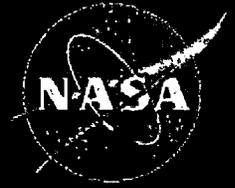


National Aeronautics and Space Administration



The Nation's Vision for Exploration – An Update



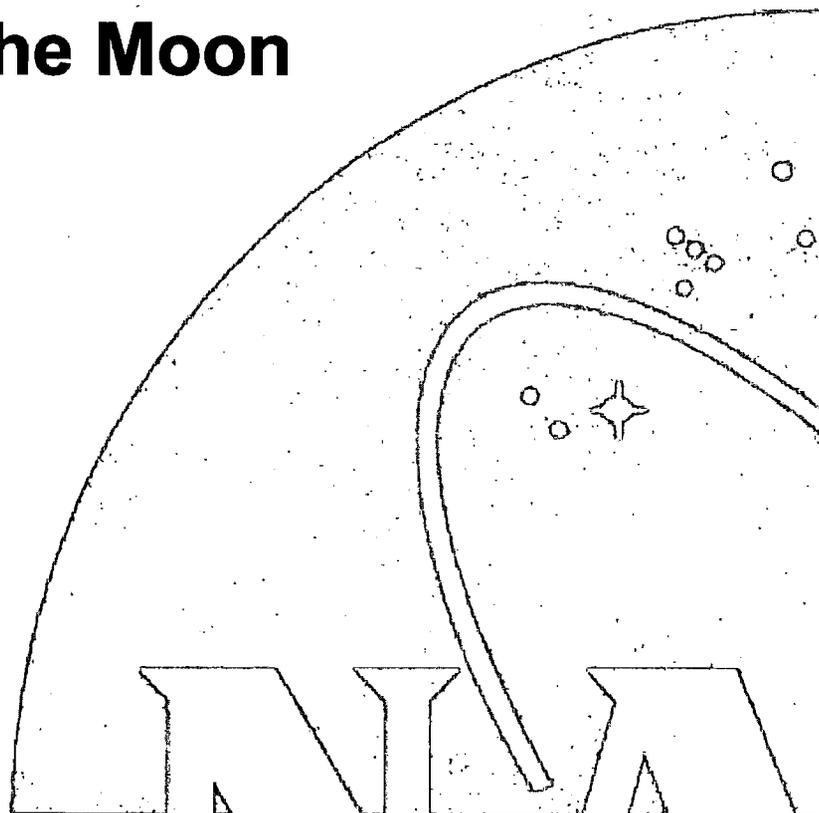
Michael J. Sander
August 2007



◆ **Background**

◆ **Getting to the Moon**

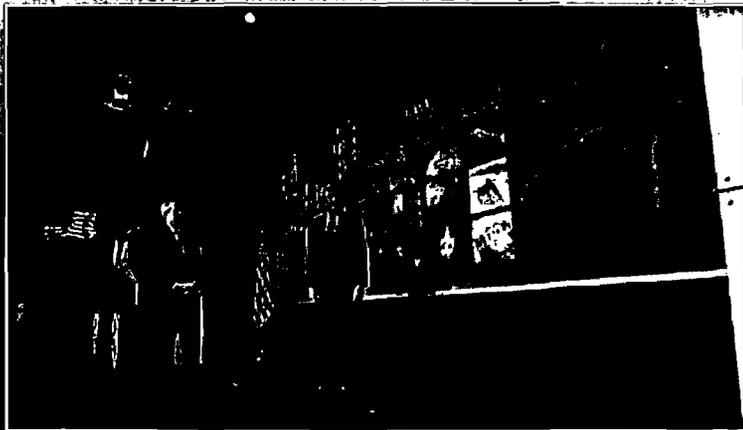
◆ **On To Mars**



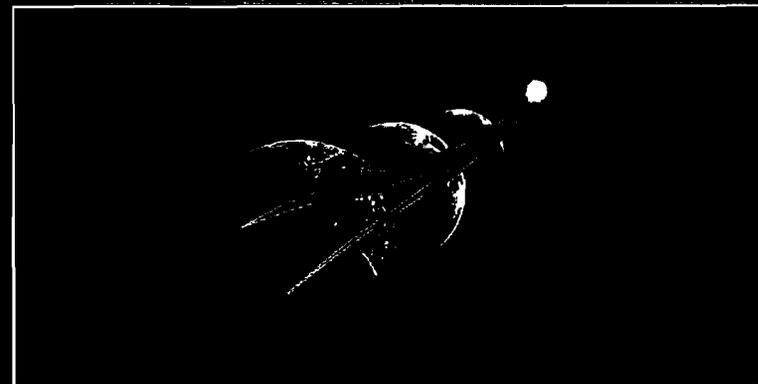
Nation's Vision for Space Exploration



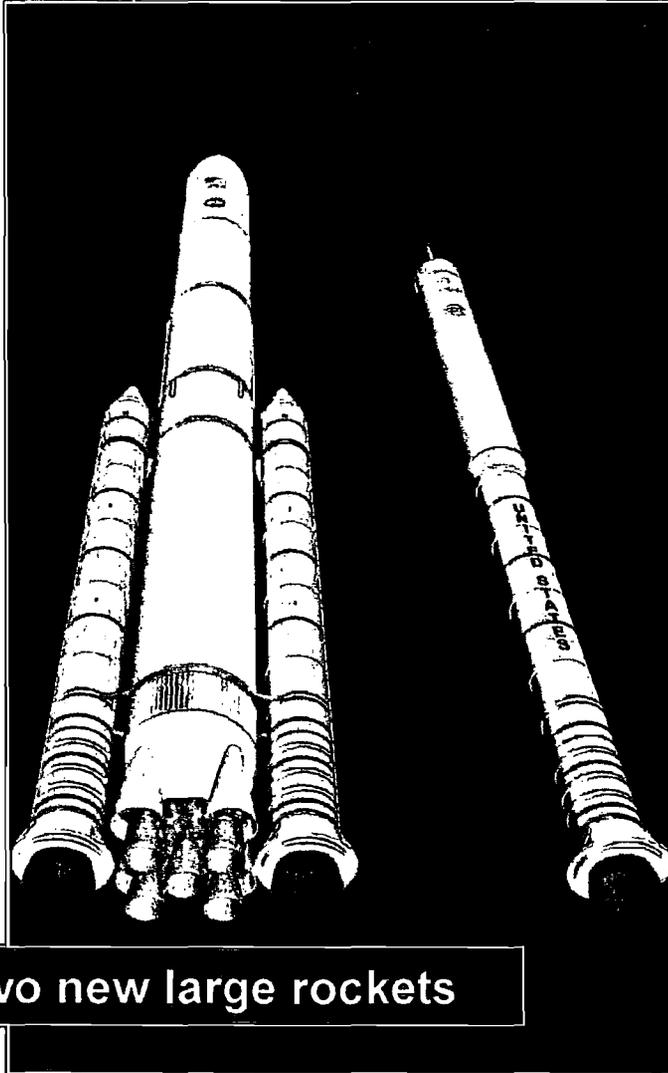
- ◆ Announced on Jan 7, 2004 by President Bush
- ◆ Bottom line – Get humankind out of low Earth orbit to Mars and beyond
- ◆ Project Constellation formed



"A new plan to explore space and extend a human presence across our solar system"

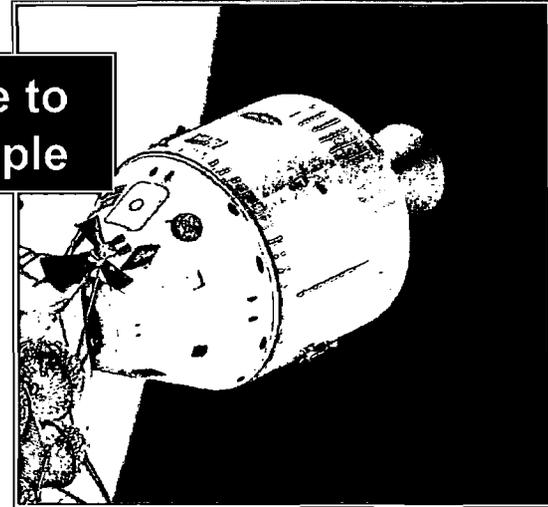


What is Constellation?

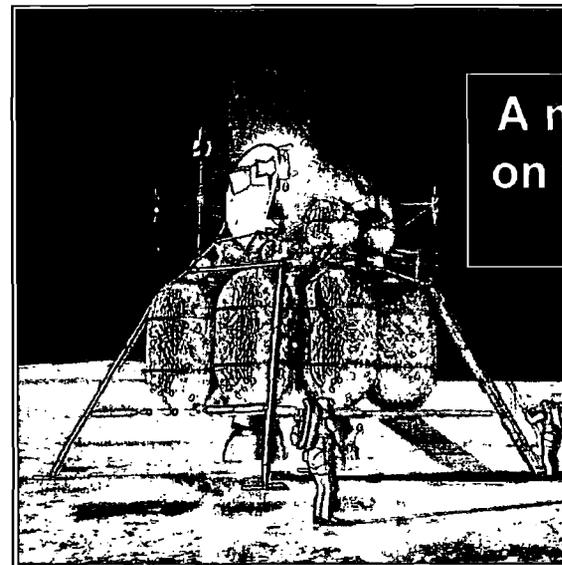


Two new large rockets

A capsule to carry people



A means to land on the Moon and return



Why These Elements?



◆ Industry, Academia, Public search for ideas

◆ Ground rules from the White House

- Stay inside the current NASA budget envelope
- Continue scientific endeavors of the Agency
- Return the Shuttle to flight
- Finish the Space Station, then retire the Shuttle
- Create a journey, not a destination



◆ “90 day study team” started in May 2005

- Examined many options
- Concluded
 - Use Apollo-like architecture
 - Use as much of Shuttle infrastructure as possible
 - Leverage other existing technologies, minimize need for inventions (in the short term)
 - Use the Moon as a “waypoint” prior to going to Mars
 - We can go to the Moon with existing technology... not so with Mars



◆ **Background**

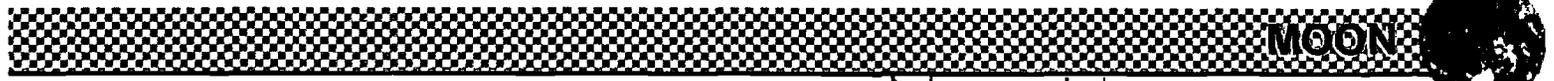
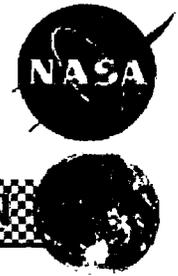


◆ **Getting to the Moon**

◆ **On To Mars**



Going to the Moon-Current Approach



Vehicles are not to scale.

100 km
Low Lunar
Orbit

LLV Performs LOI

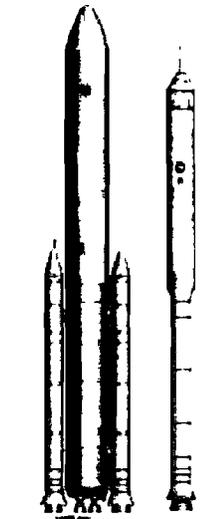
Ascent
Stage
Expended

Earth Departure
Stage Expended

Service
Module
Expended

Low
Earth
Orbit

Direct Entry
Land Landing

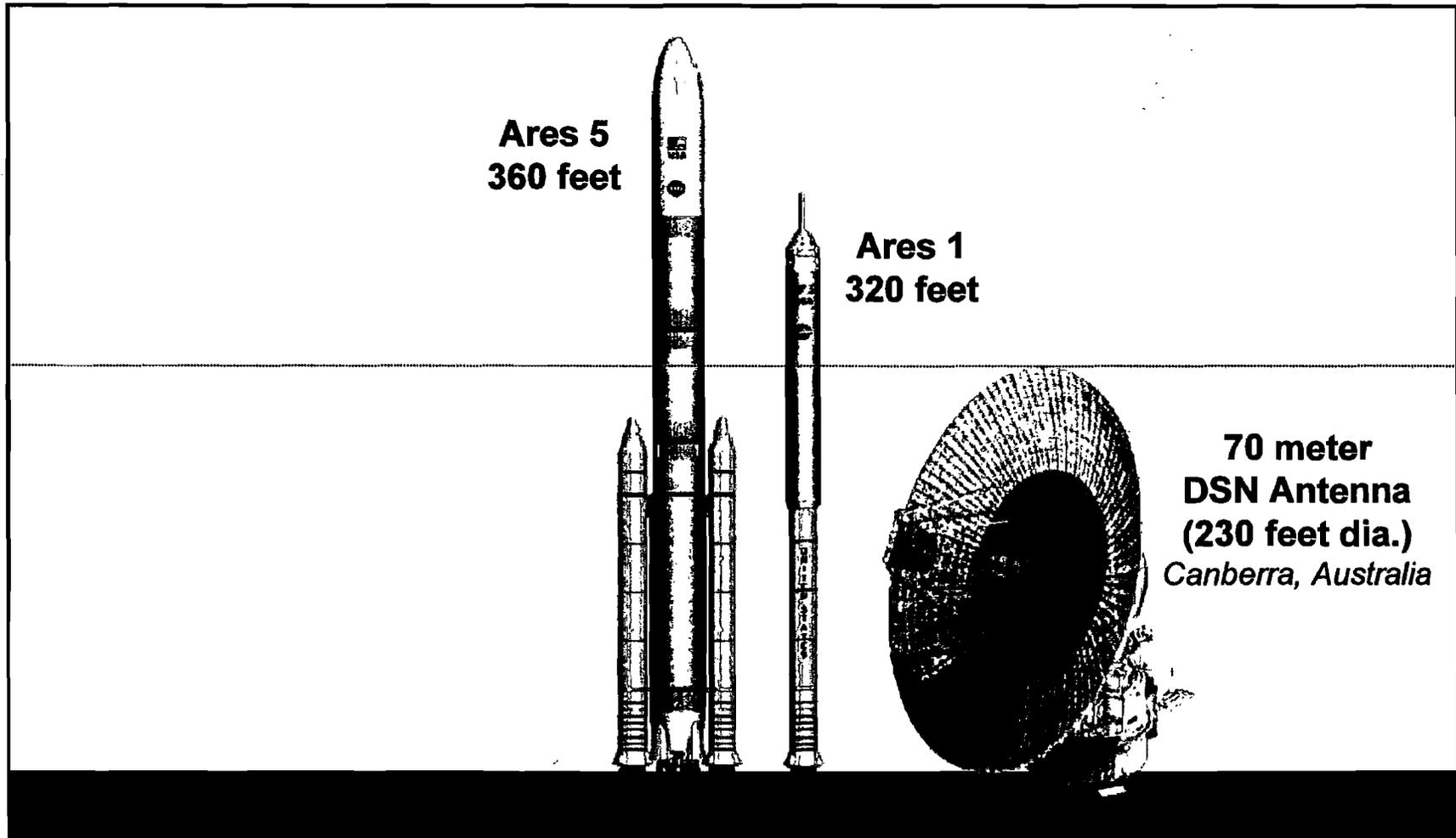


Ares 5-EDS, LLV

Ares 1-Orion

EARTH

Constellation Systems – Ares 5 and Ares 1 Launch Vehicles)



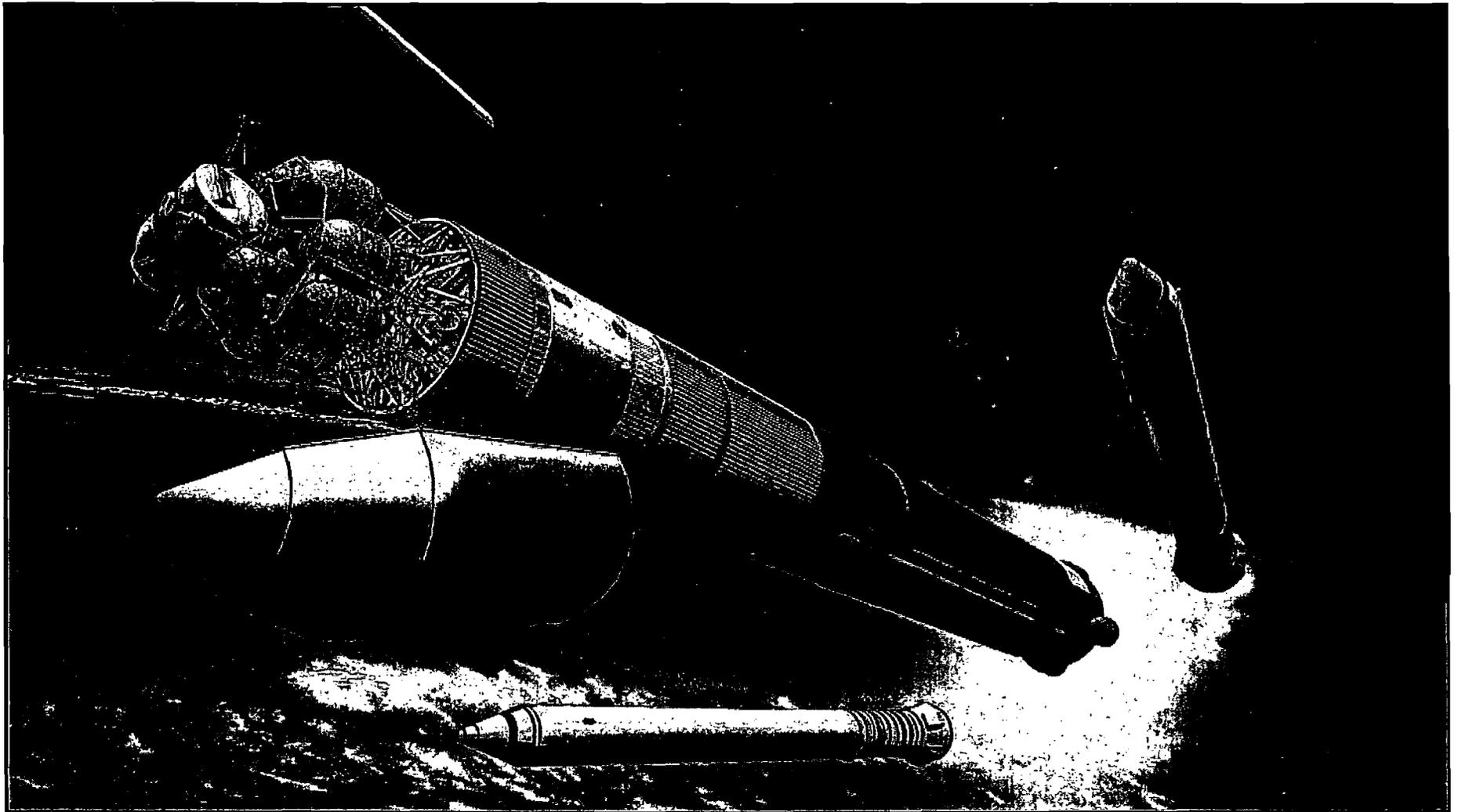
Orion On The Ares 1 Launcher



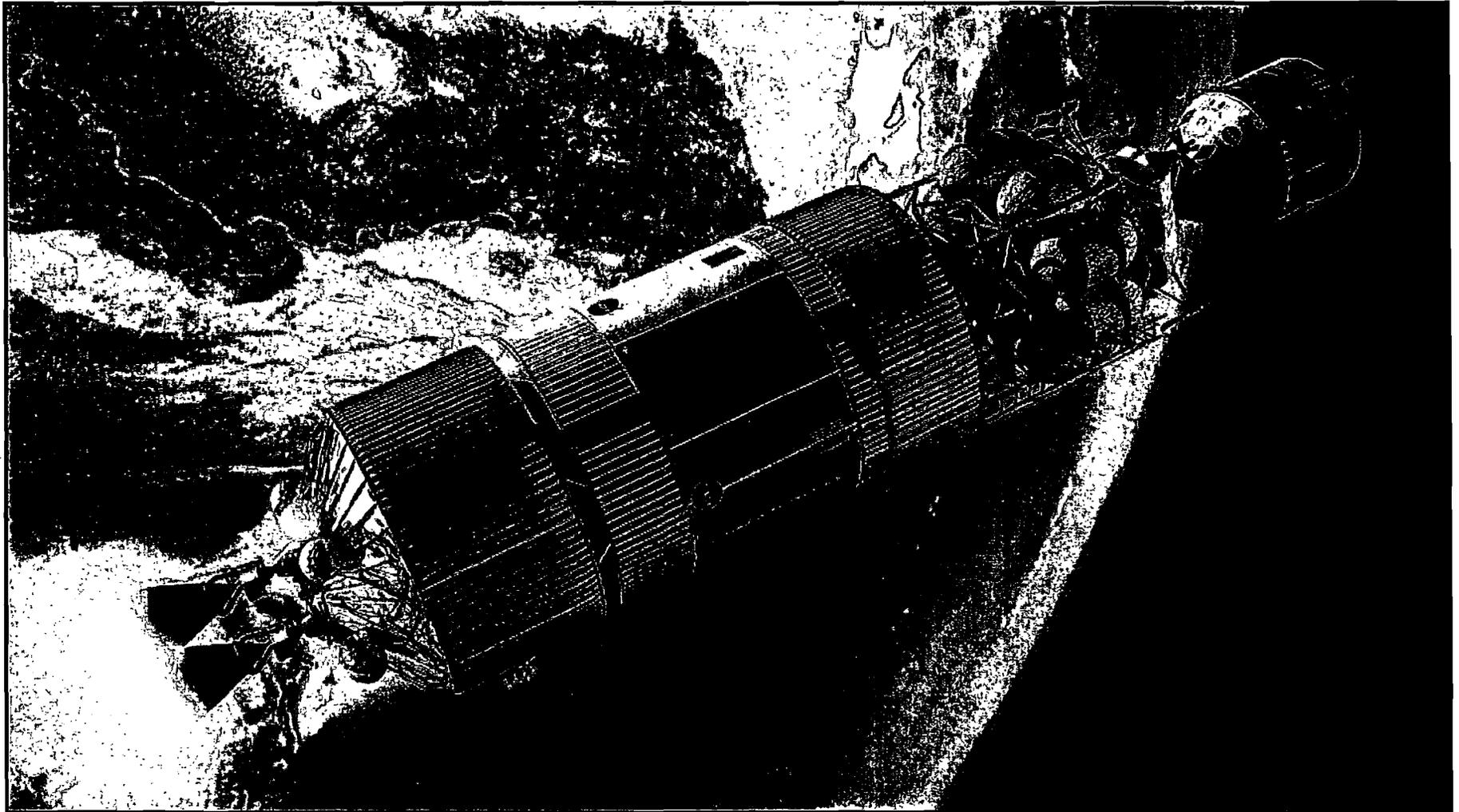
August 21, 2007

MJS-9

Lunar Lander Vehicle (LLV) on Ares 5



Orion and LLV on Earth Departure Stage (EDS)



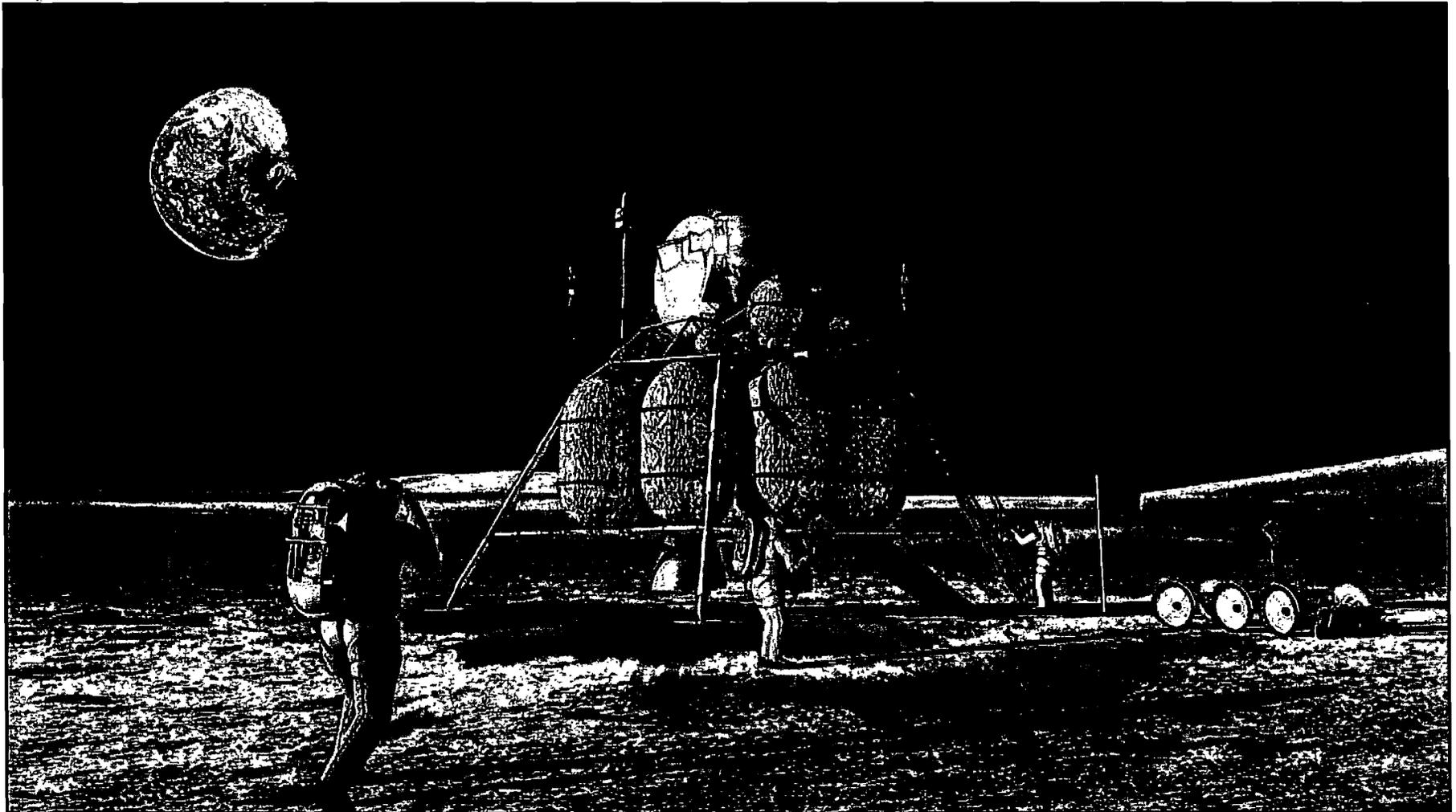
August 21, 2007

MJS-11

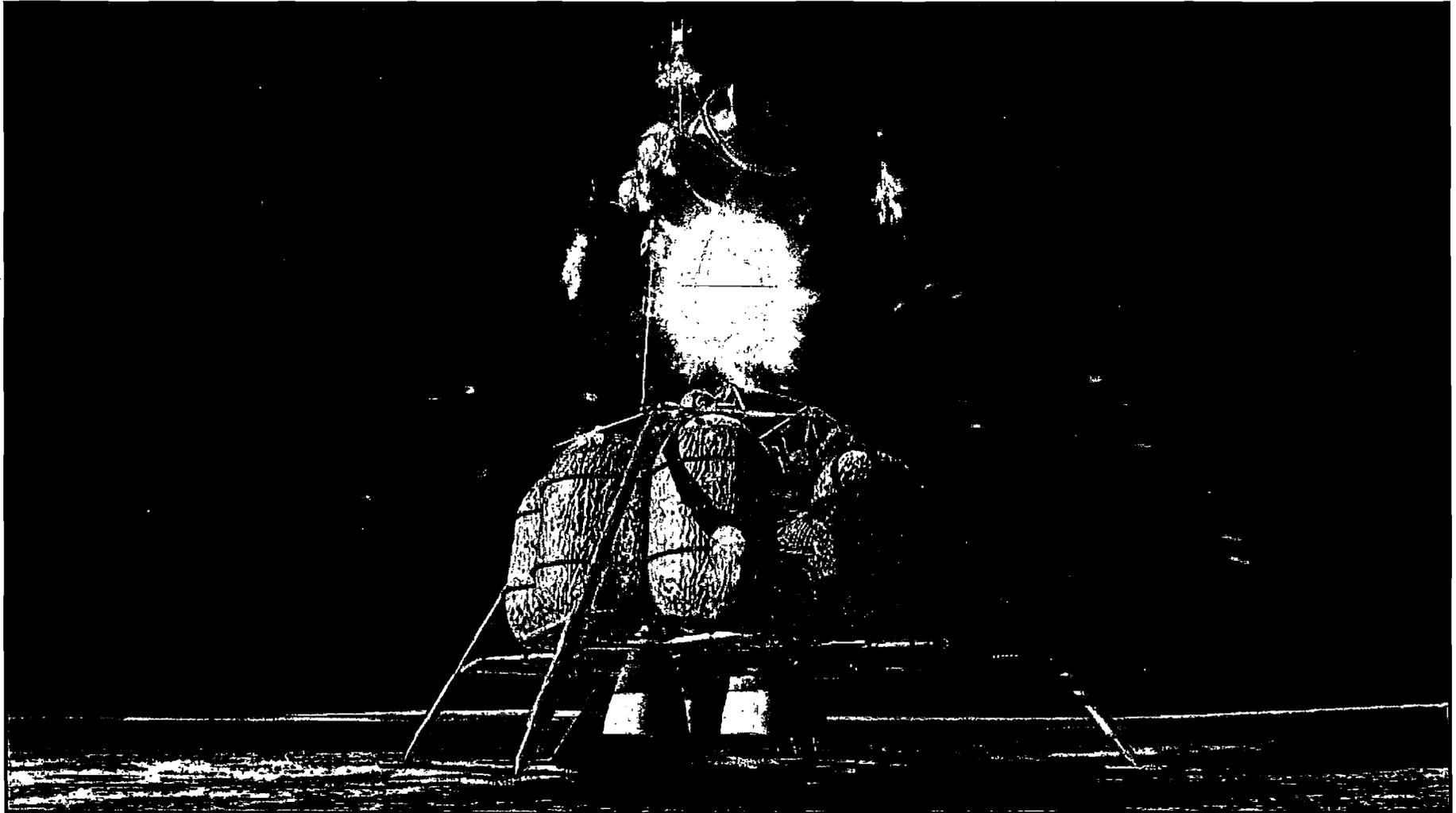
Orion and LLV at the Moon



LLV on the Moon



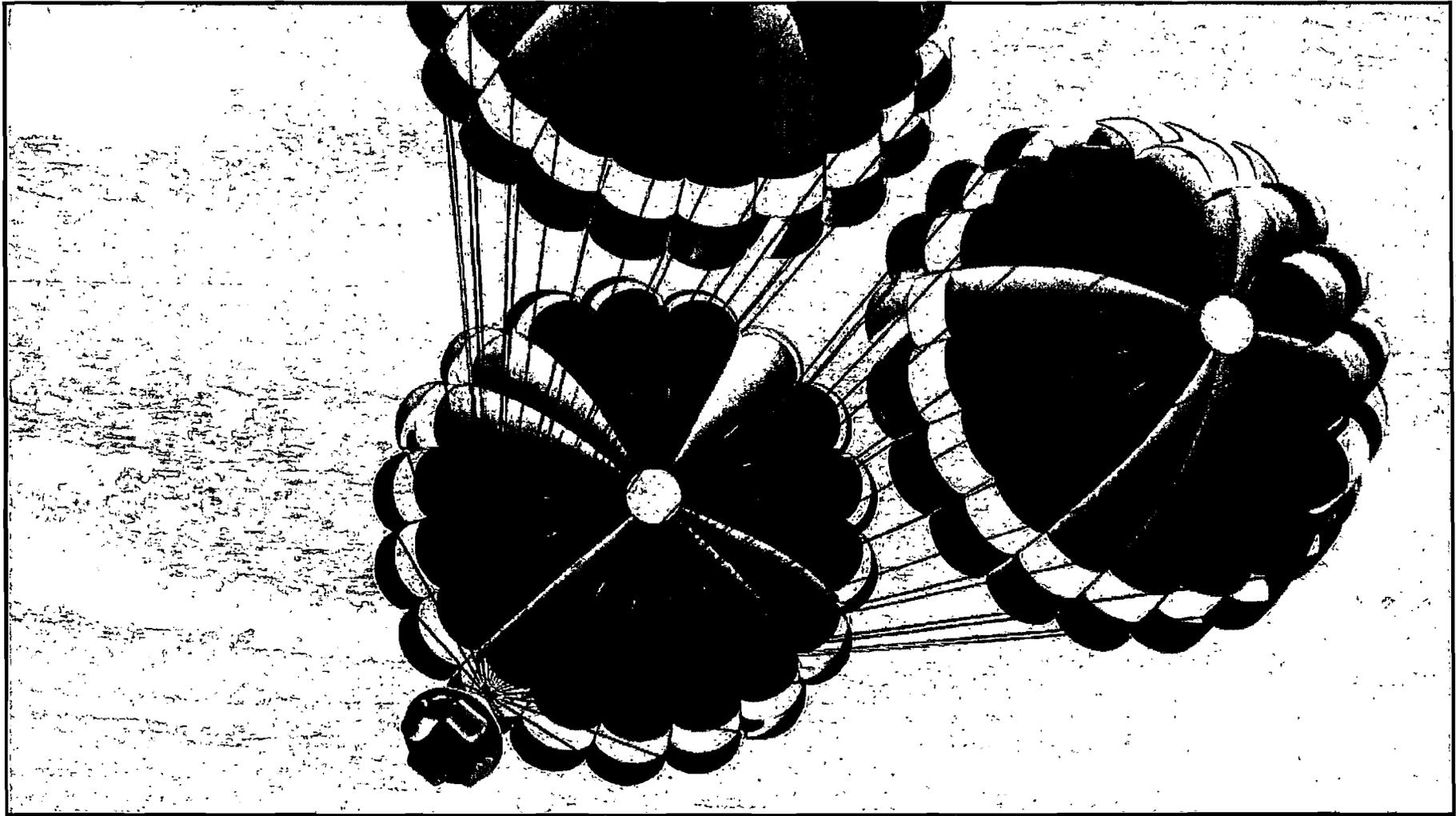
Launch of Ascent Stage



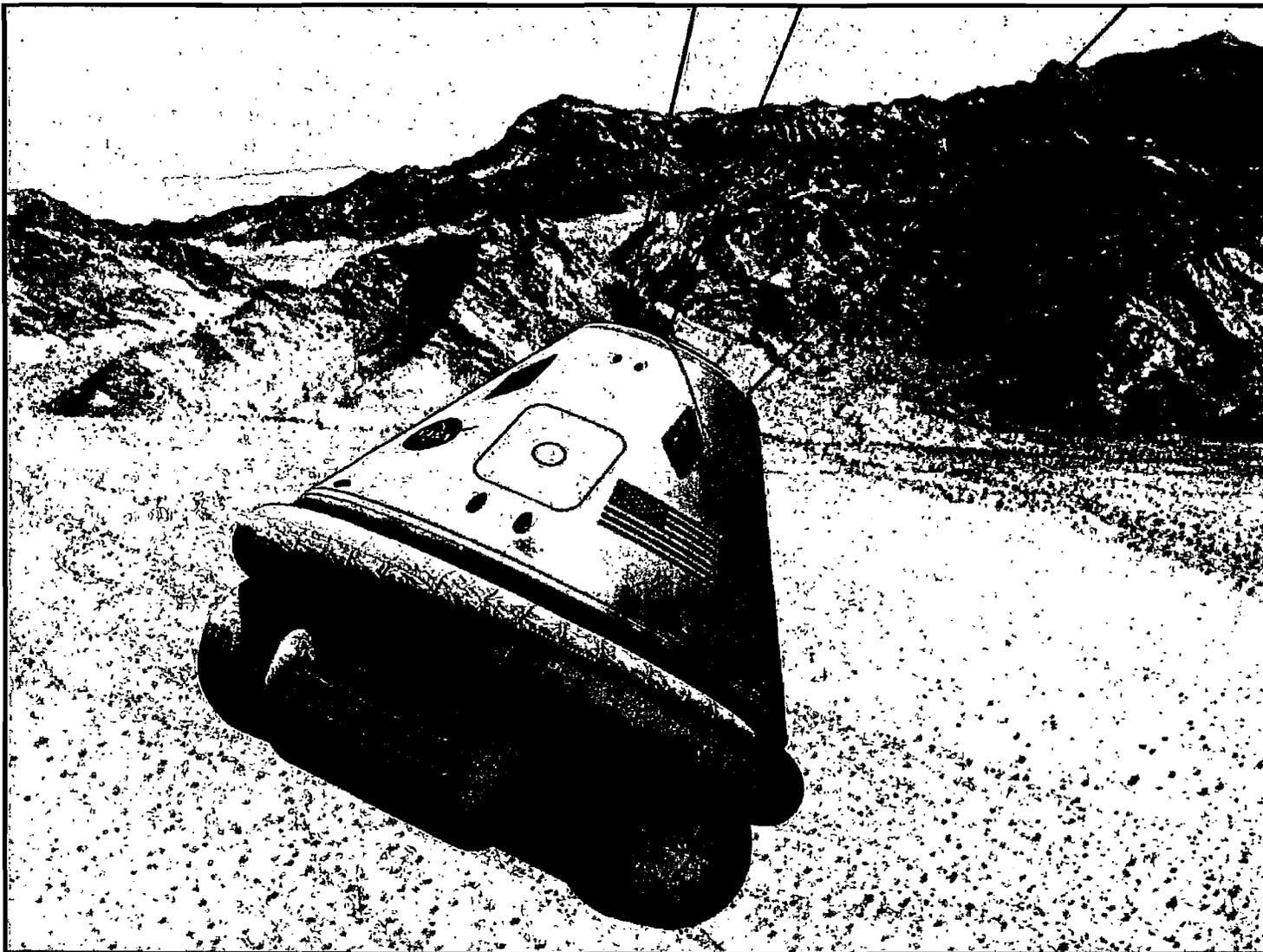
August 21, 2007

MJS-14

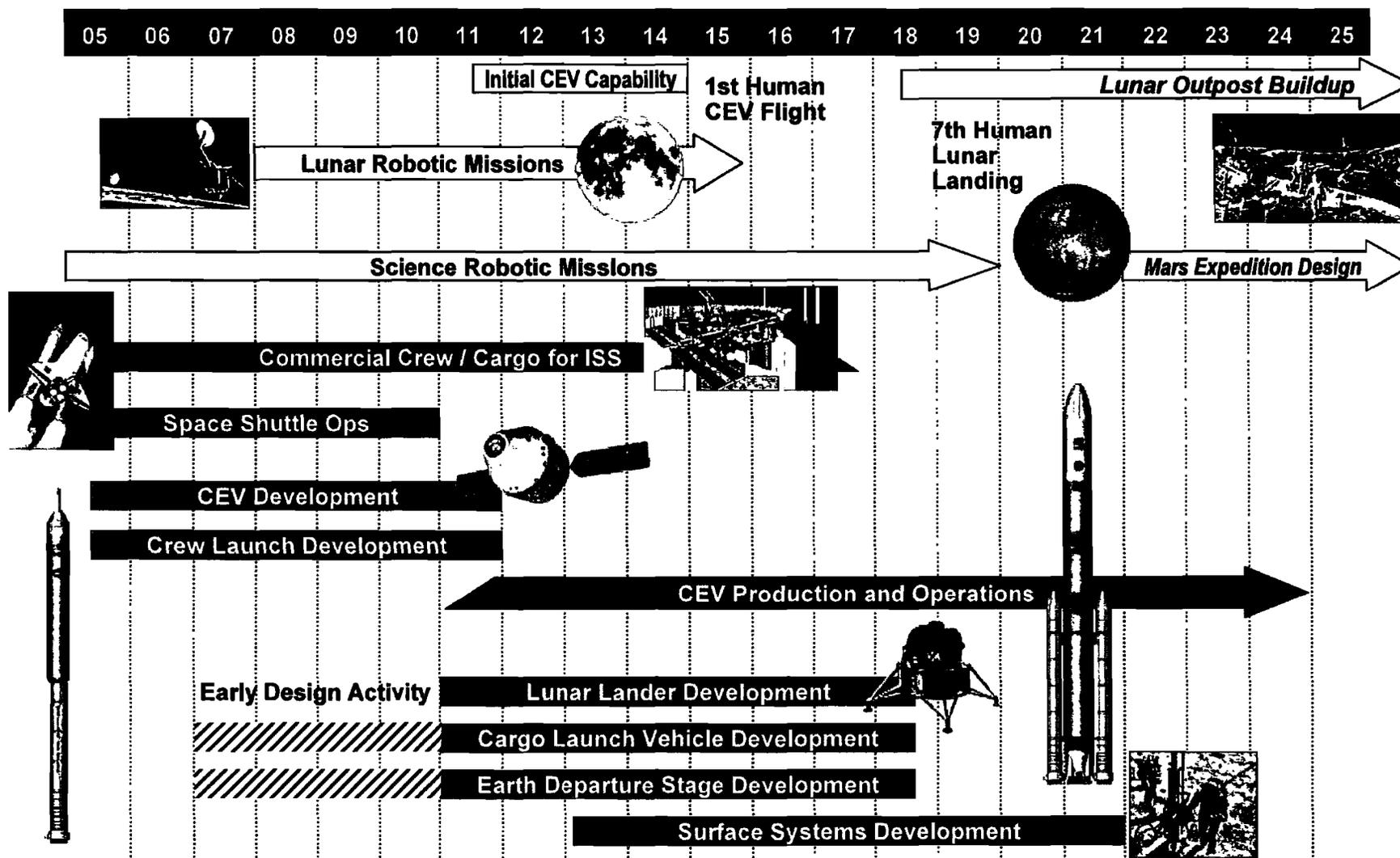
Orion Parachuting to Earth



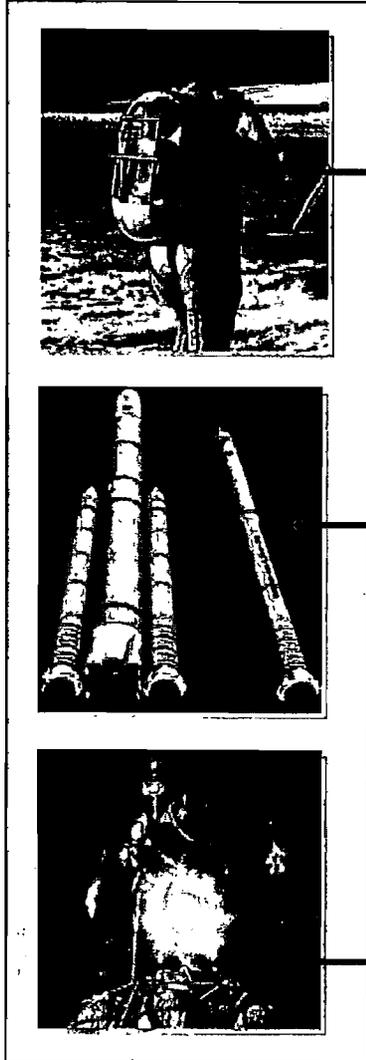
Orion With Landing Attenuation System Deployed



NASA's Exploration Roadmap



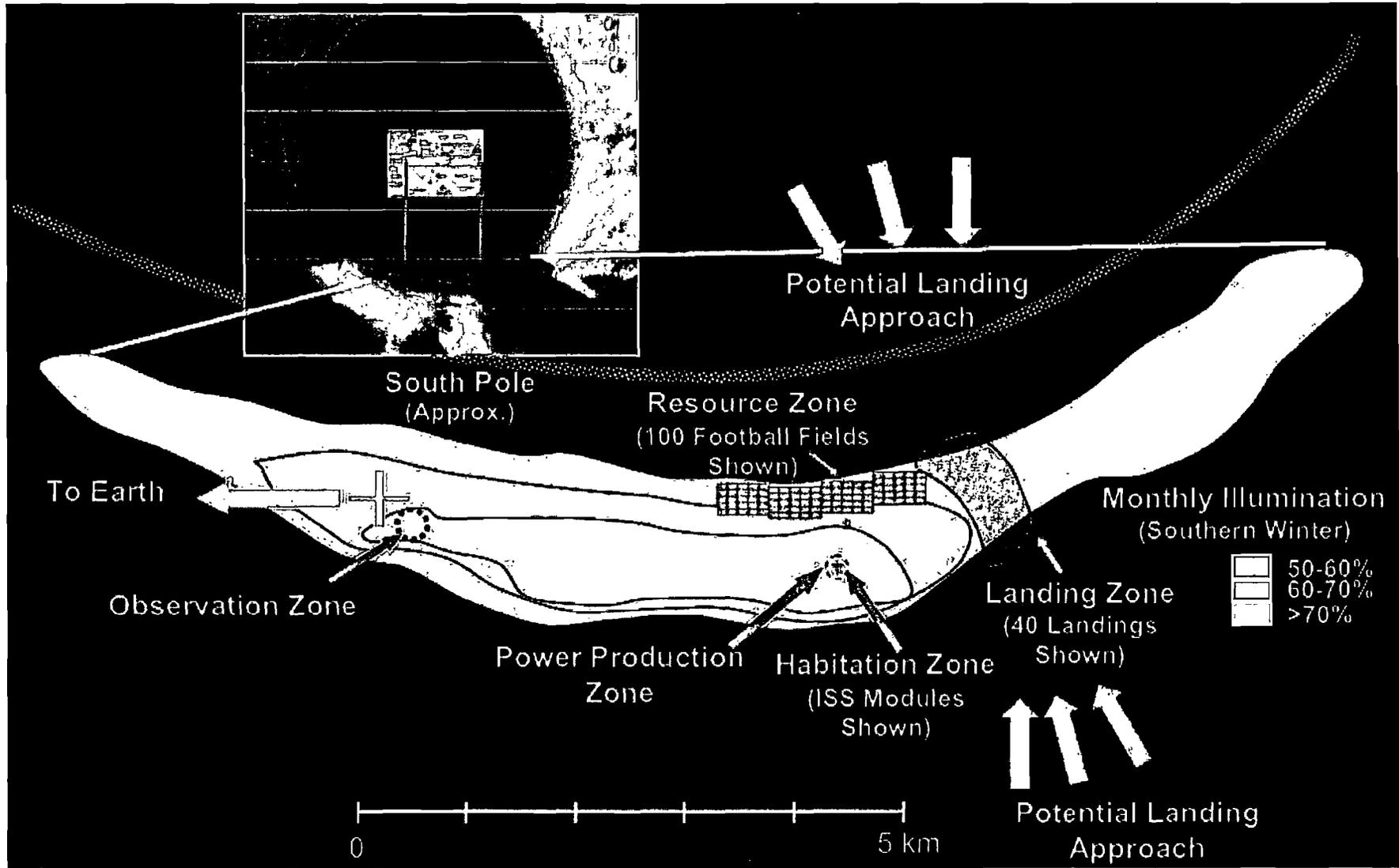
Major Constellation Assignments



- **Space Suits**
(Johnson Space Center)
- **Ares 1 – Ares 5 - EDS** (Marshall Space Flight Center)
- **Lunar Lander Vehicle**
(Johnson Space Center)
- **Lunar Ascent Vehicle** (Johnson Space Center)
- **Orion** _____
(Johnson Space Flight Center)
- **Orion Support Module** _____
(Glenn Research Center)



Shackleton Crater Rim with Notional Activity Zones



JPL Activities



◆ **Current key activities**

- **Constellation Level 2-System Engineering**
- **Lunar Architecture Team (LAT) 2-technology assessment and architectural option for the lander**
- **Mars Architecture Team-system engineering support, Science integration, precursor program planning**
- **Lunar Lander Project Core Team- GN&C and Flight system engineering**
- **Technology program-supporting multiple projects in robotics, power systems, aero entry technology**
- **Mission Operation Project-Mission operations system engineering**
- **Advanced Environmental Monitoring Instruments**
- **Lunar Reconnaissance Orbiter instrument (Diviner)**

◆ **Mission Proposals**

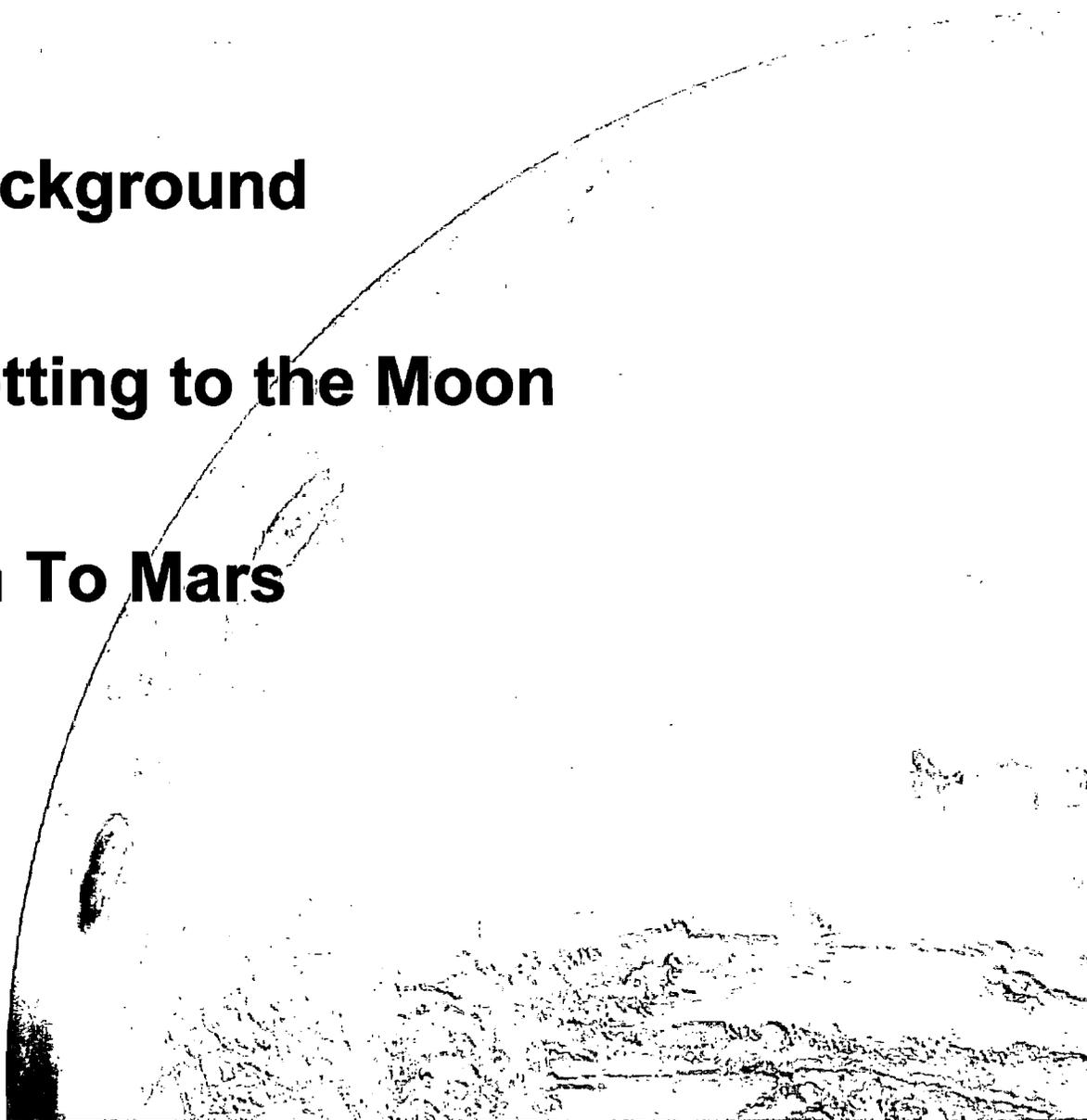
- **Lunar Sample return**
- **Lunar Gravity field mapper**



◆ **Background**

◆ **Getting to the Moon**

➔ ◆ **On To Mars**



On to Mars

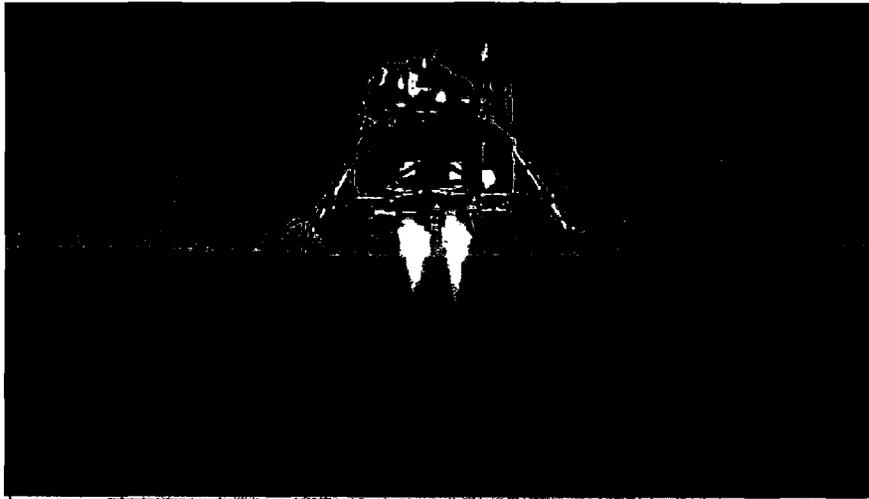
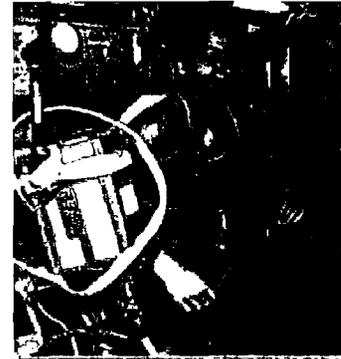
Important Technical Problems To Be Solved



◆ Counter measures for human physiological changes

- Calcium loss from bones
- Atrophy in muscles
- Immune system changes
- Radiation damage

To mention a few



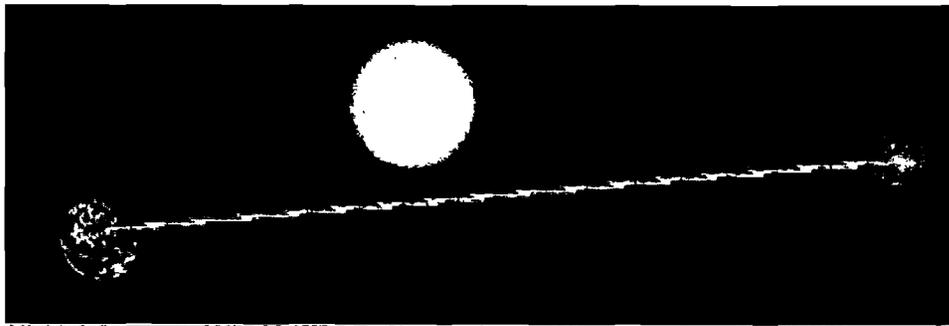
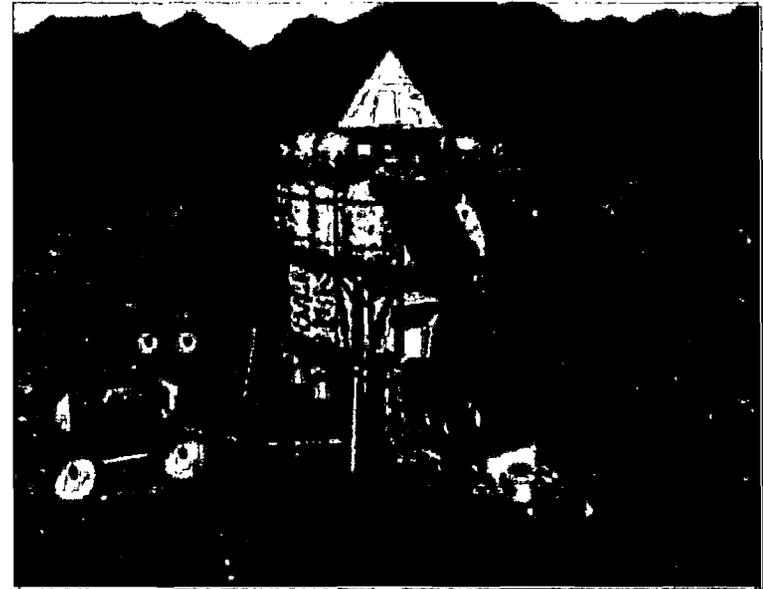
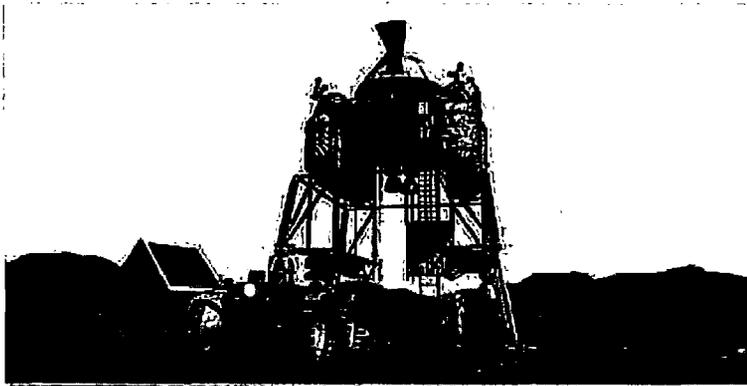
◆ Landing 25 metric tons safely

On to Mars

Important Technical Problems To Be Solved



- ◆ **Living off the land – using resources from Mars, don't ship from Earth**



- ◆ **Operating 20 minutes (to 30 days) from contact with Earth**

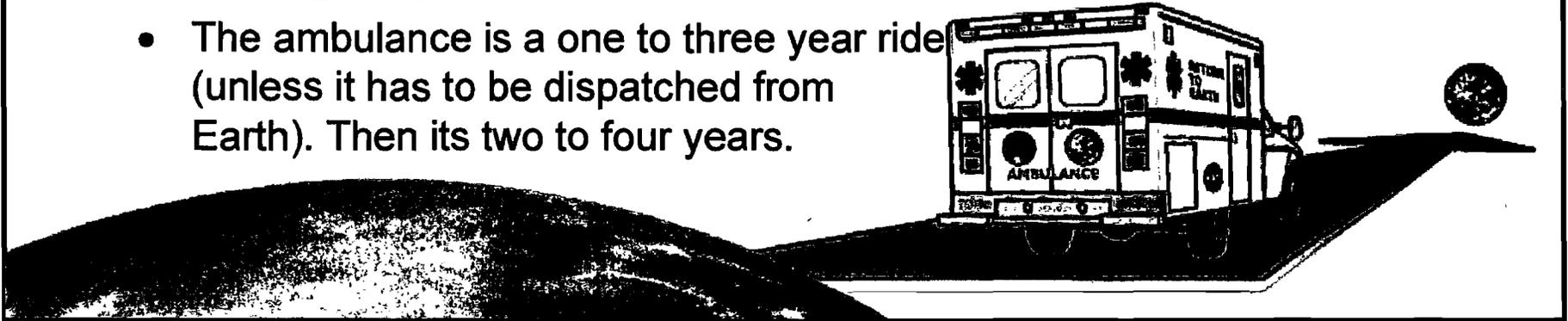
On to Mars

Important Technical Problems To Be Solved

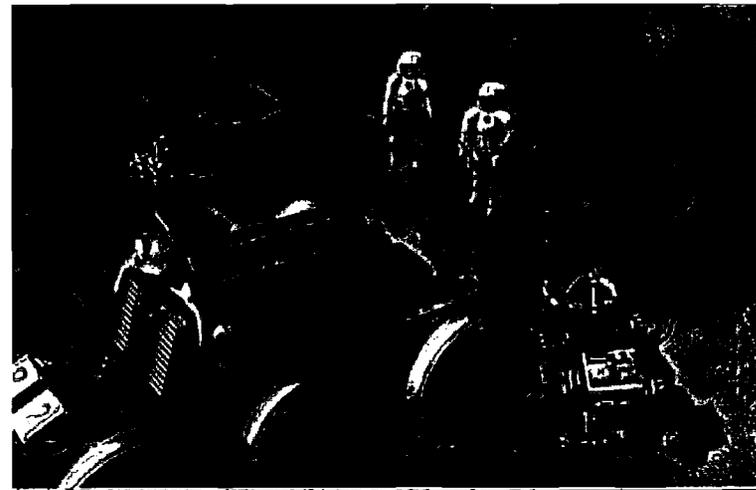
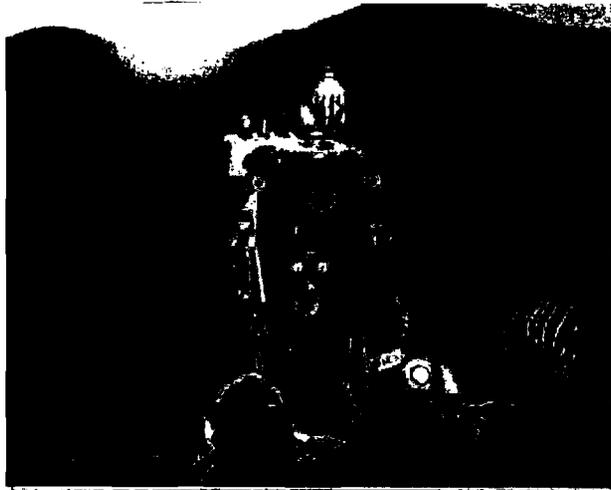


◆ Operating on your own

- The ambulance is a one to three year ride (unless it has to be dispatched from Earth). Then its two to four years.



◆ Understanding how robots and humans can leverage each other



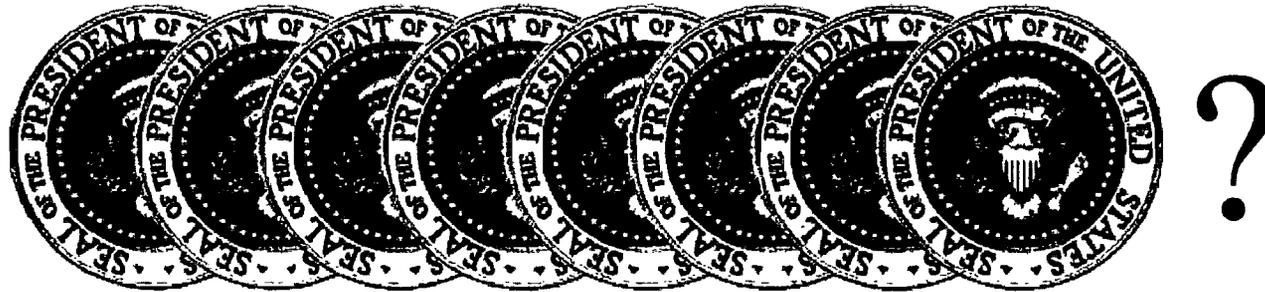
On To Mars

Important Program Problems To Be Solved



◆ A long term program

- 10 to 15 elections
- 4 to 8 presidents and at least that many NASA administrators



◆ Science and engineering skills

- Declining enrollment in needed specialties
- Regearing NASA and industry as skilled people retire

On to Mars

How It Might Be Done



- ◆ 6 launches of the Cargo Vehicle place six 100 + metric ton payloads in low Earth orbit
- ◆ Payloads are assembled into a Mars Expedition Vehicle
- ◆ 6 month trip to Mars
- ◆ Expedition enters into an orbit around Mars
- ◆ Lander descends to a “camp” pre-positioned with equipment including system to utilize local resources
 - Water ice
- ◆ 600 day stay on Mars
- ◆ Return to low Mars orbit, rendezvous with orbiting assets
- ◆ 6 month return to Earth



Why?



“Humankind needs expanding frontiers. We are a curious, questioning outward-going (in every sense), contentious, competitive bunch. We don’t like confinement – even when the boundaries of our confinement are as wide as the world that gave us birth.

Man will not be contained.

Let him soar”

**– Tom Clancy / General Chuck Horner
“Every Man a Tiger”**

End of File

