EDITORS' CHOICE

edited by Gilbert Chin

NEUROSCIENCE

Watchful Waking

Sleep is traditionally thought to consist of two states: slow-wave sleep (SWS) alternates with periods of rapid eye movement (REM) sleep. These two states can easily be identified in hippocampal and neocortical EEG recordings by their distinctive activity patterns.

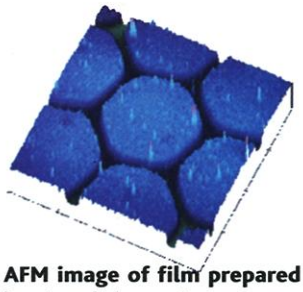
Jarosiewicz *et al.* describe a third physiological state that can consume up to 20% of overall sleep in the rat. In the hippocampal EEG, they observed a repeated pattern during sleep of small-amplitude irregular activity (S-SIA). During this state, the EEG is low in amplitude, and a small subpopulation of neurons (3 to 5% of the total cells) is active while the other cells remain virtually silent. The active cells display the features of pyramidal (complex spike) neurons and the characteristics of place cells, which denote a rat's location within its environment. The S-SIA appears several times within periods of SWS and immediately after every REM episode. The authors hypothesize that during S-SIA the animal may take in and process information from the sensorium without immediately acting on it, in contrast to SWS (which resembles drowsy waking states in exhibiting large-amplitude irregular activity) and REM or dreaming sleep (which exhibits the strong 7 to 8 hertz theta activity associated with active waking exploration). — PRS

J. Neurosci. **22**, 1373 (2002).

POLYMER SCIENCE

Patterning Thin Films with Water

Thin films can be assembled from alternating layers of polymer materials. When polyelectrolytes are used, the films are stabilized by electrostatic interactions. Weak polyacids that are stabilized via hydrogen bonds can also be used at low pH where the polyacids are not ionized. Yang and Rubner show that thermal treatment of layered poly(acrylic acid) and polyacrylamide generates imide cross links that serve to stabilize the films to physiological solutions (pH 7). Alternatively, the imidization reaction can be triggered by light after first adding a top layer containing a free-radical initiator. Patterns could be introduced in these films by using water as the etching or wash agent. For features in the 200-micrometer range, ink jet printing was used to select the areas to be removed; the printed sections that had been exposed to pH 7 water became ionized and did not react on heating. For smaller features, photolithography was used, and the masked areas, shielded from light, were then removed upon washing. — MSL



AFM image of film prepared by photolithography.

J. Am. Chem. Soc. 10.1021/ja017681y.

CLIMATOLOGY

Matching Milankovitch

It is generally agreed that changes in the amount of incident solar energy, arising from variations of Earth's orbit around the Sun, are the ultimate cause of our glacial cycles, but how well the timing of these cycles agrees with the pattern of insolation remains controversial. For example, although the start of the last deglaciation coincides with the increase in insolation at that time, the penultimate deglaciation appears to have begun thousands of years earlier than would have been expected on the basis of orbital forcing. In order to understand better the timing of glacial cycles, more glacial terminations need to be examined.

Using the same precise U-Th dating method but on entirely different samples, Bard *et al.* and Robinson *et al.* probe the timing and structure of marine isotope stage (MIS) 7, which is the interglacial period that lasted from approximately 240 to 190 thousand years ago (ka). They find substantial agreement with predictions based on orbital forcing patterns. Bard *et al.* present the growth record of an Italian stalagmite and show that the MIS 7.1 high stand of sea level occurred between 202 and 190 ka and was between 9 and 18 meters below present sea level, in good agreement with standard astronomical theory. Robinson *et al.* measure

CONTINUED ON PAGE 1605

PALEONTOLOGY

Leaving Their Mark

The extinction of the dinosaurs at the Cretaceous-Tertiary (K-T) boundary about 65 million years ago has been traced to the impact of a large object. The fossil record of insect extinction at the K-T boundary is not as clear, and it has been assumed that insects were better able to survive the impact because of their small size, flexible lifestyles, and overall abundance.

Labandeira *et al.* analyzed 13,000 fossil plant specimens collected from above and below the K-T boundary at Williston Basin, North Dakota. For each plant, they cataloged any signs of the presence of herbivorous insects, such as holes created by feeding. Across the 51 types of plant-insect associations, most of the insects that were specialized for feeding on one kind of plant became extinct at the K-T boundary. These results also suggest that the plant-insect diversity bottleneck, which spans the first 10 million years of the Tertiary in the fossil record of Wyoming, may have been precipitated by the impact event. — LR

Fossil plants with feeding holes (left) and galls (right).

Proc. Natl. Acad. Sci. U.S.A. **99**, 2061 (2002).

CREDITS: (TOP) YANG & RUBNER, *J. AM. CHEM. SOC.* 10.1021/JA017681Y; (BOTTOM) LABANDEIRA *ET AL., PROC. NATL. ACAD. SCI. U.S.A.* **99**, 2061 (2002)

the oxygen isotope composition of aragonite sediments from the Bahamas to investigate sea level changes over the duration of MIS 7, finding that the deglaciation at the beginning of MIS 7 occurred when it should have (and not before), based on astronomical theory. These records suggest that MIS 7 was more like MIS 1, the current interglacial period, than the preceding warm interval MIS 5, in the sense that its chronology matches the pattern of orbital forcing of that time. — HJS

Earth Planet. Sci. Lett., in press.

MICROBIOLOGY

A Tough Day Out for *Nostoc*

Cyanobacteria are ubiquitous but, being sessile, cannot escape the environmental onslaughts of sunlight, desiccation, and diurnal temperature fluctuation. Dvornyk *et al.* sampled *Nostoc linckia* from the opposing slopes of two canyons in Israel to look for genetic polymorphisms associated with the differential environmental stresses experienced by the cyanobacteria. The canyon walls are only 50 to 400 meters apart, but the south-facing slope receives six times as much solar radiation as the north-facing slope and thus offers an excellent opportunity to distinguish the relative

The nitrogen-fixing *Nostoc linckia*; cyanobacteria were formerly known as blue-green algae.

mutational effects of contrasting UV doses. In the 60 strains analyzed, the authors found eight haplotypes of the *kaiABC* gene cluster, which regulates daily circadian rhythms in *N. linckia*, that differ by nucleotide sequence or in the copy number of genes. The multiple-copy haplotypes were found at the sampling sites exposed to the greatest environmental extremes. The *kai* multigene family is relatively large and evolutionarily recent, and the diversification may have evolved (in an adaptive manner) as a result of the site-specific environmental conditions, developing and changing in severity with time. — CA

Proc. Natl. Acad. Sci. U.S.A. **99**, 2082 (2002).

CHEMISTRY

Swing Your Partners

In olefin metathesis, two unsaturated organic molecules exchange substituent groups that are attached to carbon-carbon double bonds (an example is the reaction of 2-butene and ethylene to produce propylene). Metathesis can be an efficient synthetic route, and increasingly sophisticated catalysts are providing access to targets that would otherwise be difficult to prepare. However, most metathesis catalysts are homogeneous and hence difficult to remove from the reaction. For practicality in a commercial context, supported catalysts would be preferable.

Based on their previously reported homogeneous chiral metathesis catalyst, prepared in situ from commercially available components, Hultzsch *et al.* have developed a polymer-supported version, which retains appreciable reactivity and excellent enantioselectivity in asymmetric olefin metathesis reactions. The slightly lower activity may result from less efficient diffusion of substrate molecules to the catalyst. The product contains less residual metal and can be isolated by filtration and solvent evaporation; furthermore, the supported catalyst can be recycled, although efficiency drops after a few cycles. Chiral metathesis catalysts of this kind are of particular interest for combinatorial synthesis and medicinal chemistry. — JU

Angew. Chem. Int. Ed. **41**, 589 (2002).

CELL BIOLOGY

Destroying to Rebuild

Epithelial cells are glued together by cell adhesion molecules, and the modulation of cell adhesion may be important in regulating differentiation of epithelia during development. E-cadherin is a substrate for tyrosine kinases, and tyrosine phosphorylation is followed by further posttranslational modification, the addition of ubiquitin molecules. Ubiquitination of E-cadherins causes their internalization and increases cell motility. Fujita *et al.* find that the protein Hakai (which means destruction in Japanese) binds specifically to tyrosine-phosphorylated E-cadherin and acts to stimulate ubiquitination and endocytosis. In cells expressing increased levels of Hakai, cell-cell contacts are disrupted, and internalization of E-cadherin is increased, as is cell motility. These effects of Hakai can be attributed directly to its being a member of the family of E3 ubiquitin ligases, enzymes that catalyze the terminal step in ubiquitination pathways. — SMH

Nature Cell Biol., 10.1038/ncb758.

CREDIT: GÜNTER H. STANJEK