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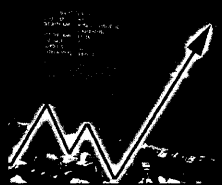

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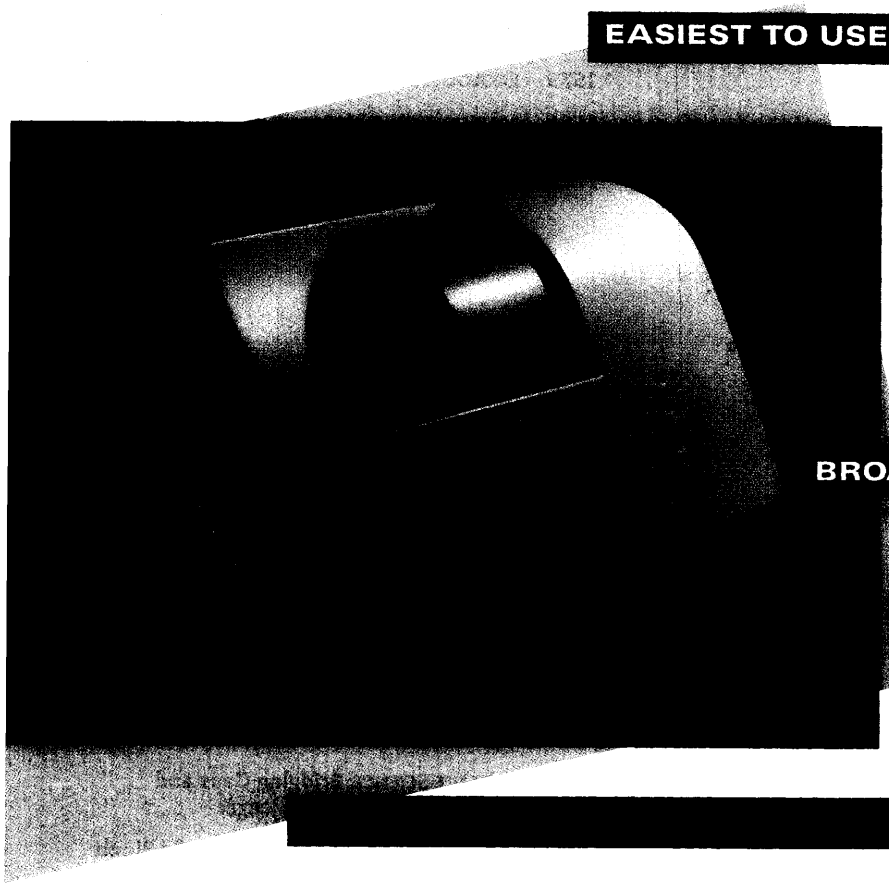

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Science

Volume 293 31 August 2001 Number 5535

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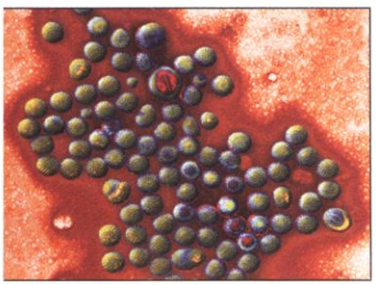


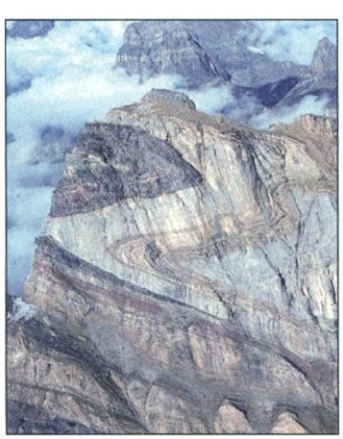
1576
Rotavirus vaccine redux

NEWS OF THE WEEK

NEWS FOCUS

1566
New vision for astronomy

SCIENCE'S COMPASS



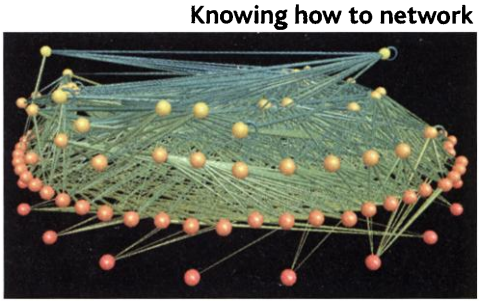
1597
Stressed rocks

POLICY FORUM

BOOKS *ET AL.*

PERSPECTIVES

1604
Knowing how to network

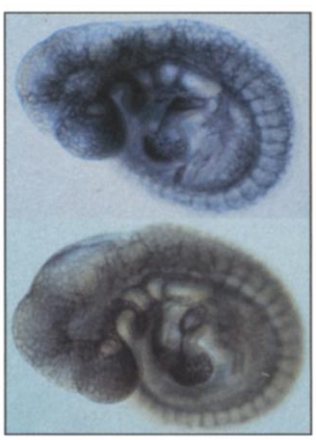


TRENDS IN UNDERGRADUATE EDUCATION

COVER 1607

The undergraduate experience is recognizable the world over, and from generation to generation. Yet there are also many changes afoot in science education, from better mentoring, to improved assessment, to a growing presence online. A special section discusses these trends. [Photo: Sam Kittner]

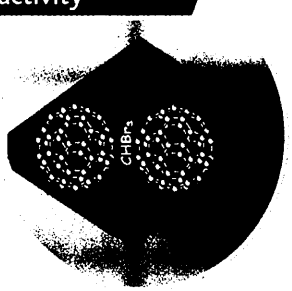
RESEARCH



1666

Coagulation and vascular development

New on *Science* Express Bromoform boosts C_{60} superconductivity



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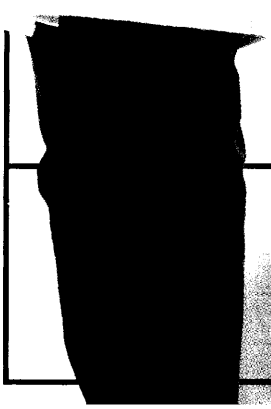

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High-Temperature Superconductivity in Lattice-Expanded C_{60}
▼ J. H. Schön, Ch. Kloc, B. Batlogg
1570 Field-induced doping of the expanded crystal lattice of the fullerene C_{60} gives a superconducting transition temperature of 120 K.

Phosphorylation-Dependent Ubiquitination of Cyclin E by the SCF^{Fbw7} Ubiquitin Ligase D. M. Koepp *et al.*

A conserved ubiquitin ligase controls cell proliferation through degradation of cyclin E.

Structure of Arp2/3 Complex in Its Activated State and in Actin Filament Branch Junctions N. Volkmann *et al.*

The Arp2/3 complex binds to the side of an actin filament.

TECHNICAL COMMENTS

Gene Duplication and Evolution

Two comments examine a study by Lynch and Conery (Reports, 10 Nov. 2000, p. 1151) that estimated the "birth rate" and half-life of gene duplications for several eukaryotic species over evolutionary time. Long and Thornton argue that the measure for duplicate-gene-pair age used in the study, substitutions per silent site (S), may not be "a suitable proxy," that the half-life calculation rests on the "untested, hidden assumption" of a constant long-term rate of gene duplication, and that analysis of the statistical data suggests alternatives to the interpretation of Lynch and Conery. Zhang *et al.* hold that the study's conclusions "are compromised by the fact that their data . . . included many redundant records" and raise several other issues. Lynch and Conery defend their use of S, note that the assumption of long-term rate constancy was "stated explicitly" and "was not relevant to our birth rate estimates," and address the statistical questions raised by Long and Thornton. They also "present some reanalyses . . . that take into consideration the concerns raised by Zhang *et al.*"

The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/293/5535/1551a.

science's stke www.stke.org

Perspective: The Torso Ligand, Unmasked? D. Stein and L. M. Stevens

Has the ligand of the transmembrane tyrosine kinase Torso finally been identified?

Perspective: Unzipping Ion Channels S. Nee MacFarlane and I. B. Levitan

Leucine zippers have been found in ion channel proteins. What are they doing there?

Review: Fungal Histidine Kinases J. L. Santos and K. Shiozaki

Multistep phosphorelays in yeasts.

science's next wave www.nextwave.org

Global: Special Focus on Undergraduate Education

To tie in with this week's *Science* special feature, Next Wave highlights our many resources (including an online forum) for undergraduate students and educators.

UK: Connecting People K. Urquhart

Six new pilot projects aim to test the concept of "grid computing," which could allow geographically remote scientists to work together.

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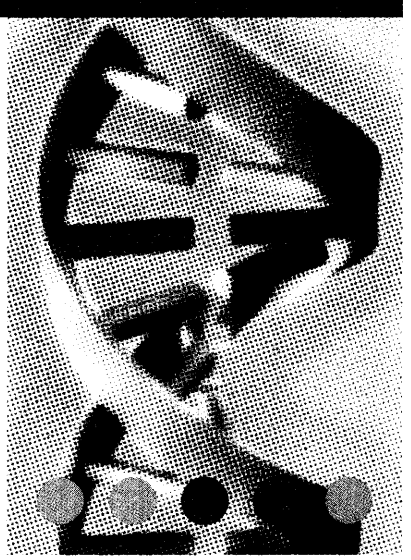

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THIS WEEK IN Science

edited by Phil Szuromi

Source of Galactic Plane Plasma

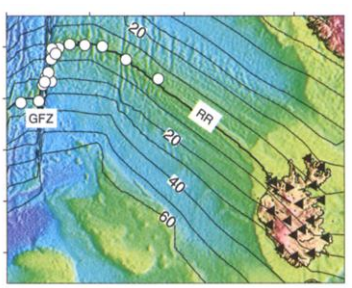
Hard x-ray emissions from the Galactic plane of the Milky Way form a ridge-like structure. The hard x-rays are from ionized elements such as silicon, sulfur, and iron, and the source of this plasma has been a mystery. Ebisawa *et al.* (p. 1633; see the news story by Irion) completed a deep and high-resolution x-ray survey of part of the Galactic plane using the Chandra X-ray Observatory and found 36 new point sources. The majority of these point sources are extragalactic, and thus the diffuse plasma is not from Galactic sources. Instead, the authors suggest that supernova remnants may be the source consistent with theoretical models for producing this extremely high-temperature, high-density plasma.

▼1639 Lighting a Route to Hydrogen Production

In principle, it should be possible to create small molecules that catalyze the conversion of their hydrogen-containing solvents into H_2 in the presence of sunlight without relying on any heterogeneous mediators. Heyduk and Nocera (p. 1639; see the Perspective by McCusker) show that a dirhodium compound dissolved in pure hydrohalic acids (HX, such as condensed HCl with no water present) can photogenerate H_2. In the catalytic cycle, ultraviolet (UV) light removes a CO ligand so that HX can bind in a two-electron step to create a mixed-valence Rh^0–Rh^{II} species. Two of these molecules react to add an additional HX and then to liberate H_2. Finally, UV light eliminates X^- to regenerate the catalyst. This system is still short of the goal of photoproduction of H_2 from H_2O, but it shows that important steps, such as halide removal, can be catalyzed by two-electron processes.

Buoyant Reykanes Ridge

Iceland sits atop a hot spot plume and a slow spreading mid-ocean ridge. The intersection of these two magmatic systems provides a natural laboratory to study plume-ridge interactions. Gaherty (p. 1645) studied the difference in the travel time of vertically-polarized Rayleigh waves versus transversely-polarized Love waves along the Reykanes mid-ocean ridge, just south of Iceland (and the center of the hotspot plume). The Love waves traveled more slowly than the Rayleigh waves, a difference attributed to an extended region of vertical flow along the ridge created by the plume. Thus, the enhanced buoyancy and magmatism along the Reykanes Ridge is a consequence of the hotspot plume.



CREDIT: GAHERTY

All Patterns Great and Small

The interaction of chemical reactions and molecular diffusion can create reaction fronts on length scales far larger than the molecules themselves. Sachs *et al.* (p. 1635; see the Perspective by Jaeger) have now visualized reaction fronts at the atomic scale for the oxidation of hydrogen on the (111) surface of platinum. Scanning tunneling microscopy revealed that an underlying autocatalytic process, which generates diffusing OH, affects patterns that form on the scale of tens of nanometers. Modeling studies show that a simple reaction-diffusion model cannot quantitatively describe the results and that more complex interactions between surface species need to be taken into account.

The Grass That Grows

It has been proposed that atmospheric CO_2 has been the dominant influence on the relative abundance of C_3 plants, such as trees, and C_4 plants, such as grasses, in the geologic past. These two types of plants are distinguished by their use of different photosynthetic pathways, and they respond differently to higher or lower CO_2 concentrations. Huang *et al.* (p. 1647; see the news story by Kerr) examine the generality of this proposal by comparing two lake sediment cores from Mesoamerica. They find that moisture variations over the past 25 thousand years have had a large effect on the expansion and contraction of C_4 species, and that the two sites have responded differently depending on the climatological control of aridity. These results indicate that compiling C_4 plant histories based solely upon CO_2 concentrations overlooks an important variable.

Information with a Twist

DNA microarrays show tremendous power for yielding information. By sorting on the basis of fluorescent protein expression, Furlong *et al.* (p. 1629) acquired enough biological material to do DNA microarray analysis on *Drosophila* embryos of known developmental stages and known mutant status. With a particular view toward mesoderm development, the data yield information on hundreds of genes that are turned on and off during normal mesoderm development, seemingly orchestrated by a particularly important transcription factor, Twist. Analysis of embryos lacking Twist and embryos overexpressing Twist, when compared to expression profiles from normal embryos, leads to insights into the function of individual genes as well as groups of co-regulated genes.

Ubiquitin Stimulation of Transcription

The herpes simplex virus transcription factor VP16 has long been studied for its ability to activate transcription. Similar to other transcription activators, VP16 has a transcription activation domain that overlaps with a domain that signals its degradation. Is there a mechanistic link between transcription and proteolysis? Salghetti *et al.* (p. 1651) show that in yeast the Met30 subunit of a ubiquitin ligase is not only required for the ubiquitin-proteasome pathway but is also required for transcriptional activation by VP16. The process of transcription activation was separated from proteolysis by artificially ubiquinating VP16. Ubiquitin may be fulfilling this additional role, separate from that in protein degradation, by recruiting the proteasome.

Published online in *Science* Express

CONTINUED ON PAGE 1555

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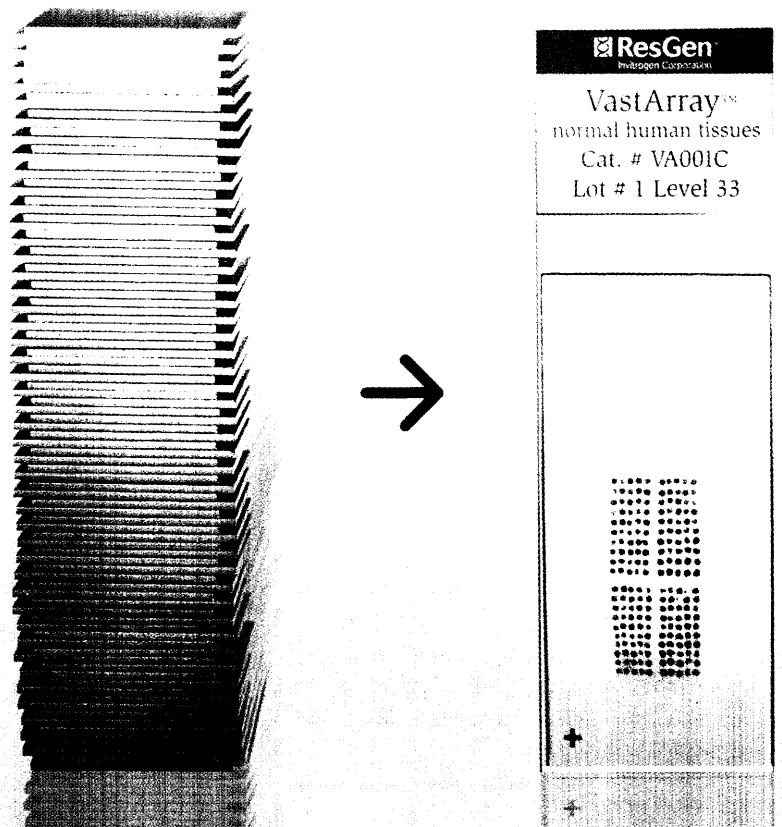

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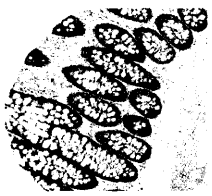

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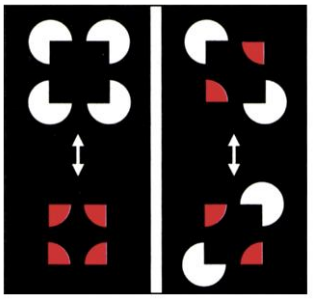
Afterimages and Illusions



At what stage in the visual pathway does the production of afterimages with illusory filling-in occur? Shimojo *et al.* (p. 1677) tried to dissociate this type of afterimage from traditional afterimages that are thought to occur within the retina due to bleaching of photoreceptors. They observed a clear dissociation of aftereffects associated with illusory filling-in from those associated with actual stimuli, and they conclude that the former has a cortical rather than a retinal locus.

Maintaining Fluid Homeostasis

Natriuretic peptides are hormones that are involved in the regulation of fluid balance, with particular relevance for cardiovascular function and blood pressure. This family of peptides is recognized by a family of cell surface receptors (NPR-A, -B, and -C). He *et al.* (p. 1657) have determined the crystal structures of the extracellular portion of NPR-C with and without natriuretic peptide C bound. One molecule of the peptide binds to a receptor dimer; binding appears to close the cleft between the monomers.

Extracellular Signaling Pathways

Heparan-sulfate proteoglycans (HSPGs) are important mediators of extracellular signaling by Wnt, Fgf, and hedgehog proteins. Dhoot *et al.* (p. 1663) identify a member of a family of conserved sulfatases, QSulf1, which is responsive to *Sonic hedgehog* (*Shh*) signaling in the somite and neural tube. However, Qsulf1 does not function directly in the *Shh* signaling pathway. Instead, HSPG mediates Wnt signaling during avian myogenesis. This work connects heparan sulfate proteoglycans (HSPGs) to signaling events in cell fate determination and identifies a sulfatase enzyme as a signal modulator.

Strengthening Blood Vessels

After an injury, the coagulation cascade goes into action to repair damaged tissue. When coagulation factors are eliminated in mouse embryos, they die at mid-gestation and display extensive bleeding. Whether this is a result of defective platelet function or vascular defects has been unclear. Griffin *et al.* (p. 1666; see the Perspective by Carmeliet) have addressed this question by examining the role of Par1, a G protein—coupled receptor that binds to and is cleaved by thrombin, a serine-protease coagulation factor. Par1 is shown to be an endothelial factor and is needed for normal vascular development and integrity.

Sweet View of Heart Development

Cardiac valves are essential for normal heart function. Formation of the atrioventricular valve in the developing vertebrate heart involves complex but poorly defined signaling interactions between myocardial and endocardial cells at the boundary of the atrium and ventricle. Walsh and Stainier (p. 1670) provide molecular insight into this process through their analysis of a zebrafish mutant called *jekyll*, which is severely defective in the initiation of heart valve formation. The mutated gene encodes UDP-glucose dehydrogenase (UGDH), an enzyme required for production of hyaluronic acid and proteoglycans. Loss of UGDH appears to disrupt the events that mark the valve-forming region as distinct from atrium and ventricle.

Aspirin for Diabetics

Resistance of cells to the actions of insulin is a prominent feature of type 2 diabetes. As early as 1876, reports emerged that high doses of aspirin could help decrease concentrations of glucose in the blood of diabetic patients, an action that could reflect enhanced insulin action in target cells. Yuan *et al.* (p. 1673) are finally able to provide a mechanism that may explain this effect. Their studies show that aspirin in high doses inhibits the protein kinase IKKβ, which mediates the actions of pro-inflamatory cytokines. Furthermore, heterozygous mice that had lost one allele encoding IKKβ were protected against insulin resistance when fed a high-fat diet. Thus, IKKβ may be a useful target for therapeutic agents designed to ameliorate insulin resistance.

CREDIT: SHIMOJO *ET AL.*

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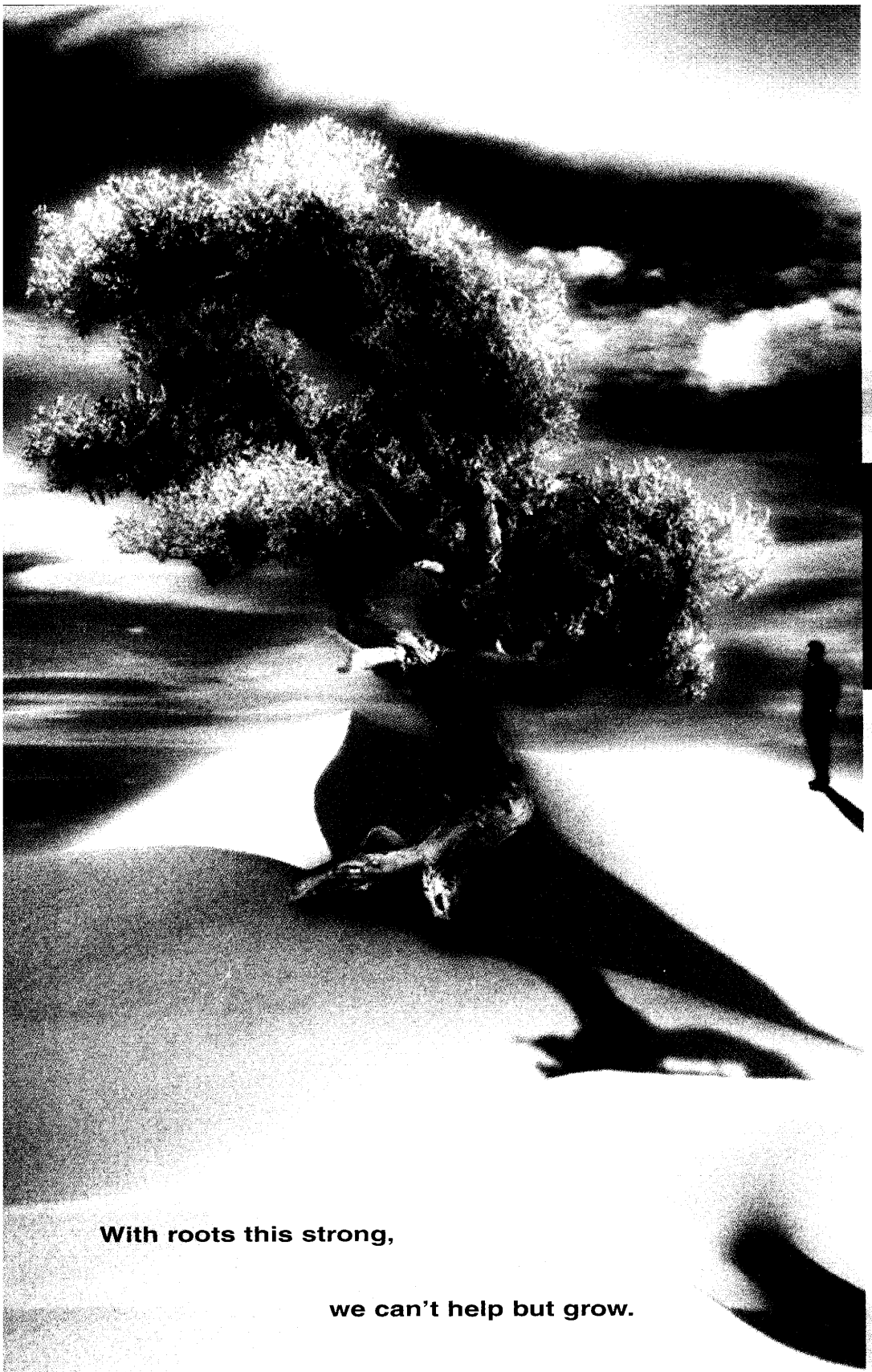

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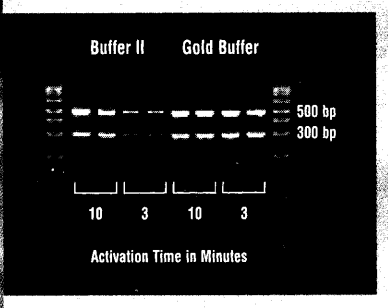

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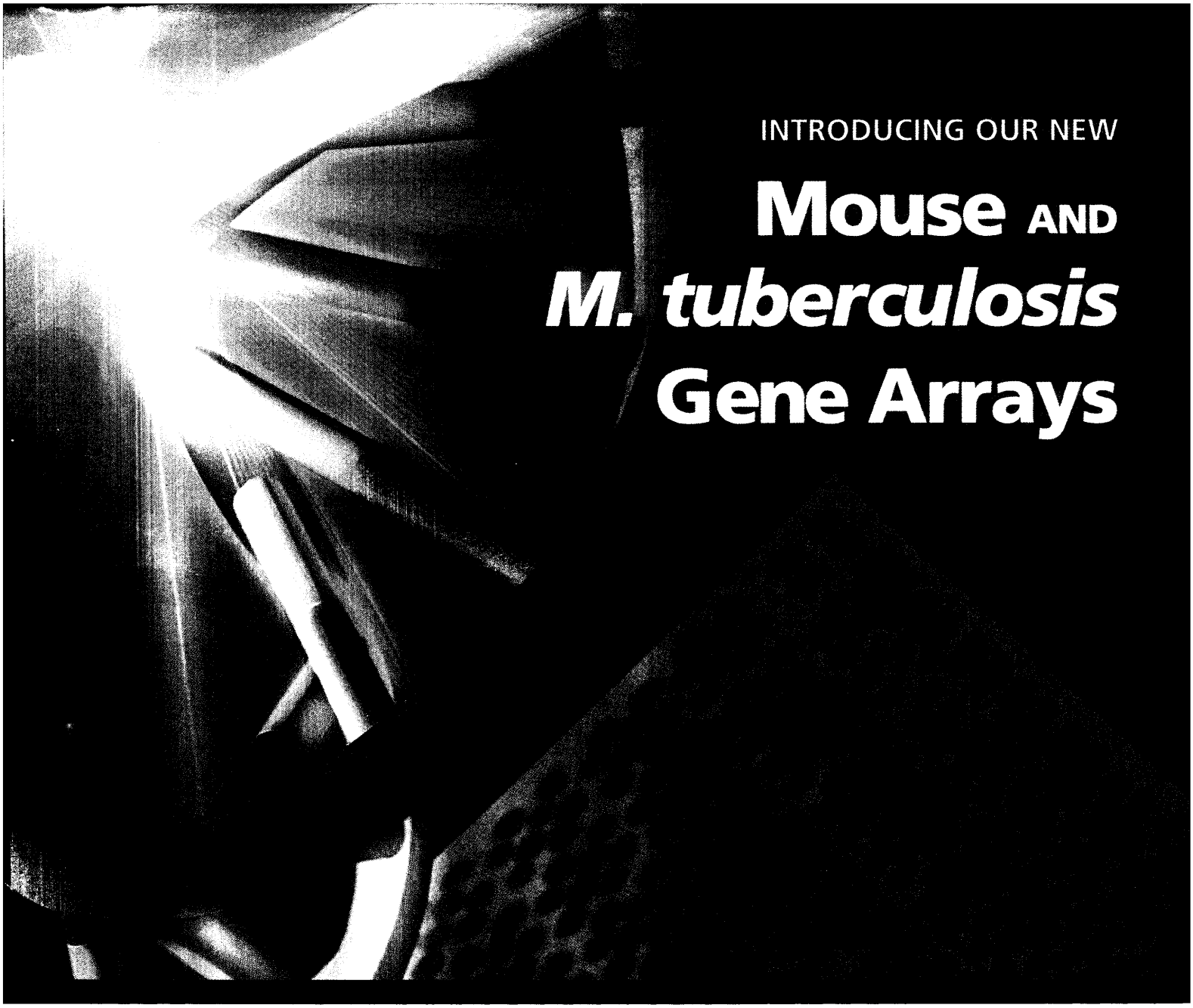

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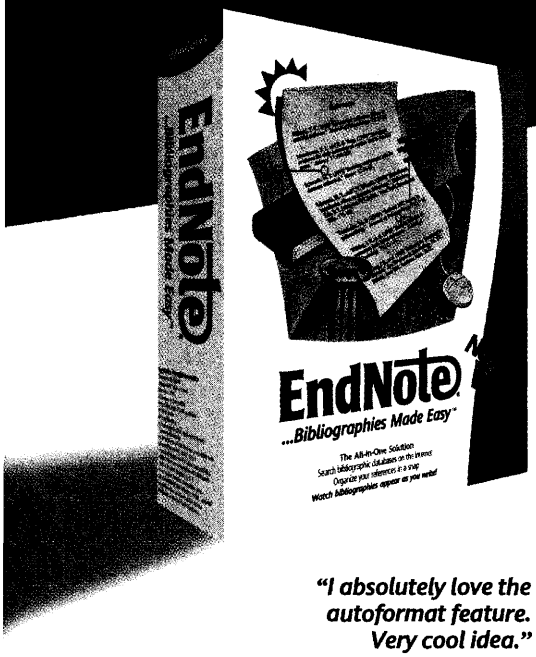

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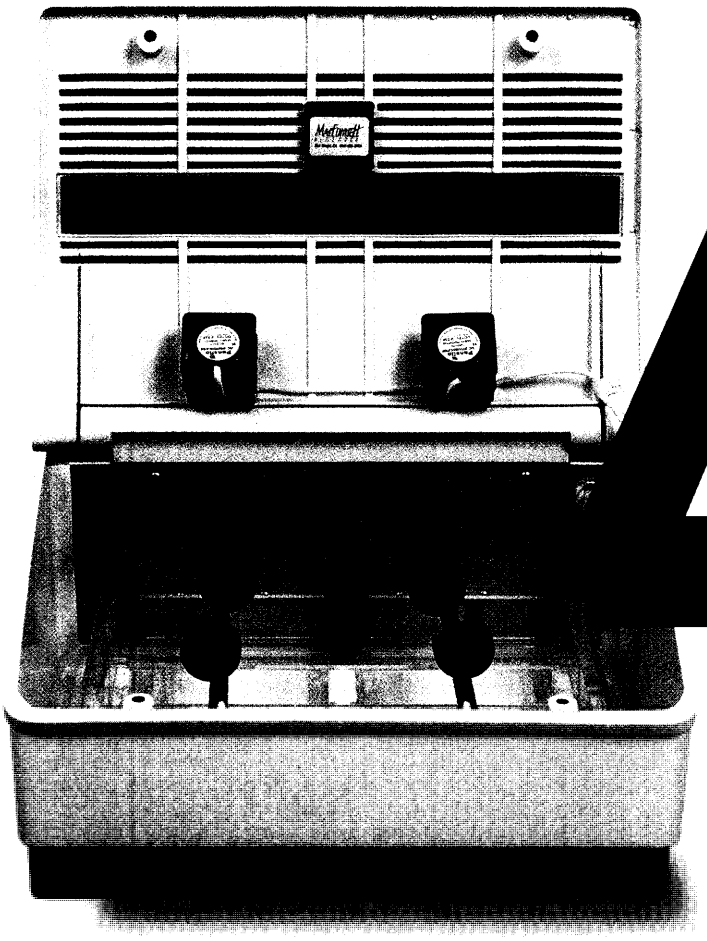

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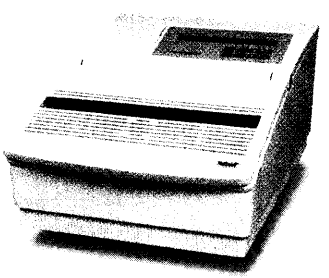

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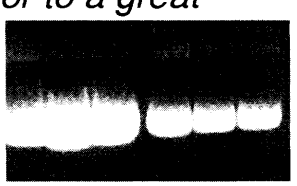

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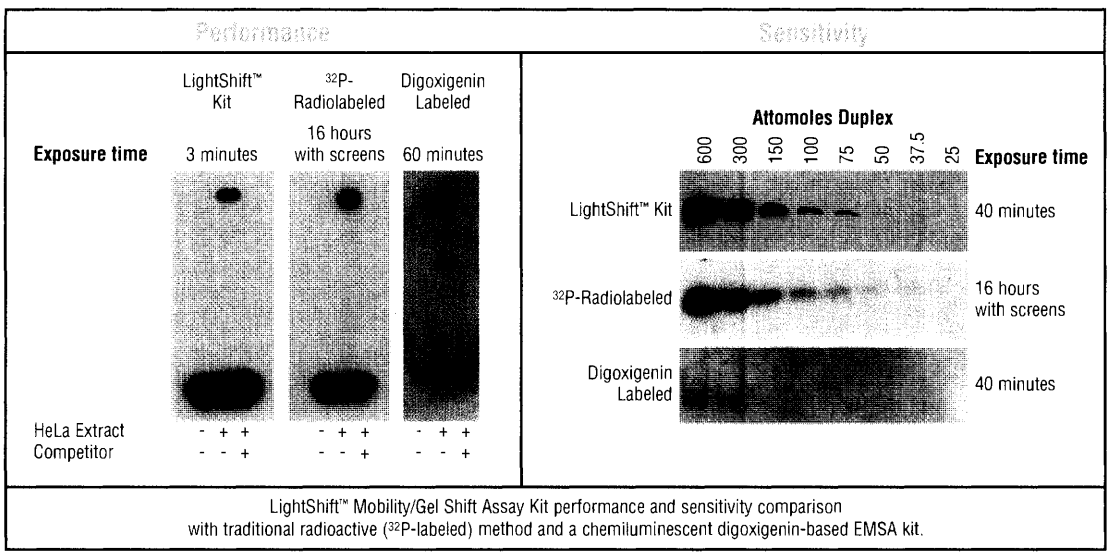

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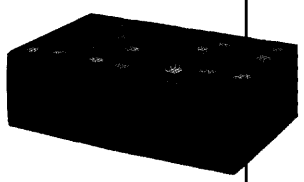

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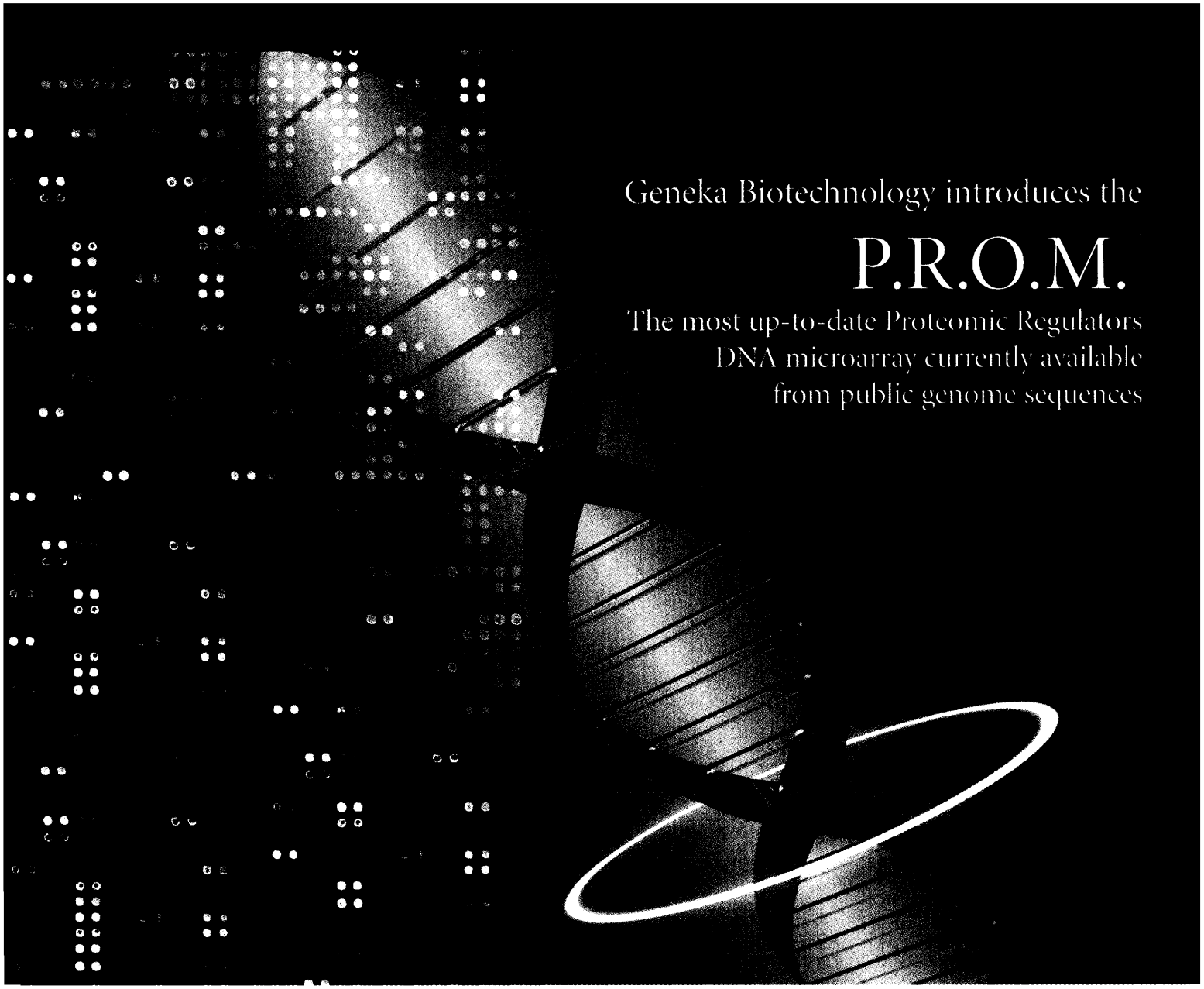

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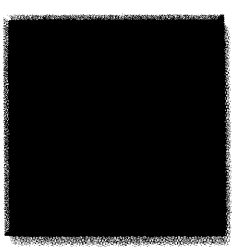

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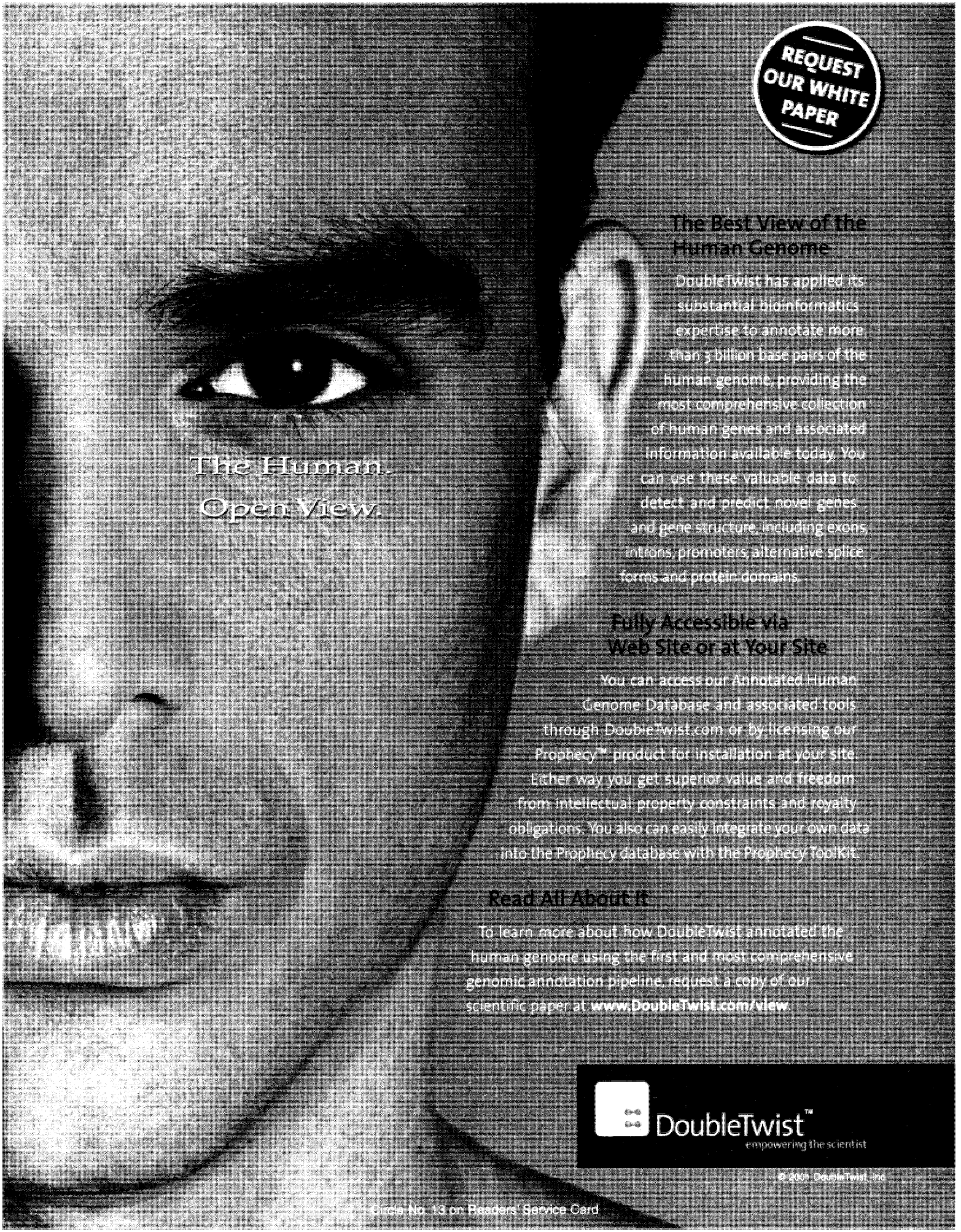
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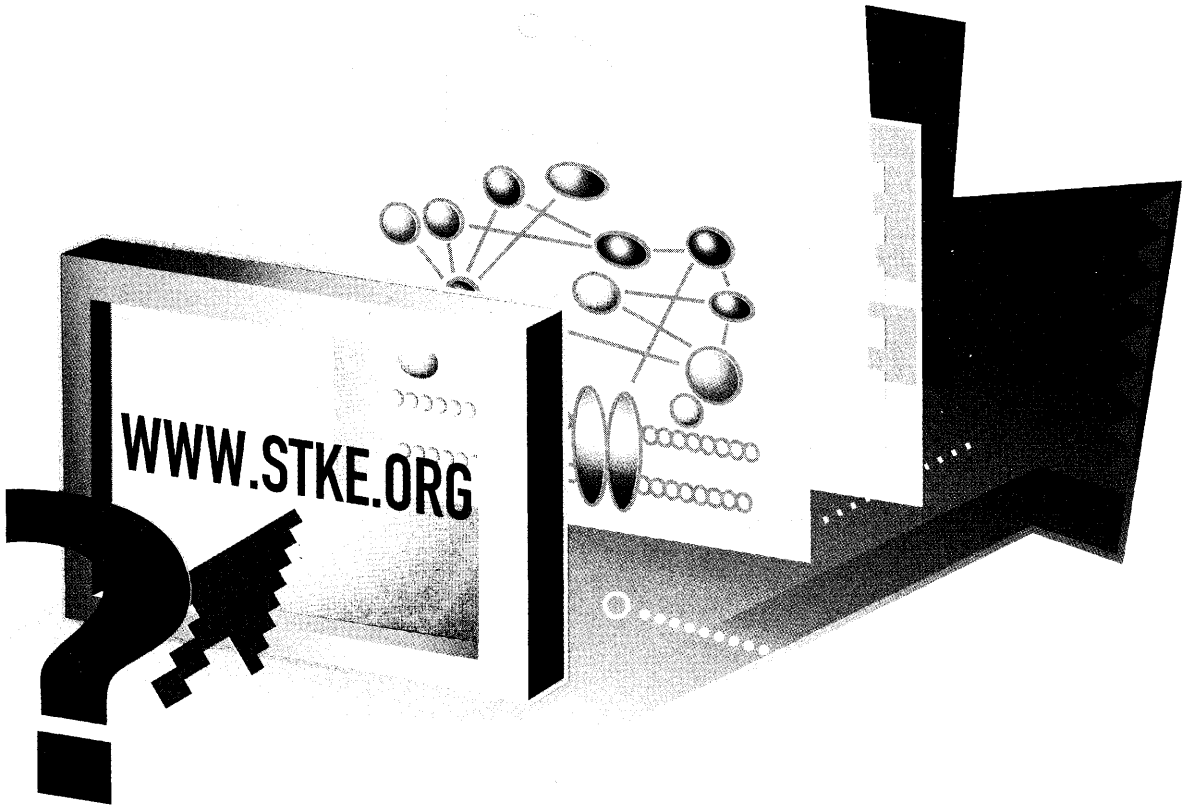

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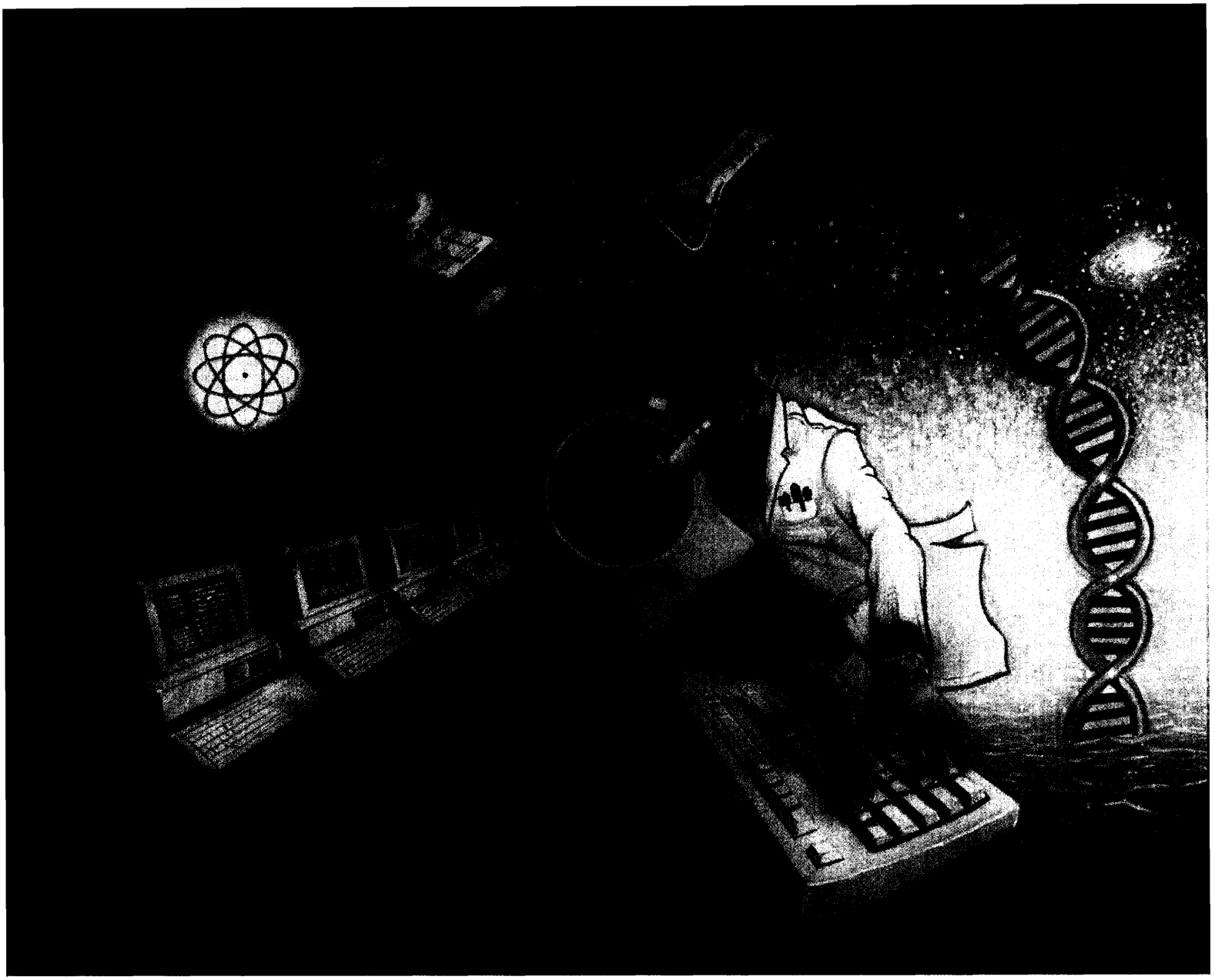

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Science's Next Wave is a weekly online publication dedicated to career development and job market trends for early career scientists. All of the articles, written by experts and role models from the international scientific community, seek to prepare Next Wave readers for today's ever-changing employment market.

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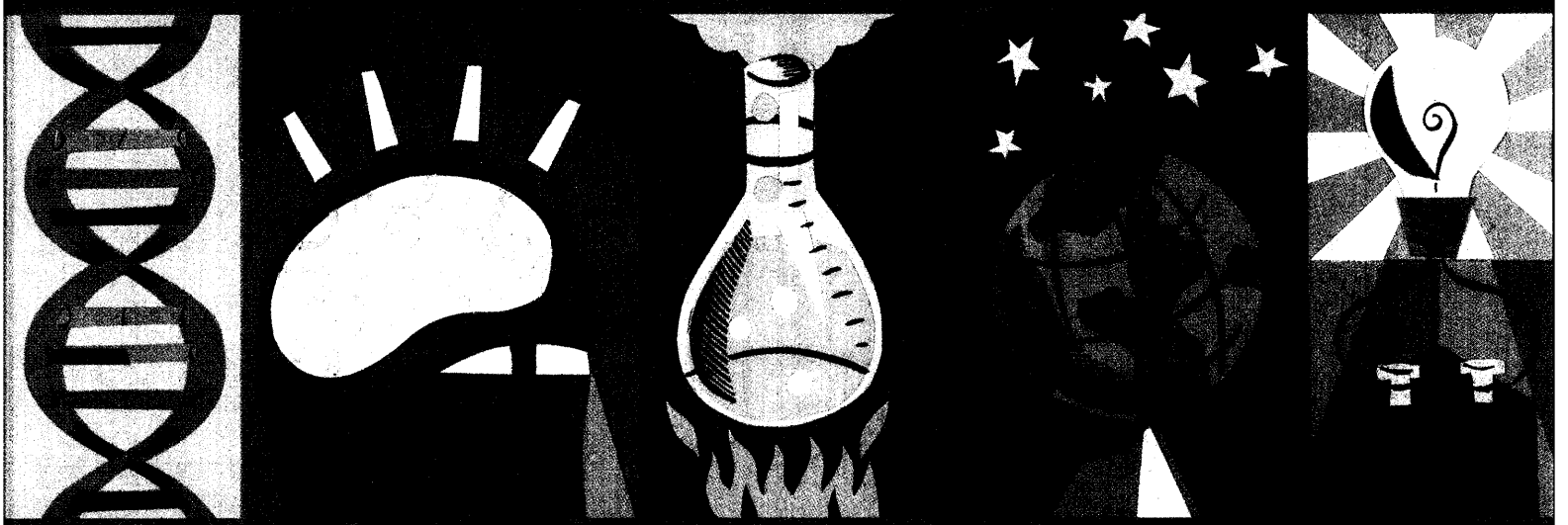
Call for Posters

Submission Deadline:
8 November 2001



AAAS Annual Meeting and Science Innovation Exposition

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The AAAS Poster Session

- Provides the opportunity to present your research and update meeting attendees on new scientific developments
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AAAS

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NEW PRODUCTS

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EYEING 3D

For many years, stereo visualization hardware has been available for UNIX-based systems, but it is only now appearing for personal computers. Stereo visualization works by continuously switching between two screen images of the same object as seen from slightly different angles. When the flashing image is viewed through a pair of glasses that obstructs sight one eye at a time in conjunction with the screen changes, the user perceives a three-dimensional (3D) screen image.

The StereoGraphics CrystalEyes system is considerably improved from earlier versions. Its glasses are lighter and better balanced. The enhanced battery life permits up to 250 hours of continuous use, and the battery charge indicator light is a welcome addition. The view from the lenses is unrestricted, and the dynamic range between the "on" and "off" states is large, resulting in a crisper 3D representation than with older systems. Glasses can be used up to 20 feet from the monitor.

Under Windows 98, hardware installation is easy. The emitter plugs into the keyboard output for power, and a small stereo enabler fits between the graphics card and monitor cable. The CD that accompanies the hardware contains trial programs and plug-ins. For Windows 2000 and NT, a stereo-enabled graphics card is necessary. The range of software supported is large and covers over 60 programs, including most major mechanical design, computer-aided design (CAD), molecular modeling, and virtual reality programs. Plug-ins are available for some products that do not support 3D visualization by default.

The emitter is too large to place on top of a standard monitor and will not rest on top of a thin-film transistor (TFT) flat screen. A possible solution would be the inclusion of an attachment pad to fix the emitter to the monitor. The emitter can be automatically activated by the software. Because the screen constantly changes from one view to another, the refresh rate of the 3D image is half the standard refresh rates. Therefore, one would need to use a high refresh rate monitor setup so that the 3D image does not flicker. Refresh rates with a mid-level graphics setup under Windows 98 are high enough that screen flicker is not problematic under normal use. Windows 2000 stereo-enabled graphics cards allow high refresh rates, but at an increased cost.

CrystalEyes is a considerable improvement on the previous versions in software and operating system compatibility and also in comfort and ease of use. A drawback is that drivers for Windows 98 graphics cards are available, but only the more expensive, stereo-enabled graphics cards under Windows 2000 or NT are supported.

—Pedro Lahoud

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INTEGRATION AND RETRIEVAL SYSTEM

The BioRS system is a high-speed, sophisticated search and retrieval system for biological information, such as DNA sequences. The speed and flexibility of the system can facilitate gene discovery projects, including genomics, proteomics, and drug targeting. The system enables researchers to quickly and efficiently retrieve all known biological data on a given topic, independent of the size of the database or the complexity of the query. A new version provides researchers instant access to multiple biological data sources, including in-house proprietary databases. The BioRS system makes use of convenient Web interfaces and standardizes data formats from differenet databases through the use of eXtensible Markup Language (XML). It works efficiently with both flat-file and relational databases, and makes it easy for any organization to integrate its own proprietary database.

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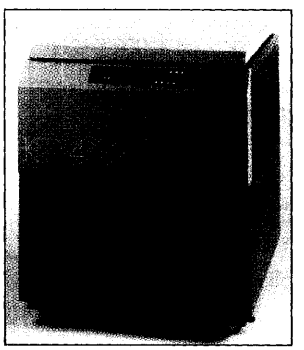

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All 4289 genes of *Escherichia coli* are represented on the Pan *E. coli* Array through the use of a 1 gene/1 oligonucleotide method, in which each bioinformatically designed oligonucleotide is 100% gene-specific and thus guaranteed to identify the gene for which it was produced.

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The NanoDrop ND-1000 Spectrophotometer makes ultraviolet/visible spectrophotometry easy and accurate for one microliter samples. NanoDrop technology eliminates cumbersome cuvettes and capillaries. The user simply pipettes the sample directly onto the measurement surface. Using surface tension, the sample is drawn into a column between the ends of two optical fibers creating the measurement path. After measurement, the user simply wipes the sample off and loads the next sample. The sample handling mechanism is integrated with a xenon flash lamp and charge-coupled device array to achieve a photometric range of 0.02 to 50 absorbance from 220 to 750 nm. This unit is suitable for measuring nucleic acid sample concentration and quality from 1 ng/μl to 3000 ng/μl (without dilu-

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tion) and for measuring microarray sample fluorescent dye labeling density. It is operated over a USB connection to a computer running Windows 98, ME, or 2000.

Applied Scientific Instrumentation
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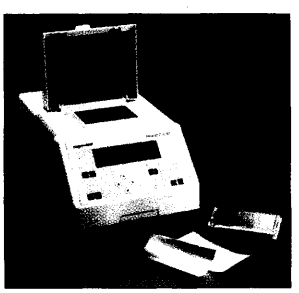
The Mastercycler 384 thermal cycler combines tried and tested features with new qualities. It has been optimized for use in the modern high-throughput lab and is particularly useful for polymerase chain reaction (PCR). The new thermal block is designed for 384-well microtiter plates. Its geometry, adapted to the shape of the test tubes, ensures that the walls of all 384 tubes are in close contact with its metal walls. This not only accelerates thermal transfer to the sample, but also increases the homogeneity and reliability of the results. A special cover design optimizes sample handling: The lid is heated, which effectively prevents condensation in the upper areas of the tube. It is kept pressed on by a sophisticated mechanism that solves the problem of evaporation. A defined sealing force ensures that the microtiter plate is always securely sealed for running PCR. A gradient PCR option is designed to increase efficiency in high sample capacity.



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LITERATURE

U.S. EPA Method 8270 for Multicomponent Analyte Determination is a six-page application note that highlights the use of gas chromatography/mass spectrometry (GC/MS) for this analysis, detailing the benefits of the AutoSystem XL GC and the TurboMass MS. This combination of quantitative sensitivity and large volume injection affords the analyst an attractive alternative to dual column electron capture detector analysis for the measurement of multicomponent analytes. The application note includes extensive charts and graphs to delineate the analytical conditions, detection limits, linearity, accuracy, and precision data of the GC/MS technique.

Newly offered instrumentation, apparatus, and laboratory materials of interest to researchers in all disciplines in academic, industrial, and government organizations are featured in this space. Emphasis is given to purpose, chief characteristics, and availability of products and materials. Endorsement by *Science* or AAAS of any products or materials mentioned is not implied. Additional information may be obtained from the manufacturers or suppliers named by circling the appropriate number on the Reader Service Card and placing it in a mailbox. U.S. postage is free.