Queensland Brain Institute
Building #79, Upland Road
The University of Queensland
St Lucia QLD 4072

Telephone: +61 7 3346 6300
Facsimile: +61 7 3346 6301

Email: qbi@uq.edu.au
Website: www.qbi.uq.edu.au

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Queensland Brain Institute **2010 Annual Report**

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Editor
Denise Cullen

Graphic Designer
Dee McGrath

Photographers
Yan Chan
Stewart Gould
Dee McGrath
Jeremy Patten
David Sproule

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Cover Image: *Streams of consciousness*. Tractography, a MRI technique measuring water diffusion, showing the axonal connections of a mouse brain. Georg Kerbler.

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Vice-Chancellor's Report

Vice-Chancellor's Report

The University of Queensland is continuing to further its reputation as a research centre of global significance, and no part of the university more strongly reflects that standing than the Queensland Brain Institute (QBI). With high-quality infrastructure, leading researchers from across the globe and a host of the country's most talented and capable students, QBI has truly taken its place on the world stage since its inception in 2003.

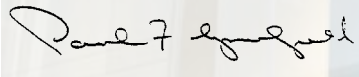
As you will see detailed in the pages that follow, innovative research is one of the hallmarks of the Institute – as is, increasingly, international collaboration. In this year, perhaps more than any other, QBI has built partnerships with other leading neuroscience research institutes across the globe. Chief among these was the announcement of a partnership with the Institute of Biophysics (IBP) at the Chinese Academy of Sciences in Beijing, supported by a $1 million National and International Research Alliances Program (NIRAP) grant from the Queensland Government. This world-first joint laboratory is intensifying efforts to identify what causes disorders such as ageing dementia and depression, which remain among the most significant health challenges of our time.

As the major centre for neuroscience at The University of Queensland, QBI also helped the University to secure the top rating of five in neurosciences in the recent Excellence in Research for Australia (ERA) assessment, which is designed to assess research quality across many different fields of research within Australia's higher education institutions. The University of Queensland was one of only three institutions to receive the maximum possible rating for neurosciences. This result highlights QBI's consistently high standard of neuroscience research, as the rating is characterised by evidence of outstanding performance well above world standards and is judged on research quality, volume and activity, application and recognition.

An independent review into operations at QBI undertaken during the year has further confirmed the Institute's outstanding performance on a range of key targets. The review was conducted as part of an agreement established in 2008 between the State Government and The University of Queensland to fund QBI's operational costs of $25 million over five years. The review panel described the growth of the Institute, along with its positive contribution to the reputation, status and economic standing of Queensland, as "exceptional against most of the metrics".

During 2010, QBI maintained a substantial cohort of students undertaking PhD or MPhil degrees. Coming from a diversity of countries, 28 of them were international students, attracted by the Institute's enviable reputation. QBI's desire to nurture the next generation of neuroscientists can also be demonstrated via its pivotal role in the annual Australian Brain Bee Challenge, which this year attracted record numbers of high school entrants.

In summary, it has been a year of outstanding discovery and real-world breakthroughs. I congratulate Perry and all staff and students on the accomplishments of this year, and look forward to following them as they enter the next exciting phase in their mission to better understand the human brain.



Professor Paul Greenfield AO
Vice-Chancellor

Left: Professor Paul Greenfield AO, Vice-Chancellor with Professor Deborah Terry, Deputy-Vice-Chancellor (Academic). Right: Screens in the QBI foyer displaying video footage taken in the laboratories by artist Fiona Hall.

Director's Report

Though neuroscientific discovery can be a slow and, at times, painstaking process, 2010 proved to be another productive year as QBI concluded its seventh year of operation. Researchers have continued to build upon findings of previous years, uncovering fresh insights into how brain function is regulated which is, in turn, expected to lead to ground-breaking therapies for a range of neurological and mental illnesses. In these endeavours, we remain cognisant that the world-renowned research being conducted at the Institute is only possible because of the ongoing financial support of funding councils and governments, and through the generous support of donors. We appreciate the partnership provided by our myriad supporters.

Among the advances highlighted in this year's report are the discovery by Professor John McGrath that babies with low vitamin D levels were twice as likely to develop schizophrenia in later life, a finding which may ultimately inform pre-natal health care recommendations; investigations by Assoc. Professor Bruno van Swinderen into the attention span of fruit flies, the outcome of which may promote better understanding of attention-deficit hyperactivity disorder (ADHD) and autism in humans; and, for the first time in humans, the pinpointing by Dr Oliver Baumann of a region of the brain that is sensitive to navigation and direction

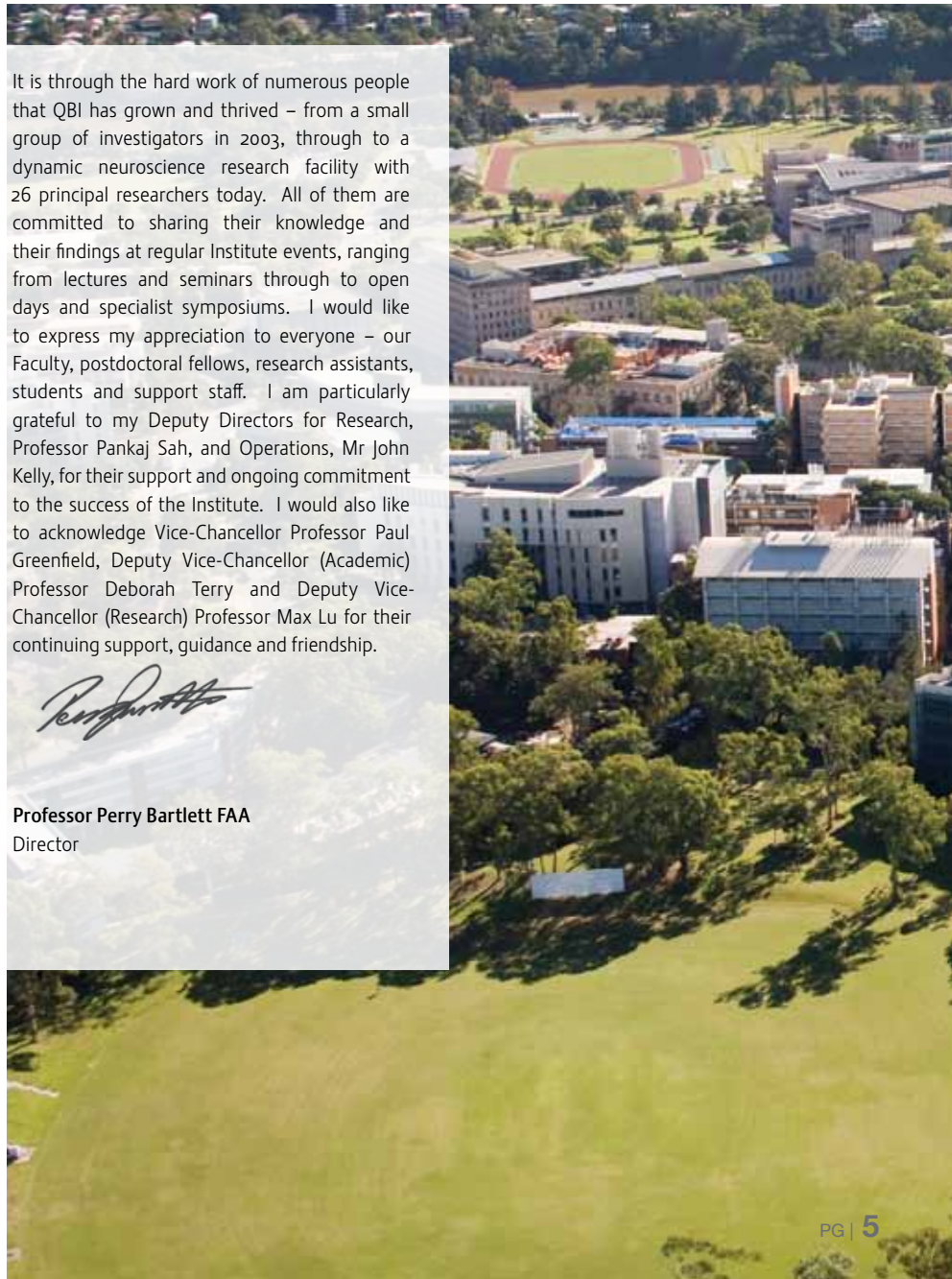
Director's Report

and thus acts like a compass. In January, leading investigator Professor Justin Marshall joined QBI from UQ's School of Biomedical Sciences, and has continued his fascinating work into how animals such as reef fish and birds communicate with colour and signals outside the range visible to humans.

As part of our mandate to translate discoveries into practical applications, QBI established the Science of Learning Centre in June. The Centre is focussed on discovering the mechanisms underlying learning, and translating those findings into effective strategies for teaching both children in the classroom and adults in the workplace. Eventually, up to 20 QBI neuroscientists will work with educators, psychologists and other scientists in the interdisciplinary Centre, which is funded by the Institute and The University of Queensland. QBI is continuing to seek state and federal government funding for the project.

Plans for a Centre for Ageing Dementia Research are also flourishing. The Centre, due to officially open in 2011, will focus on developing revolutionary therapies that regulate the death and regeneration of neurons within the adult human brain. Early animal research at QBI has shown promising results which indicate that processes like neurogenesis may reverse cognitive decline associated with ageing. Within five years, QBI hopes to have defined the molecules and processes which regulate neurogenesis and be approaching clinical trials and is currently seeking additional funding support to facilitate such discovery.

Against this backdrop of continuing growth and discovery, I would like to take this opportunity to thank all QBI staff and, in particular, congratulate those whose achievements throughout the year have been outstanding. Linda Richards was promoted to full Professor and to Principal Research Fellow within the NHMRC system and former postdoctoral fellows have established new laboratories both here at UQ (Mike Piper) and at Charles Sturt University (James Crane, Andrew Delaney and Adam Hamlin) - I wish them great success. I also wish to farewell Professor David Vaney who has spent 35 years researching the structure and function of the retina. He has subsequently been appointed Emeritus Professor of The University of Queensland, a title which recognises an academic's long and distinguished service and expresses the hope that they will continue to contribute to university life. I would like to take this opportunity to thank David, on behalf of all QBI, for his support over the years. We wish him all the best for the new challenges that await, as he pursues his long-standing interest in photography – thus still exploring vision but from a different perspective.



It is through the hard work of numerous people that QBI has grown and thrived – from a small group of investigators in 2003, through to a dynamic neuroscience research facility with 26 principal researchers today. All of them are committed to sharing their knowledge and their findings at regular Institute events, ranging from lectures and seminars through to open days and specialist symposiums. I would like to express my appreciation to everyone – our Faculty, postdoctoral fellows, research assistants, students and support staff. I am particularly grateful to my Deputy Directors for Research, Professor Pankaj Sah, and Operations, Mr John Kelly, for their support and ongoing commitment to the success of the Institute. I would also like to acknowledge Vice-Chancellor Professor Paul Greenfield, Deputy Vice-Chancellor (Academic) Professor Deborah Terry and Deputy Vice-Chancellor (Research) Professor Max Lu for their continuing support, guidance and friendship.

Professor Perry Bartlett FAA
Director

Left: QBI's Director Professor Perry Bartlett. Right: Aerial view of UQ's St Lucia campus looking North.

Development Board's Report

Development Board's Report

During 2010, the Development Board continued to raise awareness of the Institute and promote the award-winning research being conducted by QBI's team of dedicated neuroscientists. In all, it was a year in which we consolidated the developments of the past seven years, with a view to further expanding our vision for the future.

Substantial progress was made during the year towards the establishment of a centre within QBI dedicated to the development of therapeutic approaches to treat ageing dementia. In July, QBI hosted a visit by the Hon Mark Butler MP, who, at that time, was Parliamentary Secretary for Health, and is now Federal Minister for Mental Health and Ageing. We updated him on the substantial existing financial support for the Centre; and the urgent need to push ahead with research into a condition that is projected to affect more than 981,000 Australians by 2050.

To formally establish the Centre for Ageing Dementia Research, QBI is seeking a $17.5 million Federal Government contribution, with further funding being sought through philanthropy. It was encouraging to note that by the end of 2010, almost $4 million had been pledged by both small and large donors. In particular, we would like to acknowledge the substantial generosity of the Estate of Dr Clem Jones AO, The Helpful Foundation and G. James Australia Pty Ltd.

Behind the scenes, QBI was also engaged in compiling information for a Queensland State Government Review, which was required in order to ensure continued operational funding. It was very pleasing to note that QBI over-performed on every one of the indices and it is hoped that this will drive the necessary longer-term funding for operational costs.

We particularly appreciate the efforts of Jeff Maclean for continuing to actively promote fundraising activities throughout the year to raise funds for motor neuron disease through the Ross Maclean Fellowship.

I thank my fellow Development Board members for their ongoing support and commitment to the Queensland Brain Institute, and to Professor Perry Bartlett for his leadership and vision. I look forward to the continued growth of the Institute, and the enhanced possibility for breakthroughs in our understanding of brain functioning that this will allow.

David Merson
Chair, QBI Development Board

Right, Board Members from left to right, top down: David Merson, Paul Greenfield, Bob Atkinson, Mark Gray, Sallyanne Atkinson, John Lyons, Perry Bartlett, Jeff Maclean, Milton Dick

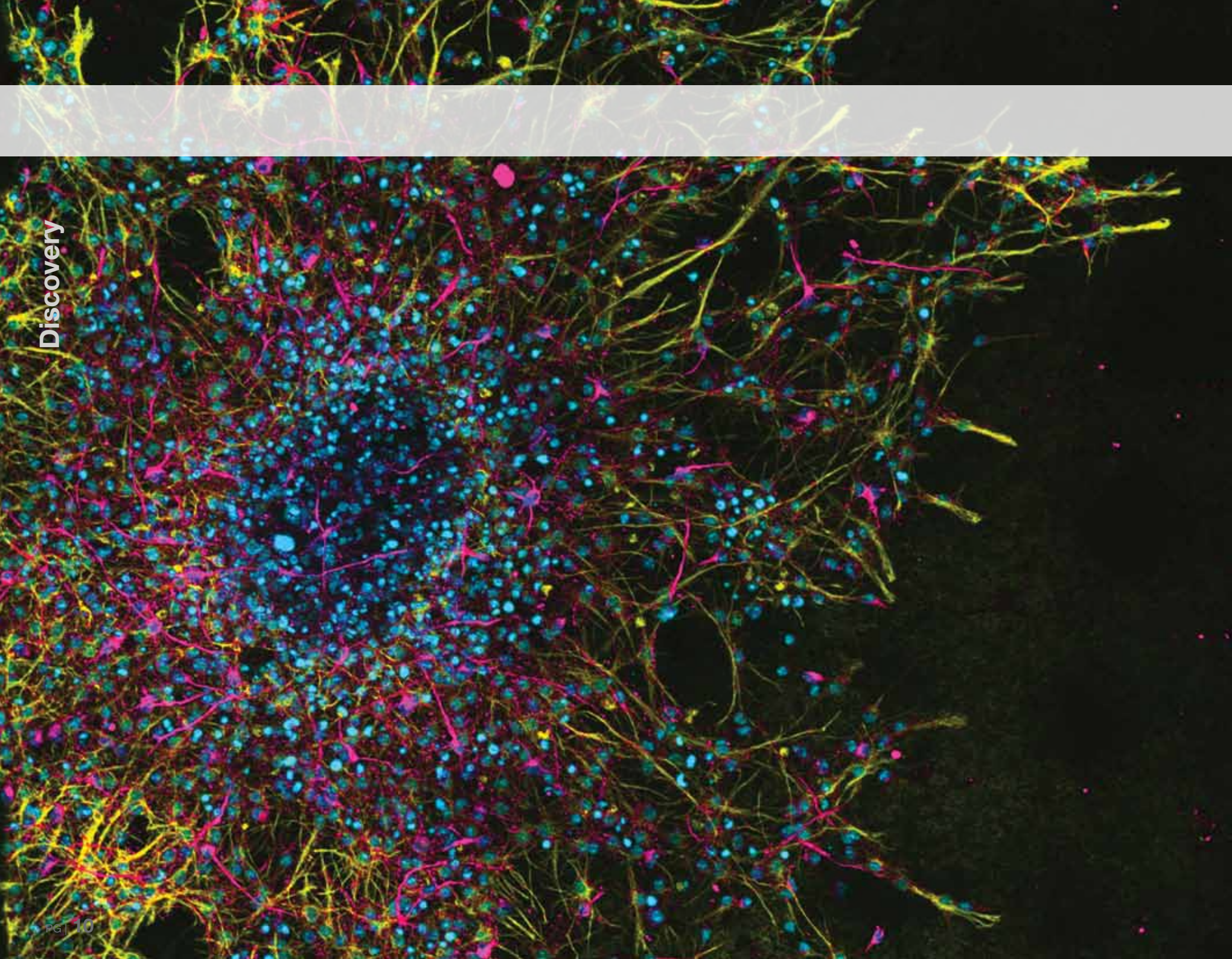
Discovery

Christine Dixon undertakes patch clamping procedures.

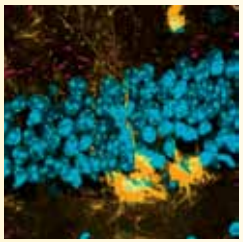
Discovery

In less than a decade, the Queensland Brain Institute has positioned itself as one of the world's leading neuroscience research facilities. Working out of a $63 million state-of-the-art centre, researchers handpicked from across the globe along with a host of high calibre students have demonstrated the Institute's commitment to improving the lives and health of everyday Australians.

Research at QBI aims to create an environment of discovery that will ultimately lead to the development of much-needed therapeutic treatments for neurological disorders and neurotrauma. Indeed, the diverse discoveries made during 2010 have reaffirmed the value of this approach, proving once again the dedication of the Institute's researchers.



All in the **Mind**



Neuroscientists at the Queensland Brain Institute have uncovered how antidepressants stimulate the brain to improve a person's mood – however their research has also found that not all antidepressants work in the same way.

They discovered the class of drugs that increases levels of a neurotransmitter known as norepinephrine triggers neurogenesis in the hippocampus, which is the area of the brain responsible for learning and memory.

Neurogenesis, or the growth of new neurons, is seen as vital in warding off neurological disorders such as dementia.

Lead researcher Dr Dhanisha Jhaveri explained: "If you block hippocampus neurogenesis, antidepressants no longer work. That suggests antidepressants must up-regulate neurogenesis in order for them to actually have any effect on behaviour."

However, the neuroscientists found the results were not mirrored with all antidepressants.

Surprisingly, the class of antidepressants that increase levels of the neurotransmitter called serotonin (Prozac is a common example) fails to stimulate neurogenesis.

Dr Jhaveri explained: "Norepinephrine is basically binding directly onto the precursors which then initiate a signal which leads to the production of more neurons.

"Serotonin just doesn't do that. Prozac doesn't work by regulating the precursor activity – it may work outside that region, but it isn't regulating the hippocampus directly. More research is needed to find out what serotonin actually does."

The team, which is part of QBI's neural plasticity laboratory, used rodent models to establish that selectively blocking the re-uptake of norepinephrine directly activated hippocampal stem cells. In turn, they discovered a much larger pool of dormant precursors in the hippocampus than were previously thought to exist.

Further, the research expanded existing understanding of the mechanisms by which norepinephrine activated the precursors in the hippocampus. It found that the expression of β3 (beta-3) adrenergic receptors is critical in mediating the effect.

Armed with this information, the team can now explore improved treatments for serious neurological disorders, such as depression and ageing dementia.

"Since dementia – especially in the ageing population – appears to be related to a decrease in neurogenesis this discovery opens up exciting new ways to stimulate the production of new neurons to alleviate the devastating effects of dementia in our society," said Laboratory Head and QBI Director Professor Perry Bartlett.

The findings will also allow researchers to develop more specific – and therefore more effective – antidepressants.

"Depression is a complex disorder, so we are going to test different behavioural outcomes to see whether the compounds that increase norepinephrine levels or stimulate β3 adrenergic receptors work only for certain aspects of depression. We just don't know yet but it may, for example, improve learning and memory, or reduce anxiety," Dr Jhaveri said.

The research was conducted by Professor Perry Bartlett, Drs Dhanisha Jhaveri, Sanjay Nandam and Adam Hamlin, and Eirinn Mackay (QBI) and Dr Vidita Vaidya and Swananda Marathe (Tata Institute of Fundamental Research, India). The findings were published in the *Journal of Neuroscience* in February.

Left: A differentiated primary neurosphere derived from norepinephrine-treated adult hippocampal precursor culture contains a large number of βIII-tubulin-positive neurons (pink). Astrocytes are labeled with glial fibrillary acidic protein (yellow) and cell nuclei with DAPI (blue). Above: A population of Hes5-GFP-positive neural precursors in the subgranular zone of the dentate gyrus of adult mice display characteristic radial-glial like morphology. Right: Dr Dhanisha Jhaveri in the laboratory.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Lord of the **Flies**

The world around us can be overwhelming – just ask the Queensland Brain Institute's Assoc. Professor Bruno van Swinderen who investigates how the brain pays attention.

The cognitive and behavioural neuroscientist has discovered a way to measure the attention span of a fruit fly, which could lead to further advances in the understanding of attention-deficit hyperactivity disorder (ADHD) and autism in humans.

Combining genetic techniques with brain recordings, researchers found different mutations can either increase or decrease a fly's attention span. Interestingly, all of these mutations produce learning and memory problems.

Using the genetic fruit fly model *Drosophila melanogaster*, lead researcher Assoc. Professor Bruno van Swinderen found that a fly's level of distractibility is finely tuned to allow 'normal' behavioural responses to a constantly changing environment.

"We now have the two ends of an attention spectrum in our model. We have a fly memory mutant that is hard to distract and another fly memory mutant that's too distractible.

"They both have the same result – they don't learn well but for completely different reasons, not unlike human patients afflicted with autism and ADHD," Assoc. Professor van Swinderen said.

"You need a certain amount of distractibility to be able to assimilate your world – concentrating too much or too little affects your ability to process and retain information."

Understanding the processes regulating attention and memory in the fly brain will allow researchers to better understand how memory and attention work together to govern behaviour.

"One question I'm really interested in is, how do perceptual suppression mechanisms work? How does the brain 'block' you from seeing the world – what are the actual mechanisms that prevent you from responding to distracting stimuli, for example? I really think that's been overlooked," he said.

Throughout the research, Assoc. Professor van Swinderen fed the *Drosophila* methylphenidate, which is sold under the brand name Ritalin and used to treat children with ADHD. He found the drug had similar affects on fruit flies as it did on people: it helped the distractible flies to pay attention to visual stimuli.

"It suggests there may be similar pathways in the brains of fruit flies and humans, which means we now have a simple reductionist model, with all the genetic tools that go along with it, to try to understand exactly what this drug is doing," he said.

"We know that this drug affects different pathways. Now we can really try to ask how that translates to other brain phenomena, such as how neurons talk to one another. It will help us form the bigger picture."

To help him build that picture sooner, QBI opened the first joint neuroscience research laboratory between Australia and China in September. Assoc. Professor van Swinderen is collaborating with leading learning and memory researcher Dr Li Liu to better understand how attention and memory are mechanistically linked in the *Drosophila* model.

The $3.7m laboratory will investigate brain disorders in fruit flies before advancing up the evolutionary ladder to mouse models and eventually humans.

Assoc. Professor van Swinderen's learning and memory research was published in the *Journal of Neuroscience* in January.

Above: Assoc. Professor Bruno van Swinderen. Right: Two glass electrodes are implanted into the *Drosophila melanogaster* fly brain to record brain activity. The fly is feeding on a morsel of Ritalin-laced food.

Common Scents **Approach**

Every moment of every day the brain is forced to process thousands of separate odorants from the world around us.

Through the study of honeybees, scientists at the Queensland Brain Institute have discovered the brain has an advanced ability to isolate specific odorants and recollect smells.

"There's a lot of information coming into the brain whenever a scent is detected and it would be difficult to process it all.

"We've found that honeybees pick only a handful of so-called 'key odorants' out of every complex aroma that they really learn. They may remember just six or seven odorants from a couple of hundred – the rest are ignored," said lead researcher Dr Judith Reinhard.

"If you had to learn the hundreds of compounds your brain is subjected to every minute of every day you would be overwhelmed with information. By choosing the key odorants, you can function more effectively without the brain being swamped," added fellow researcher Dr Charles Claudianos.

The research has also allowed the scientists to explore how the learning of odours is linked to molecules that have been associated with autism and schizophrenia.

Dr Claudianos explained: "These synaptic molecules connect neurons and help wire the brain correctly. If the molecules are out of balance, as is the case in autism and schizophrenia, odour processing goes haywire. People with these neurological disorders perceive smells differently, which can be used for early diagnosis."

During their studies, the researchers found that the honeybee brain responds to sensory experience.

"The honeybee brain – like the human brain – adapts to its sensory environment by adjusting the expression of molecules involved in odour detection.

"It is a complex process and we do not yet fully understand it, but it seems that the brain increases or decreases expression of these molecules, depending on what scents are out there, to optimise odour detection," Dr Reinhard explained.

The findings could also have an enormous impact on Australian farming. Scientists will be able to isolate key odorants from the complex aromas of crops and then use these to train honeybees to pollinate specific harvests.

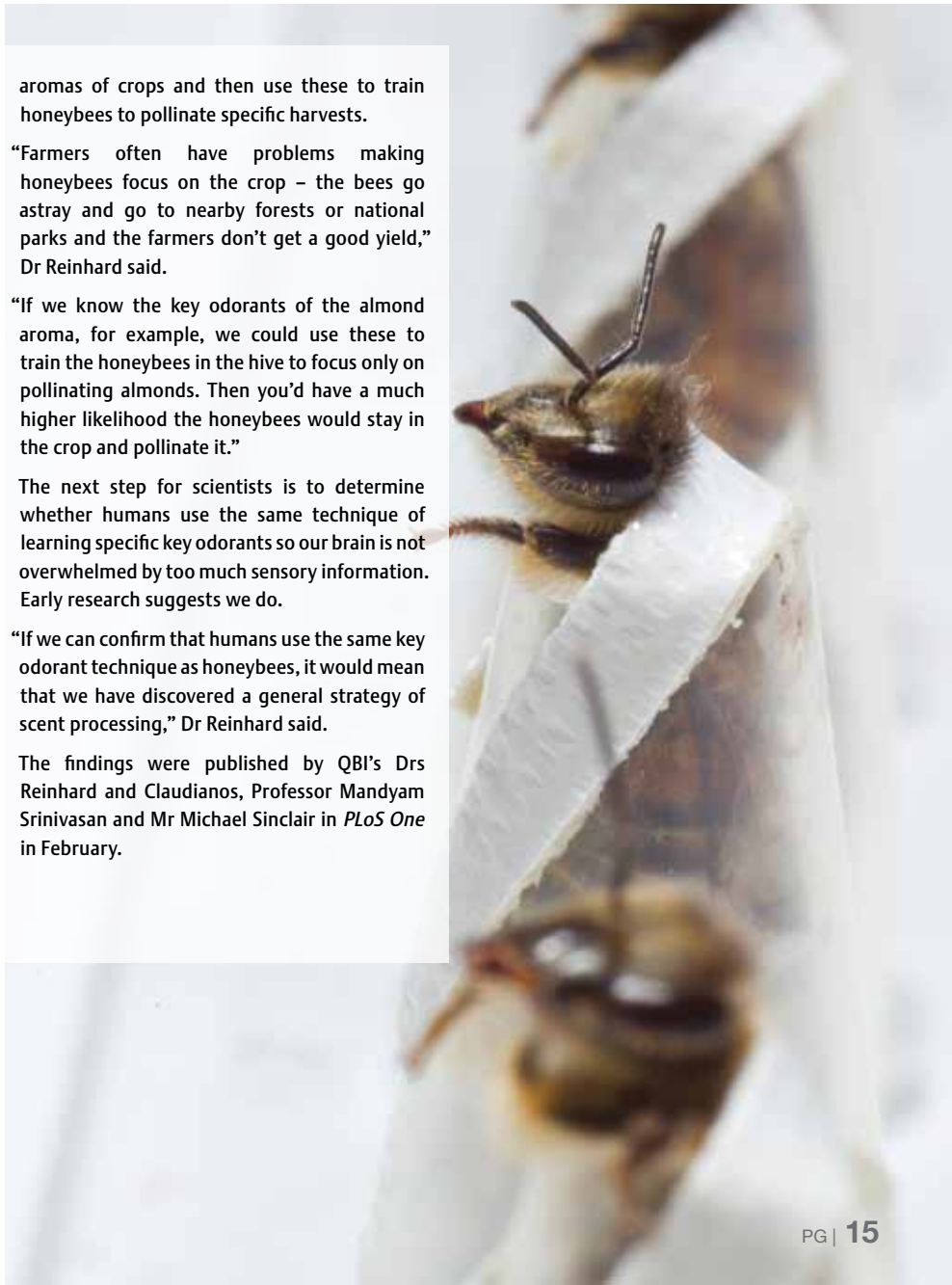
"Farmers often have problems making honeybees focus on the crop – the bees go astray and go to nearby forests or national parks and the farmers don't get a good yield," Dr Reinhard said.

"If we know the key odorants of the almond aroma, for example, we could use these to train the honeybees in the hive to focus only on pollinating almonds. Then you'd have a much higher likelihood the honeybees would stay in the crop and pollinate it."

The next step for scientists is to determine whether humans use the same technique of learning specific key odorants so our brain is not overwhelmed by too much sensory information. Early research suggests we do.

"If we can confirm that humans use the same key odorant technique as honeybees, it would mean that we have discovered a general strategy of scent processing," Dr Reinhard said.

The findings were published by QBI's Drs Reinhard and Claudianos, Professor Mandyam Srinivasan and Mr Michael Sinclair in *PLoS One* in February.



Above: Almond blossoms. Left: Dr Judith Reinhard tending to the bees. Right: Restrained honey bees.

Shining Light on **Schizophrenia**

Sunshine has long been seen as vital for healthy bones – now Queensland Brain Institute researchers have found a link between newborn babies with low levels of vitamin D and an increased risk of schizophrenia.

Using tiny blood samples from Denmark newborns, the team compared vitamin D concentrations in babies who later developed schizophrenia, with healthy controls – and confirmed those with low vitamin D were twice as likely to develop the disorder.

Vitamin D, or the 'sunshine hormone', is the result of sunshine on the skin, however deficiency is common in many countries.

"Although we need to replicate these findings, the study opens up the possibility that improving vitamin D levels in pregnant women and newborn babies could reduce the risk of later schizophrenia," Professor John McGrath said.

Schizophrenia is a poorly understood group of brain disorders that affects about one in 100 Australians, and usually first presents in young adults.

Findings from the three-year study could eventually inform public health messages, in much the same way that pregnant women are encouraged to increase folate to reduce the risk of spina bifida in their children.

However, it is not just this research that is being heralded – the techniques used by the researchers have also garnered international attention.

As the blood samples available were exceptionally small, scientists had to develop a new way to test – or assay – vitamin D levels.

"It took three years of hard work but we have probably developed the world's most sensitive assay for vitamin D," fellow investigator Dr Darryl Eyles explained.

The assay has been so effective it is now being used by scientists researching cancer, diabetes, multiple sclerosis, autism and asthma.

Meantime, in a separate project, Professor McGrath found that young adults who use cannabis from an early age are three times more likely to experience psychotic symptoms.

The study of more than 3,800 21-year-olds, born at Brisbane's Mater Hospital, revealed those who use cannabis for six or more years have a greater risk of developing psychotic disorders or the isolated symptoms of psychosis, such as hallucinations and delusions.

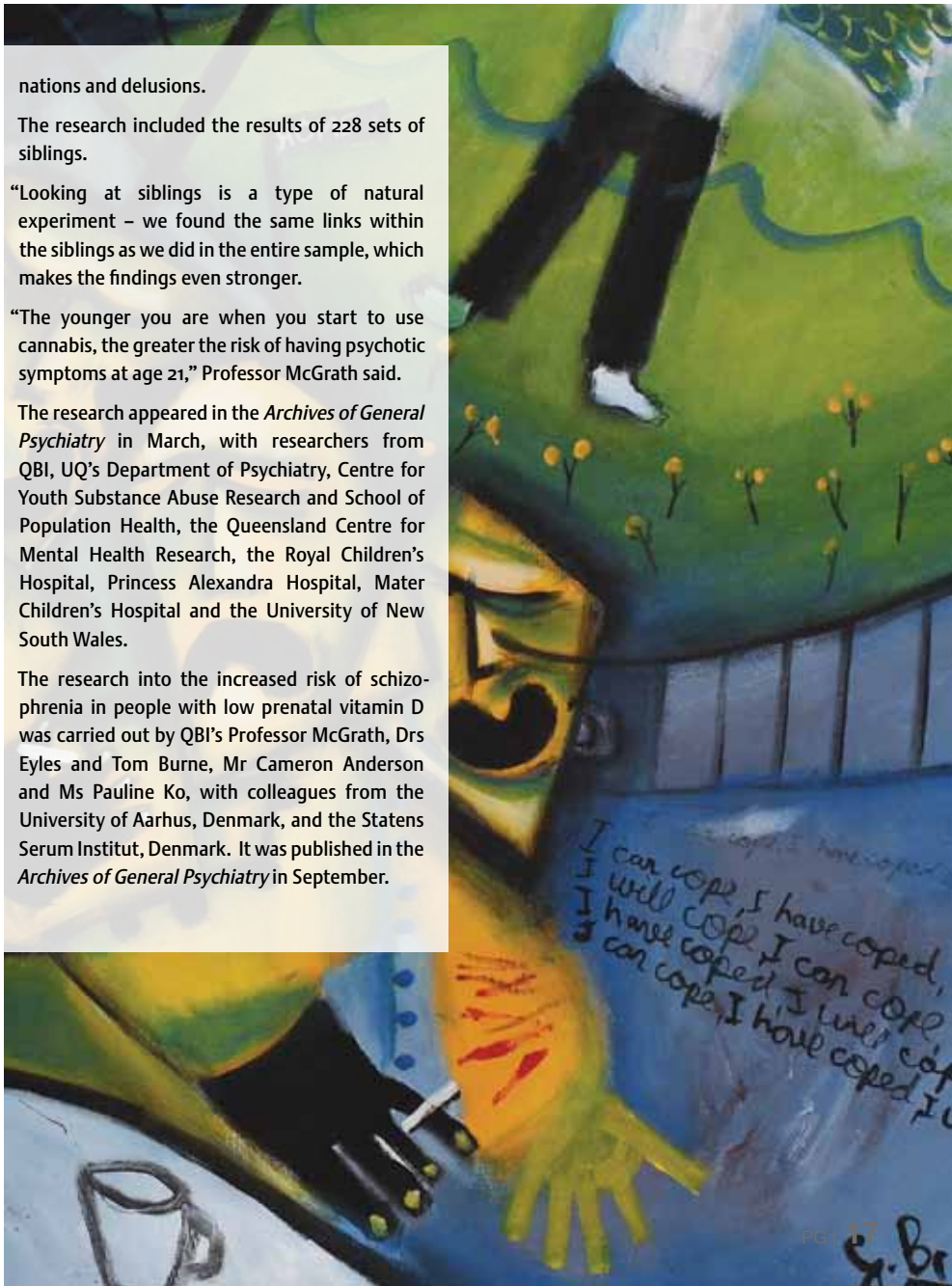
The research included the results of 228 sets of siblings.

"Looking at siblings is a type of natural experiment – we found the same links within the siblings as we did in the entire sample, which makes the findings even stronger.

"The younger you are when you start to use cannabis, the greater the risk of having psychotic symptoms at age 21," Professor McGrath said.

The research appeared in the *Archives of General Psychiatry* in March, with researchers from QBI, UQ's Department of Psychiatry, Centre for Youth Substance Abuse Research and School of Population Health, the Queensland Centre for Mental Health Research, the Royal Children's Hospital, Princess Alexandra Hospital, Mater Children's Hospital and the University of New South Wales.

The research into the increased risk of schizophrenia in people with low prenatal vitamin D was carried out by QBI's Professor McGrath, Drs Eyles and Tom Burne, Mr Cameron Anderson and Ms Pauline Ko, with colleagues from the University of Aarhus, Denmark, and the Statens Serum Institut, Denmark. It was published in the *Archives of General Psychiatry* in September.



Above: Professor John McGrath. Left:Low doses of Vitamin D during pregnancy are twice as likely to result in babies with schizophrenia. Right: Section of artwork by Glenn Brady. *In one side and out the other*.

Navigating a path for **improved diagnosis**

If you have ever lost your sense of direction in an unfamiliar place then Queensland Brain Institute researchers may be able to help.

They have discovered a neuronal population sensitive to heading direction in humans. Head direction sensitive cells have been found in rodents, but evidence for such cells in humans had been lacking.

Lead researcher Dr Oliver Baumann asked volunteers to learn the directions to landmarks around a computer-generated maze over several days. He then measured the volunteers' brain activity as they viewed each of the landmarks in isolation.

"The brain acts like a compass, with different neurons firing depending on the direction people think they are heading. We certainly do not have a magnetic sense, but we have a brain region that nevertheless codes the direction we are heading in," Dr Baumann explained.

"Our study provides not only the first evidence of a brain region sensitive to heading direction in people, but also its precise location in the brain."

The researchers used functional magnetic resonance imaging to monitor people's brain activity as they carried out the computerised testing.

They found that a small area in the parietal cortex, located toward the back of the brain, provides critical details for navigation and information about the direction in which a person is heading.

"Here we have evidence in a normal, healthy human population that there is a dedicated cluster of neurons that encodes our sense of direction," fellow researcher Professor Jason Mattingley said.

"If this brain region is damaged it can severely disrupt a person's ability to navigate in new situations. Such damage is common in stroke and Alzheimer's disease. People haven't made this link before – previously it was just a clinical anecdote."

Professor Mattingley predicted clinicians could eventually use navigational tests, such as those created for this study, as an early probe for the onset of dementia.

"Our research suggests that one of the important cognitive functions we should be testing in people with suspected dementia is their sense of direction," he said.

Dr Baumann added: "The assessment of navigational skills in people with suspected dementia could be more sensitive to early signs of Alzheimer's disease than traditional screening tests. Furthermore, performance on virtual reality navigation tasks could serve as a valuable behavioural marker of disease progression."

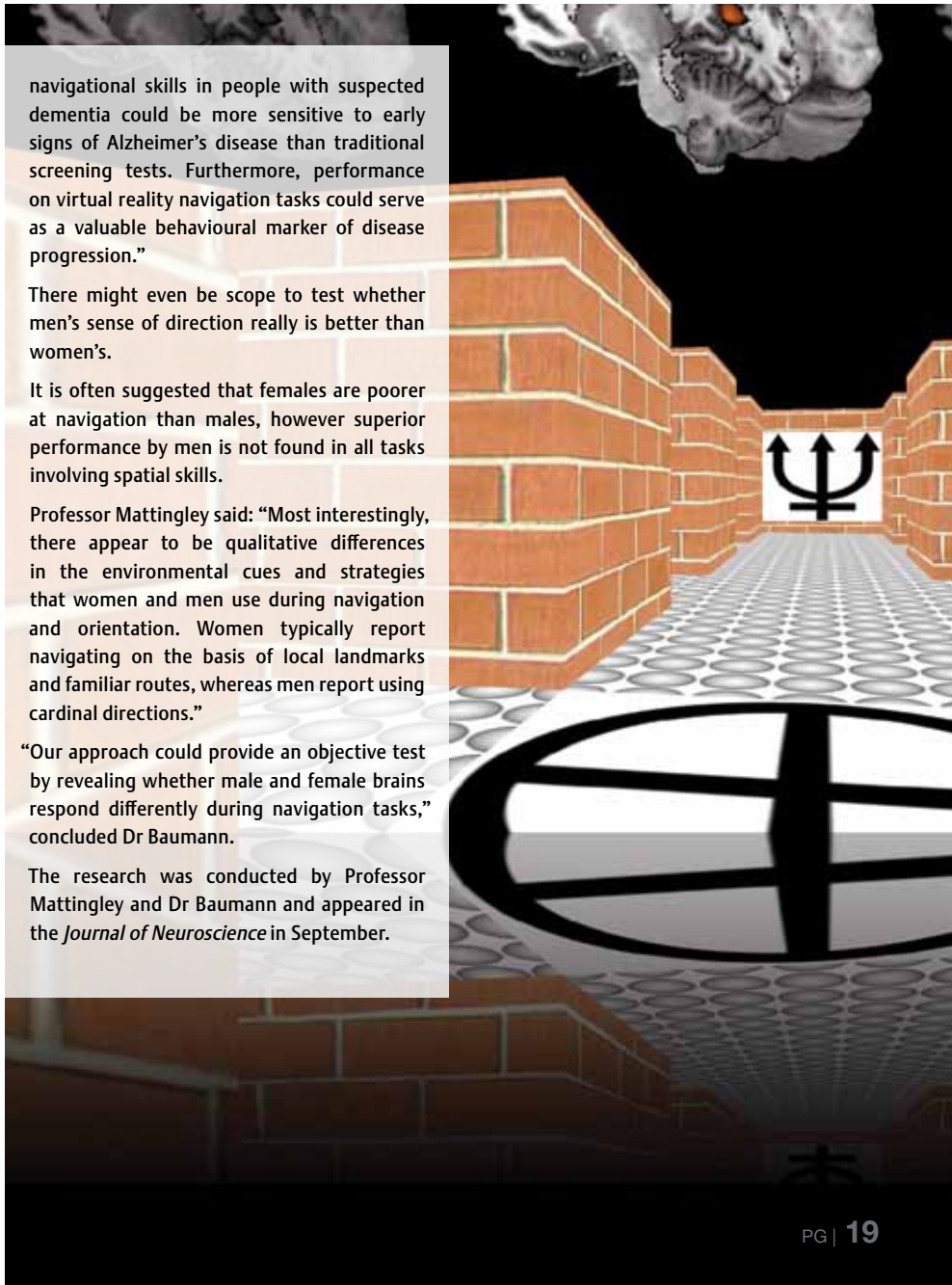
There might even be scope to test whether men's sense of direction really is better than women's.

It is often suggested that females are poorer at navigation than males, however superior performance by men is not found in all tasks involving spatial skills.

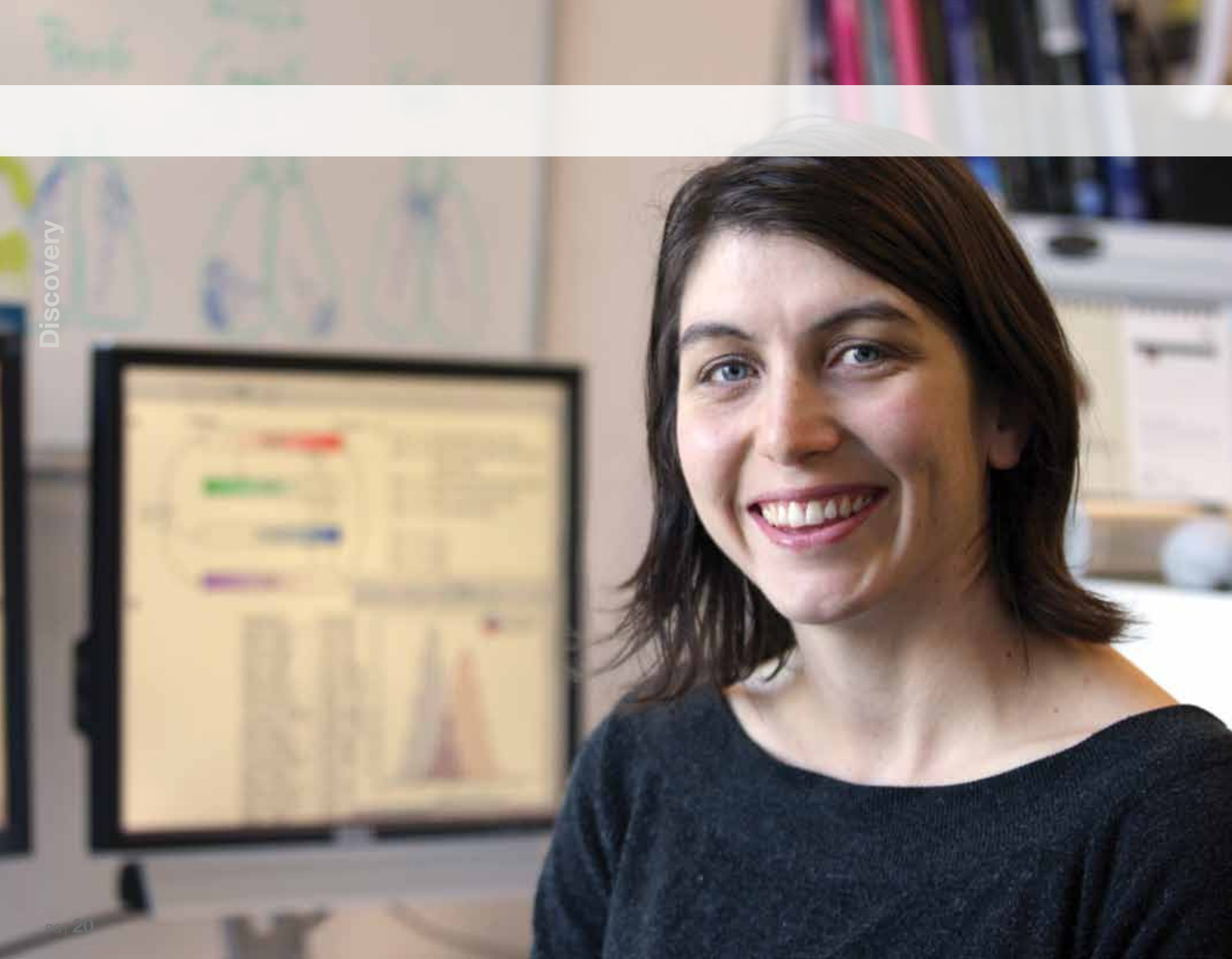
Professor Mattingley said: "Most interestingly, there appear to be qualitative differences in the environmental cues and strategies that women and men use during navigation and orientation. Women typically report navigating on the basis of local landmarks and familiar routes, whereas men report using cardinal directions."

"Our approach could provide an objective test by revealing whether male and female brains respond differently during navigation tasks," concluded Dr Baumann.

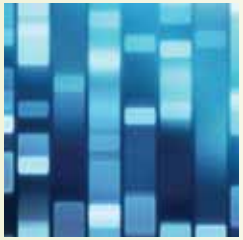
The research was conducted by Professor Mattingley and Dr Baumann and appeared in the *Journal of Neuroscience* in September.



Above: Dr Oliver Baumann. Right: First-person perspective of a passageway within a computer-generated, virtual maze. Healthy human volunteers learned the spatial layout of the maze over five days by navigating between landmarks (black symbols) using a joystick.



Research adds up to better **understanding**



Computational neuroscientists at the Queensland Brain Institute have done the sums – and found that a mathematical model could help improve the understanding of brain development.

The model addresses the development of a crucial region of the brain known as the cerebral cortex, which is responsible for functions such as vision, touch and motor control.

If the cerebral cortex fails to form correctly in the embryo, a person can develop autism, epilepsy and learning difficulties.

"In the adult, different areas of the cerebral cortex are defined by specific patterns of genes and patterns of connections, which makes the cortical areas highly specialised and quite different to each other," lead author Clare Giacomantonio said.

"We're trying to understand how those specialised areas develop. We're specifically looking at one aspect of that development, which is how the patterns of gene expression form."

Every cell in an individual contains the same set of genes. Some of these genes are turned into proteins that do work around the cell, a process called gene expression. Specialised cells in different areas of the body differ, in part, in the genes they express.

As cells specialise during development, expression becomes more complex so that by adulthood there are very specific patterns of gene expression.

"The genes make proteins but these proteins sometimes interact with other genes and control whether or not they are expressed. This research was trying to understand that control process," explained Ms Giacomantonio.

The research used a mathematical model to systematically explore different possible interactions between the genes and proteins involved in development of the cerebral cortex.

The neuroscientists simulated a small period of cortical development many times in the presence of different combinations of interactions and looked for interactions that ensured either correct or incorrect development.

"Our modelling helps make it clear which gene interactions are crucial for normal development to occur, which is very important information," Laboratory Head Professor Geoffrey Goodhill said.

"If we can understand how normal development occurs you can certainly get a better idea of understanding how things can go wrong and, eventually, how you might steer development back in the correct direction," Ms Giacomantonio added.

The computational neuroscientists will now focus on using the model to understand more about the effects of genetic mutations on brain development. These mutations alter the patterns of gene expression.

"Data from mice on the changes in expression patterns can be used to refine our model and give it greater power to understand which interactions between genes are critical for correct cerebral cortical development," Ms Giacomantonio said.

Professor Goodhill explained: "The predictions of our model may be used by experimental neuroscientists to guide future experiments."

"The larger research effort to understand development of the normal cerebral cortex may help us understand how the adult brain operates and what can go wrong during development to give rise to developmental disorders."

The research was carried out by QBI's Professor Goodhill and Ms Giacomantonio. It was published in *PLoS Computational Biology* in September.

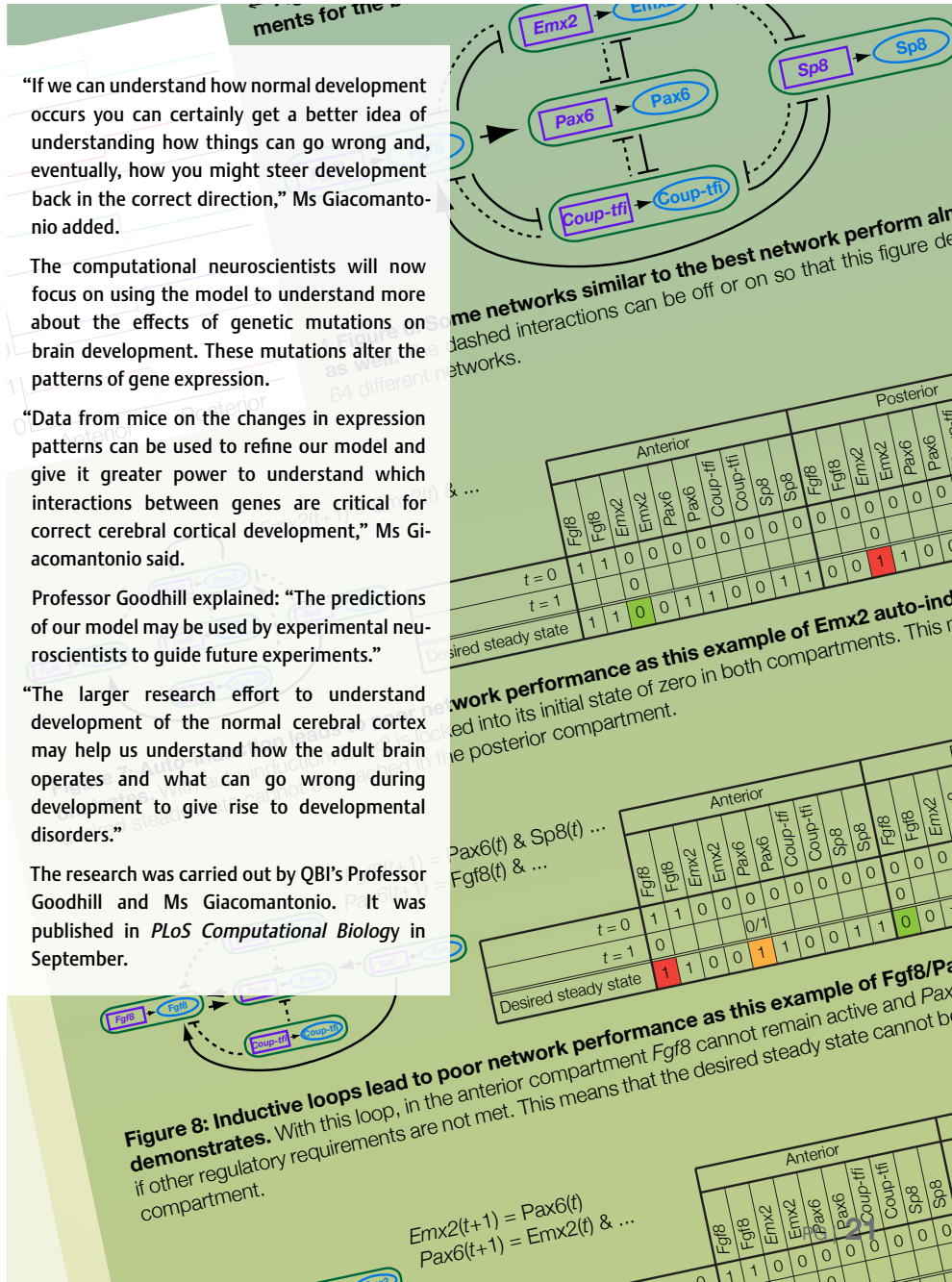


Figure 8: Inductive loops lead to poor network performance as this example of Fgf8/Pa demonstrates. With this loop, in the anterior compartment *Fgf8* cannot remain active and *Pax* if other regulatory requirements are not met. This means that the desired steady state cannot b compartment.

Left: Clare Giacomantonio. Right: Detail from Clare Giacomantonio's 2010 poster entitled *A computational model of the patterns of gene expression underlying cortical area development.*

Discovering **Creatures of the Deep**

Pushing the boundaries is an almost daily requirement for any scientist.

Hence, it is no surprise that neurobiologists from the Queensland Brain Institute have delved deep into the Coral Sea to learn more about ocean life and, in turn, human vision.

Using high-tech equipment and instrument platforms new to Australia, prehistoric six-gilled sharks, giant oil fish, swarms of crustaceans and many unidentified fish were caught on camera 1,400m below sea level at Osprey Reef, 350km northeast of Cairns.

The team, led by Professor Justin Marshall, captured the sea creatures using special low-light sensitive, custom-designed remote controlled cameras, which sat on the sea floor. The Australian Research Council funded the equipment that was built at The Harbour Branch Oceanographic Institute in Florida.

"Osprey Reef is one of the many reefs in the Coral Sea Conservation Zone, which has been identified as an area of high conservation importance by the Federal Government. Therefore, it is paramount that we identify the ecosystems and species inhabiting the area," Professor Marshall said.

"As well as understanding life at the surface, we need to plunge off the walls of Osprey to describe the deep-sea life that lives down to 2000m, beyond the reach of sunlight. We simply do not know what life is down there and our cameras can now record the behaviour and life in Australia's largest biosphere, the deep-sea."

Scientists working on the Deep Australia Project also collected amazing footage of the Nautilus, a relative of squid or octopus that still lives in a shell as they have done for millions of years.

Researchers measured these living fossils to find out more about their biology before returning them to the sea.

"Learning about these creatures' primitive eyes and brain could help neuroscientists to better understand human vision," research student Andy Dunstan said.

Professor Marshall explained most of our knowledge on how nerve cells function and communicate was first pioneered through work on squid giant nerve cells.

"We are now returning to these original model systems, both for their own intrinsic interest and also to better understand brain disorders which lead to conditions such as epilepsy," he said.

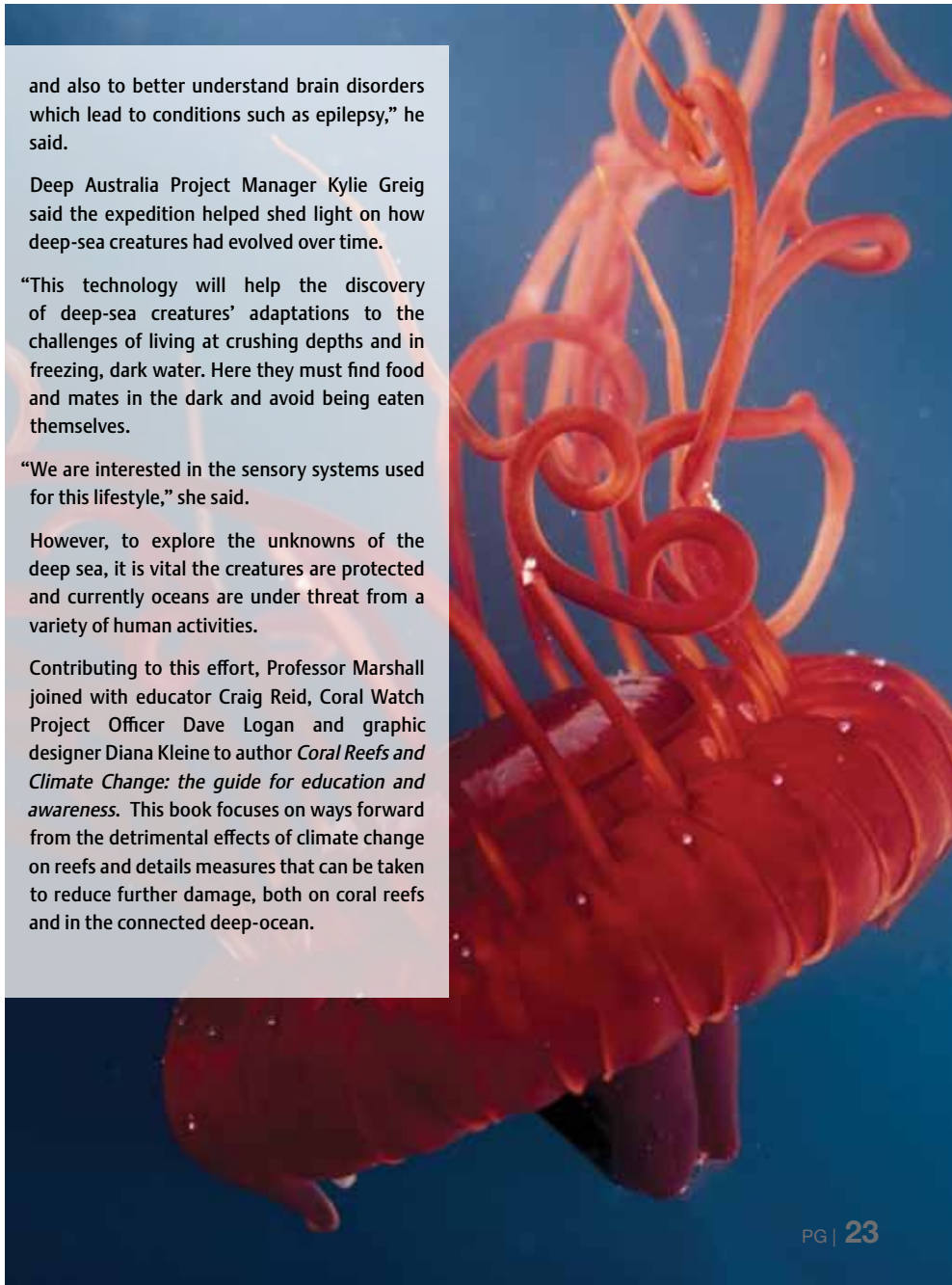
Deep Australia Project Manager Kylie Greig said the expedition helped shed light on how deep-sea creatures had evolved over time.

"This technology will help the discovery of deep-sea creatures' adaptations to the challenges of living at crushing depths and in freezing, dark water. Here they must find food and mates in the dark and avoid being eaten themselves.

"We are interested in the sensory systems used for this lifestyle," she said.

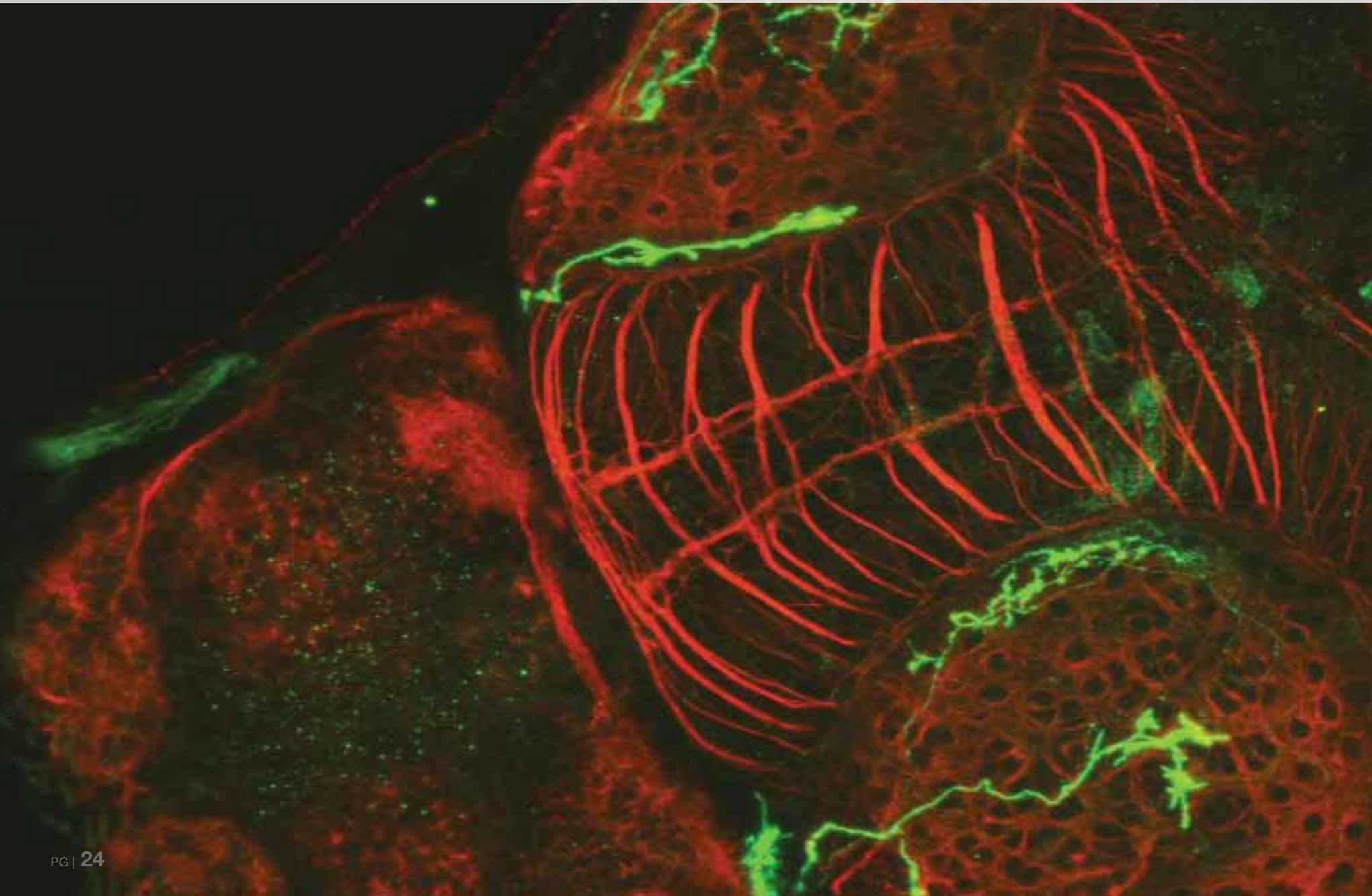
However, to explore the unknowns of the deep sea, it is vital the creatures are protected and currently oceans are under threat from a variety of human activities.

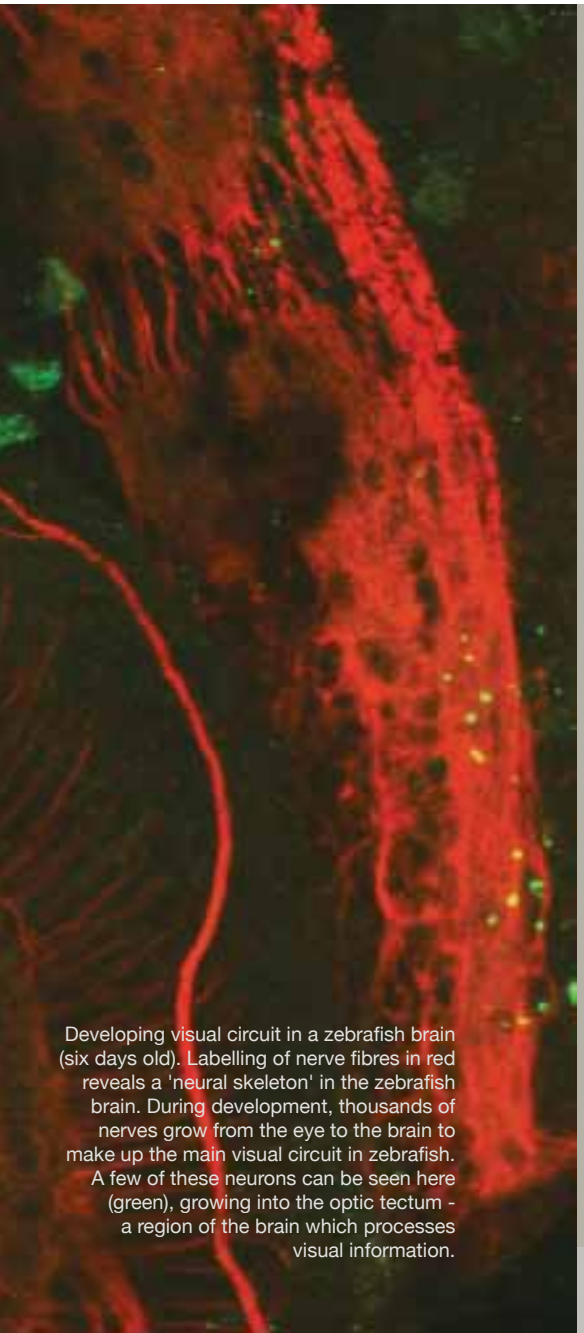
Contributing to this effort, Professor Marshall joined with educator Craig Reid, Coral Watch Project Officer Dave Logan and graphic designer Diana Kleine to author *Coral Reefs and Climate Change: the guide for education and awareness.* This book focuses on ways forward from the detrimental effects of climate change on reefs and details measures that can be taken to reduce further damage, both on coral reefs and in the connected deep-ocean.



Left: The deep sea anglerfish *Bufoceratias wedli* is covered with rows of vibration-detecting lateral line organs that enable such fish to detect neighbours in the lightless depths of the deep-sea. Above: Professor Justin Marshall. Right: The red jellyfish *Atolla* possesses a bright ring of bioluminescent organs on its body to warn off potential predators.

Research





Developing visual circuit in a zebrafish brain (six days old). Labelling of nerve fibres in red reveals a 'neural skeleton' in the zebrafish brain. During development, thousands of nerves grow from the eye to the brain to make up the main visual circuit in zebrafish. A few of these neurons can be seen here (green), growing into the optic tectum - a region of the brain which processes visual information.

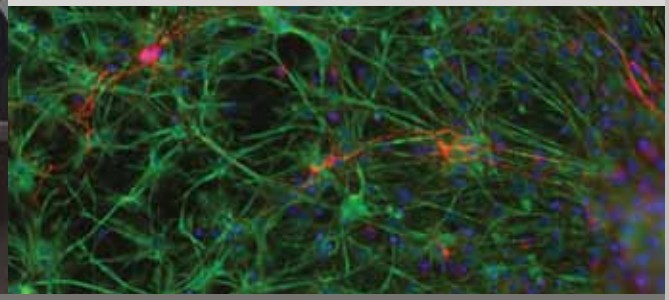
Research

Unlike other research organisations which focus on particular diseases or conditions, QBI is structured to study the brain's fundamental molecular and physiological mechanisms. Research is conducted across the seven key themes of cognition and behaviour, computation and neuronal circuits, neurogenesis and neuronal survival, neurogenetics and epigenetics, neuronal development and connectivity, sensory systems and synaptic function.

QBI neuroscientists use the world's most advanced investigative technologies for their research, including flow cytometry and mass spectrometry equipment. They use human volunteers in their research and also study a range of animal models, including the mouse, honeybee, fruit fly, frog, zebrafish and flatworm.

Laboratory Head **Professor Perry Bartlett**

Neurogenesis, the production of new nerve cells in the adult brain by populations of resident stem cells, has been implicated in regulating learning and memory. Research to date has suggested that stimulating this production may be therapeutic for diseases such as dementia and depression. To study how various factors released by nerve stimulation activate stem cells in the hippocampus to produce new nerve cells, members of the Bartlett laboratory are using unique cell-sorting technologies to isolate stem cells and novel in vivo *techniques.*



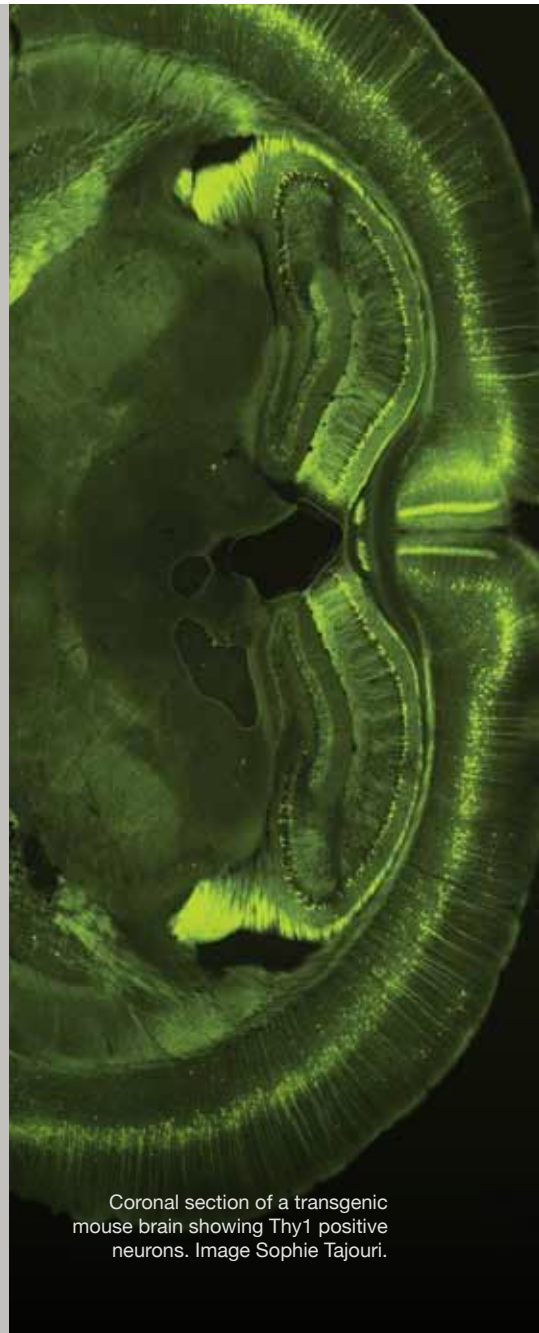
Above: Bartlett group photo. 2010 Laboratory Members: Debra Black, Daniel Blackmore, Lavinia Codd, Michael Colditz, Kirsty Dixon, Dhanisha Jhaveri, Vilija Jokubaitis, Masahiro Kameda, Tamara Koudijs, Li Li , Eirinn MacKay, Estella Newcombe, George Rigley, Gregory Robinson, Sumiti Saharan, Jay Spampanato, Mark Spanevello, Sophie Tajouri, Chanel Taylor, Jana Vukovic, Tara Walker, Dianne Walker, Di Xia. Above right: Neurosphere from an aged (24 month) mouse demonstrating that neural stem cells within old animals retain the ability to produce neurons (in red) and astrocytes (green).

Stimulating neurogenesis in the brain

During 2010, the laboratory continued to investigate the regulation of neurogenesis in the brain, with the specific aim of discovering molecules that activate resident precursor cells. During the year, the team discovered a second population of precursors in the hippocampus that are normally dormant, but can be activated by the neurotransmitter norepinephrine (NE) to produce new nerve cells both *in vitro* and *in vivo*. Furthermore, we demonstrated that NE acted directly on the precursor population through a beta-3 adrenergic receptor, defining for the first time a mechanism of action for the class of antidepressants that raise NE levels.

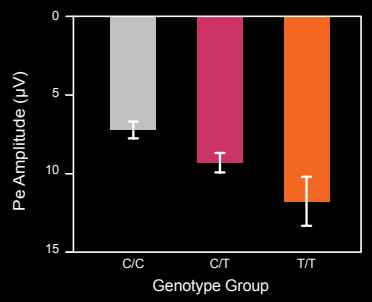
Previously, it has been posited that antidepressants that raise NE or serotonin levels may act by increasing neuronal production in the hippocampus. Our studies show that only NE directly regulates this, suggesting that serotonin may act indirectly or through raising NE levels. These discoveries present new opportunities for developing antidepressants which target the beta-3 receptor.

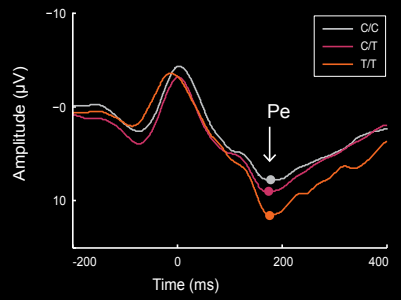
Also, the finding reveals that there is more than one population of precursors in the hippocampus, since the NE-activated population is quite separate to the one we previously described in 2008, which was activated by synaptic activity. Thus, it appears that there are discrete populations of precursors which respond to different stimuli, raising the possibility that they may give rise to populations of neurons with subtle differences in their synaptic machinery, which may explain why different stimuli lead to different hippocampal-dependent behavioural outcomes. This possibility is now being investigated.



Coronal section of a transgenic mouse brain showing Thy1 positive neurons. Image Sophie Tajouri.

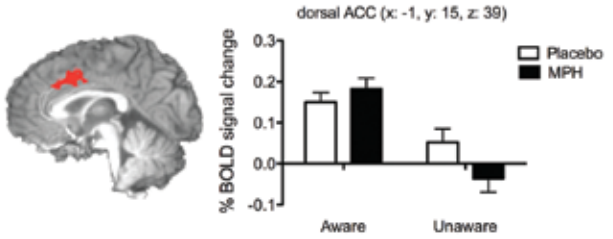
Laboratory Head **Assoc. Professor Mark Bellgrove**





Individuals with ADHD process errors abnormally. We have shown that a risk gene for ADHD, the dopamine D5 receptor gene, influences an electrophysiological marker of error processing, known as the Pe, in healthy volunteers.

Work in Assoc. Professor Mark Bellgrove's laboratory explores fundamental questions of cognitive science from several perspectives, including genetics and pharmacology. This work has direct implications for conditions such as attention deficit hyperactivity disorder (ADHD), a common and controversial condition most prevalent in children. ADHD is heritable, meaning it runs in families. Thus, the group is actively engaged in international research efforts to identify risk genes for the condition.



Above right: Bellgrove group photo. 2010 Laboratory Members: Angela Dean, Ziarih Hawi, Natasha Matthews, Bung-nyun Kim, Tarrant Cummins, Joseph Wagner, Kelly Garner, Daniel Stjepanovic, Inga Laube, Jessica Barnes, Edgar Chan, Sanjay Nandam, Elliot Lambert, Lynn Tan, Teresa Hall, Johnathan Phan, Gemma McKeon. Above Left: Drugs such as methylphenidate (MPH), more commonly known as Ritalin, improve our awareness of performance errors compared to placebo. This effect is mediated by changes in activity within the dorsal anterior cingulate (dACC).

Scrutinising genetic contributions to ADHD

How does the human brain enable cognitive control? How are individual differences in such abilities implicated in conditions like ADHD? These are the crucial questions studied within the Bellgrove laboratory.

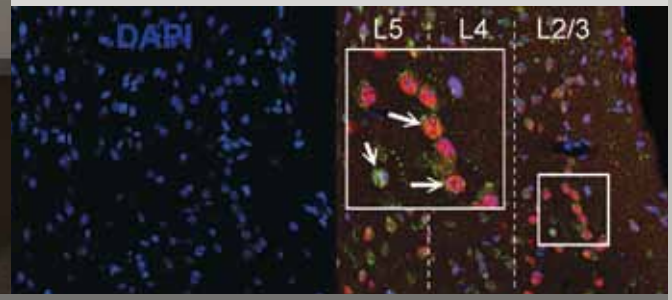
An excellent candidate gene for ADHD is the dopamine transporter gene (DAT1). Drugs such as Ritalin, which are used to treat ADHD, act on the dopamine transporter to make more of a chemical known as dopamine available for signalling messages in the brain. Although a large number of international studies have now confirmed DAT1 as a risk gene for ADHD, how variation in this gene might give rise to differences in behaviour has previously been unknown.

Researchers in the Bellgrove laboratory are now conducting one of the largest ever Australian studies into the disorder. They have been asking children with and without ADHD to perform detailed cognitive assessments and have discovered that DNA variation in the DAT1 gene has an important influence on the attention of children. Specifically, variation in this gene influenced the degree to which attention was caught by sudden-onset or distracting stimuli. Although the effect of the gene was present in both children with and without ADHD, the effect was magnified in children with the condition who carried the DAT1 risk gene.

This confirms the gene might confer risk to ADHD, in part through its influence on the development of attention networks in the brain, including the frontal and parietal cortices. Work in the Bellgrove laboratory is now testing these additional hypotheses.

Laboratory Head **Dr Timothy Bredy**

Dr Timothy Bredy's laboratory is interested in elucidating how the genome is connected to the environment, and how this relationship shapes brain and behaviour across the lifespan. In contrast to the information conveyed by a static genome, the epigenome is very dynamic and can be modified by exposure to a variety of environmental stimuli, including learning, exposure to drugs of abuse, environmental toxins, dietary factors and social interaction.



Above: Bredy group photo. 2010 Laboratory Members: Kevin Dudley, Carlos Coelho, Wei Wei, Xiang Li , Danay Baker-Andresen, Vikram Ratnu, Roger Marek, Zoran Boskovic, Maria Galeanos, Joanne Loh, Zhanzhi Yan. Above right: The transcription factor ATF4 is coexpressed with the histone acetyltransferase PCAF within the infralimbic prefrontal cortex.

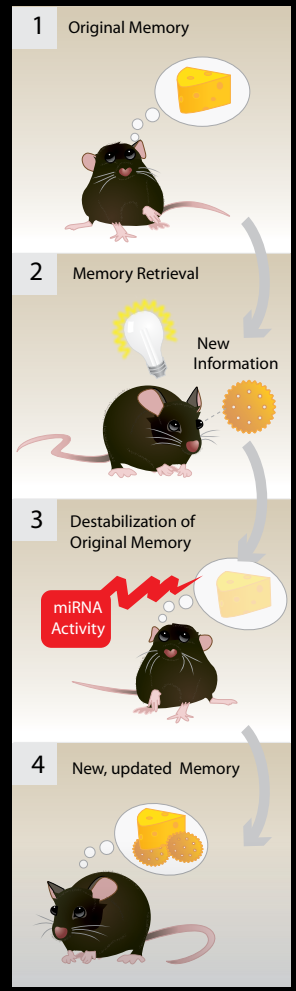
Shaping scientific understanding of epigenetic mechanisms

In 2010, the Bredy group discovered that, in mice, the extinction of conditional fear (a form of inhibitory learning important for the treatment of anxiety disorders) is regulated by microRNA activity in the prefrontal cortex. We also demonstrated that there are epigenetic regulatory proteins such as p300/CBP-associated factor (PCAF), which are unique to the extinction learning process. We have also been performing genome-wide methylation profiling experiments to determine whether sex-specific cortical DNA methylation patterns are associated with sex differences in fear-related learning and memory.

The year has been a busy one in other ways. Laboratory members organised the first Epigenetics, Behaviour and Disease symposium, while Dr Bredy delivered invited talks at a range of neuroscience events. Dr Bredy and Dr Kevin Dudley, a postdoctoral fellow, published a review on epigenetic mechanisms mediating vulnerability and resilience to psychiatric disorders.

In December, the group welcomed PhD candidate Ms Danay Baker-Andresen, who holds a National Science and Engineering Council post-graduate scholarship, from Canada. We were fortunate to host a summer research scholar, Mr Xiang Li, and we also welcomed two co-supervised PhD students – Mr Vikram Ratnu with Professor John Mattick, and Mr Roger Marek with Professor Pankaj Sah.

Our research associates, Drs Wei Wei and Carlos Coelho, continued to perform extraordinarily in overseeing experiments and maintaining the laboratory. Lastly, with the support of an ARC LIEF grant, we began working towards establishing a mass spectrometry core facility at QBI, and optimizing new technology for epigenetic profiling using the Illumina HiSeq2000 platform.



MiRNAs may regulate neural plasticity and memory by constraining or destabilising memory upon retrieval in order to allow new learning or memory updating to occur.

Laboratory Head **Dr Thomas Burne**

Dr James Kesby measures neurotransmitters in samples from brain tissue

The Burne laboratory studies brain development and behaviour in animal models to learn more about neuropsychiatric diseases. Researchers investigate the underlying biological basis for schizophrenia, with the aim of finding appropriate public health interventions. The group has been exploring the impact of developmental vitamin D deficiency on brain development, the impact of adult vitamin D deficiency on brain function and behaviour, and the neurobiological effects of having an older father. The group is part of the Queensland Centre for Mental Health Research.

Above right: Burne group photo. 2010 Laboratory Members: James Kesby, Lauren Harms, Claire Foldi, Carlie Cullen, Natalie Groves, Karly Turner, Suzy Alexander, Meggie Voogt, Pauline Ko, Henry Simila. Above left: Claire Foldi analyses magnetic resonance images of a mouse brain.

Probing the roots of schizophrenia

In 2010, the Burne group, in collaboration with QBI's Dr Darryl Eyles and Professor John McGrath, built on its previous research showing that low levels of vitamin D (the 'sunshine hormone') in the prenatal period is associated with an increased risk of schizophrenia. This work was published in the *Archives of General Psychiatry*. We have explored the behaviour, brain neurochemistry and receptor profile associated with vitamin D deficiency in animal models. Now the collaboration is investigating the impact of DVD deficiency on social and cognitive behaviours.

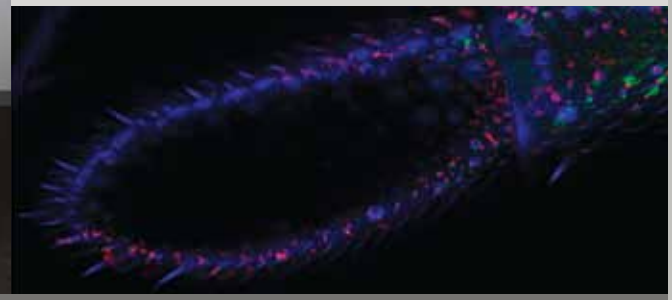
Research into the impact of adult vitamin D deficiency on brain function has also started.

The Burne group has also expanded its research tools, with a suite of cognitive behavioural tasks to assess attentional processing in rodents. The goal now is to investigate the neurobiology of altered cognition in animal models, by looking at selected cognitive domains – sensorimotor gating, working memory, attention and speed of processing, learning and memory, and problem solving – that are known to be disrupted in schizophrenia. In collaboration with other neuroscientists at QBI, we have also begun to incorporate other species, such as zebrafish and fruit flies, to ask questions of the 'small brain'. This research made the cover of *Molecular Psychiatry*.

Further, the group published the first comprehensive study of the impact of advanced paternal age in a mouse model on behaviour and brain structure. In collaboration with researchers at the Queensland Institute of Medical Research, explorations into behavioural, genomic and brain imaging in a mouse model are now underway.

Laboratory Head **Dr Charles Claudianos**

Dr Charles Claudianos' laboratory examines how sensory experience changes nerve cell junctions called synapses that control information transfer in the brain. There are literally hundreds of genes that encode or regulate proteins that contribute to development of synapses – but when these genes are defective, the synapses fail to transfer appropriate signals and cognitive disorders may result. To understand how this works in humans, researchers study the same molecules in simple insects such as fruit flies and honeybees which have advanced genetic and behavioural toolsets.

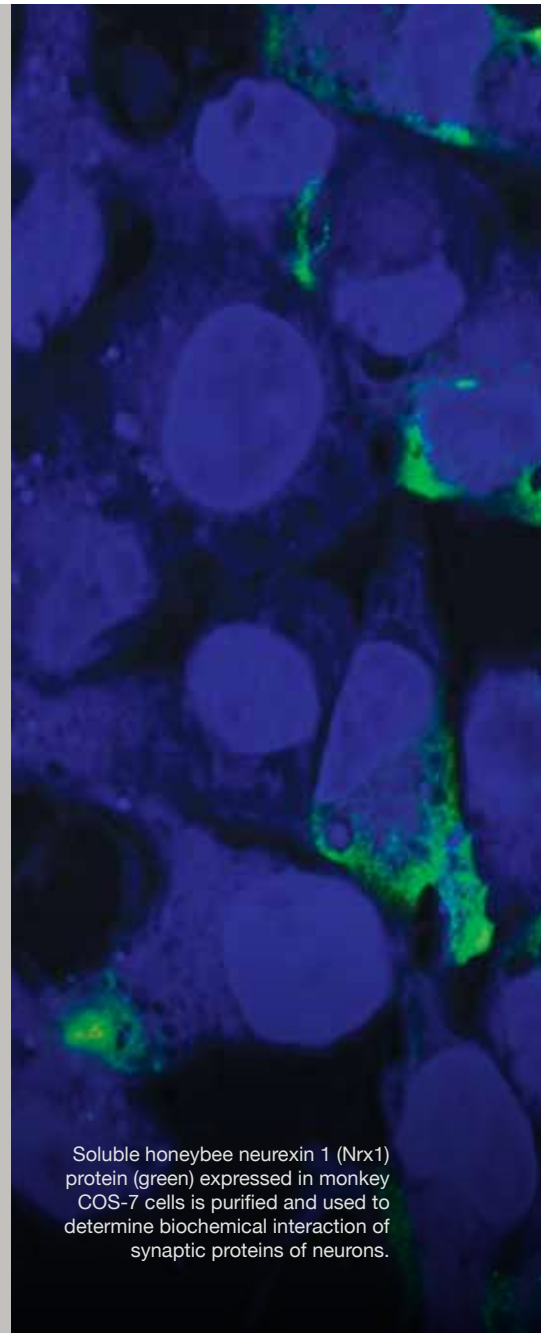


Above: Claudianos group photo. 2010 Laboratory Members: Zoran Boscovic, Alexandre Cristino, Maria Rondon Galeano, Nevitha Gunasekaran, Yeu Lin Liu, Janelle Scown, Sarah Williams, Shan Shi Yang, Zheng-yang Zhao. Above Right: Fluorescent antibody staining of olfactory receptor proteins at the tip of the honeybee antennae.

Investigating molecular response to sensory experience

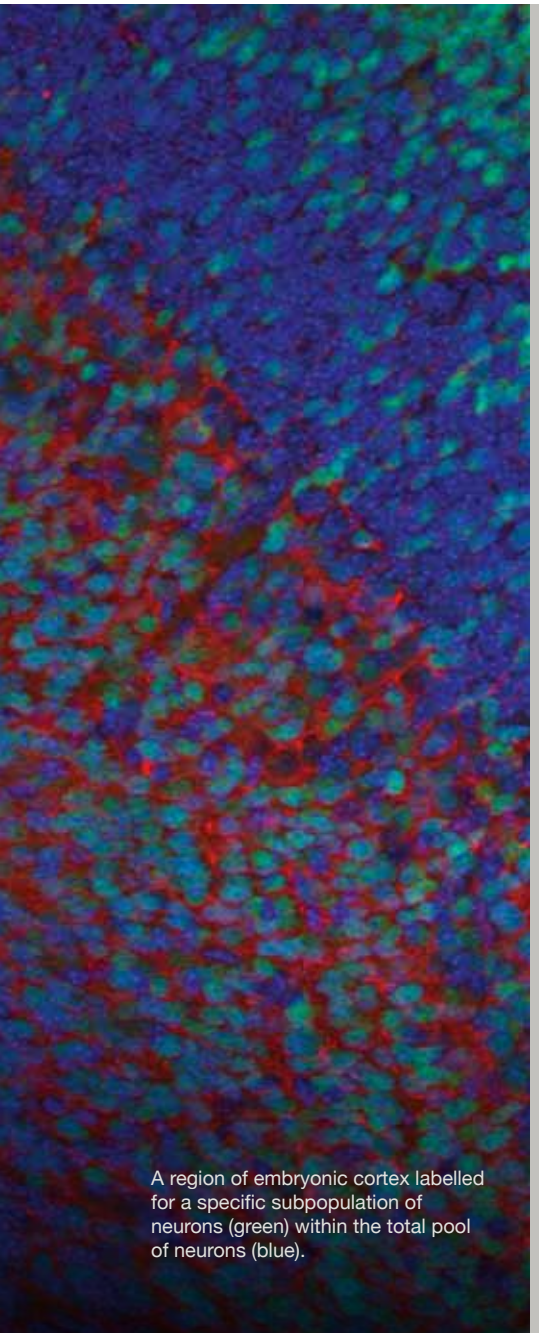
Dr Claudianos' team studies neurexin-neuroligin molecules with regard to sensory acuity, learning and memory and with respect to the greater network of genes that function in the brain - the 'neurome'. Together with QBI colleague Dr Judith Reinhard, the laboratory discovered neurexin-neuroligin molecules found in the synapse are regulated in specific patterns depending on the sensory experience. Their research, detailing how associative memories of odours significantly changed expression of these molecules in the honeybee brain, was published in *PLoS ONE* in 2010. Molecular changes occurred whenever a bee learnt new odours, showing that the sense of smell is not hard-wired but remains plastic throughout adult life. The team also discovered that the brain needs sensory information to develop normally.

During the year under review, the Claudianos' laboratory also built upon 2006 research in which it helped publish the 'honeybee genome'. A principal discovery was that the honeybee had far fewer genes than other insects, with Dr Claudianos and his colleagues hypothesising that gene shortfalls associated with environmental responses in the bee were due to the evolution of sociality in the bee. In 2010, members of his laboratory were part of an international team that sequenced the related 'wasp genome', with research published in *Science* and *Insect Molecular Biology.* The results showed that the wasp has a different complement of genes compared to the bee, supporting the idea that social behaviour reduces molecular diversity – which offers a lesson for our own human evolution.



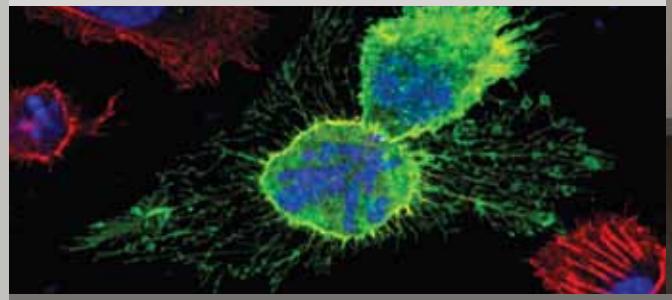
Soluble honeybee neurexin 1 (Nrx1) protein (green) expressed in monkey COS-7 cells is purified and used to determine biochemical interaction of synaptic proteins of neurons.

Laboratory Head **Assoc. Professor Helen Cooper**



A region of embryonic cortex labelled for a specific subpopulation of neurons (green) within the total pool of neurons (blue).

Research in the Cooper laboratory aims to discover how important cell surface receptors regulate the birth of new neurons and the growth of their axons in the embryonic brain. The role of these receptors in adult neurogenesis is also under investigation. These studies will provide insight into the aberrant molecular mechanisms responsible for neural tube defects, epilepsy, schizophrenia and other brain abnormalities arising during embryogenesis. A second major project seeks to develop nanoparticles as drug delivery systems for the treatment of neurodegenerative diseases.



Above right: Cooper group photo. 2010 Laboratory Members: Cathrin Nourse, Min Chen, Amanda White, Danakai Bradford, Charlotte Clark, Melissa de Vries, Haley Cox. Left: Cells in action: a dividing epithelial cell (green) is surrounded by nondividing cells (red).

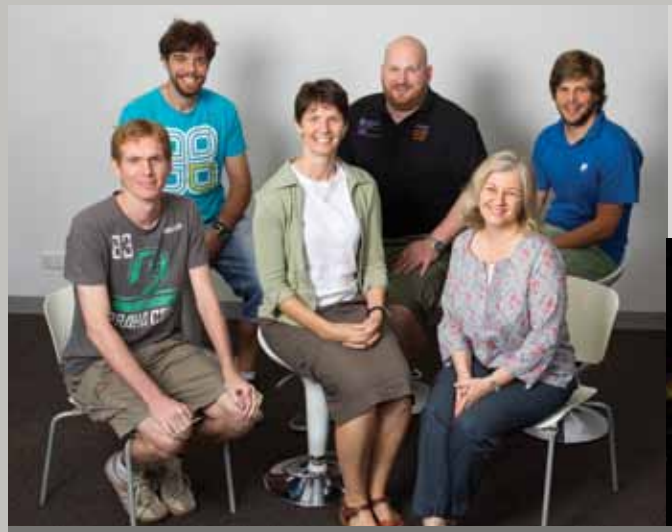
Examining the role of cell surface receptors in neurogenesis

Loss of the neogenin receptor in the developing mouse cortex and in the zebrafish neural tube leads to the collapse of the cellular architecture of the stem cell compartment and a dramatic loss of neurons. The Cooper laboratory has discovered that neogenin is required for the correct orientation of neural stem cells within the stem cell niche and for communication between individual stem cells. Loss of these interactions prevents the production of new neurons after stem cell division. Intriguingly, this receptor is present on stem cell populations in the adult human forebrain, indicating that its function is conserved in humans, providing a new target for stem cell therapies to treat the injured or diseased brain.

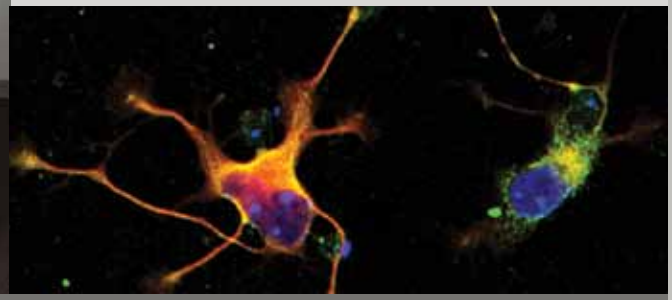
Researchers in the Cooper laboratory have shown that the Ryk receptor is responsible for the guidance of axons across the largest commissure in the mammalian brain, the corpus callosum, and into the contralateral hemisphere. Loss of Ryk leads to a failure in axon guidance which may be a consequence of inappropriate positioning of callosal neurons within the embryonic cortex.

Presently, there are no effective therapies to combat neurodegenerative diseases such as Alzheimer's or Huntington's. The NanoNeuro Project is a collaboration between the Cooper Laboratory, QBI's Professor Perry Bartlett, UQ's Australian Institute for Bioengineering and Nanotechnology and China's Fudan University. We are developing nanoparticles that can efficiently deliver small interfering ribonucleic acids (RNAs) to neurons in order to silence gene expression. These nanoparticles hold great promise as a drug delivery system as they can efficiently deliver RNAs to all regions of the adult mouse brain.

Laboratory Head **Dr Elizabeth Coulson**



The primary research goal of Dr Elizabeth Coulson's laboratory is to identify and characterise the regulators of neurodegenerative and neuronal death. By understanding the fundamental molecular mechanisms of this process, researchers aim to eventually develop therapeutics to treat neurodegenerative diseases. This work has important implications for understanding and managing conditions such as Alzheimer's disease, which is believed to be caused by the build up of a toxic protein called amyloid beta, which leads to nerve degeneration and neuronal death, and results in cognitive decline.*



Above: Coulson group photo. 2010 Laboratory Members: Alex Sykes, Adam Hamlin, Nick Palstra, Dusan Matusica, Prahatha Venkatroman, Zoran Boskovic, Georg Kerbler, Aanchal Sharma, Sophie Hill, Linda May, Brett Fisher, Nicola Marks, Hayley Lye. Above right: Hippocampal neurons in culture stained for a potassium channel involved in causing cell death (GIRK1 - green) a marker of neurons (red) and the cell nuclei (blue).

Tracing cell death pathways in Alzheimer's disease

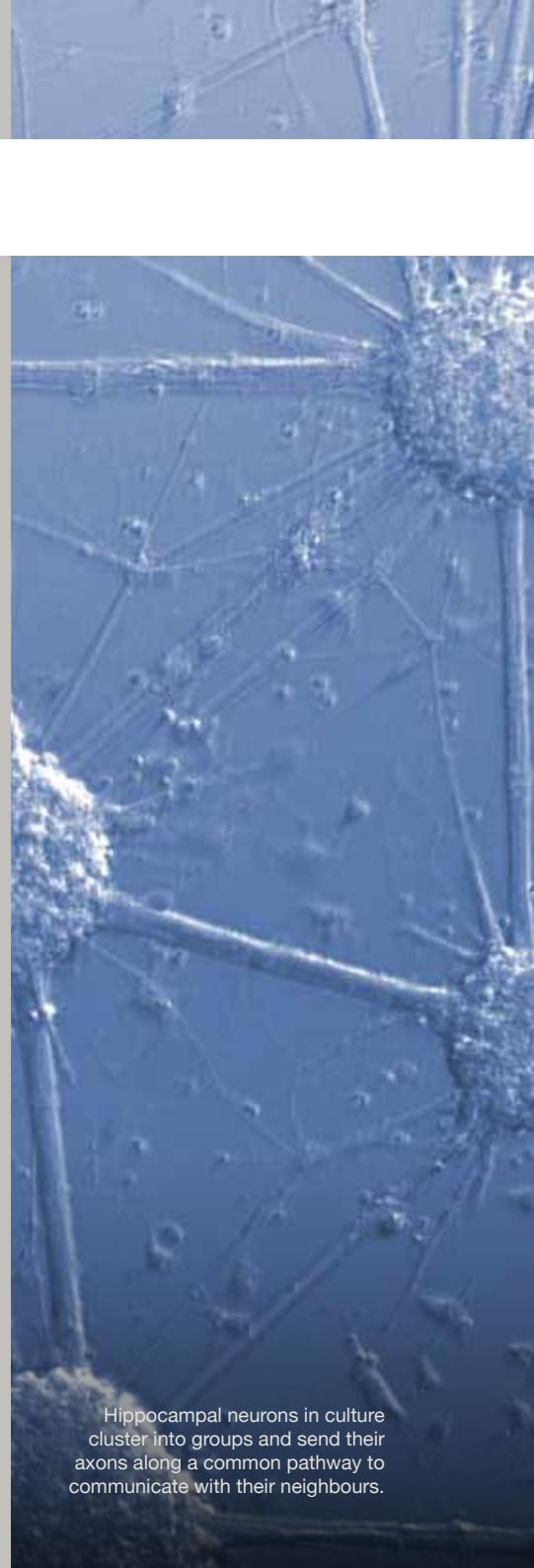
The Coulson group has been focussing on characterising the cell death signalling pathway mediated by the P75 neurotrophin receptor. P75 is a neural death receptor activated in a number of neurodegenerative conditions including Alzheimer's disease and motor neuron disease. The laboratory's current research aims are based on their expertise in studying the structure and function of P75.

During 2010, members of the Coulson laboratory found, using tissue culture methods, that certain cell death pathways were activated following over-excitation of neural circuits. They also uncovered preliminary evidence that these pathways are similarly activated in animal models of disease and have correlative evidence of the same pathways in human postmortem tissue. Such results may help to explain why particular cells are susceptible to neurodegeneration following epilepsy and in Alzheimer's disease.

Researchers have used cell cultures of neural tissue to test molecules that might interfere with, or block, this death pathway and are deciphering their mode of action through biochemical tests on animal tissue and following treatments in culture. They are also beginning to test their efficacy in animal models of neurodegeneration.

The Coulson group has established a particular behavioural test for mice with acute lesion-induced neurodegeneration of a specific part of the brain mimicking Alzheimer's disease. They have demonstrated that mice with behaviour deficits in this test also have structural changes detectable by MRI. The behaviour and MRI tests will now be tested in human cohorts that have, or are at risk of suffering from, Alzheimer's disease.

* Promoted to Assoc. Professor, effective 01 January 2011

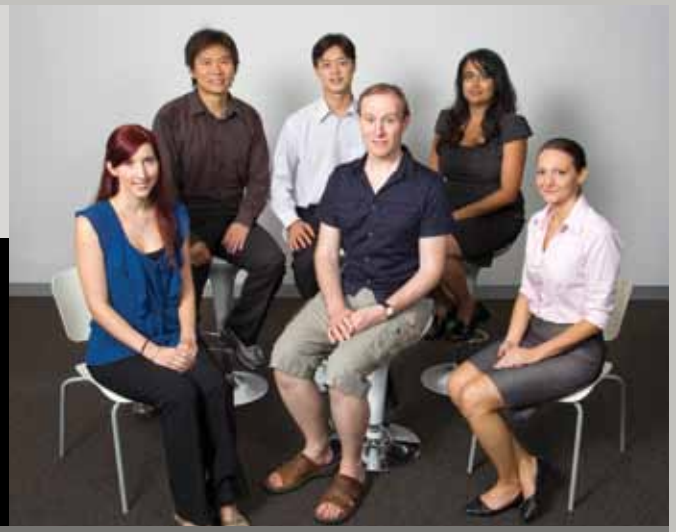


Hippocampal neurons in culture cluster into groups and send their axons along a common pathway to communicate with their neighbours.

Laboratory Head **Assoc. Professor Ross Cunnington**

Using EEG, we can see brain activity increasing over the mid-line motor areas of the brain as people plan and prepare voluntary movements.

Research in Assoc. Professor Ross Cunnington's laboratory focuses on the brain processes involved in planning and preparing for voluntary actions and for perceiving and understanding the actions of others. Whenever humans plan, imagine, or observe others performing actions, representations of those actions are encoded in the motor areas of the brain. In 2010, researchers explored brain imaging methods to examine how people form plans for action before initiating voluntary movement, and how our own plans for action can influence the way we perceive others' actions.



Above right: Cunnington group photo. 2010 Laboratory Members: Marta Bortoletto, Pascal Molenberghs, Katharine Baker, Veronika Halasz, Kian Ng, Vinh Nguyen, Simmy Poonian. Above left: We examine brain processes involved in the perception of observed actions. There appear to be specialised areas in the human brain that allow us to readily perceive and understand the actions and gestures of others.

Revealing secrets of mirroring through brain imaging

Members of the Cunnington laboratory examine the chain of brain processes that transform our intentions into plans for action that can be executed by the brain's motor system. Our research has revealed how activity in prefrontal regions of the brain, beginning up to one second before movement, is important for deciding the right moment to initiate voluntary actions. This occurs before activity starts in premotor brain areas involved in coding specific sequences of movement to make up complex actions.

Researchers are also discovering how the same brain processes involved in planning our own actions are also important for our ability to perceive and understand the observed actions of others. Known as mirroring, this process is thought to underlie the way in which we can understand intentions and empathise with others.

The laboratory also develops new methods for examining human brain activity and its function. In a collaboration with the Medical University of Vienna, researchers in the Cunnington laboratory are using ultra-high resolution brain imaging (7 Tesla human MRI) to examine neural activity of the motor system during planning. We are also developing techniques for combining the high resolution of MRI brain imaging with the high timing accuracy of brain activity recordings with concurrent fMRI-EEG measurement – allowing us to visualise and examine human brain activity in more detail than ever before.

The development of Brain-Computer Interfaces – devices that can read and 'decode' people's brain activity as they make choices between items on a computer screen – is a further exciting extension of this research. With such devices, patients can learn to select and control objects just by the computer detecting changes in their brain activity.

Laboratory Head **Dr Darryl Eyles**

Dr Darryl Eyles' laboratory is primarily focused on modelling non-genetic risk factors for schizophrenia. This work has greatly enhanced understanding of the effect of vitamin D on a person's likelihood to develop schizophrenia. Most noticeably, research in animal models has demonstrated that a developmental vitamin D deficiency in newborns increases the chances of developing the disorder in later life. Further, work from this group has firmly established that vitamin D regulates brain development. The group is part of the Queensland Centre for Mental Health Research.

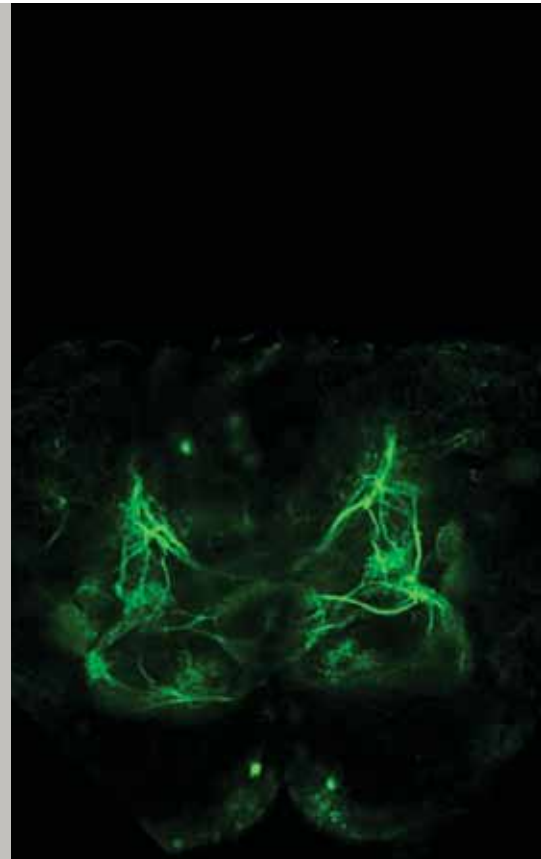
Above: Eyles group photo. 2010 Laboratory Members: Xiaoying Cui, Trudi Flatscher-Bader, Isabel Formella, James Kesby, David Kvaskoff, Pauline Ko, Henry Simila, Suzy Alexander, Karly Turner, Ashley Liu, Maggie Voogt, Lauren Harms, Claire Foldi, Elizabeth Mason, Jennifer Goddard, Karthic Purushothaman, Jacqui Byrne, Ben Calcagno. Above right: Archived dried blood spots may provide early markers for serious psychiatric disease in later life.

Understanding the neurobiology of serious mental illness

Working in close collaboration with QBI's Professor John McGrath's and Dr Thomas Burne's research groups, the Eyles laboratory continues to examine the consequences of developmental vitamin D (DVD) deficiency on both the developing brain and brain function in the adult offspring. Research has shown direct reductions in specification and maturation factors for dopaminergic neurons in foetal DVD-deficient brains, which correlate with disturbances in brain function both at the level of locomotion and selective attention.

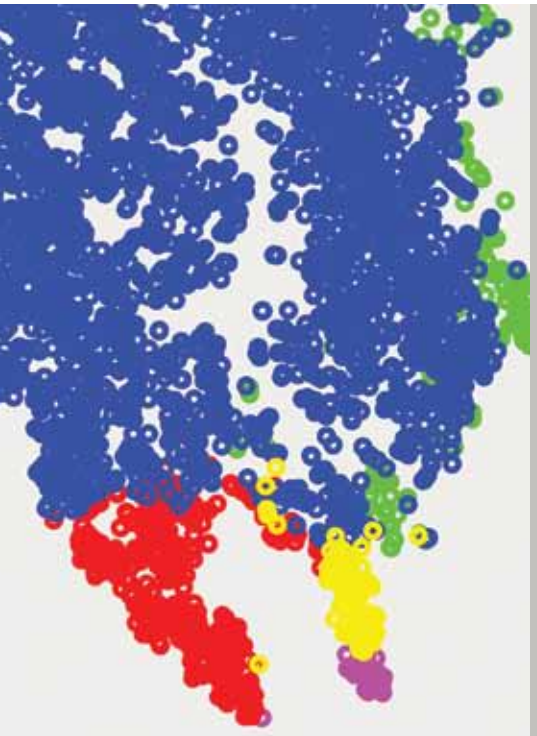
The group is rewriting the paradigm that dopamine may not represent a final common pathway for schizophrenia. Rather, it may be the initial common abnormality in brain development that precipitates the multiple disturbances seen in other neurotransmitter systems in this disorder. Currently researchers are modelling how alterations in dopamine levels affect brain development and behaviour in models such as zebrafish, fruit flies and mosquitoes. The use of a variety of model animals continues to provide a diverse and flexible research platform in understanding the neurobiology of serious psychiatric disease.

In clinical research, the Eyles laboratory has developed possibly the world's most sensitive test for 25 hydroxyvitamin D, which can detect tiny amounts of this vitamin in paediatric dried blood spots. Apart from being successfully used to indicate that low vitamin D levels are associated with schizophrenia in later life, this test is now being used in the laboratory to assess the vitamin's role in autism, cancer and multiple sclerosis.



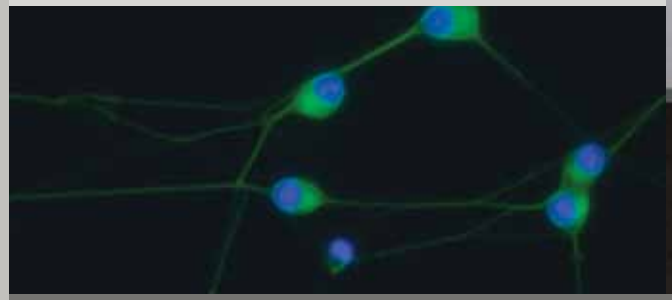
Dopamine neurites innervating the central complex and mushroom bodies of a fruit fly (*Drosophila melanogaster*).

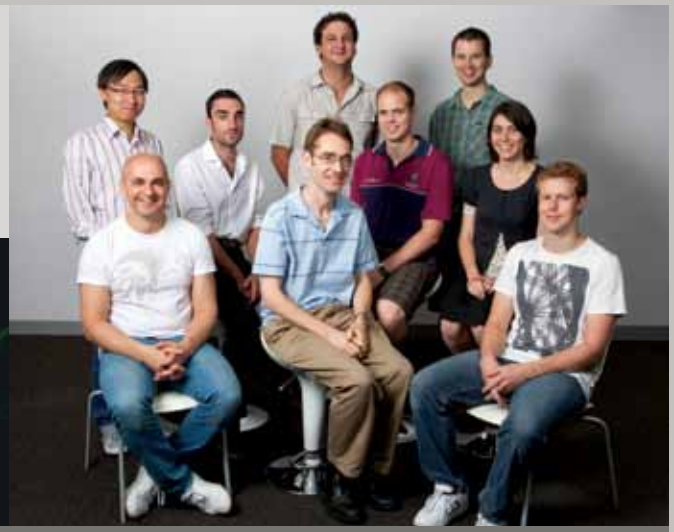
Laboratory Head **Professor Geoffrey Goodhill**



4000 photos grouped into clusters which share similar statistical properties, providing insight into the brain's visual function.

Research in Professor Geoffrey Goodhill's laboratory uses a unique combination of experiments and theoretical modelling to develop a computational understanding of how the nervous system becomes wired up during development. For the brain to function properly, its neurons must be connected correctly. The laboratory's guiding philosophy is that building mathematical models allows a much more precise understanding of the underlying phenomena than relying on purely qualitative reasoning.





Above right: Goodhill group photo. 2010 Laboratory Members: Zac Pujic, Andrew Thompson, Jiajia Yuan, Clement Bonini, Jinjun Sun, Stanley Chan, Duncan Mortimer, Jonny Hunt, Clare Giacomantonio, Hugh Simpson, Richard Faville.
Above left: Rat neurons growing in a microfluidic chamber.

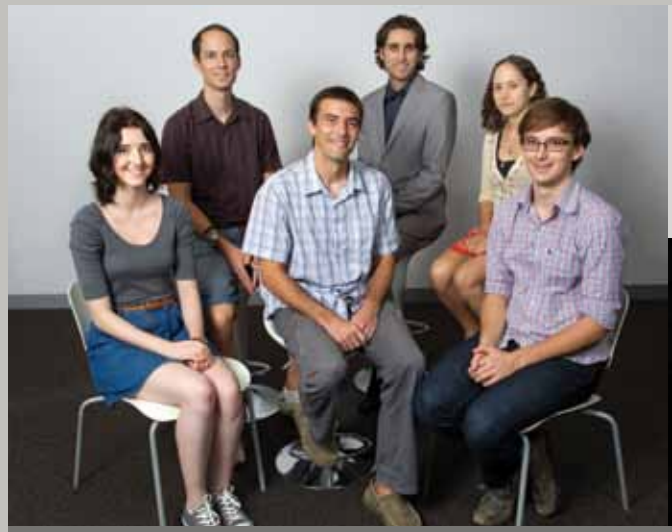
Using mathematical models to identify neural wiring defects

One area of focus for the Goodhill laboratory is how nerve fibres (axons) are guided by molecular gradients to find appropriate targets in the developing nervous system. One surprising result recently was that the response of axons to shallow gradients is different from their response to steep gradients – not only quantitatively but also qualitatively. This helps explain apparent anomalies between results from different gradient assays and also provides an insight into the way axons are affected by gradients *in vivo*.

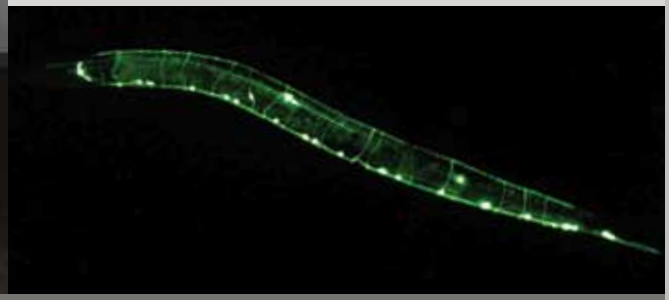
Researchers have also investigated the form and shape of growth cones, the structures at the tip of developing axons. This morphology is complex and highly dynamic but the significance of these changes for either the sensory or motor roles of growth cones is mostly unknown. As such, sophisticated mathematical techniques for characterising shape in general are currently being adapted in order to develop a more quantitative understanding of the role growth cone shape plays in effective axon guidance.

Further, the Goodhill laboratory is studying visual system development, particularly maps in the primary visual cortex. Visual maps (and thus visual function) are affected by the statistics of visual input during early life, but teasing apart the relative contributions of input-dependent mechanisms of development has proved an extremely challenging task. Researchers have investigated the effect of restricting visual input early in life on visual development. Their theoretical predictions suggest that a surprisingly large degree of visual map structure plasticity may be possible – a theory now being tested by experimental collaborators.

Laboratory Head **Dr Massimo Hilliard**



Determining how individual neurons develop is crucial for understanding how highly complex neuronal structures, such as the brain and spinal cord, are formed. Dr Massimo Hilliard's laboratory is interested in understanding how axons (nerve fibres conducting impulses from the neuron) and dendrites (nerve processes conducting impulses to the neuron) develop and how they are guided to their targets. The group also investigates how the axonal structure is maintained over time and how it can be reconstituted after injury.



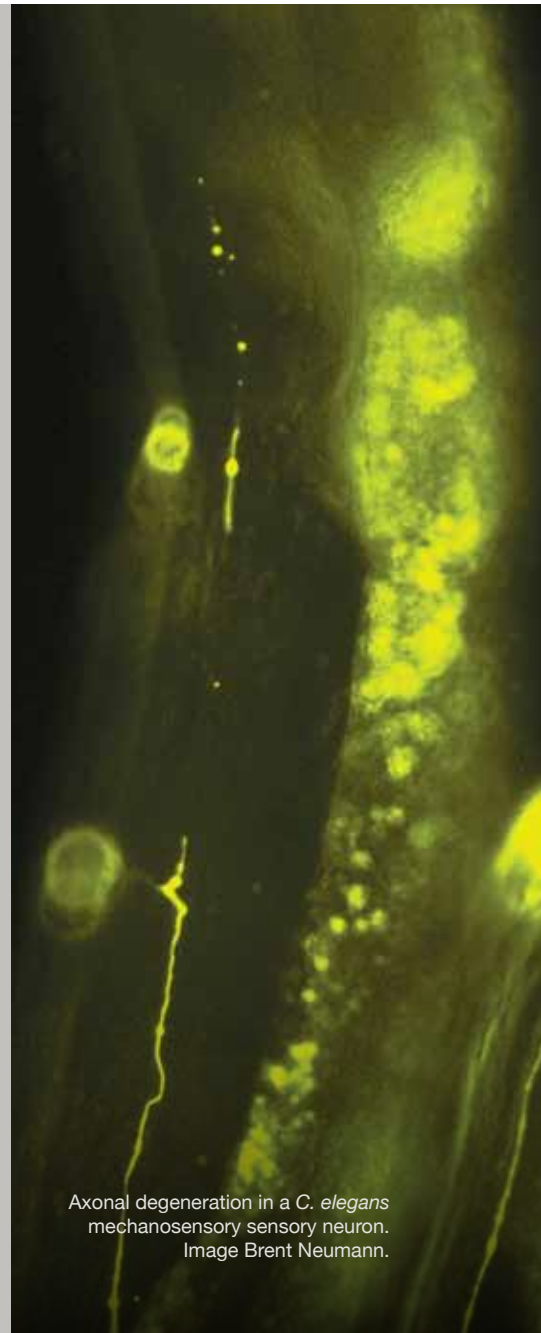
Above: Hilliard group photo. 2010 Laboratory Members: Sean Coakley, Leonie Kirzsenblat, Jujiao Kuang, Casey Linton, Brent Neumann, Divya Pattabiraman, Katherine Truong, Nick Valmas. Above right: Neuronal polarity defects in *C. elegans* sensory neurons. Image Leonie Kirzsenblat.

Unlocking secrets of axonal growth and regeneration

Neurons are among the most highly polarised cells in the body, with their dendrites and axons forming distinct morphological and functional domains. However, the understanding of how dendrites develop is poor, with only a few molecules known to play a role in this process. Using the nematode – or roundworm - *Caenorhabditis elegans* as a model system, the Hilliard group has identified two Wnt ligands and two Frizzled receptors that regulate dendrite development *in vivo*.

The axon protruding from a neuronal cell can extend extraordinarily long distances, with mechanisms in place to maintain the structural integrity of these long processes over the animal's lifetime. Failure in the maintenance of the axonal process is one of the underlying causes of different neurodegenerative conditions including motor neuron disease. Using forward genetic screens, researchers in the Hilliard group have identified mutant animals in which the axons of *C. elegans* mechanosensory neurons and oxygen sensory neurons spontaneously degenerate. The group now seeks to identify the mutated genes responsible for this condition, and to identify axonal degeneration phenotypes in motor neurons.

A crucial question for neurobiologists is how some axons can regenerate following nerve damage while others cannot. The answer will be of great value in the treatment of neuro-degenerative conditions and traumatic nerve injuries. Using a laser-based technology to axotomy single neurons in living *C. elegans* animals, the Hilliard laboratory has shown that axonal regeneration can occur by a mechanism of axonal fusion, whereby the two separated axonal fragments can specifically re-attach and restore the original axonal tract.

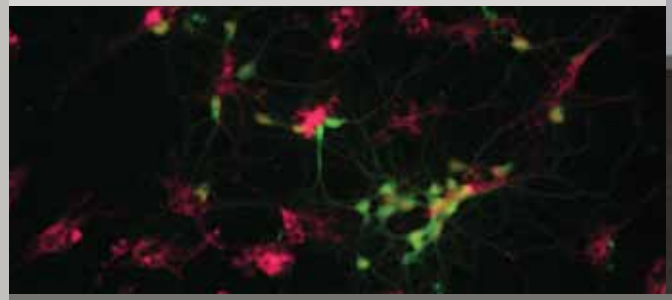


Axonal degeneration in a *C. elegans* mechanosensory sensory neuron. Image Brent Neumann.

Laboratory Head **Professor Joe Lynch**

'Bursts' of current flux induced by activation of a single glycine receptor chloride channel.

Professor Joe Lynch's laboratory explores the molecular structure and function of the glycine and $GABA_A$ receptor chloride channels that mediate inhibitory neurotransmission in the brain. The $GABA_A$ receptor is an important target for neuroactive drugs and the glycine receptor has recently emerged as a potential drug target for pain, epilepsy and tinnitus. The Lynch group aims to understand how these receptors open and close, and the locations of drug binding sites. Identifying novel drugs active at these receptors could lead to improved therapies.



Above right: Lynch group photo. 2010 Laboratory Members: Justine Haddrill, Qiang Shan, Angelo Keramidas, Daniel Gilbert, Anna Bode, Qian Wang, Yang Zhe, Christine Dixon, Prudence Donovan, Robi Islam, Tim Lynagh, Han Lu. Above left: Primary cultures grown from embryonic mouse brain, with inhibitory neurons expressing green fluorescent protein.

Targeting receptor activity in neurological disorders

Many human neurological disorders, including motor neuron disease and epilepsy, are caused by aberrant levels of neuronal activity. The Lynch group has recently engineered a new receptor for controlling this activity in humans. The idea is to express this receptor in particular populations of human neurons that are involved in the disorder and then to activate the receptor using ivermectin, a safe, orally-administered drug – thus silencing overactive neuron populations. Researchers are exploring this as a potential treatment for several human neurological disorders.

Ivermectin is an important anti-parasitic drug that exerts its anthelmintic effect by activating glutamate-gated chloride channel receptors in nematode worms. It is used so widely that ivermectin resistance has emerged as a serious problem in human nematode parasites. The Lynch group has recently shown that a glycine residue at a specific location on these receptors is essential for high ivermectin sensitivity. By providing a means of identifying ivermectin-sensitive receptors, this finding should help in characterising ivermectin-resistance mechanisms and identifying new anthelmintic target receptors.

Neurotoxic effects of the insecticides lindane and fipronil in humans are commonly thought to be mediated by inhibitory $GABA_A$ receptors, although a recent study suggested inhibitory glycine receptors mediate fipronil toxicity in zebrafish. We recently discovered that human glycine receptors are extremely sensitive to inhibition by fipronil and lindane and they are thus likely to be novel neurotoxic targets of these drugs in humans. We also discovered that these drugs interact with the glycine receptor by binding to different sites. These findings may contribute towards the rational design of novel compounds for a variety of human neurological disorders.

Laboratory Head **Professor Justin Marshall**

The Marshall laboratory seeks to understand how animals perceive their environment. By taking an approach to sensory systems that is based around ecology, but also includes physiology, anatomy, behaviour and neural integration, the laboratory aims to decode signals and their intention in animals – and fathom the parallel implications for humans. Animals under investigation include stomatopods (mantis shrimps), cephalopods (such as cuttlefish and octopus) elasmobranchs (sharks and rays) and freshwater fish, along with non-marine animals such as parrots, birds of paradise and lizards.

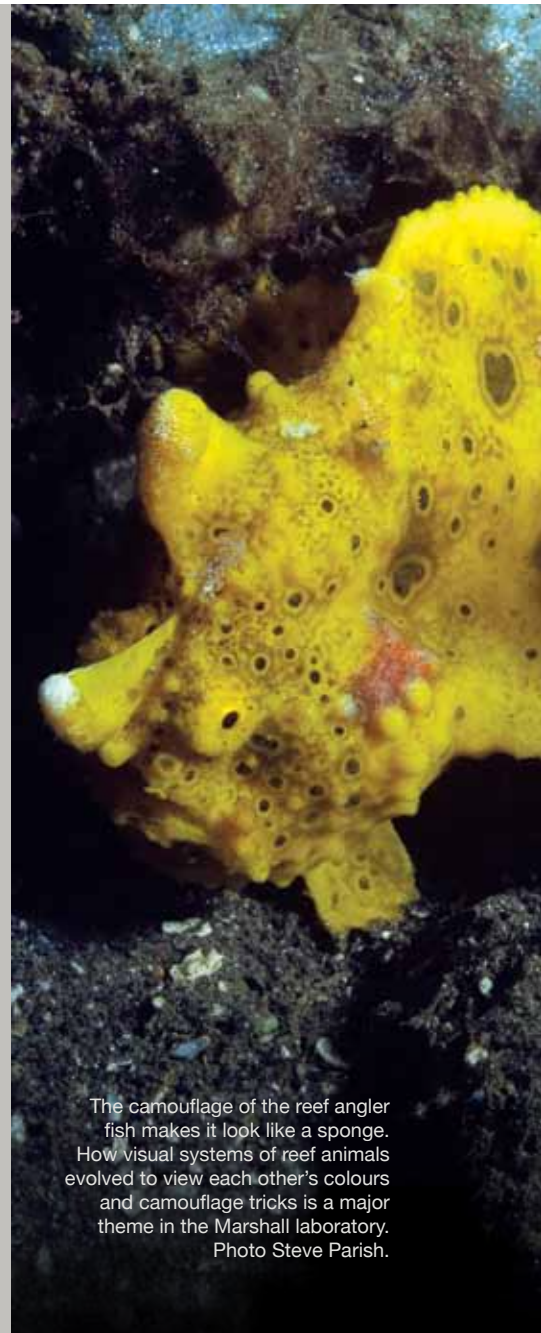
Above: Marshall group photo. 2010 Laboratory Members: Mathilde Bue, Cassie Bryant, Connor Champ, Karen Cheney, Tsyr-Huei Chiou, Wen-Sung Chung, Fabio Cortesi, Angela Dean, Fanny DeBusserolles, Andy Dunstan, Adrian Flynn, Kerstin Fritsches, Alan Goldizen, Martin How, Diana Kleine, Yi-Hsin Lee, Eva McClure, Amy Newman, Vincenzo Pignatelli, Chris Talbot, Shelby Temple, Rachel Templin, Hanne Thoe, Jack Pettigrew. Above right: The stomatopod crustacean. This *Odontodactylus scyllarus* has 12-channel colour vision and polarisation vision more complex than any animal known. Photo Roy Caldwell.

Delving into mysteries of the deep sea

The Marshall laboratory, which joined QBI in 2010, undertakes research in five different areas, all based around marine visual systems and coral reefs. Collectively, the group has produced more than 25 publications this year, including a book, contributions to *Current Biology* and two major edited reviews. This output effort from laboratory members and international collaborators is outstanding and several of our papers have also been highlighted in *Science*, *Nature* and *New Scientist*. Recognising the importance of communicating science beyond scientists, the work of the laboratory has also featured in international non-science media for work on visual systems and deep sea, including Sir David Attenborough's latest documentary *First Life* and *TIME Magazine*.

The way in which the ultraviolet (UV) region of the spectrum and other colours are used by a variety of animal communication systems is a major component of the Marshall laboratory's work. During 2010, research on vision in stomatopods continued, with publications in *Current Biology* and a theme edition for *The Philosophical Transactions of the Royal Society of London* on polarisation vision. Publications in journals including *Current Biology* have been achieved by members of the laboratory who are studying the evolution and diversity of colour vision in reef fish.

With collaborators, the 'Deep Downunder' team ran or participated in eight deep sea expeditions in 2010, discovering new species of fish and cephalopod in the process. Meanwhile, researchers immersed in the 'Coral Watch' project, commenced the year with the launch of the book *Coral Reefs* and *Climate Change* which has sold around 3,000 copies and is currently being translated for an international readership.

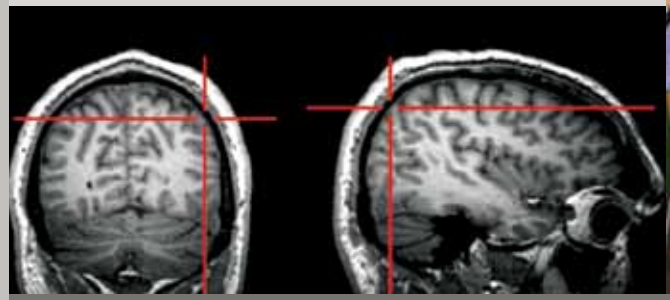


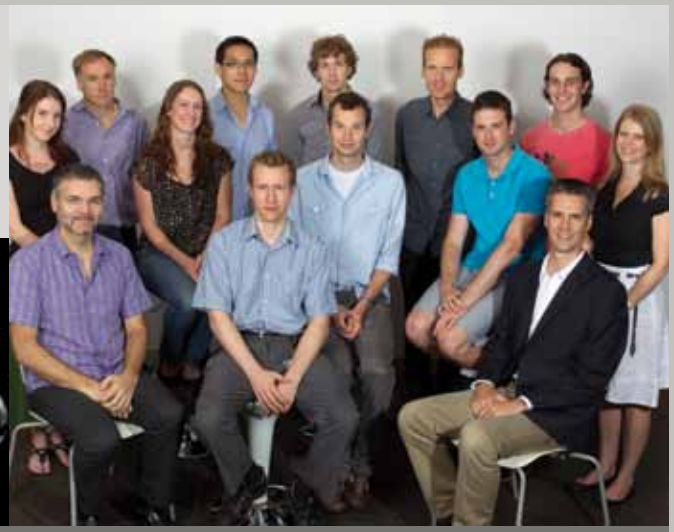
The camouflage of the reef angler fish makes it look like a sponge. How visual systems of reef animals evolved to view each other's colours and camouflage tricks is a major theme in the Marshall laboratory. Photo Steve Parish.

Laboratory Head **Professor Jason Mattingley**

Dr Marc Kamke applies TMS to test the involvement of different brain areas in selective attention.

Attentional processes are crucial for virtually all cognitive functions in humans, including learning and memory. A long-standing question is how the brain selects just a few important inputs from myriad sensory data while filtering out irrelevant elements – in other words, how it regulates mechanisms of attention. Professor Jason Mattingley's team seeks to answer this by using cutting-edge brain imaging and brain stimulation techniques, including functional magnetic resonance imaging (fMRI), electroencephalography (EEG) and transcranial magnetic stimulation (TMS).





Above right: Mattingley group photo. 2010 Laboratory Members: Oliver Baumann, Luca Cocchi, Marc Kamke, Pascal Molenberghs, Martin Sale, David Lloyd, Edgar Chan, Michael Dwyer, Veronika Halasz, Will Harrison, Oscar Jacoby, Inga Laube, David Painter, Amanda Robinson, Daniel Stjepanovic, Lydia Hayward. Above left: Measuring attention in the brain. Red crosshairs indicate a brain region involved in attention.

Analysing and understanding attentional processes

In 2010, researchers in the Mattingley laboratory continued to investigate the brain processes that regulate selective attention in health and disease. Mr David Painter, a PhD student, has recently developed a novel approach to measuring changes in brain activity that occur when attention is deployed over complex and rapidly changing visual displays. The protocol uses EEG recorded from the scalp to measure tiny fluctuations in the brain's electrical activity. During these recordings, volunteers focus their attention to locate coloured targets among flickering, multi-coloured distractors. By analysing precisely timed oscillations in the brain's activity, the researchers discovered unique signatures for sensory events that are attended and ignored – effectively showing how the human brain sorts the wheat from the chaff.

Having learned more about how attention is controlled in the healthy brain, the researchers are now using their novel tests to examine impairments of attention in patients with brain damage due to stroke. The same approach will also be used to assess the efficacy of new behavioural and pharmacological treatments for perceptual and cognitive deficits in a range of neurological disorders.

Other work being pursued by the team has focused on neural plasticity, the brain's capacity to undergo functional alterations in response to external stimulation or learning. Using TMS, work conducted by research fellows Dr Marc Kamke and Dr Martin Sale discovered that mechanisms of attention regulate plasticity in the primary motor cortex in healthy volunteers.

The next step for the team will be to determine whether the influence of attention on plasticity holds for brain areas outside the motor system. Armed with this knowledge, they hope to be able to develop more effective approaches for the rehabilitation of sensory and motor impairments following stroke.

Laboratory Head **Professor John McGrath**

Researchers in Professor John McGrath's laboratory explore non-genetic risk factors for disorders of brain development such as schizophrenia and autism. Using animal models, the group has forged productive cross-disciplinary collaborations linking risk factor epidemiology with developmental neurobiology. The McGrath laboratory has made several significant discoveries in recent years, including the importance of prenatal vitamin D on brain development. Professor McGrath has supervised major systematic reviews of the incidence, prevalence and mortality of schizophrenia.

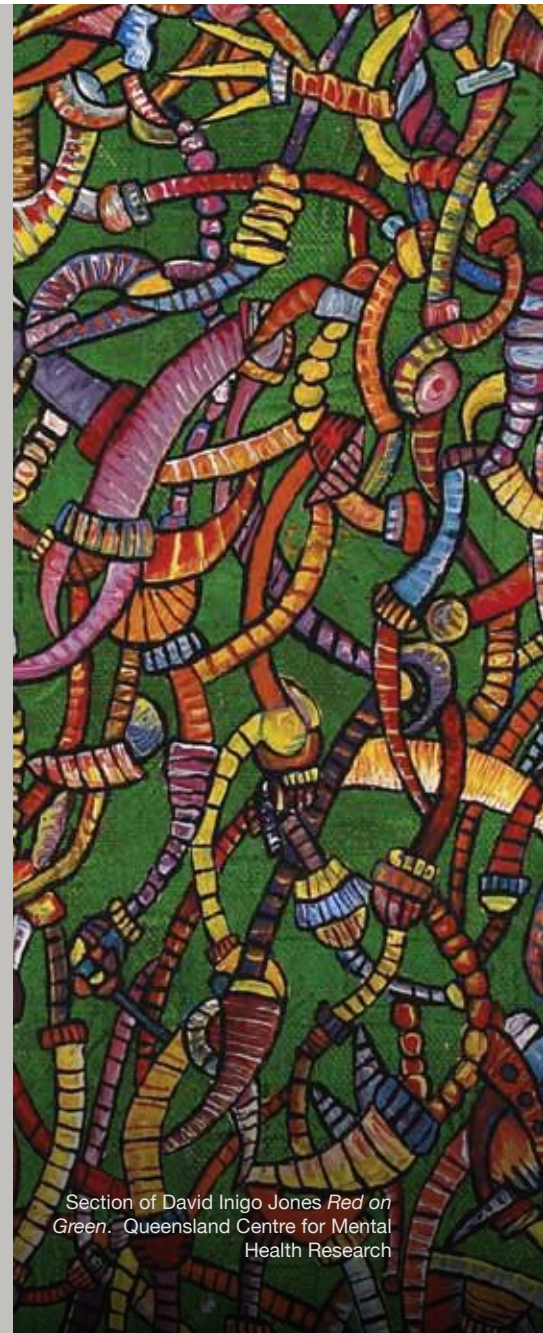
Above: McGrath group photo. 2010 Laboratory Members: Xiaoying Cui, Trudi Flatscher-Bader, Isabel Formella, James Kesby, David Kvaskoff, Pauline Ko, Henry Simila, Suzy Alexander, Karly Turner, Ashley Liu, Maggie Voogt, Lauren Harms, Claire Foldi, Elizabeth Mason, Jennifer Goddard, Karthic Purushothaman, Jacqui Byrne, Ben Calcagno. Right: Section of painting by Craig Finn *Reach sky to the*. Acrylic. Queensland Centre for Mental Health Research.

Offering clues to halt development of schizophrenia

Schizophrenia is associated with a substantial burden of disability. In the absence of major treatment advances, interventions that offer the prospect of reducing the incidence of the disorder should be vigorously pursued.

Professor John McGrath's group, which forms part of the Queensland Centre for Mental Health Research, has discovered a link between early life vitamin D levels and risk of schizophrenia. Working with Danish collaborators, the McGrath group used blood samples from newborn babies to confirm a deficiency in neonatal vitamin D levels is linked to a higher risk of developing schizophrenia. If future studies confirm the association between developmental vitamin D deficiency and a higher risk of schizophrenia, than it could raise the prospect of primary prevention – much like folate supplementation to prevent spina bifida.

Based on a large US birth cohort, researchers in the McGrath laboratory also found that the older the father, the more likely his children were to have impaired brain development. The offspring of older fathers also have a slightly increased risk of schizophrenia and autism. While it has long been recognised that maternal age is linked to conditions such as Down syndrome, paternal age has been somewhat neglected. The researchers are now part of a collaboration further examining the issue in a mouse model. Group researchers Dr Traute Flatscher-Bader and Claire Foldi have also been exploring behavioural, genomic and brain imaging in a mouse model related to advanced paternal age. Dr Bart van Alphen has collaborated with QBI's Professor Jason Mattingley and Assoc. Professor Bruno van Swinderen to explore the attentional function of the fruit fly model *Drosophila melanogaster.*

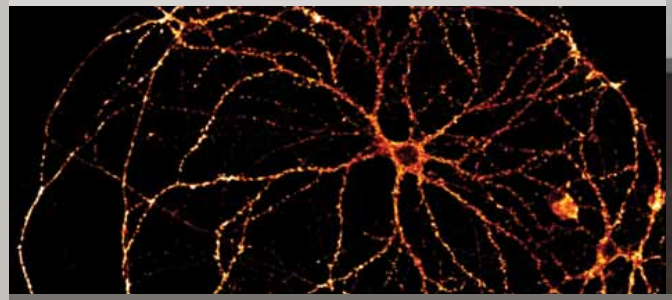


Section of David Inigo Jones *Red on Green*. Queensland Centre for Mental Health Research

Laboratory Head **Assoc. Professor Frederic Meunier**

Scanning Electron Micrograph of a *Glycera convoluta*. This blood worm can inject its prey with a highly potent neurotoxin that stimulates neurotransmitter release. EMBO J with permission.

Neurons are highly polarised cells that transport membrane compartments called organelles. They underpin functions like neuronal communication through the release of neurotransmitters at the synapse and carry important survival factors from the synapse back to the cell body. The Meunier laboratory is designing fluorescent probes and live cell microscopy which, when combined with proteomics, electrophysiology, structural biology and biochemistry, will enhance understanding of the molecular mechanisms underpinning different forms of neuronal membrane trafficking.



Above right: Meunier group photo. 2010 Laboratory Members: Tam Nguyen, Shona Osborne, Sally Martin, Regine Low, Peter Wen, Rachel Gormal, Nancy Honesta T Malintan, Vanesa Tomatis , Callista Harper , Guillaume Maucort. Above left: Hippocampal neurons stained with retrograde marker cholera toxin (B subunit).

Resolving puzzles of neuronal trafficking and communication

In 2010, the Meunier laboratory published a large body of work involving bulk endocytosis – the engulfment of a large portion of the plasma membrane – in the maintenance of neurotransmitter release.

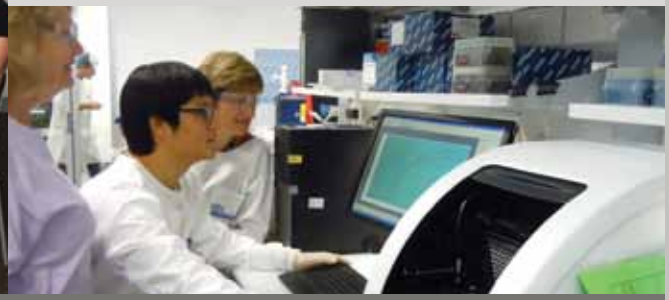
Despite decades of research, the molecular mechanism underpinning exocytosis remains poorly understood. Emerging trends suggest that the protein Munc18 acts as a chaperone to promote the delivery of Syntaxin1 to the plasma membrane - an essential protein for exocytosis, via a trafficking pathway that is yet to be characterised.

The Meunier laboratory and its collaborators have hypothesised that the Munc18 trafficking pathway is responsible for populating the plasma membrane with Syntaxin1. This is a highly significant trafficking pathway as secretory vesicles rely on Syntaxin1 to undergo regulated fusion. Researchers believe the failure of this pathway at any stage completely blocks neuroexocytosis in neurons, neurosecretory cells and insulin-releasing cells.

They have also uncovered a novel form of regulation helping secretory vesicles to acquire the competence to release their content by exocytosis. This provides the first demonstration of a link between calcium and PI3-kinase signalling pathways.

This research provides the basis for a more dynamic view of the secretory mechanism of neurotransmitter release, with important implications for the treatment of conditions characterised by the diminished release of a neurotransmitter/hormone.

The primary research goal of Professor Bryan Mowry's laboratory is to identify and functionally characterise susceptibility genes for schizophrenia and related disorders using a combination of clinical, molecular and statistical genetic approaches. During 2010, the laboratory expanded to incorporate second generation sequencing in order to comprehensively investigate genetic variants and relevant gene expression to produce reliable candidates for functional validation.



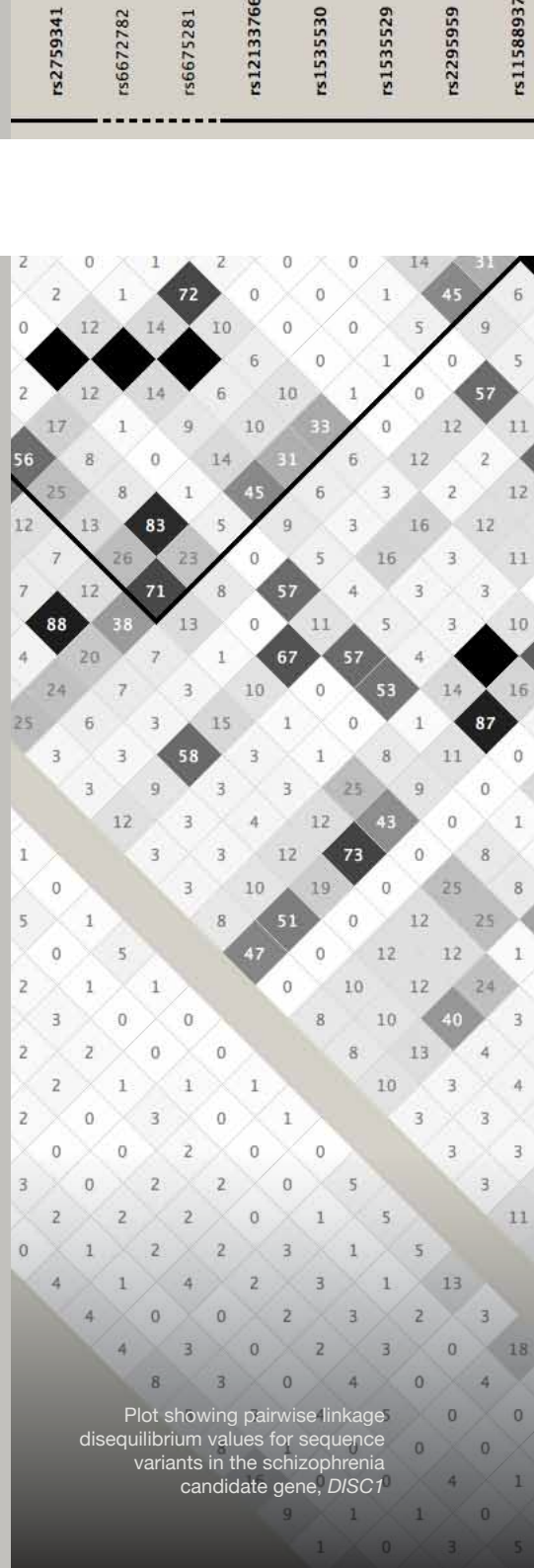
Above: Mowry group photo. 2010 Laboratory Members: Joon An, Denis Bauer*, Cheryl Filippich , Jake Gratten, Chikako Ragan, Bill Mantzioris, Kalpana Patel, Vikki Marshall*, Heather Smith. Above right: Cheryl Filippich, Joon Yong An and Heather Smith perform qPCR as part of quality control for DNA library preparation. *Affiliates (CBG).

Unravelling genetic underpinnings of schizophrenia

The Mowry group has a special interest in the study of ethnically homogeneous populations in southern India and in Sarawak. We also actively participate in the international Psychiatric Genetics Consortium (PGC), which is conducting genome-wide association studies (GWAS) on the largest available populations of European ethnicity. Additionally, we are involved in the continuing recruitment and analysis of the Australian Schizophrenia Research Bank (ASRB) cohort. In all studies, we focus on identifying homogeneous sub-types and dimensions for use in genetic analyses.

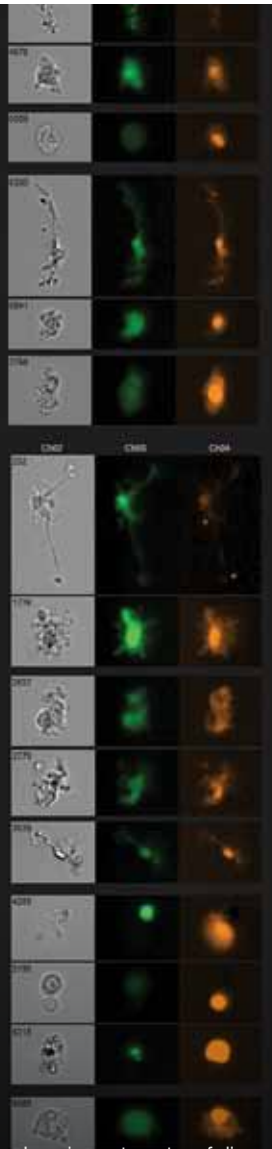
Our lab group has grown over the year, gaining further expertise in statistical genetics (Dr Jake Gratten) and psychiatry and immunology (Dr Bill Mantzioris). During 2010 QBI established the Centre for Brain Genomics (CBG), the core of which is a second-generation DNA sequencer (Illumina HiSeq 2000). This is the first installation of a HiSeq 2000 in an Australian research institute. Bryan Mowry is CBG Director, Ms Vikki Marshall is Centre Manager with expertise in molecular genetics and Dr Denis Bauer is the CBG bioinformatician consultant for user groups. The HiSeq 2000 was installed towards the end of 2010, paving the way for QBI to undertake its first sequencing projects.

Work funded by National Health and Medical Research Council (NHMRC) grants has also progressed this year, with the completion of a GWAS in the Iban of Sarawak, the analysis of second-generation sequencing data in a schizophrenia candidate gene in the southern Indian population, and the 'deep phenotyping' of a sub-set of schizophrenia patients with documented copy number variations (structural genomic variants). We continue to be involved in PGC analyses and to contribute to the growing ASRB sample size and analyses thereof.



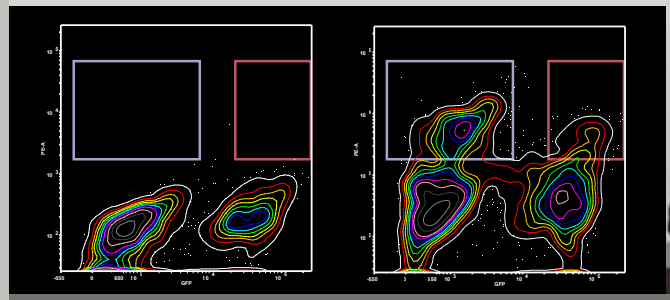
Plot showing pairwise linkage disequilibrium values for sequence variants in the schizophrenia candidate gene, *DISC1*

Laboratory Head **Mr Geoffrey Osborne**



Imaging cytometry of dissociated hippocampal cells showing morphological characteristics and associated fluorescent protein and surface marker expression.

Mr Geoffrey Osborne is unique among QBI researchers, in that he combines his work as a neuroscientist with a facilities management role. As Director of Flow Cytometry for both QBI and the AIBN, Mr Osborne leads a team that provides crucial cell sorting and analysis services. The laboratory specialises in the analysis and separation of cells derived from sources including solid tissue, blood and cultured cell lines. The laboratory also undertakes research into applications of this technology through the development and application of novel assays.



Above: Osborne group photo. 2010 Laboratory Members: Virginia Nink, John Wilson. Above left: Identification of putative neural stem cells by comparing antigen expression profiles of control with test animal (left and right panel) and selection of sub-populations identified as falling in either purple or red boxed regions.

Laying the groundwork for brain tumour therapies

Mr Osborne is dedicated to developing novel flow cytometric technologies in neuroscience projects of his own – particularly as they relate to stem cell research, and the cells involved in brain tumour research. During 2010, the laboratory's long-standing research into the most aggressive form of brain tumour, *Glioblastoma multiforme*, intensified with the continued exploration of the antigenic repertoire found on the surface of tumour cells. It is hoped this work will ultimately help facilitate the development of immuno-based therapies for this form of brain tumour which, though rare – with an estimated prevalence of 1 in every 10,000 people – has a low long-term survival rate.

Another collaboration initiated in 2010 involved the development of antibodies against receptors expressed on putative neural stem cells. The specificity and affinity of these antibodies to their targets and their relevance in a biological context is the subject of further studies, with a long-term goal of providing pure populations of well-characterized cells for trialling compounds which increase or rescue stem cell numbers.

The year also saw the publication of studies on the role that particle size has on the yield obtained from cell sorting experiments. This work on the fundamentals of cell sorter function has implications for future experimental design and alters the expectations of results from sorting large or irregular sized particles such as those typically found in neural samples. It is now the basis for ongoing research into cell sorting yield and cell recovery that seeks to identify the factors that contribute to variability in experimental outcome. The findings will be key to a number of projects in the coming year.

Laboratory Head **Dr Judith Reinhard**

Dr Judith Reinhard's laboratory conducts research in the field of neuro-ethology. This involves linking brain function to behaviour by investigating how sensory information from the environment is processed in the brain and translated into behavioural activity. A particular focus is the sense of smell and its effect on memory and cognitive performance. Researchers in the Reinhard laboratory combine insect model systems with human research and behavioural studies with physiological and molecular approaches.

Above: Reinhard group photo. 2010 Laboratory Members: Nicole van der Burg, Shao-chang Huang, Homayoun Kheyri, Mauricio Moreno, Amanda Robinson, Janelle Scown. Above right: A restrained honeybee drinks scented sugar water from the tip of a syringe.

Uncovering mechanisms underlying scent processing

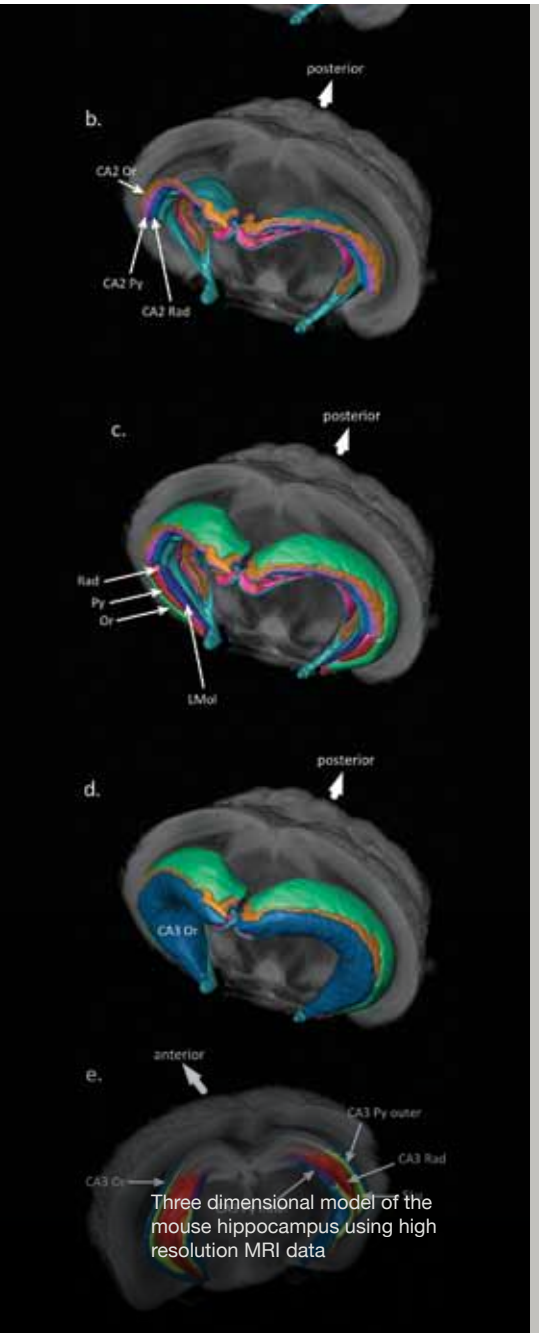
Natural scents like floral bouquets or food aromas are complex mixtures, composed of hundreds of different odorants. In 2010, the Reinhard laboratory tackled the question of how the brain makes sense of such complex information. Using the honeybee model, they published in *PLoS ONE* their discovery that natural scents are encoded via a selection of key odorants. That is, the brain filters out the majority of the information and only learns a specific key odorant signature for each complex scent. This simple reductionist strategy helps the brain to manage the massive amount of information contained in natural scents, thus enhancing processing speed and capacity.

The Reinhard laboratory then conducted a collaborative study with Dr Charles Claudianos combining behavioural and molecular approaches. The team discovered that the molecular mechanisms underlying scent processing in honeybees are highly plastic. They found that associative memories of odours significantly change expression of molecules in the bee brain that are involved in formation of synapses and neural wiring.

Based on these discoveries using the honeybee model, the Reinhard laboratory has embarked on a large-scale behavioural study with humans in 2010. They are investigating whether humans also use the key odorant strategy of scent processing, and whether the human sense of smell is similarly plastic as the honeybee's. First results suggest that the environment we live in significantly affects how we perceive scents, flavours and aromas. The group is also studying how scents affect behaviour, such as aggression, attention and decision-making.

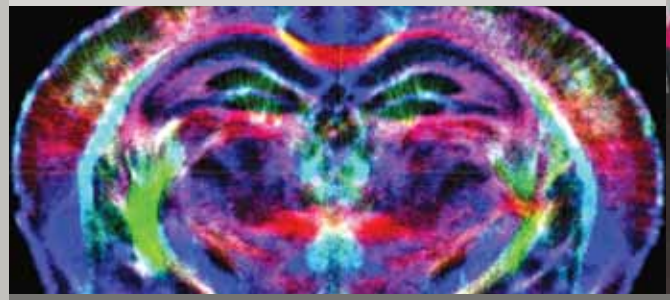
Free-flying honeybees drink scented sugar-water from a feeder, forming associative memories of the scent while drinking.

Laboratory Head **Professor David Reutens**



Three dimensional model of the mouse hippocampus using high resolution MRI data

The Centre for Advanced Imaging (CAI) brings together the skills of a critical mass of researchers and research imaging instruments such as high-field human and animal MRI scanners, human and animal PET scanners and radiochemistry facilities. Equipment in the Centre includes National Imaging Facility flagship instruments such as the combined PET/MR scanner, a cyclotron and radiochemistry facilities and a 7T human MRI scanner. The CAI received funding during 2010 to construct a new $40M state-of-the-art imaging facility.



Above: Reutens group photo. 2010 Laboratory Members: Stacey Cole, Taracad Venkatachalam, Michael Vogel, Viktor Vegh, Irina Kharatishvilli, Dr Natalie Alexopoulos, Julia Hocking, Steven Yang, Giang Nguyen, Rebecca Williams, Nahla Al Fazio, Jiaxin Du, Samuel Foong, Nyoman Kurniawan, Quang Tieng.
Above left: Track Density Imaging (TDI) of mouse brain, a novel image contrast which can reveal very fine structures down to 20 micron resolution.

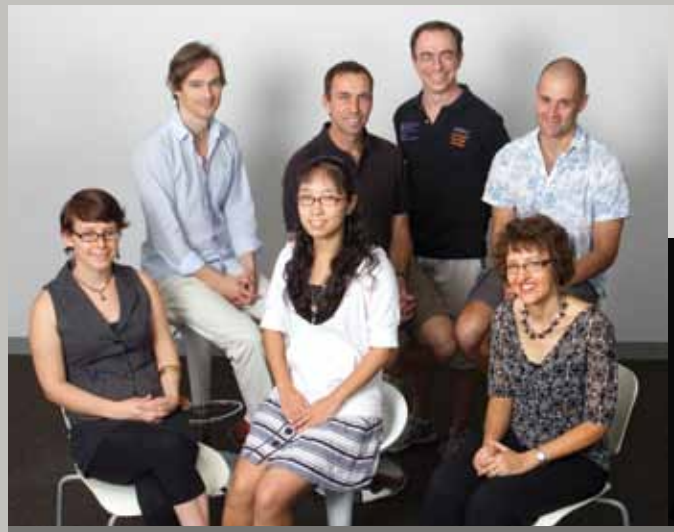
Creating images to explore living organisms

Imaging techniques are now key platform research technologies for studying the structure and function, in health and disease, of living organisms from laboratory mice to humans. The ability of ultra high-field MRI to characterise the blood flow and structure of living systems, together with developments in MRI biomarkers, will allow researchers to better phenotype animal models of disease and to map the cognitive function of the brain.

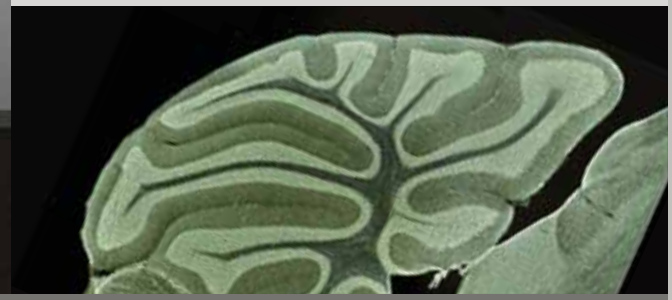
PET measures the distribution and fate of molecular markers using radiolabelled ligands, providing UQ researchers with the capacity to perform, for the first time, *in vivo* studies of metabolism, receptor-ligand binding and gene expression. The ability to study the living organism enables longitudinal studies of normal development, of the natural history of disease and of responses to novel therapies. Consequently, *in vivo* imaging methods have also become platform technologies for drug discovery and validation. By providing surrogate end points to assess the effectiveness of new therapies in clinical trials, a coherent imaging framework also speeds translation of scientific discoveries to clinical realisation. MRI and PET are now core investigative modalities in virtually all clinical specialties, informing clinical diagnosis and prognosis and facilitating the goal of personalised medicine by better characterising both disease and its response to treatment in the individual patient.

Using these imaging tools, research in our laboratory in 2010 has involved creating new atlases of the mouse brain, developing new biomarkers of epileptogenesis and stroke progression and developing new methods of mapping neural currents and using MRI information to map functional activity in the brain.

Laboratory Head **Professor Linda Richards**



Researchers in Professor Linda Richards' laboratory investigate how the brain forms connections during foetal development. The laboratory is focussed on understanding the mechanisms regulating the formation of the cerebral cortex and the corpus callosum, which connects the left and right sides of the brain and is involved in higher-order cognitive processes. These processes include sensory and motor information processing as well as speech, emotions, memory formation and storage, and many other brain functions.



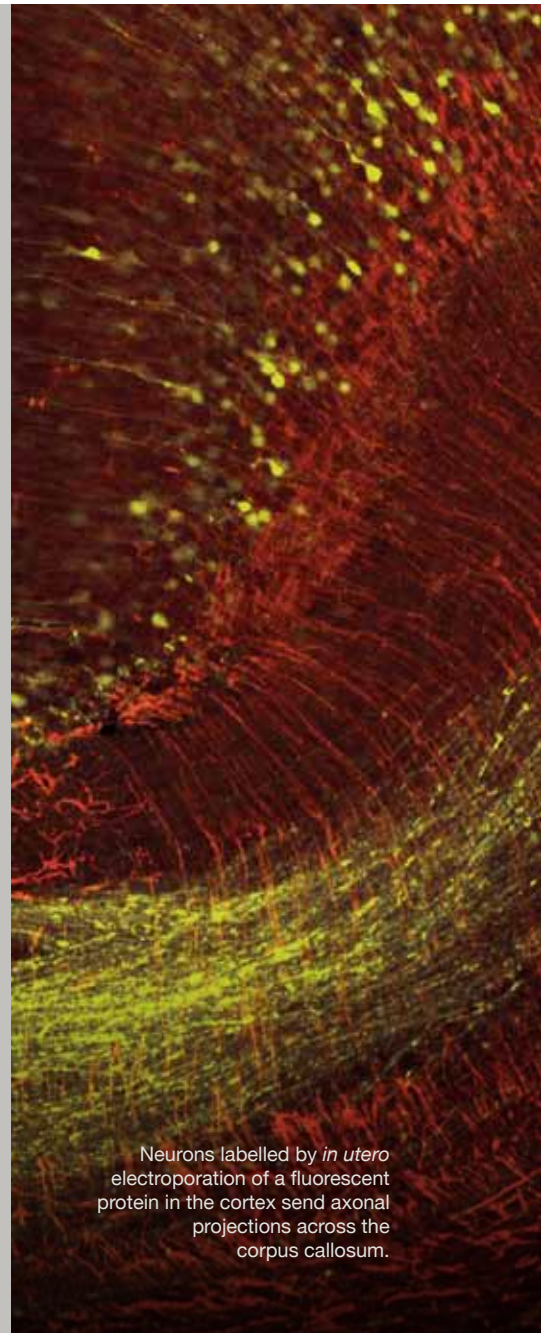
Above: Richards group photo. 2010 Laboratory Members: John Baisden, Erica Little, Oressia Zalucki, Amber-Lee Donahoo, Sharon Mason, Ilan Gobius, Samantha Liu, Skyle Murphy, Guy Barry, Michael Piper, Randal Moldrich. Above Right: A sagittal slice through the cerebellum of a mouse brain.

Elucidating formation of foetal brain connections

Researchers in the Richards laboratory have made several important discoveries during 2010. For several years, laboratory members have been studying the role of a family of transcription factors known as the nuclear factor one gene (Nfi) family in the development of the cerebral cortex. Until recently little was known about how Nfi genes regulated these events at a molecular or genetic level. Recent research has shown that Nfia plays a pivotal role in regulating proliferation and differentiation of hippocampal neurons. It does this by simultaneously turning off genes required for proliferation, such as Hes1 and turning on genes required for differentiation, such as mature glial markers. This represents a conceptual advance in understanding that, for cells to proceed to differentiation, they must first cease proliferation.

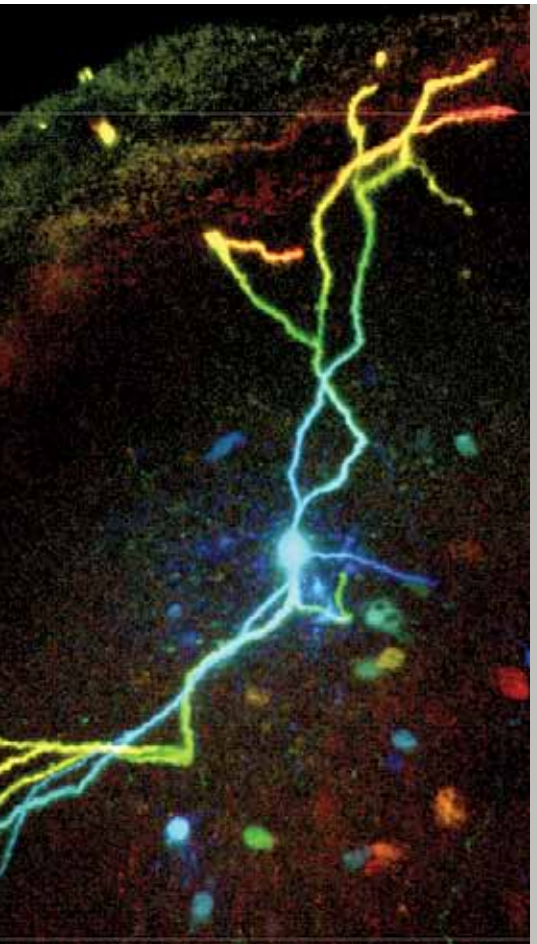
The group also published its landmark study on the discovery of the mouse commissural plate. Since the early 1900s, it has been hypothesised that a specialised region of the brain might exist that is important for the formation of all forebrain commissures, axonal tracts that connect the two sides of the brain. The group identified that a commissural plate exists in mice and is made up of four distinct regions, each with molecular and genetically defined boundaries. This work will help to identify whether disruption of the commissural plate in humans might underlie agenesis of the corpus callosum, which occurs at a rate of 1 in every 4,000 live births.

During the year, the group also published work comparing various tractography methods for optimising our ability to study axon tracts in the developing brain.



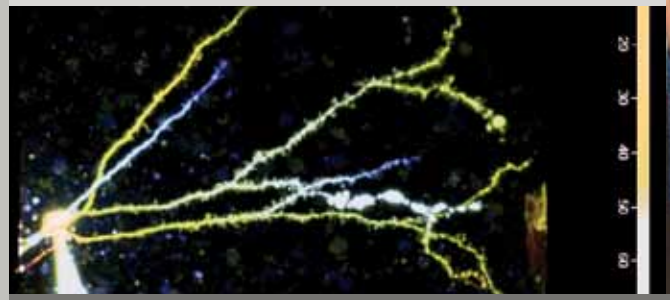
Neurons labelled by *in utero* electroporation of a fluorescent protein in the cortex send axonal projections across the corpus callosum.

Laboratory Head **Professor Pankaj Sah**



Shown is a neurone in the medial amygdala in an acute brain slice. The image is a compressed stack imaged a Zeiss 710 two photon microscope. The neurone has been loaded with Alexa 594 and is colour coded for depth in the slices. Brighter (red) indicates greater depth in the slice. Nearby cell bodies shown are neurones labelled with green fluorescent protein expressed under the GAD-67 promoter to label GABAergic interneurons.

The focus of the Sah laboratory is to understand how sensory information reaches the amygdala, is processed, stored and retrieved. The amygdala is, in evolutionary terms, an ancient part of the brain that stores and retrieves emotional content to our sensory world. Dysfunction of the amygdala leads to a range of disorders including anxiety, phobias and post-traumatic stress disorder. It is the long-term goal of the Sah laboratory to discover molecular targets within the amygdala for the development of more specific treatments for anxiety-related disorders.



Above right: Sah group photo. 2010 Laboratory Members: Eleanora Autori, Sue Campbell, James Crane, Peter Curby, Andrew Delaney, Christine Dixon, Kathryn French, Helen Gooch, Robin Johnson, Sepideh Keshavarzi, Roger Marek, John Morris, John Power, Petra Sedlak, Jay Spampanato, Cornelia Strobel, Robert Sullivan, Tim Tatterstall, Francois Windels.

Exploring learning and memory formation

Until recently, work in the Sah laboratory focussed on recordings in acute brain slices to understand the anatomy and physiology of the internal circuits within the region of the brain known as the amygdala. Now researchers in the group have developed recording techniques using tetrodes implanted in awake behaving animals in which the activity in the amygdala and other connected brain regions is recorded as they undergo behavioural tasks that engage the amygdala These recordings allow researchers to follow the cellular activity of different regions in the brain, in particular the amygdala, as the animals learn and remember.

Using two-photon imaging, researchers in the Sah group have also examined how synaptic inputs impinging on pyramidal neurons in the basolateral amygdala initiate calcium signalling mechanisms. This has led to the finding that synaptic activity initiates calcium waves in dendrites that propagate to the nucleus. These calcium waves also invade some dendritic spines but do not enter others. Changes in calcium are likely to underlie how learning takes place in the amygdala.

NMDA receptors are activated by glutamate and initiate the molecular events that underlie learning and memory formation. These receptors are made up of combinations of different subunits that are thought to play different roles during the learning process. Using a combination of molecular manipulation and physiology in acute brain slices, the Sah group has also examined the distribution of different subunits that make up NMDA receptors at different synapses in the amygdala.

Laboratory Head **Professor Mandyam Srinivasan**

Flying insects display remarkable visual agility, despite their relatively small brains and simple nervous systems. Professor Mandyam Srinivasan's group uses honeybees and budgerigars as models to understand how visual information is used to guide flight and facilitate navigation. Another aim is to explore whether some of these insights can be used to devise novel, biologically inspired strategies for the guidance of autonomous aerial vehicles.

Above: Srinivasan group photo. 2010 Laboratory Members: Samuel Baker, Parthasarathy Bhagavatula, Daniel Bland, Natalie Bland, Brenda Campbell, Nikolai Liebsch, Tien Luu, Eliza Middleton, Richard Moore, Navid Nourani, Dean Soccol, Saul Thurrowgood, Gavin Taylor, William Warhurst. Above right: A tethered bee flying in a virtual-reality apparatus for investigating the visual mechanisms of flight control.

Translating flight findings into aeronautical applications

Although research has revealed how insects use vision to guide their flight, little is known about whether flying insects actively avoid mid-air collisions and, if so, how they achieve this. The Srinivasan group's recent study of bees flying through narrow passages shows that collisions occur at a much lower rate than predicted by chance, suggesting that bees actively avoid them. Three-dimensional re-construction of the trajectories shows us how collisions are avoided.

Orchestrating a smooth landing is a challenging task for any animal or machine, particularly in the presence of wind. After establishing that bees tend to land facing into the wind, we discovered in 2010 that bees do this even when the substrate is devoid of visual texture, suggesting the direction of landing is guided by cues additional to optic flow. We also found that bees are able to orient their landings at wind speeds as low as 0.8 m/sec, indicating a high sensitivity to this external disturbance and a remarkable ability to compensate for it.

We filmed and analysed the flights of budgerigars to uncover strategies birds use to fly safely through dense and cluttered environments. Some findings parallel those previously observed for flying insects, suggesting that certain principles of visual guidance may be shared by all diurnal, flying animals.

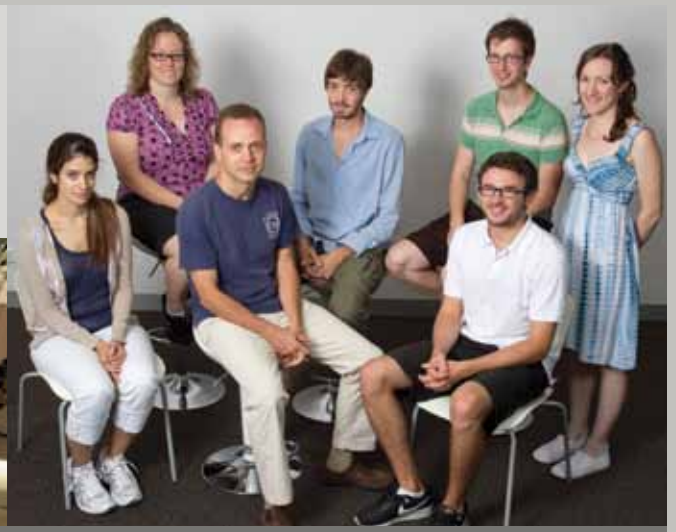
In the area of biologically inspired robotics, we have designed, developed and successfully tested vision systems that implement automatic and efficient changes of aircraft altitude and attitude, use horizon-based information to perform a range of extreme aerobatic manoeuvres (such as loops) and enable a vehicle to detect the presence of salient landmarks in its environment from the patterns of image motion generated in a camera image.

PhD student Samuel Baker with a multi-rotor aircraft that will embody biologically inspired algorithms for navigation.

Laboratory Head **Assoc. Professor Bruno van Swinderen**

A tethered fruit fly prepared for brain recordings

The van Swinderen laboratory uses the fruit fly model Drosophila melanogaster *to investigate perception and cognition. Combining molecular genetic tools with high-throughput behavioural testing and electrophysiology, the group studies the underpinnings of complex phenomena such as selective attention, memory and sleep in the more simple fly brain. This has important parallels to the human brain, which must suppress parts of the outside world in order to pay attention, learn and sleep. How this suppression mechanism works is a key question of the laboratory.*



Above right: van Swinderen group photo. 2010 Laboratory Members: Angelique Paulk, Bart van Alphen, Ben Kottler, Oressia Zalucki, Thomas Pollak, Ben Calcagno, Melvyn Yap, Oliver Evans, Joanne Daniels, Rebecca Morley. Above left: Dr Bart van Alphen and Dr Angelique Paulk in the laboratory.

Creating fruit fly models of autism and ADHD

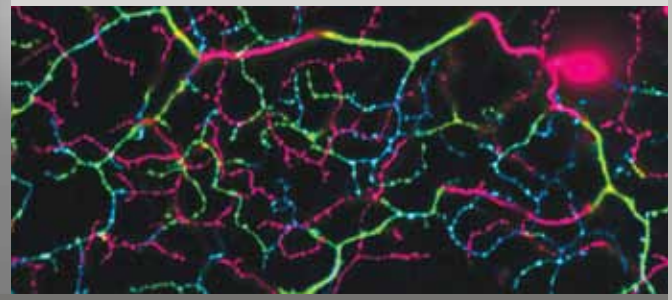
The van Swinderen laboratory has uncovered *Drosophila* memory mutants that also have attention defects. These mutants, which for the most part are involved in protein synthesis-dependent memory consolidation pathways, were found to be less distractible than wild-type flies. Genetic rescue experiments suggest that neural wiring during early brain development is crucial for eventual attention-like processes in adult flies. These defects are being examined as potential models for autism spectrum disorders in humans.

Recently, a behavioural screen has uncovered another memory mutant, called *radish*, which displays behaviours characteristic of attention deficit and hyperactivity disorder (ADHD) in humans. These ADHD-like symptoms were determined using behavioural tests as well as electrophysiology. Interestingly, *radish* attention deficits uncovered by these paradigms were rescued by exposing flies to the same drug used to treat ADHD in humans, Ritalin (methylphenidate). This suggests that similar molecular pathways control attention-like behaviour in flies and humans, and that these pathways operate in the same neurons already known to be required for memory formation. These results point the way to unravelling how memory and attention interact in a model brain.

To better address neural mechanisms of attention in the insect brain, the van Swinderen lab has recently set up a multi-channel brain-recording paradigm for flies and honeybees. Neural dynamics (both spiking activity and local field potential) are analysed in response to competing visual stimuli. The greater accessibility of the bee brain combined with genetic tools in *Drosophila* recordings provides a synergistic approach to understanding attention-like processes in insect brains.

Laboratory Head **Professor David Vaney**

Professor David Vaney retired as a Professorial Research Fellow at the end of 2010, after a 35-year career studying the structure and function of the retina. He will continue to maintain an academic association with the Queensland Brain Institute, having being appointed Emeritus Professor following his retirement. Professor Vaney will be based in Professor Marshall's laboratory, occupying the same space where he worked for 20 years as a foundation member of the Vision, Touch & Hearing Research Centre.



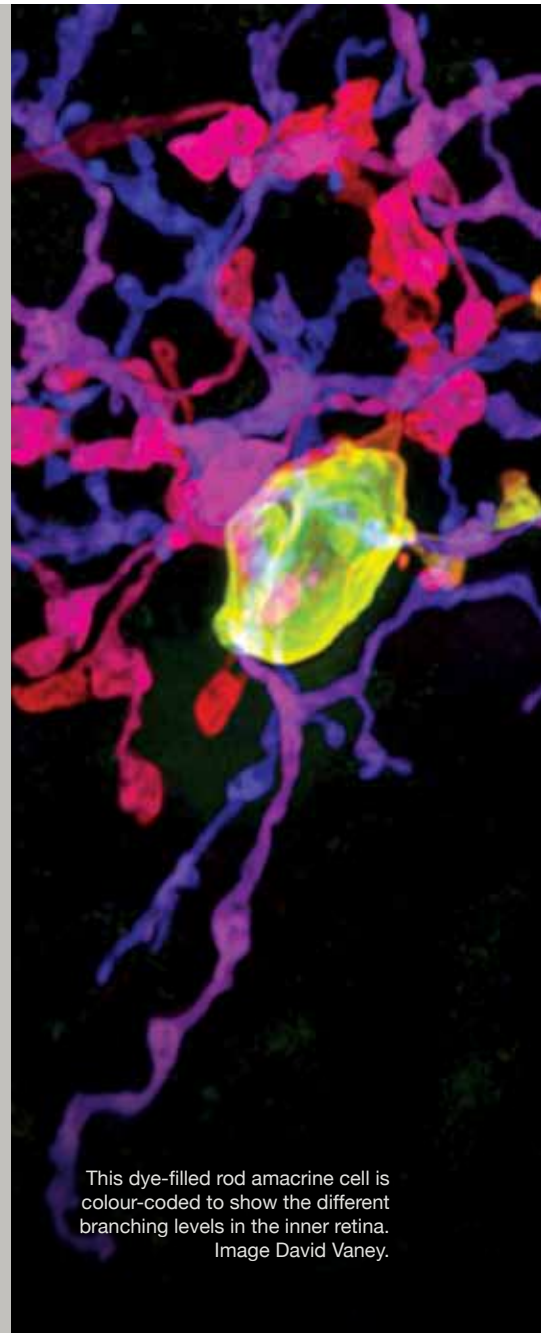
Above: Vaney group photo. 2010 Laboratory Member: Ben Sivyer. Above right: Dye-filling of the newly discovered type of retinal ganglion cell shows that its processes dive in and out of three layers of the inner retina, each represented by a different colour. Image Ben Sivyer.

Shining light on visual processing in the retina

All photoreceptors in the retina respond to light by decreasing neurotransmitter release with increasing brightness of light. By contrast, the retinal neurons that lie downstream may be either excited or inhibited by light. The retinal ganglion cells (RGCs), whose axons convey visual information from the eye to the brain, fire nerve impulses when light is turned either On or Off. In addition, it has long been known that two types of RGCs fire at both light On and Off, namely the direction-selective ganglion cells (DSGCs) and the local-edge-detectors (LEDs).

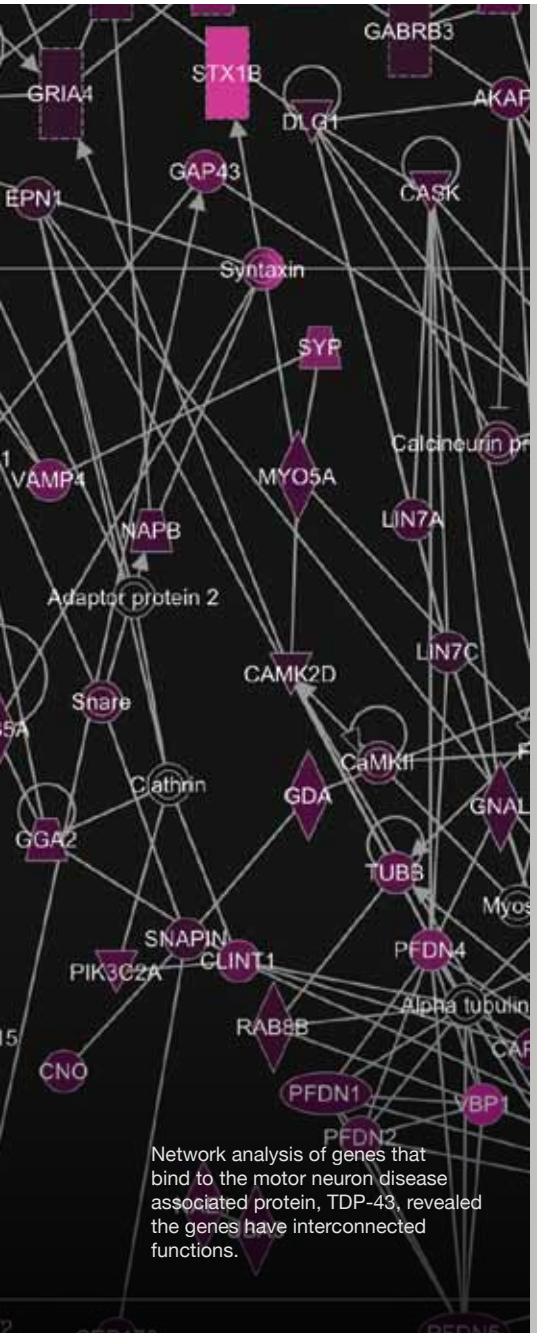
Ben Sivyer, a PhD student in the Vaney laboratory, discovered that there is a third type of On–Off RGC, which responds transiently to illumination, like the DSGCs but unlike the LEDs. However, this novel type of RGC shows no directional preference for moving visual stimuli, like the LEDS but unlike the DSGCs. Even though these 'transient On-Off RGCs' receive similar excitatory inputs to the DSGCs, the two types branch at different levels in the inner retina, indicating that they receive their inputs from different types of retinal bipolar cells.

The transient On-Off RGCs are conserved across diverse mammalian species, and thus represent an ancient channel for the transmission of visual information. However it is not clear why 3 types of On-Off RGCs are required for visual processing or, for that matter, why there are 15-20 types of all RGCs. There must be much redundancy in the information conveyed to the brain by the diverse populations of RGCs. Understanding how the visual scene is represented by their total activity is one of the major outstanding problems in retinal neuroscience.



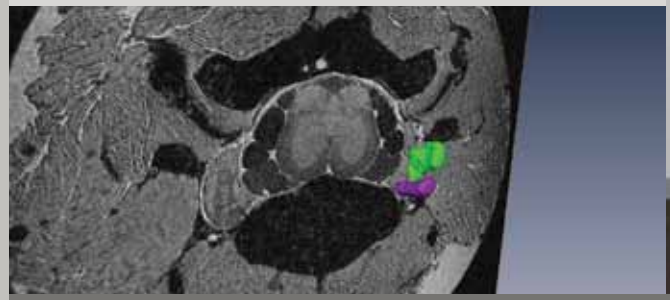
This dye-filled rod amacrine cell is colour-coded to show the different branching levels in the inner retina. Image David Vaney.

Laboratory Head **Dr Robyn Wallace**



Network analysis of genes that bind to the motor neuron disease associated protein, TDP-43, revealed the genes have interconnected functions.

The Wallace laboratory explores the genetics of neurological disorders such as motor neuron disease (MND) and epilepsy. MND is a rare, incurable disorder with late onset. Although only a small percentage of MND cases are due to genetic mutations, Wallace group researchers are exploring how these genes cause MND and working towards potential treatments. Epilepsy is a common, complex disorder with a strong genetic component. Having successfully identified several human epilepsy genes, the group continues to characterise the functional consequences of the mutations.



Above right: Wallace group photo. 2010 Laboratory Members: Marie Mangelsdorf, Tim Butler, Ramesh Narayanan, Ajay Panwar. Above left: Visualisation of spinal cord degeneration in mice with motor neuron disease, using magnetic resonance imaging.

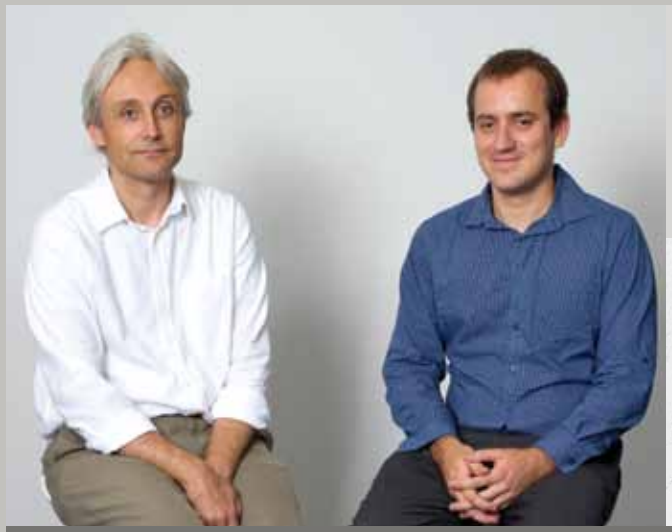
Identifying functional consequences of gene mutations

In 2010, the Wallace laboratory secured funding from MND Australia, in collaboration with researchers at the University of Sydney and Griffith University, to study the role of a newly discovered MND gene, TDP-43. TDP-43 is a protein involved in gene regulation but its function in the nervous system is currently unknown and its role in the pathogenesis of MND remains unclear. We have identified gene targets of TDP-43 and are investigating the functional consequences of TDP-43 mutations in MND patient stem cells. Potential outcomes of this project include crucial insights to understanding how motor neurons degenerate in MND and the identification of novel therapeutic targets.

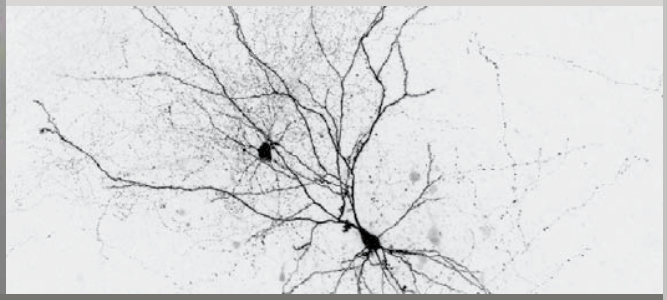
The Wallace lab has also been analysing a genetic mouse model of MND, which carries a mutation in another MND gene known as SOD1. In collaboration with the Centre for Advanced Imaging (CAI), we have demonstrated that magnetic resonance imaging is able to detect spinal cord degeneration in live mice. The high resolution imaging technique developed is an important breakthrough, as mice no longer need to be sacrificed to examine spinal cord pathology. This research has important implications for future drug trials as it has the potential to reduce the number of animals required.

In addition to MND research, researchers are continuing to study the genetics of epilepsy. We recently discovered a new gene mutation that causes a specific form of epilepsy known as myoclonic astatic epilepsy. We are now investigating exactly how this novel epilepsy gene alters nerve cells in the brain to make them susceptible to seizure activity.

Laboratory Head **Assoc. Professor Stephen Williams**



Assoc. Professor Stephen Williams joined QBI in 2010 to establish a Synaptic Plasticity laboratory which investigates key questions of single neuron and neural network computation. Synapses connect networks of neurons and facilitate information transfer between cells. A single neuron in the central nervous system may receive thousands of synaptic inputs distributed widely across its dendritic arbor. Neurons must integrate such time-varying input signals to form an output signal, or action potential, which is communicated to other neurons and/or effector systems like muscles.



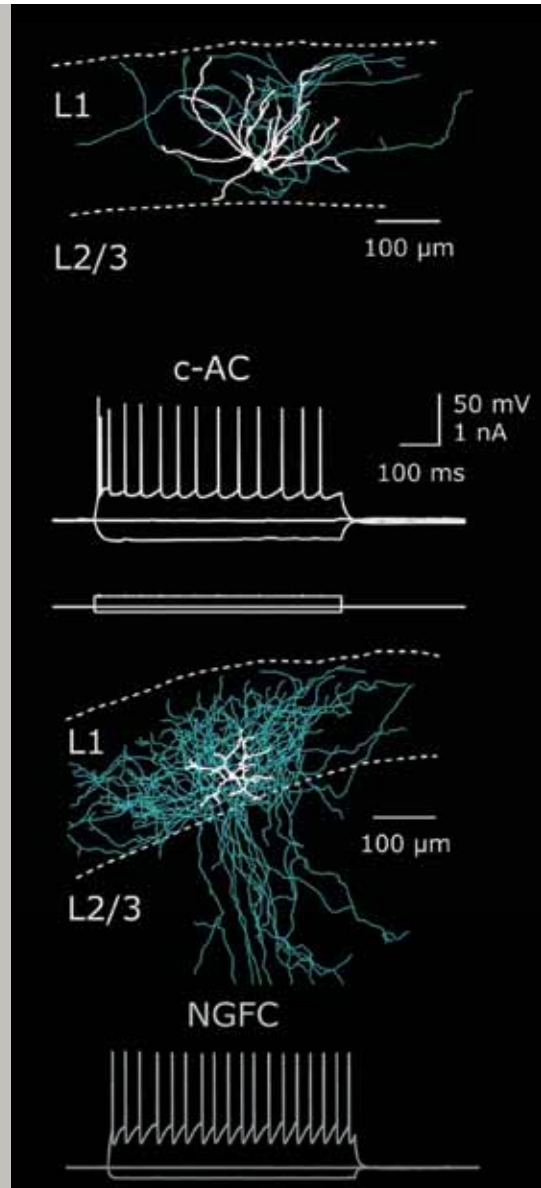
Above: Williams group photo. 2010 Laboratory Members: Arne Brombas, Ben Sivyer. Above right: Synaptically connected layer 1 inhibitory interneuron and layer 2/3 pyramidal neuron.

Form and function of neural pathways in the neocortex

Researchers in Assoc. Professor Stephen Williams' laboratory are investigating key questions of single neuron and neural network computation. They use advanced electrophysiological techniques that allow simultaneous recording from multiple dendritic sites of a single neuron and computational modelling to explore the synaptic integration mechanism in neurons of diverse morphology. The group's aims are focused on understanding the computational operations of the most numerous neuronal classes in the brain region called the neocortex (pyramidal neurons) and their relation to the physiological function of neuronal networks.

To explore this, members of the Williams laboratory activate determined neuronal pathways in the neocortex using light-activated ion channels and measure how such input signals are integrated in the dendritic tree using multi-site electrophysiological recording techniques. In September 2010, group members participated in a Brain Plasticity Symposium at QBI, where Assoc. Professor Williams spoke on the subject of synaptic integration in the first layer of the neocortex.

The Williams laboratory is also involved in an active collaboration with research groups at the Howard Hughes Medical Institute, Janelia Farm Research Campus, in the USA. Through the use of multi-site two-photon glutamate uncaging techniques, researchers are exploring the determinants of dendritic synaptic integration. This research will enable neuroscientists to better understand how networks of neurons function in the neocortex and how these processes are disturbed in disease.



Inhibitory neuronal classes in layer 1 of the neocortex.

Dr Dusan Matusica at work in the laboratory.

Students

Students

Students play a central role in the cutting-edge research undertaken at the Queensland Brain Institute. Attracted by QBI's outstanding reputation, local students and international students from as far afield as China, Iran and Bangladesh, are a familiar sight in the Institute's laboratories. Bringing fresh, innovative and international approaches, they represent, in a very real sense, the future of neuroscience research.

Students

Students play a vital role in research efforts at QBI. Research higher degree students, in particular, are the linchpins of our laboratories – accordingly, the Institute aims to maintain a cohort of around 80 PhD and MPhil degree students each year.

In 2010, QBI had 72 students enrolled at the Institute, of which 28 were from a diversity of countries, including Canada, China, Germany, Iran, Malaysia, Taiwan and Bangladesh. Nineteen students commenced their candidature, and three PhDs were conferred – Stacey Cole (Cooper Lab), Ben Sivyer (Vaney Lab) and Divya Unni (Richards Lab). Dr Unni is QBI's first international student to graduate with a PhD. These graduates have subsequently gone on to postdoctoral work or into research administration.

The high calibre of students attracted to QBI is attested to by their success securing high quality, competitive scholarships. In 2010, two of our incoming international students received the top international scholarships available at UQ, comprising the International Postgraduate Research Scholarship (IPRS) along with the UQ Centennial Living Allowance and the UQ Advantage Top Up. These students were Shao-Chang Huang (Reinhard Lab) and Elizabeth Kita (due to commence in the Goodhill Lab in 2011). Three of the twelve prestigious NHMRC PhD Scholarships awarded to UQ students in 2010 went to QBI: Ben Kamien (Richards Lab), John Morris (Sah and Mattingley Labs) and Hugh Simpson (Goodhill Lab).

Undergraduate students are also welcomed into the Institute as part of the Summer Scholars program and many pursue further studies with QBI as a result of this experience. For example, Aanchal Sharma, from New Zealand, is a former Summer Scholar who is currently undertaking a PhD in the Coulson Lab. It is pleasing to note the increasing popularity of this program, with QBI welcoming its largest number of Summer Research Scholars since the program began in 2008, with a total of 23 students in our labs over the Christmas and New Year summer break.

Above: Dr Hugh Simpson received an NHMRC PhD Scholarship in 2010.

Student success stories

The continuing progress of QBI students, both past and present, has confirmed that Institute graduates are ones to watch.

Dr Benjamin Sivyer

One of those who continues to stand out from the crowd is PhD candidate Ben Sivyer, who in 2010 was awarded a Dean's Commendation for Outstanding Research Higher Degree (RHD) thesis on the physiology and anatomy of a class of rarely encountered ganglion cells in the mammalian retina. The UQ Graduate School instituted the Dean's Commendation for Outstanding RHD Thesis in 1998, to give formal recognition to outstanding PhD and MPhil graduates who receive unanimous commendations from their examiners for a substantial contribution to their field of research. No more than 10 per cent of RHD graduates are recognised in this way and Dr Sivyer was the only QBI graduate to receive this award in 2010. This commendation follows on from a string of previous successes, including the Michael F Hickey Memorial Honours Prize (2006) for obtaining the highest overall percentage in the Anatomy Honours Program and the Istvan Törk Prize (2009) for the best oral presentation by a Student Member of the Australian Neuroscience Society (ANS).

Dr Adrian Carter

Dr Adrian Carter was one of the first students to complete his PhD through the Queensland Brain Institute, graduating from The University of Queensland at the end of 2009, and was also the recipient of the Dean's Commendation for Outstanding RHD Thesis in 2009. Dr Carter has since continued a close association with QBI with Professor Wayne Hall via his appointment at the UQ Centre for Clinical Research. There Adrian continues to investigate the social and ethical challenges of neuroscience research and emerging neurotechnologies for the treatment of addiction. This research includes an examination of the impact that neuroscience has on understanding of addiction, including notions of autonomy and responsibility, the use of coercion and the capacity to consent to addiction research, and the use of emerging technologies, such as deep brain stimulation and drug vaccines, to treat addiction.

Students

Master of Neuroscience

2010 saw the official launch of UQ's flagship Master of Neuroscience program.

The first cohort of six students, two of which were international students, started in semester 1, 2010. Brett Fisher, Hon Wai Yap, and Cheng-Liang Chou were the first graduates of the 16-unit (two semester) program. The other three, who are undertaking the 24-unit (three semester) program, will graduate in 2011. Brett Fisher has since started a PhD in Neuroscience.

The Master of Neuroscience coursework program is an initiative of QBI's Professor Perry Bartlett and Professor Deborah Terry, Deputy Vice-Chancellor (Academic).

Suited to both international and domestic students who wish to shift their career focus to neuroscience, the Master of Neuroscience is designed to train highly-qualified individuals for independent research and teaching careers. The program also provides excellent theoretical and practical grounding for those wishing to pursue PhD studies. Having a quota of only 12 ensures that students are well taken care of during their program.

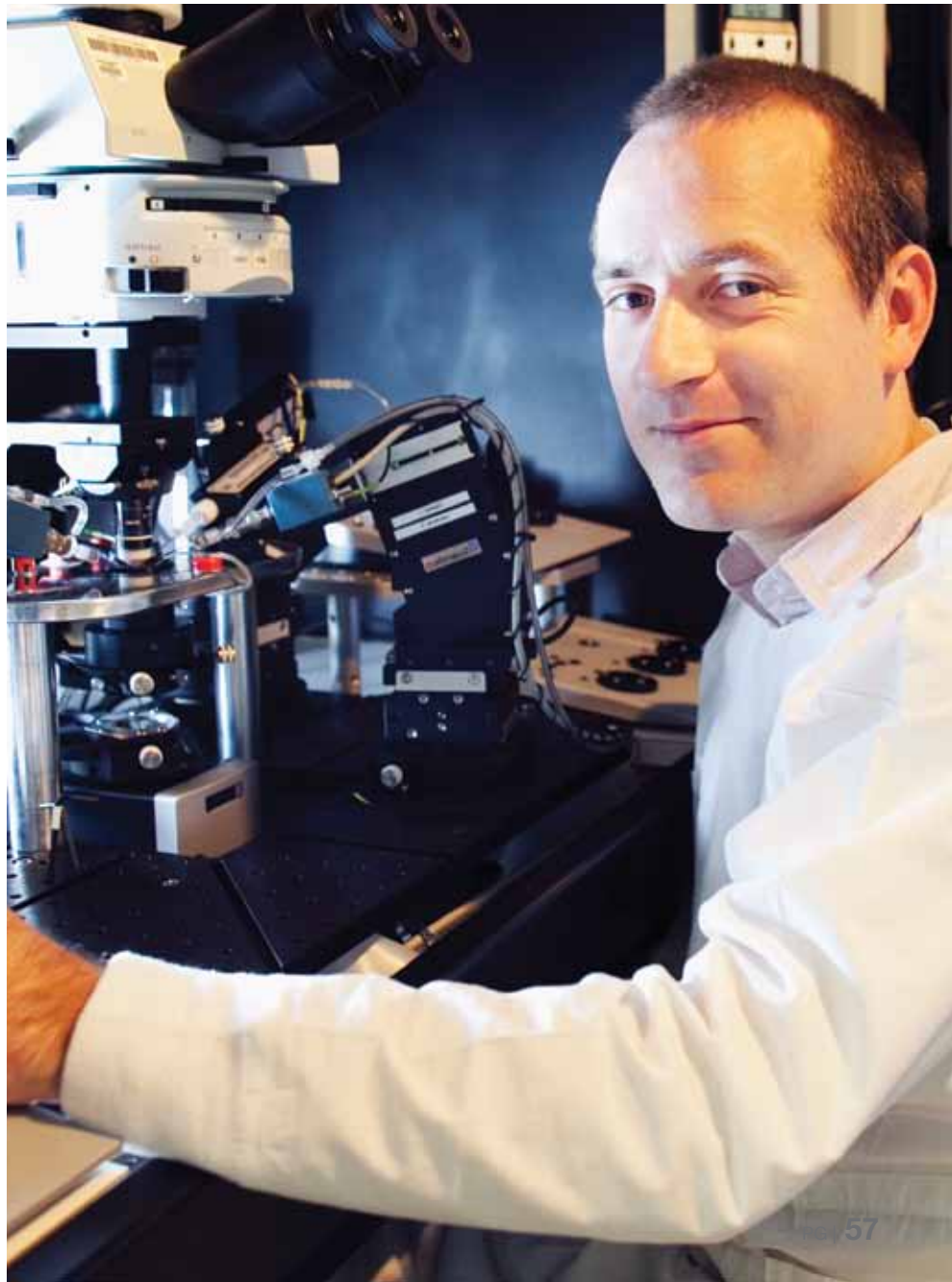
The program is coordinated by QBI and the Faculty of Social and Behavioural Sciences, but also spans many other exceptionally strong centres for neuroscience research at UQ. Providing research training and core professional skills, the program is a pathway to specialist streams including molecular and cellular neuroscience, neural imaging and computational neuroscience, developmental neurobiology, cognitive and behavioural neuroscience, visual and sensory neuroscience and epigenetics.

The compulsory courses are:

- Molecular and Cellular Neuroscience (NEUR7006) which is concerned with cell and molecular biology of the neuron.
- Systems Neuroscience: Sensory and Motor Neuroscience (NEUR7004) uses a systems approach to explore the brain with respect to circuits that integrate and process information.
- Cognitive and Behavioural Neuroscience (NEUR7005) is concerned with the elucidation of the neural basis of cognitive and behavioural phenomena.

Among the projects that Master of Neuroscience students have undertaken in the past are:

- Activation of adult mouse spinal cord neural stem cells by *in vitro* depolarisation
- Axonal degeneration in *Caenorhabditis elegans* motor neurons as a model of motor neuron disease (MND)
- Understanding of actions and motor intentions in the parieto-frontal mirror circuit



Right: Dr Benjamin Sivyer, recipient of the Dean's Commendation for Outstanding Research Higher Degree Thesis, at work in the laboratory.

Community

A group from the Mental Illness Fellowship of Queensland visits QBI

Community

Queensland Brain Institute researchers form an integral part of the communities in which they work and live. They regularly discuss the latest research discoveries with community groups, while also engaging with their peers at scientific conferences.

In 2010, QBI hosted a series of high profile lectures and conducted a range of community outreach events. In addition to educating Australians about the latest research findings, staff also expanded their efforts to encourage the next generation to consider careers in neuroscience.

QBI **Events**

Peter Goodenough Memorial Lecture

Dollars and Sense

QBI welcomed a leading philanthropic campaigner to present the Peter Goodenough Memorial Lecture in early April.

Dr Sarah Caddick is the principal neuroscience advisor for the UK's Lord David Sainsbury's Gatsby Foundation. She has built her career advocating the importance of donating to science – and said there has never been a better time for the public to become involved.

"We're going to figure out how the entire brain is wired up at some point. This is the future – who doesn't want to know why we think, how we think and where our memories come from?" she asked.

The former neuroscientist explained that institutes conducting fundamental studies – such as QBI – are leading research efforts.

"Basic science is where the answers are. There is no example of a discovery, therapy or a diagnostic that has come from the translational end."

Dr Caddick predicted research funding would evolve in the future, with increased collaborations between research laboratories and a greater emphasis on philanthropy.

"It is extremely challenging for any system of public grant making to take major risks. It's also challenging for them to explore new areas," she said.

"Philanthropists are usually less burdened with bureaucratic controls and can take those risks."

During the lecture, she acknowledged the generosity of the late Peter Goodenough, whose significant bequest led to the establishment of a motor neuron disease laboratory at QBI.

"The idea of funding basic research is exactly what we established this Institute for, so this idea resonates extremely well with us," QBI Director Professor Perry Bartlett said about the "very refreshing" lecture.

Above: Dr Sarah Caddick.

Toshiya Yamada Memorial Lecture

Research Gene-ius

There was a packed house for the Toshiya Yamada Memorial Lecture in June, hosted jointly by UQ's Queensland Brain Institute and the Institute for Molecular Biosciences (IMB).

Dr Yamada was an outstanding mid-career scientist at UQ's Centre for Molecular and Cellular Biology (now the IMB) who died suddenly in 2001.

Guest speaker for the annual lecture was Professor John Hardy from the Reta Lila Weston Institute of Neurological Studies at University College London.

After starting his career researching Alzheimer's disease, Professor Hardy went on to lead the group that found the first mutation in the amyloid gene, which causes the condition. He was also part of the teams that discovered the genetic mutations that lead to Parkinson's and Pick's diseases.

The geneticist used the lecture to give scientists an update on the sequencing of both Alzheimer's and Parkinson's diseases.

"As the number of people who are sequenced increases, more and more variants are entering the databases. This is very powerful as we can predict who has very rare mutations without sequencing them," he said.

A Fellow of the Royal Society, UK, Professor Hardy also took the opportunity to inspire young researchers considering a career in genetics.

"This is an amazing time to be a genomics-based researcher. It's the beginning of a golden era."

IMB Director Professor Brandon Wainwright said: "Professor Hardy has demonstrated the power of genetics to impact all of our studies."

He went on to describe the lecture as a fitting tribute for "our much missed colleague, Toshi".

Above: Professor John Hardy (centre, white shirt).

QBI **Events**

Merson Lecture

Neuronal Polarity

The second Merson lecture was delivered by Professor Mu-ming Poo, Director of the Institute of Neuroscience, Shanghai, and the Paul Licht Distinguished Professor in Biology at the University of California, Berkeley.

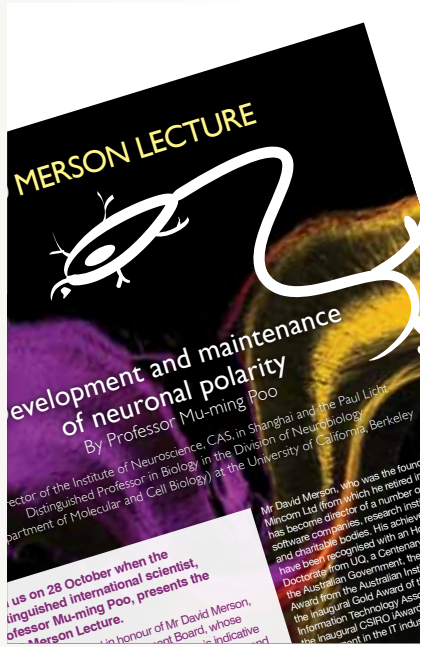
Professor Poo delighted the audience with his talk entitled 'Development and maintenance of neuronal polarity', during which he illustrated how scientists are exploring the brain at the cellular and molecular level.

He outlined how each nerve cell (or neuron) has a polarised structure consisting of one long axon and many short dendrites.

"The function of the neuron and formation of the complex neural network in the brain depends on this polarised structure, but how this polarity emerges during early neuronal development and how it is maintained in the mature neuron remain outstanding mysteries," Professor Poo said.

Named after leading businessman and Chairman of the QBI Development Board, Mr David Merson, this well-attended talk is indicative of the growing community interest in neuroscience and the cutting-edge research that is being done in the area of neurological and mental diseases.

The Merson lecture is held on an annual basis. The inaugural lecture – in 2009 – was presented by the renowned international scientist, Professor Giacomo Rizzolatti.



Above: Flyer from the 2010 Merson Lecture. Right: Professor Mu-ming Poo's talk was entitled "Development and maintenance of neuronal polarity".

QBI **Conferences**

Epigenomics, Behaviour and Disease Symposium

Changing Behaviour

Responding to increasing interest in the study of inherited changes in appearance and gene expression, QBI hosted the inaugural Epigenomics, Behaviour and Disease Symposium in March.

"Many questions of adult behaviour in the nervous system have some component of epigenetics – there couldn't be a more exciting topic," said QBI Director Professor Perry Bartlett.

Among the speakers was University of Zurich's Professor Isabelle Mansuy, who revealed that chronic maternal deprivation leads to impulsive and depressive behaviour in future generations.

"The maternal environment is of great importance for the normal development of children," she said.

"Some traits disappear in the fourth generation, but some stay ... We're testing the theory that these traits can be reversed by drugs or environmental factors."

The symposium organiser, QBI's Dr Timothy Bredy, said work presented at the conference represented major advances in the understanding of gene-environment interactions in the context of human disease.

"It's clear that the epigenome is playing a central role in that," he said.

Summer of Spikes Lecture Series

Spike up your Life

Better understanding the link between learning, rhythm and computational neuroscience was at the core of the Summer of Spikes lecture series organised by the Thinking Systems Group and held at QBI over the 2009-2010 festive season.

By increasing the understanding of these key areas, scientists hope to advance research into neurological disorders.

QBI's Dr Angelique Paulk, who organised the series with Dr Peter Stratton and Professor Janet Wiles said: "Direct interaction between scientists provides the ground-work for truly novel research which would not otherwise occur. That's why we decided to organise this course and unite eminent researchers from the computational and empirical neuroscience disciplines."

Guest speakers included Assoc. Professor Jean-Mark Fellous, University of Arizona, USA, who researches the role of noise in neural computations; and Professor Anthony Burkitt, University of Melbourne, and Assoc. Professor Michael Breakspear, University of New South Wales, who use mathematical concepts to better understand neurological functions.

Motor Neuron Disease (MND) Symposium

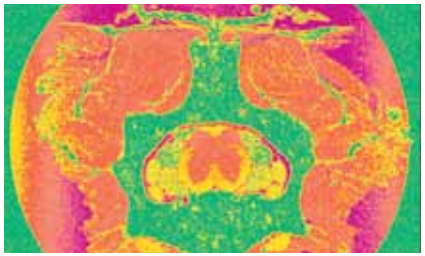
MiND Matters

Neuroscientists from across the globe gathered at QBI to learn more about the latest developments in motor neuron disease (MND) research in February.

The symposium gave researchers the opportunity to discuss advances across a range of areas, including the molecular and cellular mechanisms, genetics and diagnostic markers of MND, as well as treatment strategies and imaging.

"This highly successful symposium brought the clinical, scientific and public communities together for the exchange of ideas and new scientific knowledge on current issues in MND," conference organiser Dr Robyn Wallace said.

The Australian Neuroscience Society satellite meeting also included a series of oral and poster presentations, illustrating the quality and breadth of research that is currently being conducted into MND across the country.



Introducing Addiction Neuroethics Conference

The Neuroethics of Neuroscience

Neuroscientists are committed to improving drug treatments for a range of illnesses – but it is important to consider the ethical, social and policy implications of the treatments they develop.

Addiction is a serious illness for many people, however research is only now starting to reveal how drugs act on the brain to cause dependence and why some people are more prone to developing addiction than others. This research could lead to more effective treatments for addiction and transform social policy.

Many questions remain unanswered, including whether people are responsible for drug-induced behaviour that harms others and whether psychotropic drugs that enhance brain functions such as memory, concentration and mood should be allowed.

International speakers Professor Judy Illes from the University of British Columbia, Canada, and Assoc. Professor Eric Racine from Université de Montréal and McGill University, Canada, joined the conversation at the Introducing Addiction Neuroethics Conference in April.

Conference organiser, QBI's Professor Wayne Hall, said: "It is important that we consider the impact of neuroscience research if we are to maximise the benefits it offers."

QBI **Conferences**

Brain Plasticity Symposium

The Flies Have It

Mark Twain rarely comes to mind when you think of neuroscience.

However he was central to a lecture by Professor Ron Davis who tried to debunk the quote "the good Lord didn't create anything without a purpose – but the fly comes close" at the Brain Plasticity Symposium in September.

Professor Davis, from the Baylor College of Medicine, USA, spoke about the importance of the fruit fly *Drosophila* in understanding memory in humans.

"In the past few years we have identified several memory traces. It appears that olfactory learning is actually multiple memory phases in the olfactory nervous system," he explained.

A plethora of national and international speakers spoke on a range of topics, covering neural circuit construction and function in sensory systems, memory and psychopathology, across the two-day symposium.

QBI's Deputy Director (Research) and symposium co-organiser Professor Pankaj Sah said: "This symposium showcased new developments in this exciting area of neuroscience. The poster session was particularly good and provided an opportunity for QBI students and staff to spend time with leaders in the field."

Computational Neuroscience Workshop

Maths and Mystery

Research leaders from Australia and overseas gathered at QBI in November for the Australian Workshop in Computational Neuroscience.

First held at QBI in 2006, the two-day workshop gives computational neuroscientists the opportunity to learn more about the latest developments in their field, while also discussing potential collaborations with other researchers.

Computational neuroscience is the study of the information-processing properties of nervous systems, using a combination of mathematical and experimental techniques.

"A computational approach is essential for fully unlocking the mysteries of brain function," said workshop organiser and the head of QBI's computational neuroscience laboratory Professor Geoffrey Goodhill.

Guest speakers also included Professor Peter Dayan from University College London and Dr Si Wu from the Institute of Neuroscience in Shanghai.

Charles Watson Short Course

Forebrain basics

More than 50 people attended a short course hosted at QBI in August by Professor Charles Watson, Professor of Health Sciences at Curtin University in Western Australia.

Entitled 'The forebrain tracts – histology and MR images', the workshop focused on the fibre systems of the forebrain, first with histological sections, and then with MR scans of mouse brains.

Formal lectures preceded related group project sessions.

Participants were provided with a review of the organisation of the forebrain, an outline of the major fibre systems of the forebrain as seen in fibre-stained histological sections and interpretation of MR images of the mouse forebrain, including the thalamus, hypothalamus, subpallium and cerebral cortical areas.

This was the third in what has become an annual short course in neuro-anatomy.

Professor Watson is a world-leading authority on functional anatomy of the nervous system. His courses are always extremely popular and well-received by those who attend them.

Vision Down Under 2010

Festschrift for David Vaney

On 1 December, QBI hosted the third 'Vision Down Under' meeting.

The event marked the retirement of Professor David Vaney and provided an opportunity to celebrate his many outstanding contributions to visual neuroscience and to wish him well in the next step of his life.

VDU 2010 featured talks by Professor Vaney's past and present collaborators and colleagues, on topics ranging from axon guidance in arthropods to the Bradshaw rock paintings of the Kimberley.

Professor Vaney will retain close ties with the Institute as he has been appointed Emeritus Professor of The University of Queensland.

Above: Professor David Vaney (centre, black shirt) with delegates from VDU 2010.

Government **Relations**

Federal visit

In July, QBI was privileged to showcase its research to Mr Mark Butler in his capacity as Parliamentary Secretary for Health and Mr Steven Miles, the Labor candidate for Ryan.

The visitors met with Professor Perry Bartlett who provided them with an overview of QBI's unique "fundamental research" focus before walking them through a few laboratories. The final stop was at the research benches of Drs Daniel Blackmore and Dhanisha Jhaveri where the spotlight was on the recent developments in dementia research.

Against a backdrop of Australia's greying population, ageing dementia is emerging as one of the country's most pressing health problems.

It is expected to present significant challenges to our health care system, which makes directed research programs aimed at preventing and treating ageing dementia and preserving quality of life for older Australians all the more urgent.

Professor Bartlett used the opportunity to brief an interested Mr Butler on QBI's plans for a much-needed Centre for Ageing Dementia Research. Professor Bartlett said that the visit was an indication of the high level of importance placed on neurological health by the federal government.

The Hon Mark Butler MP currently holds the portfolio of Minister for Mental Health and Ageing, a position he took on in September 2010.

State focus

Queensland Education and Training International

The Queensland Brain Institute took out the "Best Practice in International Collaborations" in the Research category during the 2010 QETI Awards for Excellence ceremony in November.

This award was in recognition of QBI's successful collaboration with the Institute of Biophysics in Beijing (further details on opposite page).

The QETI awards occur on an annual basis and showcase Queensland's international and training institutions' best practice in international collaboration and student services.

The award was presented to Professor Perry Bartlett by Mr Michael Choi MP, Parliamentary Secretary for Natural Resources, Mines and Energy, and Trade and Investment Queensland.

Above: Recipients of the 2010 QETI awards. (Professor Perry Bartlett in cream jacket). Right: (L-R) Dr Dhanisha Jhaveri, Dr Daniel Blackmore, Mr Mark Butler, Mr Steven Miles.

International **Partnerships**

Neuroscientists predict significant progress over the next decade or two when it comes to identifying the causes and cures for disorders such as ageing dementia, depression and schizophrenia. Fortunately, the Queensland Brain Institute is positioned at the forefront of such discovery thanks to strategic partnerships established across the globe.

Joint Laboratory Opening

A growing research bond between the neuroscience communities of China and Queensland culminated in the opening at QBI in September of the world-first Joint Laboratory of Neuroscience and Cognition with the Chinese Academy of Sciences (CAS) Institute of Biophysics (IBP) in Beijing. A second opening took place in November at the IBP.

The laboratory is underpinned by a $1 million National and International Research Alliances Program (NIRAP) grant from the Queensland Government, which brings together researchers from QBI, Griffith University, IBP as well as the Chinese Academy of Sciences' Institute of Psychology.

The aim of the program is to identify the key mechanisms regulating brain plasticity and to translate this understanding into promoting normal functions such as learning, memory and cognition, as well as ameliorating diseases such as dementia, depression, schizophrenia and neurotrauma.

"Beijing's expertise in fruit fly behaviour and research, along with high resolution, functional magnetic resonance imaging facilities, aligns closely with our own," says Professor Perry Bartlett.

"Over the next decade or two, this part of the world, and China in particular, will play a leading role in making discoveries in the area of biological science."

Research Alliances

A second exciting alliance with researchers in China was formed in June 2010 with colleagues at the Shanghai Changzheng Hospital at the Second Military Medical University.

The Memorandum of Understanding establishing the alliance was signed by Professor Perry Bartlett, with Queensland Treasurer Andrew Fraser present, during Queensland Week at the World Expo being held in China.

It underpins the development of a Human Neurogenetics Research Program which aims to improve therapeutic outcomes for neurological diseases such as motor neuron disease (MND), schizophrenia and epilepsy.

"This is a wonderfully unique opportunity for us to collaborate with outstanding clinical researchers at the Shanghai Changzheng Hospital, to uncover the genetic basis of a range of devastating brain diseases," Professor Bartlett says.

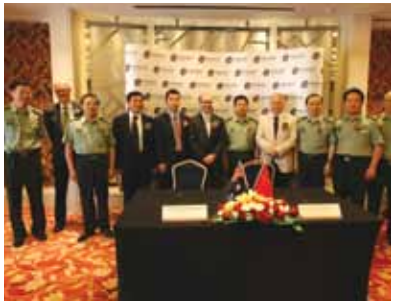
Meanwhile, a nano-neuroscience collaboration with colleagues at Fudan University is progressing well.

The collaboration aims to develop a more efficient drug delivery system based on a novel class of hybrid inorganic neuroparticles.

A further bilateral agreement with Ludwig-Maximilians-Universität (LMU) in München, Germany, was established in October 2010.

This has resulted in the planning of a joint symposium to be held at QBI in 2011, which will be attended by researchers from the Munich Centre for Neuroscience (MCN), a virtual centre in which several faculties of LMU and other Munich-based research centres participate to enable integrated, interdisciplinary neuroscience.

The Memorandum of Understanding (MOU) with the Institute of Neuroscience (ION) in Shanghai, also a Chinese Academy of Sciences Institute, was extended for a further five years. This has proved to be a most successful collaboration, with regular exchange of staff and students which enhance the research programs and have culminated in a number of joint publications.



Right Top: Bart van Alphen (white coat) talks with Professor Jinghai Li Vice-President Chinese Academy of Sciences in the laboratory during the opening of the QBI-IBP Laboratory of Neuroscience and Cognition at QBI. Below right: Queensland Treasurer Andrew Fraser witnessed the signing of the research agreement between QBI and the Second Military Medical University

Community **Outreach**

QBI's community outreach program is designed to engage people interested in discovering more about neurological disorders. The program's success is proof of the public's thirst to learn more about the latest developments in this area of research.

In addition to regular tours through QBI's world-class facilities, the Institute's researchers frequently conduct lectures, talks and discussions that are the anchor of the outreach program. This interaction – in libraries, bookstores, schools, hospitals and other community settings across the country – has continually proven beneficial for the public and scientists alike.

As the community learns more about the research being conducted at QBI, the lectures provide an unparalleled opportunity for scientists to meet people who, in many cases, know someone affected by a neurological condition. Engaging with people who will potentially benefit from QBI's research in the longer term provides an additional impetus for the neuroscientists to advance their work.

In 2010, QBI's researchers were involved in more than 35 outreach events, including:

The University of Queensland's Centenary Open Day in April attracted more than 300 people to the Institute to view our state-of-the-art facilities and learn more about our research

Dr Michael Piper spoke to members of Probus in Albany Creek

Professor John McGrath updated members of the Mental Illness Fellowship of Queensland on the latest in schizophrenia research

Dr Judith Reinhard presented a talk to the Logan West Library on her research with bees

Assoc. Professor Helen Cooper and Drs Darryl Eyles, Judith Reinhard, Daniel Blackmore and Randal Moldrich presented a neuroscience symposium at Embiggen Bookstore in Noosaville

Dr Francois Windels delivered a talk on QBI's research to the Friends of Ipswich Library

Dr Adam Hamlin delivered a lecture at the University of the Third Age Winter School

Dr Elizabeth Coulson gave a presentation on her work in Alzheimer's disease to the VIEW Club at Chapel Hill

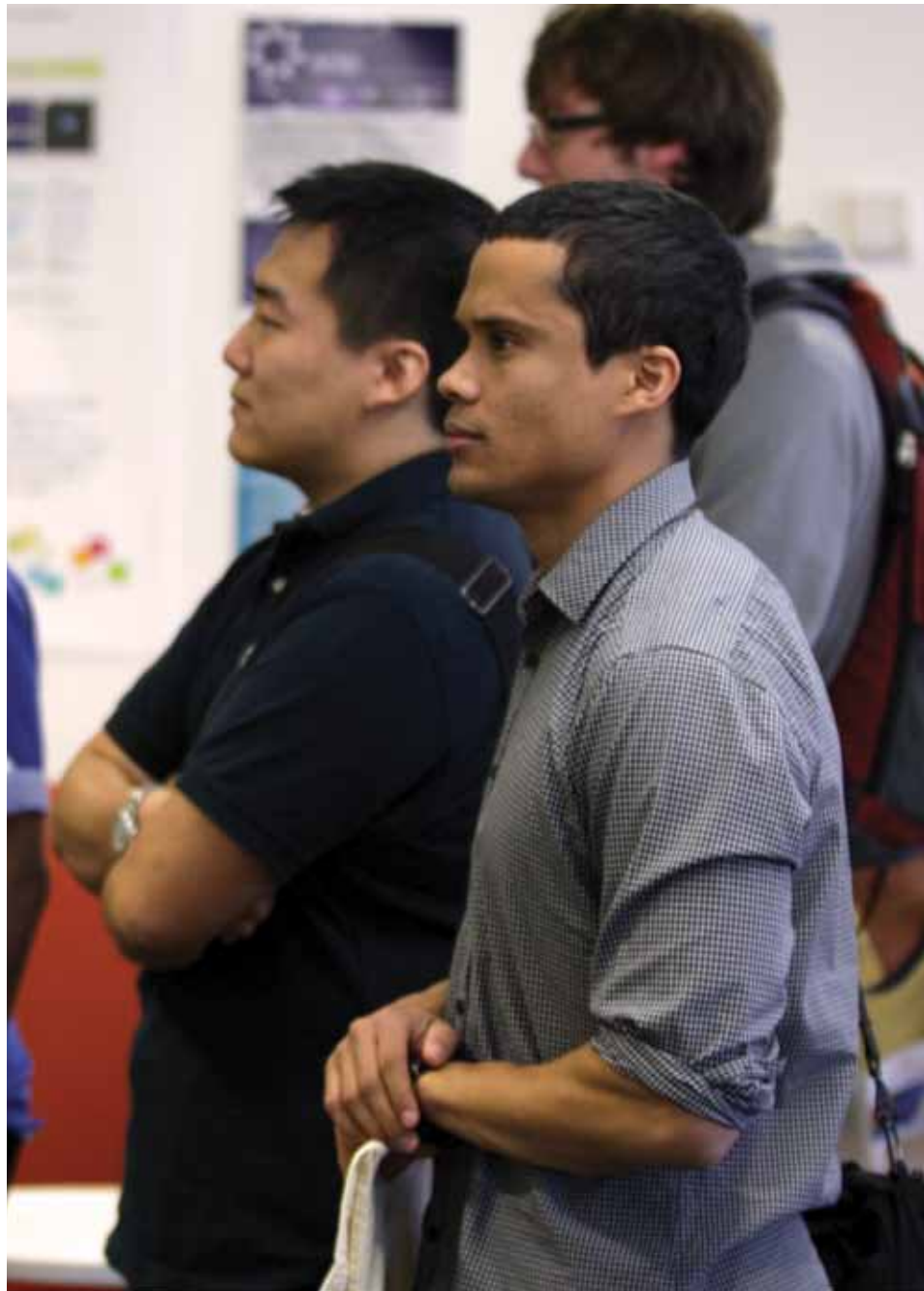


Image right: Young medical students attend a QBI information evening.

Australia New Zealand **Brain Bee Challenge**

out-smart, out-think, out-last

Established in 2006 to spark high school students' interest in pursuing careers in neuroscience, the Australian Brain Bee Challenge (ABBC) went from strength to strength in 2010. With neurological and mental illness accounting for almost half of the total disease burden in Australia, QBI views the ABBC as one way of attracting the best young minds to consider research careers.

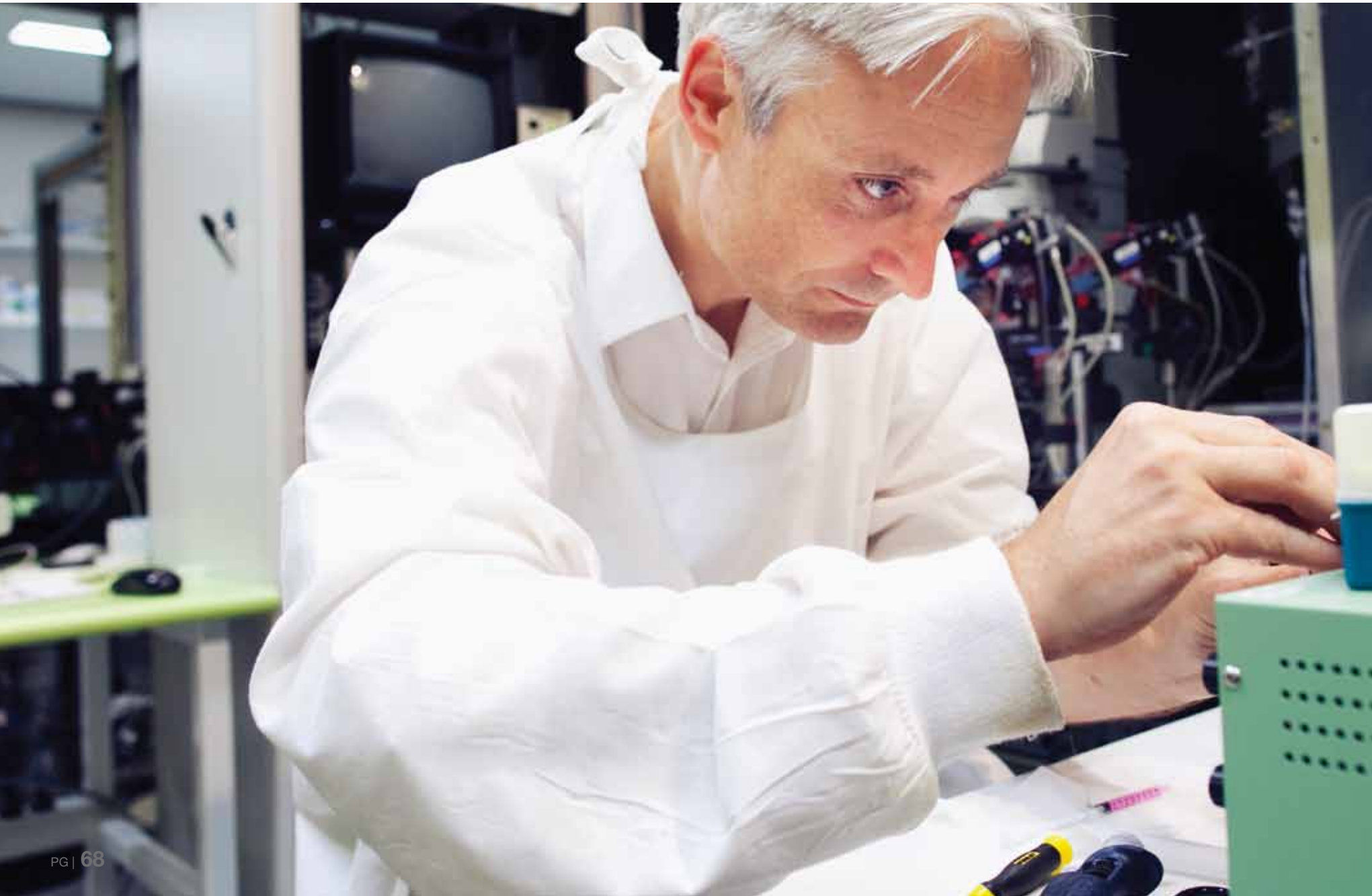
A record number of 4,526 Year 10 students from all around Australia and New Zealand participated in the 2010 competition, taking the cumulative total number of participants since the inception of the Challenge to 18,587. Designed to test students' knowledge about a range of topics, including intelligence, memory, emotions, sleep, Alzheimer's disease and stroke, the ABBC is the country's largest neuroscience competition. It is affiliated with the International Brain Bee (IBB), where the Australian and New Zealand Champions have the opportunity to compete after their National win.

The National Finals were held at the annual Australian Neuroscience Society (ANS) meeting in Auckland. After a nail-biting two days of competition, the 2010 Australian winner was Ben Thompson from Canberra Grammar School, now studying at Narrabundah College, with Rachael Wiltshire from Samuel Marsden Collegiate School crowned as the New Zealand Champion. In July 2011, Ben and Rachael will compete at the International Brain Bee Challenge being held in Florence, Italy, during the International Brain Research Organisation World Congress of Neuroscience.

Development of an ABBC Alumni program, designed to keep students connected to fellow alumni, organisers and, of course, the newest advances in neuroscience, will be a focus for 2011. Already, many former ABBC competitors have taken up neuroscience careers within QBI. These include James Nightingale, Courtney Landers, Katelin Haynes, Sophie Hill, Casey Linton and Kristy Butler. Results such as this demonstrate that the ABBC is achieving its goals of stimulating and supporting students' fascination with science, and encouraging their continued interest throughout their higher education and careers.

Left: 2010 ABBC winner Mr Ben Thompson.
Above: Brain Bee competitors in the running.

Recognition



Assoc. Professor Stephen Williams in the laboratory.

Recognition

The Queensland Brain Institute boasts more than 280 dedicated investigators working to elicit the fundamental mechanisms that regulate brain function. QBI researchers consistently shine in the neuroscience community, representing the Institute on a number of pivotal scientific organisations and serving on prestigious editorial boards. QBI's track record in terms of publications, grants and awards further attests to the high standard of research being undertaken with the aim of discovering the fundamental mechanisms regulating brain function.

Fellowships and Awards

2010 Nina Kondelos Prize

Developing Research

Professor Linda Richards was recognised for her research into how the brain develops before birth with the 2010 Nina Kondelos Prize at the annual meeting of the Australian Neuroscience Society (ANS) in January.

The Nina Kondelos Prize is presented to a female neuroscientist for their outstanding contribution to basic or clinical research.

"Linda has made a considerable mark in Australian neuroscience in the six years since she returned to the country," said QBI's Professor David Vaney, President of the ANS at the time the prize was presented.

QBI PhD students Dana Bradford and Ben Sivyer were also recognised at the ANS conference in 2010, winning two of the five student poster prizes as part of the Sir Grafton Elliot-Smith Award.

This was the second remarkable double achieved by the pair, who had both been awarded an Istvan Törk Prize for the best oral presentation by a Student Member of the ANS at the previous annual meeting in Canberra.

In relation to the poster prize, Dr Bradford says, "It was great to see a friend win the same award – even if it did mean sharing the cash."

Schering-Plough Senior Research Award

Rewarding Research

Two decades after he began researching the causes of schizophrenia, Professor Bryan Mowry has been rewarded for his efforts.

The psychiatric geneticist received the 2010 Schering-Plough Senior Research Award for his work to identify the genes that make people susceptible to developing schizophrenia and for investigating the illness' genetic complexities.

"It's a great honour to receive this award," says Professor Mowry.

"It will hopefully engender, encourage and facilitate a deeper interest in research, especially among the younger generation of psychiatrists."

The judging panel from the Royal Australian and New Zealand College of Psychiatrists, which presented the award, said it was "thrilled" to recognise Professor Mowry as a joint winner with Professor Ashley Bush from the Mental Health Research Institute of Victoria.

QBI Director Professor Perry Bartlett congratulated Bryan on the accolade.

"It's well-deserved recognition for his dedicated work in this field," he says.

Boycott Prize

Eyes on the Prize

Visual neuroscientist Professor David Vaney received the 2010 Boycott Prize for career achievement in the field of retinal neuroscience.

The award, presented by Professor Vaney's colleagues at the FASEB Summer Research Conference on Retinal Neurobiology, recognises his research on visual processing in the retina.

"The retina has been described as nature's brain slice because its structure and function remain largely intact when studied in isolation," Professor Vaney explains.

"Many discoveries first made in the retina were later shown to apply to other parts of the central nervous system."

Professor Perry Bartlett said it was an honour for Professor Vaney to be the first researcher from Australia to receive this prize, and its first sole recipient.

The Boycott Prize was a fitting tribute for Professor Vaney, who has played a leading role in neuroscience research, including a two-year term as the President of the Australian Neuroscience Society.

Above: Professor David Vaney, President of the Australian Neuroscience Society (ANS), presents the 2010 Nina Kondelos Prize to Professor Linda Richards at the Annual Meeting of the ANS.
Below: Professor Bryan Mowry is presented with the 2010 Schering-Plough award.

Fellowships and Awards

Research Fellowships

Funding for Fellows

QBI's Dr Timothy Bredy has received a coveted Australian Research Fellowship which commenced in January 2010.

His research will determine how the differences between male and female brains contribute to the formation and maintenance of long-term fear memories.

Scientists have already identified that males and females remember information in different ways – men primarily remember the gist, while women focus on the details.

Dr Bredy said improved understanding of the sex-specific differences could unlock the door to better treatments.

"We'd certainly hope to be looking at new directions in therapeutic approaches by the end of the grant," he said.

Meanwhile, QBI Faculty member and the Director of UQ's Centre for Advanced Imaging, Professor David Reutens, was awarded an NHMRC Practitioner Fellowship.

The researcher, who uses functional magnetic resonance imaging to learn more about neurological disorders, will use the five-year $500,000 grant to investigate nervous system disorders.

UQ Research Excellence Awards

QBI Shines

The Queensland Brain Institute has again proven it is a rising star, with two of 11 University of Queensland Research Excellence Awards being presented to QBI researchers in 2010.

Dr Massimo Hilliard was recognised for his project aimed at understanding nerve regeneration in the roundworm *Caenorhabditis elegans*, which could eventually enable scientists to rebuild connections in the nervous system after injury.

"This prestigious recognition comes as a strong motivation to our commitment to do good science and make important discoveries," says Dr Hilliard.

Dr Michael Piper was also rewarded for his research studying the genes that regulate stem cell differentiation in the embryonic brain, which is crucial for development.

"It's very humbling to get awards like these, as they represent acknowledgement from your peers in the scientific community," says Dr Piper.

According to Professor Perry Bartlett, the raft of awards secured in 2010 is further confirmation of the outstanding quality of the Institute's research program.

"QBI was extremely successful in snapping up these awards – it's a fantastic achievement," he adds.

Right: Dr Massimo Hilliard in the laboratory

Commercialisation

QBI's commercialisation pipeline continued to grow in 2010, with groundbreaking discoveries relating to the treatment of glioma brain tumours and botulism poisoning. However, the highlight of the year came when an earlier discovery for the treatment of neurodegenerative disease was licensed to start-up company NuNerve Pty Ltd.

Neurodegenerative diseases are characterised by the degeneration, and ultimately death, of neurons. In the seven years since QBI's inception, researchers have identified factors which regulate both neuron survival (Coulson Laboratory) and neurogenesis, the production of new neurons (Bartlett Laboratory). The biotechnology company NuNerve Pty Ltd was successful in raising $2 million and, in the first quarter of 2010, several patent families relating to these breakthroughs were licensed to the company. The company's focus is on the development of novel technologies for the treatment and prevention of progressive neurodegenerative diseases, particularly motor neuron disease (MND) and Alzheimer's disease. In the second half of the year, QBI, partnered by NuNerve Pty Ltd, was successful in its bid for ARC Linkage funding to further support the development of cell survival factors. With NuNerve on board as a partner, we are looking forward to further developing these promising leads.

Development of a treatment for acute spinal cord injury continues in collaboration with CSL Limited. QBI was successful in obtaining development funding from the National Health and Medical Research Council (NHMRC) to support the development of this promising protein, EphA4, to treat acute spinal cord injury. Last year we completed proof-of-principle studies in rats, demonstrating that treatment with EphA4 following spinal cord lesion not only results in less scarring at the injury site and regeneration of the damaged cord, but also in recovery of movement. We hope to progress this treatment closer to the clinic in 2011.

QBI's commercialisation activities are supported by UniQuest Pty Limited, the main commercialisation company of The University of Queensland which provides access to commercialisation expertise, processes and resources, and its Manager of Innovation and Commercial Development, Annita Nugent.

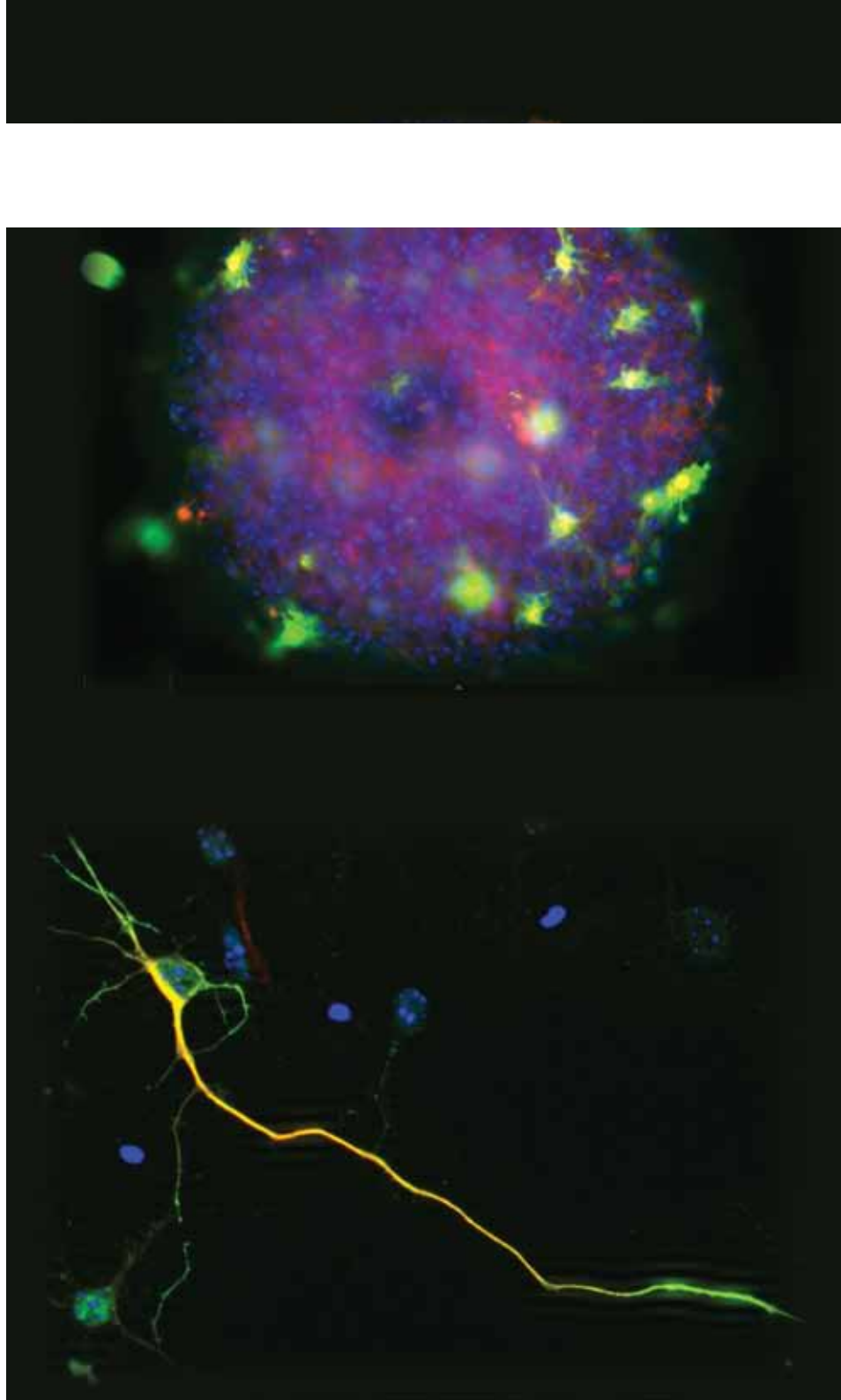


Image right: Neuronal production, in the norepinephrine-stimulated adult hippocampal neurospheres, was visualized by Thy1-YFP (in green) and beta3-tubulin (in red). A fraction of the Thy1-YFP positive cell population co-expressed both markers.

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Books and Book Chapters

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Refereed Conference Papers

Ball DM, Lehnert CF, Wyeth GF (2010). A practical implementation of a continuous isotropic spherical omnidirectional drive. In *IEEE International Conference on Robotics and Automation*, 3775-3780. Anchorage, Alaska.

Glover AJ, Maddern WP, **Milford MJ**, Wyeth GF (2010). FAB-MAP + RatSLAM: appearance-based SLAM for multiple times of day. In *2010 IEEE International Conference on Robotics and Automation*, 3507-3512. Anchorage, Alaska.

Moore RJD, Thurrowgood S, Bland D, Soccol D, Srinivasan MV (2010). UAV altitude and attitude stabilisation using a coaxial stereo vision system. In *IEEE International Conference on Robotics and Automation*, 29-34. Anchorage, Alaska.

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Grants

ANZ Trustees/Mason Foundation

A Hamlin & EJ Coulson. A new animal model of Alzheimer's disease, $48,500

Australian Research Council

Discovery Projects

Bredy, T. Epigenetic mechanisms regulating sex differences in fear-related learning and memory, 2010-2014, $802,830.

Harding, A. Multiscale stochiastic modelling of tumour robustness, 2010, $240,000. [Transferred to UQ Diamantina Institute in 2010]

Lynch, J. Activation mechanisms of Cys-loop ion channel receptors, 2010-2012, $348,000.

Paulk, A. Neural mechanisms of attention in the honeybee and *Drosophila melanogaster*, 2010-2012, $275,000.

van Swinderen, B. Presynaptic mechanisms of general anaethesia in the fly brain, 2010-2012, $415,000.

Large Infrastructure and Equipment Grants

Reutens, D., Mackay-Sim, A., **Bartlett, P**., Paxinos, G., Halliday, G., Watson, C. Facilities for automated high-throughput slide scanning and stereology, 2010, $520,000.

The Cancer Council Victoria

English, D., **Eyles, D.**, Baglietto, L. Vitamin D and risk of cancer and mortality in the Melbourne Collaborative Cohort Study, 2010-2012. $322,339. [Awarded to Dallas English and administered by University of Melbourne]

Go8 Australia - Germany Joint Research Co-operation scheme, Group of Eight Australia - Germany joint research co-operation scheme

Mattingley, J., Baumann, O., Greenlee, M., Raabe, M. Visual-Vestibular interaction for active navigation and spatial object-location memory, 2010-2011, $20,000.

Motor Neurone Disease Research Institute of Australia Inc., Grants-in-Aid for research into motor neurone disease

Wallace, R., Blair, I., Mackay-Sim, A., Nicholson, G. Identifying genes that are affected by MND-causing TDP-43 mutations, 2010. $38,962.

National Health and Medical Research Council

PhD Scholarships

Kamien, B. Investigating the genetic aetiology of Aicardi syndrome, 2010-2012. $107,750. [Relinquished]

Morris, J. The neural basis of the partial reinforcement extinction effect, 2010-2012, $107,750.

Simpson, H. Mechanisms of retinotectal map development, 2010-2012. $107,750.

Practitioner Fellowship level 2

Reutens, D. NHMRC Practitioner Fellowship, 2010-2014. $504,875. [Transferred to UQ Centre for Advanced Imaging in 2010]

Program Grant

Lewis, R., Alewood, P., **Adams, D**., Christie, M. Venom peptide modulations of pain pathways, 2010-2014. $6,360,000. [Awarded to and administered by UQ Institute of Molecular Bioscience]

Project Grants

Capon, R., **Lynch, J**. Developing novel selective glycine receptor potentiators as a means to control pain, 2010-2012. $533,997. [Administered by UQ Institute of Molecular Bioscience]

Goodhill, G. Cyclic-nucleotide-dependent regulation of axon guidance sensitivity, 2010-2012. $508,500.

Hilliard, M. Discovering molecules and mechanisms regulating dendrite formation, 2010-2012. $499,500.

Hilliard, M. Membrane fusion in axonal regeneration: molecules and mechanisms, 2010-2012. $445,125.

Meunier, F., Collins, B. Control of neurosecretion by Munc18, 2010-2012. $475,125.

Meunier, F. Modulating neuronal secretion by the PI3-kinase pathway, 2010-2012. $498,500.

Mowry, B., Holliday, E. Identifying eQTLs and endophenotyping known CNVs in a large Australian schizophrenia sample, 2010-2012. $876,750. [Awarded to UQ School of Medicine but transferred to QBI]

Mowry, B., Thara, R., Jorde, L. Nyholt, D. Studying the molecular basis of schizophrenia in a large, globally competitive Indian sample, 2010-2014. $945,563. [Awarded to UQ School of Medicine but transferred to QBI]

Osborne, S. The neuronal PIKfyve complex regulates neurotransmission and neurodegeneration, 2010-2013. $359,750.

Richards, L. DCC-Robo interactions cooperate to regulate callosal axon guidance, 2010-2012. $369,750.

Richards, L., Rubenstein, J. Fibroblast growth factors in the development of forebrain commissures, 2010-2012. $480,125.

Queensland State Government

National and International Research Alliances Program

Bartlett, P. Utilising brain plasticity to promote function and ameliorate disease, 2010-2013. $100,000.

Smart Futures PhD scholarship

Panwar, A. Molecular genetics of Motor Neuron Disease, 2010-2012. $24,000.

Queensland International Fellowship Program

Cunnington, R. The planning and readiness for voluntary movement, 2010-2011. $18,500.

Flatscher-Bader, T. Abberations in the genome of offspring born to older fathers, 2010-2011. $15,000.

Smart Futures Fellowship Level 2

Vukovic, J. Reversing the cognitive decline associated with age-related dementia, 2010-2013. $150,000.

Nicola Marks at work in the laboratory.

Neuroscience **Seminars**

The Queensland Brain Institute conducts a weekly seminar program giving neuroscientists an opportunity to learn more about the latest developments, often before research is published. The series is designed to challenge researchers in their thinking, promote excellence through the exchange of ideas and lead to future collaborations in neuroscience.

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Retinal motion generates conflicting visual signals

Dr Richard Anderson
Department of Anatomy and Cell Biology,
The University of Melbourne
Enteric neural crest cell migration

Dr Guy Barry
Queensland Brain Institute,
The University of Queensland
Transcriptional control of embryonic hippocampal development

Dr Oliver Baumann
Queensland Brain Institute,
The University of Queensland
Behavioural and neural correlates of human spatial navigation

Professor Tim Bliss
National Institute for Medical Research, London, UK
LTP: past and future

Dr Sarah Caddick
The Gatsby Charitable Foundation
Peter Goodenough Memorial Lecture 2010
Philanthropy and the brain: making connections

Professor Bruce Carter
Vanderbilt University Medical School, USA
Mechanisms of neuronal and phagocytic clearance in the developing peripheral nervous system

Professor Jim Cohen
King's College London, UK
Border controls at the developing spinal cord

Ms Stacey Cole
Queensland Brain Institute,
The University of Queensland
The role of Neogenin during neurogenesis and migration in the embryonic forebrain

Assoc. Professor Helen Cooper
Queensland Brain Institute,
The University of Queensland
Diverse roles for guidance receptors in CNS development

Ms Amber-Lee Donahoo
Queensland Brain Institute,
The University of Queensland
Molecular mechanisms regulating the development of the corpus callosum

Dr Kenji Doya
Okinawa Institute of Science and Technology, Japan
Temporal discounting and serotonin

Professor Sarah Dunlop
School of Animal Biology, University of Western Australia
Translating basic science into clinical trials for spinal cord injury

Professor G. Bard Ermentrout
University of Pittsburgh, USA
When the noise is the signal: stochastic synchrony in olfaction

Professor Richard Evans
The University of Leicester, UK
Extracellular ATP as a transmitter; physiological role, regulation and molecular pharmacology of P2X1 receptors

Assoc. Professor Jean-Marc Fellous
University of Arizona, USA
Evidence for the involvement of the dopaminergic system in post-traumatic stress disorder

Dr Tom Fothergill
Queensland Brain Institute,
The University of Queensland
Regulating axon attraction and repulsion at the midline during corpus callosum development

Professor Giovani Galizia
University of Konstanz, Germany
Honeybee odor coding and learning costs – neural networks and circadian intelligence

Professor Geoffrey Goodhill
Queensland Brain Institute,
The University of Queensland
How do axons detect and respond to molecular gradients?

Professor Jürgen Götz
Brain and Mind Research Institute, University of Sydney
Modelling Alzheimer's disease – To be a baptist, a tauist or a baptised tauist

Dr Jake Gratten
Queensland Statistical Genetics Laboratory,
Queensland Institute of Medical Research
Statistical genetics for neurobiologists: what can we learn from sheep?

Professor Benedikt Gröthe
Ludwig-Maximilian University of Munich, Germany
Sound localization in mammals: unexpected mechanisms, unexpected dynamics

Ms Lauren Harms
Queensland Brain Institute,
The University of Queensland
Effects of developmental vitamin D deficiency on brain development and behaviour in mice

Dr Julian Heng
Australian Regenerative Medicine Institute (ARMI), Monash University
Gene expression during brain development and disease

Mr Jonathan Hunt
Queensland Brain Institute,
The University of Queensland
Patterns, preferences and the primary visual cortex

Professor Judy Illes
The University of British Columbia, Canada
Advanced neuroimaging: ethical, social and legal challenges for basic research and clinical translation

Neuroscience **Seminars**

Professor Nancy Ip
The Hong Kong University of Science & Technology, Hong Kong
From understanding neural plasticity to discovery of novel neuroactive compounds

Dr Dhanisha Jhaveri
Queensland Brain Institute, The University of Queensland
Mechanisms underlying neurogenic and anti-depressant actions of norepinephrine

Professor Kozo Kaibuchi
Graduate School of Medicine, Nagoya University, Japan
DISC1 acts as a cargo adapter for neuronal transport of specific proteins and mRNAs

Professor Nigel Laing
Centre for Medical Research, University of Western Australia, and Western Australian Institute for Medical Research (WAIMR)
Gene discovery, pathobiology, therapy and research translation in genetic muscle diseases

Professor Julio Licinio
John Curtin School of Medical Research, Australian National University
Approaches to pharmacogenomics: The cases of monogenetic and polygenic diseases

Professor Andreas Lüthi
Friedrich Miescher Institute for Biomedical Research, Switzerland
Defining the neuronal circuitry of fear

Mr Timothy Lynagh
Queensland Brain Institute, The University of Queensland
Ivermectin: a successful antiparasitic drug and a neuroscience tool

Dr Marie Manglesdorf
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The genetics of motor neuron disease: identifying new candidate genes

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Emerging role for the inositol polyphosphate 5-phosphatases in embryonic development

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Osaka University, Japan
Intracortical migration of GABAergic interneurons and morphological changes during early stages of maturation

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University College London, UK
How the hippocampal cognitive map develops

Professor Noriko Osumi
Tohoku University School of Medicine, Japan
Asymmetrical inheritance of Cyclin D2 and fate determination of neuroepithelial cells

Professor Christos Pantelis
Melbourne Neuropsychiatry Centre, The University of Melbourne
Understanding brain changes in early psychosis: a brain maturational perspective

Assoc. Professor Steven Petrou
Howard Florey Institute and The Centre for Neuroscience, The University of Melbourne
Functional origins in genetic epilepsies

Professor Michael Pierce
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Specific glycans are markers for stem and neural cell differentiation and regulate the tumor initiating cell compartment of her-2-induced mammary tumors

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Regulation of midline glial development by nuclear factor one genes in the cerebral cortex

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School of Psychiatry, University of New South Wales
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Centre for Neuroscience, The University of Melbourne
Regulation of neuronal differentiation and neurite outgrowth by suppressor of cytokine signalling 2 (SOCS2)

Dr Vidita Vaidya
Tata Institute of Fundamental Research, India
Neurobiology of depression: role for Alpha2 adrenoceptors and 5-HT2 receptors

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Genetic Epidemiology, Molecular Epidemiology and Queensland Statistical Genetics Laboratories, QIMR
Neuroimaging genetics, finding genes for brain function and dysfunction

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- Motor Neurone Disease Research Institute of Australia Research Committee Member
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- Australian Neuroscience Society National Council Member
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BioMedCentral (BMC) Psychiatry
John McGrath, Editorial Board

BMC Physiology
Pankaj Sah, Editorial Board

Brain and Cognition
Jason Mattingley, Editorial Board

Channels
Pankaj Sah, Editorial Board

Clinical Schizophrenia and Related Psychoses
John McGrath, Editorial Board

Cognitive Neuropsychiatry Psychology Press
John McGrath, Editorial Board

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Jason Mattingley, Assoc. Editor

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Frederic Meunier, Editorial Board

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Jason Mattingley, Editorial Board

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Linda Richards, Editorial Board

Developmental Neurobiology
Perry Bartlett, Editorial Board

Developmental Neuroscience
Perry Bartlett, Editorial Board

Frontiers in Cellular Neuroscience
Stephen Williams, Assoc. Editor

Frontiers in Molecular Neuroscience
Joe Lynch, Editorial Board

Frontiers of Molecular Psychiatry
John McGrath, Editorial Board

Frontiers in Neural Circuits
Stephen Williams, Assoc. Editor

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International Journal of Developmental Neuroscience
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International Journal of Biochemistry and Molecular Biology
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Journal of Applied Clinical Pediatrics
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Journal of Attention Disorders
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Journal of Biological Chemistry
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Journal of Comparative Neurology
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Journal of Comparative Physiology A
Mandyam Srinivasan, Editorial Advisory Board

Journal of Neurochemistry
Frederic Meunier, Handling Editor

Journal of Neurophysiology
Pankaj Sah, Assoc. Editor

Journal of Neuroscience
Pankaj Sah, Editorial Board

Journal of Neuroscience Methods
Stephen Williams, Editorial Board

Journal of Neuroscience Research
Perry Bartlett, Editorial Board

LabSuite Brain Navigator
David Reutens, Editorial Board

Network: Computation in Neural Systems
Geoffrey Goodhill, Editor-in-Chief

Neural Circuits and Systems
Geoffrey Goodhill, Editorial Board

Neural Computation
Geoffrey Goodhill, Assoc. Editor

Neural Development
Perry Bartlett, Editorial Board

Neural Plasticity
Pankaj Sah, Editorial Board

Neurocase
Jason Mattingley, Editorial Board

Neuropsychologia
Jason Mattingley, Editorial Advisory Board

Neuroscience Research
Perry Bartlett, Editorial Board

Neurosignals
Perry Bartlett, Editorial Board
Linda Richards, Editorial Board

PLoS Biology
Mandyam Srinivasan, Editorial Board

PLoS ONE
Thomas Burne, Academic Editor
Justin Marshall, Academic Editor
Frederic Meunier, Academic Editor
Bruno van Swinderen, Academic Editor
Bryan Mowry, Academic Editor

Psychiatric Genetics
Bryan Mowry, Editorial Board

Revista Brasileira de Psiquiatria, Associação Brasileira de Psiquiatris
John McGrath, Editorial Board

Schizophrenia Bulletin
John McGrath, Editorial Board

Schizophrenia Research
John McGrath, Editorial Board

Stem Cell Research
Perry Bartlett, Editorial Board

Stroke Research and Treatment
David Reutens, Editorial Board

Translational Psychiatry
John McGrath, Editorial Board

Yonsei Medical Journal
Perry Bartlett, Editorial Advisory Board

UQ Appointments

Thomas Burne
- UQ Animal Ethics Committee

Helen Cooper
- University of Queensland, Faculty of Science local confirmation and promotions committee (Levels A-D)
- University of Queensland Biosafety Committee

Elizabeth Coulson
- UQ Research Higher Degree Committee

Ian Duncan
- Corporate Information Sub-Committee
- Phoenix Program Steering Committee
- UQ Information Technology Consultative Group Chair

Geoffrey Goodhill
- UQ Excellence in Research for Australia Steering Committee
- UQ RHD Committee

John Kelly
- UQ Biological Resources Steering Committee
- UQ Research Infrastructure and Facilities Working Group

Joe Lynch
- UQ Masters of Neuroscience Program Coordinator

Justin Marshall
- UQ Research Station Steering Committee

Frederic Meunier
- UQ Radiation Health and Safety Committee

Linda Richards
- UQ Biological Resources Animal Users Committee Chair

Pankaj Sah
- UQ Research Committee

Clare Seaman
- UQ Occupational Health and Safety Council

Robyn Wallace
- UQ Animal Ethics Committee

QBI **Staff**

Director,
Queensland Brain Institute
Professor Perry Bartlett

Deputy Director *(Research)*
Professor Pankaj Sah

Deputy Director *(Operations)*
John Kelly

Director,
Centre for Advanced Imaging
Professor David Reutens

Faculty
Assoc. Professor Mark Bellgrove
Dr Timothy Bredy
Dr Thomas Burne (Adjunct Appointment)
Dr Charles Claudianos
Assoc. Professor Helen Cooper
*Dr Elizabeth Coulson**
Assoc. Professor Ross Cunnington
Dr Darryl Eyles (Adjunct Appointment)
Dr Louise Faber
Professor Geoffrey Goodhill
Dr Massimo Hilliard
Professor Joe Lynch
Professor Justin Marshall
Professor Jason Mattingley
Professor John McGrath (Adjunct Appointment)
Assoc. Professor Frederic Meunier
Professor Bryan Mowry (Adjunct Appointment)
Mr Geoffrey Osborne
Dr Judith Reinhard
Professor Linda Richards
Professor Mandyam Srinivasan
Assoc. Professor Bruno van Swinderen
Professor David Vaney
Dr Robyn Wallace
Assoc. Professor Stephen Williams
Professor Huji Xu (Began Sep)

** Promoted to Assoc. Professor, effective 01 January 2011*

University of Queensland Affiliates
Professor Andrew Boyd
Professor Matthew Brown
Professor Chen Chen
Professor Shaun Collin
Professor Wayne Hall
Professor Ottmar Lipp
Professor Daniel Markovich
Dr Sean Millard
Dr Peter Noakes
Dr Marc Ruitenberg
Dr Ethan Scott
Professor Peter Silburn
Professor Walter Thomas
Dr Guy Wallis
Professor Janet Wiles

Adjunct Appointments
Dr Marta Bortoletto (began September)
Dr James Crane (began July)
Dr Andrew Delaney (began July)
Dr Geoffery Ericksson
Dr Robert Hester
Professor Brent Reynolds

Conjoint Appointments
Dr Lawrence Sanjay Nandam

Honorary Professors
Professor David Adams
Professor Mary Galea
Professor Dexter Irvine
Professor Tianzi Jiang
Professor Gisela Kaplan (began July)
Professor Nicholas Martin (began June)
Professor Hideyuki Okana
Professor Lesley Rogers (began July)
Professor Seong-Seng Tan
Professor Charles Watson
Professor Huji Xu (began July, finished August)

Honorary Research Consultant
Assoc. Professor Christine Wells

Industry Fellows
Professor David Gearing

Postdoctoral Fellows
Dr Natalie Alexopoulos
Dr Daniel Angus
Dr Eleonora Autuori (began July)
Dr David Ball
Dr Guy Barry
Dr Denis Bauer (began April)
Dr Oliver Baumann
Dr Daniel Blackmore
Dr Dana Bradford (began September)
Dr Arne Brombas (began March)
Dr Stanley Chan (finished August)
Dr Meiyun Chang-Smith
Dr Min Chen (began February)
Dr Allen Cheung
Dr Tsyr-Huei Chiou
Dr Robert Colvin
Dr James Crane (finished June)
Dr Alexandre Cristino
Dr Xiaoying Cui
Dr Tarrant Cummins (began November)
Dr Angela Dean
Dr Andrew Delaney (finished July)
Dr Kirsty Dixon (began April)
Dr Kevin Dudley (began April)
Dr Richard Faville (began May)
Dr Traute Flatscher-Bader
Dr Isabel Formella
Dr Thomas Fothergill
Dr Kerstin Fritsches (began January, finished September)
Dr Jacob Gratten (began May)
Dr Adam Hamlin
Dr Angus Harding (finished August)
Dr Jill Harris
Dr Ziarih Hawi (began March)
Dr Julia Hocking (finished May)
Dr Martin How
Dr Matthew Ireland (finished May)
Dr Dhanisha Jhaveri
Dr Vilija Jokubaitis (began March)
Dr Marianne Keller (finished January)
Dr Angelo Keramidas (began March)
Dr Benjamin Kottler (began March)
Dr David Kvaskoff (began June)
Mr Nikolai Liebsch
Ms Tien Luu
Dr Marie Mangelsdorf
Dr Sally Marshall (began March)
Dr Vikki Marshall (began April)
Dr Natasha Matthews
Dr Dusan Matusica (began February)
Dr Michael Milford (finished February)
Dr Randal Moldrich
Dr Pascal Molenbergh
Dr Duncan Mortimer
Dr Brent Neumann
Dr Tam Nguyen
Dr Cathrin Nourse
Dr Shona Osborne
Dr Angelique Paulk
Dr Vincenzo Pignatelli
Dr Michael Piper
Dr John Power
Dr Zlatko Pujic
Dr Martin Sale (began February)
Dr Qiang Shan
Dr Benjamin Sivyer (began March)
Dr Jay Spampanato
Dr Mark Spanevello
Dr Peter Stratton
Dr Robert Sullivan
Dr Jinjun Sun (began May, finished November)
Dr Alex Sykes (finished April)
Dr Chanel Taylor (began July)

Research Assistants
Suzanne Alexander
John Baisden

QBI **Staff**

Danay Baker-Andressen (began September)
Debra Black (finished July)
Daniel Bland
Natalie Bland
Clement Bonini (began August)
Catherine Bryant (finished July)
Tim Butler
Sean Coakley (finished June)
Dr Carlos Magalhaes Coelho
Emma Collier-Baker (began July)
Tarrant Cummins (finished November)
Dr Joanne Daniels (began March, finished September)
Oliver Evans (finished May)
Cheryl Filippich
Brett Fisher (finished July)
Kathryn French (finished May)
Kelly Garner (began March)
Alan Goldizen
Rachel Gormal
Kylie Greig (began March)
Nivetha Gunasekaran (began June)
Justine Haddrill
Melanie Havler (finished March)
Sophie Hill
Georg Kerbler
Robert Kerr (finished June)
James Kesby
Leonie Kirszenblat
Diana Kleine
Pauline Ko
Tamara Koudijs (finished April)
Beatrice Large (finished August)
Casey Linton
Erica Little (finished August)
Pei-Yun Liu (began November)
David Lloyd
Poh-Lynn Low (began January)
Eirinn Mackay (finished June)
Timothy Martin
Eva McClure (began October)
Eliza Middleton (finished May)
Rebecca Morely (began October)
Deborah Nertney (began June)
Estella Newcombe
Katherine Noakes (finished March)
Nickless Palstra
Thomas Pollak (finished March)
Kalpana Patel (began April)
Divya Pattabiraman
Matthew Pelekanos
Thomas Pollak
Gregory Robinson (began September)
Janelle Scown (finished August)
Petra Sedlak
Henry Simila
Heather Smith
Dean Soccol
Sophie Tajouri
Andrew Thompson
Saul Thurrowgood
Katherine Truong (began July)
Karly Turner
Joseph Wagner
Dianne Walker
William Warhurst (began March)
Wei Wei
Simon Weiler (began May, finished August)
Peter Wen (began December)
Oressia Zalucki (finished October)

Students
Samuel Baker (began March)
Danay Baker-Andressen (began December)
Jessica Barnes
Anna Bode (began December)
Danakai Bradford (finished August)
Kathleen Cato (finished August)
Conor Champ
Charlotte Clark
Sean Coakley (began June)
Lavinia Codd
Hayley Cox
Peter Curby
Melissa de Vries
Christine Dixon
Amber-Lee Donahoo
Jiaxin Du
Ranmalee Eramudugolla (began February)
Claire Foldi
Clare Giacomantonio
Ilan Gobius
Helen Gooch
Veronika Halasz (began February)
Lu Han
Lauren Harms (finished November)
Callista Harper (began February)
Shao-Chang Huang (began July)
Jonathan Hunt (finished September)
Md Robiul Islam
Benjamin Kamien (began February, finished August)
Sepideh Keshavarzi
Inga Laube
Sha Liu
Timothy Lynagh
Nancy Malintan
Roger Marek
Elizabeth Mason (began March)
Sharon Mason
Linda May
Richard Moore
John Morris
Ramesh Narayanan
Thai Vinh Nguyen
Truong Giang Nguyen
Navid Nourani Vatani
David Painter
Ajay Panwar
Simandeep Poonian (began June)
Miguel Renteria Rodriguez (finished March)
Amanda Robinson (began March)
Sumiti Saharan
Hugh Simpson
Benjamin Sivyer (finished February)
Daniel Stjepanovic
Cornelia Strobel
Freda Talao
Gavin Taylor
Vanesa Tomatis (began July)
Qian Wang
Peter Wen (finished September)
Rebecca Williams (began June)
Jiajia Yuan
Oressia Zalucki (began November)
Yian Zhu
Nikki Zuvela (finished March)

Masters of Neuroscience
Zoran Boscovic
Cheng-Liang Chiou
Brett Fisher
Beomjun Kim
Di Xia
Shanzhi Yan
Hon Wai Yap

Institute Manager
Helen Weir
Ray Johnson (maternity leave cover)

Institute Operations Manager
Ian Duncan (finished December)

Research Management
Senior Research Manager – Rowan Tweedale
Grants and Postgraduate Coordinator – Dr Sylvie Pichelin

Commercialisation
Annita Nugent

Laboratory Support
Scientific Services Manager – Clare Seaman

Judy Bracefield
Jane Ellis
Luke Hammond
Maureen Kearney
Colin Macqueen
Nicholas Nacsa
Virginia Nink

QBI **Staff**

Lida Stjepcevic (finished August)
Nana Sunn
Janette Zlamal
John Wilson

Occupational Health and Safety
Ross Dixon

Information Technology
IT Manager –
Jake Carroll

Phillip George
Toby O'Brien

Special Projects and Events
Alison van Niekerk

Communications
Anna Bednarek (finished October)
Peter Cook (finished November)
Denise Cullen (began December)
Ron Hohenhaus (finished May)
Dee McGrath

Development and Community Relations
Jenny Valentine

Human Resources
Brooke Ellem (began September)
Samantha Leblang (finished August)
Jackie Perren

Finance and Store
Finance Manager –
Katherine Parsonage

Wade Ebeling
Michael Perren
Elizabeth Power
Nathan Weir

Technical Services
Technical Services Manager –
David Wheeldon

Adam Barry
Brandon Horne (began June)

Personal Assistant to the Director
Deirdre Wilson

Administrative Support
Brenda Campbell
Suzanne Campbell
Sarah Eagle (began December)
Susan Earnshaw
Lesley Green
Ben Kelly (began November)
Rhonda Lyons (finished November)
Kym Mayes (began September)
Debra McMurtrie
Charmaine Paiva
Reeza Palamoodu Nazer
Amelia Sah
Elizabeth Watts
Jill Wardropper (began May)

Right: (L-R) QBI's Special Projects and Events Manager Mrs Alison van Niekerk, Deputy Director (Operations) Mr John Kelly and Institute Manager Mrs Helen Weir

In **Appreciation**

Researchers at the Queensland Brain Institute are dedicated to unlocking the mysteries of neurodegenerative diseases and mental health disorders, which currently account for a staggering 45 per cent of the burden of disease in Australia.

By improving the understanding of the fundamental mechanisms that regulate brain function, QBI researchers are working to develop new, more effective therapeutic treatments for conditions such as dementia, stroke, motor neuron disease, multiple sclerosis and neurotrauma.

QBI relies on both public and private donations to continue its research programs and is therefore grateful for the support and generosity of its benefactors.

How to support the Queensland Brain Institute

Donations

There are many ways in which you can help support QBI's research effort, including:

- *Make a donation for a specific research area*
- *Purchase scientific equipment*
- *Fund scholarships for talented students*
- *Provide fellowships for early- to mid- career scientists*
- *Sponsor Professorial Chairs*
- *Undertake laboratory dedications*
- *Provide gifts in memoriam*

Bequests

By leaving a bequest to QBI in your will, you are leaving a lasting legacy that accelerates current research and preserves future projects. Bequests can include:

- *A percentage of an estate*
- *The residuary of an estate (what remains after all other gifts and costs have been deducted)*
- *A gift of a specific sum of money*
- *A particular asset, such as property, works of art, shares, or an insurance policy*

Under current legislation, gifts to the Queensland Brain Institute are tax deductible. To discuss how you can support the Institute, please contact us at:

Queensland Brain Institute
Building #79, Upland Road
The University of Queensland
St Lucia QLD 4072

Telephone: +61 7 3346 6300
Facsimile: +61 7 3346 6301
Email: development@qbi.uq.edu.au
Website: www.qbi.uq.edu.au