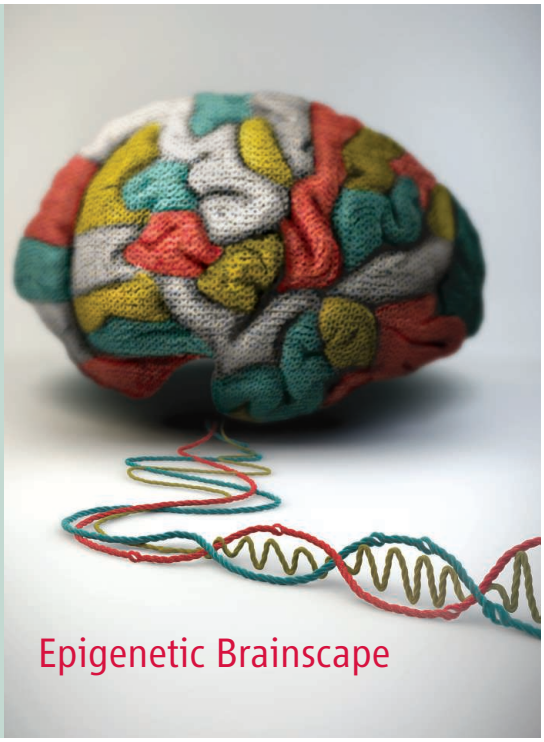
Epigenetic modifications and their potential changes during development are of high interest, but few studies have characterized such differences. **Lister *et al.*** (p. 629, published online 4 July; see the Perspective by **Gabel and Greenberg**) report whole-genome base-resolution analysis of DNA cytosine modifications and transcriptome analysis in the frontal cortex of human and mouse brains at multiple developmental stages. The high-resolution mapping of DNA cytosine methylation (5mC) and one of its oxidation derivatives (5hmC) at key developmental stages provides a comprehensive resource covering the temporal dynamics of these epigenetic modifications in neurons compared to glia. The data suggest that methylation marks are dynamic during brain development in both humans and mice.



Epigenetic Brainscape

Strongly Correlated Clocks

Optical lattice clocks with alkaline earth atoms provide one of the most stable time-keeping systems. Such clocks, in general, exhibit shifts in their transition frequencies as a consequence of interactions between atoms. Can this sensitivity be used to explore the dynamics of strongly correlated quantum systems? **Martin *et al.*** (p. 632) used a 1-dimensional optical lattice clock to study quantum many-body effects. Whereas the clock shift itself could be modeled within the mean field approximation, quantities such as spin noise required a full many-body treatment. This system may be useful for the quantum simulation of exotic magnetism.

Help Shared

Germinal centers are specialized structures within lymph nodes, where B cells undergo the changes required to produce high-affinity antibodies. This process relies on T follicular helper (Tfh) cells. The dynamic properties of Tfh cells and how they affect the selection of B cells, however, are not well understood. Using two-photon laser scanning microscopy of mouse lymph nodes, **Shulman *et al.*** (p. 673, published online 25 July) find that Tfh cells are not restricted to a single germinal center, but instead emigrate into neighboring germinal centers within the same lymph nodes. Furthermore, newly activated T cells can enter already established germinal centers and presumably influence ongoing B cell selection and differentiation. Such active movement may ensure maximal diversification of the B cell response and promote the production of high-affinity antibodies.

Faster at the Gate

Advanced designs will be needed to continue to improve the performance of the main components of high-speed computing, metal-oxide semiconductor field-effect transistors (MOSFETs) and floating-gate (FG) MOSFETs. **Wang *et al.*** (p. 640) fabricated a semi-floating gate (SFG) transistor in which a tunneling field-effect transistor couples the positively doped floating gate to the negatively doped drain region. The charge stored on the SFG was used to shift the voltage threshold for switching the transistor, which in turn sped up its operation and lowered the power consumed. These devices were used for ultrahigh-speed memory and in light sensing and imaging.

Two-Way Street

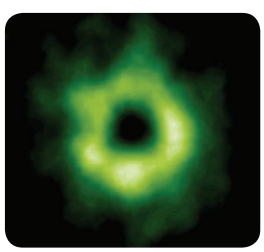
Most studies of volatile organic compounds (VOCs) found in the atmosphere, which play important roles in atmospheric chemistry, have concentrated on dominant species such as isoprene. There are thousands of other classes of VOCs, and how they are exchanged between the biosphere and the atmosphere is unclear. **Park *et al.*** (p. 643) measured the fluxes of more than 500 types of VOCs using a highly sensitive type of mass spectrometry and an absolute value eddy covariance method. The majority of these species were actively exchanged between the atmosphere and the biosphere, with more than a quarter showing net deposition. These results should help to improve air quality and global climate models, and strengthen our understanding of atmospheric VOC chemistry.

Promoting Pluripotency

A specialized mammalian cell can be set back to the pluripotent state either by transfer of the somatic cell nucleus into an oocyte or by delivery of exogenous pluripotency-associated transcription factors. **Hou *et al.*** (p. 651, published online 18 July) developed an approach to induce pluripotency in somatic cells using a cocktail of small molecules. The ability to generate such chemically induced pluripotent stem cells may provide an alternate route for therapeutic cloning and for drug development in regenerative medicine.

Solar Snow Lines

Models of the formation of our solar system have suggested that condensation lines, or snow lines—the distance from a star beyond which a gas or a liquid can condense into the solid phase—are favorable locations for planet formation. Taking advantage of the increase of N_2H^+ abundance in cold regions where CO condenses out of the gas phase, **Qi *et al.*** (p. 630, published online 18 July) used the Atacama Large Millimeter/Submillimeter Array to image the CO snow line in the disk around TW Hya, an analog of the solar nebula from which the solar system formed. This disk's snow line corresponds to Neptune's orbit in our solar system.



Microbes → Host Speciation?

No living organism is an individual—an individual's microbiota can outnumber the host's somatic cells. Working in parasitoid wasps, **Brucker and Bordenstein** (p. 667, published online 18 July) now suggest that the gut microbiota can play a crucial role in speciation and hybrid lethality. In a clade of parasitoid wasps, interspecies hybrids survived when reared on antibiotic-treated sterile food (thus eliminating gut microbiota), but experienced high mortality when reared on conventional diet or host material.

CREDITS (TOP TO BOTTOM): SCOT NICHOLLS; KARIN OBERG, HARVARD/UNIVERSITY OF VIRGINIA

Additional summaries

Controlled Polymers

Nature has achieved exquisite sequence control in the synthesis of polymers like DNA. In contrast, synthetic polymers rarely have the same fidelity in their chemistry or uniformity in chain-length distribution, especially when more than one monomer is involved. **Lutz *et al.*** (p. 628) review the progress that has been made in making sequence-controlled polymers of increasing length and complexity. These developments have come from both advances in synthetic chemistry methods and the exploitation of biological machinery.

Double Is Not Trouble

The doubling of the genome to create polyploidy is common among land plants, and most major flowering plant lineages exhibit some history of genome duplication. However, the physiological advantages of a doubled genome are not well understood. **Chao *et al.*** (p. 658, published online 25 July) identified accessions of the model plant *Arabidopsis thaliana* with naturally doubled genomes and found that the cytotype of the root, but not shoot, in these natural, as well as in artificially induced, polyploid plants appears to confer increased salt tolerance by regulating leaf potassium levels.

Controlling Skyrmions

Magnetic skyrmions—tiny vortex patterns of spins—hold promise for information storage because of their robustness to perturbations. Skyrmions have been observed experimentally, but manipulating them individually remains a challenge. **Romming *et al.*** (p. 636; see the cover) used spin-polarized electrons generated by a scanning tunneling microscope to reversibly create and destroy skyrmions in a thin iron film covered by a layer of palladium. The energy of the tunneling electrons was the decisive factor determining the probability of the process; atomic defects in the film acted as pinning sites for the skyrmions. The work demonstrates the feasibility of using spin-polarized tunnel currents for the controlled manipulation of individual skyrmions.

Follow the Leader?

The Internet has increased the likelihood that our decisions will be influenced by those being made around us. On the one hand, group decision-making can lead to better decisions, but it can also lead to "herding effects" that have resulted in financial disasters. **Muchnik *et al.*** (p. 647) examined the effect of collective information via a randomized experiment, which involved collaboration with a social news aggregation Web site on which readers could vote and comment on posted comments. Data were collected and analyzed after the Web site administrators arbitrarily voted positively or negatively (or not at all) as the first comment on more than 100,000 posts. False positive entries led to inflated subsequent scores, whereas false negative initial votes had small long-term effects. Both the topic being commented upon and the relationship between the poster and commenter were important. Future efforts will be needed to sort out how to correct for such effects in polls or other collective intelligence systems in order to counter social biases.

Poring Over the Nuclear Pore

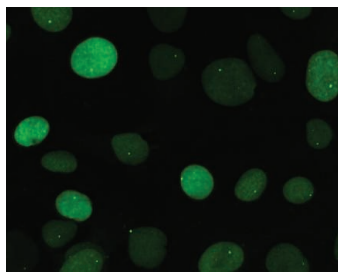
The nuclear pore is a macromolecular complex that traverses the paired membranes of the nuclear envelope through which a variety of nuclear protein and RNA cargoes must traffic. **Szymborska *et al.*** (p. 655, published online 11 July) combined super-resolution microscopy with single-particle averaging to localize the proteins that make up the structural scaffold of the nuclear pore complex with a precision well below one nanometer. These molecular positional constraints clarified contradictory models for the structure of the nuclear pore and demonstrate that the structural organization of protein complexes can be studied by light microscopy in situ in whole cells.

Pol II Micro Clusters

In higher eukaryotes, messenger RNA (mRNA) synthesis is thought to involve foci of clustered RNA polymerase II (Pol II) called transcription factories. However, clustered Pol II have not been resolved in living cells, raising the debate about their existence in vivo and what role, if any, they play in nuclear organization and regulation of gene expression. **Cisse *et al.*** (p. 664, published online 4 July; see the Perspective by **Rickman and Bickmore**) developed single-molecule in vivo analyses revealing the distribution and dynamics of Pol II clustering in living cells. Pol II clusters were smaller than the diffraction limit (<250 nm). Transient dynamics of the Pol II clusters, and correlation with changes in transcription, pointed to a role in transcription initiation rather than in elongation.

Chromosome Choreography

Chromosome translocations arise through the illegitimate pairing of broken chromosome ends and are commonly found in many cancers. **Roukos *et al.*** (p. 660) used ultrahigh-throughput time-lapse imaging on human tissue culture cells containing marked chromosomes to capture very rare translocation events. Double-strand breaks in the DNA underwent an initial "partner search," with a fraction of the ends moving into spatial proximity to each other, which resulted in persistent pairing and the merging of DNA repair foci. Most paired ends arose from breaks in close proximity, but occasionally translocations formed from more distantly positioned breaks. Proteins of the DNA repair machinery could influence the pairing and/or translocation process.



CREDIT: ROUKOS *ET AL.*

A Different Cycle for Differentiation

The regulated expression of transcription factors determines cell fate decisions during cell differentiation. The transcription factor PU.1 is an important determinant in the differentiation of hematopoietic progenitors to lymphocytes or myeloid cells, where high expression induces macrophage differentiation, whereas low expression leads to the development of B lymphocytes. How PU.1 expression levels are regulated during this cell fate choice, however, is not well understood. **Kueh *et al.*** (p. 670, published online 18 July) found that in mice, reduced transcription of PU.1 led to its reduced expression in developing B lymphocytes, whereas in macrophages, PU.1 was able to accumulate stably because of a lengthening of the cell cycle. Exogenous expression of PU.1 in progenitors supported cell cycle lengthening and macrophage differentiation, and mathematical modeling suggested that such a feedback loop could maintain a slow-dividing macrophage developmental state.

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