to follow them. Further, there are excellent sets of problems at the ends of the chapters and many of these problems contain answers, a pedagogical technique of which I approve. This book also has excellent drawings, graphs, and tables to illustrate the points made in the text. However, one criticism of the book's format is that the margins are unnecessarily large. Some publishers have purposely used wide margins so that notes about points to be stressed could be placed in the margin, a technique that has some merit. However, the margins in this book are practically unused.

Because the chapters are long and complex in the main, the authors have attempted to make subdivisions within the chapters by the use of frequent subject headings—an excellent technique. Although the paper stock is not so good as that used in the McLellan book, the binding is far superior. In my opinion this book should be seriously considered for use in advanced level general chemistry courses for especially selected groups of students whose backgrounds in mathematics, physics, and chemistry are significantly stronger than those of the average college freshman of 1966.

I am pleased to note that more well-written and stronger general chemistry texts have been appearing in recent years than ever before.

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Drugs and Enzymes (Pergamon, New York, 1965. 516 pp., $15), edited by Bernard B. Brodie and James R. Gillette, presents a valuable record of symposia held in 1963. The discussions by many of the speakers, most of them world reknown authorities, were so filled with solid facts and sound speculations that much of the volume is stimulating reading today; and it is also an important reference for research workers, graduate students, and teachers, despite subsequent research in most of the areas. A thorough reading should greatly increase the sophistication of the approach with which the pharmacologist attempts to relate his observations to possible cause and effect involvement of enzymes.

The first section contains 20 papers on the relationship between biochemical effects of drugs in vitro and their pharmacological action in vivo. Brodie's introduction points up important considerations not recognized in the past and not always clear to investigators today. However, it does not make clear that tentative proposals about where a drug may act are determined to a significant degree by the methods of study available or being used at any given time. The net influences of reversible binding are considered in great detail by Gillette, some in detail unnecessary for the more sophisticated but perhaps important for neophytes. McIlwain's discussion of ion movements in the nervous system seems dated, but Repke provides an excellent discussion of the cardiac glycosides and membrane ATPase. Greengaard and Giacobini give valuable reports on the relation of metabolism to activity in nerve tissue. Bacq and Liebecq present a long and complete consideration of radio-protective materials. Spector summarizes the ramifications that result from monoamine oxidase inhibition. The detailed analysis of carbonic anhydrase inhibitors (by Wirz, Maren, and Wistrand) illustrates clearly the depth of understanding we must have before we can with certainty ascribe physiological effects to an observed effect on an enzyme.

The second section contains an important and timely series of 21 discussions on biochemical mechanisms of drug toxicity. Kalow and Netter discuss the rapid increase in our appreciation of hereditary factors in individual variation and what it does to the "normal distribution" and "average dose," while Fouts, Conney, and Remmer present an extensive discussion of the adaptive changes in drug metabolizing systems and how they affect individual responses. Axelrod, Adler, and Williams thoroughly cover the conversion of substances to active drugs and to more toxic products. The papers by Horning, Poggi, and Heimberg give an extremely valuable summary of the mechanisms by which CCl_4 and certain other substances influence liver lipids. This work has added significantly to our knowledge of normal lipid transport processes. The cumulative effects of reserpine on the pituitary-adrenal system, drugs causing porphyria, and a very detailed discussion of photosensitivity to drugs are also included. The great problem in determining the biochemical mechanism when a drug such as thalidomide is converted to 12 metabolic products is carefully outlined by Faigle and his co-workers.

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Marine Sediments

Chemical Oceanography, vol. 2 (Academic Press, New York, 1965. 524 pp.), edited by J. P. Riley and G. Skirrow, deals mainly with marine sediments, a field with many unsolved problems. The first volume was concerned with sea water and its chemical interactions with marine organisms.

It is only recently that sediment cores have become available from any considerable part of the ocean and that one could begin to get an idea of the main mineral phases present. Systematic studies of separated phases are badly needed, among other things for checking the hypothesis—too recent even to have been mentioned in the present volume—that fine-grained silicates are important for determining the composition of ocean water.

Carbonates may behave quite well when studied one by one in the laboratory, but in sea water their equilibration is slow, and available equilibrium data are uncertain.

It is good to note that the various contributors to *Chemical Oceanography* aim to survey the facts that are known, and those that await explanation, rather than to advocate some pet theory of the author. Thus, the volumes may retain their value for many years to come.

In chapter 14, Ph. H. Kuenen briefly describes the geological conditions of sedimentation. R. Chester (chap. 15) tells *how* elements are distributed over various types of sediments. It is a challenge to inorganic chemists to explain *why*. K. K. Turekian (chap. 16) discusses a number of specific minerals, and age determinations for sediments. He asks this important question: Why are there not more sediments?

P. E. Cloud, in chapter 17, on carbonates, asks why dolomite does not form in the oceans, in spite of equilibrium data that would favor it (I feel the equilibrium data are wrong). Cloud gives an interesting survey of biological and inorganic precipitation and dissolution of calcium carbonate; one must ask why different organisms prefer to use different types of carbonate, and what the equilibria of calcium-magnesium carbonates with sea water are really like.

H. Borchert deals with the formation of marine sedimentary iron ores (chap. 18) and of oceanic salt deposits (chap. 19) and gives the inorganic chemist food for thought. Borchert treats very competently the salt deposits in Germany and various theories on their origin. One might, perhaps, have liked to see a comparison with present-day salt deposits in the Dead Sea, in Kara-Bogaz, and perhaps in some other salt lakes. Even if they are not "oceanic," they may be similar enough to be interesting.

G. D. Nicholls' chapter on the geochemical history of the ocean may need more revision than any other as our understanding of the past develops.

J. P. Riley (chap. 21) discusses the analytical chemistry of sea water. Every chemist and geochemist must be kept aware of the importance of good analytical work. Many difficulties are inherent in the analysis of sea water: marine life changes its composition even after sampling, trace elements are precipitated or adsorbed in the vessels, carbon dioxide and other gases may be lost. Determinations of minor elements are really difficult, and even a seemingly standardized procedure like the Winkler titration for oxygen may get out of control. (A Scandinavian chemist, looking at page 310, may ask why analytical chemists in other countries cling to use of the $\Delta E/\Delta V$ method for finding equivalence points rather than the much more accurate linear Gran functions.)

J. D. Burton (chap. 22) discusses the use of radioactive nuclides: long-lived nuclides, cosmic-radiation produced nuclides, and "artificially produced" (that is, bomb-produced) nuclides. Among other things one learns that the hydrogen bombs, in addition to making a muddle of future radiocarbon datings, may have left some useful tracers for the study of water movement in the ocean.

This treatise is perhaps not one that every reader should read from the first page to the last. However, each chapter is inspiring reading in its own way, because each points to many unsolved problems in oceanic chemistry. One must hope that *Chemical Oceanography* will be read, not only by those who are already devoted to various branches of ocean chemistry, but also by a fair number of other chemists, that it will interest them in some chemical problems of the ocean. The number of independent research workers in ocean chemistry is still so small that a fresh impulse from other branches of chemistry would be most welcome.

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Titanium Metallurgy in the U.S.S.R.

Hydrogen is a ubiquitous impurity that plagues metals and metallurgists with impartiality, whether they be Americans or Russians. The now flourishing titanium industry in the United States was almost sunk before it was well afloat by a rash of hydrogen-induced titanium failures during the years 1954 to 1956. From 1955 to 1960 a tremendous effort was made in the United States to learn how to measure, control, and remove hydrogen in commercial titanium alloys. At the same time, a considerable scientific effort was made to understand the mechanism whereby hydrogen did its dirty work of embrittling otherwise perfectly useful titanium products.

It is of considerable interest to review the paralleled Russian effort in the same field in this recently published book, **Hydrogen in Titanium** (Israel Program for Scientific Translations, Jerusalem; Davey, New York, 1965. 208 pp., $10.25), by V. A. Livanov, A. A. Bukhanova, and B. A. Kolachev. The book was translated from the Russian edition (Moscow, 1962) by A. Aladjem. It is apparent that the Russians have followed very closely our considerable research and development effort in the field, for that effort is reported faithfully and accurately in the book. It is also apparent that the Russian effort was phased sufficiently far behind the American effort for them to avoid some of our painful experiences.

Hydrogen in Titanium begins with an interesting review of titanium metallurgy and the status of titanium alloys in America and Russia. This section is independent of the hydrogen embrittlement problem. In general, the Russian titanium alloys follow the American and English alloy types, in some cases covering identical compositions. Presumably, an advantage of this procedure would be that it allowed them to take better advantage of the voluminous Western information on these alloys. An interesting exception is greater Soviet emphasis on chromium as an alloying element. The thermal instability associated with precipitation of titanium dichromide during elevated temperature exposure under stress has pretty well limited American use of chromium to beta-type alloys, and even here the use of chromium is decreasing. The Soviet VT3 alloy is an alpha-beta Titanium-Aluminum-Chromium alloy containing about 3 percent chromium. Thermal instability is aggravated by the presence of hydrogen, as has also been noted by the Russians, and their use of this alloy is being de-emphasized in favor of more thermally stable alloys containing molybdenum.

The book, which covers both scientific and technological information on absorption, diffusion, measurement, and contamination of titanium with hydrogen, appears to include all known information from Western and Soviet sources up to 1962. The Russian appraisal of the effects of hydrogen closely follows American thinking and evaluation to the extent that the authors seem to favor an American-supported view when there is a conflicting Russian viewpoint. There is remarkably good agreement between the American and Russian investigations on the effects of hydrogen and the mechanical properties of titanium. The hydrogen tolerances, that is, the maximum permissible hydrogen contents in various alloys, agree remarkably well.

Interesting and speculative comments are made on the nature of the interstitial solution of hydrogen in exothermic solvents like titanium (solvents in which hydrogen solubility increases with decreasing temperature). The authors state, without providing references to supporting data, that hydrogen is not completely ionized to a proton when it enters a solid solution in titanium, but exists as an excited and partially ionized atom, which is much larger than a proton, and occupies an interstitial site in the lattice. These hydrogen atoms are said to be bound to the metal atoms by certain chemical forces, the nature of which is not disclosed. As far as I know,