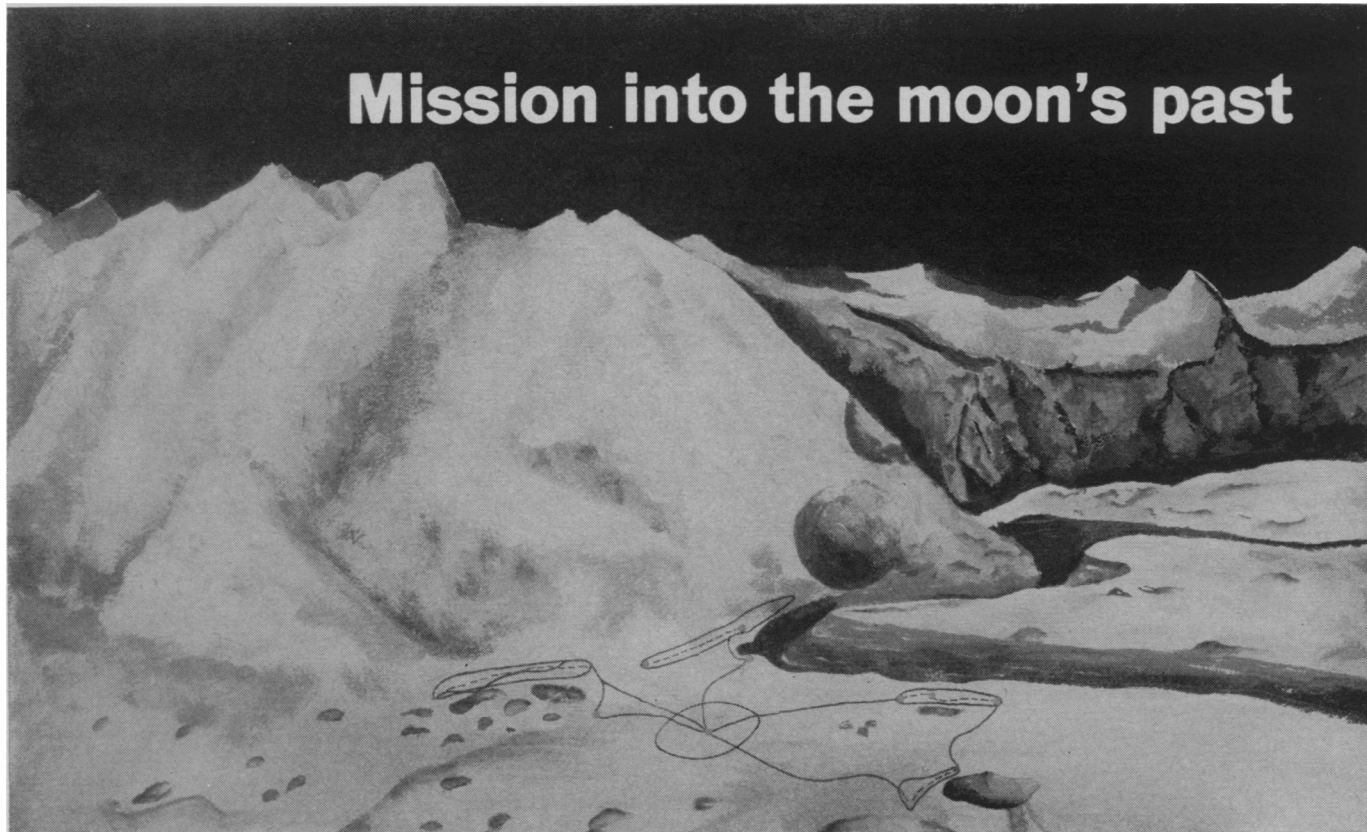


Mission into the moon's past



Drawing by E. Cherry Doyle

by Everly Driscoll

Most of the scenes that Apollo 15 Astronauts David R. Scott, James B. Irwin and Alfred M. Worden will see on man's fourth journey to the surface of the moon never have been viewed before.

As Worden orbits the moon in the command module Endeavour he will see terrain examined by man only through photographs. Three-fourths of his 74 orbits will be over new territory.

When Scott and Irwin land the Falcon July 30 at the Hadley/Apennine site, they also will view sights not seen on earth. They will touch down in an undulating, boulder-filled, crater-pocked lowland called a mare—comparable to that of other landing sites. But that is where similarity ends. To the west, they will see a winding valley resembling a river canyon. To the east, south and north, a mountain front that rises above the plains to more than 10 times the height of the Empire State Building.

Hadley/Apennine, on the southeast rim of the Imbrium basin, is a geologist's dream site. Within field-trip distances are material from at least six different events in the moon's history.

Imbrium is the largest, and by crater-counting believed to be the youngest, of the large circular basins on the near side of the moon. (Others are Serenitatis to the east of Imbrium, Crisium, Nectaris and Humorum. Orientale is barely visible on the near side.) These basins are called maria, because they looked like seas; they are now known

Apollo 15's Scott and Irwin will explore a lunar rille and mountain while Worden maps a fifth of the moon's surface

to be basins covered over with lava. But they differ in appearance and possibly origin from the other mare areas, such as Mare Tranquillitatis, Oceanus Procellarum, Mare Fecunditatis and Mare Vaporum, although these also appear to have gone through a surface-heating or lava-related event.

Serenitatis, which abuts Imbrium on the east, is believed to be the oldest of the basins. Cosmologists and geologists have only theories for the early history of the moon. They think that sometime after 4.6 billion years ago, the moon was bombarded with objects large enough to dig out the basins. The debris scattered by these impacts can still be seen. So can mountain-like ranges circling the basins. Geologists think that the Orientale basin shows the clearest record of the events that followed impact. It appears not to have gone through the subsequent extensive lava-flooding or melting that obscures the record in the other basins. After impact the subsurface and surface areas

could have gone through a period of resettling and faulting. Faulting could account for the series of concentric rings seen in Orientale (like the circles created when a stone is tossed into water). Then later, perhaps, a second heating period caused lava to flood the lowlands, the basins and highlands.

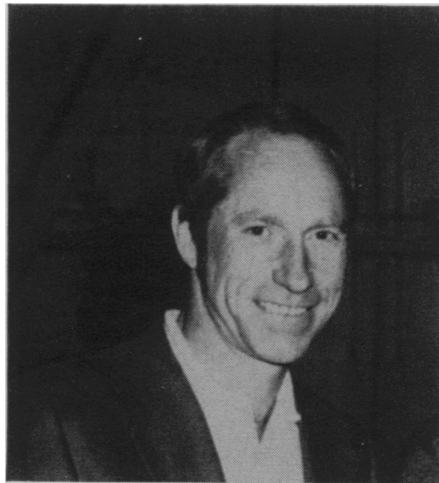
The event that created Imbrium appears to have scattered debris radially, creating other ridges. One such hummocky ridge is the Fra Mauro area of Apollo 14. Recent dating of several rocks from this area, however, gives ages of 3.8 billion and 3.9 billion years old—younger than some had expected, (SN: 7/3/71, p. 5). These dates, if the Fra Mauro region is indeed an ejecta blanket from the Imbrium event, suggest to Dr. G. J. Wasserburg of the California Institute of Technology that the melting and lava activity occurred at or near the time of impact. This would eliminate the need for a second melting period caused by internal heating.

The Apollo 15 site could add more light to this theory as well as yield material older than the Imbrium event. Two ridges overlap near the Hadley/Apennine site—those created by the Serenitatis event and those created later by the Imbrium event. Before the Imbrium impact, then, the landing area probably contained some lunar crustal material plus impact ejecta from Serenitatis. Some of it may be found at the base of the Apennine range that forms



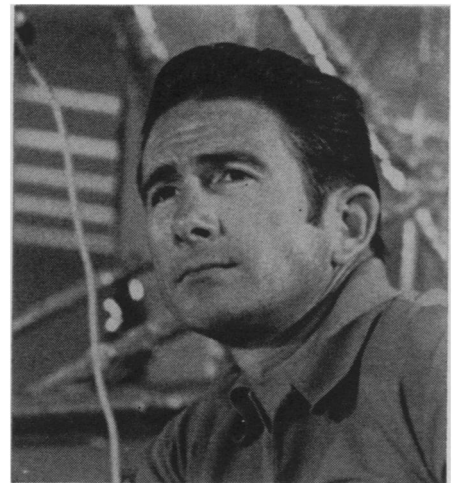
NASA

Commander Scott: A trip for science.



NASA

Worden: Will set moon-orbit record.



NASA

Irwin: Most impressed with Hadley.

the southeastern rim of Imbrium.

And it is to the base of Apennine, one of the highest ranges on the moon, that Apollo 15 is going. Examination of Hadley Rille, which snakes along the base of the Apennine for more than 100 kilometers, is another top priority goal. Theories differ, but the sinuous rille (there are other kinds of rilles on the moon) could be what is left of a collapsed subsurface lava tube (SN: 5/29/71, p. 371) or the result of faulting along the mountain front.

The mission will mark the debut of the new "J series" of Apollo spacecraft (SN: 9/12/70, p. 215). The new Apollo model is capable of carrying about twice as much scientific equipment, support hardware and supplies as the previous Apollos. It will carry consumables for more than 12 days in space and three days on the moon's surface. The lunar module has been modified to accommodate the moon-jeep or Rover (SN: 6/12/71, p. 404). And the service module now houses a new array of instruments to be used in lunar orbit.

Unlike Apollos 11, 12 and 14, all of

which landed within 125 kilometers of the lunar equator, Apollo 15 will touch down more than 790 kilometers to its north. The location is 1,200 kilometers northeast of the Apollo 12 site and 1,000 kilometers northeast of Apollo 14. The three sites will form a geophysical triangle for scientists studying data from instruments in the Apollo Lunar Surface Experiment Packages (ALSEP), such as the seismometer. Hadley/Apennine, says Dr. Joseph P. Allen, a scientist-astronaut, "is the third leg on the milking stool of lunar physics."

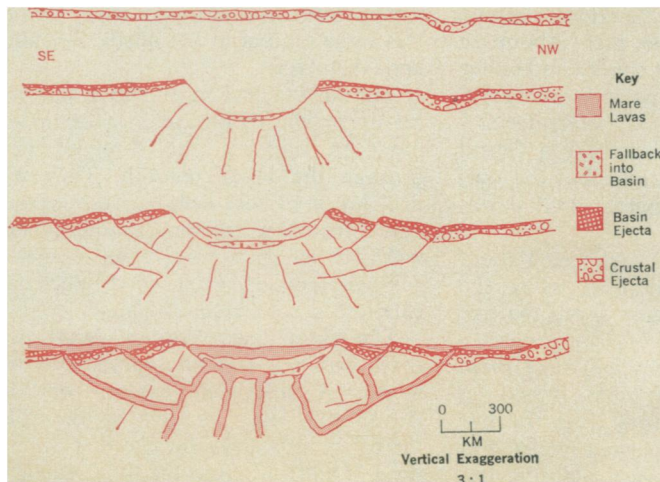
If Apollo 15 will be the third leg for surface science, it will be the first for orbital science. Because the site is so far north, the orbit required to get there will be inclined much more to the equator than in previous missions—26 degrees. This means Apollo 15 will pass over new terrain each orbit—parts of five of the basins and three of the maria. While his colleagues are on the surface, Worden will operate a mapping camera and a panoramic camera that contains more than a mile of film plus four spectrometers—gamma ray, X-ray,

alpha particle and mass. On the trip back to earth, Worden will "spacewalk" to retrieve the film before the service module is jettisoned for reentry.

"In terms of what we do in the future, the lunar orbit work is very important," says Worden. The command module will pass repeatedly over the landing site. "We can then correlate the experiments properly with what we see on the ground, thereby refining our remote sensing techniques."

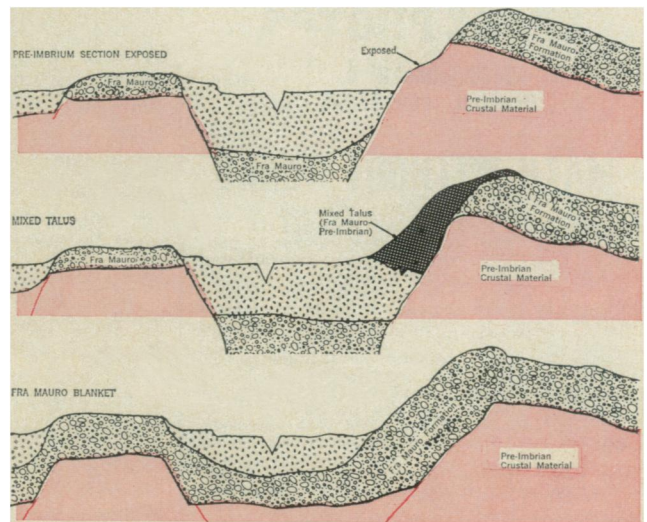
"We . . . will have a very good handle on the major elemental constituents that make up a good part of the moon," says Dr. Allen of the orbital science instruments. The gamma-ray spectrometer, for example, is sensitive to the presence or absence of potassium. (Potassium was found in high concentration in Apollo 12's Rock 13 [SN: 1/16/71, p. 43] and appears to be in abundance in the Fra Mauro rocks.)

"Apollo 15 is probably the most significant and ambitious scientific exploration ever mounted," says Commander Scott of the flight. "Never before has there been an attempt to get this much



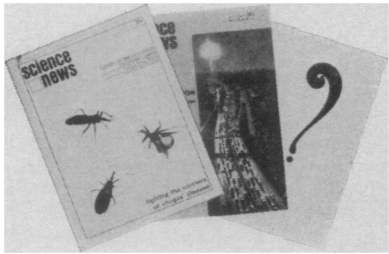
Adapted by E. Cherry Doyle

One interpretation for the origin of the circular basins.



Adapted by E. Cherry Doyle

Three possible conditions at Apennine Mountain front.



COPIES MISSING?

Keep your files of Science News complete and up-to-date. Any missing issue may be ordered by sending 25¢ per copy to:

Book Order Service

Science News

1719 N St. N.W.

Washington, D.C. 20036

SPACE WATCHERS: New releases

The complete story of APOLLO 14 told in 35 mm slides (color and black & white). Complete set of 60 slides \$15.00 plus 50¢ mailing & handling charges. (Overseas add \$2)

Complete history IN SOUND of Man's adventures in space from Sputnik 1 to the dramatic flight of Apollo 13. High Fidelity LP recording produced by MBS.

Album \$3.95 plus 50¢ mailing & handling charges. (Overseas add \$2)

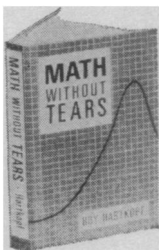
Complete catalog of 35mm slides, posters, photos, emblems and more—
GEMINI IV thru APOLLO 14 50¢

Send checks or Money Order to: Dept. SN6

SPACE PHOTOS

2608 Sunset Blvd.
Houston, Texas 77005

MATH WITHOUT TEARS



In lively non-technical language Mr. Hartkopf gives you a basic understanding of many of the everyday applications of mathematics.

Emphasizing the practical aspects of math, the author avoids mathematical terms and jargon and takes the reader from simple counting to trigonometry and calculus.

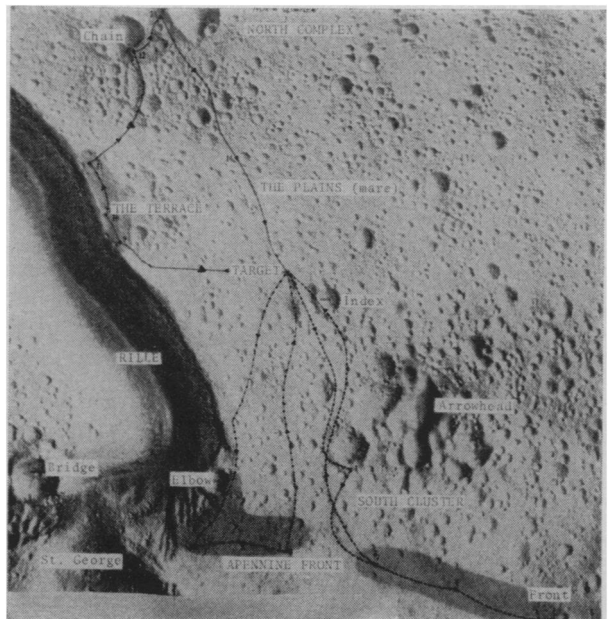
MATH WITHOUT TEARS is written with a light touch and is filled with interesting anecdotes, spiced with humor.

Learn math in the comfort of your own home at minimum cost. ORDER NOW: MATH WITHOUT TEARS by Roy Hartkopf

\$5.95, plus 25¢ handling
10-Day Money-Back Guarantee
EMERSON BOOKS, Inc., Dept. 395-T
251 West 19 Street, New York 10011

. . . Apollo 15

Scott and Irwin will take three field trips (one a day) in the lunar rover to numerous craters, the mountain and the rille.



NASA

scientific data in a 12-day mission."

As Scott and Irwin approach the landing site, they will fly over a depression in the mountain range (although they will not see the range because of the position of the lunar module). The spacecraft will pitch up after it is over the mountains and land in a backwater area of Mare Imbrium known as Palus Putredinis or the Marsh of Decay. This area appears younger than Mare Imbrium itself. It could represent, says Dr. Robin Brett, scientist at the Manned Spacecraft Center in Houston, a younger phase of Imbrium filling.

If all goes well, after landing the cabin will be depressed, and Scott will open the top hatch of the spacecraft to survey the area. If he has landed on target, he should see the mountains, to the east and north, ranging from 12 to 39 kilometers from the LM. In the north range is Mt. Hadley, towering 4,600 meters above the plain. To the south and within four kilometers of the landing spot should be Hadley Delta Mountain, 3,600 meters high. About 1.8 kilometers to the west should be Hadley Rille, which at that point is about 1.5 kilometers wide and 400 meters deep.

The rille "almost looks like a Grand Canyon," says Dr. Brett, "but the outcrop in the rille is not as well developed."

Scott and Irwin will each spend about 20 hours outside the LM, using the Rover to explore an area about the size of Manhattan Island.

Their three traverses will take them to at least six different areas. If faulting occurred after the ejecta from the Imbrium impact was deposited (called Fra Mauro ejecta), then very old, Pre-Imbrian rock could be exposed at the base of Hadley Delta Mountain. The

men will travel to its base twice to get samples. If the area is covered with ejecta material and rock debris from the mountain slope, then scientists hope that two large craters near the expected fault extend through the surface to the old material. These craters are St. George, about 2.5 kilometers wide and one-half kilometer deep, and Elbow, about 300 to 400 meters wide and 70 meters deep (about the size of Apollo 14's Cone Crater).

The men will also collect samples from the mountain range itself, possibly allowing scientists to date the event that created the range—the Imbrian impact. They will sample the rille.

The mare area will provide a fourth class of samples and give some insight into when Putredinis was melted or flooded. In the mare are two other sites, the North Complex and South Complex. The northern craters are believed to be of volcanic origin. The southern ones appear to have been created by ejecta from the impacts that formed two large craters to the north, Aristillus and Autolycus.

The ALSEP that Scott and Irwin will set up on the moon includes an instrument to measure the flow of heat through the lunar regolith. They will drill holes 10 feet deep for the sensors and 8 feet deep for core samples. They will also set up a passive seismometer, a magnetometer, solar wind spectrometer and a cold cathode gauge.

The sight that Worden, Scott and Irwin will see will be shared with the world. A television camera on the Rover will relay pictures of the rille, the mountains and—for the first time—the LM's lift-off from the lunar surface. Another television camera will photograph Worden's spacewalk. □