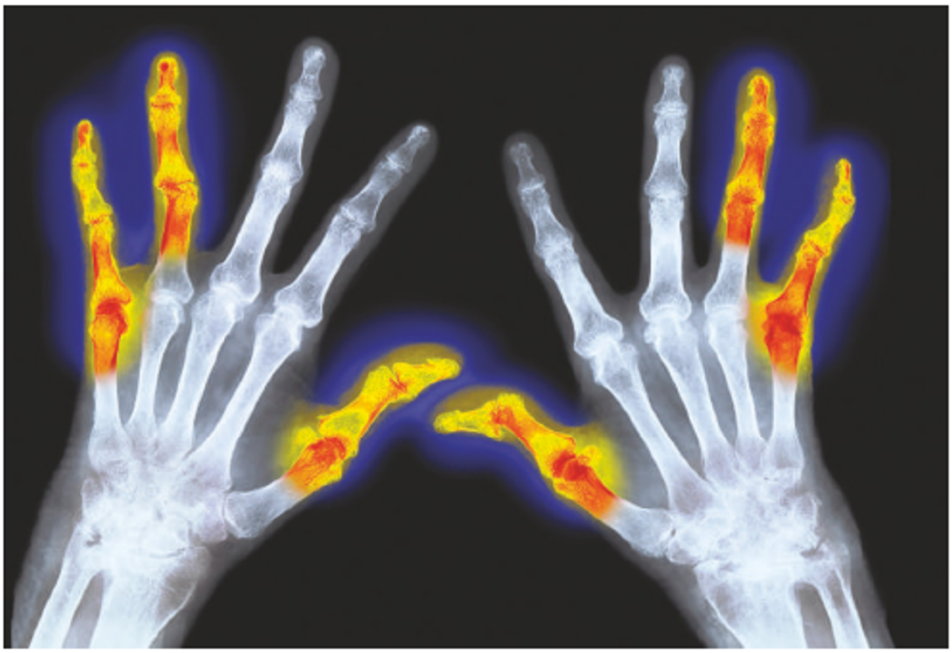
RESEARCH HIGHLIGHTS

Joint culprits

J. Clin. Invest. 116, 961–973 (2006)

A newly discovered series of antibodies that attack the body play a central role in the autoimmune disorder rheumatoid arthritis, say researchers. The team suggests that future therapies that inhibit these antibodies may reduce or prevent the onset of the disease, which destroys joints (see X-ray, right).

Michael Holers of the University of Colorado Health Sciences Center, Denver, and his colleagues injected a cow-derived form of the protein collagen, known to induce arthritis, into mice. They found that antibodies targeting cyclic citrullinated peptides — proteins with modified arginine amino acids — were the first to appear before full onset of arthritis. Mice injected with the peptides and allowed to build a tolerance to them before the introduction of collagen contracted a less severe form of arthritis.



L. LEFKOWITZ/GETTY IMAGES

CANCER BIOLOGY

Tumour assassins

Science 311, 1780–1784 (2006)

Although targeted therapies hold great potential for curing cancer, they often miss the mark because of inefficient delivery to the tumour. To improve their aim, Christopher Contag and his colleagues at Stanford University School of Medicine, California, combined two forms of these treatments.

The researchers started with a cytokine-induced killer T cell, a kind of immune cell that can home in on and kill cancer cells by detecting the abnormal proteins they make. The team boosted the T cell's killing power by inserting a tumour-killing pox virus into it. In tests on mice carrying human ovarian cancers or mouse breast cancers, whole-body imaging showed that the cells fully infiltrated the tumours and reduced them. Clinical trials utilizing this two-prong approach have been proposed.

ANIMAL BEHAVIOUR

Follow the herd

Proc. Natl Acad. Sci. USA
doi:10.1073/pnas.0507877103 (2006)

You don't need a big brain or a complex social structure to make smart group decisions, say biologists. A simple mathematical relationship between detecting a small amount of information and responding to it will do the job.

José Halloy at the Université Libre de Bruxelles, Belgium, and his colleagues tested cockroaches (*Blattella germanica*) to see how they choose to collect together in shelters. The decision to stay was influenced by the number of cockroaches already in the shelter, with the probability of a new arrival leaving for another shelter dropping sharply once a certain threshold of individuals had been reached, but only if there was sufficient room.

This resulted in optimally sized groups appearing in the shelters (as seen in the top two pictured below). The team suggests that similar rules could apply to other gregarious creatures such as shoals of fish and flocks of birds.

J. HALLOY

PHOTONICS

Silicon goes underground

Appl. Phys. Lett. 88, 121108 (2006)

On silicon chips, space is at a premium. So Tejaswi Indukuri and his colleagues at the University of California, Los Angeles, have developed a method for stacking microstructures on top of one another, burying one below the surface of a silicon wafer while placing the other on top. In this way they have combined a photonic and an electronic device on the same area of a wafer.

They created a photonic device about 350 nanometres below the wafer surface by firing oxygen ions at it through a patterned mask. The ions penetrate to a depth that depends on their energy, and subsequent annealing creates a layer of silicon dioxide, isolating the silicon above from that below and thus defining a buried silicon microstructure. The second device can then be added on top.

CHEMICAL BIOLOGY

Think zinc

ACS Chem. Biol. 1, 103–111 (2006)

Zinc is vital for many biological functions, but surprisingly little is known about its concentrations inside cells. A new method to quantify free zinc ions in cells looks set to change that.

Richard Thompson and his colleagues at the University of Maryland School of

IMAGESTATE/ALAMY

Medicine in Baltimore used a biosensor based on an enzyme called carbonic anhydrase. The biosensor fluoresces in the presence of zinc but does not react to other common metal ions such as calcium or magnesium. However, it was hard to get the biosensor into cells. So the team attached a protein fragment known to make cells take up proteins, causing sufficient quantities of the biosensor to enter cells. This allowed them to measure the picomolar concentrations of zinc typically found in ordinary resting cell culture lines for the first time.

ATMOSPHERIC SCIENCE

In-flight ozone info

J. Geophys. Res. 111, D05305 (2006)

Atmospheric ozone levels in the tropics are increasing as a result of industrial emissions, according to the results of a survey that hitches a ride on cruising commercial aircraft.

Herman Smit of the Research Centre Jülich, Germany, and his colleagues on the MOZAIC (measurement of ozone and water vapour by Airbus in-service aircraft) programme have compiled details of the levels of these compounds between 1994 and 2003. They found that man-made emissions have boosted ozone levels in the troposphere — the layer of atmosphere nearest Earth's surface and below the one where the ozone layer resides — by around one part per billion per year. Levels of water vapour, which has similar greenhouse properties to ozone, varies by a factor of 2.5 during the year — far more than expected given the modest annual temperature variation that occurs at these latitudes.

FLUID DYNAMICS

Short spurt

Phys. Rev. Lett. 96, 124501 (2006)

When water splashes on to a hydrophobic solid surface (pictured above), the result can be an extremely fine vertical jet travelling up to 40 times faster than the falling droplet. Denis Bartolo at the Ecole Nationale Supérieure in Paris, France, and his colleagues capture the process in moving pictures.

They find that the jets arise from the collapse, within a few millionths of a second, of an air bubble created in the middle of a droplet on impact. The fastest jets occur at two separate impact speeds and correspond to two fundamentally different collapse modes.

Surprisingly, at intermediate velocities, the bubble does not burst at all. Such insights could make a splash in areas such as inkjet printing in which the clean deposition of drops is essential, the authors suggest.

CHEMISTRY

Summing up

J. Am. Chem. Soc. doi:10.1021/ja058564w (2006)

Chemists in Israel have constructed a chemical calculator that can add or subtract three inputs made of single units of information, or bits.

Abraham Shanzer and his colleagues at The Weizmann Institute of Science in Rehovot made their device by modifying previous two-input addition systems based on the molecule fluorescein. By manipulating the amount of acid and base in the fluorescein solution, the researchers can control the input bits and set the system to perform addition or subtraction. The answer is obtained by measuring the frequency of light emitted by the solution.

The authors say the system is the first to integrate three-input addition with subtraction, and is a significant step towards a molecular-scale calculator.

PROTEIN STRUCTURE

Proteins, pronto

J. Am. Chem. Soc. doi:10.1021/ja0580791 (2006)

Nuclear magnetic resonance (NMR) offers a fast way to determine a protein's structure, but samples must be free of the contaminants that are often introduced during the protein's production in a living cell. Now researchers have found a quick and clean method to go from a gene to a protein NMR spectrum in under five hours. This could allow highly efficient screening of proteins to make sure they have been expressed properly.

A. J. Shaka and his colleagues at the University of California, Irvine, and the Invitrogen Corporation in Carlsbad, used a cell-free protein production system called Expressway that is manufactured by the company. Purification yields a mixture clean enough for a two-dimensional NMR that shows the structural relationships of hydrogen and nitrogen atoms in the molecule.

JOURNAL CLUB

H. Charles J. Godfray
NERC Centre for Population Biology, Imperial College London, UK

An insect-population biologist is fascinated by the latest episode in a microbial detective story.

The now routine use of molecular techniques has revealed the existence of a previously unsuspected menagerie of bacteria living inside aphids and playing a key role in their biology. Disentangling the effects of the bacteria on their hosts makes an intriguing story, although one that is a little unsettling for those of us who did traditional zoology courses that ignored microbes.

Like nearly all aphids, the pea aphid *Acyrthosiphon pisum* owes its life to a symbiotic bacterium, *Buchnera*, which provides essential amino acids that are absent from the aphid's diet. But aphids also have secondary symbionts that might be called 'lifestyle bacteria', which although not essential for life, can give the aphid an upper hand in the struggle for existence.

At least five different types of bacteria have been associated with pea aphids, and a series of studies has shown that different secondary symbionts may help them to combat heat stress, exploit particular host plants and, perhaps most surprisingly, help them resist attack from parasitoid wasps and fungi.

But if secondary symbionts are so good for you, why do the majority of individuals carry just one and not the complete set? Researchers (K. M. Oliver *et al.* *Proc. R. Soc. Lond. B* doi: 10.1098/rspb.2005.3436; 2006) artificially created double infections using two secondary symbionts that they had previously shown increased resistance to parasitoids.

The doubly infected aphids had even higher resistance, but produced far fewer offspring, whether parasitized or not. Quite why double infections so harm their host is not clear, but the study provides an important insight into the miniature bacterial ecosystems at work inside aphids.