CORONAVIRUS
Vaccine prioritization
There is likely to be high demand for the limited supplies of vaccine against severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), so how should vaccine distribution be prioritized? Bubar et al. modeled across countries how uncertainty about a vaccine’s characteristics affects prioritization strategies for reducing deaths and transmission (see the Perspective by Fitzpatrick and Galvani). In the model, vaccine efficacy and its ability to reduce disease and/or block transmission was accounted for in relation to age-related variations in susceptibility, fatality rates, and immune decline. In almost all circumstances, reducing fatalities required distributing the vaccine to those who are most at risk of death, usually persons over 60 years of age and those with comorbidities. If a vaccine is leaky or poorly efficacious in older adults, then priority could be given to younger age groups. To increase the available doses, further priority should be given to seronegative individuals. —CA
Science, this issue p. 916; see also p. 890

ATMOSPHERIC CHEMISTRY
On the surface
The uptake and hydrolysis of N₂O from the atmosphere by aqueous aerosols was long thought to occur by solvation and subsequent hydrolysis in the bulk of the aerosol. However, this mechanistic hypothesis was unverifiable because of the fast reaction kinetics. Galib et al. used molecular simulations to show instead that the mechanism is the inverse: Interfacial hydrolysis is followed by solvation into the interior. Their reactive uptake model is consistent with some existing experimental observations. —HJS
Science, this issue p. 921

PALEONTOLOGY
Not enough room
Modern carnivore communities include species that span a range of body sizes. For example, on the African savannah, there are small species (mongooses), medium species (wild dogs), and large species (lions). This variation reflects available prey sources that best suit each group. Carnivorous dinosaur communities, however, were missing species that fall into the middle, or mesocarnivore, group as adults. Schroeder et al. looked across communities, space, and time and found that this absence appears to have been driven by the distinctive biology of dinosaurs, in which giant adults start out as tiny hatchlings. Growing juvenile dinosaurs thus filled the other niches and limited trophic species diversity. —SNV
Science, this issue p. 941

GEOPHYSICS
Waiting for earthquakes to call
Instrumenting the vast ocean floor is difficult and expensive
but important for monitoring earthquakes and tsunamis. Zhan et al. used the polarization of regular telecommunication traffic to detect earthquakes and water swells in a 10,000-kilometer-long fiber-optic submarine cable (see the Perspective by Wilcock). The deep-water Curie cable is not as noisy as terrestrial counterparts, allowing the authors to detect strain from the cable. Results from the 9-month observation period showed how current submarine fiber-optic cables can also be used as a geophysical tool. —BG

Science, this issue p. 931; see also p. 882

**NANO-OPTICAL WRITING**

**Toward next-generation optical disks**

Subdiffraction information bits can be written using superresolution methods to achieve extremely high-density information storage. Using lanthanide-doped upconversion nanoparticles to locally reduce graphene oxide flakes through upconversion resonance energy transfer upon engineered illumination, Lamon et al. achieved an estimated storage capacity of 700 terabytes on a 12-centimeter optical disk by nanoscale optical writing, comparable to a storage capacity of 28,000 single-layer Blu-ray disks. This technology offers an inexpensive solution for the next generation of high-capacity optical data storage and enables energy-efficient nanofabrication of flexible, graphene-based electronics. —LNL


**IN OTHER JOURNALS**

Edited by Caroline Ash and Jesse Smith

**CHEMICAL DYNAMICS**

**Intriguing dynamics pattern in F + HD**

Despite decades of studies, the role of relativistic spin-orbit interactions in the dynamics of chemical reactions remains an intriguing topic. Using a high-resolution velocity map imaging crossed beams technique, Chen et al. observed an interesting pattern in the differential cross sections in the F + HD → HF + D reaction near the partial wave resonances (see the Perspective by Rakitizis). Further theoretical analysis showed that this pattern originates from quantum interference between spin-orbit split partial wave resonances with different total parities. The effect of the fine structure of the partial waves observed for this long known yet not completely explored three-atom system represents one more remarkable demonstration of the truly quantum nature of chemical reaction dynamics. —YS

Science, this issue p. 936; see also p. 886

**POPULATION GENETICS**

**Linking phenotype with genotype**

In humans, it is difficult to work out how natural selection affects phenotypic variation. With the accumulation of huge repositories of human genetic data and new computational methods, the impact of medical conditions and their evolutionary importance can be estimated. One challenge is that many complex diseases are linked to phenotypes with common and widely occurring genetic variants. Vy et al. predicted the overall number of deleterious genetic variants in coding proteins (known as the deleterious load) within individuals from the UK Biobank. Although overall deleterious load is not linked with any specific disease states, the authors found statistically significant associations between 27 traits and phenotypes associated with disease, including body mass, metabolic rate, and adiposity. Thus, the accumulative effect of deleterious load might be a useful indicator for general health. —LMZ


**EPIGENETICS**

**Inheriting female infertility**

Polycystic ovary syndrome (PCOS) is a major cause of female infertility. It is characterized by hormonal and often metabolic dysfunction but little is understood about its etiology. For women with PCOS who do become pregnant, there is a high probability that their daughters will develop PCOS. This heritability has been proposed to arise, at least partially, if the embryos are exposed to abnormal levels of hormones. Mimouni et al. studied a mouse model of PCOS and found several differentially methylated genes in the ovaries of third-generation mice, indicating epigenetic-mediated heritability. Several of these genes were also differentially methylated in blood samples from mothers and...
The structure of the genome in different brain diseases, and how it influences the development of Alzheimer’s disease, suggests that understanding the genetic variations in the brain could help identify new therapeutic targets.

**NEURODEGENERATION**

The protein tau is implicated in various neurological disorders, including Alzheimer’s disease, suggesting that it could be a target for therapeutic intervention. However, it is unclear how the pleiotropic roles of tau lead to neural pathology in different brain diseases.

**CANCER GENOMICS**

The heterogeneity of mammalian tumors has been well documented, but it remains unknown how differences between individual cells lead to metastasis and spread throughout the body. Quinn et al. created a Cas9-based lineage tracer and used single-cell sequencing to generate phylogenies and follow the movement of metastatic human cancer cells implanted in the lung of a mouse xenograft model. Using this model, they found that within the same cell line, cancer cells exhibited diverse metastatic phenotypes. These subclones exhibited differential gene expression profiles, some of which were previously associated with metastasis.

**LINEAGE TRACING**

Zoning in on liver growth

For organ homeostasis or regeneration after injury or disease, one or more stem cell populations is needed to rebuild lost tissue. There is considerable debate about the source of new cells in the liver. Two groups now identify the source of new hepatocytes (see the Perspective by Andersson). Although the liver may seem to lack major variation across its structure, its lobule is organized into concentric zones where hepatocytes express different metabolic enzymes. Wei et al. sought to systematically define the source of new liver cells by comparing 14 fate-mapping mice that label different liver cell types. They found that different regions of the liver lobule exhibit differences in hepatocyte turnover, with zone 2 representing a primary source of new hepatocytes during homeostasis and regeneration. Similarly, He et al. designed a genetic approach to record cell proliferation in vivo with high spatial and temporal resolution to enable continuous recording of proliferative events of any specific cell type at the whole-cell population level. Using this method, they identified zone 2 as having the highest proliferative activity and contributing the most to liver regrowth. These findings have implications for the cellular basis of chronic disease pathogenesis, cancer development, and regenerative medicine strategies.

**CORONAVIRUS**

A single sugar makes all the difference

Antibodies are divided into several classes based on their nonvariable tail (Fc) domains. These regions interact with disparate immune cell receptors and complement proteins to help instruct distinct immune responses. The Fc domain of immunoglobulin G (IgG) antibodies contains a conserved N-linked glycan at position 297. However, the particular glycan used at this position is highly variable. IgG lacking core fucosylation at this position initiates enhanced antibody-dependent cellular cytotoxicity by increased affinity to the Fc receptor FcRIIa. Larsen et al. report that COVID-19 patients with severe symptoms have increased levels of anti–severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) IgG afucosylation compared with patients with mild disease. These findings suggest that treatment of COVID-19 patients with fucosylated anti–SARS-CoV-2 antibodies may circumvent pathologies associated with severe COVID-19.

**CORONAVIRUS**

Hurting the virus by targeting the host

Many host proteins play a role in the life cycle of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), and some are required for viral replication and translation. There are efforts toward finding drugs that target viral proteins, but a complementary approach is to target these required host proteins. White et al. explored the antiviral activity of the cyclic depsideptide drug plitidepsin, which targets the hosts cell’s translational machinery (see the Perspective by Wong and Damania). The authors show that in cells, the drug is substantially more potent than remdesivir against SARS-CoV-2, with limited cellular toxicity. Prophylactic treatment protected mice against SARS-CoV-2 infection, so further investigation of plitidepsin as a therapeutic is warranted.

**OPTOELECTRONICS**

Laser-based generation of random numbers

The security of our digital networks is underpinned by the ability to generate streams of random numbers or bits. As networks expand in an interconnected way, the challenge is to increase the generation rate of the random numbers to keep pace with demand. Kim et al. designed a chip-scale laser diode that generates random bits at an ultrahigh rate (see the Perspective by Fischer and Gauthier). By tailoring the geometry of the cavity, they were able to exploit the spatiotemporal interference of many lasing modes to generate picosecond-scale emission intensity fluctuations in space and time, producing ultrafast random bit streams in parallel. Such a device will find a wide range of applications requiring an ultrafast, compact, robust, and energy-efficient random bit generator.

**3D GENOMICS**

Visualizing the 3D genome in situ

The conformation of the genome within the cell changes depending on cell state, such that being able to visualize genome structure can identify cis and trans interactions among regulatory genetic elements. Payne et al. have developed an unbiased genome-sequencing technique in single cells in situ that can infer the chromatin structure by imaging. They were able to identify sequences at subnuclei locations to analyze the proximity relationships among genetic elements within and across chromosomes in single cells. Using this technique, they could detect chromosome territories and distinctions between different types of repetitive sequences and chromosomal features. This method can map and image genomic coordinates with submicrometer resolution in intact single cells.
MOLECULAR BIOLOGY

Resolving R-loops for ribosomes

RNA-DNA hybrid structures called R-loops formed during gene transcription can alter gene expression. Jiang et al. found that the Microprocessor complex resolved R-loops for ribosomal protein–encoding genes. Mice deficient in the Microprocessor complex component Drosha had decreased ribosomal protein abundance and protein synthesis in erythrocyte progenitor cells, as well as defects in erythropoiesis that resembled anemias caused by ribosome insufficiency or dysfunction. Nutrient deprivation induced the degradation of Drosha, which suppressed protein synthesis.

—WW

NUCLEAR ASTROPHYSICS

The origin of r-process elements

Theoretical models predict that the synthesis of heavy elements by the rapid neutron capture process (r-process) occurs in extreme astrophysical environments such as neutron star mergers or some types of supernovae. Testing those predictions by comparing them with the isotopic record has been difficult. Côté et al. examined two r-process isotopes, iodine-129 and curium-247, both of which have half-lives of 15.6 million years. Therefore, their ratio remains constant even long after the nucleosynthesis event. The ratio of those isotopes at the time of Solar System formation is recorded in meteorites. Comparing this value with nuclear astrophysics calculations shows that the most likely source was moderately neutron-rich material ejected from a binary neutron star merger. —KTS
Science, this issue p. 945

NATURAL KILLER CELLS

NK cells ride the uterine cycle

Tissue-resident natural killer (NK) cells in the uterus promote successful pregnancies by regulating the depth of placental trophoblast invasion. Endometrial tissue is naturally subject to constant remodeling in response to hormonal fluctuations during the menstrual cycle, but how the changing uterine microenvironment influences the heterogeneity of uterine NK (uNK) cells is poorly understood. Strunz et al. used proteomic and transcriptomic techniques to profile human uNK cells recovered from different stages of the menstrual cycle and during pregnancy. This analysis identified sequentially expressed uNK cell surface markers that define a recurring cycle of differentiation in response to progesterone-regulated release of stromal interleukin-15. These findings pave the way for further studies on how uNK cell functions are modulated by the dynamic endometrial microenvironment. —IW