Early Lunar Rover Mission Studies

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Early Lunar Rover Mission Studies Chronology

- August 1991 - Project Conceived
- October 25, 1991 - Presentation of Concept to Dr. Griffin
- November 1991 - February 1992 Concept Refined
- February 12, 1992 - Revised Concept Presented to Dr. Griffin
- March 1992 - Study Team Formed
- April 1992 - Possible "Trafficability Problem" Identified
- April 1992 - Concept Presented to LPI Workshop
- June 1992 - Dynamic Model Designed and Fabrication Initiated
- September 1992 - Concept Presented to International Planetary Mobil Vehicles Conference
- October 1992 - Dynamic Model Tested
- November 1992 - JSC put Artemis on hold
- December 1992 - Study Completed

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Study Project Description

- Launch 1 -60kg mini rover on the Artemis lander to the Moon
- Rover shall be capable of site certification near the landing site and long traverses to obtain compositional and selenophysical profiles of the surface
- **NASA will operate rover from selected universities to support educational purposes**
- The first launch shall be within 3 years of funding availability
- **Hardware design, analysis, fabrication, test, and operations to be accomplished in-house to train young government personnel**
- **Project to be managed by LaRC; supported by Wallops, Sandia and CERL/WES**

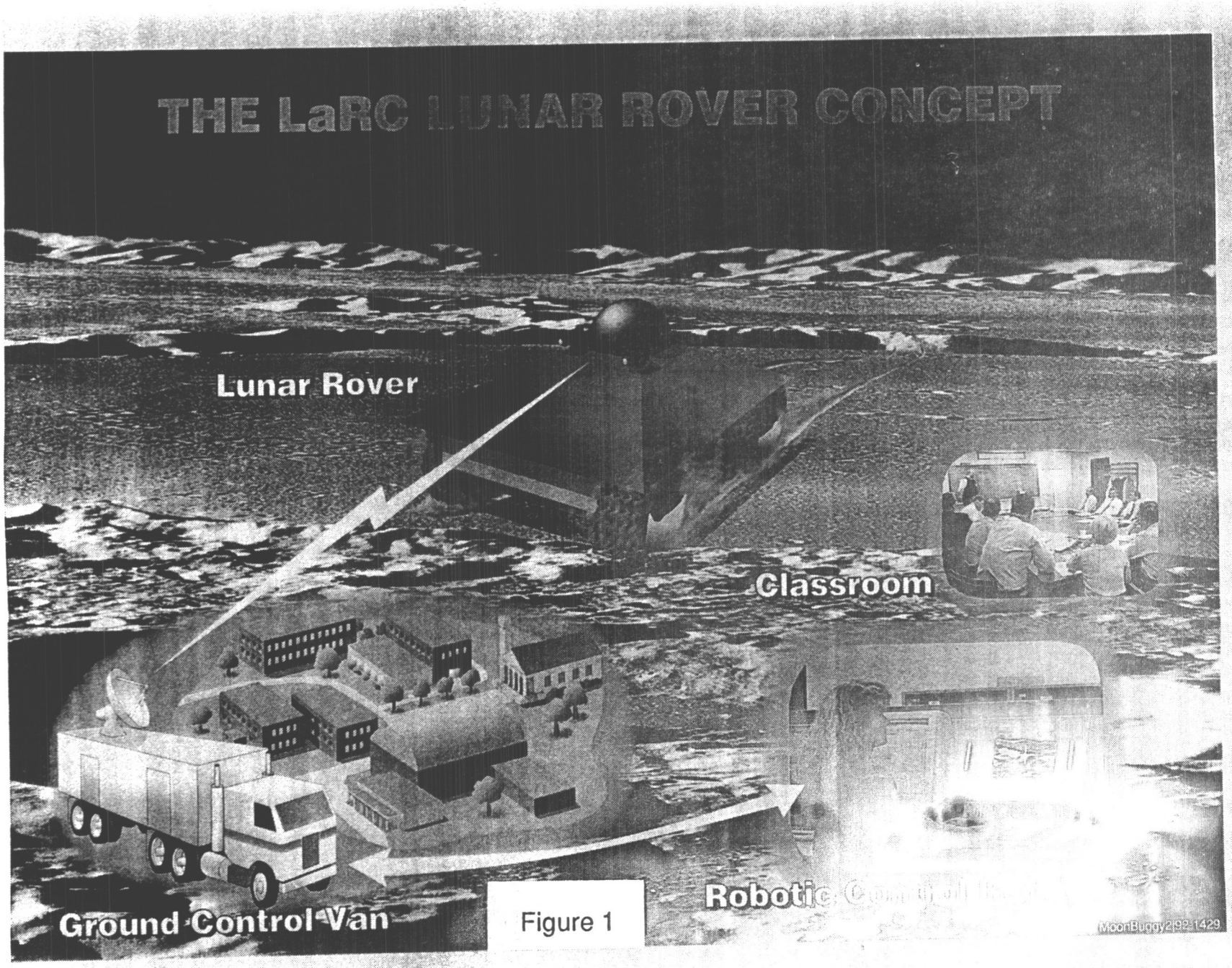
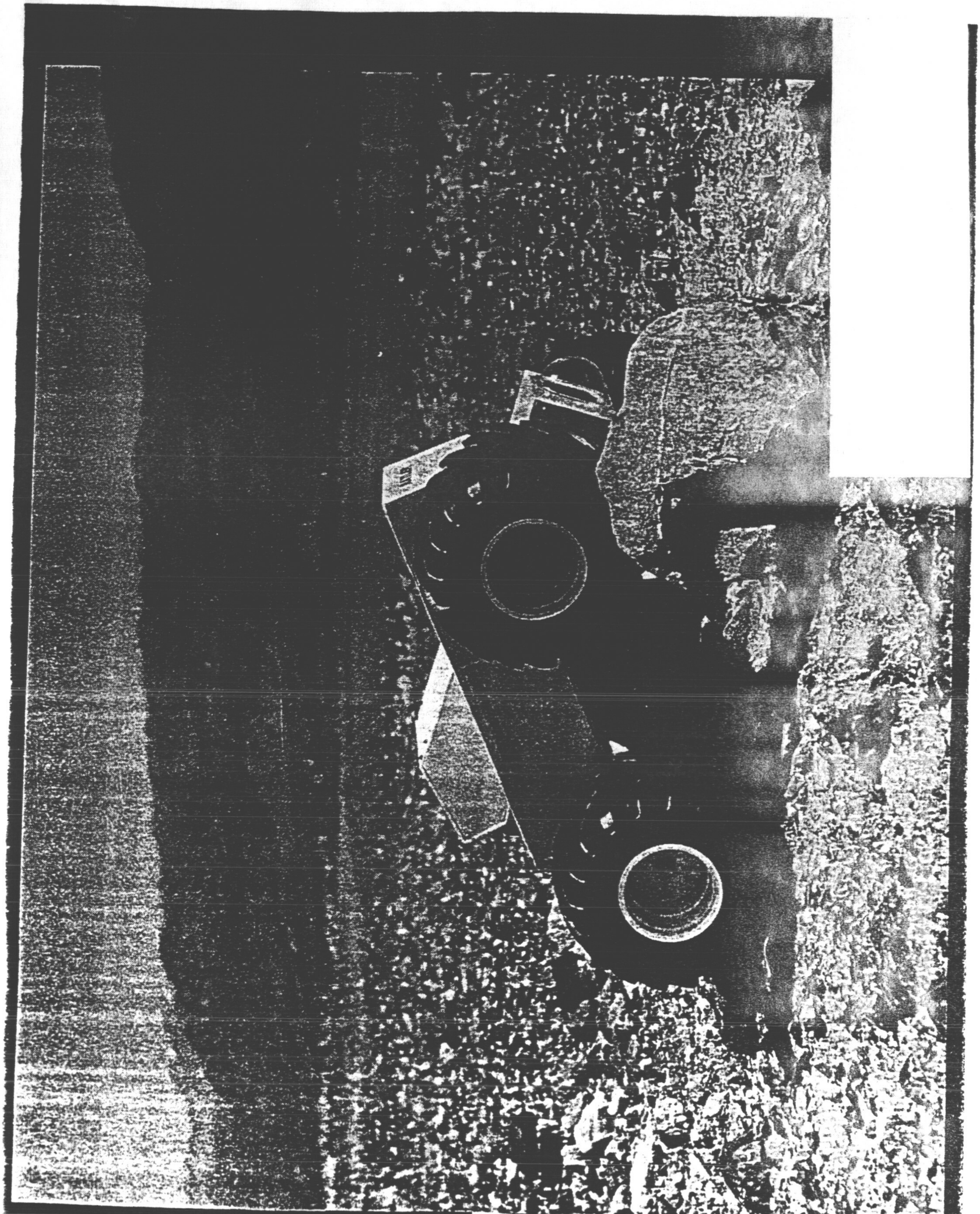
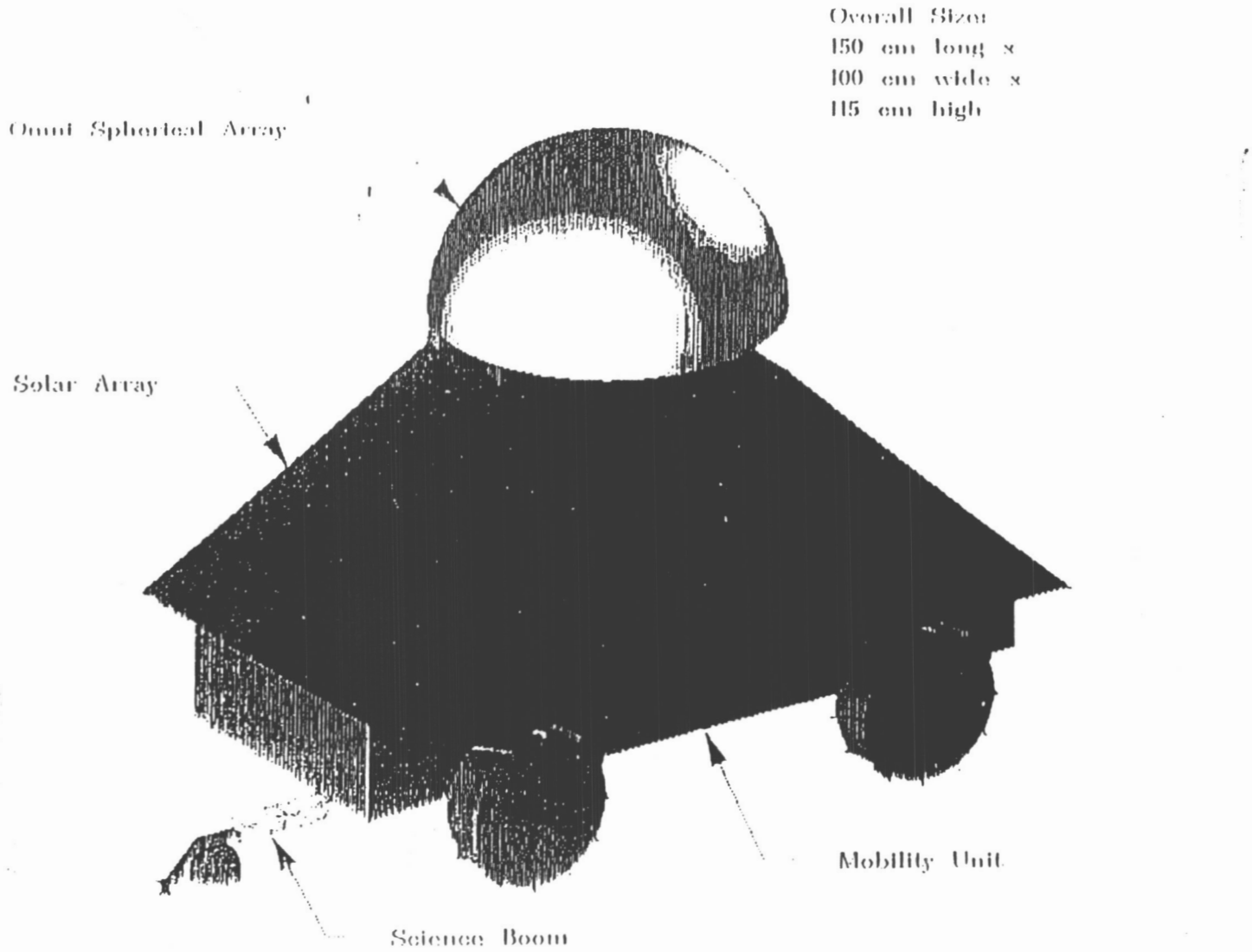

THE LaRC LUNAR ROVER CONCEPT
Lunar Rover
Classroom
Ground Control Van
Robotic
MoonBuggy2|92-1429

Figure 1

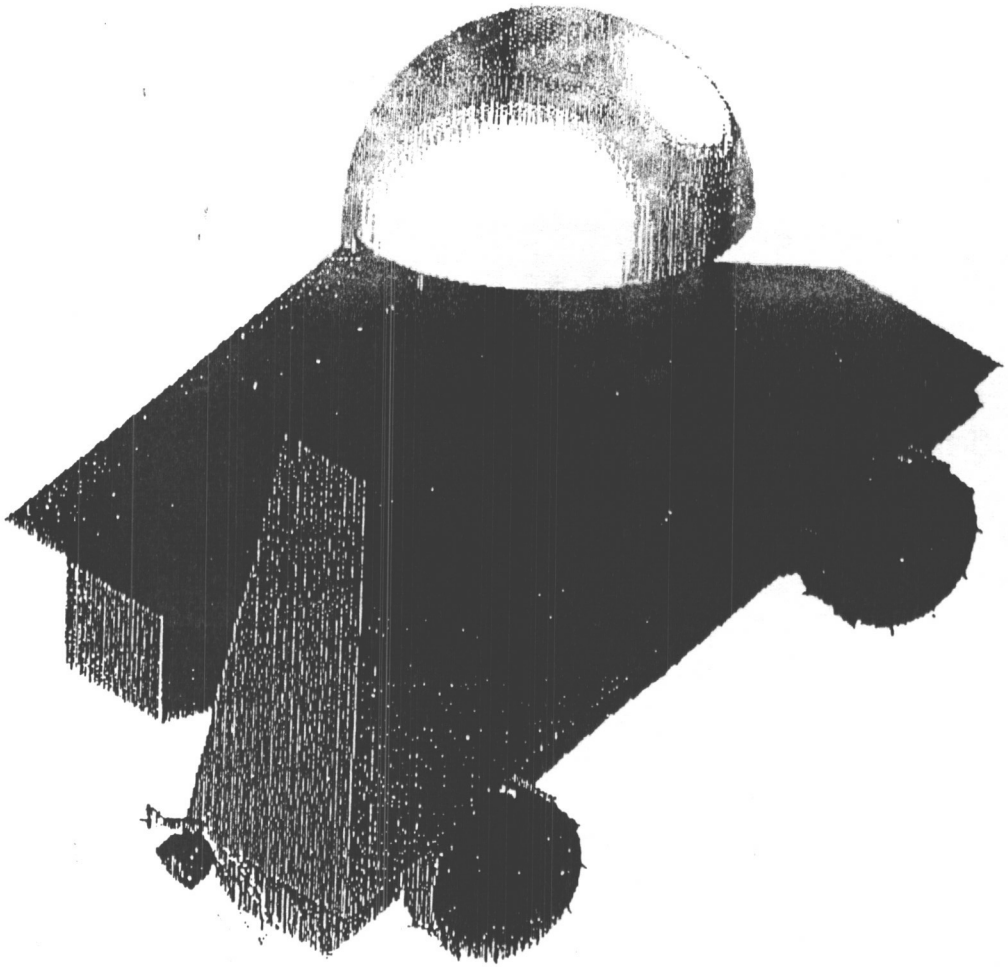




LaRC Lunar Rover

Left Side View

(8/18/92)



LaRC Lunar Rover

Left Side Rotated 30 degrees about Body Shaft

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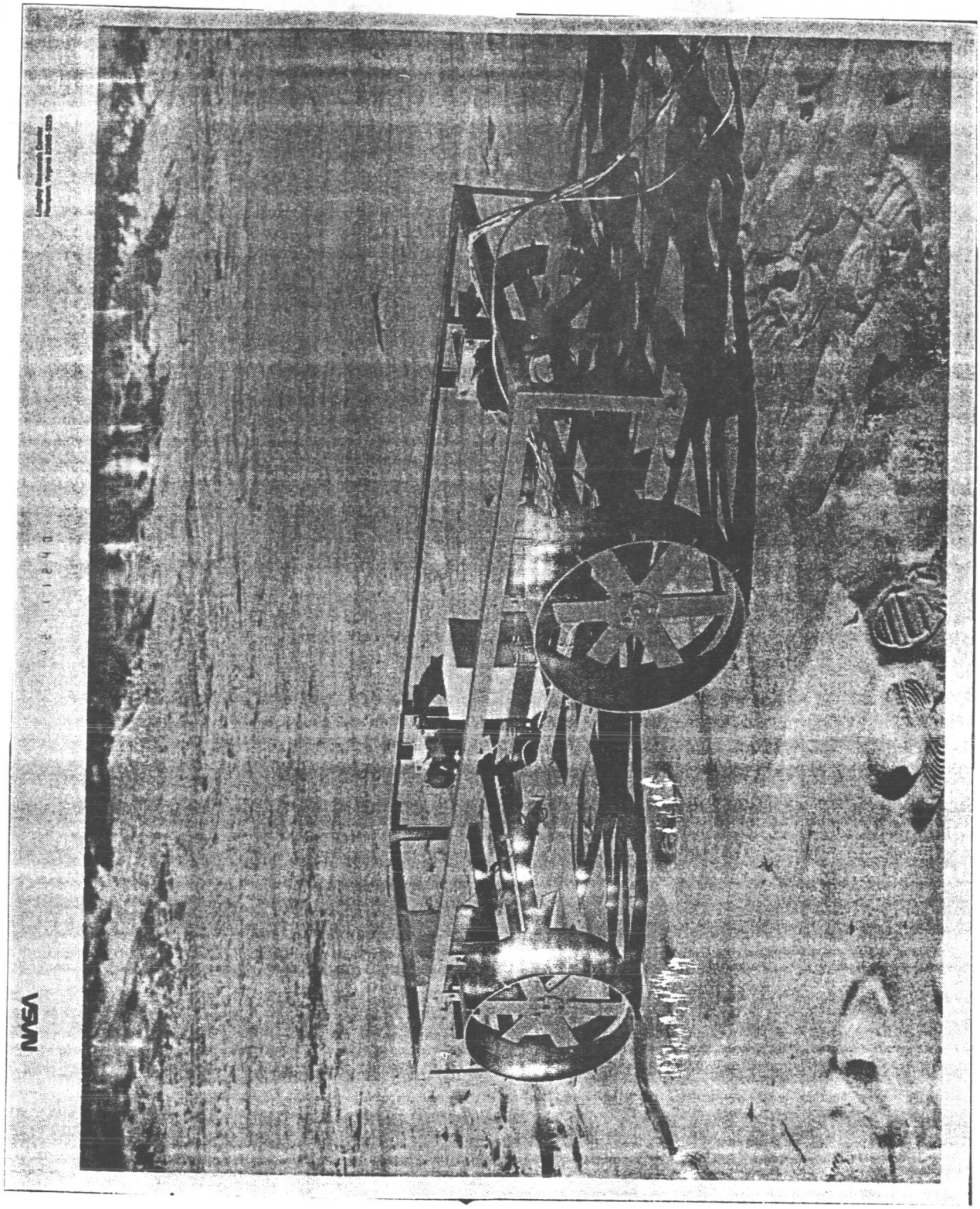
EXPLORATION

Issues Identified for Analysis and Basic Questions to be Addressed

- Mobility - Are the Bekker equations applicable to this class of vehicle?
- Power - Can solar arrays generate sufficient power for the vehicle to operate effectively?
- Imaging - Can the imaging requirements for science and mobility be met by a common camera?
- Telemanagement - What level of autonomy is required to operate the vehicle effectively?
- Communications - What data rate is required for effective operations and how can it be achieved within program constraints?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Telemanagement Results

- Teleoperation of Lunar Rovers is feasible, practical and within current technology
  - USSR used in early '70s
  - Sandia test results encouraging
- An autonomous robot is not required for lunar operations
- Some degree of telemanagement will be appropriate for lunar operations
  - Hazard detection
  - Position control

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LaRC Early Lunar Mission Study Results

- A mission to accomplish generally accepted science objectives is practical within cost guidelines
- A total systems approach is required to maximize efficiency of subsystems
- No new technology is required; although in some areas would enhance success
  - Robotics
  - Instrumentation
  - GN&C
- Significant development required in some areas specifically batteries, science instruments
- Developed excellent working relationship with Corps of Engineers and Sandia National Labs
- Completed with no program resources

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Concluding Remarks

- Experience and early test results show that early lunar rovers can be teleoperated
- Follow-on rovers and Mars rovers will require a high level of automation, although not all operations will be autonomous
- Significant development effort is needed for full autonomous operations
- Details of Lunar, Mars and lab hardware very significantly (attention to detail is an absolute must for mission success)
- LaRC has excellent working relationships with other NASA Centers, government agencies (including ESA & Russia), industry and academia