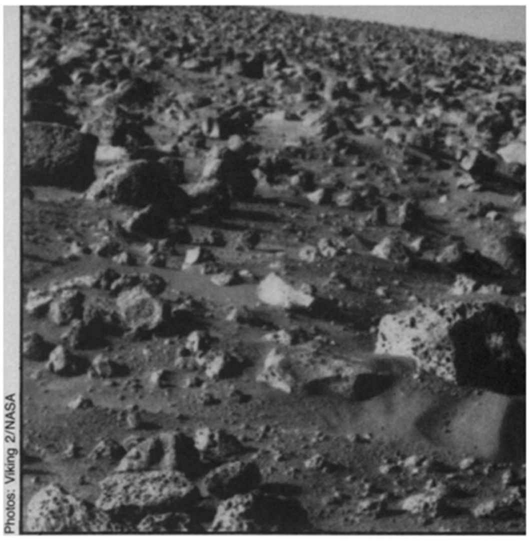
Viking 2's View of Utopia: A Rock-Strewn Martian Plain



High-resolution view of the rock-strewn Martian plain surrounding the Viking 2 lander. View covers 85°, with north at left, east at right. Slope of horizon is due to 8° tilt of the spacecraft. Large blocks litter the surface. Some are porous and spongelike like the one at left edge (size: 1½ to 2 feet). Others are dense and fine-grained, such as the bright rounded block (size 1 to 1½ feet) toward lower right.

The second time, even for such a specific task as guiding a robot spacecraft down to the surface of another planet, ought to be at least a bit more relaxed than the first. But it was not to be. The Viking 2 lander's descent to Mars was a knuckle-whitening three hours of tension, beginning just seconds after its separation from its orbiting carrier, when, with no warning at all, the power supply to one of the orbiter's three main stabilizing gyroscopes simply shut itself off. Seconds later, another one followed suit, leaving the orbiter to turn aimlessly until its high-gain antenna, a key element in relaying the lander's radio signals to earth, was no longer pointed at the earth. Although the lander was flying on instructions already stored in its computer memory, the disappearance of the orbiter's relay link meant that the whole huge Viking flight team, for all its sophisticated technology, was abruptly thrown into darkness. When the orbiter's computer activated its wider-reaching low-gain antenna, a weak signal was able to indicate only that the lander was alive and sending. All else was a mystery.

The fact that the lander reached the ground 32 seconds later than predicted did nothing to ease the tension. When a change in the data-transmission rate of its signal revealed that it had actually landed safely, the explosive cheer in the control center was considerably louder even than the one that accompanied the safe touchdown of lander 1, when there was nothing to worry about but an untried spacecraft, an unmeasured atmosphere and a planet that had apparently killed off every previous vehicle to make the attempt. Half a day later, the orbiter too was well, having been restored to at least its relay capabilities by commands sent through the low-gain antenna. At last, the harried Viking scientists were free to contemplate their new view of Mars. And to be surprised.

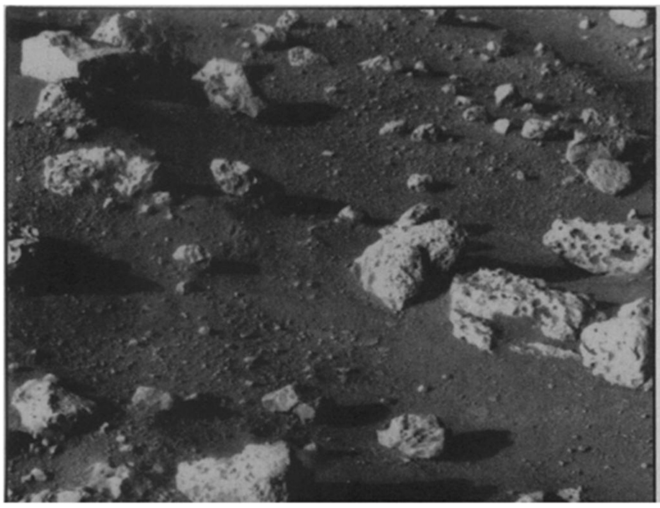
Where were the dunes? The project's geologists had concluded from orbital photographs that the site, in the northeast corner of Utopia Planitia about 7,500 kilometers from the first lander's spot in the Chryse basin, was covered by tens of meters of sandlike material, sculpted by the wind into a vast dune field. The dunes, in fact, were the whole argument for choosing the site, in the expectation that they would cover up potentially catastrophic boulders and other hazards.

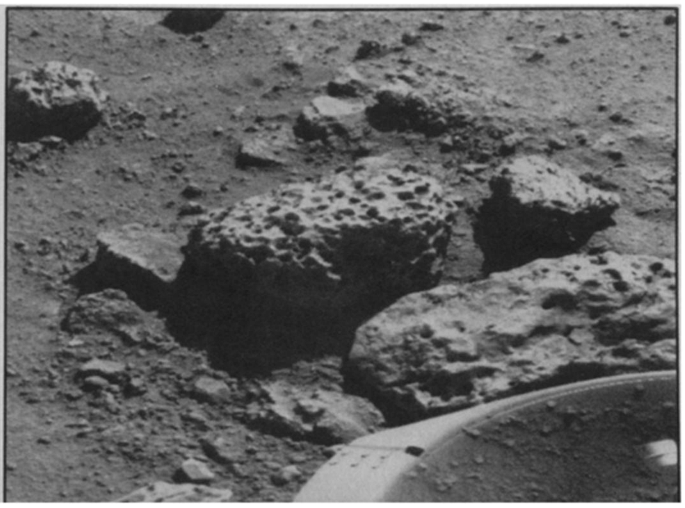
Instead, the boulders, rocks, and lesser pebbles were everywhere, strewn with remarkable regularity as far as the eye could see across a nearly dead-flat surface. The lander, in fact, apparently scored a direct hit on one of the rocks with one of its footpads, leaving the spidery craft tilted to the west at an angle of about 8.2°.

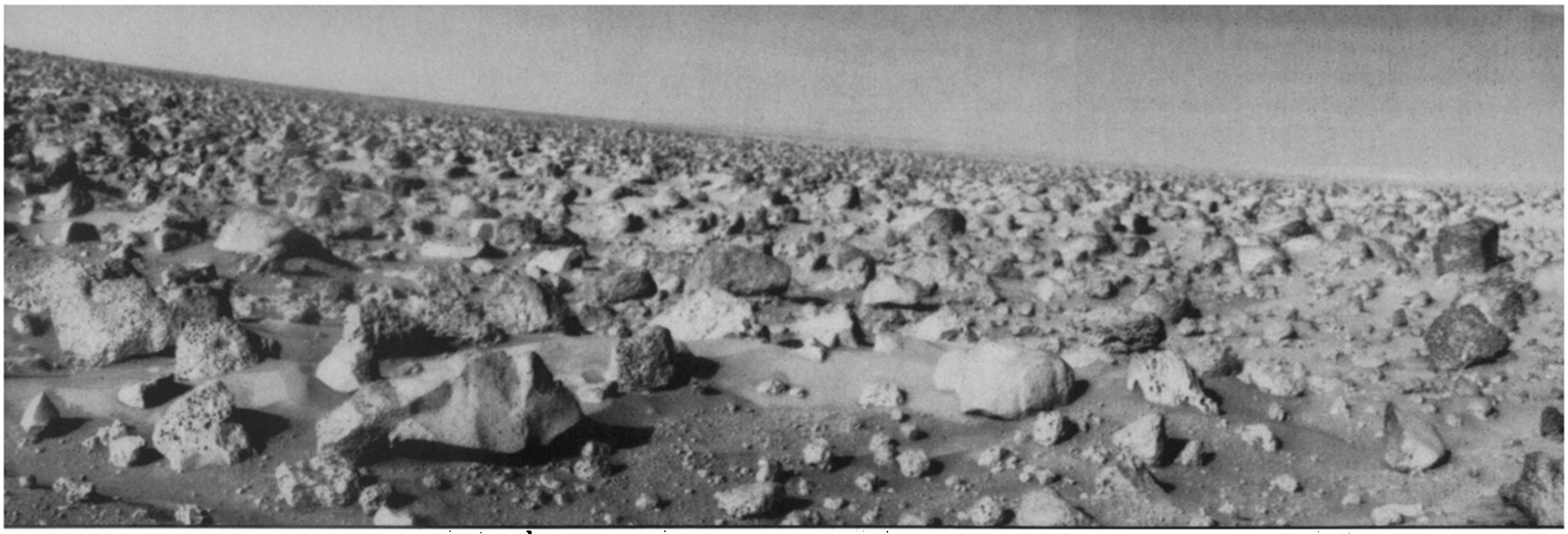
Not everything about the site is unexpected, however. "The general coloration of the ground and the sky," says lander imaging chief Thomas A. Mutch of Brown University, "is essentially the same as that of the scene at lander 1." Namely, the same intense, ubiquitous, salmon-hued brick-red. The countless rocks (actually they'll probably be counted to the last pebble by Viking's geologists) run the gamut in appearance from nearly smooth, fine-grained types to the coarsest of basaltic chunks, punctured by numerous holes that strongly resemble the vesicles created by bubbles of gas trapped during the rocks' molten evolution. One conspicuous rock, dominating the central foreground of a high-resolution, panoramic photo of the site, seems to range from a fine-grained structure at one end to a coarse-grained appearance at the other. In terrestrial lava flows, points out imaging team member Elliot Morris of the U.S. Geological Survey, the more porous part is typical of the flow's deeper strata, while the fine-grained material is like that on the upper surface. Other examples at the site show the sharp facets typical of wind-wrought ventifacts, but all across the visible terrain the watchword is diversity. At the lander 1 site, team member Alan B. Binder of Science Applications, Inc., has already isolated about 20 different morphologies, and the Plains of Utopia are likely to add to the list.

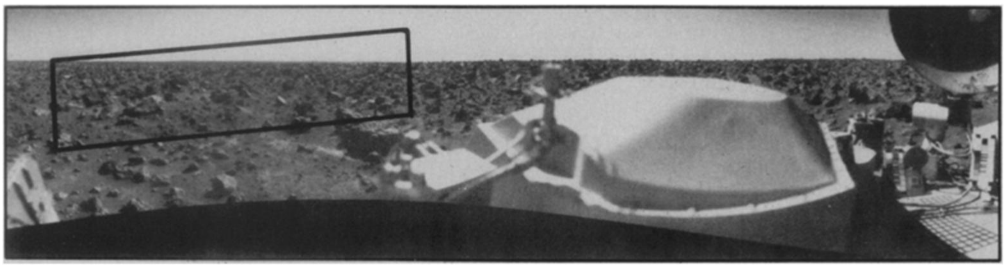
One of the most striking features in lander 2's view is a shallow trench that curves its way across the ruddy ground. Visible in the very first panorama taken by the vehicle's cameras, it looks to some eyes as though water may have trickled it into being in some ancient past, perhaps from the melting of permafrost beneath. Another possibility is that it resulted from a once-skinny fissure that was widened by periodic melting and refreezings of water between the walls, with later deposits of fine-grained material filling it in to produce the mere depression that remains. Such a process often produces surprisingly regular fissure patterns, and indeed, some transverse grooves seem to intersect the main channel-like parts of such a pattern. It is just one of the growing list of reasons that the geologists wish the sharp-eyed

Rocks 4 to 8 inches in size litter the area around lander. Most have small vesicles or holes in them, possibly sign of volcanism.









Viking 2 at Utopia: Panorama, left, sweeps all but one-tenth of the view from lander. Photo has been rectified to compensate for lander's tilt, properly revealing horizon as flat and relatively featureless. Tilted rectangle indicates area of high-resolution photo above.

lander were a little taller—or the orbiter a lot lower.

Like Chryse, the Utopia site shows signs of caliche, the surface crust that results from the upward evaporation of water-soluble salts, and if the greater amounts of atmospheric water vapor measured in the northern latitudes by the orbiter also represent more moisture in the ground, the caliche layer may be thicker, too. Wind tails are there as well, shaped wedges of sand piled up against many of the rocks' leeward sides, though, says Morris, the ones at Utopia seem for some reason to be less clearly defined.

Early data indicate that, not surprisingly, the northerly site is a bit cooler than Chryse. During the first day at the new site, the atmospheric surface pressure was measured as 7.78 millibars, about 0.63 millibars greater than at lander 1, which Alvin J. Seiff of the NASA Ames Research Center likens to a surface about 1.3 kilometers lower than that at Chryse Base. (The Chryse site is already from 1.7 to 2.0 kilometers below the mean level of Mars.)

The lower elevation is promising for the presence of greater amounts of water in some form, as is the more northerly latitude of Utopia. Though lander 1's cameras have yet to detect any transient morning fogs, according to Mutch, it is possible, says Morris, that the Utopia site may be covered in the winter months with a quite visible layer of frost. The cameras aboard the orbiters have added further hope by revealing atmospheric hazes (with optical depths as great as 0.5, according to Geoffrey Briggs of JPL) in the northern latitudes that seem to persevere beyond the first hour or so of dawn. If the ground around lander 2 really does have a few extra microns of water cycling through it every day, perhaps, suggests Joshua Lederberg of Stanford University, it will turn out to be enough to compensate resident microorganisms for the few microns of hydroxyl (OH) radicals that are "burned into" the surface material by the scarcely shielded sunlight.

The search for those local residents, meanwhile, continues to tantalize—sometimes in unintended ways. Lander 1's pyrolytic-release experiment, part of its triple-threat biology package, started with a flourish many weeks ago by producing lifelike data from its very first soil sample, then following it up with an appropriately neutral reading from a sample that had been sterilized by heat. Results from the third sample, a repeat of the first, nonsterile run, were being anxiously awaited when it was discovered that the instrument's thermoelectric coolers, designed to help its test chambers get down near ambient Martian temperatures, had failed to turn themselves on. The result was nearly three days of incubation of the sample at a temperature possibly warm enough to kill, or at least inhibit, whatever might be trying to grow inside. The key "second peak," a radioactivity measurement reflecting the release of isotopically marked carbon compounds presumably metabolized by resident microorganisms, was an ambiguous 28 counts per minute, compared to 15 counts for the sterile sample and 96 for the "active" one. Lander 2's instrument may resolve the matter, or else Viking's biologists may have to lobby for a repeat run during lander 1's current "reduced mission" (see next page). A second instrument, the labeled-release experiment, showed a convincing repetition of its own first active cycle (despite some distortion), but the lack of detectable organic molecules in still another experiment continues to keep the researchers on tenterhooks.

A different emotion—sheer elation—belongs to Viking's seismology team, which suffered through a stuck instrument on lander 1 until lander 2 touched down to save the day. "It's a pleasure," says Gary V. Latham of the University of Texas, a veteran of lunar seismological studies, "to join the 'working-experiment club.' " There were almost no scientific data from the device in its first few days on the surface, but Latham was able to report that the apparently hard surface "does not pop and creak as badly as we felt it might" in response to the temperature changes of sunrise and sunset. This, together with the good condition of the instrument, should enable clear readings of tremors on Mars, a planet some geophysicists expect to be considerably less active than earth but more active than the moon. Mars, in fact, says Latham, may be evolving toward a state of having a lithospheric melt zone, atop which, in some distant future time, crustal motions may take place.

Although it is its predecessor's twin, lander 2 will do some things differently from lander 1. A more detailed initial atmospheric analysis is possible with the organic chemistry instrument, since lander 1's low argon measurements removed fears of clogging the device's pump. The biology instruments will follow altered routines, and the vital soil-sampling arm will be operated only during warm periods when there is less chance of its sticking as its forerunner did. The technical subtleties are interesting—and endless—points out one Viking official, but that's why it is fortunate that the subject of it all is such a natural scene-stealer as the planet Mars. □