

AUSTRALIA'S SCIENTIFIC ACHIEVEMENTS

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Introduction

Internationally recognised creativity, inventiveness and excellence are major features of Australian science and technology.

Australian research scientists repeatedly demonstrate their capacity to combine creative thinking with the rigorous discipline needed for developing and testing new ideas, resulting in such advances as:

- The Sarich orbital engine;
- Gene shears for genetic engineering;
- Synroc for the stable storage of nuclear waste;
- The Interscan aircraft landing system;
- The ready-mix system of transporting concrete; and
- The 'balloon in a box' wine cask.

Nobel laureates

Vitality and freedom of intellectual movement are also characteristics of Australian scientists. They are highly regarded for their creativity and commitment of excellence.

The Nobel laureates Bragg (X-ray crystallography), Florey (penicillin), Burnet (immunology), Cornforth (steroid synthesis) and Eccles (brain physiology) are Australians or have strong Australian connections.

Australia produces about two per cent of the world's scientific papers - ranking with the US and UK on a per capita basis.

The Australian research and development (R&D) system includes 16 government research agencies, six non-profit institutions, 45 higher-education institutions and private business laboratories.

Government research agencies include the CSIRO, Defence Science and Technology Organisation, Australian Nuclear Science and Technology Organisation and the Telecom Research Laboratories.

Public sector R&D in Australia is highly accessible to industry. Public research bodies have incentives to seek sources of funds other than from governments, and so are encouraged to seek and be receptive to offers of partnership with industry.

Private sector R&D in Australia over the past 10 years has achieved almost the highest growth rate of all OECD countries.

CSIRO — driven by creativity

The CSIRO, with 5500 professional and technical staff performing advanced R&D in almost all fields, is the largest and most comprehensive government R&D agency. Most of CSIRO's 35 divisions have business managers.

CSIRO seeks to transfer its technology, and takes minority equity holdings if necessary. It has such holdings in enterprises in smokeless briquettes, agricultural chemicals, modifying the effects of unwanted genes, growth factors and related peptides, simulation and scheduling systems, and magnesite

processing. However, the organisation usually relies on licensing agreements, of which there are 400.

Other research organisations

Most universities have strong research programs of interest to industry. Higher-education institutions account for about a quarter of the nation's R&D.

Most higher-education institutions have commercial arms to handle contract research and to seek out companies interested in commercialising the results of their research.

Such companies are members of the Australian Tertiary Institutions Consulting Companies Association. Numerous companies and organisations, in Australia and overseas, have links with Australian higher education institutions.

All of Australia's public-sector research organisations and universities, institutes, and government laboratories undertake basic and applied research. Particular strengths include:

- Medical research;
- Bioscience;
- Engineering and manufacturing technology;
- Environmental science; and
- Earth and space science.

Medical research

Australia is renowned in the field of medical research, particularly in fertility, immunology, neuroscience, cardiovascular disorders, genetic engineering and nutrition.

Bioscience

In bioscience, Australia's strength is in botany, as well as in animal and plant physiology, veterinary science, food science and marine biology. Aspects of biotechnology and molecular science are also strong specialities.

Along with the development of gene shears, notable successes include the development of new breeds of poultry, a new pest-resistant strain of cotton, and a large black seedless grape.

Two University of Sydney researchers devised a chemical process to boost the production of the anti-malarial drug derived from the Chinese plant qinghao (*Artemisia anna*).

This is the key to collaboration between Chinese and Australian scientists that may lead to a cure that has eluded researchers for decades.

The extraction process, patented by the University of Sydney, is being developed by the French pharmaceutical company Rhone-Poulenc in conjunction with the University of Sydney and the Kunming Pharmaceutical Factory in Yunnan, China. An estimated one million people die each year from malaria.

UNESCO has recognised the quality of the research being done by the Uni-

versity of New South Wales Centre for Membrane Technology by signing an agreement making it a UNESCO science centre.

The UNESCO Membrane Centre will provide training in research and application of membranes, and is expected to attract membrane experts from around the world.

University of Queensland researchers have claimed a world first with a technique for circulating blood through a machine in the manner of kidney dialysis to extract fat without affecting blood protein that carries the fat and life-sustaining substances.

If human clinical trials being undertaken are successful, the technique holds the promise of sharply reducing the incidence of coronary heart disease.

Much of Australia's medical research is carried out in specialised institutes or units attached to universities and teaching hospitals. The main institutes carry out research in immunology, physiology and molecular biology, cardiovascular diseases, ageing and diabetes, birth defects, and tropical diseases.

A single drug discovered by the Walter and Eliza Hall Institute, of Melbourne, is being commercialised by Japanese and US interests and is expected to generate sales of about \$1.5 billion a year. The drug, known as G-CSF and registered in Australia in 1993, can be used to control white blood-cell levels during cancer treatment by maintaining bone marrow activity.

Engineering and manufacturing technology

Australia's expertise spans the diverse area of engineering and manufactur-

ing technology. Included in the range of Australia's research and development programs are fibre optics, optoelectronics, remote sensing, materials science, laser applications, software development, industrial control, scientific instruments, solar applications and fluid dynamics.

Results are seen in:

- Advances in Very Large Scale Intergration (VLSI) circuitry;
- Application Specific Intergration Cicuit (ASIC) design;
- Optical character recognition and voice synthesis applied to areas as diverse as astronomy, horse racing and helping blind people;
- Control of complex plastic shapes;
- Optical surface profiling; and
- Advanced ceramics.

The puncture-proof tyre and programmable electronic automatic transmission are specialised innovations in enhanced manufacturing processes, while the Ikara guided anti-submarine missile and the Barra sonobuoy are two examples of research in defence science.

Environmental science

Research in waste management, pollution control and remote-area decontamination is expanding rapidly, and Australia's world leadership in membrane and separation technology is widely recognised.

Australia is pre-eminent in radio-astronomy, ionospheric research and related areas, and Australian research in geology and related sciences and in oceanography and marine sciences has a long tradition of excellence.

Moldflow Proprietary Limited is dedicated to the development and marketing of computer-aided engineering solutions for the plastics injection-moulding industry.

The company pioneered flow technology and has an 80 per cent share of the global market. It exports more than 95 per cent of its product through subsidiaries in the UK, US, Korea and Germany. Moldflow aims to maintain its marketplace advantage by investing 25 per cent of revenue in R&D while working in close partnership with Australian universities.

The CSIRO Sirofloc process uses small particles of magnetite to remove impurities and colour from water. Sirofloc is economical, faster than conventional water treatments, overcomes sludge dispersal problems and avoids the need for large sedimentation tanks.

Large water-treatment plants using Sirofloc are operating in several countries. Using this process, a large-scale sewage treatment plant in Sydney did in 15 minutes what a conventional plant would take more than 10 hours to achieve - it removed 80 per cent of suspended solids and 90 per cent of oils and greases.

The Sirofloc plant is extremely compact, making it suitable for crowded cities.

The Centre for Photovoltaic Devices and Systems at the University of New

South Wales has achieved the four-minute mile of photovoltaic achievement by breaking the 20 per cent efficiency barrier in a solar-electric commercial generator. The centre is striving to further improve efficiency and reduce the cost of photovoltaic cells, providing a pathway to a clean energy future.

Australia's lead in solar-energy research has been recognised by the UN confirmation in June 1993 of Perth, Western Australia, as the first UN Centre for Applications of Solar Energy. This will make Perth the international centre for researching, appraising and marketing solar ideas from around the world.

More than 4500 people have received cochlear implants - bionic ears designed in Australia. Cochlear Proprietary Limited leads the world market. Cochlear's 22-channel implanted electrode array, combined with a sound capture and processing system worn externally, re-awakens the silenced hearing nerve of a profoundly deaf patient through electrical stimulation.

Visually impaired people have also benefited from R&D conducted by Robotron Pty Ltd. The company created the Eureka A4 personal laptop computer for the blind featuring a Braille keyboard, synthesised speech output and inbuilt software including word processing.

Telectronics Pacing Systems is taking part in a joint project with the University of Sydney and the University of New South Wales to design neural network silicon chips small enough to fit into the confined space of a heart pacemaker and consume such minimal power that the pacemaker will last the life of the wearer.

The project follows the finding by Telectronics Pacing Systems, which holds

25 per cent of the world pacemaker market, that neural networks produce better results than the sensing techniques currently used.

At the Aquaculture '92 conference in France, an Australian machine was judged to be 'the invention of greatest significance to aquaculture and had the most potential to generate benefits for the industry'.

The machine was named Baleen, and it mimicked the feeding habits of baleen whales to harvest zooplankton. The zooplankton is size-separated and can be fed to fish in culture tanks. Cooperative research is underway to develop zooplankton farming on an industrial scale.

Australia's highly efficient agricultural industries are partly an outcome of scientific research. Research in primary industries is conducted in a way that encourages end-user participation in the research and research organisation participation in its commercialisation.

The trials of vast distances and extremes of climate overcome by Australia's telecommunications industry are giving Australia a clear advantage in one of the world's fastest growing telecommunications markets.

China, with its similar land mass and even more extreme climate, is embracing Australian technology in its campaign to redevelop its telecommunications infrastructure.

Earth and space science

Technology to detect mineral deposits deeper and with greater accuracy is being developed by researchers at the University of Queensland. The tech-

nique, known as Ground Penetration Radar (GPR) has the potential to boost Australia's coal earnings by \$2.7 billion a year.

GPR will accurately locate stratified layer boundaries so that the technology will allow the economical recovery of 61 million tonnes of black coal in Australia previously believed to be uneconomical.

Productivity in the coal industry has been further enhanced with the application of Mineral Control Instrumentation Ltd's Coalscan 9500. Mining companies are using the equipment to monitor oar grades and sort coal as it is mined. Coalscan 9500 automatically analyses coal for 24 chemical elements.

A water-based water-repellent material developed by researchers at the Victorian University of Technology gives mud bricks a penetration resistance close to that of clay bricks. It has enormous cost-saving potential for developing countries.

The product is being tested in India and at the International Centre for Earth Constructions in Grenoble, France. Construction authorities in Africa and Asia are interested in the development.

Source: DFAT