

Program and Abstracts

An Alexander von Humboldt Kolleg on
“Our changing world in the South Pacific”

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MINISTRY OF BUSINESS,
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HĪKINA WHAKATUTUKI



Friday, 17 November

1400–1500 Registration

1500–1540 Official opening of Kolleg with remarks by:

- Chairs of the Australian and New Zealand Humboldt Alumni Associations
- Katrin Amian, Humboldt Foundation, Bonn
- Paul Stocks, Deputy Chief Executive MBIE
- Gerhard Thiedemann, German Ambassador to New Zealand.

1545–1630 Distinguished Professor Dame Anne Salmond (Auckland): Exploring Science in the Pacific

1645–1715 Dr Dave Lowe (MBIE Coordinator for New Zealand – Germany Science + Innovation Relationship): The Science and Technology agreement 40 years on: A model for cooperative success between countries

1730–1800 Professor Christopher Kellett (Newcastle): Valuing greenhouse gas emissions: Models and methods for the social cost of carbon

1900–2100 Reception hosted by German Ambassador at his residence

Saturday, 18 November

- 0900–0930 Professor Kai Matuscheski (Humboldt University): Crossing boundaries: a joint Australian-German PhD program on malaria research
- 0935–0950 Professor Murray Hamilton (Adelaide): The makeup of Southern Ocean Clouds
- 0955–1010 Dr Jeroen Schillewaert (Auckland): Exceptional symmetries and their applications
- 1015–1030 Professor Murray Cox (Massey): The Past and Future of Genomic Health in the Pacific
- 1030–1100 Morning tea
- 1100–1130 Professor Laura Parry (Melbourne): Enhancing research translation from knowledge gained through scientific investigation
- 1135–1150 Professor Nail Akhmediev (ANU): Extreme events and their mathematical description
- 1155–1210 Professor Peter Lockhart (Massey): Science for Sustainability in Oceania
- 1215–1400 Lunch
- 1400–1415 Professor Nicola Gaston (Auckland): Putting the humanity(ies) in science
- 1420–1435 Dr Peng Du (Auckland): Gastrointestinal Electrophysiology in Digestive Health and Disease for Aging Societies
- 1440–1455 Melanie Ridgway (ANU): Why a cure for malaria isn't enough
- 1500–1515 Dr David Eccles (Malaghan Institute): Private Sequencing in a Public World: the disruptive reality of nanopore sequencing
- 1515–1530 Dr Anita Perkins: Mobility and German Travel Writers of the Saddle Period
- 1530–1600 Afternoon tea
- 1600–1630 Professor Juliet Gerrard (Chair of Marsden Council of New Zealand): How do we support “blue sky” research against relentless commercial pressures?
- 1630–1700 Dr Katrin Amian: Introduction to Humboldt Programs
- 1700–1730 Professor Gerold Schneider (Hamburg University of Technology): Bioinspired hard and damage tolerant materials
- 1900–2200 Dinner at ICON Te Papa, including presentation by Professor Kate McGrath, Deputy Vice Chancellor (Research) of VUW: “Can PBRF, international rankings and talk of impact be good for research?”

Sunday, 19 November

- 0900–0915 Professor Jeff Malpas (Tasmania): On Thinking in a Thoughtless Time
- 0915–0930 Dr Anna-Sophie Jürgens (ANU): Knowledge Credibility in Fiction
- 0935–0950 Professor Allan Bretag (University of South Australia): The German contribution to the development of the Intracellular Glass Micropipette Electrode
- 0955–1010 Dr Paul Jerabek (Massey): Is Element 118 a Rare Gas or not?
- 1015–1030 Professor Tim Mehigan (Queensland): Ethics and Literature: The Case of J.M. Coetzee
- 1030–1100 Morning tea
- 1100–1130 Professor Zoya Ignatova (University of Hamburg): Viewing diseases through translational lens
- 1135–1150 Dr Glen Wheeler (Wollongong): Curvature flow, blood cells, and bushfires
- 1155–1210 Professor Motohide Miyahara (Otago): Empathy, Disability, and Accessibility
- 1215–1230 Dr Gabrielle McMullen (Mary Aikenhead Ministries): In memoriam of Dr. Heinrich Pfeiffer
- 1230–1400 Closing remarks followed by lunch and General Meetings of Humboldt Fellows Associations

Abstracts for lectures and posters

Extreme events and their mathematical description

Nail Akhmediev

Australian National University

Extreme events happen in nature, in social life and in finances. For example, one of the forms of oceanic extreme events is known as rogue waves. The concept is presently expanding into optics and other branches of physics. In order to understand and describe extreme events, a suitable mathematical apparatus must be developed. Extreme deviation of variables from their normal values requires this description to be nonlinear. The simplest way of thinking about extreme events is considering the motion of continuous media such as water or atmosphere. This approach allows us to find special solutions of wave dynamics that describe extreme deviations from average state. These type of solutions are presented in this talk.

The German Contribution to the Development of the Intracellular Glass Micropipette Electrode

Allan Bretag

University of South Australia

Glass micropipette electrodes have enabled us to understand the innermost workings of the brain, to show how individual nerve cells can excite or inhibit other cells and to explain how defects in this communication can give rise to conditions ranging from epilepsy to paralysis. Ida Hyde, born in 1857 in Davenport, Iowa, USA, to German immigrants, undertook a doctoral degree at Heidelberg, and became the first woman to graduate Dr. rer. Nat. in 1896. Back at the University of Kansas, in 1921, she pioneered the use of micropipette electrodes to stimulate living cells. At about the same time, Tibor Péterfi, in Berlin, used similar electrodes to make the first electrical measurements in Amoeba. Subsequent to this, parallel studies in the USA and by Germans and Austrians, particularly Josef Gicklhorn and Karl Umrath, found these electrodes being used to stimulate both plant and animal cells and to measure electrical activity in them. This culminated in the work of John Eccles and his colleagues, on neurones, in Dunedin, NZ, from 1951; Eccles later winning the Nobel Prize for his work.

The Past and Future of Genomic Health in the Pacific

Murray Cox

Massey University

Biologically and culturally, we all reflect the choices and challenges of our ancestors. This holds equally true in the Pacific, where – just like all of us – health care concerns of Māori and Pasifika often reflect a disparity between the environments of today and the environments of our past. At least some of these health issues have a genetic component. While genomic health is moving apace globally, benefits are increasingly restricted to individuals with European ancestry. This talk will discuss how a new initiative, Genomics Aotearoa, is hoping to address disparities in genomic health research in New Zealand. Importantly, these plans place Māori and Pasifika at the helm, rather than merely coming along for the ride.

Gastrointestinal Electrophysiology in Digestive Health and Disease for Aging Societies

Peng Du

University of Auckland

The contractions of the gut are a key physiological mechanism of a healthy digestive system. Like the heart, the motility of the gut is governed by an electrophysiological event called slow waves. Degradations in the gut electrophysiological pacemaker cells due to aging and diseases present a major avenue of research of many challenging chronic digestive conditions. Furthermore, management of gastrointestinal slow waves through electrical stimulation could also be used as potential therapeutic options of obesity. Our research highlights the breakthrough in in-vivo extracellular mapping techniques of slow waves developed in New Zealand, and ongoing collaborations with Mayo Clinic (USA) and Fraunhofer IZM (Germany). Implications for gastrointestinal clinical practice will also be discussed.

Private Sequencing in a Public World: the disruptive reality of nanopore sequencing

David Eccles

Malaghan Institute

The pocket-sized Oxford Nanopore MinION is unique among DNA sequencing technology, in that it is the only commercially-available technology that doesn't rely on base-pairing in order to derive a DNA sequence. Instead, sensors detect subtle changes in the electrical properties of bases, observing single strands of DNA (and RNA) as they pass through a nanopore.

The disruptive nature of this new sequencing technology means that there is plenty of scope for new research and analysis. In addition, the MinION is competitively priced to be accessible for the general public, with similar reagent costs, but a capital cost that is hundreds of times less than the existing established technology. As such, the barriers to its widespread introduction to the world are largely social, rather than financial.

Affordable, portable sequencing makes it possible for organisations and individuals to have control over their own privacy and carry out their own genetic studies, without requiring their samples or data to ever leave them. At the same time, the enhanced ability for controlled, public sharing of data and code allows technological advances made and shared by a few people to benefit everyone.

Observations of Environmental Changes in the Antarctic Region

Trevor Finlayson

University of Melbourne

In quite different ways, “colonial settlement” and “global warming” have had quite different consequences for the Antarctic environment. Some of these consequences will be considered. Measures taken in recent years to restore the environment in both the Antarctic and Sub-Antarctic-Island regions will be outlined. Unfortunately, the ongoing adverse effects of “global warming” on the continent and its surrounding waters continue; details of this will be illustrated.

Putting the humanity(ies) in science

Nicola Gaston

University of Auckland

The 1959 Rede Lecture of CP Snow, “The Two Cultures” has framed conversations about the relative value of the humanities and sciences for half a century. In recent decades, insistence on the practicality of scientific training has often strengthened tropes about the utilitarian nature of education, and its personal benefit to the individual, in ways that continue to undermine understanding of both research in the humanities, and in curiosity-driven science. The importance of objectivity in scientific research has been subverted to imply that scientific research is somehow objectively better, and the value of subjectivity - of understanding other cultures, other people, other times, the value of our differences and our diversity - has been systematically denied.

In this talk, I will provide some examples of scientific research – in particular within nanotechnology and physics – that has been impoverished by the continuing cultural hegemony within science, and discuss the ways in which our changing world in the south pacific might empower us to let go of this outdated narrative.

The makeup of Southern Ocean Clouds

Murray Hamilton

University of Adelaide

There is a large international effort underway to understand better the clouds over the Southern Ocean. This is motivated primarily because meteorological models are not predicting correctly the general cloudiness, or the amount of super-cooled liquid water in the clouds. This is a source of uncertainty in climate modelling and Southern Hemisphere weather forecasting, which arises primarily, we believe, because the microphysical properties of clouds (such as particle shape, and aerosols) are not taken properly into account. Remote sensing and in-situ measurements are necessary to constrain the models and any improvements that are made to them. These measurements are from satellites, the ground, ships, aircraft and balloons. In this talk I shall describe the measurement campaigns that are underway, or starting this summer, south of Australia and New Zealand.

How do we support “blue sky” research against relentless commercial pressures?

Juliet Gerrard

University of Auckland

I will explore how the recent significant increase to the Marsden fund – New Zealand’s principal source of funding for investigator-led research – came about. I will also reflect on how its core purpose has been protected in an era which focuses on impact.

Viewing diseases through translational lens

Zoya Ignatova

University of Hamburg

Several human pathologies are traditionally viewed as a mutation-driven failure of one or many protein(s) function. Protein synthesis in the cell is a multilayered process including transcription of the genetic information within DNA into messenger RNA, translation of the nucleotide code into peptide code and folding to mature functional protein that conveys a physiological activity. Translation has been seen as an obligatory intermediate with little to no effect on the final function of a protein. Using various high-resolution methods to measure translation fidelity and speed we show that translation plays a critical role in modulating disease severity. Moreover, some mutations counteract the devastating effect of a main mutation by fine-tuning translational velocity.

Is Element 118 a Rare Gas or not? How to Predict Properties of Elusive Elements with Highly Accurate Computational Methods

Paul Jerabek

Massey University

Many heavy and superheavy elements are inaccessible for precise experimental measurements. For example, we have no reliable melting temperature for the radioactive rare gas radon and for the heaviest member of the periodic table, element 118 (oganesson), it is questionable if there will be ever an experimental setup sophisticated enough to study even the most basic atomic and molecular properties. However, with state-of-the-art methods it is possible to compute the electronic structure of atoms with high accuracy, incorporating the effects of Einstein's Theory of Relativity, which are crucial for the heaviest elements. From these calculations, properties like chemical reactivity or bulk melting temperatures can be reliably predicted and reveal, among others, the outstanding position of oganesson as a chemical element.

Knowledge Credibility in Fiction. Literary non- and con-scientists and science ringmasters in the spotlight of a "post-truth" world

Anna-Sophie Jürgens

Australian National University

In fiction, testable, tested, catalogued, and evidence-based scientific knowledge may be shaken up by ambivalent scientist-protagonists, including non- and con-scientists and scientist-ringmasters. These are creative, skilled craftspeople – science-'imagineers' reminiscent of artists – who experience distrust in and ignorance of their 'data', information and scientific research not only because they creatively invent them . . . By exploring these characters in contemporary Australian novels, we investigate the questioning of scientific evidence, information and research in relation to creative imagination. I argue that Literary Studies may play an essential role in contextualising, defining, and thus better understanding mistrust in scientific research and the threat of knowledge credibility in the 'post-truth' era in which we currently live.

Valuing greenhouse gas emissions: Models and methods for the social cost of carbon

Christopher Kellett

University of Newcastle

It is well-known that anthropogenic greenhouse gas emissions are driving dangerous climate change. This has been referred to as “the greatest market failure the world has seen”, primarily due to the fact that emitters typically do not pay for the damage their emissions cause. Several recent reports have come to the conclusion that the most effective way to tackle emissions is to place a price on them and, increasingly, companies, international finance organisations, and governments use an internal carbon price in various ways. In this talk, I will discuss what constitutes a “science-based price on carbon” and indicate ongoing work in improving estimates of the so-called Social Cost of Carbon.

3D printed mounts for crystal structure analysis

Nathan Kilah

University of Tasmania

Additive manufacturing, commonly known as 3D printing, has gained considerable recent attention, and represents a significant challenge to the future of global manufacturing and supply chains. Laboratory equipment is a relatively boutique component of the manufacturing sector, with associated high costs, and there is significant appeal in the in-house production of bespoke apparatus. In this presentation I will outline our approach to adapting 3D printing technologies for the micrometre scale preparation of custom integrated mounts for the analysis of single crystals, including salts, small molecules and even proteins. Our simple apparatus is made at a fraction of the cost of the commercially available equipment (excluding the cost of the 3D printer), and is among the smallest positive feature 3D printed apparatus applied for routine laboratory analysis.

Science for Sustainability in Oceania

Peter Lockhart

Massey University

We recently established a UNESCO UNITWIN network – Science for Sustainability in Oceania. I will describe this initiative, the projects underway, and investigate whether other Humboldt Fellows would like to be involved.

Germany/New Zealand Science and Technology agreement 40 years on: A model for cooperative success between countries

Dave Lowe

Coordinator New Zealand – Germany Science + Innovation Relationship

In 1977, the NZ and German governments signed an agreement to support science projects between the two countries. This led to a remarkable success story in joint NZ/German science showing the ability of Wissenschaft or knowledge to help break down barriers and build bridges between countries. Here I describe key factors in this success.

Superconductor sandwiches: when mad ideas pay off

Ben Mallett

University of Auckland

We had a mad idea to make these things I call superconductor sandwiches. Superconductors are spectacular materials that have zero resistance to electricity. This makes superconductors uniquely useful; e.g. as powerful electro-magnets or the next generation of wind-turbines, and maybe in the future for quantum computers or the link moving electricity from solar-panels in the Sahara to Europe!

But we're not entirely sure how our best superconductors work. There are still fundamental physics questions to answer – which would help us to improve further the superconductors properties. Our idea was that, by sandwiching the superconductor between a specific magnetic-material, we could improve its properties. The idea was somewhat mad because magnets are almost always bad news for a superconductor. Despite knowing this, we tried it anyway – and to our great surprise, we discovered effects much more interesting than we had planned for.

On Thinking in a Thoughtless Time

Jeff Malpas

University of Tasmania

As it is a form of thinking, and an especially significant form at that, the question of the contemporary value and significance of philosophy cannot be asked apart from the question of the value and significance of thinking itself. Yet as Martin Heidegger argues, ours seems to be a time in which we are “in flight from thinking” – a time in which, if thinking is seen as valuable and relevant at all, it is only to the extent to which it serves an instrumental purpose – usually a purpose construed in monetary or commercial terms. Such monetized instrumentalism is deeply problematic, not only because of the way it corrodes any real sense of value or undermines even the idea of the instrumental as such, but because of the way it brings with it a loss of any real sense of limit or bound. It is just such a sense of limit or bound that is central to thinking, and so the contemporary “flight from thinking” can also be understood as a flight from limit or bound. Moreover as thinking finds its own bound, as well as its ground, in truth, so the flight from thinking is also a flight from truth, and a flight, too, from our own humanity.

Crossing boundaries: a joint Australian-German PhD program on malaria research

Kai Matuscheski

Humboldt University, Berlin

Malaria remains the most important vector-borne infectious disease and is caused by parasitic single cell eukaryotes of the genus *Plasmodium*. Despite substantial control and research investments malaria containment remains a major medical task in the 21st century, including in the Australasian ecozone. The complex challenges in disease dynamics and parasite-host crosstalk require researchers who can collect and analyze information from multiple life science disciplines immunology, cell biology, pharmacology, epidemiology, vector biology, and more. They then need to translate those findings into transformative ideas for medical products and innovative control strategies. Herein, ideas that were developed by a malaria research alliance between the Australian National University and Humboldt University will be presented. An international research training program can contribute to performing cutting-edge malaria research in a truly global partnership and will prepare the next-generation scientists to solve complex problems and navigate international collaborations. Academic cooperation on a persistent global challenge can bridge continents and strengthen the science-policy interface for disease control and public health.

Ethics and Literature: The Case of J.M. Coetzee

Tim Mehigan

University of Queensland

What do we mean when we talk of the truth of literature? How could a Romantic writer once claim that the cultivation of beauty and the search for truth are essentially the same thing? Is this claim still current? Above all, is it accurate?

The Nobel-prize winning author J.M. Coetzee, for whom truth is at bottom ethical truth, presents as a case in point. Coetzee's works, from this angle, can be read as the attempt to prove the contention that literature remains one of the most effective paths to ethical thinking for human beings today. Literature and ethics come together, Coetzee claims (a claim that must be reconstructed from his fiction and other statements), when literature reveals ethical truth to be an independent force in the world – moreover, a force that cannot be dismissed, overlooked or easily put aside.

I examine briefly some difficulties that attend this project, even as I also express sympathy for the underlying view of literature it defends and the plausibility of premises argued on the basis of an aspirational alignment between the core concerns of ethics and the basic goals of imaginative literature.

Empathy, Disability, and Accessibility

Motohide Miyahara

University of Otago

My presentation discusses my recent collaborative studies on empathy, disability and accessibility. Our research started with a qualitative interview study about accessibility for physical activity with a range of stakeholders, including people with long-term mobility impairment, service providers, funders and providers in New Zealand. We identified empathy as the key attribute which could drive our society towards accessibility and inclusion. Subsequently, we developed, piloted, and validated an assessment tool to measure empathy concern for disability and accessibility, and we are applying the assessment tool in cross-cultural and intervention studies to evaluate the adequacy of disability training.

Collective Decision-making under Ambiguity

Addison Pan

University of Auckland

We investigate the impact of ambiguous information structure on the quality of collective decision-making, given different voting rules and non-standard Bayesian updating methods. We also study the effects of embedding ambiguous information to static, finite games of incomplete information with unmediated communication. We intend to characterize the solution concept of sequential equilibria of cheap talk extensions under ambiguity. In addition, we want to test the set of equilibrium outcomes of such a game in experiments.

Enhancing research translation from knowledge gained through scientific investigation

Laura Parry

University of Melbourne

Many scientific discoveries, which have led to a better understanding of human disease, originate through years of incremental research at our universities and research institutes. Babies born small are at increased risk of developing obesity, diabetes and cardiovascular disease later in life. Decades of research have identified that fetal growth restriction largely results from disruption to placental function. Similarly, babies born prematurely because their mothers have developed life-threatening hypertension during pregnancy are also at increased risk of disease later in life. Through scientific investigation, we have identified potential drugs and treatments for placental insufficiency and pregnancy-induced hypertension. However, there are currently very few opportunities for scientists to translate their research and progress their discoveries to market and/or clinical practice. In this talk, I will provide an overview of the challenges facing university academics regarding research translation, and then present some new approaches including partnerships with industry and entrepreneurial activities.

Ambulatory Gastric Mucosal Slow Wave Recording for Chronic Experimental Studies

Nira Paskaranandavadivel

University of Auckland

Dysrhythmic bioelectric slow wave activity have been implicated in major functional motility disorders such as gastroparesis and chronic unexplained nausea and vomiting, but its correlation to symptoms is still unclear. For patients with severe gastroparesis, high-frequency gastric stimulation is offered as a therapy in some centers. Temporary gastric electrical stimulation has also been proposed an approach to screen patients who would benefit from the implantation of a permanent stimulator. In this study we introduced novel methods for recording slow wave activity from the gastric mucosa during the entire temporary stimulation phase of 5 days, in 3 patients. An ambulatory recording system was applied to record 3 channels of mucosal slow wave activity, as well as three axis accelerometer data to monitor when the patient was mobile. Techniques were developed to detect large movements and these time periods were excluded from analyses of mucosal slow waves. The frequency and amplitude of the slow waves was calculated in a 5 min segment, with 75% overlap, for the entire duration. In feasibility studies, the slow wave frequency and amplitude for the patients were 3.0 ± 0.96 cpm and 1.43 ± 1.75 mV. Large variations in slow wave amplitude were seen in comparison to slow wave frequency, which were concordant with previous studies. The use of the ambulatory system will allow for investigation of pathophysiology, correlation of electrophysiology data to patient symptoms and to determine the effects of post-prandial and nocturnal slow wave patterns. We anticipate that future use of slow wave information alongside patient symptoms will allow improved selection of patients for stimulation techniques.

Mobility and German Travel Writers of the Saddle Period (1770-1830)

Anita Perkins

How does the experience of travel transform culture over time? This is the question at the heart of a book based on my PhD, "Travel Texts and Moving Cultures", which brings together two main areas of scholarship: the cultural analysis of German literature and film and the emerging field of mobilities studies. This presentation focuses on the mobile experiences recounted by writers in a significant period of social change, coined by Reinhard Koselleck as, "the saddle period" of 1770-1830. One example is Georg Forster's *A Voyage Round the World* (1777), which recounts the young German scientist's journey to New Zealand with Captain Cook. I draw on travel text examples to look at

how mobile experiences were conveyed with reference to transformations in technology, education and culture, and how in the saddle period, a culture founded on mobilities and a desire for travel emerged.

Why a cure for malaria isn't enough

Melanie Ridgway

Australian National University

Would you save your own life if it meant putting the lives of others at risk? Current treatments for malaria increase the likelihood of spreading the deadly disease. Malaria is caused by parasites that induce fevers, coma and death. To infect another human host, the malaria parasite transforms into innocuous male and female gametocyte-stage parasites that are ingested by a mosquito. Current antimalarial drugs kill symptom-inducing parasites, but also trigger the switch to gametocyte-stage parasites, eventually leading to the spread of malaria to others. Our current knowledge of gametocyte biology is derived from studying predominantly female gametocyte populations. We compared male and female gametocyte lipids - molecules that form the protective membrane surrounding the parasite and vital energy reserves. Based on this information, we can design antimalarial compounds to disrupt the membrane and deplete the parasite's energy reserves. Lipids are the malaria parasite's soft spot that could be targeted by antimalarial drugs to both relieve disease symptoms and block transmission to others.

Exploring Science in the Pacific

Anne Salmond

University of Auckland

From the first scientific expeditions to the Pacific to the present, scientists have at once described and participated in cross-cultural encounters with Pacific peoples. We briefly discuss these encounters, and explore new ways of thinking that might arise from exchanges between different knowledge systems.

Exceptional symmetries and their applications

Jeroen Schillewaert

University of Auckland

The five Platonic solids and their symmetries have fascinated people for at least 2000 years. In higher dimensions exceptional symmetries occur, the most elusive one is E_8 in 248 dimensions. At the heart of these symmetries are slightly esoteric algebraic structures, the quaternions and the octonions. I will give an overview of these objects and their applications in adjacent fields such as theoretical physics, computer graphics, and robotics.

Bioinspired hard and damage tolerant materials

Gerold Schneider

Hamburg University of Technology

Biological materials are bottom-up designed hierarchical and multifunctional materials systems, exceptionally strong and damage tolerant. Enamel or nacre are just two examples how this principle is used to structure hierarchical nanocomposites from nanoscale hard mineral and soft organic building blocks. Guided by these natural examples we use a combination of self-assembly and conventional processing methods to manufacture macroscopic nanocomposites based on iron oxide and carbon acids as molecular linkers. A key feature for the successful development of these nanocomposites is the bonding of the organic molecules to the hard mineral nanoparticles and the control of bonding between the organic molecules. The talk presents the processing of the nanocomposites, their nano- and microstructure as well as their exceptional mechanical properties. The objective is to develop a strategy how a toolbox of nanoparticles and organic molecules can be used to synthesize nanocomposites with tailor made mechanical properties.

Curvature flow, blood cells, and bushfires

Glen Wheeler

University of Wollongong

New advances in the field of geometric analysis have enabled exciting new applications. This talk explains two of these applications. The first is to bushfires: conventional wisdom models an evolving fire front by Huygen's principle, which is known to be inaccurate in a variety of ways. One of these is for a wedge-shaped front. By comparing theoretical results with observed fires and experiments in fire tunnels, we show that by using a model that incorporates curvature, a more realistic evolution is obtained.

The second application is to the shape of red blood cells, in particular human red blood cells. Spherocytosis, the most common form of inherited anaemia in people with northern European ancestry, is a disease of the blood where blood cells assume a spherical shape. This is a serious condition that can be fatal, with the typical case requiring a lifetime of treatment. As blood cells are self-organising, it is possible to derive an equation that the shape satisfies. By investigating this equation, we can determine why blood cells are forming as spheres. Current results are preliminary, but indicate that this exciting new avenue has a lot of potential for new treatments and in the long-term a possible cure.

Counting faces of polyhedra

David Yost

Federation University

DMY Sommerville, who worked in Wellington from 1915 to 1934, was one of the early pioneers of higher dimensional geometry. I will focus on one aspect of his work, the relationships between the numbers of faces of different dimensions of a polyhedron, and my own contributions to this topic.