EDITORS' CHOICE

edited by Gilbert Chin

CELL BIOLOGY

EastEnders

A cell's nucleus represents a miracle of ordered packing, and the giant nuclei of larval *Drosophila* salivary glands provide a useful model to study chromosomal packing because they must accommodate giant polytene chromosomes. Wasser and Chia studied the nuclear architecture of larval salivary gland cells and localized a protein called EAST (enhanced adult sensory threshold) to areas of the nucleus (termed the extrachromosomal nuclear domain or END) not occupied by the chromosomes or by the nucleolus. Increasing the levels of EAST caused an accumulation of actin and the cell cycle protein CP60 in the END, and the normal fibrous distribution of CP60 inside the nucleus was found to be dependent on EAST expression. Furthermore, overexpression of EAST correlated with an expansion of the END. Altering the volume of the END may be important in restricting collision between chromosome arms, or during changes in chromosomal organization during the cell cycle. The EAST protein and the proteins associated with it appear to form an intranuclear network that also may regulate the intranuclear movement of proteins and RNAs. — SMH

Nature Cell Biol. **2**, 268 (2000).

GEOPHYSICS

Sandpile Dynamics of the Magnetosphere

Earth's magnetosphere, a plasma-rich region shaped by the interaction between Earth's magnetic field and the solar wind, shields the atmosphere and protects us from damage by charged particles from interplanetary space. The solar wind, a supersonic flow of charged particles from the sun, bombards the magnetosphere with particles and ionizing radiation, which generates aurorae and, during storms, creates magnetic disturbances that affect satellite communications.

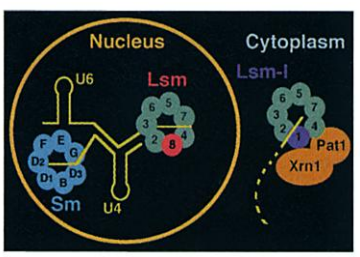
Aurorae are produced when magnetospheric electrons and protons traveling along magnetic fields lines collide with oxygen and nitrogen atoms in the upper atmosphere above the poles. Lui *et al.* analyzed global images of aurorae gathered by satellites during January 1997 to evaluate the output of energy over the entire magnetosphere. The temporal distribution of auroral 'blobs' recorded during quiet and substorm times showed similar power law relations, indicating that localized relaxations in the magnetosphere occurred with avalanche, or "sandpile" dynamics. That is, regardless of solar wind intensity, aurorae dissipate energy through nonequilibrium states that have no intrinsic length scales. This global observation improves our understanding of the state of the magnetosphere and will help to improve space weather forecasts. — LR

Geophys. Res. Lett. **27**, 911 (2000).

MOLECULAR BIOLOGY

Seven is the Magic Number

The RNA transcript made from a DNA-encoded gene cannot be used immediately as a messenger RNA (mRNA) template for protein synthesis. Instead, non-protein coding portions of this pre-mRNA must be removed by splicing, and the 5′ end of the mRNA is capped to prevent degradation by exonucleases. A group of seven distinct Sm proteins (named for their reactivity with autoantibodies of the Sm serotype) participate in the biogenesis of snRNPs (small nuclear ribonucleoprotein particles), which are complexes of proteins and snRNAs that mediate splicing, and they bind as a heptameric ring to U4 snRNA. A second group of seven proteins (Lsm2-Lsm8, named Lsm for Sm-like) are known to associate with U6 snRNA.



Three heptameric complexes

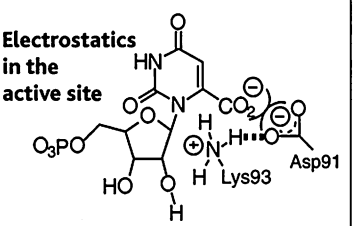
Now, Tharun *et al.* and Bouveret *et al.* have found that the almost identical heptamer Lsm1-Lsm7 forms a cytoplasmic complex with several proteins involved in messenger RNA degradation – Pat1, an activator of decapping; Dcp1, decapping enzyme; and Xrn1, an exonuclease. The similarities in stoichiometry and structure amongst these heptameric rings suggest a common mode of binding to RNA substrates and possibly a common mode of function, perhaps in regulating RNA-RNA and RNA-protein interactions in the processing of pre-mRNA and the degradation of mRNA. — GJC

Nature **404**, 515 (2000); *EMBO J.* **19**, 1661 (2000).

BIOCHEMISTRY

Lowering the Barrier with Electrostatics

The decarboxylation of orotidine 5′-monophosphate (OMP) to uridine 5′-monophosphate is accelerated by a factor of 10^{17} by the enzyme OMP decarboxylase. Several mechanisms have been proposed to account for this enormous rate enhancement in the absence of cofactors or metals; recent structural studies have revealed the arrangement of amino acid side chains within the enzyme active site. In perhaps the final



chapter to this tale, Rishavy and Cleland now have measured nitrogen-15 isotope effects and show that the bond order at N-1 does not change during the reaction. From this result, they conclude that negative charge that develops at C-6 during decarboxylation cannot be stabilized by formation of an ylide. Thus, it appears that catalysis results from: (1) stabilization of the transition state carbanion by electrostatic interaction between C-6 and Lys-93, and (2) destabilization of the ground state via electrostatic repulsion between the departing carboxylate and Asp-91. — VV

Biochemistry, in press.

ARCHAEOLOGY

Dust To Dust

The Akkadian Empire in the Fertile Crescent collapsed suddenly about 4100 years ago. Recently, it was suggested that this event is also the first example of the demise of an empire as a consequence of climate change. Wind-blown silt characteristic of arid conditions directly overlies the archeological horizons, and it is thought that the empire depended on agricultural production as the basis for its trade network.

Cullen *et al.* have examined a deep-sea sediment core in the Gulf of Oman to search for broader evidence for such a connection. The data reveal that a 300-year period of marked

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SOURCE: (LEFT) BOUVERET *ET AL.*, *EMBO J.* 19, 1661 (2000); (RIGHT) RISHAVY AND CLELAND, *BIOCHEMISTRY*, IN PRESS.

aridity began abruptly and was coincident with the radiocarbon age for the end of the empire. They also correlated a volcanic horizon that marked the empire's collapse with one marking the onset of the aridity seen in the deep-sea core. The core record implies that the aridity was perhaps almost as severe as that during the Younger Dryas (a return to near glacial conditions just before the Holocene) and well beyond any other event in the Holocene. Thus, despite the implementation of grain storage and water management, a short-lived but drastic change in climate may have devastated an early empire. — BH

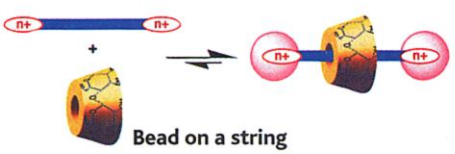
Geology **28**, 379 (2000).

CHEMISTRY

Working the Links, Threading the Needle

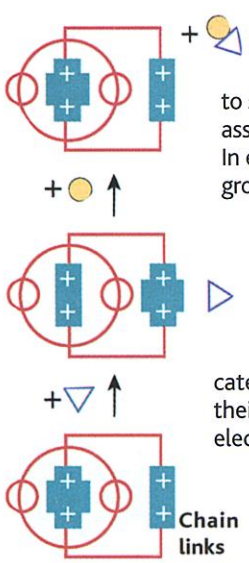
Molecules that are physically interlocked, either like links on a chain (catenanes) or a bead on a string (rotaxanes), are potentially useful in electronics or micromechanics, but significant challenges remain in designing their synthetic routes and in interrogating their physical state.

Kawaguchi and Harada have explored the use of charged end groups to hold the



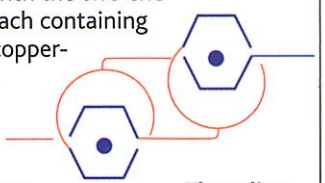
Bead on a string

"bead" of a rotaxane, a cyclodextrin molecule, onto its "string," a long alkyl chain. Nuclear magnetic resonance spectra reveal that end groups with multiple positive charges function to slow down the rate at which the string is threaded through the bead as well as to stabilize the assembled structure. In essence, these end groups act as knots.



Balzani *et al.* have tackled the problem of reading out the state of "translational isomers" of catenated links. In their system, two electron-rich hydroquinone groups are positioned on opposite sides of one ring, whereas in the other ring electron-deficient diazapyrenium and bipyridinium groups are in opposition. Rotation of the second ring with respect to the first determines which group is sandwiched between the hydroquinone moieties. They can drive this rotational isomerization by adding a small molecule that preferentially complexes with the diazapyrenium group, and they show that the two isomers have different colors and redox properties.

Jimenez *et al.* have synthesized a molecule consisting of an eyelet, a linker, and an aglet, with the two end components each containing one-half of a copper-chelating site. When copper(I) is added, two molecules form a complex, with each aglet threading through the eyelet of the other molecule. The monomer units are oriented antiparallel to each other in the threaded structure. Further modification of the monomer units may lead to more extended threaded chains, which would be capable of extending or contracting in response to an external signal with applications, for example, in sensor technology. — PDS, JU



Threading the eyelet

J. Am. Chem. Soc., in press; *J. Am. Chem. Soc.* **122**, 3542 (2000); *Angew. Chem. Int. Ed.* **39**, 1295 (2000).

BEHAVIOR

Diminishing the Price of Ostentatiousness

Males of many animal species use ornamentation or vocal display to attract females. The downside of flamboyance is that predators also can be alerted to the male's presence. Female Californian field crickets prefer males with longer calls, but males with longer calls are also more conspicuous to mice, birds, toads, and even a parasitoid fly. It has been thought that such ostentation—whether visual or vocal—would be subject to competing selection pressures.

Hedrick shows experimentally that more conspicuous males compensate with more cautious behavior; they are more reluctant than other males to leave the shelter of the cracks in the ground from which they typically call. Hedrick's study suggests that both traits—call duration and hiding behavior—may be heritable, and it therefore has the potential to alter standard evolutionary models of behavior that assume a fitness cost of sexually selected traits. — AMS

Proc. R. Soc. Lond. B **267**, 671 (2000).

CREDITS: (TOP LEFT) KAWAGUCHI *ET AL.*, *J. AM. CHEM. SOC.*, IN PRESS; (BOTTOM LEFT) BALZANI *ET AL.*, *J. AM. CHEM. SOC.* **122**, 3542 (2000); (RIGHT) JIMENEZ *ET AL.*, *ANGEW. CHEM. INT. ED.* **3**, 1295 (2000).