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Electrodialysis in Application to Some Biological Studies.

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(Introduced by Leo Loeb.)

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Among the first to use electrodialysis in biological studies were Bronfenbrenner,[1] who constructed a special apparatus for the isolation of bacteriophage, and Murphy,[2] who used this apparatus in cancer research. One of us[3] has already reported about the difficulties which might possibly arise in using this apparatus for biological investigations. For this reason an improved apparatus was constructed for our research by Dr. N. Michailowsky. The apparatus differs from the older model in the construction of the cell in which the electrochemical process is carried out. This cell is divided into 3 parts, namely: anode, cathode and middle chamber. Between the 2 electrode chambers and the middle chamber 2 Norton Alundum Membranes can be introduced. These diaphragms, which have a diameter of 3½ inches may be combined with special Ultra or Cellafilters. The electrodes are exchangeable and, therefore, different metals can be used as electrode materials. Means for proper agitation and for temperature readings are provided. It is possible to use all 3 chambers for experiments and to study the electrochemical effects of anode, cathode and middle chamber separately. This apparatus can be operated by direct or alternating currents.

In order to study the behavior of living tissue in the described apparatus, we began investigations on *Paramaecium caudatum,* chicken-sarcoma Rous and other cancerous tissues as Flexner carcinoma and sarcoma No. 10 and No. 39.

The experiments on paramaecium were carried out in the middle division; there was at the same time a continuous circulation of water in the other 2 divisions.

We found that the voltage as compared with amperage has a relatively slight influence on the mortality and therefore we maintained a constant potential of about 100 volts in our experiments. A current of 0.005 Amp. and 100 volts which is equal to 0.5 watt can be withstood practically indefinitely without any harmful effects, but a stronger current seems to be fatal.

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[1] Bronfenbrenner, J., *Gen. Physiol.,* 1926-27, **10,** 23.

[2] Murphy, J., *Rev. of Int. Conf. of Cancer,* London, 1928.

[3] Sokoloff, B., *C. R. Soc. Biol.,* Paris, 1929, **150.**

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