increases 10 to 20% above the rate prior to injection and gradually returns to its initial value. This marked acceleration seems to indicate that the heart is either innervated by augmentor nerves on the eighth day after fertilization or that the cardiac muscle of the older embryo is decidedly different physiologically from the younger embryos as no effect of the drug is shown on the cardiac muscle prior to the 8th day of incubation.

To test the above hypotheses, adrenalin was injected into embryos which had previously been immersed for 30 minutes or longer in nicotine solution, pure alkaloid 1 part in 1000 parts of 5/8 normal (isotonic) NaCl solution. Nicotine in general is considered to be a sympathetic ganglionic depressant and in this concentration nicotine did not produce any marked action on the contraction of the embryonic heart muscle.

The results of these experiments show that injection of adrenalin after nicotine does not produce any significant acceleration in the cardiac rhythm. Therefore, it seems apparent that the acceleration in rate of the older embryos after adrenalin injection is due to a stimulation of the accelerator fibers and not to a direct action on the cardiac muscle.

7024 C

Transudation Through Living Membranes.

RAYMOND RATNOFF. (Introduced by Eric Ponder.)

From Washington Square College, New York University.

Gunn[1] has devised a mechanical system for transuding liquids through living membranes. The regulation and maintenance of a definite negative pressure in this system is based upon the method of Wade and Merriman[2] employing a variable air gap. Using this apparatus, Gunn tried the effect of the transudation of caffeine citrate and of Eschis venom on rabbit mesentery. The results were negative in that no change in rate was observed with these substances when compared with the rate obtained with Locke's solution itself.

The apparatus has been simplified and improved, and in its final form provided for a complete glass assembly. (Fig. 1.) Using this improved apparatus I have carried out experiments to determine

[1] Gunn, J. A., *J. Physiol.*, 1931, **71**, 412.

[2] Wade and Merriman, *J. Chem. Soc. London*, 1911, **99**, 984.

the effect of various lysins and of a series of chloride salts (Kahlbaum) upon transudation.

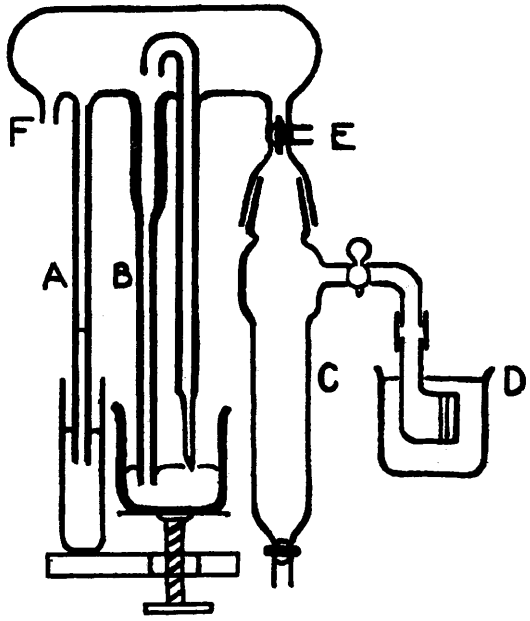

FIG. 1.

Diagram of apparatus. A, manometer; B, variable mercury air gap system; C, graduated burette for receiving transuded liquid; D, tambour in transuding solution; E, opening to air, usually closed; F, outlet to suction pump. The negative pressure in the apparatus is varied by adjusting the screw under B.

Living mesentery of freshly killed rabbits was used as the membrane. The procedure is essentially that of Gunn. The piece of mesentery, which had been previously placed in Locke's solution, is tied over the muslin-covered opening of a special tambour and transudation is begun after the tambour is fastened in place on the apparatus. To obtain a "normal curve" transudation is continued for 15 minutes under a pressure of 150 mm. Hg. at 26°C. Using a standard Locke's solution the transudation rate falls steadily with time. The beaker of Locke's solution is replaced by another containing Locke's solution to which has been added the desired concentration of lysin or salts to be tested. Transudation is continued and a new curve for the rate is obtained. Comparing the curves it is then possible to determine the change in transudation rate and thus the relative porosity of a given piece of mesentery.

I. SAPONIN. Transudation for 15 minutes in ordinary Locke's solution yields the "normal" hyperbolic transudation curve (Fig. 2).

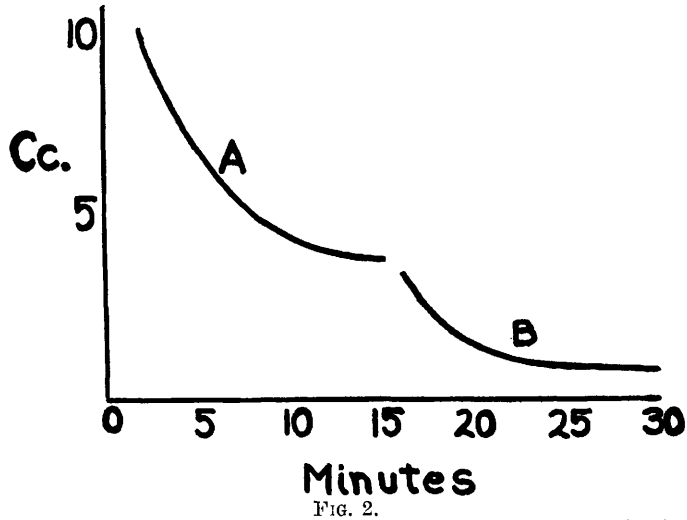

FIG. 2.

Ordinate, cc. of fluid transuded per min.; abscissa, time. Curve A, the normal transudation curve with Locke's solution; curve B, the curve when saponin, 1 in 1000, is added. The sudden decrease in transudation rate is apparent.

Upon following this by transudation for an additional 15 minutes with Locke's solution containing 1-1000 saponin there is observed, in every case, a decrease in transudation rate, in some cases small, in others quite large. The rate may drop from 3.5 cc./minute with Locke's solution to less than 1 cc. minute with saponin solution. It is as well to explain that while transudation curves of Locke's solution given by various pieces of mesentery are characteristically similar, yet, in disagreement with Gunn, I have found that the rates per minute vary greatly from mesentery to mesentery. In fact the rate for the first minute may vary from as little as 1 cc./minute to as much as 70 cc./minute.

II. SODIUM TAUROCHOLATE. Sodium taurocholate in 1-1000 dilution in Locke's solution always causes a lowering of the transudation rate. In several cases the rate falls from 3.2 cc./minute with Locke's solution to less than 0.6 cc./minute with sodium taurocholate solution.

III. ALCOHOLS. Methyl and butyl alcohols (0.5 N) both decrease the transudation rate. Ethyl and propyl alcohols (0.5N) affect the transudation rate in various ways; in some cases, the rate is increased, in others no effect is apparent, and in still others the rate is decreased. The changes are never very notable. Isopropyl alcohol has no effect.

IV. CHLORIDES. In order to obtain somewhat comparable conditions it is necessary to add such concentrations of the various

salts as exert equal osmotic pressures. The amount added to one liter of Locke's solution was 11.3 gm. for NaCl, 14.0 gm. for KCl. 30.4 gm. for $BaCl_2$, 14.4 gm. for $CaCl_2$, 7.3 gm. for LiCl, and 25.7 gm. for $MgCl_2.6H_2O$.

Both NaCl and $BaCl_2$ in these dilutions give definite increases in the transudation rate. KCl, on the other hand, causes a definite decrease. The results for $MgCl_2$ and LiCl are variable. $CaCl_2$ causes slight changes in transudation rate varying from a slight increase to a slight decrease.

V. GLUCOSE. Glucose in concentration of 68.7 gm. per liter of Locke's solution brings about no significant change.

The rate of transudation for the first minute is always very high and as transudation is continued the rate gradually decreases. (Fig. 1.) Several experiments were carried out in which transudation was stopped and recommenced after an interval. After a "rest" from transudation the subsequent flow was higher than would have resulted had the flow been allowed to continue.

Although the results are not very striking, they are sufficient to indicate that certain substances (*e. g.,* haemolysins) which increase the permeability of red cell membranes, decrease the transudation flow through mesentery. It is to be borne in mind, of course, that permeability and transudation are not measured in exactly comparable terms. Salts and alcohols affect transudation in various ways and to different extents, and do not seem to fall into any series or relation to be expected on the basis of present theories of permeability.

7025 C

A Reply to Bishop and Heinbecker's "Fiber Distribution in Optic and Saphenous Nerves."

E. A. BLAIR AND JOSEPH ERLANGER.

From the Physiological Department, Washington University School of Medicine, St. Louis.

In a paper by Bishop and Heinbecker[1] there occurs a serious misinterpretation of a statement published by us.[2] They quote from

[1] Bishop, G. H., and Heinbecker, P., PROC. SOC. EXP. BIOL. AND MED., 1933, **30**, 1312.

[2] Blair, E. A., and Erlanger, J., PROC. SOC. EXP. BIOL. AND MED., 1933, **30**, 728.