Letters

Manned Space Exploration: Case for Apollo

Prior to Apollo 11, NASA's charter was clear: land a man on the moon. The support for that objective, although nearly universal, was founded on a multitude of smaller interests. The program provided a great challenge to our aerospace industries; it tantalized scientists who had grand images of exploring the universe; it provided an unequaled boost to our economy and our technology; but, most significantly, it was a magnificent project and our nation was proud of it. In the post-Apollo 11 era, our support has fragmented. Lunar scientists want to use the excellent systems developed for Apollo to explore the moon. The valuable aerospace industry needs new projects to remain viable. Most significantly, however, in this period of a tight national budget, taxpayers are demanding that all programs be critically examined for value. It is my thesis that this country has benefited immensely from its space program and that our future possibilities are limitless.

Recently, some scientists and some congressmen have pressed for a cheaper, unmanned program. There are two arguments for man's role in space: cost effectiveness, and our very human desire to personally challenge, explore, and understand.

Those who believe that an unmanned program is a cheaper equivalent of a manned program lack due appreciation for Apollo 11 and 12 and ignore future demands on our space systems. Russia's Luna 16 returned a handful of randomly chosen lunar soil at unknown cost. Apollo 12 returned 75 pounds (165 kilograms) of selected and partially documented rocks and soil; allowed exploration of several square kilometers of lunar surface; emplaced several geophysical instruments, many of which are still returning data; and gave man a taste of planetary exploration. Future Russian systems based on the Luna series will have a roving capability; but, because of system constraints, their roving missions will be unable to return samples. During the Apollo 15 mission, we will explore 150 square kilometers of the lunar surface; collect over 130 pounds of samples during 20 hours of extravehicular activity; deploy geophysical instruments having a 2-year lifetime; photograph, with nearly a 2-meter resolution, large portions of both the near and far sides of the moon; explore much of the moon from lunar orbit with geochemical sensors; and leave a satellite in lunar orbit that measures the earth's and moon's interactions with the solar wind and measures the lunar gravitational and magnetic fields. Many of the tasks to be performed on Apollo 15 could be performed unmanned. However, such an unmanned system would not be cheap and performance would necessarily be degraded. A U.S. program similar to Luna would cost several billion dollars and would suffer from Luna's inflexibility and extremely limited potential.

For complex tasks and sophisticated observations, the man is invaluable. He is the universal tool and prime mover. He selects sites and deploys experiments; he walks over many miles of rugged lunar surface gathering interesting samples and observing as a remote camera cannot possibly observe. A man's flexibility and perspicacity cannot be equaled by a preprogrammed machine or by a man remotely operating a machine. Wherever flexibility and perspicacity are needed, either on the moon or in earth orbit, a man will do the job better. As the need for varied tasks becomes frequent, the man can also do the job more cheaply.

Other arguments against a manned program are subjective. Van Allen, a vocal opponent of the manned program, is interested in phenomena that can easily be measured by unmanned sensors. For him a manned program is a frustrating behemoth and a drain on resources available to space science. As difficult as it has been for scientists and engineers to coordinate their efforts in Apollo, I doubt if many of the over 200 research teams would give up their selected lunar sample for some of the soil returned by Luna 16. Scientists such as Eugene Shoemaker, Harold Masursky, and Leon Silver argue vehemently that man is a necessary component of lunar exploration.

The lunar program is being curtailed in NASA's necessary effort to build for the future, but the savings from such cancellations are minimal and the impact on return from the investment in Apollo is catastrophic. It is discouraging to be so strapped for funds that we must junk spacecraft and capabilities that have been paid for, simply to save the cost of using them. This has happened to the original Apollo 15 and 19 spacecraft—and, in today's budgetary climate, may happen to other currently scheduled flights. We should fly out Apollo as planned, as we should also define and build a utilitarian space station and an economical transportation system for servicing that station.

The space program is a fundamental expression of society's curiosity and spirit for outgoing adventure and challenge. This country has social problems, pollution, and the Southeast Asian dilemma. In facing these problems, as we must, we as a nation cannot become so introverted that we cease to explore for new ideas and, inevitably, new applications of ideas. We in this country have been the world's builders, experimenters, and adventurers. Lose this spirit and we will, in essence, have lost world leadership. Space exploration and the application of space technology in the broad sense of earth resources are major frontiers to be challenged now. It would be a tragic mistake to abandon the field to others.

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I value my geological friends, but none of them hold such narrow views as James A. Noble (Letters, 13 Nov.), who thinks that the outermost 25 miles of the earth's surface can provide complete evidence of the formation of Earth, one of at least nine planets in the solar system. If his theories on the origin of Earth's composition ignore evidence obtained from meteorites, the lunar surface, Mars, and the other planets, he is returning to the pre-Chamberlin 19th century.

The cost of developing seismic and deep-drilling techniques was borne primarily by the American oil industry.

NASA's space program has had more publicized federal financing, but its "giant leap for mankind" has produced data no one could derive from the earth's thin crust, which is almost certainly related to the moon's composition and age.

I suppose that a geologist can be excused for his ignorance of parts of the universe other than Planet Earth, such as the asteroids and comets that may have formed craters, mascons, and lunar maria, or the solar wind and geocorona that can be observed best from the moon, or the globules in interstellar material that we astronomers think may be forming other planetary systems, or the intergalactic material that may be detected by the Apollo lunar surface camera experiment. If he wants to understand Preston Cloud's editorial (18 Sept., p. 1159), he can get some help from the book *Origin of the Solar System* (Macmillan, New York, 1966), an elementary treatment edited by the undersigned.

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Vietnam: AAAS Herbicide Study

Philip Boffey's account (2 Oct., p. 42) of the difficulties of the AAAS team investigating the effects of the military use of herbicides in Vietnam is fine as far as it goes. . . . I was at the Plant Science Laboratories, Fort Detrick, Maryland, when Arthur Westing, a member of the AAAS investigating team, appeared on 8 April to receive a briefing on the activities of the laboratories. His opening comment, made before 15 to 20 members of the laboratory, was "I am the enemy." Matters got worse as he went on to explain that his mission for the AAAS was to assess *damage* done by herbicides. When asked whether he thought that all changes caused by herbicides should be classified as damaging, he replied that he hadn't thought about possible beneficial effects. He stated that his committee's function was not to balance benefits, such as the prevention of ambush or the detection of enemy supplies in transit, against the deficits, such as the incursion of bamboo; the committee would not, in short, consider the fact that there was a war being fought nor that herbicides were probably the least lethal weapons in use. Before he had heard a word from the staff of the Plant Science Laboratories Westing made it clear that the committee was going all out to prevent the use of herbicides in Vietnam. Later on, during the briefing, he was very disappointed to learn that the military was not employing paraquat in Vietnam since that would have made his job (of proving that the United States was poisoning Vietnam) a lot easier.

Sometime after that encounter, I read a report prepared by A. H. Westing, E. W. Pfeiffer, J. Lavorel, and L. Matasso entitled "Report on Herbicidal Damage by the United States in Southeastern Cambodia" (*1*). The report, dated 31 December 1969, was based upon 4 days of "intensive field investigation" from 25 to 29 December. Their trip was within the areas bordering Vietnam, in particular the Parrot's Beak and Fishhook regions which were the prime targets of attack by United States and South Vietnamese forces in April–June 1970. They spent their second and last days at Chup and Mimot, respectively, where large caches of military supplies and a vast underground military headquarters were discovered. One must remember that in December 1969 Prince Sihanouk had not yet admitted that North Vietnamese forces occupied the Cambodian border areas despite 5 years of American and South Vietnamese protests against the Cambodian sanctuaries. Then early in 1970 Sihanouk demanded that Hanoi remove the 45,000 to 60,000 troops (the number varied) and supplies they had stationed in his country, and not very long after that Sihanouk was in exile and the Royal Government of Cambodia (now a republic) went to war against the North Vietnamese. It appears that Cambodia, for 5 years at least, was indeed a very vital sanctuary for the Communists, providing them with a supply and headquarters complex from which they could mount offensive actions in the provinces in the southern part of South Vietnam. It is no wonder then that some of the most intensive defoliation missions were on the heavily forested border in an attempt to create a zone where aerial, if not ground, reconnaissance was facilitated.

Against this background the concluding remarks from the report by Westing *et al.* make interesting reading: "We feel particularly grieved about the innumerable direct and indirect losses suffered by the innocent local populace. The extent of these losses can never be