and in the mother affords very strong evidence in favour of this disease as the cause of the macular foci and thereby—through impaired vision—indirectly of the strabismus. Despite the pronounced concordance the strabismus must in these patients be considered as exogenously conditioned.

We were able to find two reports in the literature of monozygotic twins suffering from toxoplasmosis and lesions of the eyes. One of Zuelzer's patients died at the age of one month. Post-mortem examination revealed iritis, chorioretinitis in the macula and the intraocular presence of parasites. The other twin was under observation between the age of one and seven months and suffered from chorioretinitis and microphthalmos. In Abbott and Camp's cases, both twins exhibited bilateral widespread chorioretinitis associated with retinal angiomatosis.

SUMMARY

The patients are two definitely monozygotic twins. Both exhibited convergent strabismus as well as a healed chorioretinal focus in the macula of the affected eye. Serological tests for toxoplasmosis were positive in both twins and in both their parents. Despite the pronounced concordance the strabismus must in these patients be considered as exogenously conditioned.

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THE PATTERN OF THE CORNEAL INNERVATION IN RABBITS*

BY

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As a necessary preliminary to investigations into the nature of the corneal permeability a histological study of the corneal innervation was undertaken.

Two techniques were finally chosen as being the most suitable, methylene blue and gold chloride. In general one might say that

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gold gives a better " low-power " appreciation of the whole picture, the vital stain a better " high-power " view of the detail.

In the case of methylene blue, the solution was maintained at a temperature of 37° C., and oxygen bubbled through it during the course of the staining.

The pH of the vital dye, although varied over a wide range, did not affect the final picture. Optimum results were obtained in every case between 5.6 and 7.8. The more acid the stain, however, the shorter the time required to achieve the optimum. With a pH of 6.3 ten minutes proved an adequate period. The solution was made up as described by Heller and others (1947), but better fixation was obtained, and a deviation made from Heller's method, by using 8 per cent. ammonium molybdate (in normal saline) at 0° C. overnight. The corneae were then washed vigorously in tap water for two hours, and left, again overnight, in diethylene dioxide. Finally, they were cleared in concentrated Benzyl Benzoate. A neutral mounting medium is required.

In the case of gold chloride, the method devised by Gairns (1930) was found to require no modification. Paraffin sections are more adequate than frozen if gold serials are required.

Figs. 1 and 2 give a general picture of the nerve pattern.

FIG. 1.

Superficial corneal plexus in focus. Methylene blue. $\times 100$.

FIG. 2.

General pattern of corneal nerves. Gold chloride. $\times 50$.

An analysis of the above pattern was made from 50 rabbits. Some 20-30 main stem branches pass into the substantia propria deep to the dark limbal epithelium. These large nerve bundles, as is well known, lose their myelin sheaths within the first millimetre. This we confirmed.

Branching dichotomously the nerve fibres form networks at three levels, one within the substantia propria, occupying its whole breadth, one under Bowman's membrane, and one within the epithelium. The fibres tend to become progressively finer, but many fine solitary fibres are also present in the stroma (Fig. 3). Skeins with radiating free endings and loops occur at all levels, and can be seen in Fig. 1. No specialized end organs were found.

None of the main stem branches "anastomose," although fibres derived from the same parent main stem frequently do so. Daughter branches from two or more main stem bundles, although not "anastomosing," constantly overlap.

With gold the "anastomoses" and dichotomous branching are more readily seen. The *boutons de passage*, however, are overlaid and masked by the heavy metal.

FIG. 3.
Fine free ending in corneal stroma. Gold chloride. $\times 350$.

FIG. 4.
Two types of fibres in corneal nerve bundle. *a*, beaded. *b*, non-beaded. Methylene blue. $\times 600$.

FIG. 5.
Intra-epithelial plexus. Gold chloride. $\times 770$.

FIG. 6A.
Photomicrograph before fixation. Vital stain.

FIG. 6B.

Photomicrograph after fixation. Vital stain.

In the vitally stained preparations two distinct types of fibre were found to exist in the nerve bundles (Fig. 4). In one (Fig. 4, fibre a) the *boutons de passage* are more pronounced, but the linking nerve processes finer, than in the other (Fig. 4, fibre b). Such a marked morphological difference suggests a difference in function.

The markedly beaded type of fibre—which occurs in varying sizes—is of course typical of the dendritic ramifications of the cutaneous sensory nerves. The other we have seen in the skin, and in the iris, as well as in the cornea. In the skin they are especially prominent in the vicinity of blood vessels. These coarse fibres may well, then, prove to be autonomic.

Finally, the nature of the superficial so-called “free” nerve endings in the epithelium was observed (Fig. 5).

It would appear that the plain “end-buttons”—as they are sensory may not the phrase “*boutons premiers*” be coined?—do not end within the epithelial cells, but on and between them. Passing up in many instances to the surface, they form long arcades immediately below the outermost layer of the stratified squamous epithelium. Morphologically one cannot exclude the possibility that some of these endings may belong to autonomic axis-cylinders.

It was found that photo-micrography before fixation of the vitally stained nerves revealed details lost completely in the process of fixation. This may explain why the two types of nerve fibre have not previously been described (Figs. 6 A and 6 B).

SUMMARY

1. The pattern of the corneal innervation is shown in methylene blue and gold preparations.
2. Two types of nerve fibre are described, occurring in the multifibre nerve bundles: a large beaded one with a fine dendritic link, and a second where the beads are masked.
3. The possibility that the second of these fibres is autonomic is cited.
4. The boutons of the intra-epithelial plexus are clearly demonstrated. They do not end within the epithelial cells.
5. Photo-micrography of vitally stained specimens before fixation is essential.

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STENOSIS OF THE LOWER CANALICULUS*

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THE literature on treatment of stenosis of the lower canaliculus is not very extensive and this is my excuse for recording the few cases which I have had to deal with over a period of a good many years. An impervious fibrous stricture after trauma seemed to be a particularly troublesome condition, but I have had this small series of cases in which, by utilizing the upper canaliculus, a functional success has been achieved.

The first case was that of a girl who was injured in a ski-ing accident, the point of the ski penetrating the orbit on the inner aspect. It went through the lower lid obliterating the lower punctum and about half the lower canaliculus. I saw her some months after the accident when the wound had healed with only slight deformity. After testing the passage to the nose *via* the upper punctum and finding it clear, I slit the upper canaliculus in its

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