CHEMISTRY

## Chloramine Complexities

Chloramine is a comparatively recent weapon in the ongoing battle to eliminate harmful microorganisms from drinking water supplies. Though its disinfecting properties are straightforward, the concomitant generation of ammonia as a byproduct can give rise to a complex web of downstream chemistry that remains an active area of study. One important reaction is microbial nitrification, or oxidation of the ammonia to nitrite and nitrate, which also lowers the water's pH by acid production. Zhang *et al.* have systematically explored the efficiency of nitrification in plumbing pipes of differing compositions—polyvinyl chloride (PVC), copper, lead, and brass—at various pH and phosphate levels. They found that relative to PVC, copper inhibited nitrifier growth, whereas lead enhanced it (probably through reductive cycling of nitrate back to ammonia via lead corrosion). Brass initially resisted nitrification activity, but then shifted its behavior after ~120 days, as the efficiency of copper leaching from the alloy diminished. A perhaps counterintuitive consequence of this reaction web is that PVC pipes may ultimately cause more metal ion leaching into the water stream than copper pipes, as the acid byproducts of nitrification degrade brass valves and faucets. — JSY

*Environ. Sci. Technol.* **42**, 10.1021/es702483d (2008).

ECOLOGY

## Frogs Leap to Extinction

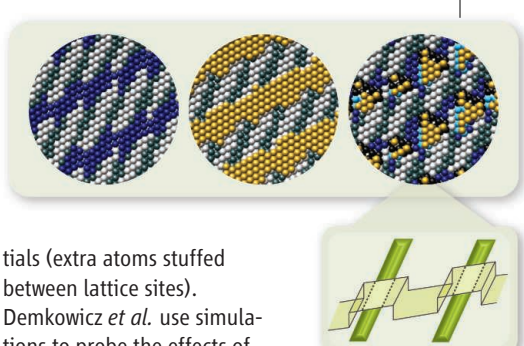
The causes of recently documented declines in frogs since the 1980s have been hotly debated. One vigorously promulgated hypothesis is that the decline has been triggered by climate change, which has promoted virulence in a previously saprophytic fungus. An orthogonal view is that the decline reflects the spatiotemporal spread of an invasive fungal disease. In either scenario, the fungus is *Batrachochytrium dendrobatidis*, which colonizes frog skin and suffocates the amphibians. The declines have been particularly noticeable among the charismatic harlequin frogs of Central and South America. Lips *et al.* have developed a technique to analyze the unavoidably incomplete frog census data (due to infrequent sampling, remote habitats, and sociopolitical challenges) and see wavelike progressions of population falloffs that look very much like the spread of an invasive pathogen originating from three source locales. They categorically found no relation with climate change; indeed, the fungus does best at altitudes where conditions are cool and moist. — CA

*PloS Biol.* **6**, e72 (2008).

MATERIALS SCIENCE

## An Extended Jog

Radiation striking crystalline materials can damage their structure and related properties by generating vacancies (missing atoms) or interstitials (extra atoms stuffed between lattice sites). Demkowicz *et al.* use simulations to probe the effects of adding or removing atoms in copper-niobium multilayer nanocomposites. Two flaw-free interfaces can form between the Cu and Nb. The first occurs from the joining of the face-centered cubic Cu {111} plane and body-centered cubic Nb {110} plane. The second requires a straining and rotating of the Cu {111} to make it about 0.5% less dense in its interfacial area ($Cu^{\alpha}$). Under strain, screw and edge dislocations can form in the various layers, but of particular note, the screw dislocations can sit either at the Cu-Nb interface, or can shift into a Cu-$Cu^{\alpha}$ interface. Thus, there are pathways for defects to move from the Nb into the Cu, for example. When an atom was removed from or added to the Cu layer, the authors found that instead of generating a localized defect, the atoms would reconstruct to form an extended jog (shown at left) that interacted and annihilated with existing screw dislocations. The efficient defect recombination suggests that materials designed to have similar interfaces to the Cu-Nb system could be useful for limiting damage from radiation exposure. — MSL



*Phys. Rev. Lett.* **100**, 136102 (2008).

MOLECULAR BIOLOGY

## Not an Open and Shut Case

Eukaryotic cells have evolved a complex machinery to ensure a precise and equal segregation of their chromosomes during cell division. At the center of this machine is the kinetochore, a large multiprotein complex found in the centromeric region of each chromosome. Kinetochores bind to the microtubules that pull replicated chromosomes apart bodily, giving one each to the daughter cells. Centromeres, and kinetochores too, are specified epigenetically—that is, not directly from signals in the underlying DNA. In order to manipulate the epigenetic state of kinetochores, Nakano *et al.* have constructed a human artificial chromosome (HAC) bearing a kinetochore with a permissive protein-binding site at its heart. These artificial kinetochores mimic the behavior of their natural counterparts, but they are completely disrupted—and the artificial chromosome is lost from the cell—when a protein that silences transcription binds to them.

CREDITS (TOP TO BOTTOM): IGNACIO DE LA RIVA; ADAPTED FROM DEMKOWICZ *ET AL.*, *PHYS. REV. LETT.* **100**, 136102 (2008)

The silencing protein nucleates the formation of repressive (or closed) heterochromatin, and it is this epigenetic change that inactivates the kinetochore. Surprisingly, the binding of an activating protein at the same site also interfered with HAC segregation, suggesting that kinetochore function is highly sensitive to the architecture of the chromatin in which it is embedded. — GR

*Dev. Cell* **14**, 507 (2008).

ECOLOGY

## Fire in the Far North

Paleoecological data sets contain historical records of biotic responses to changes in climate. Currently, high-latitude regions are suffering a particularly aggressive regimen of climate change; hence, an understanding of past vegetation dynamics in these regions is especially pertinent. Higuera *et al.* have analyzed pollen records from north-central Alaska and find that a combination of drier climates and shrubbier tundra during the late glacial period 14,000 to 10,000 years ago led to regular fires. Given present-day increases in shrub biomass and temperature, tundra fire activity might increase again, with consequences for vegetation dynamics and carbon cycling. Tinner *et al.* have analyzed pollen and other records from the past 700 years (a period that includes the Little Ice Age of 1500 to 1800 CE) in southern Alaska, and find that temperature fluctuations of 1° to 2°C, together with changes in moisture balance, led to conversions between boreal forest and tundra with concomitant alterations in fire regimes. Taken together, these findings are consistent with models predicting a conversion of tundra to boreal forest as temperatures increase. — AMS

CREDIT: WILLY TINNER

*PLoS ONE* **3**, e0001744 (2008); *Ecology* **89**, 729 (2008).

PHYSICS

## Heralded Photon Purification

Quantum information processing requires techniques for the generation and transportation of quantum data. The use of photons as the carriers of that quantum information, with the data encoded as different polarization states of the light, is particularly appealing because photons are robust against decoherence effects and can be transported over long distances. The photons, however, need to be indistinguishable; i.e., identical and in a pure quantum state. Although techniques exist for the generation for single photons, determining whether they are in fact indistinguishable and pure has generally required a postselection or spectral filtering process that compromises their quantum utility. By careful design of the parametric downconversion process, in which a single photon is divided into two entangled photons, Mosley *et al.* show that restricting the optical modes into which the photon pairs emerge can provide a method for the generation of heralded (by measurement of one member of the pair) indistinguishable single photons of high purity. — ISO

*Phys. Rev. Lett.* **100**, 133601 (2008).



## << Just When You Thought It Was Pseudo…

Approximately 10% of the known protein kinases are thought to be catalytically inactive, and therefore dubbed pseudokinases, because they lack one or more conserved motifs in their active sites. The pseudokinase $Ca^{2+}$/calmodulin (CaM)–activated serine-threonine kinase (CASK) has an altered DFG motif, which would normally bind a $Mg^{2+}$ ion that coordinates the phosphoryl group to be transferred from ATP onto the substrate. CASK is known to bind to synaptic adhesion molecules, including neurexin, and *CASK*-deficient mice exhibit synaptic defects and perinatal death. Mukherjee *et al*. determined the structure of the CaM-kinase domain of CASK and found that it resembles a constitutively active kinase. They also show that a fluorescent ATP analog bound to recombinant CASK in the absence of $Mg^{2+}$ and that adding $Mg^{2+}$ inhibited this interaction. In vitro assays revealed that the CASK CaM-kinase domain exhibited autophosphorylation activity and that $Mg^{2+}$ and other divalent cations inhibited this activity. Finally, overexpression of wild-type CASK in rat hippocampal neurons resulted in increased phosphorylation of neurexin, challenging the idea that pseudokinases act merely as inactive scaffold proteins. — JFF

*Cell* **133**, 328 (2008).

# Not an Open and Shut Case

Guy Riddihough

*Science* **320** (5876), 586-587.
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