

ON MARS

Exploration of the Red Planet, 1958–1978

The NASA History

Edward Clinton Ezell

Linda Neuman Ezell

Introduction to the Dover edition by

Paul Dickson

DOVER PUBLICATIONS, INC.
Mineola, New York

Contents

	Page
INTRODUCTION TO THE DOVER EDITION	ix
FOREWORD.....	xi
INTRODUCTION.....	xiii
1. WHY MARS?	1
Attractive Target for Exploration	2
Objectives in Space	10
2. THE CART BEFORE THE HORSE: MARINER SPACECRAFT AND LAUNCH VEHICLES	25
Evolution of Unmanned Space Exploration to 1960	25
Centaur: Troublesome Launch Vehicle	31
3. THE SEARCH FOR MARTIAN LIFE BEGINS: 1959-1965	51
The Rise of Exobiology as a Discipline	54
The Results of <i>Mariner 4</i>	74
4. VOYAGER: PERILS OF ADVANCED PLANNING, 1960-1967	83
Origins of Voyager	85
Misfortunes of Voyager	100
5. REORGANIZATION AND THE CREATION OF VIKING	121
Langley Enters the Mars Business	121
Problems—Management Assignments and Budgets	139
Support for Mars Exploration	142
The Mission Mode Decision	148
6. VIKING ORBITER AND ITS MARINER INHERITANCE.....	155
Mariner Mars 69.....	156
Mariner Mars 71.....	159
First Phase of Viking Orbiter Planning	167
Viking Mission Definition No. 2	174
Mariner 69 Science Results	175
Quarterly Review.....	182
Money Problems at NASA	185
Working toward July 1975.....	192
7. VIKING LANDER: CREATING THE SCIENCE TEAMS	203
A Team of Scientists	205
Selecting a Contractor	216
Scientists, Instruments, and Subcontractors	220

8.	VIKING LANDER: BUILDING A COMPLEX SPACECRAFT	243
	Lander Mission Profile	244
	Science Data Return	249
	Top Ten Problems	251
	Testing the Lander	256
	Reorganizations and Additional Cutbacks	268
	Preparing for Launch	271
9.	SAFE HAVENS: SELECTING LANDING SITES FOR VIKING	277
	Financial Problems Threaten Orbital	
	Imaging System	279
	Preparing for Site Selection	284
	<i>Mariner 9's</i> Mission	288
	Candidate Sites	297
10.	SITE CERTIFICATION—AND LANDING	317
	Planning Site Certification	317
	The Significance of Radar	319
	Evolving a Certification Process	323
	Flight to Mars	325
	<i>Viking 1</i> at Mars	329
	Second Site No Easier	346
	Lessons Learned	356
11.	ON MARS	363
	Images from Orbit	363
	Measuring the Atmosphere	374
	On the Surface	380
	Science on Mars	390
	Life or No Life?	409
	Other Results	414
	EPILOGUE	421
	APPENDIXES	
	A. Orbital Relationships of Earth and Mars	427
	B. Voyager Project Highlights, 1966-1967	430
	C. Summary Data from Mariner, Voyager, and Viking	434
	D. Mars Experiments, Science Teams, and Investigators	453
	E. Launch Vehicles for Mars Missions	465
	F. Major Viking Contractors and Subcontractors	470
	G. Organization Charts	473
	BIBLIOGRAPHIC ESSAY	481
	ERRATA	488
	SOURCE NOTES	489
	INDEX	525
	AUTHORS	537
	LIST OF NASA PHOTOGRAPH NUMBERS	539

Tables

	Page
1. Milestones of the Recommended U.S. Spaceflight Program, July 1958.....	11
2. Proposed Lunar and Deep Space Program, 1958	20
3. JPL-Proposed Lunar and Planetary Missions, 12 January 1959	21
4. Influences on the Ten-Year Plan, 1960	23
5. Centaur Launch Schedule as Modified in January 1961	39
6. Physical Properties, Mars and Earth (1964)	60
7. Ames Life-Detection Team Evaluation of Proposed Biology Instruments—Development Status, 1963	72
8. Physical Properties of Mars: <i>Mariner 4</i> Findings	79
9. Highlights of Advanced Planetary Spacecraft Group Investigations, 1962	87
10. Ranking of Contractors Bidding on 1963 Voyager Study	90
11. AVCO Proposals for Missions to Mars, 1963	95
12. Voyager System Weights from 1963 Contractor Studies	97
13. Experiments Recommended for Voyager 1969 in 1963 Contractor Studies	98
14. NASA Budget Summary, Fiscal 1963 to 1966	102
15. Voyager Projected Costs	116
16. NASA Fiscal 1968 Budget	117
17. Final NASA Budget, Fiscal 1968	119
18. Sample Areas of Scientific Interest	130
19. Specific Objectives of an Early Mars Orbiter Probe	131
20. Post-Voyager Proposals for Planetary Exploration Projects	132
21. Estimated Costs for Mars Program, January 1968	136
22. Mars Program, January 1968	137
23. Lunar and Planetary Exploration Budget Plan, FY 1969	141
24. 20 Alternative Mission Modes Examined for Viking 73	149
25. Viking Mission Modes Examined at 8-9 November 1968 Briefing	150
26. Sources of Viking Orbiter Subsystems	156
27. Mariner 69 and 71 Spacecraft Comparisons	162
28. Major Test and Flight Hardware to be Developed by JPL for the Viking Orbiter	171
29. Pictures from Mariner Mars 69	176
30. Viking Project Orbiter System: Critical Schedule Activities, 1969	183
31. Viking Project Orbiter System: Baseline Conceptual Design Changes, Expected Weights, 1969	184
32. NASA Appropriations, FY 1968-1971	188
33. Viking Orbiter Schedules	193
34. Growth in Capacity of Data Storage Subsystems	197
35. Viking Orbiter Specifications, 1969-1975	200
36. Viking Science Proposals	212
37. Key Dates in Assessment of Viking Science Proposals	213
38. Estimates for Lander Payload, September 1969	214
39. Viking Science Cost Projections, September 1969	214
40. Alternatives for 1975 Viking Launch	219

ON MARS

41. Viking Cost Increases Because of Launch Delay	220
42. Viking Biology Instrument Schedule, 1971-1975	240
43. Cost History of Viking Lander and Selected Subsystems	251
44. Top Ten Problems	253
45. Mars Surface Thermal Simulation	261
46. Viking Cost Projections, 1974	269
47. Viking Demonstration and Training Tests	275
48. Candidate Landing Sites Selected August 1972	303
49. Changes in Candidate Landing Sites, October 1972	304
50. Polar Landing Sites Proposed December 1972	306
51. Major Training Tests for Planetary Operations	328
52. Geological Evolution of Martian North Polar Region	372
53. Structure of Martian Atmosphere	379
54. Mars and Earth Temperatures, 21 July 1976	391
55. Viking Radio Science Investigations	415