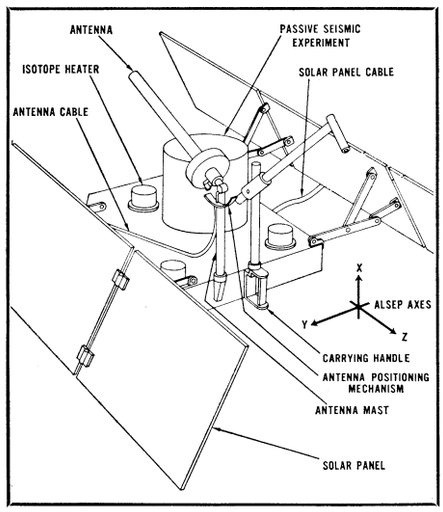
NASA

Two astronauts will deploy ALSEP, *but they won't be the first on the moon.*



Seismometer—solar panels for power.

Science on the moon

Many scientists planning research for the lunar surface will have to wait until the second landing

by Jonathan Eberhart

Their exhaustive training notwithstanding, it will inevitably be with reluctance that the first astronauts on the moon turn from staring at the awesome expanse of barren rock, with the earth suspended above, to the business at hand—the study and sampling of the lunar surface and environment.

These men will probably be the crew of Apollo 11, as yet unselected, who could reach the moon as early as July, a flight pioneered for them by the Apollo 8 astronauts (see p. 7). How they will spend their precious time on another world is being planned down to the minute by the National Aeronautics and Space Administration, which is even mapping their footsteps in an effort to make the most of the few hours allotted to the climax of man's centuries-old lust for the moon.

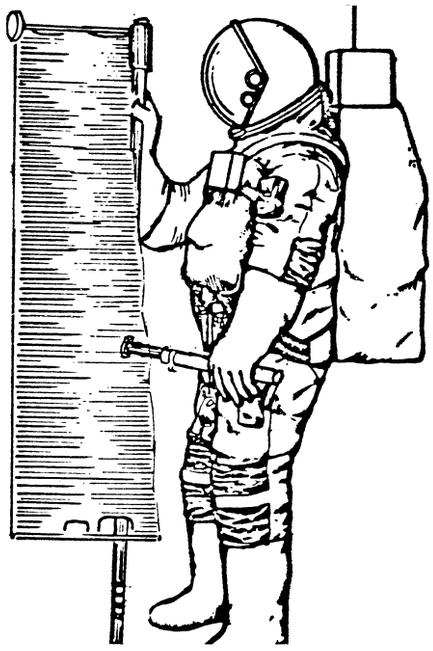
The plan has been changed dozens of times in the past and will probably be changed several more. The latest schedule, however, gives the two astronauts just 22 hours on the new frontier, while the envious third man waits in orbit aboard the command module.

The Apollo 11 astronauts' first surface task—it would be their choice even with no official schedules—will be to make sure that the spidery lunar module spacecraft, their only link with home, survived the landing intact. At this, including a brief respite for a meal if excitement lets them eat, they will spend three and a half hours.

The next item, incredibly, is eight hours of sleep. The fact that the first men on the moon may feel somewhat other than sleepy ("I might as well have been standing on my head on top of a flagpole, as far as going to sleep was concerned," said Astronaut Donn Eisele of his first night aboard Apollo 7) has not escaped the space agency, which plans to provide sleeping pills.

The snooze is necessary, the agency believes, to ensure that the crew will be alert for the rigors of walking in the moon's alien, one-sixth-normal gravity, and for the painstaking preparations for departure.

With their surface time more than half gone, the astronauts will at last begin preparing to leave the spacecraft and put their own feet on the moon. From various lockers and compartments, they will collect several hermetically sealable sample containers, along with specialized tools for gathering pieces of the lunar rock. A long-handled scoop and a pair of extended tongs will enable the astronauts to pick up surface samples without having to bend too far over in the cumbersome space suits. Several small cylinders, called drive tubes, can be stuck into the ground to collect samples from a foot or more below the surface.



Catching the wind with metal foil.

Then both men will don their EVA space suits, designed to provide extra protection from micrometeorites and radiation during extra-vehicular activity, and at last they will unpack a group of scientific experiments, to be deployed on the lunar surface. This, for many who can see beyond the adventure, is the real point of the space program—even if it takes a back seat

. . . experiments on the moon

in headlines and Federal budgets.

For years the space agency has been planning to equip the first moon-landing astronauts with an elaborate scientific array called the Apollo Lunar Surface Experiments Package. The design has been charged several times, but it generally includes four or five experiments, to be left on the moon with a nuclear power source, to measure the moon's seismic activity, magnetic field and atmosphere, as well as the solar wind and other changed particles coming in from space. It would take about an hour and a half to set up.

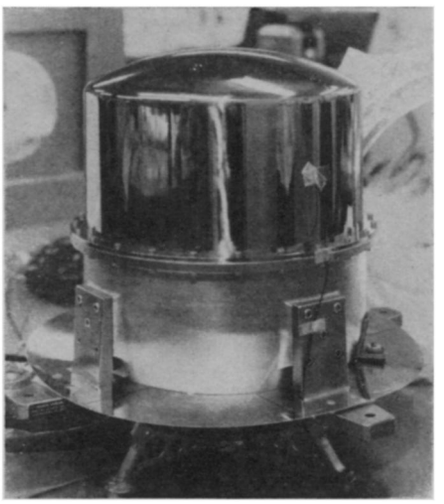
Until about six weeks ago, Apollo officials had been planning for the astronauts to take two three-hour excursions outside their spacecraft. The first time, they would hastily collect a quick choice of random rocks, in case some problem would require a sudden departure, and deploy the ALSEP array. The second moonwalk would be largely devoted to gathering carefully selected samples, ranging as far as 1,000 feet from the LM.

In mid-November, however, concerned about keeping down the astronauts' workload in an alien environment, the agency decided that two excursions were one too many. "Why push our luck?" asked one official. "If everything went well the first time we'd just be courting unnecessary risks."

With only half the time available, and the sample-gathering of prime importance, ALSEP had to go. Instead, the first astronauts on the moon will deploy three simple pieces of equipment, all within some 30 feet of the spacecraft, instead of ALSEP'S several hundred, and only one of which is complicated enough even to require a power supply.

The one powered device is a passive seismometer, designed at Columbia University's Lamont Geological Laboratory to detect tiny tremors in the lunar depths and report them by radio to earth. All the astronaut will have to do with the 100-pound device (which will weigh barely 17 pounds on the moon) is set it on the ground, open the solar panels which power the transmitter and align them in an east-west direction to face the sun.

Scientists on earth will play an active part in using the second instrument, a multiple corner reflector at which they will shine the narrow beam of a laser, precisely timing the return signal to measure more accurately the distance from the earth to the moon. Last January, a team of researchers from five universities and two Federal agencies,



This ear listens for lunar tremors.

headed by Dr. Carroll O. Alley of the University of Maryland, demonstrated the necessary aiming accuracy by shining laser beams moonward where they were photographed by Surveyor 7.

The reflector array itself is completely passive: the astronaut has only to raise the reflector panel, like the lid of a suitcase, and aim it toward earth. Besides Dr. Alley's group, other researchers planning to point lasers at the device include scientists of the U.S. Air Force, and in France and the Soviet Union. Both U.S. and Soviet scientists have bounced laser light off the moon in the past, although without the benefit of corner reflectors; the moon's curvature so dispersed the light, however, that returning signals were extremely weak and difficult to time.

The laser beam at first will be sent through the 60-inch telescope now being built for the University of Michigan's observatory on Hawaii; use of lasers at separated points could provide information on continental drift and possible shifting of the earth's crust. Other studies that could benefit from the lunar laser reflector, Dr. Alley says, include measurements of the mass distribution, size, orbit and librations of the moon, as well as the earth's rotation rate and the cyclic wandering of its poles called Chandler wobble (SN: 1/27/68, p. 88).

The last experiment is a mission planner's dream, not only easy to set up, but weighing, on the moon, less than three ounces. Designed by Dr. Johannes Geiss of the University of Berne, Switzerland, the first foreign scientist to have an experiment included on Apollo, it is little more than a piece of aluminum foil, one foot by three, unrolled by the astronaut like a

window shade and held upright on a telescoping stand. Aimed directly at the sun, the foil screen is intended to trap particles of the noble gases (helium, neon, argon, krypton and xenon) in the solar wind.

Driven at the solar wind's velocity of more than a million miles per hour, says Dr. Geiss, the particles should be embedded several hundred atomic layers deep in the foil. Rolled up again, the foil will be brought back to earth by the astronauts, where Dr. Geiss will melt it down, then use a mass spectrometer to measure the tiny amounts of trapped gas particles.

With all three experiments to be deployed within 30 feet from the spacecraft, the astronauts may not have time to get much farther away than that for sample-gathering. Some of the 135 scientists in nine countries waiting on earth for their NASA-allotted share of lunar rock are concerned that this may mean that all the samples brought back will have been contaminated by the spacecraft's exhaust during its descent. The space agency admits the possibility.

Once back in the lunar module, the two astronauts will spend the rest of their 22 hours checking out the vehicle's readiness for the ascent to rendezvous in orbit with the command module. Then it's back to earth.

The more elaborate ALSEP array has not been forgotten, however. It has merely been postponed until the second lunar landing, also in 1969, when there should be more moonwalk time available. The package comes in three assortments, the first one including a more sensitive passive seismometer as well as devices to measure the moon's magnetic field, atmosphere and the solar wind.

On subsequent flights, some of these experiments will be replaced with others. One such is a four-foot probe that will be thrust into the lunar soil to measure the rate and amount of heat radiating up from the moon's interior. A drill, included to bore the hole for the probe, could also double as a core-sampling tool.

A particularly important experiment is an active seismometer, which differs from a passive one in that it uses man-made explosions to provide its own tremors, enabling the study of the moon's geologic structure. While on the moon, an astronaut would set off small blasts with a device called the thumper, holding it upright like a Pogo stick and pulling a trigger to set off the ground-level explosion. In addition, he would plant larger charges over a wide area, to be set off later by radio from earth, while the seismometer listens and reports the signal delays.