



Science, Technology and Education News from Australia, January 2014

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1. Technology

New supermaterial made in Australia

(January, 16, 2014)

From smaller, faster computer chips to more practical and efficient solar cells through to improvements in medical technologies and vehicle and aircraft parts, silicene, a two-dimensional form of silicon, may provide a powerful material for the future. A team from the Institute for Superconducting and Electronic Materials (ISEM), located at the University of Wollongong's Australian Institute for Innovative Materials facility, has successfully fabricated single-atom-layer silicene for the first time in Australia. Silicene is similar to graphene in that it is a single-atom-thick and has the same honeycomb structure. Theoretical calculations have predicted that silicene would contain exciting properties that could be used in a range of applications. However, its complicated formation chemistry and physics makes the fabrication of this material to be extremely difficult. The research team is one of a small number of teams around the world who have successfully fabricated silicene. But being the first group to fabricate silicene in Australia was a tremendous breakthrough. The research team will continue their efforts to advance their knowledge of the fundamental properties of silicene and how they can harness its properties for use in applications from nano-electrics through to solar energy applications. The research team noted that this work would not have been possible had it not been for the three-chamber low-temperature scanning tunnelling microscope (STM), the first of its type in Australia.

To read the full article click [here](#).

Wave spotted in photonic chip

(January, 20, 2014)

An international research team, led by researchers from the University of Sydney, have observed an on-chip soliton compression in a silicon photonic crystal for the first time. Optical soliton waves in a silicon photonic crystal chip the size of a human hair could add key insights to future integrated optical communications systems. In their simplest form, solitons are nonlinear waves that propagate through a medium undistorted. One of the most striking natural examples is rogue waves, enormous water waves capable of toppling ocean-going vessels. Due to their ubiquitous appearance in diverse physical systems including, plasmas, proteins, magnetism, and optics, solitons are arguably the most fundamental nonlinear wave. The team is pursuing this avenue of research in line with the mission of CUDOS (ARC Centre of Excellence for Ultrahigh bandwidth Devices for Optical Systems) to develop photonic chips that are 'faster, smaller, greener'. This is just the beginning, from here there are many other fascinating phenomena left to explore from this experiment

To read the full article click [here](#).



2. Life Science

Jumping snails run out of bounce

(January, 07, 2014)

Sea snails that leap to escape their predators may soon lose their extraordinary jumping ability because of rising human carbon dioxide emissions, a team of international scientists has discovered. Lead author of the study published today, Dr Sue-Ann Watson from the ARC Centre of Excellence for Coral Reef Studies (Coral CoE) and James Cook University observed that the conch snail, which uses a strong foot to leap away from approaching predators, either stops jumping, or takes longer to jump, when exposed to the levels of carbon dioxide projected for the end of this century. Increased carbon dioxide and ocean acidification levels disrupt a particular neurotransmitter receptor in the snail's nervous system, delaying vital decision-making on escape. This leaves the snail more vulnerable to the poisonous dart of its slow-moving nemesis, the marbled cone shell. While this study shows that disrupted decision-making with elevated carbon dioxide levels can occur in marine invertebrates, scientists have also observed similar effects before, in fish. The study shows that they actually face the dual threat of both weaker shells and impaired behaviour. The big question now is whether sea creatures can adapt fast enough to keep up with the rapid pace of rising carbon dioxide levels and ocean acidification.

To read the full article click [here](#).

Turtle conservation needs rethink

(January, 12, 2014)

Green turtle populations have expanded so much in Indonesia's east coast islands marine protected areas that they are adopting new feeding habits, degrading the ecosystem and threatening their own conservation. Scientists and conservationists had believed that marine protected areas would be key to enhancing the recovery of protected species and ecosystems. But a new international study by The University of Queensland and Radboud University Nijmegen in the Netherlands has shown this conservation method may have the opposite effect. The scientists have shown that destructive grazing of high numbers of green turtles concentrated in a small number of marine protected areas leads to on-going degradation and imminent collapse of sea grass habitat. The study found that when the turtle numbers increased to about 20 turtles per hectare their foraging habits changed from eating only seagrass tips to digging up and consuming the roots and rhizomes, creating abundant bare gaps and increasing erosion and reducing seagrass regrowth. The study used a combination of experiments, monitoring and computer models to determine that the increasing grazer density of the turtles would cause a sudden collapse of their own habitat. It was alarming to see turtles using such desperate strategies to find food and that the real conservation problem was not the marine protected areas but the lack of good seagrass habitat in unprotected areas.

To read the full article click [here](#).

3. Health Care / Biology

Bees guided by invisible light

(January, 07, 2014)

Honeybees use a pattern of light in the sky invisible to humans to direct one another to a honey source. Researchers at the [Vision Centre](#) have demonstrated that even on days when the sun doesn't shine, bees can navigate to and from a honey source by reading the pattern of polarised light in the sky and then explain to other bees where to find it with their 'waggle dance'. Basically means the bees tell each other where the nectar is by converting their polarised 'light map' into dance movements. The discovery throws fresh light on the astonishing navigational and communication skills of an insect with a brain the size of a pinhead – but also on some of the most basic machinery of the brain itself. The researchers flew bees down a tunnel to a sugar source, shining only polarised light from above on them – the sun was not visible. Sometimes the polarised light was aligned with the tunnel, sometimes it was at right angles to the tunnel. They then filmed what the bees 'told' their fellows when they got back to the hive, by wagging their bodies. The researchers conclude that even when the sun isn't shining bees can tell one another where to find food by reading and dancing to their polarised sky map.



Besides revealing how bees perform their remarkable tasks, the researchers say it may throw new light on how very simple brains work. When the light is aligned to the tunnel, it activates two 'place cells' in the insect's brain. When the light is across the tunnel, it activates two other cells. From these four cells the bee can work out if the food source lies north-south or east-west of the hive, they conjecture.

To read the full article click [here](#).

Scientists fit tiny sensors onto honey bees to study behaviour

(January, 15, 2014)

CSIRO is working with the University of Tasmania, beekeepers and fruit growers to trial the monitoring technology, in an attempt to improve honey bee pollination and productivity. They are fitting tiny sensors to the insects, a process which sometimes involves shaving them first. This has been done before. The difference there is about the size of the sensor. And the difference is the number - about 5,000 bees. The sensors measure 2.5 millimetres by 2.5mm and act like a vehicle's "e-TAG", recording when the bees pass particular checkpoints. Researchers can use the signals from the sensors to find out how the bees move through the landscape and understand changes in their behaviour. They are also looking at the impacts of pesticides on the honey bees and the drivers of a condition decimating bee populations globally. If it impacts the bees, it impacts the whole industry that is producing food. Researchers are releasing about 20 honey bees a day from hives in southern Tasmania. The bees travel up to 700 metres from the hives, but always return, making it easy to pinpoint changes in their behaviour. Researchers hope their work will help farmers and fruit growers, who rely on the bees' pollination, to improve their practices. The next stage of the project is to shrink the sensors to only one millimetre, so they can be attached to much smaller insects such as fruit flies and mosquitoes.

To read the full article click [here](#).

Bald reef gets seaweed transplant

(January, 14, 2014)

Marine ecologists in Sydney have successfully restored a once thriving seaweed species, which vanished along a stretch of the city's coastline during the 1970s and 80s when there were high levels of sewage. A team of researchers from UNSW, the Sydney Institute of Marine Science and the NSW Department of Primary Industries has transplanted fertile specimens of the missing crayweed (*Phyllospora comosa*) onto two barren reef sites where it once grew abundantly. They took seaweed from Palm Beach and Cronulla and transplanted it to Long Bay and Cape Banks. Seaweeds are the 'trees' of the oceans, providing habitat structure, food and shelter for other marine organisms, such as crayfish and abalone. The transplanted crayweed not only survived similarly to those in natural populations, but they also successfully reproduced. This creates the potential for a self-sustaining population at a place where this species has been missing for decades. Large brown seaweeds – known as macroalgae – along temperate coastlines, like those in NSW, also encourage biodiversity and are important to the region's fishing and tourism industries. Despite improved water quality around Sydney after the introduction of better infrastructure in the 1990s, which pumped sewage into the deeper ocean, the 70 km gap of depleted 'underwater forest' – between Palm Beach and Cronulla - has never been able to recover naturally. Now, with some well-executed intervention, it looks as though this habitat-forming crayweed could make a successful comeback in Sydney's coastal waters. Their results could provide valuable insights for restoring similar macroalgae marine ecosystems in Australia and globally, but further research is needed to understand the complex processes that affect recruitment and survival.

To read the full article click [here](#).

Dingoes vital for ecosystems

(January, 15, 2014)

Urgent action is needed to protect large carnivores, such as the Australian dingo, from the "unforeseen" environmental consequences that will accompany further declines in their numbers, an international team of ecologists has warned. Over the last two centuries, large mammalian carnivores have experienced dramatic declines in population and geographic range globally, leading to a variety of negative ripple-down effects for ecosystems – the extent of which are not yet fully understood. An international review published in the journal *Science* examined the conservation status and ecological impact of the world's 31 largest mammalian carnivores, including iconic big cats like the African lion and cheetah, American and European bears and wolves, and dingoes. A scientist from the University of



New South Wales co-authored on the paper. His work is focused on ecosystem conservation and management strategies, and has revealed some important findings about what happens to Australian plants and small mammals when dingo numbers decline. The balance of ecosystems can shift dramatically. Research on dingoes from Australia shows that populations of foxes and kangaroos irrupt following the removal of dingoes. Foxes in particular pose a considerable threat to small native mammals. Overall, the suppression of dingoes has probably contributed to the endangerment and extinction of small marsupials and rodents over much of the continent. Large carnivores have a profound impact on the way food chains are structured. They limit the populations of herbivores through predation, which keeps plant life thriving, and help keep other, smaller carnivores at bay through competition. More than 60% of the animals included in the review are considered by the International Union for the Conservation of Nature to be threatened and at risk of local or complete extinction, and 77% are experiencing continuing population declines. More than 60% of the animals included in the review are considered by the International Union for the Conservation of Nature to be threatened and at risk of local or complete extinction, and 77% are experiencing continuing population declines.

To read the full article click [here](#).

4. Physics / Astronomy

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To read the full article click [here](#).

5. Environment and Climate Change

Our future: hotter than expected

(January, 02, 2014)

Global average temperatures will rise at least 4°C by 2100 and potentially more than 8°C by 2200 if carbon dioxide emissions are not reduced, according to new research published in *Nature*, led by scientists from University of New South Wales, UNSW's Centre of Excellence for Climate System Science, that shows our climate is more sensitive to carbon dioxide than most previous estimates. The research could solve one of the great unknowns of climate sensitivity, the role of cloud formation and whether this will have a positive or negative effect on global warming. The research has shown climate models indicating a low temperature response to a doubling of carbon dioxide from preindustrial times are not reproducing the correct processes that lead to cloud formation. The key to this narrower but much higher estimate can be found in the observations around the role of water vapour in cloud formation. Observations show when water vapour is taken up by the atmosphere through evaporation the updraughts often rise up to 15 km to form heavy rains, but can also rise just a few km before returning to the surface without forming such rains. In addition, where updraughts rise this smaller distance they reduce total cloud cover because they pull more vapour away from the higher cloud forming regions than when only the deep ones are present. Climate models that show a low global temperature response to carbon dioxide do not include enough of this lower-level process. They instead simulate nearly all updraughts rising to 15 km. These deeper updraughts alone do not have the same effect, resulting in increased reflection of sunlight and reduced sensitivity of the global climate to atmospheric carbon dioxide. However, real world observations show this behaviour is wrong. Rises in global average temperatures of this magnitude will have profound impacts on the world and the economies of many countries if we don't urgently start to curb our emissions.

To read the full article click [here](#).

Old trees store carbon faster



(January, 20, 2014)

Old trees contribute more to carbon storage than previously thought in a new international study that included researchers from the University of Melbourne. The study demonstrated that tree growth rates increased continuously with size, and in some cases, large trees appeared to be adding the carbon mass equivalent of an entire smaller tree each year. The significance of this study is that big old trees are better at absorbing carbon from the atmosphere than previously thought. Co-author from the ARC Future Fellow at the Melbourne School of Land and Environment, University of Melbourne, stresses that the rapid carbon absorption rate of individual large trees does not necessarily translate into a net increase in carbon storage for an entire forest. Researchers compiled growth measurements of 673,046 trees belonging to 403 species from tropical, subtropical and temperate regions across six continents, calculating the mass growth rates for each species and analysing the trends. What makes these results so compelling is the sheer scale of the datasets that they had available to work with.

To read the full article click [here](#).

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