

SPACE

Next On Moon: Surveyor

Next year, test flights will begin for Project Surveyor, unmanned spacecraft that will gather detailed data in preparation for man's arrival on the moon—By Jonathan Eberhart

► THE UNMANNED Surveyor spacecraft, the first of which should land on the moon early in 1966, will take pictures there of objects less than half an inch wide.

Each of the 17 Surveyors now planned will carry four television cameras, two less than were on the Ranger 7. The cameras will work during the approach to the moon, as well as after landing.

Once a Surveyor is on the moon, its cameras will have three jobs. One job is to serve as simply a close-up version of Ranger, taking pictures of the terrain around the vehicle. The closer an object is to a camera, the clearer its picture will be, so that the cameras will be able to "see" objects near the Surveyor almost 75 times smaller than the tiny "craterlets" photographed by the Ranger 7 before it crashed.

Another use of the Surveyor's cameras will be to transmit to earth pictures of moon crust samples. To collect the samples, telescoping tubes will bury themselves one and a half feet beneath the surface and then withdraw, filled with lunar rocks and dust.



RCA

SIX EYES ON THE MOON—Television cameras designed and built for the Ranger probe by the Radio Corporation of America yielded the first close-up pictures of the lunar surface. The two middle cameras transmitted one full-scan picture every two and one-half seconds. The four outer cameras sent back one smaller partial-scan picture every fifth of a second. (See *Science News Letter*, 86:85, 1964.)

A similar "core sampling" technique is used by geologists and oil drillers to study rock and soil strata.

In addition to being photographed, the moon samples will be chemically analyzed, and the data telemetered back.

Finally, the cameras will photograph instruments aboard the Surveyor, providing a visual check on such conditions as gravity, micrometeorites and cosmic rays.

Cameras are not the Surveyor's only tools, however. Surveyor instruments will give important information on the bearing strength of the lunar surface, that is, on how heavy a vehicle the surface can support.

The first four Surveyors will serve as test flights, beginning early next year. They will not land on the moon. The remaining 13 will be of two types. The fifth through the ninth Surveyors will serve primarily as landing research vehicles for the last eight fully instrumented versions, which will gather data on life support specifically for the Apollo men-on-the-moon program.

Surveyor was originally intended as a purely scientific moon-research mission. The change in emphasis to a man-oriented program has come about naturally with the growth and development of Apollo, said an official of Hughes Aircraft Company, prime contractor for at least the first seven Surveyors.

Depending upon results obtained by the Surveyors, several subsequent programs, such as Project Prospector, might be considered unnecessary. Prospector would be an unmanned vehicle built to travel over the lunar surface, taking pictures and samples.

• *Science News Letter*, 86:101 Aug. 15, 1964

SPACE

Evaluating Moon Pictures Will Take Three Months

See Front Cover

► WITHIN THREE MONTHS the scientists now so intensively studying the more than 4,300 remarkably clear moon pictures taken from Ranger 7 will have reached some firm conclusions concerning the lunar surface and the best place for a manned landing.

However, there were so many good photographs—every frame was of excellent quality—that it will probably take three years to evaluate all of them completely.

By that time, even better pictures, plus an analysis of the moon's surface material, should be available from future Ranger space probes, from the Surveyor spacecraft, the first of which is scheduled to make a soft landing on the moon next year, and from the Lunar Orbiter, expected to make a topographic map of the moon in 1966.

The Ranger 7 pictures seem to confirm the belief already held by many scientists that the moon is covered with a dust layer from a few inches to about a foot thick. This means astronauts in future moon shots will be able to step out on its surface without sinking deep into dust.

One of the most puzzling Ranger 7 photographs, taken from 15,000 feet, shows an odd-shaped crater with jagged rocks inside, for which there is as yet no explanation. On this week's front cover is a reproduction of this photo, taken at an altitude of three miles, 2.3 seconds before impact. Crater is in the upper left portion.

Another unexpected preliminary finding is that the sides of many of the secondary impact craters formed by debris from Copernicus, one of the moon's larger craters, have steep sides but rounded rims. Scientists now are questioning what material might produce this shape on impact.

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SPACE

LEM Can Land Even On 'Pockmarked' Moon

► DESPITE THE CRATERS and pockmarks shown on the moon's surface in pictures from Ranger 7, the LEM (Lunar Excursion Module), with its crew of two, should be able to take most such irregularities in stride when it lands on the moon.

If the LEM astronauts should find themselves approaching the surface over relatively rough terrain, they will be able to maneuver horizontally as much as 1,000 feet, while hovering several hundred feet above the ground.

A number of landing "flight plans" are being studied to find the approach that will allow the pilot the broadest choice for a final site, while conserving precious fuel.

The LEM is designed to give the pilot the last word on exactly where he will land, said Saul Ferdman, an official at Grumman Aircraft Engineering Corporation, Bethpage, N. Y., builders of the spacecraft.

If, despite all precautions, the LEM should still land "with its foot in a hole," such as one of the foot-deep craterlets photographed by Ranger 7, it will still be reasonably safe. The four telescoping legs on the LEM are adjustable during landing to keep the vehicle upright, though they cannot be moved once the landing operation is complete and the spacecraft is sitting on the ground.

The legs are equipped with large snowshoe-like "feet" to distribute the LEM's 14 tons over a greater area. If one or more feet should break through a "crust" concealing a hole in the lunar surface, the danger of tipping over will still be small. Weight distribution of the LEM allows it to sit at an angle of more than 10 degrees, with no danger of falling.

When the time comes for the LEM to take off from the moon, leaving legs and landing engine behind, the angle will be even less critical, Mr. Ferdman said. This is because the astronauts will have a great deal of attitude control, and will be able to straighten up the LEM once it is off the ground.

• *Science News Letter*, 86:101 Aug. 15, 1964