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# Imagining Other Worlds

MICHAEL CARROLL



Space artists help us visualize planets and moons that humans have only glimpsed.

**A GUST OF WIND** scatters grit across the rim of an ancient crater. In the distance, a dust devil reaches into a pink sky. The robotic rovers on Mars aren't there to witness the event, because the Red Planet is a hundred million kilometers away. This scene instead unfolds in Death Valley, California, before the eyes of a group of space artists.

In our modern age of robotic probes and orbiting observatories, we're constantly bombarded by fabulous images of alien worlds in our own solar system. In the midst of these electronic vistas, is there still room for space art? The answer is yes. Space artists can take us to vistas unseen by spacecraft or telescope, and can show us — on a human scale — what is only glimpsed by these spacecraft at ranges of hundreds or thousands of miles. In addition, artists translate non-visual science (radar imagery, magnetosphere measurements, and gravity fields) into a popular form that viewers can understand.

## Observation Informs Imagination

Space art has its roots in early painting movements such as the Hudson River School, where artists rendered fairly accurate images of natural landscapes. Painters Albert Bierstadt, Thomas Moran, and others traveled with surveying expeditions into the vast "unexplored" western regions of North America during the mid-19th century. Paintings by these artists helped convince Congress to establish the first national parks at Yellowstone and Yosemite. Bierstadt's and Moran's paintings of the new

Walter Myers envisions a variety of exotic flora and fauna dominating the landscape of a hypothetical life-bearing planet. He drew inspiration from Earth's crinoids (sea animals that resemble plants) and armored dinosaurs.

frontier have a direct parallel to the work of modern-day astronomical artists. While these past artists traveled with pack mule and Conestoga wagon, today's explorers are outfitted with circuit boards and solar panels. Robotic probes continue to return travelers' tales to a waiting world from a far more distant frontier. Perhaps humans will again do the same, as they did in the glory days of the Apollo lunar landings.

While the first space art can be found in ancient petroglyphs from the Americas to Australia, it wasn't until Galileo drew the Moon's surprisingly rugged surface that the seeds of modern space art were first planted. Before he trained his telescope heavenward, the lunar surface was thought to be a pristine sphere, reflecting the structure of the universe in harmony. Galileo's magnified views of the Moon were the earliest examples of space art that was informed and inspired by telescopic observations. The cratered wasteland Galileo depicted across



PHOTO OF DAVID A. HARDY BY FRANK HETTICK



*Above:* This original sketch by David A. Hardy shows a rift valley (graben) in Iceland where the Eurasian and North American tectonic plates are gradually pulling apart. *Below:* Similar graben are found on Mars, so Hardy later developed the Iceland sketch into this painting of a Martian scene, complete with a robotic exploration rover and looming dust storm.



his pages sent ripples through religious and scientific circles, forever changing our perception of the universe.

In the early 20th century, the French astronomer Lucien Rudaux foreshadowed the era of modern space art. Rudaux, an accomplished oil painter, attempted some of the first landscapes of other worlds. As the director of the Meudon Observatory outside of Paris, he had access to some of the best celestial views of the time. In the early 1900s, Rudaux painted remarkably realistic scenes of the Moon, Mars, and other planets, based on his observations at the eyepiece. They were among the first paintings to depict what it might be like to see these alien landscapes from their surfaces, putting the viewer directly on these strange worlds. They hold up well, even today.

The true father of modern space art, Chesley Bonestell, worked with rocket scientist Wernher von Braun to paint realistic scenes of people on other planets. His work for the book *The Exploration of Mars* (1956) depicted blue-skied Martian landscapes looking very much like the desert Southwest of the U.S., and eerily similar to the first images returned from NASA's Viking landers 20 years later. Bonestell's meticulous attention to detail and pursuit of realism in his art inspired the generation of scientists and engineers who made space exploration happen. Like Galileo's early Moon drawings, space art today actively challenges scientific paradigms while also reflecting today's scientific thinking.

### Space on Earth

One powerful tool available to astronomical artists is the study of planetary analogs. Like Bierstadt and Moran, today's space artists travel to remote sites across the globe — from Iceland to Death Valley — to study terrestrial landscapes that are geologically similar to those of other planets and moons. These travels not only inspire well-informed and convincing art, but also high adventures. "Since we can't visit the places we paint," says British artist David Hardy, "this is the next best thing."

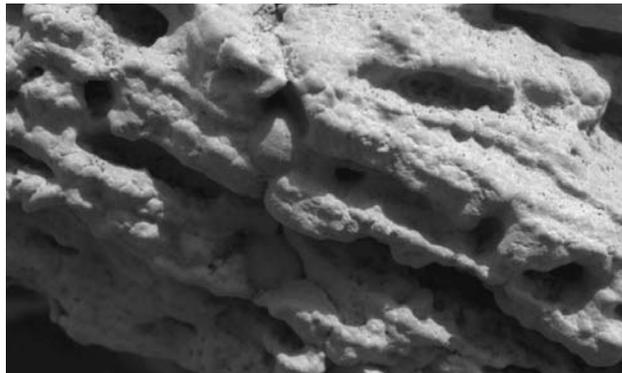
Some of the best planetary analogs stretch across Earth's deserts and arctic regions. NASA's Phoenix Mars mission recently returned images of polygonal ground patterns at its landing site in the northern arctic plains. This alien vista bears a striking resemblance to areas in Alaska and Siberia, where subsurface ice takes a geologic toll on tundra landscapes. Other places on the Red Planet, recently imaged by NASA's Mars Reconnaissance Orbiter, appear to contain rock glaciers similar to those found in the San Juan Mountains of Colorado. Images of shifting sand dunes returned from Mars resemble the landscapes of the Sahara Desert in Northern Africa. Terrestrial volcanic landscapes find their brethren on Venus, Mars, and even Jupiter's erupting moon Io.

As we venture farther into the outer solar system, ices become the dominant material, making ice analogs on



GAVIN MUNDY

*Above:* This location in Death Valley, California, was dubbed Mars Hill by members of the International Association of Astronomical Artists due to its resemblance to the Viking 1 landing site.



BOTTOM: MICHAEL CARROLL; TOP: NASA / JPL / CALTECH

*Top:* The Mars rover Opportunity captured this grayscale image of hematite globules called "blueberries" embedded in martian rock. *Above:* Similar water-related processes on Earth formed these hematite spheres in Utah, known as Moqui Marbles.





Earth more important. Glacial flows, sea ice, and ice-related geology all inform the space artist in renderings of distant moons and the frozen denizens of the Kuiper Belt.

Some of the finest Mars analogs are found in Iceland — the land of fire and ice. This island nation's unique geology is born of interactions between volcanism and glaciers. Some researchers propose that Martian volcanoes once erupted under thick ice sheets, giving rise to structures similar to the table mountains of Iceland.

Iceland has much more to offer the space artist. Its fresh volcanic structures find cousins on other terrestrial worlds. In addition to Mars's towering volcanoes, fully 90% of the surface features on Venus are volcanically related. NASA's Messenger spacecraft continues to return fresh data from Mercury, where lava flows appear to lap against some crater walls, and where potential volcanic vents have been recently identified. Earth's own Moon endured a volcanic era early in its evolution, blanketing vast regions under magma seas. Iceland's cinder cones

Texas artist Pat Rawlings envisions a martian landscape reminiscent of the desert buttes in the American Southwest. A massive dust storm and towering dust devils greet this fictional visitor from Earth.



To see more inspiring imagery from these and other space artists, visit the International Association of Astronomical Artists website at <http://iaaa.org>.

and lava fields played host to Apollo astronauts who trained there in preparation for the first Moon landings.

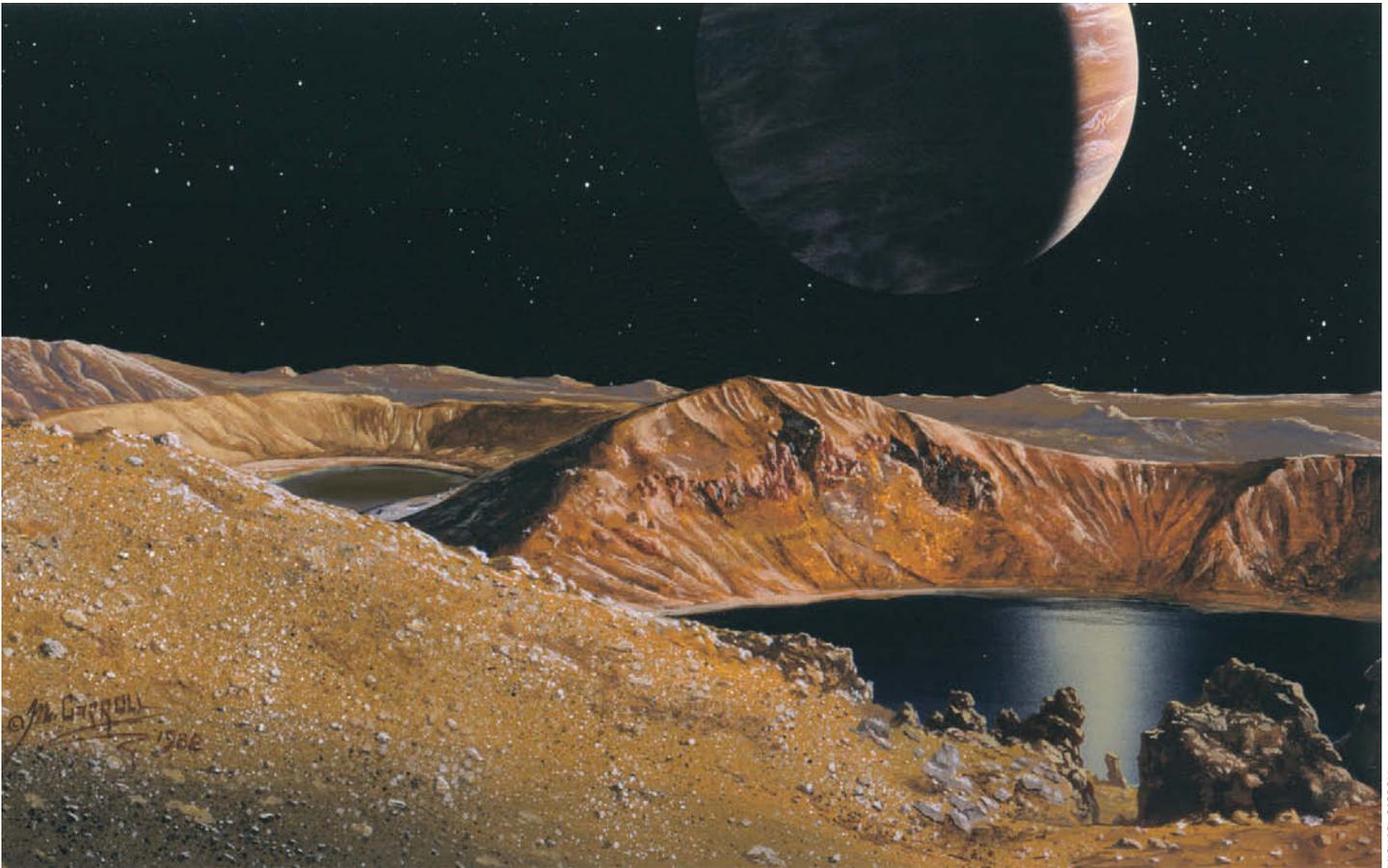
Geysers in Iceland and Yellowstone Park also have counterparts in the outer solar system. Though the mechanisms for these formations are different, their appearance may be quite similar on human scales. If humans can somehow survive Jupiter's radiation belts, travelers to Io will undoubtedly find familiar landscapes.

On location, space artists use a variety of reference materials. Cameras are a must, but sketching in nature provides many insights that photography cannot. The subtle play of light, the shifting of texture, and the visual impact of an environment can often be captured by the human eye more fully than by photographic means. These observations are put down in sketches and notes that will later inform the final artwork. Astronomer/artist William K. Hartmann paints his sketches in acrylics, while Hardy and Pamela Lee use pastels. Artists Joel Hagen and Marilyn Flynn often render information in colored pencil. Anil Rao and Paul Hoffman have embraced the age of digital technology and take laptop computers into the field, sketching in pixels.

Some environments provide quite specific lessons for the observer. A band of space artists recently journeyed to Utah's Escalante region in search of what the local population calls "Moqui Marbles," or Shaman Stones. These concretions are made of hematite, an iron-rich mineral usually formed in water. NASA sent the Mars Exploration Rover Opportunity to the Meridiani Plains to search for

## Pixel Painting

The digital realm has enhanced astronomical art in many ways. Much of the data from spacecraft is non-visual, but can be translated into visual scenes by the use of software. An example is NASA's Cassini mission, which is currently revealing the surface of Saturn's moon Titan with the use of infrared and radar systems. Artists interpret radar images, consulting with scientists, and transform Cassini data into a bit map. This artistically enhanced radar data can be fed directly into software programs such as *Terragen* ([www.planetside.co.uk](http://www.planetside.co.uk)), a fractal landscape program. Armed with this data, *Terragen* can generate accurate shorelines or mountain ranges. It is then up to the artist to create an accurate, convincing environment, complete with methane rains and liquid ethane ponds. Illustration by Steven Hobbs.



MICHAEL CARROLL

The volcanic region of Mývatn in Iceland served as the model for this view of Jupiter seen from its geologically active moon Io. From the moon's surface, Jupiter would appear as large as 39 Moons in Earth's sky.

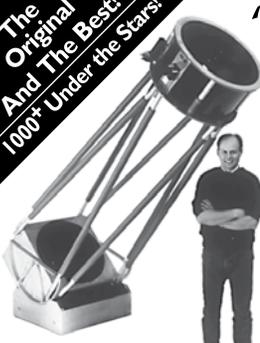
water's telltale signs, precisely because orbiters had detected hematite there. Sure enough, Opportunity found what mission planners have dubbed "blueberries," spheres of hematite eroding out of the rocks. Many geologists think that Escalante's Moqui Marbles represent a terrestrial parallel.

Painting in the field gives the space artist tools with which to render convincing — and accurate — landscapes of other worlds. Planetary orbiters and landers are designed to record scientific data to help us understand these enigmatic locales. Space artists put the viewer on the surfaces of distant worlds only hinted at

in mountains of data. The imagery they produce can inspire the next great push for human space exploration. ♦

*Science journalist, book author, and space artist Michael Carroll has a painting on the surface of Mars — in digital form — aboard the Phoenix Mars spacecraft.*

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### Art at the Telescope

The Moon is a fine subject for the fledgling space artist. At full phase, gray maria yield subtle tans and blues to the careful observer. As the Moon moves through its phases, the terminator provides the artist with a rich canvas of textures. Drawing the Moon through a small telescope or even good binoculars will teach you to see small-scale details often overlooked in a casual glance, and it will help inform your imagination.