Headache and ocular treatment / by Freeland Fergus.

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HEADACHE AND OCULAR TREATMENT.

BY

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Headache and Ocular Treatment.[1]

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A PHYSYCIAN, for whose opinion I have the most cordial regard, recently in conversation raised the question as to whether the fitting of glasses really relieved severe headache. Till the time of that remark I had never had any doubt on the subject, but since that interview, which took place about April of the current year, I have looked into the thing a little more particularly. That the wearing of spectacles does not always set the matter right is perfectly true, and before I close I shall return to that subject and have something to say upon the causes of failure. In the first part of this communication I intend to deal with a few concrete examples, thereafter I shall discuss the general question as to the forms of headache which can be relieved by ocular treatment, and I shall conclude, as already indicated, by some observations on the causes of failure.

Pursuing this plan, in the first place, I beg to submit the following cases for consideration :—

CASE I.—The first case that I wish to submit is that of myself. All through my school career and all through my university training I was much troubled by frontal headache. On two occasions, once when I was at school and again when I was at college, I was measured for glasses in Glasgow, and on both occasions I was told to wear a 24-inch convex lens. After I had graduated I was at Marlborough in the year 1886 with my uncle, and he observed my great inability to read or write on account of difficulty of vision notwithstanding the

[1] Read at a meeting of the Medico-Chirurgical Society of Glasgow held on 2nd October, 1908.

said correction. He happened to be personally acquainted with the late Sir William Bowman, and he strongly advised me to see Bowman. I journeyed from Marlborough to London and saw Sir William, who at once said I had got in each eye a dioptre of astigmatism against the rule, and prescribed glasses accordingly. After Sir William had fitted me it was at least two months before I was thoroughly well. My visit to Sir William took place about the middle of July of that year, and I wrote to him about a month afterwards to say that, although I was greatly better, I still suffered slightly from headache. His reply was that he was to be in Edinburgh on a certain day in the following month, and that he wished me to come through and see him there. He was satisfied with my condition, and told me that if I persevered in wearing the glasses the headaches would ultimately disappear, which they very soon did. Since then I have been entirely free of headache.

The following cases have been investigated since the conversation referred to above. They are only a small portion of those which I have seen, but I think they are fairly satisfactory. Unfortunately, a large clinic is productive of anything but accurate work. There is no man living who can investigate more than a very few cases thoroughly per day, and I always estimate that a proper testing will take about an hour. So, in an institution like the Glasgow Eye Infirmary, where there are a large number of patients to deal with, the testing must be rough, and unfortunately the surgeons in charge have little time to critically examine their own work. I myself have been able to do so only at one or two points, and particularly as regards the influence of bacteria in operation work. Therefore, for the present purpose, I have not drawn at all from the infirmary records, but merely submit a few cases from my private clinic.

CASE II.—The next case that I would mention is that of a doctor practising in a town in Dumbartonshire. Three or four years ago he suffered very constantly from headache while endeavouriug to read or write. At that time I fitted him with sphero-cylinders. I saw him on 14th June of this year, when he assured me that since he got these glasses headaches have been to him entirely unknown. He is able to read and to write and to conduct his business without the slightest trouble. He attributed his recovery from headache entirely to the wearing of the glasses, and the proof is that while wearing them he never has any trouble, but should he be without them, even for a short time, the headache at once begins.

CASE III.—The third case is that of a lady whom I saw on 24th June of this year. She is the wife of a medical practitioner in this city. About three or four years ago her husband sent her to see me on account of severe frontal headache. On examination I found her to have an astigmatism in each eye of about $2\frac{1}{2}$ dioptres. Correction with concave cylindrical lenses gave her $\frac{6}{6}$ of Snellen. These glasses were prescribed and the headaches at once disappeared. She has had no trouble since that time till within the last few days. The occasion of her consulting me in June, 1908, was that she suffered slightly from headache while motoring. I made a fractional change in the glass, and I quite expect to find that that little difference will put her right.

CASE IV.—The fourth case which I wish to discuss is that of Mrs. M'C., a patient from Rothesay. This patient suffered for many years from severe headache, and was sent to me by one of the gentlemen in practice in that town to have her eyesight investigated. I first saw her in the year 1902, when I found that she had a considerable amount of hypermetropia. That was duly corrected, and since that time she has not had any return of her head trouble. I again saw her on 23rd April of this year, when she informed me of this. She had found a little difficulty for near-at-hand work, which was duly explained by the fact that she was becoming presbyopic and required two pairs of glasses, one for distance and the other for near.

CASE V.—Miss M'D., residing in Glasgow. I first saw her on 13th October, 1902. Before that time, patient had very severe headaches, but since then, and I saw her so recently as April, 1908, she has had no trouble whatsoever from headache. She had a high degree of hypermetropia with a moderate astigmatism in the right eye; a slight hypermetropia and a very high astigmatism in the left eye.

CASE VI.—Miss C., residing in Glasgow, consulted me for very severe headache, especially at the back of the head. I saw her on 14th May, 1908, when I prescribed spherical lenses of 4 dioptres. To the lens for the left eye I also added a slight cylinder. On 2nd June she returned to say that the headaches had completely passed off and that she was perfectly free of them.

CASE VII.—Another case came from Sanquhar. She had suffered for a considerable time severely from headache, and in the year 1903 was sent to me by Dr. Jackson to have her eyes examined. I saw her during the currency of this year, when she stated that, since that time, she had been absolutely

free of headache till a few months ago. When I re-examined her, I found that she was becoming presbyopic, as her age was over forty.

CASE VIII.—So recently as 1st June of this year, I saw a lady, Mrs. P., by name, who was prescribed, for near-at-hand work, a spherical glass of + 2 for each eye, and to the right was added a cylinder of + 0·5 dioptre. On 24th June, I received a letter from her in the following terms:—"Mrs. P. writes to let Dr. F. know that she has benefited very much from the spectacles, and that her headaches are very much better."

CASE IX.—One other case is indicated by a letter which I received on 6th or 7th May, 1908. The writer says, "I am pleased to inform you that since my first visit to you in March, 1902, when you gave me my spectacles, I have suffered much less from headaches than previous to that date. Before Dr. —— sent me to you I had very bad headaches, also felt sick, but without doubt the spectacles have very much relieved me. Often on getting up in the morning I feel inclined to have a headache, but on putting on the spectacles I feel relieved at once."

These are a few cases which I have culled since the end of April when we had that conversation. They might have been added to indefinitely had I the leisure to collect material. They are all from my private clinic, and I confess, in certain cases where the headaches are unquestionably ophthalmic, that if they are not relieved, then it means that the correction has not been altogether a proper one.

CASE X.—One other communication which I have received is from the father of a young lady on whom I operated for exophoria. Therein he says, "I have pleasure in stating that since you operated on my daughter's eye, ten years ago, she has had no return of the severe headaches she had prior to that."

I merely mention this case. I shall later have something to say about these various anomalies which are classed under the heading of heterophoria. If now it be admitted that the preceding remarks afford *prima facia* evidence that eye-strain is often the cause of headache, then there are one or two questions which fall to be discussed. These chiefly are concerned with the nature of the ocular conditions that cause headache. In mentioning this subject to my class, I have always enumerated certain circumstances which are apt to give rise to headache. First, and most obviously, errors of refraction; secondly, insufficiency of accommodation; thirdly,

badly centred spectacles; fourthly, the various forms of heterophoria; fifthly, ophthalmic surgeons often see cases of frontal headache which are sent to them for correction, when really the condition is one allied to migraine—I need not say that even the most careful correction will not give complete relief in such a case; sixthly, every now and again I see a patient who comes to the clinic on account of headaches, but who ultimately turns out to be the subject of disease in the frontal sinus or in the antrum of Highmore. I would like to take up in some slight detail these various causes.

To begin with, it is to be observed that not every person afflicted with errors of refraction suffers from headache. I myself have often seen high degrees of hypermetropia, where the patients assured me that they never had such a thing in the whole course of their lives. On the other hand, I sometimes find with a very slight error of refraction, such as a dioptre of astigmatism, that in certain patients it gives rise to a considerable amount of headache, which entirely disappears when the error of refraction is corrected. Some of these cases are tolerably easy of explanation. Take, for example, a man living in the country, who is following the life of a farmer, and who has a hypermetropia of 4 or 5 dioptres with good visual acuteness in each eye. Very often a man of that sort escapes headaches altogether, although not invariably. The same man, if set to book-keeping or to study, will most likely suffer from headache, and here great individual differences seem to exist. A point on which I always lay special stress with my elementary students is the concurrency of the ranges of accommodation and of convergence. Take, for example, an emmetrope. When he looks at a great distance the axes of vision are parallel and he does not converge. When he looks at a distance of 1 metre, he converges 1 metric angle and accommodates 1 dioptre. When he looks at a distance of $\frac{1}{2}$ a metre, he accommodates 2 dioptres and converges 2 metric angles. When he looks at $\frac{1}{3}$ of a metre, he accommodates 3 dioptres and converges 3 metric angles.

To put the case of the emmetrope in the most general terms, when the fixation is $\frac{1}{N}$ of a metre, he accommodates N dioptres and converges N metric angles.

Now, in the hypermetrope, the conditions are different. No hypermetrope can see at a distance without accommodation, and associated with the natural tendency to accommodation there is the natural tendency to convergence. Some people cannot overcome the impulse to convergence,

and consequently they become afflicted with convergent squint. Others are able, in the interests of binocular vision, to disassociate the functions of accommodation and convergence, and to accommodate without converging. It is this act of disassociation which I think is the cause of the ophthalmic headache in hypermetropia. In this affection, the accommodation, as it were, goes in advance of the convergence. Take, for example, a case in which there is a simple hypermetropia in each eye of 3 dioptres. Such a patient will see distinctly if he uses 3 dioptres of accommodation, and when he looks at a distance he will use that amount without converging, keeping the visual axes of the eyes parallel. When he looks at a point 1 metre from him, he must accommodate 4 dioptres and converge 1 metric angle. When he looks at a point $\frac{1}{2}$ a metre from him, he must accommodate 5 dioptres and use 2 metric angles of convergence. To put the case in general terms, when the fixation is $\frac{1}{N}$ of a metre from him, then the accommodation used must be $3 + N$ dioptres, and the convergence must be N metric angles.

From this we see that the accommodation and convergence are no longer similar, but that the accommodation must be more than the convergence. Many people seem not to be able to disassociate these two functions; a great number of people can; but in a considerable number of them, although not in all, this disassociation is accompanied by severe headache.

In the next place, I would like to discuss the conditions in myopia. Let us investigate the case of a person who is myopic, say, to the extent of 3 dioptres. On distant fixation, the patient does not see well. He, however, keeps the axes of the eyes parallel. For fixation at $\frac{1}{2}$ a metre, he converges 2 metric angles, but still has no clear image on either retina, and does not accommodate, for the point of fixation is at a greater distance from his eyes than his distant point of distinct vision. Again, when he fixes at $\frac{1}{3}$ of a metre, he converges 3 metric angles, but in so far as his fixation point is exactly at its distant point of distinct vision, he does not accommodate. When he looks at a point $\frac{1}{4}$ of a metre, he converges 4 metric angles, and for the first time begins to accommodate. He accommodates 1 dioptre. Thus it is seen that in this case the accommodation and convergence are not similar, as in emmetropia, but that more convergence is required than the normally corresponding amount of accommodation. This state of affairs does not frequently give rise to headache, but I have known it to do so. I have

vividly before my mind just now a lad, a clerk with the Caledonian Railway, whom I saw in the Royal Infirmary Dispensary, who had 2 dioptres of myopia, but who suffered very much from headache. The careful correction of this small amount of refractive error at once cured him of his distress. I imagine it did so by restoring the harmony between the range of convergence and the range of accommodation. I was much interested at the time to learn that, so far as he knew, he was the first person in his family history to be affected with myopia. There was no history of it in any of his ancestors, and his brothers and sisters seemed free from it. I have seen a few cases like that, but they are not common. Headache, as an accompaniment of myopia, uncomplicated with astigmatism, is in my experience rare.

In astigmatism the condition is a little more complicated. With astigmatism there is the general error to be considered, either hypermetropic or myopic, and in addition to that there are, I believe, special sectional contractions of the lens which the patient makes in order, as it were, to correct his astigmatism. If this view be correct, and there is much evidence in its favour, the lens, in compound hypermetropic astigmatism, undergoes a contraction to correct the general hypermetropia, and probably in most cases there is a secondary contraction, or, if not that, at anyrate a tilting of the lens in an attempt to correct the astigmatic error. In my experience, astigmatism is much more liable to give rise to severe headache than a plain hypermetropia of moderate amount, and yet it has to be observed that, in persons who are not what may be called neurotic, or who live a tolerably free out-of-door life, there may be a fair amount of astigmatism without any headache. When headache occurs, there is probably a nerve element in it, or what we may call a neurotic element, as well as an error of refraction, for we sometimes find persons who have a high degree of refraction error without any headache, and others who have a very trifling error who suffer considerably. The three conditions, then, which come to be of importance are—(1) the precise error and its amount; (2) the mode of life of the patient; (3) the absence or presence of an unstable nervous system.

Another defect of refraction which constantly gives rise to headache is a lack of proper accommodation. People begin to get presbyopic about 40 years of age, and, generally speaking, the rule which I adopt in combating presbyopia is the following:—I first make the patient emmetropic by a suitable correction, then I add 1 dioptre of convexity for

every 5 years that the patient is over 40. To put the rule into general terms, it may be said: suppose a case has M dioptres of ametropia, then between 40 and 45, for near-at-hand work, I usually give M + 1; between 45 and 50, M + 2; between 50 and 55, M + 3; and between 55 and 60, M + 4. No further addition is necessary, for that should give clear vision at 10 inches. Few people, in my experience, take their full accommodative correction at once, and, as I shall afterwards point out, that seems to me to be one of the causes of failure to relieve headache by optical correction.

Now, as regards badly centred spectacles; possibly it would have been better to have discussed these after we had considered the various forms of heterophoria, but as we are dealing with optical matters at anyrate, it is perhaps, allowable to take it here. I know from personal experience that headache is sometimes relieved by the proper centration of badly centred glasses; I mean by that, that I have occasionally seen a patient who has had his or her errors of refraction carefully and, so far as I observed, accurately tested elsewhere, but yet has experienced little or no relief of the pain in the head. I have on certain occasions found that the proper centration of the glasses has put that right. The subject is a very large one, and a great deal more should be said upon it than I have time to say or perhaps than you have time to hear. Bad centration may be said to arise from two causes, first, displacement of the lens centres; second, rotation of the lenses round their horizontal axes. They are both important, and in my opinion are productive of much discomfort. Convex and concave lenses are most easily understood; therefore, for elementary consideration, they alone will be considered. I would respectfully refer those who wish full information on this subject to the work of Mr. Percival, of Newcastle-on-Tyne, than whom there is no higher authority anywhere. He is a gentleman whose profoundness of knowledge in this special department of physiological optics is acknowledged by all who are competent to form an opinion, and is the envy of not a few.

A reasonably good account of the decentration of lenses is also given in the last edition of Mr. Maddox's book on *Ocular Muscles*, and to that I may refer again. Meantime, limiting myself to the two lenses which I specified, it is to be observed that unless the axis of a pencil of light coincides with the principal optical axis of a convex or concave lens, then there is not only refraction, but there is displacement. The further out from the axis of the lens that the pencil is

incident, the greater is the prismatic effect. Here it may be pointed out that the principal axis of a convex lens is the line passing through the optical centre of the lens, and also through the centres of curvature of its surfaces. A pencil of light incident on the lens, the axis of which coincides with the principal axis of the lens, undergoes refraction so as to form a definite image on the principal axis of the lens. On the other hand, if the axis of the pencil of incident light is not approximately coincident, although parallel with the axis of the lens, and the point of incidence is at some considerable distance from the lens axis, then a well-defined image may be formed, but there will always be a considerable amount of displacement, and the farther you go on the lens surface from the axis, the greater is that amount of displacement. Occasionally advantage is taken of this fact to give the patient the benefit, not merely of the correction of an error of refraction, but also of the correction of heterophoria.

Such an arrangement is called a decentration. As already indicated, this subject has been very thoroughly investigated by Mr. Percival, of Newcastle-on-Tyne, and by others. The formula which I myself used to go by was that of Holden, which I got from an American source, and in the main it was found to answer quite well. The more recent work, however, of Mr. Percival has superseded previous writers. The rule which now controls my own work is very well stated by Maddox in his recent edition (pp. 231, 232, 233). It is based on the fact that a gradient of 1 degree is approximately $1\frac{3}{4}$ in 100. Therefore, as he says, since a lens of 1 dioptre has a focal length of 1 metre, it will have to be decentered $1\frac{3}{4}$ centimetres to obtain 1 dioptre of deviating effect on light. Not infrequently we find patients wearing spectacles which are most defective as regards centration; the axis of vision of one or of both eyes cutting the spectacle glass at such a distance from the principal axis as to cause a considerable amount of muscular strain in an effort to get binocular vision. When we come to deal with heterophorias, we shall find that the plan of decentration has only a limited application.

Another frequent defect in glasses is that the visual axis does not cut the plane of the glass at approximately a right angle, but at a more or less oblique one. When a pencil of light passes through a convex or concave lens in an oblique manner, then there is no longer a well-defined image, but the refraction is, as it were, through a sphero-cylinder.

I take, for example, the lenses which make me emmetropic, and which easily give me $\frac{6}{5}$ of Snellen's scale. I rotate these

glasses round their horizontal axis for a matter of perhaps not more than 20 degrees, and I find, with even so small a rotation, that the visual acuteness at once sinks to something like $\frac{5}{1\frac{1}{2}}$ of Snellen. The glasses themselves are only + 1 dioptre cylindrical; if they were stronger, the fall in the visual acuteness would be very much greater. It is thus to be remembered that, when you are dealing with an oblique refraction, it must necessarily give rise to the same condition as if the glass used were a sphero-cylinder, and consequently, except in the very rare instance in which the obliquity corrects a natural astigmatism, the inconvenience occasioned must be considerable. No doubt the faulty refraction may be compensated to some extent by the sectional contraction of the lens, which, in my opinion, sometimes exists. Such oblique refractions are not treated at all in text-books of ophthalmology. So far as I have observed, they generally are discussed in treatises on geometrical optics. From the time that I was in Donders' laboratory, I was well aware of the general phenomenon, but the first definite information I had on the subject was when I read an elementary treatise on geometrical optics by Aldis. I found a tolerably adequate discussion of oblique pencils on pp. 34 to 45 of that book. I find that it was published in 1888, and I remember reading it shortly after it appeared.

Now, if you examine a number of people who are wearing glasses, especially pince-nez, straight-bar glasses, frameless eyeglasses, I think you will find, that in many of them, the plane of the glass by no means cuts the line of sight at approximately a right angle, and that there is a greater or less amount of inclination. Where that is the case, there must always arise a considerable amount of irritation, and the stronger the glasses the worse the defect. That is why I personally prefer spectacles to any form of pince-nez. The inclination in the rigid frame of a properly made pair of spectacles is very much less than with any form of eyeglass that has as yet been invented. I have, however, seen one or two pairs of frameless eyeglasses which have fitted tolerably well.

Just one other point before we leave spectacles. That is, the index of refraction of which the lens is made is not altogether an unimportant matter. Lenses are ground to certain patterns, that is to say, the surfaces are given a definite curvature, but, of course, that curvature only gives a certain power of lens for the index of refraction of the glass of a particular quality. If it be less than that amount, the lens will not be so strong as is supposed; if it be greater,

then it will be stronger. Hence, it is not advisable to order special kinds of glass, the index of refraction of which is unknown to the person who is about to grind the lenses.

In the next place, I have no doubt whatever that these defects, which are generally classed under the name of heterophorias, are productive of considerable disturbance, yet, in my experience, few persons are examined for this condition either by physicians or by ophthalmic surgeons. There is scarcely a month passes but what I find some patient or other who has been again and again tested for glasses for the relief of headache, and slight alterations made, in the hope of relieving it, but without having the muscular balance tested, and in whose case the correction of a heterophoria has put the patient right. The subject is a huge one, and it would make a greater demand on space and time than the limits of this paper admit of; still I think I can put the gist of the matter in comparatively few sentences. The heterophorias which are most easily understood are those of esophoria and exophoria. I propose to discuss these in some detail, and only briefly refer to the vertical forms.

Exophoria and esophoria will be more easily understood after a short discussion of the range of convergence. Granted a man with good vision in both eyes, for distant fixation the visual axes are parallel. If he have binocular vision at 1 metre, then he must converge approximately 1 metric angle; if at $\frac{1}{2}$ metre, 2 metric angles; if at $\frac{1}{3}$ of a metre, 3 metric angles, and so on. I personally class as exophorias all patients who have not got a sufficient range of convergence to allow them to read in comfort.

Unfortunately, in this country we still must use the linear measurement of the inch, for most people still think in inches and feet, and there is some little trouble in translating them into the metric scale. For convenience of reckoning, we generally take the metre as being 40 English inches. Thus, if a man has binocular vision at 40 inches, he uses 1 metric angle of convergence; if at 20 inches, he uses 2 metric angles, and so on. Now, suppose an individual requires to work at 16 inches from his eyes, that by itself would require him to use for binocular vision a convergence of $2\frac{1}{2}$ metric angles, but he would require to have at least 3 in reserve. If I remember rightly, that is the figure given by Landolt, a gentleman whose researches have added enormously to our knowledge of muscular conditions. In my own experience, that, as a rule, is not quite enough in certain people, although it is ample for most. Now, that would mean that he must have altogether

5½ metric angles at least, or even more for comfort. His near point of binocular fixation would thus require to be approximately $\frac{4.0}{6}$ inches, nearly 7. Unless he has that amount he has discomfort. Take the case of a man who requires to work as close as 10 inches. That man would require to have his near point of binocular fixation at a not greater distance from his eyes than 6 inches. So far as I am aware, the best instrument for testing this binocular point of convergence is Landolt's ophthalmo-dynamometer. There are other methods of measuring which I sometimes employ, but that is the one which I always teach junior students to use, and which I find to be about the best in practice.

Now, there is no doubt whatever in my mind that defects in this range of convergence are a frequent source of ophthalmic headache. The patient quoted above, No. 10, was an instance in point, and I could lay my hands just now on notes of about a dozen of cases where relief of persistent and long continued headache had been secured by the proper treatment of a defect in convergence. There are at least three distinct methods of remedying such defects. The first is, as noted above, the decentration of the spectacles which the patient wears. That, of course, involves that he has such an error of refraction as requires correction. The second is the wearing of prisms with the apices out, and where the error is not greater than can be overcome by a prism of 1½ or even 2 degrees of minimum deviation before each eye, I think that to be quite a legitimate mode of treatment, if the person wear the glasses absolutely constantly. The third method, the one which in the main I prefer, is the advancement of one or other of the internal recti; the particular muscle to be advanced being determined by the investigation of the fields of fixation. I never resort to operation immediately after seeing a case of this kind, for I am aware that sometimes, by proper tonic and hygienic treatment, the condition may improve, and render operative treatment unnecessary. Still, I often find cases where operation is refused, and in which the patient continues to suffer notwithstanding all the treatment employed. About a year ago I had such a patient, jointly with Dr. M'Clure, a girl who had suffered considerably from headaches, and who had run the whole gauntlet of treatment for their relief. She was made absolutely well, by the simple operation of advancement of an internal rectus muscle, an operation which is perfectly easy, and for the most part perfectly safe. These observations must suffice for the consideration of exophorias.

I wish now to make a few remarks on esophoria. To begin with, there are many people who have difficulty in keeping the visual axes parallel for a distance. I examine almost every patient in my own rooms with a Maddox rod, and all but invariably find on distant fixation that a person who has a hypermetropia, which has not been corrected, has a slight amount of esophoria. The plain image and the blurred one are placed homonymously to each other; that is a defect which generally passes off with the correction of hypermetropia. Occasionally, however, it does not, and the strain put upon one or other of the external recti, to get binocular fixation for a distance, is sometimes the source of headache. Here the defect may generally be corrected by decentration of the convex glass used to correct the hypermetropia. Occasionally one finds a case in which there is no hypermetropia, but in which this defect is present. When that is so it can, as a rule, be remedied by treatment with prisms, the apices of which are placed inwards, or by operative treatment. In the main, I personally prefer to operate, for if I succeed, it relieves the patient of the inconvenience of wearing glasses.

One other set of phenomena must be mentioned, and that is what I call the absence or restriction of the latent powers of divergence. If I mistake not, many authors call this a restricted range of negative convergence. The phenomena here do not essentially differ from those discussed under esophoria. If a person with healthy eyes be made to look at a distance at a suitable object, such as a lighted candle, with both eyes open, under ordinary circumstances there is binocular fixation. If now, a weak prism be put in front of one eye, with its apex outwards, there is for a moment, diplopia. That is only temporary, however. The external rectus is usually called into play, the anterior surface of the eyeball is rotated slightly outwards, and binocular vision is re-established. While this is true of a person using weak prisms, it is by no means true when a strong prism is used, for then the diplopia remains. A healthy person, however, will easily overcome a prism of $2\frac{1}{2}$ or even 3 degrees of minimum deviation, with the apex outward, so as to preserve binocular vision, but not a greater amount. The provision here is obvious. If the external recti were kept on a constant strain, then they would soon get fatigued, and there would be diplopia. The parallel position requires that they have a certain amount of their power in reserve, and thus we find that in health that power enables them to overcome a prism of 3 degrees

minimum deviation, with the apex out. When that is the case, then distant fixation gives rise to no trouble. When, however, this latent power of divergence is seriously diminished, and the muscles are kept on their maximum tension to ensure binocular fixation for distance, then it is quite certain to give rise to headache. I have myself on several occasions —three I distinctly remember—absolutely removed severe ophthalmic headache by advancing an external rectus muscle. The range of convergence, both positive and negative, should invariably be taken. When a patient suffers from ophthalmic headache very frequently, when the malady is not explained by an error of refraction, it is so by an error of convergence, positive or negative, and yet hundreds of patients are supposed to have had their eyes examined, and in whose cases no attempt has been made to investigate this important matter.

The vertical heterophorias are not essentially difficult, but they are a little more complicated than the lateral ones. I have twice in my lifetime operated for a vertical heterophoria due to defective superior oblique. On both occasions I advanced the inferior rectus of the affected eye. Some text-books recommend for this defect the tenotomy of the inferior rectus of the other eye, which, to my mind, is little short of *mal-praxis*, and I think only shows that a few authors have not yet realised the physiological conditions regulating the treatment of the various forms of strabismus.

Indeed, a sound knowledge of such investigations seems to be but scantily diffused. I do not ever remember to have seen in a medical ward or in a medical dispensary the apparatus necessary for testing convergence and latent divergence, and yet the information afforded by such investigations is frequently of importance. Even where better things might have been expected, we often find defects. Some years ago, when Maddox, by his book, popularised in this country muscle testing, he recommended a special tangent scale. In one clinic in the South, which I happened to visit, I found this tangent scale placed more than half-way up towards the roof, instead of being, as it should be, approximately on a level with the patient's head. A mistake of that kind of course simply indicates that the person or persons responsible for such a position have not seriously studied the matter at all. I remember the late Dr. Finlayson took a considerable interest in such testing, and in my early days, when I had the privilege of giving demonstrations in his wards, at his request we gave one on the testing of the positive convergence, but apart from that I do not remember ever to have seen in my student days

prisms used in any other medical ward in the Western Infirmary or in its dispensary, and I should be somewhat interested to find how far they have come into general use. As a student I never saw them at the Glasgow Eye Infirmary, and I did no practical work with them till I went to Landolt and to Snellen. My feeling is that there is no part of ophthalmology more closely allied to medical practice than muscular testing.

No doubt the importance of muscular treatment has been over-estimated; I think particularly is this so in America. An author there at one period expressed his conviction that many forms of epilepsy might be cured by muscular advancement. It is quite true that the muscular balance is defective in many epileptic patients, but that is a *post hoc* not a *propter hoc.* Unquestionably there was much exaggeration as to the good effect produced by muscular treatment, but at the same time it is perfectly clear to anybody who has investigated the facts that often the greatest relief is to be had by operation, by prisms, or by the decentration of spectacles.

In conclusion, I should now like to offer a few observations on the causes of failure. To begin with, it must not be forgotten that ocular conditions are only one of the many causes of headache. Just the other week a lady came into my room to be measured for spectacles. She told me she had consulted me five years ago on account of severe headache, that I had ordered spectacles, and told her at the time that I did not anticipate that the correction of her errors of refraction would relieve her of headache. That opinion had turned out unfortunately to be but too correct. The diagnosis which I made was one of migraine, and I think events have shown that it was a correct one. I myself certainly see a good number of patients every year who are similar to that. Not infrequently we are consulted by patients who have suppuration in one of the cavities bordering on the orbit. Frontal sinus disease is a very frequent cause of headache which is mistaken for ophthalmic headache. Probably the same remark holds true for suppuration or disease in the sphenoidal sinus. Although I personally have not diagnosed a case of that affection, yet the writings of Panas and many others leave no doubt that it often occurs and that it may be the source of severe headache.

Cases, however, unquestionably occur in which the measurement of errors of refraction or of convergence apparently do not relieve the headache. These merit careful consideration. Not infrequently the defect lies with the patient

himself or herself. An accurate measurement will take nearly an hour to do, and yet sometimes a patient will rush in and expect to be measured in the course of twenty minutes on his way to catch a train.

Measurements done in a hurry like that can never be relied upon, especially in youngish persons. Probably one of the chief sources of disappointment is the function of the accommodation. Errors of refraction of a hypermetropic character invariably involve the function of accommodation, and, as is well recognised, unless this function is in abeyance the actual error of the patient can only be roughly ascertained. If a measurement has been made without paralysing the accommodation then it is not a correct one, and may not give the relief which was expected. The chance of failure is greater the younger the patient.

Again, in cases of astigmatism, even in myopic astigmatism, I believe that there is a secondary contraction of the lens or a rotation of it in an effort to correct the error. Unless at the time of the measurement care is taken to paralyse the accommodation the correction will be only approximately accurate. Further, when glasses have been selected so as to correct the error when the accommodation is paralysed, then directly the effect of the mydriatic passes off the accommodation again begins to play, and there is always the chance that the combination of accommodation and glass may not so suit the patient as to give relief to him. This is particularly true when a person first begins to wear an approximate correction. In my own case it took a couple of months before the glasses arranged by Sir William Bowman began to relieve me, and my experience is similar to that of a great number of other people. There is just this difference, that I followed Sir William Bowman's directions absolutely faithfully. A considerable number of patients never give the thing a fair chance.

Then, again, in correcting for presbyopia; if you give the full correction of Donders' table you will find that patients at first complain that the objects have to be held too near. This is a very common experience, and consequently they don't use the glasses sufficiently freely. Occasionally a patient is given in to and a somewhat weaker glass is prescribed, with the result that before long the accommodation again fails and the headache returns. Lastly, the new correction of the errors of refraction may disturb what has been the usual relationship between convergence and accommodation for the particular patient, and thus often increases

the disturbance, which brings me to the last item of this communication, as to the training necessary for a man who is to practise this branch of the profession.

Just the other day I saw a prescription for glasses given in Ireland, and on it was written, "Centre very carefully." In other words, the surgeon in this case left one of the most important factors to the tender mercies of the spectacle vendor. What would be thought of a naval architect who in drawing up the specification for a vessel gave a general direction to the builders to put the engine and boilers in the proper place? That is precisely analogous to the matter under consideration.

The General Medical Council see to it that a man who intends to become an ophthalmic surgeon shall take full courses of midwifery, but they do not insist that he shall have a competent knowledge of those subjects which are the basis of a very large part of his special work. To my way of thinking a man cannot read the best books on the higher but essential parts of ophthalmology unless he has a good knowledge of plane trigonometry and is familiar with some of the ideas contained in the calculus. I do not mean that he must be expert at differentiating and integrating, but certainly he should have some knowledge of the nature of limiting values and of approximations.

Notwithstanding the want of proper training there have always been a large number of men well suited for the work. That number would no doubt be augmented did the General Medical Council decree that in future those who intend to follow this branch of the medical profession shall be properly trained for their work.

Elsewhere I have formulated the conclusions at which I have arrived on this important subject. To my mind the question has become all the more urgent since of recent years many spectacle sellers have undergone a certain although an entirely inadequate amount of training. I should, however, be sorry to think that some of them are as regards optics better equipped than are a few ophthalmic surgeons. Yet as matters stand at present the thing is quite possible. Ophthalmic science properly so called should rest on a triple basis, viz., physiology, pathology, and physics, and the last is by no means the least important. The relationship of the spectacle vendor to the surgeon should be that of the builder to the architect, that of the pharmaceutical chemist to the physician.