zeiten) wird gesondert berichtet werden. Für die vorliegende Fragestellung ist lediglich die Tatsache entscheidend, dass die nahe dem Chiasma abgeleitete Spontanaktivität des N. opticus durch ischämische Blockade der intraretinalen Strecke des Neurons bzw. seiner präsynaptischen Verbindungen ausgelöscht wird und daher nachweislich nicht an der Ableitstelle entsteht.

Die Frequenz der Spontanentladungen zeigte eine bemerkenswerte Varianz. Bei 12 einwandfrei isolierten Einheiten wurden nach jeweils einstündiger Dunkeladaptation die in Abbildung 2 dargestellten Impulsfrequenzen gemessen (Mittelwert ± Standardabweichung 22 ± 11 Impulse/s). Sie stimmen grössenordnungsmässig mit den bei retinalen und kortikalen Ganglienzellen beobachteten Spontanfrequenzen gut überein (retinale Spontanfrequenz etwa 20–30/s nach KUFFLER[2], Variationsbreite der Spontanfrequenz lichtaktivierter kortikaler Einheiten 2–40/s nach JUNG und BAUMGARTNER[9]).

Der eindeutige Nachweis einer physiologischen Natur der Spontanaktivität im N. opticus erscheint insofern von Interesse, als dieses Phänomen grundsätzlich bei jeder Sehtheorie berücksichtigt werden muss.

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Summary

Spike potentials were recorded with metal microelectrodes from single fibers in the intracranial part of the cat's optic nerve with the retina left completely intact. All units studied as yet showed a marked spontaneous activity irrespective of differences in their response to light stimuli. The spontaneous activity in the intracranial part of the optic nerve could be suppressed reversibly by increasing the intraocular pressure up to 200 mm Hg. Thus spontaneous activity has been verified as a normal feature of the retina. A spontaneous firing rate of 22 ± 11/s after 1 h dark adaptation was found in altogether 12 well-isolated fiber units.

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Studies of the Differences of Osmotic Pressure between the Aqueous Humor and the Serum in some Species of Animals

The first attempts to measure differences in osmotic pressure between the plasma and the aqueous humor were made in 1927 by DUKE ELDER[1]; he determined the modifications of electrical conductivity of the two fluids separated by a collodion membrane, and stated at the time that they were in osmotic equilibrium. However, subsequent investigations, by GILMANN and YUDKIN[2] and by BENHAM *et al.*[3], led to the definite conclusion that aqueous humor is hypertonic to serum, with a difference of 5 *mM* NaCl.

The findings have since been confirmed by ROEPKE and HETHERINGTON[4], BARANY[5], KINSEY[6], and SCHAEFFER[7], and at the present time it is generally accepted that stabilization of this osmotic gradient is of considerable importance in the mechanism of intraocular pressure.

Although now several authors have abundantly proved that the osmotic pressure of the aqueous humor is higher than that of the plasma in man, rabbits, dogs, and cats by some 2–4%, and equivalent to a hydrostatic pressure of some 90–180 mmHg, and normal intraocular pressure is only 20–25 mmHg, the hydrostatic potential of this difference in osmotic pressure does not manifest itself, and as things stand now, no satisfactory explanation of this can be given. HARRIS[8] is very probably right in his assumption that the flow of aqueous humor in the eye is so rapid that osmotic and hydrostatic balancing does not take place.

DUKE ELDER[1], ROEPKE[4], BARANY[5], and KINSEY[6] carried out their observations using the thermo-electric method of BALDES, which measures the depression of the water vapour in the fluids under study; a later modification by KINSEY[6] of this method, eliminating some disadvantages of the thermo-couples, was used to study modifications of the osmotic pressure under some experimental conditions. ROEPKE and HETHERINGTON[4] did not find any differences of the molar concentration of the aqueous humor in subjects with glaucoma simplex; BARANY[5] found no differences of osmotic pressure in the aqueous humor of rabbits after unilateral ligation of the carotid, although he saw a decrease of ascorbic acid and an increase of lactic acid and CO_2. The same author observed a slight decrease of osmotic pressure after instillation of eserine and atropine.

More recently, SCHAEFFER[7] made some studies of the osmotic pressure of the lacrimal fluid, in which he applied a very simple method for which no complicated apparatus is needed and which makes it possible to carry out determinations even in quantities of fluid of less than 0·1 ml with a precision of ± 0·01 *M*. In an attempt to contribute to the solution of this interesting problem of the possible modifications of the osmotic pressure under normal and pathological conditions, I have started preliminary studies of the aqueous humor and serum of various species of animals, and of the aqueous humor and serum of man under normal conditions.

Experimental Part. – The method used, a modification by NIEDERL and LEVY[9] of the well-known method of BARGER, is based on the fact that in a closed system, in which two fluids contained in capillary tubes are compared, a modification of the proportion of the volumes is due to a difference in the distribution of the water vapour in the two solutions. The tendency of the system is towards osmotic equilibrium, and the solution with the highest molarity will increase in volume and that with the lowest molarity will decrease in volume until an equilibrium is attained.

When this method is used, two capillary tubes are filled with the solutions in question, closed at one end and placed in an outer tube in such a way that the two menisci are at the same level; the pressure in the outer tube is decreased by some 15 mmHg, after which the

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[2] A. GILMANN and A. M. YUDKIN, Amer. J. Physiol. *104*, 235 (1933).

[3] G. H. BENHAM, H. DAVSON, and W. S. DUKE ELDER, J. Physiol. *89*, 61 (1937).

[4] R. R. ROEPKE and W. A. HETHERINGTON, Amer. J. Physiol. *130*, 340 (1940).

[5] E. H. BARANY, Acta physiol. scand. *13*, 81 (1947).

[6] V. E. KINSEY, J. gen. Physiol. *34*, 389 (1951).

[7] A. I. SCHAEFFER, Arch. Ophthal., N. Y. *43*, 1026 (1950).

[8] I. E. HARRIS, Eye Digest, May 1952.

[9] I. B. NIEDERL and A. M. LEVY, Science *92*, 2384 (1940).

Animals	Number of samples	Aqueous humor	Serum	Difference
Horse	4	161·4	158·2	+ 3·2
Cow	4	162·0	158·6	+ 3·4
Sow	3	160·6	159·5	− 1·4
Dog	8	159·6	157·4	+ 2·2
Rabbit	12	157·2	156·8	+ 1·4
Guinea-pig . .	12	156·3	156·8	− 0·5
Man	2	160·4	158·3	+ 2·1

tube is sealed. In the original method, the system was then left to stand at room temperature for 4 days, after which the difference in level between the two menisci was read. Since, however, the prolonged interval made it possible for the fluids to undergo chemical changes which might influence the results, the original method has been modified by NIEDERL and LEVY in such a way that the time required for equilibrium is decreased, at the same time decreasing the space to be evacuated in which evaporation and osmotic equilibrium occur.

It may be presumed that the value of exchange in the time t of the quantity of fluid evaporated, m, equals a factor α minus a quantity which is inversely proportional to the volume V. Expressed as a differential equation, this reads:

$$\frac{dm}{dt} = \alpha - \frac{\gamma}{V} m \,. \qquad (1)$$

The integral solution is:

$$m = \frac{aV}{\gamma} (1 - e)^{\frac{-\gamma}{V}} . \qquad (2)$$

Consequently, when all other conditions remain the same, decrease of the volume decreases the time needed for an equilibrium to be attained.

In my investigation, 15 mmHg was evacuated, after which the system was left to stand at room temperature for 12 h; and the difference in level between the two menisci was then read. If the two menisci were at the same level, the fluids had the same osmotic pressure; if not, they were hetero-osmotic.

Using slight magnification, one is able to demonstrate differences of 0·01 M (about 0·06 g NaCl/100 ml).

Previous to the tests of the aqueous humor, a series of tests had been made in which standard solutions of NaCl of 0·83% and of 0·98% were compared; the values for the aqueous humor were expressed in terms of isotonicity with solutions of NaCl in mM/kg H_2O.

This method, which is very simple and can be repeated at will, makes it possible to carry out determinations in quantities of aqueous humor of less than 0·1 ml.

In my present preliminary investigations, I have determined the osmotic pressure of the aqueous humor in some species of animals in relation to the osmotic pressure of the serum. The two fluids were taken from the same animal, at practically the same moment. In the Table, the results obtained in the various species examined are given.

Scrutiny of this table reveals that the hypertony of the aqueous humor over the serum is a constant finding in all the species examined, with the exception of guinea-pigs.

The fact that in guinea-pigs the aqueous humor is hypotonic with regard to the plasma is not surprising if one remembers the recent observations by DAVSON[10], who has demonstrated a difference of the ratios of concentration of bicarbonates in aqueous humor and plasma of various species of animals, and a variability of the ratio of concentration of the chlorides. The guinea-pig, in particular, shows a deficiency of anions (chlorides and bicarbonates) and it is this deficiency which explains the hypotony of the aqueous humor which makes it possible to maintain a rate of flow of the endocular fluid compatible with a relatively normal intra-ocular pressure.

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Riassunto

L'autore ha eseguito determinazioni della pressione osmotica dell'U. Acqueo e siero in alcune specie animali col metodo di NIEDERL E LEVY. In tutte le specie animali ha riscontrato sempre un'ipertonia dell'Acqueo rispetto al siero di circa 2 m/M.

Soltanto nella cavia l'acqueo è leggermente ipotonico in rapporto al siero. L'autore spiega questa eccezione con la deficienza di anioni (cloruri e bicarbonati riscontrata nell'acqueo di cavia).

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A Comparison of the Effect of Potassium Ions on the Metabolism of Retina and Brain Cortex Slices *in vitro*

It is generally accepted that potassium ions play an important role in the functional metabolism of nervous tissue[1]. Further information on the metabolic response of nervous tissue to increased K^+ concentration *in vitro* therefore appears to be desirable.

Comparing the available evidence on the metabolism of brain cortex slices and retina *in vitro*, it will be noted that an increased concentration of K^+ in glucose-containing saline brings about an increased oxygen consumption and aerobic glycolysis of incubated brain cortex slices[2], while no such response has been observed in retina[3]. The results of TERNER *et al.*[4] indicate that the same mechanism applies to the movement of K^+ in both retina and brain cortex slices. It is also known that *on incubation retina releases considerable amounts of* ammonia[5], in a similar way as do brain cortex slices. Experiments were published supporting the view that ammonia formation is closely connected with the functional metabolism of retina as well as of other nervous

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