

BIOMEDICINE

Mounting a Counterattack

Although pathogens display a remarkable ability to outmaneuver host defenses, this struggle has been described as a never-ending arms race. Through antigenic variation of their variant surface glycoproteins (VSGs), trypanosomes successfully evade host immune responses, rendering prevention via vaccination difficult at best. Baral *et al.* have engineered the latest attempt to combat *Trypanosoma brucei*, the causative agent of sleeping sickness, which is transmitted via the tsetse fly. One component of human serum, apoL-I, has been identified as being able to punch holes in most trypanosomes but is stymied by the serum resistance-associated (SRA) protein produced by the resistant strain *T. b. rhodesiense*. The authors chopped off the portion of apoL-I to which SRA binds and attached the rest to an antibody that recognizes VSGs. This conjugate proved efficacious in lysing trypanosomes in vitro and in curing mice suffering from an acute infection by *T. b. rhodesiense*, and it also completely cleared parasites from the bloodstream in chronically infected mice. — GJC



The fly and the parasite.

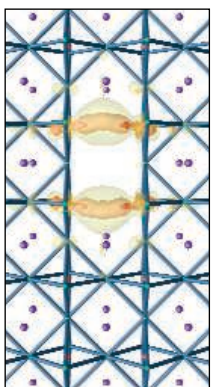
Nat. Med. **12**, 10.1038/nm1395 (2006).

MATERIALS SCIENCE

Bistable Atomic Memories

The conductivity of ferroelectric perovskites, such as strontium titanate, is related to lattice dislocations and local oxygen concentration. SrTiO_3 has a simple cubic structure and a high dislocation density at the crystal surfaces, and bistable switching between insulating and metallic states has been observed after doping with chromium.

Szot *et al.* show that bistable switching is possible in undoped SrTiO_3 crystals if the oxygen concentration is varied at the surface. For bulk crystals, cycling was achieved by heat treatment under vacuum to lower resistance, followed by reoxidation to a more insulating state at room temperature, and then restoration of the metallic state by exposure to an electric field under vacuum. Individual dislocations could also be switched using an atomic force microscope with a conducting tip; application of the local electric field transported oxygen along the dislocation, thereby varying the conductance. The material therefore



Simulated charge delocalization (orange) in a SrTiO_3 lattice defect (Sr, purple; Ti, red; O, green).

holds strong promise for fabrication into memory devices with a bit size of only a few atoms and with state stabilities that would eliminate the current need for refreshing in fast-responding static and dynamic memory chips. — MSL

Nat. Mater. **5**, 312 (2006).

MOLECULAR BIOLOGY

Surveillance by No-bodies

Within eukaryotic cells, mRNAs that contain errors are subject to strict quality-control measures and are rapidly degraded to prevent any inadvertent molecular catastrophes. Dez *et al.* reveal some of the nuts and bolts of a similar quality-control system that monitors ribosome biogenesis. Ribosomes are built in the nucleolus and nucleoplasm before being exported into the cytoplasm, where they undergo final maturation and function as the protein-synthesizing workhorses of the cell. Dez *et al.* find that preventing the export of “under-construction” pre-ribosomes results in the rapid appearance of ribosomal RNA (rRNA) and protein components in distinct nucleolar foci they christen “No-bodies.” Components of the nuclear exosome and the TRAMP polyadenylation complex—molecular assemblies that have been implicated in the elimination of defective nuclear RNAs—are also found to accumulate in the No-body, and furthermore, they seem to be responsible for concentrating the pre-60S ribosomes here. The large rRNAs are polyadenylated within the subcellular foci by the TRAMP complex, and this mark seems to tag the rRNAs for destruction by the exosome.

Based on these results, the authors suggest that the No-body is the site at which surveillance of pre-ribosomes occurs, and they speculate that defects in maturation might be identified by the failure to displace pre-ribosome-associated factors, resulting in the recruiting of TRAMP. — GR

EMBO J. **25**, 1534 (2006).

CHEMISTRY

Polypropylene Piece by Piece

The properties of polypropylene plastic depend strongly on the relative stereochemistry of the methyl groups appended to every second carbon in the polymer chain. Elasticity, for example, arises from a structure with interspersed segments of random methyl configuration (termed atactic) and strictly parallel configuration (isotactic). Harney *et al.* present a catalytic system to prepare bulk quantities of polypropylene in which isotactic or atactic segments of any specified length can be incorporated in any desired order (demonstrated up to a total polymer molecular weight of ~170,000). The technique is especially promising for studying relations between molecular structure and bulk properties.

The catalyst precursor is a $\text{Zr}(\text{CH}_3)_2$ complex with amidinate and pentamethylcyclopentadienyl ligands. Scission of a $\text{Zr}-\text{CH}_3$ bond by an anilinium borate salt yields a catalyst that selectively produces isotactic polypropylene. The authors previously showed (by adding half an equivalent of borate) that if only half of the precursors lose CH_3 , ligand migrations between pre-

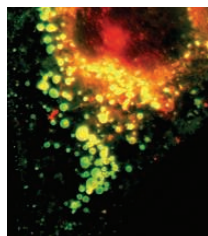
cursor and active catalysts result in atactic polymer. They now find that the CH_3 groups can be restored to the catalyst complexes, regenerating the precursor, by adding another $\text{Zr}(\text{CH}_3)_2$ compound bearing a bulky neopentyl substituent. They can thereby tune polymer stereochemistry by successively adding either borate (to prepare an isotactic segment) or the bulky Zr methyl transfer agent (for an atactic segment). — JSY

Angew. Chem. Int. Ed. **45**, 2400 (2006).

CELL BIOLOGY

What Comes In Must Get Out

Certain bacterial toxins, viruses, and proteins enter cells by an atypical form of endocytosis mediated by caveolae, which are cholesterol- and glycolipid-rich membrane invaginations particularly prevalent on the endothelial cells that line blood vessels. The mechanisms involved in caveolar uptake are not well understood. Choudhury *et al.* find that syntaxin 6, a protein known to be involved in membrane fusion events in the secretory pathway, is required. It seems that syntaxin 6 is involved in the recycling and delivery of caveolar components, such as caveolin, GM1 ganglioside, and glycosylphosphatidylinositol-linked proteins, to the cell surface via the Golgi complex.



Inhibition of syntaxin 6 results in cytoplasmic accumulation of cholesterol (red) and GM1 (green).

A key factor in the process may be ganglioside trafficking; the addition of GM1 ganglioside to cells with inhibited syntaxin 6 restored caveolin delivery to the cell surface, and caveolar endocytosis. — SMH

Nature Cell Biol. **8**, 317 (2006)

ASTROPHYSICS

Double Take

Most stars exist as binaries, in which two stars orbit one another about their common center of mass. Statistically, individual stars can span a wide range of masses, and there are many more light stars than heavy ones, so if binaries assemble at random, the relative masses of their constituents should generally differ significantly. Moreover, the more massive star in the pair should evolve and die more quickly than its companion.

Pinsonneault and Stanek suggest that a surprisingly high proportion of binaries are twins, with both stars of about the same mass and age. In a spectroscopic sample of the nearby Small Magellanic Cloud galaxy, about half of the well-separated binary pairs are twins, far more than chance would predict. Other literature reports are consistent with twins constituting at least a quarter of all binaries. Because the twin stars are identical, they must both have formed at the same time and evolved at the same rate. This preponderance of twins may impinge upon a range of astrophysical questions related to the interactions, mergers, and deaths of binary stars, including the progenitors of (Type Ia) supernovas and gamma-ray bursts. — JB

Astrophys. J. **639**, L67 (2006).



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<< Signaling Stress in Asthma

That stress worsens childhood asthma seems paradoxical. Stress promotes the secretion of cortisol (which diminishes airway inflammation) and epinephrine (which acts as a bronchodilator); these chemicals should alleviate asthmatic symptoms. Miller and Chen studied the relationship between life stress and expression of the glucocorticoid receptor (GR) and the β_2 -adrenergic receptor (β_2 AR). They administered a stress assessment interview to 38 healthy children and 39 who had been diagnosed with asthma, and quantified the expression of the GR and the β_2 AR in leukocytes in blood samples. Although the levels of β_2 AR and GR mRNA were greater in children with asthma, chronic stress was associated with a decrease in the abundance of β_2 AR mRNA in asthmatic children and an increase in β_2 AR abundance in healthy children. No effect of chronic stress alone on GR was apparent, and isolated major life events (acute stressors) within the past 3 or 6 months failed to affect the expression of either the β_2 AR or the GR. However, major life events that occurred in the context of chronic stress exacerbated the effects of chronic stress on the β_2 AR and uncovered a decrease in GR expression in asthmatic children. Thus, the effects of stress on β_2 AR and GR expression were in a direction consistent with decreased sensitivity to glucocorticoids and β_2 -adrenergic agonists, which could have implications for the clinical management of asthmatic children. — EMA

Proc. Natl. Acad. Sci. U.S.A. **103**, 5496 (2006).

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