pate in this error. But the oculist has only too often been convinced by sad experience of the contrary. I have no hesitation in saying, that a near-sighted eye is not a sound eye. In it there exists more than a simple anomaly of refraction. The optical characteristic of myopia may consist in this, the anatomical is a prolongation of the visual axis, and the latter depends upon a morbid extension of the membranes. If this extension has attained to a certain degree, the membranes are so attenuated, and the resistance is so diminished, that the extension cannot remain stationary, the less so, because in the myopic eye the pressure of the fluids is usually increased. In this progressive extension progressive myopia is included, which is a true disease of the eye.

"From what has here been said, it will easily be understood that high degrees of myopia are less likely to remain stationary than slight degrees are; at a more advanced time of life they even continue to be developed, with increasing atrophy of the membranes. In youth, almost every myopia is progressive; the increase is then often combined with symptoms of irritation. This is the critical period for the myopic eye: if the myopia does not increase too much, it may remain stationary, and may even decrease in advanced

age; if it is developed in a high degree, it is subsequently difficult to set bounds to it. At this period, therefore, the above-mentioned promoting causes should be especially avoided. On this point I cannot lay sufficient stress. Every progressive myopia is threatening with respect to the future. If it continues progressive, the eye will soon, with troublesome symptoms, become less available, and, not unfrequently, at the age of fifty or sixty, if not much earlier, the power of vision is irrevocably lost, whether through separation of the retina from the choroid, from the effusion of blood, or from atrophy and degeneration of the yellow spot."

It is of great consequence in myopia that the glasses should be selected with accuracy and care, and that we should be guided in their choice by the individual peculiarities of each case. For if they are unsuitable, more particularly if they are too strong, they may prove most injurious to the eyes.

In selecting spectacles for short-sighted persons, we should, in the first place, determine with exactitude the degree of myopia, by ascertaining the position of the far point. We find, for instance, that the patient cannot see at a distance, being unable to decipher No. *cc* at a distance of 20′. We next ascertain the furthest distance

up to which he can read No. 1 with ease and comfort.

Let us suppose that he is able to do so up to 10″ from the eye, his far point (r) consequently lies at 10″, and his myopia = $\frac{1}{10}$. With a concave lens of 10″ focus he would be able to unite parallel rays upon the retina, as this glass would render parallel rays so divergent as if they came from 10″ in front of the eye. The position of the far point at the same time affords us a clue as to the number of the glass which the patient will require for distant objects. In this case it would be about concave 10. But although, theoretically, a glass of 10 inches focus would be the proper one, we find that, practically, it would be somewhat too strong. The reason of this is to be found in the convergence of the optic axes, which prevents the eye from accommodating itself for its far point, the latter being only attainable when we look at distant objects with parallel optic axes. We, therefore, find that the patient in our supposed case, would require about concave 12 for distance.

We may easily determine whether or not the glass thus found accurately suits the patient's sight. In order to ascertain this fact, we try whether

with this lens he can read No. XX distinctly at a distance of 20 feet. In the case before us, the trial lens would be about concave 12. We find that with it he can read each letter of No. XX with fluency and ease. We next alternately place very weak concave and convex lenses before the spectacles, and try their effect. If slightly concave glasses improve the vision, the original glasses (No. 12) are too weak; if, on the other hand, convex glasses improve it, they are too strong. If neither the one nor the other render any improvement, the spectacles suit exactly. Let us illustrate this proceeding by the following simple examples :—

A comes to us with a myopia = $\frac{1}{10}$. We give him concave glasses of 10″ focus, and desire him to read No. XX at 20′ distance. He can do so, although the letters are not quite distinct and sharply defined. We then place No. 60 convex before the spectacles, and find that this renders the letters clearer; convex 50 improves vision still more, with it he can see the individual letters most distinctly; but convex 40 renders them more indistinct. The original glass (concave 10) is consequently somewhat too strong, and, in order to suit the patient's sight exactly we must deduct 50 from it. The glass required is therefore

$\frac{1}{10} - \frac{1}{50} = \frac{1}{12\frac{1}{2}}$. We then try concave 13, and now find that neither concave nor convex glasses render any improvement. He is, therefore, accurately suited.

B also appears to be suffering from a myopia $= \frac{1}{10}$. He is tried in the same way as A with concave 10. In his case, however, we find that convex glasses render his vision more indistinct, but that concave glasses improve it—concave 50 most of all; we have, therefore, to add this number to the original glass (No. 10), which was too weak. The glass required will therefore be found thus, $\frac{1}{10} + \frac{1}{50} = \frac{1}{8\frac{1}{3}}$. We then try concave 9, and find that vision is not further improved by the addition of any concave or convex glass. It is, therefore, the proper lens. It may be laid down as a rule that the *weakest* glass with which the patient can see distinctly at a distance should be given.

A short-sighted person may desire to have spectacles which enable him to see objects at a distance of about two feet (for instance, the music whilst he is playing the piano). Let us suppose that he requires concave 12 for distant objects. How are we to find the right number for objects at 2′ distance? Simply thus: If his myopia equals

about $\frac{1}{12}$, the number required for objects at 24″ will be found thus: $-\frac{1}{12} + \frac{1}{24} = -\frac{1}{24}$. Hence concave 24 will suit him for seeing at 2′ distance.

In the same way we can find what glasses are required for reading at 1′ distance in a myopia $= \frac{1}{6}$; $-\frac{1}{6} + \frac{1}{12} = -\frac{1}{12}$. Concave 12 would be required for this purpose. We shall, however, find that the patient requires a somewhat weaker glass, because the convergence of the optic axes to a point 12″ distant, already necessitates an accommodation for a nearer point.

As the amount of the range of accommodation which the patient possesses very materially influences our choice of spectacles, and the question whether or not they are to be used for near objects, we must, in the next place, shortly consider how the range of accommodation is to be tested in a myopic eye, we may do this in two ways:—

1. We let the patient read No. 1 of the test-types, and by alternately moving it nearer and further from the eye, we ascertain his near (p) and far (r) point. Let us suppose that $p = 3''$, and $r = 6''$. His range of accommodation is found by the formula—

$$\frac{1}{A} = \frac{1}{P} - \frac{1}{R}, \text{ therefore } \frac{1}{A} = \frac{1}{3} - \frac{1}{6} = \frac{1}{6}.$$

2. Donders has lately, however, preferred the following plan :—He gives the patient those glasses which neutralize the myopia, and enable him to see distant objects distinctly (by means of which he can, therefore, unite parallel rays upon the retina). Let us again suppose that No. 10 (concave) is the weakest glass with which he can read No. XX quite distinctly and sharply at 20′ distance. His far point will therefore, with concave 10, lie at infinite distance (∞). With the same glass we now try how near he can read No. 1 comfortably, and with ease; let us suppose that this be at 5″, $\frac{1}{A}$, therefore, $=\frac{1}{5}$, for $r = \infty$, $p = 5$, $\frac{1}{A} = \frac{1}{5} - \frac{1}{\infty} = \frac{1}{5}$.

The great advantage of this method is, that the patient really accommodates for his far point which is not the case in the former plan; for owing to the amount of convergence at 6″, the patient cannot sufficiently relax his accommodation to accommodate for his far point.

In determining the degree of myopia, and in examining the range of accommodation, both eyes may be at first examined together, but they should then be always tested separately. For although we find in the majority of cases that the myopia is nearly the same in degree in both eyes, we occasionally meet with a very marked difference,

which may demand glasses of different focus for the two eyes. This question will, however, be fully considered in the article upon spectacles.

Short-sighted persons often inquire whether they may wear spectacles for distant objects, or whether this would injure their sight and tend to a rapid increase of the myopia. Now, there cannot be any harm in giving them suitable glasses for distance. By so doing, we neutralize the myopia and change their eyes into emmetropic ones, and thus enable them to unite parallel rays upon the retina. We should, however, prescribe the weakest glass with which the patient can see clearly and distinctly at a distance, so that he may only require to make use of a minimum of his power of accommodation, and not have to strain it unduly when he is observing near objects. For we must remember that he will but seldom have to look for any length of time at a distance, but will alternately observe near and distant objects; one moment looking at something on the opposite side of the street, the next into a shop window, or at some object near at hand. Now if the glasses are too strong, he is already obliged to use more than a minimum of his power of accommodation when he is observing distant objects, and will consequently have to make use of a still greater amount

(perhaps almost the whole) when he is looking at things but a short distance from him. This would soon lead to an increase of the myopia.

If the myopia is only moderate in degree, and if the range of accommodation is good, we may permit the use of glasses which entirely neutralize the myopia, such in fact as enable the patient to see as well at a distance as a normal eye, and render his eye emmetropic. If the patient is young, if the range of accommodation is good, and the degree of myopia moderate, such glasses should be worn not only for distance, but even for near objects, as in reading, writing, sewing, etc. Donders has indeed found that the myopia is, under such circumstances, remarkably little progressive, and he thinks that the use of glasses in myopia should be commenced early in life.

But when the degree of myopia is considerable ($\frac{1}{5}$ or $\frac{1}{6}$), the range of accommodation diminished, and the acuteness of vision impaired, it is not advisable completely to neutralize it. We should then give the patient weaker glasses, and permit him the use of a double eye-glass to hold before the spectacles when he desires to see a distant object very distinctly.

If persons desire spectacles to enable them to see objects at a distance of 18″—24″, as for

instance, the music in playing the piano, it is generally best to furnish them with glasses that bring their far point to this distance, for if the myopia is at all considerable, and they use completely neutralizing glasses, these are sometimes found to inconveniently diminish the size of the music, and render it somewhat indistinct and difficult to decipher.

It is still a somewhat debated question whether myopic persons may be allowed the use of glasses in reading, writing, etc. Where the myopia is but slight in degree, so that the person is not obliged to approximate the work very closely to the eye, they may be dispensed with. But just in these cases we find that the myopia may be completely neutralized, and the glasses used with advantage for all purposes. Where the short sight is considerable, so that the far point lies very near the eye, and necessitates a close approximation of the object, it is advantageous to give glasses which will remove the far point to a distance of 14—16 inches, so as to prevent the necessity of stooping, more particularly if the patient is tall and much engaged in writing. This habit of stooping gives rise to an increased flow of blood to the eye, and to an increase in the tension of the fluids within the eye. And this undoubtedly greatly tends to promote the

development of sclerotico-choroiditis posterior, effusions of blood, and detachment of the retina, which are so apt to occur in short-sighted persons. On this account, we should, therefore, always direct myopes to read with their head well thrown back, and to write at a sloping desk.

But the strong convergence of the optic axes, which takes place when the object has to be held close to the eye, is also a source of great danger, for it is always accompanied by an increased tension of the eyeball and of the accommodation. The latter is an associated action, not arising from the mechanism of the convergence, but existing within the eye itself, and may, consequently, easily give rise to an increase of the myopia. But besides this, the pressure of the muscles upon the eyeball is greater when the optic axes are convergent than when they are parallel, and this increase of pressure must tend to give rise to the development of posterior staphyloma, and to hasten its progress. The increase in the tension of the eyeball is particularly marked when the internal recti muscles are weak, and thus render the convergence of the optic axes more difficult.

Now if we afford such very short-sighted persons the use of glasses which enable them to read and write at a distance of 14—16 inches from the eye,

we do away with the necessity of a considerable convergence of the optic axes, the stooping position, and the evils to which these give rise.

But it may, on the other hand, be urged that it is just in looking at near objects that myopic persons have an advantage, as they can see them remarkably distinctly. The great danger is, moreover, that after reading for some time with spectacles, the patient, on getting somewhat fatigued, is apt, instead of laying the book aside, to approach it nearer to the eye in order to gain larger retinal images, and thus to strain and overtax his power of accommodation. If, for instance, we give a patient, whose far point lies at 8″, a pair of spectacles which enable him to read at 12″—14″, he will, if not very careful, after a short time, almost insensibly bring the book nearer to his eyes, and thus be forced to make use of a greater amount of his accommodative power. If he does this frequently, the myopia will soon increase in degree.

Spectacles may also be used for near objects in those cases of myopia which are accompanied by muscular asthenopia (depending upon an insufficiency or weakness of the internal recti muscles), which manifests itself as soon as the patient has worked at near objects for a short time.

Whilst these forms of myopia may, with advantage, be permitted the use of spectacles for near objects, they must be forbidden if the range of accommodation is very limited, and if the patients suffer from such a degree of amblyopia (generally depending upon sclerotico-choroiditis posterior), that they are unable to read No. 2 or 3 of Snellen's types. The glasses will diminish the size of the letters, and, in order to see them under a larger visual angle, the patient will bring the object very close to the eye, which will cause the accommodation to be greatly strained, the intra-ocular pressure to be increased, and serious mischief will but too surely ensue. Hence spectacles should not be permitted for near objects when much amblyopia exists.

If the myopia is very considerable, we find that generally only one eye is employed for near objects, and the convergence of the optic axes therefore annulled. Donders says with reference to this point, "This appears to me to be often a desirable condition: in strong myopia binocular vision loses its value, and the tension which would be required for it cannot be otherwise than injurious. Now, in such cases, for reading no spectacles are given; in the first place, because the acuteness of vision has usually somewhat decreased, and the diminution

of concave glasses is now troublesome; in the second place, because, with the retrocession of r, injurious efforts at convergence and at binocular vision might be excited. In any case the spectacles should be so weak as to avoid these results."

The question as to the shape of the spectacles, and whether they are preferable to single eye-glasses, etc., is treated of in the chapter upon spectacles.