Oxide Formation

High-Temperature Oxidation of Metals. PER KOFSTAD. Wiley, New York, 1966. 354 pp., illus. $13.50.

As Kofstad points out in his preface, this book is not intended as an exhaustive, critical review of the literature of the high-temperature oxidation of metals. Indeed, only the results for the oxidation of the six refractory metals titanium, zirconium, hafnium, tantalum, niobium, and tungsten are covered in detail, a choice no doubt reflecting both the current upsurge of technological interest in these metals and the author's own extensive investigations of their oxidation properties. Aside from the convenient summary of the oxidation data for these six metals, the considerable value of this book lies in its clear discussion of the principles and techniques of high-temperature oxidation research.

The section on experimental methods contains much useful information. A brief summary of current theories of low-temperature oxidation is given, but the major portion of the theoretical section is given over to a discussion of the Wagner theory of oxidation. There is an extensive treatment of the kinetic approach to the analysis of oxidation mechanisms. The chapter on diffusion in oxides, while not mathematically complete, is particularly welcome because of the distinction drawn between the contributions of the enthalpies of defect formation and those of defect motion to the activation energy for diffusion. The potential importance, especially at low temperatures, of grain-boundary and short circuit diffusion is also pointed out.

The sections on experimental results emphasize the factors which complicate oxidation mechanisms—for example, the effects of stress development in both oxide and substrate during oxidation, the consequences of oxygen solution in metals, and the importance of oxide morphology. The overall picture of high-temperature oxidation which emerges is that of a highly complex process on which a variety of experimental techniques must be brought to bear if it is to be understood. That contribution alone would be enough to make this book a valuable addition to the literature of the oxidation of metals.

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IBP Symposium: Environmental Photosynthesis

Primary Productivity in Aquatic Environments. Proceedings of an International Biological Programme symposium, Pallanza, Italy, April–May 1965. C. R. GOLDMAN, Ed. University of California Press, Berkeley, 1966. 464 pp., illus. $7.

Eddying between the streams of photosynthetic physiology and biogeochemical systems ecology is a field of science that relates the role of light and chemical inflows as controlling agents in photosynthesis to the distribution of these agents in lakes and oceans in order to predict the rate of production of organic matter. This rich flowering of 27 papers showing causal relations and predictive procedures attests to the success of the International Biological Programme when it concentrates on a single theme.

The symposium shows a split of faith not at all hidden by the alternation of papers of opposite view. To some of the authors the performance characteristics of species in laboratory isolation provides the means of predicting what happens in the group system, the latter being the sum of the actions of the species. Soeder, for example, regards phytoplankton as "a mixture of many pure cultures" each in a stage of development like that exhibited by his synchronous cultures. Those of the opposite faith see the group processes as dependent on limiting rates of flow between species, a property of the group system and physical circulations not predictable from a study of the parts. Thus Steele documents the regenerating animal components as critical system factors; Hobbie and Wright show that the performance of bacterial-algal mixtures differs from that of the separate cultures.

Duursma regards organic-matter release from plants as a second trophic level, implying a necessary tenfold loss of fuel. It is less confusing to regard organic releases as a flow from a sequence of biochemical compartments prior to respiration, and thus as an output of the first trophic level. Fogg and Watt's report of an acceleration of glycollate release when light intensity is increased suggests a safety-valve release from the primary photosynthetic drive, hardly a secondary-trophic-level phenomenon.

As in the work reported at the limnological congress at Wisconsin, the carbon-14 method continues to be used to give results approximately an order of magnitude too low in benthic and pond environments, probably because of the improper use of the tracer method in which long finite increments are used for instantaneous processes without using compartmental modeling, a procedure used in other sciences for years. These ecologists will have to learn some systems kinetics or see their science captured by those who do. Some papers do deal with systems analysis as a means of predicting group performance. The one by Beyers on a photosynthesis-respiration loop system-control model has somehow been put in the section on photosynthesis and adaptation of algae. Yet the editor's own good paper in the limiting-factor section has hyperbolic uptake graphs for molybdenum that seem to be explained by that same charge-discharge system model.

Papers providing new understanding of bacterial roles include Sorokin's report of experimental stimulation of animal growths on food chains from bacterial blooms by the addition of chemosynthetic, gaseous substrates of hydrogen and methane. However, Sorokin confuses trophic concepts by calling the organic consumption steps primary production (this being firmly defined as the conversion of light energy into chemical potential energy).

The papers show many vital truths emerging, with clarification of issues indicating a live science in progress. From Yentsch we have clarification of a mystery through documentation that the large chlorophyll-like substances found below the lighted zone in the sea are without their magnesium (pheophytin) and are mostly nonfunctional whereas chlorophyll that is still in operating condition there is potentially as efficient as that at the surface. The well-presented account of the production limnology of Africa's Lake Victoria by Talling is probably headed for textbook use. The tropical production far exceeded that of the English Lake Windermere. There is a fine review of diurnal methods for primary production in streams by Owens, with proper attention given to new means for making the atmospheric aeration correction. Jorgensen and Steemann-Nielsen use photosynthesis-light curve analysis to infer that more enzymes are adapted when the cells are at work at low temperatures.

This reviewer's challenge to some sci-