

THE JOURNAL FOR SCIENCE, ENGINEERING AND TECHNOLOGY

advances

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Integral to innovation is change. To innovate, you must introduce something new, whether it is a product, a method or an idea. Sometimes a great idea is only the first step, with the process of true innovation being a collaborative effort between experts.

With that in mind, the editorial team are delighted to launch this edition of Advances at Venturefest Wales, bringing entrepreneurs, investors and companies together to inspire business growth. The event provides businesses with the opportunity to collaborate, share ideas, meet experts and find solutions through a mix of workshops, presentations, and one-to-one meetings.

As featured in this edition, collaborative effort was also key to the success of a study using nature as a drug discovery tool, with academia, industry, the local community, and even honeybees in the search for antibacterial properties in plants and honey (page 14). By working together, Welsh scientists, researchers and engineers are contributing to global issues, and Wales is fast becoming a centre of novel developments and explorations. This edition sees Wales build the UK's first 'smart' carbon positive energy house (page 26), host the UK's first self-healing concrete trial (page 6), pilot a new smart parking app in its capital city centre (page 3), and open the world's first man-made commercial lagoon using Wavegarden® technology (page 7).

We hope you enjoy this edition, packed with innovative projects, groundbreaking research, novel technology and collaborative ventures from Wales.

Your views on Advances are important to us and we want to ensure we deliver content that is relevant and interesting for you. Please complete the questionnaire at the back of this issue to share your comments with us.

The editorial team

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Interaction at the zoo:

Mobile app enhances interactive experience for zoo visitors

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Advances Wales is a high-quality, quarterly 'transfer of technology' journal produced by Welsh Government to showcase new developments in science, engineering and technology from Wales. Devoted to concise reports and commentary, it provides a broad overview of the current technology research and development scene in Wales. Advances raises the profile of the technologies and expertise available from Wales in order to facilitate collaborative relationships between organisations and individuals interested in new technologies and innovation.

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Airbus finalises \$26.6bn plane deal with Indian airline IndiGo



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European aerospace group confirms its single-largest order with the sale of 250 A320neo planes, the wings of which will be made at North Wales plant

Airbus has finalised a record \$26.6bn (£17bn) deal to sell 250 A320neo planes to an Indian airline in a boost for engineers working for the European aerospace group in the United Kingdom. Airbus, which has manufacturing operations in Broughton, Flintshire, and Filton near Bristol, said this was its largest ever order by number.

The wings for the Airbus A320 planes will be made at Broughton in North Wales, before being sent on to aircraft production lines in Hamburg, Toulouse or China. The company employs 16,000 people in the UK and produces 1,000 aircraft wings a year at the Broughton plant.

The latest deal extends the lead of Airbus in the most lucrative sub sector of the commercial aerospace market for narrow-body planes, where it is pitched against US rival Boeing. The A320 family of planes, which includes the A320neo - the latest, most fuel-efficient model, are the most popular single-aisle aircraft in the world, with more than 11,800 orders to date and 6,600 aircraft delivered to 400 different airlines.



www.airbus.com

Smarter parking for Cardiff

The Smart Parking technology uses vehicle detection sensors installed at parking bays in the city to indicate available spaces.

Cardiff, the Welsh capital, is the first city outside of London to use this technology, following a study published in April that claims Cardiff drivers spend on average 11 minutes finding a space to park, which is longer than in any other major UK city.

The technology works by sending an infra-red signal from a sensor recessed in the road. If the beam bounces back because a car is parked, the data is picked up by another sensor mounted on a nearby lamppost. All of the data is relayed to a central server that updates an online app in real time, showing parking spaces as being full or empty.

The council said that if the pilot areas, across a number of locations in and around the centre of Cardiff, are successful, it would look at extending the scheme.

It is hoped the system will cut down on both congestion and carbon emissions.



www.smartparking.com

£600m hospitals revamp plan unveiled for south-west Wales

Radical plans for a £600m transformation of hospital services in south-west Wales have been revealed. The project, known as Arch, is a collaboration between Abertawe Bro Morgannwg University Health Board, Hywel Dda University Health Board and Swansea University.

Spanning six local authority areas and serving one million people, the project includes plans for Swansea's Morriston Hospital to double in size and become a regional centre for specialist treatments, with an acute hub to house the emergency department, acute GP unit, acute medical unit and a GP out-of-hours service covering Swansea and Neath Port Talbot.

The city's other hospital, Singleton, would be a centre of excellence for a broad range of diagnostic, rehabilitation and treatment services - including both urgent and planned care. A rapid assessment and ambulatory care centre will give access to state of the art diagnostics including advanced imaging and laboratory facilities.

A medical science park, known as Medi-Park, will expand Swansea University's Institute of Life Science (ILS) healthcare technology centre and offer a joint clinical research facility with the intention of this collaboration broadening to span all three Arch partners.

Also proposed is the Wales Centre for Rural Health, a centre of excellence for research, education, service development and technology innovation intended to improve access to healthcare in the more remote areas

of Wales. It will help to provide a workforce skilled and suited for rural healthcare in Wales, based in a number of integrated community and primary care resource centres across the Hywel Dda area.

"It breaks free from an outdated healthcare system designed more than 50 years ago and replaces it with an accessible one specifically planned for today's needs, in purpose-built or refurbished accommodation."

Sian Harrop-Griffiths
Director of Strategy
ABMU Health Board



www.abm.wales.nhs.uk

Backward-moving glacier helps scientists explain glacial earthquakes

The relentless flow of a glacier may seem unstoppable, but a team of UK and US researchers have shown that during some calving events – when an iceberg breaks off into the ocean – the glacier moves rapidly backward and downward, causing characteristic glacial earthquakes, which until now have been poorly understood.

Glacial earthquakes have increased seven-fold in the last two decades and have been migrating north, suggesting an increase in rates of mass loss from the ice sheet through calving. This new insight into glacier behaviour should enable scientists to measure glacier calving remotely and will improve the reliability of models that predict future sea-level rises in a warming climate.

Researchers from Swansea, Newcastle and Sheffield Universities installed a robust wireless network of Global Positioning System (GPS) devices on the chaotic surface of Helheim, one of the largest glaciers in south-east Greenland, in order to measure velocity and displacement of the glacier surface.



With US collaborators from Columbia University's Lamont-Doherty Earth Observatory, the University of Michigan and Emory University, earthquake data from the Global Seismographic Network and scaled-down models in water tanks were used to explain the unexpected movements of the glacier in the minutes surrounding the calving events.

Understanding this glacier behaviour and the associated glacial earthquakes is a crucial step towards measuring calving events and their contribution to sea-level change. This tool has the potential to provide unprecedented, global and near real-time estimates of iceberg loss from the ice sheet.



www.swansea.ac.uk

Clinical wipes project cleans up at Cardiff University's Innovation and Impact Awards

A partnership which developed clinical wipes to tackle hospital 'superbug' infections has been named the People's Choice at Cardiff University's Innovation and Impact Awards 2015, sponsored by leading law firm Geldards and IP Group.

Nearly 1,000 votes were cast in a social media competition. More than a quarter selected this collaboration between GAMA Healthcare and the University as the public's favourite.

A Knowledge Transfer Partnership (KTP) grant was awarded by Innovate UK and the Department for Environment, Food & Rural Affairs which allowed GAMA to use the University's knowhow to set up and run clinical trials, train staff and develop in-house R&D capability.

Microbiologist Harsha Siani, the KTP Associate, transferred scientific knowledge and expertise from Cardiff University into GAMA, helping to ensure the

company's products complied with EU regulations and met stringent test conditions designed to reflect the product's use.

Receiving the Award, Professor Jean-Yves Maillard, from Cardiff University's School of Pharmacy & Pharmaceutical Sciences, said: "We are delighted to win the Award. Our project shows how researchers can interact with industry 'in the real world' to create innovation with impact. We helped to ensure a product used as part of an infection control regimen in healthcare settings can make a difference and help infection control against troublesome pathogens."

A team of mathematical modellers picked up the award for Innovation in Healthcare. The experts studied queues and flows in hospitals to help improve NHS services, cut waiting times, and improved access to care.

The Innovation Policy Award went to research which has shown how best to support families of loved ones with severe brain injuries by translating accounts of

catastrophic brain injury into a multi-media online support/training resource.

The Social Innovation Award went to University researchers who helped change the lives of homeless young people by developing new screening techniques to help identify 'at risk' warning signs and deliver effective support services.

The Innovation in Sustainability Award went to a team who designed a smart house that produces more energy than it uses - the first to combine reduced energy demand, building integrated renewable energy supply and energy storage. See pages 26-27 for full article on this project.



www.cardiff.ac.uk



www.gamahealthcare.com

Celebrating research impact: Swansea University Impact Awards 2015

Swansea University has recognised the impact of some of its most outstanding research projects, from the Connected Communities initiative that celebrates the history of the Swansea Valley and beyond, to the development of novel light therapies used to treat a range of skin conditions.

The event's headline sponsor was Geldards law firm and the evening was hosted by broadcaster - and Swansea University graduate - Jason Mohammad, and also featured a presentation from the 65 Degrees North team, who achieved the world's first unsupported crossing by an amputee of the Greenland Ice Cap, a challenge which was aided by the University's researchers. The event itself is part of a programme of activities supported by the University's Engineering and Physical Sciences Research Council (EPSRC) funded Impact Acceleration Account.

Swansea University Impact Award Winners Include:

The Age UK Award for Outstanding Impact in Health and Wellbeing

"Finding the Cause for Paediatric Neurological Disease: Hyperekplexia" - Prof. Mark Rees and Dr Seo-Kyung Chung and the Neurology Research Team, College of Medicine

The BBC Research and Development Award for Outstanding Impact on Professions, Practices and Services

"Empowering rural digital communities" - Prof. Matt Jones, Dr Jennifer Pearson and Dr Simon Robinson, College of Science

The TATA Steel Award for Outstanding Impact in Commerce, Industry and Enterprise

"Novel light therapies for the treatment of skin conditions" - Prof. Marc Clement and the Enterprise and Innovation Team, College of Medicine

A full list of award winners can be found at:
www.swansea.ac.uk/research/impactawards2015



www.swansea.ac.uk

New £7M Digital Economy Centre takes research to the next stage

Swansea University's College of Science is to become home to a new digital economy research centre worth in excess of £7M, which will help create and deliver digital innovations with real-world impact.

The new CHERISH-DE Centre – or Challenging Human Environments and Research Impact for a Sustainable and Healthy Digital Economy – has received a Government funding boost through the Engineering and Physical Sciences Research Council (EPSRC), with further investment from industrial and research partners.

Led by Professor Matt Jones, head of the College of Science, the centre will explore how to deliver digital innovations that help people relate and respond to the rapidly expanding technological world, with a focus on health and social care, resource-constrained communities, heritage, and cybersecurity and cyberterrorism.

The project will combine the expertise of researchers from social science, computer science, economics, medicine, arts and humanities, and law.

The project's major partners include the BBC, the DVLA, Abertawe Bro Morgannwg University Health Board (ABMU), Microsoft, IBM and, critically for the economy, a broad and deep network of small to medium sized enterprises (SMEs). These include Leadin, a Finnish company attracted to Swansea by the opportunities of growing the regional technology cluster.

"This investment, in excess of £7M, will ensure that Swansea's strengths can be mobilised to help position the UK as a world leader in digital economy innovation."

Professor Richard B Davies
Vice-Chancellor
Swansea University



www.swansea.ac.uk

UK's First Self-Healing Concrete Site Trial to Begin in Wales

A section of the A465 Heads of the Valleys road in South Wales will, this September, host the UK's first ever trial of a self-healing concrete structure. The principal contractor for the scheme, Costain, will be hosting the trial, and the material is being developed through the Materials for Life research project. The research, funded by EPSRC, is led by Cardiff University who, along with Bath and Cambridge Universities, have been carrying out laboratory tests on self-healing concrete for the past two years.

As explained in a feature article of Advances issue 70, self-healing concrete makes use of shape memory polymers, microcapsules, microorganisms and flow networks to heal its own cracks. Since then, the university researchers have up-scaled their experiments and combined the techniques in different ways to maximise the healing efficiency of the concrete. The ultimate aim is to develop more environmentally sustainable concrete structures with reduced whole life costs.

The trial will involve the construction of several full-scale concrete panels, which will be artificially damaged and monitored while exposed to outdoor conditions.

"From this trial we expect to gain a significant understanding of how self-healing capabilities can be incorporated into concrete structures and how these structures will perform within real life conditions. As the first trial of its kind, it demonstrates how Costain and the Materials for Life team are bringing state of the art innovation into UK infrastructure."

Oliver Teall
Costain Civil Engineer and PhD student



www.costain.com

World-first Wavegarden® opens in Surf Snowdonia, North Wales

In August 2015, following an exhaustive decade of research and testing on three full-scale prototypes, the first commercial lagoon using Wavegarden® technology has opened its door to the public.

Located in the lee of the Snowdonia mountains next to the village of Dolgarrog, Surf Snowdonia has transformed a derelict aluminium works into an innovative surf facility.

The surfing lagoon measures 300 metres by 120 metres, equivalent in size to three football pitches long and two wide. The £12m facility provides the

opportunity for visitors to ride ocean-like waves tailored for surfers of all ability levels. Perfect waves ranging between 0.7m and 2m high, with a lengthy surfing experience of 16 seconds per wave, are consistently generated in a safe and natural environment.

The facility produces waves by pulling a hydraulic snowplough-like wedge along under the water. The wedge travels 180m in 19 seconds under a central pier, before being sent back the other way, to produce waves in opposite directions.

Transforming the derelict site into the new facility involved the removal of eighteen tanker-loads of heavy metals and hydrocarbons. Around 25,000

cubic metres of other materials were removed from the old foundations, crushed and re-used.

The new facility is estimated to create over 60 direct jobs, and sustain around 100 other jobs in the supply chain. The owners are expecting in excess of 75,000 visitors per year.



www.surfsnowdonia.co.uk

Fossil forest gets national recognition and protection



A fossil forest in Brymbo, near Wrexham, which pre-dates dinosaurs, has been designated a Site of Special Scientific Interest (SSSI) by Natural Resources Wales. Covering an area nearly half the size of a football pitch, the site contains a variety of 300 million year old fossilised plants and trees. Natural Resources Wales (NRW) says it is a world-class site for plant fossils.

The fossils were first revealed in 2004 on the former iron and steel works site in Brymbo. They are the

remains of plants that grew in hot, humid conditions near the equator - and include 20 fossilised giant clubmosses, which look like massive tree stumps.

Plans to establish an excavation and visitor centre on the site are being led by Brymbo Heritage Group, who will ensure the right conditions are set up to study and display these fragile fossils.

Some of the best and rarest fossils have been removed and are being conserved in the National Museum of Wales. They will be returned to Brymbo for public display, once a suitable building is ready.

It is illegal to remove fossils or damage a Site of Special Scientific Interest.



www.nationalresources.wales

Welsh cluster to lead development and commercialisation of compound semiconductor technologies in Europe

IQE plc, the leading global supplier of advanced semiconductor wafer products and services, has announced that it has established a joint venture with Cardiff University to lead the development and commercialisation of compound semiconductor technologies in Europe.

The establishment of this joint venture is a key milestone towards the creation of a European compound semiconductor cluster centred in Wales, which is increasingly seen as a strategic enabler for UK and European electronics industries.

Cardiff University will now have a very clear and effective route to commercialise the world-class R&D to be carried out at Cardiff University's Institute of Compound Semiconductors, whilst IQE will be able to take the technologies developed at the institute directly into large-scale mass production.



"This joint venture with Cardiff University is a key step in creating the world's first compound semiconductor cluster, spanning the complete technology readiness level scale from basic research to full scale production. Our goal is to build this cluster into one of global significance and scale, leading to widespread economic benefits for the region, and providing a broad range of compound semiconductor technologies to support the rapid growth of the key enabling technologies agendas, in Europe and throughout the rest of the world. IQE look forward to working closely with the Institute of Compound Semiconductors to commercialise these exciting new technologies."

Dr Drew Nelson
Chief Executive
IQE



www.cardiff.ac.uk



www.iqep.com

IN BRIEF

We Predict Investment

The Swansea-headquartered business, whose software platform analyses large volumes of data for some of the world's biggest automotive companies, is expanding with the backing of a £1.25m equity investment. Finance Wales has invested from the Wales JEREMIE Fund, alongside the group of business angels who have previously invested in the company, to help We Predict expand in the UK as well as in the US, where it has recently established a sales team. At its R&D centre in Swansea's Technium 1, We Predict employs mathematicians, statisticians and computer scientists who work alongside domain experts for clients like Honda, Bombardier and Kostal.

Plans to save Welsh 'rainforest'

The Woodland Trust has a unique opportunity to purchase and protect 220 hectares of ancient woodland, pasture and heathland in the Snowdonia National Park. Llennyrch lies to the south of Coed Felinrhyd, a wood already in the care of the Woodland Trust, and adjoins two National Nature Reserves. With over 200 species of lichens on tree trunks, it is among the richest woodland lichen sites in Wales. The site is a vital part of the Meirionnydd Oakwoods Special Area of Conservation – of European importance for its extraordinary plantlife. Within the last year, the lichen *Thelotrema petractoides* was discovered in the neighbouring Coed Felinrhyd, which is found nowhere else in Wales.

Growth for bilingual digital content production company

A bilingual digital content production company set up by three graduates with a joint personal investment of £7,000 is expanding thanks to a loan from the Wales Micro-business loan fund managed by Finance Wales. Cardiff-based Storm+Shelter is using the loan to buy cameras, lenses and a lighting system as well as an aerial drone, which will enable it to offer customers a wider range of services, including aerial footage. Creative Director and Newport Film School graduate Josh Bennett, Managing Director Gruff Vaughan and Technical Director Nick Patterson have already established the company's reputation with productions for high-profile clients such as the BBC and Sony.

Jellagen secures grant for jellyfish collagen development

Pembrokeshire-based Jellagen, which supplies medical grade jellyfish collagen, has secured a £97,477 grant to develop a new wound care product. The company has received SMART grant funding from Innovate UK, which will be used to develop a new method of using jellyfish collagen to tackle two clinical issues associated with chronic wounds; sepsis and maintaining healthy blood flow to the site of injury. As part of a 12-month project, Jellagen will work with the University of Highlands and Islands (UHI), Neem Biotech, Syncura, the Welsh Wound Innovation Centre and University College London (UCL), with the aim of developing new intellectual property and wound care products. Jellagen were previously featured in *Advances* Issue 74.

National recognition for ABMU Health Board research

Research carried out by Abertawe Bro Morgannwg University Health Board into the relationship between patients' psychological states and their recovery from pelvic floor problems through physiotherapy has been nationally recognised in the UK, and is one of the winners in a national research competition for a podium presentation at the UK conference on Pelvic Obstetrics Gynaecological Physiotherapy. An interdisciplinary team at Singleton Hospital, Swansea, comprising psychologist Dr. Lisa A. Osborne, physiotherapists C. Mair Whittall and Ruth Emanuel, and uro-gynaecological consultant surgeon Mr. Simon Emery, along with Professor Phil Reed from Swansea University's Psychology Department, have established that depression and anxiety are major obstacles to recovery from pelvic floor dysfunction and incontinence in women.

Swansea University sports scientist reveals vital 'window' to enhance athletes' performance

A performance science expert from Swansea University has led research that has revealed there is a vital window on the day of a sporting competition when athletes' performance can be acutely enhanced with a number of pre-competition strategies.

Professor Liam Kilduff has worked for 12 years in the area of performance science at Swansea University with a focus on elite athlete preparation strategies. His research has been embedded into the preparation strategies of some of the UK's most successful teams competing at the summer and winter Olympic games as well as teams competing in team sport at a world cup level.



These strategies include techniques for enhancing muscle temperature; activating motor unit recruitment and stimulating anabolic hormones; three factors that are known to impact on an athlete's ability to increase power.

"Sport scientists and strength and conditioning professionals spend the majority of the year trying to ensure that their athletes' training and recovery strategies are appropriate for optimal performance on competition day. However, there is an additional 'window' leading up to an event on the day of competition where performance can be acutely enhanced with a number of pre-competition strategies."

Professor Liam Kilduff
Performance Science
Swansea University



www.medicine.cf.ac.uk

Expansion for Precision engineering firm Formagrind

Formagrind, established in 1983, is a specialist in the manufacture of high-precision components and tooling with customers in the aerospace, defence, semiconductor, medical, automotive and manufacturing sectors. The new site at Milland Road Industrial Estate in Neath is more than twice that of the current Llandarcy Estate premises. Formagrind managing director Mike Couser said: "The business is working on a number of exciting projects with major customers and the increase in space will enable us to be more reactive to our customer's requirements. The new property ticks all the boxes in terms of size, location and is ideal for our needs and future plans."

Ventilation systems firm to be sold in £145m deal

A South Wales headquartered ventilation systems manufacturer which employs 450 staff is to be sold by its private equity backer in a deal worth around £145m. Piping system manufacturer Polypipe Group has agreed to acquire Nuaire from Electra Private Equity and other shareholders. Nuaire makes equipment for commercial and residential applications; its products help clients reduce their energy consumption and carbon emissions. From its base in Caerphilly, the business serves more than 5,000 customers in the UK and internationally. In the UK, the company's customers are mostly contractors and building consultants.

Quantum Pharma acquires Deeside pharmaceutical firm

Quantum Pharma has acquired a Deeside-based pharmaceutical manufacturer and its trading subsidiary in a deal that could be worth more than £13m. Deeside-based NuPharm Group and NuPharm Laboratories have been bought for £9.34m to be paid on completion, and up to £4m potentially payable under earn-out arrangements. NuPharm is an outsourced manufacturer for solid and liquid dose small batch-made specials and niche licensed pharmaceutical products operating in North Wales. The acquisition of NuPharm provides Quantum with a platform to extend its manufacturing capabilities, which until now have been limited to the production of single, bespoke formulations that are made-to-order.

Which LED Light illuminates with new website

Which LED Light, has re-launched its website aimed at helping users to find the right LED light through a quick and simple process. Which LED Light is a company incubated by the Alacrity Foundation, a Welsh Government funded initiative established in collaboration with successful Welsh entrepreneur Sir Terry Mathews. The UK's first LED lighting comparison search engine offers free and impartial LED light education and comparisons for users.

NASA astronaut inspires science pupils in Merthyr Tydfil

Spaceman Steve Swanson has been helping Welsh pupils get inspired by science. The NASA astronaut has been taking part in the Mission Discovery project, run by the International Space School Educational Trust, for over 200 schoolchildren from across South Wales. It was held at Bishop Hedley High School in Merthyr Tydfil, thanks to extra funding aimed at improving performance at schools in deprived areas. Mars Rover astrogeologist Dr Jim Rice has also been helping pupils, as they hope to have their ideas for an experiment carried out on the International Space Station.

Spineless personalities

New research from Swansea University has revealed that individual differences in physiology are linked to risk-taking behaviour in marine shore crabs.

Over the past decade, there has been growing interest in understanding 'animal personality', where individual animals consistently differ in their behaviour over time and contexts.

It is now well acknowledged that personality is not unique to humans. Fish, birds, mammals, insects and other invertebrates display different personalities. This means that they vary consistently in their behavioural responses, for example being bold or shy, but if animals show 'fixed' personalities, what happens when the environment changes? To answer part of this question, researchers from Swansea University have been exploring the link between behaviour and physiology.

While vertebrate animal personalities are often underpinned by consistent individual differences in physiological traits, known as 'coping styles', whether this is also true for invertebrates has been unclear. The aim of the research from Dr Ines Fürtbauer and Swansea University's Department of Biosciences was to address this question in a marine invertebrate, the shore crab (*Carcinus maenas*).



Reactive individuals can be characterised by high physiological stress and immobility. Proactive individuals, in contrast, can be characterised by low physiological stress and high locomotor activity.



'Coping styles', are correlated suites of behaviour and physiology, and provide a useful concept for understanding how individuals deal with changes in the environment. For example, in many vertebrates, we find reactive and proactive coping styles.

differences in exploration, time spent immobile, and time spent near shelter.

In addition to this work, Dr Fürtbauer collected haemolymph (which is analogous to blood in vertebrates) and measured its density on a weekly basis. Crab haemolymph density was highly consistent across six weeks. This indicates that individuals vary consistently in their physiology. Furthermore, haemolymph density was linked to the crabs' risk propensity, meaning that crabs with higher haemolymph density spent more time hiding near shelter.

This research provides the first evidence of 'coping styles' in an invertebrate. The next step for the researchers is to investigate the sources of individual variation in haemolymph density to discover which proteins underlie the variation.

The research project explored individual differences in behaviour and physiology of shore crabs, measuring the crabs' consistency in behaviour by filming them in a test tank. From the video footage, Dr Fürtbauer was able to extract the extent of exploration of the environment in the tank, how much time was spent immobile, and how much time was spent near shelter. The time spent near shelter was indicative of risk-taking behaviour, i.e. if an individual hides more it is assumed to be more risk averse. The crabs showed consistent individual



”

“Both metabolism and immunology have been linked to variation in personality in vertebrates but can be difficult to study. Invertebrates, in general, provide several advantages over vertebrates and, together with my findings, offer great potential for studying the physiological underpinnings of animal personality.”

Dr Fürtbauer
Department of Biosciences
Swansea University

In crustaceans, 70–95% of total haemolymph protein is haemocyanin, the oxygen transport molecule in crustaceans and many other invertebrates. The remaining proteins include various antimicrobials, such as proteins associated with immune defence, suggesting a link between the crabs’ personality and their metabolism and immunology.



In crustaceans, haemolymph density is directly proportional to blood protein concentrations, meaning that the more proteins in the blood, the higher its density. Haemolymph protein concentrations are often used as an indicator of physiological condition.

Profile

Product

Invertebrate coping styles

Applications

Linking physiology and risk-taking

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The location for innovation

GE Healthcare's Innovation Village

Designed to nurture growing businesses, GE Healthcare's Cardiff Innovation Village provides a campus for early stage companies who are developing tools and technologies for the life science industry.

The first phase of the Innovation Village is located in a dedicated building in the GE Healthcare Life Sciences Maynard Centre in Cardiff, South Wales. It aims to help companies reach a stage where they are confident to operate independently and progress to the next stage of their development, whilst providing them with opportunities to collaborate with GE and other businesses that share the same space.

With the aim of creating a unique ecosystem where non-competing, complementary businesses can work side by side and take advantage of co-creation opportunities, the Innovation Village also offers its inhabitants the resources and expertise of the wider GE Healthcare organisation.

Businesses will benefit from access to scientific and manufacturing equipment, process, supply chain and commercialisation expertise, and a global distribution network. As they develop, the early stage businesses can also

receive advice from GE Healthcare on Lean processes, a way of eliminating waste from a manufacturing process, and Six Sigma, techniques for improving outputs.

Ultimately, the Innovation Village should become a dynamic environment that can maximise the potential for businesses to flourish through the exchange of ideas and expertise. Looking to the future, GE expects the composition of the Village to remain fluid, with new companies taking space as existing tenants move on. Based on the rapid early success of the first phase, GE also intends to expand capacity over the next 12 months in line with demand.

”

“The outstanding interest in the Cardiff Innovation Village illustrates just how active the life sciences industry is. Growing innovative businesses in this field are keen for support to help them to progress to the next level. We can help them to scale up while exploring any collaboration opportunities.”

Penny Owen
Innovation Village Director
GE Healthcare



Profile

Product
Innovation Village

Applications
Accelerate business innovation and collaboration

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Diagnostics in a spin

CMD shines a light on the future of diagnostics

Based at the GE Innovation Village, Cotton Mouton Diagnostics (CMD), a spin out from Cardiff University and Exeter University, is developing a point of care test for the rapid diagnosis of the life-threatening condition known as sepsis.

CMD has developed a technique that could mean that sepsis is diagnosed quickly, therefore dramatically improving patients' chances of recovery. The team takes advantage of an insight known as the Cotton Mouton magneto-optic effect, discovered by French scientists – Messrs. Cotton and Mouton – at the turn of the 20th century, allowing them to develop an innovative healthcare tool that can be used for the diagnosis of sepsis and malaria.

The CMD tool works by creating a 'lighthouse' effect. By applying a magnetic field to a large number of rod shaped microscopic magnetic particles, they all align and face in

the same direction. If the field is then rotated, the particles rotate with it. The Cotton Mouton effect occurs when light is passed through this cloud of rotating particles creating a 'lighthouse' effect, as it only passes through the cloud of particles when they are facing in the same direction as the light source. When the particles are pointing perpendicular to the light source, the light is obscured.

When conducted on a nano scale, with tiny rods suspended in a blood sample from a patient, certain proteins from the blood bind to the sides of these rods, slowing down their rotation. This in turn affects the rate at which the light shines through the sample. By measuring the light that shines through when these rods are in a blood sample, the identification and diagnosis of sepsis can take place.

Although the team's initial focus is on sepsis, the platform nature of this technology means that it is broadly applicable across a range of sectors. The team at CMD is looking to explore opportunities with collaborative partners to deliver solutions to sectors outside of healthcare over the next 18 months.

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"Supported by Innovate UK funding, we are now transforming our innovative malaria diagnostic system into an exciting, multi-analyte sensing platform. With an initial focus on sepsis, we hope to be able to help reduce the significant human and healthcare costs associated with this all-too-often fatal condition."

Jenna Bowen
Co-founder
CMD

Profile

Product

Diagnostics platform

Applications

Quick diagnosis of diseases like Sepsis

Contact

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Bees in fight with superbugs

Using nature to find new antibiotics, the honeybee is a drug discovery tool

Scientists from Cardiff University's School of Pharmacy and Pharmaceutical Sciences and the National Botanic Garden of Wales have been working together to identify plant-derived drugs which could be used to treat antibiotic resistant hospital pathogens.

Numerous species of bacteria have become resistant to antibiotics over the past few decades, so there is an increasing need to prevent and control the emergence and spread of antimicrobial-resistance in hospitals.

Funded through the Knowledge Economy Skills Scholarships (KESS), Dr Jenny Hawkins has carried out research for a PhD project that uses honeybees to help source natural antibacterial properties in plants. Professor Les Baillie from Cardiff University's School of Pharmacy and Pharmaceutical Sciences led the microbiology aspects of the project.

For thousands of years, honey has been used to treat sore throats, wounds and infections, due to compounds present in the honey that kill bacteria. These properties are the result of a range of factors including the phytochemicals donated by the plants. The contribution of these phytochemicals to the overall antibacterial activity of a particular honey depends on the properties of the plants visited by the bees. For example, Manuka honey from New Zealand is produced when bees forage on the Manuka bush (*Leptospermum scoparium*), a plant that produces a compound with potent antibacterial properties. The search to identify other antibacterial phytochemicals has led to the screening of honey produced by bees that have fed on plants from a variety of UK habitats.

"Our plan was to employ bees as private investigators and to send them out to interview every flowering plant in the country. During each visit, they collect a forensic material in the form of nectar containing phytochemicals – some of which may be antibacterial – and pollen which holds the DNA fingerprint of the plant," Dr Hawkins explained.

Dr Hawkins and the team took the antibacterial analysis of 250 samples of honey and DNA barcoded 20 of these. They were successful in using bees as a natural drug discovery tool. Compounds were present in honey found in the back garden of a beekeeper from Tywyn in Gwynedd that can kill microorganisms and combat MRSA.

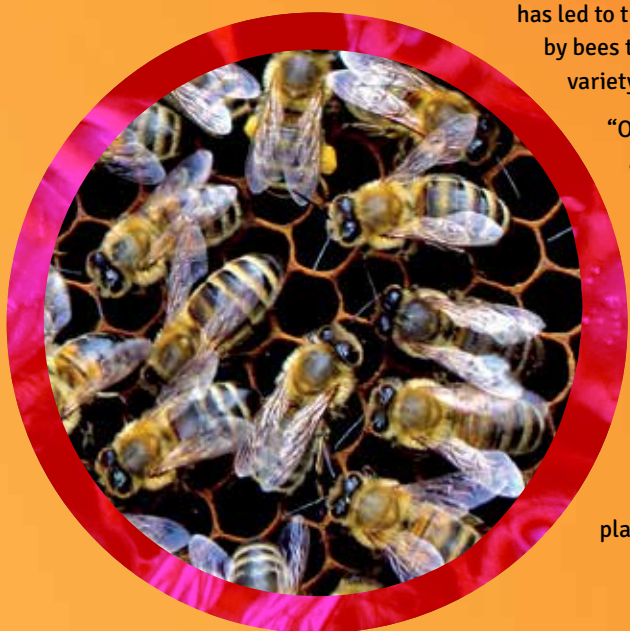
By breaking the DNA code, the team could find out which plants the bees are using to create the honey. The top 20 plants in antibacterial honey have been identified, along with other novel drugs that are currently in the process of analysis.

Using the knowledge from this project, it is possible to create a special honey by leading bees to plants with strong antibacterial elements. Dr Baillie and his team are now trying to put these plants in as many places as possible for the bees to feed upon. They plan to use a grass meadow on the rooftop of St David's 2 shopping centre in Cardiff, where they can place beehives, to see if bees will produce honey with antibacterial properties. They are also engaging with the community in Grangetown in Cardiff and hope to find a new use for a disused bowling green by creating a new habitat for bees there, too.

”

"We are working with the honeybees of Wales to survey the plants of Wales, to identify new drugs that can be used to treat the people of Wales."

Professor Les Baillie
School of Pharmacy and Pharmaceutical Sciences
Cardiff University



Professor Arwyn Jones from Cardiff University's School of Pharmacy and Pharmaceutical Sciences worked with Julian Rees from Pollen8 Cymru to expand the reach of the project, and organised a large science exhibition in the Science and Technology Pavilion at the 2014 National Eisteddfod of Wales in Llanelli. Welsh beekeepers were invited to take 200g honey samples to the Eisteddfod to help widen the study of honey from around Wales.

The project also incorporates the Barcode Wales project, led by the National Botanic Garden of Wales and supervised by Natasha de Vere, and has created DNA bar codes for 1,143 indigenous flowering plants and conifers in Wales.

Profile

Product

Antibacterial properties in plants and honey

Applications

Development of novel and natural antibiotics

Contact

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The honey DNA metabarcoding research article has recently been published and can be found here: <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0134735>

MicroRNAs with big potential

New research could help to prevent irreversible kidney failure

Scientists at Cardiff University in South Wales are investigating whether the urine of patients with acute kidney injury (AKI) could give previously hidden clues to how their condition will progress, and show how likely they are to recover from their illness. AKI affects one in six people who are admitted to hospital, causing around 40,000 deaths every year in the UK.

Dr Timothy Bowen and his team from the School of Medicine have received almost £200,000 from Kidney Research UK. They hope their work will lead to the development of new tests to show the status of AKI in patients, so doctors can monitor them accordingly. AKI can occur as a result of an operation, infection or severe illness inducing 'shock' to the kidneys, causing them to suddenly stop working properly. With the potential to become a life-threatening problem within hours, early recognition and prompt treatment are crucial. The severity of the condition can range from minor loss of kidney function to complete kidney failure, and 50-60% of people who develop the condition die as a result. This figure has not changed in the last four decades.

Existing tests for AKI include monitoring a patient's urine output and measuring the amount of toxins building up in their blood stream as a result of kidney failure. Both show that the kidneys are not working properly but will not indicate a problem immediately. However, a newly discovered group of molecules called microRNAs could help to predict the progression of AKI with a much faster test. MicroRNAs constitute a class of non-coding RNAs that play key roles in the regulation of gene expression. Previous data have shown that the levels of these molecules change in AKI, and the team will investigate this further.

During the study the team will collect urine samples from patients with AKI and evaluate the ability of microRNA levels to predict what subsequently happens to that individual. Different levels of microRNAs could indicate how likely a patient is to recover from the condition, or how likely it is that their condition will deteriorate.



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“Even though AKI is preventable, it has a very high mortality rate. We therefore wish to find ways to identify which AKI patients are most at risk of progressing to irreversible kidney failure. This will allow doctors to monitor these patients closely, and treat them sooner, to prevent this happening. We're hopeful that, in time, this work will help us to develop new methods to screen for AKI. Ideally, we'd like to produce a traffic light system enabling doctors to say which patients are at increased risk of kidney failure and will require closer monitoring.”

Dr Timothy Bowen
School of Medicine
Cardiff University

Elaine Davies, Director of Research at Kidney Research UK, said: “There is an immediate need to improve the early detection of acute kidney injury to allow earlier treatment of the condition. Unfortunately there has been little progress in recent years, and the mortality rate remains steady.

“Although it's in its early stages, we are hopeful that this research will lead to a solution. However it's also vital to increase the understanding of the seriousness of the problem, and raise awareness of the condition amongst medical staff.”



Kidney Research UK is the largest UK funder dedicated to research into the causes and prevention of kidney disease.

Clinically, AKI is characterised by a rapid reduction in kidney function resulting in a failure to maintain fluid, electrolyte and acid-base homeostasis.*

A 2009 report suggests that up to 30% of cases may be preventable.

Symptoms of AKI may include nausea and vomiting, dehydration, confusion, high blood pressure, abdominal pain.**

Those who are more likely to develop AKI are aged 65 or over, already have a kidney problem, have a long-term disease, are dehydrated, or have a blockage in their urinary tract.**

Profile

Product

Urinary microRNA detection test

Applications

Acute kidney injury prediction

Contact

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*source: The Renal Association. **Source NHS Choices www.nhs.uk

HBRU making its mark

New biomarkers show promising results for diagnosing and monitoring disease and treatment

A team at the Haemostasis Biomedical Research Unit (HBRU) at Morriston Hospital in Swansea, South Wales, has developed new biomarkers of clot microstructure, which show promising results in terms of diagnosing and monitoring disease and treatment. They have recruited almost 1,500 patients and have published their work extensively in high profile journals.

One study looked into a new biomarker that quantified the differences in clot microstructure in patients with venous thromboembolism (VTE). The study found that a biomarker of clot microstructure and clot formation was the only way to identify a significant difference between patients with or without VTE. The 'abnormal' clot microstructures in the VTE patients suggest either the presence of a procoagulant state that has not been detected by other markers, or an inadequate response to anticoagulant therapy. Furthermore, elevated values of the biomarker were found in first time patients who later developed a secondary event, indicating that this biomarker may identify those at risk of recurrence.

Founded as part of a 7-year project to develop a strategy for groundbreaking research to improve and inform healthcare, HBRU is a multidisciplinary collaboration between the ABMU Health Board and Swansea University's School of Medicine and Engineering.

The centre is led by Professor Phillip Adrian Evans and focuses on several common diseases including stroke, heart disease, sepsis, trauma, DVT, and cancer. All of which are prevalent in Wales and can result in abnormal clotting. Current tests in many of these disease states can lack diagnostic sensitivity and can be difficult to interpret in terms of disease progression and treatment effects in evaluating clinical outcome.

The latest observational phase of the research was carried out to determine how the new biomarker could be validated in a clinical setting to help with the early detection of abnormal clot microstructure in disease, assess current efficacy of treatment (anticoagulant therapy) and determine improvements in monitoring and

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“Clot microstructure is an important factor in health, disease and its treatment. The Haemostasis Biomedical Research Unit has developed an excellent reputation in the field of coagulation research. Many of the patients who come through the Emergency Department at Morriston have illnesses that affect their clotting system such as stroke, infection, trauma or heart attacks. Over the last 10 years, we have been looking at developing new biomarkers that can help us detect these effects earlier and will hopefully help us direct and improve treatments in time.”

Professor Phillip Adrian Evans
Unit Director
Haemostasis Biomedical Research Unit
Morriston Hospital



Biomarker - A naturally occurring molecule, gene, or characteristic by which a particular pathological or physiological process, disease, etc. can be identified.*

Venous thromboembolism (VTE) is a condition where a blood clot forms in a vein. This is most common in a leg vein, where it's known as deep vein thrombosis (DVT).*

Anticoagulant therapies and medicines help prevent blood clots.*

treatment. The research was also used to show how new biomarkers give improved results when compared with current standard markers of coagulation.

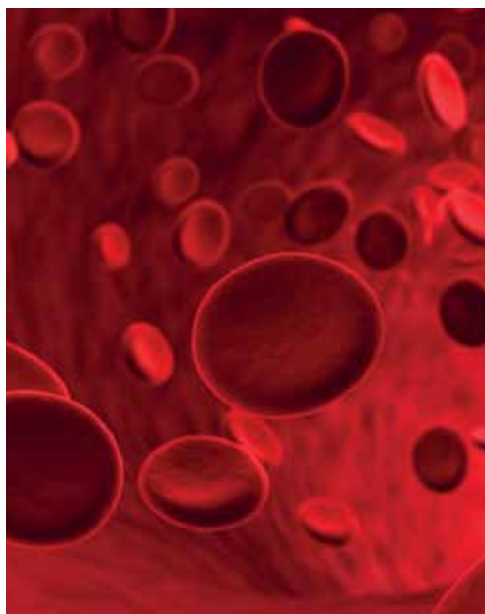
The next research phase will concentrate on selected disease states in larger clinical diagnostic studies to show how these new biomarkers can generate better clinical outcomes.

Profile

Product
Biomarkers

Applications
Diagnosing and monitoring disease and treatment

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*Source NHS Choices www.nhs.uk

Baby-making biology

Novel incubation technology creates virtual womb environment for IVF

Pioneered by entrepreneur **Andrew Skinn at Ruskinn Lifesciences in South Wales, AC-tive® IVF is a novel incubation technology that presents a controlled environment for embryos by mimicking the conditions of the female womb.**

Technology and techniques for clinical pregnancy success rates have been evolving since the first IVF baby was born in 1978, but IVF is still a relatively new science and every step of the procedure

can potentially have fatal impact on survival of the embryo. Oxygen plays a critical role in cell behaviour and the open air can be toxic to cells and limit success.

Until now, an embryo might be taken in and out of its correct conditions during development. Such movement between incubators, biological safety cabinets and microscopes compromises the success of the treatment and causes stress to the embryo.

AC-tive® IVF is a highly advanced incubator that replicates the physiological conditions of the womb and improves the success rate

system affords such stability during the process of oocyte and embryo examination. They are continuing to build clinical evidence, and so far the technology has led to highly successful results of clinical pregnancy rates between 40-70%.

For the future, Andrew sees the technology evolving to deliver a patient specific micro-controlled environment and incorporate time-lapse imaging to remotely monitor the embryo as it grows, without having to remove it from the virtual conditions of the womb. There is no existing technology that combines the perfect environment with patient specific

treatment and remote monitoring. These new developments offer an innovative future for embryologists and the potential for higher success rates of IVF.

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“For me, this innovation is about how our technology can improve the success rates of clinical pregnancy. Of course, normally entrepreneurs want to make money, but I had another philanthropic reason for developing the technology. My motivation is deeply rooted in personal experience and I wanted to bring better clinical success rates to couples that are experiencing problems with infertility. I wanted to make embryology better.”

Andrew Skinn
Director
AC-tive® IVF

by keeping the embryo in this environment throughout its time in the IVF clinic. This means that the embryo remains in the optimum conditions whilst within the reach of the embryologist, who can carry out all of the required manipulations from oocyte selection to embryo culture and embryo selection.

Every system delivers a stable incubation environment and maintains control over the critical parameters of; temperature, humidity, oxygen, CO2 and pH level. The company says that no other incubation

Profile

Product

Incubation technology

Applications

Higher success rates of IVF

Contact

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Could smell hold the key to ending pesticide use?

Scientists recreate natural insect repellent

By recreating a natural insect repellent, researchers from Cardiff University and Rothamsted Research in Harpenden may have discovered a way to save plants from attack and avoid the use of chemical pesticides.

The scientists were able to make a smell that is similar to chemical pesticides by providing the enzyme ((S)-germacrene D synthase), which creates the smell, with alternative substrate molecules.

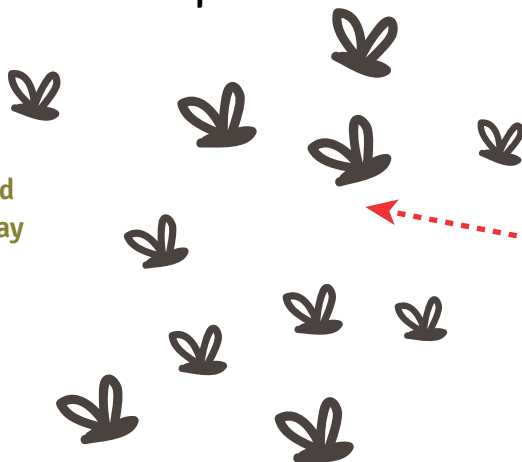
When testing how effective the smell or perfume function was as an insect repellent, the team found that the smells repelled insects in all but one case. In this case a reversal of behaviour – an attractant – was observed, which may be harnessed to develop a trap-and-kill device in the future.

Until now, progress in recreating smells has been extremely slow due to the volatile and chemically unstable nature of smell molecules.

A breakthrough in the rational design of smells, this study offers an innovative way to recreate scent by using a novel technique to produce smells with different and potentially superior properties to the original.

“By using alternative substrates for the enzymes involved in the ligand biosynthesis (biosynthesis of the smell) we can create the appropriate chemical space to reproduce, with a different molecular structure, the activity of the original smell,” said Professor John Pickett, FRS, Rothamsted Research.

The team hopes that their research could provide a new way of designing and developing small smell molecules, which would otherwise be too difficult to produce by usual scientific and commercial methods.



With field trials coming up for the current research, these findings have wide commercial and scientific potential because the research can be applied to a variety of areas.

By researching an exciting class of enzymes, scientists now have the ability to produce molecules that nature doesn't create. Their work is applicable to any molecule, meaning

there is potential to replicate drugs such as Artemisinin, an anti-malarial molecule that can also be used for cancer treatment.

These replications can also be cheaper, more readily made, enhanced and tailored to the application. Manipulating a natural molecule could even lead to the production of greener fuels or help to tackle drug resistance.

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“We know that many organisms use smell to interact with members of the same species and to locate hosts of food or to avoid attack from parasites. Through the power of novel biochemical techniques, we have been able to make insect repellent smell molecules which are structurally different but functionally similar to the original.”

Professor Rudolf Allemann
Head of the School of Chemistry
Cardiff University

Profile

Product

Smell molecules

Applications

Recreating natural insect repellent

Contact

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Hooked on the net

Researchers reveal link between problematic Internet use and impulsivity

Researchers at Swansea, Milan and Abertawe Bro Morgannwg University Health Board (ABMU) have conducted research revealing that individuals demonstrating a problematic use of the Internet become more impulsive after exposure.

The association between behavioural and cognitive problems and excessive use of the Internet is a growing concern, which has prompted the suggestion that a new psychiatric disorder – Internet Addiction Disorder (IAD) should receive further study.

An area of particular importance and concern with many behavioural addictions is the relationship between excessive engagement in an activity and high levels of impulsive behaviour, which has also been suggested as a potential concern in relation to IAD.

Professor Phil Reed from Swansea University collaborated with Professor Roberto Truzoli and Michela Romano from the University of Milan, and Dr Lisa A. Osborne from ABMU in a study to explore the impact of Internet exposure on the impulsivity of individuals who reported high or low levels of problematic Internet behaviours. During the study, levels of problematic Internet use in 60 individuals, with an average age of 24, were measured using the Internet Addiction Test (IAT).

Participants were exposed to a choice assessment, in which they could choose between a small immediately delivered outcome (impulsive), a medium-sized outcome with a medium delay (optimal), and a larger longer-delayed outcome (self-controlled).

They were given 15 minutes access to the Internet, during which most participants chose to visit social media sites. They were

likely to make 'impulsive choices', and reducing their 'self-controlled' choices.

This is the first time that research data has shown, experimentally, the changes in behaviour choice as a result of exposure to the Internet.

The key finding, that exposure to the Internet induced those with higher levels of problematic Internet use to display greater levels of impulsivity, not only establishes a link between IAD and other behavioural addictions, but also has implications for the understanding of the subsequent development of other IAD-related behaviours as a clinical phenomenon.

The behavioural acts that are encompassed by IAD, such as increasing amounts of exposure to the Internet over time, may also serve to increase the likelihood of further impulsive behaviours which, in turn, have been shown to predict further Internet usage, producing a 'circle of addiction' to the Internet.

In recent years, the Internet has dramatically altered the world largely for the better. However, this study raises awareness of the possible dangers of using such a powerful tool carelessly.




then presented with the choice test again. After Internet exposure, higher-problem users displayed greater impulsivity than before they used the Internet, indicated by a move from self-controlled to impulsive choices, suggesting that individuals reporting Internet-related problems become more impulsive after exposure to the Internet.

The research data shows that Internet exposure differentially impacted those with higher IAT scores, increasing their



Patterns of behaviour described as 'impulsive' are associated with deficits in decision-making, and can be associated with problematic behaviours, such as gambling.



“We are now beginning to see the psychological impacts of Internet misuse on a group of young people. These effects include them becoming much more impulsive and unable to produce long-term plans, which is concerning. Previous work has shown that overuse of the Internet reduces ability to study at university, which also fits with problems with long-term planning.”

Professor Phil Reed
Chair of Psychology
Swansea University

Through studying the negative effects, Professor Reed and his team hope to ultimately lead people towards regulating their use of the Internet and social media to avoid the detrimental effects.

With a large number of studies delving into the basic psychological effects of this technology, the next step is to look at the physical and physiological effects of Internet addiction. The team want to study whether physiological changes can lead to a suppressed immune function, for example, making individuals susceptible to the common cold or flu. This phenomenon could develop from increased excitement when using the Internet, or conversely from a sense of calm that causes stress and anxiety when separated from the Internet. Professor Reed and his colleagues hope to monitor participants using heart rate, blood pressure and galvanic skin response to measure alterations of the nervous system function related to Internet use, and look into the negative impact on immune function.

Profile

Product

Psychological research on Internet use

Applications

Greater understanding of Internet Addiction Disorder (IAD)

Contact

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Interaction at the zoo

Mobile app enhances interactive experience for zoo visitors

Located in Colwyn Bay in North Wales, The Welsh Mountain Zoo offers an array of animals to visit, including red pandas, Californian sea lions, the royal python and snapping turtles.

To enhance visitor experience, the Zoo has recently teamed up with Livetech – a digital creative agency based in Llandudno, to

design and launch the Welsh Mountain Zoo free mobile app to complement the Virtual Habitat, a dynamic technology for visitors to participate in.

The app uses NFC (near field communication), which is the same technology used for contactless payments and has become a more interactive way of using a Smartphone. Once the QR code has been scanned or the NFC procedure has been followed, a profile page will emerge offering background, insight and



All the main enclosures and other significant points throughout the zoo have had QR codes added to them which, combined with the latest NFC tags, enable users to download apps without the need to search and install it themselves and provide an interactive guide book on the users Smartphone.

information about the specific animal being viewed. This enables users to expand their knowledge of various animals and learn more about their food, habitat and location. They can also find out more about plants such as the Oak Tree, Maidenhair Tree and Tasmanian Tree Fern, whilst also discovering the history of local legends and culture.



“With everyone being mobile phone mad, a mobile app was an obvious way of improving visitor experience. It was great to have the opportunity to work with the Zoo to ensure a wide and varied approach to the visitor experience and appealing to all ages.”

Paul Levy
Director
Livetech Digital Creative Agency



Providing an interactive experience for visitors as they explore the grounds, the new technology gives a relevant dimension for Smartphone users visiting the zoo, which will save on printing costs and be easier to keep up to date. With the Zoo Map feature available in the app, users can follow the paths and click on pinpoints to

bring up information on what enclosures are available to view in a specific area of the park.

The future plans for Livetech are to continue keeping pace with new developments and technology, maintaining a close relationship with their clients to ensure that the technology meets their needs.



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“The new technology has added a modern aspect to the visitors' experience. The app allows visitors to access further information about the animals while stood at the enclosure, and the immersive bits in our Media Centre allow them to sense what it is actually like in the wild habitats of some of our animals.”

Jamie Toffrey
Marketing Officer
Welsh Mountain Zoo

Profile

Product

QR Codes and the latest NFC Tags

Applications

Mobile app with interactive experience for zoo visitors

Contact

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Surfing the waves

All-Optical Wavelength Conversion developed by The Wireless & Optoelectronic Research and Innovation Centre (WORIC) at the University of South Wales.

The Centre has developed a new technology that allows All-Optical Wavelength Conversion (AOWC) with the advantages of high bandwidth, high speed and low power consumption. Headed by Professor Nigel Copner, Chair of Optoelectronics, its core competence is the use of semiconductor light sources in the fields of life science, digital media, telecommunications and metrology.

Transmitting digital information to homes and offices involves a complex package of advanced technologies. Increasing demands on the global delivery of high-performance network-based applications, such as cloud computing and high definition video-on-demand, means meeting the requirements for bandwidth is a continual challenge for industry.

The most critical component in the delivery of digital information is optical fibre, which enables information to travel over longer distances at lower cost and higher bandwidth.

Sending information over long distances is usually straightforward. However, when the optical fibre reaches the edge of a city, network operators need to separate and route the information to numerous locations within the metropolitan network. Although a message may be transmitted on a long-haul fibre at one wavelength, the metro network needs to use different wavelengths to route data to the right address.

Wavelength conversion is achieved by converting an optical signal to an electronic signal (O/E), and then back to an optical signal (E/O), before re-transmitting it on a new wavelength. This approach suffers from high power consumption and creates an 'electronic bottleneck' in high-speed networks.

Due to the critical need to develop the next generation of all-optical networks with higher capacity and more powerful signal processing capability, researchers at WORIC have worked to create a solution.

The new developments will enable the key functionality required for delivery of high-performance network-based applications and support next generation all-optical networks, representing a 'step change' for the telecommunications industry and its users.

Based on a novel physical effect, this new phenomenon, named "spoof four-wave fixing", was discovered and theoretically and experimentally verified by researchers at WORIC.

The benefits of the technology are that it can provide format-transparency and high-speed broadband range wavelength conversion without the need for conversion into an electronic signal. This will allow for better efficiencies and services for internet users. The technology can be used for telecommunications and other applications where dynamic wavelength tunability is essential, such as high-performance network-based applications. It can also be used for next generation all-optical networks, and for spectroscopy, metrology and sensing. The team is currently seeking more cooperation and funding to refine this technology to meet industry requirements.

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"This proposed technology is based on modulating a nonlinear grating with a dynamic grating induced by pump and signal lasers. It does not require phase matching and thus allows broader range wavelength conversion than existing technology based on four-wave mixing."

Dr Yongkang Gong
Wireless and Optoelectronics Research and Innovation Centre (WORIC)
University of South Wales

Profile

Product

All-Optical Wavelength Conversion

Applications

Transmitting digital communication

Contact

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Powered by nature

Greenscreen - The self-cleaning screen that requires no electrical power

Samatrix, a wastewater management company based in Swansea, has developed an innovative water pumping system that cleans itself during an emergency event without the requirement of electrical power. With no running costs and a low carbon footprint, the Greenscreen offers a maintenance free operation.

Usually during an emergency spill event, such as exceptionally heavy rainfall or an electrical power failure, overflow screens prevent solids or rags going into watercourses. The current static screens will achieve their objective, but must be manually cleaned once they have become blocked.

The Greenscreen idea arose when Samatrix was called to several sites to investigate why rags were flowing into the river. Upon investigating these pumping stations, it was noted that the screens were blocked; causing an overspill that carried the rags with it.

As a solution, the Greenscreen was developed with a screen face that is swept clean as soon as the open area of the screen is significantly reduced. The outflow is then restored to its maximum. This is repeated every time the screen becomes clogged until the end of the event; when the screen will give itself one final clean in preparation for the next time it is required.

The Greenscreen uses a set of weighted floats, which operates a linkage that, in turn, raises an arm. This arm is fitted with a stiff polypropylene brush that lifts when the inflow to the screen initially occurs. Once the brush is raised, it latches into position ready for release. When the screen face partially blocks, the weighted arm and brush will release and descend by gravity providing a high impact cleaning motion and removal of any debris that is fouling the screen face.

Requiring no electrical connection, the system has a low carbon footprint compared to an electrically powered screen.

Samatrix plans to develop a range of screens that are self-powered to operate in a number of different applications. They plan to open a new facility in Wales to develop and manufacture the equipment in the future.

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“Greenscreen is an innovative solution for all types of screened overflows. It has a low carbon manufacturing footprint and is powered by nature, making it the perfect choice for the environment and the cost-conscious alike.”

Samuel Munn
Managing Director
Samatrix

Profile

Product

Self-cleaning screen

Applications

Emergency event water pumping system

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The greener house effect

UK's first 'smart' energy positive house

Experts from Cardiff University in South Wales have designed and built the UK's first purpose-built, low-cost energy smart house, which is capable of exporting more energy to the national electricity grid than it uses.

The house, designed by Professor Phil Jones and his team based at the Welsh School of Architecture, has been built as a prototype to meet tough new targets for zero-carbon housing set by UK Government.

Designed and constructed as part of the Wales Low Carbon Research Institute's (LCRI) SOLCER project, and supported by SPECIFIC at Swansea University, its unique design combines, for the first time, reduced energy demand, renewable energy supply and energy storage to create an energy positive house.

Professor Jones, who heads the SOLCER House project, explains, "The UK Government, and governments across the world, have set future targets for achieving zero-carbon housing. This means that as an academic community we have to rise to that challenge and come up with innovative new ways to build houses of the future. Through this project, we have risen to this challenge and used the latest design and technology to build a smart energy positive house. This is the first house in the UK that has been purposely built, using a systems approach, to be carbon positive."

Zero-carbon energy performance involves a combination of reduced energy demand and renewable energy supply, using the electricity grid to import and export energy.

The design of the SOLCER House follows the 'Buildings as Power Stations' concept developed by the SPECIFIC Innovation and Knowledge Centre and is unique in that it uses a number of technologies and design

approaches developed by the LCRI's Low Carbon Buildings Research Programme.

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"Buildings that can generate, store and release their own renewable energy could be a game-changer. The SOLCER House is intentionally built with the best off-the-shelf, affordable technologies, so it proves what's possible even now – and there's plenty more technology in the pipeline."

Kevin Bygate
Chief Executive
SPECIFIC

In order to drastically reduce energy demands, the house was built with high levels of thermal insulation, reducing air leakage, and uses an innovative energy efficient design which includes low carbon cement, structural insulated panels (SIPS), external insulated render, transpired solar collectors and low emissivity double glazed aluminium clad timber frame windows and doors.

The south-facing roof is comprised of glazed solar photovoltaic panels, fully integrated into the design of the building, allowing the roof space below to be naturally lit. This has been designed to reduce the cost of bolting on solar panels to a standard roof.

The house's energy systems combine solar generation and battery storage to power its combined heating, ventilation, hot water system and its electrical power systems that include appliances, LED lighting and a heat pump. A 'Transpired Solar Collector' preheats the ventilation air, which is topped up from a thermal water store.



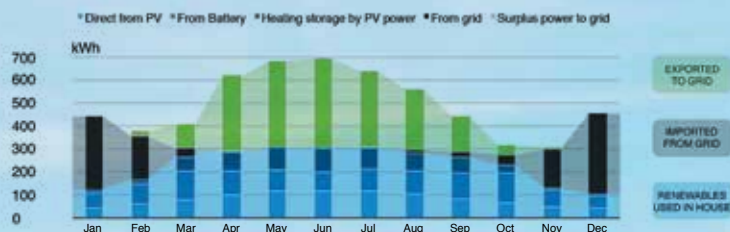
Key elements of the house:



Results

ENERGY POSITIVE

The predicted energy performance is 70% autonomous, with a 1.75 grid export-to-input energy ratio.



Professor Jones adds, "Now the house has been built, our key task is to ensure that all of the measures that we have put in place are monitored to maintain the most energy efficient use. We will use this information to inform future projects, with the aim that Wales remains at the heart of the development of a zero-carbon housing future. The building demonstrates our leading edge low carbon supply, storage and demand technologies at a domestic scale which

we hope will be replicated in other areas of Wales and the UK in the future."

The SOLCER House, situated on the site of Cenin Renewables Ltd in Pyle, near Bridgend, took a total of 16 weeks to construct and was completed in February 2015.

The project has been part-funded by the European Regional Development Fund through the Wales European Funding Office.

Profile

Product

Energy positive house

Applications

Exporting more energy to the national electricity grid than it uses

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