EDITORS' CHOICE

edited by Gilbert Chin

ATMOSPHERES AND OCEANS

Ocean Dumping of CO_2

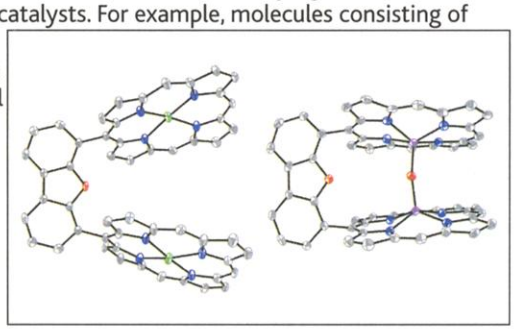
We have made it but we don't want it, so what do we do with it? This question could be asked about any number of the byproducts of better living, although the one with which Caldeira and Rau are concerned is anthropogenic carbon dioxide (CO_2). They suggest moving CO_2 from the atmosphere into the oceans by mimicking the carbonate weathering and dissolution that would occur naturally over thousands of years. Their proposal involves dissolving the CO_2 from exhaust gases produced by power plants in seawater, to make carbonic acid, and then reacting that solution with pulverized carbonate minerals such as limestone to produce a bicarbonate solution that can be released into the ocean. This method would have the advantage of sequestering CO_2 as it is made and should cost only one quarter of the projected expense of injecting CO_2 directly into the deep sea. Still, this process would require a substantial investment in materials, transportation, and infrastructure, and would not remove all of the CO_2 produced at a facility. Nevertheless, in combination with other CO_2 mitigation strategies, it could reduce significantly the impact of burning fossil fuels. — HJS

Geophys. Res. Lett. **27**, 225 (2000).

CHEMISTRY

Induced Fit in a Molecular Pac-Man

Many fundamental oxidation-reduction ("redox") reactions require the transfer of several electrons. In biological systems, such multielectron redox reactions are often catalyzed by enzymes that contain multiple metal atoms. Chemists are devising biomimetic synthetic systems to understand the underlying mechanisms and to develop new catalysts. For example, molecules consisting of two porphyrin units linked by a spacer—cofacial bisporphyrins—can catalyze reactions such as the direct reduction of oxygen to water.



A Pac-Man with porphyrin jaws

J. P. Collman suggested in the mid-1980s that some cofacial bisporphyrins may show a "Pac-Man"-like flexibility that would allow their binding pocket to accommodate reaction intermediates during catalysis in a manner similar to "induced fit" in enzyme catalysis. Now, Deng *et al.* have synthesized cofacial bisporphyrins linked by a rigid dibenzofuran pillar and show that the molecules can open and close their binding pockets with a "bite" of more than 4 angstroms in the presence of suitable ligands. The authors have recently used the biscobalt(II) derivative of the dibenzofuran platform to catalyze the electrochemical four-electron reduction of oxygen to water. — JU

J. Am. Chem. Soc. **122**, 410 (2000).

SOURCE: D. NOCERA, Y. DENG, C. CHANG

CELL BIOLOGY

Buttons and Zippers

Tissue organization requires the formation of specific intercellular junctions in order to create three-dimensional structures in organs and to define internal and external fluid compartments. One type of intercellular junction is known as the adherens junction, which cements neighboring cells together.

Vasioukhin *et al.* have examined the dynamic aspects of junction formation in freshly isolated, primary cultures of epithelial cells and find that the production of junctions is a complex phenomenon involving several morphological stages. First, in response to increased extracellular calcium, each cell extrudes actin-rich projections known as filopodia; neighboring cells are drawn into close contact by these interdigitating filopodia. Then, adherens junction proteins cluster at the tips of the filopodia and serve to button cells together at these contact points. Finally, the actin cytoskeleton is reorganized to zip up the membranes of two cells along the surfaces between adherens junctions. This process provides the driving force to push the cells together tightly to form the junctional seal.

Raich *et al.* have used time-lapse, multiphoton laser-scanning microscopy to visualize these events—extension of filopodia, recruitment of junctional proteins, and sealing of the epithelial sheet—during embryonic development of *Caenorhabditis elegans.* — SMH

Cell **100**, 209 (2000); *Curr. Biol.* **9**, 1139 (1999).

ASTRONOMY

Continuous Source Quasar

Quasars, or quasi-stellar objects, are compact extragalactic sources that emit tremendous amounts of energy. They are thought to be powered by supermassive black holes surrounded by accretion disks. A small fraction of quasars emit at radio wavelengths, and by studying the variability in the radio emissions, astronomers can learn more about the source and the material through which the emissions travel on their way to Earth.

Dennett-Thorpe and de Bruyn observed the most variable (in radio emissions) quasar, J1819+3845 for 96 hours with the new Westerbork Synthesis Radio Telescope multi-frequency front end receivers (www.nfra.nl/wsrt). They found that the variability is due to interstellar scintillation and that the source of the scattering is probably the Local Bubble, close to Earth. After defining the location of the scatterer, the authors inferred that the source region for most of the flux intensity has less than a 16 microarcsecond radius and that the emissions come from a steady source of outward flowing particles. The steady source may be either a cauldron near the active galactic nucleus where the particles are continuously regenerated or a relativistic jet. — LR

Astrophys. J. **529**, L65 (2000).

ECOLOGY

Unintended Consequences

The introduction of alien species is one of the principal threats to biodiversity, especially in island ecosystems, but despite decades of research our understanding of the ecology of invasions is still very patchy. Of the many injurious aspects of species introductions, the phenomenon of hyperpredation is one of the potentially more devastating. Under hyperpredation, populations of indigenous prey species become especially vulnerable to extinction following the intro-

CONTINUED ON PAGE 771

duction of a non-native prey species, because of a concomitant increase in the population of an introduced predator.

Yet the evidence for hyperpredation on islands is largely circumstantial; there are no detailed field studies. Does hyperpredation work in theory? Courchamp *et al.* have modelled the population dynamics of a system involving introduced cats (predator), introduced rabbits (prey), and indigenous birds (prey) in an island context. Their models confirm the destructive potential of hyperpredation on the indigenous species, even in the absence of direct competition between indigenous and introduced prey. This work identifies hyperpredation as a factor that should always be considered in island conservation programs. Just as importantly, it is a step toward a better understanding of the processes that follow invasions of alien species. — AMS

J. Animal Ecol. **69**, 154 (2000).

PHYSIOLOGY

A Skeleton in Leptin's Closet

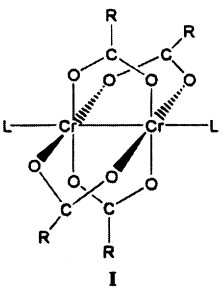
Osteoporosis is one of the most common diseases in the Western world and is increasing in prevalence as the population ages. The development of effective treatments depends on a better understanding of the factors that regulate bone formation and remodeling. Ducy *et al.* challenge the prevailing view that bone mass is largely determined by factors that are produced locally in the bone microenvironment. In studies using mouse models, they find that the hormone leptin is a selective inhibitor of bone formation and that this effect is mediated through the central nervous system. Leptin's effect on bone appears to be independent of its celebrated role in the control of body weight. These results, while offering a new direction for the design of therapies for osteoporosis, also serve as a cautionary note about anti-obesity therapies that are based on stimulation of leptin activity. — PAK

Cell **100**, 197 (2000).

CHEMISTRY

The Short of It

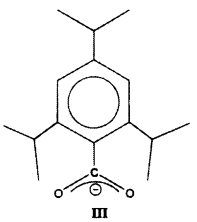
Chromous acetate, first reported in the 1840s, adopts a 'paddlewheel' structure (**I**, where R is a methyl group and the ligand L is water). Elimination of the water ligands should allow an additional bond (presumably a fourth or 'quadruple' bond) to form between the chromium atoms and shorten the bond distance from 2.34 angstroms (Å), but x-ray studies show that the oxygen atoms of the carboxylates play the role of axial ligands. An electron-diffraction study of the water-free gas-phase compound gave a bond distance of 1.97 Å, but theoretical studies and the lack of crystal structures cast some doubt on whether such a short bond would form.



I

A chromium paddlewheel

Cotton *et al.* now report that, with judicious design of the carboxylate ligand (**III**), a species with no axial ligands can be crystallized that has a Cr–Cr bond distance of 1.97 Å. These results should stimulate new theoretical studies of Cr–Cr quadruple bonds, which are among the shortest seen between any pair of atoms relative to their size. — PDS



III

J. Am. Chem. Soc. **122**, 416 (2000).

Science's stke

Cross-talk in Neurotransmitter Receptors

Typically, extracellular signals are communicated from a plasma membrane receptor via second messengers to the target effectors. Liu *et al.* demonstrate that members of distinct neurotransmitter receptor families also may communicate through direct interaction. They report that the type A GABA (γ-aminobutyric acid) receptor, a ligand-gated Cl^- channel, and the dopamine D5 receptor, a G protein–coupled receptor, inhibit each other's signaling activity through direct contact of their cytoplasmic domains. The interaction between the receptors attenuated the stimulation of adenylyl cyclase triggered by dopamine and diminished chloride currents induced by GABA. Analysis of cultured hippocampal neurons suggest that the complex formation is physiologically relevant: the two receptors co-localize, and a D5 receptor agonist decreased $GABA_A$ receptor—mediated current. It remains to be determined whether other co-localized receptors also undergo regulation through such direct protein-protein interaction. — NG

Nature **403**, 274 (2000).

CREDITS: COTTON *ET AL.*, *J. AM. CHEM. SOC.* **122**, 416 (2000).