mixtures or syrups, palatability is essentially a question of degree of sweetness and character of flavor. It is well known that in equal concentrations *d*-glucose does not taste as sweet as cane sugar. However, the degree of sweetness and the character of the flavor preferred in a given food varies with the individual. The factor of palatability does not enter in the use of glucose in bakery products and confections, where the taste and flavor are determined by other ingredients.

Summary and Conclusions.

The addition of commercial glucose in the amounts of about 2.5 g. to 3.5 g. per kilo body weight per day to the diet of white rats for a period of six months has no abnormal influence on the animals, either favorable or unfavorable, as determined by the rate of growth fecundity, immunity reactions, and the condition of the organs.

As both the glucose fed and the control groups of rats were kept on a liberal diet throughout the observation period, the experiment does not show to what extent the commercial glucose was actually absorbed and oxidized, but in the quantities fed the commercial glucose certainly has no injurious effects.

CHICAGO, ILL.

[CONTRIBUTION FROM NORTHWESTERN UNIVERSITY MEDICAL SCHOOL.]

A SIMPLE CELL FOR THE DETERMINATION OF HYDROGEN ION CONCENTRATION.

BY J. H. LONG.

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Since the importance of the determination of H ion concentration has been recognized in so many fields of research there has been no end of suggestions as to types of cells assumed to have distinct advantages for the purpose in this or that direction. While, theoretically at least, the use of two hydrogen electrodes, the electrode in the liquid under investigation balanced against the similar electrode in a liquid of known ion concentration, is logically the simplest and most direct arrangement for the observation in hand, most attention has recently been given to the combination made up of one hydrogen electrode in the liquid plus a known calomel electrode. The advantage in this case is found mainly in the fact that the experiment requires the preparation of only one side of the cell, the calomel electrode being constant. In practical work, therefore, the double hydrogen electrode scheme has been largely abandoned, especially in physiological researches.

In cells constructed in part of the calomel electrode the recent types involve the recognition of the principles brought out in the researches of

Soerensen,[1] Hasselbalch[2] and others, in which the great advantage of a thorough agitation of the liquid and the overlying hydrogen is made plain. The constancy of potential is soon reached in this way, which is a matter of importance where many tests are being made. The Hasselbalch cell itself[3] is excellent, but it is somewhat fragile and the large number of ground glass stopcocks make it relatively expensive at the present time. Among several suggested improvements the cell described recently by Clark[4] seems to satisfy fully all requirements for accuracy and convenience in manipulation. A constant potential is soon reached with it.

In this laboratory we have experimented with several forms of home-made cells which can be put together with materials at hand without complicated glass blowing or expensive stopcocks, and have found that with some very simple arrangements it is possible to secure a considerable degree of accuracy. Such tubes as are described by Michaelis and Rona[5] are of this category. Speed and convenience in use may be lacking in such forms, however. The Clark apparatus leaves little to be desired in these respects, but its relatively complex construction makes it rather expensive, especially where but few determinations are to be made. This limits its usefulness. In many lines of investigation the great accuracy which may be reached with this and some other forms is not really necessary, in view of the uncertain character of much of the material to be tested. A satisfactory result with less costly apparatus may be desirable.

A simple form of cell which has been used for some work in this laboratory is shown in the figure. It holds about 15 cc. of liquid, but the amount present during the test is about one-third of this, the rest of the space being occupied by the hydrogen. The cell is essentially a large Y tube, with one branch quite narrow. The liquid is admitted at A in the smaller figure and flows out at B. The wide branches of the Y are closed by small rubber stoppers with two holes, the exposed surfaces being covered with melted paraffin. This coating is perfectly satisfactory and can be renewed when the cell is cleaned. Through one of the holes of one of the stoppers a small, glass tube, filled with mercury, passes and this connects with the platinized electrode by means of a platinum wire. The washed hydrogen passes through from D to C, which are very narrow tubes. Small, rubber tubes over these may be closed by pinchcocks, by means

[1] Soerensen, *Biochem. Z.*, 21, 131 (1909); also *Ergebnisse der Physiologie*, 12, 393 (1912).

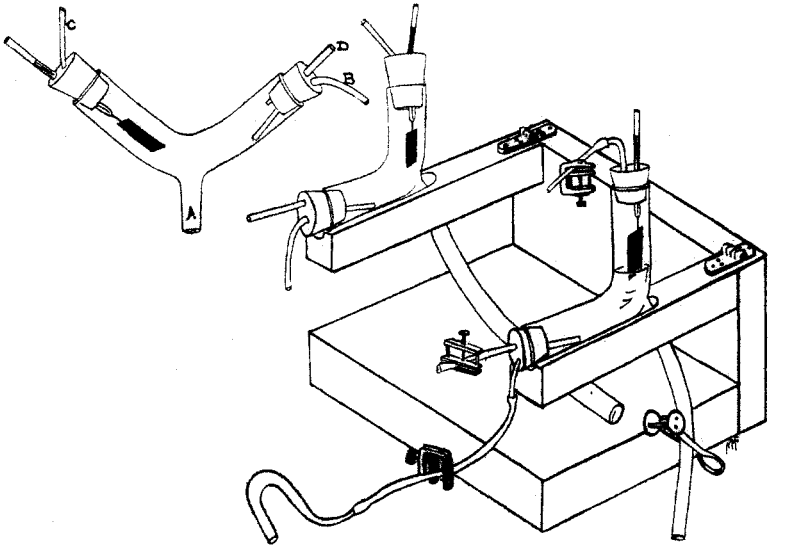
[2] Hasselbalch, *Biochem. Z.*, 30, 317 (1911); 49, 451 (1913).

[3] *Loc. cit.*, 30, 317 (1911).

[4] *J. Biol. Chem.*, 23, 475 (1915).

[5] *Biochem. Z.*, 18, 317 (1909).

of which the flow of the hydrogen may be regulated. The liquid exit tube is connected by means of a capillary tube, extended into a much wider tube, with the bridge intermediary vessel containing 3.5 N KCl and connected in turn with the calomel electrode.



At the right of the figure is shown a pair of such cells mounted in the position for use. They rest on short wooden arms to which they are fastened by rubber bands. These arms are hinged to a strong support which gives stability to the apparatus. By means of the hinge it is possible to incline the arm at any angle and thus regulate the depth to which the platinum is immersed in the liquid. The hydrogen is distributed in the two branches without breaking the liquid connection. The hinge arrangement provides also for the rapid agitation of the liquid and gas mixture. This requires no additional mechanism; raising and dropping the bar by the finger is sufficient.

The apparatus has been tested in comparison with Hasselbalch cells and by the use of liquids of known hydrogen ion concentration. The final results are the same where an accuracy of about 0.5 millivolt is sufficient, and in the readings both the capillary electrometer and a delicate galvanometer have been used. Constant readings are secured in about ten minutes after filling with liquid and hydrogen and agitating. For example, an observation with a mixture of equal volumes of Soerensen's primary and secondary phosphates at 20° gave a π value of 0.7341, from which,

$$P_H = \frac{0.7341 - 0.3379}{0.0582} = 6.808.$$

A normal urine tested at 21° at short intervals gave the following readings after finishing the shaking at 2 hours and 15 minutes:

Readings at.....	2:30	2:34	2:40	2:45	3:07	3:16	3:55
π.....	=0.5988	0.6476	0.6468	0.6475	0.6476	0.6476	0.6479

Constant potential values appear in about ten minutes. Slight compression of the pinchcock on the tube leading to the potassium chloride bridge has about the same effect as closing the glass stopcock in the other forms of apparatus. It is of advantage to insert a plug of washed cotton in the bent tube leading to the potassium chloride.

CHICAGO, ILL.

NEW BOOKS.

Elementos de Fisica Geral (Elements of General Physics). By F. J. SOUSA GOMEZ, Professor in the Faculty of Science in the University of Coimbra, and ALVARA R. MACHADO, Assistant Professor of Physics in the University of Porto. Livraria, Escolar de Cruz & Cie, Braga, Brazil.

As the title page states, this book of some 260 pages is "For use in the Portuguese Lyceums (6th and 7th grades), Gymnasia, and Normal Schools of Brazil."

It is the first part of a larger work, subsequent parts of which will presumably deal with the subjects of heat light, magnetism and electricity.

It differs from most similar works of American origin in the sequence of the arrangement of the subject matter, the order being:

(1) Generalities (28 pages), (2) Mechanics (91 pages), Gravity, not treated under Mechanics, but separately (40 pages), and (4) Properties of matter (100 pages).

The type is excellent as are the cuts, of which a liberal use is made. The treatment of the subjects discussed is distinctly mathematical. It is a book which is calculated to give a diligent student a good grasp of the fundamental laws and phenomena of the branches of physics which it embraces.

W. N. BERKELEY.

Quantitative Laws in Biological Chemistry. By SVANTE ARRHENIUS. London: G. Bell & Sons. 1915. Pp. vii + 173.

This interesting and stimulating book should be in the hands of every biologist, biological chemist and pathologist. It treats of many complex and obscure phenomena of biochemistry in a simple and illuminating fashion, showing how they are to be explained. Arrhenius, as is well known, has emphasized for some time the importance of physical chemistry conceptions in the elucidation of biochemical reactions, and he has made many contributions of value illustrating his point of view. A series of