

mentally a small effort. Throughout its fifty-year history, radar astronomy involved only a few institutions, including England's Jodrell Bank, MIT Lincoln Laboratory's Haystack Observatory, the Goldstone tracking stations of the Jet Propulsion Laboratory, and the crown jewel of all earthbound radars, Cornell's one-thousand-foot dish at Arecibo in Puerto Rico, funded by the National Science Foundation and NASA. Only a few dozen individuals played important roles in this history, and Butrica gives us a fine sense of their trials and tribulations, their successes and failures, and their interactions with other disciplines. Butrica not only presents the history of the institutions and individuals in the context of radar astronomy, he also provides an interesting history of failures along the way, including the Navy's notorious six-hundred-foot dish, never completed, at Sugar Grove, West Virginia.

As a well-defined subject at the intersection of science and engineering, driven at various times by ionospheric research, military science, and the space program, radar astronomy serves as a manageable case study of many of the general problems of current interest to the fields of history of science and science studies. We should be grateful to NASA and its centers (in this case the Jet Propulsion Laboratory) for sponsoring an increasing number of scholarly, insightful, and useful histories such as this one, which, while grounded in the technical aspects of science, is at the same time sensitive to broader issues.

STEVEN J. DICK

Kevin Madders. *A New Force at a New Frontier: Europe's Development in the Space Field in the Light of Its Main Actors, Policies, Law, and Activities from Its Beginnings up to the Present.* xxiv + 604 pp., illus., figs., apps. Cambridge: Cambridge University Press, 1997. \$150.

This book describes the evolution of the European space effort from its inception in the early 1960s up to the present, primarily by presenting an overview of the activities of the organizations devoted to a collaborative European effort in space. These organizations were, initially, the European Space Research Organization (ESRO) and the European Launcher Development Organization (ELDO), both established officially in 1964 and both superseded by the European Space Agency (ESA) in 1975. Kevin Madders supplements the story of these intergovernmental organs with brief accounts of national space efforts in some European countries; he acknowledges the most important space powers, the

United States and the Soviet Union, only insofar as they bear directly on the programs of the European agencies. In the final chapter Madders discusses the growing interest of the European Commission in space matters and ESA-EC relationships in particular.

To suggest what the reader will find in this book, I need only mention Madders's primary source material. First, Madders has drawn on the official publications of the various agencies involved, along with special reports commissioned for them (e.g., the crucial Causse report on future European space policy, prepared in 1967). Second, he has made extensive use of the resolutions taken by the councils (the highest decision-making bodies) of these organizations and of the legal arrangements that have been drawn up to implement a variety of programs in science, application satellites, launchers, and manned space platforms. Such documents have given Madders material for an interesting, well-organized summary, at a general level, of particular policy decisions taken at key milestone dates and for some analysis of the enabling legal arrangements. But they do not give us history.

What Madders's book lacks is an account of the complex, time-consuming process whereby the decisions presented in it were actually arrived at. Missing too are the stories of the sometimes-tortuous negotiations over clauses in the legal agreements. The sources for this kind of study are available in the public domain and are in fact being exploited by the ESA history project (conducted by myself and two other scholars, Arturo Russo and Lorenza Sebesta), as well as by other researchers. Indeed, the subtitle of the book notwithstanding, flesh-and-blood actors and the conflicts between them barely appear in its pages. More precisely, they appear only in the person of nation-states (France, Germany, Britain) or as firms (Telespazio, Dornier, Aerospaziale), just as they appear in the documentation with which Madders works. Limiting himself to this level of documentation, Madders does not disaggregate these fictitious entities into more discrete and concrete components (government departments and their ministers, scientific fields and their leaders, for example). For the historian who seeks to understand the inner workings of the European space effort, therefore, this book will serve mostly as a useful reference work, although even in that respect its value is marred by the absence of a name or subject index.

JOHN KRIGE

James Harford. *Korolev: How One Man Masterminded the Soviet Drive to Beat America to*

the Moon. xviii + 392 pp., illus., app., bibl., index. New York: John Wiley & Sons, 1997. \$30, Can \$42.50.

This book is the first original English-language biography of Sergei Pavlovich Korolev, who was, and bore the title of, chief designer of the Soviet missile and space programs from their inception to the mid 1960s. Until his sudden death in 1966, Korolev's life and even his name had been shrouded in secrecy. Afterward, Soviet authors nearly canonized him, glossing over the complexities of his life. Now, in this lively biography, which combines vivid personal stories and important technical details, James Harford has made a serious attempt to reexamine the personality of the chief designer and his role in the Soviet space program.

Harford's account is based on extensive research among recently released documents and on over sixty interviews with Korolev's colleagues and friends. From the material in these generously quoted interviews, there emerges a multifaceted portrait of a man shaped by harsh experiences in a Stalinist labor camp and a prison laboratory. The trajectory of Korolev's life takes the reader through the crucial stages that led to the formation of the Soviet space program: early experiments in rocket technology during the 1930s, efforts to replicate German rockets after World War II, and, in the 1950s, the development of an intercontinental ballistic missile capable of reaching the United States. This book brings to light details of numerous unsuccessful launches, canceled projects, and irregular working conditions never revealed in official Soviet reports.

The chief designer operated in a tangled web of dozens of supervising party and government agencies and hundreds of subordinate enterprises, often complicated by political tensions, professional rivalries, and fierce competition for funding. The very complexity of this system, Harford argues, created room for maneuver. Korolev's story seriously challenges the conventional image of Soviet top-down decision making and emphasizes the pivotal role played by powerful individuals lobbying for their projects and creating networks of support. In particular, the launch of *Sputnik* (1957) owed much to Korolev's personal initiative despite the skepticism of his superiors, especially among the military.

Soviet political leaders, Harford maintains, realized the enormous political gains of the *Sputnik* publicity only after the unexpectedly strong reaction of shock and astonishment in the West.

From that moment on, they began to pressure Korolev to produce spectacular launches, which they exploited politically, but they failed to make the space program a national priority, as President Kennedy did in the United States in 1961. Korolev then had to look for new military applications of space technologies to secure funding for his projects.

Telling the story of the U.S.-Soviet space race, Harford makes a number of illuminating comparisons between space projects in the two countries, drawing on his expertise as former long-time executive director of the American Institute of Aeronautics and Astronautics. He cites inadequate funding, bureaucratic barriers, duplication of effort, rivalries and lack of cooperation among various design bureaus, all-pervasive secrecy, and the impossibility of critical discussion in the media or by the citizenry as key factors contributing to the failure of the Soviet manned lunar landing project. And not least among them was the untimely death of Korolev and the collapse of the personal network of support he created.

The value of this book is unfortunately diminished by Harford's somewhat incautious use of interviews. His analysis could be more theoretically sophisticated; it is often dominated by the perspectives of his interviewees: unable to obtain access to still largely classified archives and making limited use of secondary sources, Harford relied heavily on his interviewees' claims. Various factual inaccuracies passed from the interviews into print undetected. On most crucial points—the role of Nikita Khrushchev, for example—interviewees expressed contradictory views. A more subtle analysis might have revealed in this diversity of participants' accounts some of the deeper conflicts and tensions that shaped the Soviet space program.

Nevertheless, Harford's book is a delightful read for space enthusiasts and a general audience and provides a useful, if not definitive, account for historians.

SLAVA GEROVITCH

Hans-Jörg Rheinberger. *Toward a History of Epistemic Things: Synthesizing Proteins in the Test Tube.* (Writing Science.) xii + 325 pp., illus., app., bibl., index. Stanford, Calif.: Stanford University Press, 1997. \$49.50.

In the introductory chapters of this book, Hans-Jörg Rheinberger, now director of the Max Planck Institute for the History of Science in Berlin, presents an "epistemology of contemporary experimentation based on the notion of