

optical illusion.<sup>14</sup> Is the Mars "face" just another example of the human brain's extraordinary capacity to make sense out of random patterns and to fill in details with the aid of imagination and fantasy? Planetary scientist and Mars expert Harold Masursky gives the best answer to this question.<sup>1</sup> Quipped Masursky of the Mars "face": "This is the guy that built all of Lowell's canals."

### Acknowledgements

I would like to thank Emory Kimbrough for his astute comments and suggestions on this final draft.

### References

1. J. Eberhart, "Viking: a lively look for life," *Science News* **110**, No. 10, 1976, 84-86.
2. G.A. Soffen, "Life on Mars?" In J.K. Beatty, B.O'Leary, and A. Chaikin (eds.), *The New Solar System*, Sky Publishing Corp., Cambridge, Mass., 1981, 93-96.
3. C. Snyder, "Mars face, touted to investors, draws vigorous scientific reply," *Skeptical Inquirer* **12**, 1988, 340-343.
4. V. DiPietro and G. Molenaar, *Unusual Martian Surface Features*, Mars Research, Glenn Dale, Md., 1982.
5. M. Gardner, "The Great Stone Face and other non-mysteries," *Skeptical Inquirer* **10**, 1985, 14-18.
6. F. Golden, "Facing up to Mars," *Discover* **6**, No. 4, 1985, 92.
7. R. Hoagland, *The monuments of Mars*, North Atlantic, Berkeley, Calif., 1987.
8. M.J. Carlotto, "Digital imagery analysis of unusual Martian surface features," *Applied Optics* **27**, No. 10, 1926-1933.
9. J. Muller, "Wishful seeing," *Skeptical Inquirer* **11**, 1987, 296-297.
10. W.J. Kaufmann III, *Universe* (2nd ed.), W.H. Freeman, New York, N.Y., 1988, p. 607.
11. R. Pozos (ed.) "The face on Mars: evidence for a lost civilization?" Chicago Review Press, Chicago, Ill., 1986.
12. M. Mueller, "The Shroud of Turin: a critical appraisal," *Skeptical Inquirer* **6**, 1982, 15-34.
13. J. Nickell, "Unshrouding a mystery: Science, pseudoscience and the cloth of Turin," *Skeptical Inquirer* **13**, 1989, 296.
14. W.J. Kaufmann, III, *Universe* (2nd edition), W.H. Freeman, New York, N.Y., 1988, 224-225.

**Richard A. Crowe** is assistant professor with the Department of Physics and Astronomy, University of Hawaii at Hilo.

# The "Face on Mars": Summary of Image processing results

The "Face on Mars" has been the subject of a small and unusual debate for over 10 years. Initially dismissed by NASA as a trick of light and shadow when it was imaged by a Viking Orbiter in 1976, the "face" was rediscovered by DiPietro and Molenaar<sup>1</sup> several years later. A series of independent investigations<sup>2,3,4</sup> followed, which have prompted curious reactions from the planetary science community. The accompanying article by Crowe<sup>5</sup> states a view expressed by many in that community that the "face," along with several other nearby objects, are naturally occurring geological formations. This view is based on one or more of the following arguments:

- The human mind can see faces in just about anything, so one should not be surprised to find one on Mars;
- The development of a technological civilization capable of creating such objects is inconsistent with current theories about Mars, so they should not be there, or alternatively, consideration of an extraterrestrial origin is pure speculation;
- The "experts" have already examined the data and concluded the objects are completely natural.

PART  
TWO  
BY  
MARK  
J.  
CARLOTTO

... the sophisticated imaging analysis is not relevant because to conclude that the feature may not be natural still requires a so-called "leap of faith."



The present forum is not the place to debate a psychological phenomenon or the philosophical/scientific basis behind the search for extraterrestrial intelligence (SETI). However, the last argument deserves some comment, as it strikes me as somewhat premature. In the remainder of this article, I would like to summarize some of the image processing results obtained to date—results that suggest the question is far from resolved.

Figure 1 (all figures on pages 24-25) shows the "Face on Mars" along with the several other nearby objects (termed the "city"\*) that include a triangularly-shaped formation (the "fortress") and one of the five-sided pyramids that have been observed in this region. Whether it is natural or artificial, the "face" is interesting as an optical phenomena in that it retains its appearance over a wide range of illumination conditions and from a variety of perspectives<sup>7,8</sup> (Figure 2). This is not the case for often-cited terrestrial analogs like New Hampshire's naturally-formed Old Man of the Mountain, presented in Figure 3 for comparison. Also shown (Figure 4) is a digitally enhanced and magnified image of the "face" from one of the later low-resolution morning views (753A34). It is difficult to draw any real conclusions about the symmetry of the "face" from such a photograph.

The Martian Face is also interesting from a geological standpoint. Quantitative analysis of terrestrial landscapes has shown that fractals are good models for the structure of terrain. The metric properties of fractal surfaces follow power-law relations over some range of scales.\*\* Using an algorithm that measures the deviation from such behavior on a local basis (originally developed to detect man-made objects in aerial photographs), an analysis of five Viking frames (35A70-35A74) revealed the "face" to be the least fractal (and, one could conclude, the least natural) object within that area, which is over 15,000 sq. km. in size.<sup>9</sup> Close up, a detailed examination of the "face" reveals subtle features such as broad lateral strips across the object, crossed symmetrical lines in the "forehead" area, and fine structure in the "mouth"—features that one would not expect to find in a naturally-formed mesa (Figure 5).

The origin of the "face" cannot be decided on the basis of the available data. I do believe, however, that the image processing results summarized here justify a closer look by

the Mars Observer, scheduled for launch in 1992. Ultimately, the question can be resolved one way or the other by purely *technical* means. Given the potential impact of this phenomena on our culture, the collection of a few high resolution photographs of the "face" and other nearby objects should be among the top imaging priorities for the Mars Observer.

## References

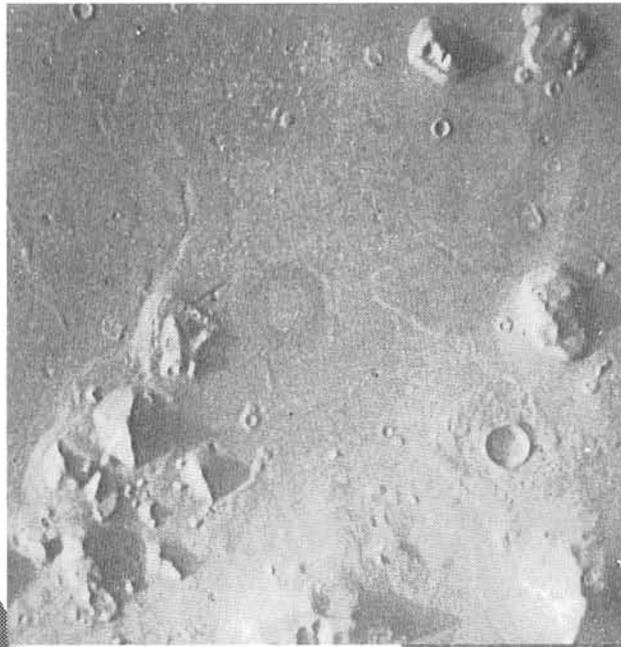
1. V. DiPietro and G. Molenaar, "Unusual Martian surface features," presented at 156th Meeting of the American Astronomical Society, June 15-18, 1980, College Park, Md, abstract in *Bulletin of the American Astronomical Society*, 12, No. 2, 1980.
2. W. Beatty, *et al.*, "The preliminary findings of the Independent Mars Investigation Team: New thoughts on unusual surface features," presented at *The Case for Mars II* conference, July 10-14, 1984, Boulder, Colo.
3. R. Pozos, *The Face on Mars: Evidence for a Lost Civilization?*, Chicago Review Press, Chicago, Ill, 1986.
4. R. Hoagland, *The Monuments of Mars*, North Atlantic Books, Berkeley, Calif., 1987.
5. R. Crowe, "The return of the Martian canal-builders," *Opt. & Phot. News* 2, June 1991, 20-22.
6. M. Carlotto and K. Hartt, "Connection machine system for planetary terrain reconstruction and visualization," *SPIE Symposium on Advances in Intelligent Robotics Systems* 1192, Nov. 5-10, 1989, Philadelphia, Pa.
7. M. Carlotto, "Digital imagery analysis of unusual Martian surface features," *Applied Optics*, 27, 1988, 1926-1933.
8. B. O'Leary, "Analysis of images of the Face on Mars and possible intelligent origin," *Journal of the British Interplanetary Society* 43, 1990, 203-208.
9. M. Carlotto and M. Stein, "A method for searching for artificial objects on planetary surfaces," *Journal of the British Interplanetary Society* 43, 1990, 209-216.

"Whether it is natural or artificial, the 'face' is interesting as an optical phenomena . . ."

\*In this article, terms such as the "city" and "fortress" are used only to refer to the objects themselves—there is no intention to suggest what their function, if any, might be.

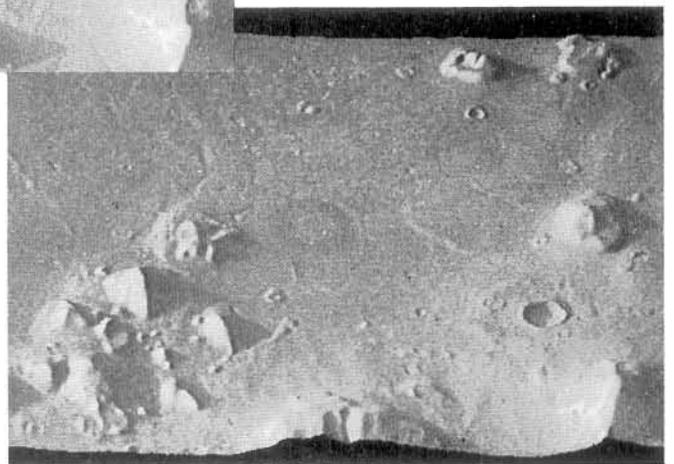
\*\*For example, the standard deviation of the difference in height between two points a distance  $r$  apart for some range of  $r$  is proportional to  $r^{3-D}$ , where  $D$  is the fractal dimension and is related to the roughness of the landscape.

**M.J. Carlotto** heads an image processing/artificial intelligence R&D group at TASC in Reading, Mass.

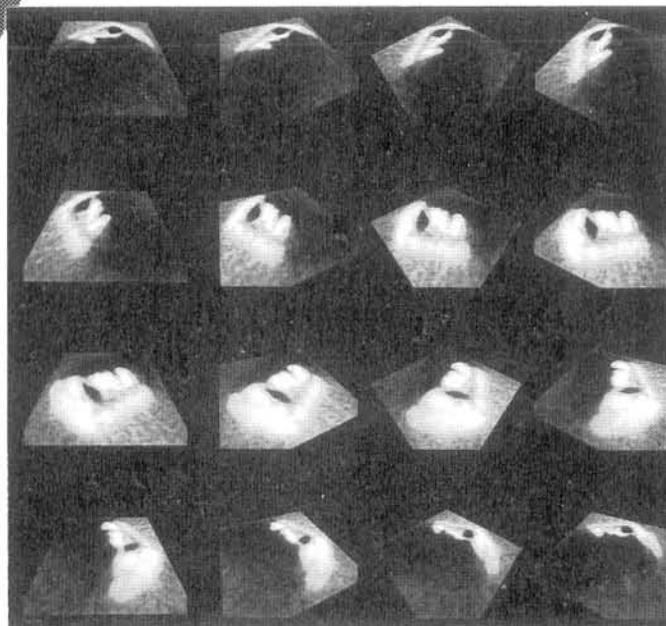


**FIGURE ONE**

The "Face on Mars" and nearby objects shown from above in a digitally restored and enhanced image from Viking Orbiter frame 35A72 (top) and from a point 30° above the southwest horizon in a synthetic image perspective view<sup>6</sup> (bottom).

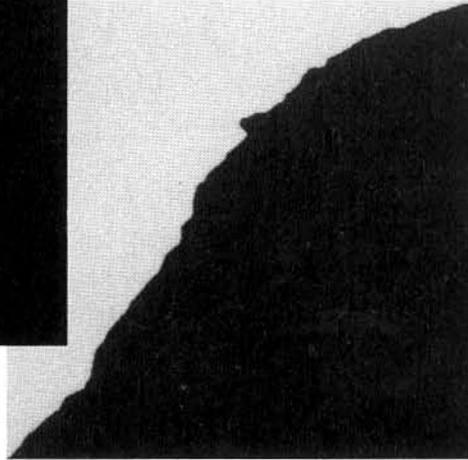


"The origin of the 'face' cannot be decided on the basis of the available data."



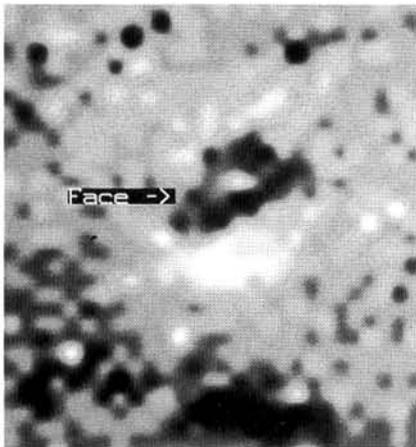
**FIGURE TWO**

Perspective views from around the "face." Three-dimensional relief determined by the method of shape-from-shading. Detail on the right side of the "face" is limited due to shadowing.



**FIGURE THREE**

Two views of New Hampshire's Old Man of the Mountain— one from the tourist area, the other from a short distance away as the illusion disappears.



**FIGURE FOUR**

Lower resolution image of the "face" in morning light [753A34] taken later in the mission when the spacecraft was about five times farther away from the planet.



**FIGURE FIVE**

Local contrast enhancements of the "face" from 35A72 and 70A13. Note subtle detail present in both images.