Sulfur for the Smelter

Over geological time scales, the affinity of sulfur for precious metals such as gold, copper, and platinum can result in the formation of massive ore deposits. The metals are transported through high-temperature fluids by sulfur species and, once the fluids cool, the metals are enriched and the sulfur solidifies as sulfide and sulfate minerals. Pokrovski and Dubrovinsky (p. 1052; see the Perspective by Manning) show that another chemical species of sulfur, the $S_2^-$ ion, may be the dominant sulfur species in such fluids.

Ancient Remains

Early human remains from North America are scarce, and burial sites, which can provide additional information, have been commonly disturbed, complicating understanding. Potter et al. (p. 1058) describe the cremated remains of a child that were buried in a semi-underground house in central Alaska about 11,500 years ago. The site also included a large number of artifacts. The burial, house design, and artifacts appear to be more similar to those of a site of comparable age in Kamchatka, Russia, than other sites in North America.

DNMT1 Caught in the Act

In eukaryotes, methylation of DNA, generally on the C base of CpG dinucleotides, is critical for the epigenetic regulation of numerous critical cellular processes. Patterns of DNA methylation are preserved from generation to generation, in large part by DNA methyltransferase-1 (DNMT1) or in one of its homologs. Song et al. (p. 1036, published online 16 December; see the Perspective by Godley and Mondragon) have solved the structure of DNMT1 from mouse and humans, both free and bound to CpG-containing double-stranded DNA. The structure reveals how DNMT-1 avoids methylaing sites that have unmethylated CpGs on both DNA strands, rather than the preferred target in which CpGs are methylated on one strand (the parental DNA) but not the other (the daughter DNA).

An Iron(V) Nitride

Enzymes rely heavily on iron to catalyze oxidation and reduction chemistry. Although iron is most commonly found in its +2 and +3 oxidation states, its reactivity hinges on fleeting access to +4 and +5 states. Model compounds in these higher states should help understanding of their behavior. Scepaniak et al. (p. 1049) prepared an iron nitride complex in the $+5$ oxidation state and characterized its structure. The four-coordinate iron center formed a triple bond to a single nitrogen atom, which it released efficiently as ammonia on exposure to water and an electron donor even at low temperature.

Not So Lonely First Stars

How did the first stars in our universe form and evolve? Theoretical calculations have suggested that early stars were mostly solitary, with some occasionally forming binary systems. Clark et al. (p. 1040, published online 3 February) present results from numerical simulations that show that primordial stars were surrounded by gravitationally unstable disks that fragmented into multiple clumps. Although the simulations do not show how the primordial disks evolved beyond this stage, based on our knowledge of present-day star formation, it is reasonable to think that the process could have led to binary or multiple star systems and thus to a much less solitary life for the universe’s first stars.

Keeping Time

Optical lattice clocks are comprised of atoms placed in an optical lattice formed by opposing laser beams and can be more precise than traditional microwave atomic clocks because of the higher frequency at which they operate, and the number of atoms available for interrogation. However, interactions between the atoms may lead to shifts in the frequency of the clock transition, usually proportional to the atomic density. Swallows et al. (p. 1043, published online 3 February) demonstrate an opposite and unexpected effect of interactions: For sufficiently strongly interacting systems, the frequency shift is suppressed. Indeed, in a strontium-based fermionic lattice clock, the shift and its associated spread were reduced by an order of magnitude.

Third-Order Problem

A Bose-Einstein condensate (BEC) is an exotic state of matter where constituent atoms act in unison below a certain transition temperature. A rigorous way of expressing the degree of “connectedness” of the atoms is to measure their long-range correlations, which should behave differently above and below the transition. The long-range coherence for BECs has been demonstrated up to second order. Now, Hodgman et al. (p. 1046) have used metastable helium atoms to measure the third-order correlations directly, and find that the coherence is still preserved below the transition. This finding supports the idea that BECs have long-range coherence at all orders.
Mice in Camouflage

Natural variation in vertebrate color pattern is one of the most conspicuous traits related to fitness. Using genetic and functional analyses in natural populations of *Peromyscus* mice, *Manseau et al.* (p. 1062) uncover the developmental mechanism for the establishment and subsequent evolution of color patterns, which function in camouflage from visual predators. The Agouti protein, known to be involved in pigment-type switching in adult skin, establishes a molecular prepattern during embryonic development to generate the adult color pattern. These changes in the time, place, and level of embryonic expression of *Agouti* affect adult color pattern and explain the difference in coloration between locally camouflaged mouse populations.

Ants Cross the Bridgehead

Fire ants (*Solenopsis invicta*) are native to South America, but invasive populations pose increasing problems to ecological and agricultural systems. Fire ant populations have been naturalized in the southern United States for nearly 90 years. More recently, however, populations have become established in California, China, Taiwan, and Australia. Genetic study of over 75 fire ant populations from throughout their native and introduced ranges allowed *Ascunce et al.* (p. 1066) to identify Argentina as the source of the U.S. population. All newly established populations, however, were derived from the southern U.S. population, mostly by separate invasions. This represents a classic bridgehead effect, where an introduced population serves as the source for subsequent invasions.

Spinning Eggs

Insects and birds produce oval eggs to adapt to a terrestrial life-style. Eggs, however, often begin development as spheres. How do they acquire the ellipsoid shape? *Haigo and Bilder* (p. 1071, published online 6 January) performed live imaging of developing eggs in the fruit fly *Drosophila melanogaster* and found that the eggs spin around the elongating axis. These revolutions help build a surrounding extracellular matrix that channels growth of the egg to form and maintain an ellipsoid shape.

Anti-Evolution Agents

Fungi that infect mosquitoes are potential tools for supporting malaria control efforts. Such biocontrol agents can be genetically engineered to make them more effective, to counter resistance as it evolves, or to express a range of foreign proteins into their hosts. *Fang et al.* (p. 1074) inserted toxin and antibody genes into the mosquito fungus *Metarhizium anisopliae*, so that the foreign proteins were expressed in the insect’s hemolymph, which severely compromised malaria parasite development in the vectors.

Rebuilding the Heart

Frogs, newts, and fish have a remarkable ability to rebuild functional heart muscle after injury—a useful skill set that appears to have been lost in higher vertebrates like mammals. A study of newborn mice now reveals that there is a small window of time after birth during which the mammalian heart is capable of regeneration. *Porrello et al.* (p. 1078) show that surgical removal of part of the heart’s ventricle in 1-day-old mice triggers a regenerative response that restores normal ventricular anatomy and function. This response, which involves cardiomyocyte proliferation, is lost by the time the mice are 7 days old. Understanding this transient regenerative capacity may suggest new therapeutic approaches for restoring function to human hearts damaged by disease.

Location, Location, Location

Eukaryotic messenger RNAs (mRNAs) can be targeted to specific subcellular compartments in the cytoplasm, where localized translation occurs. In prokaryotic cells, gene transcription and translation are generally considered to be tightly coupled, with protein localization driven by intrinsic features of proteins and not of their mRNA transcripts. However, *Nevo-Dinur et al.* (p. 1081; see the Perspective by *Ramamurthi*) now show that, in live *Escherichia coli* cells, tagged mRNAs are transported to the locations in the cell where the proteins they encode function. Thus, protein localization in bacteria can be determined at the level of mRNA targeting in a translation-independent manner.