achievements





Llywodraeth Cymru Welsh Government

Introduction

Living Wales

The Environment and Science Bioscience and Health Energy

Building Wales

The Built Environment Engineering Materials

A Wider Wales

Telecommunications and ICT Creative Industries Transport

People

This publication is also available in Welsh.

Welsh Achievements is available online at: businesswales.gov.wales/innovation/news

Print ISBN: 978-1-83876-835-5 Digital ISBN: 978-1-83876-920-8 © Crown copyright 2020 WG40257 "Great scientific discoveries are an inspiring testament to the profound capabilities of the human mind. The recognition of such talent in Welsh Achievements is designed to inspire young academics and future generations, by demonstrating what is possible when ability is recognized, nurtured, and given the opportunity to flourish".

Prof Peter W Halligan Chief Scientific Adviser for Wales



On a global scale Wales is a small, but smart country, in which every opportunity has been taken to optimise resources, designs and processes.

Shaped by landscape and culture it made its mark on the world through the maximisation of the great natural mineral wealth found here.

Wales continues to make its mark through in-depth scientific and technical understanding and commercial innovation.

From the past to the present an impressive list of achievements, many of which are the first of their kind in the world, have given Wales a great momentum for the future.

2,000 years ago

Roman engineering technology used to extract gold from the Welsh hills along with copper, lead, zinc and silver.

AD 300

Ancient Celtic boatbuilding techniques being used in Wales.

AD 780

King Offa builds a dyke from sea to sea which defines the eastern boundary of Wales.



The Environment and Science

With its long history of mining metal smelting and slate quarrying, it was not surprising that Wales faced many environmental challenges in dealing with contaminated land.

Through a combination of academic research, enlightened civil engineering and central government funding these challenges have been overcome to regenerate safe and beautiful landscapes throughout Wales.

Wales's expertise in the environmental sciences is assisting organisations throughout the world to deal with environmental issues and has seen many challenges abroad successfully overcome by Welsh-based groups.

AD 800	1557	1563
St. Cadfan's stone at Tywyn contains the earliest known example of written Welsh language.	Equals (=) sign in mathematics invented by Robert Recorde of Tenby.	First pound lock canal in Britain built by Glamorgan based engineer John Trew.

The BEACON Biorefining Centre of Excellence at the Institute of Biological, Environmental & Rural Sciences (IBERS) at Aberystwyth is engaged in the scientific process of transforming plants into valuable chemicals and commercial products such as cosmetics, fuels, pharmaceuticals, textiles and health products.

A polar explorer and authority on the study of temperate glaciers and their modelled response to climate change, Professor Tavi Murray of Swansea University has been honoured with the Polar Medal for both Arctic and Antarctic research.

DNA-based technology for detecting and identifying pollution affecting our waterways and beaches was pioneered by Ystrad Mynach based EnviroGene Ltd.

Born in the Rhondda Professor Howard Purnell pioneered gas chromatography for chemical analysis at Swansea University.

Live willow support systems for slope stabilisation, was developed by Richards, Moorehead and Laing of Ruthin who have also pioneered the use of bulk waste materials as cement substitutes in collaboration with Cardiff University.

Lion Laboratories of Barry developed the world's first electronic breathalyser in 1974 used by police forces around the world to measure the evidential alcohol levels of motorists.

1568

First brass in Britain produced at Tintern.

1613

Sir Thomas Button commanded an expedition to find the Northwest Passage. He explored the west coast of Hudson Bay and named the area New North Wales and New South Wales.



Aberdare born Dr Lyn Evans led the most significant attempt so far to unravel the mysteries of the universe, using the European Nuclear Research Organisation's Large Hadron Collider in Geneva.

Eleanor Vachell and Margaret Davies were active in Welsh conservation and botanic studies with Kathleen Sampson pioneering research into diseases of herbage crops. All three regarded as international women in science.

1700

World's first waterpowered rolling mill at Pontypool mass produces sheet plate iron.

1715

First Newcomen atmospheric steam engines erected in Wales.

1755

Pontypridd bridge, completed by William Edwards across the river Taff, was Britain's largest span bridge. The National Plant Phenomics Centre at IBERS uses one of the most sophisticated research greenhouses and a unique <u>facility</u> in the UK. Welsh scientists contributed to the fight against climate change with the IPCC scientific assessment working group co-chair Sir John Houghton being a joint recipient of the 2007 Nobel Peace Prize.

The application of computers to weather forecasting was introduced by Sir Oliver Sutton of Cwmcarn during his term as Director of the Meteorological Office from 1953 – 1965.

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Standards for contaminated land reclamation were set by the 1966 Lower Swansea Valley Report that followed the successful programme that reclaimed 450 hectares of land.

Major aircraft manufacturers and airlines use a portable monitor developed by ECHA Microbiology of Cardiff to measure microbial fouling in aviation fuels.

Welsh physician, physicist and statistician, William Morgan FRS, is considered the father of modern actuarial science and is credited as the first to record the 'invisible light' produced when a current is passed through a partly evacuated glass tube – the first x-ray tube.

Remembered today as 'the mother of freshwater ecology'; Kathleen Carpenter enrolled at Aberystwyth University in 1907. Work based on Welsh rivers and their biota led to her pioneering work, lecturing in Britain and the USA and the first freshwater ecology textbook in English; *Life in Inland Waters*.

1762	1766	1768
World's earliest recorded railway tunnel at Landore near Swansea.	The first major canal in Wales is Thomas Kymer's canal at Kidwelly.	Anglesey's Parys Mountain mines supplies the world's demand for copper ore.



Bioscience and Health

The Bioscience and Health sector is an important one in Wales and one with a longstanding reputation for scientific and academic excellence.

With increasing demands and expectations for further improvements in healthcare, market opportunities have encouraged numerous spin-outs to emerge from the university sector where closer links between the various disciplines such as medicine, biosciences, electronics, chemistry and computer science are producing world-class developments.

1774

At Bersham, John Wilkinson's cylinder boring machine is used for the production of cannon and later for steam engine cylinders.

1793

World's first iron railway bridges, at Pontycafnau and Cyfarthfa, in Merthyr Tydfil.

1804

Steam locomotive built by Richard Trevithick makes the first steam railway journey in the world from Merthyr Tydfil to Abercynon. The diagnosis of adverse health conditions has benefited greatly from the convergence of different scientific disciplines for self-testing kits and telemetric systems to convey results without the need to attend in person. Innovative wearable technology is being pioneered by Aparito using wearables and disease specific mobile apps to deliver patient monitoring outside of the hospital.

Snowdonia's icy lakes were the inspiration for a revolutionary cooling technology helping to save lives by maintaining temperature without power. Tywyn-based Sure Chill technology was the brainchild of Ian Tansley, a means of cooling that can maintain the temperature of a fridge without power at 4°C for at least 10 days and ideal for storing life-saving vaccines.

Led by Professor Jorge D. Erusalimsky, the Cellular Senescence and Vascular Biology Group at Cardiff Metropolitan University has discovered that proteins called Sirtuins protects cells that form the inner lining of blood vessels.Work that may lead to interventions to slow down the development of aging-related vascular pathologies.

The team led by Professor Ole Petersen at Cardiff University's School of Biosciences has discovered a protein that could lead to new treatments to reduce the risk of pancreatic cancer.

1805

Opening of Pontcysyllte aqueduct, built by Thomas Telford, was the highest in the world.

1806

Merthyr Tydfil's Cyfarthfa ironworks the largest in the world until overtaken by Dowlais in 1822.

1807

The Oystermouth railway, Swansea, becomes the world's first timetabled passenger carrying railway. Pioneering research from Swansea University Medical School has discovered that a harmless strain of the bacteria Salmonella could be used to deliver a new generation of better cancer treatments. Scientists at Cardiff Metropolitan University are exploring the use of crocodile blood as an antibacterial source. A new facility for medical research; the Cardiff University Biobank, will give researchers access to up to a million biological samples for research into the prevention, diagnosis and treatment of a wide range of illnesses.

Cardiff University's Wound Healing Research Unit was the first specialist unit in the world in this subject putting research into clinical practice.

The Human Gene Mutation Database at Cardiff Wales Gene Park, supported by the Institute of Medical Genetics, has put Wales at the forefront of genetics research.

The protocol for the controlled trials of drugs devised by Professor Archie Cochrane at Cardiff was to become the world-wide standard procedure in drug evaluation.

Home to one of Europe's most powerful MRI scanners, Cardiff University's Brain Research Imaging Centre (CUBRIC) is leading the search for treatments that can protect cognitive function through research on the brain's white matter – as opposed to grey matter.

Bangor University was the first in the world to study the timing of chemical changes in the brain related to its function by combining electroencephalography (EEG) and mass resonance spectroscopy (MRS).

1820	1820	1821
Brown Lenox of Pontypridd supplies iron for the Union Chain Bridge, the first vehicle carrying suspension bridge	Swansea accounts for 90% of all the copper-smelting capacity of Britain.	Swansea is the first town in Wales to have gas lit streets.

Facial structure rebuilding following extensive surgery has greatly benefited from the use of rapid prototyping techniques by Cardiff Metropolitan University to construct a 3D model based on CT and MR scan information.

Doppler ultrasound equipment was developed and is manufactured in Cardiff, for the assessment of cardiovascular disease and foetal heart monitoring.

Novel organoid expansion technology for cancer research has been developed by Cellesce based at Cardiff Medicentre.

Scientists at Swansea University have discovered that nanoparticles derived from tea leaves can inhibit the growth of lung cancer cells.

Antidotes for snake and scorpion bites are among the antisera produced by MicroPharm of Newcastle Emlyn.

Russell IPM based at Deeside Industrial Park have developed alternatives to traditional pesticides to protect fruit and vegetable crops from insect pests and can be used to monitor for the first signs of pest infestation, and physically trap flying pests.

BioMonde of Bridgend have pioneered maggot-based products to treat ulcers.

1825

Welsh ironworks supply the Stockton and Darlington Railway with iron rails.

1826

Thomas Telford's Menai Suspension bridge opens as the largest iron suspension bridge in the world.

1831

Classification of geological periods begins using Welsh placenames for period terms.



1838

Muntz Metal is first made at Swansea for the sheathing of ship's hulls.

1839

The Bute dock at Cardiff is opened, then the largest in the world.

1850

The first electrically powered boat, using Grove cells, is operated by John Dillwyn Llewelyn on Penllergaer lake.



Energy

Traditionally Wales has been renowned for its coal but today Wales is moving towards becoming the UK's leader in the field of renewable energy being well positioned for wind and tidal power options.

Wave power could supply 10% of global electricity by 2050 but harnessing the power of the ocean to produce affordable energy is the toughest engineering challenge in renewable energy.

Increasing expertise in the Welsh academic sector is producing more efficient photovoltaic materials and thermoelectric devices. Hydrogen as an energy source and the generation of the gas from wind, solar and bacteria represents another step forward.

1855	1856	1857
David Hughes from Bala invents the type-printing telegraph used throughout the USA.	Dowlais ironworks become the first to take out a licence to make Bessemer steel.	John Dillwyn Llewelyn and his daughter Thereza take some of the earliest lunar photographs from their Penllergaer observatory.

Milford Haven is one of the few natural harbours in Europe capable of accommodating super-tankers to supply the refinery industry and the receiving terminal for imported LNG (liquefied natural gas), as the cleanest of the fossil fuels. A number of valleys in Wales have been dammed for water storage and supply whilst others provide hydroelectric power.

Wave power was first used in the sixth century at a tidal mill for grinding corn adjoining the Carew castle in Pembrokeshire.

Marine Power Systems launched their WaveSub 1:4 scale prototype at Pembroke Docks in 2017 to capture energy using the continual orbital motion of waves.

Gwynt y Môr 750MW wind farm is among the largest commercial offshore windfarms worldwide.

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FLEXIS (Flexible Integrated Energy Systems) is a £24 million project to develop an energy systems research capability in Wales based on world-leading research across Welsh universities.

The Bristol Channel and Severn Estuary has the second highest tidal rise and fall in the world.

Welsh coal made trans-Atlantic steam navigation viable and was the preferred coal of the Royal Navy.

1857	1857	1862
First steel rail in the world is rolled at Ebbw Vale.	The tallest viaduct in Britain is opened for railway traffic at Crumlin.	The Newtown and Llandiloes Railway cutting at Talerddig was Britain's deepest.

18

Lord Nelson considered Milford Haven to be one of the finest natural harbours in the world.

Lord Walter Marshall of Rhymney succeeded Brian Flowers as director of the Atomic Energy Research centre at Harwell and was later chairman of the Central Electricity Generating Board.

The precursor of the fuel cell, the gas battery, was developed by William Grove of Swansea.

The Centre for Alternative Technology in Machynlleth has a world-wide reputation and provided expertise and working examples in the field of energy generation and usage for over thirty years.

Milford Haven's import and regasification of LNG (Liquefied Natural Gas) was one of the largest hydrocarbon projects of its kind. It involved the construction of a 300km pipeline to Gloucestershire that was the UK's largest high-pressure gas pipeline delivering 20% of the natural gas required by the UK.

The Baglan Energy Park hosts the hydrogen energy research centre, developed by the University of South Wales in partnership with Neath Port Talbot Council.

1866

Atlantic Telegraph Cable uses copper refined in Llanelli with the signal passing through south Wales on route to London.

1869

Landore Works near Swansea opens to make steel by the Siemens-Martin open-hearth method.

The basis for the classification of fossil foraminifera, an essential feature in oil exploration, was laid by Professor Alan Wood at Aberystwyth University.

Margam Green Energy Plant, an Eco2 and the Western Logs Group joint venture, is a 40MW biomass power station and the UK's first commercialscale plant of its kind. It burns waste wood that would otherwise end up in landfill.

Clarence Arthur Seyler, working in Swansea, devised the original classification of coal ranks.

Welsh scientists made a major contribution to atomic energy research, including the bomb programme. Ieuan Maddock, an electronic instrumentation specialist, led important work in the field of seismology making a significant contribution to the Partial Test Ban Agreement between Britain, the United States and the Soviet Union in 1963. This banned nuclear testing in the atmosphere.

The Mond Nickel Company in Clydach, near Swansea, developed part of the process for the first atomic bomb, the only place in the world that could produce the nickel for the membranes.

1878

The use of phosphatic iron ores for iron and then steel making was invented by Sidney Gilchrist Thomas and Percy Carlisle Gilchrist at Blaenafon.

1879

Lord Nelson Hotel Ballroom at Milford Haven is first in Britain to be electrically lit.

The Active Classroom, designed by Swansea University's SPECIFIC centre, can generate, store and release its own energy using Tata Steel's special sheet steel cladding to generate electricity. Dr Joan Elizabeth Curran of Swansea developed the idea which came to be known as 'Operation Window' – the scattering of 'metallic confetti' or chaff in the path of enemy aircraft to disrupt their radar. She also worked on the electromagnetic isotope separation process for the atomic bomb.

Myfanwy Prichard-Roberts of Caernarfon, worked at Rhydymwyn, and was one of ten women and seventy men who worked there testing nuclear equipment prototypes.

The Nuclear Futures Initiative at Bangor University is helping to develop a new generation of scientists and engineers to tackle the urgent need for low carbon energy and energy security.

1879

David Hughes first transmits electromagnetic waves.

1886

Severn Railway Tunnel opened; at 7.2km, was Britain's longest tunnel.

1895

The Stepney spare wheel, was invented in Llanelli and universally adopted throughout the world. Pontypool-based Flamgard Calidair, is playing a crucial role in the 10 year €1.5bn multinational engineering project to make the 1986 Chernobyl nuclear disaster site safe. They are developing specialised fire and shut off dampers as part of the containment structure over the encased nuclear reactor.



The Built Environment

Superimpose centuries of human activity on a country bounded on three sides by the sea, on a topography laden with mountains, and river valleys and you have testing conditions for crossings of all sorts – from roads to railways and canals.

Crossing rivers and estuaries has preoccupied engineers in Wales for centuries and some of the major innovations in design and the use of materials have been designed or built here. From the early use of stone and cast-iron to the fine lines of cable stayed structures, Wales has been at the forefront of bridge construction.

With an abundance of natural building stone, the man-made landscape in Wales has great variety. The use of dressed local stone has given many terraced-house communities in the mining valleys a unique character and the abundance of high-quality slate extracted

1896	1897	1897
The Snowdon	Weavers Building,	Gugliemo Marconi makes
Mountain Railway	Swansea, was	first over-water transmission
opens, the highest	Europe's first multi-	of radio waves, over the
railway, and the only	storeyed reinforced	Bristol Channel, supported
rack railway system, in Britain.	concrete building.	by Welsh engineer William Preece.

from the north-west quarries graces not only local buildings but also many world-wide. The Wales Millennium Centre in Cardiff combines slate, timber, glass and stainless steel to reflect the natural and man-made resources of Wales in an award-winning structure.

Wales will become a leading international destination for business when the International Convention Centre Wales (ICC Wales) is completed in 2019 at the Celtic Manor Resort and Golf Club in Newport, which hosted the 2010 Ryder Cup golf tournament and the 2014 NATO summit.

Recycling discarded materials from Wales' industrial past, Carapace Slate offers a revolutionary, snap-fit roof tile with the natural beauty of quarried Welsh slate that replicates its regional character and colouring.

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The highest dam in the UK is Llyn Brianne, completed in 1973 to supply water to Swansea.

The box-girder bridge was developed to cross the Menai Straits with Robert Stephenson's first wrought-iron tubular bridge being built at Conwy in 1848, it still stands today.

Richard Rogers's pioneering 1982 design of the innovative Inmos factory at Newport (now part of IQE) exposes the services and structural members outside leaving the inner space free of detail.

184	4 24

The Dinorwig Quarry Hospital installs the first x-ray machine in Britain.

1899

First hydro-electric station opens in Wales at Monmouth.

1902

Ludwig Mond opens the Clydach Nickel Smelter using the nickel carbonyl process. The largest single span glasshouse in the world was designed by Lord Norman Foster and partners for the National Botanic Garden of Wales at Llanarthne. Self-healing concrete systems to maintain infrastructure such as roads, bridges, tunnels and embankments are being developed under the RM4L project which includes Cardiff University – one of 200 projects recognised by the Institution of Civil Engineers in 2018.

Tensile fabric clad buildings have been pioneered by Architen Landrell of Chepstow. Work includes the London 2012 Aquatics Centre and on the tunnel on the Kelana Jaya Line of Malaysia's LRT, which is ridden by over 164 million people annually.

Concrete Canvas of Pontyclun manufactures a ground-breaking material technology called Concrete Cloth which allows concrete to be used in a new way. Requiring only water and air for construction and used for emergency accommodation the flexible 'concrete on a roll' is capable of many other civil engineering applications and is used worldwide.



1906

Newport Transporter Bridge opened to provide a road crossing over the River Usk without hindering ship access.

1906

Hon. C S Rolls sets up Rolls Royce Ltd to manufacture cars and aeroplane engines.

1911

Harry Grindell Matthews makes the first radio transmission from ground to air near Cardiff.

Engineering

With the basic production of metals, particularly iron and steel, extending back over centuries it was natural for Wales to become a major supplier to the engineering sector.

Metal production and finishing has traditionally ranged from large castings and forged items, the rolling of rails for the railways, tinplate and other specialised coatings and alloys to structural steelwork and steel for the automotive industry. The trend is now towards the manufacture of smaller and more complex items and components with, ultimately, the arrival of technology suitable for manufacturing machines on a nano-scale. The development of micro and nanotechnology devices continues apace and new materials, control systems and finite element techniques are much in evidence with engineered items, for the biomedical, electronics and environmental sectors are being made to very high tolerances.

1912	1913	1913	
Arthur 'Artie' Moore received the world's first SOS call, from the Titanic, at his home near Blackwood.	Barry docks exports the highest coal tonnage of any dock in the world.	The world's first million-pound business deal is rumoured to have been struck in the Cardiff Coal Exchange.	

One of the largest maritime civil engineering projects in Europe was the Cardiff Bay Barrage built to create a permanent fresh water lagoon and flood relief provision.

Rapid prototyping is revolutionising product design, and here industry is supported by a unique university partnership, the Advanced Sustainable Manufacturing Technologies (ASTUTE) The Welding Institute (TWI) technology Centre provides wide ranging support including nondestructive testing (NDT) at its R&D facility at Port Talbot.

Eureka UK lists the Finite Element Method outside the area of solid mechanics, pioneered by Olgierd (Olek) Cecil Zienkiewicz of Swansea University, as 'world-changing' in the top 100 discoveries made in a British university.

The charging of blast furnaces was improved by George Parry at Ebbw Vale in 1850 by his bell and hopper arrangement which greatly reduced the loss of hot gases.

Chain cable for every Royal Navy ship from the 1820s to WWI was supplied by Brown Lenox of Pontypridd. The chainworks also supplied Brunel's Great Eastern steamship and the Cunard QE2.

A novel method of fastening sheet materials together was developed by High Torque Fastener Systems Ltd of Swansea – eliminating the need for external fasteners.

Zip-Clip manufactures wire suspension systems which feature in a wide range of construction projects and are made at Welshpool.

1915

Charlotte Nicholas of Cardiff, patented a minesweeping apparatus and what she called 'disintegrators' – a idea for a 'tank' before their first appearance on the western front.

1921

Britain's first major oil refinery opens at Llandarcy. The first universal speed control drive compatible with all types of electric motor was designed and manufactured by Control Techniques Ltd of Newtown.

Newport-based Cintec has helped save Egypt's first pyramid, the earthquake damaged 4,700-year-old Step Pyramid of Djoser, using unique methods, developed in restoring historic buildings such as Windsor Castle, the White House and the Wailing Wall in Jerusalem.

1926

J G Parry Thomas breaks the world land speed record at Pendine at 171.02 mph.

1935

Felinfoel Brewery in Llanelli markets beer in tin-plated steel cans, the first company in Europe.

1940

Edward Bowen from Swansea develops airborne radar, used in World War II.



The top-secret Valley Works at Rhydymwyn in Clwyd tests atomic bomb components.

Hugh lorys Hughes's 'Hippo' piers and 'Crocodile' bridge units are used in the D Day Mulberry Harbour

First experimental microwave television transmission made by the Post Office across the Bristol Channel from Newport.


Materials

Materials research, development and manufacture have been a major feature of academic and industrial operation for many years. For a small country, Wales has been a major contributor in the manufacture and processing of materials.

From steel manufacture and rolling to primary aluminium smelting and pure nickel production, tin-plate manufacture and titanium processing, Wales supplies world-wide markets.

University expertise is assisting in the synthesis and evaluation of novel semiconductor materials and the examination of material surfaces which offers the promise of major advances in materials application. The technology lies behind global 'megatrends' including smart phones and tablets, powering change across many sectors and will be essential to the realisation of most new technologies of the future such as 5G, autonomous drive vehicles and the Internet of Things.

1947

Maurice and Spencer Wilks sketch the outline of a vehicle in the sand at Anglesey and the 'Land Rover' is born.

1948

A system for maintaining constant pressure on rolling mills was devised and patented by Statimeter Ltd of Rhydymwyn which became widely adopted. Wales is investing in the sourcing of materials from renewables, particularly plants. The properties of plant-derived polymers on their own and in conjunction with other materials are being studied at the BioComposites Centre in Bangor and novel applications for naturally occurring polysaccharides are being evaluated at Wrexham Glyndŵr University.

Successive investments have established one of the world's largest silicone polymer plants, the world leader in development and manufacture is Dow Corning at Barry.

CS connected is the world's first compound semiconductor cluster.

The Catapult, part of the UK's nationwide network of technology innovation centres, forms an essential pillar of the CSconnected cluster and is supported by IQE and Newport Wafer Fab.

The identification of crystal faces using 'Miller's Indices' was devised by William Miller of Llandovery during the mid-19th century.

The application of powdered metals technology was pioneered by Osprey Metals of Neath following applied research at Swansea University.

1950

The world's first scheduled helicopter service opens between Cardiff, Wrexham and Liverpool.

1957

The world's first jet airliner, the De Haviland Comet, produced at Broughton.

1961

Welsh born Tecwyn Roberts, working at NASA, is part of the team to put the first American into Space. Ammanford boasts the global HQ of Haydale, one of the UK's leading research centres for graphene, made of carbon, its potential of what has been hailed as the new 'wonder material' is only realised when you can properly disperse it into another material. Graphene enhanced prepreg material has been used for a composite-skinned unmanned aerial vehicle at the Farnborough Air Show. Eventually it'll find its way into everyday objects like cars, clothes, phones and fridges.

6

Refgas technology developed at Sandycroft converts waste wood from construction and demolition into an incredibly clean gas, cleaner than the natural gas we use in our homes.

A blast isolation system developed by Newport based Cintec International Ltd uses water to reduce the potential for harm in explosive situations.

1962

The world's first scheduled hovercraft service opened between Rhyl and Wallasey.

1962

Llanwern is the first integrated steelworks in Britain and pioneers computerised mill control.

1962

Hymac produce first excavator in the UK to be operated solely by hydraulic power.

Telecommunications and ICT

Wales has made major contributions to man's ability to communicate and has been instrumental in developing technology such as the microphone, the telegraph, radio transmission and microwave television transmission.

In 1966 Donald Davies of Treorchy became involved in the development of his idea to achieve communication between computers for which a fast message-switching communication service was needed, devising a technique called 'packet switching' and an important element of the internet.

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Commissioning of the first major pumped storage power facility in Britain at Ffestiniog of 360-megawatt capacity.

1964

George Street bridge, Newport opens, the first British example of a cable-stayed bridge.

1966

The Severn Bridge and Wye Crossing incorporates aerodynamic deck units manufactured in Chepstow. The High Performance Computing (HPC) cluster dubbed 'Hawk' is at the heart of Cardiff University's £15 million Supercomputing Wales programme to put Wales on the global supercomputing map.

FinTech and cyber security companies in Wales include Amplyfi, Airbus Defence & Space and Wolfberry Cyber Security. The Tech Valley programme will see the new Thales Cybercentre at Ebbw Vale in full operation by 2021 for companies to test and develop digital concepts.

Industrial and academic investments are maintaining Wales' presence at the forefront of communications technology and developments are also well represented in the growth of digital commerce companies such as comparison websites. This includes the UK's first car insurance comparison site; Confused.com, based in Cardiff with Gocompare.com in Newport and Moneysupermarket.com in Ewloe, Flintshire.

Chepstow based ZoneArt Networks has developed Follow Spot, a system to locate users and objects in space-time. It combines high-speed and accurate geolocation from a single access point.

In 1946 the Post Office made the first experimental microwave television transmission from Newport across the Bristol Channel.

1967

Britain's first motorway tunnel opened on the M4 at Brynglas, Newport.

1969

Admiral Desmond Hoare patents the rigid inflatable boat (RIB) after research and development at Atlantic College, St. Donats.

1971

Wylfa, a 1180-megawatt Magnox nuclear power station was the largest in the world. Technology company AMPLYFI is using artificial intelligence (AI) to access and interpret vast amounts of previously untapped data from the internet.

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Sony's UK Technology Centre in Bridgend is the global production site for the Raspberry Pi computer.

Computer scientist Alan Cox of Swansea University was responsible for one of the first Linux installations on a busy computer network and contributed to the development of the whole kernel, which led to developments such as the Android operating system.

Charles Wheatstone demonstrated submarine telegraphy in 1844 with experimental scientist and industrialist, John Dillwyn Llewelyn, from a boat in Swansea Bay to Mumbles lighthouse.

Known as the 'father of airborne radar'; Edward George 'Taffy' Bowen (1911-1991) was a Swansea born physicist who succeeded in compacting terrestrial radar into an aeroplane's cockpit. Part of this work was carried out at RAF St Athan.

1972

Sir Terry Matthews founds the Mitel Corporation at Caldicot to manufacture and supply private exchanges (PABXs) for organisations worldwide.

1973

Britain's highest dam completed at Llyn Brianne with a height of 300 ft.

Creative Industries

Wales is well defined and well established as a centre for creative businesses to establish and grow. The diverse sector comprises a wide range of companies ranging from software development, games and animation, to high-end film and television production, music, journalism and fashion design. Innovative sound and image technologies are a rapidly growing aspect of the economy.

In 1923 broadcasting in Wales began when the then British Broadcasting Company opened in Cardiff. Today services are provided in English and Welsh and the media plays a significant role in modern Welsh culture.

1978

World's first test tube baby is conceived through the ground-breaking IVF work of Professor Robert Edwards, a graduate of Bangor University, working with Patrick Steptoe.

1979

The A470 bridge, across the Usk, is the first British glued segmental concrete bridge.

Major TV productions include Doctor Who and other flagship network series have included Torchwood, Merlin, Atlantis whilst Casualty continues to be produced with the BBC Cymru Wales 'stamp' at the end of the credits.

ge courtesy of BBC Wales.

The national film and TV bodies are easily accessible with a branch of Bafta; Bafta Cymru, here. Other Welsh based agencies include Ffilm Cymru Wales supporting Welsh or Wales based writers, directors and producers and Film Hub Wales which aims to bring more films to more people. The National Screen and Sound Archive of Wales houses a comprehensive collection of films, television programmes, videos, sound recordings and music.

Wales's creative industry is backed by a full range of resources with companies like Real, Tinopolis, Aventi Media, Gorilla; It's My Shout; Milk VFX; Crash Editing, Bang, Cranc Cyf and Mercury FX.

Merthyr-born Laura Ashley established her first shop in 1968 with the company headquarters set near Newtown.

A documentary photography diploma course was established by David Hurn of Magnum fame at the Newport College of Art in 1973.

Boom, based in Cardiff Bay's Gloworks, is one of Wales's largest production groups and one of the largest producers of children's content in the UK.

Artes Mundi, the international contemporary visual art show is one of the most significant in the world, hosted at Cardiff's National Museum & Galleries of Wales.

1984

Dinorwig Power Station, a world class engineering project producing 1800 megawatts opens in the largest man-made cavern in Europe.

1987

The BAFTA Best Animation award was given to Siriol Productions of Cardiff for their animated cartoon series Superted. Cardiff University's Cardiff School of Journalism, Media and Cultural Studies has moved into a new home, a city centre location alongside BBC Cymru Wales.

An innovative new scheme sees the social media giant Facebook partnering with WalesOnline and others, as part of a community news project to support local journalism.

A major success has been the Nordic noir-like Hinterland/Y Gwyll, a co-production between BBC Wales, Fiction Factory, S4C and others.

Cardigan, formerly the home of Britain's biggest jeans factory, is still making jeans by the Huit Denim Company.

William Haggar gave his first public performance of a 'Bioscope' show in 1898 at Aberavon Fair, in 1901 he went on to film what is regarded as the first fictional film produced in Britain.

Major works produced or scheduled include; Sex Education, with Gillian Anderson; Watchmen, starring Jeremy Irons; Keeping Faith, with Eve Myles; Six Minutes to Midnight, starring Eddie Izzard and Dame Judi Dench; The Secret Garden, with Colin Firth and Julie Walter; Pitching In; Warren and an adaptation of the Philip Pullman trilogy; His Dark Materials, starring James McAvoy.

1996

Second Severn Crossing opens, a 16824 ft/5128 metre long cable-stayed design.

1997

THRUST SuperSonic Car (SSC) breaks the sound barrier at 763mph with expertise from Swansea University contributing to the aerodynamic design.

The Royal College of Music and Drama is the National Conservatoire of Wales, the first All-Steinway Conservatoire in the UK. Dragon Studios near Bridgend has facilitated major film and TV drama such as The Bastard Executioner, Will, A Discovery of Witches, Journey's End and Transformers: The Last Knight.

Name of Street

CONTRACTOR

Alfred Sisley a leading figure behind the Impressionist movement, came to south Wales in 1897, inspired by the Welsh land and seascape.

Welsh gold, mined for Celtic chieftains over 2,000 years ago, is still used to make jewellery for the Royal family.

Specific Media is a global interactive media company and owner of MySpace, with a presence across the US and Europe. It has a base in Wales in the shape of Xumo, a provider of online video products and solutions.

1999

The Millennium Stadium is opened to host the Rugby World Cup in Cardiff.

2000

The first purposebuilt science centre in the UK opens at Cardiff's Techniquest.

2000

Blaenafon and its surrounding landscape made a World Heritage Site.



Transport

The onset of the Industrial Revolution put pressure on innovators to develop transport systems capable of carrying bulky and heavy loads and Wales was at the forefront of canal and railway building. The early days of aviation and road transport benefited greatly from the activities of the Hon C S Rolls of Monmouth, and wales now has an extensive manufacturing supply chain for both.

Newcomer Aston Martin will be producing its first luxury SUV, the DBX, at Aston Martin Lagonda's new facility at St Athan. The forthcoming range of Lagonda and electric vehicles will also be built at the plant that will ultimately become the 'Home of Electrification' when the marque's fully-EV models enter production.

2004

Penderyn distillery whisky goes on sale using a unique design of still.

2009

Centre for NanoHealth at Swansea University, first facility of its kind in Europe to focus on the diagnosis of disease and medical intervention at a molecular level. Riversimple's new zero emission hydrogen-electric car is called the Rasa, it emits only a minute amount of water, performs the equivalent of around 250mpg and is charged in only three minutes.

The CHERISH Digital Economy Research Centre at Swansea University along with researchers in Grenoble are jointly investigating the human dimension as one of the most complex obstacles to the mainstream adoption and societal acceptance of driverless vehicles.

Extended space travel will have a great impact on human health, Professor of Physiology and Biochemistry; Damian Bailey, of the University of South Wales is researching the impact of reduced gravity. NASA's commitment to send astronauts to Mars by the 2030s will mean a typical 'round trip' of between three to six months and with time on the Red Planet space travellers may have to live in reduced (micro) gravity for about three years.

Aerospace has been a feature on the Welsh industrial scene for many years through the Ministry of Defence Establishments in providing facilities for military aircraft and test ranges for unmanned aerial vehicles.

2009

Time magazine nominates Aberystwyth University's 'Adam' robot as fourth most significant scientific discovery.

2009

Professor Julie Williams work on Alzheimer's disease at Cardiff University is cited as one of the world's top ten medical breakthroughs by Time magazine.



2010

Fully customerqualified 6" semiconductor wafers are produced for the first time by IQE plc of St. Mellons, Cardiff.

2010

One of Britain's most technically advanced cryoscanning electron microscopes is installed at Swansea University.

Safer travel is improved in a joint venture by Sequestim between QMC Instruments Ltd and Cardiff University. Established in 2016 to commercialise the next generation of terahertz imaging technology developed by the partners for security screening applications, that can be used at airports. Sensitive technology originally developed to study the furthest reaches of the universe. Lockheed Martin Space has used Bridgend based Spectrum Technologies Nova laser wire marking equipment in the manufacture of the complex electrical wiring system for the NASA JPL (Jet Propulsion Laboratory's) Mars InSight lander, currently exploring the deep interior of Mars.

The world's first scheduled helicopter service opened between Cardiff, Wrexham and Liverpool in 1950 and the world's first scheduled hovercraft service opened between Rhyl and Wallasey in 1962.

British Airways Maintenance Cardiff has the facility to maintain Boeing 767, 777 and 787's in four bays at one of the world's largest hangars at Cardiff Airport.

The Comet, the world's first jet airliner, was manufactured at the Broughton factory of the De Haviland Aircraft Co from 1957.

The Deeside plant of Toyota was the first outside Japan to manufacture a hybrid vehicle engine in 2010.

ParcAberporth in west Wales was the first unmanned flying facility of its

kind in Europe.

Zip World in Snowdonia includes the fastest zip line in the world and the longest in Europe.

2011

Roath Lock, the new drama production studios for BBC Wales opened in the Porth Teigr area of Cardiff Bay. Home to dramas Casualty, Pobol Y Cwm and Doctor Who.

2011

Aberystwyth University's Institute of Biological, Environmental and Rural Sciences (IBERS) wins the first ever BBSRC 'Excellence with Impact' award. Welsh based academic expertise was instrumental in developing the aerodynamic design for the Thrust supersonic car, expertise which has also been involved in aspects of the Airbus designs. The rigid inflatable boat (RIB) was designed in Wales and the fastest rigid RIB ride in the world can be taken here on 'Velocity' based on the Menai Straits.

Professor George Bryan of Bangor University researched 'Stability in aviation' in 1911. He was presented with the gold medal of the Royal Aeronautical Society – the second ever awarded (the first was presented to the Wright Brothers).

Bill Frost built a flying machine to his own, patented design, which reportedly flew in 1896 at Saundersfoot.

Tecwyn Roberts of Llanddaniel worked at NASA and helped put the first American into Space and was honoured by NASA for his work with famous astronauts such as Neil Armstrong.

2011

Cardiff University's Morgan-Botti Lightning Laboratory opens for the study of aircraft lightning strikes.

2012

Scientists and engineers at Glyndwr University, begin work on part of the European Extremely Large Telescope (E-ELT), the world's largest telescope, in Chile.



Recognising Achievement

The Nobel Prize is widely regarded as the most prestigious award given for intellectual achievement in the world. For a country with approximately 3 million people Wales compares favourably with other Nobel Prize-winning countries.

2013

Sir Ranulph Fiennes, uses thermal blanket covers, developed by Architen Landrell of Chepstow, to provide a 'lifesaving' insulated zone on his Antarctic Expedition.

2015

Swansea University's 65-acre science and innovation Bay Campus opened – one of the 'biggest knowledge economy projects in Europe'. Several prestigious awards are named after Welsh born individuals or those who made their principal work in Wales, these include the Menelaus Medal after William Menelaus and the Royal Society's Hughes Medal after the Welsh born scientist David E. Hughes.

Bertrand Russell author, mathematician and philosopher, received the 1950 Nobel Prize in Literature for his literary work in championing humanitarian ideals and freedom of thought.

Sir Clive Granger, awarded, jointly with Robert F. Engle, the Nobel Prize in Economic Sciences in 2003 for their contributions to the analysis of time series data.

Brian Josephson, shared the Nobel Prize in Physics in 1973 for his prediction of the Josephson effect, made in 1962.

Stroud born Professor Sir Martin Evans, Nobel Prize winner in 2007, has been a leading figure in Welsh science and in shaping Cardiff University as a world-leading centre for biomedical research.

Sir John Theodore Houghton, co-chair of the Nobel Peace Prize winning Intergovernmental Panel on Climate Change's (IPCC) scientific assessment working group.

2017	2018	2019
Aventi Media secures 3-year contract for producing Songs of Praise.	The Rutherford Cancer Centre at Newport is the first centre in the UK to offer high energy proton beam.	Aston Martin's new manufacturing facility will begin production of its all-electric model in St Athan.

German born biochemist Robert Huber working at Cardiff University, the Nobel Prize in Chemistry 1988 was awarded jointly to Robert Huber and two others 'for the determination of the three-dimensional structure of a photosynthetic reaction centre.

The 1933 Nobel prize winner was Thomas Hunt Morgan (1866-1945) who claimed Welsh ancestry from a James Morgan who came to Boston from Wales in 1636, and from whose brother was descended the industrialist J. Pierpont Morgan

The first woman to present a scientific invention at the Royal Society was the Welsh soprano, Margaret Watts-Hughes, who in 1876 attempted to measure the power of her voice through an instrument that produced geometric patterns, leading to the invention she called the eidophone.

The 1960 recipient of the Eddington Medal, awarded by the Royal Astronomical Society for outstanding investigations in theoretical astrophysics, was Rhayader born Robert d'Escourt Atkinson for his work on stellar fusion.

Professor Bernard Frederick Schutz, born in the USA but working here since 1974, receives the Eddington Medal in 2019 to acknowledge his investigation of '…outstanding merit in theoretical astrophysics'.

2019	2019	2020
The Centre for Photonics Expertise (CPE) opened at the OpTIC Technology Centre in St Asaph.	Construction work scheduled on the new Thales Cybercentre at Ebbw Vale.	What next?
		e

Dr Henry Naunton Davies (1828-1899), the Rhondda doctor, was awarded the first British Medical Association Gold Medal for his action during the Tynewydd Inundation of 1877.

Frances Hoggan (1843-1927) was the first Welsh woman physician as well as being a social reformer and education campaigner. Together with Elizabeth Garret Anderson and Dr Elizabeth Blackwell they founded the National Health Society in 1871 'to promote health amongst all classes of the population'.

Welshmen have founded three of the world's leading universities. Elihu Yale, the main benefactor of Yale University, was the son of Welsh immigrant parents. Joint founder of Brown University was Morgan Edwards, who came from Pontypool and Beijing University grew out of the city's language school set up in 1869 by missionary Hopkin Rees, from Cwmafan.

1983 - Dr. Jessica Bruce.

Welsh educated, her spin-out company from The University of Oxford; Run3D, won an Innovate UK's Women in Business Innovation Award in 2019.

1979 - Haley Gomez. b. Barry.

Professor of Astrophysics at Cardiff University, Haley is an international expert in astrophysics, working to understand the formation and evolution of cosmic dust.

1976 - Dr Elin Haf Davies. b. Parc, near Bala, North Wales.

Aparito entrepreneur and CEO, developing wearable technology and disease specific mobile apps to deliver patient monitoring outside of the hospital.

1957 – Professor Julie Williams. b. Merthyr Tydfil.

A global leader in research into Alzheimer's disease at Cardiff University, work highlighted by Time magazine as one of the world's top 10 medical breakthroughs of 2009.

1957 - Sir Chris Evans. b. Port Talbot.

Entrepreneur in the field of biotechnology and founder of companies in the fields of genes, enzymes and micro-organisms.

1955 – Michael Moritz. b. Cardiff.

The internet search engines Google and Yahoo! were developed with funding from Welsh born Michael Moritz.

1952 – Terry Morgan. b. Cwmbran.

Engineer and chairman of Crossrail, Europe's biggest construction project one that will see 13 miles of new tunnels built under London.

1951 - Sir Leszek Krzysztof Borysiewicz, FRS. b. Cardiff.

Polish British immunologist, scientific administrator and Vice-Chancellor of Cambridge University, Britain's only billion-pound university.

1951 - Richard Parry-Jones. b. Bangor.

Group Vice-President, Global Product Development and Chief Technical Officer, Ford Motor Company up to 2007. In 2012 he became chairman of Network Rail.

1946 – Professor John Harries, b. Aberavon.

The first chief scientific advisor to the Welsh Government. Professor of Earth Observation at the Blackett Laboratory in Imperial College, London, as a scientist he led the team providing the first direct observational evidence of an increase in the Earth's greenhouse effect. Awarded NASA's Distinguished Public Service Medal in 2011.

1945 - Professor Anthony Campbell. b. Bangor.

Professor in Medical Biochemistry at Cardiff University and authority on intracellular signalling and chemi- and bio-luminescence. Founded the Darwin Centre for Biology and Medicine in Pembrokeshire.

1943 - Sir Terry Matthews. b. Newbridge.

The serial high-tech entrepreneur, and Wales' first billionaire, who has founded or funded over 100 companies in the high-tech communications field, notably Mitel, Newbridge Networks and the Wesley Clover Foundation.

1942 – Howard Stringer. b. Cardiff.

Chairman and Chief Executive Officer Sony Corporation up to 2013 and 2012 respectively.

1942 - Dame Jean Thomas. b. Swansea.

A biochemist who has studied the structure of chromatin and the first person to isolate and characterize the histone octamer.

1939 - Brian Josephson. b. Cardiff.

Nobel prize winner through his studies of the phenomena of lowtemperature physics, especially superconductor and insulator combinations.

1935 – 2013 Dr Tom Parry Jones. b. Anglesey.

Inventor of the 'Breathalyser' and the later electronic version, the 'Alcolmeter'. Which was adopted world-wide.

1932 – Sir John Meurig Thomas. b. Gwendraeth Valley.

Leading Welsh chemist and and one of the most cited authors in the field of heterogeneous catalysis.

1932 – 1995 Lord Walter Marshall. b. Rhymney.

Director of Atomic Energy Research Establishment Harwell and later Chairman of Central Electricity Generating Board.

1931 - Sir John Houghton. b. Dyserth.

Director of the Meteorological Office 1983 – 1991, and authority on global warming

1931 - Sir Bernard Knight. b. Gower.

Over 25,000 post-mortem examinations were carried out by one of the world's leading forensic pathologists.

1926 - 2005 Professor John Vaughan. b. Merthyr Tydfil.

Professor of food microscopy, King's College London. Pioneer in the properties of oilseeds and their industrial applications.

1925 - 1996 Professor Howard Purnell. b. Rhondda.

Professor of Chemistry at Swansea University. Pioneering research into gas chromatography for chemical analysis.

1924 - 2000 Donald Davies. b. Treorchy.

Working at the National Physical Laboratory, he laid the foundation for the Internet through his work on packet switched data communication.

1916 – 1999 Joan Elizabeth Curran b. Swansea.

Welsh scientist who played important roles in the development of radar and the atomic bomb during the Second World War.

1912 - 1978 Sir Morien Morgan b. Bridgend.

A noted Welsh aeronautical engineer, sometimes referred to as 'the Father of Concorde' because of his research into the development of a supersonic passenger airliner and work with wind tunnels.

1911 – 2002 Professor Ewart Jones. b. Wrexham.

Waynflete Chair of Chemistry at Oxford University. Research in natural product chemistry including steroids, terpenes and vitamins.

1910 - 1992 Professor Alan Wood.

Chair of Geology at UW Aberystwyth. Laid the basis for the classification of fossil foraminifera, an essential feature of oil exploration.

1909 - 1988 Professor Archibald Cochrane.

Chair of tuberculosis and chest diseases at Welsh National School of Medicine. Developed protocol for controlled trials of drugs which became worldwide standard procedures in drug evaluation.

1907 – 1997 Frank Llewellyn Jones CBE. b. Penrhiwceiber.

World authority on the physics of ionised gases and electrical contact phenomena who established two internationally renowned research schools at Swansea University.

1906 - 1994 Professor Gwendolen Rees FRS.

The first Welsh woman to be made a Fellow of the Royal Society. She devoted her life to helminthology, the study of parasitic worms.

1904 - 1987 Donald Holroyde Hey. b. Swansea.

Organic chemist who observed that the decomposition of benzoyl peroxide gave rise to free phenyl radicals, important reactions in processes ranging from synthetic rubber to biochemical damage to DNA.

1904 - 1972 Emily Dix. b. Gower.

Revolutionised plant biostratigraphy, techniques critical in the story of tropical forests and climate change during Late Carboniferous (Pennsylvanian) times.

1903 – 1989 Professor Sir Brynmor Jones.

His department at Hull University became famous for the development of liquid crystal display technology.

1903 – 1945 Evan James 'Desin' Williams. b. Cwmsychpant.

Desin Williams become a physicist who worked with the giants of international physics of the day and predicted the existence of a new atomic particle, the meson.

1903 - 1977 Sir Oliver Sutton. b. Cwmcarn.

Director of Meteorological Office from 1953 – 1965 where he emphasised the use of computers for forecasting.

1903 - 1963 Sir Horace Evans. b. Merthyr Tydfil.

Physician to Queen Mary, King George V and Queen Elizabeth.

1902 - 1977 Hugh lorys Hughes. b. Bangor.

Civil engineer who designed the bridge and pier units for the Mulberry Harbour used in the Normandy landings of WWII.

1896 - 1949 Prece Blackborow b. Newport.

Stowed away on *Endurance* during Ernest Shackleton ill-fated Imperial Trans-Antarctic Expedition in 1914, receiving the Polar Medal for his service on the expedition.

1893 – 1973 Sir Clement Price-Thomas. b. Abercarn.

Pioneer of the treatment of chest disorders with radium.

1888 - 1962 Dr Ezer Griffiths. b. Aberdare.

Leading authority on the study of heat and refrigeration.

1887 – 1949 Arthur (Artie) Moore. b. Pontllanfraith.

One of the first people in the world to hear the Titanic's distress message at Gelligroes Mill where his radio station was driven by a generator coupled to the mill wheel. He would go on to work for Marconi and patent a form of Sonar, called the 'Echometer', in 1932.

1886 - 1926 Ernest Thompson Willows. b. Cardiff.

Designed his own airship at the age of nineteen, made his first flight in 1905 and the first to fly across the English Channel, from London to Paris, in 1910.

1881 - 1945 Sir Thomas Lewis. b. Cardiff.

A cardiologist who coined the term 'clinical science' and championed applying the experimental method to clinical problems and the clinical application of the electrocardiograph.

1880 – 1941 Henry Grindell Matthews. b. Winterbourne, Gloucestershire.

Inventor of the 'Aerophone' or radiotelephone in 1911, first demonstrated in Cardiff. Talking pictures followed and claims that he invented an electric ray in 1923 gave him the nickname of 'the death ray man'. By 1934 he was living and working at Tor Clawdd on Betws Mountain above Ammanford where he died in 1941.

1878 – 1951 Dorothea Minola Alice Bate. b. Carmarthen.

Also known as Dorothy Bate, a British palaeontologist and a pioneer of archaeozoology. Her life's work was to understand how and why giant and dwarf forms evolved.

1877 – 1910 The Hon Charles Stewart Rolls. b. Monmouth.

Motorist, aviator and joint founder of Rolls-Royce.

1872 – 1970 Earl Bertrand Russell. b. Trellech, Monmouth.

Pioneer of the study of mathematical logic.

1866 – 1959 Clarence Seyler.

Leading authority on the analysis of coal, carrying out his chemical classifications at Swansea.

1864 – 1928 George Hartley Bryan.

Professor of Pure & Applied Mathematics at the University of North Wales, Bangor, published 'Stability in aviation; an introduction to dynamical stability as applied to the motions of aeroplanes' in 1911.

1858 - 1921 John Reginald Harding. b. Monmouth.

Architect and engineer who designed lightouses in China, Taiwan and Korea and the Royal Palace in Seoul.

1857 – 1932 Dr Martha Maria Cannon. b. Llandudno.

Pioneer of health measures and women's rights in the USA, where she had emigrated with her parents in 1858, becoming one of the first Utah women to receive the degree of M.D. and the first woman state senator.

1856 – 1932 Richard Stephens. b. Cwmbran.

Early designer of motor cars. Setting up a bicycle-making business in Clevedon he designed and built his first car in 1897/8. Amongst his many improvements was the adjustable drum brake shoe, the basis of all such shoes in use today.

1851 – 1925 Elizabeth Phillips Hughes MBE. b. Carmarthen.

Educationalist, who established a training college for women in 1885 in Cambridge which would be named after her, Hughes Hall; the only Cambridge College to be named after a woman. Retiring to Barry, she established the 20th Century Women's Club.

1850 - 1885 Sidney Gilchrist Thomas.

And his cousin Percy Carlisle Gilchrist. Developed furnace linings at Blaenafon enabling enabled iron to be smelted from phosphatic iron ores and then used in steel making. The 'basic' slag from the smelting became a valuable phosphate fertiliser.

1848 – 1935 William Frost. b. Saundersfoot.

Welsh designer of an early flying machine, the Frost Airship Glider.

1846 – 1904 Samuel Jones. b. Beddgelert.

A pioneer of oil extraction who emigrated to the USA and invented an improved pumping rod for oil wells. Renowned as a model employer who was elected mayor of Toledo, Ohio, in 1897.

1842 - 1907 Megan [Margaret] Watts Hughes. b. Dowlais.

The first to experiment with and observe the phenomenon of visualizing resonating sound using a device she invented called an 'eidophone' and which she was the first woman to demonstrate an invention at the Royal Society.

1834 - 1920 Sir Pryce Pryce-Jones.

A draper of Newtown who saw the potential of railways and postal services to establish Britain's first major mail-order business. He sold Welsh flannel to Europe, America and Australia and is credited with inventing the sleeping bag, patented in 1876 as the Euklisia Rug.

1834 - 1913 Sir William Henry Preece. b. Caernarfon.

Electrical engineer and inventor who developed his own system of wireless telegraphy and telephony in 1892 but who would later champion Guglielmo Marconi's system and assist with his experiments and in securing funding.

1829 - 1904 Isaac Roberts.

A farmer's son from Denbighshire who pioneered deep space photography taking the first picture of the spiral Andromeda Galaxy and revealing its true form to astronomers for the first time.

1823 – 1913 Alfred Russel Wallace. b. Usk.

Trained as a surveyor and undertook railway work for Brunel but is best remembered as a anthropologist and biologist who independently proposed a theory of natural selection, prompting Charles Darwin to publish his own theory.

1821 – 1894 Henry Hussey Vivian. b. Swansea.

With his father, John Henry Vivian (1785-1855), he established Swansea as the centre of the world copper industry with Hafod. Copperworks in the lower Swansea valley, becoming the largest refiner and producer of copper and other metals in the world.

1818 – 1882 William Menelaus.

Scottish-born engineer who was instrumental in bringing the Dowlais works into the steel era.

1811 – 1896 William Robert Grove. b. Swansea.

Improved the voltaic cell and developed the gas battery, the precursor of the fuel cell.

1810 – 1882 John Dillwyn Llewelyn. b. Swansea.

Industrialist who established an observatory in 1851 at Penllergaer near Swansea. With his daughter Thereza Llewelyn, 1834-1926, (later Thereza Story-Maskelyne), they took some of the earliest photographs of the Moon.

1801 – 1880 William Miller. b. Llandovery.

Applied mathematics to the study of crystals and devised Millers Indices for the identification of crystal faces.
fl. 1794 Philip Vaughan.

Carmarthen-based inventor and ironmaster Philip Vaughan patented the first design for a ball bearing in 1794. His design for reducing friction is fundamentally unchanged in all rotating machines and vehicles today and his contribution is acknowledged in a 1981 NASA Technical Memorandum.

1789 - 1864 Richard Roberts. b. Llanymynech.

Engineer and inventor best known for his work in the spinning and weaving of cloth and railway locomotives. He devised a machine to accurately punch holes in the iron plates for the Conway tubular bridge using Jacquard cards.

1785 - 1852 Sir Josiah John Guest.

Dowlais ironmaster whose iron products, especially rails, were exported worldwide.

1781 – 1847 Lucy Thomas. b. Llansamlet.

Coal proprietor, known as; 'The mother of the Welsh Steam Coal Trade'.

1776 – 1847 William Weston Young.

Entrepreneur and inventor, develops a high quality fire-brick for furnace lining using Dinas silica rock. It was exported world-wide and even today the Russian word for 'firebrick' is 'Dinas'.

1774 - 1852 Captain Sir Samuel Brown RN.

Introduced the iron chain cable into shipping and established the Brown Lenox works at Pontypridd.

1725 – 1804 Nathaniel Pigott.

Astronomer, who with his son Edward (1753 – 1825), were noted for observing astronomical phenomena such as eclipses, a transit of Venus and comets. A number of double stars were noted using the telescopes erected at Frampton House, near Llantwit Major.

1719 – 1789 William Edwards. b. Groes-wen.

Independent minister, architect and engineer. Famous as a builder of bridges, in particular Pontypridd bridge. Other bridges and industrial buildings followed, such as Wales' earliest planned industrial village for John Morris's copperworks near Swansea. His sons Thomas, David and Edward would continue his bridge-building tradition.

1675 - 1749 William Jones.

Welsh mathematician and the first to use the symbol π to represent the ratio of the circumference to the diameter in 1706.

1664 - 1734 John Hanbury.

Pioneer of the rolling of sheet iron and established Pontypool as the foremost producer of tinplate and Japanware in the 1800s.

fl. 1563 – 1588 John Trew.

A mining surveyor and engineer of Glamorgan who was engaged in 1564 to build the Exeter canal, the first pound lock canal in Britain.

1560 – 1631 Sir Hugh Myddelton.

The Welsh businessman, engineer and goldsmith responsible for the 'New River' project which brought fresh water to the City of London.

1510 – 1558 Robert Recorde. b. Tenby.

Leading physician and Comptroller of the Mint, he was also a mathematician whose symbol for the 'equals' sign has become the standard.

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"Science may set limits to knowledge, but should not set limits to imagination."

Bertrand Russell