biology 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

lectures may be read with utmost profit. His style is utterly transparent and completely without artifice. The range and depth of his observations cannot fail to move his readers. His pages glow with wisdom and humanitarianism. He and his sponsors and publishers are to be congratulated upon the production of what can only be called a lovely book.

JOHN R. GREGG
Zoology Department, Duke University

Milner Revised

Sedimentary Petrography. vol. 1, *Methods in Sedimentary Petrography* (643 pp.); vol. 2, *Principles and Applications* (715 pp.). Henry B. Milner. Allen and Unwin, London; Macmillan, New York, ed. 4, 1962. Illus. $35.

Forty years and three editions later, a slim volume of 125 pages has grown into two volumes of 1358 pages. Although this fourth edition has a dozen contributing authors, old friends will continue to call it *Milner*.

Milner has done most of my work for me. In his preface he describes the contents, chapter by chapter, tells us what is retained as well as what is new, and introduces the contributors.

Almost all of the first volume, *Methods in Sedimentary Petrography*, is new or completely rewritten and enlarged. For example, chapter 6 (19 pages in 1940) has grown into eight chapters (266 pages) the last of which is entitled "Nuclear methods in mineral and rock analysis." A chapter on the theory and application of statistical methods to specific problems closes the volume.

Let me stress that this volume on "methods" should be useful in many fields other than, or in addition to, geology. Just one example (p. 137) is the use of air elutriation for particle-size analysis of cement and of flour.

About half of the second volume, *Principles and Applications*, is devoted to the identification and description of minerals and rocks and, to a limited extent, to the interpretation of these data. No major change has been made in this material since the third edition (1940). Much of the rest of the volume is given to important new chapters on clay minerals and on soils, each with its own impressive bibliography, and to a final chapter on asphalts, slags, ceramics, fillers, and other esoteric substances, many of them industrial raw materials and products.

In his preface Milner explains why the material in chapters 4, 5, and 6 has been retained pretty much as it was. This section, some 85 pages, deals with such fundamental problems as correlation and paleogeography, and this ever-demanding reviewer wishes Milner had provided an entirely new version, even if that were to mean another volume and a thousand pages more! But much of the literature (up to about 1957) which would have been used in this rewriting can be found in the final bibliography of some 1600 titles.

For geologists not familiar with the earlier editions, it should be restated that Milner's book is aimed principally at techniques, methods, and economic applications. It avowedly does not devote much space to theory, origins, and processes, fields in which Pettijohn's *Sedimentary Rocks* (1957) is particularly strong. The two books complement each other.

Nongeologists working in research, engineering, and industry should find Milner useful in ways far beyond my power to imagine.

LINCOLN DRYDEN
Department of Geology,
Bryn Mawr College

Resources of the Sea

Meeresprodukte. Ein Handwörterbuch der marinen Rohstoffe. Ferdinand Pax. Borntraeger, Berlin, Germany, 1962. xii + 459 pp. Illus. DM. 78.

Since the last edition of Tressler's *Marine Products of Commerce* there has been no general handbook for ready reference on the commercial and applied resources of the sea. This encyclopedia will partially fill the need.

Mineral products are less adequately covered than biological products, and although there are short entries on sodium, potassium, magnesium, bromine, and iodine, one looks in vain for gold or manganese nodules. Fossil resources from below the sea—such as amber, sulfur, and petroleum—are likewise neglected. And only one column refers to perhaps the most important marine resource—the inexhaustible supply of fresh water that eventually will be retrieved from seawater. However, the animals range from Aal (eel) to Zwergwal (little piked whale) and the plant materials from Agar-agar to Zelex (a commercial dental impression material derived from alginates).

There is good coverage of individual genera of both plants and animals, from *Acipenser* and *Alaria* to *Zeus* and *Zostera*. There are fascinating articles on palolo worms, sea-silk, "Thallasotherapie," Tyrian purple, wampum (Molluskengeld"), and molluscs used as symbols and magical materials ("Zaubermittel"). Kombu, nori, and dulse are there, though Limu is not. Ambergris is pictured (in a 417-kg lump), and so is precious coral.

Amongst the commercial biological products, certain shellfish are very well covered: thus mussels have 16 pages, and oysters 26, while lobsters have but 4 pages, langouste 2, and crabs a bit over 1. Fishes as a group have only 8 pages (of which a third is illustration), but various commercially important fishes have the following coverage: cod, 1 page; herring, 1½; mackerel, 1; menhaden, 1; sardine, 2; sturgeon, 1; and tuna, 1. On the other hand, trepang (*bêche de mer*) gets 2½ pages (including a picture of canned trepang in piquant tomato sauce!) and caviar 2 pages. Pearls rate 12 pages and Perlmutter 6 (compared with ½ page for potash).

There is abundant reference to seals and sea lions, sponges, squid, sepia, octopuses, and whales. Strangely, however, elasmobranchs and sharks escape the index, though *Ecklonia* and eelgrass, *Eledone* and elephant's ear, shad and sheepshead, shrimp and sild, and even skate and *Raja* are all there in the multilingual entries. One must be a good enough ichthyologist or linguist to look up nurse, hammerhead, basking, and other sharks as such; there is not even a German entry for *Hai*. Shark fins (*Haifischflossen*) are discussed, but shark-liver oil appears only briefly under fish-liver oil.

However, despite such discrepancies, the book should be useful. The German is fairly simple, equivalents are often given in eight or ten languages, and despite some omissions, the entries are generally indexed in these languages as well as in German.

L. R. BLINKS
Hopkins Marine Station,
Stanford University