edited by Stella Hurtley and Phil Szuromi

Going with the Grain Boundary

High-resolution electron microscopy can achieve angstrom-level resolution, but imaging of light atoms is still challenging. Recently, oxygen vacancies in single crystals of perovskite ceramics were identified. **Zhang *et al.*** (p. 846) have now resolved oxygen atoms in grain boundaries, a problem of considerable interest because grain boundaries affect a number of material properties. They observed atom-spacing changes at the boundaries and expanded metal-oxygen bonding. These observations validate recent density functional theory calculations on the grain-boundary structure.

The Fundamentals of Fragility

Many materials that normally crystallize can form amorphous glasses if they are cooled rapidly. Empirically, the ease with which a glass will form has been described by its "fragility," which can be quantified by measuring how fast its viscosity changes as it approaches the glass transition temperature T_g. **Scopigno *et al.*** (p. 849) show that the fragility can be correlated to the vibrational properties of the molecules well below T_g, which links the empirical fragility index to the interatomic interactions.

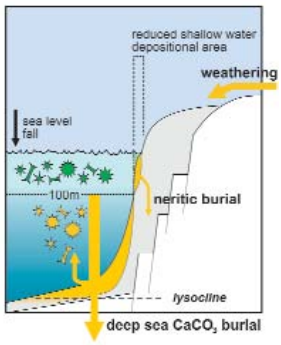
Thinned Out

Was the collapse of two large sections of the Larsen Ice Shelf in Antarctica during the past decade directly related to climate warming? **Shepherd *et al.*** (p. 856; see the news story by **Kaiser**) report satellite elevation measurements that show evidence of a widespread mass imbalance of the Larsen Ice Shelf, and conclude that ocean-driven melting has progressively thinned the ice shelf at its base. Their analysis shows that the shelf has thinned for at least 9 years, beginning prior to the well-documented collapse events of 1995 and 2002, and that this thinning may have played a pivotal role. They conclude that the remaining Larsen-C section will reach a similar condition in ~100 years. These results identify a possible direct link between the observed climate warming and the breakup of ice shelves at the Antarctic Peninsula.

Iceman Origins

The Alpine Iceman, a well-preserved mummy with clothing and hunting-gathering equipment from the Neolithic-Copper Age of Europe, was recovered from a glacier along the Alpine watershed between Italy and Austria. The Iceman was about 46 years old when he died and lived about 5200 years ago. **Müller *et al.*** (p. 862; see the news story by **Holden**) have determined the Iceman's origin and migration from isotopic analyses of tooth enamel and dentine, cortical and trabecular bone, and contents of the intestine. The Iceman lived south of the Alpine watershed within a range of about 60 kilometers for his entire life, but he spent his early childhood at a different site within this range from where he spent most of his adulthood.

An Old Unstable Ocean



859

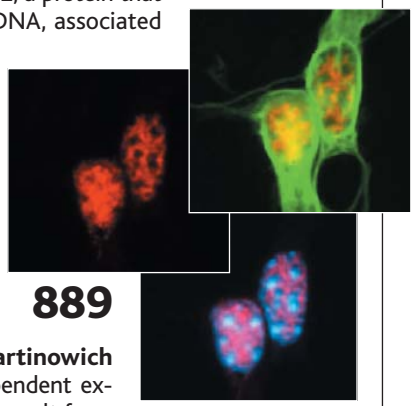
The "snowball" conditions of the Neoproterozoic may have been the coldest in Earth's history. Between 750 and 550 million years ago, essentially the entire planet was periodically covered with ice, although it is not clear why such extreme glaciations occurred only during that era. **Ridgwell *et al.*** (p. 859; see the Perspective by **Archer**) use a coupled model of the atmosphere-ocean-sediment carbon cycle to develop an explanation for the severity of Neoproterozoic ice ages. They found that an ocean without pelagic calcareous plankton—like that of the Neoproterozoic, because calcifying coccolithophores and foraminifera did not evolve until the early Phanerozoic—would be subject to intense swings of the carbon cycle, with low atmospheric CO_2, and thus cold conditions, occurring when sea level fell.

Transcription of the *Arabidopsis* Genome

Although the genome of the model plant *Arabidopsis thaliana* has been sequenced, it will be crucial for the research community to have all of the transcriptional units identified. **Yamada *et al.*** (p. 842) used two strategies to provide such a map. They produced both a set of full-length complementary DNAs and a set of high-density oligonucleotide arrays that "tiled" the entire genome. Using these tools, evidence was produced for the expression of previously hypothetical genes. In addition, a large fraction of genes were seen to have antisense expression. Finally, the work revealed the existence of transcriptional hotspots within centromeres, the region of the chromosome responsible for faithful chromosome segregation during cell division.

Unmasking Silenced DNA in Neurons

Methylation of DNA is thought to be important for long-term silencing of gene expression. **Chen *et al.*** (p. 885) and **Martinowich *et al.*** (p. 889) now show that DNA methylation is a critical regulator of acute neuronal gene expression in response to depolarization (see the Perspective by **Klose and Bird**). In both studies, MeCP2, a protein that specifically binds methylated DNA, associated with the promotor of the gene encoding brain-derived neurotrophic factor (BDNF) in unstimulated neurons, but was released once depolarization-induced signaling occurred. **Chen *et al.*** show that such release correlates with increased expression of the *BDNF* gene and appears to be associated with regulated phosphorylation of MeCP2. **Martinowich *et al.*** suggest that activity-dependent expression of the *BDNF* gene may result from release of a repression complex that contains MeCP2, histone deacetyase 1, and the corepressor mSin3A. The proposed role of MeCP2 in learning and memory may help to explain why mutations in MeCP2 leads to Rett syndrome, a human disease that causes abnormal brain development and progressive neurological decline.



889

CONTINUED ON PAGE 743

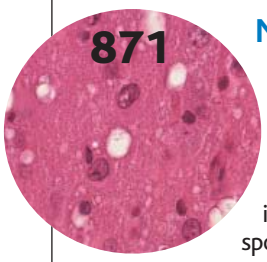
CREDITS: (TOP TO BOTTOM) RIDGWELL *ET AL.*; MARTINOWICH *ET AL.*

Predation Drives Lemming Population Dynamics

Within the study of rodent population dynamics, it has been long debated whether predator-prey dynamics alone can account for high-latitude cycles in lemmings and voles, or whether dynamics of food plant availability and quality plays a key role in cycles. **Gilg *et al.*** (p. 866; see the Perspective by **Hudson and Bjørnstad**) bring together a remarkable set of long-term data (15 years, or three full 4-year cycles) for collared lemmings and their four vertebrate predators (stoat, fox, owl, and skua) in their 75-square-kilometer study site in Greenland. No evidence was found for food limitation of the lemmings at this site, even at peak population densities.

Making Bigger DNA Helices

Many nucleic acid analogs have been reported, but most of these represent modifications of the DNA backbone. **Liu *et al.*** (p. 868) describe a genetic pairing system with the bases expanded by the width of a benzene ring (or about 25%). Expanded adenine and thymine bases paired with the appropriate unmodified bases through normal hydrogen bonding. The expanded-diameter double helices were more stable than the Watson-Crick helix, probably because of enhanced base stacking. Pairing of four expanded bases with the four natural bases could potentially yield eight base pairs for information coding.



Neurons Hold the Key

The prion protein, PrP, is universally expressed in multiple cell types and is linked to the establishment and propagation of so-called prion diseases, such as new variant Creutzfeldt-Jakob disease in humans and bovine spongiform encephalopathy in cattle. **Mallucci *et al.*** (p. 871; see the news story by **Couzin**) show that neuronal PrP depletion in mice with established neuroinvasive prion disease reverses early spongiform neuropathology, prevents neuronal loss, and completely halts progression to clinical disease. Thus, even in a background of cells still producing the pathological form of PrP, neurons lacking PrP do not undergo the pathological changes associated with prion disease.

Organ Transplantation: Extending a Brief Encounter

The need for improved specificity and lower toxicity in immune-suppressive drugs for organ transplantation has focused attention on the intracellular signaling pathways that regulate the immune responses of lymphocytes. Among these, the Janus kinase 3 (JAK3) has particular potential, because it mediates signals by several key cytokines, which each utilize a common gamma chain. **Changelian *et al.*** (p. 875) developed a highly selective, low-molecular-weight inhibitor of JAK3 that significantly extended organ allograft survival in primate and mouse organ transplant models after oral administration.

Perceptions and Illusions

Imaging studies have revealed the underlying causes of two different illusions (see the Perspective by **Eysel**). A motion stimulus (for example, a moving pattern on a screen) can cause the perceived location of a nearby stationary stimulus to be shifted toward the direction of motion. Using functional magnetic resonance imaging, **Whitney *et al.*** (p. 878) found that in early visual processing areas, the retinotopic location of the region activated by the stationary stimulus shifts in the opposite direction of motion. In contrast to what one would have predicted, the activation site shifts in the opposite direction to the perceived location. In the tactile funneling illusion, stimulating the tips of two adjacent fingers results in the perception of a single, stronger point of stimulation between the two fingers. **Chen *et al.*** (p. 881) used optical imaging to investigate the neural basis for this illusion in the primary somatosensory cortex (area SI). Consistent with the perception, area SI contains a focus of activity at the perceived site, which is greater than in control conditions, whereas neural activity represented at the two actual stimulation sites is less than when either site is stimulated alone. Thus, the location of the neural focus in SI explains the perceived location of the illusion, whereas the pattern of increases and decreases of activity across the three sites (two actual, one illusory) explains the perceived intensity.

CREDIT: MALLUCCI *ET AL.*