PREFACE

Growth of electric power capabilities in space will pace mankind's future achievements in this hostile environment. The more ambitious missions of the future will demand lighter systems with greatly increased power levels. Future high levels of electric power will make possible, for example, extended life support facilities and, in addition, the anticipated step change in propulsion effectiveness which will accompany the use of electric thrust in space.

The advances of 1962 represented in this volume reflect in a broad sense a pattern of continuing growth. In power level, the systems discussed range from tens of watts to kilowatts, a considerable advance over the few hundred milliwatts of Explorer and Vanguard. The photovoltaic systems that implemented these early achievements are now highly reliable tools for low-level power generation. On the horizon are dynamic solar power systems, which offer higher power levels (perhaps several kilowatts), and thermionic generators, which may extend the reliability of the solar cell to higher power levels. The really large power plants, which will implement the explorations of the future, must wait for the first nuclear reactors in space, but unfortunately, security limitations prevent a full technical discussion of this subject in an open book.

The present volume does not represent complete coverage of the field; rather, it is a compilation of carefully selected papers which report effectively on certain major technical areas of space electric power. To construct a cohesive volume, the editors have arranged these papers into four primary topical areas: Selection of Power Systems; Chemical Power Systems; Solar Power Systems; Heat Transfer, Storage, and Rejection.

The initial group of papers examines the basic criteria governing the selection of space power systems for specific applications. These range from the very limited power requirements of a ballistic space test through the ambitious goals of life support in lunar exploration to the long-range goal of electric power systems for vehicle propulsion.

Chemical power systems are limited to relatively short missions or recycling systems. In the second section these chemical sources are divided between dynamic systems, in which a high-temperature working fluid is employed, and static systems, such as the battery and fuel cell, in which reversible electrochemical processes are involved. The batteries discussed here may also be used in conjunction with the low-temperature solar converters which begin the next section.

The section on solar energy sources, the third topic, discusses presently operative systems using photovoltaic cells and explores technological developments leading to advanced thermoelectric and thermionic static coversion systems and the larger conversion systems employing rotating machinery. A series of papers on solar concentrators, requisite for obtaining the required high temperatures, precedes discussions of thermionic and dynamic solar power systems in the section.

Although papers on the detailed nature of nuclear powered systems could not be included, the heat transfer problems scanned in the final section are critically important to this area. The section on heat transfer, storage, and rejection covers the space power system from energy source to waste-heat rejecting radiators. Several papers treat the characteristics of alkali metal heat transfer and radiator surface conditioning. Energy storage in both thermal and electromagnetic form is considered for such systems. Finally, a series of papers on meteoroid penetration leads to discussions of specific radiator designs.

This volume is an outgrowth of the Second Bienniel Space Power Systems Conference, held in Santa Monica, California, September 25-28, 1962, under the sponsorship of the American Rocket Society. Designed to be particularly valuable to scientists and engineers engaged in the development and utilization of chemical, solar, and nuclear power equipment for space, the program constituted a major technical forum for specialists in space power. The forty-four contributions included here were critically selected from over one hundred papers presented in thirteen sessions. For a review of earlier developments, and for discussions of important topics not covered in this volume, the reader should consult Volumes 3 and 4 of this Series titled, respectively, "Energy Conversion for Space Power" and "Space Power Systems."

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