

Discoveries to change the world

As scientific boundaries are relentlessly extended, **Laura Fountain** examines some of the biggest breakthroughs

1 Bionic technology A case of mind over matter?

This year, Claudia Mitchell, of Maryland, US, became the first woman to receive a bionic arm. A former US Marine Corps officer, Mitchell was in a motorcycle accident in 2004 that severed her left arm at the shoulder.

Bionic technology that allows patients to move prosthetic limbs by thought has been used on a handful of amputees, with advancements in sensory feedback now being made to allow patients to feel whether they are touching hot or cold objects.

Bionic technology
The science of combining mechanics with human thought and nerves opens a new realm of possibilities

The extraordinary technology for this latest breakthrough in bionic transplants was developed by the Rehabilitation Institute of Chicago's Neural Engineering Centre for Bionic Medicine in the US.

"Before the surgery, I doubted that I would ever be able to get my life back," says Mitchell. "But this arm and the work by the Rehabilitation Institute of Chicago have allowed me to return to a life that is more rewarding and active than I ever could have imagined was possible." ►►



2 LifeStraw® Seeking purity in the world

LifeStraw was developed in direct response to the United Nations' ambitious Millennium Development Goal of "reducing by half the proportion of people without sustainable access to safe drinking water" by the year 2015.

Designed to turn surface water into drinking water, LifeStraw is a cheap personal mobile water purification tool that provides access to safe water wherever the user is.

Based on a simple straw design, the device effectively removes salmonella typhi and salmonella paratyphi, E.coli and vibro cholerae, and other waterborne diseases. Further development of the straw aims to see it eliminate arsenic, fluoride, protozoa and heavy metals.

Mikkel Vestergaard Frandsen, CEO of Vestergaard Frandsen, who developed and produce LifeStraw, said: "At any given moment, about half the world's poor are suffering from waterborne disease, of which more than 6,000 – mainly children – die each day by consuming unsafe drinking water."

"Safe water interventions have vast potential to transform the lives of millions of people, especially in crucial areas such as poverty eradication, environmental upgradation, quality of life, child development and gender equality."

3 Aviation Lofty ambitions: the Airbus A380

Airbus predicts that its A380 will become "the flagship commercial aircraft of the 21st century". Despite its ability to carry as many as 555 passengers – 35 per cent more than its competitors – the A380 burns 12 per cent less fuel per seat, claims Airbus.

With the aviation industry predicting that by 2050 global air passenger numbers could triple from current levels, the A380 could not only physically change the way that we fly by allowing for increased space and comfort, but also provide the technology that allows us to increase our personal number of flights per year.

The A380's development has been far from painless, however. Airbus recently admitted its delivery schedule would slip by a year, to late 2007 – partly due to difficulties installing the 500km of cabling on each plane – prompting high-profile executive resignations.



5 Biofuels A global burning ambition

Biofuels offer the attractive possibility of salvation from both climate change and high oil prices. The theory behind biofuels is that the amount of carbon dioxide released when these plant-based fuels are burned is offset by the amount of gas absorbed by the plants when they were alive.

However, there is concern over the pressure that could be placed on the environment by demand for land to grow the plants – such as cereals, soybean, oil seed rape and sugar cane – that are used for biofuels. That fear is speeding up progress towards a second-generation alternative. Future technology will allow more efficient second-generation biofuels that can be manufactured from any plant material.

This year, Chevron, one of the largest integrated energy companies in the world, formed an alliance with the Georgia Institute of Technology and pledged \$12 million for the development of commercially viable transportation fuels from renewable resources, while fuel giant BP pledged \$500 million for an energy institute.

Rick Zalesky, vice president of Biofuels and Hydrogen, Chevron Technology Ventures, says: "Once developed, second-generation processing technology will allow waste products to be converted into renewable transportation fuels, opening the door to a new phase in alternative energy."

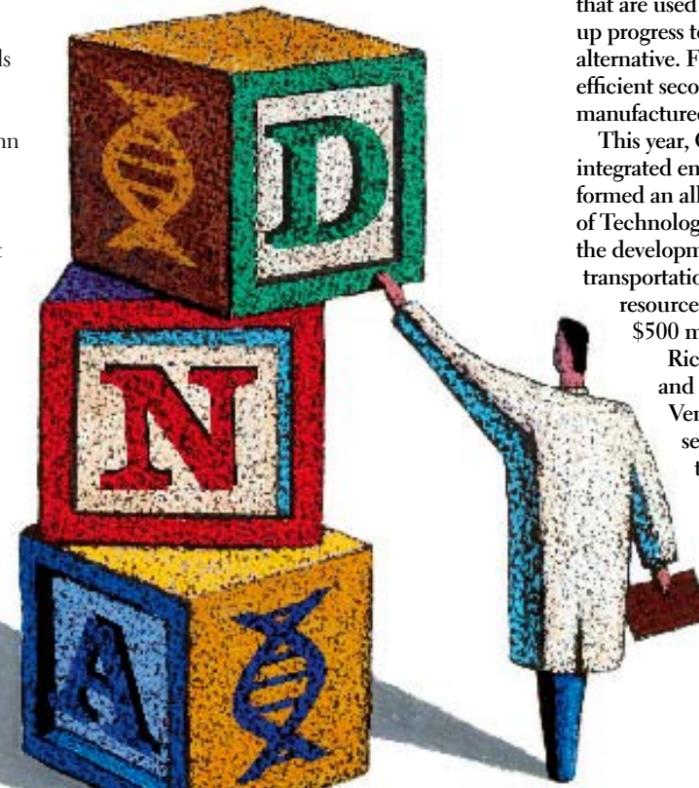
4 Gene therapy Unravelling the design for life

The potential of using gene therapy to treat disease is enormous. The basic principle behind the science involves inserting genes into cell tissue to replace a defective gene.

Recent developments have seen a team at the National Cancer Institute (NCI) in the US manipulating immune cells from skin cancer patients to recognise and attack specific cancers – in this case malignant melanoma. The team has also shown it is capable of manipulating immune cells to attack breast, liver and lung cancers.

Acting NCI Director John Niederhuber said: "These very exciting successes in treating advanced melanoma bring hope that this type of gene therapy, altering lymphocytes, could be used in many types of common cancers and could be achievable in the near future."

It is hoped that gene therapy will revolutionise the treatment of all disease and will even be able to prevent hereditary illnesses.



6 3DTV Vision of the future

Three-dimensional image televisions could be in homes within three years, according to the 3DTV network, a consortium of 200 European researchers.

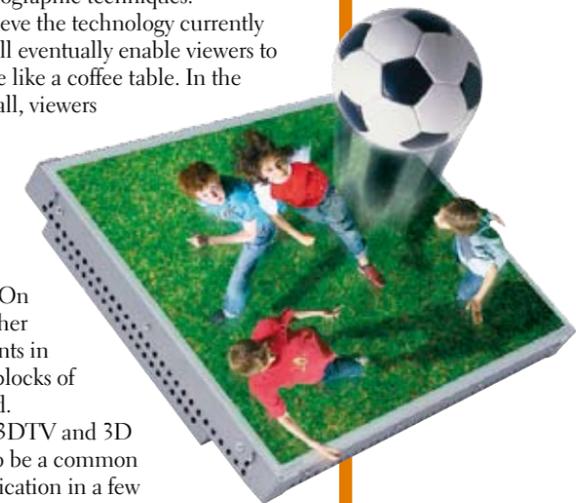
The consortium has already developed and tested several different auto-stereoscopic displays, which need no special glasses for viewing 3D images, and has also experimented with holographic techniques.

The researchers believe the technology currently under development will eventually enable viewers to watch a TV that will be like a coffee table. In the case of watching football, viewers would see small-scale football players made from light running around on the table.

Levent Oral, the co-ordinator of the 3DTV network, says: "On the technical side, further significant improvements in all technical building blocks of 3DTV can be expected."

"Stereoscopy-based 3DTV and 3D cinema are expected to be a common form of mass communication in a few years. However, high-end performance and technologies based on holographic techniques probably need another 10 years of intensive and extensive research."

As well as changing the way television and cinema are viewed, the imaging science being developed could have applications in fields such as medicine, air-traffic control and military technologies.



7 Nanotechnology Small, but perfectly formed

Although it exists only in laboratories for now, nanotechnology has the potential to transform every aspect of our lives.

Nanotechnology is science and engineering at the scale of atoms and molecules. Derived from the word 'nanometre', meaning a billionth of a metre, it is the manipulation and use of materials and devices so tiny that nothing can be built any smaller.

In the short-term, nanotechnology promises to improve medical diagnostic tools and sensors, solar energy collection and direct hydrogen production. Longer-term nanotechnology is hoped to lead to the development of replacements for human tissues and organs, and PCs with the power of today's computer centres. ■