RESEARCH HIGHLIGHTS

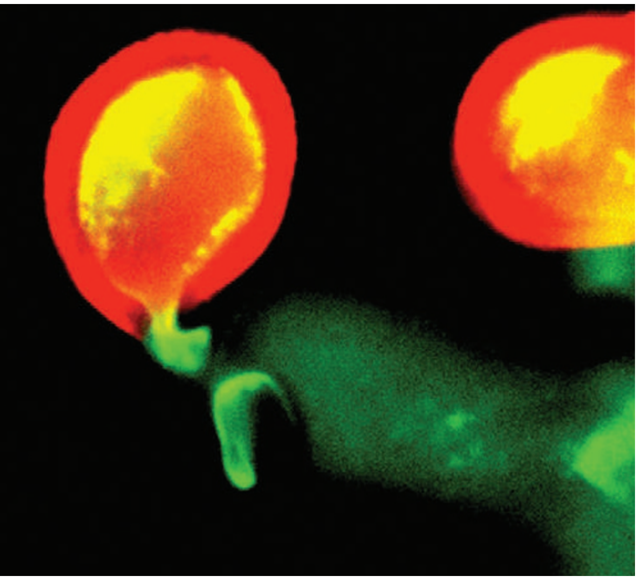
Female to male communication

Science **317,** 656–660 (2007)

Fertilization in plants depends on the female sexual apparatus detecting and accommodating its species' pollen. Research led by Ueli Grossniklaus of the University of Zürich in Switzerland has identified a receptor-like protein on certain cells of a flower's female reproductive structure that is key to this recognition process.

When a pollen grain (red in picture) arrives at the female structure, it begins to grow a pollen tube (green) towards the reproductive cells, through which the male gamete contained within the grain is delivered to the egg. *Arabidopsis thaliana* plants lacking a protein known as FER fail to arrest the pollen tube's growth and to ensure that it ruptures in the right place, meaning that fertilization does not occur.

It may be possible to manipulate this system to allow cross-species fertilization, but it is not yet known what molecule on the pollen grain FER binds.



J.-M. ESCOBAR-RESTREPO

TOXICOLOGY

Plastic changes to a diet

Proc. Natl Acad. Sci. USA doi:10.1073/pnas.0703739104 (2007)

Dietary supplements seem to protect developing mouse embryos from the effects of a worrying chemical. Bisphenol A (BPA), a hardening agent used in consumer plastics, has been shown to damage mouse eggs and produce problems later in life through epigenetic changes — heritable alterations to the genome that affect gene regulation.

Randy Jirtle and his colleagues at Duke University in Durham, North Carolina, investigated the effects of BPA in a mouse model in which epigenetic alterations cause the mouse's coat to change colour between brown and yellow. Offspring of mice exposed to BPA were more likely to be yellow than those of control mice. If expectant mothers exposed to BPA were also fed a diet high in folic acid or genistein, a phytooestrogen found in soy, this effect disappeared.

CANCER BIOLOGY

Microbial tumour fighters

J. Clin. Invest. doi:10.1172/JCI32205 (2007)

The gut's microbial flora may stimulate the immune system's fight against tumours, report researchers from the US National Cancer Institute.

Chrystal Paulos, Nicholas Restifo and their colleagues studied a treatment in which cancer patients are irradiated and then given tumour-specific immune cells that find and kill the cancer cells. The radiation was thought to help by killing other immune cells that would interfere with this process and by boosting the production of helpful proteins. But this team found that radiation also benefits mutant mice that already lack these interfering cells and beneficial proteins.

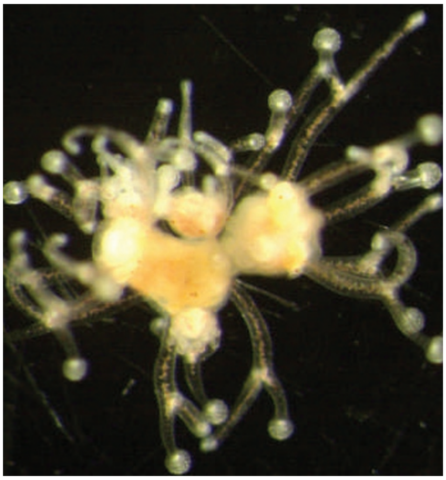
The researchers propose that this is because radiation breaks down the barriers of the gut, enabling bacterial molecules to travel into the serum and lymph nodes. Once there, they are thought to nudge the immune system into greater action. Antibiotics or elimination of the bacterial molecules reduced the positive effects of radiation.

PHYSICS

Turned out right

Phys. Rev. Lett. **99,** 050401 (2007)

Two experimental teams on opposite sides of the globe have joined forces to put Einstein's theory of relativity to a stringent test.



W. JAKOB

Holger Müller of Stanford University in California and his colleagues looked for violations of Lorentz invariance — the assumption in relativity that the laws of physics are the same in all reference frames — by combining data from experiments in Berlin, Germany, and Perth, Australia. The first data set compares the frequencies of light resonating in two quartz cavities, the second the frequencies of microwaves in two sapphire crystals. Together, these test the behaviour of both photons and electrons. Each experiment was rotated to change the reference frame it probed.

Some physical theories predict Lorentz violations, but relativity survived this test. Data recorded over a period of more than a year set simultaneous constraints on the possible size of 14 Lorentz violation parameters that are between 3 and 50 times smaller than the previous best limits.

GENETICS

Two heads better than one?

PloS One **2,** e694 (2007)

Silencing a single gene can induce a jellyfish to grow multiple heads, Wolfgang Jakob and Bernd Schierwater of the University of Veterinary Medicine Hannover, Germany, have found.

The researchers used RNA interference to switch off *Cnox* genes in the jellyfish, *Eleutheria dichotoma*. *Cnox* genes help to shape development of the organism's body plan, similar to the *Hox* genes found in other animals, including humans. Inhibiting one or both of the genes *Cnox-2* and *Cnox-3* produced multiple 'heads' (pictured left), whereas inhibiting *Cnox-1* resulted in additional tentacles.

Related genes are found in Cnidaria including jellyfish, anemones and coral. These genes may have had a role in the evolution of some colony-forming Cnidaria that have multiple heads sharing a stomach.

DRUG DISCOVERY

Challenging drug resistance

Nature Chem. Biol. doi:10.1038/nchembio.2007.21 (2007)

Bacteria that have become resistant to certain antibiotics may meet their match in lactivicin — an antibiotic with an unusual architecture.

Lactivicin inhibits enzymes, known as penicillin-binding proteins, essential to building the bacterial cell wall. Several other antibiotics also target these enzymes, but their activity is underpinned by a β-lactam group, which lactivicin lacks. From crystal structures, Christopher Schofield, at the University of Oxford, UK, and Andréa Dessen, of the Jean-Pierre Ebel Institute of Structural Biology in Grenoble, France, and their colleagues have deciphered how lactivicin inhibits these enzymes.

They also report that lactivicin can inhibit a mutated form of the enzyme from bacteria that are resistant to β-lactam antibiotics. The results may spur the design of a new suite of antibiotics.

IMMUNOLOGY

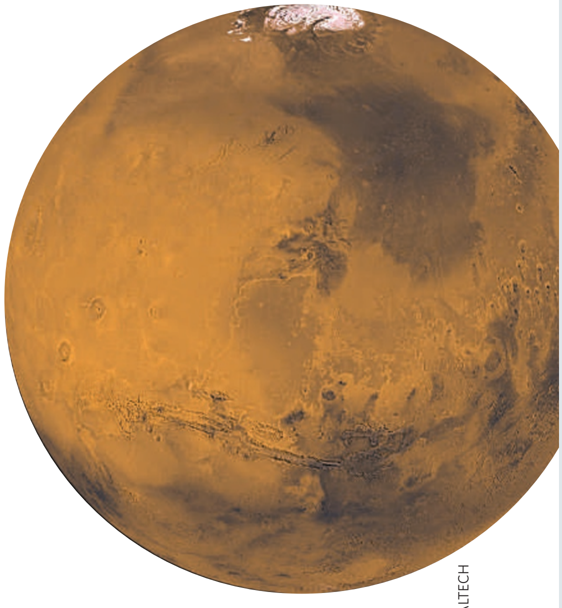
The mouse gap

Nature Immunol. doi: 10.1038/ni1500, doi: 10.1038/ni1496 and doi: 10.1038/ni1497 (2007)

Three papers offer new details about how the immune system's T_H-17 cells develop. The work indicates that mice are of limited use as models for the development of such cells in the human immune system.

Michael Lohoff, of Philipps University Marburg in Germany, and his colleagues studied mice, and found that T_H-17 cell formation requires a protein known as interferon-regulatory factor 4.

Two additional reports — one by Federica Sallusto, Eva Acosta-Rodriguez and their colleagues at the Institute for Research in Biomedicine in Bellinzona, Switzerland, and another by Rene de Waal Malefyt of Schering-Plough Biopharma in Palo Alto, California, and his colleagues — catalogue the proteins involved in differentiation of T_H-17 cells in humans. These reports reveal unexpected differences in this process between humans and mice.



NASA/JPL-CALTECH

PLANETARY SCIENCE

Volcanic roots

Geophys. Res. Lett. **34,** L14202 (2007)

Researchers in Germany have come up with a mechanism to explain how volcanoes on Mars — some of which can be seen in the image above — have remained active for much of the planet's life.

Evidence from spacecraft suggests that some volcanic flows on the red planet formed as recently as 2 million years ago, long after the planet's surface was expected to be cold and geologically dead. One hypothesis is that a mantle plume sustained the volcanism. Sandra Schumacher of the University of Münster and Doris Breuer of the German Aerospace Center in Berlin-Adlershof present a rival theory. They calculate that the crust in the major volcanic regions, which is thicker than elsewhere, can trap enough of the heat coming from the planet's interior to melt the rock beneath the crust.

CHEMICAL BIOLOGY

Minds made up

J. Am. Chem. Soc. **129,** 9258–9259 (2007)

Researchers have found a chemical that can transform muscle cells into neuron-like cells. The work could lead to treatments for neurodegenerative disease if these cells prove able to develop into fully fledged neurons.

Injae Shin and his co-workers at Yonsei University in Seoul, Korea, screened a library of molecules and found one, dubbed neurodazine, that triggers mouse and human muscle cells to display neuron-like behaviour. The treated cells start to produce neuron-specific proteins and to generate and exchange synaptic vesicles, the structures that transport neurotransmitters within nerve cells.

Previous methods to grow neurons from other cell types have either relied on chemicals with potentially disruptive biochemical effects or worked only in embryonic stem cells.

JOURNAL CLUB

Michael Purugganan
New York University, USA

An evolutionary geneticist wonders why certain crops were 'invented' not once but multiple times.

Crop species have always captured my imagination — perhaps because Darwin saw domestication as a model for the evolutionary process, or maybe because I am an inveterate foodie. Whatever the reason, I work on the evolution of crop species as diverse as rice, barley and cauliflower, using genomic methods to trace their origins.

I was struck by two recent molecular studies that indicate that key crops may have evolved more than once in association with different cultures, after Neolithic farmers began to cultivate various wild plants and select desirable traits 12,000 years ago.

Rice seems to have originated from the wild rice *Oryza rufipogon* separately in China and in India and southeast Asia (J. P. Londo *et al. Proc. Natl Acad. Sci. USA* **103,** 9578–9583; 2006). Meanwhile, barley, which originated once in the Fertile Crescent — a region defined by an arc through Lebanon, Syria, Turkey and Iraq, and home to the oldest archaeological evidence for agriculture — may also have had a second origin in present-day eastern Iran (P. L. Morrell and M. T. Clegg *Proc. Natl Acad. Sci. USA* **104,** 3289–3294; 2007).

Previous genetic mapping studies of the loss of seed shattering in rice and barley suggests that the trait is controlled by different genes in different lineages of these crops. This makes sense in the light of a multiple-origins scenario.

The pattern is not unique — cattle, sheep and goats were also domesticated multiple times. So did different cultures learn how to go about domesticating wild plants and animals from each other, or did they arrive at the same evolutionary solutions independently when faced with similar challenges? Hopefully the genetic data will motivate archaeologists to dig for evidence of how groups of people went about developing these crops.

Discuss these papers at **http://blogs.nature.com/nature/journalclub**