THE ANTERIOR CHAMBER OF THE COELACANTH EYE*†

BY

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THANKS to the courtesy and co-operation of Prof. K. S. Thomson of the Department of Biology and the Peabody Museum of Natural History, Yale University, New Haven, Conn., it has been possible to obtain material from the anterior segment from an eye of *Latimeria chalumnae*. The specimen in question (a male) was caught off Iconi, Grand-Comore, on March 14, 1966, frozen immediately after capture, and brought to the Peabody Museum, Yale University (No. 1482 in the Fish Collection), (Thomson, 1966; Pickford and Blake Grant, 1967).

The present account concerns material obtained from the whole animal which had been allowed to thaw over a period of some 60 hours at 2–10°C., the period of thawing terminating on May 30 (Memorial Day), 1966.

Methods

Chemical

Some 20 μ l. aqueous humour were aspirated into a Hamilton syringe before the globe was opened. Total osmolarity, magnesium, and urea were determined on this sample and an account of the methods employed and of the findings which resulted has been given elsewhere (Pickford and Blake Grant, 1967).

Morphological

The eye having been opened by a circumferential incision, the anterior segment and lens were placed in cold (0°C.) 10 per cent. (v/v) neutral (pH 7.0–7.2) isotonic (*i.e.* with 0.9 per cent. NaCl) formaldehyde for embedding and subsequent histological study. Some pieces of the corneo-scleral junction and iris were embedded in paraffin; others were used for frozen sections.

Sections were cut at 8 to 15 μ and were stained with haematoxylin and eosin, methyl green-pyronin (Kurnick, 1955), or by the periodic acid Schiff method (McManus, 1948).

After fixation the anterior segment was frozen and bisected and the two sectioned surfaces photographed. The photographs were enlarged and tracings made of the outlines of the anterior chamber. From these tracings the volume of the chamber was estimated using a balance described by Jones and Maurice (1963). While it is acknowledged that the whole of this procedure is open to many errors, such as distortion during fixation and displacement of the lens, it has seemed worth reporting the findings since no others are available for this species.

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Results

Sections of the ciliary region showed a well-developed ciliary papilla covered by pigmented and non-pigmented layers of epithelial cells. This latter continued onto the posterior surface of the iris (Fig. 1, and Fig. 2, p. 417).

FIG. 1.—*Latimeria chalumnae*, section of anterior chamber angle (haematoxylin and eosin).

The anterior surface of the iris showed some flattened endothelial cells and, in frozen sections, occasional patches of crystalline material. The stroma contained very little, if any, muscular tissue and few blood vessels.

Cartilaginous plaques were found in the sclera immediately behind the corneo-scleral junction.

TABLE I
DIMENSIONS OF THE ANTERIOR SEGMENT OF AN
EYE FROM *L. CHALUMNAE*

Corneal diameter	3.0 cm.
Diameter of lens (coronal) (antero-posterior)	1.72 cm. 1.50 cm.
Depth of anterior chamber (anterior surface of lens to posterior surface of cornea)	0.11 cm.
Volume of anterior chamber	1.61 cm. ³

Figures for the dimensions of the anterior chamber are given in Table I and must be accepted with the reservations mentioned above. Although the value for the volume of the anterior chamber may appear to be high it is in no way inconsistent with the other dimensions or with the measurements reported by Millot and Anthony (1965).

Values for osmolarity and for urea and magnesium concentrations are shown in Table II on page 417.

FIG. 2.—*Latimeria chalumnae*, section of ciliary papilla (methyl green and pyronin).

1. Non-pigmented epithelium
2. Ciliary pigment epithelium
3. Stroma

TABLE II

COMPARISON OF TOTAL OSMOLARITY, AND OF UREA AND MAGNESIUM CONCENTRATIONS IN BLOOD AND AQUEOUS HUMOUR OF *L. CHALUMNAE*
(From Pickford and Blake Grant, 1967)

Blood Fluid	Osmolarity (mOsm/l.)	Urea (mM/l.)	Magnesium (mEq/l.)
Heart Blood	921 ± 3	324 ± 12	27.8
Blood (average of renal and hepatic portal vein and heart)	1181	355	28.7
Aqueous	952	303	7.3

Estimated osmolality of environment (Indian Ocean equatorial water) at site and depth of capture = 1090 mOsm/l.

Discussion

One of the interesting features of the solute composition of both the blood serum and the aqueous humour is the high concentration of urea in both fluids (Table II). Its high level in serum and the presence of enzymes of the ornithine-urea cycle in the liver of this

species (Brown and Brown, 1967) strongly suggest that urea plays an important role in osmoregulation, as is the case in the elasmobranchs (Smith, 1936). Further, the values for serum and aqueous urea and for the aqueous serum concentration ratio in *Latimeria* are similar to those reported by Doolittle, Thomas, and Stone (1960) in plasma and aqueous of the elasmobranch *Mustelus canis* (aqueous humour concentration = 320 mM/kg. water; plasma concentration = 342 mM/kg. water).

It is probable that the considerable difference between the magnesium concentrations in aqueous and serum was occasioned by intravascular haemolysis and it seems likely that the value reported for the aqueous more closely represents the true concentration present in the serum before death (Pickford and Blake Grant, 1967). Even so, the amount originally present in the aqueous may well have been augmented by loss from damaged cells in the surrounding tissues.

On the basis of the total osmolarity estimated from the average values in renal and hepatic portal venous blood and in cardiac blood (Table I), the aqueous humour (952 mOsm/l.) appears to be hypotonic both to plasma (1181 mOsm/l.) and to the external environment (1090 mOsm/l.). This situation, *i.e.* where Environment > Aqueous < Blood, would entail either an active removal of solute from the aqueous or else an active transport of water into it.

If, on the other hand, the best estimate of serum osmolarity is given by the cardiac blood sample (921 mOsm/l.), then the tonicities would be represented as Environment > Aqueous > Blood, suggesting a net loss of water from blood to environment across the aqueous and cornea. This would be the converse of the situation in *M. canis* where, as Davson (1962) points out, one would anticipate a net flux of water from environment to blood.

An earlier account of the eye in *L. chalumnae* given by Millot and Anthony (1965) describes it as having neither ciliary body nor ciliary process. The present observations are therefore of interest in that they show in the ciliary region a distinct papilla, somewhat similar to that described in the chondrosteian eye by Duke-Elder (1958), covered with two layers of epithelium. Unfortunately neither the histological nor the biochemical findings presently available enable one to determine whether or not this structure has any secretory function.

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