One small step for space science

Apollo 12 will do more science than did Apollo 11, but there is a long way to go

ALSEP as it will be deployed by Apollo 12 astronauts for lunar research, and Cdr. Alan Bean simulating photographic inspection of landing site.

Bendix

by Frederick W. Detje

There can only be one First Man on the Moon. Apollo 11 gave the honor to Neil Armstrong, as well as gathering the other plaudits associated with man's initial visit to another world. The moon will never seem quite the same, and future missions will inevitably appear anticlimactic, now that someone has proven that it can be done.

Being second, however, in a way gives Apollo 12 an advantage: the opportunity to try harder.

With the landing capability an already-demonstrated fact, the Apollo 12 astronauts will be free to extend themselves in almost every way. They will spend more time on the lunar surface, devote more of their time to exploration on foot, deploy more scientific experiments and be more picky in collecting samples of material from the lunar surface.

Even the flight from earth to the moon shows the space agency's increased confidence. Apollos 8, 10 and 11 all made the trip on what is termed a free-return trajectory, one in which the spacecraft would swing around the moon and return automatically to earth if its engine failed to lock it into a lunar orbit. Because of lunar lighting conditions and other constraints, Apollo 12 will instead follow a so-called hybrid trajectory, which counts on the course being successfully altered near the moon either to lock the vehicle into a lunar orbit or send it home. Though the choice of moonward trajectory will have no bearing on the mission once Apollo 12 finds its proper orbit, it shows that the National Aeronautics and Space Administration is fast developing confidence in the transportation system it sacrificed everything else to develop.

One of the sacrificial victims, many observers would argue, has been science. The space agency counters that its first responsibility has been to get the equipment working so that science could take advantage of the ride. But space researchers have complained—and many have resigned—in the belief that science was just stuffed in through a side door to help justify the costly program.

The heavy science in the Apollo Program will not begin until Apollo 16, when the spacecraft will be extensively modified for studies such as radar depth-sounding of the lunar crust and infrared mapping of the surface. This will be the sixth landing mission and the eighth manned flight to the moon.

By comparison, the Apollo command module, heart of the system, received only one manned test before the Apollo 8 astronauts took it to the moon. The lunar module also underwent but a single earth-orbital flight prior to taking two astronauts within 50,000 feet of the moon.

Nevertheless, considerably more scientific knowledge stands to be gained from Apollo 12 than came from its predecessor. Not only will Charles Conrad, Richard F. Gordon Jr. and Alan Bean have more scientific chores to perform, in closer liaison with scientists on the ground; they will have more time in which to perform them.

Instead of being limited to lunar excursions of only two hours and 32 minutes, the second landing crew is programmed for two periods of lunar exploration, each to last three and a half hours—with an additional half-hour if the life-support systems will permit it.

The distances they can roam from the landing vehicle are to be extended to nearly half a mile, well beyond the 250 feet to which Neil Armstrong and Edwin Aldrin were tethered.

If the landing is accurate enough (SN: 10/18, p. 355), that half mile should easily encompass an exciting bonus: Surveyor 3. The robot spacecraft, placed on the moon more than two and a half years ago, has been sitting there ever since exposed to micrometeoroid impacts, the solar wind, whatever lunar atmosphere may exist and other aspects of the lunar environment. The astronauts will carry special tools to remove parts of the Surveyor

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for return to earth, where researchers will study them both for scientific data and to aid engineers planning long-life lunar structures such as scientific stations. Glass surfaces such as lenses and mirrors, for example, will reveal two years' cumulative loss of light transmissivity or reflectivity. Other components will be checked for metal fatigue.

But more than time and space, the equipment they will have to deploy will most sharply mark the difference between Apollo 11 and Apollo 12.

The space agency has had in its pockets for some time a package of research instruments called ALSEP, for Apollo Lunar Surface Experiments (SN: 1/4, p. 17). These were scheduled originally for Apollo 11, but they were ruled out to preserve the maximum flexibility required for men entering so alien an environment for the first time.

The ALSEP, and the data to be accumulated by the ground-based scientists who will be monitoring it far into next year, bid fair to emerge as a key element in mankind's second manned lunar landing. And the scientists patient enough to have waited for it may well now be in a position to play a first-hand role in the payoff.

The five major scientific experiments contained in the ALSEP package are designed to answer a variety of key questions Apollo 11 was forbidden.

- A passive seismic experiment similar to the marginally successful one deployed by Apollo 11 will measure lunar quakes and produce data on the moon's interior and possible origin.
- A surface magnetometer, designed to detect and measure magnetic fields in all directions, will be sensitive enough to measure magnetic intensity as weak as 0.01 times that at earth's equator. The earth's magetic field, for instance, is too strong to admit many cosmic particles; a lunar base would be far more suitable for the detection of charged-particle phenomena.
- Relatively little is known about the interaction of the solar wind with a cold body such as the moon, with or without a magnetic field, and another solar wind experiment (SN: 1/4, p. 17) will be deployed to measure energy and flux of particles in all directions.
- A lunar ionosphere detector will measure charged particles near the lunar surface. Scientists contend that, because the moon has practically no atmosphere and very little magnetism, there may be a variety of unique magnetic and electrical phenomena near its surface. The detector will seek quantity, speed and energy of positive ions, and will be placed on a ground screen to which a voltage can be applied. By varying the voltage, local electrical fields on the moon's surface may be determined.
- A lunar atmosphere detector, keyed to neutral particles, will seek any residual lunar atmosphere. The fact that the moon has essentially no atmosphere has been established; scientists would still like to determine if the vacuum is absolute. There is a school of thought that says it is not.

And even though the lunar atmosphere, if detected, will be slight, it could carry traces of volcanic gas, and this would be highly significant to selenologists who may never end their quarrel about ancient lunar seismic activity. In addition, men on the moon contribute atmosphere in the form of gases they and the lunar module produce. The rate at which this alien atmosphere dissipates is also of interest.

In addition to these major experiments, a lunar dust detector will be deployed, and the astronauts will again collect samples of lunar rock—better documented as to source than those of Apollo 11—including samples from within craters for the first time. And extensive lunar multispectral photography will be done from low lunar orbit.

All of ALSEP's experiments will be linked to a central station. This will be powered by a SNAP-27 isotope-energized thermoelectric generator. This will be the first time such terrestrially proven power sources for remote installation will have been tested on the moon. Apollo 11 used nuclear powered heaters in its seismometer package, but these were not a power source.

The central station will not only transmit; it will also be able to receive commands from the earth, enabling the scientists to tailor the experiments to conditions as they develop.

Though the scientists who have stayed with the Apollo Program may continue to have questions about the adequacy of the science they are able to do so far, even with so relatively sophisticated a package as ALSEP, they have what may be a more serious concern.

There is still apparently no provision to feed back what they have learned from one flight into the very next one, taking best advantage of the results of each flight (SN: 9/20, p. 235).

And it may well be Apollo 14, rather than 13, before the sophistication gained on Apollo 12 will have the effect that it should on the design of future missions.

The Apollo Program may be geared well for fast-moving engineers, but, as several space scientists, many of whom have left the program, have declared, the fast and furious Apollo Program may still be paced too fast, and far too furious, for science. □