Cleaning up our Precious Water

Precious freshwater systems are being polluted every day by the metals discharged by active and abandoned mines. A team of Civil Engineering experts at Newcastle University is helping to tackle this global problem.

The expertise of the Newcastle team, led by Dr Adam Jarvis and Dr Jamie Ameesha, has shaped international guidelines on mining pollution management as well as policy and practice at a national and regional level.

Already the daily practice of thousands of professionals worldwide is informed by the research, which has helped shape the Global Acid Rock Drainage Guide. An initiative of the world’s major mining houses, this is the first comprehensive international document on mining pollution management.

The value of the work came to the fore during one of Peru’s most high profile mining conflicts at Tintaya mine in Espinar, which centred around issues of alleged pollution and its impact on the local environment. The Newcastle University team was called upon by the Catholic Agency for Overseas Development to provide policy advice and technical support to help bring about a resolution to the dispute.

Currently, they are testing a system to remove metal from water without the need for energy or chemicals. The “vertical flow pond”, in the heart of the Lake District National Park, will be the UK’s first fully-operational, large-scale passive mine water treatment scheme. Designed by the Newcastle team, working with the Coal Authority, National Trust and Environment Agency, and funded by the Department for Environment, Food and Rural Affairs, it uses compost and limestone to treat metal-rich mine water. It is being constructed at the site of the former waste lagoons at Force Crag mine outside Keswick.

Construction on the project began in September 2013 and the ponds will be up and running by early 2014. The aim is to test the effectiveness of the technology on a large scale. If successful the method could pave the way for cleaning up hundreds of abandoned metal mines across England and potentially across the world.

Making Light of heavy Oil

Research by a team of geochemists and microbiologists at Newcastle University, led by Professors Ian Head and Steve Larter, is opening up untapped oil reserves. Ian Head explains.

The majority of the world’s petroleum deposits are made up of heavy crude oil, which is highly viscous and cannot easily flow to production wells under normal reservoir conditions making it difficult and costly to extract and refine. It is generally considered to be a less valuable resource than light oil, which flows freely at room temperature, and produces a higher percentage of gasoline and diesel fuel when converted into products by an oil refinery.

Heavy oil is formed by the biodegradation of crude oil in petroleum reservoirs, but until recently, little was understood about the process. The breakthrough in our research came when we established that in-reservoir biodegradation is actually an anaerobic process driven by water-hydrocarbon reactions at an oil-water contact zone, rather than one driven by oxygen delivered in hydrocarbon reactions at an oil-water contact zone, rather than one driven by oxygen delivered in water-hydrocarbon reactions at an oil-water contact zone.

Our research led to the launch of a spin out company, Gushor Inc, by our collaborators in the University of Calgary. Gushor was recently acquired by Schlumberger, which provides services to the heavy oil sector, and has been far-reaching. Using fundamental insights, models and software tools that the research generated, companies can now more accurately identify areas of greatest potential in biodegraded oil fields.

The impact of this research on the oil industry and related companies has been far-reaching. Using fundamental insights, models and software tools that the research generated, companies can now more accurately identify areas of greatest potential in biodegraded oil fields. Our research led to the launch of a spin out company, Gushor Inc, by our collaborators in the University of Calgary. Gushor was recently acquired by Schlumberger, which provides services to the heavy oil sector.

We are currently exploring ways to harness the microbial processes that led to heavy oil formation over geological timescales. Even the most advanced extraction processes can leave as much as 60% of oil trapped in reservoirs. By manipulating these natural processes, we hope to be able to recover the energy from this left over heavy oil and residual oil by converting it to methane gas. Methane is more readily recovered and has the added advantage that electricity generation from methane produces about one third less CO2 per kWh than oil itself.

This could be an important route to lower – though clearly not zero – emission fossil energy. Such strategies will be important bridges from our current fossil fuel based energy economy to a future when sustainable energy generation from a range of sources becomes a reality.

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In 2011, Newcastle became the first UK university to establish a medical campus overseas. Later this year, the first cohort of 20 medical students will graduate from Newcastle’s medical school in Johor, Malaysia, to embark on new careers in the country’s health service.

This important milestone is a tangible demonstration of Newcastle University’s commitment to working with international partners to invest in collaborative teaching and research projects.

### Malaysia

The origins of medical education at Newcastle, in the North East of England, can be dated back to 1834 when a School of Medicine and Surgery was first established in the city.

Since that time, Newcastle has been at the forefront of major advances in the understanding and treatment of medical conditions which continue to blight humankind, with work in areas such as diabetes, Alzheimer’s disease and cancer establishing Newcastle as a world leader.

The opening of an international branch campus for medicine and biomedical sciences – Newcastle University Medicine Malaysia (NUMed) – saw the beginning of a new chapter in Newcastle’s medical history.

Subject to final accreditation by the General Medical Council (GMC), the junior doctors now graduating from NUMed will hold a UK Primary Medical Qualification, making them eligible for provisional registration with both the GMC and the Malaysian Medical Council.

### Singapore

Newcastle University has been a destination of choice for Singaporean students for decades. Building on this strong track record, Newcastle University has been a partner of the Singapore Institute of Science (NUIS) since 2009.

The University entered into a Strategic Partnership with NUIS to foster academic, cultural and social links between Newcastle and Singapore, and the Malaysian Medical Council.

This partnership represents a significant commitment on the part of both institutions to collaborate across a wide range of research, teaching and cultural activities. These include energy; cultural and creative industries; ocean sciences; and public health.

The collaboration will also lead to new teaching programmes that are relevant to global needs, and to the offering of jointly between the two Business Schools in Xiamen and Newcastle.

### China

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Newcastle University, together with Siemens and Northern Powergrid, are key players in this new project.

In the past, electrical networks were operated in a passive manner, electricity flowing from high voltage networks down towards the customer.

But as low carbon technologies have come along all that has changed. Distributed generation such as wind farms right down to heat pumps and solar panels means power is now flowing in both directions and in a relatively unpredictable way. We need to find a way of managing that power in real time such that the low carbon transition can be achieved at reasonable cost and without degrading power system reliability.

"That’s why a smart grid system is so important. We need to match supply to demand in real time and within network constraints and that means making the grid more intelligent.

"This intelligence allows demand response, the involvement of customers, and energy storage to be integrated into existing networks.

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Fighting Back

Pioneering research by geographers and sociologists at Newcastle University is helping women and children – suffering from the scourge of human trafficking – to change their lives. Dr Meena Poudel, former Director of Oxfam in Nepal and an alumnus of Newcastle University, was inspired by the work of Professors Nina Laurie and Diane de Jong, and Dr Janet Townsend, who she decided to support as a Power Group Advisor.

She felt the need for action after learning that girls and women who were rescued from trafficking in a police raid on an Indian brothel in 1996, it would have been easy to assume their fortunes were about to change. However, this was just the start of a traumatic new chapter in their lives, which saw them stigmatised, labelled as prostitutes and HIV carriers and locked away in remand homes in India where conditions were as bad as it gets. They were worse than, prison. On their return to their homeland they struggled to regain social status, social acceptance and even basic human rights. Rejected by their families and communities, they were left believing they were to blame for being trafficked.

The beginning of this story is all too familiar to survivors of human trafficking, who often face extreme challenges in accessing citizenship and establishing new livelihoods after escaping their ordeal – and whose voices, until now, have not been heard. But this particular group of women, aged just 15 to 18 years, have fought back.

Their voices, until now, have not been heard. But this particular group of women, after escaping their ordeal – and whose voices, until now, were virtually unheard in terms of making a positive contribution to “education for all”. But their research has altered this dramatically, changing awareness, attitudes and policies among international agencies such as the Department for International Development and national governments, leading to massive investment in 20 countries across five continents.

Initially focused on the slums and shantytowns of Ghana, Nigeria, Kenya, India and China, Tooley and Dixon’s research culminated in 2013 with a focus on the world’s most affected region: the conflict-battered African states of Liberia, Sierra Leone and South Sudan.

Tooley explains: “The findings were remarkable. In urban areas, the vast majority of schoolchildren were found to be in low-cost private schools, while in rural areas, only a minority were being educated in this way.”

Tests and questionnaires among 35,000 children revealed that the choices made by poorer parents made sense. Low-cost private schools were outperforming government schools in core subjects. “Tests and questionnaires among 35,000 children revealed that the choices made by poorer parents made sense. Low-cost private schools were outperforming government schools in core subjects.”

From a 15-minute film for BBC Newswatch in the UK to an American full-length film and an Indian best-selling book, the communication of the findings has been critical in inspiring investors, philanthropists and donors alike.

Among the initiatives inspired by the research are a voucher programme in Pakistan which enabled hundreds of thousands of girls from poor families to attend low-cost private schools, and the $300 million Girls’ Education Challenge Fund, which seeks to stimulate non-state providers to get up to one million girls into schools in the hard-to-reach places.

Not-for-profit organisations have already contributed $150 million to the scheme as a direct result of Newcastle’s research and more is awaited to follow as the momentum created by Tooley and Dixon continues to build.

Tooley directly inspired my life’s work. As a result, I believe, that over the next 20 years, 20 million impoverished children will have received a much better education than otherwise would have been possible.”

Chris Cramer, President and CEO of Edify USA, a non-profit organisation that has provided significant investment for low-cost schooling.

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Power of Arts & Culture

A cultural development programme that has grown out of research by Dr Nanette de Jong, of Newcastle University’s International Centre for Music Studies, is contributing to the fight against poverty, HIV/AIDS and gender inequality in Southern Africa by strengthening the region’s cultural sector.

Southern Africans’ diverse and dynamic cultural heritage is one of the region’s richest resources, with the potential to generate significant economic and social benefits. Nanette de Jong’s study, carried out during a two-year fellowship at the University of Pretoria, found that cultural activities have already contributed $350 million to the scheme and more is awaited to follow as the momentum created by Tooley and Dixon continues to build.

Dr Nanette de Jong, Newcastle University’s International Centre for Music Studies, is contributing to the fight against poverty, HIV/AIDS and gender inequality in Southern Africa by strengthening the region’s cultural sector.

SCALC’s work has already contributed $350 million to the scheme as a direct result of Newcastle’s research and more is awaited to follow as the momentum created by Tooley and Dixon continues to build.

Dr Meena Poudel now works for the International Organisation for Migration as Policy and Programme Adviser.

Newcastle University has been awarded the Queen’s Anniversary Prize for Higher and Further Education. Guy Garrod, Director of the Centre for Rural Economy (CRE), explains its work.

Research into rural economies and societies at Newcastle University has been recognised with a Queen’s Anniversary Prize for Higher and Further Education. Guy Garrod, Director of the Centre for Rural Economy (CRE), explains its work.

CRE was founded in 1992 under the inspiring leadership of Professor Philip Lowe. For the past 21 years, CRE has led studies of some of the world’s most pressing challenges, from how we use land and natural resources, to the changing relationships between rural and urban communities and how we tackle rural social exclusion.

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Life after liver disease

The internationally recognised clinical trial work of Newcastle University’s team of hepatologists is focused on prolonging life and improving quality of life for patients with liver disease. Recent advances by the Liver Research Group, published in Hepatology and the Journal of Hepatology, among others include the establishment of a new diagnostic technique for a form of liver disease that is rapidly becoming commonplace in the Western world. The group has also contributed to the discovery of a gene mutation for excessive alcohol drinking.

In the developed world, up to one in four people suffers from non-alcoholic fatty liver disease (NAFLD), a condition closely associated with obesity; that, in its early stages, causes scarring on the liver, known as fibrosis. At an advanced stage it can progress to cirrhosis, liver failure and cancer, as well as heart disease.

Until the breakthrough by Newcastle University, the only accurate way to determine the amount of scarring caused by NAFLD was by liver biopsy, an invasive, expensive, invasive and sometimes painful procedure that can be unreliable and has occasionally been associated with the death of some patients.

Working with colleagues from the USA, Europe and Australia, studies led by Professor Chris Day at Newcastle University have established a safe and reliable non-invasive alternative to a biopsy — the NAFLD Fibrosis Score (NFS), which is capable of accurately differentiating patients with and without fibrosis.

The diagnostic, which has now been incorporated into two sets of international guidelines, allows liver biopsy to be avoided in 75% of patients, and has the potential to save the National Health Service £2 million annually.

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Tackling dementia

Dementia devastates the lives of 36 million people worldwide and costs $315 billion in healthcare. Ian McKeith, Professor of Old Age Psychiatry, is part of a team of researchers and clinicians specialising in dementia research at Newcastle University’s Institute for Ageing and Health.

Professor McKeith leads research that resulted in the first diagnosis and treatment of dementia with Lysine bodies (DLB), a condition affecting over 4 million people worldwide which is now known to be the second most frequent cause of degenerative dementia after Alzheimer’s disease. Yet little more than a decade ago the disease was relatively unknown and those affected by it were often treated with drugs that could worsen their unpleasant symptoms or even prove fatal.

Until the team of Newcastle University developed a new brain imaging technique to identify DLB, the mental symptoms of Alzheimer’s — such as memory loss and confusion — were often mistaken for Alzheimer’s disease, while the motor symptoms, including gait and slowness of movement, were mistaken for Parkinson’s disease. The breakthrough came when the team identified that cholinesterase inhibitors (CHEs), a class of drug originally developed for use in Alzheimer’s disease, would be of greater benefit in DLB and also in Parkinsonian’s disease dementia.

The research has been published in The Lancet, The Lancet Neurology, BMJ and Neurology. CHEs are now recommended in international and national guidelines for the cognitive and psychiatric symptoms associated with both of these conditions which previously had no effective treatment.

Professor McKeith explains: “The DaTSCAN brain imaging technique developed in collaboration with GE Healthcare for use in dementia diagnosis, and the class of drug that we use first to look for a large, plaque-controlled, randomised trial, are now in use around the world. These have revolutionised the lives of patients. For the first time, we are able to manage symptoms such as cognitive failure, hallucinations, apathy and anxiety.

“IT has been a long wait for our understanding of this devastating and distressing condition. The moment we have created has enabled us to establish world-class facilities at Newcastle University. In collaboration with other international groups, we are now using our tissue resource to investigate why brain cells become dysfunctional. We are also planning to take part in the first trials to treat the disease process.”

It wasn’t until they were found to target cancer-specific weaknesses, by selectively killing breast and ovarian cancers caused by mutations in a gene called BRCA, that the pharmaceutical industry became interested. Fast forward to today and I’m pleased to report our continued research, initiated in the 1990s, has not only led to the first drug of its kind being developed and trialled in Newcastle but also has harnessed a new era in cancer treatment.

PARP has now been adopted as a key cancer target by the pharmaceutical industry, with major companies having invested around $385 million in clinical trials to date. Since 2008, more than 7,000 patients have been enrolled in 33 major companies have invested around $385 million in clinical trials to date. Since 2008, more than 7,000 patients have been enrolled in 33

Pioneering ‘Smart’ Drugs

For more than 20 years, Newcastle University has been at the forefront of the global battle against cancer, driving breakthroughs in the development of ‘smart’ drugs known as PARP inhibitors. Nicola Curtin, Professor of Experimental Therapeutics, explains.

The potential of PARP inhibitors to treat cancer has long been championed by Newcastle University, but in the early days of our project no-one agreed it wasn’t until 2005 that the first PARP inhibitor entered clinical trials in Newcastle. The 2006 study in the New England Journal of Medicine is now perhaps the most influential paper in all of oncology, having a significant influence on clinical practice.

For more than 20 years, Newcastle University has been at the forefront of the global battle against cancer, with a mission to bring new treatments to those affected by this devastating disease.

One of those affected with mitochondrial disease is Nicola Parker (pictured above with Professor Doug Turnbull) who did not know she had Mitochondrial Myopathy, a condition which reduces her energy levels and restricts her movement, until she had already passed it on to her daughter.

Nicola says: “No parent would ever want to pass on an illness to their child, so this work should be applauded. It means my daughter could now have the chance of being a mother herself one day, without the risk of this genetic condition being passed on again.”

To find out more about the pioneering IFV technique scan here.

Newcastle University is developing a pioneering IFV (in vitro fertilisation) technique to protect future generations from the risk of mitochondrial diseases. Professor Doug Turnbull and Mary Horvath are both members of the Wellcome Trust Centre for Mitochondrial Research at the University where the team is integrating international research with training for new scientists and engaging with policy makers, patients and the public.

With funding from the Wellcome Trust, the University is refining the technique to ensure families affected by mitochondrial diseases are able to access these technologies in the clinic at the earliest opportunity. To find out more about their work, please visit the website: www.wellcome.org.

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