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WRIGHT (C.W.)

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BY
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CHARLES W. WRIGHT, M.D.,
Professor of Chemistry in the Kentucky School of Medicine; formerly
Professor of Chemistry in the Medical College of Ohio, etc.

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PHYSICS 311

CHARLES W. WELCH

LECTURE NOTES

1952-1953

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AN ABSTRACT
OF A
LECTURE ON VISION.

The lens, in all eyes, is adjusted to a particular focal distance, which is fixed, and all objects, at different distances, are brought into focus by dilatation, or contraction, of the iris.

The focal distance, as adjusted by the lens, is, comparatively speaking, *fixed*, varying only in different individuals, and at different periods of life in the same individual.

The changes produced in the lens by age, according to Gray, are the following:

“In *the fœtus*, its form is nearly spherical, its color is of a slightly reddish tint, not perfectly transparent, and so soft as to readily break down on the slightest pressure.

“In *the adult*, the posterior surface is more convex than the anterior, it is colorless, transparent, and firm in texture.

“In *old age*, it becomes flatter on both surfaces, slightly opaque, of an amber tint, and increases in density.”

From the above changes in the lens, it will be observed that the fixed focal distance, in individuals advanced in life, is favorable to distinct vision at great distances, and less so in early life, and *vice versa*.

That the dilatation and contraction of the iris is the means by which the eye is enabled to

adapt itself to viewing objects distinctly which are situated at different distances from the observer, I think there cannot be a doubt. Thus, in a uniform light, the eye can be made to see objects distinctly at different distances, by viewing them through apertures of varying diameters, the apertures being diminished as the objects approach the eye. This operation may be carried to such a degree, by using apertures sufficiently small, that a person will be enabled to read printed matter which is held within a half inch of the cornea. A similar experiment can be made with the iris itself, by allowing the sun's rays to fall directly upon the printed page, when it may be brought in contact with the eyelashes, and the words will be distinctly legible. In such an experiment the pupil is contracted to a diameter less than that of the head of a common pin. Opium will also shorten the focal distance, by contracting the iris, and belladonna, pink-root, and hyosiamus, produce the opposite effect, by dilating the pupil. The pupil is always observed to expand when a distant object is viewed, and to contract as one near the eye is observed.

Both eyes are never used simultaneously in the same individual, in the careful examination of an object, but are employed alternately. If the object examined is situated to the left of the observer, the corresponding eye is used, if to the right, the right eye is employed. Hence the pupils of the eyes of the same individual

are not always of uniform diameters at the same time.

The explanation most commonly given of the means by which the eye adapts itself to different focal distances, is the change in position which the lens undergoes, by the assistance of the ciliary muscle. That such an explanation has no foundation in truth, a proper investigation of the subject cannot fail to convince any one. Thus, if it were possible for the crystalline lens to be thrown forwards, by the contraction of the ciliary muscle, in viewing a near object, the cornea would become more convex; and when looking at a far object it would become flattened, but, according to the researches of Heueck, there is no change in the form of the cornea in adjusting the eye to different focal distances. Aside from all speculations on the subject, it is a physical impossibility for the lens to change its position in the sound eye without a corresponding change in the convexity of the cornea; for there is no communication between the aqueous and vitreous humors, and if the lens were thrown forward the cornea would be pushed out the same distance, and the retina would also advance in a corresponding degree, which would have the effect of preventing any change whatever in the focal distance of the eye.

By the employment of glasses, which serve the purpose of lenses, in adjusting the fixed focal distance after the operation for cataract, the individual is enabled to vary the focal distance

by the iris alone, without moving the glasses either forward or backward, in viewing objects at different distances. If the lens adjusted the eye for variable focal distances, glasses, which serve the purpose of lenses, would have to be shifted backwards and forwards, like the tube in a camera obscura, accordingly as a distant or near object was brought into focus. In fact an individual who has been operated upon for cataract can enjoy a considerable range of distinct vision by the lenticular properties of the iris alone.

From its mechanical relations to the lens, the ciliary muscle cannot change the position of that medium, and the only office of that muscle seems to be that of regulating the quantity of blood sent to the iris and choroid coat, by which the sensibility of the latter, and the retina, to the rays of the light, is increased or diminished.

It is stated by some writers that the adapting power of the ciliary muscle, is destroyed by belladonna, which paralyzes it. Now, belladonna paralyzes the circular fibres of the iris, and does not affect the radiating fibres of that structure, whereby presbyopia is temporarily produced. In such cases an artificial iris, constructed of perforated card, will enable a person whose pupil is dilated by belladonna to see distinctly at the usual focal distance.

On the other hand, opium, by paralyzing the radiating fibres of the iris, and not exerting any effect on the circular ones, induces temporary myopia.

It is not more remarkable that opium should localize itself in the radiating fibres of the iris, and produce its characteristic effects, and belladonna, in a like manner, fix itself in the circular fibres, than that lead should localize itself in the extensor muscles of the fore arm, and paralyze them, and that arsenic, however introduced into the system, should fix itself in the coats of the stomach, and produces the effects peculiar to itself.

Opium and belladonna are not stimulants to muscular fibre; on the contrary, they allay or destroy muscular excitability.

The cause of long and short-sightedness is attributed to a change in the refracting media of the eye, or to a change in the diameter of that organ, or to both causes combined. Thus, in myopia, the refracting power of the humors is said to be too great, by which the image of an object falls short of the retina; whereas, in the opposite condition, presbyopia, the refraction is said to be diminished, and the rays of light are not sufficiently converged to depict an image on the retina. In the former condition there is supposed to be an over-convexity of the cornea and lens, and in the latter a diminished density and quantity in the humors of the eye. In regard to the first of these conditions, there is no proof that the refracting power of the lens, or other humors of the eye, is increased, and in the great majority of cases the cornea is not more convex in near-sighted persons than in those not

so affected; on the contrary, the reverse frequently appears to be the case. The only foundation for such a supposition, is the fact that the sight of the myopic is improved by the use of concave glasses, by which the rays of light are dispersed, and prevented from coming to a focus before reaching the retina, or rather the black pigment, which is in reality the surface upon which the image of an object is painted.

Now, the essential cause of shortsightedness is to be sought for in the iris, which is in all cases preternaturally contracted, or possesses an unusual degree of irritability. When the case is congenital the iris possesses an excessive degree of sensibility to impressions of light; in fact, this form of the affection is almost always observed in individuals of nervous temperament, together with an excessive degree of excitability. Exposure to a bright light aggravates the congenital form of the affection, by producing contraction of the circular fibres of the iris; and the same remark will apply to large doses of opium, which paralyzes the radiating fibres of the iris. It will even produce temporary nearsightedness in a person not so affected. In congenital cases, any means that will cause dilatation of the pupil, such as belladonna, for example, will benefit the patient, and will enable him to read with the book held at the same distance from the eyes as a person would require it whose eyes are sound.

I have repeatedly experimented with opium and belladonna, and always with the same opposite results—shortening the field of vision with opium, extending it with belladonna.

Snow blindness is due in great part to powerful contraction of the pupil; short-sightedness, it is in fact, to an excessive degree. It is well known that myopia is much more common in cold climates, where the ground is covered with snow for several months in the year, than it is in warm ones, cases being frequently met with in the New England States, but rarely in the Southwest.

The retina is exceedingly sensitive to luminous impressions in myopic individuals. They can see to read by a light which would be wholly insufficient to a person whose eye is possessed of ordinary sensibility.

The true cause of long-sightedness consists in a preternatural dilatation of the pupil of the eye, or, what amounts to the same thing, a loss of irritability of the circular fibres of the iris. This, as is well known, is a condition common to persons advanced in life, or those who are in the habit of viewing objects in the distance.

Contrary to the statements of most writers on the subject, the sight of the myopic improves as he advances in life, from a diminution of the irritability of the circular fibres of the iris. In senile presbyopia, the iris does not respond to the nervous influence, or the rays of light, as readily as before that condition obtains. That this condi-

tion is to be referred to a diminished control over the contractile power of the iris, and not to any change in the refracting power of the humors of the eye, or to any alteration in the diameter of that organ, is, I think, sufficiently established by the following experiments:—

Thus, a large dose of opium, by producing contraction of the pupil, will enable the presbyopic to read when the page is held at the usual distance from the eye. Opium could not possibly produce any change in the density, or refracting power of the humors, or in the diameter of the eye itself.

Since the first publication of my article on the use of opium in restoring the sight in senile presbyopia, Professor Nascar, of Naples, has made successful application of that remedy, in a number of cases, in that class of affections.

Exposing the page to the direct solar rays enables the far-sighted individual to read, by powerfully stimulating the iris, when under other circumstances he cannot distinguish a letter without the assistance of glasses. A card perforated with a common pin, and interposed between the eye and the object viewed, by subserving the purpose of the contracted pupil, will enable the individual to distinguish objects at the usual focal distance. The perforated card should be held as near the eye as possible in making these experiments.

Any thing which will cause an increased flow of blood to the eye, by which the irritability of

the muscular fibres of the iris is augmented, will restore distinct vision. Thus, violent coughing will frequently enable the far-sighted to see objects distinctly at the usual distance for a period of from ten to fifteen minutes.

Myosis and mydriasis might, with propriety, be termed the acute forms of short and long-sightedness, inasmuch as the former signifies preternatural contraction of the pupil, and the latter dilatation. Ergot benefits the sight in mydriasis, by producing contraction of the circular fibres of the iris. Myosis is most frequently met with in persons whose occupation compels them to look at minute objects. Objects seen through a pupil contracted by opium, or one contracted by a powerful light, or viewed through a perforated card, are invariably magnified.

Man is capable of exerting a considerable voluntary control over the muscular fibres of the iris. Thus, by practice, the pupil can be made to dilate, or contract, with as much facility, by an effort of the will, as the number of respiratory movements can be increased, or diminished, by the same effort. This power over the iris can be acquired by rapidly changing the focal distance of the eye, which can be accomplished by interposing a small object between the eye, and near to it, and a larger one situated at a considerable distance from the observer. A common pin, held at a distance of four or five inches from the eye, and on a line with the distant object, is well adapted to the experiment.

On viewing alternately the far and near object, the iris will be observed to dilate when the eye is fixed on the former, and to contract when fixed on the latter. On making this experiment a number of times, the individual will be enabled to contract or dilate the pupil at will; at first by fixing the eye upon imaginary objects, and, in a short time, without any assistance of the kind. The experiment is best conducted in a room where the sun's rays have not a direct entrance; in other respects the light may be as intense as that which is most agreeable in reading. In a strong light voluntary control over the iris greatly diminishes.







