ECOLOGY

Collecting Coral

The global decline in reef-building corals and the many threats to coral reefs are well documented, but proven practical solutions that prevent coral loss and increase reef resilience are lacking. Marine protected areas are a potential tool to enable local and regional managers to conserve corals. Selig and Bruno have now confirmed that marine protected areas can delay the loss of coral cover from tropical reef systems relative to unprotected areas undergoing reductions in coral cover. Differences were observed among regions in the effectiveness of marine protected areas, probably due to the differences in the locations of establishment as well as regional enforcement, but, on the whole, the protected areas tended to show a reduced decline in coral. Marine protected areas needed time to stabilize and become effective—most did not prevent coral loss until they were at least 5 to 15 years old. Thus, long-term benefits can be obtained by the establishment of protected areas. — LMZ

PLoS ONE 10.1371/journal.pone.0009278 (2010).

GEOCHEMISTRY

Split When the Going Gets Hot

When magma within Earth cools, minerals precipitate according to their crystallization temperatures. Because the isotopic distribution of elements within the resultant mineral grains is assumed to be relatively stable at high temperatures, this information has been used to estimate the composition of the parent melt and also to deduce the region in Earth's interior where the grains formed. However, Huang *et al.* observed mass-dependent calcium isotope fractionation between two different silicate mineral phases (orthopyroxene and clinopyroxene) in peridotite rocks from the upper mantle. This fractionation, which was previously observed only at low temperatures between seawater and calcite, probably depends on Ca-O bond strengths and not kinetic processes related to isotopic diffusion. These measurements provide a robust estimate for Ca isotope composition of the upper mantle, which can be used to make comparisons of isotopic abundances between other former melts in the solar system, such as the Moon and meteorites. — NW

Earth Planet. Sci. Lett. 10.1016/j.epsl.2010.01.042 (2010).

ASTRONOMY

Bursting Expectations

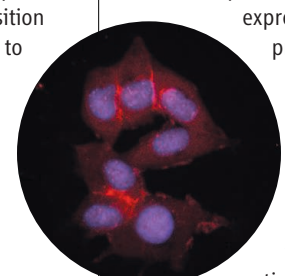
The gamma-ray burst GRB 090423 is the most distant astronomical object known. Chandra *et al.* detected its radio afterglow using the Very Large Array radio astronomy observatory. In combination with previous x-ray and infrared measurements, the data imply that the amount of energy released by GRB 090423 and the properties of its afterglow are not sufficiently different from those of less distant gamma-ray bursts to implicate a different type of progenitor star. Thus, even though GRB 090423 occurred only 630 million years after the Big Bang, there is no reason to believe its progenitor star belonged to the initial generation of metal-free stars, which are thought to have been brighter, hotter, and more massive than stars today. Regardless of distance, there is evidence that long-duration gamma-ray bursts occur preferentially in low-metallicity environments, as expected from stellar evolution theory. Using the Keck telescope, Levesque *et al.* acquired spectra of the host galaxy and explosion site of GRB 020819—an unusual long-duration gamma-ray burst originally detected in 2002, with no optical afterglow—and their data imply that the burst did occur in a high-metallicity environment. — MJC

Astrophys. J. **712**, L31; L26 (2010).

CELL BIOLOGY

p75 Goes Nuclear

The p75 neurotrophin receptor binds to all members of the neurotrophin family, which promote differentiation, growth, and survival of diverse cell types in the nervous system. On its own, p75 can also produce signals, which appear to require its proteolysis by a presenilin-dependent γ-secretase. In the case of the receptor Notch, such cleavage produces an intracellular domain (ICD) fragment that moves to the nucleus to regulate gene expression. Parkhurst *et al.* present evidence that the p75 ICD may similarly regulate gene expression. A fusion protein was produced with p75 linked to a transcriptional activator that would cause expression of green fluorescent protein (GFP) if the cleaved fragment of the receptor reached the nucleus. Production of GFP was indeed detected in human cells transfected with the receptor construct, which was prevented by inhibition of γ-secretase. In PC12 cells (a cell line with neuronal characteristics), the endogenous p75 protein ICD fragment was detected in the nucleus.



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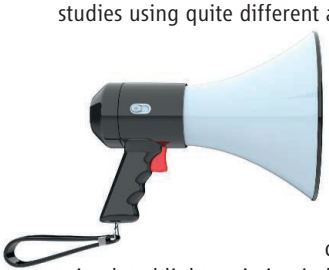
Furthermore, the p75 ICD associated with the promoter of the cyclin E1 gene when PC12 cells were treated with nerve growth factor for 3 hours. The ICD can interact with multiple intracellular proteins and may thus influence numerous signaling events. Thus, a primary action of the p75 ICD (and possibly fragments of the related receptors) may be direct regulation of transcription in the nucleus. — LBR

J. Biol. Chem. **285**, 5361 (2010).

PHYSICS

A Coherent Sonic Boom Box

This year marks the 50th anniversary of the invention of the laser, which now has an extraordinarily diverse and growing range of applications, from consumer electronics to the highest-precision metrology. Two independent studies using quite different approaches now report successful coherent sound wave amplification, in which mechanical vibrations are produced by processes that mimic stimulated light emission in laser operation. Grudinin *et al.* use a coupled optomechanical resonator system in which excitation by an optical laser induces mechanical oscillations. Above a critical threshold power of the pump laser, amplification and gain of the mechanical oscillations are observed, producing coherent sound from radio to microwave frequencies. Beardsley *et al.* use a superlattice semiconductor system to which an electric field is applied. Precise tuning of the superlattice structure produces coherent sound at several hundred GHz, in range of the clothes-penetrating THz scanners being rolled out at airports. The ability to produce intense and coherent beams of sound in these frequency ranges should find immediate application in the imaging technology sector. — ISO



Phys. Rev. Lett. **104**, 83901; 85501 (2010).

CANCER

Enzymes Adopt New M.O. in Cancer

Identification of genes that are recurrently mutated in human tumors can potentially lead to new cancer treatments, but first we need to understand how the mutations alter the biochemical activity of the encoded protein and contribute to tumor development and progression. The recent discovery that a subset of human brain tumors harbor mutations in the gene encoding isocitrate dehydrogenase 1 (IDH1) has focused interest on this cytosolic metabolic enzyme and its mitochondrial homolog IDH2. Mutations in these genes have been detected in acute myeloid leukemia that always alter the same amino acid in the enzymes' catalytic sites and are always present in heterozygous form, suggesting that tumor cells contain "normal," as well as mutant, versions of the enzymes. Ward *et al.* and Dang *et al.* now show how the tumor-associated mutations alter the biochemical activity of IDH1 and IDH2. The mutant enzymes not only lose their normal activity (the conversion of isocitrate to α-ketoglutarate) but also acquire a new activity: the reduction of α-ketoglutarate to 2-hydroxyglutarate. Indeed, elevated levels of 2-hydroxyglutarate were detected in human tumor samples that contained either IDH1 or IGH2 mutations. Determining how 2-hydroxyglutarate, a so-called "oncometabolite," contributes to the biology of brain tumors and leukemia will be an important next step in moving from mutant gene to therapy. — PAK

Cancer Cell **17**, 1 (2010); *Nature* **462**, 739 (2009).

DEVELOPMENT

Methylation Map

Epigenetic modification, such as DNA methylation at CpG sequences, functions in normal cell differentiation and development. Dysregulation of DNA methylation is associated with altered gene expression and disease. Now Laurent *et al.* have used bisulfite sequencing technology and bioinformatices to identify whole-genome DNA methylation maps with single–base pair resolution for three cell types at various stages of differentiation: human embryonic stem cells (hESs), neonatal fibroblasts, and a fibroblast derivative from hESs. These maps were compared to those of mature peripheral blood mononuclear cells. Methylation of CpGs, and to a lesser degree CpAs, was higher in the gene body and lower in promoter regions. At areas of higher DNA methylation, there was depressed binding of histone H3 trimethylation. Furthermore, the pattern of methylation around exons and introns suggests a possible role in regulation of mRNA splicing. Overall, methylation decreased with differentiation progression; however, many differentially methylated regions, some of which are key pluripotency and differentiation-associated genes, increased methylation during differentiation. — BAP

Genome Res. 10.1101/gr.101907.109 (2010).

Methylation Map

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DOI: 10.1126/science.327.5971.1305-c