is divided into three main sections in which the author discusses the general properties of dislocations, the behavior of dislocation networks, and the interaction of dislocations with other defects. A most valuable addition, and one that immediately establishes the physical reality of the subject, is the inclusion in the first chapter of some excellent photographs of optical, electron microscope, and x-ray observations of dislocations. With the aid of this visual advantage, the subsequent chapters seem to describe reality well. The author's style has not suffered in the translation, the fluency of the French version being retained, and this retention makes the book valuable both as a reference work and one that could be used as an advanced textbook. Its value as a source book is increased by lists of colloquia, books, and review papers published in the field, together with a most comprehensive set of references to the original papers cited in the text. Anyone who wishes to understand dislocations will find this list a more than adequate introduction to the field.

In summary, the book fills a place too long vacant in the literature of the solid state, and provides a very adequate introduction and a stimulus to further endeavor in an area that is fundamental to our understanding of the behavior of real solids.

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Statistics

Statistics for Scientists and Engineers. R. Lowell Wine. Prentice-Hall, Englewood Cliffs, N.J., 1964. xvi + 671 pp. Illus. $12.

The title means "an introduction to standard statistics for undergraduate (or first-year graduate) students in science and engineering." In the preface we read that "There are good statistical books for research workers in science and engineering, but generally speaking they are not very useful as a first introduction to statistics." It is not made clear why the author believes this. There are now at least 25 textbooks in English that cover the same ground that this one covers, for students with the same preparation and interests. Some of these start at more elementary levels, some at more advanced levels. There is a high degree of accord on what should be included. All agree that the field of statistics is growing rapidly, yet all have very nearly the same content, presented in very nearly the same order.

There is some pedagogical innovation in the present text in that applications of elementary statistical methods are occasionally given before the presentation of "theory." This is excellent. Many sections end with good sets of exercises, and many of these deal with real life situations. But the author's interests are mainly mathematical, and mostly arithmetical and algebraical. He is not concerned, or not concerned enough, with the actual *fitting* of the mathematical model to the physical situation.

The well-known *t*-test for judging the reality of a single comparison is discussed in 40 pages (in this case a new rat diet tried on 12 rats is compared with a standard diet). But the student scientist or engineer is not told which are the key assumptions for its valid use. The author writes, "Assume that the twelve sample values were independently obtained from the same normal population." There is no hint that normality is unimportant but that independence is crucial. There is no discussion of, or warning about, the extreme technical difficulty of guaranteeing that the data are indeed a fair sample of the population about which inferences are to be made. Without this guarantee the *t*-test becomes an exercise in arithmetic; its so-called significance level, meaningless. The principle of randomization, judged by many to be one of modern statistics' major contributions to scientific methods, is mentioned only incidentally in later chapters.

The largest and best problem in the text concerns a four-factor experiment, one factor being at three levels, the others at two each. The whole set of 24 experimental conditions was produced three times. The effects of deliberate variation in the proportions of *cement, water, type of water* (tap or sea water), and *thickness of concrete test strip* on the rate of corrosion of an embedded steel ribbon were measured. The usual "analysis of variance" is carried through to conclude mainly that embedded steel corrodes more rapidly when seawater is used in making the surrounding concrete! Four other minor and rather complex findings are stated to be significant at or near the level of 1 percent, and *are then not interpreted.* The interested reader is invited to study the tables himself. If the statistician had studied these tables before rushing into arithmetical routines, he might have noticed that a combined analysis is not justified since the pattern of the tap water responses (with error about 1000) is quite different from that of the seawater results (with error about 5000). There are, furthermore, three tap water values that one might want to discuss with the experimenter, since they appear to show large *negative* rates of corrosion! Otherwise a simple interpretation of the two sets of results seems entirely manageable. It is difficult to see how the analysis given will deepen the engineer's understanding of the physical situation.

The general adverse comments made here should not be taken as applying only to this text. They apply to many others. But this work does not distinguish itself from the mass of its competitors in the way it handles, and ignores, the problems of getting generalizable data, of checking the key assumptions behind the statistical tests used, and of interpreting the statistical judgments made.

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Phosphorus Compounds

Topics in Phosphorus Chemistry. vol. 1. Martin Grayson and Edward J. Griffith, Eds. Interscience (Wiley), New York, 1964. viii + 262 pp. Illus. $12.

This volume, the first of a new series, endeavors to summarize and survey some relatively defined subareas in the field of the chemistry of phosphorus compounds. In the words of the editors, "no fixed pattern has been established" for the series.

Volume 1 deals with five topics: synthesis of organophosphorus compounds from elemental phosphorus, nucleophilic displacements by organometallic compounds on phosphorus halides and esters, the Michaelis-Arbuzov and related reactions, the lower oxo acids of phosphorus and their salts, and, finally, the condensed phosphates containing other oxo acid anions. Thus, the division between organic and inorganic derivatives is very nearly balanced.

The first chapter gives a clearly drawn, largely descriptive picture of

the present literature applicable to synthesis of a variety of organophosphorus compounds from various forms of the element. No specific experimental details are provided, however, and it is necessary in many cases to go back to the original papers for an adequate presentation of the necessary conditions and similar details. Although the coverage of the literature is, on the whole, quite adequate, I noted some omissions. For example, in discussing the reaction products of phenol with phosphorus in the presence of water, the author fails to mention the isolation of an appreciable amount of triphenyl phosphate, with but minor amounts of phosphines, in reactions run under a set of certain conditions, a result that has been reported by Soviet workers. Because such a product has a distinctly practical possibility, this omission is relatively serious. The mode of nomenclature is somewhat uncertain in spots. On page 13 the author mentions the formation of tri-*n*-butyl trithiophosphite, a name not in accord with the presently accepted nomenclature used by our journals and by *Chemical Abstracts*.

The chapter on organometallic displacements on phosphorus presents a large body of material that has come into being in the past 15 years and, in a workmanlike fashion, covers some reactions related to such displacements. However, the authors' predilection for tagging various compounds with arabic numerals, a rather confusing style which also makes the reading less enjoyable, is, in my opinion, quite unnecessary in a publication of this length. The chapter is largely descriptive, quite complete in coverage, and useful as a literature compilation through about 1962.

The chapter on the Michaelis-Arbuzov reaction and its related topics is the best in this volume. It presents both the theory and the practice of this reaction with literature compilation through part of 1963. Some very recent work is missing, but this must be expected in a book. A wide range of reactions, many of them useful to the "ordinary" organic chemist, are provided in this chapter, which can be read with profit by anyone interested in modern organic chemistry.

The chapter on the lower oxo acids of phosphorus deals with the very difficult chemistry of condensed acids of phosphorus in the lower states of oxidation, a quite new area of phosphorus chemistry in which changes occur almost daily. The chapter is quite easy to read owing to the use of the relatively simple Blaser-Worms system of notation, of which an adequate description is given. The chapter, which is largely descriptive (as one would expect in view of the present state of the art) gives a vast amount of data from various physical and chemical measurements used in the exploration of these fascinating substances. The bibliography even includes one reference dated 1964. The entire topic is really only 5 or 6 years old; thus, the size of this chapter is a good index of the proliferation of research in this area.

The final chapter, which deals with condensed phosphates that contain links of silicon, sulfur, vanadium, and arsenic, is quite similar to the preceding chapter in its general approach. It is largely descriptive of groups of substances that have been prepared and recognized properly within the past 5 years.

On the whole this volume is a welcome addition to the literature on phosphorus chemistry. The book is well made and, although relatively expensive, should be welcome on the desk of any chemist who is interested in phosphorus chemistry. Since forthcoming volumes are indicated, one can expect a wider range of topics to be covered, although this will require a truly monumental amount of space at this time. Future volumes might provide condensed tables of compounds, for in a literature search such tables would allow one to quickly locate specific compounds. The tables could be included in each chapter.

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Keplerian Motion

Fundamentals of Orbital Mechanics. D. A. Pogorelov. Translated from the Russian edition (Moscow, 1961) by Morris Friedman. Julius J. Brandstatter, Translation Ed. Holden-Day, San Francisco, 1964. viii + 112 pp. Illus. Paper, $5.

Numerous equations for all five types of Keplerian motion—rectilinear, elliptic, circular, parabolic, and hyperbolic—are derived in this book, with a minimum of advanced mathematics. The first half of the book deals with flight velocity, altitude, range, and duration. Maximum range trajectories and minimum energy trajectories take up the third quarter of the book. The last quarter is devoted to the effects of injection errors and includes many explicit formulas for the relevant partial derivatives.

Solar and lunar perturbations and the effects of the earth's oblateness are not discussed, even though a book entitled *Fundamentals of Orbital Mechanics* can certainly be expected to cover them. But the fault is not the author's, for an accurate translation of the Russian title would include the words "Theory of Keplerian Motion." Without the word "Keplerian," the English title is misleading.

Nor is the English rendering of the text altogether happy. Some technical terms are translated literally, irrespective of the technical context: For example, the word *zavisimost'*, which occurs many times, is translated as *dependence*, although in mathematics it usually means *equation*; the term *kinetic heskii moment* is translated as *kinetic moment* rather than *angular momentum*. Sometimes the Russian text is misunderstood: For example, on page 28 the translation reads "seems to be indeterminate" instead of "proves to be indeterminate"; on page 87 the Russian word for "somewhat" is translated as "somewhere," leading to the curious statement that "we explained somewhere above," although the author meant something like "we explained a little earlier." There is also some awkward English usage: For example, on page 9 we learn that a certain constant has a certain numerical value "according to the data of many works"; on page 64 we "rewrite the obtained expression"; and on page 75 we "determine the mentioned angular range."

In short, although the Russian original is an unpretentious and patient exposition of idealized orbital motions, the English translation of the title suggests a much wider scope than that, and the translation of the text is careless.

In a book with so many equations, misprints are practically unavoidable. But, since Pogorelov's derivations are so detailed, a careful reader should have little difficulty in correcting the misprints in the translation, such as the unwanted vector arrows in Equation (2.3).

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