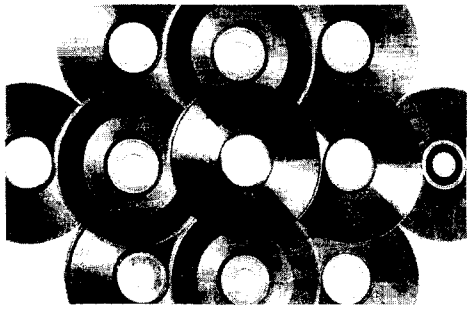
A celebration of science in the UK

10 BRITONS WHO

Today, the nation's universities are saluting the pioneers whose research has

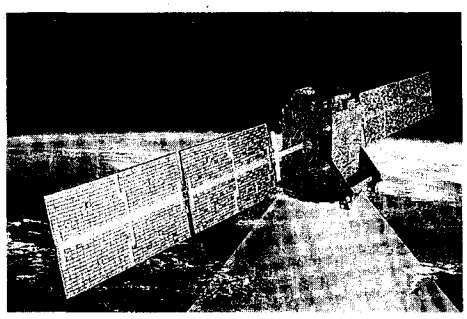


Alf Adams

Eureka moment: The discovery of the strained quantum-well laser.

How has it changed our lives? The strained quantum-well laser lies at the heart of most technologies that require the transfer of digital information, from the most basic CD player to the complex fibre-optic systems that keep the internet functioning across the world. Everyone reading this newspaper will today have had some contact – directly or indirectly – with a strained quantum-well laser. Semiconductor lasers receive electrical signals and turn them into pulses of light, called photons. In a quantum-well laser, there is an extremely thin layer of semiconducting crystals in which the laser light is generated. In his laboratory at the University of Surrey, Adams discovered that if the crystal lattice of this layer was grown in such a way to place it under strain the lattice would lose its symmetry. This distortion of the crystalline lattice produces photons much more efficiently – allowing far more information to be carried by the light energy.

What next? Adams is Distinguished Professor of Physics at Surrey and maintains a strong research interest in opto-electronics.

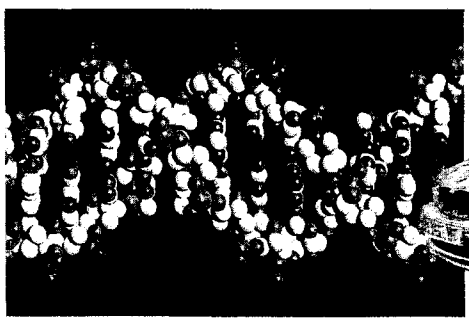


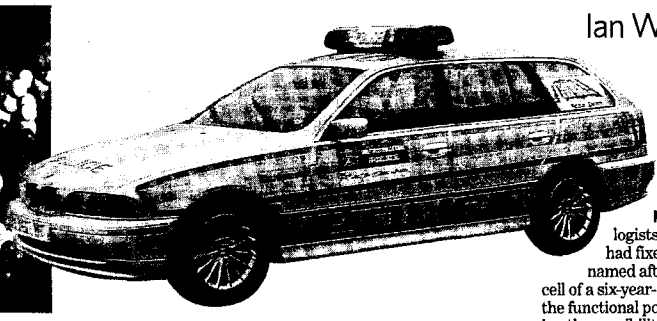
Martin Sweeting

Eureka moment: Building a small, low-cost satellite as part of his PhD project, which was successfully placed in Earth's orbit and transmitted signals back to the base station at Surrey University.

How has it changed our lives? Satellites are becoming increasingly important for monitoring the state of the Earth, for telecommunications and for navigation. Conventionally, satellites have been big, bulky and expensive to build and launch, which put them beyond the reach of many organisations that would benefit from them – aid agencies monitoring disaster areas, for example. Sweeting showed that satellites can be made small, compact and at low cost by taking advantage of the development of smaller and more robust electronics. Following his early research, Sweeting founded the company Surrey Satellite Technology.

What next? Sweeting was knighted in 2002 in recognition of his pioneering work. Among his company's latest developments is a "constellation" of five small satellites, which allows daily monitoring of a given location. The system is currently being used to detect illegal logging activities in South America.





Ian Wilmut

Eureka moment: Taking the nucleus from an adult cell and transplanting it into an egg cell, which in turn was inserted into the uterus to conceive Dolly the sheep, the first clone using a method of "cell nuclear replacement".

How has it changed our lives? Almost all biologists previously believed that the cells in our bodies had fixed roles. The conception in 1997 of Dolly – named after Dolly Parton – from the mammary gland cell of a six-year-old sheep forced biological science to reconsider the functional possibilities of cells. Researchers began investigating the possibility that cell nuclear replacement might be able to change very precisely the functioning of any gene in an animal. It also opened the possibility that, in human cloning, babies could be created without debilitating conditions. Scientists have since been attempting to "wash" egg cells that are affected by motor neurone and Huntington's disease. Cloning also promised much for the future of medicine and agriculture. Herds of cloned animals could potentially be designed to produce insulin in milk, and be made immune to diseases such as BSE and CJD. Part of the enormous impact that Dolly the sheep's brief life had on society was that it brought to the fore once more the ethical debate on cloning and embryology.

What next? Wilmut was appointed OBE in 1999 and was elected a Fellow of the Royal Society of Edinburgh in 2000for his work in embryology. He has also won a fellowship in the Academy of Medical Sciences. However, Wilmut's role in the Dolly project has become a matter of controversy. He had to testify at a court in Edinburgh earlier this year where he gave himself less than a third of the credit for Dolly's creation. Wilmut believes that in the future we will be able to change the functioning of cells without having to use a hollowed-out donor egg, which would permit the tackling of genetic defects without the ethical complications.

Fred Sanger

Eureka moment: Developing a way of determining the chemical structure of proteins, and of "reading" DNA sequences.

How has it changed our lives? Sanger has been described as the father of genomics. He invented a way of finding out the sequence of the building blocks – called "base pairs" – of DNA. This pioneering work laid the foundation for the sequencing of large and more complex genomes, culminating in the human genome. Sanger also discovered a way to work out the chemical structure of proteins, and revealed the amino acid sequence of insulin, enabling it to be manufactured. Sanger is one of only four people to be awarded two Nobel Prizes – in 1958 for sequencing proteins, and in 1980 for sequencing DNA.

What next? Sanger is now retired, but the Wellcome Trust Sanger Institute in Cambridge is one of the leading centres in the world for genomic research.

Deborah Withington

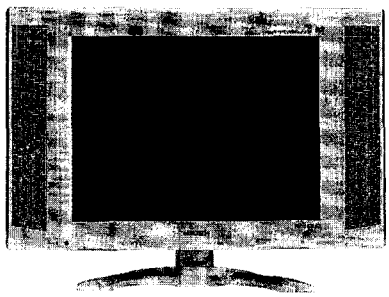
Eureka moment: Realising that "directional sound", which can be pinpointed instantly by the listener, could have safety uses.

How has it changed our lives? Withington, a professor at the University of Leeds, was sitting in a car trying to locate an emergency vehicle from the noise of its siren when it struck her how useful it would be if people could pinpoint immediately the source of such sounds. She decided to develop a system to help people evacuate buildings in an emergency and, because she was told she would not get funding from the research councils due to the potentially commercial nature of her idea, she set up a company to develop and market the technology. The company has also created a siren system for emergency vehicles that allows motorists to locate the vehicle quickly and allow it to pass.

What next? Withington's team is currently developing a new cane for blind people that emits an ultrasonic beam.

SHAPED OUR WORLD

resulted in global change. **Simon Hadlington** looks at some of the most inspiring examples



Martin Evans

Eureka moment: The discovery of embryonic stem cells.

How has it changed our lives? Many medical scientists believe stem cells hold the key to treating a range of illnesses, from Parkinson's disease to diabetes. Stem cells are "undifferentiated" – they have not yet become a heart cell or a liver cell, for example – but retain the ability to do so. The type of stem cells considered to have most potential are those derived from embryos. Evans, then a researcher at the University of Cambridge, discovered embryonic stem cells in mice in 1981. He was the first person to demonstrate the use of gene therapy to cure the deficit in cystic fibrosis in a whole animal. Researchers across the world are now building on Evans's work, trying to understand how to turn human embryonic stem cells into specific cell types in an attempt to find new ways of repairing tissues or organs.

What next? Evans, now director of the School of Biosciences at Cardiff University, continues to give important insights into the function of genes. He was knighted in 2004.

George Gray

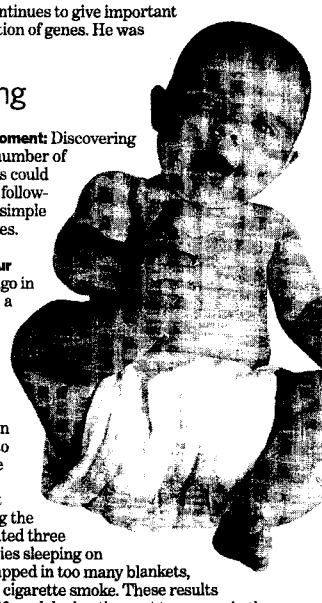
Eureka moment: Creating the first stable liquid crystals suitable for liquid crystal displays.

How has it changed our lives? Liquid crystal displays (LCDs) are used in everything from pocket calculators and watches to mobile phones and laptop computers. Scientists had been aware of the potential for using liquid crystals in displays for many years, but the materials that were available were insufficiently stable at room temperature, and could be destroyed when exposed to moisture, air or light. Working with the Ministry of Defence in 1973, Gray and his colleagues at the University of Hull discovered a new class of liquid crystalline material which was stable at room temperature. This was seized upon by the electronics industry and consumer products that contained small LCDs, such as watches and calculators, rapidly became ubiquitous. Liquid-crystal technology now forms the basis of an industry estimated to be worth some £20bn worldwide.

What next? Gray is now retired from the University of Hull but continues to play an active role in liquid crystal matters around the world.

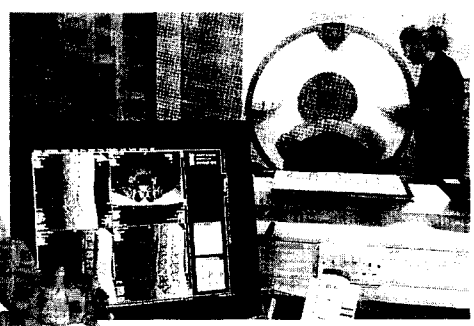
Peter Fleming

Eureka moment: Discovering that the number of cot deaths could be cut by following a few simple procedures.



How has it changed our lives? Twenty years ago in the UK, 2,000 babies a year died every year for no apparent reason in their sleep. Fleming and colleagues at the University of Bristol carried out a survey in the Avon area to try to discover if there were any discernible risk factors relating to cot death. After analysing the data Fleming pinpointed three potential factors: babies sleeping on their front, being wrapped in too many blankets, and being exposed to cigarette smoke. These results were published in 1989, and during the next two years in the Avon area a public health campaign was launched. By the middle of 1991 cot death rates had been cut by more than two thirds. Backed by the TV presenter Anne Diamond, Fleming persuaded an initially sceptical and reluctant Department of Health to launch the "Back to Sleep" campaign nationwide. Very soon, a similar reduction in rates of cot death was achieved nationally.

What next? Fleming has been a member of Baroness Kennedy's committee, which examines how agencies such as the police and social services react to unexpected deaths of babies.



Peter Mansfield

Eureka moment: Performed the first MRI scan of a living human body part – his own finger.

How has it changed our lives? More than 60 million MRI scans are carried out each year around the world. MRI (magnetic resonance imaging) is a technique for visualising the inside of living organisms. It can detect cancer, for example, without the need for surgery. It works by subjecting the body to a magnetic field and radio waves, which cause the nuclei of hydrogen atoms, contained within water in the blood and soft tissues of the body, to emit a tiny radio signal. Mansfield's pioneering work at the University of Nottingham produced a way to decipher mathematically the signals produced by the scanner very quickly, enabling three-dimensional images of structures within the body to be created.

What next? Mansfield was knighted in 1993 and awarded the Nobel Prize for Medicine in 2003 for his work on developing the concept of MRI. He is an emeritus professor at Nottingham.

Helen Muir

Eureka moment: Emergency procedures in aircraft.

How has it changed our lives? Muir's research at Cranfield University has helped aircraft designers and operators to improve safety procedures by assessing how survivors of aircraft accidents react. Her research team was the first to reproduce real human behaviour in an emergency. Researchers used a large simulator of a smoke-filled aircraft cabin and, to get an accurate representation of the panic that occurs during an emergency, volunteers were offered £5 if they got out of the aircraft first. In this way Muir could pinpoint weaknesses in evacuation procedures and the design of the aircraft. She discovered, for example, that extra space is needed next to the aeroplane exits, and this finding has been incorporated into planes around the world.

What next? Muir, head of the department of human factors at Cranfield, still works in the field of passenger safety – including trains as well as planes.