EDITORS' CHOICE

edited by Stella Hurtley

BIOCHEMISTRY

A More Stable Leucine Zipper

Incorporation of unnatural amino acids into peptides and proteins modifies their properties in unique ways. New functionalities that do not exist in peptides containing only natural amino acids can be introduced, which may be important in applications from drug design to enzyme catalysis. Tang *et al.* have incorporated a "hyperhydrophobic" modification of leucine, trifluoroleucine, into leucine zipper peptides in bacterial cultures. The extent of leucine replacement was 92% when the bacteria were grown in medium containing only the trifluorinated leucine. The resulting leucine zippers were more stable to denaturation than those of the wild-type protein, while the overall structural characteristics remained the same. In contrast, substitution of leucine by other natural amino acids results in reduced structural stability. In the future, the in vivo incorporation of trifluoroleucine and similar hyperhydrophobic residues may be useful for stabilizing a variety of other hydrophobic protein cores. — JU

Angew. Chem. Int. Ed. **40**, 1494 (2001).

BIOMEDICINE

Bone Remodeling Gone Awry

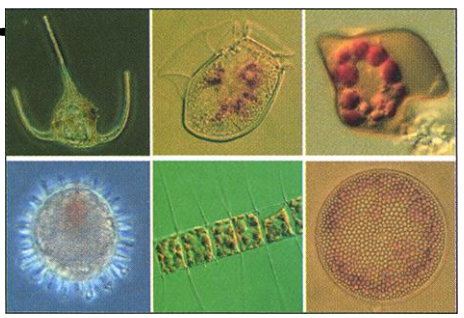
Craniometaphyseal dysplasia (CMD) is a rare skeletal disorder characterized by overgrowth of bones, especially in the head and facial area. Children with this disorder, which was brought into the public eye through the movie *Mask*, are severely disfigured and can also suffer from visual and neurological damage caused by progressive and uncontrolled bone thickening.

Now Reichenberger *et al.* have identified the genetic defect responsible for the autosomal dominant form of CMD. The causative mutations lie in the *ANK* gene, on chromosome 5p, which encodes a multispanning transmembrane protein previously linked in mouse studies to transport of intracellular pyrophosphate (PPi) into the extracellular matrix (see Ho *et al.*, Research Articles, 14 July 2000, p. 265). The authors speculate that alterations in transport of PPi disrupt the finely tuned balance of bone resorption and regrowth (remodeling) that occurs throughout life. Discovery of the importance of this gene in CMD may eventually lead to the development of drug therapies for the disease and for other related skeletal disorders. — PAK

Am. J. Hum. Genet., in press.

ECOLOGY

Limits of Predictability



Phytoplankton species.

SOURCE: BENGT KARLSON

When a number of species compete for only one or two resources, both modeling and experimental studies have shown that the community settles to a stable and predictable species composition. However, when there is multispecies competition for three or more resources, Huisman and Weissing have now shown that this stability and predictability break down. Applying a standard deterministic resource competition model to phytoplankton species, they showed that—for some species compositions—the outcome of competition for more than two resources showed great sensitivity to the initial conditions—one of the hallmarks of chaos. Although ecologists are no strangers to chaos, the levels of unpredictability found in these models pose practical problems; for instance, for water managers trying to predict the occurrence of toxic phytoplankton blooms. — AMS

Am. Nat. **157**, 488 (2001).

ASTROPHYSICS

Producing Planetary-Mass Objects

Models suggest that stars form by the gravitational collapse of a molecular cloud, whereas planets form in circumstellar disks around young stars by accretion. Recent observations have uncovered isolated planetary-mass objects, and neither model is adequate to explain these lonely objects unless some additional assumptions are made. Boss has developed a refined model to create planetary-mass objects through the collapse of a molecular cloud. He includes magnetic pressure effects (which approximate a magnetic field) in a slowly rotating cloud. The cloud starts to collapse due to gravitational forces and heats up at the center. The combination of thermal and magnetic pressures then allows the central region to rebound radially outward, and clumps begin to form where the rebounding material meets the collapsing material. Under these circumstances, clumps as massive as Jupiter can form, and these objects eventually become unstable within the system. These instabilities can lead to the ejection of an object into the emptiness of space. The isolated objects produced do not have enough mass to burn hydrogen like stars or deuterium like brown dwarfs, and they do not form like planets. Thus, the author suggests that they should be called sub–brown dwarfs. — LR

Astrophys. J. **55**, L167 (2001).

IMMUNOLOGY

The Long and the Short of It

Rapid clonal expansion is used to generate sufficient numbers of antigen-specific lymphocytes to deal with pathogens. For T cells, this expansion originates through contact with antigen-presenting cells in the lymph nodes, from where dividing antigen-primed T cells move rapidly to contain infection at peripheral sites.

Two studies, by Kaech and Ahmed and by van Stipdonk *et al.*, now suggest a means by which $CD8^+$ T cells balance the need for antigen-driven expansion with the need for rapid deployment to sites of infection. It might be predicted that dose and length of exposure to antigen would dictate the extent of cell division and differentiation undertaken by naïve $CD8^+$ T cells. Instead, however, a short initial encounter with antigen was sufficient to induce naïve T cells to commit to a differentiation program including a minimum of seven cell divisions, resulting in the acquisition of effector and memory cell characteristics. Similar results were found when the length of antigen exposure was carefully regulated. This programming of $CD8^+$ T cells to expand and differentiate independently of antigen-presenting cells after a fleeting first encounter with antigen makes much immunological sense as a strategy for coping with infection. — SJS

Nature Immunol. **2**, 415; 423 (2001).

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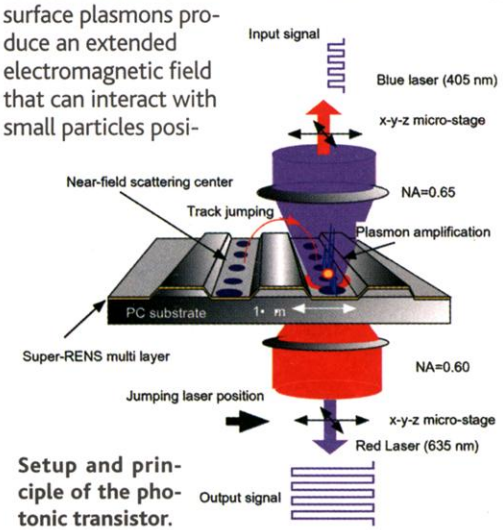
APPLIED PHYSICS

Taking a Shine to Optical Transistors

To produce an all-optical logic architecture will require the development of components analogous to those that drive digital electronics, especially the optical equivalent of the electronic transistor. In such a device, an input signal would be switched on by a second light signal: the gate. Illuminating a metal surface can result in the creation of surface plasmons, a collection of excited electrons at the surface of the metal. The surface plasmons produce an extended electromagnetic field that can interact with small particles positioned in close proximity to produce effective light-scattering centers. Using two lasers, one red and the other blue, focused on the same spot of a fast-rotating optical disk decorated with silver particles, Tominaga *et al.* show that the blue laser light scattered from these centers can be enhanced 60-fold by controlling the incident power of the red laser. Such switching of light with light brings the realization of an all-optical transistor a step closer. — ISO



Setup and principle of the photonic transistor.

Appl. Phys. Lett. **78**, 2417 (2001).

CLIMATOLOGY

Warmer Weathering

Atmospheric CO_2 traps heat through its role as a potent greenhouse gas. Eventually, however, atmospheric CO_2 combines with water to form corrosive carbonic acid, which weathers silicate minerals. These combined effects should help to stabilize climate: As temperature rises, so does the rate of weathering, which should consume CO_2 at a higher rate and decrease its concentration in the atmosphere, thus helping to lower global temperature. This hypothesis is simple to understand but difficult to prove.

Recently Ravizza *et al.* measured the isotopic composition of osmium in bulk marine sediments from around the time of the Late Paleocene Thermal Maximum (LPTM), an episode of unusual warmth 55 million years ago. They found a 220,000-year osmium isotopic excursion coincident with the LPTM that is consistent with an increased rate of weathering of young mantle-derived rocks. This finding suggests that a drawdown of CO_2 caused by more rapid chemical weathering could have helped to arrest the LPTM warming and appears to support the idea that a temperature-dependent weathering-based mechanism can help to regulate climate on time scales of 10^4 to 10^5 years. — HJS

Paleoceanography **16**, 155 (2001).

HIGHLIGHTED IN *SCIENCE*'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

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Slit: Leukocytes Don't Like It Either

Slit proteins were identified as secreted ligands that mediate neuronal repulsion through interaction with members of the Robo family of single transmembrane receptors. Now Wu *et al.* have shown that Slit2 and Slit3 and the Robo1 receptor are expressed in several non-neuronal tissues. In leukocyte migration assays, Slit2 inhibited migration stimulated by the chemokine SDF-1a and by the bacterial peptide *N*-formyl-Met-Leu-Phe (fMLP). This was not due to simple repulsion but represented an inhibition of the attraction signaling mechanism, so that Slit2 was able to inhibit migration when applied to either the chamber containing the cells or the target chamber. Inhibition of SDF-1a–stimulated migration by Slit2 could be reconstituted in human embryonic kidney cells after cotransfection of the chemokine receptor CXCR4, a G protein–coupled receptor (GPCR) and Robo1, which suggests that the two receptors may interact functionally. Thus, the molecular mechanisms of guidance pathways across multiple systems appear to be conserved. Slit2 and Robo1 may represent new avenues of exploration for controlling leukocyte-mediated inflammatory processes. — NG

Nature **410**, 984 (2001).