We extended the study on paramaecium and made a few preliminary experiments observing the effects of electromagnetism at a temperature of 35° C. A magnetic field with a strength of more than 5000 gauss applied for several hours had a paralyzing effect on these organisms. After removal from the magnetic field they regained their former activity.

A similar study to that on paramaecium has been carried out on the above mentioned tissues. The exact survival time was determined by many series of grafts made in chickens with the sarcoma Rous and in rats with other tumors mentioned, after they had been exposed to electrolysis. All three chambers of the apparatus were used for the experiments on cancerous tissues. It is interesting to note that sarcoma Rous is about 10 times more resistant to the electric current than the other 3 cancerous tissues. The anode and middle divisions kill chicken sarcoma, while the cathode chamber does not show an appreciable effect. On the other hand paramaecium and the tumors are killed in the cathode chamber as well as in the other 2 divisions. It is furthermore of interest that similar relations exist between the mortality curves of sarcoma Rous and paramaecium. During the above described experiments the pH of the applied substances was not changed appreciably by the electric current.

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Electrochemical Behavior and Electromigration of Adrenalin.

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(Introduced by Leo Loeb.)

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We made use of the apparatus described in the preceding paper to study the electrochemical behavior of adrenalin.

If adrenalin in aqueous solution is added to the middle division of our apparatus, a current of 1 Milliamp. and 4 volts will effect a migration of this substance in the direction of the electrodes. It will be noted that adrenalin passes through the Norton Alundum discs used as diaphragms as well as through various Zsigmondy filters. All qualitative determinations of adrenalin were made by means of iron chloride, gold chloride and Folin's reagent. Quantitative experiments showed that the migration of adrenalin in the direction

of both poles occurs unequally. After the addition of alkali or alkaline salts to a solution of adrenalin hydrochloride a greater amount of adrenalin migrates in the direction towards the positive pole, while the addition of acid or acid salts causes a more marked migration in the opposite direction. The quantitative determination was carried out by the method of Folin as modified by Hitchcock and Benedict, using the colorimeter of Dubosque.[1, 2, 3]

We also made investigations concerning the electrolysis of adrenalin. We investigated first the influence of various electrode materials on the rate of decomposition of adrenalin. Carbon electrodes seemed to be the least efficient electrode material, while the metals Ni, Pt, Ag, Cu, Fe, Hg, represent a series with increasing efficiency. The rate of decomposition of adrenalin by electrolysis in the 3 divisions of the apparatus is shown in the following table, which may serve as an example of many other similar cases. The experiments were carried out at a temperature of 25° C. using Pt electrodes.

TABLE I.

Time in minutes	Volts	Amp./ squ. dm.	Anode Div. mgr/min.	pH	Middle Div. mgr/min.	pH	Cathode Div. mgr/min.	pH
15	7.0	0.9	0.05	7.0	0.07	7.5	0.13	7.5
30	7.0	0.9	0.02	4.5	0.09	9.3	0.15	9.5
45	9.0	0.8	0.015	4.2	1.00	10.0	0.24	10.0
60	6.0	0.8	0.07	4.0	1.30	10.0	0.35	10.0

J. Roest[4] had previously determined the rate of oxidation of adrenalin in alkaline solution (pH 7 to 7.2) to be about 0.3 to 0.5 ccm. per minute, but it could be as high as 3.0 ccm. per minute (pH 7.4). It can be seen from our table that the rate of decomposition in all 3 divisions is less than that found by Roest. Therefore, it can be stated that an electric current if not of excessive strength will within certain limits not attack the cathechol group of adrenalin.

If minute quantities of iron chloride are added, the electrolytical decomposition of adrenalin will be considerably accelerated.

In the anode division decomposition products like diketo-quinones, quinhydrone, aldehydes and other ketones were found, while in the cathode division hydroquinone, p-cresole and cyclic alcohols were present in addition to other substances which we have not yet determined.

[1] Folin, O., and Macallum, A. B., Jr., *J. Biol. Chem*, 1912, **13**, 363.

[2] Folin, O., and Denis, W., *J. Biol. Chem.*, 1913, **14**, 95.

[3] Benedict, S. R., and Hitchcock, E. H., *J. Biol. Chem.*, 1915, **20**, 619.

[4] Roest, J., *Biochem. Z.*, 1926, **176**.