Planetary Protection, NASA, the Science Mission Directorate, and Everything

John D. Rummel
NASA Headquarters, Washington, DC USA

6 July 2006

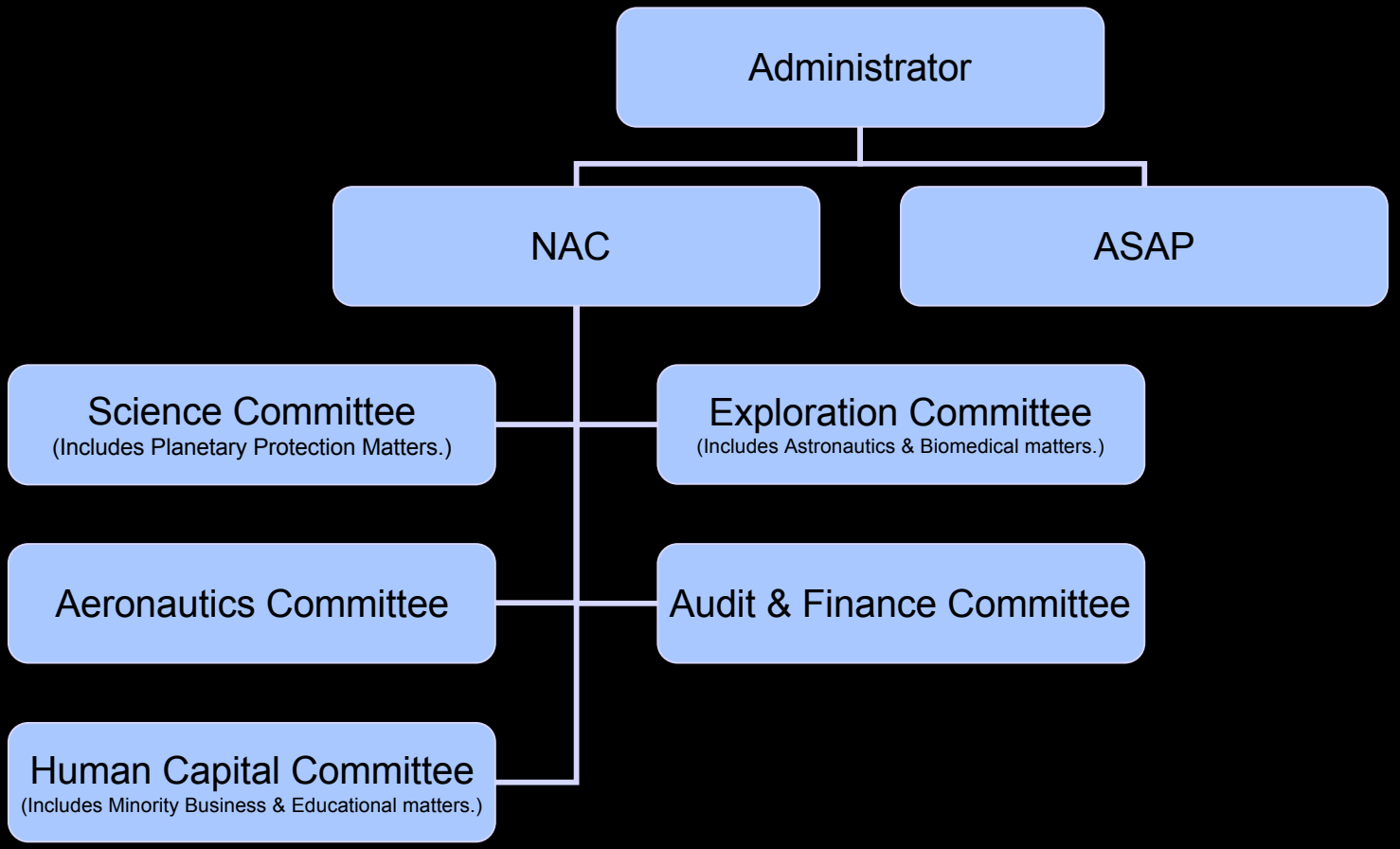
NAC Science Subcommittee Meetings

July 2006

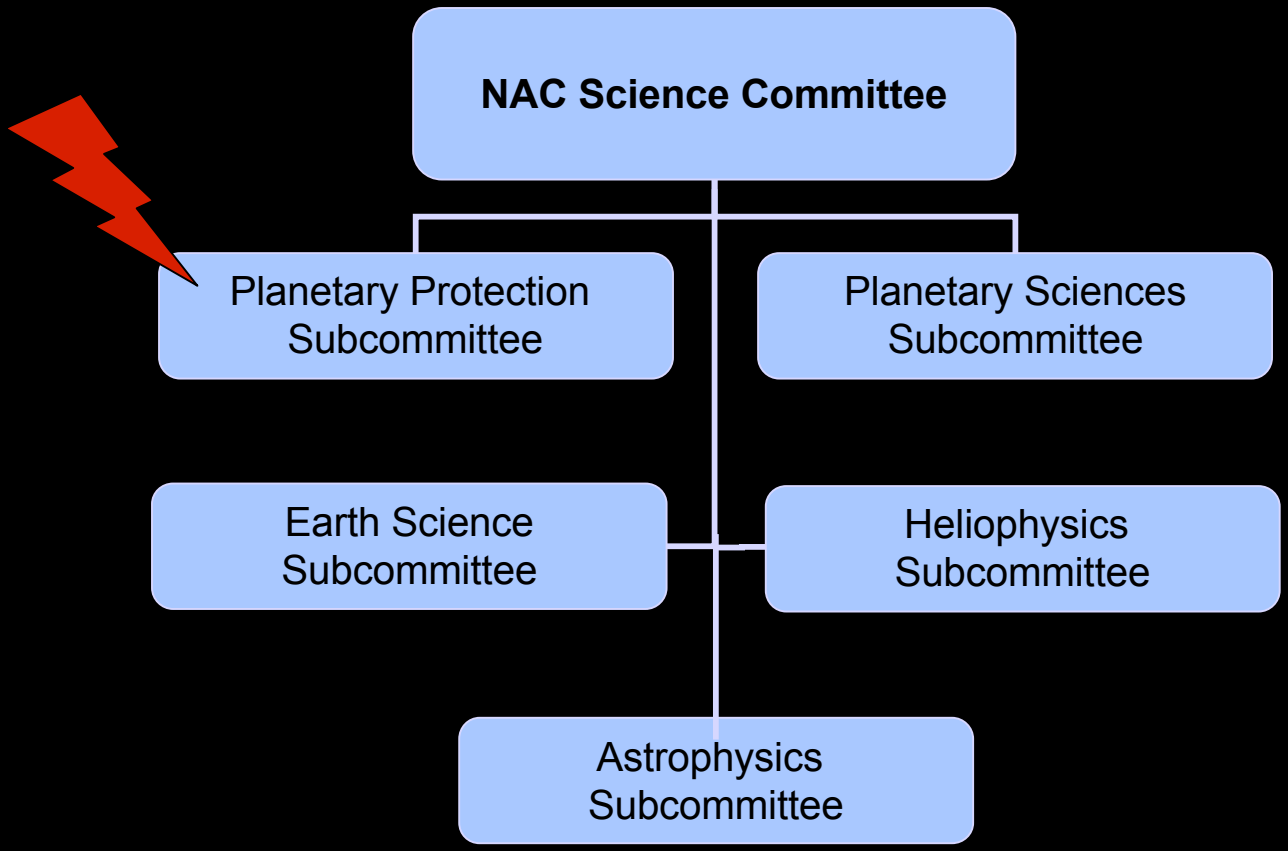
6 July

830-845	Welcome	Schmitt
845-900	Logistics	Allen
900-945	Conversation with the Administrator	Griffin (Invited)
945-1015	*Science Mission Directorate Update*	*Cleave*
1015-1045	Risk Management for Science Missions	Ledbetter
1045–1100	*Break*	
1100-1145	Exploration Strategy and Architecture Development	Cooke
1145-1230	Lunar Science Workshop Planning Introduction	Jolliff
1230-130	*Lunch*	
130-330	Subcommittee Topics (breakouts)	Chairs
330-345	*Break*	
345-600	Subcommittee Topics (breakouts)	Chairs
601pm	Subcommittee is OVER	

NEW ADVISORY COUNCIL STRUCTURE



NEW ADVISORY COMMITTEE STRUCTURE



NASA ADVISORY COUNCIL
PLANETARY PROTECTION SUBCOMMITTEE

TERMS OF REFERENCE

The Planetary Protection Subcommittee (PPS) is a standing subcommittee of the NASA Advisory Council's (the Council) Science Committee supporting the advisory needs of the Administrator, the Science Mission Directorate (SMD), the Exploration Systems Mission Directorates (ESMD), and other NASA Mission Directorates as required. The scope of the Subcommittee includes programs, policies, plans, hazard identification and risk assessment, and other matters pertinent to the Agency's responsibilities for biological planetary protection. This scope includes consideration of NASA planetary protection policy documents, implementation plans, and organization. The Subcommittee will review and recommend appropriate planetary protection categorizations for all bodies of the solar system to which spacecraft will be sent. Outside the scope of the Subcommittee's responsibilities are issues that pertain solely to the quality and interpretation of scientific experiments and data, however, these matters should be included in its deliberations.

Per NPD 1150.11, the Subcommittee will be managed under procedures that ensure the same spirit of openness and public accountability that is embodied by the Federal Advisory Committee Act (FACA). This includes public meetings as appropriate and public access to Subcommittee records.

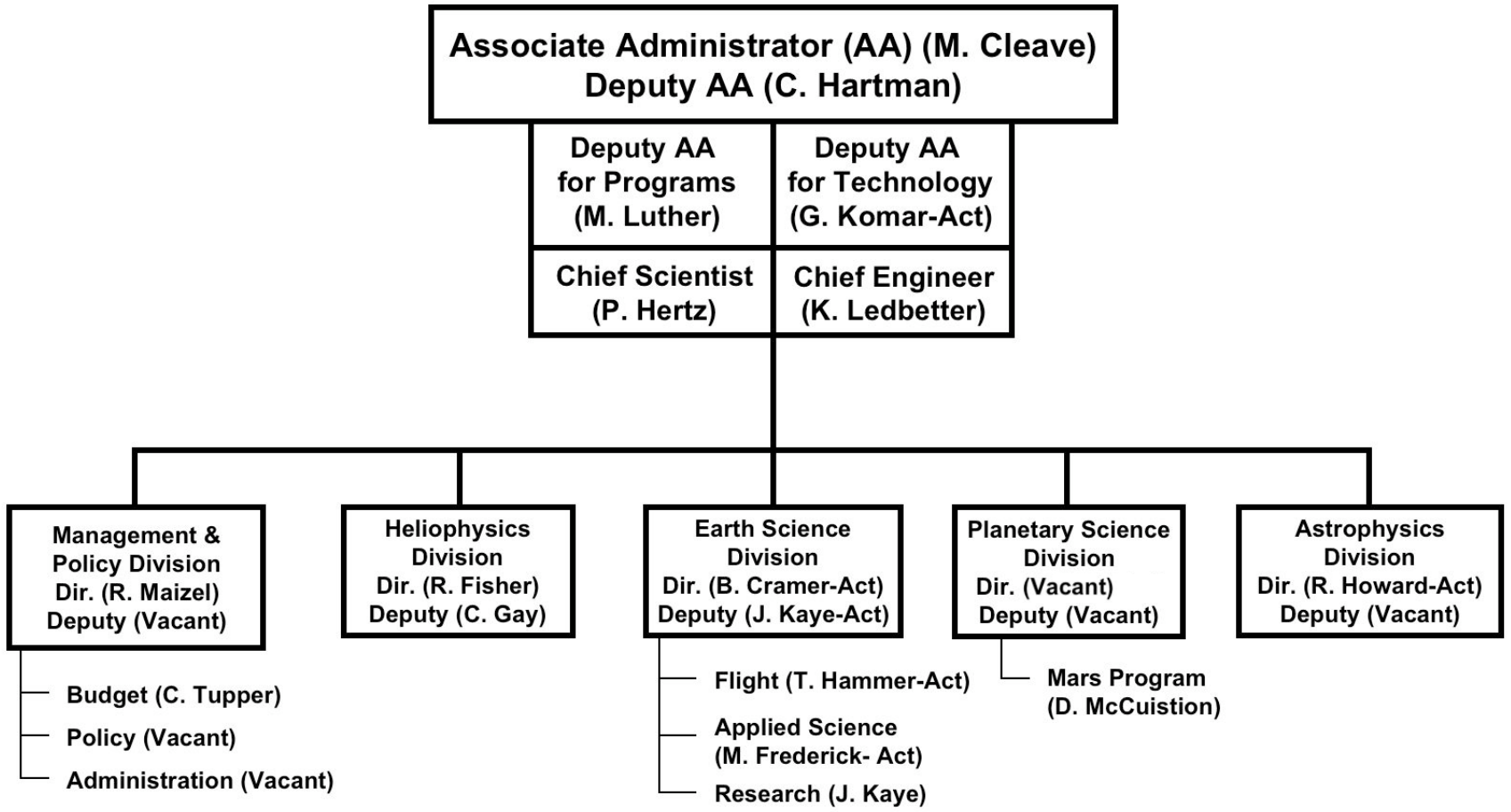
[redacted]

MEMBERSHIP

The membership of the Subcommittee will consist of leading scientists with relevant expertise drawn from industry, academia, independent researchers and Government institutions. The Administrator, in consultation with the Council Chair, will appoint the members and Chair of the Subcommittee. The Council Chair will consult with the SMD and ESMD Associate Administrators and the Council Committee Chairs in making Subcommittee Chair and membership recommendations to the Administrator. Appointments generally will be for a three-year term, with reappointment and replacement, at the discretion of the Administrator, made in consultation with the Subcommittee Chair as well as with the parties indicated above. A Vice-Chair will be selected from among the members by the Subcommittee Chair in consultation with the Chair of the Council's Science Committee.

In addition to regular members, nonvoting representatives from other U.S. Government agencies with an interest in planetary protection will be invited as Subcommittee observers. Nonvoting liaison representatives from other national and international organizations undertaking joint solar system exploration missions with NASA also will be invited as Subcommittee observers. Invitations to participate as observers in these two categories will be issued by the SMD Associate Administrator, in consultation with the Science Committee Chair and the Subcommittee Chair.

Science Mission Directorate Organization Chart



Current Status, Planetary Science Division

- Cassini remains in prime mission around Saturn—spectacular results
- New Horizons mission is enroute to Pluto
- 5 US missions and 1 European mission are currently in operation around or on Mars—2 more US and 1 European in development
- Venus Express (ESA) is in orbit around Venus
- MESSENGER is enroute to Venus, Mercury
- DAWN Discovery mission was reinstated, is now continuing development for launch in 2007
- Juno mission (New Frontiers) planned for 2010 launch
- Proposals to Discovery AO are under initial review
- Mars Scout AO proposals due in early August
- R&A funding projected for 15% cut—Astrobiology R&A already cut by ~one-third in FY2006
- Mars technology base is severely restricted—focused only

Current Status, Planetary Science Division (Personnel)

- Division Deputy left to MSFC on 31 March
- Division Director's last day on the job (he is leaving NASA) is tomorrow
  - Replacements for above have not been identified
- DAWN PE resigned from NASA (personal reasons)
- Non-PhD Program Scientists are being replaced, regardless of work experience
  - Reassignments in work/underway
- One PSD Secretary left NASA—not replaced yet
- Dr. Catharine Conley is on detail from ARC to work on planetary protection!

FY 2006 Op Plan/FY 2007 Request

FY06 as Amended	(Budget Authority in Millions)	FY 2006 Op Plan	FY 2007	Change	FY 2008	FY 2009	FY 2010	FY 2011
9,829.4	**SCIENCE, AERO & EXPLOR.**	**9,721.3**	**10,524.4**	**8.3%**	**10,594.4**	**11,136.4**	**11,747.0**	**15,526.4**
5,341.8	**SCIENCE**	**5,253.7**	**5,330.0**		**5,383.1**	**5,437.1**	**5,491.5**	**5,546.4**
1,667.5	Solar System Exploration	1,582.3	1,610.2		1,598.6	1,840.4	1,899.6	1,846.7
1,522.4	Universe	1,507.9	1,509.2		1,500.9	1,307.9	1,276.1	1,309.7
2,151.9	Earth-Sun System	2,163.5	2,210.6		2,283.7	2,288.9	2,315.8	2,390.0
	EXPLORATION SYSTEMS	**3,050.1**	**3,978.3**		**3,981.6**	**4,499.8**	**5,055.9**	**8,775.1**
	Constellation Systems	1,733.5	3,057.6		3,067.6	3,612.9	4,083.8	7,698.4
	Exploration Sys Res & Tech	692.5	646.1		632.2	605.1	679.2	764.6
	Human Sys Reseach & Tech	624.1	274.6		281.8	281.8	292.8	312.1
	AERONAUTICS RESEARCH	**884.1**	**724.4**		**731.8**	**732.4**	**722.8**	**722.7**
	CROSS-AGENCY SUPPORT PR	**533.5**	**491.7**		**497.9**	**467.1**	**476.8**	**482.2**
	Education Programs	162.4	153.3		152.4	153.1	154.0	153.3
	Advanced Business Systems	156.3	108.2		106.9	73.8	78.5	80.6
	Innovative Partnerships	214.8	197.9		205.5	206.2	209.7	212.9
	Shared Capabilities	0.0	32.2		33.1	33.9	34.7	35.5
	EXPLORATION CAPABILITIES	**6,869.7**	**6,234.4**	**-4.4%**	**6,680.4**	**6,442.3**	**6,242.9**	**2,896.7**
	SPACE OPERATIONS	**6,869.7**	**6,234.4**		**6,680.4**	**6,442.3**	**6,242.9**	**2,896.7**
	International Space Station	1,753.4	1,811.3		2,200.3	2,255.6	2,197.1	2,360.8
	Space Shuttle*	4,777.5	4,056.7		4,087.3	3,794.8	3,651.1	146.7
	Space and Flight Support	338.8	366.5		392.8	392.0	394.7	389.2
	INSPECTOR GENERAL	**32.0**	**33.5**	**4.7%**	**34.6**	**35.5**	**36.4**	**37.3**
	TOTAL AGENCY	**16,623.0**	**16,792.3**	**3.2%**	**17,309.4**	**17,614.2**	**18,026.3**	**18,460.4**
	*yr to yr increase***			*3.2%*	*3.1%*	*1.8%*	*2.3%*	*2.4%*

House Appropriations Action

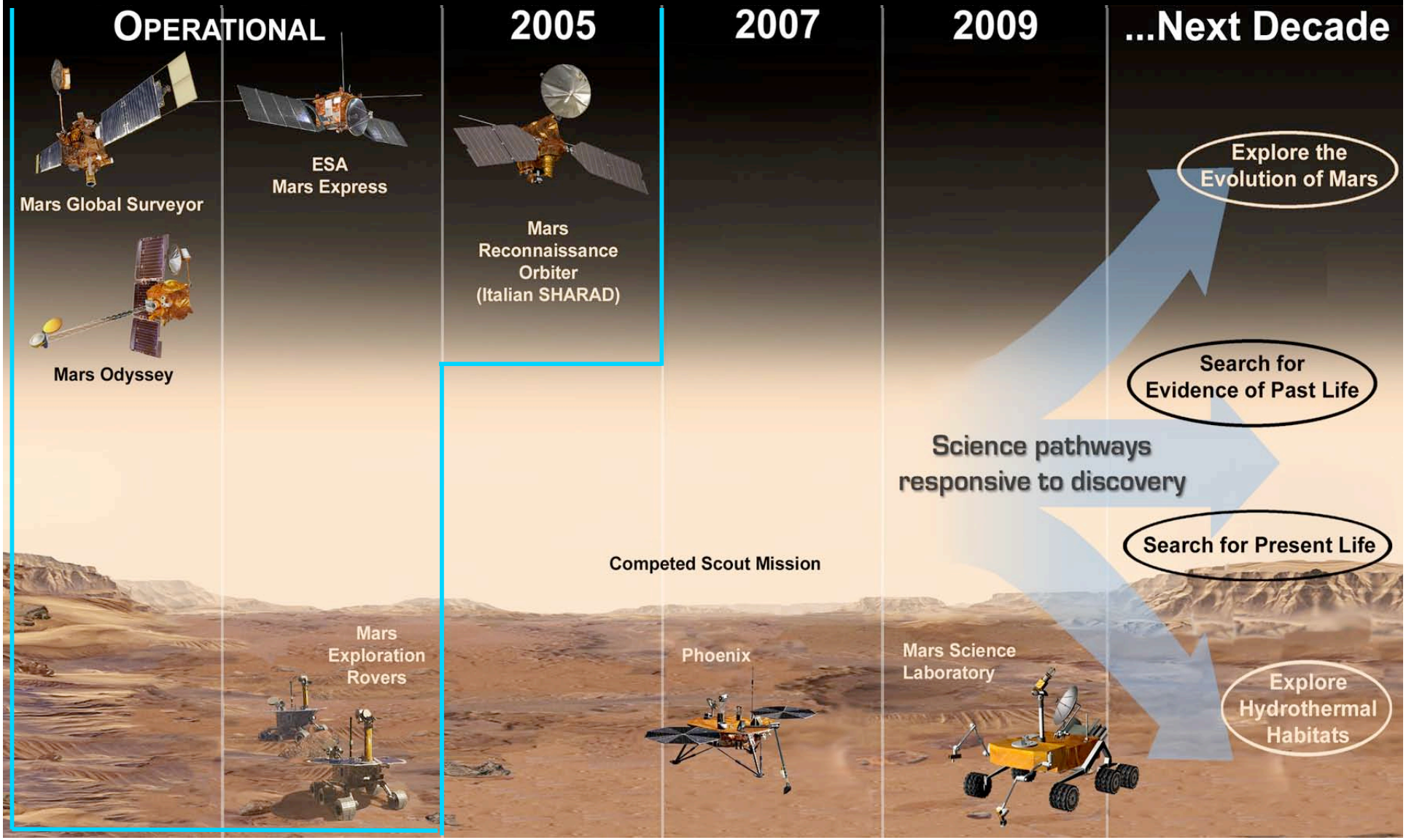
Space Science—

- The recommendation includes a total of $5,404,800,000 for the Science Mission Directorate, an increase of $75,000,000 above the request
- Increases above the request include: $50,000,000 for research and analysis (allocation TBD);
- $15,000,000 to initiate planning for an orbiter/lander mission to Europa;
- and $10,000,000 for Terrestrial Planet Finder for continued technology development.

Senate action TBD....

MARS: Where We Are…Right Now

Launch Year



…and Where We Are Now

The President's *proposed* FY07 budget to Congress

Program funding expected to remains slightly below the FY05 budget level

Growth rate capped at 1.0-1.2%

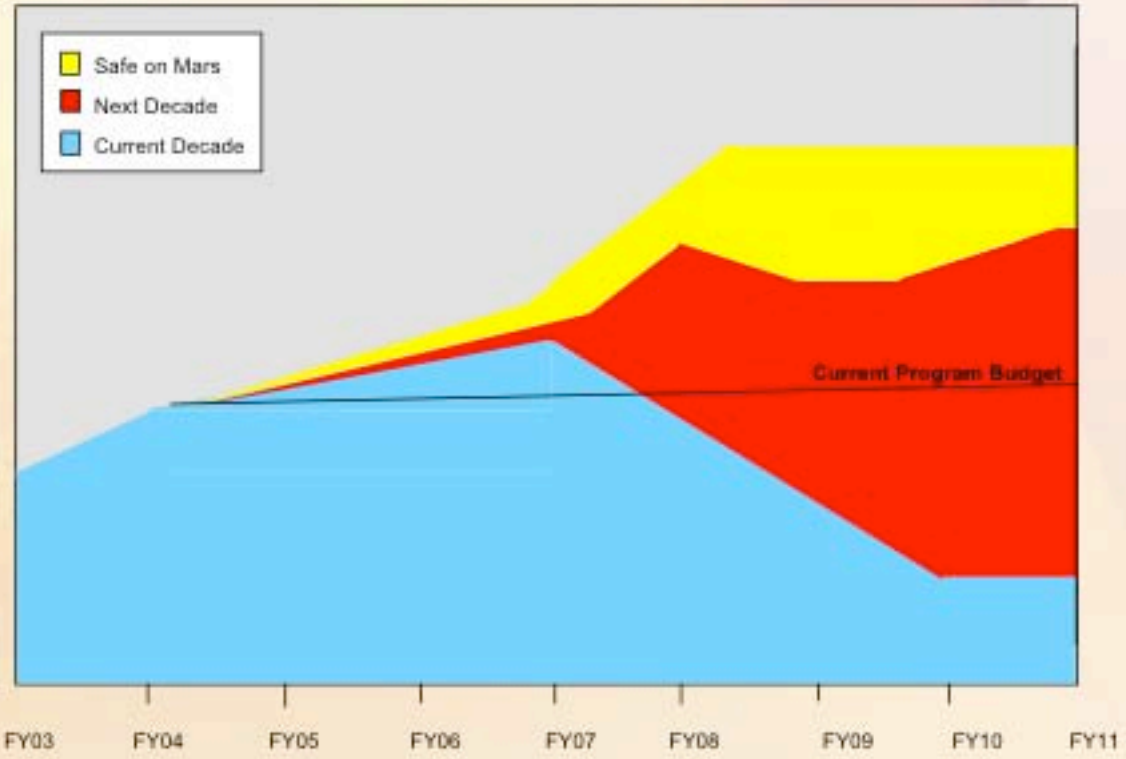
Operating Missions reduced

All Program Management elements reduced

- E/PO
- Reserves
- Other Program elements

Technology significantly reduced

Scout AO MoO available funding reduced

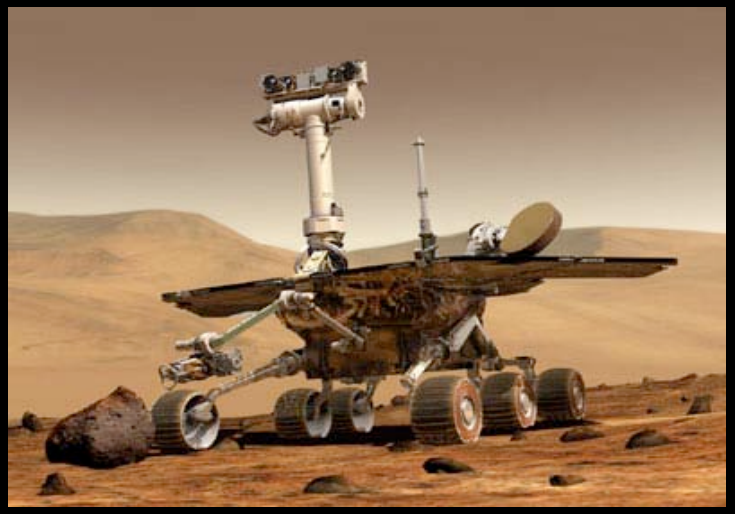


Proposed funding will support a viable Mars robotic exploration program through most of the next decade

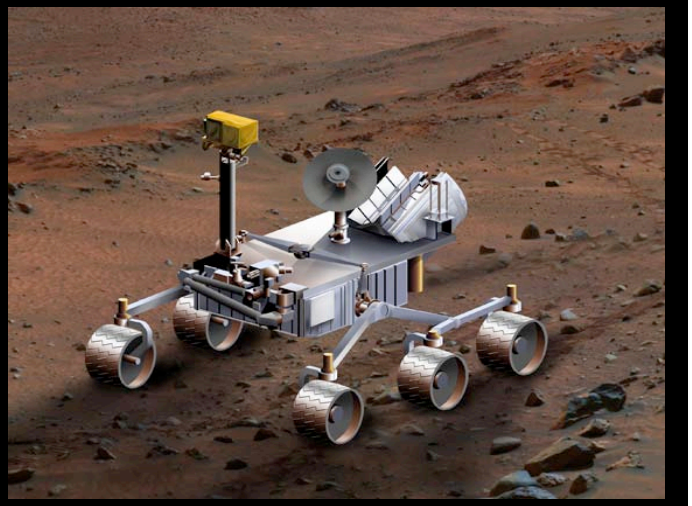
Mission Concepts Evaluated

Mars Science Orbiter and Telecom

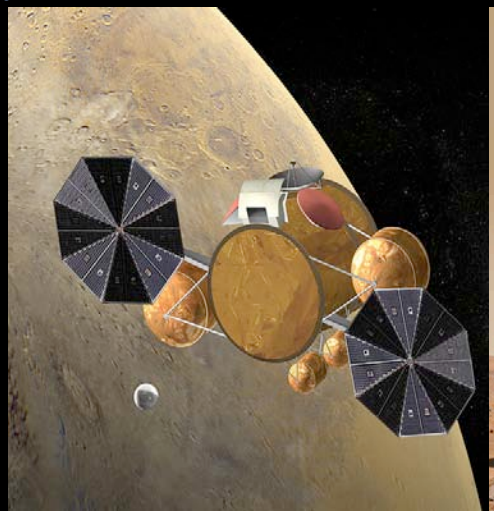
Midrovers



Astrobiology Field Laboratory

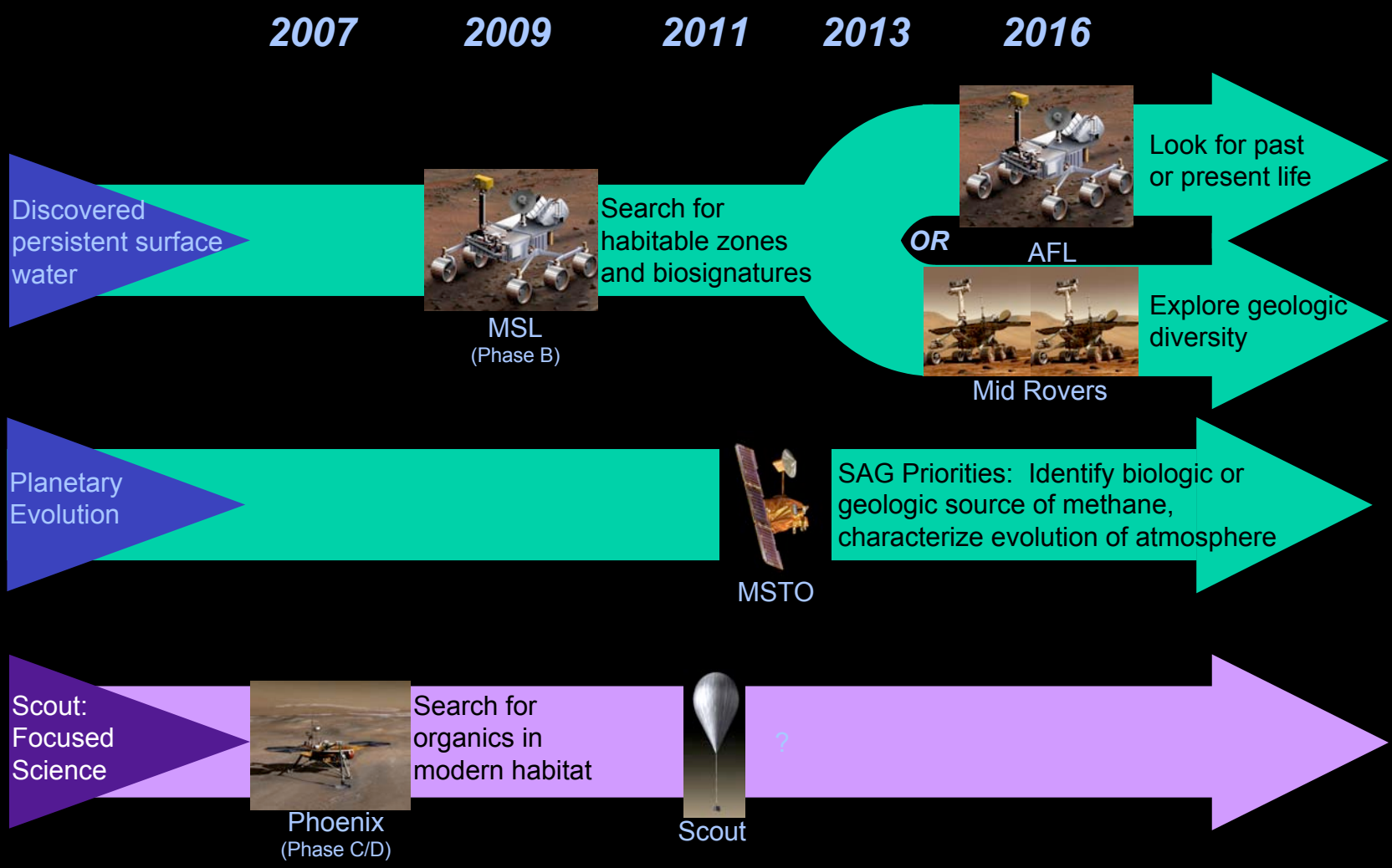


Planetary Evolution and Meteorology Network



Mars Sample Return

Where We Are With The President's '07 Budget



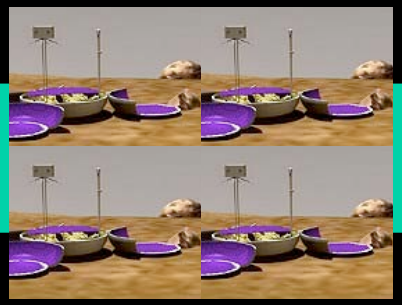
…plus Missions Beyond 2016

Laboratory Studies

Mars Sample Return

Study geological history and climate; test definitively for life; study evolution and interactions of atmosphere/hydrosphere/regolith

Planetary Evolution



Network Landers

Understand structure, state and processes of interior; characterize meteorology

Scout: Focused Science

Scout

Focused studies of life, climate, and geological sciences

Order and timing depends on budgets & discoveries

Summary

Outstanding science has been, and will continue to be done, however:

- *We are likely to remain in a challenging resources environment*
  - *The President's budget has not yet been approved*
- *MSL is critical to establishing the next decade*
  - *Keep it in '09 or possibly lose it*
- *Missions past '16 are dependent on future budget and discoveries*
- *Overall, the program is fragile*
  - *Any demands for additional funds must come from something else in the Program*
- *Technology is at a critical juncture—2013/2016 focus only*
- *International collaboration can open opportunities to enhance this portfolio of missions*
- *Human Exploration linkage needs to be maintained in support of the Vision*

NASA's Vision and Mission

(from Paul Hertz, SMD Chief Scientist)

- The Vision for Space Exploration:
  - Fundamental goal "to advance U.S. scientific, security, and economic interests through a robust space exploration program"
    - NASA's has embraced this challenge as the Agency's vision
    - SMD leadership role to advance U.S. space and Earth science interests in the context of the vision

- NASA's Mission:
  - To pioneer the future in space exploration, scientific discovery, and aeronautics research
    - SMD leadership role to pioneer the future in scientific discovery

SMD Science Priority Strategy

(from Paul Hertz, SMD Chief Scientist)

- Priorities set through Dialog with the Science Community
- Strategic recommendations on science priorities via the NRC
  - Decadal surveys
  - Focused questions of a strategic nature
  - Review of strategic plans
- Tactical advice on implementation of strategic priorities via
  - Science committee of the NAC and subordinate groups
  - Workshops with science investigator community
  - Participation in major professional societies (AGU, AMS, AAS, etc)
- Technical interchange on detailed requirements and engineering trades via funded Principal Investigators and Science Teams

NAC-led Lunar Science Workshop

(from Paul Hertz, SMD Chief Scientist)

- The NAC Chair has asked the Science Committee and Subcommittees to convene a workshop this Fall to identify lunar science priorities for use in influencing Lunar Exploration architecture and capabilities
  - Led by NASA Advisory Council Chair
- Historically comparable to 1965 Woods Hole conference for Apollo [et seq.]
- Overall objectives:
  - Consider exploration science, Lunar science, and Lunar-based science for a return to the Moon
  - Develop science objectives and priorities as contribution to return to the Moon program
  - Planning, spacecraft design, training, and operations
  - Consider Decadal Surveys and other strategic inputs

NAC-led Lunar Science Workshop

Topics Suggested by NAC Chair

Planetary Sciences

- Testing of Giant Impact Hypothesis
- Age(s) of Extremely Large Basin(s)
- Testing of Impact "Cataclysm" Hypothesis
- Global Delineation of Internal Structure of the Moon
- Timing of Lunar Core Formation and Dynamo Circulation
- Global Sampling / Remote Sensing Correlations of Major Geological and Geochemical Units
- Depositional History of Polar Cometary Volatiles
- Determination of Resource Distribution & In Situ Concentrations, Particularly at the Poles
- Testing of Mars Sampling Systems and Strategies
- Lunar-Based Instrumentation Networks

Discipline-Specific Possible Lunar-Based Science Considerations

- Astrophysics
  - Potential role for the Moon as observatory platform
  - Information for evaluation of designs of potential Lunar-based observatories
    - Additional characterization of Lunar environment
    - Protection of critical systems
  - Galactic and solar radiation history
- Earth Science
  - Lunar-based instrumentation
- Heliophysics
  - Lunar-based instrumentation
  - Regolith and ejecta blanket stratigraphy
- Planetary Protection
  - Testing of Systems and Strategies in an Extreme Environment
- Planetary Science (non-Lunar)
  - Very low pressure clathrate experimentation (Europa and Mars)
  - Martian field exploration systems and approaches

Lunar Quarantine?

Dr. Worden (7 May 06) —

"...Perhaps the nearest term use of the moon to quarantine dangerous technologies may be the return of possibly life-bearing Martian material. With growing life evidence in the form of variable methane and formaldehyde concentrations on Mars, the likelihood that either human expeditions to Mars or even return of Mars samples will be forbidden until they can be determined to be safe—or possible Mars life can be ascertained.

Our experience with mixing vastly different life forms is that one usually destroys the other. The benefit of knowledge and even products of Martian life, if it exists is awesome. But I for one wouldn't want to take the maybe 50-50 chance that Earth life is on the losing side of the exchange.

Correspondingly, I think that building a Mars habitat and receiving laboratory on the moon for Mars samples could allow us to determine its safety - and perhaps compatibility with Earth life. Several investigators such as Paul Todd have designed simple and affordable Mars habitats for the moon that could perform this function. Given the benefits I would suspect these facilities might even be funded from private sources.

Again, one of the key aspects to the use of the moon as a quarantine lab for private product development is the issue of ownership. No one will invest in expensive facilities unless they have some confidence in continued use akin to ownership. As noted earlier, I believe the Outer Space Treaty arguably allows private, non-government ownership. It's essential that we address this issue soon...."

Lunar Quarantine?

Response, Rummel —

- The issue of formaldehyde and methane on Mars is an intriguing one, but the detection of formaldehyde has only been reported by one investigator and the source of the methane reported by him and two others has not been established. Life is only one of several choices, and the others are considered more likely by most.

- That being said, there is no impact of methane detection on the plans we have made for the safe return and quarantine of Mars samples—plans which have been vetted by the most distinguished biological and planetological experts in the world, and which have been commented upon (favorably) by a number of public groups. We *have* to assume that Mars life exists in order to make any containment and quarantine protocol credible.

- Earth return can be done safely, though it is expensive (at about $150M for the sample return facility and the same amount for the flight system enhancements to keep the failure rate to < 1 in 10^6). On the other hand, any such return and quarantine on the Moon would cost tens of billions of dollars and add years to the time required to accomplish a Mars sample return mission. That scenario requires a wait for the lunar return, the establishment of an appropriate lunar infrastructure and baseline biological database.

Lunar Quarantine?

Response, Rummel (cont.) —

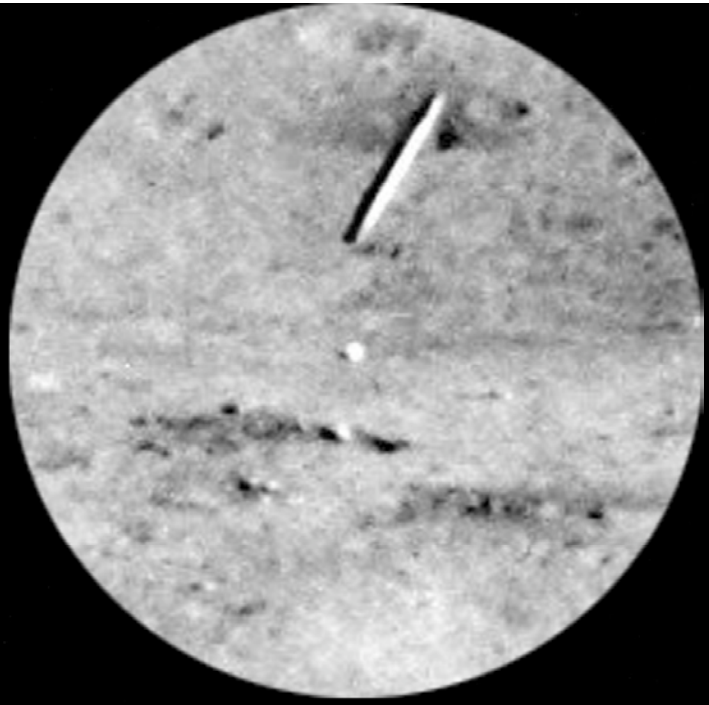
- I estimate that a lunar quarantine would also result in a net decrement to safety—especially if one wishes to include the safety of the people setting up and doing the analyses—with or without the potential for danger in a Mars sample. Adding people working in a remote and hazardous environment (e.g., the Moon) is no way to ensure a robust, efficient, and thorough hazard assessment. One presumes that they will eventually wish to return to Earth themselves, and any number of non-nominal issues in sample handling—including a breach in handling, or a required evacuation of the lunar handling facility—could compromise the safe handling of the sample in an unforgiving environment.

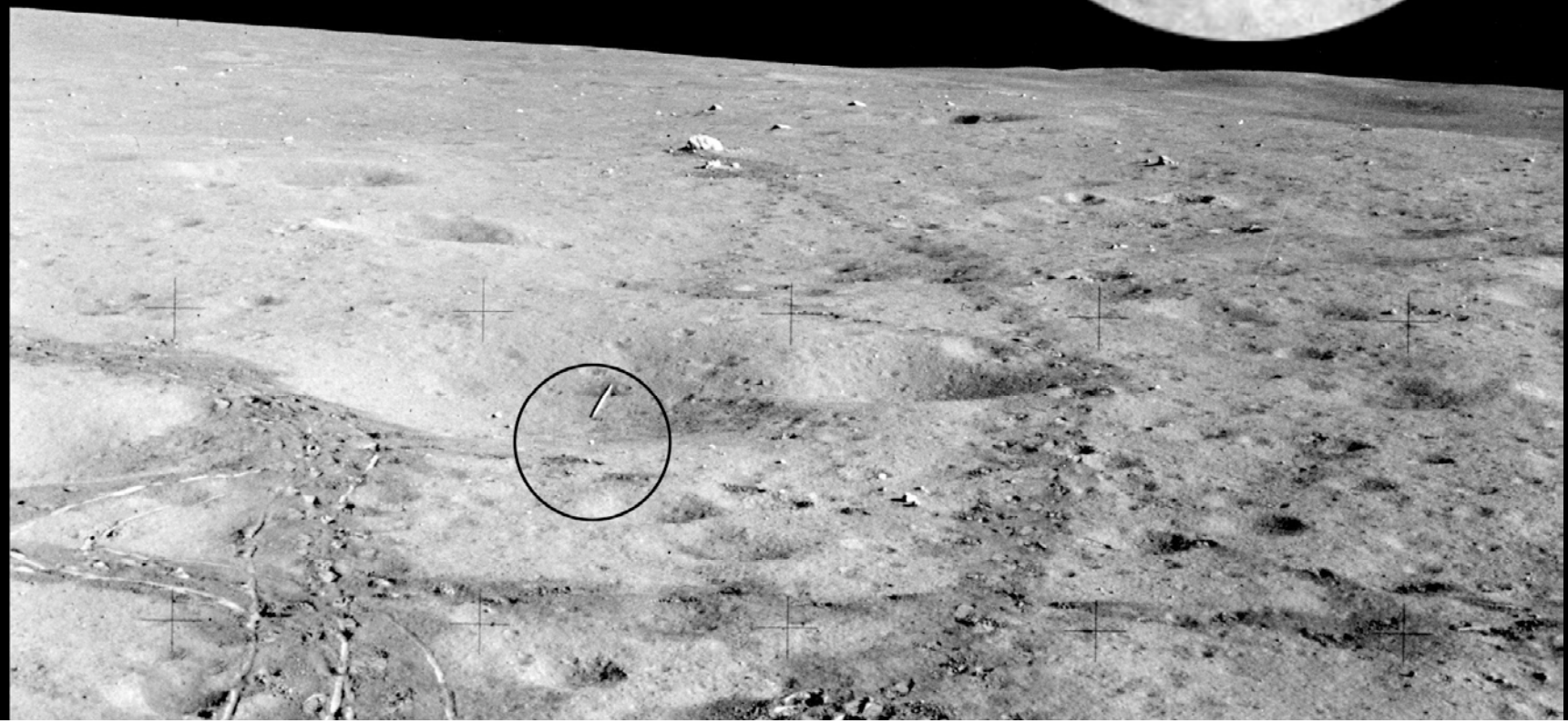
Lunar Quarantine?

And this sort of thing is why we need to address this issue in some detail:

Category	Objective ID Number	Name	Summary	Value
Global Partnership	**mGP5**	Establish internationally recongized planetary protection mechanisms to prevent forward and backward contamination of the Moon.	Characterize the effects of human activity on the lunar surface to create planetary protection mechanisms to prevent contamination of the Moon by items brought by Earth. Also, test planetary protection of the Earth by items arriving from the Moon.	Understanding the impact of human activity on the Moon's environment and the impact of lunar activities on the Earth's environment can help develop protocols and standards for future settlement of the Moon and exploration of Mars. These protocols will help prevent environmental contamination of sites on the Moon and Mars. Also, the Moon may be an ideal place to return Mars samples, so as not to contaminate the Earth.

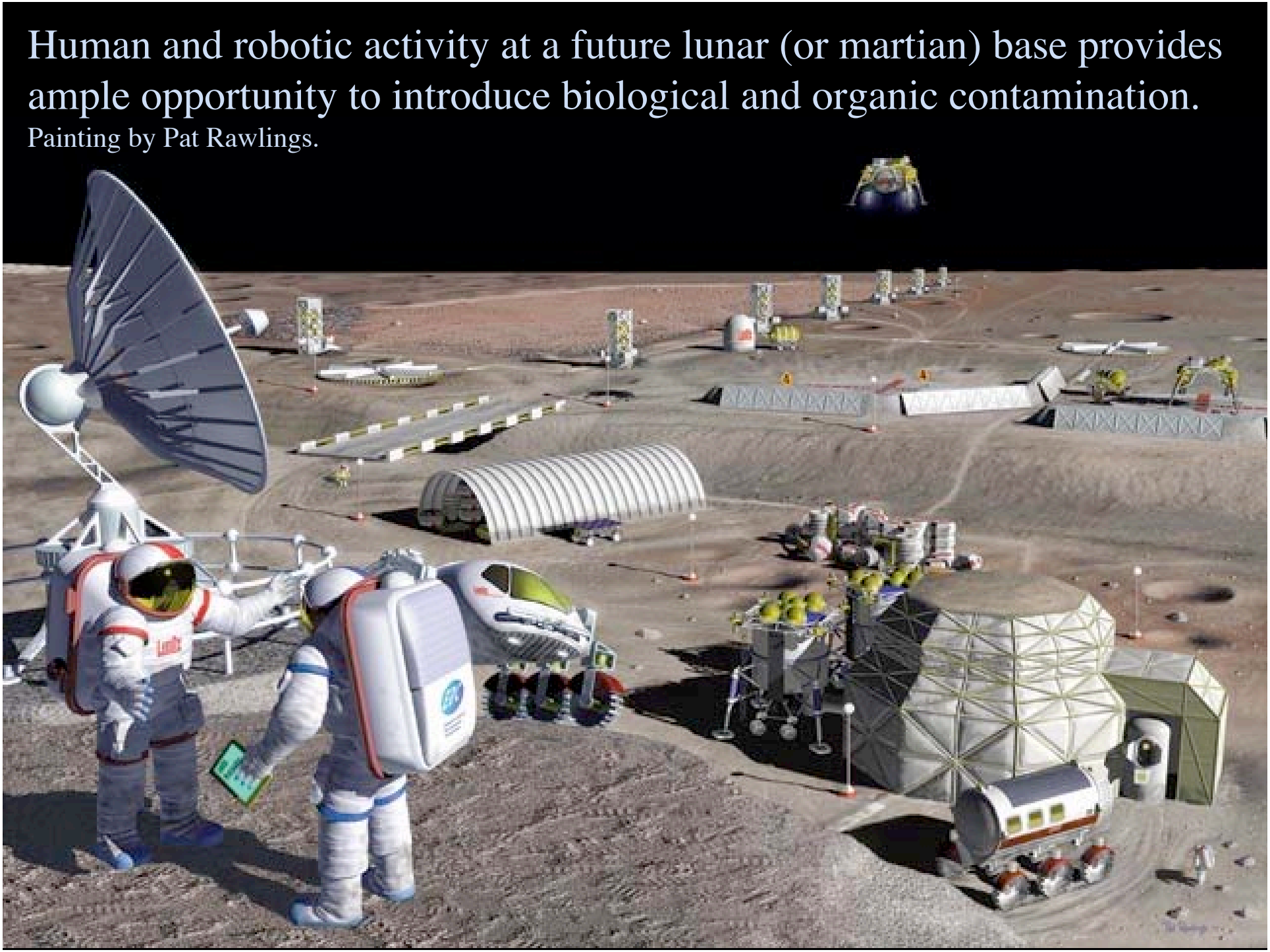
Photo (AS14-66-9337) of the lunar surface taken during the Apollo 14 mission. The enlarged region contains one of the golf balls hit by Alan Shepard; next to the golf ball is the Solar Wind Collection mast thrown as a javelin by Edgar Mitchell. It is unlikely that any organisms remain on the top of these objects due to intense UV exposure, but what about the bottom side? Are there any organic compounds present?





Human and robotic activity at a future lunar (or martian) base provides ample opportunity to introduce biological and organic contamination.

Painting by Pat Rawlings.



Concepts in Lunar Research

- Chemical and microbiological studies on the impact of terrestrial contamination
  - During the Apollo missions
  - During subsequent lunar robotic and human missions
- Future in situ investigations of a variety of locations on the Moon by highly sensitive instruments designed to search for biologically derived organic compounds would help assess the contamination of the Moon by lunar spacecraft and astronauts
  - Valuable “ground truth” data for Mars sample return missions and planetary protection requirements for future Mars missions.

PPS September 28-29 Meeting

Discuss and Prepare Advice for NASA (sent through the NAC) on:

- Status NASA planetary exploration activities/implementations
- Address any Discovery mission that requires evaluation after TMCO review
- Receive a report from COSPAR Assembly in Beijing
- Address the application of the Special Regions Concept to Mars planetary protection requirements and future plans
  - Including a survey of Mars Scout concepts received in August
- Address planetary protection requirements for humans on Mars
  - Lunar opportunities for preliminary preparation
- Address planetary protection future planning, responsibilities, and international cooperation
  - Extension of “orbital debris” regulations to Moon and Mars

NAC Science Subcommittee Meetings (PPS)

6 July 2006

830-845	Welcome	Schmitt
845-900	Logistics	Allen
900-945	Conversation with the Administrator	Griffin (Invited)
945-1015	Science Mission Directorate Update	Cleave
1015-1045	Risk Management for Science Missions	Ledbetter
1045–1100	*Break*	
1100-1145	Exploration Strategy and Architecture Development	Cooke
1145-1230	Lunar Science Workshop Planning Introduction	Jolliff
1230-130	*Lunch*	
130-330	Subcommittee Topics (breakouts) – Update and lunar considerations	Chairs
330-345	*Break*	
345-600	Subcommittee Topics (breakouts) – Future meeting planning	Chairs
< 601pm	PP Subcommittee is OVER