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A TEST FOR ACCURACY OF THE INSTITUTE'S QUINHYDRONE ELECTRIC HYDROGEN ION APPARATUS

by

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A quinhydrone set manufactured by the W. M. Welch Company was purchased by the Institute for Fisheries Research about 1932. This electric pH set has been used by several members of the Institute staff at various times since purchase and considerable controversy has arisen from time to time as to the accuracy of the recordings. At least twice since purchase, the set has been tested for accuracy and on both occasions was reported to be registering low. It was checked against a similar set belonging to Dr. Gustafson of the University Botany Department and found to be registering low by 0.25. When using the electrodes from his set, this set was found to register favorably. This resulted in the belief that the electrodes were at fault; consequently, a pair of electrodes like those of Dr. Gustafson's set was purchased and at a later date again tested and found to still be registering low by 0.32. The last test conducted was in 1940 and the report was that it registered low by an uncertain amount.

Due to the apparent inaccuracy of this set, it has not been in use for the past few years. In July of 1943 this pH set was checked for accuracy in readings. The procedure and technique used in the testing of this apparatus were as follows: A series of Clark and Lub's buffer mixtures was prepared ranging in pH from 4.8 to 8.2 at intervals of 0.2 to 0.6 and tested by a standardized glass electrode set belonging to the

University Chemistry Department. The actual pH of each solution was recorded. These buffer mixtures were then checked with the Institute's quinhydrone set and the total data are recorded in Table 1.

Table 1

The Results of Tests With the Quinhydrone Electric Hydrogen Ion Set On Standard Buffer Mixtures

Actual pH readings of test solutions	Quinhydrone readings of same test solutions	Difference in readings
4.87	4.864	-.006
5.24	5.304	+.064
5.65	5.663	+.013
5.82	5.833	+.013
6.20	6.241	+.041
6.61	6.598	-.012
6.80	6.836	+.036
7.22	7.227	+.007
7.62	7.669	+.049
8.00	7.975	-.025
8.23	8.196	-.034

From the data in Table 1 it can be seen that the difference in pH recordings between the correct glass electrode set and the quinhydrone are in most instances insignificant. Out of 11 tests, the latter set registered low four times and high seven. The highest recording was at a known pH of 5.24 registering 5.304 or high .064. The lowest recording was taken at a known pH of 8.23 registering 8.196 or a low of .034. The recordings of the remainder buffer mixtures fell within this range. This variation between the two sets can probably be accounted for by making a temperature correction and computing the reading to two decimal places instead of three as these factors were considered in readings of the glass electrode set.

The only difficulty encountered in using this set was experienced in the adjustment of the six ohms rheostat knob; a slight turn would cause

the millivolt meter to fluctuate wildly. There may be some loose connection within the set which is responsible for this abnormal condition. This difficulty was overcome by using the 50 ohms rheostat knob for fine adjustment instead of the six.

In conclusion, this set if properly used will give pH readings well within the accuracy needed in our laboratory work. Care should be taken in the preparation of the potassium acid phthalate solution as the actual pH of this reagent is the basis for computing the hydrogen ion of the unknown test solution. Also, it is essential that the platinum electrodes be kept clean; this can be accomplished by heating them in fresh cleaning solution (sulfuric acid and potassium dichromate mixtures), washing them well in water and thoroughly drying. If the operator follows the directions as given in the folder which was issued with the set, a reliable reading can be expected. It should be remembered, however, that this set should not be used for pH determinations where one is likely to encounter active reducing or oxidizing agents as the reading cannot be relied on as being accurate. Also, the presence of protiens and salts will cause a discrepancy in reading. The approximate pH range for the quinhydrone is from 4.2 to 8.5; beyond this range the readings become unreliable.

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