Whither Lunar and Planetary Exploration in the 1970's

AAAS Symposium
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Boston

The last year in this decade has proven to be a momentous one for the National Aeronautics and Space Administration (NASA) and its lunar and planetary exploration programs.

The Apollo program reached its primary goal set by President Kennedy in 1961 with the successful Apollo 11 mission and the landing of astronauts Neil Armstrong and Edwin Aldrin on the lunar surface. The scientific benefits of that mission are slowly coming forth. The results to date, in particular the first data on the elemental analysis of the returned rock samples, are most provocative. Features such as their high titanium content and great age have altered many previous concepts and initiated new chains of reasoning. There is little doubt that the more detailed studies now under way in the laboratories of the 142 principal investigators will divulge new information which will have further impact on our thinking on the origin and evolution of the moon.

In the Apollo program, the first manned lunar landing had to take precedence over the scientific exploration of the moon. However, now that this goal has been achieved, the purpose of a continued program of lunar exploration must rely heavily on the science to be carried out. There are other national objectives to be met, such as the desire to maintain manned spaceflight capability; but in the eyes of scientists the dominant one should be scientific research. Consequently, it is vital to have a thorough, open discussion of the scientific goals and priorities of lunar exploration. Major questions to be answered include:

1) What are the major scientific questions, both short and long range?

2) What is a logical sequence of exploration? What sites are the most promising for providing new insights? What is the optimum frequency for exploring these sites? Should the investigations be essentially sequential or can they be at least partially in parallel?

3) What is the role of man? How can he best be used to provide the desired scientific information?

4) What is the role of automated exploration? Are follow-ons to the Surveyors and Lunar Orbiters desirable elements?

5) How important is surface mobility? Are automated and manned rovers essential ingredients in the total mix?

6) What are the merits of a permanent lunar base? If it is desirable, what should be the timetable for its construction? Are there any critical measurements which should precede any decision to establish such a base?

7) In what ways does the experience gained in manned lunar exploration prepare the way for manned planetary exploration? Are there any requirements which the latter should impose on the former?

In the area of planetary exploration, this year has seen the remarkably successful flights of Mariners VI and VII past Mars. The advance in technology over previous planetary missions is typified by the increase in the communications rate from 8⅓ bits per second for Mariners IV and V to 16,200 bits per second for Mariners VI and VII. Moreover, the implementation of two similar Mariner orbiters of Mars in 1971 is well under way, and work has begun on the Viking lander/orbiter missions to Mars in 1973. Preparations for the initial exploration of Jupiter by Pioneers F and G in 1972 and 1973 have started. A flyby of Mercury via Venus in 1973 is in the budget for 1970 currently under consideration by Congress. All of these flights are elements of a balanced program of planetary exploration, the "balanced" concept having received strong support within both the scientific community and NASA.

With the prospect of an expanding planetary program in the 1970's a range of issues must be studied and resolved. These include:

1) What are the major scientific questions?

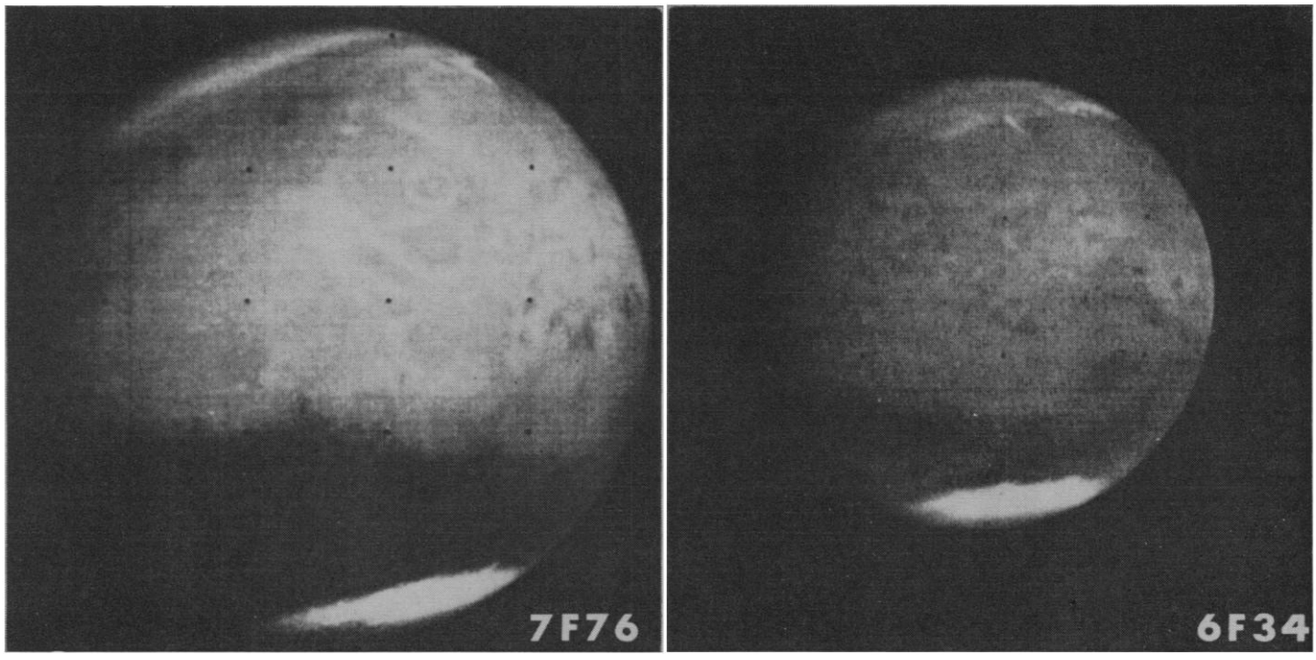
2) What information should be sought to enable us to understand more completely phenomena on Earth such as atmospheric circulation and earthquakes? Which are the most promising planets for these studies?

3) Is the balanced strategy appropriate, or should major emphasis be placed on one or a few planets, for example, Mars or the Jovian planets?

4) If the balanced program is accepted, how should the emphasis be divided among the solar system bodies?

5) For the individual planets what is the relative importance of orbiters, atmospheric probes, and landers? Is the sequential approach necessary, or can a partially parallel exploration be conducted with high efficiency?

6) How should manned flights to the planets fit into the scientific exploration program? What measurements or precursory explorations should be con-



Mariner VII far-encounter pictures showing atmospheric effects. Picture shutter times were as follows: 7F76, 4 August 1336 U.T.; 6F34, 30 July 0732 U.T. [NASA]

ducted prior to beginning manned exploration of the planets?

These two sets of questions on lunar and planetary exploration deserve serious consideration at this time. They are not new and have been debated to varying degrees by the different scientific advisory groups to NASA. What has heretofore been lacking is an open discussion in a forum which provides exposure to the broad scientific community, which then has an opportunity to react to the rationales used. This AAAS symposium is intended to fill this need.

The symposium is divided into three sections: (i) the planets, (ii) the moon, and (iii) a panel discussion. The first two will cover their topics in considerable detail. Each of the speakers is an outstanding scientist who is actively engaged in research on the subject he is presenting.

The Panel will have the broad mandate of examining the total lunar and planetary exploration program and integrating the detailed presentations of the prior two sessions. Included in the membership of the Panel are leading members of three major advisory groups—the President's Science Advisory Council, the Space Science Board of the National Academy of Sciences, and the Lunar and Planetary Missions Board—and a responsible NASA official. The Panel is eminently qualified to illuminate in a highly knowledgeable manner the issues which must be faced and resolved at the beginning of the next decade of NASA's exploration of the moon and planets.

DONALD G. REA
National Aeronautics and Space Administration, Washington, D.C.

Speakers and Topics

Arranged by Donald G. Rea and Donald U. Wise (University of Massachusetts).

26 December

Mercury and Venus, Bruce C. Murray (California Institute of Technology).

Mars, Wolf Vishniac (University of Rochester).

Jupiter and the Outer Planets, Richard M. Goody (Harvard University).

Knowledge of Earth's Atmosphere from Comparative Studies of Other Planets' Atmospheres, Seymour L. Hess (Florida State University).

Knowledge of the Earth's Interior from Comparative Studies of the Other Planets' Interiors, Don L. Anderson (California Institute of Technology).

27 December

Lunar Geophysics, Frank Press (Massachusetts Institute of Technology).

Lunar Geochemistry, Paul W. Gast (Lamont Geological Observatory).

Lunar Geology, Eugene M. Shoemaker (California Institute of Technology).

Orbital Science, Wilmot N. Hess (Environmental Science Services Administration).

28 December

Panel Discussion. John W. Findlay (National Radio Astronomy Observatory), *chairman.*

Participants: John E. Naugle (NASA).

Gordon J. MacDonald (University of California, Santa Barbara).

Carl E. Sagan (Cornell University).

Lewis M. Branscomb (National Bureau of Standards).

S. Fred Singer (U.S. Department of the Interior).