

AMERICAN  
ASSOCIATION FOR THE  
ADVANCEMENT OF  
SCIENCE

# SCIENCE

17 DECEMBER 1993  
VOL. 262 • PAGES 1789-1944

\$6.00





# Breaking the Mold



# In Thermostable Enzyme Research

## The Commitment to Discovery

Stratagene is committed to thermostable enzyme research. We literally go to the ends of the earth looking for novel microorganisms which may contain useful thermostable enzymes. Our goal is to make recombinant DNA methodologies more efficient and less time-consuming by exploiting these newly discovered enzymes that excel at elevated temperatures.

## The Results of Our Search

Stratagene's search has been quite fruitful. We have broken new ground with thermostable enzymes isolated from the hyperthermophilic marine archaeon, *Pyrococcus furiosus* (*Pfu*)<sup>1</sup>. This extremely thermophilic microorganism grows optimally at 100°C and as may be expected, possesses a host of exceptionally thermostable enzymes.

Scientists at Stratagene have recently cloned *Pfu* DNA ligase<sup>2,3</sup>, which remains active following one hour incubation at 95°C and functions superbly in the ligase chain reaction (LCR)<sup>4,5</sup>. Cloned *Pfu* DNA polymerase\* exhibits 12-fold higher fidelity than *Taq* polymerase<sup>6,7</sup>. The exonuclease-deficient mutant of *Pfu* DNA polymerase can be used to directly sequence PCR\*\* products with <sup>35</sup>S-dATP<sup>8</sup>.

This is just the beginning of Stratagene's commitment to explore thermophilic enzymes and their applications. Just the beginning of the already unmatched line of Stratagene enzymes that can take the heat.

## Products

### Cloned *Pfu* DNA ligase

Extremely thermostable. Exhibits higher specificity with substantially less blunt-ended activity than *Tth* DNA ligase, making it ideal for use in LCR. Cat# 600191

### Cloned *Tth* DNA ligase

Until now, the only commercially available thermostable DNA ligase. The original LCR technique employs this enzyme. Cat# 600193

### LCR Kit

Includes *Pfu* DNA ligase, reaction buffer, positive and negative control oligonucleotides, control plasmid template and a detailed LCR protocol complete with experimental design and troubleshooting section. Cat# 200520

### Cloned *Pfu* DNA Polymerase

Extremely thermostable. Exhibits 3' to 5' exonuclease-dependent proofreading activity and the highest fidelity of any thermostable DNA polymerase. Cat#'s 600153, 600154, 600159

### Native *Pfu* DNA polymerase

The original high-fidelity *Pfu* polymerase isolated from the hyperthermophilic archaeobacterium, *Pyrococcus furiosus*. Cat#'s 600135, 600136

### Exo-minus *Pfu* DNA polymerase

The genetically engineered mutant of *Pfu* polymerase possesses no detectable exonuclease activity. Ideal for cycle sequencing PCR products with <sup>35</sup>S nucleotide analogs and for other high-temperature primer extension reactions that do not require high-fidelity DNA synthesis. Cat# 600163

### Cyclist™ Exo-minus *Pfu* DNA sequencing kit

Contains all the reagents required for cycle sequencing with Exo-minus *Pfu*. Designed for direct sequencing of PCR products or purified plasmid templates, labeled with <sup>35</sup>S-dATP. Cat# 200326

### Native *Taq* DNA polymerase

Traditionally used for high-temperature primer extension reactions. Stratagene's *Taq* DNA polymerase is purified using a proprietary technique that makes the enzyme extremely thermostable. Cat#'s 600131, 600132

### Cyclist™ *Taq* DNA sequencing kit

Contains all the reagents required for cycle sequencing with *Taq* polymerase. Designed for direct sequencing of PCR products, plasmids from colonies or phage from plaques, using <sup>32</sup>P- or <sup>33</sup>P-dATP. Cat# 200325

## REFERENCES

1. Fiala, G. and Stetter, K. (1986) *Arch. Microbiol.* 145:56-61.

2. Marsh, E., et al. (1992) *Stratagies* 5:73-76.

3. Mathur, E., et al. (1992) *The San Diego Conference on Nucleic Acids Abstract* #10.

4. Barany, F. (1991) *PCR Methods and Applications* 1:5-16.

5. Barany, F. (1991) *Proc. Natl. Acad. Sci. USA* 88:189-193.

6. Lundberg, K., et al. (1991) *Gene* 108: 1-6.

7. Mathur, E., et al. (1991) *Nucleic Acids Res.* 19:6952.

8. Hedden, V., et al. *Stratagies* (1992) 5:79-80



# STRATAGENE®

Call Stratagene for the distributor nearest you.

### USA:

#### Corporate Headquarters

Easy Ordering: (800)424-5444  
Telefax: (619)535-0034

### Germany:

#### Stratagene GmbH

Telephone: (06221) 400634  
Telefax: (06221) 400639

### United Kingdom:

#### Stratagene Ltd.

Telephone: (0223) 420955  
Telefax: (0223) 420234

### France:

#### Stratagene France

Telephone: (0590) 7236  
Telefax: (1) 44281900

### Switzerland:

#### Stratagene GmbH

Telephone: (01) 3641106  
Telefax: (01) 3657707

\* Patents Pending

\*\* The Polymerase Chain Reaction (PCR) process is covered by U.S. patents owned by Hoffmann-La Roche. Use of the PCR process requires a license.



**DNA DIPSTICK**

*From Invitrogen*





# Funny, It Doesn't look like A **Revolution** *in* NUCLEIC ACID QUANTITATION.

Don't be fooled by the modest appearance of the new DNA DipStick™ Kit from Invitrogen. It's nothing short of a revolution in the quantitation of DNA, RNA and oligonucleotides.

The DNA DipStick™ is the economical solution for quantifying amplification products, mRNA, total RNA, cDNA or plasmid DNA.

WE'RE SENSITIVE *to* YOUR NEEDS.

The easy-to-use DNA DipStick™ is so sensitive, it quantitates nucleic acid at concentrations as low as 0.1 ng/μl. That's a big advantage over conventional techniques like ethidium bromide staining or spectrophotometry, which are less sensitive and require ~~substantially more sample.~~ **≥0.1 ng/μl**



HOW FAST *is* FAST?

With the DNA DipStick™, you'll get results in less than 10 minutes. It's as easy as spotting 1 μl of sample on the DipStick and placing it in three solutions.

The DNA DipStick™ makes quantification of single- or double-stranded DNA, RNA or oligonucleotides fast, accurate and economical. Plus, it provides a permanent record of results.

JOIN *the* REVOLUTION. CALL NOW.

Customer Service Representatives are standing by! To order the DNA DipStick™ Kit, call and ask for catalog no. K5632-01.

**1-800-955-6288 or Fax 1-619-597-6201**



3985 B Sorrento Valley Boulevard, San Diego, California 92121

**European Headquarters:**  
**Invitrogen BV**

De Schelp 26, 9351 NV Leek  
The Netherlands  
Tel: (0) 5945-15175  
Fax: (0) 5945-15312

Toll free Telephone Numbers  
The Netherlands 06-02208848  
Belgium 078-111173  
Germany 0130 8100 43  
Switzerland 155-1966  
Austria 0660-8127

UK Tel: (0235) 781045 Fax: (0235) 533420  
France 05 90 72 49  
Sweden 020 793149  
Norway 050 11033  
Denmark 80 01 85 92



**Italy**  
Tel: 39-238103171  
Fax: 39-238101465



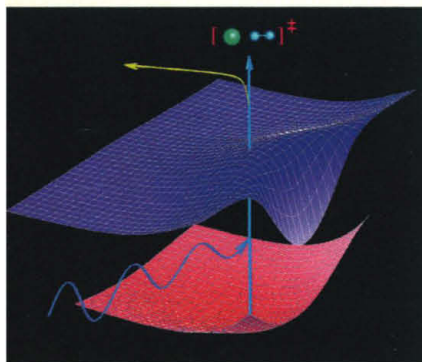
**Japan**  
Tel: 81-356841622  
Fax 81-356841633

Austria 43-1-8891819 Australia 61-38089077 Finland 35-80420807 India 33-594127 Israel 972-8472563 Spain 34-14091251 or 34-3-4560607 Singapore 65-779-1919 Germany/Switzerland 62-21303907



## 1816 & 1850

Possible new  
high for  
superconduc-  
tivity critical  
temperatures



## 1828 & 1852

Making a quick  
transition

### NEWS & COMMENT

CERN: Alone on the Frontier 1808  
A Leader by Consensus

Hubble Telescope: Repairs Rekindle 1810  
3-Year-Old Dreams

DOE Lifts the Veil of Secrecy From 1811  
Laser Fusion  
An 'Openness Initiative'

Research Ethics: Scandal Scars 1812  
Minnesota Medical School

### RESEARCH NEWS

A Big Step for Superconductivity? 1816

New Bind for Ulcer Bacterium 1817

'Bubble Boy' Paradox Resolved 1818

Ancient Climate Coolings Are on Thin Ice 1818

Is the Future Here for Gallium Arsenide? 1819

AIDS Vaccine Research: A New Goal: 1820  
Preventing Disease, Not Infection

### PERSPECTIVES

Transition States of Chemical 1828  
Reactions  
G. C. Schatz

Two Jobs for the Origin Replication 1830  
Complex  
C. S. Newlon

### ARTICLE

Distributions of Phytoplankton Blooms 1832  
in the Southern Ocean  
C. W. Sullivan, K. R. Arrigo, C. R. McClain,  
J. C. Comiso, J. Firestone

### RESEARCH ARTICLES

Origin Recognition Complex (ORC) 1838  
in Transcriptional Silencing and DNA  
Replication in *S. cerevisiae*  
M. Foss, F. J. McNally, P. Laurensen, J. Rine

Yeast Origin Recognition Complex 1844  
Functions in Transcription Silencing and  
DNA Replication  
S. P. Bell, R. Kobayashi, B. Stillman

### DEPARTMENTS

THIS WEEK IN SCIENCE 1797

EDITORIAL 1799  
The Lessons of the Super Collider

LETTERS 1801  
Success in Science: W. E. Frick • Nationality of  
Engineering Students: D. N. Frey • M.D.-Ph.D.  
Degrees: D. L. Gottheil, T. G. Waldrop; A.  
DePalma • Conflict of Interest: D. F. Klein;  
D. E. Koshland Jr. • NIH: Intramural and Extramu-  
ral Programs: C. Kupfer • Japanese Superconduct-  
ing Computer: T. Sakamoto • Saving Old-Growth  
Forests: D. A. Perry

SCIENCESCOPE 1807

RANDOM SAMPLES 1814  
New Start for Behavioral Researchers • Study Sec-  
tions Not Kosher?, etc.

BOOK REVIEWS 1906  
*In the Name of Science*; *Targeted*; *The Hijacking of  
the Humane Movement*; *Monkey Business*, reviewed  
by H. Herzog • *Beyond the Wall*, K. Macrakis •  
*Symmetry in Chaos*, J. D. Crawford • *Thermodynam-  
ics in Geochemistry*, J. Walther • Vignettes • Books  
Received

PRODUCTS & MATERIALS 1914

### Board of Reviewing Editors

John Abelson  
Frederick W. Alt  
Don L. Anderson  
Michael Ashburner  
Stephen J. Benkovic  
David E. Bloom  
Floyd E. Bloom  
Piet Borst  
Michael S. Brown  
Henry R. Bourne  
James J. Bull

Kathryn Calame  
C. Thomas Caskey  
Dennis W. Choi  
John M. Coffin  
Paul J. Crutzen  
Robert Desimone  
Nicole Le Douarin  
Bruce F. Eldridge  
Paul T. Englund  
Richard G. Fairbanks  
Douglas T. Fearon

Harry A. Fozzard  
K. Friedrich  
Theodore H. Geballe  
Margaret J. Geller  
John C. Gerhart  
Roger I. M. Glass  
Stephen P. Goff  
Peter N. Goodfellow  
Corey S. Goodman  
Stephen J. Gould  
Ira Herskowitz

Eric F. Johnson  
Stephen M. Kosslyn  
Michael LaBarbera  
Charles S. Levings III  
Alexander Levitzki  
Harvey F. Lodish  
Richard Losick  
Diane Mathis  
Anthony R. Means  
Shigetada Nakanishi  
Roger A. Nicoll

William H. Orme-  
Johnson III  
Stuart L. Pimm  
Yeshayau Pocker  
Dennis A. Powers  
Ralph S. Quatrano  
V. Ramanathan  
Douglas C. Rees  
T. M. Rice  
Erkki Ruoslahti  
David C. Rubie

Gottfried Schatz  
Jozef Schell  
Ronald H. Schwartz  
Terrence J. Sejnowski  
Ellen Solomon  
Thomas A. Steitz  
Michael P. Stryker  
Richard F. Thompson  
Robert T. N. Tjian  
Emil R. Unanue  
Geerat J. Vermeij

Bert Vogelstein  
Harold Weintraub  
Zena Werb  
George M. Whitesides  
Owen N. Witte  
William A. Wulf  
Keith Yamamoto



Model of the protein lysin superimposed on the shells of a red abalone. To fertilize the egg, the abalone spermatozoon must disrupt the protective vitelline envelope. Lysin binds to the filamentous glycoproteins that form the envelope and creates a hole by means of

a nonenzymatic process. The lysin-glycoprotein association also contributes to the species recognition between sperm and egg. See page 1864. [Cover design: Peggy Myer. Digital photography: Bob Turner. Molecular model: Mike Pique]



## REPORTS

### Evidence Suggesting Superconductivity at 250 K in a Sequentially Deposited Cuprate Film

1850

M. Laguerre, X. M. Xie, H. Tebbji, X. Z. Xu, V. Mairret, C. Hatterer, C. F. Beuran, C. Deville-Cavellin

### The Transition State of the F + H<sub>2</sub> Reaction

1852

D. E. Manolopoulos, K. Stark, H.-J. Werner, D. W. Arnold, S. E. Bradforth, D. M. Neumark

### Nitrogen-15 and Oxygen-18 Characteristics of Nitrous Oxide: A Global Perspective

1855

K.-R. Kim and H. Craig

### Superheating Effects on Metal-Silicate Partitioning of Siderophile Elements

1858

D. Walker, L. Norby, J. H. Jones

### Orphan Strontium-87 in Abyssal Peridotites: Daddy Was a Granite

1861

J. E. Snow, S. R. Hart, H. J. B. Dick

### The Crystal Structure of Lysin, a Fertilization Protein

1864

A. Shaw, D. E. McRee, V. D. Vacquier, C. D. Stout

### A Functional Recombinant Myosin II Lacking a Regulatory Light Chain-Binding Site

1867

T. Q. P. Uyeda and J. A. Spudich

### Isolation of ORC6, a Component of the Yeast Origin Recognition Complex by a One-Hybrid System

1870

J. J. Li and I. Herskowitz

### Sharing of the Interleukin-2 (IL-2) Receptor $\gamma$ Chain Between Receptors for IL-2 and IL-4

1874

M. Kondo, T. Takeshita, N. Ishii, M. Nakamura, S. Watanabe, K.-i. Arai, K. Sugamura

### Interleukin-2 Receptor $\gamma$ Chain: A Functional Component of the Interleukin-7 Receptor

1877

M. Noguchi, Y. Nakamura, S. M. Russell, S. F. Ziegler, M. Tsang, X. Cao, W. J. Leonard

### Interleukin-2 Receptor $\gamma$ Chain: A Functional Component of the Interleukin-4 Receptor

1880

S. M. Russell, A. D. Keegan, N. Harada, Y. Nakamura, M. Noguchi, P. Leland, M. C. Friedmann, A. Miyajima, R. K. Puri, W. E. Paul, W. J. Leonard

### Active Oxygen Species in the Induction of Plant Systemic Acquired Resistance by Salicylic Acid

1883

Z. Chen, H. Silva, D. F. Klessig

### Functional Requirement of a Site-Specific Ribose Methylation in Ribosomal RNA

1886

K. Sirum-Connolly and T. L. Mason

### Inhibition of Transcriptional Regulator Yin-Yang-1 by Association with c-Myc

1889

A. Shrivastava, S. Saleque, G. V. Kalpana, S. Artandi, S. P. Goff, K. Calame

### Attachment of *Helicobacter pylori* to Human Gastric Epithelium Mediated by Blood Group Antigens

1892

T. Borén, P. Falk, K. A. Roth, G. Larson, S. Normark

### Separate GTP Binding and GTPase Activating Domains of a G $\alpha$ Subunit

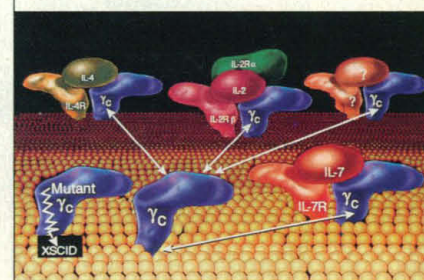
1895

D. W. Markby, R. Onrust, H. R. Bourne

### Linearity of Summation of Synaptic Potentials Underlying Direction Selectivity in Simple Cells of the Cat Visual Cortex

1901

B. Jagadeesh, H. S. Wheat, D. Ferster



1818, 1874, 1877  
& 1880

Common subunit for  
interleukin receptors

## AAAS Board of Directors

F. Sherwood Rowland  
Retiring President,  
Chairman  
Eloise E. Clark  
President  
Francisco J. Ayala  
President-elect

Robert A. Froesch  
Florence P. Haseltine  
William A. Lester, Jr.

Alan Schriesheim  
Jean'ne M. Shreeve  
Chang-Lin Tien  
Warren M. Washington  
Nancy S. Wexler

William T. Golden  
Treasurer  
Richard S. Nicholson  
Executive Officer

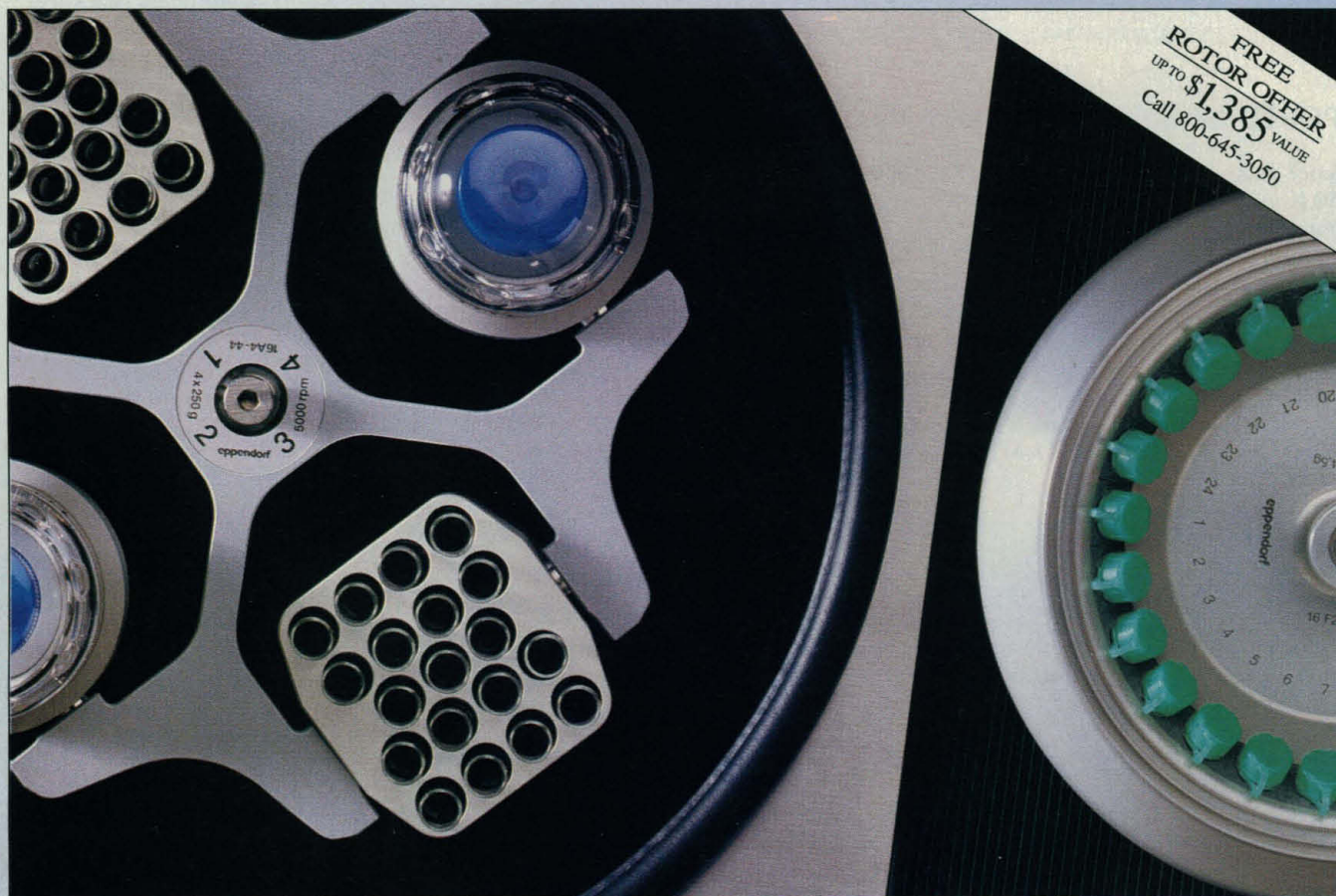
■ **SCIENCE** (ISSN 0036-8075) is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1333 H Street, NW, Washington, DC 20005. Second-class postage (publication No. 484460) paid at Washington, DC, and additional mailing offices. Copyright © 1993 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): \$87 (\$47 allocated to subscription). Domestic institutional subscription (51 issues): \$205. Foreign postage extra: Mexico, Caribbean (surface mail) \$50; other countries (air assist delivery) \$95. First class, airmail, student and emeritus rates on request. Canadian rates with GST available upon request, GST #1254 88122. **Change of address:** allow 6 weeks, giving old and new addresses and 11-digit

## Indicates accompanying feature

account number. **Postmaster:** Send change of address to *Science*, P.O. Box 2033, Marion, OH 43305-2033. **Single copy sales:** \$6.00 per issue prepaid includes surface postage; Guide to Biotechnology Products and Instruments, \$20. 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 the base fee of \$1 per copy plus \$0.10 per page is paid directly to CCC, 27 Congress Street, Salem, MA 01970. The identification code for *Science* is 0036-8075/93 \$1 + .10. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.



# NEW EPPENDORF® CENTRIFUGES WITH MICRO AND MACRO CAPABILITIES...



FREE  
ROTOR OFFER  
UP TO \$1,385 VALUE  
Call 800-645-3050

## MORE VERSATILITY THAN EVER BEFORE.

Eppendorf, the name you trust for quality and innovation, expands your options for centrifugation with new benchtop designs.

**Our expanded line** of centrifuges now includes new Model 5416 and Refrigerated Model 5403. Both models accommodate *interchangeable* rotors for tube sizes from 0.25 mL to 100 mL. The variable-speed, brushless motor generates up to 15,000 rpm and over 23,000 x g. Refrigerated Model 5403 features a temperature control range of -10°C to 40°C and uses a *CFC-free* refrigerant to protect the environment.

In addition, our new economical Micro Centrifuge Model 5410 offers outstanding value without sacrificing important operating features.

When you're looking for a reliable benchtop centrifuge, there's just one name to remember—Eppendorf.



eppendorf

**BRINKMANN** Quality products for research and control.

Brinkmann Instruments, Inc., One Cantiague Road, P.O. Box 1019, Westbury, NY 11590-0207 • 800-645-3050, FAX: 516-334-7506  
Brinkmann Instruments (Canada) Ltd., 6670 Campobello Road, Mississauga, Ont. L5N 2L8 • 800-263-8715, FAX: 416-826-5424

Eppendorf® is a registered trademark of Eppendorf-Netheler-Hinz GmbH. BRK-10556 5201-303

For information circle reader service number 23  
For a demonstration circle reader service number 24



## Origins and silence

In yeast, extra copies of the mating-type genes are silenced, or maintained in an inactive state. Silencing requires flanking sequence elements (silencers). One silencer, HMR-E, contains an ARS consensus sequence, a sequence found at yeast replication origins. A link has now been made between transcription silencing and DNA replication (see the Perspective by Newlon, p. 1830). Foss *et al.* (p. 1838) found a mutation in a gene *ORC2* that disrupts both transcriptional silencing and the cell cycle. The sequence of this protein matches that of a protein subunit (*ORC2*) of the origin recognition complex (*ORC*) characterized by Bell *et al.* (p. 1844). Li and Herskowitz (p. 1870) screened for proteins that bind to the yeast ARS sequence and found another *ORC* subunit, *ORC6*, which was also characterized by Bell *et al.*

## Pinning down the transition state

Although numerous studies have been made of the elementary reaction between F and H<sub>2</sub>, quantitative agreement between theory and experiment has been elusive. Manolopoulos *et al.* (p. 1852; see the Perspective by Schatz, p. 1828) used photoelectron spectroscopy to characterize the FH<sub>2</sub><sup>+</sup> intermediate, which undergoes electron photodetachment near the transition state, for the *para* and *normal* populations of the hydrogen rotational state. Exact quantum reactive scattering simulations of these spectra on a highly accurate *ab initio* potential energy surface yielded excellent agreement. Such agreement could not be obtained with semiempirical potential energy surfaces that have normally been used.

## Pushing superconductivity to 250 kelvin?

One characteristic of the various families of high-temperature cuprate superconductors is that the transition temperature is roughly a function of the number of CuO<sub>2</sub> layers. However, it has proven difficult to synthesize pure phases for materials with more than three layers. Laguës *et al.* (p. 1850; see news story by Pool, p. 1816) report the epitaxial growth of a thin film of an artificial cuprate compound of the BiSrCaCuO family with building blocks of eight adjacent cuprate layers. This material was grown by sequentially imposed layer epitaxy on a single crystal of SrTiO<sub>3</sub> at a substrate temperature of 500°C. The resistivity of this material drops five orders of magnitude between 280 and 250 K, and it exhibits a diamagnetic variation of susceptibility and magnetization below 290 K. These and other results suggest the possibility of a superconducting transition at 250 K.

## Riding high

Nitrous oxide (N<sub>2</sub>O), a greenhouse gas, is currently increasing in abundance in the atmosphere. Like CO<sub>2</sub>, its global budget seems to be out of balance between known sources and sinks. To estimate fluxes from sources better, Kim and Craig (p. 1855) measured nitrogen and oxygen isotopic ratios of N<sub>2</sub>O in several soils and in stratospheric gas samples. The data imply that there is a large back flux of N<sub>2</sub>O from the stratosphere, but this flux appears to be so large that it must in turn be balanced by a large input of N<sub>2</sub>O from the oceans.

## Separation anxiety

The abundances of siderophile (metal-loving) elements such as nickel and iridium in the Earth's mantle seem too high to account for equilibrium fractionation of the iron-rich core at temperatures up to 1600°C, the limit of earlier measurements. A recent controversial proposal is that this imbalance can be explained by the separation of the core at higher pressures and temperatures where the distribution coefficients for siderophile elements between iron

melt and silicate mantle are closer to unity. Walker *et al.* (p. 1858) report measurements of distribution coefficients for some of the problematic elements at temperatures up to 3000 K. Coefficients for germanium, gold, sulfur, and nickel do decrease significantly with temperature, but discrepancies among elements are still evident. The data for sulfur also suggest that it or carbon, rather than oxygen, may be the light element in the core.

## Share and share alike

Mutations in the  $\gamma$  chain of the interleukin-2 receptor (IL-2R $\gamma$ ) can lead to X-linked severe combined immunodeficiency (XSCID) in humans, yet mice that do not produce IL-2 still develop a population of mature T cells. The IL-2R $\gamma$  was found to be a component required for high-affinity binding by the IL-4 receptor (Kondo *et al.*, p. 1874, and Russell *et al.*, p. 1880) as well as the IL-7 receptor (Noguchi *et al.*, p. 1877). The cytokines IL-4 and IL-7 both exhibit T cell growth factor activity; disabling activation in several receptor systems

may account for the virtual absence of T cells in XSCID patients (see news story by Nowak, p. 1818).

## Oxygen signal

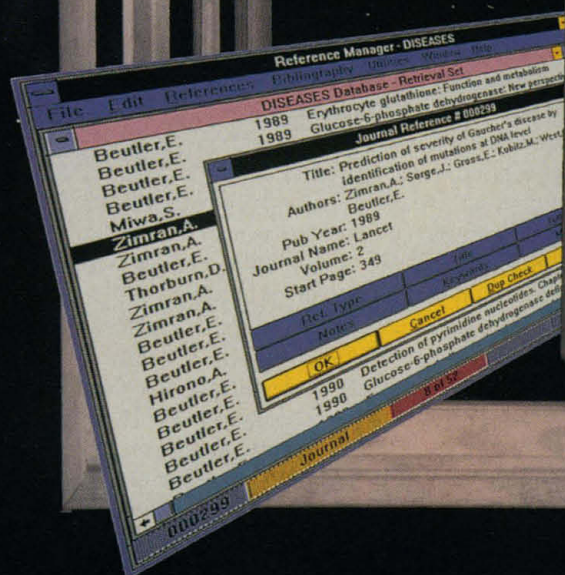
When infected by a pathogen, plants may produce both local and systemic defensive responses. This phenomenon, termed systemic acquired resistance, is mediated in part by salicylic acid (SA). Chen *et al.* (p. 1883) have cloned an SA-binding protein that has catalase activity and is inhibited by SA. Inhibition increases the amount of active oxygen species and induces the expression of defense-related genes. Active oxygen species as well as SA seem to be critical elements in the signaling pathway from infection to systemic resistance.

## In one package

Many cellular functions are controlled by guanosine triphosphate (GTP)-binding proteins. Hydrolysis of GTP by these proteins causes their inactivation. The small GTP-binding proteins like Ras are regulated by GTPase activating proteins or GAPs. However, the heterotrimeric GTP-binding proteins (G proteins) that couple receptors on the cell surface to intracellular signaling pathways have intrinsically high GTPase activity. Markby *et al.* (p. 1895) present evidence that G proteins contain a separate domain that functions as a GAP. The GTP-binding and GAP-like portions of a G protein  $\alpha$  subunit were expressed separately and shown to retain their essential functions. The results suggest a mechanism by which GTPase activity may be enhanced.



**Competitive Upgrade - save \$300**  
 Only \$199  
 Users of EndNote, Pro-Cite and Papyrus  
 Call Now - Limited Time Offer



# Reference Manager® Opens New W I N D O W S

The leading bibliographic software is now available for Microsoft® Windows™!

Since 1984, Reference Manager has been the leading bibliographic management software package for scientists, information professionals, and other scholars. Now Reference Manager is available for the Microsoft Windows operating system as well as for MS-DOS, Macintosh, and the NEC 9801.

In addition to the features found in its DOS and Macintosh counterparts, Reference Manager for Windows contains a number of enhancements, including greatly increased flexibility in bibliographic formatting and the ability to "cut and paste" entire references or their components using the standard clipboard function of Windows.

Reference Manager for Windows - The Best Bibliographic Management Software is now the only product of its kind for Microsoft Windows!



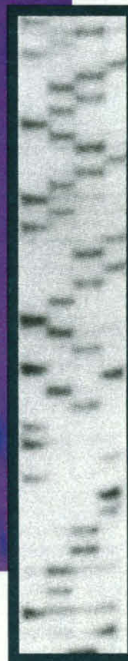
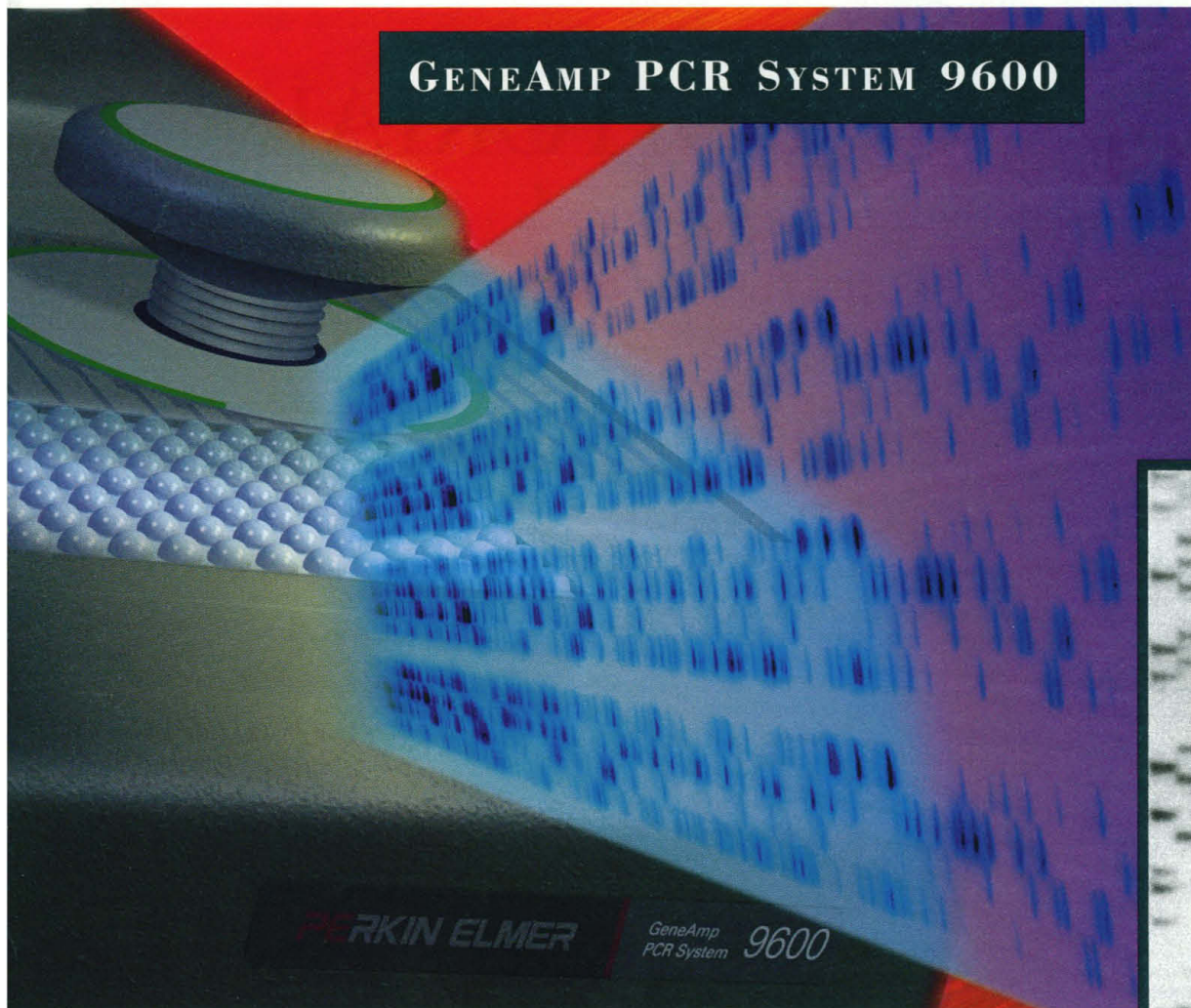
**Research Information Systems**

2355 Camino Vida Roble, Carlsbad, CA 92009-1572  
 (800) 722-1227 • (619) 438-5526 • Fax: (619) 438-5573

Circle No. 6 on Readers' Service Card



## GENEAMP PCR SYSTEM 9600



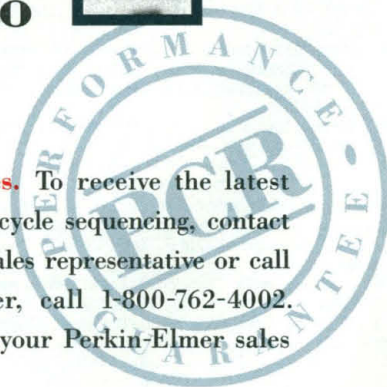
DNA SEQUENCING OF  
RETROVIRAL LTR USING PCR  
PRODUCTS AMPLIFIED  
FROM NIH 3T3 FIBROBLAST  
CELL LINE ON THE GENEAMP  
PCR SYSTEM 9600. COURTESY  
OF PIA MARIA CHALLITA,  
CHILDREN'S HOSPITAL,  
LOS ANGELES, CALIFORNIA.

## Turn PCR Performance Into Sequencing Power.

**Rapid PCR cycles.** Oil-free, low-volume reaction mixes. Demonstrated reproducibility. Only the GeneAmp™ PCR System 9600 gives you the throughput, reliability and convenience you need to achieve the highest level of productivity in cycle sequencing. Only the GeneAmp PCR System 9600 delivers the high PCR performance demanded by leading sequencing labs.

To ensure consistent sequencing results, the GeneAmp PCR System 9600 integrates innovative instrument design with advanced MicroAmp™ Reaction Tubes, the Perkin-Elmer AmpliTaq® Cycle Sequencing Kit and proven protocols. All backed by the expertise, experience and commitment of Perkin-Elmer's worldwide technical support organization. A commitment reaffirmed every day, sample to sample, by our PCR Performance Guarantee.

**Free technical notes.** To receive the latest information on PCR and cycle sequencing, contact your local Perkin-Elmer sales representative or call 1-800-762-4000. To order, call 1-800-762-4002. Outside the U.S., contact your Perkin-Elmer sales representative.



### PERKIN ELMER

Europe Vaterstetten, Germany Tel: 49-8106-381-115 Fax: 49-8106-6697  
Canada Montreal, Canada Tel: 514-737-7575 Fax: 514-737-9726  
Far East Melbourne, Australia Tel: 61-3-560-4566 Fax: 61-3-560-3231  
Latin America Mexico City, Mexico Tel: 52-5-651-7077 Fax: 52-5-593-6223

Perkin-Elmer PCR reagents are developed and manufactured by Roche Molecular Systems, Inc., Branchburg, New Jersey, U.S.A.



MicroAmp is a trademark and Perkin-Elmer is a registered trademark of The Perkin-Elmer Corporation. AmpliTaq is a registered trademark and GeneAmp is a trademark of Roche Molecular Systems, Inc. The GeneAmp PCR process is covered by U.S. patents owned by Hoffmann-La Roche Inc. and F. Hoffmann-La Roche Ltd.

Circle No. 25 on Readers' Service Card



# We Put 800 Scientists On The Line Every Day



**When you need scientific information, turn to the experts at CAS.**

CAS has over 800 scientists on staff with one job — to make sure you have access to the best scientific information at the push of a button, or with a single phone call.

Our experts read scientific literature from all around the world (in 50 different languages) to create the most accurate, comprehensive and up-to-date scientific databases available anywhere.

So, whether it's online or in print, CAS is your one source for scientific information.

Call 1-800-933-4350



A Division of the American Chemical Society

Circle No. 16 on Readers' Service Card



## ATTOFLUOR™ REAL-TIME DIGITAL FLUORESCENCE ANALYZER



NOW // WITH RATIOVISION™ SOFTWARE IN WINDOWS™

### FASTER. SIMPLER. MORE SOPHISTICATED.

State-of-the-art computerized workstation ideally suited for kinetic measurements of calcium, pH, cyclic AMP and other ions.

- Zeiss AXIOVERT for exceptional fluorescence transmission.
- Highly sensitive, compact intensified CCD camera.
- Vibration-free excitation filter changer for up to four ratios per second.
- Powerful 486 class computer.

ATTOFLUOR provides effortless image acquisition, processing, archiving and data file manipulation. It's offered as an integrated turnkey system, or as individual components.

For immediate detailed information and pricing, contact Roxanne Moosher at 914-681-7653, fax 914 681-7446. Or call 800-233-2343.

Carl Zeiss, Inc.

Microscope Division  
One Zeiss Drive  
Thornwood, New York 10594  
800-233-2343 • Fax 914-681-7446



SEE  
WHAT  
YOU'RE  
MISSING

Brightfield  
Microscopy

Darkfield  
Microscopy

Phase  
Contrast  
Microscopy

Fluorescence  
Microscopy

Differential  
Interference  
Contrast  
Microscopy

Polarizing  
Microscopy

Video  
Microscopy

Confocal  
Microscopy

Image  
Analysis

Microscope  
Photometry

Circle No. 36 on Readers' Service Card

Over 200,000 copies sold

## The Essential Reference

### THE MERCK INDEX

The Eleventh/Centennial Edition

TO ORDER, CALL TOLL-FREE  
1-800-659-6598, EXT. 753  
(VISA OR MASTERCARD ONLY) OR COMPLETE THE COUPON.

### Accurate. Authoritative. Accessible.

- Information on more than 10,000 significant drugs, chemicals, and biologicals
- New entries: pharmaceuticals with novel mechanisms of action, unique naturally occurring compounds, and chemicals of environmental concern
- New indices: therapeutic category/bioactivity, CAS Registry Numbers

- ☐ Please send me \_\_\_\_\_ copy(ies) of *THE MERCK INDEX*, Eleventh/Centennial Edition at \$35.00 each. Enclosed is my payment. I will not be charged for shipping (U.S. only).
- ☐ Check enclosed. Make check payable to Merck & Co., Inc.
- ☐ VISA    ☐ MasterCard

Card No. \_\_\_\_\_ Exp. Date \_\_\_\_\_

Signature \_\_\_\_\_

Name \_\_\_\_\_

Address \_\_\_\_\_ City \_\_\_\_\_

State \_\_\_\_\_ Zip \_\_\_\_\_ ☐ Residence ☐ Business (check one)

Please allow four to six weeks for delivery.



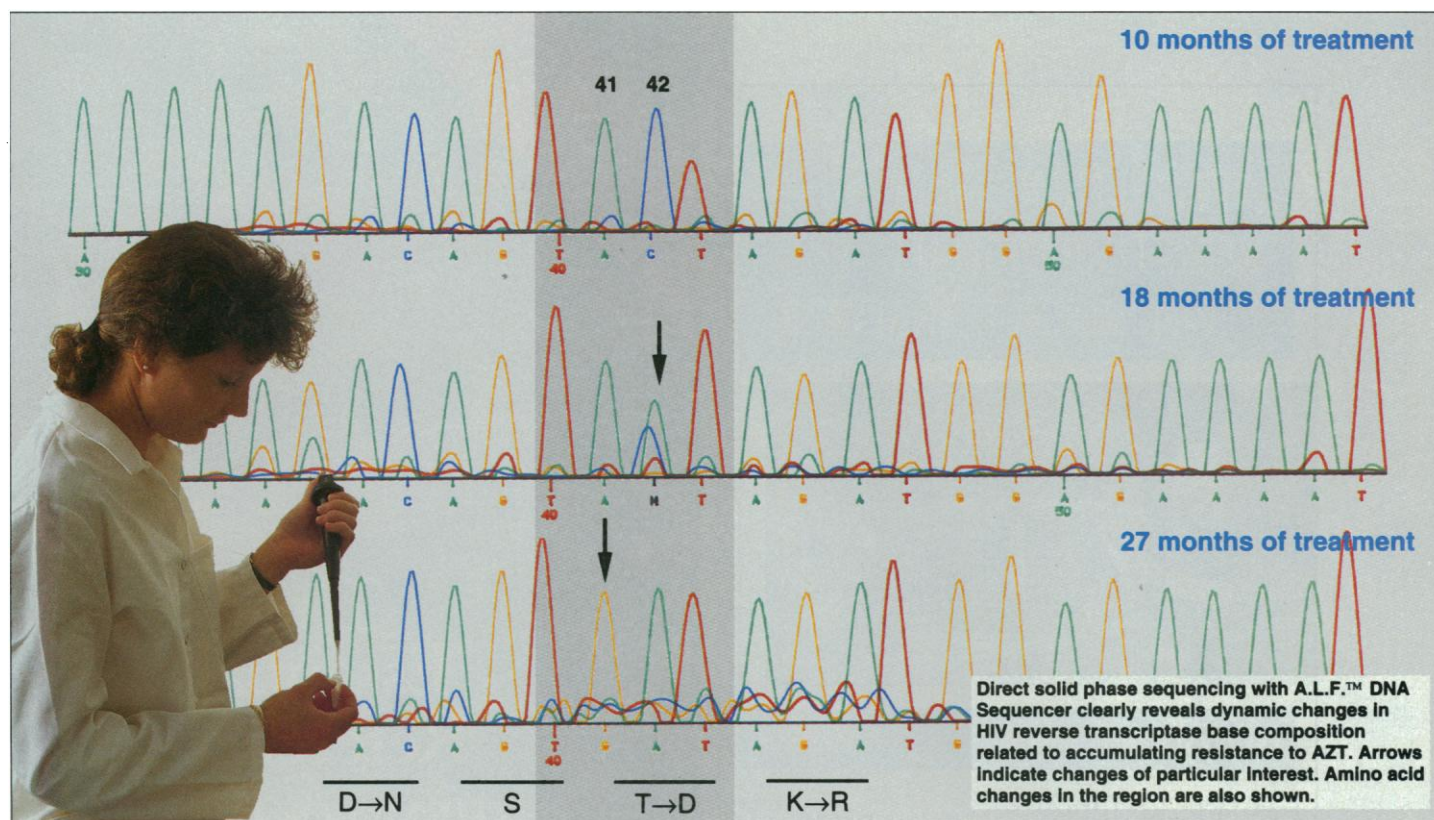
Mail to:  
Merck Publishing Group  
P.O. Box 2000 RY7-220  
Rahway, NJ 07065

At Merck...our commitment to education speaks volumes.

Merck & Co.—research intensive...education intensive...publishing scientific information on a nonprofit basis for 100 years

Circle No. 35 on Readers' Service Card





## A.L.F.™ DNA Sequencer helps AZT fight HIV

Accurate detection of heterozygote point mutations has enormous potential as a clinical research tool. Nothing illustrates this better than the recent spectacular analysis of emerging AZT resistant HIV species by direct, solid phase genomic sequencing with A.L.F.™ DNA Sequencer.

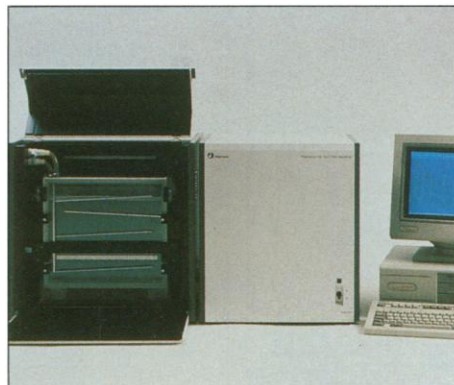
The non-edited data output above shows DNA sequences of HIV RT from a patient undergoing AZT treatment<sup>(1)</sup>. This clean sequence with little background signal emphasizes the suitability of A.L.F. for direct genomic sequencing of clinical samples. Detailed analysis revealed dynamic changes in base composition.

Take a close look at the changes A.L.F. detected at position 42. The C residue after 10 months treatment became a 50% A/C mixture at 18 months and a clear A nucleotide at 27 months. With a secondary shift from A to G at position 41, Thr69 changed to Asp, a substitution not previously reported.

Only the Automated Laser Fluorescent detection system of A.L.F. combines all the advantages for detecting point mutations like these.

Fixed laser detection of sample bases is essential to reduce background noise. With its unique fixed laser (A.L.F. has no moving parts apart from the door), background noise is lower than other sequencers. Hence its base calling is more accurate.

And because A.L.F. uses just one single fluorescent label, you don't have to worry about spectral overlaps and mobility shifts, which again makes base calling more accurate.



*A.L.F. DNA Sequencer accurately detects heterozygote point mutations. DNA sequencing with A.L.F. has many applications in clinical research.*

Furthermore, the well-proven Sanger technique, already cited more than 20,000 times, leaves nothing to chance with the reaction chemistry.

A.L.F. thus provides the accuracy needed to yield the "consensus" sequence of viral genomes in samples from HIV-1 infected patients treated with AZT.

So with A.L.F. generating precision data like this, clinical researchers can rapidly determine the molecular basis for drug resistance and more effectively plan treatment with alternative drugs or combinations of drugs. And, of course, direct DNA sequencing with A.L.F. has plenty of other clinical applications in areas such as infectious diseases, cancer, genetic disorders and forensics.

*Ask for more details and a reprint of the reference.*

1. Dynamic changes in HIV-1 quasispecies from azidothymidine (AZT) treated patients. *FASEB Journal* 6 (1992), Wahlberg, J., Albert, J., Lundeberg, J., Cox, S., Wahren, B., Uhlen, M.

**Pharmacia  
Biotech**

1123



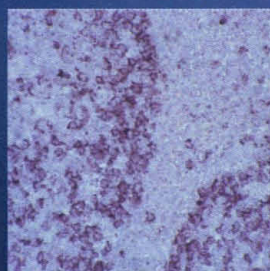
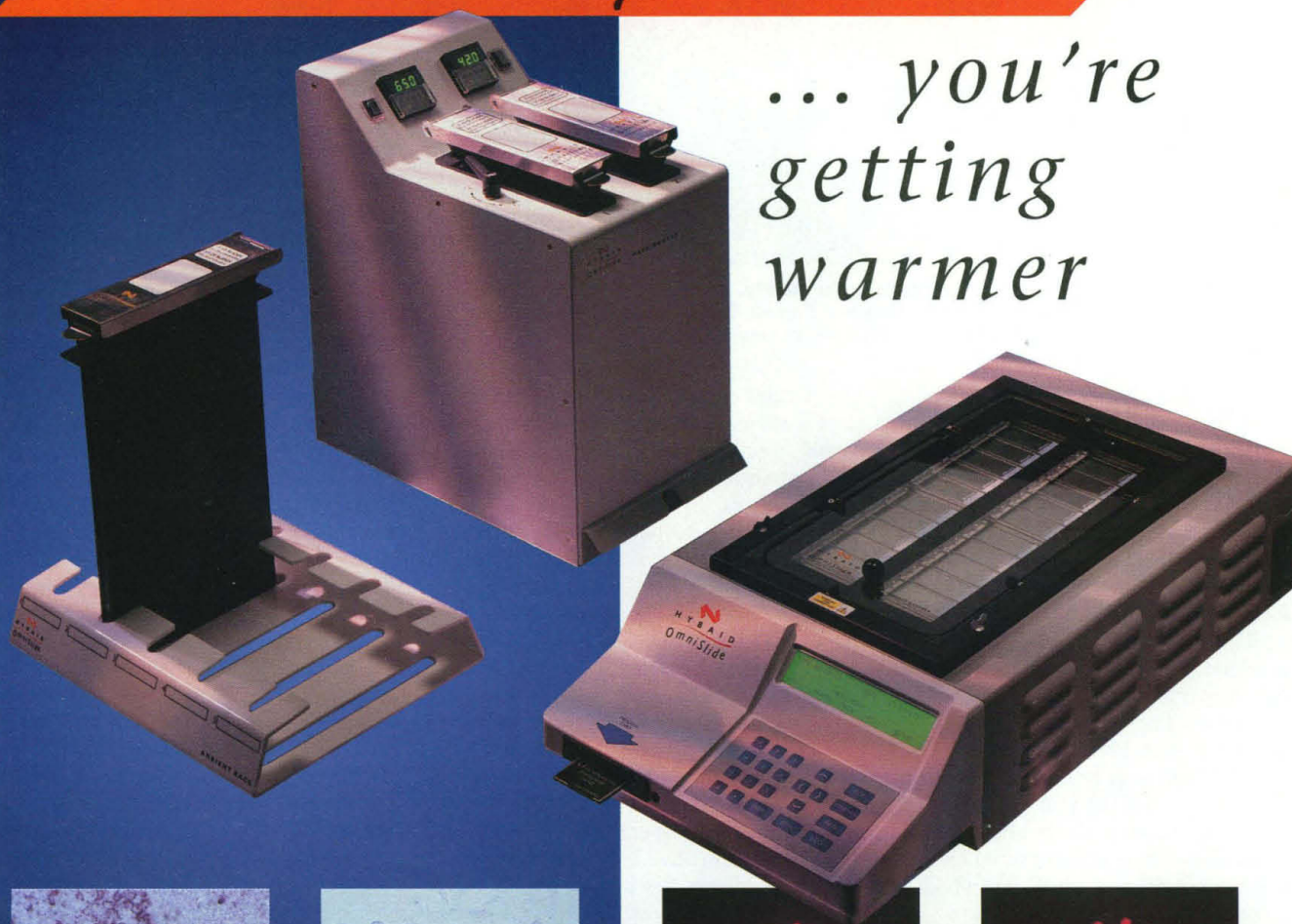
Head office Sweden 46 (0)18 16 50 00 Australia 02 367 4200 Austria 01 68 66 25 Belgium 02 727 43 51 Brazil 011 872 68 33 Canada 800 463 5800 Denmark 48 14 10 00 Finland 90 5021 077 France 130 64 34 00 Germany 0761 49 030 Great Britain 0906 60 30 65 Hong Kong 811 86 93 Holland 03480 77911 India 812 26 76 30 Italy 02 273 221 Japan 03 34 92 94 99 Malaysia 03 735 3972 Norway 63 89 23 10 People's Republic of China 01 25 65 603 Portugal 01 417 24 72 Republic of Korea 02 511 0801 Spain 93 589 07 01 Sweden 08 623 85 00 Switzerland 01 821 1816 Taiwan 02 831 5310 United States 800 526 3593 Eastern Europe +43-(0)1 982 38 26 Far East 852 811 8693 Latin America 55-11 872 68 33 Middle East 30 -(0)1 96 27 396 Other countries 46 (0)18 16 50 00

Circle No. 29 on Readers' Service Card



# Looking for an In-Situ System....?

... you're  
getting  
warmer



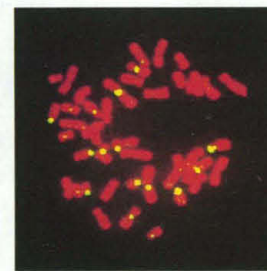
mRNA ISH



DNA ISH



PRINS



Cycling PRINS

**HYBAID LIMITED**  
111-113 WALDEGRAVE ROAD,  
TEDDINGTON, MIDDLESEX TW11 8LL U.K.  
TEL: +44 (0)81 614 1000, FAX: 081 977 0170

**INTERSCIENCE INC**  
ONTARIO, CANADA L3R 1A9  
TEL: 416 9401831, FAX: 416 9401832

**NATIONAL LABNET CO.**  
NEW JERSEY 07095 U.S.A.  
TEL: 908 5492100, FAX: 908 5492120

**HYBAID**  
*One step ahead in molecular biology*

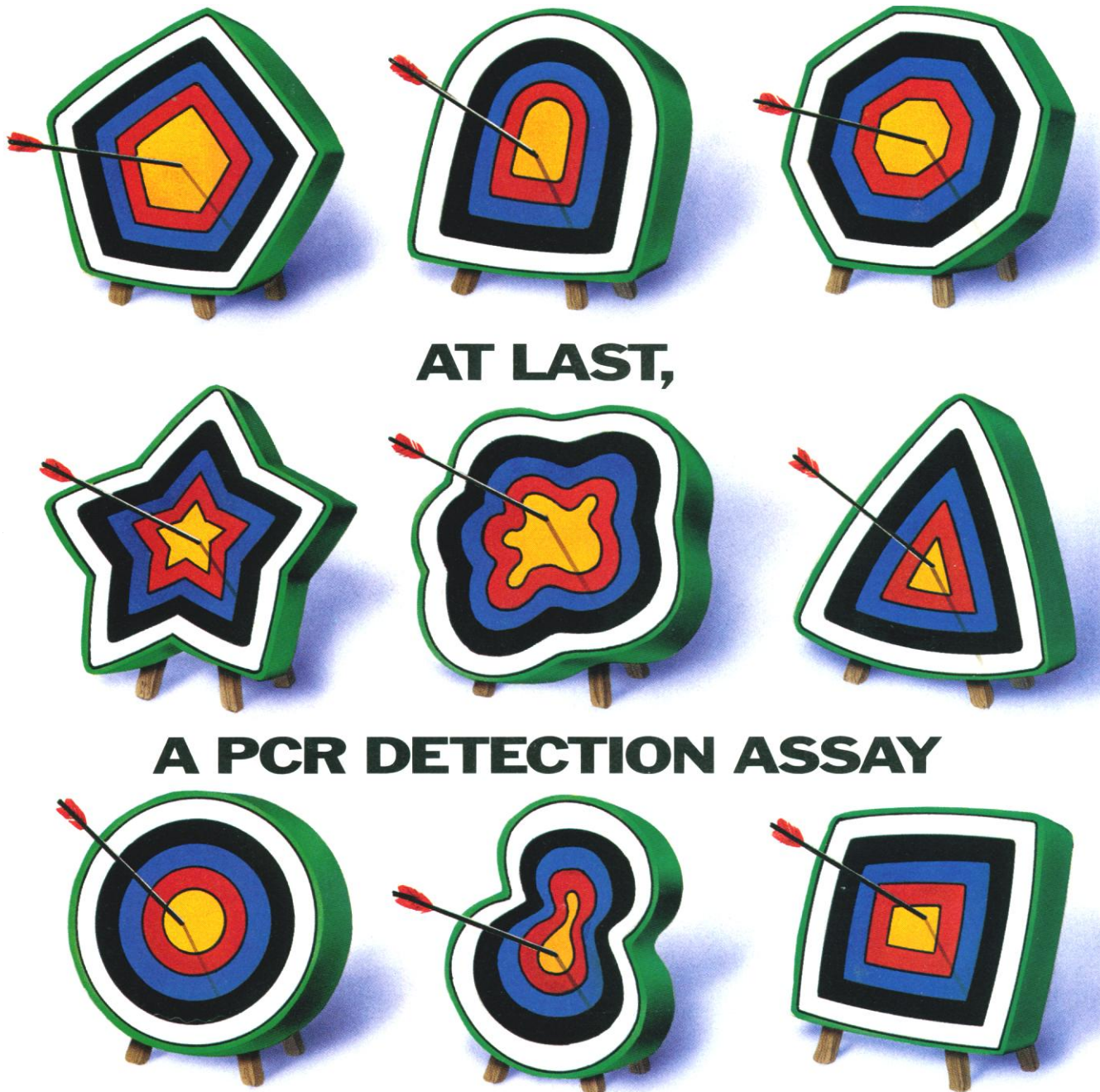


INTERSCIENCE

**Labnet**

DISTRIBUTORS: Australia: Integrated Sciences Pty. Ltd. 008 25 2204 (toll-free), Austria: Biomedica GmbH 0222 292 3527, Canada: InterScience 800 661 6431 / 416 940 1831, Denmark: AH Diagnostics 45 86 101055, Egypt: Lab Technology 20 2 245 1785, Finland: KEBO Lab Oy 358 080 44900, France: Schleicher & Schuell 16 1 3475 9077, Germany: MWG Biotech 8092 24071, Israel: Gamidor Limited 03 535 1505, Italy: Celbio 392 3810 3171, Japan: Cosmo Bio Co. Ltd. 81 3 3663 0720, Korea: BMS Co. Ltd (02) 569 6902/4, Malaysia: Supreme Lab Supplies SDN BHD (03) 9300460, Netherlands & Belgium: BIOzym 31 45 32 77 55, New Zealand: Sci Tech 4 499 8868, Norway: Erling & Morten Lind A/S 22 72 2100, Portugal: Izasa Portugal - Dist. Tecnicas Lda. 35 1 757 0740, Singapore: Sci Med (Asia) Pte Ltd 266 1884, South Africa: South African Scientific Products 11 886 4710, Spain: Izasa SA 34 1 663 0500, Sweden: KEBO Lab AB 46 8 621 3400, Switzerland MWG Biotech 061 4111122, Taiwan: Chin Tycoon Enterprises Co. Ltd (02) 366 1681-4, Thailand: Diagnostics Biotechnology Co. Ltd (662) 5414259-62, USA: National Labnet 908 549 2100. Contact head office for further distributors or information.





**AT LAST,**

**A PCR DETECTION ASSAY**

**THAT ADAPTS TO ANY TARGET.**

Universal detection capability is one reason why Digene's SHARP Signal™ System hits the mark with so many labs. Because the same protocol can detect a variety of targets, it's cost-effective. It uses no radioactive isotopes, so there are no disposal costs to consider. It's so sensitive, it can detect positive PCR specimens that start with as few as 10 input molecules. Assay results are available in just a few hours. And, it won't detect PCR artifacts such as

primer dimers – only the target of interest is detected. Best of all, it's a standardized strip-well microplate format that gives both qualitative and quantitative colorimetric results. All considered, Digene's SHARP Signal System is one PCR detection assay that's right on target.

To order your kit or for more information, call 1-800-DIGENE-1. International inquiries, call 301-470-6500 or fax 301-680-0696.

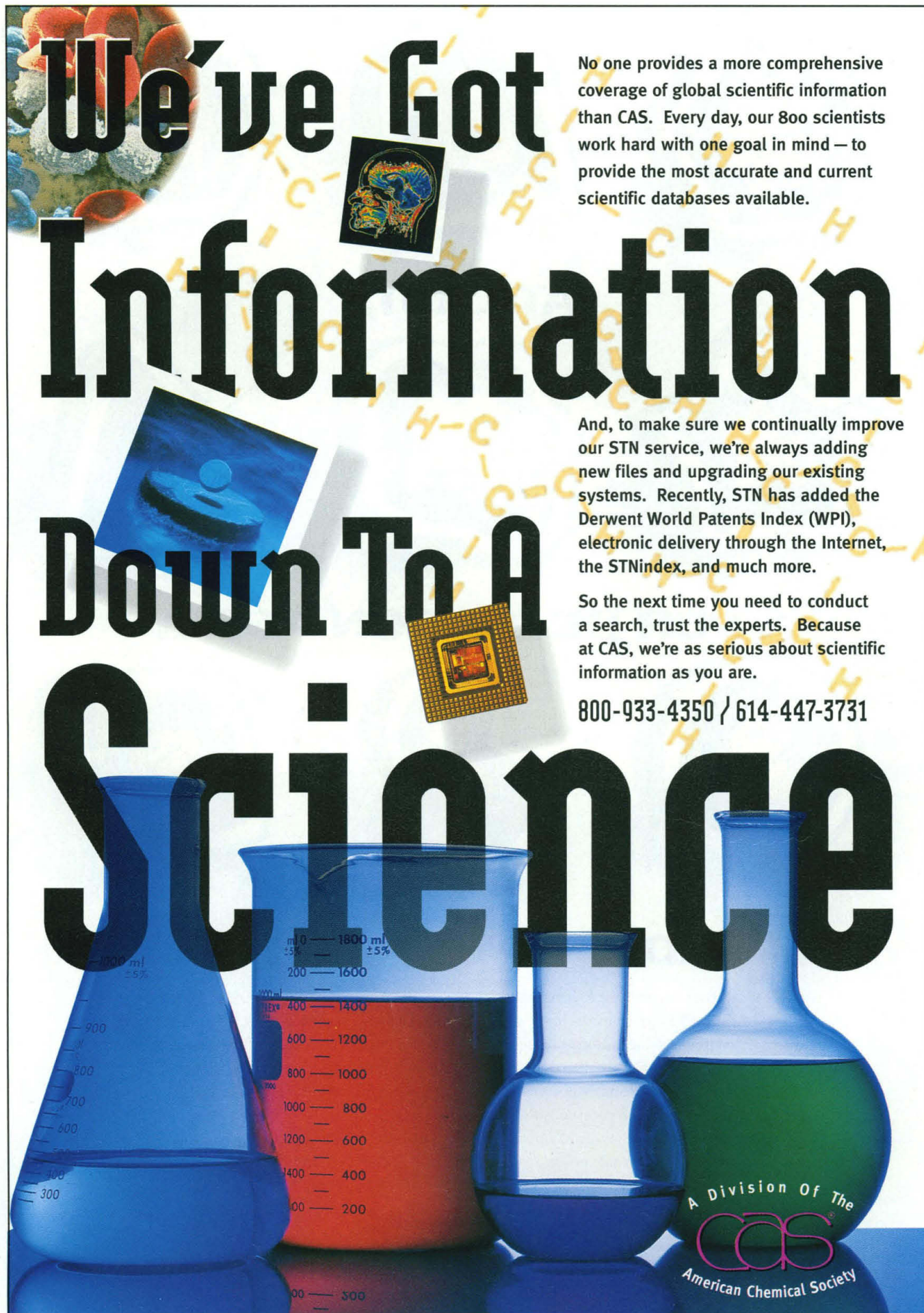


*Digene SHARP Signal System Probe/Primer Sets are available to detect HIV, HBV, HCV, CMV, Mtb, and other infectious disease targets.*

**For research use only.** The Polymerase Chain Reaction (PCR) process is covered by U.S. patents owned by Hoffman-LaRoche.

Circle No. 13 on Readers' Service Card





# We've Got Information Down To A Science

No one provides a more comprehensive coverage of global scientific information than CAS. Every day, our 800 scientists work hard with one goal in mind — to provide the most accurate and current scientific databases available.

And, to make sure we continually improve our STN service, we're always adding new files and upgrading our existing systems. Recently, STN has added the Derwent World Patents Index (WPI), electronic delivery through the Internet, the STNindex, and much more.

So the next time you need to conduct a search, trust the experts. Because at CAS, we're as serious about scientific information as you are.

800-933-4350 / 614-447-3731

A Division Of The  
**CAS**  
American Chemical Society

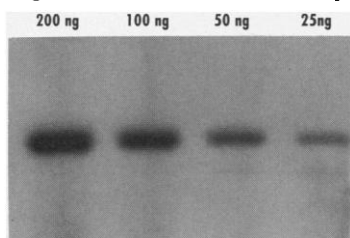


# GENOSYS

No. 1 Custom Oligonucleotide and Peptide Synthesis

## ALKALINE PHOSPHATASE LABELED OLIGOS GIVE YOU PERFORMANCE YOU CAN COUNT ON

Conjugate your oligos directly with alkaline phosphatase (AP), and eliminate radioactivity from your hybridizations. It's a great idea. Unfortunately, many researchers have found that



AP-labeled probe for the GAPDH gene yields high signal to noise ratios in a 33-minute exposure.

improperly purified AP-conjugates cause their own set of problems, including high background and decreased sensitivity.

With Genosys AP-conjugated oligos, you get performance you can count on. Each oligo is purified before conjugation. Free AP is removed from the conjugated product by ion exchange HPLC. As a final step, the activity of the product is quantitated by an enzyme-catalyzed colorimetric titration. The result: high sensitivity and quick exposure times.

Pricing and delivery are attractive, too. Only \$500 per oligo, typically delivered in 7-10 working days.

### NOW YOU CAN ORDER WHOLE GENES AS EASILY AS PROBES AND PRIMERS.

We'll work with you to design a coding sequence to suit your application. We'll clone it into the vector of your choice, verify the sequence, and deliver a guaranteed product, complete with restriction maps and QC autoradiographs.

### Non-Radioactively Labeled Primers

For chemiluminescent or colorimetric detection, Genosys offers a series of standard sequencing primers labeled with non-isotopic reporter molecules. The labeled primers are supplied purified, dried and ready to use — enough for over 100 sequencing reactions.

Choose any combination of the following primers and labels:

**Primers:** M13 (-21) Universal Primer, M13 Reverse Primer, T3 Primer, T7 Primer, SP6 Primer

**Labels:** Biotin, Fluorescein, Digoxigenin, ABL Dye Kit (includes primers labeled with FAM, JOE, ROX and TAMRA.)

With every Genosys oligo, the proof is in the package. Your Quality Assurance Certificate includes a digitized PAGE image, measured yield in O.D.s and mgs, and valuable information about your oligo, such as melting temperature, molecular weight and %AT.

**CUSTOM OLIGOS \$2.50 PER BASE, PLUS \$20 SETUP**

### Arbitrary 10-mer primer kits for fingerprinting and genetic mapping by PCR

Each kit includes ten arbitrary 10-mers, selected on the basis of a 60-80% G+C content. The arbitrary sequences avoid the presence of complementary ends and palindromes. Additional kits contain 10-mers with common restriction sites, so that amplified products may be digested and cloned for further study. All primers are supplied dry with a guaranteed yield of 0.5 O.D. units. Prices start at \$65 per kit.

### ORDER NOW AND GET A FREE STANDARD PRIMER OR PROBE!

Return or fax this coupon for details, or call **1-800-234-5362**

Free standard primer or probe    Custom oligo synthesis  
Alkaline phosphatase conjugated oligos  
Custom gene synthesis    Arbitrary 10-mer primers  
Non-isotopic primers

Name \_\_\_\_\_

Company/Institution \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

Phone \_\_\_\_\_ Fax \_\_\_\_\_

GENOSYS

Genosys Biotechnologies, Inc.

8701A New Trails Drive, The Woodlands, Texas 77381-4241  
Phone: (713) 363-3693 Fax: (713) 363-2212

The PCR process is covered by patents issued to Hoffmann-La Roche, Inc.

Circle No. 38 on Readers' Service Card



A unique enzyme with all the advantages

# Lacto-*N*-biosidase

from a strain of *Streptomyces* sp. 142

## A New Potent Tool for the Structural Analysis of Sugar Chains from TaKaRa

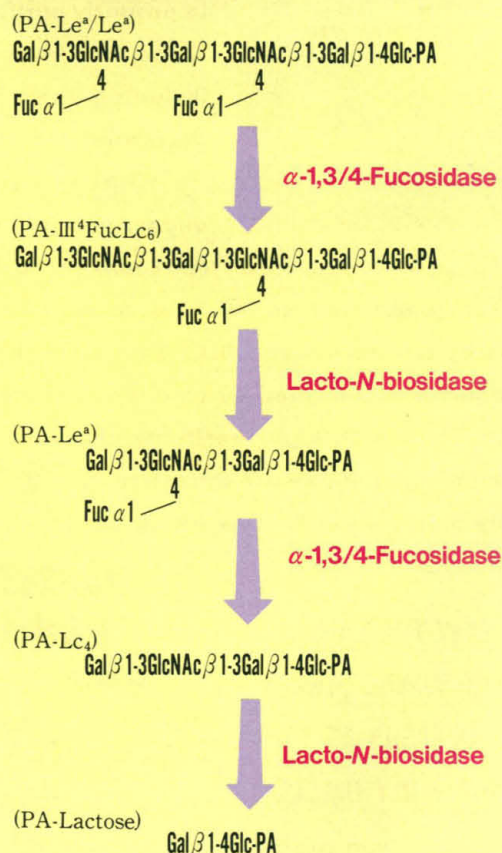
Code No. 4456 100  $\mu$ U

Lacto-*N*-biosidase acts **specifically** on oligosaccharides with type 1 chains releasing lacto-*N*-biose (Gal $\beta$ 1-3GlcNAc) from the nonreducing terminus. It never hydrolyzes oligosaccharides with type 2 chains. Therefore, it allows you to distinguish type 1 chains from type 2 chains in glycoproteins and glycolipids. In addition, you can distinguish Lewis<sup>a</sup> structures from Lewis<sup>x</sup> structures **more easily and rapidly** than ever by using Lacto-*N*-biosidase and  $\alpha$ -1,3/4-Fucosidase (TaKaRa Code No.4453) together. Consequently, Lacto-*N*-biosidase helps clarify the structure and function of oligosaccharides in glycoproteins and glycolipids.

Reference  
1) Sano, M. *et al.* (1992) *Proc. Natl. Acad. Sci. USA* **89**, 8512-8516.



Lacto-*N*-biosidase along with  $\alpha$ -1,3/4-Fucosidase sequentially digests dimeric Le<sup>a</sup> oligosaccharide



PA:Pyridylamino group  
Pyridylation, a fluorescence labeling method, facilitates sensitive detection.



**TAKARA SHUZO CO., LTD.**  
Biomedical Group:  
Seta 3-4-1, Otsu, Shiga,  
520-21, Japan  
Tel : +81 775-43-7247  
Fax : +81 775-43-9254

Distributor:  
USA and South America  
**PanVera Corporation**  
565 Science Drive, Madison  
Wisconsin 53711, USA  
Tel : 608-233-5050  
Toll Free: 1-(800)791-1400  
Fax: 608-233-3007

Europe  
**PBS-organics**  
Parc de l'Innovation BP 209,  
67405 Illkirch, Cedex, France  
Tel : 88 66 88 30  
Fax: 88 67 38 61

**ITC Biotechnology GmbH**  
Postfach 103028, 69020 Heidelberg, Germany  
Tel : (06221)303907  
Fax: (06221)303511

**British Bio-technology Products Ltd.**  
4-10, The Quadrant, Barton Lane, Abingdon  
OX14 3YS, UK  
Tel : (0235)529449  
Fax: (0235)533420

Taiwan  
**Cheng Chin Trading Co., Ltd.**  
No. 75, Sec. 1, Hankow St., Taipei, Taiwan  
Tel : (02)331-3111  
Fax: (02)382-2197



# A Full Spectrum of Cell Culture Products

*Sera & Alternatives*

*Cell Culture Media*

*Custom Media*

*Serum & Protein-Free Media*

*Growth Factors / Immunochemicals*

*Bioprocess Container Systems*

Within the spectrum of cell culture research and production, HyClone has the products and backup services to meet the changing future needs of cell culturists.



**HyClone®**  
Laboratories, Inc.

*"Innovative Products for Cell Culture"*

HyClone Laboratories, Inc. 1725 South HyClone Road, Logan, Utah 84321 Phone: 1-800-HYCLONE (492-5663) FAX: 1-800-533-9450  
HyClone Europe, Ltd. Nelson Industrial Estate, Cramlington Northumberland NE23 9BL United Kingdom  
Phone: 44-670-734093 FAX: 44-670-732537  
Other Countries: 1-801-753-4584 FAX: 1-801-753-4589

Circle No. 22 on Readers' Service Card





# Protein Science

A PUBLICATION OF THE PROTEIN SOCIETY

**Protein Science**, a major scientific publication of The Protein Society, is dedicated to the exploration of all scientific aspects of the "building blocks of life" — protein molecules. This innovative monthly journal presents research by leading scientists from round the world that advances the understanding of proteins in the broadest sense, ranging from their discovery, isolation, function, and molecular structure to the most advanced areas of molecular and cell biology in which proteins of defined molecular properties play a significant role. Published by Cambridge University Press for The Protein Society.

**CAMBRIDGE**  
UNIVERSITY PRESS

## ANNOUNCING ... ANNUAL AWARD FOR THE BEST PAPER

Parke-Davis Pharmaceutical Research, Division of Warner-Lambert Company will sponsor an annual award of \$5,000 plus \$1,000 for travel to the annual Symposium of The Protein Society, for the best paper published in *Protein Science*. The Final selection will be made by an anonymous jury. The first award will be announced at the annual Symposium in July 1995 for the best paper published in Volume 3 (1994). Nominations should be sent to Dr. Hans Neurath, Editor-in-Chief, *Protein Science*, University of Washington, SJ-70, Seattle, WA 98195.

40 WEST 20TH STREET  
NEW YORK, NY 10011-4211

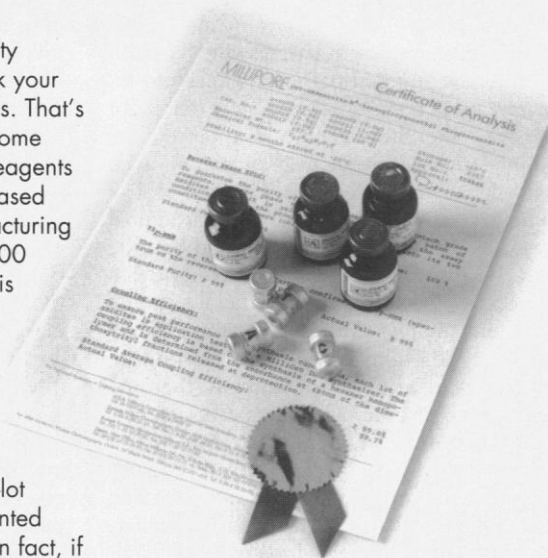
Circle No. 33 on Readers' Service Card

**Now available for ABI systems!**

# DNA/RNA Synthesis Reagents.

Synthesizing a quality oligonucleotide requires quality reagents. So you wouldn't risk your research on just any chemicals. That's why Certificates of Analysis come with all of our amidites and reagents — from one of the first U.S.-based companies to have its manufacturing facilities registered to ISO 9000 Quality System Standards. This is the reason why we're the leading supplier of DNA monomers used to synthesize nucleotides as antisense therapeutics — products that have to meet stringent FDA standards. You get lot-to-lot consistency with fully documented processes. We guarantee it. In fact, if you're not satisfied with the quality of our products we'll replace it, free.

**MILLIPORE**



**And when you need help with an application or protocol, our Technical Support Group is just a phone call away.**

### Let us show you how to:

- Reduce DNA cleavage and deprotection time from up to 8 hours to 15 minutes at 55 °C.
- Build DNA analogs with a peptide backbone.
- Make RNA that handles like DNA.
- Synthesize fluorescein-labelled primers automatically.

Or just build a simple oligo. These are just some of the applications developed for you by our team of scientists dedicated to nucleic acid synthesis.

We're sure that our chemicals are top quality. To prove it, we'll send you a qualifier card for a *free sample kit of amidites* for use in your ABI, Millipore or other synthesizer when you order our catalogue. Call today toll-free **1-800-MILLIPORE** (1-800-645-5476). In Europe, FAX 33-1-30 12 71 89.

© 1993 Millipore Corporation  
ABI is a trademark of Applied Biosystems, Inc.

Circle No. 27 on Readers' Service Card