
Science
25 June 1999
Vol. 284 No. 5423
Pages 2045–2220 $8
Evolution
American Association for the Advancement of Science

VOLUME 284 25 JUNE 1999 NUMBER 5423

Science

www.sciencemag.org

COVER Fossils of the large (15 to 30 cm), soft-bodied organism *Pteridinium simplex* are locally abundant in sandstone beds of the terminal Proterozoic (~550-million-year-old) Nama Group in Namibia. New insights from paleontology, geochemistry, and molecular genetics are collectively illuminating the pattern, developmental basis, and environmental context of early animal evolution. These insights are part of the special section on evolution beginning on p. 2105. [Image: A. H. Knoll]

2070
Animal minds

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SCIENCE (ISSN 0036-8075) is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1200 New York Avenue, NW, Washington, DC 20005. Periodicals Mail postage (publication No. 484460) paid at Washington, DC, and additional mailing offices. Domestic individual membership and subscription (51 issues): $110 ($62 allocated to subscription). Domestic institutional subscription (51 issues): $325; Foreign postage extra: Mexico, Caribbean (surface mail) $55; other countries (air assist delivery) $90. First class, airmail, student, and emeritus rates on request. Canadian rates with GST available upon request, GST #1254 88122. Publications Mail Agreement Number 1069624. **Printed in the U.S.A.**

SCIENCE'S COMPASS

EDITORIAL

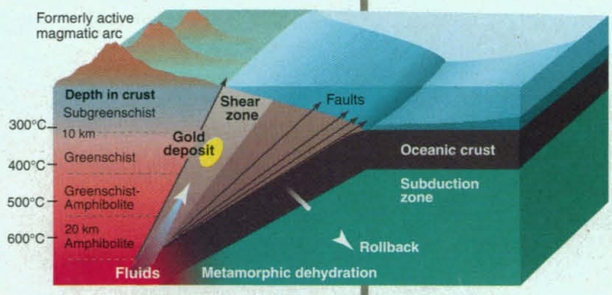
LETTERS

POLICY FORUM

BOOKS *ET AL.*

2101

How Earth makes gold deposits



PERSPECTIVES

2164

Digital imaging

TECHNICAL COMMENTS

www.sciencemag.org/cgi/content/full/284/5423/2055a

SCIENCE ONLINE
www.scienceonline.org

SCIENCE
THE JOURNAL
www.sciencemag.org

SCIENCENOW
DAILY NEWS SERVICE
www.sciencenow.org

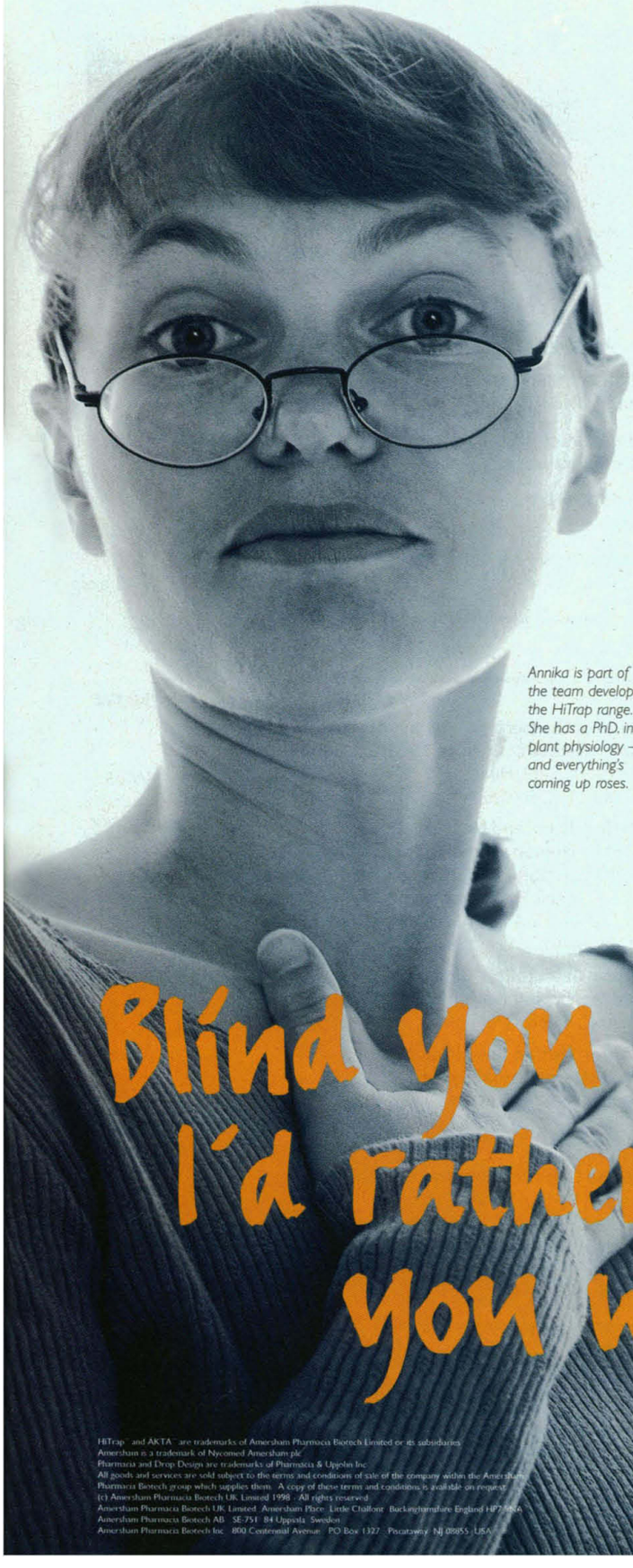
NEXT WAVE
WEEKLY CAREER UPDATES
www.nextwave.org

GRANTSNET
RESEARCH FUNDING DATABASE
www.grantsnet.org

NEUROAIDS
EXPERIMENTAL WEB SITE
www.sciencemag.org/NAIDS

QUARTERLY AUTHOR INDEX
www.sciencemag.org

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



Annika is part of the team developing the HiTrap range. She has a PhD. in plant physiology – and everything's coming up roses.

That's just what you get with our pre-packed HiTrap™ columns. Results. Time after time, giving you peace of mind and time to concentrate on other important aspects of your work.

New HiTrap™ columns for hassle-free purification

HiTrap frees you from the needless details of many purification procedures because we've done all the work. Pre-packed columns and easy-to-follow instructions ensure fast start-up and method optimisation. There are even recommendations for sample handling.

In addition to applications for His-tagged fusion proteins, monoclonal and polyclonal IgG and DNA-binding proteins, the HiTrap range now includes immobilised lectins, immobilised streptavidin and media for purification of IgM and IgY.

Solvent delivery can be as simple as a syringe or as sophisticated as an ÄKTA™design system. No other range offers such a choice of application from affinity to desalting.

Give us a call: in Europe +44 (0)1494 544550; in the US 1-800 526 3593; in Japan +81 3 5331 9336 and from the rest of the world +44 (0)1494 544100.

Or visit our web site: **www.apbiotech.com/hitrap** – it'll be an eye-opener.

Blind you with science? I'd rather dazzle you with results.

Circle No. 28 on Readers' Service Card

amersham pharmacia biotech

17-98 MMC

PLANTS UNDER ATTACK

One danger of an increase in global temperature is that it might increase predation of insects on plants. Wilf and Labandeira (p. 2153; see the Perspective by Coley) test this possibility by looking at the fossil record. They examined the predation of insects on plants during the Paleocene and Eocene, about 50 million years ago, a time when Earth's climate warmed considerably. Data from many plant fossils at comparable sites and latitudes in western North America show that predation was significantly greater during the warmer climates of the Eocene.

GLOBAL CLIMATE LINKS

The historic climate record shows that the Indian summer monsoon and the El Niño–Southern Oscillation (ENSO) have been linked: A weak monsoon generally coincided with a warm El Niño event. Another factor influencing the Indian monsoon is Himalayan snow cover, which correlates with Eurasian temperatures. Kumar *et al.* (p. 2156) have analyzed the historic record and show that the ENSO-monsoon connection has weakened in the last couple of decades. One possible explanation may be recent increases in Eurasian temperatures, which may help sustain monsoon rainfall during warm ENSO events.

THERE'S GOLD IN THOSE ROCKS

The origin of major regional gold deposits has been uncertain; much gold is found in quartz veins in metamorphic rocks, either in a magmatic arc or in oceanic crust accreted to the front of the arc. Knowledge of the solubility of gold with pressure and temperature is critical for inferring how the gold was concentrated in the vein-forming fluid and then deposited. Loucks and Mavrogenes (p. 2159; see the Perspective by Kerrich) measured gold solubility by creating gold-rich inclusions in quartz, which served as experimental pressure vessels. The data show that the solubility of gold species in fluids is quite high at high pressure and temperature but drops abruptly with cooling and depressurization. Sudden depressurization of a fluid containing gold could lead to an economically viable deposit.

RECONSTRUCTING THREE-DIMENSIONAL IMAGES

Many fields take advantage of two-dimensional optical imaging to record data, but in many cases it would be more useful to image the object in three dimensions. Most methods with this capability require a point-by-point scanning of the object or illumination with coherent light (lasers) as in holography. Marks *et al.* (p. 2164; see the news story by Radov) describe a method that uses ordinary incoherent white light. The cones of light scattered from each point on the object contribute to the total intensity at each pixel, as measured on a two-dimensional sensor array. By analyzing this mutual intensity function using interferometry and algorithms developed for x-ray tomography, the authors were able to reconstruct accurately a three-dimensional image of an illuminated object.

INTEGRATING ETHYLENE RESPONSES

An unusual protein anchors signal transduction for the ethylene hormone in plants and may as well coordinate responses to other volatile chemical signals. Alonso *et al.* (p. 2148) have now cloned and characterized the *EIN2* gene from *Arabidopsis*.

Analysis of the sequence predicts one domain with 12 transmembrane helices and a second hydrophilic domain that functions in ethylene signaling but shows little similarity to other known signaling proteins. Interactions of EIN2 with the rather distinct ethylene and jasmonate pathways suggest molecular explanations for the coordination of signaling responses.

CLOSURE DOMAINS CLOSED

As electron spins undergo ordering in magnetic materials, energy minimization will cause the material to split into macroscopic regions where all of the individual magnetic moments have the same orientation. Between the domains and near the surface of the films are regions of in-plane magnetization called closure domains, which tend to elude imaging by normal magnetic scattering techniques. Dürr *et al.* (p. 2166; see the Perspective by Hillebrecht) describe a method for imaging based on scattering of circularly polarized x-rays. Magnetization profiles in thin iron-palladium films were obtained in which these in-plane closure domains could be seen.

SMELL AND RESPONSE

Despite the enormous progress made in the molecular biology of olfactory receptors, our understanding of subsequent signal processing in the olfactory system is still rather limited. Duchamp-Viret *et al.* (p. 2171) examined the odor tuning of rat olfactory receptor neurons assayed by electrophysiological recordings from the nasal mucosa. Their results indicate that the responses of olfactory receptor neurons are only rarely specific to only one odor; the majority of cells respond to a broad range of substances. This finding challenges the hypotheses that one neuron expresses only a single olfactory receptor. Rather, it appears that arrays of neurons are activated in response to a specific odor.

LIKE CLOCKWORK

Human circadian clocks have been thought to run with widely variable periods that average near 25 hours, which is considerably longer than that of other animals, and that the period decreases with age, which would account for the well-known early awakening of elderly people. Czeisler *et al.* (p. 2177; see the Perspective by Moore) now show that neither of these statements are true. They used an experimental protocol in which young and old subjects were exposed to environmental cues in a rhythm so far from that of the endogenous clock that these cues had no influence on the clock's period. Under these conditions, the free-running period of the human circadian clock was 24 hours and 11 minutes in both young and old subjects, similar to that of other animals.

ACCELERATING TRANSCRIPTION WITH A METHYLTRANSFERASE

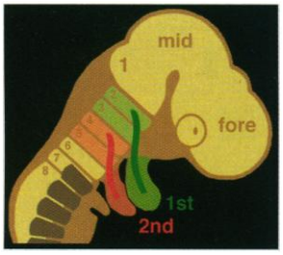
The protein-DNA complex of chromatin presents a critical barrier to the transcription process; cells are able to deal with this structural barrier by utilizing chromatin-modifying factors such as histone acetyltransferases, or HATs. Several coactivators have been shown to have HAT activity. Chen *et al.* (p. 2174) now identify a so-called secondary coactivator that in-

CONTINUED ON PAGE 2055

teracts with a nuclear hormone receptor coactivator to increase transcription activation. This secondary coactivator, CARM1, displays another enzyme activity—that of a methyltransferase. CARM1 may, like HATs, affect chromatin structure through histone modification. Alternatively, CARM1 may affect transcription by modulating the activities of other factors in the transcription complex.

DIRECTING BRAIN DEVELOPMENT

Development of the vertebrate hindbrain and the surrounding branchial arches depends on an intricate interplay between the two types of tissue. By using an ingenious combination of ectopic expression



and orthotopic transplantation, Bell *et al.* (p. 2168) clarified how *Hox* genes specify positional identity in these tissues. The results of these studies in chick embryos show that the *Hox* genes regulate recognition cues that direct the interactions between different tissues.

CALMING THE GI TRACT

Motilin is a peptide hormone long known to stimulate the transport of nutrients (motility) in the gastrointestinal (GI) tract. A human receptor for motilin has now been identified in a mass screening by Feighner *et al.* (p. 2184). The same receptor also binds to erythromycin and may explain the uncomfortable side effects of this antibiotic. The motilin receptor turns out to be a G protein–coupled receptor that is similar to that for human growth hormone secretagogues. With the motilin receptor now in hand, more effective agonists and antagonists may be designed to treat multiple disorders of GI motility.

DESIGNER LIPIDS

The membranes that make up chloroplasts and house the photosynthetic apparatus have a distinctive lipid composition that is made up largely of galactolipids. Dörmann *et al.* (p. 2181) have now cloned one of the genes, *DGD1*, that affects galactolipid assembly in *Arabidopsis*. Genetic and biochemical studies indicate that the galactolipids are derived from two synthetic pathways, one in the plastid and one in the endoplasmic reticulum. Structure predictions from the cloned gene sequence suggest that the DGD1 protein is associated with the plastid envelope.

TECHNICAL COMMENT SUMMARIES

Culture and Genetic Evolution in Whales

The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/284/5423/2055a

H. Whitehead (Reports, 27 Nov., p. 1708) suggested that, in four species of whale, "the selection of matrilineally transmitted cultural traits, upon which neutral mitochondrial DNA (mtDNA) alleles 'hitchhike,' has the potential to strongly reduce genetic variation. Thus, in contrast to other nonhuman mammals, culture may be an important evolutionary force for the matrilineal whales."

Four comments question whether the data, collected from several different studies, are sufficient to support Whitehead's suggestion. S. L. Mesnick *et al.* state, "it is difficult to imagine selective sweeps, cultural or otherwise, acting to maintain low interocean diversity." C. Schlötterer states, "low mtDNA diversity could be a result of the effective population size of these species simply being smaller than that of the other species surveyed." R. Tiedemann and M. C. Milinkovitch state, "any stochastic heterogeneity in fecundity through space and time will cause a drastic reduction of mtDNA variability in matrilineal populations." W. Amos states that, in subpopulations where "dispersal from natal group is rare or absent," a hypothesis of "groups as life history units" may account for the data.

In response, Whitehead discusses each comment in turn, providing further details of his analysis and performing some new calculations. He notes that "scientists are currently collecting and analyzing long-term data on the social structure of a number of species of cetaceans" and states, "I presented one possible evolutionary scenario for this phenomenon, but the data are not conclusive, and I strongly support [the] call for an exploration of all feasible explanations."

Your **electroporator** should **not** be **a variable.**

The Gene Pulser® II Continues to be the Most Reproducible Electroporator...Period.

For efficient transfection, there are enough variables without your electroporator being one of them. The Gene Pulser II has the unique ability to test and recalibrate its capacitors. This ensures that you get the least amount of variation for reproducible performance today and in years down the road. Sample resistance is tested *before* the pulse, which prevents arcing that could ruin your results. Why repeat experiments? Use your time better with the Gene Pulser II — the only system you can fully trust. For more information, contact your local Bio-Rad representative or visit our website at **discover.bio-rad.com**.

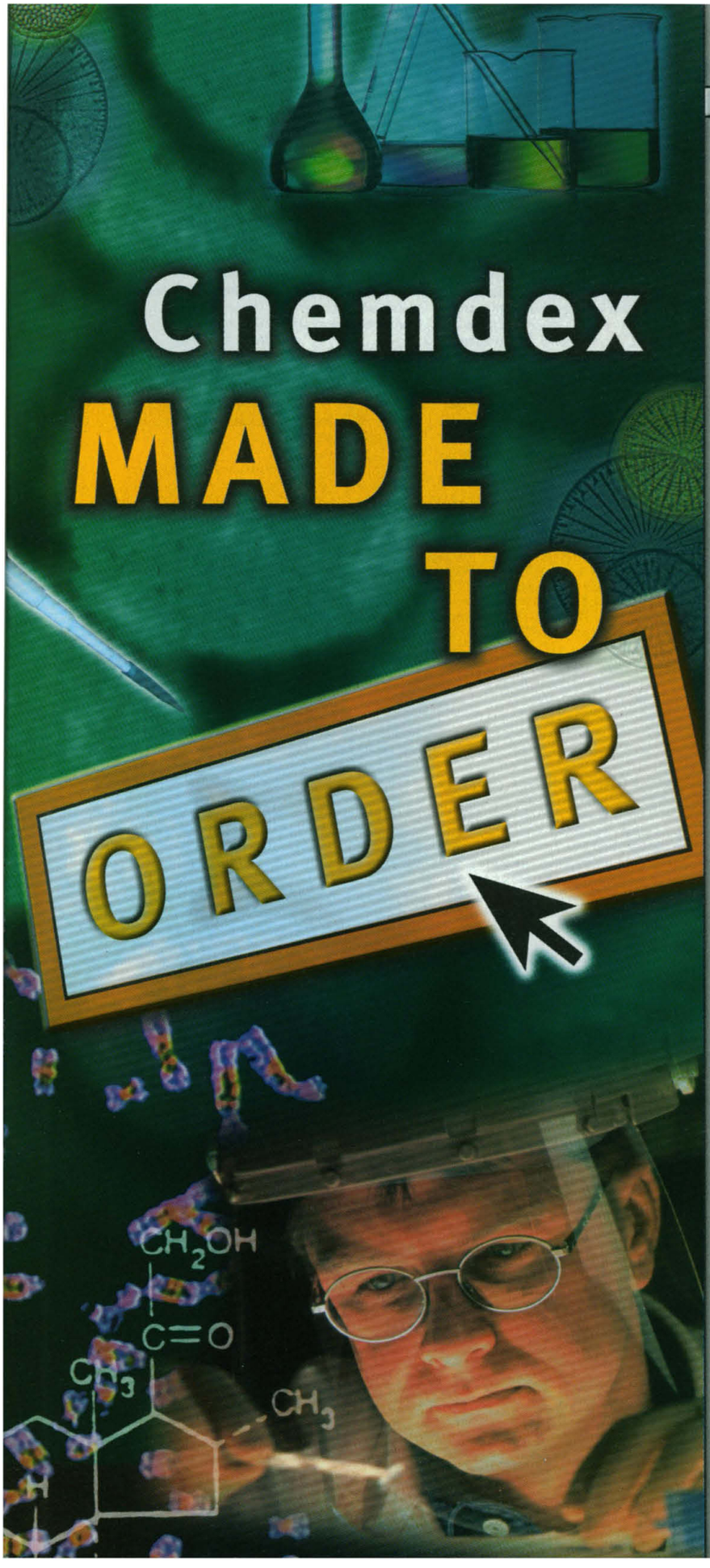
BIO-RAD **Bio-Rad Laboratories**

Life Science Group

Website *www.bio-rad.com* ***U.S.*** *(800) 4BIORAD* ***Australia*** *02 9914 2800* ***Austria*** *(01)-877 89 01* ***Belgium*** *09-385 55 11* ***Canada*** *(905) 712-2771*
China *86-10-62051850/51* ***Denmark*** *45 39 17 99 47* ***Finland*** *358 (0)9 804 2200* ***France*** *01 43 90 46 90* ***Germany*** *089 318 84-0*
Hong Kong *852-2789-3300* ***India*** *(91-11) 461-0103* ***Israel*** *03 951 4127* ***Italy*** *39-02-216091* ***Japan*** *03-5811-6270* ***Korea*** *82-2-3473-4460*
Latin America *305-894-5950* ***Mexico*** *514-2210* ***The Netherlands*** *0318-540666* ***New Zealand*** *64-9-4152280* ***Norway*** *22-74-18-70*
Russia *7 095 979 98 00* ***Singapore*** *65-2729877* ***Spain*** *34-91-661-7085* ***Sweden*** *46 (0)8-55 51 27 00* ***Switzerland*** *01-809 55 55*
United Kingdom *0800-181134*

Sig 031799

Circle No. 24 on Readers' Service Card



Convenient One-Stop Shopping

Buy online at Chemdex.com

The Chemdex Marketplace is the best way to buy biological and chemical reagents online. We are adding lab supplies, instruments, and equipment to create a convenient one-stop source for all your laboratory needs.

When you purchase online with Chemdex, you can:

- Buy from the suppliers you know and trust
- Find what you need quickly with our precision search engine
- Order from multiple suppliers with one electronic order form
- Rely on world-class customer service

Visit the Chemdex Marketplace today at www.chemdex.com.

Custom Procurement Solutions

Streamline your purchasing

Chemdex procurement solutions go far beyond our Web site. Our e-commerce technology can be integrated into your company's current systems and customized to match your existing business rules.

Chemdex procurement solutions feature:

- Custom pricing and catalog views
- Electronic requisition routing and approval
- Summary billing and consolidated reporting

Let Chemdex streamline your organization's purchasing process so you can focus on what's important — research and development.

To learn more about our custom procurement solutions, call 1-888-810-4732 or e-mail enterprise@chemdex.com.

Chemdex
Accelerating Science

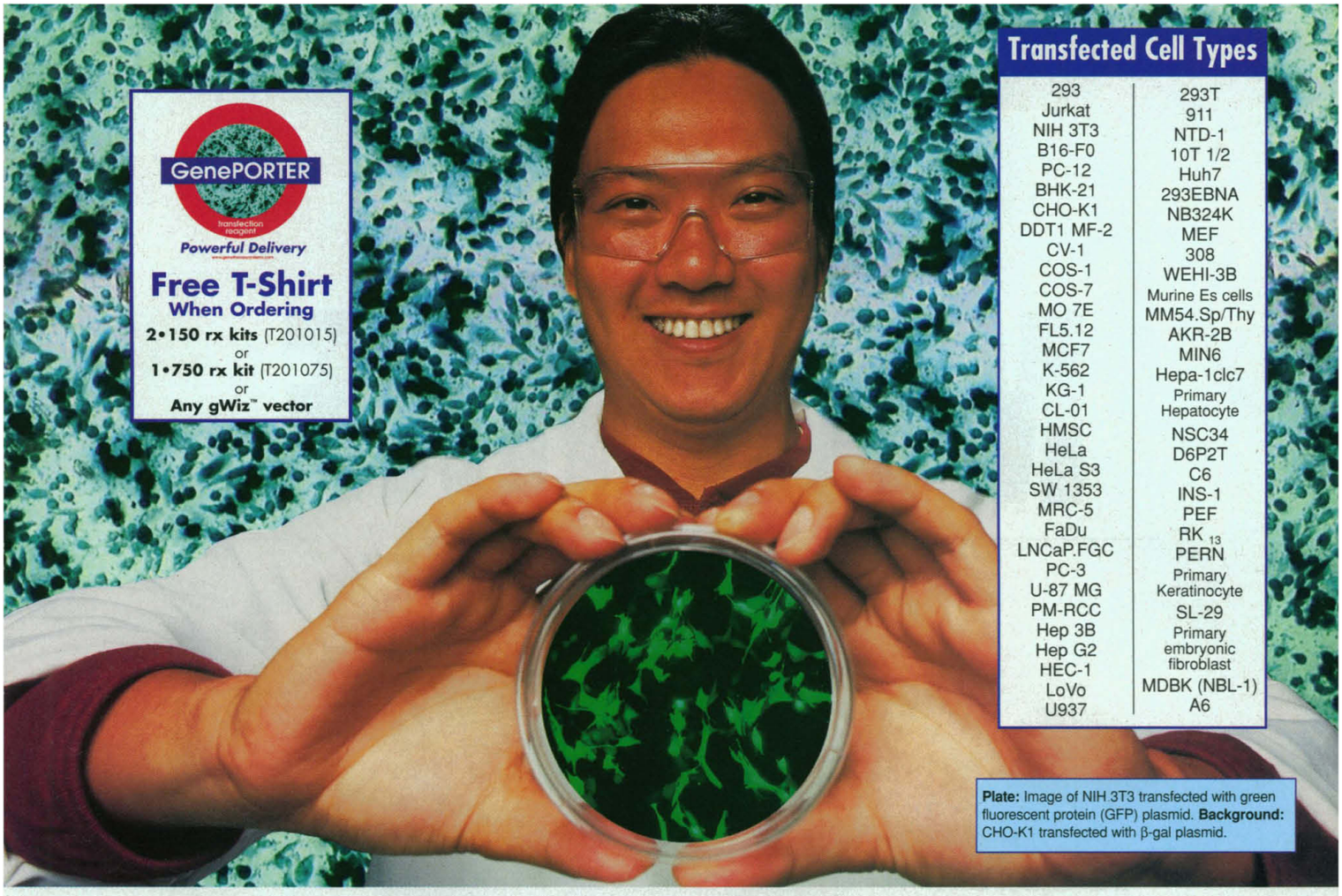
Chemdex Corporation
3950 Fabian Way, Palo Alto, CA 94303 • 650-813-0300

Circle No. 46 on Readers' Service Card

www.sciencemag.org
Science

Published by the **American Association for the Advancement of Science (AAAS)**, *Science* serves its readers as a forum for the presentation and discussion of important issues related to the advancement of science, including the presentation of minority or conflicting points of view, rather than by publishing only material on which a consensus has been reached. Accordingly, all articles published in *Science*—including editorials, news and comment, and book reviews—are signed and reflect the individual views of the authors and not official points of view adopted by the AAAS or the institutions with which the authors are affiliated.

The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objectives are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of human welfare, to advance education in science, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

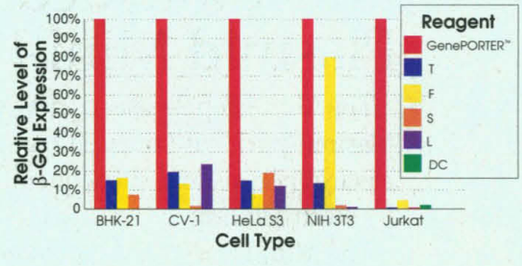


Finally, a transfection reagent that makes you smile, every time!

Introducing

GenePORTER™ Transfection Reagent*

GenePORTER™ reagent, which incorporates direct hydrophilic conjugation (DHC) technology,* is the latest innovation from the lab of Dr. Philip Felgner, inventor of lipofection. In a variety of cell lines, GenePORTER reagent consistently delivers higher levels of transfection than any other commercially available product. This robust reagent performs in a wide range of conditions, including different ratios of plasmid and reagent. GenePORTER reagent is easy to use and does not require enhancers or special handling of cells, saving time, cost, and reagents. Order GenePORTER reagent today. The results will make you smile.



The β-gal expression plasmid was delivered into cells using GenePORTER or competitor's transfection reagents. Each manufacturers protocol was followed. A colorimetric assay was used to measure β-gal expression 48 hours after transfection.

GenePORTER™
Transfection Reagent
75 reactions (0.75 ml) • T201007
150 reactions (1.5 ml) • T201015
750 reactions (5 x 1.5 ml) • T201075

New High Expression Vectors
gWiz™* Expression Vectors
Call for a brochure or visit our web page
* Patents pending.

GTS
Gene Therapy Systems
"the art of innovation"

To Order: 888-428-0558
Fax: 619-623-9494
10190 Telesis Court, San Diego, CA 92121, USA
Check out the Gene Therapy Systems web site @
http://www.genetherapysystems.com

Gene Therapy Systems International Distributors

Australia • ASTRAL +61-2-9540-2055 **Austria** • BIO-TRADE +43 1 889 18 19 **Benelux** • BIOzym+31+(0)45 532 77 55 **Denmark, Finland, Norway, Sweden** • KEBO Lab +46 8 621 35 07 **France** • OZYME +1 30 85 92 92 **Germany** • BIOzym GmbH +49 5152-9020 **Italy** • Duotech 39 02 331 066 30 **Japan** • Funakoshi +81-3-5684-1622 **Korea** • Core Bio +82 2 841-7530 **Spain** • BioNova +34 91 551 54 03 **Switzerland** • Axon Lab AG +41 56 484 80 80 **Taiwan** • PROtech, Ltd. 886-2-23810844 **United Kingdom** • Lifescreen Ltd. +44 0 1923 241515

Circle No. 38 on Readers' Service Card

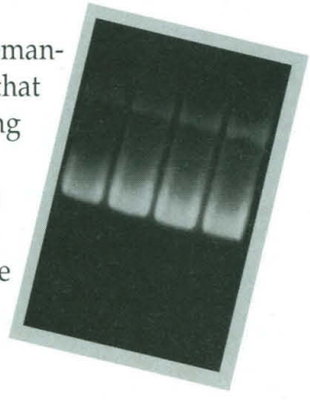
TIME MACHINE

The New **Mini-Prep 24** for Automated Plasmid Mini-Preps

The Mini-Prep 24 uses a new method of plasmid purification based on agarose gel electrophoresis and subsequent recovery by electroelution.

The Mini-Prep 24 uses premanufactured sample cassettes that come ready for direct loading of up to 2 ml of culture.

Call now to learn how the New Mini-Prep 24 can give you with quality DNA while saving you lots of time.



High Purity - sufficient for automated fluorescent and manual sequencing.
Easy Operation - begin prep with direct loading of bacteria culture - no centrifugation step saves you time.
Consistent Results - up to 6 µg of plasmid per ml.
Fast - up to 24 preps per hour, saving you time.
Quality - time and time again.

MacConnell RESEARCH

1-800-466-7949

11339 SorrentoValley Rd • San Diego, CA 92121 Phone: (619) 452-2603 Fax (619) 452-6753
www.macconnell.com

Circle No. 19 on Readers' Service Card

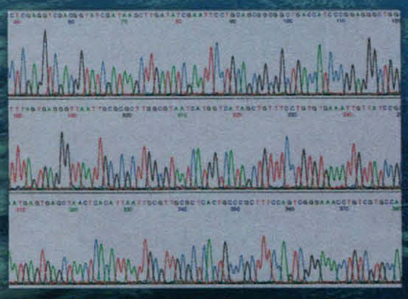
A Midiprep with Maxi Capacity

StrataPrep® EF Plasmid Midiprep Kit

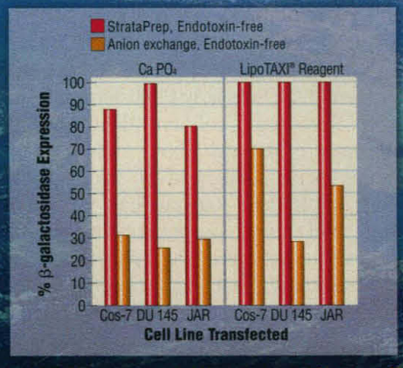
- Over 3x greater yields than other kits
- Fast, easy, efficient spin format
- Endotoxin-free DNA (optional step)
- Unique color-indicating protocol
- Application-ready pure DNA

StrataPrep® Technology. The StrataPrep® EF plasmid midiprep kit uses a silica-based fiber matrix technology in a convenient spin column format. Produce high yields (up to 350 µg) of pure DNA in 90 minutes or less.

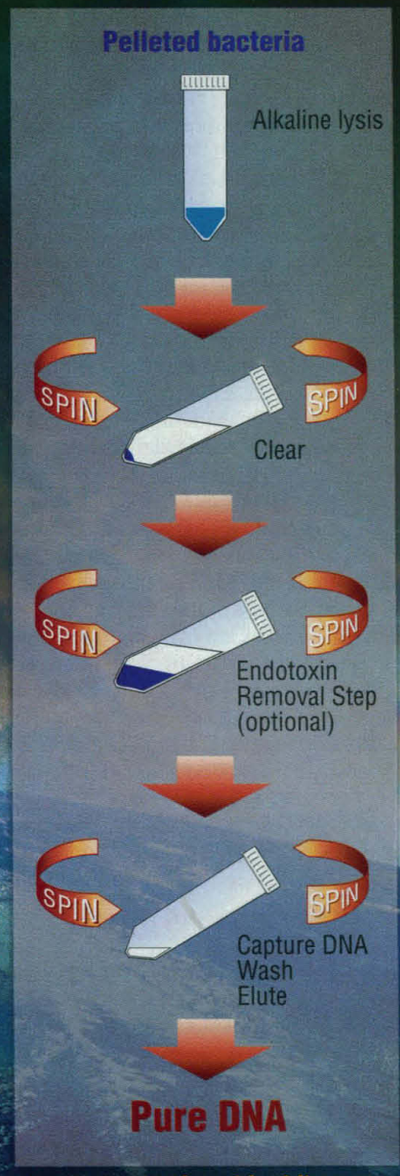
Endotoxin-Free DNA. The presence of endotoxins will sharply reduce transfection efficiencies in sensitive cell culture lines. The StrataPrep EF plasmid midiprep kit includes a unique step for extracting endotoxins to produce up to a 5-fold increase in transfection efficiency.



Ideal for automated sequencing



Transfects sensitive mammalian cells



StrataPrep EF Plasmid Midiprep method

StrataPrep® EF Plasmid Midiprep Kit	20 preps	#400721
	100 preps	#400722
Endonuclease A Removal Buffer	500 ml	#400723
Pyrogen-free 50-ml Conical Tubes	20 tubes	#400734

UNITED STATES AND CANADA
(800) 424-5444

INTERNET:
techservices@stratagene.com

STRATAGENE EUROPE
Austria: 017 956 7036
Belgium: 027 13 12 11
Germany: 0699 509 6197
Netherlands: 0800 023 0448
Switzerland: 01 800 9045
United Kingdom: 0171 365 1056

DISTRIBUTORS
For a list of worldwide distributors, please visit the Stratagene website at www.stratagene.com.

STRATAGENE
www.stratagene.com

Circle No. 42 on Readers' Service Card

Call for Papers

A NEW SECTION OF MCB: "MAMMALIAN GENETIC MODELS WITH MINIMAL OR COMPLEX PHENOTYPES"

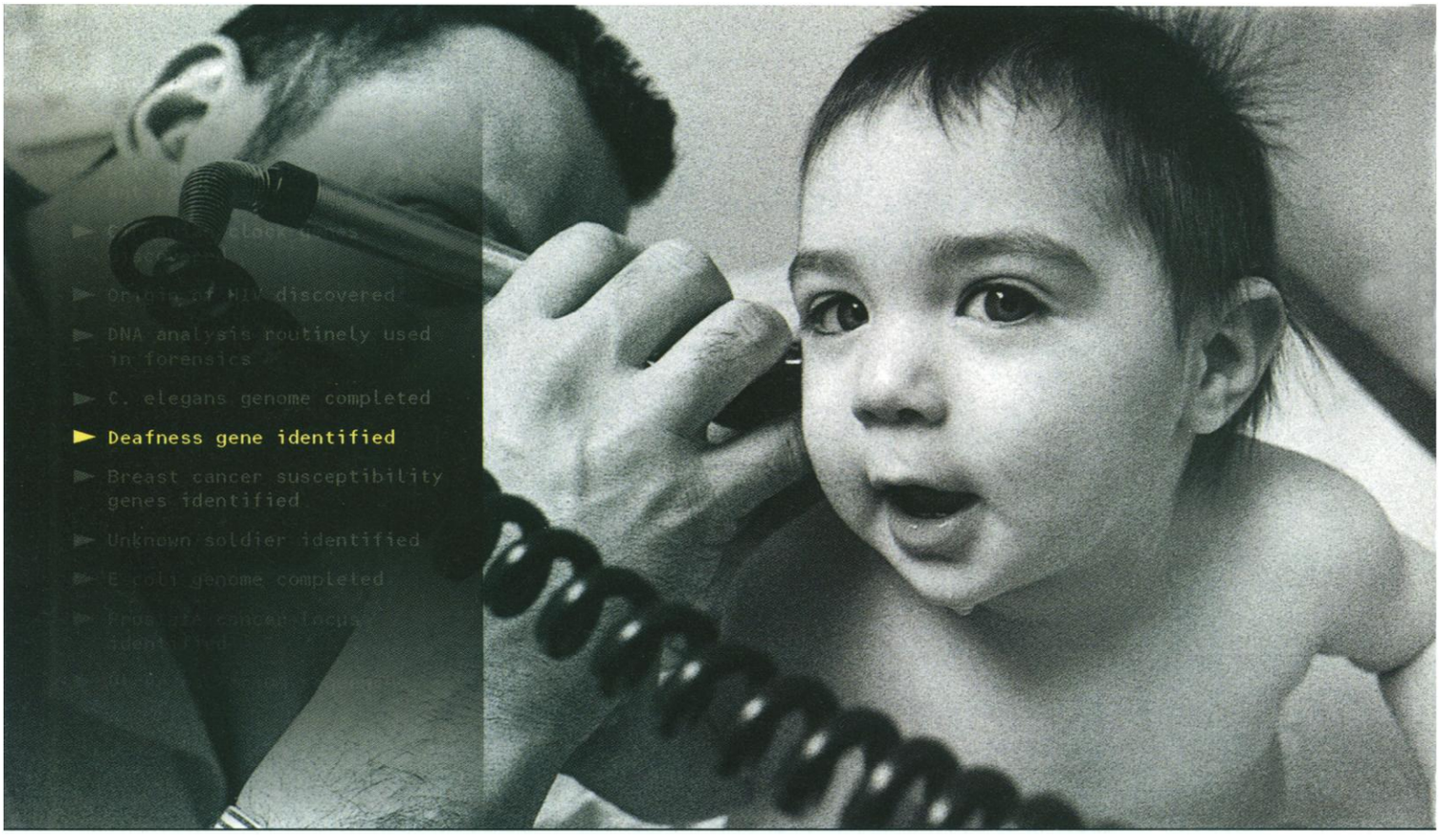
Many mouse knockouts have little or no obvious phenotype, or a very subtle phenotype, making it difficult to publish reports of mutant construction and analysis. Much of the publication problem may be due to a misconception: "no" phenotype is viewed as a "negative result," rather than as one more useful clue to the complex biology of mammals. This is unfortunate: the biomedical community is deprived of essential information, investigators are deprived of essential recognition, and arduous work may be needlessly duplicated in different laboratories. Moreover, as we learn more about redundant pathways, it may become routine to test new mutants in backgrounds containing other targeted deletions. This requires that the single mutants first be characterized, described in the scientific literature, and made available to the research community.

To address these issues, ***Molecular and Cellular Biology*** (MCB) is initiating a new section of the journal entitled "Mammalian Genetic Models with Minimal or Complex Phenotypes." The new section will be listed separately in the table of contents, and is intended only for knockouts that have no phenotype or unexpected phenotypes that are not easily reconciled with the suspected gene function. Knockouts providing additional information about known gene functions will be published in the section most appropriate for that function.

Manuscripts intended for the new section will be reviewed as are all other reports of original research. The manuscript should describe how the knockout was constructed, and should rigorously document the absence of gene expression. The manuscript should also explain how the phenotype of the mutant animals was characterized, but supporting data should not be shown unless absolutely necessary. Although manuscripts should be formatted as usual, publication will be strictly limited to five printed journal pages and a total of no more than five figures and tables. Manuscript length can be estimated by assuming that 1 printed page equals 5 double-spaced manuscript pages or 53 references; figure and table sizes can be estimated by eye.

Manuscripts for the new section may be submitted immediately. As one purpose of this new section is to make mutants available to the entire biomedical community, authors submitting to this section of the journal must agree to maintain the knockout line for at least 6 months following publication, or to generate cryoembryos.

Three copies of each manuscript should be submitted to: MCB, Journals Department, American Society for Microbiology, 1325 Massachusetts Ave., Washington, DC 20005-4171, U.S.A.



The ABI PRISM® 377 DNA Sequencer. It's a part of discoveries that touch us all.

Whether they are identifying the genes that cause deafness or investigating the origin of the HIV virus, thousands of researchers around the world rely on the ABI PRISM® 377 DNA Sequencer to deliver their most important results. With its unparalleled reliability, proven technology, and up to 96-lane capability, the 377 system is the ideal choice to meet the demanding needs of life scientists. Add the world's best DNA reagents, service, and support, and the 377 system emerges as the gold standard. In fact, it's changing life as we know it. For more information, visit our Web site at www.pebiosystems.com/377.

ABI PRISM® 377 DNA Sequencer

Applied Biosystems

PE Biosystems

ISO 9000

Australia: 800.033.747 China (Beijing): 86.10.6238.1156 Europe/West Asia: 49.0.61.03.708.301
Japan: 81.47.380.8500 North America: 800.345.5224 South America: 55.11.50.70.9600

Circle No. 17 on Readers' Service Card

PE Applied Biosystems develops and manufactures its products in accordance with ISO 9000 quality systems requirements. For Research Use Only. Not for use in diagnostic procedures. To further its goal of offering the broadest range of enabling systems and services for life sciences research and related applications, Perkin-Elmer has merged with PerSeptive Biosystems and created the PE Biosystems Division. PE Biosystems consists of the Applied Biosystems, PerSeptive Biosystems, PE Informatics, and Tropix Centers of Excellence.

Resist the Temptation to Screen Libraries.

GeneStorm™ Expression-Ready Human Genes

Tempting or not, screening cDNA libraries is a time-consuming but necessary evil. We can help. GeneStorm™ is the only organized collection of full-length, expression-positive human genes available. Save yourself some time. Spend a few minutes screening the GeneStorm™ database before spending weeks screening a cDNA library.

CATEGORY	CLONES AVAILABLE
Signal Transduction and Cell Signaling Genes	404
Oncogenes, Cancer, and Tumor Suppressor Genes	158
Adhesion Molecules and Cell Surface Antigen Genes	195
Cell Receptor Genes	198
Cytokines, Chemokines, and Growth Factor Genes	127
Apoptosis Genes	37

The GeneStorm™ Difference.
Unlike cDNA libraries and other gene collections, GeneStorm™ Clones are actually expression- positive clones. This means you don't have to spend time cloning and testing for expression. Simply find your gene of interest in the GeneStorm™ database and you're ready for downstream functional genomics, gene analysis, and drug discovery applications.

Thousands of Genes. The GeneStorm™ collection now contains thousands of full-length, expression-positive clones. There are many important genes in a variety of categories so you're likely to find the genes you're looking for.

Easy Access. The entire time-saving, expression-positive GeneStorm™ collection is easily accessible on the GeneStorm™ web site. Make sure you are getting the right advice. Visit the GeneStorm™ web site today (www.invitrogen.com/genestorm) and have the clone you need tomorrow.

Circle No. 34 on Readers' Service Card

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

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

Finland:
Tel: 990800 5345 5345
Fax: 990800 7890 7890
Sweden:
Tel: 009800 5345 5345
Fax: 009800 7890 7890

Distributors:
Austria 0222 889 18 19
Australia 1 800 882 555
China 010 6255 3477
Hungary 01 280 3728
India 91 80 8391453
Israel 02 584 1111
Italy 02 38 19 51
Japan 03 5684 1622
Malaysia 03 736 9198
Poland 058 341 47 26
Portugal 01 453 7085
Singapore 65 2922130
South Korea 02 3471 6500
Spain 03 450 2601
Taiwan 886 2 238 10844
Thailand 246 7243

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

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

The PCR Company

MWG AG BIOTECH

The chemically actuated lid, MWG-BIOTECH's newest development, omits one of the last manual steps in automated PCR - to apply the exact pressure for oil free PCR in microtitre plates.

It's time to change your PCR

Take advantage of the newest technology

The PCR Consumable

The Thermosprint PCR plate, ***ultra fast & ultra thin*** 96-well PCR consumable for optimum thermal transfer and therefore better results. Ensures ***absolute airtight*** sealing of each individual cavity. Frames and hole plates can be autoclaved and re-used. Available as 96-well PCR plates (covered and open) or as 2 x 8 strips. This means it can be matched cost effectively to different sample numbers. The vessels are ***compatible*** with every 0.2 ml standard thermocycler block.

The PCR Thermocyclers

Multi PCR System including ***four separate blocks*** for high throughput PCR. ***Multi Temperature Gradient block*** with ***six*** different ***temperature zones*** for real optimisation. For ***96*** and ***384-well*** plates with ***High Temperature Range*** performance: fastest heating and cooling - extreme block reliability. The ***High Pressure Lid*** automatically adjusts to apply the perfect pressure to seal PCR plates (up to 30 kg). ***Fully automated*** opening and closing of the lid without manual intervention.

The Automated PCR System (APS)

RoboAmp® & RoboSeq® 4200 the fully integrated PCR robots that automate PCR ***absolutely cross contamination free*** (NCC-PCR). The only solution available worldwide that allows automated opening and closing of individual lids. The ***integrated thermocycler*** allows automation of PCR protocols, fragment analysis, DNA sequencing and virtually all applications in molecular biology. ***Optimized for microarray technology.***
Amplifies thousands of DNA samples contamination free.

Applications:

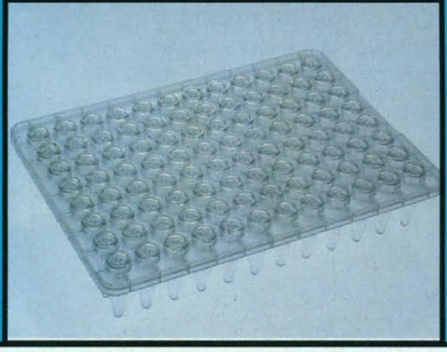
- PCR
- RT-PCR
- Cycle Sequencing
- Genotyping
- Enzymatic Digestions
- Agarose Gel Analysis
- Comb Loading

Circle No. 44 on Readers' Service Card

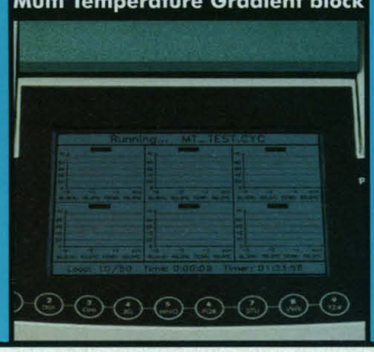
MWG AG BIOTECH

Your partner for automated PCR

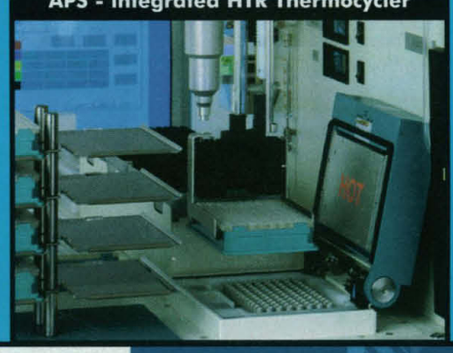
Thermosprint PCR plate



Multi Temperature Gradient block



APS - integrated HTR Thermocycler

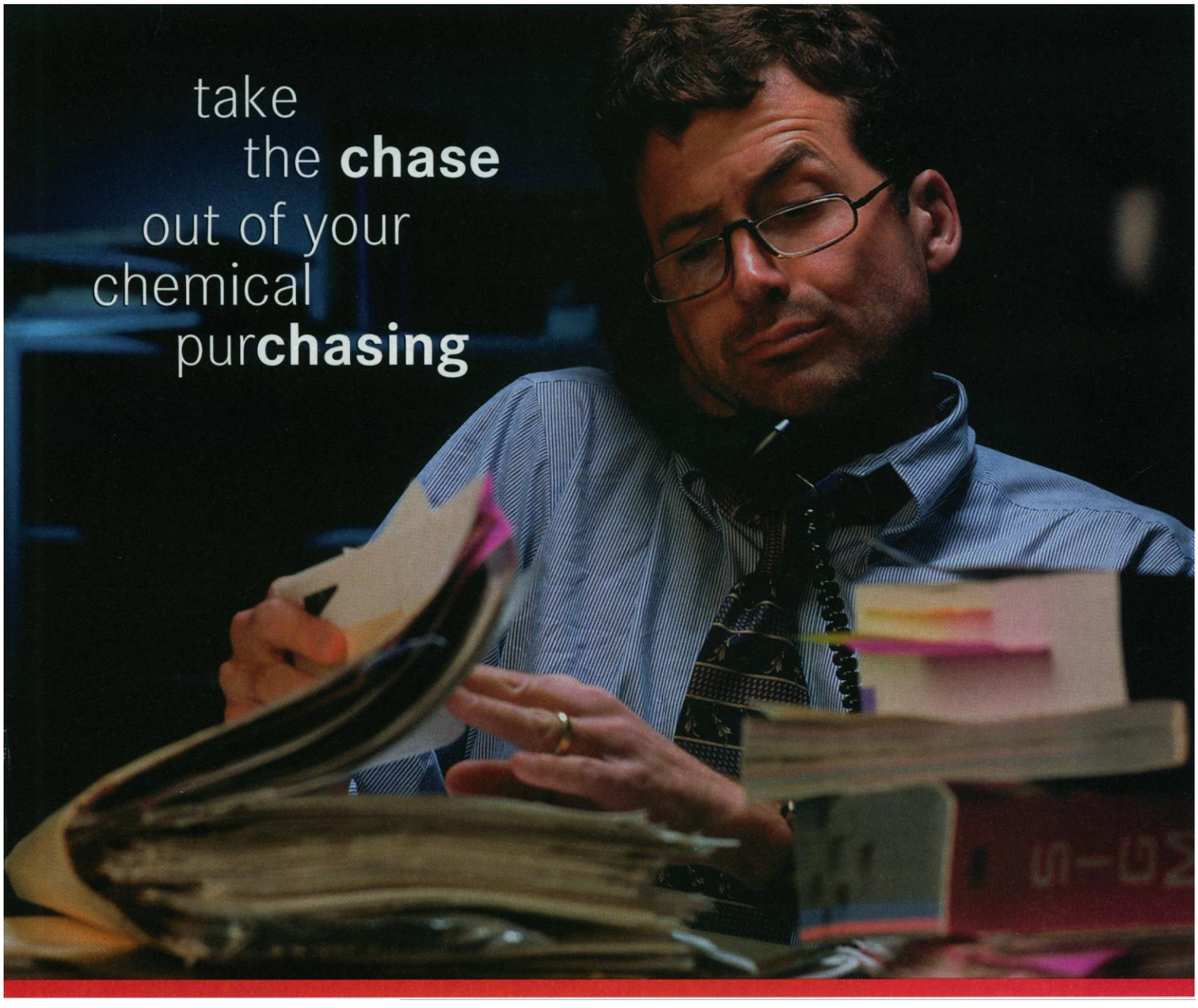


SWITZERLAND
TEL.: +41(0)- 61/4 16 06 16
FAX +41(0)- 61/4 16 06 19
E-MAIL: mwgbiotech@magnet.ch

FRANCE
TEL.: +33-(1) 69 59 20 50
FAX: +33-(1) 69 59 20 55
E-MAIL: info@mwg-biotech.fr

USA
TEL.: +01-336-812-9995
FAX : +01-336-812-9983
E-MAIL: info@mwgbiotech.com

GB
TEL.: +44-(0)19 08/24 77 00
FAX : +44-(0)19 08/24 77 24
E-MAIL: info@mwg.co.uk



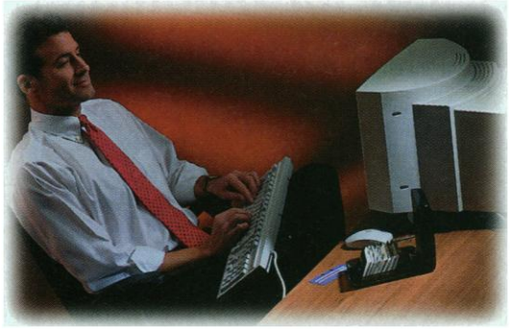
TRY OUR eCOMMERCE SOLUTION @ www.sigma-aldrich.com

EASY ON-LINE ORDERING

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

FIND WHAT YOU NEED FAST

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



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

A TOTAL INFORMATION RESOURCE

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

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

SIGMA-ALDRICH

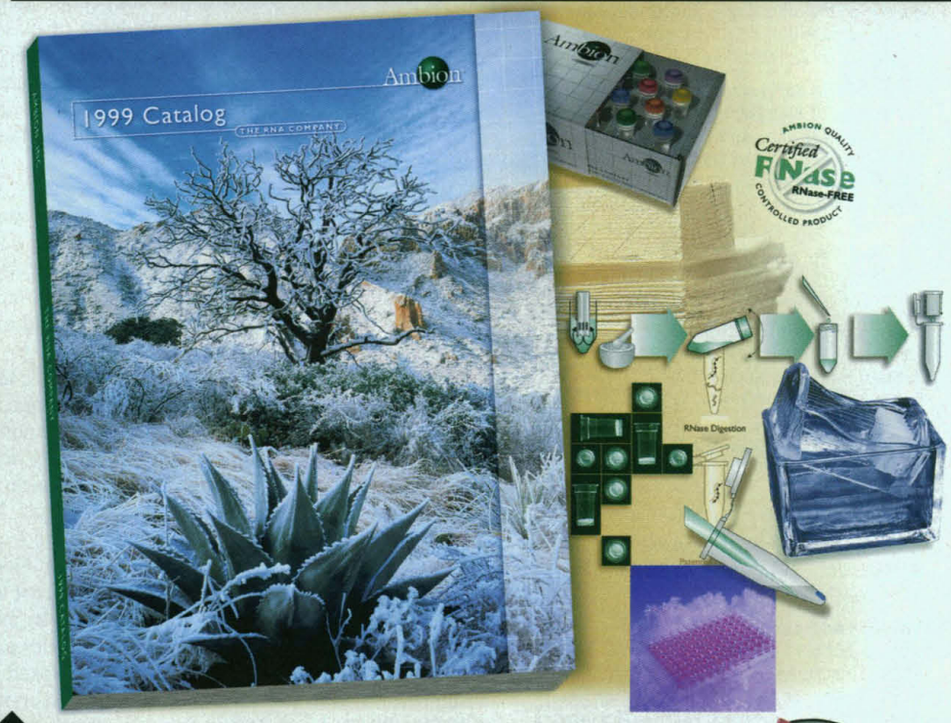
3050 Spruce Street, St. Louis, MO 63103 • 800-521-8956 or 314-771-5765

Circle No. 23 on Readers' Service Card

MORE THAN 97 NEW WAYS TO STUDY

RNA Better, Faster, Easier.

Choose from the best selection of leading edge products and kits optimized for solving the unique challenges of RNA analysis. In the new 1999 Catalog, you will discover more than 97 new products to help you optimize isolation for higher yields, increase the sensitivity of detection assays and quantitate RNA better, faster and easier.



ISOLATE, DETECT, QUANTITATE

Do you isolate, detect or quantitate RNA? Then you need the innovative products from Ambion, The RNA Company.

New in the 1999 Catalog

- NEW ADVANCES IN RNA ISOLATION THAT OPTIMIZE YIELDS
- TOOLS TO IMPROVE RT-PCR QUANTITATION AND USE RELATIVE RT-PCR IN A NEW WAY
- A REVOLUTIONARY METHOD TO PERFORM IN SITU HYBRIDIZATIONS
- NEW WAYS TO IMPROVE YIELDS IN TRANSCRIPTION:TRANSLATION REACTIONS

GET INFORMATION NOW VIA EMAIL ON THE BEST NEW PRODUCTS OF 1999:

To immediately receive descriptions, catalog numbers and prices on the hottest new products and to request your 1999 Catalog, email your postal mailing address to 99cataloginfo@ambion.com

Catalogs may also be requested by phone, fax or the reader service number below.

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

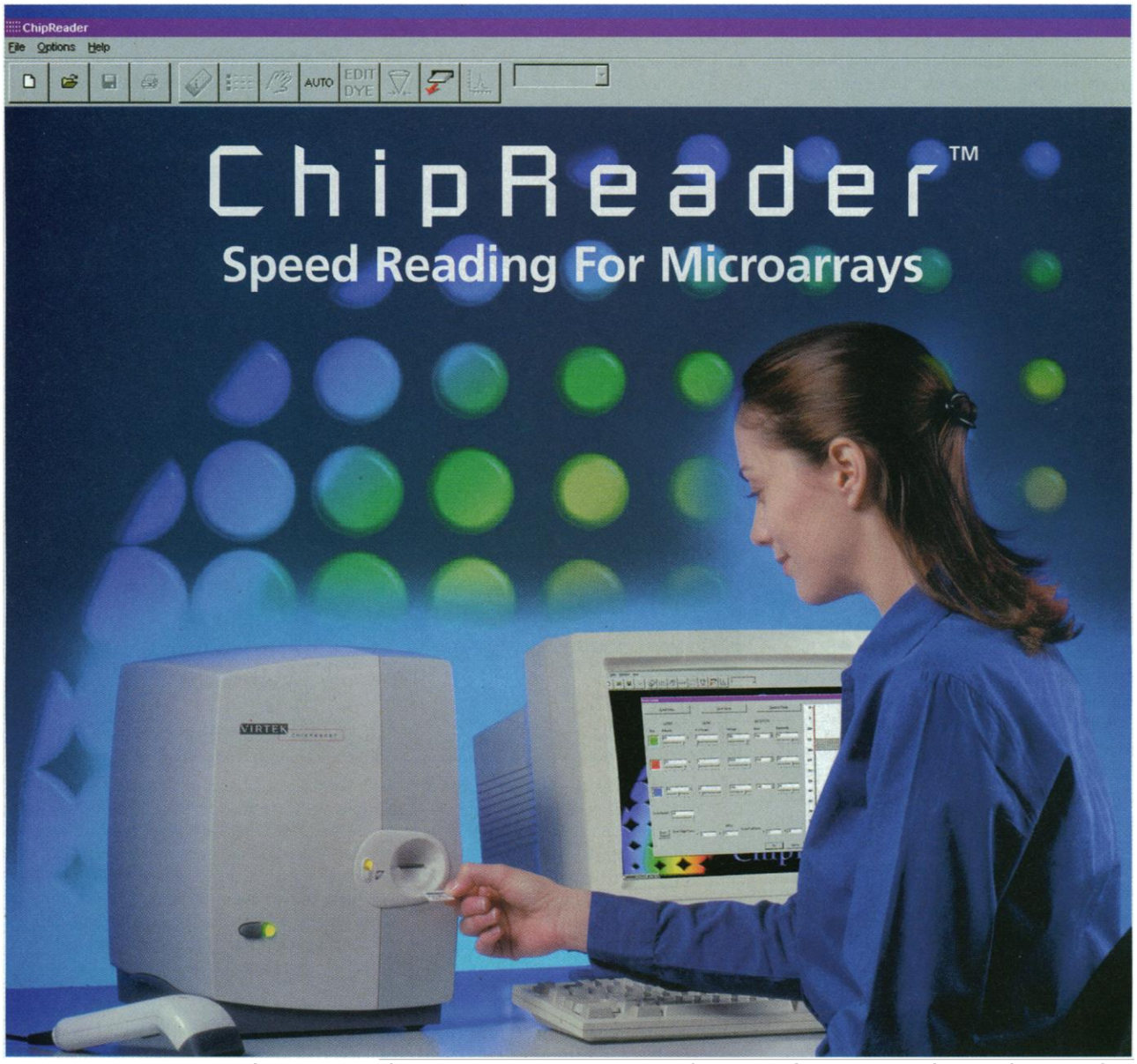
U.S. (800)888-8804
Canada (800)445-1161

Ambion®
THE RNA COMPANY™

[2068]

Circle No. 45 on Readers' Service Card

Ambion, Inc. • 2130 Woodward St. • Austin, TX 78744-1832 • tel(512)651-0200 • fax(512)651-0201 • email: moinfo@ambion.com • www.ambion.com



ChipReader™ is the first biochip imaging system to offer simultaneous reading of up to 5 different fluorescent dyes.

ChipReader is a high-sensitivity laser confocal system for imaging microarray biochips. It offers an array of speed and efficiency benefits.

Highest Sensitivity

Our a-chromatized objective lens provides the highest collection efficiency available.

Highest Throughput

ChipReader works up to 10 times faster than competitive products. The high-speed scanning mechanism reads up to 5 different dyes simultaneously, over a 20 x 20 mm area, in less than one minute.

Greatest Flexibility

ChipReader's modular design accommodates your changing needs. Use standard slides, stainless steel cartridges, or 3" x 4" (76 x 98 mm) glass plates. ChipReader can read glass substrates with the array printed on the top or bottom, wet or dry – with or without a cover glass! It can also read silicon, plastic and nylon substrates.

Smallest Footprint Available

Measuring just 11" in length, 9" in width, and 12" in height, there is no greater space-saving imaging option for your microarray biochips!

Easy To Run; User Friendly

To optimize experiment performance, parameters such as speed and number of scans can easily be set using ChipReader's icon driven Windows NT software. It can be integrated with your lab automation systems and is Y2K compliant.

Contact Beverly Giammara, 1-800-933-9011
Visit us at www.virtek.ca

VIRTEK

LEADING THE WORLD IN PRECISION LASER APPLICATIONS

Circle No. 49 on Readers' Service Card