Mission impossible?

A new Department of Homeland Security is to be given the task of defending the United States against further terrorist attacks. Geoff Brumfiel outlines the challenges facing its research wing.

One year ago, on a crisp and gloriously sunny morning, the United States' sense of domestic invulnerability was shattered. Grief, shock and anger over the attacks on the World Trade Center and the Pentagon have since been joined by anxiety about the nation's ability to prevent future outrages. This has been fuelled by media criticism of intelligence agencies' failure to warn of al-Qaeda's assault, and of the government's handling of the subsequent anthrax mailings — for which a perpetrator has yet to be identified.

In an attempt to reassure a troubled public, President George W. Bush unveiled plans on 6 June to upgrade the existing Office of Homeland Security, created in the aftermath of the 11 September attacks, to a full department of the federal government. Research is an integral part of the plan. "Our scientific community is serving on the front lines of this war," Bush told researchers in a speech at the Argonne National Laboratory in Illinois in July. "You all know better than anybody, when we research and we set priorities, this great nation can achieve any objective."

With bills to establish the Department of Homeland Security still being considered by the Congress, the details remain unclear. But the department is likely to have a budget of \$32 billion a year, including several hundred million for research. It will also help to manage the much larger sum requested for biodefence research under the National Institutes of Health (NIH).

Counter-terrorism experts agree that science will be key to addressing the threat. But they warn that the department's research

Devastating: satellite pictures of Manhattan and the Pentagon the day after the 11 September attacks.

wing faces some major challenges. First, it must interact with the department's operational divisions, many of which will be plucked from other agencies with no strong scientific culture. Second, it must coordinate its own activities with other agencies and departments whose research efforts feed into the homeland-security agenda. Above all, it must respond to a nebulous threat. "Everybody moving into this department will require exceptional talents," observes Parney Albright, assistant director for homeland and national security at the White House Office of Science and Technology Policy.

A tricky target

Scientific research has long been central to US national security policy. Throughout the cold war, US researchers strove to develop better weapons and intelligence-gathering technologies than their Soviet counterparts. But when confronting terrorism, where the threats are diverse and hard to assess, it is not so easy to set research priorities. "It's going to be more complex than building a rocket or a nuclear weapon," says Page Stoutland, deputy division leader for counter-terrorism at the Lawrence Livermore National Laboratory in California.

The main concern is the possibility of terrorists gaining weapons of mass destruction. These include a long list of potential chemical and biological weapons — and, even if nuclear weapons are beyond their grasp, terrorists might be able to put radioactive material into a 'dirty' conventional bomb. One key challenge for the department's research wing will be to develop technologies to detect

any attack rapidly, determine its source and respond quickly to mitigate its effects.

According to counter-terrorism experts, the threat from biological weapons is a top priority for research. There are clear vulnerabilities to be addressed, and the promise of developing the means to mitigate attacks. Last year's anthrax mailings, for instance, might have killed many more than their five victims, had the bacterium used been resistant to antibiotics. Although anthrax cannot spread from person to person, other potential bioweapons — the smallpox virus, for example — are communicable. In these cases, the ability to identify rapidly when an attack has occurred, to deploy vaccines, and to isolate and treat infected people will be crucial.

But an enormous amount of work remains to be done. "The development of new vaccines, antiviral drugs and antitoxins is in a pretty sorry state," says Steven Block, a biophysicist at Stanford University in California who is a member of the JASONs, a group of scientists that advises the US government on issues such as bioweapons. Block believes that basic research into disease pathology and immune responses will help to counter a broad range of threats. It may be possible, for example, to develop generic vaccine technologies that could quickly be applied against any agent — even one genetically modified to increase its potency.

"This research's utility goes beyond the next bioweapon attack," agrees Claire Fraser, who heads The Institute for Genomic Research in Rockville, Maryland, which has sequenced the anthrax bacterium's genome and helped to analyse the strain used in the

Breached defences: last year's anthrax attacks revealed clear vulnerabilities needing research.

postal attacks. "Understanding the biology of infective agents, improving diagnostics and determining what makes a great vaccine will have a big impact on treating more run-of-the-mill diseases," she says.

But the need to set priorities in biodefence research illustrates the difficulties facing the homeland-security department. Initially, Bush proposed transferring the \$1.75 billion requested for the NIH for biodefence research in 2003 to the new department (see *Nature* **417**, 675; 2002). But the money is now expected to remain within the NIH, with the homeland-security department having joint management responsibility. The NIH will award grants and the new department will help to set priorities. But how this will work has yet to be decided, as have the department's links with other bodies working in the field, such as the Defense Advanced Research Projects Agency (DARPA).

Divided by defence

Tony Fauci, director of the National Institute for Allergy and Infectious Diseases in Bethesda, Maryland, which will run the NIH's biodefence programme, is optimistic about relations with the new department. "We feel that we are well-positioned at the NIH to do the kinds of research that would provide the Department of Homeland Security with what it needs," he says. But Washington insiders and senior scientists warn that joint-management arrangements are fraught with difficulty. "At this point, I'm sceptical whether it's going to put us in a position where things are handled more efficiently than they are now," says Fraser.

The fact that biodefence research will yield results applicable to infectious diseases in general also raises thorny questions about the dissemination of results of interest both to researchers and terrorists. Against this background, bodies that represent biologists

remain suspicious of the new department's involvement. "We really think the research is dual-purpose and that the NIH would be in the best position to set priorities," says Janet Shoemaker, the American Society for Microbiology's director of public affairs.

Another major task for the department's researchers will be developing techniques to identify terrorists before they commit atrocities. "Once a terrorist moves towards his target, half the battle is already lost," says Magnus Ranstorp of the Centre for the Study of Terrorism and Political Violence at the University of St Andrews, UK. He stresses the importance of developing analytical tools to glean information about terrorist activities from the Internet and other communications networks, and from databases such as those held by financial institutions.

Won Kim, president of Cyber Database Solutions in Austin, Texas, says that this will involve research to modify the 'data mining' programs used by banks and other companies to probe their records. "From databases

High alert: public expectations for government action are high following last year's attacks.

of, say, bank transactions and passport controls, this technology can discover unusual patterns that could lead to terrorists," he says.

Refining these tools to comb the vast reaches of cyberspace will be no small task, says David Farber, a computer and information scientist at the University of Pennsylvania in Philadelphia. The challenge, he says, is to develop software that can exceed the capabilities of human analysts in spotting suspicious patterns among reams of data. "It's probably one of the hardest problems in computer science," says Farber.

Here again, the new department's relations with other agencies may present difficulties. Ideally, researchers developing data-mining tools would have access to raw data gathered by the CIA and the FBI. But the proposals currently before Congress do not call for these data to be made available. "There are great sensitivities among existing intelligence agencies," observes William Happer, a physicist at Princeton University in New Jersey who has served on numerous panels advising on civilian and military research.

Lateral thinking

Relations between research and operational divisions will also require attention. The department is to incorporate a diverse range of existing agencies — including the Coast Guard, the Customs Service and the Immigration and Naturalization Service — many of which have no strong tradition of interacting with in-house researchers to assess their technological needs.

Even the structure of the department's research arm remains hazy, for now. Various strategies have been discussed, including launching new research centres at universities and establishing homeland-security divisions within existing national laboratories. Senator Joseph Lieberman (Democrat, Connecticut), whose staff were working on proposals to establish a homeland-security department before Bush adopted the idea, also favours launching a counterpart to DARPA to explore long-term, innovative projects.

But all of the proposals include the appointment of an undersecretary to run the new department's own research programme and to coordinate with other agencies to ensure the relevance of research across the federal government to the security agenda. The person chosen will require formidable talents. "Whoever runs this needs to be a pretty skilled Washington in-fighter," says Happer.

He or she will also need to move quickly. The legislation establishing the department could be finalized as early as this month, and an immense weight of public expectation will be brought to bear from day one. Says Albright: "As soon as that department unlocks its front doors, the American public is going to expect that we are prepared."

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