

CONTENTS

16 OCTOBER 2025 | VOLUME 390 | ISSUE 6770



230

Svalbard's permafrost could preserve RNA viruses deposited by generations of seabirds and other wildlife.

EDITORIAL

217 A view of Horizon Europe's future —L. Borrell-Damián

NEWS

222 Papers based on open health data face bans
PLOS, Frontiers, and others announce policies intended to stem the tide of suspect papers —C. O'Grady

223 DNA from rum-soaked fishes chronicles century of change
Museum specimens reveal loss of genetic diversity in marine fishes of the Philippines —E. Stokstad

225 Did lead poisoning help drive human evolution?

"Bold" hypothesis suggests tolerance for lead allowed *Homo sapiens* to outlive Neanderthals —M. Price

226 Architects of molecular cages win Chemistry Nobel

Spongelike materials called metal-organic frameworks can separate and store gases —D. Clery and C. Offord

228 Chaos and confusion as U.S. shutdown drags on

Mass layoffs, and subsequent reversals, have added to research spending woes —Science News Staff

FEATURES

230 Cold storage

On an Arctic archipelago, frozen soil may preserve a hidden history of viruses —K. Kupferschmidt

PODCAST

COMMENTARY

PERSPECTIVES

236 Kiss, shrink, run

A unified mechanism directs synaptic vesicle release —K. Lichter
RESEARCH SUMMARY p. 258

237 Making hydrogen production durable

An interphase shields polymer electrolytes from electrochemical oxidation in an alkaline environment —Y. Seung Kim
RESEARCH ARTICLE p. 294

239 Neural compass in the sky

Head-direction neurons maintain stable directional signals during large-scale navigation in the wild —Y.-Q. Zhou and J. J. Knierim
RESEARCH SUMMARY p. 259

241 Quantum trions in equilibrium

Quantum fluid of trions is demonstrated in two-dimensional material systems —T. Ouyang and S.-F. Shi
RESEARCH ARTICLES pp. 299 & 304

POLICY FORUM

242 Mobilizing capital and technology for a clean aviation industry

Research managers and investors need better approaches to weigh risks and potential benefits of scalable, transformational technologies —D. G. Victor *et al.*

BOOKS ET AL.

246 Knowledge for two

A psychologist explores common knowledge and coordination —J. Goodman and C. Firestone

247 A radically organic worldview turns 100

A philosopher's seminal book traced how science shaped the mentality of the modern world
—Á. Gómez-Marín

LETTERS**248 Stemming green tides in the Yellow Sea** —L. Yang *et al.***248 Australian algal blooms require national action**

—D. McAfee and B. Martin

249 Chile's framework law erodes institutions

—I. Ojeda-Pereira

RESEARCH**HIGHLIGHTS**

251 From *Science* and other journals

RESEARCH SUMMARIES**254 Proteomics**

Mapping early human blood cell differentiation using single-cell proteomics and transcriptomics
—B. Furtwängler *et al.*

255 Lineage tracing

High-resolution spatial mapping of cell state and lineage dynamics in vivo with PETracer
—L. W. Koblan *et al.*

256 Pigmentation

A mosaic of modular variation at a single gene underpins convergent plumage coloration
—D. Lutgen *et al.*

257 Imaging

Mesoscale volumetric fluorescence imaging at nanoscale resolution by photochemical sectioning
—W. Wang *et al.*

258 Cell biology

"Kiss-shrink-run" unifies mechanisms for synaptic vesicle exocytosis and hyperfast recycling
—C.-L. Tao *et al.*

PERSPECTIVE p. 236

259 Neuroscience

Head-direction cells as a neural compass in bats navigating outdoors on a remote oceanic island
—S. Paldi *et al.*

PERSPECTIVE p. 239

260 Global sea level

Global mean sea level over the past 4.5 million years
—P. U. Clark *et al.*

RESEARCH ARTICLES**261 Organic chemistry**

The total synthesis of (–)-spiroaspertrione A: A divinylcyclopropane rearrangement approach
—W. Huang *et al.*

266 Infectious disease

Architectural immunity: Ants alter their nest networks to prevent epidemics
—L. Leckie *et al.*

PODCAST

272 Organic chemistry

Visible light-driven stereodivergent allylation of cyclic hemiacetals with butene for polypropionate synthesis
—H. Nakao *et al.*

279 Animal symbiosis

Defensive fungal symbiosis on insect hindlegs
—T. Nishino *et al.*

284 Plant ecology

Drought intensity and duration interact to magnify losses in primary productivity
—T. Ohlert *et al.*

290 Organic chemistry

Synthesis of triple stranded porphyrin nanobelts
—A. Rodríguez-Rubio *et al.*

294 Electrochemistry

Durable, pure water-fed, anion-exchange membrane electrolyzers through interphase engineering
—S. Hou *et al.*

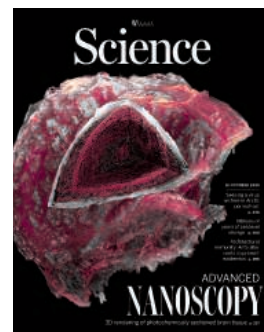
PERSPECTIVE p. 237

2D materials

299 Electrically controlled interlayer trion fluid in electron-hole bilayers
—R. Qi *et al.*

304 An equilibrium trion liquid in atomic double layers
—P. X. Nguyen *et al.*

PERSPECTIVE p. 241

ON THE COVER

This three-dimensional rendering of a mouse olfactory bulb exposes axons and myelin sheaths, the neuronal wiring that transmits odor information. The dataset was acquired using volumetric imaging via photochemical sectioning (VIPS), which alternates light-driven sectioning and on-block imaging to build a seamless volume. VIPS enables organ-wide nanoscale reconstruction for quantitative mapping of connectivity and molecular landscape in intact tissue. See page 257. Credit: Gao laboratory, University of Illinois Chicago; Upadhyayula laboratory, University of California, Berkeley

**ON THE PODCAST**

Hunting ancient viruses in the Arctic, and how ants build their nests to fight disease

WORKING LIFE

310 An immigrant's dilemma
—M. Gelambi

308 Science Careers



Science serves as a forum for discussion of important issues related to the advancement of science by publishing material on which a consensus has been reached as well as including the presentation of minority or conflicting points of view. Accordingly, all articles published in *Science*—including editorials, news, commentary, and book reviews—are signed and reflect the individual views of the authors and not official points of view adopted by AAAS or the institutions with which the authors are affiliated. *Science* (ISSN 0036-8075) is published weekly on Thursday, except 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 © 2025 by the American Association for the Advancement of Science. The title *Science* is a registered trademark of the AAAS. Domestic individual membership, including subscription (12 months): \$165 (\$74 allocated to subscription). Domestic institutional subscription (51 issues): \$2865; Foreign postage extra: Air assist delivery: \$135. First class, airmail, student, and emeritus rates on request. Canadian rates with GST available upon request. GST #R125488122. 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: \$15 each plus shipping and handling available from backissues.science.org; bulk rate on request. Authorization to reproduce material for internal or personal use under circumstances not falling within the fair use provisions of the Copyright Act can be obtained through the Copyright Clearance Center (CCC), www.copyright.com. The identification code for *Science* is 0036-8075. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.