and there is a copy in the Bowman Library, a presentation copy from the author to James Wardrop.

Benjamin Gibson was born at Newcastle-on-Tyne in 1784. After having received his general education at Richmond, Yorkshire, he was apprenticed to Mr. Ingham, surgeon, of Newcastle-on-Tyne, and in 1796, he was in London, studying under Mathew Baillie. He went to Manchester, as assistant to the celebrated surgeon, Charles White, in 1799. Gibson was surgeon to the Manchester Infirmary, 1804-1812; he was also assistant surgeon to the Royal Manchester and Salford Volunteer Regiment of Infantry. He suffered from consumption, and died at Ardwick, March 6, 1812. These few facts about him are extracted from Brockbank's "Honorary Medical Staff of the Manchester Infirmary, 1752-1830."

CONGENITAL ABSENCE OF THE LENS, WITH SPECIAL REFERENCE TO AN APHAKIC HUMAN EMBRYO*

BY

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CONGENITAL absence of the lens is of such rare occurrence that some observers have denied that it is ever found apart from gross malformations such as anophthalmos and severe degrees of microphthalmos. From time to time, however, cases have been reported clinically, but have not been verified by microscopic examination. All these cases, as far as I am aware, occurred in America, and the first was reported by Baker in 1887. The details in this case are so meagre that very little information can be gained from the account. Since then other cases have been reported by Cherryholmes (1902), Adams, Hardy and Sherer (1915). In Cherryholmes' case there was microphthalmos with an interpupillary distance of only $1\frac{1}{8}$ inch, and also nystagmus, convergent strabismus and amblyopia.

Cases of microphthalmos which have been subjected to microscopic examination are many, and in the majority of them (for example, Wiegel's case of microphthalmos and atypical vitreous) the lens could be identified, though it was often only represented by a few degenerate epithelial cells enclosed in a much wrinkled capsule. Cases in which it was entirely absent were usually those severe degrees of failure of development in which all that could be found of the eye was a cyst or vesicle of entirely atypical structure, or

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possibly showing some traces of retina, but without lens, ciliary body, iris or pupil, as in the case described by Becker. The question of the possibility of congenital aphakia occurring in an otherwise normal or nearly normal eye can therefore still be said to be an open one.

As to aphakia being seen in an embryo, one case has been described by Rabl in an Amblyostoma embryo. In this instance the condition was unilateral and was associated with general failure of ectodermal structures on that side of the head, the central nervous system and the optic cup being smaller than on the other side and the whole head deformed. Cases of simple failure of development of the lens with a normal or almost normal optic cup have been hitherto unknown, and the human embryo about to be described forms, as far as I am aware, an unique case and goes far to prove that aphakia can occur as an isolated malformation at any rate in foetal life.

As is well known, the human lens normally develops from an invagination of the whole thickness of that portion of the surface ectoderm with which the primary optic vesicle comes in contact. The following table* shows the normal correlation between the degrees of development of the eye and the size of the embryo.

Length	No. of Somites	Condition of optic cup	Condition of lens
4 mm.	35	Distal wall of optic vesicle thickened and almost in contact with surface ectoderm. Wide communication between optic vesicle and cavity of ventricle	Rudiment of lens recognizable as thickened epithelial plate
6.75 mm.	38	Optic cup formed. No retinal pigment yet. Stalk of optic cup still very wide	Rudiment of lens a flat groove in which are cell proliferations
7 mm.	40	Traces of pigment in retina	Lens vesicle just closed, but not separated from ectoderm. Proximal wall thickened
13 mm.	—	Choroidal fissure almost closed. Abundant retinal pigment. Anterior chamber not yet formed. No nerve fibres in optic nerve	Lens vesicle closed and separated from ectoderm by mesodermal cells. Lens fibres beginning to appear

The aphakic human embryo (one of Professor Frazer's collection) which forms the subject of this paper was compared with a normal human embryo of 13 mm. (measured when fresh). After sectioning, the aphakic embryo measured 8.64 mm. and the normal one 8.67 mm. They are thus of approximately the same size. They also show the same degree of general development as evidenced by

* Modified from the "Normentafel" of Keibel and Elze.

the condition of the central nervous system, of the submaxillary outgrowth (which is just appearing in both) and of the nasal fossae. We can thus assume that the aphakic embryo had reached a stage of development normal for its size. No sign of failure of any ectodermal structure other than the lens was discovered.

The eyes of this embryo will now be described in detail. As far as one can judge the condition is similar in both eyes, but some of the serial sections passing through the left eye are broken. The drawings and measurements were therefore made from the right eye.

FIG. 1.

Section through right eye of aphakic embryo. Passes through upper part of fissure. Shows hyaloid vessel, absence of lens, inner and outer layers of optic cup, etc.

The optic cup occupies its normal position on the side of the head. It is well formed, roughly spherical in shape and measures 0.51 mm. in diameter. (The right optic cup of the comparison normal embryo measures 0.54 mm. in diameter.) The choroidal fissure is still open with the lips of the fissure almost in apposition. The fissure, however, does not extend into the optic stalk. (The choroidal fissure of the comparison embryo is closed except for a notch at the pupillary margin.) The hyaloid vessel enters the globe at the extreme upper end of the fissure and there is a larger vessel than normal running in the line of the fissure outside the optic cup. The blood drainage

is that usual at this stage, namely by two main systems, both joining the cavernous sinus, one *via* the supraorbital plexus and the other by broken channels *via* the remainder of the anterior plexus. The hyaloid vessel is large and full of blood and breaks up into numerous blood spaces in the pupil. These drain round the edges of the pupil into the large vessel running in the line of the cleft and into other scattered channels in the surrounding mesoderm. This can be seen in Figs. 1 and 2. The condition of the retina, both inner and pigment layers, is normal. This can be seen by comparison of Figs. 1 and 2 with Fig. 3, which shows the eye of the normal 13 mm. embryo for comparison. It is to be noted that in the normal embryo the anterior chamber has not yet been

FIG. 2.

Section through right eye of aphakic embryo, slightly lower in the series than Fig. 1. Shows in addition abortive lens as epithelial projection from deep surface of corneal ectoderm.

formed, there being still mesoderm situated deep to the cornea and spreading round the lens on each side. In the abnormal embryo there is no trace of a lens beyond the presence of a very small blunt-pointed epithelial projection from the inner side of the surface ectoderm. This is almost in the middle of the pupil (namely 0.01 mm. below and slightly anterior to the middle). It is approximately 0.02 mm. thick and affects the deep layer of the ectoderm only and is not accompanied by a corresponding

depression on the surface. It possibly represents an abortive attempt at a lens thickening which has never invaginated or separated. (It is shown in Fig. 2.) Surrounding the hyaloid vessel is a loose reticular tissue showing fibrils similar to those seen in the developing vitreous in the 13 mm. embryo. The mesoderm deep to the cornea passes round the pupillary margin and blends with the mesoderm surrounding the vessel, as in the normal embryo.

The condition then is one of congenital aphakia. It is of course merely speculation to consider the possible end result had the embryo continued to develop. The somewhat delayed closure of

FIG. 3.

Section through eye of normal 13 mm. embryo. Shews similar stage of development of optic cup and also a well formed lens vesicle separated from surface ectoderm.

the foetal cleft suggests that some form of coloboma might have arisen, but it is interesting to note that there is no sign of microphthalmos at present, the eye being of normal size for the stage of development of the embryo. Some observers (e.g., Bach) consider that microphthalmos is produced by gross abnormality or absence of the lens, but this is rendered doubtful both by observations showing that the optic cup is self-differentiating, and also by the work of Ochi on the experimental production of abnormalities of the head in chicks by alterations in the osmotic pressure in the albumen in the neighbourhood of the head. He

succeeded in producing microphthalmos, but the small eyes nearly always contained a lens.

The possibility that in this embryo a lens did form and subsequently degenerated has been considered, but the most careful examination has failed to reveal any traces of it. Also W. H. Lewis has shown that degeneration of the lens after it has once formed is usually associated with overgrowth of mesoderm between the optic cup and the lens causing their separation sooner than usual, and in this case there is no evidence of such abnormal growth.

The case is also of interest in that it offers confirmatory evidence concerning the experimental results of W. H. Lewis, Spemann and others working on the power of self-differentiation possessed by various organs. Both Spemann and Lewis have shown that invagination of the optic vesicle to form the optic cup is not dependent either on the formation of a lens or even on contact with the surface ectoderm, since it occurs in optic vesicles transplanted into various parts of the embryo. Lewis, however, states that when an optic cup forms from a transplanted optic vesicle without a lens, the invagination is not perfect and a small irregular cavity is formed which is filled with mesenchyme, there being no trace of the formation of the vitreous or of the chambers of the eye. This may well be so under experimental conditions, and may possibly be accounted for by distortion of the optic vesicle at the time of the operation and by the abnormality of the blood supply in such a transplanted vesicle. The present case shows that in aphakia arising without external interference the vitreous at any rate begins to differentiate quite normally.

Though the invagination of the optic cup is independent of the presence of a lens, it is generally accepted that the formation of a lens is dependent on contact between the developing optic cup and the surface ectoderm. The exact position of contact appears to be immaterial. A chemical substance has been postulated which is secreted by the optic cup, which substance, acting during a certain period, stimulates the overlying ectoderm to proliferation and lens formation. In this embryo contact has undoubtedly taken place, since there is a trace of ectodermal thickening, but one might suppose that there had then been failure of the continued stimulus (chemical or otherwise) necessary to produce complete differentiation of the lens. It is conceivable that this failure on the part of the optic cup to produce the requisite stimulus need not imply sufficient abnormality in the cup to prevent its own differentiation.

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THE YIELDING OF THE OPTIC NERVE-HEAD IN GLAUCOMA

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IT is not an uncommon thing to find writers on glaucoma, making a casual reference to the possible influence on their subject of anatomical variations in the intraocular portion of the optic nerve, and in the canal which contains it. Such references are, however, for the most part so vague and indefinite as to provoke the suggestion that they are not founded on well-ascertained data. The writer has felt the need of greater precision in our knowledge of the subject, and this has been especially impressed upon him in connection with his study of the various paracentral scotomata which are met with in the glaucomatous. Of the various sources of information to which he is indebted, he would wish to make an early and special acknowledgment of two, viz., Salzmann's "Anatomy and Histology of the Human Eyeball" translated by Dr. E. V. L. Brown (University of Chicago Press, Chicago, 1912), and Fuchs' illuminating article "On the Lamina Cribrosa" (*Arch. f. Ophthal.*, 1916, Vol. XCI, Part iii). The latter paper is by no means an easy one to study in the original, and this for various reasons, not the least of which is the arrangement therein followed. The writer desires to express his acknowledgments to Mr. E. E. Henderson for the help he has derived from that gentleman's lucid abstract of this voluminous paper (B.J.O. 1918, Vol. II, p. 50), and for the personal help he has given him in unravelling difficult details of the translation. It is in no sense derogatory to this abstract to say that, clear and helpful as it is, it was only by careful study of the original, and by putting together facts and statements in the order of sequence in which they affect the problems the writer had before him, that a clear view of the subject was obtained. Glaucoma teems