EDITORS' CHOICE

edited by Gilbert Chin

ECOLOGY/EVOLUTION

Eating and Cleaning

Classically, the shapes and sizes of birds' bills are held to be adaptations to the type of food they eat. Clayton and Walther show that a second selective factor may be operating as well. For 52 species of Peruvian birds, they measured the abundance and diversity of ectoparasitic chewing lice that were infesting the birds' plumage. The abundance of lice was less in birds in which the upper mandible overhung the lower. An overhanging bill appears to be a more efficient tool for shearing lice by pressing them against the host's body. Thus, parasite infestation may be a selective force acting on bills, such that their morphologies might represent a compromise between the optimal shapes for feeding and for preening. — AMS

Pteroglossus marlae **(a toucan) with overhang (top) and *Malacoptila semicincta* (a puffbird) without (bottom).**

Oikos **94**, 455 (2001).

IMMUNOLOGY

NK Cells all in a Row

Natural killer (NK) cells are functionally distinct in their responses to viruses and tumors and in immune regulation. Hence, they have been proposed to mature in a bifurcated fashion analogous to that of type-1 and type-2 T helper cells, which are classified by the profile of cytokines they produce.

Loza and Perussia set out to test the idea that NK cells and T helper cells follow a similar course of differentiation in the acquisition of type-1 or type-2 characteristics. Immature NK cells were isolated from human blood and cultured in the presence of cytokines known to induce either a type-1 or type-2 phenotype. Cell fate was then tracked by using expression of the type-2 cytokine interleukin 13 (IL-13) and the type-1 cytokine interferon γ (IFNγ) as markers for differentiation. The cytokine IL-4 promoted proliferation of NK precursors into immature type-2 (IL-13) NK cells but did not support their development into an intermediate type-0 (IL-13/IFNγ) cell. Instead, this transition was induced by IL-12, which caused these intermediary cells to cease production of IL-13 and to progress to fully functional type-1 (IFNγ) NK cells. Thus, all three phenotypes of NK cell may be related by a linear pathway of differentiation. — SJS

Nature Immunol. **2**, 917 (2001).

GEOPHYSICS

Less is Better

One concern with the safety of the proposed high-level nuclear repository at Yucca Mountain is the risk of a nearby earthquake. This repository is located in the active Basin and Range region of the western United States, an area that has been undergoing broad crustal extension; in addition, a magnitude 5.4 earthquake struck southwest Nevada in 1992. One of several recent geodetic surveys suggested that the region including Yucca Mountain was extending fairly rapidly to the northwest at a rate of nearly 1 millimeter per year across 14 kilometers of the proposed repository. This result also suggests that deformation within the Basin and Range might be episodic. Savage *et al.* have obtained new geodetic results from an extensive array centered on Yucca Mountain and conclude that the deformation is no more than half this amount. — BH

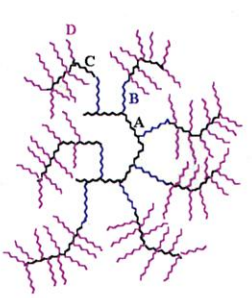
J. Geophys. Res. **106**, 16483 (2001).

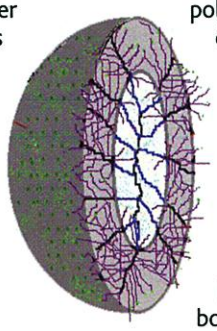
POLYMER CHEMISTRY

Arborescent Polymers

Although most commodity synthetic polymers are composed of linear or randomly branched chains, other architectures are possible. These include "combs" (regularly spaced short branches along the backbone), "stars" (three or more chains extending from a central structure), and "dendrimers" (tree-like branching from a central atom).

Building on their work on stars and combs, Muchtar *et al.* have used a graft-on-graft technique to create tree-like polymer molecules that are similar to but less dense than their dendritic cousins. Starting with polystyrene (PS)–branched poly(chloroethyl vinyl ether) (PCEVE) as the core, successive layers of PCEVE and lithium-terminated PS were added to the molecule. Like dendrimers, the molecules take on spherical shapes, but for the largest polymer created, a cylindrical shape was obtained that the authors believe resulted from their control of the length of the initial PCEVE backbone. By enlarging the length of the first PS graft, they can make molecules that have a dense shell structure surrounding a vacant core. — MSL





Macromolecules 10.1021/ma010429q.

CLIMATOLOGY

Reassessing Rapid Variations

Millennial-scale episodes of rapid climate change occurred throughout much of the latter part of the Pleistocene. These oscillations generally occurred with greater regularity and intensity during glacial periods, which are characterized by the greater volume of the large continental ice sheets. Whether the oscillations depend on other factors, such as insolation, is a question that climatologists have asked since the discovery of these cycles.

McIntyre *et al.* present North Atlantic sedimentary records from the late Pliocene to the early Pleistocene, with ages between 1.93 and 1.75 million years ago. During this period, maximum ice volumes were only one-third to one-half as large as during the late Pleistocene, and glacial cycles occurred every 41,000 years instead of every 100,000 years. Nevertheless, the patterns of iceberg formation and deep-water circulation that existed then share many characteristics with those of more recent records. These find-

CONTINUED ON PAGE 17

SOURCE: (LEFT) DALE H. CLAYTON, PH.D./UNIVERSITY OF UTAH; (RIGHT) MUCHTAR *ET AL.*, *MACROMOLECULES* 10.1021/MA010429Q

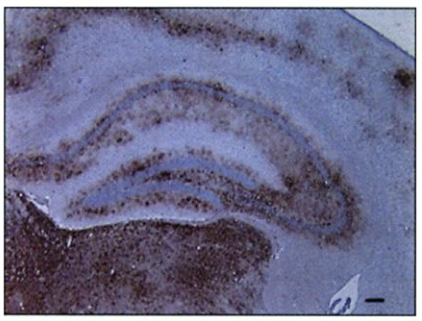
ings suggest that the oscillations also are controlled by forcing external to the ice sheets themselves and not just by internal ice sheet dynamics or by the strongly nonlinear interaction between climate and solar forcing that results from the presence of large ice sheets that form during 100,000-year-long glacial cycles. — HJS

Paleoceanography **16**, 535 (2001).

BIOMEDICINE

Moving the Goal Posts

The transmissible spongiform encephalopathies (TSEs), such as mad cow disease and scrapie, are thought to be caused by aberrations in the expression and conformation of the prion protein (PrP). Disease-inducing forms of the PrP can be transferred from one animal host to another, but the efficiency of disease transmission is affected by the characteristics of the endogenous PrP in the recipient.



Hippocampal PrP (brown) in a P101L mouse inoculated with vCJD.

In examining the species barrier to transmission of three nonmurine TSEs, Barron *et al.* discovered that a single amino acid change (from proline to leucine at position 101) in mouse PrP produced a significant reduction in the incubation period when these mice were challenged with inocula from infected hamster and sheep. The same change, however, extended the incubation time for susceptibility to a human source (a patient with variant Creutzfeldt-Jakob disease) of infectivity. The authors speculate that a structurally flexible region in PrP is particularly important in maintaining the species barrier during TSE transmission. — SMH

EMBO J. **20**, 5070 (2001).

CHEMISTRY

No Thaw Flaw in the Third Law

At the melting point of a substance, the liquid has a higher entropy than the solid. If the liquid is supercooled below the melting temperature, this entropy difference decreases because the liquid has a larger heat capacity than the solid. Usually kinetics takes over and the liquid freezes, but what if the liquid could be taken to absolute zero? As pointed out by Kauzmann, extrapolations of heat capacities have suggested that the molar entropies of the supecooled liquid and the crystal could become equal at a temperature above absolute zero (a positive Kauzmann temperature T_K). In that case, the supercooled, disordered liquid would have negative entropy at absolute zero, in contradiction of the third law of thermodynamics.

Stillinger *et al.* have analyzed both data for real substances (such as liquid helium and some polymers) as a function of temperature and pressure and results from simulations. They pronounce the third law to be in good shape and also find no support for arguments proposing an "ideal glass transition" based on positive T_K values. — PDS

J. Phys. Chem. B. 10.1021/jp011840i.

NEUROPSYCHOLOGY

Hold'em, Fold'em

One of the most widely used tests of deficits in prefrontal cortex (PFC) function (as might occur in patients with brain damage) is the Wisconsin Card Sorting Task (WCST). Test cards must be matched to one of a set of reference cards on the basis of common color, number of items, or the shape of the item represented on the card. Changing the classification criterion tests for two components of executive function: shifting to a new set of rules and monitoring recent events that are held in working memory.

Monchi *et al.* have used event-related functional brain imaging to obtain supporting evidence for the existence of coincident activity in areas within the PFC and the basal ganglia, as would be expected if circuits connecting these areas subserved the executive function. They observed that midventrolateral PFC (Brodmann area 47/12) and the caudate were both active after negative feedback had been given, meaning that a rule change had occurred and thus that set-shifting was required. The middorsolateral PFC (area 9/46) was active after both negative and positive feedback, suggesting that this area was involved in monitoring performance and accessing working memory. The putamen, another part of the basal ganglia, was active during the match made after negative feedback, consistent with a role in executing a novel action. — GJC

J. Neurosci. **21**, 7733 (2001).

CREDITS: BARRON *ET AL.*, *EMBO J.* **20**, 5070 (2001)