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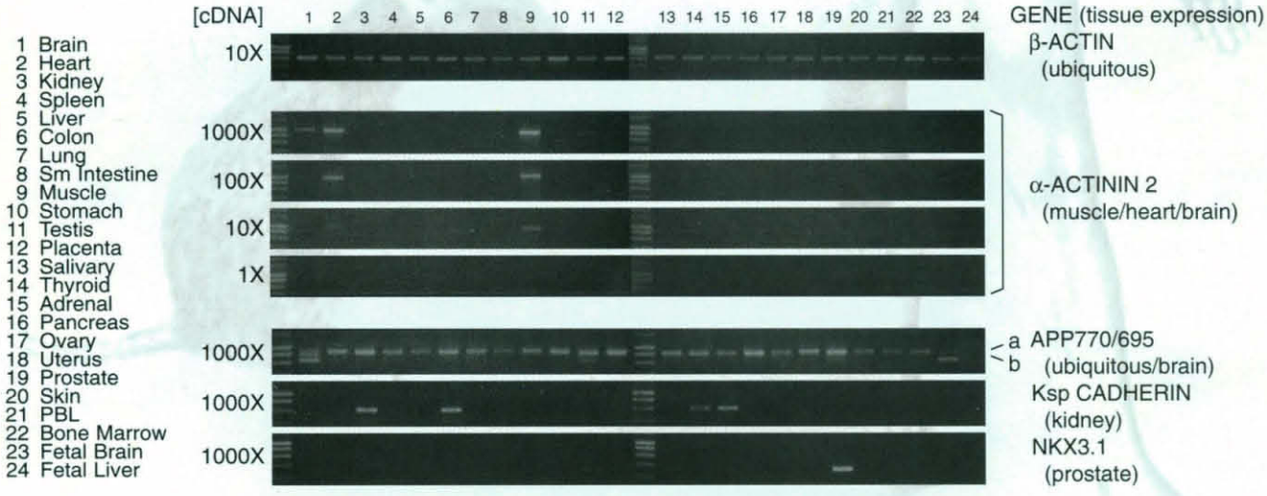

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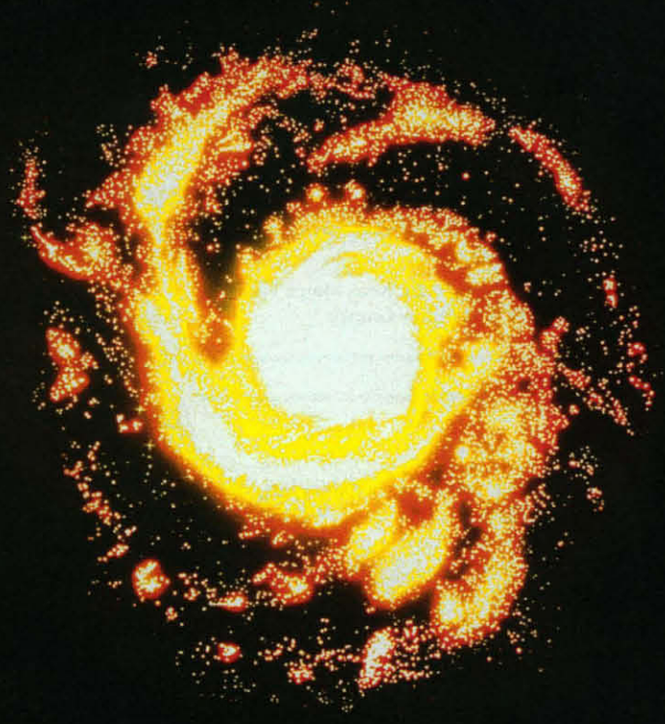

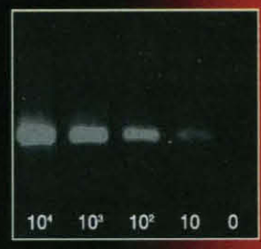

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COVER Corn, soybean, rice, and cassava are just a few of the important agricultural crops that are being modified through biotechnology to be more health enhancing, more nutritious, and more productive. The science and the business of agricultural biotechnology, including questions of consumer acceptance and ownership of technology, are topics of the special section beginning on page 367.

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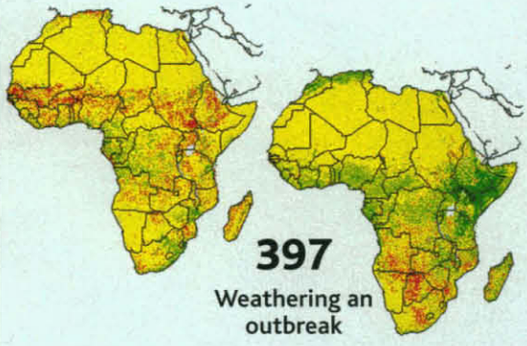

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DEPARTMENTS

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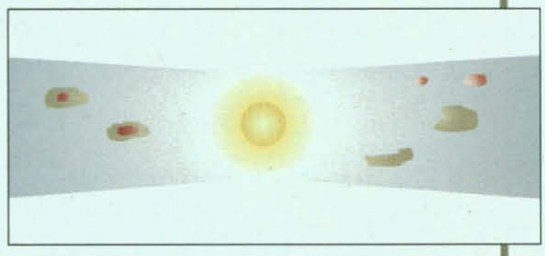

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Mysteries of the early solar system

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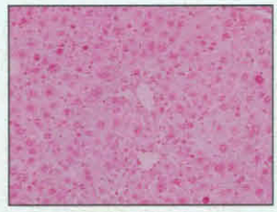

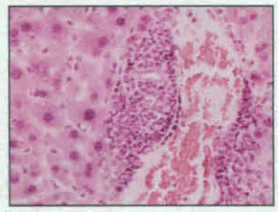

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Preventing graft versus host disease

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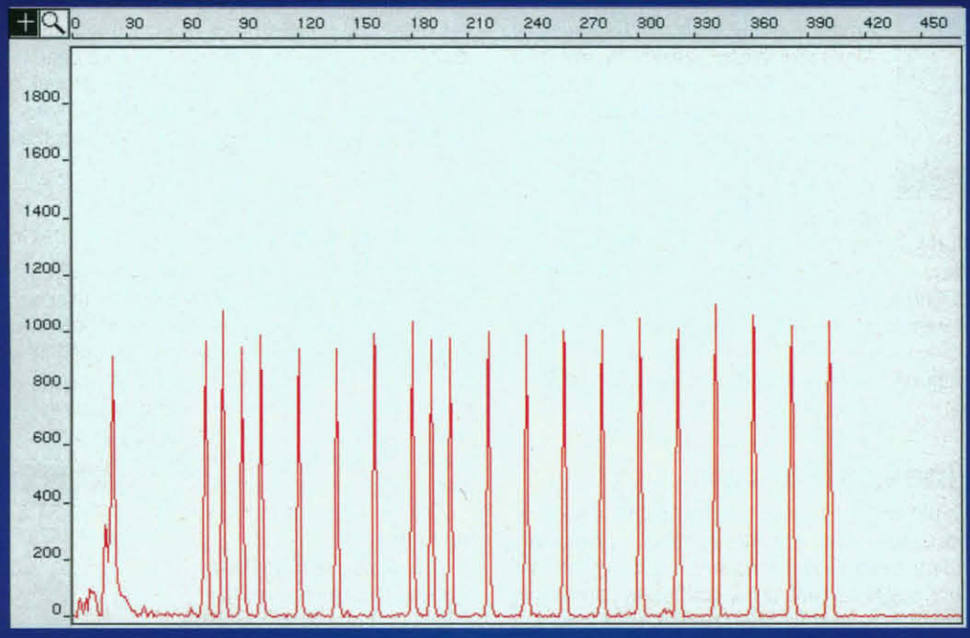

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MALLEABLE MOLECULAR LOGIC GATES

One approach for increasing the density of devices for computing is to rely much more heavily on accessing large arrays of programmable memory. If the density of interconnections is high, then the presence in individual devices of defects that may form during assembly or even during operation need not impair the operation of the remainder of a chip. Collier *et al.* (p. 391; see the news story by Service) have harnessed the electrochemical properties of rotaxane molecules in solution to create switching devices for such computers. When used as a barrier layer between two electrodes, these molecules create a "closed" switching state, but an oxidizing pulse can irreversibly "open" the switch. By selectively applying such pulses, logic circuits (AND and OR gates) can be created because the high and low current levels differ by more than a factor of 10. The performance of these micrometer-scale devices is expected to scale to much smaller dimensions.

FORECASTING RIFT FEVER EPIDEMICS

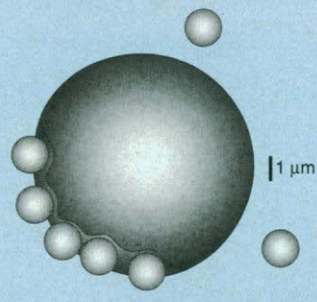
Rift Valley fever periodically infects humans and livestock in eastern Africa. The virus is transmitted by mosquitoes, and thus all major epidemics in the past half century have occurred after periods of heavy rainfall. Linthicum *et al.* (p. 396; see the Perspective by Epstein) have developed a metric based on an analysis of climate indicators and satellite observations of vegetation distribution that may allow outbreaks to be predicted up to 5 months in advance. Such advance notice of outbreaks, along with satellite monitoring of vegetation to infer locally affected areas, would greatly facilitate measures to control or limit epidemics through vaccination and mosquito control.

SHEDDING LIGHT ON PHOTOSYNTHESIS

During bacterial photosynthesis, light-harvesting antenna complexes absorb photons and enter an excited state. Subsequent steps transfer excitation energy to the reaction center. Understanding the precise processes of excitation and energy transfer has been the focus of intense research, but characterizing the electronic excited states has proved difficult. Van Oijen *et al.* (p. 400; see the Perspective by Orrit) used low-temperature single molecule spectroscopy to study two different parts of the antenna complex LH2. They found that the excited state is localized in one part but delocalized in the other. The results have implications for the rate and mechanism of energy transfer in photosynthesis.

SOMETIMES, OPPOSITES REPEL

Opposite charges attract, so our intuition tells us that charged particles will uniformly cover a surface with the opposite charge. Aranda-Espinoza *et al.* (p. 394) examined the adherence of negatively charged latex particles to the surface of large vesicles (20 micrometers in diameter) made of mixtures of positively charged and neutral surfactants and found that a separation into adhesive and nonadhesive (repulsive) zones occurred. The authors argue that negatively charged counterions aggregate on the inside surface of the vesicle in the nonadhesive zones and that it is their charge that repels the latex particles. This effect, electrostatic adhesion saturation, may operate between membranes and vesicles in cells.



COLORS FROM ALL OVER THE SPECTRUM

The energy for photosynthesis in plants and bacteria comes from visible light. Jiang *et al.* (p. 406) report the isolation from the photosynthetic bacterium *Rhodospirillum centenum* of a hybrid photoreceptor that appears to be related to both blue-light (cryptochrome) and red-light (phytochrome) photoreceptors. With one domain that is similar to the prokaryotic photoactive yellow protein (PYP) and contains the blue light–absorbing *p*-hydroxycinnamic acid chromophore and another domain that displays similarity to the red-light sensitive phytochromes, the new protein is named Ppr, for PYP-phytochrome–related. Ppr mediates blue light–dependent regulation of the chalcone synthase gene, and it may represent a component of an ancient bacterial signaling system that later gave rise to the plant phytochromes.

WAS THAT A RIGHT OR A LEFT?

From outward appearance, most vertebrates display left-right (LR) symmetry. However, the design of the internal organs is frequently asymmetric. Recent studies have provided insights into the genetic program that functions in directing LR asymmetry. In the chick, the fibroblast growth factor FGF8 and the Sonic hedgehog protein (SHH) act as early right and left determinants, respectively. As a comparison, Meyers and Martin (p. 403) examined the mouse, only to find that FGF8 and SHH perform very different functions in the two organisms. The chick right determinant FGF8 is a left determinant in mouse, and instead of activating left-determining factors as it does in chick, SHH blocks the left-specifying genes from being expressed on the right in mouse.

HELPING HOSTS ACCEPT GRAFTS

Bone marrow loss that may occur during cancer chemotherapy is fatal unless a bone marrow donor can be found who is an exact match—that is, completely histocompatible—so that the graft cannot attack the host. One approach for avoiding graft versus host disease (GVHD) is to deplete mature T cells from the bone marrow. Unfortunately, this procedure often makes the bone marrow cells less likely to engraft and less potent against tumor recurrences. Shlomchik *et al.* (p. 412; see the news story by Hagmann) now show that for minor histoincompatibilities, GVHD is precipitated only through the antigen-presenting cells (APCs) of the host. Thus, it may be possible to increase the likelihood of successful transplantation by targeting only the appropriate APCs of the host rather than the T cells in the graft.

INHERITING A BAD BACK

Intervertebral disc disease, which is typically associated with sciatica, is a common and costly public health problem. Although a genetic component has been suspected, it has been difficult to demonstrate because the disease is multifactorial—environmental and physiological factors also contribute. Annunen *et al.* (p. 409) refined the usual methods of linkage analysis and were able to demonstrate an

CONTINUED ON PAGE 299

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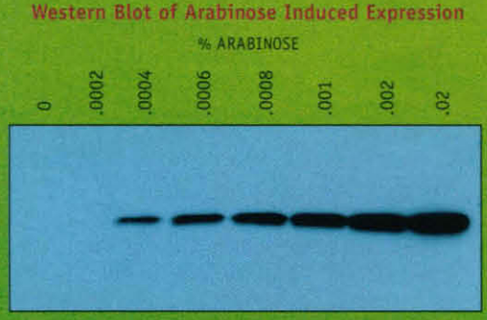

Arabinose induction of *E. coli* transformed with pBAD/His/SuperGFP

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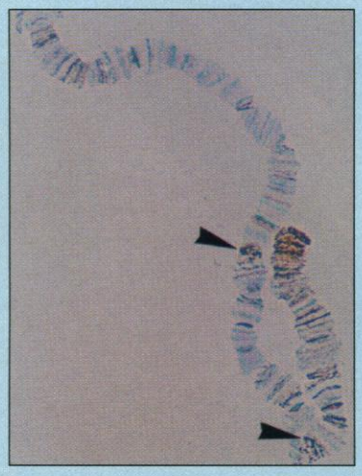

IMPLICATING TRANSPOSABLE ELEMENTS IN INVERSIONS

Genomic variability is generated by multiple events such as inversions, insertions, deletions, and rearrangements. Although inversions are widely distributed in many genomes, the origin of these sequence alterations is uncertain. Indirect evidence indicated that transposable elements can create inversions, but direct support for this event in a natural population has been elusive. By cloning and characterizing the *2j* inversion of a natural *Drosophila* population, Cáceres *et al.* (p. 415) now provide support for the causal role of a transposable element in generating the inversion. A mechanism for the *2j* inversion, as directed by a novel transposable element, is proposed.

association between the disease in a group of unrelated individuals from Finland and an allele coding for one of the polypeptide chains of collagen IX.

CUT THE PROTEINS, DIVIDE THE CELL

Proper segregation of chromosomes during cell division, which often goes awry in cancer cells, requires precise timing of the release of sister chromatids and the beginning of anaphase. In yeast, selective proteolysis of the securin proteins Pds1p and Cut2p is required for chromatid separation. Related proteins with similar sequences have not been found in mammalian cells, but Zou *et al.* (p. 418; see the Perspective by Orr-Weaver) report the identification of proteins from *Xenopus* and humans that are functionally related to Pds1p and Cut2p. The vertebrate proteins are degraded by the anaphase-promoting complex, and a mutant version of the *Xenopus* protein that is not degraded blocks separation of sister chromatids in *Xenopus* egg extracts. The human securin protein is the product of a transforming gene called *PTTG* (for pituitary tumor-transforming gene) that is overexpressed in some tumors and in carcinoma cell lines. Thus, the vertebrate analog of Pds1p may contribute to tumor formation by causing missegregation of chromosomes.

STRESSING VIRUS AND HOST

Understanding the molecular basis of adaptation in response to stress is key to being able to predict the ability of a virus to become resistant to drug therapies. Previous studies of this phenomenon have been hampered by the ability to look at changes in only a few genes at one particular time. Wichman *et al.* (p. 422) have done a dynamic, genome-wide study of the evolution of bacteriophage ϕX174 under conditions of high temperature and an unusual bacterial host. In replicate cultures, similar changes were observed but their order and timing differed greatly.

TECHNICAL COMMENT SUMMARIES

FUNCTIONAL APPROACHES TO GENE ISOLATION IN MAMMALIAN CELLS

The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/285/5426/299a

G. J. Hannon *et al.* (Techview, 19 Feb., p. 1129) "developed the MaRX system," which they described as "a specialized strategy to facilitate function-based gene isolation in mammalian cells."

A. V. Gudkov *et al.* comment that "the basic concepts and most of the technical aspects of the MaRX methodology ... seem indistinguishable from the principles and methods that our laboratories and others have published over many years." A. Kimchi *et al.* describe one of the early "well-established methods ... the technical knock out (TKO)," which was designed according to the same principles as those applied by Hannon *et al.* and which has been used for isolating novel genes that control a complex biological process.

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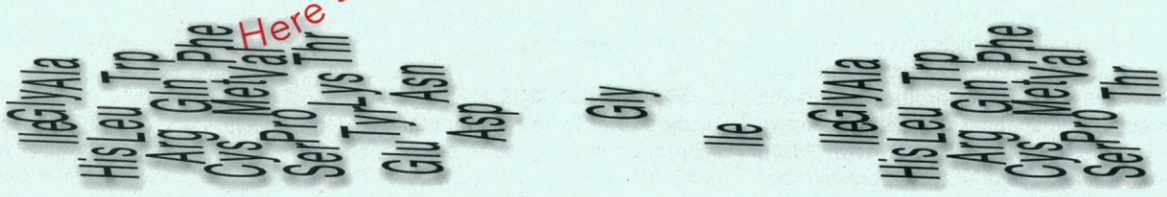

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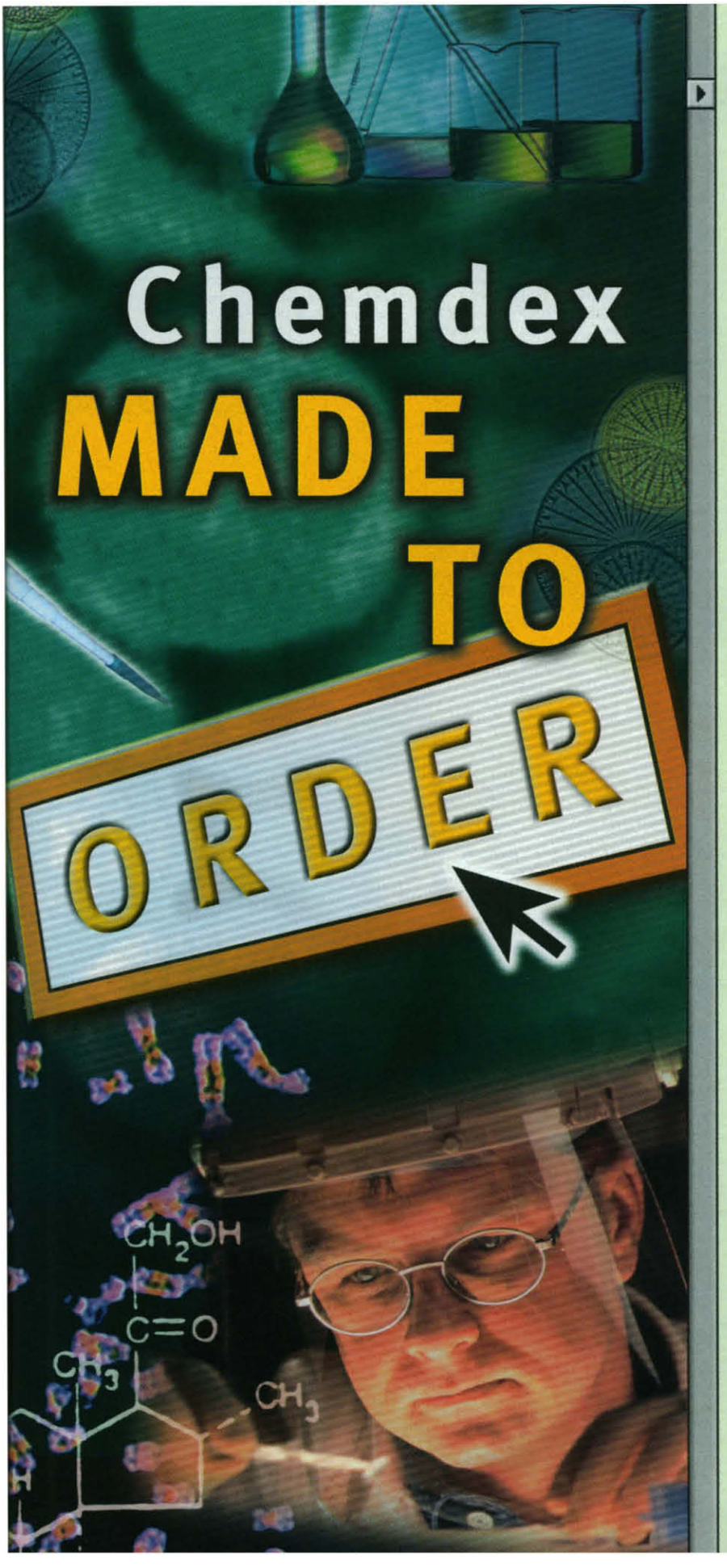

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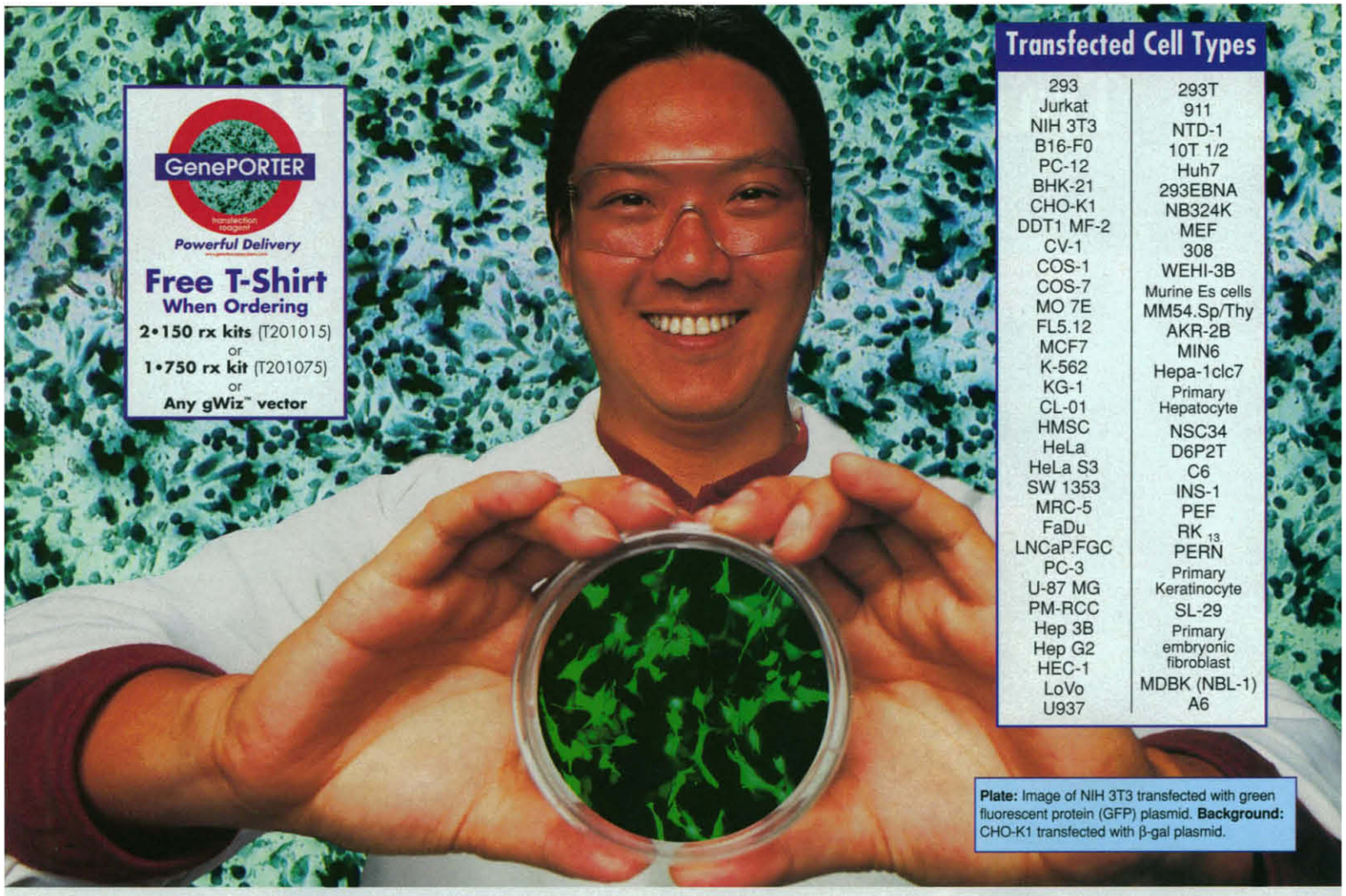

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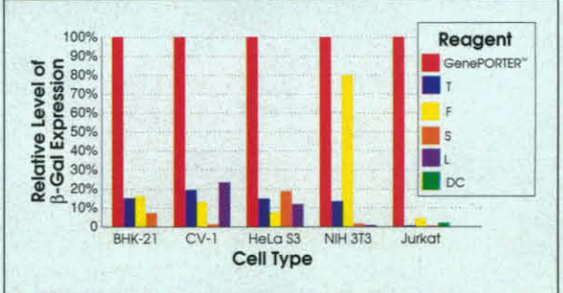

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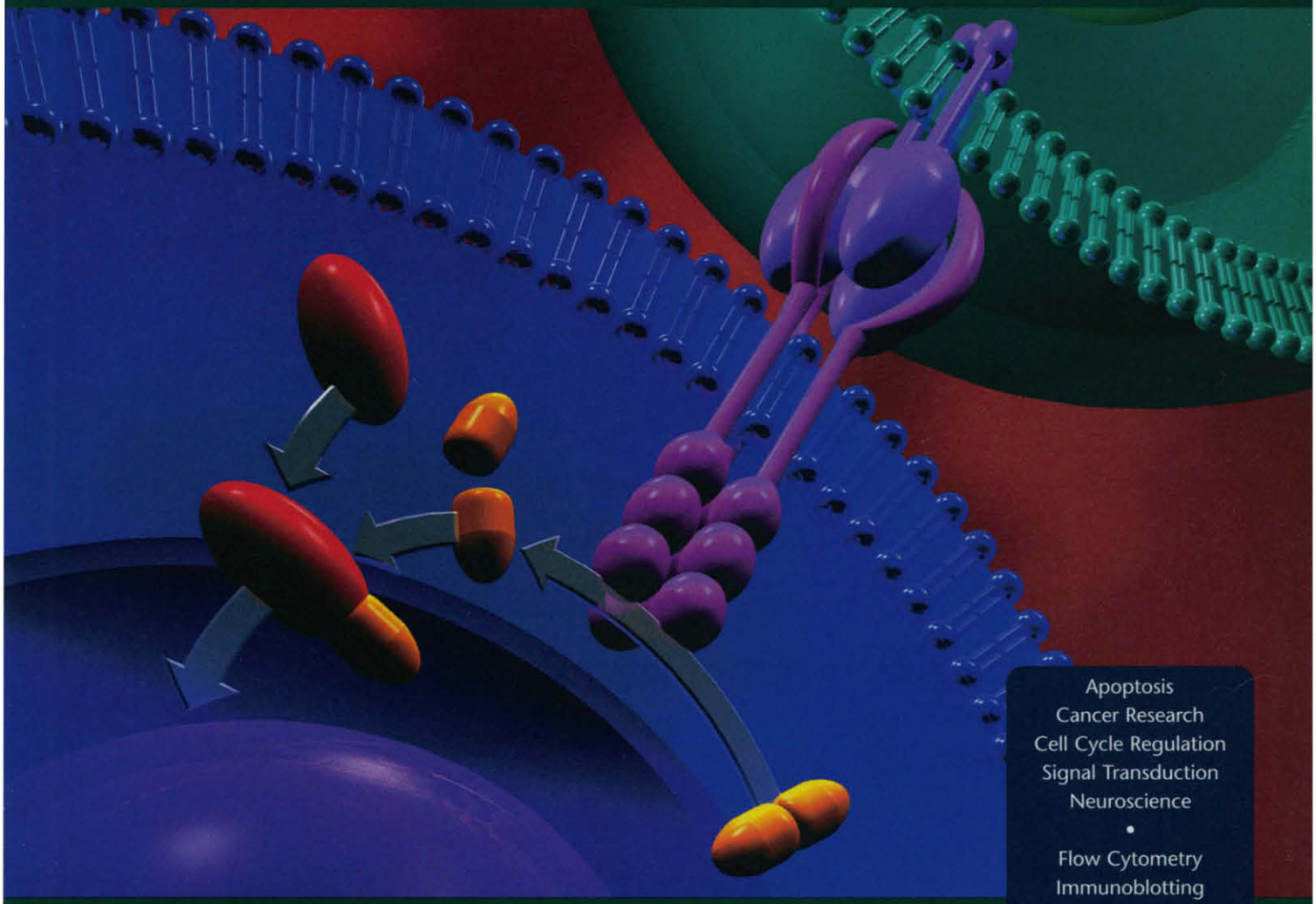

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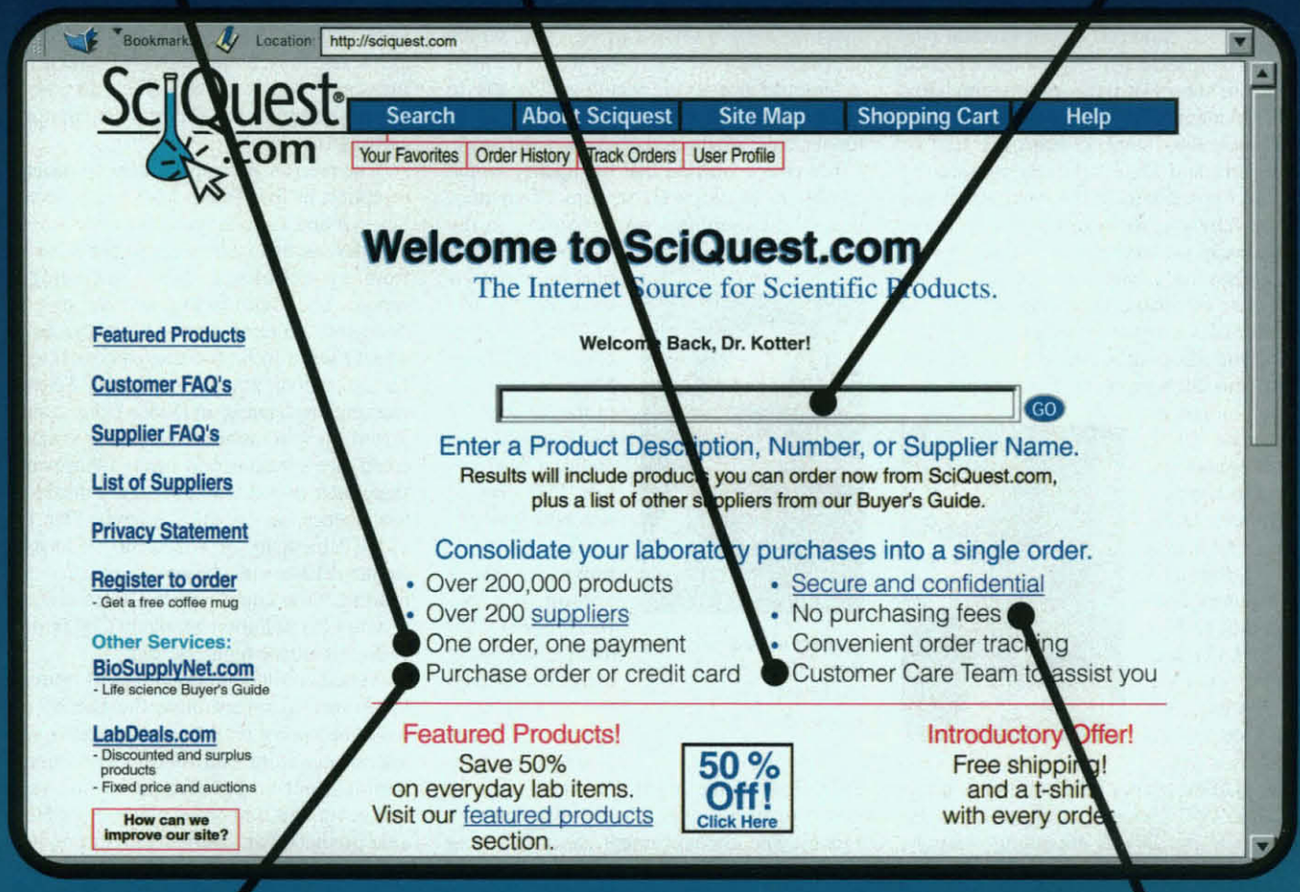

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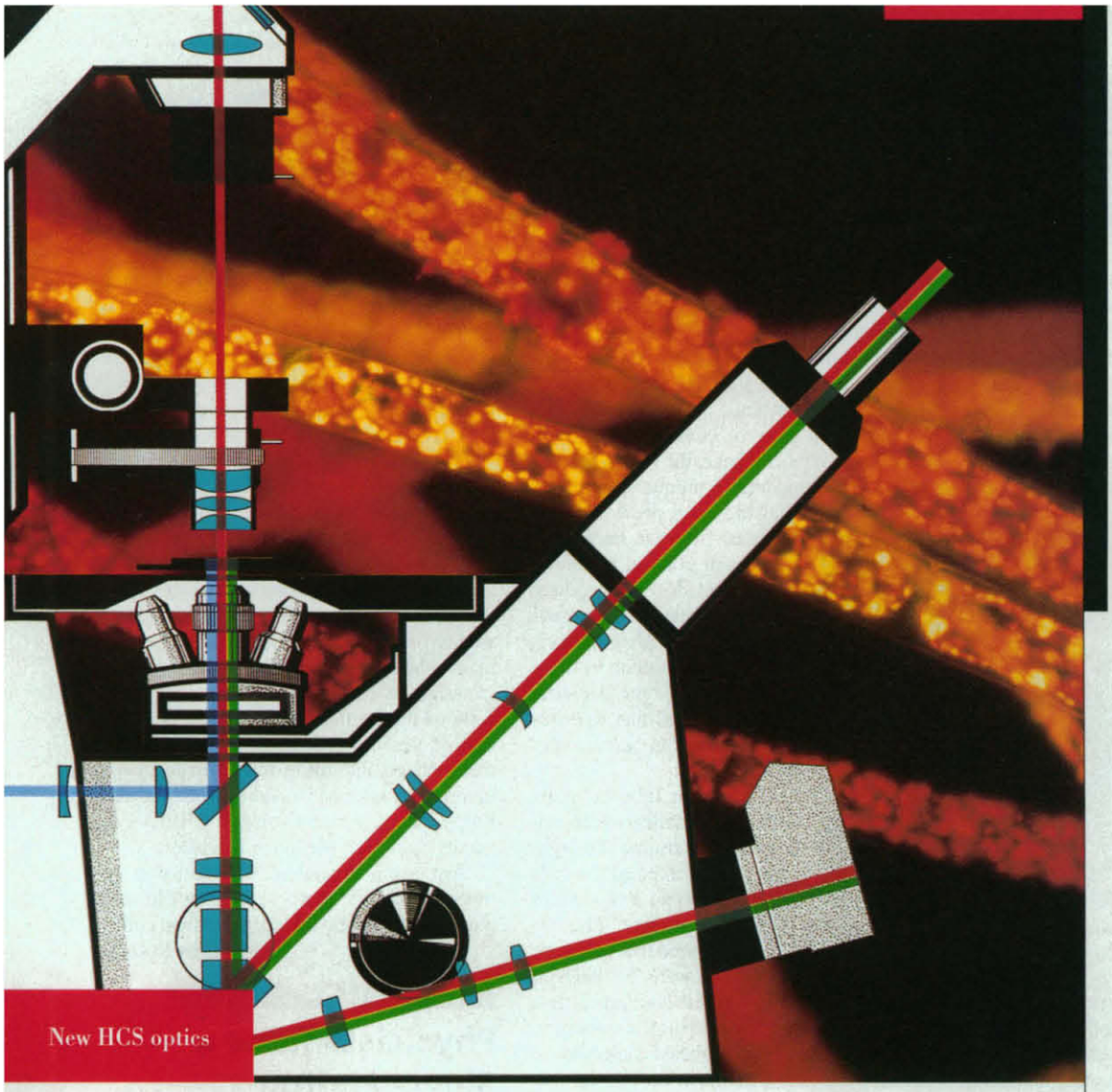

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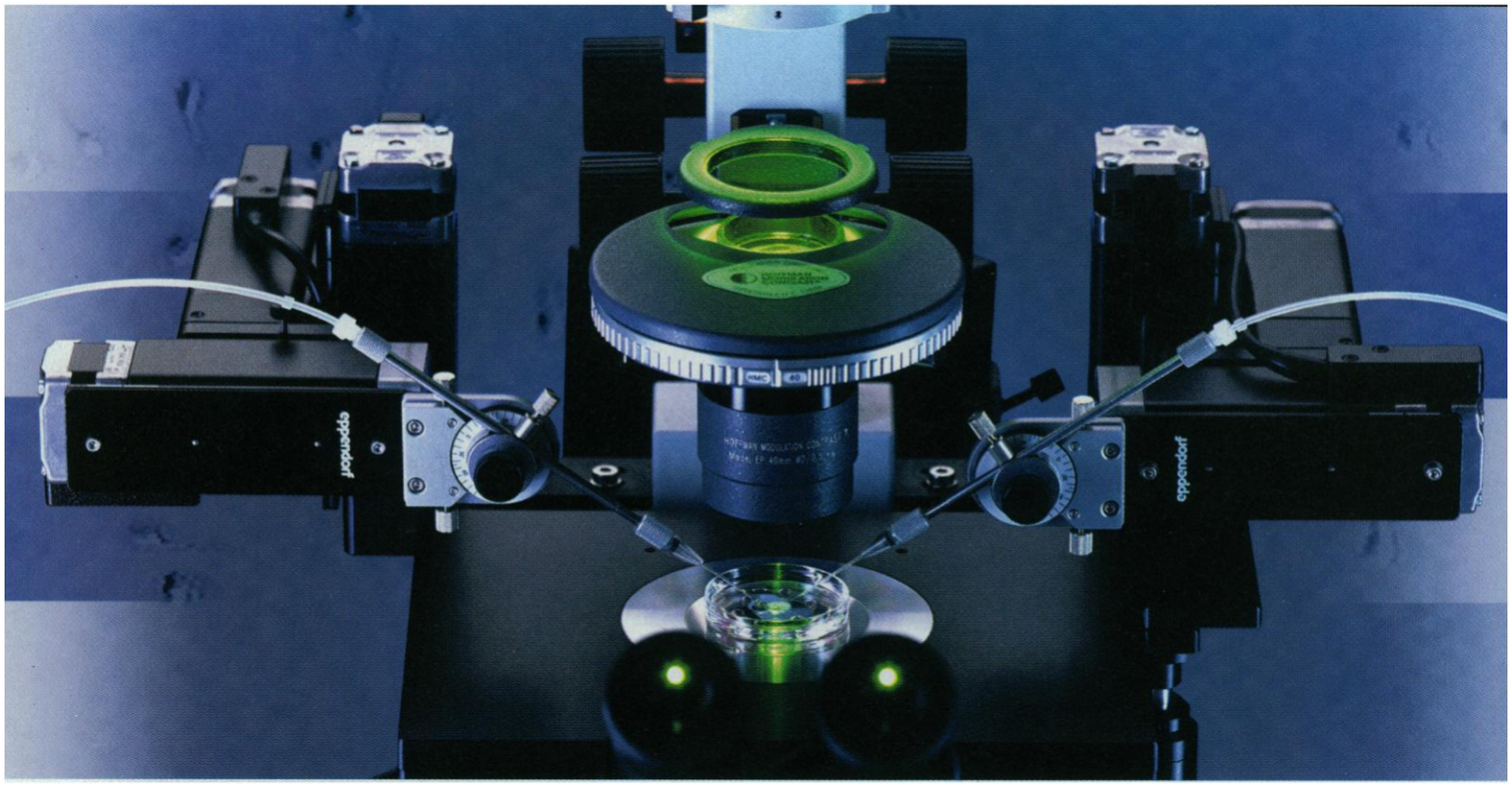

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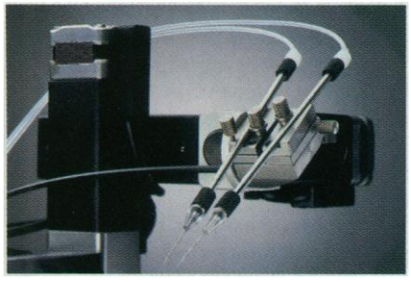

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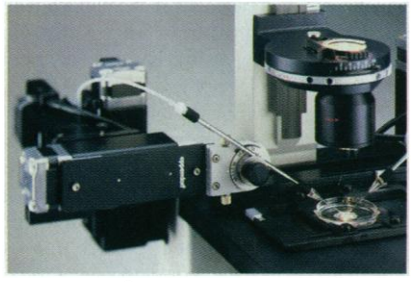

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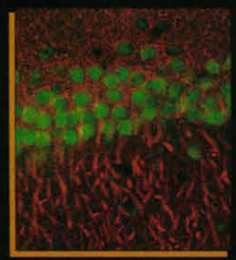

Confocal image of double immuno-staining for Phospho-p53 (Ser15) Antibody (green) and propidium iodide (red) in rat hippocampus CA1 region from tissue section of 15 minutes of transient cerebral ischemia followed by 3 hours of reperfusion. Yellow represents overlay of red and green. (Provided by Dr. Bingren Hu, Queens Medical Center, Hawaii.)

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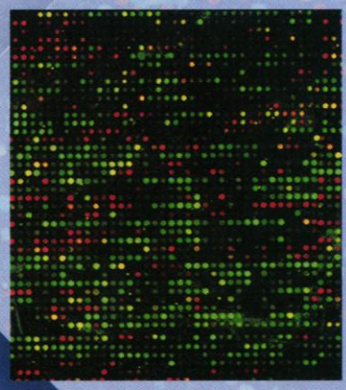

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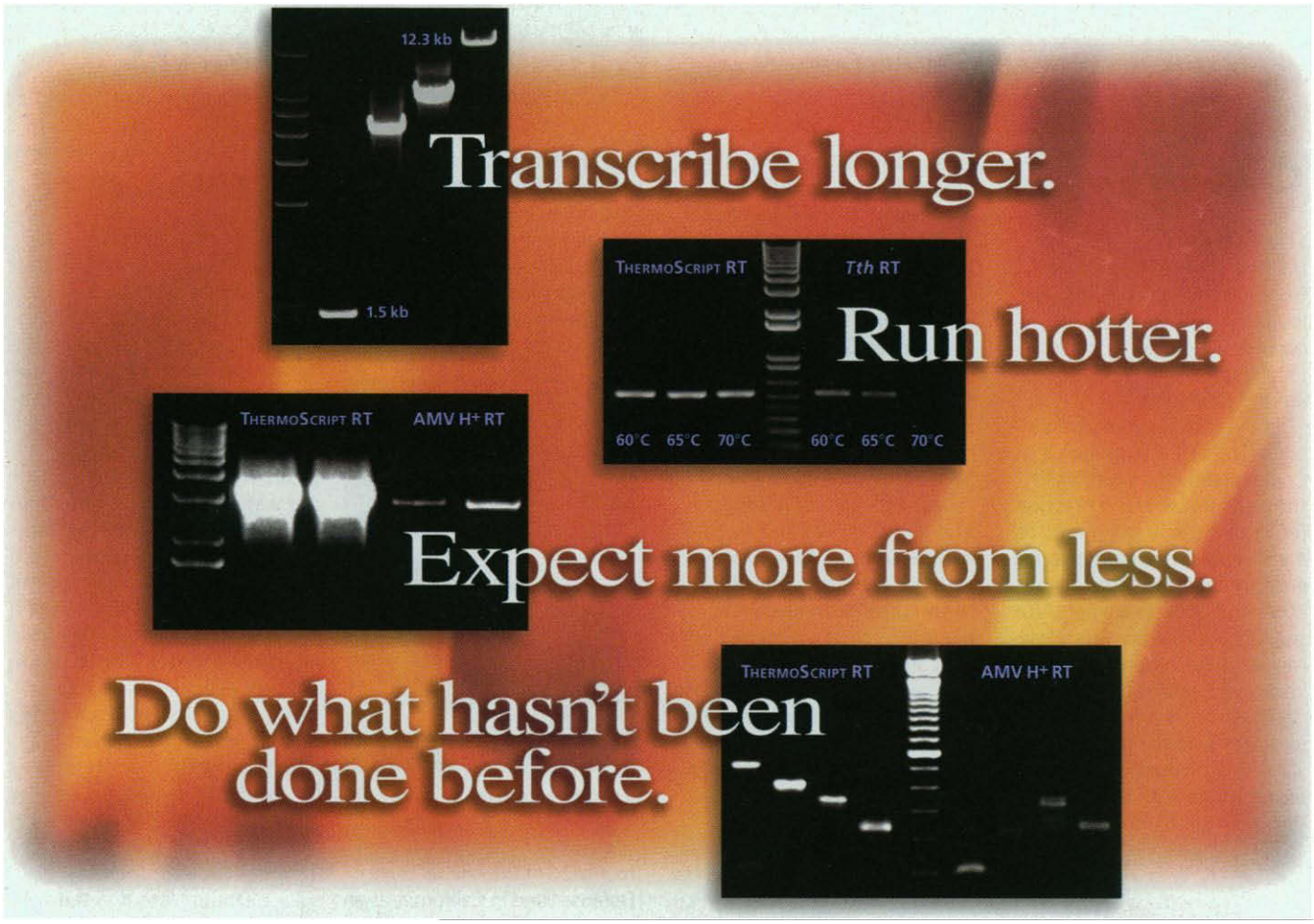

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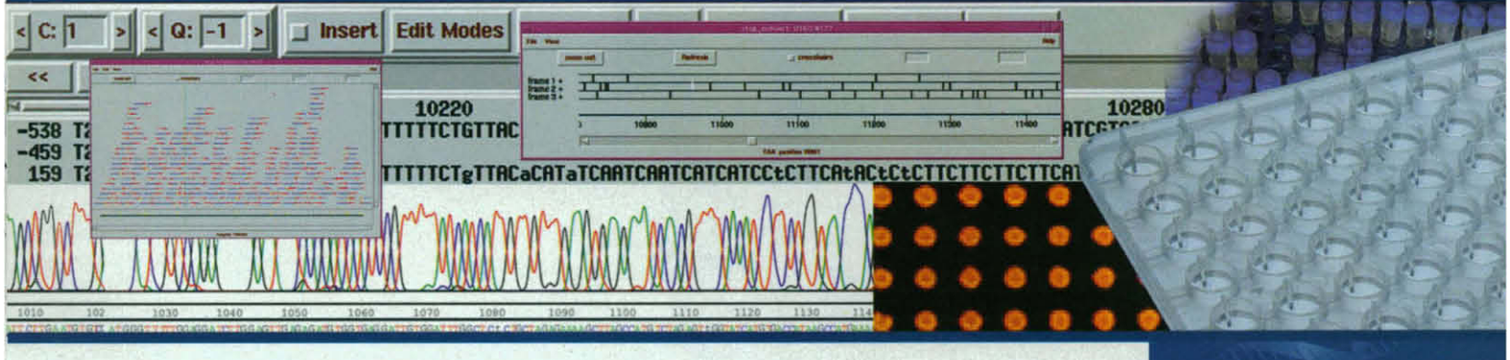

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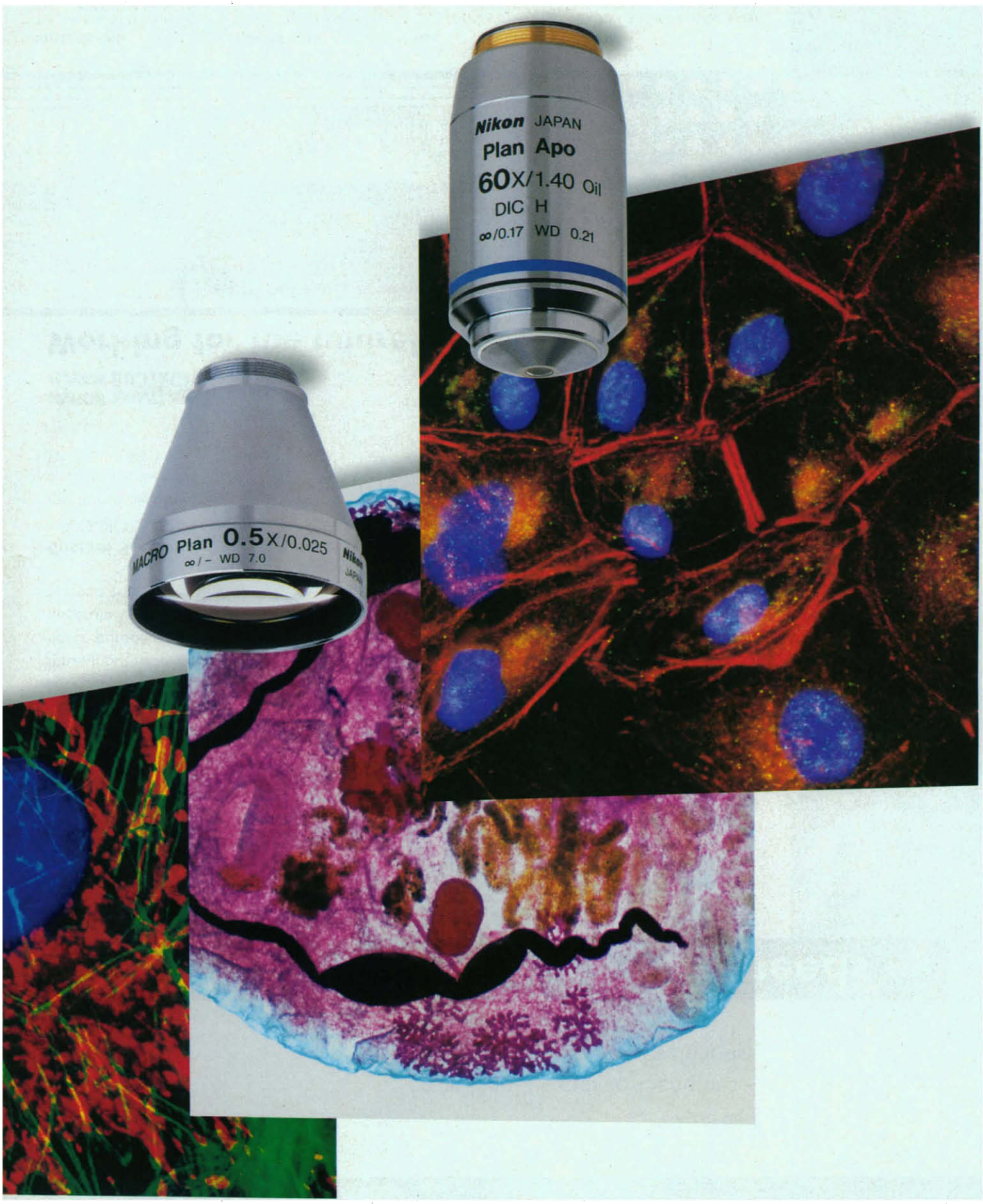
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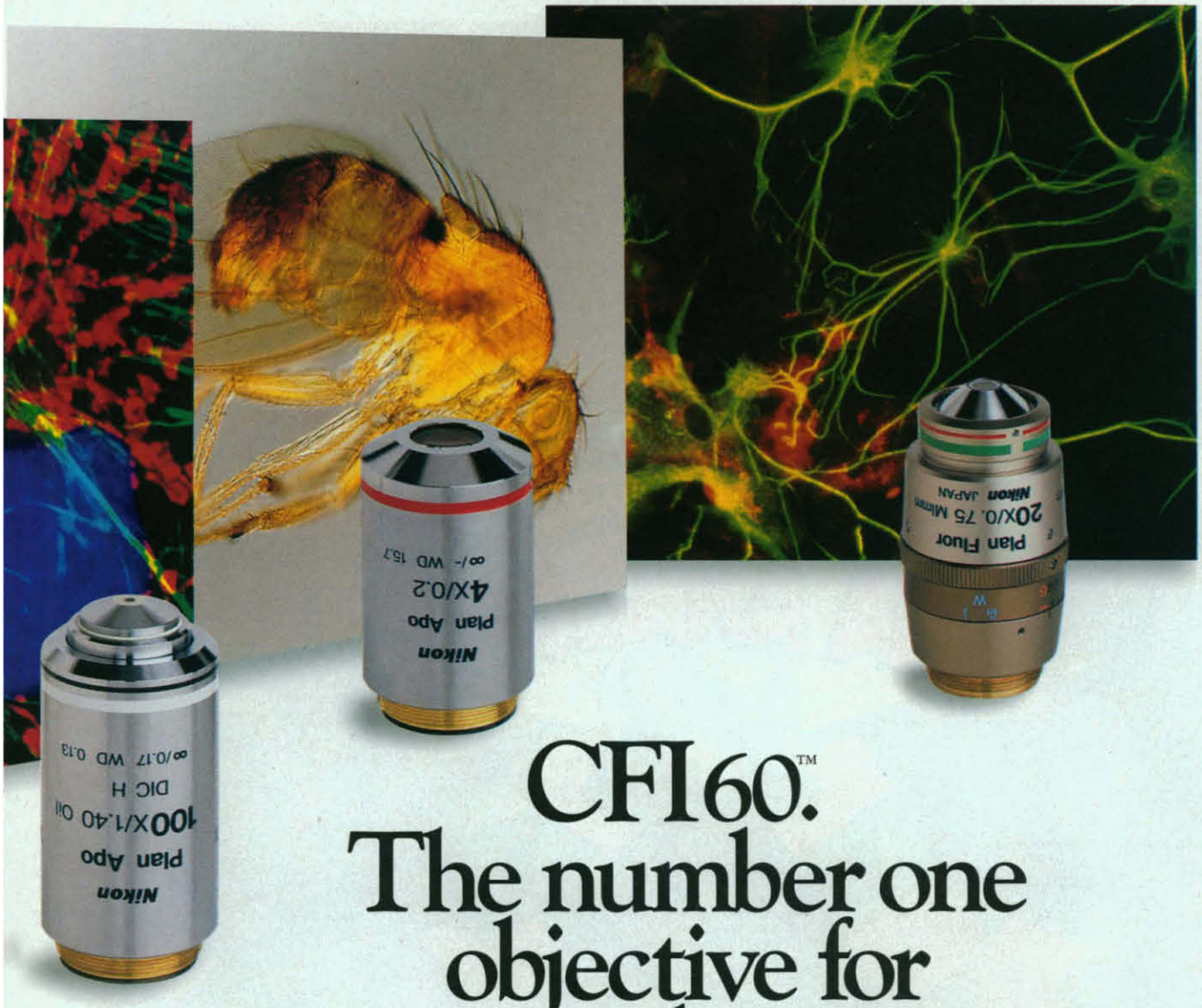

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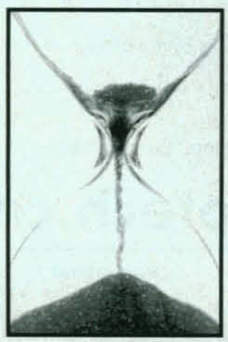

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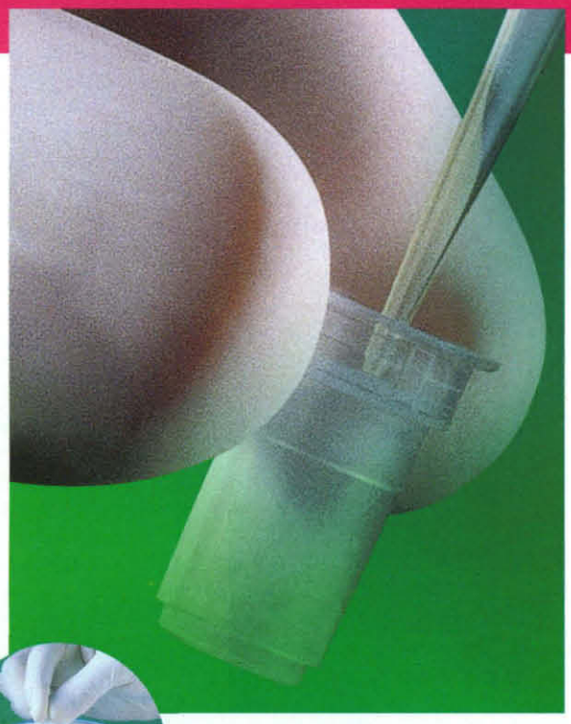

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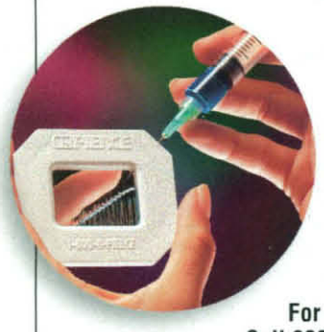
Slide-A-Lyzer® MINI Dialysis Units

SnakeSkin™ Dialysis Tubing



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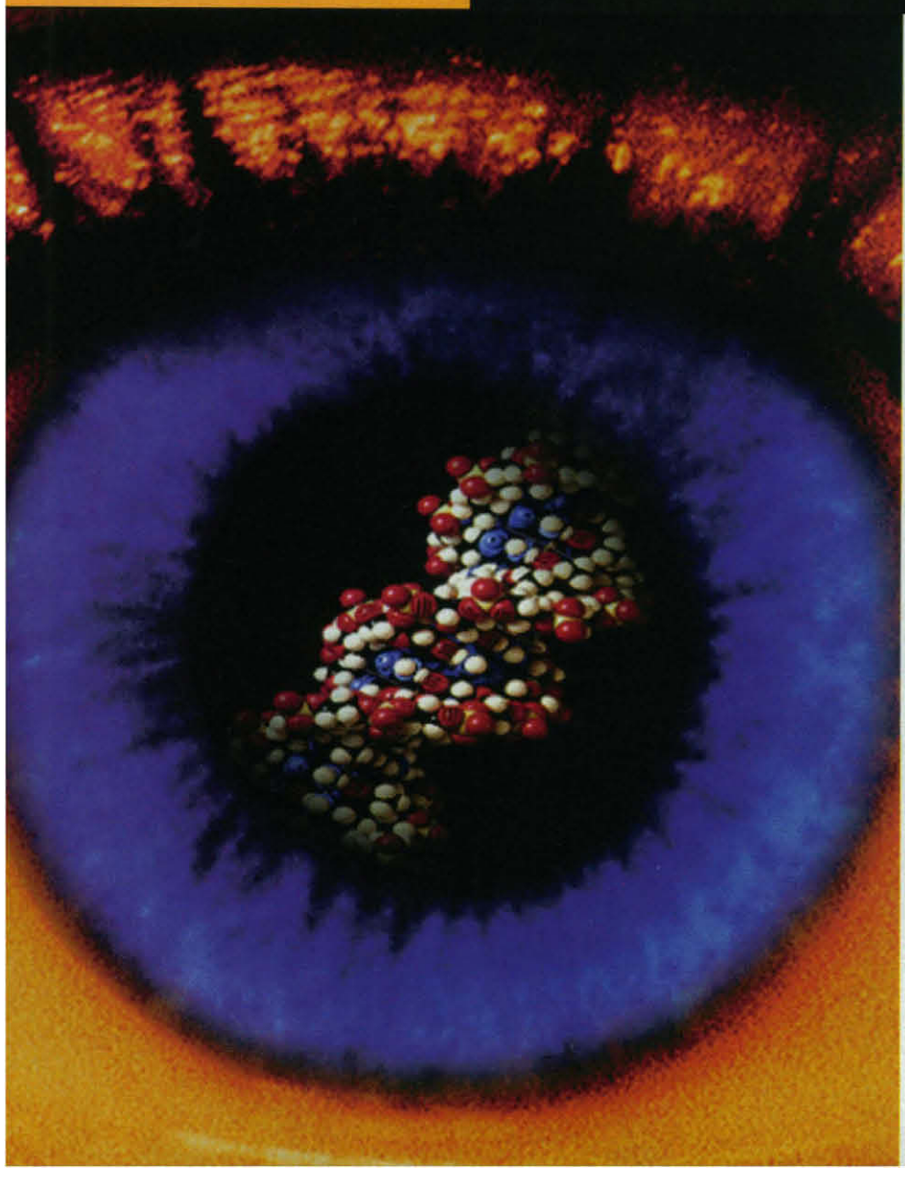

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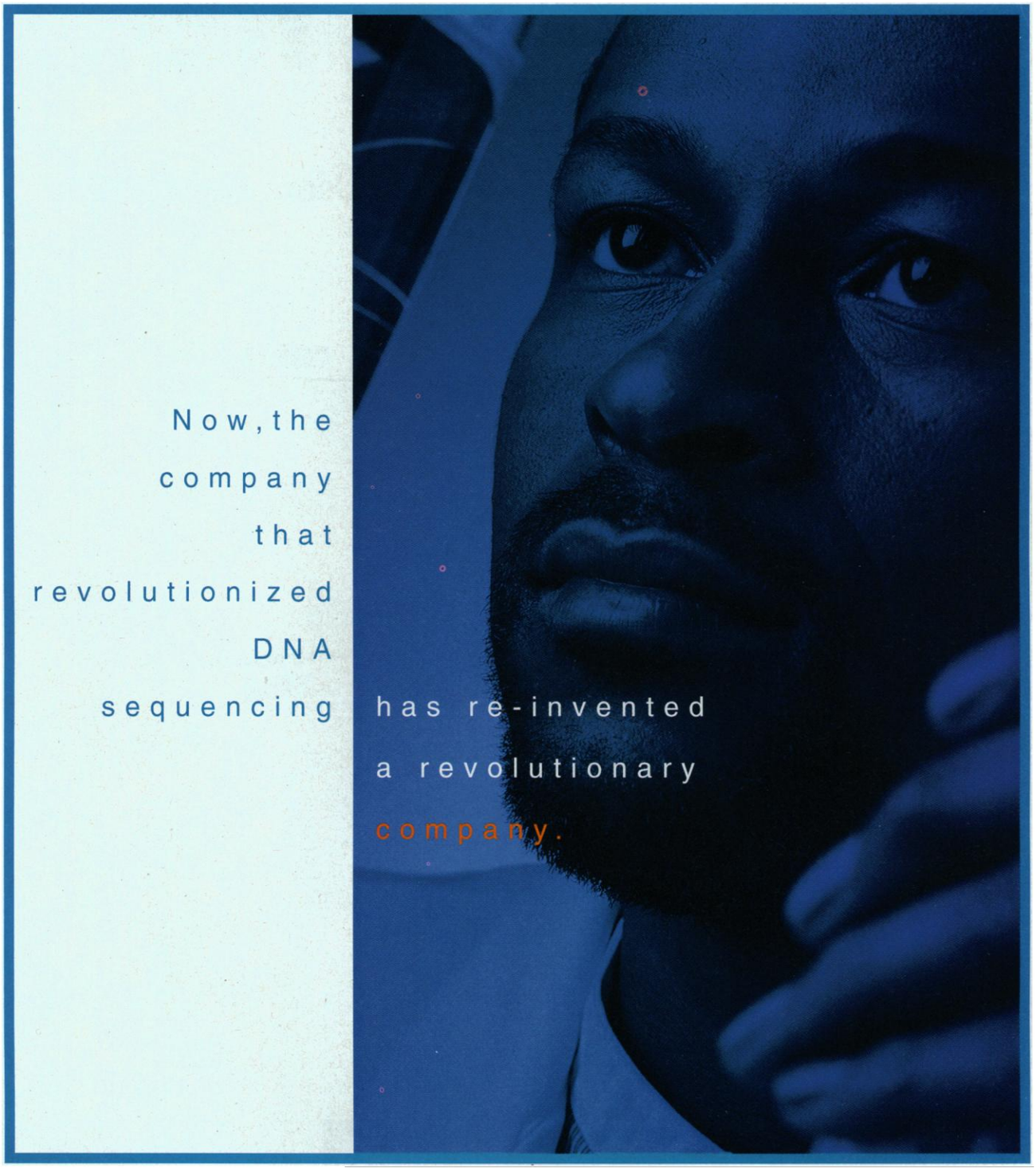

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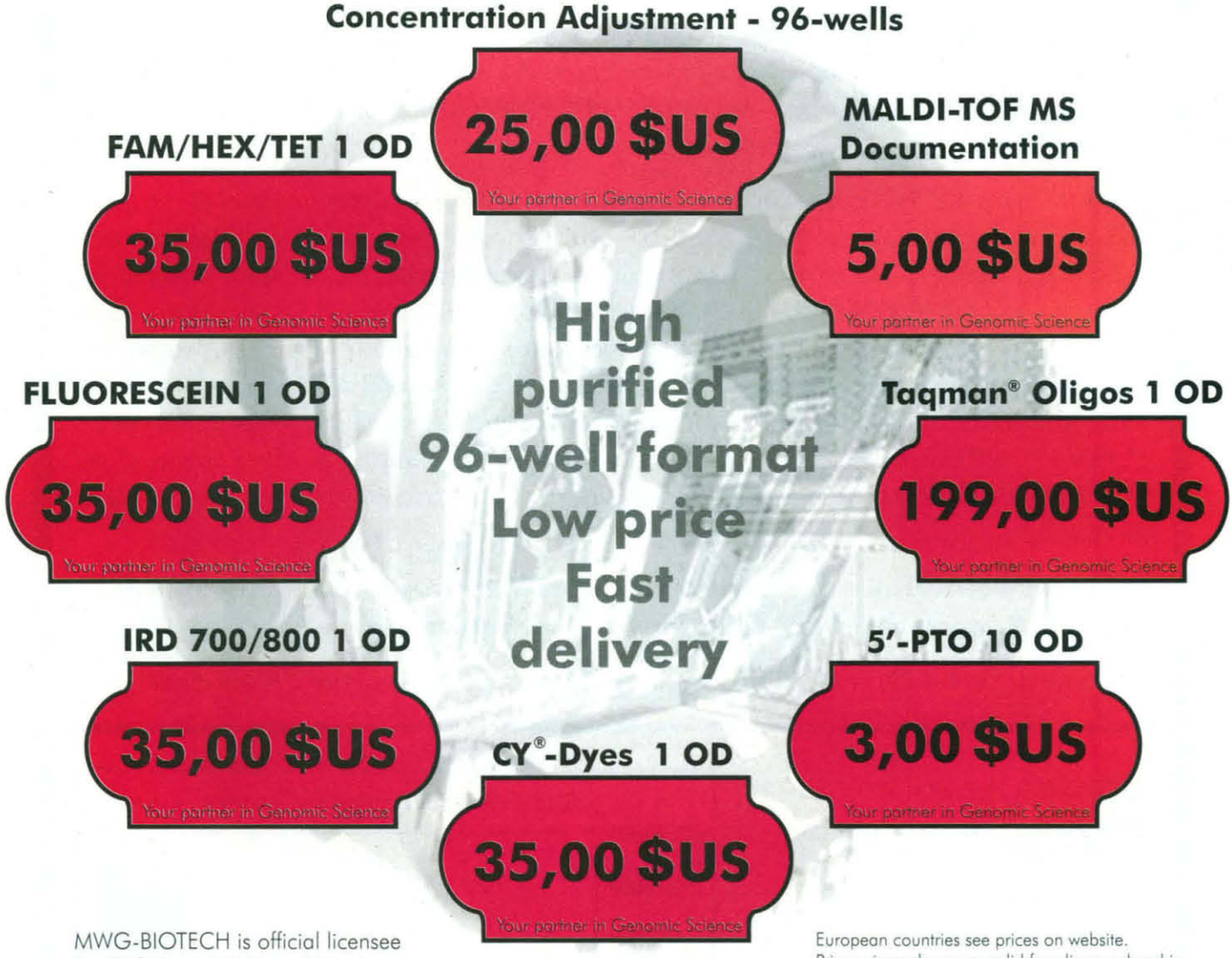

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Super-Promoter

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Scientists at Purdue University, in a project funded by Biotechnology Research and Development Corporation, have developed a novel chimaeric promoter for plants that exhibits much greater activity than other promoters currently available. This super-powerful promoter **("SUPER-PROMOTER")** is useful for expressing genes at high levels in genetically engineered transgenic plants.

Led by Dr. Stanton B. Gelvin, the scientists dissected the transcriptional regulatory sequences of two genes, encoding octopine synthase (ocs) and mannopine synthase (mas2[1]), and "mixed and matched" their transcriptional promoter and activator sequences in various combinations, one of which produced the extraordinarily active **SUPER-PROMOTER**. When attached to the GUS gene and introduced into tobacco plants, the **SUPER-PROMOTER** drives GUS expression at levels approximately 40 to 100-fold higher than other known strong promoters, such as CaMV35S, double CaMV35S, and "Big Mac" (see chart below). Similar results have also been obtained in cassava and cow-pea. Microscopic analysis of plant tissues reveals that the **SUPER-PROMOTER** functions in virtually all plant cell types. Furthermore, the strong activity of the **SUPER-PROMOTER** is uniform and stable for several generations in transgenic tobacco plants growing in tissue culture or soil.

The **SUPER-PROMOTER** also functions in corn. Quantitative studies in corn indicate the **SUPER-PROMOTER** functions as effectively as other promoters in side-by-side comparisons.

Patents for the **SUPER-PROMOTER** have been allowed, issued or are pending in the U.S. and abroad.

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TECHNICAL INFOMORMATION:

Dr. Stan Gelvin
Phone: (765) 494-4939 • Fax (765) 496-1496
E-mail: gelvin@bilbo.bio.purdue.edu.

LITERATURE REFERENCE:

M.Ni *et al.*, Plant Journal 7
661-676 (1995).

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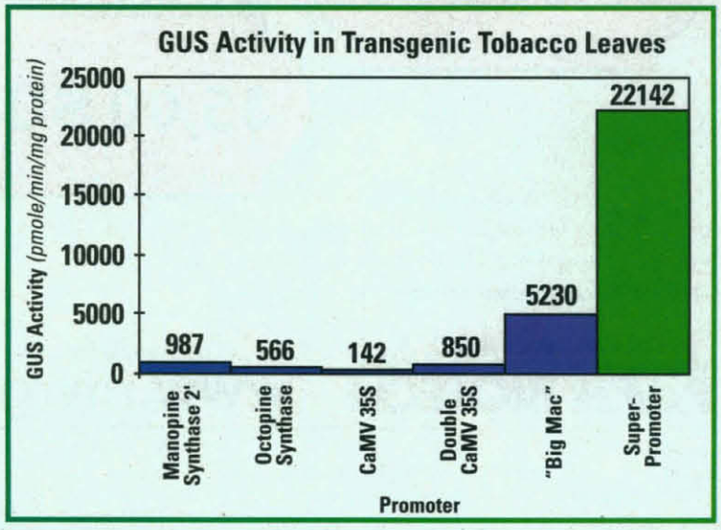

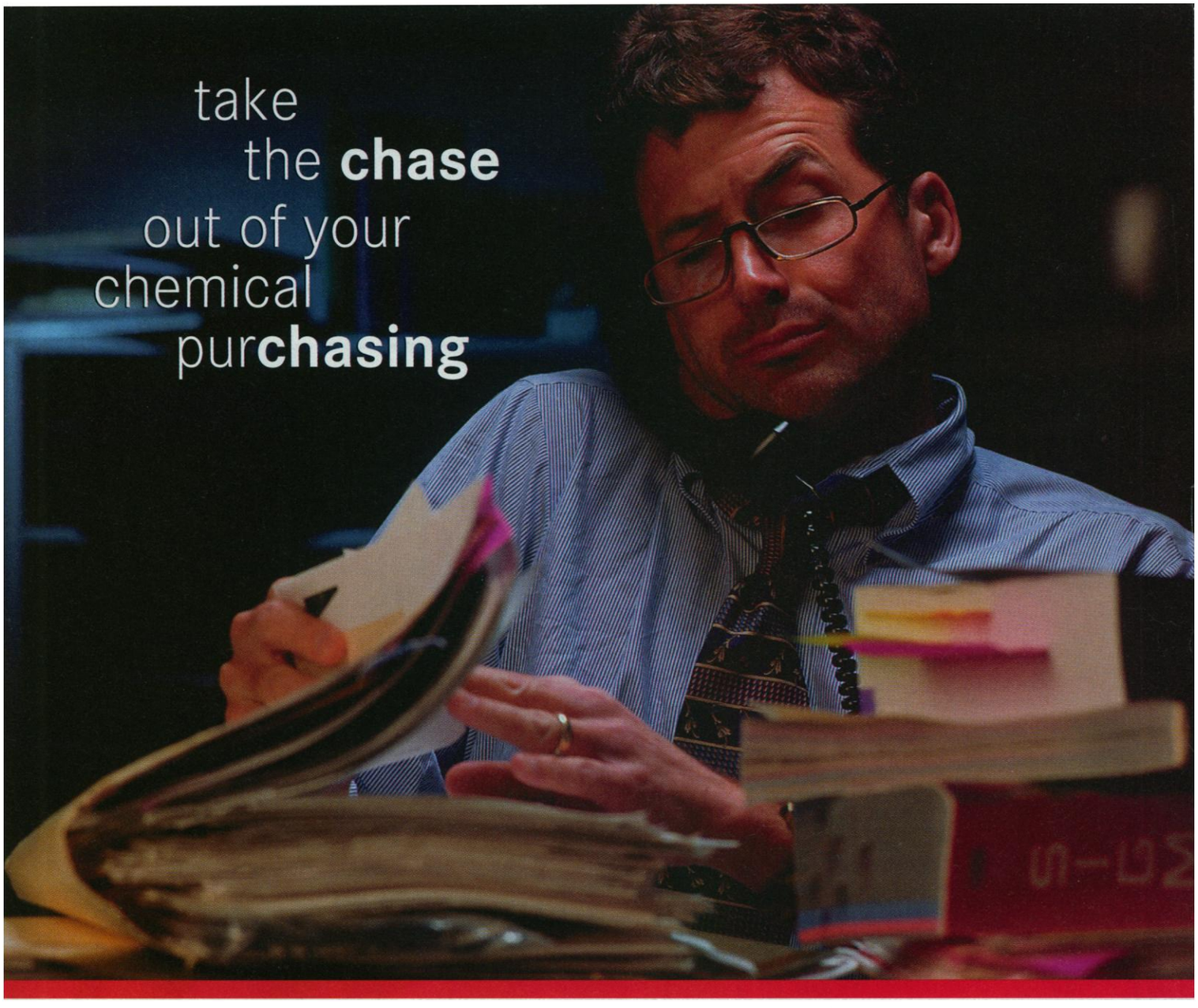

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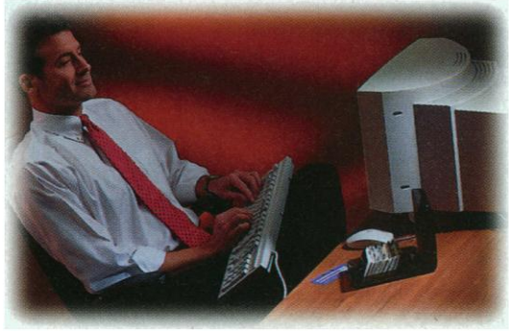

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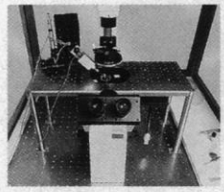

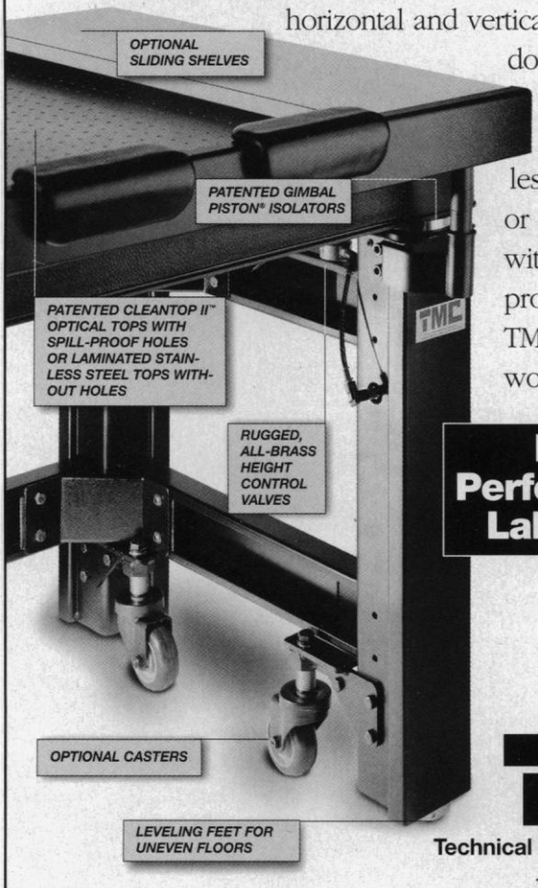

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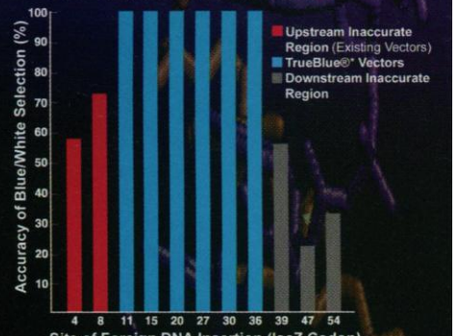

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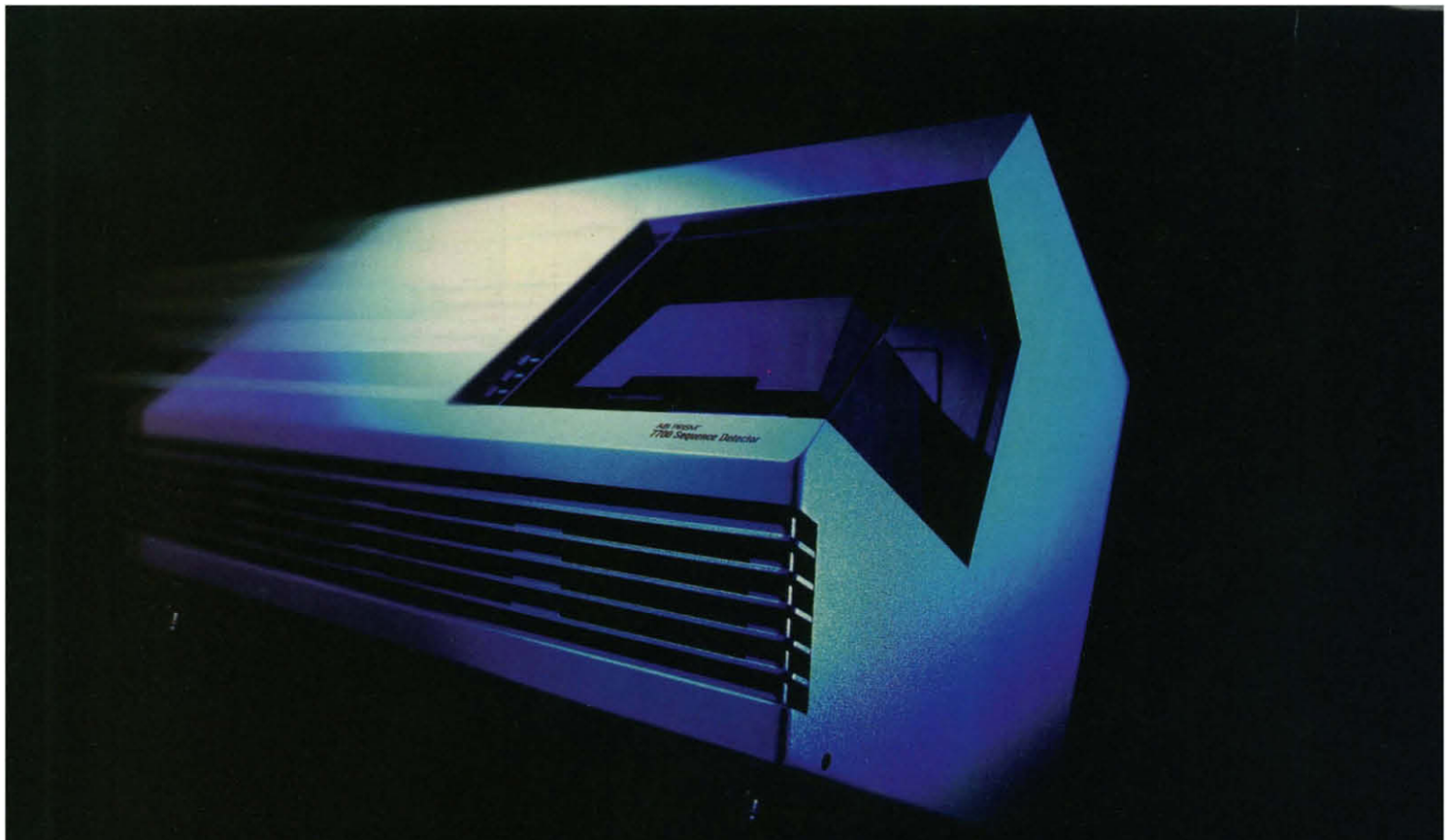

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