Microbes shaping history

Distinguished science writer **Bernard Dixon** reflects on the past, present and future effects of microbes on our world.

Some time in 1845 *Phytophthora infestans* began to ravage Ireland's previously healthy potato plants – the country's staple food. A million poor folk died in the ensuing famine, and 2 million emigrated for a better life in the New World and Australia. Among those who crossed the Atlantic were two entire families – the Fitzgeralds from Kerry and the Kennedys from Wexford County. So it was that John Fitzgerald Kennedy, born in 1917, was available to become President of the United States in 1960.

The story of late blight of potatoes, recounted in this issue by Gareth Griffith (p. 12), illustrates in both general and particular the huge impact that micro-organisms have had and continue to have on human affairs. Hans Zinsser highlighted another example by giving the title '*On the comparative unimportance of generals*' to one of the chapters in his classic book *Rats, Lice and History*. He pointed out that as Napoleon's armies marched back and forth across the continent of Europe, typhus and other infections struck down far more soldiers on both sides than did the many battles in which they were involved. Gavin Thomas develops this theme on p. 8, while Milton Wainwright (p. 16) discusses the links between World War II, infectious disease and both penicillin (a microbial product) and sulphonamides.

Despite their minuscule measurements, bacteria, viruses and other forms of microscopic life have done incalculable damage and brought incalculable benefits to all other inhabitants of the biosphere. Whether in medicine, agriculture or industry; through their manifold roles in shaping the natural environment, or as a consequence of their influences on the lives and deaths of the powerful and famous, micro-organisms have been major, though usually unheralded players in the history of the world.

Perhaps the most powerful way in which micro-organisms have affected history in recent decades is through their influence on the progress of scientific research. This was already clear half a century ago when Kluyver and van Niel wrote *The Microbe's Contribution to Biology* (Harvard University Press, 1956). In contrast to its modest size, this slim volume was intellectually monumental in reviewing microbial contributions not only to our knowledge of genetics but also to our understanding of evolution, energetics and the unity of all terrestrial life. Far more substantial than today's human celebrities, the iconic figures of bioscience at that time were *Escherichia coli*, *Aspergillus niger* and *Rhodospirillum rubrum*.

Looking back over the emergence of molecular genetics during the past 50 years, from the deciphering of the genetic code to the advent of recombinant DNA, the recognition of the cell cycle and the latest developments in intra- and intercellular signalling, it's clear that bacteria and viruses (especially phages) have been major players at every stage. Genetically modified interferons, insulin and other drugs, which are now saving countless lives and ameliorating many more, comprise just one practical outcome of the knowledge gained from this great collaboration between microbes and humans.

Bacteria are also moving rapidly into clinical practice in their own right (Baker, M., 2005, *Nat Biotechnol* **23**, 645). One that has entered clinical trials recently is *Streptococcus lactis*, genetically modified not to make enamel-eroding lactic acid, which is introduced into the mouth to replace those strains that do rot teeth. Others include a *Lactobacillus lactis* recombinant that secretes a therapeutic protein to help Crohn's disease patients; and a *Lactobacillus crispatus* strain to combat recurrent urinary tract infection. Meanwhile *Clostridium novyi*, an anaerobe that can infect hypoxic regions within tumours, is showing promise as a means of delivering chemotherapeutic agents (Cheong, I. *et al.*, 2006, *Science* **314**, 1308).

Reviewing the scientific insights now being provided by micro-organisms in abundance, one is impressed above all by their diversity. A fast-evolving feline immunodeficiency virus, for example, has revealed details of the population structure and demographic history of its natural wildlife host (the cougar) that were impossible to obtain by any other means (Biek, R. *et al.*, 2006, *Science* **311**, 538). Studies on the deep-sea-living *Photobacterium profundum* have yielded a first glimpse into the molecular basis for life in the largest portion of the biosphere (Vezzi, A. *et al.*, 2005, *Science* **307**, 1459), and single-celled algae have shown how abnormalities in human cilia can explain the basis not only of Bardet–Biedl syndrome but also of many other conditions too (Vogel, G., 2005, *Science* **310**, 216).

Whatever the truth behind contemporary cogitations regarding global warming, it's clear that microbial life will be here long after we have departed, just as it flourished on Earth aeons ahead of our arrival. Those verities alone tell us much about the resilience and diversity of micro-organisms. The articles in this issue of *Microbiology Today* illustrate just four of their countless areas of influence. While human ingenuity has fashioned the fabric of the planet of today, microbial versatility has an even greater range of terrestrial activity to its credit.

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◀ Ruins of stone houses in County Mayo, Ireland, abandoned during the Irish potato famine. *Richard Cummins / Corbis*