

611 This Week in *Science*

Editorial

613 New Materials: Chemistry and Physics: J. I. BRAUMAN

Letters

620 Global Warming: B. D. SOLOMON AND M. J. ADLER; W. FULKERSON, D. B. REISTER, S. I. AUERBACH, A. M. PERRY, A. T. CRANE, D. E. KASH ■ BEIR V: Implications for the Nuclear Workforce: R. E. LAPP; W. K. SINCLAIR ■ RU 486 Development: D. PHILIBERT AND G. TEUTSCH ■ Waste Site Cleanup: D. F. LUECKE AND M. KASSEN

News & Comment

624 Huntington's Gene: So Near, Yet So Far ■ Three Steps Forward, Two Steps Back
628 NIH Director: The Search Goes On. . . and On
629 Fetal Research Ban on Shaky Ground?
Bush Names Science Committee
630 Stretching the Point
631 Fish, Money, and Science in Puget Sound
632 *Briefings*: New Lease on Life for Dahlem Meetings ■ What's in the Bowl? ■ Layoffs Hit Draper Laboratory ■ Protecting Progress ■ Going Where Nukies Fear to Tread ■ European Weather Forecasters Get One Right ■ U.S.-Soviet Diabetes Project ■ Patent Court Gets First Scientist ■ Room at the Top

Research News

634 The Children of the STM
637 Asking for the Moon ■ The Return of Cold Dark Matter

Articles

Fundamentals of Materials Science

649 Solid-State Chemistry: A Rediscovered Chemical Frontier: F. J. DiSALVO
656 Structural Chemistry and the Local Charge Picture of Copper Oxide Superconductors: R. J. CAVA
663 Electrides: Ionic Salts with Electrons as the Anions: J. L. DYE
669 Quantum Confinement and Host/Guest Chemistry: Probing a New Dimension: G. D. STUCKY AND J. E. MAC DOUGALL
679 All-Optical Nonlinearities in Organics: B. I. GREENE, J. ORENSTEIN, S. SCHMITT-RINK
688 Current Issues and Problems in the Chemical Vapor Deposition of Diamond: W. A. YARBROUGH AND R. MESSIER

Reports

697 Precision Lattice-Parameter Determination of (Mg,Fe)SiO₃ Tetragonal Garnets: R. MATSUBARA, H. TORAYA, S. TANAKA, H. SAWAMOTO

■ **SCIENCE** is published weekly on Friday, except the last week in December, and with an extra issue in March by the American Association for the Advancement of Science, 1333 H Street, NW, Washington, DC 20005. Second-class Non-profit postage (publication No. 484460) paid at Washington, DC, and at an additional entry. Copyright © 1990 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): \$75. Domestic institutional subscription (51 issues): \$120. Foreign postage extra: Canada \$46, other (surface mail) \$46, air mail via Amsterdam \$85. First class, airmail, school-year, and student rates on request. **Single copy sales:** Current issue, \$3.50; back issues, \$5.00; Biotechnology issue, \$6.00 (for postage and handling, add per copy \$0.50 U.S., \$1.00 all foreign); Guide to Biotechnology Products and Instruments, \$18 (for postage and handling add per copy \$1.00 U.S., \$1.50 Canada, \$2.00 other foreign). 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 the base fee of \$1 per copy plus \$0.10 per page is paid directly to CCC, 27 Congress Street, Salem, Massachusetts 01970. The identification code for *Science* is 0036-8075/83 \$1 + .10. **Change of address:** allow 6 weeks, giving old and new addresses and 11-digit account number. **Postmaster:** Send Form 3579 to *Science*, P.O. Box 1723, Riverton, NJ 08077. *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 1948 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 Superlattices of *p*-nitroaniline molecules self-assemble and orient within the polar, 9-angstrom-wide channels of ALPO-5, a molecular sieve. Nanometer-scale clusters of molecules or semiconductors can have useful nonlinear optical and electronic properties. The dimensions of such clusters are comparable to the distances traveled by optically excited electrons. This issue of *Science* focuses on applications of physics and chemistry in the design of new materials. See page 669. [Photographic image by Mark Stucky]

- 699 Effects on Carbon Storage of Conversion of Old-Growth Forests to Young Forests: M. E. HARMON, W. K. FERRELL, J. F. FRANKLIN
- 702 An Aptian Plant with Attached Leaves and Flowers: Implications for Angiosperm Origin: D. W. TAYLOR AND L. J. HICKEY
- 704 Expression of β -Nerve Growth Factor Receptor mRNA in Sertoli Cells Downregulated by Testosterone: H. PERSSON, C. AYER-LE LIEVRE, O. SÖDER, M. J. VILLAR, M. METSIS, L. OLSON, M. RITZEN, T. HÖKFELT
- 707 Induction of Cellular Senescence in Immortalized Cells by Human Chromosome 1: O. SUGAWARA, M. OSHIMURA, M. KOI, L. A. ANNAB, J. C. BARRETT
- 710 A Potent GAL4 Derivative Activates Transcription at a Distance in Vitro: M. CAREY, J. LEATHERWOOD, M. PTASHNE
- 712 Suppression of Tumorigenicity of Human Prostate Carcinoma Cells by Replacing a Mutated *RB* Gene: R. BOOKSTEIN, J.-Y. SHEW, P.-L. CHEN, P. SCULLY, W.-H. LEE
- 715 Antigen Presentation Requires Transport of MHC Class I Molecules from the Endoplasmic Reticulum: J. H. COX, J. W. YEWDELL, L. C. EISENLOHR, P. R. JOHNSON, J. R. BENNINK
- 718 T Cells Responsive to Myelin Basic Protein in Patients with Multiple Sclerosis: M. ALLEGRETTA, J. A. NICKLAS, S. SRIRAM, R. J. ALBERTINI
- 721 Influence of Scene-Based Properties on Visual Search: J. T. ENNS AND R. A. RENSINK
- 723 Growth Factors Induce Phosphorylation of the Na^+/H^+ Antiporter, a Glycoprotein of 110 kD: C. SARDET, L. COUNILLON, A. FRANCHI, J. POUYSSÉGUR

Technical Comments

- 727 "Subjective Perception": B. LIBET; N. K. LOGOTHETIS

Book Reviews

- 731 The Informal Economy, reviewed by N. FONER ■ Dinosaur Tracks and Traces, A. R. FIORILLO ■ Photons and Atoms, G. C. HEGERFELDT ■ Neurobiology of Glycoconjugates, S. HOCKFIELD ■ Books Received

Products & Materials

- 735 Centrifugal-Partition Chromatography ■ Automated DNA Sequencer ■ Cell Adhesion Protein ■ Variable-Intensity Transilluminators ■ Bacteria and Fungus Detector ■ Capillary Electrophoresis Systems ■ Single-Button ICP-MS Control ■ DISCUS Cell for IR/FTIR Gas Analysis ■ Dedicated 2-D Electrophoresis System ■ HPLC Pump ■ Scientific Graphing Software ■ HPLC System ■ Preparative Column Packer ■ Automated Liquid Transfers ■ Molecular Microanalysis System ■ Alkaline-Resistant HPLC Columns

Board of Directors

Walter E. Massey
*Retiring President,
Chairman*

Richard C. Atkinson
President

Donald N. Langenberg
President-elect

Mary Ellen Avery
Francisco J. Ayala
Floyd E. Bloom
Mary E. Clutter
Eugene H. Cota-Robles
Joseph G. Gavin, Jr.
John H. Gibbons
Beatrix A. Hamburg
William T. Golden
Treasurer

Richard S. Nicholson
Executive Officer

Editorial Board

Elizabeth E. Bailey
David Baltimore
William F. Brinkman
E. Margaret Burbidge
Philip E. Converse
Joseph L. Goldstein
Mary L. Good
F. Clark Howell
James D. Idol, Jr.
Leon Knopoff
Oliver E. Nelson
Yasutomi Nishizuka
Helen M. Ranney
David M. Raup
Howard A. Schneiderman
Larry L. Smarr
Robert M. Solow
James D. Watson

Board of Reviewing Editors

John Abelson
Don L. Anderson
Stephen J. Benkovic
Gunter K.-J. Blobel
Floyd E. Bloom
Henry R. Bourne
James J. Bull
Kathryn Calame
Charles R. Cantor
Ralph J. Cicerone
John M. Coffin
Robert Dorfman
Bruce F. Eldridge
Paul T. Englund
Fredric S. Fay

Theodore H. Geballe
Roger I. M. Glass
Stephen P. Goff
Corey S. Goodman
Stephen J. Gould
Eric F. Johnson
Stephen M. Kosslyn
Konrad B. Krauskopf
Charles S. Levings III
Richard Losick
Joseph B. Martin
John C. McGiff
Anthony R. Means
Mortimer Mishkin
Roger A. Nicoll
Carl O. Pabo
Yeshayau Pocker

Dennis A. Powers
Erkki Ruoslahti
Thomas W. Schoener
Ronald H. Schwartz
Terrence J. Sejnowski
Robert T. N. Tjian
Virginia Trimble
Emil R. Unanue
Geerat J. Vermeij
Bert Vogelstein
Harold Weintraub
Irving L. Weissman
Zena Werb
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: Richard S. Nicholson

Editor: Daniel E. Koshland, Jr.

News Editor: Ellis Rubinstein

Managing Editor: Patricia A. Morgan

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

EDITORIAL STAFF

Assistant Managing Editor: Monica M. Bradford

Senior Editors: Eleanore Butz, Martha Coleman, Barbara Jasny, Katrina L. Kelnner, Phillip D. Szuroimi, David F. Voss

Associate Editors: Keith W. Brocklehurst, R. Brooks Hanson, Pamela J. Hines, Linda J. Miller

Letters Editor: Christine Gilbert

Book Reviews: Katherine Livingston, *editor*

Contributing Editor: Lawrence I. Grossman

Chief Production Editor: Ellen E. Murphy

Editing Department: Lois Schmitt, *head*; Mary McDaniel, Patricia L. Moe, Barbara P. Ordway

Copy Desk: Joi S. Granger, Margaret E. Gray, MaryBeth Shartle, Beverly Shields

Production Manager: James Landry

Assistant Production Manager: Kathleen C. Fishback

Art Director: Yolanda M. Rook

Graphics and Production: Holly Bishop, Julie Cherry, Catherine S. Siskos

Systems Analyst: William Carter

NEWS STAFF

Correspondent-at-Large: Barbara J. Culliton

Deputy News Editors: John M. Benditt, Jean Marx, Colin Norman

News and Comment/Research News: Mark H. Crawford, Constance Holden, Richard A. Kerr, Eliot Marshall, Joseph Palca, Robert Pool, Leslie Roberts, Marjorie Sun, M. Mitchell Waldrop

European Correspondent: Jeremy Cherfas

West Coast Correspondent: Marcia Barinaga

BUSINESS STAFF

Circulation Director: John G. Colson

Fulfillment Manager: Marlene Zendell

Business Staff Manager: Deborah Rivera-Wienhold

Classified Advertising Supervisor: Amie Charlene King

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

Employment Sales Manager: Edward C. Keller

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 60914: Jack Ryan, 525 W. Higgins Rd. (312-885-8675); San Jose, CA 95112: Bob Brindley, 310 S. 16th St. (408-998-4690); Dorset, VT 05251: Fred W. Dieffenbach, Kent Hill Rd. (802-867-5581); Damascus, MD 20872: Rick Sommer, 11318 Kings Valley Dr. (301-972-9270); U.K., Europe: Nick Jones, +44(0647)52918; Telex 42513; FAX (0647) 52053.

Information for contributors appears on page XI of the 22 December 1989 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, New York, NY 10036. Telephone 212-730-1050 or WU Telex 968082 SCHERAGO, or FAX 212-382-3725.

New Materials: Chemistry and Physics

New materials are receiving increasing attention in the science and technology communities. High strength, new electronic behavior, and novel optical properties are among the interesting and important features of these substances. With improved theoretical understanding and much better ability to measure properties, we have now reached a threshold where new materials may soon be designed rationally, with specific properties, rather than limited by accidental discovery or by limitations of synthetic methods which give only the thermodynamically controlled or most stable products. Because materials have properties that arise both from their chemical composition as well as their physical nature, they present a set of especially interesting challenges. In this issue of *Science* we present some examples where physics and chemistry are coming together to provide new insights and new possibilities in materials research. The great achievements already here, especially in electronics, provide promise of much to come in other areas.

DiSalvo presents an overview of some aspects of solid-state chemistry. He points out the long-term challenges that currently make the design and prediction of new families of solid-state compounds difficult. He addresses, in particular, extended solids as contrasted with molecular solids. Current research directions in selected areas are discussed.

High-temperature superconductivity is an area of special importance, but theory has not yet evolved to a state which is satisfactory for complete understanding. Cava describes crystal structures of copper oxide superconductors organized by structural families. A picture is presented by which common features of all these structures can be understood. Once the basic principles are laid out, the complexities are clarified.

Dye describes a new family of chemical compounds: electrides. These are ionic materials in which electrons trapped in cavities serve as the negative counterion. Interestingly, the ability to make these compounds is a consequence of the cation solvating compounds such as crown ethers and cryptands. Electron mobilities depend on the structure of the crystal. Because of their small mass and consequent quantum effects, the trapped electrons exhibit unusual and complex interactions.

Stucky and MacDougall deal with the nanosize regime in which quantum mechanical effects can modify the electronic and optical properties of materials. They discuss the strategy of using three-dimensional crystalline surfaces such as those found in zeolites to assemble clusters of fixed arrangement and size in a periodic lattice. These issues are of importance particularly in nonlinear phenomena that are used in electrooptics and optical switching.

Nonlinear optical materials are destined to play an important role, especially in communications, because of the higher mobility of photons, as contrasted with electrons, in many materials. Greene, Orenstein, and Schmitt-Rink discuss a simple theoretical model that treats both semiconductors and organics. This provides a framework on which to base expectations for optical nonlinearities in organic and inorganic materials. This work attempts to unify the inorganic semiconductor and organic fields, showing their differences and similarities. The potential for new devices and applications is also appraised.

Diamond, remarkable for its physical properties has, until recently, not been a "workable" material. Yarbrough and Messier discuss the synthesis and characterization of diamond. They provide a critical examination of major issues and problems in the chemical vapor deposition of diamond. The physical principles involved must be understood better in order to assess possibilities for using this technique to synthesize other materials.

Ancient civilizations are characterized by the kinds of materials that were in wide use (stone, iron, and bronze). We are now in an era in which many novel materials with extraordinary properties will bring us new and exciting advances; these will change our lives in important and unexpected ways.—JOHN I. BRAUMAN