South African Union
Edinburgh.

[Signature]

20/9/13

Harvey Littlejohn, Esq., F.R.C.S. Ed.

Dear Sir,

While House Surgeon at the Royal Victoria Eye Hospital, Dublin, I made a special study of Strabismus, with the object of writing the enclosed thesis.

I hope it will meet with your approval.

Dear Sir,

I remain,

Yours obediently,

John Hewat.

[Signature]
John Hewat.

Royal Victoria Eye, Ear Hospital.
Dublin.

Address.
South African Union.
Edinburgh.
ETIOLOGY and TREATMENT of CONVERGING CONCOMITANT STRABISMUS

with special reference to a reefing operation introduced

by Mr. MAXWELL of Dublin.

Of the many theories advanced to account for strabismus, perhaps only a few are of any real importance. First, the muscular theory. The turning of the eyes are accounted for by a congenital want of equilibrium between the muscles, or by a partial paresis of the external rectus, or a faulty insertion of the muscles to the globe.

It can be demonstrated, however, that the actual muscle changes are not primary, but secondary; and even in the majority of old standing squints these secondary changes can be demonstrated to be very slight in degree. Donders, in his treatise on "Anomalies of Refraction and Accommodation", pointed out that the temporal excursions of both eyes are almost always restricted in convergent strabismus. It may only be slight in recent cases, but is the rule for cases of long standing. These changes, at first dynamical, become organic in course of time. Worth found, after investigating a large number of squints, that the power of divergence in each eye to be quite perfect in 81%, thus showing that there is no undue shortening of the internal recti, or paresis of the external recti muscles. The remaining 19% were old standing cases of squint, and the defective movements were /
were found to be in proportion to the length of time the squint had lasted; thus demonstrating the secondary changes. Not long after the muscular theory, the Dutch Physiologist pointed out the fact of the frequency of convergent strabismus among hyperopes—95% of converging concomitant squints being hypermetropic—especially in the medium degree of hyperopia; and concludes therefore, that this condition is the primary cause of the condition. Donders explained this fact by the relations between convergence and accommodation.

All hyperopes have to use an excess of accommodation; the greater the amount, the nearer the object looked at. But, in addition to this, their eyes converge proportionately. Nagel states that it may be considered as inversely proportional to the distance between the object and the eye. A certain latitude exists, however, as Donders showed, between accommodation and convergence, a latitude which might be named relative accommodation and convergence. The hypermetrope can accommodate more, the myope less than the emmetrope with the same degree of convergence.

On this account, therefore, all ametropes are not doomed to strabismus. This only when a hypermetrope reaches the limit of his relative amplitude is he in danger of convergent strabismus. The relative amplitude varies to a great extent in different individuals, and thus a certain degree of hypermetropia in one will not produce strabismus, whereas the reverse may hold good in another. Again, if the vision in one eye be feeble, either on account of opacity, an irregularity of curvature of the refracting /
refracting surfaces, or of changes in the fundus to such a degree that the image in that eye may be easily disregarded, the patient being hypermetropic might find it easier to squint, and avoid using his relative amplitude.

It is often noticed that strabismus follows immediately after some febrile disease, such as diphtheria, measles, etc. This fact may be accounted for by a weakness in the ciliary muscle, sharing in the general muscular weakness, and thus in the hypermetrope a superadded effort of accommodation is called for. The limit of the relative amplitude is then reached and the child is found to squint. It may be stated by some, however, that the internal rectus also shares in the general muscular weakness, and thus matters would be again equalled. It has recently been found that the degenerative changes following febrile diseases first appear and are greater in unstriped than in striped muscle. There is no reason, therefore, that this condition should not hold good in the ocular muscles as in other parts. Hypermetropes of high degree do not squint, because even the strongest converging effort would not suffice to call forth the amount of accommodation required. They therefore do not attempt the effort, preferring indistinct vision. The convergent strabismus of hyperopes is according to Donder's explanation a "spastic, and active strabismus." Hence when the patient relaxes the accommodation one would expect this strabismus to disappear; this often, however, does not occur.

The supporters of his theory put forward the argument that all
all hypermetropics suffer to a certain degree from spasm of accommodation, and thus their strabismus continues, but whenever the sphincter is absolutely relaxed by a local or a general anaesthetic early hyperopes stop squinting.

Donder's theory, for some time, was supposed to account for all convergent squints. However, it has been shown that some individuals have converging strabismus and are not hyperopes; others have a normal degree of hypermetropia, while a small percentage are actually myopic. On looking through one thousand cases of convergent strabismus, I found that forty were myopic, ten were emmetropic, and that seventy had hypermetropia below two diopters.

Donders points out that the most important secondary cause of squint is the loss of fusion. Landolt goes further in stating that all squints are a combination of hypermetropia and loss of fusion, whereas Worth assumes that the essential cause of squint is a defect of the fusion faculty. The fusion faculty begins to develop when the child is only a few months old, and at the age of two years has fully developed. Nothing but an actual muscular paralysis after this age can produce squint. It has been found, however, in some, that the fusion faculty develops later than it should, or it develops only to a slight degree, or may be entirely absent. During the time taken for the newly acquired faculty to develop, the motor co-ordination has the sole control of the movements of the eye, and, if the faculty tends to develop later than it should, the child by then may have commenced /
commenced to use his accommodation, and thus with no binocular vision to control the direction of the eyes a squint is produced. Donder's theory is therefore assumed by Worth to be only a secondary condition. He puts forward an ingenious cause for squint appearing so frequently after specific fevers. The fusion sense being defective, during convalescence, the child is given picture books, etc., which call into play the accommodation. The eyes, which were previously only controlled by motor co-ordination and slight fusion, are over-taxed, and strabismus produced. The abnormal convergence is at first only dynamic, but if not relieved by glasses, a static convergence is produced.

Emerson, Parinaud, and Delaye, while accepting Worth's theory as to the origin of strabismus, think we may go further and assume the existence of a fusion centre. Strabismus appearing after the full development of the fusion faculty might be accounted for by a deterioration after it has developed. This deterioration of the fusion faculty may be due to a defect of the fusion centre, but may equally well be caused by congenital, orbital, or muscular abnormalities, congenital or acquired amblyopia, or anisometropia of high degree, the centre itself being intact. "To conclude, however, that all strabismus has a similar cause seems to go too far, and to declare that convergent strabismus is due to an excess of energy of the centre for convergence, is arguing too simply".
In taking up the treatment I should dwell especially on the method followed in the Royal Victoria Eye and Ear Hospital, Dublin, where I have seen over three hundred treated, and have at hand over a thousand records of former cases with final results.

When the patient first visits the Hospital the history is taken in full, and the angle of the squint and the vision noted. Whenever possible, the perimeter is used for measuring the angle, both for "longe and proxe", and the angle of gamma noted for both eyes.

The perimeter, although held by many to be an inaccurate instrument, is on the contrary in experienced hands fairly accurate, and is an extremely easy and rapid method. For children, who refuse the perimeter, the angle is taken as near as possible by Priestley Smith's tape measurement.

The vision having been taken, the patient is sent away for one week to use atropine ointment, ½%, at home, twice daily. At the end of this time he returns for retinoscopy.

In the case of young children there is no time to try any reasonable method of finding out the vision, even where it may be possible. The mother, if apparently intelligent and interested in her child, is told to buy several white marbles, and on returning home to play a game of ball with the infant, first covering one eye, and then the other. The mother, on her following visit, is often able to state fairly accurately the eye the child sees best with, and the distance at which the marbles can be seen. According to Worth, this test only takes a few minutes, and can be done satisfactorily in the Hospital out-patient department. This
is very seldom attempted here, however, as most children will not leave their mother's sides to play any game with a total stranger.

Every squinting patient from one year up is then prescribed glasses. The astigmatism is fully corrected, and the hypermetropia less 0.5. In myopia the full correction is given both in cylinders and spheroicals. In the very young it is certainly difficult or even impossible to do an accurate retinoscopy, but it is almost always possible to get an approximate result which will have to be followed for the time being. The atropine is then stopped, and glasses are worn constantly. Many ophthalmologists do not prescribe glasses for the young, but use a mydriatic in preference over a considerable period. This, however, seems unnecessary, as suitable frames can easily be made, and children appear to have a strange liking for glasses.

The next step undertaken is to improve the vision in the amblyopic eye. This is done either by bandaging the good eye for intervals of one week until marked improvement takes place, or by using atropine once daily in the good eye.

The bandaging appears to have a greater effect, and is more rapid. As a rule one finds there is marked improvement in two weeks, and within several months the vision in the previously amblyopic eye is almost perfect. This improvement depends, however, on the eye of the child and the duration of the amblyopia.

The majority of children below four years of age are able to have vision equal to 6/6 (Snellen type) within a short time, even when the squint has lasted some considerable time. In fact, the change /
change takes place so rapidly in some, that the vision of the former fixing eye has to be watched carefully, as it may become amblyopic during the time the atropine or the bandage is used. After the eighth year of age it is very difficult to ever get a patient to read 6, in the previous amblyopic eye, although there are many cases up to the age of fourteen which have under the atropine treatment improved from counting fingers, to 36 or 24. In 15% of the constant converging concomitant squints, ages varying from eight to fourteen years, there was no improvement in the squinting eye after atropine treatment for several months. In 45% there was slight improvement, and in the remaining 40% there was marked improvement (\( \frac{6}{12} - \frac{6}{9} \)). From the age of five to eight years there was almost perfect vision in 30%, (\( \frac{6}{12} \)), test type, 52% showed satisfactory improvement (S. T. Type \( \frac{6}{12} - \frac{6}{9} \)), and in 18% there was slight or no improvement. All the cases taken had vision of \( \frac{6}{60} \) or were able to count fingers at 6 metres distant at commencement of treatment. In the first group the strabismus had lasted from five to eight years; in the second from three to five years. It was found that the greater was the improvement, the shorter the duration of the squint and the younger the child. The child once having reached counting fingers at 6 metres or the equivalent, the development of the fusion faculty is considered. This is only possible, however, in children below the age of seven, and is only undertaken in the apparently intelligent and better class out-patient. The child, aging from three to six, sometimes seven years, is brought up to Hospital twice weekly for two weeks, then once a week for two months, for a lesson lasting about /
about ten minutes. First pictures are used which only require simultaneous vision, then those requiring fusion, and finally those requiring the power of perspective. After the child has been taught fusion at the Hospital the mother is then told to continue the lessons at home once daily with a cheap stereoscope (Price 3/6), and a few pictures of interest to the child. In this way the most tedious step in the whole treatment is done at home, namely improving the power of fusion to that of perspective. This treatment, in spite of its great benefit, has many drawbacks.

There are frequent failures, there is a good deal of time and patience required, and it is only in the minority of squints that it is undertaken.

It seems unfortunate that some method could not be used whereby every patient reaped the benefit of these lessons, as it has been found that in many of the cases, and certainly in all those which once again the third grade of binocular vision - perspective, the squint rapidly disappears.

Fortunately, many children when brought early enough are cured of their deviation by the correction of their error of refraction and amblyopia, without fusion training. In these cases, the fusion faculty seems to develop naturally. On the examination of fifty children between the age of two and four years, who were cured by glasses and atropine for a period in the non-squinting eye, it was found four years later that the fusion sense developed fully in fourteen, only partially in twenty-five, and not at all in the remaining eleven.

To sum up, therefore, the non-operative treatment we might divide /
divide it into two classes. Those that are treated by glasses, and atropine or bandage, this includes the majority under the age of eight years, and those where the squint has lasted for a period of less than six months whatever be the age of the patient. The other class includes the selected patients under the age of five years who have the above treatment, but in addition, fusion training. The superiority of the second class of treatment will be seen from the following results. During the year at the rate of 70% were taught binocular vision in some form, including those who did not carry out the treatment at home, and 60% were cured of their squint within five months.

These figures may however be slightly erroneous in so far as the percentage was taken only from a limited number of cases.

Operative Treatment.

If there is found to be no diminution in the angle of the deviation either with glasses on, or while under atropine after the foregoing treatment for several months, operative interference is undertaken, and also when the strabismus has lasted many years and when it is concerned with a very amblyopic eye, one proceeds to operate without hesitation, glasses, etc., being of no use.

The operations most commonly performed on the muscles of the eye are tenotomy, advancements, including tucking of the muscle, lengthening of the muscle, or a combination of the above. For many years tenotomy was almost the only operation, no doubt on account of the simplicity, rapidity, immediate effect on the squint, and to the theory that the antagonist gains in power that which the tenatomised muscle loses. The tide, however, appears to /
to be rapidly changing, and many eminent ophthalmologists prefer advancements wherever possible to the old fashioned tenotomy, and use tenotomy only as a secondary aid. A strong objection put forward to tenotomy is that the final result, even when the immediate effect may be insufficient, may be excessive. Thus the young patient who is slightly under-corrected to-day may in the near future squint outward. Thus a deformity of slight disfigurement prior to the operation is converted into a hideous disfigurement later.

Roeunne, working on statistics of the Copenhagen Clinic extending over forty years, states that during this period, 3,865 'Tenotomy' operations on converging squints were performed, and in 211 cases an operation for secondary divergence squint became necessary.

Among the other objections, might be mentioned - the globe becomes more prominent, the marked retraction of the caruncle, and the almost always remaining weakness of convergence.

On two hundred cases of converging concomitant strabismus treated by full tenotomy of the internal rectus, the average amount gained was $15^\circ$, about 85% of the cases varying between $18^\circ$ and $12^\circ$. The result of a second operation on the internal rectus of the 'sound eye' two weeks later was greater than that of the first by $5^\circ$.

The results in several cases was very variable, the greatest reduction obtained being $35^\circ$ and the least $0^\circ$.

Fifty were seen two years or more after the operation, and there was no evident deformity noticed except in four, two
two of which had slight divergence - 8° or less, the remaining two, divergence of over 10°. The practice of one of the surgeons in the Royal, Dublin, is to use sutures to control the result of the tenotomy operation. The technique is as follows: - The muscle having been freed in the usual way, a silk thread, with a needle at both ends, is passed under the muscle, and each end brought through the tendon from the posterior surface near the margins. The tendon is now separated from the sclera and allowed to retract. The two needles are threaded through the conjunctiva proximal to the cornea and knotted, so that just sufficient slack is left to give the necessary effect. In this way, the immediate effect, or the effect within 24 hours, can be altered by tightening or slackening the sutures. At the end of 48 hours these sutures are removed.

Kuhunt has recently devised a millimetre scale cut in the blades of his scissors, and allows one millimetre of lengthening for each 5° of correction necessary.
Of the many ingenious methods of lengthening the tendon, there are few where the final result is satisfactory.

In many where a decided improvement has occurred immediately after operation, cicatrical tissue evidently forms, and in contracting gives an almost negligible result. When performed in conjunction with advancement, the gain is below 8°, the average being about 5°. Of the methods shown below, the first is the most unsatisfactory, as the pull on the eye is altered, and rotation of the globe occurs. The second method only gives a very small gain, and several months later is often nill. The third gives the most satisfactory results, although somewhat tedious to perform.
Lastly, in taking up the operative treatment by advancements or reefing of the tendon, I only propose describing those that I have seen most frequently performed. The results are taken from notes recorded in the Royal Victoria Eye Hospital. The first method is one of the oldest of advancement operations, and is still used most satisfactorily by many surgeons. The conjunctiva and tenous capsule having been divided by a vertical incision, the tendon is caught up by Prince's advancing forceps. Two double armed threads are passed through the muscle well back from the insertion. One of the threads is passed back at the upper, the other back at the lower border of the muscle, and the latter is transfixed from below forward at about the middle of its breadth. The muscle is then divided close to the sclera. The other ends of the threads are then brought through the superficial layers of the sclera near the cornea - one above, and one below---. The surface of the sclera is then lightly scraped and the upper and lower threads are tied separately. The tighter the threads are drawn, the further is the muscle brought forward.

In this way the effect of the operation can be regulated. De Wecker modifies the above operation by only using one thread, armed with three needles, one in the centre, and one at each end. The central needle is passed through the centre of the tendon, and the loop is cut, so as to have two free ends; one is tied to the thread that is inserted into the scleral tissue above the cornea, and the other to the one inserted into the same tissue below the cornea.
The late Sir Henry Swanzy always in advancements tied the sutures in a knot to the tendon, and before the stitch came away, it had to slough through the tendon with the result that when this happened there was a marked slipping back. In De Wecker's advancement the final results were found to be about the same as the primary results, but as stated above, this was the contrary in Sir Henry Swanzy's method.

In the advancement recommended by Argyle Robertson and Prince, the tendon is brought forward by one stitch, so that there is less chance of producing a rotation of the globe. The final results seem to yield much the same results as De Wecker's and Swanzy's. Worth in his modification catches up conjunctiva, tenous capsule, and tendon with a Prince's forceps, and transfixing with sutures brings conjunctiva capsule and muscle forward. He holds that the immediate effect under cocain is the permanent result. No over correction is necessary. From the results recorded here, however, on this method the final result is found to be considerably less that the primary.

Though all operations so called advancing operations are virtually only shortenings; however far forward the end of the tendon is advanced, its under surface must lie on the original insertion now made raw, and becomes attached to it. The muscle will therefore act mechanically no further forward than this point.

Of the reefing operations, there are three methods which appear to be worthy of special note, and are the only ones used frequently /
frequently in the Hospital.

Blanco's method is different from other methods in so far as he divides the tendon completely.

After exposing the tendon and muscle in the usual way, and freeing it from the connective tissue surrounding it by an ample dissection, the tendon is taken hold of at the posterior limit of the dissection by the double hook devised by De Wecker. It is then divided immediately in front of the hook, and the posterior part of the tendon and muscle is fixed to the superficial surface of the tendon, which has remained attached to the globe, by means of a blanket stitch passed near the insertion into the sclera. Of the cases done recently in the Royal by this method, the results have proved very satisfactory, although in every case the correction had to be overdone, as the primary result was markedly greater than the final result.

The unsightly mass produced by the folded tendon is avoided, but the operation requires more skill and time than either of the following.

The second is that of Bishop Harmon: "The eye is secured by means of anchor sutures fixed into the sclera close to the limbus. At first these are used in place of fixation forceps, and later to anchor the eye at the end of the operation in abduction.

"Two button-holes are then cut through the conjunctiva and capsule above and below the parallel to the edges of the tendon, and midway between insertion and canthus. Freshen the upper and lower /
"lower surface of the tendon with the rash, and apply the reefing forceps so as to include tendon and capsule, lock the blades and slowly turn the forceps from under canthus across the eye until the handle comes to rest on the nose. The tendon is then reefed, after which the base of the reef is sutured at the upper and lower edge with silk passed through conjunctiva.

The needle of each reefing suture is then brought forward and passed through conjunctiva and superficial sclera near the cornea and thus the muscle is pulled more forward. Finally, the eye is fixed in abduction by means of the anchor sutures." This method has worked out most unsatisfactorily in the Royal, Dublin. The majority of the patients are only relieved of 12° of squint, although the primary result may be a decided over correction of a squint of 25° convergence.

The primary result is due to the tucking of the tendon with the addition of the pulling of the same forward by sutures inserted into the sclera, but the final result appears to be only the tucking of the tendon. Immediately after the scleral sutures are removed, the muscle slips back the amount it was pulled forward, by the tightening of these sutures.

Of thirty cases performed without tenotomy, five with a converging angle of 10° to 12° left Hospital apparently straight. Thirteen with a convergence of 20° finally had a squint of from 5° to 10°, and had to undergo a second operation. Ten with an angle of 25° finally had a convergence of from 10° to 15°, and the remaining two had no improvement, probably due to the tucking sutures /
18.

sutures having slipped. In many cases the reefing of the tendon was performed in combination with lengthening of the antagonistic 'Internus' by method I., shown on page 13, but this gave a very small amount extra in the final measurement.

The technique of all the above operations appear to be faulty, in so far as the necessity of catching up the sclera with the suture in concerned. The area of sclera used lies immediately above the uveal tract, the most dangerous part of the eye. On several occasions I have seen the needle pass too deep in most skilled of operators hands. Only in one case, however, was an iridocyclitis set up which fortunately passed off under treatment.

To avoid, therefore, this surgical error, Mr Maxwell of Dublin, introduced a reefing operation which he has practised for the last fifteen years with occasional slight modifications.

I first propose describing the steps of this operation, and then giving results with conclusions based on over 300 cases which Mr Maxwell has kindly allowed me to make use of while House surgeon under him.

The conjunctiva and tenous capsule over externus are divided in the usual way. The tendon is taken up on a hook and its side attachments freed. An instrument consisting of two parallel fixed hooks separated by an interval which allows a central moveable hook to slide between them, is placed in such a position that the central hook takes up the tendon. The amount of tendon that can be taken up is regulated by a screw and stop and is shown in millimetres on a scale. A suture with a needle at each end is now passed from behind forwards, first through conjunctiva, then
through the double tendon as close to the upper surface of the fixed hooks as possible. The instrument is then withdrawn. The needles are again taken up and passed under the edge of the anterior part of the conjunctiva, each end of the suture is threaded with a coloured bead and tied tightly together.

The conjunctiva is taken up by the sutures in order to prevent the sutures cutting through the tendon and also to aid in their removal at a later date. The anterior flap of conjunctiva is not taken up by the sutures with a view to pulling the muscle forward; — The amount gained depending solely on the amount of tendon doubled.

The beads are used to aid the removal of the sutures, and also help to prevent the tendon slipping.

Bishop Harmon was present at this operation when demonstrated by Mr Maxwell several years ago in Dublin, and appeared to be greatly taken by the use of the beads. So much so, that he introduced them into his own operation almost immediately.

During the last year Mr Maxwell has modified the operation by using fixation sutures and thus taking all strain off the reefed muscle. The results in these cases appear to be even more certain than the former ones, and the prolonged after-treatment need not be so severe.

Prior to the exposing of the external rectus, the intact conjunctiva and superior rectus are grasped by forceps and a suture passed through them; both ends are then brought out through the outer canthus, slightly above, well back, and from the posterior surface.

A similar suture is used to transfix the conjunctiva and
inferior rectus, and is also brought out at the outer canthus, but this time slightly below. These sutures are left slack until the reefing of the external rectus is complete, and are then tied together over a piece of rubber tight enough to keep the eye in a marked abducted position.

The after treatment is most rigidly adhered to.

Both eyes are bandaged for one week, the dressing only being changed if the patient complains of pain. At the end of this time the fixation sutures are removed, atropine is dropped into the eyes once each day, and the double bandage continued for three days longer. The bandages are then removed, the atropine stopped, and glasses worn continually. Prior to the operation, the refraction under atropine is always taken and glasses ordered, so that immediately the bandaging of the eyes is abandoned the glasses can be worn, and thus any tendency to convergence avoided. At the end of two weeks the reefing sutures are easily removed by snipping the silk between the two heads.

The after treatment is modified, however, if there is any divergence present. In these cases the bandages are removed at the end of a week together with the fixation sutures, and glasses worn so as to allow the eye free movement; and in this way the reef in the external rectus is slightly stretched. If this is found not to be sufficient the eye can be pulled into marked abduction with forceps several times a day.

There are frequently cases where children will not keep a bandage on the eyes, and whenever the nurse turns her back, off comes the dressing. A useful preventative is to have the children's arms in splints, and
and a bandage passing under the chin and over the head fixed to 
the circular eye bandage.

Recently Mr Maxwell has been using a well-padded wire mask 
fitted tightly to the cheeks, and fixed behind. The little 
patient is thus unable to get at the bandage, and appears to be 
happier than with the arms fixed in extension.

The simplicity and rapidity of this method of operation 
are marked features - the average time taken being from 8 to 10 
minutes. This is of great importance where a general 
anaesthetic has to be administered. The very slight difference 
between the primary and final results, as compared with many other 
methods, is most satisfactory. Also, the final results 
estimated from over 500 consecutive cases are encouraging, and there 
is no danger of piercing the globe. The objections that might 
be put forward are first, the liability to sepsis on account of the 
muscle not being completely covered by conjunctiva. There is 
only one case of sepsis following this method reported, and this 
was traced to direct infection during the operation. Second, 
the large unsightly mass left after the operation; this mass, 
however, soon disappears entirely. In one month it is greatly 
diminished, and at the end of three months the conjunctiva over 
the muscle is smooth and colourless.

In about 2% the lump had not diminished by one month, but 
after snipping most of it away with scissors the remainder 
rapidly disappeared. Thirdly, the liability for the reef to 
slip. This is in most cases due to faulty technique, and after 
treatment /
Fourthly, the muscle reefed loses in dynamic power what is gained by the advanced muscle. That is not the case, however, as pointed out previously. Finally, the wide variations which sometimes occur, thus giving the impression that a successful issue was quite a matter of chance. I think in many cases this wide variation can be traced to either an abnormal weakness or strength of the opposing internal rectus. If, before the operation the condition of the muscles was estimated by prisms and the reefing done accordingly, these variations would be probably much less frequent. Many of these patients have been seen at the Hospital from time to time, and those reported straight on leaving Hospital, averaging three weeks after admission, have remained straight. None were found to have secondary divergence, and of those that left Hospital with slight convergence, some returned later showing improvement; others, however, appeared slightly worse. The eyes once having been operated on, and a nearly satisfactory result obtained, the treatment as advised prior to operative interference is again energetically undertaken in all children under eight years. In those above six and below sixteen years an effort is made to improve the amblyopic eye, but fusion training is not undertaken.

It is important to bear in mind that when an operation is performed on one who has not previously worn glasses, a too small result may be increased by their aid, but a too great result cannot be remedied, also that in a case when glasses have already produced /
produced their full effect they will again, after operation, produce a further reduction. In every case, therefore, the angle of the squint is taken without glasses, and again, in a week under atropine or glasses. Of course, if the patient is already wearing the correct glasses, there is no necessity to wait a week between the two measurements, as both can be done at the same visit.

The difference in the angle is to a certain extent a guide as to how much to correct by operation.

The average results on reefing the external rectus are 9° with the instrument set at 10 m.m., 11° with 12 m.m., and 14° with 14 m.m. With reefing of both external recti at the same operation the results were 27° with 12 m.m., 33° with 14 m.m., and 45° with 18 m.m. Reefing the external rectus of the sound eye appears to give a slightly greater effect than that of the other eye. 15° was gained with 12 m.m., and 20° with 14 m.m.

In a large number of squints above 35° Mr Maxwell performs a tenotomy with sutures, as described previously, immediately preceding the advancement, no fixation sutures being used.

The after treatment in these cases is the same as in the reefing operation, but the eyes are dressed daily, and if there is any tendency to divergence, the tenotomised muscle is pulled forward by tightening the sutures. The average amount gained by tenotomy and reefing was Longe 23°, Proxe 27° with 10 m.m., L. 28° P. 29°, final with 12 m.m. On taking the average results in 200 cases of tenotomy combined with reefing, it was found to be an angle of 2°.
2° Longe 4° Proxe, of convergence - 71 cases were reported straight, 90 with an angle of 5° or less of convergence, and 40 with an angle of over 10°. These, however, were advised to return in several months for another operation.

On looking through notes on 1,000 cases operated on by the late Sir Henry Swanzy and Benson, Mr Story and Maxwell, the following figures were obtained:

Males, 375; females, 622; right eye, 445; left eye, 450; alternating squints, 130; converging squints, 795; and diverging, 200. The average age of duration of the squint was eight years.

Age of commencement:

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>0 - 2 yrs</td>
<td>42%</td>
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<tr>
<td>2 - 3 yrs</td>
<td>23%</td>
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<tr>
<td>3 - 6 yrs</td>
<td>10%</td>
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<tr>
<td>6 - 9 yrs</td>
<td>6%</td>
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<tr>
<td>9 - 00 yrs</td>
<td>18%</td>
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</tbody>
</table>

The largest number thus commences during the age of 0 - 2 yrs. The occurrence gradually diminished until one reached nine years, and upward. This increase is no doubt due to two factors, the inclusion of a large number of years; and also that in the majority of these cases, there was some visual defect such as traumatic cataract, nebulae, etc., preceding the strabismus, in the latter instance and thus it may be assumed that there was present a latent squint which became manifest whenever binocular vision was interfered with.

Average Angle of Squint:

<table>
<thead>
<tr>
<th>Angle of Squint</th>
<th>Degree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longe</td>
<td>27.3°</td>
</tr>
<tr>
<td>Proxe</td>
<td>30.7°</td>
</tr>
</tbody>
</table>

Refraction /
Refraction of sound eye - 2.5. 
" squinting " - 3.6.

Of the converging strabismus cases, ten had myopic astigmatism.

Hypermetropic Astigmatism - 63%
Astigmatism in squinting eye and not in sound eye - 25%.

**Average results obtained by Operation.**
Final reduction by full tenotomy on squinting eye - 15°.
On sound eye two weeks after tenotomy of squinting eye - 17°.

De Wecker's advancement of external rectus with tenotomy of internal rectus - L. 35°.  

P. 32°. 

Sir Henry Swanzy's advancement with tenotomy :-
L. 27°.  
P. 25°: 

Bishop Harmon's reefing and partial tenotomy :-
L. 19°.  
P. 16°. 

Mr Maxwell's reefing with tenotomy :-
c. 10 m.m. - L. 23  
P. 27  
c. 12 m.m. - L. 28°  
P. 29° 

with 14 m.m. - L. 30°  
P. 37° 

Mr Maxwell's reefing without tenotomy - quoted on page 23.