THE

CAUSES AND PREVENTION

OF

NEAR-SIGHTEDNESS.

BY

DR. KAMPF,

SURGEON OF THE AUSTRIAN IMPERIAL ARMY.

Translated from the Wiener Zeitung by

HENRY W. WILLIAMS, A.M., M.D.

PRESIDENT OF AMERICAN OPHTHALMOLOGICAL SOCIETY; LECTURER ON OPHTHALMIC SURGERY IN HARVARD UNIVERSITY; OPHTHALMIC SURGEON TO THE BOSTON CITY HOSPITAL; FELLOW OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES; FELLOW OF THE MASSACHUSETTS MEDICAL SOCIETY; HONORARY FELLOW OF THE RHODE ISLAND MEDICAL SOCIETY, ETC. ETC.

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THE CAUSES AND PREVENTION OF NEAR-SIGHTEDNESS.

THE researches, prosecuted with great industry and untiring perseverance by Dr. Cohn, of Breslau, upon the refractive condition of the eyes of 10,000 school children have led to this noteworthy result :— that in all the classes, from the lower schools up to the University, there was a great proportion of near-sighted pupils ; and furthermore, that this anomalous condition was met with more frequently in the city than in the country schools, and in the higher more than in the lower classes. This general result appears little surprising ; but

the detailed statements respecting the percentage of these same classes, showing the enormous increase of the defect as they reach the higher schools, may well excite astonishment.

The village schools show but 1·4 per cent. of near-sighted children, the primary town schools 6·6 per cent., the intermediate schools 10·3 per cent.; in the higher schools the proportion reaches 21 per cent., while in the University it is 40 per cent., almost one half the whole number of students. From these reliable, carefully elaborated data the following conclusions necessarily follow :—

1st. That nearly the same proportion of near-sightedness will be found among all highly educated people.

2d. That the number of near-sighted persons must increase in rapid proportion with the raising of the standard of scientific cultivation.

3d. That with the presumptive increase of culture in the future we are on the direct road to become a generation of short-sighted people; unless, knowing these facts, we resolve to take measures whereby the tendency to excessive increase of learning, augmenting these defects of refraction to a hazardous degree, may meet with energetic opposition.

These considerations induce me to speak of the causes and the prevention of myopia, though I must content myself with a general sketch, as want of time does not permit me to treat exhaustively of the subject.

Before proceeding to the consideration of these questions, let me, for the sake of clearness, premise a concise explanation of the compass of vision in normal and in near-sighted eyes.

An eye is termed normal when it can unite parallel incident rays, coming from objects at an infinite distance, to a focus upon its retina, and form there distinct images of

such objects. The focal point of these eyes is at the retina. A near-sighted eye unites parallel incident rays to form an image at a point in front of the retina, these rays reaching the retina only as circles of dispersion. The focal point lies, in this case, in front of the retina.

Up to a certain point, termed the far-point, normal eyes are capable of forming a distinct image of approaching objects, without an effort of accommodation, notwithstanding an increasing divergence of the incident rays; because, from the shorter focal distance of the crystalline lens, an enormous difference in the distance of remote objects requires but a minimum variation of the focal point; because, even in a normal eye, on account of the differences of curvature in the different meridians of the cornea, we may speak of a focal line rather than a focal point; because, moreover, the eye is capable of neutralizing, to a certain extent, the circles of dispersion;

and because, lastly, the material dimension of the retinal nervous tissue admits of a certain latitude in the formation of distinct images.

If, however, the divergence of the incident rays becomes considerable, on account of the approach of objects within a less distance than the far-point, the accommodative power must be exercised to adjust the focus, so that clear images may be formed on the retina. The agency of the accommodation begins at the far-point, and must be gradually increased as objects approach the eye from this point, reaching its maximum at the near-point. The distance between the far- and the near-point represents the range of distinct vision.

In short-sighted eyes the focal point lies in front of the retina; therefore objects must be brought nearer, so that the rays from them may fall upon the cornea with such a degree of divergence that clearness of the retinal picture may be obtained.

The point at and from which images begin to be clearly defined for near-sighted eyes, is their far-point.

If objects are brought nearer to short-sighted eyes than their far-point, the accommodative power must be brought into play; but their range of clear vision lies nearer the cornea than in normal eyes. The normal eye sees clearly both distant and near objects; the short-sighted eye sees clearly only such objects as are between its far- and its near-point, whilst rays from things at an infinite distance, or beyond the far-point, are received upon the retina only as circles of dispersion, and do not form well-defined images.

The causes of near-sightedness depend generally on either an elongation of the optic axis or on an increased convexity of some portions of the eyeball. This altered form, of the entire globe or of one of its parts, constitutes the anatomical characteristic of near-sightedness.

The entire series of causes of myopia may be divided into two anatomical groups.

1st. An elongated formation of the globe.

2d. Posterior staphyloma.

These groups include all the conditions in which a lengthening of the optic axis is attended with a relative abbreviation of the natural range of vision.

At a certain period of fœtal life the globe of the eye has an elongated form, which, as development goes on, is changed to a rounded, nearly spherical shape. It frequently happens that from arrest of development the elongated form persists until birth. In these cases the antero-posterior diameter, which may measure 17 lines, causes so great a prominence that even ordinary observers notice it, and the individuals in whom it is met with are designated as goggle-eyed.

Posterior staphyloma constitutes the second cause of elongation of the optic axis. This condition is characterized by a more

or less conical projection at the posterior half of the eyeball, thus lengthening the axis.

These anomalies of form were first noticed by Demours and Ammon in 1814, and we have to thank Scarpa, of Pavia, for more precise descriptions of them. An account of a section of an eyeball by Ritterich, led Arlt for the first time to consider posterior staphyloma as an efficient cause of near-sightedness.

A clear proof of the influence of posterior staphyloma in producing myopia is afforded by the circumstance that this refractive condition sometimes changes year by year, the myopia being developed in one eye to a much greater degree than in the other—these differences resulting from the formation in one eye of posterior staphyloma. (Stellwag.)

The condition in question has its origin (according to E. Jaeger) in a small, circular zone of the inner layer of the sclera,

anterior to the sheath of the optic nerve. The expansion usually begins at a point in the outer half of this zone, and advances from thence to the margin of the papilla of the nerve, gradually extending upwards and downwards in a crescentic form, and at a later period taking the shape of a pointed arch or an ellipse, or it takes an indefinite enlargement and at last completely encircles the optic papilla. These variously shaped cones may remain stationary at any stage of their development, or may increase slowly or rapidly ; and the gradual increase of myopia year after year keeps pace with the enlargement of the staphyloma.

The choroïd overlying the posterior part of the sclera and united to it, participates in its projection backwards, and is at last completely atrophied over the whole extent of the staphyloma, so that the clear white color of the sclera becomes visible to ophthalmoscopic inspection. Where the sta-

phyloma is of recent date its groundwork is whitish red, with scattered patches of pigment and vascular spots.

The retina, lying loosely upon the choroïd, except at the macula lutea, extends itself generally uninjured over a small staphyloma, and seems to give way only when this becomes larger or increases rapidly. But if the staphyloma assumes any considerable expansion, or its growth is rapid, the retina becomes more or less irritable, and extravasation of blood at the macula lutea, inflammation and separation of the retina, and disease of the vitreous humor may ensue.

We must perceive that posterior staphyloma is a condition from which by no means trivial consequences may ensue; which, in fact, may in many instances result in total annihilation of the visual function. The important question then arises, by what causes is it most often engendered?

E. Jaeger sometimes found, even in new-

born children, well-marked changes of structure, high degrees of staphyloma being combined with coloboma of the eye, and with corresponding defects in other members of the same family; so that his conclusion that it is sometimes attributable to hereditary descent appears to be well grounded. This view is still further established through other and numerous researches of the same observer, according to whose data posterior staphyloma is excessively frequent in the descendants of near-sighted ancestors. He finds even that the aspect and the specific form of ectasia in mother and child, and even in each of several sisters and in both eyes of the same individual, are often surprisingly like those of the ancestors, or even exactly resemble them.

In the majority of cases the original seat of the posterior staphyloma is in the outer zone of the sclera, near the optic papilla, at the spot where, according to Ammon, the fœtal fissure closes, and which offers

less power of resistance to the intra-ocular pressure.

Another etiological condition is to be found, as observed by E. Jaeger, in the immediate proximity of the so-called posterior vascular circle to the optic nerve entrance ; which, by its hyperæmia and by the serous infiltration of the neighboring tissues, favors the giving way of the parts least capable of resistance.

The positions of these above-named parts of the sclera which have least power of resistance, and of this vascular circle, predispose, in case of augmented intra-ocular tension, or of a hyperæmic condition at a certain point, to the production of staphyloma, and with it of short-sightedness.

I have said that short-sightedness may result ; but we must observe that this condition and posterior staphyloma are not necessary factors of each other. Not seldom, indeed, the latter may be associated with hypermetropia, as I have repeatedly ob-

served at the clinic of my respected teacher, Stellwag, and in my own practice. But this occurs in cases where an eye of an exceedingly short axis does not attain, even with the existing staphyloma, the length of the axis of the normal globe.

We should often fall into error if we should draw a conclusion as to the degree of myopia from the size of the posterior staphyloma, for an extensive staphyloma is frequently coincident with the lower degrees of myopia, and the converse. For an eyeball of elongated build may, in acquiring a slight crescentic staphyloma, attain a high degree of myopia, whilst in an eye of short antero-posterior diameter the myopia may remain very slight in spite of a strongly developed staphyloma.

Posterior staphyloma, sometimes congenital, is often acquired, and with it myopia, in consequence of overstraining of the eyes, especially where there already existed a congenital tendency to it. * * *

As we now look over the portrayed series of causes of myopia, we find them made up in equal parts of congenital and acquired conditions. The question before us is as to the means by which we may bring about a rational prevention.

The best prophylactic method, where we have to do with congenital conditions, will be that which will hinder their increase. In acquired myopia such measures as may be successfully interposed against the known exciting causes will have the highest value. The inducing causes, leading to acquired, or to the increase of congenital near-sight, through the production of posterior staphyloma, or of a permanent increase of the convexity of the lens, are, especially, an augmented intra-ocular pressure, a hyperæmic condition of the bloodvessels, and a too great demand upon the accommodative powers, and are originated—

1st. By bringing objects too near during continuous use of the eyes.

2d. By insufficient light.

3d. By unsuitable use of spectacles.

4th. By opacities of the transparent media.

To counteract these injurious influences must therefore be the basis of prophylactic treatment.

A principal cause of myopia is found in the too near approximation of objects while the eyes are employed upon small things, and are making use of a large share of their accommodative power and keeping up the increased convexity of the lens. The eyes are then liable to a hyperæmic condition and to augmentation of intra-ocular pressure, of which the last results from the action of the external muscles, the tension of the globe being augmented in proportion to the increased convergence.

A second cause is found in the continuous occupation of the eyes upon small objects, as in many trades, such as watchmaking, engraving, &c.; or in uninterrupted

reading, writing, sewing, embroidery, or the frequent use of the microscope. Yet another cause is to be traced to the use of the eyes with unsuitable glasses, or by an insufficient light. The retina needs, as we know, in order to its sufficient excitation for the formation of images, a certain degree of intensity of light to give a sufficient illumination of external objects. We know, also, that the intensity of light must be, not in single but in quadruple proportion to the distance of the object. If, therefore, objects are insufficiently lighted they must be brought nearer the eye, and thus the whole series of morbid phenomena will be called forth. Similar consequences ensue from the use of very strong concave glasses, by which the virtual image is thrown very near the eye, at the cost of requiring a higher degree of the accommodative power.

Opacities of the transparent media, especially of the cornea, have also great influ-

ence as causes of myopia. The disturbances of vision accompanying these conditions become in some measure lessened by a very close approximation of objects, because thus many of the lateral rays of diffused light are cut off, whilst on the other hand the size and brightness of the retinal images is increased. (Stellwag.)

The means of preventing near-sightedness, of which I here merely sketch the outlines, must consist chiefly in averting the mischievous effect of its exciting causes, by combatting them even in the family and the school, through such means as should be enforced by the government, in accordance with the advice of the profession.

We must first of all endeavor to make these important matters as clear as possible to the comprehension of the mass of the people by means of widely circulated popular articles, in which the injurious influences to which the eyes are exposed during the juvenile period should be described

in detail. In every family preservative rules should be watchfully observed, in order that clear vision may be retained. It should be understood that a bent position of the head in study is hurtful; that the pursuit of certain artistic vocations will cause the eyes, if having a tendency in this direction, to become short-sighted; and that, therefore, a child having elongated eyeballs or posterior staphyloma should not be placed to learn trades which require long-continued occupation upon minute objects, such as watchmaking, lithography, engraving, &c.; and that all great or continued straining of the eyes, especially after severe attacks of typhoid, variola, scarlatina or measles must be avoided.

Special vigilance and attention should be exercised with regard to the children of the common schools, as well as those who are to be sent to the higher schools. The plans, the site, the lighting of the school-houses must be adjusted to meet the requirements of

modern knowledge. The relatively too great height of the desks, and the imperfect lighting of our school-rooms, are great evils, because they lead to the bringing of objects too near the eyes, and thus involve the inordinate exercise of the accommodative power.

A school-room should be in a brightly lighted situation, and should have ample window spaces. The pupils should occupy seats with backs, and with desks of less than 45° of inclination, placed at a distance of ten to twelve inches from the eyes. The hours of study should be suitably regulated, and the injurious overburdening with home lessons diminished. Pale ink, bad type, too fine or too closely printed characters, too fine pens, too dark paper—in short, all those agencies which exert the above-described hurtful influences by creating a strain upon the eyes, should be done away with.

15 *Arlington Street, August*, 1871.

NOTE.—In the last No. of von Graefe's *Archiv für Ophthalmologie* is an elaborate article by Dr. Fred. Erismann, of St. Petersburg, giving the results of the testing of the vision, and the ophthalmoscopic examination of the eyes of 4,358 children, by himself, in the schools of that city. His researches fully confirm the conclusions announced by Dr. Kampf; the number of myopic pupils being 30·2 per. cent of the whole, and the frequency of this affection being found to increase enormously in the higher classes in the schools. He says, "at the rate we are going on, a few generations will find us a universally short-sighted people." H. W. W.