EDITED BY STELLA HURTLEY AND PHIL SZUROMI

## << The Makings of Self-Pollination

Plants that produce both male and female gametes use various strategies to determine whether they will predominantly self-fertilize or predominantly use pollen from other flowers. Although compatibility of cell surface receptors is part of the story, the geometry of flower parts also affects what pollen lands on the stigma. In the flower of the domesticated tomato, the stigma is buried within the anthers, which makes self-fertilization more likely. In wild relatives of the tomato, however, the stigma projects beyond the anthers and favors cross-fertilization. **Chen *et al.*** (p. 643) now identify the gene that regulates the length of the style, and thus regulates the relative geometry of stigma and anthers in the tomato.

## A Pocketful of Sugar

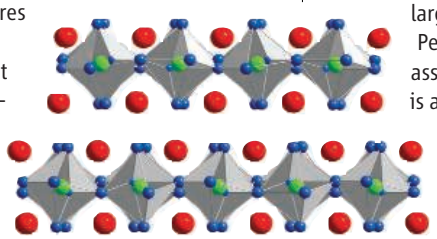
Selective binding of distinct sugars in water is a challenge for molecular recognition because the abundant OH substituents must be differentiated from one another, as well as from the markedly similar surrounding solvent. **Ferrand *et al.*** (p. 619) have prepared an organic receptor that achieves the task for certain disaccharides with an efficacy approaching that of the much more structurally complex lectin proteins, and so holds promise for biochemical applications. The receptor binds cellobiose and related compounds, in which all OH groups are equatorially oriented, with an association constant of ~600 inverse molar; the affinity drops more than 10-fold for substrates with an axial OH group. Nuclear magnetic resonance spectroscopy confirms a binding motif in which polar walls in the receptor interact favorably with the hydroxyls while aromatics at the top and bottom straddle the alkyl portions of the guest.

## Mapping Mantle Heterogeneity

Earth's upper mantle shows a series of seismic discontinuities that have been linked to phase changes in mineralogy. Although the discontinuities occur at similar depths, there are local variations. **Schmerr and Garnero** (p. 623) investigate mantle structures beneath South America and adjacent oceans by stacking up weak precursors to *SS* seismic waves to map the discontinuities at depths of approximately 410- and 660-kilometers (km). On the down-dip side of subduction zones, they see that the 410-km discontinuity occurs tens of kilometers deeper, counter to expectations for cold slab material. Explaining the features seen requires both chemical and thermal contributions to the phase changes and confirms the influence of deep tectonic processes in generating mantle heterogeneity.

## A Stress on the Insulating Phase

The band theory for conductivity of solids predicts that materials with an odd number of electrons in their unit cell would behave as metals, but some materials, such as NiO, are insulators at low temperatures because of the dominating effect of Coulomb interactions and electronic correlations. These insulators can undergo a transition to a metallic phase (by increasing temperature), but typically these metal-to-insulator transitions (MITs) are accompanied by structural phase transitions. **Moore *et al.*** (p. 615) show that in the layered perovskite $Ca_{1.9}Sr_{0.1}RuO_4$, the surface undergoes its MIT at 130 Kelvin, well below the bulk transition temperature of 154 Kelvin that is accompanied by a structural phase transition. The authors argue that surface stresses that allow that Ca and Sr ions to be pulled into the bulk stabilize a surface phase that favors the Mott insulator ground state relative to the bulk structure. Thus, the MIT can occur before the phase transition.



## Inevitable Uncertainty

Climate sensitivity is defined by the change in global average temperature that would result from changes in radiative forcing equal to that which would be caused by a doubling from pre-industrial levels of the atmospheric concentration of $CO_2$. Past work has shown that while the most likely value of climate sensitivity is between 2.0° and 4.5°C, there is a small probability that the increase could be much higher—8°C or even more. This persistent, high-temperature tail of low probability has been one impediment to political action, as policy-makers have been reluctant to formulate policies to address climate change when the range of uncertainty is so large. **Roe and Baker** (p. 629; see the Perspective by **Allen and Frame**) assert that this tail of low probability is an intrinsic feature of the climate system, not a result of inadequate data or models, and that this tail will persist even in the face of more observations and more advanced modeling. They conclude that putting off decisions about climate policy until greater certainty is achieved is futile.

## Thawing and Warming

Around 18,000 years ago, near the beginning of the last deglaciation, the atmospheric concentration of the greenhouse gas methane began to rise rapidly, but the origin of this increase is still uncertain. **Walter *et al.*** (p. 633) add another potential methane source to the mix: the frozen areas of northern Asia and North America that were not covered by ice sheets. As the climate

*Continued on page 531*

CREDITS (TOP TO BOTTOM): ANDRE KESSLER/CORNELL UNIVERSITY; MOORE *ET AL.*





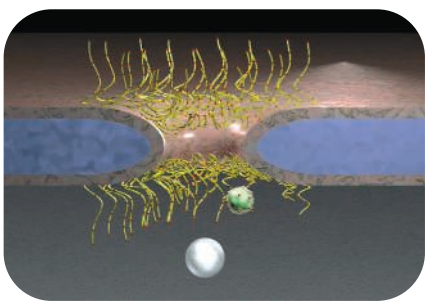
*Published by AAAS*

*Continued from page 529*

began to warm, these grounds thawed and lakes formed that would have emitted large volumes of methane bubbling up from their organic-rich sediments. Such a process could have supplied as much as 85% of the methane that Arctic and boreal regions are understood to have contributed during deglaciation. This methane emission would have contributed significantly to the warming that occurred at the Pleistocene-Holocene transition.

## Pack Mentality?

Explaining the origin of altruism and parochialism has posed a challenge for theoretical biologists. **Choi and Bowles** (p. 636; see the Perspective by **Arrow**) describe a simulation based on interactions between groups in a game-theory framework in which hostile intergroup interactions lead to war and nonhostile interactions lead to trade. Groups composed of individuals who are both altruistic and parochial—who favor members of their own group and disfavor outsiders—are more successful than groups that are either only altruistic or only parochial.



## Regulating Nuclear Transport

In eukaryotic cells, the nuclear pore complex (NPC) acts selectively to gate entry and exit of macromolecules into and out of the nucleus. **Lim *et al.*** (p. 640; published online 4 October) studied the biophysical response of the phenylalanine-glycine (FG)–domain of one of the nuclear pore proteins to biochemical interactions that govern nucleocytoplasmic transport. The FG-domains collapse into more compact structures upon binding to the nuclear transport receptor karyopherin-β. This collapse is reversed by Ran guanosine triphosphate, a known regulator of nuclear transport. The reversible collapse of the FG-domains may represent the underlying mechanism that regulates passage through the NPC.

## Plant-Pathogen Arms Race

Plants recognize pathogens through immune-like receptors, which activate a resistance response. In turn, pathogens have evolved means to modify plant signaling pathways to avoid triggering the resistance response. **Kay *et al.*** (p. 648) and **Römer *et al.*** (p. 645) tackle the molecular mechanisms underlying this evolutionary arms race between plants and pathogens. The bacterial type III effector protein, AvrBs3, functions as a pathogenicity factor in susceptible host plants, which lack a resistance gene known as *Bs3*, by acting as a transcriptional activator. In contrast, plants carrying Bs3 recognize the AvrBs3 protein and activate the resistance gene *Bs3*, which simulates the plant resistance pathway.

## Extracellular Death Factor

Programmed cell death (PCD) has traditionally been considered to be restricted to eukaryotic multicellular organisms; however, several genetic modules in prokaryotes are known to mediate a type of programmed cell death. In *Escherichia coli*, *mazF* encodes a stable toxin, and *mazE* encodes a labile antitoxin, that prevents the lethal effect of MazF. **Kolodkin-Gal *et al.*** (p. 652; see the Perspective by **Kolter**) now show that *E. coli mazEF*–mediated cell death is a population phenomenon that requires a quorum-sensing signal molecule, extracellular death factor (EDF). EDF is a symmetric, linear pentapeptide whose amino acid sequence is Asn-Asn-Trp-Asn-Asn. In synthetic peptides, the symmetrical arrangement of each of the five amino acids of EDF was important for *mazEF*-mediated killing activity.

## Drug Craving, Malaise, and the Insula

An important factor that contributes to drug-seeking in addicted individuals is the negative feelings that result from abstinence. Such mood states are monitored by the interoceptive sensory system, and particularly by a brain area called the insular cortex, known to process emotional information. **Contreras *et al.*** (p. 655) observed that inactivation of the rat posterior granular insula reversibly disrupts the craving for amphetamine in animals repeatedly injected with amphetamine, as well as the behavioral signs of malaise induced by lithium administration. Thus, therapeutic interventions in the insula may help to alleviate drug cravings.

CREDIT: HANS-RUDOLF HIDBER/UNIVERSITY OF BASEL, SWITZERLAND





*Published by AAAS*