

<< Initial Events in X-ray Excitation

X-ray methods have enabled atomic-scale structural characterization of many systems, but the high energy of x-rays can induce chemical damage. Such damage is challenging to probe because the seminal events occur on time scales much shorter than the duration of technologically accessible x-ray pulses. The recent advent of laser-induced high harmonic generation has overcome this limitation, and **Gagnon *et al.*** (p. 1374) apply the technique to study the interaction dynamics of N_2 molecules with femtosecond x-ray pulses. The pulses have sufficient energy to eject an electron and simultaneously excite an additional electron in the same molecule, which leads to shell rearrangements on an ultrafast time scale that the authors could characterize through imaging of further ionization events.

Quantum Criticality in Helium Bilayers

Unlike classical critical points, quantum critical points occur in the limit of zero temperature, where two possible ground states of the system compete as a function of some other system parameter, such as pressure or magnetic field. Quantum criticality is thought to hold the key to understanding the states of matter that do not conform to the “standard model” of condensed-matter physics, Landau Fermi liquid theory. Historically, bulk liquid ^3He , the simplest Fermi system, played a key role in the development of Landau’s theory. However, **Neumann *et al.*** (p. 1356, published online 26 July; see the Perspective by **Hooley and Mackenzie**) show that bilayers of ^3He show quantum critical behavior when the coverage reaches a critical density. Finding a ^3He analog of behavior more commonly associated with complex materials may provide a more theoretically tractable system for studying quantum criticality.

Reassessing Core Spinning

Saturn’s rocky core spins hidden beneath thick cloud layers. By combining Cassini gravity measurements with Pioneer and Voyager radio occultation and wind data, **Anderson and Schubert** (p. 1384; see the Perspective by **Podolak**) deduce that Saturn’s core rotates 7 minutes faster than the rate determined from previous estimates based on periodicities in magnetic and low-frequency radio data that were not tied directly to the actual motion of the core. Relative to the fast spinning core, our perspective of Saturn’s atmospheric winds must also be altered. Much slower

eastern wind speeds are needed at the equator, corresponding to a reduced equatorial bulge from 122 to 10 kilometers, and the winds at higher latitudes flow both east and west, as on Jupiter. The more rapid rotation implies a relatively small ice-rock-metal core at Saturn’s center.

Flexible Force Generation

As a compact source of motive power, muscle cells retain many advantages over artificial systems they have inspired; for example, the force delivered and the frequency at which muscle contraction occurs can be tailored over a wide range. However, taking full advantage of muscle cells in devices requires the ability to mimic the three-dimensional nature of muscle tissue starting. **Feinberg *et al.*** (p. 1366) have cultured neonatal rat ventricular cardiomyocytes onto polydimethylsiloxane (PDMS) films on the centimeter size scale. Pre patterning of the support with micro-contact-printed lines of fibronectin controlled the tissue shape, and PDMS film thickness controlled the bending stiffness. In this way, complex shapes, such as the spiral form of a mailing tube, could be created. Small devices, which can contract spontaneously or be paced by an external potential, were able to swim, walk, or grip objects.

Clues to Body Sizes of Bird Ancestors

The changes involved in the early evolution of birds and flight (before *Archaeopteryx* appeared in the Jurassic) are poorly preserved in the fossil record. **Turner *et al.*** (p. 1378) describe a later Cretaceous dinosaur from Mongolia that retains many primitive features and is phylogenetically positioned as a basal dromaeosaurid (which are part of the clade Paraves that also includes *Archaeopteryx* and later birds). The taxon’s small body size (70 centimeters) supports the notion that a decrease in body size in dinosaurs preceded the evolution of flight in the lineage that led to birds; the largest *Archaeopteryx* is about 65 centimeters.

Reflections on Sooty Surfaces

Black carbon, or “soot,” can impact climate through its extremely efficient absorption of sunlight. Although most of the impact of soot comes from its presence in the atmosphere, its influence can be critical when it deposits on snow and ice and dramatically changes surface reflectivity. **McConnell *et al.*** (p. 1381,

see the Perspective by **Alley**; published online 9 August) present a 215-year-long record of North American emissions of black carbon, based on its concentration in an ice core from Greenland. Black carbon deposition was greatest between about 1850 and 1950, and industrial activity

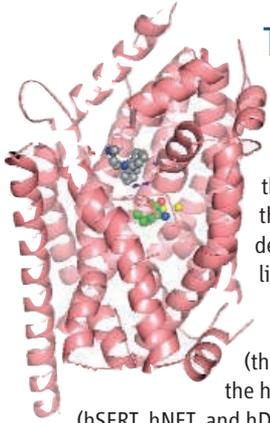
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during that period resulted in an increase of radiative forcing at the surface as much as eight times greater than that during the preindustrial era.

Acquiring the Necessary Skills

Humans are social animals and, aided in large part by language, are supremely capable of transferring knowledge and skills across generational and genetic boundaries. One way to gain insight into how these social cognitive skills arose is to detect differences in the onset of some of these skills in human, ape, and monkey infants. **Herrmann *et al.*** (p. 1360) present the implementation of what they have labeled the Primate Cognition Test Battery, which has been designed to assess social and physical cognition, in approximately 100 children, 100 chimpanzees, and 30 orangutans. At an age of 2½ years, human children perform as well as chimpanzees on the physical tasks and much better than them on social tasks. Human adults normally use their hands, not their heads, to turn a light switch. So do infants, even after they have observed an adult using their head—if they see that their hands were occupied by holding a blanket. However, if infants see an adult use their head when their hands are free, they conclude that there must be some underlying reason for using the head, and they will do so, too. **Wood *et al.*** (p. 1402; see the news story by **Pennisi**) assess whether this capacity for looking beyond the surface to see the intentions underlying goal-directed actions can be detected in nonhuman primates. They find that it can—in chimpanzees, macaques, and tamarins—implying that bases for this cognitive skill arose at least 40 million years ago.



The Molecular Machinery of Mood Swings

The action of monoamine neurotransmitters that serve as signaling molecules in mood and motivation begins when they are released from the presynaptic nerve terminal and ends when they are transported from the extracellular space back into the cytoplasm via dedicated sodium-dependent plasma membrane transporters. **Zhou *et al.*** (p. 1390, published online 9 August) describe the crystal structure of a bacterial homolog (LeuT) of the mammalian monoamine transporters in complex with its substrate (leucine) and an inhibitor of norepinephrine transport (the antidepressant desipramine). On the basis of homology modeling of the human transporters for serotonin, norepinephrine, and dopamine (hSERT, hNET, and hDAT), they construct mutants of hSERT and hDAT and show that these exhibit the predicted sensitivity of serotonin and dopamine uptake to desipramine inhibition.

Genetic Risks in Exfoliation Glaucoma

Exfoliation glaucoma (XFG) is a common, sight-threatening disease associated with chronic accumulation of fibrillar matrix products caused by abnormal aggregation of elastic microfibril components (exfoliation syndrome). **Thorliefsson *et al.*** (p. 1397, published online 9 August; see the 10 August news story by **Marx**) performed a whole-genome association study on an Icelandic cohort and a Swedish cohort and found that XFG was associated with variation in the *LOXL1* gene, a member of the lysyl oxidase family of proteins, that is involved in the formation of the elastin polymer fibers. Two common single nucleotide polymorphisms (SNPs) that result in changes in the region of the protein that affects substrate specificity were identified that were associated with the exfoliation syndrome and with XFG. The risk for XFG that they confer on those who have two copies of the high-risk haplotype of the two SNPs is more than 100 times greater than that for those with only the low-risk haplotypes.

A Genetic Handle on Head Blight

Fusarium graminearum, a fungal plant pathogen that causes head blight of wheat and barley, has resulted in the largest economic loss to United States agriculture in the last decade. **Cuomo *et al.*** (p. 1400) sequenced the genome of *F. graminearum* and revealed genes involved in host-pathogen interactions. In addition to the genome sequence, more than 10,000 single nucleotide polymorphisms were identified through comparison with a sequence from a second strain. These data suggest that within the genome, highly variable and gene-rich regions harbor genes potentially associated with pathogenicity.

CREDIT: ZHOU ET AL.