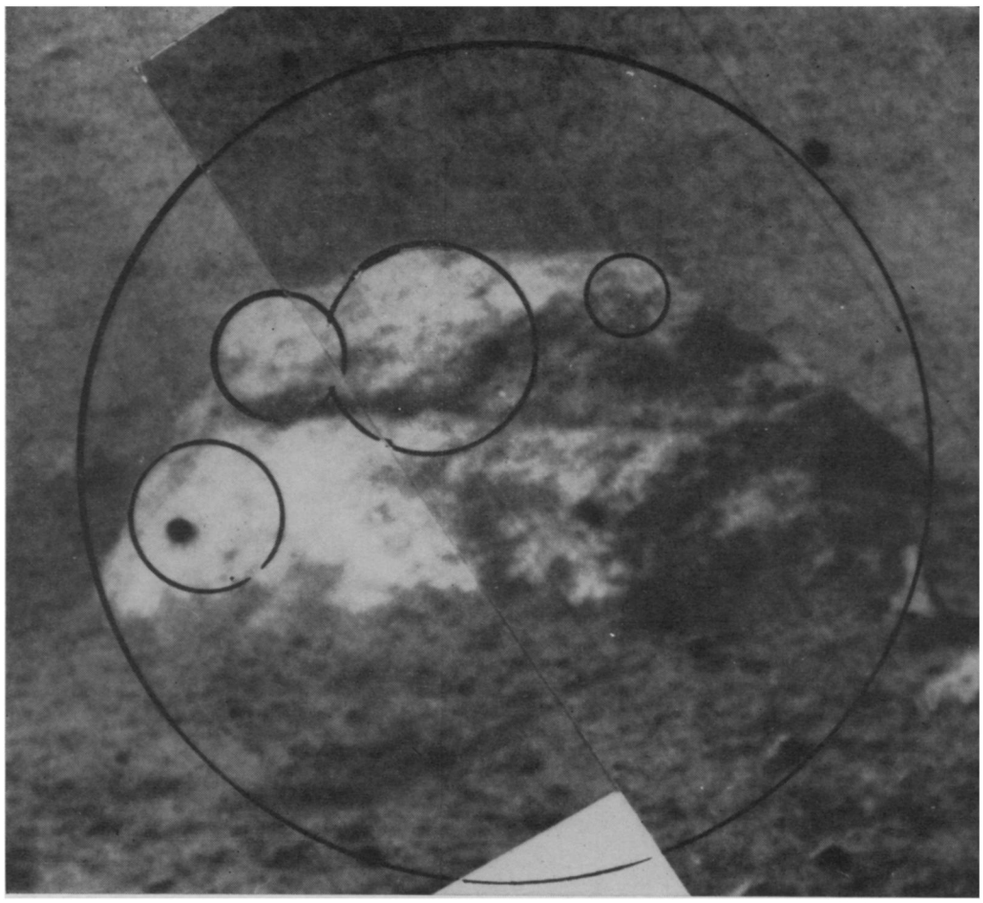
Astronauts and scientists want different moons. Surveyor seeks both.



NASA

Something is rounding off lunar rocks; these circles measure how much.

Surveyor's Moon

Moon-bound astronauts hope to find nice, smooth plains on which to land. Scientists studying the moon like to look at boulders, fissures, craters and crags.

It is ironic that the gently-landing Surveyor lunar robots, bound like almost everything else in the space program to serve Apollo, must thus slight the science that is so much of their reason for being and act as advance inspectors for manned landing sites.

To be considered for a close-up going-over by Surveyor, most sites must be smooth enough to ensure the craft at least a 66 percent chance of a safe landing, which lets out many of the rough areas that could add greatly to man's knowledge of the moon.

Last week, the National Aeronautics and Space Administration revealed that it has considered for Surveyor at least one site so rough that it offers only a 30 percent chance of success. But Apollo is a stern taskmaster, and even with four Surveyors left, NASA is unlikely to risk one on a non-Apollo target area.

Still, the scientists studying the patch of moon inhabited since April 19 by Surveyor 3 have added their share of clues to the lunar mysteries. An "enormous advantage," according to Dr. Eugene Shoemaker of the U.S. Geological Survey, chief interpreter of the spacecraft's photos and data, is that the third Lunar Orbiter, launched two months earlier, was able to photograph Surveyor's site from overhead soon after the surface probe arrived on the moon. This enabled detailed charts, contour maps, crater counts and rock measurements to be prepared for comparison with Surveyor's pictures, greatly improving the accuracy of photo-interpretation.

It was the lack of this correlative data, Dr. Shoemaker admitted at a news conference last week, that caused him to misjudge distances near the horizon in some of last year's Surveyor 1 photos by as much as 50 percent. Since then, Surveyor 1 data have been found to agree remarkably closely with those of Surveyor 3, which landed almost 400 miles away, and in a crater. "It is now possible to begin to draw generalizations with some confidence," Dr. Shoemaker says.

One such generalization, especially important to Apollo planners, is that at least half of the lunar plain has about the same abundance, distribution and range of sizes of craters as was observed by the two Surveyors. This "crater count" is valuable both to smoothness-seeking astronauts and to scientists who can use it to estimate the age of lunar surface features by the number of craters that have accumulated on them.

Surveyor 3 also confirmed that some process, possibly the continual bombardment of the lunar surface by micrometeorites, is rounding off the moon's rocks. To find out how much any given rock has been rounded, Dr. Shoemaker and his colleagues have invented a "roundness factor." First, several small circles are drawn on the rock's photograph, fitted to the corners and rounded parts of the rock's outline. The average radius of these circles, divided by the radius of the smallest circle that can contain the entire rock, determines the roundness factor.

One surprise from the spacecraft, according to Dr. Leonard Jaffe of Jet Propulsion Laboratory, which has managed all of the Ranger, Lunar Orbiter and Surveyor moon flights, is an indication that the surface of the moon gets lighter with time, instead of darkening as had previously been theorized (SN: 1/7). This is indicated by the lighter hue of more-newly-exposed areas on the surface.

On the other hand, Surveyor's

surface-sampling claw has revealed from its diggings that below the topmost layer of light surface material, the rest of the lunar soil is quite dark. Dr. Shoemaker coined the term "lunar varnish" to describe the charcoal gray particles, referring to a terrestrial phenomenon called desert varnish. This is a black coating found on some rocks in hot, dry areas such as the southwestern U.S., formed by deposits of iron and manganese oxides left by evaporating rainwater. On the moon, the subsurface blackening could be minerals left by upward-moving gases—an idea which supports the increasingly popular theory that there has been volcanic activity in the moon's geologically recent past.

More evidence of lunar gas comes from close-up photos of rocks whose surfaces are covered with tiny pits that may once have been bubbles formed in molten lava. Some scientists believe that if any gas remains in such pockets today, it could give a boost to the remote possibility of living microorganisms surviving on the moon.

Everything that fell under the gaze of Surveyor 3's TV camera—including the earth, Venus, the sun and the starry skies—received a skew glance. This was due to the spacecraft's surprise landing spot: halfway up the side of a 50-foot-deep, 650-foot-diameter crater, and tilted at an angle of almost 15 degrees. Though the tilt was not planned, it made possible the spectacular photographs of the sky that otherwise would have been above Surveyor's field of view.

Most impressive of these was a series of pictures of an eclipse of the sun by the earth, a phenomenon never seen before by any being on earth. Though the earth's disk was some four times larger than that of the sun behind it, the planet's atmosphere bent the sun's rays so that they formed "beads" of light visible from the moon around the dark edge of the earth. To determine the position of the earth as Surveyor 3 saw it, the scientists looked back at photos of earth's cloud cover taken by the ESSA-3 satellite the day before. By matching the beads with the white cloud cover and even with snowy mountain peaks, the scientists were able to determine Surveyor's view exactly.

LSD Harms Cells

The blood cells of LSD users bear out the grim suspicion, first raised two months ago: "Acid" damages chromosomes.

Whether the damage is permanent, whether germ cells are affected and whether a few doses of LSD can be taken safely under medical auspices—these questions have yet to be answered.

But two separate studies on people who have taken LSD illegally show an excessive degree of chromosomal breaks in the blood cells. Completely apart from the question of heredity, the damage offers another danger—that of disease, possibly leukemia.

Investigators in Oregon and New York have discovered in some users a chromosomal piece that looks like the Philadelphia-1 chromosome. Ph-1 is strongly linked with chronic myelogenous leukemia. It is virtually non-existent in normal people.

That LSD may damage chromosomes first came to light in March in a test-tube experiment on cell cultures. Human studies began immediately in New York, Oregon and Pennsylvania. The Oregon analysis—the only one to be completed—revealed chromosome breakage three to four times normal rate in six out of eight users—a strikingly high rate, even though the sample was small.

Dr. Samuel Irwin of the University of Oregon and Jose Egozque of the Regional Primate Center in Oregon believe that both leukemia and an autoimmune disorder are possible from the damage they have seen. An autoimmune disorder is one in which the body manufactures antibodies harmful to its own tissues.

In New York, a study of three mothers, all LSD users, and their four children is revealing similar chromosomal breakage. The results are not all in, but one of the children shows blood cell abnormalities. This does not mean the mother's germ cells were damaged, says Dr. William A. Frosch of New York University's School of Medicine. The women took LSD both before and during their pregnancy. "We are pretty sure LSD passes through the placenta," says Dr. Frosch.

A third study in progress, however, poses a different picture. Led by Dr. Charles Shagass of the Temple University Medical School in Philadelphia, the analysis is being done on people given LSD for psychotherapy. In no case did the subjects take more than three doses of the drug. "So far we haven't seen anything to get alarmed about," Dr. Shagass reports.

"If there is an LSD effect, the question will be how much can one take safely," he adds.

None of these studies, however, will answer the key question of LSD impact on germ cell chromosomes and the possibility of hereditary damage.

Germ cells are extremely difficult to study, requiring operations on women and biopsies on men. Consequently, once the blood cell work is complete, investigators will resort to studying animal reproductive cells.

But the blood evidence does strongly suggest that germ cells have been affected, says Dr. Maimon Cohen, geneticist at the State University in Buffalo, who is working with Dr. Frosch and Dr. Kurt Hirschhorn of Mt. Sinai Hospital.

Leukocytes—blood cells—generally reflect what is happening elsewhere in the body, he says.

Saturn: Four Rings

Three and a half centuries ago, the pioneer Galileo observed what he thought were two mysterious objects in space, one on each side of the planet Saturn. The mystery went unsolved for 45 years, until Christian Huygens discovered that they were in fact a pair of concentric rings around the planet. In the 19th century another ring was found, bringing the total to three: an outer one, a bright central one and a dark inner one.

Now Walter A. Feibelman of the University of Pittsburgh's physics department has found evidence indicating a fourth ring. Such a ring had been sought before, but not seriously since 1909, when the American astronomer Edward Barnard came up with seemingly conclusive negative results. There have been enough hints at its existence, however, that the elusive fourth ring has been compared to the Loch Ness Monster—some see it, some do not.

Late last year, a rare event inspired Feibelman to take up the quest anew. Every 14.78 years, the rings of Saturn can be seen edge-on from earth, and the past winter marked one of these opportunities. It was during this occurrence, in fact, that other astronomers discovered and confirmed that Saturn has a tenth moon, now named Janus because one of the definitive sightings was made on Jan. 9, feast day of the Roman god of doorways (SN: 1/14).

Reporting the detection of the fourth ring took longer because positive identification could be made only by charting how much the ring darkened a photographic plate. Although the ring can be seen visually on a photograph, as can the satellite, Feibelman wanted to be as certain as possible that the thin line was not the result of instrumental or observational problems.

Feibelman photographed the planet with the 30-inch refracting telescope at the Allegheny Observatory, University of Pittsburgh.

On any of the exposures "a very thin extension of the nearly edge-on ring system can be seen," Feibelman reported in the May 20 NATURE.

The thin ring "extends to more than twice the known ring diameter" (or a total of 340,000 miles), and is so faint