

571 This Week in *Science*

Editorial

573 Research Applications of Lasers: D. F. VOSS

Letters

575 Chernobyl Radiation Dose: M. GOLDMAN ■ Learning Science: C. L. ROBERTS ■
"Progress" in Evolution: F. K. MCKINNEY ■ Skepticism About SDI:
J. P. BLEWETT ■ Ecology of Marine Communities: C. SMITH AND P. JUMARS ■
Infrared Astronomy: J. F. ARENS

News & Comment

591 Thirty Ways to Temporize on Waste
592 Yale Accelerator to Be Dedicated
593 White House Spotlights New Superconductors
594 Nuclear Test Watchers Feel Political Heat
596 Bolivia Swaps Debt for Conservation
597 *Briefing*: Proposed Growth in U.K. Space Budget Rejected ■ Comings and Goings
■ Peer Review and ARS

Research News

598 The Genetics of Personality
599 Measuring Personality
602 Oncogene Action Probed: New Family of Growth Factor Genes Identified ■ *ras*
Oncogene Activated in Human Colon Cancers
604 Compact Discs Shrinking Data Storage Costs

Articles

Lasers in Research

605 Laser Techniques in High-Pressure Geophysics: R. J. HEMLEY, P. M. BELL,
H. K. MAO
612 Laser Spectroscopy of Trapped Atomic Ions: W. M. ITANO, J. C. BERGQUIST,
D. J. WINELAND
618 Hole-Burning Spectroscopy and Relaxation Dynamics of Amorphous Solids at
Low Temperatures: R. JANKOWIAK AND G. J. SMALL

Reports

626 Evidence for Chain Molecules Enriched in Carbon, Hydrogen, and Oxygen in
Comet Halley: D. L. MITCHELL, R. P. LIN, K. A. ANDERSON, C. W. CARLSON,
D. W. CURTIS, A. KORTH, H. RÈME, J. A. SAUVAUD, C. D'USTON *et al.*
628 First Polymer in Space Identified in Comet Halley: W. F. HUEBNER
630 High-Resolution Electron Microscopy and Scanning Tunneling Microscopy of
Native Oxides on Silicon: A. H. CARIM, M. M. DOVEK, C. F. QUATE,
R. SINCLAIR, C. VORST

■ **SCIENCE** is published weekly on Friday, except the last week in December, and with an extra issue in February by the American Association for the Advancement of Science, 1333 H Street, NW, Washington, DC 20005. Second-class postage (publication No. 484460) paid at Washington, DC, and at an additional entry. Now combined with **The Scientific Monthly**® Copyright © 1987 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): \$65. Domestic institutional subscription (51 issues): \$98. Foreign postage extra: Canada \$32, other (surface mail) \$27, air-surface via Amsterdam \$65. First class, airmail, school-year, and student rates on request. Single copies \$2.50 (\$3 by mail); back issues \$4 (\$4.50 by mail); Biotechnology issue, \$5.50 (\$6 by mail); classroom rates on request; Guide to Biotechnology Products and Instruments \$16 (\$17 by mail). **Change of address:** allow 6 weeks, giving old and new addresses and seven-digit account number. 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 the base fee of \$1 per copy plus \$0.10 per page is paid directly to CCC, 21 Congress Street, Salem, Massachusetts 01970. The identification code for *Science* is 0036-8075/83 \$1 + .10. **Postmaster:** Send Form 3579 to *Science*, 1333 H Street, NW, Washington, DC 20005. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.

■ The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.



COVER Laser spectroscopy of samples in diamond-anvil high-pressure cell. The excitation argon-ion laser (tuned to wavelength of 488 nanometers) is focused by a lens at upper right corner to a 100-nanogram hydrogen sample at a pressure of 30 gigapascals. The optical arrangement is used for Raman scattering, Brillouin scattering, ruby fluorescence, and laser heating at high pressures. See page 605. [Photography by Linda Mao, Fairfax, VA]

- 633 Radioactive Cesium from the Chernobyl Accident in the Greenland Ice Sheet: C. I. DAVIDSON, J. R. HARRINGTON, M. J. STEPHENSON, M. C. MONAGHAN, J. PUDYKIEWICZ, W. R. SCHELL
- 635 *ery*, a Human *ets*-Related Gene on Chromosome 21: Alternative Splicing, Polyadenylation, and Translation: V. N. RAO, T. S. PAPAS, E. S. P. REDDY
- 639 Naturally Acquired Antibodies to Sporozoites Do Not Prevent Malaria: Vaccine Development Implications: S. L. HOFFMAN, C. N. OSTER, C. V. PLOWE, G. R. WOOLLETT, J. C. BEIER, J. D. CHULAY, R. A. WIRTZ *et al.*
- 642 Astrocytes Block Axonal Regeneration in Mammals by Activating the Physiological Stop Pathway: F. J. LIUZZI AND R. J. LASEK
- 645 Eosinophils Cocultured with Endothelial Cells Have Increased Survival and Functional Properties: M. E. ROTHENBERG, W. F. OWEN, JR., D. S. SILBERSTEIN, R. J. SOBERMAN, K. F. AUSTEN, R. L. STEVENS
- 648 Concanavalin A Alters Synaptic Specificity Between Cultured *Aplysia* Neurons: S. S. LIN AND I. B. LEVITAN
- 650 Pheromone Components and Active Spaces: What Do Moths Smell and Where Do They Smell It?: C. E. LINN, JR., M. G. CAMPBELL, W. L. ROELOFS
- 652 Evidence for Reduced Recombination on the Nondisjoined Chromosomes 21 in Down Syndrome: A. C. WARREN, A. CHAKRAVARTI, C. WONG, S. A. SLAUGENHAUPT, S. L. HALLORAN, P. C. WATKINS *et al.*
- 655 Developmental Stability of the Tonotopic Organization of the Chick's Basilar Papilla: G. A. MANLEY, J. BRIX, A. KAISER

AAAS News

- 660 AAAS Summer Fellows at Work: L. A. LEVEY AND S. SAUER ■ Abelson Receives National Medal of Science: J. L. TERAMANI ■ More Cost Savings for Insured Members ■ 1987 Science Education Directory Available ■ Seminar Looks at Movement of Scientists and Engineers Between Germany and U.S.: C. V. KIDD ■ Judging Panel Selected for Public Understanding Award ■ Pacific Division Meets in San Diego ■ Obituaries

Book Reviews

- 665 Scientific Colonialism, *reviewed* by D. P. MILLER ■ The Development of American Physiology, P. J. PAULY ■ To Infinity and Beyond, J. CALLAHAN ■ Some Other Books of Interest ■ Books Received

Software Reviews

- 669 Contour Mapping and SURFACE II: J. C. DAVIS

Products & Materials

- 673 Computer System Reads 2-D Gels ■ EM with Variable Voltage, Pressure ■ Chemical-Structure Search Software ■ Polypropylene Filters for Liquid Clarification ■ ELISA Chromophore System ■ Color Electrostatic Plotter ■ Computerized Chemical Templates ■ MEDLINE on Optical Disk ■ Literature

Board of Directors

Lawrence Bogorad
*Retiring President,
Chairman*

Sheila E. Widnall
President

Walter E. Massey
President-elect

Robert McC. Adams
Floyd E. Bloom
Mary E. Clutter
Mildred S. Dresselhaus
Beatrix A. Hamburg
Donald N. Langenberg
Frank von Hippel
Linda S. Wilson

William T. Golden
Treasurer

Alvin W. Trivelpiece
Executive Officer

Editorial Board

Elizabeth E. Bailey
David Baltimore
William F. Brinkman
Philip E. Converse
Joseph L. Goldstein
James D. Idol, Jr.
Leon Knopoff
Seymour Lipset
Oliver E. Nelson
David V. Ragone
David M. Raup
Vera C. Rubin
Larry L. Smarr
Solomon H. Snyder
Robert M. Solow
James D. Watson

Board of Reviewing Editors

John Abelson
Qais Al-Awqati
James P. Allison
Don L. Anderson
Elizabeth H. Blackburn
Floyd E. Bloom
Charles R. Cantor
James H. Clark
Bruce F. Eldridge
Stanley Falkow
Theodore H. Geballe
Roger I. M. Glass
Stephen P. Goff
Robert B. Goldberg

Corey S. Goodman
Stephen J. Gould
Richard M. Held
Gloria Heppner
Eric F. Johnson
Konrad B. Krauskopf
I. Robert Lehman
Karl L. Magleby
Joseph B. Martin
John C. McGiff
Alton Meister
Mortimer Mishkin
Peter Olson
Gordon H. Orians
Carl O. Pabo
John S. Pearce

Yeshayau Pocker
Jean Paul Revel
James E. Rothman
Thomas C. Schelling
Ronald H. Schwartz
Stephen M. Schwartz
Otto T. Solbrig
Robert T. N. Tjian
Virginia Trimble
Geerat J. Vermeij
Martin G. Weigert
Harold Weintraub
Irving L. Weissman
George M. Whitesides
Owen N. Witte
William B. Wood

American Association for the Advancement of Science

Science serves its readers as a forum for the presentation and discussion of important issues related to the advancement of science, including the presentation of minority or conflicting points of view, rather than by publishing only material on which a consensus has been reached. Accordingly, all articles published in *Science*—including editorials, news and comment, and book reviews—are signed and reflect the individual views of the authors and not official points of view adopted by the AAAS or the institutions with which the authors are affiliated.

Publisher: Alvin W. Trivelpiece

Editor: Daniel E. Koshland, Jr.

Deputy Editors: Philip H. Abelson (*Engineering and Applied Sciences*); John I. Brauman (*Physical Sciences*)

EDITORIAL STAFF

Managing Editor: Patricia A. Morgan

Assistant Managing Editor: Nancy J. Hartnagel

Senior Editors: Eleanor Butz, Ruth Kulstad

Associate Editors: Martha Collins, Barbara Jasny, Katrina L. Kelner, Edith Meyers, Phillip D. Szuromi, Kim D. Vandegriff, David F. Voss

Letters Editor: Christine Gilbert

Book Reviews: Katherine Livingston, *editor*; Deborah F. Washburn

This Week in Science: Ruth Levy Guyer

Contributing Editor: Lawrence I. Grossman

Chief Production Editor: Ellen E. Murphy

Editing Department: Lois Schmitt, *head*; Mary McDaniel, Barbara E. Patterson

Copy Desk: Lyle L. Green, Sharon Ryan, Beverly Shields, Anna Victoreen

Production Manager: Karen Schools

Assistant Production Manager: James Landry

Graphics and Production: Holly Bishop, James J. Olivari, Eleanor Warner

Covers Editor: Grayce Finger

Manuscript Systems Analyst: William Carter

NEWS STAFF

News Editor: Barbara J. Culliton

News and Comment: Colin Norman, *deputy editor*; William Booth, Mark H. Crawford, Constance Holden, Eliot Marshall, Marjorie Sun, John Walsh

Research News: Roger Lewin, *deputy editor*; Deborah M. Barnes, Richard A. Kerr, Gina Kolata, Jean L. Marx, Leslie Roberts, Arthur L. Robinson, M. Mitchell Waldrop

European Correspondent: David Dickson

BUSINESS STAFF

Associate Publisher: William M. Miller, III

Business Staff Manager: Deborah Rivera-Wienhold

Classified Advertising Supervisor: Karen Morgenstern

Membership Recruitment: Gwendolyn Huddle

Member and Subscription Records: Ann Ragland

Guide to Biotechnology Products and Instruments:

Shauna S. Roberts

ADVERTISING REPRESENTATIVES

Director: Earl J. Scherago

Traffic Manager: Donna Rivera

Traffic Manager (Recruitment): Gwen Canter

Advertising Sales Manager: Richard L. Charles

Marketing Manager: Herbert L. Burkland

Sales: New York, NY 10036: J. Kevin Henebry, 1515 Broadway (212-730-1050); Scotch Plains, NJ 07076: C. Richard Callis, 12 Unami Lane (201-889-4873); Chicago, IL 60611: Jack Ryan, Room 2107, 919 N. Michigan Ave. (312-337-4973); San Jose, CA 95112: Bob Brindley, 310 S. 16 St. (408-998-4690); Dorset, VT 05251: Fred W. Dieffenbach, Kent Hill Rd. (802-867-5581); Damascus, MD 20872: Rick Sommer, 24808 Shrubbery Hill Ct. (301-972-9270); U.K., Europe: Nick Jones, +44(0647)52918; Telex 42513; FAX (0392) 31645.

Information for contributors appears on page XI of the 26 June 1987 issue. Editorial correspondence, including requests for permission to reprint and reprint orders, should be sent to 1333 H Street, NW, Washington, DC 20005. Telephone: 202-326-6500.

Advertising correspondence should be sent to Tenth Floor, 1515 Broadway, NY 10036. Telephone 212-730-1050 or WU Telex 968082 SCHERAGO.

Research Applications of Lasers

Laser light comes in many sizes, shapes, and colors. The most powerful lasers produce intensities as high as 10^{16} watts per square centimeter, one trillion times the intensity at the surface of the sun and enough to cause fusion reactions. Pulses that are 6×10^{-15} second in duration, consisting of three optical cycles, are now available from dye lasers, and wavelengths shorter than 100 angstroms have been generated by x-ray lasers. Such lasers are interesting objects of study in their own right, but the lasers that operate within the limits are the workhorses: commercially available and approaching turn-key reliability. Lasers are increasingly used as tools for scientific research; with them it is possible to open new avenues of inquiry. In this issue of *Science* are three articles—in geophysics, atomic physics, and chemical physics—that present several ways in which lasers are employed as tools in the laboratory.

Hemley, Bell, and Mao describe some of the uses of lasers in laboratory geophysics. Inside the earth, planetary matter is subjected to pressures that approach several million atmospheres and temperatures in the thousands of degrees. Because direct observation is not possible, an understanding of internal structures and transformations can only be achieved by simulation of these extreme conditions. Small amounts of minerals or their constituents are sandwiched between diamond surfaces and subjected to large static pressure, the latter communicated by the calibrated fluorescence of a ruby chip. An infrared laser beam, passing unhindered through the transparent diamond, may heat the tiny sample, thus raising the compressed environment to high temperature. A visible-wavelength laser can probe the sample for Raman and Brillouin resonances, which reveal the subtleties of the dynamics of the earth and other planets. Raman spectra disclose the remarkable phase transitions of minerals under pressure, and Brillouin scattering permits a quantitative measure of the elastic and acoustic properties important in seismic studies.

Itano, Bergquist, and Wineland describe laser spectroscopy of ions held captive in an electromagnetic trap. In these experiments, quantum states are studied with extraordinary precision; from the results we learn more about atomic clocks and fundamental physics. Confined to a small space and freed from the perturbing influence of neighbors, single atomic ions exhibit quantum-mechanical resonances that are exceedingly narrow in comparison with the broad spectral lines of denser matter. A precisely tuned laser can further constrain the atomic motion by radiation pressure. Lasers that are under strict frequency stabilization can be used to record high-resolution spectra of the isolated ion. In other experiments, this trapped performer can be made to execute quantum jumps, abruptly fluorescing and then going dark.

Jankowiak and Small review experiments that reveal much about the properties of solids at temperatures near absolute zero. In particular they discuss “hole-burning” spectroscopy as a means of extracting harmony from chaos. Amorphous materials, glasses and polymers for example, are disordered on a microscopic scale, and this disorder is reflected in the broad optical absorption spectrum of a collection of guest molecules. The confusion caused by this disorder can be cleared away by carefully exciting a limited group of molecules to higher energy states with a narrow-band laser. These chosen few molecules, now absent from the ground state, are represented by “holes” in the spectrum. This select group can be watched closely: the holes will fill up as the guests rush back to their places. The glass structure can change, however, before the guest molecules have returned, and persistent spectral holes are the result. Even at temperatures below 1 K this structural reorganization continues: no longer thermally activated, the glassy rearrangement instead occurs by quantum tunneling. With laser hole-burning spectroscopy, researchers can probe the time scales of these dynamic events over 15 orders of magnitude, obtaining new information about basic properties of an important class of materials, the disordered solids.

Perhaps the most exciting future role for lasers is in those applications at the limits of performance: electronic pulse generation with ultrashort laser pulses, long baseline laser interferometers for gravity wave detection, and the creation of “squeezed” states of light with exotic statistical properties, to name a few. In these explorations, grand discoveries await researchers equipped with the next generation of laser tools.—DAVID F. VOSS