LECTURES ON THE HISTOLOGY OF THE EYE: (BEING THE ARRIS AND GALE ANATOMICAL LECTURES.)

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BY

JOHN WHITAKER HULKE, F.R.S., F.R.C.S.,

Assistant-Surgeon to the Middlesex Hospital, and Surgeon to the Royal London Ophthalmic Hospital.

LECTURE III. (Concluded.)

IT is a remarkable circumstance, that the retina in the greatest number of vertebrate animals does not contain any *blood-vessels*. A retinal vascular system is confined, I believe, to mammalia; and amongst these there are great differences in the distribution of the vessels. In man, the whole extent of the retina, from the optic nerve entrance to the ora serrata, is vascularised; and the same obtains, I believe, in the ox, sheep, deer, and antelope; while in the hare, the vessels are restricted to the area of the opaque nerve-fibres; and in the horse, they form a narrow zone around the optic nerve entrance.

In the human retina, no capillaries penetrate farther outwards than the intergranule layer on the inner surface of the outer granule layer. In consequence of this arrangement, the rods and cones are nearer to the chorio-capillaris than to the retinal capillaries. This alone would make it probable that they derive their nourishment from the capillaries; and morbid anatomy abundantly confirms this, for it is an established fact, that atrophy of the chorio-capillaris, entailing atrophy of the hexagonal pigment epithelium, is also followed by atrophy of the rods and cones.

In the common hedgehog, I have observed a peculiar disposition of the vessels, which is intermediate between the typical distribution in man and most other mammals I have examined, and that which obtains in the lower vertebrates; viz., the larger vessels, arteries, and veins, channel the capsula hyaloidea, while capillaries only pierce the retina.

In fish, batrachia, and reptiles, the vascular net which pervades the capsula hyaloidea represents the retinal vascular system of mammals, but in birds, this hyaloid net is wanting; and the great development of the pecten was thought by Müller to be a compensatory provision for both its absence and that of retinal vessels.

The description of the retina which I have just given was a general one, applicable (with the exception of what I have anticipated regarding the blood-vessels) to any retina. I will now pass on to notice—and I can only do so very briefly—the characteristic modifications which the retinal elements undergo in the five vertebrate orders.

In *Fish*, the retina is distinguished by the occurrence of cones of 2

peculiar kind—double or twin-cones, as they are commonly called, by the large quantity of connective tissue it contains, and by the presence of very large branched connective tissue corpuscles in the intergranule layer.

The twin cones have distinct outer segments or shafts. Their symmetrical appendages are joined together down one side, and at their inner end they sometimes appear to be actually continuous. Each twin has, I think, its own outer granule, and detaches a separate fibre inwards.

The *Batrachian* retina is distinguished by the large size of its elementary tissues: the rods are very large. The cones, which are smaller, contain a pale yellow or colourless bead—the cone bead—which always lies in the outer end of the appendage. Twin-cones have been discovered in it by Schultze.

Amongst *Reptiles*, lizards possess cones only; these contain a pale yellow bead (in all I have examined). They are single and twin; but the twin-cones differ in many respects from those of fish. They are unsymmetrical in form, and one is beaded while the other is beadless. Their union is much less intimate than that of the fish's twin-cones. A little violence frequently dissociates them.

The chameleon, iguana, gecko, and many other lizards, have a fovea centralis, from which the primitive bacillary fibres radiate towards the periphery of the retina, and pursue an oblique course from the outer towards the inner surface of the retina, crossing the vertical radial connective tissue fibres, which enables us easily to distinguish the nervous and connective tissue fibres in this region.

In many lizards, a well developed, conical, or sword-like pecten, stands foremost from the optic-nerve in the vitreous humour towards the lens. In the common alligator, and in the Nile crocodile, there is no projecting pecten, but the optic disc is marked with a brown pigment.

The blind worm's retina closely resembles that of typical lizards, especially in the presence of a pale cone-bead.

A cone-bead is wanting in snakes. In other respects, their retina resembles that of lizards.

The common English snake has no pecten; the viper has a rudimentary one; and the boa's optic nerve has a minute globular one.

The *Chelonian* retina agrees very closely with that of birds. Both are distinguished by bright cone-beads, and by twin-cones, the structure of which, particularly in chelonian, resembles that of lizards, and differs in the same way that this does from that of the fish's twin-cone. Each twin has certainly its own outer granule, and its separate primitive cone-fibre, which, as in lizards, takes an obliquely radial direction from the posterior pole of the globe. The cone-beads are of three colours—ruby, which are the largest, and orange, passing through pale yellow into pale green: the orange and green beads are the most numerous. The intergranule layer contains large branched connective tissue corpuscles, resembling those occurring in the same layer in the fish's retina.

The *Bird's* retina, as I have just said, agrees in several particulars with that of the chelonian. It has cones with beads of three colours, except in the case of nocturnal birds, e.g., owls, in which, as Schultze first showed, all the beads are pale, almost colourless, a light yellow. It has also twin-cones, like those of reptiles; and in many birds there exists a very distinct fovea, and in some H. Müller discovered two, one at the posterior pole, and the other near the ora retinae, the former being affected by the incident pencils in monocular vision, the latter coming into use in vision with both eyes. The primitive bacillary fibres radiate obliquely from the fovea, as in man and reptiles.

The *Mammalian* retina is marked by the absence of twin-cones and of cone-beads. Its elements are smaller than those of the lower vertebrates. That of man has a macula lutea, in which is a distinct fovea centralis. The macula lutea occurs also in certain apes. The bat, mouse, hedgehog, and certain other animals, chiefly of nocturnal habits, have rods only, in most others, cones and rods are both present, as in man. The retina is vascular; the distribution of the vessels, however, varies in different families.

There are two situations where the structure of the retina in man and some other vertebrates which I have particularised is peculiar; these are the macula lutea and the ova retinae. The macula lutea is an oval spot, at the posterior pole, of a yellow colour: the coloration is not produced by granular pigment, as in that of the choroid, but it is a diffuse stain of the elementary tissues. In the centre of the macula is the minute pit—not a perforation—the fovea centralis. This pit is produced by the radial divergence of the primitive cone-fibres from a central point, and by the thinning and outward curving of all the retinal layers (except the bacillary) as they approach this point. In the fovea and the macula, except at its periphery, cones only occur, and they are more slender and longer than in other parts of the retina. The greater length is chiefly due to the elongation of the cone appendage. The slenderness of the cones does not allow their appendages to include the outer granules, so

that these latter lie, all of them, at the inner side of the membrana limitans externa. Owing to the radial direction of the primitive cone-fibres, the outer granules belonging to the central cones lie peripherally, so that the outer granular layer is absent from the foveal centre.

At the inner surface of this layer the cone-fibres combine in a plexus, the bundles of which, near the centre of the macula, are directed obliquely towards the inner surface of the retina; between the centre and the circumference of the macula they assume a direction nearly parallel to the retinal layers, and at the circumference of the macula they run nearly vertically.

At its inner surface, the cone-fibre-plexus breaks up into primitive fibres, which pass through a thin connective tissue stratum, the intergranule layer, and enter the inner granular layer. This latter, at its beginning in the centre of the fovea, is not separate from the ganglionic layer. The nerve-fibres pursue in it the same direction as in the outer granule layer.

The ganglionic layer, at the periphery of the fovea, contains three or four tiers of cells; these become fewer towards the foveal centre, but even here they lie in a double or treble series, bedded in a granular tissue.

The ora retinæ is the other situation to which I referred as having a peculiar arrangement of its tissues. Being less important than the fovea, I can notice it only very briefly. Towards the ora the nervous elements gradually become fewer, the layers thin out, the beads and cones shorten, and become stouter. With this decrease of the nervous tissues, the connective tissues predominate, and they are prolonged beyond the ora as the pars ciliaris retinæ, the radial fibres becoming, according to Kölliker's observations, the columnal, epithelial-like bodies, which line the pars striata.

In conclusion, Mr. President and gentlemen, let me thank you for the attention you have kindly bestowed on me during these lectures. If they shall have succeeded in putting the minute anatomy of the eyeball in a clearer light, and still more, if they shall induce any to take up the subject and work it out, I may hope that the honour the Council conferred on me in electing me the successor, in this anatomical chair, to Clopton Havers, may not prove without useful results.

AN OBSTACLE TO LONGEVITY.—At the recent meeting of the British Association for the Advancement of Science, Sir Duncan Gibb read a paper on "An Obstacle to Human Longevity beyond Seventy Years." He drew attention to the position of the epiglottis, and said that in 5,000 healthy people of all ages, and in 11 per cent., it was found to be drooping or pendent, in place of being vertical. He had discovered, he said, that in all persons over 70, its position was vertical, without a single exception—a circumstance of the highest importance bearing upon the attainment of old age amongst Europeans. In a number of instances where the age varied from 70 to 95, in all was this cartilage vertical. Many of these he cited as examples, such as the well-known statesmen Lord Palmerston, Lord Lyndhurst, Lord Campbell, and Lord Brougham. He also gave instances among old ladies still alive at ages from 76 to 92, whose epiglottis was vertical. But the most remarkable was that of a gentleman still alive 102 years old, in whom it occupied the same position. He summed up his views in the following conclusions:—1. As a rule, persons with a pendent epiglottis do not attain a longevity beyond 70. Possibly a few may overstep it, but such examples are exceptional. 2. With pendency of the epiglottis life verges to a close at or about 70, and the limit of old age is reached. 3. A vertical epiglottis, on the other hand, allows the attainment of four score years and upwards, all other things being equal, and affords the best chance of reaching the extremest limit of longevity. 4. Lastly, pendency of the epiglottis is an obstacle to longevity—certainly beyond the age of 70 years—and it is a peculiarity that occurs in 11 per cent. of all ages amongst Europeans.

AN ADDRESS

DELIVERED IN

THE SECTION OF STATE MEDICINE,

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By WILLIAM FARR, M.D., D.C.L., F.R.S., ETC.

GENTLEMEN,—In opening this Section, I have in some respects an easy task to perform. Our course was buoyed out for us last year by my eloquent predecessor, Mr. Simon. We are prosecuting a work which engaged the earnest attention of the founders of the Association; and the interest of the subject is admitted on all hands.

Public Medicine comprehends something more than Public Hygiene—a word which comes to us from Greece through France. Medicine is, in a certain sense, one and indivisible; it has to do with the whole nature and forces of man. And yet, in great cities, divided fields of practice exist: there is the surgeon, and there is the physician; one man practises midwifery; another is an oculist; another is an aurist; another ministers to minds diseased. As each organ leads its own life, each organ—each disease—has its special student. Yet the parts forming a whole are united; there is a concert in their suffering; and all the members are directed by central volition. So one physician—one general practitioner—takes charge of the community of confederated organs. Now, men in the same town form one body; they have a life in common; they have common interests and common wants. The families coalesce under a Council, by whom they are governed. Each member has his own special adviser in sickness; and is it not, by analogy, natural that the incorporated community—the town—should have its town physician? Otherwise, in the absorbing interest of the parts, might not the interests of the whole be overlooked?

A new department of science is open to the town physician. For of some things the laws are most easily discerned in large masses; it is so with the stars, and it is the case here. The mortality of two town populations is easily determined; their mean lifetime can be calculated. It is possible to forecast the health of a city, and to determine the effects of any great changes in the condition of its population; whereas no man can calculate how much an individual dies daily—how long he will live—what the precise effect of any condition on his health will be. Hence the difficulty of judging the effect of therapeutic agents on a patient. Communities can only supply certain wants by common work. If they desire roads, the roads must be made and repaired at the common cost. Then light, and water, and sewerage, can only be provided adequately by that company—the town—of which every ratepayer is a shareholder. Public Medicine is in this category. Our towns, counties, and districts, are parts of that still grander community, the State; and the State, whatever may be its constitution, whether monarchical, aristocratic, or republican, has public duties to perform in watching over the public life. This is an office of high police, and was recognised in the early forms of civil society. The chief open dangers in woods and savage wildernesses were wild beasts; and the heroes of the age, like Hercules and Theseus, killed lions, wild boars, and serpents. Against fierce men and hostile tribes, in the struggle for existence, the warrior-king defended his people. These were visible enemies. But for protection against the pestilence that walketh in darkness, the people also looked to the king; they held him responsible; of him they sought remedy; and they often ascribed their afflictions to his crimes. The deaths by plague of the Greeks before Troy were ascribed to the wrath of the Sun-God, and to the misdeeds of Agamemnon.* In that more modern time of which Thucydides writes, the plague of Athens rendered Pericles unpopular. Under another form of civilisation, in Egypt, the plagues were charged against the reigning Pharaoh; and, in the wilderness, Moses undertook to stay the plague; his brother stood between the dead and the living. When their mysterious desolations were referred to the ire of the immortal gods by the Romans, the oracles were consulted by the great officers of the city and the empire.

Hippocrates inaugurated the true philosophy of disease by announcing that all its phenomena are alike divine. Plagues are traced no longer to accidental antecedents; and a complete revolution in modern thought is the consequence of the development of this doctrine. Diseases as disastrous as ever assailed the Greeks before Troy befel the British army in the Crimea; but who would now accept the explanation, that the gods thus slew the British soldier to avenge the insults offered by a

* This Greek sentiment is well wrought out in the *Ædipus* of Sophocles.