Kingdom's Operational Research Society. Third, the relation of the system's concept to operations research emerges with a sense of both primary and growing importance. Fourth, simulation techniques are repeatedly stressed as a means for resolving problems that are too complex for treatment by the methods of classical mathematical techniques.

One point about which I disagree with the authors must be cited. They overemphasize the team concept. Although circumstances exist wherein only a team can effectively perform, this condition should not be used to describe the "essential characteristics" of operations research, thereby excluding individual effort. As Aesop warned us, we must beware lest we lose the substance by grasping at the shadow.

*Operations Research in Research and Development*, edited by Burton Dean, contains 12 papers that were originally delivered in 1962 at a conference held at Case Institute of Technology on applications of operations research to the management of research and development.

In the past, OR has concentrated its attention on problems that can be classified as decision-making under conditions of *risk* (where reasonable forecasts could be made) or under conditions of *certainty* (where the system's behavior is invariant to noncontrollable forces). Thus, models were developed for short-term, repetitive conditions to obtain near-optimal work schedules, inventory policies, distribution systems, and so forth.

Long-range planning models laced with intangible factors and conditions of *uncertainty* were on the horizon. They still are, but the horizon seems to be moving closer. Operations research is observably metamorphosing in the direction of long-term problems; this collection of papers is additional evidence of that fact.

Three major areas appear to include most of the topics that received attention at the conference: The objectives of R&D and measures of system's performance (in the papers by Johnson, Perlman, and Martin); The use of network theory for planning and controlling projects (Malcolm, Norden, Freeman, and Ashley and Austin); The use of decision theory models for improving the management of R&D functions (Hertz and Carlson, Rubenstein, Shepard, Weiss, and Marschak).

In the lead-off paper, a hard-hitting, heavily documented essay, Ellis Johnson attempts to develop relevant measures of the effectiveness of R&D, measures which can be used to illustrate that the performance of R&D management in the United States is inadequate. Johnson suggests that a committee be formed within the American Association for the Advancement of Science to study ways of remedying deficiences in the methods by which this country applies research to technology (p. 37).

Other papers are concerned with the development of mathematical models that might provide basic insights into the R&D process. Thus, for example, Martin presents a modified version of Ackoff's model of human communication, and Norden describes a model for predicting the utilization of manpower in development schedules. Perhaps more important than any one paper are the terms that are used and the study pattern which emerges. It is not yet time to tell whether OR has any fundamental contributions to make to the management of R&D projects, but there can be no doubt that OR wishes to participate in this critical endeavor.

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## Chemical Engineering

**High-Temperature Inorganic Coatings**. John Huminik, Jr., Ed. Chapman and Hall, London; Reinhold, New York, 1963. x + 310 pp. Illus. $10.

This short book contains eight chapters which vary from 7 to 100 pages in length. The chapters cover coating materials and coating systems, structural materials for high temperature use, methods of applying coatings, the testing and evaluation of coatings, designing with coatings, and the mechanisms that operate in coatings.

The manner of presentation combines the style of a handbook with that of an encyclopedia. There are a large number of tables and graphs with fairly short, almost entirely qualitative, discussions, a reflection of the fact that the work is being done by a large number of people in widely separated locations who are working under great pressure to achieve the desired results in a hurry. That quality of the presentations varies greatly and the material is somewhat repetitious is to be expected in a text authored by a number of persons but in one instance there is considerable repetition in two consecutive paragraphs.

The book appears to have been published hurriedly because the text needs editorial attention, and the quality of the plots and the printing ranges from fair to poor. The material is up to date and, despite its brevity, covers the subject matter.

According to the editor, the book is intended primarily for those who are beginning research in the field, for those who design and construct equipment for operation in hot environments, and as a general reference book, uses for which it is suited. Many will find its brevity an especial advantage.

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## Silicon Chemistry

**Volatile Silicon Compounds**. E. A. V. Ebsworth. Pergamon, London; Macmillan, New York, 1963. vi + 179 pp. Illus. $7.50.

Although this excellent book is included in the publisher's "International Series of Monographs on Inorganic Chemistry," persons interested in either organosilicon or inorganic silicon chemistry should find it equally useful. The author stresses the fundamental experimental work and the hypotheses that are basic to both the organic and inorganic silicon fields.

The molecular and chemical properties of the silicon hydrides and all their known volatile inorganic derivatives are critically discussed. Where appropriate, comparisons are made between analogous carbon, silicon, germanium, and tin compounds. Properties of certain organosilicon, and to a much lesser extent organogermanium and organotin compounds, are examined where these serve to illustrate trends or concepts important to the understanding of the chemistry of silicon.

The role of $(p \rightarrow d)\pi$ bonding between silicon and an attached element is evaluated with particular care, and in the last chapter a concise but critical summary is presented, which gives physical and chemical evidence for the presence of this type of bonding in certain linkages containing silicon.

Since portions of organosilicon, ger-