



# LAUNCHING INTO THE FUTURE

75 YEARS OF EXCELLENCE IN SPACE RESEARCH AT RAND

A black and white portrait of Michael Rich, a middle-aged man with glasses, wearing a dark suit, white shirt, and patterned tie. He is looking directly at the camera with a neutral expression. The background behind him is a dark, starry space scene with a bright, glowing nebula or star formation on the left and a rocket launch structure in the distance.

**MICHAEL RICH**  
PRESIDENT AND CHIEF EXECUTIVE OFFICER

RAND is proud to celebrate 75 years of excellence in space research and analysis. Bringing quality and objectivity to bear on critical policy issues, including the challenges and opportunities humanity confronts in space, is core to RAND's mission. Indeed, since the publication of Project RAND's first report—*Preliminary Design of an Experimental World-Circling Spaceship*—in 1946, our research and analysis have been inextricably linked to RAND's contributions to space policy. In the past 75 years, RAND has produced more than a thousand reports related to space. In this document, we spotlight a small number of those reports to highlight the range of our contributions and celebrate our commitment to making a difference for decades to come.



RAND has a rich history of significant and impactful research related to space, and RAND will continue to be a thought leader tackling the complexities of space policy in the New Space Era. We work hard every day to better connect RAND's space-related research and researchers with policymakers and practitioners around the globe. RAND is committed to providing the best possible insights and advice to space policymakers and to the public through its research on space situational awareness, responsible space behavior, deterrence and warfighting, and other critical space policy topics. As humanity faces a future that will increasingly depend on space, RAND is committed to pursuing space research and serving the public interest.



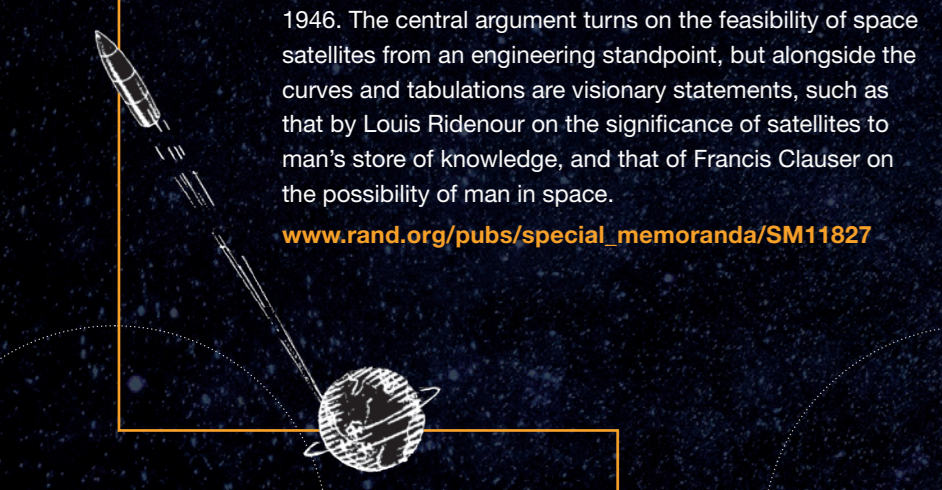
**BRUCE McCLINTOCK**  
RAND SPACE ENTERPRISE INITIATIVE

### MAY 2, 1946

## Preliminary Design of an Experimental World-Circling Spaceship

More than 11 years before the orbiting of Sputnik, history's first artificial space satellite, Project RAND—then active within Douglas Aircraft Company's Engineering Division—released its first report: Preliminary Design of an Experimental World-Circling Spaceship (SM-11827), May 2, 1946. The central argument turns on the feasibility of space satellites from an engineering standpoint, but alongside the curves and tabulations are visionary statements, such as that by Louis Ridenour on the significance of satellites to man's store of knowledge, and that of Francis Clauser on the possibility of man in space.

[www.rand.org/pubs/special\\_memoranda/SM11827](http://www.rand.org/pubs/special_memoranda/SM11827)



1940 >

**OTHER NOTABLE PUBLICATION**  
February 1, 1947  
*Communication and Observation Problems of a Satellite*

**OTHER NOTABLE PUBLICATION**  
February 1949  
*Mixing in Inhomogeneous Gas Jets*

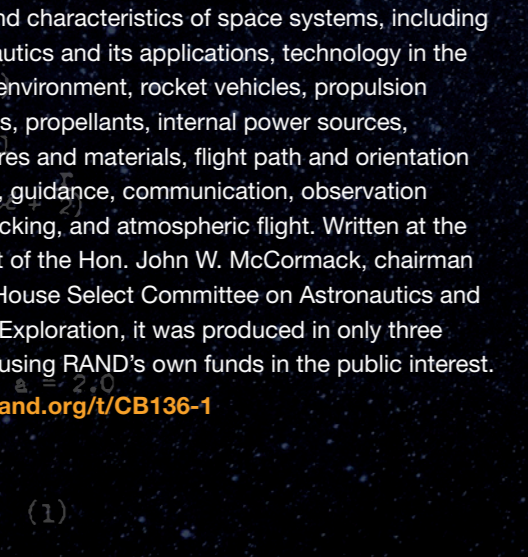
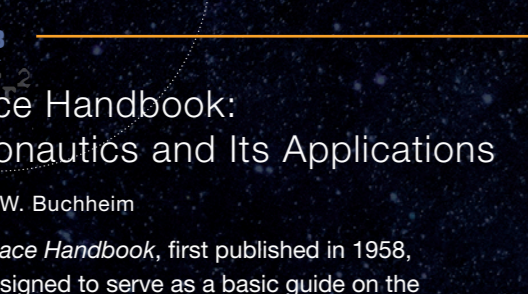


### 1950 >

## Space Handbook: Astronautics and Its Applications

Robert W. Buchheim  
The *Space Handbook*, first published in 1958, was designed to serve as a basic guide on the uses and characteristics of space systems, including astronautics and its applications, technology in the space environment, rocket vehicles, propulsion systems, propellants, internal power sources, structures and materials, flight path and orientation control, guidance, communication, observation and tracking, and atmospheric flight. Written at the request of the Hon. John W. McCormack, chairman of the House Select Committee on Astronautics and Space Exploration, it was produced in only three weeks using RAND's own funds in the public interest.

[www.rand.org/t/CB136-1](http://www.rand.org/t/CB136-1)



### 1964

## Habitable Planets for Man

Stephen H. Dole  
*Habitable Planets for Man* examines and estimates the probabilities of finding planets habitable to human beings, where they might be found, and the number there may be in our own galaxy. The author presents in detail the characteristics of a planet that can provide an acceptable environment for humankind, itemizes the stars nearest the earth most likely to possess habitable planets, and discusses how to search for habitable planets.

[www.rand.org/t/CB179-1](http://www.rand.org/t/CB179-1)



**SPACE MILESTONE**  
October 4, 1957  
Soviet Launch of Sputnik, the First Artificial Satellite

**SPACE MILESTONE**  
July 29, 1958  
National Aeronautics and Space Administration (NASA) Is Established

**OTHER NOTABLE PUBLICATION**  
March 1, 1954  
*Project Feedback Summary Report, Vol. 1 and Vol. 2*

**OTHER NOTABLE PUBLICATION**  
1956  
*Motion of a Small Body in Earth-Moon Space*

**OTHER NOTABLE PUBLICATION**  
July 20, 1959  
*Public Opinion and Social Effects of Space Activity*

**SPACE MILESTONE**  
October 1963  
RAND Engineer Walt Cunningham Is Selected by NASA for the Third Group of Astronauts. Cunningham Piloted Apollo 7's Lunar Module.

**SPACE MILESTONE**  
1964  
First NASA Administrator T. Keith Glennan Begins Ten-Year Service as a RAND Trustee

**OTHER NOTABLE PUBLICATION**  
June 1969  
*Creation of an Atmosphere for the Moon*

1960 >

**OTHER NOTABLE PUBLICATION**  
1962  
*The Commercial Uses of Communications Satellites*

**SPACE MILESTONE**  
March 18, 1965  
Alexey Leonov Becomes the First Human to Space Walk

**OTHER NOTABLE PUBLICATION**  
1966  
*Procedures for Estimating the Resource Requirements of Manned Space Flights*

**SPACE MILESTONE**  
July 20, 1969  
Neil Armstrong Becomes the First Human to Step on the Moon

**SPACE MILESTONE**  
April 22, 1968  
United Nations (UN) General Assembly Adopts the Rescue Agreement

**SPACE MILESTONE**  
April 12, 1961  
Yuri Gagarin Becomes the First Human to Travel in Space

**SPACE MILESTONE**  
October 10, 1967  
The Outer Space Treaty Goes into Effect

**OTHER NOTABLE PUBLICATION**  
1973  
*Martian Surface Coordinates*, published by Merton Davies, who, according to a 2001 *New York Times* article, may have "single-handedly observed more of the solar system than any other human."

**SPACE MILESTONE**  
January 14, 1975  
UN General Assembly Adopts the Registration Convention

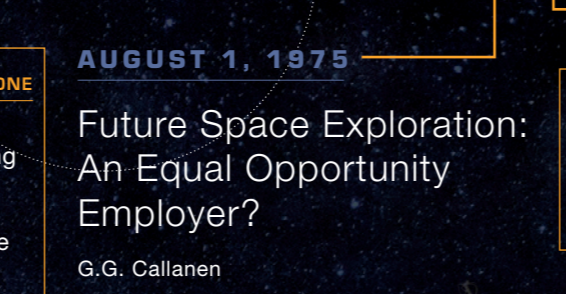
**SPACE MILESTONE**  
1979  
Apollo 11 Astronaut Michael Collins Begins Ten-Year Service as a RAND Trustee

### 1970 >

## Future Space Exploration: An Equal Opportunity Employer?

G.G. Callanan  
A discussion of the feasibility of women as future space travelers. The results of related past physiological tests are reviewed. Included are data on fatigue, endurance and response; reaction to altitude conditions; hormonal functions; and psychosocial obstacles. A brief historical perspective and some cost implications are presented.

[www.rand.org/pubs/papers/P5492](http://www.rand.org/pubs/papers/P5492)



### 1983

## A Development of Logistics Management Models for the Space Transportation System

Manuel J. Carrillo et al.  
This report identifies the characteristics of logistics system capability assessment and stockage optimization methods that reflect the unique nature of NASA's Space Transportation System's (STS's) launch and recovery cycle. It presents the mathematical foundations of approaches to such methods and demonstrates their feasibility in the context of NASA's and the U.S. Air Force's need to develop a sound, well-formulated logistics support strategy for the STS program.

[www.rand.org/pubs/reports/R3083](http://www.rand.org/pubs/reports/R3083)



**OTHER NOTABLE PUBLICATION**  
April 1978  
*Application of Electron Beams in Space for Energy Storage and Optical Beam Generation*

**SPACE MILESTONE**  
December 18, 1979  
UN General Assembly Adopts the Moon Agreement

**SPACE MILESTONE**  
April 12, 1981  
Space Shuttle Columbia's First Mission

**SPACE MILESTONE**  
January 28, 1986  
Space Shuttle Challenger Disaster

**SPACE MILESTONE**  
April 25, 1990  
Hubble Space Telescope Is Launched

1980 >

**OTHER NOTABLE PUBLICATION**  
1982  
*Crew Roles in Military Space Operations*

**SPACE MILESTONE**  
September 1, 1982  
U.S. Air Force Space Command Is Established

**OTHER NOTABLE PUBLICATION**  
May 1985  
*Commercial and Military Communication Satellite Acquisition Practices*

**SPACE MILESTONE**  
June 1983  
Dr. Sally Ride Becomes the First American Woman to Travel to Space

**SPACE MILESTONE**  
August 1983  
Dr. Guion Bluford Becomes the First African American to Travel to Space

**OTHER NOTABLE PUBLICATION**  
February 1987  
*New Weather Sensing and Forecasting Capabilities for Ground-to-Space Operations*

**SPACE MILESTONE**  
November 20, 1998  
International Space Station Is Launched

**OTHER NOTABLE PUBLICATION**  
1998  
*International Agreements on Cooperation in Remote Sensing and Earth Observation*

**SPACE MILESTONE**  
April 28, 2001  
Dennis Tito Becomes the First Space Tourist

**SPACE MILESTONE**  
January 11, 2007  
Anti-Satellite Missile Test by China

**OTHER NOTABLE PUBLICATION**  
June 17, 2007  
*Space Command Sustainment Review: Improving the Balance Between Current and Future Capabilities*

**SPACE MILESTONE**  
November 2, 2000  
First Crew Occupies the International Space Station

**OTHER NOTABLE PUBLICATION**  
November 2, 2010  
*Confronting Space Debris: Strategies and Warnings from Comparable Examples Including Deepwater Horizon*

**SPACE MILESTONE**  
December 21, 2015  
Falcon 9 Becomes the First Reusable Rocket Stage

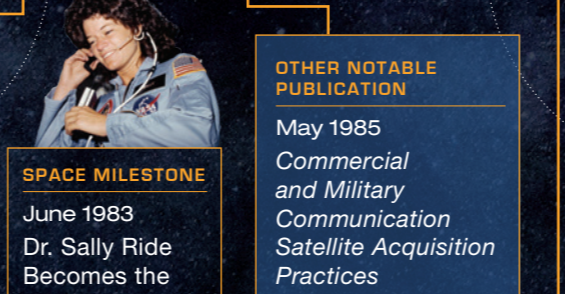
**SPACE MILESTONE**  
January 2018  
Dr. Mae Jemison, the First Black Woman to Travel into Space, Delivers 11th Haskins Lecture on Science Policy at RAND.

### 1990 >

## Space: Emerging Options for National Power

Dana J. Johnson, Scott Pace, and C. Bryan Gabbard  
This report presents the results of a study that examined the extent to which both military and economic spacepower will influence national security strategy and the conduct of future military operations. It attempts to articulate the key military space policy issues facing the United States and place them in the larger context of a changing strategic environment to define new options for the exercise of spacepower in the pursuit of national interests.

[www.rand.org/t/MR517](http://www.rand.org/t/MR517)



**OTHER NOTABLE PUBLICATION**  
1995  
*The Global Positioning System: Assessing National Policies*

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First Crew Occupies the International Space Station

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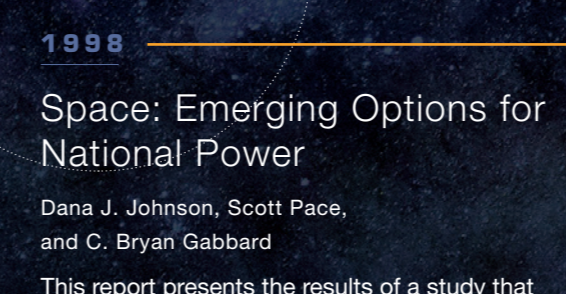
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### 2000 >

## Gaming Space: A Game-Theoretic Methodology for Assessing the Deterrent Value of Space Control Options

Forrest E. Morgan et al.  
The objective of the research in this report is to help the Air Force assess the deterrent value of alternative defensive space control (DSC) options. Specifically, the authors sought to develop a methodology to identify those DSC options that would likely contribute to deterrence and those DSC options that would likely generate escalation dynamics or political costs that could further imperil U.S. interests.

[www.rand.org/t/RR694](http://www.rand.org/t/RR694)



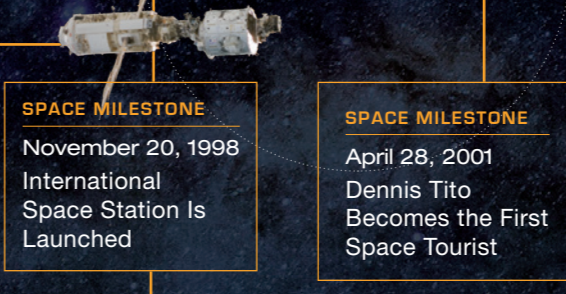
**SPACE MILESTONE**  
2009  
RAND Trustee Barbara Barrett Trains as an Astronaut and Serves on Backup Crew for Soyuz TMA-16

### 2010 >

## Responsible Space Behavior for the New Space Era: Preserving the Province of Humanity

Bruce McClintock et al.  
The past two decades have seen the start of a New Space Era, characterized by more spacefaring nations and companies and a growing risk of collisions and conflict. Yet the basic treaties and mechanisms that were crafted 50 years ago to govern space activities have only marginally changed. To help address the gap between current space governance and future needs, the authors of this Perspective summarize the development of space governance and key problem areas, identify challenges and barriers to further progress, and, most importantly, offer recommended first steps on a trajectory toward responsible space behavior norms appropriate for the New Space Era.

[www.rand.org/t/PEA887-2](http://www.rand.org/t/PEA887-2)



**OTHER NOTABLE PUBLICATION**  
June 2, 2014  
*Satellite Anomalies: Benefits of a Centralized Anomaly Database and Methods for Securely Sharing Information Among Satellite Operators*

**SPACE MILESTONE**  
January 1, 2002  
Space Weapons, Earth Wars

**OTHER NOTABLE PUBLICATION**  
1994  
*A League of Airmen: U.S. Air Power in the Gulf War*

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### 2020 >

## Assessing the Impact of U.S. Air Force National Security Space Launch Acquisition Decisions: An Independent Analysis of the Global Heavy Lift Launch Market

Assessing the Impact of U.S. Air Force National Security Space Launch Acquisition Decisions

[www.rand.org/pubs/papers/P5492](http://www.rand.org/pubs/papers/P5492)



**OTHER NOTABLE PUBLICATION**  
March 13, 2020  
*Creating a Separate Space Force: Challenges and Opportunities for an Effective, Efficient, Independent Space Service*

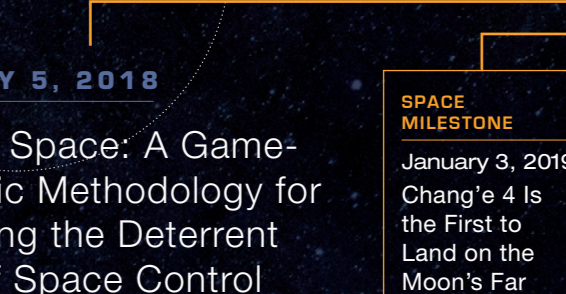
**OTHER NOTABLE PUBLICATION**  
May 17, 2021  
*Analyzing a More Resilient National Positioning, Navigation, and Timing Capability*

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