

PREFACE

UNDERSTANDING THE PLANET MERCURY

Thirty years have elapsed since the one and only mission to Mercury, Mariner 10, performed three flybys of the planet, capturing moderate-resolution (100m at best) images of one hemisphere (45% of the surface) and discovering that Mercury could be the only other terrestrial planet to have a global magnetic field and core dynamo analogous to the Earth's. At the time of this writing, the MESSENGER mission to Mercury has been launched. We are still a couple of years away from the first of the next flybys of Mercury, by MESSENGER, on its way to insertion into a nearly polar, but highly elliptical, orbit, seven years from launch. In the interim, a plethora of ground-based observations has been providing information on hitherto unseen aspects of Mercury's surface and exosphere. Furthermore, Mariner 10 data have been analyzed and reanalyzed as the technology for modeling and image processing has improved, leading to important breakthroughs in our understanding of Mercury and its environment.

Thus, we are writing this book with the realization that we are in a time of transition in our understanding of the planet Mercury. Of particular interest to us in this book is the emerging picture of Mercury as a very dynamic system, with interactions between interior, surface, exosphere, and magnetosphere that have influenced and constrained the evolution of each part of the system. Previous well-written books have compellingly emphasized the results of Mariner 10 and current ground-based measurements, with very little discussion of the nature and influence of the magnetosphere. This book will present the planet in the context of its surroundings, with major emphasis on each sphere, interior, surface, exosphere, and magnetosphere, and interactions between them.

Our organizational scheme for this book is as follows: Chapter 1 will provide an introduction to the solar system, planets, and their subsystems as

dynamic interconnected systems, as well as a view of Mercury in the context of the solar system. Following this, Chapter 2 will discuss missions to Mercury, including details of the only deep-space mission to reach Mercury to date, Mariner 10, and brief summaries of the next committed missions to Mercury, including NASA's MESSENGER (launched in 2004) and ESA/ISAS Bepi Colombo (launch anticipated for 2014). Chapters 3 through 6 will include reviews of our current knowledge of and planned observations for Mercury's interior, surface, exosphere, and magnetosphere, respectively. The dynamic interactions between subsystems are also considered. Results already obtained by instruments on the Mariner 10 spacecraft and by multi-disciplinary ground-based observations will be described. Current interpretation of those results will be given, along with response, in the form of anticipated capability and scientific objectives of the planned missions. The final chapter describes the future of Mercury exploration, including a profile for a mission that has the potential to complement and enhance the results obtained from MESSENGER and Bepi Colombo. The final section also contains our overall conclusions.

In this way, we hope to lay the foundation for the next major influx of information from Mercury and contribute to the planning for future spacecraft encounters.

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Dynamic Planet

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