1 November 2002

Science

Vol. 298 No. 5595
Pages 911–1122 $10

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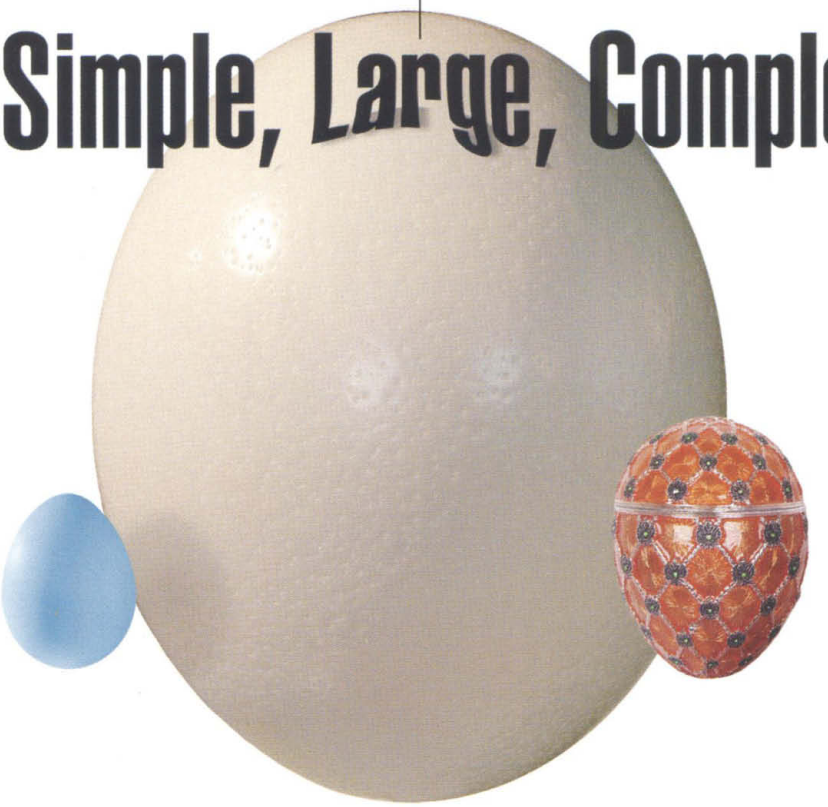

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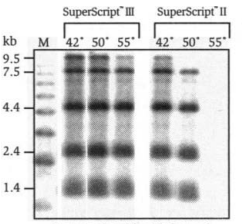

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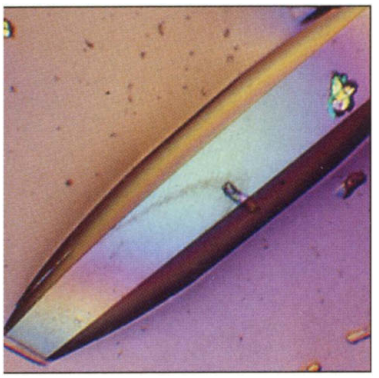
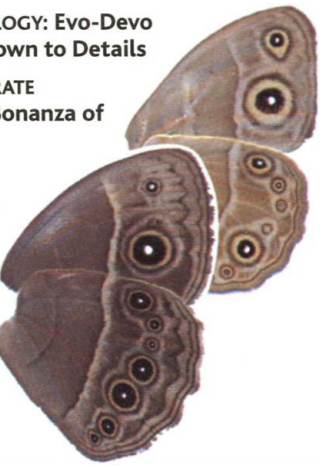


948
Hard slog from DNA to structures

NEWS



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Evo-devo: details, details

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Mathematical legacy of Archimedes

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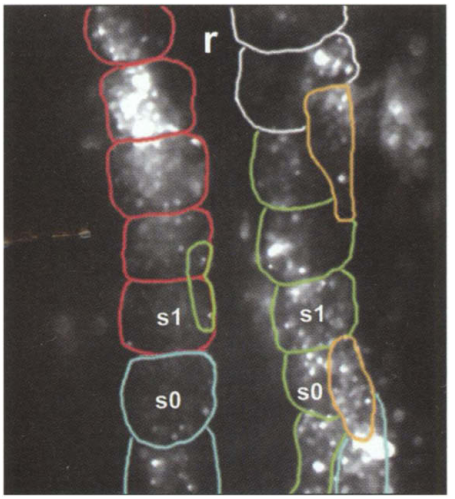

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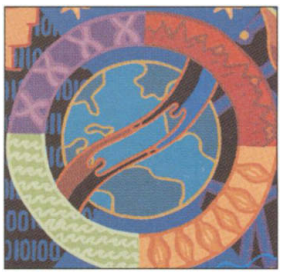
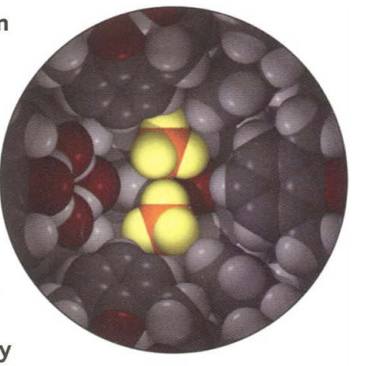
Sculpting somites



COVER 1048

Science, engineering, and technology permeate all areas of modern life. The 2003 AAAS Annual Meeting and Science Innovation Exposition, convening 13 to 18 February in Denver, will explore science in our daily lives in a sterling array of symposia and lectures by leading experts. [Illustration: Jose Ortega]



1000
Orchestrated changes in the solid state

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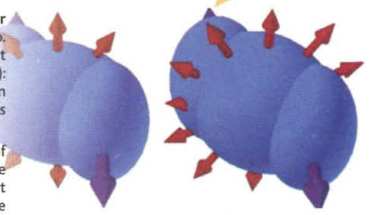

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SCIENCE (ISSN 0036-8075) is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1200 New York Avenue, NW, Washington, DC 20005. Periodicals Mail postage (publication No. 484460) paid at Washington, DC, and additional mailing offices.

Domestic individual membership and subscription (51 issues): $120 ($66 allocated to subscription). Domestic institutional subscription (51 issues): $390; Foreign postage extra: Mexico, Caribbean (surface mail) $55; other countries (air assist delivery) $85. 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.**

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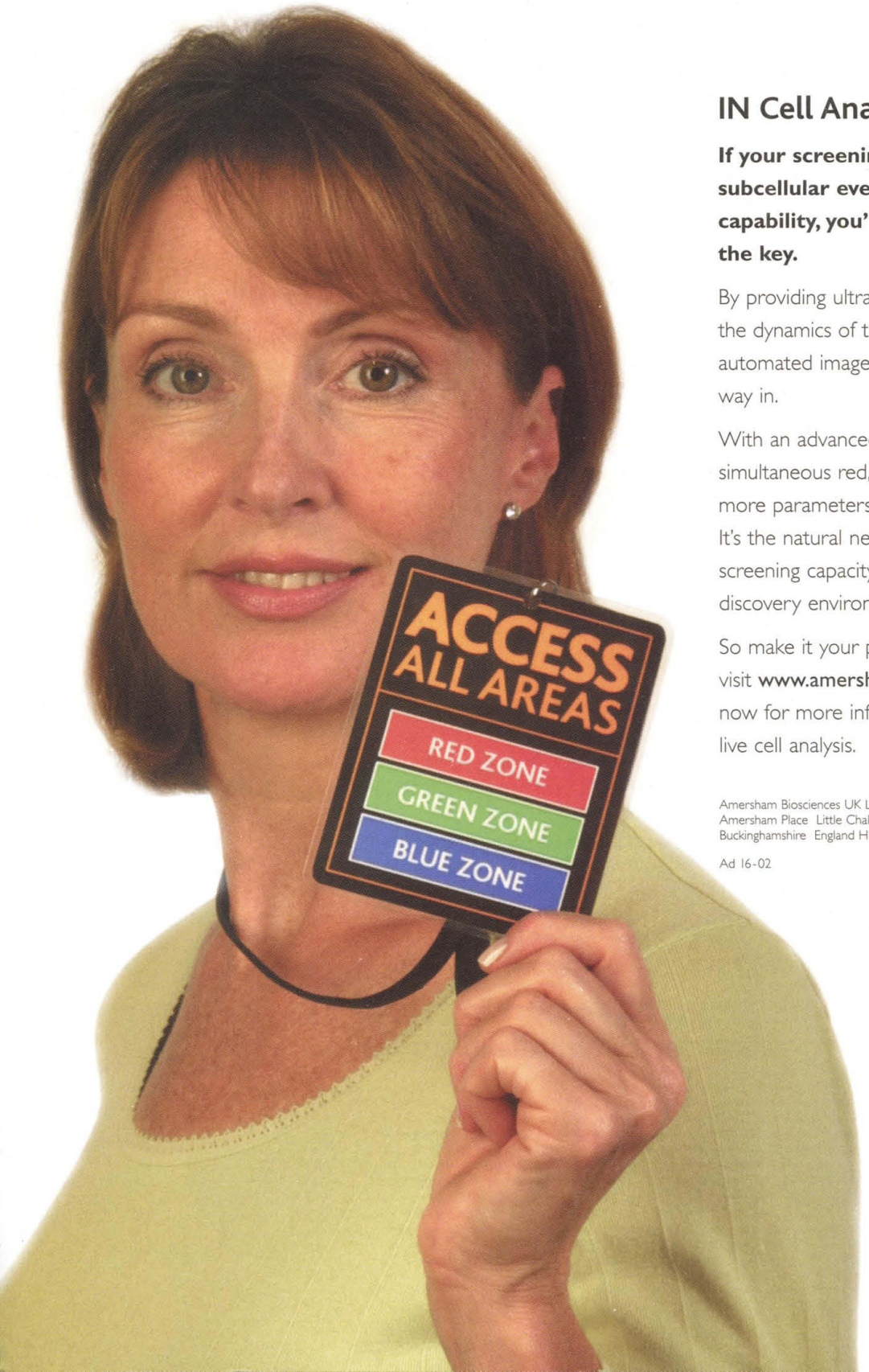

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CONTENT HIGHLIGHTS AS OF 1 NOVEMBER 2002

science magazine www.sciencemag.org

SCIENCE EXPRESS www.sciencexpress.org

Determination of the Equation of State of Dense Matter
P. Danielewicz, R. Lacey, W. G. Lynch

Behavior of superdense matter, like that found in supernovae and neutron stars, is determined based on experimental extrapolation.

Long-Distance Signaling in Nodulation Directed by a CLAVATA1-like Receptor Kinase I. R. Searle *et al.*

Receptor kinases control apical and nodule meristem proliferation in soybeans.

Small Nuclear Ribonucleoprotein Remodeling During Catalytic Activation of the Spliceosome E. M. Makarov *et al.*

Proteomic analysis of two new complexes defines structural changes in the spliceosome that occur before and after RNA splicing.

TECHNICAL COMMENTS

Origin and Significance of Archean Quartzose Rocks at Akilia, Greenland

Fedo and Whitehouse (Reports, 24 May 2002, p. 1448) reinterpreted 3.8 billion year old quartzose rocks in Greenland—previously thought, based on carbon isotope signatures, to harbor evidence for Earth's oldest life—as metasomatized ultramafic igneous rocks, an origin that, they maintained, invalidates claims that the rocks record early biological activity. In separate comments, Mojzsis and Harrison and Friend *et al.* argue that rare earth element signatures and other geochemical patterns of these rocks are more similar to those of ancient sedimentary banded iron formations than to those of ultramafic igneous rocks, and that field relations suggest that Fedo and Whitehouse did not analyze a key unit sampled in earlier studies. Fedo and Whitehouse respond that these earlier studies, and the current comments, have relied heavily on a single sample that has not been adequately described in the literature, and that a more comprehensive evaluation of field and geochemical data from the Akilia locality supports the interpretation of these rocks as metasomatized ultramafics.

The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/298/5595/917a

science's next wave www.nextwave.org

career resources for scientists

GLOBAL: Careers Feature—Science on the Farm Edited by L. McKarney

From microclimate mapping to bioengineering, the range of technologies applied to agricultural research is expanding exponentially—as are the career opportunities.

CANADA: A Multifaceted Approach B. Van Bergen

It's difficult to define what a biosystems engineer does, except to say that they apply engineering principles to everyday life.

US: Making the Best of Your PI's Sabbatical S. Collins

Your postdoc advisor is going on leave? Don't panic!

SINGAPORE: After the Ph.D. C. Ng

A senior scientist's advice to doctoral students looking to make smart post-Ph.D. career choices.

UK: Personalized Development—Time Out for Postdocs
K. Urquhart

Going back to Gradschool—the Research Councils' intensive career development workshop—but this time as a mentor.

KNOWLEDGE ENVIRONMENTS

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science of aging knowledge environment

PERSPECTIVE: Of Worms, Flies, Dwarfs, and Things That Go Bump in the Night W. E. Sonntag and M. M. Ramsey

Insulin/IGF-1 signaling in the nematode influences life-span during adulthood but not during larval development.

NEWS SYNTHESIS: Flies Like Us M. Leslie

Drosophila soars as a model for brain diseases.

NOTEWORTHY THIS WEEK: Tissue-Tampering Turn-On R. J. Davenport

Protein activates senescence genes.

NOTEWORTHY THIS WEEK: The Eyes Have It C. Seydel

A retina's own molecules might cause blinding disease.

science's stke www.stke.org

signal transduction knowledge environment

PERSPECTIVE: OxyR—A Molecular Code for Redox Sensing?
J. D. Helmann

A discussion of the controversy surrounding the activation of the bacterial transcriptional regulator OxyR.

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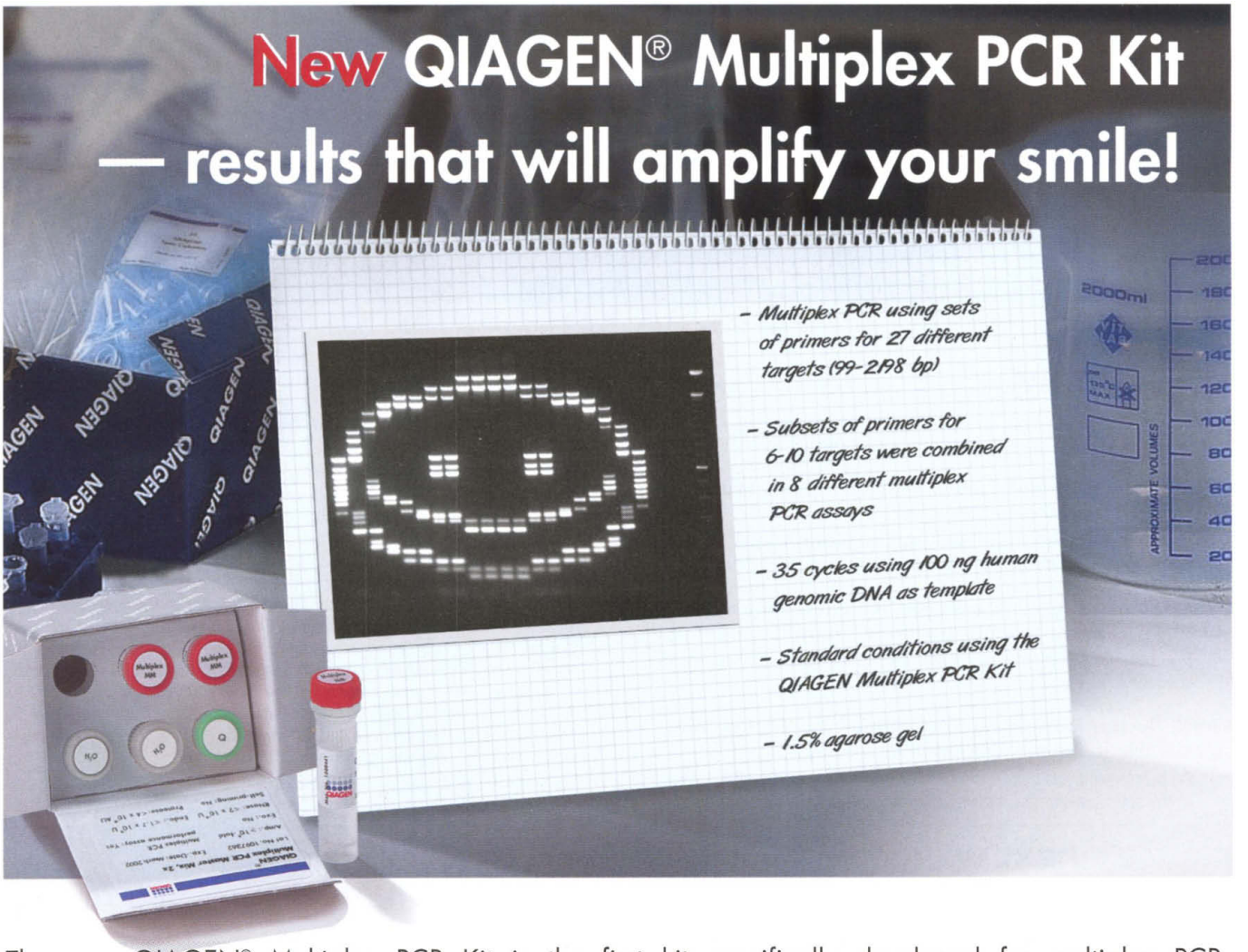

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PCRMP092002SWW

THIS WEEK IN Science

edited by Phil Szuromi

Faster Growing Grains

When carbon steel is cooled from the melt, it forms a polycrystalline structure that undergoes several solid-state transformations. Using newly developed x-ray techniques and a synchrotron source, Offerman *et al.* (p. 1003; see the Perspective by Militzer) studied the transformations as they occur in individual crystal grains and found that current models do not capture the full physics of grain growth. Grain nucleation occurs much faster than previously thought. These observations may lead to enhanced methods for carbon steel forming.

1000 Cooperative Change

Transformations that preserve single crystals of organic molecules usually must avoid large motions of the lattice that would shatter the crystal and have mainly been seen in systems where double bonds convert to single bonds or where guest molecules move through pores. Atwood *et al.* (p. 1000; see the Perspective by Steed) observed a host-guest transformation where the addition of the guest to a nonporous host led to large-scale cooperative motion of the atoms, and thus maintained a single crystal. Once the transformation was initiated, it proceeded to equilibrium, even when the host was only partially saturated with guest molecules.

And in Brevia ...

A new assessment of the number of plant species threatened by human activity, by Pitman *et al.* (p. 989), indicates that at least 30% of all plant species are at risk of extinction this century.

Less Indirect Effect

The indirect aerosol effect—the modification of cloud coverage and properties by atmospheric aerosols—is the largest uncertainty in the calculation of the net solar energy budget. Lohmann and Lesins (p. 1012) propose a more precise estimate of the anthropogenic indirect aerosol effect by constraining predictions from complex climate models with observations of aerosol and cloud properties made by the POLDER satellite. By considering the effects of aerosols on both cloud albedo and cloud lifetime, their estimate of the indirect aerosol effect, 0.8 watts per square meter (W m^{-2}), is much smaller than previous values derived from climate model simulations alone (1.4 W m^{-2}).

Silent Earthquake in Japan

The Tokai region of central Japan, about 200 kilometers south of Tokyo, has been accumulating strain since its last large earthquake in 1854, and there are concerns that another large-magnitude event may occur in the eastern Tokai region in the near future. Ozawa *et al.* (p. 1009) used global positioning system data to study ground deformation and found evidence for aseismic slip (also called a silent earthquake) as great as 2 centimeters in the western Tokai region in 2001. The aseismic slip in the western Tokai region is altering the stress state and may increase the probability of an earthquake in the eastern Tokai region.

Moths Making Traveling Waves

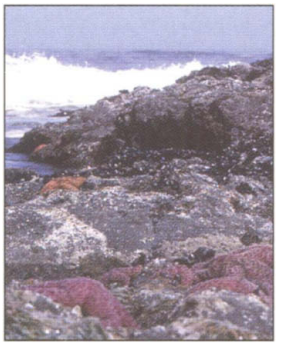
Nonlinear processes should be capable of producing a variety of spatiotemporal patterns in animal population dynamics, such as traveling waves, but experimental examples have been rare. Bjørnstad *et al.* (p. 1020; see the Perspective by Ranta *et al.*) report their aerial survey data from the European Alps of the long-term defoliation dynamics (covering more than four decades) of the larch budmoth, a species that exhibits extreme local cyclicity in abundance. Statistical modeling of spatiotemporal data with spatially extended theoretical models reveal the presence of regular traveling waves of budmoth outbreaks every 8 to 9 years.

Solvent Scrubbing

An anaerobic bacterium that reductively dechlorinates trichloroethane, a problematic groundwater contaminant, has been discovered by Sun *et al.* (p. 1023; see the Perspective by Gossett). These organisms are phylogenetically different but related to other dechlorinating anaerobes. A bioaugmentation study described in this work shows that these organisms could be used in the cleanup of trichloroethane-contaminated groundwater sediments.

Intertidal Hot Spots

The intertidal zone is believed to be a bellwether of climate change because organisms there are thought to live very close to their thermal-tolerance limits. Helmuth *et al.* (p. 1015) show that the common intertidal mussel species *Mytilus californianus* responds to patterns of high-temperature exposure across a latitudinal gradient along the west coast of the United States in a manner more complex than might be expected. They find that in most cases, thermal stress is likely to be most severe at northern locations and may lead to localized extinctions rather than a general shift of the species to higher latitudes as warming progresses.



CREDIT: HELMUTH *ET AL.*

The Nature of Nurturing

The evolution of complex organs such as eyes or placentas presents a dilemma because they demand a large number of individual adaptations to function property, so it can be difficult to envision how they could all fall into place. The live-bearing fish genus *Poeciliopsis* displays a continuum of placental development, which ranges from little or no provisioning (yolk feeding) to more extensive maternal provisioning, that allows evolution of this organ to be studied. Reznick *et al.* (p. 1018; see the news story by

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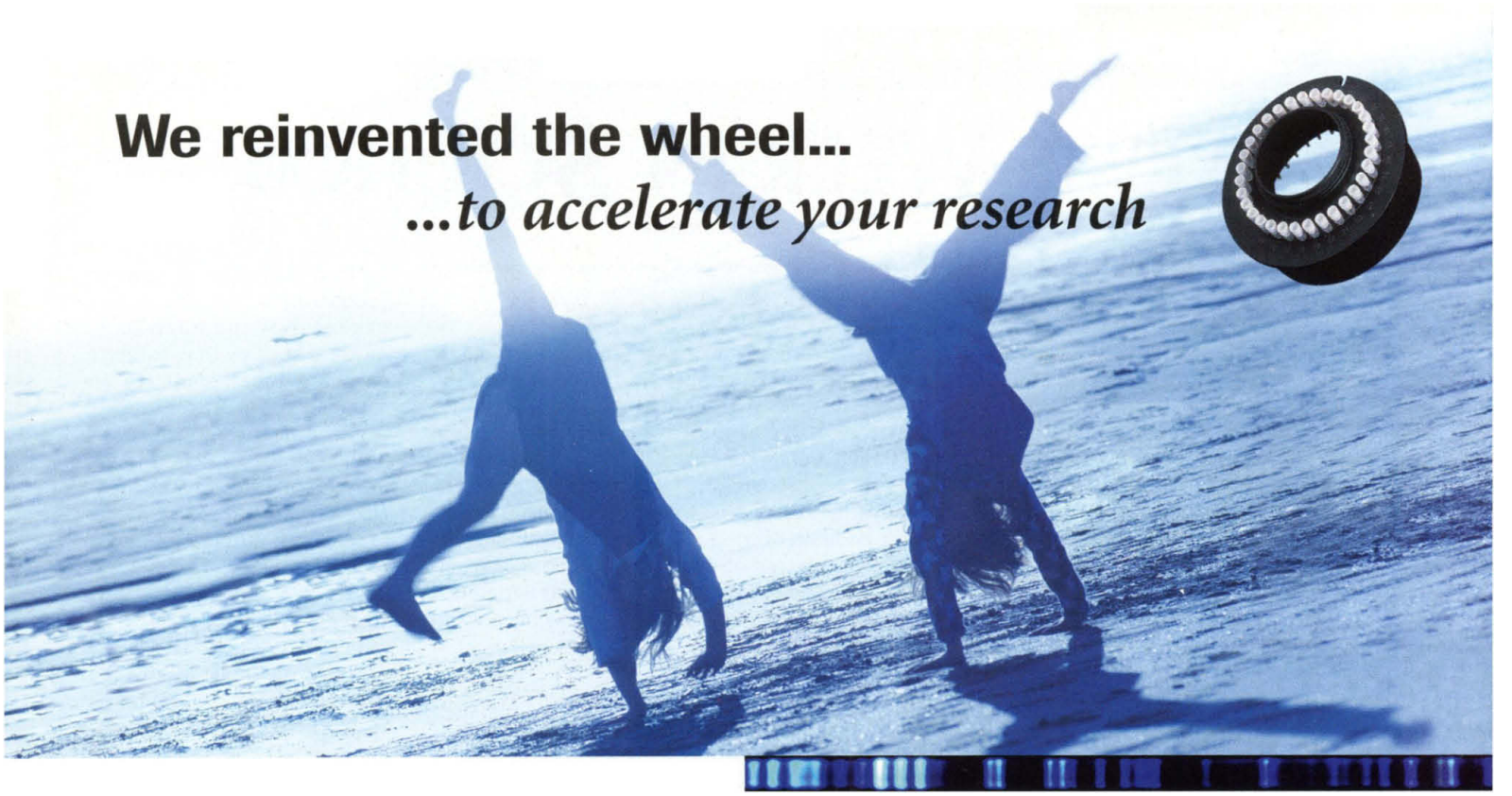

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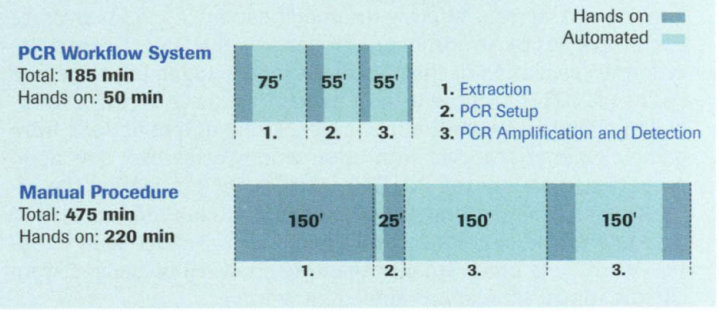

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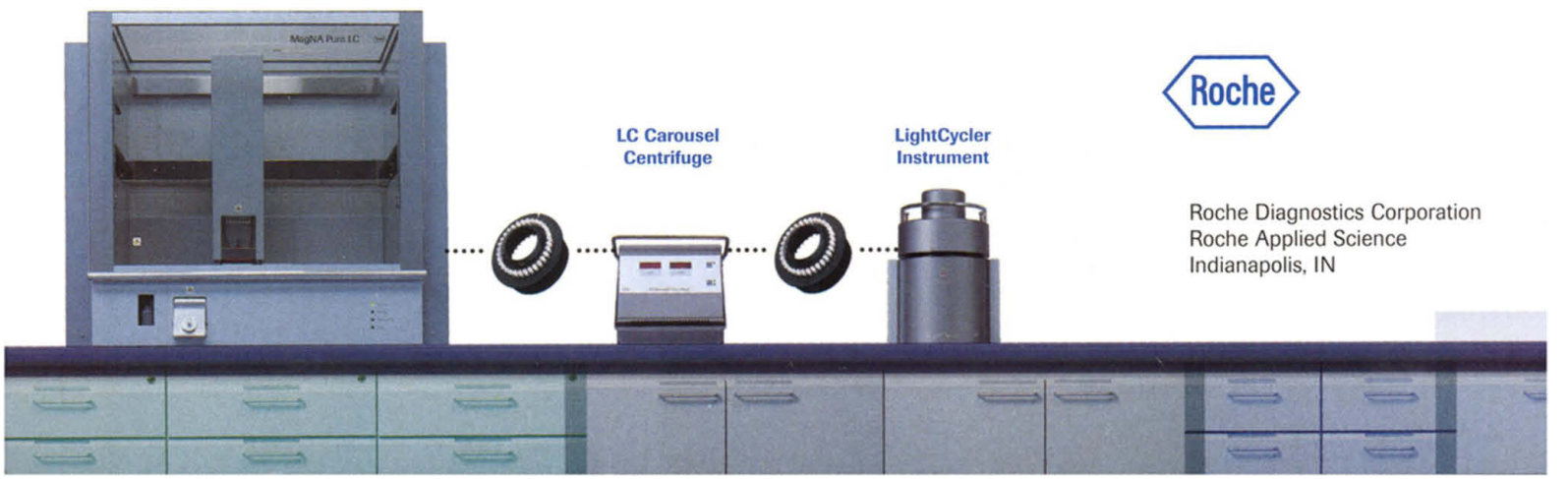

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Morrell) show that there have been three independent origins of extensive maternal provisioning in the genus. The upper estimates for the evolution of extensive postfertilization provisioning range from 0.75 to 2.34 million years. Such relatively rapid evolution has been predicted in theoretical models.

Defensins Strategies

The innate immune system responds rapidly to pathogens, either by obstruction and direct killing of microbes or by activation of the adaptive arm of the immune system. Defensins have feet in both camps, and two studies add insight into how they work (see the Perspective by Ganz). Although chemokines play a role in the inhibition of human immunodeficiency virus–type 1 (HIV-1) replication by CD8 T cells, the full identity of the factors involved has been elusive. Zhang *et al.* (p. 995; see the 27 September news story by Cohen) used mass spectrometry and protein chip technology to examine culture supernatants from CD8 cells isolated from patients who are long-term nonprogressors to AIDS. On the basis of amino acid sequencing and antibody recognition, they identified a set of defensins that only appeared upon T cell activation. Antibodies to these molecules blocked viral inhibition by CD8, and commercial preparations of α-defensins-1 and -2 inhibited different HIV-1 isolates. Biragyn *et al.* (p. 1025) find that one defensin, β-defensin-2, could activate dendritic cells (DCs) by binding Toll-like receptor-4 (TLR-4), a cell-surface pattern-recognition protein hitherto considered to be limited to recognizing pathogen-derived molecules, such as the Gram-negative bacterial endotoxin, lipopolysaccharide (LPS). In DCs, the interaction of β-defensin-2 with TLR-4 induced much the same cellular activation program as LPS, with the stimulation of costimulatory molecule and pro-inflammatory cytokine expression.

Protecting the Heart

Within the mitochondria of heart cells, ion channels control the flux of different ions and change the physiological status of the mitochondria, which in turn affect the relative health of the heart cell. Xu *et al.* (p. 1029) now describe the role of a calcium-activated potassium channel in the inner mitochondrial membrane of guinea-pig heart cells in protecting the cells from ischemia. A drug that opened the channel could protect the heart from infarction.

Taking Advantage of the Host

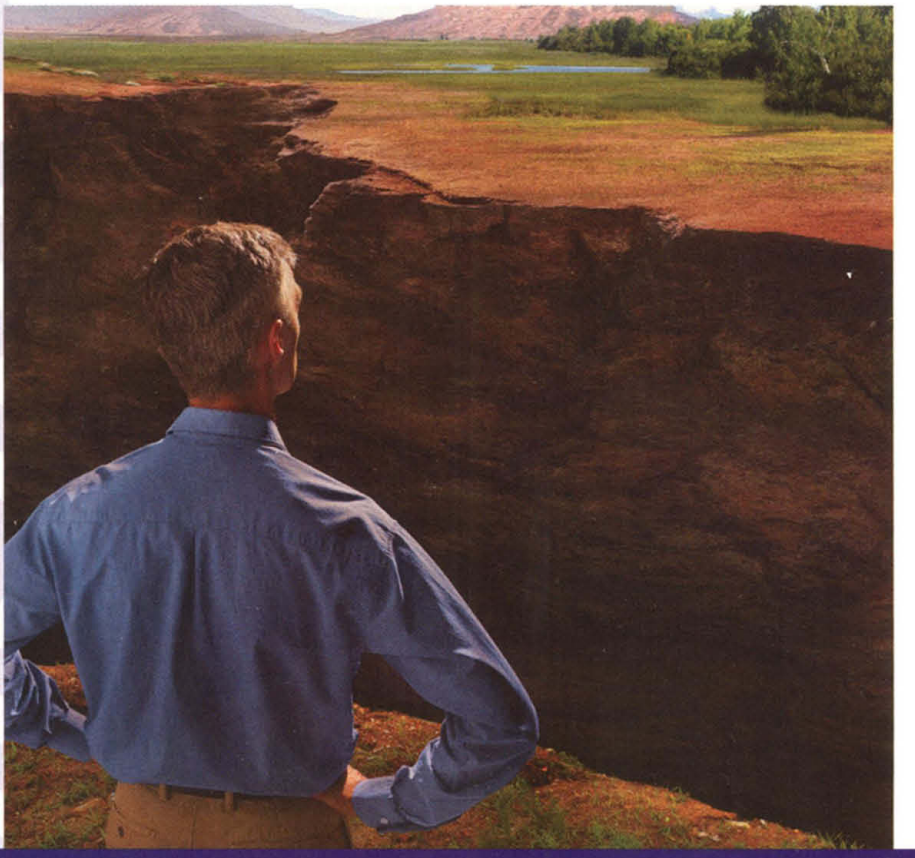
The tick-borne protozoan parasites *Theileria* spp. (related to the malaria parasites, *Plasmodium* spp.) cause a cancer-like disease in cattle that is of major economic importance in Africa and Asia. Heussler *et al.* (p. 1033) show how this pathogen subverts its host's signaling pathway for its own good. The schizont stage of the parasite infects the B and T cells of the immune system and immortalizes them into tumor-like cells capable of metastasis. Transformation seems to occur because the parasite activates the nuclear factor–κB (NF-κB) pathway and prevents apoptosis. This activation cannot be blocked by treatment with drugs that affect steps in the NF-κB signaling pathway upstream of multisubunit IκB kinase (IKK). The authors show that the intracellular foci of *Theileria* are associated with recruitment and aggregation of the IKK signalsome complex. Such aggregation seems to be sufficient to activate the kinase and subsequently activate NF-κB.

Polycomb Group Methylation

The covalent modification of histones, proteins that help package genomic DNA into chromatin, plays a critical role in gene expression and the segregation of chromosomes. The Polycomb (Pc) group of proteins have been implicated as chromatin-modifying proteins, and Cao *et al.* (p. 1039) now show that one of the two known Pc complexes, ESC-E(Z), specifically methylates histone H3 on residue lysine 27. This modification recruits the second complex, Polycomb repressive complex 1, likely through Polycomb protein itself, and shuts down gene expression.

CREDIT: ZHANG *ET AL.*

genomics



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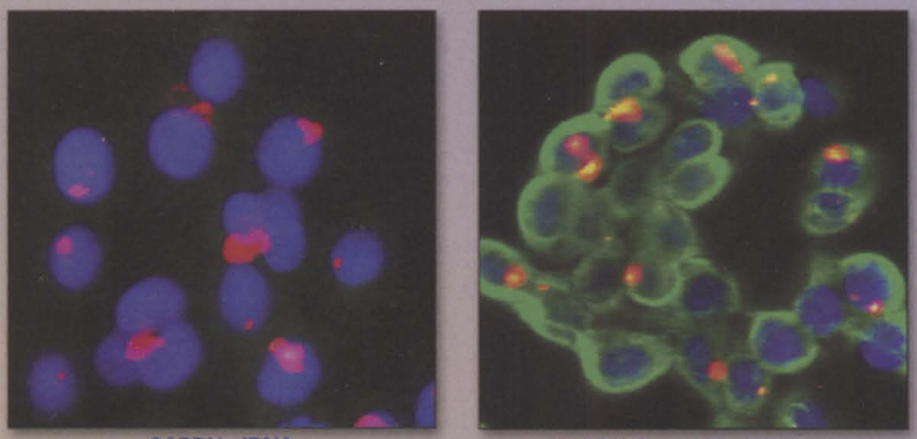

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siRNA Silencing of GAPDH Gene Expression. siRNA to human GAPDH (Cat #4602) and a scrambled control were fluorescently labeled with Cy™3 using the *Silencer*™ siRNA Labeling Kit (Cat #1632), transfected into HeLa S3 cells, and analyzed by fluorescence microscopy. **LEFT:** siRNA silencing of GAPDH expression. **RIGHT:** Control siRNA had no effect on GAPDH protein levels. RED: Cy3 labeled siRNA; GREEN: Anti-GAPDH antibody detected with fluorescein labeled secondary antibody; BLUE: DAPI stained nuclei.

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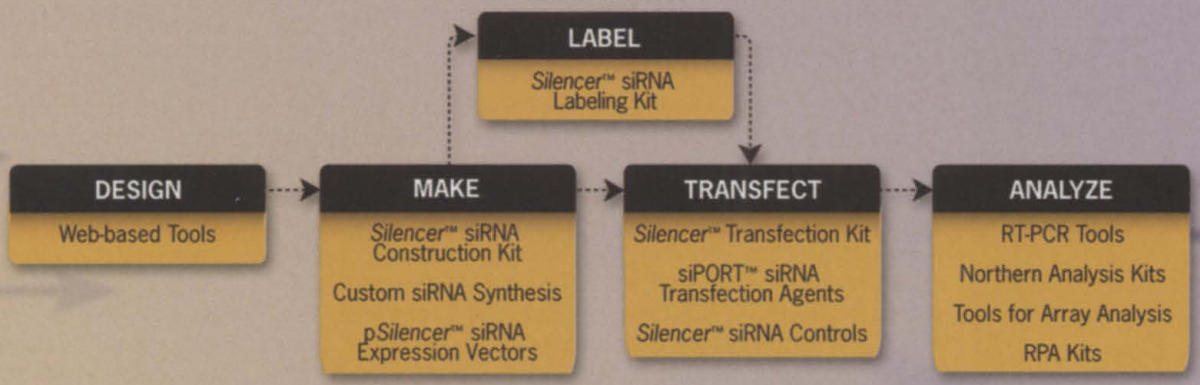

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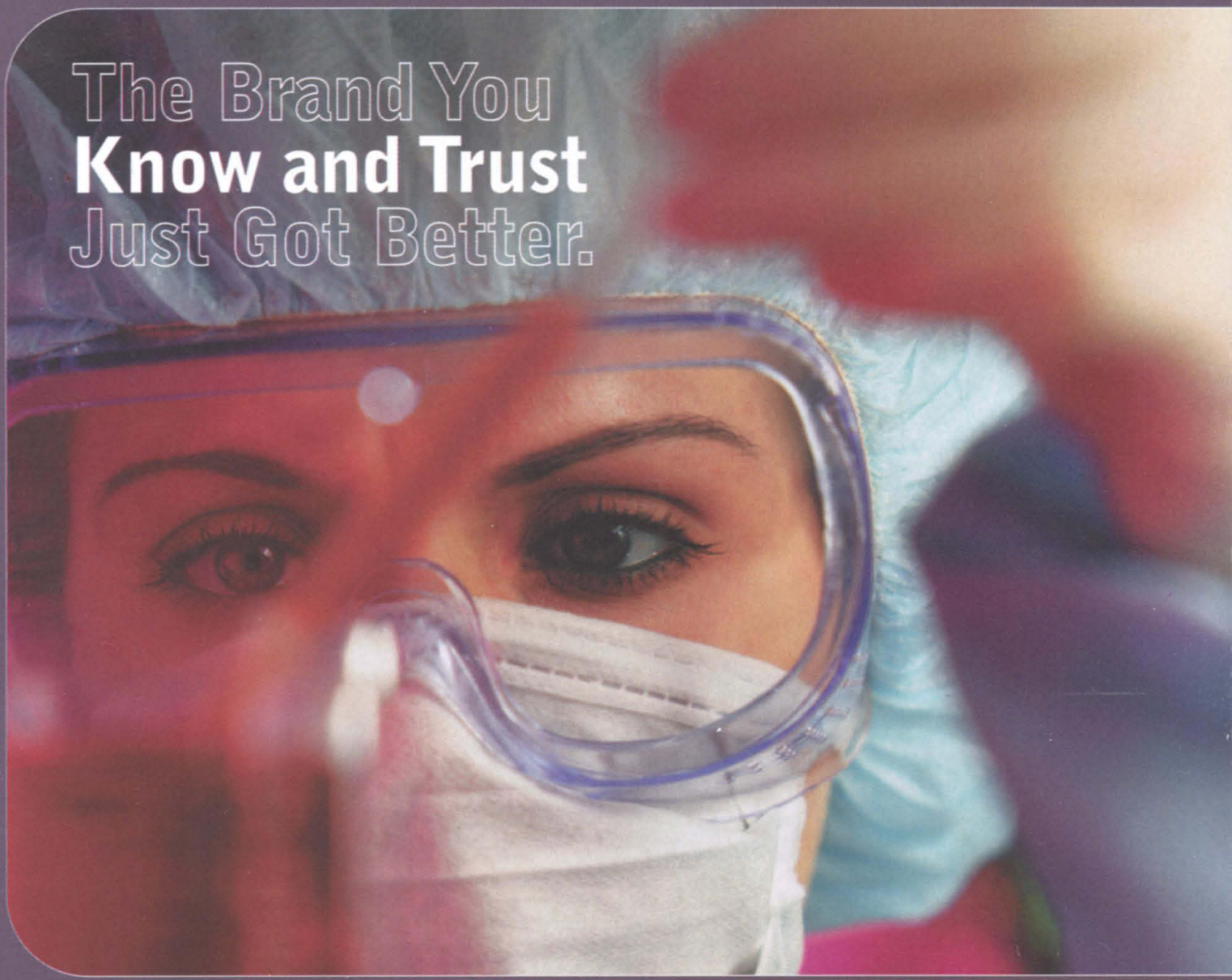

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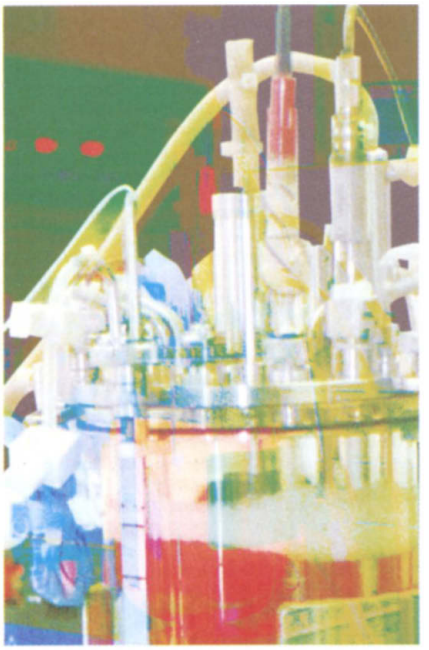

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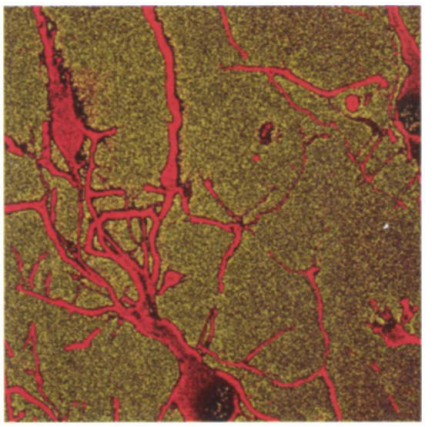

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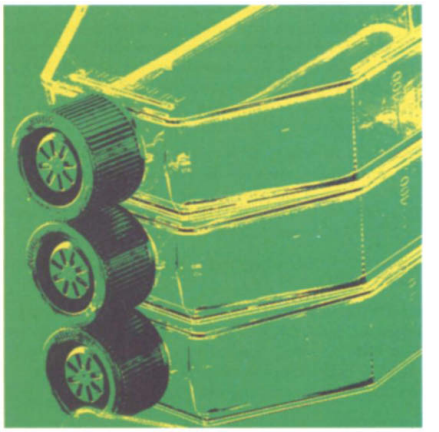

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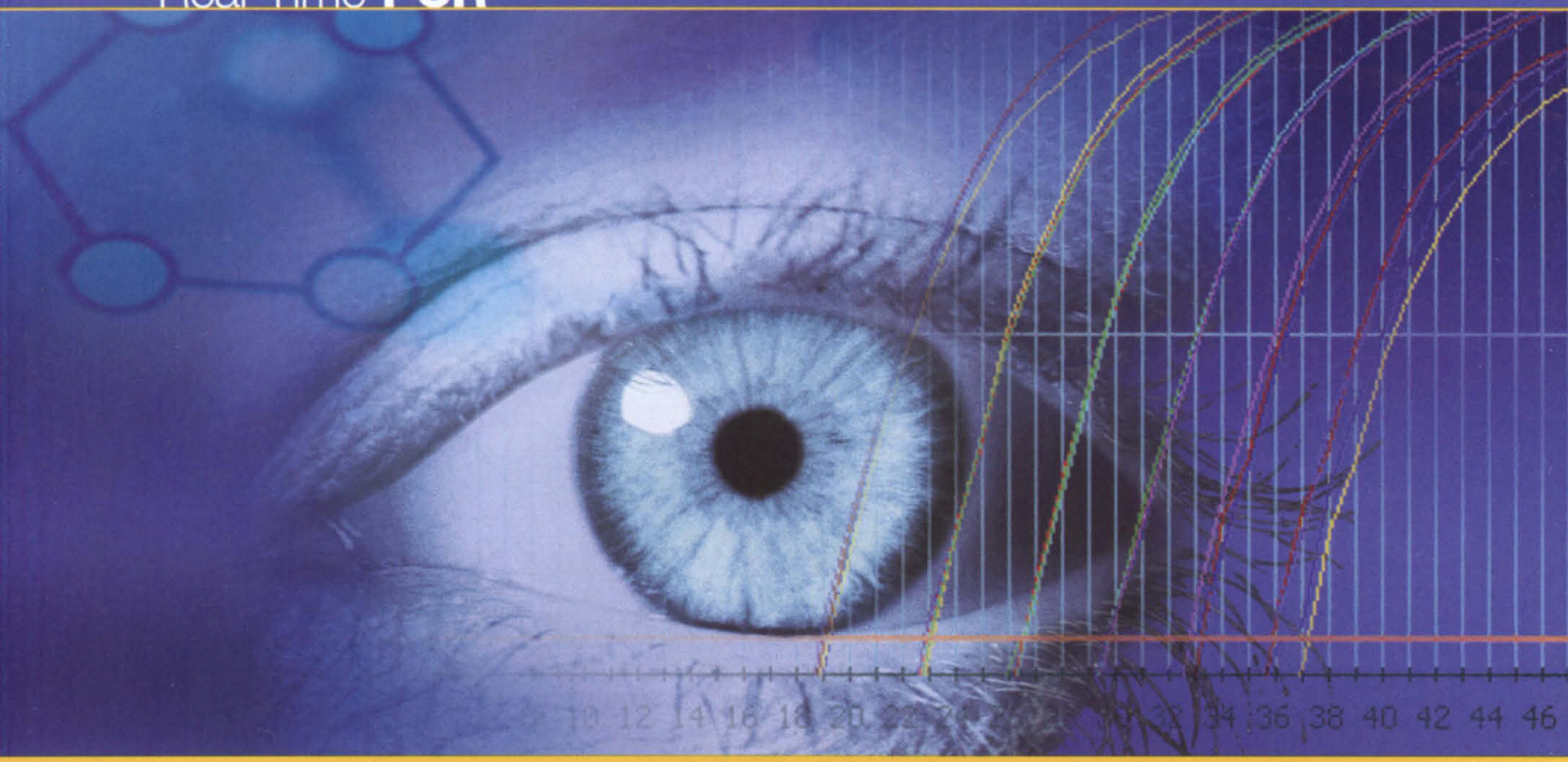

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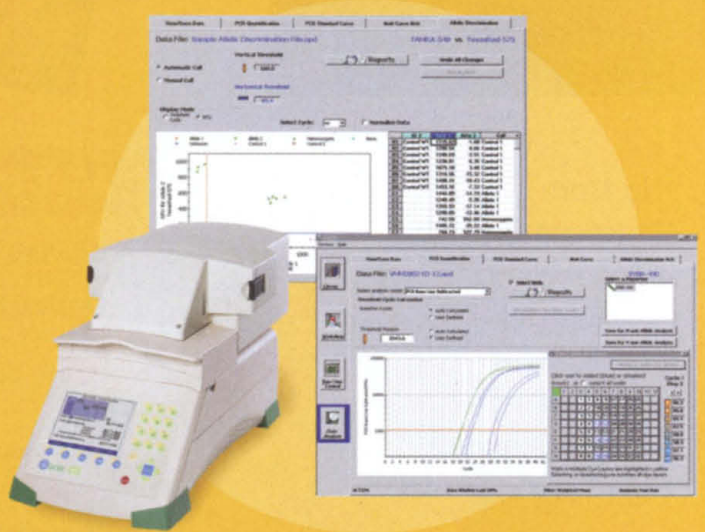

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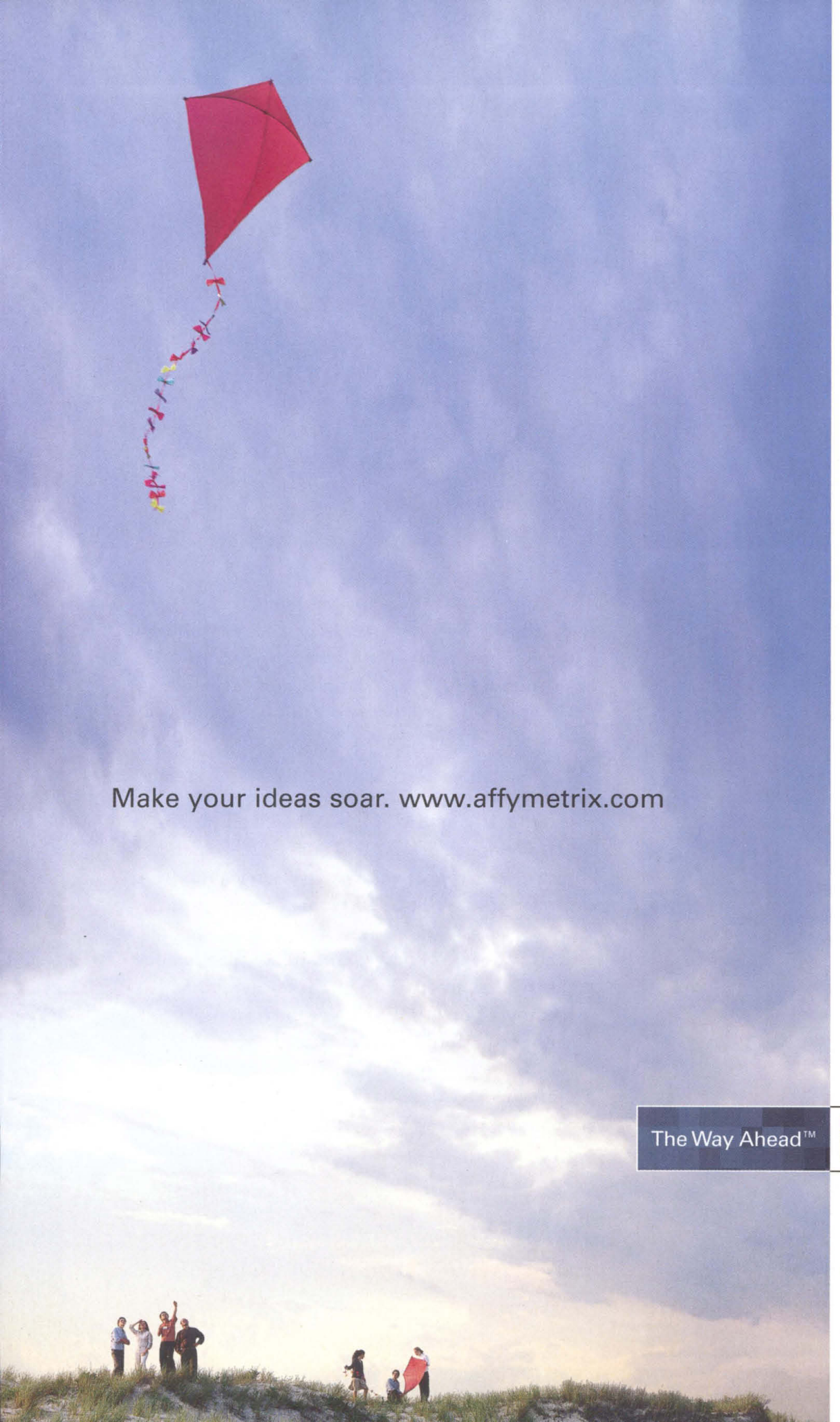

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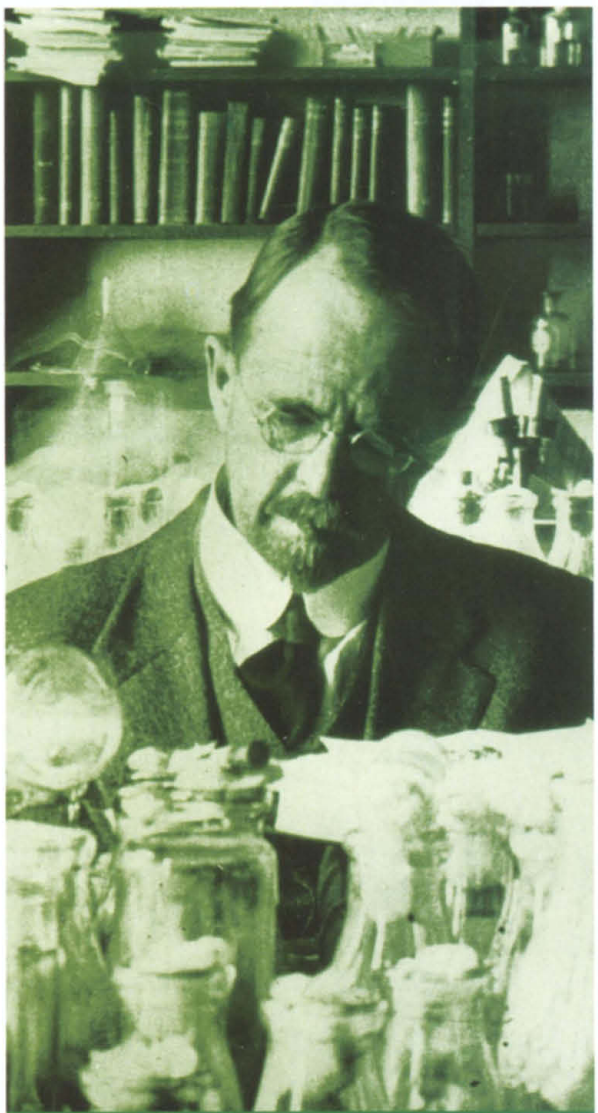

Thomas Hunt Morgan in the lab, 1922

Photo by A. F. Huettner, Courtesy of the Archives, California Institute of Technology

The lowly fruit fly became a noble harbinger of scientific discovery in 1910, when *Science* published Thomas Hunt Morgan's pioneering genetic experiments with *Drosophila*. His work helped determine how heredity and genetics influenced evolution, and he won the Nobel Prize in 1933.

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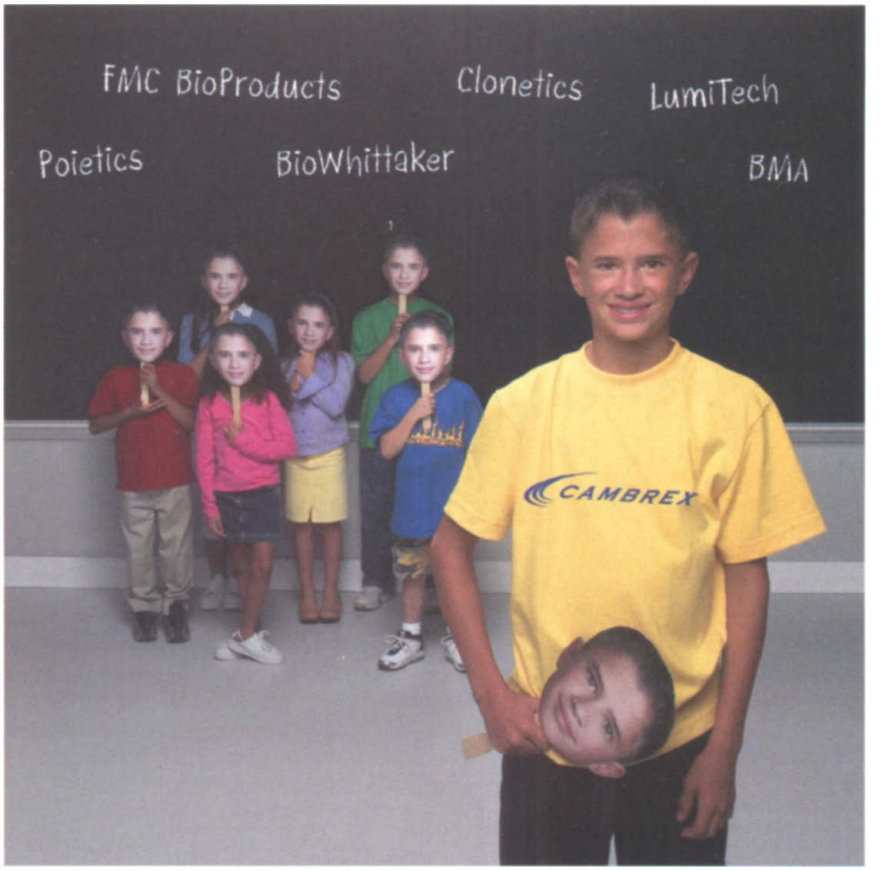

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PRIZE FOR
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And the 2002 winner is...

Dr. Anjen Chenn from the Feinberg School of Medicine, Northwestern University

Congratulations to Dr. Chenn, 2002 Eppendorf & Science Prize winner, for his contributions in the area of mammalian neuronal development. Through his research with transgenic mice, he has found that those expressing a stabilized form of ß-catenin in neural precursors develop abnormally enlarged brains with increased cerebral cortical surface area and expanded neural progenitor populations. His findings suggest genes such as ß-catenin can regulate cerebral cortical size by controlling the production of neural progenitor cells.

Eppendorf and *Science* have initiated this annual research prize of $25,000 for outstanding contributions to neurobiology research based on methods of molecular and cell biology, and Dr. Chenn has been selected as the very first winner of this prestigious award. A committee of independent scientists chaired by the Editor-in-Chief of *Science* selected Dr. Chenn's work from an impressive field of entrants, and the prize is being awarded in conjunction with the 2002 annual meeting of the Society for Neuroscience.

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Young scientists who have received their Ph.D. or M.D. within the past 10 years are eligible to win the 2003 Eppendorf & Science Prize. The deadline for applications is June 15, 2003.

For more information visit:
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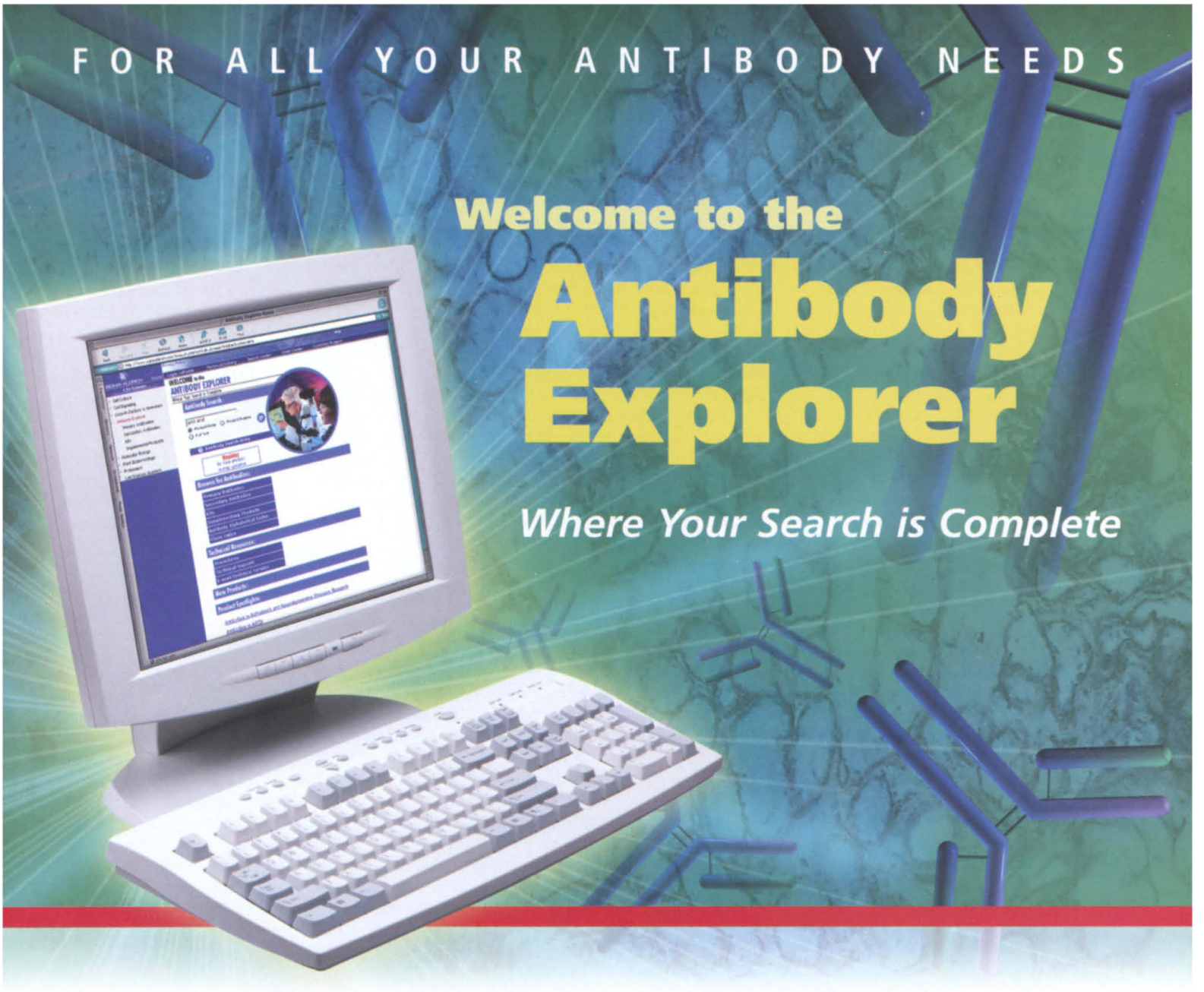

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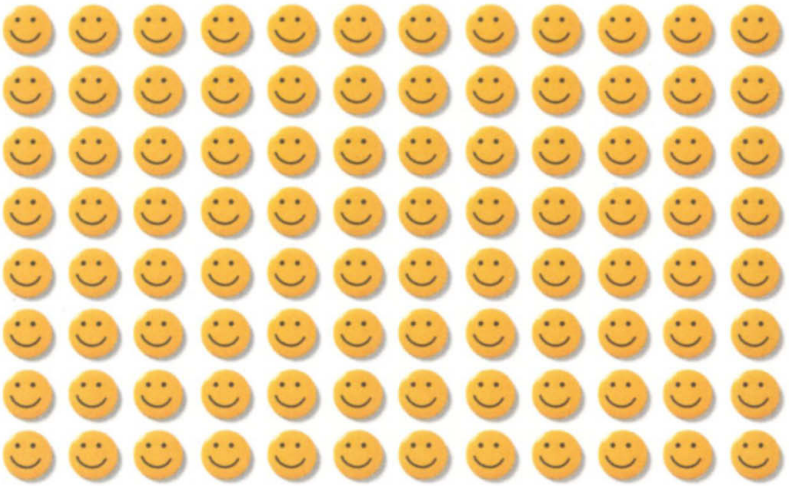

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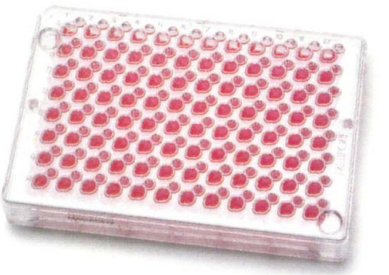

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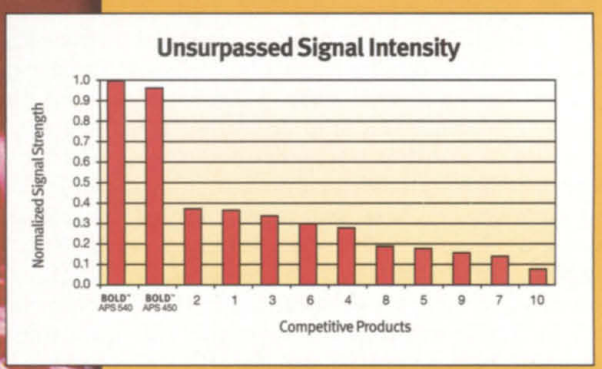

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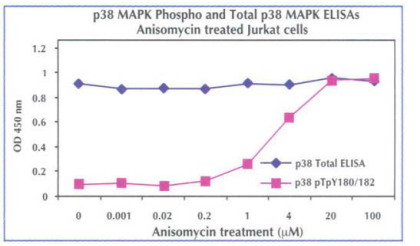
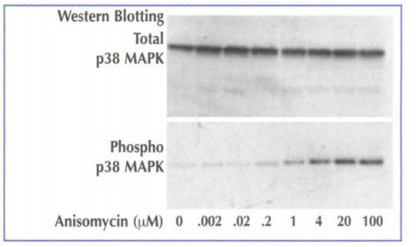


Solid Results



Cell lysates from Jurkat cells treated with various concentrations of anisomycin were tested with Total p38 MAPK ELISA (Cat.#KHO0061), phospho p38 MAPK ELISA (Cat.#KHO0071) and Western blotting. The data show excellent correlation between ELISA and Western blotting.

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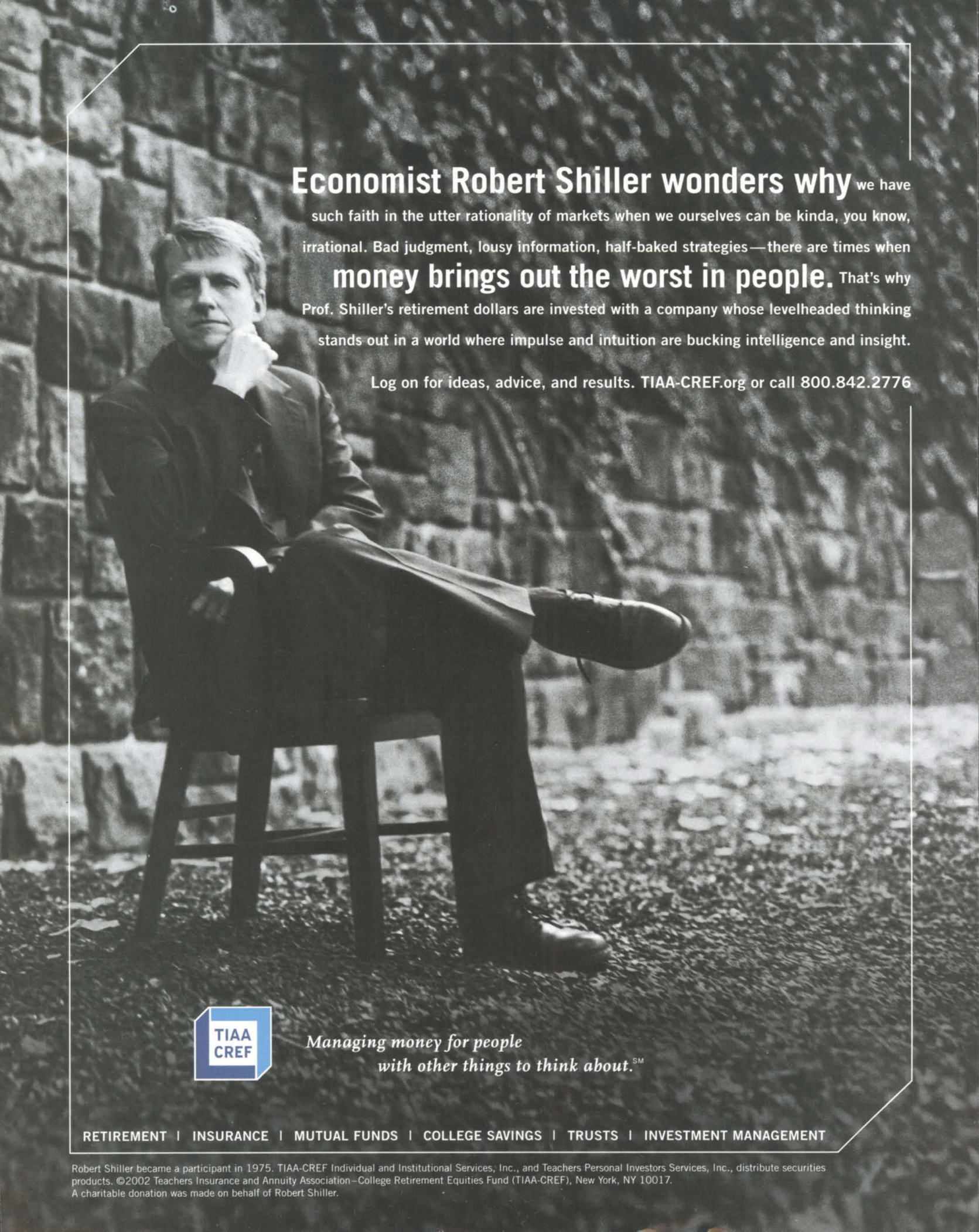
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