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NOTE ON THE SYSTEM OF RECORDING RATE OF CHEMICAL REACTION.

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The present method of recording rate of reaction suffers somewhat from lack of directness. Even the chemist familiar with this subject has to pause when he is told that the velocity constant of a reaction is 147×10^{-4}, before he is able to visualize the significance of that information. For this reason the author ventures to make the suggestion that this mathematical value should be replaced by a number which has such direct physical significance that it conveys a mental impression even to those who have not specially familiarized themselves with this subject.

All equations representing rate of reaction may be written in the form—

$$k = \frac{1}{t} \text{ (remainder of the expression)},$$

where k is the present rate constant of the reaction and t is the time the reaction has been going on.

The equation may be written

$$kt = \text{(remainder of the expression)},$$

where k and t appear only as a simple product varying in inverse proportionality to each other from case to case. It is necessary, then, to give, not only the value of k, but also the value of the unit of time. Thus k has to be taken sixty times smaller if hours are used instead of minutes.

The proposal outlined in this note is to set k always equal to unity, and to choose the unit of time accordingly. The equation then simplifies to—

$$t = \text{(remainder of expression)},$$

where k disappears altogether.

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The first difference is that we give up using whole minutes (or seconds, or hours) as the unit of time, and take instead the new time unit necessary to express the rate in this form. The advantage of this is that a single number such as " 3·36 hours " completely records the rate of reaction; whereas the corresponding constant as usually expressed, " $k = 0{\cdot}298$ " has to be supplemented by the information that " time is expressed in hours."

The second and important advantage is that the proposed " unit of time " gives a direct idea of the rate of the reaction. Thus, to quote once more the reaction alluded to in the first paragraph, instead of saying that the inversion of menthone in the presence of N/100 HCl at 20° " has a velocity constant equal to 147×10^{-4} and that the time is expressed in minutes," the proposal is merely to state that " the unit of time for this reaction is 68 minutes " (which is, of course, $1/147 \times 10^{-4}$).

The present rate constant k can be given physical significance by recollecting that if the concentrations of all the reacting substances could be kept up to unity (1 gram. mol per litre) for unit time—perhaps by adding supplies as required—the number of gram. mols of substance reacting would be equal to k.

It appears to me that this is not nearly so direct as the statement that " the time unit is 68 minutes," which means that if the concentration were kept up to unity it would take 68 minutes for one gram. mol of the substance to react.

The arithmetic involved in both cases is the same. The conversion of values hitherto recorded to the new system merely requires that the reciprocal of k be taken and the word " hours " or " days " or " seconds " or " minutes " added. A third incidental advantage of the system now suggested is the avoidance of small decimals. This arises, of course, from the fact that very few rate constants have been recorded for reactions that are all over in less than a minute, and clearly such reactions do not lend themselves to measurement. Consequently nearly all rate constants are small decimals.

In the case of monomolecular reactions the new " unit of time " gives the time required for the reaction to go to the extent of 63·2 per cent. Further, if multiplied by the natural logarithm of 2 (which is 0·693) it gives the time required for the reaction to go half-way.

Owing to military duty the author has not the opportunity of searching the literature in order to ascertain whether the suggestion contained in this note has already been put forward, but he has no recollection of any previous proposal to do away with the rate constant altogether as a method of recording rate of reaction.

BRISTOL UNIVERSITY,

February 18, 1917.