DNA 50th Anniversary of DNA

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UK - at the forefront of science innovation

THE United Kingdom is at the forefront of the biotechnology revolution as Europe's pre-eminent centre for leading-edge biotechnology research. The industry is based on the solid foundations of the UK's prestigious scientific community and has strong government and industry backing as it moves into its third decade of excellence.

Companies and scientists around the UK are working on a whole range of applications in sectors from pharmaceuticals through diagnostics, agriculture and chemicals to theenvironment. They are currently undertaking groundbreaking work in the vitally important fields of genomics, gene therapy, stem cell research and drug discovery all fields in which the UK's dynamic and innovative bioscience industry is particularly strong.

A large and fast-growing market

The UK biotechnology market is the largest in Europe and second only to the US in global terms. In 2001 the UK market value was $5.4 billion and is forecast to grow to $18.6 billion in 2006, a massive 200 per cent increase since 2002.

UK biotechnology market dimensions

- UK biotechnology market worth $5.4 billion (2001)
- UK biotechnology market is forecast to reach $18.6 billion by 2006
- UK biotechnology employment market is growing at 20% a year
- Employs 42,000 people

Accounts for a quarter of the European market and half of the European listed biotech companies.

Source: Datamonitor "United Kingdom Biotechnology" (November 2002) and BioIndustry Association www.bioindustry.org

The UK biotech sector benefits from a mature pharmaceutical industry which is the fifth largest in the world by sales, the third largest by exports and accounts for 10 per cent of world pharmaceutical R&D spending. This wealth of resources and knowledge gives domestic biotechnology firms a major competitive advantage over their international rivals.

There are over 450 biotechnology companies in the UK, including over 40 publicly listed companies more than in any other European country. Collectively they are responsible for roughly three-quarters of the drugs in late stage clinical trials in Europe.

An industry built on strong foundations

The UK owes its position as a global leader in the field of biotechnology to three crucial factors: a world-class science base, a strong and well-established financial services sector and the unbending support of the government.

World-Class Science

UK scientists have been awarded over 40 Nobel Prizes in the past 50 years more than half of those in the fields of bioscience and medicine. Perhaps one of the most significant pieces of recent biotechnology research was completed in the UK in 1997 when Dolly the Sheep was cloned by Ian Wilmut at the Roslin Institute in Scotland.

Innovation in clusters

Universities are playing an important role in transferring their newly discovered knowledge and expertise into new start-up ventures. With the help of the government's Regional Development Agencies (RDAs) these ventures have been strategically placed in clusters around some of the most prominent UK universities, including Oxford and Cambridge. The triangle between these two cities and London is now referred to as the Golden Biotech Triangle.

Biotech Clusters

Oxford: A well-established and thriving cluster of 120 companies, laboratories and research organisations with close links to University of Oxford and Oxford Brookes University.

www.oxfordshirebioscience.net/index.htm

Cambridge: Over 175 biotech companies from large multinationals to smaller private enterprises,

30 research institutes and universities, over 10,000 people employed in directly related businesses. Particularly strong in biopharmaceuticals and bioinformatics.

www.bioportfolio.com/erbi

London: Part of the Golden Biotech Triangle with Oxford and Cambridge. Over 90 companies in the London area spending over £300 million on biotech-related research. New London Bioscience Innovation Centre and research facility.

www.londonbiotechnology.co.uk

Edinburgh: One of the newer clusters from the home of Dolly the Sheep. Based around Edinburgh University, one of the UK's leading centres for bioscientific and biomedical research.

The BioCampus outside Edinburgh is Scotland's flagship £100 million National Biomanufacturing Centre.

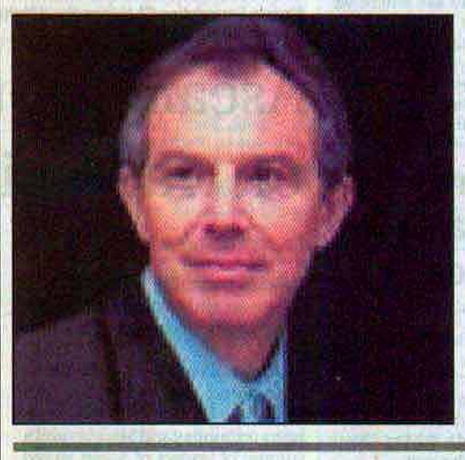
www.edinbioalliance.org/cluster.html

Pioneering Stem Cell Research

Britain is leading the world in stem cell research that could lead to a new era of regenerative medicine, to treat a huge range of diseases, including diabetes, heart failure, stroke and Alzheimer's. The work has been licensed by the Human Fertilisation and Embryology Authority (HFEA) after the government established a legislative framework that permits research on early embryos.

Both the government's Medical Research Council and the charitable Wellcome Trust are spending many millions of pounds building up research in the field as quickly as possible.

Dolly



"The science of biotechnology is likely to be to the first half of the 21st century what the computer was to the second half of the 20th century. Its implications are profound, its potential benefits massive…Britain is well placed to keep our lead in Europe. I want to make it clear: we don't intend to let our leadership fall behind and are prepared to back that commitment with investment."

--**Tony Blair** at European Bioscience Conference (November 2000)

The greatest scientific discovery of the century

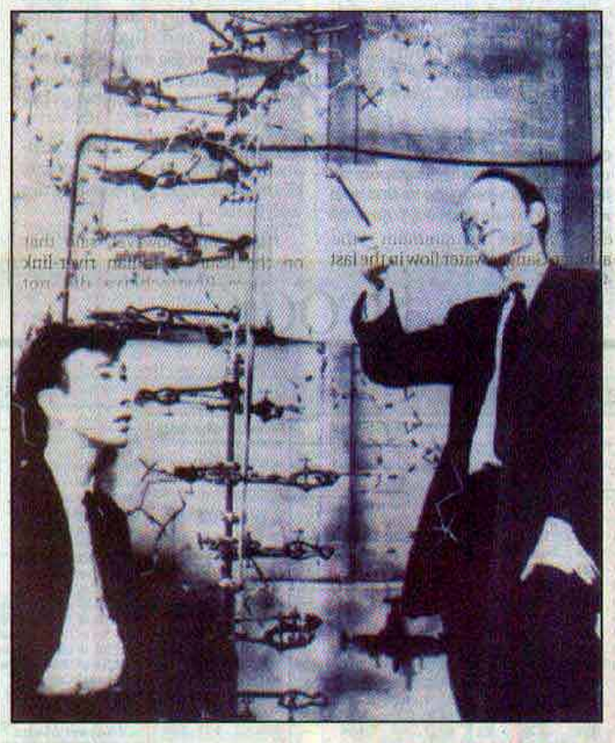
ONE lunchtime in March 1953, a young scientist called Francis Crick rushed into his local pub in Cambridge and triumphantly declared that he and his colleague, James Watson, had just discovered 'the secret of life'. The breakthrough the two had made was, indeed, extraordinary, for they had worked out the molecular

structure of DNA -the chemical substance found in the nucleus of every living cell. The double helix structure they had deduced revealed that DNA could do two crucial things -it could carry information and it could replicate itself. It was a discovery that would revolutionise biology.

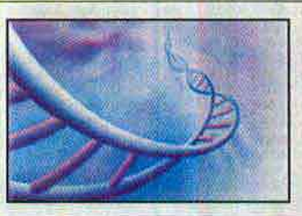
By the early 1950s, scientists had already identified DNA as the molecule that carried the biochemical information that enables all living things to exist, and so a race was on to discover exactly how it did this. Also close to solving the puzzle were the New Zealander Maurice Wilkins and Rosalind Franklin, who were both working on X-ray pictures of DNA at King's College, London, and the great American physical chemist Linus Pauling.

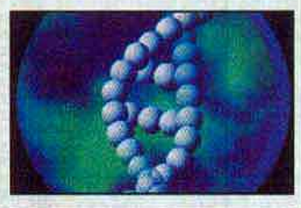
Crick and Watson met in 1951 at the Medical Research Council's Cavendish Laboratory in Cambridge, where Crick, then 35, was working on a study of haemoglobin crystals, and Watson, an American and 12 years his junior, had just arrived from America to work on another project. The two shared an office and discovered not only that they shared a fascination with DNA but that they were both intrigued by Linus Pauling's theories.

Deciding that they needed clearer X-ray pictures of the molecule, they made contact with Franklin and Wilkins at King's College. and Watson then attended a conference at which Rosalind Franklin described her x-ray results. Using the information he brought back. he and Crick produced their first model structure. which they invited Rosalind Franklin to view. But she was unimpressed. because the model was inconsistent with her results which Watson had in fact misunderstood.



James Watson (left) and Francis Crick photographed in front of their DNA model at the Cavendish Laboratory, Cambridge in 1953.





MESSAGE

The Foreign and Commonwealth Office in partnership with colleagues from British Council, is proud to be marking this 50 anniversary of the discovery of DNA with a series of events around the globe including in Bangladesh.

Fifty years ago, on Saturday, February 28 , 1953 Jim Watson and Francis Crick walked into the Eagle pub in Cambridge and announced to the lunchtime crowd that they had discovered the secret of life. Using data produced by Maurice Wilkins and Rosalind Franklin in London, what they had in fact discovered was the structure of DNA. This crucial discovery has enabled us to decode the human genome, create Dolly the sheep, develop new drugs and start to unravel the complex causes of cancer and heart disease.

As well as producing 50 years of exciting science this discovery also led to the establishment of a new industry, the modern biotechnology industry in which the UK is one of the world's leaders. Because of the strength of our science base, the UK biotechnology industry is the largest in Europe and second globally. With 1% of the world's population, we fund 4.5% of the world's science industry, produce 8% of the scientific papers and receive some 10% of the citations. In the past 50 years 46 UK scientists have been awarded Noble Prize and over 50% of these have been in the biosciences and medicine.

The bioscience and the technology they generate will be one of the prime drivers of the 21 Century. The British Prime Minister said in his "Science Matters" speech to the Royal Society last May that biotechnology was likely to be to the 21 Century what IT was to the 20 Century. Bioscience will impact on all our lives and provide tremendous opportunities to improve our quality of life -- through advances in healthcare and environmental protection and through generating the wealth we need to implement these advances.

The discovery of the structure of DNA was a brilliant and creative piece of science. This week we are honouring not only the creativity and skill of Jim Watson, Francis Crick, Maurice Wilkins and Rosalind Franklin, but also showcasing the achievements of the UK Science industry.

I am delighted that the DNA50 exhibition is coming to Bangladesh this week and hope that the exhibition, as well as the events to be held at British Council, will be both educational and stimulating.

David Carter
British High Commissioner in Bangladesh

PROGRAMME OF DNA50 EXHIBITION
6-13 October 2003
British Council Auditorium

Date	Event	Time
6th October	Inauguration	10:00AM-11.00 AM
	General Public Viewing of Exhibition	10:00AM-7:00PM
7-8th October	Celebrating the miracle of the DNA molecule in our Lives- A presentation by Department of Genetic Engineering and Biotechnology, University of Dhaka for the Students of Schools, Colleges and Universities (by Invitation only)	03:00PM-05:30PM
	General Public Viewing of Exhibition	10:00AM-7:00PM
9th October	General Public Viewing of Exhibition	10:00AM-7:00PM
10th October	General Public Viewing of Exhibition	10:00AM-7:00PM
11th October	Science Fair for Bengali Medium Schools	10:30AM-4:00PM
	Prize giving ceremony	4:00PM-5:00PM
	General Public Viewing of Exhibition	10:00AM-7:00PM
12th October	Closed	
13th October	Science Fair for English Medium Schools	10:30AM-4:00PM
	Prize giving ceremony	4:00PM-5:00PM
	General Public Viewing of Exhibition	10:30AM-7:00PM

DNA50 Exhibition in Chittagong
25-31 October 2003
British Council Auditorium, Chittagong

UK Molecular Biology 1953 - 2003

FROM the Foreign and Commonwealth Office booklet "DNA and After: 50 years of Excellence"

British achievements need to be seen in the following historical context:

1953 The double helix

Jim Watson and Francis Crick solve the three-dimensional molecular structure of deoxyribonucleic acid (DNA), the molecule that carries genetic information and transmits it from one generation to the next. Working at the Cavendish Laboratory, Cambridge, Watson and Crick used data obtained largely by Rosalind Franklin and Maurice Wilkins of MRC's Biophysics Research Unit (Kings College, London), to deduce that DNA is a double helix. For the first time, their structure suggested how genetic information might be copied during cell division. Watson, Crick and Wilkins received the 1962 Nobel Prize for Physiology or Medicine for their discovery. Rosalind Franklin had died of cancer before the award was made.

1956 Genetic disease

Vernon Ingram, MRC Unit for Research on the Molecular Structure of Biological Systems, shows that sickle-cell anaemia is caused by a single amino-acid change in haemoglobin, the oxygen-carrying molecule found in red blood cells. This was the first time that the molecular cause of a human genetic disease was established. Later DNA analysis revealed the corresponding haemoglobin gene mutation - a change to a single letter of the DNA code - that Ingram's work predicted.

1961-66 The genetic code

Francis Crick and Sydney Brenner working at the MRC Laboratory of Molecular Biology in Cambridge propose that DNA carries genetic information as a non-overlapping three base code, which is translated to specify the order in which amino acids are assembled to make proteins. Their theory was confirmed in 1966 when Marshall Nirenberg, Heinrich Mathaei, and Severo Ochoa worked out the correspondence between the DNA triplet code and each of the twenty amino acids, and so deciphered the genetic code.

1970-73 Genetic engineering

Scientists discover bacterial enzymes capable of cutting DNA at specific sites and learn how to splice foreign DNA segments into existing molecules to create new combinations, with altered function. Paul Berg and Herb Boyer produced the first 'recombinant' DNA molecules in 1972. In 1973, Boyer, Stanley Cohen and Annie Chang transferred DNA between different organisms for the first time, combining viral and bacterial DNA segments and reintroducing them to bacteria to make them antibiotic resistant.

1975-77 DNA analysis

Ed Southern, based at Edinburgh University, invents 'Southern Blotting', a DNA analysis technique crucial to most modern molecular biology research. Southern blotting allows researchers to determine how DNA fragments cut from intact DNA were originally ordered. The method reveals information has underpinned vast research programmes in many different fields of biology, diagnostics and medicine, including early genetic mapping work in the human genome project.

In 1975 Dr Cesar Milstein and Dr George Kohler, working at the Medical Research Council's Laboratory of Molecular Biology in Cambridge, transformed biomedical research and launched the international biotechnology industry, by discovering a way to produce monoclonal antibodies (mAbs) - immune system protein which recognise and bind to foreign invaders, singling them out for elimination by the body's immune systyem. In 1977 Fred Sanger, at the MRC Laboratory of Molecular Biology in Cambridge, developed a technique to read DNA's genetic code one letter at a time. His method forms the basis of the sophisticated technology still in use today to sequence all 3 billion letters of the human genome.

1984 DNA fingerprinting

Alec Jeffreys, working at the University of Leicester, invents DNA fingerprinting, which can identify people from a sample of their DNA. The technique has since found widespread use in forensic medicine and provided vital evidence to solve murder and rape cases, resolve immigration disputes, and to determine paternity.

1987 Sheep Pharm

Research by Dr John Clark and colleagues at the UK Animal Breeding Research Organisation leads to an offshoot company PPL, producing Tracy, a transgenic sheep that secretes a human protein in her milk.

1989 Gene discovery

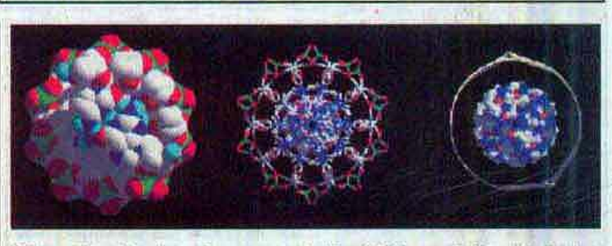
Francis Collins and Lap-Chee Tsui use new gene mapping techniques to pinpoint the faulty gene that causes cystic fibrosis. For the first time scientists are able to hunt down faulty disease-causing genes without knowing their actual function.

1990-2002 The genomics era

The Human Genome Project, an ambitious international effort to locate every single human gene was officially launched in 1990. In 1995, Craig Venter, Claire Fraser, Hamilton Smith, and their US colleagues completed the first full genetic sequence of a living organism, the bacterium Hemophilus influenzae. In 1996, Dolly the sheep, the first adult mammal is cloned at the Roslin Institute by Ian Wilmut and colleagues. In 1998 Dr John Sulston's MRC team and their scientific collaborators, led by Dr Bob Waterston at the US National Institutes of Health, described the first complete genetic details of a multicellular organism, the nematode worm Caenorhabditis elegans.

The first human chromosome, chromosome 22 was sequenced in 1999 and the first working draft of the whole human genome sequence was announced in 2000. The John Innes Centre leads a team that publishes the whole genetic sequence of Arabidopsis thaliana in 2000 producing an invaluable resource enabling plant scientists to understand more about evolution and biology. In 2001 Rhys Evan is successfully treated by gene therapy for severe combined immunodeficiency by doctors at Great Ormond Street Hospital.

In 2002 Sir John Sulston and Dr Sydney Brenner received the 2002 Nobel Prize for Physiology or Medicine for their work on the nematode worm. Also in 2002 British scientists sequence nature's antibiotic factory - scientists from the John Innes Centre and the Sanger Institute publish the genetic sequence of Streptomyces Coelicor, the common soil bacteria which produces more than two-thirds of the worlds antibiotics. The complete human genome sequence is expected to be announced in 2003, just 50 short years after Watson, Crick, Wilkins and Franklin published their groundbreaking work on DNA, the molecule of life



- Record funding for science research. The UK Research Councils Budget will reach almost £3 billion by 2002 - 2006 - more than double the figure in 1997 - 1998. The November 2002 spending review allocated:
- £40m for research into stem cells
- £136m to build on the genomics and proteomics research programme
- £15m to take advantage of recent advances in brain science
- £20m for research to look at the impact of the changing role of the countryside on the rural economy, including use of non-food crops, and
- £28m for research into sustainable energy
- £115 million to continue research into the next generation of computing technology