26 March 1999

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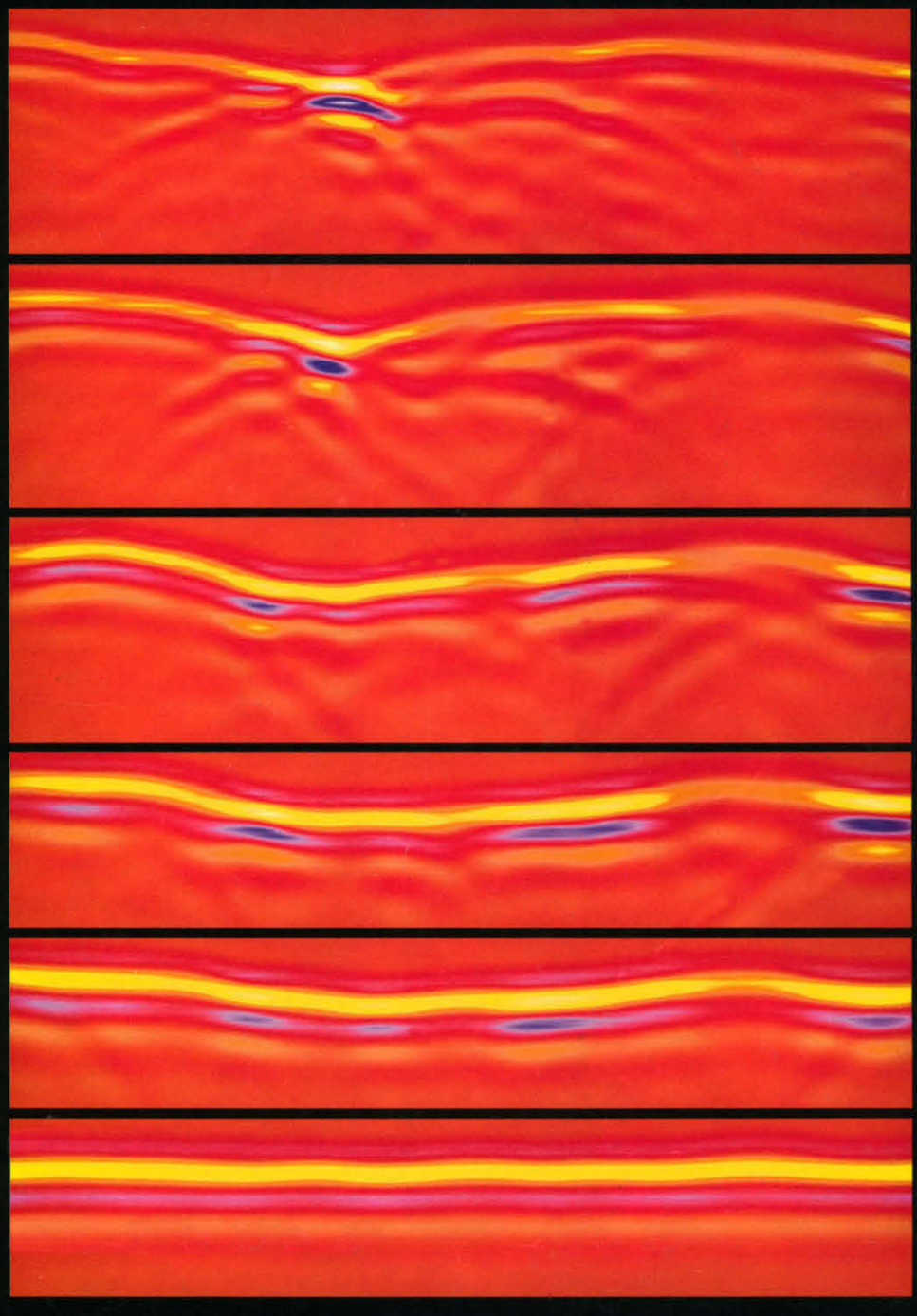

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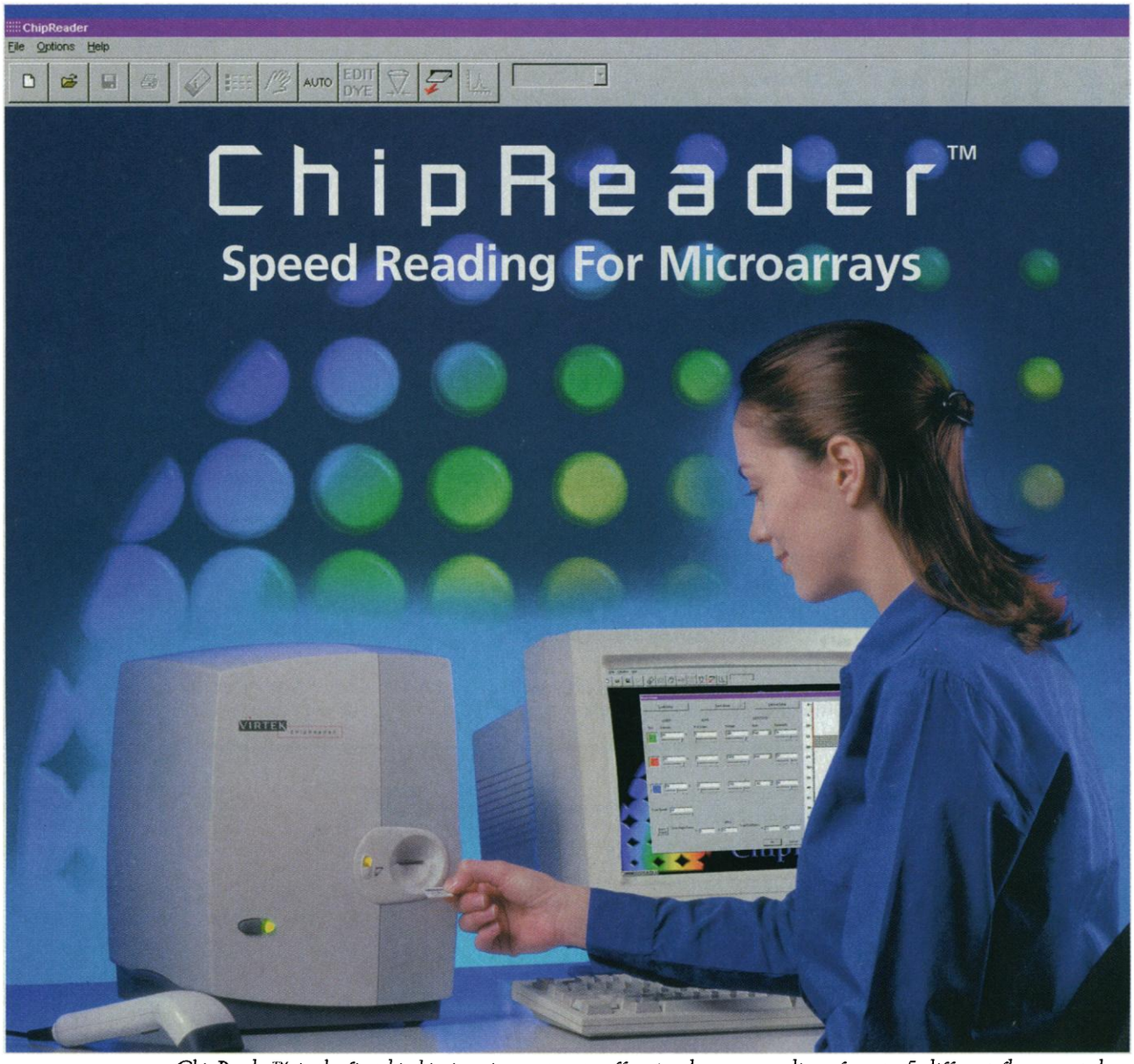

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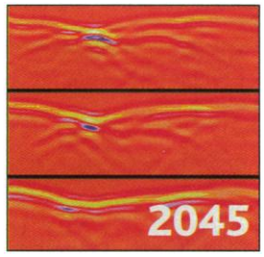
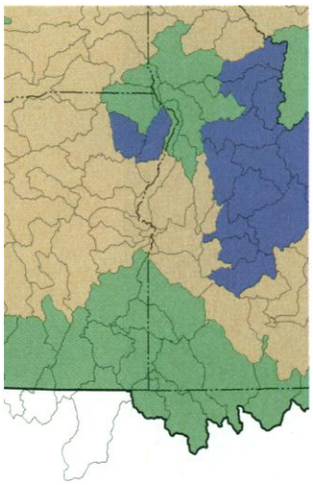


COVER Six time-depth snapshots show amplitude variations as an initially uniform-amplitude earthquake shear wave propagates through a model of southern California crust from a depth of 8 km (bottom) toward the surface (yellow and blue are maxima). Material property variations in the crustal model modify the wave as it propagates, strongly affecting peak ground motions and explaining apparently nonlinear sediment responses during the Northridge earthquake. [Image: D. O'Connell]



1996
Battle lines in the national forests

NEWS

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1986 SCIENTIFIC COMMUNITY: DOE Lab Exchanges Targeted in Wake of Espionage Claims
1987 PLANT SCIENCE: Data in Key Papers Cannot Be Reproduced
1989 PALEONTOLOGY: Fossil Offers a Glimpse Into Mammals' Past
1990 SCIENCE AND THE MEDIA: Chinese Center Sues Over Study Coverage
1992 SCIENCE CAREERS: MIT Issues Mea Culpa on Sex Bias
1992 IMMUNIZATION: UN to End Children's Vaccine Initiative
1993 ASTROPHYSICS: Gamma Beams From a Collapsing Star
1995 EDUCATION RESEARCH: Agencies Launch Effort to Improve U.S. Schools

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1996 ECOLOGY: Call for 'Sustainability' in Forests Sparks a Fire
1998 SCIENTIFIC PUBLICATIONS: The March of Paradigms
1999 PEER REVIEW: NIH Invites Activists Into the Inner Sanctum
2001 SCIENTIFIC COMMUNITY: EU Facilities Program Keeps Researchers on the Move
▼2003 2069 2073 2075 ASTRONOMY: Watching the Universe's Second Biggest Bang
2004 HUMAN EVOLUTION: Did Cooked Tubers Spur the Evolution of Big Brains?

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2050 **Unconditional Security of Quantum Key Distribution over Arbitrarily Long Distances** H.-K. Lo and H. F. Chau

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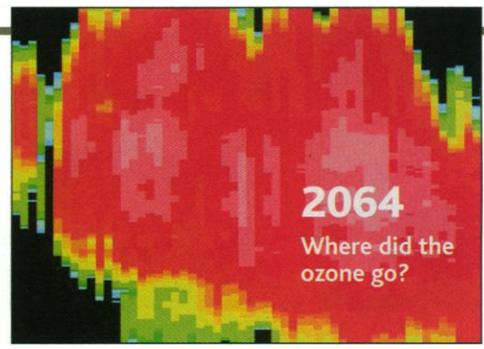

2064 **Arctic Ozone Loss Due to Denitrification** A. E. Waibel, Th. Peter, K. S. Carslaw, H. Oelhaf, G. Wetzel, P. J. Crutzen, U. Pöschl, A. Tsias, E. Reimer, H. Fischer
▼2069 2003 2073 2075 **Decay of the GRB 990123 Optical Afterglow: Implications for the Fireball Model** A. J. Castro-Tirado *et al.*
▼2073 2003 2069 2075 **Polarimetric Constraints on the Optical Afterglow Emission from GRB 990123** J. Hjorth, G. Björnsson, M. I. Andersen, N. Caon, L. M. Cairós, A. J. Castro-Tirado, M. R. Zapatero Osorio, H. Pedersen, E. Costa

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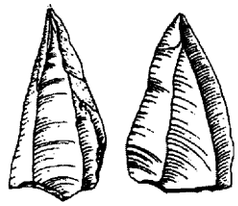

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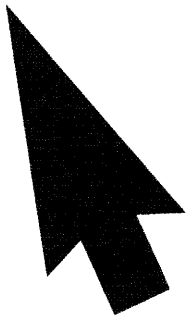

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KEEPING SECRETS

Secure cryptography is possible if the key to unlocking the code can be kept secret. Quantum key distribution at first was thought to solve this problem because eavesdropping on a quantum signal would change the states in a detectable manner, but it was later shown that undetectable eavesdropping was indeed possible. Lo and Chau (p. 2050) now show that a scheme offering unconditional security could in principle be constructed, given the availability of quantum computers. Although it may seem paradoxical, reduction of the quantum scheme to a classical one can make key distribution arbitrarily secure, even if the eavesdropper helps in distributing the elements of the quantum key.

METALS SLICED THIN

Until recently, it had been accepted that when charge carriers such as electrons or holes were confined to two dimensions, the resulting materials would be insulators, but experiments on high-quality, two-dimensional (2D) systems have revealed unexpected metallic behavior. Papadakis *et al.* (p. 2056) controlled the extent of the spin splitting (the lifting of spin degeneracy) in high-quality gallium arsenide 2D hole systems and found a relation between the temperature dependence of the resistivity and the spin splitting of the charge carriers. These results should help constrain any successful theory that attempts to describe this metallic behavior in reduced dimensions.

PRESSURING POLYMER TOPOLOGY

Synthesis of highly branched polymers, such as the highly regular dendrimers or the more random hyperbranched polymers, often require many synthetic steps or require synthesis of specific reagent monomers that make these potentially interesting materials expensive. Guan *et al.* (p. 2059) now show that the simple ethylene molecule can be used to make hyperbranched polymers with a palladium-α-diimine catalyst. At high ethylene pressure, linear polyethylene with some branching is produced, but at lower pressures the catalyst "walks" along the growing chain and creates numerous additional branch points.

SHAKING SEDIMENTS

Prediction of the ground motion that results from large earthquakes is critical for the engineering of structures. Regions of alluvial fill, such as in the Los Angeles Basin, have been particularly difficult to model because of the nonlinear amplification caused by sediments—for example, the amplification of aftershocks of the 1994 Northridge earthquake was twice that of the main shock. Such nonlinear responses need not be an intrinsic material effect. O'Connell (p. 2045; see the cover and the Perspective by Frankel) found that a three-dimensional, finite difference model that includes a linear response from soil sites, along with random variations in velocity, can reproduce the apparent nonlinearities and observed ground motions for the Northridge earthquake. He cautions that seismologists should avoid using only one-dimensional, layered velocity structures or including nonlinear soil responses in their models because these approximations can lead to inaccurate ground-motion predictions.

ATTENUATING ARCTIC OZONE

The springtime ozone losses in the Antarctic and the Arctic polar stratosphere have largely been attributed to increases in halogens from chlorofluorocarbons (CFCs) reaching the stratosphere. Worldwide emission restrictions on CFCs are beginning to show an effect, and thus reductions in ozone destruction are expected. However, another culprit in ozone destruction has been identified: Removal of active nitrogen from the gas phase through aerosol-particle sedimentation (denitrification) can substantially increase ozone losses. Waibel *et al.* (p. 2064) show that this loss is particularly significant in the Arctic, where future stratospheric cooling may enhance denitrification and ozone losses despite halogen reductions.

TRAPPED IN ICE

Spectra of the icy surface of the jovian satellite Europa obtained during the Galileo mission have revealed the presence of sulfur dioxide and hydrated minerals. Carlson *et al.* (p. 2062) have now matched a previously unidentified peak in Europa's infrared spectrum with a peak in a laboratory spectrum caused by the presence of hydrogen peroxide in water ice. They infer that this trace of hydrogen peroxide (0.13%) is produced by intense plasma irradiation of the Europan surface by the jovian magnetospheric.

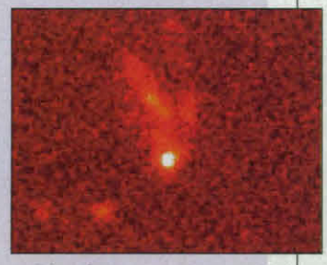
A HEARTFELT ROLE

Signaling by transforming growth factor–β (TGF-β) is a conserved pathway that controls cell growth and differentiation. Two TGF-β receptors, TBRI and TBRII, function in this signaling pathway. TGF-β binds to TBRI, which in turn phosphorylates TBRII for subsequent activation of Smad transcription factors. A third receptor, TBRIII, has been identified, but its role in TGF-β signaling was uncertain because TBRIII lacks a recognizable signaling domain. Brown *et al.* (p. 2080) used explanted chick atrioventricular cushion to examine the role of TBRIII during cardiac development and found that TBRIII is necessary for epithelial-mesenchymal transforma-

CONTINUED ON PAGE 1979

AIMED RIGHT AT US

Gamma-ray bursts are brief emissions (seconds to minutes) of high-energy photons that are thought to be associated with some unobserved stellar explosion. Only recently have astronomers had the tools, such as the x-ray satellite BeppoSAX and the Compton Gamma-Ray Observatory, to pinpoint the location of these bursts and observe their decay of the optical afterglow over days and months at numerous wavelengths. Three reports indicate that the steep decline of the recent bright gamma-ray burst GRB 990123 is consistent with beaming of the emission in our direction, as opposed to isotropic emission (see the news story by Schilling). Starting with observations in Beijing about 8.5 hours after the burst and ending with observations in Spain on 18 February, Castro-Tirado *et al.* (p. 2069) determined that the decay in the intensity of the emission from the afterglow may be due to a collimated jet pointing directly at us. Hjorth *et al.* (p. 2073) used the Nordic Optical Telescope (NOT) on the Canary Islands to measure an upper limit of linear light polarization of 2.3% from the afterglow, which is consistent with emission from a jet, and Andersen *et al.* (p. 2075) obtained an optical spectrum of the afterglow with NOT that is also consistent with a jet and that places an upper limit on the redshift of 2.05 for the distance of the burst from Earth. Although a collimated jet is not a unique explanation for these observations, it provides a plausible solution to the quandry of a highly energetic source at such large cosmological distances.



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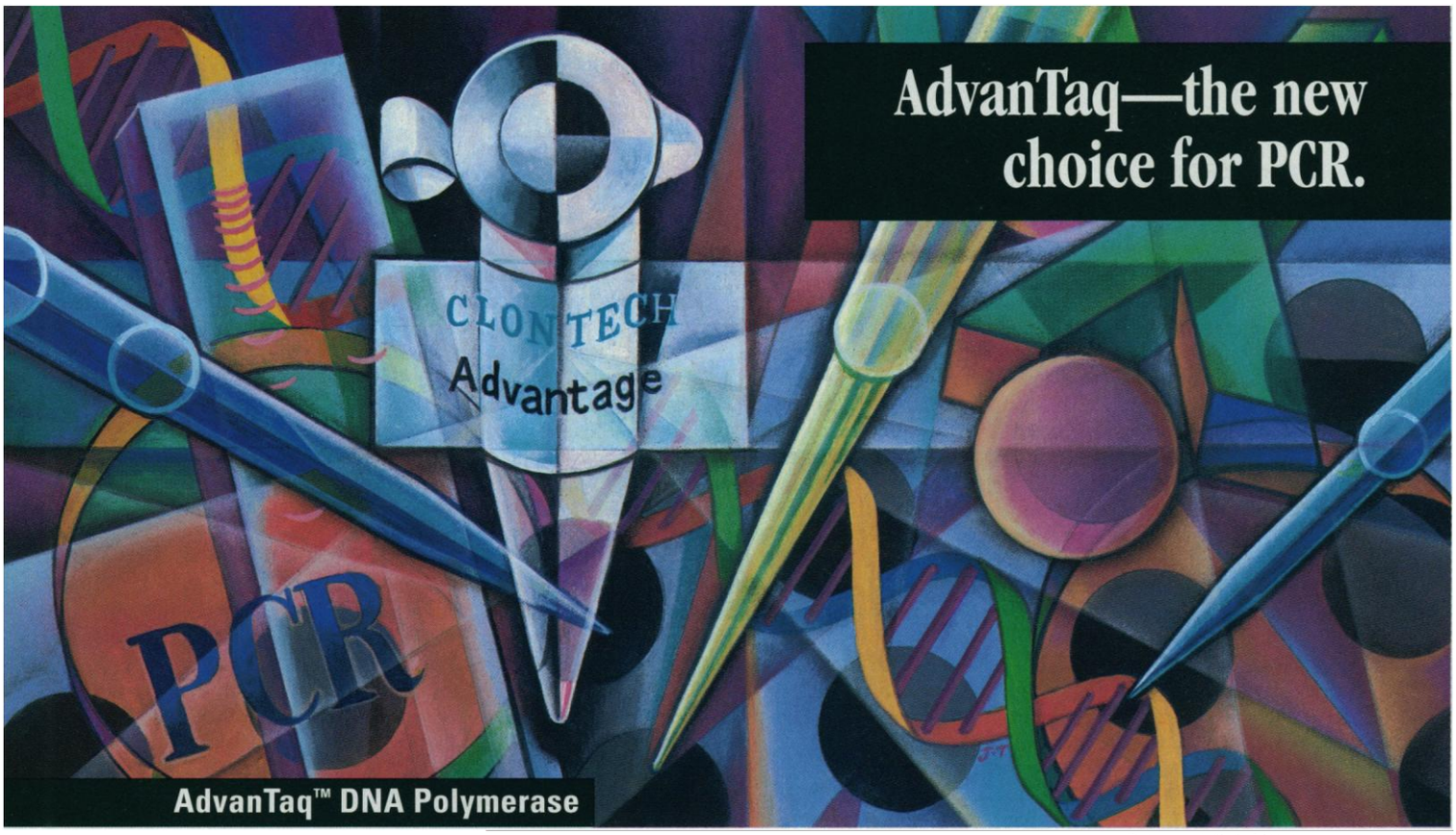

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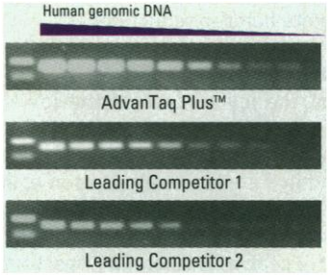

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tion and mesenchymal cell migration. A mechanism for TBRIII action in TBRI-TBRII signaling is proposed.

BREAKING AND ENTRY

Upon contacting a host cell, the bacterium *Salmonella typhimurium* uses a specialized secretion system to translocate several bacterial effector proteins into the host. These proteins then somehow trigger rearrangements in the actin cytoskeleton and cell membrane that facilitate bacterial uptake. Zhou *et al.* (p. 2092) show that one of these translocated proteins, SipA, is an actin binding protein that functions by stabilizing actin filaments. This stabilizing activity results in spatial restriction of the host cell membrane structures that are involved in bacterial entry.

TRANSFER RNA TARGET

One of the common side effects of a regimen of antibiotics is diarrhea caused by the disturbance of intestinal flora that otherwise live unnoticed. Colicins are bacterial proteins that are secreted under stressful conditions and they act through a variety of pathways to kill other strains of *Escherichia coli*. Ogawa *et al.* (p. 2097) describe the mechanism by which colicin E5 inhibits protein synthesis. Unlike other members of the colicin E family that appear to cleave ribosomal RNA, E5 hydrolyzes transfer RNAs (for Tyr, His, Asn, and Asp) that contain the modified base queuine at the wobble position of their anticodons.

ENZYMES IN ACTION

Understanding of complex cell biological processes such as transmission of signals through networks of biochemical pathways would be facilitated by the ability to measure the local activity of regulatory proteins. Ng *et al.* (p. 2085) describe a method that allows analysis of localized enzymatic activity of protein kinase Cα (PKCα) in live or fixed cells. An autophosphorylation site was identified on PKCα and used as a marker of the activated enzyme. A specific antibody to this site and another monoclonal antibody to PKCα were labeled with fluorophores, and their proximity was measured by monitoring fluorescence resonance energy transfer. This protocol enabled imaging of active PKCα in live or fixed cells.

CYTOSKELETAL DYNAMICS

Changes in cell morphology and cell movement are mediated by remodeling of the actin cytoskeleton. The small guanosine triphosphatases (GTPases) Rac and Cdc42 regulate the actin cytoskeleton through stimulation of the protein kinase PAK (p-21-activated protein kinase). Sanders *et al.* (p. 2083; see the Perspective by Burridge) show that PAK1 then acts to phosphorylate myosin light chain kinase (MLCK) and decreases the activity of that enzyme. Subsequent decreases in phosphorylation of myosin light chain apparently lead to decreased interaction of myosin II with actin and contribute to cell spreading induced by Rac. These results help explain the opposite effects of the small GTPase Rho, which leads to decreased phosphorylation of MLCK.

KEYSTONE COLLAPSE

The classic example of a "keystone species" —one that controls the structure and function of a community or ecosystem—is the sea star, *Pisaster ochraceus*, which preys on mussels on the Northwest Pacific shoreline. In the presence of the predator, there is a rich assemblage of algae and invertebrates; in its absence, the intertidal zone shifts to a monoculture of mussels. Sanford (p. 2095) now shows that small temperature changes exert a strong effect in this species. Both in field studies during cold water upwelling associated with El Niño and in lab experiments, decreases in water temperature of around 3° Celsius dramatically affected sea star predation.

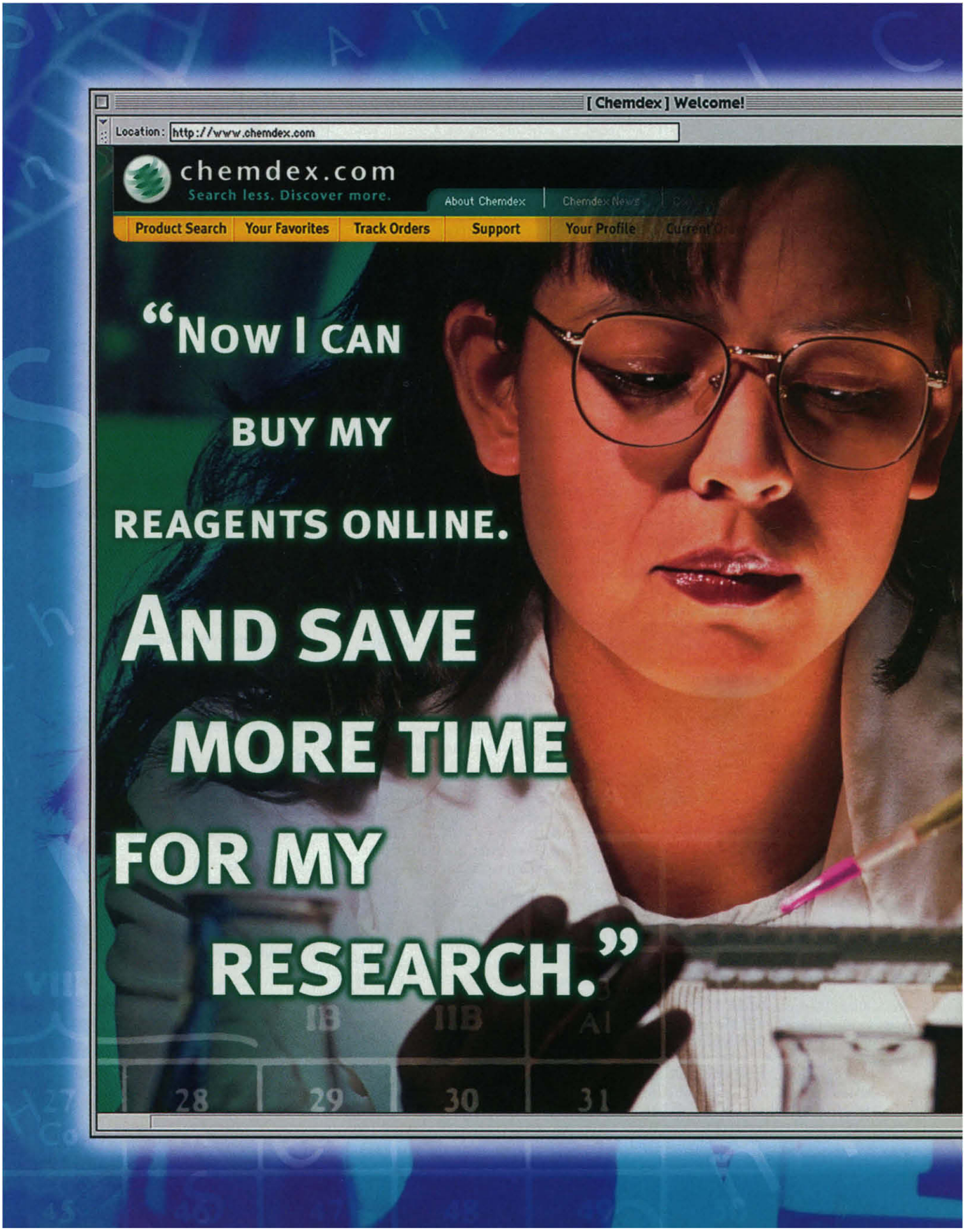
TECHNICAL COMMENT SUMMARIES

The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/283/5410/1979a

Species Abundance Across Spatial Scales

W. E. Kunin (Reports, 4 Sept., p. 1513) developed "a scale-independent measurement of species abundance" with the use of "a commonly available device: the distributional 'dotmap.'" He found that species abundance could be "estimated accurately even at scales finer than those used to parameterize the model...."

J. C. Finlayson took data from his studies "of birds in the southern Iberian Peninsula" and "tested the predictive power of coarse- and medium-scale abundance to fine-scale abundance" with the use of Kunin's linear extrapolation method. Finlayson concludes that Kunin's method "appears to have wider taxonomic application [and] opens a window for the use of the now plentiful bird atlas data...."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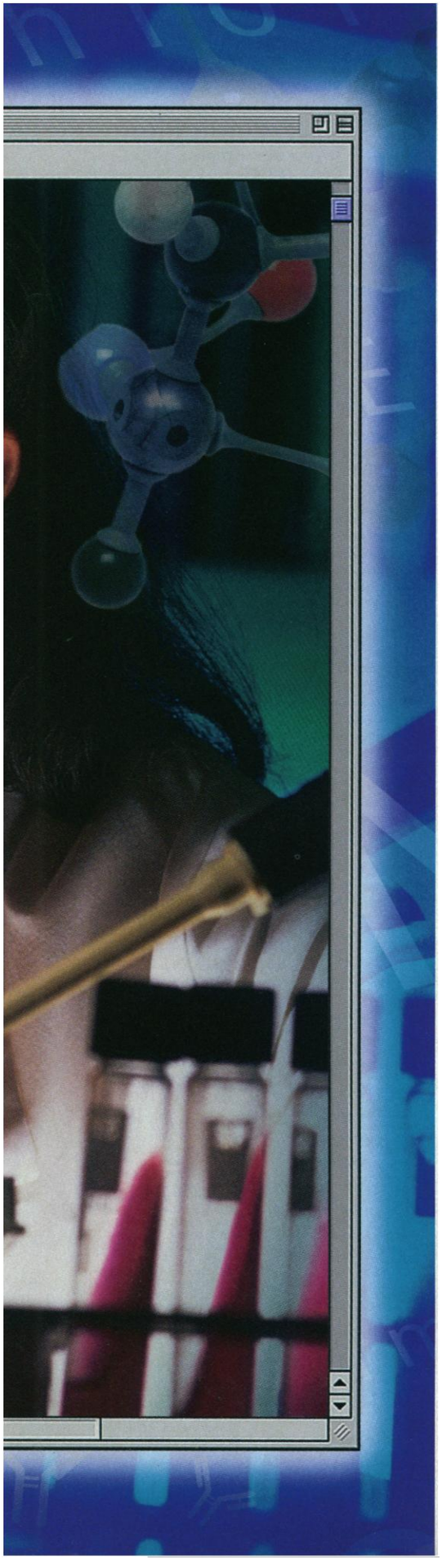

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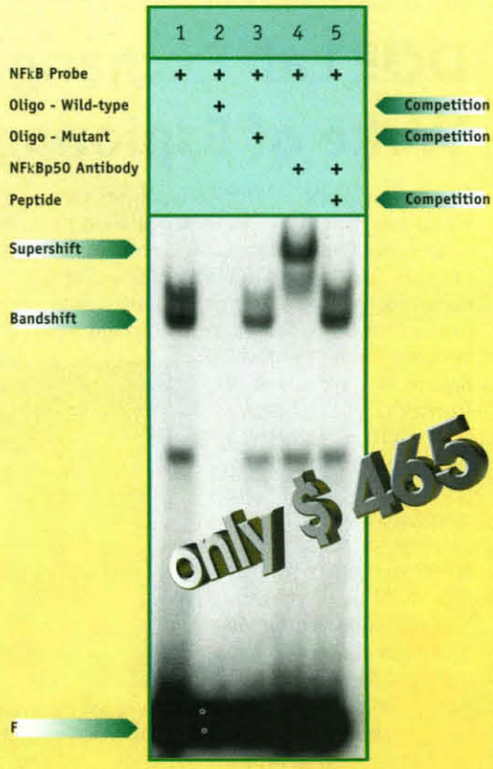

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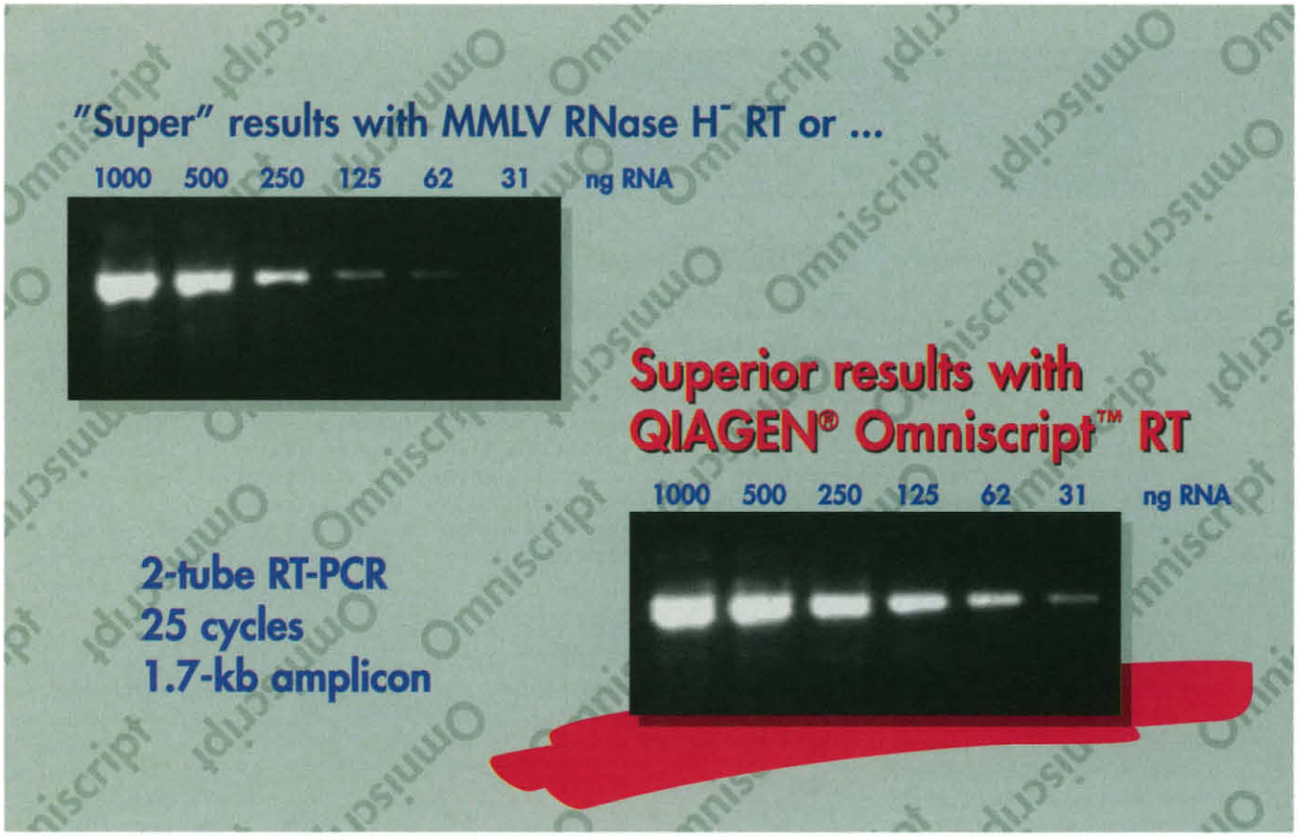

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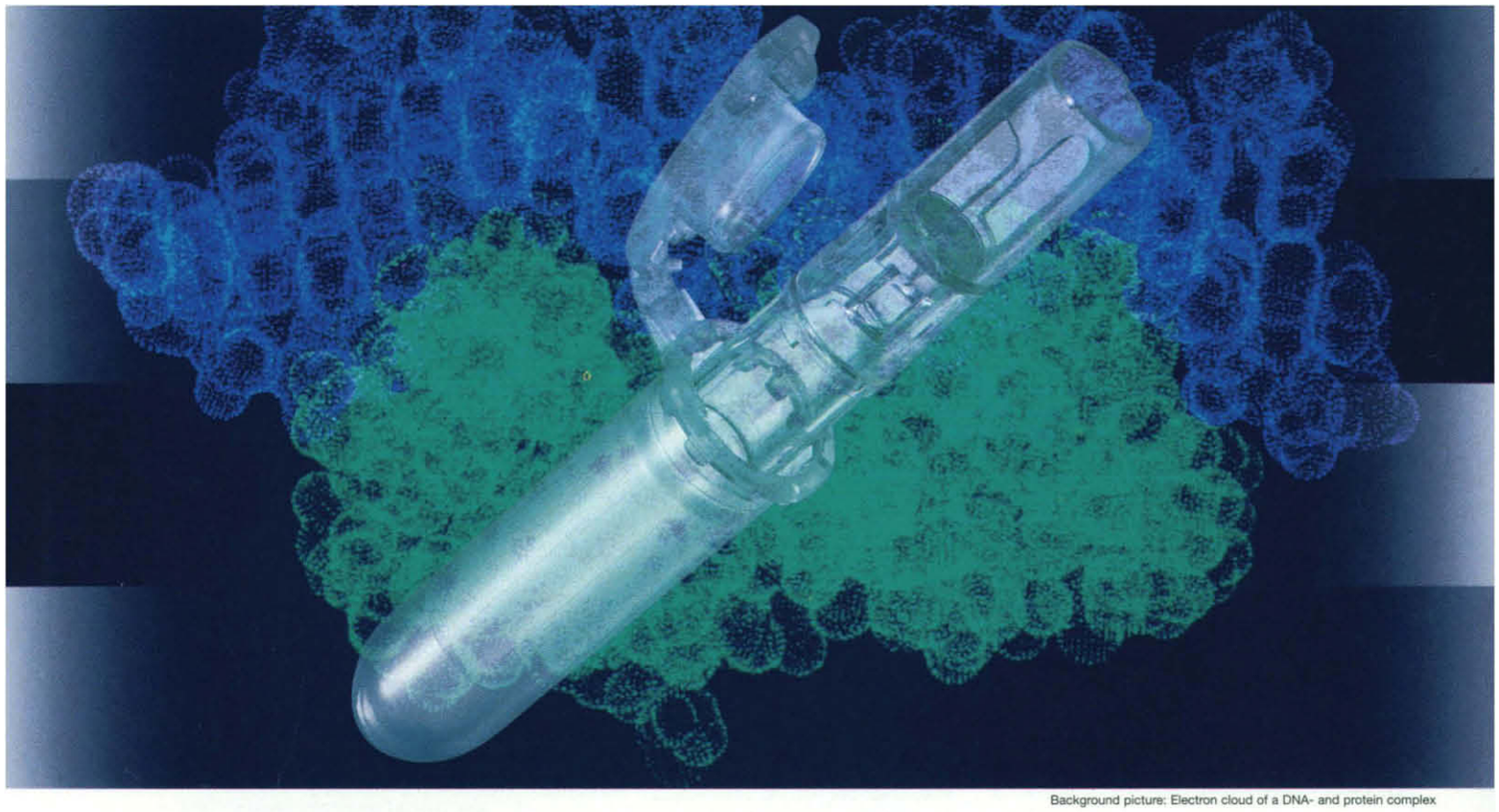

Background picture: Electron cloud of a DNA- and protein complex

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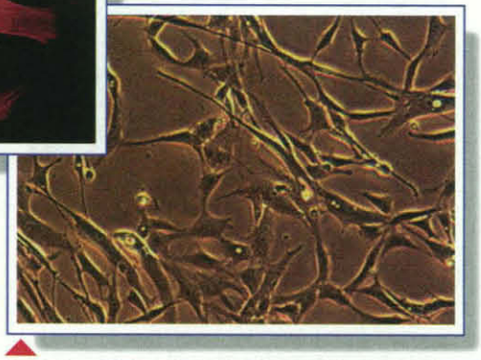

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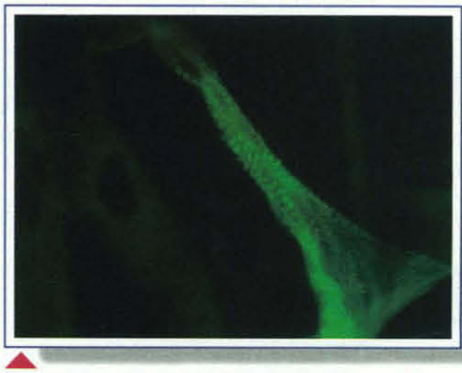

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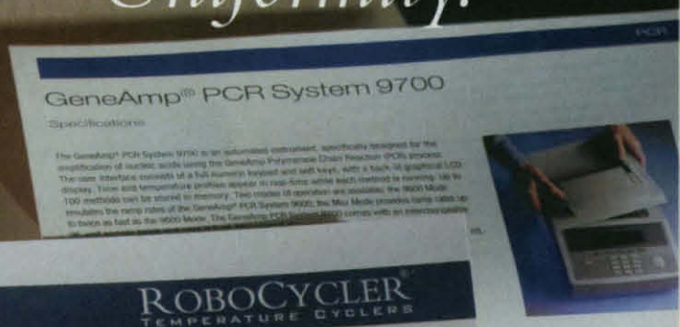

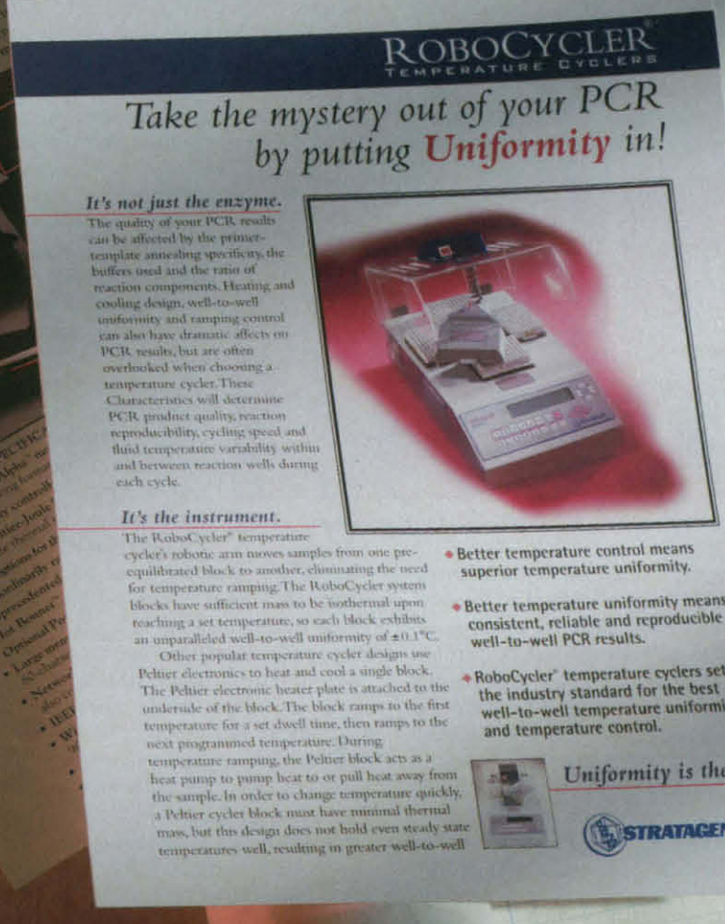

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Examples of how THE GUIDE* recommendations apply to the One Cage™ System

Number of animals recommended per cage based on 80 sq. inches of usable floor area, 7-3/4" interior cage height:

MICE (>25g.)	
HAMSTERS (>100g.)	
RATS (200-400g.)	
GUINEA PIGS (≤350g.)	

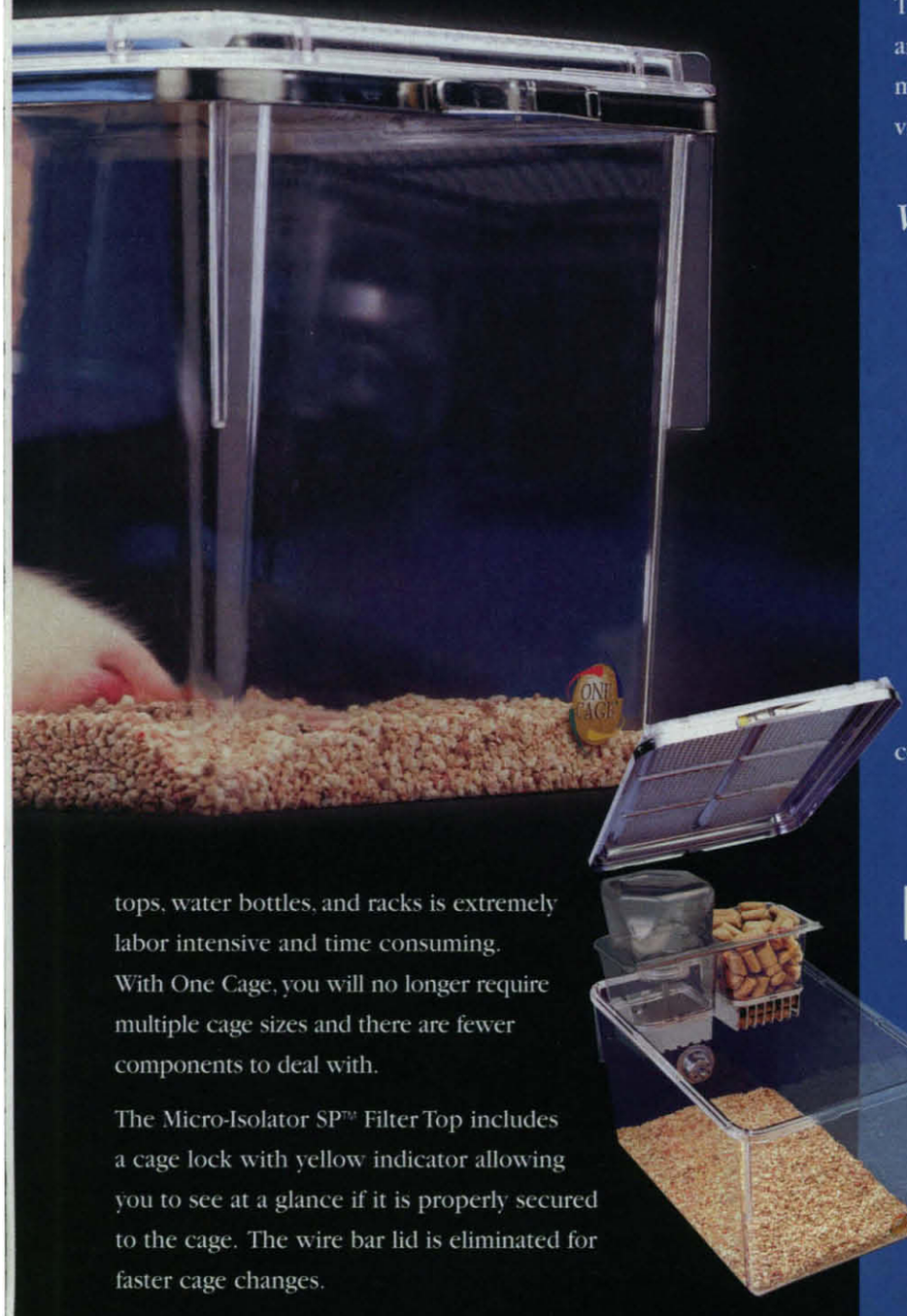
*Based on the Animal Welfare Act of 1966 as ammended 1985 and the Guide for the Care and Use of Laboratory Animals, Institute of Laboratory Animal Resources, Commission of Life Sciences, National Research Council, National Academy Press, 1996.

With One Cage, 560 mice, 448 hamsters, 224 rats, or 112 guinea pigs can be housed in a single rack. This represents up to a 273% increase in animal populations. (A facility housing 2,200 rats would require 37 racks housing 30 cages with 60 rats per rack *(based on old-style racks).* Compare this to 10 One Cage racks housing 224 rats per rack.)

You can house more rodents in less space while meeting interior cage height and floor space requirements.

Cleaning and handling multiple cage sizes, wire bar lids, filter

e™ System



The filter replacement device provides quick and easy exchange of filters. The clear plastic modular delivery system provides greater visibility of food and water for easy inspection.

With One Cage, you can:

- House more animals in less space at less cost.
- Be in full compliance with The Guide* and prepared for the arrival of new animal care policies.
- Streamline your work while improving your level of care.
- Simplify purchasing, cut down on inventory and reduce the number of turnaround units.
- Eliminate wire bar lids.

When you look at the options, there's no contest. It's One Cage.

tops, water bottles, and racks is extremely labor intensive and time consuming. With One Cage, you will no longer require multiple cage sizes and there are fewer components to deal with.

The Micro-Isolator SP™ Filter Top includes a cage lock with yellow indicator allowing you to see at a glance if it is properly secured to the cage. The wire bar lid is eliminated for faster cage changes.

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Introducing The One R

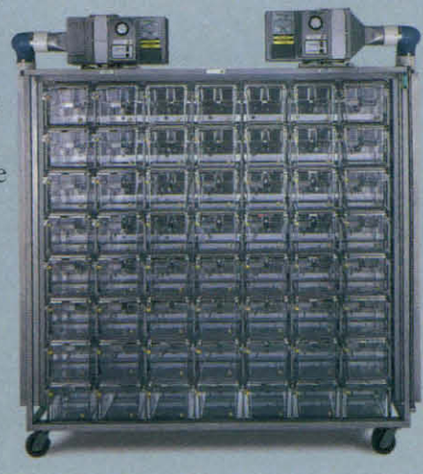
Are your animal rooms crammed with odd, assorted cages? Do you find it difficult to negotiate your way around? Are you losing precious time handling and cleaning outmoded equipment?

How would you like to house more animals per square foot, maximize available space, *and* comply with both the Animal Welfare Act and the ILAR Guide* recommendations? Would streamlining animal care and greatly reducing labor and costs make your job easier?

We have the answer: One Rack.™

Our One Cage™ High Density Housing System features a single, double-sided rack that can accommodate 112 units and house 560 mice, 448 hamsters, 224 rats, or 112 guinea pigs. *This represents up to a 273% increase in animal populations.*

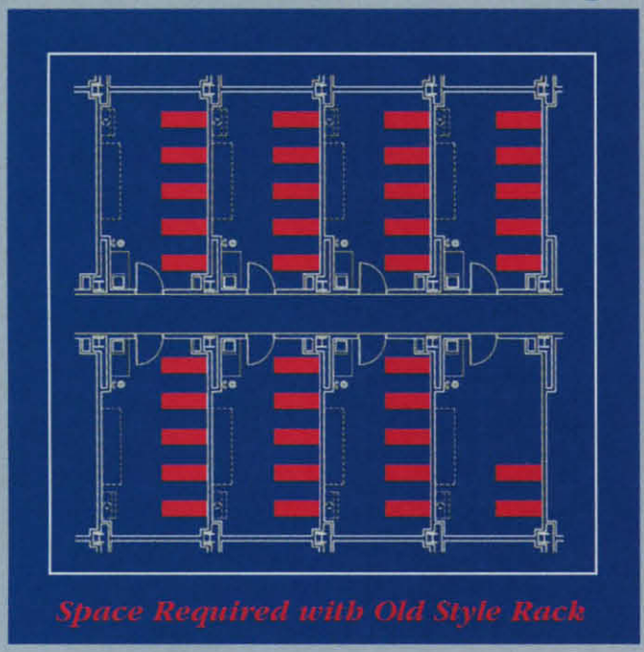
One Rack offers a dramatic impact on facility space: Normally, a facility housing 2,200 rats would require 37 racks housing 30 cages with 60 rats per rack (based on old-style racks). Compare this to 10 One Cage racks housing 224 rats per rack.)



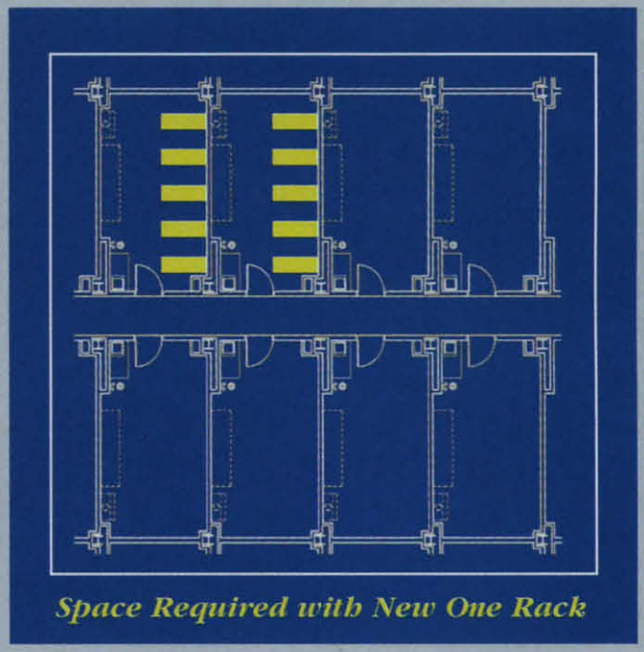
The One Cage™ High-Density Housing System.

*Based on the Animal Welfare Act of 1966 as ammended 1985 and the Guide for the Care and Use of Laboratory Animals, Institute of Laboratory Animal Resources, Commission of Life Sciences, National Research Council, National Academy Press, 1996.

Only ack™ System



Space Required with Old Style Rack



Space Required with New One Rack

The number of animal rooms required can be reduced from eight to two based on a plan of five racks per room.

With One Rack, you can house more rodents in less space, while meeting interior cage height and floor space requirements.

In addition, our environmental control system supplies HEPA filtered air into the cage and introduces a clear plastic canopy that functions as a hood, capturing air exiting the cage through the filter top. The cage is secured in the rack by a manual lock that provides visual indication the cage is secure.

One Cage™ and See-Through™ System
Lab Products also provides See-Through Racks featuring the One Cage and house up to 84 units per rack.

Each cage is suspended from a perforated shelf that serves as a cage cover. These mobile units are ideally suited for various biomedical research studies including toxicology, breeding and many others. With the new One Cage, our See-Through systems have become more flexible than ever.

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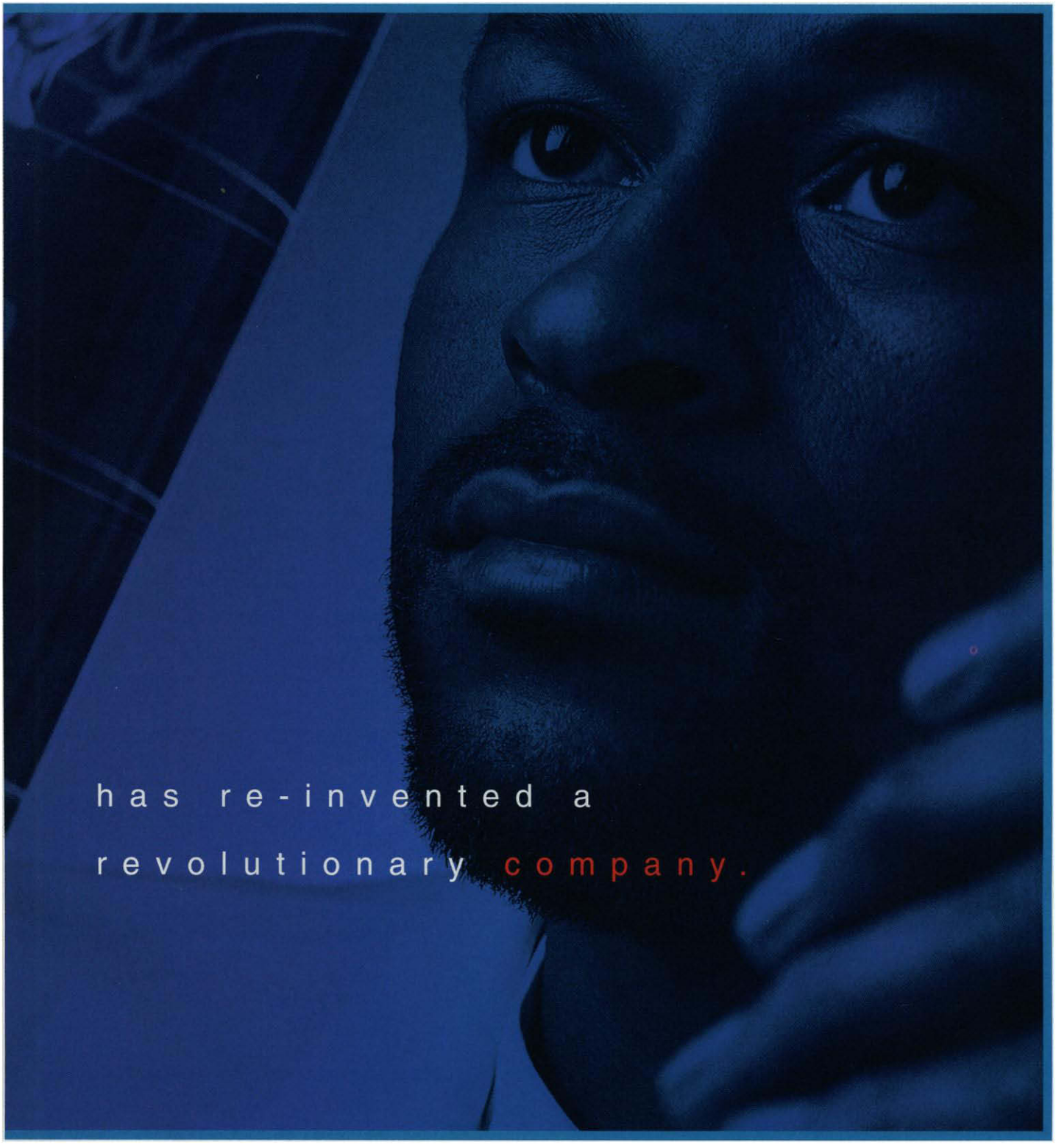

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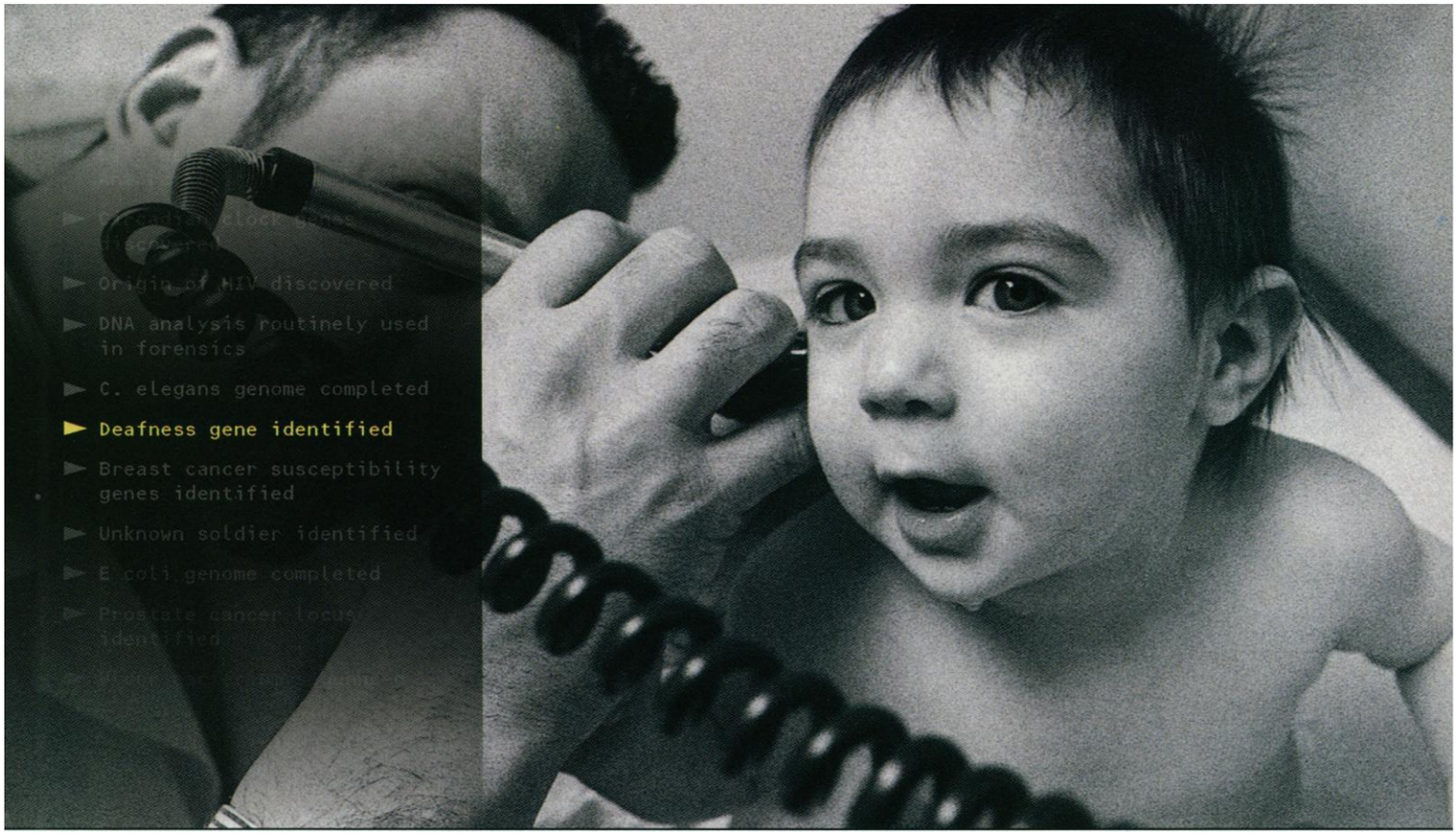

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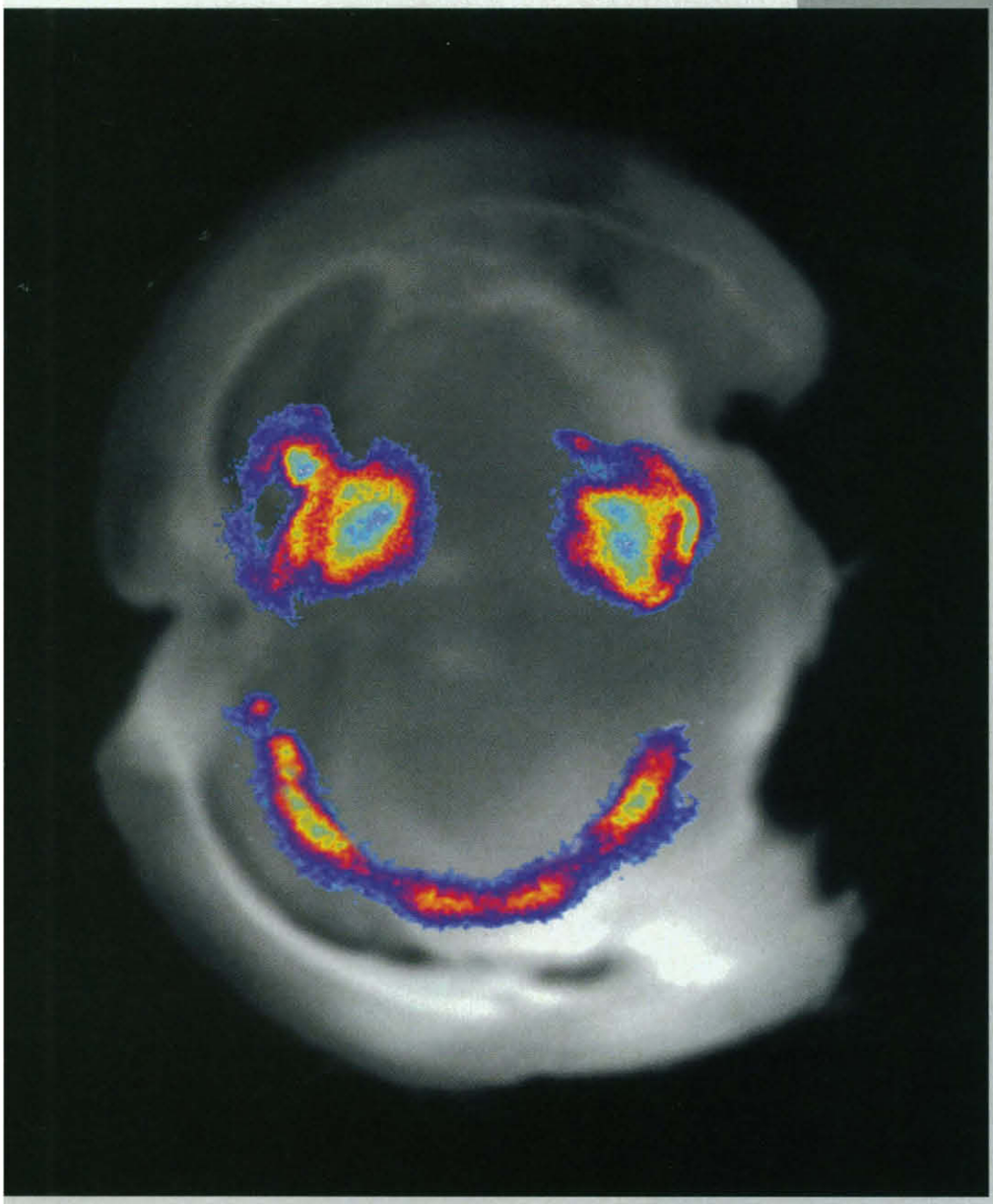

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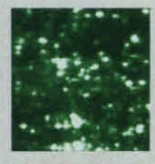

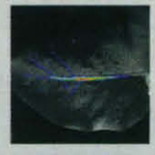

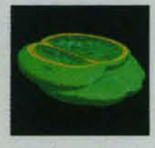

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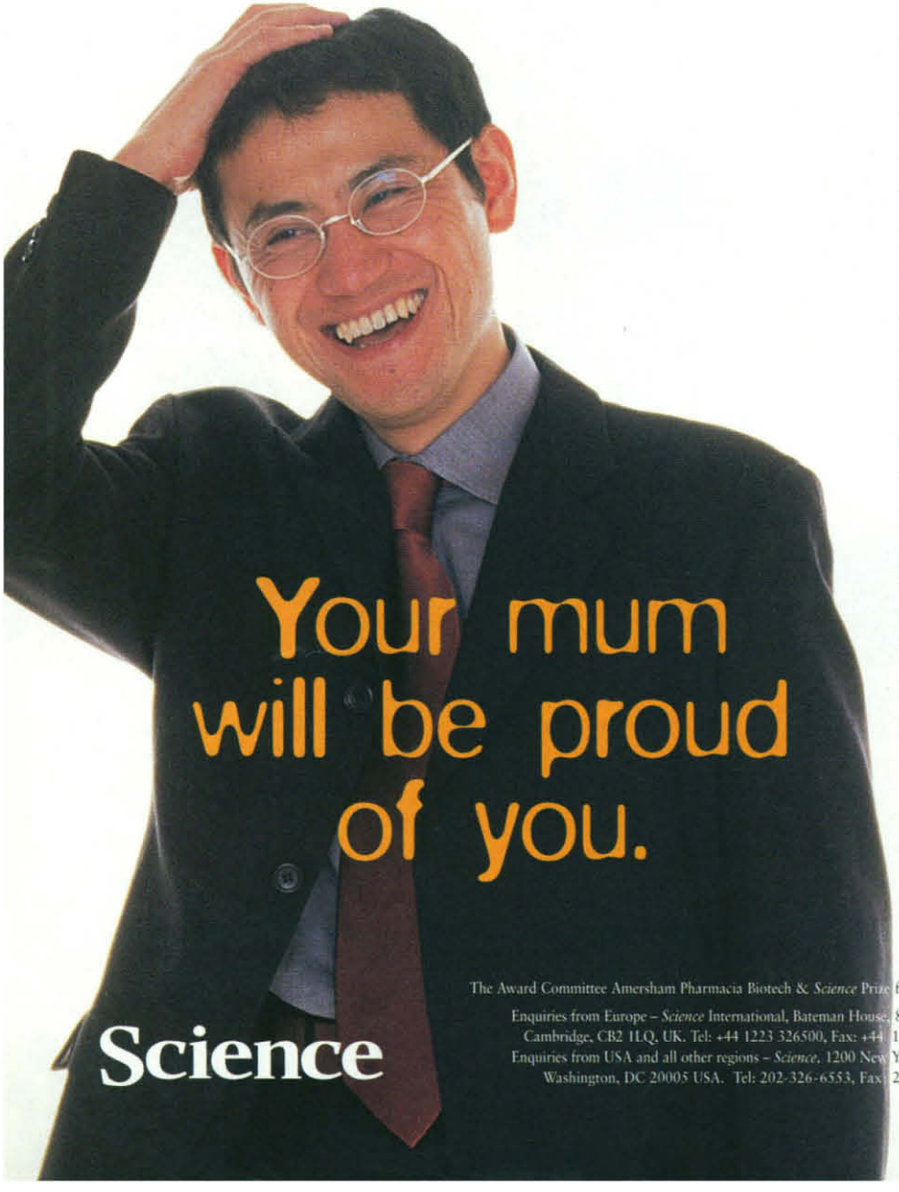

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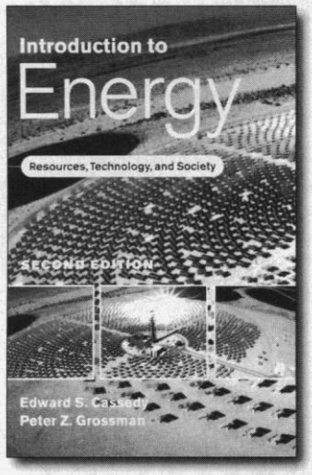

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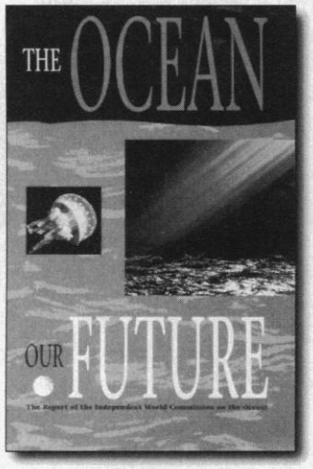

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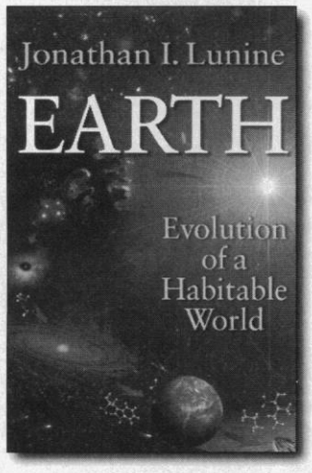

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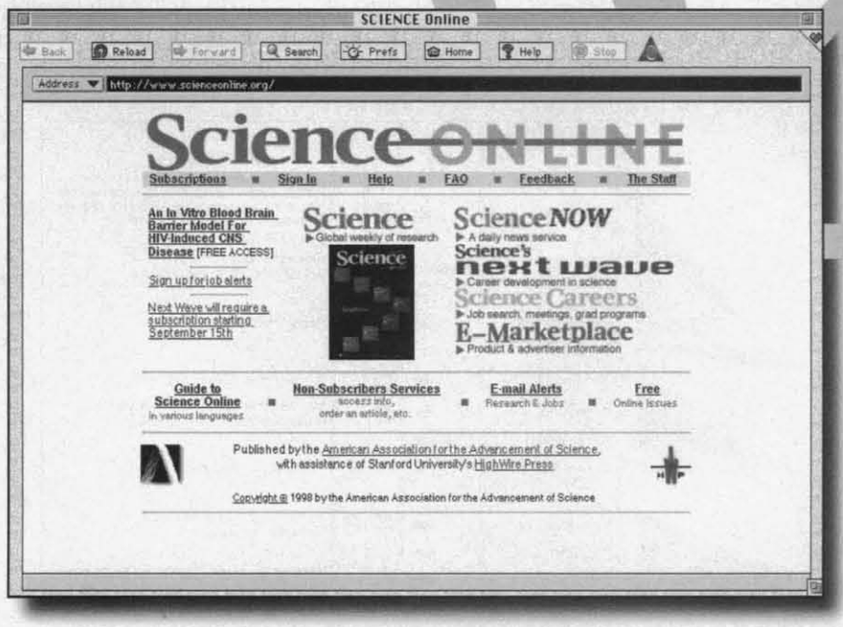

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