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ON THE ETIOLOGY AND TREATMENT OF CONVERGENT SQUINT.

THE frequency with which advice from each of us is sought respecting cases of strabismus, and the large numbers of such cases that pass before us, render the subject of our discussion both interesting and important. At different times many distinguished men have bestowed upon it great labour; and, whilst much of our information respecting strabismus is of an accurate character, on the other hand there are still points requiring elucidation, and matters in dispute needing settlement.

The subject for our discussion is, however, so wide that, within proper limits and with a due regard to your patience, it will be quite impossible for me to deal completely with it. I must, therefore, content myself with traversing the field as well as I can, feeling confident that my omissions or deficiencies will be made good by the many distinguished *confrères* who will follow.

It is hardly questioned, I think, that a close relation exists between strabismus convergens and hypermetropia. The frequent association of the two is a standing proof of some relation. It has been asserted that hypermetropia is present in 95 per cent. of the cases of internal squint; and this number may be enlarged by adding thereto many of the cases with corneal nebulae, which are also hypermetropic. Hirschberg asserts that such eyes are hypermetropic, and that without this condition they would not squint. In the cases coming for treatment, emmetropia is rarely met with, and in the large number of convergent squints I have seen I recollect only three associated with myopia.

It is also generally held that the degree of hypermetropia associated with squint is neither the high nor the low, but the medium. This has been the opinion held from Donders onwards, and explanations have been given to show why in the high and low degrees squint is less frequently found. The view held is, I believe, generally correct; but I think it may be stated in another way. A consideration of my squint operations showed that by far the greater number were performed on patients between the ages of 6 and 18 (inclusive), and in the Infirmary books was a total of 285 operations between these ages. Comparing the degree of hypermetropia in these cases with that present in 200 instances within similar limits of age, who had come under treatment simply for their refractive condition, it was found that the average degree of hypermetropia in each class was very closely alike, the former yielding an average of nearly 4.25 D, and the latter a fraction higher. There appeared more tendency to rise above the medium degree of hypermetropia than to pass to the lower.

Whilst, therefore, it is correct that strabismus is associated with the medium degrees of hypermetropia, it seems equally true that it occurs with the same degrees that are usually present at the ages that squint most frequently comes under treatment.

Is the female sex more subject to squint than the male; and is strabismus more common in the left eye? Out of 421 squint cases at the Infirmary, 250 were in females and 171 in males. In my private practice the sexes were equally matched. On the other hand I have met with nearly double the number of cases of strabismus in the left eye, in private practice. At the Infirmary they were equally balanced. The two together gave an excess of left.

An important point is the age at which squint usually appears. Seldom before about three, or it may be occasionally at two and a-half, the majority will be found to have commenced between that age and five. Cases starting after eight are uncommon. The age closely corresponds to the period that accommodative efforts have to be made, and this adds a second element associated in the development of squint, namely, the hypermetropic refraction, and the onset of the strabismus at the time when the accommodation is taxed for the production of clear images of near objects and the necessary convergence. It was on this interdependence of the functions of convergence and accommodation that Donders taught depended the causation of squint. In the hypermetrope the vision of near objects especially requires extraordinary tension, and there exists a certain connection between accommodation and convergence of the visual lines, the more strongly we converge the more powerfully can we bring our faculty of accommodation into action. It is the effort thus produced that throws convergence out of gear, and the individual sacrifices binocular vision for clearness of perception, and squint results.

The association so frequently of amblyopia with the squinting eye is of great interest, and, especially recently, has received considerable attention. Mr. Frost has estimated that as often as in 60 per cent. the squinting eye is amblyopic. Donders remarked, respecting this want of visual power, "The acuteness of vision suffers more and more in the deviated eye. It may be recovered by practice, and improves almost always immediately after tenotomy." It is well known, moreover, that Donders explained the amblyopia as arising from psychical exclusion or suppression. He remarked that it is an admitted fact that through attention we can sharpen our senses. How rapidly, on the other hand, a nerve may become blunted, from whose impressions we wish mentally to abstract ourselves, the case under consideration supplies an example important for physiology at large. Although no organic changes of the retina are to be observed, no improvement of any importance is obtained, if fixing no longer occurs under any circumstances either by practice or tenotomy. Briefly expressed, the foregoing represent Donders' views as to the causation of squint and the part that amblyopia plays in it. It will be observed that he asserts the latter is a consequence of the squint.

I confess that this has always seemed to me to be a very comfortable theory. It explained sufficiently easily the manner in which the squint arose, and, moreover, the production of the amblyopia in the way proposed had great advantages. For it enabled a simple explanation to be given to friends as to the effect on the squinting eye, and the self-same argument to be urged in support of not delaying tenotomy when glasses failed or were unsuitable, with the object of preserving vision in the deviating organ. It is needless to mention the many names of those who have supported these views; it will suffice for my purpose to say that they met with perhaps general adoption.

Now, however, even the eminent authority of Donders is called in question, and the opinions he expressed have been roughly assailed on different sides by many well known authors, and from various

standpoints. Authority in medicine is held in no greater awe than it is in general science or politics. This is a matter for congratulation, and it may well be considered a healthy sign, for to whichever side our opinions may lean, it is much to be desired that the subject should now be thoroughly discussed and something like truth arrived at.

Some of the criticisms against the usually accepted amblyopic theory have been urged against it, as if it rested entirely on simple exclusion from use.

Thus, for instance, the fact that cataract may exist for many years, and then be removed with successful restoration of vision has been trotted out to do duty against such a theory. There is a manifest difference between the case of a child just commencing to observe closely and such a case as the suggested cataract. There is, moreover, no question of any mental process. It can hardly be denied that "suppression of sense impression does take place. As soon as our attention is entirely engrossed upon anything we are in a position to disregard the impressions upon all other organs of sense; they do not reach our consciousness." It is contended that the mind in strabismus is intent on the image from the fixing eye, and disregards the imperfect one formed excentrically in the other organ.

Schweigger may be put forward as the most redoubtable opponent of Donders' theory. He regards the amblyopia as identical with a congenital form which in one of its forms is always monocular. He has supported his opinions with elaborate statistics.

All of us are accustomed to observe cases of congenital amblyopia, but I doubt if we are prepared to accept his conclusions as to its frequency. It is not easy to calculate the percentage of squints in hypermetropes; it can only be done by estimating the proportion of squints to hypermetropes who seek advice. Stellwag has given somewhat more than 16 as the percentage of strabismus to cases of hypermetropia. In 756 cases of hypermetropia, including astigmatism (mixed and hyp.) in my private case-book, as many as 93 possessed manifest convergent squint, the percentage becomes thus a fraction over 14 per cent. Accepting my lower estimate, and taking also Mr. Frost's of 60 per cent. of amblyopia as occurring in strabismus, brings a total of 8.4 per cent. of amblyopia in all cases of hypermetropia. For my part I think I should hesitate to accept such a percentage as this even of cases of congenital amblyopia existing in hypermetropes.

Schweigger¹ says he sees no difference whether squint is present or not, as the form of defective vision is the same, and nothing happens in the combination with squint which could not also be proved without it. Thus I gather that he places congenital amblyopia as having a high percentage in hypermetropia. In 177 cases of hypermetropia, of 1 to 3D, including a few cases of divergent squint, he found defective sight less than $\frac{1}{2}$ in 31.6 per cent.; in hypermetropia of 3D and more, in 70 cases of convergent squint the percentage of defective sight was 44.2. He remarks, also, that there appears a regular increase of defective sight with the increase of the hypermetropia. This large proportion of monocular amblyopia in hypermetropia I confess my experience hardly prepares me for, and I fancy, full as Schweigger's statistics are, further evidence is necessary before it is laid down as correct that about one-third of the cases of hypermetropia are amblyopic in one eye.

Donders held that the vision in the deviating eye "suffered more and more," and was of opinion also that vision recovered after tenotomy, and with practice of the amblyopic eye. Both these circumstances are not in harmony with the facts concerning congenital affections. I shall refer again to these points.

¹ Schweigger, *On Squint* (English Translation).

The absence of diplopia in concomitant squint is made a subject for comment. It appears that it may be undoubtedly present at the outset, and be unobserved or uncommented on by the little patients. But a marked difference exists between the gradual onset of concomitant squint and that from paralysis. Schweigger thinks that the habit of binocular vision may not have been learnt or forgotten; and asks why should those who squint from their earliest childhood not see well with both eyes, but yet with each separately, just as is the case with animals with laterally placed eyes? But then in children, as soon as they at all commence to observe, both eyes move regularly, and appear directed to the same object; and thus it would seem that fixation does not need much acquiring. He has asserted that diplopia can often be produced by a vertical prism and a red glass before one eye, and this he considers conclusive evidence against the "suppression theory." We are familiar with the fact that in ocular muscular palsy the most distressing diplopia results when the deviation is not great, and the false image is perceived at no great distance from the macula. Images formed more at the periphery are less troublesome, and especially after a time are less regarded by the patient. It is not, I think, difficult to understand in a case of squint, in which it is presumed that imperfect images formed on the less sensitive periphery of the retina and suppressed, should be rendered evident in diplopia by the images being brought nearer the more sensitive macula. If the false image were not suppressed, it seems almost evident that, in alternating squint, diplopia would be more common than it is at present. Schweigger, it may be observed, allows the suppression of images, but denies that it ever passes the bounds of incapacity for use; and he draws a distinction between incapacity for use in these cases and defective vision, the former being due merely to weakness of accommodation; but I should fancy that very few of those who have written on squint amblyopia have in any way placed such cases in that category.

Dr. Mules (JOURNAL, 1886, vol. i, p. 836), representing Schweigger's views, says: "Visual acuity, in its relation to squint, is as follows: Equal visual acuity in the two eyes is represented by persistent alternating strabismus. Slight monocular amblyopia causes at first alternating strabismus, but finally determines the amblyopia as the fixed squinting eye. High monocular amblyopia determines the fixed eye from the commencement."

Now it is only in the permanent squint that amblyopia is very commonly met with, while a squint is periodic or alternating, visual acuteness in the two eyes is equal. This can be verified, and in going over my cases I am satisfied that it is so. If Dr. Mules' way of expressing it were correct, we should certainly find more during the periodic and alternating stages who were amblyopic. For it seems to me for a squint to become immediately fixed is very unusual. Dr. Mules' statement is precise and ingenious, but is rather in advance of our present experiences. It appears, also, that it is desirable to have some more exact definition of what is meant by slight and high monocular amblyopia. From my cases it seems that the majority vary in visual acuity, after correction, from $\frac{1}{4}$ to $\frac{1}{2}$, the greater number being nearer the former.

The question as to why some hypermetropes only are cross-eyed is a very interesting one. It has already been touched upon in referring to amblyopia. Landolt thinks that with the majority of those who squint there exists a predisposition to strabismus, with whose exact nature we are not yet entirely acquainted. He, moreover, as others have done, lays stress on one eye being inferior, from higher degree of hypermetropia, strong astigmatism, etc., in fact, any cause which diminishes visual acuteness, as giving rise to strabismus. He considers this plausible, and that it is often confirmed by clinical experience.

There are numerous exceptions, and he admits the fact that strabismus is met with in cases where the eyes are of equal strength. But, he adds, "until somebody has proved, by ample statistics, that such cases constitute the majority, we shall hold that the inferiority of a hypermetropic eye may become for it the cause of convergent strabismus."

There can be little question that in squint the degree of refraction is often different in the two eyes, and that, as a general rule, the higher degree will be found in the squinting eye. In this way it may often be accepted as conducing to determining which shall be the squinting eye. Another way suggests itself of looking at this subject. It is held now that hypermetropia in many instances becomes less in degree, and passes on its way towards myopia. In strabismus the full efforts of accommodation will be directed from the fixing eye, and will be but little exerted in the squinting eye. Does not the hypermetropia become less in the fixing eye? The relations of the refraction of each eye in ordinary hypermetropia, and also in squint, might with advantage be statistically worked out, ascertaining the relative condition in each.

Ulrich² held that to account for some hypermetropic eyes squinting and others not, something beyond the convergence and accommodation must be found, and he sought for it in the muscles.

Schweigger, also, it is well known, has assigned a prominent place in the production of convergent squint to the preponderance of the internal with insufficiency of the external recti. Much has been said of insufficiency of the internal recti; why not let attention be directed to the condition of the external muscles? It may, however, be remarked that any marked weakness, though not amounting to paresis of the external recti, would tend greatly to obliterate the distinguishing features between concomitant and paralytic squint, but in the circumstances calling for such an extra use of the convergence as, at all events, Donders taught, a very trifling weakness would suffice to allow of the internal overcoming the external recti. The existence of such a condition seems plausible, and receives support from the little effect division of both internal recti has, in certain cases, towards straightening the eye, the external recti lacking power of abduction.

Schneller's³ observations, undertaken to ascertain the normal equilibrium between the two muscles, internal recti and external recti, also lend valuable assistance. He found that in eyes without strabismus, the field of action of the internal recti surpassed ordinarily, according to the cases, from 1 to 11 degrees (measured by a perimeter) as much in hypermetropia as in myopia. More rarely the external recti predominated. Normally, the internal recti surpassed the external recti; more rarely, the external recti, and without the slightest squint. In the cases, so common, of strabismus which disappear with correcting spectacles, the predominance of the internal recti do not exceed the limits laid down. Some of these cases, to see clearly at ordinary vision at 25 to 35 centimètres, found it necessary to employ at least $\frac{2}{3}$ of accommodation. This is nearly always the case with hypermetropia of 3.5 D. Schneller conceives that it is just a rule that when it is necessary to use as much as $\frac{2}{3}$ of accommodation, convergent squint will result. In convergent strabismus (muscular), which cannot be corrected by plus glasses, Schneller found that the field of action of the internal recti always surpassed that of the external recti beyond the physiological limits before indicated.

² *Klin. M. f. Augen.*, October, 1878, abstracted in *Annales d'Oculistique*, vol. ii, 1879, p. 268.

³ *Annales d'Oculistique*, vol. i, 1883, p. 156 (abstract).

Alfred Graefe, Hasner, and others have looked to the muscles as aiding in the causation of squint. Giraud Teulon thought a muscular anomaly the primary cause, in consequence of which parallelism could only be maintained by a struggle between the tendencies of the muscle and fusion. Hypermetropia acted in turning the balance in favour of pathological convergence.

Stilling, in Knapp's *Archives of Ophthalmology* for 1886, p. 270, has published perhaps the most original of recent articles on the *Origin of Squint*. He deals with the position of "rest" of the eyes, and sums up his contention in the following terms: "The cause of squint is not hypermetropia, but the position of rest usually associated with hypermetropia, namely, convergence."

The assumption that in the position of rest the visual axes are parallel is true only of a limited number, for he asserts that in the majority of mankind it is a squinting one. In dreamless sleep, his tests prove, he thinks, that the eyeballs as a rule occupy the position of equilibrium peculiar to the individual, which may be either convergence, divergence, or parallelism, whereas the observations of Raelhlmann and Witkowski have shown that during sleep the co-ordination of both eyes is suspended, there being neither associated nor convergent movements as in binocular vision.

It must be recollected, moreover, that Stellwag has seen high degrees of squint disappear during sleep, chloroform narcosis, and death. Graefe signalled equally the possibility of the eyes changing their position in narcosis and sleep. Raelhlmann has often during sleep ascertained the absence of squint present during waking. These observations tally with our own experience, for all ascertain before using an anæsthetic the eye which is to be operated upon, nor can we estimate the effects produced until narcosis is past and gone.

Stilling asserts that in the great majority of hypermetropes the position of rest is convergent; in 16 all were convergent; in 65 myopes, 41 were divergent; in 86 emmetropes, 68 were convergent. Arguing on these data, he asserts that "normal vision is a continual struggle of the ocular muscles for binocular fixation against natural obstacles. If for any reason one eye becomes unable to keep up this struggle, or if it becomes impossible for both eyes to continue it in unison, then either one eyeball or both alternately will pass into the natural position of rest." He defines the causes of abolition of binocular vision as originating in the muscles or eyeball itself, among the latter differences of refraction and varieties of amblyopia; and all causes tending to weaken or suspend accommodation.

"In hypermetropia, the position of rest is convergent; and if, for any of the reasons given, one eye is incapable of participating in binocular fixation, the laws of relative accommodation will become inoperative, and the eyeball, instead of assuming a convergent position corresponding to the object fixed, will pass into its individual position of rest. If this position be marked convergence, convergent strabismus will ensue; if slight, the consequence will be relative divergent strabismus, either permanently or temporarily changing later into absolute convergent squint by reason of secondary atrophy of the relaxed external rectus, and contracture of the internal muscle." It will be observed that he adopts the amblyopia as a cause of squint, but he calls Donders' theory of the inter-dependence of convergence and accommodation greatly to his aid. Thus he explains the production of squint in moderate hypermetropia, or where the eyes are visually equal in this manner.

In monocular vision we can dispose of the whole range of accommodation, whilst in binocular vision we are subject to the laws of relative accommodation. In hypermetropes the positive part of the relative range of accommodation is apt to become too small as compared with the negative part, rendering it impracticable to keep up

the effort of accommodation pertaining to a certain position of convergence for any length of time, or even to attempt it at all. The faculty of convergence is difficult to maintain whenever accommodation makes default, and therefore one of the eyes or both pass into the position of repose. By sacrificing binocular vision the hypermetrope frees himself from the laws of relative accommodation; the absolute accommodation becomes free for monocular vision and asthenopia disappears partly or entirely.

It appears as if Stilling required to explain more the factors influential in determining the position of rest, besides the refraction and muscular condition. The shape of the orbital cavity, the topographical relations of the fibrous structures and soft parts surrounding the globe, the position of the optic nerve entrances are all given. These may have some influences. We know from Donders, that in hypermetropes, the macula is further from the temporal border of the papilla than it is in either emmetropia or myopia. Landolt's researches support this. In a case, however, of complete ophthalmoplegia, as under observation at the present time, on uncovering the globe, the eyeball is not found to be convergent or divergent but placed in the centre. Such a case seems to show that the other causes mentioned by Stilling play a very unimportant part, and it throws back on the muscular apparatus the production of the position of repose. He has not found that the relative powers of adduction or abduction bore any constant relation to the position of rest; he thinks the squint may be occasioned by fatigue of the external recti. It thus approaches nearer to Schweigger's and others views as to muscular influence. It appears to me a fair criticism of Stilling's work, to say as Mr. Frost⁴ has done, that throughout "he lays too little stress upon the simultaneous innervation of the two eyes; he speaks repeatedly of one eye passing into its position of rest."

Stilling adopts the opinion that the amblyopia is precedent to the squint, but then it is well known that the position assumed by amblyopic eyes quite independently of their state of refraction is divergent. If the position of rest in hypermetropes and emmetropes be convergent, and the grounds on which Stilling argues be correct, the form of amblyopic squint should be convergent, and divergent in myopes. Stilling makes use of the position as made by Donders, up to the time when the eye turns it, when Stilling asserts it assumes its position of rest, and Donders that it does so to avoid conflicting images, and in consequence of convergence not keeping pace with the requirements of accommodation.

Gardiner, in the recent March number of Knapp's *Archives*, under the title of "Is the Position of Rest the Cause of Strabismus," has an article in which the author controverts Stilling's views. He believes that the generally accepted theory, that holds that one eye by excessive convergence actively aids the other to attain and to maintain a tension of accommodation much higher than what its angle of convergence would warrant, is correct. This is proved by covering one eye of a hypermetrope of 2 or 3 D. While he fixes a distant object, the covered eye will deviate inwards, not because it assumes a position of rest, but because the accommodation, operating to the extent of 2 or 3 D, calls for convergence of 2 or 3 A.M. The inherent desire for binocular fixation and a consequent shifting of the relative range of convergence prevented this deviation before one eye was covered. That the position of rest is not the cause here is obvious, because emmetropic and even myopic eyes, with parallel or slightly divergent axes, if rendered hypermetropic, will respond in like manner to the experiment. Again, if the absolute near point of hypermetropia or emmetropia is found, by placing an object in the median line while one eye is covered, on

⁴ *Medical Record*, June 15th, 1887.

inspection, the excluded eye will be observed to be squinting inwards, thus assisting the uncovered eye in its accommodation by excessive convergence; and not by assuming the position of rest, for in those whose position of rest is parallelism the above condition of things would not take place, and Gardiner asserts that it can be proved it does.

Donders has, he maintains, satisfactorily explained why the eye assumes the position it does. The relative accommodation is done away with, but the correlation between accommodation and convergence is not abolished by strabismus. The improvement in cases of squint, even where one eye is amblyopic, obtained from the continued use of atropine and suitable distance glasses, is given as a proof against the position of rest theory. What inducement would there be to return to its normal position? On the other hand, the interdependence of accommodation and convergence affords a ready explanation. Here is cause and effect. Nature, relieved of her burden, once more struggles for that which is normal.

It is somewhat curious that whilst Stilling has been asserting that the inward position is caused by its seeking the "position of rest," Cuignet,⁵ in a recent article, has argued that it does so to seek shelter or cover at the inner orbital angle; for he asserts that strabismics suffer much from photophobia, circles of diffusion, and the annoyance of reflex of the other eye. I do not, however, think he sheds much light on the causation of squint. While, however, he opposes Donders as to the origin of strabismus, he strongly supports the opinion that the amblyopia is acquired, not congenital.

At the American Ophthalmological Society last year, a discussion was introduced by Theobald, of Baltimore, as to whether the amblyopia was "a determining cause, or a consequence of the squint." In taking the latter view, he combatted the opinions of Schweigger and Alfred Graefe, as to the non-establishment of identical retinal points, justly observing that if this were true of squint, it would be noticed at younger ages much more frequently than is the case.

The regional characteristics of the amblyopia he thought a crowning argument. Without appreciable changes, he believed such a degree of amblyopia very unusual except in a squinting eye.

Noyes and Wadsworth expressed their belief in the amblyopia as not being due to the squint.

Landolt supports generally the theory of Donders. The correctness is proved, he thinks, by the following experiment: "If we possess binocular vision let us fix a near object; cover one eye—the left, for instance—and place a concave glass before the right. This will not change its direction, but will continue to see clearly. But the effort of accommodation which it is forced to make in order to neutralise the negative glass imposes itself at the same time on the other eye, and provokes in the latter a convergent strabismus of a degree corresponding to the power of the concave glass. The existence of this strabismus may be easily established objectively, and manifests itself subjectively by a homonymous diplopia at the moment when the diaphragm is removed from in front of the left eye."

I have now dealt as completely as time permits with the various points connected with the etiology of squint. The question remains, and a very practical one—the restoration of binocular vision after operation. Partly from want of space, and chiefly because it will be dealt with by our distinguished *confrère* (Landolt), my remarks will be brief. He has asserted that in the majority of cases, after operation, there is persistent abolition of binocular vision. Noyes goes so far as to say that, while binocular fixation after operation is not infrequent, according to his experience, binocular vision is obtained in

⁵ *Recueil d'Ophth.*, February and March, 1887.

only one-fifth of the cases. In a large number binocular vision is undoubtedly absent, but it occurs more frequently in cases where the operation has been undertaken early and before the habit of doing without binocular vision has become confirmed.

Does the amblyopia progress? has been discussed. But does improvement in vision follow after operation? Recorded experience is divided on this point. My own opinion is that, in a fair proportion, improvement does take place; nor do I think Mittendorf's explanation, that it results from removal of the pressure exerted by the superior and internal recti, accounts for it. My personal statistics are not numerous or complete enough to make them worth troubling you with. It, however, is a subject worthy of extended research.

From the opinions I have already expressed, it will, I trust, be plain that in my judgment much of Donders' theory still holds the field. I mean especially the association of hypermetropia and the interdependence of convergence and accommodation. That there are other supplemental causes is clear, and among them in particular appears, I think, the muscular condition before mentioned. The theory advanced is a good working one, and is closely associated with a rational treatment in the form of spectacles either without or after operation. If Schweigger's theory as to the amblyopia be accepted, the operation becomes a cosmetic one, and it matters little when it is performed. On the other hand, if the amblyopia be held to result from the squint, the period of operation is of the utmost importance. Any way, while any question remains, our patients should fairly have the benefit of the doubt of the suppression theory, and the operation be considered under its influence.

The difficulties in elucidating many questions associated with our subject are great. It is desirable to learn the state of vision in the pre-squinting period, and yet the early onset of the strabismus renders this in the great majority well-nigh impossible; and the same remark attaches to ascertaining whether or not binocular vision had existed anteriorly. The proof on either point is difficult and yet important. Other questions can and ought to be settled. In what proportion does amblyopia occur in cases of hypermetropia and in squint cases? Schweigger's views can be supported or controverted on these and other points. The character of the amblyopia, whether it progresses or whether it improves after operation—these and many others are questions which are capable of settlement; I do not mean by opinions, but by facts. Collective investigations might profitably come in here. A committee formed from this Section, or, better, through the organisation of the Ophthalmological Society, would collect evidence sufficient to settle many points. A dozen observers in different parts, recording their experience in a systematic manner, would provide material which a committee free from bias would sift, and out of the many conflicting opinions evolve truth.

I will now pass on to discuss as briefly as possible the second part of our subject, namely, the treatment of convergent squint. Our aim is to correct the strabismus, and by this is intended not merely to remove the undue convergence, but to restore a harmonious working of the two eyes, and to preserve binocular vision.

The correction of the error of refraction, whether simple hypermetropia or astigmatism, in cases of squint, with suitable spectacles, comes as a natural sequence to what has before been said as to the influences of convergence and accommodation. And it is well known that many, if not most, of the cases, if seen sufficiently early, and suitable glasses be ordered, will in this way be cured. Our improved methods of investigating errors of refraction, especially by retinoscopy, have rendered the task of prescribing spectacles, even in young children, comparatively easy. After the ages of 4 or 5 they can generally be safely ordered; occasionally at 3 I have done so with advantage.

The necessity of enforcing the importance of wearing the spectacles from morning until night requires notice, for many friends expect a miracle to be immediately wrought. My practice is to order spectacles somewhat under the total correction, and to do so in all cases of periodic and most alternating squints, and in some also in which the strabismus is permanent. Caignet recommends that the spectacles should be tinted. I see no objection to this plan, though I do not agree with him that strabismics have such intolerance of light, or that it plays the important part in causing squint as he asserts.

Atropine to set on one side accommodative efforts has been advocated and extensively used. Employed by itself, the benefit was often only temporary; but I think it may be fairly said that the cases as a rule relieved by atropine would be cured by the additional use of spectacles. Used in this way, sometimes before, and continued even after glasses have been prescribed, it has rendered good service. Landolt⁶ has thus adopted in declared and permanent strabismus a course of atropine and full correcting spectacles; a solution of atropine (1 in 4,000 or 1 in 2,000) may be continued for months. Near vision is prohibited at first; then it is allowed gradually. If, on discontinuing the mydriatic, the patient does not relapse into squint, a change in the spectacles is made to the strongest convex glasses he is able to see at a distance with. These are worn constantly, and the necessity for the use of the spectacles is urged to prevent a return of the squint. As to the alternative use of eserine, I have no personal experience.

When a patient is too young to wear spectacles, it is desirable to advise abstinence from close application, especially to small objects. Hence, a child is allowed to look only at large things, and, in short, to avoid accommodative work as much as possible. In addition, the good eye is desired to be covered, and the squinting eye used daily once or twice regularly for a quarter to half an hour. The suggestion is also good that atropine may be instilled in the good eye, and thus compel the use of the squinting organ for near work.

Caignet carries this method of practice still further, and suggests, if a child is sufficiently docile, he should be taught his letters, etc., with the intermediary of a ruler, held perpendicularly between the eyes. At first the patient will read with each eye in turn, for when one eye encounters the obstacle the other will take up the reading. Little by little the two eyes try to read together, and in time it is achieved, in a good third of the cases in which no scotoma exists.

Many cases of strabismus yield to measures such as have been mentioned, and I anticipate that our experience is alike in this, that we all operate on a smaller proportion of squints than was formerly the case. There are, however, cases in which palliative treatment has failed, or the degree of the squint, its duration, or other reasons, that render it necessary for us to resort to surgical interference.

At the meeting last year at Brighton of the Association, I brought before this Section a short paper setting forth the advantages of dividing the internal rectus from above, instead of, as is usually done, from below. The manuscript has been unfortunately misplaced, and as consequently I am afraid it will not now be published, I may be excused for making reference to the subject again on this occasion. I have now in fully 100 different operations divided the internal rectus from above, and my experience with this method is most satisfactory. The few instances since I commenced the new operation in which I have resorted to section from below have satisfied me of the superiority of the upper operation. It is always simpler to cut down than to cut up, and, moreover, one's position is behind the patient, a point of no mean importance, for two reasons. The majority of my

⁶ *Refraction and Accommodation of the Eye* (English translation).

operations are now performed with cucaine, and thus the patient is not compelled to see the instruments about to be used on him or her—a matter especially of some consequence with timid children. Strabotomy is, again, one of the very few ophthalmic procedures which necessitated an ambidextrous operator to change his position from behind the patient; this is obviated. I think it will be found, also, that there is less tendency to sinking of the caruncle than under the old proceeding, because inspection will show that the caruncle and semilunar fold are more carried into, and more closely associated with, the conjunctiva below than above. It may be urged against the plan suggested that the conjunctival wound not being dependent, there will be more ecchymosis. If the hæmorrhage is free or likely to settle, a counter opening on the top of the squint hook is made below, but it is by no means frequently required; hardly more often than under the old operation a counter opening was necessary above, nor do I think that the ecchymosis generally resulting is greater. I believe that those who may adopt the proceeding I have mentioned will prefer it for most cases to the older and almost universally recognised plan from below.

There is a great deal to be said in favour of the theoretical and often practical value of dividing both internal recti, and thus allowing both tendons to fix themselves on something like corresponding points in the respective sclerotics. It is hardly scientific to put one tendon back, and to leave the other still forwards, and especially when one of our objects is to restore harmonious working to the respective muscles of each eye.

Practically, however, there can be little doubt, except the squint be very severe, that greater danger of over correction attends division of both internal recti at the same sitting than if one eye only is operated upon at a time. A consideration of the last 500 cases of strabismus convergens that I have operated upon testifies to this, for in those instances in which both internal recti were divided at the same sitting over correction did, in about 2 per cent., give some trouble, whilst in the larger number, where only one tenotomy was performed at a time, no such difficulty arose.

My practice generally, therefore, is to operate upon the squinting eye, and at the lapse of a week, or later if necessary, to do tenotomy on the other internal rectus. It may be roughly stated that a squint under 5 millimètres may be corrected by an operation on the squinting eye, but one over 5 millimètres will require tenotomy of both internal recti.

Beyond directing the eyes to be well bathed with cold water no after-treatment in way of closing the eyes by bandages, etc., is adopted. It has appeared an advantage for the eyes to accommodate themselves to the altered condition of affairs as soon as possible. No harm has at any time resulted even to patients travelling afterwards a considerable distance. Spectacles, if not ordered before the operation, are prescribed for regular use immediately afterwards. In cases where the operation has been a free one, or where there be a tendency to divergence, glasses may with advantage not be ordered immediately; a slight tendency to divergence may thus correct itself.

It appears the wiser plan not to aim at complete correction by operation, but to trust to the spectacles worn constantly to further remedy the defect.

The age at which any case should be operated upon will vary according to the circumstances. Generally speaking it need not be delayed beyond about five years of age. The operative results are distinctly better if undertaken while the patient is young.

The need of practising the amblyopic eye must be mentioned. In some cases the plan of placing the good eye under atropine, and thus obliging the other to do something, as before mentioned, is worthy of

trial. Or the good eye may be covered, and the amblyopic practised with a magnifying glass, or in other ways, that readily suggest themselves. In all cases of strabismus the refraction of each eye should be tested, and the error, hypermetropic or astigmatic, be suitably corrected.

Wecker has recommended advancement of Tenon's capsule, combined with tenotomy, and Knapp has given his approval to the operation; Abadie also prefers it to advancement of the muscle, as its effects can be more easily increased or decreased in a few days. Advancement of the external recti has also been practised, instead of division of the internal recti. Of these procedures I have no personal experience, and the same remark applies to Scherk's recommendation of abscission of a piece of tendon in high degrees of strabismus.

Orthoptic exercises with prisms and the stereoscope have from time to time been recommended. The following suggestion is made for what it is worth.

Professor J. Michel, in Zehender's *Klinische Monatsblätter* for November, 1877, p. 373, suggested the use of passive motion in cases of palsy of the ocular muscles by seizing the conjunctiva over them, and moving as far as possible the eyeball in the line of action of that muscle. There were difficulties, owing to the discomfort occasioned, in its performance. Recently, however, Spalding (*Knapp's Archives*, 1886, p. 492) and Alt (*American Journal of Ophthalmology*, April, 1887) have revived the proceeding with the aid of cocaine. Quite recently it occurred to me that such a plan would have some uses in the treatment of convergent squint. By dragging the eyeball outwards in the line of action of the external rectus, it might increase the effect of this muscle; and, moreover, by putting the internal rectus fully on the stretch, might overcome any tonic contraction of that muscle. These were the ideas that suggested themselves at the outset to me. I have only adopted the plan in two cases, once with distinct benefit; the other is too recent to decide; both were cases of extreme convergence. My experience is far too limited to offer any opinion as to whether the suggestion thrown out will be of value or not. It appears that atropine and spectacles must be made use of also; and I think it is possible that the plan I have suggested may increase the number of cases curable without operative means, and leaving the physiological conditions intact. The proceeding is very simple; cocaine is instilled, and the eyelids separated with a speculum. The conjunctiva over the insertion of the external rectus is seized with forceps, broad ribbed, and the eyeball rotated outwards and backwards, so as to put the internal rectus on the stretch. The irritation resulting is not sufficient to prevent a repetition of the proceeding the next day, or day after, as may be desired.