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The Face on Mars

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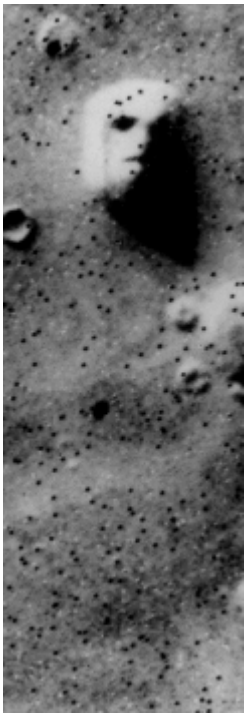


The "Face" on Mars
(Courtesy NASA_

The planet Mars has intrigued humans since we first began to study the sky. It is the only planet that looks red to the naked eye, which may explain why the ancient Greeks and Romans associated it with the bloody god of war. Spacecraft that visited Mars in the 1960s and 1970s found a freezing, arid, dead world. Nevertheless, the idea of life on Mars, and, in particular, intelligent life on Mars, fed by years of science fiction stories, persists in the public mind, despite the weight of scientific evidence against it.

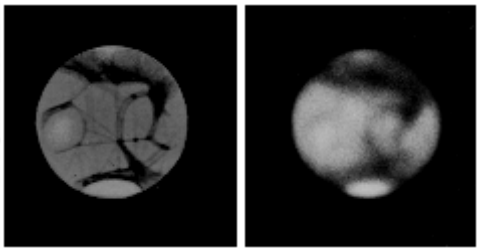
This myth has surfaced again in the so-called "Face on Mars,'' a rock outcropping that looks like a human face when lit from the side. Astronomers see it as a mere optical illusion, proof of the power of human imagination. But a few, very vocal individuals see it as proof of an ancient Martian civilization. Some of them even go so far as to accuse NASA of deliberately destroying the billion-dollar *Mars Observer* spacecraft at the end of August to keep from having to admit that the Face is "real.'' Such extraordinary claims require extraordinary proof, which is sorely lacking in this case. But the Face on Mars is not the first time humans have been misled about evidence for life on our neighboring planet.

The Martian Canals

When early astronomers trained their crude telescopes on Mars, they could see few details of its surface beyond some dark patches and white polar caps. In some ways, the mysterious planet seemed tantalizingly like Earth. A Martian day is only 37 minutes longer than one on Earth. Mars' equator is tilted relative to the plane of its orbit around the Sun by almost the same amount as the Earth's, which gives Mars, like Earth, seasons. And the ice caps on its north and south poles wax and wane with the seasons. By the 1800s, Mars seemed enough like Earth that astronomers and science fiction writers began to dream of a Mars populated with intelligent, alien beings.

In 1877, Mars came within 56 million kilometers (35 million miles) of Earth, about as close as it ever gets (because its orbit is somewhat elongated, its distance at closest approach to Earth varies from year to year). Taking advantage of the close range, American astronomer Asaph Hall discovered two moons circling Mars.

Other astronomers strained to learn as much as they could about the red planet. Using the 8-and-3/4-inch refracting telescope at the Brera Observatory in Milan, Italian astronomer Giovanni Schiaparelli reported seeing a network of very fine, regular lines crisscrossing the reddish deserts of Mars. He called them *canali*, which means "channels'' or "grooves,'' but the word was translated into English as "canals.'' Given the limited understanding of the Martian atmosphere and climate at the time, and the known similarities to Earth, many people jumped to the conclusion that Schiaparelli's canals had been constructed by intelligent beings.



Left: Drawing of Mars, done on October 11, 1916, showing "canals'' seen by an astronomer looking through a telescope. Right: Photograph of the Red Planet taken the next evening. (Courtesy Lowell Observatory)

Percival Lowell, a successful Boston businessman, was so captivated by this idea, that, in 1893, he built a major observatory in the clear skies of Flagstaff, Arizona to study the Martian canals (a great deal of other research has since been done at the Lowell Observatory, including the discovery of Pluto). Lowell was convinced that intelligent Martians had built a network of canals to pump water from the melting ice caps to dying cities in the desert.

Not all astronomers believed in the canals. In fact, many famous astronomers never saw them, including Asaph Hall. Those who did see canals rarely agreed on their locations and intensities; some said they were broad, diffuse stripes, while others maintained they had a thin, spider-web appearance. As time went on and more was learned about the red planet, astronomers realized that Mars was too cold and its atmosphere too thin for liquid water to exist on its surface. In 1971, the *Mariner* 9 spacecraft sent back to Earth the first really good, high-resolution maps of the planet. Absolutely no canals were seen, and the volcanoes, valleys and craters that were mapped didn't correspond to any feature seen by Lowell.

It turned out there never were any canals on Mars. When straining to look at things that are barely visible, the human eye tends to join faint but distinct markings together. That's what happened to the astronomers struggling to learn more about the surface of Mars. The Martian canals say more about human perception and imagination than anything else. As Carl Sagan said in *Cosmos*, "Lowell always said the regularity of the canals was an unmistakable sign that they were of intelligent origin. This is certainly true. The only unresolved question was which side of the telescope the intelligence was on."

The Face on Mars

A similar statement can be made about the Face on Mars. In 1976 two unmanned *Viking* spacecraft went into orbit around Mars. Each sent a lander down to the surface, while the orbiters radioed back over 60,000 photographs of the Martian surface. Not long after the orbiters began their mission, *Viking* scientists noticed a picture of a squarish, mile-long low hill or mesa in the Cydonia region of Mars that looked sort of like a face. They released the image to the press as a sort of joke, an example of our tendency to see apparently familiar shapes in complex landscapes. The researchers and the press recognized the Face as an unusual rock formation created by weathering. The dramatic low angle of late-afternoon lighting in the photo made the outcropping look like a face.

Three years later, two computer scientists with no particular expertise in Martian geology working for a contractor at NASA came across the image while going through the *Viking* photo archives. They experimented with some image-enhancement programs and concluded that the Face did not occur naturally. They also noticed several "pyramids'' near the Face, and published a book calling attention to the structures.

In the 1980s, Richard Hoagland, a science journalist, took up the cause of the Face on Mars in several books and numerous radio and TV appearances. In the scattered hills of Cydonia, Hoagland sees evidence of a

ruined "city'' and "fort.'' He claims the city and the Face are aligned in a way that may have, in the manner of Stonehenge, pointed to the place where the sun rose on the Martian solstice half a million years ago (which Hoagland takes to be when the Face was made), although the orientation has no meaning today. Clearly, to Hoagland, this region of Mars is the result of a gigantic construction project by intelligent beings.

But who were they? And why does the Face look human? Hoagland has several theories. Perhaps evolution worked the same way on Mars as it did on Earth and so the Martians looked human. Or maybe a previously unknown, technologically advanced civilization from Earth's distant past traveled to Mars (or, alternatively, an advanced Martian civilization came to Earth long ago, and we look like them). Or perhaps the Face was built by some sophisticated extraterrestrials from beyond the solar system as a signal (or test) for us when we had reached a certain stage of technological evolution (rather like the black monolith in the movie *2001: A Space Odyssey*).

The Face on Mars

Is the Face Real?

Certainly the rock outcropping on Mars is suggestive of a human face. But that doesn't mean it is a monument deliberately constructed to look like a face. According to psychologists, the human visual system is organized to look for familiar features in random patterns. And there is a particularly strong human tendency to see faces given minimal details. For example, people all over the world see the face of a man when they look at the Moon (others see a rabbit in the Moon). We see animals and human faces in clouds. In New Hampshire, the face of the "Old Man of the Mountain'' gazes impassively out from the side of a cliff. If you look on the left and right sides of the maple leaf on the Canadian flag, you can see the faces of two people arguing with one another. We've all seen people in the news or on TV talk shows who have found vegetables or potato chips that look like famous people. Another *Viking* image shows a Martian crater with what looks like a smiling "happy face'' inside. No one thinks any of these were deliberately created, so why should the Face on Mars be any different?

What about the "pyramids'' near the Face on Mars? There are a number of small mountains on Mars that resemble pyramids, both in Cydonia and another region called Elysium. Geologists who specialize in desert landscapes are quite familiar with similar wind-sculpted formations here on Earth, for example, in the deserts of Arizona. The "city'' on Mars is a cluster of these pyramid-shaped mountains, the biggest a few kilometers at the base, all oriented in the same direction. Carl Sagan has noted that similar formations, called *dreikanters*, from a German word meaning three sides, are seen in Antarctica. Strong winds blowing from mostly the same direction over many years turn what were once irregular bumps into nicely symmetrical pyramids. Dreikanters are small, only about knee-high, while the Martian "pyramids'' are much taller. But winds on Mars are much fiercer than those on Earth, with wind speeds that can reach half the speed of sound, and it is not unreasonable to suggest that dust storms blown by these strong winds could sculpt larger versions of dreikanters.

Several of the Martian "pyramids'' appear highly eroded, and distinctly non-symmetrical. Proponents of the Face on Mars suggest that they were "damaged,'' perhaps during some kind of Martian war. Skeptics take this as further evidence that wind erosion produced the structures. The Cydonia region of Mars is dotted with many low hills that have been molded into odd shapes, perhaps by a combination of ancient mudflows and wind erosion. The Face on Mars seems to have been created in the same way as these features, even though they don't look like anything in particular.

The original *Viking* photograph of the Face on Mars is riddled with black dots. These dots correspond to areas where data was lost during the transmission of the picture from the *Viking* orbiter to Earth (such transmission losses are common given the problems of communicating with spacecraft over interplanetary distances). If we look carefully at the original image, we see that a black dot of lost data happens to fall right about where we would expect to see a "nostril'' on the Face. This makes the rock look even more like a face, but doesn't correspond to any real feature on the Martian surface.

This Martian impact crater looks like the largest known "Happy Face'' in the solar system. The smiling mouth and eyes were formed by fractures caused by the original meteor impact. The main crater is about eight kilometers (five miles) across. (Courtesy NASA)

The "Old Man of the Mountain'' in the White Mountains of New Hampshire looks like a face when viewed from the side. (Courtesy Dick Hamilton Photo, White Mountain News Bureau)

"Pyramids'' in the Cydonia region of Mars, were most likely sculpted by wind erosion. (Courtesy NASA)

Scientists take great care when interpreting images sent back by spacecraft. When confronted with an alien landscape, it is easy to see what you want or expect to see, not necessarily what is really there. Similar care is needed when interpreting enhanced images. There is only so much information that a picture contains. Image processing or image enhancement will bring out details that were present in the original picture, although not obvious. If you process an image too much, you run the risk that things will appear in the enhanced picture that were not present in the original; such things cannot be believed. This is an issue that astronomers constantly struggle with, given today's emphasis on electronic detectors and computer processing in astronomical research. But it is an issue that is rarely adequately addressed by proponents of the Face on Mars, who depend on enhanced images to back up some of their claims. For example, early proponents claimed to see a "honeycomb'' structure on the Martian surface, which they took to be a complex of rooms. Later, the honeycomb was shown to be an artifact of the computer image processing, and not something that was present in the original images. Still, some proponents continue to cite the honeycombs as evidence of a Martian civilization.

And what about the reported alignments of the pyramids and the Face? In order for the alignment to work, Mars' equator would have to be tilted 17.3 degrees relative to the plane of its orbit around the Sun (it is now tipped 24 degrees). It is possible that Mars at one time had such a tilt. But, in this case, there are so many possible variations, with so little to restrict them, that random chance would no doubt produce some apparent alignments. Given that proponents had the freedom to choose any of a number of solar or celestial alignments, any time since the beginning of the solar system, and to move the planet any amount to fit an alignment, the fact that one can be found is not proof that it was intended.

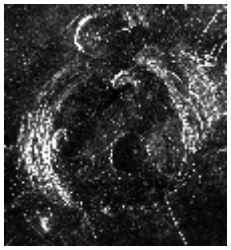
Hoagland has recently taken his analysis of this and other alleged alignments several steps further. He now claims that encoded within the alignments are mathematical constants that reveal information about a "new physics.'' The beings who built the Face and pyramids are trying to tell the universe about this new physics, he says, which includes the potential for an almost limitless source of energy. According to Hoagland, similar constants can be discerned in the so-called "crop circles'' that appeared in English grain fields over the past several years. Such fantastic claims test the credulity of even those who want to believe in the Face on Mars.

Extraordinary Claims Require Extraordinary Proof

The *Viking* orbiters took only a few images that show the Face on Mars. The pictures are of such low resolution and poor quality that they cannot prove conclusively one way or the other whether the Face on Mars is naturally occurring or artificial. One of the guiding principles of scientists is that simple, straightforward explanations of phenomena are more likely to be correct than complicated, convoluted ones. This principle, known as *Occam's razor* (after the fourteenth century English philosopher, William of Occam, who first proposed it; razor is used in the sense of shaving an argument to its simplest terms), means that if two hypotheses fit the observations equally well, the one that makes the fewest assumptions should be chosen.

Applying Occam's razor to the Face on Mars, we ask which is the simpler explanation: that wind erosion, over millions of years, molded a low hill into a shape that happens to resemble a human face when lit from the side, in the same way that it molded many other odd shapes in the same area; or that technologically

advanced, intelligent aliens, who may or may not have looked like us and who left no other evidence of their existence, created a gigantic monument with a human face for an unknown reason? If we can explain the Face on Mars as the product of well understood geological processes that we know occur elsewhere on the planet, why do we need to invoke unknown alien beings working in an unknown way for unknown reasons to explain it? Out of the 150,000,000-square-kilometer total surface area of Mars, is it so surprising that a tiny one-square-kilometer-sized area looks a little funny?



Fotla Corona, an oval-shaped volcanic feature on Venus, looks rather like the muppet Miss Piggy, minus one ear. A corona is thought to form when a large blob of hot magma rose, created a large bulge or dome in the surface and then sank, collapsing the dome and leaving a ring that looks like a "fallen souffle.'' This feature is 200 kilometers (120 miles) in diameter. The ear and eyes are actually flat-topped volcanic features called "pancake domes.''

This unusual lava flow pattern resembles the muppet Kermit the Frog. It lies on the flank of Alba Patera, a large volcano in the northern hemisphere of Mars. A small impact crater in the flow looks like an eye. (Courtesy NASA)

Mars is a fascinating planet. Its huge volcanoes dwarf those on Earth. Along its equator, a gigantic chasm stretches so far that, on Earth, it would span the entire United States. Perhaps most intriguing are what look like dry river channels that snake across the Martian deserts. Although liquid water cannot exist on the surface of Mars now, evidently some time in the past the atmosphere was thick enough and the temperatures warm enough for pools of water, rivers, rain and floods to scour the Martian surface. The reality of Mars is exciting enough; we don't need artificially created monuments to manufacture interest in the red planet.

We should always remain skeptical of outrageous stories like that of the Face on Mars, unless there is unquestionable evidence to back them up. Like the Rorschach ink blot tests that psychologists use to probe a person's psyche, claims about the Face on Mars tell us more about humanity's desire not to be alone in the universe than about Martian geology.

There is another region on Mars that looks like Kermit the Frog. On the planet Venus, there is a volcanic feature that resembles the face of Miss Piggy (minus one ear). Taken together, and using the same logic as proponents of the Face on Mars, these two features would seem to prove that there once was a group of intelligent aliens who traveled from planet to planet, and worshipped Muppets! Most people would agree that is just a little absurd.

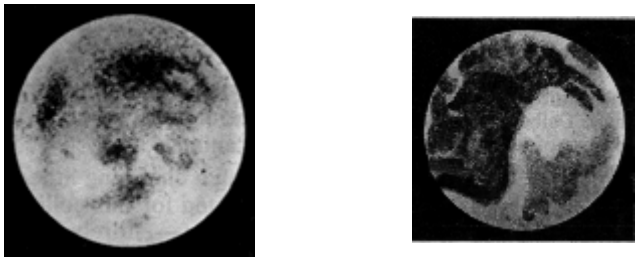
The Face on Mars

Activities in the Classroom

Looking for patterns: The Man on the Moon

If you go out tonight and look up at the full Moon, and you're like most people, you'll probably see the face of a man, or, alternatively, a rabbit superimposed on the bright disk of the Moon. Yet if you were to look through even a small telescope at the full Moon, or at a photograph of it, you probably wouldn't see either thing. Why is that? The human tendency to see familiar shapes in random patterns of light and dark no doubt comes into play, especially given the blurring effects of turbulence in the Earth's atmosphere. Telescopic images and photographs contain enough sharp detail that your mind no longer needs to try to make sense out of the random patterns it sees by looking for familiar shapes.

Have your students make sketches of the full Moon while they are at home. Ask them to draw something like a first impression, a quick sketch that focuses mainly on the outlines of the dark maria, or lava plains on the lunar surface. Compare the sketches with a photograph of the Moon. Discuss what the sketches look like. How many look like a rabbit? How many like the Man in the Moon? How many like something else? Finally discuss whether there really is a rabbit or a giant face on the Moon.



When people look at the full Moon, they often see either a Man in the Moon (left) or a rabbit in the Moon (right). (Courtesy American Museum of Natural History)

Faces, Faces Everywhere

The Face on Mars is a naturally occurring rock outcropping that just happens to look like a face when lit from the side. Where else can you see naturally occurring objects that look like a face? Show your students pictures of clouds, tree bark, rock formations, or any other picture with a fairly complex structure to it, and have them look for faces or shapes of different animals in them. See how many different faces or animals students can find in the same picture. Also notice how once one student points out a face or animal, it is sometimes hard to see any other shape. You can also have the students draw a page of random, squiggly lines. Then have them see how little (or how much) it takes to turn parts of the "squiggles'' into recognizable shapes.

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What Happened to Mars Observer?

On Saturday, August 21, 1993, NASA mission controllers lost contact with the *Mars Observer* spacecraft, one day before it was to enter orbit around Mars and begin a three-year mission to survey and study the Red Planet. Communication was lost after ground controllers had radioed commands to pressurize its fuel tanks in preparation of rocket firings to slow the spacecraft down and allow it to be captured by Mars' gravity.

Initially there was speculation that a problem with the pressurization may have caused the fuel to leak, making the spacecraft tumble out of control, or even explode. After a few days of silence, a second theory emerged: a pair of electronic transistors in *Mars Observer*'s master clock, the timekeeper for most of the craft's computers, may have failed, disabling the spacecraft. Researchers found a similar problem in the master clock of the *NOAA*-3 weather satellite before its launch last June. The faulty transistors were from the same manufacturing batch as those aboard *Mars Observer*. The transistors on the weather satellite were replaced before launch, but *Mars Observer* was already on its way to Mars when the problem was discovered. A NASA task force investigating the cause of the loss of *Mars Observer* should release its findings around Thanksgiving of this year.

What about other missions to Mars? The *Mars Environmental Survey* (*MESUR*) will include a network of a dozen or more landers. Each lander will have a small mobile robot to explore the Martian surface. The first lander in the network, *MESUR Pathfinder*, is scheduled for launch by NASA in 1996 (to arrive at Mars in 1997). The *MESUR*missions are not dependent on results from *Mars Observer*, and thus should not be effected by its loss.

On the other hand, two planned Russian missions to Mars, *Mars 94* and *Mars 96*, had hoped to use the *Mars Observer* orbiter to relay data from a Russian lander (in the case of *Mars 94*) and atmospheric balloon (for *Mars 96*) to their orbiters farther away from the planet. At this time it is unclear what effect the loss of *Mars Observer* will have on these missions. NASA scientists are also looking into the possibility of creating a new spacecraft to replace *Mars Observer*, using parts scavenged from other missions. But this replacement won't be ready until November 1996, at the earliest.

Viking's Search for Life

On July 20, 1976, exactly seven years after the first manned landing on the Moon, the robotic *Viking* 1 lander safely touched down on the surface of Mars in a plain called Chryse. Two months later, a sister ship, *Viking* 2, also landed in a plain called Utopia. The two landers took thousands of pictures of the Martian surface and relayed millions of weather reports back to Earth.

The landers also carried miniature biological laboratories designed to perform three different tests for microorganisms in the Martian soil. The three tests were all based on the idea that living things alter their environment -- they eat, breathe, and give off waste products. In each test, the lander's long robotic arm scooped up some soil and put it in a closed container, with or without certain nutrients. The containers were then analyzed for changes in their contents, changes that could be attributed to biological processes. The three experiments were as follows:

- The *gas-exchange experiment* looked for evidence of what could broadly be called "respiration.'' The soil sample was placed into the container along with a controlled amount of gas and nutrients. Gases in the container were then monitored for any changes in their chemical composition.
- The *labeled-release experiment* looked for evidence of "metabolism.'' The soil sample was moistened with nutrients containing radioactive carbon atoms. Any organisms in the soil that "ate'' the carbon would give off gases containing radioactive carbon, which would be detected.
- The *pyrolytic-release experiment* looked for evidence of photosynthesis, the process by which plants on Earth convert carbon dioxide gas into organic compounds, using sunlight as an energy source. The soil

sample was placed in a container with radioactive carbon dioxide gas and exposed to an artificial light source. If photosynthesis occurred, some of the radioactive carbon would be incorporated into microorganisms in the soil.

A fourth instrument pulverized the soil to look for traces of organic matter.

In almost every case, rapid and extensive changes took place within the experimental containers. But later analyses showed that the activity could have been caused by ordinary chemical, not biological, reactions. It appears that Martian soil is much more chemically active than soil on Earth, perhaps because of its exposure to the Sun's ultraviolet radiation (due to the lack of a protective ozone layer in the Martian atmosphere). The organic experiment found no trace whatsoever of organic material, which was apparently killed by this same ultraviolet light.

The *Viking* experiments were sensitive enough that they would have easily detected signs of life anywhere on Earth, with the possible exception of Antarctica. While the possibility of life on present-day Mars has not been conclusively eliminated, it does not appear likely.