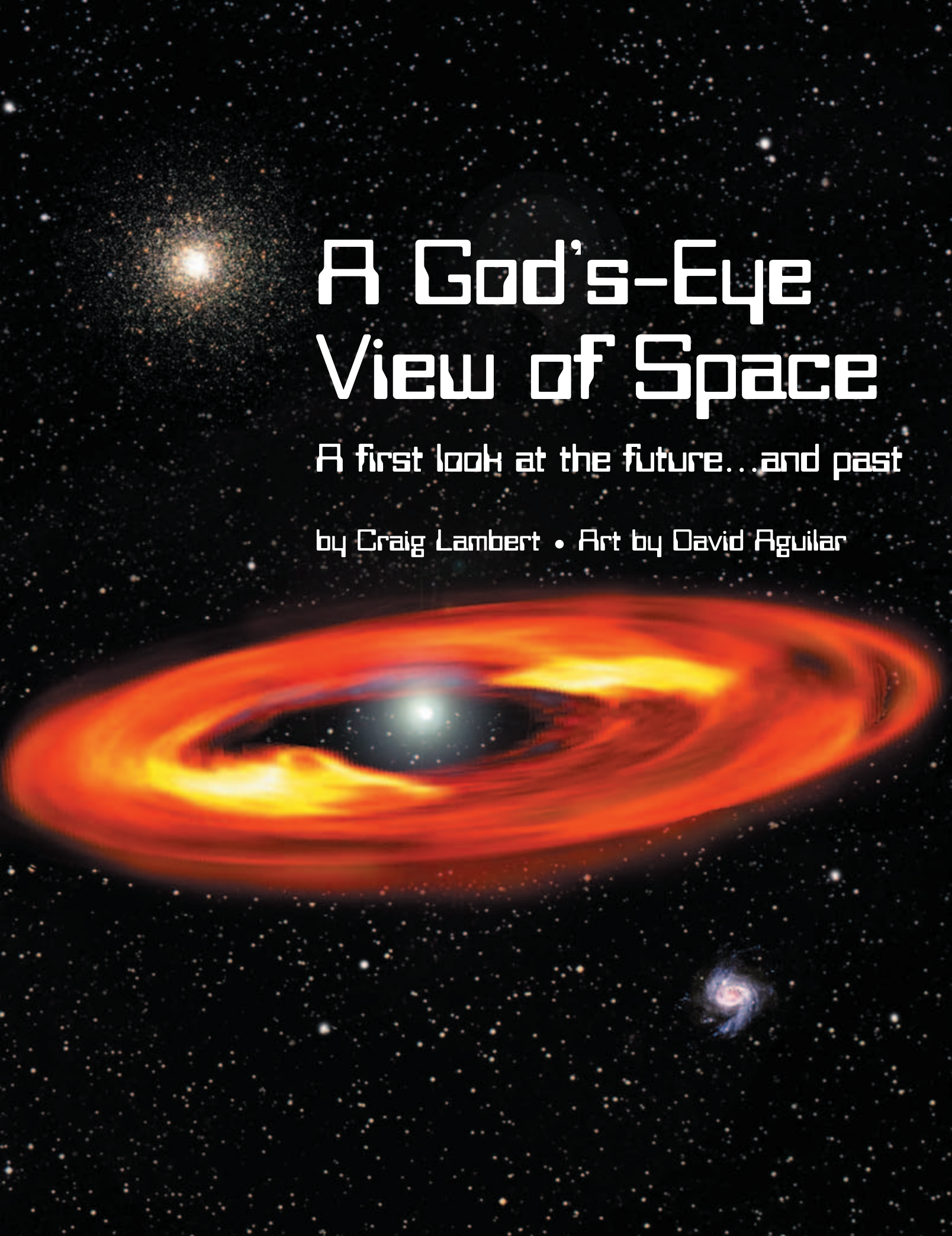


A God's-Eye View of Space

A first look at the future...and past

by Craig Lambert • Art by David Aguilar

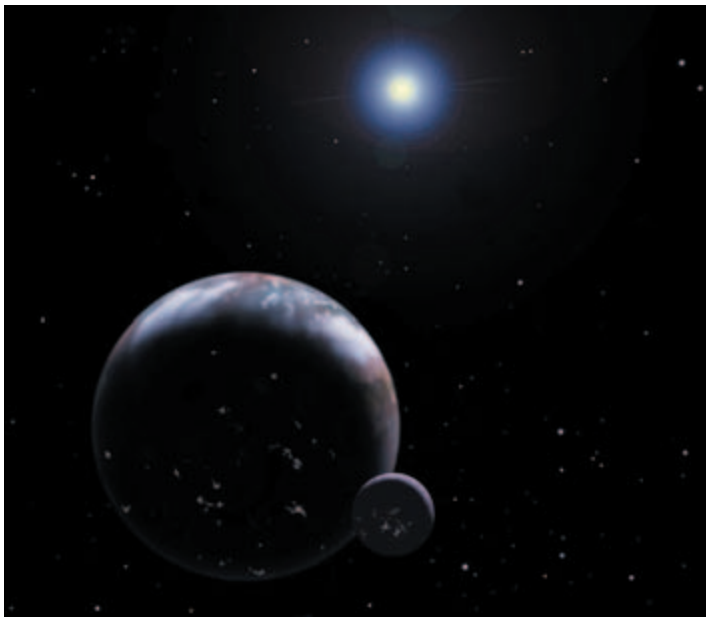
Space artists, like other artists, often draw things that no one has ever seen. "I give you a God's-eye view—what it would be like if you were God in space," says David Aguilar, a public-affairs officer at the Harvard-Smithsonian Center for Astrophysics (CfA). The trained astronomer is pioneering a new form of space art that combines rigorous astronomical science with the power of computer graphics.

Frequently, the underlying scientific data he uses come from radio telescopes, spectroscopes, gamma-ray telescopes—instruments whose output is by definition invisible. "The images aren't there," Aguilar says. "So what do you do? You go to an artist's rendering. Space art opens the door for people to understand the wonder of these discoveries—it draws them in."

There are three main types of space art, he explains. Some artists create works of fantasy realism, for example, for their own pleasure. A second stream originates with science writers or illustrators who work closely with them, and appears in books and magazines. The third, smallest, and "most exciting" space art, Aguilar says, is his own niche: working directly with astronomers like the constellation of scientists at the CfA. "No one has heard of or seen this [discovery] before," Aguilar says. "You are making the first impression, the one that introduces the world to this new phenomenon of space."

The father of space art was Chesley Bonestell (1888-1986), an architectural engineer who helped design the Chrysler Building. In 1938 he began a second career as a special-effects artist who worked on Hollywood science-fiction movies like *War of the Worlds*. His art also appeared in *Time*, *Life*, and *Collier's* magazines. When famous astronomers such as Wernher von Braun and Willy Ley began writing books on the solar system and the conquest of space, Bonestell contributed illustrations of rockets landing on the moon, for example, and of a hypothetical, wagon-wheel-shaped space station.

In the early 1980s, Aguilar organized a space-art show at the Cabrillo College Planetarium in California. Bonestell exhibited 20 of his paintings, and the two men became friends; Bonestell even gave Aguilar a painting. But "Never in my dreams did I think I'd be doing space art myself," Aguilar says. Yet recently, when a *U.S. News & World Report* cover article on "Mysteries of the Universe" displayed four images side by side, one of them was Aguilar's, next to a painting by Bonestell.

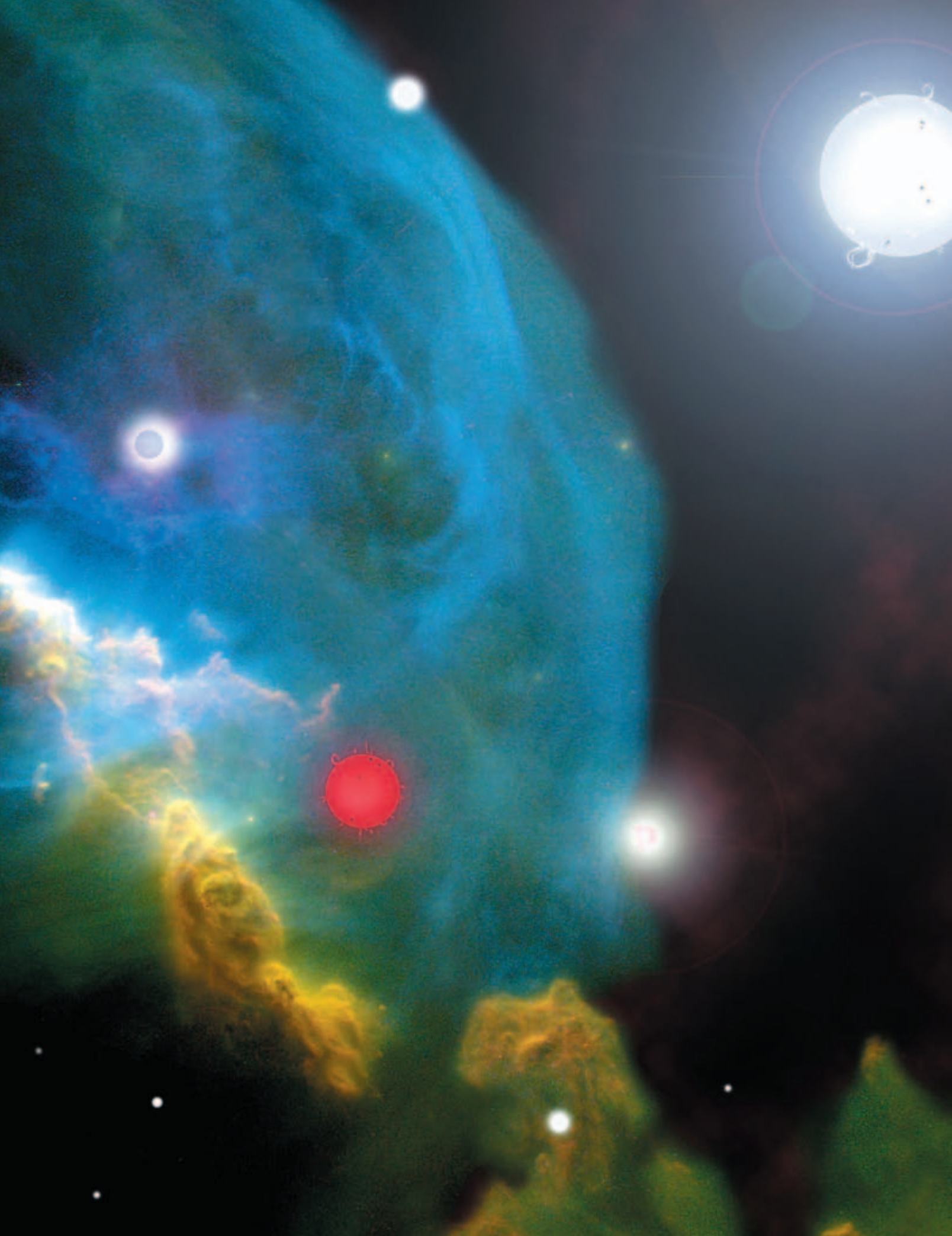


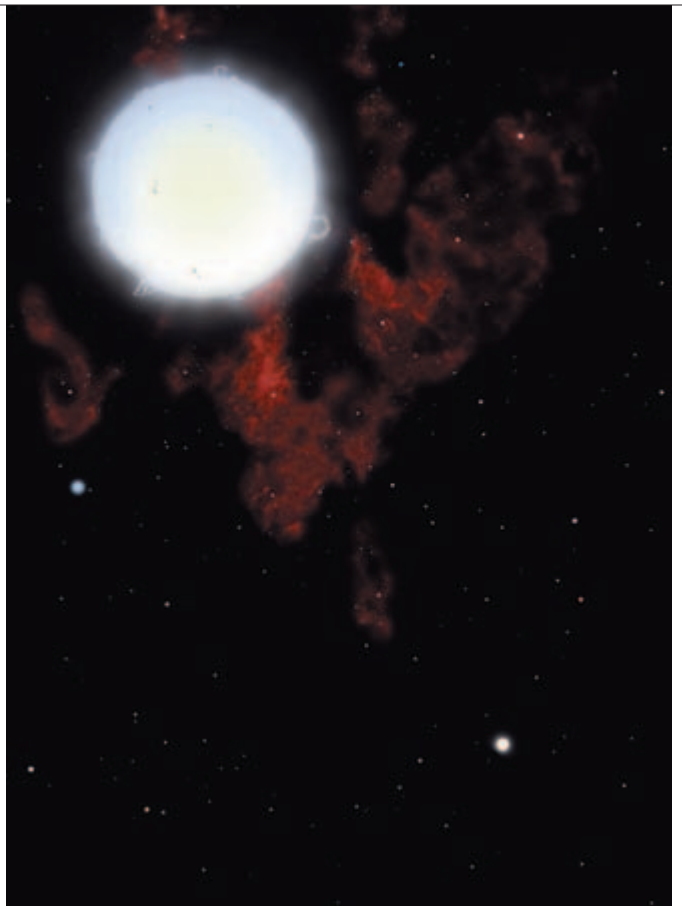
Opposite: Features observed in clouds of dust (artificially colored red and yellow) swirling around the nearby bright star Vega (center) may be the signatures of an unseen orbiting planet, says lecturer on astronomy David Wilner. The planet's gravity affects the distribution of the dust particles. With a much larger surface area, the dust clouds are far easier to detect than the planet itself—much in the way that a boat's wake is readily visible from an airplane even when the boat itself is too small to be seen. Above, top: The eruption in 2000 on the star Rho Cassiopeiae, seen from a hypothetical neighbor. The star blasted off large quantities of gas, losing more mass than ever recorded in any other stellar eruption. Astrophysicist Alex Lobel predicts that another eruption could take place at any time. Rho Cassiopeiae will one day explode as a supernova, destroying itself in a final fiery cataclysm. Bottom: Two distant worlds—one perhaps a moon of the other—may be habitable, since they have clouds and water. Astronomers Wesley Traub and David Latham of the Harvard College Observatory are among those seeking such an extrasolar planet, looking for telltale signatures in the planet's atmosphere, such as the presence of oxygen.

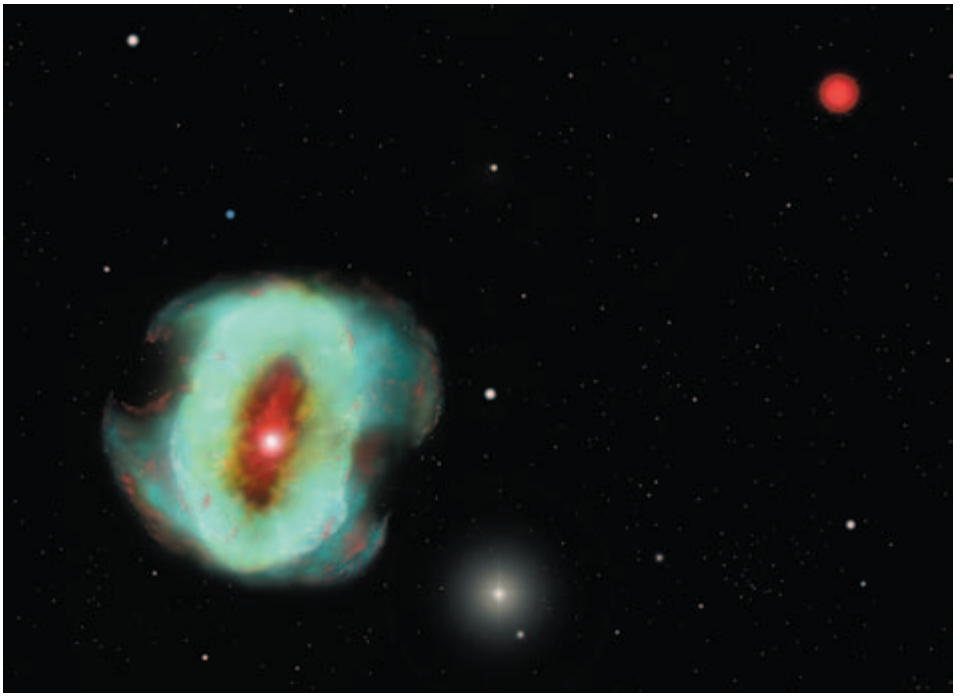
The wonder of space touched Aguilar as a boy, when he entertained himself by building models of satellites and astronomical objects as well as a small telescope—even polishing the mirrors—that enabled him to see four moons of Jupiter and the stripe across that planet. He has built more than 100 other telescopes since. He majored in astronomy at California State University in San Jose, and added a master's degree at UC-Santa Cruz. As an artist he is an autodidact who started by doing biological illustrations to help put himself through college.

His passion for space art may have crystallized when he worked for the contracting firm Ball Aerospace in Boulder, Colorado, between 1983 and 1996. An astronomer there phoned him one day to ask, "Can you join us at 10 tonight?" The occasion was the first flight of a spacecraft into the nucleus of Halley's comet. "[The nucleus] looked like a burnt potato," Aguilar recalls. "That night I turned on one light in a darkened room to simulate the sun, took a hunk of clay, and sculpted the first model of the nucleus of Halley's comet. I photographed it and the next day it hit the wires."

Working with real astronomers imposes demands that the fantasy-realist painter need not confront. "Is the orbit right? Is the shadow correct? These are things you work on with the scientist," Aguilar says. "The toughest thing is to create a visual image that conveys the depth



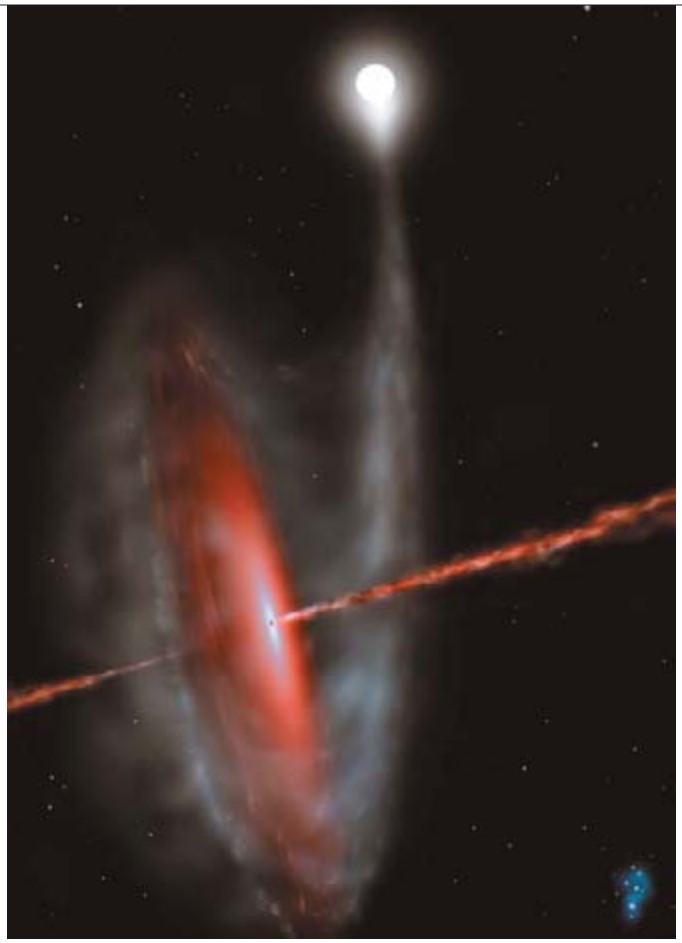




Opposite: The very first generation of stars were not at all like our sun, says theorist Volker Bromm. Blue and green clouds of gas, illuminated by the stars forming inside them, became white-hot, massive stars that burned for only a million years, then collapsed and exploded as brilliant supernovae. Such ur-stars seeded the universe, spreading elements like carbon and oxygen. Above left: Two white second-generation stars—the first sun-like stars—form amid red clouds of hydrogen. The white star at the upper left is at a more advanced stage of its life cycle than the younger star at the lower right, which spins out two jets of gas from its poles, thus slowing its rotational momentum. Above right: The same two stars have now stabilized. Left: The younger star (now at upper right), having exhausted its hydrogen fuel, has expanded into a red giant. At the lower left, the older star, once a red giant, has become a planetary nebula, puffing off its outer layers of gas and spreading heavy elements. Eventually, Bromm says, such elements accumulated enough mass to form planets like Earth. He estimates that the window for life opened sometime between 500 million and 2 billion years after the Big Bang.

of space, the mystery of space, the vastness of space." Recently, Volker Bromm, a postdoctoral fellow in the Harvard College Observatory, theorized about what the early universe looked like when the first sunlike stars were born: a space devoid of life and even planets, since there were not enough heavy metals for planet formation. "I have to do a painting of that and be absolutely scientifically accurate," Aguilar says, "but also communicate the loneliness of the young universe. For a few billion years it was very chaotic, yet filled with promise."

A different challenge arises from the work of professor of astronomy Dimitar Sasselov, whose team found the largest planet yet discovered in orbit around a distant star—which happens to be a red giant (see "Far-Out Sagittarian," March-April 2003, page 16). In our solar system, tiny Mercury circles the sun every three



Above: Harvard astronomer Jon Miller led a team that found the first "intermediate-mass" black hole. A black hole is an object so dense that not even light can escape its gravity. It is detectable only when it sucks in gas from a star that wanders too close. Here, a black hole pulls matter away from the white star at the top. Near the black hole, rotation accelerates as matter heats and flattens into a disk. X-ray energy is represented as two axle-like jets that accelerate away from the black hole. The exotic, "intermediate-mass" black hole is hundreds of times larger than a stellar-mass black hole left over by an exploding star, yet thousands to millions of times smaller than the supermassive black holes lurking in galactic centers. Top right: The variable star Mira, seen from a hypothetical orbiting planet. Mira was once a star like our sun. With age it began to swell and dim, then brighten and shrink again, in a 332-day cycle. Lecturer on astronomy Mark Reid found that when it expands and dims, chemicals not previously associated with the star form in its outer atmosphere—ironically, the same chemicals used in sunscreen. Five billion years hence, our sun, having become a variable star like Mira, may swell into a giant red orb that swallows *its* inner planets, including Earth. Lower right: A supernova (lower left) explodes in a distant galaxy. Clowes professor of science Robert Kirshner tracks such events, which can be brighter than a billion suns and suggest that cosmic expansion is accelerating. Opposite: A giant Jupiter-like extrasolar planet, seen from a moon. Orbiting very near their stars, with "years" measured in days or hours, these new, hot, giant gas planets are called "Roasters." All of the 110 extrasolar planets detected so far are such (lifeless) gaseous giants. Finding the first other *living* planet "only happens once in the history of an intelligent species," says professor of astronomy Dimitar Sasselov, "and we are closing in on it."

months, but *this* planet orbits its star every 29 hours—and is 100 times as big as Earth. "How do you make it visually real?" asks Aguilar. "From the information supplied by the astronomers, we realized that the planet's predominant colors would be blues and purples, very different from the more familiar red and orange bands and stripes on Jupiter, for example."

Most space artists still work with airbrushes, pastels, and acrylic paints, but for the last year and a half, Aguilar has used computer graphics packages like Adobe's PhotoShop and Illustrator. "I build 3-D models, photograph them, and drop the images into the computer art," he says. "I found an old rusted oil tank at [the CfA's] observatory in Hawaii. Some day it's going to appear as a space ship. The computer allows infinite layering to bring out details. It can integrate digital images, which is why Hollywood films' special effects are becoming so realistic. There's so much more latitude—it's done with paint pixels instead of paint molecules." Still, he believes that "*how* it's produced is not as important as *what* is produced."

Currently, there is no training for this kind of space art. "You train yourself by trial and error," Aguilar explains. "In the evening, I sit down in front of my screen with a cup of tea or a Scotch and say, I'm going to see what this [software] can do. You also learn by talking with other space artists, and asking them 'How in the world did you do that?'"

Imaginative, science-based space art is emerging amid an environment of increasingly good photographs from outer-space probes. "[The] Hubble [space telescope] raised the bar on good images," Aguilar explains. Like the telescope, art is a way of exploring space and of bringing the unseen into this world. "What I enjoy working with every day are the real discoveries that change the way we think about ourselves and the universe," he says. "I am giving you that first look at your future."

Craig A. Lambert '69, Ph.D. '78, is deputy editor of this magazine.