Science and Technology: Screening for screams; Bacteriology

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A rapid method of identifying dangerous bacteria

AT THE moment, identifying bacteria is a time-consuming business that involves taking a sample, adding nutrients, incubating the result and waiting until there is a large enough colony to test chemically. This can take hours. It would help patients (and, if it came to a terrorist attack involving bacteria, it would help the authorities, too) if this process could be speeded up. According to Laszlo Kish and Maria King, of Texas A&M University, it can be. Using a combination of virology and, surprisingly, microelectronics, they have devised a technique for identifying small quantities of bacteria in minutes.

The virological part of the test involves bacteriophages. Phages are viruses that attack bacteria with the same verve that some other viral species attack people. But phages are choosy about their prey. Most species can parasitise only a single sort of bacterium. In the past, bacteria-detection researchers have tried to exploit this specificity using conventional techniques: culturing samples, infecting them, and then testing for by-products of bacterial death. Though the results are often clearer than for ordinary assays, they still take a long time to arrive--too long for some patients.

That is where the second prong of Dr Kish's and Dr King's research kicks in. They realised that you do not have to wait until the bacteria die before you can tell whether they have been infected. Phages start their attack by injecting DNA into their victims. When this happens, there is a short-lived flow of ions (electrically charged atoms and molecules) out of the bacterium. This phenomenon, whimsically described as the bacterium "bleeding" or "screaming", is the first proof that the phage has found its target. Detect the scream and you know what type of bacterium you are dealing with.

The problem is "hearing" the scream. The signal created by the liberated ions would be hard enough to detect if all those ions were flowing in the same direction, and thus producing an electric current. But since they move off at random, even that minuscule current quickly vanishes.

The solution Dr Kish and Dr King have come up with is a device that can detect activity over a small enough distance for the current not to have vanished. It is called, with that delight in creating forced acronyms that plagues many branches of science, "sensing of phage-triggered ion cascade", or SEPTIC. It consists of a so-called nano-well into which the sample is decanted and which contains a capacitor with a gap of just 150 nanometres (billionths of a metre) between its plates.

A capacitor is a routine electronic component, and capacitors of such minute dimensions are found by the zillion in computer chips. They consist of two electrodes known, by historical analogy with the structure of their ancient macroscopic ancestors, as plates. The plates are separated by an insulator, and if a positive charge is put on one plate and a negative charge on the other, the whole arrangement can act as a temporary electrical store.

If a drop of liquid containing the phage-infected sample is put between the plates, though, it will change the properties of the capacitor by changing the voltage between the plates. Any ions released into the liquid will change things further. And such changes can be detected in the electrical circuitry attached to the capacitor.

Initial tests of SEPTIC on that workhorse of all bacteriologists, E. coli, show that it works, and the team seems confident that similar results will be found with anthrax, plague, botulism and shigella. So next time an envelope containing white powder turns up in the post room, you will not have to wait long to find out whether it is dangerous. Better still, doctors will be sure from almost the outset that they are giving the correct antibiotic to infected patients. That should greatly improve the medicine's usefulness.