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REPORT OF THE SECTION
ON
OPHTHALMOLOGY, OTOLOGY AND
LARYNGOLOGY.

A SIMPLE AND VALUABLE OPTOMETER.

By JULIAN J. CHISOLM, M. D.,
Professor of Eye and Ear Diseases in the University of Maryland.

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A SIMPLE AND VALUABLE OPTOMETER.

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Errors of refraction, faults of accommodation, and diseases of the inner eye structures interfering with good vision, are among the most numerous of eye affections. Such eye troubles are met with every day, and form the majority of cases seen by specialists in office or dispensary practice. To facilitate the diagnosis in these many patients is a matter of time economy. Each specialist has adopted some method by which he can be the more readily guided in the direction of the diagnosis, and possibly in the selection of a remedy. In many cases some form of spectacle is to do the work of restoration to useful vision.

Ophthalmic surgeons use charts as tests of the strength of eyesight, and have in possession a case of trial glasses, in which are found lenses of all strengths, convex and concave, spherical and cylindrical. From these they seek the special lens which will secure clear and easy sight to the patient. The strongest convex lens found in this trial case focuses at 1 inch. It is one of extreme strength, seldom called for, even when the crystalline lens is removed from the human eye, as after cataract extraction, and therefore can never be used in supplementing the lens existing within the eye. Still it is the unit of strength by which all lenses are measured, and explains why the numbers of spectacles are written in fractions.

The law of optics fixes as the strongest lens the one of greatest convexity of surface, and necessarily the one which, by condensing light the more rapidly, must have the shortest focus. When we accept the lens of one inch focus as the strongest we need in eye-glass adjustment, all others must be weaker in strength, and therefore a part only, or a fraction of the stronger one.

For good clear sight, a sharp image or picture, minute of course, must be formed upon the nerve layer of the eye, the retina. A magnifying lens must do this condensation of light, and it must be so adjusted as to focus accurately upon the sensitive layer within the eyeball.

The human eye is about one inch in diameter. The yellow spot, the central part of the retina, especially prepared by nature for sharp vision, is distanced about one inch from the central portion of the cornea, in front of the pupillary opening. The crystalline lens is located near the middle of the eye, about $\frac{5}{8}$ of an inch from the retina, and therefore must represent a powerful lens of a little over a $\frac{1}{2}$ inch focus. There are human eyes so very short in this antero-posterior diameter that the light condensed by the crystalline lens is obstructed by the retina long before the focus of a $\frac{1}{2}$ inch is reached. Take out a cataract lens from such a very flat eye and it may become necessary to use before it a lens approaching in strength that of one inch focus, to produce a clear picture upon the retina of a small object held near to it. Hence it is that the very strong convex lens of one inch focal power is adopted as the strongest lens required. As the eyeball cannot be entered to locate a glass lens near the retina, one of greater strength than the inch can never be wanted.

As we recede from this standard of one inch for extreme focal strength, a lens which focuses twice as far, or at two inches, must be only half as curved, and necessarily only half as strong. Such a lens is called a No. 2 Convex, or as it is usually written $\frac{1}{2}+$. In like manner a lens which focuses sunlight at 10 inches is only $\frac{1}{10}$ as thick in its convexity as one which focuses at one inch. It is called a No. 10, or as we write it $\frac{1}{10}+$. The same rule holds good for glasses which focus at any distance. The weakest in the large trial cases are those which if held 148 inches from a screen will show a feeble condensation of sunlight upon it. These are only $\frac{1}{148}$ the strength of the strongest, that of one inch focus. By opticians the denomination of the fraction is used to designate the strength of the spectacle, and consequently the larger the number used the feebler the glass. Persons old enough to require spectacles commence to use the largest numbers, which represent the weakest glasses, and as the increase of age requires stronger ones, the number of the glass diminishes. As the strongest convex glasses are rarely called for, we may say the same of the weakest.

When age creeps on and 40 years is reached, all good eyes begin to feel that looking at small print for a length of time is irksome. The aid of a weak pair of spectacles of $\frac{1}{60}+$ the strength of the very strongest one, the No. 60 Convex of the optician, restores former comfort and removes altogether the tired feeling. As increasing years continue to take away the accommodation properties of the lens, a smaller number, stronger spectacle, must be used. The $\frac{1}{60}+$ gives way to $\frac{1}{50}+$, these in turn to $\frac{1}{40}+$, $\frac{1}{30}+$, $\frac{1}{20}+$, $\frac{1}{15}+$, and $\frac{1}{10}+$, till in very old age even $\frac{1}{5}+$ may be needed to supplement our own $\frac{1}{2}$ inch crystalline lens, to enable the very aged to retain their reading privileges. When the crystalline lens becomes opaque, and as a cataract is extracted from the interior of the eye, then an entire condensing apparatus must be substituted, and the stronger convex lenses, $\frac{1}{4}+$, $\frac{1}{3}+$, or $\frac{1}{2}+$, are required. These selections of spectacles are all based upon the healthy and perfectly formed eye, and mark the changes which age always induces.

Overwork of the eyes during childhood, too close and long-continued study in early school life, keeping up a hyperemic state of the organ when the coats of the eye are still soft, yielding and growing, permits as it were of an expansion of the organ from within, which the recti muscles enveloping the sides, the upper and lower, the inner and outer sides, to a certain extent oppose. The result is an elongation of the eyeball in the direction of least restraint, antero-posteriorly, and this produces the long eye of near-sighted children. Once the young eye yields and loses its primitive form, continued work forces it to yield the more readily, and progressive myopia is established. This is a general weakening of the organ, which in the course of time leads to many serious and even destructive diseases. The lengthening of the eyeball, usually at the expense of the posterior wall, carries the retina away from the lens. This elongates the focal distance for vision, and necessitates the use of concave glasses of various strengths to follow up the retreating retina and secure the needful focusing of an image upon its percipient surface which is an essential for good sight.

In the trial cases of glasses each convex lens is matched by a concave one of corresponding strength, called negative or minus glasses, running therefore from 1 inch negative focus to 148 inch focus. Sections of cylinders as well as sections of spheres are represented in these convex and concave glasses. From the collection of these numerous lenses of the trial case, every person with faulty vision from defective shape of the eyeball, whether they be over-sighted or flat-eyed, called *hyperopic;* near-sighted or long-eyed, called *myopic;* old-sighted with flattened lens, called *presbyopic;* or irregularities in the corneal surface, called *astigmatism*, can have sight improved.

In adjusting glasses which advancing age requires, in persons whose eyes have always been strong and of proper shape, observation has taught us that the natural deterioration in the elasticity of the crystalline lens makes itself evident at about 40 years of age, when the outline of fine print becomes somewhat blurred; and it steadily advances to the end of life. This progress of failing sight is so regular that a table indicating the strength of spectacles to suit respective ages can be prepared.

If a good eye at 40 years of age needs a $\frac{1}{60}+$ glass to sharpen the outline of small printed letters, at the age of 45 a $\frac{1}{40}+$ glass will be needed. The same eye at 48 years of age requires a $\frac{1}{30}+$ and at 50 years of age a $\frac{1}{20}+$, at 55 years a $\frac{1}{15}+$, at 60 years a $\frac{1}{10}+$, at 63 a $\frac{1}{9}+$, at 65 a $\frac{1}{8}+$, at 70 a $\frac{1}{7}+$, and so on. If all eyes corresponded strictly to this normal standard in shape, only such glasses as designated would be needed, and the manner of supply would be extremely simple. Consult the age of the person and the card for corresponding strength of spectacles, and the deteriorating vision is at once made sharp by the spectacles selected. Unfortunately, perfectly formed eyes may nearly be called the exception among the civilized races. The more advanced in mental culture, the more irregular the shape of the eyeball. Eye faults, organic in their nature, are creeping in with education, and are transmitted with individual peculiarities to children. When these faults are present, whether by hereditary transmission, or acquired by too much study in very young eyes, they stay permanently. Modifications in eye shape, from the typically round one—some being long and others flat—break into the simple table for adjusting glasses and render these calculations nearly useless. Every eye must be examined for itself, and its individual defects corrected.

The common mode of doing this is to place the person to be examined at a fixed distance before a card upon which graded letters are arranged, of a size and dimensions mathematically determined upon, the basis of vision being that belonging to an emmetropic or perfectly formed eye. If, standing 20 feet from this card, a person can readily read letters designed to be seen only by a perfectly formed eye at the given distance, then such a person has perfect distant vision. Should the person examined only see from the distance of 20 feet letters which should be read at 30, 40, 60, 80, 100, or even 200 feet, such eyes are deemed faulty to these various degrees, and are classified as ametropic. To determine whether the faulty seeing is caused by a flattened or an elongated condition of the eyeball, a weak concave and a weak convex glass are taken from the trial case and placed alternately before the eye. The one which improves the vision shows the direction in which the search is to be made. By following up the examination with stronger lenses, the one which gives the most perfect vision or permits the reading of the letters designed to be read at 20 feet, from a 20-foot distance, is the one to be selected. This successive changing of lenses requires time—an item of value to a busy physician.

To have some quicker guide to direct us to the glass wanted is most desirable. Many specialists have recourse to the ophthalmoscope, which, while revealing the error of refraction, also enables the eye to be explored for any diseased condition which may exist. This requires special knowledge. The general physician, however skillful he may be in the diagnosis of disease, could not make this ophthalmoscopic examination. Even the specialist in eye diseases often desires a more rapid method; hence optometers—instruments for the measuring of eyesight—have been devised.

They consist of a convex lens attached to one end of a metallic rod. Upon this rod slides a small plate or card, upon which letters are printed. On the sides of the rod are marks with figures attached, which figures represent the strength of a glass that the person reading at such distances requires. This is the method used by jewelers in adjusting spectacles, and gives them all the data they possess for carrying on their traffic. Even this crude instrument, with carelessly ground lenses, has its advantages. The more elaborate and expensive optometers are similar to it in construction.

When a student at the Royal Ophthalmic Hospital in London, many years ago, I found in constant use in the dispensary a simple form of optometer. It seemed to solve promptly many eye problems. On my return home I took up the instrument, determined to get out of it all that it was capable of doing, and for many years have made it my daily companion in office and dispensary work. I am sure that I can get out of it more information in a short time than by any other method of research, and I am in the habit of appealing to it quite early for information in the examination of an eye.

This optometer consists of a two-foot rule in a single piece, as if it were two-thirds the length of a yard-stick, split through the middle, to diminish its bulk, and retaining all the inch-marks. To one end of this graduated stick is secured a carefully ground lens of 10 inches focus. On the stick is a sliding ferrule, with an upright support, holding a printed card containing three sizes of letters, some of them very small. The lens of 10 inches is preferred because the decimal facilitates calculations. When the printed matter is placed 10 inches from the lens it is at the focus of the lens. As the lens is a fixture, any movement of the printed card to or from the lens is equivalent to a change in the focal strength of the lens. The range of the sliding card, 24 inches on the stick, permits this simple instrument to represent nearly the entire trial case of lenses, from the very strongest concave to strong convex ones.

If a patient can be made to see to read by any glass, there must be a position on this stick at which some of the letters on the card can be made out. As we all know, the external appearance of an eye gives no index of its visual power. Some of the very brightest, as far as cornea and pupil can express a healthy organ, have neither retina nor optic nerve worthy of the name. The brightest of eyes, to all outward appearance, may have no visual properties whatever. In a very few seconds the optometer will show not only if a glass can be beneficial, but what lens to select.

In using the optometer the examination is made by closing one eye, and requiring the patient to look through the lens placed before the open eye; the end of the stick with lens attached resting upon the cheek near the inferior orbital ridge. The printed card is placed near the lens, and is slowly withdrawn. Should the patient not be able to read the text at some point on the stick, the conclusion surely drawn is that no relief can come from glasses. In the minute that is required to draw the printed card the length of the rod you have presented before the eye of the patient every concave lens, from the strongest of two-inch focus to the weakest of 148-inch focus; also every convex lens, from the weakest of 148-inch focus to the strong one of six inches focus, a range which must supply every eye capable of being benefited by spectacles. Should no reading point be found, the case becomes one for ophthalmoscopic investigation to discover the diseased condition which has destroyed useful vision.

An eye properly formed must possess good distant vision; that is to say, light coming from distant objects must be clearly focused on the retina. Rays of light coming from distant objects are practically considered equivalent to parallel rays, or such as come from the sun. The focal power of a lens is the concentration of sunlight to a point. A 10-inch convex glass is one which will focus sunlight, our standard for parallel rays, at just 10 inches from the centre of the lens. This also means that if a brilliant point of light be put 10 inches from a convex lens of 10-inch focal power, the rays of light diverging from that source and passing through the transparent lens must be so changed in direction as to go out from the opposite surface of the lens as parallel rays. If now a normally shaped eye be put behind this lens to concentrate these parallel rays by its own crystalline lens, a perfect point of light would be reformed on the retina, similar to the source from which it started. Such an eye, having focused diverging rays of light made paralled by passing them through a lens, can focus parallel rays coming from any distance, and therefore such an eye must have good distant vision. Any eye that can readily read fine print through a 10-inch convex lens at 10 inches distant, must also possess the property of focusing perfectly parallel rays of light from distant objects, and consequently must have perfect distant vision. There is no need of taking such a person to the door and asking him to read a distant sign. He has already read the specially prepared card on the optometer, and can as a matter of course see any distant object that any one else can see.

When a normally shaped eye looks at distant objects, the muscular apparatus within the eye, which influences the lens in reading, is not at work. A well established law of optics is, that rays of light from an approaching object necessarily become more and more divergent. As these diverging rays pass through a convex lens they must lengthen the focus of said lens, and therefore it is necessary for the screen receiving the focused rays to be moved back from the lens in the same proportion to the moving forward of the source of illumination. The newly acquired foci are called conjugate foci, in contradistinction to the true focus of the lens for distant rays of light. If it be desired to focus on a fixed screen which cannot be moved backwards, then the lens must be made stronger for every advance of the illuminated object. Our retina, the normal sensitive screen placed in the back of the eye chamber, is fixed, and nature has so intended it that it cannot be moved, as a healthy condition. If near and far objects are to be equally seen by the human eye, there must be some apparatus within the eyeball which will adapt the focus for these varying distances.

The living crystalline lens is a marvel of creative ingenuity. It is a clear, very elastic mass, of great condensing power, capable of changing its shape through muscular agency. These inner eye muscles comprise the accommodating apparatus. To understand the working of the young, vigorous crystalline lens, we may liken it to an elastic ball across the front of which a resisting band is firmly drawn, flattening it. If the pressure of this band be relaxed, the inherent elasticity renders more convex the surface of the ball. There is just such a compressing band, the Zonula of Zinn, tightly drawn across the anterior face of our living crystalline lens, with muscles arranged in such a way that when they contract the pressure of the band is lifted. The surface of the elastic crystalline lens then becomes more convex, and with necessarily an increase of focal power. When an object approaches a good eye from a distance, these muscles commence to act; increasing in activity with each step of progress, till with a very near object the whole energy of the muscles is required to release the lens from all pressure and bring out its whole elastic and consequently full focal power. This is called the range of accommodation. Soon after the lens matures it commences to lose some of this elastic property. When one attains 60 years of age the elastic properties of the lens are nearly gone, so that in the aged the muscles afford no longer help in seeing. Even should the band be lifted the lens now remains flat. Convex spectacles are required to make this old eye do its former work. This is no fault of the nervous machinery. The retina, ever ready, only needs a properly focused image. Spectacles, if properly selected for advancing age, enable our weakening lens to secure this essential focusing for good vision.

Human eyes, although they should be of fixed dimensions, vary much in depth. Often the retina is approached too near to the crystalline lens, as in flat or *hyperopic* eyes, necessitating stronger lens work for the shorter focus. In another class of eyes, the near-sighted or *myopic*, the retina is too far off, making the lens too strong for distant vision. The focus of parallel rays from distant objects is made before the retina is reached. To make such eyes see well distant objects, some of the strength of the lens must be taken away so as to lengthen the focus. Concave glasses will do this work, and hence they are worn by near-sighted persons.

The change which a good eye requires in its lens to enable it to see near small objects as well as it does distant ones, is equal to a lens of 10-inch focal power added to the passive crystalline lens. If a solution of atropia be put in such a well formed eye, it temporarily paralyses the accommodation for all near seeing, but does not interfere with the clear seeing of distant objects. If a 10-inch convex lens be placed before such an atropenized eye, the ability to see fine print is at once regained. With the optometer a good eye reads the fine print on the trial card 10 inches from the lens, and as the slide is moved inwards continues to read with equal clearness till it reaches 5 inches. The halving of the distance on this graduated rod from 10 inches to 5 is equivalent to the doubling of the strength of the 10-inch lens. It represents a lens of 10 inches focal strength added to our crystalline lens, and marks our useful and needful accommodation. It is an indication of the proper functioning of the accommodating muscles. With this optometer therefore, any eye which can clearly read the test card at 10 inches must have perfect distant vision. If the eye continues clearly to read the test as it is advanced till it reaches 5 inches, the index of perfect near vision, it clearly shows that the eye is capable of seeing at all distances, near and far, without help, and needs therefore no glasses.

Often young eyes can still see clearly the card letters as it is advanced within the 5 inches to 4 and even to 3 inches. This indicates a superabundance of accommodation, an amount of elasticity to spare, which all young lenses possess, and which age up to 40 will gradually use up. The 5-inch point on the optometer is equivalent to holding a finely printed book at 12 inches from the eyes in reading. Young eyes may see the page with equal clearness at 10, 8, or even 6 inches, but this is uncalled for, and if kept up for a long time would annoy. It is the equivalent of reading through the 10-inch optometer at 4 and 3 inches.

To be sure, we have *Test Types* that mean the same thing and will give the same results as the optometer does—types prepared to be read by good eyes at various distances, from one foot to two hundred. These are necessarily of graduated sizes made to correspond with an angle of 5 minutes, which means that two diverging lines starting from a point in the centre of the crystalline lens and moving backward to the retina, measuring at the angle of divergence 5 minutes or $\frac{5}{60}$ of one degree, will by the time they touch the retina form an image of light sufficiently large to impress the retinal elements and establish perception, or the recognition of an object. Continue these lines from the point of contact in the lens outward through the pupil and cornea, diverging as they go into space, any letter sufficiently large to touch these diverging lines at any point of their course can be clearly seen.

Test types are prepared in accordance with this mathematical formula. Each letter makes a picture upon the retina equivalent to a space covered by this 5-minute shadow, and each arm of the letter must cover $\frac{1}{5}$ of the whole space. The letters of the *Baltimore Sun*, our daily newspaper, notoriously of very fine type, would touch these lines at about one foot from the eye, and may be used as a coarse test for near seeing. In the back of most works on eye diseases are test type plates for these investigations. The larger type, such as would measure the distance between these diverging lines at 10, 15, 20, 30, 40, 60, 80, 100 and 200 feet, are printed upon a heavy card and are suspended from the office wall. Should a person sitting on the opposite side of the room, say 15 feet off, read promptly and correctly the letters or numbers designed to be seen by a good eye at 15 feet, we can also say that such an one has good distant vision, because if we extend these mathematically adjusted diverging lines far enough, at 500 feet they will take in a large sign, at $\frac{1}{4}$ of a mile a man, and at 2 miles a church steeple. With the wall letters on the one hand, aided by the finely printed matter in book form, the trial for accommodation is soon tested.

Up to this point the optometer has shown no superiority over the graded test types. Should the individuals see clearly the near fine print and not the distant wall letters, the presumption is that they are near-sighted, and we must go to the trial case of glasses to find out, by testing one after another, what concave glass will be needed to make distant vision good. Should on the contrary the wall print be readily read and the fine near print not, the persons, if old enough, that is over forty, may be deemed *presbyopic*, if under that age *hyperopic*, and we experiment with convex glasses to find out what magnifier they will require to read with comfort. It is in these adjustments that the optometer shows its very marked superiority over the arbitrary method of selecting an unknown lens from the many dozens of the trial case until the proper one is secured. With the optometer the selection of the glass is promptly secured; and here is the working of it.

We have already seen that any eye which can read the printed matter on the optometer test card at from 10 inches to 5 inches possesses all that good vision requires. If at the same time it can read at four and three inches, this we call a superabundance of accommodation. Should an eye reading clearly fine print up to the 10-inch mark, indicating good distant sight, not read clearly also at the 5 inch, but possibly at the 6 or 7 or 8 or 9 inch only, then such an eye is old or flat, *presbyopic* or *hyperopic*, and does not possess the reading power for books or near fine work. To restore this power it will be necessary to bring back the vision to the 5-inch point of the optometer, the point of good near sight, and the fraction which marks the difference between the $\frac{1}{5}$ or 5-inch point for near reading and the $\frac{1}{6}$, $\frac{1}{7}$, $\frac{1}{8}$ or $\frac{1}{9}$ at which the eye actually reads, will indicate the glass needed. If reading is only clear at the $\frac{1}{6}$-inch point, the difference between $\frac{1}{5}$ and $\frac{1}{6}$ is $\frac{1}{30}+$ glass, $\frac{1}{5}-\frac{1}{6}=\frac{6}{30}-\frac{5}{30}=\frac{1}{30}$. If at the $\frac{1}{7}$-inch point, the difference between $\frac{1}{5}$-inch point and $\frac{1}{7}$-inch point is $\frac{1}{5}-\frac{1}{7}=\frac{7}{35}-\frac{5}{35}=\frac{2}{35}$, reduced to $\frac{1}{17\frac{1}{2}}$, or $\frac{1}{17}+$, throwing out the parts of a fraction. If between the $\frac{1}{5}$-inch point and the $\frac{1}{8}$ point, $\frac{1}{5}-\frac{1}{8}=\frac{8}{40}-\frac{5}{40}=\frac{3}{40}$, reduced to $\frac{1}{13\frac{1}{3}}$, or $\frac{1}{13}+$, and so on. These calculations can be made as quickly as the eye records its visual powers. By this method it is seen that glasses needed by good eyes in advancing years can be determined in a very few seconds. So much for *presbyopia* of every grade.

Now let us take the flat eye, or *hyperopic*, a very numerous class of congenital defects, and also an acquisition in very advanced age, over 60. We have seen that a well shaped eye with a good lens focuses parallel rays of light from a distance without the aid of the eye muscles, and that the 10-inch point of the optometer is its equivalent. A flat eye with retina too near the lens, requiring a great shortening of its focus, is not able to do this without muscular aid. Such an eye is using up its accommodative powers for distant vision, as expressed when it is reading fine print through the 10-inch optometer lens at 10 inches. Give the muscles a chance to relax, by drawing away the reading matter from the 10-inch point to 11, 12, 13, 14, 16 or 18 inches. If reading is still clear, it is an evidence of the amount of muscular power required to read at 10 inches. When an eye has only a certain amount of accommodation and uses one-half of it for distant vision, it has but little left for near and continued work. The difference between the distance at which the individual can see on the rod and the distant point, 10 inches, for good distant vision, will indicate the glass needful to permit distant seeing without calling upon the eye muscles for aid. If an eye that should not be able to read beyond 10 inches can see clearly the fine letters as far out as 15 inches, the difference between the $\frac{1}{10}$ and $\frac{1}{15}$ ($\frac{1}{10}-\frac{1}{15}=$

$\frac{15}{150} - \frac{10}{150} = \frac{5}{150}$, reduced to $\frac{1}{30}+$) is the glass needed for constant use to rest the eye when viewing distant objects, or to aid the eye when used for reading, sewing, or writing.

When such an eye gets older it may lose the power of reading at 5 inches, representing a loss of near vision, but it may still read from $\frac{1}{8}$ inch to $\frac{1}{15}$ inch of the optometer. Distant seeing will then require a magnifying glass the difference between $\frac{1}{10}$ and $\frac{1}{15} = \frac{5}{150}$, or $\frac{1}{30}+$, which glass will be too weak to read with, because he can only make out fine print through the 10 inch optometer at 8 inches when he should do so at 5. The difference between $\frac{1}{5}$ and $\frac{1}{8}$ is $\frac{3}{40}$ or $\frac{1}{13}+$ magnifying glass, the one needful for reading, nearly three times as strong as the one used for walking.

We often see old persons who have not only lost all power of accommodating for near work, but the crystalline lens has become so hard, dried and flat that it can no longer focus at even 10 inches. Its very best work is to see fine print at 13, 15, or 17 inches of the optometer, with no range at all. Under such conditions the old eye cannot read any print, and has lost also the ability to see distant objects clearly. Such persons live in a smoke or fog all the time unless they use glasses for all purposes. If such an eye can be made to see at any point of the optometer, say 15 inches, not clearly further off or nearer to, the glasses needful to restore to it most of its former privileges are soon determined. For distant glasses $\frac{1}{10}$ what the eye ought to do to see clearly distant objects, $\frac{1}{15}$ what the eye does $= \frac{5}{150}$ or $\frac{1}{30}+$ removes all the mist from distant objects. $\frac{1}{5}$ what the eye ought to do to read, $\frac{1}{15}$ the only point at which it can now read, $\frac{1}{5} - \frac{1}{15}$ gives $\frac{10}{75}$ or $\frac{1}{7\frac{1}{2}}+$ for reading fine print, so that spectacles to suit such a case would be $\frac{1}{30}+$ for all day use, and $\frac{1}{7\frac{1}{2}}+$ magnifying glasses for reading, sewing, or writing, or what is still better, have them set in a frame as $\frac{1}{2}$ glasses for constant wear—Franklin glasses, as they are called.

Now for the near-sighted or *myopic* eye, an error of refraction constantly met with. The 10 inch point of this optometer must ever be our reference for good distant vision. An eye reads at 5 inches, the index of good near vision, but cannot read clearly beyond 6 or 7 or 8 or 9 inches. This condition marks near-sightedness. The difference between the 10 inches at which the patient ought to read, and 6 inches, the most distant point at which he can read, $\frac{1}{6} - \frac{1}{10} = \frac{10}{60} - \frac{6}{60} = \frac{4}{60}$, reduced to $\frac{1}{15}-$, clearly indicates the concave glass which will give good distant vision. In the very near-sighted even the five inch point cannot be reached on the optometer. With some the 4 inch, 3 inch, or even 2 inches from the 10 inch lens is the very best that the patient can do for distant vision. Such persons can only see printed matter when held very close to the face: in sewing, an uncomfortable and even dangerous proximity. They will need weak concave glasses for seeing near things, and much stronger ones for walking or seeing distant objects. If we will keep in mind that it is best to bring all near sight up to the 5 inch point of this optometer, and all far sight up to the 10 inch point, the glasses needed for both purposes are quickly determined. The patient ought to read at 5 inches to be able to read at a comfortable distance without glasses, the patient can only read at 3 inches, $\frac{1}{3}-\frac{1}{5}=\frac{5}{15}-\frac{3}{15}=\frac{2}{15}=\frac{1}{7\frac{1}{2}}$, or $\frac{1}{7}$—, the concave glass for all near work; $\frac{1}{3}-\frac{1}{10}=\frac{10}{30}-\frac{3}{30}=\frac{7}{30}$, reduced to $\frac{1}{4\frac{2}{7}}$, or $\frac{1}{4}$—, the near-sighted lens which will give the best distant vision.

As one becomes more familiar with the ranges of accommodation as exhibited by the optometer, slight changes or greater deviations from standard measurements will be significant in expressing not only the various degrees of refractive errors, but also the irregularities of visual construction, so that astigmatism, whether hyperopic, myopic, or mixed, can also be foreshadowed, not however to the degree of selecting glasses for their correction. It will thus be seen that when one understands the use of a 10 inch optometer it becomes a simple instrument of great value, by which can be promptly determined whether a given case of defective vision can be benefited by glasses or not; also, if glasses can help to restore sight, what strength of spectacle is the necessary one for near-sighted, old-sighted, or over-sighted persons. To a general practitioner, who is so circumstanced that he will be consulted by eye patients, and who is not disposed to invest in an expensive trial case, this optometer, prepared at a very small cost, will enable him to administer much comfort to such of his patients as are not able to consult a specialist in eye diseases. It will also enable him to prove to a number of his patients that his knowledge of certain eye faults is correct, even when compared to the diagnosis and prognosis of the ophthalmic surgeon who is afterwards consulted.