

AMERICAN  
ASSOCIATION FOR THE  
ADVANCEMENT OF  
SCIENCE

# SCIENCE

13 JANUARY 1995  
VOL. 267 • PAGES 145-300

\$7.00





# **Pfu** For High-Fidelity PCR<sup>\*</sup> **Beats** **Taq** **12to1**

If you need the lowest possible error rate or blunt-ended PCR fragments, you need *Pfu* DNA polymerase! Unlike *Taq* DNA polymerase, *Pfu* proof-reads and corrects errors<sup>1</sup>.

The proof is in the PCR. If a 1-kb sequence is amplified for 20 effective cycles, there will be misincorporation mutations in 40% of the products generated with *Taq*, but of those amplified with *Pfu* only 3.2% will have mutations.

**The advantages  
add up to  
better PCR!**

• >12 times higher fidelity

• Blunt-ended fragments

***Pfu* DNA polymerase.  
There is only one original.**



**STRATAGENE®**

Native *Pfu* DNA Polymerase Catalog #600135 (100U), #600136 (500U)

Recombinant *Pfu* DNA Polymerase Catalog #600153 (100U), #600154 (500U), #600159 (1000U)

\*Purchase of this enzyme is accompanied by a license to use it in the polymerase chain reaction (PCR) process in conjunction with an authorized thermal cycler. Stratagene's PCR products are sold under licensing arrangements with Roche Molecular Systems, Inc., F. Hoffmann-La Roche Ltd. and the Perkin-Elmer Corporation.

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

Circle No. 43 on Readers' Service Card

INTERNET MAIL  
tech\_services@stratagene.com

#### USA

Corporate Headquarters  
(800) 424-5444  
(619) 535-5400  
Fax: (619) 535-0045

#### GERMANY

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

#### UNITED KINGDOM

Stratagene Ltd.  
Telephone: (0223) 420955  
Telefax: (0223) 420234

#### SWITZERLAND

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

***Pfu*: 3.2%  
mutations**

Our thanks to Dr. Kary Mullis for mutating

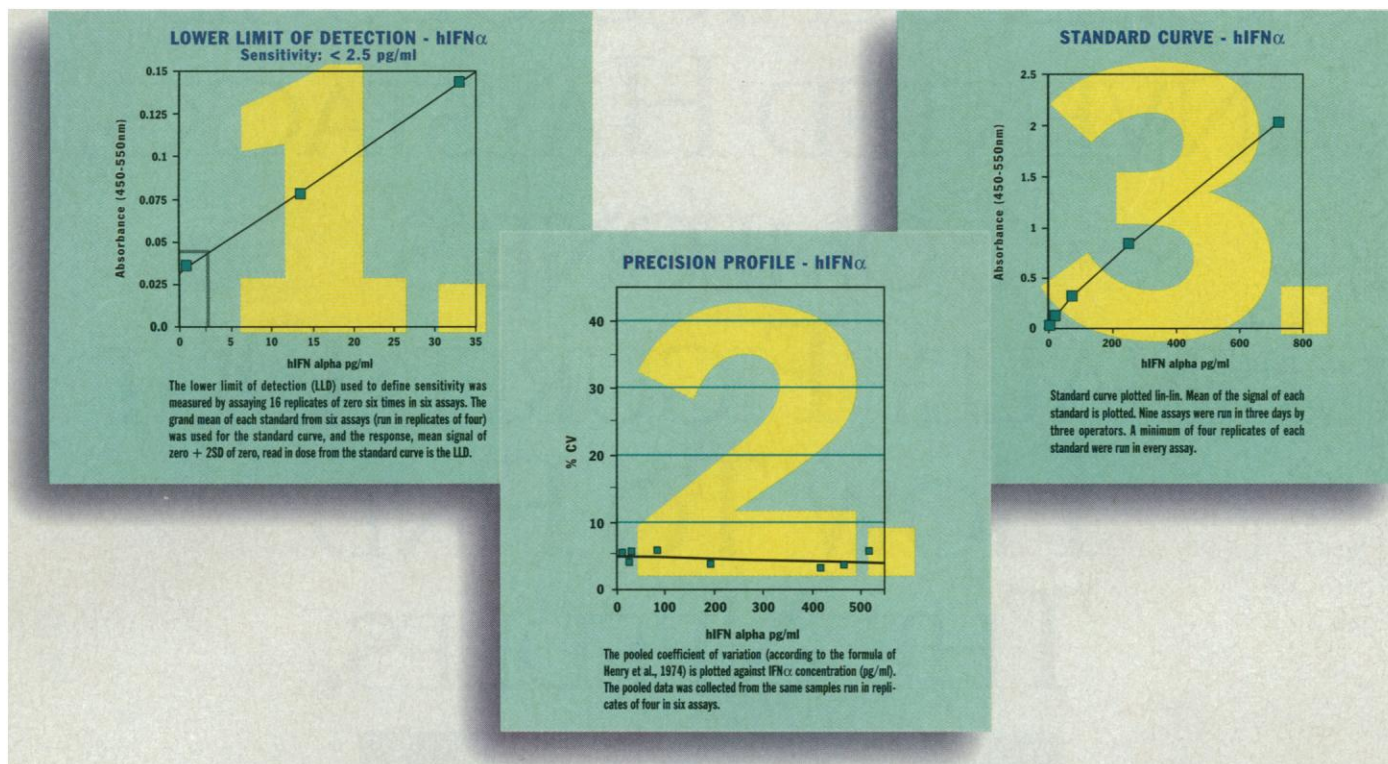
Call Stratagene or  
your Stratagene distributor  
for the complete picture.

***Taq*: 40%  
mutations**



# Human IFN $\alpha$ ELISA.

## Validate your results 1, 2, 3.



## For cytokine results you can count on.

**New.** Endogen's human Interferon alpha ELISA has been developed to meet the rigorous and unique requirements for quantitation of this cytokine.

- 1. Sensitivity: < 2.5 pg/ml**
- 2. C.V.s: < 10%**
- 3. Assay Range: 2.5 - 700 pg/ml**
- 4. Calibrated to NIAID standards**
- 5. Protocol: Rapid, User-friendly, 3 hours**
- 6. Validated by FS-7 bioassay**

**Sensitive.** High sensitivity, low background, excellent precision and the capability to detect various subtypes of IFN $\alpha$  are features you can count on.

**Tested.** This kit has been thoroughly tested in a variety of matrices including serum, plasma, urine and culture supernatants.

**NIAID compliant.** Endogen's IFN $\alpha$  is calibrated to National Institute of Allergy and Infectious Disease

OTHER CYTOKINE ELISAS	
HUMAN	MOUSE
•hIL-1 $\alpha$ <sup>new</sup>	•mIL-2
•hIL-1 $\beta$ <sup>new</sup>	•mIL-3
•hIL-2	•mIL-4
•hIL-4	•mIL-5
•hIL-6	•mIL-6
•hIL-8*	•mIL-10
•hIL-10	•mIFN $\gamma$
•hIFN $\gamma$	•mGM-CSF
•hGM-CSF	•mTNF $\alpha$
•hTNF $\alpha$	
•hTNF $\beta$ *	
CELL ADHESION ELISAS	
•hsICAM-1*	•hsTNFR*
•hsELAM-1*	•msICAM-1

reference standard  
#Ga23-901-532.

**Accurate.** For accuracy in cytokine quantitation, validate your results with Endogen.

Call us today at  
800-487-4885.

640 MEMORIAL DRIVE, CAMBRIDGE, MA 02139 USA 617.225.0055 FAX 617.225.2040  
For research use only. Not for use in diagnostic or therapeutic procedures.

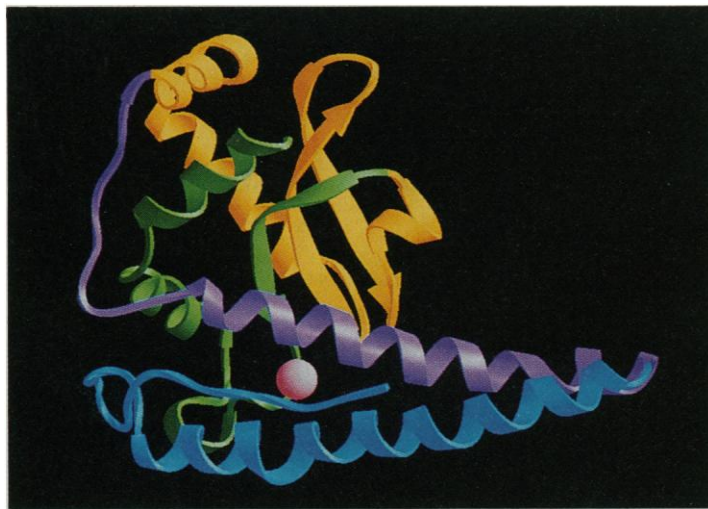
Head Office for Europe Biozol Diagnostica  
TEL 49-(89) 3192053  
FAX 49-(89) 3193611

In Japan Funakoshi Co., Ltd.  
TEL 81+(3) 56841622  
FAX 81+(3) 56841633

**ENDOGEN**  
**800.487.4885**

Circle No. 44 on Readers' Service Card

TWENTY YEARS AFTER  
MOLECULAR BIOLOGISTS  
INVENTED HAYSTACKS,  
SOMEONE'S  
FINALLY FIGURED OUT  
HOW TO FIND  
THE NEEDLES.







Crude cytokine prep.  
Lane 1: MW markers.  
Lane 2: Crude.

## You know it's in there.

Somewhere in that liter of crude extract, there's a few  $\mu$ g of your recombinant protein, if you're lucky.

It took you a year and a half to get this far. The important research won't happen until you purify the active protein.

You've made several

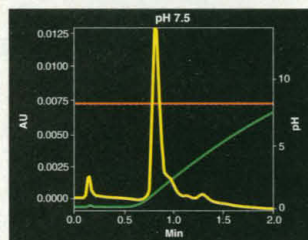
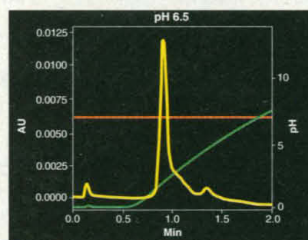
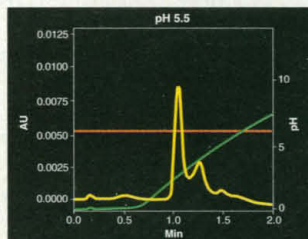
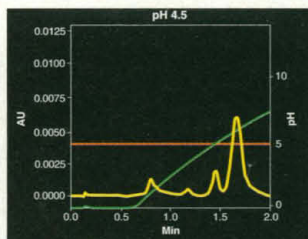
attempts with conventional chromatography columns and instruments and still don't have a clean molecule to work with.

## Is it the pH? the gradient? the loading? the surface chemistry? the...

You're in uncharted territory. There's no way to know which variable holds the key, and you don't have the luxury to test them all. Time is running out.

## There has to be a more rational approach to purification.

There is. It starts by using POROS® Perfusion Chromatography® media and one of our automated systems, like the BioCAD™ Workstation.



Initial pH mapping experiment of crude cytokine prep on POROS 20 HS cation exchange. Optimization of key separation variables including pH, gradient, loading, and flow rate can be completed in minutes.

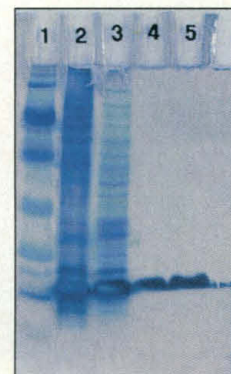
At one to three minutes per run, you are able to explore more variables (pH, buffers, column chemistries...) than you've ever considered possible. By the end of the day you've generated all the data you need for an optimal method. Then you run a final gel.

## There it is!

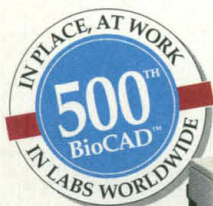
A nice, clean, biologically active protein. You're back on track, and ready to pursue the true objectives of your work.

## Accelerate your research with PerSeptive.

Complete your purification projects in days, not weeks or months. Join the thousands of researchers who have discovered PerSeptive Biosystems' broad selection of enabling tools, for every molecule and budget. Call PerSeptive Biosystems today toll-free: 1-800-899-5858.



Lane 1: MW markers.  
Lane 2: Crude.  
Lane 3: Pooled fractions after initial cation exchange step.  
Lanes 4 & 5: Purified cytokine after second purification step with POROS 20 PH hydrophobic interaction column.



BioCAD/SPRINT™



BioCAD™ Workstation



ConSep™

POROS® Columns and Media



**PerSeptive Biosystems**  
Bioseparations Products

38 Sidney Street, Cambridge, MA 02139 (617) 621-1787  
Germany Tel: +49 761 452 240 • Japan Tel: +81 353 89 7371  
France Tel: +33 1 42 05 40 81 • U.K. Tel: +44 0895 810 289

Perfusion Chromatography and POROS are registered trademarks of PerSeptive Biosystems. BioCAD, BioCAD/SPRINT, Self Pack and ConSep are trademarks of PerSeptive Biosystems. Perfusion Chromatography and POROS perfusive media are protected by US patents 5,019,270; 5,228,989; and 5,030,352. Molecular image courtesy of J. Tainer, G. Borgstahl and H. Parge: Metalloprotein Structure and Design Group, the Scripps Research Institute. © 1994 PerSeptive Biosystems

Circle No. 24 on Readers' Service Card



**172**  
*Escherichia coli*  
genome controversy

## NEWS & COMMENT

Future Grows Dim for Fusion 164

Agency Chiefs Seek Help With Budgets 165

NSF Moves Into FastLane to Manage Flow of Grants 166

Bendectin Case Dismissed 167

Critical ILL Back From the Dead 167

China to Triple Internet Links With Commercial Hookups 168

Biosphere 2 Gets New Lease on Life From Research Plan 169

## RESEARCH NEWS

Getting the Bugs Worked Out 172  
The Gold Bug: *Helicobacter pylori* 173

How Number Theory Got the Best of the Pentium Chip 175

Bigger Jolts Are on the Way for Southern California 176

A New Face for the Glutamate Receptor 177

High Turnover of HIV in Blood Revealed by New Studies 179

## PERSPECTIVE

Oscillating Catalysts: A New Twist for Plastics 191  
K. B. Wagener

## ARTICLES

Big-Bang Nucleosynthesis and the Baryon Density of the Universe 192  
C. J. Copi, D. N. Schramm, M. S. Turner

Prospects for Larger or More Frequent Earthquakes in the Los Angeles Metropolitan Region 199  
J. F. Dolan, K. Sieh, T. K. Rockwell, R. S. Yeats, J. Shaw, J. Suppe, G. J. Huftile, E. M. Gath

## REPORTS

Response of High-Rise and Base-Isolated Buildings to a Hypothetical  $M_w$  7.0 Blind Thrust Earthquake 206  
T. H. Heaton, J. F. Hall, D. J. Wald, M. W. Halling

## DEPARTMENTS

THIS WEEK IN SCIENCE 153

EDITORIAL 155  
Chairman of the House Science Committee

LETTERS 157  
"The Duesberg Phenomenon": What Does It Mean?: C. Andrews; K. Van Rompay and M. L. Marthas; R. C. Strohmman; H. Rubin; J. A. Sonnabend; R. S. Root-Bernstein

SCIENCESCOPE 163

RANDOM SAMPLES 170  
Sorry News for NIMH Head-Hunt • Jury Still Out on Gulf Syndrome • Cutting RNA With DNA • High Price of Freedom • Hope for Ethanol Fuel? • Saving Our Roots From Roots, etc.

BOOK REVIEWS 264  
*Home Is Where the Wind Blows*, reviewed by J. Faulkner • *Long-Term Potentiation*, R. Dingledine • *Ion Channels in the Cardiovascular System*, S. Sorota • Vignettes • Books Received

PRODUCTS & MATERIALS 274

## Board of Reviewing Editors

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

Kathryn Calame  
C. Thomas Caskey  
Dennis W. Choi  
John M. Coffin  
F. Fleming Crim  
Paul J. Crutzen  
James E. Dahlberg  
Robert Desimone  
Bruce F. Eldridge  
Paul T. Englund

Richard G. Fairbanks  
Douglas T. Fearon  
Harry A. Fozzard  
Klaus Friedrich  
Theodore H. Geballe  
John C. Gerhart  
Roger I. M. Glass  
Stephen P. Goff  
Peter N. Goodfellow  
Corey S. Goodman

Ira Herskowitz  
Eric F. Johnson  
Stephen M. Kosslyn  
Michael LaBarbera  
Nicole Le Douarin  
Charles S. Levings III  
Alexander Levitzki  
Harvey F. Lodish  
Richard Losick  
Reinhard Lührmann

Diane Mathis  
Anthony R. Means  
Shigetada Nakanishi  
Roger A. Nicoll  
Stuart L. Pimm  
Yeshayau Pocker  
Dennis A. Powers  
Ralph S. Quatrano  
V. Ramanathan  
Douglas C. Rees

T. M. Rice  
David C. Rubie  
Erkki Ruoslahti  
Gottfried Schatz  
Jozef Schell  
Ronald H. Schwartz  
Terrence J. Sejnowski  
Ellen Solomon  
Thomas A. Steitz  
Michael P. Stryker

Robert T. N. Tjian  
Emil R. Unanue  
Geerat J. Vermeij  
Bert Vogelstein  
Harold Weintraub  
Arthur Weiss  
Zena Werb  
George M. Whitesides  
Owen N. Witte  
William A. Wulf



Fully open flowers of *Amsinckia vernicosa*, showing the reduced flower size typical of highly self-fertilizing species. Self-fertilization has evolved many times in plants. Extreme rates of self-fertilization provide an opportunity for estimating mutation rates to mildly deleterious alleles and the average dominance level of such muta-

tions. These quantities and information on the reduced fitness of progeny from self-fertilization are important in genetic models of the evolution of sex, recombination, and self-fertilization rates. See page 226. [Photo: G. L'Heureux, McGill Biology Image Centre]



# Earthquakes in the Los Angeles Metropolitan Region: A Possible Fractal Distribution of Rupture Size

S. E. Hough

211

# Rapid Accretion and Early Differentiation of Mars Indicated by $^{142}\text{Nd}/^{144}\text{Nd}$ in SNC Meteorites

C. L. Harper Jr., L. E. Nyquist, B. Bansal, H. Wiesmann, C.-Y. Shih

213

# Oscillating Stereocontrol: A Strategy for the Synthesis of Thermoplastic Elastomeric Polypropylene

G. W. Coates and R. M. Waymouth

217

# Segregation in DNA Solutions Induced by Electric Fields

L. Mitnik, C. Heller, J. Prost, J. L. Viovy

219

# High-Rate, Gas-Phase Growth of $\text{MoS}_2$ Nested Inorganic Fullerenes and Nanotubes

Y. Feldman, E. Wasserman, D. J. Srolovitz, R. Tenne

222

# Mutation Rates and Dominance Levels of Genes Affecting Total Fitness in Two Angiosperm Species

M. O. Johnston and D. J. Schoen

226

# Inhibition of Host Gene Expression Associated with Plant Virus Replication

D. Wang and A. J. Maule

229

# A Salt-Sensitive 3'(2'),5'-Bisphosphate Nucleotidase Involved in Sulfate Activation

J. R. Murguía, J. M. Bellés, R. Serrano

232

# Identification of Bases in 16S rRNA Essential for tRNA Binding at the 30S Ribosomal P Site

U. von Ahsen and H. F. Noller

234

# Cleavage of an Amide Bond by a Ribozyme

X. Dai, A. De Mesmaeker, G. F. Joyce

237

# Metabolic Engineering of a Pentose Metabolism Pathway in Ethanologenic *Zymomonas mobilis*

M. Zhang, C. Eddy, K. Deanda, M. Finkelstein, S. Picataggio

240

# A Phagosome-to-Cytosol Pathway for Exogenous Antigens Presented on MHC Class I Molecules

M. Kovacsovics-Bankowski and K. L. Rock

243

# Requirement of FGF-4 for Postimplantation Mouse Development

B. Feldman, W. Poueymirou, V. E. Papaioannou, T. M. DeChiara, M. Goldfarb

246

# Inhibition of Ras-Induced Proliferation and Cellular Transformation by p16<sup>INK4</sup>

M. Serrano, E. Gómez-Lahoz, R. A. DePinho, D. Beach, D. Bar-Sagi

249

## TECHNICAL COMMENTS

# Assessing Molecular Phylogenies

A. W. F. Edwards; M. Nei, N. Takezaki, T. Sitnikova; D. M. Hillis and J. P. Huelsenbeck

253

# The GISP Ice Core Record of Volcanism Since 7000 B.C.

S. J. Fiedel; J. R. Southon and T. A. Brown; G. A. Zielinski, P. A. Mayewski, L. D. Meeker, S. Whitlow, M. S. Twickler, M. Morrison, D. A. Meese, A. J. Gow, R. B. Alley

256

# Delayed Helix Formation of Mutant Collagen

B. Steinmann and M. Raghunath

258

176, 199,  
206 & 211

Bad breaks for  
Southern California



## AAAS Board of Directors

Eloise E. Clark  
Retiring President,  
Chairman  
Francisco J. Ayala  
President  
Rita R. Colwell  
President-elect

William A. Lester Jr.  
Simon A. Levin  
Anna C. Roosevelt

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 © 1995 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): \$97 (\$50 allocated to subscription). Domestic institutional subscription (51 issues): \$228. Foreign postage extra: Mexico, Caribbean (surface mail) \$53; other countries (air assist delivery) \$93. First class, airmail, student and emeritus rates on request. Canadian rates with GST available upon request. GST #1254 88122. Printed in the U.S.A.

## Indicates accompanying feature

**Change of address:** allow 6 weeks, giving old and new addresses and 11-digit account number. **Postmaster:** Send change of address to *Science*, P.O. Box 20333, Marion, OH 43305-2033. **Single copy sales:** \$7.00 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 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.



## NOMINATIONS FOR THE 1996 LOUIS JEANTET PRIZE FOR MEDICINE

Nominations are being sought for the 1996 Louis Jeantet Prize for Medicine. One to three prizes will be awarded. They will amount to a maximum of 2 million Swiss Francs (approximately 1.4 million US Dollars) in 1996. These prizes will provide substantial funds for the support of biomedical research projects (fundamental or clinical) of the highest quality. Candidacies in clinical research are strongly encouraged.

Candidates (either individuals or research groups) must be nominated by scientists, physicians or institutions having detailed knowledge of the candidates' research. The Louis Jeantet Prize for Medicine is not intended to honour past accomplishments but to help and encourage the winners' continued research activity. Candidates shortlisted for the final selection will therefore be asked to provide a research project to which the financial support of the Prize could give decisive impetus.

The previous winners of the Louis Jeantet Prize for Medicine have been **Luc Montagnier, Michael Berridge and Désiré Collen** in 1986, **Sidney Brenner, Walter Gehring and Dominique Stehelin** in 1987, **Bert Sakmann, John Skehel and Rolf Zinkernagel** in 1988, **Roberto Poljak, Walter Schaffner and Greg Winter** in 1989, **Nicole Le Douarin, Harald Von Boehmer and Gottfried Schatz** in 1990, **Pierre Chambon, Frank Grosveld and Hugh Pelham** in 1991, **Paul Nurse, Christiane Nüsslein-Volhard and Alain Townsend** in 1992, **Jean-Pierre Changeux, Richard Henderson and Kurt Wüthrich** in 1993, **Thierry Boon, Jan Holmgren and Philippe Sansonetti** in 1994, **Dirk Bootsma and Jan Hoeijmakers, Peter Goodfellow and Robin Lovell-Badge, and Peter Gruss** in 1995.

The following general points should be noted:

1. The Prize is intended for researchers working in European countries, members of the Council of Europe. The candidates need not, however, be themselves nationals of any of these countries.
2. Applications must be submitted, confidentially, on the official forms only. These are obtainable from:

**The Secretary of the Science Committee  
The Louis Jeantet Foundation for Medicine  
P.O. Box 277  
CH—1211 GENEVA 17  
Switzerland**

Further information will be sent with the nomination form.

3. The deadline for applications is February 15, 1995.

The name(s) of the winner(s) of the 1996 Louis Jeantet Prize for Medicine will be announced in January 1996. The Prize Ceremony will take place in Geneva (Switzerland) in April 1996.



## Dissecting the dark

Measurement of the present cosmic abundances of deuterium, helium, and lithium constitutes an increasingly refined probe of nucleosynthesis during the first few minutes of cosmic history. To make models and measurements agree, Copi *et al.* (p. 192) argue that at least some of the notorious cosmological dark matter must be baryonic. If the total density of the universe is at or close to the critical value, however, as many observations indicate, most of the dark matter must be non-baryonic.

## Polymers to order

Polymer properties such as elasticity can depend on the way in which the monomer building blocks are joined. For example, isotactic polypropylene, in which all the pendant methyl groups are arranged in the same way, is a crystalline thermoplastic, whereas atactic polypropylene, in which the methyl groups are arranged at random, is an amorphous gum. Coates and Waymouth (p. 217; see the Perspective by Wagener, p. 191) have developed a transition metal catalyst for the polymerization of propylene that allows the degree of stereoregularity (the mix of atactic and isotactic content) and hence the physical properties of the polymer to be varied simply by changing the propylene pressure and the reaction temperature.

## Inorganic fullerenes

Arc discharges and plasma conditions are generally needed for synthesizing carbon fullerenes and nanotubes. Feldman *et al.* (p. 246) have synthesized MoS<sub>2</sub> in the form of nested fullerenes or as nanotubes through the gas-

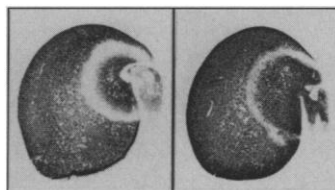
## The stress of waiting

The measured accumulation of strain across the Los Angeles region is more than can be accounted for by recorded seismic activity in the past two centuries, suggesting that there is a potential for moderate to large earthquakes, with magnitudes larger than the recent Northridge quake ( $M_w$  6.7), to occur in the future. Dolan *et al.* (p. 199) and Hough *et al.* (p. 211) present two separate analyses of this problem, both concluding that the typical interval between larger quakes, up to  $M_w$  7.6, is a few hundred years or more. In a related study Heaton *et al.* (p. 206) predict through a modeling study that the effect of ground motion associated with such quakes may cause collapse even of newly designed buildings close to the epicenter. Additional lessons learned from the Northridge quake, which occurred 1 year ago, are discussed in a news story by Kerr (p. 176).

phase reaction of MoO<sub>3-x</sub> and H<sub>2</sub>S at elevated temperatures (800° to 950°C). Turbulent flow conditions in the reactor produced the highest yields, and an inorganic fullerene phase with a narrow size distribution could be obtained.

## Viral disturbance

Pea seed-borne mosaic virus infects the plant embryo early in development and, as the infection proceeds, spreads into the cotyledons. Wang and Maule (p. 229) have studied the



effect of the invading virus on the metabolism of the host cells. Viral replication occurs early in infection, and thus in pea cotyledons is localized to the infection front; in the same region, the virus suppresses the expression of host genes and disturbs host protein translation. These changes plausibly underlie the appearance of viral symptoms in the plants.

## Coping with salt

A little bit of salt may be tasty, but too much is hard on the metabolism of many types of cells. Murguía *et al.* (p. 232) have found that, in yeast cells, the salt tolerance gene *HAL2* encodes a nucleotidase that participates in the general sulfur metabolism of the cell and is inhibited by sodium and lithium. When *HAL2* is overexpressed, the cells can tolerate higher than normal amounts of extracellular salt. Understanding the mechanisms of salt tolerance may aid the development of crop plants with greater salt tolerance, an important agricultural goal as heavy irrigation tends to make soil increasingly salty.

## Wood alcohol

Efforts to produce ethanol from lignocellulosic biomass, such as agricultural and forestry residues, have been hindered by the lack of microorganisms that can efficiently ferment pentose sugars, which commonly occur in hemicellulose. Zhang *et al.* (p. 240; see Random Samples, p. 171) have engineered the bacterium *Zymomonas mobilis*, which already has some advantages

over yeast in the fermentation of glucose to ethanol, so that it can digest xylose. The genes for the enzymes required for xylose assimilation and the pentose phosphate pathway were transformed into *Z. mobilis*, which was able to ferment both xylose and glucose to ethanol.

## Primitive biochemistry

In the primordial world, an ancestral RNA enzyme (ribozyme) may have catalyzed both RNA polymerization and peptide bond formation. Dai *et al.* (p. 237) present data that may support this scenario. They show that a variant form of a group I ribozyme, optimized by in vitro evolution for its ability to cleave phosphodiester bonds, can also cleave an unactivated amide bond. These results have implications for both the evolution of catalytic function and the origin of protein synthesis.

## From the outside in

Generation of a cytotoxic T lymphocyte (CTL) response is normally initiated by an antigen-presenting cell bearing major histocompatibility complex (MHC) class I molecules bound to a peptide synthesized by the cell, but in a few cases pathogens or particulate antigens also generate a CTL response. Kovacsics-Bankowski and Rock (p. 243) show that macrophages can transport these extracellular antigens into the cytosol, from which point they are dealt with by the normal MHC class I pathway. These results suggest that it may be possible to induce a CTL response by means of inert particulate proteins without the use of a live vaccine to introduce the antigen into cells.



# MAPPING THE HUMAN GENOME

Advanced by a diverse  
range of 8-Base Cutters  
from New England Biolabs

At New England Biolabs, we are dedicated to producing highly-pure restriction enzymes for the manipulation and analysis of genomic DNA. Our diverse range of 8-base cutters includes recombinant Not I, Asc I and Sfi I. And now, NEB introduces recombinant Fse I which offers both the exceptional purity and unmatched value essential for success in your genomic research.

<b>Fse I</b>	#588S	100 units	<b>Pac I</b>	#547S	100 units
	#588L	500 units		#547L	500 units
<b>NEW!</b>		5'...G G C C G G C C...3'	5'...T T A A T T A A...3'		3'...A A T T A A T T...5'
		3'...C C G G C C G G...5'			
<b>Asc I</b>	#558S	500 units	<b>Pme I</b>	#560S	100 units
	#558L	2,500 units		#560L	500 units
<b>MORE UNITS!</b>		5'...G G C C G G C C...3'	5'...G T T T A A A C...3'		3'...C A A A T T T G...5'
		3'...C C G G C C G G...5'			
<b>Not I</b>	#189S	500 units	<b>Sfi I</b>	#123S	2,000 units
	#189L	2,500 units		#123L	10,000 units
		5'...G C C G G C C G C...3'	5'...G G C C N N N N G G C C...3'		3'...C C G G N N N N C C G G...5'
		3'...C G C C G G C G...5'			

For more information about 8-Base Cutters from New England Biolabs contact us at 1-800-NEB-LABS or via the Internet at [info@neb.com](mailto:info@neb.com).

- New England Biolabs Inc. 32 Tozer Road, Beverly, MA 01915 USA 1-800-NEB-LABS Tel. (508) 927-5054 Fax (508) 921-1350 email: [info@neb.com](mailto:info@neb.com)
- New England Biolabs Ltd., Canada Tel. (800) 387-1095 (905) 672-3370 Fax (905) 672-3414 email: [info@ca.neb.com](mailto:info@ca.neb.com)
- New England Biolabs GmbH, Federal Republic of Germany Tel. (0130) 83 30 31 (06196) 3031 Fax (06196) 83639 email: [info@de.neb.com](mailto:info@de.neb.com)
- New England Biolabs (UK) Ltd. Tel. (0800) 31 84 86 (01462) 420616 Fax (01462) 421057 email: [info@uk.neb.com](mailto:info@uk.neb.com)

DISTRIBUTORS: Australia (075) 94-0299; Belgium (0800) 1 9815; Brazil (011) 66-3565; Denmark (31) 56 20 00; Finland (90) 420-8077; France (1) 34 60 24 24; Greece (01) 5226547; Hong Kong 649-9988; India (542) 311473; Israel (03) 5351205; Italy (02) 38103171; Japan (03) 3272-0671; Korea (02) 556-0311; Mexico (5) 519-3463; Netherlands (033) 95 00 94; New Zealand (09) 418-3039; Norway 22 22 04 11; Singapore 4457927; Sweden (08) 7348300; Switzerland (061) 481 47 13; Taiwan (02) 8802913



20 years and beyond...

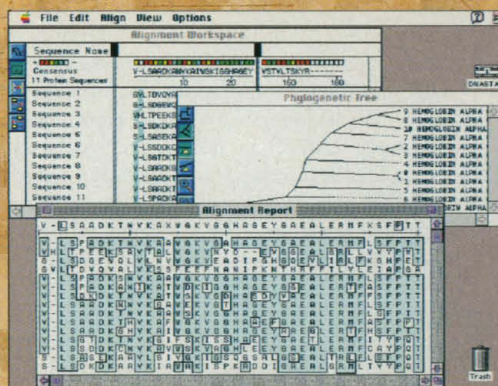
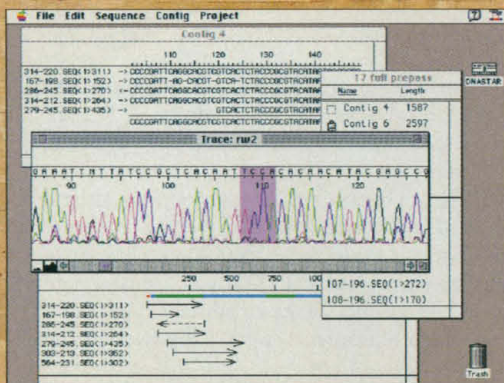
Circle No. 32 on Readers' Service Card





# LaserGene

## PREMIER SOFTWARE FOR THE MACINTOSH



## AVAILABLE NOW FOR WINDOWS!

Call **DNASTAR**

**USA: (608) 258-7420**

**Fax (608) 258-7439**

**Europe: (44)-81-566 8282**

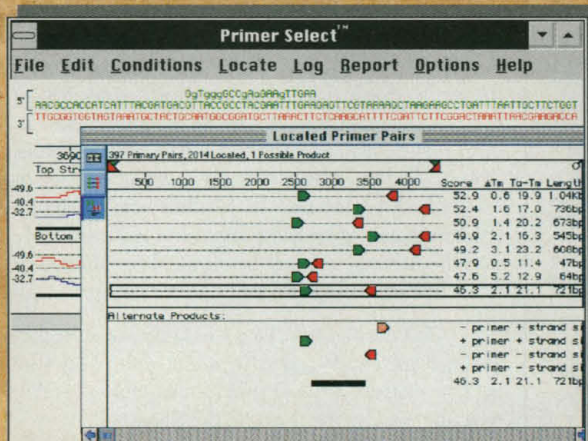
**Fax (44)-81-566 9555**

**Internet:**

**[sales@dnastar.com](mailto:sales@dnastar.com)**

**[support@dnastar.com](mailto:support@dnastar.com)**

for 30 days FREE software  
on Macintosh or  
WINDOWS



# BIOCOMPUTING

SEQUENCING

NETWORKS

DATABASES

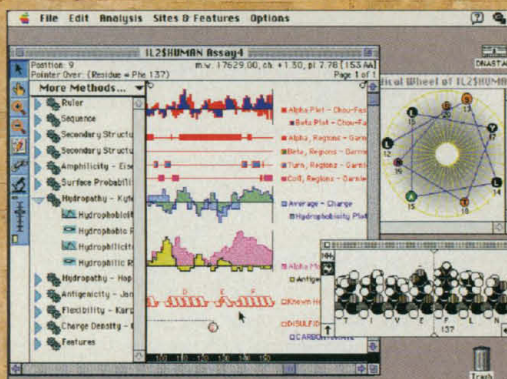
PROTEINS

PRIMERS

RESTRICTION

ALIGNMENT

EVOLUTION



“ This is a powerful, expandable and comprehensive molecular biology package for the Mac, with the best protein analysis and restriction mapping software available. I recommend DNASTAR to any lab requiring this level of power and expandability. DNASTAR is currently unique in its support for networking as well. ”

**Peter Markiewicz, UCLA**

**DNASTAR**

DNASTAR Inc. USA: 1228 South Park Street, Madison, Wisconsin 53715. Tel (608) 258 7420, Fax (608) 258 7439  
European Sales & Support: Abacus House, West Ealing, London, W13 0AS, U.K. Tel (44) 81 566 8282, Fax (44) 81 566 9555.  
Circle No. 33 on Readers' Service Card



# New Technique Revolutionizes Microscopic Study of Living Cells

Some of the most significant biological research being done today involves the study of cellular dynamics inside living tissue. Using the Nikon RCM-8000 realtime confocal microscope and a special water immersion objective developed by Nikon, scientists are observing phenomena never before seen by the human eye. These include changes in calcium concentration during cell contractions, protein sub-unit transport mechanisms in living cells, neuronal cell-to-cell interactions and communications, and early developmental structures in living embryos.

Scientists have found that many of the optical microscopy techniques currently available are not well suited for the study of cellular dynamics inside living tissue.

Working with thinly cut sections of fixed tissue placed up against the cover glass, researchers are able to produce superb images using techniques such as confocal microscopy, DIC and epi-fluorescence. The problem arises when they try to study living cells *in vivo* or *in vitro* surrounded by physiological solution.

In the past, researchers have tried to achieve higher resolution by using plan apochromat or fluor high numerical aperture (NA) oil immersion objectives. This technique

works well when the details or events being studied are no more than 15 $\mu$ m below the cover glass, but cannot be used when the area of interest is 100 $\mu$ m to 200 $\mu$ m deep.

## **Spherical aberration is a problem**

The problem is the different indexes of refraction of the oil and glass (1.515) and the aqueous physiological solution (1.33). The light rays are bent toward the higher refractive index at the glass interface, causing severe spherical aberration. This is seen as a loss of intensity and contrast, inability to collect and resolve small spatial frequencies and reduced accuracy of reproduction — all in direct proportion to how deep beneath the cover glass the area of interest lies.

Spherical aberration is especially troublesome in confocal imaging, a technique which is normally used to achieve increased resolution and narrow depth of field while eliminating out-of-focus light. In confocal systems, the illuminating pinhole is imaged on the specimen and a moving mirror mechanism scans the specimen in a raster pattern. The light emitted from the specimen is rescanned by the same mechanism and reimaged through the pinhole. Since only the light that passes back through the pinhole is imaged, all out-of-focus light is eliminated.

When scanning deep within a specimen using an oil immersion objective, spherical aberration can become so extreme that much of the

light coming back from the specimen is out of focus and unable to return through the pinhole.

## **Water immersion is the solution**

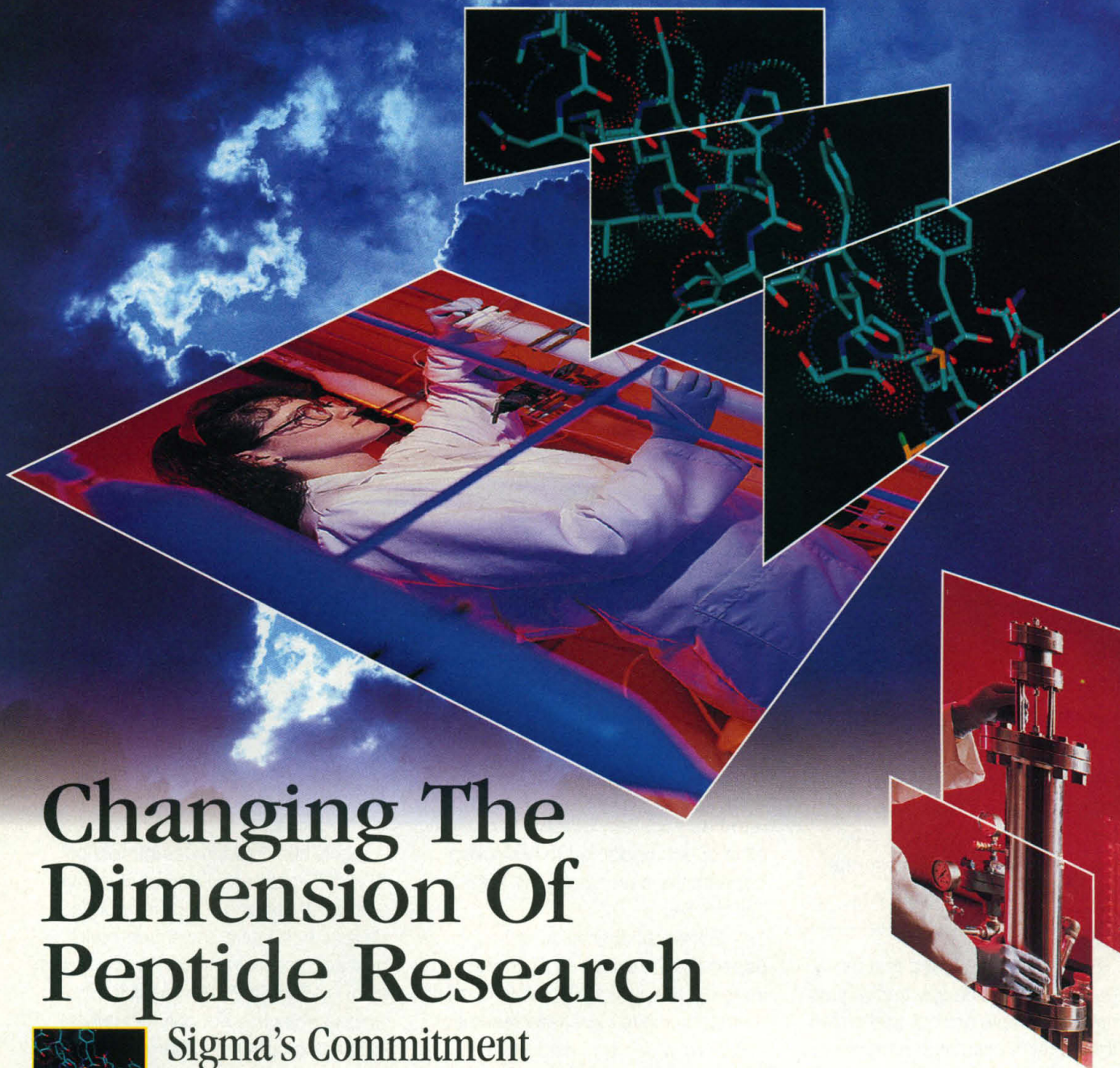
This problem can be solved through the use of a water immersion objective. The refractive index of water closely matches that of both physiological solution and living cells, so that the effect of spherical aberration is dramatically reduced when looking deep within a specimen. Water also offers practical advantages because it will not fluoresce or contaminate physiological solution, and is easy to clean up.

Nikon has successfully produced a highly corrected water immersion 60x CFN plan apochromat objective with a 1.2 NA and a 220 $\mu$ m working distance. It has a correction collar that accommodates for cover glasses from 0.15mm to 0.18mm thick. This unique objective not only virtually eliminates spherical aberration, but is also chromatically corrected with high transmission in the near ultraviolet through the red spectrum, making it useful for confocal, fluorescence and DIC microscopy.

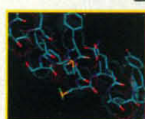
For more information on this exciting new technique, call Nikon at (516) 547-8567, fax us at (516) 547-0306, or contact us on the Internet at [nikonbio@aol.com](mailto:nikonbio@aol.com).

**Nikon Inc., Instrument Group**  
Biomedical Instrument Department  
1300 Walt Whitman Road  
Melville, NY 11747





# Changing The Dimension Of Peptide Research



**Sigma's Commitment  
Advances Your Research Potential**

The dynamic nature of peptide research requires more than just the highest quality products and reagents available. That is why *Sigma Peptides And Amino Acids* is committed to being the single

source of quality peptide related products, technical support and unsurpassed service. Our commitment will enable you to take peptide research into the next century and beyond.

Commitment - Another way *Sigma Peptides and Amino Acids* meets your needs so you can concentrate on research.



**SIGMA** 

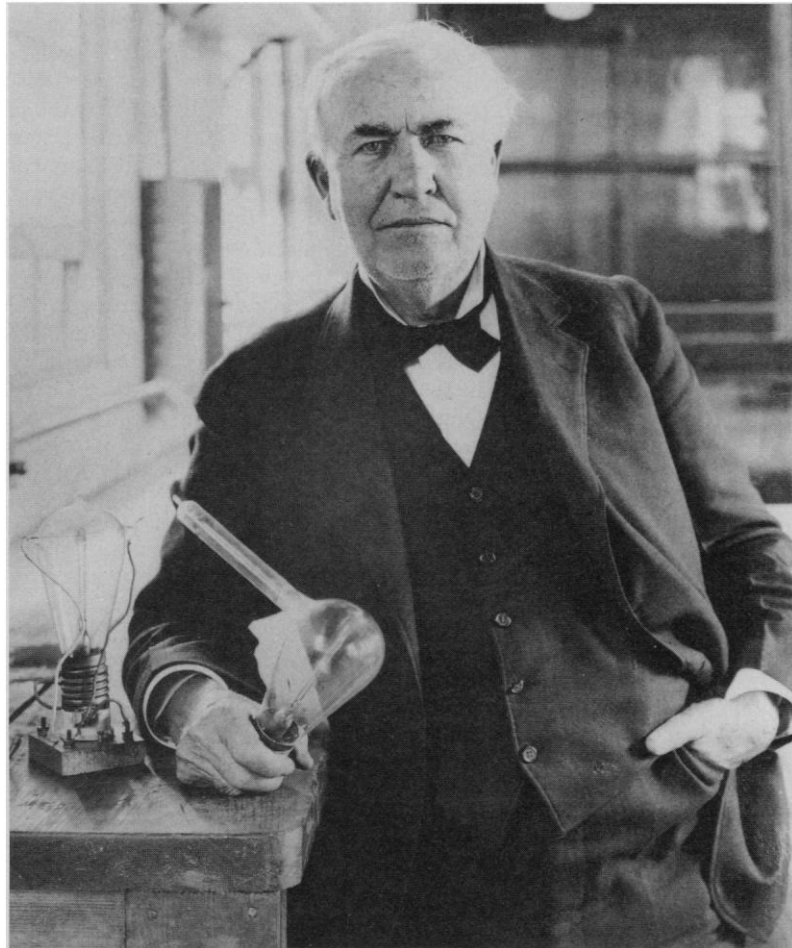
Where Science and Service Come Together.

Call collect: 314-771-5750  
800-325-3010,  
or contact your local Sigma office.

AUSTRALIA AUSTRIA BELGIUM BRAZIL CZECH REPUBLIC FRANCE GERMANY HUNGARY INDIA ITALY  
JAPAN KOREA MEXICO NETHERLANDS POLAND SPAIN SWEDEN SWITZERLAND UNITED KINGDOM UNITED STATES

A Sigma-Aldrich Company

Circle No. 39 on Readers' Service Card



**In 1879, Thomas Edison  
found the filament that turned  
electricity into illumination,  
and changed our world forever.**





**In early 1995, CAS will turn  
you on to a new research tool  
that will cast scientific discovery  
in a whole new light.**



CAS is a division of the American Chemical Society®  
614-447-3731 • 1-800-753-4227

Circle No. 25 on Readers' Service Card



# *In Perfect Balance*

According to the ancient Chinese philosophy of yin and yang, the universe is composed of opposing but interdependent forces. ■ Interestingly, this philosophy resembles the concept of homeostasis, the natural balance that occurs within living organisms, including the harmony between antagonists and agonists that regulate vital functions. Thus, an important factor in the search for new medicines is the development of compounds that work together with the body's own restorative and regenerative abilities. ■ To lead healthy lives, we must seek balance with nature, with society, and within ourselves. Through pharmaceutical research, we are striving to help people attain this balance.

**TAKEDA**  
Takeda Chemical Industries, Ltd.

Head Office: 1-1, Doshomachi 4-chome, Chuo-ku, Osaka 541, Japan Tokyo Head Office: 12-10, Nihonbashi 2-chome, Chuo-ku, Tokyo 103, Japan

Circle No. 29 on Readers' Service Card



# THE NEW AVANTI™ J-25. GET READY FOR THE DRIVE OF YOUR LIFE.

**N**o conventional centrifuge keeps pace with the new 25,000-rpm Avanti J-25 High-Performance Centrifuge Systems from Beckman. Everything about the Avanti J-25 series – from their innovative SR\* drive to their new lightweight, large-volume rotors – helps you perform more separations in less time.

## ACCELERATE YOUR THROUGHPUT... WHILE CUTTING RUN TIME

Now your lab can complete more separations, more quickly, than with any conventional high-speed. That's because the Avanti J-25 offers greater speeds and g-forces, with larger volumes, than any competitive model. A high-torque SR direct drive makes these benefits possible by accelerating and braking in up to *half the time* of conventional high-speeds. Set-up is quick and easy. And with the J-25I, you're freed from rotor ID by an innovative Instant Rotor Identification System (IRIS™).

## SAFE FOR THE ENVIRONMENT...AND FOR YOU

Because Beckman shares your concerns about environmental safety, the Avanti J-25's brushless SR drive is air-cooled, and an advanced refrigeration system eliminates CFCs from its design. The Avanti J-25 also consumes much less power, produces less than half the heat, and is 50% quieter than conventional models. Compliance with some of the world's highest standards for quality and operator safety is guaranteed by CE marking, UL and CSA approval.

High-performance productivity is another part of the Beckman Plus, that extra level of personalized service and support available only from Beckman. For more information about the Avanti J-25 series, contact one of our sales offices worldwide.

\* SR drives are manufactured by Beckman with technology licensed from Switched Reluctance Drives Limited.



## BECKMAN

Worldwide Offices: Africa, Middle East, Eastern Europe (Switzerland) (22) 994 07 07. Australia (61) 02 816-5288. Austria (2243) 7292164. Canada (800) 387-6799. China (861) 5051241-2. France (33) 1 43 01 70 00. Germany (49) 89-38871. Hong Kong (852) 814 7431. Italy (39) 2-953921. Japan 3-3221-5831. Mexico 525 575 5200, 525 575 3511. Netherlands 02979-85651. Poland 408822, 408833. Singapore (65) 339 3633. South Africa (27) 11-805-2014/5. Spain (1) 358-0051. Sweden (8) 98-5320. Switzerland (22) 994 07 07. Taiwan (886) 02 378-3456. U.K. (01494) 441181. U.S.A. 1-800-742-2345.

©1994 Beckman Instruments, Inc.

Circle No. 9 on Readers' Service Card





# THINK OF IT AS GETTING 23% MORE FREEZER CAPACITY FOR PEANUTS

## INTRODUCING HIGH-DENSITY CRYOGENIC STORAGE

Our new NALGENE SYSTEM 100™ cryobox proves the old saying that "you can't get too much of a good thing" by providing a 23%\* increase in the number of vials stored with no change in box size. The box now holds 100 vials, and still fits your 5¼" x 5¼" x 2" stainless-steel inventory rack system.



Look at it as getting 23% greater freezer capacity without the cost of additional freezers.

## THE CRYOBOX

Increased capacity within the same box dimensions allows 23% more vial storage. It holds 100 SYSTEM 100 vials or other similarly-sized externally-threaded vials and most internally-threaded 1.2 and 2.0 ml vials for use in vapor-phase liquid nitrogen and mechanical freezers. Clearly-numbered,

\*Compared to typical 81-vial capacity storage boxes.

corner-keyed cover can't be reversed so samples are always in the right order. Polycarbonate box has a usable temperature range of +121°C to -196°C.

## THE VIAL

NALGENE SYSTEM 100 vials have an internally-threaded, long-skirted, 1½ turn closure with an integral gasket to



provide effective sealing for centrifugation (up to 8,000 x g) and shipping applications. Reduces contamination risks, too. The 1.0 and 1.5 ml vials have printed fill-line and graduations on the side with a white marking area for easy sample identification. Ideal for vapor-phase liquid nitrogen and mechanical freezers.

## THE HOLDER

Unique benchtop vial holder has a locking feature that keeps the vial from turning, making removing and replacing the closure a simple

one-handed operation. Holder has a widely-spaced, staggered array



making access to individual vials easy. Accommodates up to 25 NALGENE vials.

## THE FREE STARTER KIT

To receive a FREE NALGENE SYSTEM 100 Starter Kit consisting of the cryobox, holder, a sampling of vials in two sizes and a set of color coders, simply call or write: Nalge Company, A Subsidiary of Sybron International, Dept. SYSTEM 100, P.O. Box 20365, Rochester, NY 14602-0365. Phone 800-872-4552. Fax 716-586-8431.

Available from Authorized  
NALGENE  
Labware Dealers  
Worldwide.



**Nalge Company**

NALGENE® Brand Products

SCI 1/95

# NALGENE® SYSTEM 100™

© 1994, Nalge Company

Circle No. 14 on Readers' Service Card



# Don't let small sample dialysis get out of hand.

Take control with the new Pierce Slide-A-Lyzer™ Dialysis Cassettes!

Load a sample for dialysis easier and faster than ever with this revolutionary new system. The new Pierce Slide-A-Lyzer™ Dialysis Cassette replaces the mess and hassles of conventional tubing with a more convenient, more effective approach.



1.

No more boiling, soaking, tying, or clamping - all you need is a syringe to load and remove your sample from these ready-to-use, disposable cassettes. The exclusive cassette design gives you total sample control, good surface-to-volume ratio and consistently reliable sample recovery. For even greater convenience, use the accessory Buoys to float your sample during dialysis, and as a bench-top cassette stand during loading and recovery.



2.

Pierce Slide-A-Lyzer™ Cassettes have a 0.5 - 3.0 ml sample capacity, 10,000 molecular weight cut-off, and are ideal for routine dialysis of protein, nucleic acid and carbohydrate samples.



3.

Product #	Description	U.S. Price
66425	<b>Slide-A-Lyzer™ 10K Dialysis Cassettes*, 10 pack</b> Contains: 10 cassettes (10,000 Molecular Weight Cut-off, 0.5 - 3.0 ml sample capacity)	\$49
66430	<b>Slide-A-Lyzer™ Buoys, 10 pack</b>	\$12
66490	<b>Slide-A-Lyzer™ Syringe and 18G Needle Accessories, 10 pack</b> Contains: 10 each of 5 cc single-use, sterile, polypropylene syringes with Luer-Lok® tips and single-use, sterile, 18-gauge, 1" needles compatible for use with the Slide-A-Lyzer™ Dialysis Cassette. Ideal for nucleic acid applications.	\$9



Call for your FREE copy of Pierce's Life Science & Analytical Research Products or Molecular Biology Catalog!

To order in the U.S.A.: Pierce • 3747 N. Meridian Rd. • P.O. Box 117 • Rockford, IL 61105 • **Telephone: 800.874.3723 FAX: 800.842.5007**

European Office: Pierce Europe B.V. • P.O. Box 1512 • 3260 BA Oud Beijerland • The Netherlands • Telephone: 31.1860.19277 FAX: 31.1860.19179

**European Distributors:**

Austria 018891819  
Belgium 036465511

Denmark 44948822  
France 070038855  
Germany 0224196850

Italy 025097220  
Holland 0206113133 or  
076795795

Norway 22722100  
Spain 017290333  
Switzerland 0217287772

United Kingdom 0244382525  
Sweden 087460035

**PIERCE**

a Perstorp Biotec Company

Outside Europe and the U.S., contact Pierce U.S. for your local Pierce distributor. Telephone: 815.968.0747 FAX: 815.968.8148

© Pierce Chemical Company, 1994. \* Patent Pending

Circle No. 10 on Readers' Service Card





## NEW SORVALL® PLUS SUPERSPEEDS. THEY'LL IMPROVE MORE THAN YOUR WORKING ENVIRONMENT.

**50% Quieter, 20% Cooler, *plus* SUVA® CFC-Replacement Coolant.**

The first thing you'll notice about the new RC-5B PLUS and RC-5C PLUS Superspeed centrifuges\* is the substantially reduced sound. They're 50% quieter. Then you'll notice the cooler operating temperature – 20% cooler. But we didn't stop with cooler and quieter. We also included SUVA® refrigerant, a new DuPont replacement coolant that reduces ozone depletion and global warming.

In addition to the reliable performance you expect from a SORVALL®, you'll get 21,000 rpm

without a vacuum, plus increased brush life that results in less maintenance.

We've also introduced the first of a new line of biosafety tested\*\* SUPER-LITE™ rotors which are up to 50% lighter than conventional rotors. That's not all. They offer higher g forces and faster acceleration and deceleration times which yield quicker separation times.

For more information on how to improve your workplace and the earth's environment, call 1-800-551-2121.

\* Manufactured under a quality system registered by UL.

Manufactured under a quality system approved by BSI.

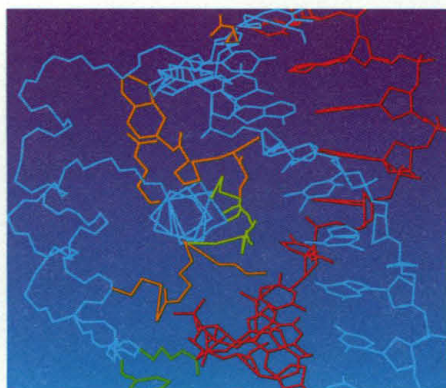
\*\* Tested by Biosafety Unit, Division of Biologics, PHLS CAMR, Porton Down, U.K.

**SORVALL®...a better choice.**

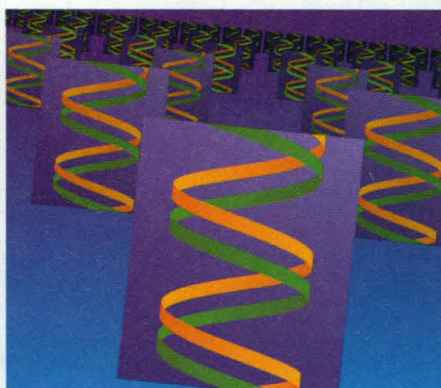




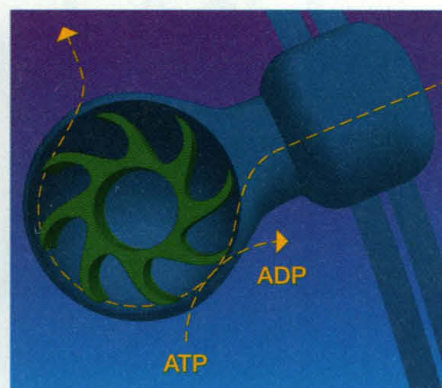
# One fluorimeter fits more.



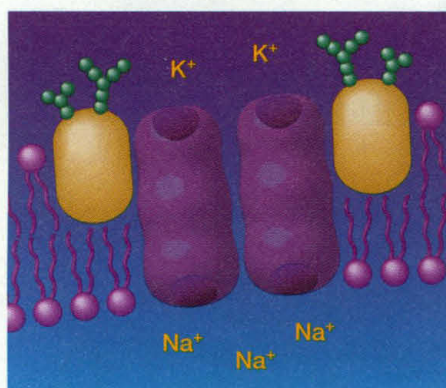
*DNA Quantitation*



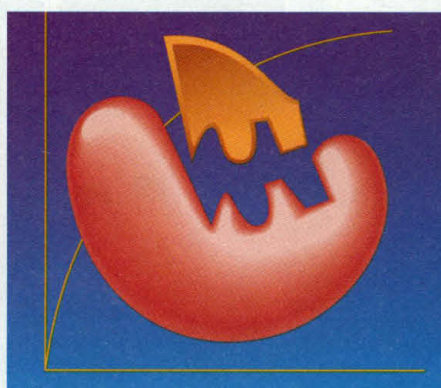
*PCR Detection*



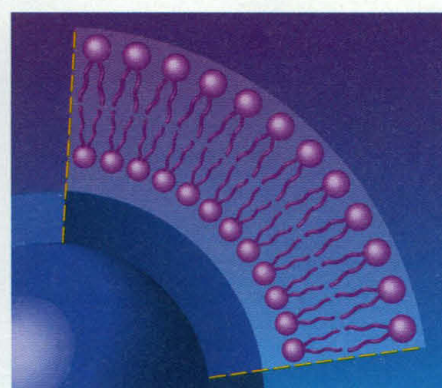
*Low Level ATP*



*Intracellular Ion Determinations*



*Enzyme Kinetics*



*Membrane Fluidity*

## New accessories are expanding the applications of the LS-50B Luminescence Spectrometer.

With even more versatility in sample handling and enhanced measurement capabilities, the LS-50B meets the demands of your most challenging experiments. Yet its simplicity makes it a practical everyday analytical tool.

From ATP research using the new luminometer accessory and PCR detection with the new multi-format well plate reader, to enzyme kinetics

and membrane studies...the LS-50B's performance and reliability are supported by Perkin-Elmer's commitment to life science research. Designed to grow with your needs, the LS-50B is a sound investment for your laboratory.

For sales information or literature in the U.S., call 1-800-762-4000. Outside the U.S., contact your Perkin-Elmer representative.



## LS-50B Luminescence Spectrometer

**PERKIN ELMER**

The Perkin-Elmer Corporation, 761 Main Avenue, Norwalk, CT 06859-0012, USA  
Perkin-Elmer Ltd., Post Office Lane, Beaconsfield, Bucks HP9 1QA, UK; Bodenseewerk Perkin-Elmer GmbH, Postfach 10 17 61, D-88647 Ueberlingen, Germany  
All analytical instruments and systems manufactured by Perkin-Elmer are certified under the quality requirements of ISO 9001.  
The GeneAmp PCR process is covered by U.S. patents owned by Hoffmann-La Roche Inc. and Hoffmann-La Roche Ltd.

Circle No. 23 on Readers' Service Card

Order No. 94-326



# The Logical *R*Evolution



## Finally, a logical approach to biomolecule purification. Presenting the BioLogic System.



Easy to use. Versatile. Affordable. The new BioLogic System is a logical evolution in biomolecule purification. Our **user-friendly**, Windows® based software features pull-down menus and intuitive icons for simpler methods programming and system operation. And simple, concise dialogs allow you to work like you think: logically. Now you can concentrate on the separation, not the equipment.

An extended, 1,000 psi pressure limit permits a **wider choice of chemistries**, including ion exchange, affinity, HIC, hydroxyapatite, size exclusion, and reversed phase. Best of all, the BioLogic System is very **affordable**.

Call 1-800-4-BIORAD for information about the BioLogic System, the logical choice for biomolecule purification.

**BIO-RAD**

**Bio-Rad  
Laboratories**

Life Science Group

(US) (800) 4BIORAD • (AU) 02-805-5000 • (AT) (1)-877 89 01 • (BE) 09-385 55 11 • (CA) (905) 712-2771 • (CN) (01) 2051873 • (FR) (1) 49 60 68 34 • (DE) 089 31884-0 • (IT) 02-21609 1 • (JP) 03-3534-7665 • (HK) 7893300 • (NL) 08385-40666 • (NZ) 09-443 3099 • (SG) (65) 443 2529 • (ES) (91) 661 70 85 • (SE) 46 (0) 8-735 83 00 • (CH) 01-810 16 77 • (GB) 0800 181134

Windows is a trademark of MicroSoft Corp. SIG 071494

Circle No. 38 on Readers' Service Card



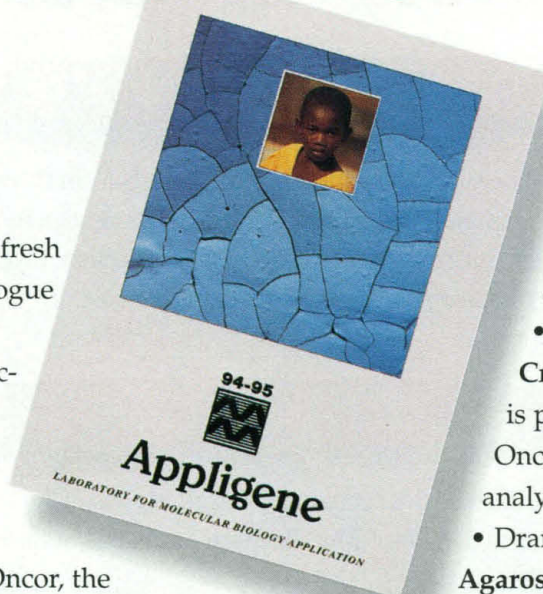
A New Breed of  
Molecular Biology Products

# Get this catalogue and increase your molecular biology *savoir-faire.*

Here's informative reading fresh from France: an exciting catalogue of innovative instruments, systems and reagents manufactured by Appligene, one of Europe's leading molecular biology companies.

These products are now marketed and supported by Oncor, the leading developer of products for genetic analysis, among them the breakthrough **ApopTag™ In Situ** Apoptosis Detection Kit.

• **Penetratin™ 1**, a patented 16 amino acid peptide, delivers DNA and peptides directly to the cell nucleus and is the newest Appligene Oncor



tool for gene targeting and antisense research.

• The versatile, oil-free **Crocodile III** temperature cycler is part of a full line of Appligene Oncor instrumentation for DNA analysis.

• Dramatically clear **Infinity™** Agarose Enhancer is among many Appligene Oncor products for DNA isolation, electrophoresis and blotting.

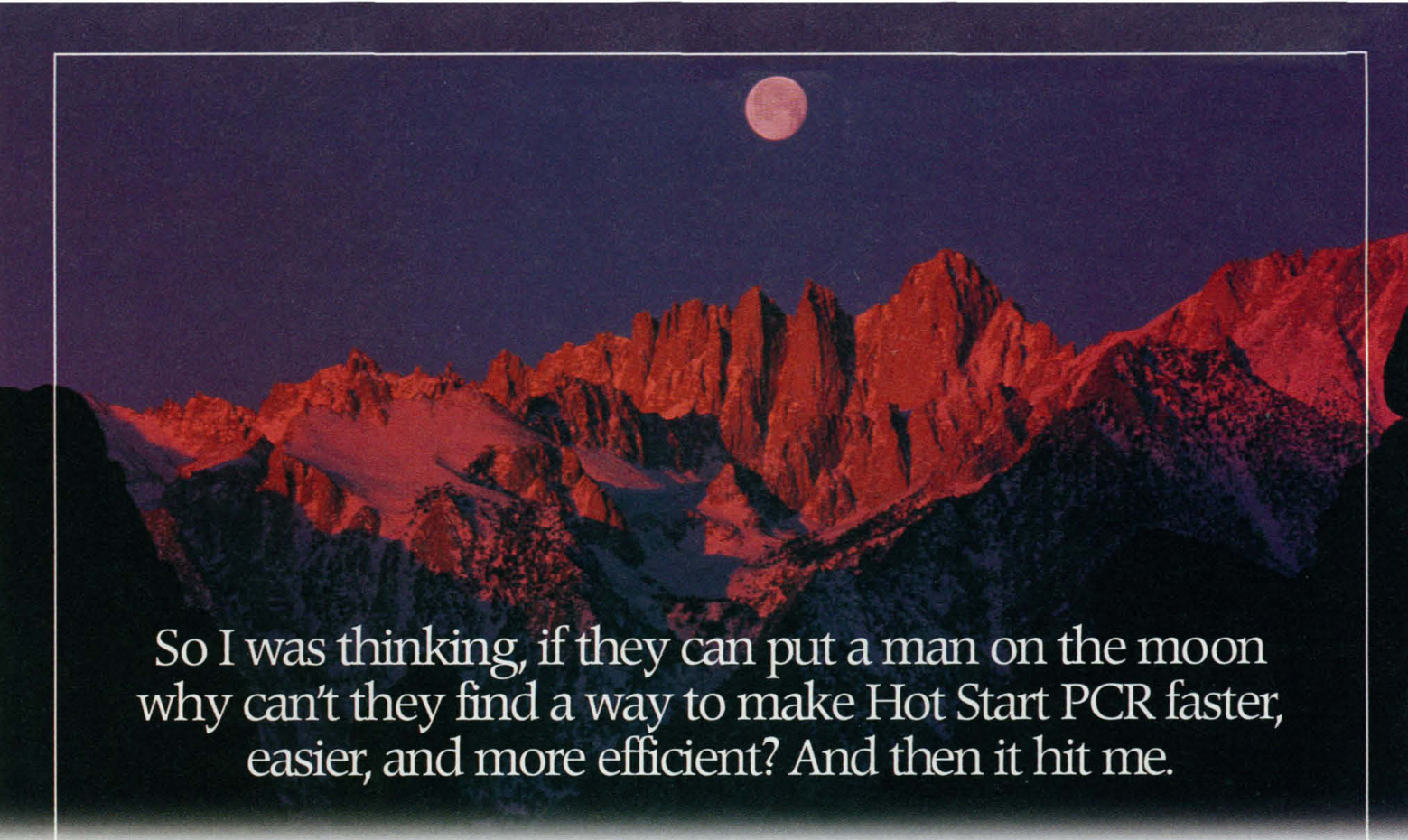
**Be savvy. Call us for a catalogue now.**  
**We'll get it to you *tout de suite.***

**oncor®**

For Research Use Only. Not for use in diagnostic procedures.  
Penetratin™ is a trademark of Appligene. Infinity™ and ApopTag™ are trademarks of Oncor, Inc.

209 Perry Parkway 1-800-77-ONCOR  
Gaithersburg, 301-963-3500  
MD 20877 Fax: 301-926-6129





So I was thinking, if they can put a man on the moon  
why can't they find a way to make Hot Start PCR faster,  
easier, and more efficient? And then it hit me.

{ HotWax™ Mg<sup>2+</sup> Beads. }

*Better than Wax Alone.*

Once in a blue moon, there's a hot new idea like HotWax™ Mg<sup>2+</sup> Beads from Invitrogen. They make Hot Start PCR\* as easy as conventional PCR. Unlike "simple" wax, HotWax™ Mg<sup>2+</sup> Beads contain molecular biology grade MgCl<sub>2</sub> which is released during your first denaturation step. Just set up your reaction, drop in a HotWax™ Mg<sup>2+</sup> Bead and start thermocycling. No messy oil, and no stopping and restarting your reactions.

*Perfect PCR.*

With Hot Start PCR this easy, you can use this technique with all of your PCR experiments, before you have a problem with non-specific background bands. HotWax™ Mg<sup>2+</sup> Beads are available in three MgCl<sub>2</sub> concentrations. Mg<sup>2+</sup>-free buffer is provided free with each order.

See for yourself how fast and easy Hot Start PCR can be. Call Invitrogen to ask about HotWax™ Mg<sup>2+</sup> Beads today.

**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 06-0228848  
Belgium 078-111173  
Germany 0130 8100 43  
Switzerland 155-1966  
Austria 0660-8127

UK Tel: +44 (0)235 531074  
UK Fax: +44 (0)235 533420  
France 05 90 72 49  
Sweden 020 793149  
Norway 800 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 03-562-6888 Finland 35-804208077  
Spain 34-3-4560607 Singapore 65-779-1919

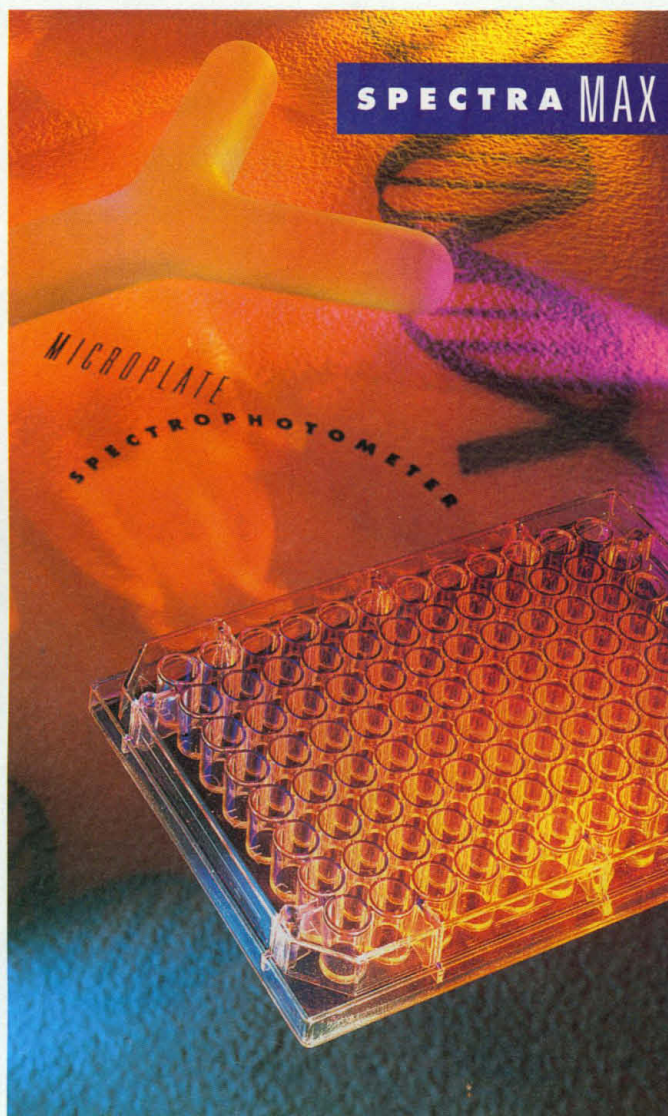
\*PCR is covered by patents owned by Hoffmann-LaRoche Molecular Systems, Inc. and issued to Cetus Corporation.

1-800-955-6288

**Invitrogen®**

3985 B Sorrento Valley Blvd.  
San Diego, California 92121  
Telephone (619) 597-6200  
Fax (619) 597-6201





**SPECTRA MAX 250**

# Now... Read DNA, RNA, and Proteins Directly

.....

**SPECTRAmax 250:**  
**IT'S MORE THAN A MICROPLATE READER**



SPECTRAmax™ 250 combines the tunability of a spectrophotometer with the efficiency of a microplate reader. Simplify your analysis using the speed and convenience of a microplate format.

## **Direct UV measurements in a microplate**

Directly determine the concentration of up to 96 different DNA, RNA, or protein samples in a few seconds using a SPECTRAplate UV transparent disposable or quartz microplate. Protocols are included to measure the purity of DNA samples by calculating  $A_{260}/A_{280}$  ratios. Use up to six different wavelengths to quantitate your samples.

## **UV/VIS Spectra Scans**

Perform a spectral scan from 250-750 nm, in 1 nm increments, on all 96 wells of your microplate to determine the absorption maxima of your sample. Analyze column fractions or characterize the composition of inorganic samples.

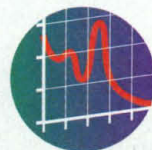
## **New SOFTmax® PRO**

The built-in spreadsheet capabilities of SOFTmax® PRO give you complete control of calculations and data presentation.

**Discover the advantages of SPECTRAmax 250 – contact your local representative today at 1-800-400-9060**



TUNABLE WAVELENGTH



SPECTRA ANALYSIS



UV TRANSPARENT MICROPLATE



PRECISE TEMP. CONTROL



**Molecular  
Devices**

1311 Orleans Dr., Sunnyvale, CA 94089  
(800) 400-9060



# WORLD LEADER



## FORMA SCIENTIFIC ... ENVIRONMENTALLY CONTROLLED EQUIPMENT ... SERVING THE GLOBAL MARKET

**Cell Culture Incubators** with CO<sub>2</sub> and/or O<sub>2</sub> control in water jacketed, forced draft, or HEPA filtered styles from 5.7 to 32 cu. ft.

**Non-CFC, Ultra-Low Temperature Freezers** with automatic voltage compensators and microprocessor or solid-state controls, upright or chest styles up to 23 cu. ft.

**Biological Safety Cabinets** in 4, 5 or 6 ft. styles (NSF Listed) and **Laminar Airflow Clean Benches** in console or benchtop.

**Cryopreservation Systems** - LN<sub>2</sub> storage and controlled rate freezers with microcomputer programming.

**Orbital Shakers** available in tabletop and console models with microprocessor control/monitoring system and speed range of 25-525 RPM.

**Blood Bank** refrigerators, red cell and plasma storage freezers, blast freezers, thawing baths and platelet incubators.

**Laboratory Refrigerators/Freezers** available in chest and upright configurations from 1.4 to 36.5 cu. ft.

**Glassware Washers** with microprocessor controls and stainless steel pumps.

**Monitor/Alarm Systems** capable of monitoring up to as many as 24 pieces of equipment from one control location.

**Baths and Circulators** in shaker, countertop and floor models with temperature ranges from -40°C to +100°C.

**Centrifuges** for general purpose, multi-purpose and refrigerated applications.

**Custom Designed Products** and environmentally controlled rooms can be tailored to your specific needs.



### Forma Scientific, Inc.

Box 649, Marietta, OH 45750 · 614-373-4763

Fax: 614-373-6770 · Telex: 29-8205

**Toll Free 1-800-848-3080**

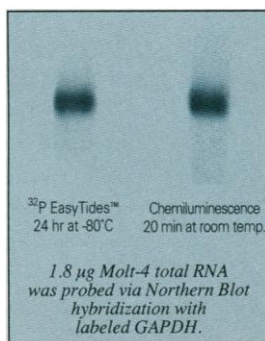
An ISO 9001 Company





# Smile! Renaissance™ non-rad DNA labeling kits give you reproducible results, not high backgrounds.

Are you repeating experiments just to reduce backgrounds? Then look into Renaissance™ non-radioactive DNA labeling and detection products from DuPont NEN®. And get low backgrounds and reproducible results the first time, and every time.



- Sensitive HRP-luminol systems for colony plaque lifts and Northern, Southern, and Western blots.
- Results in minutes.
- Guaranteed one-year shelf life.
- Backed by full protocol and comprehensive technical service.
- Now available: Random Primer Fluorescein dUTP Labeling Kit and Oligonucleotide 3' End Labeling kit (Fluorescein ddUTP).

DuPont gives you a choice of radioactive and now Renaissance non-radioactive labeling and detection products. For information, or orders call 1-800-551-2121. For information by fax, call 1-800-666-6527 and request number 9002.

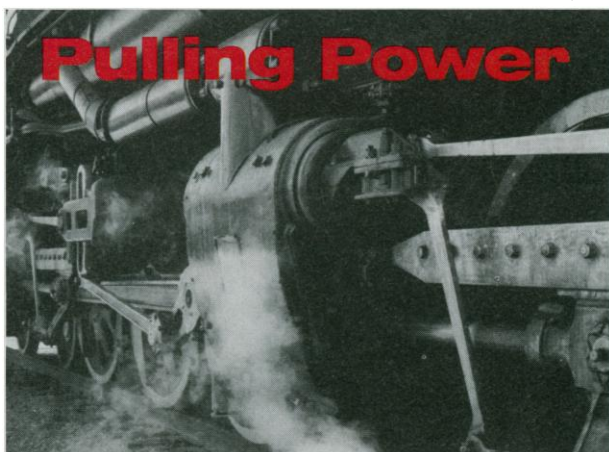
All DuPont products are manufactured under an ISO 9001 quality system registered by UL and approved by BSI.

**United States 1-800-551-2121** • Canada 1-800-387-8391 • Australia +61 (008) 257149 • Belgium +32 (02) 7242717  
Denmark +45 31506610 • France (01) 6982 5450 • Germany +49-6172-872600 • Italy (02) 25302 481/483  
Japan +81 (03) 5421-1354 • Latin America/Asia Pacific Fax +1 (617) 426-2464 • Netherlands +31 (073) 206550  
Sweden +46 (08) 7503700 • Switzerland +41 (01) 8410330 • United Kingdom +44 (0438) 724037



DuPont NEN®





**...with this  
much control**



**Model P-97**

phone 415-883-0128 fax 415-883-0572

Circle No. 36 on Readers' Service Card

Sutter micropipette pullers are the finest available.

Built-in versatility and repeatability are based on 20 years of continuous research and development.

Call or write for a free catalog.



**Sutter**  
Instrument Company  
40 Leveroni Court  
Novato CA 94949

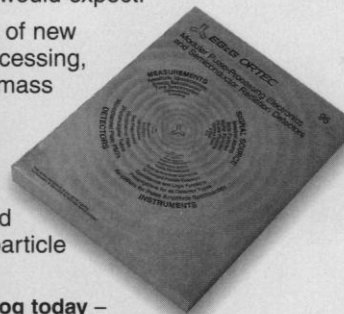
**FREE**

## NEW ORTEC Catalog Features Modular Pulse-Processing Electronics and Semiconductor Radiation Detectors

**"This Isn't a Catalog. It's a Tutor!"**

The first recipient of EG&G ORTEC's new catalog, "Modular Pulse-Processing Electronics and Semiconductor Radiation Detectors," spoke those words. We thought they bore repeating. This "catalog" contains more tutorial information, applications advice, and instrument selection charts for the research scientist than anyone would expect.

Included are a myriad of new products for pulse processing, multichannel scaling, mass spectrometry, LIDAR, fluorescence lifetime, single-photon counting, radiochemistry, picosecond timing, and gamma-ray or alpha-particle spectroscopy.



**Request the NEW catalog today –**

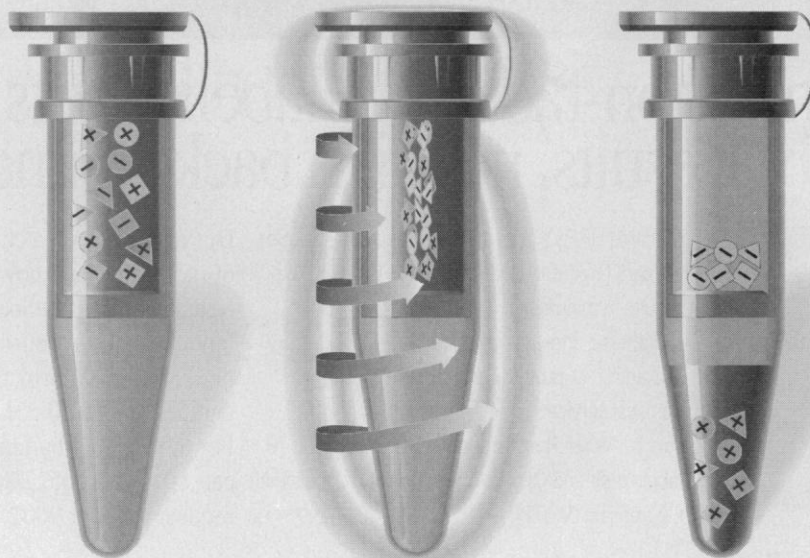
PHONE: 800-251-9750, FAX: 615-483-0396, or  
E-mail (MCI: 709-6992; Internet: 709-6992@MCIMAIL.COM;  
CompuServe: MCIMAIL:709-6992).

**EG&G ORTEC**

Circle No. 6 on Readers' Service Card

## A New Spin On DEAE-Based Separations.

# The Power Of DEAE. With A Twist.



Now you can achieve, on a microscale level, very fine separations of complex protein mixtures—fast. Introducing the Ultrafree®-MC DEAE centrifugal filter from Millipore. The only device that gives you the speed and ease of centrifugal filtration and the selectivity of an anion-exchange chromatography membrane.

How about a test spin? Call us for a free sample. US and Canada, 1-800-MILLIPORE ext. 8017. Japan, fax to (03) 3474-9141. Europe (fax to our Paris headquarters), +33.1.30.12.71.83.

**MILLIPORE**

Internet Lab Catalogue: access URL menu, type: <http://www.millipore.com>

© 1994 Millipore Corporation

Circle No. 37 on Readers' Service Card



**Hear about the Molecule  
of the Year from the  
research leaders on  
SCIENCECAST!**

# DNA REPAIR

## JOIN THE DNA REPAIR EXPERTS

Join SCIENCECAST authors Paul Modrich, Philip Hanawalt and your colleagues from around the world during the next live SCIENCECAST audio conference to discuss the hottest topics in DNA repair. You'll have the chance to pose your questions during a live interactive question and answer session and receive two research books upon this unique conference with a short presentation. Be sure to get to hear about the future of this exciting field.

## SCIENCECAST: CONNECTING SCIENCE READERS AND AUTHORS

The new SCIENCECAST audio conference series offers you direct access to the top names in research. For only \$30 you can participate in the conference privately in the comfort of your own office or invite colleagues and associates to listen on your speaker phone. The SCIENCECAST audio conference preserves your hot line to the experts. Be sure to look for upcoming SCIENCECAST conferences.

## SCIENCECAST Live Audio Conference

**SCIENCECAST topic:** DNA Repair

**Guest speakers:** Paul Modrich and  
Philip Hanawalt

**Date and time:** 9 February 1995, 1:00 P.M.  
to 2:00 P.M. EST.

**Registration fee:** \$30.00, includes phone charges and  
conference materials.

**To register or for more information call:** U.S. & Canada:  
1-800-776-0700; International: 913-661-0825.

Produced in cooperation with

**SCIENCE**

**TeleMarq**

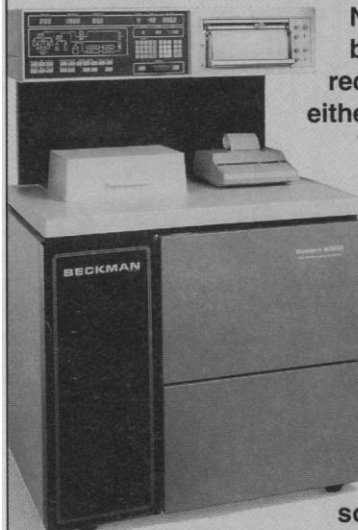
Columns, buffers, ninhydrin,  
standards for

## Beckman System 6300 Amino Acid Analyzers

**T**he complete system of ion-exchange columns and chemicals for the Beckman System 6300 methodologies is available from Pickering Laboratories:

- Pre-run and serialized cation-exchange columns and guards
- Buffers for Sodium (hydrolysate) and Lithium (native sample) step-gradient protocols
- TRIONE®, a patented Ninhydrin reagent
- Column regenerants
- Calibration mixtures and sample diluents
- Reagents for the preparation of native samples

Pickering Laboratories certifies the performance of each column and chemical on its own Beckman System 6300 amino acid analyzer.



None of the Pickering buffers or reagents requires refrigeration, either in transit or storage.

TRIONE ninhydrin reagent comes completely formulated and ready to use, with a guaranteed 3-month shelf-life at room temperature.

Compare Pickering's prices—and immediate availability—with your present

source, by calling

Pickering Laboratories today. We'll rush you Product Bulletin RB-6 and a price list.

**PICKERING  
LABORATORIES**

**The Premier Resource for  
Amino Acid Analysis Chemicals**

Pickering Laboratories, Inc.  
1951 Colony Street, Suite S  
Mountain View, California 94043  
800 654 3330 415 694 6700 FAX 415 968 0749