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ON NEAR SIGHT,

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ON

NEAR SIGHT,

AGED SIGHT, IMPAIRED VISION,

AND THE

MEANS OF ASSISTING SIGHT.

BY

WILLIAM WHITE COOPER,

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TO

SIR BENJAMIN COLLINS BRODIE, BART., F.R.S.,

SERGEANT-SURGEON TO THE QUEEN, ETC., ETC., ETC.

This Volume

IS BY PERMISSION INSCRIBED,

AS A TESTIMONY OF RESPECT FOR HIS EMINENT TALENTS,

OF ADMIRATION FOR HIS VALUABLE CONTRIBUTIONS

TO MEDICAL SCIENCE,

AND OF

GRATITUDE FOR MANY FAVOURS CONFERRED.

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TO

THE SECOND EDITION.

THE circumstance of the First Edition having been for some time out of print is encouraging to the author, and leads him to believe that the work has been found useful.

In the present Edition important alterations —improvements it is hoped—have been made; much has been re-written, and much practical matter added, whilst the chapter on the Anatomy and Physiology of the Eye has been omitted as unnecessary. The author has availed himself of valuable information contained in Dr. Sichel's excellent "*Leçons Clinique sur les Lunettes*," and ventures to believe that his own experience during the last six years has not been without its value.

W. W. C.

19, *Berkeley Square*,
January, 1853.

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ON NEAR SIGHT,

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CHAPTER I.

MYOPIA OR NEAR SIGHT.

Every eye, when in a state of rest, is adapted by its figure and size, and the refractive powers of its media, to the formation of a distinct picture of an object presented before it at one particular distance.

The distance at which ordinary print is legible varies from twelve to twenty inches.[1]

[1] Dr. Young states that Mr. Abernethy had perfect vision from three inches to thirty, and that Dr. Wollaston could see well at seven inches with converging rays.—On the Mechanism of the Eye. Phil. Trans. 1801.

The shortest distance at which it can be seen with distinctness and without exertion, is from six to eight inches. Any one who habitually brings small objects nearer to the eye than this may be considered short-sighted. The term *myopia* (μυω, I shut, ὤψ, the eye), has been applied to this condition, because short-sighted persons, when looking at distant objects, are in the habit of half closing the lids.

Myopia may be treated of under two heads.

I. When it arises from imperfection in the form, consistence, or relation, of some of the refractive media.

II. When it arises from the loss of adjusting power.

I. *Myopia from imperfection in the form, consistence, or relation, of some of the refractive media.*

The most frequent cause of congenital myopia is too great a convexity either of the cornea, or of the crystalline lens, or of both. In many cases of aggravated myopia, I have satisfied myself that the cornea had too much curvature, and that the anterior chamber was preternaturally large.

Myopia may be the result of too convex a crystalline lens,[1] or of too great distance between the cornea and retina, arising from the

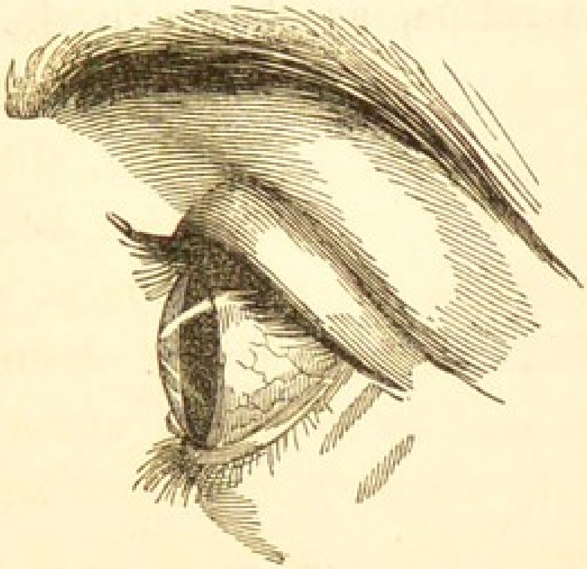


Fig. 1.

mass of vitreous humour being greater than the other parts of the eye require.

An undue density of any or of all the refractive media, though the figure of the eye be normal, may also occasion this affection.

Instead of the rays of light from objects at the usual distance being concentrated to a

[1] Jesu Haly mentions as one of the causes of myopia *enlargement* of the crystalline lens. (De Oculis, iii. 6.) Alsaharavius states that exposure to cold and snow, sometimes occasions near-sightedness. Paulus Ægineta sets down myopia as wholly incurable, "being occasioned by a weakness of the optic spirit."

focus on the retina, which is essential to distinct vision, they are, by being so much re-refracted,[1] brought to a focus before they reach the retina, as shown in the adjoining section.

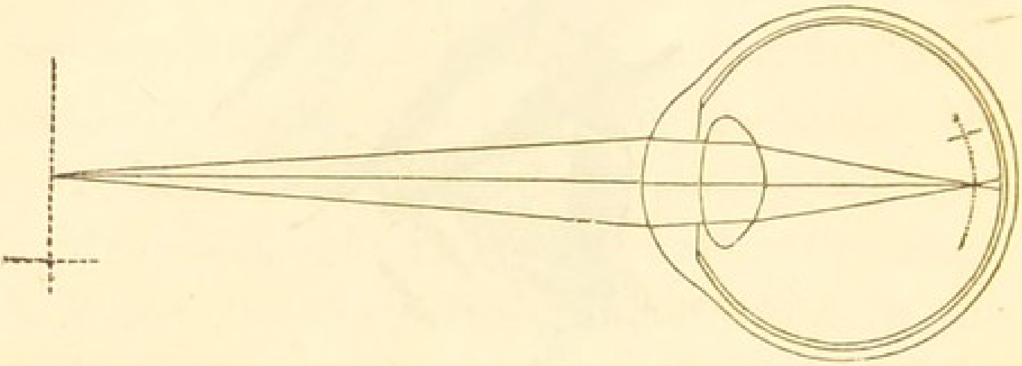


Fig 2.

Short-sighted persons, in holding objects near the eye to procure distinct vision, are acting in conformity with the laws of optics, for the nearer an object is brought to the eye, the more divergent are the rays which proceed from it, and the further they will have to go before the refractive power of the eye will be able to bring them to a focus. So that whilst the picture of an object which is ten inches

[1] The sine of the angle of refraction is a constant quantity, and, therefore, although the size of the angle is less when the impinging ray is near the centre of the cornea, it is only as much less as the ratio which it bears to the sine of the angle of incidence requires it.

off would be formed, as in Fig. 2, before the retina, and of course be indistinct; one placed at four inches from the eye might have its picture formed distinctly on the retina, as shown in Fig. 3.

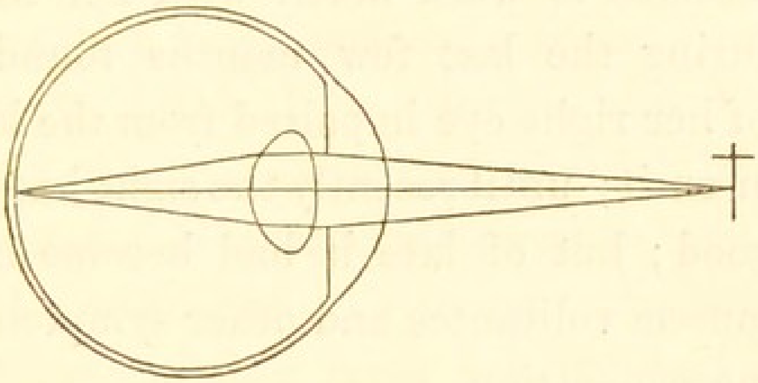


Fig. 3.

The discovery of short-sightedness is generally made by accident, either by comparing the sight with that of others, or by looking through a concave lens. A patient told me the pleasure he experienced on looking through a glass for the first time, was as great as if he had acquired a new sense; although fond of theatrical amusements, he had never clearly discerned the features of the performers on the stage, and had frequently experienced surprise at the remarks made by others whose sight he considered to be extraordinarily acute. A concave glass of low power enabled him to see the features of persons at a distance which he had never before conceived possible.

Case I.—In April 1852, I was consulted by Anne Spencer, aged 23. She stated that she had always been blind of her left eye, and being obliged to work much with her needle, had during the last few months found the sight of her right eye impaired from the labour thrown on it; until recently the sight had been very good; but of late it had become misty, with muscæ volitantes and other symptoms indicating congestion.

Examination failed to detect any imperfection in the left eye; the pupil acted vigorously and the organ seemed in all respects sound and healthy; I was therefore led to doubt the blindness of that eye. On trying the reading distance of the right, it proved to be fourteen inches. At three inches, she could see with the left. On trying her with glasses, it was found that No. 4, Myopic brought the left eye into focus with the right, and, to her great surprise, she discovered, that with the supposed blind eye she could read with perfect comfort, assisted by that glass. She was directed to have a spectacle frame mounted with a suitable lens, the right circle being blank, and thus literally gained an eye.

The following is also a case of true congenital myopia, combined with amblyopia, and the two also illustrate well the difference in the focal length of the eyes—a condition far more common than is generally supposed.

Case II.—Miss H——, aged 14, was brought to me by Miss Shepheard, of Notting Hill, for my opinion. Her parents were both very near-sighted, and though this young lady had perfect vision with her right eye, she had never seen with her left, although it presented a perfectly natural appearance. On placing a page before that eye, the right being closed, she just distinguished that it was paper at two inches, but could see no print. With a No. 3, Myopic glass, she could discern large type at four inches; but nothing more, and the effort soon caused the eye to ache. This young lady was directed to practice the eye with the glass in question, in order to bring it gradually into use, and rapid improvement took place.

I will mention one more instance of an eye, congenitally myopic, and becoming amaurotic from long disuse.

Case III.—In April, 1851, Mr. Fernandez, aged 27, born in Spain, consulted me, and gave the following history of his case Until eighteen years of age, he was not aware of any inequality in his eyes, and discovered it thus accidentally: he was out shooting with a friend; who, observing that though the gun was brought to his right shoulder, he glanced along the barrel with his left eye, told him of his awkwardness, and desired him to take aim with the right eye, and to close the left. On doing so, he found to his great surprise, that he was unable to see anything except the largest objects with his right eye. Alarmed at this, he sought medical advice, and was subjected to a variety of treatment, without the slightest benefit, and at length he ceased to think about the matter. Being in town, however, he called upon me.

On placing a series of printed types before him, he was only able to make out with the imperfect organ a few letters of double pica, and that with much difficulty. Looking at me he could barely discern the outline of a face. On examining the eye, there was nothing found to account for this. Every part was perfectly natural in appearance, and the pupil acted freely.

With a double concave lens, No. 5, he could distinguish the letters clearly, and the next sized type indistinctly. He was directed to bind up the left eye and practise the right, and I subsequently heard that its vision had considerably improved.

Near-sighted persons see with less effort in partial darkness than those whose sight is perfect, for to the former it is natural to bring the object close to the eye, and they receive the full advantage of all the light which proceeds from it,[1] whereas persons who are not short-sighted are obliged under similar circumstances partially to close the lids and contract the pupils in order to see distinctly; consequently much less light enters their eyes than those of the myopic individual, and they therefore see with less distinctness and more effort.

Distant objects appear large to near-sighted persons, because a distinct picture is formed only at the point of intersection of the rays pro-

[1] In connexion with this circumstance it must be borne in mind that the quantity of rays from an object is always in an inverse ratio to the square of the distance.

ceeding from an object, and as this point falls short of the retina in these persons, the retina receives the rays beyond the point of intersection, and consequently where they are more extended.

Near-sighted individuals often write a very small hand: the proximity of the letters to the eyes enlarging the visual angle subtended by them, thus increasing their apparent size.

If a near-sighted person looks through a pin-hole in a card, he can distinguish objects clearly at a greater distance than before; this is effected by excluding the circumferential rays, which by their too speedy convergence would tend to form foci *before* they reach the retina, and thus cause indistinctness of vision. The pupils of the eyes of myopic persons are generally large, and their habit of half closing the lids when looking at distant objects is upon the same principle, that is, for the purpose of excluding all but the central and direct rays.

This partial closing of the lids may also, by gently pressing upon the eye, somewhat increase the adjusting power. The following case affords a remarkable illustration of the aid afforded by pressure so applied.

Case IV.—In September, 1852, Mr. A. P. applied to me for advice. He stated, that he was born when his parents were advanced in life, had been a very weakly infant, and having been near-sighted as long as he could remember, his eyes had been used but little. To read at fourteen inches, he required No. 5; and No. 7 to see distant objects. He remarked, that to distinguish the flag-staff in the practice ground at Woolwich, at 1,200 yards, he was obliged to use No. 10. But the curious feature in his case was, that by making gentle pressure with two fingers, the one on the upper part of the eye, the other on the lower (thus altering the antero-posterior diameter), he was enabled to read with perfect facility at twenty-five inches. This I proved by repeated experiments.

In a recent number of the Philosophical Magazine, Sir David Brewster has considered a myopic peculiarity of vision to which his attention was drawn by a correspondent. If a silhouette or black profile of the human face looking from *left to right,* be fixed in a window, and a short-sighted spectator stands with one eye shut, at about two feet distant from it, and moves a piece of black cardboard with a smooth edge, from right to left, about two-thirds of the way between him and the window, then, as the left edge of the cardboard approaches the silhouette, a second, or phantomic silhouette will appear in that left edge, looking from *right to left*, so that the two profiles will look each other in the face. On repeating the experiment (apparently after several failures), Sir David Brewster ascertained that these phantoms were not, as supposed, images derived optically from the real silhouettes, but were phenomena arising from the penumbral shadows of bodies held at different distances from the eye, and seen indistinctly by persons with every variety of sight. In some long-sighted eyes, where the crystalline lens had begun to decay, and to give slightly double images of objects, the phantom silhouette, emerging from the real, will seem to be somewhat separated from it; but, in good eyes the prominence of the projecting features is merely increased, giving the appearance of the phantom emerging from the reality.

The space upon the retina acted upon by rays of light passing through an aperture, depends upon the size of the aperture, and its distance from the eye. Diminish the aperture or increase its distance from the eye, and such space may be reduced indefinitely. When, therefore, indistinct vision arises from any of the surfaces, either of the cornea, or of the crystalline lens, or of the retina not being adapted in form to each other, or to the refractive media contained by them, we have the following as reasons for distinct vision through small apertures.

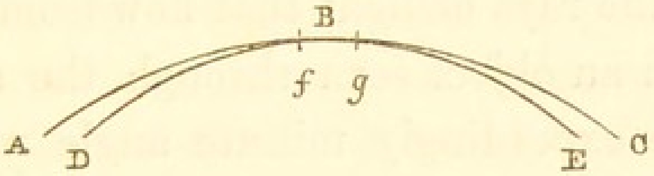


Fig. 4.

Let the curve A B C, Fig. 4, be a section of an existing surface, whether of the retina, or cornea, or crystalline lens, producing, or aiding in the production of indistinct vision; and let D B E be a curve supposed to be capable of producing distinct vision, and placed for the sake of illustration touching the curve A B C, at the point B; then, so long as the respective portions of the surfaces acted upon by the light passing through the aperture are contained within a short distance of B—as, for instance, between *f* and *g*, not only do the true curve and the untrue one so nearly correspond in form as scarcely to admit of a perceptible difference ; but those circumferential rays, that would have fallen upon the untrue surface, and have produced confusion by their crossing, are prevented entering the eye by the opaque substance in which the aperture is made. And although, for the sake of illustration, it was supposed that the curve adapted for distinct vision coincided, at the point B, with the curve of indistinct vision, yet, as the rays of light that flow from any one point on an object seen through the aperture, form an exceedingly minute angle with each other, indistinct vision could scarcely be produced, whether the surface of the retina were a little nearer to the front of the eye, or a little more remote from it, than a surface correctly placed would be.

Nearsightedness is one of the symptoms accompanying Hydrophthalmia or *Dropsy of the anterior chamber*, which is caused by excessive secretion of the aqueous humours, the result of inflammation of the secreting membrane. It is of importance not to confound this with simple myopia, as the two affections ought not to be treated alike. When we deal with myopia, the result of inflammation, we adopt measures to arrest the secretion by removing the inflammatory action.

Strumous children are most liable to this disease, and the exciting cause is either inflammation of the cornea and aqueous membrane together, or of the aqueous membrane alone (*aquo capsulitis*). If the former, the myopia will have been preceded by more or less redness of the cornea and the appearance of a zone of vessels around it, pinkness of the sclerotic, intolerance of light, and some opacity of the cornea. If, however, the inflammation has been confined to the aqueous membrane, the cornea will not have been affected externally, but upon close examination will appear slightly turbid, with whitish spots visible upon its posterior surface, giving to it a mottled appearance. There will also be dulness of the iris, and not uncommonly some intolerance of light and vascularity of the sclerotica; and though there will not be much pain, there will be a sense of weight, and of distension of the globe.

If such a case presents itself to us after the acute symptoms have subsided, the first thing that will strike us will be the enormous size of the anterior chamber: twice or three times as large as usual. The flat surface of the iris appears to have receded from its natural position, the unusual amount of refractive power of the excessively protuberant cornea, giving it the appearance of being concave. In some cases there does not appear to be much alteration in the form of the cornea; it appears thinner, but does not assume the pointed form characteristic of conical cornea. The extra prominence is general.

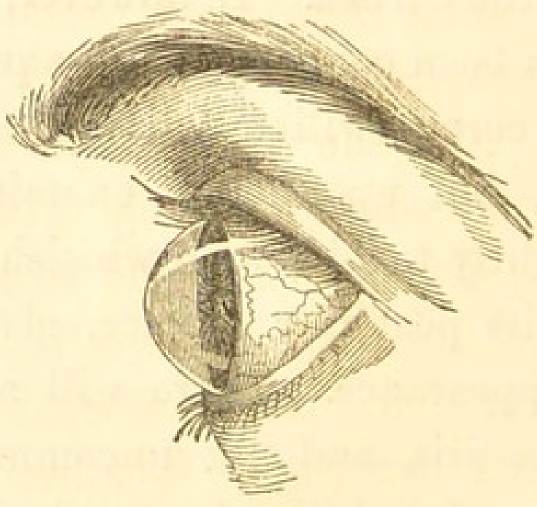


Fig. 5.

In the cases which have fallen under my observation, there has always been more disturbance of vision than the altered form of the cornea could account for. The movements of the iris have been impaired, and in some instances it has been quite insensible to the stimulus of light. In other cases the iris has been tremulous. In all, there has been a tendency to amaurosis, and although in some favourable cases of dropsy of the aqueous chambers, the retina is sound; in the majority, its sensibility, so far as my experience goes, is somewhat impaired.

The following case is an illustration of the fallacy under which some persons labour, as to the true condition of their eyes.

Case V.—Miss H. aged 69, resident at Nottingham, consulted me in February, 1852. She stated that she had always been near-sighted, using moderately strong glasses; and, that residing alone, reading had been her chief solace and occupation. During the last two years her near-sight had increased, and to meet this condition her glasses had been changed several times, but without affording the assistance expected. As she could not readily meet with stronger glasses than those last bought, she came up to town for my opinion, perfectly confident that extreme near-sight was her only ailment.

On examining her glasses, I found them to be the deepest concaves, apparently No. 14, diminishing objects to an extreme degree; but it was not surprising that they failed to afford assistance, as a glance at the eye revealed the true nature of the case: in each pupil was seen a hard, amber-coloured cataract, complete in the right eye, and considerably advanced in the left. A state of things beyond the aid of spectacles!

Conical cornea in its early stage may be confounded with simple myopia, as it gives rise to nearness of sight. The disease consists in an elevation of the central portion of the cornea into a pyramid or cone, giving to the eye, from the peculiar form of the reflecting surface, an unusual amount of brilliancy. Conical cornea is most frequent in the female sex, and usually occurs about the period of puberty. It would appear to be the result of absorption of the cornea near the centre, and its consequent yielding to undue pressure from behind; in a case which Dr. Jäger, of Erlangen, had the opportunity of examining after death, the apex of the cone was found to be very thin, and Mr. Wardrop mentions the case of a gentleman afflicted with this disease, whose cornea was burst by a blow upon the eye from a whip.

Conical cornea commences without any apparent cause, its progress is painless and slow, and it generally affects one eye more than the other. An early symptom is shortness of sight, and as the disease advances, vision becomes most seriously interfered with; the only sight indeed the patient then has, is through the side of the cornea, so that objects are not only held extremely close to the eye, but on one side of it. Objects also appear multiplied from irregular refraction of the incident rays produced by inequalities on the surface of the cornea.

The disease may be best recognised laterally, when the conical cornea will be seen having

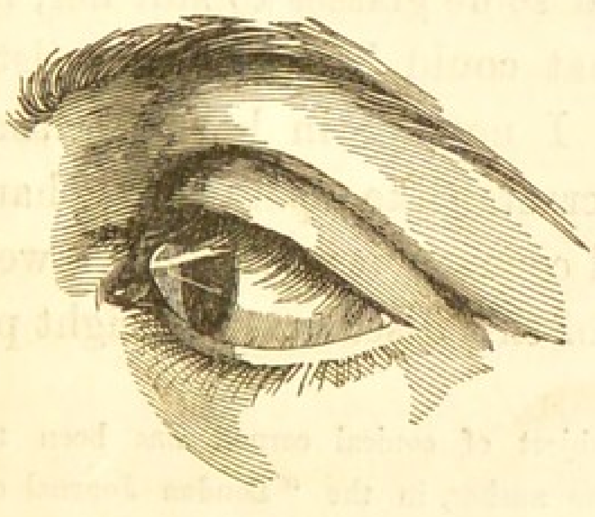


Fig. 6.

much the appearance of a piece of pure crystal attached to the front of the eye.

When the disease is far advanced, the apex of the cornea is liable to be rendered opaque by the irritation caused by the friction of the lids.[1]

Case VI.—Miss R., a lady from Huntingdonshire, placed herself under my care in May, 1852.

She stated that when young she had good sight, but that for many years her right eye had been gradually becoming more and more near-sighted; it was now useless, and within the last twelvemonths the left had began to fail in the same way. She had consulted a gentleman, who told her that it was an aggravated case of myopia, and that unless she could find some glasses to suit her, he did not know what could be done. Whilst she was speaking, I noticed in her eyes that unmistakable crystal-like sparkle so characteristic of conical cornea; it was indeed a well marked example of this disease. The right presenting

[1] The subject of conical cornea has been treated of at length, by the author, in the "London Journal of Medicine," vol. ii.

precisely the appearance delineated in Fig. 6 (though that represents another case). The left cornea had undergone less change. This lady found very decided assistance from a pierced diaphragm fitted with a deep concave lens.

Since the publication of the first edition, several instances have fallen under my notice in which imperfect congenital cataract has been mistaken for aggravated myopia; four of these have been related by me in the second volume of the "London Journal of Medicine." The following was printed as it stood in my case-book in the first edition, but the description is now slightly altered for the sake of clearness.

Case VII.—A gentleman, 30 years of age, consulting me in 1844 respecting his sight, stated that he had been exceedingly near-sighted from childhood, and acting under medical advice, had for some time worn double concave glasses, but without deriving benefit; on the contrary, his sight was becoming decidedly worse. On attempting to read tolerably large type, he held the book very near to his eyes, and turned his back to the windows that he might at the same time illuminate the page and keep his eyes in the shade. It was with difficulty that even a few words were made out, the letters appearing confused and misty. On examining the eyes before the window, the pupils contracted to mere pin-holes; still an indistinct grey appearance was visible. To ascertain the nature of this, the pupils were placed under the influence of atropine, and then there came into view a greyish, semi-transparent, jelly-like cataract, suspended as it were in the centre of each pupil, but allowing, when the pupils were dilated, of the access of light all round. Through these clear spaces this gentleman saw distinctly for the first time in his life; all objects appeared to have undergone a transformation, as if they had been touched with a magician's wand. Looking at a mirror, he for the first time discovered that his eyes were blue. Colours appeared immeasurably brighter than he had ever imagined, and though the day was cloudy, he expressed much surprise at the brightness of the light. The glory of the mid-day sun he had yet to see. That morning he first discerned the features of his wife, and saw the faces of his children clearly, and it was interesting and touching withal to observe his feelings and eager curiosity. Until then he had never seen like other people, and many were his erroneous impressions. The cataracts were removed by the operation of solution, and the newly acquired powers of vision thereby rendered permanent.

Whilst on the subject of congenital cataract, I may mention two curious cases related to me by my excellent friend, Mr. Soden, of Bath.

An infant was brought to him by his parents, and was found to have congenital cataract in both eyes. The father was about fifty years of age, and entered with deep interest into all the particulars of the operation necessary for the cure of his child. The following day he called on Mr. Soden with an embarrassed air, and said that on reaching home the preceding day he was consoling his wife, who was in tears at the idea of the operation, and whilst doing so happened to place his hand before his right eye, when, to his dismay, he found that he was blind of that eye. Mr. Soden examined it, and discovered a cataract the fac-simile of those existing in the infant, and doubtless, like them, congenital. The gentleman having small pupils, and never particularly using that eye, was unconscious of the defect.

A worthy miller, 76 years of age, consulted Mr. Soden, who discovered double lenticular cataract. "Well, my man! we'll do first one eye, and then the other," said he. "Why, bless ye, sir," replied the countryman, "you surely be'ent agoing to do anything to my left eye! Why, I've been blind o' that eye ever since I was born, and 'twas found out at my christening." Nevertheless, Mr. Soden extracted both cataracts, and the miller had as good sight with the left eye as the right eye: considering that the retina had not been used for seventy-six years, this is the most remarkable instance I know.

As myopia constitutes a ground of exemption from military service, young men sometimes feign it to escape such service. The French employed a simple and ingenious mode of distinguishing the feigned myopes who endeavoured to evade the conscription laws. The officers placed spectacles of various powers on the faces of the conscripts, and suddenly bringing before them a printed paper, with the contents of which they were not acquainted, desired them to read, and the facility with which they did this pointed out with considerable accuracy the actual condition of vision. In some instances, however, the young men who expected to be drawn for the army habituated themselves to glasses for the express purpose of rendering themselves near-sighted. It is surprising to what an extent persons will carry self-torment. For many weeks a girl of sixteen, a patient of mine at St. Mary's, kept up an inflammation in her eye by wearing, when out of my sight, a chip of wood between the lid and the eye, where, notwithstanding her artfulness, it was at length found.

Oculo-cerebral congestion may give rise to myopia ; a case alluded to by Dr. Smith was probably of this nature,—it is that of a person who suddenly became myopic on coming out of a cold bath. And Revielle-Parise mentions a case of an officer who was similarly attacked at the end of a troublesome ague. Local congestion is said to produce the same effect. M. Desmarres relates a remarkable instance of a lady excessively presbyopic, but who became near-sighted during a severe attack of conjunctivitis, the former condition of vision returning after the attack had subsided. Mr. Tyrrell also mentions a lady who had long suffered from granular lids, which were eventually cured, though she required the aid of concave glasses, in consequence of the cornea having become unusually convex during the continuance of the chronic disease. In each of these cases, however, there may have been some change, either in the quantity or quality of the aqueous humour.

It is very common to find the eyes differing in their focal length, and in such cases one usually falls into disuse. We also occasionally find that one eye will be myopic and the other presbyopic, a condition of vision embarrassing both to the patient and the surgeon; but the nature of which may easily be ascertained by careful trial with glasses. Dr. Serre, in a memoir on the application of *phosphenes*, or the luminous spectra excited by compression of the eye, states that they assist in the diagnosis of myopia. He says that in such cases the nasal and the orbital phosphenes appear equal to the temporal in constancy, brilliancy, and sometimes in size; but he cautions us against concluding that the retinæ of myopes are more sensitive than those of persons having normal vision, ascribing the above appearances to the greater prominence of the eyes, which facilitates compression, and admits of its application to the deeper parts of the eye. These results, he adds, are at complete variance with the opinion of M. Stœber, of Strasburg, who thinks that the proximal cause of myopia may sometimes be a peculiar alteration of the retina admitting of a complication of myopia with amblyopia, or commencing amaurosis; for that if the retina be essentially affected, the orbital, and sometimes the nasal, phosphenes are scarcely appreciable, or they may be entirely wanting. Dr. Serre further asserts, what is certainly contrary to received opinions, and, I may add, to my own experience, that when the foci of two myopic eyes differ, the retina of the eye with the shortest focus being that which is least used, is absolutely stronger and more active than the retina of the other eye.

The following case affords an interesting example of the energy with which nature strives to supply a defect in one organ by calling another into activity.

Case VIII.—A Member of Parliament, well known for his literary talents, consulted me in October, 1852. He stated that he had always been near-sighted, but the eyes being of different foci the left had been exclusively used, so that from long disuse the right had become of no service. To show the amount of labour thrown on the left eye, he mentioned that he had frequently, and for a long time together, worked in his study for sixteen hours together. About ten months prior to my seeing him he had occasion to read some long documents during a speech in the House of Commons, and whilst doing so found great distress from the glare of light. Soon after, the sight of the left eye became considerably obscured, and he consulted Mr. Dalrymple, who pronounced that there was cataract. From that time the right or useless eye was brought into play, and gradually increased in strength, so that he could read without glasses at six inches, and with No. 9 Myopic could discern distant objects distinctly.

Myopia may be caused by abdominal irritation as in the following case:—

Case IX.—*Myopia caused by intestinal worms.*—On the 25th of January, 1845, I saw a young gentleman aged 13, who was stated to have suddenly become near-sighted. Three weeks previously it was observed that he seemed to read with difficulty, and to hold the book very close to his eyes; he was also unable to discover distant objects. Prior to that period his vision had been good, but he was pallid, of a feeble constitution, and had occasionally been troubled with worms from infancy.

Upon examination of the eyes the pupils appeared rather dilated, but acted freely under the stimulus of light, and no abnormal appearance was to be detected. When he attempted to read, he held the book at about five inches from his eyes, and in an oblique position; he could not discern features at a distance of fifteen feet. Both eyes seemed equally affected, but he could read more easily by looking through a pin-hole in a card. Upon applying a double concave glass of thirty-six inches focus to his eyes, his vision was improved, and on looking through one of thirty inches focus, he said he could see "nearly as well as ever." Upon inquiry I was informed, that his breath was fœtid, his appetite capricious, and that he ground his teeth when asleep. Believing that the affection of the vision was in connexion with abdominal irritation, three powders were prescribed, each containing three grains of calomel, four of scammony, and four of jalap: one to be taken every night, and the evacuations to be watched. No worms appeared on the first morning, but on the second, a large *ascaris lumbricoides* was passed; and after the third dose, two more came away. I then prescribed ten drops of the tinct. ferri sesquichloridi in an ounce of inf. quassiæ, thrice a day, and another purgative powder at the expiration of three days, but no more worms were expelled. At the end of a week I had the satisfaction of finding that an improvement had taken place in the vision; at the expiration of a fortnight he left town, but I subsequently heard, that by steadily pursuing a plan of diet and medicine which was laid down, together with exercise in the open air, his sight continued to get better, and in two months was quite restored.

Treatment.—It has been explained that true myopia arises from the want of adaptation existing between the refractive powers of the eye, and the situation or the form of the retina. The resources of art have been made successfully to supply such want. When treating of spectacles, I shall name the chief points to be attended to in their selection, and shall here confine my observations to the manner in which they act, and the mode in which they are to be used.

Concave glasses are required by near-sighted persons, and double concaves are better than single concaves. They both render parallel rays divergent, and divergent rays still more divergent; thus causing the picture of an object to be thrown back upon the retina instead

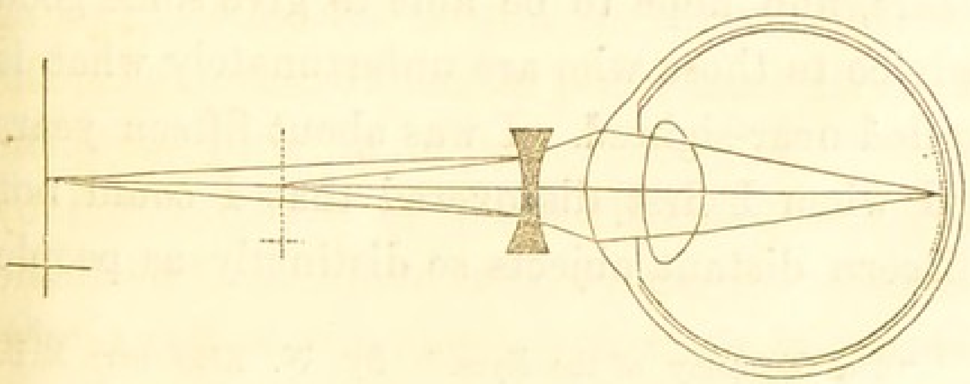


Fig. 7.

of being anterior to it, as is the case in the unassisted myopic eye.

It is not only of the highest consequence that near-sighted persons should avoid increasing the power of their spectacles needlessly, but they should carefully avoid wearing them constantly; for with proper care of the eyes, such as the avoidance of much close application, of reading by the light of a hot fire, or studying by too brilliant a light, glasses of a low power will answer every useful purpose for a long series of years.

Dr. Kitchener has written so sensibly, and withal so feelingly, upon the evil consequences resulting from a too frequent change of glasses, that I shall quote his words.[1]

"Being a short-sighted mortal myself," says he, "I write this chapter with confidence, from my own experience of upwards of thirty-one years, and hope to be able to give some good advice to those who are unfortunately what is called near-sighted. I was about fifteen years old when I first discovered that I could not discern distant objects so distinctly as people

[1] "The Economy of the Eyes." By W. Kitchener, M.D. P. 95.

who have common eyes usually do; and seeing I could not see what persons with common eyes frequently pointed out to me as well deserving my attention, I paid a visit to an optician, and purchased a concave eye-glass, No. 2.

"After using this for some time, I accidentally looked through a concave, No. 3, and finding my sight much sharper with this than with No. 2, had my spectacles glassed with No. 3, which appeared to afford my eye as much assistance as it could receive.

"After using No. 3 for a few months, I chanced to look through No. 4, and again found the same increase of sharpness, &c., which I perceived before when I had been using No. 2 and first saw through No. 3; therefore concluded that I had not yet got glasses sufficiently concave, and accordingly procured No. 4. However, this soon became no more stimulus to the optic nerve than its predecessors Nos. 2 and 3 had been.

"I then began to think that the sight is subject to the same laws which govern the other parts of our system: *i. e.* an increased stimulus by repetition soon loses its power to produce an increased effect; therefore I refused my eye any further assistance than it received from spectacles glassed with No. 2, which I have worn for upwards of thirty-one years, and it is very nearly, if not quite, as sufficient help to me now as it was when I first employed it, giving me a sight (for objects at a moderate distance), as I find by comparison, about upon a par with common eyes."

Dr. Wells,[1] in his experiments and observations, states that he was informed by Mr. George Adams, an eminent optician, "that he does not know a short-sighted person who has had occasion to increase the depth of his glasses, if he began to use them in the form of spectacles; whereas he can recollect several instances where those have been obliged to change their concave glasses repeatedly for those of higher powers who had been accustomed to apply them to one eye only."

The above is a fact which ought to be generally known, and is an argument against the use of single eye glasses.

Near-sighted persons are very apt to stoop

[1] "Experiments and Observations on several subjects in Optics." London, 1818.

while engaged in study. To avoid a practice so injurious to the figure and to health, they should use a high desk when reading or writing and if glasses are indispensable, such only should be used as just suffice to enable the parties to pursue their occupations at the ordinary reading distance, that of about fourteen inches. Small type, etching, microscopical pursuits, and objects requiring close inspection, should be avoided; the individual should overcome his natural tendency to a cramped hand, and write boldly and freely; and be the pursuit what it may in which he is engaged, the greatest possible distance should be maintained between his eyes and the object.

In all cases of myopia, and especially in early life, or when the affection is just commencing, it is highly important, than any tendency to an over supply to the eyes should be counteracted by a proper amount of bodily exercise, and every opportunity should be embraced for exercising the eyes on distant objects. Near-sight is comparatively rare in persons engaged in agricultural pursuits, and is almost, if not quite unknown among those uncivilised nations whose eyes are constantly practised in nomadic warfare, or in the chase.

Near-sight may be acquired in early youth by the habit common to infants of approaching their eyes very close to any object on which their attention may happen to be engaged. Observe a group of children learning to write or to draw—almost all will be seen with their faces sideways, and their tongues in one corner of their mouths, nearly touching with their cheeks the paper or slate on which they are laboriously accomplishing their task. Many an infant has been rendered short-sighted, and many have acquired squints from constantly playing with small toys; for, as the visual axes converge when objects are held near the eyes, frequent repetition of this may end in strabismus; and I may here remark, that strict attention should be paid to the position of an infant's sleeping cot, and to the attitude in which it is placed in its nurse's arms. The eyes of infants ever seek the light, and many an unsightly cast has been entailed on a child by its being always placed with one and the same side to a candle or a window. The light in the nursery should not be too much on one side of the cradle, nor should a candle or lamp be so placed in the evening, that the eyes of the child are distorted when looking at it.

There is sound judgment in printing childrens' books in good bold type, in encouraging them to observe distant objects, and in inviting them to describe what they see in landscapes. Near-sighted children are often fond of books, and love to pore over some favourite story in a quiet corner for hours together. They should be watched, and compelled to hold their heads ten or twelve inches from the page, and the same when in the school-room. Such children are obliged during music lessons to lean forward in a very unseemly manner to distinguish the notes; to obviate this, a sliding book-stand should be attached to the piano, and should be drawn forward when the child is practising: as, however, some musical instruments will not admit of such an arrangement, spectacles of a low power may be worn at that time, and then only, and the lesson should not exceed half an hour without a pause of some minutes for the eyes to rest.

Insufficiency of light in rooms where children receive instruction, or where they are taught mechanical work, is a cause of near-sight, and occasionally of even more serious mischief. Care should therefore be taken that parochial and infant school-rooms (which to my knowledge are frequently on the basement floor), should be properly and sufficiently lighted. To prove that this is no unnecessary caution, I will state a case which recently came under my notice.

Case X.—In the month of last November, I was consulted by Lady B——, who gave the following history of her case. In order that she might enter society with a full amount of accomplishments, she had been compelled, when about seventeen, to study exceedingly hard in a school-room very imperfectly lighted. Little by little her eyes failed, and at length the sight, especially of the right eye, became so seriously impaired, that her studies were discontinued, and medical advice obtained. For more than two months she did not open a book, and the eyes gradually became better, though the sight of the right was never fully restored. During her subsequent life she had read, written, and drawn much, and in addition, undergone considerable mental anxiety. Two years ago, finding the right eye again failing, she consulted the late Mr. Dalrymple, who laid down a plan of treatment which was not, however, productive of much benefit. She then went to Germany, and placed herself under an oculist who declared she had cataract; not feeling satisfied, she returned to England, and consulted me.

When an open book was placed before her, the left eye being closed, she could merely distinguish with the right a difference of tint—that there was a sort of shadow on the white—neither letters nor lines could be discerned. The pupil was nearly immovable, and on dilatation with atropine, presented that deep-seated greenish hue so characteristic of chronic inflammation of the choroid and retina. With the left eye she could read, but all objects were confused with a gauze-like veil.

The history of this case clearly showed that a high state of congestion, if not of inflammation, of the delicate retinal and choroidal tissues had been excited when she was at school; that a tendency to this had been kept up by her subsequent pursuits, and that as age drew on, an amaurotic condition had been the result. Whether beyond treatment I cannot at present say.

In making choice of a trade or profession for a lad, the condition of his sight is seldom taken into consideration. A dull-sighted or myopic lad stands no chance of improvement if he be apprenticed to a watch-maker, a jeweller, or an engraver; whereas, if he be made a sailor, gardener, or agriculturist, he may in time obtain good sight. In these days of emigration, lads who in Australia would be invaluable as shepherds, are condemned too often to a purblind life in a cobbler's stall, or a jeweller's workshop.

Constant practice will lengthen the focus for near objects, and will enable the myope to read and write at an increased distance, but experience shows that where the defect is congenital, little alteration takes place in respect to distant vision. On this point M. Sichel gives his own experience: "During more than a quarter of a century," says he, "I have applied myself with perseverance to increase as much as possible my distance for reading and for writing. Accordingly I have doubled the focus of my vision for these occupations, and in this respect I might be taken for a presbyope ; but when I try to look at large distant objects, or persons, at about twelve feet distant, I remain at the same point, and anybody would easily know me for a myope, from my manner of looking or of bowing."

The following case bears out the position of the able author just quoted, that, with practice and attention, the focus for reading may be greatly lengthened.

Case XI.—Miss P., aged 17, was brought for my advice in September, 1850. She had remarkably prominent eyes, amounting indeed to proptosis, and there was a slight want of uniformity in the direction of the visual axes ; on examination it was found that with the left eye the reading distance was seven inches, with the right five inches.

She was directed to exercise her eyes at regular periods every day, both with a pierced diaphragm and at distant objects ; to avoid studies which required close attention, to bathe the eyes with cold water, and to take twenty drops of the tincture of acetate of iron twice daily in water. It is unnecessary to state the periodical progress of the case, but at the expiration of three months, this young lady read with facility at fourteen inches with the left eye, and at eleven with the right.

There is a particular condition of sight liable to be mistaken for myopia, but which I am inclined with M. Sichel to refer to a congenital weakness of the retina. Such persons cannot see distant objects as well as other people; but they distinguish tolerably large distant objects better than small near ones, and the effort required to make out small type is frequently productive of fatigue in the eyes; as they habitually approach objects nearer to the eyes than natural, they pass for near-sighted people; but there are these points of difference: a true myope, having found his point of distinct vision, can read or write for any length of time without fatigue, and can see clearly even in a feeble light. His vision of distant objects, too, is materially assisted by concave glasses. The amblyope (as the other may be called from the dullness of his sight) always requires a strong light, being quite unable to read any but the largest character in imperfect light, and that but for a short time. Concave glasses, instead of assisting, rather confuse his vision and diminish objects; convex glasses of a low power, on the other hand, rather assist him. In such cases slightly magnifying glasses may, by increasing the dimensions of small objects, diminish the fatigue of the eyes, but they should not be granted without due caution. I have known instances of children having been punished for supposed stupidity—they not learning to read as quickly as others, but slowly, and, with many mistakes, blundering over their spelling. This really depends, in some cases, on imperfect sight, and the child, with every desire to do his best, is unable to distinguish the letters quickly. In these cases encouragement, rather than punishment, is needed; the child should have large type, plenty of light, and not be kept at his lessons too long at one time; his general health should be strengthened, and the eyes freely bathed with cold water night and morning. The question often arises as to whether young boys should be sent to public schools; I am quite of opinion that those labouring under defective vision should not; for being physically unable to compete with other boys, they are placed in a false position; whilst it is quite impossible that they can receive from the masters that patience and attention necessary for their advancement. Thus they are kept back in every respect, are laughed at by their school-fellows, and have the unfair character allotted to them of dunces, or incorrigible idlers.

Mr. Guthrie has suggested the application of leeches to the eyelids at regular and pretty frequent intervals, where myopia appears about the period of puberty, supposing that the defect arises from the too rapid development of certain parts of the eye. Mr. Middlemore states he has tried this plan, and that it has most unequivocally failed.[1]

As the myopia which comes on at that period may frequently be traced to a partial loss of the power of adjustment to distant objects, no great advantage would in such cases be likely to accrue from local depletion.

M. Bonnet, of Lyons, was of opinion that one form of near-sight arises from the muscles of the eyeball acting so energetically on it as to elongate its anterior axis, thus rendering the cornea unnaturally prominent: and he at-

[1] "A Treatise on the Diseases of the Eye." Vol. ii. p. 207.

tempted to remove some of the pressure by dividing the inferior oblique muscle. In nine cases, he states, in which this operation was performed, the distance of distinct vision for reading was nearly doubled, and that for distant objects trebled or even quadrupled.

M. Guerin, in a communication to the Academy of Sciences, describes two species of myopia, the *mechanical* and the *optical*. The mechanical he considers to result either from the original shortness, or the undue contraction of the four recti muscles together, or of two or three only. In such cases M. Guerin recommends the subconjunctival division of the short or contracted muscles. He relates a case of a young woman in whom he states that he divided all the four recti muscles with great alleviation of the symptoms!

It is scarcely a question, however, whether either of these remedies is not worse than the disease, especially as relief can always be afforded by the very simple contrivance of glasses.

Myopia dependent upon loss of power of adjustment to distance.

That a power of adjusting the focus of the eye to different distances exists in the healthy eye is proved as follows :—

Let a person place a couple of thin objects fifteen or twenty yards asunder, in a line with one eye (the other being shut), and let the nearest object be a yard from the eye. On fixing the eye upon the nearer object, he will perceive the distant one to be indistinct, and on looking at the distant object, the nearer one will become indistinct, and at each change of the object of vision he will be conscious of an alteration in the adjustment of the interior of the eye.

If, then, a person employs himself for long periods together, and that for successive days, in reading, microscopical observations, or other pursuits requiring close application, he becomes, not strictly near-sighted in the usual acceptation of the term, for he does not hold objects much nearer to the eye than usual, but he finds that he discerns distant objects less and less distinctly. In fact, he finds that the eyes being exercised so much in adjusting the focus for near objects, lose the power of adjustment to the focus for distant objects. The prevalence of concave spectacles amongst the Germans, who are great readers, is proverbial; and many must have noticed the same prevalence at our Universities. Mr. Ware found that, out of 127 students at one college in Oxford, thirty-two used either a hand-glass or spectacles. Indeed, I believe that few persons of studious and sedentary habits entirely escape this consequence of their labours.

The public are little aware of the extent to which the studious, and those who live by the exercise of their intellect, suffer from imperfection of sight. Many instances have fallen under my notice of poor students and writers, whose poverty compelled them to pursue their literary avocations in the gloom of dusky apartments, or by the aid of a dim candle, and who have become myopic and amblyopic in consequence. And scarcely less numerous are those, who, though pursuing their labours under more favourable circumstances, are equally visited with this affliction. It would appear that even the study of ophthalmic science may cause the same penalty to be paid; for M. Desmarres informs us that one of his pupils became very myopic by exerting his eyes too much in the diagnosis of diseases of the eye; a sad result of most rare industry!

The progress of this affection is generally by insensible degrees; and it often happens that the person in whom it is commencing is less warned of it by his own feelings than by the remarks of others, who notice that, when studying or regarding objects, he holds his face nearer than was his wont. After a time, however, he is sensible that he cannot distinguish distant objects as quickly as formerly; that the eye does not seize them at once, and that when seen they are indistinct; and when the affection has made still more progress, they cannot be seen at all. If in the very earliest stage a low convex glass be held to the eye, vision is rather assisted; but when the abnormal condition is established, convex glasses not only cease to render aid, but concaves are required. If this affection is induced in an adult whose eyes have been previously strong, it may be overcome without much difficulty, if taken in time; but when the subjects of it are feeble strumous youths, in whom the intellectual powers are more vigorous than the bodily, and who have perhaps suffered in infancy from constitutional weakness of the eyes, the case is much more unmanageable, and the prospects of cure much less favourable.

I could bring forward scores of cases which have been treated with various success, but the following will be sufficient for my purpose.

Case XII.—In December, 1845, when the railroad mania was raging, a gentleman, aged 19, consulted me. He stated that for three months he had been almost incessantly engaged in drawing plans, sections, &c., of railroads; that his sight, which had been excellent up to that period, had in consequence become so much impaired, that, although he was still able to write and draw at the ordinary distance, he could not distinguish the features of persons on the opposite side of a street, and was much troubled with muscæ volitantes in his left eye. He had ascertained that with the assistance of glasses he could see perfectly well, and his object in calling upon me was for advice as to the description of spectacles that would be proper. My advice to him was on no account to use glasses, but to go into the country, and give his eyes perfect rest, by abstaining *in toto* from the pursuits upon which he had been recently engaged. An alterative course of medicine was prescribed, and he was directed to apply a blister over the left brow, and to repeat it three times, with an interval of a week between each application.

My patient called again at the expiration of a month, and stated that his general health was much improved, that the muscæ had nearly disappeared, and that there was a decided amendment in his vision. He was recommended to pass another month in the country, and to exercise his eyes freely upon distant objects. By the last accounts sent, he was still in the country, had been taking much exercise, and his sight was nearly restored.

Case XIII.—A gentleman, aged 20, consulted me in January, 1845. He stated that he had enjoyed excellent vision until seventeen years of age, at which time he began to read daily for ten hours, allowing himself only an hour's exercise. He paid little attention to the fact, that at the end of three months of this close reading, his vision for distant objects was less perfect, but went on with his studies, till at the end of six months he could not distinguish a person's features at the distance of thirty feet. He then provided himself with glasses which assisted his vision, but still his sight became worse, and he accordingly used stronger and stronger glasses. When I saw him, he was using a lens of 11 inch focus for his right eye, and one of 7 inch focus for his left. Though in reading he held the book at about thirteen inches from his eyes, yet, upon my placing myself at the opposite end of the room (a distance perhaps of fifteen feet), he was unable to distinguish my features: an outline alone of a face could he make out. From the history of the case, and from the circumstance of his holding the book at the ordinary reading distance, there was but little doubt that the imperfection of vision was caused by loss of adjusting power. My recommendation to him was, to abstain from study, to visit the country, and, whilst taking plenty of exercise, to especially strive to make out more and more distant objects, to provide himself with glasses two numbers lower than those he was using, and to employ them only when absolutely necessary.

This gentleman called upon me nine months afterwards to say that he had derived great benefit from following this plan; he had passed much of his time in the open air, and his health was greatly improved. He began to perceive an amendment in the power of distinguishing distant objects in about six weeks after leaving town, and that power had steadily progressed; so that he could now recognise his friends across a tolerably wide street, and very rarely required the use of his glasses. He wished to know whether he might venture to resume his studies. I advised him never to read long without exercising his eyes in looking at distant objects, to study as little as possible by artificial light, to make a point of taking exercise every day, and never to put on his glasses when doing so, in order that the eyes might be kept in exercise as to distant objects.

Case XIV.—A distinguished professional friend, in the course of conversation upon the subject of loss of adjusting power, mentioned that, when a student, he had worked hard at dissection, and studied closely during the whole of one session. In consequence he lost the power of discerning objects beyond forty or fifty feet. The following summer he passed in the country, and before the commencement of the next winter session his vision had become perfect. By abstaining from too close application in future, the imperfection in his sight did not return; and, although now advanced in years, he is in the enjoyment of excellent vision.

Case XV.—In July, 1844, a young gentleman who had been reading for honours at one of our Universities called upon me respecting a serious imperfection in his vision, which he dated from the commencement of his close study. It appeared that he had been frequently in the habit of sitting up till three or four in the morning studying intensely, besides much close application during the daytime. The only recreation he allowed himself was a short walk daily; he stated that his eyes felt hot and uncomfortable, with much itching; but what alarmed him was the discovery that, from having had excellent vision, he had become quite near-sighted, rendering the assistance of an eye-glass necessary; he regretted being obliged to have recourse to this, and wished to know whether any suggestion could be offered for his benefit. Upon a book being placed in his hand, he held it about twelve inches from his eyes, at which distance he could see the type, but said that he felt much inconvenience when walking in the streets, on account of his inability to distinguish features, or read the names upon the shops. Upon examination of the eyelids, chronic inflammation was apparent; but beyond this and some congestion of the superficial vessels of the eyeball, there was nothing unusual in the aspect of the eyes themselves; the pupils acted freely, and the irides were brilliant.

Upon his trying concave glasses, it appeared that the right eye required two numbers higher than the left (no doubt from his having used the eye-glass), but that numbers 4 for the left eye, and 6 for the right, afforded him good vision.

I recommended country air, exercise, and total repose from study: a mild alterative course was prescribed to correct the secretions, with cold ablution followed by friction in the morning, and careful attention to diet.

He was advised to lay aside his eye-glass, to be much in the open air, and to exercise his eyes upon distant objects.

After the expiration of four months, this gentleman called upon me, and stated that he had been shooting in Scotland, that his health was quite restored, and his eye-sight greatly improved, although not as yet so perfect as it had originally been.

The popular idea that the eyes of near-sighted persons become less near-sighted as they advance in years is not borne out by experience. The subject has been investigated by Dr. Wells, whose acute mind was well qualified for such inquiries. He says,[1] "It has been very generally, if not universally, asserted by systematic writers on vision, that the short-sighted are rendered by age fitter for seeing distant objects than they were in their youth. But this opinion appears to me unfounded in fact, and to rest altogether upon a false analogy. If those who possess ordinary vision when

[1] Phil. Transactions, 1811.

young, become from the flatness of the cornea or other changes in the mere structure of the eye, long-sighted as they approach to old age, it follows that the short-sighted must from similar changes become better fitted to see distant objects. Such appears to have been their reasoning; but the course pursued by Nature seems very different from that which they have assigned to her. For of four short-sighted persons of my acquaintance, the ages of whom are between fifty-four and sixty years, and into the state of whose vision I have inquired particularly, two have not observed that their vision has changed since they were young, and two have lately become, in respect to distant objects, more short-sighted than they were formerly. I shall here relate the more remarkable of the two cases: a gentleman, who is a fellow of this society, became short-sighted in early life, and, as his profession obliged him to attend very much to minute visible objects, he for many years wore spectacles with concave glasses almost constantly; by the aid of which he saw as distinctly, and at as great a variety of distances, as those who enjoy the most perfect vision. At the age of fifty, however, he began to observe that distant objects, though viewed through his glasses, appeared indistinct, and he was hence led to fear that his eyes were affected with some disease. But happening one day to take up, in an optician's shop, a single concave glass, and to hold it before one of his eyes whilst his spectacles were on, he found to his great joy that he had regained distinct vision of distant objects : with regard to such objects, therefore, he had become shorter sighted than he had formerly been. But along with this change another occurred, of a directly opposite kind ; for, when he wished to examine a minute object attentively, such as he used to see accurately by means of his spectacles, he now found it necessary to lay them aside, and to employ his naked eye. The power, consequently, in this gentleman to adapt the eye to different distances is either totally lost or much diminished."

I have lost no opportunity of inquiring of myopic persons whether their sight had improved, and I cannot call to mind a single instance in which the reply was decidedly in the affirmative. One case specially occurs to me—a lady, eighty-two years of age, who is a patient of Mr. Walter Bryant's. This lady told me that so long as she could remember, she had used No. 8 Myopic glasses, and that with them she could read the smallest type, and thread a needle with perfect facility, but most decidedly her sight had not altered as to focus within her recollection. I examined her eyes and her glasses very carefully, and satisfied myself of the power of the latter.

CASE XVI.—The following case is highly instructive, and illustrates, in a remarkable manner, the evil consequences likely to result from the improper use of glasses, and over exertion of the eyes in a constitution naturally excitable. It is given in the words of the sufferer.[1] "I am now in my fifty-seventh year; my sight was originally near, but not distressingly so: at eighteen years of age I could read at the distance of twelve inches; about that age I became acquainted with convex glasses, and was so delighted with the distinct view and sharp outline they gave to objects, that I began to wear them habitually when reading and writing, as well as when

[1] A Case of Diseased Vision. By William Keir, Lecturer on Science.—Lancet, Oct. 8th, 1842.

walking: the consequence was that I soon became much nearer sighted, and had to increase the depth of my glasses. This from time to time I continued to do, and I was distressed to find that, with every increase of power, my vision finally settled for reading at twelve inches, or within it, whilst everything was as indistinct and ill-defined at a distance as before I began to wear glasses. The right eye I found to have not much more than half the focal distance of the left; in consequence, not only when the eyes are bare, but also when the glasses are on, objects appear double, the shadowy one being higher apparently than the other."

Mr. Keir then states that he has for many years been troubled with muscæ and occasional scintillations when in a state of irritation. In March, 1841, he made a sea voyage, and after landing, for several nights saw coloured coruscations and halos: he goes on to say, "The day was exceedingly bright, and for many hours each day I was engaged in reading, or consulting a book which had a great deal of small print in it. This was done in a *white* room, into which the sun shone brilliantly.

In the evening, studies in the same book were prosecuted with a small candle. I know not whether it was owing to the severity of the application, the brilliancy of the light in which it was conducted in the morning, the transition to the comparative gloom in the evening, or the state of the digestive organs, but at the end of a fortnight I became conscious of some apparent disorganization of the visual organs. The print would disappear and re-appear ; an undulating cloud seemed to be floating before my eyes, with occasional openings in it ; through the openings I could see the print distinctly, but it immediately became obscured, a denser part of the cloud intervening. I desisted from my close study, but if that had been the cause of injury, it was too late, for every object had the same clouded appearance: faces seemed to have black, ill-defined, large blotches on them ; bright objects, as fire-irons, exhibited a tremulous, undulating light and shade ; the large white letters painted on a black ground on the ends of the streets became ill-defined and shaggy on the edge, as if fringed with hoar frost. Besides the misty undulation and dark, scaly-looking, floating specks, a general dimness of vision had evidently been induced, for all my manuscripts and books appeared uncomfortably obscure and faint. As light passing through glass is necessarily partly lost, I laid aside the use of glasses, to which I had been constantly habituated for thirty-eight years, and had rather more light to read by.

"Neither seclusion from light, nor low regimen, nor the severe depletion and physicings, to which, for an attack of inflammation on the chest, I was subjected, produced any sensible improvement in my sight.

"Recently I have not noticed the coruscations much, but often when I shut my eyes I observe a small bright light which gradually fades away. I should have mentioned that the retina throughout has been unnaturally retentive of impressions caused by faint impulses of light. I sometimes see the appearance of well-defined black Roman capitals in the air, and sometimes I have a hasty, evanescent glimpse of a whole word, as if printed in small Greek letters; lines of print occasionally appear curved, and actually undulating: so also do straight objects (especially if they be bright) when moved in a horizontal position.

Rings, circles, and all circular and globular objects often lose their symmetrical appearance, appearing compressed and dimpled in every direction. The universal dimness appears almost uniformly permanent, for though a gleam, like that of sunshine, sometimes illuminates an object, it instantly fades away."

These cases illustrate the affection of which I am speaking. The symptoms in all were the result of long-continued close application of the eyes upon near objects; there did not appear to be any material alteration in the focal length, for the reading distance averaged about twelve inches; the history, however, of four of the cases clearly indicated that the eyes had been temporarily deprived of their due adjusting power. The point which I am desirous of impressing upon the reader is, that in cases such as I have described, spectacles are absolutely injurious; they afford, it is true, the means of discerning distant objects, but they tend to confirm the disorder, and render the individual dependent upon artificial aid for the remainder of his life. The course which ought to be pursued is plain; the patient should abstain from study and all pursuits requiring close application, and he should endeavour, by due and well-regulated exercise of the eyes, in the country if possible, to recover that adjusting power of which, by injudicious exertion, he has deprived them.

One of the most frequent questions asked by patients at eye infirmaries is, "Do you think, sir, that spectacles will be of any use to me?" It matters little whether the sight be impaired by over-work, by congestion, by debility, or by opacities of the cornea, the same idea is current in the minds of the poor. They often try them, and if they do not find assistance from ordinary spectacles, they take to coloured glasses, green or blue, as an improvement on the former. I need scarcely say that, unless really called for, glasses do more harm than good; and, for reasons hereafter to be given, such coloured glasses are inadmissible; not only are they injurious by exciting complementary colours, but they are apt to render an eye over-susceptible of light, and if there be retinal congestion, it cannot fail to be aggravated by the additional effort required to see objects but indistinctly illuminated; therefore, in cases where the sight is impaired, but where no intolerance of light exists, the habitual use of coloured glasses is highly objectionable.

It sometimes happens, as remarked by Dr. Mackenzie, that young persons about the age of puberty, after severely trying their eyes upon minute objects, as in painting, embroidering, and the like, suddenly become short-sighted. They and their friends are alarmed at their being no longer able to see objects on the opposite side of the street, which a few days before were distinguished with ease. The effort necessary for seeing small objects is attended with pain, and instead of fifteen or twenty inches, at which the patient used to read, the book must be brought as close to the eyes as six or eight inches. Sudden myopia is most apt to occur in boys sent to learn such trades as watchmaking or engraving, or in young ladies at school occupied with music, painting, embroidery, and other pursuits requiring continued and keen employment of sight. In these cases the intense application has temporarily paralysed, as it were, the adjustment to distant objects, and the proper course to pursue is to give the eyes rest for a few days, when they will recover their natural condition; frequent bathing with cold water will relieve any congestion of the vessels that may exist.

The circumstance of eyes differing in their focal length is a common occurrence, and needs a few words on the proper course to be pursued. There is a very general impression that one eye is stronger than the other, the right being supposed to be the strongest, partly, perhaps, from its being preferred for looking at objects when one eye only is required, as in taking aim in shooting, using a microscope or telescope, &c. Convenience has much to do with this, the right arm and the right eye corresponding in action. When, however, there is really a difference in the vision of the eyes, it may be ascertained how far this depends on focal length by placing an open book at the ordinary reading distance, and looking at the page with the eyes alternately, the one not used being closed. Suppose the type appears then distinct to the right eye, but confused to the left, the book should be slowly drawn nearer, and if the focus of the left be shorter than that of its fellow, the type will become distinct at a certain distance, one or more inches less than the ordinary distance. To make the point more certain, the vision of the left eye can be made equal with the other by holding before it a slightly concave glass if the difference be trifling, of a higher power if the inequality be great.

It is important to all persons, but especially to the young, and those whose position in life requires much exercise of the eyes, that they should have the benefit of both, and that all the labour should not be thrown on one, as necessarily happens in the condition of vision under consideration—a condition sometimes produced by the carelessness of inferior opticians, or the hawkers of cheap spectacles, who sell lenses of different focal lengths in frames intended for persons whose eyes are equal; or who supply those eyes in which there is an inequality in the foci with duplicate glasses, rendering in each case one eye useless.

In early life the vision of the eyes may often be brought into harmony by blindfolding the perfect eye, and patiently practising the other at the utmost distance, increasing that distance by small but steady degrees, avoiding rapid or vacillating changes. If this does not suffice, practice with lenses hereafter to be described will be proper; but if circumstances prevent the exercise being satisfactorily carried out, it will be necessary to have a spectacle frame made, with a lens for the imperfect eye, just sufficiently strong to equalise the vision. The circle before the perfect eye should be blank, but in order to counteract the weight of the lens (which would throw the frame out of its proper position), the empty side of the frame should be heavier than the other.

The following are two singular cases of inequality of vision :—

CASE XVII.—" A gentleman (says Mr. James Russell) came to Edinburgh for a consultation on account of a severe complaint in his stomach. Previously to the commencement of this, he saw equally well with both eyes, and the focal distance of distinct vision was the same in each of them. A great change had, however, taken place in this respect, and what was remarkable was, that the change in the two eyes was in opposite directions, the focal distance of one having become longer, and that of the other shorter, than the original focal distance. But, although the eyes no longer corresponded in their limits of distinct vision, each of them still retained the power of adapting itself to the variations in the distance of external objects, so far as its limits of distinct vision admitted.

"This affection was referred to the irritation excited by the gastric disorder, but as the patient returned into the country the result of the case was not known."

Case XVIII.—On the 27th August, 1849, M. B., residing at Metz, brought his son, aged 12, a student at the college of that city, to Dr. Deval.[1] The child was very delicate, and had been long subject to attacks of ophthalmia; the eyes were generally red, and very sensible to light. In the course of the previous July the inflammatory appearances suddenly vanished whilst under treatment, but the sight, hitherto perfect, became troubled; the eyes were incapable of reading many lines without such confusion taking place that the reading was obliged to be discontinued, and diplopia occasionally manifested itself. On taking up a book he held it near his eyes, and Dr. Deval gave him a pair of concave glasses, which in-

[1] Traité de L'Amaurose, p. 81.

creased the reading distance; stronger and stronger glasses were successively tried, and the child read easily with their help; but, singular enough, convex glasses assisted the sight nearly as much as concave. The conclusion arrived at by the Doctor was, that one eye was myopic, the other presbyopic, sometimes one of them, and sometimes the other, accommodating itself to the perception of objects, according to the glasses presented. It was found impossible to continue the investigation at that time, from the fatigue of the boy, and he left for the country the same day, being directed to use tinted glasses to subdue the light, and various means to improve the health, but all work, and every sort of spectacles, were forbidden. This advice was attended with the best result, for on the 31st of the following October Dr. Deval again saw his patient, and learned that the affection of the sight had decreased little by little until it finally disappeared; neither reading nor writing caused any fatigue, even in the evening, and he used a gun with much skill at long distances. He required no glasses whatever.

CHAPTER II.

PRESBYOPIA OR AGED SIGHT.

THERE cannot be a stronger proof of the harmony which exists throughout the processes of nature, than the exquisite nicety with which every part of the eye retains its proper form and relations, notwithstanding the changes of particles incessantly going on from the time of birth till that of death. When we consider that the difference of an infinitesimal fraction of a line in any one of the numerous curved surfaces would derange the whole visual refraction; that a little difference of density in the humours would turn the balance and render our sight all confusion, our admiration of the wonderful skill (so to speak) of the Supreme Being cannot be too highly excited.

During youth, the development and elevation of the bones of the nose increase the distances of the points of attachment of the muscles, consequently these must increase in length, and the globes must increase in size. In manhood, there is a tendency in the cornea and the crystalline to flatten, and unless compensation be made in some part, the indices of refraction will be altered; yet not till the evening of life draws on, do we find the equilibrium destroyed.

It is about the age of forty that the human frame begins to experience those changes which, however reluctantly it may be admitted, proclaim advancing age, one of the earliest indications being an alteration in the refractive powers of the eyes, producing long-sightedness or presbyopia (πρέσβυς, old, ὤψ, the eye). Dr. Kitchener has thus aptly described the premonitory symptoms of this change. "The first indication of the eyes beginning to be impaired by age is, that when you wish to read small print, you are obliged to remove it farther from your eyes than you have been accustomed to do, and desire the aid of plenty of light; and, on looking at a near object, it becomes confused, and appears to have a kind of mist before it, and the letters of a book run one into another, or appear double, &c., and by candlelight you catch yourself holding your book close behind the candle, and you begin to admire the ingenuity of that gentleman who invented snuffers."

Facetious as is this description, it conveys a correct idea of the effect of the first of those constitutional changes which warn the individual that the prime of his life has passed.

It is in reading, or in working with the needle by candlelight, that the deterioration of vision is noticed, and surprise is often experienced that the eyes are now strained and fatigued by what had heretofore been an ordinary and agreeable occupation.

The following case affords a fair illustration of the general characters of commencing Presbyopia:—

Case XIX.—A professional friend consulted me January 13th, 1851. He was in his fortieth year, and had always enjoyed good vision until within the last few months, during which he had been much troubled with pain over the brows after reading at night. At first he saw well, but after a short time the pain came on with aching of the eyes, rendering it impossible for him to continue his studies; on one occasion, when he persevered longer than usual, the frontal pain was attended with vertigo, which continued until the following morning.

He was extremely depressed in spirits, taking (as is too often the case with medical men) the gloomiest view of his case. The inability to study was indeed of serious consequence to him, as circumstances compelled him to read and write much, and this he could only do after the labours of the day were concluded.

On placing a low double convex glass before his eyes he felt the greatest relief, and having, by my advice, provided himself with a pair of 36-inch Presbyopic spectacles, was at once relieved of his difficulties, and enabled to read and write with comfort.

Various structural changes in the eye have been mentioned as giving rise to this presbyopic state.

1. A flattening of the cornea, from a diminution in the bulk, either of the aqueous or

vitreous humours, or of both, the result of defective secretion.

2. An alteration in the consistence and diminution in the convexity of the crystalline lens.
3. Diminished density of the various humours.
4. Diminished curvature of the retina, which existing while the vertical diameter of the globe remains about the same, prevents the refracted rays that enter the flattened cornea from forming a picture upon the retina.

Whichever of the above may happen or exist, the effect is to cause the converging rays of light to be brought to a focus beyond the retina, as shown in the figure, thus producing a confused and imperfect picture.

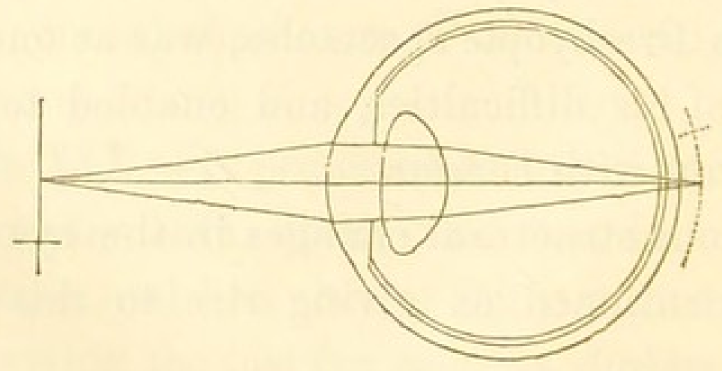


Fig. 8.

Distant objects are still seen distinctly without aid, inasmuch as the rays which proceed from them require less refractive power to bring them to a focus by the time they arrive at the retina.

Another change which the eye undergoes in age is the impairment of its power of adjustment. Dr. Mackenzie, in his able work,[1] truly says, "As we advance in life, not only do the refractive powers of the eye diminish, but we lose the power of accommodating the organ to near objects. The eye, in its state of perfect indolent vision, is adapted only to distant objects, and it cannot see near objects distinctly but by an effort. This effort, long persevered in, becomes painful, whereas the regarding of distant objects can be continued without any feeling of fatigue. The power to make the peculiar effort in question is partially or totally lost by the presbyopic eye: a fact analogous to the diminished activity which takes place in all the functions of the body as life advances."

The symptoms of presbyopia, then, are—

Difficulty in discerning close objects: so

[1] Physiology of Vision. By W. Mackenzie, M.D. P. 157.

that a person who, in early life, could read ordinary print, with comfort, at twelve or fourteen inches, is now obliged to hold a book two feet, or even further, from his eyes; and the act of threading a needle, or of nibbing a pen, becomes fatiguing to the eyes, if not almost impossible, excepting when assisted by an increase of light. Employing them at fine work long together, induces headache and uneasiness about the brows and forehead.

These symptoms may be accounted for thus: in consequence of the object being removed to a greater distance, the visual angle, the quantity of light, and the picture on the retina, become smaller; so small, indeed, as to render it difficult for the retina, with its impaired sensibility, duly to appreciate it without effort and a considerable increase of light. The diminished size of the pupil, too, which attends advancing years, frequently increases the necessity for more light.

There is usually little in the appearance of the eyes to account for these changes. This, indeed, might be expected; for although the cornea, in the majority of cases, is perhaps somewhat diminished in convexity, yet it is not perceptible. The inefficiency of the eye, probably depends less upon the altered form of the cornea than upon that of the other media of the organ, especially of the crystalline lens. The eyes of old persons are commonly sunken in the sockets ; but this is dependent upon the general absorption of the adipose tissue of the orbits, as well as of the body generally, which is one of the phenomena of age. It is the diminution of the aqueous contents of the globe, in combination with peculiar changes in the lens, which becomes denser, less convex, of diminished transparency, and more or less of an amber hue, which influences the refractive powers. As age creeps on, the pigmentum nigrum (to which the blackness of the pupil is due) diminishes in quantity, giving to the pupil a greenish or greyish hue, which, to an inexperienced eye, might easily be mistaken for incipient cataract. The cornea becomes less transparent, a white circle, called *arcus senilis,* forms round its margin, the colours of the iris fade, and the nervous power of the eye becomes less energetic.

The period of life when presbyopia displays itself is the same as that at which hard cataract commences, and I have seen many cases where the imperfection of vision caused by the decay of the lens has been confounded with presbyopia. Of these I will relate two.

CASE XX.—On January 8th, 1851, I was consulted by T. P., Esq., 68 years of age. He was a large, stout man, greatly crippled by gout; thirty years of his life had been passed in Jamaica, where he had such a severe attack of yellow fever that he was laid out for dead, and about to be buried, when, fortunately, symptoms of vitality appeared, and he was restored. His sight had been very good until about twelve months before the above date, when, finding a difficulty in distinguishing objects, he purchased glasses of twelve inches focus. After a few months he had recourse to nine inch, and when I saw him he could read only with a powerful lens. The optician in the country, of whom he had purchased the glasses, considered it one of the most remarkable examples of presbyopia he had ever seen, and, had it *been* presbyopia, such would certainly have been the case.

On placing a book with large type in his hand, he held it at nine inches and a half, closed the eyes, reading with difficulty even with the glasses. All objects appeared misty, and when a candle was looked at from a distance of ten feet it appeared a great burr of light.

Before examining the eyes, I had little doubt that the symptoms were referable to incipient cataract; the pupils, however, were small and sluggish, and though they had a yellowish tinge, I could not be positive as to the nature of the case without dilating them. When they were fully under the influence of atropine, two amber-coloured cataracts were displayed, principally involving the centre and posterior portions of the lenses. Great improvement was caused in the sight; with the right eye he could read easily at ten inches and a half, without glasses; with the left, in which the cataract was most advanced, he required a moderate magnifying glass.

I performed the operation of extraction on this gentleman, and though I did not auger very favourably of the case, from the gouty diathesis, he made one of the most rapid recoveries I ever saw, leaving London for the country on the tenth day after the operation, the eye being well, so far as the wound was concerned. He was prudent in the use of his eye, and now enjoys excellent vision with moderate glasses.

CASE XXI.—A gentleman residing in Yorkshire, 83 years of age, but of remarkable vigour, consulted me, May 3rd., 1852. He stated that his eyes had always been of different foci, and that being near-sighted, he had used double concave glasses, which had afforded him good vision until about three months previous to the above date, when he remarked that he did not see as well as usual, and that the flame of a candle appeared multiplied twice or thrice. An optician recommended magnifying glasses; he tried several powers without advantage, and under those circumstances he came to town, and placed himself under my care.

At this time, he stated that a candle-flame was broken up into five or six when looked at with the right eye, and that when seen with the left alone, it was merely foggy. The pupils were very small and sluggish, and nothing unusual could be detected until after they had been dilated, when the right lens was seen to be streaked with opaque lines at its posterior surface, which lines, breaking up the pencils of luminous rays, caused the multiplication of lights. The left lens was a little turbid, but not striated. The following day, this gentleman called on me to say, that the dilatation of the right pupil had produced an extraordinary effect. When walking down Regent-street the evening after the atropine had been applied, there appeared a most brilliant illumination, for with his right eye, he saw twenty or thirty lamps in place of each one. However beautiful the effect might be in the street, it was embarrassing in a room, and he wished to know when it would pass away? I explained that it was caused by a larger surface of the lens and more striæ having been exposed, and that as the pupil contracted, the number of lights would diminish.

To facilitate the recognition of doubtful cases, I will point out the distinctive marks of commencing cataract.

Hard lenticular cataract is never found under the age of forty. The opacity usually commences at the centre of the lens. When facing the sunshine, or light, the patient complains that objects appear obscured, as by a mist; this obscuration is produced by the partially opaque lens arresting a portion of the light, and causing objects to appear as if seen through a bright thin cloud. When, however, the back is turned to the light, vision is greatly improved, because the dilatation of the pupil which then takes place, exposes a large portion of the lens which is still clear, and vision is greatly improved; more light also, from the position, falls upon the object looked at, and this again renders it more distinct. To obtain as much dilatation of the pupil as possible, the patients, when oppressed with too much light, knit their brows, and shade their eyes with their hand. The flame of a candle appears as if enveloped in fog, and the sharp outlines of objects are lost. Cataract may form in an eye previously presbyopic, in which case the symptoms now described will develope themselves, in addition to those which have been mentioned as characterising simple presbyopia.

A decided opinion as to the non-existence of cataract can only be ventured on with safety after the pupil has been dilated with belladonna. When cataract does exist, it will generally be seen on dilating the pupil fully, as a greenish, greyish or amber-coloured haze in the centre of the pupil; and of an opacity in proportion as the nucleus is hard. It is by no means unusual, when the iris is under the influence of this valuable drug, to find spots in the lens, or streaks extending from the circumference towards the centre; or even the whole margin of the lens opaque. Yet these changes will be concealed by the iris if the pupil is in its natural condition: much credit has at times been gained for superior skill in the detection of cataract by simple attention to this one point.

Dilatation of the pupil is effected most rapidly and for the longest time by dropping into the eye a solution of the essential principle of belladonna, which is far more cleanly, certain, and elegant than the drug itself. One full drop of a solution of the sulphate of atropine, in the proportion of four grains to the ounce of distilled water, will keep the pupil expanded for several days. As, however, this is not desirable when a mere examination is all that is required, the best plan is to lightly touch the inner surface of the lid with a camel's hair pencil moistened with the solution; the lids should be closed for ten minutes; if at the expiration of that time no effect is apparent, the patient may keep the eye open, and in a few minutes more the pupil will dilate.

It should be borne in mind, that the preparations of belladonna have the effect of depriving the eye, for a time, of a portion of its power of adjustment. It is found that, as the dilatation of the pupil increases, the point of distinct vision is removed further from the eye. The inconvenience is but temporary, yet it is well that the patient should be warned of this effect, lest he imagine that the eye has been injured by the application of the atropine.

A general impression entertained by persons who find their sight failing is, that they require glasses. As, however, the deterioration of vision may be caused by commencing *amaurosis*, where glasses would be highly improper, it has been deemed advisable to state some of the chief symptoms of this disease.

The symptoms of amaurosis, or gutta serena, are as follows:—Objects are rendered dim by a haze or network before the eyes; spots, threads, lines, or strings of globules seem to be moving in the air, sometimes singly, at other times in great numbers, and under a variety of forms; lines of type appear confused and irregular; letters are distorted; they may be magnified, or they may appear diminished in size: double vision is a common and important symptom. Sparks, flashes, or circles of fire, annoy the patient, especially at night. Occasionally the flame of a candle appears to be surrounded by a coloured halo; in other cases it may appear broken up into two or more flames. In reading, some of the letters, or even words, are lost. There is generally dull pain felt in the head, the brow, or the eye itself; oftentimes there is pain down the side of the nose. The sight is best in a strong light, from the insusceptibility of the retina, and the patients seek light by raising the brows and opening the eyes; which gives the staring look characteristic of amaurosis, as the contracted brow and hand shading the eyes, is characteristic of cataract.

If the patient admits the existence of the above symptoms, or even of a large portion of them, there is disease, or at least disturbance, of the functions of the retina. It occasionally happens, however, that amaurosis takes place without the ordinary symptoms. A distressing instance recently came under my notice, of a medical friend who had undergone severe trials and much affliction, and who became blind apparently from simple loss of sensibility of the retina. The only account he could give was, that his sight became weak; day by day he saw less distinctly, until at length thick darkness came over his eyes, and in spite of every treatment, he became completely, and hopelessly, amaurotic.

If we examine an eye in which amaurosis is commencing, the pupil, from the diminished sensibility to light, will be seen to act slowly and imperfectly. It may, from sympathy, contract briskly when the other eye is open, but if the healthy eye be closed, its motion will be sluggish. It is proper, therefore, not only to compare the action of the pupils when the lids of both eyes are suddenly separated, but carefully to remark the action of the pupil of the suspected eye, when the lids of the other are closed.

I have considered it desirable to say thus much on the subject of amaurosis, for the information of those who are doubtful as to the propriety of beginning the use of glasses.

Cases of which the following are examples, are occasionally met with, in which persons who have for many years used convex glasses, seem to acquire the power of seeing readily without them.

CASE XXII.—Mrs. N—— S——, aged 69, residing in Lincolnshire, consulted me May 7th, 1852. She stated that she had been presbyopic all her life, using glasses of twenty inches focus; but, that during the last twelve months she had acquired the power of reading at the ordinary distance, and did so now from choice, as the glasses rather fatigued her eyes. The sight of the left eye had, however, become imperfect, and examination discovered incipient cataract. I tried her with various glasses, and although she preferred reading at ten inches without any assistance, she thought that low concaves were more agreeable than convex glasses.

CASE XXIII.—General C., aged 71, consulted me last October, for irritability of the eyes and chronic ophthalmia. After mentioning the symptoms which annoyed him, he stated, that he had taken to spectacles early and had used them of a rather high power, for more than thirty years; but, that he had recently done without them, and in proof of this, he read ordinary newspaper type at about twelve inches distance with ease.

Mr. Ware offered the explanation that this change in the focus was the consequence of the absorption of a portion of the vitreous humour, which permitted the sides of the sclerotic to be pressed inwards by the action of the muscles; the effect being to lengthen the axis of the eye, whereby the aberration becomes corrected. M. Sichel, however, is of opinion that this apparent return of the power of accommodation, is but a shortening of the visual focus caused by the use of too strong convex glasses, and he thus explains it.

Persons long accustomed to use strong convex glasses are obliged to approach objects nearer to the eyes than the natural focus, and even in some cases are under the necessity of using weak concave glasses for distant objects, in consequence of the focus for those objects becoming positively diminished. They, in fact, acquire a sort of myopic condition, in which they can read without glasses but only by approaching the page nearer to the eyes than the natural focus. I have not seen a sufficient number of these cases to be enabled to speak positively, but from the observation of three or four which have fallen under my notice I am inclined to agree with this explanation of M. Sichel.

Cases are occasionally met with in which persons appear to be suddenly attacked with presbyopia, but this condition admits of a very simple explanation.

Belladonna has the property, as already mentioned, not only of dilating the pupil, but also of suspending the power of adjustment, so that the individual is rendered temporarily highly presbyopic. I have known repeated instances of this occurrence when belladonna has been given internally or used as an external application.

Mydriasis, or permanent dilatation of the pupil, will also materially interfere with vision, rendering presbyopic glasses necessary. The following is a good example :—

CASE XXIV.—In November last I was consulted by a lady aged 50. Her husband was an officer of rank, and the exigencies of the service had caused him to pass many years in various parts of India, during the whole of which time his wife was with him. Her sight, originally good, had failed whilst up the country, and on her reaching Calcutta she was pronounced to have amaurosis. On this she returned to England. The chief inconvenience of which she complained was indistinctness of vision; at a dinner party she could not see the persons on the opposite side of the table, and she was quite unable to read. She habitually used glasses of ten inches focus, but even these did not assist her sufficiently at times, so that, when wishing to see anything in a hurry, she often folded her glasses, and looked with one eye through them doubled.

The chief peculiarity visible in her eyes was the large size and almost motionless condition of the pupils, but I was inclined to regard the case as mydriasis rather than amaurosis. She was requested to look through a pinhole aperture, when, to her amazement, she saw my features clearly, and read without much difficulty; a twenty-inch convex glass was added to the aperture, and this enabled her to read perfectly. I therefore recommended her to provide herself with pierced diaphragms for wearing at table, and to have a similar frame fitted with twenty-inch lenses for reading.

There is a condition well described by M. Sichel, erroneously supposed to be indicative of sudden presbyopia, but the real circumstances are these. Many persons are slightly presbyopic during the greater portion of their lives, but in so trifling a degree as to be overlooked by themselves and others. Being in easy circumstances, they have no need to try their eyes, read and work little, and do not require glasses, as a moderate elongation of the ordinary reading distance suffices for their purpose. The presbyopia, however, gently and insensibly increases until about the age of fifty, when it becomes marked; some accidental circumstance then calls their attention to their sight, and to their dismay, they find that, for reading, working, or examining small objects, glasses of considerable power are required. Such persons think they have been suddenly and seriously afflicted with aged sight, being quite unconscious of the gradual steps by which they have arrived at that point.

Congestion of the eyes will sometimes produce presbyopia. Supposing the story handed down to us to be true, it might be that which gave rise to a singular condition of the sight of Michael Angelo. It is related that he completed the gigantic painting of the ceiling of the Sistine Chapel at Rome in twenty months, and that the effect of the incessant application upon this work rendered him incapable, for a long time after, of seeing any picture or near object but by holding it high over his head.

Neuralgia of the eye is an occasional accompaniment of presbyopia, and if the real exciting cause be not recognised, the patients may be subjected to much unnecessary and useless discipline. Of this I have seen several instances, and as the patients have generally been of irritable constitutions, and inclined to literary pursuits, the deprivation and discomfort have been great.

Case XXV.—A nobleman of exceedingly excitable temperament consulted me in September, 1852. Neuralgia of the eyes was a source of perfect torment to him. No sooner did he attempt to read a newspaper or a book, but especially the former, the type being more trying, than a painful aching commenced in the eyes and extended to the forehead, causing a profuse discharge of tears, and compelling him to spasmodically close the lids. He declared that the vexation and worry consequent on this perpetual interruption to a favourite occupation rendered life miserable. Blisters and a variety of remedies had been tried in vain, and a seton in the neck was talked of. Spectacles had never been recommended, as he had a strong prejudice against them. With difficulty he was persuaded to look through my trial glasses, and no prejudice was ever more suddenly or effectually removed, for he found that with thirty-inch Presbyopics he could enjoy his newspaper at his ease.

In such cases, however, the patients should be warned against using their eyes too much, and if the neuralgia has been severe, perfect repose for some weeks may be necessary to enable the morbid irritability to subside, and when study is resumed it should be by very gradual steps; considerable nicety, too, is required to adapt to the eyes the precise power necessary to their wants, as too high glasses may keep up the very irritation a lower number would subdue.

It occasionally happens that, if persons persist in using their eyes without glasses after the necessity for them has become marked, they are rendered unable to read or work without great and constantly increasing discomfort and fatigue, symptoms which spectacles, when at length they are driven to them, fail to relieve. In such cases absolute rest to the eyes is all important, to afford time for the restoration of the suspended power of adjustment. After a time, the eyes should be cautiously exercised with glasses of low power, and also in viewing large distant objects, but the utmost caution is necessary not to fatigue them.

Very similar treatment is required when persons have over-tried their eyes by the use of too powerful magnifying glasses. Here, too, absolute repose is essential, during which the use of convex glasses should be prohibited. When some weeks have elapsed, the lower numbers may be used, at first for a few minutes, and gradually for longer periods, the eyes being regularly practised on large objects, and bathed in the intervals with cold water, if possible from an eye-fountain. Symptoms of retinal congestion are common in such cases, and require counter-irritation and other decided measures for their removal.

The following is a well marked illustration of the ill consequences following the use of too powerful magnifying glasses.

Case XXVI.—Miss H——, aged 45, a governess residing in Somersetshire, came to town for my opinion, Nov. 16th, 1852. She stated, that three years previously, after pursuing her studies with her pupils for some time, a dimness came over the sight, and she was obliged to leave off. Soon after this, she consulted a gentleman who appears to have rather hastily examined the eyes, and simply ordered a slight stimulating embrocation to the forehead, recommending her to use glasses of twenty inches focus. She provided herself with a pair, and returned to the country. From that time the discomfort in her eyes greatly increased. After reading for a time through the glasses, pain came on, at first aching in the eyeballs, then darting, with the sensation as of red hot sand in the eyes themselves. The pain soon extended to the brow, with the appearance of a cobweb suspended before the eyes; and if she persevered in spite of this, so violent a headache came on, with cramps of the muscles of the eyes, that, to use her own words, "she was nearly driven mad." For a fortnight before I saw her she had been incapable of using her eyes at all from the distressing pain, and was greatly depressed, as her prospects in life threatened to be completely blighted.

On examination, her eyes showed symptoms of congestion, external and internal, but nothing more. She was desired to give her eyes total rest, to keep two small blisters open on the temples, to use an eye-fountain frequently, and to take fifteen drops of tinct. ferri acetatis twice daily.

The glasses she had in use were discarded, and as thirty-six inches Presbyopic enabled her to read with comfort, she was provided with that power for day, and thirty for night. She left town on the 30th, having entirely lost the pain and the appearance of the cobweb, and with the eyes perfectly comfortable.

Presbyopia is not confined to age; I have seen several cases in which it was congenital.

Case XXVII.—An intelligent girl, eight years of age, was brought to me for an opinion. Her grandfather stated, that she had always been remarkable for holding her book and work at a considerable distance from her. Upon examination, it appeared that the distance at which she held her book when reading, was twenty inches; nearer, she could not see distinctly. When threading a needle, she held it literally at arm's length. Her vision for distant objects seemed to be excellent, and there was nothing unusual in the appearance of her eyes. A double convex glass, of thirty inches focus, enabled her to thread a needle at twelve inches distance: and with a lens of twenty-four inches focus, she was able to do so at eight inches. Concave glasses rendered vision indistinct. Her grandfather stated, that each of her parents required glasses at thirty years of age. The child was recommended to abstain from glasses; and there is good reason to believe, that as she grows older, and her eyes are more employed upon near objects, the distance of the point of distinct vision will decrease.

Case XXVIII.—A lady under my care for incipient amaurosis, had been presbyopic from birth in the right eye, the left being of a natural focus.

Case XXIX.—A young lady, aged 14, was seen by me in January, 1851. Her attitude when reading or working was stiff and constrained, from the manner in which the head was thrown back, and the arms extended. Her reading distance was, by measurement, rather more than nineteen inches. A pin hole aperture, reduced it to fourteen. Forty-eight inch Presbyopic glasses had a similar effect; thirty-six inch glasses brought it to twelve inches. She was desired to use glasses as little as possible, and to content herself with the forty-eight inch when absolutely requiring them.

The question may arise, whether it be presbyopia, or asthenopia, with which a young person is affected. The diagnosis will be assisted by remembering that in asthenopia, near objects can be seen for a time, though the sight soon becomes confused, and that by resting the eyes, the clearness of vision is temporarily restored. Whereas in presbyopia objects are never seen within a certain distance, and rest of the eyes produces no effect whatever. In both, vision is assisted by convex glasses.

Presbyopia may exist as a temporary condition.

Case XXX.— On the 17th April, 1840, a boy, eleven years of age, was brought to Edinburgh from the country for the opinion of the late Dr. James Hunter. Fifteen days previously, he was at school in perfect health, when one evening the discovery was made that he could not read common type, nor distinguish accurately any very small or near object. There was neither pain nor symptom of disease in either eye, but the vision of each was equally affected. The general health of the lad was unimpaired, and he had not received any injury either of the eyes or any other part. During the two following days the sight became worse, but after that it had remained stationary. Excepting the administration of some purgatives, no treatment had been adopted. Previous to the attack, his sight had been extremely good, and he had not been troubled with worms, or other ailment since infancy.

The eyes, upon examination, appeared perfectly healthy, and the only complaint made was, the inability to read common print, or to see minute and near objects: distant objects, he thought, were as distinct as ever (although it was subsequently ascertained that his distant vision was slightly affected). Large type was best seen at eleven inches from the eye; small print could not be read at all; distant objects were discerned pretty accurately; and the power of the two eyes seemed equal. Concave glasses rendered his sight much less distinct, convex glasses improved it.

Dr. Hunter strictly prohibited spectacles, and prescribed a combination of anthelmintic and tonic treatment, with spare diet and plenty of exercise in the open air. No worms made their appearance. The presbyopia continued until the end of May, when an amendment was perceived which increased daily, and in about ten days the sight was perfectly restored.

Case XXXI.—*Congestive presbyopia in young persons.*—A lad, aged 8, suddenly became presbyopic, but after the affection had continued a fortnight, it entirely disappeared under the application of leeches to the temples and the administration of purgative medicines.

Case XXXII.—Two sisters became presbyopic: the eldest, aged 20, had never been able to do fine work, and for three years had used convex glasses. The youngest, aged 15, became presbyopic at fourteen, since which time she had used spectacles whenever she worked or read. She recovered in six weeks by the repeated application of leeches to the temples, but her sister, although she experienced much relief, was not entirely cured by similar treatment.

Case XXXIII.—*Presbyopic sight changed to myopic.*—In 1798, Mr. Ware met Sir Walter Farquhar to consider the case of a lady on account of a very considerable mist which she constantly perceived before her right eye. The sight of her left eye had long been imperfect, and the present dimness of the right eye, which continued a fortnight, followed a cold which affected her head, but had not produced any considerable inflammation of the eye itself. She appeared to be a strong healthy woman, but had suffered much from anxiety shortly before the dimness of sight came on. On account of the depressed state of her spirits she had taken volatile medicines; but these had produced a disagreeable heat on the skin, and rather an increase of the dimness. It was doubted whether the disease proceeded from nervous debility, or from an inflammatory diathesis, but an antiphlogistic course of treatment was decided on. Mr. Ware opened the vein on the right side of the nose and abstracted four ounces of blood, and a purging mixture was prescribed; animal food and all excitement were prohibited. The eye was ordered to be fomented thrice a day with weak brandy and water, and the precipitate ointment to be applied at bed-time. On the following day the eye was much the same. Counter-irritation was now applied to the back, and a cooling laxative prescribed to be taken every six hours. On the third day an improvement was perceptible, and in a week the mist was removed, but the pupil continued of one fixed size in all degrees of light. A preparation of bark was now ordered. Shortly after this the lady went into the country, the right eye being perfectly free from any defect of sight, but it had undergone an extraordinary change, for she was now able to see near objects without the aid of convex glasses, which she had always before required, and distant objects appeared so confused that she was obliged to use a No. 6 concave glass whenever she wished to discern such objects distinctly.[1]

Case XXXIV.—*Myopia succeeding presbyopia.*—A gentleman, 60 years of age, who had spent a great part of his life in the West Indies, and whose sight, when young, enabled him to distinguish both near and distant objects with great precision, began at the age of forty to experience a difficulty in reading and writing. He immediately procured convex glasses of the lowest power, and by their aid he continued to read and write with ease (distinguishing perfectly all distant objects without them) until he was fifty. At this time he began to perceive an indistinctness in the ap-

[1] Chirurgical Observations relative to the Eye. By James Ware. Vol. ii. p. 164.

pearance of distant objects, and on trying different glasses, he discovered that by looking through a double concave glass (No. 6), he was enabled to see distant objects distinctly. He continued to use glasses of this description for the purpose of seeing distant objects, from that time to the period of his consulting Mr. Ware, but was obliged to remove them and employ the convex glasses above mentioned for reading or writing.

Case XXXV.—*Myopia succeeding presbyopia.*—A woman, 50 years of age, of a full habit, who for several years had been obliged to make use of convex glasses in order to read small print, was seized with a dimness in the sight of the right eye, accompanied with a small degree of inflammation. Recourse was immediately had to copious evacuations, by means of which the inflammation and dimness of sight were soon removed; but afterwards the patient was much alarmed on finding that the spectacles she had been accustomed to wear, instead of affording their usual assistance, confused her sight; however, upon looking through her husband's myopic glasses, which were double concaves, she saw distant objects much better, although they did not assist her in looking at near objects, but she was enabled to read by bringing the book a little nearer than she had been previously accustomed to place it.

Case XXXVI.—*Presbyopia succeeding myopia.*—A lady who had been subject to muscæ volitantes of an aggravated character, consulted Mr. Ware on account of her discovering that she was unable to read with her left eye. Mr. Ware could not detect any unnatural appearance in the eye, but, upon desiring his patient to read, observed that she held the book at a considerable distance, which was the more remarkable as the eye had previously been myopic. It was now evidently presbyopic, and on holding a convex glass of thirty-six inches focus before it, vision became distinct, and the smallest characters were read without difficulty. Notwithstanding this sudden change in the sight of the left eye, the right continued myopic, and required a concave glass to enable it to discern distant objects. As the lady was far advanced in pregnancy and of a full habit, Mr. Ware recommended the abstraction of ten ounces of blood from the arm, and prescribed cooling medicines. By this treatment the presbyopic condition of the left eye was in a short time removed, and the right became somewhat less short-sighted.[1]

Case XXXVII.—A lady, about 50, was attacked with an inflammation in both eyes, which was speedily removed by leeching and purgatives; she was then much gratified by finding that the necessity for using glasses when she read, which had existed many years, was removed, and that she could see both near and distant objects correctly without any extraneous help. The amendment was, however, only temporary, and after a few weeks she was obliged to have recourse to her convex glasses for seeing near objects, the same as before the attack.

An eminent mathematical instrument-maker, who had long used convex glasses for reading, told Mr. Ware that on many occasions, after he had been engaged for some hours daily for weeks together in looking through a microscope, he has been able to read without his glasses for weeks, but that the amendment gradually abated.

[1] Medico-Chirurgical Transactions. Vol. v. p. 263.

Case XXXVIII.—*Presbyopia occurring in combination with ptosis.*—The following case is related by Dr. Wells: "I was consulted in the beginning of 1809 upon a disease of vision which, as far as I know, has not hitherto been mentioned by any author. The subject of it was a gentleman about 35 years old, very tall, and inclining to be corpulent. About a month before I saw him he had been attacked with a catarrh, and as this was leaving him, he was attacked with a slight stupor and a feeling of weight in his forehead. He began at the same time to see less distinctly than formerly with his right eye, and to lose the power of moving its upper lid. The pupil of the same eye was now also observed to be much dilated. In a few days the left eye became similarly affected with the right, but in a less degree. Such was the account of the case which I received from the patient himself, and from the surgeon who attended him. The former added, that previously to his present ailment his sight had always been so good that he had never used glasses of any kind to improve it. On examining his eyes myself, I could not discern in them any other appearance of disease than that their pupils, the right particularly, were much too large, and that their size was little affected by the quantity of light which passed through them. At first I thought that their dilatation was occasioned by a defect of sensibility in the retina, but I was quickly obliged to abandon this opinion, as the patient assured me that his sensation of light was as strong as it had ever been during any former period of his life. I next inquired whether objects at different distances appeared to him equally distinct: he answered that he saw distant objects accurately, and in proof told me what the hour was by a remote public clock ; but he added that, the letters of a book seemed to him so confused that it was with difficulty he could make out the words which they composed. He was now desired to look at the page of a printed book through spectacles with convex glasses. He did so, and found that he could read it with ease. From these circumstances it was very plain that this gentleman, at the same time that his pupils had become dilated and his upper lids paralytic, had acquired the sight of an old man, by losing suddenly the command of the muscles by which the eye is enabled to see near objects distinctly."

Treatment.—The sun of our animal existence has been wisely ordained to travel at so slow a rate, that his progress is almost imperceptible; and so ardently do we love to bask in his rays, that when time whispers to us he has passed the meridian, we vainly endeavour to persuade ourselves that he may have mistaken the point of his culmination.

We have already said that the failure of the sight is one of the earliest premonitory symptoms of declining years, but there is often a strong disinclination to admit this failure; at any rate we are not willing to proclaim it by adopting glasses. Their use, however, should not be deferred; for, although it is a common notion that spectacles are injurious to the eyes (and no doubt they are so if those of an improper description be employed), yet when the powers of the eye so begin to fail that we can neither read nor write for any length of time without great discomfort, it is reasonable to conclude that refraining from their use is more injurious than their adoption. We, therefore, who prize the most valuable gift of nature, should be less anxious as to what others may think of our age, than for the preservation of so valuable a possession.

The term "preservers" applied as it has been to the lowest description of convex glasses alone, tends to convey the idea that if such glasses are used in time they prevent any further changes in the eye. This is erroneous, and it is to be regretted that the lowest magnifying powers should have received that appellation, for all glasses are "preservers" if well adapted to the wants of the eye; whereas by applying that term to those particular glasses alone, thousands are induced to use them before they really require them, which is productive of injurious consequences, inasmuch as by assisting the eye before it needs help, we encourage it to be indolent in its action. As a general rule for the presbyopic eye, glasses always act beneficially when they afford just so much assistance to the eye in its attempts at adjustment, as enables it without fatigue to form a distinct picture upon the retina, rather than beyond it, as shown in the figure.

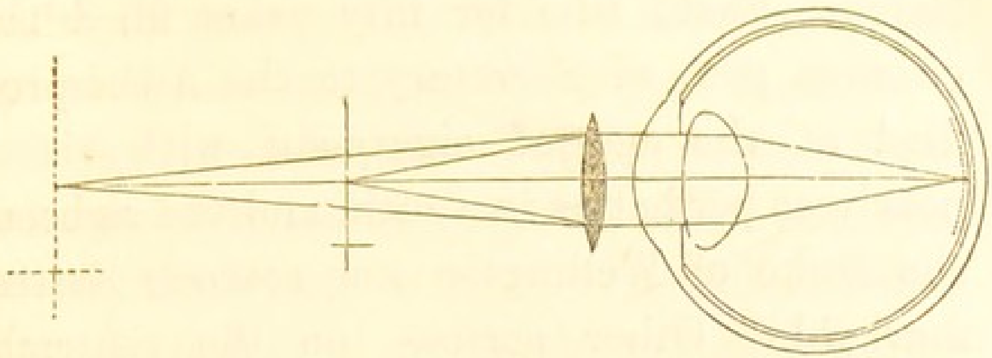


Fig. 9.

Some refrain from the use of glasses who really require their aid, from the belief that if they once begin to use them they will never be able to leave them off. In the great majority of cases this is perfectly true; but even then it is better to submit with a good grace to an affliction which can seldom be averted, and to have recourse to those simple means which at once set the eye at ease, and enable its possessor to enjoy many hours of comfort and rational employment which would otherwise be lost.

Daily experience teaches us that the decay of vision is hastened by many causes which are frequently overlooked. Although it is about forty that the sight usually begins to fail, yet we find that some persons attain extreme old age without needing glasses at all. A respected friend of mine, the late Sir John

Barrow, Bart., who for fifty years filled the onerous post of Secretary to the Admiralty, died at the age of eighty-six with vision nearly as perfect as in youth, and the sight of the Duke of Wellington was scarcely less remarkable. Other persons, on the contrary, require glasses by the age of thirty, and though much depends on constitution, much also depends upon a person's habits.

One of the worst of habits is that of overworking the eyes by candle-light at night. Repose from labour, so necessary for the restoration of tone and vigour to the several organs of the body, is too sparingly granted to the eyes. Some from a desire to distinguish themselves, others urged by necessity, encroach upon the hours of rest, and overtax the sight without mercy, by lamp or gas-work. To the poor but working classes, medical treatment, when the eyes are thus oppressed, affords only temporary relief; the return to similar habits, however necessary, invariably brings back the same disease, and by its repeated attacks vision is sooner or later destroyed. Let us hope that the advancing spirit of the age will arrest so crying an evil.

The following remarks are addressed to the former class: to those who, from motives of ambition, or from love of study, neglect those ordinary precautions without which the eyes will inevitably suffer. Let it be remembered that day-work is preferable to night-work: that while the light of a candle or lamp is trying even to a strong eye, the moderate light of the sun is strengthening to it. Those whom circumstances compel to study in the evening, should select that kind of work which is least distressing to the eyes: they should especially avoid indistinct writing or small print. The "Diamond editions," in which the print is extremely small, are very hurtful to the eyes. I have a volume of Burns's Poems thus printed, and if I attempt to read it my eyes feel strained, and the appearance of muscæ volitantes is excited before I have perused half a page.

Persons who write much, especially in the evening, should use "blue wove" paper in preference to that yellowish white description to which the term "cream laid" is applied. There is a paper of a deeper blue than ordinary, which is very agreeable to irritable eyes for writing by artificial light. Jet black ink is far better than blue or the fancy shades of purple, brown, &c. Pale ink is altogether bad, and the fair sex especially would do well to bear in mind, that they would show the most kndly consideration for their correspondents and benefit their own sight by using good black ink, and, I may add—writing legibly. Red ruled lines, when in any number on a page, are objectionable. One of the omnibus timekeepers, whose duty it is to note in books ruled with many red lines the journeys of those vehicles, complained to me of the distress the constant gazing on that bright colour caused his sight. At my suggestion he obtained a book ruled with blue lines, which at once set him at ease.

It is wise to change the position occasionally during hard study—to write sometimes standing, at other times sitting, and to break the labour now and then by walking about. The simple plan elsewhere mentioned, of raising the eyes from the sheet or page, and fixing them for a few seconds on the cornice at the other side of the room, so that the adjustment of the vision may be altered, cannot be too strongly recommended.

Persons with feeble sight or irritable eyes should not sleep with their couches facing the window, nor should their writing-tables be in that position. There is another thing to be specially avoided by such parties, namely, reading whilst travelling in a railroad carriage. The peculiar vibration imparts an unsteadiness to the page which is most trying to the eyes, and more than one person has, to my knowledge, suffered from this thirst for knowledge during daily journeys to and from town.

Reading by firelight, or simply gazing at the fire when sitting alone, or in a contemplative mood, is highly injurious to feeble eyes, and should be avoided by all. It is not advisable to read by twilight; too little light is as pernicious as too much light, yet many persons will, evening after evening, try their eyes in this way rather than burn a candle. It is injurious to the eyes to be long exposed to the reflexion of a strong light, whether artificial or natural, such as the reflected sunshine from the page of a book. Too brilliant a light produces undue excitement of the eyes: travellers in the African deserts find it necessary to protect these organs from the sun's rays by a piece of crape. The inhabitants of some Eastern countries, for the same purpose anoint the edges of the lids and the eyelashes, with a black pigment composed of oxide of antimony and oil, which has the effect of subduing the light, and at the same time improving personal appearance. The inhabitants of the Arctic regions ingeniously protect their eyes from the light reflected from the snow, by wearing in front of the eyes a long and thin piece of wood perforated by two narrow horizontal slits, one corresponding to each eye. By means of this simple contrivance, just such a quantity of light is permitted to enter the pupil as will suffice for vision. To preserve weak eyes as much as possible from a strong light, neutral tint spectacles, or the protectors hereafter described, are exceedingly suitable.

In reading and writing, just that amount and quality of light, whether natural or artificial, should be allowed, which, while it thoroughly illuminates the object, feels grateful and pleasant to the eyes. This desideratum can never be obtained without due regard to the position of the light. The light cast upon a book whilst the candle is in front, is by no means pleasant, and the glare of the flame is very trying to weak eyes. It will be found, that if the candle or lamp be placed behind the reader, a little elevated and slightly on one side, the pleasantest and least injurious effect is produced; for the light then reflected to the eyes is less distressing, and at the same time the eyes are perfectly protected from the heat and glare of the flame.

The habit common with presbyopic persons of drawing a candle to them, and holding the book they are reading close to it, has reference to the need which then exists for strong light. Eyes when presbyopic require more light than younger eyes, and judgment is required to secure this without overdoing it, and stimulating the organs too much.

It would be well if in our public buildings more attention was paid to the position of the lights: it is very distressing to sit in a gallery immediately opposite the glare of a gas burner or lamp, for an hour or more; the eyes frequently do not recover from the irritation thus excited for several days [1]—not only might the evil be easily removed by employing lights of greater power, properly subdued, and placed near the ceiling, but there would be a great advantage gained from the increased purity of the air.

Sudden transitions from gloom to strong light should be avoided. The dazzling effect produced when we come suddenly from darkness into light, arises from the pupils having been widely dilated to admit the greatest possible number of luminous rays whilst in the gloom; and as the pupil of the eye requires time to contract, sudden transitions from comparative darkness to a bright light, compels the eye to admit far more rays than is either agreeable, or than it is calculated to bear without injury: temporary dazzling and a sensation of pain is excited in consequence. So weak and susceptible do the eyes become

[1] The New House of Commons seems to be lighted in a very objectionable manner. Several Members of Parliament have, to my knowledge, received positive injury to their sight from the great glare which prevails in the House.

if kept for a long time in darkness, that the ordinary light of day is distressing to them. I have frequently been consulted by patients labouring under this morbid sensibility, sometimes from having been kept for a long time in a darkened room; at other times from having injudiciously covered up the eyes with a bandage or shade in the hope of subduing an inflammation. The working classes are fond of binding up their own eyes, or those of their children, if attacked with any disorder, whether attended with increased sensibility to light or not, and it is difficult to convince them of the necessity of taking the bandage off, and by degrees accustoming the eyes to the stimulus of light.

The late Sir William Herschell, when sweeping the heavens with his forty feet telescope in search of nebulæ, used to shut out the light from surrounding objects by means of a black hood, to increase the sensibility of the retina; and so effectually did he succeed, that with his eye so prepared, when a star of the first magnitude approached the field of view it was needful for him to withdraw his eye from the telescope until it had passed, otherwise that sensibility would be lost for some time. When Sirius approached the field of view, the appearance of the sky was to his eye like the dawn of morning, gradually increasing in brightness till it had attained a splendour resembling that of the rising sun, compelling Sir William to retreat from the glorious spectacle.[1]

[1] Galen in his tenth book "De usu partium" tells us that Dionysius, the tyrant of Syracuse, used to bring forth captives from dark dungeons, into a brilliantly lighted room, and the effect of this sudden and powerful transition was to render the miserable wretches blind.

Similar effects, though not from similar motives, were produced at Paris in 1789, at the destruction of the Bastile, when some of the unhappy persons who had been confined for years in its dark subterraneous dungeons, were blinded by being incautiously brought in their feeble state into the full blaze of a July day.

Sir David Brewster observes (Martyrs of Science, p. 49) that, "It does not appear from the history of solar observations at what time and by whom coloured glasses were first introduced, for permitting the eye to look at the sun with impunity. Fabricius was obviously quite ignorant of the use of coloured glasses. He observed the sun when he was in the horizon, and when his brilliancy was impaired by the interposition of their clouds and floating vapours: and he advises those who may repeat his observations, to admit at first to the eye a small portion of the sun's light, till it is gradually accustomed to its full splendour. When the sun's altitude became considerable, Fabricius gave up his observations, which he often continued so long that

To supply the defective powers of the presbyopic eye, convex glasses are used, the double convex being preferred. The lowest power in ordinary use in England has a focus of 48 inches, but in France, very much lower powers are used. M. Sichel commences with a 72 inch and in some cases, with a 96 inch. Mr. Andrew Ross, however, whose experience as an optician is well known, has informed me that in the course of his business, he has met with but one person who could perceive any sensible difference between those two powers, as far as assistance to the sight was concerned.

It is quite possible that in the early stage of presbyopia a 72-inch glass may be sufficient, and if found to be so, it should by all means be preferred to a higher number; but, practically speaking, a 48-inch is that most usually required, because persons in this country seldom seek assistance until the presbyopia has advanced beyond the aid of a 72-inch glass. It has been recommended to calculate the requirements of the eye by the age of the individual, but this is fallacious, as eyes differ

he was scarcely able for two days together to see objects with their usual distinctness."

much in their natural powers of vision and not less in the amount of assistance they need. The only true mode of obtaining suitable spectacles is by absolute trial.

It cannot be too strongly urged upon any one about to use spectacles for the first time, that that power which will enable him to read without much exertion by candlelight, is the only power suitable for him. It is by candlelight only he should use glasses at first, and so soon as he finds that he stands in need of glasses by day as well as by candlelight, and that the glasses he uses no longer afford him sufficient assistance by candlelight, it will be proper to use the next power for the evening, but for the evening only, and to allow himself the use of the others—and their use only—during the day. The greatest caution as to increasing the power of glasses should be observed, for persons who change their glasses unnecessarily, increasing their power each time, are exhausting the resources of art instead of economising them as much as possible. Optical aid can only be extended to a certain point, and the steps to that point should be as slow and as numerous as possible. By exercising prudent precautions, persons may often attain great age, and yet never require the aid of glasses beyond a very moderate power: others on the contrary, who from ignorance frequently increase the power of their glasses, may run through the whole assortment, and leave themselves only the most inconvenient resources to fall back upon—viz., the very highest powers.

In conclusion, the following rules may be laid down:—

Glasses should never be worn by young persons without advice, under the idea of strengthening their sight; it is a very great, though common error.

Elderly persons should have recourse to spectacles as soon as they find their eyes aching and distressed in the evening with ordinary work; far more harm will arise from struggling against this failing of nature than from the moderate use of suitable glasses.

Spectacles should never be used unnecessarily nor indiscriminately, nor should they be worn in the open air unless their aid cannot be dispensed with. They should be wiped with wash-leather when dull, and if the glasses become scratched they should be renewed.

Lastly, if people value their eyesight, they will shun cheap and imperfect spectacles and puffing opticians.

CHAPTER III.

IMPAIRED VISION FROM OVERWORK.

There are few people who have not, at one time or other, felt heat and irritation about their eyes after exposure to the glare and foul atmosphere of a brilliantly lighted and crowded apartment. These sensations, temporary perhaps while the exciting cause is occasional, often become permanent with the student who reads much by artificial light, and still more with those who do much fine work by gaslight in ill-ventilated rooms. The uncomfortable feelings arising from an injury thus inflicted upon the external tunic of the eye, though in themselves unpleasant and troublesome enough, are not unfrequently followed by others of a more formidable character. With this uncomfortable heat and dryness of the eyes there is not only the sensation as if particles of grit were in them, but the tears are hot and scalding; and as the affection proceeds, a film renders objects indistinct, and gives to each light a coloured fringe. This effect is caused by a mucus of peculiar quality that is poured out, and carried by the action of the lids over the cornea. At the inner angle of the eye and at the roots of the eyelashes, an accumulation of thick yellow secretion takes place, and the lids are glued together upon the patient awaking in the morning, so that they are separated with difficulty: an unpleasant quivering of the lids often accompanies these symptoms, and is not the least annoying of them; and though a person thus suffering finds temporary relief from going into a dark room, yet the symptoms are again brought on by reading, writing, or any other employment requiring close application by candle or gaslight.

If we examine a patient in this condition the first thing that will attract our attention will be the dull watery aspect of the globe of the eye, which has not its natural pure white colour. The edges of the eyelids are red, and the patient makes frequent efforts to avoid the glare of light by half closing them. Upon examining the inner surface of the lower lid, we find it to be of a bright red, and many vessels around the circumference of the globe are manifestly in a state of congestion. The caruncle at the inner angle of the eye is also generally swollen and red. If examined by day when less irritated, the inner surface of the lower lid is marked with red patches, and between these patches are seen blood-vessels in a state of congestion. The papillæ of the lids are frequently somewhat enlarged, and it is a common thing to find small tumours in the lids, which give a purplish or yellow appearance to the corresponding point of the inner surface of this eyelid, and the point is generally surrounded by a cluster of vessels. The sclerotic coat has not that white hue natural to it, but is dull, and more vessels are visible than appear in its healthy state. Should the eye be long subject to this morbid condition, the edges of the lids become thickened, and in bad cases ulceration of their margins occurs, causing irregularity, if not entire loss of the eyelashes, and in very aggravated cases, more or less eversion of the eyelids.

It is important, by early and judicious measures, to arrest this disordered action before it has had time to produce effects so distressing and so unsightly.

There are, however, other affections of the eye less offensive perhaps outwardly, but more serious in their consequences to the patient himself. Take the case of a hard-reading student: after being engaged at his books for some time, a sort of mist comes over the sight, accompanied with a peculiar sensation in the eyes; the letters and words seem to run into one another, and the whole becomes indistinct. He ceases reading, closes the eyes, and probably covers them with his hand; after a few seconds he finds that the mist has cleared away, and that he can again see distinctly; sometimes sufficient relief is afforded by simply turning the eyes away from the page, and looking out of the window or at some distant object in the room. Persisting, however, in his studies night after night, he finds the mist returns again and again, the intervals becoming shorter, and the attacks lasting longer, until at length it remains permanently. By-and-bye other symptoms appear: the patient is now annoyed by small black objects which he takes to be flies or smuts floating in the air, but after a time discovers that they are mere illusions. Now, and more especially during the darkness of night, he is startled by the appearance sometimes of flashes, at other times of sparks, coruscations, or perhaps of circles of light. He feels a dull pain and sense of weight about the brow and forehead, extending occasionally down the side of the nose, and an uneasy fulness or aching towards the back of the eye. There is either susceptibility of the retina, so that a strong light causes pain, or the patient becomes conscious of less sensibility of that membrane, and does not see an object distinctly except when strongly illuminated. As the disease advances, the muscæ volitantes become more numerous, and assume a variety of forms. At one time they appear as strings of beads, at other times as globules, and in some cases they take the permanent form of black spots of different sizes, so that an object really appears smeared with Indian ink. These muscæ the student always finds most troublesome on a cloudy day, and after the eyes have been much used. They are seldom seen by artificial light, unless the disorder has proceeded to a formidable length. If the exciting cause be still persevered in, the confusion of vision ceases to be temporary, and a gauze or net-work is constantly present: this may merely obscure the central part, or one portion of objects, or the whole may be veiled. At this time the flame of a candle not unfrequently appears surrounded by a prismatic halo, and type loses its distinctness, the letters in some cases having a sort of shadow rounding off their outline, in others appearing distorted and irregular. The patient writes more easily than he can read, but requires strong light for both. If he still perseveres, the cloud will become thicker and thicker, the effort to see greater and greater, until at length perpetual night draws on, and, in the expressive languge of our great poet—himself a sufferer[1]—the eyes,

[1] The case of Milton, which presents a well-marked illustration of the blindness produced by overwork, is given in the Appendix.

"Though clear
To outward view of blemish or of spot,
Bereft of sight, their seeing have forgot;
Nor to their idle orbs doth sight appear
Of sun, or moon, or star, throughout the year,
Or man or woman!"

A most fruitful exciting cause of this condition of the eyes is the combination of much mental activity and long-continued ocular exertion, with want of sleep: it has fallen to my lot to witness many sad instances. In some, governesses toiling with pupils throughout the livelong day, have eagerly pursued their own studies during the quiet hours of the night; in others, men of intellectual refinement, but compelled by the force of circumstances, have passed the day in the drudgery of copying deeds or other cheerless occupations, and have sacrificed their hours of rest for the luxury of more congenial and cultivated pursuits; and I may add, too many instances have come under my notice (and I feel true satisfaction in having been able to alleviate in some, and in others to avert the threatened evil) where men of talent and education have been brought to the verge of blindness by necessity compelling them to compose, to write, or to translate by night and by day, in order that they might gain a precarious subsistence.

Besides literary men—tailors, sempstresses, shoemakers, embroiderers, jewellers, and watch-makers, are frequently sufferers from impaired vision from overwork; among them, whose daily bread depends upon their labours, it is met with in its most aggravated form, for they are unable to rest their eyes though sensible of the necessity, and fight on in spite of failing vision till they can contend no longer. Such persons are enabled, by the thorough rest of Sunday, to work during the first two days of the week in comparative comfort; but each succeeding day brings increased distress, till Saturday evening finds them with aching and straining eyes, toiling in a half-blind condition.

Just in proportion as persons are compelled to work in dull light and by artificial light (as is very commonly the case in the confined offices and workshops in large cities) are they likely to suffer from impaired vision, and this tendency is considerably increased if they have previously been affected with strumous ophthalmia, or have nebulous opacities of the cornea. Generally speaking, both eyes are equally affected, but the disorder may be limited to one from the axes of the eyes not corresponding, or their focal lengths differing, or from one being imperfect through disease, or again from one being exclusively used, as by watchmakers and microscopists.

Persons in whom this affection has displayed itself frequently resort to convex glasses, which afford relief but mask the true character of the case, causing it to be regarded as simple presbyopia; but the diagnosis is easy, for in presbyopia rest has no effect in clearing the sight, and objects are always held afar off, whereas in impaired vision suspension of labour relieves the symptoms materially.

Differences of opinion exist as to the precise nature of the disorder of vision now under consideration; on the continent it is generally termed "kopiopie:" *asthenopia* is a term proposed for it by Dr. Mackenzie in a most able article, and the following are his views:[1]—

"On exposing an asthenopic eye to various degrees of light, the motions of its pupil may

[1] Edinburgh Medical and Surgical Journal. Vol. lx. p. 73.

be as vivid and extensive as those of a healthy eye. On first being turned towards a near object, the pupil may also be observed to contract, but if we watch the eye applied seriously to the continued vision of a near object, as in reading, the pupil will be seen in general to assume a medium state of dilatation, and not to maintain its state of contraction, as would the pupil of a sound eye under the same circumstances. We cannot doubt that the ciliary circle assumes also a medium degree of expansion—a state of parts sufficient of itself to produce almost the whole symptoms of the disease. The effect necessary for adjustment cannot be sustained, the focal length of the eye can no longer be shortened as it should be, the letters of the book necessarily fade from before the sight, and the feeling of fatigue creeps over the eye. It is probable that the cause of impotency resides not in the ciliary circle nor in the ciliary nerves merely, but in the third nerve and other muscular nerves of the eye generally. The contraction of the recti and obliqui, then, so necessary for keeping the eye in a state of libration, for directing it along the lines of the printed page, for converging the two eyes to the same point, and perhaps for compressing the globe of the eye so as to maintain an increased distance between the retina and the cornea, must in this case gradually give way under the effort demanded, so that these muscles fall into a state of minimum contraction. The consequence is, that at length the upper eyelid drops, and the patient is obliged to indulge in that cessation of visual exertion which experience has taught him will regenerate his exhausted powers of sight, and enable him by-and-bye to resume his labours."

It is highly probable that in the earlier stages of this affection, and in the slighter cases, an enfeebled condition of the adjusting organs is the main fault; but I have no doubt that congestion is speedily superadded, and that this local congestion is, in the majority of cases, in connexion with general debility. In many cases the vessels of the eye seem to have lost their tonicity; a trifling effort at reading visibly reddens the surface of the globe, and with a lens many small vessels may be seen distended with blood; from this, in connexion with the symptoms, we may predicate the state of the deeper tissues. It is probable that the great advantage derived from cold applied to the eye itself, from iron, and from general invigorating measures, is referable to the effect produced by such remedies in restoring tone to the weakened vessels and imparting vigour to the nervous apparatus. When, however, the congestion has proceeded beyond a certain point, other treatment becomes necessary.

The following is a well-marked illustration of the effect produced on the vascular system of some eyes by overwork.

Case XXXIX.—Mr. H., house surgeon at one of our county hospitals, consulted me Oct. 30th, 1852. He was pale, of delicate constitution, and feeble circulation, his pulse being usually 56. His eyes were deeply set, the irides blue, pupils rather dilated.

About two years before I saw him he had used his right eye much in microscopical investigations; at first no inconvenience arose, but ere long a zone appeared around the cornea after every attempt to use the eye; muscæ also appeared, and a mist gradually arose before the sight. He now gave up using that eye for the microscope, but pursued his researches with the left eye; after a time this was also attacked in a precisely similar manner. Mr. Dalrymple was now consulted, and by his advice blisters were applied to the nape of the neck and his mouth made sore with mercury, but whilst actually under its influence, the sclerotica became red, and symptoms of severe congestion arose on two or three occasions.

At the time of his visit to me the slightest effort brought on the zone and the mist, so that he was almost precluded from ordinary reading and writing; the pupils acted freely, and there were no adhesions.

The treatment recommended was frequent use of the eye-fountain, the tinctura ferri acetatis, and open blisters on the temples; the eyes to have perfect rest, and every means calculated to improve his health to be adopted.

Mr. Dalrymple entertained a strong opinion that the symptoms of impaired vision were of a congestive character, and the following are his views as to the *modus operandi* of this condition in exciting the mischief. His Pathology of the Human Eye is not paged, but the extract is from "Congestion of the Choroid."

"When we recollect that in health the sclerotica and cornea are tough, inelastic, and resisting tissues, and that the fluids within the eye are so nicely balanced, that no vacauity is left, and that no undue pressure is perceived—when we remember also, that the retina is interposed between the choroid and the incompressible vitreous body, we shall readily perceive how increased bulk from congestion of the vascular tissue, must exert a direct and injurious pressure upon the most delicate of nervous structures—how, in fact, this important organ becomes as it were benumbed by compression, and its functions and sensibilities to the pictured image presented by the rays of light, interfered with, altered, or suppressed. While this effect is being produced on the special properties of the retina, we see also that the ciliary nerves that traverse the exterior of the choroid, become in like manner compressed against the sclerotica, and as these are in part the channels of the common sensation of the globe, pain is induced, first, of a sense of distension; secondly, of dull aching; and lastly, pain in the brow or forehead, partaking somewhat of a neuralgic character, induced by radiation to the frontal branches of the first division of the fifth pair."

The following cases illustrate this affection:—

Case XI.—A gentleman engaged in literary pursuits consulted me in June, 1845. He stated, that for some time past he had been unable to pursue his studies by night, in consequence of a confusion of vision, which came on soon after he commenced reading or writing. A sort of thrill was felt in the eyes, and all objects became indistinct before them:—at first, the act of winking removed this, but after a time he found it necessary to keep the eyes closed for a short period; and of late, the mist had become of such frequent occurrence, and caused so much annoyance, that he found it necessary to seek advice. It further appeared that he was extremely subject to muscæ volitantes, of which two in particular were persistent, but these, from long habit, he had ceased to regard. He had felt occasional dull pain about the brow, and a sensation of fullness in the eyes. Upon examination there was evident congestion of the vessels of the globe, and some irritability of the retina was apparent, as the patient shrunk from the exposure of the eyes to a moderate light. The pupils were contracted and sluggish in their movements. His general health had been good, and his habits temperate. By pursuing the plan of treatment which will be hereafter mentioned, this gentleman entirely recovered from the symptoms, with the exception of the two persistent muscæ; these, however did not cause him much inconvenience.

Case XLI. — Harriet Porter, a delicate looking female, aged 19, applied at the North London Eye Infirmary, Feb. 17, 1846. She was apprenticed to a milliner, and had been for some time in the habit of working with her needle for ten hours each day. During the London season, it was no uncommon thing, she stated, for her to work twelve, and even fourteen hours, daily. Her eyes felt strained, and ached, after sewing for a short time, and she experienced great difficulty in working, especially at night, in consequence of a mist which came over her sight, and rendered all objects indistinct. This mist had been gradually increasing, and of late she had seldom been free from it. She was subject to headache, and frequently experienced a sensation of weight over the brows, with aching of the eyes, muscæ volitantes after the slightest exertion, and occasional flashes of light. The movements of the pupils were slow, the irides dull, and in the left eye I detected two minute adhesions of the margin of the pupil to the anterior capsule of the lens.

Rest to the eyes, an alterative course of mercury, in connexion with tonics, and continued counter-irritation to the forehead and temples, produced a highly beneficial effect; and the patient was discharged at the expiration of four months, greatly improved in health, and with her vision nearly perfectly restored.

Case XLII.—In December, 1845, I saw a gentleman, 35 years of age, who gave me the following history of his case:—he was, by profession, a solicitor, and two years previous to the above date, had been engaged in the superintendence of a complicated law-suit, which required the examination of a large number of ancient deeds and manuscripts, many of them almost illegible. Whilst engaged in the investigation of these documents he had frequently perceived muscæ volitantes and had experienced confusion of vision, the lines and words running into each other. After a time he discovered that the sight of his right eye was impaired; objects were rendered indistinct by the appearance of a gauze or network intervening before them, and a black spot was constantly present to that eye. He did not pay much attention to these symptoms, thinking they would go away of themselves, but in this he was mistaken. The sight became worse and worse, letters appeared distorted, the flame of a candle was broken up and surrounded by a prismatic halo, ordinary print could no longer be discerned, and portions of words and lines disappeared, when he attempted to read large type. He was annoyed by a dull, heavy, pain in the forehead, extending round the head to the occiput, as if from the pressure of a tight cord. The sight of the left eye about this time became impaired, and the patient sought medical advice; but, with the exception of some doses of aperient medicine, and a lotion for the eyes, no particular treatment seems to have been adopted. When I saw the gentleman six months afterwards, vision was nearly extinct in the right eye; he could only make out a letter here and there of large type, and told me, that all objects seemed to be obscured by a thick, dark, grey cloud, occasionally illuminated by flashes of light; the frontal pain was a source of great annoyance, and he experienced, at times, considerable pain deep in the eye. With the left eye he could still read ordinary print, but only for a short time, as the confusion of vision came on after the slightest exertion of the eyes.

Upon examination, the pupil of the right eye appeared dilated, of a muddy greenish hue, and insensible to the stimulus of light; the iris was dull and altered in colour; numerous purple vessels were visible upon the surface of the globe, and the sclerotica was of a leaden tint. The iris of the left eye was dull, the pupil inactive, and the same unhealthy condition of the external tunics was apparent, although in a less degree than in the right.

Blood was taken from the temples by cupping, the patient subjected to a mercurial course, counter-irritation employed for a long period, and the general health carefully attended to. The result was, that the mischief in the left eye was arrested, and useful vision restored ; but disease had made too great progress in the right eye to admit of much benefit by remedial measures, although the pains in the head and the eye were subdued, and the health of the patient greatly improved.

For the particulars of the following case I am indebted to Mr. Baker, one of the able resident medical officers of St. Mary's Hospital.

Case XLIII. — Sarah Sharp, aged 50, became a patient of Mr. White Cooper, at St. Mary's, November 30, 1852. She stated that she had always been near-sighted, though seeing very clearly at short distances. During the last eight years she had gained her living by fine needle-work, working often twelve hours a day, and sometimes for a day and a night with scarcely any intermission. In January, 1851, she first perceived some black spots floating before the eyes for half a day, and the next morning a greenish cloud obscured the left eye, and after this objects appeared misshapen. This lasted seven or eight months, since which the sight of that eye has gradually become worse, so that she can now barely distinguish a window. The right eye has of late been weak, with small black specks floating before it ; a month since sparks of light frequently crossed the eye, but these have ceased of late ; she has now clouds or cobwebs passing before this eye, but not so thick as to prevent her reading print, but she cannot look at it for any length of time. Her general health has been good, but she has suffered much from deep seated pain in the eyeballs and from headaches.

On examination, the pupils of both eyes have a muddy, greenish hue, not unlike the colour of hard cataract, but deeply seated ; the iris of the left eye is motionless, that of the right acts slowly and imperfectly. The surfaces of the eyes are covered with fine conjunctival vessels, and a faint pink zone surrounds the right cornea. The lining membrane of the lids is also much congested.

She was ordered to take $\frac{1}{16}$ gr. bichloride of mercury thrice a day in infusion of quassia, and to have cantharidine paper applied to the temples, the blisters to be kept open ;

a steady perseverance in this treatment had the effect of subduing the pain and congestive symptoms, and in some degree of benefiting the sight.

The following remarks relative to the general proceedings in cases of impaired vision from overwork may be perused with advantage by the non-professional reader; but the specific instructions as to treatment are intended for the guidance of medical men, as nothing is more hazardous than for a sufferer to take on himself the management of his own case. The members of my profession seldom undertake the responsibility of prescribing for themselves when ill, knowing that, under such circumstances, the cool judgment and unbiassed view so necessary for success are wanting; how much more should the non-professional person pause before tampering with the integrity of the noblest of our senses!

When an eye has been overworked, the first and most important point is to give it rest. Without rest, no treatment, however skilful, can avail. I am well aware that such a *dictum*, to persons whose livelihood depends on their daily labour with the needle or pen, is like condemning them to starvation; but the point is of such importance that it must be carried, either wholly or in part.

If circumstances admit, the absolute repose obtained by a temporary suspension of the injurious pursuit is of all steps that best calculated to bring about the perfect restoration of sight. To such a circumstance we are indebted for that very interesting narrative, "Two Years before the Mast;" the author, Mr. R. H. Dana, stating that his object in undertaking a two or three years' voyage in the capacity of common seaman was "a determination to cure, if possible, by an entire change of life, and by a long absence from books and studies, a weakness of the eyes which had obliged me to give up my pursuits, and which no medical aid seemed likely to cure;" and though many hardships and severe privations were endured, the experiment was attended with perfect success. A sea voyage, indeed, is an excellent break, and one which I have recommended to many: the thorough change of habits, the cheering excitement of new scenes, and the constant passage through pure and ever varying air, does more good in three months than a mere desultory change from town to country effects in six. If a sea trip cannot be achieved, a tour through mountain scenery is the next best thing, and failing that again, a residence for two or three months in the country.

But as the fortunate few only can avail themselves of these advantages, I will point out the steps by which the impairment of vision is to be counteracted without completely leaving off all ordinary occupations.

The golden rule will then be, always to stop short of fatigue: if, for instance, a person has found that after reading or working for an hour, discomfort in the eyes comes on, he should cease at the expiration of half an hour, give them a rest of some minutes, walk about the room, and bathe them with cold water: or better still, use an eye-fountain: a fine jet of cold water thrown on the closed lids for some minutes is most refreshing and highly beneficial. Messrs. Bigg, surgeon-machinists, of Leicester Square, have, at my request, constructed an eye-fountain, moderate in price, and which, by means of an elastic tube, admits of the water being thrown on the eye without that necessity for bending the head, which renders other instruments of the same description objectionable. It is represented in Fig. 10.

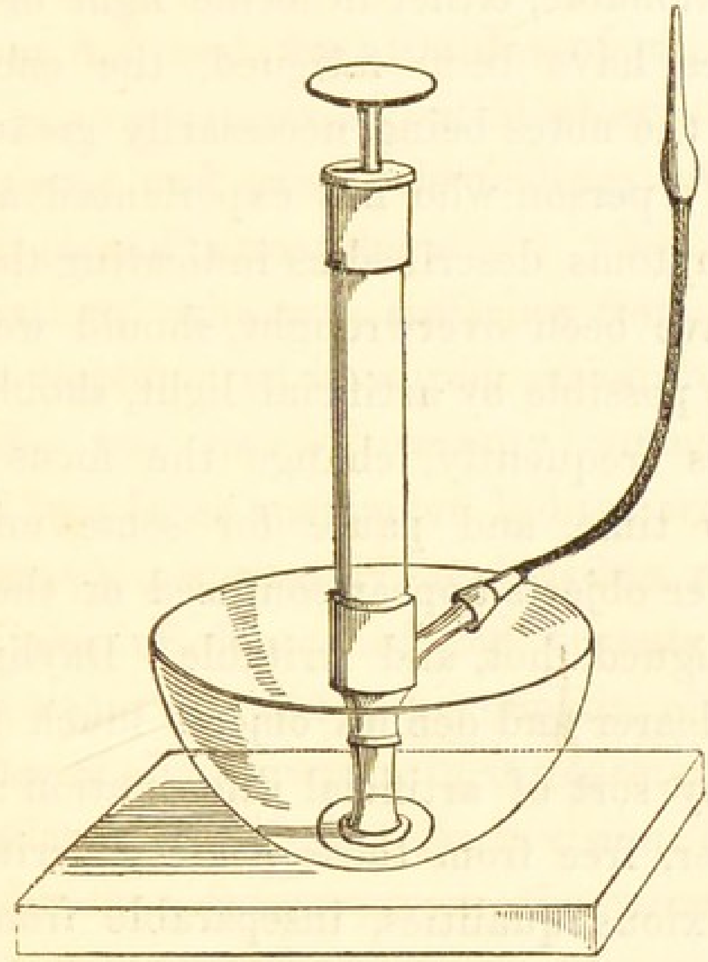


Fig. 10.

If possible, the daily occupations should be so arranged that those least fatiguing to the eyes should be undertaken in the evening. Ladies should then put aside gaudy worsted work, artizans should reserve for daylight the manipulation or engraving of bright metals, and sempstresses should especially avoid sewing black and dark blue materials by artificial light. Practising music not familiarly known is objectionable, either in feeble light or after the eyes have been fatigued, the effort to discern the notes being necessarily great. In a word, a person who has experienced any of the symptoms described as indicating that his eyes have been overwrought, should work as little as possible by artificial light, should rest his eyes frequently, change the focus from time to time, and pause for some minutes whenever objects appear confused or the eyes feel fatigued, hot, and irritable. Daylight is much clearer and defines objects much better than any sort of artificial illumination : it is moreover, free from those heating, irritating, and noxious qualities, inseparable from the latter.

Free ventilation, is another point of paramount importance; many affluent persons close almost hermetically, with sandbags, listings, &c., every crevice and chink in their apartments, and then marvel at suffering from oppression of the head, and hot, uncomfortable eyes. Among artizans, the system of crowding together large numbers of workpeople in close ill-ventilated rooms, with flaring gas-lights, is most pernicious: the general health suffers, a hectic flush plays on the pallid cheeks, the eyes fail, and the stimulus of gin is resorted to, to overcome by artificial excitement, the languor and miserable feelings produced by the poisoned atmosphere.

A patient, who was suffering from aggravated symptoms of impaired vision, told me that she was one of seventy women who worked in a large apartment lighted with gas, and who were constantly employed in making up articles of dress: of the seventy there were not ten, who did not complain either of weakness of sight, or pain in the eyes.

If symptoms of impaired vision display themselves in a young person, the wisest step would be to abandon the sedentary occupation, and enter on some other pursuit requiring less exertion of the eyes, for it may be fairly concluded from the symptoms commencing early in life, that the patient cannot with impunity continue the occupation which has given rise to them. In reference to this point, Dr. Deval states, that "having often prevailed on individuals possessing this disposition (of the sight), to adopt a profession exempting them from sustained application, I have subsequently seen them acquitting themselves without difficulty and preserving their vision sound, as long as those who had always enjoyed the strongest sight."

And now with reference to the medical treatment applicable to persons whose eyes are suffering from overwork, and from the pernicious influence of gas-light and ill-ventilated rooms.

Counter-irritation avails much, both in relieving the congested and irritable conjunctiva, and the turgid and often weakened vessels of the choroid and retina. The least troublesome and most effectual proceeding is to apply to the temples, the papier epipastique of Albespeyer; of this, there are three strengths, No. 3, adapted for blistering ordinary skins; No. 2, for irritable persons; and No. 1, weak, which may be used as a dressing to keep the blistered places open. A piece, the size of a shilling, may be placed on the temple, and changed once in the twenty-four hours. The discharge will be moderate, and this application scarcely ever causes any of that puffing of the neighbouring parts, especially the eyelids, which is so annoying an accompaniment of ordinary blisters, nor does it ever excite any constitutional sympathy. I frequently use the æthereal tincture of cantharides, an elegant preparation, admitting of application by the surgeon himself, without alarming the patient. I have mentioned the temples as the seat of application; but, in slight cases, the blisters may be placed behind the ears. If the case be recent, it may not be necessary to continue the counter-irritation beyond a week or ten days, but if the muscæ, scintillations, and hazy vision, are easily excited, and have been of long standing, a steady perseverance for two or three months is very important. The blisters may, in such cases, be varied from the temples to the brow, and region of the supra-orbital foramen. In recent cases, I think, repeated blisters allowed to heal are best; in old cases, open blisters produce the most effect. In very bad cases, which set at defiance all ordinary measures, I have seen marked benefit from an issue in the temple. As this leaves a scar, it is a remedy not to be lightly resorted to, but it is of great value when milder treatment fails.

Stimulating embrocations in the neighbourhood of the eye are useful, but ingredients should not be selected which can irritate the eyes by their fumes, and an especial caution should be given to the patient not to allow any of the fluid to enter the eye. The lower classes are proverbially careless with respect to medicines. Only a few weeks ago, a young woman applied to me for the relief of a terrible inflammation of her left eye, brought on by bathing it with a mixture of hartshorn and cantharides, which a friend had given her as a remedy for corns. She used a mild collyrium to her afflicted feet, and the previously irritable eye was washed with the corn mixture.

The abstraction of blood, by cupping or leeching, is occasionally useful but requires discrimination, for the general character of the class of persons who suffer from impaired vision from overwork, is that of low vitality and feeble powers.

An alterative course of mercury is a powerful means of arresting mischief in the deep-seated textures of the eye, when they are in a state of chronic inflammation. That which I prescribe most frequently, is the bichloride of mercury, in the proportion of $\frac{1}{20}$ or $\frac{1}{16}$ of a grain, twice or thrice a day. The best vehicle for its administration is the *vinum belæ,* a preparation of the Indian pomegranate (*cratæva marmelos,* Linn.). One drachm of this with the bichloride may be given in a wine glass of water immediately after meals, and it effectually prevents any griping or other unpleasant effects. The bichloride may also be given in combination with tincture of bark, tincture of quassiæ or sarsaparilla. As soon as evidence of mercurial action appears by the breath or gums, the dose should be diminished or suspended for a few days, as salivation is neither necessary nor desirable.

If there are objections to the bichloride, two grains of hydrargyrum cum creta, with one grain of extract of hop or of henbane, may be substituted, and may be taken night and morning. An excellent combination in feeble subjects, is two grains of hydrargyrum cum creta, with five of the potassio tartrate of iron, twice daily.

In those persons whose pallid countenances, cold extremities, and languid circulation, proclaim anæmia, tonics, especially the preparations of iron, are of great service, and I confidently recommend the tincture of acetate of iron of the Dublin Pharmacopœia, as particularly well adapted for such cases. I have also seen the superphosphate of iron (first recommended by Dr. Routh) of much service.

The citrate of iron and the citrate of quinine and iron often prove serviceable.

It must, however, be borne in mind that torpidity of the liver and bowels is almost constant in these cases, and require mild purgatives for its relief. The Marienbad water is an elegant and agreeable medicine for promoting the action of these organs. It appears to excite a peculiar stimulating influence on the action of the liver, while copious purgation is prevented through the presence of silica and iron. A tumblerfull may be drunk the first thing in the morning, pure or mixed with warm milk.

Cold ablution is one of the most energetic agents for imparting tone to the system, and, when judiciously employed, is of great service where there is local congestion in connexion with feeble circulation. The shower-bath or the cold douche, if they can be borne, are the most powerful; but rapid friction with a wet towel is useful where the shock of the others would be too great. Two points, however, should always be attended to in cold bathing. First, to get the body well warmed by exercise before entering the bath, and, secondly, to have a large dry sheet thrown completely over the person the instant of leaving it; this prevents the escape of heat and consequent chilliness: the body should be dried by rough towels, with a rapid, bustling action, and the friction should be continued with them or with horse-hair gloves till a thorough general glow is excited. If the cold shower-bath be taken with the feet in warm water the shock will be more easily borne.

It has been stated that an unhealthy condition of the external tunics of the eye and of the adjacent parts is one of the commonest accompaniments of impaired vision from overwork. In the early stage this is perfectly amenable to treatment, but when it has been neglected, and has given rise to disease of the meibomian glands, and general thickening of the lining membrane of the lids, it is often exceedingly intractable, giving rise in some cases to loss of the eyelashes and unsightly distortion of the lids.

Under such circumstances the patient should never attempt to open his eyelids by force, though annoyed by their being commonly glued fast in the morning. The dried secretion should be softened with warm water, or milk and water, and then gently removed. If the lashes are roughly separated, there will be great risk of inflicting such injury on their bulbs as will render them ever after feeble, stunted, and irregular.

There are a vast number of applications made use of for imparting a more healthy action to the diseased membranes and glands. Among the foremost, rank astringent collyria of nitrate of silver, sulphate of zinc, and diacetate of lead, which may be used in the strength of from one to four grains to an ounce of distilled water. Frönmuller strongly recommends a solution of six to twelve grains of tannin, a drachm of wine of opium, and two ounces of water, in cases where the chronic ophthalmia is accompanied with irritability of the eyes.

The diluted unguentum hydrargyri nitratis is most serviceable when the tarsal margins of the lids are affected, but must be carefully rubbed into the minute ulcerated spots at the roots of the lashes to be really efficacious. In aggravated cases of this description the local application of nitrate of silver or sulphate of copper will be attended with most salutary effect.

CHAPTER IV.

ACHROMATOPSY, OR THE INABILITY TO DISTINGUISH COLOURS.

THE article "VISION," for the "Cyclopædia of Anatomy and Physiology," having been intrusted to me, I was led to investigate the subject of Achromatopsy, or want of power of distinguishing colours, and not until then was I fully aware of the great variety of curious phenomena connected with the subject. Persons affected with this peculiarity shrink from making it known from the fear of ridicule, and there are many affected with it in a minor degree who are not conscious of its presence, or only become so by some accidental conflict of opinion between themselves, and others with perfect vision. The nearest approach to this condition in the healthy eye, and a test by which the embarrassment of Daltonians may be judged of, is the difficulty of distinguishing between blue and green by candlelight—a difficulty which must be familiar to every one. The organ of hearing presents in some persons an analogous condition to that of the achromatoptic eye, they being utterly unable to detect the differences between musical notes, especially semitones, or, as pointed out by Dr. Wollaston, their ears may be absolutely insensible to sounds at one extremity of the scale.

Prevôst arrived at the conclusion that the relative frequency of achromatopsy to perfect vision is as one to twenty; and Seebeck states that five out of forty youths who composed the two upper classes in a gymnasium at Berlin were affected with it. In some cases it is hereditary to a remarkable extent, occurring either in alternate or in successive generations, of which a remarkable instance has been published by my very able friend, M. Cunier, thirteen cases occurring in five generations of one family, all being females; but this presents a remarkable exception to the rule, which is that males are nearly as ten to one more frequently affected than females.

Dr. Pliny Earle, who has published a very interesting account of its prevalence in his own family, states that, of thirty-one cases, twenty-seven were males and four were females.

Achromatopsy appears under two distinct forms, congenital and non-congenital. The former is always persistent, the latter may be permanent or temporary.

The congenital is the most common, and may with propriety be divided into the *dichromatic*, or that in which black, white, and the intermediate shades of grey, are alone recognised; and the *polychromatic*, where the range of colours is more extensive.

The term "Daltonism" is of common use in reference to this affection, and is taken from the name of the celebrated chemist, Dr. Dalton, who laboured under this imperfection of vision; the term has the recommendation of brevity and convenience, though it is to be regretted that the infirmity of an individual should have been thus marked.

The persons who are subjects of Dichromatic Daltonism (as it is called by Wartmann) distinguish with facility the forms of objects and the gradations of light and shade, but to them all the charms of nature and of art, as expressed by colour, are unknown; their retinæ are rather sensitive than otherwise, and they not only see objects at a great distance, but can read with facility in an obscurity amounting to darkness. It occasionally happens that these persons have a taste for painting, but their productions are the reverse of happy. M. Collardeau was exceedingly fond of this pursuit, and, so long as he confined himself to the pencil or to sketching in one colour, he designed with much skill; but his productions in colour were remarkable; he was known to confound on the canvass yellow with blue, and red with green, regarding his work with the complaisance of one who felt that he had achieved success. He took infinite pains with one picture, representing a scene in which a dog was portrayed, but as he unfortunately painted red all those parts of the picture which should have been blue, his friends were less gratified than himself with the general effect.

A curious and rather anomalous case has been recorded by Dr. Decondé—that of a soldier, who confounded all the colours of the spectrum in two fundamental hues, yellow and blue. Dark red, bright red, rose, orange, yellow, green in which yellow predominated, and grey white, all appeared as different shades of yellow; whilst blue, green, and white with a blueish shade were perceived as blue. All the very deep colours were regarded as black, and all the very light ones had a whitish appearance, though the man did not seem to have cognizance of white, properly so called. Light decomposed by a prism appeared to him of uniform blue. His sight was feeble, and easily fatigued.

The Polychromatic Daltonism of Wartmann includes a vast number of shades and degrees of insensibility to colours. That which of all others is the stumbling-block is lilac, and next to it rose, indigo and violet.

The following are the most common confusions of colour, ranged in order of frequency.

1. Deep red with deep blue.
   Indigo with violet.
   Deep blue with violet.
   Bright orange with bright yellow.
5. Deep brown with deep green.
   Dark blue with indigo.
   Bright brown with bright green.
   Dark red with dark green.

Rose with bright blue.
10. Dark orange with dark yellow.
Bright red with bright green.
Deep yellow with dark green.
Dark brown with black.
Bright red with bright blue.
15. Bright yellow with bright green.
Bright red with bright yellow.
Dark red with black.
Dark red with dark brown.
Dark green with violet.
20. Dark red with dark yellow.
Dark red with violet.
Bright yellow with bright brown.
Bright blue with violet.
25. Dark red with dark grey.
Dark red with indigo.
Rose with violet.
Dark blue with dark grey.
Dark green with indigo.
30. Rose with dark blue.
Rose with indigo.
Dark green with dark grey.
Bright orange with bright green.
White with faint green.

Putting aside the differences in the brilliancy of the tints, it has been found that the following numbers express how many times each of those tints is proportionally seen without error.

Red	37	Blue	100
Orange	12	Indigo	0
Yellow	100	Violet	0
Green	59		

Dr. Dalton did not discover any peculiarity in his vision till the age of twenty-six, when it was made known through an accidental discussion as to the colour of a geranium; he subsequently investigated the subject with care, and the following are the principal results at which he arrived. The solar spectrum appeared composed of three colours, yellow, blue, and purple, the red being little more than a shade or defect of light. The orange, yellow, and green were shades of yellow, whilst green and blue were strongly contrasted. Of ordinary colours, crimson and dark blue were identical; the colour of a florid complexion being a dull opaque blackish blue, upon a white ground; blood seemed of a bottle green; the face of a laurel leaf was a good match for a stick of sealing wax; and the back of the leaf answered to the lighter red of wafers. Green baize appeared a dark brownish red; and a light drab was not to be distinguished from a light green ; browns were diversified, some having a great affinity for green, others for red ; pink appeared sky blue by daylight, but assumed an orange or yellowish appearance by candle-light. Dalton believed, but incorrectly, that the peculiarity in his vision was caused by the vitreous humour of his eyes having a blue tint.

Professor Wartmann instituted a careful series of experiments on the vision of a young man, M. D.——, in whom the inability to discern certain colours was well marked ; and ascertained that the appearances presented by a solar spectrum were as follows,—the coloured bands, brilliant and distinct, extended a length of about 0·102′. D—— perceived four colours only, blue, green, yellow, and red. He limited the blue part exactly to the space occupied by the violet, indigo and blue: he called the green and yellow bands, less an interval of 0·002′ towards the orange, green; he called that band of 0·002′, and a fraction of the red 0·012′ in breadth, yellow; lastly, the remaining 0·008′ of red appeared to him of a red difficult to define. By refracted light the results were nearly the same, thirty-seven plates of glass exhibiting only four different colours in various intensities.

When examined by polarised light, it would seem that on the one hand he did not appreciate the equality of intensity of two complementary colours as did ordinary vision; but, on the other hand, he found a total and abrupt difference when colours passed at once from the finest red to very rich deep blue, a distinction far from being marked to others.

It seems that his visual organ was unable to perceive the different mixtures of the red which accompany the blue to make it pass into purplish violet. This precise circumscription of the constitutive domain of a colour is a fact which, in the opinion of Professor Wartmann, was new and worthy of being remarked.

Whilst a series of these experiments with polarised light were going on, the sun, which had been obscured, suddenly shone out, and M. D—— declared that the colours immediately assumed a different tint to his sight, and all reddened in a sensible manner, so that he called red that which he had before named green and ill-defined blue, whereas the Professor saw no other change in the colours than an increase of their brilliancy and strength.

Professor Wartmann then submitted his patient to experiments to ascertain his perception of the complementary colours, and the result showed as might be expected, that although his eyes were not insensible to them, the colours which appeared to him complementary were not the same as those so regarded by the normal eye. The professor then painted a human head, giving to each part a complementary colour. Thus the hair and eyebrows were white, the flesh brownish, the sclerotica black, the lips and cheeks green. When asked what he thought of the head, he replied that it appeared to him natural, that the hair was covered with a white cap a little marked, and the carnation of the cheeks was that of a person heated by a long walk.

With very few exceptions, Daltonians perceive black and white correctly, but sometimes very faint colours are confounded with white, and very dark colours with black; as a rule, the true colours most generally recognised are yellow and blue, after them come green, red, and grey. The shades of the latter are, however, sometimes oddly mistaken, as in the case of an old gentleman of Lausanne, who electrified a large assembly by appearing in a full suit of rose coloured silk, which he mistook for "gris de tourterelle," or dove colour, a hue then much the fashion.

Several men of intellectual eminence have been unable to distinguish colours correctly. Among them may be mentioned Dr. Dalton; the metaphysician, Dugald Stewart; Sismondi, the historian; Troughton, the eminent optician; Professor Duméril, the celebrated herpetologist; Dr. Sommers; Dr. Unzer, of Altona; and Professor Brandis.

Non-congenital achromatopsy may be either permanent or temporary. One of the best illustrations of the permanent form, is a case related by M. Szokalski, in which a bootmaker, after a copious bleeding, lost all perception of colours, being only able to discern white, black, and grey. He one day bought a piece of yellow morocco leather by mistake for a white piece, and when examined by M. Szokalski, he could not distinguish any coloured patterns which were exhibited to him. There were, however, amaurotic symptoms besides this achromatopsy.

An interesting example of the temporary form has been related in the 22nd volume of the "American Journal of Medical Sciences," by a very able physician, Dr. Hays, of Philadelphia, and the particulars of three cases which fell under my own notice, are contained in the article "Vision." The symptoms in question are in connexion with derangement of the circulation and especially present themselves in congestive amblyopia. For instance, M. Cunier mentions an officer who suffered from this affection, and every time that the congestion was aggravated by exertion as in executing manœuvres, his soldiers' uniforms underwent a change. The red colour of the epaulettes, of the tuft of the shako, and of the facings of the coats vanished, and the men appeared dressed entirely in blue and black. A brief repose, with the application of cold to the forehead and eyes, soon restored natural vision.

Some authorities have considered the inability to distinguish colours as standing in relation with Albinism, or the absence of the colouring pigment from the eye. Professor Wartmann availed himself of an unusually favourable opportunity for testing this. In the canton of Vaud there resided two brothers named Detoit, having perfectly natural eyes, who had married two sisters with equally good organs of vision ; yet all the children born to these parents were albinos. The family of Pierre Abram were aged respectively thirteen, eleven, and nine years ; that of Jean David were nine and four years. All had the characteristic pure white hair and eyelashes, the blue iris with whitish streaks, the inability to face the light, and the incessant movement of the eyes. Dr. Wartmann instituted a very careful series of experiments, and ascertained that the perception of colours and of shades of colour was complete ; the only evidence of imperfection was, that application of the eyes in reading brought on considerable fatigue in them after it had been continued some minutes.

It would seem that the albinism was derived from the female line, for the eldest brother subsequently lost his wife, and, re-marrying, had a son whose eyes presented no trace whatever of this peculiarity.

A great variety of explanations have been offered to account for the achromatoptic condition ; it is, however, a matter of pure speculation. Nevertheless, I will give the most recent and most carefully elaborated view—that offered by Professor Wartmann, in a memoir published in 1849.

The Professor is of opinion that achromatopsy is produced by an unnatural condition of the retina, which is similarly acted on by two or more different coloured rays. If the vibration caused by a red ray is identical with that produced by a green ray, confusion will result. In order to bear out this statement, he draws a parallel between the mechanism of the sight and that of hearing. Unite in a perfectly equal manner several elastic surfaces which are naturally independent of atmospheric vibrations. Determine then the particular musical note which is capable of rendering each of these sonorous by communication, and place them together near a musical instrument frequently used. At the expiration of some days the note which vibrates one of the surfaces will produce the same effect on a second, then on several others. Thus the elements of this system would be modified in their facility of vibration, and in resounding too easily under the influence of different tones, they resemble the retina of a Daltonian, who confounds different colours. If the change of elasticity of each conjoined layer could be made to be affected in an equal manner by all the tones, proportional to their intensity, the system would represent the retina of dichromatic Daltonians, for whom there is only bright grey and dark grey, that is to say, the various sensations of light and shade. This supposition has nothing inadmissible, since the chromatic sensibility of the sound eye does not embrace the interval of a minor sixth.

It is known that the eye and the ear acquire by exercise the faculty of distinguishing the shades of colour or musical tones inappreciable to an ordinary organ. Thus the habitual and moderate vibration of the retina by the coloured rays, of which it studies the various tints, far from diminishing its sensibility, gives it greater delicacy.

The theory (says Professor Wartmann) which explains Daltonism by an abnormal elasticity of the retina has the advantage of substituting a realisable physical condition for a vague notion about the sensorium. Further, it is supported by facts, because changes which alter the ordinary condition of the visual organ are capable of exciting permanently or temporarily a false perception of colours. Finally, it appears to be confirmed by the circumstance that, with many Daltonians, the eye sees less distinctly the red rays than those of which the refrangibility is much greater. An individual examined by Seebeck declared that the most brilliant part of the spectrum was not the yellow, but the common limit of green and blue. Another described a pattern of fine deep violet as being the brightest of a collection of papers of all shades.

The important question, can achromatopsy be remedied or alleviated, does not admit of a very satisfactory reply. Daltonians endeavour to obviate the annoyances arising from their infirmity by taking some standard colours or shades as points of comparison; they also bring the sense of touch to their assistance, and are enabled by these means and close attention to avoid many errors; nevertheless, they feel repugnance to express an opinion upon colours. Jüngken and Chelius have recommended the use of coloured bands bearing the name of their colour, and Szokalski has suggested that sensations of the various shades may be excited by fixing the eyes on different coloured patterns and then on a black or white surface. This, however, is less beneficial than the plan suggested by Wartmann, the employment of coloured glasses of a certain known tint. Suppose, for example, this tint red, the impression of a green body and that of a red body, which would appear of the same colour to the naked eye, will be distinguished by the use of the glass.

When the inability to distinguish colours is dependent on local or general causes, it will be necessary to direct our treatment to the removal of those causes. Every case must necesssarily be a study of itself, and it would be foreign to the object of this work to enter into the consideration of a subject which is very extensive, and belongs to the treatises on ophthalmic medicine.

CHAPTER V.

GLASSES.

In order that the action of spectacles may be clearly understood, I will, before entering upon the subject, explain the effect of the different kinds of lenses upon rays of light.

There are six varieties of the common lens:

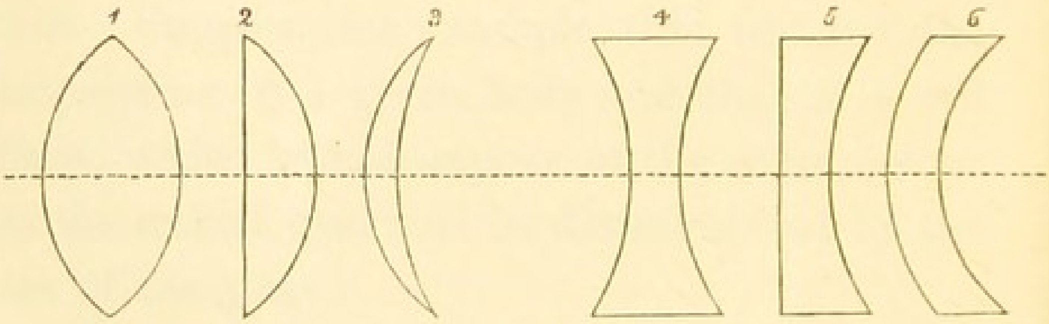


Fig. 11.

1. The *double convex lens* is bounded by two convex spherical surfaces, each of whose centres is in the axis of the lens only on the sides opposite to their surfaces.

2. The *plano-convex* has one side convex, the other plane.
3. The *meniscus* has one surface convex, the other concave, and the surfaces meet if continued.
4. The *double concave* is bounded by two concave spherical surfaces whose centres are on the same sides of the lens as their surfaces.
5. The *plano-concave* has one surface plane, the other concave.
6. The *concavo-convex* has one surface concave, and the opposite convex, but these do not meet if continued.

The first three magnify.

The following is a short demonstration of the principles of action of concave and convex lenses :

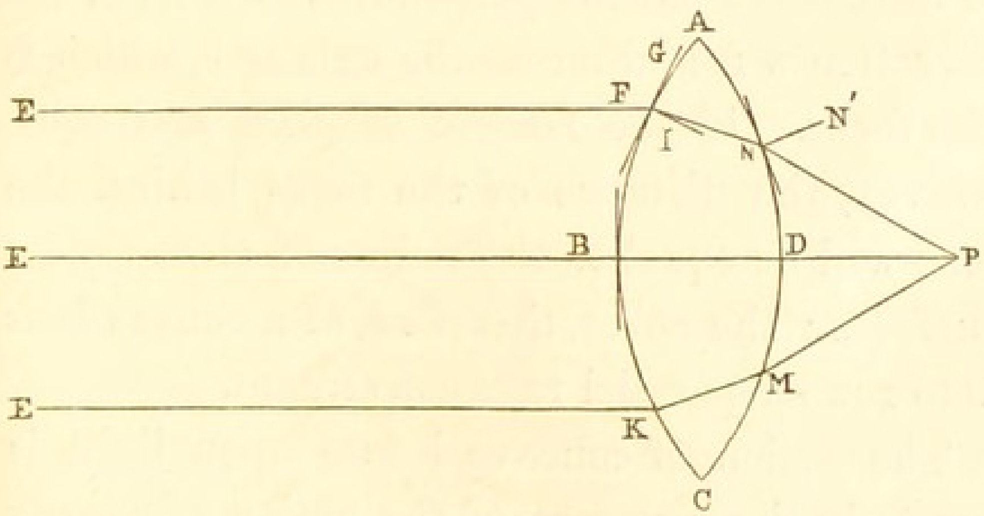


Fig. 12.

Let A B C D, Fig. 12, be a transverse section of a double convex lens, and E F, E B, E K, parallel rays of light falling upon such lens. As the ray E B falls at right angles to the tangent of the arc A B, it passes straight through the lens in the direction B D in a straight line with E B.

But the ray E F, on passing into the lens, that is from a less to a more refracting medium, and in a direction not at right angles to the tangent F G, is refracted towards the line I F, which is perpendicular to the surface of the lens at the point at which the ray E F entered. Having traversed the lens, it undergoes a further refraction on leaving it, but in this case, because it is leaving the more refractive, and entering a less refractive medium, it is refracted from the perpendicular N N′, in the direction N P, and meets the axis at P, which is the focus. If the lens be of glass and equiconvex, the distance of the focus behind the lens will be equal to the radius of either of its surfaces; the effect, therefore, of a convex lens is to render parallel rays convergent.

The action of concave lenses upon light is precisely the converse of the action of convex lenses. Concave lenses render the rays *divergent.*

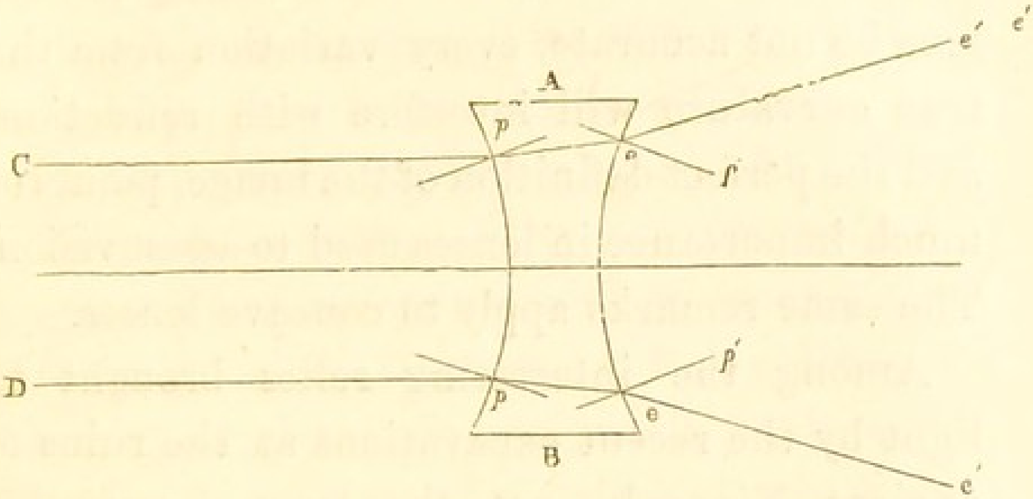


Fig. 13.

A B (Fig. 13) is a transverse section of a double concave lens—C and D are parallel rays incident upon it. These rays on entering the lens are refracted towards *p p*, the perpendiculars to the surface at the points at which the rays C and D entered, and on leaving the lens they undergo a further refraction: in this case from *p′ p′* the perpendiculars to the surface at the points at which they emerge, that is, they will diverge in the directions *e, é, e, é.*

When a convex lens is properly worked, it should exactly represent two segments of the same sphere, or of two different spheres with their plane surfaces in opposition, and placed in the same axis. Then only does it give a clear and distinct image of the object submitted to its action. If the working of the lens be not accurate, every variation from the true curvature will interfere with refraction, and the perfect definition of the image, points of much importance in lenses used to assist vision. The same remarks apply to concave lenses.

Among the interesting relics brought to light by the recent excavations at the ruins of ancient Nineveh, not the least remarkable was the discovery in the treasure-house, of a rock crystal lens, found in company with bronzes and other articles of value. This was appropriately placed in the hands of Sir David Brewster, who described it at the meeting of the British Association at Belfast last year. The lens was not entirely circular in its aperture, being $1\frac{6}{10}$ths inches in its longer diameter, and $1\frac{4}{10}$ths in its shorter. Its general form was that of a plano-convex, the plane side having been formed of one of the original faces of the six-sided crystal, as ascertained by its action on polarised light. This was badly polished and scratched. The convex side of the lens had not been ground in a dish-shaped tool in the manner in which lenses are now formed, but was shaped on a lapidary's wheel, or in some such manner. Hence it was unequally thick, but its extreme thickness was $\frac{3}{10}$ths of an inch, its focal length being $4\frac{1}{2}$ inches.

In China rock crystal is used throughout the empire for lenses. They are ground with the powder of corundum, and when mounted form most original spectacles, being circular, of immense size, and retained in position by silken cords with weights attached, which are slung over the ears. Manni states, that the art of making spectacles was carried to China by the Florentine Jesuits in 1697, but I am strongly inclined to believe they are of a far more ancient date.

M. Caesemaeker, a Belgian optician, has published some particulars of the early history of spectacles,[1] which differ from those generally received. They are said to be the result of diligent researches amongst the ancient records of the convents and monasteries. According to this writer, Roger Bacon, who occupied the

[1] Aenteekening van Verschillige merkwaerdigheden over de Brillen, en verderen Zienglazen, &c., door Fr. Eug. de Caesemaeker, Gant.

chair of philosophy at Oxford, passed some years at the Convent of Cordeliers at Lille, before he received that appointment. During his stay at Lille, he formed a friendship with the learned theologian Henri Goethals, known better as Doctor Solemnel, and with the chronicler Philip Mussche. To these he paid annual visits during the vacations at Oxford, and availed himself of the opportunities of procuring from the Belgian glass manufactories, fine glass fit for optical purposes which could not be obtained in England. With this glass, polished by himself, he made lenses, and communicated to his learned friends the secret of spectacles. Thus they became known in Flanders. The Dominican monks, to whom the Italian writers attribute the invention, learnt it thus. During the pontificate of Martin IV., who died in 1286, a question arose touching the interests of certain monks, who confided their defence to Henri Goethals. He, being sixty years of age, used spectacles, the glasses for which had been given to him by his friend Roger Bacon. Arrived in Tuscany, Goethals visited his old friend Nicolas Messo, prior of the Dominicans, and stayed among them two or three weeks ; and it was in this way that Allessandro di Spina, the Dominican, became acquainted with the use and manufacture of spectacles. In the course of his researches, M. Caesemaeker discovered that the sister of Henri Goethals, abbess of the Hospital of the Hermitage at Eeckergem being dead, the *religieuses* preserved for a long time, her glasses mounted in gold, and he ascertained that several cavaliers of the court of Guy de Dampierre, Count of Flanders, at the end of the thirteenth century, wore glasses. He found that the glasses were in those days always mounted in gold, silver, or iron, and that those with gold and silver frames were regarded as treasures, and received special mention in wills and deeds,[1] being carefully preserved in cases of ebony and of silver. They were always of the description called by the French "pince-nez," or nose clips, the true spectacles being far more modern.

[1] In the inventory of the valuables of the Emperor Charles V., made after his death at Yuste, in 1558, there are enumerated together, collars and badges of the golden fleece, various charms, as the bezoar stone against the plague, gold rings from England good for the cramp, a morsel of the true cross, and twenty-seven pairs of spectacles.

Whether the actual credit of the discovery rests with Roger Bacon, Alessandro di Spina, or Salvinus Armatus, a Florentine, is not of much moment, especially as there seems to have been no distinct rules as to their application until the time of Maurolicus, of Messina, who lived about 1575. He it was who pointed out the real cause of myopia and of presbyopia, and explained how concave glasses rectified the former, and convex glasses the latter. To him and to the original discoverers mankind owe a debt of gratitude, for it is not too much to say that, through the aid of spectacles we continue in the enjoyment, even in old age, of one of the most noble and most valuable of our senses. They enable the mechanic to continue his labours, and the artist to display his skill, in the evening of life ; the scholar pursues his studies by their help, adding to the knowledge of others, and recreating his own mind with intellectual pleasures, thus passing days and years in satisfactory occupation that might otherwise have been devoured by melancholy or wasted in profitless idleness.

The village of Fürth, in central Franconia, is one of the largest seats of manufactures of spectacles in Europe. More than 115,000 dozens of pairs are there annually made, besides an equal number of glasses for frames simply resting on the nose, and which are principally destined for the Turkish and American markets. The average price of these spectacles is from one to two florins per dozen. The proportion of each description of lens is as follows:—convex glasses are in proportion to concave as 10 to 1, and periscopics are to ordinary lenses as 1 to 153. The powers most in demand are in Bavarian measures, for glasses, convex, No. 8 to No. 20; for spectacles also convex, No. 10 to No. 25, whilst concaves range from No. 12 to 20. It is stated that not only is the continent largely supplied from this source, but many of these cheap spectacle glasses find their way into England: Sheffield, however, is the great mart in this country for cheap spectacles.

I shall, in the first instance, describe the mode in which spectacles are made, and after that proceed to their application.

The glass principally employed for spectacle and optical lenses is plate glass of the purest quality; it requires the nicest adjustment as to the proportion of its ingredients, silicate of soda and lime; the presence of too much alkali attracts humidity from the atmosphere, causing the glass to become dull, or, in the language of the opticians, to "sweat." The French plate glass is in point of colour superior to the British, but has the disadvantages of softness, fragility, and a tendency to become dull; therefore, though this is preferred by some opticians, the glass known as "British plate" is on the whole the best.[1]

The mode of making spectacle glasses and lenses generally is as follows:—

A piece of glass, of a thickness proportionate to the convexity or concavity of the intended lenses, is cut into small squares with a diamond; after these small squares have had

[1] At the Great Exhibition in 1851 a council medal was awarded to M. Maes, of Clichey, near Paris, for the application of a novel chemical combination in the manufacture of lenses for optical purposes, by means of which glass remarkable for its purity, brilliancy, and beauty has been produced. The novelty consists in the use of barytes of magnesia and oxide of zinc in combination with boracic acid, which facilitates their fusion and easy vitrification, a point of great importance, as it tends to the more perfect commingling of the substances employed in the formation of the glass, and consequently frees it from striæ, bubbles, and other defects.

their corners snapped off, they are fixed with cement to a metal tool, the concavity or convexity of which corresponds to the curve they are intended to receive

They are then worked by hand, or machinery, on the smoothing tool, which latter must be perfectly true, and of a radius in accordance with the focal lengths of the intended lenses. They are worked with a peculiar kind of eccentric motion, which is found to give equal friction to all parts of the surface. After the lenses have been thus gradually rounded into shape, and smoothed by emery powder of different degrees of fineness, prepared for the purpose, they are subsequently polished with oxide of tin, commonly called *putty*, which is laid on a polisher made of felt and cement, and formed to the curve of the smoothing tool. When one side of the lens is completed, the other side is subjected to a like process, and when both sides are perfectly polished, all that is required is to cut and grind the edges to fit the spectacle frames.

There is a common prejudice in favour of pebbles, and they certainly possess two advantageous qualities, extreme hardness, rendering it difficult to scratch or break them, and clearness, never becoming dull from moisture. They have, however, the disadvantage of being expensive, partly on account of the additional labour in making them, partly from the number of imperfect ones met with during their manufacture, whereby the price of good pebbles is enhanced.

From time immemorial the Chinese have used for checking the glare of the sun a substance called "cha-she," or tea-stone, from the resemblance of its transparent hue to a weak infusion of black tea; it is probably smoky quartz or silex, allied to the cairngorm of Scotland. In selecting this colour they have shown wisdom; for, although glasses of all tinges of blue and green are to be found in our opticians' shops, the hue called *neutral tint*, similar to that used by the Chinese, is least injurious to the eyes, and for the following reasons.

When the eye, after having been strongly impressed with any particular species of coloured light, is directed to a sheet of white paper, it will not be capable of determining, for some time, that the paper is white, neither will it attribute to the paper the colour with which the eye was impressed, but a different colour, which is called its accidental, or complementary colour. The following is a table of the colours, and of those which are complementary to them.

COLOUR.	COMPLEMENTARY COLOUR.
Red	Blueish green
Orange	Blue
Yellow	Indigo
Green	Violet reddish
Blue	Orange red
Indigo	Orange yellow
Violet	Yellow green
Black	White
White	Black

Thus, then, when the eye has been for some time looking through a blue glass, the retina becomes less sensible to blue light. Consequently, the moment the blue glass ceases to be used, the retina being less sensible to the blue rays which form part of the white light flowing from the paper, the paper will appear of that colour which arises from the combination of all the rays in the white light which it reflects, with the exception of the blue, that is, it will appear *orange red.* In like manner *green* will excite a *violet red* spectrum. As coloured glasses are almost always made use of to screen the eyes in cases where there is undue sensibility of the retina, anything which unnecessarily blunts the sensitiveness of that membrane (such as a particular colour), though temporarily, should be avoided. It is on this account that the neutral tint glasses are to be preferred, being, as the name implies, of no definite colour; they screen the eyes from all colours alike, and produce, in the sunshine, the effect of a cloudy day, which is exceedingly grateful to weak and irritable eyes.

There are two descriptions of neutral tints, a blueish grey and a brownish grey, and several shades of each. I give the preference to the brownish grey. The chief risk in selecting glasses of this description is that of choosing too dark a shade. Neutral tinted glasses are serviceable in two distinct classes of cases; those in which the retina is irritable, and will not bear the excitement of light, and those cases of incipient cataract in which they assist vision simply by modifying the light and causing dilatation of the pupil. In the first class of patients, the use of too dark glasses is injurious by rendering the eyes still more susceptible of light, producing, in fact, the same effect as shutting up the patient in a darkened room. The shade selected should be that which is grateful to the eye, but never darker than necessary; and if dark glasses have been in use it will be proper to discontinue them, and to gradually accustom the eyes to the stimulus of ordinary light, by reducing the tint in successive changes. It is advisable that persons habitually using tinted glasses should close the eyes once or twice for a second on taking them off, thus rendering the contrast between the shade and the light less marked.

It must be borne in mind with reference to the darker shades of neutral tints, that they are liable to *heat* the eyes; a black substance absorbs all the calorific, as well as the luminous rays, and therefore sooner becomes warm and rises to a higher temperature than substances of other colours. The nearer then, the neutral tinted glass approaches to black, the more it will heat the eye. I may refer *en passant* to an experiment of Benjamin Franklin's, proving to demonstration the relative heating properties of black and white. He covered two patches of snow with cloths, the one black the other white. The snow beneath the black cloth very soon melted, whilst little or no effect was produced on that beneath the white. This is a fact of practical value, for the tunics of a sensitive and morbidly irritable eye, soon feel the discomfort arising from this property of dark glass, which literally, as well as figuratively, feels hot to the eye it covers.

It occasionally happens that myopic persons require the aid of neutral tinted glasses ; there are two ways of supplying the want, either by grinding the lens of the tinted glass itself, or by cementing an ordinary plano-concave lens on a tinted plane glass. The last mode is much used by Messrs. Carpenter and Westley, who inform me that the low numbers up to about No. 6, may be cemented with the utmost nicety ; but that when a higher number is required it is preferable to have a tinted side-piece let down when required, as the inequality of the refractions if cemented, would interfere with the perfection of the spectacles.

The desire to conceal from the world any imperfection which wounds our self-love, is inherent in the human heart, and leads to all sorts of artifices on the part of those who, by natural conformation, advancing years, or other causes, suffer from imperfection in their vision.

Thus it is, that some persons prefer to use an eye-glass, others reading-glasses, in lieu of spectacles. Reading-glasses, *les binocles* of the French, are adapted for occasional use, as the elastic mounting enables them to be opened and brought into position at once; but they are objectionable from not being firmly fixed in front of the eyes. The motion of the head not being in accordance with that of the hand which holds the glasses, has the effect of trying the eyes exceedingly in their constant and ineffectual endeavour to adjust themselves to the position of the glasses, inducing considerable fatigue of the eyes, and rendering necessary an earlier resort to glasses of a higher power than would have been required had proper spectacles been adopted from the commencement. The "pince-nez," or nose-clips, which are fixed by a spring to the nose, have the disadvantage of the centres of the glasses never being exactly in front of the pupils, and, though like the others serviceable for prompt and occasional use, are objectionable for reading, writing, or any continued occupation.

But a single eye-glass is more injurious still; and many young men, who, from shortness of sight, or affectation, have thought proper to use a quizzing-glass (as it is termed) have had reason to regret it to the end of their lives. I am acquainted with a gentleman, the sight of whose right eye has been seriously impaired from his having in early life constantly used one of these eye glasses, and numerous other instances have come to my knowledge. The consequences to perfect vision are serious, for as one eye is made to do more work than the other, an alteration in their relative strength takes place; the result is, that sooner or later when the person resorts to spectacles, he finds that the lens which suits one eye will not at all suffice for the other.

Watchmakers, and other artists, who work with a magnifier, are very subject to this imperfection of vision, and generally find that they see better with one eye than the other. If, instead of always applying the magnifying glass to one eye, they were to use the other eye in turn, a habit which might be easily acquired in early life although with difficulty afterwards, they would preserve the power of their eyes more equally, and the perfection of vision longer; for, by using the eyes alternately, rest, and an opportunity of recovering from the fatigue produced by the exertion of looking through the magnifier, would be afforded to each. In like manner, those who indulge in microscopical or astronomical pursuits, should learn to use either eye indifferently, instead of always trusting to one, although we almost instinctively apply the right eye to a telescope or microscope.

An eminent optician informed me that, from constantly looking through microscopes, &c., with his right eye, the focus of that eye has been rendered so much longer than that of the left, that whilst the left eye is suited by a glass that is perfectly plane, the right requires a lens of 36 inches focal length.

There are three varieties of lenses in common use for spectacles. The double concave for short-sighted persons, the double convex for long or aged sight, and a third description, invented and patented by Dr. Wollaston, to which he applied the term *periscopic;* so called, from the facility they were supposed to afford for looking round at various objects, without turning the head, and so giving a wider field for vision. They were also intended to obviate the defect in common lenses, that no object appears distinct through them, except such as are seen through the centre of the lens. Dr. Wollaston conceived that, by making each side concave towards the eye, each portion of its surface might be nearly at right angles to the axis of vision, and would thus render lateral objects distinct, without impairing the distinctness of those seen through the centre. This effect for far-sighted persons he accomplished by means of the meniscus with the concave surface next the eye, and for short-sighted persons he adopted the concavo-convex. There can be no doubt that the advantage of a wider field is gained in proportion as the second surface of the lens approaches to the form of the curvature of the cornea, but this is scarcely necessary, as we generally turn the head to look at an object, instead of glancing at it obliquely. To persons who are in the habit of regarding objects thus obliquely, periscopic glasses would be applicable, but they do not render vision so distinct as ordinary lenses, and they increase (although in a very trifling degree) the aberration both of colour and figure; therefore the double concave or convex lenses are to be preferred to the periscopic.

Cases are occasionally met with, where, from some peculiarity in the form of the refractive media, or in the sensibility of the retina, the assistance derived from glasses is greatly increased by sloping them or holding them obliquely. Of this I have recently seen a striking example in a young nobleman, whose left eye was rendered useless by an injury, and who, when looking at an object with his right eye (which is very myopic), slopes his glass at an angle of about 20°, whereby the sharpness and clearness of the objects are much improved. Messrs. Carpenter and Westley met this requirement by an ingenious contrivance. Within the circle of the right eye-piece of an ordinary spectacle frame, a second circle, moving on vertical pivots, was fitted, and in this the lens was fixed. The frame being worn in the usual manner, a slight touch brought the lens to the required angle, from which it could be replaced in a moment. This is the best apparatus for the purpose with which I am acquainted.

Portrait painters and others who require to compare objects at different distances quickly and frequently, often use semicircular lenses, straight at the top, so that by raising the eyes they can see over them. This, however, causes grimaces and fatiguing elevation of the brows, and for this reason the spectacles invented by the philosopher, Benjamin Franklin, are preferable. Finding it troublesome to be frequently changing his glasses when he desired to see distant objects, or to read, he had the lenses in use for both purposes, cut in halves, and a portion of each mounted in the eye-pieces of his spectacles. The circles are made rather large in this description of spectacle, and the two segments of lenses are united as finely as possible in the median line. The most convex or reading lens, is below, the least convex above, so that by simply dropping the eyes, or raising them, the person can see near or distant objects. Sir Joshua Reynolds was much in the habit of using such glasses when painting his inimitable portraits.

Great judgment and discrimination are required before giving a decision as to the propriety of a patient having recourse to spectacles, and many points should be borne in mind before assenting to their use. We should first satisfy ourselves that the impairment of vision does not arise from diminished sensibility of the retina, and that the case is not one of incipient amaurosis : if it be so, the temporary comfort occasionally afforded by the aid of glasses will be purchased at the price of more speedy extinction of vision ; and we discover, when too late, that measures very different from those recommended would have been the means perhaps of rescuing the individual from the horrors of blindness. If the case is supposed to be one of myopia, we should carefully ascertain that the defective vision arises from an alteration in the powers of the refractive media, and is not the consequence of the eye having lost the power of adapting itself to the focus for distant objects.

In the latter case we should commit a grave error in recommending glasses, for, as I have explained elsewhere, their employment is absolutely injurious.

Amongst the lower classes, near-sight, unless it be in a marked degree, is but little regarded, and the individuals make increased exertions to distinguish distant objects without troubling themselves about spectacles; by so doing they frequently overcome the imperfection in their vision, or at all events prevent its becoming greater. But persons in the higher ranks of life, no sooner discover a trifling imperfection in their vision than they have recourse to artificial aid, and thereby render permanent a defect which might perhaps have left them altogether.

Having made these preliminary remarks, I will proceed to the subject of choosing spectacles.

There cannot be a greater error than in purchasing cheap and imperfect spectacles; such frequently are those which are advertised as possessing remarkable and peculiar qualities. The mode in which glasses act is simple, and has been already noticed. The rules for their selection are equally simple, but of paramount importance. After ascertaining that the glasses are perfectly free from specks or veins, by moving them backwards and forwards between the eye and the flame of a candle, the next point of importance to be attended to is, whether the figure of the lenses is accurate. This may be ascertained by moving each glass backward and forward between the eye and the page of a book. If the lens has not been completely ground, or the material is not homogeneous, the characters will appear distorted. Another point of great importance is to select the lowest power that is productive of distinct vision. The glasses, of whatever description, when placed near the eye, should give a blackness and distinctness to the letters of a book without enlarging or diminishing them, or exciting the least sensation of straining or fatigue of the eye. The glasses employed in myopia are *double concaves*, and each side should be accurately ground to the same curve. We should (as in presbyopia) select glasses of the lowest power, or, in other words, those in which the surfaces are portions of the largest spheres; and so long as these enable the person to distinguish the outlines of objects distinctly at about forty or forty-five feet, he should not have recourse to a higher power; for if he rashly increases the power, or if he begins with one that is too powerful, he will not only find it difficult to go back, but that the tendency of the eye to crave a higher power will still remain. Persons are frequently induced, by the pleasure they derive from looking at objects through a high power, to have recourse to that power; at first it certainly renders objects clearer, and defines them more sharply, but after a time this effect passes away, and a still higher number is sought after; for although the eye will become accustomed to undue and continued excitement, yet its susceptibility is diminished thereby, never perhaps to be restored.

It has been already mentioned that in France the conscripts purposely render themselves myopic to escape military service. The following is a curious illustration of the consequences of such a proceeding. It is mentioned by Dr. Deval.[1]

Case XLIV.—A printer's compositor consulted Dr. Deval in 1851. This man, natu-

[1] Traité de L'Amaurose. P. 118.

rally presbyopic, attributed his bad sight to the efforts he had formerly made to become near-sighted rather than encounter military life. He had begun to exercise his eyes with No. 12 concave glasses; then descending lower and lower in the scale, he reached No. 3 at the expiration of three months, and read very well with them, whilst he had become incapable of distinguishing distant objects. But afterwards, notwithstanding his abandoning the glasses, the sight became troubled with any work; he was tormented by scintillations and by muscæ; the eyes were distressed by daylight. To relieve these symptoms he took to convex glasses, which he changed many times without finding a number which afforded him real relief.

The result was that he was obliged to give up his occupation and resort to some other means of obtaining a livelihood, but the man probably never recovered from the effects of his ill-judged tampering with glasses.

Many instances have fallen under my notice in which persons have seriously impaired their sight by beginning with too strong glasses. They have, perhaps, adopted those of a relative, without being aware that what suited him well in old age might be very improper for them. At first, vision was assisted agreeably enough, but after a time these persons became conscious of fatigue in their eyes and confusion of vision; indifferent to these warnings, they persevered with their ancient spectacles, until at fifty they had fixed the focus of their eyes at the same point as that of the venerable original owner at perhaps fourscore. Others, again, have sought assistance from an optician, and have found that a number higher than that in use was very pleasant; it magnified, certainly, but that they considered rather an advantage than otherwise, as it rendered objects more distinct; the glasses were bought, but in a few months the individuals were as badly off as before, and changed again; for be it observed that when the higher powers are attained, the stimulus is so exciting that sight declines rapidly. In some instances patients of this description have even used a second pair of spectacles when reading, to increase the magnifying power; and it may be here remarked, that the habit which some persons thoughtlessly acquire of reading in indifferent light, making up for the deficiency by using either a large reading-glass or double spectacles, cannot be too highly deprecated.

Another point which all should attend to in selecting spectacles, is to look through each glass, with each eye, separately, at small print, and carefully to ascertain whether the effect upon each eye is the same from each glass; should it happen, as is not uncommon, that the focal power of one eye differs from that of the other, the inequality will thus be discovered.

There is one point of considerable importance which is often disregarded,—viz., the fitting of the spectacle frame, so that the centre of each glass shall be exactly opposite to the pupil of the corresponding eye. A moment's reflection will show how important this is. There are scarcely two persons of precisely the same width between the eyes, and yet in the majority of cases this fact is entirely lost sight of in the selection of spectacles. A person finds that, when at an optician's he looks through a lens of a certain power, it suits him exactly: he sees delightfully with it, and forthwith orders spectacles of that power.

He tries them on as soon as he receives them, anticipating with eagerness the comfort they will afford him; instead of which, he finds that he can hardly see at all, or if he does, his eyes soon feel fatigued. The glasses are right, the error is in the frame. Unless the width between the eyes is such, that the centre of each glass is exactly in front of the eye which it is to assist, the rays that pass through the lens will not all enter the pupil, and the spectacles will be comparatively valueless. Care should be taken then, in every case, to have the bridge made of such a curve and such a width, that the position of the lenses as regards the eyes shall be perfect, both horizontally and vertically.

In ordinary myopic spectacles the average height of the bridge above the axis of the lenses is from one-eighth to three-sixteenths of an inch. Where the arch of the nose is depressed, the bridge is made one-eighth below the centre. The most remarkable spectacles I have ever seen are those which were worn by General Sir Charles Napier during his Indian campaigns.[1] The bridge is full half an inch

[1] In the possession of Messrs. Carpenter and Westley, 24, Regent Street.

above the axis, and the concave lenses are of the extraordinary power of No. 16.—the highest ever seen by me—reducing objects to microscopic minuteness, but enabling the gallant general to enjoy the most acute vision without the slightest discomfort.

The three most usual forms of spectacle frames are represented in the following figures. The first (Fig. 14) is that commonly used for presbyopic glasses. The second (Fig. 15) brings the glasses near the eyes. The third (Fig. 16) is sometimes preferred, as being generally useful.

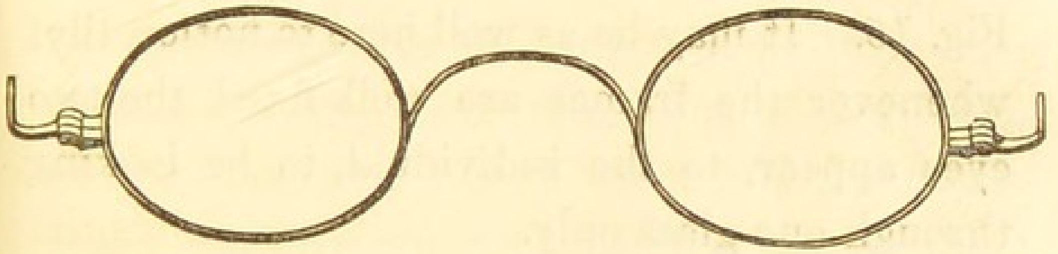


Fig. 14.

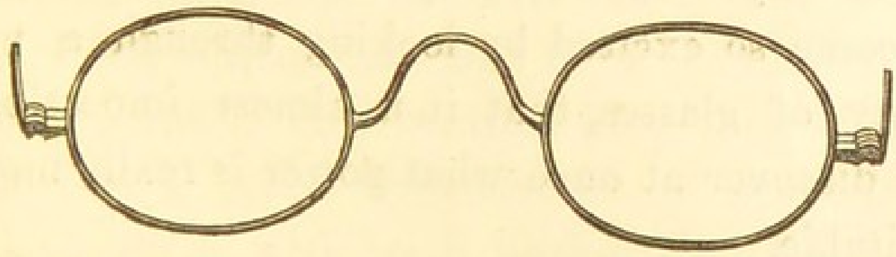


Fig. 15.

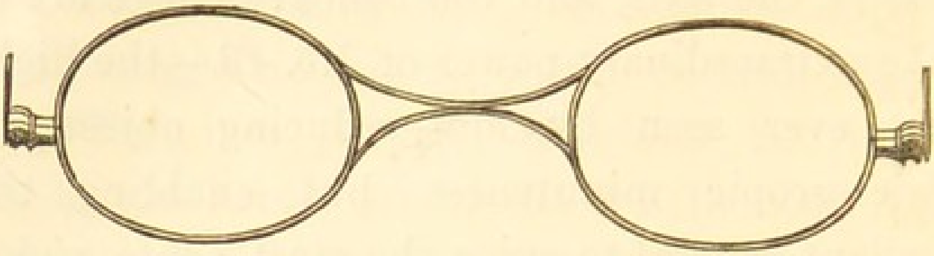


Fig. 16.

I have mentioned the curve as well as the width, for by it the height of the glasses is adjusted. Short-sighted persons require the glasses to be nearer the eyes than do the far-sighted, and this is to be regulated by a peculiar kind of curvature of the bridge, a curvature in two planes rising vertically and projecting out at the same time,—as shown in Fig. 15. It may be as well here to notice, that whenever the frames are well fixed, the two eyes appear, to the individual, to be looking through one glass only.

Before spectacles are finally decided upon, they should be worn for a day or two in order that they may be fairly tried, for the eyes become so excited by looking through a variety of glasses, that it is almost impossible to discover at once what power is really most suitable.

The material best adapted for spectacle

frames is blue steel, which combines the advantages of lightness, elasticity, durability, and neatness of appearance. The brilliancy of gold and silver frames is objectionable, as tending to dazzle the eyes, and from this the blue steel frame is free. Some persons prefer tortoise-shell frames, but these have a heavy appearance, and are very liable to be broken. If, however, fancy inclines towards them, care should be taken that the front is all black, because if it is made of variegated shell, the dazzling will be even greater than that from the gold or silver. The front of the frame should be made to project sufficiently far beyond the glasses to protect them from friction in drawing them in and out of the cases, or from being scratched when laid flat down. Many persons are very careless as to this; leaving their spectacles about, allowing them to become dim with moisture and dirt, and wiping them with the first thing that comes to hand—their coat-tails or pocket handkerchief; but if they wish to keep their glasses in a good state, they should be sedulous to clean them with wash leather that has been freed from the yellow ochre used to colour it, for this offers less risk of scratching the glasses than does silk, or any other material.

Spectacle lenses are best distinguished by their focal lengths. The following are the focal lengths of double concave and double convex glasses made by an excellent optician, Mr. W. Hawes, of 79, Leadenhall Street.

Double concave (Myopic.)	Double convex (Presbyopic.)
No. 00	about equal to 42 inches focal length.
0	30
1	24
2	20
3	16
4	14
5	12
6	10
7	9
8	8
9	$6\frac{1}{2}$
10	$5\frac{1}{2}$ [1]
11	$4\frac{1}{2}$

[1] The lens of $5\frac{1}{2}$ inches focal length is the highest power usually required by eyes which have not undergone operation for cataract. The numbers below that are the double convex glasses generally supplied to cataract patients.

No. 12	4
13	$3\frac{5}{8}$
14	$2\frac{3}{4}$
15	$2\frac{5}{8}$
16	$2\frac{1}{2}$
17	$2\frac{2}{10}$
18	2
19	$1\frac{3}{4}$
20	$1\frac{1}{2}$

Mem. The agreement of the radius of the sphere with the focal length depends upon the quality of the glass.

The French opticians have a much wider range of numbers than the English. The following is the scale of M. Chevalier of Paris :—

No. 60, 30, 20, 18, 16, Myopie faible.

" 15, 14, 13, 12, 11, 10 . . } Myopie plus prononcée.

" 9, 8, 7, 6, 5, $4\frac{1}{2}$, 4, Myopie forte.

" $3\frac{3}{4}$, $3\frac{1}{2}$, 3, $2\frac{3}{4}$, $2\frac{1}{2}$, 2, $1\frac{3}{4}$, $1\frac{1}{2}$, 1 . } Myopie très forte.

" 100, 80, 72, 60, 48, 36, 30, 24, 20 . . . . } Presbytie commençante.

" 18, 16, 15, 14, 13, 12, Deuxième degré.

No. 11, 10, 9, 8, 7, 6, 5 . . .	Presbytie bien prononcée.
" $4\frac{1}{2}$, 4, $3\frac{1}{2}$, 3, $2\frac{1}{2}$, 2, $1\frac{3}{4}$, $1\frac{1}{2}$, 1	Dernier degré.

In choosing concave glasses for remote objects beyond two or three hundred yards, the focal distance of the glasses should be the distance at which a small object appears indistinct to the naked eye. For example: if the common type of a book is read distinctly without glasses at the distance of twelve inches, then the concave glasses required for seeing distinctly at the distance of two or three hundred yards, must have a focus of twelve inches. If distinct vision is required at the distance of twelve inches, and the distance at which a person reads with ease with the naked eye, be four inches, then by multiplying 12 by 4, and dividing by 12 minus 4, thus $\frac{12+4}{12-4}=\frac{48}{8}=6$ inches, which is the focus required.

The eye pieces to common spectacles are generally oval, but sometimes circular. The oval glasses have an equal range of vision in a lateral direction, and are, of course, lighter than those of a circular form. There is occasionally an advantage in being able to look over them, but where an individual requires the same glasses for walking as he does for reading, the round ones may be preferred. Some persons suppose that round glasses must be ground more perfectly than those of an oval form, but in reality the latter are circular when they are ground, and subsequently clipped to the oval shape. In cases where spectacles are used for distant objects, the elasticity of the frames ought to be confined to the sides, and the front should be strong enough not to bend in the slightest degree, for if this point is not attended to, the glasses will lose their parallelism with the eyes; but for reading, the case is different, and the front should yield a little, so as to throw the plane of each glass at right angles to the axis of vision for each eye.

A simple and convenient mode of ascertaining the focal length of spectacle glasses, is to fix a piece of white paper against the side of a room opposite to a window, and slowly to withdraw the lens from the paper till the images of the most distant objects out of doors are distinctly seen upon it. The number of inches between the lens and the paper will be the focal length.

Another mode is to turn the lens with its axis pointing to the sun, and to withdraw it slowly from a piece of paper held at right angles to the axis of the lens: the point at which the sun's image is the smallest and brightest, is the focus, and the distance from this point to the lens, is the focal length of the glass. Of the same focal lengths, that glass which gives the smallest image or focus of light, is the best.

There is a peculiarity in the form of the eye occasionally though rarely met with, which was first investigated and explained by Professor Airey, Astronomer Royal. It depends on the curvature of the cornea being greater in the vertical plane than the horizontal, whereby the rays are refracted to a nearer focus in a vertical than in a horizontal plane; this gives rise to much confusion of vision, a point appearing a line, a circle an oval, and a square a parallelogram. In an interesting case related by Dr. Robert Hamilton,[1] the patient, when

[1] Monthly Journal of Medical Science, June, 1847.

looking at a clock, was unable to distinguish the hands if they pointed perpendicularly, as at six o'clock, but if horizontally he had no difficulty: so when looking at a wheel at a little distance, the horizontal spokes only could be seen. The patient was a coach painter by trade, and this peculiarity of vision greatly interfered with his business, for he could not draw vertical lines with any degree of correctness, and unwittingly made them slanting, a serious fault in heraldic devices; horizontal lines he drew with perfect precision. His method of correcting the perceptions of perpendicular lines was to bend his head at right angles with his body, whereupon upright bodies became distinct and accurately represented. This man also practised a manœuvre which forcibly reminds us of an act common to persons having conical corneæ, that of placing the fore-finger at the outer angle of the eyelids and drawing them outwards, whereby vision is improved.

To remedy the defect under which he laboured, Professor Airey made a pin-hole in a blackened card, which he caused to glide on a graduated scale; then strongly illuminating a sheet of paper, and holding the card between it and the eye, he had a lucid point on which he could make observations with ease and exactness. Then resting the end of the scale on the cheek bone, he found that the point at the distance of 6 inches appeared a very well-defined line, inclined to the vertical about 35°, and subtending an angle of 2°. Again, at the distance of $3\frac{1}{2}$ inches, it appeared a well-defined line at right angles with the former, and of the same apparent length. It was therefore necessary to make a lens which, when the parallel rays were incident, should cause them to diverge in one plane from the distance of $3\frac{1}{2}$, and in the other plane from the distance of 6 inches. The professor obtained a lens of which the radius of the spherical surface was $3\frac{1}{3}$ inches, of the cylindrical $4\frac{1}{2}$ inches, and with this he was able to read the smallest print.

In Dr. Hamilton's patient the relation of the horizontal to the vertical focus appeared to be as $5\frac{1}{2}$ inches to $6\frac{1}{2}$ inches, and on trying him with plano-concave cylindrical lenses, it was found that a lens of 24 inches focal length, the cylindrical surface being made to act horizontally, operated very beneficially. Besides this irregular refraction the man was myopic, but the lenses in question, fitted as spectacles, enabled him to see very well.

Mr. Andrew Ross informs me that he has succeeded in adapting glasses to two cases of this peculiar formation. To one of these, an architect, a profession above all others requiring correct vision, sphero-cylindrical lenses were supplied which completely obviated the defect in the curvature of the cornea. The defect of the cylindrical eye may be detected by making a small pinhole in a card, which is to be moved from close to the eye to the arm's length, the eye meanwhile being directed to the sky, or any bright object of sufficient size. With ordinary eyes the indistinct image of the hole remains circular at all distances, but to an eye having this peculiar defect it becomes elongated, and when the card is at a certain distance passes into a straight line. On further removing the card the image becomes elongated in the perpendicular direction, and finally, if the eye be not too long-sighted, passes into a straight line perpendicular to the former.

Professor Stokes has invented a highly ingenious instrument for determining the nature of the required lens, and the following is the proposition on which it is based.

Conceive a lens ground with two cylindrical surfaces of equal radius, one concave and the other convex, with their axes crossed at right angles; call such a lens an *astigmatic* lens: let the reciprocal of its focal length in one of the principal planes be called its *power*, and a line parallel to the axis of the convex surface its *astigmatic axis.* Then if two thin astigmatic lenses be combined with their axes inclined at any angle, they will be equivalent to a third astigmatic lens determined by the following construction:—

From any point draw two straight lines representing in magnitude the powers of the respective lenses, and inclined to a fixed line drawn arbitrarily in a direction perpendicular to the axis of vision at angles equal to twice the inclinations of their astigmatic axes, and complete the parallelogram. Then the two lenses will be equivalent to a single astigmatic lens represented by the diagonal of the parallelogram in the same way in which the single lenses are represented by the sides. A plano-cylindrical or sphero-cylindrical lens is equivalent to a common lens, the power of which is equal to the semi-sum of the reciprocals of the focal lengths in the two principal planes, combined with an astigmatic lens, the power of which is equal to their semi-difference. If two plano-cylindrical lenses of equal radius, one concave and the other convex, be fixed one in the lid and the other in the body of a small round wooden box, with a hole in the top and bottom, so as to be as nearly as possible in contact, the lenses will neutralise each other when the axes of the surfaces are parallel; and by merely turning the lid round an astigmatic lens may be formed of a power varying continuously from zero to twice the astigmatic power of either lens. When a person who has the defect in question has turned the lid till the power suits his eye, an extremely simple numerical calculation, the data of which are furnished by the chord of double the angle through which the lid has been turned, enables him to calculate the curvature of the cylindrical surface of a lens for a pair of spectacles which will correct the defect in his eye.

A curious case is related in the Annales d'Oculistique, of an anomaly of vision, which was probably the consequence of a defect in the form of the cornea such as that under consideration. M. Schnyder, the pastor of Menzberg, in the canton of Lucerne, was presbyopic for horizontal lines and myopic for vertical. This he remedied by wearing spectacles the glasses of which were cylindric bi-convexes, with rectilinear horizontal and similar axes. These glasses obviated the presbyopia relative to the horizontal lines, and they were combined with sphero-bi-concave lenses to get rid of the myopia for vertical lines. Each of the glasses was made moveable for facility of cleaning.

The following means are recommended to ascertain if an eye has the defect now described. The person should attentively contemplate for some time and with attention a cross, three or four lines in size, made of fine wire, and fixed in a frame. If affected, he will see the horizontal lines differ in thickness and blackness of tint from the vertical.

To determine the focal length which the lenses should have, a person whose sight is presbyopic in one direction should take bi-sphero-convex lenses which enable him to see distinctly at the ordinary distance the lines which otherwise appear indistinct: he can deduce the focal distance of the cylindrico-convex glasses. A person myopic in one direction should do the same with regard to bi-sphero-concave lenses. The convex glasses should be chosen of one or two numbers stronger.

CATARACT GLASSES.

The object aimed at in operations for cataract is, either to extract the opaque crystalline lens from the eye, to cause its absorption, or to displace it so as to give a free passage to light. As the image formed on the retina depends upon the refractions produced by means of the crystalline lens and on its power of self-adjustment to objects at different distances, the consequences of its loss usually are indistinctness of vision and loss of power of accommodation to distance. If, prior to the formation of cataract, the eye was perfect (not merely as to its power to define objects at a given distance, but as to the power of adjustment to distance also), there is after the operation an incapability of discerning near objects, as the eye no longer has the power to accommodate itself to the necessary focus.

To remedy these inconveniences double convex glasses are employed;[1] and it is necessary to have two pairs, of different focal lengths; one for looking at distant objects, the other for reading and writing.

The following are the numbers of my test-glasses:—

For reading, No. 2, $2\frac{1}{4}$, $2\frac{1}{2}$, 3.

For distant objects, No. $3\frac{1}{2}$, 4, $4\frac{1}{2}$, 5.

Opticians, however, have a greater variety to suit exceptional cases.

[1] The lenses used by *divers*, if made of crown glass and equi-convex, must have the curvatures of both surfaces equal to that of the cornea, for in order that the refraction of such a lens may be equal to that of the cornea which it is intended to supply, the focal length of the lens in water must be equal to that of the cornea in air.

It must be borne in mind that when the eye is immersed in water, the first and most considerable of its refractions is lost, for the refractive power of the aqueous humour is very nearly that of water, and so the cornea, being bounded by surfaces which are nearly parallel, the rays will pass from water into the aqueous humour without undergoing refraction. Thus a powerful convex lens is required to afford distinct vision.

Where only one eye has been operated on, or where the operation has failed in one, it is convenient to have a frame with a double bridge, as in Fig. 16, so that it can be worn with either side up; one circle may be fitted with a reading lens, the other with a lens for distant vision, and by simply turning the frame, either may at will be placed before the useful eye.

If the sight of one eye be so imperfect that it interferes with the vision of the other, a dark neutral tinted glass, or thin opaque plate, may be advantageously fitted in the circle intended for that eye.

There is considerable variety in the amount of assistance required, but glasses of four and a half inches focus ordinarily serve for viewing distant objects, and two and a half inches focus for writing or reading. In the selection of glasses, those of the *longest* focus that will answer the purpose are to be preferred.

The glasses recommended by my lamented friends, Mr. Tyrrell and Mr. Dalrymple, were of three quarters of an inch diameter, and mounted in a broad tortoise-shell rim, to

Q

diminish the weight of the spectacles, and limit the quantity of light admitted into the eye.

A cataract glass should, when placed in front of the eye, give perfect vision of objects at the distance at which they could be distinctly seen before the change in the lens commenced. If the focus be too long, the patient will find it necessary after a time to remove the glasses two or three inches from the eyes in order to see distinctly: in such a case glasses of a shorter focus must be procured. If the focus be too short, the patient will mistake the distance of objects from him, as they will appear nearer than they really are, and the hand, in the effort to grasp them, will fall short of them.

For some time after operation for cataract, the patient, (especially if young), should endeavour to do as much as possible without glasses, for although the adjusting power inherent in the eye is destroyed by the operation, nature will, if compelled, make great efforts to provide a substitute. Mr. Middlemore observes,[1] "Some years ago I

[1] A Treatise on the Diseases of the Eye. Vol. ii. p. 202.

operated on a child four years old, and directed the little patient's friends not to employ glasses to assist his sight without my permission: they carefully obeyed my directions, and this boy is now at the present time much more far-sighted than many persons whose lens has not been removed."

Sir W. Adams operated upon a postillion who was blind from cataract in both eyes. When the man resumed his employment he wore spectacles, not being able to walk without them: finding, however, that travellers objected to be driven by a person requiring spectacles, he gradually left them off, and at the end of twelve months could drive and walk perfectly well without their aid.

During the last summer I extracted a cataract from the right eye of Mr. B——, a surgeon in Essex. He subsequently scrupulously adhered to my directions to use glasses as little as possible, and five months after the operation was driving about in his gig, without glasses, conducting a very extensive practice with perfect ease. He only requires spectacles for writing, &c., and performing operations, when a $3\frac{1}{4}$ inch lens affords him excellent vision.

Glasses, then, should not, under any circumstances, be permitted for a considerable time after the operation, nor indeed so long as vision continues to improve without them. If they be used too early, and the glasses are too powerful, the eyes may become enfeebled and require more and more assistance, so that after a time no lenses will be found of sufficient power. If the individual will wait until the eye has completely recovered, and will habituate the organ as much as possible to its altered state, he will then be in a condition to select glasses of a proper strength, and these, if used sparingly, will probably serve him all his life.

GLASSES IN AMAUROSIS.

The first person who appears to have systematically used magnifying glasses as a means of restoring sight to amaurotic eyes, was a German charlatan named Schlesinger, who visited Brussels in 1838, professing to cure weak sight, strabismus, cataract, amaurosis, &c., with glasses of his own invention. This attracted the curiosity of Dr. Cunier, who, after some pains, discovered the means employed by this man, which were neither more nor less than practising the eyes daily with plano-convex glasses, beginning with very high powers and reducing them first by quarters of an inch, then by halves, and lastly by one and two inches, till the lowest powers were reached.

Dr. Cunier put this in practice with happy effect. The following is a description of the treatment as applied to a particular case.

Case XLV.—Madame la Baronne de R——, 40 years of age, perceived that the sight of her left eye failed without particular cause, and after eight years, during which treatment was unsuccessfully employed, she could with difficulty discern the large letters forming the heading of newspapers, neither could she distingush the features nor the form of a person one or two feet distant.

On examination, the pupils were seen to be moderately contracted, but on covering the right eye, that of the left dilated widely, and did not re-act under the strongest light. The greenish grey tinge often seen in long standing amaurosis was visible deep in the eye. After a variety of unsuccessful treatment, Dr. Cunier determined to try what could be done by means of glasses.

With No. 3, plano-convex, Madame R—— recognised, though with difficulty, letters of the largest type. After some minutes' exercise there was confusion of sight, the eye watered, and a sort of veil, thickening more and more, grey, then black, shrouded the letters ; frontal pain also came on, and it was necessary to discontinue the exercise ; but, on the application of cold water to the forehead and eyes, these symptoms soon disappeared.

On the second day the reading was with No. $3\frac{1}{2}$; and was practised seven times, from eight to ten minutes each time, before fatigue came on. The interval of an hour took place between each excrcise. The letters were easily recognised that evening at the distance of three inches.

The following is a summary of the exercises :

No. 3.	one day	5	exercises	of from	2 to	4 min.
$3\frac{1}{2}$	,,	7	,,	,,	8	10 ,,
4	half-a-day	3	,,	,,	10	15 ,,
$4\frac{1}{2}$	,,	5	,,	,,	,,	15 ,,
$5\frac{1}{2}$	one day	6	,,	,,	,,	16 ,,
6	two days	13	,,	,,	,,	15 ,,

No. $6\frac{1}{2}$	one day	6	exercises	of	from 10 to	15	min.
7	,,	6	,,	,,	,,		,,
8	,,	7	,,	,,	,,	15	,,

The exercise was continued on the evening of the tenth day during 22 minutes. Madame de R—— saw the hour by the clock at 75 centimetres, and recognised persons at double that distance. The glasses then used were

11th	day	of	treatment	No. 11.
12	,,	,,	,,	,, 12.
13	,,	,,	,,	,, 14.
14	,,	,,	,,	,, 16.
15	,,	,,	,,	,, 18.
16	,,	,,	,,	,, 22.
17	,,	,,	,,	,, 24.

Each of the exercises occupying from 20 to 40 minutes. Small text was read on the seventeenth day without difficulty. Madame R—— did not cease to use No. 24, until the expiration of two months, during which time aloetic medicines were taken. Ultimately the left eye became as good as that of the right for reading at from 12 to 14 inches, and for seeing large objects at from 10 to 14 metres.

M. Fronmüller has already reported favourably of the use of graduated glasses, and states, that by their aid he has cured many cases of amblyopia and mydriasis. He thus explains their action. The retina is irritated by the employment of glasses, and especially by the increase of light thrown upon it, and by the direct excitement of its function. This irritation communicated to the brain and reflected from it through the oculo-motor nerve, neutralises the action of the sympathetic, which (he imagines) determines the dilatation of the pupil, and so the disorder is overcome. This explanation will, it is feared, not be satisfactory to physiologists in general, but there can be no doubt, whatever may be the *modus operandi*, that in many cases of amblyopia, either from disuse of the eye, or from deficient energy in the retina, the careful and judicious employment of glasses is attended with excellent effect. The plan which seems best, is to commence with such power as enables the person to see large type; to rouse, but not fatigue, the retina by repeated exercises, short in duration at first, but gradually increased in length; and to reduce the power of the glasses by very short steps, so that each glass in succession may establish and improve upon the effect produced by the former. Simple though the plan is, it requires caution, should not be adopted without consideration, and the practice should be carried on under the superintendence of a competent authority. In the first instance, the largest type may be required, but its size should be diminished in proportion as the dormant sensibility of the retina is roused. The exercises should be performed in good light, and after each, the eye should be bathed with cold water, if practicable, by means of an eye-fountain.

In cases of strabismus, where the sight is imperfect from disuse, the practice with the glasses may be concurrent with that recommended to strengthen and equalise the muscles: and in cases of amaurotic insensibility, treatment calculated to remove any functional derangement which may tend to keep up the disorder of the sight, ought to be carefully employed.

CHAPTER VI.

EYE PROTECTORS, ET CETERA.

The injurious effects produced upon healthy eyes by a strong glare of light is well-known, though happily in this country the misery arising from snow-blindness on the one hand, or ophthalmia from the burning glare of the African desert on the other, is unknown.[1] Still, in these days of travel and of enterprise, when every corner of the earth is sought by the foot of man, it may be useful to point out the best modes of protecting the eyes under various contingencies; and not less to indicate the best appliances for subduing the glare in those cases of intolerance of light, so familiar to medical men.

[1] See Appendix, B.

The earliest mention with which I am acquainted of snow-blindness and the means of preventing it, is the following passage in Xenophon;[1] "Some of the men also (says that historian) who had lost their sight by the snow, or whose toes were rotted off by the intenseness of the cold, were left behind. The eyes were relieved against the snow by wearing something black before them." There are indeed two modes by which nations exposed to eternal snows obviate the distress thence arising, and both tend to one point, namely, to subdue the light either by interposing some dark material between the eyes and the snow, as mentioned by Xenophon, or by limiting the quantity of light entering the eye.

The inhabitants of Greenland have from an early period adopted the latter plan. The great botanist, Ray, makes mention of it nearly two hundred years ago, describing in his itinerary, the figure of a "native of Groenland 'hung up in a sail room at Hull.' On his forehead a thing like a trencher, which serves as a *bongrace* to fence his eyes from the sun, and it may be too from the dashing of the

[1] Expeditio Cyri. lib. iv. cap. 5.

water." This bongrace was a plate of bone with two slits cut in it, which was worn in front of the eyes. A similar contrivance is adopted by the Tungusians, and is thus described by Ermann.[1] "The Tungusian snow shades are opaque plates, in which is cut only a narrow horizontal slit before each eye * * * of these plates which have an area of perhaps ten inches, I saw several made of beaten and polished silver, which looked like the visors of knights' helmets: however, most of the men use instead of these expensive shades, a piece of yellow birch bark of the same shape, bound at the edges with leather, and then fastened to the ears with thongs."

The best illustration of the other mode of protecting the eyes, is the contrivance adopted by the Yakuts, a very neatly made narrow meshed net of black horsehair, about six inches long, and broad enough to cover the eyes, having its elliptical border sewed to a thin piece of leather, in such a way that the side turned to the face is a little concave. It is fastened with thin leather loops to the ears. Of this apparatus, Ermann says: "One of

[1] Travels in Siberia, &c., by Adolph Ermann. London, 1848.

these eye-protectors was given to me as a present, and at first I thought of treasuring the friendly gift; but, as the weather grew bright, I found myself obliged to tie it over my spectacles. This simple contrivance moderated in the most agreeable manner the dazzling light which in a few hours had brought on a violent inflammation, with a continual flood of tears from my eyes."

The infinite number of contrivances for protecting the eyes which have been devised by the ingenuity of opticians resolve themselves, with one exception, into modifications of these two modes, the exception being the employment of coloured glass, which, in the form of goggles, has long been popular.

The frequent injury to the eyes from particles of grit striking them violently in railway travelling, led to the invention of a simple apparatus much used by guards and engine-drivers—which is nothing more than concave plates of wire gauze fitted to the orbits, and retained in place by elastic bands. These, though sufficiently well adapted for the purpose for which they were devised, have the disadvantages of the vision being rather interfered with by the coarseness of the gauze, and of being too near the eye.

Various modifications have been devised, one of the best being the application of fine gauze tissue instead of the wire. It is cool, and much lighter than the wire ; indeed, the free ventilation permitted gives it an advantage over the neutral tinted glasses, and the best mode of protecting irritable eyes is either to have such an apparatus as that represented in Fig. 17, which is made entirely of gauze, or

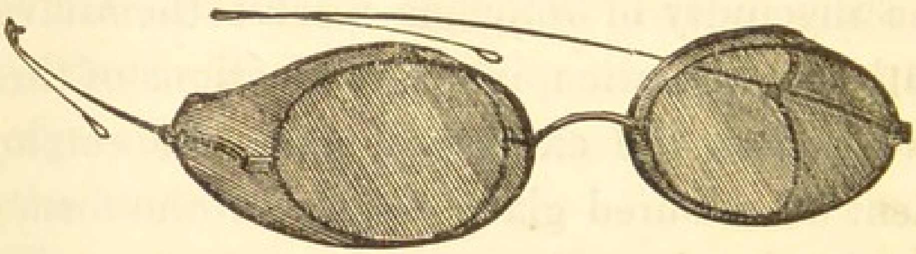


Fig. 17.

if neutral tinted glasses are essential, and side pieces are required, those side pieces should be of gauze, and not of glass, the disadvantage of the glass being its weight and heating properties. An apparatus of this kind affords the greatest comfort to travellers crossing the desert, or exposed to the sandy plains of India or Africa.

Gauze net or wire protectors, however, are not adapted for wearing in a room at night, in consequence of the action produced by these materials on the rays of artificial light. If gauze wire be held before the eyes, and the flame of a candle eight or ten feet distant be looked at, four brilliant rays, in the form of a St. Andrew's cross, and striped with prismatic colours, will be seen issuing from the flame. If the wire be slowly revolved the four rays will be broken into six, still presenting the colours. If the candle be near, the same will be seen, though much less distinctly. Gauze crape tissue gives a different appearance; a distant candle seen through it is surrounded by a bright halo, beyond which are two beautiful prismatic circles, the outermost being faint. When near, strips of prismatic colours are seen on each side the candle. If gauze net be used a similar effect is produced, though in a much less degree.

These phenomena are due to diffraction and interference of light.

It occasionally becomes necessary to shut out lateral vision altogether, as in the case of a clergyman, so nervous that, when performing duty, he experienced the utmost annoyance from the distraction caused by movements of the persons in the side galleries. Messrs. Carpenter and Westley set him at ease by constructing a spectacle frame with horn side pieces, or blinkers, which completely shut out all view of lateral objects.

Before the departure of Sir Edward Belcher's expedition to the polar regions in search of Sir John Franklin, I was requested by a gentleman high in the Admiralty to devise some means for obviating the dreadful sufferings which the seamen had on former occasions undergone from snow-blindness and from the fearful drifts of sleet characteristic of those icy regions. The conditions were, that, whilst the eyes were to be protected, neither metal nor glass were to be used, and that the eye-protectors should be proof against cold, heat, and wet. With the assistance of an ingenious optician, Mr. Pillischer,[1] the apparatus shown in Fig. 18 was constructed, the idea being taken from the Esquimaux and Greenland frames. The material is papier-mâché, varnished on the outside and "deadblacked" within, to prevent reflexion. The eye-pieces are edged with velvet,

[1] M. Pillischer, 398, Oxford Street.

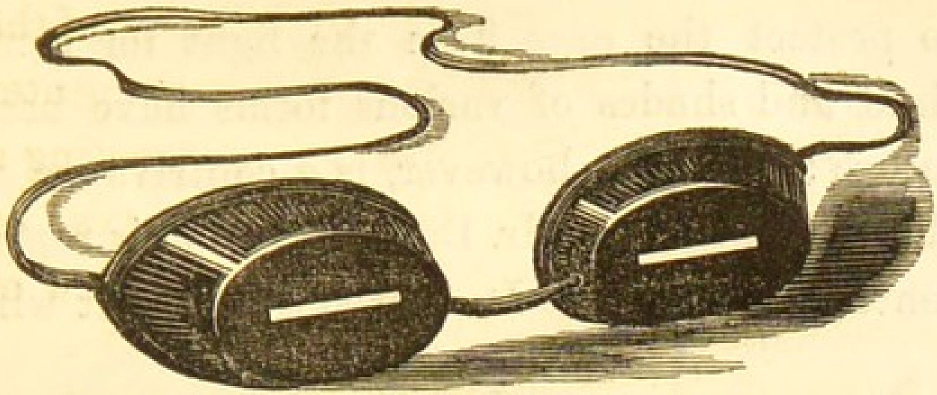


Fig. 18.

to afford a soft cushion and to completely exclude all side drafts. The slits are sufficiently large to permit vision, and the distance at which they are placed from the eyes is intended to protect those organs from the sleet, whilst the slits themselves protect them from the glare by shutting out all unnecessary light. The apparatus is retained in place by bands of vulcanised Indian-rubber, and can be lifted up and down with the utmost facility, whilst the elasticity of the bands admits of its being worn either with or without the fur cap which forms part of the costume.

Mr. Pillischer informs me that this apparatus is already in request for India and the Desert, being equally applicable for hot climates as for cold.

After the operation for cataract it is proper to protect the eyes from the light for some time, and shades of various forms have been in use: the best, however, is a contrivance of (I believe) the late Mr. Dalrymple, and is represented in Fig. 19. It consists of a light wire

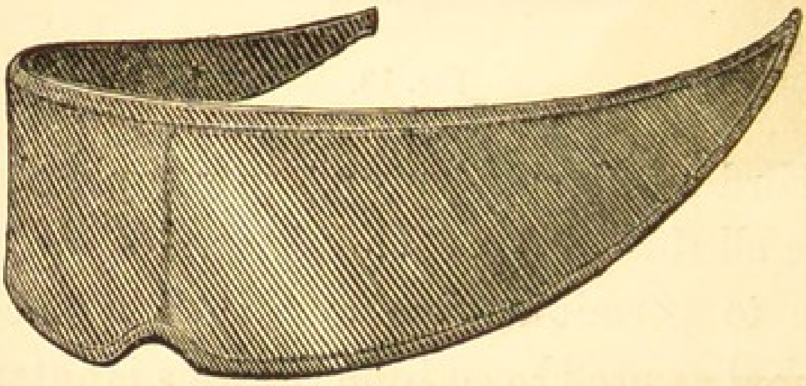


Fig. 19.

frame, covered with black crape and lined with silk, blue, green, or brown, as is most agreeable to the patients. The brown is rather the best, causing, in combination with the crape, a neutral tint shade. The elasticity of the wire, by clipping the sides of the head, fixes the shade in its place.

It is often desirable, after an eye has been destroyed, to conceal it by a patch; this is usually fixed by strings; but Fig. 20 represents a much neater mode, which was suggested by me. The patch is of black silk, stretched on a light steel frame, and is retained in its place by a fine steel spring passing over the ear to the back of the head, and having a piece of steel attached, which curving behind the ear, secures the whole firmly.

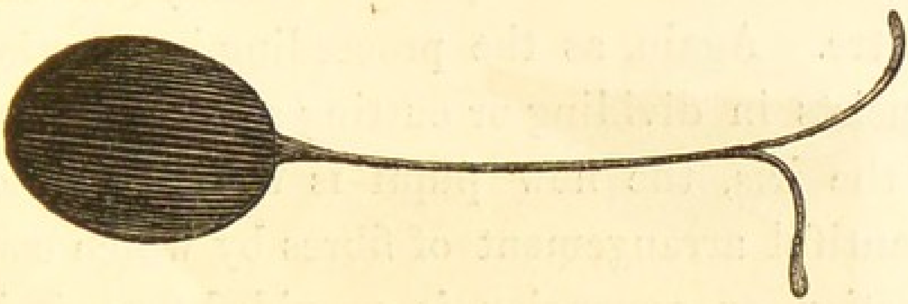


Fig. 20.

I now proceed to speak of those contrivances by which assistance may be rendered to eyes where the vision is impaired from accident, operation, or imperfection in form or direction.

For perfect vision it is essential that the rays of light pass through the centre of the crystalline lens, as then only is a true and correct image depicted on the retina; this cannot take place if the pupil be displaced, and just in proportion as it is removed from its natural position towards the periphery of the iris is the refraction imperfect, and consequently the vision confused.

This almost always follows in a greater or less degree the operation for artificial pupil;

for the very object of the operation is to give sight by making a new opening in the iris in cases where the natural pupil has been closed or destroyed; and the instances are few in which this can be placed exactly in the centre. Again, as the proceeding in question consists in dividing or cutting away a portion of the iris, the new pupil is devoid of that beautiful arrangement of fibres by which contraction or expansion is provided for; it is, therefore, motionless under all conditions of light. The following are the results of many experiments made by me for the relief of such cases.

If the aperture be central but too large, it resembles *mydriasis*, or permanent dilatation of the pupil, and may be thus obviated. A thin plate of japanned black steel, slightly concave on the inner side, should be fitted into a spectacle frame. In the centre there should be a small hole, the actual size of which must be determined by experiment in each case, in order that its dimensions may be precisely those which afford the best vision. This, worn before the eye, imitates a pupil in a state of contraction, and, by limiting the light entering the eye, materially assists vision. It may, however, be more convenient to have a slit instead of a simple aperture, to admit of extended lateral vision. Fig. 21 represents both forms.

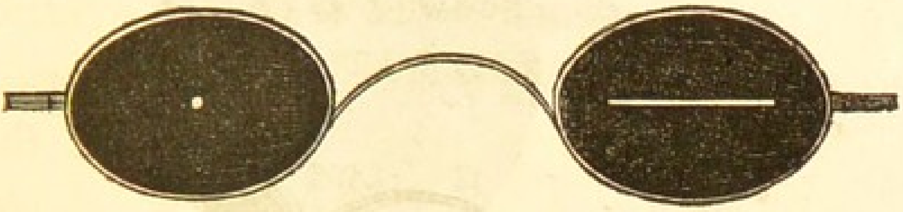


Fig. 21.

Supposing the lens to be absent in addition to the mydriasis, as would be the case if artificial pupil had been made for closed pupil after extraction of cataract, a cataract glass will be required in addition to the diaphragm, and the best contrivance for combining them is to have the diaphragm on a movable pivot, as in Fig. 22, or in the event of a spectacle-frame being preferred, and in most cases it is preferable, the diaphragm should be attached by a hinge to the outside of the frame, so that it can be lifted up as a side-piece, or folded down next the eye, as in Fig. 27. The object of the diaphragm being movable is to admit of the lens being wiped, which cannot be satisfactorily done if the two are fixed together.

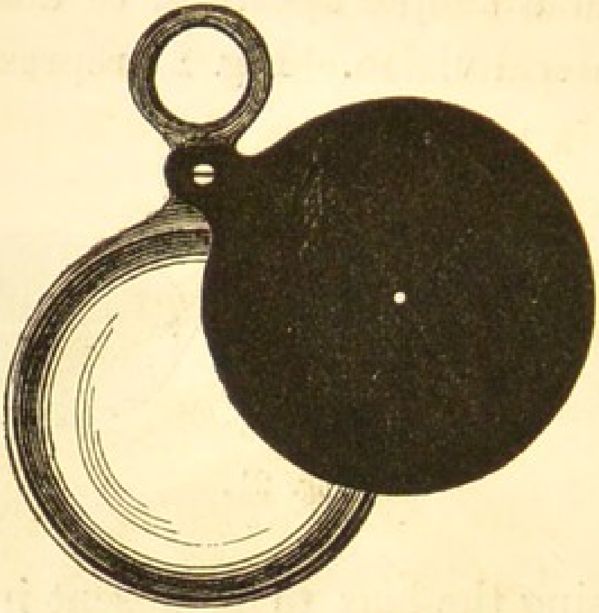


Fig. 22.

In such cases two pairs of spectacles are required, one for reading and writing, the other for the open air. It will generally be found that a simple aperture will best suit for the former, the play of the eye in study being limited; whereas a wider field being required for distant sight, a slit will be most agreeable for that purpose.

In cases where the lens is sound, and the artificial pupil placed to one side of the natural pupil, an apparatus similar in general form to the above will be found useful, but a less powerful lens will suffice, and it should be so clipped that its centre corresponds with the opening in the iris. The slit, too, in the opaque screen should be rather to the side, that it may also correspond. Such were the contrivances adopted in two cases on which I operated, and which are here represented.

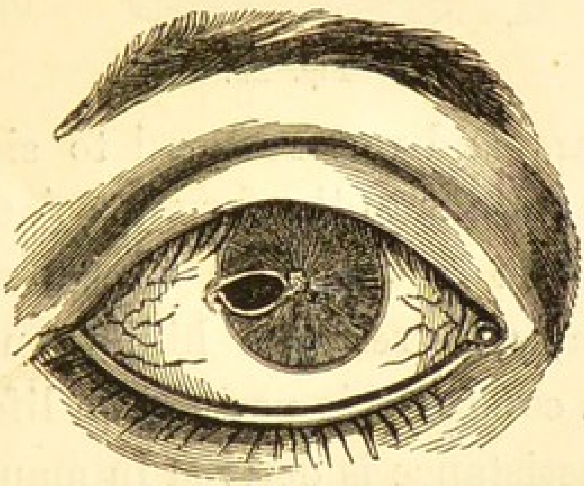


Fig. 23.

In Fig. 23 the pupils of both eyes had been closed as a consequence of iritis, and the person had been blind three years. The artificial pupil made in his right eye afforded him excellent vision, with the assistance of a diaphragm and No. 12 convex glass.

Fig. 24 represents the left eye of a patient in whom the pupil had been closed and become adherent to the cornea through an inflammation which had completely destroyed the right eye. He too had been blind for

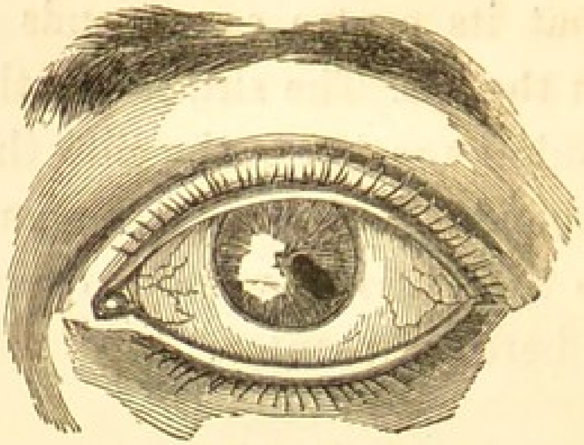


Fig. 24.

seven years, and was restored to sight by an operation similar to the former. A diaphragm with a No. 14 lens enabled him to work as a shoemaker, and restored him from absolute want to a comfortable position in life.

Much assistance is derived in many cases of conical cornea, from the use of an opaque diaphragm with a transverse slit, or a simple central aperture, according to circumstances; by preventing the entrance into the malformed cornea of a large number of those rays which, by their irregular refraction and reflection, cause confused vision, the sight is greatly improved. In some instances the addition of a powerful concave lens, as in Fig. 22, is a further aid.

In those cases of congenital malformation of the iris called *coloboma iridis,* where a fissure extends from the pupil through the iris, the simple pierced diaphragm is found useful, and it is of material assistance in simple *mydriasis*, or widely dilated pupil, from paralysis of the third pair of nerves.

Singular cases are from time to time met with, in which the art of the optician renders unexpected and signal service. The following is an interesting example:—

CASE XLV.—Lewis Lewis, aged 55, a bootmaker residing at Aberystwith, was admitted into St. Mary's Hospital, November 16th, 1852. He was a stoutly-built, healthy man, who had always enjoyed good health. Eight years ago he received a blow from a fist upon his left eye, which instantly deprived it of sight. The eye continued blind for a fortnight, at the expiration of which, perception of light returned, and then some sight, but never beyond the extent of enabling him to discern large objects faintly. Three months prior to his admission, he was unlucky enough, whilst endeavouring to separate two men who were fighting, to receive a blow upon the right eye, which completely blinded him. The case appears to have been regarded as beyond relief; but he came up to town in the faint hope that I might be able to render him some assistance. The wood-cuts (Figs. 25, 26) show the condi-

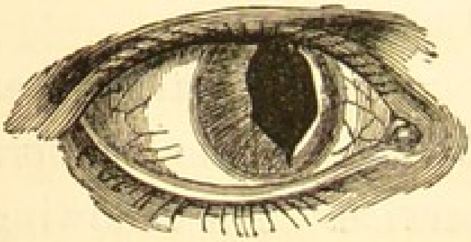


Fig. 25.

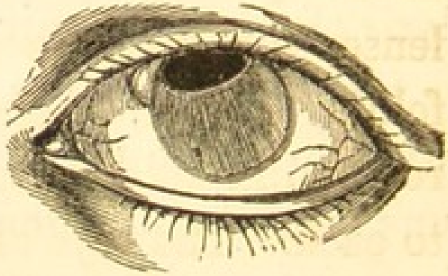


Fig. 26.

tion of the eyes. In the right, but a small semicircular strip of iris remained, there being a wide gap in its place. In the left, there was also a gap at the upper third of the iris ; the remaining portions of iris were tremulous, but immovable under light. From the assistance rendered by cataract glasses, it appeared that the crystalline lenses were absent, and they had probably escaped through the rents in the sclerotica at the time of the accident. He could faintly distinguish the outline of a hand when held up, and could just make out that there was a difference in tint between the type and paper on a printed page.

Careful examination convinced me that the only hope was to remedy the enormous artificial pupils by optical means, and after many experiments he was enabled to read with facility by the contrivance shown in Fig. 27, made by Carpenter and Westley; $2\frac{3}{4}$ cataract lenses were fixed in a light steel frame, and a folding screen, having a small aperture corresponding to the gap in the iris, was attached to each. The rays entering the eye were thus

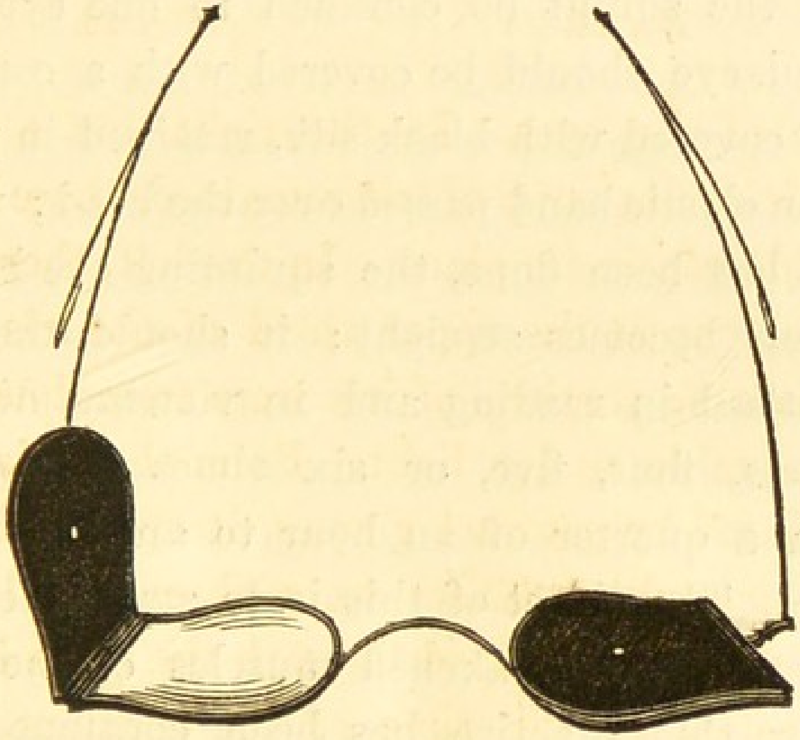


Fig. 27.

limited, and the magnifying glass supplied the place of the crystalline: to enable him to see distant objects, another frame fitted with 4-inch lenses was supplied, but the diaphragms in this had slits, for reasons already given.

There are, doubtless, many cases generally regarded as hopeless which might be materially benefited by skilfully adapted optical apparatus. In the numerous cases of strabismus, which depend rather on irregular action of the muscles than on their permanent contraction, much benefit is frequently derived from methodical practice of the following description.

If the squint be confined to one eye, the sound eye should be covered with a concave pad covered with black silk, retained in place by an elastic band passed over the head; when this has been done, the squinting eye immediately becomes straight; it should then be practised in reading and in viewing distant objects, four, five, or six times each day, from a quarter of an hour to an hour each time. The object of this is to strengthen, by exercise, the weakened muscles of the eye. After this practice has been continued for about a fortnight, we may proceed to harmonize the action of the muscles of the two eyes. It may be remarked that a squinting person rarely looks directly at an object. The face is held a little obliquely to throw the object out of the field of vision of the imperfect eye, because as the visual axes do not correspond, a double image would otherwise result. To overcome this, the following apparatus is of service; a pair of papier-mâché cups, similar to those represented in Fig. 18, but having simple central apertures exactly in front of the eyes, instead of the slits, should be worn several times during the day for practice, as follows. A small object, as a wafer, should be fixed against the wall at each end of a long room or passage, and on a level with the face of the patient. He then, wearing this apparatus, should march slowly backwards and forwards from one end of the room to the other, keeping his eyes steadily fixed on the wafers. As the only means of seeing them is by looking straight forwards through the holes, the eyes gradually acquire the power of working in harmony, and the two exercises described will often, if steadily persevered in, overcome very considerable distortions of the eyes.

If both eyes squint, each should be covered and practised in turn.

We receive material assistance in forming an opinion as to the precise nature of a case of strabismus by closing the sound eye, the other remaining open. If the squint still continues, and if the eye be unable to follow the movement of a pencil-case passed slowly transversely before the eye, we may fairly conclude that there is contraction of one or more of the muscles, and the case is favourable for operation. But if the distorted eye becomes straight on the other being closed, and follows the pencil-case without difficulty, we may reasonably hope to overcome the distortion by judicious practice, without having recourse to operative proceedings. It is useless to attempt it, however, in young children; they do not comprehend the object, and will by no means consent to the constraint of wearing or using the apparatus.

A countrywoman, aged 45, belonging to a family in which presbyopia was hereditary, consulted Dr. Cunier for external strabismus of the left eye. The deviation was very marked, was almost permanent, and had existed about eighteen years. It thus arose :—

The patient, who had refused to carry glasses so long as she was single, had, two years after marriage, began to use her brother's convex glasses.

She then obtained from a roving optician a pair of the same number. At first she found benefit from the glasses, but continued as before to give the preference to the right eye, and this increased, because the vision of the left eye was such that she could not see through the glass, so that she was obliged to keep it closed. This eye began to swerve outwards after much use of the organs, and the squint gradually became confirmed.

The treatment adopted by Dr. Cunier was as follows :—The patient was desired to cover the right eye with a bandage, and to read with the left at first four times during the day, an hour each time, gradually increased to eight hours. She was to read through glasses, of which the power was from time to time diminished. After six weeks' steady perseverance in the treatment, the strabismus ceased to be permanent. The left eye was then provided with a No. 9 concave glass, the right with No. 20 convex, and with these she could read without any deviation of the eye. The strabismus was eventually perfectly cured by these means.

CHAPTER VII.

ARTIFICIAL LIGHT.

If the eyes are employed for a considerable period upon objects that are minute and highly illuminated by artificial light, the retina is very liable to be injured; the injury may be trifling at first or even transient, but if the exciting causes are prolonged, blindness will be a very probable result, and for reasons now to be shown.

I may, in the first place, remark that the proportions in white light of each of the seven colours visible by a prism are as follows, according to the observations of two of the ablest observers :—

	Newton.	Fraunhofer.
Red	45	56
Orange	27	27
Yellow	40	27
Green	60	46
Blue	60	48
Indigo	48	47
Violet	80	109
	360	360

Sir David Brewster, however, showed that the Newtonic theory of light being composed of seven colours was incorrect, the solar spectrum in reality consisting of only three primary colours, red, yellow, and blue, each of which exists throughout the whole of the spectrum; and that the super-position of these in different degrees of intensity in different parts produces the seven hues. The proportion in which the primary colours combine to form white or daylight is—

Yellow, three parts.
Red, five parts.
Blue, eight parts.

If these proportions are not exactly maintained, the light, instead of being pure and colourless, will be tinged with the hue that is in excess.

Each of the seven prismatic colours possesses a degree of refrangibility peculiar to itself, and the undulations of each are distinct as regards number, size, and velocity; as shown in the following table, carefully constructed by Sir John Herschel:—

Coloured Rays.	Length of luminous waves in parts of an inch.	Number of undulations in an inch.	Number of undulations in a second.
Extreme Red	0.0000266	37640	458 mills. of mills.
Red	... 256	39180	477 ... ...
Intermediate	... 246	40720	495 ... ...
Orange	... 240	41610	506 ... ...
Intermediate	... 235	42510	517 ... ...
Yellow	... 227	44000	535 ... ...
Intermediate	... 219	45600	555 ... ...
Green	... 211	47460	577 ... ...
Intermediate	... 203	49320	600 ... ...
Blue	... 196	51110	622 ... ...
Intermediate	... 189	52910	644 ... ...
Indigo	... 185	54070	658 ... ...
Intermediate	... 181	55240	672 ... ...
Violet	... 174	57490	699 ... ...
Extreme Violet	... 167	59750	727 ... ...

Each colour possesses a degree of heat also peculiar to itself, for, according to the experiments of Sir Henry Englefield, a thermometer exposed to the red rays stood at 72° Fahrenheit, whereas under the influence of the blue rays the mercury sunk to 56°.

Thus, as we are conscious of the existence of light, and the phenomena of colours by impressions made by the vibrations of the rays upon the retina, we can at once understand how the undulations of the red, being the fewest in number, the greatest in length, and attended with the largest amount of heat, affect the retina most forcibly.

Consequently, as artificial light possesses more red and yellow rays than daylight, it is more fatiguing and injurious to the eyes.

It is a well known fact, that when flame is not raised to a very high temperature, it gives out red light: at a higher temperature, the light is orange or yellow coloured; if the heat be still more increased, the blue rays are formed in greater abundance, and the light becomes much whiter. The blue rays, which are so necessary to neutralise the red and yellow rays, are not developed until the particles of carbon in the flame are more effectually brought into contact with oxygen. In flame produced from the combustion of tallow, oil, and coal gas, this is particularly the case, and if the particles of carbon are not sufficiently brought into contact with oxygen, the combustion is imperfect, and the flame smokes, that is, throws off a large quantity of soot.

"When in flames," says Dr. Ure, "pure gaseous matter is burnt, the light is extremely feeble. The density of a common flame is proportioned to the quantity of solid charcoal first deposited and afterwards burned. The form of the flame is conical, because the greatest heat is in the centre of the explosive mixture. The heat diminishes towards the top of the flame, because in this part the quantity of oxygen is least. When the wick increases to a considerable size from the collecting charcoal, it cools the flame by radiation, and prevents a proper quantity of air from mixing with its central part. In consequence, the charcoal thrown off from the top of the flame is only red hot, and the greatest part of it escapes unconsumed."

When the eye is exposed to light in which the red and yellow rays prevail, the colours in excess produce first an excitement, and afterwards a degree of debility of the retina, precisely similar to the phenomena which have been already explained as following the use of blue or green glasses. Consequently, that light which approaches the nearest to white is best suited for the eyes, and that which partakes most of red, the worst.

Another cause of the injurious effects of artificial light is the direct and concentrated manner in which it acts upon the eyes. The rays from a candle or lamp fall direct upon the object which a person is regarding (the page of a book or sheet of writing paper for instance), and are thence reflected into the eyes, carrying with them a considerable quantity of heat, which irritates and inflames the external coats of the eyes, and the lining membrane of the lids. A great portion of the heat which accompanies the sun's rays is absorbed by the repeated reflections from the atmosphere and clouds, or from the surface of the earth, which the light undergoes before it reaches the eyes.

Another cause of the distress produced by artificial light upon some eyes, is the fact of the rays not falling in parallel, but divergent lines upon the object, from which they are reflected in equally divergent lines; consequently, indistinctness of vision results from the want of definition of the object; whereas, the rays from the sun, owing to its immense distance from the earth, may be regarded as parallel.

The unsteadiness of artificial light is another serious evil to persons suffering from weak eyes. Every one must have experienced the discomfort and annoyance arising from the flickering of some candles, and have felt the relief afforded when they have been snuffed and made to burn steadily. One great superiority of daylight over artificial light is its perfect evenness. It is some inequality, either in the current of air, or in the supply of combustible material, that renders the common flame unsteady and wavering.

Carbonic acid gas is one of the chief products of combustion, and when in excess in the air we breathe, is prejudicial to the human system; where so far diluted with air as to admit of its being received into the lungs, it operates as a narcotic, producing drowsiness, difficulty of breathing, pain in the head, giddiness, and faintness. But carbonic acid gas is given out in respiration also; for respiration is a slow combustion, and presence of the gas in undue quantity is the cause of the headache so often felt when in a crowded, ill ventilated, and brilliantly lighted room.

Carbonic acid gas, and the vapour of water (the products of the oxygenation of the carbon, and the evolution of hydrogen during combustion), accumulate to a great extent in crowded apartments, not properly ventilated, and especially so when the lights are numerous.

The effects upon the human system are very serious, leading to impairment of health, principally through the medium of the brain and nervous system. This gas has neither colour nor smell, and a person may be exposed to its pernicious influence for some time unconsciously, and even at last is only made aware of its presence by its effects. The air in rooms artificially illuminated may have other sources of contamination; if, for example, the tallow of the candles has been hardened by admixture with arsenic, or the gas has not been purified from sulphurous compounds, the fumes arising from the combustion of the arsenic and of the sulphur, materially increase its deleterious character. The effects upon the human frame are shown occasionally in chlorine manufactories, where the workmen, from an accidental exposure to a stream of pure chlorine gas, sometimes fall down suddenly, as if they had been shot; and even in manufactories of sal ammoniac, the men employed endure the most severe convulsions, when exposed, as they are occasionally, to the influence of sulphuretted hydrogen gas.

As a knowledge of the different kinds of artificial light and their comparative merit, is desirable, I propose to add a few remarks upon those principally employed, and to suggest some means of obviating their injurious effects.

The artificial light in most extensive use at the present day, is that arising from the combustion of carburetted hydrogen gas, a gas produced from the destructive distillation of common coal.

For general purposes this answers effectually, although it is open to the objection of evolving a large quantity of heat and carbonic acid gas. The ordinary gas-burners are not well adapted for reading, writing, sewing, drawing, or similar employments which require a light of considerable defining power and pure colour. The colour of a common gas-light is yellow, and to define minute objects it is necessary for it to be placed near the eyes, which are liable to be injured by its heating properties as well as its impure colour. Gas-lights differ from most other lights in their extreme tenacity of combustion; they will burn for a considerable time in air so loaded with carbonic acid, moisture, and nitrogen, as to extinguish oil lamps and candles. There is generally also some escape of unconsumed gas, so that special arrangements ought to be made for the ventilation of rooms lighted with gas.

The principal kinds of gas-burners in use are, 1. The *Cockspur jet*, in which the gas issues from a small hole in a steel nozzle. 2. The *Batswing*, a thin sheet of gas produced by its passing through a fine saw-cut made in the upper part of a hollow globe. 3. The *Fish-tail jet*, in which two jets of gas meet each other at an acute angle, and spread each other out in a thin film of gas at right angles to the line in which the two jets are. The flame has the form of a thin triangular sheet or fish-tail with the narrow end downwards. 4. The *Argand*, in which the gas issues from a number of small jets arranged in a circle: when lighted, all the jets unite, forming a tube of flame; a chimney being then applied, and equable currents of air established on each side of the flame, great facility is afforded to the union of the oxygen of the atmosphere with the carbon of the gas. 5. The *Fan* is a spreading semicircle of small and separate jets.

The argand, if properly attended to, excels all others in brightness and steadiness of flame.

Every burner has just one quantity of gas that suits it best, or, in other words, is the most economical; affording a greater amount of light, with less smoke, than any other quantity with which it can be supplied.

The combustible, which has perhaps of late years attracted the greatest amount of attention, is camphine. Camphine is a liquid obtained from common turpentine, being separated by distillation from the resin which is a component ingredient in the latter. From the great abundance of turpentine in the American forests, camphine was long in use in the United States before its introduction into England. Various modifications of lamps for burning this substance have appeared, but whatever the name, whether "Vesta," "Paragon," or "Imperial," all present in common a reservoir generally of glass, placed between the supporting pillar and the burner; the spirit is contained in the reservoir, and a cotton wick dips down into it; the arrangements for the admission of air to the flame constitute the chief points of difference between the rival lamps. The purity of the flame and the strong illuminating powers of camphine lamps have obtained for them great celebrity. Of the Vesta, Dr. Ure states that, when burning with its utmost brilliancy, it emits a light equal to very nearly twelve wax or sperm candles of three or four to the pound; but this very brilliancy, although highly desirable for illuminating apartments, constitutes a serious objection to its use for reading or writing; it resembles, in fact, the glare of the bright sun, and as such is too stimulating for the eyes. Many persons have complained that, after having used a camphine lamp in their studies, the light of ordinary candles became insufficient. Many of the more brilliant hand reading-lamps, which are surrounded with shades enamelled white on the inside, are open to the same objection; they throw too strong a light on the page or the paper. By the injudicious employment of too brilliant light for the purpose of study, the sensibility of the retina may be blunted by slow and scarcely perceptible degrees, without the patient being alarmed by sudden impairment of vision or marked difference in the sight. Vivid lights render ordinary candles dull and insufficient in the same way that the too rapid increase in the power of spectacles annihilates the effect of the more moderate numbers.

Dr. Ure has given the following table of the relative cheapness of a given quantity of light among various lamps and candles, the first being the cheapest, and the proportionate price gradually increasing:—

Hot oil lamp with southern whale oil.
Carcel lamp with sperm oil.
Hot oil lamp with sperm oil.
——————— with common olive oil.
——————— with cocoa-nut oil.
French lamp with sperm oil.
Mould tallow candles.
Palmer's spreadwick candles.
Stearic acid candles.

Cocoa-nut stearine.
Spermaceti candles.
Wax candles.

Mr. Smee recommends napthalized coal gas as affording a very superior light. It is the ordinary gas passed through an apparatus containing a series of sponges saturated with coal-tar naptha, and that gentleman advises that it should be burned, either by means of a "Scotch fish-tail burner," or else by an argand, in order that a good supply of oxygen may be obtained, which is as indispensable for the production of a brilliant light, as for the prevention of smoke.

The light obtained by burning oil is of a superior description, but much depends on the construction of the lamp. In common oil lamps there are two prominent defects, the tendency of the oil to thicken in cold weather, and the difficulty of keeping the wick well moistened with oil up to the verge of the flame.

In the *Carcel* lamp, so popular in Paris, the oil is raised through tubes by clockwork, so as continually to overflow at the bottom of the burning wick, thus keeping it thoroughly soaked.

In Parker's "hot oil lamp" there is a second tube at a small distance around the tube which contains the wick, and the space between them forms a reservoir in which the oil is contained: it there becomes warm, and descends through a valve to the wick, whilst the intensity of the flame is modified by raising or lowering a bell-mouthed glass chimney.

In the *Argand* lamp the wick is hollow and cylindrical, and receives a current of air both internally and externally, whereby a very perfect combustion is obtained. In the *Solar* lamp the action of the air on the exterior of the wick is still more decided, and the combustion consequently more complete, whereby a brilliant and clear flame is secured.

A lamp of much pretension is the "*Moderateur,*" in which rape oil, under the denomination of colza oil, is burnt. The lower part of the pedestal consists of a reservoir for the oil, provided with a kind of piston or plunger worked from the outside. The rising of this piston causes a coiled wire spring to press upon the surface of the oil which is forced up through a tube to the flame. This lamp gives a good light, and much artistic skill has been displayed in Paris upon the form and ornaments.

Before dismissing the subject of lamps, I may mention that Sir David Brewster has invented a lamp which affords an homogeneous yellow light, valuable in microscopical observations as preventing chromatic aberration. The term *monochromatic* has been applied to it. It consists of a spirit lamp, whose wick has been soaked in strong brine, and the flame is allowed to play on a mass of common salt placed above it; under its influence the brilliant red of vermillion appears pale yellow. Cochineal assumes a black hue, as does the bright blue of ultramarine and cobalt.

Palmer's candles are now very extensively used,[1] and differ from ordinary candles in not

[1] In the Report of the Jurors of the Great Exhibition, in 1851, it is mentioned that Price's Candle Company is the most colossal establishment in the world in this branch of manufacture. Possessed of five different manufactories, besides plantations of cocoanut trees in Ceylon, they employ 800 workpeople, and divide annually in profits between 40,000*l.* and 50,000*l.*

There were no less than 46 exhibitors of rival lamps and 64 requiring snuffing. This is attained by causing the wick to bend out of the flame so as to come into contact with the atmosphere. The wick is formed of two halves twisting spirally round each other; each half is bound round in a tolerably compact form, and the process of untwisting the spiral by the gradual burning of the candle causes the tops of the two wicks to spread out laterally beyond the boundary of the flame. The charred part of the wick being then consumed, the candle needs no snuffing. The plaited wick is not applicable to the tallow candle without some special contrivance, as in curling over the outside of the flame it causes the tallow to melt in such large quantities that constant guttering is produced. It is, therefore, necessary to protect the candle if a self-snuffing wick be employed. In Palmer's lamp this is effected by the candle being enclosed in a vertical cylinder with a cap whose orifice is smaller than the candle, and as the candle is consumed, a spiral spring presses it upwards

exhibitors of candles in the Exhibition, and though the Jury reported on the candles, they shrunk from a decision on the merits of the lamps from the expense and difficulty attending it.

against the cap. Plaited wicks are not adapted for wax candles, as the plaiting, by diminishing the capillary action, entails the necessity for so large a wick that it obscures the light; besides which, it is apt to curl round and round in the flame, and to collect a quantity of soot. The wicks of wax candles are always made of twisted, unbleached Turkey cotton, the fibre of which appears best calculated to resist the temperature of the highly heated wax during combustion.

In France the wax candle has been completely superseded by the more luminous candles of pure white stearic acid, which are invariably used for their grand fêtes. The light afforded by these, or by wax candles, is remarkably pure and agreeable to the eyes. It is sufficient for the purpose of illumination without inducing fatigue of the organs. Its defining powers are considerable, whilst it is devoid of the glare and heating properties which render gas so objectionable. Common candles emit a very inferior light, and the flickering, unevenness, and want of steadiness of the flame constitute an objection from which even those made of wax are not quite free, but which is particularly conspicuous in the commoner descriptions of candles. Upon the whole, a person who employs his eyes much by night, cannot if circumstances admit of it, do better than use wax candles. I find from experience that the light they afford enables me to write longer with less distress to the eyes, less irritation of the lids, and a greater amount of general comfort than any other.

The best *composition* candles are made of stearine mixed with one-fourth or one-eighth of its weight of wax. They afford an excellent light, and are less expensive than wax.

The injurious effects of artificial light shown to arise from its having an excess of red and yellow rays, may be obviated by surrounding the light with a shade, coloured blue on the inner surface. The blue rays reflected from the shade mingle with the reddish yellow rays proceeding directly from the flame, and produce a light of a much purer and whiter colour; this may be effected by painting the inner surface of the shade with cobalt blue, applied evenly.

Another mode of improving artificial light is by surrounding the lamp with a glass chimney tinged with a pale blue; this absorbs the excess of red and yellow rays, and renders the light more agreeable.

A third means of absorbing the red and yellow rays, is by causing the light to pass through a fluid coloured blue. Wood engravers are in the habit of employing a glass globe of about six inches diameter filled with water, which being interposed between the light and their work, converges the rays and thus increases the illuminating power. If a very small quantity of ammoniuret of copper be added to the water, it assumes a delicate blue colour, and renders the light transmitted through it purer by absorbing a portionof the red and yellow rays. The water should be of such a tint that a piece of white paper held behind the bottle by daylight appears sky blue.

Condensers, such as are here described, have another advantage; that of diminishing the heating powers of the rays, for Professor Melloni has shown, that when rays of artificial light are passed through a thin stratum of water, their heating power is diminished eighty-nine per cent. It is an interesting fact that though the heat of the sun-light will pass through transparent media, that of a candle will not, so long as such media are cold.

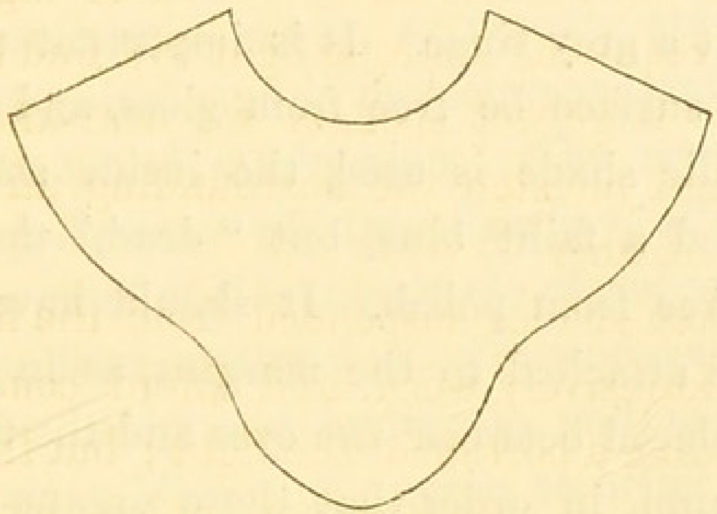
Persons working in rooms heated with hot air, should place (as is done on the continent) in some convenient situation, a flat dish containing water, which by its exhalations will render the air less arid; and those engaged in work requiring a strong light will find that one or two large wet sponges set near them, will cool and moisten the surrounding air in the same manner.

Silken shades suspended from the forehead are extensively worn, and afford comfort by excluding a portion of the light; but they tend to keep the eyes too hot, unless means are taken to cool the upper surface of the shade by damping it. It is preferable, when it can be accomplished, to have the shade around the light.

Blue spectacles are sometimes used, but, independent of the objections to them before stated, they soon become hot and uncomfortable in consequence of the rays absorbed by them from their want of perfect transparency; if neutral tint glasses are made use of, this evil may be obviated by having two pair, and using them alternately.

A simple and convenient shade may be made of cartridge paper cut into the shape indicated in Fig. 28.

Fig. 28.



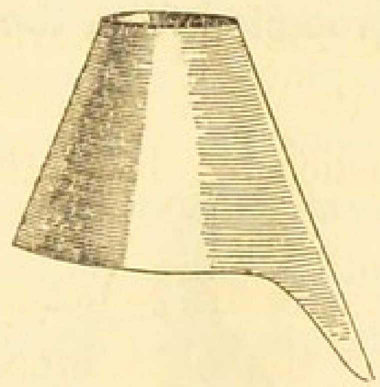


Fig. 29.

When the straight edges are united, a conical shade is formed, with a tail-piece to it, as in Fig. 29.

This shade fits over any ordinary reading lamp, and is to be placed so that the tail-piece shall be between the eyes and the candle. It may be coloured on the inside with a solution of cobalt blue, and the outside should be tinged with a weaker solution of the same to give it a grey tinge. It is important that the inner surface be free from gloss, and when a metallic shade is used, the inside should be painted a faint blue, but "dead," that is to say, free from polish. It should have pieces of tin attached to the margins, as in Fig. 30, and placed between the eyes and the flame of the lamp, in order that those organs may be completely protected from the glare and heat.

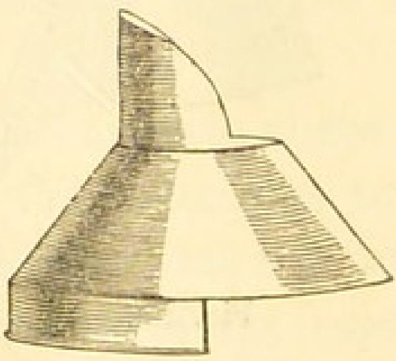


Fig. 30.

The comfort afforded to weak eyes by this simple contrivance is very great.

Shades of ground-glass are well adapted for purposes of general illumination, as they soften the light and diffuse it by presenting a great number of luminous points. They are not, however, so well adapted for reading lamps, an opaque shade being preferable.

Carbonic acid gas is, as already stated, a powerful poison, and is the common product of respiration and combustion. The results of the experiments of Dr. Faraday afford a striking proof of the magnitude of the product resulting from combustion. Oil and gas each contains carbon and hydrogen, and each requires the addition of oxygen to bring about combustion. The results of the combustion are, *water*, by a combination of some of the oxygen with the hydrogen, and *carbonic acid*, by the combination of more of the oxygen with the carbon: and the quantities of these two substances so produced are quite extraordinary. We learn from Professor Faraday that a pint of oil, when burned, produces a pint and a quarter of water, and a pound of gas more than two and a half pounds of water, the increase of weight being due to the absorption of oxygen from the atmosphere. A London argand gas lamp, in a closed shop window, will produce in four hours two pints and a half of water; a pound of oil also produces nearly three pounds of carbonic acid, and a pound of gas two and a half pounds of carbonic acid. For every cubic foot of gas burned, rather more than a cubic foot of carbonic acid is produced. If, therefore, many persons are employed in a close room where numerous lights are burning, the amount of carbonic acid so produced must of necessity be highly deleterious; inasmuch as the quantity produced is in a ratio to the crowded state of the room and the number of lights burnt.

Dr. Arnott states that "in respiration a man draws into his chest at one time about twenty cubic inches of air, and of that air a fifth part is oxygen, of which again there is converted into carbonic acid gas nearly one-half. About fifteen inspirations are made in the minute, vitiating, therefore, three hundred cubic inches, or nearly one-sixth of a cubic foot of atmospheric air; but which, mixing as it escapes with several times as much pure air, renders unfit for respiration, under ordinary circumstances, at least two cubic feet of air per minute."

Tredgold calculates that the air directly vitiated amounts to eight hundred cubic inches per minute. He also computes that it requires three cubic feet of air per minute to carry away the insensible perspiration of the skin.

Taking these results, and the quantity of air vitiated by combustion, he calculates that when a room containing several persons is lighted to the customary degree, it will be necessary to supply four times as many cubic feet of fresh air per minute as there are persons in the room.

Carbonic acid gas, where pure and of equal temperature, is heavier than common air, but the carbonic acid gas of respired air is warmer than common air, besides being combined with nitrogen and the vapour of water, both of which also are lighter than common air ; so that respired air, though containing carbonic acid gas, is really lighter than common air and rises to the ceiling ; and as fast as it escapes by openings in the ceiling, fresh air rushes into the room under doors, and through any apertures which may exist near the ground.

In rooms thus ventilated, the carbonic acid is carried away and can exercise no pernicious influence upon the human frame; but in crowded, low, ill-ventilated apartments, this impure air accumulates to a great degree, and gives rise to headache, oppression of breathing, giddiness and indistinct vision, and eventually produces a serious effect upon the health. For instance, in its most aggravated form it not only induces apoplexy and consumption, but decidedly favours that depression which leads to habitual lowness of spirits and even to suicide. So that bad ventilation may be fairly said to be injurious to the mind as well as the body.

Perhaps no class of men suffer more severely from the evil effects of impure air than tailors. They generally work in crowded rooms, strongly illuminated, and where, from an utter neglect of ventilation, the heat is excessive, and the atmosphere most vitiated. Dr. Southwood Smith draws the following vivid picture of their condition. "In a room (says he) sixteen or eighteen yards long and seven or eight wide, eighty men worked together; they were close together, nearly knee to knee; in summer-time the heat of the men and the heat of the irons made the room twenty or thirty degrees higher than the heat outside. The heat was then most suffocating, especially after the candles were lighted; such has been the state of the atmosphere, that, in the very coldest nights, large thick tallow candles have melted and fallen over from the heat. This state of the place of work produced a very depressing effect on the energies of the workmen; many could not stay out the hours, and went away earlier. Those who were not accustomed to the place generally lost appetite. The natural effect of the depression was, that recourse was had to drink as a stimulus, gin being taken instead of food."

In printing houses, even with low ceilings, there is often an immoderate use of gas, and no means of obtaining heat, except from the gas lamps and products of combustion.

I have stated these facts somewhat at length, because the impaired vision so distressingly common amongst tailors and printers may be attributed quite as much to the unfavourable condition in which they work as to the unavoidable strain upon the eyes.

The pernicious effects of gas-lights may partly be obviated by preventing the vitiated air mingling with the air of the apartment. Let a tube be attached to the burner which shall convey the products of combustion completely away. There are two modes: either by an upward movement, or by a downward movement. Professor Faraday's ventilator is as nearly perfect as possible.

The gas-light has a glass chimney as usual, but the glass-holder is so constructed as to sustain not merely the chimney, but an outer cylinder of glass larger than the first. The glass-holder has an aperture in it connected by a mouth-piece with a metal tube, which serves as a ventilating flue, and which, after passing horizontally to the centre of the chandelier, there ascends to produce draught, and carry off the foul air. The tube may be conducted into a chimney, or through a wall, if a single light be burnt.[1]

[1] The apparatus is to be procured of Mr. R. Faraday, 114, Wardour Street, Soho.

The carbonic acid gas, aqueous vapour, smoke, and other emanations from the flame, having no means of escape except through the tube, are wholly cut off from contact with the atmosphere of the room, and are conveyed out of the house. The mode of carrying out the arrangement may be varied in details, but I know from observation that the general result is, that the light is brighter, the space around the lamp cooler, and the air of the room less vitiated than when common burners are employed. The apparatus is in use at the Athenæum Club, and indeed the invention arose out of a complaint that, in consequence of the vitiation of the air of the library of that club by the lamps formerly used, the binding of the books was seriously injured.

A plan devised by P. C. de la Garde, Esq., has been adopted at the Devon and Exeter Institution, and it is said to be attended with great success.

A tube an inch in diameter, having a trumpet-mouth, is suspended immediately over the flame of an argand burner. The upper part of this tube enters for about twelve inches into a tube of similar shape, but of double the diameter.

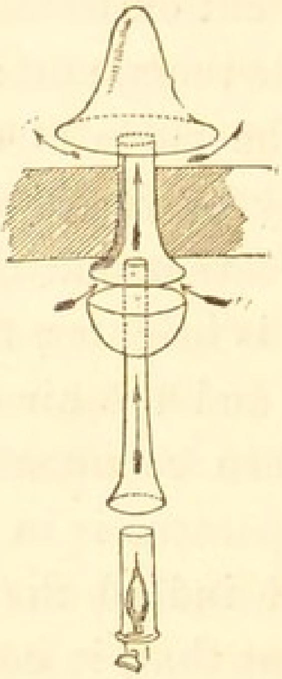


Fig. 31.

The lip of the trumpet-mouth of the larger tube is exactly level with the ceiling; the upper end passing through the roof is protected from rain by a conical cap. The column of hot air ascending rapidly the glass chimney, passes through the small tube with great velocity into the larger tube, through which it also occasions an ascending current; whilst the air vitiated by combustion escapes, the larger tube permits an escape through the roof not only of the air which is received from the smaller tube, but also of the air vitiated by respiration or other cause, and collected in the upper part of the room. All moisture condensed in the upper tube during cold weather is caught in a vessel which surrounds the tube, immediately below the mouth of the upper one. The entire apparatus is of copper, and for seven years required neither cleaning nor repairing.

It would be foreign to the purpose of this work to enter more fully into the subject of ventilation; but those interested in its application to the dwellings of the poor, may advantageously consult a pamphlet published by the "Metropolitan Working Classes Association, for improving the Public Health." It is entitled "On the Ventilation of Rooms, Houses, and Workshops,"[1] and contains many useful suggestions, simple and easy of application.

[1] Churchill. London, 1846. Price One Penny.

APPENDIX.

APPENDIX A.

The case of Milton affords a well marked example of destruction of sight from over-work of the eyes, and we are enabled to trace its progress from the beginning to the end. In his "Second Defence of the People of England," he writes: "My father destined me from a child, for the pursuits of polite learning, which I prosecuted with such eagerness, that after I was twelve years old, I rarely retired to bed from my lucubrations till midnight. This was the first thing which proved pernicious to my eyes, to the natural weakness of which were added frequent headaches." His eyesight was much impaired when he undertook his celebrated answer to Salmasius. During the progress of that work he became blind of one eye, and soon after its completion, he lost the use of the other also. Then it was, that he wrote the following description of his case to his distinguished friend Philaras, in the hope that Thevenot, a celebrated oculist of that day, might suggest some treatment for his relief.

"To Leonard Philaras the Athenian.

"I have always been devotedly attached to the literature of Greece, and particularly to that of your Athens; and have never ceased to cherish the persuasion that that city would one day make me ample recompense for the warmth of my regard. The ancient genius of your renowned country has favoured the completion of my prophecy, in presenting me with your friendship and esteem. Though I was known to you only by my writings, and we were removed to such a distance from each other, you most courteously addressed me by letter; and when you unexpectedly came to London, and saw me, who could no longer see, my affliction, which causes none to regard me with greater admiration, and perhaps many even with feelings of contempt, excited your tenderest sympathy and concern. You would not suffer me to abandon the hope of recovering my sight, and informed me that you had an intimate friend at Paris, Dr. Thevenot, who was particularly celebrated in disorders of the eyes, whom you would consult about mine, if I would enable you to lay before him, the causes and symptoms of the complaint.

"I will do what you desire, lest I should seem to reject that aid which perhaps may be offered me by Heaven.

"It is now, I think, about ten years since I perceived my vision to grow weak and dull; and at the same time I was troubled with pain in my kidneys and bowels, accompanied with flatulency. In the morning, if I began to read, as was my custom, my eyes instantly ached intensely, but were refreshed after a little corporeal exercise. The candle which I looked at, seemed, as it were, encircled with a rainbow. Not long after, the sight in the left part of the left eye (which I lost some years before the other) became quite obscured, and prevented me from discerning any object on that side. The sight in my other eye has now been gradually and sensibly vanishing away for about three years; some months before it had entirely perished, though I stood motionless, every thing which I looked at seemed in motion to and fro. A stiff cloudy vapour seemed to have settled on my forehead and temples, which usually occasions a sort of somnolent pressure upon my eyes, and particularly from dinner till the evening; so that I often recollect what is said of the poet Phineas, in the Argonautics:—

> 'A stupor deep his cloudy temples bound,
> And when he walked, he seemed as whirling round,
> Or in a feeble trance he speechless lay.'

"I ought not to omit that, while I had my sight left, as soon as I lay down on my bed, and turned on either side, a flood of light used to gush from my closed eyelids. Then, as my sight became daily more impaired, the colours became more faint, and were emitted with a certain inward crackling sound; but at present, every species of illumination being, as it were, extinguished, there is diffused around me nothing but darkness, or darkness mingled and streaked with an ashy brown; yet the darkness in which I am perpetually immersed, seems always, both by night and day, to approach nearer to white than black; and when the eye is rolling in its socket, it admits a little particle of light, as through a chink; and though your physician may kindle a small ray of hope, yet I make up my mind to the malady as quite incurable; and I often reflect, that as the wise man admonishes, days of darkness are destined to each of us. The darkness which I experience, less oppressive than that of the tomb, is, owing to the singular goodness of the Deity, passed amid the pursuits of literature and the cheering salutations of friendship. But if, as is written, man shall not live by bread alone, but by every word that proceedeth from the mouth of God, why may not any one acquiesce in the privation of his sight, when God has so amply furnished his mind and his conscience with eyes? While he so tenderly provides for me, while he so graciously leads me by the hand, and conducts me on the way, I will, since it is his pleasure, rather rejoice than repine at being blind. And, my dear Philaras, whatever may be the event, I wish you adieu with no less courage and composure than if I had the eyes of a lynx.

"*Westminster, September* 28, 1654."

Amongst the reflections excited in his mind by his blindness, the following are not the least remarkable for their sublimity, and the spirit of resignation which they breathe.

"Whatever," says he, "I have written, yea at any time (since the royalists in their exultation imagine that I am now suffering for it by way of atonement, as they will have it), I call God to witness that I have written nothing which I was not persuaded at the time, and am still persuaded, was right and true, and pleasing to God; and this without being moved by ambition, by lucre, or by glory; but solely a sense of duty, of grace, and of devotion to my country; that, above all, I have done this with a view not only to the deliverance of the Commonwealth, but likewise of the Church. Hence, when that office against the royal defence was publicly assigned to me, and at a time when not only my health was unfavourable, but when I had nearly lost the sight of my other eye; and my physicians expressly foretold, that if I undertook the task I should in a short time lose both—in nowise dismayed at this warning, methought it was no physician's voice I heard—not the voice even of Æsculapius from the shrine of Epidaurus—but of some diviner monitor within. Methought that by a certain fatality of my birth, two destinies were set before me, on the one hand blindness, on the other duty—that I must necessarily incur the loss of my eyes, or desert a sovereign duty. Hence I thought with myself, that there were many who purchased a less good with a greater evil; for instance, glory with death. On the contrary, I proposed to purchase a greater good with a less evil: namely, at the price of blindness only, to perform one of the noblest acts of duty: and duty being a thing in its own nature more substantial even than glory, ought on that account to be more desired and venerated. I decided therefore, that as the use of light would be allowed me for so short a time, it ought to be enjoyed with the greatest possible utility to the public. These are the reasons of my choice—these the causes of my loss. Let the slanderers then of the judgments of God cease their revilings; let them desist from their dreamy forgeries concerning me; in fine, let them know that I neither repine at, nor repent me of my lot: that I remain fixed, immovable in my opinion; that I neither believe, nor have found that God is angry; nay, that in things of the greatest moment I have experienced, and that I acknowledge his mercy, and his paternal goodness towards me; that above all, in regard of this calamity, I acquiesce in his divine will, for it is he himself who comforts and upholds my spirit—being ever more mindful of what he shall bestow upon me than of that he shall deny me; last of all, that I would not exchange my own consciousness of what I have done, for any act of theirs however well performed, or lose the recollection of it, which is always so calm and delightful to me. As to blindness, I would rather at last have mine, if it must be so, than either theirs, More, or yours. Yours, immersed in the lowest sense so blinds your mind, that you can see nothing sound or solid: mine, with which you reproach me, deprives things merely of their colour and surface; but takes not from the mind's contemplation whatever is real and permanent in them. Besides, how many things are there which I should choose not to see: how many which I might be unwilling to see: and how few remaining things are there, which I could desire to see! Neither am I concerned at being classed (though you think this a miserable thing), with the blind, with the afflicted, with the sorrowful, with the weak; since there is a hope that on this account I have a nearer claim to the mercy and protection of the Sovereign Father. There is a way (and the Apostle is my authority), through weakness, to the greatest strength. May I be one of the weakest, provided only in my weakness, that immortal and better vigour be put forth with greater effect: provided only in my darkness the light of the Divine countenance does but the more brightly shine: for then I shall at once be the weakest and the most mighty; shall be at once blind and of the most piercing sight. Thus, through this infirmity shall I be consummated—perfected: thus, through this darkness should I be enrobed in light. And in truth we who are blind, are not the least regarded by the Providence of God; who, as we are the less able to discern anything but himself, beholds us with the greater clemency and benignity. Woe be to him who makes a mock of us! Woe be to him who injures us! he deserves to be devoted to the public curse. The divine law, the divine Saviour, has made us not merely secure, but as it were sacred, from the injuries of men: nor would seem to have brought this darkness upon us, so much by inducing dimness of the eyes, as by the overshadowing of heavenly wings: and not unfrequently is wont to illumine it again when produced, by an inward and far surpassing light. To this I attribute the more than ordinary civilities, attentions, and visits of friends: of whom there are some with whom, as with true friends, I may hold the dialogue of Pylades and Orestes. For they do not suppose that by this misfortune I am rendered altogether a nullity: they do not suppose that all which belongs to a man of sense and integrity is situated in his eyes. Besides as I am not grown torpid by indolence, since my eyes have deserted me, but am still active, still ready to advance among the foremost to the most arduous struggles for liberty: I am not therefore deserted even by men of the first rank in the state. On the contrary, such men, considering the condition of humanity, show me favour and indulgence as to one who has completed his services; and readily grant me exemption and retirement. They despoil me of no dignity, they deprive me not of any public office I before held; they disparage not the benefit which may have accrued from that particular service: and though they are aware that they are now to confer their favours upon one who is become less useful, they think it ought to be done with no less benignity: indeed, with the same honour as if, like the Athenians of ancient times, they had decreed a maintenance for me in the Prytaneum. Thus, while I can derive consolation in my blindness both from God and man, let no one be troubled that I have lost my eyes in an honourable cause; and far be it from me to be troubled at it; far be it from me to possess so little spirit as not to be able without difficulty to despise the revilers of my blindness, or so little placability as not to be able, with still less difficulty, to forgive them."

The astronomer Galileo shared with the great poet in the calamity of blindness. The following circumstances are related by Sir D. Brewster.[1]

[1] Martyrs of Science. P. 107.

"Although his right eye had for some years lost its power, yet his general vision was sufficiently perfect to enable him to carry on his usual researches.

"In 1636, however, this affection of his eye became more serious, and in 1637 his left eye was attacked with the same disease. His medical friends at first supposed that cataracts were formed in the crystalline lens, and anticipated a cure from the operation of couching. These hopes were fallacious. The disease turned out to be in the cornea, and every attempt to restore its transparency was fruitless. In a few months the white cloud covered the whole aperture of the pupil, and Galileo became totally blind. This sudden and unexpected calamity had almost overwhelmed Galileo and his friends. In writing to a correspondent he exclaims, 'Alas! your dear friend and servant has become totally and irreparably blind. These heavens, this earth, this universe which by wonderful observation, I had enlarged a thousand times beyond the belief of past ages, are henceforth shrunk into the narrow space which I myself occupy. So it pleases God, it shall therefore please me also."

His friend, Father Castelli, deplores the calamity in the same tone of pathetic sublimity: "The noblest eye," says he, "which ever nature made, is darkened—an eye so privileged, and gifted with such rare powers, that it may truly be said to have seen more than the eyes of all that are gone, and to have opened the eyes of all that are to come!"

APPENDIX B.

SNOW-BLINDNESS.

The painful interest excited by the uncertainty as to the fate of Sir John Franklin and his brave party has led to many searching expeditions, public and private, by sea and by land, to explore every portion of the Arctic regions where there is a possibility of finding traces of our countrymen. Though as yet, unhappily, the main object has not been attained, much knowledge on many subjects has been derived; and I am indebted to Captain Sherard Osborn (who is at the present time commanding a vessel engaged in a further search) for much valuable information on the subject of snow-blindness. Some idea may be formed of the fearful difficulties encountered by the searching parties, from the following extracts from private and official accounts. Lieut. W. H. Browne reports :—

"20th April. Found great difficulty in making a straight course, the weather being very thick, not an object being visible on the sublime but dreary waste of snow, the sky harmonising with the gloom of the floe, being of an uniform sombre tint overhead, while round the horizon a purplish cloud, edged with misty streaks, completely blending sky and snow. This strange effect was very tedious to the eyes, especially those of the leaders, who were frequently compelled to turn round and gaze on the dark forms composing our little caravan, thereby trying to afford some relief to their straining eyes."

Another officer thus describes the sufferings of his party :—

"The cutting wind frequently blowing in

their faces, together with the hard, uneven ridges of snow and lines of heavy hummocks, over which the sledges were obliged to be dragged, rendered the work of the travellers very laborious. Their faces were constantly frostbitten; scarcely was one cheek restored, when the other would be caught. Their feet were so affected by the cold, that in several cases serious accidents were the results. The glare of the snow caused snow-blindness and soreness of the eyes, and on one occasion there were fifteen men attacked with it out of four sledges' crews, consisting of thirty persons."

The following is the very interesting account furnished to me by Captain Osborn in answer to certain inquiries which I drew up:—

"The early spring is the most trying, when the eye, weakened by the long darkness of the winter, has to contend with the action of a strong sunlight thrown upon snow of spotless purity—or otherwise when, in walking over the floes in hazy weather, the difficulty of finding the road and preserving a certain course causes great straining of the eye, leaving it, even if blind ness does not occur, with a dull, aching sensation within the eyeball.

"Snow-blindness usually begins with a great aversion to light, causing one to involuntarily close the eye; throbbing at the temples and a general indistinctness of vision; a film appears to be before the eye, the white part of the eye becomes bloodshot, a violent irritation as if sharp and hot sand was within the lids, and in the worst cases, fearful heat of the forehead and temples, and the eye feels as if it would burst in one of those spasms which appeared to me to concentrate within themselves all that was painful. The chief feature is inability to look at objects; the intolerance of light, the shock the smallest ray of light seems to give, the sensation as if the sun was streaming through the closely compressed eyelids, all justify me in thinking so. I can remember, although my head was bandaged tight up and my eyes closed, feeling perceptibly the increased light in the tent whenever the door was opened, and the men and myself often remarked how wonderful it was.

"With care and active remedies it generally passes away in three days, and the eye appears to recover its tone and power very rapidly—sometimes in a day, and the attack comes on equally suddenly.

"The *treatment* found most efficacious was purgative medicine and wine of opium dropped into the eye three times a day; goulard water mixed with snow and a cloth wetted with it bandaged tight over the eyes, compression of the most violent description; especially over the eyes and in the neighbourhood of the temporal artery, afforded great relief.

"The first time I was snow-blind was in May, 1851, shortly after leaving the ship. I was not in good health or spirits; we soon got entangled amongst immense piles of ice, which rendered progress very difficult, and my mind was racked with anxiety: the sun came out unusually strong, and the reflection was intense, whilst I had to take off my spectacles to assure myself that we were in the right road. That night I felt a dull aching sensation in my eyes, next day I could not bear the light, and objects looked hazy. I followed the party, keeping my eyes intently fixed on the black part of my sledge, and by night time was perfectly blind, requiring to be led about. By the third day I was again all right and at work again, and continued well for some thirty or forty days. At the end of this time I was returning to the vessels—it was June 12th—I had to make a forced march of thirty miles, taking no rest at night. My party and myself were in perfect health, and well knit from the long journey of about 600 miles. We reached the ship that night; two or three complained of pain in the eyes; next day I, and indeed five out of the seven constituting the party, were snow-blind, the cases being far more severe than when, in the month of May, seventeen out of a division of thirty men were laid up with it. In my case I was assured by Dr. P. of the Pioneer, that except in a favourable termination which left my eyesight unimpaired, I had what resembled the worst cases known of Egyptian ophthalmia.

(Signed) "SHERARD OSBORN,
"Late in command of H. M. S. Pioneer,
"Arctic regions."

The Peak of Orizava is a mountain well known to all who have visited the Gulf of Mexico. Mr. Thornton and a young German made the ascent in April, 1851, reaching an elevation of 17,000 feet above the level of the sea, but not being able to reach the very summit, which was about an additional thousand feet. In an interesting paper, read before the Geographical Society, Mr. Thornton mentions his sufferings from snow-blindness. "According to the advice (says he) of our guide, we had not taken any spectacles with us, for, as he truly said, it was necessary to see the danger well in order to avoid it. Upon getting back to our hut, therefore, we congratulated ourselves a good deal upon feeling no disagreeable sensation in the eyes. I counted without my host; for after returning to the Paso, and dining, I began to feel great heat about my eyes and head. I went to bed, and half an hour afterwards the inflammation increased and the pain was most intense. Cold water was my only remedy, but so acute was the inflammation that the wet rags dried up and became hot in three or four minutes. For two days I was quite blind, and for two days more I dare not look at the light. Now I am tolerably well, though there is still a cloud over distant objects."

The effects produced upon the eyes by the glare from the snow is thus graphically described by a sufferer, Jacques Balmat, who was the first to ascend Mont Blanc. Dr.

Paccard was the companion of his adventurous exploit, and both underwent great hardships in the journey. Balmat says,[1] "By the time I had reached the grand plateau, my eyes were so dazzled by the snow that I was nearly blind: now we always provide ourselves with green veils for those expeditions, but at that period we were ignorant of their use. As I could not see to advance—for whichever way I looked I saw nothing but large drops of blood—I sat down and closed my eyes: in about half an hour, when I opened them, my sight was so far restored that I could venture to move forward." These two adventurous men struggled on, and succeeded in effecting their purpose, but had to pass the night in the snow. Balmat thus continues:—"About six o'clock the next morning the Doctor (Paccard) woke me. 'Balmat,' said he, 'it's very odd—I hear the birds singing, and it's quite dark!' 'Dark?' said I; 'open your eyes and look about, it's broad daylight.' 'I don't think I can open them,' said he, 'I can see nothing.' I looked at him—his eyes were as wide open as he

[1] Abridged from Chambers' Edinburgh Journal.

could stare—he was perfectly blind: however, I got him down hill and took him to his home."

It is satisfactory to know that the Doctor eventually recovered his sight, but Balmat himself could only see in the twilight for a long time afterwards.

A case is mentioned by Mr. Lawrence,[1] of a gentleman who had gone out shooting at night, the ground being covered with snow; the next day his sight was dull—it became very imperfect, and continued so in spite of a variety of treatment.

The following account is given by an eye-witness:—"When the division of Cordova marched from Cuzco to Puno there was a very heavy fall of snow. They continued their march the next morning. The effects of the rays of the sun reflected from the snow upon the eyes produces a disease which the Peruvians call *norumpi*. It occasions blindness, accompanied by excruciating tortures. A pimple forms in the eye-ball, and causes an itching, pricking pain, as though needles were continually piercing it. The temporary loss of sight is occasioned by the impossibility of

[1] A Treatise on the Diseases of the Eye. P. 511.

opening the eyes for a single moment, the smallest ray of light being absolutely insupportable. The only relief is a poultice of snow, but as that melts away the intolerable tortures return. With the exception of twenty men and the guides, who knew how to guard against the calamity, the whole division were struck blind with the *norumpi*, three leagues distant from the nearest human habitation. The guides galloped on to a village in advance, and brought one hundred Indians, to assist in leading the men. Many of the sufferers, maddened by pain, had strayed away from the column, and perished before the return of the guides, who, together with the Indians, took charge of long files of the poor sightless soldiers, clinging to each other with agonised and desperate grasp. During their dreary march by a rugged mountain path, several fell down precipices, and were never heard of more. Out of three thousand men, Cordova lost above one hundred."[1]

[1] Memoir of General Miller. Edinburgh Phil. Journal. Vol. xviii.

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THE END.

LONDON:
G. J. PALMER, SAVOY STREET, STRAND.