Humans to Mars

Fifty Years of Mission Planning, 1950—2000

David S. F. Portree

Monographs in Aerospace History #21

NASA SP-2001-4521

Humans to Mars

Fifty Years of Mission Planning, 1950–2000

by David S. F. Portree

NASA History Division
Office of Policy and Plans
NASA Headquarters
Washington, DC 20546

Monographs in Aerospace History Series
Number 21
February 2001

Library of Congress Cataloging-in-Publication Data
Portree, David S. F.
Humans to Mars: fifty years of mission planning, 1950–2000/by David S. F. Portree.
p. cm.–(Monographs in aerospace history; no. 21) (NASA publication SP)
Includes bibliographical references and index.
1. Space flight to Mars–Planning. 2. United States. National Aeronautics and Space Administration.
I. Title. II. Series. III. NASA SP ; no. 4521.

TL799.M3 P67 2000
629.45'53–dc21 00—062218

Contents

Foreword v

Preface vii

Chapter 1: On the Grand Scale 1

Chapter 2: Earliest NASA Concepts 5

Chapter 3: EMPIRE and After 11

Chapter 4: A Hostile Environment 23

Chapter 5: Apogee 33

Chapter 6: Viking and the Resources of Mars 53

Chapter 7: The Case for Mars 57

Chapter 8: Challengers 67

Chapter 9: Space Exploration Initiative 77

Chapter 10: Design Reference Mission 89

Acronyms 101

Endnotes 103

Bibliography 127

About the Author 141

Index 143

NASA History Monographs 151

Foreword

The planet Mars has long held a special fascination and even mythic status for humans. While not the closest planet to Earth, scientists have considered it to be the planet that most closely resembles Earth and thus is the other planet in our solar system most likely to contain life. Since before the space age began, people have wondered about the "red planet" and dreamed of exploring it.

In the twentieth century, robotic spacecraft and then human space flight became a reality. Those who wanted to explore Mars in person felt that this might finally become a reality as well. The Apollo program, which put twelve Americans on the surface of the Moon, certainly encouraged the dreamers and planners who wanted to send astronauts to Mars. Indeed, many people in and out of the National Aeronautics and Space Administration (NASA) have felt that human exploration of Mars is the next logical step in human space flight after the Moon.

Clearly, however, many obstacles have remained. Human travel to and from Mars probably would take many months at best. Thus the biomedical and psychological implications of such long-duration missions are daunting. The logistics of getting enough food, water, and other supplies to Mars are also challenging at best. What would astronauts do once they got to Mars? How long would they stay on the planet's surface and how would they survive there before returning to Earth? The financial cost of sending humans to Mars would almost surely be measured in billions of dollars. Aside from technical and financial issues, there remains the political question of why we should send humans to Mars at all.

David Portree takes on these questions in this monograph. By examining the evolution of 50 mission studies over the past 50 years, he gives us a sense of the many options that Mars human space flight planners in the United States have explored. Portree covers a wide variety of ideas for human exploration of Mars, ranging from Wernher von Braun's of the 1950s to the Space Exploration Initiative of 1989. These concepts, culled from a much larger pool of studies, range from hugely ambitious flotilla-style expeditions to much leaner plans. This monograph provides historians, space policy practitioners, and other readers with a very valuable overview of how much planning has already been done. If humans do go to Mars any time in the near future, it is quite conceivable that their mission profile will resemble one of the plans described here.

A number of people helped to produce this monograph. In the NASA History Office, M. Louise Alstork edited and proofread the manuscript, while Stephen J. Garber and Nadine J. Andreassen also assisted with editing and production. The Printing and Design Office developed the layout and handled the printing. Shawn Flowers and Lisa Jirousek handled the design and editing, respectively, while Stanley Artis and Warren Owens saw this work through the publication process.

This is the twenty-first in a series of special studies prepared by the NASA History Office. The Monographs in Aerospace History series is designed to provide a wide variety of aerospace history investigations. These publications are intended to be tightly focused in terms of subject, relatively short in length, and reproduced in an inexpensive format to allow timely and broad dissemination to researchers. Thus they hopefully serve as useful starting points for others to do more in-depth research on various topics. Suggestions for additional publications in the Monographs in Aerospace History series are welcome.

Roger D. Launius
Chief Historian
National Aeronautics and
Space Administrations
October 25, 2000

Preface

> The story of the dreams and the unbuilt spaceships for flights to Mars should be recorded so that in the future people can examine past ideas of space travel just as we can examine the unconsummated ideas of Leonardo da Vinci by reading his notebooks. Years from now people should be able to decide for themselves whether they want to go to Mars or if they prefer to stay earthbound. But let us not destroy the dream, simply because we do not wish to pursue it ourselves. (Edward Ezell, 1979)[1]

In the past half century, visionary engineers have made increasingly realistic plans for launching astronauts to Mars to explore the planet. This monograph traces the evolution of these plans, taking into account such factors as on-going technological advancement and our improving knowledge of the red planet.

More than 1,000 piloted Mars mission studies were conducted inside and outside NASA between about 1950 and 2000. Many were the product of NASA and industry study teams, while others were the work of committed individuals or private organizations. Due to space limitations, only 50 mission studies (one per year, or less than 5 percent of the total) are described in this monograph. The studies included are believed to be representative of most of the technologies and techniques associated with piloted Mars exploration.[2]

In addition to tracing the evolution of mission concepts, this monograph examines piloted Mars mission planning from a policy standpoint. Mars plans are affected by their societal context and by the policies that grow from that context. When the human species eventually decides to send a piloted mission to Mars, the political environment in which it develops will have at least as much impact on its shape as technology, human factors, and the Martian and interplanetary environments. Hence, it stands to benefit the space technologist to study the ways in which policy has shaped (and thwarted) past Mars plans. This idea may seem obvious to some readers, yet the history of piloted Mars mission planning shows that this truism has often been ignored or imperfectly understood, usually to the detriment of Mars exploration.

This history should be seen as a tool for building toward a future that includes piloted Mars exploration, not merely as a chronicle of events forgotten and plans unrealized. The author hopes to update and expand it in 15 or 20 years so that it tells a story culminating in the first piloted Mars mission. Perhaps a university student reading this monograph today will become a member of the first Mars mission crew tomorrow.

The author gratefully acknowledges the assistance provided by the following: Robert Ash, Donald Beattie, Ivan Bekey, John Charles, Benton Clark, Aaron Cohen, John Connolly, Mark Craig, Dwayne Day, Michael Duke, Louis Friedman, Kent Joosten, Paul Keaton, Geoffrey Landis, John Logsdon, Humboldt Mandell, Wendell Mendell, George Morgenthaler, Annie Platoff, Marvin Portree, Gordon Woodcock, and Robert Zubrin. Thanks also to the Exploration Faithful at NASA's Johnson Space Center for their insights and encouragement these past several years. Finally, thanks to Roger D. Launius, NASA Senior Historian, for soliciting this work and providing overall guidance.

David S. F. Portree
Houston, Texas, September 2000

A Note on Measurement

In this monograph, measurements are given in the units used in the original study. Tons are U.S. tons (short tons) unless specified as metric tons. Measurements not associated with a specific study are given in the metric system.