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ANSTO Technology

PHANTOM PAINS OF THE OPERA HOUSE

ANSTO scientist Dr Robin Walsh and two steeplejacks at work on the main sail of Sydney Opera House.

Along with the world's finest orchestras raising the roof, and the frequent lively renditions of Gilbert and Sullivan rattling the windows, ANSTO scientists have also been regular performers at the Sydney Opera House.

Rather than in an artistic capacity, they have been utilising their scientific expertise to assess the condition of the roof and windows.

ANSTO has been subcontracted by Taywood Engineering Ltd to see whether rainwater is penetrating between the outer roof tiles and the underlying concrete of the largest sail of the Opera House roof.

Finding evidence of water penetration is a tough job as the tiles are firmly bonded to the precast concrete panels. The trick is to remove the tiles without damaging the panels. ANSTO has developed neutron moisture instruments which are ideally suited for these situations as they are non-invasive.

Dr Robin Walsh, leader of ANSTO's Neutron Sources Project, performed preliminary moisture tests on mock-ups of the Opera House roof structure at Lucas Heights before attempting the real thing.

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FROM THE EXECUTIVE DIRECTOR

ANSTO currently has more than $25 million of capital projects underway.

The National Medical Cyclotron is being fabricated in Belgium and the building at Royal Prince Alfred Hospital has commenced. The tandem accelerator building at Lucas Heights has been completed and those for Australian Radioisotopes are well underway.

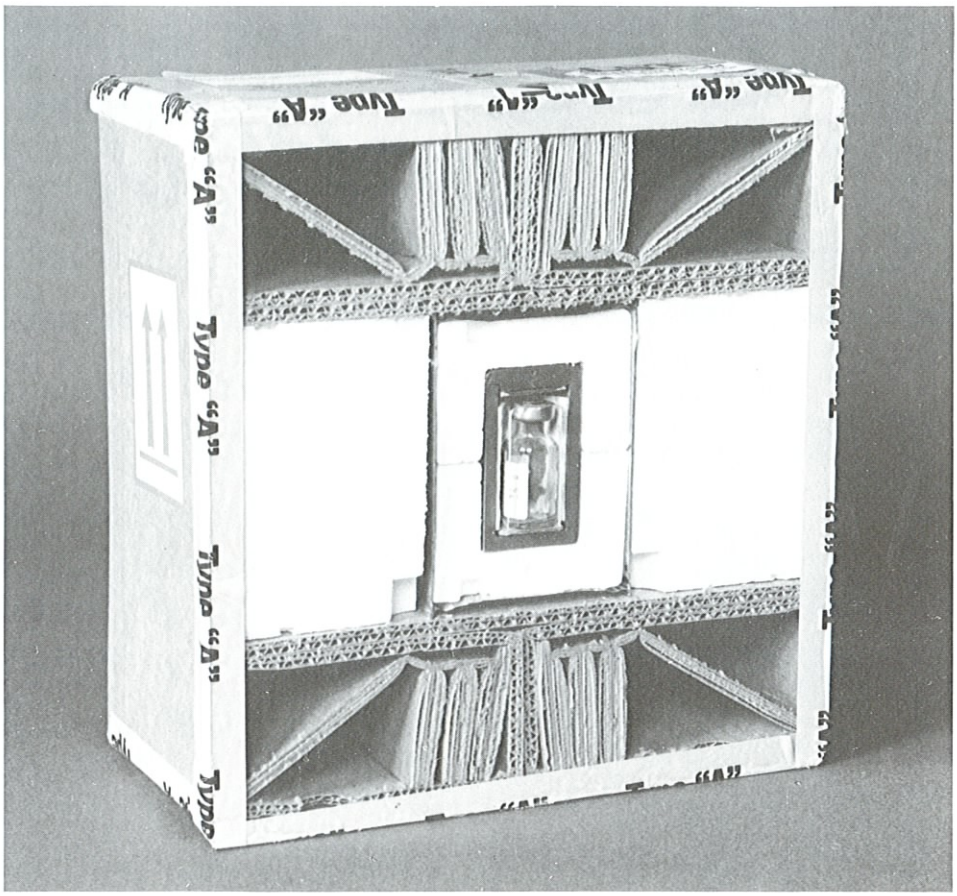
The sod turning ceremony for the Incubator building of the Building and Technology Park was held on February 12.

These projects are integral to the development of ANSTO and to science and technology in Australia.

Modem science is becoming increasingly sophisticated in terms of instrumentation, measurement and facilities. It is only through the provision of modem buildings and equipment that Australian science, and ANSTO, can contribute to the technological development that is vital for our international competitiveness.

David J. Cook

PACKAGING AND TRANSPORT OF RADIOACTIVE MATERIALS



Radiopharmaceuticals are packaged to international standards designed to prevent accidental damage during transit.

Thirty thousand shipments of radioactive materials are made from ANSTO each year.

Australian Radioisotopes (ARI) is ANSTO's commercial centre which manufactures and distributes radioisotopes. Around 85 percent of the products are used in the diagnosis and treatment of disease, with the remainder used in industry, environmental studies and research.

During 1989 about 340,000 Australians benefitted from ARI radioisotopes in nuclear medicine centres around the country. Radioisotopes used for these procedures are short-lived and must be delivered frequently to hospitals and clinics, in many cases daily.

ANSTO's engineering department designs, tests and obtains Department of Transport approval for most of the packages used by ARI. The basic criteria the packages must meet is that they withstand accidental damage and that radiation levels are safe for handling.

Transport containers must comply with stringent international regulations. Radiation levels within the package must be safe to handle and they must withstand accidental damage. Even though most of the packages transported carry relatively small amounts of radioactivity, they are all tested according to strict performance tests specified by the International Atomic Energy Agency.

Radioisotopes supplied by ARI are used by every nuclear medicine centre in Australia and some overseas. Because of the short life of some isotopes it has been essential to establish a very efficient airfreight distribution system. With the cooperation of the airlines, ARI isotopes can be delivered overnight to any destination from Perth to Wellington, New Zealand, Brisbane to Hobart.

IT'S OK TO HAVE WATERLILIES IN YOUR DIET

A local Aborigine collecting waterlilies.

ANSTO has undertaken a study of the uptake of the radioactive element radium-226 by the waterlily *Nymphaea violacea* which grows on the floodplain of Magela Creek, downstream from the Ranger uranium mine in Jabiru, NT.

While ANSTO has funded the majority of the work, the Office of the Supervising Scientist has contributed towards some transport and freight costs.

With two large near-surface uranium ore bodies in the immediate vicinity, the area has naturally high levels of radioactivity.

Portions of the plant are eaten by the local Aboriginals, particularly at the end of the wet season when they are prolific. ANSTO scientists are investigating the extent to which the waterlily may absorb radium should there be releases of mine wastes. The results of this study will be used to make an assessment of the radiological dose from radium-226 to the Aboriginal population.

Scientists analysed the Magela Creek water, sediment and plants for radioactive and other elements to determine the natural concentrations. They also collected samples of the waterlily plants for testing in the ANSTO laboratories.

Plants were exposed to varying degrees of radium contaminated water to study uptake and then transferred into clean water to observe loss rates. Of main interest were the roots and the foliage, the two main paths for radium accumulation.

Older plant tissue was found to accumulate a much higher concentration of radium than that of young healthy plants which were more likely to be harvested. In addition, other elements which may be released from Ranger, such as calcium and magnesium, reduce the waterlily's ability to take up radium.

LOSSES

The study found that the waterlily loses most of the radium it accumulates when exposed to clean water, and there was no significant increase in the environmental concentrations of radium since mining began.

Results obtained to date show that there is no hazard from eating waterlilies collected on the Magela flood plain.

ALLIGATOR RIVER PROJECT EXTENDED

ANSTO scientists collecting water samples from the Koongarra uranium ore body.

The Alligator River Analogue Project (ARAP), an international project sponsored by the Nuclear Energy Association (NEA) to study the migration of radionuclides from the Koongarra uranium ore body in the Northern Territory, has been extended until 1992.

ARAP, which came into existence in 1987 and has been managed on behalf of the NEA by ANSTO, is an important study as it gives a guide to regulatory authorities worldwide on the possible migration of material from high level nuclear waste repositories to the surrounding environment.

In a report to a major meeting on ARAP in Las Vegas in February, project manager Peter Duerden, from ANSTO, said that initial studies indicated that the radionuclides in the Koongarra deposit had migrated about 80 metres in a million years, a result somewhat less than expected.

The project extension was agreed at the same meeting with the focus now directed at the safety assessment needs of the ARAP partners.

SECOND PHASE

The ARAP partners, from Japan, the USA, Sweden and Great Britain, are closely involved in all aspects of the study.

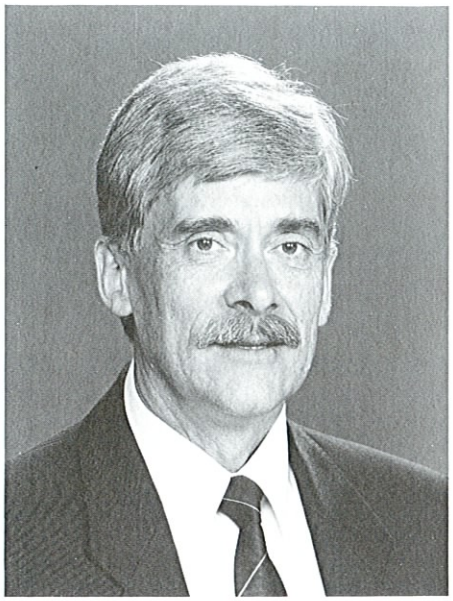
In the second phase of work, until August, 1992, close attention will be paid to the hydrogeology of the ore deposit, the movement and chemistry of the groundwater and interaction between water and rock.

"We need to understand the activity and structure of the water because Koongarra, subject to the extremes of the 'wet' and 'dry' in Northern Australia, is a worst case in water leaching terms for an ore body. The crucial thing to understand is whether the water flows we see now have been stable over a long period of time," Mr Duerden said.

VALIDATION

Parts of the ARAP study will also be subject to assessment by INTRAVAL (International Transport Model Validation) which aims to independently validate the scientific findings. The ARAP project is a test case for INTRAVAL.

NEW DIRECTION FOR BIOMEDICINE AND HEALTH PROGRAM



Professor Len Wiebe

Professor Len Wiebe has been appointed as Director of ANSTO's Biomedicine and Health program.

Born in Canada, Professor Wiebe earned both his initial degree and Masters from the University of Saskatchewan. He was awarded his Ph.D in drug metabolism from Sydney University then returned to Canada where he was a member of the faculty of the University of Alberta.

As Director he is responsible for developing nuclear techniques for diagnosis, treatment and prevention of disease, and providing research support to *Australian Radioisotopes,* an ANSTO subsidiary and the sole producer of radiopharmaceuticals in Australia.

Professor Wiebe's particular interest is in furthering ANSTO's role in the research and application of nuclear medicine internationally, particularly in Asia.

He will continue ANSTO's commitment to keep abreast of new developments in nuclear medicine by using materials like monoclonal antibodies for the detection of blood clots, therapeutic radioisotopes such as dysprosium-165 for the treatment of certain forms of rheumatoid and osteoarthritis and samarium-153 for pain relief in bone cancer patients.

He will also direct ongoing projects such as the development of a body protein monitor which uses neutrons to measure nutrition during illness. The monitors have been successful overseas and shall continue to be marketed.

ANSTO has long been experimenting with neutron capture therapy to treat melanoma. Professor Wiebe has been involved in cancer research and plans to expand ANSTO's work on the diagnosis and treatment of cancer, particularly melanoma.

With the development of Australia's National Medical Cyclotron, currently under construction at the Royal Prince Alfred Hospital in Sydney, the research work of the Biomedicine and Health Program will expand. The cyclotron will supply very short-lived radioisotopes, not available from a nuclear reactor, which will give further insight into conditions including cancer, heart disease, epilepsy and asthma.

MAJOR GRANTS FOR SALINITY AND WATER STUDIES

Two grants from the Australian Water Resources Advisory Council (AWRAC), worth $365,000, to study salinity and water quality have been awarded to Dr David Waite of ANSTO's Environmental Science Program.

Both grants, for a period of three years, will allow Dr Waite and his team to study salt concentrations and flow processes at three sites in New South Wales and conduct laboratory experiments on sub micron sized particles in natural waters.

"For the salinity study we have selected three sites, at Williams Creek near Yass, the Box Hill catchment near Inverell and the Wattle Retreat catchment near Cootamundra. Field work has already begun with the first trip to the Yass site during March," Dr Waite said.

"The aim is to use a combination of hydrogeochemical and isotope techniques to improve our understanding of the salting process and assist in designing and monitoring the effectiveness of remedial measures," he said.

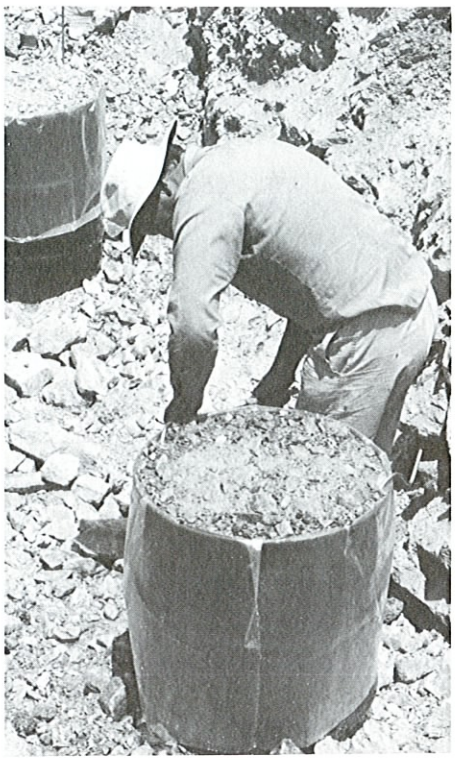
"The Soil Conservation Service of NSW has already undertaken some work in the Williams Creek area to reduce salt impact. We will be testing to determine the effectiveness of their efforts".

The study on sub micron sized particles in natural water will be a laboratory study with the aim of determining the implications these minute particles have on water quality and treatment.

"The sub micron particles are important scavengers of organic and inorganic pollutants. We will be using the dynamic light scattering techniques of photon correlation spectroscopy and laser doppler velocimetry to measure size distribution and surface charge of these particles and static light scattering methods coupled with fractal analysis to examine the structure of aggregated particles".

"From the studies we hope to be able to determine just how much waste these particles can take up, what impact their size and surface structure has on this ability and whether they can be captured on filters during water treatment processes".

ANSTO DEVICE ASSISTS IN MINE SITE REHABILITATION



ANSTO scientists installing two lysimeters in a mine waste heap

ANSTO is applying techniques gained in its experience with uranium mine sites to aid the rehabilitation of other mines.

ANSTO scientists have developed a type of lysimeter to assist in the rehabilitation work.

ANSTO has been involved in monitoring the waste rock dumps at the disused Rum Jungle uranium mine in the Northern Territory, and has also applied the techniques to the Bougainville copper mine in Papua New Guinea.

WASTE ROCK

Most mining operations produce a large amount of waste rock. Without mining interference, natural erosion causes chemicals to be released at a rate which the environment generally can cope with. However, when placed in a heap, or dump, acids and heavy metals such as zinc, manganese and copper can leach out too fast and pollute local creeks and rivers.

A layer of compacted clay over the waste dump is often used to reduce the infiltration of water and subsequent release of pollutants. ANSTO's lysimeter measures the amount of water which seeps in through this layer.

The lysimeter consists of a metal drum filled with a layer of coarse gravel to make a water collection zone and topped with layers of graded sand and dump material. It is buried 30cm below the clay layer. A small access tube leading to the surface allows the amount of water collected to be measured and therefore the effectiveness of the clay cover in reducing water penetration to be determined.

The lysimeter measurements provide early indications of the success of the rehabilitation and allows long-term assessments to be made.

ANSTO is keen to employ this expertise in other mines and is involved in several studies at copper mines.

From page one

The tests involved the use of neutron beams from a radioactive source to detect the hydrogen which is present in the water. Hydrogen interacts strongly with neutrons.

Importantly, the tests proved that the method of moisture detection was feasible before they were to be performed on the actual roof. They also established the sensitivity of the instruments in relation to the various geometries of the roof support structure.

Although the measurement program was strictly undertaken in the laboratory, such testing is equally effective on the site. The exercise is a graphic example of the type of moisture probing service ANSTO offers industry.

In another project, ANSTO has been subcontracted by Ove Arup and Partners to examine the Opera House's laminated windows for possible deterioration. Scientists are investigating whether the plasticiser in the polyvinyl resin, between the two plates of glass in each window, is evaporating and causing voids near the edges of the glass.

In work done on samples of the glass at ANSTO's research laboratories at Lucas Heights, scientists determined whether direct solar radiation, rain or stress contribute to the problem.

The principal tests involved heating samples of the glass to between 60 to 150 degrees C for periods of up to 14 days to accelerate delamination. The samples were then inspected and monitored for weight losses from the evaporation of the plasticiser.

Three-point bend tests were used to stress the samples. These tests attempted to simulate the stress which wind places on the windows. As the wind buffets the glass, pressure is applied to the edges where delamination might be occurring.

Ultrasonic tests were used to ascertain whether the voids could be detected before they could be seen by the naked eye. Using a conventional flaw detector and a small transducer, an ultrasonic signal is transferred into the resin between the plates of glass. Variations in the signal indicate flaws.

The test results help to determine how fast the deterioration can occur under normal conditions. A decision on whether the windows need to be repaired can then be made.

Sales and Marketing enquiries: General Manager (Commercial) (02) 543-3801 Fax: (02) 543-9272
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