## HIGHLIGHTS OF THE RECENT LITERATURE

# EDITORS' CHOICE

### CLIMATOLOGY

### Long-Term Rain Forecasts

The ability to anticipate multiannual regional rainfall patterns is an important part of water resource planning and management. One factor that regulates the amount and distribution of precipitation in North America is the Atlantic Multidecadal Oscillation (AMO), a cycle of North Atlantic sea surface temperature variability with a period of 65 to 80 years.

Enfield et al. outline the geographical pattern of variability in North American rainfall for the last century. They supplement these findings with river discharge data for two representative hydrological provinces and then compare them to the AMO. During warm phases of the AMO, the United States receives lower than normal rainfall, particularly over the eastern Mississippi Basin. Other areas, however, such as Florida and parts of the Southeast, experience more precipitation. Because the current trend in the AMO is toward higher temperatures, the forecast is for decreased annual rainfall over much of the United States. The nonstationary pattern of the expression of El Niño-Southern Oscillation in North America is found to be connected to the AMO, too. --- HIS

Geophys. Res. Lett. 28, 2077 (2001).

### STRUCTURAL BIOLOGY Marked for Destruction

One of the critical enzymatic mechanisms that regulates progression through cell division is the tagging and degradation of proteins. The anaphase-promoting complex (APC) functions as a ubiquitin ligase and attaches a small protein, ubiquitin, to those mitotic components, such as cyclins, that need to be



Pamlico Sound before (left) and after (right) the influx of brownish floodwaters produced by Hurricane Floyd.

### ECOLOGY Winds of Change

Infrequent major disturbances of ecosystems are, by definition, hard to study. They don't happen often, and pre-disturbance baseline data may not have been gathered. Hence, it can be difficult to determine whether an ecosystem recovers to its former state or switches to a new trajectory.

Paerl et al. studied the ef-

fects of floodwaters generated by three successive 1999 hurricanes (Dennis, Floyd, and Irene) on the estuarine ecosystem of Pamlico Sound, North Carolina, USA. Hydrological, biogeochemical, and ecological baseline data had been collected in monitoring programs installed the previous year. The floodwaters from the surrounding watershed were sufficient to displace 75% of the saline estuarine waters, producing a cascade of effects on water chemistry and on nutrient availability to phytoplankton, with significant depression of the estuarine food chain and fisheries. Although some ecosystem properties rebounded, these results suggest that the effects of the floodwaters might persist in the shallow estuary (average depth of 4.5 meters) for several years. — AMS *Proc. Natl. Acad. Sci. U.S.A.* **98**, 5655 (2001).

destroyed. The ubiquitin tag serves as a signal that is recognized by the 26S proteasome, a large recycling center that digests proteins within a cylindrical reaction chamber. Gieffers *et al.* have prepared an 11-subunit 22-23S APC, which retains a ubiquitin-transferring activity



Features and relative sizes of the APC.

and has a molecular mass of approximately 850,000. Visualization of these particles by cryoelectron microscopy revealed an asymmetric globular object of 135 angstroms in diameter. Substrate access to an internal cavity large enough to hold ubiquitin and the upstream ubiquitin-conjugating enzyme E2 could be dictated by regulatory factors. — GJC *Mol. Cell* 7, 907 (2001).

### CELL BIOLOGY Two Roads Diverged

The posttranslational modification of proteins by the attachment of the protein ubiquitin is known to play a role in the regulated degradation of many proteins by the proteasome. A

> role for ubiquitination in triggering the internalization of membrane receptors in yeast also is well established.

Now, Helliwell *et al.* define another function for ubiquitination in controlling the intracellular roadmap followed by

the general amino acid permease (Gap 1p) in yeast. When sources of nutritional nitrogen are limiting, Gap 1p travels to the cell surface; in times of plenty, Gap 1p is routed to the vacuole for degradation. In cells that expressed high levels of two proteins, Bul 1p and Bul 2p, which promote the attachment of ubiquitin, Gap 1p was transported to the vacuole irrespective of nitrogen levels. Con-

versely, when the *bul1* and *bul2* genes were deleted, the Gap1 protein was delivered predominantly to the plasma membrane. Ubiquitinated forms of Gap1p were abundant in the former situation and greatly diminished in the deletion strains. Furthermore, truncation of Gap1p, which forestalled ubiquitination, enhanced delivery to the cell surface. Thus, it appears that ubiquitin can direct the paths taken upon exit from the Golgi complex, as well as during endocytosis from the cell surface. — SMH

J. Cell Biol. 153, 649 (2001).

### GEOLOGY

### Dating the Great Barrier Reef

Coral reefs are important as marine ecosystems, and their growth has been linked to the carbon dioxide content in Earth's atmosphere. However, the timing of major reef growth has been uncertain for many reefs, including Earth's largest, the Great Barrier Reef of Australia. Analysis by an international consortium of two CONTINUED ON PAGE 1453

# SOURCE: (TOP) PAERL ET AL., PROC. NATL ACAD. SCI. U.S.A. 98, 5655 (2001); (BOTTOM) GIEFFERS ET AL., MOL. CELI 7, 907 (2001);

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recent drill cores taken from the Great Barrier Reef indicates that it began to form about 600,000 years ago. This age is based on magnetic stratigraphy through the drill core (and the absence of the marked geomagnetic reversal 790,000 years ago) and on the Sr isotope composition of the corals. This age implies that the Great Barrier Reef has grown by about 10 to 28 centimeters per year, which is similar to the growth rate of other reefs worldwide. Why reef growth started at that time is unknown, but it might reflect a period of increased sea surface temperatures, a connection with atmospheric carbon dioxide levels, or both. - BH

Geology 29, 483 (2001).

### CHEMISTRY

### Bound to Give an Explanation

Often, reactions in solution are better characterized than those on surfaces, in part because solution species tend to be homogenous and can be probed in bulk with analytical and spectroscopic methods. Gallagher and Meyer provide an example in which binding of a reactant to a surface leads not only to mechanistic insights but also to greater control over the reaction, in

this case a partial oxidation by a Ru<sup>IV</sup>--oxo complex. In solution, two-electron (2e<sup>-</sup>) oxidation forms Ru<sup>II</sup>, but this species reacts rapidly with Ru<sup>IV</sup> to produce the Ru<sup>III</sup> that is observed. However, when tethered to a TiO<sub>2</sub> surface grown on glass, the disproportionation reaction is slowed, and the Ru<sup>II</sup> species can be detected by ultraviolet-visible spectroscopy. Surface binding also helps limit the reaction with organic species to a single 2e<sup>-</sup> oxidation. Thus, whereas cyclohexene in solution is oxidized to the ketone, the surface-bound complex yields primarily the alcohol. --- PDS

J. Am. Chem. Soc., in press.

### BIOCHEMISTRY Escort Service

Nitrogenase is a complex enzyme: It contains an iron (Fe) protein dimer and a molybdenum-iron (MoFe) protein  $\alpha_2\beta_2$ tetramer, and it catalyzes reduction of dinitrogen to ammonia. The Fe protein transfers electrons to the MoFe protein and also is involved in the biosynthesis of a Mo-7Fe-9S-homocitrate (FeMoco) cluster and in the insertion of this cofactor into the  $\alpha$  subunits of the MoFe protein.

Ribbe and Burgess show that insertion of this cofactor, which forms the binding site for dinitrogen, requires the chaperone GroEL. They used a mutant strain of Azobacter vinelandii that is defective in FeMoco insertion to generate a FeMoco-deficient MoFe protein. Addition of a crude extract together with MgATP and wild-type Fe protein restored full activity in vitro to partially purified FeMoco-deficient MoFe protein. The component required for FeMoco insertion was purified and identified as GroEL by NH<sub>2</sub>terminal sequencing and antibody cross-reactivity. Yet GroEL, MgATP, and Fe protein were not sufficient for FeMoco insertion into purified FeMoco-deficient MoFe protein, suggesting that other factors also help to escort this metal cluster. --- VV

Proc. Natl. Acad. Sci. U.S.A. 98, 5521 (2001).

### POLYMER SCIENCE Form and Function

The method of fabrication of a conjugated polymer film influences the packing of the polymer chains and the morphology of the film; it also can affect the electronic properties that are critical for device applications. For example, films of the polymer



Photoluminescence detected from bumps (dashed line) and flat regions (solid line) of a MEH-PPV film. MEH-PPV that are spin cast from a good solvent show a flat texture but exhibit numerous nanometer-sized bumps and have poorer photoluminescence than films cast from a poor solvent. Nguyen *et al.* 

have used nearfield scanning optical microscopy to examine the correlations between

morphology and electronic structure and wear resistance. They find that there are direct correlations between the topography and morphology of the film and the local electronic properties, and that the diminished properties associated with the bumps are due to enhanced interchain interactions in these areas. However, these more densely packed areas suffer less damage during photo-oxidation. Annealing of the films can remove these spatial features, but once cooled, the chains pack with a large number of interchain interactions to produce a film with weak photoluminescence. — MSL

J. Phys. Chem. B, in press.

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