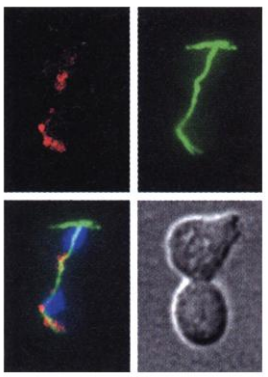
EDITORS' CHOICE

edited by Gilbert Chin

CELL BIOLOGY

Timing is Everything

A critical stage in cell division is the equitable partitioning of the genetic material in the nucleus. This means that division of the nucleus must occur before the cell exits mitosis and undergoes cytokinesis, or cell cleavage. How is the timing of these events coordinated? In the budding yeast *Saccharomyces cerevisiae*, Bardin *et al.* find that a key step is the transient co-compartmentalization of two proteins previously implicated in the signal transduction pathway for mitotic exit. Specifically, mitotic exit cannot be initiated unless both Tem1, a GTP binding protein, and Lte1, its putative nucleotide exchange factor, are present in the bud. Because Tem1 associates with the mitotic spindle pole body, and therefore co-localizes with Lte1 in the bud only after the nucleus enters the bud during nuclear division, this regulatory mechanism ensures that the daughter cell receives its share. — PAK



Tem 1 (red), the spindle (green), DNA (blue), in budding yeast.

SOURCE: (LEFT TO RIGHT) BARDIN *ET AL.*, *CELL* **102**, 21 (2000); ACKERLEY *ET AL.*, *J. CELL BIOL.* **150**, 165 (2000).

Cell **102**, 21 (2000).

GEOCHEMISTRY

Plumbing the Depth

Recently, several minerals that are thought to come from Earth's lower mantle (which lies at depths below about 670 kilometers) have been identified. These minerals, preserved as minute inclusions in diamonds, represent Earth's deepest sampled minerals and thus provide direct information on the nature of Earth's deep interior. They also demonstrate that there has been at least some material transfer across the boundary between the upper and lower mantle, which bears on a long-standing question regarding Earth's dynamics.

Now, Kerschhofer *et al.* have examined large (up to several millimeters across) baddeleyite crystals (ZrO_2) from a kimberlite in the Congo. Transmission electron microscopy analysis of twin microstructures suggests that these grains likely formed with cubic symmetry, which is the stable phase at temperatures above 2370°C. Such high temperature would require an origin in the deep lower mantle (perhaps 2000 kilometers or deeper). Because baddeleyite also readily incorporates uranium and other elements useful for dating and geochemical analyses, these inclusions may provide important clues about the composition and history of the lower mantle. — BH

Earth Planet. Sci. Lett. **179**, 219 (2000).

BIOCHEMISTRY

Doing Double Duty

The decoding of genetic information into protein sequence relies upon the interaction of messenger RNA (mRNA), which contains information in the form of a string of three-nucleotide codons, and transfer RNA (tRNA), which contains complementary anticodons at one end and the designated amino acid at the other. In bacteria, a quality control system utilizes a hybrid molecule known as tmRNA that binds to ribosomes lodged on a defective mRNA. The alanine residue of tmRNA accepts the incomplete protein, and the ribosome then switches over to begin translating a portion of the tmRNA that encodes a tag that targets the finished (but defective) protein for proteolytic degradation.

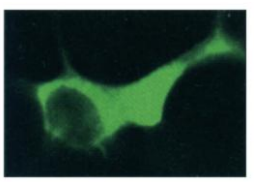
Keiler *et al.* describe the identification of a circularly permuted, two-piece tmRNA in *Caulobacter*. This bipartite RNA species is functional, and similar sequences are found in cyanobacteria and *Rickettsia* and even the mitochondrion of the protist *Reclinomonas*. Not only does this finding open a new door to studying the mechanisms for translational checkpoints (as reviewed by Karzai *et al.*), but it serves also to highlight the challenges in annotating permuted sequences. — GJC

Proc. Natl. Acad. Sci. U.S.A. **97**, 7778 (2000); *Nature Struct. Biol.* **7**, 449 (2000).

NEUROSCIENCE

Glutamate Applies the Brakes

Neurofilaments form structural networks in neurons and are transported from the neuronal cell body (the site of synthesis) into the axons via a process known as slow axonal transport. Using neurofilament subunits tagged with a fluorophore, Ackerley *et al.* show that glutamate, a neurotransmitter which at high concentrations leads to excitotoxicity, can alter neurofilament transport. Glutamate slowed neurofilament transport, most probably due to stimulation of mitogen-activated protein kinases, which are capable of phosphorylating neurofilament subunits. This observation provides a mechanistic link between excitotoxicity and neurofilament accumulation associated with neurodegenerative disorders such as Parkinson's disease and amyotrophic lateral sclerosis. — SMH



A backlog of subunits at the cell body.

J. Cell Biol. **150**, 165 (2000).

ASTRONOMY

Every Burst Is not the Same

The standard model of gamma ray bursts (GRBs) and the subsequent afterglow (in the x-ray to radio wave spectrum) is that an exploding fireball creates a shock wave that is driven into the interstellar medium (ISM). Synchrotron emission from electrons that are accelerated in this relativistic blast wave interact with a constant-density ISM to produce the observed flux and decay of emissions through a range of wavelengths.

Chevalier and Li have used the latest observations to refine the standard model and to revise their alternative model. In their model, a massive progenitor star still explodes initially, but the afterglows are produced by expansion of the blast wave into the stellar wind of the progenitor star rather than the ISM. Their model is consistent with a rapid fading of the optical emission, the association of GRBs with supernovae, and high estimated densities in radio emissions. The revised ISM model fits with observations of bright optical flashes related to reverse shock waves and other flux and emission characteristics that are different from the GRBs associated with the stellar wind model. Thus, the ISM model is applicable to GRBs whose progenitors are the mergers of compact stars while the stellar

CONTINUED ON PAGE 363

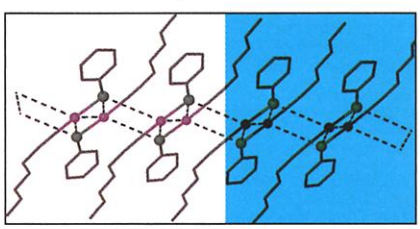
wind model fits those GRBs that form through the explosion of a massive star (such as a Wolf-Rayet star). — LR

Astrophys. J., in press [astro-ph/9908272].

CHEMISTRY

Golden Chains and Cartwheels

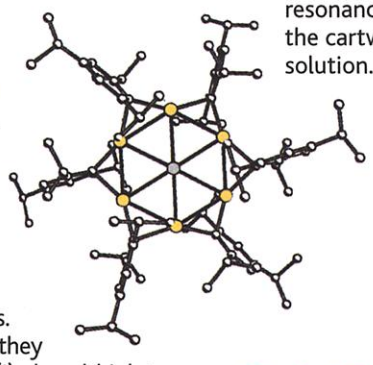
Gold atoms in the +1 oxidation state can exhibit strong noncovalent interactions. Bachman *et al.* planned to take advantage of this property of gold(I) thiolates to build supramolecular assemblies. However, the compounds they synthesized, isonitrilegold(I) phenylthiolates (RNCAuSPh, where R = *n*-alkyl), apparently polymerized into $[PhSAu]_n$, where the monomers are chained through Au–Au and Au–S bonds. The ethyl precursor reacted almost immediately and, unlike other forms of PhSAu previously synthesized, the product exhibited orange-red luminescence;



Gold: linked to form polymers (above) and spoked around a silver axle (top).

with the longer *n*-heptyl reactant, the polymerization could be slowed, and the intermediate compound retaining the isonitrile could be isolated and characterized.

Organometallic complexes that contain two different metals may provide insight into intermetallic bonding and may have applications in catalysis. Cerrada *et al.* have synthesized an unusual complex, in which a silver atom is surrounded by six gold atoms where alternate atoms are slightly above or below the plane of the cartwheel. The bond lengths in the crystal structure indicate that true intermetallic bonds are formed, and nuclear magnetic resonance spectra indicate that the cartwheel structure persists in solution. Two other complexes, containing five gold atoms and one silver or copper atom, could not be crystallized but appeared to form similar structures. — PDS; JU



J. Am. Chem. Soc., in press; *Angew. Chem. Int. Ed.* **39**, 2353 (2000).

APPLIED PHYSICS

Single Photons from Diamonds

As the field of quantum optics develops, so does the requirement for a light source that can emit photons one at a time and on demand. One approach to fabricating a single-photon source is to attenuate the light source so that on average only a single photon will reach its destination.

More control can be achieved by using an excited organic molecule and observing its fluorescence as it relaxes. Such molecules do emit single photons, but suffer from a limited lifetime. Kurtsiefer *et al.* show that a single nitrogen vacancy in diamond, which combines the robustness of the diamond structure with the fluorescent properties of the vacancy itself, is an effective candidate for a stable, single-photon light source. Their experiments reveal that when the vacancy is excited with green light, photons are emitted one at a time over the red to near-infrared wavelengths as it relaxes. Even after the emission of more than 10^{13} single photons, there were no observable changes in the emission characteristics. — ISO

Phys. Rev. Lett. **85**, 290 (2000).

HIGHLIGHTED IN *SCIENCE*'S SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

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Protease Inhibitor Side Effects

Administration of HIV protease inhibitors, while beneficial to AIDS patients, often results in serious side effects; for instance, patients may develop insulin resistance that leads to type 2 diabetes. Murata *et al.* studied the effects of the HIV protease inhibitors indinavir, ritonavir, and amprenavir on glucose transport and found that glucose uptake in 3T3-L1 cells via the transporter Glut4 was severely reduced. Because this transporter is responsible for the insulin-stimulated glucose uptake into muscle and fat, this result suggests a direct connection between protease inhibitors and the development of insulin resistance, and perhaps other disruptions of lipid metabolism. — JN

J. Biol. Chem. **275**, 20251 (2000).

CREDITS: (TOP TO BOTTOM) CERRADA *ET AL.*, *ANGEW. CHEM. INT. ED.* **39**, 2353 (2000); BACHMAN *ET AL.*, *J. AM. CHEM. SOC.*, IN PRESS.