EDITORS' CHOICE

edited by Gilbert Chin

DEVELOPMENT

Adding from Top to Bottom

Drosophila embryos develop as a syncytium (containing 6000 nuclei) and then undergoes cellularization—a specialized type of cytokinesis—which involves the addition of membrane and the formation of 6000 polarized epithelial cells.

Lecuit and Wieschaus describe the delivery of intracellular membrane components first to the apical and then to the lateral surfaces of the forming cells. By labeling the cell surface and tracking particle movements in living embryos, they observed four phases of membrane growth and reorganization. In phase 1 invaginations develop that demarcate the individual cells; in phase 2 these furrows grow slowly, and the nuclei begin to elongate; in phase 3 the furrows extend more rapidly as distinct cells become more obvious; and in phase 4 cellularization is completed. Microtubules are required for membrane delivery, and membrane delivery is required continuously. In addition to creating a polarized distribution of membrane (old at the base and new at the apex) in these epithelial cells, membrane insertion may provide the impetus for furrow growth during cytokinesis. — SMH

J. Cell Biol. **150**, 849 (2000).

PHYSICS

Haven for Quantum Computation

Their potential for solving difficult problems that classical computers cannot, and doing so more quickly, has generated much interest in the development of quantum computers. Just as a noisy environment can break our train of thought, the manipulation of a quantum state can result in its being disturbed or lost during interactions with its own environment—a process known as decoherence. Quantum error correction, in which code words placed in the message tell us how much the system has been distorted, works well for recovering the lost information but exacts a heavy computational cost.

In a decoherence-free subspace (DFS), fragile quantum states are protected from noisy surroundings. However, it was thought that useful calculations requiring manipulation of the quantum state would require moving out of this protected environment. Now, two approaches have been proposed that show that quantum calculations can be performed without the need to leave the DFS. Bacon *et al.* describe a scheme for performing a calculation while staying within the DFS. Beige *et al.* utilize the Zeno effect, the quantum-mechanical equivalent to soccer's juggling the ball, to maintain the system in a DFS while the calculation takes place. Both approaches should be particularly useful for solid-state implementations of quantum computers. — ISO

Phys. Rev. Lett. **85**, 1758 (2000); *Phys. Rev. Lett.* **85**, 1762 (2000).

MOLECULAR BIOLOGY

Benefits of Careful Editing

In eukaryotes, the faithful copying of DNA sequences into RNA transcripts does not in itself ensure that an organism can produce the diverse array of proteins it needs. The initial RNA transcripts, called precursor messenger RNAs (pre-mRNAs), experience a series of tightly regulated processing events, such as the splicing reactions that remove nocoding sequences, or introns. An additional, less common form of pre-mRNA processing is called RNA editing. In one type of editing, adenosine (A) is converted to inosine (I) by an enzyme called ADAR (for adenosine deaminase acting on RNA). In the case of the pre-mRNAs encoding glutamate receptor subunits, this editing is site-specific and results in a mixture of functionally distinct proteins that differ by only one amino acid.

To examine the biological significance of RNA editing, Palladino *et al.* generated strains of the fruit fly *Drosophila* that lacked a functional *ADAR* gene and therefore were incapable of A-to-I editing. Although the flies developed normally, the adults showed profound behavioral defects in motor control, mating, and flight. These deficits increased in severity with age and were associated with neurodegeneration. Thus, RNA editing has a critical role in nervous system function, perhaps as a post-transcriptional means of generating subtle yet functional variation. — PAK

Cell **102**, 437 (2000).

COMPUTATIONAL BIOLOGY

Decoding Noncoding Regions

As the genomes of complex organisms are deciphered, an increasing amount of DNA sequence becomes available, of which only a small fraction (about 3% of human chromosome 22) encodes proteins. Knowledge of the genetic code makes it feasible to recognize the amino acid–coding parts of genes and to perform sophisticated comparisons across species and individuals.

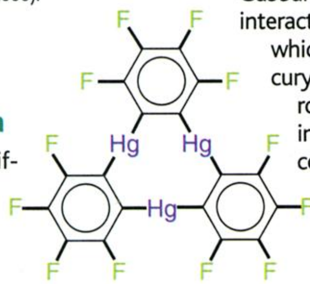
Bussemaker *et al.* are tackling the problem of recognizing gene regulatory sequences, making use of recent data collected from microarray studies. Their algorithm, MobyDick, reveals common motifs in the form of words from the unbroken string of As, Ts ,Cs , and Gs; many of the words in their dictionary correspond to those

CONTINUED ON PAGE 1435

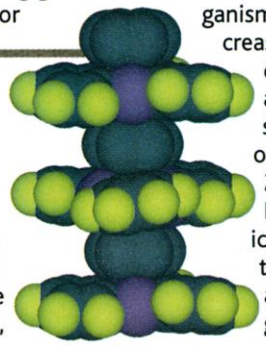
CHEMISTRY

Triangular Benzene Sandwiches

Electron-rich species such as benzene can interact with low-lying unoccupied orbitals of metal centers, for instance, when benzene adsorbs on metal surfaces. Mercury cations and organomercurials are known to have high affinity for arenes. Tsunoda and Gabbai have modeled such surface interactions with the compound **1**, which contains three mercury atoms bridged by fluorophenylene groups. Boiling **1** in benzene yields a supramolecular complex whose crystal structure reveals stacks of benzene molecules alternating with **1** in staggered fashion. Each mercury atom interacts with a π bond of benzene in an "η^2" fashion (an orbital from the mercury atom points into a π bond). The interaction is highly symmetrical in that the benzene molecules are undistorted; it is also weak, in that the C–C bond lengths in benzene remain unchanged. — PDS



1



A benzene filling between slices of **1**.

J. Am. Chem. Soc., in press.

SOURCE: TSUNODA AND GABBAI, *J. AM. CHEM. SOC.*, IN PRESS.

associated with genes whose expression changes during either sporulation or general repression in yeast. — GJC

Proc. Natl. Acad. Sci. U.S.A., in press.

CLIMATOLOGY

Ice-Sheet–Driven Shifts

Rapid shifts from cold to warm to cold climate, called Dansgaard-Oeschger (D-O) events, occurred during the last glacial period with a periodicity of about 1500 years and culminated in massive discharges of icebergs into the North Atlantic once every 5000 to 10,000 years. These discharges, called Heinrich events, left trails of continental debris on the seafloor that are found mostly between the latitudes of 55° and 40° N, and are believed to have had a controlling influence on deep water formation in the North Atlantic and thus on global ocean circulation and climate.

Using two deep-sea cores from east of Greenland, van Kreveld *et al.* assessed the frequency and impact of iceberg production at latitudes north of the main belt of Heinrich debris. They reconstructed surface- and deep-ocean characteristics to show that iceberg production between 46,000 and 22,000 years ago had a periodicity of about 1500 years, like D-O cycles. They also determined how temperature and salinity varied and could be related to changes in ocean stratification and circulation, and how ice rafting events were tied to the surface air temperature changes recorded in Greenland ice. With these data, they construct a detailed relative timeline of a typical 1500-year climate cycle and show how the internal dynamics of the Greenland ice sheet may have acted as the primary pacemaker of the D-O events. — HJS

Paleoceanography **15**, 425 (2000).

ECOLOGY AND EVOLUTION

Clocks and Alternative Lifestyles

North American cicada nymphs (*Magicicada* spp) spend 13 or 17 years underground, depending on species, before emerging synchronously to spend their final few weeks as reproducing adults. This extraordinary lifestyle has been a subject of research for over a century.

Magicicada septendecim ovipositing female (above); adult female on flower (below).

Karban *et al.* have found that cicadas track time by counting the seasonal cycles of vegetation, rather than years. Cicada nymphs feed on root xylem sap, and the amount of nutrient obtained varies according to season. Manipulating the seasonal cycle of host peach trees (double cropping) induced early metamorphosis of nymphs into adults.

Two studies examine speciation. Simon *et al.* report evidence for an "instantaneous" speciation event by a shift in reproductive timing (life cycle) of 17-year cicadas; a 13-year lineage, recently derived from a 17-year lineage, now overlaps geographically with a genetically distinct, pre-existing 13-year lineage. Marshall and Cooley find that male mating calls and female preferences differ between two 13-year species where they overlap, reinforcing reproductive isolation, yet the calls of 13-year and 17-year species are indistinguishable. — AMS

Ecol. Lett. **3**, 253 (2000); *Evolution* **54**, 1326 (2000); *Evolution* **54**, 1313 (2000).

HIGHLIGHTED IN *SCIENCE*'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

Science's stke www.stke.org

A Three-Body Problem

Hedgehog (Hh) is a secreted signaling protein that regulates tissue patterning during *Drosophila* development by binding to Patched (Ptc), its cell surface receptor. Signal transmission is accommodated by another cell surface protein called Smoothened (Smo), and it is thought that a preformed complex of Ptc and Smo inhibits Smo-mediated signaling; that is, when Hh binds to Ptc, a conformational change would relieve Ptc-mediated repression of Smo.

Now, in support of an indirect interaction, Denef *et al.* propose that, in the absence of Hh, Ptc promotes dephosphorylation of Smo through a type 2A protein phosphatase. Binding of Hh to Ptc causes a decrease in the amount of cell-surface Ptc, which may deactivate this phosphatase, resulting in increased phosphorylation of Smo and localization to the cell surface for signal transduction. — LDC

Cell **102**, 521 (2000).

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