more on this subject I refer you to the chapter on "The Sense of Sight."

It is said that all children are born far-sighted, so this defect may be considered as want of development of the eye; some of them remain far-sighted, some become normal, and others pass on to short-sightedness, so that this latter may be considered an over-development of the eye. Of the total of any population the proportion of abnormal eyes is surprisingly great; some authorities say 80 per cent., others quote as high as 95 per cent. Anyhow, those people who have normal eyes are very hard to find, and, in fact, an absolutely mathematically perfect eye is perhaps almost impossible.

An object may be considered as a mass of luminous points from each of which a pencil of light diverges to the eye; each pencil forms a cone, of which the point of origin is the apex and the cornea the base. Its axis is the central ray of the cone, and it is not refracted because it is perpendicular to the surface of the cornea at its point of contact. All the other rays of each cone, being refracted, are again brought to a point on the retina. An image may be considered as a series of foci of the rays from the series of points on the object.

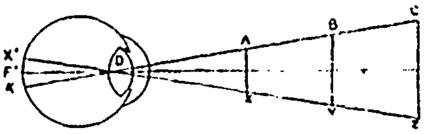

Fig. 30.

In Fig. 30, the eye being emmetropic, parallel rays from the object *AX* fall on the cornea, and being refracted by the dioptric media form a sharp inverted picture, *X'A'*, on the retina. The principal axial ray *FF'* is not refracted, and the secondary axial rays, *AA'*, *XX'*, pass through also without any or with very little refraction, crossing the principal axis at the nodal point *D*. The size of the inverted retinal picture *X'A'* depends on the angle subtended at the nodal point *D* by the rays *AA'* and *XX'*, from the extremities of the object *AX* after they cross each other at *D*, and this again depends on the angle under which they enter the eye.

It will be noted that *AX* at, say, 20 ft., *BY* at, say, 60 ft., and *CZ* at, say, 200 ft., all form the same sized retinal picture *X'A'*, and only habit and education cause us to know whether it be a smaller object at a shorter distance or a larger one at a greater distance than is seen. The retinal image of a certain object is not of the same dimension in every eye, as the longer the distance from the crystaline to the retina the greater will be the space occupied by it. Comparative size of objects, however, is the same in all eyes. (See chapter on "Sense of Sight.")

The P.R.—*Punctum Remotum*—far point of vision, is the very greatest distance at which the eye can see, and in the emmetropic eye it is at infinity (symbol ∞). The rays of light from the most distant star can enter an eye and be brought to a focus on the retina, and therefore infinity, which means a distance without limit, is the furthest point of vision (symbol V) of the emmetropic eye. As the divergence of light rays is so small when they proceed from very distant points to the pupil of the eye, they are considered parallel. If the source of the light be 20 ft. or further away the rays are considered to be parallel equally with those from one of the fixed stars. Therefore, in practical optics 20 feet is taken as ∞, that distance being the nearest point from which rays incident to the eye are parallel, and it is the P.R. in emmetropia. Rays of light from points nearer than 20 ft. are divergent rays.

The P.P.—*Punctum Proximum*—near point—is the nearest point at which the reading of fine print can be effected. In the emmetropic eye it is at any distance between 2¾ and 8 in. according to age, it being nearer in youth and gradually receding to a greater distance. It is considered normal if at 8 in., the eye then being practically fully accommodated and changed from a 50D lens to one of 55D. The crystaline lens, which is the only part of the eye that will have altered its form, being changed from a 23D lens to a 28D.

At 20 ft. no accommodation is employed, because, the rays being parallel, the refraction of the eye (50D) suffices to bring them to a focus at the retina, the eye being entirely at rest. Some consider that the adjustment of the eye for parallel rays is achieved by an equilibrium between the radiate and sphincter fibres of the ciliary, both being always in a state of tension for vision near and far. I know of nothing to support this theory.

At any point nearer than 20 ft., say, 19 ft., the rays are divergent, and if they have to be focussed on the retina a small amount of accommodation must be employed. As the distance between the object seen and the eyes is decreased more and more accommodation must be exerted until the nearest point at which the eyes can be accommodated is reached. Therefore, accommodation is used for every distance lying between the P.R. (20 ft. in emmetropia) and the P.P., and this distance is called the range of accommodation.

The necessary dioptric change of the crystalline lens for seeing at the P.P. represents the greatest amount of accommodation that can be exerted, and is called the amplitude of accommodation.

As accommodation is a function dependent on the strength of the ciliary muscle and the flexibility of the crystalline lens, it is but natural to find that in old age it becomes weaker and more deficient; in fact the amplitude of accommodation is greatest at ten years of age, when the lens is possessed of extreme flexibility, and then commences to decrease gradually. This decrease is about equal in all eyes, whether emmetropic, hyperopic or myopic, and therefore the amplitude of accommodation—that is, the amount that can be exerted—is practically the same, (or at least should be) no matter what the condition of the refraction in everyone's eyes according to age. This must not be confused with the range of accommodation, which varies considerably according to the refraction.

As the nearer the object is to the eyes the more divergent are the rays, so also the nearer it is the more accommodation must be exerted in order to see it. Conversely, the more accommodation a person can exert the nearer he can bring a thing up close to the eyes and still see it, so the greater the amplitude of accommodation the shorter is the distance of the P.P. The following table gives the two at various ages:

Age Years	Accommodation in Diopters	Corresponding P.P. Distance in inches.	in Cm.
10	14.00	2¾	7.
15	12.00	3¼	8.50
20	10.00	4	10.
25	8.50	4¾	11.50
30	7.00	5½	14.
35	5.50	7	18.
40	4.50	9	22.50
45	3.50	11	28.50
50	2.50	16	40.
55	1.75	22	60.
60	1.00	40	100.
65	.50	80	200.
70	.25	160	400.
75	Nil	∞	∞

The loss of the accommodative power is smaller when there is a lesser quantity to lose it from, so that the decrease in the five years between 10 and 15 is 2D, that between 65 and 70 is ¼D.

To know the amplitude is often necessary. It can be accurately determined by the following test. Place the reading card at a distance of, say, 16 in.—ordinary reading point—and, without allowing it or the head to be moved, find the very strongest convex and the very strongest concave lenses through which can be read the smallest line possible. The difference between the two numbers represents the amplitude of accommodation; because when the person reads the line with the strongest convex lenses his crystaline lens must have been flattened as much as possible; that is to say, he read without employing any accommodation; and when he reads through the strongest concave lenses he is exerting the utmost accommodation that he is capable of; and therefore the difference between the two lenses shows how much that is. If he reads with +2.50D and −2.50D he has an amplitude of 5D. Sometimes both lenses are concave, as −7D and −2D, then the amplitude is also 5D, or they may be both convex as +2D and +4D, the amplitude being 2D.

The small Cape marigold (*calendula Pluvialis*) was dedicated to St. Swithin.

The habitat of oats is believed to have been the region north and west of the Alps.