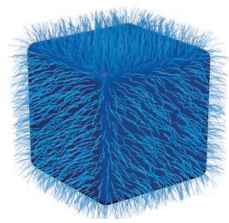
RESEARCH

DNA used to order nanoparticle assembly

Lin et al., *p. 669*



IN *SCIENCE* JOURNALS

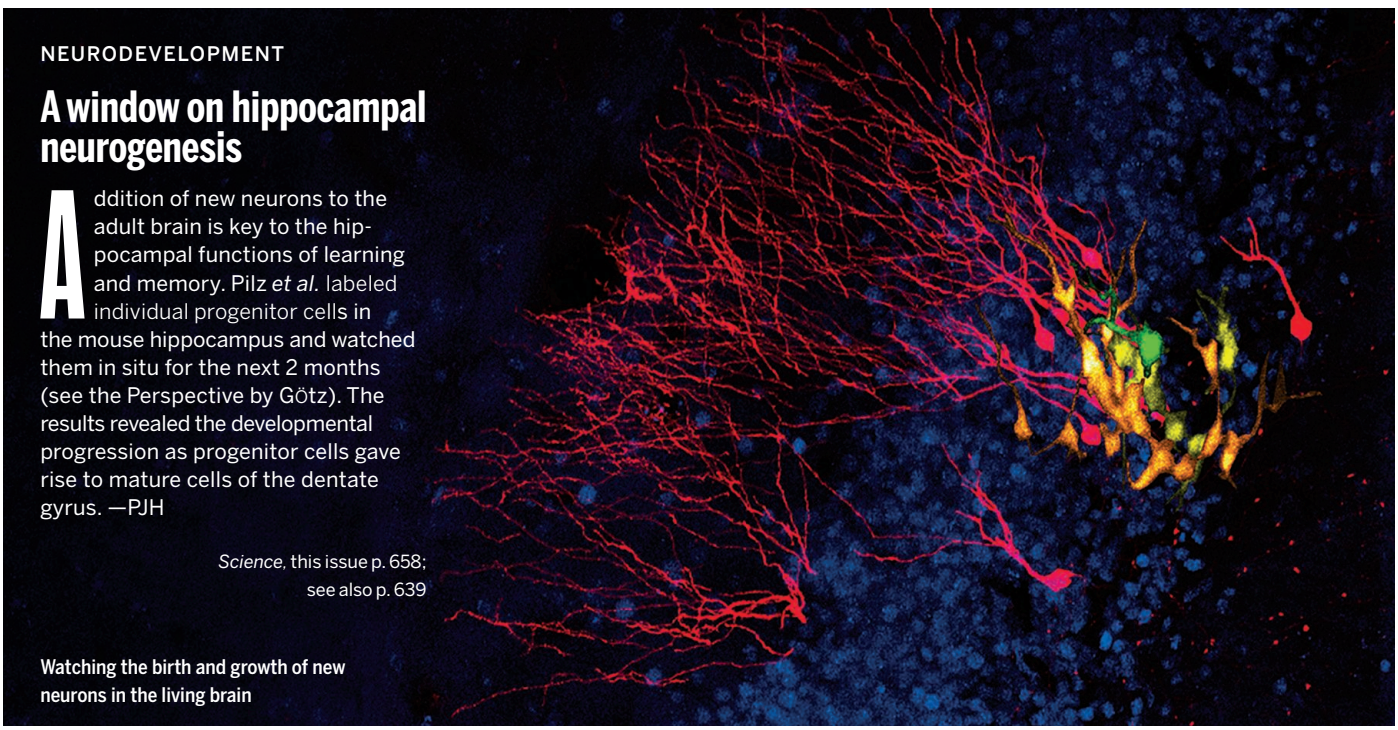
Edited by **Stella Hurtley**

NEURODEVELOPMENT

A window on hippocampal neurogenesis

Addition of new neurons to the adult brain is key to the hippocampal functions of learning and memory. Pilz *et al.* labeled individual progenitor cells in the mouse hippocampus and watched them in situ for the next 2 months (see the Perspective by Götz). The results revealed the developmental progression as progenitor cells gave rise to mature cells of the dentate gyrus. —PJH

Science, this issue p. 658; see also p. 639



Watching the birth and growth of new neurons in the living brain

PSYCHIATRIC GENOMICS

Genes overlap across psychiatric disease

Many genome-wide studies have examined genes associated with a range of neuropsychiatric disorders. However, the degree to which the genetic underpinnings of these diseases differ or overlap is unknown. Gandal *et al*. performed meta-analyses of transcriptomic studies covering five major psychiatric disorders and compared cases and controls to identify coexpressed gene modules. From this, they found that some psychiatric disorders share global gene expression patterns. This overlap in polygenic traits in neuropsychiatric disorders may allow for better diagnosis and treatment. —LMZ

Science, this issue p. 693

PROTEIN BIOCHEMISTRY

Interactions of LARKS protein domains

More than 1500 human proteins contain long, disordered stretches of "low complexity"—strings of just a few of the 20 common amino acids. The functions of these low-complexity domains have been unclear. Hughes *et al*. present atomic-resolution structures that suggest that short segments of two such domains can bind weakly to each other by forming a pair of kinked β-sheets. Because aromatic amino acid side chains stabilize these interactions, the interacting motifs are termed LARKS, for low-complexity, aromatic-rich, kinked segments. Numerous proteins associated with membraneless organelles of biological cells contain low-complexity domains housing multiple LARKS. —SMH

Science, this issue p. 698

CANCER

Safer without PUMA

Gastrointestinal toxicity is a major cause of side effects from chemotherapy and radiation that can decrease quality of life and limit the dosing of cancer treatments. Tumor suppressor p53 plays a major role in chemotherapy-induced intestinal cell death, but inhibiting p53 is not safe because its loss would worsen cancer growth. Leibowitz *et al*. blocked only the detrimental function of p53 by inhibiting its downstream effector, PUMA. A small-molecule inhibitor of PUMA protected intestinal cells in mice and in human colon organoids but did not protect cancer cells. The approach may thus provide a viable strategy for intestinal protection in cancer patients. —YN

Sci. Transl. Med. **10**, eaam7610 (2018).

QUANTUM OPTICS

Building up to superradiance, one by one

Superradiance is a quantum phenomenon that occurs when emitters are sufficiently close to change spontaneous emission. Controlling the position and state of emitters within an atomic ensemble, however, is technically challenging. Kim *et al*. show that spatial correlations can be replaced by temporal

CREDITS: (TOP TO BOTTOM) Q.-Y. LIN *ET AL.*; GREGOR PILZ AND SARA BOTTES/BRAIN RESEARCH INSTITUTE, UNIVERSITY OF ZURICH

Published by AAAS

correlations to achieve superradiance (see the Perspective by Meschede). They dropped prepared atoms into a high-quality optical cavity and found that the number of photons within the cavity built up superradiantly as the atoms dropped through one by one. The method provides a versatile platform for generating nonclassical states of light. —ISO

Science, this issue p. 662; see also p. 641

CARDIOVASCULAR BIOLOGY

Protecting the heart by destabilizing mRNA

The CCR4-NOT complex removes polyadenylate tails from mRNAs that then undergo degradation. Yamaguchi *et al.* found that this complex was required to prevent cardiomyocyte death (see the Focus by Das). Mice deficient in a component of this complex had cardiac dysfunction and died of heart failure. Cardiomyocytes from these mice had less deadenylated *Atg7* mRNA, which resulted in the activation of cell death–associated genes. These results raise the possibility of cardiovascular side effects for autophagy-promoting drugs, which have been explored for the treatment of various diseases. —WW

Sci. Signal. **11**, eaan3638; see also eaar6364 (2018).

MATERIALS SCIENCE

Crystallography of sensitive materials

High-resolution transmission electron microscopy is an invaluable tool for looking at the crystalline structures of many materials. However, the need for high beam doses, especially as a sample is rotated to find the crystal axes, can lead to damage, particularly in fragile materials. Zhang *et al.* combined a state-of-the-art direct-detection electron-counting camera with ways to limit the overall electron dose to analyze delicate materials such as metal organic frameworks. With this approach, they could see the benzene rings in a UiO-66 linker and the coexistence of ligand-free (metal-exposing) and ligand-capped surfaces in UiO-66 crystals. —MSL

Science, this issue p. 675

BIOMECHANICS

Making quick turns

Hummingbirds are well known for their impressive maneuvering during flight. Dakin *et al.* used a computer vision approach to characterize the details of flight in >200 hummingbirds from 25 species (see the Perspective by Wainwright). Larger species had enhanced agility owing to increased muscle mass. In all species, muscles dictated transitional movement, whereas wing shape facilitated sharp turns and rapid rotations. Species, and individuals within species, played on their strengths by combining inherent traits and learned skills. —SNV

Science, this issue p. 653; see also p. 636

QUANTUM OPTICS

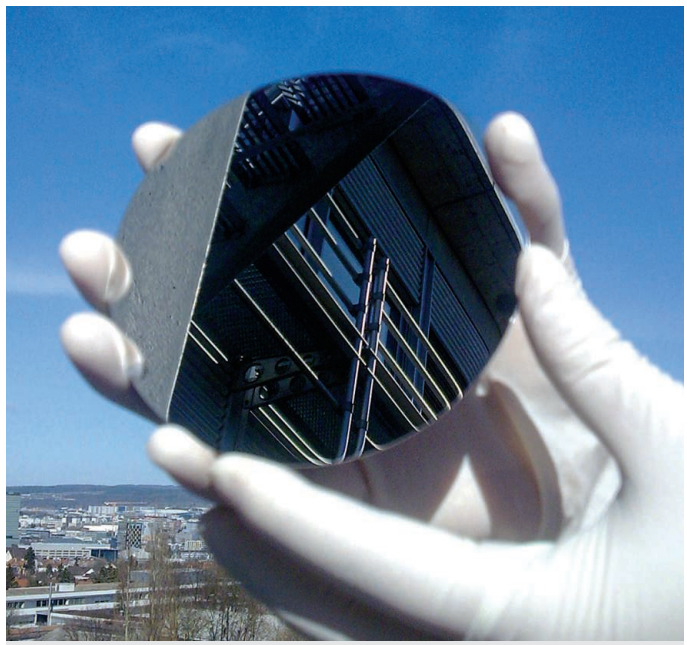
Connecting quantum emitters

Exploiting topological properties of a system allows certain properties to be protected against the disorder and scattering caused by defects. Barik *et al.* demonstrate a strong light-matter interaction in a topological photonic structure (see the Perspective by Amo). They created topological edge states at the interface between two photonic, topologically distinct regions and coupled them to a single quantum emitter. The chiral nature of single-photon emission was used to inject single photons of opposite polarization into counterpropagating topological edge states. Such a topological quantum optics interface may provide a powerful platform for developing robust integrated quantum optical circuits. —ISO

Science, this issue p. 666; see also p. 638

IN OTHER JOURNALS

Edited by **Sacha Vignieri** *and* **Jesse Smith**



Large-area hexagonal boron nitride nanomesh can be grown on a single-crystalline rhodium thin film substrate (shown here).

NANOMATERIALS

Scalable h-BN sheets

Growth of two-dimensional material in situ is a scalable route for device production, especially if the films can be transferred to another substrate. Cun *et al.* grew single crystals of hexagonal boron nitride (h-BN) on ~10-cm rhodium films supported on silicon wafers. After electrochemical treatment with an organic acid and spin-coating with a polymer layer, the h-BN was electrochemically exfoliated by generating hydrogen bubbles at the rhodium surface. These films could be transferred onto a germanium surface to prevent their high-temperature oxidation. Films in which nanovoids had been introduced into h-BN functioned as freestanding membranes after removal of the polymer support. —PDS

Nano Lett. 10.1021/acs.nanolett.7b04752 (2018).

CELL BIOLOGY

Migration without a nucleus

When cells migrate, they normally do so by adopting a characteristic polarized morphology with the nucleus seemingly pushing from behind. The internal cytoskeleton forms well-organized arrays, and the mechanics within the cell, as well as the interactions with the surface on which the cell is moving, are well understood. It has been assumed that the nucleus itself is important for directed migration. Graham *et al.* examined the migration of enucleated mammalian cells and found that the nucleus was dispensable for directed migration, at least along flat surfaces. When it came to migration in three-dimensional (3D) environments, the lack of a nucleus was important. It seems

PHOTO: H. CUN *ET AL.*, *NANO LETT.* 10.1021/ACS.NANOLETT.7B04752 (2018)

ALSO IN *SCIENCE* JOURNALS

Edited by **Stella Hurtley**

SYNTHETIC BIOLOGY

Toward programmed therapeutics

Advances in synthetic biology are enabling the development of new gene and cell therapies. Kitada *et al*. review recent successes in areas such as cancer immunotherapy and stem cell therapy, point out the limitations of current approaches, and describe prospects for using synthetic biology to overcome these challenges. Broader adoption of these therapies requires precise, context-specific control over cellular behavior. Gene circuits can be built to give sophisticated control over cellular behaviors so that therapeutic functions can, for example, be programmed to activate in response to disease biomarkers. —VV

Science, this issue p. 651

TISSUE REGENERATION

Keeping cholesterol at bay

A decline in tissue repair is a universal hallmark of aging. The failure to regenerate myelin sheaths in multiple sclerosis lesions contributes to chronic progressive disease and disability. Understanding the cause and preventing this failure is a key goal in regenerative medicine. Cantuti-Castelvetri *et al*. report that the self-limiting inflammatory response, which is necessary for remyelination to occur, is maladaptive in the central nervous system (CNS) of old mice (see the Perspective by Chen and Popko). Cholesterol-rich myelin debris overwhelmed the efflux capacity of phagocytes, resulting in a transition of free cholesterol into crystals, thereby inducing lysosomal rupture and inflammasome stimulation. Thus, drugs being developed to promote cholesterol clearance in human atherosclerosis lesions may also be good candidates for regenerative medicine in the CNS. —SMH

Science, this issue p. 684; see also p. 635

MOLECULAR BIOLOGY

Tracking mitotic chromosome formation

How cells pack DNA into fully compact, rod-shaped chromosomes during mitosis has fascinated cell biologists for more than a century. Gibcus *et al*. delineated the conformational transition trajectory from interphase chromatin to mitotic chromosomes minute by minute during the cell cycle. The mitotic chromosome is organized in a spiral staircase architecture in which chromatin loops emanate radially from a centrally located helical scaffold. The molecular machines condensin I and II play distinct roles in these processes: Condensin II is essential for helical winding, whereas condensin I modulates the organization within each helical turn. —SYM

Science, this issue p. 652

NEUROSCIENCE

Stimulating deep inside the brain

Noninvasive deep brain stimulation is an important goal in neuroscience and neuroengineering. Optogenetics normally requires the use of a blue laser inserted into the brain. Chen *et al*. used specialized nanoparticles that can upconvert near-infrared light from outside the brain into the local emission of blue light (see the Perspective by Feliu *et al*.). They injected these nanoparticles into the ventral tegmental area of the mouse brain and activated channelrhodopsin expressed in dopaminergic neurons with near-infrared light generated outside the skull at a distance of several millimeters. This technique allowed distant near-infrared light to evoke fast increases in dopamine release. The method was also used successfully to evoke fear memories in the dentate gyrus during fear conditioning. —PRS

Science, this issue p. 679; see also p. 633

OPTICS

Seeding a laser amplifier

Amplification of femtosecond laser pulses requires a lasing medium or a nonlinear crystal. The chemical properties of the lasing medium or adherence to momentum conservation rules in the nonlinear crystal constrain the frequency and the bandwidth of the amplified pulses. Vampa *et al*. seeded modulation instability in a laser crystal pumped with femtosecond near-infrared pulses. This provided a method for the high gain amplification of broadband and short laser pulses up to intensities of 1 terawatt per square centimeter. The method avoids constraints related to doping and phase matching and can be expected to be applied to a wide pool of glasses and crystals. —ISO

Science, this issue p. 673

PROTEIN TARGETING

When do you really need SRP?

Proteins destined for the cell exterior are recruited during synthesis to the surface of the endoplasmic reticulum (ER) by the signal recognition particle (SRP). The classic view suggests that SRP recognizes signal sequences at the beginning of proteins. Working in yeast, Costa *et al*. found that many proteins with cleavable signal peptides were efficiently targeted during synthesis in the absence of SRP. In contrast, proteins with internal targeting signals universally depended on SRP and were susceptible to aberrant mitochondrial targeting in its absence. These studies establish the full physiological role of SRP in ensuring accurate and efficient protein targeting in the secretory pathway. —SMH

Science, this issue p. 689

ATMOSPHERIC CHEMISTRY

Do we know the air we breathe indoors?

Many people spend most of their lives indoors, yet air pollution studies tend to focus on outdoor air. In a Perspective, Gligorovski and Abbatt highlight recent advances in understanding the reactions that occur in indoor living environments—for example, owing to smoking and the use of cookstoves and cleaning agents. Even the mere presence of humans in a room changes the air chemistry. Because of these reactions, humans are exposed to a bewildering array of chemicals with little-known health impacts. —JFU

Science, this issue p. 632

AUTOIMMUNITY

At home in the pancreas

Type 1 diabetes (T1D) is associated with enrichment of autoreactive $CD8^+$ T cells that target pancreatic islet cells. Culina *et al*. studied islet-reactive $CD8^+$ T cells reactive to the zinc transporter $8_{186–194}$ ($ZnT8_{186–194}$) and other islet epitopes in healthy individuals and T1D patients. These epitopes showed equivalent functionality and similar frequencies and naive phenotypes in the peripheral circulation across both groups. In contrast, $ZnT8_{186–194}$-reactive $CD8^+$ T cells were enriched in the pancreases of T1D patients relative to those of healthy controls and showed cross-reactivity to an epitope from the commensal *Bacteroides stercoris*. Thus, incomplete central tolerance may allow the survival of these islet-reactive $CD8^+$ T cells in the periphery, and proinflammatory

conditions in the islets may contribute to T1D progression. —CNF

Sci. Immunol. **3**, eaao4013 (2018).

NEUROSCIENCE

A brain rhythm for speech integration

Spoken communication demands coordination between auditory and motor aspects of language processing. Assaneo and Poeppel measured brain oscillations while humans listened to speech produced at different rates. Neural synchrony across auditory and motor speech areas was selectively enhanced at 4.5 Hz, a frequency corresponding to the mean syllable rate generated across human languages. Neural network simulations validated the findings, revealing an oscillatory mechanism for coupling sensory and motor codes of speech patterning. —KSL

Sci. Adv. 10.1126/sciadv.aao3842 (2018).

NANOMATERIALS

Programmed nanoparticle stacking

A polymer pore template can control the order of assembly of nanoparticles into well-defined stacks and create superlattices. Lin *et al*. used DNA strands on gold nanoparticles to control interparticle distance. The DNA strands contained modified adenines with more rigid ribose groups that formed stronger base pairs. The height of the stacks of three different types of gold nanoparticle could be changed with different solvents, which in turn changed their optical response. —PDS

Science, this issue p. 669