Fox (L. W.)

A

HISTORY OF SPECTACLES

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A HISTORY OF SPECTACLES.

BY L. WEBSTER FOX, M. D.,

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Spectacles are crutches for the eyes, said an old writer on optics; but the date at which the invention of spectacles was brought to the notice of the world is now one of the things which have been "lost in the mists of antiquity."

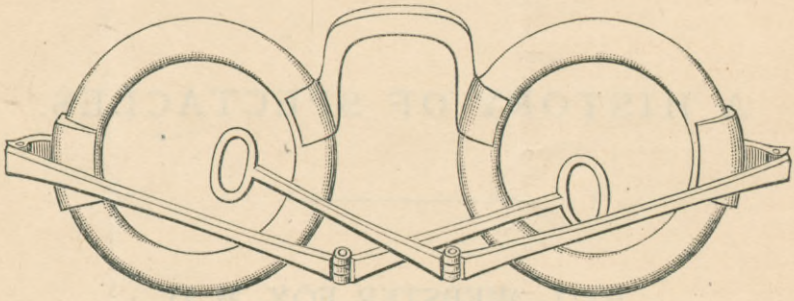
The late Wendell Phillips, in his lecture on the "Lost Arts," said: "And even spectacles are among the things which were known to the ancients;" but on the tombstone of Salvinus Armatus, a Florentine nobleman, who died in 1317, is inscribed that he was the inventor of spectacles. Whether the ancient Egyptians and Phœnicians possessed the knowledge of the action of lenses is only a matter of conjecture. The art of engraving upon glass was known 2423 years B. C., and it is impossible to recognize certain delicate lines in specimens of engraved glass which date back many centuries before Christ, without the aid of a strong convex lens. It is therefore reasonable to suppose that the artist had an aid to his vision in engraving these delicate lines. At one time glass-blowing was the chief industrial occupation of the inhabitants of Alexandria. Rome excelled in the making of glass, and in many respects this art has never been equaled. Pliny tells us that, for drinking vessels, glass was preferred to gold and silver. If the art of making glass had reached such a degree of perfection, why should not spectacles have been also made and used?

History also mentions that Nero (A. D. 68) used to view the games in the theatre from the top of the Procenium, and in the amphitheatre, through a concave glass suspended in front of him, because he was exceedingly near-sighted. Whether or not the ancients had spectacles we do not know; but it is reasonable to suppose that they had at least aids to assist their vision in the exquisite engraving found upon gems and jewels.

Our first positive knowledge of spectacles is gathered from the writings of Roger Bacon, who died in 1292. Bacon says: "This instrument (a plano-convex glass or large segment of a sphere) is useful to old men

and to those that have weak eyes; for they may see the smallest letters sufficiently magnified." Alexander de Spina, who died in 1313, had a pair of spectacles made for himself by an optician who had the secret of their invention. De Spina was so much pleased with them that he made the invention public. M. Spoon fixes the date of the invention between 1280 and 1311. In a manuscript written in 1299 by Pissazzo, the author says: "I find myself so pressed by age that I can neither read nor write without those glasses they call spectacles, lately invented, to the great advantage of poor old men when their sight grows weak." Friar Jordan, who died in Pisa in 1311, says in one of his sermons, which was published in 1305, "that it is not twenty years since the art of making spectacles was found out, and is indeed one of the best and most necessary inventions in the world."

Fig. 1.



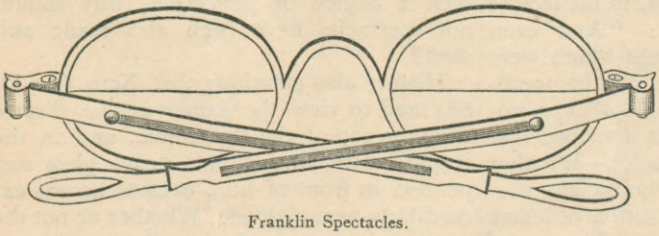
Ancient Spectacles.

Granting that spectacles were invented about 1292, it was not known until the year 1600 why certain individuals required convex and others concave glasses.

Kepler, who demonstrated in what manner the rays of light were refracted through the humors of the eye and formed a distinct picture upon the retina, also showed how the images of objects became confused and how concave glasses rendered such images clear. He further explained why it is that the brain receives an erect impression, although the image of the object is inverted upon the retina. After the application of convex and concave glasses for visual defects, the next peculiar discovery was made by Sir David Brewster, who upon testing his vision with a Porterfield optometer (about 1758) found that he could see vertical lines at a distance of ten inches, while horizontal lines were visible to him only at a distance of seven inches.

Benjamin Franklin has been credited with devising a double-focus spectacle—in what year history does not record. Franklin was born in 1706, and being hypermetropic, it is reasonable to suppose that he devised this glass about 1750. These spectacles were split glasses, the upper half to be used for distant vision, and the lower half for reading or near work. The chief objection to wearing this kind of glasses is that they cut off the lower half of the visual field in walking. (Fig. 2.)

Fig. 2.



Franklin Spectacles.

Sir David Brewster was the first to discover the astigmatic eye; but the correction of this abnormality of sight was left to Mr. Airy (1825), who found that his left eye had very defective vision, so that he was unable to read with it, while the appearance of a candle-flame looked at with his left eye was not circular—as when seen with his right eye, which was also defective for distant vision—but was shaped like an ellipse, with its long diameter inclined at about 35°. The concave glass which rendered vision distinct for the right eye partly corrected the defect in the left. He concluded that the curvature of the

cornea was greater in one diameter than the other. He found, too, by drawing on paper two lines crossing each other at right angles that at a certain distance from the crossing point one line was distinct while the other was indistinct. He also found that, by bringing the paper nearer, the invisible line became clear and the formerly clear line became indistinct. From these phenomena he concluded that the refraction of one plane of his eye was different from that of the other, and, consequently spherical lenses would not benefit him. His object was then to make a glass which should refract rays more powerfully in one plane than in another plane at right angles to it. He therefore had a lens constructed which was doubly concave, one of the surfaces being spherically concave, and the other cylindrically concave, and of such a curvature as to bring to the same point the vertical and horizontal lines. An optician by the name of Fuller, at Ipswich, made this glass, which gave Mr. Airy useful vision in his left eye.

FIG. 4.

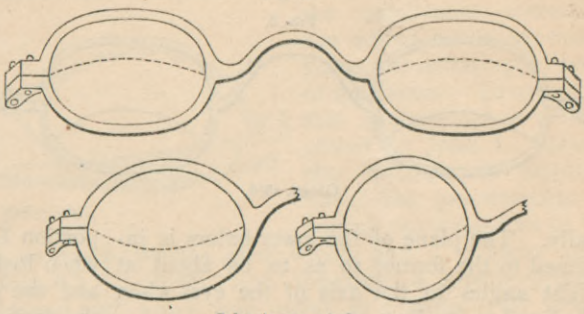
Jachan, 1839.

An improvement on the Franklin glass was made by Schnaitman, of Philadelphia, who, in 1836, was granted a patent on bifocals, which were the first ground bifocals made in this country. (Fig. 3.) The upper half was used for distant vision, the lower half for near work.

C. H. L. Jachan, of New York, in 1839, was granted a patent of a glass for spectacles, "by leaving a small, circular, clear space opposite the pupil of the eyes, to be surrounded by a ground portion, extending over the remainder of the surface so adjusted as to leave a larger proportion thereof above the eye, and in the case of concave or convex glasses that the centre of convexity or concavity shall coincide with the centre of said clear, circular space. I also claim," he says, "in combination therewith the location of the bridge and the hinges and bows to adjust the clear space to the pupil of the eye all in the manner and for the purpose above described." (Fig. 4.)

Hotchkiss and Norton, on April 17, 1849,

FIG. 3.



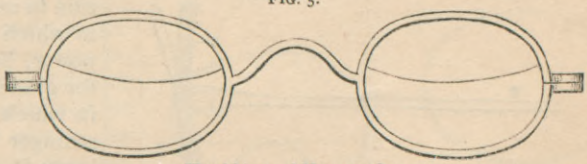
Schnaitman, 1836.

were granted a patent for a bifocal which was exactly like the bifocal glasses devised by Schnaitman in 1836, as show in Fig. 5, and which was no improvement over the spectacles made thirteen years before.

Samuel Gregg, of Boston, in November, 1866, was granted a patent on bifocal spectacles based on the following claims: "constructing glasses of spectacles where two distinct lenses or *segments* of lenses are contained in one glass adapted for seeing near and distant objects in such a manner that the upper edge of the convex lens adapted for seeing near objects shall be concentric with the upper edge of the lens adapted for seeing distant objects for the purpose of enlarging the field of vision." (Fig. 6.)

Edmondson, in 1867, followed with a more complex bifocal spectacle. The following is his description of it:

FIG. 5.



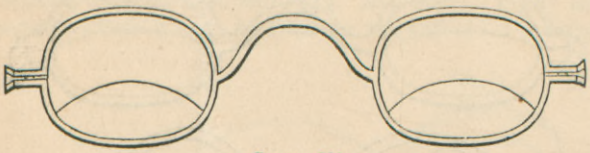
Hotchkiss and Norton, 1849.

"Fig. 7a is a perspective view; Fig. 7b is a section on the line $x\ x$ of Fig. 7a.

"Each lens consists of two pieces, of different magnifying powers, and set in different planes. The line of division between

the two is the horizontal mid-section; the upper portion is of greater focal distance for viewing more distant objects. The plane of the upper portion is at right angles to that of the bows, and at about the same angle to the axis of the eyes when adjusted horizontally. The plane of the lower halves is inclined to the former so as to be about at right angles to the axis of the eyes when declined in reading, etc.

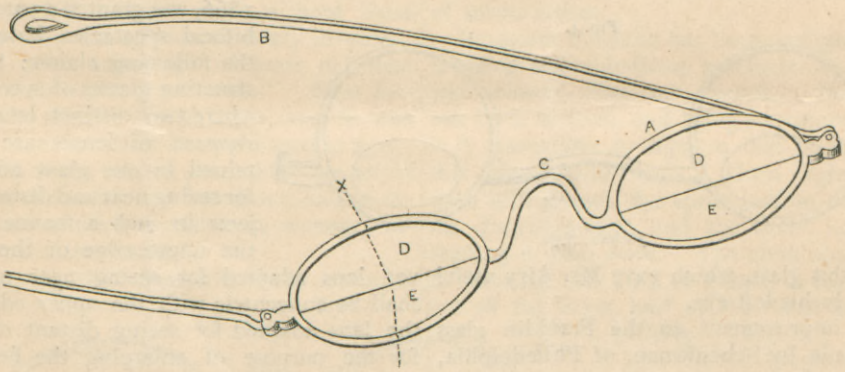
FIG. 6.



Gregg, 1866.

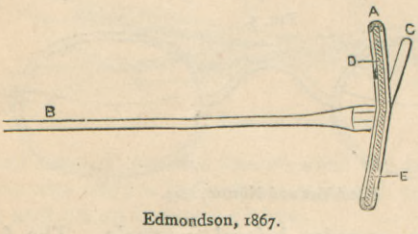
"In the drawings, A A are the bezels, which confine the lenses; B the bows, by which the spectacles are clasped to the head; and C the bridge by which they are supported in position. The lenses in each case consist of two pieces. The upper half, D, is of a longer focal distance than the other, that is, less convex; it is designed for distant objects such as ordinarily seen by a party walking, objects which are assumed to be about the height of the eye and short distances above and below. The lower half, E, is of a more convex character, so as to suit the eye for reading, writing, needlework, etc., for which purpose a stronger power is generally required, as is familiarly instanced in the case of a person reading with spectacles and looking over them at persons or other ordinary objects at a greater distance than the book. It is desired to maintain the proper relative positions of the two portions to the axis of the eyes, and to secure this the upper half is in a plane at right angles to the bows B, so that the portion D meets the requirements of the eye when looking straight forward at the scene, and the portion E is at such an angle with the portion D as will correspond to the ordinary declination of the axis of the eyes in reading, etc. This adjustment of focal length and plane to the varying conditions and requirements is a valuable and hitherto undeveloped feature in spectacles.

FIG. 7a.



Edmondson, 1867.

FIG. 7b.



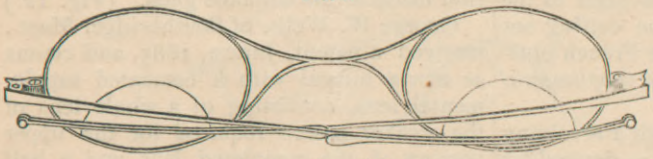
Edmondson, 1867.

"I have heretofore spoken of the invention in reference to the use of convex glasses, in which case the upper portion has the least power, but my improvement is also adapted for glasses for those troubled with myopia, in which case the upper half would be the stronger power, more concave than the lower."

I have in my possession a pair of bifocal spectacles which came from Paris in 1870, in which a *supplemental* lens was cemented on the lower third of the distant glass, and is semicircular in form. This added lens is ground exceedingly thin at its outer and upper periphery, so that in looking through it the juncture between distant and near

glass cannot be noticed by the wearer. How long these spectacles had been in use in France I have not been able to ascertain; but they were not considered a novelty when I purchased them. In fact, these spectacles are of the same style as those which have recently been so much written about and advertised in theatre programmes, as something entirely new and novel. (Fig. 8.)

Fig. 8.

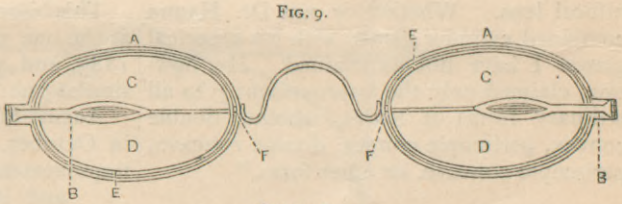


French Spectacles. Before 1870.

Ira S. Doten, in May, 1877, devised and patented spectacles having separate frames from the frames of the spectacles proper, and having such frames on pivots, so that the glasses may be turned to bring the required foci into proper position for use.

"As shown in Fig. 9, the spectacles are arranged for reading, the section D, having the strongest focus, being down. In this position the upper segment C can be used, if it is desired to look at anything above the wearer, at a distance off, without changing the positions of the foci; but when it is desired to use the spectacles for walking, the segment C must have the lowest position, as the eye naturally looks down in walking; and to attain this end all that is necessary to be done is to revolve the frame E, bringing the section C to the lowest position, when the focus will be the one required for walking.

Fig. 9.



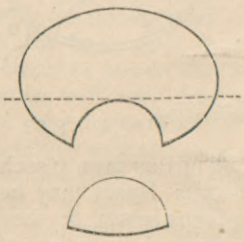
Doten, 1877.

"By this arrangement all the advantages derived from two pair of spectacles having different foci will be obtained, and the disadvantages arising from the use of spectacles having glasses with sections of different foci held stationary in the frame will be overcome, as by revolving the glasses the proper focus can be brought into position with no change in the place where worn."

Louis Franklin, in this same year, claims an improvement in spectacles, which consists in so constructing the two glasses that the upper one can be removed or folded back out of the way, so as not to obstruct the vision, or it can be folded down over the lower one, so as to form a double thickness and thereby increase its powers for reading.

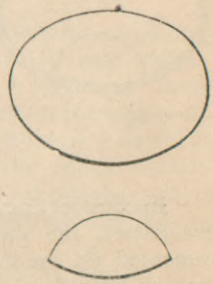
In all spectacles of the bifocal pattern, cylinder glasses were not added up to this date. When it was necessary to use a stronger glass for reading, an "extra front" spectacle was universally given, or else the presbyopic correction was added to distant-vision glasses necessitating two pairs of spectacles. To overcome this inconvenience I suggested to John L. Borsch, the optician, in October, 1883, the practicability of cutting out a segment of the distant glass which had a cylinder glass added, and inserting a sphero-cylinder, which was useful in reading. By such a mechanical contrivance it is obvious that but one pair of glasses was needed for distant and near work. These spectacles, from the manner in which they were made, had their optical centres in the geometrical centres, and in consequence had not the disadvantage of a prismatic effect. (Fig. 10.) One serious objection was raised against these bifocals, and that was that, where it was necessary to give a combination of high power, the curved lines formed by the double refracting surfaces at the juncture of the lenses interfered with vision. In low powers, however, this was not so noticeable. The "curved line objection" was overcome

Fig. 10.



Fox, 1883.

Fig. 11.



Fox, 1883.

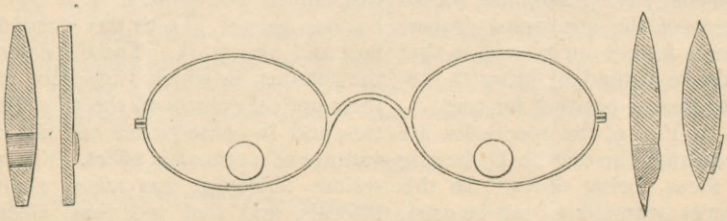
by Borsch, in making an "improved bifocal" in which the segmental lens was cemented upon the long-distance glass, grinding this supplemental lens so thin at its upper and outer periphery as to make an almost invisible line at the juncture of the two glasses. (Fig. 11.)

The only originality to which I lay claim is the adding of the cylinder glass to the sphericals. Gregg devised the cutting out of the *segmental* lens, and the French opticians the cementing on of the *supplemental* lens.

Roberts, in 1884, follows with a revolving spectacle practically the same as devised by Mr. Doten.

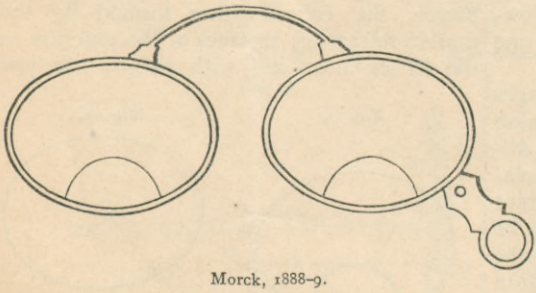
In October, 1884, Dr. B. M. Hanna, of Pittsburgh, received a patent for an improved bifocal lens. Whether or not Dr. Hanna combined cylinder glasses with his spherical glasses I have not ascertained. He, however, claimed only the improvement "to all ordinary forms of lenses, whether double convex, periscopic convex, double concave, periscopic concave, or other form."

Fig. 12.



Hanna, 1884.

Fig. 13.



Morck, 1888–9.

"In constructing," he further says, "such eye-glasses, the short-focus lenses may be cemented on the long-focus lenses, or they may be formed in the original operation of grinding, or by subsequent grinding, or the lens may be bored out and the lenses inserted with cement. I, therefore, do not confine my invention," he says, "to any particular mode of construction, as that will be best determined by the circumstances of individual taste, conditions of use, relative cost, or the fancy of the maker. Likewise the form of the lenses may vary." Dr. Hanna has only one claim to originality, and that is the insertion of the reading glass in the perforation made in the distance glass. (Fig. 12.)

George W. Wells, of Southbridge, Mass., received a patent, June 2, 1885, and claims as new a bifocal with a cemented supplemental lens, consisting of a whole lens of the weaker power required for the upper portion of the completed lens and a half lens applied to the inner face of the whole lens to give the stronger power required in the lower portion of the completed lens.

This bifocal lens is exactly the same model as the one made for me by Mr. Borsch in 1883, and was followed by Morck with a similar one five years later. (Fig. 13.)

August Morck, Jr., was granted a patent in October, 1888, in "reference to certain improvements in spectacles or eye-glasses, and its object is to render more effective such spectacles or eye-glasses as are employed for combined near and far range purposes." Morck was the first to claim by patent, "in combination with spheres, *cylindrical* glasses and prisms." In describing the segmental lens which is cemented upon the long-range glasses, he uses the following language: "Is made to taper to a feather edge along the segmental line, and therefore the lens has its thickest part along the lower edge. This construction obliterates the surface-line to the sight while giving a perfectly defined area for near vision." In April, 1889, Mr. Morck received another patent on a "spectacle lens," in the construction of which he employs "two lenses of different powers of such configurations and relative sizes as to avoid the objection

of the eye resting at the same time on both lenses and the consequent blurred or dizzy effect upon the vision;" and he claims as new "the combination, with a far-vision lens, having its lower edge cut out centrally in semicircular form, of a near-vision lens shaped to fit said central semicircular opening in the far-vision lens and secured therein by suitable adhesive substance substantially as set."

To any one who has followed this article it must be obvious that Morck's first patent had already been anticipated in the glasses in use in Paris in 1870, by me in 1883 and by Dr. Hanna in 1884. His second patent was anticipated by Gregg in 1866 and by me in 1883.

Having now given a history of the development of the "bifocal" lens from Franklin's day to the present writing, I must describe a "trifocal" which was made for me by Messrs. Borsch & Rommel, January 15, 1890. The patient required *sph.* + *1. D.*, for distance; *sph.* + *3. D.*, for (piano) music; and *sph.* + *4.50. D.*, for near work. The occupation of the individual made necessary this kind of glass, which has been worn constantly up to the present with entire satisfaction. (Fig. 14.)

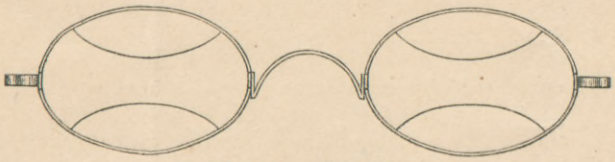
Where it is necessary, concave or convex lenses, with or without cylinders, may be made in like manner.

The base glass is the *sph.* + *3 D.*, the optical centre coinciding with the geometrical centre—understood in optics as the normal centre—and is the glass used for medium vision. The segmental lens may be ground in such a way as to preserve its prismatic effect. In other words this lens has the following equation:—*1.50 D. sph.* on one surface and—*0.50 D. sph.* combined with a prism 3°, base up, which, when cemented upon the *sph. 3. D.*, equals *sph.* + *1. D.*, optical centre coinciding with geometrical centre; being the glass used for long range. The lower, segmental lens equals on one surface *sph. 1.50 D.* on the other surface *sph. 3. D.*, with prism 3° base down; which when cemented to the *sph.* + *3. D.* (base glass) equals *sph.* + *4.50. D.*, reading glass, the optical centre coinciding with the geometrical centre of near vision. If the base glass is of a higher or lower refractive power, the figures of the segmental lenses will vary correspondingly; and it is of great importance that the optical centres coincide with the geometrical centres; which has not been so in the old bifocals and in many as made to-day.

This brief sketch—which makes no pretension to completeness—shows how true it is, that there is nothing new under the sun.

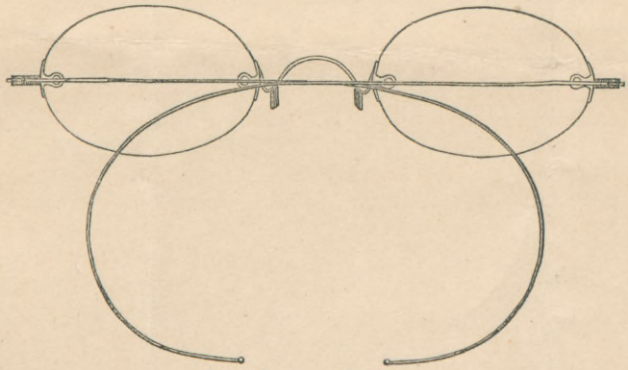
1304 Walnut Street.

Fig. 14.



Fox, 1890. (Trifocal.)

Fig. 15.



Latest Improved Spectacles.