EDITORS' CHOICE

edited by Gilbert Chin

ECOLOGY/EVOLUTION

A Forest Sere

Tropical rainforests, despite their locations, can suffer from drought, and during severe droughts, a rainforest can even become susceptible to fire. Evidence of past forest fires, in the form of charcoal deposits, can be found in many parts of the humid tropics, but there has been little documentation of the effects of such catastrophic disturbances on the ecology of tree species.

Van Nieuwstadt and Sheil have examined the effects of drought and fire in a lowland rainforest in East Kalimantan, Indonesia, by censusing live and dead trees in adjacent burned and unburned areas. The drought of 1997–1998, one of the most severe ever in a tropical rainforest, was followed by fire. The consequences of the drought were more pronounced in the larger, mature trees: Nearly half of the trees with trunk diameter >80 cm were lost, whereas less than one-quarter of trees <20 cm in diameter died. In contrast, fire killed smaller saplings disproportionately: Almost no individuals <10 cm in diameter survived. Some species (particularly dipterocarp and palm) withstood fire better than others. In sum, drought and fire both reduce biomass, alter patterns of forest dynamics by removing reproductive individuals and regenerating saplings, and change the relative abundances of species, but do so in different ways. — AMS

Views from within (inset) and above the forest, showing the effect of drought on larger trees.

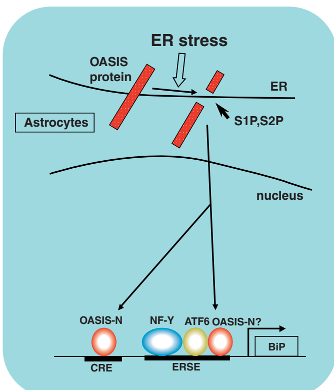
J. Ecol. **93**, 191 (2005).

CELL BIOLOGY

Astrocytes and Stress

Eukaryotic cells sense stressful conditions, such as the accumulation of abnormal proteins, in their endoplasmic reticulum (ER) by means of the aptly named unfolded protein response (UPR). As a protective mechanism, the UPR system activates the expression of damage-control proteins, such as the ER protein-folding chaperonin BiP.

Kondo *et al.* have determined that astrocytes of the central nervous system employ an ER stress transducer called old astrocyte specifically induced substance (OASIS). OASIS is an ER transmembrane protein in the same transcription factor family as CREB/ATF. When astrocytes were treated with agents that disrupt protein glycosylation or calcium homeostasis in the ER, OASIS was cleaved, and its N-terminal domain moved into the nucleus. This fragment stimulated transcription by activating a promoter with known ER stress-responsive elements (ERSEs). ER stress induced OASIS expression in astrocytes but not in neurons or fibroblasts. Knockdown of OASIS expression reduced the expression of BiP, whereas OASIS overexpression conferred resistance to cell death in response to ER stress. Thus, astrocytes may utilize a cell type–specific mechanism to survive stress induced by ischemic or hypoxic conditions. — LDC



Pathway for OASIS activation of the UPR.

Nature Cell Biol. 10.1038/ncb1213 (2005).

CHEMISTRY

Xe as a Ligand

For more than 20 years, liquid xenon (Xe) has been used as a solvent for studying highly reactive transition metal compounds that attack solvents usually thought of as inert, such as alkanes and fluorocarbons. Nevertheless, infrared spectroscopy showed that in some cases, the Xe reacted transiently with the metal centers, binding with an enthalpy comparable to that of a hydrogen bond. Ball *et al.* have characterized a rhenium (Re)–Xe linkage directly by low-temperature nuclear magnetic resonance (NMR) spectroscopy. They prepared a Xe solution of (^{i}PrCp)Re(CO)$_2$PF$_3$ (where ^{i}PrCp is isopropylcyclopentadienyl) and induced CO loss by ultraviolet irradiation through an optical fiber inserted into the sample probe. The appearance of a ^{129}Xe NMR signal, shifted more than 700 parts per million upfield from the free solvent, confirmed that a Xe atom was coordinated to the unsaturated Re center, and further evidence came from nuclear spin coupling of the bound Xe to the PF$_3$ ligand, observed via ^{31}P and ^{19}F NMR spectra. The compound persists for hours in liquid Xe at –110°C. — JSY

Proc. Natl. Acad. Sci. U.S.A. **102**, 1853 (2005).

IMMUNOLOGY

Arresting Connections

Our T cell repertoire is individually tailored by positive selection, during which developing thymocytes are vetted for their ability to interact appropriately with self peptides bound to major histocompatibility complex proteins. Using two-photon microscopy, Bhakta *et al.* scrutinized the calcium concentration and motility of thymocytes undergoing positive selection. To maintain the intricate thymic stromal environment, thymocytes were labeled with a dye and introduced into slices of intact thymic tissue. Under conditions in which positive selection did not take place, thymocytes wandered about in much the same way as naïve lymphocytes have been observed to do in lymph nodes. However, this behavior altered in positive selection environments, with thymocytes slowing down considerably and prolonging their interactions with cells of the thymic stroma. Furthermore, these thymocytes displayed increased oscillations of intracellular calcium, indicative of cellular activation. Interruption of Ca^{2+} signaling

CONTINUED ON PAGE 819

CREDITS: (TOP) VAN NIEUWSTADT; (BOTTOM) KONDO *ET AL., NATURE CELL BIOL.* 10.1038/NCB1213 (2005)

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was sufficient to restore motility to the thymocytes, suggesting that Ca^{2+} is induced to promote positive selection, most likely by modifying the expression of genes that favor interactions with the thymic stroma. — SJS

Nature Immunol. **6**, 143 (2005).

MATERIAL SCIENCE

Primarily White

For organic light-emitting devices (OLEDs), white light emission has been achieved through the complex and tailored fabrication of multilayer devices either by evaporative or spin coating deposition, or by the blending of two blue-light emitters whose interactions give rise to an exciplex state. In all of these cases, the purity of the white light depends on the quality and concentration of the various species, and generally is a function of the applied voltage.

Mazzeo *et al*. have fabricated an OLED that requires only a single layer of material to generate white light by using an oligothiophene compound. As single molecules in solution, this compound has an intrinsic blue-green emission, whereas in the solid phase, it also produces a red-shifted emission, as crosslinked dimers form. Optical measurements on thiophene compounds that did not form dimers did not show a red-shifted emission spectrum. When wired into a device, the oligothiophene showed electroluminescent emission spectra similar to its photoluminescence, but with a more intense red-shifted peak, leading to the emission of white light (superposed blue-green and red emissions). The intensity of the output in air was similar to that of the best multilayer OLEDs, indicating that this material may find use in general lighting applications. — MSL

Adv. Mater. **17**, 34 (2005).

BIOMEDICINE

Being Sensible About Cholesterol

As a recent advertising campaign reminds us, high cholesterol cannot be blamed solely on our unhealthy diets— the genes we inherit play a role as well. Analyzing a large multiethnic population in Texas, Cohen *et al*. found that individuals with exceptionally low levels of low-density lipoprotein cholesterol (LDL-C), or bad cholesterol, were far more likely than average to carry nonsense mutations in a gene called *PCSK9*; these mutations were found almost exclusively in African-Americans.

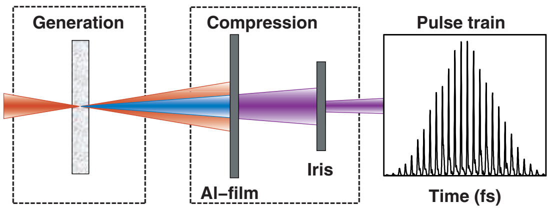
Missense mutations in *PCSK9* had previously been identified as the cause of a rare inherited disorder characterized by extremely high cholesterol levels. The *PCSK9* product is a serine protease (proprotein convertase subtilisin kexin 9), and an independent study of cultured human liver cells describes its role in cholesterol metabolism. By comparing the properties of cells overexpressing the wild type and a catalytically inactive form of the protease, Maxwell *et al*. conclude that PCSK9 accelerates the degradation of a protein that is a key determinant of plasma LDL-C levels, the LDL receptor. — PAK

Nature Genet. **37**, 161 (2005); *Proc. Natl. Acad. Sci. U.S.A.* **102**, 2069 (2005).

PHYSICS

Getting Attosecond Pulses into Shape

The ionization of atoms by intense infrared laser pulses produces light that spans the frequency spectrum from the ultraviolet to soft x-rays. Because this broadband output is made up of many harmonics of the central emission frequency, it should be possible to produce light pulses of several tens of attoseconds in duration. However, not being able to harness the output light has meant that the pulses tend to be several hundreds of attoseconds instead. López-Martens *et al*. show that by compressing and spatially filtering the output light, they can effectively control the phase and amplitude of the attosecond pulses and reduce the length of the pulses to just 170 attoseconds. Such controlled pulses and trains of pulses should provide the precision tools necessary to probe some of the fastest electronic processes, such as the dynamics of atomic excitations and electron orbits. — ISO



Schematic of the experimental design.

Phys. Rev. Lett. **94**, 033001 (2005).

CREDITS: LÓPEZ-MARTENS *ET AL*., *PHYS. REV. LETT*. **94**, 033001 (2005)