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Science

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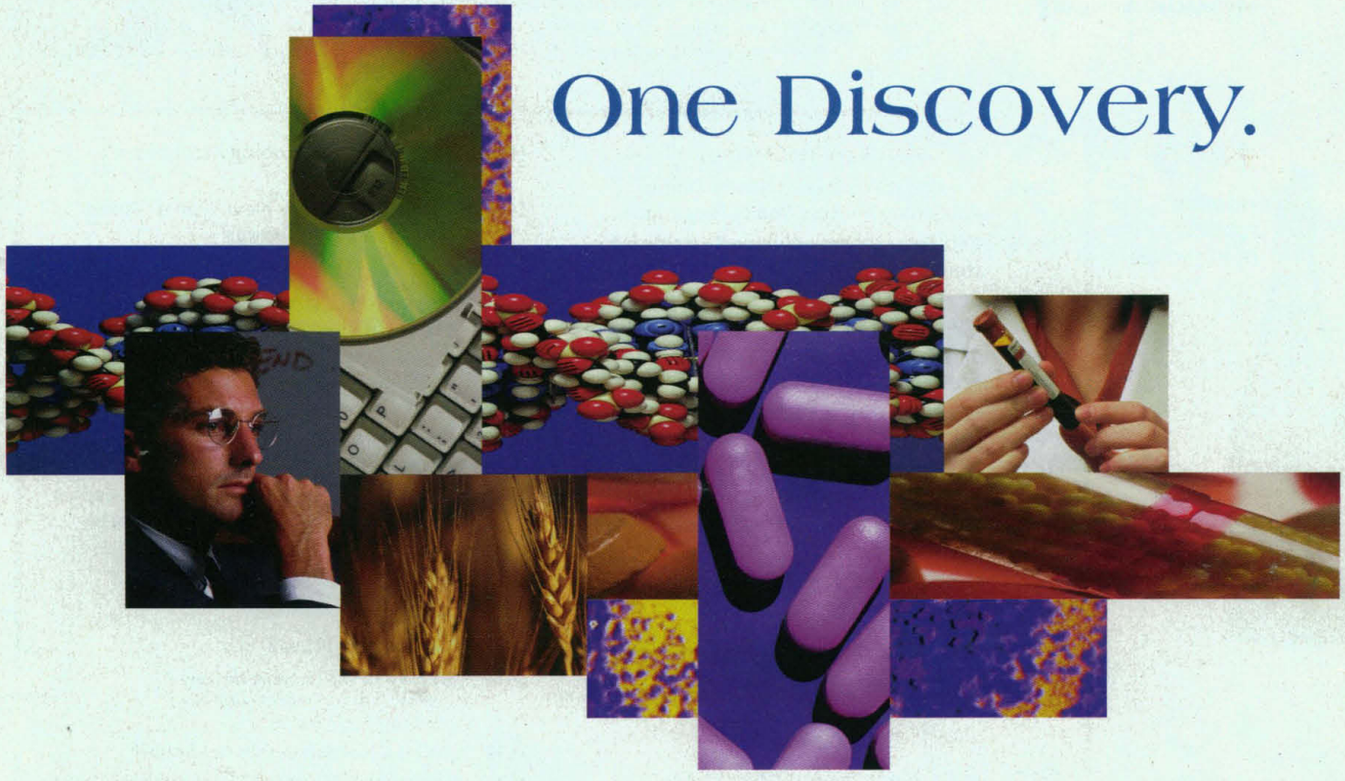

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Science

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COVER Many academic laboratories, like this one operated by Robert Langer at the Massachusetts Institute of Technology, depend heavily on the work of postdoctoral fellows. Beginning on page 1513, this special section takes a look at postdocs' efforts to gain greater respect within the scientific community, as well as European efforts to make better use of postdocs and Japan's attempt to incorporate the best aspects of the U.S. system while avoiding the pitfalls. [Photo: Sam Ogden]

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Humble roots of noble wines

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POSTDOCS WORKING FOR RESPECT

NEWS

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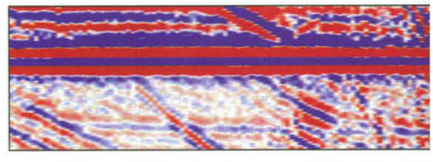

DEPARTMENTS

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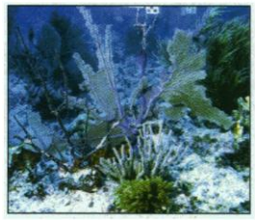

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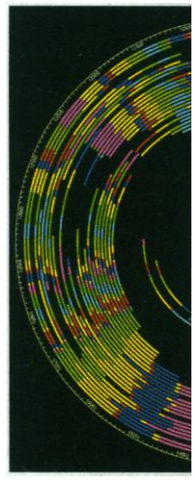

1558
Optical mapping of the genome of a radiation-resistant bacterium

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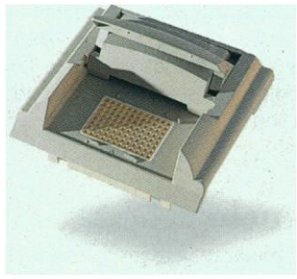

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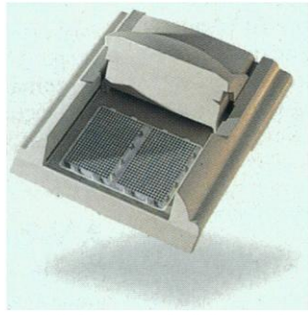

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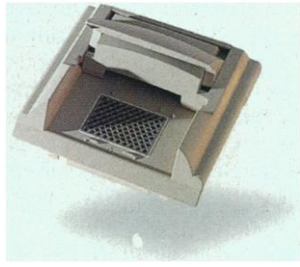

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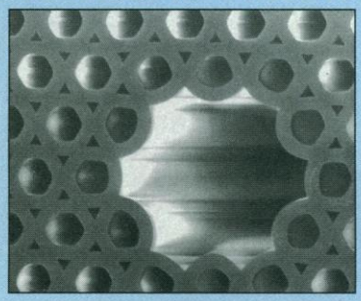
VACUUM-GUIDED OPTICAL FIBERS

Optical fibers have relied upon total internal reflection to guide light down the fiber. Such fibers, which require an interior core of high refractive index material surrounded by a sheath with lower refractive index, are limited to



relatively low-power transmission because of nonlinearities that occur in most optical materials at higher powers. Cregan *et al.* (p. 1537) have designed an optic fiber with a hollow core, or vacuum fiber, which incorporates a defect-mode photonic band gap structure to confine the light to the hole area and allow only certain wavelengths to propagate. This design has the potential for much higher power transmission to be realized.

MIXING SILICON AND SUGAR

Silicon coordinated to five or six ligands is relatively rare. Pentacoordinated silicon has been observed in glasses and melts, where it plays a role in relaxation processes, and both penta- and hexacoordinated silicon has been observed in various organic solvents and in crystal structures. In contrast, stable structures in aqueous solution are rare and have to date been reported only for some hexacoordinated silicate species with aromatic ligands. Kinrade *et al.* (p. 1542) now demonstrate that penta- and hexacoordinated silicates can also be stabilized in aqueous solution by using very simple sugar molecules as ligands. The observation may have implications for the uptake and transport of silicon by plants.

A SMALLER JUMP

Earth's upper mantle contains two well-resolved changes of state determined by sharp increases in the velocity of seismic waves (velocity jumps) that occur at depths of 410 and 660 kilometers (km). These discontinuities are observed globally, but more detailed observations have led to discrepancies in the amount of the average increase in the seismic wave velocities at these boundaries. Shearer and Flanagan (p. 1545) used more than 30,000 seismograms collected between 1976 and 1997 to determine the velocity jumps and density jumps at these two boundaries. They found that the density jump at the 660-km discontinuity is about half that estimated from the preliminary reference Earth model (PREM). This result will require a reevaluation of the possible mineral phase transformations and the pattern of convection at the 660-km discontinuity.

A SPUTTERING ROUTE TO NANODOTS

In situ fabrication of semiconducting nanodots generally has been done either by using lithography to impose a pattern or through self-organized growth of islands on the substrate. Facsko *et al.* (p. 1551) show that when a gallium antimonide surface [(100) GaSb] is subjected to argon-ion sputtering at normal incidence, large, regular arrays of nanodots appear after a few minutes. The competition between surface roughening caused by etching and smoothing caused by diffusion leads to nanodot formation.

THE COMBINED FORECAST

Seasonal and longer climate forecasts, as well as shorter weather predictions such as those of hurricanes, are of great economic and societal importance. Such forecasts are primarily based on climate models. Krishnamurti *et al.* (p. 1548) used a multiple regression analysis of model forecasts against observations to combine several climate models into a superensemble that can significantly decrease errors compared to individual models or to a simple averaging of the different model forecasts. They propose a protocol in which models can be linked to return more accurate superensemble forecasts.

SHOW ME THE STEM CELLS

Hematopoietic stem cells can generate all of the cells found in the blood and have the capacity to self-renew. The defining phenotypic characteristics that would enable their ready identification and isolation have been elusive—in particular, there has been no easy way to differentiate them from progenitor cells that can only make particular lineages of blood cells. Ziegler *et al.* (p. 1553) now report that the receptor for the cytokine VEGF (vascular endothelial growth factor), called KDR, marks a highly enriched subpopulation of primitive hematopoietic cells as stem cells, not progenitor cells.

MAPPING RADIATION RESISTANCE

The ability to make rapid physical maps of the genomes of microorganisms will greatly facilitate sequencing efforts and speed up the analysis of multiple genomes. Lin *et al.* (p. 1558) were able to construct a whole-genome restriction map of *Deinococcus radiodurans*, a bacteria of great interest because of its extreme resistance to radiation, from optical mapping of randomly selected fragments generated by restriction enzyme digestion. This procedure enabled the discovery and characterization of a second (mini) chromosome. Images of DNA from cells that were γ-irradiated showed no evidence for the mediation of DNA repair by circular intermediates.

THROUGH THE GRAPEVINE

Molecular genetic techniques have begun to reveal the hitherto unknown origins of many of the ancient grape varieties that produce classic wines. In a far-reaching DNA analysis of the wines of northeastern France, Bowers *et al.* (p. 1562; see the news story by Hagmann) not only reveal the origin of Chardonnay but also show that almost all of the wines of this region are full siblings. Their parents are Pinot noir and the much lesser known (and oft-denigrated) Gouais blanc. This finding has implications for the viticulture industry, including the conservation of rare germplasm.

SPECIAL DELIVERY

Delivery of therapeutic proteins into tissues and across the blood-brain barrier is severely constrained by protein size. Schwarze *et al.* (p. 1569; see the news story by Strauss) have achieved efficient delivery of a large biologically active protein into mice by a method called protein transduction. The protein of interest is fused to an 11–amino acid sequence from the human immunodeficiency virus Tat protein, a sequence shown in earlier cell culture studies to mediate passage of proteins through lipid bilayers. Mice that had been injected intraperitoneally with a Tat-β-galactosidase fusion protein showed β-galactosidase activity in all

CONTINUED ON PAGE 1459

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CONTINUED FROM PAGE 1457

tissues, including the brain, within 4 hours. This method may lead to new possibilities for experimental manipulation of model organisms as well as for delivery of therapeutic proteins.

ALTERNATIVE ANTIMALARIAL PATHWAY

The search for new antimalarial drugs is being pushed by the increasing development of resistance to known therapeutic agents. Jomaa *et al.* (p. 1573; see the Perspective by Ridley) have found that, unlike their human hosts, *Plasmodium falciparum* uses a nonmevalonate pathway (DOXP) for the biosynthesis of isoprenoids. On the basis of similarities between bacterial and algal enzymes and sequence on chromosome 14 of *P. falciparum*, the authors identified and cloned a DOXP reductoisomerase from *P. falciparum*. *Plasmodia* in culture and in a rodent model were inhibited by fosmidomycin, a drug known to target DOXP reductoisomerase, as well as one of its derivatives. The drugs had low toxicity and could be taken orally.

A BARD'S SHORT MESSAGE

Polyadenylation of messenger RNA (mRNA) precursors requires a complex protein machinery. Kleiman and Manley (p. 1576) show that one component of this machinery is BARD1, a protein previously identified as a factor that physically associates with the breast cancer susceptibility protein BRCA1. BARD1 binds to the polyadenylation factor CstF-50 and inhibits polyadenylation in vitro. These results suggest that BARD1 may prevent inappropriate processing of mRNAs, for example, of nascent transcripts stalled at sites of DNA damage.

REMEMBRANCE OF THINGS PAST

The recollection of simple facts, such as individual words in a list, relies upon brain structures within the medial temporal lobe. Fernández *et al.* (p. 1582; see the Perspective by Schacter and Wagner) used invasive electrodes, inserted pre-operatively into the medial temporal lobes of patients about to undergo resection, to monitor the time course of electrical activity during presentation of word lists. Some words were freely recalled; others were not. Comparison of the electrical activity for remembered and forgotten words revealed a difference in amplitude at about 0.3 seconds (after the word was first seen) in the rhinal cortex, followed at 0.5 seconds by an amplitude difference in the hippocampus. Thus, the formation of declarative memory can be broken down into sequential subprocesses.

TECHNICAL COMMENT SUMMARIES

Tropical Tree Richness and Resource-Based Niches

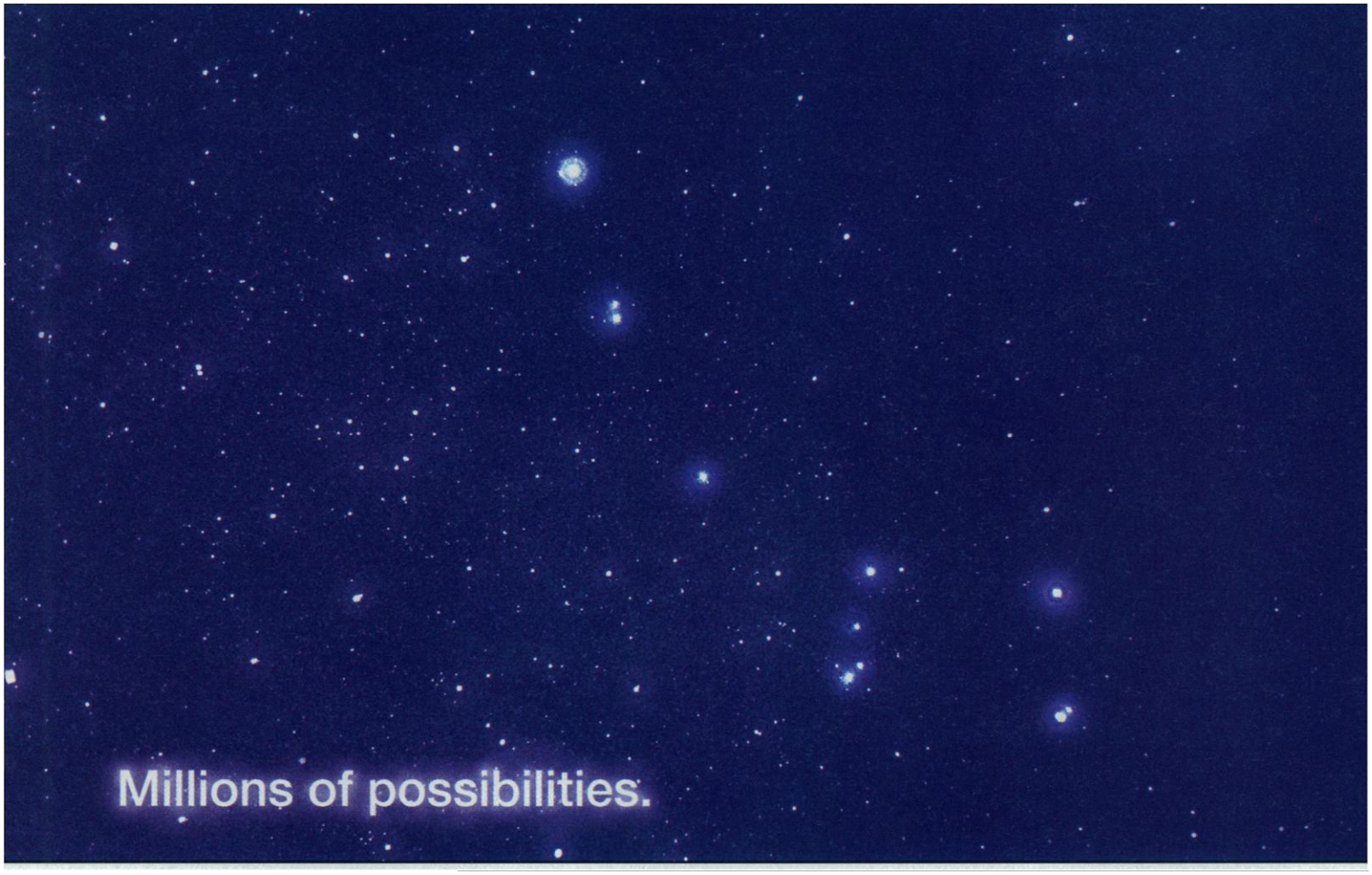
The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/285/5433/1459a

S. P. Hubbell *et al.* (Reports, 22 Jan., p. 554) studied trees growing beneath "more than 1200 gaps in a tropical forest in Panama over a 13-year period." Such openings in the forest canopy let in light and are thought to allow different species of trees to get a foothold in a mature forest. Hubbell *et al.* tested this hypothesis by asking "whether spatial and temporal variation in the gap disturbance regime is actually predictive of stand-to-stand variation in tree species richness and composition in particular tropical forests." They found, contrary to expectations, that "spatial and temporal variation in the gap disturbance regime did not explain variation in species richness."

R. L. Chazdon *et al.* comment that "the intermediate disturbance hypothesis predicts not simply that species richness in any one gap will be greater than in the same area of mature forest matrix, but that gaps collectively will be richer than the matrix, because gaps provide more diverse conditions and resources." They also state that "species per stem is an inappropriate statistic for comparing species richness among samples that differ in density."

R. K. Kobe comments that "normalizing richness by stem number leads to upward-biased estimates of richness under low density...and downward-biased estimates of richness under high density."

In response, Hubbell provides a figure showing cumulative number of tree species plotted against cumulative number of individual trees. These data show that, in the forest under study, "gaps are actually species-poorer than the mature forest, whether or not one normalizes per stem. Moreover, contrary to the intermediate disturbance hypothesis, there is a monotonic decrease in species richness of the species-individual curve as gap size increases."



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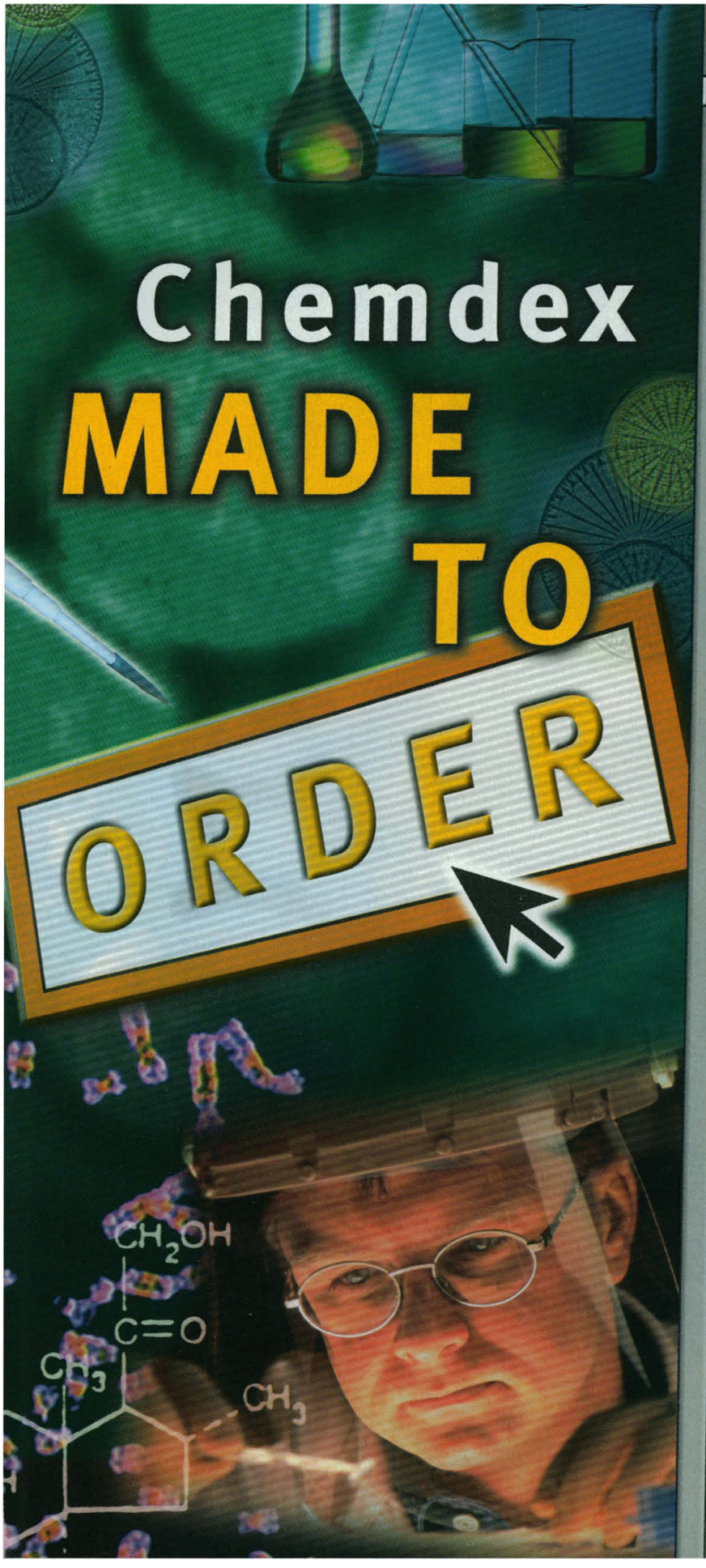

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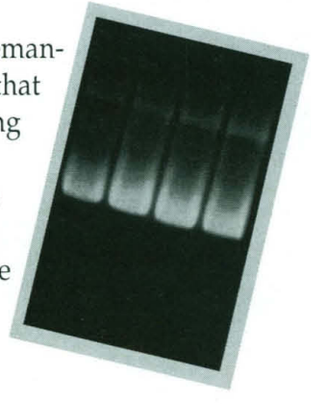

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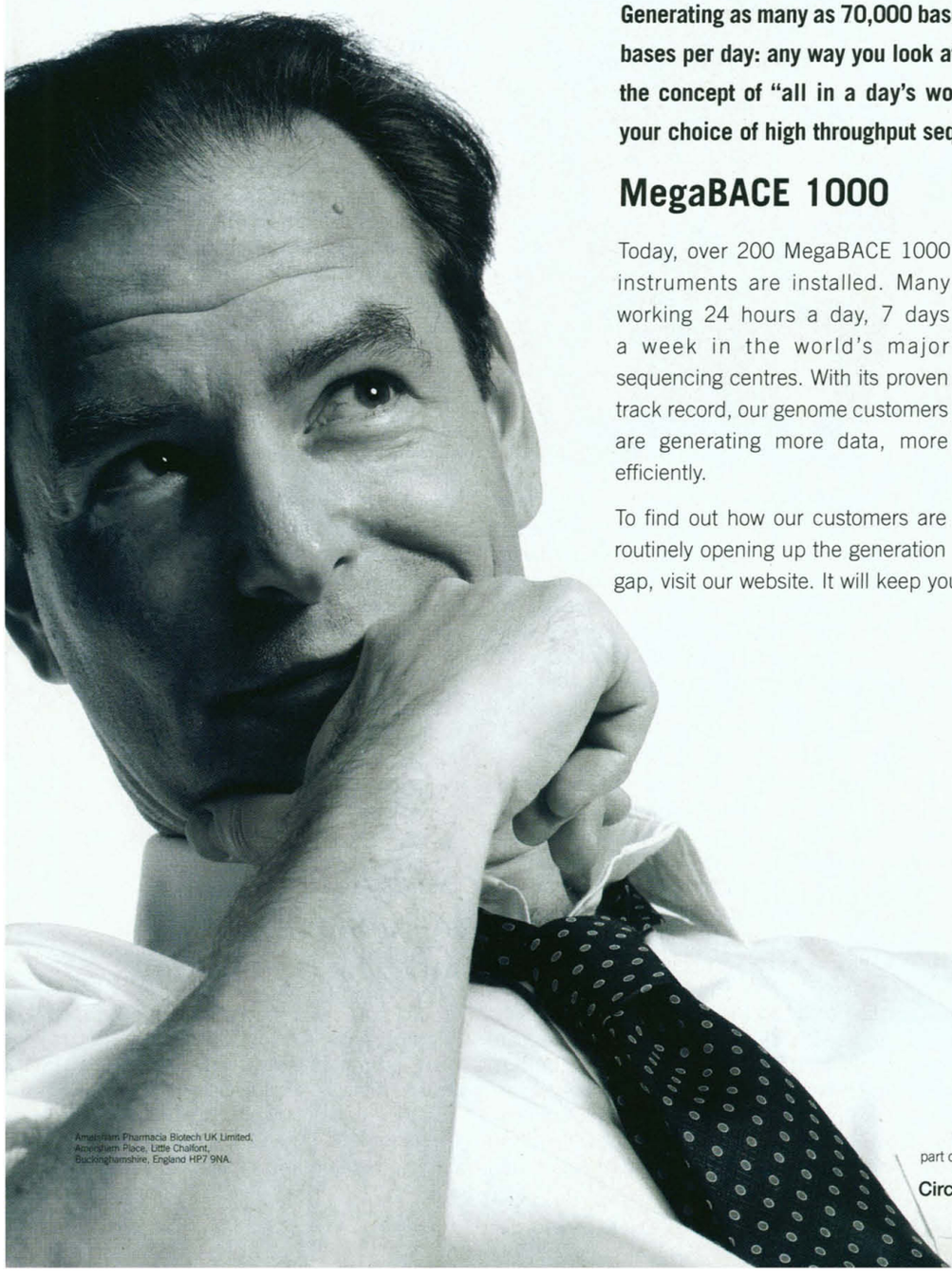

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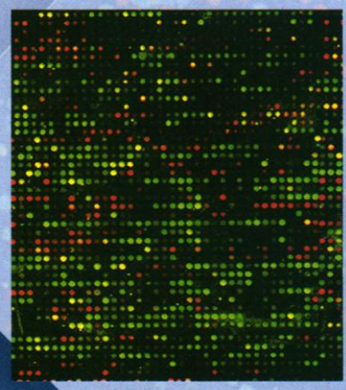

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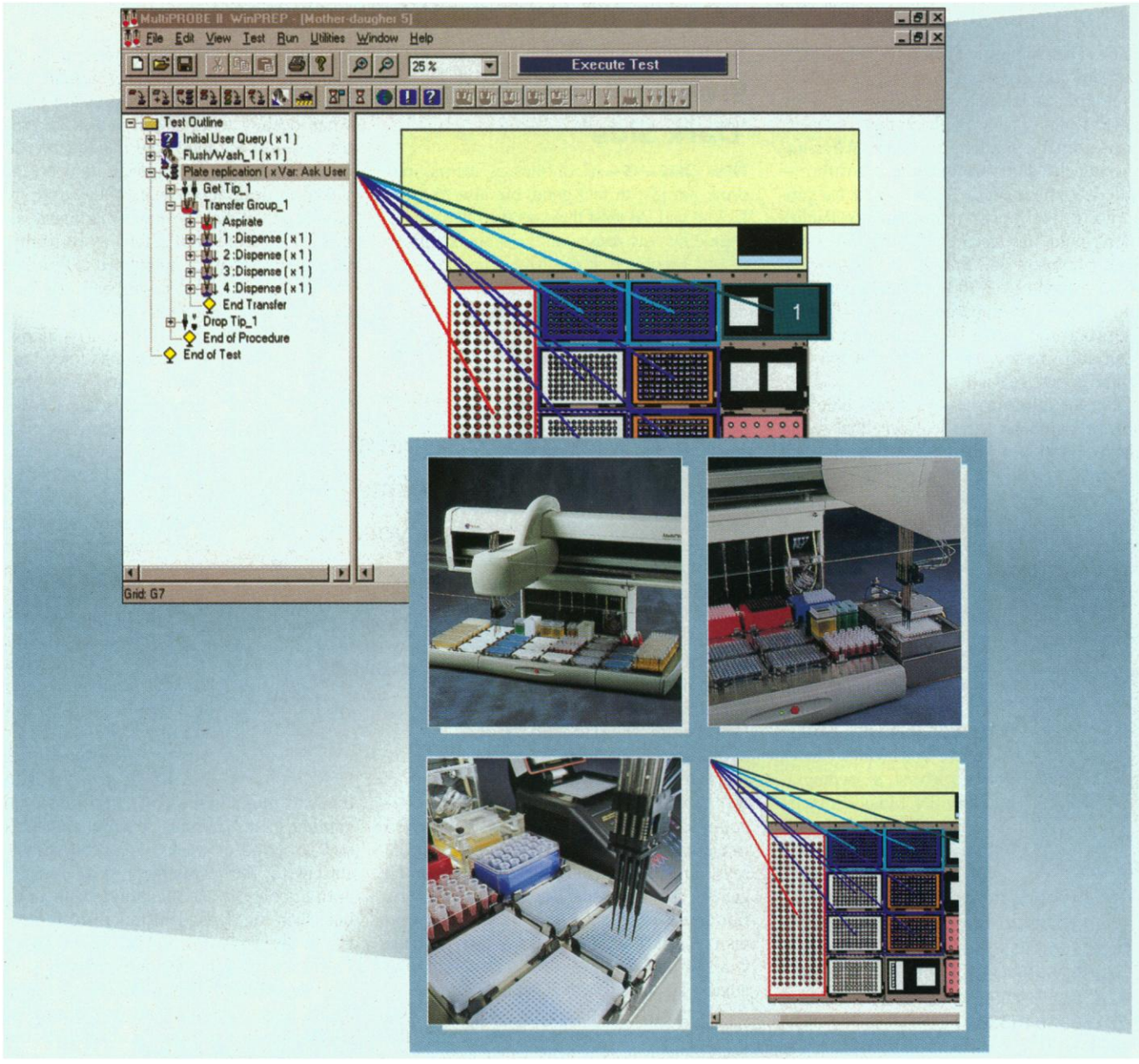

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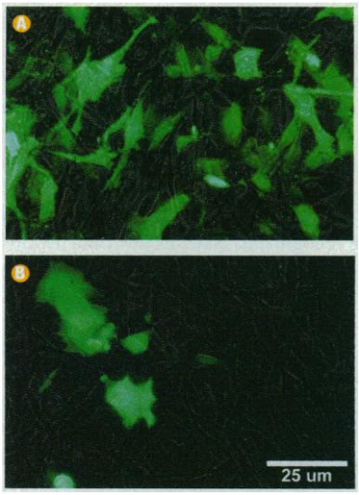

Expression of GFP in MC3T3-E1 cells, following transfection with vector phGFP-S65T using (A) FuGENE 6 Reagent or (B) leading supplier's liposomal transfection reagent (LF). *(Data courtesy of S. Ritter, Univ. of Texas, Houston, TX, USA)*

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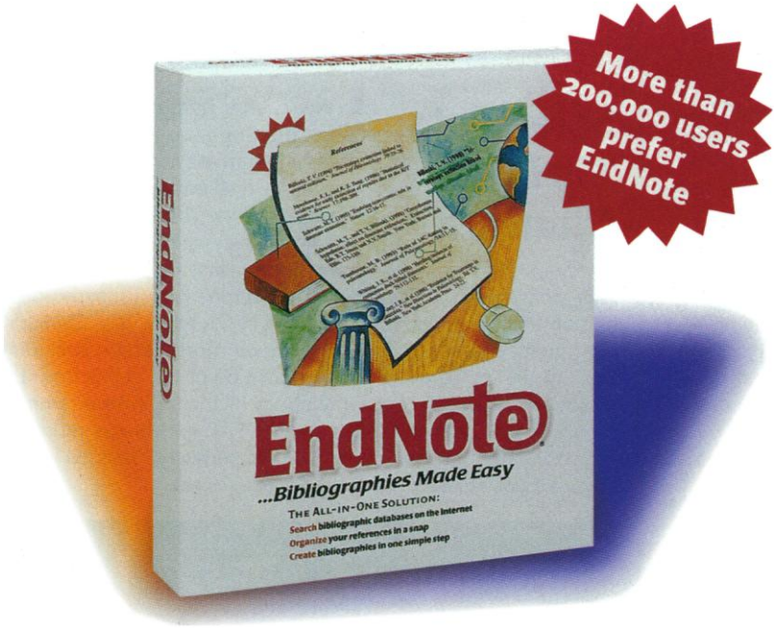

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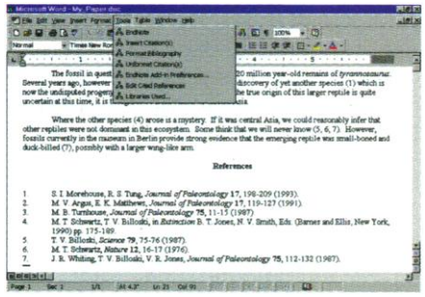

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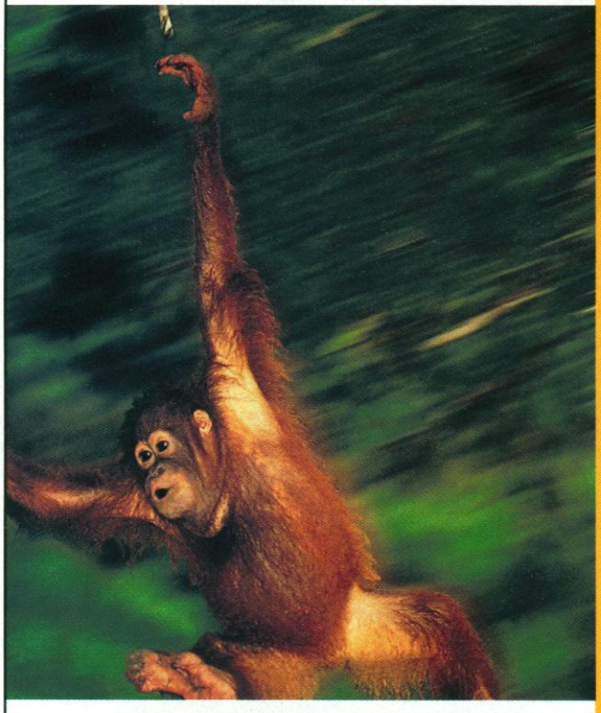

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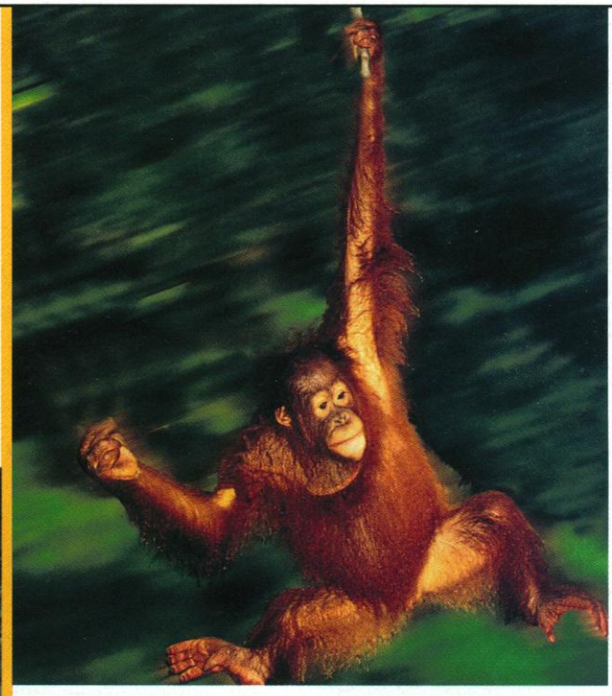

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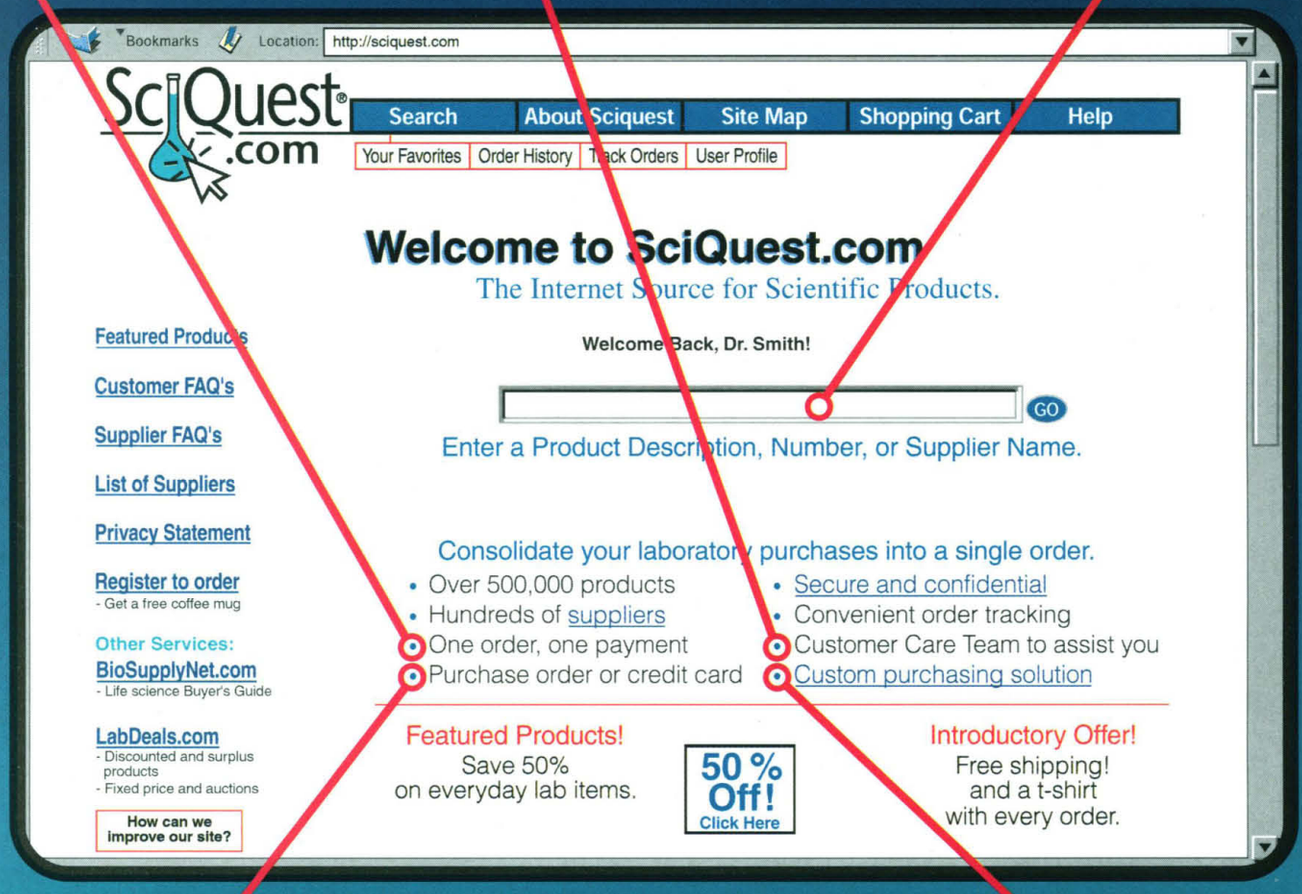

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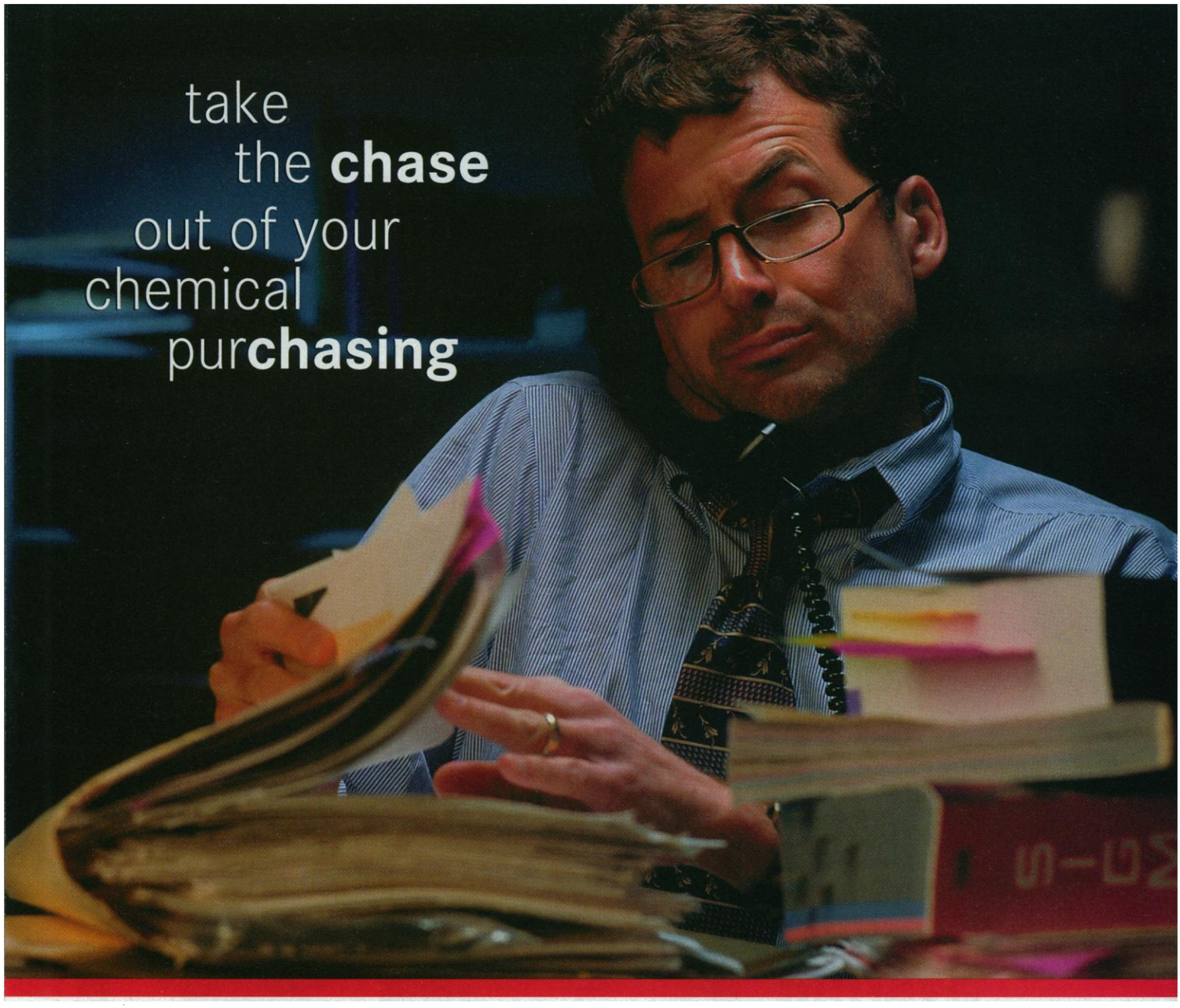

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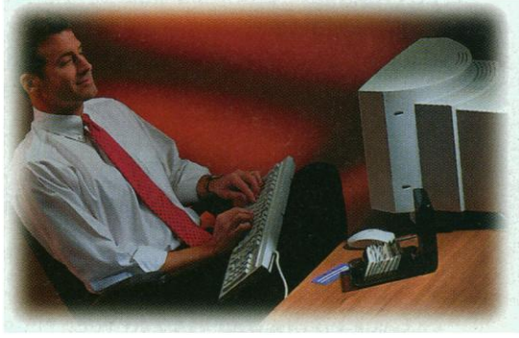

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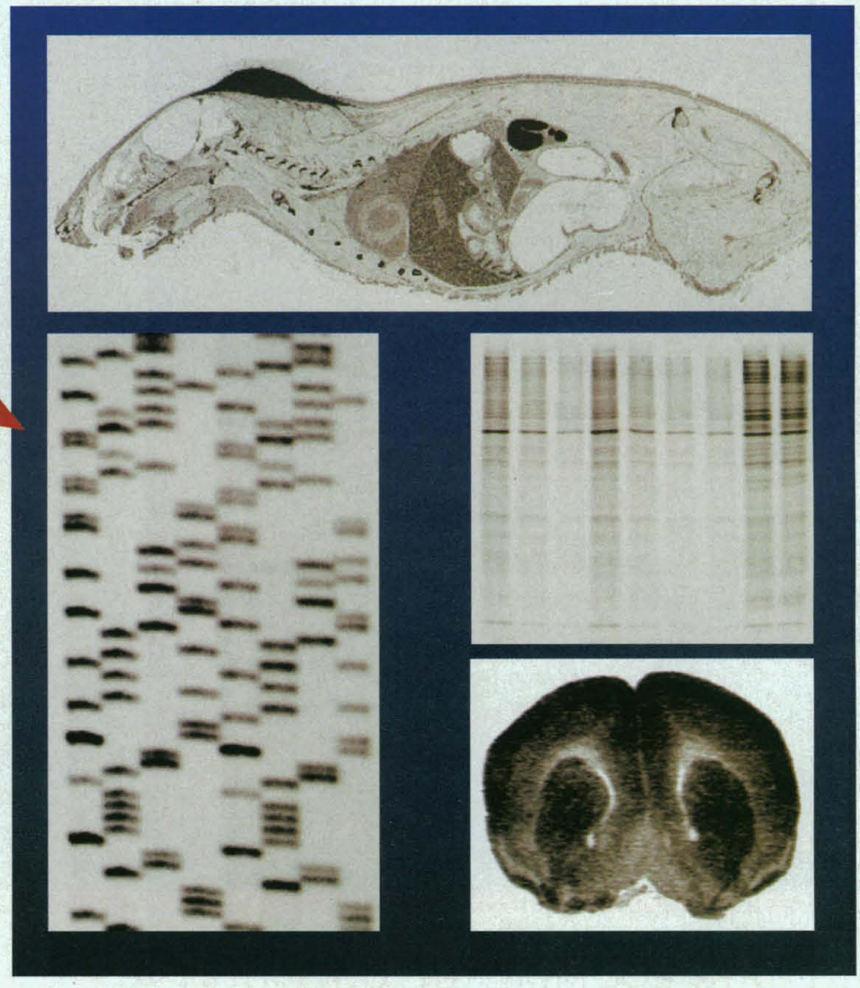

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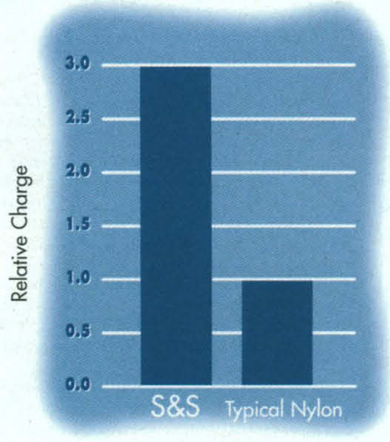

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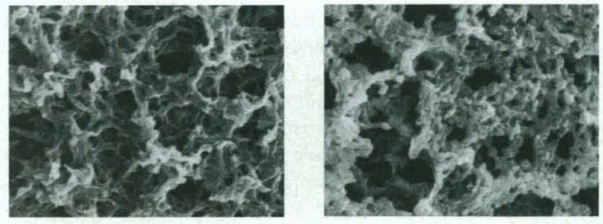

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