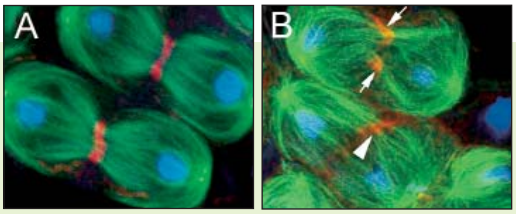
edited by Gilbert Chin

CELL BIOLOGY

## Inside and Outside the Beltway




**A molecular motor (red) forms a belt around the midsection of the central spindle microtubules (green) in normal spermatocytes (A), but not in *orbit* mutants (B); DNA, blue.**

Microtubules form the mitotic spindle, which is the scaffold on which chromosomes are separated. Inoue *et al*. wanted to understand what microtubules might do after the partitioning of the chromosomes is complete; in the final stage of cell division, cytokinesis, the two daughter cells are physically separated from one another.

Looking at primary spermatocytes from *Drosophila melanogaster* with time-lapse microscopy, they find that at the onset of cytokinesis the central spindle has two populations of microtubules—some localized to the interior of the central spindle and others extending toward the periphery—which are affected differentially in the presence of a mutant form of the microtubule-associated protein Orbit (aka Mast or CLASP). Normally, Orbit localizes to interior rather than peripheral central spindle microtubules, but in hypomorphic *orbit* mutants these interior microtubules become less stable. The remaining peripheral microtubules can still probe the cell cortex, where they help to initiate the cleavage furrow. However, some of the other components involved in cytokinesis fail to assemble properly, and ultimately the furrow regresses, yielding multinucleate cells. — SMH

*J. Cell Biol.* **166**, 49 (2004).

CHEMISTRY

## Extraordinary in the Infrared

Nanoarrays of metals can exhibit "extraordinary" transmission of light, meaning that they transmit more light than would be expected on the basis of the combined area of the holes. This effect occurs because surface plasmons that are excited tunnel through the holes and then are emitted as photons on the other side.

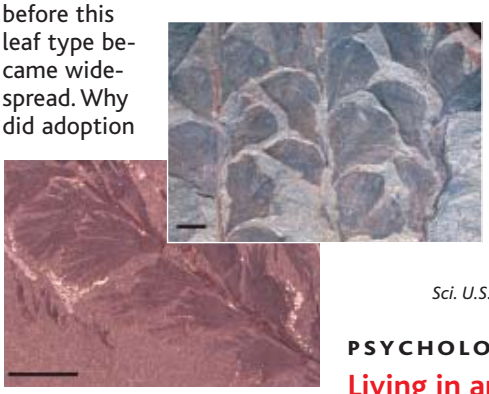
Williams *et al*. have used this effect in the infrared regime to study the oxidation of methanol to formaldehyde on a copper oxide surface. They electrodeposited copper on a commercial nickel mesh until the hole size irised in to 3 to 4 μm. This surface was allowed to oxidize in air for 3 months. After activation with a drop of water to produce surface hydroxyl groups, a drop of methanol was placed on the surface, and the spectra of the adsorbed species that formed could be recorded with a conventional Fourier-transform infrared spectrometer. Extraordinary transmission was suppressed by oxide formation, but upon methanol exposure, two primary resonances (the 1,0 and 1,1) were recovered. Although the origin of the extraordinary transmission for a surface oxide is not fully understood, some of the absorbances, such as those for the methoxy radical species, are more than 100 times greater in intensity than those seen with more conventional surfaces. — PDS

*J. Phys. Chem. B* 10.1021/jp0489368 (2004).

PALEOBIOLOGY

## Leaf Story

The first tiny megaphyll leaves appeared in vascular land plants 50 million years before this leaf type became widespread. Why did adoption of such an advantageous photosynthetic structure take so long?



**Leaf fossils.**

Osborne *et al*. performed a morphometric analysis of 300 plant fossils from the Devonian and Carboniferous Periods in order to assess trends in leaf size and to estimate the rates of convective and evaporative heat loss. They used these data to test the theory that high levels of atmospheric $CO_2$ delayed the increase in leaf size by restricting stomatal development; larger leaves, possessing only limited cooling capacity, would have intercepted more solar energy and thereby suffered lethal overheating. As $CO_2$ decreased, leaf blades were able to grow in size, and stomatal number rose abruptly. This analysis therefore supports the idea that the evolution of leaves was constrained by atmospheric $CO_2$ concentrations. — HJS

*Proc. Natl. Acad. Sci. U.S.A.* **101**, 10360 (2004).

PSYCHOLOGY

## Living in an Uncertain World

Very few things in life are certain, apart from death and taxes, and coping with probabilistic events is essential if we are to make any decisions at all. Most of us do, in fact, make decisions daily, but our assessments of event probabilities may not be as accurate or as coldly rational as we would like to believe.

In particular, Hertwig *et al*. compare the choices of people who received written descriptions (the amount of money to be gained or lost and the probability of winning or losing it) of two options with those made by people who were not given the descriptions and instead were allowed to sample the possible outcomes freely and iteratively, thus forming an empirical estimate of the expected values of the options. The authors find that the first group tends to overweight the likelihood of rare events, so that a large but infrequent payoff, for example, is selected more often than rational decision theory would predict. Conversely, the second group tends to discount rare events because they're unlikely to come across them during the sampling period (which may be constrained by our working memory cache), and they pay more attention to recently experienced outcomes, which are, of course, unlikely to include instances of rare events. — GJC

*Psychol. Sci.*, in press.

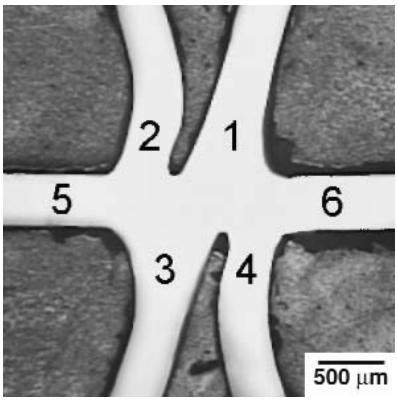
CREDITS: (TOP) INOUE *ET AL*., *J. CELL BIOL.* **166**, 49 (2004); (BOTTOM) OSBORNE *ET AL*., *PROC. NATL. ACAD. SCI. U.S.A.* **101**, 10360 (2004)

APPLIED PHYSICS

## Pull Here, Twist There

In most fluid flow, both stretching and rotation of the fluid elements occurs, and controlling this ratio can be advantageous during materials processing, such as in the use of predominantly extensional flow to make strong and oriented polymer fibers. Pioneered by Taylor in the 1930s, the four-roll mill has long been used to study flow behavior, because the type of flow and the flow rate at the stagnation point can be controlled by the speed and rotation direction of the four rollers.

To study the rheology of fluids and suspension on a smaller scale, Hudson *et al*. have developed a microfluidic analog of the four-roll mill. The key to the device is the use of a cross-channel design, with chiral dividers between the sets of vertical channels. To achieve extensional flow, fluid is injected through ports 1, 2, 3, and 4, with the flow through ports 1 and 3 at 70% of that through 2 and 4, and then exits through ports 5 and 6. Simple shear, which consists of an equal mix of extension and rotation, can also be achieved, which is not the case for the four-roll mill. Control over the various flow rates is sufficiently precise that objects such as cells and liquid drops can be trapped at the stagnation point for several minutes. — MSL




**A microfluidic four-roll mill.**

CREDIT: HUDSON *ET AL., APPL. PHYS. LETT.* **85**, 335 (2004)

*Appl. Phys. Lett.* **85**, 335 (2004).

MOLECULAR BIOLOGY

## Making a Switch

In the past couple of years, numerous small noncoding RNA molecules have been shown to participate as regulators of gene expression in plants and animals. Lenz *et al*. show how they are used within a bacterial quorum sensing pathway to achieve an all-or-none type of control. Bacteria have a need to know how densely they populate the local environment, because investing in some behaviors only makes sense if everyone takes part, and the quorum-sensing circuits—containing the customary complement of ligands, receptors, kinases, and transcriptional regulators—send and decode these signals. The authors identified five distinct small RNAs in the bioluminescent marine organism *Vibrio harveyi* (and four in the human pathogen *V. cholerae*) and found that any one of the five suffices for signaling, meaning that transcription of luciferase is repressed at low population densities. However, having multiple redundant small RNAs has the effect of making the transition from individualistic to communal behavior an abrupt on/off switch. — GJC

*Cell* **118**, 69 (2004).

HIGHLIGHTED IN *SCIENCE*'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

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## Controlling Bad Calcium

Transient ischemia, as occurs during stroke, kills some neurons—particularly CA1 pyramidal neurons of the hippocampus—but not others. Susceptibility is associated with the influx of $Ca^{2+}$ or $Zn^{2+}$ through AMPA (α-amino-3-hydroxyl-5-methyl-4-isoxazoleproprionic acid) receptor channels, which are activated by the neurotransmitter glutamate. Not all AMPA receptors conduct $Ca^{2+}$, and the identity of an amino acid [arginine (R) or glutamine (Q)] in the GluR2 subunit is the critical determinant. Liu *et al*. expressed the GluR2(R) subunit in the rat hippocampus, and this blocked the inward flux of $Ca^{2+}$ and protected the CA1 pyramidal cells from ischemia-induced injury. Conversely, expressing the $Ca^{2+}$-permeable GluR2(Q) subunits in neurons in the CA3 area and dentate gyrus of the hippocampus, which normally are not susceptible, resulted in cell death after an ischemic insult. Therapeutic strategies aimed at protecting neurons with AMPA antagonists are problematic because glutamate receptors on uninjured cells are also blocked, but selective inhibition of the $Ca^{2+}$ permeability of AMPA receptors may offer another path to treatment. — LBR

*Neuron* **43**, 43 (2004).