MARS: A Possible New Quake and Some New Theories

"5:55 p.m.: Viking seismology report if there are results."

It was just one of nearly 200 scheduled reports at the annual meeting of the American Astronomical Society's Division for Planetary Sciences in Honolulu, and it was quite a hefty "if." After all, Mars was proving to be seismically even quieter than expected during Viking lander 2's months on the surface, with the exception of a single apparent tremor—albeit a large one—on Nov. 4 (SN: 1/15/77, p. 36). But the Red Planet has struck again. A second quakelike event, weaker than the initial one but much closer to the spacecraft, has been found in the lander's data, where it registered less than three weeks after the first.

The event occurred on Nov. 24 at 3:01 a.m., again at a time when the Martian winds were too quiet to be shaking the spacecraft and again when none of the lander's other experiments were whirring or clicking or otherwise agitating the seismometer. And, like its predecessor, it followed the classic pattern: pressure wave, shear wave and then tapering off. With the jammed seismometer aboard lander 1 unable to help pinpoint the epicenter, Viking researchers have been able to conclude only that the event rated about a 3 on the Richter scale and that it originated about 25 to 30 kilometers from lander 2's site in Utopia Planitia. Still, says Frederick K. Duennebier of the seismology team, "it is almost certainly a natural seismic event."

The question is, what caused the seism? A jittery lander has been virtually ruled out, but the shock could still have come from a meteorite impact (as could that of the first event, which was pegged at a magnitude of 6 or better and a distance of about 7,000 kilometers). At the very least it will take a good many more events to find out. "Two data points is not very good statistics," Duennebier says. But the seismologists are hoping that they will get several events from the same distance. If that happens, and if the extremely rough triangulation of the seismometer's two horizontal axes seems to point in the same direction, then the inference would be that Mars itself is doing the quaking, since meteorites, like lightning bolts, seldom strike twice in the same place.

The lander's recording of the second event does have one advantage over the first. The initial event occurred when the lander was taking its readings only four times a minute, since during the reduced-operation period of solar conjunction the seismometer was spending barely two hours a day at its normal rate of one sample per second. By sheer good fortune—and the seismologists are certainly due for some by now—the second event began just 30 seconds after the instrument had switched to the higher sampling rate. The result is a 15-times-clearer portrait of the tremor. In fact, says Duennebier, "if it had come at the low rate, we might not have seen it."

If, as seems likely, the event was a natural one—whether Marsquake or meteorite—it has already revealed something about the Red Planet. On earth's moon, the seismologist says, a magnitude-3 event would show up in the data for an hour, reverberating around the moon's dry interior. The fact that it was so brief seems to confirm that Mars has a more earthlike interior, with some water present to damp out the "ringing."

On the moon, furthermore, a magnitude-3 quake would be a once-a-year event, according to Duennebier, and a magnitude-4 tremor is rare indeed. The Viking lander has already recorded an event of 6 or more, and it is funded to operate through May of 1978. By that time, Mars may have acquired an image of quite a lively place.

There should also be a considerably better understanding of what it's made of.

Although Viking's biologists are having a tough time finding a material and an environment which will reproduce their Martian results by inanimate chemistry, members of the project's inorganic chemistry team have now succeeded in assembling a mixture of minerals that seems to fit the Martian surface's response to X-ray fluorescence spectroscopy. They have, in other words, come close—at least by their instrument's definition—to creating Mars-dust in the laboratory.

The "model" of the fine material on the planet's surface, as team member Alex Baird told the scientists at the DPS meeting, was derived from a combination of computer studies (in which the computer shuffles mineral percentages around to try to match Viking's data curves) and actual attempts to mix up a batch. The leading candidate at present is an "intimate mixture" of about 80 percent iron-rich clay (59 percent nontronite and 21 percent montmorillonite), 10 percent magnesium sulfate (perhaps in the form of kieserite), 5 percent carbonate (perhaps as calcite) and 5 percent iron oxides such as hematite, magnetite, maghemite and goethite. (This fits with the conclusion of the magnetic-properties team that the fine material clinging to the lander's magnetic test panels includes, from 3 to 7 percent by weight, "highly magnetic minerals.")

This model is not necessarily true for the "fines" over the whole planet, of course. Even though the two landers have reported remarkably similar X-ray analyses from widely different latitudes and longitudes, the samples are still biased in a sense, if only by the criteria that limited the choice of landing sites.

Still, it is an important step forward and may even help narrow down the alternatives for the biologists trying to find a substance that will mimic *their* results. Late last fall, when the X-ray team had only a simple element-by-element analysis of the "fines," some of the biologists discounted using the data in their own test because the specific mineralogy might be just as important as the elements themselves. Now a proposed mineralogy exists.

If Mars does prove to be uninhabited, a major factor will almost surely have been its cold, dry, near-airless climate. A pair of reports at the DPS meeting suggest a fascinating parallel between Mars and the earth as friendly abodes for living things: Both may have evolved along a razor-thin pathway with only the subtlest of details making the difference between, well, life and death.

In an elaborate computer study of earth's atmospheric evolution, Michael Hart of the NASA Goddard Space Flight Center considered a large number of variables ranging from gas-escape processes to carbon dioxide fixation in carbonate rocks to changes in the sun's luminosity. Until perhaps 2 billion years ago, he says, the large quantity of CO_2 in the atmosphere kept temperatures far higher than they are today—it was only the appearance of free oxygen that allowed the temperature to fall. If earth had been only slightly closer to the sun, a runaway greenhouse effect would have kept the heat unlivably high. However, Hart says, "had the earth been only slightly *farther* from the sun, it would have iced over almost completely during that period, and would have remained so."

Mars was not (by terrestrial standards) so lucky. But, according to Joseph A. Burns of Cornell, William R. Ward of the Harvard-Smithsonian Center for Astrophysics and Brian Toon of the NASA Ames Research Center, the factor at odds with the sun this time was not the atmosphere, but the solid planet itself.

Mars is not a round world—few if any planets are. It is oblate because of its spin, and further out-of-round due to various density inhomogeneities and crustal features. But Burns et al. have calculated that a loss in oblateness of as little as 7 percent could have a major effect, causing the planet's axis of rotation to tilt considerably further than it is today. And 6.4 percent of that oblateness, they say, is due to a single surface feature: the huge Tharsis bulge, thousands of kilometers

across, atop which sit the four largest volcanoes on the planet. Another 3.6 percent or so is due to other crustal and density irregularities.

Today Mars rotates at an angle of about 25°, oscillating in a long-term cycle that ranges about 13° on either side of that number. But before internal geologic processes thrust Tharsis up to its present height, perhaps producing other features as well, the planet's axis may have been centered at a steep 32°. And therein lies the tale.

At the present inclination, according to the authors, maximum temperatures at the poles are about 240°K (− 27.4°F). At an inclination of 35°, however, the lengthened exposure to the sun would raise the poles above the melting point of water for about 40 days in the 688-day Martian year, and they would occasionally get as warm as 280°K (44.6°F). At a 45-degree tilt, temperatures would be above freezing for 90 days, reaching a balmy maximum of 300°K (80.6°F). This would have released vast quantities of water and carbon dioxide into the atmosphere, perhaps enabling a greenhouse effect that could have sustained such a climate for a long time. Certainly the difference from the present would have been, as Burns says, "profound."

Then Tharsis came and spoiled it all. But there is the possibility, boosted of late by the two apparent seismic events detected by Viking, that Mars is still a geologically active planet. Two years ago, in fact, a scientist at a DPS meeting proposed that Tharsis's crust is too weak to hold itself up by main strength, and that active convection is doing the work. Could the bulge recede? Viking has found that the residual polar caps are now only water, a possible sign that there may not be enough carbon dioxide left to rethicken the atmosphere even in warmer conditions. Proposed surface-roving vehicles and instrumented "penetrators" dropped over various points on the planet could tell more. The question is open. □

A new moon of Saturn, and an old one

To an outsider to the field of astronomy, the range of reactions to the term "Janus," listed in many references as the 10th moon of Saturn, is often a bit of a shock. Responses range from acceptance to tolerant smiles to expletive deleted. Claimed as a discovery by Audoun Dollfus in 1966, it was reported only over a relatively short number of days by a small number of astronomers and remains controversial to this day. This controversy is partially due to its cited position, which is so close to the outer edge of Saturn's rings that it can presumably be spotted only on the rare occasions when the rings are edge-on to earth. According to one astronomer at the AAS Division for Planetary Sciences meeting in Honolulu last week, "Saturn is the only known planet which has not only rings, but invisible moons."

Two University of Arizona astronomers, however, have reexamined both Dollfus's original plates and those of other observers as well. They have reported not only the confirmation of a 10th moon of Saturn, but the discovery, in many of the same plates, of an 11th one as well.

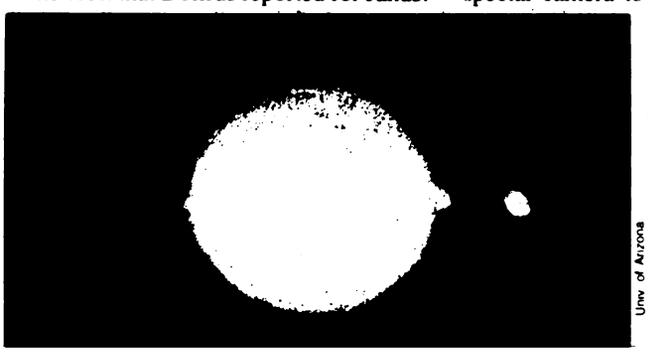
Astronomers Stephen Larson and John Fountain are firm in their conclusion.

"There are no less than 11 objects," Fountain says. The only uncertainty, they maintain, is whether number 10 is really in the orbit that Dollfus reported for Janus. In 18 of the 21 plates they studied, it can be plotted roughly on Dollfus's cited orbit. When all 21 plates are considered together, however, preliminary indications are that a somewhat different orbit yields a better fit.

Fountain points out that Dollfus's observations covered only three consecutive nights, hardly enough time to make precise measurements of such a tiny satellite's motion. However, the other astronomers' plates, cited by Larson and Fountain, represent a combined span of 51 days and should yield a more reliable ephemeris when precise calculations are completed.

The 11th satellite, meanwhile, is in a path with a semimajor axis of 151,000 kilometers, Fountain says, compared with 137,000 kilometers for the outer edge of the rings. Number 10 has a semimajor axis that is either slightly larger or slightly smaller than that of 11, depending upon whether Dollfus's orbit holds up.

The next favorable viewing opportunity will run from late 1979 through late 1980, a period beginning, coincidentally, just after Pioneer 11 has flown by Saturn to make it a still more intriguing place. Are the Arizona astronomers impatient for a chance to check out their conclusions first hand? "We're impatient enough," says Fountain, "that we've already built a special camera to look with." □



Univ of Arizona

A 10th and 11th moon of Saturn are indicated on this enhanced 1966 photo.

Legion disease: Culprit caged

Center for Disease Control

The bacterium held responsible for the deaths of Legion convention-goers last July. These fluorescent antibody stains indicate the presence of the organism.

After months of searching and researching two microbiologists from the Center for Disease Control (CDC) in Atlanta have isolated the mysterious microorganism responsible for the deaths of 29 American Legionnaires last July. The culprit turned out to be a bacterium of as yet unknown species. It was first thought to be rickettsia, a rod-shaped bacterium carried by ticks, because of the close physical resemblance. Further study, however, proved that the larger "Legionnaire" bacterium was far different from rickettsia or any other bacterium.

Credit for the discovery goes to Charles C. Shepard and Joseph E. McDade of the leprosy and rickettsial branch of the CDC. McDade reviewed tissue sample slides and noticed the bacterium, which had eluded previous inspections. With Shepard, he conducted a series of antibody fluorescence tests, which eventually linked the bacterium with the disease.

Despite their discovery, the researchers are still bewildered by the unusual qualities of the bacterium. Although the organism has been grown successfully in yolk sacs, the CDC staff aren't sure they can grow it in an artificial medium where commonly known bacteria thrive. Says one researcher: "We've seen some growth, but we're not sure it's the same as in the yolk sac."

Nevertheless, the organism has the size and shape of a bacterium, ruling out the possibility that the organism is a virus (which cannot grow in an artificial medium as well). "It's not an ordinary organism," one researcher said. "It doesn't fall into any of the accepted categories of commonly known bacteria."

How the strange bacterium made its way to Philadelphia and singled out the American Legion convention is still an unresolved question. One piece of the puzzle materialized when the CDC staff tested blood sera from victims of a pneumonia epidemic that occurred in 1965 at