

THE JOURNAL FOR SCIENCE, ENGINEERING AND TECHNOLOGY

advances **WALES**

Exploring how human brains cope in space

Welsh scientists are studying the impact on the brain during prolonged exposure in space



11 Identifying Parkinson's risk through smartwatches



13 Honey alternative to antimicrobial drugs



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Medicine

- 6 Exploring how human brains cope in space
- 8 Researchers develop app to help GPs spot skin cancer
- 9 Non-invasive prostate cancer detection
- 10 Exploring the link between facial scarring and mental health
- 11 Identifying Parkinson's risk through smartwatches
- 12 Electrospinning transforms wound care

Agriculture & Food

- 13 Honey alternative to antimicrobial drugs
- 14 Genomics spearheads sheep breeding innovation
- 16 Using hydrogen to fuel sustainable food production

Biotechnology

- 17 Imprinted genes determine if mice are good parents

Information Technology

- 18 Using AI to help with disaster recovery

Earth Sciences

- 20 Advancing tidal energy and wildlife protection

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In issue 101 of Advances Wales, in print and online, we showcase the dynamic, diverse, and determined spirit of Welsh innovation.

Across Wales, a revolution in science and technology is unfolding. Advances Wales is your guide to the innovations and research propelling Wales to the forefront of global progress.

In this issue we delve into the effects of space on the human brain and reveal a new cosmic object born from a planetary collision in a distant solar system. Meanwhile, Welsh firms receive significant investment, promising to elevate Wales' space infrastructure to new heights.

In health, we explore non-invasive prostate cancer detection methods, the world's largest study linking facial scarring to mental health and look at how smartwatches could predict the onset of Parkinson's disease. Also featured is a new innovative micro fibrous wound dressing, along with a vital search for antimicrobial drug alternatives using honey. Plus, a poignant study examines the impact of loneliness on autistic individuals.

We look at how Welsh scientists are redefining sustenance, exploring how to create food literally out of thin air. While Wales is also leading the world with its sheep genetic program and transforming sewage waste into revolutionary farm fertiliser.

In animal science we discover how the 'parenting hub' of the brain, influenced by imprinted genes, determines parenting skills in mice – a breakthrough with potential implications for humans.

In the aerospace we learn about the use of drones in disaster zones, providing a beacon of hope in managing catastrophes.

Our environmental feature rings an alarm, with experts predicting a catastrophic ecosystem collapse of UK forests within 50 years if urgent action is not taken.

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Gwyn Tudor
Editor

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For information on how to contribute features contact the editor,
tel 029 2047 3455
email: advances@teamworksdesign.com

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Experts warn of threat to UK forest ecosystems

A team of European experts, including a scientist from Bangor University, has conducted a horizon scanning exercise to identify fifteen critical issues that could significantly impact UK forests in the next fifty years.

The top-ranked concern was 'catastrophic forest ecosystem collapse', identified by 64% of experts as their top issue and 88% within their top three. This term refers to the interconnected hazards leading to total or partial collapse of forests, a phenomenon that has already been observed in continental Europe and North America.

Additional threats to UK forests include competition with society for water, viral diseases, and the impact of extreme weather on forest management. Climate change is further predicted to disrupt forest management as extreme weather conditions leave a smaller window of time for forestry operations to be carried out.

The experts also stress that some emerging issues present new opportunities. Specifically, it highlights the potential for trees to play a central role in future urban planning. The term



'Forest lungs' underlines a shift towards greater integration between urban and rural areas, emphasising the expansion of green infrastructure and improved connectivity between natural environments and urban spaces.

The study emphasises the urgency of action to enhance forest resilience and highlights Bangor University's crucial role in identifying strategies to ensure the sustainable supply of essential forest products.

 www.bangor.ac.uk

New cosmic object observed from planetary collision



ARTISTIC IMPRESSION

A group of astronomers, including an expert from Cardiff University, has observed the collision of two ice-giant planets in a distant solar system for the first time. The study provides insights into a process that scientists believe our own planet underwent when it was just a few million years old, resulting in the formation of our Moon.

The term "ice-giant" typically refers to a type of planet like Uranus or Neptune, which contain water ice, frozen ammonia and methane ices, as well as hydrogen and helium gases.

The collision process has unveiled the signature of a new type of astronomical object – a "synestia", which is described as a cloud of molten and vaporised rock that takes on a doughnut-shaped

"After the alert, we decided to take a longer look with Las Cumbres Observatory's global network of telescopes. This revealed the light from the star was dimming in a wholly unexpected way."

Dr. Edward Gomez
Honorary Lecturer
School of Physics and Astronomy
Cardiff University

structure. This discovery also solves the mystery of a flash of infrared light from the host star three years previously, when the planets collided.

The research originated with an alert from the All-Sky Automated Survey for Supernovae (ASAS-SN), indicating an unanticipated dimming of a star.

This study links these two events, revealing for the first time a complete picture of how the synestia was formed. In a few million years this synestia could form a planet and moon system, similar to the Earth and Moon.

 www.cardiff.ac.uk

Sewage waste could revolutionise farm fertiliser

Researchers at the University of South Wales are exploring how sewage waste could transform the development of large-scale farm fertilisers. The team is experimenting with the byproducts of anaerobic digestion (AD).

AD is a process where human, animal, or food waste is broken down to produce biogas, an alternative to fossil-based gases, and biofertiliser. This process occurs in large, sealed, oxygen-free tanks, using microbes to separate useful gases and nutrients.

Until now, the left-over slurry, known as digestate has been difficult to develop further, despite having a high nutrient content ideal for fertiliser. Its large liquid content makes it prone to being washed away, and transport can be costly.

Furthermore, nutrients can easily leach into soil and groundwater, causing pollution. Nutrient pollution can severely impact rivers and lakes, leading to algae growth that depletes the oxygen essential for aquatic life.

The team, at the Sustainable Environment Research Centre (SERC), have developed a method to enhance digestate



by adding substances easily utilised by organisms. These proprietary additives enrich this byproduct with additional crop-beneficial nutrients. They enhance the soil conditioning properties of the final product, and the bio-available substrates transform the digestate from a liquid to a gel, slowing nutrient release approximately sevenfold compared to standard fertilisers. This ensures more nutrients are absorbed by crops, reducing nutrient pollution and soil degradation. Increased nutrient uptake has led to higher crop yields.

"There's significant potential here, with AD producing low-carbon energy in the form of biogas and the leftover digestate supporting agriculture as a fertiliser."

Dr. Christian Laycock
University of South Wales

www.southwales.ac.uk

IN BRIEF

Space companies awarded £7.9m

Two Welsh companies have been awarded almost £8m from a new fund, the Space Clusters Infrastructure Fund (SCIF), set up by the UK Space Agency to develop two research, manufacturing, and testing facilities in Wales. Cardiff business Space Forge has received £7.9m to build a National Microgravity Research Centre for advanced material research and production. The centre will be the first of its kind and play a pivotal role in advancing in-space manufacturing research, with a primary focus on inorganic crystal structures grown in microgravity conditions for use in electronics. Aerospace company Snowdonia LLP has been awarded £800,000 in SCIF funding to develop a Space Technology Test Centre at the Snowdonia Space Centre in Gwynedd. It will exploit its unique location to provide a flight test range for rocket-powered test vehicles, near-space scientific flights, microgravity research, and trials of re-entry vehicles and payload recovery systems.

Human waste heats Welsh homes

Welsh Water's wastewater treatment work in Ruthin is now processing human waste to produce gas for homes in north Wales. The waste is treated using a chemical process to turn soluble phosphorus in wastewater into a solid. The sewage sludge is then transported to a Welsh Water site in Wrexham, where it is effectively cooked using an advanced anaerobic digestion process. This produces methane gas, which is cleaned and then put into the gas grid so that people in Wrexham can heat their homes and cook using human wastes. Ruthin Wastewater Treatment Work (WWTW) is a conventional biological filtration works, serving a population of 6,403. Welsh Water has recently invested over £5m to reduce phosphorus levels at the works. The aim of this is to help reduce overall phosphorous levels within the River Clwyd.

Global Centre of Rail Excellence boosted with £15m funding

Plans for the world's first integrated train and rail infrastructure testing facility have been boosted with £15m research council funding for a related railway research and innovation centre. The Global Centre of Rail Excellence (GCRE) project plan includes the construction of two electrified rail track testing loops: one extending to 6.9km, able to test high-speed rolling stock at a maximum speed of 177kph, and an inner 4km loop allowing speeds of 65kph. It will also be able to test new developments, such as hydrogen-powered rolling stock, and infrastructure like signalling. The £15m funding from the Research Partnership Investment Fund has been earmarked for a new centre of excellence for railway testing, validation, and customer experience at the GCRE. This follows a successful bid from a consortium led by the University of Birmingham, working alongside Cardiff and Swansea universities.

American games company selects Wales as new European HQ

A US specialist games company, with offices in New York and Texas, is set to establish its new European headquarters in Wales. Rocket Science will establish its new studio in Cardiff, creating highly paid and skilled jobs for games industry graduates and professionals. These roles will involve working directly on, and solving, some of the most challenging technical projects for the world's biggest video games. The company plans to establish a presence in Wales to mirror its already successful operation in New York, with the Welsh studio positioned to support the company's European clients. Rocket Science's co-founder, Tom Daniel, is originally from Bridgend in South Wales. This investment represents a significant step-change for the games sector in Wales, as the country aims to capture a larger share of the global games market, projected to exceed \$200 billion by 2025.

Warmer, wetter winters increase risks to river insects

Warmer, wetter winters in the UK, attributed to climate change, are impacting river and stream insect populations, according to research from Cardiff University. Conducted over four decades as part of the Llyn Brianne Stream Observatory project, the study demonstrates changes in water quality, flow patterns, temperature, and river species. The findings reveal that warmer, wetter winters cause significant fluctuations in insect populations, indicating an increasing trend of species composition instability due to climate change. This study serves as a warning about the considerable influence of climate change on Welsh aquatic ecosystems. It underscores the need for proactive measures to mitigate these effects, such as protecting biodiversity and implementing flood management strategies in upland landscapes.

The impact of loneliness on autistic people



New research by Swansea University has revealed that rates of loneliness are significantly higher among autistic adults, disproving the common stereotype that they are not interested in social relationships.

Loneliness, typically referring to the absence of meaningful social connection, is a factor that significantly impacts

physical and mental health. It's observed to be up to four times more prevalent in autistic individuals than in neurotypical individuals. Autistic individuals also exhibit a heightened vulnerability to the adverse physical and psychological effects of loneliness.

People with autism often encounter greater difficulties in processing everyday sensory information than neurotypical individuals. The social landscape, in particular, can make it more challenging for those with sensory differences, often

acting as barriers to meaningful interactions. The study, including first-hand reports from autistic adults, revealed that sensory differences are related to higher rates of loneliness and poor mental health. This effect is particularly pronounced in individuals with autism due to a higher prevalence of sensory processing differences.

The study challenges the stereotypes about autistic adults lacking social motivation. It highlights the link between where people live and its impact on social interaction. One example autistic participants described is that they often struggle to make meaningful connections because their sensory sensitivities keep them from going out.

During a broader cost-of-living crisis, these challenges can become more significant for autistic individuals who often experience financial inequalities related to employment opportunities, support, and access to benefits.

"A real societal effort is needed to create spaces that consider the sensory needs of all neurotypes."

Dr. Gemma Williams
Swansea University

 www.swansea.ac.uk

Funding to develop next generation blood glucose monitor

Scientists at South Wales company Afon Technology have received €2.4 million from the European Innovation Council to support further development of the first wearable, non-invasive, real-time, continuous blood glucose sensor, a technology that supports individuals living with diabetes in managing their condition. Diabetes is a global health concern, affecting 537 million adults worldwide. In the UK, a significant portion of the NHS budget is spent on diabetes, particularly on addressing complications arising from poorly managed diabetes. The new device will use ultra-low-powered RF/microwave technology to track changes in blood glucose levels. It will be worn on the underside of the user's wrist and will connect to a companion app on the user's smart device, providing continuous glucose readings. Compared to traditional finger-pricking methods for obtaining blood glucose readings, continuous glucose monitors represent a significant advancement, allowing users to monitor their blood glucose patterns throughout the day.

Panasonic announces £20m investment in Cardiff facility

Global electronics company Panasonic has announced an investment of up to £20m in its facility in Cardiff. The firm has earmarked the facility to roll out a state-of-the-art net-zero power system as part of its ambition to use the site as a Centre of Excellence for Green Technologies within the UK. Panasonic's self-sustaining system makes use of hydrogen fuel cell generators, photovoltaic generators, and storage batteries and will strengthen Panasonic as a key supplier in assisting customers to achieve Net Zero. The technology, currently only in use at the firm's facilities in Japan, will turn Cardiff, which employs around 400 people, into another pilot site. The company will engage with higher education institutions while developing the project, and the first phase is expected to be operational by 2024.

Semiconductor cluster welcomes Investment Zone

A recently announced investment zone will focus on the globally recognised semiconductor cluster based in and around south Wales. The South Wales semiconductor cluster has been recognised as a key capability that will provide a path to stronger economic growth in Wales and the UK as a whole. Chris Meadows, Director of CSconnected, said, 'Semiconductors represent one of the world's largest and fastest-growing industry sectors. Specialising in compound semiconductor technologies, Wales plays a key role within this essential industry sector that is at the heart of our digital world, from handsets to data centres, mobility and net-zero applications, healthcare, robotics, and AI.' Investment zones form part of the UK's levelling-up strategy, focusing on high-potential clusters linked to strong research, innovation, and manufacturing capabilities. CSconnected is working with the Welsh Government and Cardiff Capital Region to design the investment zone interventions that will accelerate growth in the semiconductor sector across the region and beyond.

A new home for aerospace training

A new Training Academy at GE Aerospace Wales, north of Cardiff, is dedicated to the induction of new recruits and to providing ongoing training for aircraft engineers who work on aircraft engines from around the world. The Academy also delivers training to existing GE employees to develop additional skills in new and emerging technologies. The Academy includes a purpose-built classroom for delivering engineering theory and compliance training, and a comprehensive practical training area that utilises engine modules and components to accelerate the learning of new starters. An extensive range of real engine components is available for new employees to train for production roles focused on the overhaul and repair of commercial aircraft engines. In conjunction with Coleg y Cymoedd, the new facility also provides a training area for new electrical and mechanical engineering apprentices. University placement students can also spend time at the Academy, ensuring they have the best possible start to their year with GE Aerospace.

Putting bugs on the map

Wales has become the first country in the world with a map of its most important areas for insects and other invertebrates. Buglife – The Invertebrate Conservation Trust has launched the 'Important Invertebrate Areas: Putting Bugs on the Map in Wales' report. The report lists a network of 17 Important Invertebrate Areas (IIAs) identified by the charity, working with experts and using millions of records collected by naturalists. Wales is home to iconic and threatened species found nowhere else in Britain, such as the Cliff Mason Bee, now only known from two short stretches of Welsh clifftop, and the Critically Endangered Scarce Yellow Sally Stonefly, which is only found on the River Dee. The IIAs, which are home to nationally or internationally significant invertebrate populations and their habitats, took nearly five years to map. They cover 1,344km² of Wales. Although this is just 6.5% of the country, they are home to over 10,800 species of invertebrate, including 7 species found nowhere else in the world.

Exploring how human brains cope in space

A team of researchers from the University of South Wales has initiated a year-long expedition to the most isolated base on Earth, collaborating with an international space crew.

Unlike the Earth's atmosphere, the pressure in space is close to zero. When the human body is exposed to such conditions, the lack of atmospheric pressure can lead to the diffusion of oxygen out of the bloodstream and into the lungs. This, in turn, can result in hypoxia, a condition where there is a deficiency of oxygen reaching the body's tissues.

The focus of their investigation involves studying the impact on the brain during prolonged exposure to low oxygen levels, a phenomenon inherent in space exploration. Hypoxia is known to induce symptoms like headaches, difficulty breathing, rapid heart rate, and bluish skin.

The collaborative project involves partners such as the European Space Agency (ESA), French Polar Institute (IPEV), Italian National Antarctic Program (PNRA) and German Aerospace Centre (DLR). In collaboration with Benjamin Stacey, Lecturer in Clinical Science from USW's Neurovascular

Research Laboratory, the study will investigate the effects of extended exposure to low oxygen levels on the brain.

In November 2023, the expedition crew journeyed to the Concordia Research Station located in Antarctica. Positioned on a plateau 3200 meters above sea level, with winter temperatures dropping to -80°C and a yearly average of -50°C , Concordia offers a unique setting for research. As it's situated at the southern tip of Earth, the crew will experience four months of living without sunlight due to the sun not rising above the horizon in winter and not setting in summer in the region. These extraordinary conditions present unparalleled research opportunities at the base.

The study aims to shed light on the long-term effects of hypoxia and make valuable contributions to the future of space exploration, which will necessitate astronauts to spend prolonged periods in hypoxic conditions.



“The future of human space exploration will require astronauts to perform activities outside their spacecraft, and consequently experience extended periods of hypoxia. The long-term consequences of this extended lack of oxygen have been associated with impaired learning and memory in those that fail to acclimatise to the environment. For the next stage of the research, we have trained a medical doctor within the crew to collect data for us.”

Professor Damian Bailey
Principal Investigator

The project has provided a unique opportunity to capture longitudinal data to explore precisely how the brain behaves in response to this environmental stress by assessing changes in brain structure and function, thereby contributing to the future of space exploration.



The Concordia Research Centre, Antarctica



Contact
Damian Bailey
University of South Wales

www.southwales.ac.uk
damian.bailey@southwales.ac.uk



PONTYPRIDD

Researchers develop app to help GPs spot skin cancer

Researchers at the University of South Wales are harnessing the power of artificial intelligence to develop an app that can support doctors in diagnosing skin cancer more efficiently.

Rates of skin cancer have been rising in both men and women in recent years. According to Cancer Research UK, 86% of melanoma skin cancers in the UK are linked to overexposure to ultraviolet (UV) rays, originating from the sun and, increasingly, from sun beds.

While much less common than other skin cancers, melanoma is often called one of the most serious because it is more likely to spread to other organs in the body. Like many cancers, melanoma is treatable if it is diagnosed early.

The app, developed in collaboration with Cardiff and Vale University Health Board, aims to offer a new ground-breaking tool to help GPs more easily identify potential skin cancers.

Using anonymised data collected from NHS patients, and the results of analysis of their potential skin problems, it

can learn what characteristics to look for and highlight any features that are clinically important, and then flag this to the medical staff. This includes characteristics such as shape, colour, asymmetry, border irregularity and dermoscopic structures of the lesions - which are common signs of malignant growths.

By analysing this data, the app offers a valuable tool to support GPs in diagnosing skin lesions, which are abnormal growths or changes in the skin's appearance, colour, or texture, helping them decide if a referral to a specialist is required.

GPs are not specially trained in spotting potentially malignant marks on a patient's skin. Dermatologists have also found themselves overwhelmed by the number of referrals they receive from GPs looking for specialist support in this challenging field.

The app aims to allow room to use a more objective system to identify particular characteristics of any

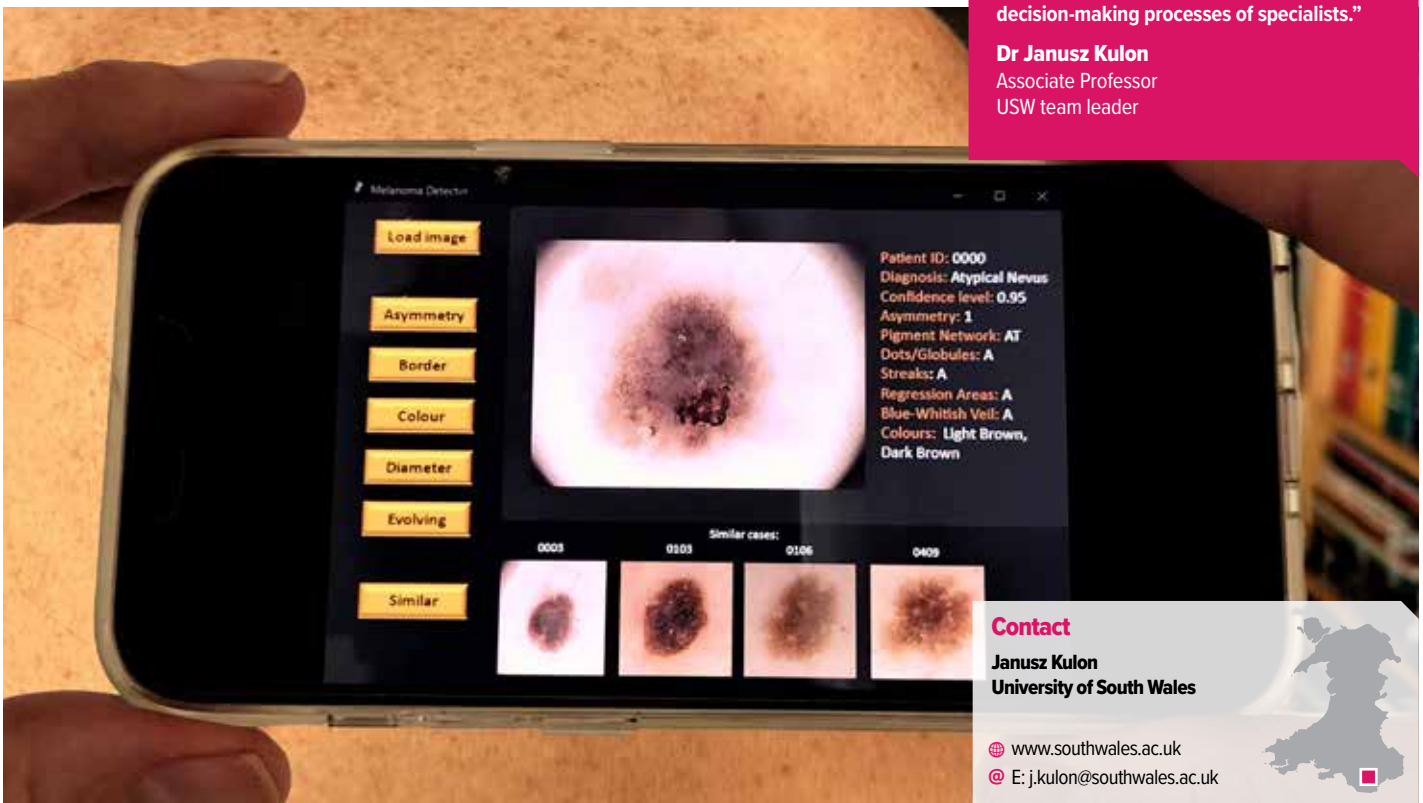
abnormalities that are especially diagnostically challenging.

While not pegged as a replacement for human expertise, the aim is to offer an AI-based tool to support medical specialists and make the diagnosis system more efficient. The next phase involves transitioning the concept into real-world evaluation.



“The endpoint of this project is an app which has been validated through a clinical trial. What we have at the moment is a set of algorithms which are being developed to help the system continually learn and understand how changes in the lesions have impacted patients in the past, and how that knowledge could be used in the future to support the decision-making processes of specialists.”

Dr Janusz Kulon
Associate Professor
USW team leader



Contact

Janusz Kulon
University of South Wales

🌐 www.southwales.ac.uk
✉ E:j.kulon@southwales.ac.uk



PONTYPRIDD

Non-invasive prostate cancer detection

Prostate cancer is the most common form of cancer to affect men, with over 52,000 cases diagnosed in the UK per year. Most patients have slow growing cancers, but some patients have aggressive disease and require urgent treatment.

Current diagnostic tests, such as the PSA (Prostate Specific Antigen) blood test, are not sufficient and early identification of those patients with aggressive disease remains a major challenge. Accurate diagnosis often requires an invasive biopsy which has associated risks, including potential impotency and incontinence. As a result, there is a need for a non-invasive way of identifying patients with aggressive prostate cancer while limiting the need for invasive biopsy, and so improving the lives of patients living with this disease.

To address this challenge, Swansea University's Medical School have been studying the mechanisms associated with prostate cancer progression. It is widely understood that the tumour microenvironment is complex, and communication between the key components is fundamental to the pathological processes associated with tumour growth and disease progression.

One aspect that is rapidly gaining interest is the role of extracellular vesicles (EVs). EVs carry many of the cargoes associated with the cell of origin and can therefore be said to act as a miniature representation of the cell. Importantly, researchers have shown that EVs can pass through tissues, cross biological barriers, and enter the circulatory system, they are therefore present in biological fluids such as blood and urine. The team is developing several assays (detection methods) that

can detect prostate cancer EVs, either in patient blood or urine. At present they have two assays focussing on detection of specific genetic material (RNA) contained within EVs, or sugars (glycosaminoglycans) present on the EV surface.

Early results from these assays are very promising, suggesting that they can predict the outcome of biopsy with greater accuracy than the current PSA blood test.

The team are now testing the assays on larger numbers of patient samples. It is hoped that these assays could sit alongside existing tests used for prostate cancer diagnosis, providing additional information to both the patient and clinical team to help inform decisions relating to management of disease. Importantly, the assays only require a small



“The blood sugars we're focusing on aren't the same as the sugar, or glucose, we consume in food and drinks. These sugars are made by cancer cells and therefore present on the surface of 'extracellular vesicles', released by prostate cancer cells, and so provide a potential novel method for diagnosing this disease. Early diagnosis is key to treating prostate cancer and it is certainly one of the things that has become more apparently over recent years.”

Dr Jason Webber
Research Lead

sample (less than a teaspoon) of blood or urine and are non-invasive so, if needed, they can be regularly repeated throughout the care process without a risk to the patient.

By limiting the need for biopsy the team hope to improve the lives of men undergoing diagnostic testing for prostate cancer. Since the tests are non-invasive there is no associated recovery time – unlike biopsy, which is a surgical procedure, requiring patients and/or family members/carers to take time either away from work or other pursuits.

Contact

Dr Jason Webber
Swansea University

www.swansea.ac.uk

01792 205678 ext 1655

j.p.webber@swansea.ac.uk



SWANSEA

Exploring the link between facial scarring and mental health



Researchers at Swansea University have published the world's largest study highlighting the association between anxiety and depression in people with facial scarring.

The study revealed that people with facial scars have an elevated risk for anxiety and depression compared to the wider population. Facial scarring is categorised as congenital or acquired, affecting individuals of all demographics. Despite advancements in wound healing and surgical techniques, there's a shortage of effective prevention and post-surgical management for facial scarring. Since the face is constantly exposed to the environment, scars on this part of the body may have a tougher time healing.

Key findings from the study indicated that mental health challenges are most prevalent in cases of facial scarring from self-harm, assault, or traumatic injuries like burns. Conversely, those with scars from congenital conditions are less likely to be treated for anxiety and depression. Additionally, women, individuals

with a history of poor mental health, and those experiencing deprivation face an elevated risk.

The research, which analysed health data from Wales based on Swansea University's SAIL Databank, identified 179,079 people with facial scars. The researchers compared these records with an equal number of individuals without scars, considering factors like socio-economic status, age of facial scarring, and gender. By comparing the GP records of these matched pairs, the researchers determined the number of people with and without facial scars who received treatment for anxiety and depression.

While estimates suggest that 1 in 100 people in the UK live with facial scarring, psychological support is often limited. The study aims to reshape the support provided to individuals with facial scars, ensuring these individuals can live without shame or anxiety.



"I've been a plastic surgeon for 20 years, and I see a huge number of patients that need to have cancers on their face removed, or who have facial injuries. Every surgery leaves a scar but currently, there is an absence of psychological support for patients. It's important to me as a doctor that I know the repercussions of treatment on my patients beyond the immediate physical effects. I want to give my patients better information and a better patient experience. I hope this research leads to a more robust system of mental health support for patients with facial scars."

Professor Iain Whitaker

Lead Investigator
Swansea University Medical School

Contact

Kathy Thomas
Swansea University

🌐 www.swansea.ac.uk

☎ 01792 604290

@ katherine.thomas@swansea.ac.uk



SWANSEA

Identifying Parkinson's risk through smartwatches

New research by Cardiff University has found that smartwatches could help to predict who is likely to develop Parkinson's disease, up to seven years before clinical diagnosis.

Parkinson's disease is a progressive movement disorder caused by the loss of brain cells that use dopamine. However, by the time of clinical diagnosis approximately 50-70% of these brain cells will have been lost. This makes early diagnosis of the disease difficult.

While Parkinson's is largely recognised for its motor symptoms, such as tremors and slowness of movement, non-motor changes in an earlier stage of the disease called the prodromal stage, can predate the onset of these symptoms by many years.

In a clinical setting, continuous or semi-continuous monitoring of individuals can't be achieved because of time, cost, accessibility and sensitivity. But smart devices capable of collecting accelerometer data are worn daily by millions of people.

The team from the University's Neuroscience and Mental Health Innovation Institute (NMHII) and the UK Dementia Research Institute, found that wearable tech that tracks accelerometry

– the acceleration of motion – could be vital in identifying individuals in the general population who are most likely to develop Parkinson's disease.

Using data from over 500,000 individuals aged 40-69 years through the UK Biobank which dated back to 2006, the researchers compared data on accelerometry to models based on genetics, lifestyle, blood biochemistry, and prodromal symptoms data. They found that computer programmes trained using the accelerometry data were able to distinguish both patients with clinically diagnosed Parkinson's disease and prodromal Parkinson's disease from the general population. No other data type in their research performed better than accelerometry.

While more work will need to be done before this is put into clinical practice, the discovery marks significant progress in the early diagnosis of Parkinson's disease and suggests that devices such as activity trackers and smartwatches could play a key role in clinical monitoring.



“We know that as Parkinson's disease develops, there are changes to the speed of movement, so we investigated whether accelerometry could work as a prodromal marker for Parkinson's disease, and ultimately allow for earlier diagnosis.”

Dr Kathryn Peall

Clinical Senior Lecturer
NMHII



“To our knowledge, this is the first demonstration of the clinical value of accelerometry-based biomarkers for prodromal Parkinson's disease in the general population. Our results showed a pre-diagnosis reduction in acceleration was unique to Parkinson's disease and was not observed for any other disorder that we examined. It suggests that accelerometry could be used to identify those at elevated risk for Parkinson's disease on an unprecedented scale.”

Dr Cynthia Sandor

Dementia Research Institute

Contact

Alice Gray
Cardiff University

www.cardiff.ac.uk

029 2087 6986

graya8@cardiff.ac.uk



CARDIFF

Electrospinning transforms wound care

A new technology stands at the forefront of medical innovation in the field of wound care.

With their portable electrospinning device, Corryn Biotechnologies, a spin-in company to Swansea University, aims to improve the treatment of chronic and complex wounds.

This method of fabricating and applying advanced dressing materials offers significant advantages, including reduced interventions and re-dressings, and allowing for completely contactless dressing application. The approach is especially significant in the context of diabetes and its associated chronic wound risks.

The challenge of chronic and complex wounds is significant, often leading to poor clinical outcomes, high treatment costs, and negative patient experiences. Chronic wounds represent a major global health issue, according to the International Diabetes Federation, there are 537 million diabetic adults worldwide, with 6.8% of the global population affected by diabetes. Among these individuals, 1 in 4 is expected to develop a chronic wound at some point in their lifetime which translates to approximately 135 million people at risk. More alarmingly, up to 27 million of these people could face amputation due to chronic wounds, with a subsequent 5-year mortality rate as high as 55%. Furthermore, more than 50% of healed wounds may recur within two years, re-exposing patients to risks of mortality and amputation while treatment of chronic wounds in the UK costs the NHS £5.6 billion per year.

Corryn's new electrospinning solution, a non-contact wound-dressing applicator with advanced resorbable dressing materials, addresses the challenges related to treating chronic wounds. Clinical use data for electrospun wound dressing products have shown advantages over traditional dressings on partial-thickness wounds, complex arterial ulcers, pressure ulcers and diabetic foot ulcers, including reduced inflammation and oedema (swelling caused by fluid trapped in the body's tissues), and leading to faster wound healing times. The company combines the use of these materials with a novel application approach which minimises pain for the patient, whilst keeping costs low for healthcare providers.

As the company moves towards clinical trials and further development, their technology stands to make a significant impact on the lives of people suffering from chronic wounds, while potentially easing the financial burden on healthcare systems globally.

Dr Luke Burke, Co-Founder & CEO, Corryn Biotechnologies says: As a breakthrough treatment for patients suffering with complex wounds, there is a long road to market, to ensure our technology is brought to patients safely and effectively. We're really excited to see our technology develop through biocompatibility and preclinical studies, to advance our mission of providing bespoke dressing solutions for every wound, and every patient."



Electrospinning technology offers several benefits:

- **Biomimetic tissue scaffold:** Mimicking the natural extracellular matrix, it facilitates natural cell growth and wound closure.
- **Fully resorbable materials:** These advanced polymers eliminate the need for painful dressing removal.
- **Non-contact application:** Reduces pain and infection risk by avoiding direct wound contact.

Contact

Luke Burke
Director

🌐 www.corryn.co.uk

☎ 0597 784273

@ luke.burke@corryn.co.uk



SWANSEA

Honey alternative to antimicrobial drugs

Scientists at Cardiff University are looking to honey as an innovative alternative to antimicrobial drugs to step up the fight against antimicrobial resistance.

Antibiotic resistance is one of the biggest threats to global health. While it's a process that occurs naturally, the antibiotic crisis has been accelerated by the misuse of antibiotics in humans and animals.



Today a growing number of infections like pneumonia and tuberculosis are becoming much harder to treat. In 2019, bacterial AMR was directly responsible for 1.27 million global deaths, and by 2050, antibiotic resistance is predicted to kill as many people as cancer annually.

Honey has been used for thousands of years to treat wounds, but Cardiff University scientists are now using it in a search for an innovative way to lessen reliance on antimicrobial drugs. It is known to contain compounds that are antimicrobial, making it powerful against a variety of microorganisms including multidrug resistant bacteria.

Its antimicrobial properties arise from a variety of factors, including low water content, high sugar concentration, natural acidity, bee derived compounds and the presence of phytochemicals like flavonoids, which come from plants visited by bees. These factors create an inhospitable environment for bacteria, dehydrate them, and inhibit microbial growth.

Known for its antimicrobial properties, the effectiveness and potency of honey against bacteria is influenced by the geographic location from which the honey was collected and the manner in which the honey was processed.

Given that honey is a complex mixture of components, the challenge now is to identify and isolate the individual compounds which are responsible for antimicrobial activity. Researchers are currently examining samples, collected from different locations across the UK, in an effort to identify the plants which are the original source of these antimicrobial compounds.

They are able to do this by analysing the pollen found in raw honey as it represents a record of all of the plants visited by the bees to make a particular sample of honey.

Using a DNA based approach makes it possible to identify individual plants and test them for the presence of compounds capable of killing antibiotic-resistant bacteria such as MRSA.

Long-term, the research aims to enlighten the way for developing drugs derived directly from the plants rather than relying on honey alone, making it a valuable tool in the search for new antibiotics, acting as a "drug discovery tool".

Contact

Professor Les Baillie
Cardiff University

www.cardiff.ac.uk

Bailliel@cardiff.ac.uk



CARDIFF

Genomics spearheads sheep breeding innovation

Livestock breeders in the hill sheep sector are leveraging the power of genomics. Welsh farmers and breeders are setting a new standard in the use of genomic breeding values, a method previously well-established in the dairy and rapidly developing in the beef industry but not yet fully utilised in the UK sheep sector.

The Hill Ram Scheme was delivered by Hybu Cig Cymru - Meat Promotion Wales (HCC). Its fundamental aim was to foster the use of data and genetics among hill farmers and breeders, enabling them to make informed decisions about their flocks and create a critical mass of performance-recorded hill flocks.

Traditional livestock breeding involves the identification and selection of animals for specific breeding objectives based on their performance and that of their relatives. The scheme has explored the feasibility of developing genomic breeding values in the hill sheep sector as well as empowering hill farmers to performance record their flocks without making fundamental changes to their extensive systems. This approach moves away

from predictions based on assumed inherited genes to using genomic information that reveals the actual genes an animal possesses.

Genomic information provides critical insights, especially for traits that are time-consuming to assess, such as ewe longevity, traits expressed only in females, or those expensive to record like meat quality. This information is crucial as it verifies parentage but also provides information



DNA Shepherding



about the myriad of small genetic variations that cumulatively determine the overall genetic merit of an animal.

A unique and extensive DNA database has been built up, enabling the determination of lamb parentage through the extraction of DNA sequences (genotypes) from tissue samples of lambs, ewes, and rams. A feasibility study conducted as part of this work has shown that by accounting for genetic linkage between flocks, predictions of genetic merit can be made relative to the wider recorded population, offering breeders increased accuracy and confidence in their genetic selections.

Fifty farmers participated in the scheme, using the latest DNA technology for recording within their flocks to utilise the genomic data further. Their work, along with the guidance of geneticist advisors from the Hill Ram Scheme has been instrumental in the success of the project.

This work is a first of its kind project that puts Welsh farmers and breeders at the forefront of livestock breeding and genetic information and demonstrates their capability as a leader in sustainable and effective hill farming. The legacy of the scheme will be to inform and transform the wider sheep sector, paving the way for a new era in genomic sheep breeding.






“Bringing the latest scientific breeding technology to traditional hill farms in Wales was a unique project, but Welsh hill farmers rose to the challenge And as a result have put the industry in a stronger position.”

John Richards
 Producer and Processor Lead
 HCC



Contact

Meat Promotion Wales

-  www.meatpromotion.wales/en
-  01970 625 050
-  info@hybucig.cymru



ABERYSTWYTH

Using hydrogen to fuel sustainable food production



The FerMôntation project, led by the social enterprise Menter Môn in collaboration with Lafan Consulting Group, explores the use of hydrogen for sustainable food production through precision fermentation.

FerMôntation is the first project in Wales to investigate the potential of hydrogen for protein production. The project is centred on assessing the feasibility of this innovative technology. Precision fermentation is a sophisticated variant of traditional brewing, it involves the cultivation of microbes to produce specific products, such as proteins. This project aims to research the feasibility of hydrogen as a feedstock to develop a diverse array of food products, including alternative proteins

Precision fermentation has the advantage of being a sustainable and cost-effective method for food production. This technology aligns with the growing global demand for sustainable food sources. The integration of this process into food production can lead to the creation of novel food products and diversifying the food industry.



The scope of the project extends to evaluating the potential role of hydrogen in enhancing sustainable food production and its contribution to the economy. Further scope could include a potential laboratory

phase, which will provide tangible insights into the practical applications of hydrogen usage in precision fermentation for food production.

Precision fermentation could represent a significant step towards sustainable food production. Ongoing research will play a key role in determining the full potential of precision fermentation for food production in Wales.

Contact

Menter Môn

🌐 www.mentermon.com

☎ 01248 725 700

✉ enquiries@mentermon.com



LLANGEFNI

Imprinted genes determine if mice are good parents

New research by Cardiff University delves into the fascinating role that imprinted genes located in the “parenting hub” of the brain plays in determining whether a mouse is a good or bad parent.

Mammals have two copies of every gene – one inherited from each parent. Normally, each copy has the potential to be active, or “turned on”, in any cell. The function of genomic imprinting has long baffled scientists, though the concept has become better understood in recent years. With imprinted genes, only one of the two copy is turned on, either the one inherited from the father or the mother. Researchers are not yet sure why some genes are imprinted while others are not.

The research unveiled compelling evidence suggesting a connection between the parenting capabilities of mice and imprinted genes in the brain's “parenting hub”. By delving into the fascinating role that imprinted genes play, the study is a step closer to unravelling the complexities of genetic influences on parenting.

To verify the involvement of imprinted genes, the team analysed sequencing data from neurons in the hypothalamus, the “parenting hub,” of mice. They discovered a high prevalence of imprinted genes in these cells, including *Magel2*, a previously unrecognised gene associated with parenting. Subsequent experiments revealed that mice without an active *Magel2* gene form were inattentive parents, responsible for creating below-par nests.

The latest study highlights the significant role of genomic imprinting in influencing parenting behaviour in mice. Intriguingly, past studies have indicated that when mouse pups lose the paternal version of *Magel2*, they produce fewer ultrasonic vocalizations, a means to attract their mother's attention.

Together these findings collectively support the notion that genomic imprinting has evolved to coordinate parental interactions between a mother and her offspring.

Understanding these genetic influences can have broader implications for studying parental care and behaviours in various species, including humans, as it provides insights into the molecular basis of parenting.



“Our study demonstrates the importance of imprinted genes as a group in neural circuitry that controls parenting behaviour in mammals. These findings imply that the maternal and paternal genomes may differentially manipulate parental care for their own ends, and thus shaping the evolution of parenting behaviour in mammals.”

Professor Anthony Isles
Cardiff University



Contact

Professor Anthony Isles
Cardiff University

www.cardiff.ac.uk

029 2068 8467

IslesAR1@cardiff.ac.uk



CARDIFF

Using AI to help with disaster recovery

Research underway at the University of South Wales holds promising implications for improving structural health monitoring (SHM) through the integration of AI, with potential life-saving impacts in regions susceptible to natural disasters.

In civil engineering, structures can undergo deterioration over time if not properly maintained, leading to a decline in their structural integrity and eventual failure. SHM plays a pivotal role in inspecting and evaluating various infrastructure systems like bridges, railways, tunnels, buildings, and dams. This preventative measure helps ensure the ongoing safety and reliability of these structures to prevent catastrophic failures that could have severe consequences, including loss of life.

The project aims to look in more detail at how the use of drones and AI can make the SHM process quicker, safer, and more robust – and able to be carried out remotely. Traditionally, the process involves on-site visual inspections by qualified engineers, searching for signs of deterioration like cracks,





corrosion, or deformation. These inspections are often complemented by lab tests. However, these methods are resource-intensive, lack consistency, and may not provide real-time data.

The project aims to make this more efficient by incorporating AI techniques to identify defects, damage, or potential failures. This could have significant implications for enhancing infrastructure resilience and safety and the ability to respond effectively in crisis situations.

With real-time data provided by the AI system, for instance, emergency response teams can be better equipped to act promptly. This becomes especially significant in regions prone to frequent or intense natural disasters, as it allows teams to respond remotely, ensuring their safety while addressing urgent infrastructure needs.



“When natural disasters, such as earthquakes, occur, being able to monitor infrastructure remotely could have a range of benefits. The system can be deployed from a safe distance, specialists far from the area can gauge any damage and need for repair or advise on the need to restrict access to any unsafe structures - the applications could be numerous.”

Dr Ian Wilson

Associate Professor
Faculty of Computing, Engineering and Science
University of South Wales



“By continuously monitoring and assessing structural integrity, we can make timely repairs and retrofitting existing infrastructure, and extend the lifespan of critical infrastructure to address the challenges posed by climate change and to create a more resilient future for our communities.”

Dr Jiping Bai

Associate Professor
Research and Development
University of South Wales

Contact

Mthabisi Nyathi
University of South Wales

🌐 www.southwales.ac.uk

📧 mthabisi.nyathi1@southwales.ac.uk



PONTYPRIDD

Advancing tidal energy and wildlife protection

The development of Morlais tidal energy off the coast of Holyhead in north Wales, is the largest consented scheme of its kind in the UK and represents significant progress in terms of both renewable energy generation and environmental protection.

Key to the scheme is the Marine Characterisation Research Project (MCRP). Run by social enterprise, Menter Môn, it involves a network of academics, environmental bodies and businesses from around the UK which ensures comprehensive monitoring of marine mammals and birds in the Morlais zone.

An important aspect of the work carried out by the MCRP is the deployment of an advanced environmental monitoring buoy. The buoy, equipped with data collection technology including surface and underwater infrared and red-green-blue (RGB) cameras, is designed to protect marine wildlife in the area. The data gathered from these technologies will provide insights into the feeding patterns and movements of various sea creatures, such as dolphins and porpoises.

Clare Llywelyn, MCRP project manager explains: “The buoy will help us carry out valuable environmental research which will support this development as well as other similar schemes across the world. The main focus is to trial visual data collection methods as well as to analyse the information gathered to automatically identify species. The project will help us learn more about



The buoy will gather environmental data and help to safeguard wildlife in the sea

marine mammals living in the area and how we can protect them.”

The project’s findings will be shared with similar tidal stream energy projects around the world. It will inform the development of the global tidal energy sector, helping to ensure that the deployment of turbines does not negatively impact the marine ecosystem.

The first phase of the project focuses on environmental monitoring and is expected to continue until 2026. Following this, the installation of turbines will begin, with continuous environmental

monitoring throughout the project’s lifetime to safeguard marine mammals and seabirds.

As the development progresses, it is set to make a substantial contribution to sustainable energy and wildlife protection, setting an example for similar initiatives globally. Once fully operational, Morlais will be able to provide clean electricity for up to 180,000 homes.

Contact

Clare Llywelyn
Menter Mon

🌐 www.mentermon.com/en/prosiectau/prosiect-ymchwil-nodweddu-morol

🌐 www.morlaisenergy.com

✉ enquiries@mentermon.com



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