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THE THERAPEUTIC EFFECT OF PRISMS IN OPH-  
THALMIC PRACTICE: A STUDY OF ONE HUND-  
RED CASES IN WHICH THEY WERE PRE-  
SCRIBED.

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Among the cases herewith presented are included both those in which subjective eye symptoms were the controlling element, those in which these were associated with headache and other nervous disturbances, and those likewise in which headache and nervous troubles were the only symptoms complained of. The subjective eye symptoms were of the kind commonly grouped as asthenopic. In making records, little effort was made to draw from the patient an elaborate story of his sensations; only prominent features were selected both to save time and from a dislike to verbosity. On the contrary, the objective symptoms, in examination of refraction and of muscular capacity, were patiently investigated. The state of refraction was determined by the ophthalmometer, by the ophthalmoscope, by test glasses; and, in selected cases, by the help of full accommodative paralysis with atropia. Every case was examined by two observers. Resort was had to atropia when there were signs of spasm of accommodation, when the finding by the ophthalmoscope and the ophthalmometer did not tally with the examination by glasses, and when no obvious reason appeared for the failure to procure normal visual acuity. If the question is asked how spasm of accommodation is to be discovered without



employing a mydriatic, the answer is: the ophthalmometer discloses what is practically the real degree of astigmatism (admitting an occasional error of 0.5 D or 1 D, which belongs to the lens), the ophthalmoscope (carrying behind it, if needful, a correcting cylinder) will, in almost every case, disclose hypermetropia; and lastly the patient is asked to read Snellen's line of smallest capitals, No. 1: N P R T, etc., through a pair of convex prisms, consisting of  $+ \frac{1}{12}$  combined with prism  $5^\circ$ , the bases inwards. Emmetropic eyes see this print if there be no spasm at 12 inches without the prisms, provided the convergence of the visual lines does not induce accommodative effort. If the convergence of the visual lines be abated by prisms amounting to  $10^\circ$ , this stimulus to accommodation is eliminated, and emmetropic eyes, with visual lines converged not to a point 12" distant but to one about 60" distant, will read the print at 12". Hyperopic eyes will read it beyond 12"; myopic eyes at less than 12". In all cases, having by other methods acquired an approximate idea of the state of refraction, the behavior of accommodation is denoted by the distance at which through the convex prisms the print is read. A variation of one inch is not important; but if emmetropic eyes can make out the print at only 10" or 9", this signifies spasm, and suggests atropia. I have employed this plan of proceeding for twenty years, and am satisfied, in a general way, of its trustworthiness. Subjective symptoms of extreme pain, of frequent blur, of lachrymation, etc., will sometimes give decisive indications, and both the youth and sex and excitability of the patient will determine what should be done. This explanatory statement is made to vindicate the avoidance of mydriasis when no rational indications for it appear.

It is proper here to remark that deficient power of abduction is frequently associated with spasm of A, and that it is also set aside by suitable prisms (viz., adductive) without mydriatics.

Among the 100 cases to be discussed atropine was used in 7 instances, and in all these the ametropia was 1 D or less. What has been remarked is intended to rebut the argument that if in the following cases atropia had been more extensively used, a larger amount or a larger proportion of refractive error would have been disclosed, whose correction would have

or might have relieved the symptoms without resorting to prisms.

It is admitted that in some cases an unnoted error of 0.5 D or .75 D might have been brought to light, but it is not admitted that this addition to the correcting glass would have furnished relief. In many instances the experiment had been made of using glasses to correct ametropia, and with only partial relief; while the full benefit was not secured until prisms had been added. A very notable instance is case 51: the patient was provided with suitable cylinders for astigmatism, but did not get relief until she wore prisms for both insufficient abduction and vertical error (hyperphoria).

This paper might be entitled a study in therapeutics. Confessedly, no chapter in medicine is beset with so many difficulties. Especially is this the case when the test of our success or failure is the patient's testimony about pain or improved function. The possibilities of mistake the experienced physician well knows. Patients are eager to be better or are discouraged, and may deceive themselves and him either in one direction or its opposite. It is true we deal with measurable factors when we test ocular muscles by prisms, but experience shows that there is no absolute standard of normal capacity and comfortable use of the eye muscles. Although it will appear, I think, in this paper that some reliable data can be obtained to determine within what boundaries we are to look for pathological conditions, some unexplained discrepancies thrust themselves forward. We find, for example, that in some instances of notable relief there was very little corresponding change in the behavior of the ocular muscles; in other such instances there were improved muscular conditions. But the answer must be, that in such complex problems we do not know all the elements. Nevertheless and in spite of seeming inconsistencies, we have no other reliance than the persistent declaration of a patient that whereas once I could not work, now I can work; whereas I once had pain, I now have no pain or less pain, etc., etc. The one indispensable condition for a just conclusion is, that the patient shall have been under observation long enough to render a judg-

ment sound and correct. In these 100 cases this condition is complied with. In this respect I think it may be claimed that they are removed from the category of imaginative cases of which a most signal class is found among the patients now being dealt with, as the French say, "by suggestion." My aim has been to exclude such; and while in all the cases presented there seemed reason for employing prisms, in not a few their prescription was made as an experiment, just as, in giving drugs, we try this or that at a venture. These tentative cases are reported; and if the result sometimes was failure, an attempt is made to tell why. Sometimes it is as difficult to account for a success as for a failure.

The 100 cases discussed are taken consecutively as they occurred in private practice, and the only rule of selection has been, that there should be definite knowledge of the final result of treatment in each one.

The cases may be classified as follows:

*Sex.*— Males, 60; females, 40 = 100.

*Age.*— Under 10 years, 2  
 " 10 to 20 " 32  
 " 20 " 30 " 39  
 " 30 " 40 " 19  
 " 40 " 50 " 5  
 " 60 " 2  
 " 83 " 1 = 100

*Occupation.*— School children, students, and teachers, 39

|                         |   |
|-------------------------|---|
| Book-keepers,           | 8 |
| Lawyer,                 | 1 |
| Typewriter,             | 1 |
| Mechanical draughtsman, | 1 |
| Seamstresses,           | 2 |
| Milliner,               | 1 |
| Merchants,              | 4 |
| Physicians,             | 4 |
| Dentist,                | 1 |
| Banker,                 | 1 |
| Managers,               | 3 |
| Army officer,           | 1 |

|  |          |
|--|----------|
| Restaurant keeper,                       | 1        |
| Peddler,                                 | 1        |
| Commercial traveler,                     | 1        |
| Not specified, and mostly married women, | 30 = 100 |

In more than three-fourths of the cases the occupation was of a character demanding persistent and exacting eye-labor.

*Health.*—In all cases where conspicuous conditions existed a note was made; but, when there was no evident reason for inquiry because manner and appearances betokened good health, and nothing was said to the contrary, no note was taken.

|                           |          |
|---------------------------|----------|
| Health, good in           | 63       |
| Over-worked or exhausted, | 15       |
| Health, not good in       | 22 = 100 |

It appears that about 40% can be said to be in poor condition. Yet, by no means all of them were invalids. All were able to come to my office. Among the cases were not a few instances of persons in typical and even exuberant health. Some were men of large stature and great physical development.

*Ocular Symptoms* may be grouped as follows: pain, in 49; blurring or unsteadiness of print, in 18; inability to look at moving objects, such as a crowd of people, scenery from a railway window or from a carriage, playing cards, turning leaves of a book, etc., in 17; inability to look fixedly at one object, as at a speaker in church or at a theater or in conversation, 12 (these last two symptoms are eminently characteristic, and much more frequent than the record shows); incapacity for continuous reading or sewing or piano playing, etc., in 60; tendency to lose the place in reading, 2; troubled by seeing the nose, 2; difficulty in keeping eyes open, 2; occasional diplopia, 5; occasional strabismus, 2; photophobia, 4; unsteadiness of globes, especially twitching at the outer angles in lateral movements, in 11 (this symptom is far more common than is thus indicated; it belongs to a majority of the cases, because the recti externi are the muscles chiefly at fault: *vide infra*); spasm of accommodation, in 14; conjunctivitis usually slight, in 35; blepharitis, in 2.

*General Symptoms.*—Headache, in 57. In many instances it was the determining symptom which demanded relief. In most cases this was general; in some it was frontal or temporal or occipital or at the vertex. A singular feature of headache to which my attention has been called more and more of late is, that it often exists on first waking in the morning, and is increased during the day. I have come to regard this fact as indicating neurasthenia quite as much as asthenopia. But it does not always appear in persons of poor health. Vertigo noted in 9; nausea, in 7; insomnia, 1; melancholia, 1; forgetfulness, 1; inability to fix mind on work, 3; pain in remote parts, 3 (this number might have been much enlarged had care been taken to make thorough inquiry, but lack of time usually prevented); tenderness over supra orbital nerves, 3. Nasal catarrh was found in 16, and this complication was carefully looked for. Sometimes it required treatment; it was always complicated with palpebral conjunctivitis, and often severe. It may be noted that headache co-existed with nasal catarrh in only 5 of the 16 cases; and 11 were free from headache.

Passing now to the *state of refraction*, we have emmetropia, 47; hypermetropia, 25; myopia, 0; astigmatism, 27; viz., as. hypermetropic, 21; as. myopic, 4; as. mixed, 2; antimetropia, 1 = 100.

The refractive condition is certainly noteworthy, because 47% were normal eyes. Moreover, the degree of ametropia was less than 1 D in 45 more, making the total, in whom refractive error was either absent or insignificant, 92. The presentation of this fact seems quite enough to establish the claim that the element of distress in the cases was not the refractive error. A further argument to corroborate this conclusion is found in the fact that in 18 cases exhibiting refractive error, correcting glasses had already been tried without any beneficial result, and relief was obtained where prisms were employed with or without what may be called "focalizing" glasses.

We have next to state what muscles were chiefly affected. It would be most accurate to classify the cases by the functions of adduction and abduction and vertical movement, since in all of them several muscles are concerned; but, for the sake of

simplicity, the interni and externi will represent the groups concerned in adduction and abduction.

|   |         |
|---|---------|
| The number of cases of actual or supposed weakness of the externi was | 92      |
| The number of cases of actual or supposed weakness of the interni was | 7       |
| The number of cases of general muscular weakness was                  | 1 = 100 |

It must be added that among these cases were seven which exhibited, in addition, an error in movements up and down, whether the meridian was vertical or oblique. Since considerable importance has been attached to the influence of this kind of error, reference may be made to the individual cases: they were numbers 10, 11, 19, 26, 50, 51, and 52.

No. 10 was a case of weakness of externi, and there was a vertical error of  $2^\circ$  for both distance and near. He was a medical student, aged 20; was emmetropic; was under observation two years. He wore prisms of  $2^\circ$  each with bases outward, and had complete relief and ability to work; the vertical error disappeared.

No. 11 had insufficiency of the interni, besides vertical error; prisms were of no use, and tenotomy was advised.

No. 19, aged 20, was a typewriter, emmetropic, with weak externi, and a very slight vertical error not more than  $\frac{1}{2}^\circ$ ; wore prisms  $1\frac{1}{2}^\circ$  bases out constantly; was under observation  $2\frac{1}{2}$  years; while wearing glasses, had perfect relief. The remark is made that tenotomy for vertical error was suggested, but was never done.

No. 26, merchant, aged 34, with weak externi, given prisms  $1\frac{1}{2}^\circ$  O.U. for constant wear; under observation 6 months; was greatly improved, but did not get entire relief. A small vertical error was found, but nothing done for it.

No. 50, male, aged 19, student, with weak externi H + 0.50, was given prisms  $1\frac{1}{2}^\circ$  bases out for constant wear; was under observation 2 months. The existence of vertical error was predicated upon his habit of carrying the head inclined to the left shoulder. Moderate relief was obtained by the prisms, viz., the

increase of reading ability from  $1\frac{1}{2}$  hours to 3 hours daily. This result was not esteemed satisfactory, and tenotomy was advised.

No. 51 had proper glasses for astigmatism, but only got relief, by correcting errors both of abduction and of vertical deviation, viz., O.D. prism  $1^\circ$  base up, O.S. prism  $2^\circ$  base out, added to cylinders.

No. 52, female, aged 20, complains chiefly of headache, and had it for 2 years; under atropine H + 1 D; has weak externi; the head inclines to the right shoulder. Left eye stands higher than the right; asymmetry of the bones of the face; Ord. prisms  $1\frac{1}{2}^\circ$  bases out which she wore constantly for a month; subsequently used them only in near work; under observation 6 months; almost complete relief. For a time tenotomy was contemplated, but was not done. General health became better under the comforting effect of the prisms, and in the end they were laid aside.

These are all the cases of vertical error included among the present hundred, and in only one was this corrected by prisms. In the remaining cases it had no special import. I can furnish others where prisms with bases vertical were worn to advantage, and in other cases I have done tenotomy of either the superior or inferior recti. I find vertical errors rare, and in the large number of cases they do not need special consideration. I do not omit looking for them when proper relief is not obtained, nor where any suspicion of their existence can arise.

It will be seen that muscular asthenopia falls upon the function of abduction with an overwhelming preponderance. I was being led to this conclusion, in 1884, when a paper was read on this topic before the International Medical Congress at Copenhagen. Wider experience has given rise to absolute conviction that the externi are at fault with far more frequency than the interni. But it is not claimed that the ratio is so high as the present cases would indicate. This fact will more frequently come to the surface, when investigators shall free their minds from the prejudice that muscular asthenopia must be associated with ametropia, whether myopia or hyperopia or astigmatism. As a fact, the number of emmetropic eyes



among the community is immensely in excess of ametropic eyes. They *should* yield the largest contingent of cases of muscular error, provided the searcher looks for muscular error habitually and apart from, as well as associated with, ametropia.

*Diagnosis and Mode of Examination.*—My examinations have had respect to the working amplitude of convergence. I have not paid any heed to the so-called fusion near point or maximum of convergence. For emmetropic eyes I have taken 13" or one-third of a metre as a standard for the near (*punctum agendi*), and the same for hypermetropia, with proper refractive correction. Only in myopia has a shorter distance been sometimes employed. I believe we can come to more valuable practical results by testing the patient's capacity to overcome prisms at 13" than we can arrive at by employing the seemingly more scientific method of the nearest point of absolute fusion and working upon a basis of angles of convergence. We must give a patient time to learn what he is to do with prisms, and for facility of testing I may commend very strongly a simple device for holding prisms and other glasses which I have used for twenty years and which is figured in my text-book on diseases of the eye, p. 195. What we learn by prisms at 13" is, how much is the reserve power, and what are the relations of opposing muscular groups at the place where the patient does his work. This is the real object of our inquiry, and at this distance should we make our investigation. I make these remarks, because in this I differ from Landolt and most of the European authorities who write on this topic.

Neither do I lay so great stress upon the indications of the so-called equilibrium test of Graefe as many do. Especially do I insist that we ought to abandon the habit of designating the findings by this test as the measure and expression of the muscular insufficiency. For example, many say, and I formerly said, that if, in causing vertical diplopia by a prism with base upward, the images require a prism of  $3^{\circ}$  or of  $6^{\circ}$  to bring them into a plumb line with each other, this prism of  $3^{\circ}$  or  $6^{\circ}$  is the measure of the muscular insufficiency, and we assume that we have to do with exactly this amount of muscular

debility. (The new nomenclature of Dr. G. T. Stevens gives special names to these deviations, — esophoria and exophoria, — and, by so doing, tends to fix upon them an unwarranted importance in perpetuation of the former opinion.) I admit the great value of this test, and constantly reckon with it, but I shall show that its precision as a standard of measure is overrated; that it must be taken in connection with other elements, viz., the power of adduction and abduction, both for near and remote points. I suggest that a correct phrase, when we make this test, is to simply write in our notes how many degrees of displacement from the perpendicular there may be in vertical diplopia, whether of convergence (v. d.  $3^{\circ}$  conv.) or of divergence (v. d.  $3^{\circ}$  div.), and leave the designation of the amount of actual muscular insufficiency to be estimated by all the findings we gather. We may be unable to state the amount in number of degrees with precision, but we can state it proximately, and escape the error of a false estimate by assuming an unreliable standard.

It has become my rule to regard abductive power, at 20 feet, of  $5^{\circ}$  or less, as sub-normal. Sometimes abduction of  $6^{\circ}$  is regarded with suspicion. As a rule the normal amount at 20 feet I find to be from  $6^{\circ}$  to  $8^{\circ}$ . If adduction stands at  $20^{\circ}$  or  $25^{\circ}$ , and after a few days rises still higher, while abduction remains  $5^{\circ}$ , and *distressing symptoms exist*, the indication for prisms with bases out is clear enough for trial. If abduction be  $4\frac{1}{2}^{\circ}$  or less (because half degrees are important), the indication is conclusive.

I do not assert that abduction less than  $5^{\circ}$ , even with adduction above  $25^{\circ}$ , must always be regarded as proof of deficient ability for eye-work. I have examined many persons, who come under this category, who made no complaint of their eyes or of headache. My assertion is, that when complaint of eye or head symptoms concurs with such findings in abduction and adduction, we then are entitled to fix upon the muscles as the probable factors in the trouble. In other words, to some persons very feeble muscles or muscles in very great disproportionate power do not cause distress; while to other persons they are most

manifest cause of distress. What the unnamed quantity may be which determines either of these results, is matter for study. It may reside in the muscles or in the innervation or in both combined. Because it is unnamed, and may be various in character, it does not vitiate the conclusions of a scientific induction of ascertained facts.

*Treatment.*—It is almost needless to premise that any indications to be gathered from the state of health were invariably, and, so far as possible, efficiently, attended to. For example, exhausting causes, viz., over-work, extreme study, physical depression, mental distress, lack of suitable food and exercise, were so far as possible controlled. In some there was an extremely neurotic diathesis or irritating gouty diathesis to be dealt with, and usually with small success. Some were instances of great nervous depression, to be fairly called neurasthenia. In some there was uterine disease; in one there was chronic cystitis; in two there was chorea. Two had epilepsy. Nasal catarrh was noted in 16 cases, and always was attended to, and its influence upon the symptoms carefully discriminated. Mild conjunctival irritation was common, and in some cases was the chief source of discomfort. Usually it disappeared. But in two cases it proved obstinate, and the attempt to relieve it by prisms did not succeed. Giving heed to all that general therapeutics required, it is to be stated that many patients had already, at the hands of other physicians, been submitted to general and local treatment without relief; some had been seen by oculists. All these patients were regarded as having muscular asthenopia, and in the great majority this was counted the efficient factor in their trouble. In some the employment of prisms was tentative, and considered of uncertain value, and in some cases they were given to determine the diagnosis. Sometimes adductive prisms were given when the adduction was as low as  $7^{\circ}$  or  $10^{\circ}$ ; and if they were afterwards found notably useful, adduction materially increased. In some extremely difficult cases, with both abduction and adduction feeble, such prisms were employed as a possible relief, but proved to be of almost no benefit. I attach controlling importance to the results of examination at the far point. I order prisms with this in view, and have been taught

by experience that errors at the near point will frequently disappear or be so much abated as to secure the patient's comfort. Hence, I prescribe prisms to be worn continuously, and in exceptional cases only do I order a different kind of prismatic glasses for the near point. I sometimes, in a doubtful case, hook a pair of prisms upon the frame of the glasses which a patient must use for refractive error, and this permits their removal when desirable. Schiötz (l. c., p. 183) says: "Prisms are the most difficult things to order, because we can never predict what effect they will have. Many people cannot endure them; to others they are of the greatest assistance. If prisms seem indicated, I always tell the patient that they are chiefly experimental, and may be of no use to him." My experience has taught me to look for benefit from prisms with much more certainty in properly selected cases than most oculists have been able to do. I always insist that the patient must persevere in wearing them for several hours daily until all the preliminary annoyances disappear, and they can wear them for the entire day. I usually say that they must expect to be bothered in crossing streets and going down stairs, etc., and they will not be fully used to them for a week. After that period I want them to report to me. My rule is, to employ prisms of low degree, and it will be instructive to note that in the hundred cases the strength of the prisms was as follows:

|        |                     |             |    |         |
|--------|---------------------|-------------|----|---------|
| Prisms | 1°                  | each eye in | 7  | cases.  |
| "      | 1½°                 | " " "       | 65 | "       |
| "      | 2°                  | " " "       | 20 | "       |
| "      | 3°                  | " " "       | 4  | "       |
|        | 1½° O. D., 2° O. S. |             | 1  | "       |
|        | 2° O. D., 1° O. S.  |             | 1  | "       |
|        | 3° O. D., 2° O. S.  |             | 1  | "       |
|        | 4° O. D., 2° O. S.  |             | 1  | " = 100 |

In 66 cases the total amount of the prisms reached only 3°, and in 20 it reached 4°. In 1 case it was 5°; in 5 it was 6°. In 7 cases it was only 2°. What physical effect on the visual lines is gained by prisms of 3°? This amounts to a little less than half a metric angle (one metric angle is represented

by a prism of  $7^\circ$  for an interocular base line of 61 mm.). The cases in which the total amount of the prisms was  $4^\circ$  and less, sum up 94. Of these, 88 wore prisms with bases out, 3 wore prisms with bases in, and nearly all wore them constantly. In 4 cases, Nos. 54, 65, 69, and 78, they were only used in reading, and there are some other partial exceptions. We find, therefore, that these weak prisms were used in 88 cases to relieve the strain on divergence; and that the abatement was about one-half a metric angle. The total amount of convergence called for in normal eyes at 13" or  $\frac{1}{3}$  metre is 4 metric angles, viz., 3 positive and 1 negative. But the cases under discussion were always defective in the negative metric angle, because their abduction was less than  $5^\circ$ , and we may call it  $3\frac{1}{2}^\circ$ , which gives them for a working distance of  $\frac{1}{3}$  metre a total range of active convergence of  $3\frac{1}{2}$  metric angles. An abatement of  $\frac{1}{2}$  a metric angle is in the case of these persons a reduction of the labor of the adductor muscles of one-seventh. This way of presenting the matter seems fair, notwithstanding the total capacity of convergence is disregarded by leaving out that large part which lies between  $\frac{1}{3}$  metre and the absolute near point of fusion. The portion considered is what we use, and the continual relief which is bestowed by subtraction of one-seventh the labor required seems to me an adequate explanation of the good results. A closer analysis will be made a little later.

In a general way the results of treatment may be stated as follows:

|  |           |
|--|-----------|
| Relief of symptoms complete or very great in | 69        |
| “ “ moderate or partial                      | 10        |
| “ “ slight or temporary                      | 7         |
| “ “ not attained                             | 14        |
| Total,                                       | <hr/> 100 |

The failures were cases 11, 17, 25, 27, 34, 38, 42, 43, 58, 61, 66, 71, 72, 97. Of these, Nos. 11, 25, 66, 71, and 97 were advised to have tenotomy. No. 17 suffered severely from chronic cystitis; and when she made this known and was treated for it, her eye troubles ceased. No. 27 was a proper case for tenotomy, but in health too feeble and too neurotic to per-

mit it. No. 34 had persistent follicular conjunctivitis. No. 38 had blepharitis and conjunctivitis which were hereditary; trial of prisms caused headache, and he used them only a few times. No. 42 was a physician whose health had broken down, and who was extremely neurasthenic. His eye muscles were all weak, and the trial of prisms was made with little hope of good effect. No. 43 was a seamstress of unhappy temper and surroundings. Treatment by prisms, although correctly indicated, did no good, but at a later time, when her life became more comfortable, her eye troubles ceased. No. 58 was a child of many ailments and poor constitution. The trial of prisms was purely experimental, and the negative result was no disappointment to me. On the muscular findings any other result would not be expected. I yielded to a mother's urgency. No. 61 was an epileptic child for whom the trial of prisms was made for the general malady, and with no success. No. 66 was 60 years old, an ardent sportsman, who practiced pigeon-shooting one day in the week for many hours. He had much tremor of the eyes when turned to the temporal angles. The abduction was very unsteady, giving variable findings; neither prisms nor plus glasses for slight H did much good. He had to relinquish his favorite sport in great measure. A careful tenotomy would have been justifiable.

Cases of slight or temporary relief were Nos. 33, 37, 56, 68, 91, 93, 97. No. 37 had uterine disorder; prisms given tentatively on account of low abduction. After using prisms constantly for a month, no important change in behavior of muscles or symptoms. No. 56 had extreme asthenopia; tenotomy advised. No. 68, extremely neurotic; has most severe neuralgic headache; finds prisms helpful; ought to have tenotomy, but unwilling. No. 93, medical student, with weak interni; prisms useful for two weeks, but not longer; both abduction and adduction low, and, therefore, a difficult case.

It is important to discover what results were obtained in regard to *headache*, for which especially prisms were often ordered.

In 48 cases it was severe enough to be noted, and the result of treatment is recorded:

|                            |    |        |
|----------------------------|----|--------|
| Complete relief            | in | 19     |
| Great or very great relief | "  | 19     |
| Moderate or slight relief  | "  | 6      |
| Temporary                  | "  | 1      |
| No                         | "  | 1      |
| Excited headache           | "  | 2 = 48 |

In 79% the prisms had a most happy effect, and were warmly appreciated. There can be no doubt, of course, that the soothing effect was by the muscles upon the innervation. Hence, it is evident that for therapeutic purposes we need not trouble ourselves about the ultimate pathology of the condition we now discuss.

In view of the fact that nearly 70% of all the cases derived marked benefit from prisms, let us analyze the muscular conditions before and after treatment, in hope of discovering some reason for the fortunate effect.

It is proper to remark that in some cases the beneficial effect was greatly aided by diminution in amount of eye-work (case 5, *et al.*), by improvement in general health (cases 22, 47, 52, *et al.*), and by better surroundings. Moreover, in certain cases, as in 48, relief continued for a period of many months (12), and then trouble returned. Note is made of the instances when the above causes were co-operative.

Out of 69 cases much or completely relieved, I find only 33 in which the figures are complete for the muscular findings both for the near and remote distances, and both at the beginning and end of the observation of the case.

After careful scrutiny, no modification in muscular conditions appears with sufficient uniformity to warrant any categorical deductions. Evidently we have to do with some factors which evade our inquiry, and a large allowance must be made for individual peculiarities (the personal equation). We meet this fact in all living organisms; and without attempting to reduce the findings by prisms to averages or any numerical statements, the following conclusions may be stated:

No typical features prevail in the cases, save *low abduction for distance*, and in most instances this is associated with low abduction at 13". The degree of *adduction* is extremely variable,

and the same relative amount does not, in all cases, hold good for the two ends of the region. We must not lay undue stress on moderate variations in adduction especially for the near. A fluctuation of  $4^{\circ}$  or  $5^{\circ}$  need not have great significance, unless the total is small. The ratio which ought to prevail between abduction and adduction cannot be deduced from examination of these cases, because they are all pathological. Neither can it be ascertained from a study of the condition of the cases which had experienced great or complete relief. They present at this stage very diverse features. We find, as the result of treatment of weak abduction, that in most cases abduction grows less or remains the same; rarely does it increase. A change of  $1^{\circ}$  for  $18'$  is important. The behavior of the *adduction*, under constant use of prisms with bases outward, is various. First, the most fortunate cases are those in which it notably increases; bringing usually complete relief. If not fully relieved, they are suitable for tenotomy or may even choose it in preference to wearing glasses. Second, some cases of great improvement show little gain in adduction. In them it may be assumed that adduction has always been low, and the asthenopia has been determined by strain on both adduction and abduction, whose ratio to each other is such as to easily be made discordant, because the reserve capacity in both directions is small. In the previous class adduction is strong and abduction weak; it only requires that the latter function be made able to care for itself and balance its antagonist for ordinary ranges. This being done, there arises no impulse to discordant action. In them it seems often true that the real condition is one of *spasm of adduction* rather than *paresis of abduction*. As a result of long continued spasm, the dominant muscles may ultimately become wearied, and show an abnormally low capacity. Under the soothing effect of prisms benefit accrues to all the muscles, and the original status is restored, viz., weak abduction with high adduction, and is kept harmonious by the influence of the prisms. Third, when we have weak externi coupled with weak interni, and trial by abductive prisms demonstrates that the weak adduction is not temporary or induced by fatigue as just noted, the case can derive little benefit from prisms.



We must address ourselves to the general health, and counsel prudence in eye-work. In these cases weak convex glasses in reading will often give some aid. Resort to regulated use of the eyes (Dyer's method) is very helpful; gymnastic prisms give only little help.

In regard to the equilibrium test something further may be said. It is not rare to find that the degree of lateral displacement with the vertical prism is not fixed. For example, if at 18' the convergence under vertical diplopia is  $3^\circ$ , a patient may accept a prism of  $5^\circ$  or  $7^\circ$  by a little urgency, and the images continue perpendicular to each other. This means an unstable condition of the muscles in which they are ready for more contraction. The supposition that the suspension of correct binocular vision by a vertical prism renders all the muscles passive, leaves out of view the fact that muscles in tonic spasm cannot immediately relax. We recognize this fact elsewhere; and why not in the eye muscles. I call this, as Loring did, latent insufficiency, or still better, latent spasm of the opponents. Admitting the general correctness of the equilibrium test, more consideration must be given to numerous exceptional cases. For example, if this test is to be our exclusive or even chief guide in prescribing prisms, what is to be said in view of case 10 in which, with low abduction and good adduction, and notable increase of the latter by the prisms and complete relief from asthenopia during two years of observation, the convergence under vertical diplopia rose for 18' from  $7^\circ$  to  $10^\circ$ , and at 13" from  $15^\circ$  to  $19^\circ$ . This increase in convergence would denote a more abnormal status of muscles than before wearing prisms, — a conclusion completely negated by the patients' experience. Almost the same remarks are pertinent to case 44, a case under observation nearly ten years, who wore prisms  $2^\circ$  base out constantly and with entire comfort. His abduction, exceptionally low, dropped from  $1\frac{1}{2}^\circ$  to  $\frac{1}{2}^\circ$ , and the convergence on vertical diplopia rose from  $8^\circ$  to  $12^\circ$  for 18'. Again, the amount of lateral displacement (convergence) on vertical diplopia bears no constant relation either to the abduction or adduction at either end of the range. In case 50 at 18' we have abd.  $5^\circ$ , add.  $45^\circ$ , v. d.  $\triangle$  or conv.  $4^\circ$ . In case 89 we have at 18' abd.  $\frac{1}{2}^\circ$  to  $3^\circ$ ,

add.  $44^\circ$ , v. d.  $\infty$ . In case 92 at 18' abd.  $0^\circ$ , add.  $25^\circ$ , v. d.  $25^\circ$  conv. In case 87 at 18' abd.  $4\frac{1}{2}^\circ$ , add.  $15^\circ$ , v. d.  $3^\circ$  conv. A glance over the list of cases will verify the assertion that no fixed relation of this kind can be made out. It is a well-known fact that under vertical diplopia the images may, at 18', be homonymous, and at 13" be heteronymous. For example, with vertical diplopia at 13", a divergence corrected by a prism of  $5^\circ$  is so common as to be tantamount to a normal condition, and it need rarely be considered. On this point my views are supported by Schiötz (Archives of Ophthalmology, Vol. xix, Nos. 2, 3, p. 188, Am. edition) who says: "All this goes to show that the equilibrium test sometimes gives no result at all, and in others an incorrect result, but still I do not believe that we are justified in rejecting the test entirely as some have proposed."

We sometimes are wholly deprived of the ability to use the equilibrium test, as in cases of monocular amblyopia or when one eye is wanting. Muscular amblyopia in persons who have had converging strabismus is not rare. Case 45 is an example; tenotomy for converging squint had been done 11 years previous; each eye had the same degree of astigmatism + 1 D, and in one v. = 1, in the other v. = 0.1, and the defective eye had central scotoma. There was no binocular vision, and, despite thorough trial, double images could not be elicited. The history of the case and the jerky movements of the globes, when striving to reach the outer canthi, determined the diagnosis and treatment. Prisms  $3^\circ$  bases outwards gave entire relief. Case 73 had spontaneously recovered from converging strabismus. It was impossible to cause double images in the beginning. After wearing adductive prisms and frequently repeating the tests, a convergence of  $11^\circ$  on vertical diplopia was found at 18'. She was much helped by the prisms. It seemed also that the tendency to epileptic attacks was diminished.

A suggestion already made seems to me of eminent importance and worthy of repetition, that in many cases of low abduction the controlling circumstance is persistent spasm of the adductor muscles rather than paresis of abductors. This may either remain or pass into exhaustion.

The following conclusions may be deduced from the above discussion :

1. Tests for muscular asthenopia at the punctum remotum have greater value than for the punctum proximum or for the punctum agendi (average 13").

2. The equilibrium test is valuable, but not decisive, and should not be the measure of error.

3. Weakness of abduction is a far more fruitful cause of muscular asthenopia than is weakness of adduction; the preponderance is not far from 3 to 1.

4. Abduction, at 18' less than 5°, accompanied by headache or eye strain justifies a trial of weak adductive prisms, which should be worn continuously. They may become permanently necessary, and can, in many cases, be superseded by tenotomy. The rules on this subject are not now considered. They may be only a temporary necessity, and symptoms disappear. In these cases we do not always find the abduction to have increased; in other cases all the muscles show a gain in power or disappearance of spasm. Sometimes the prisms are worn in near work only (cases 54, 69, 78). Prisms, after having been worn with benefit, sometimes lose their good influence, and in most cases tenotomy will give relief.

5. Refractive errors must always be corrected; but when of low degree, search must also be made for muscular faults; and if detected, prisms are indicated in conjunction with the optical correction.

6. Many neurotic symptoms, such as headache, vertigo, nausea, mental disturbance, and remote neuralgic conditions, may be relieved by prisms.

## APPENDIX.

| No. Muscles. | Sex. | Age. | Occupation.       | History and Symptoms.  | Refraction.  | Musc. Condition (Primary).   | Treatment.  | Musc. Condition (Ultimate).   | Results and Remarks.  |
|--------------|------|------|-------------------|--|--|--|---|---|---|
| 1 Ext.       | F.   | 21   | .....             | Headache (occipital) Conj. Unable to use stereoscope. Print unsteady Spasm A.  | O. U. + 1 D.<br>V. = +1.                                   | 18' abd. 5" add. 20° v. d. 5" conv.;<br>13" abd. 6" add. 30° v. d. 10" conv. | Prism 2°, base out, O. U. with correction of R. constantly. Local applications for conj.                              | 18' abd. 3" add. 26°; 13" abd. 8" add. 43° v. d. 11" conv.                  | Under observation 11 months. Headache completely relieved. Unable to read long.   |
| 2 Ext.       | M.   | 16   | Student.          | Conj. Sees nose. Nasal catarrh.  | E.   | 18' abd. 2½" add. 7° v. d. 1" conv.;<br>13" abd. 12" add. 17° v. d. 2½" div. | Local applications. Prism 1½°, base out, O. U. constantly.  | 18' abd. 2" add. 20° + v. d. 2½" conv.;<br>13" abd. 10" add. 25°.           | Under observation 2 years. Conj. and catarrh relieved. Unable to use eyes more than a few minutes with comfort. Sister has similar trouble.   |
| 3 Ext.       | M.   | 12   | .....             | Sees nose. Print blurs. Pain in eyes. Nasal catarrh. Conj.   | E.   | 18' abd. 3" add. 24°; 13" abd. 8" add. 50° v. d. 10" conv.                   | Prism 2°, base out, O. U. constantly.   | 18' abd. —1" add. 36°; 13" abd. 0" add. 45° + v. d. 13" conv.               | Under observation 2 years. Great relief.  |
| 4 Ext.       | F.   | 8    | .....             | Eyes diverge at 4". Occasional diplopia. Pain in eyes. Some headache.  | O. U. + 1 D.<br>V. = 1.                                    | 18' abd. 3½" add. 24°; 13" abd. 10" add. 20° v. d. 3" conv.                  | Prism 2°, base out, O. U. for distance.   | 18' abd. 4" + add. 24°; 13" abd. 7" add. 40° v. d. 4" conv.                 | Under observation 1 year Eyes comfortable. Less headache.   |
| 5 Ext.       | M.   | 44   | Lawyer.           | Had + 1 D. 4 years ago, which did not relieve severe neuralgic pain in eyes. Conj. Photophobia. Unable to use eyes regularly, sometimes not over 10 minutes. Nasal catarrh. Not a robust man. Occasional headache. | O. D. + 1 c.<br>180°, V. = 1.<br>O. S. + 0.75S.<br>V. = 1. | 18' abd. 6½" add. 14°; 13" abd. 10" add. 30° v. d. 5" conv.                  | Local applications. Prism 1½°, base out, O. U. for distance and in combination with spherocyl. glasses for near work. | 18' abd. 6" add. 30° v. d. 13" add. 8" add. 45° d. 17" conv. * Note.        | Under observation 3 years. Partial relief. Much less pain. Obligated to spare eyes. Tenotomy indicated.   |
| 6 Ext.       | M.   | 46   | Railroad Manager. | Overworked and exhausted. Vertigo. Unable to read over 15 minutes. Eyes feel strained.   | O. U. + 1 c.<br>180°, V. = 1.                              | 18' abd. 3" add. 15°; 13" abd. 15" add. 18° v. d. 5" div.                    | Prism 2°, base out, O. U. with correction for constant use.   | 18' abd. 2" add. 19° v. d. 7" conv.;<br>13" abd. 10" add. 20° v. d. 2" div. | Under observation 8 months. Reads 2 hours with cylindrical prismatic glasses. Very comfortable with glasses worn constantly. Tried cylinders alone without relief. Daughter similarly affected. |

\* The sign ∞ signifies equilibrium.

|            |       |                  |   |   |   |  |  |  |
|------------|-------|------------------|---|---|---|--|--|--|
| 7<br>Ext.  | M. 10 | .....            | Pain in eyes in reading. Occasional strab conv. O. S. Can't learn lessons. Teacher thinks him stupid.   | E.  | 18' abd. 4½' add. 36'; 15'' abd. (?) add. 40° v. d. 10° conv.   | O. D. Prism 3°, base out. O. S. Prism 2°, base out. A r o p. used first. Prisms worn constantly. | 18' abd. 3° add. 47° v. d. 3° conv.; 13'' abd. 10° add. 40° v. d. 5° conv. | Under observation 4 years. De-lighted with his glasses. Wears them constantly. Complete re-lief. No trouble about lessons. Tetanomy indicated. Heredi-tary tendency.                             |
| 8<br>Ext.  | M. 27 | Merchant.        | Conj. No trouble in use of eyes until a few months ago, when he broke down from overwork. Pain in eyes after reading. Seldom has headache. Nasal catarrh.         | E. Slight spasm A.                              | 18' abd. 3° add. 11° v. d. 1° conv.; 13'' abd. 18° add. 20°. Slight ver-tical error.                                | Local applications to lids. Dobell's spray in nose. Prism 1½°, base out, O. U. for constant use  | 18' abd. 3° add. 24° v. d. 4° conv.; 13'' abd. 10° add. 15° v. d. 1° div.  | Under observation 2½ years. Able to use eyes in office work at pleasure by daylight. Irritation of lids much less. Unable to go without prisms.  |
| 9<br>Ext.  | F. 39 | .....            | Severe pain in eyes for 2 months. Wakes at night with pain. Un-able to do near work. Sick headache.   | O. U. + 1 D. V.=1.                              | 18' abd. 2½' add. 4'; 13'' abd. 15° add. 10° v. d. 5° div.  | Prism 1½°, base out, O. U. for con-stant use.  | 18' abd. 3° add. 6'; 13'' abd. 17° add. 28° v. d. 4° div.                  | Under observation 3 months. Very little pain if she wears glasses all day.   |
| 10<br>Ext. | M. 20 | Medical Student. | Fatigue of eyes in reading. Eyes unsteady in movements out-wards. Irregular movement of O. S. evidently depending on faulty Inf. Obl.                             | E.  | 18' abd. 3° add. 24° v. d. 7° conv.; 13'' abd. 5° add. 30° v. d. 15° conv. Vert. error of 2° for distance and near. | Prism 2°, base out, O. U. for con-stant use.   | 18' abd. 1° add 37° v. d. 10° conv.; 13'' abd. 6° add. 40° v. d. 19° conv. | Under observation 2 years. Ver-tical error disappeared under use of add. prisms. Prisms give entire relief.  |
| 11<br>Int. | M. 28 | Medical Student. | Headache, unrelieved by treat-ment, for 5 or 6 years. Unable to read without pain in eyes and headache. For a few days un-able to read at all. Blurring of print. | O. D. + 0.75s. V.=1. O. S. + 0.75c. 100°. V.=1. | 18' abd. 12° add. 11° v. d. 14° div. Vertical error of 14° for distance.  | Prism 3°, base in, O. U. for con-stant use.  | 18' abd. 20° add. 13° v. d. 15° div.                                       | Under observation 2 weeks. Prisms utterly inadequate. Operation imperative.  |
| 12<br>Ext. | M. 32 | Physician.       | Pain in eyes. Unable to read at night. Pain so severe that he often has to go to bed. Fron-tal headache.  | E.  | 18' abd. 2½' add. 20'; 13'' abd. 17° add. 30° v. d. 4° conv.  | Prism 1½°, base out, O. U.   | (?)  | Under observation 6½ months. Wears prisms only part of the time. Puts them on when he has the old pain and headache, and is always relieved. Brother similarly affected.                         |
| 13<br>Ext. | M. 22 | Book-keeper.     | Headache and pain in eyes. Obligated to give up college course at end of second year.   | O. U. + 0.50 D. V.=1.                           | 18' abd. 1½' add. 13° v. d. 1° conv.; 13'' abd. 14½' add. 18°.  | Prism, 1½°, base out, O. U. for constant use.  | 18' abd. 2½' add. 35'; 13'' abd. 7° add. 23°.                              | Under observation 8 mos. Very little trouble after putting on prisms. Had only three or four slight headaches after putting them on. Headache if he leaves them off. Brother similarly affected. |

NOYES: *The Therapeutic Effect of*

## APPENDIX. — CONTINUED.

| No. Muscles | Sex. | Age. | Occupation. | History and Symptoms.  | Refraction.  | Musc. Condition (Primary).   | Treatment.  | Musc. Condition (Ultimate).  | Results and Remarks.  |
|-------------|------|------|-------------|--|--|--|---|--|---|
| 14<br>Ext.  | F.   | 20   | .....       | Pain in eyes, headache, and bleph. mag. Not relieved by +1.50 O. U. for reading. When first seen had had constant headache for six weeks. Is rather delicate. Spasm A. Eyes sometimes feel as if they would burst. | O. D. +0.75s<br>+0.50c 180.<br>V.=1. O. S.<br>+1.00s. C+<br>0.50c. 180.<br>V.=1. | 18' abd. 6° add. 12°<br>v. d. 1 div.; 13''<br>abd. 22° add. 30°<br>v. d. 4° div. | Atropine. Prism 1½, base out, with +1 D. O. U. for reading.   | 18' abd. 4° — 5°<br>add. 22°.  | Under observation 6 mos. At one time lost glasses and was "in misery" until they were replaced. Died suddenly a few months after last examination.  |
| 15<br>Ext.  | M.   | 17   | Student.    | Eyes strained from over use. Conj. irritation. Eyes not painful but feel weak. Can read only 15 or 20 minutes. Some nasal catarrh.   | E.   | 18' abd. 5½° add.<br>22° +; 13'' abd.<br>15''(?) add. 27°<br>v. d. 6° conv.      | Prism 1½, base out, O. U. for constant use with additional +1 D., O. U. in reading.   | 18' abd. 9° add.<br>21° v. d. Δ; 13''<br>abd. 18° add. 35°<br>v. d. Δ. | Under observation 1½ years. Soon became able to read from four to six hours a day, reading two hours at a time. Ultimately able to discard glasses.   |
| 16<br>Ext.  | F.   | 60   | .....       | A few striae in lenses. Nasal catarrh. Conj. Pain in eyes for several years, increasing of late.   | O. D. +0.50c.<br>90°. V.=1.<br>O. S. — 1.50s.<br>C+2.50c. 80°.<br>V.=0.9—.       | 18' abd. 7° add.<br>17° v. d. Δ; 13''<br>abd 20° add. 36°<br>v. d. 5° div.       | Sphero-cyl. correction for distance with additional +3 D. for reading, followed by prism 2°, base out, O. U. as supplementary reading glasses | 13'' abd. 20° add.<br>30 v. d. 5° div.                                 | Under observation one month. Before prisms were added could not use eyes at all without great pain. After prisms were added could read one-half hour at a time and could also read some in evening, a thing she said she had been unable to do for a long time. |
| 17<br>Ext.  | F.   | 34   | .....       | General health not good. Has some cystitis. Conj.  | E.   | 18' abd. 6° — 3°<br>add. 32°; 13''<br>abd. 10° + add.<br>38° v. d. 6° conv.      | Prism 2°, base out, O. U. for reading.  | (?)  | Under observation nine months. Could not wear prisms.   |

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|            |       |                         |   |                                   |   |  |  |  |
|------------|-------|-------------------------|---|-----------------------------------|---|--|--|--|
| 18<br>Ext  | F. 27 | .....                   | Inherits eye trouble and has had it as long as she can remember. Pain in eyes, gums, ears, and back of head follows all kinds of eye work. Eyes twitch, and this is prevented only by great effort. Difficulty in looking at moving objects, and easily nauseated in so doing. Sick headache. Pain in eyes, often so severe as to keep her awake nights. Has had some uterine trouble. Occasional attacks of rheumatism. Neurotic tendencies. | O. U. + 1 D. V.=1.                | 18' abd. 3° add. 9° v. d. Δ.                                  | Prism 14° base out, O. U. for constant use.      | 18' abd. 8° add. 25° v. d. Δ; 13' abd. 14° add. 30°.                           | Under observation five months. + 1 D. gave only temporary relief. Prisms entirely relieved headache. She is dizzy if she leaves them off, and wholly unable to do without them. On account of neurotic tendencies, value of operative interference doubtful.             |
| 19<br>Ext. | M. 20 | Type-writer.            | Trouble in use of eyes for 18 months. Can read from two to four hours a day. Has little pain or headache, but says he can't use eyes. Eyes twitch, particularly at outer angles. Has very slight vertical deviation (hyperphoria).  | E.                                | 18' abd. 4½° add. 17° v. d. Δ; 13' abd. 10° add. 25° v. d. Δ. | Prism 14° base out, O. U. for constant use.      | 18' abd. 5° add. 18° v. d. Δ; 13' abd. 15° add. 18° v. d. Δ.                   | Under observation 2½ years. At end of that time could read three to four hours a day. Has found that when he breaks prisms he has headache until they are repaired.  |
| 20<br>Ext. | F. 25 | .....                   | Rather delicate, and had a very serious illness six months ago. Unable to use eyes for three months, and has had pain in using them for a longer period. Pain through temples and eyeballs, with nausea, on attempting to use eyes. Considerable headache. Has trouble only in near work. Prism tests provoked vertigo.   | E.                                | 18' abd. 3½° add. 19° v. d. Δ; 13' abd. 16° add. 23° v. d. Δ. | Prism 14° base out, O. U. for constant use.      | 18' abd. 5° add. 33° v. d. Δ; 13' abd. 10° add. 30° v. d. 5° conv.             | Under observation three months. Able to read one-half hour several times a day. Use of eyes beyond that provokes the old pain, but it does not persist if she stops. Formerly had headache whenever she read, now about once a week only. Improvement in general health. |
| 21<br>Ext  | F. 18 | Mechanical draughtsman. | For three or four years has had pain around eyes, headache and strained feeling in use of eyes. Sight at times blurred.   | O. U. - 0.75c. + 0.75c. 90° V.=1. | 18' abd. 5° add. 20°; 13' abd. 20° add. 35° v. d. 2° conv.    | O. U. + 0.75c. 90° prism 13° base out, for work. | 18' abd. 4° add. 27° + v. d. 3° conv.; 13' abd. 21° add. 30° + v. d. 3½° conv. | Under observation two months. Continued to use eyes steadily at her work, mechanical drawing. Much less pain with glasses. Hardly able to work without them. Convex cylinders without prisms had been tried without benefit.   |

## APPENDIX. — CONTINUED.

| No Muscles | Sex | Age | Occupation       | History and Symptoms.  | Refraction.   | Musc. Condition. (Primary).  | Treatment.   | Musc. Condition (Ultimate).  | Results and Remarks.   |
|------------|-----|-----|------------------|--|---|--|--|--|--|
| 22 Ext.    | M.  | 17  | .....            | Unable to use eyes for two or three years. Almost constant, severe headache. Had to give up school because effort of looking made him feel "bad." Head seems queer on looking steadily at anything. Not a rugged boy. [Some conj]. | O. D. V. = 0.7; Oph + 1 D. O. S. E.                                     | 18' abd. 5 $\frac{1}{2}$ " add. 5"; 13" abd. 18" add. 15" v. d. 10" div. | Prism 1 $\frac{1}{2}$ " base out, O. U. for constant use. Local applications for conj.       | 18' abd. 6" add. 3" + v. d. 2; 15" abd. 17" add. 23" v. d. 2.              | Under observation four and one-half months. Uses eyes very little in reading, but has no pain or headache, whereas before wearing prisms headache was almost constant.   |
| 23 Ext.    | M.  | 20  | Clerk.           | Headache for six years, increased by eye work. Has had to give up reading. Headache in church and theater. Severe nasal catarrh.   | E.  | 18' abd. 5" add. 20"; 13" abd. 10" add. 15"                              | Prism 1 $\frac{1}{2}$ " base out, O. U. for constant use. Local applications for catarrh.    | 18' abd. 3" add. 30"   | Under observation ten months. After wearing prisms a short time tried to leave them off for a day, but had headache with nausea, which was instantly relieved by putting on prisms. At end of ten months could read by daylight but not much in evening. Relief was great. |
| 24 Ext.    | M.  | 25  | Medical Student. | Been reading late at night. Sight gives out suddenly after long reading, so that he fails to recognize a person across lecture room. No trouble until a month ago.   | O. D. + 0.75s. V. = 18-15. O. S. + 0.75s. C. + 0.50c. 180°. V. = 18-20. | 18' abd. 14" add. 15" v. d. 3" conv.; 13" abd. 18" add. 15" v. d. 2.     | O. D. + 0.50s. C. prism 2" base out; O. S. + 1c 180° C. prism 2" base out; for constant use. | 18' abd. 1" add. 21" v. d. 2; 17" abd. 16" add. 19" v. d. 2.               | Under observation one and one-half years. Complete relief with prisms. Unable to go without them.  |
| 25 Ext.    | M.  | 27  | Peddler.         | Pain in eyes for ten years. Inability to read long. Nasal catarrh.   | E.  | 18' abd. 4" add. 17" (?); 13" abd. 20" add. 15" v. d. 7" div.            | Prism 1 $\frac{1}{2}$ " base out, O. U. for constant use.                                    | 18' abd. 14" add. 25" v. d. 3" conv.; 13" abd. 10" add. 38" v. d. 1" conv. | Under observation four months. Little or no relief from prisms, but they demonstrate the true nature of the trouble. Tenotomy advised.   |
| 26 Ext.    | M.  | 34  | Merchant.        | Troubled with eyes for fourteen years. Unable to read in evening. Conjunctivitis. Nasal catarrh.   | E.  | 18' abd. 3" add. 74"; 13" abd. 15" add. 20" v. d. 8" div.                | Prism 1 $\frac{1}{2}$ " base out, O. U. for constant use.                                    | 18' abd. 2" add. 14"   | Under observation six months. Condition greatly improved, but not entire relief. Able to read several hours. Had tried + 1 D. for reading without benefit. Has slight vertical error, but was relieved without taking this into consideration.                             |



|            |    |    |                   |   |  |  |  |  |  |
|------------|----|----|-------------------|---|--|--|--|--|--|
| 27<br>Ext. | F. | 16 | Schoolgirl.       | Aching and fatigue of eyes for eight months. Eyes usually feel very tired. Is studying hard and is anaemic. Spasm A. General health poor.   | O. D. — i.c<br>180°. V. = 1.<br>O. S. E. | 18' abd. 3° add. 12°<br>v. d. Δ; 13'' abd.<br>20° add. 30° v. d.<br>5° div.            | After trying rest, tonics and atropia for a month, ordered prism 2° base out, O. U. for constant use.                  | 18' abd. 3° + add.<br>20° +; 13'' abd.<br>18° add. 40° v. d. Δ.  | Under observation three months. Unable to wear prisms with comfort. Often relieved by removing them. General condition poor.   |
| 28<br>Ext. | F. | 23 | Music Teacher.    | Unable to use eyes in evening; they feel strained and "crazy." Difficulty in keeping eyes open in evening. Is "miserable" the next day after going to opera. Conj. and bleph. severe.   | O. U. + 1 D.<br>V. = 1.                  | 18' abd. 3° add. 15°<br>v. d. Δ conv.;<br>13'' abd. 8° add<br>15° v. d. 1° div         | Prism 1½° base out, O. U. for constant use.  | After 3 months:<br>18' abd. 3½ add.<br>21° v. d. 2½<br>conv.; 13'' abd.<br>5° add. 25° v. d.<br>4° conv. | Under observation six months. Able to read one and one-half hours in evening. Comfortable with glasses and unable to go without them. Bleph. cured.  |
| 29<br>Ext. | M  | 21 | Medical Student.  | Burning pain in eyes and blurring of print after reading a few minutes. Almost constant headache.   | E.                                       | 18' abd. 3° add. 9°<br>v. d. Δ; 13'' abd.<br>15° add. 15° v.<br>d. Δ.                  | Prism 1½° base out, O. U. for constant use, with + 1 D in addition for reading.  | 18' abd. 1° add.<br>13° v. d. Δ; 13''<br>abd. 13° add. 20°<br>v. d. 3° conv.                             | Under observation three months. Able to study three or four hours daily. Cannot go without glasses.  |
| 30<br>Gen. | M. | 38 | Retired Merchant. | Case of general prostration from too close application to business. Unable to use eyes more than a few minutes at a time. Pain in back of head and neck. Pain extends to arm and leg on mental application or use of eyes. Eyes tire in looking at pictures, etc. Difficulty in looking at moving objects. Closes eyes on Broadway and gets relief. | E.                                       | 18' abd. 4½° add.<br>15° v. d. Δ<br>conv.; 13'' abd.<br>18° add. 28° v.<br>d. 3° conv. | Prism 1° base out, O. U. for constant use; later prisms of 1½° and still later + 0.75s. O. U. in addition for reading. | 18' abd. 4° add.<br>22° v. d. 3° conv.;<br>13'' abd. 10° add.<br>14° v. d. 3° conv.                      | Under observation nearly two and one-half years. Gets a certain amount of relief from glasses. Can read paper ten minutes at a time and can attend to personal business. Has had the best advice for general condition, and the slight improvement in eyes seems due to general improvement. |
| 31<br>Ext. | F. | 26 | .....             | Eyes ache and she has "dreadful" headaches when she reads or sews. Conj. Slight spasm A. Very nervous woman. Trouble for two or three years.  | E.                                       | 18' abd. 5° (?) add.<br>17° v. d. Δ; 13''<br>abd. 12° add. 30°<br>v. d. Δ.             | Prism 1½° base out, O. U. for constant use.  | 18' abd. 3° add.<br>17°; 13'' abd.<br>8° add. 23°.   | Under observation one year. Prisms relieved headache almost completely from the very first. Much less conjunctival irritation. Patient in much better spirits and very thankful for prisms.  |

## APPENDIX. — CONTINUED.

| No. of Muses. | Sex. | Age. | Occupation. | History and Symptoms.   | Refraction.            | Musc. Condition (Primary).  | Treatment.   | Musc. Condition (Ultimate).   | Results and Remarks.  |
|---------------|------|------|-------------|---|------------------------|---|--|---|---|
| 32<br>Ext.    | F.   | 16   | Schoolgirl. | Has been studying hard to obtain first place in class. Trouble with eyes for three or four months. Pain in eyes and fatigue. Photophobia. Slight spasm A. Eyes often feel tremulous. Slight twitch at outer angles. | E.                     | 18' abd. 5° add.<br>35'; 13' abd.<br>18" add. 45° +<br>v. d. 8° conv.           | Rest of eyes, no glasses. At end of year condition about the same, although eyes had been used in moderation. Ordered prism 1½°, base out, O. U. for constant use. | 18' abd. 5° (?) add.<br>45'; 13' abd.<br>12" add. 50° +<br>v. d. 1° conv.     | Under observation one year. Two weeks after putting on prisms reported herself much relieved. Had been able to use her eyes ad libitum without pain in studying for college examinations.   |
| 33<br>Ext.    | F.   | 17   | Schoolgirl. | More or less trouble for six months. Conjunctivitis. Hard to keep eyes open. In reading apt to lose the place if she lifts eyes from book. Can not embroider. Health good. Light hurts eyes.                        | E.                     | 18' abd. 4° add.<br>22'; 13' abd. 16°<br>add. 30° + v. d.<br>6° conv.           | Prism 1½°, base out, O. U. for constant use.   | 18' abd. 5° + add.<br>20'; 13' abd.<br>11" add. 25° v.<br>d. 7° conv.         | Under observation four months. Used glasses with comfort for two months. She then had pain in eyes and was unable to use them. Later had headache, but this stopped on leaving school.  |
| 34<br>Ext.    | F.   | 15   | .....       | Has follicular conjunctivitis. Reading irritates eyes. Is made tired by prism tests. Lids have been treated for several months. Subject to headache.  | E.                     | 18' abd. 3° add.<br>20'; 13' abd. 10°<br>add. 35° v. d. 4°<br>conv.             | Treatment of lids. Prism 1½°, base out, O. U. for constant use.  | 18' abd. 4° add.<br>23° v. d. Δ;<br>13' abd. 5° add.<br>40° v. d. 7°<br>conv. | Under observation nine months. Wore prisms three months without benefit. Conjunctivitis persists. Headache rather worse.  |
| 35<br>Ext.    | M.   | 48   | Manager.    | Severe vertigo. Pain in head. Creeping sensations for two weeks. Melancholia. Forgetfulness. Sugar in urine. Powerful physique.   | O. U. + 1 D.<br>V=1. + | 18' abd. 5° add.<br>25° v. d. Δ;<br>13' abd. 25° add.<br>35° v. d. 10°<br>conv. | O. U. + 1 D. ◯<br>prism 1½°, base out, distance;<br>O. U. + 3 D. ◯<br>prism 2°, base out, for reading. Spherical correction later increased to + 4 D. O. U.        | 18' abd. 3° v. d.<br>3° conv.   | Under observation for nearly three years. At end of first month said he would not take a million dollars for his glasses. Relief was prompt and not dependent on improvement in general condition. At end of two years said he had "lots of fun" with his eyes. He shortly after this had another break-down from anxiety due to business reverses and death of brother. He had much pain in head, sugar reappeared in urine, and he was unable to read at all. Reading glasses were slightly increased in strength. Subsequently regained eye power. Brother had weak externi. |

|            |       |                     |   |   |   |  |  |
|------------|-------|---------------------|---|---|---|--|--|
| 36<br>Ext. | M. 28 | Physician.          | Pain in O. S., a "real ache."<br>Unable to use eyes with comfort<br>Powerful man. Picture of health.  | O. D. + 3 s. ( )<br>+ 0.75c. 75.<br>V = 1. O. S. ( ) +<br>+ 3 s. ( ) +<br>0.75c. 120. V<br>= 20-20. | 18' abd. 5° + add.<br>33' v. d. ∞; 13'<br>abd. 20° add. 50°<br>v d. 3° conv.  | Prism 2°, base out,<br>O. U. with cor-<br>rection of refrac-<br>tive error.  | Under observation one and one-<br>half years. Complete relief.<br>Able to use eyes as much as he<br>wished. Brother of preceding<br>case.  |
| 37<br>Ext. | F. 27 | .....               | Trouble with eyes for two years.<br>No pain or headache, but un-<br>able to read more than a few<br>minutes. Under treatment for<br>uterine trouble.  | E.  | 18' abd 3° add.<br>15; 13' abd. 18°<br>add. 20° v. d.<br>2° div.  | Prism 1°, base out,<br>O. U. for con-<br>stant use. Dyer.  | Under observation one month.<br>Thought glasses were of some<br>assistance in reading. Could<br>read with them from twenty to<br>thirty minutes.   |
| 38<br>Ext. | M. 21 | Clerk.              | Irritation of lids for ten months.<br>Trouble in study or work.<br>Chronic conj. and bleph. marg.<br>which is hereditary.   | E.  | 18' abd. 4' ( ) add.<br>22° + 13' abd.<br>16° add. 28° v.<br>d. 5° conv.  | Prism 1½°, base<br>out, O. U. for<br>constant use.   | Under observation four months.<br>Wore prisms only a few times<br>and they seemed to make head<br>ache.  |
| 39<br>Ext. | M. 35 | Merchant.           | Tired feeling in eyes. Reading<br>has become a burden. Has<br>had considerable anxiety. Ob-<br>liged to discriminate carefully<br>between colors in his business.<br>Trouble of recent date. Pa-<br>tient rather overworked and<br>worried. Eyes tire on cars, etc. | E.  | 18' abd. 3½° add.<br>9'; 13' abd. 18°<br>add. 17°.  | O. U. + 1-6os. ( )<br>prism 1½° base<br>out, O. U. for<br>reading. Two<br>years later in-<br>creased spheri-<br>cal glass to +<br>0.75s and prism<br>to 2°. O. U. for<br>reading and to<br>use old ones for<br>distance. | Under observation three and one-<br>half years. Prisms gave great<br>relief although eyes were se-<br>verely taxed.  |
| 40<br>Int. | M. 26 | Medical<br>Student. | Trouble for two years. Pain in<br>lids, not in eyes, in readings,<br>etc.   | E.  | 18' abd. 5° add 5'<br>v. d. ∞; 13'<br>abd. 23° add. 8°<br>v. d. 6½° div.  | Prism 2° base in,<br>O. U. for con-<br>stant use.  | Under observation fourteen mos.<br>Wore glasses for over a year<br>with perfect comfort. At the<br>end of that time eyes became a<br>little fatigued from over-work,<br>preparing for examination for<br>degree.   |
| 41<br>Int. | F. 16 | Schoolgirl.         | Trouble with eyes for a year fol-<br>lowing excessive use of eyes<br>while confined to bed with in-<br>jured foot. Strasm A. Able to<br>read a short time only. No<br>headache. Nasal catarrh.  | E.  | 18' abd. 7° add. 13°<br>v. d. ∞; 13'<br>abd. 12° add. 10°<br>v. d. ∞. Image<br>O. D. 1° lower<br>than that of left. | Atrop., gt. iv ad<br>02.1, followed by<br>O. D. Prism<br>2°, base in; O.<br>S. Prism 1°<br>base in. She<br>had already<br>worn above.<br>Later increased<br>O. S. to 2°.   | Under observation two and one-<br>half years. Able to use eyes<br>seven or eight hours a day, in-<br>stead of one-half hour as for-<br>merly. Occasionally goes with-<br>out her prisms, but generally<br>wears them constantly. Perfect-<br>ly comfortable with them. |

NOYES: *The Therapeutic Effect of*

## APPENDIX.—CONTINUED.

| No. Muscles. | Sex. | Age. | Occupation.      | History and Symptoms.  | Refraction.   | Musc. Condition (Primary).  | Treatment.  | Musc. Condition (Ultimate).  | Results and Remarks.  |
|--------------|------|------|------------------|--|---|---|---|--|---|
| 42 Int.      | M.   | 43   | Physician.       | Weak constitution. Not much physical stamina. Has large practice and is overworked. About fifteen years ago overtaxed eyes and they gradually gave out. No trouble before that time. Unable to read over fifteen minutes without great distress, and is obliged to wear prisms of from 2° to 7° bases in. Does not sleep well. Difficulty in looking from one object to another. Diagnosis of weak interni made years ago by Dr. Dyer. Eyes twitch at outer angles. Headaches during the last year only. | O. U. + 0.75s.<br>V = 1.  | 18' abd. 3° add. 3°<br>v. d. 3° div.;<br>13'' abd. 15° add.<br>0° v. d. 15° div.        | Has had tonics, electricity, and prisms. O. U. + 1.60 ◊ prism 14°, base out, for distance; O. U. + 1.125 ◊ prism 6°, base in, for reading. To use gymnastic prisms. | 18' abd. 4½° add.<br>8'; 18' + 1.60s.<br>add. = 15°.                                       | Under observation eight months. Habitually uses but one eye in reading, either one. Case of general muscular weakness. Marked neurosthenia. Had consulted various oculists. Operation suggested. Case of breakdown from too intense application in a person with neurotic tendencies. |
| 43 Ext.      | F.   | 27   | Seamstress.      | Some conj. Pain in eyes in a warm room. Under some nervous excitement—mental worry—for six months. Headache all the time. Supra-orbital tenderness.  | E.<br>O. D. + 0.5s. V.<br>= 0.6 —. O.<br>S. + 0.75s. V.<br>= 0.4. | 18' abd. 14° abd.<br>17'; 13'' abd. 18°<br>add. 20°.                                    | Prism 2°, base out, O. U. for constant use. Later reduced prisms to 1°.   | 18' abd. 3° add.<br>20° v. d. 2° conv.;<br>13'' abd. 8° add.<br>33° v. d. 5° conv.         | Under observation three months. Little benefit from prisms. Tetotomy indicated. The causes of nervous tension and worry continue. Is much perturbed. Eye treatment of doubtful value.   |
| 44 Ext.      | M.   | 30   | Medical Student. | O. U. Amblyopia from corneal opacities. Unable to use eyes with comfort.   | O. D. + 0.5s. V.<br>= 0.6 —. O.<br>S. + 0.75s. V.<br>= 0.4.       | 18' abd. 14° add.<br>24° v. d. 8° conv.;<br>13'' abd. 74°<br>add. 48° v. d. 9°<br>conv. | O. U. + 1 D. ◊ prism 2°, base out, for constant use.  | 18' abd. 4½° add.<br>24° + v. d. 12°<br>conv.; 13'' abd.<br>7° add. 23° v. d.<br>10° conv. | Under treatment nearly two years. Has been able to use eyes fifteen hours a day at times with comfort. Had previously tried spherical glasses without much benefit. Relief very marked in spite of amblyopia.   |
| 45 Ext.      | F.   | 17   | Schoolgirl.      | Has for several months had headache after use of eyes. Movement outwards of eyes jerky Operation on O. S. for strab. conv. eleven years ago. Central scotoma O. S.   | O. D. + 1c. 180°<br>V = 1. O. S.<br>+ 1c. 180° V.<br>= 0.1.       | No binocular vision.  | Prism 1°, base out, O. U. for constant use.   | .....  | Under observation six months. Entirely relieved by prisms. Able to do full work in school without pain. Case of special interest on account of monocular amblyopia.   |

|            |       |                      |  |  |   |   |   |   |
|------------|-------|----------------------|--|--|---|---|---|---|
| 46<br>Ext  | F. 16 | Schoolgirl.          | More or less headache for two years. Recently more pain in eyes and head. Strong and healthy.  | E.   | 18' abd. 3° add.<br>14° v. d. 2° conv.; 13'' abd. 13° add. 20° v. d. 6° Δ.                    | Rest and tonics. Three weeks later, prism 14' base out, O. U. for constant use.   | 18' abd 3° add<br>15'; 13'' abd 7° conv. At one time after wearing prisms abd. at 18' sank to — 1°.   | Under observation four months. Partial relief from rest. With prisms able to use eyes four or five hours a day. Unable to read without them or even to walk without them. No headache.  |
| 47<br>Ext. | F. 15 | Schoolgirl.          | Eyes have given trouble for a year. Eyes ache after reading fifteen minutes, and headache follows if she continues to read. Has headache when tired, but with the headache following bodily fatigue she does not have the pain in eyes which follows reading. Under treatment for slight lateral curvature of spine. Has been too closely confined to her studies. | O. U. + 1. D. V. = 1.                            | 18' abd. 5° add.<br>27° +; 13'' abd. 15° add. 30° v. d. 4° conv.                              | Prism 4' base out, O. U. for constant use, later for near work only.  | 18' abd. 7° + add.<br>30° v. d. Δ; 13'' abd. 10° add.<br>36° v. d. Δ.                                 | Under observation twenty months. No headache, no trouble of any kind. Has been relieved from pressure of all kinds, been much more in open air and gained fifteen pounds. Part of the relief undoubtedly due to improvement in general health, but prisms gave relief immediately. Prisms to be abandoned, first for distance, later for near work. |
| 48<br>Int. | M. 33 | Commercial Traveler. | Pain in eyes in reading. Print unsteady. Has read much on cars. Much conjunctival irritation.  | O. D. + 0.50c.<br>75° V. = 4. O.<br>105° V. = 1. | 18' abd. 8° add.<br>7'; 13'' abd. 28° add. 15° v. d. 13° div.                                 | Prism 14' base in, O. U. combined with cyl. correction for constant use.  | 18' abd 9° add.<br>10' 7 d 4 + div.;<br>13'' abd 20° add.<br>15° v. d. 8° div.                        | Under observation three years. Glasses gave almost complete relief for a year. Conj. irritation greatly diminished. At end of three years old trouble returned and he had pain in eyes after fifteen or twenty minutes use. Tenotomy advised.   |
| 49<br>Ext. | M. 13 | Schoolboy.           | Trouble for six months. Blurring of print after reading a few minutes, passing off with rest. No pain or headache.   | O U. + 0.75s.<br>V. = 1.                         | 18' abd. 5° add.<br>10'; 13'' abd 12° abd 23° v. d. Δ. Same result, with and without + 0.75s. | At first ordered + 0.75s O. U., but thereafter use in reading gave rise to pain in the hands. Then ordered prism 2', base out, O. U., for constant use. | 18' abd. 5° add.<br>27°.  | Under observation three months. Wore prisms all the time and did not like to be without them. No trouble in school.   |
| 50<br>Ext. | M. 19 | Student.             | Occasional diplopia. Occasional migraine. Inclines head toward left shoulder. Some headache, i. e., pain at inner angles. Able to read one and one-half hours. Some vertigo.   | O. U. + 0.50s.<br>V. = 1.                        | 18' abd. 4° (?) add.<br>30°. Images vibrate 13'' add 11° add. 40° v. d 7° conv.               | Prism 1½' base out, O. U., for constant use.  | 18' abd. 5° add.<br>45° + v. d. Δ; v. d. 1. conv. 4';<br>13'' abd. 3° to 0° add. 45° + v. d. 8° conv. | Under observation two months. Able to use eyes three hours a day, one hour at a time. Rather less headache and vertigo. Advised tenotomy.   |

## APPENDIX. — CONTINUED.

| No. Muscles.             | Sex. | Age. | Occupation. | History and Symptoms.  | Refraction.  | Musc. Condition. (Primary.)  | Treatment.   | Musc. Condition. (Ultimate.)   | Results and Remarks.  |
|--------------------------|------|------|-------------|--|--|--|--|--|---|
| 51<br>Ext.<br>and<br>Int | F.   | 28   | Teacher.    | Naturally nervous. All her family have trouble with eyes. As a schoolgirl always had sick headache after writing. Has a "horror" of sitting down to write a letter. Never able to read over one-half hour without pain, and writing always followed by "frightful" headache. Binocular vision not constant. Vertical error of 14". Has had for over a year care fully fitted cylindrical correction with little relief. Goes home from school daily perfectly exhausted. | O. D. + 0.25s.<br>+ 0.75c. 90°. $\begin{matrix} \text{O.} \\ \text{V.} \end{matrix} = 1. \text{ O. S.} \\ - 0.50s \text{ } \begin{matrix} \text{C.} \\ \text{V.} \end{matrix} + \\ 1.50c. 90^\circ \text{ V.} \\ = 1.$ | 18' abd. 5" - add.<br>7" v. d. 14" conv.;<br>13" abd. 12" add.<br>— 10" v. d. 5" div.<br>18" v. d. 5" error $\nabla$ 14" O. D. | Her correction with O. D. prism 1", base up. O. S. prism 2", base out. | After six weeks: 18' abd. 4" - add. 27", 13" abd. 18" add. 30" v. d. 3" conv.              | Under observation four and one-half months. "Is tied to glasses" and miserable without them. Went to church sociable without them and had "terrific" headache all next day. With glasses has no headache and is able to read and sew all day and evening and to use eyes as she pleases.      |
| 52<br>Ext.               | F.   | 20   | .....       | Headache for two years, now almost daily. Often has vertigo. Difficulty in piano playing. Blurring of sight in looking steadily at objects. Reading increases headache and irritates lids. Some conjunctival irritation. Tonics used without benefit. Eyes twitch at outer angles. Prism tests cause frontal headache. Inclines head to right shoulder. O. S. stands higher than O. D. Eyes ache if she spends day in town shopping.                                     | Under atropine, $\begin{matrix} \text{O.} \\ \text{U.} \end{matrix} + 1. \text{ V.} \\ = 1.$   | 18' abd. 3 1/2" add.<br>10-15" v. d. 25;<br>13" abd. 16" add.<br>26" v. d. 4" div.   | Prism 1 1/2" base out, O. U. for constant use.                         | 18' abd. 6" add.<br>42" v. d. 1" conv.;<br>13" abd. 13" add.<br>40" v. d. 4" conv.         | Under observation six months. Wore prisms constantly for about a month, then for near work only. Able to read an hour fairly well. Improvement in general health. At end of six months had very little headache, whereas formerly it was so severe she was frequently compelled to go to bed. |
| 53<br>Ext.               | M.   | 13   | Schoolboy.  | Pain in eyes for three months, even when not reading.  | O. U. + 0.50s.<br>V. = 1.  | 18' abd. 3" add.<br>10" v. d. 25; 13" abd. 16 1/2" add.<br>30" v. d. 1" conv.  | Prism 1 1/2" base out, O. U. for constant use.                         | 18' abd. 4 1/2" add.<br>20" v. d. 3" conv.;<br>13" abd. 15" add.<br>30" v. d. 2 1/2" conv. | Under observation one year, wearing glasses all the time without "a bit" of trouble.  |

|            |       |            |  |   |  |   |   |   |
|------------|-------|------------|--|---|--|---|---|---|
| 54<br>Ext. | M. 15 | Schoolboy. | Reads and practices on piano many hours a day. Sometimes has pain in eye-balls. Pain in looking at distant objects. Eyes tire in looking at pictures. Spasm A.   | O. U. + 0.75s.<br>V. = I.                               | 18' abd. 3° add. 8°<br>v. d. ∞; 13''<br>abd. 14° add.<br>20° v. d. ∞.                      | After rest, prism 14°, base out, O. U. only in reading.   | 18' abd. 3° add.<br>40° v. d. 6° conv.;<br>13'' abd. 13° add.<br>25° v. d. 5° conv.             | Under observation one and one-half months. Wore prisms for near work only. Has had no pain in eyes, but has not been using eyes as much.  |
| 55<br>Ext. | M. 10 | Schoolboy. | Under treatment more or less for two years for dyspepsia. Much headache and nausea, particularly on use of eyes. Unable to look at moving objects without nausea. Unable to be in school more than one day in a week for several months on account of headache. Vertigo. Delicate, nervous boy.                                    | E.  | 18' abd. 3° add.<br>10° v. d. ∞; 13''<br>abd. 15° add.<br>13° v. d. ∞.                     | Prism 14°, base out, O. U. for constant use.  | 18' abd. 5° add.<br>23° v. d. 2° conv.;<br>13'' abd. 14° add.<br>25° v. d. 4° conv.             | Under observation eight and one-half months. Unable to get along without his prisms. Un- <sup>s</sup> able to concentrate mind on lesson for over one-half hour. If crowded beyond this has nausea and headache which last until following day. Has nausea if he leaves off prisms. Headache, nausea, and vertigo decidedly relieved by prisms. |
| 56<br>Ext. | M. 10 | Schoolboy. | Headache, vertigo, nausea, and distress in stomach. Unable to read. It distresses him to bend down to take off shoes. Has worn convex glasses without benefit.   | O. D. + 0.75s.<br>V. = I. O. S.<br>+ 1.00s. V.<br>= I.  | 18' abd. 1° — add.<br>25° v. d. 3° +<br>conv.; 13'' abd.<br>0° add. 12½° v. d.<br>1½ conv. | Prism 14°, base out, O. U. for constant use.  | 18' abd. — 2° add.<br>29° v. d. 3° conv.;<br>13'' abd. 0° add.<br>15° v. d. 8° conv.            | Under observation one month. Headache nearly every day, but not quite as severe as formerly. Complained of distress of stomach but once since first seen. Tenotomy advised.   |
| 57<br>Ext. | F. 25 | .....      | Headaches for a month, attributed to reading too many guide books on a recent European trip. Now unable to read at all without headache. Spasm A.  | Under atropine,<br>O. U. + 0.75s.<br>V. = I.            | 18' abd 5° add. 17°<br>v. d. 4° conv.;<br>13'' abd. 8° add.<br>40° v. d. 18°<br>conv.      | Prism 14°, base out, O. U. for constant use. In fact wore them inter- <sup>s</sup> ruptedly, always for near work. For distance they were not always comfortable. | 18' abd. 6° add.<br>27° v. d. 9° conv.<br>(latent); 13''<br>abd. 8° add. 27°<br>v. d. 12° conv. | Under observation five months. Gradual improvement. Complete relief of headache. Able to use eyes more than two hours a day without fatigue.  |
| 58<br>Ext. | F. 8  | .....      | Tendency to chorea, and has almost lived on arsenic. Occipital headache, pain extending to neck. Never able to study. If she attempts it is prostrated and has to go to bed. Is a bright, lively child ordinarily, but at times becomes moody, obstinate, and almost stupid. Spasm A. Anæmia. Child nervous and easily frightened. | O. U. — 1 s. V.<br>= I. under<br>atropine.<br>Slight H. | 18' abd. 5° add.<br>15° v. d. ∞; 13''<br>abd. 10° add. 18°<br>v. d. ∞.                     | After atropine, prism 1°, base out, O. U. for constant use, without much expectation that they would be of benefit.   | 18' abd. 3½° add.<br>22°  | Under observation one month. Prisms had no effect one way or the other. Two years later learn that condition has improved. Eyes have no bearing on symptoms.  |

## APPENDIX. — CONTINUED.

| No. Muscles. | Sex. | Age. | Occupation. | History and Symptoms.   | Refraction.  | Musc. Condition (Primary).  | Treatment.  | Musc. Condition (Ultimate).  | Results and Remarks.   |
|--------------|------|------|-------------|---|--|---|---|--|--|
| 59<br>Ext.   | F.   | 16   | Schoolgirl. | Formerly had malarial headaches which yielded to quinine. Now under treatment for slight lateral curvature of spine. Has much headache, coming on after school hours and passing off after being in open air. Some conjunctival irritation. Considerable supra-orbital tenderness. For two months headache has been almost constant. Spasm A. Spasm Interni. Rather delicate. | E.<br><br>E.   | 18' abd. 4½' add.<br>25'; 13' abd. 18' conv.<br>5" — 13' add.<br>30" + v. d. 5' conv. | Prism 14" base out, O. U. for constant use.   | 18' abd. 4" add.<br>35" + v. d. 6' conv.; 13" abd. 5" — 13' add.<br>30" + v. d. 5' conv. | Under observation four months. Complete relief of headache.  |
| 60<br>Ext.   | F.   | 31   | .....       | Thrown from sleigh two years ago. Sun-stroke one year ago. Much headache. Unable to use eyes in reading. Nervous.   | E.<br><br>After atropine, O. D. + 0.75c. 105; V. = 0.9. O. S. — 0.508<br>C + 1.75c. 80'. V. = 0.9. | 18' abd. 4" add.<br>15' v. d. 1" conv.;<br>13' abd. 11" add.<br>20' v. d. 2' conv.    | Prism 1", base out, O. U. for constant use.   | 18' abd. 2" add.<br>20" v. d. 2" conv.;<br>13" abd. 6" add.<br>23" v. d. 2".             | Under observation three months. Greatly relieved by prisms. Able to read an hour or more.  |
| 61<br>Ext.   | F.   | 36   | .....       | Patient has had malaria and is gouty. She is delicate and nervous. She has had the best medical care and has had various glasses without relief. Feels completely unstrung and discouraged. Spasm A.  | After atropine, O. D. + 0.75c. 105; V. = 0.9. O. S. — 0.508<br>C + 1.75c. 80'. V. = 0.9.           | 18' abd. 8" add.<br>15'; 13' abd. 9" add.<br>18' v. d. 4' conv.                       | Glasses correcting refracting error, later with addition of prism 14" base out, O. U.                               | 18' abd. 6" add.<br>20' v. d. 2" conv.;<br>13" abd. 4" v. d. tendency to divergence.     | Under observation six months. Both cylindrical and cylindrical-prismatic glasses unsatisfactory. Before wearing them was not subject to headache. Since using them has had much occipital headache whether using when not using eyes, although cylindrical-prismatic glasses are restful at evening and she can't play cards without them. |
| 62<br>Ext.   | F.   | 36   | .....       | Head feels tired if she watches people while driving in Park, and she has vertigo so severe on first getting out of carriage that for a minute she can hardly stand.  | O. D. + 0.75c. V. = 0.8. O. S. — 0.75c. V. = 0.5.  | 18' abd. 3" add. (?)<br>v. d. 2" conv.;<br>13' abd. 10" add.<br>(?) v. d. 5" conv.    | Prism 14" base out, O. U. for constant use. Later added — 0.50c. to O. S., which was afterwards reduced to — 0.25c. | .....  | Under observation one year. Prisms alone gave rise to diplopia, which was relieved by spherical correction added to O. S., and glasses were then worn with comfort.  |



|                     |                    |   |   |   |   |  |  |
|---------------------|--------------------|---|---|---|---|--|--|
| 63<br>M. 19<br>Ext. | Student.           | Dull headache most of time. Has nasal catarrh, conjunctivitis, and malaria. Trouble in reading in evening, and much pain in eyes after reading an hour or two at any time.  | Under atropine,<br>O. U. + 0.75s.<br>V. = 1.  | 18' abd. 5° add.<br>20° v. d. 2° conv.;<br>13'' abd. 18-10°<br>add. 20° v. d. 2°<br>conv. | Prism 14° base out, O. U. for constant use, later +0.75s. O. U. added. Glasses in both cases used constantly. Careful attention to general health, lids and nose.                             | 18' abd. 3° add. (?)<br>v. d. 2° conv.;<br>13'' abd. 12°-15°<br>add. 15° (?) v. d.<br>1° conv.   | Under observation one year. Glasses relieved the headache, and the relief was evidently due to the glasses rather than to any other line of treatment, for on going without them for a few days he again had severe headache.          |
| 64<br>M. 13<br>Int. | Schoolboy.         | Headache almost every day; often wakes with it. Has had chorea and still has some twitching of eyes.  | E.  | 18' abd. 7° add. 15°<br>v. d. 2° div.; 13''<br>abd. 18° add. 12°<br>v. d. 7° div.         | Prism 14° base in, O. U. for constant use. Fowler's Solution.   | 18' abd. 2° add.<br>22° v. d. 3° div.;<br>13'' abd. 18° add.<br>20°.   | Under observation seven months. Glasses gave immediate and almost complete relief from headache, so that after a few weeks he was allowed to go without them except in reading. At end of seven months did not need them. No headache. |
| 65<br>M. 31<br>Ext. | Merchant.          | Had palp. conj. every summer for twelve years, especially in O. S. At other times is quite well and can use eyes perfectly.   | O. D. + 0.75s. V.<br>= 1. O. S. E.<br>V. = 1. | 18' abd. 3° add. 28°<br>+ v. d. 3° conv.;<br>13 abd 20° add.<br>45° v. d. 4° conv.        | Been treated by astringents and local medication with little benefit. Has tried +60 for reading, without benefit. To have prism 2° base out. O. U. for near work and use Horic Acid for lids. | 18' abd. 4° add 20°.   | Under observation six years. Use of prisms one summer made him comfortable. The next year eyes were much better and he seldom used glasses. Since then, 1885, has not used glasses at all.   |
| 66<br>M. 60<br>Ext. | Restaurant Keeper. | "Weakness of sight," particularly after shooting. Distressed by looking out of car windows. Tremor of eyes at outer angles. Photophobia. Some slight conjunctival irritation. Fine vitreous opacities not impairing vision seriously. | O. U. + .25s.<br>V. = 1.                      | 18' abd. 5° add.<br>30° v. d. 2.5°, 13''<br>abd. 20°-5° add.<br>60° v. d. 2.5.            | Prism 14° base out, O. U. for constant use; later, weak convex glasses substituted.   | 18' abd. 5° add.<br>44° v. d. 2.5°, 13''<br>abd. — 18°-15°<br>add. 60° + v. d.<br>15° conv. With<br>+3 D O. U.,<br>18' abd. 23° add.<br>(?) v. d. 3° conv. | Under observation six weeks. No improvement except from the rest.  |

## APPENDIX. — CONTINUED.

| No. Muscles. | Sex. | Age. | Occupation.        | History and Symptoms.   | Refraction.   | Musc. Condition (Primary).   | Treatment.   | Musc. Condition (Ultimate).   | Results and Remarks.  |
|--------------|------|------|--------------------|---|---|--|--|---|---|
| 67<br>Ext.   | M.   | 28   | Theol.<br>Student. | Has had several pairs of glasses none of which satisfy him. Eyes feel uncomfortable without real pain. Never has discomfort in both eyes at once, usually only in O. D. Spasm A. Excessively nervous.   | O. D. + 0.50c.<br>100°. V. = 1.<br>O. S. + 0.50c.<br>105°. V. = 1.  | 18' abd. 2° add.<br>15° v. d. 2° div.;<br>13'' abd. 18° add.<br>20° v. d. 2° conv.   | Prism 2°, base out, O. U. with cyl. correction for constant use.                                 | 18' abd. 5° + add.<br>(?) 13'' abd. 10° add (?) v. d. 4° conv.                        | Under observation nearly two years. Wore cylindrical-prismatic glasses for several months with great benefit. He then began to use cylinders alone for distance and used prisms only in reading. Ultimately he used cylinders for all purposes.   |
| 68<br>Ext.   | M.   | 35   | Clerk.             | For seven or eight years has had severe neurotic pain in eyes and head. Pain so severe that he usually has to go to bed as soon as he gets home. Never free from pain. Has been under the best medical treatment without relief. Abduction painful. Often has diplopia.           | O. D. 0 7/11 +<br>1 D. V. = 1.<br>O. S. 0.5; not improved. O. S. Struck by a piece of wood when he was a boy. No trace of injury visible. | 18' abd. — 3° add<br>20° v. d. 8 1/2° conv; 13'' abd. — 7° add. 30° v. d. 24° conv.  | Prism 3°, base out, O. U. for constant use.  | After 10 days,<br>18' abd. — 15° add. 37'; 13'' abd. 13° add. (?)                     | Under observation two and one-half years, but no examination made after first ten days. Testimony urgently advised, but he has been unable to leave his business. He drags along and leads a wretched existence. He can't get along without his prisms, but they are entirely inadequate, as was to be expected.  |
| 69<br>Ext.   | M.   | 47   | Banker.            | Much severe headache for two months, coming on at all hours of day; often wakes with it. Pain is through temples. Prism tests bring on the headache. Prefers to ride backward in cars. Is a large man and takes little exercise. No diplopia. Is a confirmed dyspeptic and gouty. | O. U. + 1.75s.<br>V. = 1.   | 18' abd. 3° add.<br>35° v. d. 2° conv;<br>13'' abd. (?) add.<br>(?) v. d. 5° conv;<br>13'' without glasses (+1.25s.) v. d. 10° conv. | O. U. + 1.75s. — prism 2°, base out, for reading. To use his glasses, +1.25s O. U. for distance. | 18' abd. 3° — add.<br>27° v. d. 3° conv.;<br>13'' abd. (?) add.<br>(?) v. d. 5° conv. | Under observation five months. Has very little headache, but thinks relief is due to antipyrin which he began to use shortly after first visit because the headache continued after wearing glasses. Still he is very dependent on his glasses and feels that they help him. Is unable to watch a public speaker without them, and is unable to look at the minister through a whole sermon even with them. Finally gave up prisms. |
| 70<br>Ext.   | M.   | 16   | Student.           | More or less trouble for four years, unrelieved by weak glasses. Sometimes has pain in eyes in looking at distant objects, but chiefly in reading.  | E.  | 18' abd. 2° — add.<br>30° v. d. 4° conv;<br>13'' abd. 6 1/2° add.<br>35° + v. d. 10° conv.   | Prism 1 1/2°, base out, O. U. for constant use.  | 18' abd. 3° add.<br>35° + v. d. 10° conv.; 13'' abd. (?) add. (?) v. d. 23° conv.     | Under observation three months. Much more comfortable with prisms, which he enjoyed and did not like to leave off. Testimony advised.   |

|            |       |          |  |                                |   |   |   |   |
|------------|-------|----------|--|--------------------------------|---|---|---|---|
| 71<br>Ext. | M. 32 | Dentist. | Blurring of objects and print. If very tired has diplopia. Slight trouble two or three years but not much until last few months. Never has headache.   | E.                             | 18' abd. 3" add.<br>23 v. d. 3' conv.;<br>13" abd. 11' conv.<br>20 v. d. 7' conv.               | Prism 2", base out, O. U. for constant use.   | After 1 week, 18' abd. 6" add. 30' v. d. 8' conv.   | Seen one and one-half years later. Had been from one oculist to another, and was still worrying along. Tenotomy urgently advised. Nothing to be expected from any other mode of treatment.  |
| 72         | M. 10 | .....    | Epileptic convulsions for two and one-half years. Sometimes goes a day or two without having one, but usually has from two to five in a day. Under best medical treatment. Has distinct aura. Right side more affected than left. Some frontal headache.   | Nearly E.<br>Spasm A.          | 18' abd. 5" add.<br>15"; 13" abd.<br>10" add. 25' v. d. 7" conv.<br>Very error Δ 1 1/2<br>O. D. | O. D. prism 2", base out, O. S.; prism 1 1/2", base up.   | 18' abd. 5" add.<br>21" v. d. 4" conv.; 13" abd.<br>16" add. 17" v. d.<br>5' conv. Vert. error only 1/2". | Under observation nine weeks. Wore glasses faithfully for one month without appreciable benefit. Has attacks at least every other day.  |
| 73<br>Ext. | F. 48 | Married. | Had strabismus in early life, but eyes "suddenly" came into correct position without operation. Can be made to see double images only momentarily and prism tests show central blind spot. O. D. For four years has had some headache following epileptiform attacks. Some illness ("brain fever") two years ago. Has headache after a Park drive. | O. D. Amblyopia. O. S. E.      | Undetermined on account of monocular amblyopia.   | O. U. prism 1", base out, for constant use, followed one week later by O. D. prism 3/4", base out, O. S.; prism 1", base out. | 18' v. d. 11" conv. She learned to recognize double images momentarily.                                   | Under observation three months. No headache. Comfortable with prisms, and misses them if she leaves them off. Epileptic attacks have occurred, but have never been frequent.                |
| 74<br>Ext. | F. 30 | .....    | Burning pain in eyes and headache for a week, due to excessive use of eyes in China painting. Not subject to headache, but reading the paper will now provoke it. Considerable conjunctival irritation. Health not very good; is depressed on account of serious illness of a very dear friend.  | O. U. + 0.50c.<br>90°. V. = 1. | 18' abd. 3" add.<br>15" v. d. 1" conv.;<br>13" abd. 20" add.<br>20' v. d. 3' div.               | O. U. + 0.50c. 90° prism 1", base out, for constant use. Strychn. Sulph.  | 18' abd. 5" add.<br>20" v. d. 2"; 13" abd. 18" add.<br>25' v. d. Δ.                                       | Under observation eight and one-half months. Headache much abated. Health better. Can use eyes moderately.  |
| 75<br>Ext. | M. 20 | Clerk.   | Eyes tire quickly and print becomes blurred. After reading fifteen or twenty minutes lays aside book and doesn't feel like going on, although he has no real pain. Slight conjunctival irritation. Some nasal catarrh, benefited by treatment.   | E.                             | 18' abd. 5" add.<br>15" v. d. 2"; 13" abd. 10" add. 15' v. d. Δ.                                | Prism 1 1/2", base out, O. U. for constant use.   | 18' abd. 3" add.<br>27" v. d. 2" conv.; 13" abd.<br>15" add. 28" v. d.<br>5' conv.                        | Under observation one month. With prisms works easily, both by day and night. Eyes do not become tired. No blurring of print. Very little irritation of lids unless provoked by smoke, etc. |

## APPENDIX. — CONTINUED.

| No. of Muscles. | Sex. | Age. | Occupation.      | History and Symptoms.   | Refraction.  | Musc. Condition (Primary).  | Treatment.  | Musc. Condition (Ultimate).   | Results and Remarks.  |
|-----------------|------|------|------------------|---|--|---|---|---|---|
| 76 Ext.         | M.   | 14   | Schoolboy.       | Trouble for six months. Unable to read over one-half hour with comfort. Eyes feel sore and painful, print becomes blurred, and frontal headache follows use of eyes. Follicular conjunctivitis. | O. D. + 0.75s.<br>V. = 1. O. S.<br>E.                | 18' abd 5" add. 13" v. d. Δ; 13" abd. 11" add. 16" v. d. 2" div.            | Tannin and Glycerine locally. Prism 14°, base out, O. U. for constant use.  | 18' abd. 4" 5" add. 29" v. d. Δ; 13" abd. 6" 10" add. 30" 35" v. d. 3" 7" conv. Shortly before this abd. at 18' was only 14" and at 13" 6". | Under observation two years. Pain in eyes and frontal headache continued for about six months with only slight improvement. From one to three headaches a week, coming on after reading. Tenotomy was advised, but when he came a month later, expecting an operation, it was deferred on account of the improved muscular condition, the absence of pain and headache, and the marked subsidence of the conjunctival trouble. Continues to wear glasses. |
| 77 Ext.         | M.   | 23   | Medical Student. | Weariness of eyes in reading. Sense of strain in looking out of car windows.  | O. U. + 0.50c.<br>90°. V. = 1.<br>Under astigmatism. | 18' abd. 4" add. 17" v. d. 2" conv.; 13" abd. 15" add. 20" v. d. 3" div.    | Prism 14°, base out, O. U. to be worn constantly in connection with +0.75c. 90° O. U. which he had been wearing without relief. | 18' abd 24" add 24" + v. d 4" conv.; 13" abd 13" add 36" v. d. 2" conv.   | Under observation five months. Sense of strain greatly diminished by supplementary prisms. Reported that he could read twelve hours a day.  |
| 78 Ext.         | M.   | 19   | Student.         | Complains that eyes always feel tired after using blow-pipe in laboratory.  | E.   | 18' abd. 5" add 22" + v. d. 2" conv.; 13" abd. 13" add. 25" v. d. 12" conv. | Prism 2°, base out, O. U. for near work.  | .....   | Under observation five weeks. Uses prisms in blow-pipe work and gets along very well. Relief permanent.   |
| 79 Ext.         | M.   | 30   | Book-keeper.     | Trouble for eight or nine months. Pain in eyes whenever he uses them. Moderate conjunctival irritation.   | E.   | 18' abd. 4" add. 7" v. d. Δ; 13" abd 124" add. 3" v. d. Δ.                  | Prism 14°, base out, O. U. for constant use.  | 18' abd. 2" 3" add. 14" v. d. 3" conv.; 13" abd. 10" add. 20" v. d. 3" conv.  | Under observation fifteen months, at the end of which time he could read two hours without much trouble. Has given up book-keeping and is more out of doors. The case was at first thought to be one of weak innervation, and prisms were ordered with bases in. By mistake prisms were set with bases out, with result above mentioned.  |

|            |       |                     |  |                           |   |  |   |  |
|------------|-------|---------------------|--|---------------------------|---|--|---|--|
| 80<br>Ext. | M 13  | Schoolboy.          | Frontal headache and sometimes pain in eyes in reading. Often wakes with headache, and reading one-half hour will bring it on. Conjunctival irritation.  | E.                        | 18' abd. 5° add. 21° v. d. 2° conv.; 15'' abd. 20° add. 20° v. d. 7° conv.  | Prism 14 <sup>s</sup> . base out, O. U. to be used constantly temporarily.   | .....   | Under observation ten days. Wore prisms eight days, found headache cured. Attempted to go without them, and headache returned. Relief known to be permanent.                                       |
| 81<br>Ext. | F. 42 | Married.            | Very poor health for four years, following attack of nervous prostration. Uterine trouble. Until recently has been able with care to read three or four hours a day, but read too long a few weeks ago and has been unable to use eyes much since. Has suitable convex glasses for distance and near work. Four years ago began to have "terrible" headaches which persisted for two years. After the "real cure" there was relief for a year, but for the past year the headaches have occurred with the old frequency and severity. Riding in Park fatiguing. Photophobia. Insomnia. | O. U. + 0.75s.<br>V. = I. | 18' abd. 4° add. 20° v. d. 2°; 17'' abd. 15° add. 33° v. d. 4° conv. After 10 days. 18' abd. 4° add. 20° v. d. 4° conv.; 13'' no glasses. abd 20° add 23° v. d. 7° conv.; O. U. abd. 23° add. 18° v. d. 2°. | O. U. + 0.50s. prism 14 <sup>s</sup> . base out, for constant use. Later + 1.50s. Prism 14 <sup>s</sup> . base out, for reading. | 18' gl. v. d. 2° conv.; 13'' gl. v. d. 8° conv.                           | Under observation four months. Much less headache. Rest has been of benefit. Health somewhat better. Finds that prisms give much relief for distance, but not for near work.                       |
| 82<br>Ext. | F. 15 | Schoolgirl.         | Subject to sick headache as long as she can remember; during past year has had about one a week. Almost constant dull headache for three weeks. Eyes feel crossed in near work, but she persists in spite of pain.   | O. U. + 0.50s.<br>V. = I. | 18' abd. 34° add. 27° v. d. 3° conv.; 15'' abd. 15° add. 30° v. d. 2°.  | Prism 14 <sup>s</sup> . base out, O. U. for reading.   | 18' abd. 3° add. 10° v. d. 6° conv.; 13'' abd 15° add. 30° v. d. 5° conv. | Under observation five months. Complete relief from pain and headache. Able to do all her school work, besides Christmas fancy work. Tenotomy was advised, but deferred on account of improvement. |
| 83<br>Ext. | M. 22 | U. S. Army Officer. | No trouble until a year ago. During past year eyes have felt tired after reading a few hours. Recently unable to read for any length of time with comfort. A perfect specimen of a man physically. First noticed trouble after target practice.  | E.                        | 18' abd. 5° add. 24° v. d. 2°; 13'' abd. 8° add. 40° + v. d. 74° conv.  | Prism 14 <sup>s</sup> . base out, O. U. for constant use.  | 18' abd. 34° add. 21° v. d. 2°; 13'' abd. 17° add. 30° v. d. 2°.          | Under observation six weeks. Prisms a great relief. Can read two hours, but mechanical drawing is hard for him. Does not like to be without prisms long enough for his morning toilet.             |

## APPENDIX. — CONTINUED.

| No. Muses. | Sex. | Age. | Occupation.      | History and Symptoms.   | Refraction.  | Musc. Condition (Primary).  | Treatment.   | Musc. Condition (Ultimate)  | Results and Remarks.   |
|------------|------|------|------------------|---|--|---|--|---|--|
| 84<br>Ext. | M.   | 28   | Manager.         | Has for three years had so much pain in eyes and head that he could read very little, and has not been able to read at all for six months. Has worn cylindrical glasses without relief. Rather run down physically. Appetite not good.                              | O D. — i. s. $\ominus$<br>+2.25c. 90°. V.<br>= 1. O. S. —<br>0.75s. $\ominus$ + 2 c.<br>85°. V. = 1. | 18' abd. 4° add.<br>22° v. d. 5° conv.;<br>13''/abd. 12° add.<br>28° v. d. 12°<br>conv. | Correction of refractive error with prism 2° base out, O. U. for constant use.       | 18' abd. 3° add.<br>26° v. d. 8° conv.;<br>13''/abd. 20° add. 34° v. d. 9° conv.      | Under observation sixteen months. Can't get along without the prisms, but even with them eyes smart and print blurs, with sense of fatigue. At times perfectly comfortable. Feels that glasses are decidedly beneficial. |
| 85<br>Ext. | M.   | 35   | Medical Student. | Much difficulty in use of eyes for over a year. Lids feel stiff; they twitch and finally close in reading by artificial light.  | O. U. + 0.75c.<br>180°. V. = 1.  | 18' abd. 2° add. 13° v. d. $\Delta$ ; 13''/abd. 16° add. 35° v. d. 1° conv.             | Prism 14° base out, O. U. for constant use.  | 18' abd. 1° add.<br>19° v. d. 3° conv.;<br>13''/abd. 10° add.<br>40° + v. d. 7° conv. | Under observation six months. Can read with prisms for hours. Benefit permanent.   |
| 86<br>Ext. | M.   | 27   | Physician.       | Trouble in looking at people passing, moving objects, etc. Objects unsteady and print blurs — letters run together. Eyes become tired in looking at distant objects.  | E.   | 18' abd. 2½° add.<br>13° v. d. 3° conv.;<br>13''/abd. 8° add.<br>30° v. d. $\Delta$ .   | Prism 14° base out, O. U. for constant use.  | .....   | Under observation for at least twelve months. Perfectly comfortable with prisms, and unable to go without them.  |
| 87<br>Ext. | M.   | 35   | Book-keeper.     | Some headache about once a week, and dull headache most of the time. Pain frontal, about eyes. Has been book-keeper for seven years, and works from ten to fourteen hours a day. Was formerly on the western plains and then had headache. Conjunctival irritation. | E.   | 18' abd. 5° add 9° v. d. 1° conv.;<br>13''/abd. 18° add.<br>6° v. d. 2° div.            | Prism 14° base out, O. U. for constant use. Later, +0.75s. additional for desk work. | 18' abd. 4½° add.<br>15° v. d. 3° conv.;<br>13''/abd. 6° add.<br>15° v. d. 4° conv.   | Under observation six months. Continues to use eyes excessively. Has very little headache compared with what he formerly had.  |
| 88<br>Ext. | M.   | 29   | Medical Student. | Complains only of blurring of print.  | Under atropine,<br>H. = 1 D. V.<br>= 1.  | 18' abd. 3° add. 22° v. d. $\Delta$ ; 13''/abd. 16° add. 25° v. d. $\Delta$ .           | Prism 14° base out, O. U. for constant use. Has worn +1-42 s. O. U. without relief.  | 18' abd. 4° add<br>15° v. d. $\Delta$ ; 13''/abd. 13° add.<br>23° v. d. $\Delta$ .    | Under observation four months. Prisms were of great service. Was able to use his eyes all winter as much as he pleased, even in the cramming for final examination.  |

|            |    |    |                  |  |  |   |  |  |
|------------|----|----|------------------|--|--|---|--|--|
| 89<br>Ext. | M. | 12 | Schoolboy.       | Trouble for six months. Has used +0.75s. O. U. without relief. Has headache in afternoon. Some nasal catarrh. Slight conjunctival irritation.  | O. U. +1 D. s. ◯ prism 1½, base out, for constant use.   | 18' abd. 2½ add. 25; 13' abd. 3 add. 30° v. d. 5° conv.                             | 18' abd. 1½ add. 44; + v. d. 2; 13'' abd. 5° add. 38° v. d. 11° conv.  | Under observation six months. Wore glasses nearly all the time. Is better with glasses on and has very little headache, but glasses are inadequate. Tenotomy advised.  |
| 90<br>Ext. | F. | 21 | .....            | Unable to use eyes at night for a year. Trouble began after severely taxing eyes in fine painting. Eyes feel strained. Has had +1 s. for a year without much benefit. Slight conjunctival irritation.  | O. D. +0.50c. 90°<br>◯ prism 1, base out; O. S. +0.75c. 90°<br>◯ prism 1, base out, for constant use. After three mos. in reading, etc., only. | 18' abd. 6° add. 12-17° v. d. 1° div.; 13' abd. 15° add. 15° v. d. tendency to div. | 18' abd. 3½ add. 22° v. d. 2; 13'' abd. 10° add. 23° v. d. 3° conv.  | Under observation three months. Strained feeling relieved. Broke glasses at end of three months, and had to go without them for three days. Felt loss of glasses very much the first day, but suffered no inconvenience after that. Allowed to use them in near work only. |
| 91<br>Ext. | F. | 16 | .....            | Trouble for two years. Pain in eyes and inability to read much in evening.   | Prism 2°, base out, O. U. for near work.   | 18' abd. 5° add. 21° v. d. 2; 13'' abd. 20° add. 30° v. d. 10° conv.                | 18' abd. 6° add. 22° v. d. 2; 13'' abd. 10° add. 43°.  | Under observation four months. Prefers to use glasses in reading, and can do more with them than she could before she had them, but they are not of great service.   |
| 92<br>Ext. | F. | 20 | Stamstress.      | Difficulty in use of eyes for a year. Eyes feel tired. Much pain in eyes and frontal headache. Inefficiency of external tests that in the muscular with suppression of one innage. Pain in eyes often amounts to a real ache and is always worse in evening. Eyes become red and inflamed. | Prism 2°, base out, O. U. for constant use.  | 18' abd. (2) add. (2) v. d. 20° conv.; 13'' v. d. 15° add. 20° v. d. 18° conv.      | 18' abd. 0° add. 28° v. d. 25° conv.; 13'' abd. 18° add. 23° v. d. 18° conv. With red gt. 18' abd. —3° to —9°. | Under observation two weeks. Wore glasses all the time, and had only one headache. Eyes feel much stronger. No pain. Prisms nauseated her at first. Relief probably due to rest, as eyes have not been used much. Tenotomy the only remedy.                                |
| 93<br>Ext. | M. | 29 | Medical Student. | Complains of the inflammation of lids. Diagnosis of weak internal made in another city two years ago. Nasal obstruction.   | Prism 2°, base in, O. U. for constant use.   | 18' abd. 5° add. 7° v. d. 2; 13'' abd. 18° add. 15° v. d. 2½ div.                   | 18' abd. 5° add. 9° v. d. 2; 13'' abd. 26° add. 12° v. d. 7° div.  | Under observation three months. Prisms gave relief for two weeks and then failed. Suitable for operation. Probable advancement of interni.   |

## APPENDIX. — CONTINUED.

| No. Muscles. | Sex. | Age. | Occupation. | History and Symptoms.  | Refraction.   | Musc. Condition (Primary).  | Treatment.  | Musc. Condition (Ultimate).   | Results and Remarks.  |
|--------------|------|------|-------------|--|---|---|---|---|---|
| 94 Ext.      | M.   | 28   | Bank Clerk. | Trouble for two years. Great difficulty in looking at moving objects, as in playing cards, turning leaves of book. Trouble in piano and violin playing; in the latter the motion of the bow is very annoying. Can not ride forwards in cars and look out of window without great discomfort, but has no trouble in riding backwards. Is much annoyed at table looking at persons opposite. Finds it difficult to keep face in repose looking steadily at anything. Is relieved by pressure on brow and temples, and by clapping hands behind head. | O. D. + 0.50c.<br>90° V. = 1.0.<br>S. + 1. c. 90°.<br>V. = 1. | 18' abd. 4° (?) add.<br>7 v. d. Δ; 13''<br>v. d. 4° add. 4°<br>Possible vertical error of 4°. | Prism 1½° base out, O. U. for constant use, in combination with correcting cyl. glasses. Also given prisms for gymnastic purposes to increase adduction.  | 18' abd. 2° add.<br>50 v. d. Δ; 13''<br>abd. 64° add. (?)<br>v. d. 2° div.              | Under observation six months. Unable to get along without his prisms, as he found when he broke them. Is able to do all his work and gets along fairly well. Interni too weak for an operation at first, but their power greatly increased under practice. He may finally come to an operation. Cylinders without prisms did not relieve. |
| 95 Ext.      | F.   | 24   | .....       | Pain in eyes for three or four years, pretty severe for a year. After ten minutes of reading print blurs and pain comes on. Headache, frontal, temporal, and occipital. As a schoolgirl could not use eyes with comfort. Steady looking at anything painful, and she has to keep eyes closed on cars. Often has to lie down and close eyes to rest them. Has had much care and anxiety, and takes little exercise. Considerable conjunctival irritation. Has worn weak cylinders without relief.   | E.  | 18' abd. 5° add.<br>17 v. d. Δ; 13''<br>abd. 13° add.<br>15° v. d. 3° conv.                   | Local applications to conjunctiva. Gr. ii Sol. Pilocarpine with Cocaine once a day. After using Pilocarpine two weeks with little or no benefit, prism 1½° base out, O. U. for constant use, and to continue drops as before. Tonics. | 18' abd. 6° add.<br>25 + v. d. slight conv.; 13'' abd.<br>10-15 add<br>+ v. d. 5° conv. | Under observation three and one-half months. Able to read nearly one-half hour with prisms. Still has pain in eyes and headache, but less than formerly. The state of health was the main feature. Glasses used tentatively.  |
| 96 Ext.      | F.   | 23   | Milliner.   | Always had more or less pain in head, worse now than ever. Recently had severe pain in eyeballs. Trouble in riding on cars.  | O. D. E. O. S.<br>Hm. 0.25.                                   | 18' abd. 2° add.<br>33° v. d. 6° conv.;<br>13'' abd. 3° add.<br>33° v. d. 11° conv.           | Prism 1½° base out, O. U. for constant use.   | 18' abd. 11° add.<br>40° v. d. 10 conv.   | Under observation two weeks. Decidedly better. Has been able to work moderately, and with more comfort. Tenotomy advised.   |



|             |       |          |  |  |   |  |   |   |
|-------------|-------|----------|--|--|---|--|---|---|
| 97<br>Ext.  | M. 32 | .....    | Three years ago had occasional attacks of what he calls "spasm of eyes," i. e., print became unsteady in reading, and he could see parts of words only. These attacks would be followed by intense headache. He now complains of pain in top of head. Broke down in college. | O. D. +0.25s. C<br>+0.75c. 75.<br>V.=1. O. S.<br>+0.50s. C +<br>0.50c. 105.<br>V.=1. | Examined by oculist of Baltimore, three years ago.                            | Three years ago, spherocylindric correction as already noted; five months ago same correction with prism 4° base out, O. D.; prism 24° base out, O. S. | 18' abd. -6° add.<br>23' 13'' abd.<br>-5° add. 25° v. d. 12° conv.                | Under observation of former oculist for three years. Since using prisms has had none of the attacks which he formerly had. Suitable for operation.  |
| 98<br>Ext.  | F. 83 | .....    | Pain in eyes and headache after use, for a few weeks. Bright, vigorous, and well-preserved old lady. Reads and writes until eleven o'clock at night. Homonymous diplopia in distant vision.  | O. D. +1.50s.<br>V.=0.4. O. S.<br>+1.50c. 180°.<br>V.=0.4.<br>Sclerosed lenses.      | 18' Homonymous diplopia; 13'' abd. 25° add. 13° v. d. 8° div.                 | Prism 14° base out, O. U. for distance; O. U. +5° for reading.   | 18' abd. 0° add.<br>12-15° v. d. 3° conv.; 13'' abd. (?) add. 5° v. d. 10' div.   | Under observation two weeks. Headache relieved by prisms. No diplopia with prisms.  |
| 99<br>Ext.  | F. 20 | .....    | Pain in eyes; they ache most of the time. Much headache; she often wakes with it. Has been using +0.75s. O. U. in reading, etc., without relief. Brother has weak externi. Some conjunctival irritation.   | E.   | 18' abd. 4° add.<br>18° v. d. 1° conv.;<br>13'' abd. 9° add.<br>17° v. d. 5°. | Prism 14° base out, O. U. for reading.   | 18' abd. 4° add.<br>22° v. d. 1° conv.;<br>13'' abd. 8° add.<br>(?) v. d. 5° conv | Under observation fifteen months. Great relief. Continues to wear glasses.  |
| 100<br>Ext. | M. 22 | Student. | Eyes always feel weak. Often has pain in eyes after using them three or four hours. Conjunctivitis. Nasal catarrh with obstruction. Has used +0.75s. for reading, without relief. Sister has similar trouble.  | O. D. -0.75c. V.=1.<br>180° V.=1.<br>O. S. -0.50c.<br>180° V.=1.                     | 18' abd. 3° add.<br>18° v. d. 2°; 13''<br>abd. 17° add. 35°<br>v. d. 2°.      | Prism 14° base out, O. U. for constant use. Later, prisms combined with convex cylinders for distance, and convex cylinders for reading. Constant use. | 18' abd. 3° add.<br>24° v. d. 2° conv.;<br>15'' abd. 13° add. 23° v. d. 2°.       | Under observation two years. Prisms gave great relief at once, and enabled him to study eight or ten hours a day, and that before cylinders were added. Nasal obstruction removed after symptoms were relieved. At end of two years had no cause to complain of eyes. |

