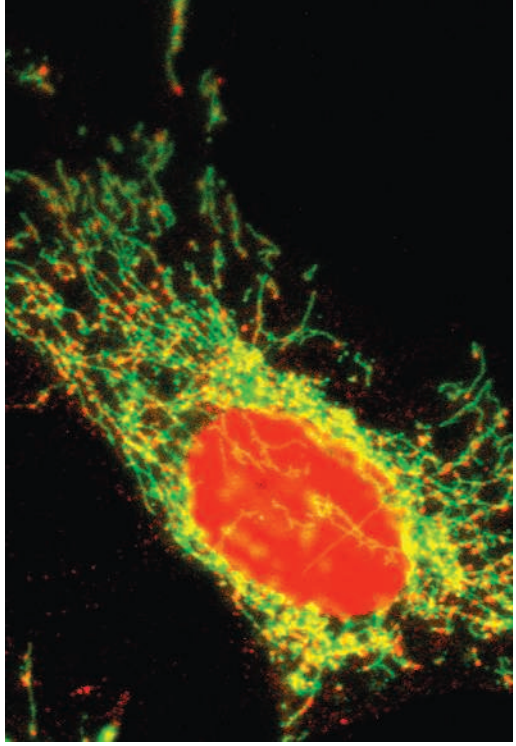
NEUROSCIENCE

Replenishing the Power Stations

Mitochondria—the microscopic powerhouses of the cell—contain their own vestigial genome (mtDNA), and each cell needs a collection of healthy organelles to survive. Mitochondria are highly dynamic and undergo both fission and fusion. They produce adenosine 5′-triphosphate by transferring electrons from organic substrates through a series of respiratory enzyme complexes to molecular oxygen. Chen *et al.* examined the function of the mitochondrial fusion protein mitofusin 2; mutations in the gene *Mfn2* have been linked to the peripheral neuropathy Charcot-Marie-Tooth type 2A, in which the very long motor and sensory neurons of the lower leg die. They generated mice that lacked Mfn2 specifically in the cerebellum and found that the mutant mice suffered cerebellar degeneration. Mitochondrial distribution, morphology, and function were all compromised in Mfn2-deficient cells, and many mitochondria appeared to have lost their normal complement of mtDNA. The authors propose that a dynamic fusion capacity is required to maintain the genetic wherewithal for each mitochondrion to synthesize adequate supplies of respiratory enzymes. Furthermore, it seems that the Purkinje cells of the cerebellum are particularly sensitive to changes in the distribution and respiratory activity of their mitochondria, perhaps as a consequence of their extensive ramifications. — SMH



Cerebellar structure (left) and mitochondrial distribution (right, yellow).

Cell **130**, 548 (2007).

MOLECULAR BIOLOGY

The Sign of Four

Nucleosomes constitute the principal structural motif of eukaryotic chromosomes and contain octomers of highly conserved histones with the almost invariant stoichiometry of two copies each of H2A, H2B, H3, and H4. Centromeres are specialized regions within chromosomes that play a critical role in the accurate segregation of duplicated chromosomes during cell division. Centromere nucleosomes contain an alternative histone, CenH3, which is thought to define centromere identity and participate in mitotic mechanics.

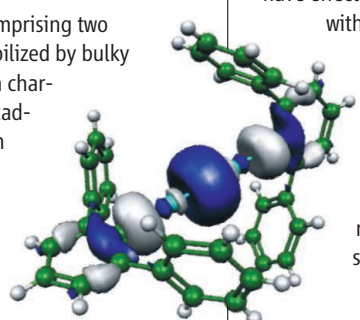
Dalal *et al.* have explored these issues through a biochemical and biophysical analysis of centromere nucleosomes in *Drosophila*. Cross-linking of bulk chromatin from crude extracts and within purified nuclei revealed that CenH3 appears in a heterotypic tetrameric half-sized nucleosome, with one copy each of CenH3, H2A, H2B, and H4. This composition was confirmed by mass spectrometry, and atomic force microscopy showed tetramers to be half the height of octomers. The tetramers protect less DNA [~120 base pairs (bp)] than the canonical octomers (~150 bp) and do not seem to form as regular higher-order structures as the octomer, yielding longer and more variable DNA linker lengths. This looser chromatin conformation, embedded within heterochromatin, may be critical for tethering the kinetochore to the centromere. — GR

PLoS Biol. **5**, e218 (2007).

CHEMISTRY

Three in a Column

Numerous compounds comprising two bonded metal centers stabilized by bulky organic ligands have been characterized. However, zinc, cadmium, and mercury, which straddle the boundary between d-block and p-block metals, have only very recently been observed in this motif. Zhu *et al.* previously prepared zinc and cadmium dimers bearing bis(diisopropylphenyl)phenyl ligands, and have now synthesized a mercury dimer with the same ligand set to complete a homologous series. The compounds were accessed by reduction of metal halide precursors, and their solid-state structures characterized by x-ray crystallography. As predicted by theoretical calculations, the mercury-mercury bond is longer (and thus likely weaker) than the analogous zinc linkage, but shorter than the cadmium bond. The calculations implicate relativistic effects in this bond shortening, in keeping with a higher proportion of s-orbital character (as well as a measure of dz^2 overlap) in the mercury dimer's highest occupied molecular orbital (HOMO). All three compounds have effectively linear C-M-M-C geometries, with the terminal phenyl rings canted at an approximate right angle relative to one another. The authors also prepared zinc and cadmium dimers incorporating bridging hydride ligands for structural comparison; the mercury hydride proved monomeric and was characterized spectroscopically. — JSY



Calculated HOMO of mercury dimer.

J. Am. Chem. Soc. **129**, 10.1021/ja072682x (2007).

MATERIALS SCIENCE

An Inside View of Weaving

Fiber-reinforced composites (FRCs) are finding increasing use as structural materials because they offer good performance at low weights. The mechanical properties of any given FRC depend on many variables, including the distribution and

orientation of the fibers within the matrix material. However, for most composites, nondestructive visualization of the fibers' response to stresses is precluded either by the opacity of the matrix material or by insufficient contrast between the fibers and the matrix.

Davies *et al.* surmount this challenge by probing an FRC through diffraction of a high-flux, microfocused x-ray beam from a synchrotron source. The sample comprised woven poly(*p*-phenylene phthalamide) (PPTA) fiber mats embedded in an epoxy matrix. A hole drilled into the center of the specimens modeled the rivet holes typically used to attach composite panels in aeronautical applications. The diffraction data clearly resolved the interleaved pattern of the woven fibers. Damage to the fibers was localized near the hole, and the tilt angle increased for fibers parallel to the strain direction as the stresses were transferred to neighboring fibers away from the hole. Because PPTA forms oriented fibers, the authors were able to determine changes in orientation of the yarn and could thus observe reorientation of the horizontal fibers caused by stress transfer. — MSL

Appl. Phys. Lett. **91**, 044102 (2007).

MATERIALS SCIENCE

Sublimed Clusters

Inorganic thin films can be formed under vacuum conditions by transferring material from one surface as a vapor and depositing it on a nearby substrate. However, forming the vapor phase often involves harsh conditions—such as heating to very high temperature or bombardment with high-energy ions or photons—to desorb atomic species or a distribution of clusters. As a result, preserving intricate synthetic structures during the transfer is often difficult. Chao *et al*. show that silicon nanocrystals (with mean diameters near 2 nm) capped with undecyl hydrocarbon chains can undergo thermal desorption at relatively low temperature (200°C) and be transferred from one surface to another for a wide variety of substrates. Composition of the transferred particles was confirmed by x-ray photoemission spectroscopy, and morphologies were examined with a range of microscopy techniques. The nanocrystals initially grew as two-dimensional islands but could also form three-dimensional clusters. — PDS

Nat. Nanotechnol. **2**, 486 (2007).

ECOLOGY/EVOLUTION

The Whole Is the Sum of the Parts

The fragmentation of natural ecosystems as a by-product of human activity is generally held to have adverse consequences for biodiversity, because it reduces the area of each habitat as well as the opportunities for dispersal and gene flow. Yaacobi *et al.* tease apart the effects of areal loss from those of degree of fragmentation in a Mediterranean scrub ecosystem in Israel. The total number of species of beetles and plants remained unaffected by the degree of subdivision of the landscape: a patch of area *A* having a similar number of species to *n* smaller patches of total area *A*. Despite this absence of an effect, the authors caution that the absolute number of species is not the only goal of conservation. Fragmentation also affects the abundance of individual species, some of which may be charismatic, and the composition of ecological communities in patches, features that are key determinants of ecosystem health. — AMS

CREDIT: YAACOBI *ET AL., PROC. R. SOC. LONDON B* **274**, 10.1098/RSPB.2007.0674 (2007)

Proc. R. Soc. London B **274**, 10.1098/rspb.2007.0674 (2007).

Science stke AAAS

www.stke.org

<< Hyperactive Antimicrobials

Rosacea is a painful acne-like skin disorder, characterized by dilated blood vessels and persistent redness of the face. Yamasaki *et al*. provide evidence that cathelicidin peptides—which are chemotactic, angiogenic, and bactericidal, and are important for innate immune responses in the skin—are involved in the pathogenesis of rosacea. Skin biopsies of patients with rosacea had elevated levels of cathelicidin and cathelicidin mRNA. Processing of the cathelicidin precursor involves cleavage of the proprotein by the kallikrein family protease stratum corneum tryptic enzyme (SCTE); rosacea samples had elevated levels of SCTE and protease activity. The abundant cathelicidin fragment LL-37 stimulated interleukin-8 (IL-8) production in cultured human keratinocytes and caused erythema, vascular dilation, neutrophil infiltration, thrombosis, and hemorrhage when injected subcutaneously into mice; injection of SCTE caused similar symptoms. In mice deficient for the gene *Camp*, which encodes cathelicidin, inflammation was substantially less than normal after application of a contact skin irritant or physical abrasion. — NRG

Nat. Med. **13**, 975 (2007).

Published by AAAS