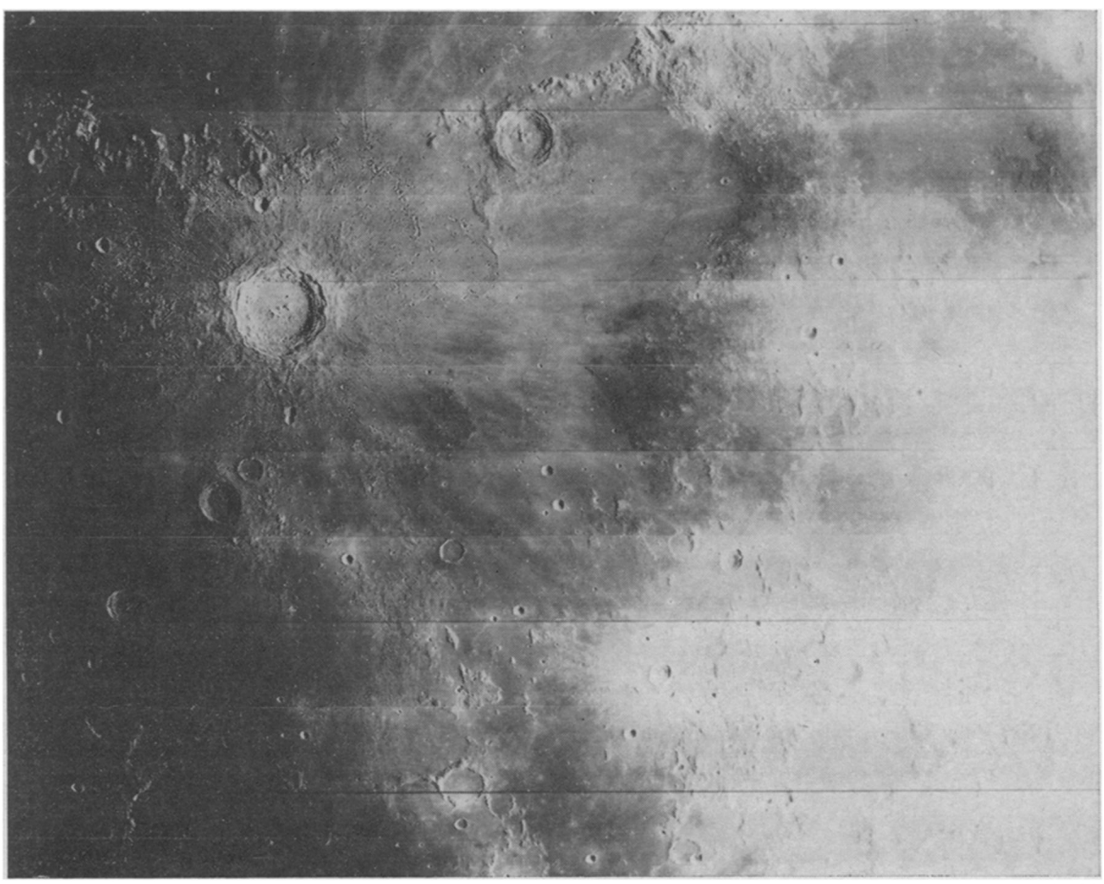
Apollo 13 to the highlands

The third trip to the moon should bring back some answers to the questions tantalizingly raised by Apollos 11 and 12



Four ages of moon should be available on the Fra Mauro highlands, extending southeast from the larger Copernicus crater. Basin (upper left corner) is Mare Imbrium.

Photos: NASA

by Everly Driscoll

Man has gone to the moon twice. Each time he has brought back pieces of moon rock. From them selenologists have tried to put together answers to the basic questions: how old the moon is, where it came from, why the maria face the earth and how old the highlands are.

They haven't found out. For every answer there are more questions.

The astronauts of Apollo 13, to be launched April 11 on the third trip to the moon, could bring back something more definitive. For this time, they are going to a part of the moon where they will find a cross-section of lunar history: the Fra Mauro Highlands.

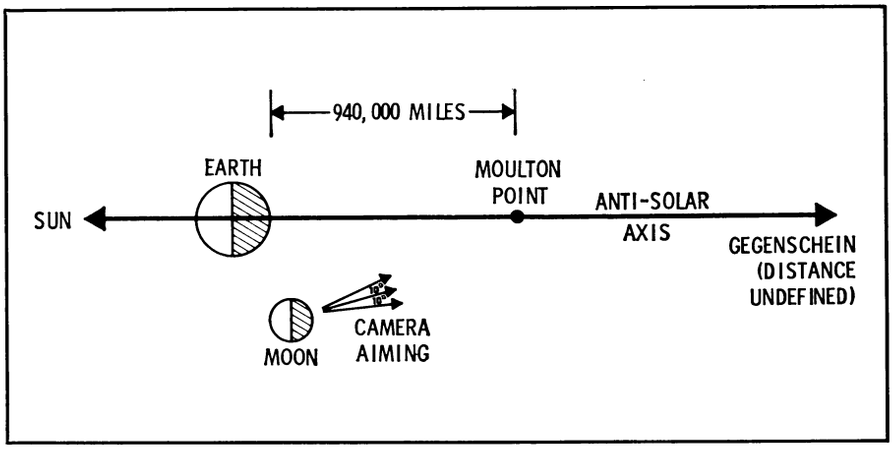
Using a drill for core-sampling that will allow them to bring back lunar soil up to 10 feet below the surface, Astronauts James Lovell and Fred Haise hope to have access to material of four different ages.

The hope is based on increased landing accuracy. A descent orbit change, bringing the module down to a 60-by-8 mile orbit, and a new landing device, should put them within reach of the rocks they want.

The oldest, interestingly enough, could be close to the surface. Around the rim of Cone Crater, near the landing site, are boulders ejected from the center when it was formed. This could be material from Mare Imbrium, a large circular basin, probably formed by the impact of a huge meteoroid, 500 miles north of Fra Mauro. The impact forming the basin, very early in time, ejected material from as deep as 100 kilometers within the moon; the ejecta formed hummocky ridges, one of which is Fra Mauro, that extend radially from the basin. Geologists use Imbrium to age-date major events in lunar history, which is the reason they are eager to get hold of a piece of it. Some geologists suggest it may be as much as 4 billion years old; others say it might not be much older than the 3.6-billion-year-old material from Mare Tranquillitatis brought back by Apollo 11.

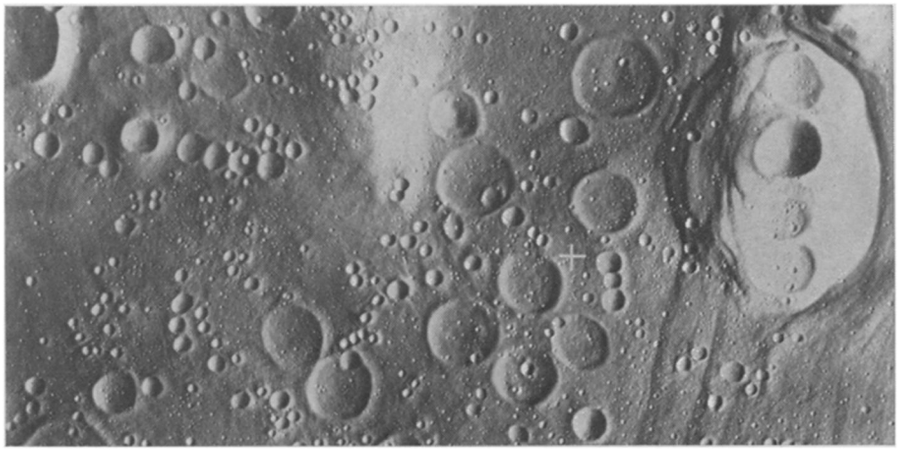
Material from two younger craters is expected to be found at the site. Ejecta from Eratosthenes, the older of the two, is covered by material from younger and larger Copernicus; both should be readily available.

And to round out the age package, the astronauts hope to find some material that was there before the cataclysmic Mare Imbrium event itself.



Photographs of gegenschein may determine if it is just another Moulton point.

Command Module pilot Mattingly.



Landing site is near Triplet and Doublet Craters, west of large Cone Crater.

Documenting these samples so that geologists will be able to identify their source will be a major problem for the astronauts—one that was not satisfactorily solved in Apollo 11 and Apollo 12, mostly because of the time pressure restricting what the astronauts could do in that regard. Apollo 13 will emphasize the importance of documentation; Lovell and Haise will spend up to 10 hours in two periods on the surface, taking pictures of the samples, observing texture and soil mechanics differences, and carefully recording the location and the kind of geological structure each sample comes from. From such data, scientists on earth should be able to identify the source of each sample to correlate the date of the phenomenon that gave it birth.

"It will be," says Houston geochemist Robin Brett, "like a dog with a new bone."

Photography will play an important role in Apollo 13—more so than in previous missions. Not only will the astronauts on the surface take more pictures; photography from the orbiting command module will also be expanded.

Scientific and low-level photography will consume much of Astronaut Ken Mattingly's time while Haise and Lovell are in the LM. Apollo 13 will take 12 cameras for stills, stereo pictures, TV pictures and moving pictures. A new topographic camera for high resolution pictures and motion compensation of lunar surface pictures will be used. Astronaut Mattingly will take low-level, visible-light pictures of the solar corona, using the moon to occult the sun. He will also photograph the zodiacal light, a nebulous light seen in the west after twilight and in the east before dawn. It is thought to be due to the sunlight reflected from multitudes of meteors revolving about the sun nearly in the plane of the ecliptic.

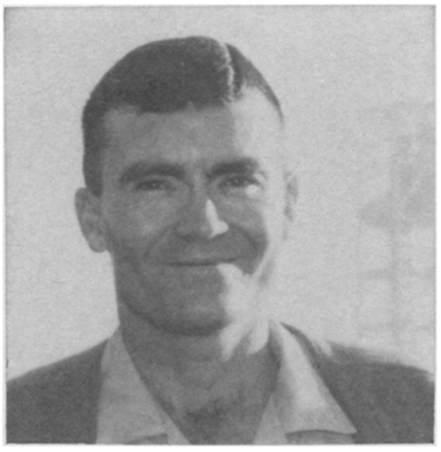
Mattingly will also attempt photographs of the gegenschein and the Moulton points. The gegenschein is a spot of light at the antisolar point, diametrically opposite the sun. This phenomenon has been observed to be joined to the zodiacal light by faintly luminous bands. Some scientists think the gegenschein may be a Moulton point. There are four or possibly five Moulton points—libration points which are believed to be areas of zero gravity where debris may collect in space; sunlight could be reflected off of this debris.

Besides the sampling and the photography, Apollo 13 will also include a package of scientific instruments to make measurements of various physical phenomena. The scientific package, ALSEP, is the second such configuration to go to the moon; the first was on Apollo 12. These packages are groups of experiments which are connected to a central power generator. The experiments will vary somewhat on each flight. During planning as early as 1965, scientists and engineers, working within the constraints of volume, power supply, site location and launch time, designed fundamental measurement tests for the moon. Experiments were chosen for Apollos 11 through 15; designs to fly on Apollos 16 through 19 will be announced in May.

The package on Apollo 13 contains two new experiments, as well as duplications from Apollo 12. One new one is a heat flow experiment, which requires drilling for the first time on the moon. Fred Haise will drill three 10-foot holes; one for a core sample, and two to sink two heat probes which will measure the heat flux of the moon's interior and temperature at various depths in order to deduce the source of heat.

The other experiment will measure charged particles in the magnetosphere, and the solar wind in interplanetary space. Complementing experiments operational from Apollo 12, it has the capacity to measure 18 energy levels of protons and electrons separately. Experiments duplicated are a passive seismometer, a cold cathode gauge, a lunar dust detector, a solar wind experiment and those sampling gas, magnetic fields and the lunar atmosphere.

There will also be two maneuvers designed to aid the seismologists during the flight. The first will be the crash of the Saturn 4-B stage rocket into the



First time in space for Fred Haise.

James Lovell: 572 hours in space.

moon with an impact equivalent to 11 tons of TNT about 140 miles to the west of Apollo 12's seismometer. This will give scientists insight into the surface structure of the moon down to 50 kilometers below the surface. Another calibration data point will come later after the second seismometer has been deployed; the ascent stage of the lunar module will again, as on 12, be impacted to a target on the moon—between Apollos 12 and 13 seismometers. This will be the first time that ground will have data from two instruments recording signals of known impact velocity and approximate distance.

The result of all this activity should provide some of the answers to questions that have been raised by previous missions. At least National Aeronautics and Space Administration spokesmen are emphasizing the importance of science in the present operation.

"Science was never the only objective of the first moon landing; but it is the only reason for going back to the moon," says Deputy Administrator George Low. Headquarters scientist Dr. Edward Davin agrees. "This is a scientifically oriented mission," he says. □