

511 This Week in *Science*

Editorial

513 Medicine from Plants

Letters

515 *Discover's* Advertisements: P. HOFFMAN; M. GARDNER ■ Soviet Sociology: S. P. DUNN ■ Soviet Alcoholism: MRS. E. P. DUNN ■ NIH Conflict-of-Interest Guidelines: P. SIEKEVITZ

News & Comment

517 Bush Budget Highlights R&D
520 Emissions Trading Goes Global
BITNET Headed for New Frontiers
521 Global Warming Continues in 1989
522 USDA Admits "Mistake" in Doctoring Study
523 Virus-Like Agent Blamed for Mad Cow Disease

Research News

524 Neuroscience Models the Brain
527 The Great Asteroid Roast: Was It Rare or Well-Done? ■ S Asteroids at Controversy's Core
529 Fetal Nerve Grafts Show Promise in Parkinson's
530 *Briefings*: Anxiety in Academe Over DOD Cuts ■ Congress and Animal Rights ■ Uptown Goes Down ■ Deutch Bows Out ■ Japan Reaches for the Moon

Articles

534 The Health Sector's Share of the Gross National Product: V. R. FUCHS
539 Experiments on the Structure of an Individual Elementary Particle: H. DEHMELT

Research Article

546 Functional Evidence for an RNA Template in Telomerase: D. SHIPPEN-LENTZ AND E. H. BLACKBURN

Reports

553 Direct Observation and Analysis of CuO₂ Shear Defects in La_{2-x}SR_xCuO₄: P. L. GAI AND E. M. MCCARRON III
556 An Empirical Model of Total Solar Irradiance Variation Between 1874 and 1988: P. FOUKAL AND J. LEAN

■ **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 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 A photograph of dark sunspots and bright faculae near the sun's limb, obtained in broad-band light with the vacuum tower telescope at Sacramento Peak Observatory. These two kinds of photospheric magnetic structures both influence the total solar irradiance. The smallest facular elements visible are approximately 500 miles in diameter. See page 556. [By permission of the National Solar Observatory/Sacramento Peak, a division of the National Optical Astronomy Observatories, Inc., under cooperative agreement with the National Science Foundation]

- 559 Common Features of Protein Unfolding and Dissolution of Hydrophobic Compounds: K. P. MURPHY, P. L. PRIVALOV, S. J. GILL
- 561 Activation of Proto-Oncogenes: An Immediate Early Event in Human Cytomegalovirus Infection: I. BOLDOGH, S. ABUBAKAR, T. ALBRECHT
- 564 Suppression of HIV Infection in AZT-Treated SCID-hu Mice: J. M. McCUNE, R. NAMIKAWA, C.-C. SHIH, L. RABIN, H. KANESHIMA
- 566 Human Sickle Hemoglobin in Transgenic Mice: T. M. RYAN, T. M. TOWNES, M. P. REILLY, T. ASAKURA, R. D. PALMITER, R. L. BRINSTER, R. R. BEHRINGER
- 568 Tumorigenicity in Human Melanoma Cell Lines Controlled by Introduction of Human Chromosome 6: J. M. TRENT, E. J. STANBRIDGE, H. L. McBRIDE, E. U. MEESE, G. CASEY, D. E. ARAUJO, C. M. WITKOWSKI, R. B. NAGLE
- 571 2,3-Dihydroxy-6-nitro-7-sulfamoyl-benzo(F)quinoxaline: A Neuroprotectant for Cerebral Ischemia: M. J. SHEARDOWN, E. Ø. NIELSEN, A. J. HANSEN, P. JACOBSEN, T. HONORÉ
- 574 Grafts of Fetal Dopamine Neurons Survive and Improve Motor Function in Parkinson's Disease: O. LINDVALL, P. BRUNDIN, H. WIDNER, S. REHNCRONA, B. GUSTAVII, R. FRACKOWIAK, K. L. LEENDERS, G. SAWLE *et al.*

Inside AAAS

- 578 1989 Election Results ■ San Salvador Investigation ■ Art & Science ■ New Books ■ AAAS Fellow Nominations ■ Upcoming AAAS Meetings

Book Reviews

- 581 Tracing Archaeology's Past, *reviewed by* C. C. LAMBERG-KARLOVSKY ■ Science in Sweden, N. ROLL-HANSEN ■ Renewing a Scientific Society, H. W. KOCH ■ Books Received

Products & Materials

- 586 Software for Three-Dimensional Graphics ■ Cell Processing Membranes ■ Growth Chamber Speeds Vapor Diffusion ■ Biological Safety Cabinet ■ Microscope Workstation for the Apple Macintosh ■ Microdialysis Probes ■ Literature

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. Kellner, 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 Broad-

way (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.

Medicine from Plants

Beginning when they are infants, human beings will put almost anything into their mouths. It is not surprising that medical effects of many plants have long been known and used. Even today about 75% of the world population still relies on plants, plant extracts, and other tools of traditional medicine. There are about 121 clinically useful prescription drugs worldwide that are derived from higher plants. About 74% of them came to the attention of pharmaceutical houses because of their use in traditional medicine. Among the drugs derived from plants are the anticancer agents vinblastine and vincristine. Morphine, codeine, quinine, atropine, and digitalis come from plants.

About 10% of the dry mass of some plants is made up of chemicals designed for defense against predators. Evolution of plants has proceeded in many directions, leading to the creation of novel uncounted substances, only some of which have been identified. Fewer of them have been synthesized in the laboratory. The defensive chemicals interact harmfully with the biochemical apparatus of predators. While many biochemical pathways of living matter are common to all forms, there are differences that can be exploited. What is one creature's poison can be innocuous or helpful to another. What is toxic to one tissue or a neoplasm may not be toxic to the rest of an animal.

Natural product research has been conducted for more than a century. In 1985, worldwide, a total of 3500 new chemical structures was discovered. Some 2619 of the chemicals were isolated from higher plants. The techniques for isolating and identifying chemicals in natural products are now many and powerful. Various forms of chromatography, mass spectrometry, and nuclear magnetic resonance are particularly useful.

The National Cancer Institute (NCI) has created a superior technology for screening for anticancer drugs.* It employs 60 different tumor cell lines in its test procedure. The lines have been selected to represent the various forms of cancer, for example, brain tumors, leukemias, and melanomas. The NCI has also developed a screening procedure for chemicals that might be effective against the AIDS virus.

The new method of screening for anticancer drugs is proving more successful than an earlier procedure in which only mouse leukemic cells were used in the initial screen. Between 1955 and 1982 chemicals from 35,000 plants were tested. Some of the extracts were active, but they brought with them harmful side effects. Many of the older plant extracts will be screened with the new procedure, and NCI will be examining both natural substances and laboratory synthetics. Ultimately the test panels will be expanded to include about 100 cell lines, and substances will be tested at the rate of about 20,000 per year.

In terms of research designed to discover new plant-based pharmaceuticals, the United States has lagged. In 1987 Japan captured 56% of natural product patents summarized in *Phytotherapy Research*. West Germany has been much more active in this field than the United States.† During the past decade West Germany developed many phytopharmaceuticals that have proven effective in a wide variety of medical problems. Only a fraction of them has been approved for sale in the United States. In the United States costs of development of a drug have risen to the vicinity of \$100 million with 10 years often required to prove efficacy and safety. In West Germany the safety of long-used natural products is generally assumed if no side effects have been reported. Proof of effectiveness is more readily achieved in West Germany than here. Heavy emphasis is placed on reports of general practitioners, and extensive clinical trials are not required.

In spite of the considerable research activity in the identification of chemicals in natural products, the potentials for medicine have not been fully exploited. Norman Farnsworth of the University of Illinois' College of Pharmacy has estimated that only 5000 plant species have been studied exhaustively for possible medical application. This is a minor fraction of the estimated total of 250,000 to 300,000 species. Most of the plants that have not been analyzed and tested grow in the tropics—a large fraction of them in the rain forests. Insofar as the forests are being destroyed, species are being lost that might yield useful medicine. This potential loss is a matter of grave concern to botanists and is one of the matters being emphasized in efforts to spare the tropical rain forests.—PHILIP H. ABELSON

*M. R. Boyd, *Princ. Pract. Oncol.* **3**, 1 (1989). †V. E. Tyler, *Econ. Bot.* **40**, 279 (1989).