edited by Gilbert Chin

OCEAN SCIENCE

Fixed Up

Nitrogen-fixing bacteria supply a large fraction of the nitrate input to the upper layer of the ocean, thereby facilitating biological production in surface waters, but quantifying the global flux of this fixed nitrogen has proven to be difficult. It should be possible to distinguish this avenue of nitrogen input, which occurs in warm stratified water, from the other important route of nitrate delivery—the upwelling of cold nutrient-rich water from below—on the basis of surface water properties.

Coles *et al.* analyze satellite data for a summer phytoplankton bloom in the western tropical North Atlantic and find that ocean color indicative of high values of chlorophyll occurs where anomalies of sea surface height show the presence of warm pools of water. Using a model that incorporates the diazotrophic cyanobacteria *Trichodesmium*, they show that this summertime bloom can be attributed to nitrogen fixation, thereby validating a technique that has the potential to distinguish production fueled by fixation from that caused by upwelling, and hence to quantify the amount of nitrate produced by nitrogen-fixing bacteria on a global scale. This is of particular interest because fixed nitrogen, unlike upwelled nitrogen that comes from the remineralization of dead organisms, can fuel new biological production and thereby remove CO_2 from the atmosphere. — HJS

Geophys. Res. Lett. **31**, 10.1029/2003GL019018 (2004).

NEUROSCIENCE

Fox Hunting

The genomes of humans and nonhuman primates differ by only a few percent, but the consequences are clear: We possess the faculty of language. Although cognitive functions are, as yet, difficult to describe in molecular terms, the linkage of mutations in the transcription factor FoxP2 to deficits in human speech and language has spurred two groups to look at FoxP2 in songbirds, which also display the capacity to modify innate vocalizations. Teramitsu *et al.* and Haesler *et al.* both find evidence for a role for FoxP2 (and possibly FoxP1) in vocal learning on the basis of comparing expression patterns in the brains of male and female zebra finches with those in other birds and animals. Of note is the differential expression in subcortical areas that are known to be involved in the integration of sensory input (song) and programmed motor output (singing). — GJC

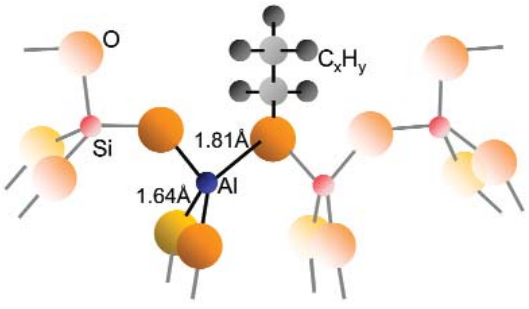
J. Neurosci. **24**, 3152; 3164 (2004).

CHEMISTRY

Catching Zeolites in Action

X-ray techniques for studying heterogeneous catalytic reactions can probe some of the structural properties of species that accumulate over a working active site. Van Bokhoven *et al.* used extended x-ray absorption fine structure (EXAFS) of the Al K edge to determine local structure during the oligomerization of ethylene over zeolite Y (which has a silicon/aluminum ratio of 2.6). Reduction of the NH_4-Y zeolite to the H-Y form created one longer Al-O bond of 1.89 Å. During reaction at 50°C, this Al-O bond shortened to 1.81 Å, and the authors attribute this change to the adsorption of a carbenium ion at the Brønsted acid site on the hydroxyl groups that bridge Al and Si atoms, forming an alkoxy species. At higher temperatures (about 350°C), they observed an increase in the Al-O bond to near that for H-Y that they attribute to desorption of the intermediate. — PDS

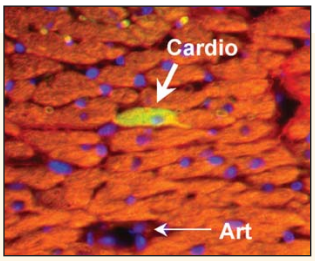
J. Am. Chem. Soc. 10.1021/ja031755j (2004).



A schematic of the high-temperature ethyoxy species on zeolite Y.

BIOMEDICINE

Hearts in Conflict



Double staining for myosin (red) and transgene (green) reveals a bone marrow–derived cardiomyocyte near an unsustained arteriole (Art).

People who suffer heart attacks often go on to develop congestive heart failure. This occurs because heart muscle cells, or cardiomyocytes, have a limited capacity to divide; cells that die during an acute coronary event typically are replaced by scar tissue rather than by new healthy cells. A recent study showing that bone marrow stem cells injected into the damaged hearts of living mice differentiated into cardiomyocytes and improved heart function was met with great excitement and prompted clinical trials of the procedure.

Now, data from two independent laboratories raise questions about the earlier mouse study. Using highly sensitive labeling methods to monitor the fate of bone marrow cells injected into damaged or healthy mouse hearts, Murry *et al.* and Balsam *et al.* find no evidence that these donor cells differentiate into cardiomyocytes. Although neither study rigorously addresses the therapeutic potential of the procedure, the results indicate that any functional improvements that might be seen in the clinical trials are unlikely to be due the cell differentiation mechanism originally proposed. — PAK

Nature **428**, 10.1038/nature02446; 10.1038/nature02460 (2004).

CHEMISTRY

Enhanced Dyeing

Traditional methods for dyeing wool use elevated temperatures that damage the fibers and require absorption enhancers that create pollution concerns. The dyeing and diffusion properties of the wool fibers are governed by the internal wool lipids that hold the cells together, and thus an understanding of how the dyeing process changes these structures is key to its optimization.

Liposomes, which consist of a water droplet surrounded by a bilayer of lipids, have been shown to enhance the dyeing process. Martí *et al.* examined the influence of phosphatidylcholine (PC) liposomes on the absorption of two dyes: hydrophilic acid green 25 (AG25) and hydrophobic acid green 27 (AG27). When the PC liposomes were added to the bath, they enhanced the

CREDITS: (TOP) MURRY *ET AL.*, 10.1038/NATURE02446 (2004); (BOTTOM) VAN BOKHOVEN *ET AL.*, *J. AM. CHEM. SOC.* 10.1021/JA031755J (2004)

absorption of AG25 but diminished that of AG27. However, when the fibers were first pretreated with liposomes, dye absorption was increased in both cases. During the dyeing process, polar lipids are removed from the wool. Liposome pretreatment enhanced the release of the polar lipids, and the liposomes were also absorbed into the fibers. The combined change to the wool cell membrane structure is what leads to enhancement of the dyeing process. — MSL

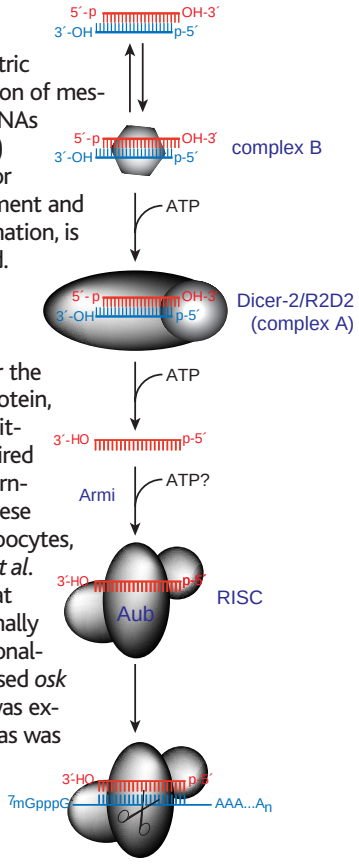
Langmuir 10.1021/la030385+ (2004).

MOLECULAR BIOLOGY

RISC Requires an Armi

RNA silencing underlies a number of important and highly related gene regulatory phenomena: RNA interference (RNAi), posttranscriptional gene silencing, regulation by microRNAs (miRNAs), and so forth. The extent to which these RNA silencing mechanisms are involved in cellular and developmental processes, hinted at in bioinformatics screens for miRNA function, is only gradually becoming apparent, with the latest evidence coming from the screen for genes involved in specifying embryonic axes in *Drosophila* described by Cook *et al*.

This screen identified the gene *armitage* (*armi*) as being required for proper axis formation in the *Drosophila* egg. Revealingly, *armi* was found to encode a protein similar to the helicase SDE3, a known component of RNA silencing in *Arabidopsis*. In oocytes mutant for *armi*, the polarization of the oocyte cytoskeleton, which is essential for the asymmetric localization of messenger RNAs (mRNAs) critical for development and axis formation, is deranged. One of these mRNAs codes for the Oskar protein, which is itself required for patterning. In these mutant oocytes, Tomari *et al*. show that the normally translationally repressed *osk* mRNA was expressed, as was the *stellate* gene, which is normally silenced by RNAi. The link between *armi* and RNA silencing was further demonstrated by showing that extracts from *armi* mutant oocytes were defective in RNAi in vitro because they did not properly assemble the RNA-induced silencing complex (RISC). — GR



A model for RISC maturation.

Cell **116**, 817; 831 (2004).

CREDIT: TOMARI *ET AL*., *CELL* **116**, 831 (2004)

HIGHLIGHTED IN *SCIENCE*'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

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In Support of Dendritic Cell Migration

CD38 is a transmembrane protein with extracellular enzymatic activity that can produce adenosine diphosphate ribose (ADPR) and cyclic ADPR (cADPR). Mice deficient for CD38, which is expressed in both B cells and dendritic cells, are unable to mount an effective T cell–dependent antibody response. Although this was initially suggested to be due to the absence of CD38 on B cells, Partida-Sánchez *et al*. show that *CD38*$^{-/-}$ B cells were capable of responding when transferred by bone marrow transplant to B cell–deficient mice with otherwise normal bone marrow. The B cell response requires T cell priming, which relies on an interaction between T cells and antigen-presenting cells (such as dendritic cells). Although dendritic cells from *CD38*$^{-/-}$ mice were capable of maturing, they did not migrate properly to the sites for T cell interaction (lymph nodes). In vitro, *CD38*$^{-/-}$ dendritic cells displayed defective migration and diminished calcium signaling in response to chemokines, despite having apparently normal expression of the chemokine receptors, and responses in wild-type dendritic cells were blocked by antagonists of cADPR and inositol triphosphate or by chelation of extracellular calcium. Thus, the authors suggest that CD38 enhances calcium mobilization in response to chemokine receptor activation through activation of plasma membrane calcium channels. — NG

Immunity **20**, 279 (2004).