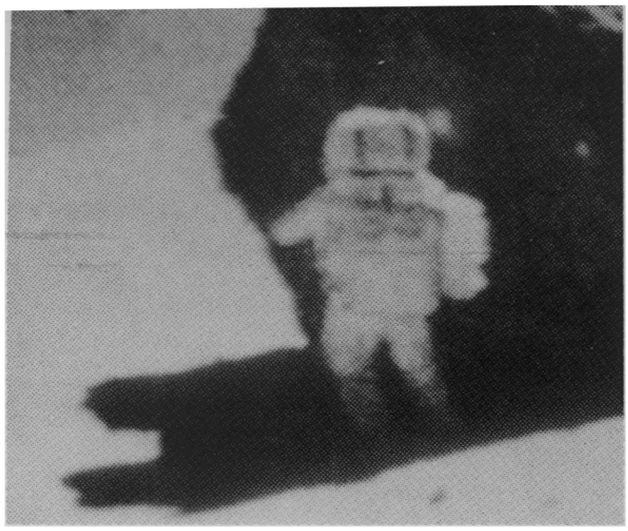
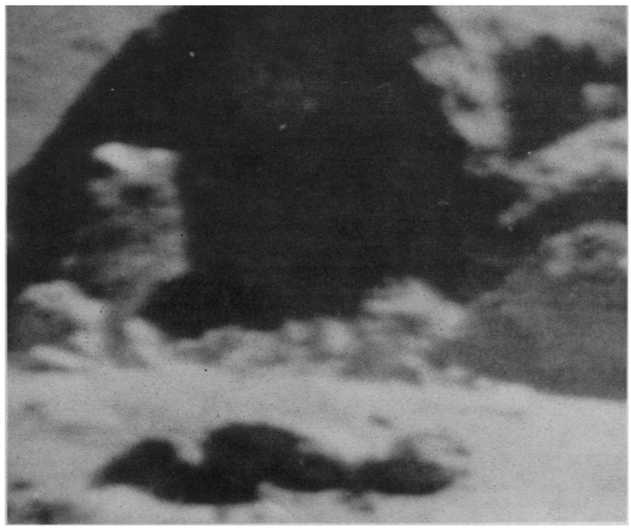


Taking a sample from one of the moon's larger rocks.



An even larger boulder was found at North Ray crater.

science news
OF THE WEEK

New moon rocks to

"There you are, mysterious and unknown Descartes, Cayley plains," said John W. Young as he set foot on the moon's Central Highlands. "Apollo 16 is going to change your image."

The extent to which the returns from Apollo 16 will change the prelanding image lunar scientists had painted of the Descartes and Cayley formations will have to await examination of the samples returned by the astronauts. But part has been changed already from the descriptions by Young and his traveling partners Charles Moss Duke Jr. and Thomas Ken Mattingly as they hopped and chuckled around on the lunar surface and orbited the moon.

The mission itself was full of changes. It had started normally enough on April 16 (SN: 4/22/72, p. 260) and continued so until after the crew separated lunar module Orion from command module Casper in lunar orbit. Prior to LM landing, Mattingly discovered a malfunction in the backup system which controls the service and command module's main engine. For a while it appeared as though the landing would have to be aborted. After more than four hours of tense examination of test data by officials at Mission Control at Houston, it was determined that the backup system, while not perfect, could still be used in case the primary system failed. The mission then proceeded as planned. Orion finally landed at Descartes at 9:23 p.m. EST on April 20. But the crew's sighing wish for a return to normalcy wasn't fulfilled. The third EVA (extravehicular activity) had to be cut short by almost two hours, and the scheduled two days in lunar orbit after LM ascent was cut short by a day. Officials said the cuts were necessary to cover the faulty secondary system.

The most unchanged part of the mission was while Duke and Young were on the surface and Mattingly was in lunar orbit. "They followed the flight plan to a T," said one lunar scientist. Every stop on the lunar geology field trip maps was visited as planned except for several on the third EVA. "Right on," the crew said repeatedly as they arrived at each station at almost precisely the distance and bearing that had been estimated.

Duke and Young spent a total of 20 hours, 14 minutes out of the LM on the surface and traveled 27.1 kilometers in the four-wheeled lunar Rover. They established the fifth U.S. scientific station on the moon, and their footprints extend from the rim of North Ray crater to the slopes of Stone Mountain, more than 8 kilometers to the south. They got a spectacular view of South Ray crater whose rays cover the landing area. In true astronaut style, they repeatedly expressed awe and enchantment with the beauty of the mountains, the rocks and the boulders. "Orion is finally here, Houston. Fantastic," Duke said after landing. Added Young, "It really is something looking at that mountain."

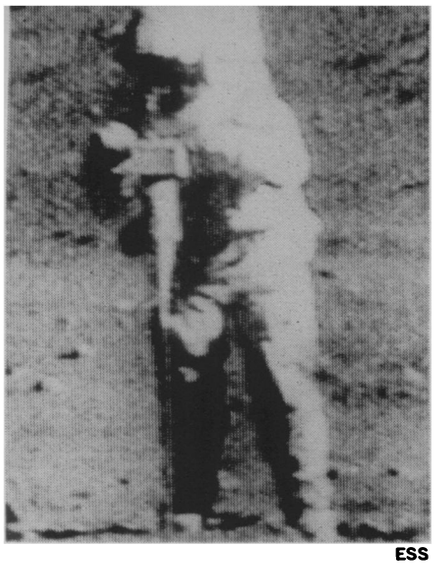
Their exuberance continued as they performed a multitude of surface tasks. They got a sample from under a large boulder in what is described as a permanently shadowed area. This sample was to enable scientists to study any volatile metals that may be retained there. Quipped Duke, "In West Texas if you do this you get a rattlesnake. On the moon you get permanently shadowed soil." The only disappointment came when Young got tangled in the cable of the heat flow instrument and pulled it and its connector off the central station. "All those hours down the drain," Duke sighed as he stopped the drilling required to emplace the then-useless instrument.

Duke and Young collected the biggest haul yet—an estimated 212 to 240 pounds of rocks. Some looked like black and white breccias (evolutionary rocks formed from several rocks by melting or impact), and some looked like crystalline rocks. But not many looked like basalts. That may be the real surprise resulting from Apollo 16.

Lunar geologists studying the highlands from orbital data thought that two different volcanic events had occurred at the Apollo 16 site. The two types of resulting fill were called the Cayley and Descartes formations (SN: 4/8/72, p. 235). The Descartes appeared to be the more viscous flow, forming hills and furrows. (The orbital and surface observations of Apollo 16 verified that Stone Mountain had terraces that appeared to have been formed by such a fill.) The Cayley was thought to be a more fluid flow, filling in the lowlands. Crustal material is thought to be anorthositic or noritic in composition. This is the material some scientists wanted to sample by going to a site other than Descartes in the Central or Southern Highlands. But if the Descartes model were true, the site's crustal material would have been covered later by this volcanic fill.

"Before the mission, we were guessing the Cayley to be feldspar-rich basalt," said W. R. Muehlberger of the University of Texas. "This was the big shock of the mission. The Cayley appeared to be all breccia."

"I really don't think we got any volcanic rocks to speak of," reflected Duke on his journey home. "The shocked



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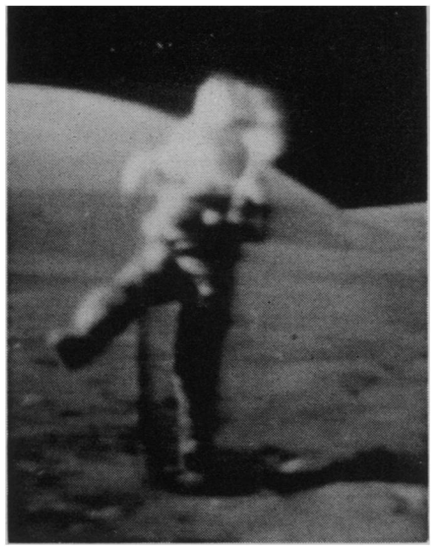
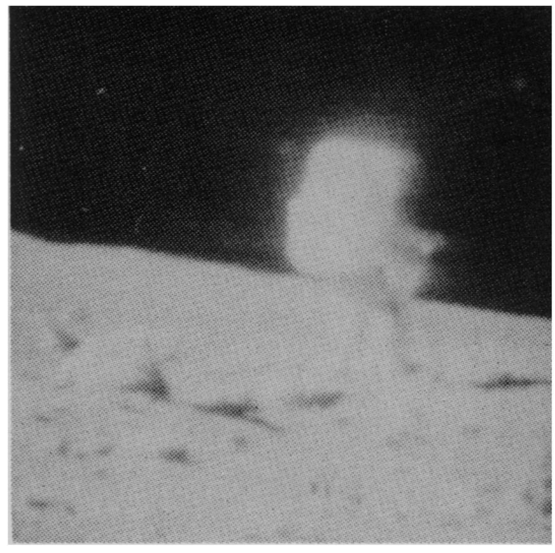
An eight-foot core sample inserted . . .



. . . a core extracted the hard way.



Crossing the slope of Stone Mountain.

make everybody happy

rocks could have been tuff breccias [breccias formed as a result of turbulent volcanic flows]."

"We thought there was a good chance you might have a tuff breccia," capsule communicator Anthony England, a scientist-astronaut, responded. "A one-rock breccia may still have the same [volcanic] information."

"There certainly were some crystalline rocks," Duke responded.

"You guys are really on the ball," England assured him. "Your landing at Descartes probably sampled the most differentiated part on the near side of the moon."

Lunar scientists already had several possible explanations for what the astronauts had seen. Harold Masursky of the U.S. Geological Survey, one of the proponents of highland volcanics, still believes that the Descartes formation is volcanic. But he thinks that Cayley may be a base surge—a fluidized mass resulting from volcanic activity and covering an area usually within one-half crater diameter eruption. "The area is probably a mixture of volcanic and subsequent impact events," he says. Now USGS geologists are speculating that Imbrium impact ejecta or Nectaris impact ejecta could account for what was found at the site.

"The Descartes site might turn out to be the most significant rock samples yet," says Farouk El-Baz of Bellcomm, Inc. Part of that anticipation comes from the data from the orbital instruments Mattingly operated. Scientists believe that highlands or terrae of the moon are what is left of the original crust. They believe the crust to be anorthositic and thus to have high ratios of aluminum to silicon. The orbital X-ray spectrometer found that the Descartes site had one of the highest ratios on the moon's near side.

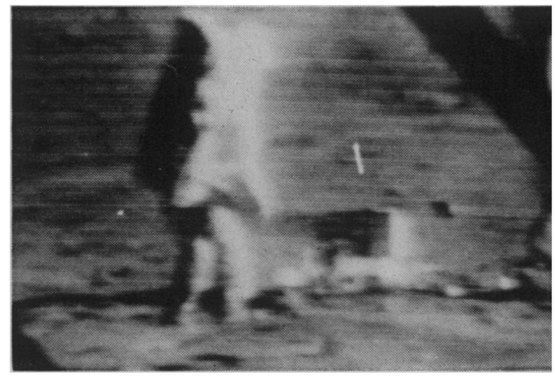
This ties in with Masursky's prediction that since the Kant Plateau to the east of the landing site was the highest region on the near side of the moon, whatever crustal evolution had occurred on the moon had occurred longer at Descartes than at any other place on the near side.

The Apollo 16 gamma-ray spectrometer revealed that the Fra Mauro region has a high radioactivity level similar to that discovered by Apollo 15 at Oceanus Procellarum.

The active seismic instrument called the thumper revealed that the regolith at the Descartes site was at least 27 meters in depth. "There was virtually no change at all in the seismic velocity down to 27 meters," said Robert Kovach of Stanford University.

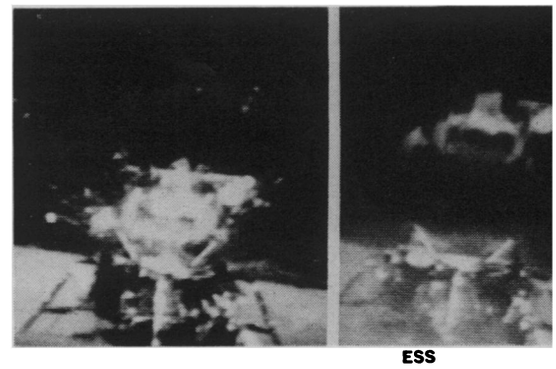
The portable magnetometer showed a magnetic field higher than any yet found on the moon—125 gammas at Station 5, 180 gammas at Spook crater, 230 gammas at the ALSEP site, 120 gammas east of the LM and 313 gammas as Station 13. "This high field may be due to the fact that the highlands are older and the paleomagnetic remnants there are more indicative of the strength of the field that induced it to begin with," said Palmer Dyal of NASA's Ames Research Center.

The Descartes site may turn out to be the Holy Grail of the Apollo program after all—yielding rocks representative of the lunar crust to please the geochemists and rocks revealing subsequent volcanism to please the geologists (SN: 2/19/72, p. 121). "We sure tried hard, anyway," sighed Duke, "I think we got a piece of every rock up there." □



The ill-fated heat flow experiment.

Making a soft landing on the moon.



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Making a hard blast off for home.