

Tackling global challenges

St Andrews has been making strides in its aim to outperform the UK sector on research impact, despite its comparatively small size. In the last Research Excellence Framework assessment, for impact St Andrews came top in the UK for Geography and Environmental Sciences, second for Biology, and in the top five for Management, Classics and English. Intellectually vibrant work is carried out here with a strong record of close collaboration between disciplines.

One important contribution is to support cutting-edge research that addresses the challenges faced by developing countries. As part of the UK Government's £1.5 billion fund, the University has attracted support from the Scottish Funding Council's Global Challenges Research Fund for the last two years. The initiative enables UK scientists to take the lead in addressing the problems faced by developing countries, whilst delivering cutting-edge research. It provides a unique opportunity to build a global community of researchers committed to sustainable development and the eradication of poverty.

Following on from the success of the previous years, St Andrews has secured £809,000 for 2018-2019 from the fund. As a result, last September the University established the St Andrews Global Challenges Forum, led by Professor Nina Laurie from the School of Geography & Sustainable Development. The Forum also comprises Professor Derek Woollins, Vice-Principal (Research and Innovation) and a team of nine academic champions from the sciences, social sciences and arts and humanities. It also benefits from an external Advisory Group of seven government, charity and National Academy stakeholders.

The Forum aims to develop strong and enduring partnerships between the University and developing countries to enhance the research and innovation capacity of both and to deliver substantial impact on improved social welfare, economic development, and environmental sustainability. A measure of success will be that each programme has a legacy beyond the initial funding investment period.

The University has identified three priority areas to receive support: Energy and innovation, Global health and inequality, Sustainability and environmental change.

In addition, the University aims to support up to nine PhD Global Challenge studentships (three per theme) with an emphasis on international students from around the globe, taking a long-term view towards relationship building with those countries. This scheme builds on one

of the University's most ancient traditions, that of attracting the best minds from every corner of the globe to this historic and dynamic intellectual corner of Europe.

Some of the projects which have received support from the Global Challenges Research Fund are featured in the next three pages beginning with one particularly successful research project by Professor Gillespie.



Professor Stephen Gillespie, School of Medicine

The worldwide application of a University of St Andrews innovation – tackling antimicrobial resistance in TB



The International TB conference in St Andrews with Professor Stephen Gillespie (third from right)

According to the World Health Organisation's *Global Tuberculosis Report 2017*, tuberculosis (TB) is the leading cause of death from infectious disease. Its incidence is even higher than HIV/AIDS, which is why we urgently need new tools to overcome it.

To tell whether a patient is responding or to test the effectiveness of new TB drugs, one must be able to count the number of live *Mycobacterium tuberculosis* from the patient's lungs. The current culture-based tests take up to eight weeks and require expensive containment facilities beyond the means of most health facilities in regions where the disease is common.

Since 2010, Professor Stephen Gillespie and his team have been developing a new biomarker for TB, the Molecular Bacterial Load Assay (MBLA) test that can diagnose and quantify live TB in four hours and have tested it in a large-scale trial

in four African centres. They are working with LifeArc, a product development charity, towards certification, the crucial step to allow the test to be used for patient diagnosis.

Professor Gillespie's team hosted an international forum in St Andrews in June 2018 to explore how to make the test available to TB control programmes worldwide. Stakeholders from 16 countries in Africa, Asia and Europe, participated in two days of hands-on training and a one-day conference to explore how to translate the test into clinical practice.

Keynote speakers included representatives from organisations WHO, LifeArc, the Foundation for Innovative New Diagnostics (FIND) the Pan-African Consortium for the Evaluation of Anti-tuberculosis Antibiotics (PanACEA Consortium) and clinicians from TB high-burden countries. The key development questions were

formulated and the conference proceedings will be published soon in the *East African Science Journal* – an accessible journal for potential MBLA users and policy makers. In WHO's *Global Tuberculosis Report 2018*, the MBLA was included as a promising new test for treatment monitoring.

This research project has had three key outcomes:

- The development of the TB MBLA test will allow researchers to detect and quantify all TB bacteria in four hours rather than eight weeks.
- The test therefore has the potential to save the lives of hundreds and thousands of the one million people killed each year by TB.
- It will simplify treatment decisions and reduce the cost for health services, researchers and pharmaceutical companies when making decisions about treatment.

Michael Dalrymple, Executive Director, Diagnostics & Science Foresight at LifeArc is eager to work with the University of St Andrews in order to "progress the assay from research use to a stage where more patients can benefit from its application. Millions of people contract TB every year. With an appropriate diagnostic, patient treatment and recovery should be much improved."

Professor Stephen Gillespie highlights the importance of the test: "For the first time, the MBLA allows healthcare workers to diagnose tuberculosis and to monitor the response to treatment rapidly. Its speed empowers those looking after TB patients to make better treatment decisions that can translate to better outcomes."

Professor Kathryn Rudy, School of Art History

Sustainable futures for international craft traditions



Weaver making dhaka (a plain weave cloth with colourful extra weft, typical of eastern Nepal) on a treadle loom, outside Kathmandu

The focus of Professor Rudy's project was to build a network for empowering traditional artisans to sustain their own cultural heritage by increasing their own creative capacity and developing an appropriate market for artisan-designed work.

For five months last year, Professor Rudy travelled together with Judy Frater, the Founder Director of the Somaiya Kala Vidya (SKV), which is a successful design school for artisans in the desert region of Kutch, India. Together they travelled to several locations around India to meet community leaders and interview traditional artisans. One goal was to meet potential partners for expanding SKV's successful model into these areas. Using an artisan-to-artisan peer mentoring approach, SKV emphasises the importance of design education in increasing the value of craft traditions, building the capacity of artisans, and raising the socio-economic status of artisan communities.

Of these regions, they found two where the model would work: one in the Himalayas and the other in Rajasthan. They developed projects with Avani in Uttarakhand, which is a community

built on the principles of sustainability and local empowerment. Fusing traditional techniques with sustainable technologies, Avani's farmers and artisans produce exquisite, one-of-a-kind textiles, art supplies and lifestyle products.

The other location was the Barefoot College in Rajasthan, which connects rural areas to help them and individuals take control of their lives and the wellbeing of their communities.

Two successful weavers from Kutch were sent to take part in an artisan-to-artisan training programme with the weavers at Avani. The Kutch weavers were able to help the Avani weavers find old cloth samples that represented a nearly lost local tradition, and to adjust these old designs for an urban market.

Finally, the project formed the basis of an initial scoping exercise toward a major humanities-based Global Challenges Research Fund bid which is currently being considered.

Dr Tim Raub, School of Earth & Environmental Sciences

Understanding drought cycles across South-Central Africa



Mulanje hydroelectric power plant

Dr Raub's team has been utilising the drought-resistant properties of the Mulanje cedar (*Widdringtonia whytei*), the national tree of Malawi, to add further information to the hydrological database to provide an Indian Ocean monsoon failure record covering the past century.

The Mulanje cedar is the longest growing pine endemic to Mulanje Mountain in the south of the country, but this 'cloud forest' pine is endangered by illicit harvesting for off-grid biomass burning. Mulanje Mountain is the centre for Malawian eco-tourism, and so conservation of this drought-resistant tree is critical to sustain that economic stream.

The reduction in the number of trees has resulted in a loss of income for the communities living around the mountain, and they have experienced floods and soil erosion due to rapid water run-off from the mountain during the rainy season. Together with local forestry officials, Dr Raub's team has been using non-destructive coring methods on the cedar trees to assess the past climate signatures. It is anticipated that this information can help forecast environmental risk for the future, which will enable the Malawi government to build resilience into their growing strategy of providing energy through hydroelectric power.

Crucial to the work is the team that Dr Raub has assembled which includes economists, agribusiness entrepreneurs and industry partners. This allows for research on not only the science but also the market and social dynamics behind energy solutions. An example of a community-scale hydroelectric project is under study in the south of the country. Here, at the MEGA Hydro project near Phalombe, an 80-megawatt plant is under construction in a sensitive area where most illicit Mulanje cedar harvesting takes place. Ensuring the future of this scheme will not only give the benefit of an abundant clean, renewable energy supply but hopefully will also ensure a future for the threatened environment.

Dr Jaremei McMullin, School of International Relations

Motoring from war to peace: understanding long-term reintegration trajectories of ex-combatant youth in Liberia's motorcycle taxi unions



Commercial motorcyclists at work on the streets of Goma City, northern Liberia

Dr McMullin's primary research interest is post-war transition and reintegration of ex-combatants, particularly within African states. He researches the disarmament, demobilisation, and reintegration of those who have been involved in war.

Last year, Dr McMullin carried out a research field trip to Liberia to interview ex-combatant youth, demobilised soldiers, and conflict-affected youth who are engaged in the commercial motorcycling transport sector there. He interviewed over 100 motorcycle taxi drivers across several parking lots in cities and towns

in Liberia. "A lot of people inside and outside of Liberia have tended to see motorcycle taxi drivers as evidence that reintegration in Liberia hasn't worked, because they just see former combatants hanging out together and they view the industry as a place where violence happens", Dr McMullin said. "This research challenges those views and shows how thousands of Liberia's young people are using motorcycling not just to survive but to generate economic and educational opportunities and build social relationships that are essential to peace and reintegration."

The project supported relationship building with the Commercial Motorcyclists Union of Liberia, who identified that key research findings helped to counter the stigmatisation and marginalisation of post-war youth. In addition, Dr McMullin presented preliminary research to international donors and organisations to advocate for educational scholarships and community safety workshops for the cyclists.

Dr McMullin, with assistance from a Liberian non-governmental organisation, the Platform for Dialogue and Peace, will facilitate additional conversations with cyclists about their economic, social, and political contributions to peace. The research also resulted in a commissioned policy report for the UN Department of Peacekeeping Operations to inform future sustainable reintegration support for ex-combatant youth.

Dr Juliana Bowles, School of Computer Science

Global solutions for managing medications for patients with multiple long-term health conditions



L-R: Carlos Eduardo Raymundo (Public Health, Federal University of Rio de Janeiro), Adelson Jantsch (GP and Director of the Family Medicine Residency Program at the Rio de Janeiro Health Department), Diana Portela (GP, Rio de Janeiro), Marco Caminati (Computer Science, St Andrews), Juliana Bowles

Dr Bowles works on automated verification techniques and is currently using them predominantly in healthcare to detect and resolve problems in polypharmacy (the concurrent use of multiple medications by a patient), avoiding inappropriate drug therapies, and suggesting alternatives that guarantee medication safety and suit individual patients and their preferences better.

Dr Bowles and her team also explored the suitability of the techniques to improve healthcare processes and recommendations in Brazil. Long-running recessions with continuous budget cuts and political upheavals in Brazil have meant that a large part of the general population is unable to get access to basic healthcare, with considerable effects for patients with long-term conditions.

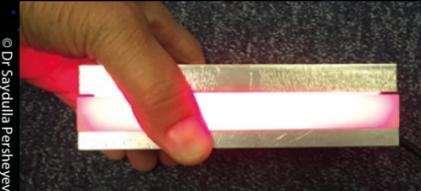
She gave a lecture on her techniques to young GPs in training in Rio de Janeiro, and together uncovered additional features which would be more suited to their clinical practice, such as restricted access to drugs and temporary lack of supplies.

Dr Bowles has established a network of Brazilian collaborators from different states, with varying roles across the whole health sector, with the aim of developing technological solutions to improve primary care and the management of chronic diseases in Brazil.

In a meeting held at the health board in Rio de Janeiro, the group discussed gaps in the management of mental health and other chronic conditions, and the government's priority in the management of HIV. They also discussed the suitability of developing algorithms for finding optimal treatment plans for patients with multiple chronic conditions in a Brazilian context.

Professor Ifor Samuel, School of Physics & Astronomy

Evaluation of a portable light source for photodynamic therapy



Light source supplied to Brazilian collaborators for testing the use of PDT to kill cutaneous leishmaniasis

Professor Ifor Samuel and his team are exploring how to apply a portable light source for photodynamic therapy (PDT), a technology they have already developed to treat skin cancer, to treat a major neglected tropical disease.

Professor Samuel moved to St Andrews in 2000 and founded the Organic Semiconductor Centre, which explores remarkable plastic-like electronic materials and their applications. This work includes understanding, developing and improving organic light-emitting diodes (OLEDs), super-light, thin, flexible and compact visible light sources.

The research resulted in the creation of portable light sources using OLED technology. Two products were ultimately developed: Ambulight, a skin cancer treatment product; and Lustre, an acne treatment product. These are approved for use in all EU countries and Australia. Healthcare benefits include an increase in the number of patients who could be treated per session, a significant reduction of pain, and

reduction of the amount of input required from hospital staff.

In this current project, experts in PDT, parasitologists and microbiologists from institutes in São Paulo and Salvador, Brazil, worked together to explore the use of PDT as a potential new treatment for *cutaneous leishmaniasis*, a serious, scarring skin infection caused by a single-celled parasite that is transmitted by the bite of a phlebotomine sand fly. Compact light sources made in St Andrews were supplied to the Brazilian teams who performed *in vitro* tests using PDT to treat *cutaneous leishmaniasis*. The project, therefore, has laid the foundation for a new approach to treating this tropical disease that is widespread in the developing world.

Dr Karen Brown, School of Art History

Empowering indigenous communities for a sustainable future



Artisan at work in Rey Curré, Costa Rica

Dr Brown has received significant research funding for a project on sustainable artisan production in indigenous communities in Costa Rica's remote areas with poor infrastructure. The project seeks to empower these communities, through the promotion of their artisan crafts, towards a sustainable future to raise awareness of their culture and way of life.

The project builds upon existing partnerships in the community museums of Costa Rica to strengthen existing indigenous systems of organisation and communal work, making them more resilient to the homogenising forces of globalisation and unethical development.

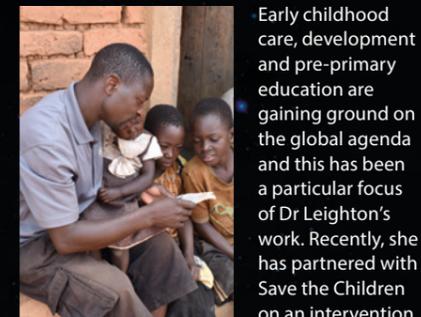
Communities such as San Vicente in the north and Boruca and Rey Curré in the south, have participated with Dr Karen Brown and Jamie Allan Brown of the University's Museums, Galleries and Collections Institute (MGCI) in finding solutions to selling local artisans' crafts to new and wider markets. Working especially with women and young people, the project has successfully documented the distinctive artisan craftsmanship workshops, for each community has mapped significant sites of interest and their daily lives in line with community and eco-museum principles.

As each community is at severe risk of natural disasters, project initiatives also contributed towards building community resilience, emergency service participation and internationally recognised training with the International Council of Museums (ICOM) to safeguard not only crafts but also their tangible and intangible heritage.

Dr Brown says, "MGCI has worked with the community museums of Costa Rica since 2015. The Community Craft and Culture project has provided a special opportunity for us to strengthen these relationships while also strengthening partnerships with the National Museum of Costa Rica and ICOM Costa Rica. These small, community-based organisations have strong roots and big ambitions. It is an honour for us to assist them in achieving their goals."

Dr Margaret Leighton, School of Economics & Finance

Tuwekeze Pamoja: Working together to give children in Tanzania a better start



Father reading with children, Mbozi, Tanzania

Early childhood care, development and pre-primary education are gaining ground on the global agenda and this has been a particular focus of Dr Leighton's work. Recently, she has partnered with Save the Children on an intervention designed and implemented by the charity in Tanzania called Tuwekeze Pamoja (Bringing Together). The purpose of the project is to pilot, test and generate learning about how interventions can

effectively be delivered in low-resource contexts, such as rural Tanzania, to support children's development and early learning. Based on Dr Leighton's recommendations, a research design and sampling framework were put in place in 2018 to monitor and learn from the project over the course of its implementation.

Tuwekeze Pamoja promotes early childhood development by simultaneously tackling a number of the early-life setbacks that prevent children from reaching their full potential. It aims to improve children's learning outcomes by providing support for girls and boys from conception to eight years old. It is focused on the rural poor in the Songwe region of Tanzania, especially the most marginalised children and families, and seeks to address the chronic prevalence of violence experienced by children in Tanzania.

Implemented in two five-year phases, it will enable caregivers to provide a more supportive environment at home, enable more effective teaching in pre- and early primary within a conducive learning environment, and ensure that communities and local government provide an enabling environment for these changes. Through Phase I of the project, it is estimated that 16,854 children, 14,581 parents and caregivers, 205 pre-primary teachers and school leaders, and 137 governmental stakeholders will be reached directly.

Dr Leighton says, "Working with Save the Children from the start of the intervention created the opportunity for my research to be responsive and relevant to the development of the programme. It is exciting to be generating research insights which have such immediate impact."