the liquor out of it into a  
“ phial, and in the evening he rubbed it with the end of a feather into his mother’s eyes.  
“ It gave her great pain for about half an hour, which abated by degrees, and her eyes  
“ watered very much: next morning she could not open them, the water as it were  
“ gluing her eyes up: he bathed them with pure water, and she began to see with  
“ the eye which had received the most liquor. He used the gall again in the evening;  
“ the inflammation dispersed, the white of her eyes became red, their colour re-  
“ turned by degrees, and her sight became strong. He repeated it a third time, with  
“ all the desired success. In short, she recovered her sight without any other remedy.  
“ The widow GERMAIN is in her fifty-third year. She had been pronounced blind  
“ by the surgeons of the Hôtel-Dieu: and her blindness and cure have been attested  
“ by order of the lieutenant general of police. She sees stronger and clearer now than  
“ before the accident.”

Annual Register, Vol. xi. page 143.

to the general principles of the different branches of science, and to collecting facts out of which new principles may be formed, or those already known better established.

The practice of applying very stimulating applications to the cornea has stood the test of twenty-five centuries, it can therefore require no support. The object of the present observations has been to explain the principle upon which the beneficial effects depend, a knowledge of which may serve as a guide to regulate our practice. It will guard us against using such medicines while the inflammatory action is increasing, it will lead us to adopt them the moment the inflammation appears to be at a stand, and not postpone this practice till an indolent unhealthy state takes place, which too often terminates in opacities no applications can afterwards remove.