A mosaic of visible to near-infrared images of the surface of Mercury, obtained by the MESSENGER spacecraft on 14 January 2008. The circular feature in the upper right is the Caloris impact basin, 1500 kilometers in diameter. Results from the flyby are discussed in a special section beginning on page 58.


SPECIAL SECTION

MESSENGER

INTRODUCTION
Mercury, Up-Close Again 58

REPORTS

Return to Mercury: A Global Perspective on MESSENGER’s First Mercury Flyby
S. C. Solomon et al.  >> Science Podcast

Spectroscopic Observations of Mercury’s Surface Reflectance During MESSENGER’s First Mercury Flyby
W. E. McClintock et al.

Reflectance and Color Variations on Mercury: Regolith Processes and Compositional Heterogeneity
M. S. Robinson et al.

Volcanism on Mercury: Evidence from the First MESSENGER Flyby
J. W. Head et al.

Geology of the Caloris Basin, Mercury: A View from MESSENGER
S. L. Murchie et al.

Laser Altimeter Observations from MESSENGER’s First Mercury Flyby
M. T. Zuber et al.

Mercury Cratering Record Viewed from MESSENGER’s First Flyby
R. G. Strom et al.

The Structure of Mercury’s Magnetic Field from MESSENGER’s First Flyby
B. J. Anderson et al.

Mercury’s Magnetosphere After MESSENGER’s First Flyby
J. A. Slavin et al.

MESSENGER Observations of the Composition of Mercury’s Ionized Exosphere and Plasma Environment
T. H. Zurbuchen et al.

Mercury’s Exosphere: Observations During MESSENGER’s First Mercury Flyby
W. E. McClintock et al.

NEWS OF THE WEEK

Big Land Purchase Triggers Review of Plans to Restore Everglades
California Emissions Plan to Explore Use of Offsets
Life’s Innovations Let It Diversify, at Least Up to a Point
Where Have All Thoreau’s Flowers Gone?

SCIENCESCOPE

Billion-Dollar Cancer Mapping Project Steps Forward
Panel to Take Closer Look at Scientific Whaling
Tiny Transistor Gets a Good Sorting Out

NEWS FOCUS

Preserving Iraq’s Battered Heritage

Epilepsy: When Death Strikes Without Warning
Competing Teams Plot Two Different Paths to a New Particle Smasher
MOLECULAR BIOLOGY
A Global View of Gene Activity and Alternative Splicing by Deep Sequencing of the Human Transcriptome
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 junctions.
10.1126/science.1160342

ATMOSPHERIC SCIENCE
BREVIA: N₂O₅ Oxidizes Chloride to Cl₂ in Acidic Atmospheric Aerosol
Laboratory studies affirm that the oxidation of chloride ions in aerosols by N₂O₅ is a significant source of chlorine in the troposphere, a major reactant that helps form ozone.
10.1126/science.1158777

LETTERS
Painful Publishing M. Raff, A. Johnson, P. Walter
>> Editorial p. 15
The Enemy Within V. L. Roggli
The Limits of Water Pumps L. Wang and P. D’Odorico
Omissions in GLAST Story G. F. Bignami et al.
Life in Science: Frogs on a Plane J. Rigg
37

BIOCHEMISTRY
The Crystal Structure of a Sodium Galactose Transporter Reveals Mechanistic Insights into Na+/Sugar Symport
S. Faham et al.
The structure of a sugar transporter suggests how these proteins may rearrange to permit the sugar to enter and leave the binding site on opposite sides of the membrane.
10.1126/science.1160406

PERSPECTIVES
A Unique Platform for Materials Design T. P. Lodge
Carbon Emissions and Acidification R. E. Zeebe, J. C. Zachos, K. Caldeira, T. Tyrrell
50

REVIEW
NEUROSCIENCE
Neuronal Diversity and Temporal Dynamics: The Unity of Hippocampal Circuit Operations T. Klausberger and P. Somogyi
53

BREVIA
EVOLUTION
Reduced Responses to Selection After Species Range Expansion B. Pujol and J. R. Pannell
An annual spurge with a geographical range that expanded after the Ice Age shows decreased response to selection at the edges of its new range, as predicted by theory.
96

RESEARCH ARTICLE
PALEONTOLOGY
Phanerozoic Trends in the Global Diversity of Marine Invertebrates J. Alroy et al.
A compilation of more than 3 million specimens of fossil marine invertebrates shows that their diversity increased more in the Jurassic and less since then than an earlier study implied.
>> News story p. 24
97

REPORTS
APPLIED PHYSICS
Self-Sorted, Aligned Nanotube Networks for Thin-Film Transistors M. C. LeMieux et al.
Treating silicon substrates with a silane layer allows them to absorb spin-coated, semiconducting carbon nanotubes, yielding aligned and densely packed nanotube films.
101
REPORTS CONTINUED...

ASTRONOMY
Relativistic Spin Precession in the Double Pulsar
R. P. Breton et al.
Four years of data track the spin precession of a pulsar orbiting a second pulsar, providing a positive test of general relativity in a strong gravitational field.

MATERIALS SCIENCE
Characterization of Step-Edge Barriers in Organic Thin-Film Growth
G. Hlawacek et al.
In contrast to the growth of inorganic films, bending of a rod-shaped organic molecule at step edges and its anisotropy leads to a change from growth of layers to terraced mounds.

CLIMATE CHANGE
Large and Rapid Melt-Induced Velocity Changes in the Ablation Zone of the Greenland Ice Sheet
R. S. W. van de Wal et al.
Measurements of ice velocity across western Greenland show that the ice sheet responds within days to excess meltwater, although annual flow has slowed about a quarter over 17 years.

CHEMISTRY
Mg/Al Ordering in Layered Double Hydroxides Revealed by Multinuclear NMR Spectroscopy
Rapid sample spinning during nuclear magnetic resonance spectroscopy reveals a highly ordered cation distribution in layered materials.

DEVELOPMENTAL BIOLOGY
Autophagy Is Essential for Preimplantation Development of Mouse Embryos
S. Tsukamoto et al.
As fertilized mouse eggs develop into embryos and maternal proteins are eliminated, the degradative process of autophagy is required for proper growth.

EVOLUTION
Phylogenetic Signal in the Eukaryotic Tree of Life
M. J. Sanderson
A survey of sequences in GenBank, which represent about 10 percent of described species, shows that the patchy distribution of data is insufficient to build a eukaryotic tree of life.

ECOLOGY
Accelerated Human Population Growth at Protected Area Edges
G. Wittemyer et al.
Contrary to expectations, human populations living near protected areas in 45 countries in Africa and Latin America are increasing nearly twice as fast as other rural ones.

CELL BIOLOGY
Robust, Tunable Biological Oscillations from Interlinked Positive and Negative Feedback Loops
T. Y.-C. Tsai et al.
Analysis of known and theoretical oscillatory circuits in cells shows that those with both negative and positive feedback are more robust and allow frequency control independent of amplitude.

MEDICINE
Sporadic Autonomic Dysregulation and Death Associated with Excessive Serotonin Autoinhibition
E. Audero et al.
In young mice, expression of higher than normal levels of a type of serotonin receptor causes sporadic death with features reminiscent of sudden infant death syndrome. >> Science Podcast

BIOCHEMISTRY
Myosin I Can Act As a Molecular Force Sensor
Myosin I, a motor protein that plays a role in hearing, is a sensitive tension sensor, reacting to small loads (less than 2 picoNewtons) by binding for much longer times to actin.

NEUROSCIENCE
The Spread of Ras Activity Triggered by Activation of a Single Dendritic Spine
C. D. Harvey, R. Yasuda, H. Zhong, K. Svoboda
When strengthened, individual synapses on dendritic spines contain an activated small regulatory protein that spreads to nearby spines, possibly altering their sensitivity.

NEUROSCIENCE
Finite Scale of Spatial Representation in the Hippocampus
K. B. Kjelstrup et al.
The rat hippocampus provides a representation of the animal’s entire spatial environment, coding distances up to 1 meter away in the dorsal region and up to 15 meters at the ventral tip. >> Perspective p. 46
Letting go.

SCIENCE NOW
www.sciencenow.org
HIGHLIGHTS FROM OUR DAILY NEWS COVERAGE

Why It’s Hard to Say Goodbye
Study links loss of a loved one to the brain’s pleasure center.

Don’t Judge a Plant by Its Species
An ant, an aphid, and a milkweed are changing thoughts about community ecology.

African Lion-Killer Had Help
Virus conspired with tick-borne parasites and extreme droughts.

TIMP-dependent dephosphorylation.

SCIENCE SIGNALING
www.sciencesignaling.org
THE SIGNAL TRANSDUCTION KNOWLEDGE ENVIRONMENT

REVIEW: Tissue Inhibitors of Metalloproteinases in Cell Signaling—Metalloproteinase-Independent Biological Activities
W. G. Stetler-Stevenson
TIMPs can act directly through cell surface receptors or indirectly through modulation of proteases.

PERSPECTIVE: The Cytoplasmic Tail of MUC1—A Very Busy Place
D. D. Carson
The cytoplasmic domain of mucin 1 (MUC1) plays numerous roles in intracellular signaling pathways.

Farewell, Micella.

SCIENCE CAREERS
www.sciencemag.org/career_development
FREE CAREER RESOURCES FOR SCIENTISTS

Educated Woman, Postdoc Edition, Chapter 18: End of the Road
M. P. DeWhyse
Micella Phoenix DeWhyse celebrates her Independence Day—and we’re sad; with related podcast interview.

Taken for Granted: By the Numbers
B. L. Benderly
A committee calls for better government data collection about jobs for scientists.

In Person: Research in France
A. Bikfalvi
Understanding the French public research system is critical to foreign scientists coming into the country.

July 2008 Funding News
J. Fernández
Learn about the latest in research funding, scholarships, fellowships, and internships.

Download the 4 July Science Podcast to hear about MESSENGER’s first Mercury flyby, possible clues to sudden infant death syndrome, preserving Iraqi antiquities, and more.