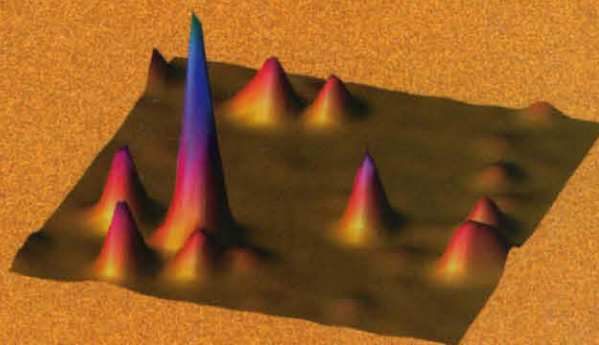
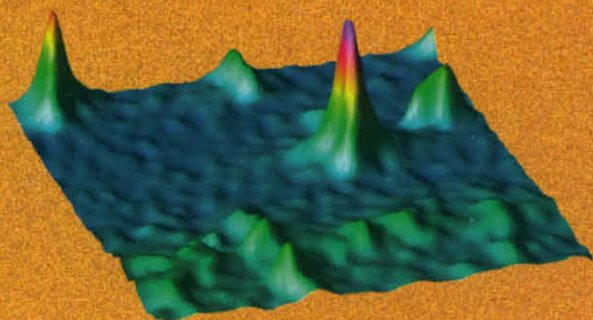


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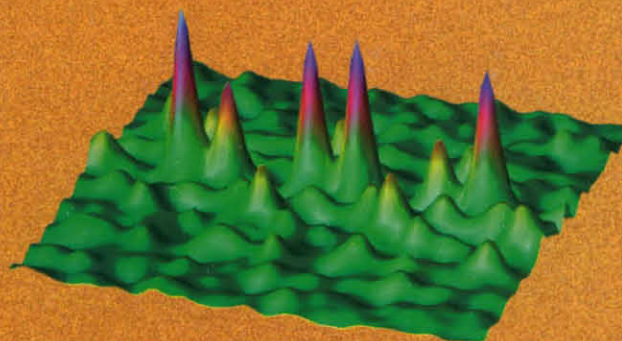
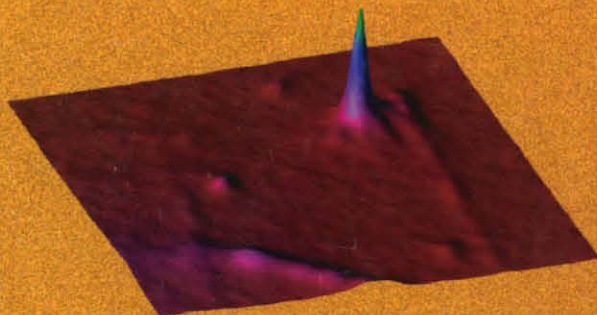
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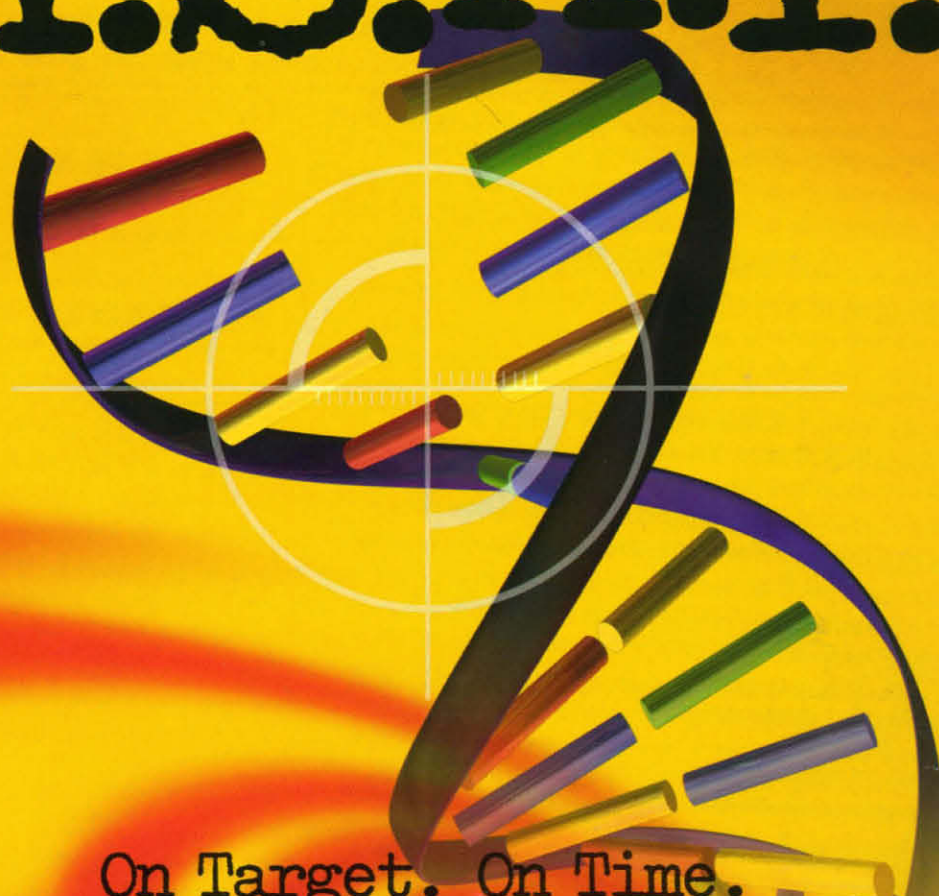
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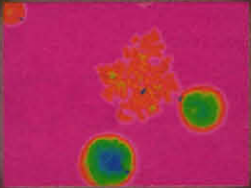
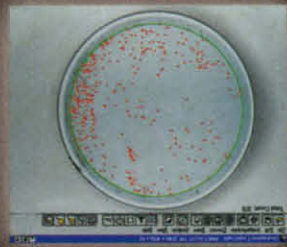
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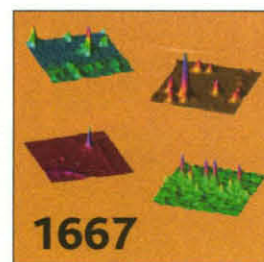
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COVER Optical images of single molecules. Clockwise from upper left. Frequency-space: pentacene in *p*-terphenyl at 2 kelvin (K). Confocal: protein kinase A regulatory subunit in agarose gel, 295 K (room temperature). Total internal reflection: green fluorescent protein in polyacrylamide gel, 295 K. Far-field epifluorescence: terrylene in *p*-terphenyl, 2 K. Special section topics begin on p. 1667. [Images: W. E. Moerner, W. P. Ambrose, S. Brasselet, J. Deich, R. M. Dickson, D. J. Norris, S. S. Taylor]



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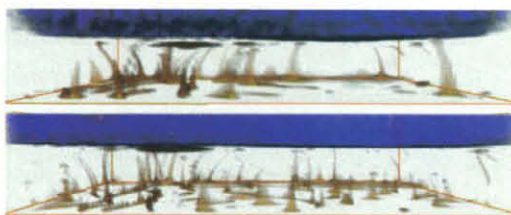
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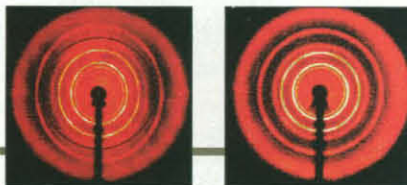
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Wings become legs

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HOTTER THAN EXPECTED

How hot is Earth's interior? Heat flow from Earth can be measured accurately, but only rough estimates of its internal temperatures have been made; for example, some estimates of temperatures at the base of the mantle differ by 500 to 1000 kelvin. Internal temperatures depend both on the heat flow and the thermal conductivity, which varies greatly with mineralogy, pressure, and temperature. Because there are only a few experimental determinations of the thermal conductivity at the relevant conditions, theoretical estimates must fill the gap. Hofmeister (p. 1699; see the Perspective by Anderson) develops a new theory for determining thermal conductivity at high pressures and temperatures based on consideration of the lattice phonon and radiative contributions. The theoretical measurements fit available infrared data of relevant minerals and imply that Earth's interior is hotter by about 500 kelvin than most current models.

ELECTRON INTERFEROMETER

The thickness of the cavity in an optical interferometer is on the same scale as that of the wavelength of the incident light. When an integer number of wavelengths fit into the cavity, constructive interference occurs and a peak in the transmission results. The ability to grow perfect silver thin films up to 100 monolayers in thickness, which is the same length scale as the electron wave function, has allowed Paggel *et al.* (p. 1709; see the Perspective by Himpfel) to create an interferometer for electrons. Photoemission spectra from the metal "cavity" can be analyzed in much the same way as in an optical interferometer and yield a wealth of information about the fundamental electronic properties of the metallic film.

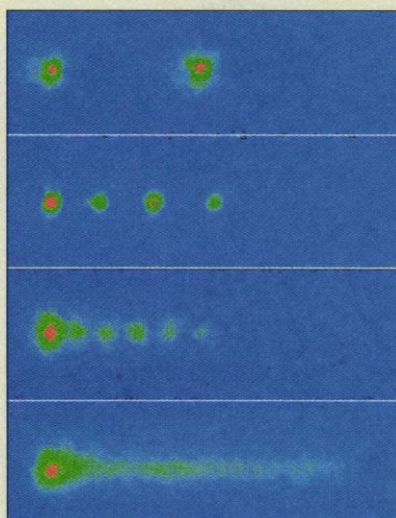
CO₂ COMPLEXITIES

Generally, atmospheric carbon dioxide (CO₂) concentrations were low during glacial times and high during interglacial periods, but whether increases in CO₂, and thus the greenhouse effect, and the retreat of ice sheets have been directly related has been difficult to evaluate. Fischer *et al.* (p. 1712) present a detailed look at how atmospheric CO₂ changed during the last three glacial cycles using new analyses of gases trapped in Antarctic ice. The resulting relation is complex: During deglaciations, increases in CO₂

seem to follow the initiation of warming, and during some glaciations, CO₂ remained high. The interaction is likely controlled by the biosphere and its response to the duration of interglacials.

COHERENT KICKS

Extracting the atoms from a Bose-Einstein condensate in a controlled fashion is the first step in achieving a coherent atomic laser. Previous methods



have had a gravity boost, essentially allowing the atoms to drop from the condensate, but this approach severely limits the beam direction. Hagley *et al.* (p. 1706; see the news story by Voss) now report the use of stimulated Raman emission to kick out a fraction of the condensate with a well-defined momentum and direction.

ALL QUIET ON THE BASIN AND RANGE

The Basin and Range Province of the western United States has nearly doubled its area over the last 15 million years and continues to extend today. Thatcher *et al.* (p. 1714) combined Global Positioning System (GPS) data from surveys in 1992, 1996, and 1998 along an east-west transect across the northern Basin and Range and found almost no current deformation in the middle of the section. All of the deformation was concentrated along the edges of the Basin and Range: adjacent to the Sierra Nevada block in the west and adjacent to the Colorado Plateau in the east. Most of the deformation is oriented in the direction of the motion of the Sierra Nevada block to the

northwest. These observations indicate that the internal deformation of the Basin and Range is determined by the traction of the adjacent blocks.

WEIGHING BROWN DWARFS

Many brown dwarfs, dead stars without enough mass to burn hydrogen, have been detected, but the actual mass of one of these objects has not been measured. Martin *et al.* (p. 1718) found an isolated, nearby brown dwarf binary system during the deep near-infrared survey and determined the separation between these brown dwarfs with the near-infrared camera and multiobject spectrometer (NICMOS) on the Hubble Space Telescope. By following the orbital motion of these brown dwarfs for a short time, they will be able to determine the masses of the brown dwarfs.

LEAVING AN IMPRINT ON C₆₀

If materials are put under severe pressure, the arrangement of chemical bonds may change and can be preserved in the material after release of pressure. If the force used to establish the pressure is directional, then a greater compression can result in some directions than in others. Marques *et al.* (p. 1720) show that if polycrystalline C₆₀ is put under such directional pressure, a large pressure memory signature is retained in the sample even at atmospheric pressure. The high symmetry of C₆₀, which has 30 isotropically distributed equivalent bonding directions, allows such a pressure memory effect to be retained in grains oriented randomly with respect to the applied pressure. The resulting three-dimensional polymerized C₆₀ lattice joins the previously synthesized one- and two-dimensional polymerized C₆₀ structures.

PULLING AND TUMBLING POLYMERS

The motion of a polymer chain that enters a region of strong shearing flow is difficult to predict—it may get pulled and stretched, but it can also be tumbled and compacted. This variability makes it difficult to understand the dynamics with methods that average over many molecules, such as light scattering. Smith *et al.* (p. 1724) used video fluorescence microscopy to image individual λ -phage DNA molecules undergoing shear flow and directly observe large fluctuations in extension corresponding to molecules moving in and out of tumbling flow.

CONTINUED ON PAGE 1603

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THIS WEEK IN SCIENCE

CONTINUED FROM PAGE 1601

FORCING BONDS APART

Direct measurements of force needed to break a single chemical bond have been made by Grandbois *et al.* (p. 1727) using an atomic force microscope (AFM). Polysaccharide chains adsorbed on silica surfaces were covalently attached to the AFM tip, and the rupture events as the chains were pulled off the surface were analyzed to identify single bond-breaking events. The force measured for rupturing a silicon-carbon bond, 2 nanonewtons, is in good agreement with estimates made from density functional calculations.

MAINTAINING INTEGRITY

During cell division, microtubules are arranged into a mitotic spindle along which chromosomes are transported. The ends of the spindle are formed by the centrosomes, which include a ring of γ -tubulin thought to be important in nucleating spindle microtubules. Avides and Glover (p. 1733) examined the role of a *Drosophila* protein known as Asp and found that it was required to maintain the association between microtubules and the centrosomal γ -tubulin ring.

GETTING A LEG UP

Much is known about limb patterning, but the genetic factors that specify hindlimbs versus forelimbs—whether they are arms in humans or wings in birds—are poorly understood. Logan and Tabin (p. 1736; see the news story by Vogel) now show that when the *Pitx1* gene is misexpressed in the chick embryonic forelimb (wing bud), the result is a wing that is transformed into a leg. Characteristics that indicate distinct leg specification are seen in the skeletal and muscle development and are evidenced in the expression of leg-specific markers.

SIGNALING AND SEGREGATION IN *DROSOPHILA*

Two reports focus on identifying molecular species that play key roles in *Drosophila* development and genetics. The Wnt/Wingless (Wg) pathway functions in many signaling processes during development by stabilizing the protein β -catenin, which in turn regulates expression of Wnt/Wg responsive genes. In mammals, Axin interacts with β -catenin, the adenomatous polyposis coli protein, and glycogen synthase kinase-3 β . Hamada *et al.* (p. 1739) have now isolated the *Drosophila* homolog of Axin, D-Axin,

which displays many of the same biochemical interactions with other proteins as seen with mammalian Axin. Furthermore, genetic analyses show that D-Axin negatively regulates Wg signaling by down-regulating Armadillo, the *Drosophila* homolog of β -catenin. *Segregation Distorter (SD)* in *Drosophila* is an example of meiotic drive, where one allele or chromosome is preferentially transmitted to offspring through meiosis. Mechanistic insights have been restricted because the identity of the key component of *Sd* was unknown. Merrill *et al.* (p. 1742; see the Perspective by Crow) show that *Sd* encodes a truncated *Drosophila* homolog of RanGAP. Because RanGAP is a guanosine triphosphatase-activating protein that is involved in nuclear import in yeast and mammalian systems, the solution to the mystery of *Sd* may include defective nuclear transport.

DIVERSITY IN DEFENSE

An early theory to explain the enormous diversity of class I and II genes of the major histocompatibility complex was that individuals carrying different alleles (heterozygous) at HLA loci could present a greater variety of antigenic peptides, and therefore would mount a better immune response against infecting organisms. By looking at heterozygosity at HLA in three cohorts of HIV-infected individuals, Carrington *et al.* (p. 1748) found that heterozygotes progressed to AIDS and death much more slowly than homozygotes and that two alleles correlated with accelerated AIDS pathogenesis.

NOT JUST FOLLOWING ORDERS

Traditional industrial organizations localize decisions to managers and production to workers. Recent thinking has opened the door to incorporating workers in some aspects of the decision process. Carpenter *et al.* (p. 1752; see the news story by Wickelgren) explore the possibility of a distributed network in the brain for encoding serial order in a stimulus-response task. The primary motor cortex constitutes the first station in the descending pathway leading to the muscles and movement. Nevertheless, some motor cortical neurons appear to encode the presentation of serial stimuli at a time prior to the point at which a response is selected and initiated, which suggests the potential for cognitive processing in this area of the brain.

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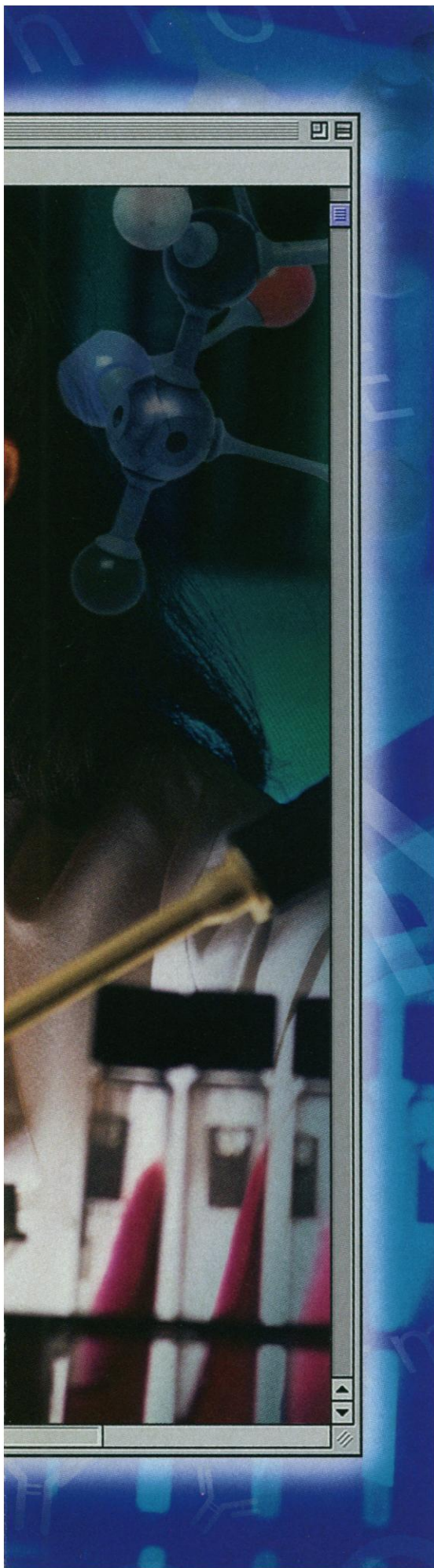
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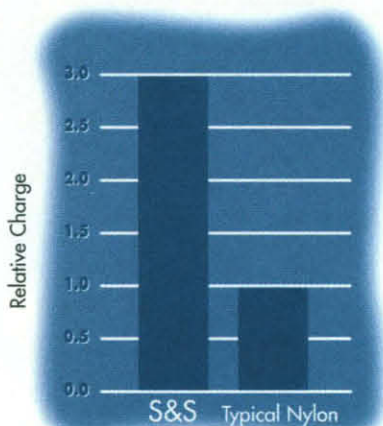
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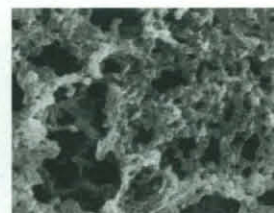


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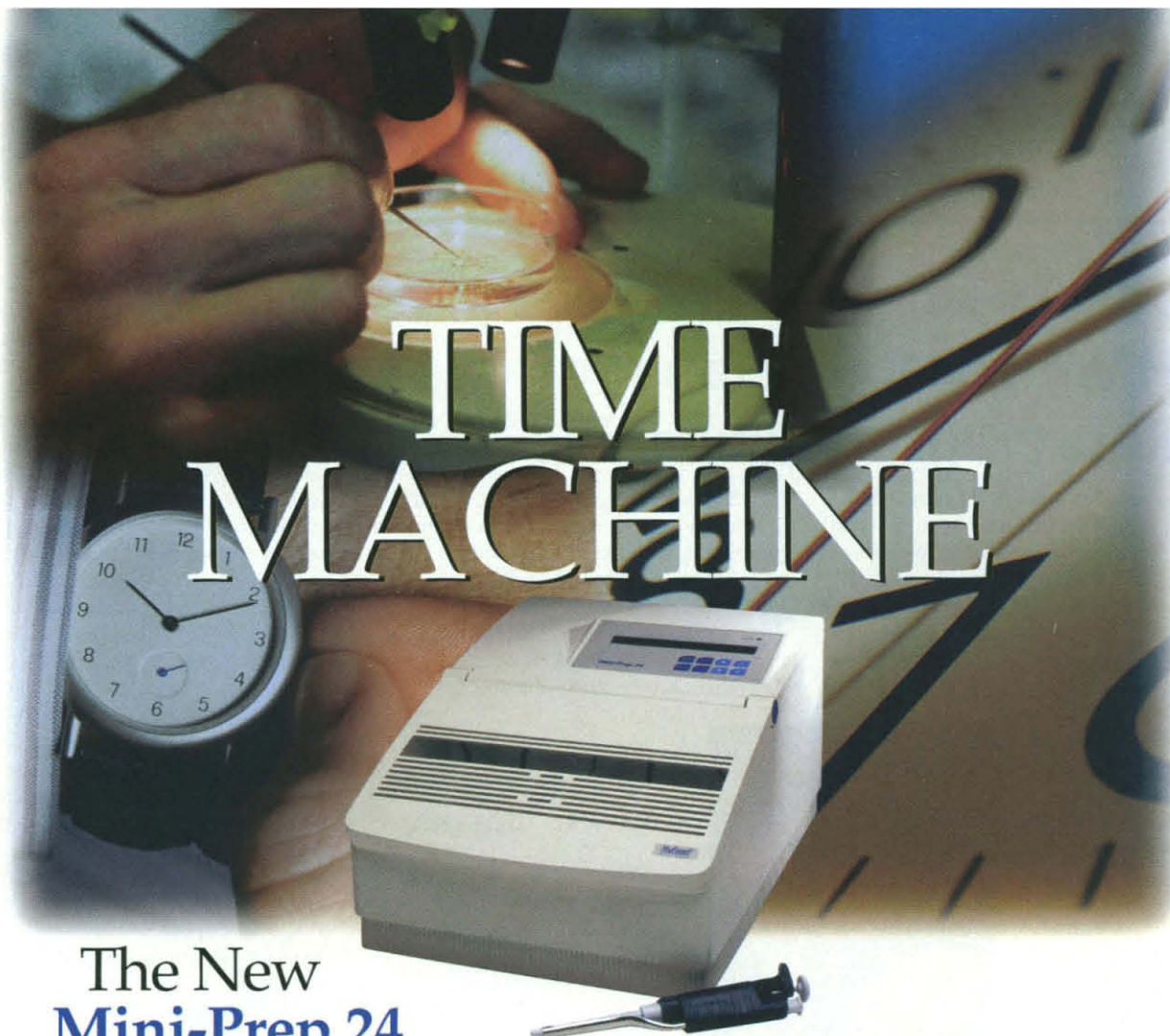
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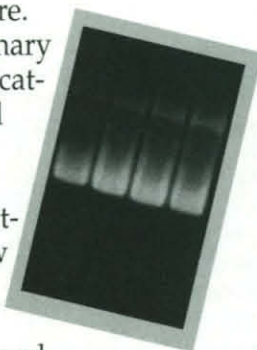
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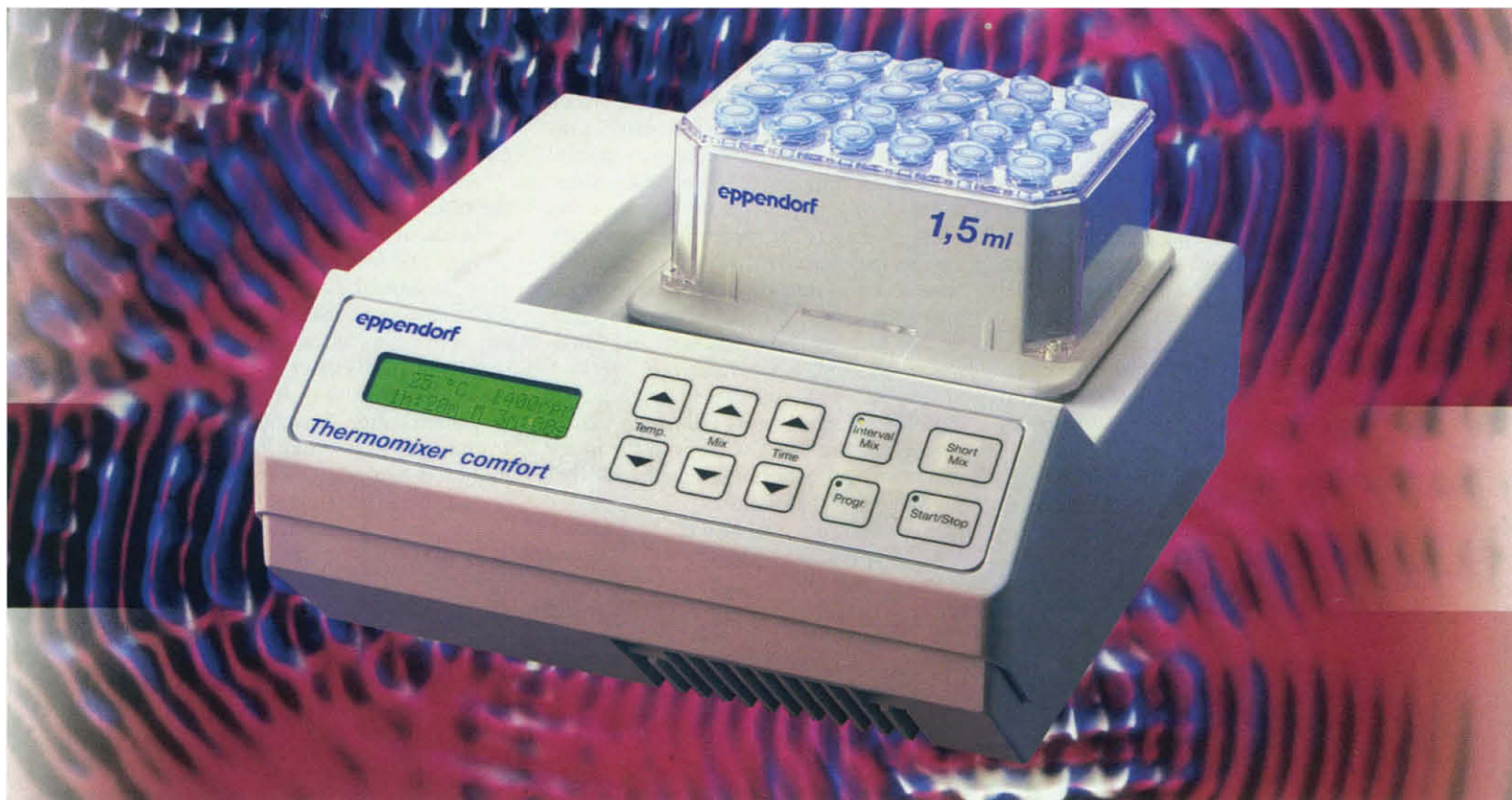


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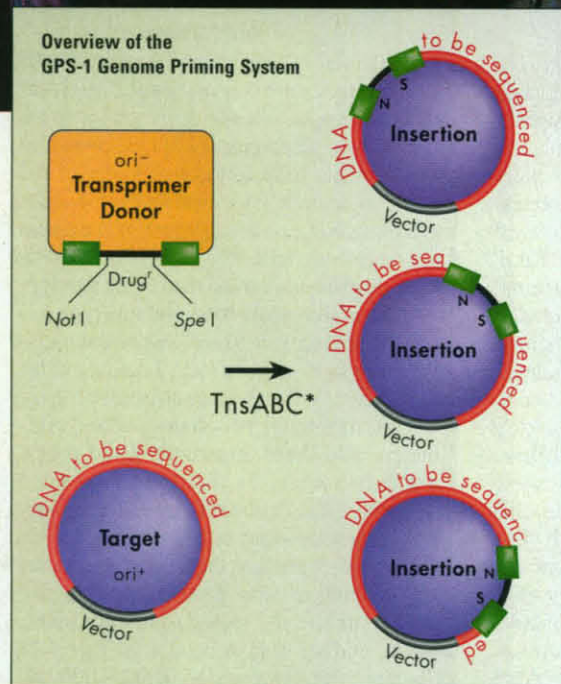
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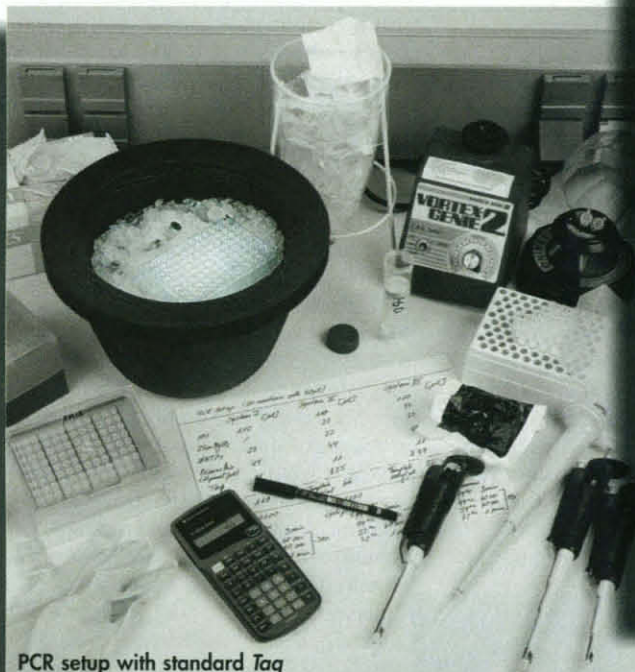
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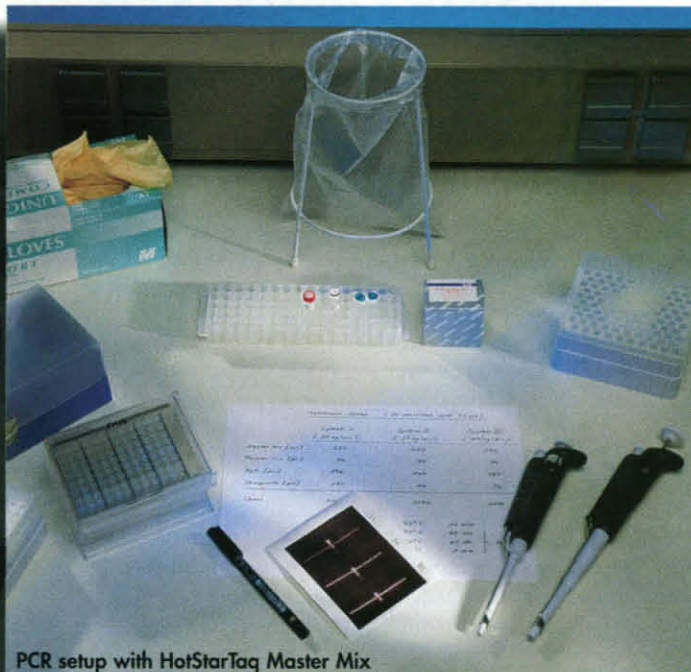
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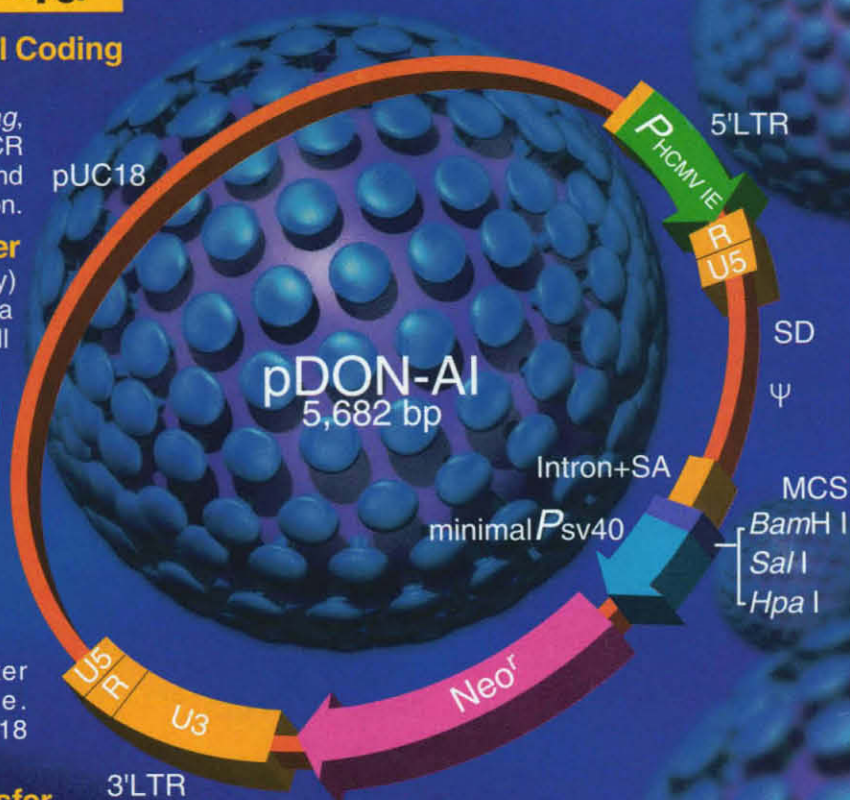
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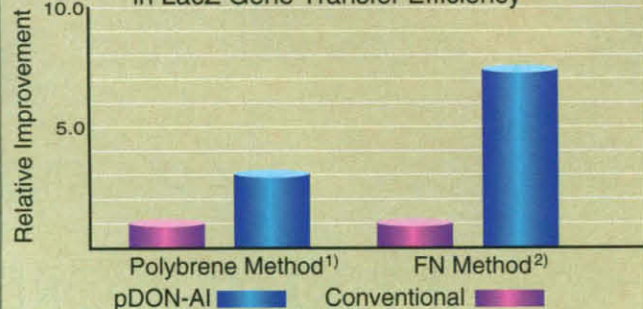
The antibiotic selective Neo^r marker gene is included with the minimal SV40 promoter downstream from the inserted gene. Furthermore, the backbone plasmid of pUC18 provides more ease in culture handling.

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In conjunction with the RetroNectin™, retroviral vectors constructed from plasmid pDON-AI transduces target cells even more efficiently.



Comparison of pDON-AI and a conventional vector in LacZ Gene Transfer Efficiency



* Developed by ViroMedica Pacific Limited (Korea)

(1) Yu *et al.* (1998) Patent filed (2) Kim *et al.* (1998) *J. Virol.* 72 (2) 994-1004

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1) Polybrene Method: NIH/3T3 cells were transduced in the presence of polybrene with the virus supernatant obtained by respective vector transfections. Viral titers were calculated as relative values by analyzing X-gal (+) cell numbers.

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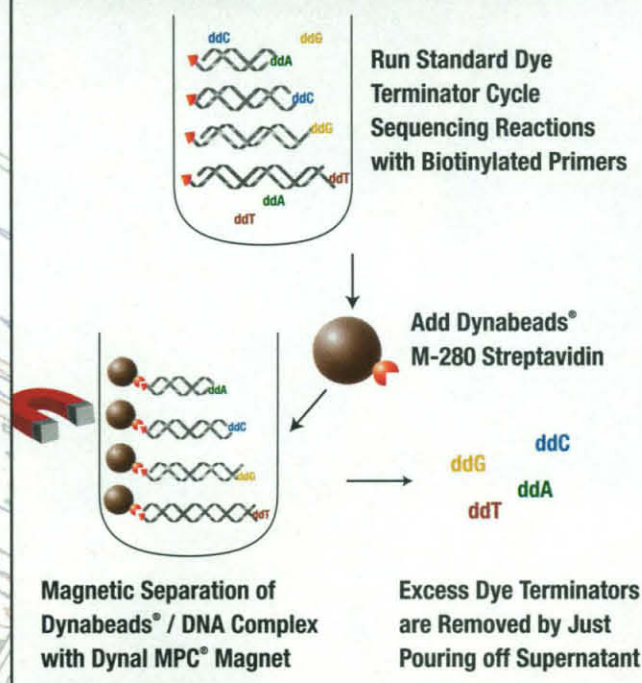
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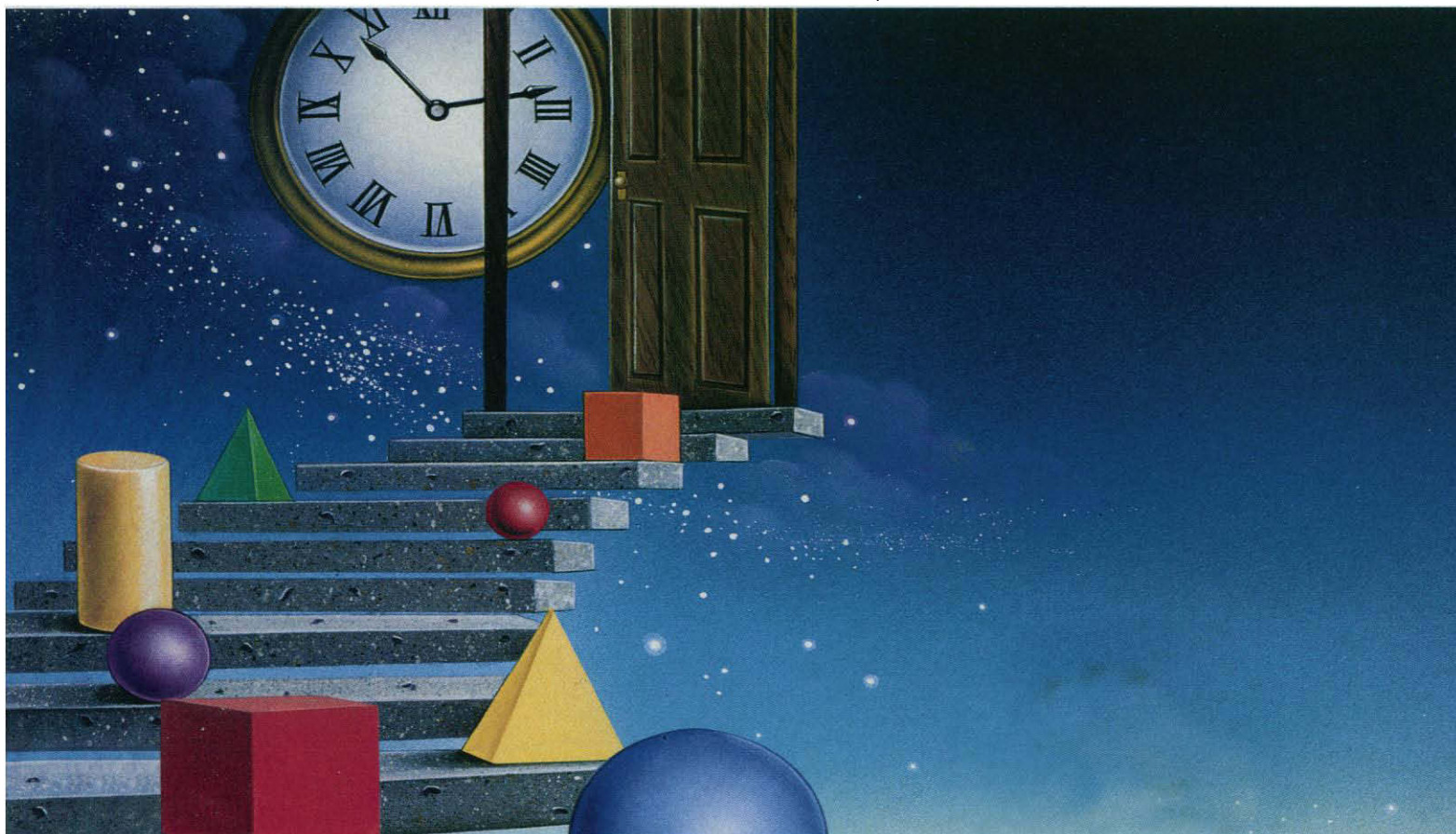
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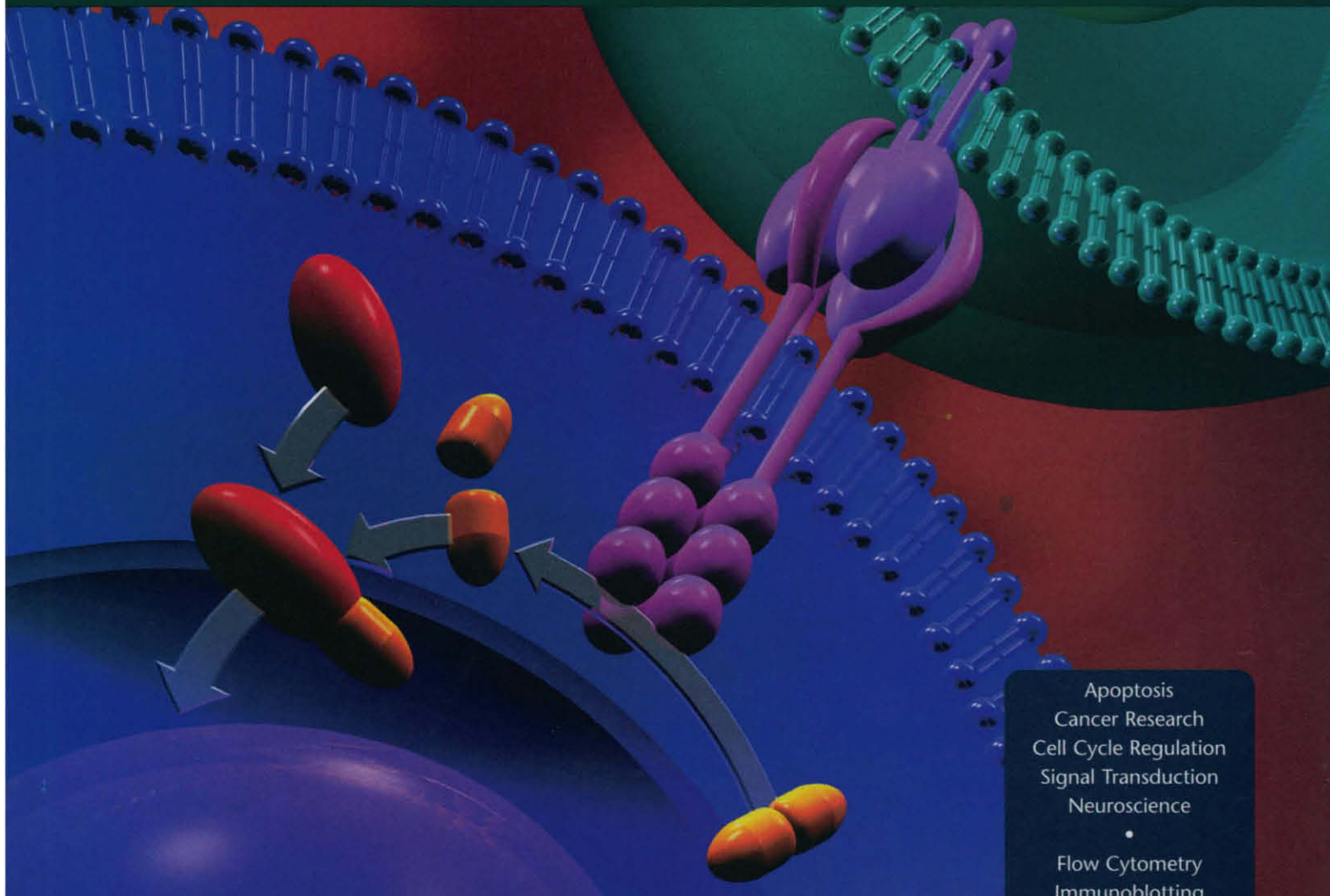


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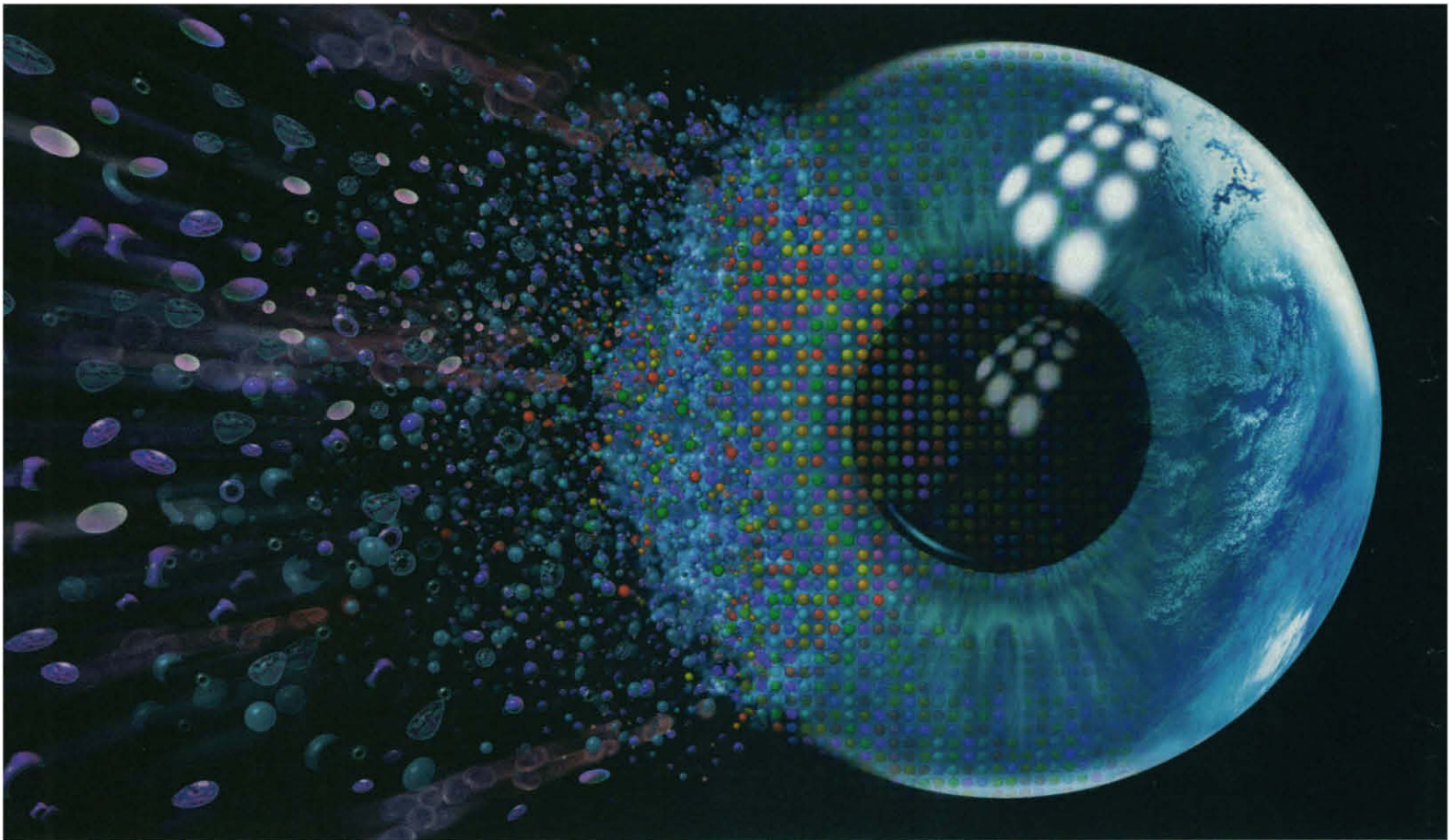
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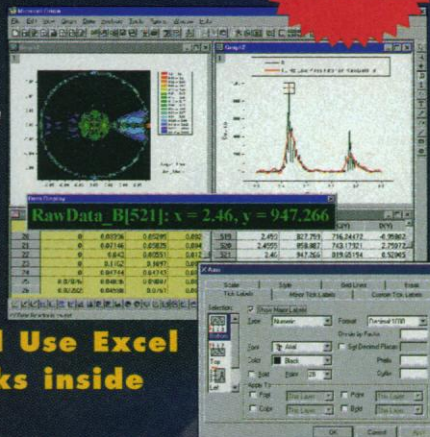
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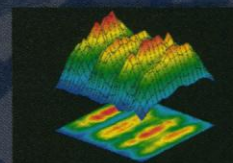
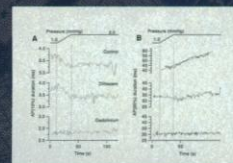


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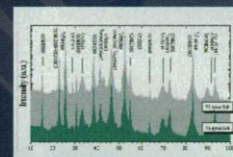
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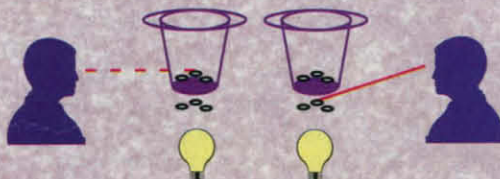
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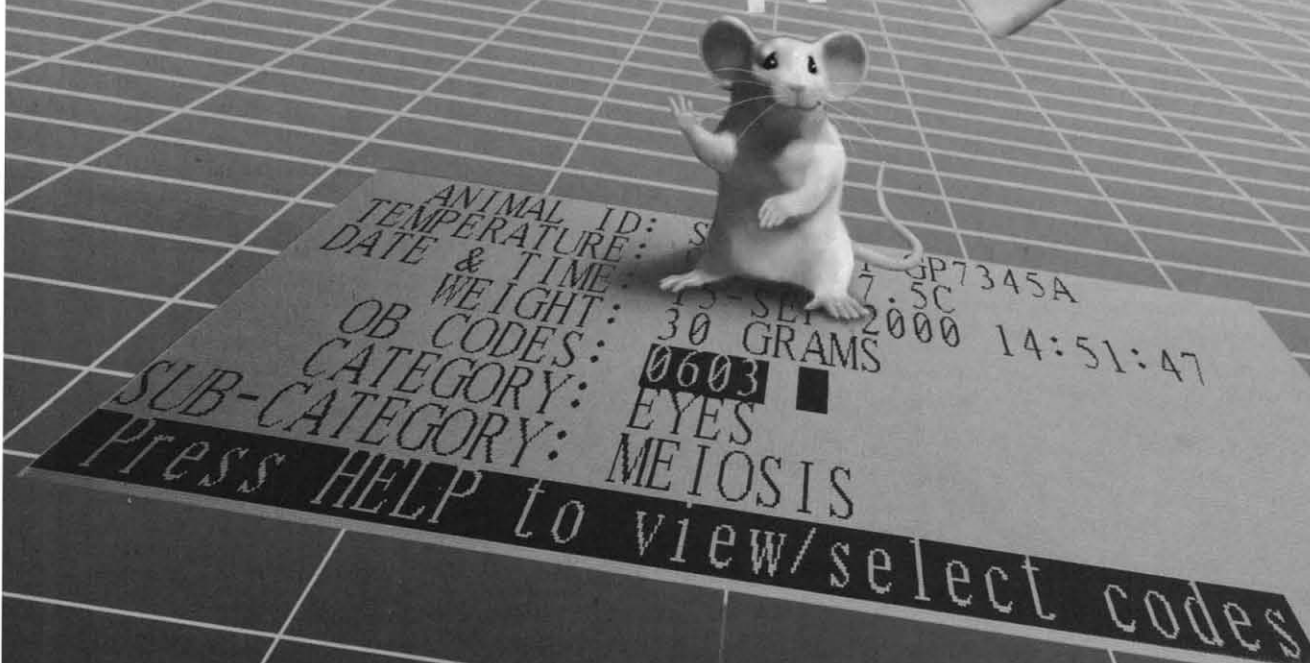
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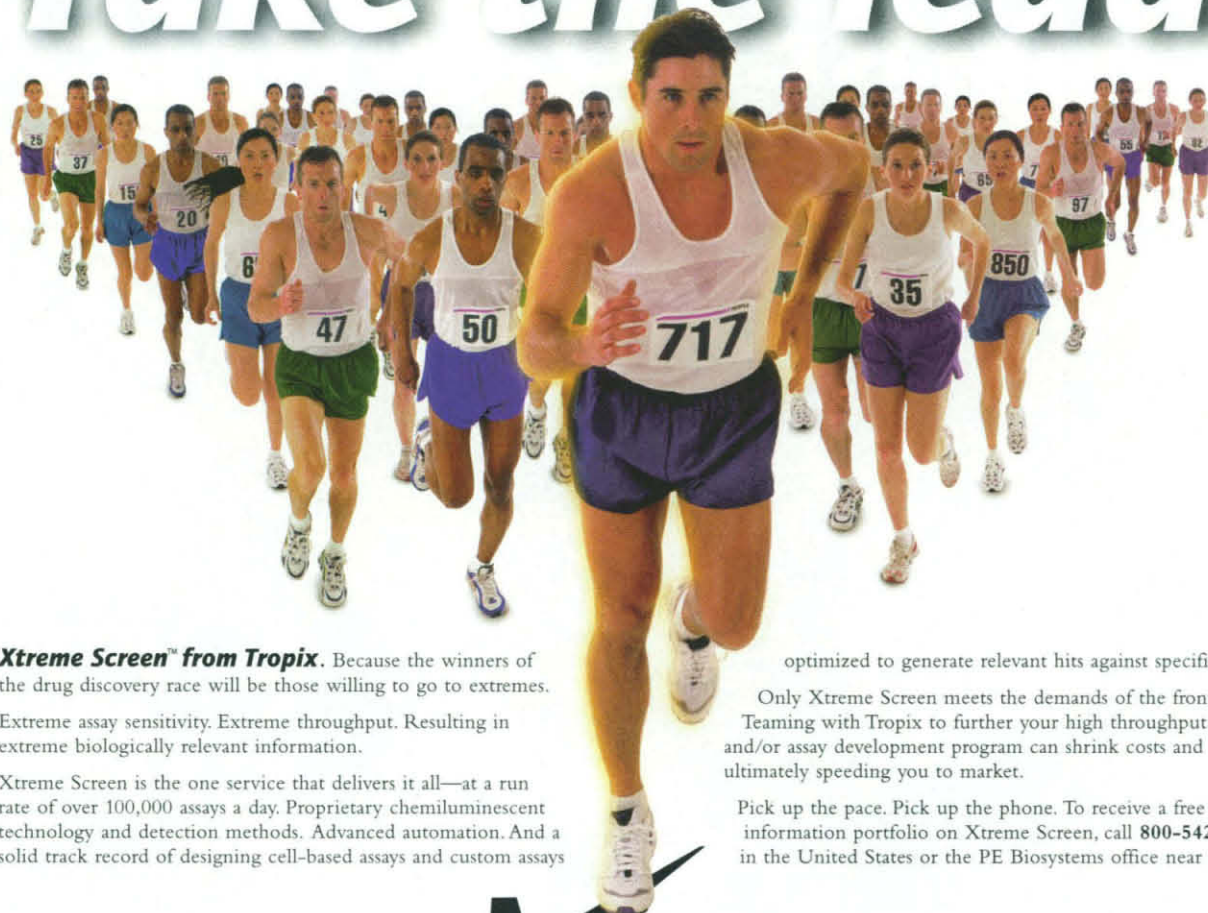
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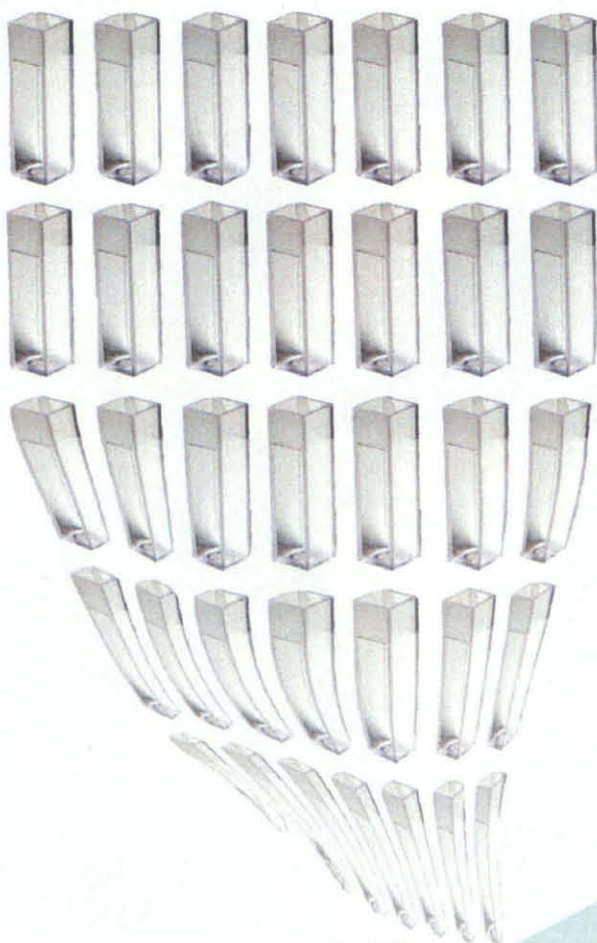
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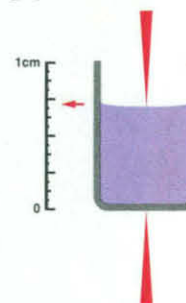
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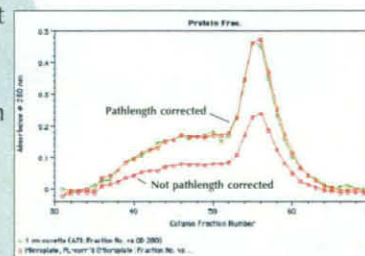
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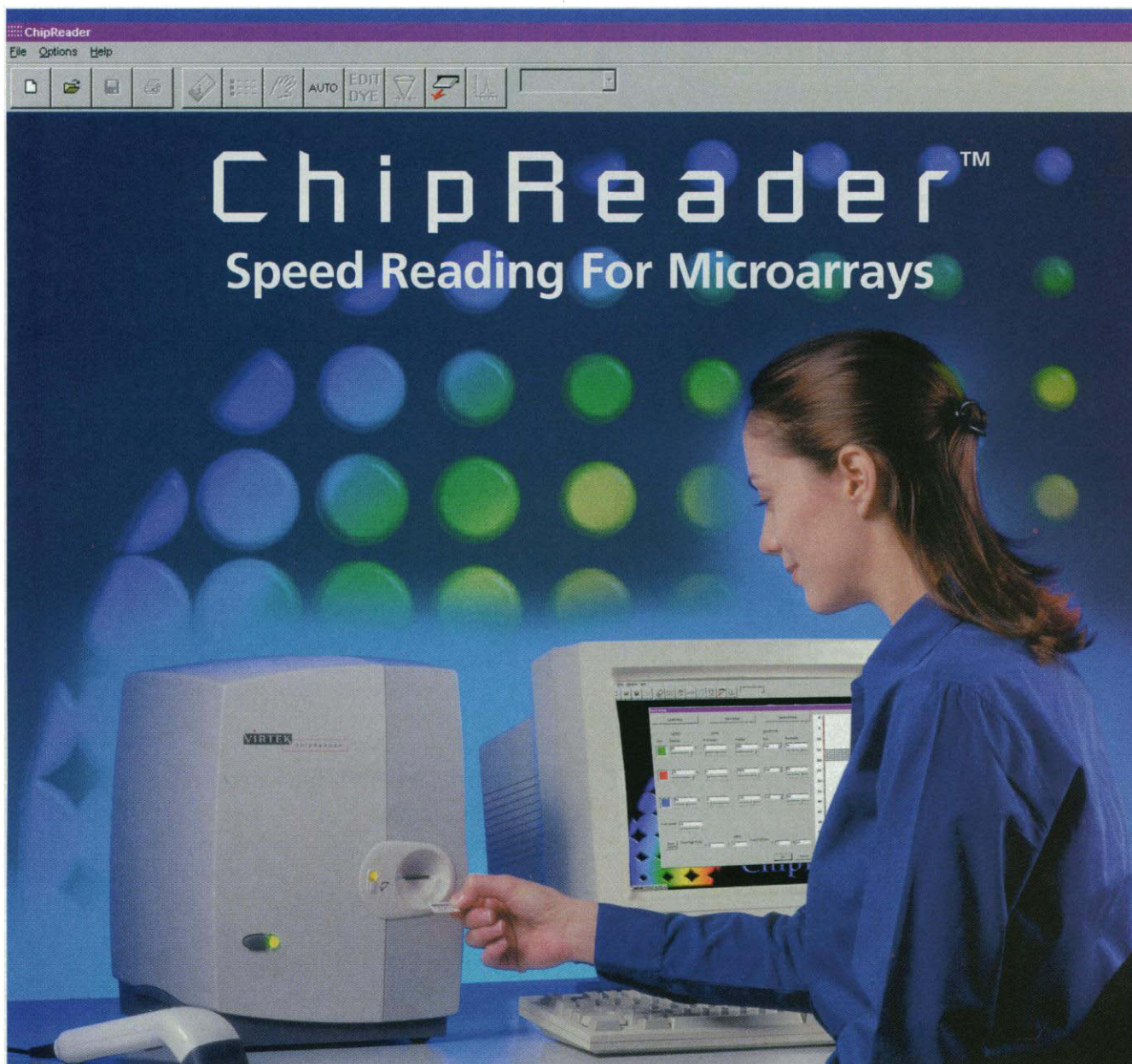


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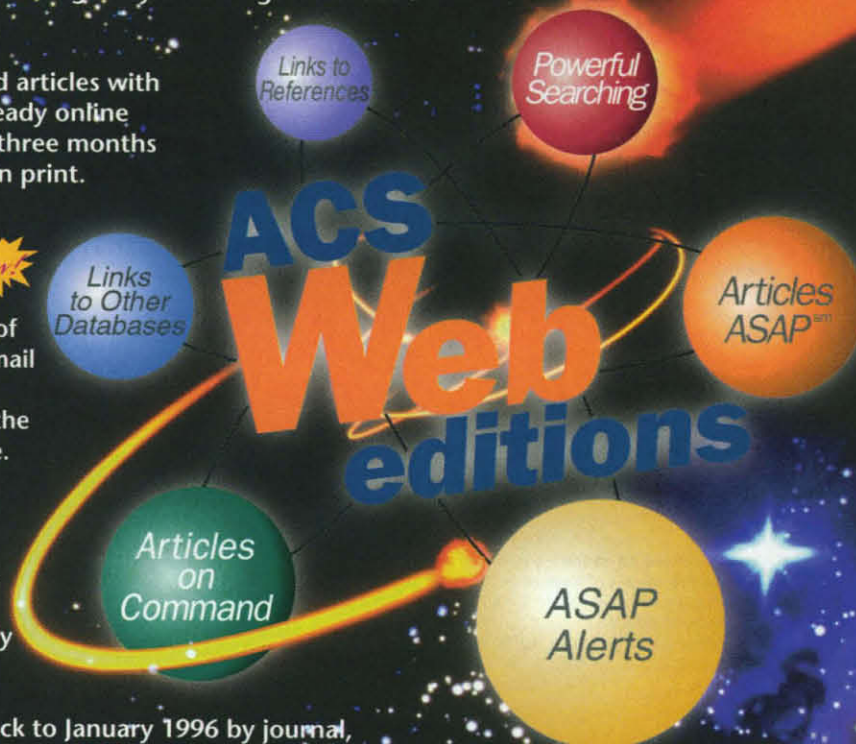
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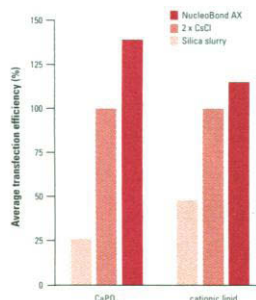


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