starrings. This is shown in Table 1 of the median age at starring.

TABLE 2

AGE OF THOSE FIRST STARRED IN 1943

	Anatomy	Anthropology	Astronomy	Botany	Chemistry	Geology	Mathematics	Pathology	Physics	Physiology	Psychology	Zoology
Median age	46	48	36	49	43	43	37	52	40	50	41	46
Oldest	65	62	55	65	59	67	78	67	54	59	57	64
Next oldest	58	51	52	62	59	65	56	58	54	58	54	64
Youngest	42	40	29	37	29	32	33	37	32	41	35	35
Next youngest ...	44	41	31	39	33	38	33	42	32	42	37	37

Table 2 gives more details as to the most recently starred group. It reveals that the median ages were lowest in astronomy and mathematics, 36 and 37 respectively. At the other extreme were pathology and physiology with medians of 52 and 50. In five of the sciences a person past sixty-five was starred but in four sciences the next to the oldest person was under 55. The youngest persons starred were an astronomer and a chemist of 29, followed by an astronomer of 31, a geologist and five physicists of 32, three chemists and two physicists of 33. Conversely, in three sciences, the youngest person starred was past forty.

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SCIENTIFIC BOOKS

STATISTICS

The Advanced Theory of Statistics. By MAURICE G. KENDALL. Vol. I. xii + 457 pp. J. B. Lippincott Company, agents. $16.00.

THE title page contains neither date nor place of publication, but the preface is dated 1943 and the publishers are Charles Griffin and Company, who publish the well-known book by Yule recently brought out in a new edition under the joint names of Yule and Kendall.

New statistical theory, though found in large amount in a few specialty journals such as *Biometrika,* the *Journal of the Royal Statistical Society, Metron* and the *Annals of Mathematical Statistics,* is really scattered very widely (for example, the great memoir of R. A. Fisher which started us off on a new line of ideas appeared in the Philosophical Transactions of the Royal Society of London). It is therefore a great convenience that Kendall has brought a large amount of this new and advanced statistical theory together in one place.

As there is no table of contents in the book we may give the titles of the chapters: I. Frequency-distributions. II. Measures of Location and Dispersion. III. Moments and Cumulants. IV. Characteristic Functions. V and VI. Standard Distributions. VII. Probability and Likelihood. VIII. Random Sampling. IX. Standard Errors. X. Exact Sampling Distributions. XI. Approximations to Sampling Distributions. XII. The χ^2 Distribution. XIII. Association and Contingency. XIV. Product-moment Correlation. XV. Partial and Multiple Correlation. XVI. Rank Correlation. Each chapter is arranged on the decimal system and is closed with notes and references. There is an excellent detailed index.

The book is therefore not only a treatise for study and reference but an indication for further more detailed study by following up the references to the literature. If the reader desires to try his hand at exercises there are plenty in true English style, some easy and some so hard he will probably have recourse to the original source cited for help. Although many who work with statistics will find much of the book quite beyond them, the author states his results succinctly and many who stop not for the proofs will use the results.

There are of course a few points I consider bad among so many good ones. I do not like the old statements that leptokurtic curves are sharply peaked and platykurtic ones flat-topped relative to the normal curve (p. 82) because I have never been able to appreciate in what way an isosceles triangle is flatter-topped or less sharply peaked than the normal curve —and for other reasons. I do not like the suggestion (p. 53) that it is a matter of convention whether we consider that a frequency function has a mean when the "principal value" of $\int xf dx$ is finite though $\int |x| f dx$ diverges, or the similar suggestion (p. 145) that there is nothing sinister about heterotypic frequency functions; for from the point of view of the sampling theory the mean in the first case and some at least of the parameters in the second have infinite standard deviations and are thus statistically indeterminate.

I note that the name of C. S. Peirce does not occur in the index nor, so far as I have observed, in the text, despite the importance of his ideas on chance and statistics. I do not like the phraseology (p. 166) "certainty that a proposition is not true is represented by zero"—it is all right, I suppose, but somehow it sounds queer. Then on page 184 it is offered as an exercise to prove that the probability is $\frac{1}{4}$ that three points taken at random on a circle lie on the same semi-circle; if the circle is divided by a given diameter the probability is $\frac{1}{4}$ that the three points lie on one or

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.