

# Bacteria for the Win

Gary Singh , San Jose, CA, USA

**B**erkeley-based biotech company MicroByre finds and domesticates novel bacteria, using robotics and automation to rapidly measure and catalog their results. The data are then used to determine what types of “bespoke bacteria” can help transform wasteful biomass into more useful materials, such as fertilizer or jet fuel, thereby reducing reliance on petroleum products to do the same thing.

Of the robots MicroByre uses, the MANTIS Liquid Handler (see cover and Figures 1 and 2) is the most fun one to watch. The MANTIS can transfer tiny volumes, as little as 0.1  $\mu$ L, to a variety of wells in a bacteria plate. The red barn on the front of the console is the MicroByre logo.

MicroByre CEO and cofounder Sarah Richardson says the MANTIS helps MicroByre run many different experiments on the same plate of bacteria, or on many different plates, all in a high throughput manner.

“What we are doing is setting up environments for bacteria to grow in,” Richardson said. “So, we might want to put 40 different chemicals in that environment. We might only want to put five, but we want to be parsimonious about what we use and therefore how much we can test at a time. So, having a human measure all of this stuff out wouldn’t work, especially with small volumes, so the tools we can use manually are not so accurate.”

Instead, MANTIS allows the MicroByre biologists to lay out precise high-volume experiments that are perfectly traceable in the future. The biologists can always go back and determine which bacteria produced which result with which chemicals.

MANTIS fills the plates, which get inoculated with bacteria, and then they go onto another kind of robot, a microbiome reactor, which incubates the plates over time. With certain mixes of chemicals, bacteria will either grow or not grow (see Figure 3).

“The difference between those wells tells us something about how the bacteria work and what they’re capable of,” Richardson said. “When they’re done growing in the bioreactor, we contain them downstream to

other analytics platforms like high performance liquid chromatography or liquid chromatography, mass spectrometry, or hopefully in the future gas chromatography, mass spectrometry.”

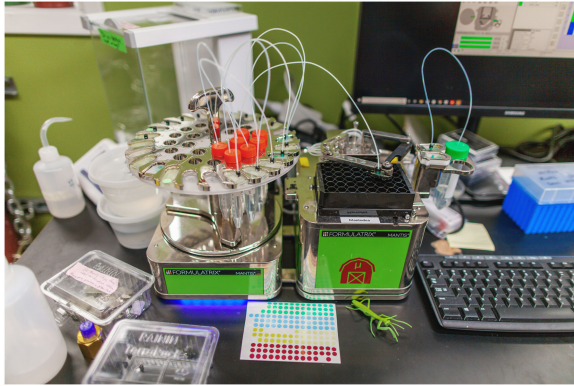
Since first building their bacteria library and the resulting dataset nearly six years ago, MicroByre now claims to know more about bacteria than any other organization on Earth, convincing Richardson that bacteria can work wonders if properly trained. For example, MicroByre has already domesticated bacteria capable of creating the chemicals that can be used to make diapers or cell phone parts.

The potential is enormous. Rather than letting fresh biomass pile up and rot, thereby producing carbon dioxide, MicroByre’s work suggests that newly discovered and cultivated bacteria—which loves to feast on fresh biomass, such as lawn clippings or poop—can instead be domesticated and used to create medicines or similar chemicals. If every chemical that can be made from bacteria is indeed eventually made from bacteria—if this research keeps going—then, someday, ideally, no one will ever need petrochemicals to make anything. Domesticating bacteria, optimizing what the bacteria is naturally good at, will be much better for the climate. Planet Earth will be happier.

## FIRST CONTACT

Richardson helped start MicroByre in 2017. Going back even further, Richardson says her passion for novel bacteria originated with reading science fiction as a kid. She dreamed of being an astronaut, or at least traveling to far-away places and meeting other life forms. Then as a high school student, she was accepted into a science program at Johns Hopkins University School of Medicine, where she first saw scientific research in action. It made her realize that life on Earth contained a plethora of mysteries to investigate. Earth was just as exciting as any alien world. She continued on to the University of Maryland to study cell biology and molecular genetics, learning much about microbes. She then began a graduate program at Johns Hopkins University in the same laboratory where she worked as a teenager.

At the same time, science fiction, especially how it can be creative or noncreative, continued to reinforce Richardson’s passion for bacteria here on Earth. For example, *Star Trek*, both the *Next Generation* and reruns



**FIGURE 1.** MANTIS Liquid Handler at MicroByre, courtesy of the Tech Interactive.



**FIGURE 2.** MicroByre biologist, courtesy of the Tech Interactive.

of the original series, all made first contact with another species seem like a very approachable, friendly experience. Just stick it out and you will find a channel to communicate productively or at least neutrally with another species.

Yet this was not the only perspective. Soon after she started MicroByre, Richardson read *The Three Body Problem* trilogy by Liu Cixin. Unlike *Star Trek*, a more dystopian thesis emerged. The universe was a dark forest, a resource-constrained place filled with predators behind every tree that would kill you for your resources. There was no such thing as a mutually beneficial first contact. You had to kill or be killed. Such a polarizing set of perspectives could not be the only way to experience first contact.

"I believe there's something in the middle," Richardson said, emphasizing that life on Earth was filled with amazing mystery. She cited the Ebola virus as an example. When scientists kept saying they did not know where Ebola came from, Richardson says what they meant was that some unknown reservoir existed, somewhere, in the wild.

"What that told me is that there are unexplored frontiers on this planet, and therefore I could go make first contact on this planet," she said.

## LAUREATE LIFE

In October of 2022, The Tech Interactive in San Jose recognized MicroByre as one of its Tech Laureates, annual awards given by the museum to innovators who harness technology's power to benefit humanity on a global scale. The laureates then individually take the stage to answer questions and address an audience of old-school Silicon



**FIGURE 3.** Petri dishes at MicoByre, courtesy of the Tech Interactive.

Valley power brokers, each a specialist in his or her own field, but who probably doesn't know the technical details of each Laureate's project.

"The challenge, always, for me, for an audience that is not technical, is to get them to laugh," Richardson told me, emphasizing that humor—especially jokes about bacteria in animal poop—always seem to break the ice. It gets people to lower their shoulders a little bit. Everyone loves a good poop joke.

"Then I can sneak in with the analogies and get them to understand, because what we're doing, we can get into great technical detail, but at its heart, we're just domesticating bacteria," she said. "It's not any different than breeding a dog, really."

**GARY SINGH** lives and works in San Jose, CA, USA. Contact him at <http://www.garysingh.info/>.