



## COVER

A dynamic aurora borealis during a storm over Canada. Energy from the Sun's extended atmosphere is stored at Earth's magnetic field and is released explosively, powering the aurorae. Previously stable aurorae brighten, filament, expand poleward, and cover the sky within 1 to 2 minutes. The energy release starts at an altitude of 130,000 kilometers, at the magnetic equator, near local midnight. See page 931.

*Image: Norbert Rosing/National Geographic/Getty Images*

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*by M. R. C. Greenwood, Gordon Ringold, and Doug Kellogg*

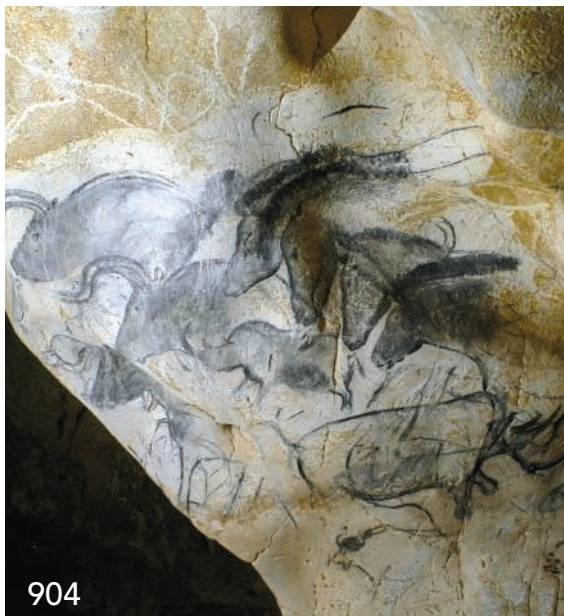
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Downloaded from <http://science.sciencemag.org/> on December 15, 2018

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## SCIENCE EXPRESS

[www.sciencexpress.org](http://www.sciencexpress.org)

### COMPUTER SCIENCE

**reCAPTCHA: Human-Based Character Recognition via Web Security Measures**  
*L. von Ahn, B. Maurer, C. McMillen, D. Abraham, M. Blum*

A security system that relies on the superior performance of humans in comparison to computers in reading distorted text can be harnessed for digitized scanned documents.  
 10.1126/science.1160379

### MATERIALS SCIENCE

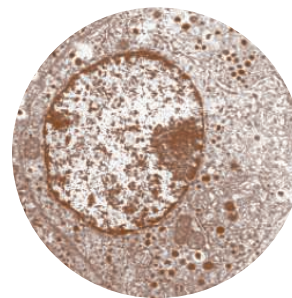
**Polymer Pen Lithography**  
*F. Huo et al.*

An array that can support millions of thin, flexible polymer pens can be used to deposit tiny molecular ink dots of variable size over large areas.  
 10.1126/science.1162193

### PHYSICS

**Transient Electronic Structure and Melting of a Charge Density Wave in  $TbTe_3$**   
*F. Schmitt et al.*

Photoemission spectroscopy is extended to reveal the dynamics of correlated electronic phase transitions, showing how ordered electrons "melt" upon heating of  $TbTe_3$ .  
 10.1126/science.1160778



### CELL BIOLOGY

**Conformational Switch of Syntaxin-1 Controls Synaptic Vesicle Fusion**  
*S. H. Gerber et al.*

The synaptic vesicle protein that mediates membrane fusion during exocytosis also regulates the rate and extent of this process by controlling vesicle tethering.  
 10.1126/science.1163174

### MEDICINE

**Germline Allele-Specific Expression of *TGFBR1* Confers an Increased Risk of Colorectal Cancer**  
*L. Valle et al.*

In patients with colorectal cancer, one allele of the transforming growth factor- $\beta$  gene produces less messenger RNA and thus less protein, a likely contributor to disease risk.  
 10.1126/science.1159397

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*W. Deng, J. Guo, J. Hu, H. Zhang*

full text at [www.sciencemag.org/cgi/content/full/321/5891/912c](http://www.sciencemag.org/cgi/content/full/321/5891/912c)

Response to Comment on "100% Accuracy in Automatic Face Recognition"

*R. Jenkins and A. M. Burton*

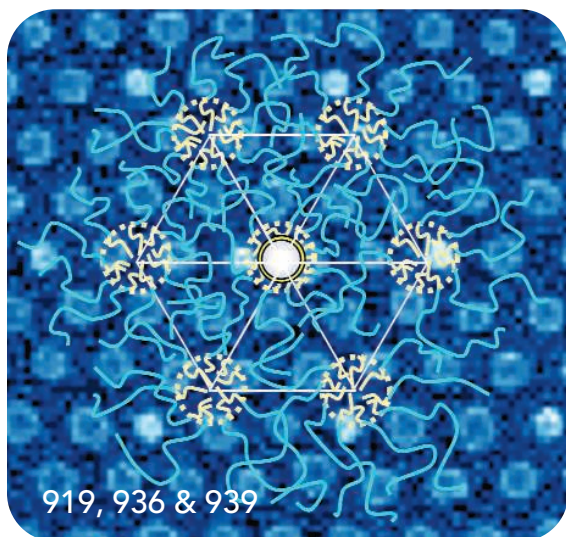
full text at [www.sciencemag.org/cgi/content/full/321/5891/912d](http://www.sciencemag.org/cgi/content/full/321/5891/912d)

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*R. J. Diaz and R. Rosenberg*



## BREVIA

### APPLIED PHYSICS

**Optical Negative Refraction in Bulk Metamaterials** 930

*J. Yao et al.*

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**Tail Reconnection Triggering Substorm Onset** 931

*V. Angelopoulos et al.*

Satellite and ground-based data show that reconnection of magnetic field lines in Earth's magnetotail precedes dramatic aurora displays and is the source of magnetic substorms. >> Perspective p. 920

## REPORTS

### MATERIALS SCIENCE

**Density Multiplication and Improved Lithography by Directed Block Copolymer Assembly** 936

*R. Ruiz et al.*

An appropriate substrate pattern can direct an even finer pattern of a block copolymer, improving the resolution for lithography by a factor of four, beyond the usual limits.  
 >> Perspective p. 919

### MATERIALS SCIENCE

**Graphoepitaxy of Self-Assembled Block Copolymers on Two-Dimensional Periodic Patterned Templates** 939

*I. Bita et al.*

A substrate patterned with a sparse array of nanoscale posts can direct the self-assembly of block copolymers to create a finely ordered lithographic array, even over a large area.  
 >> Perspective p. 919

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## REPORTS CONTINUED...

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*A. Cossaro et al.*

The structure of monolayers of alkyl thiols on gold—widely useful in nanotechnology—depends on the packing of the alkyl chains; long chains disorder the gold surface.

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**Smoke Invigoration Versus Inhibition of Clouds Over the Amazon** 946

*I. Koren, J. V. Martins, L. A. Remer, H. Afargan*

Modeling and satellite data show how absorption of light by aerosols can affect cloud properties and growth, linking these particles' opposing radiative and physical effects.

### GEOCHEMISTRY

**Ferruginous Conditions Dominated Later Neoproterozoic Deep-Water Chemistry** 949

*D. E. Canfield et al.*

Low sulfur input caused the deeper ocean to become anoxic and rich in ferrous iron 750 million years ago, a reversal from the more oxidizing conditions of the previous 1 billion years. >> *Perspective p. 923*

### PLANT SCIENCE

**Plant Immunity Requires Conformational Charges of NPR1 via S-Nitrosylation and Thioredoxins** 952

*Y. Tada et al.*

After a pathogen invades a plant, a protein, usually kept in a multimeric state by S-nitrosylation, is dissociated by thioredoxin, freeing the monomers for defense responses.

### MOLECULAR BIOLOGY

**A Global View of Gene Activity and Alternative Splicing by Deep Sequencing of the Human Transcriptome** 956

*M. Sultan et al.*

Shotgun sequencing of 27–base pair segments of messenger RNA from human kidney and immune cells identifies previously undescribed transcriptional units and splice functions.

### MOLECULAR BIOLOGY

**Small CRISPR RNAs Guide Antiviral Defense in Prokaryotes** 960

*S. J. J. Brouns et al.*

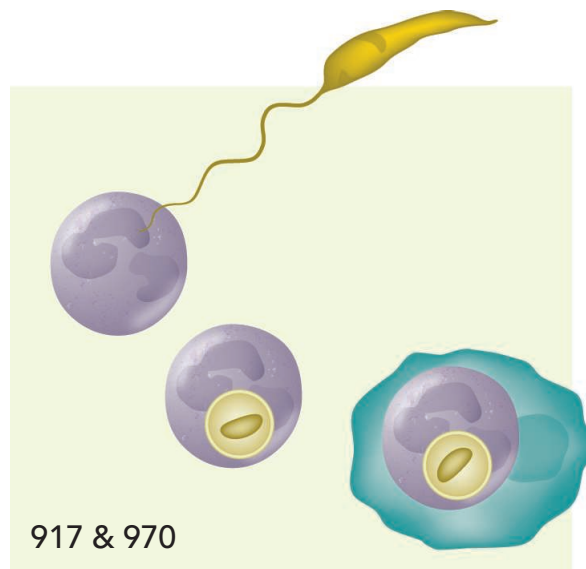
Some bacterial genomes contain remnant sequences from previous viral infections, which are transcribed into RNA to guide inactivation of the virus in subsequent infections. >> *Perspective p. 922*

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**Suppression of the MicroRNA Pathway by Bacterial Effector Proteins** 964

*L. Navarro, F. Jay, K. Nomura, S. Y. He, O. Voinnet*

Upon bacterial infection, *Arabidopsis* mounts a microRNA-mediated innate immune defense, which is inhibited by proteins of the bacteria, allowing other infections.



### MICROBIOLOGY

**Arsenic(III) Fuels Anoxygenic Photosynthesis in Hot Spring Biofilms from Mono Lake, California** 967

*T. R. Kulp et al.*

A primitive form of photosynthesis in which arsenic is the electron donor occurs in purple bacteria in a California lake, perhaps a relic of early life forms.

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*N. C. Peters et al.*

Visualization of the area around a bite from a parasite-infected sand fly shows that the first immune cells to arrive engulf and unexpectedly protect the invading parasite. >> *Perspective p. 917*

### MEDICINE

**Tumor Regression in Cancer Patients by Very Low Doses of a T Cell–Engaging Antibody** 974

*R. Bargou et al.*

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### NEUROSCIENCE

**The Contribution of Single Synapses to Sensory Representation in Vivo** 977

*A. Arenz, R. A. Silver, A. T. Schaefer, T. W. Margrie*

Only 100 synapses are required to accurately code for the animals' velocity in the mouse cerebellum; the charge transfer into neurons is linearly related to acceleration.



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Water walker.

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HIGHLIGHTS FROM OUR DAILY NEWS COVERAGE

### Water Striders Put Best Foot Forward

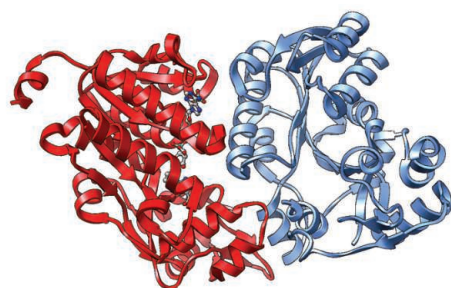
New calculation shows water-walking bugs have evolved feet of optimal length.

### Threading Light Through the Opaque

Experiment confirms that light can be passed through disordered materials.

### They Smell Like Twins

Sweaty study reveals that genetics determines body odor.



NADP-binding produces an asymmetric dimer.

## SCIENCE SIGNALING

[www.sciencesignaling.org](http://www.sciencesignaling.org)

THE SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

### PERSPECTIVE: Dinucleotide-Sensing Proteins—Linking Signaling Networks and Regulating Transcription

*H. K. Lamb, D. K. Stammers, A. R. Hawkins*

Proteins that bind NAD(H) or NADP(H) may couple cellular redox state to transcription or other signaling pathways.

### PERSPECTIVE: Great Times for Small Molecules—c-di-AMP, a Second Messenger Candidate in Bacteria and Archaea

*U. Römling*

The bacterial checkpoint protein DisA has diadenylate cyclase activity, suggesting that c-di-cAMP acts as a second messenger.



## The basics of peer review.

## SCIENCE CAREERS

[www.sciencereaders.org/career\\_development](http://www.sciencereaders.org/career_development)

FREE CAREER RESOURCES FOR SCIENTISTS

### Learning the Ropes of Peer Reviewing

*E. Pain*

Peer review demands a blend of critical skills, honesty, and empathy.

### If at First You Don't Succeed, Cool Off, Revise, and Submit Again

*L. Laursen*

Rejection can be a constructive part of the publication process, really.

### The Science Careers Web Log

*Science Careers Staff*

Here's where to find information from around the Web on careers in science.

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