

The relation of errors of refraction and insufficiency of the ocular muscles to functional diseases of the nervous system / by D.B. St. John Roosa.

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BY

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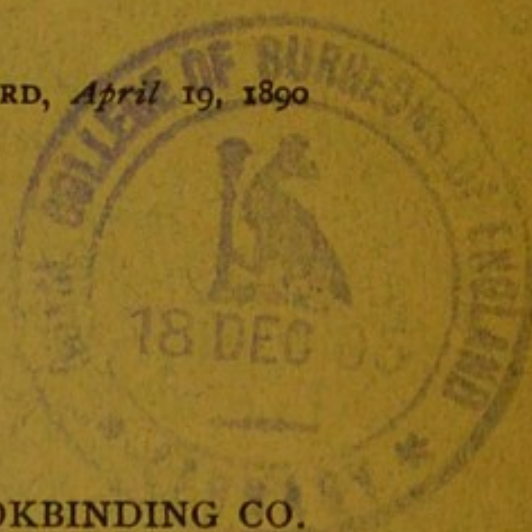
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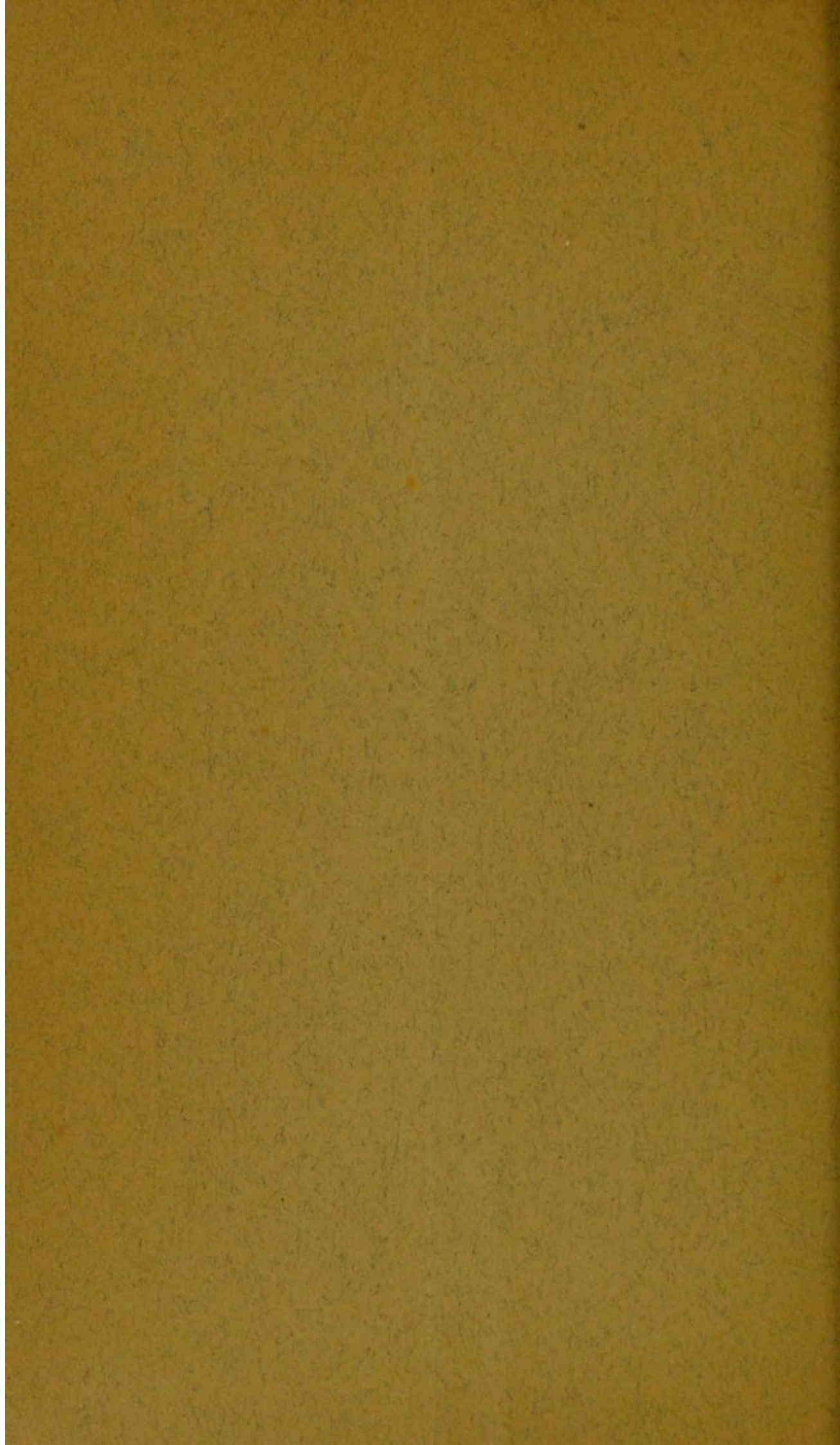
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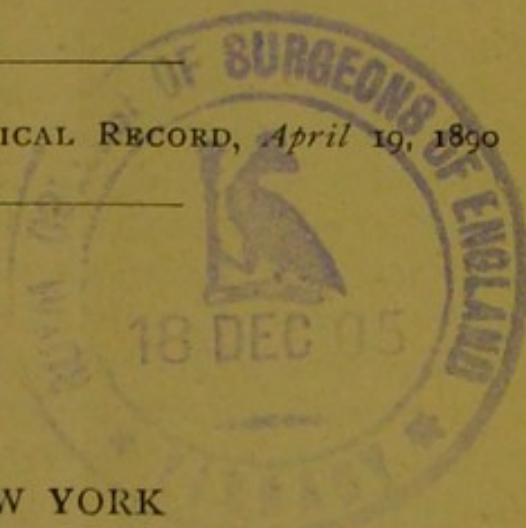
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THE RELATION OF ERRORS OF REFRACTION AND INSUFFICIENCY OF THE OCULAR MUS- CLES TO FUNCTIONAL DISEASES OF THE NERVOUS SYSTEM.¹

ABOUT thirty-three years ago, when Donders began to make known in Graefe's *Archives* his great discovery, the fruit of some years of labor in the light of the ophthalmoscope, that asthenopia was chiefly the result of an error of refraction whose nature he had himself clearly demonstrated, he found the medical profession engaged in proving that it was due to defective action of the external muscles of the eye. It was then taught by the highest authorities, that the cause of asthenopia was to be sought in a spasmodic contraction of some of the ocular muscles. There were practitioners, as Donders remarked, who had the courage to divide these muscles for asthenopia, and he proceeds to say, that this is a melancholy page in the history of operative surgery.² But these practitioners are to be forgiven; they had gone as far as our knowledge of physiology would allow. The source of the accommodation of the eye for vision at different distances, had not then been discovered, nor had its mechanism been explained. The retina, however, had been abandoned as the *fons et origo mali*, and we were nearing a solution, when the ills of asthenopia were ascribed to muscular action and not to the retina, even if the wrong muscles were attacked.

Any proper discussion of so-called ocular reflexes, re-

¹ Read before the New York Academy of Medicine, March 20, 1890.

² On the Anomalies of Refraction and Accommodation, p. 272.

sulting from strain of the eye, must begin with a definition of asthenopia. Perhaps that of Donders is the best.

"The eye has a perfectly normal appearance, its movements are undisturbed. The convergence of the visual lines presents no difficulty. The power of vision is usually acute, and nevertheless in reading, writing or other close work, especially by artificial light, or in gloomy places, the objects after a short time become indistinct and confused, and a feeling of tension comes on, especially above the eyes, necessitating the suspension of work. The person so affected now often involuntarily closes his eyes, and rubs his hands over the forehead and eyelids. After some moments' rest he once more sees distinctly, but the same phenomena are again developed more rapidly than before. The longer the rest has lasted, the longer can he now continue his work."¹

But Donders went no further than to say that the asthenopia thus described, depended upon one of two causes: either upon a short eyeball, hypermetropia; or upon some constitutional disturbance, such as occurs in a marked way in paralysis from diphtheria, and prevents the use of the muscles of accommodation. This latter form, has been often confounded with that which Donders said was caused by hypermetropia. It may exist coincidentally with hypermetropia, usually of a low degree, or with weakness of ocular muscles, and it is an accommodative asthenopia. But an error of refraction is not at all the cause of it. Exhaustion of the nervous system, hereditary or acquired, from various sources, is at the bottom of this kind of asthenopia. It often depends upon incurable general conditions. But true accommodative asthenopia is curable by means of correcting glasses. The former variety is sometimes called American asthenopia. It is more common in our country than in France, perhaps than in Germany and England. At least one Frenchman thinks it is more frequent in New

¹ Loc. cit., p. 259.

York than in Paris, because New York men and women are not so well nourished by good and well-cooked food and sound red wine, as are the corresponding class in Paris. I am not prepared to dispute this opinion.

It is important to bear in mind this distinction between accommodative asthenopia occurring in neurasthenics, women with uterine disease, malarial subjects, those recovering from typhoid fever, and so forth, who, at the same time, like the rest of the world, have slight refractive errors and insufficiencies, and pure accommodative asthenopia in healthy subjects, caused either by high degrees of hypermetropia, astigmatism of even moderate degree, great weakness of the internal recti, unequal refraction of the two eyes, or the like.

Although Donders was the discoverer of the nature and the cause of asthenopia, he had no idea of its frequency. While he recognized the fact that headaches, melancholy sensations, and a long train of evil symptoms might result from asthenopia, he did not know how frequently these symptoms were caused by ocular fatigue. In his time the public were somewhat discouraged in getting medical aid for the relief of these symptoms, and readily gave up the use of their eyes for near work, and turned to agriculture or idleness, as a palliative for what could not be cured.

Donders found in a shortened eyeball the chief cause for asthenopia; as he says, "hypermetropia is usually at the bottom of asthenopia." If he had known as much of the effects of astigmatism as he and Knapp had shown us of its nature, he would have said hypermetropia *and* astigmatism.

At this very time, Graefe was in the midst of his investigations of muscular asthenopia. Donders was careful to describe muscular asthenopia also. He believed that it depended chiefly on insufficiency of the internal recti muscles. Up to this day Donders's classification has been pretty generally accepted, and all writers speak of accommodative and muscular asthenopia. But Donders underrated the importance of astigmatism in producing

asthenopia, and, scientific and wise as he was, he was so overshadowed by the great genius and authority of the pioneer in modern ophthalmology, Graefe, that he laid undue stress upon muscular asthenopia, although his work removed a great deal of what I believe was not only then, but is now, a fictitious importance ascribed to this latter condition. Even then, he calls attention in an uncertain way to the important fact that errors of refraction were practically fixed conditions, while muscular insufficiency must be as variable in the eyeball as in the leg or hand. But Donders's work stopped much of the cutting of external ocular muscles and narrowed the field of muscular asthenopia. In reading the work of the great Dutch physiologist in the light of subsequent years, it seems as if his courtesy restrained him from speaking his full mind about the *ignis fatuus* of asthenopia dependent upon insufficiencies of ocular muscles. Graefe admitted at a very early stage, that the combined action of the recti interni for accommodation for the near point is extremely different under physiological conditions in different persons. He might have added in the same person.¹

Matters as to asthenopia, both in the old and new world, rested for a number of years about where Donders left them. Although he speaks of gloomy feelings being changed to those of hope and exuberance, in consequence of a relief from asthenopia by wearing glasses, and adduces several graphic cases of this kind, he did not fully appreciate the great relief that the practice of ophthalmology in the light of his discovery of the nature of hypermetropia and astigmatism, was to bring to thousands upon thousands of suffering men and women, much less did he dream that the origin of nearly every form of disease of the nervous system was to be found in an error of refraction or an insufficiency of ocular muscles. It was reserved for America to claim that not only asthenopic affections were due to errors of refraction and accommo-

¹ Archiv., B. iii., Ab. 1, p. 308.

dation and muscular insufficiencies, but, to quote the exact words of the author, "difficulties attending the functions of accommodating and of adjusting the eyes in the act of vision, or irritations arising from the nerves involved in the processes, are among the most prolific sources of nervous disturbances, and more frequently than other conditions constitute a neuropathic tendency."¹

But the definition of asthenopia became more comprehensive, the resulting headaches and twitching of the lids were more fully described and recognized by ophthalmologists everywhere. Blepharitis and styas and tarsal tumors, were added to the list of these consequences.² But until about 1874 the evil consequences of uncorrected errors of refraction, were supposed to be limited to the area directly in connection with the eyeball. There was no claim that asthenopia, except by mental depression, extended beyond this region in its evil effects.

At first it was claimed that chorea as well as epilepsy, although sometimes dependent upon organic lesions, were generally functional nervous affections, under which head they are classed. And even now Dr. Stevens says :

"The anatomical lesions of the brain or of the cord are sometimes coincident with chronic chorea it is true, but that there is necessary or causative relation between the two conditions has not yet been shown. Indeed, it is much more probable that the anatomical lesions of the brain and cord are among the results of chorea, or of the irritation causing it, and that they are not in any respect the original sources of irritation."³

Of late this claim has been somewhat modified, and great pains is now taken to state that, when epilepsy and chorea are mentioned, there must be careful discrimination between functional and organic chorea and epilepsy,⁴

¹ Functional Nervous Diseases, George T. Stevens, M.D., 1887, p. 21.

² Roosa: Transactions International Congress of Ophthalmology. 1876.

³ Loc. cit., p. 88.

⁴ Journal of Nervous and Mental Diseases, November, December, 1889.

and that only the former are proper subjects for operation. In the early papers we hear very little, if anything, of the differences between chorea and epilepsy dependent upon organic causes, and the functional forms. Dr. A. L. Ranney, who is well known as a disciple of the promulgator of the doctrine of the ocular origin of nervous disease, even now speaks of chorea as always a functional nervous disturbance. He says that it is doubtful to his mind, if any changes exist in the brain or spinal cord with chorea.¹ The same author admits that epilepsy may have an organic cause. But it is apparent that he believes that this is exceptionally true and that epilepsy is also a functional disease.²

When chorea, epilepsy, and insanity were all classed under the head of functional nervous disease, it was at first claimed that hypermetropia was the chief influence in the production of these functional nervous diseases. It was then deemed sufficient to correct the hypermetropia or the astigmatism. In a paper read before this Academy,³ it is plainly stated by Dr. Stevens, that "chorea is a functional disturbance of the nervous system, which may give rise to organic lesions, and which arises from irritation dependent upon anomalous refraction of the eye, and in a very large proportion of cases to hypermetropia." But of late years, say from 1886 or 1887, the muscles are said to play the chief part in causing the functional diseases, and operations upon them are necessary for the cure. A new nomenclature has been promulgated for the purpose of defining muscular insufficiencies, and operations upon these muscles have largely supplemented or taken the place of the correction of errors of refraction. Thus we have returned in a circle to the position in which Donders found Graefe, and the ophthalmologists preceding him. Asthenopia, from which

¹ Lectures on Nervous Diseases, p. 494.

² Loc. cit., 474 et seq.

³ Transactions of the New York Academy of Medicine, vol. ii., p. 440.

nervous diseases of all kinds are now said to result, is chiefly dependent upon muscular insufficiencies and is generally to be relieved by operations upon these muscles.

It now becomes necessary to make rather a long quotation, in order to show what is claimed will follow from an adoption of the general principle, that functional nervous diseases depend chiefly upon faulty action of the eye.

"I think it not unreasonable to look for the future advance in medical practice along two great lines. That advance along one of these lines was begun when Jenner, recognizing the fact that the human subject may be made sterile to the development of certain organisms when once it has been preoccupied by the presence of the same or a similar class of organisms, introduced vaccination as a preventive of one of the greatest scourges of the race. In our day an army of investigators, well trained and well equipped, is exploring the realms of the minute in search of the micro-organisms which, in their invasions in swarming myriads within the human body, threaten to destroy it by their devastations. It is not impossible that against the inroads of the various organisms whose incursions constitute typhoid and typhus, scarlet fever and measles, cholera and yellow fever, barriers may be erected which shall in large measure protect against the class of maladies which now destroys so large a proportion of the population of the world. The advances which have already been made along that line are, doubtless, but the earnest of that which is to come.

"Along the other line we may look for as great achievements. The class of maladies which has been during all time relegated to the tender mercies of fetichism and superstitious notions of cures by drugs having no relations to the origin or the nature of the disorders themselves, will ere long be regarded as irregular phenomena resulting from well-defined causes of irritation, which causes must be sought for principally in the direction of difficulties in the performance of necessary functions. With the re-

moval of such difficulties we may look with confident expectation to the cessation of the peculiar irregularity which constitutes the special form of nervous disease. Through such means we may reasonably expect that the great class of functional nervous troubles, of which epilepsy and insanity, neuralgia and hysteria may be regarded as representatives, will be nearly as effectually guarded against as is small-pox by vaccination." ¹

The quotation just made, is an extract from the paper that led to the formation of a commission of experts, to investigate the subject of the cure of nervous diseases by glasses and tenotomies.

It was supposed at one time by some of the writers who have discussed this subject in the medical journals, that insufficiencies of the ocular muscles, except of the interni, were never discussed until the discoveries of 1876 and 1880; but reference to the writings of Graefe ² the nephew, Loring, and others, show that this was incorrect, and that even latent insufficiencies of all the muscles, were recognized years before this.

It was Alfred Graefe also who clearly laid down the rule, lately so often ignored, that errors of refraction and accommodation should be corrected before noting muscular insufficiencies, and this for the simple reason that muscular insufficiencies are often caused by uncorrected errors of refraction.

These novel views as to the causation of functional nervous diseases, have now been subjected to years of very thorough investigation, accompanied, on this side of the water especially, with much acrimonious disputation. In Europe they have excited little attention. A learned commission has sat upon the whole subject, and, although its report is unanimous, and bears, on the whole, rather heavily against the value of the discovery of a great principle of cause and cure, it cannot be said to have closed

¹ Stevens: New York Medical Journal, p. 428, vol. 45, April 16, 1887.

² Saemisch: Handbuch, Band vi., 4. Theil, p. 216.

the subject, for in the discussion that followed the report of the commission, one of its members seems not to be quite certain of the propriety of an adverse report. In his remarks he lays great stress upon the delicate instruments and manipulations which have characterized these curative operations, and he also said that "not being a neurologist, he did not feel competent to judge of the therapeutic effect of these operations."

From the editorial remarks of a journal conducted by another member of the commission, we may fairly conclude that he also did not fully agree with what was supposed to be a unanimous report. A leader in this journal says: "Now, what does this prove, and does it prove anything? It would seem to prove that Dr. Stevens's method is a therapeutic measure valuable as an adjunct, and that in certain cases where toxic medication is unwise, it constitutes one more means of alleviating suffering."¹

The commission, however, unanimously expressed the opinion that the method of Dr. Stevens does not afford a sufficient degree of relief to patients suffering from chorea or epilepsy to warrant its adoption or recommendation to the Neurological Society, as a means of cure, or as the sole therapeutic measure."² In the debate that followed among the neurologists, there was a minority which did not fully agree with the report.

It is evident, that there is still such a state of unsettledness in the minds of quite a fraction of the medical profession upon this subject, as to justify further discussion. For this reason I have accepted the invitation of the President of the Academy, to present my views upon peripheric irritation as a cause of disease, especially with reference to irritations of the eye.

The basis of argument by which chorea and epilepsy were considered to be due to errors of refraction and accommodation, has, in my opinion, been long since shown

¹ New York Medical Journal, November 30, 1889.

² Report, p. 32.

to be entirely fallacious, although in the monograph upon this subject from which I have already quoted, great stress is laid upon these tables. The following is an example of one of them :

Of 118 cases of chorea,¹ 78 are said to have been hypermetropic ; 13 had hypermetropic astigmatism ; 5 had mixed astigmatism ; 6 were myopic, and 11 had myopic astigmatism.

This table, and also the similar tables that are furnished with reference *to errors of refraction* in epilepsy and migraine, are of no more importance than if they stated that of one hundred and eighteen persons suffering from measles or a broken thigh, such a proportion were hypermetropic and so forth. It has been shown by myself,² by Ely,³ in his "Examination of the Newly Born" (correcting the observations of Jaeger, who had supposed the infantile eye to be myopic), by Randall⁴ and others, that only a very small proportion of adults or infants, say seven per cent., have absolutely emmetropic eyes. We did not know this when Donders made his discoveries, although Donders knew that a low degree of hypermetropia was exceedingly common, and he did not reckon such as likely to cause asthenopia. Indeed, he did not consider it to be an abnormal condition.

Stimulated by the claim made in 1876, which I have quoted, that functional diseases of the nervous system were due to hypermetropia more than to any other one cause, my investigations of adults who had never suffered from asthenopia and whose eyes were placed under the full influence of atropia, were first made in 1877. They were followed by others, and all agree in showing that, excluding the myopic, nearly all the world is hypermetropic. If all the world be myopic or hypermetropic, how can it be in reason claimed that these conditions in themselves

¹ Stevens : Functional Nervous Affections, p. 91.

² Transactions American Ophthalmological Society, 1878.

³ Archives of Ophthalmology, vol. ix.

⁴ American Journal of the Medical Sciences, July, 1885.

cause the functional diseases of the nervous system? At least the advocates of such a doctrine would be obliged to admit that other causes must act in conjunction, with these deviations from an almost unknown normal standard, to produce any grave disease.

It was demonstrated by these papers, and by C. S. Bull, that people could be perfectly well and have all the errors of refraction and accommodation that were said to cause chorea and epilepsy. These tables of errors of refraction occurring in epilepsy and chorea were thus stripped of all their value, and the arguments resting upon them fell with them. Without fairly admitting this, the tables were still published, but the argument was now changed to meet the new facts confronting the new theory. In a paper read in 1880¹ attention was called to the fact, said to have been discovered in 1876, that insufficiencies of the straight muscles of the eye, by causing want of co-ordinate action, might cause nervous disturbance in the same manner as, or in conjunction with, refractive lesions. Then the formula was altered, and now functional nervous diseases are dependent upon anomalous conditions of the refraction and accommodation, *or upon imperfect action of the muscles of the organ*, "more than any other causes combined."

It seems to have been thus tacitly conceded, that errors of refraction alone, are not the chief source of functional nervous disease, but this was not said, although the argument was transferred to the muscles of the eye, to muscular insufficiencies. It is the doctrine that nervous disease is caused by these insufficiencies, and is relieved by ocular tenotomies that I now wish to combat.

Before I follow this doctrine of the dependence of neuroses upon want of ocular muscular equilibrium, to its legitimate ending by statistics showing how few people have such a muscular equilibrium, I will read the main outlines of a table which shows what people who come to

¹ Stevens: Transactions Medical Society, State of New York, 1880.

an oculist for glasses actually suffer from, and how few of them have anything but accommodative asthenopia. Considering the assertion that, "more than all other causes combined," epilepsy, chorea, and other functional nervous diseases depend upon conditions of the eye, is it not remarkable that so few of them consult an ordinary oculist? These tables were prepared for me from my private case-books by Dr. Frank N. Lewis.

A table showing the symptoms complained of by patients, who came to have glasses fitted.

Asthenopia	1,445
Not seeing well in the distance.	428
No history ¹	325
Blepharitis, styas, chalazia, etc.	265
Headaches	213
Not seeing well for near work	211
Glasses unsatisfactory	191
Conjunctival irritation, trachoma.	178
Pain in the eyes	149
Diplopia	43
Muscae	39
Lachrymation	31
Sent by a neurologist to learn the refraction.	20
Dizziness	15
Twitching of the lids	11
Photophobia	5
Blur before one eye	5
Chorea	3
Sudden loss of vision	3
Twitching of the muscles of the eye.	2
Orbital neuralgia	1
Dilated pupil	1
<hr/>	
Total number of refraction cases	3,584
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Total number of patients examined	6,455

¹ Those having no history were chiefly cases of presbyopia or myopia, in which no asthenopia was complained of.

The refractive conditions actually found are shown in the following table :

	H.	M.	H. ast.	M. ast.	Mixed ast.	Refraction different in the two eyes.	Pr.	Muscular insufficiency.
Asthenopia	528	81	263	86	27	86	49	23
Not seeing well in the distance	35	166	42	104	26	20	..	..
No history	30	89	30	41	8	5	82	1
Blepharitis, styes, chalazia, etc.	111	19	53	11	3	12	3	..
Headaches	53	12	71	26	9	26	5	4
Not seeing well for near work.	33	..	31	13	4	..	..	..
Glasses unsatisfactory	6	31	38	45	6	3	17	..
Conjunctival irritation and trachoma. .	95	21	24	11	2	..	17	..
Pain in the eyes.	28	23	20	22	4	6	6	..
Diplopia	10	..	1	..	1	..	..	3
Muscae	17	2	2	2	1	1	..	..
Lachrymation	12	2	6	1	..	..	6	1
Sent by neurologist	6	1	1	1	..	..	3	1
Dizziness	5	2	3	..	1	2	..	1
Twitching of the lids.	2	1	3	1	..	..	..	..
Photophobia	1	2	1	..	..	..	..	..
Blur before one eye.	2	..	1	1	..	..	..	..
Chorea.	3	..	..	..	..	..	..	..
Sudden loss of vision .....	..	1	1	..	..	..	..	..
Twitching of the muscles of the eye ...	..	1	..	1	..	..	..	..
Orbital neuralgia	1	..	..	..	..	..	..	..
Dilated pupil. ....	..	..	1	..	..	..	..	..

These patients came to me, not because they had general nervous disease, but because they had symptoms beginning plainly in the eye, or in its appendages or adjacent to them. There I think may be found a true guide in diagnosis. It will be remembered, that in accordance with the theory that the causes of chorea and epilepsy and so forth, are to be found in the ocular refraction or muscles, it is not necessary that the eye or its appendages should manifest any symptoms at all. The condition of the eye is to be revealed by skilled observations as to the refraction, and delicate tests as to muscular equilibrium. These causative conditions may be completely concealed until thus demonstrated. Patients who never knew that they had an ocular symptom, are told that all their troub-

les proceed from their accommodative and visual apparatus. This is not in accordance with the usual condition of things. A splinter in the tissue, a foreign body of any kind in any part of the body, whatever reflex disturbance it may give rise to, will usually give local symptoms also, and thus call attention to its origin. In this, I do not believe the eye, ear, nose, or throat are any exceptions. If we have actual reflex disturbances of the general system from the eye, besides those disturbances, asthenopia in one of its many forms will show itself. I do not believe that a refractive error or a want of muscular equilibrium that causes no local disturbance, will, except in highly exceptional cases, if ever, cause any constitutional affection.

It is not possible in such a paper as this, to give even the outlines of the individual cases that demonstrate in detail, and unanswerably, the failure of this theory to account for the origin of nervous diseases. If *falsus in uno, falsus in omnibus*, be good logic, every oculist's case-book will overthrow the doctrine of the ocular origin of nervous disease. Chorea has been entirely recovered from years before any correction of an error of refraction occurred. In other instances, one eye has never been used with the other, and yet most active careers, requiring most profound, patient, and exacting mental labor have been successfully carried on, marred only by slight asthenopia. Again, vertigo said to depend upon want of co-ordination of the ciliary and recti muscles, has been recovered from, while the want of co-ordination remained just the same. Every oculist of wide experience sees many such cases. They utterly destroy the theory that any discovery has been made of wide adaptation, which places refractive defects at the basis of general disease of the nervous system.

I could speak also of the essays upon this theme, which gravely fill pages of print with the most primary details as to accommodation and tests of vision, details to be found in every text-book upon diseases of the eye, but which are described as being something new in connection with the

great discovery of ocular conditions "more than all their causes combined" as giving rise to nervous disease. I might also mention the anxiety produced in the laity about their eyes, which has caused presbyopes who have no accommodation of any disturbing kind, to submit to disabling of their vision with atropine for two weeks, in order finally to get a pair of glasses, which any oculist would prescribe, and correctly prescribe, in fifteen minutes by the clock. If this dictum which we are discussing be true, most physicians should become oculists. Very little other knowledge than how to test the refraction and the muscles, and how to cut the latter will be needed, if the predictions as to the importance of this discovery are fulfilled.¹

¹ The views of those who believe that migraine is always to be ascribed to ocular defects, if those defects are found, are well presented in a recent lecture by Dr. Seguin (New York Medical Journal, April 5, 1890). He says: "The proportion of subjects of migraine who have ocular defects is amazing; very nearly all have either errors of refraction or muscular insufficiency, or both combined. In 1882, I received from Dr. G. C. Savage, of Jackson, Tenn., a very courteous letter challenging me to furnish a case of migraine in a person with normal eyes. I have not yet met with one, though I have been told of two or three by oculists in whom I have confidence. Of course the statement as to the invariable concomitance of eye-faults with migraine presupposes that the patients have been examined thoroughly—*i.e.*, under the full effects of atropine for refractive errors, and by Stevens's method for muscular insufficiency. I regret to say that there are still oculists of good standing who examine the eyes of headache cases in the most careless way, ordering glasses without having used atropine, and ignoring the muscles altogether. This has happened under my observation in New York within six months."

All this argument falls to the ground, when we learn that thousands of people have all these defects and yet have no migraine. I have also seen many persons with migraine who were no better after a careful correction of astigmatism and muscular insufficiencies, although some are much relieved by glasses, especially cylindric glasses. Dr. Seguin adds: "Another argument in favor of the ocular origin of migraine is that other remarkable fact, that in many persons of both sexes the attacks diminish and cease between the ages of forty and fifty years. It is at this period that the power of accommodation becomes exhausted and a large part of the unconscious strain which has been going on from early youth is removed."

This cannot be the explanation, for it is just after presbyopia comes on, that astigmatism often becomes very troublesome, especially astigmatism of a moderate degree. I know of many cases where astheno-

It having been pretty thoroughly established that errors of refraction among well people, are the rule and not the exception, the next thing naturally is to determine how many well people—that is, well as to asthenopia and nervous symptoms—have what is called muscular equilibrium, or, to use a modern nomenclature, have *orthophoria*, or parallel eyes.

I have recently investigated these conditions of muscles, which are said to be the prominent, if not the chief, factors in causing neuropathic conditions, and I present the table herewith. The investigations were made by one of my staff, Dr. Deynard, of the Manhattan Eye and Ear Hospital, with the phorometer, with strict attention to the details laid down in the recent writings upon this subject. I personally have never examined the cases. Dr. Deynard has been perfectly untrammelled in his investigations.

One hundred and three persons who did not have any trouble with their eyes that they knew of, who read and wrote and sewed, without headaches or asthenopia, who had no vertigo, chorea, epilepsy, hystero-epilepsy, or insanity, were selected as objects for testing. Eighty-three were aural patients attending the Manhattan Eye and Ear Hospital; 6 were friends who came with them; 11 were physicians; 1 was a music teacher; 1 was a servant, and 1 a detective. Seventeen, or sixteen per cent., were found to have muscular equilibrium; 84, or eighty-one per cent., had a want of muscular equilibrium, so-called heterophoria; of these 27, or twenty-six per cent., had deviation

pia, blepharitis, and so forth, first appeared when glasses were needed for fine print, and the spherical ones proved insufficient. The cessation of attacks of migraine can hardly, in the light of this fact, be due to the let up in the accommodation incident to middle life. Dr. Seguin falls into the error now so common of ascribing headaches and so forth to the eye, simply because errors of refraction are coincident with the neurosis.

Many neurologists have unfortunately not kept up with recent accessible ophthalmological literature. They are working upon lines that were given up by oculists ever since the actual percentage of ametropia was discovered.

outward, exophoria, insufficiency of the interni, and 74, or seventy-one per cent., exophoria in accommodation; 16, or fifteen per cent., had deviation inward or esophoria, insufficiency of the externi; 7 had esophoria in accommodation; 11, or ten per cent., had hyperphoria, a tendency of the right or left visual line upward; 24 had hyperphoria in accommodation. A re-examination of five of these patients all showed a change in the muscular examination from that found at first. This is an important observation, since it proves, as asserted by Starr and others, that the muscular power in the same eyes is not fixed, but variable.

Hence it is seen that any series of cases founded upon certain ocular insufficiencies, cannot be said to be proven when the existence of these insufficiencies is shown, for they may exist in connection with entirely healthy nervous systems just as errors of refraction may. The value of observations founded on such tables is now no more than of those founded on errors of refraction. Not only does all the world have faulty refraction, but very few people possess equilibrium of the ocular muscles.

The capacity for great intellectual work with great muscular insufficiencies, is well shown by the following extract from a letter relative to the perception of distance by Sir William Rowan Hamilton, Astronomer Royal of Ireland,¹ printed in his biography: "Though I habitually see a double universe, yet a marked improvement has taken place within the last few weeks in my power of seeing single. This I attribute to my having lately, for the first time in my life, bought a stereoscope and used it at leisure. A friend within a few minutes' walk of me has long had a stereoscope apparatus, but years elapsed before I could catch the effect at all. With each eye separately I saw a good relief, but it is 'two years ago' that I first was able to see that *tertium quid* which is the true re-

¹ I am indebted to my friend Dr. Dennet for this quotation from the life of this eminent savant.

sult of the stereoscope, and certainly it greatly astonished me " (written by Hamilton to De Morgan at fifty-eight).

Hamilton also states that on the evidence of his friends he did not squint, and his photograph shows that he did not do so in any marked degree.

The study of the causation of disease is certainly a very important one, but it is almost as puzzling at times as the theological problem of the origin of evil in the world. Yet some things we do know. If a man lives in a malarial swamp and intermittent fever attacks him, or if he drinks water polluted with typhoid bacilli and gets typhoid fever, or if he is exposed to a case of small-pox and breaks out with this disease, or if after prolonged exposure to wetting he is attacked with acute rheumatism, we have no difficulty in saying as to where the cause of his disease is to be found. But no philosopher will conclude that cholera is caused by insufficiency of the ocular muscles, because a large proportion of those seized with this disease, as is certainly true, have such an insufficiency. The true philosopher will recognize in nervous maladies a series of causes acting together, and at the bottom of them all, in this country at least, will be found that illy defined condition of which we know so little, but of which we shall know more, called, nervous exhaustion.

To go back to errors of refraction for a moment. Another fact should be noted in this discussion. Contrary to what is stated by Ranney, hypermetropia is constantly outgrown in the development of the eyeball, as every ophthalmologist knows. A hypermetropic eye may even become myopic. Glasses needed at twelve and fourteen are discarded without asthenopia at twenty, and so forth.

The inconvenience of uncorrected errors of refraction, especially of high degrees of hypermetropia, and of even inconsiderable degrees of astigmatism, can hardly be overestimated with reference to their influence upon the head and the face, and upon the spirits of some patients, but their influence generally seems to stop there, except in very rare cases in neurotic subjects.

It is not an uncommon experience in malaria and after recovery from typhoid fever, to find accommodative asthenopia, which is only relieved when quinine has cured the malaria, and time and hygiene have restored the shattered nervous system of the sufferer from the *fièvre nerveuse*.

Those who believed that in the eye, "more than in all other causes combined," are to be found the cause of functional nervous disease, would have been now on surer ground if they had stood by the first declaration, that errors of refraction were the cause, and not taken refuge in want of muscular equilibrium.

A great deal of muscular insufficiency depends upon uncorrected astigmatism. Alfred Graefe and Loring were right. We can say very little as to what constitutes a muscular insufficiency until the refraction, and I say especially the astigmatism, be corrected. A thorough use of atropia, or better still, an examination by Javal's ophthalmometer, will often cause us to correct a troublesome insufficiency by cylindric glasses and not by prisms, much less by a tenotomy.

There is a large class of neurotic patients who may or may not have high degrees of errors of refraction, generally, however, they have only low degrees of hyperopia or hyperopic astigmatism, whose accommodative asthenopia, like their headaches, depend upon hereditary faults and predispositions. These neurotic families seek, now in one panacea and now in another, cure they will never get. Palliation is all there is for them. Neurotic they are born and neurotic they will die, although for a time one set of symptoms may be transferred to another. Like Dr. Loring's case which I have before alluded to in this Academy, "their eyes have got all right, but it has gone to the stomach." I know of a neurotic family where one member has had a dozen operations upon his eyes, but he is as neurotic as ever. Another has had all her troubles transferred from her ovaries to her eyes, by excessive attention to them. She goes about discoursing

upon advancements and divisions of recti muscles; but sure that without her oculists she would have died. A third member, with myopic astigmatism in one eye and myopia in the other, and the difficulties of presbyopia coming on, is nearly harassed out of his domestic peace by the urgent desires of his more fortunate relatives that he should seek relief in ocular tenotomies. Other patients, who have never suffered from asthenopia until they began to undergo treatment for nervous disease by tenotomies, wander over the earth seeking to have a double vision removed, of which they once knew nothing, and yet complaint is made by the author of the doctrine I am combating that, after months, and even years of attendance and several tenotomies,¹ patients are withdrawn from treatment while defects of great importance are known to exist, which by continuous effort might be removed.

Donders' argument, that in errors of refraction and not in muscular insufficiencies would be found the chief cause of asthenopia, was not put very plainly, but I undertake to say that not in the muscles but in the eyeball, in the refraction, the sources of ocular reflexes are to be found, such as occasionally exist, just as a foreign body in the ear may occasionally cause epilepsy, or a decayed tooth cause spasm of accommodation. The condition of the muscles is unstable, as has been pointed out; and, as my tables show, what is a man's power in his ocular muscles to-day, may be another to-morrow.

These cases of epilepsy and chorea dependent upon peripheric irritation are entirely exceptional, while asthenopia is real and common. We have no reason to hope, from anything that has yet been shown, that there is any large class of functional constitutional nervous diseases caused by peripheric troubles, and, as I have said, whatever there are, are to be sought for not in the muscles but in the eyeball. The conclusions to which I have

¹ New York Medical Journal, April 16, 1887, p. 427.

come, as a result of twenty-six years of work in ophthalmology, with a careful consideration of the writings and works of others, including those who believe that functional nervous disease is due to the eye "more than to all other causes combined," are as follows :

First. The eyeball of the human race is very rarely in what might be defined as an emmetropic condition.

Second. Perfect equilibrium of the ocular muscles is by no means a common condition, even among persons of sound health and without asthenopia.

Third. Defects in these two states by no means necessarily produce even local disturbances, such as are comprehended under the term of asthenopia, inflammation of the edges of the lids, and so forth, although high degrees of hypermetropia, moderate degrees of astigmatism, and all cases of mixed astigmatism are apt to do so, sooner or later.

Fourth. Asthenopia depends chiefly upon two sets of causes—nervous exhaustion and uncorrected errors of refraction.

Fifth. In estimating the influence of these defects great stress should be laid upon the general condition, and the line sharply drawn between asthenopia due to exhaustion and that to faulty refraction.

Sixth. Nothing has been added essentially to Donders' discovery of the fundamental cause of accommodative asthenopia, except that astigmatism forms a more important factor in its etiology, muscular asthenopia falls into the background, while the definition of asthenopia has been much amplified by ophthalmologists.

Seventh. The origin of a considerable class of such diseases as chorea, epilepsy, and hystero-epilepsy has not been found in errors of refraction nor in insufficiencies of the muscles of the eyeball.

The observing general practitioner of our city is able to test the truth of this latter proposition as he looks among the neurotic families and individuals of his acquaintance, and observes whether or not the use of glasses and the

performance of ocular tenotomies, are beginning to lessen the cases of chorea and epilepsy. Certainly a discovery which it was predicted would vie with those of Jenner and Lister has been proclaimed with sufficient fulness and clearness, and has been acted upon in an arena large enough to allow us by this time to judge whether or not it is an advance in rational and scientific therapeutics. I do not believe that it is, but I believe that the theory of the ocular origin of nervous disease, by distracting attention from the evident, and in some instances preventable causes of neuroses, has delayed our progress, and inflicted serious damage to the reputation of our profession for accurate observation and philosophical conclusions.