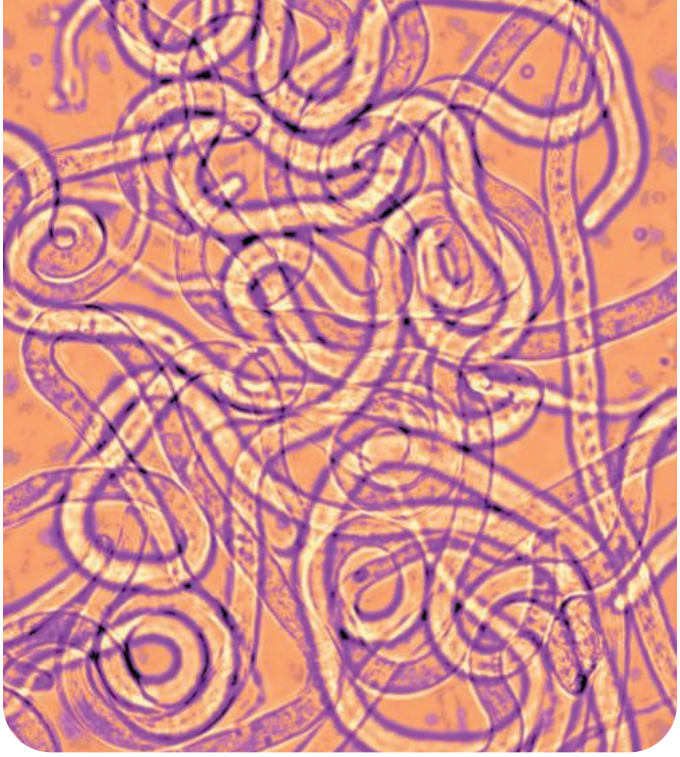
EDITED BY STELLA HURTLEY AND PHIL SZUROMI



Completing a Life Cycle of Genomes

Filarial nematodes, which are important pathogens that infect large numbers of people in developing countries within the tropics, have complex life cycles involving one or more intermediate hosts. **Ghedin *et al.*** (p. 1756) now present the genome sequence of *Brugia malayi*. The free-living *Caenorhabditis elegans* nematode genome sequences allow comparisons with the sequence for the filarial worm and offer the potential to identify the genes involved in parasitism. The genomes for all of the hosts involved in this parasite's life cycle are now available—human, mosquito, *Wolbachia*, and the filarial worm itself, which opens the door to system-based studies of these relationships.

Fractional Quantum Hall Effect in 3D

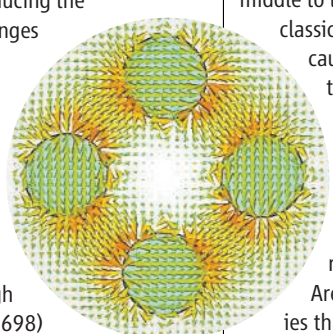
In a two-dimensional (2D) electron gas, condensation can occur at particular magnetic fields to create a state that hosts remarkable liquidlike properties. Prior work has indicated this fractional quantum Hall effect arises from intrinsically many-body quantum ground states specific to 2D systems. **Behnia *et al.*** (p. 1729, published online 16 August; see the Perspective by **Huxley and Green**) report heat- and charge-transport measurements that suggest that a similar state might also be observed in bismuth crystals at very high magnetic fields, in part because this metal has such a small Fermi surface and electrons travel with very long mean-free paths. The authors found that electron correlations in bismuth are stronger than what has been commonly assumed, and that this elemental metal may host an exotic quantum Hall fluid.

From One Ring, Many

The Diels-Alder cyclization has proven widely useful in organic synthesis for introducing structural complexity in a single reaction step. Through formation of two carbon-carbon bonds, the reaction presents the opportunity to control the stereochemistry at four different centers simultaneously. **Balskus and Jacobsen** (p. 1736) show that a chiral oxazaborolidine derivative catalyzes an asymmetric Diels-Alder reaction across preformed organic macrocycles to create ring systems with high stereoselectivity in which three rings with five to eight members are linked by edge-sharing. The broad substrate scope spans a range of macrocycles bearing *E,E* dienes, and the authors applied this approach specifically to the synthesis of a sesquiterpene natural product.

Optical Nanocircuits

Increasing the clock speed of electronic circuits will begin to push the operating frequencies toward the optical regime and will require advances in addition to reducing the size of components. Challenges include the unacceptable losses in conventional microelectronics circuitry when operated at optical frequencies as well as a lack of basic circuit elements, such as resistors, capacitors, and inductors, when operating at such high frequencies. **Engheta** (p. 1698) overviews a proposed route which considers the optical response of subwavelength nanoparticles as the nanocircuit building blocks. By combining the ability to tune the optical response of metamaterials with the ability to join the building blocks together, it may be possible to create "lumped" optical circuitry akin to the circuit diagrams and structures in microelectronics.



Deep Spin-Transition Region

The structure, composition, and dynamics of the Earth's lower mantle are affected by the quantum spin states of iron within minerals at high pressure and temperature. However, this behavior is not well established experimentally. **Lin *et al.*** (p. 1740) have determined the spin state of iron in ferropericlase at lower-mantle pressures and temperatures using an x-ray emission spectrometer with in situ synchrotron x-ray diffraction in the laser-heated diamond cell. A continuous change in spin properties occurs in a region spanning the middle to lower mantle (1300 to 2200 kilometers in depth). In the lowermost mantle, low-spin ferropericlase is stable. The spin transition in the middle to low mantle cannot be described by classical equations of state and may possibly cause steep velocity and density gradients there that may be detected seismically.

All in the Wrist?

The origins and affinity of the small-bodied hominins, *Homo floresiensis*, remain widely debated and enigmatic. Are these the fossils of a primitive species that somehow persisted in isolation on Flores until the Holocene, or pathologic modern humans, or something else? **Tocheri *et al.*** (p. 1743) show that the wrist bones of the original specimen are markedly primitive and completely unlike those of modern humans or of Neandertals.

Sperm Stem Cells

Little is known about the mammalian spermatogenic stem cell niche. **Yoshida *et al.*** (p. 1722; see the Perspective by **DiNardo and Braun**) used time-lapse imaging and three-dimensional reconstruction to reveal the localization of the

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CREDITS (TOP TO BOTTOM): GHEDIN *ET AL.*; ENGHETA

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candidate stem cells (undifferentiated spermatogonia) and found that these cells localize to the vasculature surrounding the seminiferous tubules in the mouse testis. Upon differentiation, the germ cells leave these regions to spread all through the seminiferous tubules.

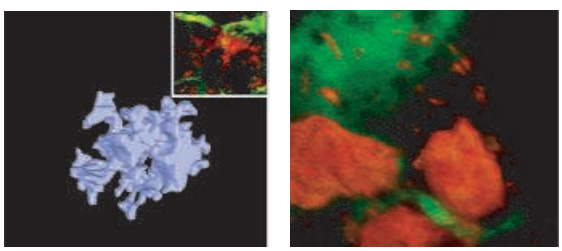
Transporting Zinc

The divalent zinc cation is found in multiple guises in prokaryotic and eukaryotic cells. **Lu and Fu** (p. 1746, published online 23 August; see the Perspective by **Nies**) present the 3.8 angstrom structure of YiiP, a bacterial membrane protein that imports Zn^{2+} by exchanging it for H^+. The structure of YiiP is a Y-shaped homodimer, through which a presumptive pathway for Zn^{2+}/H^+ exchange can be discerned. YiiP is a member of the cation diffusion facilitator family of transport proteins. Another family member, ZnT-8, is expressed solely in pancreatic β cells and has recently been associated with risk for type 2 diabetes.

Technicolor Super-Resolution Imaging

The ability to visualize molecular interactions at 20- to 50-nanometer (nm) resolution requires multicolor super-resolution imaging and has remained challenging. **Bates *et al.*** (p. 1749, published online 16 August) report the implementation of multicolor stochastic optical reconstruction microscopy (STORM) using a family of photoswitchable activator-reporter pairs. Combinatorial pairing of three reporters and three activators allowed up to nine distinguishable fluorescent probes. Three-color imaging of a model DNA sample and two-color imaging of fixed cells was obtained at 20- to 30-nm resolution.

Taking a Peek at Platelet Production



Current models of thrombopoiesis (platelet formation) have largely been derived from in vitro studies and static imaging approaches. **Junt *et al.*** (p. 1767; see the Perspective by **Geddis and Kaushansky**) use dynamic intravital imaging to reveal the behavior of active platelet-producing megakaryocytes within the bone marrow. Megakaryocytes remained in close contact with microvessels of the bone marrow, protruding long extensions into the blood stream. It appears that the shear force exerted by the bloodstream then plays an active role in the release of larger megakaryocyte protrusions that allows platelets and proplatelets to move into the peripheral circulation.

CREDIT: JUNT *ET AL.*

Crossing Kingdoms

Whole eukaryote genome sequencing projects routinely exclude bacterial sequences on the assumption that they represent contamination. However, **Dunning Hotopp *et al.*** (p. 1753, published online 30 August) found examples of genetic insertions from the bacterial endosymbiont *Wolbachia* into eukaryotic genomes in eleven species across six genera, three insect orders, and two different phyla. These inserts range from almost an entire *Wolbachia* genome to short 100–base pair inserts and are found as degenerate and transcribed genes. Thus, the movement of DNA between bacteria and eukaryotes may not be as rare as has been assumed.

Reconstituting MicroRNA Gene Regulation

MicroRNAs are small, ~21-nucleotide noncoding RNAs present in the genomes of almost all eukaryotes. They regulate gene expression in animals by repressing translation of target RNAs and also destabilizing them. The precise mechanism of repression has remained something of a mystery. **Mathonnet *et al.*** (p. 1764; published online 26 July) developed an in vitro messenger RNA (mRNA) translation system that recapitulates the ability of miRNAs to down-regulate gene expression. In this cell-free system, Let-7 miRNA acts to block the initial step of translation—recognition of the mRNA 5′ cap. Thus, degradation of mRNA is not critical for gene repression, at least at in the early stages of the process.

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