

ment was done in order to be certain that the liver itself, because of its protein and fat content, did not depress the quotient. Since the quotient in the diabetic, while having glycosuria, did not rise higher than 0.85 but did reach unity in a normal individual, it seems probable that the feeding of liver had no action on the metabolism of glucose in the diabetic.

Conclusion. The effect of liver extract on the respiratory quotient and the blood and urine sugar was studied in 2 diabetic patients. The effect of whole liver was studied in one patient. There was no evidence that either had a favorable influence on the diabetes.

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Electromotive Effect of Concentration of Tissue Membranes as the Result of HCl Formation.

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The large variability of certain biological potential differences with concentration¹ indicates that tissue membranes resemble metallic electrodes to some extent. This resemblance may lead to a better understanding of the nature of the electrical polarization in tissues as the cause of their irritability. Every attempt should be made, therefore, to understand the details of the physical nature of this important electrical property of tissues.

Beutner found that such a large electromotive effect of concentration can be imitated by a few water immiscible fluids, such as salicylic aldehyde.² The evidence points to *water immiscibility* and a certain *base binding power* as the essential properties for the production of a large electromotive variability with concentration. Michaelis found that collodion films also show such an effect.³ This confirms the theory, since collodion, a nitro-cellulose, has a marked base binding power, as will be demonstrated in a subsequent publication.

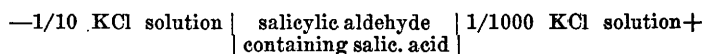
Electromotive measurements on a variety of substances and mixtures have been performed, as well as determinations of salt distribution, with the conclusion that a chemical reaction occurring at the phase boundary is the cause of the large electromotive effect of

¹ *Biochem. Z.*, 1912, **41**, 1.

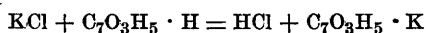
² *Am. J. Physiol.*, 1913, **31**, 443.

³ Michaelis, L., *Biochem. Z.*, 1925, **161**, 47.

concentration.⁴ For instance, the electromotive force of a system like



equals about $\frac{1}{2}$ volt. The following reaction is supposed to occur at either of the phase boundaries:



The potassium salicylate formed by this reaction accumulates in the non-aqueous solvent, salicylic aldehyde, independent to some extent of the concentration. Salicylic aldehyde in this way functions like a potassium electrode.

The objection has been raised that an entirely impossible chemical reaction is assumed. The seeming impossibility appears even more striking if we apply the same explanation to systems containing a mixture of fatty acid and cresol as central conductors. Since these systems exhibit likewise a large effect of concentration,⁴ one is led to assume that oleic acid drives the free HCl from NaCl in order to form sodium oleate. It is known, however, that oleic acid is one of the weakest acids, while HCl is about the strongest, hence HCl usually liberates the fatty acid from soap. A reaction in the opposite direction seems to be an impossibility.

And yet, such a reaction in the opposite sense actually occurs if certain non-aqueous solvents are added, even though it is impossible in aqueous solutions. For instance, in the presence of olive oil, as solvent, oleic acid actually liberates HCl from NaCl (G. H. A. Clowes⁵). Olive oil plus oleic acid would probably show an effect of concentration but on account of the very high resistance of olive oil the effect can not be demonstrated. We, therefore, used a mixture of 90% cresol plus 10% oleic acid, which mixture has a considerable effect of concentration.⁴ This mixture was suspended in water or in aqueous KCl solutions of varying concentration and NaOH added until phenol red turned red; during this titration, the fluid with the oily mixture was shaken intensively. Much more NaOH was needed when more KCl was present. Oleic acid suspended in water requires also some sodium hydroxide to turn phenol pink but if suspended in KCl solution more NaOH is needed.

In another experiment, NaOH was added to a suspension in water of cresol *without oleic acid*. In this case, *the same amount of NaOH was needed to turn phenol red pink, no matter whether KCl was added or not*. This should be expected according to our theory,

⁴ Beutner, R., *Entstehung elektr. Stroeme in Geweben*, Stuttgart, 1920.

⁵ Clowes, G. H. A., *J. Phys. Chem.*, 1916, **20**, 407.

since pure cresol has a slight effect of concentration only or none at all.

It seemed desirable to perform more reliable quantitative experiments. Various samples of the cresol oleic acid mixture, 20 cc. each, were shaken for 2 hours either with 20 cc. of water or with 20 cc. of varying KCl solutions, in the same shaking machine. The aqueous fluid of each sample was then separated from the cresol mixture and cleared by filtration. In each case 10 cc. of this fluid was mixed with 3.0 cc. of a 1/10 molecular NaOH solution and titrated back to the neutral point with phenolphthalein as indicator.

In the sample shaken with water an equivalent amount of HCl was needed to reach the turning point of the indicator, showing that no acid had been formed. In the sample shaken with KCl solution less HCl was needed to titrate back the added NaOH, indicating the formation of acid. From the excess of NaOH the following quantities of acid were calculated per 10 cc. in the sample shaken

with 1/10 molecular KCl : 0.3 cc. 1/10 molecular HCl
 " 1/50 molecular KCl : 0.18 cc. 1/10 molecular HCl
 " 1/250 molecular KCl : 0.11 cc. 1/10 molecular HCl

(These figures represent the averages of two well-agreeing experiments.)

Control experiments have been performed to show that this difference cannot be due to a "salt error".

Conclusions. The experiments show that water soluble acid, manifestly HCl, is formed from KCl and fatty acid, whenever an electromotive effect of concentration arises at the phase boundary. It seems likely that a reaction of the kind described is also a factor in the formation of free HCl in the glands of the stomach.

The theory of phase boundary potentials, referred to above, cannot be set forth in detail in this preliminary communication.

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In the Rhesus Monkey Ovulation is Spontaneous.

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In most mammals ovulation is a spontaneous event, but as first pointed out by Heape in some species, including the rabbit, the European ferret (*Mustelus putorius*), and the domestic cat, ova are