Mapping the Martian home of life evidence

A potato-sized meteorite hit the headlines this month when NASA scientists reported persuasive signs of ancient life in this fragment of Mars (SN: 8/10/96, p. 84). Astronomers believe that asteroid impacts on Mars threw the meteorite and others into space, and Nadine G. Barlow of the University of Central Florida in Orlando is pinpointing where the telltale rock originated.

Using clues from the meteorite's composition and structure, the planetary scientist winnowed its place of origin down to 2 out of 42,283 Mars impact craters in her computer database.

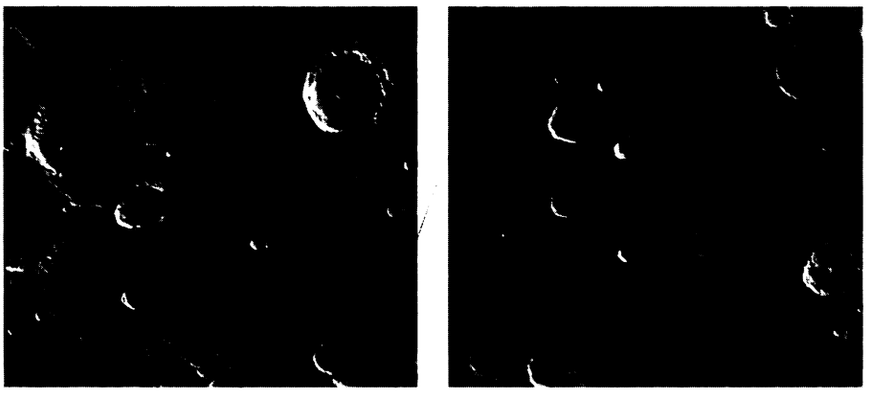
Barlow says the rock's 4.5-billion-year-old age indicates that it came from the impact-pitted highlands of the planet's southern hemisphere—the oldest terrain on Mars. Furthermore, microscopic signs of shock in the ancient rock reveal that the meterorite's home crater lay near or even atop an older, more eroded crater. Finally, laboratory test results place the asteroid impact on Mars at roughly 16 million years ago, clear evidence that the crater in question must be among the freshest visible on the planet.

Theoretical models indicate that an object 100 kilometers or larger striking Mars from straight above could have thrown the meteorite, ALH84001, off the face of the planet, but no large, round craters in Barlow's database fit the other requirements. Alternatively, a low-angle impact of a much smaller object, creating a distinctively elliptical crater, could have done the job.

Barlow was preparing to map the craters of origin for the 12 known Martian meteorites when the news broke about signs of life in one of them. So she focused on ALH84001. The 12 meteorites are considered to be Martian because their chemical signatures match readings taken by the Mars Viking landers in the late 1970s. Only ALH84001, however, is of sufficient age to date from a warmer, wetter, possibly life-supporting era 3.6 billion years ago, scientists say.

Barlow's most likely candidate lies in the Sinus Sabaeus region about 14° south of the Martian equator. The other candidate, smaller and less elliptical, is at 12°S in the Hesperia Planitia region.

The famous rock's origin is of great interest to scientists planning to use robots to collect samples during future missions to Mars, says Allan H. Treiman of the Lunar and Planetary Institute in Houston. Barlow, he adds, "far and away knows the Martian craters better than anyone." —*E. Skindrud*



Calvin J. Hamilton, Los Alamos National Lab./NASA

Sinus Sabaeus crater (left, arrow) is elliptical scar on lower rim of largest crater in this image. Note apparent water channel above the crater group. Hesperia Planitia candidate (right, arrow) shows a central peak at crater bottom.

Brain may make bright decisions early

Renaissance artists such as Rembrandt rendered a stunning but deceptive luminescence to the painted canvas by placing areas of light and dark pigment next to one another. For example, in one of the Dutch master's works, this effect—known as chiaroscuro—intensifies the apparent glow of sunlight streaming through a window while it deepens the perceived blackness of a room in which a philosopher meditates.

Scientists have now exploited this phenomenon to uncover evidence suggesting that, once visual information passes beyond the eyes, the brain immediately begins to interpret the brightness of surfaces based on light-dark contrasts, rather than solely calculating absolute levels of light.

At the very first stage of visual processing, brain cells transform signals from the retina into light perceptions that bear only an indirect relation to the pattern of illumination registered by the eye, assert neuroscientist Andrew F. Rossi of the National Institute of Mental Health (NIMH) in Bethesda, Md., and his colleagues.

Until recently, many scientists have classed neurons in the primary visual cortex as straightforward transmitters of simple visual information that play no role in the coordination of brightness, form, and color perceptions.

"Our results imply that information about surfaces, such as their brightness, is represented in the responses of the same neurons that are sensitive to [other visual characteristics]," Rossi's group contends in the Aug. 23 SCIENCE.

Rossi and his coworkers implanted electrodes into a section of the primary visual cortex of 20 awake, anesthetized cats. This allowed them to measure electrical responses of the same 160 neurons in each cat's brain.

Cats viewed on a computer screen a series of gray squares that differed in brightness. They then saw a gray square of fixed brightness displayed against a changing spectrum of light and dark backgrounds.

A large majority of the feline neurons tracked by Rossi's team showed the same electrical responses in the two trials to squares of equal perceived brightness, at least as judged by humans, rather than absolute brightness.

Although no data as yet demonstrate that cats experience a visual illusion similar to chiaroscuro, considerable similarities between cat and human visual systems suggest that the new findings apply to people as well, according to Rossi.

Moreover, he adds, the results complement studies conducted in the past several years showing that, in cats and monkeys, the perception of apparent motion, color contrasts, and surface colors also occurs in the primary visual cortex.

"Rossi's study indicates that once you move beyond the retina's photoreceptors into the earliest stages of visual processing, context effects such as the contrast between light and dark determine the perceived brightness of surfaces," asserts NIMH neuroscientist Robert Desimone.

A keen sensitivity to light-dark contrasts proves extremely useful, notes Thomas D. Albright of the Salk Institute for Biological Studies in San Diego in a commentary in SCIENCE. For instance, the shift from sunlight to shadow as the day progresses robs the world of absolute brightness, but contrasts of light to dark surfaces remain the same as dusk approaches, allowing individuals to maintain a constant perceptual portrait of their surroundings. —*B. Bower*