

Martian Robots, Taking Orders From a Manhattan Walk-Up



Librado Romero/The New York Times

Alastair Kusack, front, and Paul Bartlett, engineers at Honeybee Robotics in Lower Manhattan, monitor views of Mars's surface from a second-floor office. Honeybee was founded in New York two decades ago.

By **KENNETH CHANG**

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These days, when one of NASA's rovers drills a hole in a rock on Mars, the commands come from Lower Manhattan, from a second-floor office on Elizabeth Street, surrounded by dusted-off tenements.

This is a street where pushcarts once fed and dressed Italians just off the boat. Now its old storefronts are of-the-moment restaurants and stores, and the only trace of the neighborhood's immigrant past is in its name - NoLiTa, North of Little Italy.

Above an Erica Tanov designer clothing shop, engineers at Honeybee Robotics built the drilling tools aboard the Spirit and Opportunity rovers, which landed some 200 million miles away on Mars in January. And it is from here that they tell the rovers where to drill.

"We're writing up some commands to send to Mars, and then we'll go out to get a cup of coffee in NoLiTa," said Paul Bartlett, a project engineer at Honeybee. "We're getting casual about it."

Stephen Gorevan, Honeybee's founder and chairman, admits that his is an unusual business, even for an evolving neighborhood. "It is almost surreal," he said. "You walk down the street and there are shoe stores, bakeries and here we're controlling some robotic mechanism on Mars."

Not that anyone even notices. "We don't get any neighborhood reaction," Mr. Gorevan said. "I thought somebody would wander in from the street once in a while, but it doesn't happen. It doesn't register with people."

Space exploration usually brings to mind NASA's Jet Propulsion Laboratory in Pasadena, Calif., which has run most of NASA's robotic missions, or the launching pads at Kennedy Space Center in Florida or Mission Control in Houston.

But Mr. Gorevan lived in New York.

So two decades ago, when he was a mechanical engineering graduate student at Columbia, he set up his robotics shop in Manhattan, first on the Lower East Side on Ludlow Street, then, five years later, moving to the current location on Elizabeth, a former electrical power substation built in 1922.

Mr. Gorevan loved the building, but the neighborhood left something to be desired. "At that time, there were shooting galleries," he said, "and they were selling heroin at the corner of Elizabeth and Prince."

Mr. Gorevan never finished work on his doctorate. "I'm just an overgrown kid who loves the space business,"



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he said.

The scientists name not only every rock, but also separate locations on each rock that they examine. Earlier in the mission, true to the New York twist on this mission, the Honeybee engineers were able to assign the name New York to a grinding site on a rock named Mazatzal.

When the scientists wanted a deeper look into the rock, they changed the orientation of the grinding tool and renamed the site Brooklyn. "Somebody said it was the same target as New York but with an attitude adjustment," Mr. Bartlett said. (This being a scientific joke, it required a footnote: " 'attitude,' " Mr. Bartlett said, "can mean angle or spacecraft pointing." On another rock, six targets were named TriBeCa, Little Italy, SoHo, Chelsea, Chinatown and West Village.

Honeybee started operating the rover remotely last month, and a couple of weeks ago they successfully sent, from NoLIta, commands for their first grinding of a rock named Uchben, the Mayan word for "ancient."

For the first nine months of the mission, scientists working on the project congregated at the Jet Propulsion Laboratory. But as the rovers continued strong, far past their original designed lifetime of three months, the scientists went back to their homes, and much of the rovers' operation is now handled remotely, via teleconference and the Internet.

The loss of the space shuttle Challenger in 1986 spurred greater emphasis on robotic missions. Honeybee won a contract to make fingers on a robotic arm for the space station, but that project was canceled. Under another NASA contract, Honeybee produced a prototype device that could drill into the ground to extract geological samples. That led to Honeybee building the drill for NASA's Champollion mission that was to land on a comet. Champollion was canceled, too.

Honeybee was also building the drill for a mission that was to bring Martian rocks back to Earth, but the loss of two NASA Mars missions in 1999 ended those plans as well. Instead, NASA built the two current Mars rovers.

After 21 years, the drilling tools on Spirit and Opportunity are the first things made by Honeybee to have made it into space.

Honeybee's creation - formally known as the rock abrasion tool, informally known by its acronym, RAT - is barely larger than a soda can and runs on a mere 10 watts of power, about what it takes to illuminate the light bulb in a refrigerator. The main piece is a bar holding diamond-tipped bits at each end that whirls around 3,000 times a minute, grinding away rock.

The whirling bits sweep out a circle roughly the size of a Ritz cracker, producing a surface almost as smooth as polished granite. This allows other instruments on the rover to take unobstructed images and measurements of the minerals inside.

"They're just breathtaking in their clarity," said Dr. Steven W. Squyres, a professor of astronomy at Cornell University and the mission's principal investigator. "The RAT has been hugely valuable."

The Spirit rover is now examining an intriguing rock named Lutefisk that contains nuggets a fraction of an inch wide of unknown composition and origin. On Thursday morning, Philip Chu and Alastair Kusack, two Honeybee engineers, were sitting in the second-floor conference room, reviewing the rover's work from the night before and planning for the next night's.

To avoid dislodging the nuggets, the RAT did not grind this time, but just brushed away potentially misleading dust.

The computers in the conference room tap directly into a database at the Jet Propulsion Laboratory. "We can download all the images," Mr. Chu said. "We can download all the RAT data."

When the commands were ready, Mr. Chu deposited them in the NASA computer. Later, they were radioed to the rovers via NASA's worldwide network of radio dishes.

There is also a more tangible piece of New York on Mars. On each rover, a curved piece of metal the size of a credit card and adorned with the American flag was cut out of debris from the World Trade Center.

The Honeybee engineers obtained a box of twisted metal from the city. Mr. Bartlett recalled the smell - "that acrid electrical fire smell" - when they opened it.

Tom Myrick, Honeybee's chief engineer, flew down to Texas with a piece of aluminum from the box. At the machine shop they employ there, the metal was turned into shields to protect cables on the drilling mechanisms.

Until now, that knowledge has remained within the mission team.

"It was intended to be a quiet tribute," Mr. Gorevan said. "Enough time has passed. We want the families to know."

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