team have shown that arsenic destabilizes a protein that regulates Hedgehog activity, which may allow the pathway to boost cell growth. Mice exposed to arsenic-laced water had higher Hedgehog activity.

The researchers also analysed 265 human bladder cancer samples along with the arsenic levels in the patients' tap water. Higher arsenic levels correlated with increased tumour expression of a key player in the Hedgehog pathway.

PHYSICS

Photon storage for telecoms

Phys. Rev. Lett. **104,** 080502 (2010)

Photons have a quantum mechanical spin, which can be 'up', 'down' or both. Storing a photon using conventional methods alters this state, destroying its quantum information.

Björn Lauritzen and his colleagues at the University of Geneva in Switzerland have found a way to store infrared photons without changing them. The team shone a weak infrared laser pulse at a crystal containing erbium atoms, which had previously been excited with a different light pulse. As an infrared photon was absorbed by the crystal, its quantum state spread across many erbium atoms.

Using an electric-field gradient, the group triggered the crystal's re-emission of a photon encoding the same information as the incident photon a few hundred nanoseconds later. The efficiency was well below 1%, but the technique could prove useful in quantum-communication devices, the authors say.

CANCER GENOMICS

Melanoma's mutations

Genome Res. doi:10.1101/gr.103697.109 (2010)

Some cancer-associated genetic changes are not easily detected with standard technologies. Researchers have now found mutations linked to melanoma using RNA sequencing.

Levi Garraway of the Dana-Farber Cancer Institute in Boston, Massachusetts, and his colleagues used a high-speed sequencing technology to sequence RNA from ten patients' melanoma samples. They identified 11 abnormal RNAs resulting from genes that had fused in the genome — the first reported gene fusions for melanoma. They also found 12 instances in which two separate genes were transcribed, or 'read', together to produce a mutated RNA, seven of which occurred in more than one sample. In addition, the researchers confirmed previous findings that melanoma has a higher mutation rate than other cancers, reflecting DNA damage caused by exposure to ultraviolet light.

NANOTECHNOLOGY

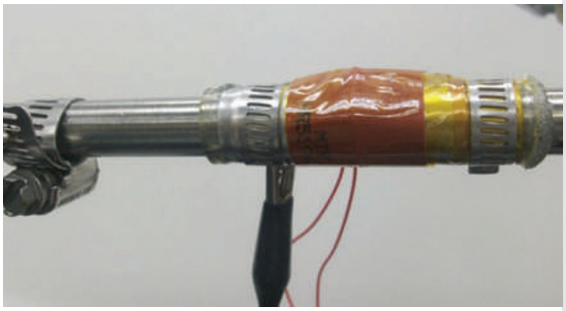
Harvesting heat

Nano Lett. doi:10.1021/nl903267n (2010)

Waste heat from vehicle exhaust pipes and industrial waste streams could offer a sustainable energy source, but current technologies for harvesting thermal energy are costly and inefficient.

Ray Baughman at the University of Texas at Dallas and his colleagues have created a 'thermocell' that can be wrapped around pipes (pictured below). Made of carbon nanotube electrodes, the device is three times as efficient as conventional platinum-based thermocells. The difference in temperature between the two electrodes creates an electrochemical potential difference, which the thermocell uses to generate electricity.

One of the team's prototypes can be attached to hot nuclear-reactor pipes.



AM. CHEM. SOC.

EVOLUTION

Creating cooperation

Evolution doi:10.1111/j.1558-5646.2010.00959.x (2010)

How cooperation evolves between species is much debated. William Harcombe, currently at Harvard University in Cambridge, Massachusetts, used bacteria to observe this evolution in the lab.

He plated out Petri dishes with an *Escherichia coli* mutant unable to produce an essential amino acid, and a *Salmonella* species that consumes waste from *E. coli* and excretes small amounts of the amino acid. In two out of ten dishes, *Salmonella* mutants arose that made large amounts of the amino acid.

When grown with *E. coli* and normal *Salmonella*, the cooperative mutants rapidly increased from 1% of the *Salmonella* population to more than 80%. When the bacteria were grown on different media such that the *Salmonella* no longer relied on the *E. coli* for food, cooperative mutant numbers crashed. This also happened when the bacteria were grown in flasks, suggesting that spatial structure of the bacterial colonies is needed for cooperation to evolve.

JOURNAL CLUB

Markus Reichstein
Max Planck Institute for Biogeochemistry, Jena, Germany

A biogeochemist looks at where all the emitted carbon dioxide is going.

Humanity is currently performing a huge global experiment, emitting increasing amounts of CO_2 into the atmosphere by burning fossil fuels. I find it astonishing that although we scientifically explore other planets, we still don't understand Earth's important carbon cycle.

Corinne Le Quéré at the University of East Anglia in Norwich, UK, and her team have put together the pieces of the contemporary global carbon cycle. They analysed observations and modelling results on fossil-fuel emissions and the terrestrial and ocean carbon cycle, which are the major contributors to the atmospheric carbon budget (C. Le Quéré *et al. Nature Geosci.* **2,** 831–836; 2009).

The bottom line is that humans are emitting more CO_2 than projected in the pessimistic scenarios outlined by the United Nations Intergovernmental Panel on Climate Change. The researchers find that only 40–45% of this CO_2 remains in the atmosphere; the rest is 'cleaned up' by the ocean and land — the 'carbon sink'. It would be interesting to know whether the fraction taken up by oceans and land remains constant, because any alterations will change the global climate–carbon-cycle feedback.

The study also indicates that we are moving towards saturation of the carbon sink, but the uncertainties are large. Many carbon pools and processes, particularly those below ground in the soil, are not well understood and are hardly accounted for in carbon-cycle models (P. Ciais *Nature* **462,** 393; 2009).

The message from Le Quéré *et al.* is that more observations are needed, that data should be fully integrated with models, and that these efforts must be more targeted and coordinated if we are to understand what is going on with the Earth system in our huge experiment.

Discuss this paper at **http://blogs.nature.com/nature/journalclub**