BRITISH MEDICAL JOURNAL:

BEING THE JOURNAL OF THE BRITISH MEDICAL ASSOCIATION.

EDITED BY ERNEST HART.

LONDON: SATURDAY, JANUARY 3, 1880.

A LECTURE

ON THE

ENLARGEMENT OF OPHTHALMOSCOPIC IMAGES.

By E. LANDOLT, M.D.,
Professor of Ophthalmology in Paris.

It is important to bear in mind that the interior of an eye examined with the ophthalmoscope is no longer presented to us in the same conditions as an object is in the ear: the tympanum of the ear, for example, as seen through an otoscope. In the case of the eye, our observations are made through the medium of a dioptric system; the dioptric system, that is, of the eye itself. Upon this we even sometimes superimpose a lens, in order, it may be, to correct ametropia or to produce an inverted image.

It is scarcely necessary to observe that, in such conditions, objects at the fundus of the eye are not seen by us in their true dimensions. When we examine with the upright image, the *fundus oculi* lies immediately at, or in very close proximity to, the focus of a magnifying lens, and is in consequence enlarged, as are all objects similarly placed. On the other hand, in the indirect method of examination, the fundus lies beyond the focus of the magnifier, as is sufficiently shown by the resulting image being an inverted one. With the convex lens commonly made use of in ophthalmoscopy, this inverted image, while smaller than the erect, is nevertheless considerably larger than the object (the fundus) which produces it. These facts, however, will already have struck you in the experiments we have performed with our elementary artificial eye.

Now, it must always be looked on as a matter of no slight importance to determine the degree in which ophthalmoscopic images are enlarged. What should we think of a histologist who should take no account of the magnifying power with which he studied his preparations? and what no less of the ophthalmologist who never pauses to inquire about the real dimensions of the portion of fundus he may be examining? The subject, I hold, is not merely interesting from a scientific point of view, but is of the first importance practically. For instance, a neoplasm may have engaged the fundus or the tunics of the eye, and may puzzle us indefinitely if we be not able to gauge its true size. But more especially is it when we come to determine the dimensions and positions of objects within the eye itself, that this knowledge is of supreme moment. I will take as an example a case we may be examining, in which it may be absolutely necessary for us to know whether a certain lesion of the fundus is situated at a greater or less distance from the macula. Again, another case may present itself, in which we may be called on to say at how many *millimètres* from the papilla a foreign body is lying, lodged, it may be, in the tissues of the fundus, and which we have decided on removing. Such an operation undoubtedly is a delicate one, but has at times succeeded. But, in a given case, how much would the chances of success have been diminished if once we had ceased to be able to interpret the invaluable information yielded by the ophthalmoscopic appearances—that is, as soon as they had been interpreted aright by having been reduced to their true dimensions.

We propose, then, to devote our lecture of to-day to a brief explanation of the enlargement of ophthalmological images; but, before touching on this question, permit me to call your attention to the principles which underlie all optical enlargements in general. The study of these principles will much facilitate your comprehension of those more special optical enlargements on which we are now entering, and the consideration of which appears to me to be very far from useless or unnecessary. The subject itself, indeed, is fraught with so much that is interesting from many various points of view, that one cannot but

feel somewhat surprised at its being so little understood by men who every day of their lives make use of optical instruments of one kind or another, be it telescopes, microscopes, opera-glasses, or ophthalmoscopes.

In a work on this subject,* I have given the following definition of enlargement. "Enlargement is the relation which the retinal image of an object, as seen with the naked eye, bears to the retinal image of the same object as seen through an optical instrument, the distance being the same in each case."

The true method to pursue in order to find the alterations in magnitude produced by optical instruments would be, then, to calculate the size of the image formed on the retina, first without, and then with, the instrument; the object observed being in each case maintained at an equal distance from the observer. The proportion then discovered to exist between the two retinal images respectively would be the expression of the enlargement produced by the instrument. For instance, suppose the retinal image in the first case to have a magnitude of 1, and in the second of 15, the increase in magnitude given by the optical instrument would be fifteenfold.

Suppose an observer to receive on his retina at one and the same moment the image of an object which he sees with his naked eye, and an image of the same object yielded by an optical instrument: it is clear that, under such circumstances, he could directly appreciate the relationship existing between the two images in regard to size, and would consequently, in this respect, be independent of all calculation. In certain cases, this can actually be done, as in determining the powers of spectacles, opera-glasses, and telescopes. For example, bring a telescope to bear with the right eye on the window of a distant house, and fix this object simultaneously with your left eye. In this way, you will have two images of the window before you, one of which will be of its natural size; the other will be magnified by the telescope. The two images, it is true, are not superimposed in the same eye, but, so to say, in the central organ which unites the impressions received from the two eyes. Now, once more, direct your telescope in such a way as to make the two images you see overlap at one corner, and then you will be able to estimate with sufficient accuracy how many times larger the window seems to be as seen through the telescope than it does as seen by the naked eye. With a view to greater exactitude in this method of determining enlargements, a graduated scale may be employed. This must be looked at simultaneously with both eyes—directly with one, indirectly with the other, with the intervention of the telescope. The resulting images become thus superimposed. There need, consequently, be no difficulty in estimating how many divisions of the scale as seen by the naked eye answer to one division as enlarged by the magnifying glass. To this way of determining the size of objects the name of "*méthode à double vue*" has been given.

The same end may be secured in another way; I mean by the use of one eye only. Take two graduated scales instead of one, both in all respects similar, only that one shall be placed immediately opposite you, while the other is placed at right angles to it, and consequently at your side; while both must be equidistant from your eye. The eyepiece of the telescope is furnished with a glass inclined at an angle of 45° to the axis of the instrument, and which is partly transparent and partly reflecting. To fulfil this condition, a fragment of mirror may be used, the silvering of which has been scored in all directions; or a piece of gilded glass, which possesses, when so prepared, a greater reflecting power than when plain; or, again, a prism, such as is used in the camera lucida. Now, if you look through the telescope thus prepared, you will see one of the scales magnified; while at the same instant the little mirror, by throwing back to your eye the other scale which is at your side, will show it to you in its true dimensions. The two images are thus superimposed upon the retina of the same eye, and an accurate comparison between them rendered possible. In all cases where both eyes are not of equal strength, this method is to be preferred to the one first mentioned. The two, however, are based on one and the same principle. The only difference between this proceeding and the

* *Le Grossissement des Images Ophthalmoscopiques*. Paris: 1874.

méthode à double vue is, that here we institute a comparison between two images seen by one and the same eye; in the other, between two images seen respectively one by each eye.

To arrive at true results, however, in this way, it is absolutely necessary that the two objects—in this case, the two graduated scales—should be placed at exactly equal distances from the eye; for, supposing we were to approximate the scale which in the mirror we see reflected in its real size, or if we were to place it at a less distance than the one we are looking at through the telescope, its retinal image would become unduly large. Conversely, if we were to remove it to a greater distance, it would become smaller relatively to the image of the scale which we look at through the telescope. In short, it would be just as if, in the first case, we were to suppose the object seen through the telescope nearer in the second farther off than it is in reality.

We can at times make use of a similar method for microscopes as for telescopes. Here, we take for our object a glass micrometer graduated into hundredths of *millimètres*. This is placed on the stage of the instrument, and alongside of it is a scale marked off into *millimètres* only. In this way, we are able with one eye to look at the micrometer through the instrument, and with the other to look directly at the scale, and so to institute a comparison between the two resulting images.

Again, using one eye only, we may look at the micrometer magnified by the microscope, and at a camera lucida, or semitransparent glass, as has been already described. A graduated scale is placed by the side of the observer, at an equal distance from his eye and from the stage of the instrument. The image of the scale is then thrown by the mirror on to his retina, and a comparison is instituted between it and the scale seen through the microscope.

You will perceive, then, that when the scale and the object are placed at the same distance from the eye—that is, on the stage of the microscope—the magnifying power is determined in precisely the same way as it is in the case of telescopes.

But it may often happen that this method, so simple and rational, of determining the powers of an optical instrument, cannot be applied in practice. It is thus with certain microscopes, but notably with convex lenses (*loupe*). Here the object we observe is approached so closely to the eye, that it would be impossible to see it at the same distance with the naked eye. For this reason, we are precluded from placing the scale which serves as our standard of comparison at the same distance as the scale at which we are looking through the lens. Hence we resort to another plan, which is, to place our standard scale at a greater distance from our eye than the object at which we are looking through the magnifier. In this way, the retinal image of the object—*e.g.*, the micrometer—which we see through the magnifying lens, is compared with the retinal image of the scale placed at a greater distance from the eye. This method, you will readily perceive, is not so exact as the one used in estimating the powers of telescopes. There is a good deal of what is arbitrary about it; for the apparent size of the image furnished by the magnifier is larger in proportion as the scale with which it is compared is further off; because the retinal image of the scale with which we compare the retinal image furnished by the magnifier is small in exact proportion as the scale is removed further off. In other words, the further we project a retinal image, the larger it seems to be.

You may easily satisfy yourselves of this fact, and at the same time arrive at a thorough understanding of what is meant by “projecting a retinal image”, by means of the following experiment. During several seconds, gaze intently at a bright-coloured object, such as a sheet of red paper placed on a dark background. After having looked fixedly for a certain length of time, the object will have formed a persistent image of itself on your retina. If now you fix your eyes on any grey surface, you will see upon it a representation of the object (in this case, green in colour) at which you have just been looking. This is what we call a “projection” of the retinal image. The projection will appear large in proportion to the distance at which the projecting surface is from your eye. In fact, the image you see upon this surface will always be in size the same as an object which, if placed at a similar distance, would produce a retinal image of a corresponding size. The retinal image, indeed, remains the same; but its projection—the object, that is, which you suppose to have produced that image—must necessarily be larger in proportion as you suppose it to be further off.

To “project a retinal image” to a given distance is, then, in other words, to suppose it produced by an object placed at that distance. We may compare retinal images with one another in this way: we may divide the surface of projection into sections, and then draw a comparison between any retinal image and the divided surface of projection.

You will perceive that it is the distance to which a retinal image is projected that determines its apparent magnitude. It is necessary, how-

ever, in order to make this method of measuring magnifying power practically useful, to arrive at a general agreement with regard to the distance to which the retinal image, as formed by the magnifying lens, shall be projected; or, in other words, as to the distance at which our test-scale shall be placed. For this purpose, a distance of from twenty-five to thirty *centimètres* has been decided upon, and has been designated the “average distance of distinct vision”. At one time, it was believed that the normal eye in a state of repose was accommodated to this particular distance. Possibly, those who supposed such to be the case were myopic. However that may be, Donders, by shedding a new light on the doctrines of accommodation and refraction, has modified very considerably our notions as to the distance for which an emmetropic eye is adapted. Nevertheless, the distance of from twenty-five to thirty *centimètres* may be retained in the case of the magnifying powers of lenses, as it has the merit, apart from its simplicity, of approximating very closely to the truth. For when, with the aid of optical instruments, we form on our retina the images of very near objects, we suppose these objects to be placed at a certain distance from us—that is, we project them to a distance, the same as that at which we are accustomed to regard minute objects in general. Hence is explained the fact that drawings of microscopic objects, seen under the same powers, present nearly the same dimensions, though made by different observers. Nevertheless, the expression “average distance of distinct vision” not being exact, I have replaced it by the expression “distance of projection”.

In practice, then, in order to determine the magnifying powers of a microscope, you must place on its stage a micrometer, and compare the image of this with a scale looked at by means of a camera lucida, and placed at a distance of from twenty-five to thirty *centimètres* from the eye.

We are now in a position to ask what method should we best adopt in order to solve the problem with which we have to deal—that is, the determination of the magnitudes of ophthalmoscopic images. Take, first, the upright image. In this case, we have the same conditions of the problem presented to us as in the examination of the magnifying powers of a lens. We observe an object—that is, the fundus of the eye—through the medium of a magnifying dioptric system, that is, the dioptric system of the eye itself. Furthermore, from habit and for reasons given above, we approach very closely to the object, in this case the eye we are examining, so closely, indeed, that a distinct view of the object would be impossible, were it not placed behind the dioptric apparatus of the eye under examination. We are thus compelled, in order to determine the size of an ophthalmoscopic image, to follow exactly the same method as when we determined the magnifying powers of a lens; that is, to project to a determined and constant distance the retinal image derived from the fundus of the eye under examination. This distance I have proposed to make thirty *centimètres*. I have done so, partly in order to be able to compare ophthalmoscopic with microscopic magnitudes, but more particularly because, as my calculations have established, the projection under such circumstances is exactly twenty times greater than the retinal image.

In order to determine according to the *méthode à double vue* the enlargement undergone by the direct image, I place behind the patient's head a plane vertical surface at the distance of projection, that is, at thirty *centimètres*. This surface is divided into spaces by vertical and horizontal lines, one *millimètre* apart. Now, while with one eye we examine the right eye of the patient, we direct our other eye on the vertical surface divided as above. Those who have had some little practice in such experiments will now see a portion of the fundus under examination—say, the papilla—projected on the plane surface, and divided vertically and horizontally into *millimètres*. (Fig. 1.) In this way, it is possible to measure the apparent size of the papilla, just as we measure an object placed behind a magnifying lens, or on the stage of a microscope.

In cases where, from a difference of refraction or visual acuity between the two eyes, this method becomes impracticable, I have pointed out another, which, like the camera lucida, allows of the experiment being performed with one eye only. (Fig. 2.) Behind an ordinary ophthalmoscope, I have placed a very small and thin mirror, deprived in part of its silvering by being scored in all directions. If preferred, a piece of gilded glass may be substituted for the mirror. The mirror is placed exactly behind the slit of the ophthalmoscope, and is kept in place by a small brass rod, movable round its own axis, in such a way that the small mirror can be inclined at a greater or less angle to the plane of the ophthalmoscope mirror. The necessary movements are performed by the thumb of the hand which holds the ophthalmoscope, and which presses, if required, on the bent end of the rod. In this experiment, the background, divided as above described, is placed at the side of, or better still, somewhat behind the experimenter's head. Now, look through the ophthalmoscope at a portion of the fundus oculi, and incline the

little mirror at such an angle that it shall reflect the divided surface of projection. Once more you will see the ophthalmoscopic image, but this time it will be divided into squares of a *millimètre* each.

It is better, we may remark in passing, to make the divisions white on a black ground, instead of black on a white ground.

Fig. 1.

A condition essential to success in both methods is, that the observer's eye, while examining the fundus, should bring into play exactly the same amount of accommodation as is required to see at the distance of projection. This is in order that both the ophthalmoscopic image and the surface of projection may appear distinct at the same moment. For, were this precaution to be neglected, then, in the "*méthode à double vue*", one eye would have to accommodate itself in a different degree from the other, or, in the "*méthode à réflexion*", the observer's single eye would have to alter its accommodation according as it fixed the fundus oculi or the surface of projection; and hence a simultaneous observation of the two objects would be impossible. The experiment, too, would become both fatiguing and inaccurate. An equality of accommodation is easily insured by means of the correcting lenses contained in my ophthalmoscope.

You perceive, gentlemen, that we have thus at our disposal two methods of measuring the apparent size of a given object at the fundus, looked at through the dioptric system of its own eye. The magnifying power of the dioptric system in question is evidently represented, as in the case of the microscope, by the relation which exists between the projected image and the real size of the object. If we have found, for instance, that the projection of an object at the fundus measures twenty *millimètres*, and we know that its real size is one *millimètre*, the enlargement is evidently twentyfold.

Unfortunately, the fundus oculi does not present any object of a constant or directly measurable size. The portion which, from its distinct appearance and well-defined outline—that is, the papilla—presents the best test-object for this experiment, is more or less variable in its dimensions. Thus, according to Listing, the papilla has a diameter of 1.55 *millimètres*; to Helmholtz, 1.81; to Hannover and Thompson,

1.616. In my own case, for my right eye, I have found it to be 1.86 *millimètres* in the horizontal diameter, and 2.1 in the vertical. G. H. Weber, who has made numerous measurements on the dead subject, has found respectively 1.72 and 2.1 in the two diameters.

The method of determining by actual experiment the degree of en-

Fig. 2.

largement under which the ophthalmoscopic upright image is seen can at best yield results only relatively exact. Nevertheless, it gives an approximation to the truth, which may be very valuable in practice. To obtain greater accuracy, and especially to gain a knowledge of the variations in size of the direct image in eyes of different refractions, recourse must be had to calculation.

In accordance with my definition of enlargement, we should be called upon, in any given case, to calculate the size of the image that an object at the fundus of the eye observed, and of a magnitude 1, would form on the observer's retina, and subsequently the size of the image so formed if projected to thirty *centimètres*. The size of the projection compared to that of the object would give the degree of enlargement. In this calculation, we must take into account the state of refraction of the eye examining, of the eye examined, the distance which separates them, and the correcting-glasses which have been employed.

Such calculations are not of the simplest. Moreover, faithful to the plan heretofore followed in my lectures, of refraining from all mathematical disquisitions, I shall not enter upon any now. You will find such given in detail in my monograph, *Sur le Grossissement des Images Ophthalmoscopiques*, to which I have already referred, or in the corresponding chapter on this subject by me in the *Traité Complet d'Ophthalmologie* by De Wecker and Landolt. I will content myself here with giving, in a very few words, the results at which I have arrived.

1. In an emmetropic eye, when examined with the upright image, the enlargement is twentyfold.

2. The degree of enlargement is less for a hypermetropic, and more for a myopic eye, and that in proportion to the degree of the ametropia.

3. The enlargement is less in the hypermetropia of curvature than in axial hypermetropia.

4. The enlargement is more considerable in the myopia of curvature than in axial myopia.

If it were possible to place the correcting-glass at thirteen millimètres from the cornea of the observed eye and of the observer's eye, the enlargement of the upright image becomes in all cases of axial ametropia the same as in emmetropia.*

Let us now proceed to consider the degree of enlargement undergone by the inverted image. The determination of this is a more simple matter than that of the upright image. You doubtless recollect that the inverted image is a real image, formed in the air by the union of the rays proceeding from the fundus of the eye under examination. This image being real, has a definite magnitude. It can be received upon a screen and measured directly, as if it were a tangible object. Here then at least there need be no hesitation as to the manner in which we should determine the degree of enlargement. The enlargement is, of course, the proportion existing between this image and the object to which it corresponds. We have, therefore, no occasion to consider the size of the image formed on the retina of the observer, any more than we have to consider the distance of projection. We have simply to measure the size of the inverted image, and compare it with the object at the fundus oculi to which it corresponds. The proportion existing between these two becomes the expression of the enlargement. M. Scheller was the first to point out a mode of measuring directly the size of the inverted image. His procedure, however, is very imperfect, and does not call for notice here. The method I prefer is one to which I have called attention in my work, *Le Grossissement*, already cited (page 78). It is as follows: "Take a cylinder such as that of Liebreich's demonstrating ophthalmoscope; one of its ends, modelled so that it can be applied to the orbit, contains a convex lens of say fifty-five millimètres focal length (D. 18), placed at a constant distance from the eye. The other end of the tube, to which the observer applies his eye, presents an opening at the side, intended to allow the light to fall on an ophthalmoscope mirror, fixed there. The inverted image is produced between the lens and the mirror. There would be no difficulty in introducing into this instrument a diaphragm marked with a network of square meshes, and steadied by a movable screw in a slit made in the side of the tube. The addition merely of this screw would permit of the diaphragm being placed at the exact spot where the inverted image was formed. We should thus obtain, at the same moment, an accurate indication of the distance the image was from us, as shown by a scale marked on the side of the cylinder, and its size, which could be directly determined from the size of the meshes of the network." The proportion existing between the size of the inverted image and the object at the fundus gives the degree of enlargement we require.

But here, gentlemen, we are met on the very threshold, as it were, of our inquiries, by the self-same difficulty which we encountered in the determination of the direct image. Here, as there, we miss at the fundus any object of known size. But if, proceeding another way, we know the degree of enlargement, we can deduce from the measured size of the inverted image the true size of the object to which at the fundus of the eye it corresponds. This we arrive at by calculation, but I have succeeded in simplifying so much the calculations required for the determination of the indirect image that they no longer present any difficulty. They may be even worked out in the mind more rapidly than the actual measurement of the inverted image can be made in practice. If we place the convex lens, which we use to produce the inverted image, at such a distance from the eye, that its focus coincides with the nodal point of the eye, which point is situated at a few millimètres only behind the plane of the pupil, that is to say, if we hold the lens in the position which has been pointed out, as being the most favourable for the inverted image, then the degree of enlargement will

be expressed by the simple fraction $x = \frac{\phi}{g}$. In this fraction, ϕ is equal

to the focal distance of the lens which produces the inverted image: g is equal to the distance which separates the nodal point of the eye examined from its retina. This distance is equal to 15 millimètres in the emmetropic eye. It is longer in the myopic, shorter in the hypermetropic eye; and the difference increases or diminishes with the degree of ametropia. There is no difficulty in finding it for each case of ametropia. Thus, let us call the difference in length of this space in an emmetropic compared with an ametropic eye η , then η will always equal 300 millimètres divided by the focal distance of the lens which corrects the ametropia. The value of η must be added to 15 millimètres in the case of myopia, but subtracted in the case of hypermetropia.

Let us take an example. What will be the amount of enlargement of the inverted image in an emmetropic eye produced by a convex lens of 15 dioptrics? In the example chosen, ϕ , that is, the focal distance of the lens, is equal to 67 millimètres, g is equal to 15 millimètres, therefore the increase in size is $\frac{67}{15}$, or 4.4; that is to say, the papilla, for example, which we see in this inverted image appears 4.4 times larger than it is in reality. If it have a diameter of 1.5 millimètres, its inverted image will have $1.5 \times 4.4 = 6.6$ millimètres. Again, let us produce with the same lens of 15 dioptrics the inverted image of a hypermetropic eye of 5 dioptrics. What will be the degree of enlargement under which the fundus of this eye will be seen in the inverted image? In this case, ϕ of the formula is still 67 millimètres. In order to find g , we must take the focal distance of the correcting lens (5 dioptrics)—that is, 200 millimètres—and divide 300 millimètres by it, in order to find the value of η , that is the difference in length between this eye and the emmetropic eye. We get then $\frac{300}{200} = 1.5$ millimètres, which must be subtracted from the corresponding length of the emmetropic eye, for the hypermetropic eye is the shorter of the two. We have, then, in this case, for the value of g , $15 - 1.5 = 13.5$ millimètres. The degree of enlargement is represented by $\frac{67}{13.5}$, or 5 nearly.

Let us now take the case of a myope who requires a concave 10 dioptrics = 100 millimètres—focal distance. The value of η here becomes $\frac{300}{100} = 3$ millimètres; g is therefore equal to $15 + 3 = 18$ millimètres. With a convex lens of 15 dioptrics, the inverted image of this myope will be $\frac{67}{18} = 3.7$ times larger than the object to which it corresponds. For a hypermetropia of 10 dioptrics, we should have obtained, for the value of η , $15 - 3 = 12$ millimètres, and the enlargement would have been $\frac{67}{12} = 5.5$ times approximately. It results as a corollary from my formula, that the inverted image is large in proportion as the lens by means of which we produce it is weak, that is to say, as its focal length ϕ is long; and again, that it is large in proportion to the amount of hypermetropia present, that is, as g is small; and that, conversely, it is smaller in proportion as the myopia is great, that is, as g is large. We have measured, let us suppose, the size of the inverted image of the papilla produced by the aid of a convex lens of 5 dioptrics, as we did in the case of a hypermetropia of 5 dioptrics, and that we have found the papilla to measure 10 millimètres in diameter. Our calculations will have shown us that the enlargement of the inverted image in this case is fourfold; therefore, the papilla will have in reality a diameter of $\frac{10}{4} = 2\frac{1}{2}$ millimètres. We may also determine the real size of an object of the fundus of the observed eye by the upright image by reducing the projection of that image to the size of the object it corresponds to. Thus, if we have found, by one of the methods above given, that the papilla projected to 30 centimètres has a diameter of 40 millimètres, we may say the increase in size of the upright image being twentyfold the true size of the papilla is $\frac{40}{20} = 2$ millimètres. However, for the mensuration of objects at the fundus, it is preferable to project the upright image to a greater distance, for example, to 3 mètres.* The increase in size will evidently be proportionably greater. Thus, if we project it to 3 mètres instead of 30 centimètres, it will be two hundredfold instead of twenty. The image of the papilla will have, in the example chosen, a diameter of 40 centimètres instead of 40 millimètres. My ophthalmoscope with two mirrors serves very well for such mensurations.

Permit me, in concluding this lecture, to lay before you a table of the enlargements of the ophthalmoscopic image in the direct and indirect methods of examination respectively.

	Inverted image, with +15 dioptrs.	Upright Image.	Proportion.
Emmetropia	4.4 ..	20 ..	1:4.54
Axile hypermetropia (punctum remotum situated at 80 millimètres) ..	5.58 ..	18.4 ..	1:3.3
Hypermetropia of curvature, do. ..	4.78 ..	15.8 ..	1:3.3
Axile myopia, ditto	3.35 ..	30 ..	1:9
Myopia of curvature, ditto	4.2 ..	38.2 ..	1:9

* Landolt, "Le Grossissement des Images ophthalmoscopiques", in Wecker and Landolt, *Traité complet d'Ophthalmologie*, tome i.

SAFFRON WALDEN.—In this district, 106 deaths occurred during 1878, equal to a rate of 15.8 per 1,000. The proportion of deaths among infants under one year of age was satisfactorily low. No less than 57 per cent. of the deaths were in persons over sixty years of age, 37 per cent. above seventy, and 19 above eighty years of age. Only 3 deaths were registered from infectious diseases, excluding 5 from diarrhoea. Consumption, bronchitis, and other lung diseases caused 22 deaths, or 3.7 per 1,000 of the population. This is a reduction on the average rate of nearly 2 per 1,000. The Hospital for Infectious Diseases, recently established, seems to have been of great service in checking the spread of infection, 11 cases of small-pox and 2 of scarlatina having been admitted into it, with only one fatal result.

* Landolt, "Die Vergrößerung des aufrechten ophthalmoscopischen Bildes"; *Centralblatt für die med. Wissenschaft.*, 1876, No. 21.