HISTOLOGICAL SIGNIFICANCE OF HEMISPHERICAL BODIES IN THE EYE*

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THE first reference in the literature to hemispherical bodies is that of von Hippel (1928) who, in describing the histological appearances of a glaucomatous eye, wrote: "hemispherical figures in Bowman's membrane are numerous, their significance unknown" (Fig. 1). Similar bodies were later observed by Wolff and Lyle (1937) in sections from an eye with old traumatic retinal detachment and secondary glaucoma. These structures were numerous and situated actually within the membrane immediately beneath the epithelium, where they appeared fairly homogeneous and more or less hemispherical; they varied in size up to 10 microns and their flattened bases were in contact with the epithelium. These workers concluded that hemispherical bodies were hyaline in nature and probably derived from degenerative products of the corneal epithelium or perforating nerves; glaucoma probably played some part in their formation but their exact cause was still unknown.

FIG. 1.—Section of Zenker-fixed eye, showing hemispherical bodies in Bowman's membrane. Haematoxylin and eosin $\times 450$.

Stimulated by these observations, Talbot (1938) studied 32 consecutive eyes fixed in Zenker's fluid, and found hemispherical bodies in fourteen cases, all of which presented evidence of glaucoma; moreover, these bodies were not found in cases presumed to have normal ocular tension. As a result of this investigation Talbot concluded that hemispherical bodies in Bowman's membrane could be found in every eye in which high tension had existed for more than a few days, and in which tension remained raised up to the time of excision. Thus the suggestion of Wolff and Lyle (1937) that hemispherical bodies were related to raised ocular tension gained some support, and Wolff (1951) subsequently described them in his text-book as pathological features of glaucoma, and further stated that they might become calcified and then be extruded (Wolff, 1944, 1951).

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We first began to doubt the validity of these views some years ago while examining a large series of eyes from autopsy examinations of premature babies. Numerous hemispherical bodies were found in one case in which there was no other ocular abnormality; it so happened that one of the eyes of this infant had been fixed in Zenker's fluid and the other in formol saline, and that hemispherical bodies were present only in the eye fixed in Zenker's fluid. Nor was it reassuring to find them one day in the cornea of an eye from an apparently normal trout (Fig. 2). Although it must be admitted that the problem is not of great importance, it seemed of interest to investigate the matter further, especially in view of the account given in Wolff's text-book. The findings will be considered under the four main questions which arise.

FIG. 2.—Section of Zenker-fixed eye of a trout, showing hemispherical bodies between the epithelium and cornea (separated through artefact).
× 600.

(1) *Distribution of Hemispherical Bodies* (Fig. 3, opposite)

It should first be pointed out that hemispherical bodies are by no means confined to Bowman's membrane, for we have found them frequently on the retinal surface (Fig. 3*a*), and less commonly in the deep layers of the cornea, on its endothelial lining (Fig. 3*b*), on the iris, on the ciliary epithelium, in the lens capsule (Fig. 3*c*), on Bruch's membrane, and on the optic disc (Fig. 3*d*). In fact, the hemispherical shape of these bodies is apparently determined merely by their apposition to a flat surface; associated structures may be found as rounded or morular bodies in the anterior chamber, in the vitreous and subretinal spaces, or free in the uveal (Fig. 3*e*), retinal, or even in orbital tissues. More irregular-shaped bodies may also be seen, and a large variety has been observed, particularly in the vitreous, where they may occur with brown or black pigmented centres, arranged in groups, or surrounding inflammatory cells. Wolff (1951) distinguished between hemispherical bodies in Bowman's membrane and the round or irregular structures seen elsewhere, which he termed "fibrin bodies". They are, however, of the same nature; in fact, Wolff himself believed that hemispherical bodies were derived from fibrin.

FIG. 3.—Sections from Zenker-fixed eyes, showing hemispherical or spherical bodies.

- (a) On the retina. $\times 333$.
- (b) In the cornea near Descemet's membrane. $\times 600$.
- (c) In the lens capsule. $\times 266$.
- (d) At the optic disc. $\times 600$.
- (e) In the uvea. $\times 400$.
- (f) Rabbit eye injected with plasma before fixation. Two bodies may be seen; spherical in the anterior chamber and hemispherical on Descemet's membrane. $\times 400$.

(2) Relation to Fixation in Zenker's Fluid

It was the custom at Moorfields Eye Hospital before 1948 to fix all eyes as a routine in Zenker's fluid, but after that date formol saline was employed. Hence the collection of slides at the Institute of Ophthalmology provided a ready opportunity to investigate our suspicion that hemispherical bodies might be a product of Zenker fixation. Of 1,000 sections examined which were prepared before 1948, 77 showed hemispherical bodies or similar structures. Of 300 sections examined which were prepared after that date, seven were positive, and it was found, on checking from the records the fixative used, that all these seven cases had in fact been fixed in Zenker's fluid. Thus in no instance were hemispherical bodies or related structures found in formalin-fixed material and it would appear that their association with Zenker's fixation is certain (Wolff's "haemoglobin bodies" are not discussed here, as we find them indistinguishable from Russell bodies, which are not, of course, the result of Zenker fixation).

(3) Relation to Glaucoma

Although hemispherical bodies are found in cases of glaucoma, especially where inflammatory exudate is present within the anterior chamber or the vitreous or both, they are not restricted to such cases, for we have found them in normal animal and human eyes and in a large variety of unrelated pathological conditions (*e.g.* trauma, malignant melanoma), where the ocular tension was known to be normal or low. Moreover, as mentioned above, they occur outside the globe. Analysis of the sections in which hemispherical bodies were found showed that they were nearly always associated with haemorrhage or inflammatory exudate, and may therefore not infrequently be found in cases of secondary glaucoma.

In our study, no evidence was obtained to support the idea that hemispherical bodies in Bowman's membrane were in any way related to perforating nerves. The histological appearances suggest rather that the protein component of the hemispherical body originates by extrusion from the lymph spaces between the basal cells of the corneal epithelium during the shrinkage of fixation. If so, this may provide some explanation for their reported incidence in glaucoma wherein these intra-epithelial lymph spaces may be much engorged.

(4) Nature of the Bodies

In view of the above findings, hemispherical bodies appear to be of no particular pathological significance, and there seemed little purpose in attempting a detailed histochemical analysis of their composition. That they occur in Zenker-fixed material but not in formalin-fixed material of itself suggests that these bodies may be protein precipitates. We have found that identical structures may be demonstrated in stained smear-preparations of precipitates obtained by adding Zenker's fluid to blood

plasma, and that of the ingredients in Zenker's fluid only mercuric chloride produces these precipitates. Finally, in rabbits' eyes injected with plasma and fixed in Zenker's fluid, round bodies were found free in the anterior chamber and vitreous; they appeared hemispherical when seen on Descemet's membrane or upon the retinal surface (Fig. 3f).

Conclusion

Hemispherical bodies in Bowman's membrane and spherical fibrin bodies seen occasionally in eye sections are of the same nature.

They are not restricted to cases of glaucoma and may be found in a large variety of conditions and even in normal eyes. They are, however, particularly liable to form when the protein content of the ocular tissues is raised—as after haemorrhage or inflammatory exudation.

In a study of 1,300 eye sections, these bodies occurred only in Zenker-fixed material, and they are probably no more than mercury proteinates formed at the time of fixation.

Apart from indicating the high protein content of the tissues and the use of a mercury fixative, they have no histological significance of value.

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