TURNING PARADISE INTO "MARS"

FOR A SELECT GROUP OF WOULD-BE ASTRONAUTS, THE SURFACE OF A HAWAIIAN VOLCANO IS TRANSFORMED INTO THE RED PLANET—ALL IN THE NAME OF RESEARCH. **BY MARK ANDERSON**

Someday later this century, after the first Mars astronauts return home, the people of Earth will want to know what it was like living on another planet. And Carmel Johnston, mission commander on a recent Mars living simulation, says the people of Earth shouldn't get *too* excited.

Johnston spent a year living and working with five others in an astronaut habitat on the surface of "Mars"—an inactive region of a Hawaiian volcano. And she says the experience was something a lot of people can relate to: "It's like going on a yearlong camping trip in one tent, and in that tent—even though it's a big tent—are five other people that you work with," she says. "You don't get to bring along any of your friends and family. You only get to cook freeze-dried and dehydrated food. It's so similar to camping it's unbelievable. Which is probably why I felt so comfortable once I got there."

The Mars expedition that Johnston led, a Hawaii Space Exploration Analog and Simulation (HI-SEAS), sealed her and five other German, French and American "astronauts" in a geodesic dome in an abandoned quarry on the northern slope of the Mauna Loa volcano on Hawaii's Big Island. The dome is 36 feet in diameter and has two floors of kitchen, lab, living and sleeping space. The HI-SEAS 4 mission participants shared these living quarters from August 2015 to August 2016.

HI-SEAS mission 5, the latest HI-SEAS mission, wrapped up after eight

ILLUSTRATION BY SÉBASTIEN THIBAULT

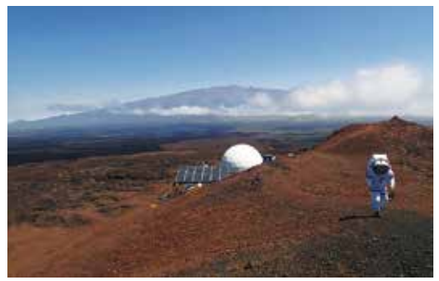
months on "Mars" in September. There were, of course, three HI-SEAS missions before missions 4 and 5, taking place in four- to eight-month stints, from 2013 to 2015. And HI-SEAS 6 is scheduled to begin this month or next. During all of the missions, funded by more than $2 million in grants from NASA, the participants had no access to the outside world and could only use and consume what they brought in.

"You can't bring very much with you," Johnston says. "You get one suitcase and a bunch of science equipment. You can make everything else you need."

As would probably be the case during a real Mars mission, the dome came prestocked with the food, supplies and water-extraction and purification systems needed to survive. Crucially, it also had 3-D printers needed to make spare parts and other essentials that cannot be planned for. (It's likely that robotic spacecraft would travel ahead of any manned Mars mission and set up everything the human explorers would need.)

The dome was the astronauts' morning, noon and night. They had no real-time communication, such as internet access or phone calls. Even emails experienced a lag time of 20 minutes each way, which would be the case on an actual Mars mission, as light and radio waves take up to 20 minutes to travel between planets.

Johnston says the 20-minute lag time was still worth it for the communications that did get through. "We had people who had grandparents die and best friends die. We had several terrorist attacks during the year," she says. "Having a good support system at home is really important . . . [people who] know that some days you're going to need puppy videos. Some days you're going to want to



HI-SEAS/NASA.GOV

vent everything that's frustrating you. And some days you just want to hear about the good things."

Leaving the dome entailed all the complexities of Mars living that one might expect. Gearing up in a space suit and going out of the space station is called extravehicular activity, or EVA, in astronaut jargon.

"An EVA is a pretty big task," says James Bevington, mission commander of HI-SEAS 5. EVAs begin the day before with extensive documentation of the excursion—what's planned and how long it's likely to take. As with the email time lags, the need for extreme documentation and preparation reflects the difficulties of a real-world Mars expedition. (Mars being harsher and deadlier than nearly any environment on Earth, crew safety requires obsessive attention to details and protocol.) The stand-in for NASA in the simulation was HI-SEAS' principal investigator Professor Kim Binsted of the University of Hawaii at Manoa, as well as dozens of volunteers around the world.

"We'd submit it to mission support so they could review it, and they'd send it back. Usually it was OK, but sometimes we'd have to make modifications," Bevington says. "It takes an hour just to suit up and get all the gear—the battery packs, water, radio, the medical kit, geology tools. Most EVAs were about three hours. Some of them were quick. If we needed just to turn on the generator, we'd be out for 15 minutes. But we had a few that were upwards of eight hours."

For all the simulated NASA protocol, Bevington says, much of a typical day was spent filling out surveys. After all, the "astronauts" and not the planet were the subject of this scientific mission. "This is actually the biggest challenge for small crews in isolation and confinement: getting along with each other over an extended period of time," says Christiane Heinicke, another participant in HI-SEAS 4.

The goal of all this research is to help inform questions of crew selection and scheduling for an eventual mission to Mars—which NASA hopes would happen by the early 2030s—and all the social and psychological pressures that would come with it.

After spending eight months on "Mars," HI-SEAS 4 explorer Tristan Bassingthwaighte says those are critical preparations. Take the worst day at the office or at home. Then multiply that by the complications of living on a planet that seems to spare no chance to try to kill you, he says.

"Understanding how a group changes under that kind of pressure, which is much more severe than I've just described, is key," Bassingthwaighte says. "Will they keep working? Will they have a societal breakdown and cease being able to even speak to each other? What's an effective mixing of personality types? Genders? Specialties? Ages? If you get that wrong on a real mission, it's game over just as surely as a broken rocket engine. People are the nebulous, fuzzy components of a mission that still need to be figured out. Who could you stay in a room with for a year, and not go crazy?"