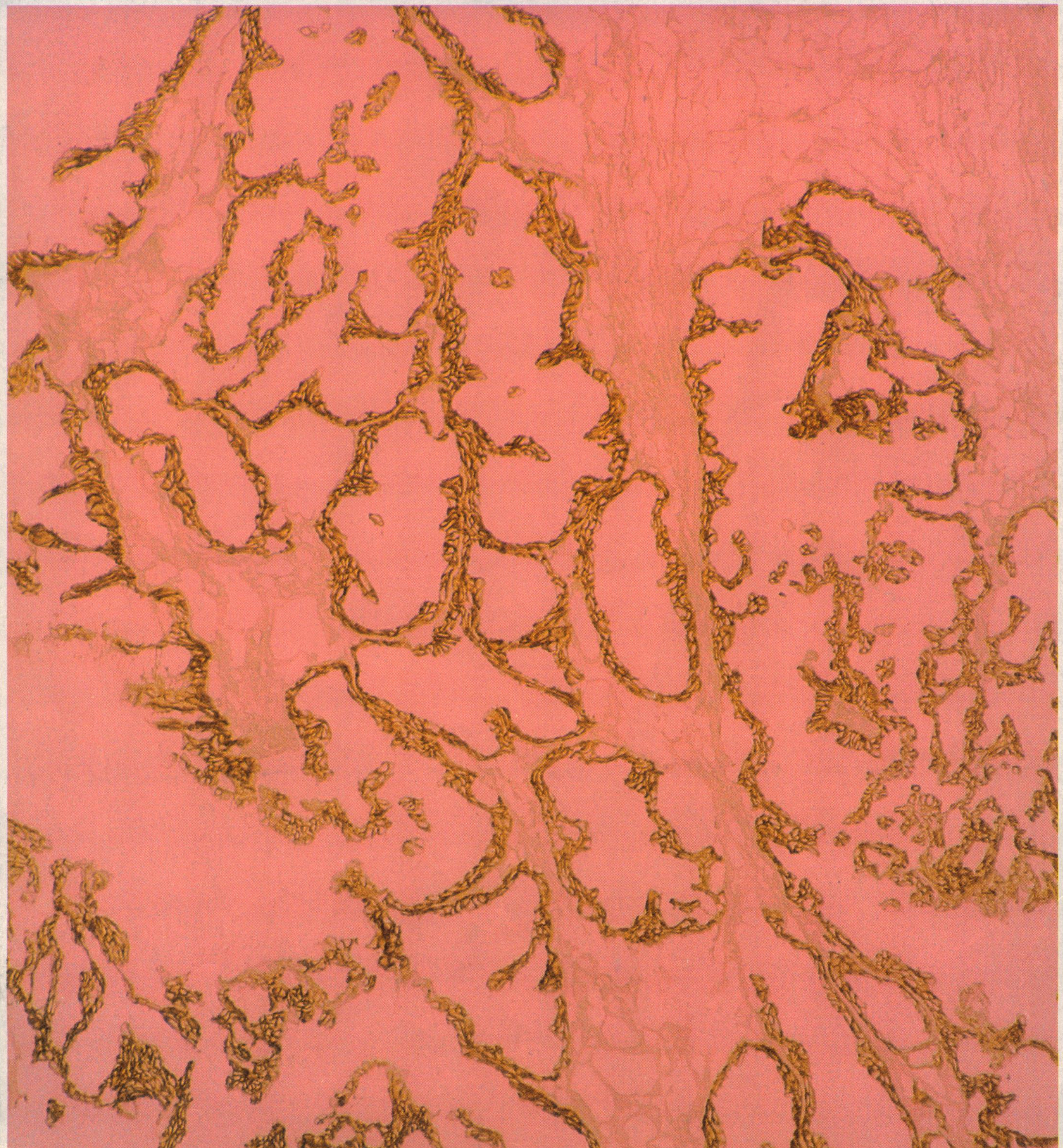
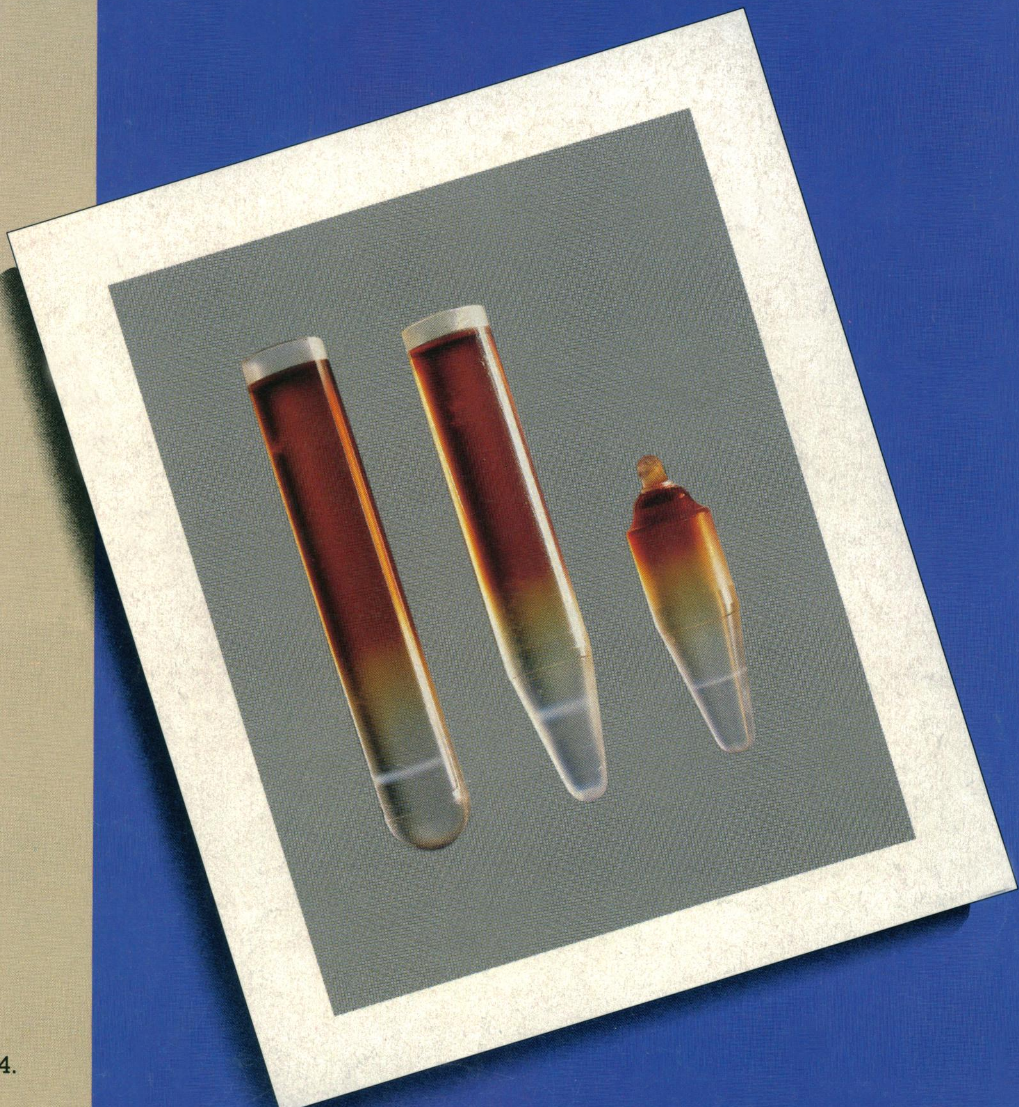
American Association for the Advancement of Science

# Science

12 May 1989 $3.50
Vol. 244 ■ Pages 621–744



# Pelleting RNA?



**RNA separations in traditional and new *k*onical™ tubes**

Now get equivalent yields in shorter run times using the Beckman g-MAX™ System with either round bottom or *k*onical™ tubes.

What takes 14 hours in the SW-41 rotor with full size tubes can be achieved in just 4 hours using the g-MAX System. Shown here are separations in 13.2-mL open-top, 10-mL *k*onical, and 4-mL g-MAX *k*onical tubes. Send for protocol. Beckman Instruments, Inc., 1050 Page Mill Road, Palo Alto, CA 94304. (800) 742-2345. Offices worldwide.

**BECKMAN**

A SMITHKLINE BECKMAN COMPANY



Circle No. 96 on Readers' Service Card

# Fantastic Plastics


**New A Vage™ Gel Apparatus** - CAT#400060 - The VAGE™ (vertical agarose/acrylamide gel electrophoresis) apparatus allows the preparation of very thin agarose gels (1.5 mm or 3.0 mm) or acrylamide gels (1.0 mm - 1.5 mm) of uniform thickness. Running a thin agarose gel facilitates rapid electrophoresis with superior resolution of DNA bands. The apparatus is supplied with spacer, a 16 lane well comb for each thickness, two gel plates and 4 clamps.

**New B Vage™ Casting Stand** - CAT# 400066 - The Vage™ Casting Stand simplifies the preparation of vertical agarose gels through the use of a clamping system. This eliminates the need for tapping or plugging the glass gel plates.

**New C Radioactivity Waste Container** - CAT# 400014 -The radioactivity waste container is a heavy duty, 9.3 mm thick, clear acrylic closed cylinder for disposing of radioactive materials. Dimensions are 18 cm H × 15.25 cm diameter.

**New D Beta Block** - CAT# 400026 - The Betablock shield is a handy rack constructed of shatter resistant, acrylic which protects one from radiation. The dimensions of the Betablock are 10 cm H × 15 cm L × 3.8 cm W.

**New E Push Column Beta Shield Device** - CAT# 400700 -This 3 piece acrylic device protects one from radiation while operating the Stratagene push column. The dimensions are 12 cm L × 12 cm W × 23 × cm H. The device supports the syringe for easier manipulation of the plunger. Please inquire regarding Stratagene's time saving push columns (CAT# 400701).

**New F Stratavac™ Vacuum Blotter** - CAT# 400080, 400082 - Available in both large and small sizes. Both Strata Vacs™ are designed for rapid blotting of both DNA and RNA. The sturdy stainless steel clamps are adjustable to provide air tight seals.

**G Stratacooler™ II** - CAT# 400002 - The durable acrylic Benchtop Freezer and lid contain a special plastic freezing material that freezes and melts at −15°C. The interior microfuge tube rack will hold twenty-four 1.5 ml tubes and eight 0.5 ml tubes. The exterior dimensions of the box are 22.9 cm L × 15.9 cm H × 14 cm W.

**H Mini Horizontal Electrophoresis Apparatus** -CAT# 400043 - The mini agarose electrophoresis apparatus has a bed constructed of UV transparent acrylic to allow easy viewing of ethidium stained nucleic acids. Exterior dimensions are 170 mm L × 87 mm W × 48 mm H. The gel bed is 88mm L × 75 mm W. Power supply leads and a safety top are included as well as 2 gel combs and a support bridge.

**Also available Double Wide Horizontal Electrophoresis Apparatus** - CAT# 400048 (not shown). Exterior dimensions are 170 mm × 170 mm W × 48 mm H. The gel bed is 160 mm W × 88 mm L.

**I Parafilm™ Dispenser** - Available in 2″ and 4″ sizes, CAT# 400031, 400032 - These dispensers will hold a full 250 ft. roll of Parafilm. The Parafilm™ can be dispensed and cut with one hand, eliminating the need for scissors.

Circle No. 131 on Readers' Service Card

**J Sequencing Tray** - CAT# 420001 - The sequencing tray replaces microfuge tubes for performing multiple sequencing reactions. Each tray contains 16 annealing tubes conveniently located adjacent to the sequencing reaction wells.

**K Radioactivity Transport Capsule** - CAT# 400010 - The radioactivity transport capsule is a heavy duty, one-half inch thick, closed cylinder for transporting $^{32}P$ and $^{35}S$ labeled substances. Interior dimensions are 90 mm H × 64 mm D. Each capsule comes with a rack that will hold 7 microfuge tubes.

**New L Two-Sided Radioactivity Shield** - CAT# 400025 -The two-sided radioactivity shield is constructed from 9.3 mm thick, shatter resistant acrylic. It has a sloped top for viewing experiments while shielding both you and others from radiation. The unique design maximizes bench space and gives protection to persons working on the opposite side of the bench.

**STRATAGENE**
11099 North Torrey Pines Road
La Jolla, CA 92037
Ordering: 800-424-5444
Technical Services: 800-548-1113
FAX: 619-535-5430
TELEX: 9103809841

***In Europe:*** Stratagene GmbH
Postfach 105466
D-6900 Heidelberg
(Federal Republic of Germany)
Telefon: (06221) 40 06 34
Telefax: (06221) 40 06 39)

**For orders outside the USA or Germany please contact Stratagene for the distributor nearest you.**

American Association for the Advancement of Science

# Science

ISSN 0036-8075
12 May 1989
Volume 244
Number 4905

627 This Week in *Science*

**Editorial**

629 Oil Spills

**Letters**

631 Budget Cuts at NIH: M. J. Peak ■ Climate and Forests: R. A. Sedjo ■ Retraction: K. M. Milam, S. Horn, P. J. Tofilon, D. F. Deen, L. J. Marton ■ Educational Reform: D. Elkind ■ Yanomami Indians and Anthropological Ethics: B. Albert and A. R. Ramos ■ Notification to Readers: J. F. Ferrer and P. Gupta

**News & Comment**

643 The Dingell Probe Finally Goes Public ■ Credit for Whistle-Blower Vanishes ■ Secret Service Probes Lab Notebooks ■ "I Am Not a Neat Person" ■ A Question of Intent ■ NIH to Use Forensics

647 Electrochemists Fail to Heat Up Cold Fusion

648 Germany Sets Up New Space Agency
Researchers Irked by Changes to Testimony

649 Frazier Honored by Psychiatrists
Koop Resigns in a Huff
Science Artifacts on the Block

650 Skeleton Alleged in the Stealth Bomber's Closet

**Research News**

652 Two Cultures Find Common Ground

654 Gene Signals Relapse of Breast, Ovarian Cancers

655 New Chip May Speed Genome Analysis

**Articles**

659 The Economic Status of the Elderly: M. D. Hurd

664 Observations in Particle Physics from Two Neutrinos to the Standard Model: L. M. Lederman

673 How Old Is the Genetic Code? Statistical Geometry of tRNA Provides an Answer: M. Eigen, B. F. Lindemann, M. Tietze, R. Winkler-Oswatitsch, A. Dress, A. von Haeseler

**Research Articles**

679 Stereochemistry of RNA Cleavage by the *Tetrahymena* Ribozyme and Evidence That the Chemical Step Is Not Rate-Limiting: J. A. McSwiggen and T. R. Cech

**Reports**

684 Model Simulation of the Cretaceous Ocean Circulation: E. J. Barron and W. H. Peterson

■ **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): $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. **Change of address:** allow 6 weeks, giving old and new addresses and 11-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 Color-enhanced tissue section from a human ovarian epithelial carcinoma. The tumor cells contain >fivefold amplification of the HER-2/*neu* proto-oncogene. The section is immunostained with antibody to the HER-2/*neu* protein. The typical cystic nature of the tumor can be seen, and there is intense membrane staining (brown color) of the tumor cells lining the cystic structures. Stromal cells and nonmalignant elements are unstained, indicating the absence of the protein (×100). See page 707. [Photograph by D. J. Slamon, Department of Medicine, UCLA School of Medicine, Los Angeles, CA 90024, and M. F. Press, Department of Pathology, University of Southern California School of Medicine, Los Angeles, CA 90033]


686 Hearing in Honey Bees: Detection of Air-Particle Oscillations: W. F. TOWNE AND W. H. KIRCHNER

688 Fibroblast Growth Factor in the Extracellular Matrix of Dystrophic (mdx) Mouse Muscle: J. DIMARIO, N. BUFFINGER, S. YAMADA, R. C. STROHMAN

690 Corn and Culture in Central Andean Prehistory: S. JOHANNESSEN AND C. A. HASTORF

692 Stereochemical Course of Catalysis by the *Tetrahymena* Ribozyme: J. RAJAGOPAL, J. A. DOUDNA, J. W. SZOSTAK

694 Identification of the Fusion Peptide of Primate Immunodeficiency Viruses: M. L. BOSCH, P. L. EARL, K. FARGNOLI, S. PICCIAFUOCO, F. GIOMBINI, F. WONG-STAAL, G. FRANCHINI

697 Calicheamicin $\gamma_1{}^{I}$ and DNA: Molecular Recognition Process Responsible for Site-Specificity: N. ZEIN, M. PONCIN, R. NILAKANTAN, G. A. ELLESTAD

700 Complementary DNA Coding Click Beetle Luciferases Can Elicit Bioluminescence of Different Colors: K. V. WOOD, Y. A. LAM, H. H. SELIGER, W. D. MCELROY

702 Reexamination of the Three-Dimensional Structure of the Small Subunit of RuBisCo from Higher Plants: S. KNIGHT, I. ANDERSSON, C.-I. BRÄNDÉN

705 Receptor-Mediated Drug Delivery to Macrophages in Chemotherapy of Leishmaniasis: A. MUKHOPADHYAY, G. CHAUDHURI, S. K. ARORA, S. SEHGAL, S. K. BASU

707 Studies of the HER-2/*neu* Proto-oncogene in Human Breast and Ovarian Cancer: D. J. SLAMON, W. GODOLPHIN, L. A. JONES, J. A. HOLT, S. G. WONG, D. E. KEITH, W. J. LEVIN, S. G. STUART, J. UDOVE, A. ULLRICH, M. F. PRESS

713 Activation of $\gamma\delta$ T Cells in the Primary Immune Response to *Mycobacterium tuberculosis*: E. M. JANIS, S. H. E. KAUFMANN, R. H. SCHWARTZ, D. M. PARDOLL

716 Neural Integration of Information Specifying Structure from Stereopsis and Motion: M. NAWROT AND R. BLAKE


## Book Reviews


719 Otto Folin, *reviewed by* J. T. EDSALL ■ Nuts and Bolts of the Past, C. PURSELL ■ Evaporite Sedimentology and Evaporities and Hydrocarbons, P. SONNENFELD ■ Continental Flood Basalts, S. A. MORSE ■ Books Received


## Products & Materials


724 Magnetic Cell Sorter ■ Statistical Experimental Design Software ■ In Vivo Electrochemistry System ■ Cell and Tissue Adhesive ■ Population Dynamics Software ■ Multivariate Data Analysis Software ■ Literature

# This Week in SCIENCE

## Cretaceous currents

WHAT were ocean circulation patterns like during the mid-Cretaceous (100 million years ago)? The tropical Pacific was flowing westward. The Tethys Ocean (the seaway that separated North America and Eurasia in the north from Africa, South America, and India in the south) was also thought—based on laboratory experiments and biogeographic studies—to have a dominant west-flowing surface current. However, recent numerical simulations of the mid-Cretaceous Tethys Ocean circulation favor eastward flow along the northern margin of the ocean (page 684). The simulations took into account Cretaceous atmospheric conditions at the sea surface, the shape and size of Tethys, the positions and shapes of the continents, sea level, and other factors. Barron and Peterson discuss how differences in these parameters may be at the root of the discrepancies between the simulations and the earlier reconstructions. The results of the simulations bear directly on interpretations of marine organism dispersal by Tethys currents after the breakup of the supercontinent Pangea some 200 million years ago.

## Honey bee sounds

A worker honey bee performs a dance to communicate to her nestmates where food is located; which of the dancer's signals are processed by the nestmates is now becoming clear. The dancer produces sounds by vibrating her wings, and the vibrations cause air particles near her abdomen to oscillate; other honey bees detect the oscillating air particles and respond by lowering their wings and raising their antennae (page 686). The responding bees do not react to the weak pressure oscillations that are also components of the traveling sound waves. Bees could learn to detect artificial airborne sounds and could distinguish between sounds at different frequencies. Towne and Kirchner speculate that the Johnston's organs on flagella of the bees' antennae detect the air-particle oscillations. These organs are most sensitive to sounds at the frequency (265 Hz) of the sounds that accompany the dance; these organs may process information about where the dancer is and where the food she has found is located.

## Corn and culture

MAIZE played an important part in prehistoric Peruvian cultures. Charred kernels of maize recovered from settlements dating from A.D. 450 to 1500 in the upper Mantaro Valley of the Andes provide a record of sequential steps in regional maize evolution and give some insights into local cultural and political developments (page 690). Johannessen and Hastorf studied kernels from six contiguous time periods and noted several trends—a general increase in kernel size, several changes in kernel shape, changes in the number of rows to an ear (inferred from the physical characteristics of the kernels), and an increase in the number of maize varieties. The gradual evolution of the maize has cultural significance. For example, the large-kerneled variety that was common by A.D. 1000 resembles maize that had suddenly come into use in coastal regions centuries earlier; the coastal maize had been attributed to the influence of the Waris (whose expansion occurred from A.D. 550 to 850), and it therefore appears unlikely that the Waris were influential in the upper Mantaro Valley. The large-kerneled maize was a local and not an Inca innovation: it and tools for growing, processing, and eating it were well established in this valley long before Inca time.

## Prognostic tool for breast and ovarian cancers

DURING 1989, there are likely to be close to 162,000 new cases of breast and ovarian cancer; these two types of cancer account for about one-third of all the cancers in women. Of the several prognosticators for long-term survival in breast cancer, the best are whether there has been amplification of the HER-2/*neu* proto-oncogene (a normal gene that is amplified in some tumors and may be associated with tumor development) and whether lymph nodes are involved; amplification of HER-2/*neu* also has now been shown to be an indicator of clinical outcome in ovarian cancer (page 707). Slamon *et al.* found in a large study that in 25 to 30% of breast and ovarian cancers there are multiple copies of this proto-oncogene. The consequences of amplification are overexpression of RNA and protein (cover); each of these indicators was assessed. Because follow-up studies show that the amount of amplification is predictive of the patient's long-term survival, HER-2/*neu* is an obvious target both for diagnostic tests and for therapies for both of these malignancies.

## $\gamma\delta$ T cells

A function has been found for a subpopulation of cells of the immune system for which no function was previously known. The $\gamma\delta$ T cells appear to provide a rapid first-line defense in the immune response against the bacteria that cause tuberculosis (page 713). Studies by Janis *et al.* show that $\gamma\delta$ T cells are responsive to mycobacteria both in vivo and in vitro. After mice had been immunized with mycobacteria, the number of $\gamma\delta$-bearing cells in lymph nodes expanded 20- to 25-fold. The $\gamma\delta$ cells participated in the primary immune response but were less active than other T cells ($\alpha\beta$ T cells) in the secondary responses that ensued after subsequent immunizations. These differences in responsiveness suggest that after $\gamma\delta$ T cells participate in the primary response to mycobacterial antigens (perhaps specifically to those antigens that are shared by many microorganisms) a switch may occur to turn on $\alpha\beta$ cells, which then mediate secondary responses to the same antigens. The $\gamma\delta$ T cells and the corresponding $\alpha\beta$ T cells recognize mycobacterial antigens in association with different cell surface structures. The two subpopulations appear to represent distinct T cell lineages.

# SCIENCE

12 MAY 1989
VOLUME 244
NUMBER 4905



## Oil Spills

The Alaskan oil spill has become the most studied and managed event of its kind. Some 30 teams from various state and federal agencies have, as their goal, assessment of damage accruing from it. Each morning at Valdez there have been briefing sessions attended by 60 to 70 scientists. The cleanup is being managed by a committee that includes representatives from about 12 state and federal agencies.

Thus far the sequence of events following the spill has been governed by local factors such as wind, temperature, ocean currents, geology, and the composition of the Prudhoe Bay crude oil. Nevertheless events have been following a pattern similar to those observed in spills of crude oil elsewhere.

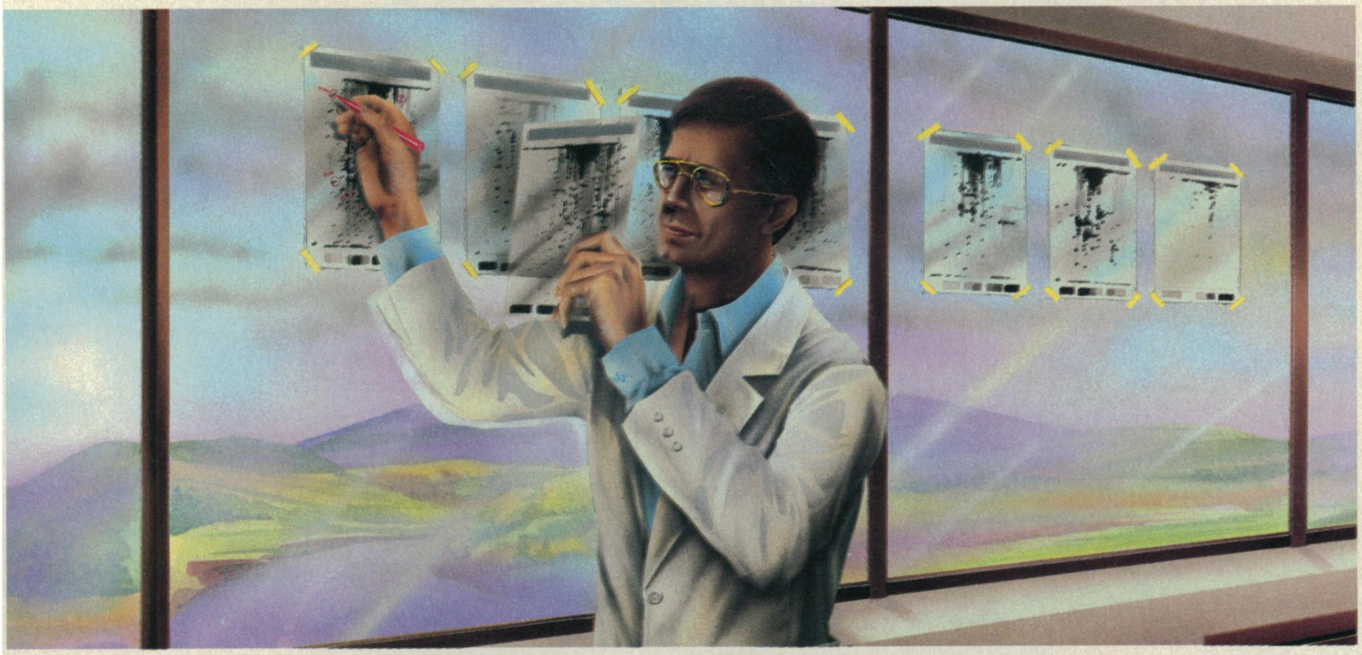
Crude oils differ, but in general they contain hundreds, even thousands, of different compounds. Some are straight-chain hydrocarbons with carbon numbers ranging from 4 or 5 to 35 or more. Other hydrocarbons have branched chains with a wide range of carbon numbers. Aromatic compounds such as benzene, toluene, and polynuclear hydrocarbons are substantially present. Other constituents include waxes and complex, high molecular weight asphaltenes. All of these substances and more are present in Prudhoe Bay crude oil. When ingested, most of the compounds are nontoxic. Notable exceptions are some of the aromatic compounds, including benzene and toluene.

After a crude oil is spilled in a marine environment, many processes follow. A typical crude has a density of about 0.85, more or less, and this factor combined with winds, wave action, and currents leads to spreading, which is particularly rapid during the first 24 hours. During that period most of the components having boiling points below 200°C volatilize. As a result some of the toxic chemicals such as benzene are removed. The composition of the floating mixture is further changed immediately and later by photooxidation, biodegradation, dispersion, and dissolution. About a day after the spill, depending on temperature and wave action, an emulsification of oil and sea water occurs, leading to formation of a highly viscous material that contains about 70% water. This material is very sticky, and it adheres to almost all objects that it encounters, including birds and sea otters. There has been one report of a minor fish kill in Prince William Sound. Observations at other oil spills indicate that dispersed oil is not toxic to zooplankton when ingested. It is eliminated in the feces. In general, oil chemicals are not concentrated in the food chain.

In Prince William Sound local factors have affected the movement and behavior of the spill. Part of the time, the sea is relatively calm, but often it is roiled by winds that create waves 20 feet high and more. The amplitude of the tide is about 15 feet. The Alaska Current enters the Sound on the east and exits on the west. This flow has protected some of the Sound from major contamination and has carried part of the spill out of the Sound. As a result of various physical , biological, and chemical processes, the inventory of oil in Prince William Sound (originally 10 million gallons) dropped about 70% during the first 4 weeks after the spill. The U.S. Forest Service, one agency active at the site, quotes an Exxon estimate as follows: evaporated, 35%; recovered, 17%; burned, 8%; biodegraded, 5%; dispersed, 5%. The total in the form of oil slicks on Prince William Sound amounted to 10% of the original spill; that on the shoreline, 18%. A large fleet of vessels was mopping up the slicks, and in good weather was capturing about 120,000 gallons a day. Previous experience has shown that once the slicks become thin (some micrometers) they are fairly rapidly destroyed by photooxidation and microbial action. However, the tarry oil on 300 miles of shoreline will only slowly be removed by wave action and by a workforce of about 4000.

Insofar as part of the oil leaves Prince William Sound and affects other portions of the Alaska coastline, Exxon will have additional problems. However, due to the cleanup, the flushing action of the Alaska Current, and the fact that some of Prince William Sound has escaped major contamination, it is likely that in a few years or less, the fauna of the Sound will be substantially restored. But television viewers will not soon forget heartrending scenes of oiled birds and sick otters.—PHILIP H. ABELSON

# How in the world can you discover subtle changes in genetic expression?...



# ...With PDI—That's How!

**We can give you the answer.**

If you work with 2-D gels in the life sciences, then you need to know which proteins are being induced, repressed, phosphorylated and glycosylated. And you need to know when they are changing. PDI can help. We've taken the empirical art of 2-D electrophoresis and made it a more precise science by creating the only total system of analytical gel services, software, and instruments to reduce biological information to useful, manageable data.

**We can quantify the changes in your cells and tissues.**

Whether you run 2-D or not, we can give you the answers you need to make discoveries. With PDI, you get the benefit of years of gel running experience linked to software development devoted to quantifying and reducing biological data to answers you can use.

**In applications such as:**

- Growth & development
- Hormonal regulation
- Genetic expression
- Effects of toxins & drugs
- Genomic sequencing

**The marriage of 2-D Electrophoresis and computer-assisted analysis.**

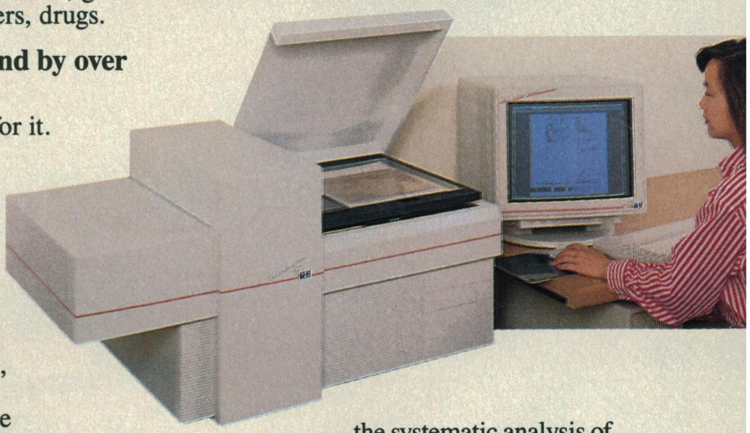
Our instrument system, the Discovery Series™, does the tedious work and frees you for the creative and intuitive processes that lead to breakthroughs. That's the power of PDI; the power to illuminate, amplify. You no longer need to reinvent the wheel every time you run an experiment with hormones, growth factors, neurotransmitters, drugs.

**Proven in top labs and by over 90 publications.**

Don't take our word for it. Over 90 publications world-wide testify to the value of PDI's partnerships with world's leading scientists. Clients from Cal Tech, Columbia University, The Pasteur Institute, The University of Penn., UCSF, Harvard, and leading pharmaceutical companies have used gel services and/or The Discovery Series™ from PDI.

**Use the Power of The Discovery Series™**

Our latest version of The Discovery Series™ is the most powerful, the most user-friendly and the most customer-proven system available anywhere for



the systematic analysis of global changes occurring in biological systems. And it's more affordable than you think! As with all our services, you can buy or lease the entire system—or you may send your samples to us and use our system on a low-cost service basis. Either way, we give you the answers. You make the discoveries.

*Call or write for our latest **"Product & Services Guide"** shown here and for more information.*

protein databases inc.

*The Thrill of Discovery*

(1) 800-777-6834

405 Oakwood Road, Huntington Station, NY 11746 (516) 673-3939, Fax: (516) 673-4502

# THERMOmax™ and SOFTmax.® The system approach to thermoregulated assays.

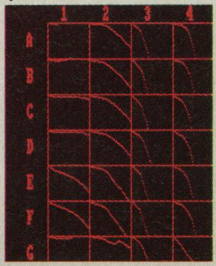
Accurate, rapid temperature regulation with precise well-to-well thermal and optical uniformity. Linear and nonlinear, positive and negative kinetics. Only the THERMOmax Microplate Reader with SOFTmax 2.00 software addresses the unique requirements of your most challenging microassays.

**Enzyme Studies.** Analyze up to 96 samples simultaneously—especially useful with unstable samples. Data quality is equivalent to that of spectrophotometers.

**Kinetic Turbidimetric Assays.** For endotoxin determination, clotting and clot lysis reactions, only THERMOmax prevents undesirable disruption of clots. SOFTmax determines log onset time versus log EU/ml.

**Superoxide Studies with Living Cells.** THERMOmax eliminates cross talk from scattered light. Readings are accurate even with highly turbid samples. And only THERMOmax and SOFTmax combine a narrow band-pass 550 nm filter, computation of maximum rates and dual wavelength kinetics.

**Microbiology.** For turbidimetric measurement of growth or kinetic measurement of pH changes, THERMOmax with SOFTmax allows you to calculate the maximum rate and the time to the maximum rate.

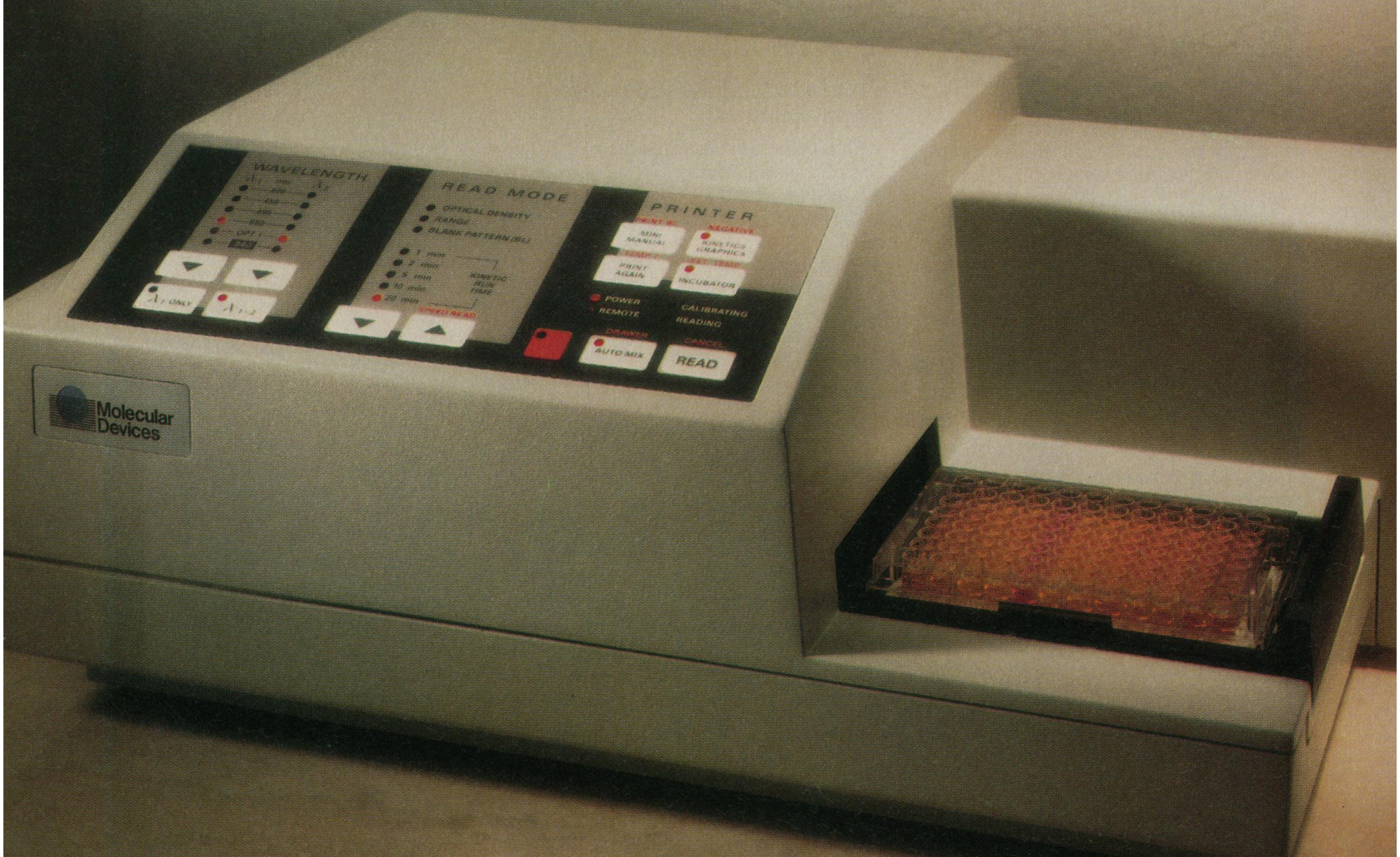



THERMOmax and SOFTmax. The complete system for thermoregulated analysis. Contact Molecular Devices today.

Molecular Devices

Molecular Devices Corporation
Menlo Oaks Corporate Center
4700 Bohannon Drive
Menlo Park, CA 94025
(800) 635-5577
(415) 322-4700
(415) 322-2069 (Telefax)
6716637 MOLEUW (Telex)






Circle No. 90 on Readers' Service Card

# New by BACHEM.
# Lymphokines and Cytokines.

*Human and mouse lymphokines are now available from BACHEM. We can deliver from stock the following new, highly pure products made by recombinant DNA technology:*

***Colony stimulating factors***
***Interleukins***
***Interferons***

*We cloned, expressed, purified and assayed these proteins in our molecular biology laboratories. These new lymphokines are another example of BACHEM's commitment to new product development, high quality and favorable prices. Call your nearest BACHEM office for complete product information and prices. Your satisfaction with our products is guaranteed.*

## THE BACHEM GROUP – FOR BETTER SERVICE, WORLDWIDE

**BACHEM Feinchemikalien AG**

serving you worldwide
except areas mentioned

Hauptstrasse 144
CH-4416 **Bubendorf**

Phone: 061/931 23 33
Fax: 061/931 25 49
Telex: 966 081

**BACHEM Bioscience Inc**

subsidiary of BACHEM Switzerland
serving the American continents

3700 Market Street
**Philadelphia,** PA 19104

Phone: 215/387 0011
Fax: 215/387 1170
Telex: 910 250 2352

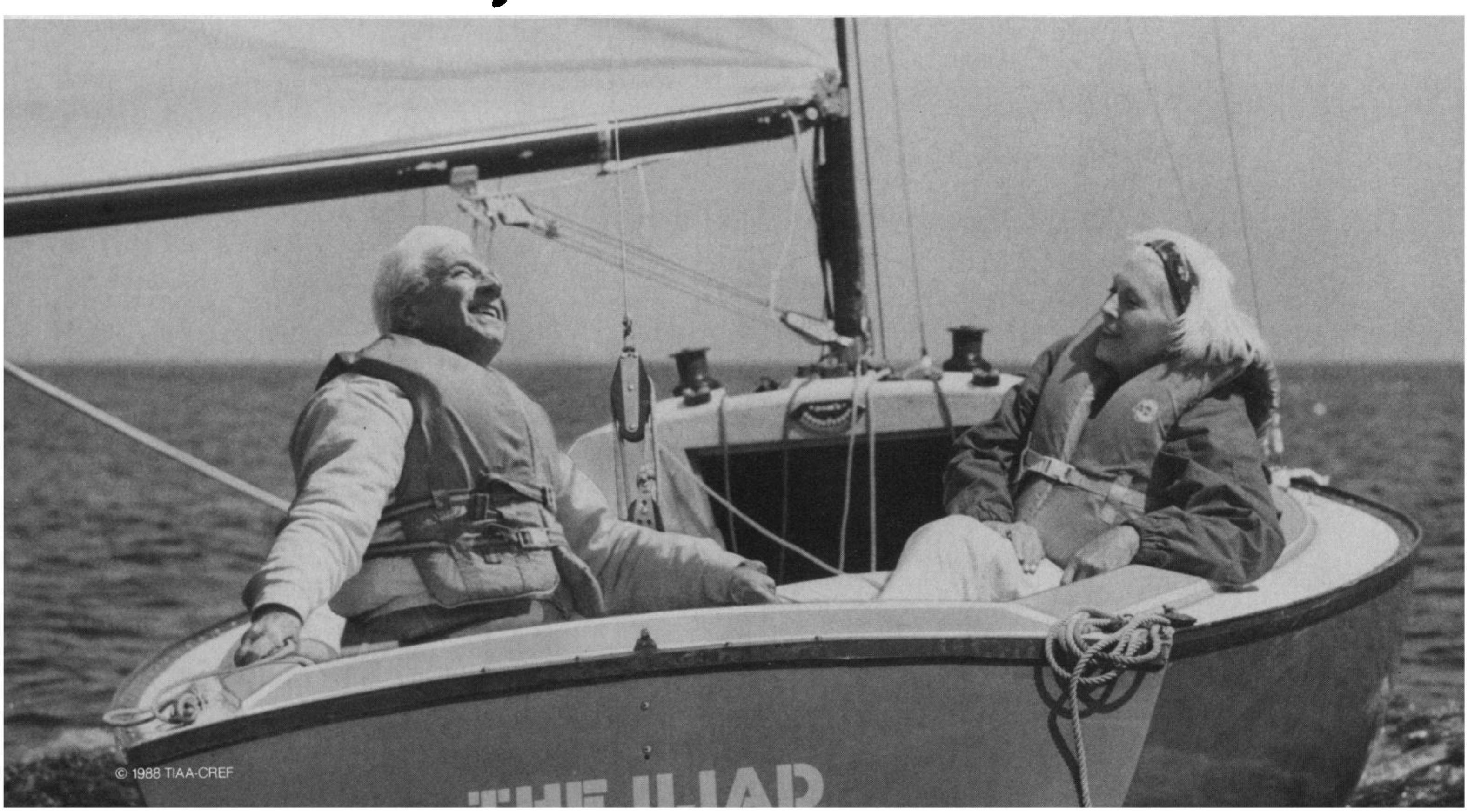
**BACHEM Biochemica GmbH**

subsidiary of BACHEM Switzerland
serving FRG, GDR and CCCP

Lessingstrasse 26
D-6900 **Heidelberg**

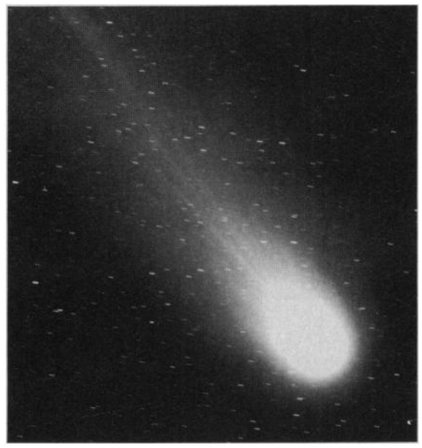
Phone: 0 62 21/16 30 91
Fax: 0 62 21/21442
Telex: 461 352

Circle No. 153 on Readers' Service Card

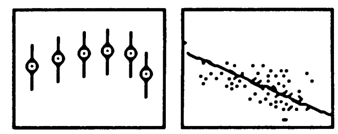

© 1988 TIAA-CREF

FORTRAN Drivers GWI
MacSpeech Lab GWI
MacADIOS Manager GWI
LABTECH NOTEBOOK
LightSpeedC Drivers GWI
QuickBASIC Drivers GWI
PASCAL Drivers GWI
MacInstruments™ GWI





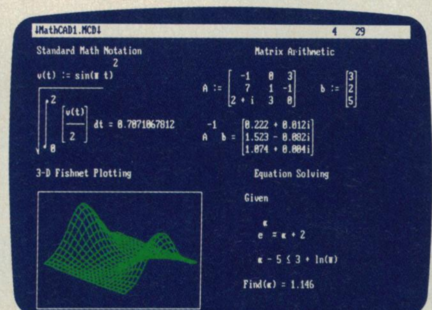


# After centuries of practice, mankind perfects scientific calculations: MathCAD.

## Announcing MathCAD 2.5: The Dawn of a New Age.

What the historians will call it, only time will tell.

Perhaps the Century of Speed, or the Era of Ease. But whatever the name, this is the age of MathCAD 2.5, the only math package that looks and works the way you think.




*MathCAD 2.5 includes 3-D plotting, HPGL sketch import, and PostScript output.*


MathCAD is far and away the best-selling math package in the world. Because it lets you perform engineering and scientific calculations in a way that's faster, more natural and less error-prone than the way you're doing them now–whether you're using a scratchpad, calculator, spreadsheet or program that you wrote yourself.

And now we've made the best even better. MathCAD 2.5 is a dramatically improved version that includes three-dimensional plotting, enhanced numerical analysis, and the ability to import HPGL files from most popular CAD programs, including AutoCAD.® And now you can print on PostScript® compatible printers.

And like before, MathCAD's live document interface™ lets you enter equations anywhere on the screen, add text to support your work, and graph the results. Then print your analysis in presentation-quality documents.

It has over 120 commonly used functions built right in, for handling equations and formulas, as well as exponentials, differentials, cubic splines, FFTs and matrices.

No matter what kind of math you do, MathCAD 2.5 has a solution for you. In fact, it's used by over 50,000 engineers and scientists, including electrical, industrial, and mechanical engineers, physicists, biologists, and economists.

But don't take our word for it; just ask the experts. PC Magazine recently described MathCAD as "everything you have ever dreamed of in a mathematical toolbox."

PC MAGAZINE EDITOR'S CHOICE
**March 14, 1989 issue.**
**Best of '88**
**Best of '87**

And for Macintosh® users, we present MathCAD 2.0, rewritten to take full advantage of the Macintosh interface. Entering operators and Greek letters into equations is pure simplicity!

Look for MathCAD 2.5 at your local software dealer, or give us a call. For more information, a free demo disk, or upgrade information,* dial 1-800-MATHCAD (in MA, 617-577-1017).

**If you purchased MathCAD 2.0 between 5/1/89 and 6/16/89, you can get a FREE upgrade to version 2.5 (otherwise, the upgrade cost is $99.00 until June 30, 1989; afterwards, the cost will be $149.00).*

**MathCAD®**

**MathSoft, Inc. One Kendall Square, Cambridge, MA 02139**

**Available for IBM® compatibles and Macintosh computers.** TM and ® signify manufacturer's trademark or manufacturer's registered trademark respectively *PS*

Circle No. 116 on Readers' Service Card

influence, and he was a devoted teacher. Eminent biochemists grew up in his department. In addition to those already mentioned, the most notable were J. B. Sumner, who later was the first to crystallize an enzyme, urease, and Cyrus Fiske, who, with his gifted collaborator Yellapragada Subbarow, discovered phosphocreatine and adenosine triphosphate; the latter was discovered independently by Karl Lohmann in Germany, who has generally, but unfairly, received most of the credit.

In addition to the main text Meites has provided, in 60 pages of small print, a detailed study of the chemistry of Folin's analytical methods and procedures. Most readers will skip this, but it is there for those who have occasion to use it. The most serious deficiency in the book is the lack of an index, which is badly needed to trace the various characters who appear and reappear.

This book provides a helpful complement to the recent biography of Walter B. Cannon (to 1917) by Saul Benison, Clifford Barger, and Ellin Wolfe (Harvard University Press, 1987). Cannon and Folin worked closely together for a quarter century, in the teaching of first-year medical students, in matters of educational policy, and occasionally in research. It is good that we now have studies of both of them.

JOHN T. EDSALL
*Department of Biochemistry and Molecular Biology, Harvard University, Cambridge, MA 02138*

## The Technological Past

**Nuts and Bolts of the Past.** A History of American Technology, 1776–1860. DAVID FREEMAN HAWKE. Harper and Row, New York, 1988. xii, 308 pp., illus. $18.95.

Historians of technology have reason to rejoice that there is an apparently broad and deep popular interest in their subject. The subject is intrinsically interesting, and there is a growing realization that it may even have important potential public benefits: that technology assessment should include a historical dimension and that "technological literacy" might be better served by a course in the history of technology than yet another in mathematics or "how things work."

There is as yet, however, only a corporal's guard of professionally trained historians of technology, and most of them have not ventured into the problematic waters of addressing the public on their subject. The public's interest in the field therefore is met, if at all, by popularizers who, at their worst, treat the hardware as a black box and perpetuate and elaborate myths about the personalities and institutions that are the other parts of the technological enterprise.

David Hawke's *Nuts and Bolts of the Past* is the latest in this sorry genre. The 262 pages of text are divided into 42 subsections, one treating "the founding fathers," another the sewing machine, yet another the Franklin Institute. Each chapter is typically based on one or two scholarly articles (perhaps a book in some cases) salted with some popular works of a previous generation and a smattering of published contemporary sources. The book represents no attempt at original research.

Nor does it offer new insights. Despite his clear dependence upon a few excellent recent studies, Hawke takes from them details rather than interpretations. The analytical contribution of the book is that some leading American technologists were "dirty fingernail people" and others were "song-and-dance men," that is, some inventors were