THIS WEEK IN Science

edited by Phil Szuromi

Spray Cleaning

Most pollution aerosols interact with clouds to reduce their droplet size, increase their albedo, and suppress precipitation. This process is reversed over oceans, however. Rosenfeld *et al.* (p. 1667) show that large sea salt nuclei in polluted oceanic air override the precipitation suppression effect of small pollution nuclei. They find that raindrops formed from airborne particles of sea salt grow by collecting cloud droplets that form on the pollution particles, thereby cleansing the air. Clouds that form in clean ocean air precipitate even more efficiently, establishing a positive feedback loop that leads to the formation of pristine maritime air masses. This mechanism, in which salt from sea spray serves as a catalyst, makes the oceans the "green lungs" of our planet.

1676 Straight Path to Linear Amines

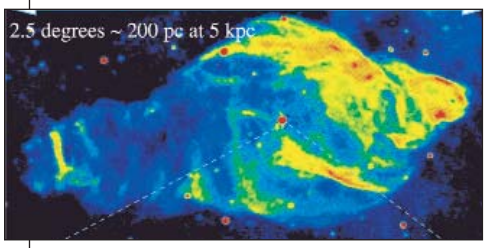
Linear amines are used in the production of numerous products, including drugs and agrochemicals. Unfortunately, the olefin feedstocks for making these compounds are made more expensive by the need for pure terminal olefins rather than cheaper mixtures containing internal double bonds. Seayad *et al.* (p. 1676; see the Perspective by Hartwig) report on an efficient, one-pot catalytic synthesis in which internal olefins are isomerized, reacted with hydrogen and carbon monoxide to create an aldehyde, and finally reduced with an amine to produce the desired linear amine.

And in Brevia ...

A copper fluoride–catalyzed route to aromatic fluorides developed by Subramanian and Manzer (p. 1665) produces water as its only by-product.

Staying Hot

Astrophysical jets, hot plasmas that are relativistically accelerated from black holes or neutron stars through the disk accretion process, provide rare observational evidence of high-energy dynamics at compact cores. Migliari *et al.* (p. 1673) obtained spatially resolved x-ray spectra of the jet from the x-ray binary SS 433 using the Chandra X-ray Observatory. The plasma retains a high velocity and a high temperature far from the core, which is inconsistent with an adiabatic cooling model for the extended jet. The extended plasma may be reheated by shock-wave pulses driven through the jet or by other processes, such as inverse Compton scattering or synchrotron radiation.



CREDIT: MIGLIARI *ET AL.*

Solid Beginnings

The earliest solid particles produced in the solar nebula are thought to make up the most primitive meteorites, the chondrites. Chondrites consist of refractory calcium-aluminum–rich inclusions (CAIs) and chondrules in a fine-grained matrix. Previous isotopic dating suggested that CAIs either formed about 2 to 3 million years before chondrules or that they formed at the same time but in an isotopically heterogeneous environment. Amelin *et al.* (p. 1678; see the Perspective by Gilmour) have now precisely dated CAI formation to have occurred about 2.7 million years before chondrule formation by using ^{207}Pb-^{206}Pb isochrons. These ages and time intervals between formation of different chondrite components will help modelers understand which processes, such as stellar winds, supernovae explosions, shock waves, or lightning, created the first solid particles in the solar system.

Powering Up

Wide–band-gap semiconductors offer the potential of larger bandwidth and higher operating temperature for applications in power electronics. Diamond, with a direct band gap of 7.5 electron volts, large thermal conductivity, and superior mechanical properties, is an ideal material, but single-crystal diamonds are expensive, and synthetic diamonds tend to have rather poor electronic qualities. Isberg *et al.* (p 1670; see the Perspective by Amaratunga) have now grown single-crystal diamond thin films by microwave-plasma chemical vapor deposition that have the high carrier mobilities required for high-power electronics.

Repairing Bacterial DNA Breaks

When ionizing radiation breaks DNA, the leftover blunt ends of the DNA helix can cause problems in the cell. Eukaryotes can repair these lesions by a process called nonhomologous end joining (NHEJ). Previously thought to be a special eukaryotic adaptation, Weller *et al.* (p. 1686) now show that *Bacillus subtilis* has the basic components of the NHEJ machinery—a simple version of the protein Ku and a DNA ligase—and that these components act together to repair radiation damage.

Phosphorylation and Proton Pumping

The family of membrane proteins that generates ionic gradients use the energy of adenosine triphosphate (ATP) hydrolysis to pump cations energetically uphill with high selectivity and efficiency. Kühlbrandt *et al.* (p. 1692) built an atomic-resolution model of the proton ATPase of *Neurospora* by fitting a high-resolution x-ray structure of the calcium ATPase into a medium-resolution cryoelectron microscopic map. Based on this model, they suggest that large, sequential rotations of three cytoplasmic domains serve to link phosphorylation by the consumed ATP to the pumping of protons from the cytoplasm into the extracellular space. They provide experimental evidence that a fourth domain functions as an autoinhibitory switch that is itself regulated by phosphorylation.

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It Takes Nitrogen to Break Nitrogen

The nitrogenase enzyme catalyzes the transformation of atmospheric dinitrogen into bioavailable ammonia. The catalytically active component of the enzyme is the MoFe metalloprotein, in which the active site is the FeMo-cofactor. Now Einsle *et al.* (p. 1696; see the Perspective by Smith) have determined the structure of the MoFe protein at 1.16 angstrom resolution and see a previously unrecognized central ligand that is likely to be nitrogen coordinated to six iron atoms in the FeMo-cofactor. This central atom completes a tetrahedral coordination for the six iron atoms instead of the rather unusual trigonal coordination that was proposed based on lower resolution structures. A nitrogen in the cofactor raises the possibility that enzymatic dinitrogen reduction has mechanistic elements in common with the industrial Haber-Bosch process, which proceeds through an iron-nitride intermediate.

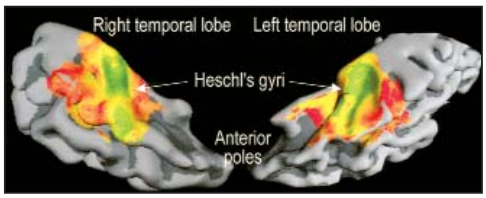
Getting Packed

Proteases destined for the lysosome—the degradative organelle of the cell—are packaged upon exit from the trans-Golgi network into clathrin-coated vesicles. Recently, a set of proteins, the GGAs, was identified as playing a role in the recruitment and packaging of these proteins. Now Doray *et al.* (p. 1700) have refined our understanding of the mechanisms involved by demonstrating a kind of molecular conveyance system by which cargo molecules—mannose-6-phosphate receptors—are sequentially handed off from the GGAs to adaptor components of the Golgi-associated clathrin-coated vesicles.

ZAPping Viral RNA

Abundant intracellular mechanisms have evolved to impede different stages of viral replication. In the search for new antiviral genes, Gao *et al.* (p. 1703) transduced a thymidine kinase (TK) negative cell line with a library of complementary DNAs (cDNAs). After infection with TK^+ retroviruses, potentially virus-resistant cells (those that lacked viral TK expression) were selected by culturing with a toxic thymidine analog. cDNA from one clone displaying high viral resistance was found to encode a gene that conferred specific antiviral activity when cloned and re-expressed in fibroblast cells. The protein ZAP encodes a zinc-fingered protein that could block nuclear export of viral RNA, pointing to an unusual mode of restricting viral replication within a host cell.

Higher Levels of Hearing in Humans



In the human auditory cortex, the spatiotemporal principles of encoding sound information are not yet fully understood. Seifritz *et al.* (p. 1706) used novel functional imaging techniques to reveal two different distinct types of neural responses associated with the same auditory stimulation. One shows a transient pattern, and the other has a sustained response. The anatomical distribution of these responses is partially segregated and correlates with the functional and morphological distinction of core and belt areas. The more transient response is found in belt areas, whereas the sustained response is localized to the core of the auditory cortex, in Heschl's gyrus, which contains primary auditory cortex.

Monkey See, Monkey Count

The ability to count would have adaptive benefits for nonhuman primates, such as in conflict situations and foraging. Although studies have shown that there are number-responsive neurons in the parietal cortex of monkeys, there has been considerable debate whether monkeys can abstract numbers from visual information. Nieder *et al.* (p. 1708; see the Perspective by Dehaene) trained macaque monkeys to respond when two consecutive displays contained the same number of dots. Once trained, recordings were obtained from neurons in the monkeys' prefrontal cortex. The authors found that there were neurons that responded preferentially to a given number of objects, and that the monkeys generalized their training so that they recognized equal numbers of objects that differed in size, shape, and arrangement.

CREDIT: SEIFRITZ *ET AL.*

Solid Beginnings

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