PHOTO / **SLOAN KULPER**

Sloan Kulper (S.B. 2003) and Audrey Roy (S.B. 2005) have designed a building in the shape of a cell for the Institute for Nanobiomedical Technology and Membrane Biology in Chengdu, China. This illustration shows the exterior in daytime. Protrusions in the facade provide meeting areas attached directly to interior laboratories.

Three at MIT conceive building in shape of cell

Novel architecture planned for China

Sarah H. Wright
News Office

An innovative cell-shaped building will house a new biomedical research institute in Chengdu, China, thanks to an unusual crossdisciplinary collaboration between Shuguang Zhang, a world-renowned bioengineer and scientist at MIT, his former student, architecture major Sloan Kulper, and computer science and electrical engineering major Audrey Roy.

Kulper (S.B. 2003) and Roy (S.B. 2005) designed the cell-shaped building for the Institute for Nanobiomedical Technology and Membrane Biology in Chengdu, China, the regional capital of Sichuan province in southwestern China. The proposed new facility will contain 170,000 square feet of laboratory, research and meeting spaces; it is slated for construction over the next three years. The building is intended to look like a cell from the outside and to include an assortment of forms inspired by molecular biology inside.

Shuguang Zhang, associate director of the Center for Biomedical Engineering, will serve as founding advisor of the new Nanobiomedical Institute, to be sited at Chengdu's Sichuan University, where Zhang received his undergraduate degree in biochemistry.

Zhang met Kulper in 2002, when he took Zhang's course, "Molecular Structure of Biological Materials: Structure, Function and Self-assembly."

In the class, Zhang frequently discusses the striking similarities between architecture and biological structures, he said. "Nature has produced abundant magnificent, intricate and fine molecular and cellular structures through billions of years of molecular selection and evolution.

"These invisible molecular and cellular structures cannot be seen by the naked eye, but can only be observed with the most sophisticated scientific tools, such as X-ray diffraction and nuclear magnetic resonance, or modeled with advanced computers. But if they can be amplified billions of times as in a building, then these molecular structures can be seen, touched and admired. At that large scale, they can also be very educational for people of all ages," Zhang said.

According to Zhang, the pioneering design for the cell-shaped building was inspired by "elegantly folded protein structures and their simple and beautiful structural motifs. The cell-shaped building attempts to combine the architecture and the biology structures," he said.

Kulper said the design of the building also arose from the pioneering spirit he discovered among life scientists and biological engineers. "They are always working at the threshold of understanding," Kulper said.

"When I took Shuguang's course, I was thrilled to learn that structural biologists had developed such an amazing language for describing new and complex forms. Also, structural biology is basically concerned with the sort of geometries that architects and designers often work with, though on a completely different scale. It's a very visual field that communicates more through illustration than through symbol," Kulper said.

The seeds of Kulper's involvement

See **CELL BUILDING** Page 7

MIT team describes unique 'cloud forest'

Trees that live in an odd desert forest in Oman have found an unusual way to water themselves by extracting moisture from low-lying clouds, MIT scientists report.

In an area that is characterized mostly by desert, the trees have preserved an ecological niche because they exploit a wispy-thin source of water that only occurs seasonally, said Elfatih A.B. Eltahir, professor of civil and environmental engineering, and former MIT graduate student Anke Hildebrandt.

After studying the Oman site, they also expressed concern that the unusual forest could be driven into extinction if hungry camels continue eating too much of the foliage. As the greenery disappears it's possible the trees will lose the ability to pull water from the mist and recharge underground reservoirs.

A report on their research was published in a recent issue of Geophysical Research Letters. They are also advising the Omani government on handling the problem.

The forest is especially unique, said Eltahir and Hildebrandt, because it "is a water-limited seasonal cloud forest" that is kept alive by water droplets gathered from passing clouds — ground fog. The water dribbles into the ground and sustains the trees later when the weather is dry. The MIT work suggests the trees actually get more of their water through contact with clouds than via rainfall.

In general, cloud forests are not really rare. But they occur most frequently in moist tropical regions where there is ample rainfall. So it is unusual, the researchers said, to find a cloud forest in a region known for chronic dryness.

The researchers studied the area in Oman to learn how the Dhofar Mountain ecosystem "functions naturally, and how it may respond to human activity" that could lead to desertification and the need for reforestation.

Eltahir and Hildebrandt, who is now at the UFZ Center for Environmental Research, in Leipzig, Germany, said the unusual forest is an interesting remnant "of a moist vegetation belt that once spread across the Arabian Peninsula" in the distant past. At that time the regional climate was generally wetter.

The forested area in the Sultanate of Oman is now semi-arid, and most of the ancient tree vegetation is gone. This small remnant has managed to survive in the Dhofar Mountains. But it is under threat.

Although many Omanis have moved into cities and towns as the country has grown rich on oil, Eltahir explained, a family's prestige still comes from owning many camels, and people now tend to keep more camels than they need, which is part of the problem facing the forest.

"It is an unusual place," Eltahir said. "It's a very good example of a unique and fragile ecosystem," where constant pressure from over-grazing can have consequences beyond defoliation. In fact, the forest illustrates how small changes can lead to major impact on far bigger systems, Eltahir said.

The trees in wetter ecosystems would likely recover from small amounts of overgrazing, Eltahir said, but "in this location, due to the nature of the interaction of the canopy structure with the clouds, the trees may not recover."

The two said the forest probably would not regenerate naturally once it is gone. Grass, even if abundant, cannot collect enough moisture from fog to let a forest regrow.

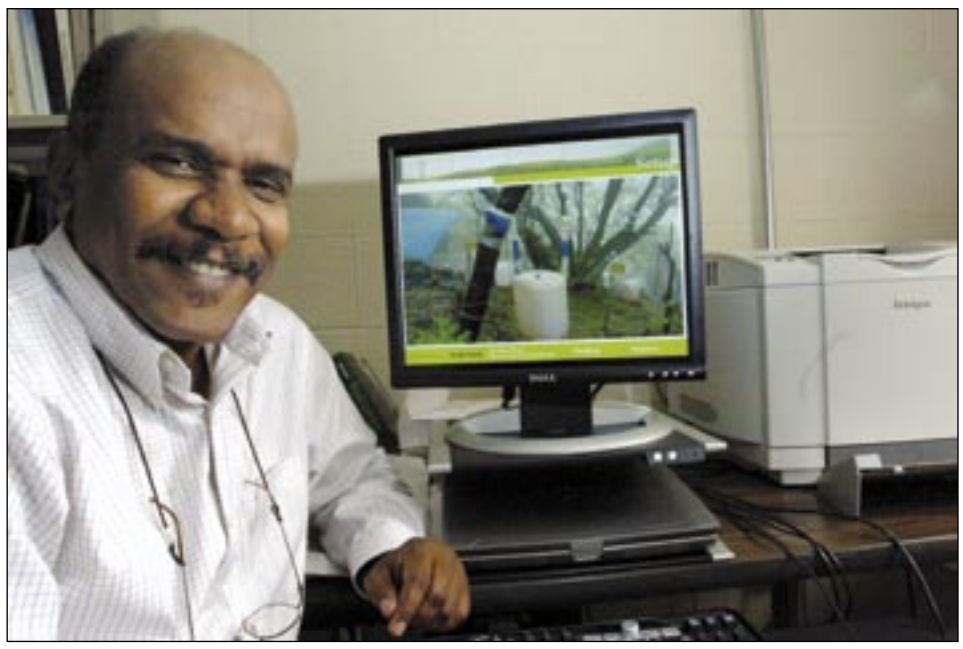

PHOTO / **DONNA COVENEY**

Research led by MIT professor Elfatih Eltahir indicates that trees in a desert forest in Oman survive by extracting moisture from low-lying clouds.

West Coast native crab nabbed; circumstances fishy

Andrea Cohen
MIT Sea Grant

MIT researchers have confirmed the first sighting of a Dungeness crab in the Atlantic Ocean. The male, whose species is common on North America's West Coast, was caught off Thatcher Island, Mass., on July 19 by Lou Williams, captain of the fishing vessel Orin C.

The origin of the crab is not known. One possibility is that it may have been purchased from a live seafood market and released. The size of the crab (18 centimeters) and its gender suggest it most likely arrived as an adult exotic species. Also known as invasive species or bioinvaders, exotic species are of concern because they can establish themselves in a new ecosystem, where they can proliferate and push out native species.

The crab was caught while Williams was gillnetting for groundfish at 45 fathoms. Suspecting the crab to be a Dungeness, he took it to Brandy Wilbur, aquaculture specialist for MIT Sea Grant, and Eric Sabo, educator at the Gloucester Maritime Heritage Center, for verification.

PHOTO / **BRANDY WILBUR, MIT SEA GRANT**

This Dungeness crab, a West Coast species, was caught by Captain Lou Williams of the Orin C two miles east of Thatcher Island, Massachusetts, on July 19. It's about 18 cm wide.

After distributing photographs of the crab to several scientists, the researchers received confirmation of the species, Cancer magister, from several experts: Julie Barber, Massachusetts Division of Marine Fisheries; Thomas C. Shirley, Texas A&M University at Corpus Christi; David Tapley, Salem State College; and Richard Strathmann and Eugene Kozloff, the University of Washington's Friday Harbor Laboratories.

Judy Pederson, MIT Sea Grant's manager for coastal resources and an expert on marine invasives, said that the finding of a female crab would have raised greater concerns about the possibility of a marine bioinvasion. In the West Coast fishery for Dungeness crab, only males may be caught and sold. Pederson adds that the chance of two species of crabs cross mating is highly unlikely. However, she points out that the male crab could carry hitchhikers, such as native Pacific barnacles, or diseases that could harm native crustaceans, such as Jonah and rock crabs.

While the crab's method of entry is unknown, Pederson notes that the capture underscores the importance of not releasing any seafood into natural waters. In addition, Wilbur notes that this finding should put seafood distributors and fishermen on watch.

MIT Sea Grant will be producing and distributing "most wanted" posters to help those who might come across a Dungeness crab identify it and alert authorities.

Suspected sightings can be reported to Judy Pederson, MIT Sea Grant, at jpederso@mit.edu or 617-252-1741. For more information about marine bioinvasions, visit massbay.mit.edu/exoticspecies; for information about the hazards of dumping seafood, visit massbay.mit.edu/seafood.