



## Physics or be damned!: the crisis in science education and awareness

### Basic science and society

How relevant is modern physics to Australia in the Einstein and World Years of Physics (see box)? Physics provides understanding of how the world and universe works, but its application to everyday life may seem arcane at times. Yet physics is fundamental to the community through computer chips, to imaging lasers and engineering, for example.

If dwindling secondary and tertiary student numbers are any indication, Australian interest in physics as a profession has declined. Often perceived as 'too hard', physics, chemistry and mathematics now languish in student take-up rates. As well, the level of unqualified teaching of physics is rising.<sup>1</sup>

Such trends are not confined to Australia. In the United Kingdom (UK), less than half of all universities now offer basic chemistry degrees. France and Germany report large drops in students doing physical science.<sup>2</sup> By contrast, there is a strong science emphasis in Asian nations.<sup>3</sup>

The Federal Government says that cultural settings make commerce, law and medicine more attractive professions.<sup>4</sup> As well it has programs, to promote science, to improve primary school teacher skills in science, tertiary places, and the [Prime Minister's Prize for Excellence in Science Teaching in Secondary Schools](#).

But questions remain as to the future importance of the physical sciences in this country. This note looks at some of the issues of concern to the science, technology and engineering communities.

### World Year of Physics 2005

This is a worldwide celebration of physics and its importance in our everyday lives. The International Union of Pure and Applied Physics declared the year 2005 as the World Year of Physics coinciding with the centennial celebration of Albert Einstein's 'miraculous year'. The event plans to bring the excitement of physics to the public and inspire a new generation of scientists. See: <http://www.physics2005.org/>.

### Einstein International Year of Physics 2005 in Australia

In 1905 at age 26, Einstein published his theory of relativity that led to  $E=mc^2$ . This and the release of a series of papers changed the study of physics and introduced the idea of light as both particle and wave. The Australian Institute of Physics is supporting a series of events to celebrate the Year: <http://www.aip.org.au/wyop2005/events.php>.

### Science education

So concerned are the Australian academies of science that they have united in urging action. [The Australian Institute of Physics](#), [the Royal Australian Chemical Institute](#), [the Institution of Engineers Australia](#), and [the Australian Mathematical Sciences Council](#) joined forces in 2002 to raise awareness of the issues. The Institution of Engineers notes that science subjects are often not taught at all or taught only on an ad hoc basis in primary schools.<sup>5</sup> It urges a much stronger emphasis on science in schools. [The Australian Academy of Technological Science and Engineering](#) has identified ongoing concerns of inadequate science teacher training, professional

development opportunities, and the associated investments.<sup>6</sup>

According to the [Federation of Australian Scientific and Technological Societies](#) (FASTS), science and mathematics teachers are in short supply in Australia. Yet newly qualified science teachers pay higher HECS fees than other subject teachers in order to cover costs of courses that use expensive equipment and thus take home less pay. To alleviate this inequity, FASTS has advocated better remuneration for science teachers, more professional development, HECS breaks, funding for support facilities and science student career programs. A recent report found a lack of national focus in science education, teaching shortfalls and curriculum limitations at the secondary school level.<sup>7</sup> Even so, there is progress towards a national voluntary system of science teacher certification and standards.

A contrast to this gloomy outlook is the impressive performance of Australia's science students in international rankings and 'Science Olympics'.<sup>8</sup> Australian science students generally perform well above the international average, showing that some teaching and mentor schemes are working very well. It might be argued, however, that this success in science student competition and engineering scores represents a passionate core group's achievements. Those who may also have excelled may not study science due to perceived difficulty, gender difference, poor science teaching experience, or just lack of opportunity.<sup>9</sup>

### Engineering skills

These trends apply similarly to the engineering profession. It has faced

declining interest among school leavers and reduced numbers of tertiary engineering courses. The Australian engineering workforce is ageing, while an increasing number of new graduates go overseas in search of better wages. Of course some will argue that, in an age of global markets, this is not a bad thing. But with Australia's alleged current infrastructure crisis, it may well cost us more in the long run to acquire the skills base necessary to deal with inadequate systems here.

### Women in science

Another aspect of the crisis is the current low level of involvement of women in the physical sciences. According to the Australian Institute of Physics, fewer than 11 per cent of staff in government laboratories, and often less in small academic departments, are female. As well only six of CSIRO's top 45 posts are held by women. Yet women are badly needed to offer talent and diversity of approach to the application of science.

### Science and the economy

In the UK, the engineering and physical science sectors account for 30 per cent of the nation's gross domestic product, 40 per cent of all investment and 75 per cent of all industrial research and development, according to a 2003 report by the [UK Science and Technology Policy Research Unit](#).<sup>10</sup> The analysis confirms the overwhelming importance of the engineering base for many manufacturing activities within the UK. These sectors account for more than 70 per cent of all Value Added Work, Employment, and Investment in plant and machinery in manufacturing. They are of even greater importance in terms of exports, accounting for more than 85 per cent of the total. We could expect similar figures for Australia.

New multidisciplinary issues are challenging science to provide answers to pressing problems. Areas such as energy production, climate change, transportation, crime prevention and detection,

biotechnology and healthcare, and communications all have complex aspects that lie outside the traditional boundaries of the established academic disciplines.

Newer disciplines such as nanotechnology, biotechnology and artificial intelligence offer the potential to mitigate some pressing problems. They also offer the prospect of a bonanza to those nations willing to invest in the future of science and technology and as yet unknown applications.

Australia has neglected some areas of international science. For example, nuclear engineering no longer exists as a faculty stream within any Australian tertiary institution. If Australia ever has the need to develop better expertise in such a discipline, it will obviously have to draw on overseas resources, at uncertain cost and security risk.

### Science meets Parliament

The annual lobbying day 'Science meets Parliament', organised by FASTS, offers parliamentarians an insight into facets of the nation's scientific endeavours. FASTS has found that parliamentarians in general are more likely to be responsive to positive messages and concrete examples of how science is providing economic, social or environmental benefits. To establish a focus, each year the event has also tackled contentious public policy issues, such as the ethics of stem cell use, or the prospect of a global influenza pandemic.

There is a vast gap in the level of sophistication of cutting edge science and ideas, technologies and insights that have a direct bearing on politicians and constituencies. Researchers tend to dwell on their current work and its possible outcomes, and may inadvertently downplay the benefits and spill-overs of past successes. It is probable that this level of connection is a source for the generally low profile of science and technology in Parliament.

One means to overcome this gulf could be through establishment of a [Parliamentary Office of Science and Technology](#) (POST). Such a body serves to inform parliamentarians in the UK. Their POST is an office of the two Houses of Parliament (Commons and Lords). It provides independent and balanced analysis of public policy issues related to science and technology. These areas include IT, environment and health.

1. D. Rood, 'Schools hit by science teacher shortages', *The Age*, 20 April 2005, p. 5.
2. M. Reddy, 'Saving Science', *The Age*, 16 August 2004, p. 6.
3. K. Burke, 'Students drag chain on maths, science', *Sydney Morning Herald*, 15 December 2004, p. 2.
4. M. Reddy, loc. cit.
5. Institution of Engineers Australia, *Encouraging Student Participation in the Enabling Sciences*. Submission to the House of Representatives Standing Committee on Science and Innovation, August 2004.
6. Australian Academy of Technological Science and Engineering, *The Teaching of Science and Technology in Australian Primary Schools a Cause for Concern*, Parkville 2002.
7. S. Holden, 'What's up with Science?', *Educare News*, April 2002, pp. 6-10.
8. K. Burke, loc. cit.
9. M. Bidinost, 'Looking for a breakthrough', *The Age*, 18 March 2003, p. 4.
10. <http://www.sussex.ac.uk/sprutest/documents/pateleps.doc> (26 April 2005).

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