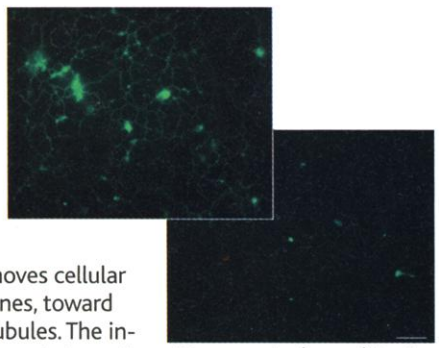
EDITORS' CHOICE

edited by Gilbert Chin

CELL BIOLOGY

The Ties That Bind



ER networks (green) in the presence (top) and absence (bottom) of dynein.

Cytoplasmic dynein is one of the primary microtubule-based motors that, in conjunction with the accessory protein complex dynactin, moves cellular cargoes, such as membranes, toward the minus end of microtubules. The interaction between dynein and dynactin involves the binding of the intermediate chain of dynein to the dynactin subunit $p150^{Glued}$. Lane *et al.* report that both the dynein intermediate chain and $p150^{Glued}$ are cleaved by caspases during programmed cell death (apoptosis). This cleavage releases the cytoplasmic dynein complex from intracellular membranes and abolishes dynein-induced movement of endoplasmic reticulum (ER) membranes in vitro. Membrane motility could be restored upon replenishment of dynein, confirming the dynamic character of the interaction between motors and cargoes. The diversion of normal membrane traffic during apoptosis may contribute to surface alterations on dying cells as a prelude to their disposal. — SMH

J. Cell Biol. **153**, 1415 (2001).

APPLIED PHYSICS

Fine-Tuning Fast Pulses

The ability to transmit large amounts of information quickly over vast optic fiber networks affects millions of people daily, in business and in entertainment. As the demand for faster transmission rates grows, one obvious tactic would be to reduce the duration of the optical pulses beyond the picosecond times used at present. However, launching intense femtosecond optical pulses into an optic fiber creates an array of nonlinear optical effects within the fiber. These effects temporally distort the spectral makeup of the pulses, thus inhibiting their accurate transmission and ultimately limiting the information-carrying capacity of the fiber.

Omenetto *et al.* report an adaptive pulse-shaping technique that can be used to overcome the distortion of the pulse as it travels along the fiber. An initialization algorithm and a series of test pulses are used to tune the shape of the input pulse, so that once it is launched into the fiber, the distortion of the pulse is minimized. The demonstrated compensation of pulse distortion is a possible route toward faster information exchange that uses shorter and more intense optical pulses. — ISO

Opt. Lett. **26**, 938 (2001).

CHEMISTRY

When Your Sugar Needs a Ring

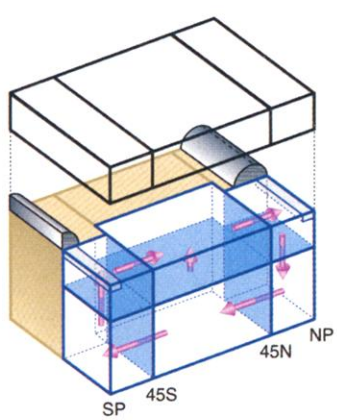
The C-aryl glycosides are an important class of naturally occurring antibiotics in which sugar groups are attached to a naphthol core of fused aromatic rings. Kaelin *et al.* have outlined two general strategies for synthesizing such molecules. The reaction of carbohydrate-derivatized furans with benzynes (deprotonated benzene derivatives generated with *sec*-butyl lithium under very cold conditions) via a Diels-Alder reaction creates a species in which one ring is bridged by an oxo group. Final products are formed by an acid-catalyzed rearrangement. Alternatively, the sugar group can be introduced by the palladium-catalyzed condensation of the oxo-bridged species with an iodoglycal. This latter reaction even works when the oxo-bridged species already contains one sugar substituent. — PDS

J. Am. Chem. Soc., 10.1021/ja0108640.

CLIMATOLOGY

Modeling CO_2's Ups and Downs

The atmospheric concentration of CO_2 has risen and fallen in a remarkably regular manner during the past 400,000 years, in parallel with the waning and waxing of continental ice sheets driven by glacial cycles. Biological, chemical, and physical processes each have contributed to this variability, but modeling how much impact each of these processes has had remains a challenge.



Modeling thermohaline circulation (red), ice cover (gray), land (ochre), and ocean (blue) compartments.

One problem with most models is that they need to have their physical boundary conditions specified externally, which leaves unexplained the physical mechanisms that produced them. Gildor and Tziperman present a global meridional box model using a qualitative physical treatment of sea ice cover changes and vertical ocean mixing that does not need the physical state of the ocean to be prescribed. This enabled them to generate a CO_2 record with a magnitude of variability consistent with observations. Their model explains the continuous evolution between glacial and interglacial states, rather than treating them as two different steady states, and reveals how ocean biogeochemistry can amplify glacial-interglacial climate variability. — HJS

Geophys. Res. Lett. **28**, 2421 (2001).

ASTROPHYSICS

Galaxy Formation: Are We There Yet?

The formation of the large-scale structure of the universe as revealed by observations of luminous ancient galaxies depends on the nature of dark matter. After the Big Bang, it is thought that dark matter started to clump together into halos and that the halos eventually merged to form galaxies. Dark matter can be cold or hot, and these two types lead to different scenarios for galaxy evolution. Although there is a growing preference for cold dark matter because it is consistent with recent observations of the background radiation in the universe (produced before galaxies formed), cold dark matter confounds galaxy formation by removing angular momentum from a protogalaxy during the halo-merging process.

Thacker and Couch have developed a smoothed particle hydrodynamic simulation of galaxy formation that keeps the

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SOURCE: (TOP) LANE *ET AL.*, *J. CELL BIOL.* **153**, 1415 (2001); (BOTTOM) GILDOR & TZIPERMAN, *GEOPHYS. RES. LETT.* **28**, 2421 (2001).

rotating gaseous disk of the protogalaxy from losing too much of its angular momentum. They tracked the evolution of tens of thousands of interacting dark matter, gas, and star particles during condensation (gravitational collapse). A gaseous high-density disk formed first, and then star formation began; later, stellar explosions (supernovae) heated the gas, which rose into the halo, but then returned to the disk, adding energy back to the system. It is this supernova energy feedback that allowed the disk to maintain its angular momentum long enough to form a simulated galaxy with properties similar to those of observed galaxies. Thus, the Big Bang and present-day galaxies can be connected through cold dark matter, and astrophysicists may be getting closer to a unified model of the evolution of the universe. — LR

Astrophys. J., in press (astro-ph/0106060).

AGRICULTURAL ECOLOGY

Organic Farming

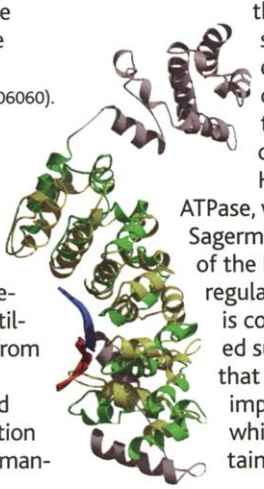
The reluctance of much of the agricultural sector to adopt "organic" procedures—the production of crops and livestock without recourse to inorganic fertilizers and synthetic pesticides—stems from fear of increased costs over those of "conventional" farming. Letourneau and Goldstein have studied tomato production on 18 commercial farms (half of them managed organically) in the Central Valley of California; they find that the withdrawal of synthetic insecticides does not lead to increased crop losses as a result of pest damage. The arthropod communities on the organic farms contained a greater diversity of species and a greater abundance of natural enemies (predators and parasitoids) of pest species. Particular arthropod groups were affected more strongly by surrounding habitat and fallow practice than by insecticides. Overall, these results suggest that the use of pesticides in this system does not lead to a net economic benefit and that organic procedures can promote biodiversity and may sustain productivity. — AMS

J. Appl. Ecol. **38**, 557 (2001).

STRUCTURAL BIOLOGY

Proton/Protein Transport

In eukaryotic cells, F-type ATPases convert a mitochondrial proton gradient into ATP (the final stage in extracting energy from the oxidation of carbon compounds) while V-type ATPases use ATP to transport protons across internal membranes, notably in the acidification of lysosomes. Although these enzymes are similar in composition and function, there are specific components, such as the H subunit of the yeast V-ATPase, whose crystal structure Sagermann *et al.* describe. Much of the H subunit, an essential regulator of catalytic activity, is composed of a right-handed superhelix of α-helices that bears similarity to the importins (or karyopherins), which bind to proteins containing nuclear localization signals (NLS) and mediate transport of them into the nucleus. One end of the H subunit sits within what corresponds to the NLS peptide binding site of the importins; whether this relates to its regulatory role or to its interaction with other proteins is unclear. — GJC



Subunit H (gray, green, and red) overlaid on karyopherin α (yellow) and an NLS peptide (blue).

CREDITS: SAGERMANN *ET AL., PROC. NATL. ACAD. SCI. U.S.A.* **98**, 7134 (2001).

Proc. Natl. Acad. Sci. U.S.A. **98**, 7134 (2001).

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Stabilizing the Myelin Sheath

Schwann cells of the peripheral nervous system express periaxin, a cytosolic protein that contains a PDZ domain, a hallmark of adaptor proteins that assemble macromolecular signaling complexes. Mutations in the human periaxin gene cause the demyelinating neuropathy of Charcot-Marie-Tooth disease, and mice that lack functional periaxin develop a similar condition. Sherman *et al.* show that periaxin associates with a cytoplasmic protein, dystrophin-related protein 2, which binds to dystroglycan, the cell surface receptor for extracellular matrix molecules. Periaxin forms PDZ domain–mediated dimers and hence clusters the associated dystrophin-glycoprotein complexes at the surface of Schwann cells. Disruption of this clustering destroys dystroglycan organization, thus affecting neuron-Schwann cell interaction and myelin sheath integrity. — LDC

Neuron **30**, 677 (2001).