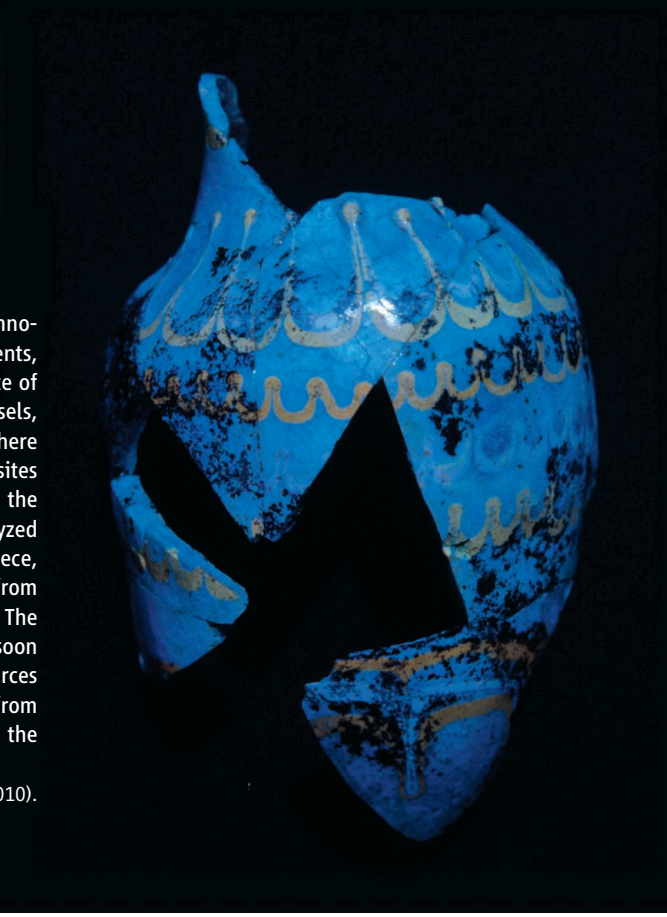


ARCHAEOLOGY

Tracing the Ancient Glass Trade

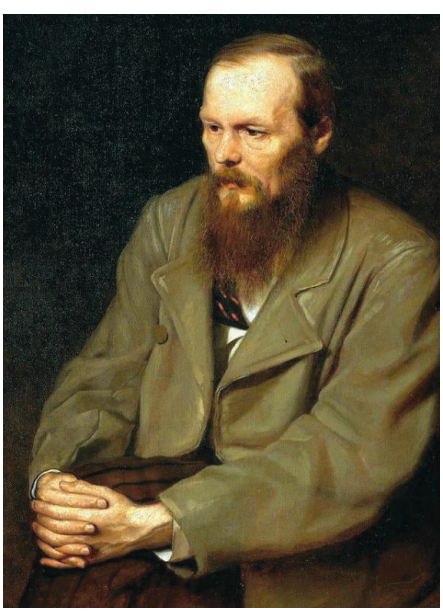
The development of colored glass and its formation into vessels marked a major innovation in the early Bronze Age. Artisans learned how to heat the two main ingredients, silica sand and a plant ash, in large containers. The plant ash served as the source of soda-lime flux that decreased the melting point of the glass. Colored glass vessels, which appeared about 1600 B.C.E. in Mesopotamia and later in Egypt and elsewhere around the Eastern Mediterranean, became prized possessions. The variety of sites where glass has been found has made it difficult to ascertain the location of the main centers of production and the extent of glass trading. Henderson *et al.* analyzed strontium and neodymium isotopes in a variety of early glass samples from Greece, Mesopotamia, and Egypt. The isotopic compositions clearly distinguish Egyptian from Mesopotamian glass, as well as glass with different colors within Mesopotamia. The results imply that there were separate industries and distinct sources of materials soon after 1400 B.C.E. The data also reveal details about the glass production and sources of sand and plant ash in each locality. Early glass in Greece evidently derives from both centers, which confirms that there was widespread early trade throughout the region. — BH

Mediterr. Archaeol. Archaeom. **10**, 1 (2010).

PSYCHOLOGY

Notes from Underground

Dostoyevsky. For anyone steeped in the traditional canon of Western literature, his name elicits visions of bleak winters filled with contemplative despair. This common perception of Russian culture has fueled speculation about an underlying symbiosis between a predisposition to focus on negative feelings or experiences and a tendency toward depression. Grossmann and Kross have examined this purported linkage by



contrasting self-reflective measures in Russians and Americans. Brooding correlated positively with depressive symptoms in University of Michigan students, but these were inversely related in students at Moscow State University even though the latter displayed a much greater propensity for rumination. Assessing the mode of self-reflection revealed that Russian students were more apt than Americans to examine their feelings from a third-person or observer's perspective, reconstruing the experiential details rather than recounting them from a first-person point of view. Distancing oneself in such a fashion mediated the opposite influences of American versus Russian cultures on the relation between self-reflection and negative affect. — GJC

Psychol. Sci. **21**, 10.1177/0956797610376655 (2010).

PHARMACOLOGY

Partners in Pain Prevention

Opioid receptors mediate the physiologic effects of morphine, which allows patients to tolerate otherwise debilitating pain, but chronic exposure to morphine results in diminished analgesia. Gupta *et al.* have explored the changes that occur as tolerance develops. The μ- and δ-opioid receptors have distinct preferences for ligands and interact to form heterodimeric receptors with new properties. When the two receptors work together, low concentrations of a δ receptor agonist that on its own is not sufficient to trigger signaling can potentiate activation of the heterodimer by μ- receptor agonists. Using a monoclonal antibody that recognized only the heterodimeric receptor, the authors showed that heterodimeric receptors accumulated in brain regions that process pain perception in mice as they developed tolerance to chronically administered morphine. These results implicate opioid receptor heterodimers as potential targets for therapeutics designed to manage pain or addiction. — LBR

Sci. Signal. **3**, ra54 (2010).

PHYSICS

Squeezing Fermi Gases into Two Dimensions

Some of the most intriguing many-body effects in solids appear when mobile particles, such as charge carriers, no longer move freely but are confined to reduced spatial dimensions, such as at a planar interface. The importance of fluctuations in the states formed by charge carriers is enhanced with respect to the three-dimensional (3D) case. In these solid-state systems, it can be difficult to tune interaction parameters smoothly, and the presence of defects can lead to scattering effects that complicate the theoretical interpretation of results. One way to simulate the effects of confinement in a tunable and impurity-free environment is to use ultracold Fermi gases. However, although the 3D and

1D trapped gases have been realized, achieving a nearly 2D Fermi gas has been an experimental challenge. Martiyanov *et al.* place a Fermi gas of lithium atoms into an optical potential that provides loose confinement in the transverse direction, whereas in the axial direction it corresponds to a tight 1D standing wave. This approach results in a 1D chain of pancake-like, 2D trapped Fermi gases. The finite temperature, interaction, and Fermi statistics effects may all cause a portion of the atomic population to leave the axial ground state, which can affect the 2D confinement, but estimates indicate that this portion is very small. — JS

Phys. Rev. Lett. **105**, 030404 (2010).

EVOLUTION

Growing Closer Together

The conversion of a free-living organism into a domesticated organelle is a remarkable event, and mitochondria and chloroplasts have become virtually indispensable components of eukaryotic life. Ran *et al.* have sequenced the genome of a nitrogen-fixing symbiont of the water fern *Azolla filiculoides* and suggest that this cyanobacterium may have been partly domesticated by its host. They note that there appears to have been co-evolution between the two organisms, as revealed in the intricate means by which *Azolla* maintains cyanobacterial colonies through successive generations. Furthermore, hallmarks

The fern (left) and the bacterium (right).

of genome reduction in the symbiont, such as excessive pseudogenization, were identified, and the pattern of gene losses resembled that of another plant symbiont, rather than closely related, free-living cyanobacteria. Several basic metabolic processes such as glycolysis, replication, and nutrient import had suffered losses, yet nitrogen-fixing pathways had remained intact. This apparent streamlining of the genome indicates that progress toward a full mutualism between the plant and the cyanobacterium may be well under way. — LMZ

PLoS ONE **5**, e11486 (2010).

CHEMISTRY

Watching Rings Cycle

In biomolecules, changes in external conditions can shift the balance of weak interactions and alter the secondary structure. In artificial systems, the controlled movement of a chemical group through changes in weak interactions can be achieved with rotaxane molecules. A chemical ring (blue) can move between different sites along a "thread"—a backbone chain—that is

terminated with bulky groups (gray), which act as stoppers to keep the ring on the thread. The drivers of movement can include light or changes in redox conditions that alter the charge interactions at the binding sites (red and green). Such changes have been inferred through spectroscopic measurements in solution, but direct visualization of this process with methods such as scanning tunneling microscopy have been difficult because of the flexibility of the rotaxane molecules. Ye *et al*. synthesized rotaxane molecules with disulfide groups on the stoppers and used these groups to bind the rotaxanes to gold surfaces (yellow) in order to reduce their mobility. They imaged these molecules and observed changes in ring binding that accompanied changes in redox state. — PDS

ACS Nano **4**, 10.1021/nn100545r (2010).

NEUROSCIENCE

Splicing Misdirects Migrants

The mammalian brain develops from the inside out; neurons migrate radially outward as they mature. A gradient of the protein reelin helps to guide the establishment of the layers. Yano *et al.* found in mice that Nova2, a protein that regulates RNA splicing, affects the migration of cortical neurons by switching out exonic sequences in the mRNA encoding disabled-1 (Dab1), which is an important component of the reelin signaling pathway. Mice deficient in Nova2 showed reduced and disorganized cortical layers; these patterns resembled the cortical disruptions seen in mice carrying mutations in reelin signaling components. With Nova2 removed, the balance between the isoforms of Dab1 (with and without the exons) is perturbed, and inappropriate neuronal migration ensues. — PJH

Neuron **66**, 848 (2010).

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