The Bowman Lecture, 1921

Surely the shade of Bowman must have been hovering in the Royal Society of Medicine when Mr. E. Treacher Collins delivered the twenty-second Bowman lecture last May. The West Hall was packed to overflowing, the enthusiasm of his audience at the opening showed the esteem in which the lecturer is held by his fellow members of the Ophthalmological Society, their enthusiasm at the close their appreciation of the subject matter placed before them. When the aforesaid shade passed on his way, he must have felt that his immortal memory was being maintained in worthy fashion.

Mr. Collins took as his title, "Changes in the visual organs correlated with the adoption of arboreal life and with the assumption of the erect posture," and this is now reproduced with many of the original illustrations in the Transactions of the Ophthalmological Society, Vol. XLI.

Mr. Collins confined his remarks mainly to the differences in the visual organs of mammals, considering the requirements of the Herbivora, the Carnivora, the arboreal mammals and man; he discussed these variations in detail under several headings.

I.—The field of vision—A large monocular field is required where safety is ensured by rapid flight; one method of obtaining it is by marked prominence of the eye. In the Ungulata the outer margin of the orbit is composed of a complete projecting bony rim which serves to hold the eye well forward; in many of the lower mammals the outer margin is incomplete externally, whilst in Primates the outer wall is again bony, but does not cause prominence of the eyeball.

Some lower mammals can increase their monocular fields by increasing the prominence of the globe; this is effected by relaxation of the retractor bulbi muscle and by contraction of the muscle of Gegenbauer, of which a vestige in man is termed "Müller's muscle."

Increase in the size of the cornea relative to that of the eyeball must increase the field, and a diagram shows this relation in several species. The changes in the shape of the lens, and its size in comparison with that of the globe also alter with the requirements of a large or small monocular field. The laterally elongated pupil of the horse was observed to become converted into two circular pupils on exposure to bright sunlight, by the apposition of the pigmented bodies (corpora nigra) at the upper and lower margins. It is suggested that this is a mechanism for clearer vision without loss of panoramic field.

Further points under this heading are the laterality of the eyes and the amount of divergence of the optic axes, least when
binocular vision is present, greatest for panoramic vision. Recession of the snout, as one ascends the scale, allows the eyes to turn forwards, and the monocular fields to overlap. The Simiae and man alone amongst mammals have parallel optic axes. Overlapping of the monocular fields gives binocular vision, and attention is called to the overlapping of these fields posteriorly in some rodents, but a high angle gamma in the Herbivora may counteract this.

Binocular vision, consensual response of the pupil to light and conjugate movements are intimately associated with semi-decussation of the optic nerve at the chiasma. The question of the bifurcation of fibres from the macula is discussed.

A field of fixation comes into being with the development of central stereoscopic vision for form, and with this is associated an increase of mobility in the movements of eye and head in order to diminish the loss of panoramic vision from a small monocular field. Such mobility is most developed in man and the higher apes.

II.—Light sense—This is the most primitive of the visual functions. The lecturer accepts the "duplicity" theory of retinal activity and by it correlates the varying structures of the retina with the habits of different species.

The value of a tapetum is discussed, and the reasons why it has disappeared in arboreal dwellers and in man, who, for protection in darkness, took to caves and lake-dwellings.

III.—Form sense—Amongst mammals, this is most acute in the Primates, which alone have a true fovea. A fovea is also met with in some reptiles and in all birds. In monkeys, fine vision is required for the picking off of insects and fruit from the branches of trees.

IV.—Accommodation and convergence—These powers are intimately associated with the evolution of the fovea and with the adoption of arboreal life. Amplitude of accommodation is greatest in man, rather less in apes, and considerably less in the lower orders. This statement is strengthened by the reproduction of an interesting series of sections of the ciliary body in a number of mammals, showing variations in the size of the ciliary muscle and in the direction of its fibres. In the lowest mammals the muscle is practically non-existent. It is only in the Primates that the circular fibres are present, and in these there is a displacement outwards and backwards of the anterior part of the ciliary body owing to the disappearance of the "pillars of the iris" which attached the iris to the termination of Descemet’s membrane. It is suggested that this displacement permits the innermost muscular fibres to develop in a circular direction. In myopia the flattening...
of the ciliary body is due to stretching of the uveal tissue and the muscular fibres become mainly longitudinal.

There follows a comparison of the shape of the lens in various animals which shows that marked flattening of the anterior surface is only present in man and apes. This is correlated with the appearance of the pars plana in the same animals, and it is pointed out how, in the development of the pars plana, the posterior fibres of the suspensory ligament become drawn out and cause a flattening of the anterior lens surface by traction on the capsule. Loss of lens curvature is compensated for as regards refraction by increase of the corneal curvature and increased depth of the vitreous chamber.

With regard to movements of convergence, these are developmentally associated with acute central form-sense, with active accommodation and with stereoscopic vision.

V.—_Colour sense_—The majority of the mammalia appear to possess little or no colour sense. Experiments and experience show that this sense is only developed in insects, such as butterflies and beetles which feed on flowers, and in arboreal mammals which feed on fruits. A plea is entered for a careful watch for the chance of a microscopic examination of a colour-blind retina, in which there may be some abnormality in the shape of the cones at the macula.

VI.—_The protective mechanisms of the eyeball._

(1.) The opening of the lids before birth in Primates is held to depend on the environment of the new born.

(2.) The third eyelid or nictitating membrane is most fully developed in the Ungulata; its rôle of sweeping the cornea is brought about by the contraction of the retractor bulbi or choanoid muscle, whilst the cornet, the muscle of Gegenbauer and a gap in the bony outer wall of the orbit also play a part in its mechanism. These appendages are absent in man and apes, owing to the failing need for a nictitating membrane, when the head is not used for grazing or hunting purposes. A discussion of the cause of proptosis in Graves’s disease lays stress on the importance of Müller’s orbital muscle, which is held to be a vestige of the muscle of Gegenbauer.

(3.) The caruncle is a vestige of the large odoriferous suborbital pit, most highly developed in those Ungulates which have a “distance sense” of smell.

The above résumé of Mr. Collins’s lecture cannot do justice to this contribution to comparative ophthalmology, a branch of our science neglected by the average clinician. The whole is made up partly of a consideration of the writings of earlier workers, partly of original observations and deductions which give much food for thought. It concerns especially the changes in the visual organs caused by the altered environment of arboreal life, and those which resulted when man descended again to terra firma.
and restarted the struggle for existence against his carnivorous foes. So many points are raised that it is impossible to review them all, and one must refer the reader to the original in the Transactions, a study which will amply repay him. Many points in embryology, physiology, and clinical ophthalmology, arise and are discussed, and help to make the lecture of practical value to the clinician.

The Variability of the Coloration of Trout

In the autumn number of the Journal of the Fly-Fishers' Club there is a short article on the variability of the coloration of trout, which is of some ophthalmic interest, by Dr. Barton, a very keen fly-fisher and naturalist.

It is well known that the trout, in common with other of the lower vertebrates, the frog and lizard for example, has the power of varying its colour according to its environment. The change is a reflex action and is produced by alterations in the distribution of the pigment in the cells of the superficial layers of the skin lying immediately underneath the transparent scales. When the pigment granules are gathered together in a central mass, the rest of the cell remains clear and transparent, and the general effect is a lightening of the colour. When the pigment granules diffuse through the cell, then the effect is a general darkening of the skin of the trout. The change seems to take about twenty minutes to complete, and, according to the writer, takes place, in normal conditions, as the result of light falling on the retina. So that if the head of the trout be in darkness the body remains dark, even though the body itself may be exposed to full light. Conversely, if the head be exposed to light and the body be in darkness, the body, nevertheless, lightens.

The same thing can be demonstrated in the frog, where it is easy to show that the change in colour is a reflex process in which the afferent impulses pass up from the retina.

In blindness, total or partial, the writer states, fish become dark, and in other variations in health, the tendency is for fish to turn black. So that all blind and unhealthy fish are black, but all black fish are not necessarily blind or unhealthy.

When the fish dies, the pigment collects into the centre of the cell and the fish becomes pale. Pressure alone will cause a dark fish to become pale, even before death. Trout fishers are well aware of this, and it is also suggested that the influence of shock will upset the reflex completely, but the evidence in support of this is not beyond suspicion.