Foraging New Terrain in Search of Extragalactic Life

Columbia Astrobiology Center explores theory that tidal heating may be supporting life on Europa

By Alex Lyda

In mid-January, the Stardust space-craft returned to Earth with its microscopic grains of dust captured from the tail of a comet and science discussions surrounding the same time, NASA launched a space probe called New Horizons to obtain the first close-up imagery of Pluto and its moons. Both efforts should help to shed light on the origins of our solar system and the formation of life elsewhere. Meanwhile, over at Columbia’s Astrobiology Center, known as the CAC, a crew of scientists is attempting to take these investigations a step further by looking into the possibility of “habitable” moons orbiting planets in our own, and other, solar systems. Based in the school of science and engineering department, the CAC brings together experts from the Earth Institute—specifically, the Lamont-Doherty Earth Observatory (LDEO), the Center for Climate Systems Research (CCSR) and the NASA Goddard Institute for Space Studies—and from the health science campus, with their counterparts at the American Museum of Natural History.

With the help of a three-year, $300,000 NASA exobiology grant, cross-disciplinary team made up of scientists from these four institutions is turning its attention to the possibility that tidal heating, a moon belonging to our solar system’s outer planets, Jupiter Europa has been a source of fascination since it was first observed by Galileo in 1610. It became the focus of renewed scientific interest about 40 years ago, when astronomer Gerard Kuiper and others showed that its crust was composed of water and ice. Europa technically lies beyond the “classical habitable zone,” where life is enabled by heat from the Sun. But the theory is that for Europa, as well as other icy moons orbiting the so-called “classical habitable zone,” life may be enabled by not solar heat but by tidal heating, whereby encased moons undergo stretching and squashing from the gravitational pull of their parent planets and neighboring moons. Europa has 63 moons and satellites, but the bodies that are of most interest to scientists are the four Galilean moons: Io, Europa, Ganymede and Callisto.

None of these moons looks like a tropical island, quips Caleb Scharf, the director of astrobiology at the CAC. “But there may be some deeply hidden pockets—or even vast regions—of liquid water, which have the potential for life to occur.”

Currently, there is good evidence to suggest that a layer of liquid water could exist below Europa’s ice—a sub-surface ocean as much as 51 miles deep. If so, it would be almost as large as the total area of liquid water exists in significant quantities.

Other striking features of Europa include a series of dark streaks crisscrossing its surface. The largest streaks are roughly 12 miles across with diffuse outer edges and a central band of lighter material.Apparent fields of icy plates cover the surface and appear to have been broken from larger sheets and then re-froze in a more jumbled arrangement. They look exactly like terrestrial sea-ice fields when viewed from above, Scharf says.

While seeking to clarify the circumstances that gave rise to moons like Europa, the CAC scientists are also interested in the possibilities this research opens up for finding life on other worlds orbiting the so-called exoplanets.

Since most of the exoplanets discovered thus far are “gas giants” akin to Jupiter, they may well harbor moons such as those around Jupiter or Saturn. In fact, these moons could easily be Earth-sized, says Scharf, adding that he and other CAC researchers are grown excited about the possibility that jovian moons “could serve as prototypes for this bigger question of tidally heated ‘exo-moons.’"

In investigating the processes by which moons and planets form, the CAC team will eventually be looking for ways not only to explore Europa but also to train instruments on more distant worlds.

In the process, CAC scientists will be scrutinizing the findings of NASA’s Stardust mission and New Horizons Pluto probe for clues as to the building blocks of nascent solar systems. “The fun of the astrobiology enterprise is in finding the connections between all these disciplines, and putting together the pieces of the puzzle,” Scharf says. “To think that tiny grains of comet material, and a probe going to Pluto, could ultimately help us find new places to look for life in the cosmos—it’s just too much for us scientists to resist.”

For more information on the Columbia Astrobiology Center, go to www.astro.columbia.edu/~astrobio/

MIT’s Charles Vest Ends Off NAS/ADVANCE Diversity Campaign

By Ernest Beck

On the eve of the State of the Union address in which President Bush called for increased support for math and science education and improved career opportunities for future engineers, Charles Vest, president emeritus and professor of mechanical engineering at the Massachusetts Institute of Technology, brought home the same message to a Columbia audience—but with an important difference in emphasis.

Speaking at Library in the first of a new lecture series sponsored by the Fu Foundation School of Engineering and Applied Science (SEAS) and the Earth Institute’s ADVANCE program, Vest expressed the need to facilitate the advancement of women and minorities in the science and engineering fields so as to reflect the racial and ethnic richness of our society.

Vest’s talk, titled “Diversity in Science and Engineering: Personal and Institutional Journeys and Obligations,” focused on his own experience of tackling the issue of diversity at MIT and the steps that he and other university administrators have taken to create a level playing field for women and minorities in the nation’s engineering and science faculties.

Introducing Vest, Lee C. Bollinger described him as a man of great modesty “who can relate to those in the political sphere as well as those who feel marginalized and excluded from society.”

Vest began his remarks by recounting his upbringing in segregated schools in West Virginia in the 1950s. He expressed that his journey through life, spent largely on different, university campuses, had given him the chance to experience a wide range of cultures and world views.

He went on to discuss the challenges he would face as MIT president when a committee led by a faculty colleague of his, Nancy Hopkins, wrote a report showing that women in the school of science were experiencing the university differently from men, and that they were in an inequitable position.

That the publication of the Hopkins report in 1999 had come as a revelation, Vest said, exposing the gap between widespread assumptions about women at the school and the reality of their experiences. Determined to turn the situation around, he instituted a number of diversity initiatives that are starting to reap results, he reported. There are now seven women of color among MIT’s tenure level faculty compared to none in 1994; and six women on its engineering faculty compared to only one a decade previously. And there is now even a woman president, Susan Hockfield.

“I am in awe of the women faculty members at MIT. They are superstars. They will be the intellectual leaders of the future.”

—Charles Vest, President Emeritus and Professor of Mechanical Engineering at the Massachusetts Institute of Technology