DOUBLE vision is comparatively rare after squint operations. This is to be attributed to two antithetical reasons. On the one hand, it may be due to the fact that some degree of binocular vision had been present from the very first, and that the functioning of the corresponding points was restored after the operation. If fusion is strong enough, it is able to force the eyes into a straight position even when they deviate in some degree immediately after the operation. In the opposite case there is no double vision because suppression of the image in the squinting eye is so developed that the patient fails to perceive the image even after the operation and continues to look with one eye only. Thus post-operative double vision occurs when suppression is not too strong and when, for some reason, there is an inability to fuse the two images. I should like to deal with some of the causes of such inability below.

Fusion may be prevented (1) by a post-operative abnormality in the position of the eyes; (2) by abnormal retinal correspondence; (3) by a difference in the size and shape of the retinal images in the two eyes.

I do not mention "horror fusionis" as an independent cause of inability to fuse since, according to more recent data, it is composed of the above factors 1 and 2.

(1) Post-operative double vision may therefore in the first place be caused by a squint due to the operation, and in a direction contrary to the former one, i.e., divergence after convergence and *vice versa*. Double vision also occasionally occurs in cases in which the operation has been insufficient. In all cases of the kind observed by me, I found that the squint had not commenced in earliest childhood but at a time when binocular vision had presumably already been practised to a certain extent. While, in his former squinting condition, the patient had become accustomed to taking no notice of the image in one eye, he was no longer able to do this in his new condition for some time at any rate. Suppression ceased spontaneously, the image in the squinting eye presented itself, but either the patient's fusion faculty was not sufficiently developed or he had not adequate fusion amplitude to unite the two images, and double vision ensued. Post-operative double vision in such cases is in all

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DOUBLE VISION after Squint Operation

The probability connected with the fact that the onset of squint did not take place in earliest childhood, and that amblyopia, as I experienced, was not of too high a degree; vision not over 5/35.

The issue of such post-operative double vision seems to depend on several factors, such as the strength of the fusion power and fusion amplitude, and further on the degree and direction of the squint. In connection with the direction of the squint it may be mentioned that post-operative divergent squint is more readily overcome by the power of fusion than convergent squint of the same degree. It is generally known that fusion amplitude in convergent direction is several times that in divergent direction. When convergence power can be readily developed by training, divergence of 5 to 10° can be overcome in a physiological way. In those cases, however, where convergence faculty is deficient and cannot be developed, the patient will sooner or later rid himself of the discomfort of double vision by means of suppression, and divergence can only be eliminated with another operation. When suppression appears in cases incapable of convergence, re-operation is justified.

I mention two cases of post-operative divergence in which double vision could be changed to fusion by means of consistent exercises. The first patient originally had divergent squint, the second a convergent one.

The patient, aged 21 years, had had divergent squint of 35° since the age of 13 years. After anteposition on both sides the remaining divergence varied from 7 to 10°, and double images presented themselves. With suitable glasses and exercises, the patient learnt to blend the images. A few weeks after the operation, there were no complaints; divergence of 2 to 3° still remained a year after the operation, but the patient could easily overcome this by fusion.

The other patient had had convergent squint of 17° from the age of 12 years. After the operation performed when the patient was 18 years old, divergence of 10° and disturbing double vision appeared. A few weeks later, diplopia was on the decline but suppression could be detected. As the patient was unwilling to undergo the operation suggested, we recommended exercises with coloured glasses for the eliciting of diplopia, the voluntary approaching of the two images, their fusion from near and far, etc., which the patient carried out diligently for 4 months. At present, he still shows divergence of 6 to 8° but can straighten his eyes at will.

The situation is a far more difficult one when convergence follows upon an operation, since the divergence faculty of even a normal pair of eyes is only about 4 to 6°. Divergence faculty also can be developed but the maximum attainable does not
generally exceed this figure. The cessation of double vision may be expected by means of suppression rather than in a physiological way. In cases of post-operative convergence of less than 8° it is worth while trying divergence exercises. In squint cases of a greater degree, re-operation will be required if the patient is an adult, for the divergence faculty cannot overcome convergent squint of such a degree. Once past adolescence, a spontaneous diminution cannot be expected except during the time immediately following upon the operation. Divergence exercises cause the patient considerable strain and should therefore, unlike convergence exercises, be performed under supervision and with more precise instruments.

I shall now cite an interesting case of post-operative convergence, the curiosity of which lies chiefly in the fact that the patient had for nine years been unable to work on account of double vision, although his eyes appeared to stand parallel.

On account of divergent squint arising in his school days, the patient had, at the age of 25 years, been operated first on his right eye and then on his left. According to his statement, two operations had been performed on each eye. After the fourth, performed on his left eye, he had immediately experienced double vision. This disturbed him so much, more especially at a distance of over 30 cm. that he kept missing objects when he reached for them at his work. He had visited several hospitals. The double images were not typical but were due to bilateral and especially left-sided weakness of the rectus externus. The eyes appeared to be parallel. The synoptoscope showed convergence of 11 to 12° and left hypophoria of 9°. The angle gamma was positive, 5° in each eye. Binocular vision: at the first two synoptoscope examinations the patient was uncertain and projection abnormal, but after two or three macular-stimulation exercises projection became normal. At the following examination, the patient was unable to blend the images and constantly saw one of the images shifted in some direction. For this reason, the case might also have been taken for one of "horror fusionis." I have, however, experienced similar behaviour with respect to fusion images in many squint cases which afterwards attained perfect binocular vision. For this reason I tried first roughly-drawn pictures with few details, and then finer pictures. The patient's fusion faculty was completely restored and he moreover acquired good fusion amplitude. Abduction exercises produced divergence power of 5 to 6°. He actually succeeded in approaching the two images at will but not in fusing them; the 6° divergence power could not compensate convergent squint of 12°. The patient did not tolerate prisms. Since the case thus appeared elucidated, remaining convergent squint was eliminated by advancement of
the left rectus externus. Upon this double vision ceased. He has been able to work undisturbed ever since. He used two 2° prisms transitionally at his work on account of insufficiency of convergence. At present he has convergent squint varying from 0 to 3°, with left hypophoria of 2° which he can readily overcome. Even when examined with the four dot test, the most sensitive of all to fusion deficiency, he sees four dots. The patient who, moreover, is neuropathic, has no subjective complaints and can work undisturbed.

The long duration of these complaints was evidently due to the fact that, on account of the low degree of squint measured by the perimeter, no operation had been recommended for the eye that had already been subjected to repeated operations. Moreover, it is highly probable that the post-operative convergence that was followed by double vision had been caused by over-correction due to the positive angle gamma. For when the eyes had seemed parallel, there had in fact been convergence. The conclusion to be deduced is that the angle gamma must always be taken into account in measurement of the angle of squint, more especially when we measure squint with the aid of corneal reflex images and not by exact methods.* A further point of interest in this case is that double vision had persisted for nine years without developing suppression.

(2) The cases discussed so far were those of double vision caused by post-operative squint. We may, however, find post-operative diplopia due to false projection. In these cases, the eyes are parallel or practically so. The abnormal correspondence frequently found in squinting patients may be considered a reasonable adaptation to a faulty position. To pairs of eyes that have become adapted in this way, the parallel position brought about by the operation is, as it were, the same change that is produced when initially parallel eyes take on a squinting position. The changed position of the corresponding points is apt to give rise to diplopia. In most cases double vision does not arise because normal correspondence can assert itself with the aid of the parallel position or, if not, the patient helps himself by means of suppression. Consequently when diplopia does arise, it is, in the majority of cases, of a temporary nature for, as experience shows, suppression easily develops in these cases. When, however, it is not temporary, it may endanger the success of the operation for the patient attempts to eliminate diplopia by placing his eye into its former squinting position. It is advisable to ascertain the existence of false projection before the operation. Not so much on account of the discomfort of diplopia but rather because the ideal result of restoring binocular vision can hardly be relied on

* Movements of the eyes at alternating monocular fixation.
in adults having false projection. The existence and degree of abnormal projection can be established exactly with the aid of perfect amblyoscope-like instruments such as the synoptophore, synoptoscope, orthoptoscope, etc. If the patient errrs as little as 1 to 2° in adjusting the pictures placed in the apparatus, the eyes while performing monocular fixation move slightly. This movement takes place on account of the macula's adjustment to the point of fixation. It is only when the dot-like pictures stand exactly adjusted to the two maculae that the eyes remain in complete repose when there is alternating monocular fixation.

Recently Bielschowsky has been recommending the ascertaining of the existence of false projection by means of Hering's positive after images. Abnormal correspondence can also be detected with the aid of the double-image test if double images can be provoked in the patient. Double images caused by false correspondence are of a paradoxical character, e.g., in case of convergence they are crossed, or the distance between the two images does not correspond to the angle of squint. Frequently, however, a patient of this kind localises the double image in an uncertain manner, right at one time and wrong at another, or faulty and correct localisation rival each other. In some such cases of squint I experienced that in double-image tests the patient saw as many as three images at some moments, and of those one was fainter than the others. With the aid of the Maddox scale it is possible to ascertain, which image corresponds to the existing angle of squint, and we then draw the patient's attention to the rightly localised image and make him practise its perception with coloured glasses. In addition to macular-stimulation exercises, simpler processes such as these may also promote the restoration of normal correspondence.

It is a well-known fact that such patients see double at moments even when looking with only one eye. This is interesting from the point of view of differential diagnosis because, apart from hysteria, monocular double vision may also occur in objective alterations such as luxation of the crystalline lens, incipient choroiditis, retinitis and lesions of the visual centre.

(3) Apart from anomalies on position and abnormal correspondence, the fusion of the images in the two eyes may also be prevented by a difference in the size and shape of the retinal images (aniseikonia). I have had no opportunity of making sensitive aniseikonia tests. In the cases cited above, I carried on examinations with the Guibor's set picture marked Andrews, for an eventual difference in size of over 2 to 3 per cent. Examining patients with this picture, I found no aniseikonia.

In short, I have dealt with cases coming under two classes of double vision consequent upon squint operations. One of these
is caused by the still faulty position of the eyes, the other by abnormal correspondence. In the former the task is to develop fusion amplitude, in the latter, bi-macular vision. In either case the measurement of the degree of squint and of the eventual angle gamma is of the greatest importance both before and after the operation. It is only on ascertaining these facts that one can determine the character of the double images,—whether they are paradoxical or not—and then deduce the cause of diplopia. By means of the methods already mentioned (double image test, positive after images) the right diagnosis may be arrived at without any precise instruments. If these, however, are at hand, the particulars obtained in the course of subjective examinations may be completed with objective data, such as the angle of squint and gamma, and the demonstration of false correspondence.\(^5\) It is generally easier to overcome diplopia in post-operative divergence than in convergence. As to cases coming under the third class, I can, for want of personal experience only refer to the publications of the Dartmouth Medical School.

The cases cited above were adult patients since I have had no opportunity of observing diplopia after squint operations in childhood.

**LITERATURE**

1. BIELSCHOWSKY.—Congenital and acquired Deficiencies of Fusion. "An apparent horror fusionis may be due to long-lasting disuse of one eye and the fusion faculty may be capable of being developed by proper training and a most careful removal of anything which may cause an inferiority of the visual acuity of one eye." *Amer. Jl. of Ophthal.*, 1935.
5. TRAVERS, in his paper on "Suppression of Vision in Squint, etc.," published after the writing of this article, gives a simple method of detecting false projection by his Mirror Screen Test. *Brit. Jl. of Ophthal.*

**ANNOTATION**

The Evil Eye

The power of the evil eye is a superstition of world-wide credulity and is certainly very old, though we are not prepared to admit that the sentence in St. Matthew’s gospel (xx. 15) "is thine eye evil because I am good?" is an instance in point. So far as we know our Lord was speaking in general terms and not of any gross ocular anomaly.