CRITICAL ISSUES IN THE HISTORY OF SPACEFLIGHT

Steven J. Dick
Roger D. Launius
Editors

In March 2005, the NASA History Division and the Division of Space History at the National Air and Space Museum brought together a distinguished group of scholars to consider the state of the discipline of space history. This volume is a collection of essays based on those deliberations. The meeting took place at a time of extraordinary transformation for NASA, stemming from the new Vision for Space Exploration announced by President George W. Bush in January 2004: to go to the Moon, Mars, and beyond. This Vision, in turn, stemmed from a deep reevaluation of NASA's goals in the wake of the Space Shuttle *Columbia* accident and the recommendations of the Columbia Accident Investigation Board. The new goals were seen as initiating a "New Age of Exploration" and were placed in the context of the importance of exploration and discovery to the American experience.

With these developments as the broad background, the essays in this volume analyze some of the perennial issues in the history of the Space Age. What are the motivations for spaceflight? Is human spaceflight really necessary when robotic spacecraft are cheaper? Are reusable or expendable launch vehicles preferable for the variety of missions that space agencies undertake? Why has it taken so long to replace the Space Shuttle? Were the Shuttle accidents preventable, and what was the role of NASA's culture in their occurrence? The essays also explore NASA's interactions with the Department of Defense, the aerospace industry, and the international community. A final section examines the state of the art of the field of space history.

On the cover: Fisheye view of the Space Shuttle *Atlantis* as seen from the Russian *Mir* space station during the STS-71 mission. (*NASA* photo no. STS071-741-064)

Inset: Astronaut Dale A. Gardner, as photographed by a fellow astronaut on mission STS-51A in 1984. (*NASA JSC* photo no. S14-104-049)

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Critical Issues Conference Speakers

Left to right: James Hansen, John Krige, Asif Siddiqi, David DeVorkin, Howard McCurdy, Woody Kay, Andrew Butrica, Margaret Weitekamp, Phil Scranton, Steven Dick, Stephen Pyne, Alexander Brown, Slava Gerovitch, Stephen Johnson, and David Mindell. Not shown: Roger Launius, Peter Hays, John Logsdon, Todd La Porte, and Diane Vaughan. The image was taken in front of the Space Shuttle *Enterprise* at the Steven F. Udvar-Hazy Center of the National Air and Space Museum.

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National Aeronautics and Space Administration
Office of External Relations
History Division
Washington, DC

2006

NASA SP-2006-4702

Library of Congress Cataloging-in-Publication Data

Critical issues in the history of spaceflight / Steven J. Dick and Roger D. Launius, editors.
p. cm. -- (The NASA history series)
Includes index.
1. Astronautics--History. I. Dick, Steven J. II. Launius, Roger D. III. Series.
TL788.5.C66 2005
629.409--dc22

2005035416

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INTRODUCTION

At a May 1981 "Proseminar in Space History" held at the Smithsonian Institution's National Air and Space Museum (NASM) in Washington, DC, historians came together to consider the state of the discipline of space history. It was an historic occasion.[1] The community of scholars interested in the history of spaceflight was not large; previously, well-meaning but untrained aficionados consumed with artifacts had dominated the field, to the exclusion of the larger context.[2] At a fundamental level, this proseminar represented a "declaration of independence" for what might be called the "new aerospace history." In retrospect, it may be interpreted as marking the rise of space history as a recognizable subdiscipline within the field of U.S. history. Bringing together a diverse collection of scholars to review the state of the art in space history, this proseminar helped in a fundamental manner to define the field and to chart a course for future research. Its participants set about the task of charting a course for collecting, preserving, and disseminating the history of space exploration within a larger context of space policy and technology.

In large measure, the course charted by the participants in this 1981 proseminar aided in advancing a very successful agenda of historical research, writing, and understanding of space history. Not every research project has yielded acceptable results, nor can it be expected to do so, but the sum of the effort since 1981 has been impressive. The opportunities for both the exploration of space and for recording its history have been significant. Both endeavors are noble and aimed at the enhancement of humanity. Whither the history of spaceflight? Only time will tell. But there has been an emergent "new aerospace history" of which space history is a central part that moves beyond an overriding concern for the details of the artifact to emphasize the broader role of the spacecraft. More importantly, it emphasizes the whole technological system, including not just the vehicle but also the other components that make up the aerospace climate, as an integral part of the human experience. It suggests that many unanswered questions spur the development of flight and that inquisitive individuals seek to know that which they do not understand.

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1. Richard F. Hirsh, "Proseminar on Space History, 22 May 1981," *Isis* 73, no. 266 (1982): 96–97. There had been previous gatherings of historians interested in the subject, but these had mostly been oriented toward specific subdisciplines such as space science. See Paul A. Hanle and Del Chamberlain, eds., *Space Science Comes of Age: Perspectives in the History of Space Sciences* (Washington, DC: Smithsonian Institution Press, 1981).

2. At that time, only the several volumes published as part of the NASA History Series, all written by credible scholars, and John M. Logsdon's *The Decision to Go to the Moon: Project Apollo and the National Interest* (Cambridge, MA: MIT Press, 1970) were accepted as works of serious scholarship by the larger historian community.

This assumption arises within historians and is based on their understanding of humans, for technological systems are constructions of the human mind.[3]

This "new aerospace history," therefore, emphasizes research in aerospace topics that are no longer limited to the vehicle-centered, project-focused, scientific internalist style of space history. Many of the recommendations that historian James R. Hansen suggested in an important historiographical article in *Technology and Culture* are beginning to come to fruition.[4] Taken altogether, these tentative explorations of themes build on what has gone before. At the same time, they represent a departure from the simplistic works that preceded them, notably the argumentative volumes and essays that either espouse or ridicule space exploration.

Twenty-four years after the 1981 proseminar, the National Aeronautics and Space Administration (NASA) Headquarters History Division and NASM's Division of Space History brought together another group of scholars—including historians, political scientists, sociologists, public administration scholars, and engineers—to reconsider the state of the discipline. This volume is a collection of essays based on this workshop on "Critical Issues in the History of Spaceflight," held at the Steven F. Udvar-Hazy Center of the National Air and Space Museum on 15–16 March 2005. The meeting was especially timely because it took place at a time of extraordinary transformation for NASA, stemming from the new Space Exploration Vision, announced by President George W. Bush in January 2004, to go to the Moon, Mars, and beyond. This Vision in turn stemmed from a deep reevaluation of NASA's goals in the wake of the Space Shuttle *Columbia* accident and the recommendations of the Columbia Accident Investigation Board. By June 2004, a nine-member Presidential Commission on Implementation of United States Space Exploration Policy, led by former Secretary of the Air Force Edward "Pete" Aldridge, had produced a report on "A Journey to Inspire, Innovate, and Discover." In February 2005, NASA's strategic objectives were released in a report called "The New Age of Exploration." All these documents placed the new vision in the context of the importance of exploration and discovery to the American experience.[5]

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3. Roger D. Launius discusses the richness of what has been accomplished thus far in "The Historical Dimension of Space Exploration: Reflections and Possibilities," *Space Policy* 16 (2000): 23–38.

4. James R. Hansen, "Aviation History in the Wider Context," *Technology and Culture* 30 (fall 1989): 643–649.

5. Columbia Accident Investigation Board, *Report*, (Washington, DC, 2003), 6 volumes. The President's program for NASA as announced on 14 January 2004 was entitled "A Renewed Spirit of Discovery." It was followed in February by a more detailed "Vision for Space Exploration." The Aldridge Commission report was *A Journey to Inspire, Innovate and Discover.* Events leading up to the Vision are detailed in Frank Sietzen, Jr., and Keith L. Cowing, *New Moon Rising: The Making of America's New Space Vision and the Remaking of NASA* (Burlington, Ontario: Apogee Books, 2004), as well as in the Aldridge report.

As the meeting took place, NASA had not flown a Space Shuttle since the *Columbia* accident on 1 February 2003 and was looking forward to returning to flight in mid-2005. At the same time, the space agency was in the midst of a reorganization and a change in programs of truly historic proportions. The transformation potentially heralded the beginning of a new era, as the Agency's human spaceflight program sought to leave the Space Shuttle behind and depart Earth orbit for the Moon and Mars—something that humans had not done since the end of the Apollo era more than three decades earlier. Because the new Vision was to be achieved with little or no addition to NASA's $16-billion annual budget, attempts to develop an implementation plan set off a debate on the relative merits of other areas of NASA's portfolio. Funding for aeronautics was under severe pressure, with serious implications for NASA's aeronautics research centers at Glenn, Langley, and Ames. In the wake of renewed emphasis on human spaceflight, the space science community was quick to argue that its activities were also exploration, an integral part of the "Moon, Mars, and beyond" vision, and therefore should not be subject to cuts. Earth science—which had been administratively combined with space science as part of the recent transformation—could not so easily make that argument, but it had Congress largely on its side because of the practical implications of the Earth Observing System. Also in the mix was the extraordinary and sustained controversy over a servicing mission for the Hubble Space Telescope, in which the public, Congress, and the science community had strong opinions, mostly favoring a servicing mission. Finally, it was also a time of transition between Administrators: after three years of heading the Agency, Sean O'Keefe departed in February, and on 11 March, the President nominated a new Administrator, Michael Griffin, who was confirmed by the Senate and became the 11th NASA Administrator on 14 April.

As these issues swirled, March 2005 thus proved a particularly appropriate time to assess some of the perennial challenges and concerns of spaceflight, with the primary goal of providing perspective on current issues. Six critical issues were chosen for analysis. The first session examined motivations—the persistent question of why we should go into space at a time when there are so many problems on Earth. The second session provided background on another often-asked question, why should so much be spent on human spaceflight if robotic spacecraft were cheaper and more efficient? The controversy then raging over servicing the Hubble Space Telescope with the Space Shuttle demonstrated that this dichotomy was not quite so simple; without human spaceflight and four servicing missions, the myopic Hubble would never have functioned properly and certainly would not have reached its 15th anniversary on 25 April 2005. The third session could provide only a sampling of case studies of NASA's relations with external groups, in this case with the Department of Defense (DOD), international relations, and a portion

of the aerospace industry. The fourth session shed light on another persistent issue: why there has been no replacement for the aging Space Shuttle. The fifth session, on NASA cultures, reflected the preoccupation with safety and risk in the wake of the *Columbia* accident. A concluding session addressed specific questions relating to the historiography of spaceflight and suggested possibilities for future research. After the assessment of distinct issues, it particularly considered the second goal of the meeting: to assess the state of the field of space history.

Two decades had passed since serious attempts had been made to assess the state of the field. In addition to the 1981 proseminar, NASA and NASM joined forces once again to hold a broader meeting in the spring of 1987, published as *A Spacefaring Nation: Perspectives on American Space History and Policy*.[6] In its treatment of issues, *Critical Issues in the History of Spaceflight* is broader in some respects but narrower in others. The title and spirit of the current volume hearkens back to Marshall Clagett's book *Critical Problems in the History of Science*, a collection of essays from a meeting at the beginning of the Space Age that had a considerable influence on the evolution of the history of science.[7] Space history was no part of that volume, but the 50 intervening years have given rise to a new kind of history with links to scientific, technological, political, cultural, and social history.

Although the subject of the meeting was "Critical Issues in the History of Spaceflight," this did not imply that history was the only mode of analysis that could be applied. Experts with a variety of backgrounds brought a variety of approaches to the chosen critical issues, including history, cultural studies, political science, and sociology. The reader will therefore find a range of approaches reflecting these backgrounds.

Certainly not all subjects could be covered at this meeting. NASA's first *A*, aeronautics, was not represented at all—not for a lack of issues, but precisely because an entire conference could be devoted to the subject. In addition, the focus was naturally on NASA and American space history, despite papers on international relations, and comparisons of the U.S. and Soviet space programs. The space sciences also received short shrift in this workshop and in this resulting volume. Again, there is more than enough in this arena to fill an entire volume. The issues encompassed by space history, along with its interconnections with the broader world and with other forms of analysis in

6. Martin J. Collins and Sylvia D. Fries, eds., *A Spacefaring Nation: Perspectives on American Space History and Policy* (Washington, DC: Smithsonian Institution Press, 1991). A similar conference hosted by Yale University in 1981 was published as Alex Roland, ed., *A Spacefaring People: Perspectives on Early Space Flight* (Washington, DC: NASA, 1985).

7. Marshall Clagett, *Critical Problems in the History of Science* (Madison: University of Wisconsin Press, 1959).

history and the social sciences, compose a field now grown so large—in scope if not in practitioners—that only a fair sampling can be given here. If this volume serves to stimulate more research in these areas, which we believe are of vital importance to the nation and the world, it will have served its purpose.

The meeting was a small workshop with 18 presentations and several dozen audience members who contributed substantially to the discussions. Even a small workshop, however, engendered numerous logistics. We would like to thank General John R. Dailey, Director of the National Air and Space Museum, for allowing us to use the beautiful Udvar-Hazy Center, just opened in December 2003 and adjacent to Dulles International Airport. It was a pleasure to contemplate space history in the midst of the Concorde, the SR-71 Blackbird, and the Space Shuttle *Enterprise*, among other aviation and space icons, all part of "the cathedral of the artifact," as it was termed during the meeting. For essential logistical help, we thank Nadine Andreassen, Giny Cheong, and Annette Lin, all of the NASA History Division. We are grateful to Chris Brunner and Tim Smith of SAIC for recording the proceedings on videotape. A copy of the video, along with transcripts of the discussions, may be accessed in the NASA Historical Reference Collection at NASA Headquarters.

At the NASA Headquarters Printing and Design Office, our thanks to Lisa Jirousek for copyediting and Shelley Kilmer-Gaul for design and layout. Finally, we wish to acknowledge the many contributions of those who participated in the workshop, both as presenters and from the audience. This book represents a final report on the activities of the workshop, and we hope that it will stimulate additional contemplation, research, and presentation of the history of spaceflight.

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Roger D. Launius, Chair, NASM Department of Space History

SECTION I

MOTIVATIONS FOR SPACEFLIGHT

INTRODUCTION

The first section of this volume examines what is perhaps the most basic question that can be asked of the Space Age: Why do nations undertake spaceflight, and why should they? It is a question equally important for understanding the history of spaceflight and for divining its future. And it is a question that history is in a unique position to illuminate. From its inception in 1957 to "The New Age of Exploration" that NASA proclaimed in 2005 in the wake of the Vision for Space Exploration, the Space Age has inevitably been linked with the idea of exploration as a motivating force. In the opening paper of the conference, Stephen Pyne argues that the idea of exploration and its links to the past need to be examined in more detail and in the context of the cultures in which it is embedded. Many writers, especially journalists, have seen space activities as part of an unbroken line of exploration going back at least to the Renaissance Age of Discovery and even earlier. Richard S. Lewis's *From Vinland to Mars: A Thousand Years of Exploration* is a prime example of this view. By contrast, Pulitzer Prize–winning historian William H. Goetzmann distinguishes a "Second Great Age of Discovery," beginning with 18th-century explorers such as Captain James Cook and Alexander von Humboldt—an age characterized by further geographic exploration, now driven by the scientific revolution and still in progress. Goetzmann sees this fissioning of ages as important to understanding the differences between the two.[1]

While examining the characteristics and lessons of the first two ages, Pyne now proposes a Third Age of Discovery, which segregates space exploration from the motivators of the Second Age and places it with the exploration of the Antarctic and the deep oceans.[2] This distinction, he argues, is important to understanding the unique character of the current age. Just as for the Second Age, science replaced God, commerce replaced gold, and national prestige trumped individual glory, the motivators for the Space Age have changed in part. Most strikingly, at least so far, and perhaps happily, since such encounters in the past have left more than one civilization decimated, explorers of the Space Age have not had to worry about encounters with indigenous inhabitants of the lands they explore.[3]

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1. William H. Goetzmann, *New Lands, New Men: America and the Second Great Age of Discovery* (New York: Penguin Books, 1987).

2. He also made this case in his article, "Space: A Third Great Age of Discovery," *Space Policy* 4 (August 1988): 187–199.

3. For a discussion of this problem, see Jane M. Young, "'Pity the Indians of Outer Space:' Native American Views of the Space Program," *Western Folklore* 46 (October 1987) 269–279.

Pyne also argues that it is "cultural conditions that prompt and sustain discovery" and that exploration is an invention of particular societies. This is no academic distinction, but one with real-life consequences: if exploration is a cultural invention, then it may pass away as have other cultural inventions and, indeed, as exploration itself has withered in some societies throughout history. This is no less true in the American context than it is in other societies, now or in the past: Carl Sagan, Ray Bradbury, Robert Zubrin, and others have argued that exploration is a societal imperative with unique valences to American history and the American character.[4] Exploration means many things to many people, and historians need to analyze these meanings and understand the myriad ways in which culture imbues exploration with meaning, or with no meaning at all.

Pyne's essay is full of provocative suggestions: that the idea of exploration needs to be decoupled from the idea of colonization; that the Second Age collapsed not only from closed frontiers, but also from a weariness with the Enlightenment enterprise; that geopolitical rivals may divert some of their energies from the battlefield to exploration; that Voyager's Grand Tour may be for the Third Age what Humboldt was for the Second and Magellan for the First; that the Third Age may already be in decline; that cyberspace may be more important in historical terms than outer space; and that although encounters with other cultures were essential to creative individuals and societies in the first two Ages, that possibility is unlikely for the Third Age, at least in the near future, unless by remote radio communication.

In the second paper, Roger Launius takes a broader view of the motivations for spaceflight and enumerates five, and only five, rationales operating over the last 50 years: human destiny and survival of the species; geopolitics, national pride, and prestige; national security and military applications; economic competitiveness and satellite applications; and scientific discovery and understanding. Launius argues that some of these rationales rest on a fundamental desire to become a multiplanetary species and, in particular, to found utopian societies beyond Earth.

In the context of the human destiny argument, Launius finds that the "frontier thesis"—the idea that the existence of a frontier has given Americans their most distinctive characteristics and that space exploration is important for that reason alone—is counterproductive for a postmodern, multiculturalist society. Yet "the final frontier" continues to be a rallying cry for space enthusiasts. Is this inappropriate, or can the frontier thesis be separated from the charges of excessive ethnocentrism?

4. See in particular Robert Zubrin, "Epilogue: The Significance of the Martian Frontier," in *The Case for Mars* (New York: Free Press, 1996).

In the area of national security and military applications, Launius emphasizes a fact little known outside the space community: that since 1982, military spending on space has outpaced civilian spending. By 2003, the Department of Defense was spending $19 billion on space, compared to NASA's $14 billion. Obviously, the military is motivated to use space as "high ground." Launius finds that the economic competitiveness argument, though emphasized by the conservative agenda since the 1980s, remains mixed: although communications satellites have proven a commercial success since COMSAT and Intelsat in the early 1960s, other efforts such as Landsat and the Global Positioning System (GPS), while great technical successes, have not yet proven commercially viable. Space tourism and private investment for access to space are barely at the beginning of their potential. Whether these activities become economically viable, thereby causing the commercial motivator to become increasingly important, is one of the great open questions of the Space Age.

Launius discusses science as a motivator at some length; however, in the context of Pyne's paper, it is notable that he does not explicitly include exploration as one of his five motivations, instead viewing it as a means to an end rather than an end in itself. He briefly discusses it in the context of the human destiny argument and the frontier thesis, and he later uses it again in the context of the science motivator, noting that a National Research Council (NRC) study in 2005 proclaimed that "exploration done properly is a form of science."[5] It should be noted that the NRC did so in the context of threatened cuts to space science—money that would go to the new human exploration program—and therefore had a vested interest in relating science to exploration. This raises the interesting question of the differences between science and exploration in principle and in practice. While it is clear that, as Launius argues, there are synergies between science and exploration, one could clearly argue that they are not one and the same. After all, Magellan was an explorer, not a scientist; conversely, many scientists undertake routine science that can hardly be called exploration. One might argue a relationship as follows: when exploration is undertaken, it may lead to discoveries, which then are explained by science and in turn add to the body of scientific knowledge. Alternatively, one might also argue that when exploration is undertaken, it is usually done with an economic, military, or nationalistic purpose in mind, but that exploration, viewed as benign while the true objective may be less so, serves as the rationale. As Pyne puts it in his article, historically "society needed science, science needed exploration, exploration to far countries [or outer space] needed support," at the national level.

5. National Research Council, *Science in NASA's Vision for Space Exploration* (NRC: Washington, DC, 2005).

These distinctions are more than semantic in nature—they become an issue of public policy when decisions must be made about the balance between human and robotic exploration (see section II). Although Apollo clearly produced important science, as Launius points out, it was criticized for not generating enough science relative to its high cost. Yet one could argue that the explorations of Apollo represented something beyond science that will be remembered as one of humanity's greatest triumphs. At least some space scientists have come to this realization, despite the high costs and the risks involved in human spaceflight. At a NASA meeting on risk and exploration, Steve Squyres, the science principal investigator for the Mars Exploration Rovers, allowed that he loved his machines, which are still active after 16 months. But, he added, "when I hear people point to Spirit and Opportunity and say that these are examples of why we don't need to send humans to Mars, I get very upset. Because that's not even the right discussion to be having. We must send humans to Mars. We can't do it soon enough for me."[6] Squyres's words reflect a deep truth: even though science may be a motivation for exploration and a product of it, human exploration is more than the sum of all science gained from it. If exploration is a primordial human urge, and in a larger sense the mark of a creative society, to what extent should a society support it in the midst of many other priorities? In a democratic society, that is a question with which the public, and public policy-makers, must grapple.

6. Steven J. Dick and Keith Cowing, eds., *Risk and Exploration: Earth, Sea and the Stars* (Washington, DC: NASA SP-2005-4701, 2005), p. 179.