4 February 2000

Science

Vol. 287 No. 5454
Pages 757–920 $8

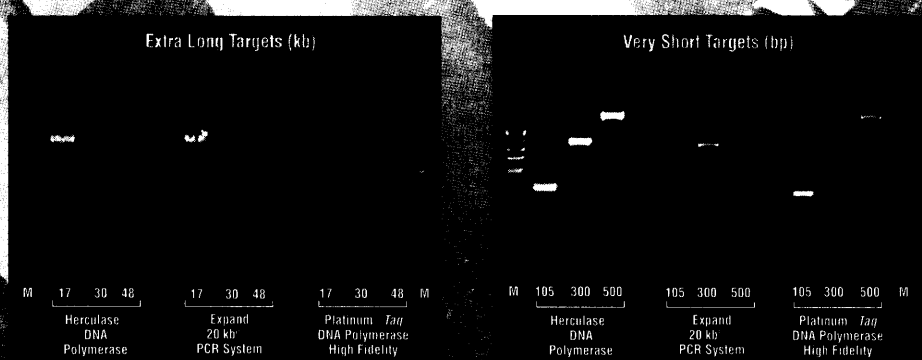
American Association for the Advancement of Science

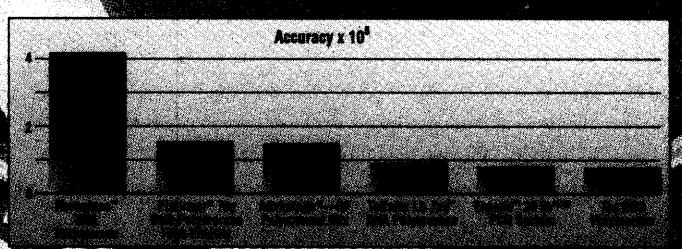
HERCULASE®

ENHANCED DNA POLYMERASE

THE MYTH You can't get high fidelity and robust yields in PCR's of long *and* short targets from one polymerase.

THE REALITY Herculase™ enhanced DNA polymerase delivers legendary fidelity and heroic performance.





New Herculase™ enhanced DNA polymerase‡‡ does it all! Get maximum yields over a wide target range with the highest fidelity. Herculase polymerase is a unique formulation optimized to all meet your PCR needs. No need to choose between fidelity and target size—Herculase polymerase gives you the high fidelity you want with the great performance you demand!

LEGENDARY *replication fidelity*

OLYMPIAN *range of simple and complex targets, from ~100bp to 50kb*

HEROIC *product yields for cloning, expression and sequencing*

HERCULASE™
ENHANCED DNA POLYMERASE

— You *can* have it all!

Herculase™ Enhanced DNA Polymerase

100U	#600260
500U	#600262
1000U	#600264

For more information, visit our website
www.stratagene.com

STRATAGENE®

Circle No. 19 on Readers' Service Card

STRATAGENE USA and CANADA
ORDER: (800) 424-5444 x3
TECHNICAL SERVICES: 800-894-1304

STRATAGENE EUROPE
Belgium, France, Germany, The Netherlands, Switzerland, United Kingdom
ORDER: 00800 7000 7000
TECHNICAL SERVICES: 00800 7400 7400
Austria
ORDER: 0800 312 526
TECHNICAL SERVICES: 017 956 7636

INTERNET
eMAIL: techservices@stratagene.com
WEBSITE: www.stratagene.com

‡ Purchase of these products is accompanied by a limited license to use them in the Polymerase Chain Reaction ("PCR") process for research in conjunction with a thermal cycler whose use in the automated performance of the PCR process is covered by the up-front license fee, either by payment to Perkin-Elmer or as purchased (i.e., an Authorized Thermal Cycler). These products are sold under licensing arrangements with F. Hoffmann-La Roche Ltd., Roche Molecular Systems, Inc., and The Perkin-Elmer Corporation. ‡‡ U.S. Patent Nos. 5,545,552 and 5,866,395 and 5,948,663 and patents pending.

VOLUME 287 4 FEBRUARY 2000 NUMBER 5454

Science

www.sciencemag.org

COVER Honeybees that have flown a few meters in a patterned tunnel falsely perceive that they have traveled several hundreds of meters. Experiments that recorded the dances of bees trained to fly through such a tunnel demonstrate that the bee's "odometer" is visually driven and provide a way of calibrating it. [Illustration: Marco Kleinhenz]

786
A prehistoric Amazon culture?

NEWS

NEWS OF THE WEEK

778 **2001 BUDGET: How NSF Came Up With the Biggest Boost in Its History**

779 **ASTRONOMY: Signs of MACHOs in a Far-Off Galaxy**

781 **FRANCE: Street Protests Keep the Pressure on Allègre**

782 **JAPAN: Blue Laser Pioneer Seeks Greener Pastures**

782 **BIOTECHNOLOGY: Both Sides Claim Victory in Trade Pact**

▼783 836 **MATERIALS SCIENCE: Stretching Horizons for Electrical Devices**

783 **CANCER RESEARCH: A Face-Off Over Tumor Blood Supply**

785 **U.S. PRIZES: 17 Get Science, Technology Medals**

NEWS FOCUS

786 **ARCHAEOLOGY: Earthmovers of the Amazon**
The Good Earth: Did People Improve the Amazon Basin?

790 **PLANT BIOTECHNOLOGY: Consumer Power Heralds Hard Times for Researchers**

791 **NEUROSCIENCE: Cold Numbers Unmake the Quantum Mind**

792 **MATHEMATICS: Fermat's Last Theorem's First Cousin**

▼793 854 **ECOLOGY: How Climate Change Alters Rhythms of the Wild**

796 **AMERICAN ASTRONOMICAL SOCIETY: New Focus on Cool Planets and Hot Gas in Atlanta**

RESEARCH

RESEARCH ARTICLE

▼826 816 **Regulation of Protein Secretion Through Controlled Aggregation in the Endoplasmic Reticulum** V. M. Rivera, X. Wang, S. Wardwell, N. L. Courage, A. Volchuk, T. Keenan, D. A. Holt, M. Gilman, L. Orci, F. Cerasoli Jr., J. E. Rothman, T. Clackson

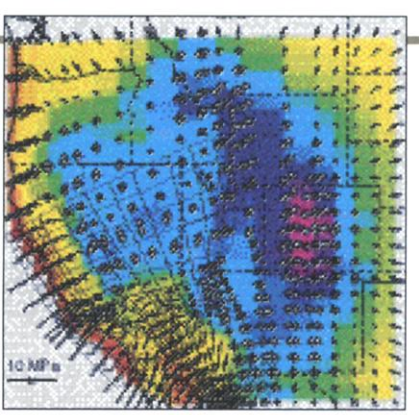
REPORTS

831 **Temporal Trends in Deep Ocean Redfield Ratios** M. Pahlow and U. Riebesell

▼834 814 **Dynamics of the Pacific–North American Plate Boundary in the Western United States** L. M. Flesch, W. E. Holt, A. J. Haines, B. Shen-Tu

▼836 783 **High-Speed Electrically Actuated Elastomers with Strain Greater Than 100%** R. Pelrine, R. Kornbluh, Q. Pei, J. Joseph

839 **Two-Dimensional Electronic Excitations in Self-Assembled Conjugated Polymer Nanocrystals** R. Österbacka, C. P. An, X. M. Jiang, Z. V. Vardeny



834
Buoyant crust meets plate collision

842 **Cool Glacial Temperatures and Changes in Moisture Source Recorded in Oman Groundwaters** C. E. Weyhenmeyer, S. J. Burns, H. N. Waber, W. Aeschbach-Hertig, R. Kipfer, H. H. Loosli, A. Matter

845 **Cross-Species Interactions Between Malaria Parasites in Humans** M. C. Bruce, C. A. Donnelly, M. P. Alpers, M. R. Galinski, J. W. Barnwell, D. Walliker, K. P. Day

DEPARTMENTS

NETWATCH 763

THIS WEEK IN *SCIENCE* 765

EDITORS' CHOICE 769

CONTACT *SCIENCE* 774

SCIENCESCOPE 781

RANDOM SAMPLES 799

NEW PRODUCTS 881

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SCIENCE (ISSN 0036-8075) is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1200 New York Avenue, NW, Washington, DC 20005. Periodicals Mail postage (publication No. 484460) paid at Washington, DC, and additional mailing offices. Domestic individual membership and subscription (51 issues): $112 ($62 allocated to subscription). Domestic institutional subscription (51 issues): $340; Foreign postage extra: Mexico, Caribbean (surface mail) $55; other countries (air assist delivery) $90. First class, airmail, student, and emeritus rates on request. Canadian rates with GST available upon request, GST #1254 88122. Publications Mail Agreement Number 1069624. **Printed in the U.S.A.**

SCIENCE'S COMPASS

EDITORIAL

801 **Lunch Selections Expanding**

LETTERS

803 **Timeline Travails** D. Ihde. ***Response*** I. Amato. **Antibiotic Rotation** L. Roccanova and P. Rappa III. **Herbicide Use on Roundup Ready Crops** J. Carpenter and L. Gianessi. **Benefits of Membership** E. Danchin and R. H. Wagner. ***Response*** J. K. Parrish and L. Edelstein-Keshet. **Corrections and Clarifications**

ESSAYS

809 **From Turin to Stockholm via St. Louis and Rio de Janeiro** R. Levi-Montalcini

810 **A Life in Science** H. G. Khorana

BOOKS *ET AL.*

811 PALEOBIOLOGY: ***Reef Evolution*** R. Wood, reviewed by J. E. N. Veron

812 EPIDEMIOLOGY: ***Anthrax*** *The Investigation of a Deadly Outbreak* J. Guillemin, reviewed by J. B. Tucker

PERSPECTIVES

813 NEUROBIOLOGY: **Regeneration in the Nogo Zone** M. Tessier-Lavigne and C. S. Goodman

812
Bioweapons victims

▼814 834 GEOPHYSICS: **The Strength of a Continent** G. A. Houseman

▼816 826 DRUG DELIVERY: **Regulating Export of ER Cargo** M. Aridor and W. E. Balch

▼817 851 BEHAVIOR: **Measuring Beelines to Food** T. Collett

818 BIOSYNTHETIC PATHWAYS: **Biosynthesis Meets Bioinformatics** D. E. Cane

REVIEW

820 BIOCHEMISTRY: **Adaptive Recognition by Nucleic Acid Aptamers** T. Hermann and D. J. Patel

848 **Mutations in *SDHD*, a Mitochondrial Complex II Gene, in Hereditary Paraganglioma** B. E. Baysal, R. E. Ferrell, J. E. Willett-Brozick, E. C. Lawrence, D. Myssiorek, A. Bosch, A. van der Mey, P. E. M. Taschner, W. S. Rubinstein, E. N. Myers, C. W. Richard III, C. J. Cornelisse, P. Devilee, B. Devlin

▼851 817 **Honeybee Navigation: Nature and Calibration of the "Odometer"** M. V. Srinivasan, S. Zhang, M. Altwein, J. Tautz

▼854 793 **Population Dynamical Consequences of Climate Change for a Small Temperate Songbird** B.-E. Sæther, J. Tufto, S. Engen, K. Jerstad, O. W. Røstad, J. E. Skåtan

857 **Connectivity of Marine Populations: Open or Closed?** R. K. Cowen, K. M. M. Lwiza, S. Sponaugle, C. B. Paris, D. B. Olson

860 **Eta-1 (Osteopontin): An Early Component of Type-1 (Cell-Mediated) Immunity** S. Ashkar, G. F. Weber, V. Panoutsakopoulou, M. E. Sanchirico, M. Jansson, S. Zawaideh, S. R. Rittling, D. T. Denhardt, M. J. Glimcher, H. Cantor

864 **Synaptic Assembly of the Brain in the Absence of Neurotransmitter Secretion** M. Verhage, A. S. Maia, J. J. Plomp, A. B. Brussaard, J. H. Heeroma, H. Vermeer, R. F. Toonen, R. E. Hammer, T. K. van den Berg, M. Missler, H. J. Geuze, T. C. Südhof

869 **A Subclass of Ras Proteins That Regulate the Degradation of IκB** C. Fenwick, S.-Y. Na, R. E. Voll, H. Zhong, S.-Y. Im, J. W. Lee, S. Ghosh

873 **Signaling and Circuitry of Multiple MAPK Pathways Revealed by a Matrix of Global Gene Expression Profiles** C. J. Roberts, B. Nelson, M. J. Marton, R. Stoughton, M. R. Meyer, H. A. Bennett, Y. D. He, H. Dai, W. L. Walker, T. R. Hughes, M. Tyers, C. Boone, S. H. Friend

TECHNICAL COMMENTS

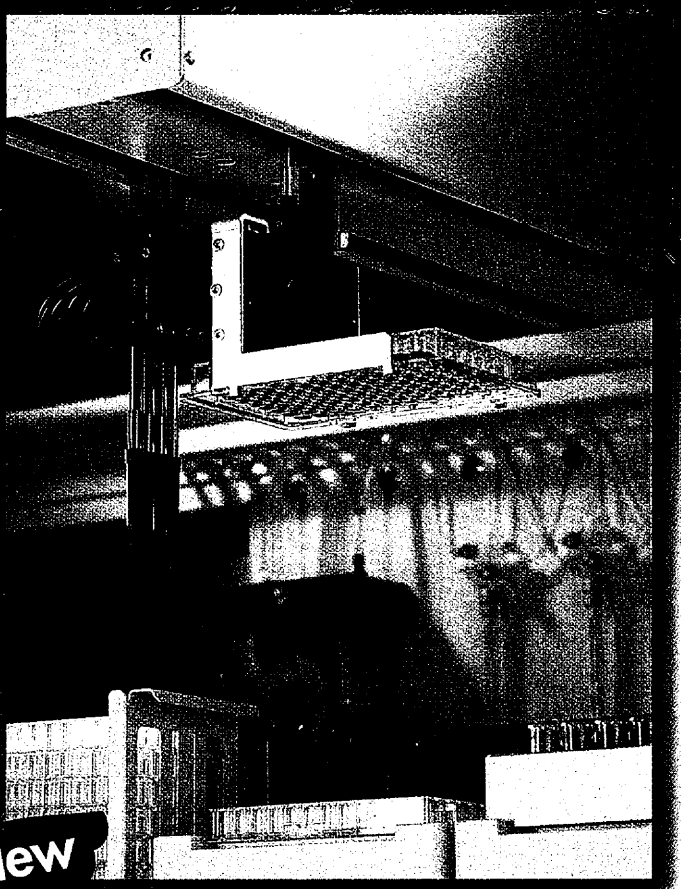
Intrinsic Versus Extrinsic Pseudogaps in Photoemission Spectra of Poorly Conducting Solids D. S. Dessau and T. Saitoh. ***Response*** R. Joynt

www.sciencemag.org/cgi/content/full/287/5454/767a

864
Brain organization in the absence of function

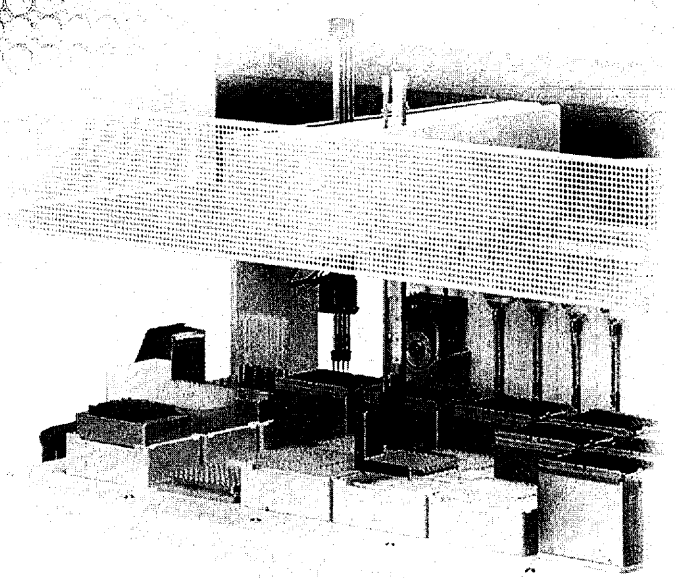
Change of address: allow 4 weeks, giving old and new addresses and 8-digit account number. **Postmaster:** Send change of address to *Science*, P.O. Box 1811, Danbury, CT 06813–1811. **Single copy sales:** $8.00 per issue prepaid includes surface postage; bulk rates on request. **Authorization to photocopy** material for internal or personal use under circumstances not falling within the fair use provisions of the Copyright Act is granted by AAAS to libraries and other users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that $4.00 per article is paid directly to CCC, 222 Rosewood Drive, Danvers, MA 01923. The identification code for *Science* is 0036-8075/83 $4.00. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.

Lab automation designed for *unlimited* flexibility



APPLICATIONS

- Liquid handling
- Protein
- Genomic DNA
- Microarray
- RNA



New

BIO ROBOT 3000

Tailor-made Molecular Biology Workstations

Each BioRobot™ 3000 is custom designed to fit your specific automation needs. A wide variety of modules is available to simplify small-volume liquid handling, walk-away plate processing, nucleic acid purification, recombinant protein purification and assay, and other life science applications. You can easily modify and expand your BioRobot 3000 whenever your needs change.

Software designed for flexibility

QIAsoft™ software gives you complete control over your processing and data handling. Clear on-screen prompts and point-and-click menus make it simple to create your own protocols. Complete process documentation and sample tracking are provided in standard file formats for easy data exchange with other laboratory instruments and laboratory information management systems (LIMS).

Comprehensive application support

Our Technical Support Specialists have extensive experience in both molecular biology and instrumentation, and offer more than just help designing and installing your workstation. We provide complete support for application development and system expansion to keep your workstation in step with your developing needs for high-throughput processing.

Lab automation your way — from the company that understands molecular biology

Contact QIAGEN today !

The BioRobot 3000 is not available in all countries; please inquire.

Circle No. 21 on Readers' Service Card

www.qiagen.com

QIAGEN:	Germany	USA	Australia	Canada	France	Japan	Switzerland	UK
Tel.	02103-892-240	800-426-8157	03-9489-3666	800-572-9613	01-60-920-930	03-5805-7261	061-319-30-31	01293-422-999
Fax	02103-892-255	800-718-2056	03-9489-3888	905-821-1327	01-60-920-925	03-5805-7263	061-319-30-33	01293-422-922

DISTRIBUTORS: **Argentina** Tecnolab S.A. (011) 4555 0010 **Austria/Hungary/Slovenia** R. u. P. MARGARITELLA Austria (01) 889 18 19 **Belgium/Luxemburg** Westburg b.v. 0800-1-9815 **Brazil** Labtrade do Brazil (11) 543 1455 or 0800 55 1321 **Central & South America** Labtrade Inc. USA (305) 828-3818 **China** Gene Company Limited (852)2896-6283 **Czech Republic** BIO-CONSULT spol. s.r.o. (02)4447 1239 **Denmark** KEBO Lab A/S 43 86 87 88 **Egypt** Clinilab 525 7212 **Finland** KEBO Lab Oy (09)-804 551 **Greece** BioAnalytica S.A. (01)-640 03 18 **India** Genetix (011)-542 1714 or (011)-515 9346 **Israel** Bio-Lab Ltd. 02. 584 1111 **Italy** GENENCO (M-Medical srl) (055) 500 1871 **Korea** LRS Laboratories, Inc.(02) 924-86 97 **Malaysia** Research Biolabs Sdn. Bhd. (03)-7312099 **Mexico** Quimica Valaner S.A. de C.V. (5) 525 57 25 **The Netherlands** Westburg b.v. (033)-4950094 **New Zealand** Biolab Scientific Ltd.(09) 980 6700 or 0800 933 966 **Norway** KEBO Lab AS 22 90 00 00 **Poland** Syngen Biotech (071) 351 41 06 or 0601 70 60 07 **Portugal** IZASA PORTUGAL, LDA (1)-424 73 64 **Singapore** Research Biolabs Pte Ltd. 445 7927 **Slovak Republic** BIO-CONSULT Slovakia s.r.o. (07) 50221 336 **South Africa** Southern Cross Biotechnology (Pty) Ltd (021) 671 5166 **Spain** IZASA, S.A. (93) 902.20.30.90 **Sweden** KEBO Lab (08) 621 34 00 **Taiwan** TAIGEN Bioscience Corporation (02) 2880 2913 **Thailand** Theera Trading Co. Ltd. (02) 412-5672 **In other countries contact:** QIAGEN GmbH, Germany

QIAGEN

BR3000LH01200005WW

STRESS IN THE WEST

The coast of California is dominated by strike-slip faults from the shearing of the Pacific Plate past the North American Plate. Further east in Nevada, the Basin and Range is characterized by extensional structures, and other large regions of the western United States show no significant crustal deformation. Flesch *et al.* (p. 834; see the Perspective by Houseman) have developed a self-consistent model of the lithosphere of the western United States that explains these different stress regimes. Their model indicates that plate boundary forces and buoyancy forces contribute to the style of deformation across the west. From their model, they can estimate the stronger regions of the crust, such as the Basin and Range, from the weaker regions of the crust, such as the coast of California.

BETTER IN THE STRETCH

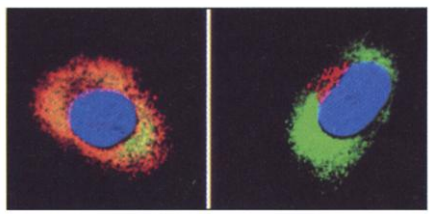
Small devices that can convert electrical energy into mechanical motion are desirable for applications ranging from acoustic speakers to miniature robots. Although more exotic materials such as piezoelectric ceramics, carbon nanotubes, and conducting polymers have been used in such actuators, ordinary polymers with a simple dielectric response to an applied electric field can produce large motions (strains) if sandwiched as thin films between compliant electrodes that can change shape. Pelrine *et al.* (p. 836; see the news story by Cho) now show that actuators containing certain commercial silicone or polyurethane polymers that were prestretched can expand by a factor of 2 or greater. The response is fast, and these actuators can transfer large amounts of mechanical power relative to other actuators.

COOLER EQUATORIALLY

One of the most controversial issues in paleoclimatology is how much cooler sea surface and continental temperatures were during the last glacial maximum (LGM) compared to the present, especially at low latitudes. Weyhenmeyer *et al.* (p. 842) have looked at the noble gas composition of groundwaters from northern Oman and found that the mean annual temperature there was 6.5°C cooler 15,000 to 20,000 years ago. They also found from the relation between the isotopic compositions of the hydrogen and oxygen in water that the dominant source of moisture at that time was the Indian Ocean, unlike present conditions where the Mediterranean is dominant. These results lend strong support to the notion of widespread and significantly cooler temperatures at low latitudes during the LGM, and suggest that important changes in atmospheric circulation patterns have occurred since then.

SECRETION ON DEMAND

Specialized secretory cells regulate the release of important bioregulatory molecules such as insulin and ensure their availability at appropriate times. Rivera *et al.* (p. 826; see the Perspective by Aridor and Balch) demonstrate that a non-secretory cell can behave like a secretory cell if the protein of



interest is engineered to accumulate within its secretory pathway. Insulin and growth hormone were linked to domains designed to aggregate. The resulting protein aggregates that formed were too large to transit through the cell's endoplasmic reticulum, but secretion was efficiently induced with a cell-permeant small molecule drug that disrupted the aggregates. Drug administration permitted the release of unmodified protein, as demonstrated in a mouse model for insulin release. This strategy holds potential therapeutic value in that secretion of physiologically important molecules may be controlled directly.

MEASURING A BEELINE

How do bees measure the distance flown between the hive and food source and then communicate that information to their sisters by their dances? By comparing waggle dances performed after flying through a narrow tunnel with those performed after flying freely outside, Srinivasan *et al.* (p. 851; see the cover and the Perspective by Collett) show that flying through a tunnel is equivalent—in the bees' perception—to flying much longer distances. Because the width of the tunnel is known, it has been possible to measure the relation between image movement and the waggle dance and show that optic flow is an important component of distance measurement.

BIGGER DIPPER POPULATIONS?

A central question in ecology is the relative contribution of density-dependent effects and stochastic variation to population fluctuations, and a major contemporary concern is to predict how organisms will react to an expected global warming. Sæther *et al.* (p. 854; see the news story by Wuethrich) address both these questions in a long-term study of a small temperate songbird, the dipper, in Norway. By using new methods of estimating and modeling stochasticities in population models, they demonstrate quantitatively that global warming will strongly influence the population dynamics of the dipper. In particular, they show that warming should have the effect of increasing average population density by reducing the frequency of environmental events that limit population size.

REASSESSING MARINE DISPERSAL

Are there barriers to dispersal of larval organisms in the sea? It has commonly been assumed that larvae are widely dispersed between oceanic islands, and that therefore ecological communities are "open" or connected with one another. Using a modeling approach, Cowen *et al.* (p. 857) show that such connectivity—at least in the Caribbean islands—has probably been overestimated a billionfold. It appears, instead, that populations are very largely sustained by local reproduction and larval retention. These findings are likely to have direct impact on conservation and management strategy for coastal marine habitats: If local retention is the rule, then local management initiatives might have a greater chance of producing local results.

MANIPULATING T CELL TYPES

T cells can help the immune response generate either a cell-mediated (type-1) or an allergic (type-2) response. The cytokines that heavily influence one pathway or another are interleukin-12 (IL-12) and IL-10, respectively. Ashkar *et al.* (p. 860) now find that the cytokine Eta-1 (also known as osteopondin) is critical for directing the increased production of IL-12, through binding to an integrin, and the decreased production of IL-10, through binding to CD44. Through the use of mice genetically defi-

CONTINUED ON PAGE 767

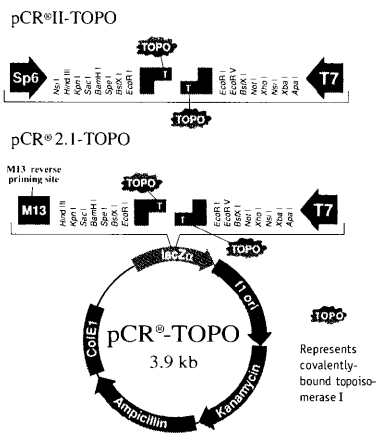
If you're Cloning PCR products...

Think Fast...

Lots of things are fast. Jet planes. Bullet trains. Sports cars. With TOPO™ TA Cloning® you can add cloning PCR products to the list.

***Superfast* Cloning.** In just 5 minutes, TOPO™ TA Cloning® lets you ligate *Taq*-amplified PCR products right on your bench top. Simply add 1 µl of your PCR (no clean-up needed!) to the topoisomerase I-activated vector, and 5 minutes later you're ready to transform.

No Extra Steps. TOPO™ TA Cloning® eliminates the need for special primers and vector preparation. There's also no post-PCR modifications. And best of all, there's no waiting. With TOPO™ TA Cloning®, you'll save an entire day.



More Recombinants. TOPO™ TA Cloning® is not just fast–it's efficient. It yields up to 95% recombinants so you'll easily find a positive clone.

Think Fast. If you want to clone your PCR products fast, just call Invitrogen and order a TOPO™ TA Cloning® Kit. It comes with your choice of cloning-ready vector (pCR®2.1-TOPO or pCR®II-TOPO), competent cells, and other reagents to optimize your results. So think fast. Order the TOPO™ TA Cloning® Kit today.

Circle No. 14 on Readers' Service Card

European Headquarters:
Invitrogen BV
P.O. Box 2312
9704 CH Groningen
The Netherlands
Tel: +31 (0) 50 5299 299
Fax: +31 (0) 50 5299 281
Email: tech_service@invitrogen.nl
www.invitrogen.com

International Toll Free Numbers:
Tel: 00800 5345 5345*
Fax: 00800 7890 7890*
*This number operates in all European countries excluding Finland and Sweden
Finland:
Tel: 990800 5345 5345
Fax: 990800 7890 7890
Sweden:
Tel: 009800 5345 5345
Fax: 009800 7890 7890

Distributors:
Austria 0222 889 18 19
Australia 1 800 882 555
China 010 6255 3477
Hungary 01 280 3728
India 91 80 8391453
Israel 02 584 1111
Italy 02 38 19 51
Japan 03 5684 1622
Malaysia 03 432 1357
Poland 058 341 47 26
Portugal 01 453 7085
Singapore 65 2922130
South Korea 02 569 6902
Spain 03 450 2601
Taiwan 886 2 238 10844
Thailand 246 7243

From all other countries, call our European headquarters at +31 (0) 50 5299 299.

United States Headquarters:
Invitrogen
1600 Faraday Avenue
Carlsbad, California 92008
Tel: 1-800-955-6288
Fax: 760-603-7201
Email: tech_service@invitrogen.com
http://www.invitrogen.com

THIS WEEK IN *SCIENCE*

CONTINUED FROM PAGE 765

cient in Eta-1, IL-12, or IL-10, the authors found that Eta-1 was necessary to protect mice from *Listeria* infections and to aid in granuloma formation. The effects of Eta-1 on the IL-12:IL-10 ratio provide another possible therapeutic target for manipulation of the immune response.

ALMOST ASSEMBLING THE BRAIN

The development of an organ as complex as the brain depends on a sequence of precisely controlled events. Is synaptic communication between neurons a requirement for the proper assembly of the brain? Verhage *et al.* (p. 864) describe a new mouse mutant, with a deletion of the *munc 18-1* gene, where neurotransmitter secretion is completely blocked. The brains of these mice are nevertheless normally assembled, major pathways are present, and structural elements of synapses form. Neurotransmission seems thus not to be necessary for synapses to form and connections to be established initially. At later stages, however, neurons die by apoptosis, tremendous cell loss occurs, and brain integrity is compromised.

FOLLOWING THE EFFECTS OF YEAST PHEROMONE

Pheromone communication between yeast cells induces arrest in the G1 phase of the cell cycle and causes mating projections to form. Roberts *et al.* (p. 873) used DNA microarray analysis to observe global patterns of gene expression in yeast cells associated with alterations in signaling through the pheromone response pathway. Pheromone receptors activate a mitogen-activated protein (MAP) kinase pathway that leads to alterations in gene expression. The results show the global patterns of regulation mediated by this pathway and related pathways that use MAP kinase signaling modules for other biological responses. They found that partial activation of the pheromone response pathway produces a gene expression pattern reminiscent of that in cells undergoing haploid invasive growth. Such regulation was previously thought to be under the contol of a distinct MAP kinase pathway. Data from 383 highly regulated genes over 46 sets of experimental conditions begin to show the predictive power of such large data sets when presented as a two-dimensional hierarchical matrix.

NUCLEIC ACID PARTNERS

The character of specific interactions of macromolecules is central to biochemistry. Hermann and Patel (p. 820) review structural studies of ligand-nucleic acid complexes, where the ligands include amino acids, small aromatic molecules, and oligosaccharides. Nucleic acids function primarily as carriers of information, encoding the DNA sequences of genes, and also as purveyors of that information in the personages of messenger, transfer, and ribosomal RNAs. More recent work, however, has revealed the importance of interaction specificity of nucleic acids in accomplishing these functions and for realizing their potential in biotechnology.

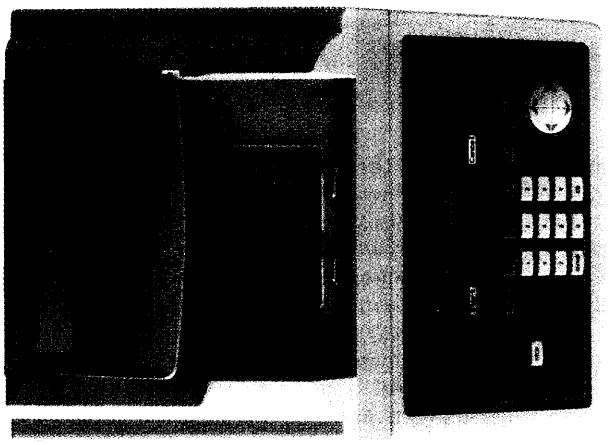
TECHNICAL COMMENT SUMMARIES

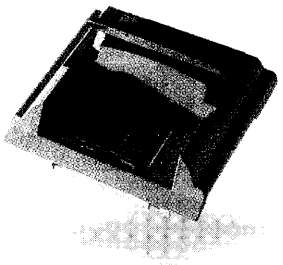
Photoemission Experiments and Pseudogaps

The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/287/5454/767a

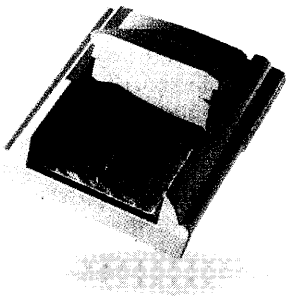
Joynt (Reports, 30 Apr., p. 777) argued that the "pseudogaps" observed in energy spectra from angle-resolved photoemission (ARPES) experiments may, for very low conductivity materials such as certain colossal magnetoresistance (CMR) manganates, stem not from intrinsic material properties but from ohmic energy losses after electron ejection. In a comment, Dessau and Saitoh, noting that these extrinsic losses should be momentum- or angle-independent, cite data from the layered CMR material $La_{1.2}Sr_{1.8}Mn_2O_7$ that show strongly anisotropic pseudogap behavior in momentum space. This anisotropy, they suggest, points to an intrinsic origin for the pseudogap. Because this CMR system's resistivity is three orders of magnitude larger than the threshold at which Joynt expected extrinsic losses to become relevant, Dessau and Saitoh conclude that such effects may not be a major experimental concern for conductivities of that order or better.

Joynt responds that, while Dessau and Saitoh are correct for the system they studied, extending conclusions from that system to all poorly conducting solids may be misleading, in part because the loss function does not depend solely on conductivity. Accurately assessing pseudogaps in poorly conducting solids, Joynt maintains, requires "both optical and photoemission measurements, followed by a careful consideration of the characteristic frequencies" for the system in question.

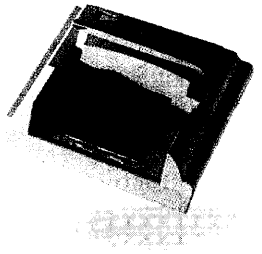




96-well 0.2 mL block



Dual 384-well 0.02 mL block



new
60-well 0.5 mL block

Flexible formats, uncompromised performance

Thanks to the new 60-well 0.5 mL block, the GeneAmp® PCR System 9700 now offers a high-volume option, for the ultimate in flexibility. But regardless of the sample block you select, you're investing in the industry's premier thermal cycler capabilities, including oil-free operation, compact 30 x 41 cm footprint, intuitive graphical user interface, and high-speed, uniform heating and cooling. Guaranteed performance and reliability all within budget. For more information or to place an order, call 650.638.5800, contact your local sales representative, or go to www.pebiosystems.com.

The GeneAmp® PCR System 9700: we've got you covered.

GeneAmp® PCR System 9700

Applied Biosystems

PE Biosystems
A PE Corporation Business

Roche

ISO 9000

PE Corporation, formerly The Perkin-Elmer Corporation, is committed to providing the world's leading technology and information for life scientists. PE Corporation consists of the PE Biosystems and Celera Genomics businesses. PE Biosystems comprises four divisions—Applied Biosystems, PE Informatics, PerSeptive Biosystems, and Tropix.

Circle No. 8 on Readers' Service Card

take
the **chase**
out of your
chemical
pur**chasing**

TRY OUR eCOMMERCE SOLUTION @ **www.sigma-aldrich.com**

EASY ON-LINE ORDERING

The Sigma-Aldrich PipeLine™ eCommerce system offers simple, on-line access to over 200,000 products from the Sigma-Aldrich brands: Sigma, Aldrich, Fluka, Supelco and Riedel-de Haën. Now you can place multi-brand orders for biochemicals, chemicals, equipment and laboratory supplies from all of our brands in a single transaction.

FIND WHAT YOU NEED FAST

With eight different ways to search, including product name, product number, CAS number, molecular formula and structure, pinpointing products is a snap.

Stop the chase and log on today.
It will make your job easier.
www.sigma-aldrich.com

A TOTAL INFORMATION RESOURCE

Because we are a manufacturer, we offer not only quality products but the technical knowledge and support to back them up.

- Over 90,000 on-line MSDS's
- Over 2 million on-line Certificates of Analysis
- Thousands of data sheets and technical bulletins

SIGMA-ALDRICH

3050 Spruce Street, St. Louis, MO 63103 • 800-521-8956 or 314-771-5765

Circle No. 29 on Readers' Service Card

Don't Kill the Messenger RNA

RNAlater™ protects RNA from degradation!

Stabilize RNA in tissue and cells for weeks at 25°C, months at 4°C or indefinitely at -20°C

•

No dry ice or liquid nitrogen needed for sample collection

•

Ideal for tissues, cultured cells and buffy coats

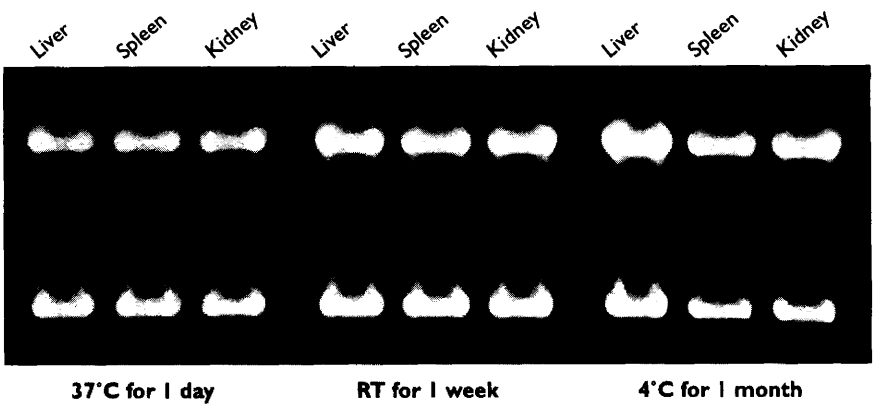


Figure 1a. Quality of RNA isolated from Tissue Stored in RNA*later*™ Solution. Fresh mouse tissues were dissected and stored in RNA*later*™ at 37°C for 1 day, room temperature for 1 week, or 4°C for 1 month. RNA was isolated using TRI Reagent® (MRC) and analyzed using denaturing agarose gel electrophoresis.

RNA*later*™ is an extraordinary reagent that allows you to harvest and dissect samples for RNA isolation in a whole new way!

RNA*later* quickly permeates cells and tissues at room temperature, rapidly inactivating RNases. Tissues or cells simply submerged in RNA*later* can be stored, dissected and even shipped at room temperature. Imagine removing a sample from the freezer, dissecting a portion for RNA isolation and archiving the remainder– it's possible with RNA*later*. RNA*later* is compatible with all RNA isolation procedures tested.

With RNA*later*, you don't have to worry about killing or degrading those precious mRNAs during sample collection and handling.

MORE INFORMATION INSTANTLY

For instant information about RNA*later*™, email rnalater@ambion.com. *Information may also be obtained by phone, fax or the reader service number below.*

RNA*later*™ AROUND THE WORLD

...a regular TechNotes feature.

"The RNAlater™ works!" One satisfied researcher, tired of constant harassment by the surgeons in O.R, traded in his liquid nitrogen and Dewars for RNAlater™.

To read the details of this and other true stories, see www.ambion.com/RNAlater.

For a complete list of distributors visit our website, http://www.ambion.com

U.S. (800)888-8804
Canada (800)445-1161

Ambion®

THE RNA COMPANY™

AMBION, INC. • 2130 WOODWARD ST. • SUITE 200 • AUSTIN, TX 78744-1832
tel(512)651-0200 • fax(512)651-0201 • email: moinfo@ambion.com • www.ambion.com

Circle No. 28 on Readers' Service Card

MILLIPORE

pure e-commerce℠

It's more than online purchasing.

It's a 24-hour, continually-updated technical resource.

Millipore's new online store is built for the scientist looking for the right purification tool — and how and where to use it. Over 7,000 products cross-linked to applications protocols, technical briefs, compatibility charts and other valuable information. Search by keyword, catalog number or a combination of parameters. Buy with a mouse click. Already know exactly what you need? Use the Quick Purchase shortcut. Pay online by purchasing card, credit card or purchase order, with secure access to high-volume contract or GSA pricing. Check it all out — including our online demo — at **www.millipore.com/purecommerce**

*Business account registration required for multiple payment options and any high volume contract pricing. Currently available in US and Canada only.

Circle No. 1 on Readers' Service Card

www.sciencemag.org
Science

1200 New York Avenue, NW
Washington, DC 20005
Editorial: 202-326-6550, FAX 202-289-7562
News: 202-326-6500, FAX 202-371-9227
Permissions: 202-326-7074, FAX 202-682-0816
Subscriptions: 800-731-4939 or 202-326-6417, FAX 202-842-1065

Bateman House, 82-88 Hills Road
Cambridge, UK CB2 1LQ
(44) 1223-326500, FAX (44) 1223-326501

EDITOR-IN-CHIEF **Floyd E. Bloom**
EDITOR **Ellis Rubinstein**
MANAGING EDITOR **Monica M. Bradford**

DEPUTY MANAGING EDITORS R. Brooks Hanson, Katrina L. Kelner
NEWS EDITOR Colin Norman

EDITORIAL/COMPASS SUPERVISORY SENIOR EDITORS Guy Riddihough, Phillip D. Szuromi; SENIOR EDITOR/POLICY FORUM Barbara Jasny; SENIOR EDITOR/PERSPECTIVES Orla Smith; SENIOR EDITORS Gilbert J. Chin, Pamela J. Hines, Paula A. Kiberstis (Boston), L. Bryan Ray; ASSOCIATE EDITORS Lisa D. Chong, Beverly A. Purnell, Linda R. Rowan, H. Jesse Smith, Valda Vinson; ASSOCIATE BOOK REVIEW EDITOR Sherman J. Suter; ASSOCIATE LETTERS EDITOR Christine M. Pearce; ASSOCIATE TC/WEB EDITOR Stewart Wills; INFORMATION SPECIALIST Janet Kegg; CONTRIBUTING EDITORS Kevin Ahern, David F. Voss; EDITORIAL MANAGER Cara Tate; SENIOR COPY EDITORS Cay Butler, Harry Jach, Etta Kavanagh, Barbara P. Ordway, COPY EDITORS Jeffrey E. Cook, Jason Llewellyn, Joshua Marcy, Monique Martineau, EXECUTIVE ASSISTANT Sylvia Kihara; EDITORIAL COORDINATORS Carolyn Kyle, Ellen E. Murphy, Beverly Shields; PUBLICATIONS ASSISTANTS Chris Filiatreau, Joi S. Granger, Jeffrey Hearn, Charlene King; Elizabeth Lenox, Gail Murphy; EDITORIAL ASSISTANTS Elise Laffman, Kathy Libal, Anita Wynn; EDITORIAL SUPPORT ASSISTANTS Osa Atoe, Patricia M. Moore, Brian White, Karen Yuan

science_editors@aaas.org (for general editorial queries)
science_letters@aaas.org (for letters to the editor)
science_reviews@aaas.org (for returning manuscript reviews)
science_ bookrevs@aaas.org (for book review queries)

NEWS SENIOR CORRESPONDENTS Eliot Marshall, Jean Marx; DEPUTY NEWS EDITORS Robert Loontz, Jeffrey Mervis, Leslie Roberts, Richard Stone; CONTRIBUTING EDITORS Elizabeth Culotta, Polly Shulman; NEWS WRITERS Martin Enserink, Laura Helmuth, Constance Holden, Jocelyn Kaiser, Richard A. Kerr, Andrew Lawler, David Malakoff, Elizabeth Pennisi, Charles Seife, Robert F. Service (Pacific NW), Gretchen Vogel, H. Adrian Cho (intern); CONTRIBUTING CORRESPONDENTS Marcia Barinaga (Berkeley, CA), Barry A. Cipra, Jon Cohen (San Diego, CA), Ann Gibbons, Robert Irion, Charles C. Mann, Anne Simon Moffat, Virginia Morell, Evelyn Strauss, Gary Taubes, Ingrid Wickelgren; COPY EDITORS Linda B. Felaco, Daniel T. Helgerman; ADMINISTRATIVE SUPPORT Scherraine Mack, Fannie Groom; BUREAUS: Berkeley, CA: 510-652-0302, FAX 510-652-1867, San Diego, CA: 760-942-3252, FAX 760-942-4979, Pacific Northwest: 541-342-6290

PRODUCTION DIRECTOR James Landry; MANAGER Wendy K. Shank; ASSISTANT PRODUCTION MANAGERS, Lizabeth A. Harman (Internet), Rob Masson; ASSOCIATES Patricia Riehn Berg (Internet), Vicki J. Jorgensen, Tara L. Kelly, Jessica K. Moshell, Rebecca Thomas

ART DESIGN DIRECTOR C. Faber Smith; ART DIRECTOR Alan T. Stonebraker; ASSOCIATE ART DIRECTOR Stephanie D. Halvorson; ILLUSTRATORS Carin Cain, Katharine Sutliff; ASSOCIATES Holly Bishop, Debra J. Morgenegg, Preston Morrighan; PHOTO RESEARCHER Leslie Blizard

***SCIENCE* INTERNATIONAL**

EUROPE (science@science-int.co.uk) EDITORIAL: SUPERVISORY SENIOR EDITOR Andrew M. Sugden; SENIOR EDITOR/PERSPECTIVES Julia Uppenbrink; ASSOCIATE EDITORS Caroline Ash, Stella M. Hurtley, Ian S. Osborne, Peter Stern; EDITORIAL SUPPORT Jenny Parker; ADMINISTRATIVE SUPPORT Janet Mumford, Liz Ellis; NEWS: EDITOR Daniel Clery, CORRESPONDENT Michael Hagmann; CONTRIBUTING CORRESPONDENTS Michael Balter (Paris: (33) 1-49-29-09-01, FAX (33) 1-49-29-09-00); Robert Koenig (Bern)

ASIA Japan Office: Asca Corporation, Eiko Ishioka, Fusako Tamura, 1-8-13, Hirano-cho, Chuo-ku, Osaka-shi, Osaka, 541 Japan; (81) 6-202-6272, FAX (81) 6-202-6271; asca@os.gulf.or.jp JAPAN NEWS BUREAU: Dennis Normile (contributing correspondent, (81) 3-3335-9925, FAX (81) 3-3335-4898; dnormile@twics.com); CHINA REPRESENTATIVE Hao Xin, (86) 10-6255-9478; science@public3.bta.net.cn; INDIA Pallava Bagla (contributing correspondent (91) 11-271-2896; pbagla@ndb.vsnl.net.in)

***SCIENCE*NOW** (www.sciencenow.org) EDITOR Erik Stokstad

***SCIENCE*'S NEXT WAVE** (www.nextwave.org) EDITORIAL: SENIOR EDITOR Nicole Ruediger; EDITORS Charles Boulakia (Canada), Robert Metzke (Bonn), Kirstie Urquhart (UK); WRITERS Melissa Mertl, Vid Mohan-Ram; MARKETING: MARKETING MANAGERS Karen Horting (US and Canada), Hazel Crocker (Europe); PROGRAM DIRECTOR Emily Klotz; ASSOCIATES Peter Cherukuri, Suzanne Moore

PUBLISHER **Richard S. Nicholson**
ASSOCIATE PUBLISHER **Beth Rosner**
MEMBERSHIP/CIRCULATION DIR. **Michael Spinella**

MEMBERSHIP/CIRCULATION (membership@aaas.org) DEPUTY DIRECTOR Marlene Zendell; MEMBER SERVICES: MANAGER Michael Lung; SUPERVISOR Mary Curry; REPRESENTATIVES Laurie Baker, Pat Butler, Elizabeth Early, Jantell Smith; MARKETING: MANAGER Scott Oser; ASSOCIATES Lauri Sirois, Deborah Stromberg; EUROPE MANAGER Jane Pennington; EXECUTIVES Ruth Jackson, Martin Paine; RESEARCH: MANAGER Renuka Chander; BUSINESS AND FINANCE: MANAGER Teressa Ellis; ASSISTANT Susan Maxim; COMPUTER SPECIALIST Charles Munson

SUBSCRIPTION SERVICES For change of address, missing issues, new orders and renewals, and payment questions: 800-731-4939 or 202-326-6417, FAX 202-842-1065. Mailing addresses: AAAS, P.O. Box 1811, Danbury, CT 06813 or AAAS Member Services, 1200 New York Avenue, NW, Washington, DC 20005

REPRINTS Ordering/Billing/Status 800-407-9190; Corrections 202-326-6501

MEMBER BENEFITS For Credit Card: MBNA 1-800-847-7378; Car Rentals: Hertz 1-800-654-2200 CDP#343457, Dollar 1-800-800-4000 #AA1115; AAAS Travels: Betchart Expeditions 1-800-252-4910; Life Insurance: Seabury & Smith 1-800-424-9883; Other Benefits: AAAS Member Services 1-202-326-6417.

FINANCE AND ADVERTISING BUSINESS MANAGER Deborah Rivera-Wienhold; SENIOR ANALYST Randy Yi; FINANCIAL ANALYST Lisa Donovan

RIGHTS AND PERMISSIONS: ASSOCIATE Emilie David; ASSISTANT Karen Lentz
MARKETING: DIRECTOR John Meyers; ASSOCIATE Allison Pritchard
ELECTRONIC MEDIA: MANAGER David Gillikin; PRODUCTION ASSOCIATES Mark Croatti, Ellen McGuire, Robert Owens, Louis Williams ADMINISTRATIVE SUPPORT Jessica Tierney

PRODUCT ADVERTISING (science_ advertising@aaas.org) NATIONAL SALES MANAGER NORTHEAST AND E. CANADA Richard Teeling: 973-694-9173, FAX 973-694-9193 • MIDWEST/ SOUTHEAST Elizabeth Mosko: 773-665-1150, FAX 773-665-2129 • West Coast/W. Canada Neil Boylan: 415-673-9265, FAX 415-673-9267 • MID-ATLANTIC AND U.S. INSIDE SALES Christopher Breslin: 410-273-1007, FAX 410-273-1591 NEW MEDIA SALES MANAGER Chris Peterson: 410-560-3960, FAX 410 560-3961 • UK/SCANDINAVIA/FRANCE/ITALY/BELGIUM/NETHERLANDS Andrew Davies: (44) 7-071-226-216, FAX (44) 7-071-226-233 • GERMANY/SWITZERLAND/AUSTRIA Tracey Peers: (44) 1-260-297-530, FAX (44) 1-260-271-022 JAPAN Mashy Yoshikawa: (81) 3-3235-5961, FAX (81) 3-3235-5852 • TRAFFIC MANAGER Carol Maddox; SALES ASSOCIATES Sean Gee, Sheila Myers

RECRUITMENT ADVERTISING (science_classifieds@aaas.org); SALES AND PRODUCTION OPERATIONS MANAGER Terri Seiter Azie U.S.: SALES MANAGER Gabrielle Boguslawski: 718-491-1607, FAX 202-289-6742; INTERNET SALES MANAGER Beth Dwyer; SALES SUPERVISOR Daryl Anderson; SALES REPRESENTATIVES Kathleen Clark, Christina Geiger, Bren Peters-Minnis, Kristin Westapher; ASSISTANTS Erika Bryant, Sussy Castilla, Jody Fenty, Shirley Young PRODUCTION: TRAFFIC MANAGER Jennifer Rankin; ASSOCIATES Christine Borkowski, Dawn Bruno U.K./EUROPE: SALES MANAGER Debbie Cummings; PROMOTIONS COORDINATOR Richard Walters SALES EXECUTIVE Sabine Lenud; ASSISTANT Elisabeth Py: (44) 1223-326500, FAX (44) 1223-326532 AUSTRALIA/NEW ZEALAND: Keith Sandell: (61) 02-9922-2977, FAX (61) 02-9922-1100 JAPAN: Mashy Yoshikawa: (81) 3-3235-5961, FAX (81) 3-3235-5852

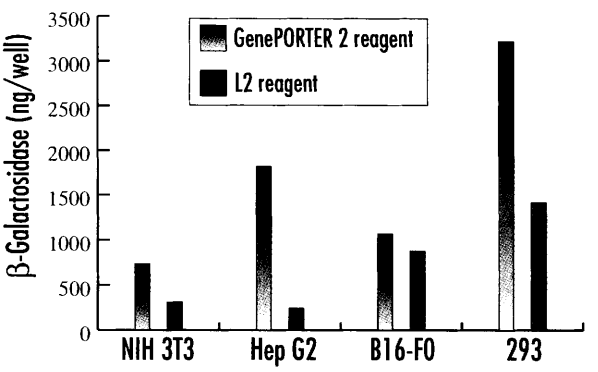
Published by the American Association for the Advancement of Science (AAAS), *Science* serves its readers as a forum for the presentation and discussion of important issues related to the advancement of science, including the presentation of minority or conflicting points of view, rather than by publishing 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.

The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objectives 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, to advance education in science, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

INFORMATION FOR CONTRIBUTORS
See pages 147 and 148 of the 7 January 2000 issue or access www.sciencemag.org/misc/con-info.shtml

- **Works great with or without serum**
- **Highest levels of transfection available**
- **Best results with hard-to-transfect cell lines**

Alienated by hard-to-transfect cell lines? GenePORTER™ 2 transfection reagent has out-of-this-world results for a variety of cell lines. This new reagent yields higher efficiencies than GenePORTER reagent, even in the presence of serum. Order GenePORTER 2 reagent today and make contact with the next generation of transfection reagent.



GenePORTER 2 reagent or a competitor's transfection reagent was used to deliver the β-gal expression plasmid into cells in 24-well plates. Each manufacturer's protocol was followed. Following transfections (48 hours), a colorimetric assay was used to measure β-galactosidase.

GenePORTER™ 2
Transfection Reagent

75 reactions (0.75 ml) • T202007
150 reactions (1.5 ml) • T202015
750 reactions (5 x 1.5 ml) • T202075

Now available on our web site:

✓ Gene Therapy Systems, Inc. 1999 Catalog
✓ Updated list of sucessfully transfected cells

Gene Therapy Systems
"the art of innovation"

To Order: 888-428-0558
Fax: 858-623-9494
10190 Telesis Court, San Diego, CA 92121, USA
Check out the Gene Therapy Systems web site @
http://www.genetherapysystems.com

Circle No. 25 on Readers' Service Card

Gene Therapy Systems International Distributors

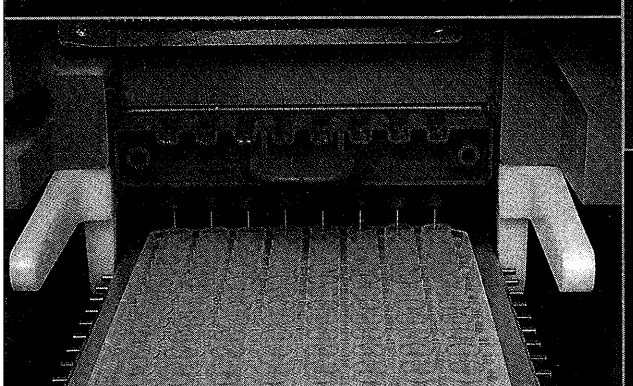
Australia • Astral 61-2-9540-2055 **Austria** • BIO-TRADE +43 1 889 18 19 **Benelux** • BIOzymTC BV +31 +(0)45 532 77 55 **China** • Shanghai Haojia Tech. 86-21-5453-0107 **Denmark** • KEBO Lab A/S +45 43 86 87 88 **Finland** • Kebo Lab +358 9 8045 5300 **France** • OZYME +33 1 30 85 92 92 **Germany** • PEQLAB 49-9131-691-470, Biozym +49 5152-9020 **Israel** • Biotech Appl. 972 8 928 5353 **Italy** • Duotech 39 02 331 066 30 **Japan** • Funakoshi 81-3-5684-1622, Takara +81-77-543-7231 **Korea** • Core Bio 82 2 841-7530 **Norway** • Kebo Lab A/S +47 22 90 00 00 **Sweden** • KEBO Lab +46 8 621 35 07 **South Africa** • Millinium 27 12 8034-876 **Spain** • bioNova +34 91 551 54 03 **Switzerland** • Axon Lab AG +41 56/484 80 80 **Taiwan** • PROtech 886-2-23810844 **United Kingdom** • Lifescreen Ltd 01895 453700

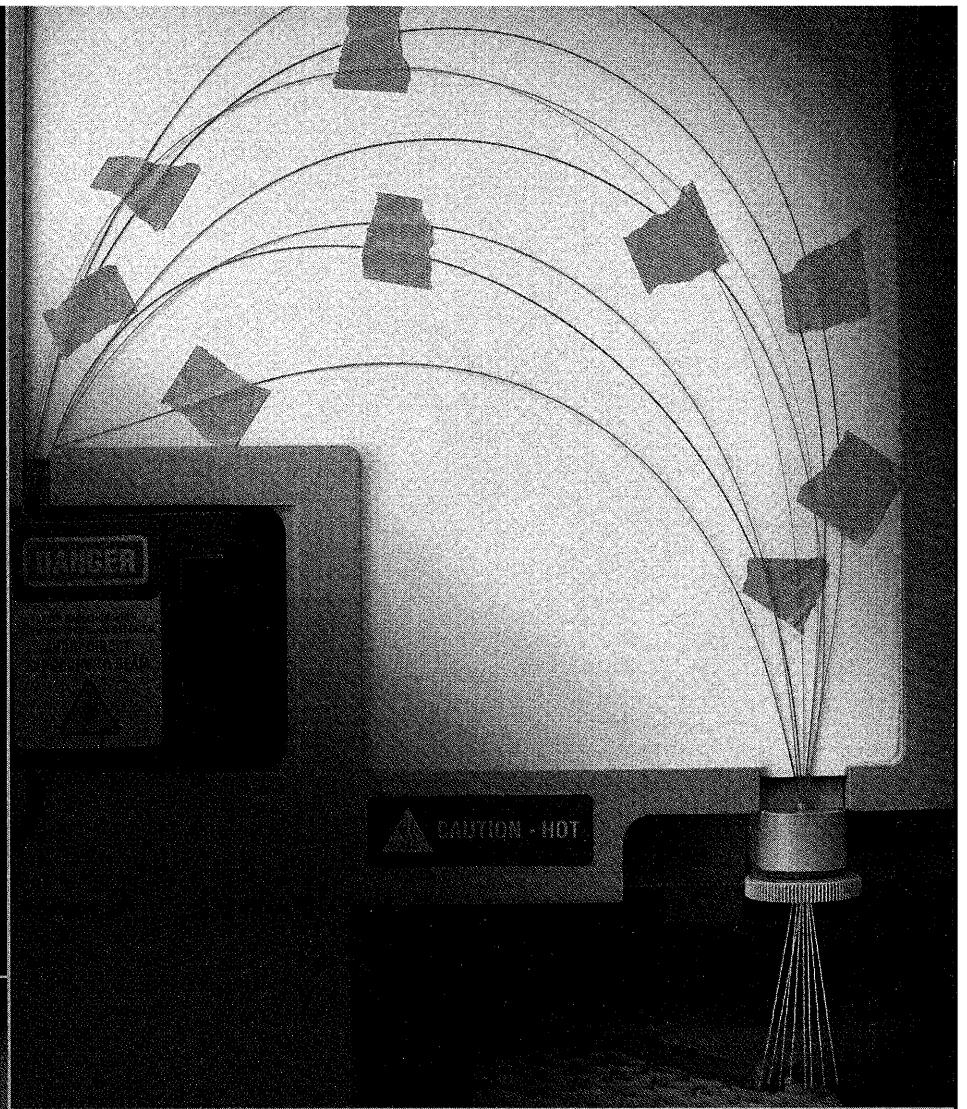
THIS IS ONE WAY

to get more from your CE DNA analysis system.

OR YOU COULD SIMPLY UPGRADE TO

CEQ™ 2000.





With its high throughput and full automation, the CEQ 2000 DNA Analysis System simplifies processes in your lab. Its auto-aligning, multicapillary array and automatic gel handling improve productivity and eliminate tedious manual tasks. And now you get all this and a $20,000 credit for trading in your single-capillary ABI system. So, save your lab time and money with CEQ 2000.

- *Increase throughput with eight capillaries instead of one*
- *Enhance efficiency by doubling fragment analysis throughput to 1,440 alleles in nine hours*
- *Improve sequencing throughput up to 50,000 bases in 24 hours*

$20,000 Trade Up

To learn how to get $20,000 off and more throughput from a CE DNA analysis system, visit our Web site at www.beckmancoulter.com/DNAtradeup.

BECKMAN COULTER™

Innovate Simplify Automate

Worldwide Bioresearch Division Offices:

Australia (61) 2 98446000 **Canada** (905) 819-1234 **China** (86) 10 6515 6028 **Eastern Europe, Middle East, Africa** (41) 22 994 07 07 **France** 01 49 90 90 00 **Germany** (89) 358700 **Hong Kong** (852) 2814 7431/2814 0481 **Italy** 02-953921 **Japan** 03-54048359 **Mexico** 525-559-1635 **Netherlands** 0297-230630 **Singapore** (65) 339 3633 **South Africa** (27) 11-805-2014/5 **Spain** 91 728 7900 **Sweden** 08-98 53 20 **Switzerland** 0800 850 810 **Taiwan** (886) 2 2378 3456 **U.K.** 01494 441181 **U.S.A.** 1-800-742-2345.

Circle No. 20 on Readers' Service Card

Fastest Turnaround Time

BioSource
Custom DNA Synthesis

24 Hours*
EconoPURE
72 Hours*
FRET Probes

*Shipped

BioSource specializes in unique modifications/conjugations requiring special purification such as FRET probes

Our commitment to service includes our "Free Replacement Guarantee" if an oligo fails to perform the first time

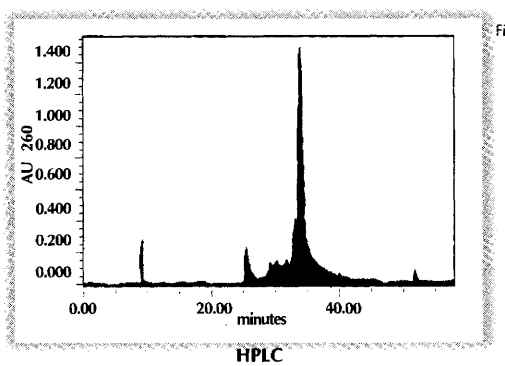


Figure 1

HPLC

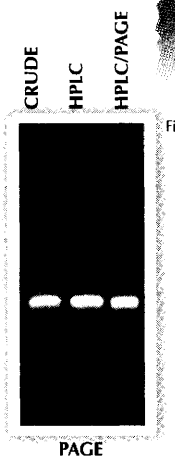


Figure 2

PAGE

Show Me! *After manufacture, FRET probes are initially purified by HPLC, followed by denaturing PAGE. The HPLC chromatogram of a FRET probe is shown in Figure 1. Figure 2 shows an analytical PAGE electrophorogram of the crude FRET probe (lane 1), following HPLC purification (lane 2), and final product after denaturing PAGE purification (lane 3). [Denaturing gel analysis of the HPLC purified FRET probe confirms that not all of the synthesis failure sequences are removed (lane 2)]. The additional purification by PAGE removes those remaining failure sequences that can lead to increased background noise in the PE-ABI 7700 Detection System.*

BioSource International, Inc.
1-800-788-4362

KEYSTONE GCB

BIOSOURCE INTERNATIONAL

Order Online www.keydna.com

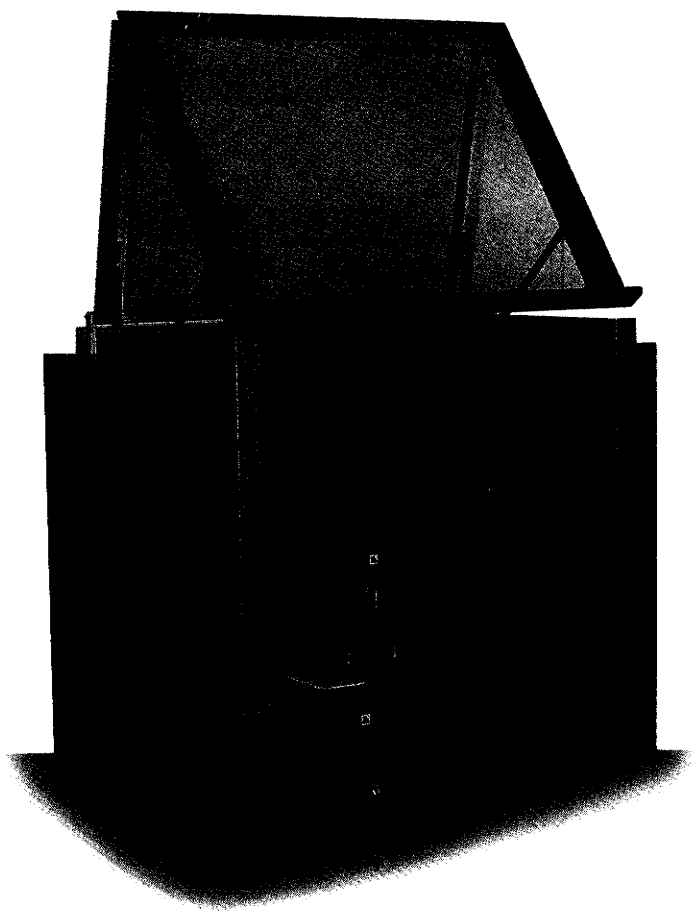
Circle No. 15 on Readers' Service Card

For research use only.

Fax: (800) 786-4362
e-mail: dna@keydna.com

The aurora borealis is formed when the earth's magnetosphere causes charged particles from the sun to collide with atmospheric gasses, emitting light.

MagNA Pure LC: Experience Flexibility and Walk-away Precision in Template Preparation



Isolate pure, PCR-ready nucleic acids from a wide variety of sample types in less than 1 hour. Increase the precision of every pipetting step while letting MagNA Pure LC do all the work! Reaction mixes are ready for real-time PCR when you return.

- Walk away from manual nucleic acid preparation.
- Increase the accuracy of your quantitative PCR.
- Automate PCR reaction set-up for 96-well plates, LightCycler Capillaries, PCR strips, or tubes.
- Achieve reproducible quality and yields of pure DNA, RNA, and mRNA.

For more information on MagNA Pure LC, visit http://biochem.roche.com/magnapure.htm or call us at 1-800-428-5433.

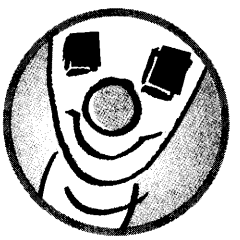
Roche

USA (800) 428 5433

Roche Diagnostics Corporation
Roche Molecular Biochemicals
Indianapolis, Indiana

Circle No. 22 on Readers' Service Card

Liquid Handling with a smile

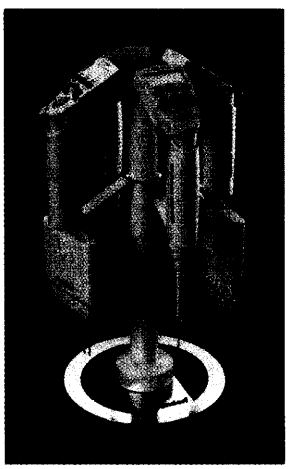


Take a journey into the future of pipetting – with the **Eppendorf Research® pro.** A new generation of pipettes with an ergonomic design, outstanding applicational versatility and extremely simple, intuitive user guidance which make your lab routines a whole lot easier. Working with the Research pro is sure to put a smile on your face!
Whether you require standard techniques, such as pipetting and dispensing, special applications or complex liquid handling procedures – everything can be done simply and precisely, with just one pipette: the Research pro. The easy-to-read display provides you with information on the current settings and guides you to the next operating step.

With its ergonomic design, the Research pro is also kind to your hand. Smooth-running buttons and a patented, reduced effort tip ejector prevent excess strain to the muscles of one arm.

The lower part is autoclavable and can be disassembled in a few simple steps.

You won't be surprised to hear that the utmost precision and accuracy in all volume ranges, both with the single- and multi-channel version of the Research pro, is guaranteed in system combination with original Eppendorf pipette tips – with or without a filter.



The future of pipetting is liquid handling with a smile. With the Research pro.

eppendorf

In touch with life

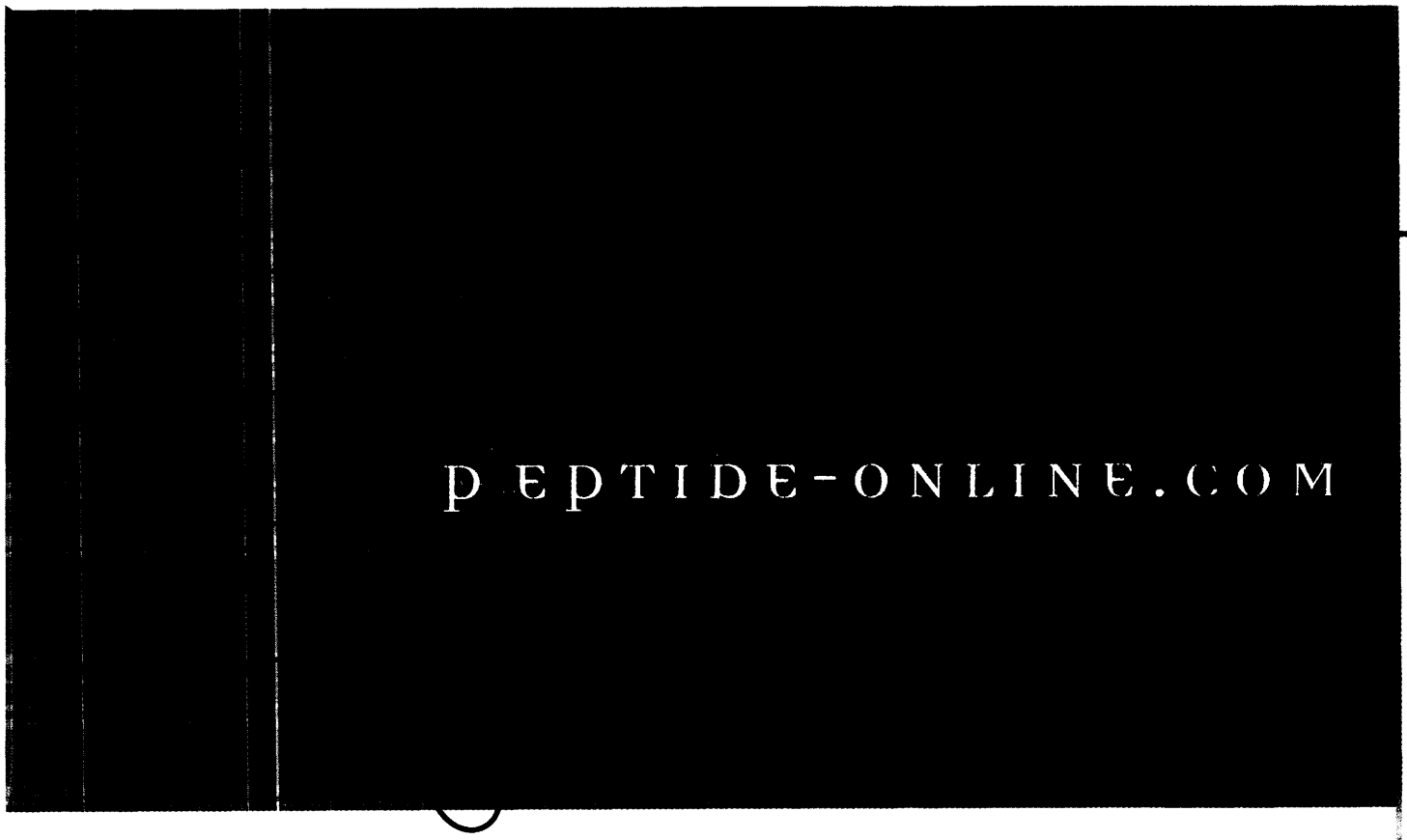
Circle No. 30 on Readers' Service Card

Eppendorf – Netheler – Hinz GmbH · 22331 Hamburg · Germany · Life Science Application-Hotline: +49 180-3 666 789 · Fax +49 40-53801-556
e-mail: eppendorf@eppendorf.com · eppendorf home page: http://www.eppendorf.com
Brinkmann Instruments, Inc. · One Cantiague Rd. · Westbury, NY 11590-0207 · Phone 800-645-3050 or 516-334-7500 · Fax 516-334-7506
e-mail: info@brinkmann.com · website: www.brinkmann.com

THE INTERNET LINK
FOR DRUG DISCOVERY

PEPTIDES
NUCLEOTIDES
CUSTOM PEPTIDES
PEPTIDE ANTIBODIES

BROWSE, CLICK, AND FIND THE BEST PRICES



www.peptide-online.com

Peptide-online.com is the first web-site designed specifically for peptides, peptide antibodies and nucleotides. Researchers in life sciences can now quickly place their requests for bids for custom, catalog, and GMP orders. The requests will be viewed and orders filled by numerous qualified manufacturers at the best prices. No more interminable phone calls with salepeople. No more waiting. No more hassles.

Manufacturers of peptides, peptide antibodies, and nucleotides can now find their customers at one place. Peptide-online.com is your connection to sales and customers.

www.pejidesign.com

the incredible new precast gel system

Accelerate Your Research—Criterion Gels Have A Greater Capacity than Any Other Mini Gel.

Criterion sets the new standard for precast gel systems, exceeding all previous performance standards for precast gel electrophoresis. Easy-open cassettes and the patented leak-free design ensure unsurpassed quality and reproducibility, while highly visible wells simplify gel loading, further accelerating throughput. Have a question or want to set up a demo? Contact your Bio-Rad representative or sign up at **criterion.bio-rad.com**.

What Will You Discover Next?

Visit our Life Science web site at discover.bio-rad.com.
Call toll free at 1-800-4BIORAD (1-800-424-6723); outside the US, contact your local sales office.

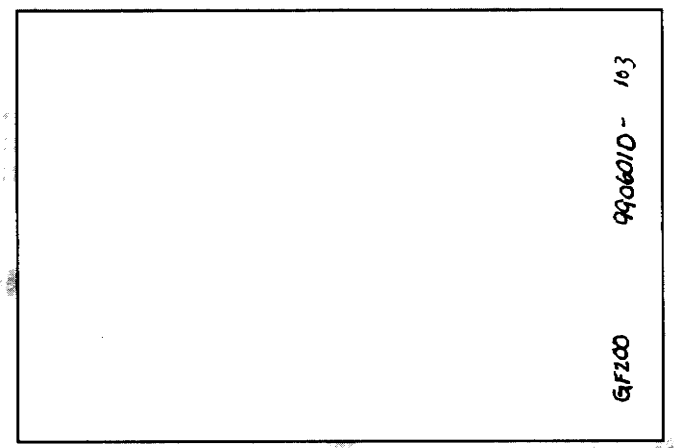
BIO-RAD

Circle No. 12 on Readers' Service Card

GENEFILTERS® MICROARRAYS

CONSISTING OF THE DNA INSERTS FROM TENS OF THOUSANDS OF SEQUENCE VALIDATED CLONES

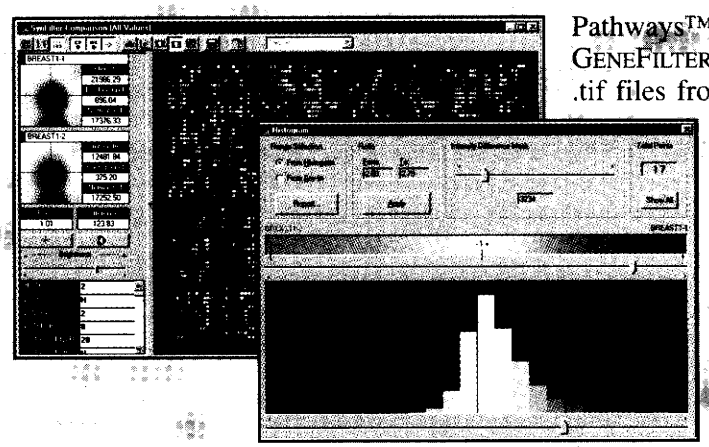
GENEFILTERS microarrays contain DNA from over 5,000 different genes spotted onto positively charged nylon membranes. Over 30,000 human genes are represented in our growing collection of sequence validated I.M.A.G.E./LLNL clones[1] chosen from the UniGene[2] set. In addition to six GENEFILTERS microarrays representing the entire human collection, individual GENEFILTERS microarrays are available which represent only named human genes or only genes that have been shown to be expressed in a particular human tissue. Three releases of rat GENEFILTERS microarrays are also available. Together the rat microarrays represent over 15,000 rat genes.[3]



(Actual Size)

GENEFILTERS microarrays offer the opportunity to carry out sophisticated, genome-wide gene expression experiments. Standard hybridization methods with ^{33}P and a phosphor imaging system produce data which can be analyzed using Pathways™ analysis software. GENEFILTERS microarrays can be probed up to five times. For a complete description of each of the GENEFILTERS microarrays, see our web site at http://www.resgen.com.

Ref: 1. Lennon, G., Auffray, C., Polymeropoulos, M., Soares, M.B. (1996) *Genomics 33*, 151-152.
2. http://www.ncbi.nlm.nih.gov/UniGene/index.html
3. http://ratEST.uiowa.edu



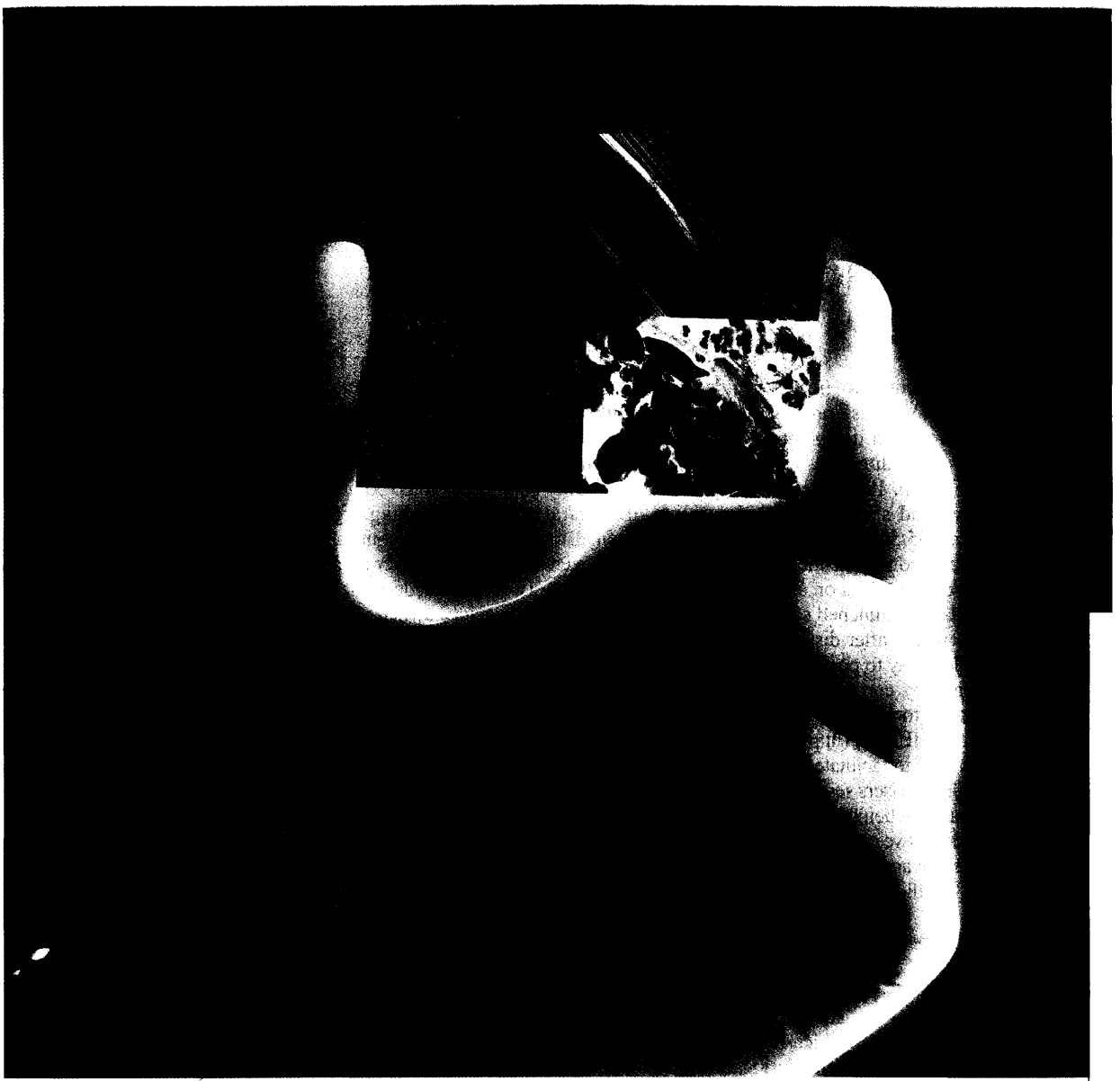
Pathways™ software was designed specifically for use with GENEFILTERS microarrays. The software imports and stores .gel or .tif files from phosphor imaging systems, and locates, calculates, and stores the spot intensities from those files. The software is capable of analyzing images from single membranes or graphically comparing two different images. A histogram tool allows selection of genes with differential expression. The internal database provides instant, on-screen identification of each spot as it is selected.

Cat. No.	Description	Price
GF200	Human GENEFILTERS Release I	$ 960.00
GF201	Human GENEFILTERS Release II	$ 960.00
GF202	Human GENEFILTERS Release III	$ 960.00
GF203	Human GENEFILTERS Release IV	$ 960.00
GF204	Human GENEFILTERS Release V	$ 960.00
GF205	Human GENEFILTERS Release VI	$ 960.00
GF211	Human Named Genes GENEFILTERS	$1,440.00
PW200	Pathways™ Software	$2,850.00

Cat. No.	Description	Price
GF300	Rat GENEFILTERS Release I	$ 960.00
GF301	Rat GENEFILTERS Release II	$ 960.00
GF302	Rat GENEFILTERS Release III	$ 960.00
GF221	Human Prostate GENEFILTERS	$1,440.00
GF223	Human Ovary GENEFILTERS	$1,440.00
GF225	Human Breast GENEFILTERS	$1,440.00
GF227	Human Colon GENEFILTERS	$1,440.00
ID1001	DermArray Human Skin array*	$1,440.00

* Co-developed with IntegriDerm LLC; Enriched with genes expressed in keratinocytes, melanocytes, fibroblasts and genes involved in drug metabolism & pharmacology. Special conditions for use apply.

Research Genetics®
Accelerating Discovery®
2130 Memorial Pkwy, SW • Huntsville, AL • 35801
U.S. or Canada 800-533-4363 Worldwide 256-533-4363
U.K. 0-800-89-1393 FAX 256-536-9016
http://www.resgen.com



Leica.
An Eye for Discovery

Image 4.98 Life Science e.

The demand for innovative system solutions in life sciences is growing all the time. Leica can provide you with just the solution you need. So why not benefit from the experience of an international technology group? Sales organizations in over 20 countries guarantee optimum support and service. Leica offers a wide range of products for life science applications to suit all requirements from routine to research.

Leica

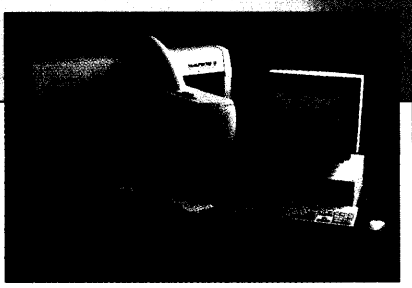
Leica Microsystems Holdings GmbH
Ernst-Leitz-Straße
D-35530 Wetzlar (Germany) .

Phone +49 (0) 64 41 29 - 0
Fax +49 (0) 64 41 22 - 25 99
www.leica.com

Circle No. 11 on Readers' Service Card

Does your robotic liquid handler allow you this much versatility?

MultiPROBE® II does.



Liquid Handling Applications

- High Throughput Screening
- Molecular Biology
- Clinical Assays
- Drug Metabolism
  - Microsomal Assay
  - Solid Phase Extraction

With the MultiPROBE II robotic liquid handling system you can automate any application by choosing integration modules to configure the system to your specific assay requirements. This flexibility stems from the unique configurable deck design and the exclusive WinPREP® software which provides simple, easy-to-use protocol automation without the expense of gripper tools and track robots. Integration modules include:

- VersaTip® adapter allows the use of three sizes of disposable tip without losing the ability to pipette using a fixed tip.
- Low Volume Tip dispensing module
- Thermal Cycler Integration module
- Vacuum manifold control module
- Microplate shaker module
- Microplate heater and cooling modules

Of course, MultiPROBE II is compatible with today's array of laboratory labware and disposables.

Please visit our **Web site** to click on your application and see what you can configure for yourself.

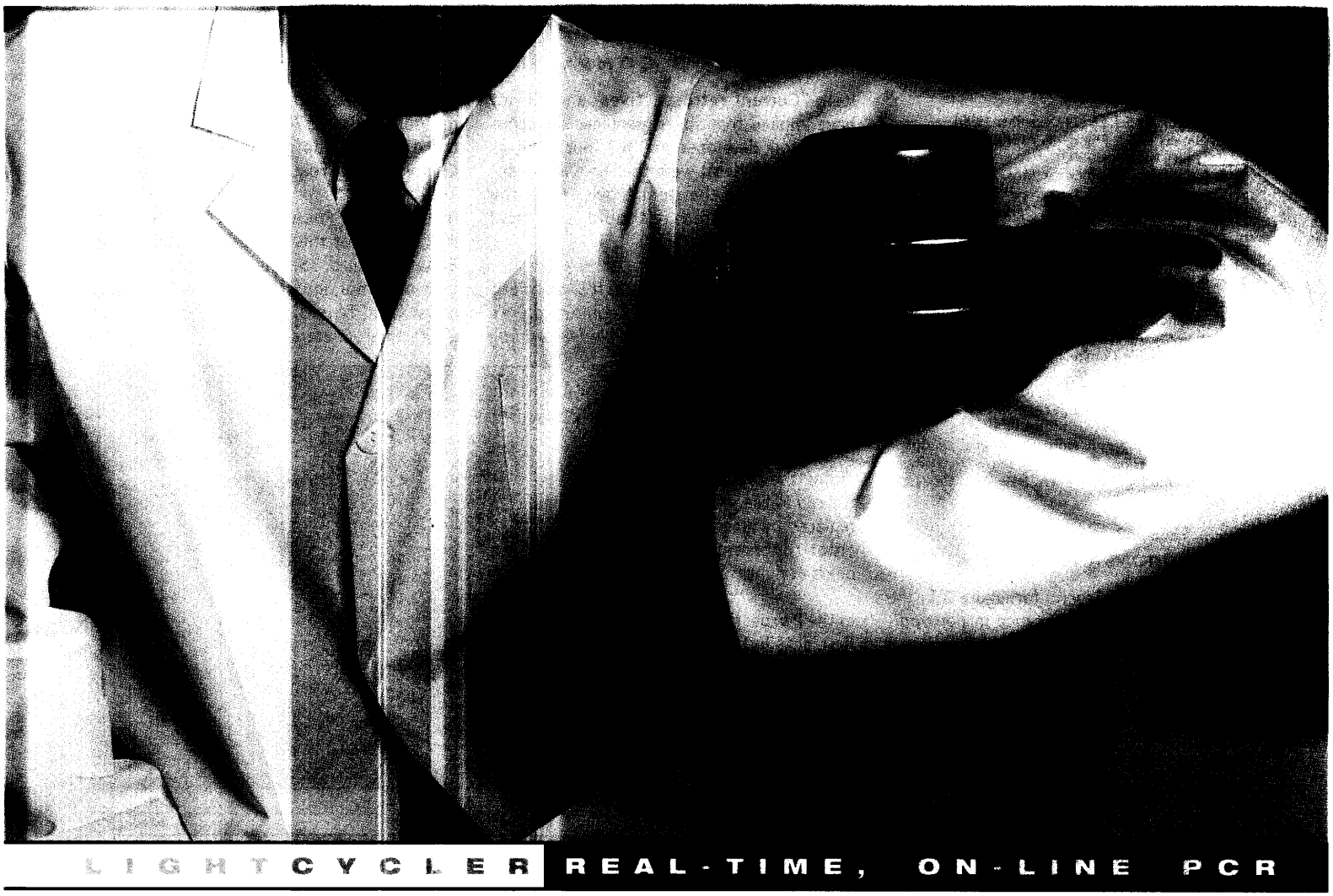
Packard
A Packard BioScience Company

Packard Instrument Company
800 Research Parkway
Meriden, CT 06450 U.S.A.
Tel: 203-639-2598 Toll Free: 1-800-323-1891
For international offices visit our Web site or contact the Packard U.S.A. office.

Code: AD3813-MP

www.packardinstrument.com

Circle No. 9 on Readers' Service Card



LIGHTCYCLER REAL-TIME, ON-LINE PCR

The only system for quantitative PCR that is as flexible as you are.

Choose the LightCycler PCR System, the only instrument flexible enough to meet your changing research needs. Select the chemistry format that best fits your requirements: SYBR Green I, Hybridization Probes, or TaqMan probes. Regardless of the chemistry you choose, the LightCycler System maximizes flexibility and performance:

- Choose the one system that does it all: quantify mRNA expression levels, detect mutations, and view melting characteristics.
- Simultaneously analyze multiple targets using dual-color detection.
- Complete PCR and real-time, on-line quantification in only 30 minutes.
- Avoid PCR surprises by viewing the results during each cycle rather than at the end of the run.
- Use intuitive, user-friendly software to analyze one data set while generating the next one.

Find out more about the flexibility the LightCycler System can bring to your research. Visit our web site at *http://biochem.roche.com/lightcycler* or contact your local representative today!

Roche

Roche Diagnostics GmbH
Roche Molecular Biochemicals
Mannheim, Germany

Australia (02) 9899 7999; **Austria** (01) 277 870; **Belgium** (02) 247 4930; **Canada** (450) 686 7050; (800) 361 2070; **Czech Republic** (0324) 45 54, 58 71-2; **Denmark** 49 13 82 32; **Finland** (09) 429 2342; **France** 04 76 76 30 86; **Germany** (0621) 759 8568; **Greece** (01) 67 40 238; **Republic of Ireland** (800) 40 90 41; **Italy** 039 247 4109-4181; **Japan** 03 5443 5284; **Mexico** (5) 227 8967, -61; **Netherlands** (036) 539 4911; **New Zealand** (09) 276 4157; **Norway** 22 07 65 00; **Poland** (22) 374235; **Portugal** (01) 417 17 17; **Singapore** 65 27 27 500; **South Africa** (011) 886 2400; **South Korea** (02) 3471-6500; **Spain** (93) 201 4411; **Sweden** (08) 404 8800; **Switzerland** 0 41/7 99 6161; **United Kingdom** (0800) 521 578; **USA** (800) 428 5433

Circle No. 23 on Readers' Service Card