Tennessee. "It's more than enough to get us off to a good start" but not enough to prevent delays, says project manager Bill Appleton about the funding, which fell $27 million short of the request.

Congress also ordered an end to DOE's once-grand plans for the $10 billion International Thermonuclear Experimental Reactor. It provided about $12 million to shut down the project, despite DOE efforts to explore scaled-down alternatives. The science office's two other research portfolios—the $696 million health and environment program and the $335 million high-energy and nuclear physics program—received a total of $9 million more than requested, but legislators earmarked $40 million for specific projects that were not in the request.

- **NASA:** Space scientists won't see much new funding in 1999. Legislators gave the agency's science programs $2.1 billion, $61 million more than the Administration's request but about the same as last year's budget. Lawmakers also met the Administration's request for $2.27 billion for the embattled international space station (see p. 206).
- **Defense:** For the first time since 1993, the Defense Department's spending on basic research will grow faster than the expected rate of inflation. The 6.1% increase, to $1.1 billion, still puts basic science spending 25% below the 1993 level, however. The defense bill also includes more than $200 million for several major biomedical programs, including $135 million for breast cancer research, $58 million for prostate cancer research, and $10 million for a new ovarian cancer program.
- **EPA:** The conferees agreed to fund the agency's science and technology account at $650 million, a 3% rise and 3% above the president's request. Within that amount, legislators boosted the agency's program on particulate matter research by $18 million, to $47 million. They also quelled a controversy over energy research related to global change policy in the wake of the Kyoto treaty. "The final language makes clear that we can proceed with commonsense actions to reduce greenhouse gases and to pursue other important environmental goals," says Todd Stern, the Administration's climate change coordinator.

Legislators were less generous to the Administration's $110 million a year Next Generation Internet project. For the second straight year, DOE, which had asked for $22 million, was blocked from spending any money. At the same time, plans by the two biggest partners, Defense and NSF, to spend $50 million and $25 million, respectively, remained on track. **–DAVID MALAKOFF**

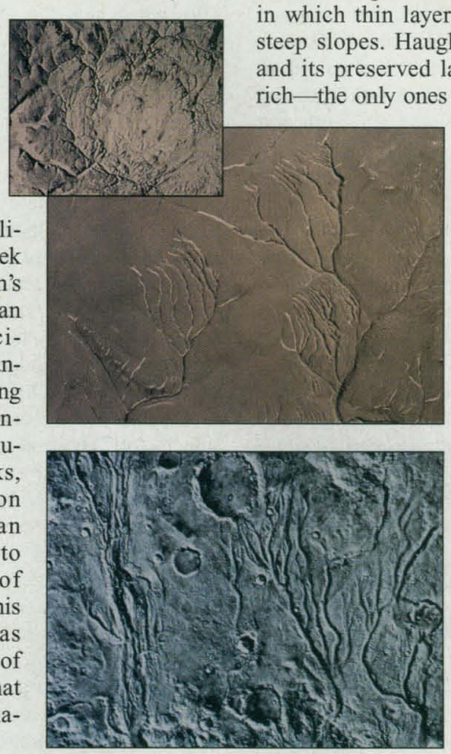
With reporting by Jeffrey Mervis and Jocelyn Kaiser.

PLANETARY SCIENCE

Geologists See Mars in The Canadian Arctic

Mars aficionados of all stripes long to walk upon the Red Planet, but a trip there is a dim and distant possibility. So some planetary geologists have opted to learn about Mars by studying similar regions on its sister planet, Earth. Now a band of NASA scientists has found what may be the most Mars-like setting yet: the Haughton meteorite crater in the hostile Canadian Arctic.

This 20-kilometer-wide basin may offer clues to the early evolution of the martian landscape, says planetary scientist Pascal Lee of the NASA Ames Research Center in Mountain View, California, who next week will present his team's work at the American Astronomical Society's Division for Planetary Sciences meeting in Madison, Wisconsin. Landslides, sinuous valley networks, and other Haughton landforms bear an eerie resemblance to terrain on parts of Mars, says Lee: "This little microcosm has an amazing variety of geologic features that may have direct analogs on Mars."



Good match. A plateau near Canada's Haughton crater *(inset)* is sliced by branching "valley networks" *(top)* that resemble those seen on Mars by the Viking orbiter *(above)*.

Scientists who have accompanied Lee to Haughton share his hopes for the 23-million-year-old crater, located on Devon Island, an uninhabited slab of rock west of Greenland and far north of the Arctic Circle. "It's an impact crater in a cold polar desert, so it may be an excellent analog for the climate and geologic processes on early Mars," says planetary geologist Aaron Zent of NASA Ames. By studying the crater's ice-sculpted terrain, the team may be able to deduce whether similar martian features arose during icy conditions, rather than during a warm and wet period postulated for early Mars. Although NASA has not yet promised more funds to study it, the crater already has captured the imagination of enthusiasts at the private Mars Society, who plan to build a prototype Mars base there.

Other martian stand-ins on Earth range from ice-covered lakes in Antarctica to wind dunes among volcanic debris in Iceland and Death Valley. But Lee's team says that images from the Viking and Mars Global Surveyor orbiters, plus air and ground surveys of Haughton, show that the crater looks startlingly like parts of Mars in several unique ways.

The similarities may stem in part from how ice and subsurface permafrost interact with the crater's shattered terrain, says Lee. For example, old ice exposed within crater walls might trigger the small landslides seen at Haughton and some martian craters, in which thin layers of rock detach from steep slopes. Haughton once held a lake, and its preserved lake sediments are ice-rich—the only ones known that may match the icy lake sediments in some martian craters. And ice locked within jumbled impact deposits at Haughton has melted to form odd cup-shaped basins at the heads of long valleys, a process proposed for similar valleys on Mars. Finally, Lee's team suspects that fans of narrow channels seen in a plateau next to the crater were carved by meltwater beneath a stationary glacial cap. The channels are the only ones on Earth sharing the strange branching patterns of some martian valley networks. "The wasting away of an ice cover might explain many of these features without requiring rainfall," Lee says. "Mars might not need to have been that warm in the past."

Planetary scientist Steven Squyres of Cornell University in Ithaca, New York, cautions that such similarities could be deceptive. "We don't know what early Mars was like," he says. "We need to apply what we see at all terrestrial Mars analog sites with a great deal of caution and humility." Lee agrees but says that studies of the crater's geologic evolution and glacial action at the crater will help.

More study is just what the private Mars Society, founded this year by aerospace engineer Robert Zubrin of Indian Hills, Colorado, is planning. The society has ambitious plans to put a "Mars Arctic Research

CREDITS: (CRATER INSET) GEOLOGICAL SURVEY OF CANADA; (TOP PANEL) CANADA DEPARTMENT OF ENERGY, MINES, AND RESOURCES/NASA HAUGHTON-MARS PROJECT; (BOTTOM PANEL) NASA

Station" at Haughton, to help field scientists learn how to interpret Mars-like terrain and test drills, robots, and other mission technology, Zubrin says. Lee, a Mars Society member along with other NASA scientists, is consulting on the structure, which could take 2 years to build and cost about $1 million in funds that Zubrin's group is raising.

At the moment, NASA has no comment on these grand plans. Officials are waiting for reports from Lee's team—based on two seasons of fieldwork funded by small grants from NASA, the National Research Council, and the National Geographic Society—before deciding on future support, says Carl Pilcher, the agency's science director for solar system exploration. But geologists who have seen Haughton are eager to do more work there. "Haughton has a lot of Mars-like geology in a very compact place," says astrogeologist James Rice of the University of Arizona, Tucson. "If I can't go to Mars, this may be as close as I can get." **–ROBERT IRION**

Robert Irion is a science writer in Santa Cruz, CA.

ASTRONOMY

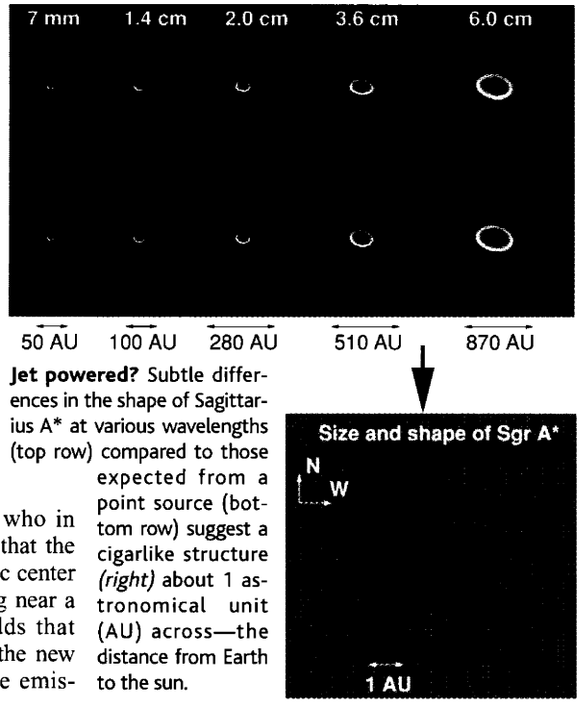
Probing the Milky Way's Black Heart

Astronomers have taken their closest look at the mysterious center of our galaxy—and uncovered a further mystery. At the very center of the galaxy lies a black hole with a mass millions of times greater than the sun's. The black hole is invisible, but just outside it, electrons torn from matter falling into the black hole gyrate around magnetic field lines, broadcasting radio waves. By mapping the radio emission with the Very Long Baseline Array, a system of linked telescopes that spans North America, a group of Taiwanese and American astronomers have found that the emitting region is drastically elongated, suggesting that the black hole is somehow shooting jets of material out of the plane of the galaxy.

"It's an interesting result," Cambridge University astronomer Martin Rees says of the map, which offers the most intimate view ever of the immediate surroundings of a giant black hole. Rees, who in 1982 was the first to suggest that the radio emission from the galactic center comes from hot gas circulating near a supermassive black hole, adds that "the jetlike shape inferred in the new observations suggests that the emission may come mainly from an outflow"—a conclusion that runs counter to many models of the radio source's structure.

From the tremendous speeds of the stars whirling around the Milky Way's central radio source, called Sagittarius A*, astronomers had calculated that it must harbor a black hole with a mass equivalent to 2.6 million suns. The region is invisible to optical telescopes because of intervening dust clouds, says team leader Kwok-Yung Lo of the Academia Sinica Institute of Astronomy and Astrophysics in Taipei, so the most detailed view of it comes from synchrotron radiation, the radio waves emitted by fast-moving electrons spiraling in a strong magnetic field. "The intrinsic size and structure of [the radio source] are crucial for our understanding of the immediate vicinity of the massive black hole," he says.

Earlier attempts to gauge the size and shape of the radio source were unsuccessful because of scattering by interstellar electrons, which made the radio source look larger than it really is, just as a streetlight looks larger when viewed in the mist. However, these blurring effects vary with wavelength. By combining near-simultaneous measurements at five different radio wavelengths, Lo and his colleagues—Zhi-Qiang Shen from Taiwan and Jun-Hui Zhao and Paul Ho of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts—were able to extract the true size and structure of the source from the scattering. The team presented the results last month at a workshop on the galactic center in Tucson, Arizona, and will publish them in the November *Astrophysical Journal Letters*.



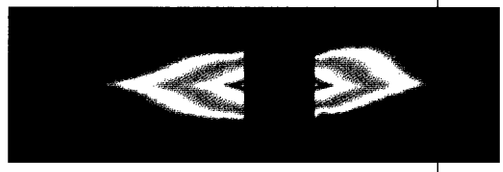
Jet powered? Subtle differences in the shape of Sagittarius A* at various wavelengths (top row) compared to those expected from a point source (bottom row) suggest a cigarlike structure *(right)* about 1 astronomical unit (AU) across—the distance from Earth to the sun.

CREDITS: (TOP) C. A. SCHULTZ/CSC/STSCI/NASA; (BOTTOM) J.-H. ZHAO *ET AL.*

ScienceScope

PH.D. FOR ET?

Budding scientists who want to join the search for extraterrestrial life can now get a leg up on the competition. The University of Washington (UW), Seattle, is creating what it claims is the first Ph.D. program in astrobiology. About a dozen students are expected to start their studies, which will range from microbiology to aeronautics, in fall 1999. Fieldwork, alas, is limited to Earth. "Everyone will have to get their hands dirty," says UW astronomer Woodruff Sullivan.



Protoplanetary disk around Beta Pictoris may harbor Earth-like bodies.

Some new blood might be welcome at NASA, where officials are still sorting out their astrobiology initiative, which links 11 scientific teams in a virtual research center (*Science*, 29 May, p. 1338). Administrative infighting has dogged the effort, which NASA says could limp without a leader into next year. Complains one researcher: "The team is playing without a coach."

AUSTRALIA PLANS R&D SUMMIT

Australian voters may have opted for the status quo in last week's elections, but their country's science policy could be on the verge of major changes.

The hard-fought campaign, which ended with Prime Minister John Howard's ruling Liberal-National coalition winning a narrow majority over the Labour party, featured promises from both sides to invigorate the country's sluggish R&D efforts through increased funding and tax incentives. The scientific community will have a chance to offer its advice to the government at a national innovation summit early next year.

"Things are not working," says Peter Cullen, president of the Federation of Australian Scientific and Technological Societies, who welcomes the summit. "This is an opportunity to take stock." Adds Vicki Sara, chair of the Australian Research Council, "The government has missed the boat" on what's needed to turn research into new products. "We need to create a seamless web of activity between all the players."

Contributors: David Malakoff, Robert F. Service, Elizabeth Finkel