

## A health warning on bioterrorism

Scientists should be careful not to exaggerate the usefulness of biological agents as terrorist weapons, and focus their efforts on developing an effective international verification regime.

The spectre of bioterrorism, in which toxic biological agents are released into the atmosphere in an attempt to injure or kill civilians, is not one that tends to elicit a measured response. But a British Royal Society report issued last week manages to sidestep the hysteria that can overtake discussion of the topic. In warning about the dangers of unnecessary panic, suggesting sensible precautions by public-health agencies, and emphasizing the central importance of current negotiations to allow the verification of the Biological Weapons Convention, the Royal Society has managed to hold this volatile issue in badly needed perspective.

The society's report, *Measures for Controlling the Threat from Biological Weapons*, points out that "the effectiveness of [biological weapons] spread in aerosol form against human populations in war or by terrorist activity has not been proven". While rightly warning against complacency about biological weapons, the report adds that "it would seem prudent not to overestimate them".

It could have added that the perceived potential of biological weapons as a terrorist threat seems to grow in proportion to one's distance from actual terrorist activity. The United States has recently made its response to bioterrorism a significant national priority, with an annual budget of \$1.4 billion — about a quarter of it going to research. Yet biological weapons have rarely been used by terrorist groups. The isolated attempt by a well-financed cult to use sarin nerve gas against commuters in Tokyo in 1995, after many previous tries, only emphasizes their relative lack of political or military utility.

The committed terrorist tends to be a ruthless pragmatist with a

clear political agenda. Explosions and even airline hijacks can meet that agenda by attracting publicity and dramatizing specific demands. Letting off poison gas in a public place is a much less effective way of doing either. Even in the movies, terrorists are seldom motivated by the indiscriminate targeting of civilian populations for its own sake.

No such reservations, however, were acknowledged in a report last year from the US Institute of Medicine, *Chemical and Biological Terrorism*. This culminated in an impressive laundry-list of research needs presented by such 'threats'. Tens of millions of dollars of extra research funding have subsequently been ploughed into this topic, and Washington conferences on the subject have been crowded out by hundreds of consultants, contractors and scientists keen to join the action. The creation of demand for such programmes, and their subsequent exploitation, has not been an edifying sight.

The best thing that can be done to safeguard the public from biological weapons, as the Royal Society correctly notes, is for the signatories to the Biological Weapons Convention to agree on a verification regime for the treaty, as they will try to do at a meeting in Geneva next week. Sensible precautions should certainly be taken by military and public-health agencies to prepare for certain types of biological attack. But the panic of an ill-informed public, as the society suggests, could be at least as dangerous as an attack itself — for example, by the disruption caused by mass evacuation in response to a perceived threat. That places an onus on the scientific community to keep such threats in perspective. ■

## Genome sequencing for all

The successful sequencing of a plant pathogen by Brazilian researchers is a political as well as a scientific achievement.

There is a common misconception that only advanced industrialized nations have the wherewithal and skilled human resources needed to achieve cutting-edge science. This misconception is fanned by the number of researchers from developing countries who find it necessary to obtain their research training abroad — and frequently decide not to return, citing a lack of scientific opportunity. But it is given the lie by a paper published in this issue which describes the result of a project carried out by a consortium of research centres in the state of São Paulo in Brazil to sequence the bacterium *Xylella fastidiosa*. This bacterium causes a disease that affects citrus fruit and other important crops, resulting in many millions of dollars of damage each year (see page 151).

As the first public sequence of a free-living plant pathogen, the paper represents a significant scientific milestone. But it also sends a clear political signal, namely both the desire and ability of countries such as Brazil to play in the big league. The sequencing project was deliberately chosen by the project's main funding agency, FAPESP, to play a catalytic role in helping research teams equip themselves for the challenge of the post-genome era. It was also intended to send a signal to Brazil's young scientists that they do not need to leave the country to engage in world-class science. In both respects, it appears to have succeeded.

Of course, sequencing the genome of the bacterium is only the first step towards controlling the damage that it causes. The next is to apply functional genomics to understand how the bacterium's genes operate, opening up routes to possible intervention in limiting its spread by insects. Eventually, knowledge of the genome could provide the information required to breed resistant varieties of the affected crops. This raises a separate set of challenges — to persuade the Brazilian public that transgenic plants can play an important economic role, and at the same time to take firm steps to avoid untoward social and environmental consequences (see page 115).

On the technical side, much of this lies some way in the future. But the success of the *X. fastidiosa* project has already attracted significant expressions of interest for similar projects from other parts of the farming community — one proposal high on the list is for the same sequencing centres to turn their attention to chicken expressed sequence tags (ESTs). It has also given rise to the welcome and relatively unusual phenomenon of an agency in the advanced industrialized world — in this case the US Department of Agriculture, worried about the impact of a variety of *X. fastidiosa* on citrus crops in California — contracting research from a developing country. Both achievements endorse Brazil's determination to enter the post-genome age hand-in-hand with scientists in richer countries. ■