EDITORS' CHOICE

edited by Gilbert Chin

GEOPHYSICS

The Sounds of Waves and Meteors

The seismology division of the Royal Netherlands Meteorological Institute operates an array of micro-barometers that detects low-frequency (0.002 to 40 hertz) sound waves traveling through the atmosphere. This frequency range covers infrasonic disturbances inaudible to humans, such as distant nuclear explosions, and similar arrays are being installed worldwide as part of the Comprehensive Nuclear Test Ban Treaty. The Deelen array covers about 1.5 square kilometers and incorporates five porous hoses attached to each micro-barometer to reduce noise from atmospheric wind.

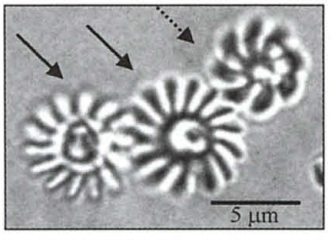
Evers and Haak report detection on 8 November 1999 of a discrete 0.15 Hz component along with a continuous 0.19 Hz component. The 0.15 Hz signal came from the northeast, and the source was identified as a meteor explosion in the atmosphere over northern Germany, as confirmed by eyewitness accounts and photographs. The higher frequency signal came from the northwest (the northern Atlantic) and was associated with standing ocean waves coupled to the atmosphere (these sounds are called microbaroms). The authors estimated that the meteor explosion occurred at about 15 km in altitude and released energy equivalent to about 1.5 kilotons of TNT, within the range for nuclear explosions. — LR

Geophys. Res. Lett. **28**, 41 (2001).

APPLIED PHYSICS

Harnessing Light Beams

The ability to manipulate microscopic particles with well-defined light fields led to the development of optical tweezers, which can be used to capture and move particles and even cells. Rotation of particles, a useful feature for gaining information about the fluid in which the particle is immersed, can be achieved by designing particular light-field gradients or by careful design of the microstructured device itself. For example, microstructured propellers will rotate when placed in the path of a light beam, in much the same way a windmill



Incident light (dashed arrow) drives the rightmost rotor, which engages and turns the other two rotors (solid arrows).

rotates in a breeze. As shown by Galajda and Ormos, careful design can also allow complex light-driven machines to be realized. Using a photosensitive resin, they sculpt freestanding, three-dimensional rotors and show that such propellers or turbines can be integrated into more complex devices. As an example, they prepare a light-driven gearing system involving a series of meshed rotors, which can serve as the basis for microscale pumps, switches, and machinery. — ISO

Appl. Phys. Lett. **78**, 249 (2001).

ASTROPHYSICS

A Windy Gamma-Ray Burst

The origin of gamma-ray bursts (GRB)—energetic, short-duration flashes of bright gamma rays—is unknown. Recent observations of iron-intensified x-ray emissions in the afterglow of GRB991216 about one and one-half days after the main burst (see Piro *et al.*, Reports, 3 November 2000) have underscored the need for explanatory models. An existing two-stage model posits a supernova explosion followed several days later by the burst of gamma rays; this allows the stellar remnant to expand before the burst-induced blast wave interacts with the envelope and results in the iron-intensified emissions.

Rees and Mészáros offer an alternative scenario, beginning with a stellar collapse of either a rapidly spinning neutron star (collapsar model) or the highly magnetized torus of a black hole (magnetar model) into the GRB progenitor. The burst would occur soon afterwards, producing the bright flash followed by the decay of the x-ray continuum in the afterglow from the GRB blast wave. The iron-intensified x-ray emissions would develop later, due to the interaction of the GRB blast wave with the magnetohydrodynamic wind emanating from the recently collapsed and possibly not quite stable neutron star or black hole. — LR

Astrophys. J. **545**, L73 (2000).

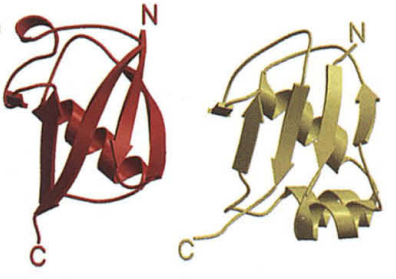
ECOLOGY

Reciprocal Subsidies

Traditionally, terrestrial and aquatic ecologists have concentrated on the complexities of interactions within their own realms, rather than between them. However, the flow of matter and energy between terrestrial and aquatic habitats may be substantial, as documented by Nakano and

BIOCHEMISTRY

Similarities in Sulfur Chemistry



Ubiquitin (red) and MoaD (yellow).

Two recent papers provide evidence for an evolutionary relationship between the pathways for molybdenum cofactor biosynthesis, thiamin biosynthesis, and ubiquitin-dependent protein degradation. Rudolph *et al.* have determined the crystal structure of molybdopterin (MPT) synthase, which comprises a small subunit (MoaD) and a large subunit (MoaE), and is responsible for generating the molybdenum-binding cis-dithiolene group. Wang *et al.* have determined the solution structure of ThiS, a sulfur carrier protein involved in thiamin biosynthesis.

The structures reveal that ThiS, MoaD, and ubiquitin are similar although the sequence identity between either ThiS or MoaD and ubiquitin is low. The three proteins share unusual sulfur chemistry, too. In ThiS and MoaD, carboxyl-terminal thiocarboxylates act as sulfur carriers, and in ubiquitin a thioester at the carboxyl-terminus is formed by the activating enzyme E1. In all three cases, activation of the terminal carboxylate is ATP-dependent, and the activating enzymes ThiF and MoeB share sequence similarity to each other and to a portion of E1. Finally, in the case of MPT, the formation of an isopeptide bond between the small and large subunits is analogous to the conjugation of ubiquitin to proteins targeted for degradation. — VV

Nature Struct. Biol. **8**, 42 (2001); *Nature Struct. Biol.* **8**, 47 (2001).

CONTINUED ON PAGE 401

SOURCE: (LEFT) GALAJDA & ORMOS, *APPL. PHYS. LETT.* **78**, 249 (2001); (RIGHT) RUDOLPH *ET AL.*, *NATURE STRUCT. BIOL.* **8**, 42 (2001).

Murakami in a study of a riparian forest environment in Hokkaido, Japan. They recorded fluxes of invertebrates between forests and streams; these fluxes accounted for 25-44% of the annual energy budgets of their vertebrate predators (birds and fishes, respectively). Flow of invertebrate prey from water to land was greater in spring, while the flow from land to water was greater in summer. The staggered timing of these "reciprocal subsidies" indicates a hitherto unsuspected level of interdependence between the two habitats. Human alteration of stream and river banks, which occurs extensively worldwide, might therefore have serious consequences for reciprocal energy exchange between terrestrial and aquatic habitats, possibly leading to depressions of biodiversity and productivity. — AMS

Proc. Natl. Acad. Sci. U.S.A. **98**, 166 (2001).

PSYCHOLOGY

Statistical Learning

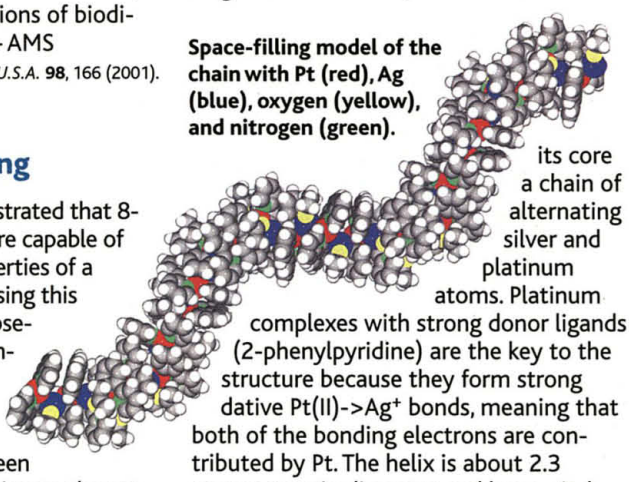
An earlier study has demonstrated that 8-month-old human infants are capable of learning the statistical properties of a stream of syllables and of using this knowledge, when tested subsequently, to group syllables into words (familiar transitions between syllables) versus non-words (unfamiliar transitions). It also has been shown that a non-human primate, the cotton-top tamarin, performs as well as human infants in rhythmic discrimination between Dutch and Japanese spoken forward and backward. Hauser *et al.* now bridge these studies by showing that tamarins are able statistical learners, too; that is, tamarins can distinguish between familiar and unfamiliar three-syllable words. Next on the agenda is identifying tasks soluble by infants but not by tamarins — GJC

Cognition **78**, B53 (2001).

CHEMISTRY

A Noble Chain

Helical structures abound in biological systems, for example, α helices in proteins and double helices in DNA. Chemists have used many different chemical approaches to mimic such helices in synthetic systems, some of which may be used as switches or conducting nanowires. Yamaguchi *et al.* have now assembled a single-stranded helix, which has at its core a chain of alternating silver and platinum atoms. Platinum complexes with strong donor ligands (2-phenylpyridine) are the key to the structure because they form strong dative Pt(II)->Ag^+ bonds, meaning that both of the bonding electrons are contributed by Pt. The helix is about 2.3 nanometers in diameter and has a pitch of 4.1 nm. In the crystal structure, the grooves of the helices are occupied by adjacent helices. The material is expected to be an insulator, but partial oxidation may lead to conductivity. — JU



Space-filling model of the chain with Pt (red), Ag (blue), oxygen (yellow), and nitrogen (green).

CREDIT: YAMAGUCHI *ET AL., J. AM. CHEM. SOC.*, IN PRESS.

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

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Steroid-Induced Motility

New studies of the migration of specialized follicle cells known as border cells in *Drosophila* point to an unexpected role for steroid hormones in control of cell motility. In a screen for mutations that disrupted border cell migration, Bai *et al.* identified mutations in a gene they call *taiman* (*tai*). The TAI protein has sequence similarity to the human protein AIB1, which is a steroid hormone receptor cofactor that shows increased expression in some breast and ovarian cancers. In vitro, TAI bound in a ligand-dependent manner to the ecdysone receptor (ecdysone is the only steroid hormone so far identified in flies). Furthermore, mutant border cells lacking a component of the ecdysone receptor failed to migrate, and the timing of cell migration in vivo was dependent on the amount of ecdysone present. The steroid receptor signaling appeared to affect the border cells only in motility and not in proliferation. The results may have implications for understanding the mechanisms by which mammalian steroid hormones promote metastasis of highly invasive breast and ovarian cancers. — LBR

Cell **103**, 1047 (2000).