

## ECOLOGY/EVOLUTION

### A Web of Spiders

Arthropod sociality is largely confined to insects—chiefly ants, bees, wasps, and termites. Less well known and far less diverse are the social spiders—about 20 species, many of which are cobweb spiders—in which large numbers of individuals occupy a communal web and cooperate in the capture of prey. Like social arthropods, the colonies tend to have a highly female-biased sex ratio.

Avilés *et al.* describe the unusual biology of an Ecuadorian social spider. These spiders live in colonies of one to several thousand individuals, proliferating and dispersing with a “boom-and-bust” dynamics whereby large colonies fragment into many smaller colonies, perhaps stimulated by the preference of an associated predator to inhabit and prey on the larger colonies. Intriguingly, the females of this species come in two sizes, which is suggestive of alternative reproductive strategies or even a caste system—possibilities that remain to be explored but are highly unusual outside the social insects. — AMS

*Biotropica* 38, 743 (2006).



## ANIMAL BEHAVIOR

### Submit or Perish

Social animals often pursue a hierarchical lifestyle, whose expression can be observed by third parties in the form of ritualized dominance displays. Primates, for example, use the relatively complex behavior of pseudocopulation between males as a means of affirming and signaling social relationships.

Issa and Edwards show that crayfish not only adopt dominance postures but also exhibit pseudocopulation. Dominance relationships are



*Procambarus clarkii*.

generally established quickly in pairs of male crayfish, with the dominant individual displaying typical male courtship behavior, including flipping the subordinate onto his back. In more than half of the pairs, the subordinate then adopted a passive supine posture reminiscent of female mating behavior. Pseudocopulating pairs spent less time fighting, with no mortality occurring in the first day. In pairs that did not pseudocopulate, the dominant males were persistently aggressive, and half of the subordinates were killed, dismem-

bered, and eaten. Thus, it seems that ritualized submission serves to increase the chance of survival for the subordinate crayfish, as it does in mammals—an intriguing example of the convergent evolution of social behavior. — GR

*Curr. Biol.* 16, 2217 (2006).

## IMMUNOLOGY

### Losses and Gains

Cytotoxic T lymphocytes (CTLs) monitor the body's cells for damage or infection by detecting changes in fragments of proteins presented on the cell surface by major histocompatibility complex (MHC) molecules. The spectrum of peptides presented depends on cellular machinery that chops the proteins into small pieces, and on endoplasmic reticulum aminopeptidases associated with antigen processing (ERAAP), which lop off N-terminal residues to generate peptides of the correct length for binding to MHC complexes.

Hammer *et al.* show that mice deficient in ERAAP display a large gap in the peptide repertoire presented. However, this hole is filled by a new set of peptides; these peptide-MHC combinations were immunogenic because they stimulated CTL and antibody production by B cells. Nevertheless, the complexes were structurally distinct from those of wild-type cells and appeared unstable because they rapidly disappeared from the cell surface. It will be of interest to investigate the activity of this editing enzyme in situations such as tumor surveillance and viral infection, perhaps with a view to modulating its activity therapeutically. — SJS

*Nat. Immunol.* 7, 10.1038/ni1409 (2006).

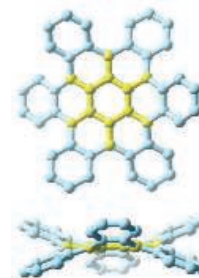
## CHEMISTRY

### Keeping the Charges in Line

Materials that convert sunlight into electrical current not only form electron-hole pairs upon light absorption but also must efficiently transport the carriers to prevent charge trapping and recombination. Disc-shaped liquid crystalline materials such as the contorted hexabenzocoronenes, which naturally form columnar conduit structures, have been studied for use in photovoltaic devices.

Cohen *et al.* find that photoconduction in films of these molecules is exclusively one-dimensional. Optical absorption spectroscopy indicates that the puckered molecular geometry disrupts full delocalization of the  $\pi$ -bonding network. As the molecules stack, the six phenyl rings at the edges interact weakly; only the nearly planar core regions overlap sufficiently for effective  $\pi$ -conjugation. Density functional

calculations were used to quantify this observation and indicated a 3.2-eV gap between the highest-energy occupied and lowest-energy unoccupied molecular orbitals in the core, in contrast to a 5.6-eV gap in the outer rings. As a result, these outer rings form an insulating cladding that promotes one-dimensional conduc-



Top and side views of hexabenzocoronene (core, yellow; cladding, blue).

tivity in the encircled radialene core. The high charge separation observed in these molecules renders them exciting candidates for applications. — MSL

*Nano Lett.* **6**, 10.1021/nl0620233 (2006).

## CLIMATE SCIENCE

## El Niño's Past and Future

The El Niño–Southern Oscillation (ENSO) causes large annual changes in tropical Pacific sea surface temperatures and leads to climate anomalies across the world. Researchers have sought a better understanding of the impact of global warming on ENSO phenomena. However, the limited temporal resolution of the few existing proxies for ENSO events has hindered reconstructions of ENSO variability in the past.

Koutavas *et al.* take an important step toward creating a more detailed paleo-ENSO record by performing oxygen-isotope analyses on single foraminifera and then combining those results with a Holocene sea surface temperature record of the eastern equatorial Pacific. They find that the variability in oxygen-isotope composition of individual forams increased since the mid-Holocene, indicating that ENSO events became more frequent or more intense over that interval. Additionally, opposing temperature variations in the eastern and western Pacific were consistent with a shift in the position of the Intertropical Convergence Zone (ITCZ). Because global warming is expected to shift the ITCZ position even further, there very well could be accompanying changes in ENSO phenomena. — HJS

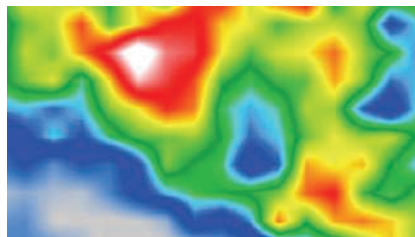
*Geology* **34**, 993 (2006).

## ASTROCHEMISTRY

## Anions in Space

Although more than 100 neutral molecules and 14 molecular cations have been identified in space, polyatomic anions have eluded detection. Most detection efforts have focused on small anions for which well-resolved spectra have been measured in the laboratory.

McCarthy *et al.* report rotational spectra for the comparatively large linear triynyl anion  $C_6H^-$ . In the millimeter band, absorption spectra were acquired from samples generated by dc discharge of acetylene at low pressures. In the centimeter band, Fourier-transform microwave spectra were



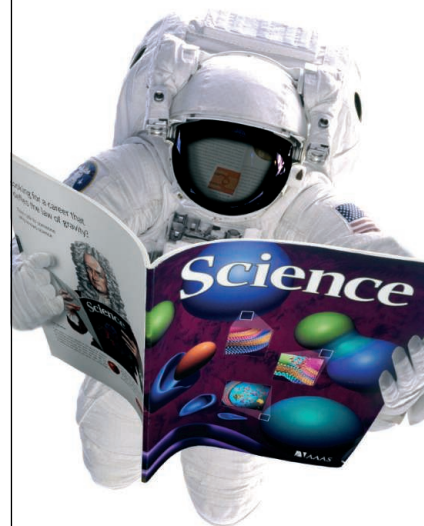
Tracer image of Taurus molecular clouds.

obtained using a molecular-beam source. Spectral shifts for the deuterated isotopomer helped to confirm the assignment. These spectra proved to be an excellent match to a harmonic series observed more than a decade ago in the infrared carbon star IRC +10216 in Leo, as well as to features observed in the Taurus molecular cloud TMC-1. The large size of this anion likely helps it to retain its excess electron despite high fluxes of ionizing ultraviolet radiation in space. — PDS

*Astrophys. J.* **652**, L141 (2006).

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## &lt;&lt; Of Arsenic and NF-κB

Arsenic is carcinogenic at low doses and cytotoxic at higher concentrations. Song *et al.* investigated the mechanisms underlying arsenite cytotoxicity, focusing on nuclear factor κB (NF-κB), which regulates the transcription of target genes when activated by means of IκB kinase (IKK). Although NF-κB generally mediates antiapoptotic signals—in part through inhibiting c-Jun N-terminal kinase (JNK) signaling—under some conditions, NF-κB signaling is proapoptotic. Wild-type mouse fibroblasts were more sensitive to the cytotoxic effects of arsenite than were cells lacking the β subunit of IKK. IKKβ<sup>-/-</sup> cells failed to show arsenite-dependent JNK phosphorylation, and inhibiting JNK signaling attenuated arsenite-mediated cell death. Arsenite acted through IKKβ–NF-κB to increase the abundance of growth arrest and DNA damage–inducible (GADD) 45α, whose up-regulation was required for arsenite-induced phosphorylation of JNK. Analysis of fibroblasts from knockout mice implicated the NF-κB1 subunit (p50) in arsenite's cytotoxic effects, and further analysis suggested that GADD45α up-regulation depended on p50-dependent inhibition of ubiquitination and proteasomal degradation. Thus, arsenite-mediated cytotoxicity appears to involve IKKβ–NF-κB-dependent activation of JNK signaling through a mechanism that depends on the accumulation of GADD45α rather than transcriptional activation. — EMA

*J. Cell Biol.* **175**, 607 (2006).

# Science

## Submit or Perish

Guy Riddihough

*Science* **314** (5805), 1516.  
DOI: 10.1126/science.314.5805.1516b

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