EDITORS' CHOICE

edited by Phil Szuromi

CHEMISTRY

A Little Water, and It Goes to Pieces

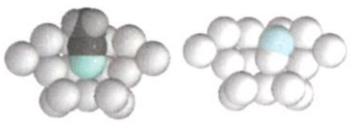
Carbonic acid (H_2CO_3) decomposes rapidly in solution, and was long believed to also be unstable in the gas phase. However, recent experimental studies have succeeded in isolating and characterizing pure carbonic acid; it was even shown that solid carbonic acid could be sublimed and recondensed. Loerting *et al.* now show that water vapor plays a decisive role in the kinetic stability of gas-phase carbonic acid. They have used variational transition state theory, corrected for multidimensional tunneling effects, to study the decomposition of carbonic acid as the isolated molecule or in the presence of one or two water molecules. The reaction barrier is lowered dramatically by additional water molecules, which accelerates the rate of decomposition. Quantum effects also play an important role—the reaction path deviates from the classical minimum energy path as a result of tunneling. The authors conclude that in the absence of water, carbonic acid should be stable over a wide range of temperatures, which increases the likelihood of the detection of carbonic acid in interstellar space. — JU

Angew. Chem. Int. Ed. **39**, 892 (2000).

CHEMISTRY

Trapping Molecules in a Bowl

Even relatively simple molecules can be surprisingly difficult to pin down. Although neutral nitric oxide (NO) and its cation (NO^+) are well known, the nitroxyl anion (NO^-) has been difficult to isolate even as a simple salt (the species known "formally" in some compounds as "bent metal nitrosyls" are still the neutral species). Kawanami *et al.*, in the course of preparing molecular oxides, isolated a vanadium oxide species ($V_{12}O_{32}$) that stabilizes the NO^- anion. Previous work had established that the species $V_{12}O_{32}$ forms a bowl-shaped species bearing four negative charges. The species now isolated has five $(CH_3CH_2)N^+$ cations, and as there is no evidence for reduction of the oxide bowl, the authors conclude that the extra cation balances a negative charge on the NO species. Indeed, a crystallographic study reveals a slightly longer NO bond length, (almost 1.20 angstroms, versus 1.15 angstroms for neutral NO). In comparison with an analogous complex in which neutral acetonitrile (CH_3CN) is trapped in the bowl, NO^- penetrates more deeply and appears to be "stuck" to its inner surface. Although closed molecular oxide cages are known to trap anionic species, this example is unusual in that an open oxide surface has trapped an otherwise unstable species. The NO^- complex is remarkably stable—it survives even after heating up to 90°C under vacuum conditions. — PDS



Cutaway view of trapped molecules.

J. Am. Chem. Soc. **122**, 1239 (2000).

ASTRONOMY

Star Formation: The Current Frontier

Star formation occurs by the collapse of a cloud of dust and gas. Spiral galaxies, which formed from collapsed clouds, have a dense nucleus or bulge dominated by older stars formed by an early, rapid burst of star formation. The spiral arms consist of gas, dust, and younger stars swirling outward away from the center. Many processes may trigger star formation, including gravitational interactions or shock waves from supernovae, but distinguishing between these processes is difficult without gaining more information about the composition and age distributions of stars in the galaxies.

Davidge has begun a survey in the near-infrared wavelength range of the Sc galaxies, the most "open" class of spiral galaxies, with the Canada-France-Hawaii Telescope (CFHT) adaptive optics bonnette (AOB) to determine the stellar structure of the centers of these galaxies and understand star formation processes. This initial study focuses on M33, the Triangulum galaxy, which is the third largest spiral galaxy in the Local Group (after the Milky Way and Andromeda). He has determined that there was a burst of star formation near the nucleus of M33 that occurred between 1 to 3 billion years ago. He also noted a recent episode of star formation in the nucleus, which is somewhat unexpected because M33 does not have a supermassive black hole at its center that might trigger star formation. Finally, he notes that the source of the gas for the recent star formation episode cannot be derived from the disk, which is chemically distinct from the young stars, so the collapsing gas is probably concentrated in the center. These results suggest that star formation is complex and variable, but more observations are needed to distinguish between the possible mechanisms that initiate the collapse. — LR

Checking Out the Stars in M33.

Astron. J. **119**, 748 (2000).

CELL BIOLOGY

Ghosts of Infections Past

The human genome contains numerous human endogenous retrovirus (HERVs) sequences that are relicts of past infections. For some time, there have been worries about the potential threat HERVs pose to xenotransplantation or as carcinogens. However, one of these genomic "fossils" appears to have been adopted by its host for a more benign purpose. A characteristic of the pathology of retroviruses like human immunodeficiency virus (HIV) is their ability to make their host cells fuse together into a syncytium. In retroviral diseases, the viral envelope protein (Env) mediates such cell fusion. HERVs are known to be expressed in the placenta, and the fetal-maternal interface, or syncytiotrophoblast, is a thin layer of fused fetal trophoblast cells.

Mi *et al.* have found a protein with significant homology to Env, which they called syncytin, that is expressed at high levels in the syncytiotrophoblast, placenta, and testis, but nowhere else. A cancerous trophoblastic cell line expressed high levels of syncytin, and recombinant syncytin induced cell fusion in several cell types. Cell fusion could be blocked in a trophoblast cell line by using antibodies against syncytin. Although the evidence looks strong, these

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authors could not rule out that syncytin may be acting in conjunction with another protein to cause syncytiotrophoblast formation, and that such an interaction might be the essential part of the mechanism. The authors suggest that syncytin disregulation may contribute to certain pathologies such as preeclampsia. — CA

Nature **403**, 785 (2000).

PHYSIOLOGY

A Model Athlete

The "catch and release" angler will no doubt disagree with the assertion in the scientific literature that an exhaustively stressed fish requires up to 24 hours for metabolic recovery, as assessed by circulating lactate levels and replenishment of glycogen stores. Milligan *et al.* now resolve this discordance by reexamining the laboratory conditions of measurement. They find that the experimental system of allowing recovering rainbow trout to remain stationary actually serves to trigger a rise in cortisol levels, in contrast to placing the exercised fish within a swim flume for the duration of the recovery period. These swimming fish do not exhibit an increase in cortisol, and their lactate and glycogen levels return to prestress values within 2 hours, as does their blood pH. Thus, post-exercise activity—the "cool down" period—is beneficial and highly recommended. — GJC

Rainbow trout (*Oncorhynchus mykiss*).

J. Exp. Biol. **203**, 921 (2000).

CLIMATOLOGY

Getting Warmer, Cooler, Warmer...

The numerous, brief episodes of warming during the last glacial period, initially identified in Greenland ice cores and called Dansgaard-Oeschger (DO) events, are now known to have occurred throughout the Northern Hemisphere. Ocean Drilling Program hole 893A in the Santa Barbara Basin off the coast of California has emerged as a gold mine of information about the marine expression of the DO events that occurred between 60,000 and 25,000 years ago in that region. Using a variety of data from this core, Kennett and colleagues already have uncovered important clues about how the North Pacific ocean behaved during that period by demonstrating that the sediments contain a record of changes in deep-water oxygenation and planktonic foraminiferal oxygen-isotopic compositions. Now, Hendy and Kennett have provided even more detail about those DO events by measuring planktonic foraminiferal species abundances and using these data to calculate sea surface temperatures. Their results show that surface ocean temperatures changed by 3 to 5°C between cool and warm periods and suggest that North Pacific surface circulation was bimodal. These findings support the idea that climate existed near a threshold between two stable states during much of the last glaciation. — HJS

Paleoceanography **15**, 30 (2000).

Science's stke

Chromatin Regulates CREB Phosphorylation

Chromatin structure influences the transcriptional activity of genes by regulating promoter accessibility to transcription factors and, as Michael *et al.* discuss, by regulating the transcription factors themselves. Cyclic AMP-regulated enhancer binding protein (CREB) is a transcription factor that is phosphorylated by the cyclic AMP protein kinase; this step leads to a transient burst in transcriptional activation followed by an attenuation phase as CREB is dephosphorylated. The CREB coactivator proteins CREB-binding protein (CBP) and p300 both possess histone acetyltransferase activity, which induces changes in chromatin structure and allows productive assembly of the transcriptional apparatus onto the target promoter. Michael *et al.* show that the phosphorylation of CREB and transcription of cAMP-responsive genes can be potentiated by inhibitors of histone deacetylase. Histone deacetylase inhibitors prolonged the length of time that CREB remained phosphorylated, which suggests a chromatin-dependent mechanism for transcriptional attenuation and the influence of promoter-bound nucleosomes on the accessibility of the protein kinase to CREB. — NG

Mol. Cell. Biol. **20**, 1596 (2000).

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