Developmental biology

Decoding stem cells' powers

Genes Dev. **17,** 126–140 (2003)

The therapeutic promise of embryonic stem (ES) cells has dominated headlines — but scientists remain largely ignorant of the genes responsible for their powers. This month, however, an international group of researchers has identified one such gene.

Ariel A. Avilion *et al.* have shown that *Sox2* is essential for the survival of healthy ES cells, which are referred to as 'pluripotent' because they spawn virtually every tissue type in the body. Mouse embryos that had been genetically engineered to lack *Sox2* quickly perished, as did ES cells grown from them. Embryos without *Sox2* could not sustain pluripotent stem cells in the epiblast, the tissue that normally gives rise to the embryo body. Death would occur even earlier, the team suspects, were it not for a dose of Sox2 protein inherited from the mother's egg.

Sox2 is only the second gene identified as appearing to endow ES cells with pluripotency. The researchers suspect that it works together with the other known gene, called *Oct4*, to switch on a series of essential regulatory molecules.

By teasing apart this genetic hierarchy, it is hoped that researchers will be able to manipulate both embryonic and adult stem cells — and coax them into growing the tissues needed for treatments. **Helen Pearson**

Atmospheric science

Lightning satellite survey

J. Geophys. Res. **108** doi:10.1029/2002JD002347 (2003)

In the most robust survey of lightning activity to date, Hugh Christian and colleagues report that the number of lightning flashes worldwide is less than half the usually accepted estimate. The survey consists of five years of data from the Optical Transient Detector (OTD), on board the MicroLab-1 satellite, which was specifically designed to spot cloud-to-ground and cloud-to-cloud lightning during night or day. One summary of the authors' results is shown on the map reproduced below.

The new data show that, on average, there are 1.4 billion flashes worldwide each year: in other words, 44 every second. The most trusted previous calculation — now 78 years old, and based on records of thunderstorm-days worldwide — produced an estimate of 100 flashes per second. Given the importance of lightning as a source of nitrogen oxides, for instance, a revision as large as this will interest researchers modelling atmospheric chemistry.

The world's lightning hotspot is near Kamembe, Rwanda, with a mean annual density of 82.7 flashes per square kilometre. More broadly, there is ten times more lightning activity over land than over sea. And 78% of activity occurs between latitudes 30° S and 30° N.

The OTD sensor is now out of service. Replacing it with an instrument in a geostationary (rather than low-Earth) orbit could provide unique data about the ways in which climatic phenomena such as El Niño and global warming affect lightning activity. **Tom Clarke**

Quantum physics

The entangling effects of motion

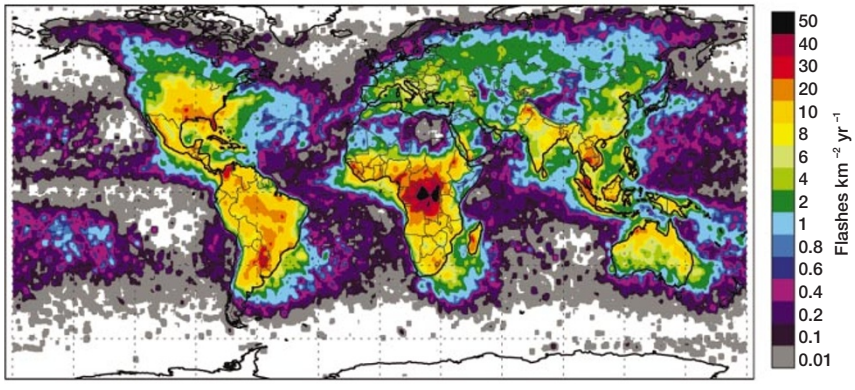
Phys. Rev. Lett. **89,** 270402 (2002)

Quantum entanglement, the phenomenon that links the fates of quantum particles by a seemingly instantaneous action at a distance, can be created by motion, according to Robert Gingrich and Christoph Adami.

Entanglement is the key to the burgeoning field of quantum information, which encompasses processes such as quantum teleportation, cryptography and computing. Entangled particles share a wavefunction, and measurements on one particle automatically define the quantum state of others with which it is entangled.

Gingrich and Adami show that, in a moving frame, quantized properties of two particles (such as spin or momentum) can become entangled when, at rest, they are not. But this weaving together does not appear out of nowhere. It results from the transference of entanglement from one set of quantum variables to another — from spin to momentum, say. If one were measuring only spin, for example, the particles might appear to become magically entwined.

It is a relativistic effect, and represents another step towards the dovetailing of quantum information theory with general relativity. This becomes important when quantum techniques (such as high-precision time-keeping) are deployed in moving frameworks on satellites, for example. And relativistic transfer of entanglement could be useful for preparing and manipulating entangled states in quantum information technologies. **Philip Ball**



Flash geography — map showing the annual distribution of lightning worldwide. Central Africa experiences the greatest activity. (Image courtesy of H. J. Christian/American Geophysical Union.)

Physiology

Machinations of the heart's strain gauge

Cell **111,** 943–955 (2002)

To avoid injury, heart muscles must detect and respond to mechanical stress. Ralph Knöll *et al.* have now identified a crucial component of the stress sensor in cardiac muscle, and have shown that it is linked to human disease.

The component in question is a protein called MLP, which lies in the muscle's Z-disk. The Z-disk is the site of attachment of filaments of the actin protein, and has an important structural role in muscle. But it seems that it also has a less passive function. The giant elastic protein titin stretches from one Z-disk to the next, attaching to another protein, telethonin. It now transpires that telethonin also binds MLP, and that in mice genetically modified to lack MLP, the regular structure of the Z-disk breaks down. This suggests that the telethonin–MLP complex detects tension in titin, helping to maintain an ordered muscle structure.

Significant numbers of people suffering from the heart disease dilated cardiomyopathy were found to have a mutation in their MLP gene. The mutation affects a region of the protein that normally binds telethonin, abolishing the interaction. Indeed, the ultrastructure of heart muscle from a patient with dilated cardiomyopathy was very similar to that of heart muscle from MLP-deficient mice. This new information increases our understanding of such heart disorders, but it remains to be seen whether it will translate into new treatments. **Christopher Surridge**