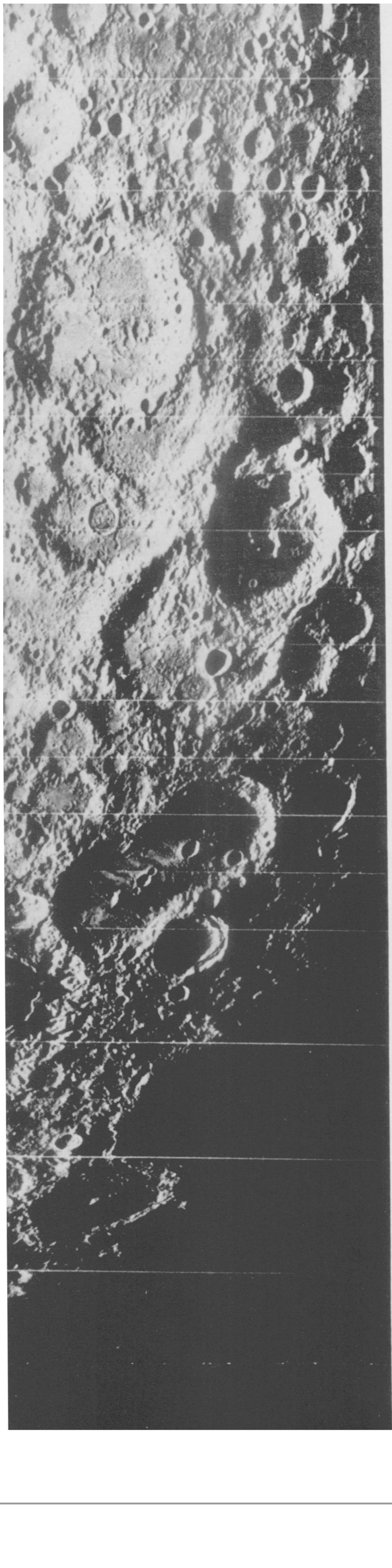


Far side: Study of contrast

The moon's far side lacks the extensive lava-flooding prevalent on the near side

by Everly Driscoll

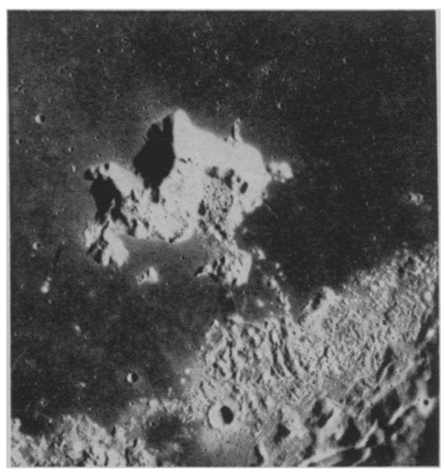
The near side of the moon—the three-fifths of the surface that always faces the earth—has been observed by man for thousands of years. But it was not until 1959, when the Russian spacecraft Luna 3 flew by, that man had his first glimpse of the far side. In 1965 Zond 3 added a little more to man's knowledge.

These glimpses whetted the appetite for more. In 1966 and 1967 the first Lunar Orbiters photographed 99 percent of the far side. The photos revealed extensive differences between the near and far sides. "They were startling," says Harold Masursky of the U.S. Geological Survey, who saw the first pictures arrive from the back side. They also evoked many more questions than answers.

The far side was indeed different. The major distinction was the lack of large lava-flooded maria areas which, on the near side, are lower in topography and in reflectivity than the highlands. In fact, the far side appeared to be all highlands—much like the Southern Highland region of the near side. There were a few concentric basins filled with lava, such as Mare Ingenii, Mare Moscoviense and the crater Tsiolkovsky, but they appeared to be much smaller than the near-side basins such as Imbrium. Since these craters were not flooded, scientists could see the structures in the crater floors—an index to the history of the basins and craters before they were flooded by lava (as on the near side). In the middle of the basin floors were central peaks—or great rings of mountains. Masursky believes that similar peaks or mountain ranges may also be on the floors of the near-side craters and basins, but have subsequently been covered by the lava flooding. Scientists do know that there are mass concentrations (mascons) of some unknown material in the basins that perturb the orbits of spacecraft, and he believes these mountain peaks may be the answer.

There were many circular basins showing little or no lava-flooding at all. The craters varied from very old to very young. One in particular—Giordano Bruno—turned out to be the brightest crater on the moon. "It is half the size of Tycho [the bright crater on the near side]," says Masursky, "but its ray system extends all the way around to the near side." The Russians, using their low resolution, fly-by photographs, had mistaken the ray system for a mountain range.

By precisely tracking the Orbiter spacecrafts around the moon, scientists could determine the height of the surface features on the near side. They found that the near side was lower than the average. (The mean radius of the moon, estimated as 1,738 kilometers, had been determined from earth-based measurements.) They were unable to track spacecraft on the far side. But astronauts on Apollos 8, 10, 11 and 12 used their landmark tracking instruments to measure the far side. "Everybody disbelieved them," says Masursky, when the astronauts reported that the far side was higher than the mean radius and higher than the near side.

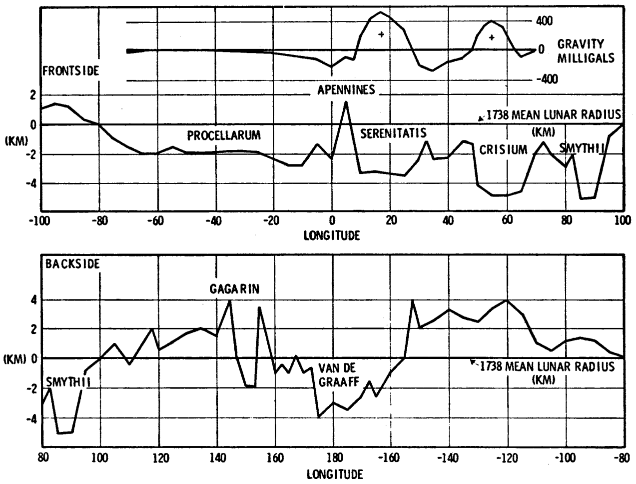


Photos: NASA

Lava surrounds Tsiolkovsky's peaks.

The far side has often been erroneously called the dark side. As the moon revolves around the earth, however, the entire surface is at one time or another in sunlight.

Now, more scientific light is being shed on the far side as the result of Apollo 15. Last month, Alfred M. Worden, the command module pilot, passed over a partially lighted far side



Gravity and laser altimeter data from Apollo 15 show that the moon's far side is 2 to 4 kilometers higher than the mean radius.

74 times. Much of the territory had never before been seen by astronauts. He made visual observations not previously detected by cameras. For example, he saw layers in the central peaks of Tsiolkovsky crater (SN: 8/7/71, p. 89). He operated orbital instruments that measured the geochemical and topographic differences between the near and far side. Data from the laser altimeter that worked for only half the orbits verify what the astronauts had reported: that the back side is higher than the near side. On the average it is more than two to four kilometers above the mean radius of the moon.

The preliminary measurements from the gamma-ray spectrometer show that the radioactivity on the far side is fairly uniform, with only small variations. The average lunar radioactivity (near and far side) is less than was found in the samples from the Apollo 14 Fra Mauro site. The data from the X-ray spectrometer indicate that the highlands are richer in aluminum than the maria, that the maria are richer in magnesium than the highlands (SN: 8/14/71, p. 106) and that the backside highlands are more enriched in aluminum than the near-side Apennine highlands. Local magnetic differences were detected in three far-side craters: Van de Graaf, Gagarin and Korolev.

The reasons for these differences between the near and far side are still not understood. Nor have other major questions been answered: why the mean radius is higher on the far side, why there are no large circular basins such as Imbrium on the far side and why there appears to be little lava-flooding in the basins that do exist. One additional difference is the lack of large irregularly shaped lowland areas on the far side. (On the near side, they are called maria—such as Mare Tranquillitatis and Oceanus Procellarum—because they are flooded with lava; but scientists are quick to make a distinction in origin between these areas and the circular basin-maria such as Imbrium, Serenitatis and Crisium.)

Masursky has a theory that he believes can answer all these questions. It goes like this: While the lunar crust was being formed, the moon was under the pull, or gravitational influence of the earth. This force caused the lunar crust to be distributed in an irregular manner. On the near side, the light-weight crust is thin. The large impacts on the near side, then, tapped the lava beneath the crust. On the far side the light-weight crust is thicker. The impacts may have been as large, but they did not tap the lava is most cases.

While additional remote geophysical sensing from orbit may answer many of the questions, perhaps the only way to determine the real reasons for differences between the two sides would be to land a spacecraft on the far side. "There are very large operational problems [for landing on the back side]," says Dr. Harrison (Jack) Schmitt the geologist astronaut assigned to Apollo 17 (SN: 9/4/71, p. 137). "But I think we would be foolish if we didn't consider such places . . . as the crater Tsiolkovsky," he says.

The major operational problem of such a landing is one of communication: the moon blocks out radio signals from the far side. One possible solution would be to place several relay satellites into moon orbit to relay the telemetry and voice data to earth. But a far-side landing would be a major deviation from Apollo rules, and most scientists believe that the National Aeronautics and Space Administration would not be willing to go that far out on the last Apollo.

Although Tsiolkovsky is on top of the preference list of landing sites, there are many places on the near side that are attractive—such as the crater Tycho in the Southern Highlands (SN: 9/19/70, p. 247), and the craters Gassendi and Proclus.

Thus, the far side may remain unsampled for years to come—except by the eye of man, or, says Masursky, "by a Russian unmanned spacecraft." □