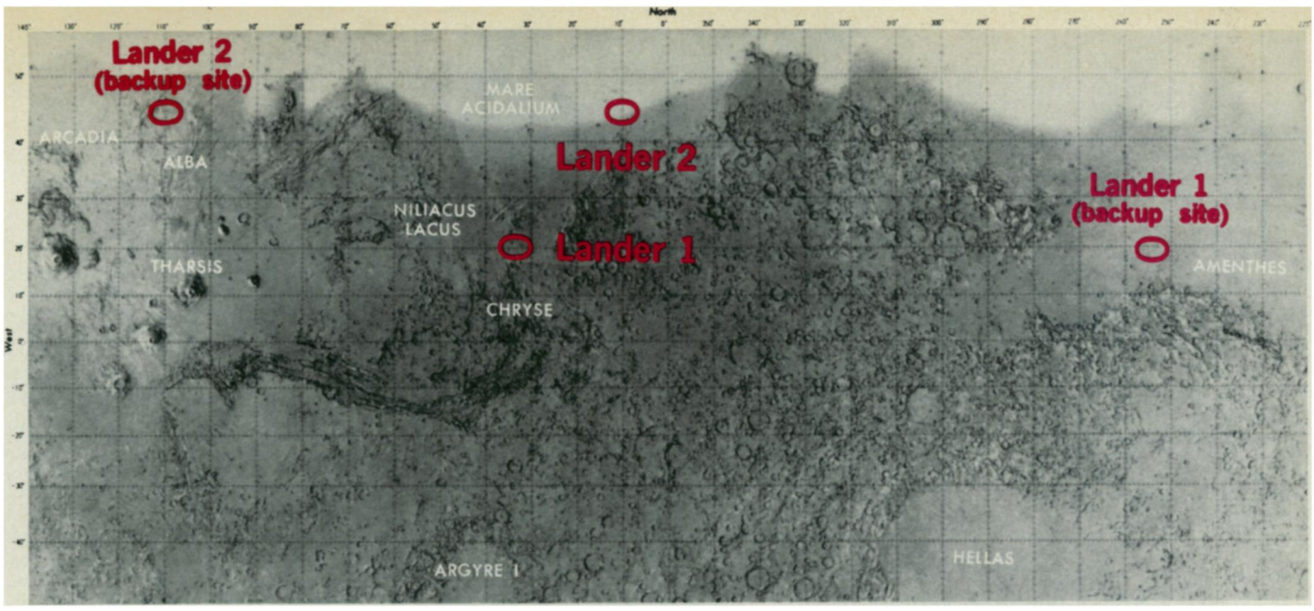

Where the United States will land on Mars

Two sites north of the Martian equator have been chosen for the first U.S. landings

by Everly Driscoll

Forty-five feet, velocity 8 feet per second, 25 feet . . . 5 feet. Touchdown. Engine shutoff. Mars, July 4, 1976. No astronaut eyes or camera lens view the descent to the foreign surface. The Viking landers are on their own. Lander 1 is on the dusty, smooth surface of the Martian plains to the north of the large area called Chryse. To the south are many channels that appear to have been cut by water. To the north is Niliacus Lacus and farther north, Mare Acidalium. The touchdown spot is in the delta, so to speak, or alluvial fan of the channels.

Chryse has been chosen as the prime site for the Viking Lander 1—the first American spacecraft to land on Mars. This month the Viking site-selection committee recommended to NASA Chryse and one other site as the prime landing targets for Landers 1 and 2. Two sites were also recommended as backups. NASA Administrator James C. Fletcher is to announce the decision soon. They could be changed between now and 1976.

The Chryse site is 20 degrees north of the Martian equator (at 34 degrees west longitude). The backup site for Lander 1 is also 20 degrees north of the equator, but across the planet in the plains of Amenthes (252 degrees west longitude). The prime and backup sites for the second lander are both 44 degrees north of the Martian equator. The prime site is north of Chryse on the border of Mare Acidalium (at 10 degrees west longitude). The backup site to Acidalium is on a seemingly flat surface in an old caldera called Alba to the east of Arcadia (at 110 degrees west longitude).

Each landing target is in an ellipse 48 miles by 360 miles in size. After the landers go into orbit around Mars, the exact touch-down spot cannot be varied in latitude by more than one degree, but there are no constraints in longitude. Lander 1 could land almost anywhere along an east-west line 20 degrees north of the equator.

Choosing safe sites that are also of scientific interest on a dusty planet some 200 million miles away has been no simple task. Engineers and scientists have been working on the selection for almost a year. Initially they looked only at areas within 30 degrees of the equator (SN: 11/4/72, p. 300). Then in December, NASA decided to examine its capability for polar landings and found that it could land anywhere on Mars from 25 degrees south to 75 degrees north (SN: 3/10/73, p. 73). The committee studied 22 sites—11 near the equator, 7 at mid-latitudes and 4 close to the north pole (from 63 to 73 degrees north). "It was a process of thinking, identifying general areas, doing engineering studies, looking at the science requirements, meeting, then thinking some more," says A. Thomas Young of the Langley Research Center. "These are the areas we will land in, if we don't learn anything else about Mars to change our minds between now and 1976."

Chances are, however, scientists will learn more about the sites between now and then. Radar studies have top priority. Scientists working at the Goldstone, Haystack and Arecibo radio observatories will be able to determine more accurately the average roughness of the areas and the slope. From the reflectivity of the surface and the strength of the radar echo they can deduce the surface characteristics. "Right now the sites look blah [flat and safe]," says Carl Sagan, a member of the selection committee. Ironically, that could be a problem. For example, some candidate sites failed the test because the surface looked too smooth. "We finally realized we were not looking at the surface at all, but atmospheric dust," says Young. NASA would not like to set the landers down on fluffy, loose, deep dust. They might sink. Nor does NASA want hard rock because the biology scoop must be able to get some soil.

Ideally the elevation of the sites should be at Mars' mean surface level or below. The lower the site, the higher the surface pressure. What the scientists are looking for are sites with an atmospheric pressure of 6.1 millibars, which, given the expected temperatures, would allow liquid water. The slopes of the landing sites can't exceed 19 degrees. And the landers could not easily survive boulders higher than 9 inches or wider than 10 feet.

Safety considerations were the first concern. Biology was the second. "We chased water all over Mars," quips Gerald Soffen, also of Langley. What is meant by biologically available water? "We were looking for that magic place where frost or ice might

become liquid water," he says. This drove them to the mid-latitudes for Lander 2. At its maximum extent the northern polar cap comes down to a latitude of 40 or 45 degrees north. Then it retreats. The scenario the scientists have in mind goes like this: Dust gets kicked up and covers the ice. The temperature of the darkened ice rises, causing some of it to melt. The result: liquid water.

Other considerations concerned requirements for the seismic, meteorological and geophysical instruments. The spacecraft can stand winds up to 150 miles per hour.

What makes the Viking venture relatively safe is its flexibility. There are two orbiters as well as landers. A final "go" for a landing spot will actually be made in Mars orbit in 1976. The mission, as now planned, goes like this: Lander 1 will go into Mars orbit June 18, 1976. For almost three weeks the spacecraft will survey Mars, passing over the potential landing sites (primary and backup) each orbit. Instruments on board will take carbon dioxide measurements which will yield surface pressure. Cameras will take overlapping pictures that will allow stereo coverage (three dimensional). The resolution of the photography will be better than the best of Mariner 9—about 120 yards. Although that time of year in the northern hemisphere of Mars (summer solstice) is meteorologically very quiet (there should not be a major dust storm), if necessary, the spacecraft can stay in orbit about two months before the lander separates from the orbiter. If all looks okay, Lander 1 will touch down July 4.

At that time Lander 2 will be approaching Mars. Lander 1 will have landed, sampled the surface, checked the weather, sent back pictures of the surface and begun the biology experiments. One-third of Viking 1's mission will be completed before engineers have to decide where to land Viking 2, which will go into orbit Aug. 7 and land Aug. 24 if things go as planned. Late in 1976, communication with the spacecraft will be lost for a month because of the positions of the sun, earth and Mars.

Project Viking will probably follow on the heels of Soviet landers. There are strong indications the Soviets will land craft similar to Mars 2 and 3 in the Martian southern hemisphere west of Hellas in 1974. The results of these missions could be an extra bonus for Viking. Radar and atmospheric results of Mars 3 have already been used in selecting the Viking sites.

It appears that the Soviet 1974 landers will not have life detectors aboard. If life exists on Mars, it will probably have to await discovery by Viking. □

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