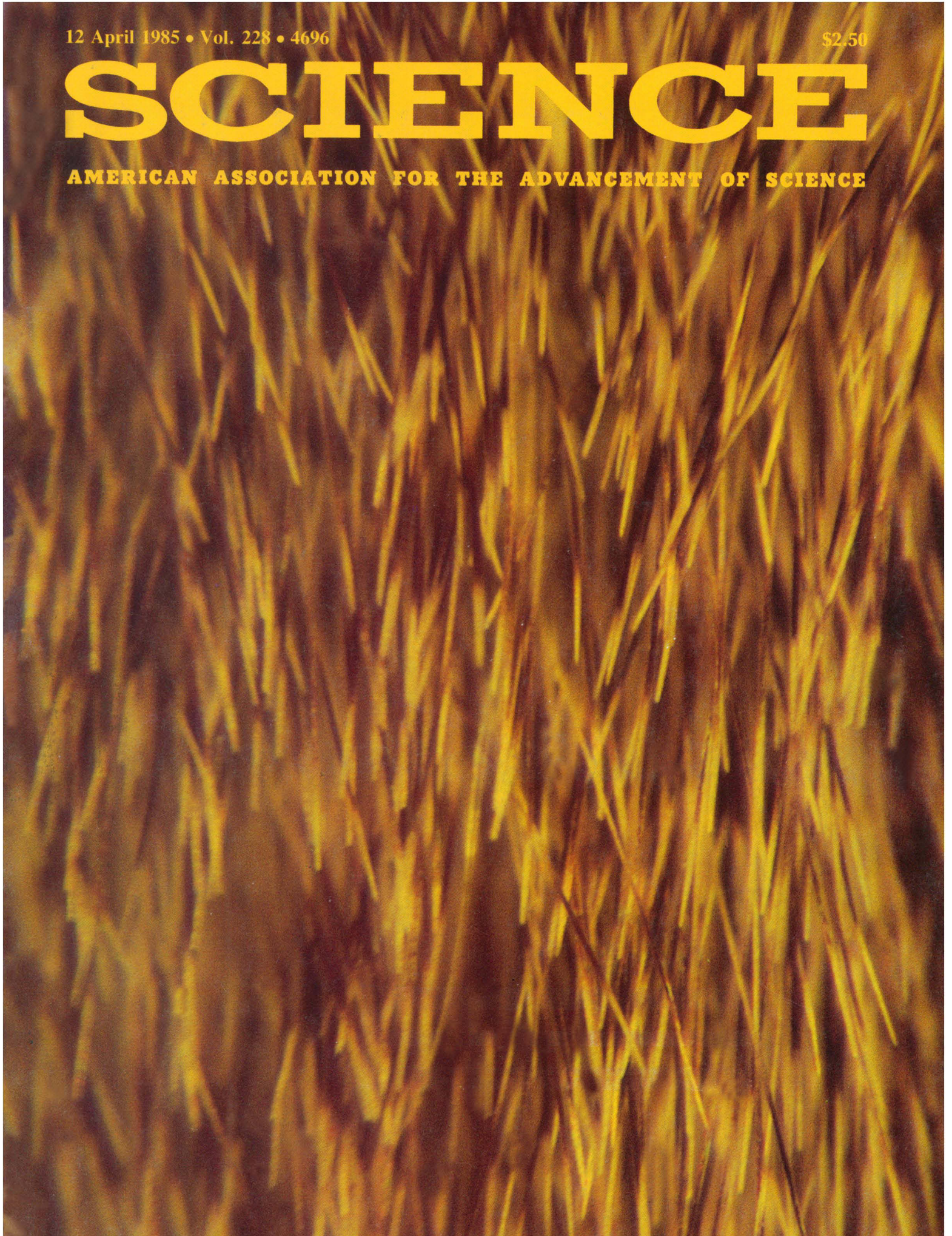


12 April 1985 • Vol. 228 • 4696

\$2.50

SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



MicroGenieTM: a powerful, easy-to-use sequence analysis program.

Now there's a program for the IBM PC or XT microcomputer that's fast enough to find every site for 100 restriction enzymes on pBR322 in two minutes, and potent enough to analyze sequences up to 60,000 base pairs in length.

It's called MicroGenie, and was developed by Drs. Korn and Queen. Users call it the most versatile and convenient program ever developed for analyzing DNA, RNA and proteins. And you don't need to know anything about computers to use it: MicroGenie contains built-in menus and help messages to guide you at every step.

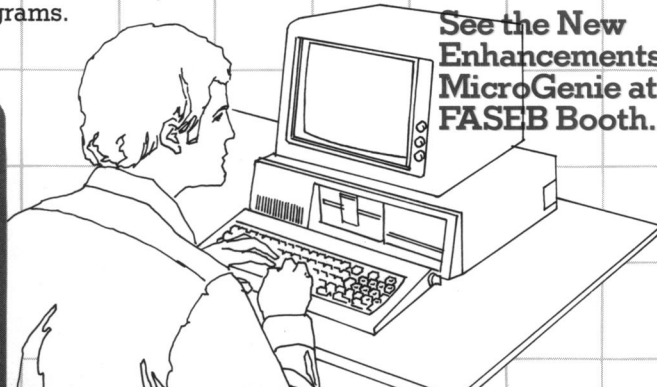
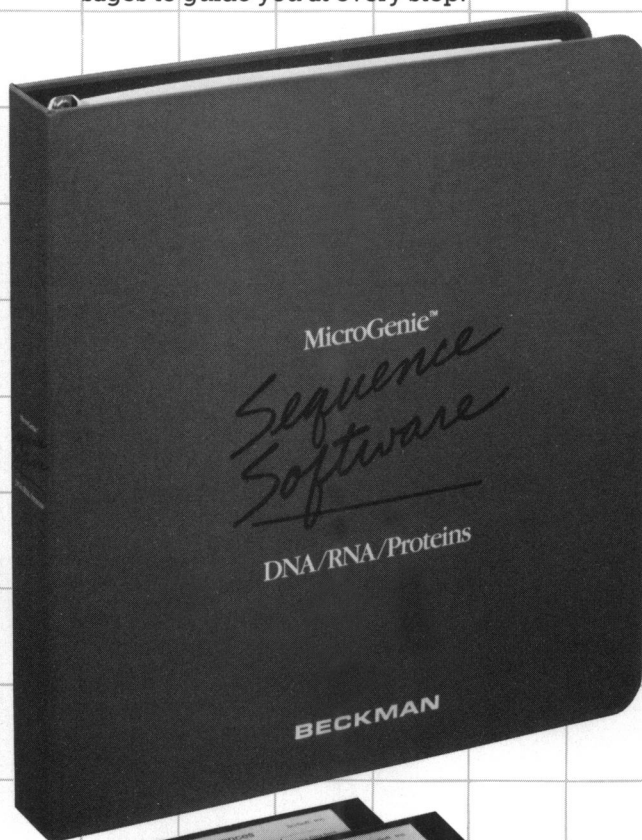
MicroGenie gives you the entire National Nucleic Acid Sequence Data Bank at your fingertips.

MicroGenie has all the features needed to collect, analyze and display sequence data. It comes with the more than 3000 sequences in "GenBankTM" and can search the whole data bank for sequences homologous to yours. A unique sequence editor helps you enter and change sequences quickly. A sonic digitizer can be used to enter sequences directly from autoradiograms.

MicroGenie determines residue and codon frequencies, translates and reverse translates, locates open reading frames, merges sequences, even predicts RNA and protein secondary structures. And more.

Convince yourself! Send for a free demonstration diskette to sample what MicroGenie can do for your research. Write on your letterhead to Beckman Instruments, Inc., Spinco Division, 1050 Page Mill Road, Palo Alto, CA 94304; or phone 800-DNA-ACGT.

See the New Enhancements for MicroGenie at Our FASEB Booth.



MicroGenie is a trademark of SciSoft, Inc., and the MicroGenie sequence analysis program is licensed for exclusive distribution by Beckman Instruments, Inc.

GenBank is a trademark of NIH.

BECKMAN

Circle No. 122 on Readers' Service Card

The one enhancer for all your gels



Our improved EN³HANCE™ Autoradiography Enhancer is the only one you really need on your shelf.

It's effective with all common types of gels—agarose, polyacrylamide, or mixed, thick or thin—and with all of them you get outstanding resolution and sensitivity.

For more details, contact your Du Pont NEN Research Products representative today. Or get our technical brochure, plus a free Guide to Fluorography Enhancement, by calling toll free: 800-225-1572. (In Mass. and international: 617-482-9595.)

Circle No. 127 on Readers' Service Card

NEN Research Products



SCIENCE

LETTERS	NIH Budget: <i>H. A. Waxman</i> ; Geophysical Clay: Medicinal Effects: <i>A. M. Behbehani</i> ; Experiment and Theory: <i>J. R. McNesby</i> ; <i>W.A. Goddard III</i>	130
EDITORIAL	Oceanography from Space: <i>R. Revelle</i>	133
ARTICLES	Microbial Degradation of Halogenated Compounds: <i>D. Ghosal et al.</i>	135
	Neurobiological Bases of Rhythmic Motor Acts in Vertebrates: <i>S. Grillner</i>	143
	Molecular Cloning of the Complementary DNA for Human Tumor Necrosis Factor: <i>A. M. Wang et al.</i>	149
NEWS AND COMMENT	A New Soviet Missile Angers the White House.....	155
	Japan and the Economics of Invention.....	157
	Europe Mirrors U.S. Debate on Car Exhaust.....	159
	<i>Briefing</i> : Biomedical Delegation Lobbies White House; Watson Fights Back; Reagan Names Space Commission; Servan-Schreiber Resigns from Computing Center; Prospects Brighten for Electron Accelerator.....	160
RESEARCH NEWS	Making Antibodies Without the Antigens.....	162
	Nuclear Winter Won't Blow Away.....	163
	Plant Communities Resist Climatic Change.....	165
	A New Approach to Cystic Fibrosis.....	167
AAAS News	Corporate Involvement Fuels Science Education Projects: <i>J. Wrather</i> ; Women Scientists and Engineers Asked to Participate in United Nations Conference; Nomination of AAAS Fellows Invited; AAAS Insurance Program Participants Receive Premium; <i>Dark Side of Science</i> Available on Disk.....	169

BOARD OF DIRECTORS

ANNA J. HARRISON
Retiring President, Chairman

DAVID A. HAMBURG
President

GERARD PIEL
President-Elect

ROBERT W. BERLINER
LAWRENCE BOGORAD

WALTER E. MASSEY
DOROTHY NELKIN

CHAIRMEN AND SECRETARIES OF AAAS SECTIONS

MATHEMATICS (A)
Gail S. Young
Lynn Arthur Steen

PHYSICS (B)
Chen Ning Yang
Rolf M. Sinclair

CHEMISTRY (C)
Fred W. McLafferty
Jeanne M. Shreeve

ASTRONOMY (D)
Patrick Palmer
Donat G. Wentzel

PSYCHOLOGY (J)
Gregory A. Kimble
William N. Dember

SOCIAL, ECONOMIC, AND POLITICAL SCIENCES (K)
Robin M. Williams, Jr.
David L. Sills

HISTORY AND PHILOSOPHY OF SCIENCE (L)
Wesley C. Salmon
David L. Hull

ENGINEERING (M)
Raymond L. Bisplingh
W. Edward Lear

EDUCATION (Q)
Marvin Druger
Joseph D. Novak

DENTISTRY (R)
Robert J. Fitzgerald
Harold M. Fullmer

PHARMACEUTICAL SCIENCES (S)
Stuart Feldman
David A. Knapp

INFORMATION, COMPUTING, AND COMMUNICATIONS (T)
Joseph Becker
Madeline M. Henderson

DIVISIONS

ARCTIC DIVISION

Robert White
President

Gunter E. Weller
Executive Secretary

CARIBBEAN DIVISION

Juan A. Bonnet, Jr.
President

Lucy Gaspar
Secretary-Treasurer

PACIFIC DIVISION

Walter Gardner
President

Alan E. Levit
Executive Director

SCIENCE is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. Second-class postage (publication No. 484460) paid at Washington, D.C., and at an additional entry. Now combined with *The Scientific Monthly*® Copyright © 1985 by the American Association for the Advancement of Science. Domestic individual membership and subscription (51 issues): \$56. Domestic institutional subscription (51 issues): \$93. Foreign postage extra: Canada \$24, 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 \$3 (\$3.50 by mail); Biotechnology issue, \$5 (\$5.50 by mail); classroom 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 0036-8075/85 \$1 + .10. **Postmaster:** Send Form 3579 to *Science*, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

BOOK REVIEWS	High Altitude and Man, reviewed by E. A. Phillipson; T. H. Huxley's Place in Natural Science, P. F. Rehbock; A Permanência de Rodolpho von Ihering, M. J. Weitzman and S. H. Weitzman; Nest Building and Bird Behavior, H. B. Tordoff; Books Received	171
REPORTS	Computerized Pattern Recognition: A New Technique for the Analysis of Chemical Communication: A. B. Smith, III et al.	175
	Flight of Winter Moths Near 0°C: B. Heinrich and T. P. Mommsen.....	177
	Mammalian and Yeast <i>ras</i> Gene Products: Biological Function in Their Heterologous Systems: D. DeFeo-Jones et al.	179
	A Region of the <i>Herpesvirus saimiri</i> Genome Required for Oncogenicity: R. C. Desrosiers et al.	184
	Hypomethylation of DNA from Benign and Malignant Human Colon Neoplasms: S. E. Goelz et al.	187
	Inhibition of Calcification of Bioprosthetic Heart Valves by Local Controlled-Release Diphosphonate: R. J. Levy et al.	190
	Ocelli: A Celestial Compass in the Desert Ant <i>Cataglyphis</i> : K. Fent and R. Wehner	192
	Temperature Acclimation: Improved Sustained Swimming Performance in Carp at Low Temperatures: L. C. Rome, P. T. Loughna, G. Goldspink	194
	Synaptic Morphology and Differences in Sensitivity: R. D. Fields and M. H. Ellisman	197
	Dynamic Modification of the Vestibulo-Ocular Reflex by the Nodulus and Uvula: W. Waespe, B. Cohen, T. Raphan	199
	Digestive Adaptations for Fueling the Cost of Endothermy: W. H. Karasov and J. M. Diamond	202
	Herbicide Resistance and Cross-Resistance: Changes at Three Distinct Sites in the Herbicide-Binding Protein: J. M. Erickson et al.	204
PRODUCTS AND MATERIALS	Ion Meter; Mass Spectrometer; Gas Chromatograph; Image Analyzer; Amino Acid Analyzer; Literature.....	208

B. SLAUGHTER E. SAWYER	SHEILA E. WIDNALL LINDA S. WILSON	WILLIAM T. GOLDEN Treasurer	WILLIAM D. CAREY Executive Officer
OGY AND GEOGRAPHY (E) W. Hay nas Dutro, Jr.	BIOLOGICAL SCIENCES (G) Dorothy M. Skinner Walter Chavin	ANTHROPOLOGY (H) James Silverberg Priscilla Reining	
AL SCIENCES (N) A. Good an E. Rhoads	AGRICULTURE (O) John Pesek Ralph J. McCracken	INDUSTRIAL SCIENCE (P) J. Kenneth Craver Robert L. Stern	
STICS (U) a A. Bailar J. J. Wegman	ATMOSPHERIC AND HYDROSPHERIC (W) William W. Kellogg Bernice Ackerman	GENERAL (X) George C. Sponsler Rodney W. Nichols	

THWESTERN AND ROCKY MOUNTAIN DIVISION

Charles E. Holley, Jr.
resident

M. Michelle Balcomb
Executive Director

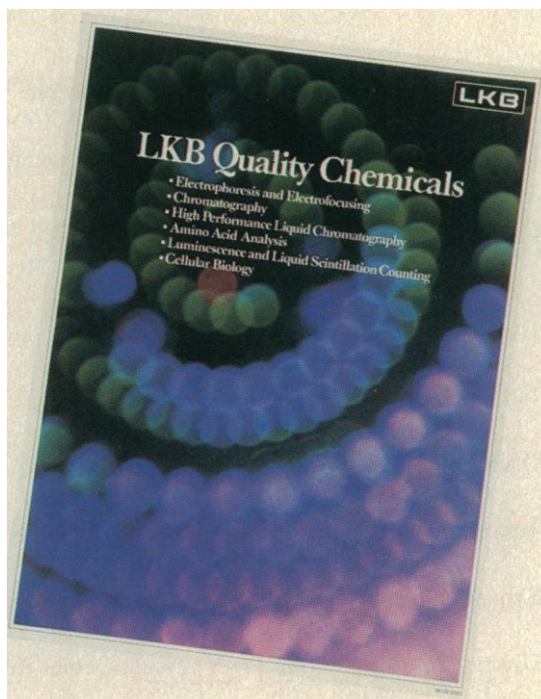
merican Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects urther the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, ove the effectiveness of science in the promotion of human welfare, and to increase public understanding and iation of the importance and promise of the methods of science in human progress.

COVER

“Fur” (technically pile) on thorax of moth, *Orthosia rubescens*. Such fur allows noctuid winter moths to maintain thoracic temperatures above 30°C during flight at near freezing temperatures in late winter. It consists of modified scales (that color Lepidoptera wings), elongated to near 2 millimeters to serve as insulation. See page 177. [Bernd Heinrich, University of Vermont, Burlington 05405]

FREE!

The new LKB Quality Chemicals Catalogue



Hot off the presses is a new 76-page, full-color catalogue—the LKB Quality Chemicals Catalogue. This latest edition packs comprehensive, up-to-date information on all the reagents, buffers, separation media and other supplies available from LKB. It also provides more information about each product, more applications and complete information on several new products such as preparative-scale chromatography columns, new HPLC columns, and amino acid

analysis buffers and reagents.

If your lab does electrophoresis, electrofocusing, chromatography, HPLC, luminescence, liquid scintillation counting, amino acid analysis or cellular biology, you can't afford to be without it. Offering complete descriptions of the nearly 400 fine chemicals and consumables in our range, it's your mail-order reference to the single-source supplier. Ask for your free copy today.



LKB-Produkter AB, Box 305, S-161 26 Bromma, Sweden. Tel. +46 (8) 98 00 40, telex 10492

Antwerp (03) 218 93 35 · Athens-Middle East +30 (1) 894 73 96 · Copenhagen (01) 29 50 44 · London (01) 657 88 22
 Lucerne (041) 55 44 57 · Madras (044) 45 28 74 · Moscow (095) 256-9002 · Munich (089) 85 830 · Paris (06) 92 86 507
 Rome (06) 39 90 33 · Stockholm (08) 98 00 40 · Tokyo (03) 293-5141 · Turku (021) 678 111
 Vienna +43 (222) 92 16 07 · Washington (301) 963 3200 · Zoetermeer (079) 31 92 01
 Over 60 qualified representatives throughout the world.

Circle No. 1 on Readers' Service Card



THE PLATE'S ON YOU. THE MUG'S ON US.

Buy a Corning® PC-351 or PC-101 Hot Plate/Stirrer and get a free Pyrex® beaker shuttle mug. It's our way of celebrating 70 years of Corning vision, from our low-expansion borosilicate beakers in 1915 to space shuttle windows and heat-resistant shielding.

Our vision of the perfect glass-ceramic hot plate surface is a Corning original—chemically durable Pyroceram® top.

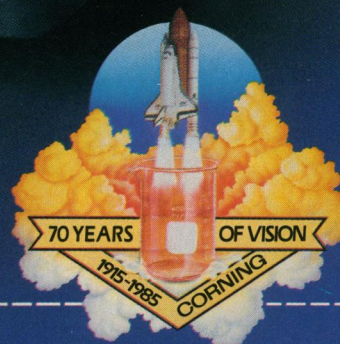
- Heats and cools evenly.
- Cleans easily.
- Resists chemical corrosion.
- Overhang protects against spills.
- Reliable, built to last.

Our vision saves yours with easy-to-read control dials and operation indicator lights. And more...

- Built-in automatic stirrer.
- 35 or 100 sq. in. surface.

See for yourself why Corning hot plates and hot plate/stirrers have become the accepted laboratory standard.

Circle No. 105 on Readers' Service Card



SE-04-85-VH

FREE SHUTTLE MUG

when you buy a Corning® PC-351 or PC-101 Hot Plate/Stirrer. Clip this coupon and Proof of Purchase to your letterhead with name, title and shipping address. Send to Corning Glass Works, Science Products, P.O. Box 1150, Elmira, New York 14902-9944. Offer ends November 29, 1985. (Proof of Purchase is the specification label from the side panel of a Corning Hotplate or Stirrer box, PC-351 or 101.)



The Most Trusted Tools Of Science

CORNING

Now You Have A Choice of Two Benchtop Ultracentrifuges

For spinning small samples at 100,000 rpm

For a decade, researchers have been using the economical little Airfuge® Ultracentrifuge to pellet microsamples quickly at high centrifugal forces. It accelerates to 100,000 rpm, pellets, and gently stops before a floor-model ultracentrifuge can even get to speed.

Now Beckman offers yet another advance in ultracentrifuge technology—the TL-100. This microprocessor-controlled bench-top model with

refrigeration does a lot more than pellet. It can isolate plasmid DNA in a 2-mL tube using precious little CsCl. It makes rate zonal separations just like big ultracentrifuges but in 2.2-mL tubes in its own miniature swinging bucket rotor. It even offers a vertical tube rotor with 2-mL tubes.

Use the Airfuge for quickly pelleting small sample volumes and for special jobs like preparing particles for electron microscopy. Use the TL-100 for any other separation technique on microsamples. Save your floor-model ultracentrifuge for larger volumes.



Which To Choose?

TL-100

Speeds to 100,000 rpm;
forces to 436,000 *g*

Pelleting; sucrose, CsCl, or any
density gradient work

Full temperature control — from
2° to 40°C

Direct induction drive powered
by standard line current

3 fixed angle rotors, plus
swinging bucket and vertical
tube rotors

Milliliter-sized samples; 0.2-2.2
mL per tube; 4-20 mL per rotor

Choice of 10 tubes including
Quick-Seal® tubes; 4 tube
materials

Airfuge

Speeds to 110,000 rpm;
forces to 199,000 *g*

Pelleting; special purposes

Operates at ambient
temperature or in a cold room

Rotor is air driven by laboratory
compressed air or separate
compressor

4 fixed angle rotors; special
rotors for EM and lipemic serum
clarification; batch rotor

Microliter-sized samples;
nominally 180 μ L per tube;
up to 1.8 mL per rotor

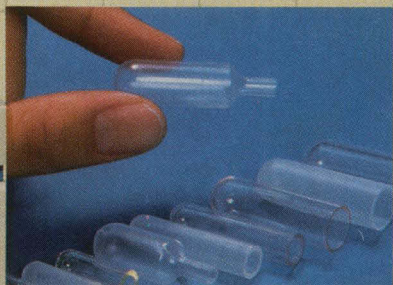
Choice of 5 tubes and 4 tube
materials



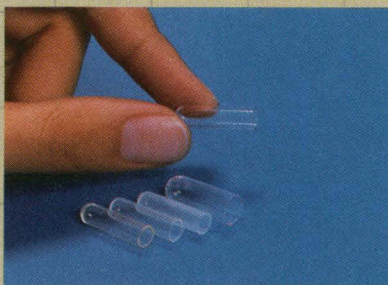
TLA-100.2 Fixed Angle Rotor,
100,000 rpm, 436,000 *g*



A-100/30 Fixed Angle Rotor,
92,000 rpm, 167,000 *g*



TL-100 milliliter-sized tubes.
A choice of 10.



Airfuge microliter-sized tubes.
A choice of 5.

The Advantages of Thinking Small

Once you've used the TL-100 or Airfuge benchtop models, you'll never want to process small sample volumes in a floor-model ultracentrifuge again:

Quicker separations — small rotors accelerate and decelerate rapidly; tubes have very short sedimentation pathlengths.

Save on gradient materials — small tubes use very little of these costly materials.

Easy sample handling — no tube caps, adapters, or special tools.

Less record keeping — no log books; TL-100 rotors are warranted for 5 years (Airfuge rotors for 1 year) regardless of the number of runs.

Save time — efficient runs, less sample handling and record keeping give you time for more runs per day.

For descriptive brochures, write Beckman Instruments, Inc., 1050 Page Mill Road, Palo Alto, CA 94304. Offices in major cities worldwide.

BECKMAN

Circle No. 121 on Readers' Service Card

OLYMPUS®

The Image of Quality

Introducing the New VANOX. A breakthrough in research capability.

The quality of any research microscope relies on the interrelationship of optical performance, computer intelligence and mechanical capability. For more than six decades, Olympus has dedicated itself to development of a unique fusion of these distinct disciplines.

Nowhere is this achievement better exemplified than in the all-new Vanox Research Microscope System. An innovative concept that builds into the System's models a broad range of skills and versatility traditionally requiring attachments, accessories and add-ons to limited-capability microscopes...all make the new Vanox the most significant contribution to research microscopes in over a decade.

Some of the built-in innovations include three photographic ports for cine, 35mm or large format cameras, auto-exposure with spot or integrated measurements, light balancing filters, choice of condensers and illuminators, including Koehler, and so much more that only a hands-on experience can attempt to show the breakthrough quality of the new Vanox models. Arrange a demonstration now by contacting Olympus Corporation, Precision Instrument Division, 4 Nevada Drive, Lake Success, NY 11042-1179. Or phone: East—(609) 482-1010; West—(415) 342-3384; Midwest—(913) 648-8323. In Canada: W. Carsen Co., Ltd., Ontario

OLYMPUS®



NEW VANOX

For Literature circle reader service number 10
For demonstration circle reader service number 12

Protecting your family better... for less



Now, TIAA MOD ONE *Plus* life insurance policies make it easier than ever to give your family the level of financial security they need. That's because:

- premiums are reduced—up to 15%—on new 5-Year Renewable Term policies at most ages
- benefit levels are improved for new Decreasing Term policies
- rate discounts are increased to 50%

Here are examples of new, lower starting premiums for 5-Year Renewable Term policies at selected ages:

		Policy Amount			
Age		\$50,000	\$100,000	\$250,000	\$500,000
25	1st Year Premium	\$83.25	\$111.00	\$249.75	\$416.50
	Rate per \$1,000	\$1.67	\$1.11	\$1.00	\$.83
35	1st Year Premium	105.00	140.00	315.00	525.00
	Rate per \$1,000	2.10	1.40	1.26	1.05
45	1st Year Premium	217.50	290.00	652.50	1,087.50
	Rate per \$1,000	4.35	2.90	2.61	2.18
	Rate Discount	—	33⅓%	40%	50%

You are eligible to apply for a TIAA policy if you are now employed by a college, university, private school or another qualifying nonprofit educational or research institution. And your spouse is eligible, too, provided more than half of your combined earned income is from a qualifying institution.

To get complete information about new TIAA MOD ONE *Plus* personal life insurance policies for your age, just fill out and mail the coupon below. Or, call the TIAA Life Insurance Advisory Center toll free 800-223-1200 (from New York or outside the continental U.S., call collect 212-490-9000).



Established as a Nonprofit
Service Organization
by the Carnegie Foundation
for the Advancement of Teaching

To: TIAA Life Insurance Advisory Center
730 Third Avenue, New York, NY 10017

S503

MOD ONE *Plus* Personal Information Request

Please send me details of new TIAA MOD ONE *Plus* policies, including personal policy illustrations for my age as indicated below:

☐ 5-year Renewable Term ☐ Decreasing Term
(please print)

Name _____ Date of Birth _____

Home Address _____

City _____ State _____ Zip _____

Job Title _____

Nonprofit educational or scientific employer (college, university, private school, etc.)

If your spouse is also eligible according to the rules at left and you wish us to send personal illustrations with an extra application, please provide:

Spouse's name _____ Date of Birth _____

Policy Approvals Pending in OR and WA.

NOW AVAILABLE...

Opioid Ligands Highly Selective for the Kappa Receptor.

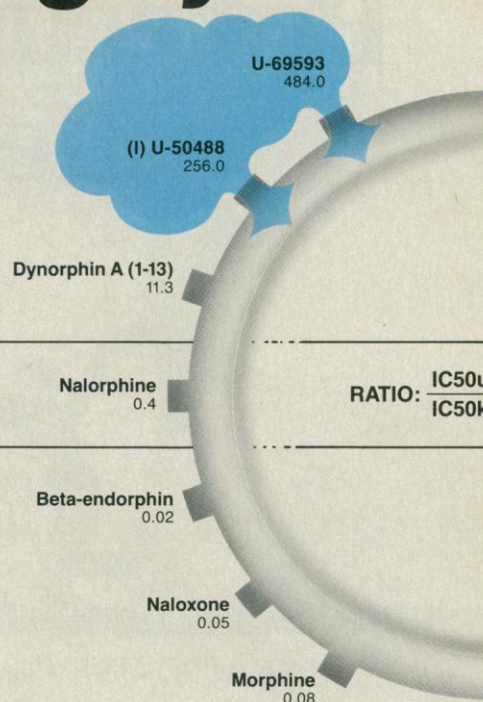
Competitive binding studies of U-50488 and U-69593 indicate the highest specificity for binding at the kappa site of any compound obtainable.

MOLAR IC50 RATIOS DEMONSTRATE HIGH KAPPA SELECTIVITY.

Simultaneous low affinity for the mu receptor allows more accurate research into kappa effects. **For more information, circle the reader service number or call (616) 385-7111.**

Compound	IC50 (nM) Values		Ratio IC50-u IC50-k
	mu-delta	Kappa 3H-U-69593	
U-69593	4600	9.5	484.0
(I) U-50488	1900	7.4	256.0
Dynorphin A (1-13)	43.0	3.8	11.3
Nalorphine	7.4	18	0.4
Beta-endorphin	5.0	230	0.02
Naloxone	8.2	160	0.05
Morphine	27.0	335	0.08

Ref. Lahti, R.A., et. al. *European Journal of Pharmacology*, accepted for publication.



Upjohn **diagnostics**

A Division of The Upjohn Company

For research use only. Not for use in human therapeutic or diagnostic procedures.

Circle No. 117 on Readers' Service Card

COMPUTERS AND RESEARCH

Special Issue of *Science*, 26 April 1985

An Approach to Complexity: Numerical Computations—*Larry L. Smarr*.

Computer-Assisted Analysis in Organic Synthesis—*E. J. Corey et al.*

New Approaches in Economic Analysis—*Leontief Wassily et al.*

Computers in Production Agriculture—*Donald Holt*.

Some Computer-Based Developments in Sociology—*David R. Heise and Roberta G. Simmons*.

Computer Applications in the Humanities—*Joseph Raben*.

Personal Computers on Campus—*M. Mitchell Waldrop*.

Electronic Databases—*Martha E. Williams*.

Intelligent Tutoring Systems—*John R. Anderson et al.*

Multis: A New Class of Microprocessor Computers—*C. Gordon Bell*.

Work Stations in Science—*William Joy and John Gage*.

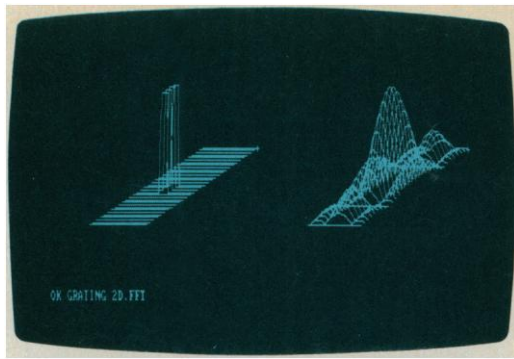
Single copy, \$3.50 (prepaid).

Write to: AAAS

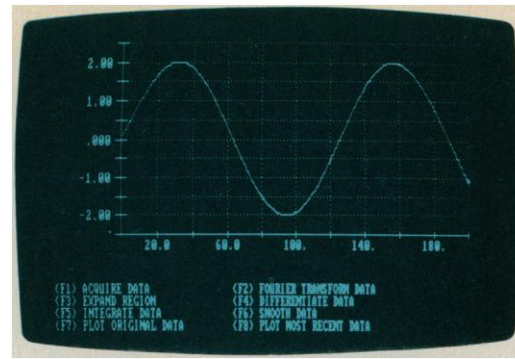
Dept. COM

1515 Massachusetts Ave., NW

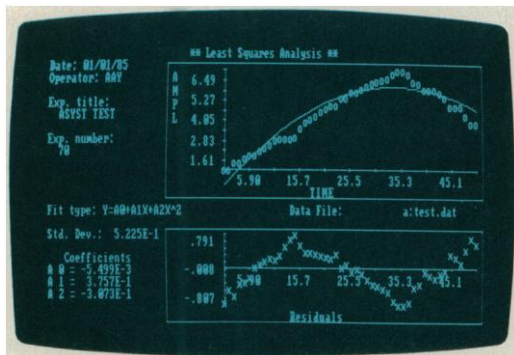
Washington, D.C. 20005



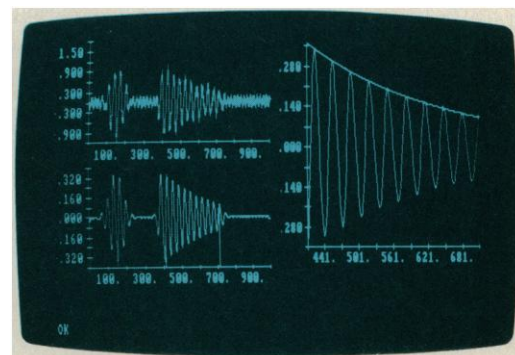
ASYST multiple windows permit side-by-side comparisons. The two-dimensional FFT routine, shown, is one of the many built-in functions.



With ASYST, data acquisition and analysis routines can be combined to create powerful, menu-driven functions.



Least squares, polynomial, exponential, and logarithmic curve fitting routines fully integrate with other ASYST capabilities.



ASYST integrates analysis functions with graphics. On-screen cursors allow interactive selection of curve segments.

ASYST Scientific Software.

Acquisition, analysis and graphics capabilities turn your IBM PC into a powerful workstation.

ASYST and your IBM PC, XT,™ AT, or compatible put you in direct control. You can reduce data while collecting—displaying results as you proceed. Now for the first time you can pull information through the analytical process without timesharing delays or software bottlenecks. See why "scientists and engineers will rejoice at having such a versatile tool to turn their PC's into minis"—PC Magazine.

Get the speed and precision of a minicomputer—at a fraction of the cost.

- ASYST fully utilizes the PC's 8087 coprocessor for precision exceeding that of other micros—and many minis and mainframes.
- A 1024-point FFT with ASYST/IBM PC takes less than 3 sec. An optimum performance custom routine on a DEC 11/23 + minicomputer with FPF 11™ took 2 sec.—at five times the price.

ASYST is composed of three separate, but fully-integrated, modules:

Module 1: System/Graphics/Statistics establishes the environment. Includes data representation and storage; arith-

metic, trigonometric, hyperbolic and other mathematical and statistical functions; direct graphics output and display; array manipulation; control of vectors and matrices; automatic plotting; file manipulation; programming control structures; and a built-in text editor.

Module 2: Analysis reduces and analyzes data. Includes Eigenvalues, Eigenvectors, polynomials, least squares approximations, curve fitting, convolutions, integration, differentiation, smoothing, and Fast Fourier Transform.

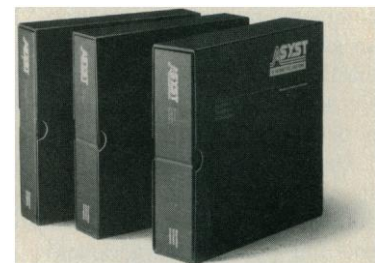
Module 3: Data Acquisition allows interfacing with laboratory instruments. Commands such as "A/D.IN" allow data communication with standard interface boards. Includes A/D and D/A conversions, digital I/O, timing, and triggering. Commands can be combined for customized automatic acquisition and control.

- Module 1 works alone—or with either of the other two modules—allowing you to tailor the system to your specific needs.
- All functions are always available. You never have to leave the system to access any of its capabilities.

Built-in routines. Full programmability.

- Use straightforward, pre-programmed commands such as XY.DATA.PLOT and ARRAY.EDIT.
- Combine and modify commands to extend the system for your custom applications.

Take advantage of our 30-day no-risk offer. Call (800) 348-0033, today!
In New York state, call (212) 702-3241.



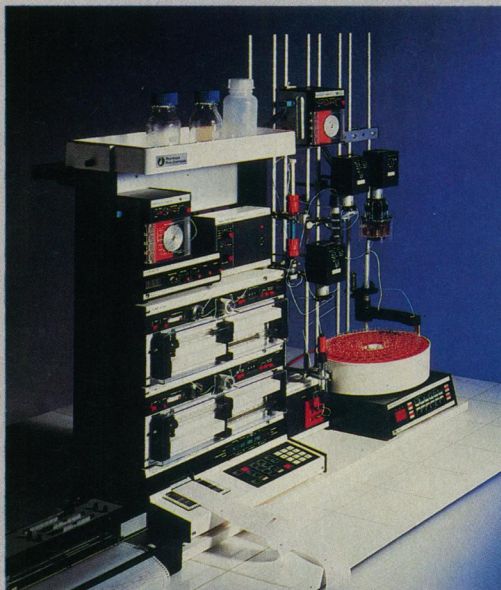
ASYST

MACMILLAN SOFTWARE CO.
An Affiliate of Macmillan Publishing Company
866 Third Avenue, New York, NY 10022

When you say "why FPLC" you are halfway there ...

... because FPLC instrumentation from Pharmacia is the state of the art in high performance chromatography equipment for the separation of biologically active molecules.

Unlike any other chromatography system, the FPLC System was designed from the beginning to meet the demands for high performance separations of complex biomolecules. Since all wetted surfaces are of glass, titanium and fluoroplastics, aqueous

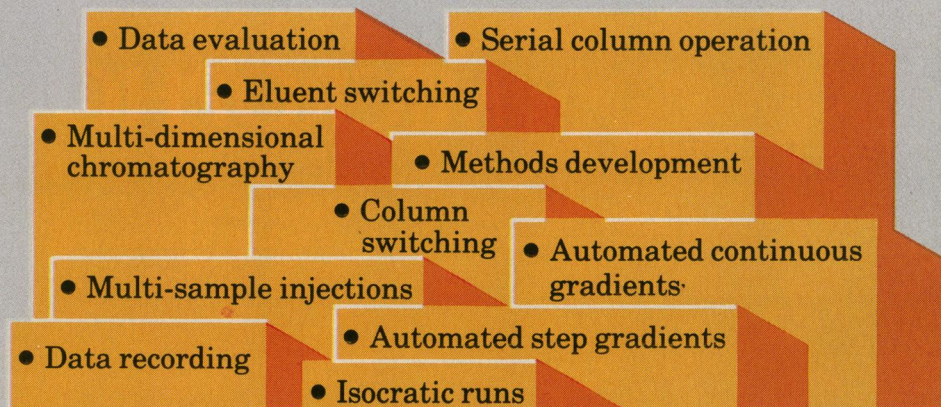


buffer solutions and organic solvents may be used for separating biological molecules while maintaining biological activity.

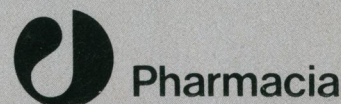
The Pharmacia FPLC System is modular and can be tailored to your needs and budget. Depending on the exact configuration chosen, the FPLC System will provide you with any of the following techniques using both the new high performance columns and traditional chromatographic procedures.

... so go all the way.

With the Pharmacia FPLC System separations of biomolecules are easily performed. Chromatography can be fully automated and reproducible results will be obtained while operator time is kept to a minimum.



Go beyond HPLC with the biocompatible FPLC System from Pharmacia



Laboratory Separation Division
Piscataway, New Jersey 08854
Information: (800) 526-3618
In NJ: (201) 457-8000

Circle No. 79 on Readers' Service Card

Pharmacia products will be on display at FASEB '85-Booths 2433, 2435, 2437, 2439, 2441, 2536, 2538, 2540.

742

THE LIGHT OF DISCOVERY

MICROPHOT

Now the most advanced research microscope.
For details contact Nikon Inc., Instrument Group, 623 Stewart Avenue,
Garden City, New York 11530 (516) 222-0200.

Nikon
Extending Man's Vision

For information circle reader service number 70
For a demonstration circle reader service number 71

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: WILLIAM D. CAREY
Editor: DANIEL E. KOSHLAND, JR.
Deputy Editors

PHILIP H. ABELSON (*Engineering and Applied Sciences*), JOHN I. BRAUMAN (*Physical Sciences*), GARDNER LINDZEY (*Social Sciences*)

Board of Reviewing Editors

JAMES P. ALLISON, LUIS W. ALVAREZ, DON L. ANDERSON, KENNETH J. ARROW, C. PAUL BIANCHI, ELIZABETH H. BLACKBURN, FLOYD E. BLOOM, MICHAEL S. BROWN, NINA V. FEDEROFF, GARY FELSENFELD, DOUGLAS J. FUTUYMA, THEODORE H. GEBALLE, STEPHEN P. GOFF, PATRICIA S. GOLDMAN, RAKIC, RICHARD M. HELD, GLORIA HEPPNER, ERIC F. JOHNSON, KONRAD B. KRAUSKOPF, PAUL E. LACY, JOSEPH B. MARTIN, JOHN C. MCGIFF, MORTIMER MISHKIN, JOHN S. PEARSE, YESHAYAU POCKER, FREDERIC M. RICHARDS, JAMES E. ROTHMAN, RONALD H. SCHWARTZ, OTTO T. SOLBRIG, ROBERT T. N. TJIAN, VIRGINIA TRIMBLE, GEERAT J. VERMEIJ, MARTIN G. WEIGERT, GEORGE M. WHITESIDES, WILLIAM B. WOOD, HARRIET ZUCKERMAN

Editorial Staff

Managing Editor: PATRICIA A. MORGAN
Assistant Managing Editors: NANCY J. HARTNAGEL, JOHN E. RINGLE

Production Editor: ELLEN E. MURPHY

News Editor: BARBARA J. CULLITON

News and Comment: COLIN NORMAN (deputy editor), MARK H. CRAWFORD, CONSTANCE HOLDEN, ELIOT MARSHALL, R. JEFFREY SMITH, MARJORIE SUN, JOHN WALSH

European Correspondent: DAVID DICKSON

Research News: ROGER LEWIN (deputy editor), RICHARD A. KERR, GINA KOLATA, JEAN L. MARX, THOMAS H. MAUGH II, ARTHUR L. ROBINSON, M. MITCHELL WALDROP

Administrative Assistant, News: SCHERRAINE MACK;
Editorial Assistant, News: FANNIE GROOM

Senior Editors: ELEANORE BUTZ, RUTH KULSTAD

Associate Editors: MARTHA COLLINS, SYLVIA EBERHART, CAITILIN GORDON, WILLIAM GREAVES, BARBARA JASNY, STEPHEN KEPPEL, EDITH MEYERS, LOIS SCHMITT. **Assistant Editor:** LISA MCCULLOUGH

Book Reviews: KATHERINE LIVINGSTON, **Editor:** LINDA HEISERMAN, JANET KEGG

Letters Editor: CHRISTINE GILBERT

Production: JOHN BAKER, HOLLY BISHOP, KATHLEEN COSIMANO, ELEANOR WARNER, ISABELLA BOULDIN, SHARON RYAN, BEVERLY SHIELDS

Covers, Reprints, and Permissions: GRAYCE FINGER, **Editor:** GERALDINE CRUMP, CORRINE HARRIS

Guide to Scientific Instruments: RICHARD G. SOMMER

Administrative Assistant: WILLIAM CARTER

EDITORIAL CORRESPONDENCE: 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. Telephone: 202-467-4400. For "Information for Contributors" see page xi, *Science*, 29 March 1985.

Business Staff

Chief Business Officer: WILLIAM M. MILLER III

Business Manager: HANS NUSSBAUM

Assistant to Chief Business Officer: ROSE LOWERY

Business Staff Supervisor: DEBORAH JEAN RIVERA

Membership Recruitment: GWENDOLYN HUDDLE

Member and Subscription Records: ANN RAGLAND

Advertising Representatives

Director: EARL J. SCHERAGO

Production Manager: DONNA RIVERA

Advertising Sales Manager: RICHARD L. CHARLES

Marketing Manager: HERBERT L. BURKLUND

Sales: NEW YORK, N.Y. 10036: J. Kevin Henebry, 1515 Broadway (212-730-1050); SCOTCH PLAINS, N.J. 07076: C. Richard Callis, 12 Unami Lane (201-889-4873); CHICAGO, ILL. 60611: Jack Ryan, Room 2107, 919 N. Michigan Ave. (312-337-4973); BEVERLY HILLS, CALIF. 90211: Winn Nance, 111 N. La Cienega Blvd. (213-657-2772); SAN JOSE, CALIF. 95112: Bob Brindley, 310 S. 16 St. (408-998-4690); DORSET, VT. 05251: Fred W. Diefenbach, Kent Hill Rd. (802-867-5581).

ADVERTISING CORRESPONDENCE: Tenth floor, 1515 Broadway, New York 10036 (212-730-1050).

Oceanography from Space

Climate variability affects large segments of our economy from the Florida citrus grower and the Kansas farmer to the utility and construction industries. Our nation would benefit in several ways from better climate prediction capabilities.*

The possibility of improved prediction depends critically on understanding the role of the oceans in the climate system. It is fortunate that new space technology promises to provide the necessary global synoptic descriptions of the upper oceans and their interaction with the atmosphere and that new computer resources are ready to help analyze and model the data.

The currents, the eddies, and the driving forces—winds, radiation, and mass flux at the ocean surface—must all be measured simultaneously and globally if we are to understand air-sea interaction processes and to construct accurate predictive models. Such measurements can be obtained only by satellite-borne instrumentation, appropriately complemented by in situ data. Satellite measurements of global biological processes, particularly near-surface ocean biology, are also an essential key to understanding the biogeochemical cycles of carbon dioxide.

The ocean science community has recognized the special role of satellites by developing a phased plan for oceanography from space, a series of four satellite missions for ocean physics, biology, and geodesy. The first of these is the Navy's Remote Ocean Sensing System (NROSS), scheduled for 1989; it will provide operational information on ocean waves and eddies and research data on surface winds.

The second of the series is proposed as a joint United States-French mission, TOPEX/POSEIDON, that will carry a high-precision altimeter to measure the topography of the ocean surface. This topography results from the combined effects of winds, currents, and gravity. Together with the ocean surface winds measured by NROSS, the global data on ocean currents revealed by TOPEX/POSEIDON will provide for the first time a synoptic global description of ocean circulation. Mission studies for TOPEX/POSEIDON have been conducted during the past 5 years, and the satellite design studies have been completed, emphasizing low-risk, flight-proven technology. Participation by the French will not only provide a significant savings in cost from a solely U.S. mission but will also continue a valuable international cooperative effort. Current planning is aimed for flight in 1990 depending on budgetary approval. Launch of TOPEX/POSEIDON in 1990 is deemed critical by oceanographers because, without simultaneous measurements of currents and winds, we cannot hope to understand the physics of large-scale and long-term air-sea interaction.

The third and fourth steps in the satellite series focus on biology and geodesy. NASA is currently investigating flight opportunities for ocean color measurements that allow determination of chlorophyll content of the surface layers and provide flow visualization. This mission has been recommended by the ocean science community for launch in 1990. For measurements of the earth's gravity and magnetic field, a geopotential research mission is proposed for launch in 1991. Measurements of the earth's gravity will enable us to determine the effect of gravity on the topography of the ocean surface—the geoid—and thus in combination with the altimeter measurements to determine absolute currents.

By coming to a general consensus, oceanographers have put together a plan that opens the door to a quantum jump in description and understanding. The data will be central to predictive systems for protection and control of our exclusive economic zone, fisheries conservation and management, offshore oil and gas production, and mineral extraction. This new program should have high priority in the nation's overall science effort.—ROGER REVELLE, *Professor of Science and Public Policy, University of California, San Diego, La Jolla 92093*

*B. I. Edelson, "Mission to planet earth," *Science* 227, 367 (1985).



The ACAS 470™ Workstation
performs automated clonal selection
and fluorescence analysis
of single cells in culture.

MERIDIAN™
Instruments, Inc.

Circle No. 160 on Readers' Service Card

For more information,
or a demonstration, contact
Dr. Peter Burrill
Meridian Instruments, Inc.
2310 Science Parkway
Okemos, MI 48864
517/349-7200
(Call Collect)

Visit us at FASEB.
Booth 2716.