Developmental biology

The trouble with the sex body

Dev. Cell **4,** 497–508 (2003)

The route by which male mammals make sperm has several stages, one of which requires the formation of a 'sex body'. This structure has quite a history in biology: it was first described in 1898, and a quarter-century later was recognized as being the closely associated X and Y chromosomes.

The genes on both chromosomes must be inactivated at this point as part of successful sperm formation. Oscar Fernandez-Capetillo and colleagues have been looking into what can go wrong in this process. Male (but not female) mice that lack a gene encoding a protein called H2AX are infertile. Fernandez-Capetillo *et al.* now find that the specific effects of lack of H2AX are failure to form the sex body and to inactivate the sex chromosomes. These consequences are likely to be associated with the protein's function in DNA packaging.

One issue to be resolved is the importance of phosphorylation of H2AX in events. Another is that, in other circumstances, the phosphorylated protein has been implicated in rejoining DNA sequences. Such DNA repair is an essential part of the general process of meiosis, by which both sperm and eggs are formed, so it seems odd that phosphorylated H2AX does not have that function here — or so it would appear, given that female mice that lack it are fertile. **Tim Lincoln**

Microelectronics

Clean-up for copper chips

J. Am. Chem. Soc. doi:10.1021/ja034091m (2003)

Copper is increasingly used for the wiring in microchips, but patterning and smoothing it is a messy business. A technique described by Carol A. Bessel and colleagues promises to do away with the toxic wastes associated with liquid etching and polishing procedures that involve water or organic solvents. It uses as the solvent pressurized, supercritical carbon dioxide, which reverts to a gas when the pressure is eased. So this is essentially a 'dry' process with no liquid waste.

At present, etching of copper wiring in microcircuits involves a mixture of chemical removal and mechanical grinding with abrasives. This 'chemical mechanical planarization' technique requires a slurry of various ingredients that cannot be easily recycled. When water is the solvent, it can also damage other chip components.

Bessel *et al.* use chemical oxidants and chelating agents dissolved in supercritical CO_2 to etch copper metal at 40 °C and a pressure of 214 bar. Up to 200,000 atomic layers of copper were removed from disks of the metal in 20 hours. But it remains to be seen whether the resulting surface can be made as smooth as chip manufacture demands. **Philip Ball**

Plant biology

Ice on top

Genes Dev. doi:10.1101/gad.1077503 (2003)

Many plants can tolerate a sharp frost as long as they have the chance to adjust to low, non-freezing temperatures first. A chilly spell activates genes that are crucial for the adaptation period, as well as those needed to survive frosts. Viswanathan Chinnusamy *et al.* now show that, in the thale cress *Arabidopsis*, the transcription factor ICE1 lies at the top of a molecular cascade that turns on many of these cold-responsive genes.

Besides a good dose of antifreeze protein, a plant's cold-survival kit contains enzymes involved in metabolism, as well as so-called chaperone molecules and proteins that help it tolerate the dehydration caused by freezing. A family of transcription factors known as CBFs drives the collective production of such proteins.

The CBFs themselves are switched on exclusively at cooler temperatures — so how is this process controlled? Chinnusamy *et al.* have identified the 'inducer of CBF expression-1' (ICE1), which is a transcription factor present in most plant tissues at normal temperatures. The researchers speculate that exposure to cold causes ICE1 (or an associated protein) to become modified, allowing it to activate CBF transcription.

Various other cold-sensitive *Arabidopsis* mutants have already been isolated. So this may be just the tip of the iceberg in the regulation of cold-responsive genes. **Marie-Thérèse Heemels**

Spongiform encephalopathies

Propagating warped prions

Cell **113,** 49–60 (2003)

The long-standing theory that prion proteins couple up to breed degenerative brain diseases — such as bovine spongiform encephalopathy (BSE) in cows and scrapie in sheep — has gained some support. Philipp Meier *et al.* have caught misshapen prions warping normal ones in mouse brains.

In animal encephalopathies and their human analogue, variant Creutzfeldt–Jakob disease (vCJD), diseased prions clump together in the brain, eventually destroying it. Misshapen prions were thought to latch onto and alter normal ones, but this liaison had not been seen in live animals — until now. Meier *et al.* genetically engineered mice to carry a new, artificial version of prions with an antibody tag. Unlike the real thing, the labelled prions are easy to isolate from cells. The authors then infused the animals' brains with the wrongly folded prion proteins responsible for scrapie. They found tagged, artificial prions attached to scrapie prions.

Meier *et al.* speculate that the artificial prions could form the basis of a new therapy. Although they bind mutant prions, they resist being transformed themselves. Mice carrying the modified prion survived exposure to scrapie proteins for at least three months longer than normal mice. **Helen Pearson**

Archaeology

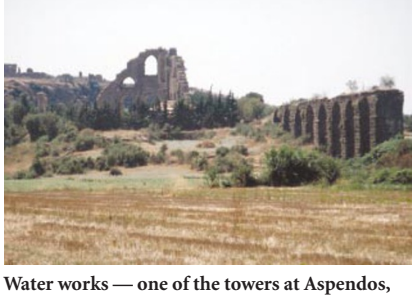
Tall story

J. Archaeol. Sci. **30,** 417–428 (2003)

Roman civil engineers knew a trick or two. In the third century AD they built a 1.67-km pipeline to carry water from a distant source across a broad valley to a tank that supplied the city of Aspendos, in modern-day Turkey. Calculations of the flow in this 'inverted-siphon' system by C. R. Ortloff and Adonis Kassinos show how its design helped to keep the flow rate steady.

The pipeline is divided into three segments, separated by two tall towers on the valley floor where the water has to ascend and then descend again (see picture). These hurdles, the researchers show, would have helped to damp out oscillations that might have arisen each time the pipeline was opened to refill the tank. Such back-and-forth sloshing would have made the flow intermittent and might even have damaged the pipeline.

According to the Roman writer Vitruvius, successful siphon function depended on *colliquiaria*. The meaning of this term is lost in time, but Ortloff and Kassinos suggest that it might refer to the small holes that perforate some of the stone blocks in which the sections of pipe are bored. These holes would have allowed water and air to escape and thus helped to dissipate turbulent 'slugs' and pressure waves, restoring steady flow. **Philip Ball**



WWW.HOLYLANDPHOTOS.ORG

Water works — one of the towers at Aspendos, with (right) remains of the aqueduct.