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SCIENCE

Lunar Science and Planetary History

People are asking why man should return to the moon again and again to get more rocks or set up new geophysical stations. Even though the President himself has stated that the nation's first goal in space is to continue to explore the moon through additional landings, the six then scheduled have now been reduced to four.

It will be hard to find an informed scientist of any breadth who views this last reduction of the Apollo program with anything short of dismay. The reason is clear and compelling. Man goes to the moon to study the earth and its relations in space. In the process he crosses a mighty ocean in time, reaching back to the early episodes of solar system history. The first billion years of this history, during which Earth's final accretionary development and its major geochemical and structural differentiation occurred, cannot be deciphered here because the record has been erased by later events. The moon's record, however, appears to be rich just where Earth's is poor. This has profound implications for our understanding of both Earth and solar system, and perhaps for the origin and distribution of ore deposits, which are concentrated in Earth's older rocks. As a side benefit, the results of lunar studies, together with those of sea-floor geophysics, are pacing a conceptual revolution in the earth sciences.

The Apollo geological sites, Rover traverses, and geophysical networks are needed to provide primary control for eventual automated lunar studies. Such a program, when activated, will extend exploration to the far side and polar regions of the moon, and will lead to improvement in early-earth and early-solar-system models. Ultimately, permanent bases may capitalize on the advantages of the moon's far side for infrared, x-ray, and radio astronomy, or on the moon's high vacuum and other special properties for more practical applications.

The moon is the only other planet we can hope to study in sufficient detail for close comparison with our own. We have just begun that study. It is as if we were trying to understand North America by examining Plymouth Rock. Samples have been returned only from one mare site and from an embayment of Oceanus Procellarum. The ancient highlands have not been sampled directly, nor will they be at Fra Mauro, located on an ejecta blanket thrown out from Mare Imbrium. Five instead of three additional landings would still permit only two visits to the very old highland rocks; one to a site that includes a highland scarp, the edge of a mare mascon, and a sinuous rille; one to a large impact crater where shock metamorphism and deep ejecta can be studied; and one to the young volcanic terrain on the mid-ridge of Oceanus Procellarum. The sites then sampled would have constituted an austere but possibly adequate data frame for a first-order understanding of early earth-moon history. The announced reduction of missions exponentially degrades that base line. If Apollo 15 and 19 are indeed canceled, the nation will have failed to achieve its primary scientific goals on the moon.

Many billions of dollars were spent to get within reach of these goals. Only a small fraction of the investment already made would see the job to a fruitful conclusion. To stop short for reasons within our control would, in retrospect, be seen as one of history's most irresponsible follies. Nothing less than the early institution of a comprehensive automated program to get similar information and sample return could begin to ameliorate such a failure.—PRESTON CLOUD, *University of California, Santa Barbara*