newsletter

Trinity College Dublin
Coláiste na Tríonóide, Baile Átha Cliath
The University of Dublin

2016/17

SCHOOL OF

# Biochemistry & Immunology

## WELCOME

The 16/17 academic year has seen six new lecturers establish their research groups in the school. They specialise in diverse research areas of Memory Formation, Glycobiology, Neuroinflammation, Lung Biology, Inflammation and Obesity and have brought in significant amounts of national and international funding to establish their research groups in our laboratories.

This variety in research activity is key to new discoveries being made and will ensure students coming through the school are trained in the latest biomedical technologies. For many students, this experience of high impact research and development is a defining moment in their scientific careers.

In the spirit of this research diversity we recently commenced three PhD fellowships in honour of one of our most celebrated scientists, John Scott. Many of you will remember John's pioneering work in the area of folate biochemistry and neural tube defects. In partnership with the School of Medicine, these Scott fellows are undertaking 'blue sky' research projects in which the biochemical mechanisms that underlie some human diseases are elucidated. The fellowships are a tribute to John's achievements and great honour for the students.

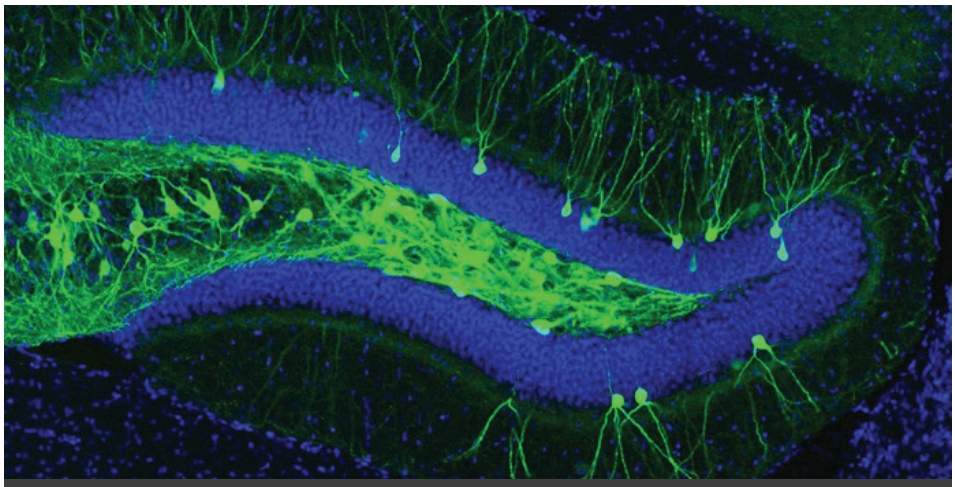
All the best for the summer ahead,

**Professor Gavin Davey**
Head of School of Biochemistry & Immunology

John Scott.

L– R The John Scott PhD Fellows: Emma O'Connor, Rebecca Amet and Gillian Barber.

# Information Storage in Memory Engrams



Hippocampal Engram Cells.

How are significant experiences stored in our brains as memories? What makes one memory different to another? How do memories, even seemingly inconsequential ones, often last a life time? A new Assistant Professor in Neuroscience, Dr Tomás Ryan, has established a team within the School of Biochemistry and Immunology in order to answer some of these questions by experimentally studying the biology of memory engram cells.

When we learn something, a material change occurs somewhere in the brain that accounts for the stored memory. That specific change in the brain is broadly referred to as a memory 'engram'. Until recently, brain researchers studied memory indirectly, by looking at general brain activity during learning or by disrupting whole brain regions and studying the effect on memory function. Over the past five years, advances in transgenics and optogenetics have allowed the development of technology whereby specific memory engrams can be labelled and manipulated in the rodent brain.

With the support of the European Research Council and Science Foundation Ireland, Dr Ryan, recently relocated from the Massachusetts Institute of Technology, and his new group are now investigating memory engram biology and function. This research programme is integrative and interdisciplinary in nature and will study the behavioural functionality of information encoded in engram cells, whilst simultaneously characterising the mechanistic biology of engram cells formation and plasticity.

# Key Role of 'Protector' Molecule in the Common Flu Fight

The team led by Assistant Professor in Immunology, Dr Nigel Stevenson, have discovered that a biological molecule important in cell growth (STAT3) is also critical in protecting us against infection — so much so that we would be unable to fight the common flu virus without it. Their discovery could pave the way to the development of new therapeutics charged with restoring our natural immunity to a whole spectrum of viruses that have evolved 'roadblocks' to the immune response.

During any viral infection our cells produce an immune molecule called interferon, which 'interferes' with the battle plans of attacking viruses — preventing them from replicating in our bodies. When our cells are stimulated by interferon a cascade of molecules within our cells is activated like a series of dominoes. When the final one falls, the cell should be able to clear the viral infection. This cascade of molecules is called a signalling pathway as it passes the 'danger signal' of viral infection through the cell.

However, many viruses are not cleared by our natural immune response and can cause serious illness. Dr Stevenson's team have discovered that STAT3 is an essential antiviral component of the interferon signalling pathway. In fact without STAT3, cells cannot fight the common flu virus or the pox vaccinia virus. This discovery increases our understanding of the interferon signalling pathway and provides a potential new target for anti-viral therapies.


Cartoonist Lisa Brown's depiction of the constant battle waging in our bodies between our immune system and viral infections.

## Keith Tipton Medal for Postgraduate Research

The Keith Tipton Medal for Postgraduate Research was awarded to Keenan Lacey, who is supervised by Dr Rachel McLoughlin. The working title of his thesis is "Investigating the Role of Cell Wall-Anchored Proteins in Staphylococcus Aureus Skin Infection and Their Potential to Activate T-Cells".


Dr Lisa Tang of MSC who sponsor the prize, Keenan Lacey, Professor Keith Tipton and Professor Richard Porter.

# Horizon 2020 Funding for Oral and Oesophageal Cancer Research

Researchers from the School of Biochemistry and Immunology and the School of Dental Science were awarded €2.9 million Horizon 2020 funding for a project "TRAining in Cancer Mechanisms and Therapeutics (TRACT)", in collaboration with European partners: Queen's University Belfast, University of Siena, University of Valencia and Oroboros Instruments.

Associate Professor in Biochemistry Dr Daniela Zisterer is the TRACT project coordinator. TRACT will enable eleven PhD Fellows to complete research projects in three critical areas: biomarker discovery, molecular resistance mechanisms and metabolic transformation mechanisms. This will allow for the discovery of novel insights into the molecular and cellular basis of oral and oesophageal cancer and generate new diagnostic tools and therapeutics that will improve patient response and survival. Through a number of SME/industrial partners, the PhD fellows will use next-generation technologies in areas such as cancer diagnosis, metabolism, biomarker identification and drug development. As well as attending a range of research training courses in the partner universities and in industry, the fellows will take courses in the Innovation Academy on how to commercialise research discovery.

# Dr Rachel McLoughlin Receives a Prestigious SFI Investigators Programme Award

Succesful SFI Investigators Programme awardees at the announcement.

Assistant Professor in Immunology Dr Rachel McLoughlin, in addition to six other Trinity PIs, is among 24 researchers nationwide who secured prestigious Science Foundation Ireland (SFI) Investigators Programme awards to pursue specific research projects in strategically important sectors over the next four to five years. Dr McLoughlin who leads the Host Pathogen Interactions lab group will continue the lab's work on MRSA to develop a vaccine against MRSA and related bacteria.

# Professor Luke O'Neill Collaborates in GSK Global Immunology Network

Professor of Biochemistry Luke O'Neill is one of five academics worldwide to join a new immunology research collaboration programme operated by the global healthcare company GSK.

The Immunology Network hosts global experts to set up research labs called the Immunology Catalyst, a sabbatical programme at the GSK facility in Stevenage, UK. The academic immunologists, who are predominantly focused on basic science, join GSK's world class R&D facility where they work alongside GSK's scientists while pursuing their own independent research programmes. Professor O'Neill leads the Inflammation research group.

Martijn Akveld, Director of Medical Affairs at GSK, said: "We are delighted that Professor Luke O'Neill has joined our researchers at our global R&D hub in Stevenage, UK, in 2016 and will remain an ongoing collaborator. He has played a key role in understanding the causes of arthritic disease and pain and will contribute significantly to the vibrant immunology community we are building across GSK."

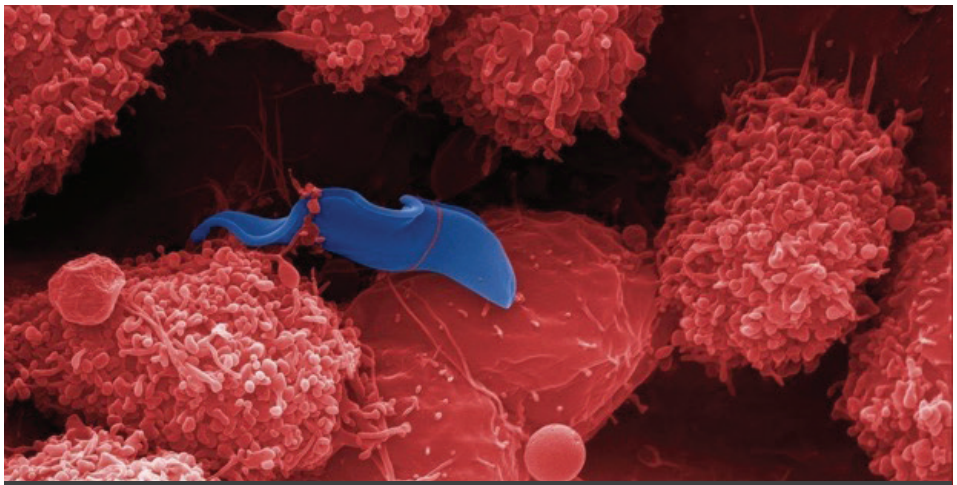
Professor O'Neill's commented: "This GSK network is a wonderfully innovative and exciting programme to be part of: it's all about working together, collaborating to generate outstanding science. By bringing in scientists who are working on frontier science, it may give rise to brand new mechanisms and insights and hopefully new medicines. It's all about collaboration in science, the possibilities of what this network together with GSK could potentially achieve and it is very exciting. I have also been able to bring with me three of my research team from Trinity to work on their basic research projects in GSK. It's a tremendous opportunity for them to develop their careers and learn new skills in GSK, as well as advance their projects."

# Solving a Putrid Camel-Pee Riddle May Aid Millions Affected by Sleeping Sickness

Dr Derek Nolan of the Molecular Parasitology group and Professor Luke O'Neill of the Inflammation research group have solved an old mystery as to the cause of especially smelly camel urine, with implications for the millions of people affected by sleeping sickness, a potentially fatal parasitic infection transmitted by the African trypanosome. Neither vaccination nor prophylactic intervention is possible and all current treatments have associated limitations that restrict their application.

The researchers identified a by-product of trypanosome metabolism called indolepyruvate. The discovery offers the possibility of developing anti-trypanosome drugs and therapies by inhibiting its production.

The group also discovered that indolepyruvate modifies the behaviour of important immune cells and prevents them from becoming fully active. Thus it has potential as an inhibitor of common inflammatory diseases.



Thousands of people suffer from sleeping sickness every year. The disease is caused by the Trypanosome parasite, which relies on the tsetse fly for transmission.

Although cases of human infection have declined recently these parasites are still a major societal burden in 36 sub-Saharan countries that are within range of the tsetse fly vector.

# Illness and Brain Dysfunction

Dr Colm Cunningham.

Dr Colm Cunningham, Assistant Professor in Neuroscience, will study the interaction between acute illness and brain dysfunction after he was awarded significant funding — a projected $1.2 million over five years — from the US Department of Health and Human Services (DHHS).

The funding, awarded by the National Institute on Aging of the US National Institutes of Health, will explore why — and how — the brain is sometimes affected by acute illness. The team will research how acute illness impacts brain function the consequences of which can be long-term cognitive impairment. Delirium is a frequent neuropsychiatric complication of acute illness in the elderly that encompasses profound disorientation and confusion. As well as being extremely distressing and often causing extended stays in hospital, it is now clear that these episodes also accelerate the onset and progression of dementia.

Although those studies will rely exclusively on mouse models, the group is also pursuing this story in elderly patients who experience acute inflammation in the form of hip fractures, as co-investigators in a collaborative project funded by Alzheimer's Research UK. Professor Cunningham commented: "These two studies can begin to piece together how acute inflammation triggers delirium and acute brain injury and to what extent this drives the progression of dementia."

## Inflazome

Dublin based start-up Inflazome successfully closed a Series A financing round for €15 million to develop treatments for chronic inflammatory diseases. Two leading life sciences venture capital firms, Novartis Venture Funds and Fountain Healthcare Partners, co-led the financing.

Inflazome is developing inhibitors of the inflammasome, a compelling biological target that regulates an innate immune response, now associated with a wide variety of diseases. Inflazome was founded by leading academics Professor Luke O'Neill, Trinity College Dublin, and Professor Matt Cooper, the University of Queensland (Australia), following a highly productive joint collaboration.

# Major Breakthrough in Understanding Inflammation

Scientists have made a major breakthrough in understanding the workings of the cellular machinery involved in a host of inflammatory diseases. They found that 'macrophage' cells, when activated, re-wire energy powerhouses called mitochondria to amplify the response – sometimes to the point that a normal bodily reaction to infection or injury is way over the top.

This elevated response is implicated in a number of inflammatory diseases, such as arthritis, inflammatory bowel disease and septic shock.

Macrophages have two jobs in the body: they must react quickly to an infection by kicking the body's inflammation response into action, and they must then depress that initial response and repair tissues that are damaged as a result.

However, the scientists found that the initial macrophage activity diverts mitochondria from their normal role of producing energy, to producing instead toxic compounds that amplify inflammation.

The scientists now hope that they can find ways of suppressing macrophages to an appropriate level, so as to reduce associated tissue damage when the body's inflammation alert status has amped up too far. The work is a joint collaboration between the Inflammation research group in Trinity, which is led by Professor of Biochemistry, Luke O'Neill, and the Medical Research Council Mitochondrial Biology Unit, Cambridge UK, which is led by Dr Mike Murphy.

It involves a major effort by nine institutions, including the Universities of Cambridge, Helsinki and Tampere, Harvard Medical School, the Medical Research Council UK Cancer Unit, Cancer Research UK Beatson Institute Glasgow and the Max Planck Institute, Germany.

# "Super" Immune System and Hepatitis C

Professor Cliona O'Farrelly.

Cliona O'Farrelly, Professor of Comparative Immunology, and her team are leading a study to discover why some people are naturally protected from HCV infection, while others are not.

In the late 1970s hundreds of Irish women were infected by Hepatitis C virus (HCV) when they were given virus-contaminated anti-D, a blood product given to women whose blood groups are incompatible with those of their baby. Anti-D prevents the mother from developing antibodies that would attack the foetus during subsequent pregnancies.

Until recently, researchers believed that receiving HCV-contaminated blood products, where high viral loads enter the blood stream directly, would lead to infection in every case. But in the aftermath of the 1977-79 outbreak, researchers made an interesting discovery: when screened for HCV almost half of the women who had received the contaminated anti-D showed no signs of infection.

The HCV resistance project funded by Science Foundation Ireland, will investigate why some women were naturally protected from HCV and showed no signs of infection.

# Next-Generation Whooping Cough Vaccines Project

Despite the availability of effective prophylactic vaccines against pertussis (whooping cough), there has been a rise in its incidence, with epidemics in Europe, Australia and the US in the last decade. Particularly problematic in vulnerable infants, and with devastating consequences in developing countries, the incidence of pertussis is also increasing in adolescents and adults, particularly in industrialised countries. It thus remains a major public health concern worldwide.

The pan-European initiative PERISCOPE sets out to accelerate improvement of prophylactic vaccines and vaccination strategies for pertussis. Professor of Experimental Immunology, Kingston Mills, and his team are part of the initiative which is funded by the EU Innovative Medicines Initiative and by the Bill and Melinda Gates Foundation.

Professor Mills' work on Bordetella pertussis has been successful in defining mechanisms of immune protection against this respiratory pathogen and will contribute to the development of new or improved vaccines against several infectious diseases, including pertussis.

# Obesity Stops 'Guardian Immune Cells' Doing Their Job

Dr Lydia Lynch of the School of Biochemistry and Immunology and Harvard Medical School studies the physiological mechanisms underlying inflammation and obesity. Her group have recently identified special guardian immune cells called Adipose Type One Innate Lymphoid Cells or ILCs, and discovered that they are unable to function properly in obesity resulting in inflammation and metabolic dysfunction. ILCs maintain the delicate balance of our immune system in normal adipose tissue by keeping other immune cells, called macrophages, in check. This function is unique as immune cells do not generally kill other healthy immune cells in non-pathological conditions.

However, when obesity becomes established ILCs are depleted and lose their regulatory killing function which results in a dangerous accumulation of macrophages.

Professor Lynch's work was recently published in the international journal *Immunity*. The findings showed that ILCs are very responsive to diet, underlining the role that healthy eating plays in our immune systems. For example, after eating a fatty diet for just five days, ILCs home in on fat cells; likewise, their numbers in blood and fat go the other way when weight is lost.

Dr Lynch believes that these cells present a new therapeutic target to prevent and control obesity-related inflammation and metabolic disease.

# 2017 ISI Public Lecture Award

Professor Andrew Bowie.

In April Professor Andrew Bowie was presented with the 2017 Irish Society for Immunology (ISI) Public Lecture Award for his contribution to the development of immunology in Ireland. In his lecture "Viruses and Us: Playing Host to the Enemy", he discussed how viruses invade our cells, how our cells are equipped to detect and thwart such an invasion.

Andrew Bowie was elected a member of the Royal Irish Academy in 2014. He is currently Head of Immunology in the School of Biochemistry and Immunology.


His main research interests are pathogen detection and innate immune signalling, and how such detection processes are subverted by viruses. His seminal discoveries have redefined our understanding of how viruses engage with human cells, and he has regularly published work in leading international journals including *Nature Immunology*, *Immunity*, *The Journal of Experimental Medicine*, *Nature Reviews Immunology* and *The EMBO Journal*.

# Interview with Alumnus – Albert McQuaid

Albert McQuaid, BA, PhD (1988)
Chief Innovation Officer, Global Taste & Nutrition, Kerry Group.

### 1. What was your childhood ambition?

Like many kids I did not really know what I wanted to do when I was young, however as I progressed through secondary school I was drawn towards technology and business. I initially planned to focus on business studies but in my leaving certificate year decided to pursue a career in science. I have always been inquisitive and like understanding how things work, however I also like to see technology applied and I believe this is where science and business overlap.

### 2. What made you decide to study biochemistry in Trinity?

The area of biochemistry and biotechnology was an emerging area of scientific research when I was considering my career choice. I felt that this had great potential and was still very much in its infancy. The choice of Trinity came from the reputation that Trinity has and the long–established quality of research that has always been done in Trinity.

### 3. What appeals to you most about your current role?

When I finished my PhD I wanted to go into industry and in particular into an industry where the results of your efforts can have a direct impact on the world around us. I was really lucky to be recruited by Kerry Group at that time. From its early days as a dairy cooperative the philosophy in Kerry has been to apply technology to generate better, more value-added products. I was taken on to focus on protein biochemistry and investigate how we could make more functional and nutritional proteins from our core dairy products that we produced in Ireland. In the last 25 years I have held a variety of roles in the company from R&D to sales to business management. My current role is as the Chief Innovation Officer for the company's Global Taste & Nutrition business. Kerry is still looking to create new and innovative products that will meet the needs of today's consumers. My role is to put in place the right infrastructure to ensure that we achieve this. It is an exciting role that brings new challenges every day and allows me to work with colleagues, companies and research institutes across the globe.

### 4. What are your strongest memories of Trinity?

My greatest memories are of the friends that I made at Trinity at both undergraduate and postgraduate levels. I also got the opportunity to travel to France while doing my PhD (I need to make a special word of thanks to Professor James Mason who made this happen) and this resulted in my spending more than 20 years living in France, meeting my wife and having three lovely Irish/French kids.

### 5. Have you any advice for students or fellow alumni?

Enjoy your years in university, it is the place where you grow up and become the person that you will be for your future. Don't be afraid to look at different career options once you finish your studies as the years in university should not prescribe your future choices. I would also strongly recommend graduates to travel to other countries, it really broadens your perspectives and it is definitely something that global companies like Kerry see as very positive.


# Remember. The power of a legacy to Trinity

There's an old saying that the true meaning of life is to plant trees under whose shade one does not expect to sit. When you leave a legacy to Trinity however big or small, you're planting a tree which will grow to provide shelter to many. You're empowering ground-breaking research which will benefit people in Ireland and all over the world. You're supporting students from all backgrounds to access a Trinity education. You're helping preserve our unique campus and heritage for new generations.

When you remember Trinity in your will, you join a tradition of giving that stretches back over 400 years – and reaches far into the future. For more information about leaving a Legacy to Trinity, please contact Carmen Leon.

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E. carmen.leon@tcd.ie
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## Get Involved

Trinity has a long tradition of outreach and community engagement. To find out about the numerous ways you can get involved with Trinity both at home and abroad, please visit www.tcd.ie/alumni/volunteer

## Upcoming Alumni Events

Alumni Weekend
25-27 August 2017

Other Events
www.tcd.ie/alumni/news-events/events/

## Class Notes

Do you have any news or updates that you'd like to share with your fellow alumni? Submit your news with an image, subject of study and year of graduation to alumni@tcd.ie. For more information please visit https://www.tcd.ie/alumni/news-events/publications/class-notes.php

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