the other of those two semi-circles, but it would seem that there must be other ways in which they could lie within some same semi-circumference.

In the hypothesis that a coin which comes down heads 15 times out of 20 (p. 198) be unbiassed the author considers only one tail of the distribution, *i.e.*, when there are 15 or more heads, but in the succeeding paragraph he seems to imply that we should use both tails. This seems inconsistent, but perhaps it is merely unclear to me. I am likewise troubled by the developments in pages 342–3 and in particular by the formulas 14.45 and 14.49, the former of which contains $\Gamma(n-2)$ in the denominator and the latter is for the special case when $n=2$; as $\Gamma(0)=\infty$ I have had trouble making the transition. The statement of the problem on page 367 seems unfortunately confused.

These criticisms are but trifles; Kendall's book is really a "must" for all who are concerned with advanced statistics.

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PROBLEMS IN PHYSICAL CHEMISTRY

How to Solve Problems in Physical Chemistry. By JOSEPH A. BABOR and GARRETT W. THIESSEN. 215 pages. New York: Thomas Y. Crowell Company. 1944. $1.25.

"How to Solve Problems in Physical Chemistry," by Joseph A. Babor and Garrett W. Thiessen, should prove to be a useful supplementary book for elementary students attempting to attain a working knowledge of physical chemistry. The well-organized and carefully classified sets of problems should prove useful to teachers seeking illustrative examples or graded homework exercises. The book consists of fourteen chapters each pertaining to a specific topic in physical chemistry such as gases, the solid state, thermochemistry, homogeneous equilibrium, chemical kinetics, electrochemistry, etc. The fundamental mathematical formulae pertaining to the topic, several completely worked out illustrative problems and numerous examples with answers are given in each chapter. The presentation is so lucid that the difficulties for the student are reduced to a minimum.

There is always danger that if too heavy emphasis is placed upon the working of stereotyped problems the student tends to lose spontaneity in the tackling of new problems and even tends to solve the problems in a mechanical fashion without fully understanding what is in back of the methods used. The teacher is therefore cautioned to encourage students to use their own initiative in solving problems, using the book as a guide and source of reference rather than as a crutch which when taken away will leave the student limping.

In summary, this small volume should be especially useful as a supplementary text in elementary physical chemistry, particularly for the average student.

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SPECIAL ARTICLES

THE EFFECT OF BIOTIN ON THE METABOLISM OF LIVER SLICES FROM BIOTIN-DEFICIENT RATS

DURING the course of the program of investigation into various phases of the biological significance of biotin which has been in progress in this department for the past few years, opportunity has been afforded us of carrying out *in vitro* studies on the respiratory metabolism of tissues from biotin-deficient animals. Certain of these studies have yielded results of considerable interest which we wish to summarize here.[1]

Specifically, we have found that small amounts of biotin added to slices of biotin-deficient rat liver respiring in Ringer-bicarbonate solution containing either lactate or pyruvate as substrate produce a significant effect on the metabolic processes of the tissue, as evidenced by both chemical and manometric data. The manometric data were obtained with the differential manometer of Summerson,[2] which permits measurement not only of oxygen consumption but also of the respiratory quotient and of bicarbonate decomposition ("acid formation") or, equally well, bicarbonate production. This latter is of particular significance in the present connection.

The nature of the effect of added biotin on the respiratory metabolism of biotin-deficient liver slices is indicated by the data of Table 1, which presents results from a number of experiments typical of the many which have been run. It can be seen that in the presence of lactate, there is usually (but not invariably) a slight rise in both the oxygen consumption and the R.Q. on the addition of biotin, but in neither instance is the change striking.

In every case, however, the presence of added biotin is associated with a marked change in the aerobic Q_G value, the so-called "aerobic glycolysis." This change is always in a negative direction, the Q_G value becoming either less positive or more negative in the presence of biotin. Since conventionally a positive Q_G value represents acid production (bicarbonate decom-

[1] This work was supported in part by grants from The National Cancer Institute.

[2] W. H. Summerson, *Jour. Biol. Chem.*, 131: 579, 1939.