

**James M Benecke** explores how microbial forensics is being employed to route out the source of biological terrorist attacks

# THE FIGHT BA BIOLOGICAL

Most people are familiar with the cases of anthrax letters being sent through the US postal system shortly after the attacks of 11 September 2001. The investigation into those letters was code named Amerithrax and consisted of more than 25 full-time investigators from multiple agencies logging hundreds of thousands of work hours and resulted in the suicide of a person of interest working for the United States Army who charges were about to be brought against. A lot of this is known, what most people don't realise is that the investigations into the anthrax letters lead to the development of new scientific techniques that allowed not only the strain of anthrax to be determined, but also allowed scientists to determine the exact laboratory from which it had been cultivated. This is arguably the birthplace of microbial forensics and most definitely the commencement of its use as a tool in investigating biological terrorism.

There are many theorised investigative applications for the future of microbial forensics. This is possible because humans die with over 45 times more genes than the number that they were born with. This is due to the accumulation of microscopic organisms over the normal course of human development and life. Most of these microscopic organisms are transmissible and the makeup of this portion of additional life as part of the human varies to a degree from person to person. Given that this microbial community varies from person to person, we can assume that it is able to or will at some point be able to be individualised. Additionally given that most of this microbial community is transmissible, we can assume when taken into account with Locard's exchange principal that some of this entity will be transferred whenever contact is made with another surface.

Think about your family tree and how your cousins, many times removed, who live in Europe and you have never met can be definitively identified genetically as your relatives even though your genetic connection dates back dozens of generations. This same principle can be applied to the microorganisms living as a part of you. When you touch a surface and transfer a portion of that microbial community to that surface it continues to grow and change since being biological, it is by definition alive. The 'microbial aura' that surrounds you is always growing and changing, but using the same principles that connect you to your European cousins; the transferred microbial sample can be connected to the one currently living with you and matched through genetics like a microbial

“**Biological weaponry has been in use since the 14th century**”

fingerprint. To illustrate the uniqueness of the microbial aura one paper published in the UC Davis Legal Studies Research Paper Series noted that: “(T)he palm surface of any two individuals share only 13 percent of the same bacterial phylotypes”.

During the Amerithrax investigation it became clear that simply knowing what biological substance was used was not going to be enough to discover the source of the material and with it the perpetrator or perpetrators of the attacks. As such, forensic analysis was applied in a way that the required information could be obtained. The BioSciences Division, Research & Technology Directorate at the Edgewood Chemical Biological Center states that: “The emerging subfield of microbial forensics, (scientific principles applied to the acquisition, analysis, and interpretation of evidence) are now being applied to the analysis of microbial materials, including potential and actual biocrime agents”. The identification of the biological agent had to go down deeper to the exact strain that was used and even then, more specificity would be required. As stated by the Co-director of the Centre for the Deterrence of Biowarfare and Bioterrorism, microbial forensics provides “much greater detail to determine the precise strain and substrain”. In doing so, the source of the anthrax was eventually traced to a vat from the United States Army Medical Research Institute for Infectious Diseases (USAMRIID) laboratory and a person of interest was identified. This biological terror event is probably the most well known today, but was far from the first or the only.

The CDC defines bioterrorism “as the deliberate release of viruses, bacteria or other agents used to cause illness or death in people, and also in animals or plants”. Different agencies, however, have different definitions and for the purpose of this feature we will add to the CDC definition by saying the goal of that deliberate release should have the motivation of pushing an agenda by instilling fear or terror in the population. Biological weaponry has been in use (though not widely accepted)



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**Hazardous material workers searching for anthrax on Capitol Hill, Washington DC**

# ACK AGAINST TERRORISM



in one form or another since at least the 14th century.

The Amerithrax incident is perhaps the most well-known biological terrorism attack in recent years, but it is interesting to point out that Aum Shinrikyo – a terrorist organisation more commonly known for its sarin nerve agent attack in Japan – had an anthrax program and was very interested in pursuing biological weapons more thoroughly.

Terrorist organisations around the world are keen to

develop a biological weapon capability. Biological attacks can go undetected until symptoms start to manifest in multiple individuals and are likely to cause panic and fear throughout the population, affecting everything from the amount of time the average person spends outside their home to national commerce.

When it comes to responding to a biological terrorism event, the level of preparedness to deal with it depends on where it occurs and how far it spreads.

# THE FIGHT BACK AGAINST BIOLOGICAL TERRORISM



*Personnel from the Self Defence Agency are seen clearing sarin off platforms after the 1995 gas attack on Tokyo's subways*

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Different countries and even different counties and regions within those countries have different capabilities, funding, resources and interest in preparing for such a biological terror event. A 2015 study published in *Homeland Security & Emergency Management* cited many difficulties that local assets may face in a biological terror event; two of these seemed to be due to lack of familiarity. The study stated that local and government officials as well as incident responders just did not know much about the hazards or the mitigation capabilities and that the lack of knowledge led to a diminished ability to make appropriate choices in the event of a biological terror attack situation.

The results of this study that took place in Colorado can be seen throughout the world. A lot of money is invested in nuclear weapons, with defence being the biggest ball on the court. Chemical defence also gets more attention given the widespread use during World War II, events like the sarin attacks on the Tokyo subway and even industrial accidents that occur more frequently than anyone would like. That being said, according to a paper put out by the Military Institute of Preventive Medicine in Belgrade, Serbia: "Biological weapons are nearly as easy to develop, far more lethal, and easier to deliver than chemical weapons and, unlike nuclear weapons, they are inexpensive to produce and the risk of detection is low. Progress in molecular biology has made fast and easy biotoxin production possible". This statement is not a fanciful one and when you include the ease of information availability given the internet, all that is really needed is for a little source material to be cultivated. Many developed nations initiated biological weapons programs in the late 1920s and continued until the creation of the Biological and Toxin Weapon Convention (BTWC) in 1972 and some even beyond.

This means that many of these nations had the source material required to create biological weapons. However, not all nations are alike, and while the programs should have been dismantled and the source material safely destroyed or transferred to a suitably secure environment, this may not have always been the case. With the knowhow and the material being available it is only a matter of time before we see another biological terror event.

When the time comes for the next biological terror event, microbial forensics will play a bigger and much smoother role than it has in the past. Having learned the lessons from the Amerithrax investigation we now know – and will know at the initiation of the investigation – how important microbial forensics will be in identifying the source of the material and therefore a suspect in the case. As discussed earlier, simply identifying the type of biological material will do little to really help to narrow down the suspected source of the material itself. But the identification of the particular strain and even the substrain will be vital in figuring out where the biological material originated from. That being said, from a very early stage the investigation will strive to identify the biological material at a level of scrutiny that will allow for this type of characterisation. If that happens as it should, the point at which the origin of the source material is identified should happen much quicker than it would have otherwise; allowing for the investigation to narrow its scope and identify a perpetrator or perpetrators to ensure we can act to counter the potential proliferation of the attack.

Microbial forensics may have a plethora of uses in the future to include person to biological trace evidence, but it has a vital niche in biological attack incidents that no other technique is currently capable of filling.

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