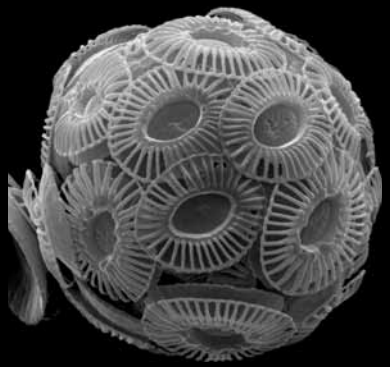
UNIVERSITY OF TASMANIA

THE DIRT ON CARBON STORAGE



SCALES OF CHANGE

ASKING THE BIG QUESTIONS

THE FUTURE OF CORAL REEFS

THE BUFFERS THAT HELP YOU BOUNCE BACK

UTAS

Research to Reality

2011 EDITION 7

Welcome to the first edition of *Research to Reality* for 2011, a celebratory one in the sense that its content reflects the University of Tasmania's top marks in a recent national analysis of university research. UTAS is meeting or exceeding world standards in 71 per cent of disciplines, according to the Excellence in Research for Australia assessment released at the end of January. It's great news for a one-university state and for many of the more than 26,000 UTAS students because it means that they are being taught by some of the world's top researchers.

We received the highest possible ranking in three disciplines – Analytical Chemistry, Horticultural Production and Oceanography – and were ranked above world standard in nine other areas, including Astronomical and Space Sciences. This issue features some of those exceptionally gifted researchers who have helped put UTAS at the forefront of research.

Professor Paddy Nixon
Pro Vice-Chancellor (Research)

Saving lives by sifting through the sewers

"If we can figure out ways of stopping drugs getting into prisons, we have a much better chance of prisoners actually being rehabilitated."

Science and sewerage are being mixed to measure Australia's illicit drug trade, under a research program being jointly conducted by UTAS, the Australian Federal Police and chemists from the University of Queensland.

The research team has been monitoring wastewater from a Queensland suburb and using analytical chemistry to determine illicit drug levels, in what is the first Australian study of its kind.

UTAS criminologist Dr Jeremy Prichard said that compared with other methods, such as surveys, chemical analysis of wastewater gave extremely accurate indications of the prevalence of illicit drugs in the general community.

Wastewater analysis could identify different drugs and the amounts being used, and might one day become a law enforcement tool to detect whether chemicals related to the manufacture of drugs, or even explosives, come from a particular building. The research could ultimately influence policing methods and government anti-drug strategies.

"We are really excited about how useful this could be," Dr Prichard said.

"Our focus is not on busting perps and getting tough on drugs. We are coming at it from a health model. If we can't estimate properly the level of public drug use then government policy is not being informed properly, and we may not be directing the right amount of resources into national supply-and-demand reduction strategies."

In coming months Dr Prichard and his team, including Dr Raimondo Bruno from the UTAS School of Psychology, will also begin monitoring wastewater from some Australian prisons, after striking an agreement with corrections authorities.

Dr Prichard said it was hoped the research would give prison authorities accurate information about the types of drugs prisoners were taking, and how well prison anti-drug strategies were working.

Despite the high security of Australian prisons, Dr Prichard said drug use was a common problem for inmates, sparking violence and encouraging addiction and the spread of blood-borne diseases such as hepatitis C and HIV.

"Overdoses and drug-related deaths are problems facing prisons internationally," Dr Prichard said.

"This system of measuring prison wastewater has a lot of positives. It's completely covert and by the same token it respects privacy. You can't identify any individual inmates. It is cheap to run, it doesn't impinge on the day-to-day operations of the prison and the chemists are amazingly accurate with what they can detect.

"If we can figure out ways of stopping drugs getting into prisons, we have a much better chance of prisoners actually being rehabilitated. And, yes, I believe it could ultimately save lives."

This work is part of a $317,000 grant from the Queensland Government and the Australian Federal Police.

Why some victims suffer more than others

"Very little is known about the mechanisms that underpin resilience in adult trauma victims."

Recent Australian data indicate that 17 per cent of all women aged 18 years and over have experienced violence perpetrated by a partner. It is has been shown that intimate partner violence comes at a high cost to both the victim (physical harm and poor mental health) and society (cost of medical services and decreased productivity in the workforce).

Danielle Riley, DPsych candidate in the UTAS School of Psychology, is investigating resilience in women affected by violence in her project, *An examination of factors that influence resilience in female victims of intimate partner violence.*

"Trauma research indicates a significant proportion of people who experience a traumatic event often display little or no psychological difficulties," Ms Riley said. "So it is plausible that a proportion of women who experience intimate partner violence may display fewer psychological difficulties than others – yet this area of research has been significantly neglected."

Ms Riley's project aims to help fill this gap in the existing body of research.

"One of the issues integral to the study of intimate partner violence is the need to better understand why some victims suffer more psychologically than others."

Ms Riley said researchers had recently begun to focus on resilience. This means the ability to recover or cope in the face of substantial adversity. However, most resilience research to date has examined the responses of children to adversity and very little is known about the mechanisms that underpin resilience in adult trauma victims.

"My research aims to investigate the factors that serve as protective resources to reduce psychological distress and buffer negative outcomes for victims of intimate partner violence," Ms Riley said. "The project will assess the relationship of resilience to personality, coping and psychopathology in female victims of intimate partner violence."

This project is supervised by Associate Professor Frances Martin and co-supervised by Kimberley Norris.

Fertile grounds for carbon research

Research could soon determine how land management practices can increase carbon storage in soil. The Soil Carbon Research Program is a three-year nationwide project, coordinated by the CSIRO in Adelaide.

Researchers from the Tasmanian Institute of Agricultural Research (TIAR) will analyse soil used for crops and pasture at 325 sites in Tasmania, including the Midlands, the north and the Derwent Valley.

Property owners from each site will provide a 10-year history of what crops, livestock and fertilisers have been used on the land to help determine the relationship between soil type, land management practices and soil carbon levels.

The study, which will conclude in June 2012, has a strong focus on climate change. "Sequestration of carbon in the soil could help to ameliorate climate change. But in order to do this we need to know which soil types and land management practices can promote storage of carbon in the soil," said Dr Eve White, a TIAR Technical Officer.

Project manager Mr Garth Oliver further explains: "The carbon stored in soil far exceeds what is in the atmosphere and in living plants. Soil with a high organic carbon level is more fertile, absorbs nutrients better, holds water and is more productive."

Samples are analysed locally and sent to Adelaide where they are used to calibrate mid infrared spectroscopy (MIR), which has the potential to be a more efficient method of measuring carbon in soils.

"It is essential to have this information in order to include agriculture in any future carbon accounting system," Dr White said.

Dr White with project manager Garth Oliver and some of the soil samples taken from 325 sites in Tasmania.

This study is supported by $600,000 in funding from the Commonwealth Department of Agriculture, Fisheries and Forestry's Climate Change Research Program.

Getting the scrip right for a new age of medicine

"We're eager to know what people think would be good in terms of regulation, while still allowing scientists to challenge and achieve."

Australia is entering an age of personalised medicine in which some treatments will be based on an individual's genetic profile. Personalised medicine holds promise for improved healthcare but there are concerns that we're yet to fully develop regulations to ensure that this research is ethical, and that the privacy of patients is protected.

Professors Dianne Nicol, Donald Chalmers and Margaret Otlowski from the UTAS Faculty of Law, along with Dr Christine Critchley, a social psychologist from Swinburne University of Technology (Victoria), are embarking on a four-year project to research and develop proposals to create a best-practice regulatory system for personalised medicine.

"Our team has been doing research in this area since the early 1990s," Prof. Nicol said. "That was the time of the Human Genome Project, which set out to sequence the entire human genome.

"From the start there were concerns about the legal and social implications of the developments in genetics, such as issues to do with privacy, research ethics and commercialisation. We've continued this work as human genetics has expanded towards clinical application and now personalised medicine."

This latest project, *The age of personalised medicine: regulatory challenges for Australia*, aims to address three main areas of concern:

- **Broad access to genetic testing and direct-to-consumer testing (DTC):** More genetic tests are becoming available but these must be carefully assessed for efficacy and reliability, and should only be introduced where genetic counselling is available. There is a growing trend of genetic tests being made available to the public by commercial companies. Apart from issues to do with the reliability and verifiability of these tests, DTC raises questions about non-traditional healthcare delivery, particularly the receipt of medical information online (which may be inaccurate) without proper medical guidance.
- **The regulation of clinical trials:** The current complex, randomised, protracted and costly clinical trial procedures for new drugs are likely to be replaced by faster, smaller trials with participants selected on the basis of their genetic profile, raising questions about the reliability and verifiability of results.
- **Genetic research and the governance of biobanks:** Any research into genes generally involves accessing large tissue collections and databases of genetic information across a particular population (called biobanks). These collections need appropriate governance regimes in place to protect privacy and confidentiality, a particular concern to participants when the research becomes a commercial endeavour.

Prof. Nicol said the first stage of the research project will involve a mapping exercise – basically updating their knowledge of what is currently taking place in the field of personalised medicine.

"We'll also be doing interviews with regulators and researchers, people in the industry and members of the general public," Prof. Nicol said.

"We're eager to know what people think would be good in terms of regulation, while still allowing scientists to challenge and achieve.

"It's fantastic that we have received funding for this research but it's also challenging. Ultimately, this research will feed into proposals for the creation of new regulatory structures, helping to establish international best practice."

This project is funded by a four-year, $281,000 Australian Research Council Discovery Grant.

Professors Margaret Otlowski, Dianne Nicol and Donald Chalmers.

SCALES OF CHANGE:
Phytoplankton face acid test

This three-year study is funded by a $280,000 Australian Research Council Discovery Grant.

A species of microscopic phytoplankton could provide vital early signs of the effects of man-made carbon dioxide emissions on Southern Ocean waters. *Emiliania huxleyi* is one of the most plentiful and widespread phytoplankton, ranging from tropical to subarctic waters. It belongs to a group called coccolithophorids, which are covered in minute calcium carbonate scales.

Large blooms can have a counterbalancing effect on greenhouse warming as these cells absorb CO_2 from the atmosphere through the process of photosynthesis. When the blooms die, the cells sink to the bottom of the deep sea and can become a permanent deposit of chalk, as happened in the formation of the White Cliffs of Dover.

In the past 200 years, increases in carbon dioxide in the atmosphere, due to the burning of fossil fuels, have increased the Southern Ocean's acidity, reducing pH by 0.1 units. This is predicted to fall by 0.4 units by 2100, adversely affecting the ability of coccolithophorids to form calcareous scales.

Professors Gustaaf Hallegraeff and Tom Trull from the Institute for Marine and Antarctic Studies at UTAS will study *E.huxleyi* to determine how this organism and others respond to climate change.

"Changes in the abundance of this organism and its extent of calcification can have an effect on atmospheric CO_2 levels equivalent to five to 20 years of industrial emissions," Prof. Hallegraeff explained. "It may also significantly alter Southern Ocean food webs. Because ocean acidification will occur first in polar waters, our focus will provide early warning for later possible impact on Australia."

However, in an interesting twist, increased carbon dioxide may also have a positive effect in stimulating photosynthesis by *E.huxleyi.*

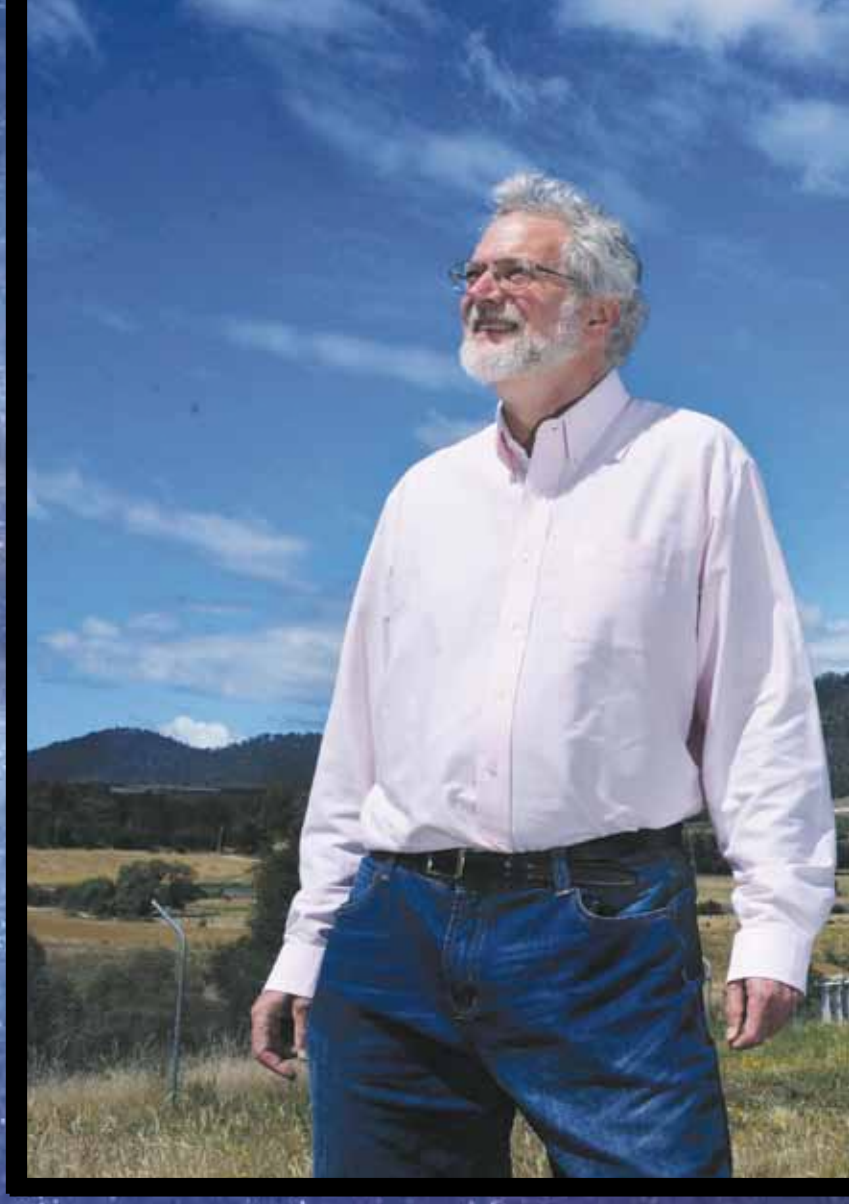
"While the response of *E.huxleyi* to ocean acidity has been extensively studied in the Northern Hemisphere, there is ample evidence to suggest that the type found in the Southern Ocean (newly described as *var. aurorae*) will respond differently," Prof. Hallegraeff said.

"There will be winners and losers from climate change – one thing we can be certain about is local changes in species composition, abundance and timing of algal blooms."

Professor Hallegraeff and Dr Marius Mueller review cultures of *E.huxleyi*. Prof. Hallegraeff has attracted the expertise of Dr Mueller, a German postdoctoral research fellow who studied the same species in the Northern Hemisphere.

Left: *E.huxleyi* lives in a well-lit surface layer of the world's oceans, obtaining energy from photosynthesis.

A big leap out into space



"It's a bit like Captain Cook sailing into the South Seas and finding a bunch of islands that no-one knew were there."

Most of us, at some time, have looked towards the heavens and wondered how it all came to be. A new research collaboration – led by Professor John Dickey, Head of the School of Mathematics and Physics at the University of Tasmania, and Dr Naomi McClure-Griffiths from the CSIRO Astronomy and Space Science division – is setting out to explore the clues held within our Milky Way Galaxy.

This collaboration is one of the first projects to use the Australian Square Kilometre Array Pathfinder, which is currently being built in Western Australia. Astronomers believe that this innovative radio telescope is a factor 10 times better than any of its predecessors and will set the stage for the next 50 years in radio astronomy.

"This radio telescope will allow us to see thousands and thousands of galactic radio sources that have never been seen before," Prof. Dickey said. "It's a bit like Captain Cook sailing into the South Seas and finding a bunch of islands that no-one knew were there. But when we journey into the Milky Way, we'll discover things like little islands in space."

The project involves collaboration with 48 scientists at 31 institutions in 11 countries. Specifically, it will study the structure of the Milky Way: how it's put together, how it moves, how it stays together, how stars are formed, how stars die, the matter between the stars and so on. The research will also look at the Magellanic Clouds, two dwarf galaxies that are orbiting the Milky Way, to measure the halo surrounding our galaxy.

"But the biggest question behind all this is how we got to be the way we are," Prof. Dickey said.

"When we look around the world – the cities and countries and societies and so on - we can study history to understand how we got to be Australians, or we can study other animals to understand our natural evolution. But what about when we take the big leap out into space?

"To me, these questions are at the core of what we call the human condition: What is it to be human? What is this universe in which we find ourselves? Studying how galaxies evolve is one part of the answer. In a way, it's the biggest part. It's not that immediate to most people, but it's pretty important that as human beings we should ask that question."

This is a three-year, $230,000 Australian Research Council Discovery Project.

Left: What is this universe in which we find ourselves? Professor John Dickey at the Mt Pleasant Radio Telescope near Cambridge.

Above: Open day at Mt Pleasant.

Bid to break the link in fatty foods chain

Eating fatty foods takes an almost immediate toll on our physical and cognitive performance, a recent study has confirmed. If researchers can now discover why fats have this effect – and prevent the process from happening – then people with heart and lung conditions might be the first to benefit.

Dr Lindsay Edwards is a lecturer at the UTAS School of Medicine and an Honorary Fellow at the Menzies Research Institute. During his doctoral studies at the University of Oxford, in the UK, Dr Edwards was part of a team that placed 20 sedentary men on a high-fat diet for a week. By the end of the week, two key things happened. First, the subjects' physical efficiency was substantially reduced, meaning that they needed extra oxygen – more than 10 per cent – to perform a standard physical task. Second, their cognitive function, measured using an automatic computer system, was significantly impaired.

"This is a fundamental physiological mechanism that hasn't been described before," Dr Edwards said, "and that in itself is exciting.

"But there are also important clinical implications. If you're a person who has heart problems, or any condition in which your lungs are impaired – such as from asthma, cystic fibrosis or emphysema – then the extra oxygen you need may not be available to you."

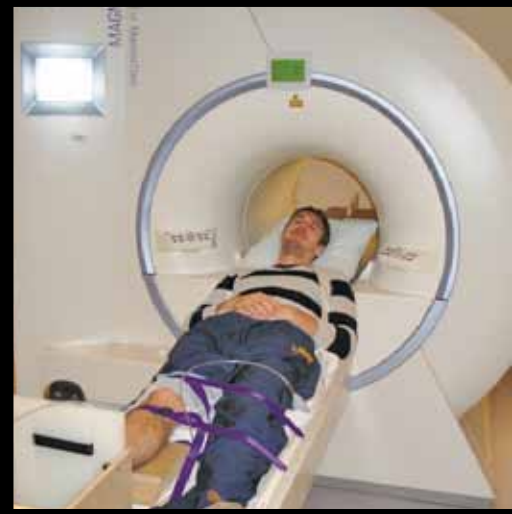
To date, it's not completely clear why fatty foods impair whole-body efficiency and cognitive function in the manner that the Oxford team observed. Dr Edwards' hypothesis is that high levels of fatty acids may activate a process called 'uncoupling', which increases the oxygen required when a cell generates ATP (the cell's energy 'currency').

In the next stage of the research Dr Edwards, along with Dr Renee Dwyer from the School of Medicine and Dr James Horne from UTAS' Central Science Laboratory, will attempt to determine the mechanisms behind the initial findings.

"We've confirmed that there's a link between fats, efficiency and cognition," Dr Edwards said.

"The next thing we want to know is how we can break that link. If we can stop it, then it might give a bit of extra quality of life to someone suffering a heart or lung condition. The results could be quite tangible, such as allowing a person to stroll to the shops, or walk up a flight of stairs."

Dr Edwards is lead author of the article titled *Short-term consumption of a high-fat diet impairs whole-body efficiency and cognitive function in sedentary men*, published recently in the biology journal *FASEB J*.



Top: Second author Andrew Murray measures a subject during exercise testing.

Above: A subject entering Oxford's research Magnetom, which measures chemical changes in muscle and heart.

New tool a world first? CORSET is

"Simulation models such as CORSET are great tools for exploring future responses of reef systems to multiple threats..."

An innovative world-first tool for exploring the future of coral reefs around the globe has been developed at UTAS.

The Coral Reef Scenario Evaluation Tool (CORSET) will be useful to coral reef managers, policy makers, conservation groups and researchers.

A web portal, www.reefscenarios.org, allows anyone connected to the Internet, even by smartphone, to access and use CORSET on the UTAS supercomputer from anywhere around the world, for free.

Dr Jess Melbourne-Thomas developed CORSET as part of her PhD while a UTAS/CSIRO Quantitative Marine Science student.

She then worked with staff from the Tasmanian Partnership for Advanced Computing (TPAC) and electronic Marine Information Infrastructure (eMII) to create Reef Scenarios, which provides an easy-to-use interface through which anyone can use CORSET.

"Coral reefs provide essential ecosystem services that support the livelihoods of millions of people in coastal populations around the globe," Dr Melbourne-Thomas said.

"But human activities have severely degraded a large number of reefs worldwide, and reef ecosystem function is under continuing threat from human impact."

Dr Melbourne-Thomas stressed the need for novel approaches such as CORSET to develop strategies for ensuring reefs are managed effectively.

"Simulation models such as CORSET are great tools for exploring future responses of reef systems to multiple threats and for evaluating the effectiveness of alternative management strategies," Dr Melbourne-Thomas said.

"The fact that the model is now available via the web to anyone who wants to use it is a great demonstration of how web technologies can be applied in making tools like CORSET accessible to end-users."

Dr Melbourne-Thomas said CORSET is a generic model framework that can be applied at a regional scale to tropical coral reef systems anywhere in the world.

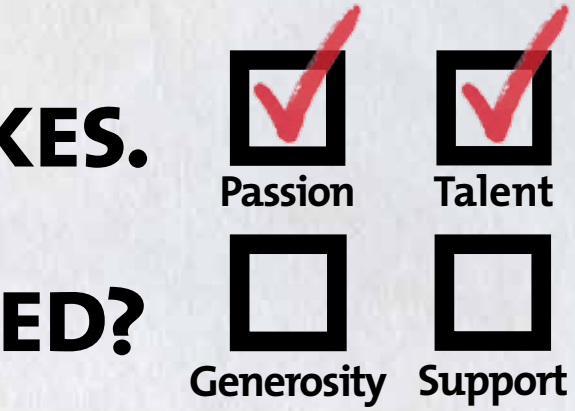
Dr Melbourne-Thomas worked on the project with UTAS researchers Dr Roger Proctor (eMII), Professor Craig Johnson (Institute for Marine and Antarctic Studies) and Professor Nathan Bindoff (TPAC).

The best kind of office: Dr Jess Melbourne-Thomas accesses CORSET on her laptop near Bolinao Marine Laboratory, the Philippines. Photo by Professor Craig Johnson.

This research was supported by the Global Environment Facility's Coral Reef Targeted Research Program and a CSIRO Fellowship in Marine Ecosystem Modelling.

OUR GRADUATES HAVE WHAT IT TAKES.

DO YOU HAVE WHAT THEY NEED?



The University of Tasmania needs to attract researchers with the talent, passion and desire to excel in graduate research. We are now offering Elite Research Scholarships to outstanding applicants, and any business or individual interested in supporting our growing international reputation for research excellence is invited to contribute to the program by providing $7,500 per annum as a silent or identified sponsor. Valued at $30,000 tax-free per annum, Elite Research Scholarships are offered in specific project areas to help keep the research passion alight. **If you're keen to tick the final two boxes, contact the Dean of Graduate Research on (03) 6226 7127.**

Graduate research at UTAS

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Production: UTAS Communications and Media
Writers: Janette Brennan, Cherie Cooper, Catherine Rogers and Luke Scott
Design & printing: ClemengerTasmania

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CRICOS Provider Code 00586B

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