Zusammenfassung. Einfache und empfindliche Methode zur differentiellen fluorimetrischen Bestimmung von 0.01–1 μg/ml Menge von Adrenalin und Noradrenalin. Die Oxydation wird mit $K_3Fe(CN)_6$ bei pH 6.8 durchgeführt. Nachdem die fluorescierenden Derivate von Adrenalin und Noradrenalin sowie von Noradrenalin allein mittels basischem Askorbat bzw. Cystein-Thioglykolsäure stabilisiert worden sind, wird die Fluorescenz bei 409 nm und 519 nm gemessen[9].

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Measurements of the Flow of Aqueous Humor According to a New Principle

Though several methods have been devised for determining the flow of aqueous humor, none of them is sufficiently perfect to make a new approach to the problem uninteresting. The method to be described, which aims at a determination of the flow through the pupil, is based on the following observations.

If fluorescein in a solution is instilled into the conjunctival sack it penetrates the cornea and colours the aqueous humor. The penetration can be enhanced by iontophoresis, and in ca. 15 min the aqueous humor is strongly coloured. By movements of the eye the staining of the content of the anterior chamber can be made fairly homogeneous. The method relies on the fact that the newly-formed aqueous humor which emerges from the pupil is uncoloured and remains observable as a clear, slowly increasing volume, well demarcated against the green content of the anterior chamber for up to about 30 sec (Figure 1). After that time convection and diffusion make the boundaries of the volume indistinct and 'Schlieren' are formed. However, the content can be mixed again and the growing volume can be observed anew an arbitrary number of times. A flow value in absolute units might be obtained if the volume of the clear-growing 'vesicle' could be measured on 2 occasions at a known interval.

A method for estimating the volume of superficial tumours by means of 'Lichtebeneschnitte' has recently been described[1]. A number of parallel equidistant slits are projected over the surface of the tumour. This is photographed from an angle, fixed to the projector axis. On the photograph a series of lines are seen, deviating over the surface of the tumour. The areas between the deviations and the corresponding base lines are planimetered and the volume is easily estimated when the distance between the slit images is known. In trying to apply this new method to the present situation, it had to be modified by taking a series of single slit pictures in rapid succession (12/sec) with a cine-camera. The distance between the adjacent slit images was 0.28 mm (Figure 2).

The best measuring conditions are obtained with miotic pupils. The convection currents in the anterior chamber may disturb the formation of a well-defined 'vesicle' but it seems to be possible to master this difficulty by, for instance, irrigation of the cornea with warm or cold water. A number of experiments on rabbits have given flow values inside the normal range (1.5–3.8 mm^3/min). Al-

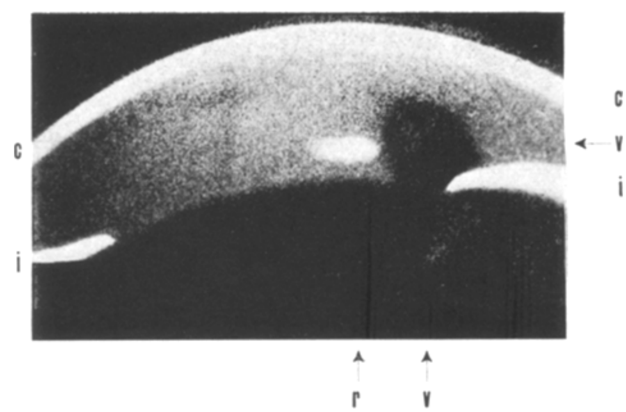

Fig. 1. Slit image giving an optical section through the auterior chamber; c = cornea, i = iris. The content is fluorescent apart from a clear 'vesicle' (v) at the pupillary border. Beneath the 'vesick' is the corneal reflex (r).

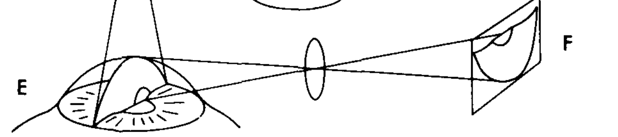

Fig. 2. Schematic diagram of measuring device. S = slit, illuminated from behind, which is projected on the eye (E) and photographed (F). The positions of the sections in a series of exposures and the corresponding images are shown.

[1] O. HOLM and C. E. T. KRAKAU, Acta universitatis lundensis, Sectio II 1965, No. 31.

lowance has been made for the effect of the corneal curvature on the image size, but the possible effect of diffusion on the values has not yet been estimated. The dispersion of the values taken in succession is considerable (range $\pm$ 20%), which may be explained by the fact that the number of slit images covering the small vesicle is low (4–5). The precision of the mean flow value may be increased by decreasing the distance between successive sections or by taking a greater number of consecutive determinations.

There does not seem to be any hindrance to applying the method to other species besides rabbits[2].

Zusammenfassung. Wird der Vorkammerinhalt des Auges von aussen mit Fluorescin gefärbt, so ist das aus der Pupille herausfliessende Kammerwasser kurzfristig als ungefärbte «Blase», deren Volumen photogrammetrisch bestimmbar ist, sichtbar. Das Minutenvolumen ist durch zwei zeitlich getrennte Messungen feststellbar.

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THEORIA

A Quantum Theory of Brownian Movement

It is believed that Brownian movement is a fundamental type of motion of matter at a molecular level. Although such a motion cannot be found at a submolecular level, in which it is governed strictly by the mechanical laws of motion without irreversibility, Brownian particle-like motion may appear as a result of space-time correlation of irregular fluctuating forces. According to the theorem of fluctuation-dissipation, there may occur dissipation where there is fluctuation. Furthermore, it must be considered that the fluctuation comes from some generalized Brownian motion of a moving body in the system. The investigation of Brownian motion will be important in the boundary field between the world of microscopic moving bodies and that of macroscopic moving particles, in order to seek the essential cause of irreversibility which is a characteristic property in the macroscopic world. Regarding the theory of Brownian movement[1], it is well known that there are two kinds of approach: one is Einstein's and the other is Langevin's. Here, we will deal with the problem along the line of Langevin's approach from the statistical mechanical point of view.

In the present article, the problem is to obtain a generalized form of Langevin's equation of motion, not on the ordinary stochastic basis but in the systematic way, from the quantum mechanical equation of motion in the Heisenberg picture, and to express the relation of Einstein-Nernst in a general sense.

The operator of an arbitrary observable A changes temporally according to the equation of motion

$$dA/dt = i\,\hbar^{-1}[H, A] \equiv i\,\omega^*\,A\,, \qquad (1)$$

whose solution is given by

$$A(t) = \exp(i\,t\,H/\hbar)\,A(0)\exp(-\,i\,t\,H/\hbar) \equiv \exp(i\,t\,\omega^*)\,A(0)\,, \qquad (2)$$

where H is the Hamiltonian of the system, $\hbar$ is Planck's constant divided $2\,\pi$, and ω^* is defined by Eq. (1) as an operator of angular frequency of transition whose classical analogue is Liouville's operator.

By making use of a projection operator P, the operator of A can be split identically into $\overline{A} \equiv P\,A$, projected onto a subspace of the operator Hilbert-space, and $A' \equiv (1-P)\,A$, projected onto an orthogonal complement of the P-subspace:

$$A = P\,A + (1-P)\,A = \overline{A} + A'\,. \qquad (3)$$

According to ZWANZIG's technique[2], we obtain the following coupled equations from Eq. (1):

$$d\overline{A}/dt = i\,P\,\omega^*\,(\overline{A} + A')\,, \qquad (4a)$$

$$dA'/dt = i\,(1-P)\,\omega^*\,(\overline{A} + A')\,. \qquad (4b)$$

By means of the Laplace transformation of

$$A(s) = \int_0^\infty \exp(-\,s\,t)\,A(t)\,dt, \qquad \text{(real part of } s \text{ being positive)},$$

we can deal with Eqs. (4a and b) in an algebraic manner. These are transformed into

$$s\,\overline{A}(s)\overline{A} - (0) = i\,P\,\omega^*\,\{\overline{A}(s) + A'(s)\}, \qquad (5a)$$

$$s\,A'(s) - A'(0) = i\,(1-P)\,\omega^*\,\{\overline{A}(s) + A'(s)\}, \qquad (5b)$$

where $\overline{A}(s)$ and $A'(s)$ are the Laplace transforms of $\overline{A}(t)$ and $A'(t)$, respectively. At first, from Eq. (5b), we obtain

$$A'(s) = [s - i\,(1-P)\,\omega^*]^{-1}\cdot A'(0) + [s - i\,(1-P)\,\omega^*]^{-1}\cdot i\,(1-P)\,\omega^*\,\overline{A}(s)\,. \qquad (6)$$

Inserting this into Eq. (5a), we obtain without approximation a unified equation of

$$s\,\overline{A}(s) - \overline{A}(0) = i\,P\,\omega^*\,\overline{A}(s) + i\,P\,\omega^* \times [s - i\,(1-P)\,\omega^*]^{-1}\cdot i\,(1-P)\,\omega^*\,\overline{A}(s) + i\,P\,\omega^* \times [s - i\,(1\,\%\,P)\,\omega^*]^{-1}\cdot A'(0)\,. \qquad (7)$$

[1] R. EISENSCHITZ, *Statistical Theory of Irreversible Processes* (Oxford University Press, London 1958).

[2] R. ZWANZIG, J. chem. Phys. *33*, 1338 (1960).