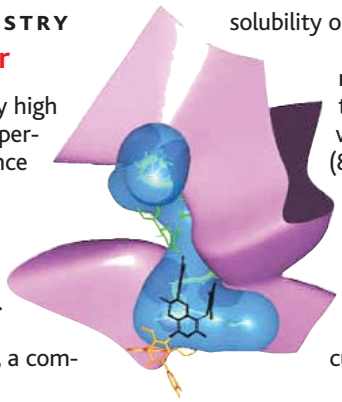
EDITORS' CHOICE

edited by Gilbert Chin

BIOCHEMISTRY

A Dry Year



Sequestering tannins (green, black, and orange) on the hydrophilic side of IB7 (blue surface).

The unusually high summer temperatures in France have raised winemakers' hopes for a truly memorable vintage. The polyphenolic tannins, a component of red wines, come primarily in two varieties: the flavan-3-ol polymers (made of catechin and epicatechin monomers) from the grape skins and seeds, and the hydrolyzable tannins (made of ellagic and gallic acids) from the oaken barrels. These compounds are responsible for the astringent taste of red wine and are thought to bind to proline-rich proteins (PRPs) in saliva. Previous attempts to define this interaction have been hampered by the limited solubility of the complexes. Working in the remarkably true-to-life solvent of water:ethanol (88:12, v/v; pH 3.5), Simon *et al.* describe the association of three procyanidin B3 (catechin-4a,8-catechin) molecules with a 14-residue fragment of salivary protein IB7. Using circular dichroism, mass spectrometry, NMR, and molecular dynamics calculations, they find that the peptide adopts a type II helical structure typical of proline-rich sequences. Furthermore, the B3 tannins bind via hydrogen bonds with only millimolar affinity to the hydrophilic side of the peptide, reducing its conformational flexibility. The potential range of binding stoichiometries and dynamics in a mixture of tannins and PRPs reminds us how infinitely varied wines can be. — GJC

Biochemistry 10.1021/bi034354p (2003).

GEOCHEMISTRY

A History of Grass

Grasslands are thought to have spread widely during the late Cenozoic, starting about 10 to 15 million years ago, and this expansion has been suggested to have had major effects on ecology and evolution: a radiation of ruminants and decline of other grazers, and eventually the rise of humans. Grasses use a different photosynthetic process (C_4) than trees and shrubs (C_3); the C_4 pathway is favored at lower atmospheric CO_2 levels and cooler temperatures, conditions that became prevalent later in the Cenozoic. Assessing the expansion of grasses and whether there was an abrupt change in ecosystems is critical for testing these proposed links.

Because the C_4 and C_3 pathways produce different stable carbon isotope signatures in plants, a fingerprint of the abundance of grasses can be recovered from the geologic record. Fox and Koch examined paleosoils from the Great Plains in the United States (now mostly grassland) spanning the period since about 23 million years ago. Their data imply that grasslands were about 20 % of the plant biomass until about 5 million years ago, and then expanded to modern levels by about 2.5 million years ago. This record differs from those suggesting an earlier expansion, and implies a local, not global, climate control of grassland extent. — BH

Geology **31**, 809 (2003).

BIOPHYSICS

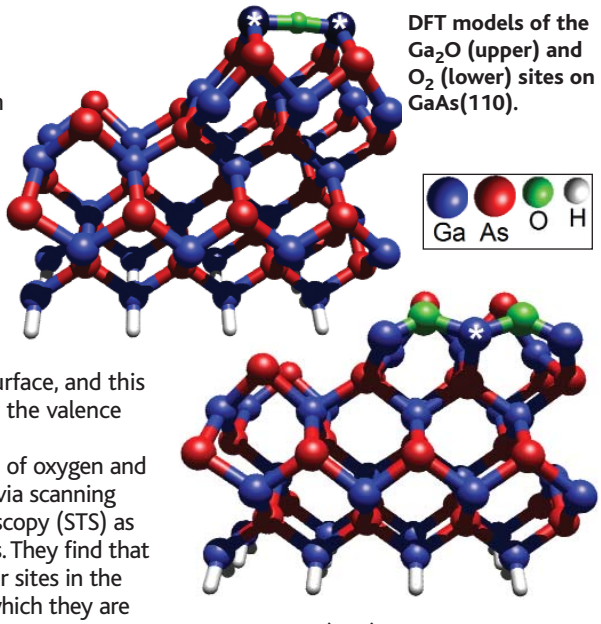
A Gentle Tug

Designing a protein is such a complicated undertaking in terms of satisfying multiple operating constraints that it seems miraculous that anything works at all. The order of amino acids must allow the spontaneous formation of secondary and tertiary structure during protein synthesis, and the global fold must be flexible enough in enzymes to support catalytic movements and sturdy enough in structural components to resist deformation. Finally, it has to be feasible to tear down these constructs in order to recycle damaged molecules.

Brockwell *et al.* pull on the N terminus of a lipoyl domain (from a subunit of pyruvate dehdrogenase) while holding onto either the nearby C terminus or the lipoic acid, which is covalently attached to a lysine midway between the termini. Carrion-Vasquez *et al.* pull on polyubiquitin in which the monomers are linked either by an amide bond between the N and C termini or between an interior lysine and the C terminus. In both cases, yanking on the middle leads

SURFACE SCIENCE

Unpinning Gallium Arsenide



DFT models of the Ga_2O (upper) and O_2 (lower) sites on GaAs(110).

The metal oxide semiconductor field-effect transistor (MOSFET) is made from silicon rather than GaAs, even though GaAs has a direct band gap and high carrier mobilities. The reason is that the insulating oxide layer that forms on the GaAs surface has a high density of states that "pin" the valence and conduction bands, rather than letting them move with respect to the Fermi level. The classical explanation is that oxidation liberates As atoms from the surface, and this "antisite" indirectly creates states above the valence band maximum.

Hale *et al.* have studied the adsorption of oxygen and Ga_2O onto the GaAs(110)-c(2×8)/(2×4) via scanning tunneling microscopy (STM) and spectroscopy (STS) as well as via density functional calculations. They find that oxygen in fact creates donor and acceptor sites in the band gap directly from the Ga atom to which they are bonded. However, Ga_2O bonds by inserting into As dimer pairs to form a c(2×2) unpinned surface. Chemisorption of GaO appears to restore surface Ga and As atoms to nearly their bulk charge states, whereas O_2 creates charged Ga atoms that lead to pinning. — PDS

J. Chem. Phys. 10.1063/1.1601596.

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CREDITS: (TOP) SIMON *ET AL.*, *BIOCHEMISTRY* 10.1021/BI034354P (2003); (BOTTOM) HALE *ET AL.*, *J. CHEM. PHYS.* 10.1063/1.1601596

to unfolding at much lower forces, by roughly an order of magnitude, than tugging on the two ends. Perhaps this explains how proteins can be tough, yet have a sensitive side. — GJC

Nature Struct. Biol. 10.1038/nsb968; 10.1038/nsb965 (2003).

ECOLOGY/EVOLUTION

Fungal Specimens

Plant species have traditionally been described and named from dried, pressed herbarium specimens mounted on card. In taxonomic convention and parlance, the "type" is the single specimen from which the original description was made. Although taxonomists generally take pains to use a specimen for this purpose that is

Anther smut disease on a living *Silene* specimen.

CREDIT: MICHAEL HOOD

well within the perceived range of natural variation for the species, it is possible for aberrant or otherwise extreme specimens to be accorded a unique species name. A strange example of this has been brought to light by Hood and Antonovics, who have discovered that several type specimens of species of *Lychnis* and *Silene* in herbaria were infected with anther smut disease, which causes the anthers to be filled with dark purple fungal spores. In several cases, the discolored anthers were incorporated into unique species descriptions—different than those of healthy specimens—in the 18th and 19th centuries by, among others, Linnaeus himself. In at least one case, the spuriously named diseased specimen has persisted into present-day floras. — AMS

Proc. R. Soc. London Ser. B 10.1098/rsbl.2003.0063 (2003).

APPLIED PHYSICS

Accelerating Lithography

A number of lithographic techniques are currently being used for the transfer of patterns into materials and semiconductors. The exposure of photoresist to ultraviolet light, x-rays, electron beams, or focused ion beams can be used for the patterning of structures with submicrometer features, with some state-of-the-art facilities regularly achieving features finer than 100 nm. For small features, however, scattering of secondary electrons and diffuse scattering profiles within the patterned medium present a problem.

Beams of protons, which are heavier than electrons and subject to less scattering in the material, are shown by van Kan *et al.* to be a powerful addition to the lithographic toolbag. The proton beams are accelerated to 1 MeV, focused to a sub–100-nm spot size, and used to sculpt three-dimensional structures with high aspect ratio and smooth walls with less than 3-nm roughness. The technique should find particular use in specialized high-end applications such as the developing field of nanoelectromechanical systems. — ISO

Appl. Phys. Lett. **83**, 1629 (2003).

BIOMEDICINE

A Risky Business

Almost all of us know of someone who has suffered a heart attack despite leading a healthy lifestyle. Cardiologists continue to debate the extent to which conventional risk factors such as smoking, diabetes, high cholesterol levels, and high blood pressure precede the development of coronary heart disease (CHD). In independent studies, Greenland *et al.* and Khot *et al.* address this issue by examining the prevalence of these four factors among patients with CHD. Compiling data from 14 clinical trials and three large cohort studies, they conclude that 80 to 90% of patients with clinically significant CHD had at least one of these modifiable risk factors, a finding that supports previous research emphasizing the predictive value of these factors and the lifestyles underlying them.

For the millions of people who experience heart attacks, immediate treatment to restore coronary blood flow is imperative. In a study of over 1500 patients in Denmark, Andersen *et al.* compared two treatments: emergency balloon angioplasty, which requires transfer of patients to specially equipped hospitals; and on-site administration of fibrinolytic ("clot-busting") drugs, a procedure that is more widely available and therefore more commonly used throughout the world. Angioplasty was found to reduce the risk of death and major complications by about 40% in comparison with drug therapy, provided that hospital transfer occurred within 2 hours. — PAK

J. Am. Med. Assoc. **290**, 891; 898 (2003); *N. Engl. J. Med.* **349**, 733 (2003).