Migrants walking through the Little Ethiopia area of Los Angeles, California

VASCULAR BIOLOGY
Lymphatics limp along after MRSA

Lymphedema is associated with skin and soft tissue infections, and both can be recurring, causing continual suffering in affected patients. To better understand the relationship between bacterial infections and lymphedema, Jones et al. used intravital imaging. They examined the lymphatics of mice infected with MRSA (methicillin-resistant Staphylococcus aureus) and observed lymphatic muscle cell death, which led to prolonged dysfunction months after the bacteria had been cleared. In vitro experiments with human cells indicated bacterial toxins were responsible for damaging the lymphatic muscle cells. The findings suggest that these bacterial toxins could be targeted in patients to interrupt this brutal cycle. —LP

NANOROBOTICS
Electrically driving a DNA arm

Most nanoelectromechanical systems are formed by etching inorganic materials such as silicon. Kopperger et al. improved the precision of such machines by synthesizing a 25-nm-long arm defined by a DNA six-helix bundle connected to a 55 nm–by–55 nm DNA origami plate via flexible single-stranded scaffold crossovers (see the Perspective by Hogberg). When placed in a cross-shaped electrophoretic chamber, the arms could be driven at angular frequencies of up to 25 Hz and positioned to within 2.5 nm. The arm could be used to transport fluorophores and inorganic nanoparticles. —PDS
Science, this issue p. 296; see also p. 279

SYNTHEtic BIOLOGY
Large-scale gene synthesis in tiny droplets

Gene synthesis technology is important for functional characterization of DNA sequences and for the development of synthetic biology. However, current methods are limited by their low scalability and high cost. Plesa et al. developed a gene synthesis method, DropSynth, which uses barcoded beads to concentrate oligos and subsequently assemble them into synthetic genes within picoliter emulsion droplets. DropSynth allows generation of large libraries of thousands of genes and functional testing of all possible mutations of a particular sequence. —SYM
Science, this issue p. 343

VACCINES
Avoiding interferon avoidance

Interferon (IFN) expression is a mammal’s first response to viral infection. Many viruses have thus evolved mechanisms to evade IFN. Du et al. developed a method to systematically ablate IFN evasion genes from live, attenuated influenza virus

Data-driven refugee assignment

The continuing refugee crisis has made it necessary for governments to find ways to resettle individuals and families in host communities. Bansak et al. used a machine learning approach to develop an algorithm for geographically placing refugees to optimize their overall employment rate. The authors developed and tested the algorithm on segments of registry data from the United States and Switzerland. The algorithm improved the employment prospects of refugees in the United States by ~40% and in Switzerland by ~75%. —BJ
Science, this issue p. 325
(see the Perspective by Teijaro and Burton). A combination of mutants was assembled to construct a virus that triggered transient IFN responses in mice but that was unable to replicate effectively. The transient IFN responses led to robust antibody and memory responses that protected against subsequent challenge with different influenza viruses. This approach could be adapted to improve other RNA virus vaccines. —CA
Science, this issue p. 290; see also p. 277

QUANTUM FLUIDS
Making dilute quantum droplets
In recent years, quantum fluids have been studied largely in gaseous form, such as the Bose-Einstein condensates (BECs) of alkali atoms and related species. Quantum liquids, other than liquid helium, have been comparatively more difficult to come by. Cabrera et al. combined two BECs and manipulated the atomic interactions to create droplets of a quantum liquid (see the Perspective by Ferrier-Barbut and Pfau). Because the interactions were not directional, the droplets had a roughly round shape. The simplicity of this dilute system makes it amenable to theoretical modeling, enabling a better understanding of quantum fluids. —JS
Science, this issue p. 301; see also p. 274

STRUCTURAL BIOLOGY
Recognizing centromere by kinetochore
The kinetochore proteins CENP-N and CENP-C recognize the histone H3 variant CENP-A in the centromeric nucleosome. This ensures proper kinetochore assembly and accurate segregation of chromosomes. Chittori et al. describe the cryo-electron microscopy structure of the human CENP-A nucleosome—CENP-N complex. The interaction of CENP-N with CENP-A and the nucleosomal DNA together ensure specific and stable centromeric nucleosome recognition. Mutational analyses using both human and Xenopus CENP-A and CENP-N proteins suggest that the proteins have coevolved to preserve the interacting surfaces. —SYM
Science, this issue p. 339

RESEARCH METHODS
Algorithms fail to improve predictions
In the United States, algorithms are commonly used to predict the likelihood that a criminal defendant will commit a crime, and these predictions influence pretrial, parole, and sentencing decisions. Commercial software, such as the widely used COMPAS system, promises to make these predictions more accurate than human judgments. Dressel and Farid show that COMPAS’s impressively sounding 137-feature black box is nearly equivalent to a trivial linear classifier using two features, and both approaches are no more accurate or fair than predictions made by people with little or no criminal justice expertise. —AC

INDUCED SEISMICITY
Seismicity curbed by lowering volume
Determining why hydraulic fracturing (also known as fracking) triggered earthquakes in the Duvernay Formation in Canada is important for future hazard mitigation. Schultz et al. found that injection volume was the key operational parameter correlated with induced earthquakes in the Duvernay. However, geological factors also played a considerable role in determining whether a large injection volume would trigger earthquakes. These findings provide a framework that may lead to better forecasting of induced seismicity. —BG
Science, this issue p. 304

GEOPHYSICS
Going dry in the Pacific Northwest
Volcanic belts such as the Andes result from deep melting as water dragged down during subduction fluxes into the crust. Canales et al. show that the Juan de Fuca slab, which is subducting below the Pacific Northwest in North America, is much drier than other subducting slabs. The distribution of water in the slab may help determine the origins of seismic tremor and episodic slip that occur in this region. It also confirms a hypothesis that volcanism in the region is not the result of the influence of water, but rather is due to the decompression trigger melting more commonly seen along mid-ocean ridges. —BG

MOLECULAR BIOLOGY
Time-out for mRNAs in the nucleus
Cell cycle events are precisely orchestrated to ensure accurate cell division. Yang et al. have discovered that sequestering mature mRNAs in the nucleus modulates cell cycle players. In dividing Arabidopsis cells, nuclear retention of CDC20 and CCS52B mRNAs prevents them from being released into the cytoplasm until the nuclear envelope breaks down at pro-metaphase. Released mRNAs are rapidly translated into proteins, ensuring their regulatory functions at the proper cell cycle stage. Similar nuclear sequestration strategies may be used for other mRNAs in different cellular contexts. —SYM

NEUROSCIENCE
Serious damage by soluble tau
Alterations in the metabolism of the neuronal microtubule-associated protein tau are central to several neurodegenerative diseases. In these diseases, tau usually loses solubility and forms aggregates that impair cell
A plastic plan for organic synthesis

The infrastructure for chemical synthesis typically lies at either end of a spectrum: small-scale studies in ad hoc assemblies of glassware or large-scale production in capital-intensive custom reactors. Kitson et al. report a hybrid protocol that customizes a blueprint for synthesis of a target compound in a series of interconnected plastic modules, which can be assembled en masse by 3D printing (see the Perspective by Hornung). The approach, demonstrated for the commercial muscle relaxant bacofofen, establishes a systematic workflow that is potentially amenable to automation: All that is necessary for synthesis and purification is the introduction of stock solutions and variation of temperature or pressure. —JSY

Science, this issue p. 314; see also p. 273

MEMBRANE PROTEINS
Making your way through the side of a barrel

The mechanism of membrane insertion and assembly of β-barrel proteins is a central question of outer membrane biogenesis of mitochondria, chloroplasts, and Gram-negative bacteria. Höhr et al. developed assays to address this fundamental problem. They systematically mapped precursor proteins transported by the mitochondrial Omp85 channel (Sam50) to elucidate the entire membrane insertion pathway of a precursor in the native membrane environment. Their findings directly demonstrate translocation of precursor proteins through the lumen of the mitochondrial Omp85 channel, signal recognition by β-strand exchange between channel and precursor, and exit through the lateral gate into the membrane. —SMH

Science, this issue p. 289

BIOPHYSICS
Watching single molecules in motion

Structural techniques such as X-ray crystallography and electron microscopy give insight into how macromolecules function by providing snapshots of different conformational states. Function also depends on the path between those states, but to see that path involves watching single molecules move. This became possible with the advent of single-molecule Förster resonance energy transfer (smFRET), which was first implemented in 1996. Lerner et al. review how smFRET has been used to study macromolecules in action, providing mechanistic insights into processes such as DNA repair, transcription, and translation. They also describe current limitations of the approach and suggest how future developments may expand the applications of smFRET. —VV

Science, this issue p. 288

MAGNETIC MATERIALS
Boosting chiral nanoparticle responses

Optical nanomaterials that combine chirality and magnetism are useful for magneto-optics and as chiral catalysts. Although chiral inorganic nanostructures can exhibit high circular dichroism, modulating this optical activity has usually required irreversible chemical changes. Yeom et al. synthesized paramagnetic cobalt oxide (CoO) nanoparticles with L- and D-cysteine surface ligands. These ligands created chiral distortions of the crystal lattices, and this anisotropy led to much stronger chiroptical activity. The circular dichroism in the ultraviolet of nanoparticle gels could be modulated with magnetic fields of ~1.5 tesla. —PDS

Science, this issue p. 309

CHEMICAL BIOPHYSICS
A global map of soil bacteria

Soil bacteria play key roles in regulating terrestrial carbon dynamics, nutrient cycles, and plant productivity. However, the natural histories and distributions of these organisms remain largely undocumented. Delgado-Baquerizo et al. provide a survey of the dominant bacterial taxa found around the world. In soil collections from six continents, they found that only 2% of bacterial taxa account for nearly half of the soil bacterial communities across the globe. These dominant taxa could be clustered into ecological groups of co-occurring bacteria that share habitat preferences. The findings will allow for a more predictive understanding of soil bacterial diversity and distribution. —AMS

Science, this issue p. 320

MOLECULAR BIOLOGY
Substrate recognition by Dicer elucidated

The Dicer protein generates short RNAs from double-stranded RNA (dsRNA) substrates and is critical for RNA interference and antiviral defense. Sinha et al. report structures of a Drosophila Dicer protein that shed light on its two distinct mechanisms for recognizing and cleaving substrates: adenosine triphosphate (ATP)—independent, distributive cleavage of 3′-overhang dsRNAs and ATP-dependent, processive threading of blunt-end dsRNAs. This flexibility might provide invertebrates with the optimization capabilities needed for antiviral defense. —SYM

Science, this issue p. 329

CHEMICAL BIOLOGY
A naturally modified cellulose

Cellulose is the most abundant biopolymer on Earth and an important component of bacterial biofilms. Thongsomboon et al. used solid-state nuclear magnetic resonance spectroscopy to identify a naturally derived, chemically modified cellulose, phosphoethanolamine cellulose (see the Perspective by Galperin and Shalaeva). They went on to identify the genetic basis and molecular signaling involved in introducing this modification in bacteria, which regulates biofilm matrix architecture and function. This discovery has implications for understanding bacterial biofilms and for the generation of new cellulose-like materials. —SYM

Science, this issue p. 334; see also p. 276

VASCULAR BIOLOGY
Processing microRNAs for blood vessels

Patients with hereditary hemorrhagic telangiectasia (HHT) are prone to hemorrhages and nose bleeds. This is usually (but not always) because of mutant proteins in a signaling pathway that regulates blood vessel formation. Jiang et al. found that zebrafish or mice deficient in the microRNA processing enzyme Drosha had vascular defects similar to those found in HHT patients. Rare mutations in DROSHA were overrepresented in HHT patients who lacked the typical disease-associated mutations. Two of these mutants showed reduced activity and could not rescue the vascular phenotypes of Drosha-deficient zebrafish. —WW


THYMUS
Regeneration circuits in the thymus

Chemotherapy and radiation treatments in cancer patients damage a number of tissues and organs, including the thymus. Prolonged thymic damage can lead to T cell deficiency

Science, this issue p. 334; see also p. 276

Edited by Stella Hurtley
and increased susceptibility to opportunistic infections and malignancies. Wertheimer et al. examined thymic regeneration in mice after sublethal total body radiation. They found a critical role for bone morphogenetic protein 4 (BMP4) signaling in thymic regeneration. Endothelial cells provided a critical source of BMP4, which induces expression of the transcription factor FOXN1 in thymic epithelial cells to promote thymic regeneration. —AB