Editorial

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Australia's biota was in for a shock with the arrival of European explorers and settlers. European ships carried people along with plants and animals of both terrestrial and marine varieties. Viruses and microorganisms such as mould and bacteria were inevitable passengers. Some were legitimate travellers; others were stowaways. Some have joined the ranks of the most intractable biosecurity problems in Australia.

Max Whitten (p.4) shares an important perspective on biosecurity with his background as former chief of the CSIRO Division of Entomology, Commonwealth Visitor for the Weeds Cooperative Research Centre and chairman of the Honeybee R&D Council. He says that "agriculture in Australia, since the arrival of Europeans, has been dependent on exotic plant and animal species from across the globe... Our need to import exotic plants and animals, or at least improved genetic stock, will always continue if we wish our primary producers to remain profitable and sustainable." In this context he invites us to look further than the "hand of quarantine" at airports to the biosecurity challenges posed by, for example, weeds and the potential entry of the varroa mite, which can destroy bee populations.

In late 2008 the Beale review of Australia's quarantine and biosecurity arrangements was submitted to the federal government (p.11). The Panel's definition of biosecurity – "the protection of the economy, environment and human health from the negative impacts associated with entry, establishment or spread of exotic pests (including weeds) and diseases" – reiterates Whitten's message about the scope of biosecurity and the implications of its challenges. Included in the review's list of biosecurity risks are urbanisation; movement of people, goods and genetic material; skills shortages; and climate change.

The black and the brown rat are thought to have been introduced to Australia with the First Fleet. The devastating consequences of *Yersinia pestis* infection (aka the plague) via the bites of fleas often harboured by rodents have been extensively documented. Australia and Antarctica are the only continents not naturally inhabited by *Yersinia pestis*, writes David Durrheim, Professor of Public Health Medicine at the University of Newcastle (p.15). According to a World Health Organisation assessment, he says, "in a worst-case scenario, 50 kg of plague bacilli released as an aerosol over a city with five million inhabitants could result in 150,000 cases of pneumonic plague, with two-thirds of those affected requiring hospitalisation and up to 36,000 deaths".

This scenario has remained unrealised, but events with similar potential, such as anthrax-laced letters in the US postal system, have occurred. Smallpox, a disease caused by the variola virus and brought to indigenous Australians by Europeans, was declared eradicated in 1980. Durrheim says that smallpox vaccination also ceased at this time, leaving younger generations vulnerable to an outbreak. He urges the government to advocate strengthening of the Biological and Toxins Weapons Convention, "in particular demanding an enforceable protocol that includes verification and compliance provisions".

Plague and anthrax bacilli, and the viruses that cause smallpox, avian influenza, dengue fever and SARS, are all microorganisms that cause infectious disease. Their invisibility to the human eye and the rapid spread of the diseases they cause necessitate a unique set of biosecurity measures. An Asia–Pacific "converging technologies" meeting in 2007 recognised the importance of information systems in tackling these sorts of biosecurity problems, as well as the

benefits of cross-disciplinary and international cooperation (p.18).

Stephen Prowse of the Australian Biosecurity Cooperative Research Centre for Emerging Infectious Disease explains that emerging diseases – changing to a different form, a different country or a different host – are difficult to predict and can have dire public health, social and economic consequences (p.21). "To be well-prepared to respond to disease outbreaks," says Prowse, "we must develop and retain skilled people in the science of disease research and investigation. As we do not know where and how the next epidemic will emerge, these skills must be transportable and be able to be applied broadly to any disease outbreak."

Just over a decade ago, a "high flyers" think tank with the theme "Emerging Diseases – Ready and Waiting" was organised by the Australian Academy of Science. Two members of the original team – Brian Jones (Western Australian Department of Fisheries) and Martyn Jeggo (CSIRO Livestock Industries) write that much has been done to improve biosecurity during this time, but more action should be taken (p.25). Their retrospective focuses mostly on aquaculture. "Surveys of ports have confirmed that over 250 marine species have been introduced to Australia since colonial days, and many of these are thought to have come either in ballast water or as hull-fouling organisms on ships," they write. One aquatic biosecurity initiative taken since 2004 aims to "develop programs to prevent, watch for and respond to pest incursions anywhere in Australia through a shared funding arrangement between the jurisdictions".

Probability and statistics can be applied to biosecurity in both a retrospective and prospective manner – in the form of biosurveillance. According to David Fox at the Australian Centre for Biometrics (p.29), "this discipline certainly has a role to play in assisting managers, politicians and scientists to make informed decisions about what to monitor, where to monitor and when to monitor".

The First Fleet brought a species of prickly pear to Australia, although not the species that overran millions of hectares in NSW and Queensland in the early 20th century. The settlers planned to extract cochineal dye from the pear's resident cochineal beetles. The monitoring and surveillance of plant pests is vital in any effort to improve biosecurity, says Sarah Wilson of CABI (p.34). "Unlike diseases of humans and animals, there has been no systematic approach to gathering plant pest and disease information on a global scale," she writes. CABI's Global Plant Clinic was set up to help meet this need, with 80 clinics across 10 countries. Wilson explains: "Farmers from the surrounding area can bring a sample of their ailing crop to a 'plant doctor' for a diagnosis and practical advice to improve their crop health… Farmers benefit from improved yields while they provide valuable information on the occurrence of potentially disastrous plant pests and diseases."

The cane toad is a more recent introduction to Australia. It was brought in to Queensland to control the sugar cane beetle, but swiftly overtook the beetle in its invasiveness. Physical and biological controls have proved largely unsuccessful, so Robert Capon and colleagues at the University of Queensland's Institute for Molecular Bioscience are investigating chemical solutions (p.38). Research thus far "raises the possibility that the addition of synthetic tadpole alarm pheromone to controlled waterways (e.g. dams, lakes, streams, irrigation canals) during the breeding season could disrupt normal cane toad development and reduce generational recruitment".

Molecular analysis is the technique of choice to study the lesser grain borer at the Cooperative Research Centre for National Plant Biosecurity (p.42). This borer shows high levels of resistance to the crop fumigant phosphine, posing a threat to a $7 million dollar grain export industry. Strategies include a same-day test to confirm insect resistance and thus to adjust fumigation strategies accordingly. Alternative fumigants are also being considered.

Grain export by ship introduces another aspect of biosecurity. "Reducing the risk of ballast water-mediated invasions represents a significant technological challenge," says Gustaaf Hallegraeff at the University of Tasmania's Institute of Marine and Antarctic Studies (p.45). Once the International Convention for the Control and Management of Ships' Ballast Water and Sediments is ratified by sufficient countries, limits will apply to the number and concentration of certain organisms discharged. Strategies to meet these limits include chemical treatment methods, ballast water retention and ballast-free ship design.