

## EDITORIAL

- 205 The Art of Translation  
*Bruce Alberts*

## NEWS OF THE WEEK

- 212 U.S. Researchers Recognized for Work on Telomeres
- 213 Digital Imaging, Communications Advances Honored
- 214 Francis Collins: Looking Beyond the Funding Deluge
- 215 Chronic Fatigue and Prostate Cancer: A Retroviral Connection?
- 215 From *Science's* Online Daily News Site
- 216 Agricultural Science Gets More Money, New Faces
- 217 Both of the World's Ice Sheets May Be Shrinking Faster and Faster
- 217 From the *Science* Policy Blog

## NEWS FOCUS

- 218 Looking for a Target on Every Tumor  
*>> Science Podcast*
- 221 For a Famous Physics Laboratory, a Quick and Painful Rebirth
- 224 New Work May Complicate History of Neandertals and *H. sapiens*

## LETTERS

- 227 Life-Long Learning for Physicians  
*K. Ahmed and H. Ashrafian*  
Make Room for Computing  
*M. W. Klymkowsky*  
News Story on Italy's MIT Disappoints  
*R. Cingolani and E. Bizzi*  
Response  
*L. Margottini*

Conflicting Data About Dyslexia's Cause  
*J. R. Skoyles and B. C. Skottun*  
Heretical DNA Sequences?  
*D. G. King and Y. Kashi*

- 230 CORRECTIONS AND CLARIFICATIONS
- 230 TECHNICAL COMMENT ABSTRACTS

## BOOKS ET AL.

- 231 The Monty Hall Problem  
*J. Rosenhouse, reviewed by D. O. Granberg*
- 232 Sex and War  
*M. Potts and T. Hayden, reviewed by H. Kaplan*

## POLICY FORUM

- 234 'Omics Data Sharing  
*D. Field et al.*
- 236 Genome Project Standards in a New Era of Sequencing  
*P. S. G. Chain et al.*

## PERSPECTIVES

- 238 Nuclear Power for Axonal Growth  
*M. C. Subang and P. M. Richardson*  
*>> Report p. 298*
- 239 Life After GWA Studies  
*E. T. Dermitzakis and A. G. Clark*
- 240 Monsoons and Meltdowns  
*J. P. Severinghaus*  
*>> Research Article p. 248*
- 242 Aorta's Cardinal Secret  
*R. Benedito and R. H. Adams*  
*>> Report p. 294*
- 243 On the Mammalian Ear  
*T. Martin and I. Ruf*  
*>> Report p. 278*
- 244 Sensing a Small But Persistent Current  
*N. O. Birge*  
*>> Report p. 272*
- 245 Energy Flow Under Control  
*V. S. Batista*  
*>> Report p. 263*

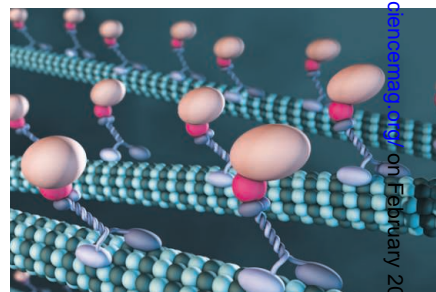
CONTENTS continued >>



page 218



page 232



pages 238 & 298



## COVER

First described by David Hilbert in 1891, the Hilbert curve is a one-dimensional fractal trajectory that densely fills higher-dimensional space without crossing itself. A new method for reconstructing the three-dimensional architecture of the human genome, described on page 289, reveals a polymer analog of Hilbert's curve at the megabase scale.

Image: Leonid A. Mirny and Erez Lieberman-Aiden

## DEPARTMENTS

- 201 This Week in *Science*
- 206 Editors' Choice
- 208 *Science* Staff
- 211 Random Samples
- 306 New Products
- 307 *Science* Careers

Downloaded from <http://science.sciencemag.org/> on February 20, 2019

## BREVIA

- 247 **Reconstituting Bacterial RNA Repair and Modification in Vitro**  
C. M. Chan et al.  
A protein heterotetramer repairs RNA cleaved by ribotoxins, and methylation protects against further ribotoxin attack.

## RESEARCH ARTICLES

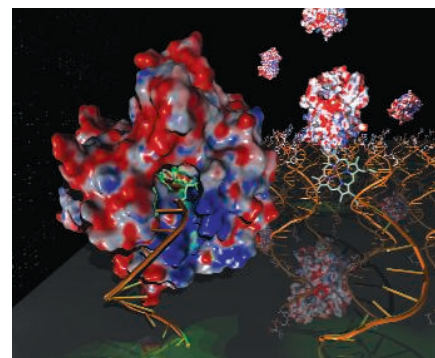
- 248 **Ice Age Terminations**  
H. Cheng et al.  
Variability of the Asian Monsoon over the past 400,000 years correlates with the ends of glacial periods.  
>> *Perspective p. 240*
- 252 **Reactome Array: Forging a Link Between Metabolome and Genome**  
A. Beloqui et al.  
A microarray technique uses trapped, dye-associated metabolites to allow rapid global characterization of metabolic activity.
- 257 **Unbiased Reconstruction of a Mammalian Transcriptional Network Mediating Pathogen Responses**  
I. Amit et al.  
Inflammatory and antiviral programs in dendritic cells are controlled and tuned by a network of regulators.

## REPORTS

- 263 **Mapping Excited-State Dynamics by Coherent Control of a Dendrimer's Photoemission Efficiency**  
D. G. Kuroda et al.  
A simple manipulation of the phase of a laser pulse optimizes photoemission efficiency in a complex molecule.  
>> *Perspective p. 245*
- 267 **Repetitive Readout of a Single Electronic Spin via Quantum Logic with Nuclear Spin Ancillae**  
L. Jiang et al.  
Controlled interactions with nearby nuclear spins help improve the quantum memory of a nitrogen vacancy in diamond.
- 272 **Persistent Currents in Normal Metal Rings**  
A. C. Bleszynski-Jayich et al.  
A nanomechanical resonator is used to detect weak persistent currents that flow in resistive metal rings.  
>> *Perspective p. 244*; *Science Podcast*

- 275 **The Shape and Surface Variation of 2 Pallas from the Hubble Space Telescope**  
B. E. Schmidt et al.  
Like the asteroids Ceres and Vesta, Pallas is a protoplanet that has remained intact since its formation.
- 278 **Evolutionary Development of the Middle Ear in Mesozoic Therian Mammals**  
Q. Ji et al.  
Fossil evidence and studies of mutant mice show that gene patterning allowed multiple evolutions of the mammalian middle ear.  
>> *Perspective p. 243*
- 281 **Daily Electrical Silencing in the Mammalian Circadian Clock**  
M. D. C. Belle et al.  
Clock-containing neurons in the mouse brain display complex electrophysiology not seen in other brain cells.
- 285 **Broad and Potent Neutralizing Antibodies from an African Donor Reveal a New HIV-1 Vaccine Target**  
L. M. Walker et al.  
High-throughput screening has revealed two new broadly neutralizing antibodies from a clade A-infected donor in Africa.
- 289 **Comprehensive Mapping of Long-Range Interactions Reveals Folding Principles of the Human Genome**  
E. Lieberman-Aiden et al.  
Chromosomes are organized in a fractal knot-free conformation that is densely packed while easily folded and unfolded.  
>> *Science Podcast*
- 294 **Arterial-Venous Segregation by Selective Cell Sprouting: An Alternative Mode of Blood Vessel Formation**  
S. P. Herbert et al.  
An alternative developmental pathway for vertebrate vasculature segregates a precursor vessel into two separate vessels.  
>> *Perspective p. 242*
- 298 **KLF Family Members Regulate Intrinsic Axon Regeneration Ability**  
D. L. Moore et al.  
The regenerative capacity of mouse retinal ganglion cells after injury is regulated by the KLF family of transcription factors.  
>> *Perspective p. 238*

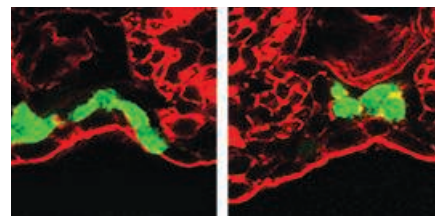
CONTENTS continued &gt;&gt;



page 252



pages 243 &amp; 278



pages 242 &amp; 294

## SCIENCEONLINE

## SCIENCEEXPRESS

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

### Genotype Analysis Identifies the Cause of the "Royal Disease"

*E. I. Rogaev et al.*

DNA from historical specimens reveals the mutation causing the hemophilia that afflicted the royal families of Europe.  
10.1126/science.1180660

### Detection of an Infectious Retrovirus, XMRV, in Blood Cells of Patients with Chronic Fatigue Syndrome

*V. C. Lombardi et al.*

Two-thirds of a sample of 101 U.S. patients with chronic fatigue syndrome harbor an infectious retrovirus in their blood cells.  
10.1126/science.1179052

### A New Virus for Old Diseases?

*J. M. Coffin and J. P. Stoye*

10.1126/science.1181349

### Coupling of CO<sub>2</sub> and Ice Sheet Stability Over Major Climate Transitions of the Last 20 Million Years

*A. K. Tripati et al.*

Changes in global sea level and atmospheric carbon dioxide levels were similar during the past 20 million years.  
10.1126/science.1178296

### Microsecond Simulations of Spontaneous Methane Hydrate Nucleation and Growth

*M. R. Walsh et al.*

An extended simulation uncovers the intricate steps whereby methane can be trapped in ice.  
10.1126/science.1174010

## TECHNICALCOMMENTS

### Comment on "The *Arabidopsis* Circadian Clock Incorporates a cADPR-Based Feedback Loop"

*X. Xu et al.*

full text at [www.sciencemag.org/cgi/content/full/326/5950/230-b](http://www.sciencemag.org/cgi/content/full/326/5950/230-b)

### Response to Comment on "The *Arabidopsis* Circadian Clock Incorporates a cADPR-Based Feedback Loop"

*A. N. Dodd et al.*

full text at [www.sciencemag.org/cgi/content/full/326/5950/230-c](http://www.sciencemag.org/cgi/content/full/326/5950/230-c)

## SCIENCENOW

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

Highlights From Our Daily News Coverage

### Biosafety Bra, Beer Bottle Ballistics Win Ig Nobels

Read about the annual extravaganza of song, dance, and unbelievable science.

### Buried Treasure Fills in Ancient Roman Puzzle

Forgotten coin stashes suggest Roman population dropped as the republic became an empire.

### Helping Crops Shed Pesticides

Dousing plants with their own hormones helps them expel toxic chemicals.

## SCIENCE SIGNALING

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

The Signal Transduction Knowledge Environment

### RESEARCH ARTICLE: Wingless Promotes Proliferative Growth in a Gradient-Independent Manner

*L. A. Baena-Lopez et al.*

Proliferation of cells in the *Drosophila* wing does not require a gradient of the morphogen Wingless.

### RESEARCH ARTICLE: Coordinated Responses to Oxygen and Sugar Deficiency Allow Rice Seedlings to Tolerate Flooding

*K.-W. Lee et al.*

The protein kinase CIPK15 integrates the response to hypoxia with sugar signaling to allow submerged rice seedlings to grow.

### PERSPECTIVE: Apoptosis—Calling Time on Apoptosome Activity

*C. Adrain and S. J. Martin*

Caspase-9 autoprocessing displaces active caspase-9 bound to the apoptosome, thereby limiting proteolytic activity.

### PERSPECTIVE: Snapshots Form a Big Picture of Guanine Nucleotide Exchange

*K. Rittinger*

DOCK9 uses a unique mechanism to discriminate between GDP- and GTP-bound forms of Cdc42.

## PODCAST

*J.-P. Vincent and A. M. VanHook*

Graded distribution of Wingless is not required for cell proliferation in the fly wing disc.

## SCIENCE CAREERS

[www.sciencereers.org/career\\_magazine](http://www.sciencereers.org/career_magazine)

Free Career Resources for Scientists

## SPECIAL RISK-TAKING ISSUE

### Audacity, Part 2: A Blueprint for Audacious Science

*A. Sasso*

Breakthrough science needs passion, a supportive institution, and a suitable problem.

### The Entrepreneurial Bug

*A. Kotok*

Academic scientists tell how they became driven to commercialize their science.

### Making the Most of Opportunities and Challenges

*R. Mejia*

Neuroscientist Sam Pfaff went on to success after a falling out with his adviser.

## SCIENCE TRANSLATIONAL MEDICINE

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

Integrating Medicine and Science

## EDITORIAL: Space for the Cures

*E. A. Zerhouni*

*Science* launches a new journal for translational research.

### COMMENTARY: Changing Models of Biomedical Research

*W. F. Crowley Jr. and J. F. Gusella*

Academic medical centers at the hub of a new style of research.

## RESEARCH: Building Better Bones

*D. Gesty-Palmer et al.*

A biased agonist may promote bone growth more effectively.

## PODCAST

This inaugural podcast features Advisory Board member Betsy Nabel on translational medicine and a discussion with several authors about osteoporosis drugs.

## SCIENCEPODCAST

[www.sciencemag.org/multimedia/podcast](http://www.sciencemag.org/multimedia/podcast)

Free Weekly Show

Download the 9 October *Science* Podcast to hear about personalized cancer treatments, persistent currents in nonsuperconductors, the organization of chromosomes, and more.

## ORIGINSBLOG

[blogs.sciencemag.org/origins](http://blogs.sciencemag.org/origins)

A History of Beginnings

## SCIENCEINSIDER

[blogs.sciencemag.org/scienceinsider](http://blogs.sciencemag.org/scienceinsider)

Science Policy News and Analysis

**SCIENCE (ISSN 0036-8075) is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1200 New York Avenue, NW, Washington, DC 20005.** Periodicals Mail postage (publication No. 484460) paid at Washington, DC, and additional mailing offices. Copyright © 2009 by the American Association for the Advancement of Science. The title SCIENCE is a registered trademark of the AAAS. Domestic individual membership and subscription (51 issues): \$146 (\$74 allocated to subscription). Domestic institutional subscription (51 issues): \$835; Foreign postage extra: Mexico, Caribbean (surface mail) \$55; other countries (air assist delivery) \$85. First class, airmail, student, and emeritus rates on request. Canadian rates with GST available upon request, GST #1254 88122. Publications Mail Agreement Number 1069624. **Printed in the U.S.A.**

**Change of address:** Allow 4 weeks, giving old and new addresses and 8-digit account number. **Postmaster:** Send change of address to AAAS, P.O. Box 96178, Washington, DC 20090-6178. **Single-copy sales:** \$10.00 current issue, \$15.00 back issue prepaid includes surface postage; bulk rates on request. **Authorization to photocopy** material for internal or personal use under circumstances not falling within the fair use provisions of the Copyright Act is granted by AAAS to libraries and other users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that \$20.00 per article is paid directly to CCC, 222 Rosewood Drive, Danvers, MA 01923. The identification code for *Science* is 0036-8075. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.



ADVANCING SCIENCE. SERVING SOCIETY

# Science

**326 (5950)**

*Science* **326** (5950), 201-306.

**ARTICLE TOOLS**

<http://science.sciencemag.org/content/326/5950>

**PERMISSIONS**

<http://www.sciencemag.org/help/reprints-and-permissions>

Use of this article is subject to the [Terms of Service](#)

---

*Science* (print ISSN 0036-8075; online ISSN 1095-9203) is published by the American Association for the Advancement of Science, 1200 New York Avenue NW, Washington, DC 20005. 2017 © The Authors, some rights reserved; exclusive licensee American Association for the Advancement of Science. No claim to original U.S. Government Works. The title *Science* is a registered trademark of AAAS.