

395 This Week in *Science*

## Editorial

397 Space Science: Past and Future

## Letters

399 AIDS Risk: V. DE GRUTTOLA AND S. W. LAGAKOS ■ Viviparity and Testability: D. G. BLACKBURN ■ Military Funding of Biological Research: K. WISIOL ■ Longevity and Gender: D. S. MCLAREN ■ Dolphin Research: B. SMUTS ■ Is *Science* "Gender-Blind"?: B. J. WISNIESKI; D. E. KOSHLAND, JR.

## News & Comment

405 IVF Research Moratorium to End? ■ West Germany Moving to Make IVF Research a Crime  
407 Unbelievable Results Spark a Controversy  
408 Germany Boosts Research Funds  
Math Education: A Mixed Picture  
409 B-1 Bombs on Capitol Hill  
410 Reagan Awards Science, Technology Medals  
411 There's (Plastic) Gold in Them Thar Landfills

## Research News

413 California's Quakes Forecasted ■ The Prediction Record So Far  
415 The Biological Tangle of Drug Addiction ■ Drug Reward in the Brain  
418 Seeing All There Is to See in the Universe  
419 Human Gene Therapy Test  
420 *Random Samples*: Science by Committee ■ Love Story ■ Fiddling Around the Lab

## Articles

421 Building Black Holes: Supercomputer Cinema: S. L. SHAPIRO AND S. A. TEUKOLSKY  
426 Development and Testing of AIDS Vaccines: W. C. KOFF AND D. F. HOTH

## Research Articles

433 Numerical Evidence That the Motion of Pluto Is Chaotic: G. J. SUSSMAN AND J. WISDOM

## Reports

438 Ultraviolet Radiation Levels During the Antarctic Spring: J. E. FREDERICK AND H. E. SNELL  
440 The Position of the Gulf Stream During Quaternary Glaciations: T. KEFFER, D. G. MARTINSON, B. H. CORLISS  
442 Direct Measurement of O<sub>2</sub>-Depleted Microzones in Marine *Oscillatoria*: Relation to N<sub>2</sub> Fixation: H. W. PAERL AND B. M. BEBOUT

- **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 © 1988 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): \$70. Domestic institutional subscription (51 issues): \$110. Foreign postage extra: Canada \$32, other (surface mail) \$32, air-surface via Amsterdam \$85. First class, airmail, school-year, and student rates on request. Single copies \$3.00 (\$3.50 by mail); back issues \$4.50 (\$5.00 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** An egg of the frog, *Xenopus*, previously injected with messenger RNA for the M1 muscarinic acetylcholine receptor, undergoing cortical contraction after exposure to acetylcholine. Application of acetylcholine after introduction of the receptor into the egg membrane initiates this and other responses similar to those normally initiated by sperm ( $\times 110$ ). See page 464. [Douglas Kline, University of Connecticut Health Center, Farmington, CT 06032]

- 445 Translation in Mammalian Cells of a Gene Linked to the Poliovirus 5' Noncoding Region: D. TRONO, J. PELLETIER, N. SONENBERG, D. BALTIMORE
- 448 Carboxyl Terminal Domain of  $G_{s\alpha}$  Specifies Coupling of Receptors to Stimulation of Adenylyl Cyclase: S. B. MASTERS, K. A. SULLIVAN, R. TYLER MILLER, B. BEIDERMAN, N. G. LOPEZ, J. RAMACHANDRAN, H. R. BOURNE
- 451 Viroid-Induced Phosphorylation of a Host Protein Related to a dsRNA-Dependent Protein Kinase: H. J. HIDDINGA, C. JESSEN CRUM, J. HU, D. A. ROTH
- 453 Fish Oils Inhibit Endothelial Cell Production of Platelet-Derived Growth Factor-Like Protein: P. L. FOX AND P. E. DICORLETO
- 456 Site-Specific Oligonucleotide Binding Represses Transcription of the Human *c-myc* Gene in Vitro: M. COONEY, G. CZERNUSZEWICZ, E. H. POSTEL, S. J. FLINT, M. E. HOGAN
- 459 Large Microtubule-Associated Protein of *T. brucei* Has Tandemly Repeated, Near-Identical Sequences: A. SCHNEIDER, A. HEMPHILL, T. WYLER, T. SEEBECK
- 462 Nonoxidative Glucose Consumption During Focal Physiologic Neural Activity: P. T. FOX, M. E. RAICHLER, M. A. MINTUN, C. DENCE
- 464 Fertilization Events Induced by Neurotransmitters After Injection of mRNA in *Xenopus* Eggs: D. KLINE, L. SIMONCINI, G. MANDEL, R. A. MAUE, R. T. KADO, L. A. JAFFE
- 467 RH 5849, a Nonsteroidal Ecdysone Agonist: Effects on a *Drosophila* Cell Line: K. D. WING
- 470 RH 5849, a Nonsteroidal Ecdysone Agonist: Effects on Larval Lepidoptera: K. D. WING, R. A. SLAWECKI, G. R. CARLSON

## Technical Comments

- 473 Absence of a Blood-Brain Barrier Within Transplanted Brain Tissue?: R. D. BROADWELL; J. M. ROSENSTEIN ■ Model of Huntington's Disease: S. W. DAVIES AND P. J. ROBERTS; M. F. BEAL, N. W. KOWALL, K. J. SWARTZ, R. J. FERRANTE, J. B. MARTIN

## Book Reviews

- 476 Genetics, Paleontology, and Macroevolution reviewed by A. LARSON ■ Ordered to Care, J. P. BRICKMAN ■ Population Ecology of Individuals, D. B. MERTZ ■ North America and Adjacent Oceans During the Last Deglaciation, W. R. FARRAND ■ Books Received

## Products & Materials

- 485 Capillary Electrophoresis System ■ Microinjection System ■ Purification Kit ■ LC-MS System ■ HPLC System ■ Scientific Calculator ■ Liquid Handling System ■ Literature

### Board of Directors

Sheila E. Widnall  
Retiring President,  
Chairman

Walter E. Massey  
President

Richard C. Atkinson  
President-elect

Floyd E. Bloom  
Mary E. Clutter  
Eugene H. Cota-Robles  
Mildred S. Dresselhaus  
Joseph G. Gavin, Jr.  
Beatrix A. Hamburg  
Donald N. Langenberg  
William T. Golden  
Treasurer  
Alvin W. Trivelpiece  
Executive Officer

### Editorial Board

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

### Board of Reviewing Editors

John Abelson  
Qais Al-Awqati  
Don L. Anderson  
Stephen J. Benkovic  
Floyd E. Bloom  
Henry R. Bourne  
James J. Bull  
Charles R. Cantor  
Ralph J. Cicerone  
John M. Coffin  
Bruce F. Eldridge  
Paul T. Englund  
Theodore H. Geballe  
Roger I. M. Glass

Stephen P. Goff  
Robert B. Goldberg  
Corey S. Goodman  
Jack Gorski  
Stephen J. Gould  
Richard M. Held  
Gloria Heppner  
Eric F. Johnson  
Konrad B. Krauskopf  
Charles S. Levings III  
Richard Losick  
Karl L. Magleby  
Philippa Marrack  
Joseph B. Martin  
John C. McGiff  
Mortimer Mishkin  
Jiri Novotny  
Gordon H. Orians

Carl O. Pabo  
Yeshayau Pocker  
Michael I. Posner  
Jean Paul Revel  
Russell Ross  
James E. Rothman  
Daniel V. Santi  
Ronald H. Schwartz  
Vernon L. Smith  
Otto T. Solbrig  
Robert T. N. Tjian  
Virginia Trimble  
Geerat J. Vermeij  
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:** Eleanore Butz, Ruth Kulstad

**Associate Editors:** Martha Coleman, R. Brooks Hanson, Barbara Jasny, Katrina L. Kelner, Edith Meyers, Linda J. Miller, Phillip D. Szuroni, David F. Voss

**Letters Editor:** Christine Gilbert

**Book Reviews:** Katherine Livingston, *editor*; Deborah Field 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,

Patricia L. Moe, Barbara E. Patterson

**Copy Desk:** Joi S. Granger, Beverly Shields, Anna Victoreen, Barbara Wittig

**Production Manager:** Karen Schools

**Assistant Production Manager:** James Landry

**Graphics and Production:** Holly Bishop, James J. Olivari, Yolanda M. Rook

**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, Gregory Byrne, Mark H. Crawford, Constance Holden, Eliot Marshall, Marjorie Sun, John Walsh

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

**European Correspondent:** David Dickson

## BUSINESS STAFF

**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

**Employment Sales Manager:** Edward C. Keller

**Marketing Manager:** Herbert L. Burkland

**Sales:** New York, NY 10036: J. Kevin Henebery, 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. Diefenbach, 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 24 June 1988 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.

## Space Science: Past and Future

A symposium and a substantial number of recent publications have provided a basis for estimating the past performance and the prognosis for the U.S. space effort (see Research News, 8 July, p. 162). Once this country enjoyed enormous prestige for both its manned presence in space and its excellent scientific achievements. Its present position and its future status are less favorable. A crucial weakness in the NASA program has been excessive emphasis on man in space. The great adventure of visits to the moon won universal attention and admiration. But in this era and in the future, repeated travel to a space station near the earth becomes monotonous, with excitement mainly stirred by stunts and by the possibility of a tragic accident. A principal justification for the space station, then, is its potential role in scientific and biomedical research. That is not negligible, but it does not match the past accomplishments of unmanned missions or their potential if unleashed. The robotic missions are much less costly, are flexible, can be conducted more rapidly, and can probe phenomena inaccessible to the human presence. They have a superior record of leading to practical applications and will probably stir increased interest as concern about the environment mounts.

In terms of prestige and science and engineering, the planetary missions were exemplary. That was particularly true of the Voyager missions. The engineering achievements involved in the Voyagers were magnificent, including durability of the craft, their flexibility in responding to earth-borne commands, and the capability of the system to convey information to distant earth.

For the present and the future, some of the most important observations from space will relate to the earth and sun. Changes in stratospheric ozone and potential greenhouse phenomena urgently require steady monitoring. Observations of ocean currents that give rise to El Niño and related climate and weather phenomena are of practical importance. Changes in vegetation worldwide can best be followed by sensors on satellites. Phenomena in the sun and solar-terrestrial relations will be of enduring importance.

The capabilities of satellite sensors are impressive. They can be used to obtain vertical temperature profiles in the atmosphere and to determine concentrations of many important trace gases in the atmosphere and their variations with altitude. Visible and near-infrared imagery are important in weather forecasting as well as in the estimation of marine resources. A striking example of the potential of a space mission in physical science is the Laser Geodynamics Satellite, which was built at a cost of \$6 million (1987 dollars). Reflectors allow ground-based lasers to track the position of the object with centimeter accuracy. This capability has led to improved knowledge of post-glacial rebound and of electromagnetic coupling between core and mantle.

In following developments regarding the atmosphere and oceans, it is desirable to maintain time series of measurements. The outlook for some of the most important observations is chancy. We are highly dependent on the Nimbus 7 satellite that has long outlived its expected usefulness. A gap in ocean color observations has already occurred, owing to termination of the coastal zone color scanner measurements on Nimbus 7. Global stratospheric ozone measurements with high spatial resolution are also likely to become unavailable. No firm plans have been made for a follow-on mission to the Nimbus 7 total ozone mapping spectrometer.

Earlier, when operation of the space shuttle was expected, our great national capability of expendable launch vehicles was destroyed. Launches of satellites were assigned to the shuttle. This led to delays and to costly extra requirements for quality control.

In the future, major U.S. earth monitoring activities will involve polar orbiters, but these have not yet been included in the budget. Present indications are that these satellites will not be launched before the late 1990s. In the meantime, other countries are proceeding with a variety of programs for earth observations, and they will provide strong competition for leadership in the field. The United States has embarked on a program of restoring its launch capabilities. That effort should be expedited, and correspondingly faster schedules of unmanned missions should be established.—PHILIP H. ABELSON