The maximal electromotive effect of the concentration as seen in plants is the only suitable object for artificial reproduction, as its magnitude is much higher, ranging from 0.09 to 0.1 volt for the interval 1/1000-1/10 mol. KCl, and particularly because in this case only a somewhat limited number of selected substances is exclusively capable of reproducing it. Such substances are: salicylic aldehyde, nitrobenzene solutions of salicylic acid, picric acid, fatty acid, lecithin, or solutions of these acids in some other solvents like guaiacol,[3] also nitrocellulose (collodion) in an air dried state (according to recent investigations of Michaelis and Fujita.[8] As an example, the effect may be quoted which is observed with a guaiacol + oleic acid mixture as central conductor between 1/1000 and 1/10 KCl; this is 0.1 volt, a value about five times as large as that given by Mond for his alkaline gelatin cell.[2])

[1] Beutner, R., and Menitoff, A., PROC. SOC. EXP. BIOL. AND MED., 1927, xxiv, 462.

[2] Mond, R., *Pflüger's Archiv.*, 1924, ccliii, 247.

[3] Beutner, R., *Entstehung electr. Stroeme in Geweben Stuttgart*, (F. Enke) 1920. *J. Am. Chem. Soc.*, 1913, xxxv, 344, and 1914, xxxvi, 2046. *Am. J. Physiol.*, 1913, xxxi, 343.

[4] Blom, Oker, *Pflüger's Archiv.*, 1901, lxxxiv, 191.

[5] Rohonyi, *Biochem. Zeitchr.*, 1914, lxvi, 231 and 248.

[6] Fujita, A., *Biochem. Zeitschr.*, 1925, clix, 370.

[7] Fujita, A.; also Michaelis, L., and Dokan, S., *Biochem. Zeitschr.*, 1925, clxii, 255 and 258.

[8] Michaelis, L., and Fujita, A., *Biochem. Zeitschr.*, 1925, clvi, 47.

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The Effect of Hyper- and Hypotonic Solutions on Oxidations by the Red Blood Cell.

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It has previously been reported[1] that under the proper conditions of nutrient supply, the adult red blood cell has a well defined metabolism. At the same time it was shown that dialyzed solutions of hemoglobin have the power to oxidize the same substrate, sodium lactate to CO_2. While the oxidation by the red cell is of long duration and considerable magnitude as compared with the same activity in the case of hemoglobin, one may suppose the blood pigment is associated with this oxidative activity of the cell. That this is the

case is shown by the fact that loss of oxygen by the hemoglobin of the cell results in a diminished production of CO_2.

That there is a relationship between structure and oxidative activity appears to be beyond question.[2] This relationship becomes of peculiar interest in connection with the rôle of hemoglobin in oxidations by the red blood cell. If the hemoglobin of the cell is upon the cell surface, and, the assumption is correct that the blood pigments play a rôle in the oxidation by the red cell, it is conceivable that any change in the surface of the cell would produce a profound effect in the metabolism. This, of course, is dependent on the fact that the cell-solution interface is the one functioning in the process of metabolism. If this is true an increase in surface area such as would be brought about by the treatment of the cells with a hypotonic solution should cause an increase in oxidation. Conversely, the exposure of cells to a hypertonic solution should decrease the surface area with a decrease in oxidation. Suppose, on the contrary, that it is not the cell-solution interface that is active but the interfaces within the cell. In this case the hemoglobin may be conceived to be adsorbed on the surface of the colloidal matter within the cells. The result would be the direct opposite to that postulated above. The exposure of the cell to a hypotonic solution would result in the dilution of the fluid cell contents and a consequent loss of material from the surface through a redistribution of adsorbed material. A decrease in oxidation, provided these are the active surfaces, would be the result.

With these arguments in mind the following experiments were carried out upon the effect of hyper- and hypotonic solution on the metabolism of the red blood cell. Solutions of M/12.5 sodium lactate were made isotonic with the following concentrations of NaCl: 0.5, 0.7, 0.9, 1.1, and 1.3 per cent. This was done by the addition of NaCl. These solutions were placed in flasks, covered by a layer of paraffin oil and the whole sterilized in the autoclave at 15 pounds pressure for fifteen minutes. They were then stored in the cold and were warmed to 25° C. when used and maintained at this temperature throughout the course of the experiment. The blood cells were taken from dog's blood treated with sodium oxalate. They were washed three times in sterile saline, care being taken to preserve the original volume.

After a thorough oxygenation with room air the cells were added to the lactate solution in the proportion of 20 cc. of cell suspension to each 100 cc. of lactate solution. All concentrations were tested at the same time so that variations in temperature would exert the same influence on all. The oxygen content of the solution was determined at the start and at the end of the experimental period (24

hours) by the Van Slyke method. The total volume of the cells was determined at the end of the experiment either by the hematocrit or the conductivity method of Stewart.[3] The following table presents a summary of the experimental results. The data are the average of those obtained in 5 experiments. In all cases the reaction of the cells in 0.9 per cent saline has been taken as the normal amount, 100 per cent in the table.

TABLE 1.

NaCl Equivalent of the Solution	Volume of Cells Per Cent	Per Cent of O_2 Consumed
0.5	115	62
0.7	107	90
0.9	100	100
1.1	87	80
1.3	78	50

In all cases the reaction of the solution was pH 6.9.

It may be seen that the variations in the tonicity of the solution decreases the amount of oxygen consumed during the period of the reaction, and, that the solution isotonic with the blood is the most favorable for the reaction. In the light of the above discussion, provided the assumptions are correct, it is difficult to conceive of the surface of the cell being an important factor in the oxidations by the cell. At the same time it is evident that disturbances in structure profoundly influence the oxidations of the cell, as might be supposed.

[1] Ray, G. B., *Am. J. Physiol.*, 1927, lxxxii, 405.
[2] Warburg, O., *Ergeb. Physiol.*, 1914, xiv, 253.
[3] Stewart, G. N., *Am. J. Physiol.*, 1924, lxix, 531.

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Effect of Starvation on Healing of Rickets in Rats.

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McCollum and his coworkers[1] demonstrated in 1922, that fasting would cause active rickets to heal within 24 or 48 hours. The immediate cause of such healing seemed clear when it was demonstrated by Kramer and Howland[2] and confirmed by Cavins[3] that