Researchers are generally cautious about setting aside dust as a killer. "This is a very complicated problem," says atmospheric physicist Brian Toon of the University of Colorado, Boulder. "We're all inferring this. The relation between big and small particles is not obvious."

Planetary physicist Kevin Zahnle of NASA's Ames Research Center in Mountain View, California, tends to agree that dust was not the likely killer, but he's not persuaded by Pope's evidence. He, Toon, and others have estimated that 10-kilometer impactors would produce huge amounts of dust. But Zahnle acknowledges that if dust really can trigger major extinctions, there should have been many impact-triggered extinctions in the past few hundred million years, because there have been many impactors larger than the few-kilometer minimum for a global dust cloud. Yet, none besides the dinosaur killer has been proven, so Zahnle now leans toward global fire and its sun-blocking smoke. Such fires would come from vapor condensing into blazing-hot droplets that fall to the surface, radiating heat on the way down; only an impactor 10 kilometers in size or larger could throw up enough vapor to set the planet on fire.

"Everyone has their own favorite mechanism," says Zahnle. "We don't know the facts, so you operate from your intuition."

If dust really isn't to blame, then the environmental punch of larger impacts would be less than researchers have generally assumed, and encounters with smaller objects might be less disastrous. But, as Zahnle cautions, because the only data come from a single huge example, taking a lesson from the death of the dinosaurs is fraught with difficulty.

–RICHARD A. KERR

ANALYTICAL CHEMISTRY

New Test Could Speed Bioweapon Detection

Last fall's anthrax attacks in the United States exposed more than the potential dangers of terrorism by mail. They also showed that current schemes for detecting the deadly bacterium carry an unwelcome trade-off: They're either fast but prone to mistakes, or highly accurate but slow (*Science*, 9 November 2001, p. 1266).

Much the same can be said for tests to detect other pathogens, including both potential biowarfare agents such as smallpox and botulism and more common threats such as the bacteria that cause strep throat and other infections. But a new way to detect specific DNA sequences offers hope for swift and accurate microbe detection.

On page 1503, three researchers at Northwestern University in Evanston, Illinois, report creating simple electronic chips that can detect DNA from anthrax and other organisms in minutes. The chips appear to be vastly more sensitive than other high-speed techniques. And, unlike many such tests, they don't rely on the polymerase chain reaction. This procedure, commonly used to amplify snippets of DNA, can be tricky to carry out and sometimes introduces unwanted errors.

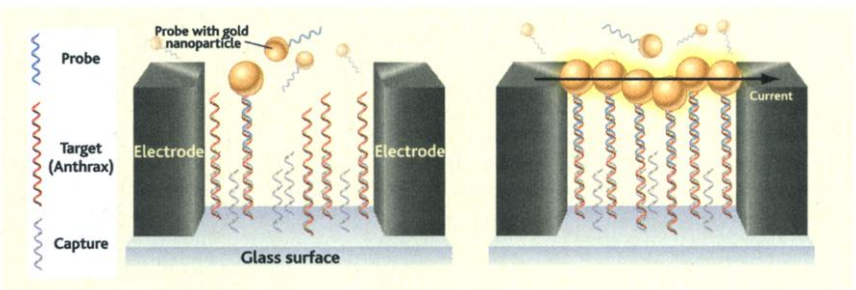
The new test is "a very clever idea that would lend itself to very inexpensive [diagnostic] devices," says Stephen Morse, a molecular biologist at Columbia University's Mailman School of Public Health and former program manager of the Advanced Diagnostics Program at the Defense Advanced Research Projects Agency. "It sounds like this technique has a lot of potential."

The work grew out of earlier experiments, in which Northwestern University chemist Chad Mirkin and colleagues linked DNA to microscopic specks of metal, known as nanoparticles, to create chemical complexes that changed color in the presence of a target DNA strand (*Science*, 22 August 1997, p. 1036). But because it takes a fair amount of target DNA to produce the color change, Mirkin decided to look for a more sensitive test.

Mirkin and group members So-Jung Park and T. Andrew Taton (who is now at the University of Minnesota, Twin Cities) devised a two-part scheme for first capturing their DNA-based target, then converting that DNA into a wire to carry an electrical current between two electrodes. The researchers started by placing a pair of electrodes 20 millionths of a meter apart atop a glass microscope slide. To the glass surface between the electrodes, they anchored numerous identical snippets of single-stranded DNA, each designed to bind to one end of complementary DNA from the target organism: the anthrax bacterium. The team then immersed the setup in a beaker containing the target DNA and waited a few minutes while the chip-bound DNA yanked the target strands out of solution, filling the space between the electrodes with a patchy lawn of anthrax DNA.

To turn those DNA strands into a wire, Mirkin's group created a second set of single-stranded DNAs, called "probe" strands. One end of each probe was designed to bind to the free end of the target DNA strand; the other end toted a tiny gold particle. When the probes were added to the solution and found their targets, they towed the gold particles into position between the two electrodes. These gold particles act like steppingstones in a river to carry electrical current between the shores of the two electrodes, Mirkin says. The electrical DNA detector could spot anthrax DNA in concentrations of just 500 femtomolar, orders of magnitude more sensitive than current high-speed detection schemes.

The test turned out to be highly selective as well. All current DNA hybridization techniques are plagued by mismatches in which DNA strands that differ from the target by just one or two nucleotide bases also bind to capture strands, threatening false-positive readings. Because mismatched DNA doesn't bind as tightly to its partner as perfectly matched pairs do, researchers typically dislodge mismatched strands by heating their samples. But that requires additional equipment to heat and cool the samples.



Golden gate. New technique detects target DNA (here, anthrax) by using it to link fixed "capture strands" with "probe strands" attached to current-carrying gold nanoparticles.

Mirkin's team found that adding a little salt produces the same result. Adding a solution with the right amount of salt, the Northwestern researchers discovered, forced target strands with even a single mismatch to shake loose, leaving behind only the fully complementary DNA sequences they were seeking.

"The salt work is a very nice development," says Dan Feldheim, a chemist at North Carolina State University in Raleigh. Eliminating the need for heating and cooling elements, he says, should make future DNA-detection devices both small and cheap.

Another potential advantage is versatility. Mirkin and colleagues can pack their electrical DNA detectors into arrays that look for different target DNAs simultaneously. Such multitasking could pave the way for hand-held readers that scan for a battery of different infectious agents. Mirkin is already associated with a company called Nanosphere that he says is likely to commercialize this work.

–ROBERT F. SERVICE

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