EDITORS' CHOICE

edited by Gilbert Chin

CELL BIOLOGY

Lipid-Cytoskeleton Coordination

In the final stage of cell division, cytokinesis constricts and then seals the plasma membrane between the two daughter cells. The constriction is powered by a contractile ring of actin, and scission involves a fusion or rearrangement of the lipid bilayer of the cell membrane. Previously, Emoto and Umeda observed that the lipid phosphatidylethanolamine (PE), which normally resides in the internal leaflet of the bilayer, can be found in the external leaflet in the cleavage furrow.

Now they find that a PE-binding peptide blocks scission, leaving daughter cells connected by an actin-containing cytoplasmic bridge, and that then adding PE liposomes caused the contractile ring to disassemble, although without subsequent scission, yielding binucleate cells. Mutant cells defective in PE synthesis could not grow in the absence of exogenous PE, and they exhibited a defect in cytokinesis leading to the presence of cells still connected by cytoplasmic bridges. Thus, it appears that surface-exposed PE is needed to coordinate the reorganization of the cytoskeleton and the plasma membrane during cytokinesis. — SMH

J. Cell Biol. **149**, 1215 (2000).

VIROLOGY

Reshuffling the Deck Evenly

Reverse transcriptase decodes the genetic information carried by the RNA genome of retroviruses. The viral nucleocapsid protein (NCp7 for HIV-1) is known to function as an RNA chaperone, enhancing the ability of the RNA genome to fold into a stable conformation and promoting annealing of complementary RNAs. Negroni and Buc now suggest that it also promotes genetic reshuffling in the retroviral world.

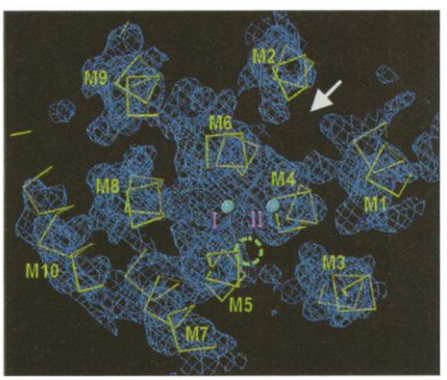
Because retroviral particles contain two single-stranded molecules of RNA, one mechanism for generating diversity is by homologous recombination in which the reverse transcriptase jumps from one template to the other. Formation of intrastrand stem-loop structures would be expected to influence the location and likelihood of the interstrand base-pairing of homologous regions. When naked RNA was used in vitro as a template for reverse transcriptase, two hot spots for recombination were found. However, if the acceptor strand (to which the transcriptase jumps) was allowed to bind NCp7, there was much more recombination, and the greatest increases were observed in areas where recombination had been relatively infrequent. A similar effect was seen with a different chaperone, *Escherichia coli* StpA, indicating that chaperone-mediated RNA folding (and unfolding) may be a general mechanism for more evenly promoting recombination. — BJ

Proc. Natl. Acad. Sci. U.S.A. **97**, 6385 (2000).

BIOCHEMISTRY

Forcing Calcium Through

Cells excel at interconverting types of energy under mild and controlled conditions; for example, the uphill transport of calcium from the cytoplasm into the sarcoplasmic reticulum of muscle cells is driven by the hydrolysis of ATP. Toyoshima *et al.* provide a high-resolution view of the enzyme responsible for this activity, the Ca^{2+}-ATPase. The salient features are a bundle of ten transmembrane α-helices and a cytoplasmic trio of domains that together bind one molecule of ATP and couple the energy released by hydrolysis to the movement of two calcium ions through the helical bundle. Although structural characterization of reaction intermediates lies ahead, the cytoplasmic domains appear to reorient and coalesce during catalysis, which may result in lever-like movement of the helices and extrusion of the ions much as air is expelled from a hand bellows. — GJC



Bundled calcium ions (cyan).

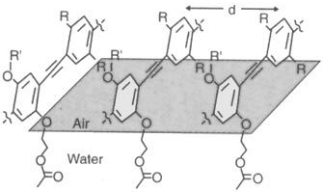
SOURCE: (LEFT TO RIGHT) TOYOSHIMA *ET AL.*, *NATURE* **405**, 647 (2000); MCQUADE *ET AL.*, *J. AM. CHEM. SOC.*, IN PRESS.

Nature **405**, 647 (2000).

CHEMISTRY

About Face

The spacing between chains in conjugated polymers affects their photoluminescent (PL) properties. If the functional groups containing the conjugated double bonds are too close, fluorescence tends to be quenched; this effect can limit the performance of these materials in thin films. McQuade *et al.* systematically varied interchain distances in poly(*p*-phenylene ethynylenes) in Langmuir films in which the conjugated groups of the polymer chain are oriented edge-on at the air-water interface and thus pack face-to-face. By changing the side chains from methyl to isopropyl groups, they increased the interchain spacing by 20%—but more than doubled the efficiency (the PL quantum yield) from 7% to 16%. — PDS



Spacing efficiently.

J. Am. Chem. Soc., in press.

OCEANS

Tracing Ocean Circulation

Understanding past climate depends, to a large extent, on understanding the circulation of oceanic deep water masses because the atmosphere contains so much less mass and heat than the oceans and because most of the oceans are deep water. One way to study deep ocean paleocirculation is to measure the distribution of nutrient tracers contained in the shells of benthic foraminifera; the deep water masses in which these forams grow have many distinctive chemical and physical characteristics that are reflected in the composition of their calcium carbonate skeletons. However, different tracers can give conflicting results.

Marchitto *et al.* have identified a promising new proxy, Zn. Their measurements of Zn/Ca in two taxa of Holocene benthic foraminifera show that the ratio mirrors that of the bottom water where the forams grow. They suggest that Zn/Ca, used in conjunction with data on Cd/Ca (another deep water tracer), may be useful in solving one of the central puzzles in oceanog-

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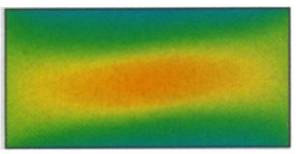
raphy and paleoclimatology: how the carbonate ion concentration of the ocean has varied in the past. — HJS

Paleoceanography **15**, 299 (2000).

APPLIED PHYSICS

Getting a Boost up the Ladder

Most studies of magnetization reversal have looked at the classical regime in which a magnetic field larger than the critical switching field is applied at low temperature (zero temperature limit); magnetization reversal starts immediately and finishes within several nanoseconds. However, as most devices will operate at finite temperature, a better understanding of the microscopic dynamics of magnetization reversal is required, especially as magnetic memory devices get even smaller.



Magnetization directions before (top) and after (bottom) the switch.

Koch *et al.*, using spin-polarized electron tunneling to investigate magnetic thin films, found that when a magnetic field lower than the critical field was applied, the extra energy required for reversal could be made up thermally. Their results, which show the probability of reversal initially increasing before exponentially decreasing, are consistent with a model in which a ladder of energy states separate the two metastable states of magnetic orientation. Thermal energy can provide the boost needed to step up to the higher rungs. — ISO

Phys. Rev. Lett. **84**, 5419 (2000).

EVOLUTION

Running Out of New States

Phylogenetic analyses seek to identify the hierarchical order of organisms from the distribution of character states—molecular or morphologic—shared amongst them. Homoplasy, the presence of identical states because of evolutionary convergence rather than common ancestry, is the bane of such studies. For molecular data, the small number of bases introduces the possibility that character matrices will be saturated by chance homoplasies, especially when few taxa are sampled relative to the amounts of change. With no obvious limits on the numbers of states for morphologic characters, this problem of exhaustion of states has seemed less important for morphological data such as the fossil record provides.

Wagner uses the frequencies of derivations of new morphologic states in cladistic studies of a wide range of animal fossil taxa to demonstrate that limits to the number of states might exist after all. New states are generally not added continuously throughout the histories of clades; instead, the proportion of incompatible character pairs (which necessarily imply homoplasy) increases as clades age. The patterns suggest that morphologic evolution is restricted, perhaps by intrinsic constraints or persistent selective trends. As younger taxa introduce homoplasy, the hierarchical structure of the character data deteriorates and maximum congruence among states becomes less likely to reflect homology. Exhaustion indicates that sampling high proportions of taxa and considering stratigraphic occurrence data may be required for accurate phylogenetic reconstructions. — SJS; AMS

Evolution **54**, 365 (2000).

ATMOSPHERES

Tracing Water Vapor

Water vapor participates in key reactions in the stratosphere and acts as a tracer for atmospheric motions. Balloons and aircraft measurements have been useful, but global coverage of the stratosphere now has become possible through satellite measurements.

Pumphrey *et al.* have analyzed data from the Microwave Limb Sounder (MLS) instrument on the Upper Atmosphere Research Satellite (UARS), which performed daily measurements from September 1991 to April 1993. Their analysis extends the usable range of data into the lower stratosphere, significantly lower than in previous analyses. The annual cycle in lower stratospheric water vapor is shown to be initiated in the northern hemisphere tropics, and to spread from there into the southern hemisphere tropics and then into the midlatitudes. Seasonal trends in stratospheric water vapor also are reported by Smith *et al.* The trends are derived from Halogen Occultation Experiment (HALOE) data for January 1992 to April 1999. Stratospheric increases in water vapor during this period are attributed to large autumnal increases in upper tropospheric water vapor. Increased convection in the second half of the Asian monsoon season may explain the positive trends in water vapor levels. — JU

Geophys. Res. Lett. **27**, 1691 (2000); *Geophys. Res. Lett.* **27**, 1687 (2000).

CREDITS: KOCH *ET AL.*, *PHYS. REV. LETT.* **84**, 5419 (2000).