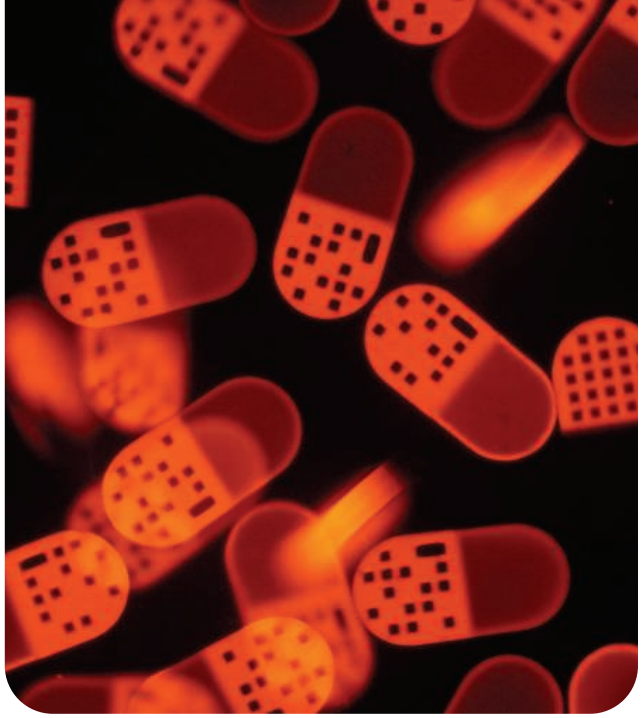
EDITED BY STELLA HURTLEY AND PHIL SZUROMI



<< Flow the Codes

Ideally, molecular screening should allow for the simultaneous analysis of many molecular targets. **Pregibon *et al.*** (p. 1393) used microfluidics and lithographic masks to create flat particles with lateral dimensions of ~100 micrometers and thicknesses of about 30 micrometers. One half of each particle bears a distinct fluorescent barcode (out of more than 1 million possible codes); the other half bears a probe for target binding. After incubation with a sample, a flow-based analysis system then scans each particle via single-wavelength fluorescence for its code and evidence of bound target. Fluorescently labeled DNA targets could be detected at the 500-attomole level.

Electronic Superstructure and Superconductivity

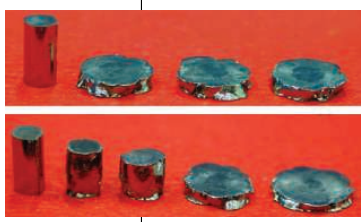
The cuprates that exhibit high-temperature superconductivity (HTSC) are formed from parent antiferromagnetic insulators by chemical doping, which removes electrons from the CuO_2 planes. Most HTSC theories have focused on the transition from antiferromagnetic to superconducting states, and the effects of only lightly "hole doping" the materials have often been ignored. **Kohsaka *et al.*** (p. 1380, published online 8 February; see the cover and the Perspective by **Zaanen**) present scanning tunneling spectroscopy measurements for two families of underdoped cuprate superconductors with different lattice structures that reveal a common electronic superstructure in both materials. The authors argue that the electronic superstructure, which forms narrow stripes with a spatial period of four unit cells, is an intrinsic property of the cuprates and is the precursor parent phase to the onset of superconductivity. The results suggest that superconductivity in the cuprates emerges with increasing hole doping as electrons become delocalized from the intrinsic bond-centered electronic glass.

Quantum Hall Effect in Metal Oxides and Graphene

The quantum Hall effect (QHE), in which the resistance of a two-dimensional electron gas varies by precisely quantized steps in response to a magnetic field, has generally been confined to high-quality, high-mobility semiconductors at cryogenic temperatures. **Tsukazaki *et al.*** (p. 1388, published online 25 January) now report the observation of the QHE in an oxide heterostructure grown from layers of ZnO and $Mg_xZn_{1-x}O$. **Novoselov *et al.*** (p. 1379) report the observation of the QHE in graphene sheets at room temperature. These results present the possibility of combining quantum Hall physics with the versatile metal oxides and in the emerging graphene sheet system (see the Perspective by **Ramirez**).

Increasing Plasticity of Metallic Glasses

Bulk metallic glasses (BMGs) hold much promise because of their high strengths, but suffer from brittle fracture through the formation of shear bands. This mode of failure is not desirable in most applications because there is little warning of the impending material failure. **Liu *et al.*** (p. 1385) report observations of large compressive plasticity of >150% obtained in several zirconium-based BMGs at room temperature as a result of highly controlled tuning of the alloys' composition. The materials develop a two-phase microstructure that includes "strongly bonded regions" separated by narrow "weakly bonded regions." Although shear banding appears to be initiated in the weakly bonded regions, the strongly bonded regions act to prevent the further growth of the bands.



High and Dry

Particulate air pollution can provide many more nuclei for forming cloud droplets compared to unpolluted air. The increased number of cloud droplets that form decreases their size, which leads to less frequent coalescence into raindrops and less precipitation. This effect is thought to account for decreased orographic precipitation, in which rainfall is caused by the upward deflection of an air mass by a ridge or a mountain, but this effect has not been tested against actual data on aerosol concentration and precipitation. **Rosenfeld *et al.*** (p. 1396) analyze a 50-year-long record of aerosols and precipitation from central China, one of the most polluted areas of the world. Strongly polluted air provided only half as much orographic precipitation as did clean air.

Eat Up to Meet Up

Different members of the Toll-like receptor (TLR) family have evolved to recognize the distinct signatures left by pathogens, including the single-stranded (ss) and double-stranded nucleic acid genomes of viruses. In the case of plasmacytoid dendritic cells (pDC), detection by TLRs culminates in a program of gene activation that helps these cells prime antiviral adaptive immune responses. The response to some viruses, such as influenza, is achieved without the need for replication of pDC, which makes the process of immune activation less dependent on direct infection of pDC. However, **Lee *et al.*** (p. 1398, published online 1 February; see the Perspective by **Reis e Sousa**) show that for RNA viruses that generate replication intermediates in the cytosol, a direct indicator of viral replication is needed. In such cases, autophagy—the sequestering of organelles and

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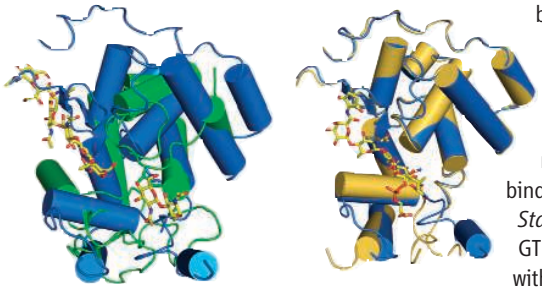
long-lived proteins for delivery to the lysosome for degradation—helped unite ssRNA and its TLR sensing protein in the lysosome. It is not clear if this link between autophagy and innate recognition represents a broader means of facilitating immunity to pathogens.

Toward Antibacterial Development

The bacterial cell wall is built by glycosyltransferase (GT) and transpeptidase (TP) enzymes. Penicillin and related antibiotics act on TP enzymes, but bacterial resistance is developing against these antibiotics. GT enzymes are an attractive target for new drugs because they are essential and are membrane bound and thus accessible. **Lovering *et al.*** (p. 1402; see the Perspective by **Wright**) have determined the crystal structure of penicillin-binding protein 2, a bifunctional enzyme from *Staphylococcus aureus* that contains both a GT and a TP domain. Structures with and without the inhibitor moenomycin bound in the GT domain provide insight into the mechanism of cell-wall biosynthesis and provide a starting point for structure-based design of antibacterials.



CREDIT: LOVERING *ET AL.*

Checkpoint, What Checkpoint?

Cells use biochemical signaling mechanisms known as checkpoints to monitor the status of the cell so that cell division only occurs when conditions allow for successful mitosis. One such checkpoint allows cell division to occur only if DNA replication is complete and no active replication forks are present. However **Torres-Rosell *et al.*** (p. 1411; see the Perspective by **Weinert**) describe experiments in which uncompleted replication of ribosomal DNA (rDNA) genes does not prevent cells from proceeding into anaphase. Thus, at least in the scenario studied in which yeast bear mutations in the genes encoding the Smc5 and Smc6 proteins (which function as a heterodimer in DNA repair), the delayed replication of rDNA did not trigger a checkpoint that blocks progression of the cells into mitosis.

Robotic Salamander

The locomotion of the salamander provides an opportunity to connect research on vertebrate swimming (such as in the lamprey) to research on tetrapod locomotion. **Ijspeert *et al.*** (p. 1416; see the news story by **Pennisi**) develop a theoretical model to show how a lamprey-like system can be extended to explain salamander locomotion. The model explains the transition from traveling to standing waves of body undulations, the automatic switch from one mode of locomotion to the other, the coordination between limbs and body during walking, and the control of speed and direction. To validate the model, the authors built a salamander-like robot capable of producing (and switching between) swimming, serpentine crawling, and walking gaits.

Regulating Calcium in Plants

In *Arabidopsis*, the concentration of intracellular calcium fluctuates in a daily cycle, above and beyond other responses to signaling inputs. **Tang *et al.*** (p. 1423) have now analyzed the interactions between intracellular and extracellular calcium concentrations, and various signaling components in between, to arrive at a complex view of calcium physiology in the plant. Not simply a passive reflection of external calcium status, the calcium levels within a resting cell are actively monitored and managed.

Smell, Sleep, and Memory Consolidation

The evocative nature of smell is well known, but can smells actually enhance memory retention? **Rasch *et al.*** (p. 1426; see the news story by **Miller**) examined in humans whether memory consolidation is actively assisted by slow-wave sleep. Subjects were first trained on an object-place association task in the presence of a distinct odor. During subsequent slow-wave sleep, this odor was reintroduced to facilitate reactivation of memories from the paired associate task. Odor application led to enhanced activity in the hippocampus. Subjects who experienced the odor during slow-wave sleep performed better on an episodic memory retention test on the subsequent day.

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