EDITORS' CHOICE

edited by Gilbert Chin

GEOCHEMISTRY

Backflushing Mid-continent Basins

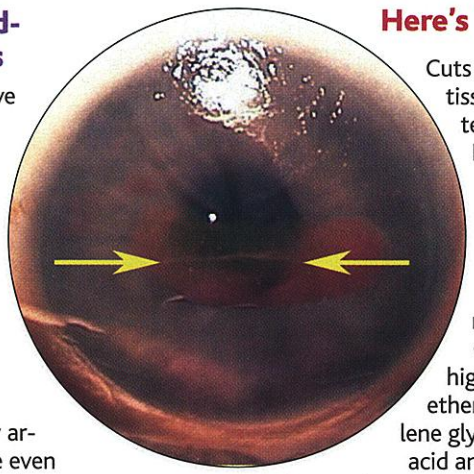
Pleistocene glaciations have had dramatic effects on surface hydrology across North America and Europe, such as the formation of the Great Lakes and the establishment of the courses and flows of most of the major rivers in the Northern Hemisphere. In addition, glaciations have affected deep groundwater flow in many areas of this region and have even influenced the production of natural gas.

McIntosh *et al.* document an example from the midcontinent basins of North America. Several large basins filled with sedimentary rocks formed hundreds of millions of years ago, and these relatively stable formations developed a local system of groundwater flows. Pores in the rocks contained saline groundwater as well as some gas and petroleum. This area was covered repeatedly by continental ice sheets during the past 1 million years. Melt waters from the base of the ice sheet apparently penetrated into some of the basins, which reversed the directions of flows and reduced the salinity in much of the upper ground waters. Black shales along the margins of some basins experienced microbial production of methane in response to the influx. — BH

Geochim. Cosmochim. Acta **66**, 1681 (2002).

CHEMISTRY/BIOTECHNOLOGY

Here's Looking at You, Kid



A sealed laceration (arrows).

Cuts and incisions, even in fragile tissues such as the eye, are often repaired with sutures. Biodegradable adhesives could offer the dual advantages of holding tissue edges together with more evenly distributed pressure and of not requiring manual removal after healing. Carnahan *et al.* synthesized highly branched polyester-ethers composed of poly(ethylene glycol), glycerol, and succinic acid and used these copolymers to seal cuts in enucleated eyes. These molecules, which have a short linear core and two dendrimeric ends, have low viscosity and thus could spread over an eye laceration. Light from an argon laser was used to cross-link the polymer, creating an elastic and transparent film that sealed a full-thickness, 4.1-millimeter corneal laceration against a pressure of about 170 mm of Hg (normal intraocular pressure is about 20 mm of Hg or 2.7 kilopascals). — PDS

J. Am. Chem. Soc. **124**, 5291 (2002).

NEUROSCIENCE

Systems Analysis

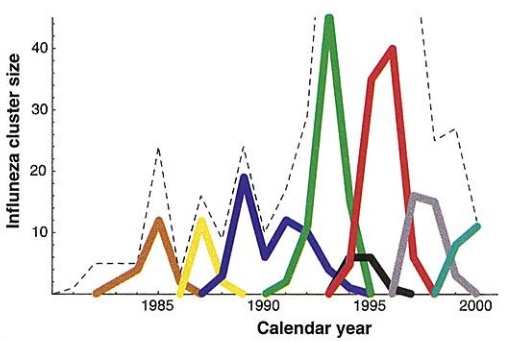
Drugs of abuse, unfortunately, continue to present a scientific challenge in defining their sites and mechanisms of action and in understanding the behavioral consequences. White introduces a set of six reviews aimed at bringing together the prospectors for molecular definition (primarily though not exclusively focused on dopamine and the dopaminergic pathways subserving reward) and the explorers of animal models used for the in vivo investigation of psychomotor stimulants (cocaine), opiates (heroin), and cannabinoids. In their review of the large body of work on cocaine, Everitt and Wolf point to experimental results illuminating the parallels between the acquisition and reinforcement of drug-induced behaviors and various forms of learning. Taken together, these results suggest that drugs of abuse operate not only by augmenting endogenous neural reward systems that normally contribute to learning but also by blocking the influence of inhibitory control systems that would otherwise serve to dampen cellular responses and preserve synaptic plasticity. — GJC

J. Neurosci. **22**, 3303; 3312 (2002).

VIROLOGY

Flu Season Dynamics

The gradual mutation of the hemagglutinin surface protein of influenza A produces immunologically distinct strains (drift variants). If you survive an influenza infection, you gain lasting immunity to that drift variant, but within a few years you become susceptible to influenza again as new drift variants arise. Hence, vaccines have to be updated to be useful.



The eight largest clusters of HA1 sequences (color) and their durations (dotted line; number of total isolates).

An expanding database of sequences allows for the reconstruction of hemagglutinin evolution, and the resulting phylogenies show how the most immunogenic part of the molecule, HA1, periodically accumulates the kind of mutations that will cause amino acid changes. This clustering effect suggests that HA1 is under strong Darwinian selection, and the clusters can be used to predict where a phylogentic branch point may emerge, signaling a new lineage. Plotkin *et al.* have developed a computational technique, complementary to phylogenetic techniques, to predict the course of influenza evolution and thereby offer a tool for updating vaccines. — CA

Proc. Natl. Acad. Sci. U.S.A. **99**, 6263 (2002).

IMMUNOLOGY

A Reservoir of HIV

Latent infection of quiescent $CD4^+$ T cells by HIV represents an obstacle to the treatment of infection by means of highly active antiretroviral therapy (HAART). Viral persistence in these T cells establishes a permanent reservoir of infection that can fuel the reappearance of significant levels of virus upon cessation of therapy.

However, not all virus detected after HAART withdrawal can be accounted for by latent HIV in $CD4^+$ T cells, which led Valentin *et al.* to search for other cells that might act as pools of persisting virus. First, the au-

CONTINUED ON PAGE 1369

CREDITS: (TOP) CARNAHAN *ET AL.*, *J. AM. CHEM. SOC.* **124**, 5291 (2002); (BOTTOM) PLOTKIN *ET AL.*, *PROC. NATL. ACAD. SCI. U.S.A.* **9**, 6263 (2002)

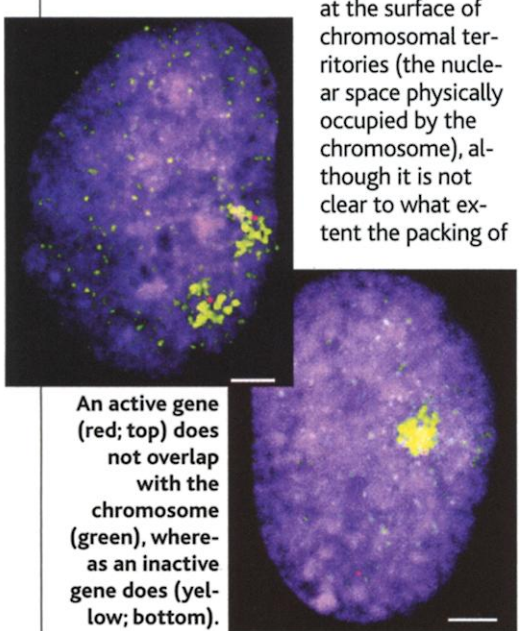
thors identified CD56+ natural killer (NK) cells that expressed CD4 and the chemokine receptors CXCR4 and CCR5, which are known to act as coreceptors for viral entry into T cells. Primary cultures of these NK cells could be infected efficiently with HIV-1 virus, and virus could be obtained from NK cells purified from infected individuals. In longitudinal studies of patients undergoing HAART, NK cells were persistently infected with virus, suggesting that these lymphocytes represent a potentially important reservoir of HIV that is distinct from T cells and other mononuclear cells. — SJS

Proc. Natl. Acad. Sci. U.S.A. **99**, 7015 (2002).

CELL BIOLOGY

Extraterritorial Transcription

It has been thought that, within the nucleus, genes might be localized according to their level of transcriptional activity. That is, active genes would be found predominantly at the surface of chromosomal territories (the nuclear space physically occupied by the chromosome), although it is not clear to what extent the packing of the 30-nanometer chromatin fibers within territories would block entry of the transcription machinery. In order to address these issues, Mahy *et al.* have imaged large stretches of actively transcribing genes in human and mouse cell nuclei using fluorescence in situ hybridization. They observed a conserved spatial organization in which some of these regions were preferentially located at the periphery of chomosomal territories. Nevertheless, not all actively transcribing regions were seen at the periphery, supporting the notion that chromatin packing does not necessarily interfere with access to genes. — SMH



An active gene (red; top) does not overlap with the chromosome (green), whereas an inactive gene does (yellow; bottom).

CREDITS: MAHY *ET AL.*, *J. CELL. BIOL.* **157**, 579 (2002)

J. Cell Biol. **157**, 579 (2002).

MATERIALS SCIENCE

Colloidal Cores and Shells

A number of techniques have been used to create submicrometer colloidal particles that change size in response to external stimuli. Used in applications ranging from microfluidic valves and drug delivery capsules, the colloids typically are made from cross-linked polymer nanogels that undergo large swelling changes in response to changes in temperature or pH. Polymers based on *N*-isopropylacrylamide (PNIPAAm) collapse when heated above 35°C, and side chains based on 2-vinylpyridine (P2VP) swell below a pH of 4.8. By grafting P2VP onto a PNIPAAm backbone, Kuckling *et al.* create a polymer that shows both temperature and pH responses. The PNIPAAm chains were cross-linked to form the core, with the P2VP grafts forming the outer shell, producing two independent means for controlling the size of the nanogels. — MSL

Langmuir 10.1021/la015758q.

CHEMISTRY

A Radical Mechanism

Ziegler-Natta catalysts are used widely in the polymerization of ethylene and other unsaturated hydrocarbons, producing highly ordered polymers with a narrow molecular weight distribution. The mechanism by which they act remains incompletely understood because direct investigation of the active catalyst is difficult; most insights have been gained from studying reaction products. In particular, the role of the cocatalyst, usually an alkyl aluminum compound such as $Al(CH_3)_3$, remains speculative. Addition of $Al(CH_3)_3$ is believed to result in the reduction of Ti and formation of alkyl radicals, whereas for $Al(CH_2CH_3)_3$ no radical formation is expected.

The limited knowledge of the catalytic mechanism has hampered efforts to design new catalysts or optimize existing ones. To address this problem, Risse *et al.* have studied a model Ziegler-Natta catalyst, $TiCl_4$ anchored to a $MgCl_2$ film, with in situ electron spin resonance. Activation of the catalyst by addition of $Al(CH_3)_3$ is shown to involve the formation of alkyl radicals, as expected. The authors conclude that radical formation likely occurs at the interface between the cocatalyst and $TiCl_4/MgCl_2$ after alkylation of the catalyst by ligand exchange. In contrast, activation with $Al(CH_2CH_3)_3$ is not accompanied by radical formation, providing direct support for the previously proposed reaction mechanisms. — JU

Angew. Chem. Int. Ed. **41**, 1517 (2002).