



In the 1970s, the Mars Viking landers were sterilized in ovens.

PLANETARY SCIENCE

Fear of microbial taint curbs Mars explorers

Upheaval in NASA planetary protection office could put restricted areas back in play

By Paul Voosen

Since its arrival on Mars in 2012, NASA's Curiosity rover has zapped and drilled ancient rocks in the hopes of finding evidence for past life. But it may never get a chance to investigate something far more exciting: the possibility that martian microbes exist today. In the coming years, as the rover trundles up the side of Aeolis Mons, it will pass rocks that, seen from orbit, seem to host mysteriously intermittent dark streaks—perhaps marking seasonal water seeps. But NASA's planetary protection office, charged with keeping earthly microbes from colonizing other bodies, has said it may nix a visit. It fears that Curiosity could contaminate this so-called special region because the rover was not fully sterilized before launch.

To Alberto Fairén, a planetary scientist at Cornell University, that makes no sense. Sooner or later humans—biped rovers that can't be sterilized—will set foot on the planet, hopelessly confounding any hope of finding indigenous life, he and several colleagues argue in an op-ed in press in the journal *Astrobiology*. “We need to investigate Mars's special regions carefully and fully prior to human missions,” he says.

Bureaucratic changes at NASA could create an opening for his view, which some Curiosity team members share. In July, a NASA job posting signaled that the planetary protection office was moving out of its longtime home in the science directorate to NASA's Office of Safety and Mission Assurance in Washington, D.C., a place more accustomed to working directly with engineers. Cassie Conley, the planetary protection office's longtime chief, will face competition to keep her job, and she could be replaced by someone with less strict views on sterilization requirements. Meanwhile, by the end of this year, the National Academies of Sciences, Engineering, and Medicine are expected to complete a head-to-toe examination of how the office works and whether it keeps abreast with current science, and later this year NASA is holding a major workshop that could lead to a redefinition of special regions on Mars, the warm and watery areas that are off-limits for all but the most sterile of spacecraft.

The Viking landers of the 1970s were the only missions to Mars ever to be completely cleaned to the highest standards of planetary protection. They were baked in a purpose-built giant oven, and the cost of doing so is thought to have been roughly 10% of the mission. Ever since then, says Conley,

researchers have complained about the office, as if it exists solely to burden them and make their missions impossibly expensive. “People like to have a villain,” she says.

The office has clashed in recent years with the Jet Propulsion Laboratory (JPL) in Pasadena, California, which assembled Curiosity. JPL baked parts of the rover in ovens at 110°C for nearly a week, to sterilize them to a level where the rover could explore special regions. But in 2011, weeks before launch, JPL engineers decided that Curiosity should launch with one of its drill bits mounted on its robotic arm. They opened the already-sterilized bit box, a violation of planetary protection protocols that caused the office to downgrade Curiosity's sterility. During postmortems, JPL engineers complained about the confusing and vague way the office presented its requirements.

More recently, says John Rummel, a biologist who was NASA's planetary protection officer before Conley, JPL has butted heads with the office over the next big mission, the Mars 2020 rover, which will gather rock samples for later retrieval to Earth. JPL is interested in having the rover target areas with subsurface brines, an activity that would not be allowed with its planned level of cleanliness. Moreover, the planetary protection office has not yet agreed

on the efficacy of the techniques JPL will use to sterilize the tubes in which the rover will cache rock cores. If the issues aren't resolved, Rummel says, the rover could be headed for a bureaucratic "train wreck."

The office, which has always been limited by a small budget and staff, continues to gauge a spacecraft's "bioburden" based on a classic measure—the number of cultivable microbial spores it carries. "Some of the numbers we've been operating on date back decades, and it'd be great to revisit them," says Sarah Johnson, a planetary scientist at Georgetown University in Washington, D.C. She thinks the office should take advantage of two innovations: chemicals that can separate DNA from dead and living cells, and genomic sequencers that can classify living microbes by type. Scientists could then, for example, assess their individual likelihoods of surviving on Mars.

As a member of the Curiosity team, Johnson would like to see a change in policy that would allow the rover to sidle up to the wet streaks to give them a close look, even if the drill itself—on the fritz since December 2016—could not be used. In their op-ed, Fairén and his colleagues go further, saying NASA should slightly lower its sterilization standards so that robots as clean as Curiosity could explore special regions. Fairén says there is growing evidence that the harsh environment on the martian surface—a combination of frigid temperatures, caustic chemicals, and deadly cosmic radiation—would kill Earth's microbes quickly, especially in the limited numbers that ride along with robots. Even if some survive, he adds, future missions could distinguish between earthly and martian microbes by sequencing their genomes.

Rummel, who is now at the SETI Institute in Mountain View, California, plans to submit a rebuttal to *Astrobiology*. He disagrees with Fairén's assumption that contamination from robots won't spread, but that it would from human exploration. Rummel says Fairén also makes technical mistakes in his paper, like insisting that the 1967 Outer Space Treaty would have to be amended to reflect the planetary protection changes he proposes—it wouldn't.

Whether NASA's policy might change won't be clear until a new planetary protection chief is installed, and after the National Academies panel and special regions workshop have weighed in. But some planetary scientists aren't losing too much sleep over the debate. Jim Kasting, a geoscientist at Pennsylvania State University in State College, says that the soil on Mars has proved to be so lethal that the "chances of finding life in the martian near-surface environment are close to nil." ■

PUBLIC HEALTH

Revolutionary malaria tests have unexpected downsides

Despite rapid tests, health workers undertreat malaria—and overuse antibiotics—a big new study shows

By Leslie Roberts

A simple fix to a major public health challenge has turned out to be not so simple after all.

In the early 2000s, researchers developed rapid diagnostic tests (RDTs) for malaria, a major childhood killer. Simple as a home pregnancy kit, RDTs need just one drop of blood from a finger prick to detect malaria parasites. They enabled health workers in remote villages in Africa and Asia to accurately and almost instantly tell whether a patient with fever has malaria, making them less likely to overuse the new generation of "wonder drugs," artemisinin-based combination therapies (ACTs), which were in danger of being lost to drug resistance.

The use of RDTs skyrocketed after the World Health Organization in 2010 recommended that all suspected cases of malaria be confirmed by a test before treatment; roughly 314 million tests were ordered in 2014. Together with ACTs, they have transformed malaria treatment in poor countries.

But now the largest analysis of RDT use yet, in poor settings in Africa and South Asia, suggests that along with its enormous benefits, the roll-out had unintended—and undesirable—effects. Where RDTs were used,

the number of ACT prescriptions dropped, as hoped. But antibiotic prescriptions surged; at most study sites, 40% to 80% of patients walked away with the drugs, considerably more than needed them. (In one study in Zanzibar, just 22% of children with fever needed an antibiotic.) Such overuse could contribute to the global rise in antibiotic-resistant infections; it's a classic example of when fixing one problem exacerbates another, says Heidi Hopkins of the London School of Hygiene & Tropical Medicine (LSHTM), who along with colleague Katia Bruxvoort led the international team.

Even more concerning, Hopkins says, is that in several settings more than 30% of patients who tested negative for malaria received ACTs, whereas more than 20% who were positive did not, leaving them at risk of severe disease or death.

The work is a synthesis of data from 10 studies conducted by the ACT Consortium in five sub-Saharan countries and Afghanistan between 2007 and 2013, covering 562,368 individual patient visits—an "extraordinary" number, says Patricia Walker, president of the American Society of Tropical Medicine & Hygiene in Oakbrook Terrace, Illinois, which published the paper online on 7 August. The prescribers tended to be volunteers from the



A health worker takes a drop of blood to test a woman for malaria in Lagos in 2016.

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