Signals of Mosquito Speciation

Malaria in Africa is transmitted by the mosquito species complex *Anopheles gambiae*. **Neafsey *et al.*** (p. 514) made high-resolution single-nucleotide arrays to map genetic divergence among members of the species. Differentiation between populations was observed and evidence obtained for selective sweeps within populations. Most divergence occurred within inversion regions around the centrosome and in genes associated with development, pheromone signaling, and from the X chromosome. The analysis also revealed signals of sympatric speciation occurring within similar chromosomal regions in mosquitoes from different regions in Africa. **Lawniczak *et al.*** (p. 512) sequenced the genomes of two molecular forms (known as M and S) of *A. gambiae*, which have distinctive behavioral phenotypes and appear to be speciating. This effort resolves problems arising from the apparently chimeric nature of the reference genome and confirms the observed genome-wide divergences. This kind of analysis has the potential to contribute to control programs that can adapt to population shifts in mosquito behavior arising from the selective effects of the control measures themselves.

Watering the Moon

About a year ago, a spent upper stage of an Atlas rocket was deliberately crashed into a crater at the south pole of the Moon, ejecting a plume of debris, dust, and vapor. The goal of this event, the Lunar Crater Observation and Sensing Satellite (LCROSS) experiment, was to search for water and other volatiles in the soil of one of the coldest places on the Moon: the permanently shadowed region within the Cabeus crater. Using ultraviolet, visible, and near-infrared spectroscopy data from accompanying craft, **Colaprete *et al.*** (p. 463; see the news story by **Kerr**; see the cover) found evidence for the presence of water and other volatiles within the ejecta cloud. **Schultz *et al.*** (p. 468) monitored the different stages of the impact and the resulting plume. **Gladstone *et al.*** (p. 472), using an ultraviolet spectrograph onboard the Lunar Reconnaissance Orbiter (LRO), detected H_2, CO, Ca, Hg, and Mg in the impact plume, and **Hayne *et al.*** (p. 477) measured the thermal signature of the impact and discovered that it had heated a 30 to 200 square-meter region from ~40 kelvin to at least 950 kelvin. **Paige *et al.*** (p. 479) mapped cryogenic zones predictive of volatile entrapment, and **Mitrofanov *et al.*** (p. 483) used LRO instruments to confirm that surface temperatures in the south polar region persist even in sunlight. In all, about 155 kilograms of water vapor was emitted during the impact; meanwhile, the LRO continues to orbit the Moon, sending back a stream of data to help us understand the evolution of its complex surface structures.

Mixing Chaos

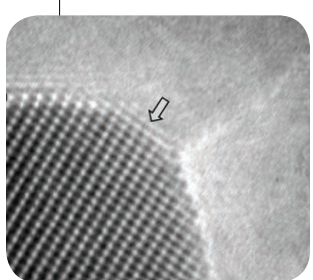
Modeling the future movement of chaotic fluids is the basis for predicting the weather and ocean currents. Usually parcels of fluid are traced and geometrical and statistical approaches incorporate parameters for mixing and chaos, as well as the resulting uncertainty. **Mezić *et al.*** (p. 486, published online 2 September; see the Perspective by **Thiffeault**) adapted this approach to consider different mixing and stretching regimes to improve predictions. As a test, they simulated and successfully predicted the spread of oil patches from the Deepwater Horizon oil spill in a model for the Gulf of Mexico.

PIAS1 Repression

Regulatory T cells (T_{regs}) promote immune tolerance and protect against autoimmunity. T_{regs} develop in the thymus, and their differentiation and acquisition of suppressive function requires expression of the transcription factor Foxp3. Although several transcription factors have been identified that turn on *Foxp3* gene expression, how Foxp3 remains turned off in non-T_{regs} is not well understood. **Liu *et al.*** (p. 521) have demonstrated that a regulator of cytokine signaling, PIAS1, represses Foxp3 expression by chromatin modification. PIAS1 promoted the methylation of the *Foxp3* promoter by recruiting methyltransferases to inhibit expression. PIAS-deficient mice have more T_{reg} cells than controls, and they appear to be protected against the development of experimental autoimmune encephalomyelitis, a mouse model for multiple sclerosis.

Growing Nanowires

In vapor-liquid-solid (VLS) growth of nanowires, the liquid phase acts as a transporter to bring material from the gas phase to the growing solid. By heating a single crystal of sapphire in a high-resolution transmission microscope, **Oh *et al.*** (p. 489) monitored the growth of sapphire (α-Al2O3) nanowires out of an aluminum droplet. The liquid aluminum brings oxygen to the growing wire surface, in alternating growth and dissolution reactions at the edge of the wire. The oscillation created an optimum face at the self-catalytic site for atomic stacking and regenerated the junction between the VLS phases, allowing growth of the nanowire.



Incompatible Self-Compatibility

Macroevolutionary processes driving species differences in diversification rates are important in explaining the variation we see in nature, but the extent of this process and how much the traits within a single species can drive changes in the diversification rate are unknown. **Goldberg *et al.*** (p. 493; see the Perspective by **Wright and Barrett**) analyzed the phylogenetics of the plant family Solanaceae and found that rates of extinction are greater for self-pollinating species than outbreeding species. Species-level selection against the deleterious effects of inbreeding may explain why self-fertilization, despite its short-term evolutionary advantages, has not spread to become more common in the flowering plants.

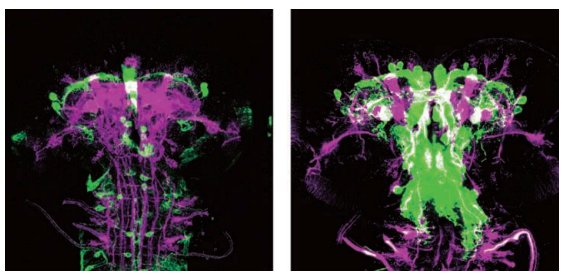
CREDITS (TOP TO BOTTOM): JAMES GATHANY/CENTERS FOR DISEASE CONTROL AND PREVENTION; OH *ET AL.*

Cloning Futures

Cloning mammals by somatic cell nuclear transfer is a technique with many potential applications in regenerative medicine, agriculture, and pharmaceutics; however, it is inefficient because of the incidence of aberrant genomic reprogramming. **Inoue *et al.*** (p. 496, published online 16 September) found that the gene product of *Xist*, which normally inactivates one of the two X chromosomes in females, was unexpectedly expressed ectopically from active X chromosomes in cloned mice. When *Xist* was deleted from the mice, gene expression returned to normal and the efficiency of somatic cell nuclear transfer increased about ninefold, offering promise for future nuclear transfer technology.

Light-Hating Target

Young larvae of the fruit fly *Drosophila* like to hide in the dark. Older larvae nearing pupation are less timorous. **Gong *et al.*** (p. 499; see the Perspective by **Vogt and Desplan**) have identified part of the neural circuit that links perception of light to behavior. The authors used targeted expression of the tetanus toxin to disable neurons selectively in the larval central nervous system. The results identified a neural circuit responsible for regulating the preference—or disinclination—for light. The circuit, which is composed of a bilateral pair of neurons, receives input from the larval visual circuit, and its activation strengthens photoavoidance behavior. The results give a glimmer into how the brain interprets perceptual inputs.



CREDIT: GONG *ET AL.*

Three's the Charm

The molecular machinery mediating membrane fusion during secretion from a cell requires a complex of so-called SNARE protein that forms a coiled bundle of four parallel α-helices. **Mohrmann *et al.*** (p. 502, published online 16 September) developed an elegant approach to find out how many SNARE complexes are required to promote secretion of individual secretory vesicles in living chromaffin cells by titrating the ratio of wild-type and mutant SNARE proteins expressed. For fast synchronous release, a minimum of three SNARE complexes per vesicle were required. Fewer SNARE complexes resulted in slower release.

M2 Out of the Envelope

The M2 protein from influenza A virus forms an acid-activated tetrameric proton channel in the viral envelope and is essential for viral replication. Two manuscripts shed light on the functional mechanism of this channel. **Sharma *et al.*** (p. 509; see the Perspective by **Fiorin *et al.***) determined the structure of the conductance domain in a lipid bilayer and propose that a histidine and tryptophan from each monomer form a cluster that guides protons through the channel in a mechanism that involves forming and breaking hydrogen bonds between adjacent pairs of histidines. **Hu *et al.*** (p. 505; see the Perspective by **Fiorin *et al.***) focused on the structure and dynamics of the proton-selective histidine at high and low pH, proposing that proton conduction involves histidine deprotonation and reprotonation.

Stress, DNA Damage, and ATM

The protein kinase ATM (ataxia-telangiectasia mutated) is a key component of the signaling pathway through which cells are protected from DNA damage. ATM becomes activated within a protein complex at sites of double-stranded breaks in DNA. ATM is also activated in response to increased production of reactive oxygen species (ROS). Such activation was thought to reflect DNA damage caused by ROS, but **Guo *et al.*** (p. 517) showed that ATM was in fact directly activated by ROS. A cysteine residue in ATM contributes to the formation of disulfide-linked dimers of activated ATM on exposure to ROS in vitro. Experiments using mutated forms of the enzyme suggested that two distinct mechanisms regulated ATM activity.