EDITED BY GILBERT CHIN AND JAKE YESTON

ANIMAL BEHAVIOR

The Avian Working Class

Shearwaters are ocean going birds that hunt small pelagic fish and squid. They forage the continental shelf off eastern Spain, flying several hundred kilometers a day in search of their peripatetic prey. On the weekdays; that is, from Monday to Friday; the food supply is more reliable and comes from the waste discarded from fishing boats. Although bad weather can be disruptive, the fishermen's routines and foraging patterns are constrained into temporal and spatial regularity by legislation and by their neighbors' fishing rights. Thus, by coupling satellite data on the birds' movements in a random walk model, Bartumeus *et al.* show how shearwaters respond to trawler discard and exploit an otherwise inaccessible food source. Thus, during weekdays, shearwaters feed in the trawler fishing grounds and consequently can make more return trips to feed their young, because they can trust the fishing boats to supply the next meal. In contrast, during weekends and public holidays, unaided by boats, the birds have to undertake lengthy exploratory trips to seek food. — CA

Curr. Biol. **20**, 10.1016/j.cub.2009.11.073 (2010).

PHYSICS

Factoring in Noise

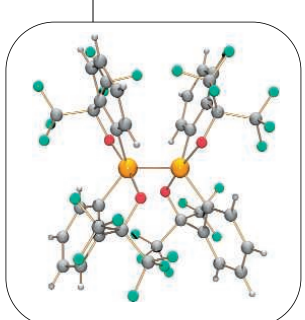
Quantum dots are semiconducting nanostructures often referred to as "artificial atoms" because of the discreteness of their energy levels. However, unlike real atoms, quantum dots of a given elemental formula are not all created equal: A typical manufacturing process inevitably results in dots that vary in shape and size, leading to differences in energy levels and other properties. Thus, the full ensemble of quantum dots must be carefully characterized before the potential use of its constituents in spintronics and quantum information applications. One of the most important properties in these contexts is the current carriers' response to external magnetic fields, quantified by the so-called Landé or *g* factor. The *g* factor is usually measured through optical pump-probe studies. Now, Crooker *et al.* have analyzed the weak spin noise signature in (In,Ga)As/GaAs quantum dots using sophisticated power spectral averaging to extract the response of both negative (electron) and positive (hole) carriers. The applied magnetic field causes the carriers' spins to precess and centers the spin fluctuation spectrum at the associated Larmor frequency, proportional to the *g* factor. The study reveals that the hole *g* factor is highly anisotropic and that within the sample this anisotropy varies monotonically with the quantum dot confining energy. — JS

Phys. Rev. Lett. **104**, 36601 (2010).

CHEMISTRY

Five on Five

In most molecular contexts, silicon behaves like carbon in forming covalent bonds to four neighboring atoms. Kano *et al*. have now coaxed the element into a more crowded motif. Specifically, by using lithium as an electron source, the authors reduced two four-coordinate silicon centers and brought them together to form a bond. The resulting dianion, characterized in solution as well as the solid state, proved remarkably stable, even persisting for days in boiling water. Protonation with acid liberated a substituent at each silicon, forming a product with more conventional four-coordinate centers, but the process was efficiently reversed on treatment with a strong base. The authors attribute the stability of the unusual five-coordinate bonding arrangement partly to the electron-withdrawing character of the surrounding substituents (benzyl alcohol derivatives bearing trifluoromethyl groups). Theoretical calculations supported a bond order between silicons approaching 1 and suggested that the silicon centers themselves bore positive charges, despite the overall dual negative charge of the complex. — JSY



Nat. Chem. **2**, 112 (2010).

MATERIALS SCIENCE

Stringing DNA Along

The high base-pairing fidelity of DNA makes the biopolymer a powerfully versatile templating material for precise nanoscale fabrication. Unfortunately. it is costly to prepare long sequences and thus to direct structure over a long range. In contrast, synthetic block copolymers are well suited to creating periodic structures over long distances because of the microphase separation of the covalently linked blocks that ensues in a selective solvent. Carneiro *et al.* attached a dendritic oligo(ethylene glycol) (OEG) unit to one end of 10– to 20–base pair DNA oligomers. Hybridization with the complementary DNA strands then formed a

CREDITS (TOP TO BOTTOM): JOSÉ MANUEL ARCOS, SEO/BIRDLIFE; KANO *ET AL.*, *NAT. CHEM.* **2**, 112 (2010)

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triblock, with dendritic units at either end that could assemble into long fibers when a selective solvent was added. The fibers extended for several micrometers and could further align into parallel rows. Fiber formation could be tuned or eliminated by changing the ratio of DNA to OEG or by changing the number of arms on the OEG. More complex structures could also be prepared by hybridizing three linking strands to three dendritic DNA strands, yielding a three-helix bundle that, despite the internal complexity, could still form long ordered strands. — MSL

J. Am. Chem. Soc. **132**, 679 (2010).

BIOPHYSICS

Molecular Yoga

The influence of tremendous advances in biological crystallography—most notably of membrane proteins and of large complexes of nucleic acids and proteins—has been profound. Perhaps too much so, for the glittering array of colorful macromolecules has tended to obscure the fact that they are constantly stretching, contracting, bending, or twisting.

Using molecular dynamics and normal mode analysis, Grinthal *et al.* illustrate the potential biological impact of these restless movements. Protein phosphatase 2A (PP2A) consists of a catalytic subunit (yellow), a regulatory subunit (green), and the PR65 scaffold (blue). This last component contains 15 repeats of a two-helix unit and adopts a curved solenoid shape. The lowest-frequency mode of the PP2A heterotrimer combines torsion and flexion of PR65, and the

effect is to repetitively open and close the catalytic site (red) located at the interface between the other two subunits. Tuning these motions either by transiently applying force or via mutation within the interhelix linkages would result in what might be called an elasto-steric regulation of enzyme activity. — GJC

Proc. Natl. Acad. Sci. U.S.A. **107**, 10.1073/pnas.0914073107 (2010).

CREDIT: GRINTHAL *ET AL.*, *PROC. NATL. ACAD. SCI. U.S.A.* **107**, 10.1073/PNAS.0914073107 (2010)

IMMUNOLOGY

Gut Reactions Gone Awry

Crohn's disease is a debilitating autoinflammatory disease of the gastrointestinal tract. Genome-wide association studies have demonstrated strong links between Crohn's disease and polymorphisms in genes involved in microbial recognition (*NOD2*) and autophagy (*ATG16L1*), which is a broad-spectrum intracellular degradation pathway. How microbial recognition and autophagy might intersect, however, has been unclear.

Travassos *et al.* and Cooney *et al.* have found that NOD2 detection of bacterial peptidoglycans results in the recruitment of ATG16L1 to sites of bacterial entry at the plasma membrane. This aids in the formation of autophagosomes, a process that promotes bacterial degradation and leads to the presentation of bacterial antigens to $CD4^+$ T cells. Both groups then went on to connect these events to Crohn's disease. Using cells either from Crohn's disease patients expressing the disease-associated variants of NOD2 or ATG16L1 or from mice homozygous for a NOD2 disease-associated variant, they observed deficits in ATG16L1 localization to the plasma membrane, autophagy induction, antigen presentation, and bacterial clearance. Together, these studies suggest that bacterial persistence, due to impaired autophagic degradation, may be an important driver in the pathogenesis of Crohn's disease. — KLM

Nat. Immunol. **11**, 55; *Nat. Med.* **16**, 90 (2010).

BIOTECHNOLOGY

The Heart of Nanotechnology

Muscle cells in the heart must adopt specific orientations so that they can work together to produce strong contractile forces. The cells receive organizing cues from the surrounding extracellular matrix (ECM). In tissue culture, myocyte orientations are random in the absence of ECM, and large-scale patterning (on the order of 10 μm) of the substratum can instill an organized pattern of growth.

Kim *et al.* have used capillary lithography to create a synthetic extracellular matrix from polyethylene glycol hydrogel arrays, with grooves and ridges a few hundred nanometers tall and wide—a scale that may mimic the effect on cells of ECM fibrils in vivo. Although the rat ventricular myocytes sometimes spanned several ridges, they were sensitive to ridge spacing. The physical properties of the synthetic matrix influenced cell orientation, cell size, adhesion, and electrophysiological properties. Expression of the gap junction protein connexin 43, which supports intercellular communication, was also sensitive to variation in the spacing of the ridges. The authors note that the ability to synthesize such materials may be essential for engineering tissue-repair processes in medical applications. — LBR

Proc. Natl. Acad. Sci. U.S.A. **107**, 565 (2010).

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