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LIFE | IDEAS | R AND D

The Bacteria That Can Help Find Land Mines

Israeli scientists say that a harmless, genetically engineered version of E. coli can detect invisible vapors that explosives emit over time

Scientists at the Hebrew University of Jerusalem say they can spot land mines using genetically engineered bacteria and a laser-based scanner. PHOTO: HEBREW UNIVERSITY

By Daniel Akst
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In 2015, land mines killed or injured 3,233 people in 61 countries, according to the International Campaign to Ban Landmines—and 78% of those casualties were civilians. Buried explosives can remain armed and lethal long after wars end.

One key problem is detecting the mines, which can be slow, hazardous work. Current methods, which rely on metal detectors, X-rays and other legacy

technologies, often require placing people or animals dangerously close to buried explosives.

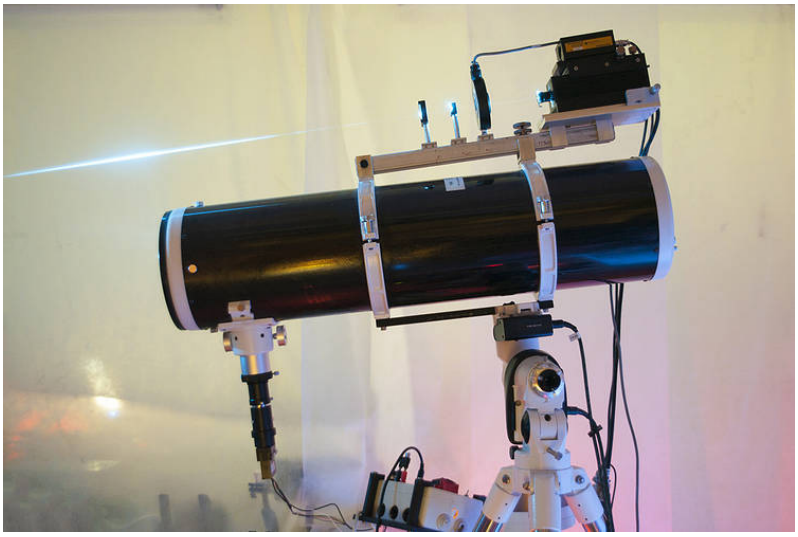
Now scientists at Israel's Hebrew University, reviving an American technology, have demonstrated a way of detecting land mines using genetically engineered bacteria and a laser-based scanner. The technique works, they say, without sending people, animals or even robots into harm's way—and could eventually be extended to detect a host of different contaminants in a range of settings by tailoring bacteria as needed.

The technology, pioneered in the late 1990s at the Oak Ridge National Laboratory in Tennessee, hinges on the invisible vapors that land mines emit over time. Shimshon Belkin, one of the Israeli scientists, explains that land mines usually contain TNT, which gives off a degradation product called DNT. "DNT is the best signature chemical for explosives in general and land mines in particular," says Dr. Belkin.

The Israeli scientists developed a version of E. coli that reacts to DNT in soil by producing a green, fluorescent protein. Although not visible to the naked eye, this fluorescence can be excited by a laser built into a scanning device that reports its findings to a computer. Best of all, the bacteria can be distributed without setting off any explosives, and the scanning can be done from a safe distance.

In an experiment reported in a recent peer-reviewed letter to the scientific journal Nature Biotechnology, the scientists tried the technology on a plot of land about 12 feet by 4 feet that contained TNT-laden antipersonnel mines that lacked trigger mechanisms. Over this ground, the researchers manually spread their bacteria, which they had encased in 3-millimeter beads made of an algae extract that lets the explosive vapors pass through. Dr. Belkin says that the bacteria are harmless and designed to die after just a few hours outside the laboratory.

That is about how long it takes for the technology to find the mines. Scanning from 22 yards away, the scientists detected all 13 samples variously buried in sand for three to five months, with no false positives. On the other hand, the scientists failed to detect four mines they had buried in garden soil just five days before the experiment ended. They believe it's because there wasn't enough time for the mines to emit a detectable amount of DNT, or because organic material in the soil soaked up the emissions before they could reach the bacteria. A subsequent trial will address this question, Dr. Belkin says.



This laser-based scanning system has been used to locate buried land mines. PHOTO: HEBREW UNIVERSITY

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The Israeli scientists readily acknowledge that the basic approach (using different bacteria) was patented by American researchers in 1999 but say it has since lain dormant. Robert Burlage, a microbiologist who led the research when he was at Oak Ridge, says that the patent has expired and that he never published the work in scientific journals. He says the Oak Ridge results were strong, but Defense Department funding ran dry.

Dr. Burlage is now a professor in a pharmacy school in Wisconsin. As for the Israeli scientists, "I wish them all the luck in the world," he says, adding: "I'd love to clear minefields all over the world."

"Remote detection of buried landmines using a bacterial sensor," Shimshon Belkin, Sharon Yagur-Kroll, Yossef Kabessa, Victor Korouma, Tali Septon, Yonatan Anati, Cheinat Zohar-Perez, Zahi Rabinovitz, Amos Nussinovitch and Aharon J. Agranat, Nature Biotechnology (April 11)

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