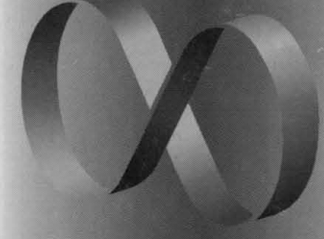
AMERICAN
ASSOCIATION FOR THE
ADVANCEMENT OF
SCIENCE

SCIENCE

21 OCTOBER 1994 $6.00
VOL. 266 • PAGES 337–512

UNITY IN DIVERSITY



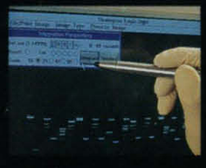
THE 1995 AAAS ANNUAL MEETING AND SCIENCE INNOVATION EXPOSITION

Still Video Digital Documentation of Gels, Autorads and Elisa Plates Just Became . . .

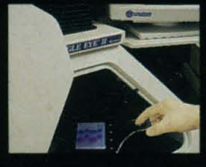
1 Fully integrated system with powerful state-of-the-art electronics

2 Uniquely progressive optics: easy-to-focus television zoom lens, closeup adapter and UV-selective filter

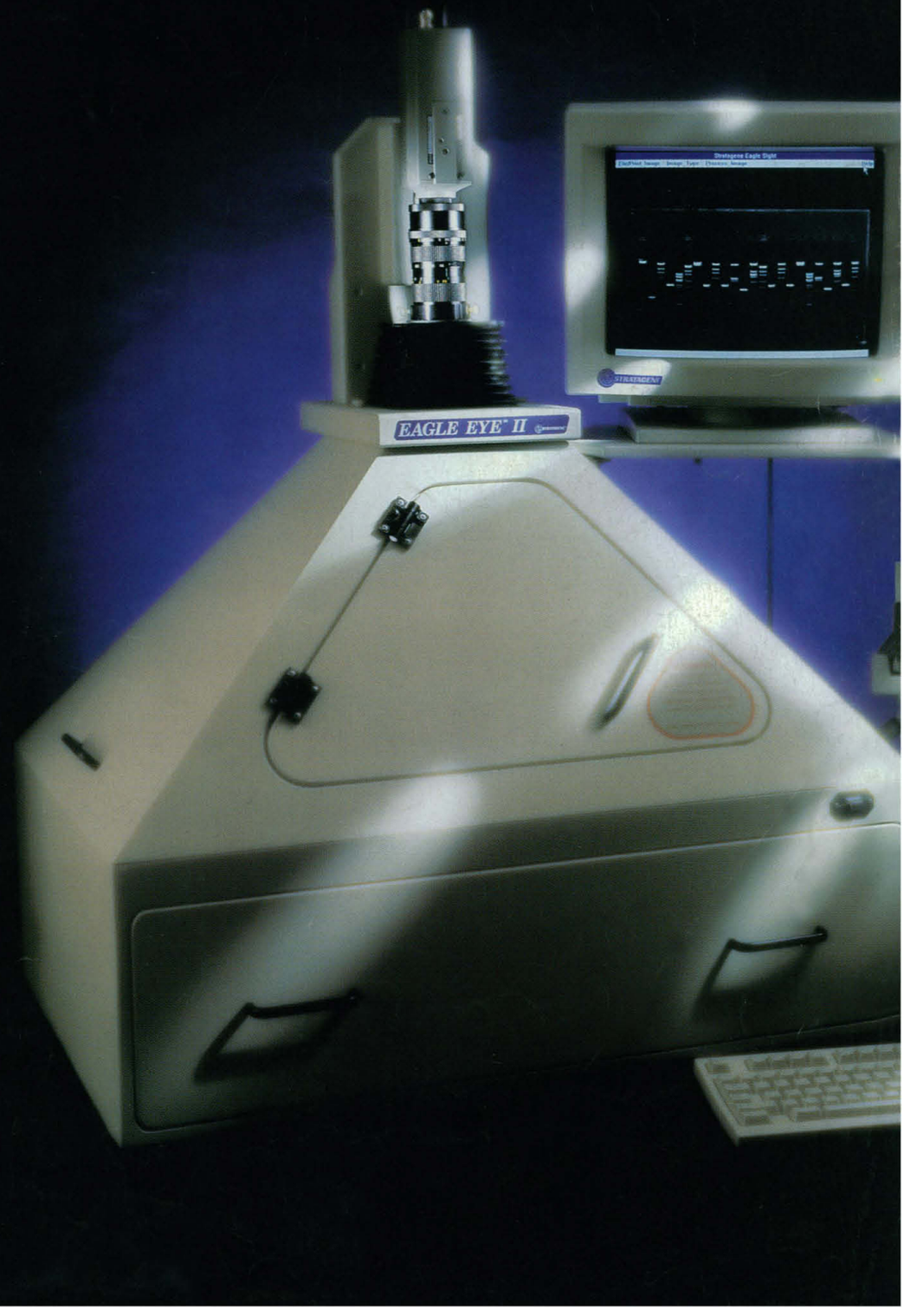
3 Sensitivity heightened by computer integration . . . So even faint bands appear in high-resolution display



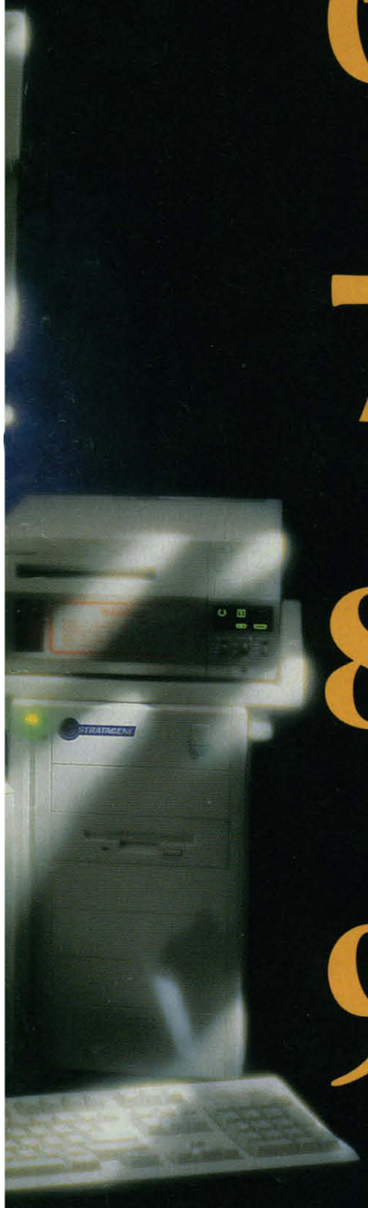
4 Built-in light-tight dark room accommodates virtually any illumination device



5 Roll-out transilluminator tray for quick, easy access to gels



10 Times Smarter



6 Eagle Sight™ Windows® Software for intuitive control of imaging

7 Effortless "touch-screen" user interface with light pen, out of reach of chemical splashes

8 Sharp thermal prints in seconds at 1/10th the cost of instant photos

9 Images saved as electronic TIFF files . . . On system's hard disk or on floppies for publication, slide-making and analysis on PC or Macintosh™ work stations

10 Multiple applications: stained nucleic acid or protein gels, TLC plates, blots, ELISA plates, autoradiographs and more . . .

The future of still video imaging for laboratory documentation has arrived: The Eagle Eye™ II still video system from Stratagene.

This most advanced still video system is a fully integrated system that combines progressive imaging electronics with powerful computer control and sensitive CCD optics. The Eagle Eye II still video system produces publication–quality images.

The Eagle Eye II still video system focuses on the method, the user, the results. The system has a built-in dark room which lets you capture your data at the bench.

Images can be instantly printed or saved as electronic files for analysis and used in slides and publications. The simplicity of our Eagle Sight™ software provides unparalleled control of imaging. The camera's unique television zoom lens provides extremely sharp prints.

So bring our gel documentation system and portable dark room to your bench. The Eagle Eye II is here. Let us show you our vision of the future.

Call Stratagene today to set up a demo of the Eagle Eye II system in your lab. In the US . . . call 1-800-424-5444 ext. DEMO (3366). Overseas . . . call 06221-400637 in Germany, 01-3641106 in Switzerland, 0223-420219 in the UK. Or call the distributor nearest you.

Eagle Eye™ II Still Video System
Catalog #400218, 100/120 V
Catalog #400219, 220 V

UV Transilluminator 4000
Catalog #401010, 100/120 V
Catalog #401012, 220 V

STRATAGENE®

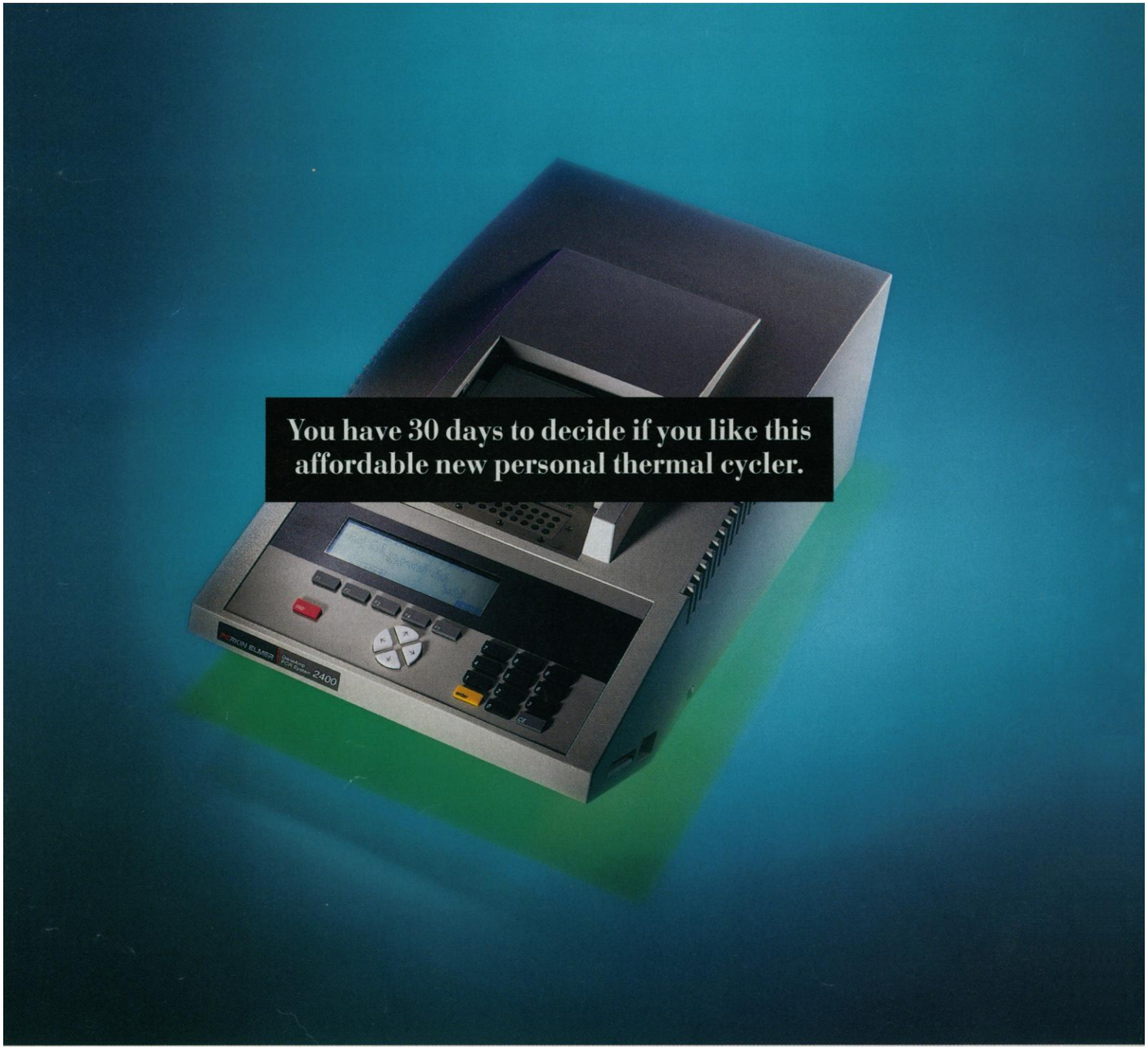
USA:
Corporate Headquarters
Telephone: 800-424-5444
Fax: 619-535-0034

Germany:
Stratagene GmbH
Telephone: (06221) 40 06 34
Telefax: (06221) 40 06 39

United Kingdom:
Stratagene Ltd.
Telephone: (0223) 42 09 55
Telefax: (0223) 42 02 34

France:
Stratagene France
Telephone: (0590) 72 36
Telefax: (1) 44 28 19 00

Switzerland:
Stratagene GmbH
Telephone: 01-3641106
Telefax: 01-3657707

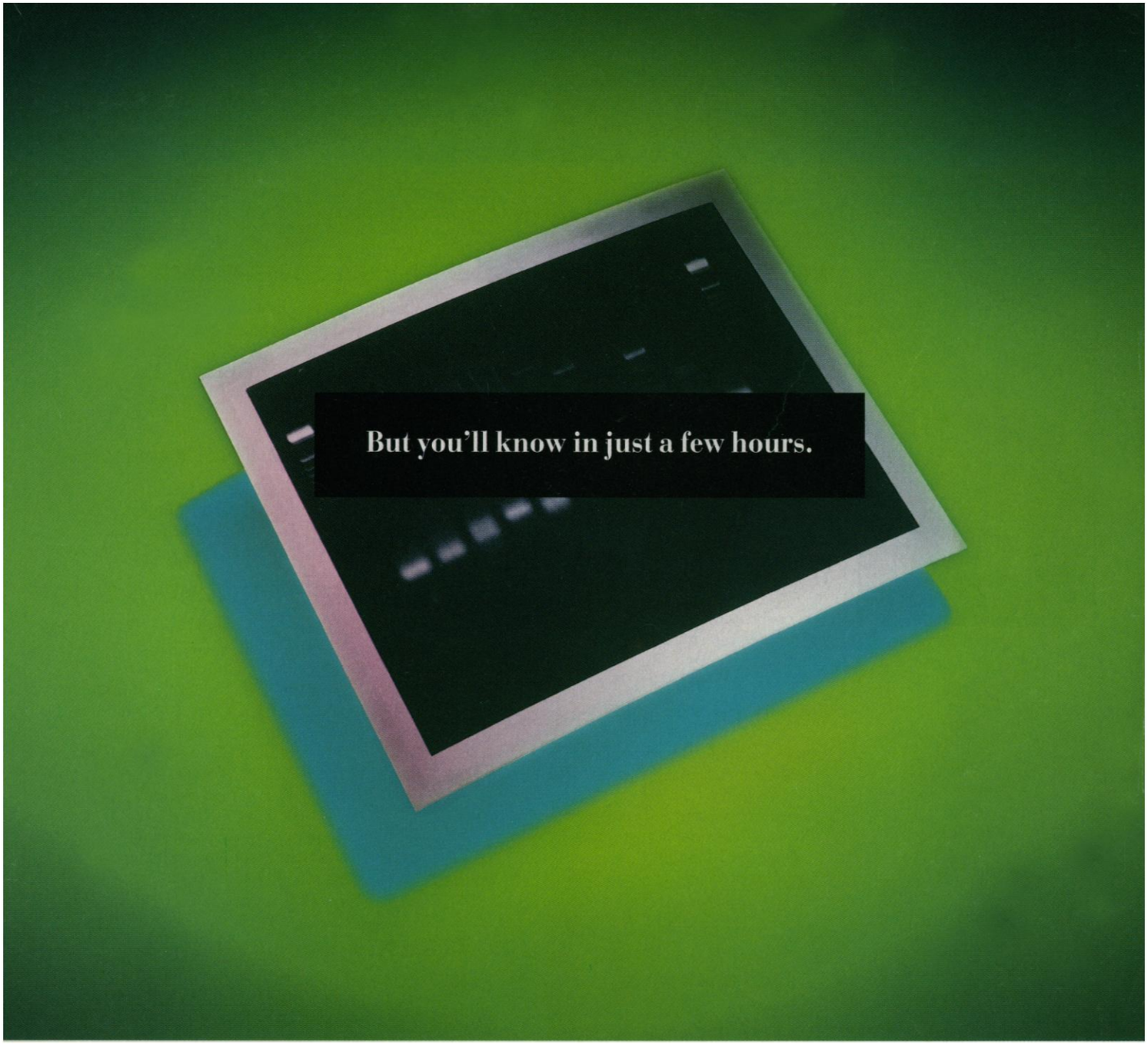


The GeneAmp® PCR System 2400 is the first thermal cycler that gives you the performance and flexibility you want—at a personal thermal cycler price. In fact, with its advanced design and fast, easy programming, the GeneAmp PCR System 2400 may be exactly the thermal cycler you've been waiting for.

New graphical user interface: Our new personal thermal cycler brings unmatched convenience and simplicity to PCR protocol programming.

Uncompromising results. The GeneAmp PCR System 2400 offers the same uncompromising performance that has made Perkin-Elmer thermal cyclers the world standard. Its 24-well sample block provides the accuracy and uniformity required for outstanding reproducibility during high-speed PCR amplification. A precision heated cover eliminates the need for oil, dramatically reducing sample handling time.

The superior performance of the GeneAmp PCR System 2400 is identical to the GeneAmp® PCR System 9600, so you can transport protocols directly from one instrument to the other. And a broad range of MicroAmp™ consumables and reagents developed specifically for our high-performance PCR systems ensure optimal results for all your PCR research.



Backed by the leaders in PCR technology.

As with all Perkin-Elmer PCR products, the GeneAmp PCR System 2400 comes with our PCR performance guarantee and access to worldwide technical support. The integrated resources of our Applied Biosystems Division offer the most comprehensive range of systems, technologies, and support in PCR, nucleic acid synthesis, genetic analysis and protein research.

To make it easy for you to decide if you like this affordable new personal thermal cycler, Perkin-Elmer is offering a no-risk, money-back guarantee. Purchase a GeneAmp PCR System 2400, and try it in your lab for 30 days. If you're not completely satisfied, return the system for a complete refund.

To take advantage of this trial offer, call or fax your local Perkin-Elmer representative.

PERKIN ELMER

U.S. Foster City, U.S. Tel: 800-345-5224 Fax: 415-572-2743
Europe Langen, Germany Tel: 49-6103-708-0 Fax: 49-6150-708-210
Canada Mississauga, Canada Tel: 905-821-8183 Fax: 905-821-8246
Japan Tokyo, Japan Tel: 81-4-7380-8500 Fax: 81-4-7380-8505
Latin America Mexico City, Mexico Tel: 52-5-651-7077 Fax: 52-5-593-6223
Australia Melbourne, Australia Tel: 61-3-212-8585 Fax: 61-3-212-8502

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

Roche

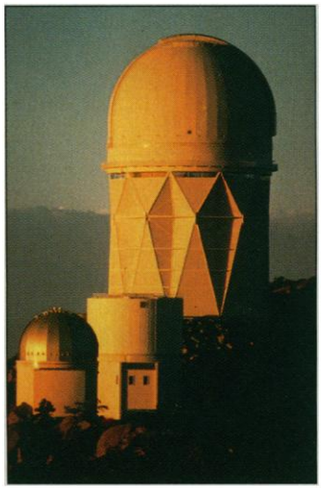
ISO 9001

Circle No. 21 on Readers' Service Card

ISSN 0036-8075
21 OCTOBER 1994
VOLUME 266
NUMBER 5184

SCIENCE

AMERICAN
ASSOCIATION FOR THE
ADVANCEMENT OF
SCIENCE



356
Too many telescopes?

368

NEWS

NOBEL PRIZES

PERSPECTIVES

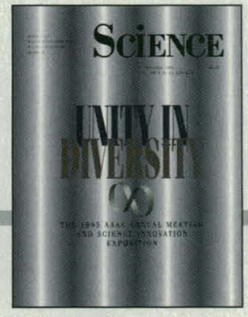
ARTICLE

RESEARCH ARTICLES

DEPARTMENTS

COVER

Unity in Diversity is the theme for the 1995 AAAS Annual Meeting and Science Innovation Exposition in Atlanta from 16 to 21 February. For the first time, the interdisciplinary traditions of the annual meeting will be blended with the biomedical research focus of the Science Innovation meeting. Researchers from every facet of science will convene to exchange ideas, publicize new knowledge, and discuss what is to come, not only within their disciplines but with regard to science in the context of society. See page 471 for a complete program with registration and hotel forms.

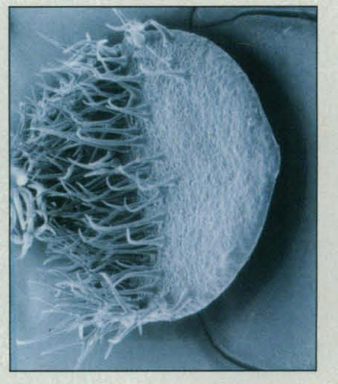


REPORTS

TECHNICAL COMMENTS

422
Visual excitement

436
Inducible hairs

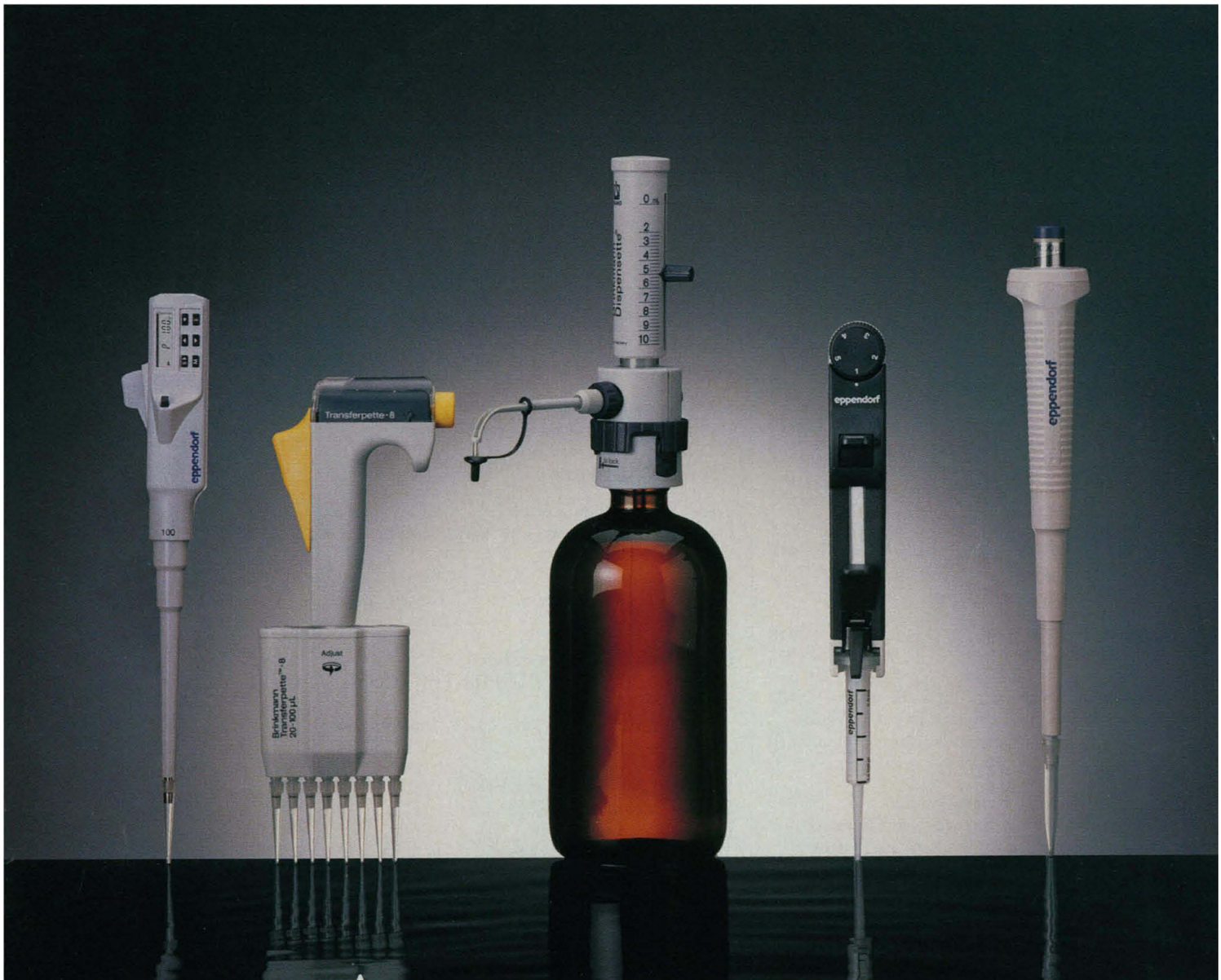


◩ Indicates accompanying feature

■ **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.

Domestic individual membership and subscription (51 issues): $92 ($50 allocated to subscription). Domestic institutional subscription (51 issues): $215. 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. **Printed in the U.S.A.**

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 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 0036-8075/83 $1 + .10. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.



A SOLID REPUTATION FOR LIQUID HANDLING.

Pipettes and dispensers for volumes from 0.5 µL to 100 mL. All from Brinkmann.
Brinkmann features a comprehensive array of high quality liquid handling products, all ISO 9001-certified and perfect for the volume of liquids you handle.

- Pipettes that meet a wide range of needs include adjustable-volume (air and positive displacement), fixed-volume, multichannel, repetitive, and electronic models.
- Bottletop dispensers that are easily operated, durable, and safely dispense reagents ranging from aggressive acids to strong alkalis, culture media to saline.
- Pipette tips and microcentrifuge tubes including Eppendorf® Biopur™ disposables which are certified pyrogen-free, RNase-free, DNA-free, ATP-free and sterile.

New Brinkmann Liquid Handling Catalog
The new Brinkmann catalog is full of liquid handling products, micro centrifuges, and sample preparation products to meet routine and special needs. All of the products above are described in detail. To get your free catalog, call **800-645-3050.**

BRINKMANN
Quality products for research and control.

Eppendorf ® is a registered trademark of Eppendorf-Netheler-Hinz GmbH.

5101-305B

For information circle reader service number 24
For a demonstration circle reader service number 25

edited by PHIL SZUROMI

Northridge assessment

The Northridge, CA, earthquake of 17 January 1994 was the most costly to hit the United States since the great San Francisco earthquake of 1906 and re-emphasized the hazards posed by buried thrust faults to the Los Angeles area. Scientists of the U.S. Geological Survey and the Southern California Earthquake Center (p. 389) overview the earthquake and resulting damage. One surprising cause of damage was the failure of welds in steel-frame buildings.

■

Ends game

The ends of linear chromosomes (telomeres) of eukaryotes require multiple repeats of simple sequences for stability. Because of the nature of the DNA replication machinery, one strand of the telomeric DNA is synthesized by a distinct ribonucleoprotein enzyme called telomerase. To date, most of the work on telomerase has occurred in ciliates. Singer and Gottschling (p. 404) isolated and characterized a telomerase component from the yeast *Saccharomyces cerevisiae*. They used a genetic screen to look for genes that when overexpressed would relieve the inhibition of transcription of genes located near the telomeres. The gene they isolated, *TLC1*, encodes the template RNA for telomerase.

■

No longer pristine

Phytoplankton assemblages in several arctic ponds on Ellesmere Island, Canada, that have been relatively stable for several millennia have apparently changed suddenly and dramatically, as documented by Douglas *et al.* (p. 416). These changes began in the 19th century and their pattern is consistent with recent warming of the high arctic. The current biota of these and other ponds may not reflect the population of a stable ecosystem.

Radical chemistry and stratospheric ozone loss

Stratospheric ozone destruction in the lower stratosphere has long been thought to be due to the catalytic action of nitrogen radicals (NO and NO_2). Wennberg *et al.* (p. 398) used an airborne instrument package to measure free radical concentrations (OH, HO_2, NO, NO_2, ClO, and BrO) in the mid-latitude lower stratosphere. The reaction of HO_2 with ozone accounts for one-half of its loss, and reactions involving ClO and BrO account for another third; nitrogen oxide accounts for less than 20 percent of ozone removal.

■

Reversal record

Geomagnetic field reversals have been particularly enigmatic; most data on what happens to the field have come from analysis of sediment cores or lava flows. Ratcliff *et al.* (p. 412) describe evidence that a reversal was trapped in rapidly cooled shallow intrusions, which fortuitously were emplaced and cooled through a reversal lasting perhaps a few hundred years. The data, from rocks about 8.5 million years ago in southern Nevada, imply that the magnetic pole during the reversal was confined to central Pacific longitudes.

■

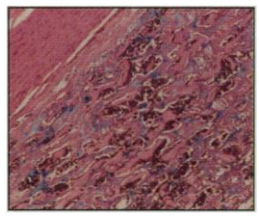
Resistance pressure

Bacterial cell walls must withstand high osmotic pressures, and many common antibiotics such as penicillin and vancomycin inhibit the enzymes that cross-link the peptidoglycan strands of the cell wall. Fan *et al.* (p. 439) present the crystal structure of such an enzyme, D-alanine:D-alanine ligase, in complex with adenosine triphosphate and a transition-state inhibitor, S,*R*-methylphosphinate. They propose a mechanism for D-Ala–D-Ala synthesis and also suggest how VanA ligase, which has been implicated in vancomycin resistance, can produce a D-Ala–D-lactate depsipeptide.

■

Fos function

Exploring the essential roles of the c-*fos* oncogene can be difficult because its protein product c-Fos, which is part of the AP-1 transcription factor complex, forms heterodimers with Jun proteins. Mice that lack Fos develop osteopetrosis (abnormal thickening of bone) and have altered hematopoiesis. Grigoriadis *et al.* (p. 443) show that in Fos mutant mice the differentiation of bone-resorbing osteo-



clasts from hematopoietic progenitors was blocked and the number of bone marrow macrophages increased. Normal development could be restored by bone marrow transplantation and by expression of c-*fos* in the defective osteoclasts. Thus, Fos appears to regulate the determination of osteoclast-macrophage lineages.

Cerebellum connection

The dorsolateral prefrontal cortex, also known as Walker's area 46, is thought to be involved in spatial working memory—roughly speaking, temporary memories that pertain to spatial characteristics. As such, area 46 participates in directing or guiding behaviors and thus can be said to subserve cognitive functions of the brain. Middleton and Strick (p. 458) provide evidence that neurons in the basal ganglia and cerebellum project to area 46 via the thalamus, suggesting that information from those portions of the brain contribute to the processing that occurs in area 46 neurons. The projection from the basal ganglia is not unexpected because Parkinson's and Huntington's patients, two diseases of the basal ganglia, display cognitive deficits. Whether the cerebellum might be connected to cognitive functions, however, has been controversial.

■

Kept in the fold

The newly synthesized proteins must be correctly folded before they can leave the endoplasmic reticulum. Hammond and Helenius (p. 456) examined the interaction of two chaperones, BiP and calnexin, that assist in this folding process. Newly synthesized vesicular stomatitis virus glycoprotein interacted first with BiP and then seemed to be passed along to calnexin, which helped the protein to complete its folding. When binding to calnexin was inhibited, the viral protein did not fold correctly, and some escaped from the endoplasmic reticulum. Thus calnexin may also play a role in the retention of misfolded proteins so that they are not expressed at the cell surface.

DISCOVER HOW *Fast* and *Easy* it is to QUANTITATE Nucleic Acid.

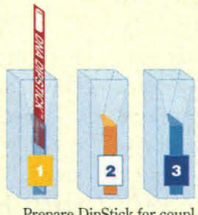
HOW FAST *is* FAST?

The DNA DipStick gives you results in 10 minutes. Now that's fast! It's hours faster than electrophoresis or radioactive assays. The simple DNA DipStick protocol requires no agarose gels or spectrophotometry and eliminates the use of ethidium bromide and radioactivity.

WE'RE SENSITIVE, TOO.

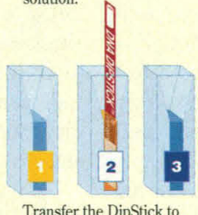
The DNA DipStick is so sensitive it uses five times less DNA for quantitation than spectrophotometry and ten times less than EtBr staining. That's plenty sensitive to measure nucleic acid concentrations and yields associated with techniques such as mRNA isolation, PCR, plasmid preparation and more.

Spot 1 µl of RNA, DNA, or oligonucleotides on the membrane. Allow to dry.



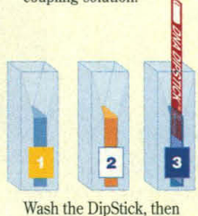
1 Min.

Prepare DipStick for coupling by incubating in wash solution.



6 Min.

Transfer the DipStick to coupling solution.



10 Min.

Wash the DipStick, then transfer to the developing solution.

Compare spot intensities to standards. Keep as a permanent record of your results.

TRY *it* TODAY!

Each DNA DipStick™ Kit contains all the reagents necessary to carry out 50 independent quantification assays (up to 150 samples). Discover how quickly you can quantitate nucleic acid. Call today and ask for the DNA DipStick™ Kit, catalog no. K5632-01.

Try it and if it's not the fastest, most sensitive way to quantitate nucleic acid, we'll cheerfully credit your purchase.

3985 B Sorrento Valley Blvd.
San Diego, CA 92121
1-800-955-6288
FAX 1-619-597-6201

Invitrogen®

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: +44 (0)235 531074 FAX: +44 (0)235 533420
France 05 90 72 49
Sweden 020 793149
Norway 800 11033
Denmark 80 01 85 92

R&D SYSTEMS

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

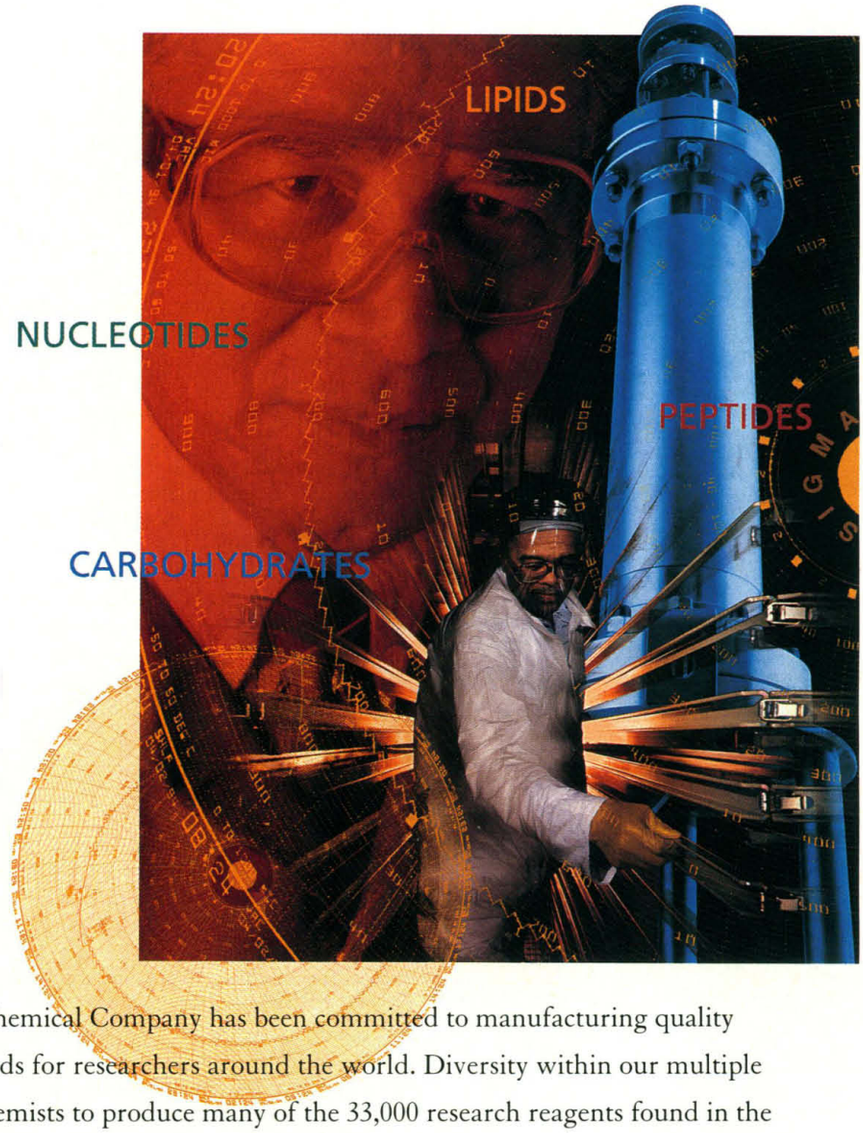
Japan
Tel: 81-356841622
Fax 81-356841633

Austria 43-1-8891819 Australia 61-38089077 Finland 35-804208077
Israel 972-8472563 Spain 34-3-4560607 Singapore 65-779-1919

Circle No. 26 on Readers' Service Card

Sigma.

Manufacturing Quality Products. Providing Expertise and Service.



For nearly half a century, Sigma Chemical Company has been committed to manufacturing quality biochemicals and organic compounds for researchers around the world. Diversity within our multiple manufacturing sites enables our chemists to produce many of the 33,000 research reagents found in the Sigma general catalog. This diversity allows Sigma to formulate custom blends, to produce specific purities and to fulfill milligram to large-scale production requests for our customers.

In order to support the tradition of quality that you have come to expect from Sigma, our chemists closely monitor every stage of manufacturing, and analytical chemists assay every product we offer. We package experience, service and expertise into every product you receive. But commitment to our customers does not stop here. Sigma continues to provide exceptional service that includes a large inventory of packaged stock, fast delivery and technical assistance.

Weigh all the advantages. Consider Sigma as your single source for research biochemicals.

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 MEXICO NETHERLANDS SOUTH KOREA SPAIN SWITZERLAND UNITED KINGDOM UNITED STATES

A Sigma-Aldrich Company

Circle No. 6 on Readers' Service Card

ADVICE TO THE STATISTICALLY WEARY.

Just call 1-800-4-JANDEL to order SigmaStat today!
–SigmaStat Advisor

Dear SigmaStat Advisor,
Help! I'm a scientist, NOT a statistician. I need a foolproof way to pick the best statistical tests for my research data.
Signed,
Looking for Answers
P.S. I'm running on Windows.

Dear Looking,
Look no further! The Jandel SigmaStat Advisor can help. Simply type your research goals into new SigmaStat for Windows and the "Advisor" feature automatically suggests the best statistical test for your data. SigmaStat also checks your assumptions and evaluates the validity of your results. It can even suggest the ideal sample size. New SigmaStat for Windows, puts your own expert statistician right on your desktop!
–SigmaStat Advisor

Dear SigmaStat Advisor,
Help! I tripped and dropped a test tube! What do I do now that my data is unbalanced?
Signed,
Statistically Unbalanced

Dear S.U.,
You need Jandel SigmaStat! Other statistical packages either use erroneous substitution methods or make you throw out valuable data points. SigmaStat for Windows uses a sophisticated general linear model to give you the most accurate results possible from your "messy" data.
–SigmaStat Advisor

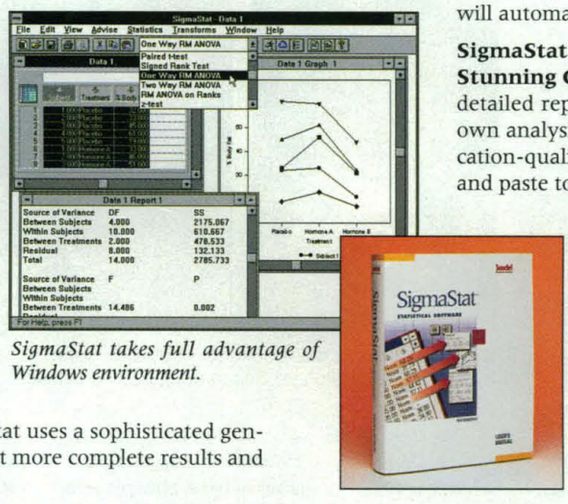
Dear SigmaStat Advisor,
How do I get a copy of new SigmaStat for Windows? (I heard from a trusted colleague that SigmaStat is the fastest, easiest way to do statistical analysis on my research data.)
Signed,
Searching for SigmaStat

Dear

Try New Jandel SigmaStat™ for Windows! New SigmaStat for Windows comes complete with your own expert statistician right in the box! The SigmaStat Advisor appears with a click of your mouse to make your statistical worries go away. What's the ideal sample size? Which statistical test is best? Are your assumptions and results valid? SigmaStat has the answers.

The SigmaStat Advisor Automatically Picks the Best Test for You. SigmaStat automatically points you to the appropriate tests. You simply type in your goals, and SigmaStat's Advisor automatically suggests the best statistical test for your data!

SigmaStat Gives You Better Results from "Messy Data." Other statistical software packages throw out valuable data. Not SigmaStat for Windows. SigmaStat uses a sophisticated general linear model to fill data gaps, so you get more complete results and better conclusions.



SigmaStat takes full advantage of Windows environment.

SigmaStat Checks Your Assumptions. SigmaStat automatically checks that your data fit the assumptions underlying the statistical methods you're using. If there's a problem, SigmaStat will automatically suggest a more appropriate test!

SigmaStat Lets You Print Detailed Reports and Stunning Graphs. SigmaStat automatically creates a detailed report of your test results–complete with its own analysis! Plus you can automatically print publication-quality graphs of your SigmaStat results or cut and paste to your favorite Windows application.

TO ORDER SIGMASTAT TODAY
CALL 1-800-4-JANDEL

Competitive and customer upgrades available. Quantity, academic, and student pricing available.

Inc. 500®

12th 1982 1994

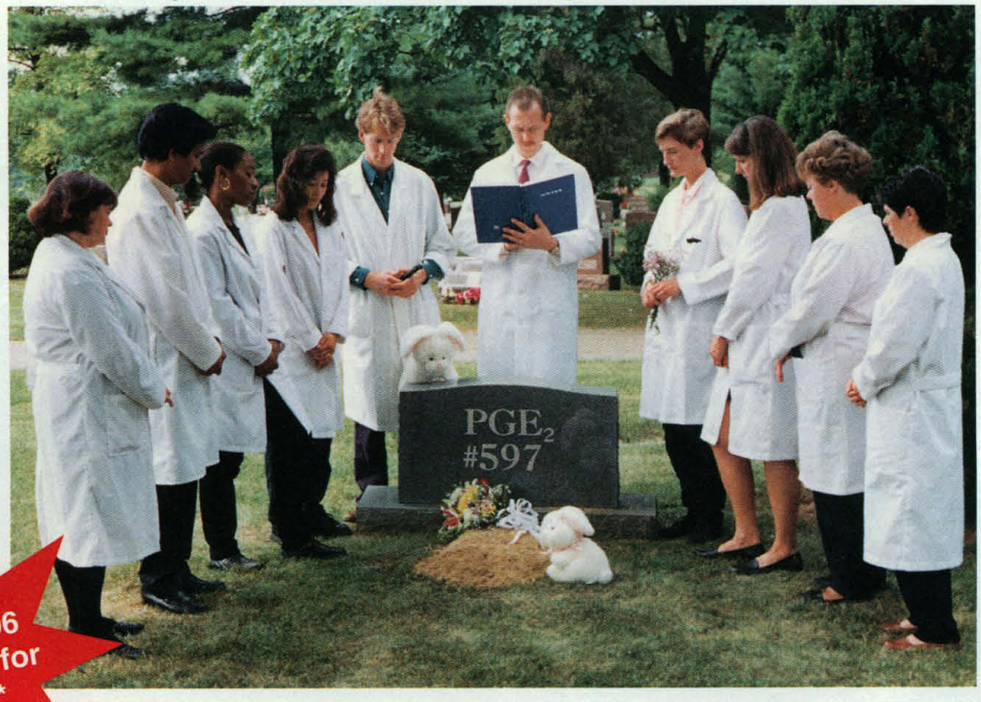
Jandel
SCIENTIFIC SOFTWARE

2591 Kerner Blvd., San Rafael, CA 94901 Phone: **(800) 4-JANDEL,** (415) 453-6700 Fax: (415) 453-7769, Internet: sales@jandel.com

In Europe: Jandel Scientific, Schimmelbuschstrasse 25, 40699 Erkrath, Germany 02104/36098 02104/33110 (FAX)
For international dealers call: Australia 2 958 2688, Denmark 45-42150544, Canada 519 767 1061, France 059-03755, Japan 3 3590 2311, Switzerland 41-617121616, Taiwan 2 785 3202, UK 0800-894982

Circle No. 41 on Readers' Service Card

An untimely loss can have severe consequences...



Get a 96 well kit for $60!*

Introducing

THE IMMORTAL
Prostaglandin E_2 Assay

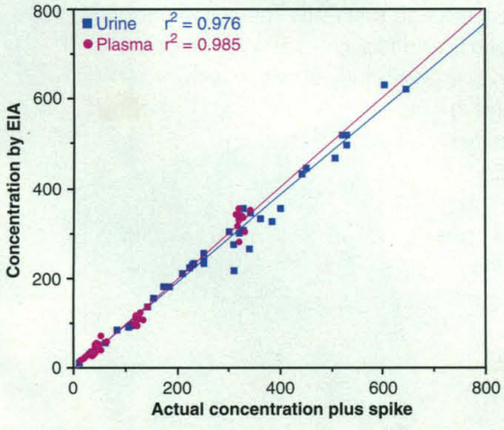
Cayman Chemical was the first company to offer a comprehensive line of reliable, affordable Prostaglandin EIAs. Our most popular product was the PGE_2 assay because of its unrivaled sensitivity. Unfortunately, the loss of our widely-acclaimed PGE_2 polyclonal rabbit antiserum in 1992 was a real setback for this assay.

Since then, our R&D division has been working diligently to replace this kit, directing their efforts toward the development of a monoclonal antibody. The result is one of the most specific and sensitive PGE_2 antibodies ever produced (and because it's monoclonal, the supply is unlimited!).

Our new kit using this antibody outperforms any other PGE_2 EIA on the market. We're so excited about this assay (and we think you will be too) that we're offering it for a special introductory price of $60!*

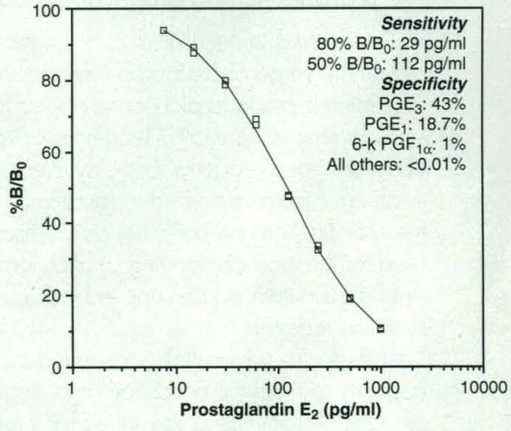
Experience the *ACE™ monoclonal* difference in a simple, easy-to-use assay.

Reliable!



CAYMAN CHEMICAL

Sensitive & Specific!



Circle No. 20 on Readers' Service Card

Cayman Chemical Company • 690 KMS Place • Ann Arbor, MI 48108 • Ph: (800) 364-9897, (313) 662-6756 • Fax: (313) 662-6896

**To qualify for this offer, each order must be accompanied by proof of purchase for a PGE_2 kit from any company within the past two years. Limit one 96 well kit per customer. Shipping charges additional. This offer expires December 31, 1994.*

ACE

Imagine Having The Tools To

Remember the milestones in your life. The ones that revealed your talent to create, solve, explore, and discover.

Maybe it was a special science fair project. Or a certain insight you had in a college lab. Or maybe it was a tool, like an EM, that let you really delve into what makes things tick. Somehow it all came together into a career in the sciences.

Biosearch specializes in creating tools that fuel your inner drive to discover. Tools that allow your imagination to take on today's frontiers.

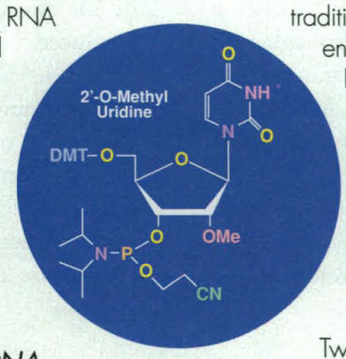
RNA

RNA oligomers have shown promise in therapeutic and diagnostic applications, including inhibition of viral replication, cancer etiology, and gene regulation and expression.

To bring these applications within easy reach, Biosearch was the first to introduce a complete, automated RNA synthesis system with nucleotide monomers, reaction columns, pre-packaged reagents, and optimized synthesis protocols.

Our new Expedite™ RNA chemistry makes your work-up procedures faster, easier, and more efficient. The milder cleavage and deprotection conditions reduce chain degradation and increase yield. The Expedite RNA reagents employ our patented betacyanoethyl phosphoramidite chemistry that's become the method of choice in DNA and RNA synthesis.

Our researchers are currently developing protocols for large-scale synthesis of RNA oligomers. (Photo of RNA crystal, courtesy of Dr. Alex Rich, MIT, was synthesized at a scale of 70 μ mole on Biosearch's 8800 Synthesis System.)



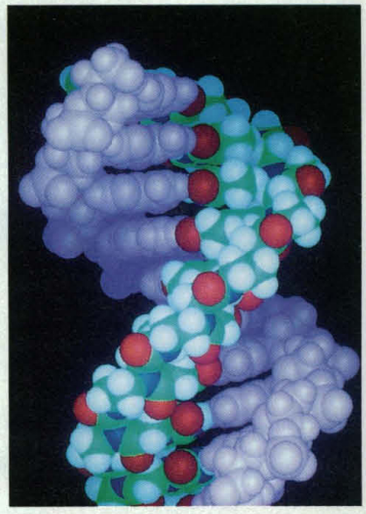
Therapeutic and diagnostic grade DNA

Researchers in the clinical and diagnostic use of DNA are on the verge of creating a new class of pharmaceuticals. Biosearch is proud to pioneer new tools for their work.

Biosearch is the world's leading supplier of systems, chemicals, and reagents for the synthesis, purification, and analysis of therapeutic and diagnostic DNA. We've tightened the specifications on our products to ensure that they can be used for the most demanding applications. A Certificate of Analysis is automatically supplied with all of our DNA synthesis reagents.

We've also substantially expanded our manufacturing capacity to meet the needs for large single-batch production of material, minimizing your need for internal quality control.

In addition to standard reagents, Biosearch can also supply phosphoramidites and bulk quantities of synthesized oligomers on a custom-synthesis basis.



PNA

Peptide Nucleic Acids–PNA oligomers. These molecules are so novel that they're rewriting the very nature of nature. Biosearch is the world leader in the development and synthesis of these exciting new molecules.

Similar to DNA and RNA, PNA carries information in sequences of the four bases: adenine, guanine, cytosine, and thymine. In PNA, however, these code carriers are connected to a completely different backbone–a polyamide backbone similar to that found in peptides. PNA oligomers are more stable than their natural counterparts yet bind more specifically and with higher affinity to natural DNA and RNA.

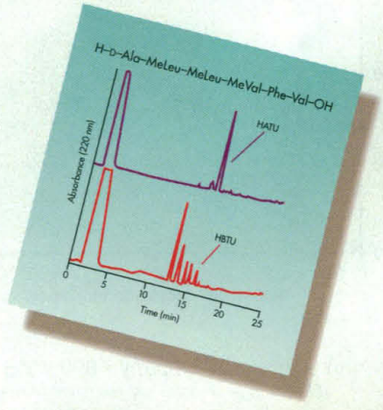
PNAs can be used in many of the same applications as traditional DNA. Their greatest contribution, however, may come from applications that can't be performed using traditional DNA oligonucleotides, such as restriction enzyme blocking, PCR clamping, and DNA mapping.

Biosearch can provide you with custom PNA oligomers, or the monomers, supports, and reagents to synthesize your own oligomers.

HOAt and HATU peptide coupling reagents

Two new coupling reagents, HOAt and HATU, simplify your peptide synthesis. These new reagents enhance coupling yields and reduce racemization and coupling times. They are particularly effective with difficult couplings and in the synthesis of peptides containing hindered amino acids.

HOAt and HATU have structures similar to the commonly used reagents HOBt and HBTU, and are compatible with all standard activation strategies.



Keep Up With Your Imagination.

PEG-PS™ peptide synthesis supports

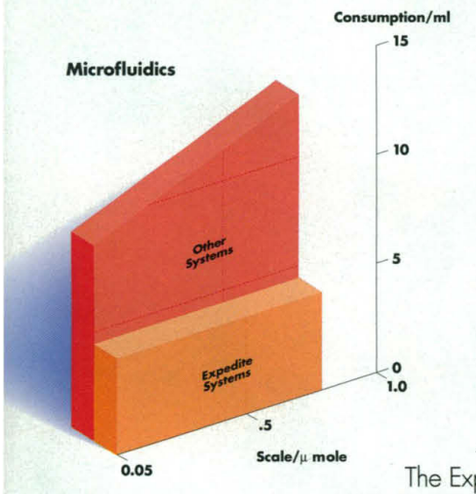
PEG-PS (polyethylene glycol-polystyrene) peptide synthesis supports from Biosearch help you achieve improved peptide purity with shorter cycle times.

Unlike traditional supports, PEG-PS beads more closely resemble the nature of the growing peptide chains. Solvation of the peptide resin is higher, resulting in a higher peptide purity. Synthesis is fast and effective due to high coupling efficiency and minimal side reactions.

PEG-PS supports are easy to handle, compatible with a wide range of solvents, and are especially well suited for the synthesis of long or difficult peptides.

Microfluidics

In the real world, achieving "end product" is not the only concern. There are dozens of production costs as well as the escalating costs of hazardous waste disposal.



Biosearch's Expedite Nucleic Acid Synthesis System, with its patented microfluidics technology, not only enables fast cycle times but also provides the bonus of reduced reagent consumption. The distance between the reagent reservoir and the column is minimized so that a single coupling cycle requires less than 4.5ml of reagents. The Expedite system (with optional trityl monitor) can also separate the chlorinated waste–simplifying disposal tasks and reducing associated costs.

Membrane synthesis

Perform nucleic acid synthesis on a membrane? It's now possible–and practical–thanks to Biosearch Nucleic Acid Membrane Supports, a breakthrough synthesis technology developed by Biosearch.

Biosearch membrane supports use a proven PTFE membrane system that directly replaces traditional controlled pore glass (CPG) supports. Membrane devices have standard luer fittings, so they can be plugged into any brand of synthesizer.

Biosearch membrane supports allow you to synthesize both long and short oligomers on the same type of membrane; no longer do you need to select the size of the CPG according to the length of the oligomer.

With Biosearch membrane supports, not only do you eliminate beads, but there's no centrifuging and no washing. Just remove the membrane from its holder, cleave, and deprotect.

Allyl-based protection for complex peptides

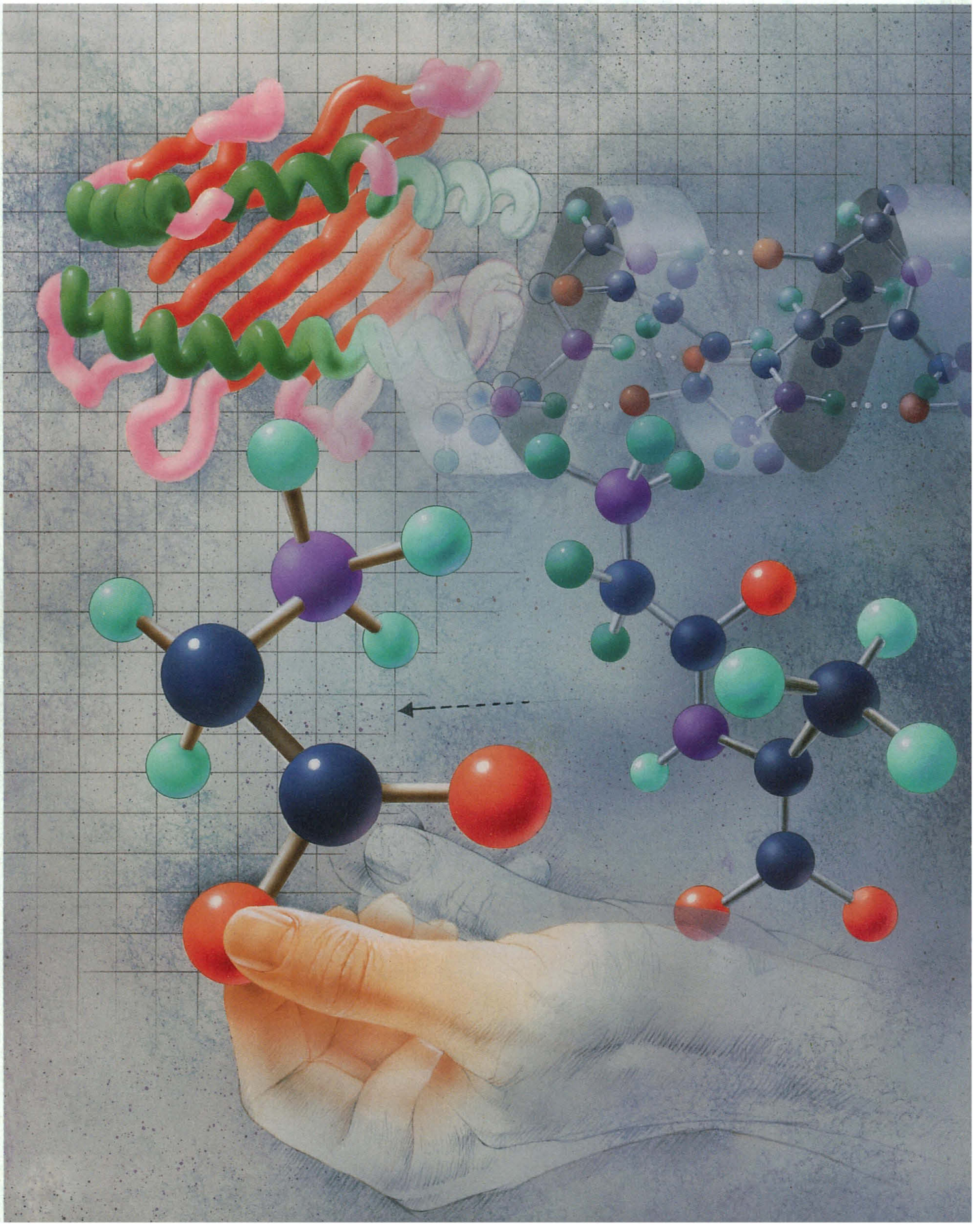
The synthesis of cyclic, branched chain, sulfonated, glycosylated, and phosphorylated peptides have traditionally been time consuming and problematic.

To synthesize these complex peptides quickly and efficiently, Biosearch scientists have perfected convenient techniques using allyl-based protecting groups. Allyl amino acids can be selectively deprotected in a manner which is compatible with other classical protecting groups (such as Fmoc, Boc, *t*Bu), sensitive amino acids (Met, Trp), and side chain modifications (Tyr(SO_3H)). Biosearch has also developed protocols for the fully automated synthesis of cyclic peptides, branched peptides, and MAPs on our 9050 Plus PepSynthesizer.™

If we've intrigued you with some of these innovative tools, it's easy to find out more. For our "Directory of Chemical Products"–one of the most comprehensive synthesis tool kits in the world–call the Biosearch Group in the US and Canada at 1-800-872-0071, in Germany at (49) 040-853267-36, in Japan at (03) 3471-8191, in France at (33) 1 30127002, and in the UK and the rest of Europe at (44) 0923 211107.

BIOSEARCH
Subsidiary of Millipore

Circle No. 30 on Readers' Service Card



M A N P L U S

PROTEIN CHARACTERIZATION

How to get more information, from less sample, faster!

Characterizing proteins often means making the most of your precious sample. Innovative solutions from Beckman give you more information to validate your research, microsampling to conserve your costly samples and automation to get you to the finish line faster.

ACQUIRE MORE INFORMATION

Obtaining more information is important to your protein research. With the P/ACE™ 5000 Capillary Electrophoresis System you can now acquire more information than with classical gels. SDS-PAGE replaceable gels and IEF options offer direct quantitation of your proteins.

Low noise protein sequencer chemicals allow you to sequence farther into picomole amounts of protein or peptide.

USE LESS SAMPLE

Now you can use smaller amounts of sample with proven methods from Beckman. A sedimentation profile on the Optima™ XL-A provides quantitative data describing self-association and binding between different macromolecules in a single run using less than 50 µL. Multi-sample runs also evaluate protein mass, conformation and purity — all in native solutions with no standards.

CE analyzes your proteins by injecting only nanoliters of sample.

Use as little as 5 µL of sample with the DU® Series UV/VIS Spectrophotometers. Evaluate K_m, V_{max} and allosteric behavior with our integrated Enzyme Mechanism software and determine molecular weights with gels or films.

COMPLETE YOUR RESEARCH FASTER

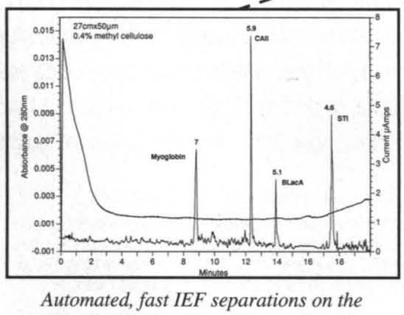
Time is critical in protein research and automating your lab is important. With the BIOMEK® 2000 BioRobotics System, automating ELISAs, temperature-sensitive receptor assays and high density hybridoma screening of up to 1,536 samples on a single membrane is now possible.

Check the purity of 10 µL HPLC fractions in less than 20 minutes with our CE System and avoid wasted sequencing time.

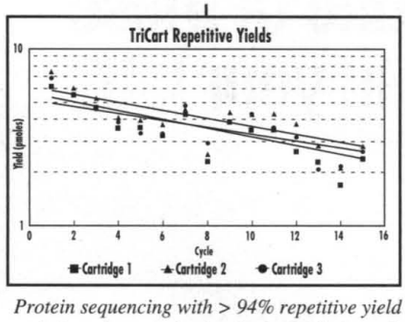
Load three samples at a time and run programs for up to six samples with the TriCart option on the LF 3000 Protein Sequencer for increased laboratory throughput.

THE BECKMAN PLUS

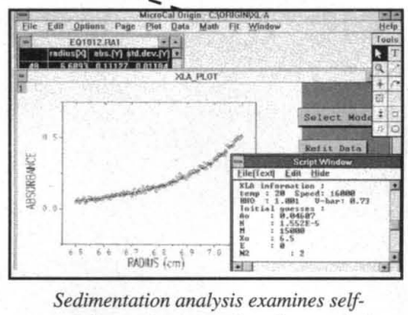
Ask your Beckman representative for *free* applications information about these and our other protein research products including AAA and HPLC by contacting your local Beckman office.



Automated, fast IEF separations on the P/ACE 5000 Capillary Electrophoresis System with direct quantitation.



Protein sequencing with > 94% repetitive yield optimizes characterization in the 1-10 picomole range. The only sequencer with an upgrade path to grow with your application needs.

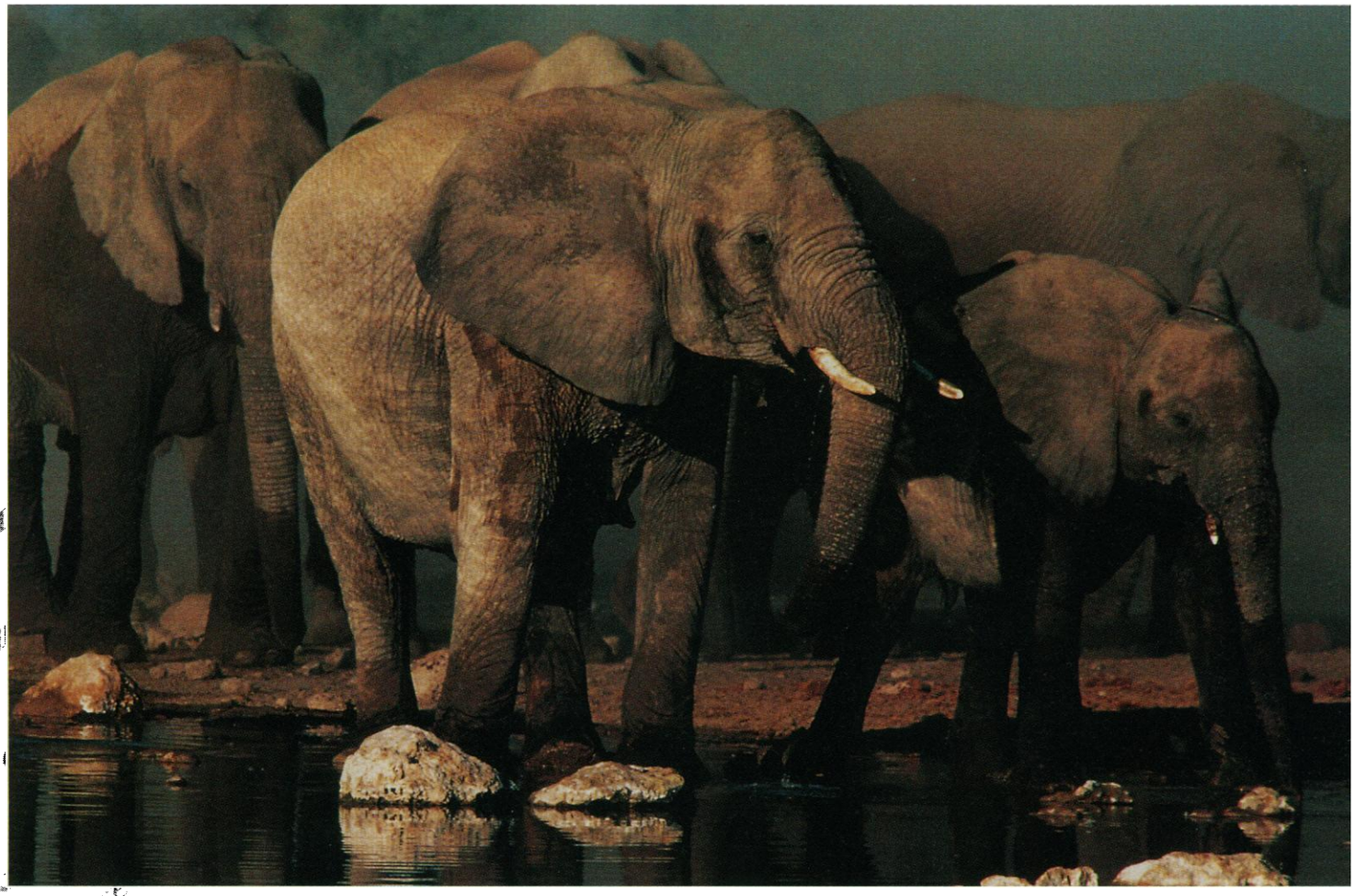


Sedimentation analysis examines self-association and aggregation characteristics. Evaluate stoichiometry and binding constants in native solutions.

BECKMAN

Worldwide Offices: Africa, Middle East, Eastern Europe (Switzerland) (22) 994 07 07. **Australia** (61) 02 816-5288. **Austria** (2243) 85656-0. **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.** (0494) 441181. **U.S.A.** 1-800-742-2345.

Circle No. 9 on Readers' Service Card



How'd you like to see one of these in your lab?

Not an elephant, but a big, colorful "Elephants at the Watering Hole" poster representing the powerful security and peace-of-mind you get with Boehringer Mannheim PCR products. You can, when you participate in our PCR Peace-of-Mind program, now until November 30, 1994. Call 1-800-428-5433* to receive information on how to qualify for this poster, plus your choice of designer watches, subscriptions to *Nature* Magazine, or dollars off your next order. But Hurry! Come November 30th, these big fellas will be gone.

*Sorry, this promotion is limited to U.S. customers only.

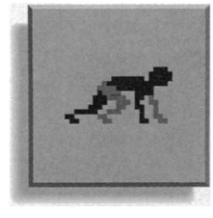
This product is sold under licensing arrangements with Roche Molecular Systems and The Perkin-Elmer Corporation. Purchase of this product is accompanied by a license to use it in the Polymerase Chain Reaction (PCR) process in conjunction with an Authorized Thermal Cycler.

mannheim boehringer *Biochemicals*

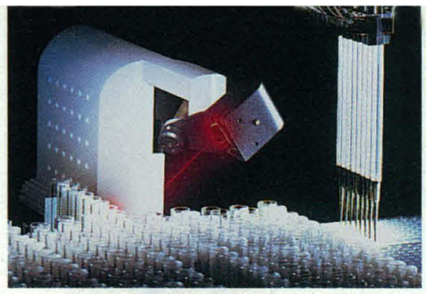
BOEHRINGER MANNHEIM Corporation
9115 Hague Road
P.O. Box 50414
Indianapolis, IN 46250-0414
USA

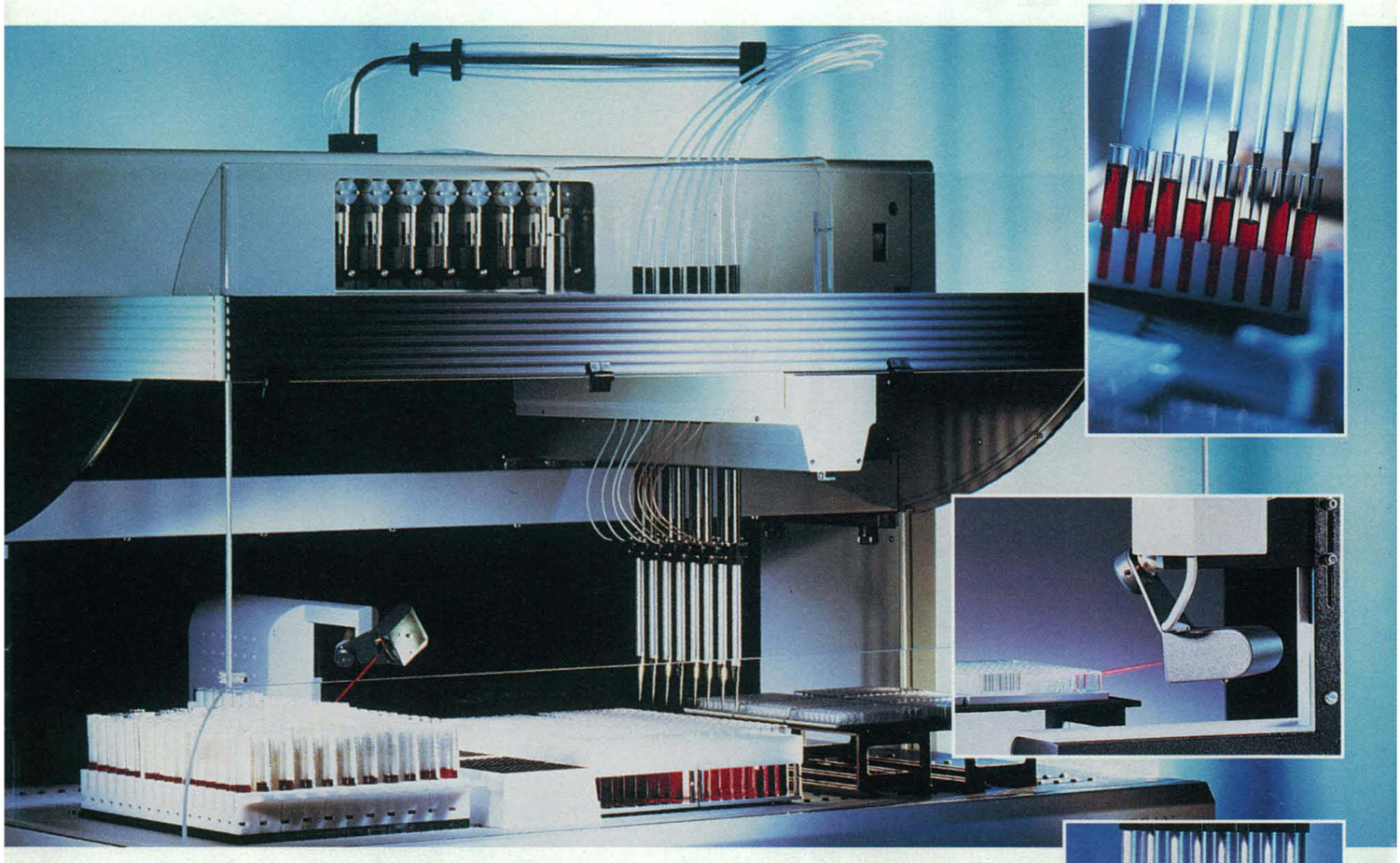
Circle No. 40 on Readers' Service Card

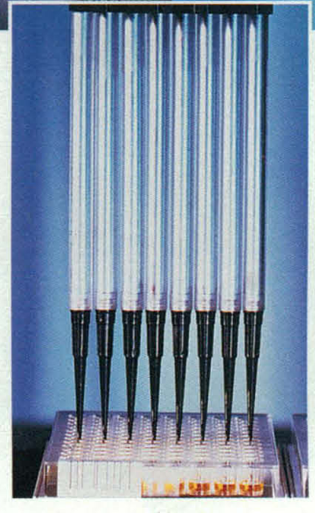
The Logical Evolution



A new concept in Robotic Sample Processing







Robotic Sample Processors used to be either fast, or flexible - but not both.

That's all changed. The GENESIS Series combines total flexibility with extremely rapid throughput.

GENESIS Series

Now you have the freedom to choose tips, carriers and workspace configuration. This choice is extended by a wide range of options. All matched with true high speed processing.

For pharmaceutical and biotechnology work adjustable liquid level detection allows the smallest volumes to be used. For clinical applications, safe and secure processing is guaranteed by Positive Identification. Even the most complex research protocols are simply co-ordinated through Windows™ - based software.

GENESIS Series - the platform for all your applications.

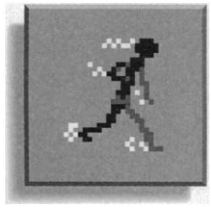
● **TECAN AG,** Tel: 055 41 81 11, Fax: 055 42 38 83, Hotline: 055 41 82 82 ● **TECAN France SA,** Tel: 1 30 64 90 70, Fax: 1 30 64 90 64
● **TECAN Asia PTE. Ltd.,** Tel: 0567 0600, Fax. 0567 2122 ● **TECAN UK Ltd.,** Tel: 01491 875087, Fax: 01491 875432 ● **TECAN Japan Co. Ltd.,** Tel: 04 2334 1790, Fax: 04 2334 0401
● **SLT Labinstruments GmbH,** Tel: 07951 5035, Fax: 07951 5038 ● **TECAN US Inc.,** Tel. 919 361 5200, Fax: 919 361 5201, Hotline: 800 338 1226

Worldwide sales and support are provided by an additional, extensive and specialist network of Representatives. To find out more information about your local TECAN Representative, contact TECAN AG.

TECAN.

Circle No. 5 on Readers' Service Card

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 now for more information about the BioLogic System, the logical choice for biomolecule purification.

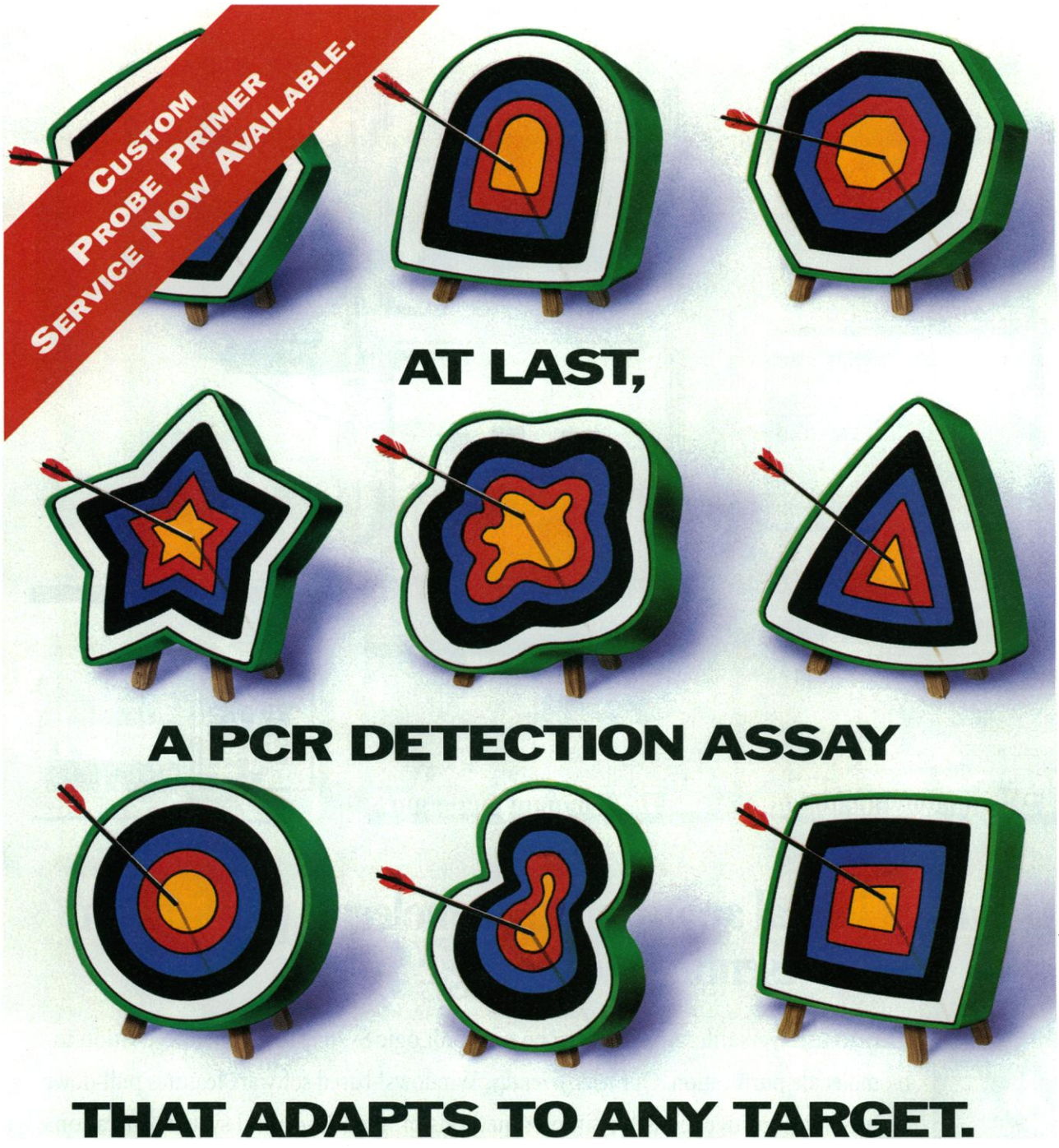
BIO-RAD **Bio-Rad Laboratories**

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. 49 on Readers' Service Card



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.

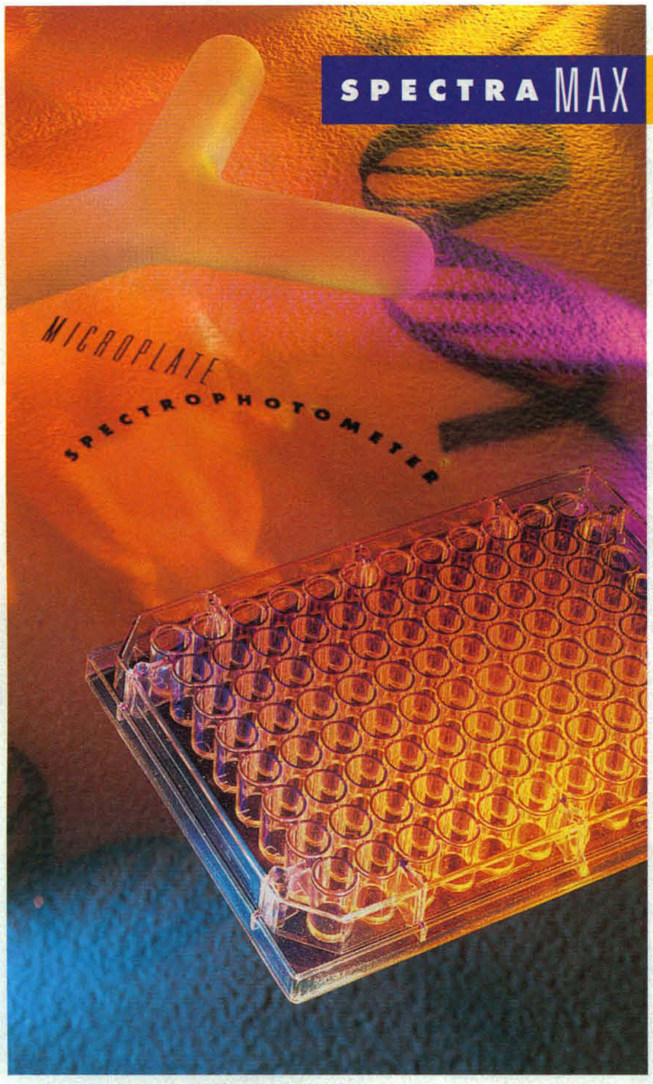
To order your kit or for more information, call 1-800-DIGENE-1. International inquiries, call 301-470-6500 or fax 301-680-0696.

DIGENE
DIAGNOSTICS, INC.

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. 43 on Readers' Service Card



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.

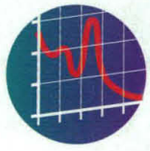
Direct UV measurements in a microplate
Directly determine the concentration of up to 96 different DNA, RNA, or protein samples in a few seconds using a SPECTRAplate UV transparent disposable or quartz microplate. Protocols are included to measure the purity of DNA samples by calculating A 260/A 280 ratios. 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

Circle No. 32 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.

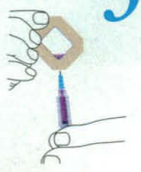
1.

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	**Slide-A-Lyzer™ 10K Dialysis Cassettes*, 10 pack** Contains: 10 cassettes (10,000 Molecular Weight Cut-off, 0.5 - 3.0 ml sample capacity)	$49
66430	**Slide-A-Lyzer™ Buoys, 10 pack**	$12
66490	**Slide-A-Lyzer™ Syringe and 18G Needle Accessories, 10 pack** 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

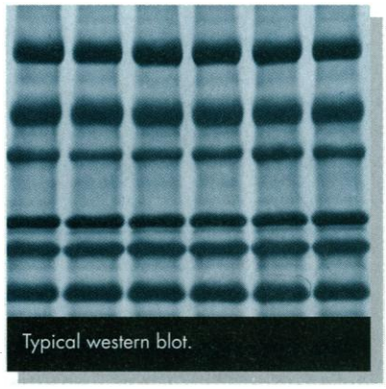
European Distributors:
Austria 018891819
Belgium 036465511
Denmark 44948822
France 070038855
Germany 0224196850
Italy 025097220
Holland 0206113133 or 076795795
Norway 22722100
Spain 017290333
Switzerland 0217287772
United Kingdom 0244382525
Sweden 087460035

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

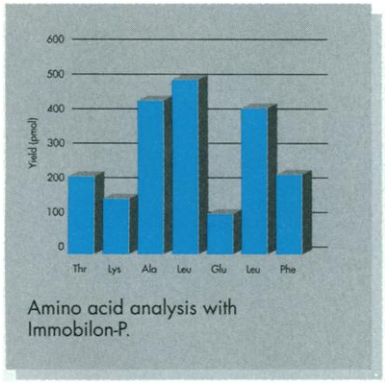
Circle No. 8 on Readers' Service Card

Call For A Free Sample.

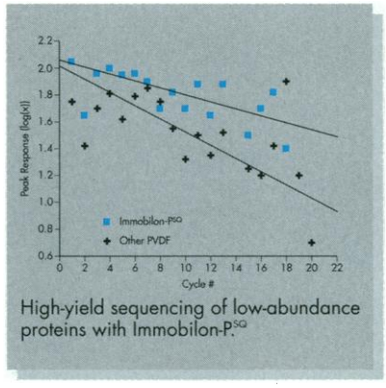


Typical western blot.

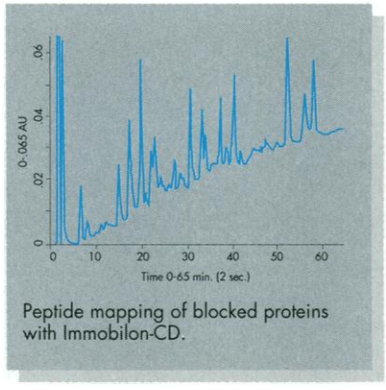
Information.



Amino acid analysis with Immobilon-P.



High-yield sequencing of low-abundance proteins with Immobilon-P^{SQ}



Peptide mapping of blocked proteins with Immobilon-CD.

Information Superhighway.

To elucidate the properties of your protein, let one of the Immobilon™ transfer membranes pull out the maximum information possible.

Millipore has developed unique Immobilon matrices—each optimized for different biomolecule studies.

Immobilon-P is the ideal PVDF matrix for general western blotting and immunodetection, delivering stronger bands and better signal-to-noise than traditional nitrocellulose. The broad compatibility of PVDF makes it particularly well suited for amino acid analysis.

Immobilon-P^{SQ} is a specialized PVDF membrane that binds three-to-five times more protein than conventional PVDF. The capture of peptides or low-abundance proteins with nearly 100% efficiency makes this the membrane of choice for high-yield sequencing.

For peptide mapping of N-terminally blocked proteins, there's no better choice than Immobilon-CD. Its cationically-charged PVDF surface permits reversible sample immobilization, allowing protein bands to be eluted from the membrane after transfer for sequencing.

Don't let vital information slip through your fingers. Take the high road—and find out what you've been missing. For a free sample of the Immobilon membrane of your choice and key references, in the US and Canada call 1-800-MILLIPORE ext. 8202. Japan, fax to (03) 3474-9141. Europe (fax to our Paris headquarters), +33.1.30.12.71.83.

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

MILLIPORE

Circle No. 47 on Readers' Service Card