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Water ice on Mars?

Puddles on Mars?

Living microbes on Mars?

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IN THIS ISSUE

- The cover image is Ron Levin's processing of an image from Mars rover *Opportunity*. His research is the subject of our third article concluding that the smooth, semi-translucent bluish features in this one-square-meter area on a Martian crater floor could be ponds.
- Webmaster Don Holeman pointed out that the Roman (serif) fonts we usually use for this publication may be best suited for print, but sans serif fonts are easier to read on screen. Don recommended the Georgia font, which we are trying out for the electronic edition of this issue. Readers experienced with fonts or who find the readability improved or worsened are encouraged to comment to <tomvf@metaresearch.org>.
- Our quote boxes in this issue all have the same theme – short-sightedness by some of the leading experts of the times. The five quotes (between articles) are spaced in time roughly a generation apart. It's now time for yet another famous expert to make history by being short-sighted once again; but of course, it takes a while before that becomes evident to everyone. Our readers are encouraged to send in their nominations for "most short-sighted expert" of the early 21st century. We'll post most of them and let the future judge our ability to see through the authorities of the times when they lack sufficient vision of the future.
- Our readers have come to expect to learn first of many major astronomy-related breakthroughs in this publication, often years in advance of general coverage in most other media. Our 15-year record of research results and prediction successes is unparalleled by any other publication in the field. In this, our "Life on Mars" issue, we hope to continue that record.
- Our first three articles deal with the researches of Gilbert Levin and Ron Levin, who describe good cause to conclude from the data of several spacecraft missions that the results are now in and are decisive: There is water-ice, there is liquid water, and there are *living* microbes on Mars right now, today.
- In our fourth article, we comment on why NASA has not endorsed these major findings of extraterrestrial life on Mars, allowing outside scientists and space agencies for other countries to claim these discoveries for themselves and leaving the major media uncertain about how to proceed.
- *Meta Science in the News* begins with recent reports of subterranean caves on Mars, which we conclude are real but probably of natural origin. We follow with a note about updates to the sound track of our "Violent history of Mars" video from the previous issue. The third news note reports on the ESA response to SPSR inquiries about the "horn" feature on ESA's media release image of the Cydonia Face, which is non-existent in the raw data and all other images to date. Then Michael Fischer writes about how the new *Stardust* mission results so clearly support the EPH, yet no one has commented on this in the journals. Finally, we report on the first well-confirmed occultation of a star by an asteroid satellite. Occultations played a major role in the initial discovery of asteroid satellites back in 1976, although few credited those early observations, even the confirmed ones, because the idea was thought implausible in the extreme by mainstream theorists of the time. Now the mainstream projects that at least 5% of main belt asteroids have satellites large enough to be discovered under the right conditions. So new occultation data showing not just the existence of another asteroid satellite, but also possible details of the satellite's size and shape, show once again the folly of dismissing observations rather than dealing with them.

Interpretation of New Results from Mars with Respect to Life

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ABSTRACT

NASA has frequently stated that its highest priority is the search for extraterrestrial life. However, no life detection instruments have been sent to Mars since the Viking *Mission in 1976 produced highly disputed evidence for microbial life in the Martian soil. The unfortunately lost* Beagle 2 *and the successfully landed* Spirit *and* Opportunity *are all devoid of means to investigate the* Viking *findings or otherwise to determine whether or not life exists or ever existed on the red planet. However, all of these spacecraft contain instruments that are designed to obtain data ancillary to that vital and supreme question. Imaging and spectral data have now arrived from the European Space Agency's orbiter,* Mars Express*, and from NASA's Mars Exploration Rovers* Spirit *and* Opportunity. *These data are discussed from the standpoint of their impact on the prospects for life on Mars, and, specifically, on the 1976* Viking *Labeled Release (LR) experiments that the author claims proved the presence of active microbial life in the topsoil of Mars.*

1. INTRODUCTION

The primary objective of NASA's 1976 *Viking* Mission to Mars was to search for life. The results were highly provocative. The LR experiment demonstrated the presence[1] of a highly reactive agent in the surface material of Mars. The author's conclusion in 1997[2] that the activity was caused by living microorganisms in the soil has not been generally accepted by the scientific community. Maintaining the search for life as its highest priority, NASA has followed a careful, step-by-step program to that end. The European Space Agency's *Mars Express* currently orbiting Mars, and NASA's Mars Explorer Rovers *Spirit* and *Opportunity* have produced, and are producing, data of relevance to the possibility of life on Mars.

2. BACKGROUND

Important background for this paper is a 2003 report[3] by the author that NASA's Mars orbiter *Odyssey* had detected water within a few centimeters of the surface over very large regions of Mars, including the two *Viking* landing sites. However, the water was presumed to be ice. Publications by the *Odyssey* scientists have not addressed the possibility that the water may be in biologically available form despite the facts that Pathfinder found the near-surface atmosphere of Mars to be well above the freezing point of water,[4] and experiments in the cited reference showing liquid water to exist under Martian environmental conditions. Because of the importance of this issue, the new data from *Spirit* and

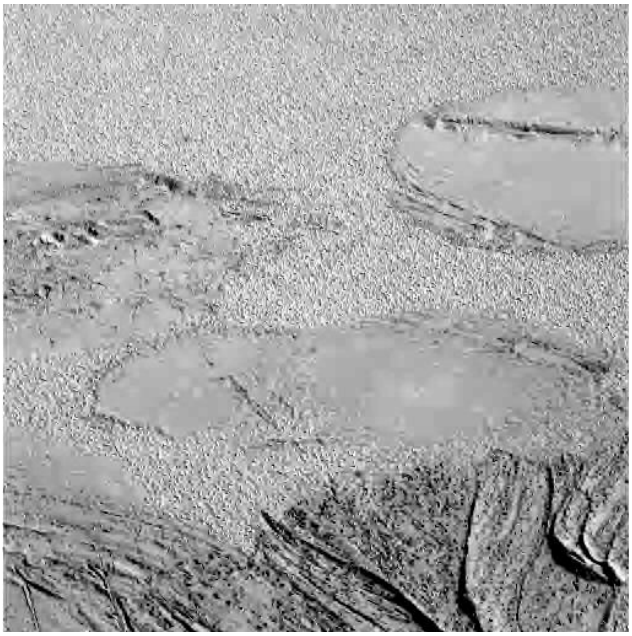

Figure 1. Mud Puddles on Mars? (image 1P128287581EDN0000P2303L5M1)

Opportunity are herein examined for possible indications of liquid water, the habitability of Mars, and implications for life.

3. NEW RESULTS

Early images beamed to Earth, such as that from *Opportunity* in Figure 1, caused a reporter viewing them at a press conference to ask the obvious question "Is that mud?" The project scientist responding stated that, while it does look like mud, it cannot possibly be mud, because liquid water cannot exist on the surface of Mars. This comment, however,

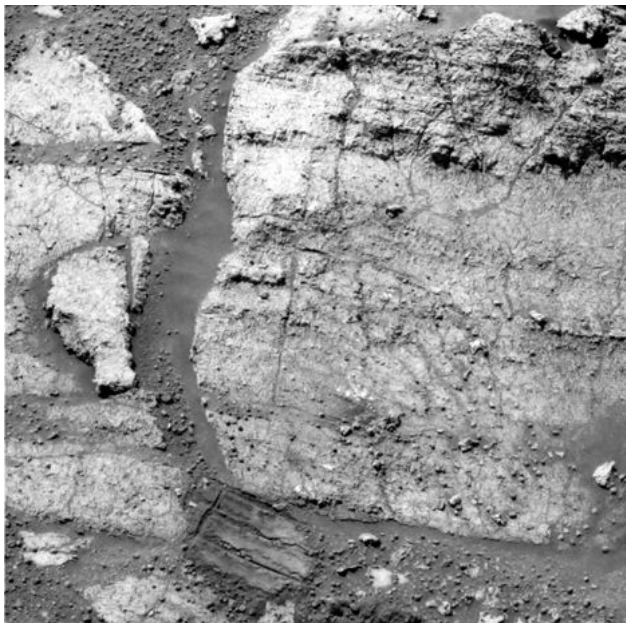

Figure 2. *Opportunity* Rover Track on Mars

ignored the experimental results reported above. An examination of images from the Rovers *Spirit* and *Opportunity* are relevant to this issue. The images should be reviewed against the background of surface temperatures as varying from below to above freezing reported by both *Spirit* and *Opportunity*.[5]

Figure 2 shows part of the track made by the Rover *Opportunity* on Sol 37. The dark vertical channel has the appearance of a stream or the muddy remnants thereof. Partway down the course, the berries seem to be moved over towards the left side, as they would be deposited by flowing water. At the bottom of the picture, a portion of the Rover's track is shown. The sharp impression, having what appear to be vertical or nearly vertical walls, suggests the presence of liquid water. NASA scientists have said that there might be a possible unknown mildly bonding material in the soil, perhaps liquid water.[6] It is difficult to propose what seems to be a 90° angle of repose of the soil without some bonding material, typically moisture on Earth. It appears that the Rover passed over the area and the pressure from its tracks squeezed water out of the soil, the water having frozen as the temperature dropped. An alternative explanation would require this substance to have been in place prior to the Rover's travel. However, none of the surrounding area shows this type of formation. Were this image taken on Earth, few would interpret it other than as showing a muddy patch amidst rocks.

Figure 3 is an image from *Opportunity* taken after the Mössbauer Spectrophotometer had been applied to the

Figure 3. Ice and Mud?
(1P139113486EFF2811P2535L5M1, 535 nm/20 nm bp)

surface of the soil. A whitish background material pervades this image. The impression left by the Mössbauer instrument has become white, and part of the impression has been filled over. While the filling may have been caused by retraction of the device disturbing the soil, the covering does not seem random, but more lobate, as if the material had flowed onto the disk area. To the right of the impression is a vertical line that also seems to be the product of flow. The entire region surrounding the impression of the Mössbauer and below it seems different from the surrounding area and brings to mind either an old, hardened, mudflow, or a present one. If the Mössbauer instrument caused the white material to appear in the disk impression, it might mean that the pressure or heat of the instrument caused water to flow out of the soil or mud and that subsequently the temperature dropped below freezing, producing ice. There is a reflective arc bordering the right side of the impression which also might be attributed to ice. The "berries" appearing in the lobate area seem smaller than those in the adjacent areas and are also less distinct, as if partially covered. An alternative explanation to that of ice would require either some very light colored material to lie just beneath the surface that became revealed where the Mössbauer instrument made its contact, or for the radiation from the Mössbauer to have changed the properties of the soil.

Figure 4 is another *Opportunity* image showing a bright white material lying in depressed areas of the rock. The material has no structure and appears as if it might be frost or snow. Again, those berries that do appear in some portions of the white material seem to be partially covered with some of that material, suggesting that other berries may be completely buried in it. Figure 5 shows the ubiquitous whitish background common in these images, but, in addition, what could be taken for a small rivulet flowing, or having flowed, around the dense white island in the center of the picture. There is no unambiguous evidence to date the flow. However, the upper left area along the "bank" of the rivulet is darker than the general color in the rivulet, raising the question of current moisture. The same is

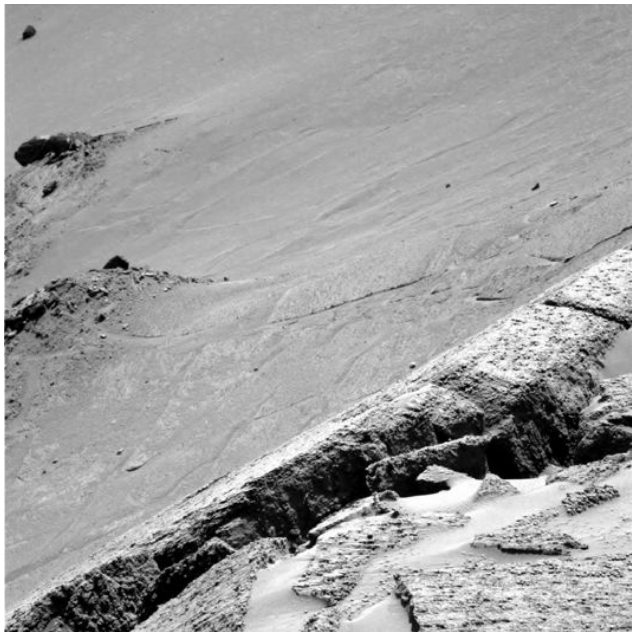

Figure 4. Snow on Mars?
(1P139009490EFF2809P2262L6M1, 739 nm/38 nm bp)

Figure 5. Water Holes?
(1P138565929EFF2809P2297R2M1, 754 nm/20 nm bp)

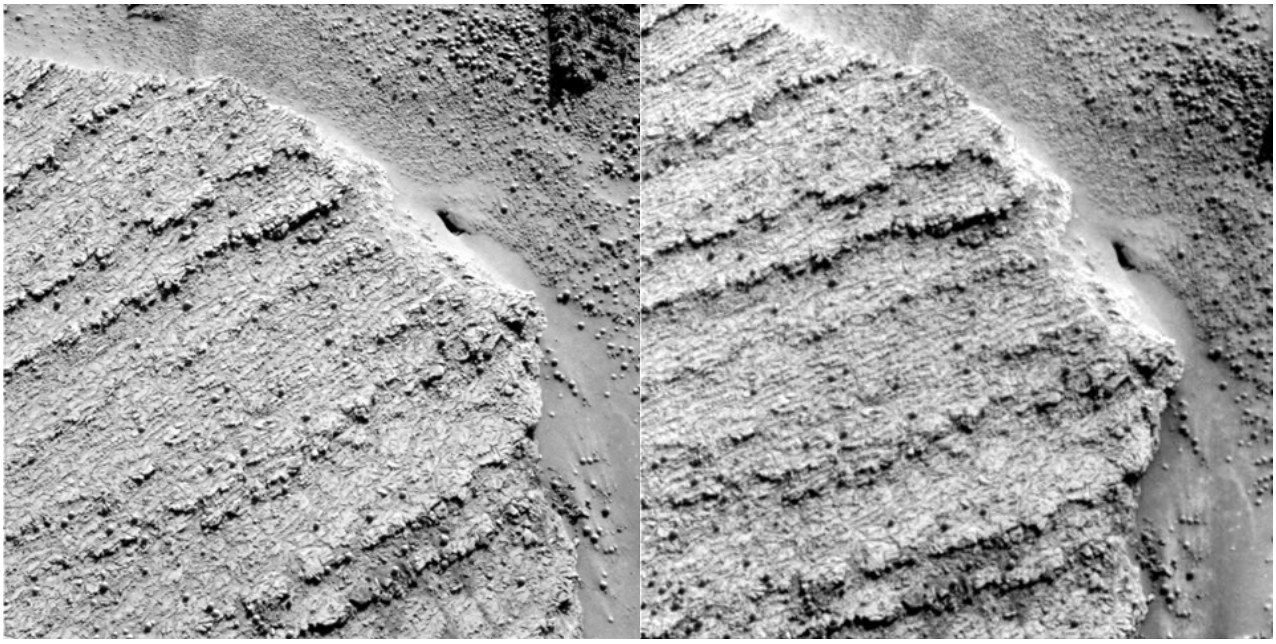

Figure 6. (a) Sink Hole? (1P139377590EFF2831P2540L5M1, 535 nm/20 nm bp); (b) Filter-Enhanced Evidence for Liquid Water? (1P139377824EFF2831P2540R7M1, 1,009 nm/38 nm bp)

true of the bank of the rivulet on the right side of the picture just above center. These moist-appearing areas do not contain any berries. Even more interesting are the sharply defined holes adjoining the large white mass in the lower portion of the picture. They have the appearance of sinkholes created by flowing water, past or present.

Another possible "sinkhole" appears in Figure 6 (a). Lines of flow, indicated by tailings behind some of the berries establish the direction of flow toward the hole. No berries appear in the area just before the hole, and fewer berries appear in the flow path than in adjacent areas. Berries in the flow path seem to be immersed in the material surrounding them. Further examination of these features was made possible by the *Opportunity* Rover's use of spectral filters. Figure 6 (b) shows the same scene taken only about 3 minutes later. In Figure 6 (a), a 535 nm filter was used, while that of Figure 6 (b) was 1,009 nm. The "fluvial" region near the right bank is darker in Figure 6 (b), consistent with the presence of moisture revealed by the larger wave number filter.

Figure 7 provides the spectrum of liquid water.[7] It shows that, as the wavelength increases from about 400 nm to 1,000 nm, the spectral range embracing the filters, the absorption coefficient increases at a nearly constant, steep slope. Thus, liquid

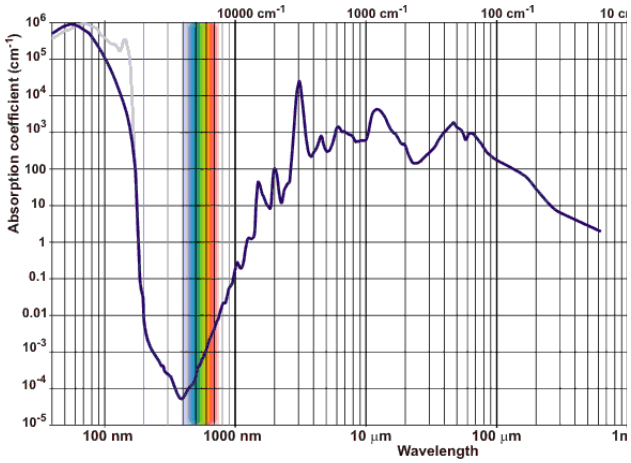

Figure 7. The Spectrum of Liquid Water. (Credit: http://www.sbu.ac.uk/water/vibrat.html)

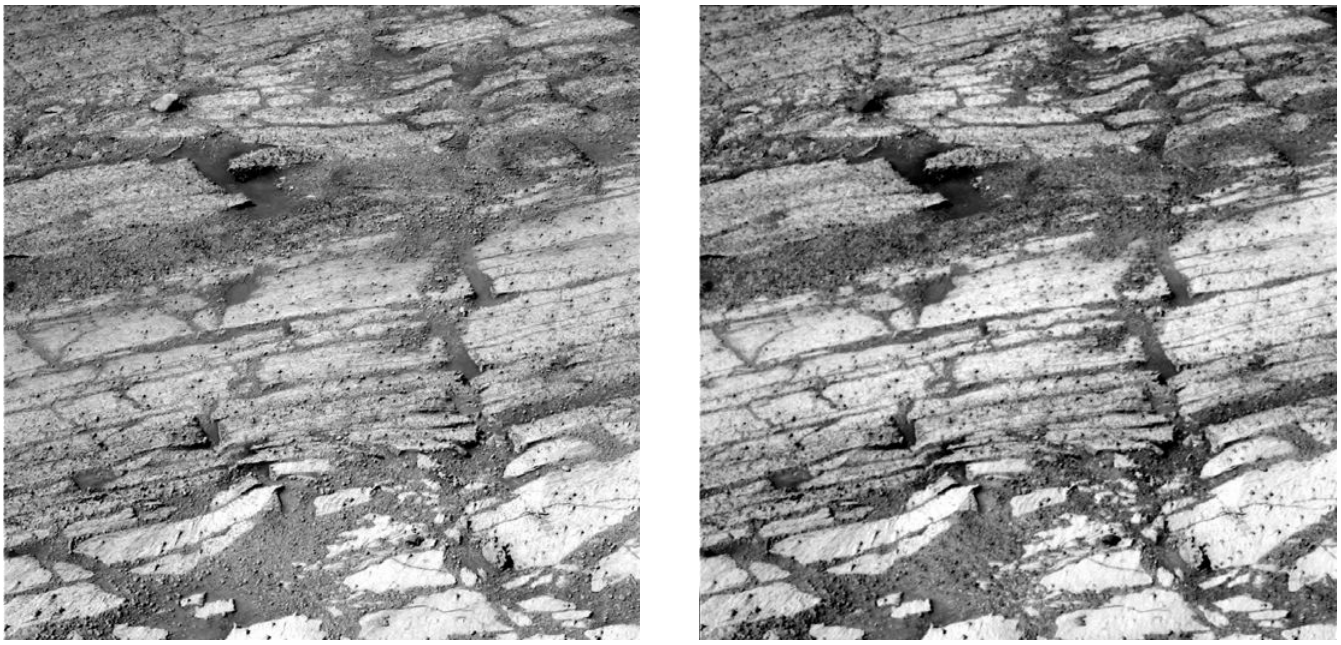

Figure 8. (a) Outcrop Area (1P140084775EFF3160P2372L5M1, 535 nm/20 nm bp); **(b)** (1P140084741EFF3160P2372L2M1, 753 nm/20 nm bp)

water absorbs light more intensely at 1,009 nm than at the 535 nm. This would mean that, if liquid water were present, any moist areas in the image taken with the 1,009 nm filter would appear darker than in the 535 nm image.

Other *Opportunity* Rover images taken with filters support the presence of liquid water. One such pair, taken of an outcrop area, is given in Figure 8 (a) and (b). Figure 8 (b), taken at 753 nm, shows darker

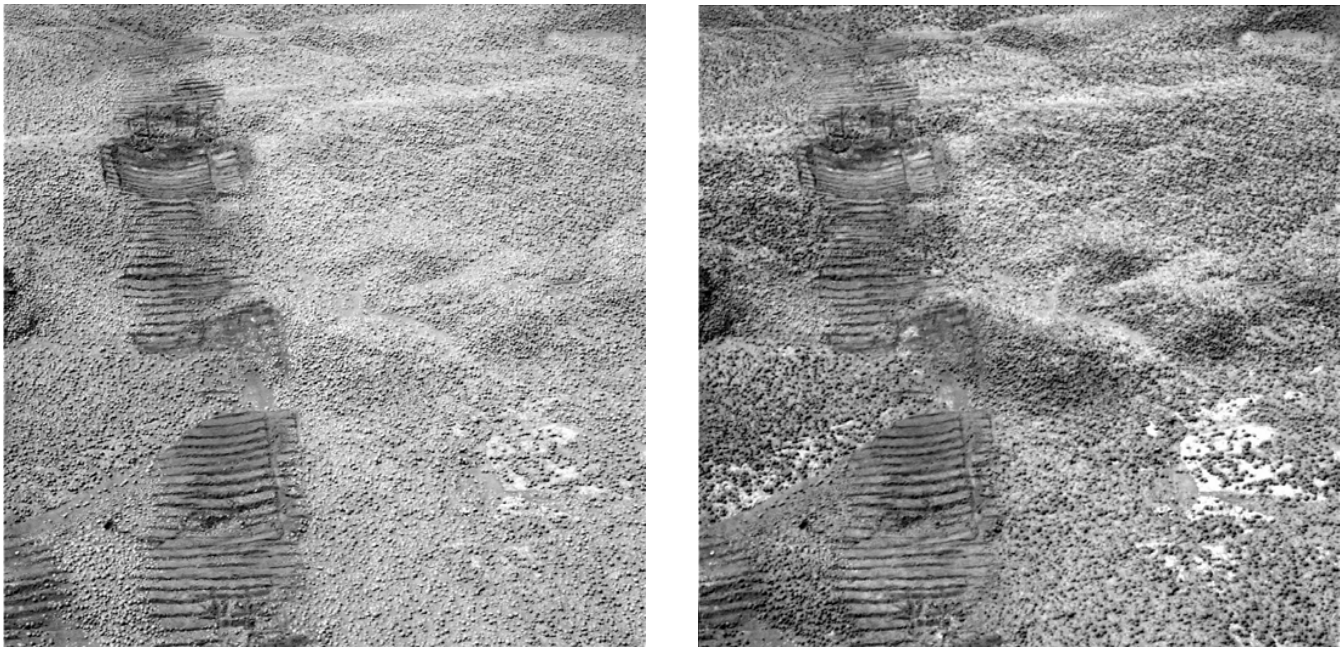

Figure 9. (a) *Opportunity* Rover Tracks (1P139722803EFF3054P2546L5M1, 535 nm/20 nm bp); **(b)** (1P139722770EFF3054P2546L2M1, 753 nm/20 nm bp)

Figure 10. "Rubber Chicken" (a) (1P139563668EFF3034P2544L7M1, 432 nm/32 nm bp); **(b)** (1P139563603EFF3034P2544L5M1, 535 nm/20 nm bp); **(c)** (1P139563583EFF3034P2544L2M1, 753 nm/20 nm bp)

darks than does Figure 8 (a), taken at 535 nm, both with the same band pass width. The muddy-looking region at about 11:00 o'clock in the figures is darker in Figure 8 (b) than in Figure 8 (a), for example. The wave number differences are not as great as in the previous pair of figures, but the increased darkness, indicating moisture or liquid water, is obvious.

Two different filters were used to take a pair of images of the track made by Rover *Opportunity*. They are given as Figure 9 (a) and (b), taken at 535 nm and 753 nm, respectively, both at 20 nm band pass widths. Areas in the 753 nm image are darker than in the corresponding 535 nm image taken within one minute. The increased absorption with increased nm is, again, consistent with the presence of liquid water.

The next three images [Figure 10 (a), (b), and (c)] are not as easily explained. They show a field of berries with a white "rubber chicken" superimposed. The images were taken at approximately one-minute intervals, at 432, 535, and 753 nm, respectively. The principal observation is that the rubber chicken seems to grow white wings with increasing nm. It is tempting to think of the emerging white areas as being thin ice brought into view by the larger nm filters.

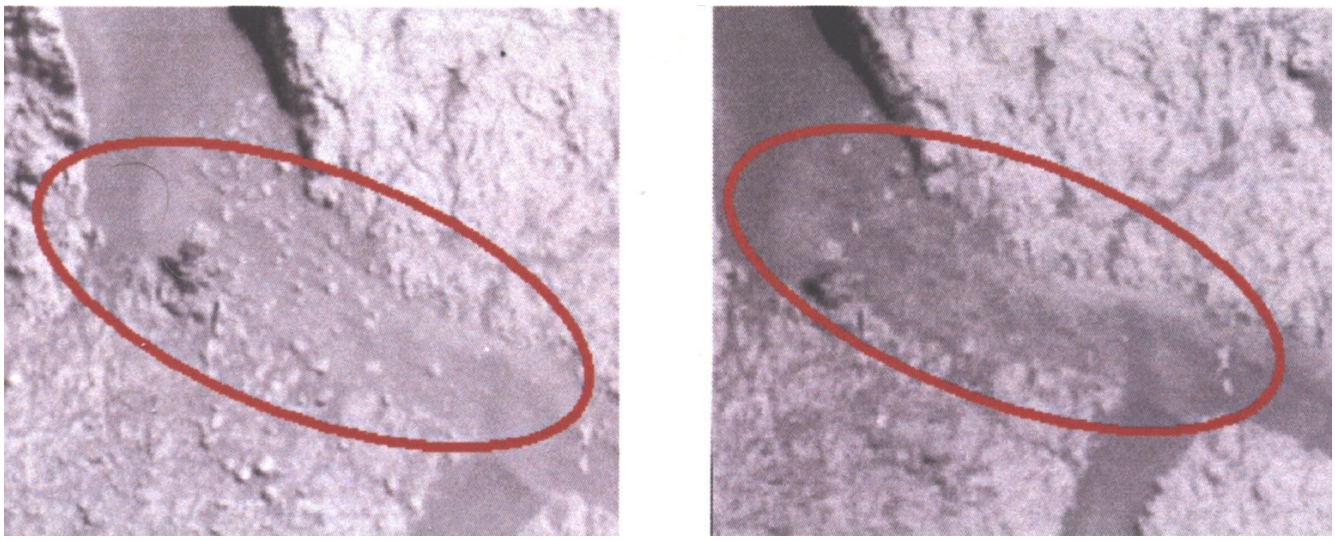

Figure 11. Close-up of McKitrick: (a) Possible Standing Water, Shallower; (b) Possible Standing Water, Deeper.

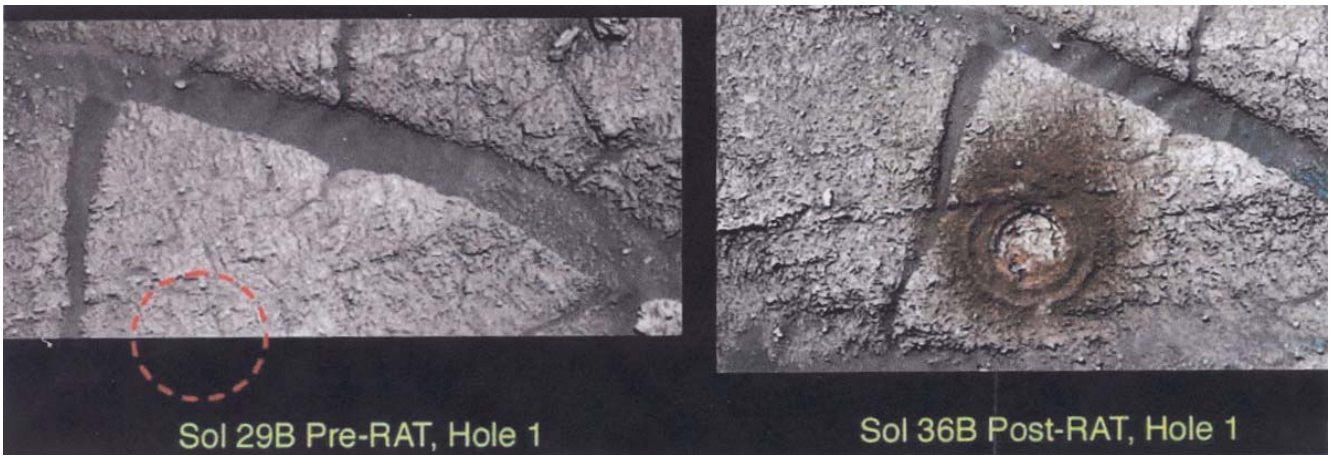

Figure 12. *Opportunity* Photo of McKitrick.

However, the absorption of ice varies greatly depending on depth and crystal size, so no conclusion is drawn with respect to the wings of the rubber chicken, except to call attention to this interesting filter-dependent feature. The increase in darkness with increasing nm in defined areas of the background is consistent with the presence of liquid water or moisture. The consistently white rubber chicken could be ice formed on those berries.

Figure 11 (a) and (b) in the area of the rock "McKitrick" may be of special interest. They were taken only 645 seconds apart. Figure 11 (a) was taken first with a 535 nm filter, 20 nm band pass width; and Figure 11 (b) was taken with a 673 nm filter, with a band bass width of 16 nm. They are thus quite comparable. Attention is drawn to the areas encompassed by the superimposed ovals. In Figure 11 (a), the berries are quite distinct. However, in Figure 11 (b), the berries seem less distinct, as they would if submerged in liquid water. This difference in appearance could conceivably result from variation in depth of flowing water in the approximately 10-minute interval separating the two images. However, this difference may be an artifact of the slight difference in contrast evident between the two images.

Images of the same area were taken on Sol 29 and Sol 36, before and after the RAT holes were drilled, as seen in Figure 12 (a) and (b). The same location in Figure 11 and Figure 12 is readily identified by the wide vertical channel-like feature. This feature on Figure 12 (b) is narrower than in Figure 12 (a) and indicates a higher edge on the left side. This would be consistent with the possibility that the water level in Figure 12 (a) was higher than in Figure 12 (b), in which, as in the case of Figure 11 (b), the berries seem more distinct in the image that might indicate shallower depths of water. This is further indicated by the undulations in the nearly horizontal channel, with their appearance in Figure 12 (b) far more pronounced than in Figure 12 (a), again indicating shallower water in Figure 12 (b).

The fact that the RAT hole was dug subsequent to the Sol 29 image would not seem to have any bearing on these observations. Figure 13 is a composite of the three images of the McKitrick area. The three images were combined to produce an image constructing the color of the area to the extent of the information available. The red dust is seen produced from the RAT hole, possibly indicating the iron content of McKitrick. It is noted, however, that the center of the RAT hole is largely white, possibly indicating the formation of frost since the hole was drilled.

Figure 13. Color Image of Post-RAT Area. This image was constructed by combining the 3 filter images: (1P131384868EFF0504P2531L4M1.JPG, 1P131384899EFF0504P2531L5M1.JPG, and 1P131384923EFF0504P2531L6M1.JPG)

The source of the liquid water and/or ice may be possibly explained by Figure 14 which, according to the NASA caption, shows "water clouds near the surface up to heights of 20 kilometers." These low-lying water clouds are consistent with the model and analysis[8] made in 1998 to explain liquid water on Mars. Precipitation from these clouds could have produced snow or, perhaps, rain when the temperatures were, as reported by both *Spirit* and *Opportunity*, above freezing. As explained in the above cited reference, any such liquid water resulting from the melting of snow or direct precipitation as rain would not immediately boil or entirely evaporate.

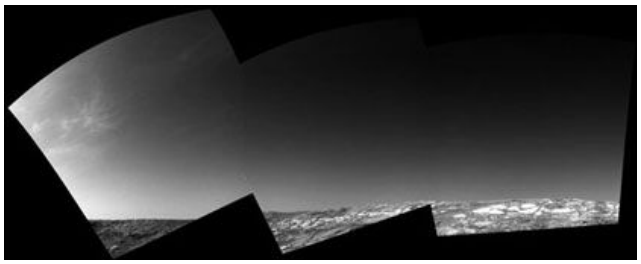

Figure 14. Water Clouds Roll in for Martian Winter.

In an earlier paper,[9] it was pointed out that the detection of magnetic iron at the *Viking* landing sites argued against the highly oxidizing soil widely postulated as an explanation of the LR results. Figure 15 shows the result of a magnetic experiment by the *Opportunity* Rover in which dust was collected from the air. As with *Viking*, significant amounts of soil were retained on the magnet. Thus, the *Opportunity* Rover landing site does not contain strong oxidizing agents. This is further supported by the Mössbauer analysis performed by the *Opportunity* Rover. The spectrum results, shown in Figure 16, identifies iron in the +2 state as being more plentiful than in the more oxidized, +3, state.

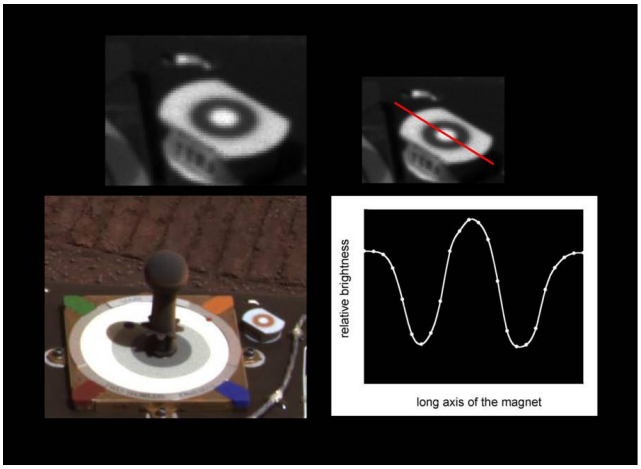

Figure 15. Low Valence Iron on Mars—Evidence Against Highly Oxidizing Environment. (Credit: http://www.jpl.nasa.gov/mer2004/rover-images/mar-05-2004/captions/image-20.html)

This image composite highlights the Mars Exploration Rover *Opportunity*'s "sweep" magnet, which scientists use to study the origins of dust in the atmosphere ... scientists have concluded that nearly all of the dust particles in Mars' atmosphere are magnetic.

Methane and Ammonia:

Very recently, the detection of methane in the Martian atmosphere was

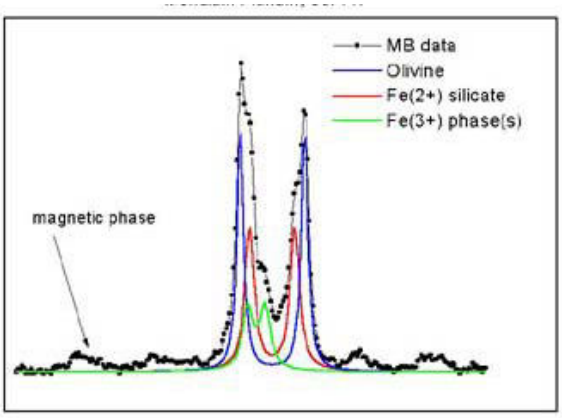

Figure 16. Mössbauer Spectrum on Martian Soil, Meridiani Planum, Sol 11. (Credit: http://www.jpl.nasa.gov/mer2004/rover-images/feb-04-2004/mb_soil_opportunity-380.jpg)

reported by the ESA *Mars Express* orbiter.[10] This confirms earlier reports of Earth-based observations.[11] It is generally acknowledged that the presence of methane in the Martian atmosphere might be indicative of extant life. This is because the half-life of methane in the atmosphere, where it is subject to photolytic decomposition, is so short that its presence would require its continual production. This production could be effected by volcanic outpourings or by living organisms. However, in the considerable mapping of Mars by the various orbiting spacecraft, no active volcanoes have been detected. Vittorio Formisano, PI of the ESA Planetary Fourier Spectrometer, was quoted[12] as saying of volcanoes, "none of which have been found yet on Mars." BBC News reported[13] on July 15, 2004, that researchers on the ESA *Mars Express* Orbiter have tentatively identified ammonia in the Martian atmosphere. As in the case of methane, but with even a shorter half-life in the atmosphere, ammonia must be constantly replenished to be present. Again, replenishment could be effected by active volcanoes or living microorganisms. In the article, a NASA scientist is quoted as having told BBC, "There are no known ways for ammonia to be present in the Martian atmosphere that do not involve life." The article concludes by stating, "But, so far, no active volcanic hot spots have been detected on the planet by the many spacecraft currently in orbit."

4. SUMMARY

The evidence presented strongly indicates the presence of liquid water or moisture at the Mars Exploration Rover sites. Recent or current mini-erosion features have been seen. Images taken through filters indicate the presence of moisture or liquid water. Evidence that could be interpreted as standing liquid water has been presented. Soil surface temperatures at both the *Opportunity* and *Spirit* Rover sites, as at the *Viking* Lander sites and the Pathfinder site, rise above freezing at some portion of the day, perhaps seasonally. It would thus seem that all factors necessary to constitute a habitat for life as we know it exist on current-day Mars.

5. CONCLUSIONS

Mars today could support many forms of terrestrial microbial life. Liquid water or moisture is present. There are some strong hints that atmospheric disequilibria may be caused by living organisms. None of the many new findings about Mars reported above or elsewhere conflict with, or render untenable, the conclusion that the *Viking* LR experiment detected living microorganisms in the soil of Mars.

6. RECOMMENDATION

With the demonstrated uncertainty of achieving successful spacecraft landings on Mars, each spacecraft lander should carry a life detection experiment. The proposed chiral LR experiment[14] should be among those experiments in that it builds on the LR legacy and could render unambiguous confirmation of life. It is important that whatever methods to detect life are sent to Mars, or elsewhere, they should be capable of measuring on-going metabolism, rather than merely detecting life-associated chemicals.

The later, alone, cannot prove the presence of extant life.

ACKNOWLEDGMENTS

The author wishes to thankfully acknowledge the essential help of Susan Smith who found many of the desired images presented herein by tireless searching of the JPL *Spirit* and *Opportunity* websites. He also wishes to thank Ron Levin for his construction of the color image, Figure 13, from the raw images. Finally, but not least, he thanks Kathy Brailer for her enormous effort and help in assembling this manuscript.

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"Men might as well project a voyage to the Moon as attempt to employ steam navigation against the stormy North Atlantic Ocean." – Dr. Dionysus Lardner (1838)
Professor of Natural Philosophy and Astronomy, University College, London

Historic Mars Lander 'Did Find Life'

A BBC interview with Gilbert Levin of Spherix Inc., author of the preceding article, appears at http://news.bbc.co.uk/2/hi/science/nature/2941826.stm. It is about the discovery of Martian microbes and the research to show that they are present-day, living biological organisms. An accompanying two-minute overview video of the interview was recently posted to the web site of the Society for Planetary SETI research (SPSR) with BBC permission, through the efforts of SPSR member Ananda Sirisena. This

may be viewed by going to http://spsr.utsi.edu/, clicking on the first link: "SPSR News", then click on the link to the Levin video. For the convenience of our readers, we provide the two direct links below – one to the larger 50MB MPG version of the file, the other to a 14MB small-screen version of the same file.
Levin video: 50MB or 14MB.

There are few scientific findings of comparable importance. You are reading about it here long before the mainstream media are willing to "risk their reputations" by reporting this. Most say they are waiting for NASA's okay. But NASA has turned control of the Martian orbiters and landers over to Caltech's Jet Propulsion Laboratory (JPL), which has a financial interest in the pace of discovery being slow so their approved Mars missions through 2016 don't get cancelled. Those missions target various lines of evidence designed to determine if ancient life ever existed on Mars billions of years ago. The two active rovers now on Mars, *Spirit* and *Opportunity*, have no water detection instruments, but were designed to look for mineralogical evidence of ancient water. In the meantime, the European *Mars Express* spacecraft and the Mars Rovers found evidence of present-day water-ice in craters. And the next article discusses strong evidence that the water is even in liquid form in places. So happily for the progress of science, the JPL "baby steps" strategy is not working as well as they might wish.

###

"When the Paris Exhibition closes electric light will close with it and no more be heard of." – Erasmus Wilson (1878) Professor at Oxford University

Mars rover finds "puddles" on the planet's surface

Background

This article is based on a preprint by two scientists and a news story in New Scientist magazine, a publication (like our own) developing a reputation for publishing science news that most other publications are not ready to cover because they can't get an okay from "authorities" such as NASA. See http://space.newscientist.com/article/dn12026-mars-rover-finds-puddles-on-the-planets-surface.html for the news story.

The preprint by R. L. Levin and Daniel Lyddy is titled "Investigation of possible liquid water ponds on the Martian surface" (2007 IEEE Aerospace Applications Conference Proc., paper #1376, to be published in IEEE Xplore). Both authors are at the aerospace company Lockheed Martin in Arizona. Levin is a physicist and an expert in advanced image processing, and the original images for this analysis are posted to the Jet Propulsion Laboratory's website. Lyddy is an engineer.

Levin's father Gilbert was principal investigator of an experiment on the *Viking* Mars landers in 1976, which found evidence for life on the planet. Negative results from a separate test for organic materials led most scientists to doubt the evidence for biology. But subsequent research showed that the organic molecule detection instrument was insufficiently sensitive and also failed to detect organics in a sample from Antarctica containing a known virus.

Overview

A new analysis of pictures taken early in its mission by the Mars rover *Opportunity* reveals what appear to be small ponds of liquid

water on the surface of Mars. See the cover photo for this issue.

Specific spots appear to have contained liquid water in 2003, when *Opportunity* was exploring a crater called Endurance. However, this interpretation of the images is highly controversial because many scientists still believe that liquid water cannot exist on the surface of Mars today because the atmospheric pressures on Mars are too low. Moreover, the existence of such ponds would significantly boost the odds that living organisms could survive on or near the surface of Mars. Therefore, much is at stake in interpreting these images correctly.

In this new analysis, stereoscopic reconstructions made from paired images from the rover's twin cameras show bluish features that look perfectly flat. The surfaces are so smooth that the computer could not find any surface details within those areas to match up between the two images.

Apparently, the flat areas occupy the lowest parts of the terrain. They also appear transparent: some features that may be submerged rocks or pebbles appear below the plane of the smooth surface.

What form of water?

The smoothness and transparency of the features could be due to either water or very clear ice. However, ice or some other material should show evidence of surface erosion, such as rubble or sand or other surface irregularities.

Images from orbit led to reports last year showing the existence of gullies on crater walls where water appears to have flowed in the last few years. Those are short-lived flows and are thought to have frozen over almost immediately. Standing liquid water has not been previously recognized as such.

Theory indicates a range of temperatures and pressures where liquid water might be stable on Mars. Such conditions might exist in "micro-environments" with special conditions, such as regions with hot springs on Earth. But it is difficult to find general conditions on Mars that could support liquid water, although the absence of winds with significant force is a big help.

Perhaps the most promising explanation is the "briny water" theory. It is likely that any water on Mars would contain dissolved salts, and these would extend the range of stability significantly. When combined with wind-sheltered locations such as the interior of Endurance crater, and temperatures found at mid-day in the Martian summer, stable liquid water states are feasible.

A simple test

The rover is now far from Endurance crater. However, if similar features are found elsewhere in the rover's explorations, Levin proposes a simple test that would prove or disprove the presence of liquid. Simply use the rover's drill on the surface of the flat area. If it is ice or any solid material, the drill will leave unmistakable markings. But if it is liquid there should be no trace of the drill's activity.

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"That the automobile has practically reached the limit of its development is suggested by the fact that during the past year no improvements of a radical nature have been introduced." – Scientific American, Jan. 2, 1909

The Next Mars Mission and the JPL Agenda

A new spacecraft will be launched toward Mars this summer. The scheduled date is August 3. The mission is known as "*Phoenix*", and consists mainly of a lander with the capability to dig, scoop, and drill, then photograph and analyze soil and samples.

Our first reaction, especially in light of the preceding articles, might be that we will finally get some definitive answers about liquid water and life. But sadly, that is not the case. At the official web site for *Phoenix*, http://phoenix.lpl.arizona.edu/mission.php, we learn that the probe will land in the northern arctic regions and its goal is to answer three questions: (1) can the Martian arctic support life, (2) what is the history of water at the landing site, and (3) how is the Martian climate affected by polar dynamics?

However, the "support life" question means the probe will determine if the chemical and environmental conditions are such that life might have existed there billions of years ago. The emphasis is really on climate change rather than life because finding out whether ancient life could ever have existed is reserved for the last of the planned missions in this series in the year 2016. No instrument aboard this mission can detect present-day or even past life.

From the CNN news story at http://www.cnn.com/2007/TECH/space/05/09/mars.probe.reut/, we learn that scientists want to understand the environmental and climatic changes that turned what is believed to have been a warm, watery world into the cold, dry desert that exists today – assumptions that are wrong if the exploded planet hypothesis is correct. The *Phoenix* mission will add a microscopic perspective to the mix.

Upon reaching Mars in May 2008, the spacecraft is to land just as the winter ice begins to recede around the polar cap. The probe should touch down on newly exposed soil, but their true target lies just beneath the surface. This is where *Phoenix*'s scoop and drill come into play. Samples will be dissolved in water to look for salts that likely would have been deposited during watery conditions in the past. *Phoenix*'s onboard laboratory also includes small ovens to break down minerals in the samples for chemical analysis.

Some scientists believe a vast frozen ocean is buried beneath the ice. Another theory says Mars' polar ice solidified from atmospheric water vapor, not a widespread ocean. *Phoenix* will be able to make isotopic measurements of the hydrogen and oxygen molecules and perhaps resolve this puzzle.

Phoenix is a resurrection of spare parts and instruments from the unsuccessful *Mars Polar Lander* and *Mars Surveyor 2001 Lander* initiatives. *Polar Lander* was lost as it attempted to touch down in December 1999. *Mars Surveyor* was canceled in the wake of *Polar Lander*'s failure and the loss of a sister probe, *Mars Climate Orbiter*, two months earlier. NASA traced the failures to inadequate testing and oversights. A metric conversion error led to the orbiter's demise, for example. Like *Polar Lander* and *Climate Orbiter*, *Phoenix* is a relatively low-cost mission. Rather than building "faster, better, cheaper" spacecraft, as had been NASA's aim in the 1990s, *Phoenix* achieves its savings by narrowly focusing its science agenda to determine one goal: if Mars had the ingredients for life.

And in that simple goal statement, we have a succinct summary of the near-term future of our space program – deliberate baby steps rather than breakthroughs in discovery and understanding. In 1976, we were sending life-detection experiments to Mars, and they came back with all-positive readings. Rather than following up, in 2007 we are sending "ingredients" detection experiments and studying climate change. Apparently, the U.S. space program will not attempt to answer the big questions for perhaps another decade or two! Fortunately, other countries are not similarly demotivated.

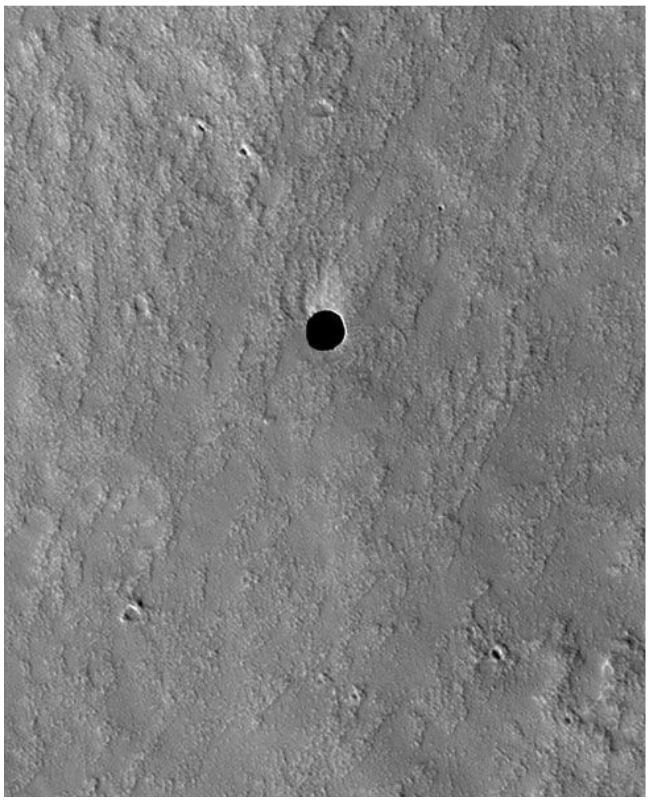
###

"There is not the slightest indication that [nuclear energy] will ever be obtainable. It would mean that the atom would have to be shattered at will." – Albert Einstein, 1932

Meta Science in the News

Subterranean caves on Mars?

The image shown here and the following caption are from the "Astronomy Picture of the Day" for 2007 May 28, http://antwrp.gsfc.nasa.gov/apod/ap070528.html: "Black spots have been discovered on Mars that are so dark that nothing inside can be seen. Quite possibly, the spots are entrances to deep underground caves capable of protecting Martian life, were it to exist. The unusual hole pictured above was found on the slopes of the giant Martian volcano Arsia Mons. The above image was captured three weeks ago by the HiRISE instrument onboard the *Mars Reconnaissance Orbiter* currently circling Mars. The holes were originally identified on lower resolution images from the *Mars Odyssey* spacecraft. The above hole is about the size of a football field and is so deep that it is completely unilluminated by the Sun. Such holes and underground caves might be prime targets for future spacecraft, robots, and even the next generation of human interplanetary explorers."



Fredrik Persson and Neil DeRosa on the Meta Research Message Board (http://metaresearch.org/msgboard/topic.asp?TOPIC_ID=978) and several members of SPSR have recently discussed these images and several news stories they generated about possible caves on Mars. See for example this paper from the Lunar and Planetary Science XXXVIII conference (2007): http://www.lpi.usra.edu/meetings/lpsc2007/pdf/1371.pdf; or this link to the Planetary Society story: http://www.planetary.org/blog/article/00000984/. Quoting these discussions:

"Analyses of the candidates suggest that they are not of impact origin, not patches of dark surface material, and are likely skylight openings into subsurface cavernous openings. ... Thermal infrared data suggests temperatures inside these features that remain constant throughout each diurnal cycle." The temperatures inside these

caverns are warmer at night and cooler during the day than surface temperatures, properties consistent with subterranean caverns, especially on Mars where surface temperatures would fluctuate widely due to the thin atmosphere."

Although these images and stories have generated both excitement and speculation, we think the most likely explanation for their origin is one suggested by reading a Space Daily news story about vast water deposits near volcanoes on Mars at http://www.spacedaily.com/news/mars-water-00b.html. If thick layers of ice form on the sides of volcanoes, and a later eruption sends lava flowing down the slopes, the lava is likely to harden before a thick ice layer can be completely melted. If the ice later sublimates over geological time, it will leave vast caverns under the solidified lava surface.

"Violent history of Mars" video

The video accompanying our last issue has proved very popular. Since it was first posted, we have improved the sound track. Soon, the text boxes will be replaced with a voice-over explanation. Check back soon to view and hear the latest version. Interest in it has also been expressed by a production company working on a new science series. We'll let you know if that matures into an appearance on TV. To go directly to the video, click http://metaresearch.org/media%20and%20links/animations/violentmars.wmv for the full-screen version or http://metaresearch.org/media%20and%20links/animations/violentmars_small.wmv for the small screen version.

ESA comments on "horn" on Cydonia Face image

Our 2006 September 15 issue (http://metaresearch.org/publications/bulletin/2006issues/0915/Mrb06c.asp) contained an article about the new 3-D stereo image of the Cydonia Face – the real image seen by the spacecraft and the "processed" one with selectively exaggerated vertical relief and a "horn" on the forehead that was released to the world media. Knowing that this image was obtained by the ESA *Mars Express* spacecraft, the Society for Planetary SETI Research (SPSR) asked ESA to comment. Lan Fleming, Dr. Mark Carlotto, and Dr. Horace Crater of SPSR wrote about this and finally received a reply from Prof. Dr. Gerhard Neukum of the ESA team. The discussion of problems with the media image and the complete response from ESA may be viewed at the "SPSR News" in the top-left corner sidebar link at http://spsr.utsi.edu/.

The article is titled "The Two Faces of ESA" and appears along with a reply letter by Dr. Neukum. The key sentence from that letter says: "we are also not convinced that the 'peak' exists in the way it appears in the second DTM." That would be a reference to the "horn" feature.

Stardust and the EPH – a letter from Michael Fisher

"In the December 15, 2006 issue of Science magazine are seven papers that present preliminary results from analysis of the particles from the coma of comet Wild 2 that were returned to earth by the *Stardust* mission. The papers are in a special section of issue 5806, accessible online at: http://www.sciencemag.org/content/vol314/issue5806/index.dtl.

"It seems to me that the reported results provide support the EPH, although there is no mention of the EPH in any of the articles.

"The introduction to the *Stardust* special section includes the statement '... many particles are mixtures of minerals, mostly silicates. The lack of amorphous grains is one surprise, because such grains are seen in interstellar space. Isotopically, the comet specs resemble rocks from the inner solar system; virtually no grains that pre-date the Sun were seen. A single grain contains minerals produced at high temperatures, in a region close to the Sun, and with isotope ratios similar to those of some meteorites. Thus, material has been mixed across the solar system, from the innermost portion to the outer regions of the Kuiper belt where this comet originated.'

"It seems to me that the EPH offers a far simpler explanation for these 'surprising' results: that the comet itself originated in the inner solar system, and was flung out to a cometary orbit by an explosion event (which also caused the isotopically similar meteorites to reach the earth)."

First well-confirmed observations of an occultation by an asteroid's satellite

From Dr. Mitsuru Soma, Japanese National Astronomical Observatory:

"The occultations by (22) Kalliope and its satellite Linus were observed in Japan at around 19:49 UT on 2006 Nov 7. As shown at http://uchukan.satsumasendai.jp/data/occult/0611Kalliope-red-E.gif, positive observations of the occultation by Kalliope were reported by eight observers so far, and those by Linus were made by six, and the observations are consistent with each other. The angular distance between Kalliope and Linus turned out to be 0.26 arcsec at the time of the occultation. The occultation by Linus was predicted by Dr. Jerome Berthier of IMCCE in France (whose prediction was brought to us by J. Lecacheux in France 19 hours before the event) and it turned out that the prediction was accurate within about 100 km. This is the first successful observation of an occultation by an asteroidal satellite known previously by other means.

"We hope that this will encourage more observers to monitor close appulses to try to find and confirm occultations by satellites of other asteroids.

"It was fortuitous that the path for the occultation by Linus passed over the outer western suburbs of Tokyo where several observers were ready to time it. At least one observer between the two shadow paths (for Kalliope and Linus) reported no occultation.

"Although Tsutomu Hayamizu is preparing an enlarged figure for Linus, you can see Takashi Setoguchi's figures (map and more detailed views) now at http://www7.ocn.ne.jp/~set/Unlink/Kalliope.html."

[Note by David Dunham: The very elongated outline of Linus in the figure on the above link is surely an artefact of the observations that probably have some timing errors, and not a good distribution across the object; it would be better to just fit a circle that would have a radius a little less than the major axis of the plotted ellipse since the observations aren't sufficient to determine the true ellipticity of Linus.]

"There is no need for any individual to have a computer in their home." – Ken Olson, 1977, President, Digital Equipment Corp.

General INFORMATION

Pertinent articles and discussion of published articles, especially those related to Meta Science, are welcome. The preferred format is Microsoft Word. Appropriateness for this Bulletin is at the discretion of the editor; but if accepted by referees, articles will be published without significant editing of content. A response by the editor or a referee may then also be published. The first author is shown any such response and offered the opportunity to adjust his contribution in the light of the response. If time permits, this process is iterated until all parties are satisfied. Until the publication deadline, authors have the option to defer publication to a later issue to complete this process.

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- Author-signed copies of the 1999 (2nd) edition of the Meta-Research-sponsored book *Dark Matter, Missing Planets and New Comets* by Tom Van Flandern, published by North Atlantic Books in Berkeley. Subject matter is the origin and nature of all things astronomical. $22.50+S&H
- *Pushing Gravity: New Perspectives on Le Sage's Theory of Gravitation*, M. Edwards, ed., published by C. Roy Keys Inc. in Montreal. Subject matter is the fundamental nature of gravitation and its physical mechanism. $25+S&H
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- A CD containing all 15 MRB volumes (60 issues) from 1992-2006 is also planned, and will be announced at a later date.

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The name "Meta" (pronounced with a short "e") comes from the dictionary meaning of that prefix: "later or more highly organized or specialized form of; more comprehensive; transcending; used with the name of a discipline to designate a new but related discipline designed to deal critically with the original one."

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Our office hours are 9 a.m. to 6 p.m. Pacific Time. Our expeditions are led by Meta Research astronomers. For eclipses, we go to near the edge of the path of totality, where the view is most spectacular. Plans for future expeditions are on hold. Check the "Expeditions" tab at our web site or go directly to <http://eclipseedge.org> to learn of such plans, which may develop on short notice because of unexpected astronomical developments.

AUTHOR INFORMATION

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