Book Reviews

On Standards for Textbooks

Modern Microbiology. Wayne W. Umbreit. Freeman, San Francisco, Calif., 1962. viii + 507 pp. Illus. $8.50.

Familiarity with Oginsky and Umbreit's *Introduction to Bacterial Physiology* (Freeman, 1954, ed. 2, 1959), and the deservedly high reputation of the publisher, had led me to expect that *Modern Microbiology* would be a sound and well-written textbook. Unfortunately, a careful study has convinced me that it is not.

When Starr reviewed Thimann's *Life of Bacteria* for *Science* [**126**, 455 (1957)], he related the excellence of the book to its long gestation period: 15 years. By contrast, Umbreit's text must have been written in a hurry; I cannot otherwise account for the utter carelessness with which facts and concepts have been presented. So numerous are the examples of bad grammar and phraseology, of factual errors, and of poor reasoning that about one-third of the pages in my copy now bear marks, often more than one to a page, to this effect.

After the reader has been told on the first page that "a single organism is a bacteri*um*; a group are bacteri*a*," it is shocking to find that plural nouns (bacteria, media, data, phenomena, protozoa, hyphae, and others) are so often followed by a verb in the singular. Nor can I excuse expressions such as: "the death curves . . . are S-shaped with log"; "more media is supplied so that the organism is always at this turbidity"; "waters possessing other environments"; "sometimes we are unable to know whether such atoms are organic or inorganic"; "bacteria can grow only as fast as the media enters"; "sauerkraut consists of a fermentation of cabbage"; "quantities of a high carbohydrate"; "most media, test tubes, . . . all use steam"; *Clostridium botulinum* "types B and C are mostly animal diseases," to mention but a few passages picked at random.

Among the many errors is the claim that "a bacterium can be seen only when one uses a microscope that magnifies by 500 to 1000 diameters." This leads to the argument that Leeuwenhoek, with his simple microscopes, magnifying 200 to 300 ×, could not have seen bacteria without using a special and secret method of observation. But the claim is flatly contradicted by the photomicrographs of bacteria, published some 30 years ago by Barnett Cohen, Kingma Boltjes, and van Cittert, which were made with extant Leeuwenhoek microscopes or comparable instruments, magnifying no more, and without special tricks. The hemocytometer is described as ruled in squares "1/20 cm on the side"; subsequently the area of the squares is given as 25 mm^2. Every hemocytometer I have seen is ruled so that the (smallest) squares, like those of a bacterial counting chamber, measure 0.05 × 0.05 mm; the difference between the two is that the distance between cover glass and slide is 0.1 mm (not *cm*, as Umbreit states) in the former, and 0.02 mm in the latter. Figure 2-20 correctly shows this depth; but the text mentions 0.01 mm, and refers to the figure as that of a hemocytometer. Based on the dimensions of 0.05 × 0.05 × 0.01 mm, Umbreit computes the volume of a "box" of the bacterial counting chamber as 2.5×10^{-7} ml, which is off by a factor of 10.

Veldkamp's photograph of a culture plate showing agar decomposition is reproduced in Fig. 5-3 as demonstrating starch hydrolysis; Wolfe's photomicrographs illustrating locomotion of *Beggiatoa* filaments, included as Fig. 15-11, are alleged to show this bacterium *growing* at the rate of 20 μ in 6.5 seconds, which would imply a generation time of about 2 seconds, so that a single cell should produce nearly 10^9 offspring per minute! It is incomprehensible that Umbreit failed to note the absurdity of this consequence. Similarly, the legend to Fig. 28-2, showing electron micrographs of bacteriophages, asserts that the lines in the pictures represent 0.5 μ; if this were true, the phage heads should be readily observable by ordinary microscopy. The section on Beggiatoales contains the statement that "multiplication in most is by transverse rather than binary fission"; myxobacteria are described as having a plasmodium; and the microcysts (called sporoids) as "not [looking] like spores of bacteria, see photograph Fig. 18-7." But the latter is a picture of a noncystforming *Cytophaga*, accompanied by the information that "The round bodies are not sporoids but involution forms." How, then, can it be used to illustrate the morphology of the "sporoids"?

It is stated that "if yeast juices were given pyruvic acid they would make ethyl alcohol and CO_2"; but pyruvate yields acetaldehyde, not ethanol. "Zwischenferment," the apoenzyme of glucose-phosphate dehydrogenase, is characterized as "the enzyme between ('zwischen') $DPNH_2$ (or $TPNH_2$) and the respiratory enzyme," and "turned out to be" a flavoprotein. The formula of muramic acid (Fig. 3-10) contains two pentavalent C-atoms; and the streptidine ring depicted in Fig. 14-13, with presumably four trivalent H-atoms, is "a curious structural ring" indeed.

From the start, the kind of reasoning that disturbs me, and characterizes much of the book, is apparent from the defense of the verdict that bacteria "are plants." This is discussed as a problem of fundamental importance ("really the heart of the matter"), and, although some reasons are mentioned why dissident views have been expressed, the argument lamely concludes "for our purpose, since the older definitions had plants, we will retain this word." Similarly, the demarcation of various orders of bacteria from the Eubacteriales is introduced by the flat assertion: "If an organism possesses anything else, for example, chlorophyll, or if it reproduces in some other fashion, but is otherwise related to the bacteria, we shall call it a 'higher bacteria'."

The account of simultaneous adaptation for the study of sequential metabolic events contains errors in fact and suggests a lack of comprehension of the principle involved; it is impossible to follow the development and to appreciate the value of the method.

A few other examples of poor reasoning may be quoted: "There is one spore per cell, hence it is called an endospore (within the cell)"; "We determine the dilution of the chemical (not its concentration, but its dilution)"; "Microbiology is the study of any organism one may see with a microscope. Unicellular algae and protozoa come within its ken, as indeed they do, if only superficially"; "The single cells of yeasts might be regarded as a septate mycelium, if they formed mycelium"; "organisms were discovered, early in bacteriology, which did show branching with considerable regularity; so often indeed that it could not be regarded as inadequate cell wall"; "These [the Corynebacteria] formed club-shaped cells, and their mode of division was uncertain; certainly it was some modification of binary fission."

It seems unnecessary further to document my conclusion that the book exhibits such a disregard for the requirements of a textbook that it can only be hoped few students will be exposed to it. One may make allowances for careless writing in an examination paper, prepared under stress; but I cannot condone it in a book intended for the instruction of students. It is an acknowledged fact that many American students have great difficulty in expressing themselves clearly and correctly; and this regrettable situation can be improved only if their mentors set an example. As such, *Modern Microbiology* fails to achieve an acceptable standard.

C. B. VAN NIEL
Hopkins Marine Station, Pacific Grove, California

Applications of Formulas

Collection of Problems in Physical Chemistry. Jiri Bares, Cestmir Cerny, Vojtech Fried, and Jiri Pick. Translated by Helena Watney. Pergamon, London; Addison-Wesley, Reading, Mass., 1962. xviii + 608 pp. Illus. $9.75.

Problem solving is one of the most effective aids available both to those who are trying to learn physical chemistry and to those who need to regain their grasp of the subject. Theoretical knowledge acquired from textbooks and from lectures can, with problems, be put to a practical test. Not only does the student learn to use what he knows, but if the problems are good ones, he also deepens and refines his understanding of the basic principles.

Two kinds of problems are useful in this connection. The first requires the student to recall or to modify an appropriate formula and then to substitute numbers correctly into that formula. This would appear to be a rather trivial educational exercise; but it is important that students be able to do it, and many students seem to require some exposure to it. Furthermore, this is likely to be the kind of problem that many students will have to deal with in later life—they may have to correct boiling points for changes in barometric pressure, to estimate molecular weights from freezing-point depressions, and to estimate the heat capacity of a diatomic gas at the elevated temperature of a rocket-engine exhaust. But a second kind of problem is pedagogically far more effective. Here the student is confronted with an unusual and complex situation that forces him to review the derivations of his formulas, to be sure of where they are valid, and to inquire more deeply into the meanings of the concepts of physical chemistry. Such problems can be regarded as minor mental research projects in which the student explores for himself somewhat beyond the limits of what he has been taught.

The book by Bares, Cerny, Fried, and Pick is an unusually extensive and comprehensive collection of problems of the formula-substitution type. All aspects of physical chemistry are considered—atomic and kinetic theory, basic thermodynamics, the states of matter, phase equilibria and chemical equilibria, electrochemistry, reaction kinetics, surface and colloid chemistry, and the estimation of physical properties from molecular structure. Approximately 200 sample problems, usually employing data from original papers, are worked out in full detail. More than 400 additional problems are presented, with answers only, for the student to try on his own. On the whole, the problems are straightforward—one calculates the diameter of a molecule from the gas viscosity, the heat of reaction at 1000°C from heats of formation at room temperature and empirical heat capacity equations, the partial molal volume of sodium chloride from an empirical volume-molality equation, the entropy of hydrogen sulfide from the molecular moments of inertia and vibration frequencies, and so on. Some of the problems are very easy, perhaps serving the useful purpose of giving confidence to weaker students. Others require varying intensities of cogitation. Rarely, if ever, does one see anything that entails the sophistication or the careful consideration of the meanings of concepts required by some of the problems in Moore's *Physical Chemistry*, which, admittedly, is exceptional in this respect. There is a 47-page appendix that contains a number of useful tables, and tucked into a pocket are three charts that show with some precision how compressibility factors, fugacities, and expansion factors vary with reduced pressure and temperature.

In the foreword the authors state that they have tried to give "as comprehensive a survey of physical chemistry as possible." They have been successful to a considerable degree and have produced a book of value to teachers and students. Perhaps even more particularly this book may be useful to those who need to brush up on the applications of half-forgotten formulas.

WALTER KAUZMANN
Department of Chemistry, Princeton University

Christmas Lectures

The Unseen World. René Dubos. Rockefeller Institute Press and Oxford University Press, New York, 1962. viii + 112 pp. Illus. $4.75.

In 1825 Michael Faraday was made director of the laboratory of the Royal Institution of Great Britain. One of his early official acts was to inaugurate a series of lectures, the "Christmas Course of Lectures Adapted to a Juvenile Auditory," whose success established a custom perpetuated by the Royal Institution. Inspired by this tradition, the Rockefeller Institute has begun Christmas Lectures of its own. The first series, in 1959, was delivered by René Dubos, who was chosen by reason of the similarity of his talents to those of Faraday. *The Unseen World* is a beautifully printed and illustrated retelling of Dubos's lectures.

The invisible universe to which the title alludes is that of microorganisms. Dubos's account of its exploration is a small but incredibly rich and luminous verbal tapestry: a fabric compounded of biography, factual and theoretical biology, methodological observations, and philosophical reflections. As I read it, I tried to summarize its contents, but without success. Finally, on page 104, I came with great relief to the author's admission that he was not able to do so, either.

What may be said is that the author's