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THE CAUSES OF ASTHENOPIA.

By D. B. St. John Roosa, M.D., LL.D.,
PROFESSOR OF DISEASES OF THE EYE AND EAR, NEW YORK POST-GRADUATE MEDICAL SCHOOL;
SURGEON TO THE MANHATTAN EYE AND EAR HOSPITAL, NEW YORK.

Ever since the invention of the ophthalmoscope and the discovery of hypermetropia and astigmatism, the profession has been often agitated in certain parts by the discussion of the causes of asthenopia. Like many other great discoverers, Donders remained unaware of the magnitude of his own work, perhaps until the date of his death, but thought he discovered in hypermetropia the source of nearly every form of asthenopia. He grudgingly admitted that there might be what is termed muscular asthenopia, but the general tenor of his treatise indicates a practical familiarity with accommodative asthenopia only. As has been often demonstrated, he found the profession ignorant of the true source of a large percentage of the cases of asthenopia, and busily and blindly engaged in cutting muscles for its relief. Although he discovered the existence of astigmatism, he seems not to have been aware of the widespread occurrence of this defect, and certainly he did not at all comprehend its importance in the production of asthenopia. It has been reserved for the later generation to demonstrate this. My thesis is that asthenopia is the result of ametropia, so far as it depends upon the refraction—not merely of hypermetropia, which is a large factor in the production of the train of symptoms that we group together under the term asthenopia, but also of astigmatism, chiefly hypermetropic astigmatism. While myopia plays some part in the production in a limited number of cases of asthenopia, it has no such importance as hypermetropia and hypermetropic and mixed astigmatism. Myopes are not usually asthenopic. I utterly discard muscular asthenopia, and regard it as a term founded upon insufficient knowledge of the real causes of the inability to continue to use the eyes. I attach no importance whatever to the measurement of the power of the muscles of the eye, in the same or in different individuals, except as a matter of unimpor-

tant physiological investigation, or as a means of noting what have been the evil effects of ametropia.

After years of investigation of the large class of asthenopic cases that come to the ordinary ophthalmologist—probably at least 40 per cent. of all the cases presented to him—I find, after a fair trial of prisms and tenotomies for insufficiencies, that complete correction of the refractive errors is the only means of satisfactory results. For a number of years I was in the habit of thoroughly using atropine to relax the accommodation, and although its use was temporarily unpleasant to the patient, annoying and trying to the practitioner, I found that there was no substitute for it, and that I must get the accommodation fully relaxed before I could determine the exact condition of the refraction.

While active in this kind of practice, I became familiar with the perfected ophthalmometer which Javal, after years of hard work in conjunction with his assistants, finally presented to the profession, having been stimulated to the study of ophthalmometry by Helmholtz, who invented an ophthalmometer that could only be used in the laboratory. I found in it a means of determining the astigmatism absolutely, without atropine, and, at one swoop, all my difficulties from the enforced use of atropine vanished. The relief and the exactness now afforded me in my practice are simply incalculable. Once having demonstrated the cure of astigmatism the rest became easy. Fortified by my previous experience of the inutility of the measurement of the strength of ocular muscles, I have been enabled to continue my work with a satisfaction hitherto unknown. I regard the perfected ophthalmometer as an instrument second only in importance to the ophthalmoscope. I am very far from asserting that all cases of asthenopia depend alone on errors of refraction; but I do assert that they depend either upon constitutional conditions such as neurasthenia, nervous exhaustion or the like, or else upon errors of refraction, or upon the two causes combined, and that muscular insufficiencies have nothing whatever to do with them. The doctrine of reflex symptoms extending beyond the eye and the eyelids as being caused by want of muscular balance, I utterly reject.

The term asthenopia comprehends a great deal, and its definition has been enlarged by the observations and researches of the last ten years. We say a person is asthenopic when he is unable to continue to use his eyes upon very near objects for any considerable

length of time. Of course it exhibits itself in such occupations as reading, writing, sewing, and the like, very prominently. The patient commences to read or sew or write, and may be able to go on for a few moments with ease and celerity, but soon, as they expressively state, a blur comes over the page, the eyes fill with tears, they wipe them away in vain, and soon find themselves compelled, on account of the pain and inconvenience, to give up their work.

This is the simple picture of asthenopia, but added to it we have learned to find certain objective conditions, the result of this impaired action of the muscles of accommodation. Reddened eyes, reddened eyelids, watery eyes, headaches, are all now recognized as results or coincidents of asthenopia. The natural inquiry is, What is the cause of this train of symptoms? In attempting to discuss this, I will first say that I dismiss from consideration, for the present, for the sake of clearness, all those cases in which the eye is actually diseased: the asthenopia resulting from inflamed eyes, inflammation of the cornea, inflammations of the humors of the retina or the nerve, are not included in the present discussion. I speak simply of the asthenopia in eyes that are sound, except as far as their refractive conditions are concerned. It is an old and a true statement, that there is no such thing as a perfect eye. The ideal eye is one in which parallel rays unite upon the retina without any effort of accommodation, without any adaptation of the ciliary muscle, when the eye is in a passive state. This is the emmetropic eye, but this eye, when we have excluded the myopes, does not exist probably in more than 4 per cent. of cases. The average eye is hypermetropic. When the existence of hypermetropia was discovered as a general defect by Donders, it was supposed that it was an exceptional condition, although it was known that an absolutely emmetropic eye was comparatively rare. We now know that a high degree of hypermetropia may be concealed by an effort of accommodation, and that it may never become troublesome, until patients become presbyopic. It is utterly unreasonable, therefore, from any radical standpoint, to assume that asthenopia depends exclusively on any error of refraction, when the whole world has errors of refraction, and only a small number suffer from asthenopia.

Astigmatism, which as we all know is but an exaggeration, in one meridian of the eye, of the hypermetropia or myopia that may exist in the other—astigmatism has come to the front as a factor in

the causation of asthenopia. Probably the human race can tolerate less of astigmatism without asthenopia, and especially of hypermetropic astigmatism, than they can of any other ocular defect, but even here we find a great deal of tolerance to abnormal conditions; that is to say, conditions that are technically abnormal. If we were to examine a large number of people who had never suffered from asthenopia, we should find a large proportion of them hypermetropic, or having hypermetropic astigmatism. The investigations that I have made and published in this direction show this. The profession, in my opinion, has fallen into an error in seeking the causes of asthenopia too exclusively in errors of refraction, but they have made a much greater error in assuming that conditions of the muscles produced entirely by errors of refraction are causes of asthenopia. An enormous degree of energy has been expended in determining the relations of the external muscles of the eye to each other. Numerous interesting machines for the measurement of the power of these muscles have been invented—but the machines are unnecessary, because we are merely measuring a relative power; we are determining merely how much effect an error of refraction has had upon disturbing the relation of the muscles to each other. Strabismus, or squint, is a striking example of this. Whatever else causes strabismus, one of the most important factors in its etiology is the refraction. At the bottom of most cases of strabismus convergens will be found hypermetropia, or hypermetropic astigmatism, together with the unequal refraction of the two eyes. Whenever it is possible to secure binocular vision by glasses, it is often very easy to correct the strabismus without operation.

In my opinion, the matter of strabismus explains the whole subject of insufficiencies—want of coördination of the ocular muscles; that is to say, in strabismus such a marked deviation is invariably found to be associated with a decided error of refraction, and is corrected in very many cases simply by correcting the error of refraction. It is certainly proper to infer that latent insufficiencies of the muscle, latent squints if you please, are also caused by the errors of refraction—the greater includes the less. After operation for the deformity which we call strabismus, we correct the remaining insufficiency by glasses, not by prisms, but by spherical or cylindrical or spherico-cylindrical glasses as the case may require.

I conclude—

1. That errors of refraction of a decided degree may of themselves, in healthy, non-neurotic subjects, cause asthenopia.

2. Especially is this true of hypermetropic or mixed astigmatism. Asthenopia is comparatively rare in myopes.

3. Slight errors of refraction are the rule in the human race, and do not of themselves cause asthenopia.

4. Muscular insufficiencies are entirely the consequences of errors of refraction.

I have stated these four theses, referring only to the refraction of the eye, and I wish to add that neuroses, acquired and congenital, are in themselves a fruitful source of asthenopia. Neurotic people will be annoyed by a slight error of refraction. It will cause in them very many symptoms, but it must be carefully noted that the ocular defect is only one of the innumerable things of their environment which render them unable to use their eyes, their brains, or their limbs without annoyance and trouble. A fair specimen of an acquired neurotic condition is to be found in a patient convalescing from typhoid fever or from any grave malady like this or the "grip." The physician who endeavors to alleviate the distressing symptoms of which asthenopia will form one, in such patients, by glasses or tenotomies, will find himself chasing an *ignis fatuus*, which will lead him into a bog from which he never will be extricated.

There is a vast deal of legitimate work in the relief of asthenopia, by the finding out of the exact deviation of the eye from a normal standard of refraction. But it is not the part of wisdom to seek to limit the causes of asthenopia even to fixed refractive conditions. We have learned very much since the original discoveries of Donders upon this subject, but all that we know is, I believe, a logical deduction from principles which he has laid down. So far as we have departed from these principles we have gone into error.