

871 This Week in *Science*

Editorial

873 The Arctic: A Key to World Climate

Letters

875 Navy Marine Mammals: S. H. RIDGWAY; D. C. MORRISON ■ Snowbird II: A Dissenting View: A. RICE

News & Comment

- 881 Bush Adopts Reagan's R&D Budget
882 New U.K. Science Initiatives Backed
R&D Suffers After Corporate Raids
883 Environment, Culture, and Change in the Arctic
884 Shuttle Faces Tough Schedule in 1989
Bahcall to Head New Astronomy Survey
885 Court Ruling Rekindles Controversy Over SATs
887 AIDS Panel Urges New Focus
888 CIA Details Chemical Weapons Spread
High Energy Physics Crunch Foreseen
889 Wanted: Normal Brains
Frazier Reinstated at McLean
Cancer Board Attacks Tobacco

Research News

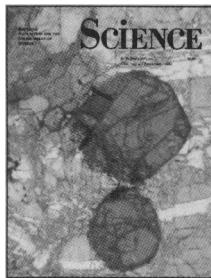
- 890 Our Future in the Stars?
891 1988 Ties for Warmest Year
892 The Supernova 1987A Pulsar: Found?
New Trial Evaluates Parkinsonian Therapy
893 Quantum Chaos: Enigma Wrapped in a Mystery ■ Chaos in a Hydrogen Atom
896 *Random Samples*: Unclogging L.A.'s Streets ■ One Mailing List to Avoid ■
Banishing the "Mad Scientist"

Articles

- 901 Finite Social Space, Evolutionary Pathways, and Reconstructing Hominid Behavior: R. A. FOLEY AND P. C. LEE
907 Polymer Synthesis and Organotransition Metal Chemistry: R. H. GRUBBS AND W. TUMAS
916 Coordinate Regulation and Sensory Transduction in the Control of Bacterial Virulence: J. F. MILLER, J. J. MEKALANOS, S. FALKOW

■ **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 © 1989 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 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. **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*, P.O. Box 1722, 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 fragment of lunar cordierite-spinel troctolite from the Apollo 15 mission. Two spinel crystals (reddish brown) and an adjacent grain of cordierite (lavender pink, upper left) are included in twinned plagioclase feldspar (blue and yellow). The crackled textures, offset twin lamellae, and weblike pattern (lavender pink and yellow) of finely crushed feldspar are shock features. (False-color photomicrograph taken in partially cross-polarized light with gypsum accessory plate; long edge of field is 0.53 millimeter.) See page 925. [Photomicrograph by Ursula B. Marvin]

Reports

- 923 Length-of-Day Variations Caused by El Niño–Southern Oscillation and Quasi-Biennial Oscillation: B. F. CHAO
- 925 Cordierite-Spinel Troctolite, a New Magnesium-Rich Lithology from the Lunar Highlands: U. B. MARVIN, J. W. CAREY, M. M. LINDSTROM
- 928 Molecular Modeling of the HIV-1 Protease and Its Substrate Binding Site: I. T. WEBER, M. MILLER, M. JASKÓLSKI, J. LEIS, A. M. SKALKA, A. WŁODAWER
- 931 Ubiquitous Expression of *sevenless*: Position-Dependent Specification of Cell Fate: K. BASLER AND E. HAFEN
- 934 The Human Papilloma Virus–16 E7 Oncoprotein Is Able to Bind to the Retinoblastoma Gene Product: N. DYSON, P. M. HOWLEY, K. MÜNGER, E. HARLOW
- 937 Point Mutational Inactivation of the Retinoblastoma Antioncogene: J. M. HOROWITZ, D. W. YANDELL, S.-H. PARK, S. CANNING, P. WHYTE, K. BUCHKOVICH, E. HARLOW, R. A. WEINBERG, T. P. DRYJA
- 940 Epithelial Cell Surfaces Induce *Salmonella* Proteins Required for Bacterial Adherence and Invasion: B. B. FINLAY, F. HEFFRON, S. FALKOW
- 943 A Family of Putative Potassium Channel Genes in *Drosophila*: A. BUTLER, A. WEI, K. BAKER, L. SALKOFF
- 947 Antisense RNA–Induced Reduction in Murine TIMP Levels Confers Oncogenicity on Swiss 3T3 Cells: R. KHOKHA, P. WATERHOUSE, S. YAGEL, P. K. LALA, C. M. OVERALL, G. NORTON, D. T. DENHARDT

Book Reviews

- 953 The Other Nomads, reviewed by L. BECK ■ Coping with Uncertainty in Food Supply, N. HOWELL ■ The Community Ecology of Sea Otters, K. P. SEBENS ■ Books Received

Products & Materials

- 956 Roller Apparatus for Cell Culture ■ Light-Scattering Photometer ■ Semi-Dry Blotting Transfer Cell ■ Ultrasonic Processor ■ Hydraulic Microdrive ■ Inert Ion Chromatograph ■ Gel-Permeation Chromatography System ■ 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

Philip H. Abelson
Executive Officer, Acting

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
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
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
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
Gordon H. Orians
Carl O. Pabo

Yeshayau Pocker
Michael I. Posner
Dennis A. Powers
Russell Ross
James E. Rothman
Erkki Ruoslahti
Ronald H. Schwartz
Vernon L. Smith
Robert T. N. Tjian
Virginia Trimble
Emil R. Unanue
Geerat J. Vermeij
Bert Vogelstein
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: Philip H. Abelson, *Acting*

Editor: Daniel E. Koshland, Jr.

Deputy Editor: John I. Brauman (*Physical Sciences*)

EDITORIAL STAFF

Managing Editor: Patricia A. Morgan

Assistant Managing Editor: Nancy J. Hartnagel

Senior Editor: Eleanore Butz

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

Letters Editor: Christine Gilbert

Book Reviews: Katherine Livingston, *editor*

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: Jol S. Granger, Jane Hurd, MaryBeth Shartle, Beverly Shields

Production Manager: Karen Schools Colson

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

Deputy News Editors: Roger Lewin, Colin Norman

News and Comment/Research News: William Booth, Gregory Byrne, Mark H. Crawford, Constance Holden, Richard A. Kerr, Eliot Marshall, Jean L. Marx, Robert Pool, Leslie Roberts, Marjorie Sun, M. Mitchell Waldrop

European Correspondent: David Dickson

Contributing Writer: John Walsh

BUSINESS STAFF

Circulation Director: John G. Colson

Fulfillment Manager: Ann Ragland

Business Staff Manager: Deborah Rivera-Wienhold

Classified Advertising Supervisor: Karen Morgenstern

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

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 23 December 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, or FAX 212-382-3725.

The Arctic: A Key to World Climate

The Arctic is part of a great global heat engine. Changes in the arctic atmosphere, ocean, sea ice, and permafrost are early precursors to climate change elsewhere. In the past, those changes have been drastic. Only 18,000 years ago, virtually all of Canada and some of the United States were covered by a thick layer of ice.

At the recent AAAS Annual Meeting, a symposium brought together some of the leading research scientists active in studies of resources and climate.* In one of the sessions, speakers reviewed information about the evolution of the arctic climate.

A principal impression that could be drawn from the symposium was that the current hypothesis concerning effects of greenhouse gases on arctic behavior is probably simplistic and may be quite wrong. The public has been told repeatedly that a result of increased greenhouse gases would be a substantial rise in sea level due to melting of polar ice. A related statement frequently made is that the increase in polar temperatures would be substantially greater than those of global averages. For example, one estimate is that an average rise of 2°C would be accompanied by a 10°C increase in the Arctic. That estimate may or may not adequately take into account climatic feedback mechanisms. At the symposium this point was raised implicitly by John T. Andrews, who stated that the Greenland Ice Sheet and the Laurentide Ice Sheet advanced during a period of warm water influx into Baffin Bay at the end of the last interglaciation.

The vapor pressure of water is quite sensitive to temperature. Condensing moisture in the form of snow provides a surface cover that highly reflects solar energy leading to a regional cooling. The albedo (reflectivity) of ordinary soil is about 0.1. The albedo of snow is about 0.8. At present, some of the arctic land areas that have averaged annual temperatures of about -14°C receive only 10 centimeters of total H₂O per year. Most of the time the surface is bare and is a good absorber of solar heat. Were more precipitation to occur, the total heat absorbed by the surface would decrease. With greater moisture in the air, there would be more clouds. The net effects of these are controversial. Some say that more clouds would reflect more energy away from the earth. Others point out that added moisture would enhance a greenhouse effect in the Arctic. In any event, the factors controlling arctic climate are complex.

One of the obstacles to confidence in predicting the future of the arctic climate is an imperfect knowledge of the past. We know that 70 million years ago, the climate was mild and the Arctic Ocean was ice-free. Sediments formed about 5 million years ago contained glacially related materials. We know little about what happened in the long interval, and knowledge concerning more recent events is sketchy. No long cores have been obtained from the Arctic Ocean. The impediment is the perennial ice sheet that covers most of that ocean. The thickness is usually about 3 to 4 meters, and the sheet tends to keep moving. At the geographic North Pole, the depth of the ocean is about 3500 meters.

Our best source of evidence concerning the last million years is found in near-shore sediments, and particularly on fossil-bearing terraces. Molluscan fossils are particularly useful. Different molluscan species have different temperature affinities. In addition, they contain partially hydrolyzed proteins. The degree of racemization of isoleucine is a function of times and temperatures. The shells also contain strontium as a trace element which provides a dating potential. The ratio of ⁸⁷Sr to ⁸⁶Sr in seawater has changed monotonically over the last several million years. For events during the past 40,000 years ¹⁴C dating can be applied. Other types of fossils are being studied and additional dating methods employed. Measurements of ratios of ¹⁸O to ¹⁶O in ice are useful in determining temperatures at which atmospheric moisture was converted into ice. Oxygen isotope ratios of shells reveal temperatures present during their formation.

The importance of understanding the past, present, and future of the arctic climate requires that support for such activities have a top priority. Desirable efforts include more studies of fossils, an international program of deep drilling in the Arctic, more weather monitoring, and additional satellite surveillance of the polar region.—PHILIP H. ABELSON

*"The Arctic: A New Key to World Climate and Resources," organized by P. W. Barnes and K. A. Kvenvold of the U.S. Geological Survey, Menlo Park, CA, and held on 19 January 1989 in San Francisco, CA.