



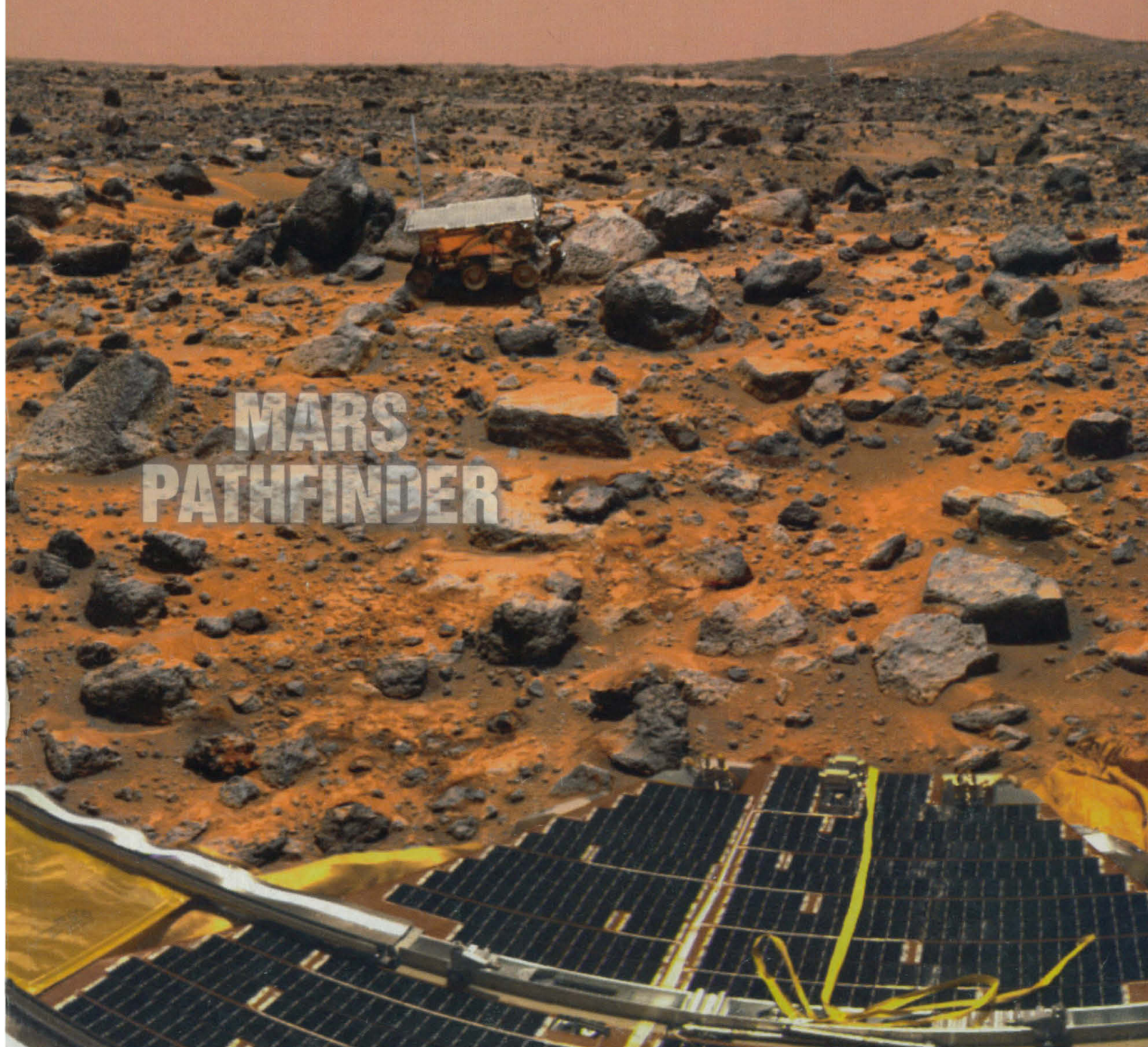
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# SCIENCE

5 DECEMBER 1997  
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MARS  
PATHFINDER



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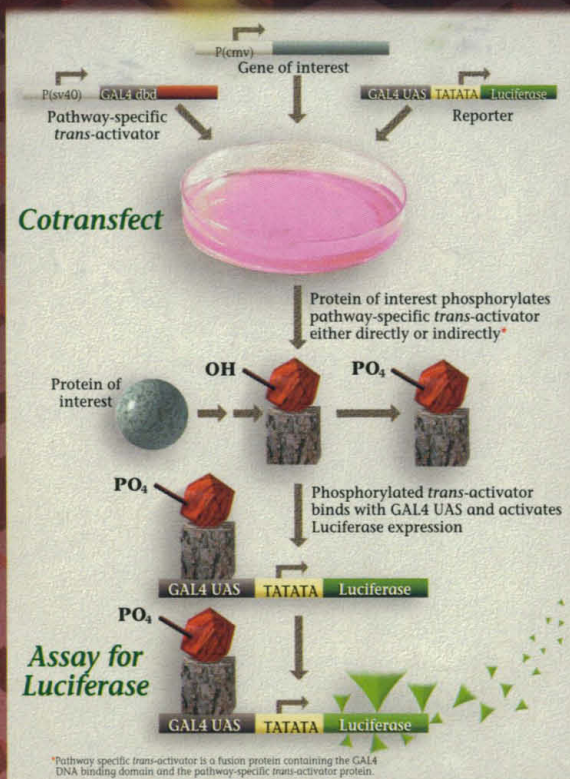
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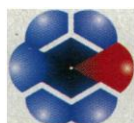
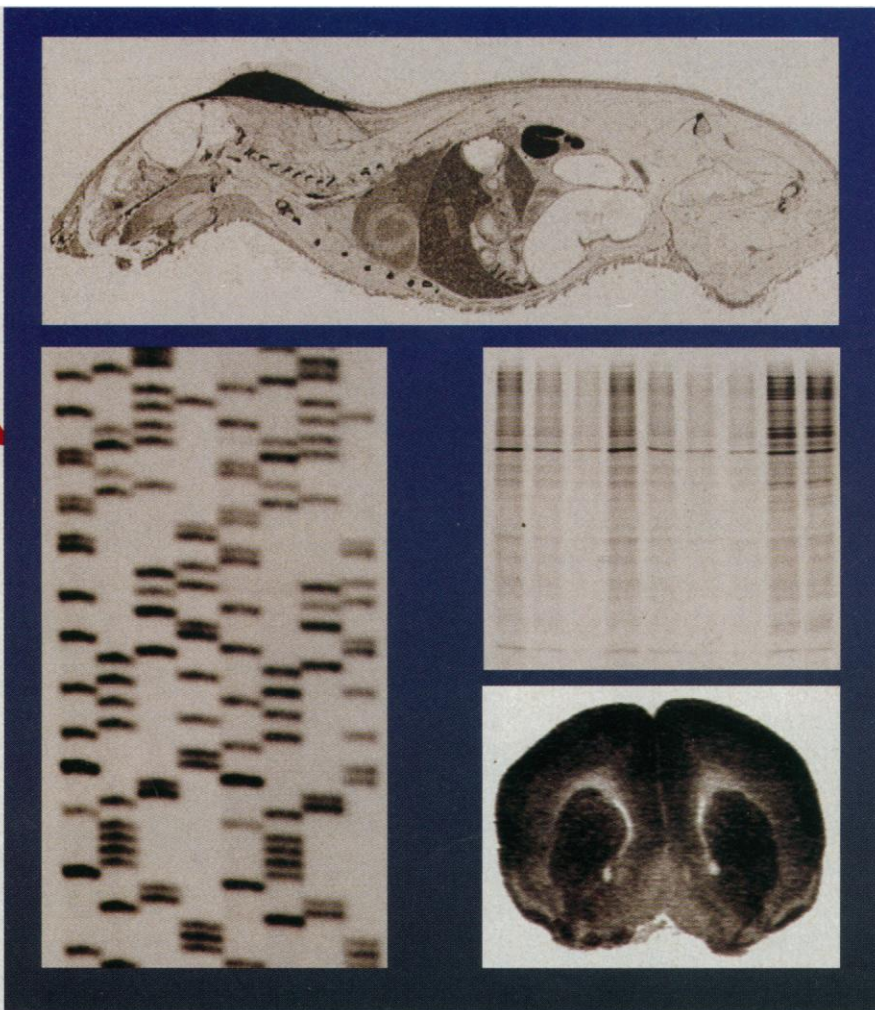
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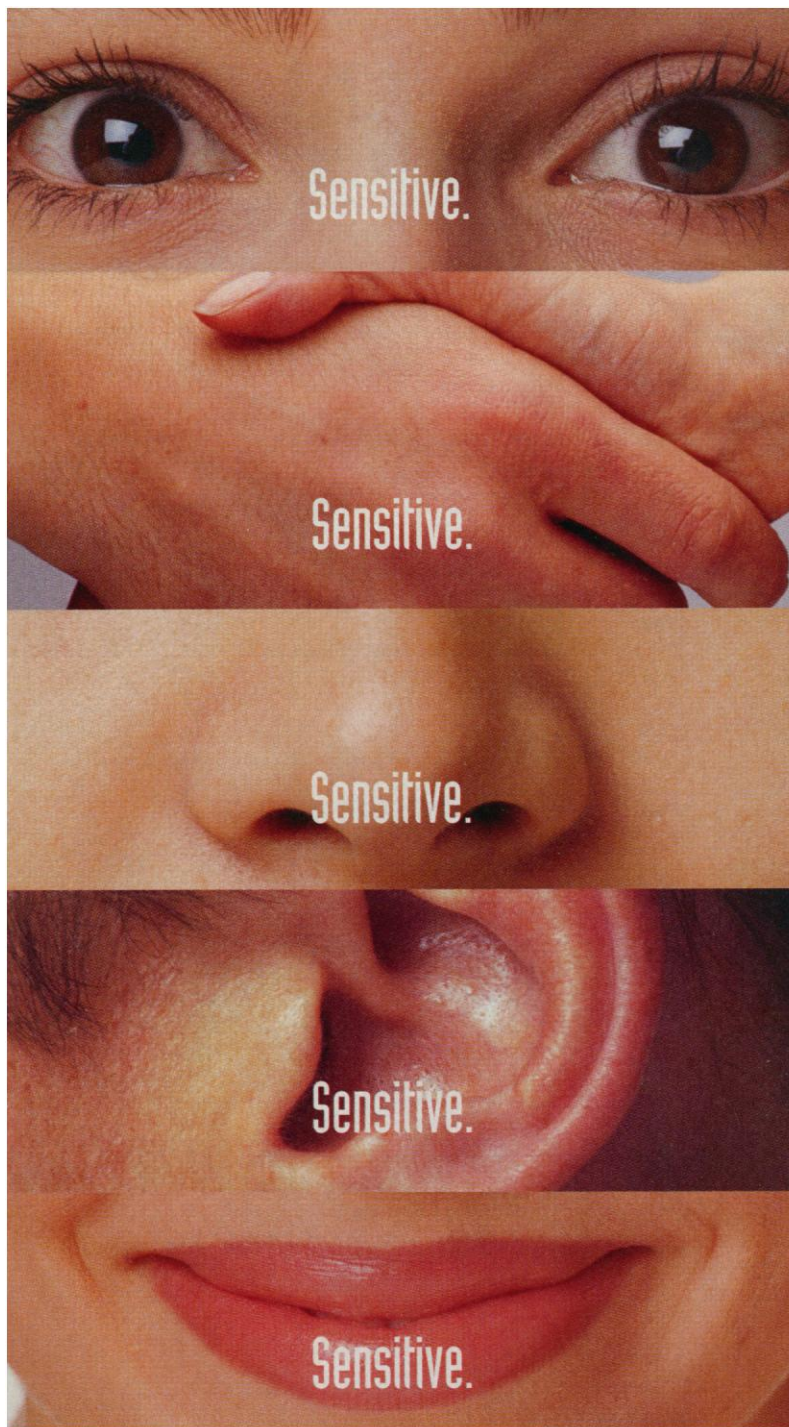
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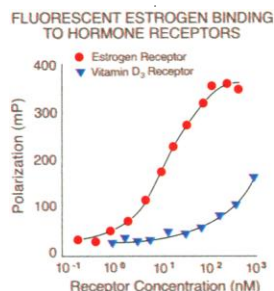
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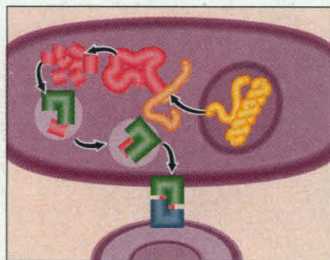
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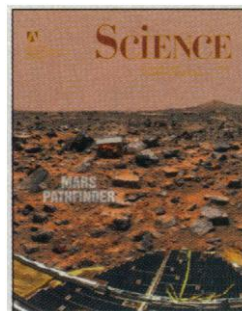
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## COVER

Pathfinder on Mars. The Sojourner Rover deploys the  $\alpha$ -proton x-ray spectrometer onto the rock named Moe within the rock garden in this 75-image, color-enhanced mosaic taken by the imager on the lander. (Image of the rover in the rock garden was taken on a different day than

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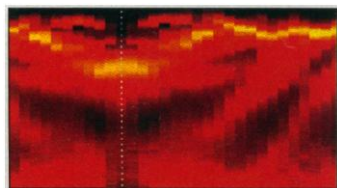
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# THIS WEEK IN SCIENCE

edited by PHIL SZUROMI

## On the quantum dots

Quantum dots, nanometer-scale semiconductor structures that can be charged with electrons, can exhibit excited-state transitions that mimic those of atoms (see the Perspective by McEuen, p. 1729). Kouwenhoven *et al.* (p. 1788) show that in circular, defect-free quantum dots, quantum numbers and transitions corresponding to Hund's rule in atoms can be identified. Schedelbeck *et al.* (p. 1792) studied the formation of artificial molecules from such artificial atoms. The overlap between the wave func-



tions from two quantum dots led to the formation of bonding and antibonding levels whose coupling strength depended on the distance between the dots. Stewart *et al.* (p. 1784) studied irregular quantum dots to investigate electronic transitions in systems lacking symmetry. Strong correlations in excitation spectra were observed for quantum dots with different numbers of electrons, despite the difference in charging energies, and one electron, rather than two electrons with paired spins, were sufficient to fill a level.

## Isotopes and N<sub>2</sub>O

Nitrous oxide is both a greenhouse gas, and thus important in the troposphere, and is also involved in ozone destruction in the stratosphere. It has been difficult to obtain a global budget for N<sub>2</sub>O and unidentified sources or sinks. A key tracer is provided by the many isotopes of N<sub>2</sub>O, as shown in three reports. Rahn and Wahlen (p. 1776) show that heavy isotopes of N and O are enriched in stratospheric N<sub>2</sub>O, and Cliff and Thiemens (p. 1774) show that tropospheric N<sub>2</sub>O is

## A view of Mars, then and now

Mars Pathfinder safely bounced onto the surface of Mars on 4 July 1997, unfolded the solar panel petals of the lander, and deployed its rover, Sojourner, to sample the rocks and soil surrounding the lander (Golombek *et al.*, p. 1743). Radio tracking from the lander allowed Folkner *et al.* (p. 1749) to improve the estimate of Mars rotation rate and the wobble of the polar axis; the results suggest that Mars has a dense, iron-rich core. Pressure, temperature, and density measurements of the atmosphere (Schofield *et al.*, p. 1752) show a slightly warmer daytime temperature than Viking 1 and evidence for dust devils. The imager on the lander provided stunning panoramic images (see foldout) of a variety of rock shapes and textures on a dusty surface of ridges and troughs that may be related to water, wind, and impact erosion of the landing site (Smith *et al.*, p. 1758; see the cover). The Rover Team (p. 1765) found evidence of sedimentary processes, including a possible conglomerate, in their analyses of soil and rock characteristics from the rover, while a series of magnets on the lander allowed Hviid *et al.* (p. 1768) to conclude that water may have been involved in the oxidation of magnetic minerals. Finally, the  $\alpha$ -proton x-ray spectrometer (APXS) on the rover conducted about a dozen chemical analyses and determined that the sampled rocks are high in silica, unlike the martian meteorites, and probably represent a differentiated crust (Rieder *et al.*, p. 1771). The sampled soils have a different composition from the rocks, and these soils may have formed by the addition of magnesium and iron from mafic rocks, like the martian meteorites, to the locally eroded rocks during weathering. All of the observations and analyses suggest that Mars was indeed a warmer and wetter place a long time ago.

enriched in <sup>17</sup>O through a mass-independent process. Yung and Miller (p. 1778) propose that the stratospheric enrichment may reflect selective photolytic destruction of the isotopically lighter species.

## Hydrogen in the core

Earth's core consists mostly of iron, but seismic observations infer that there must be a lighter element or elements in the core to account for the lower observed density of the core compared to iron metal at core pressures. Okuchi (p. 1781; see the Perspective by Wood, p. 1727) kept hydrogen bubbles from segregating from iron metal at high pressure (~7.5 gigapascals) and temperature (1200° to 1500°C). By determining the volume of hydrogen in the quenched samples he infers that about 60 percent of the core's density deficit can be explained by hydrogen.

## The grass is greener

Why do large grazing animals prefer particular patches of grasslands? Observations made by McNaughton *et al.* (p. 1798) in the Serengeti National Park support a "positive feedback loop" in which grazing accelerates nutrient availability. The rate of nitrogen mineralization was enhanced, and levels of sodium in the soil increased in grazed areas. The increased sodium availability more likely benefits the grazers than the plants.

## Handy virus

PBCV-1 is a virus that infects a green algae that normally lives inside a paramecium. DeAngelis *et al.* (p. 1800) show that this virus can synthesize the carbohydrate hyaluronan, rather than following the normal route of relying on host enzymes or host carbohydrates. One speculation is that production of this polysac-

charide may make it hard for the algae to be taken up by paramecium and thus leave it vulnerable to infection.

## Producing the pituitary

Mammalian pituitary glands develop from a complex interplay between the floor of the neural tube and the roof of the oral cavity. Differentiation then generates a variety of cell types, each with specific hormonal and physiological function. Sheng *et al.* (p. 1809) have further elucidated the transcription factors that control this process. The *Lhx3* and *Lhx4* genes redundantly control formation of Rathke's pouch, the precursor from the oral ectoderm. Subsequently, *Lhx3* independently controls fate choices of some of the pituitary precursor cells, and *Lhx4* seems to have more of an effect on the proliferation of cells.

## The protein's graveyard

Misfolded and misassembled secretory and membrane proteins in the endoplasmic reticulum (ER) are sent to the cytosolic side of the ER membrane for degradation by ubiquitin-dependent processes, including defective proteins that had been translocated into the ER membrane. Biederer *et al.* (p. 1806; see the Perspective by Riezman, p. 1728) now reveal that one of the key enzymes in ubiquitin-dependent degradation, Ubc7p, localizes at the cytoplasmic surface of the ER by association with a newly identified protein, Cue1p. The interaction of Ubc7p with Cue1p is required not only for the degradation of ER proteins, but also for bona fide cytosolic proteins. The cell apparently uses the ER surface as a scaffold to concentrate the components of the cytosolic protein degradation material, which include the Ubcs and the proteasome.

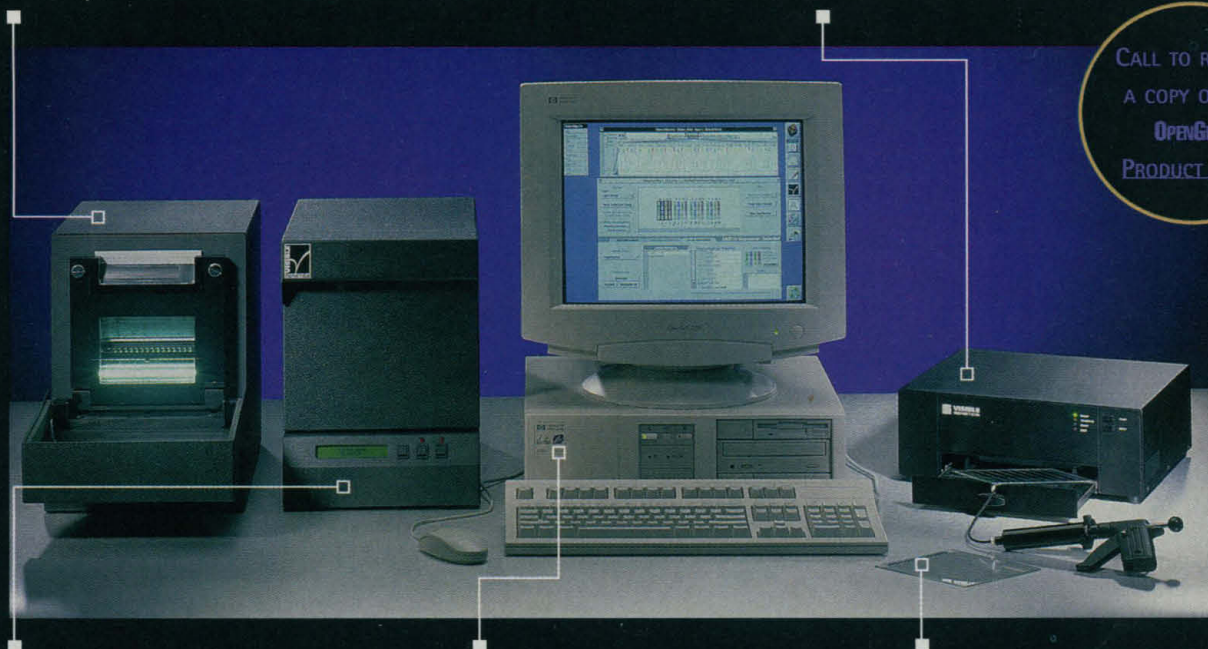
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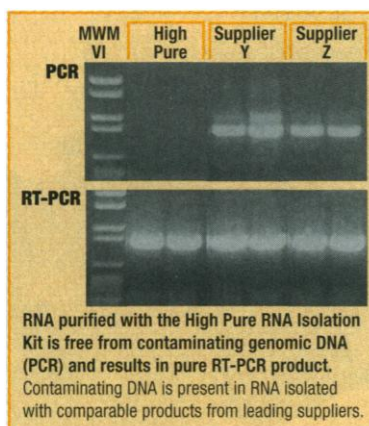
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<sup>1</sup> Noppen, C. *et al.* (1997) *Biochemica* 1997(4):11-13.

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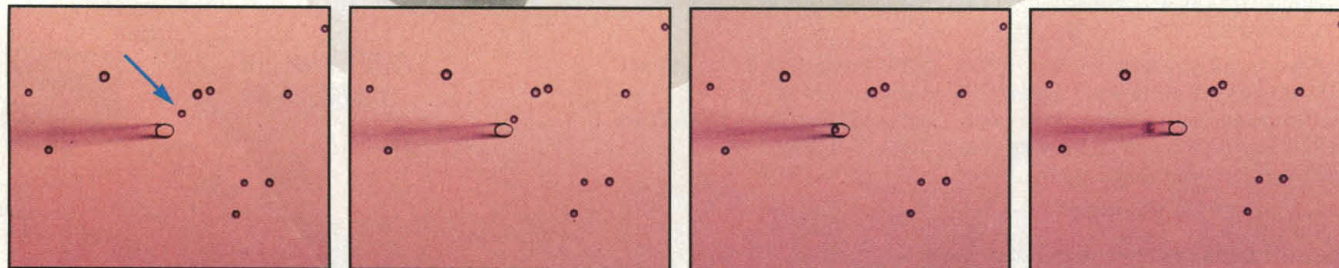
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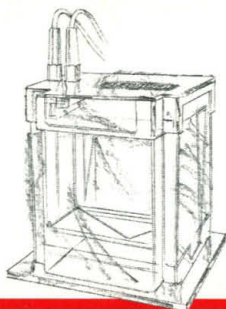
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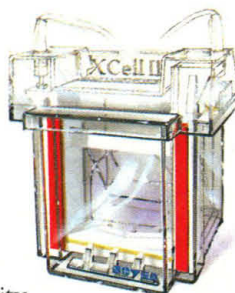
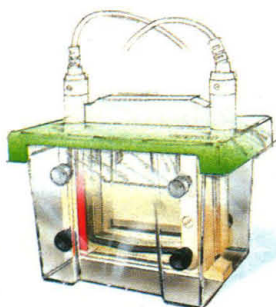
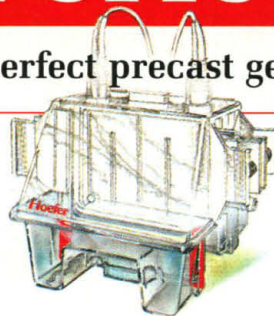
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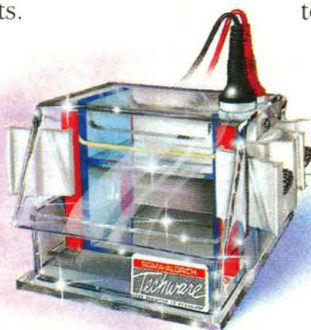
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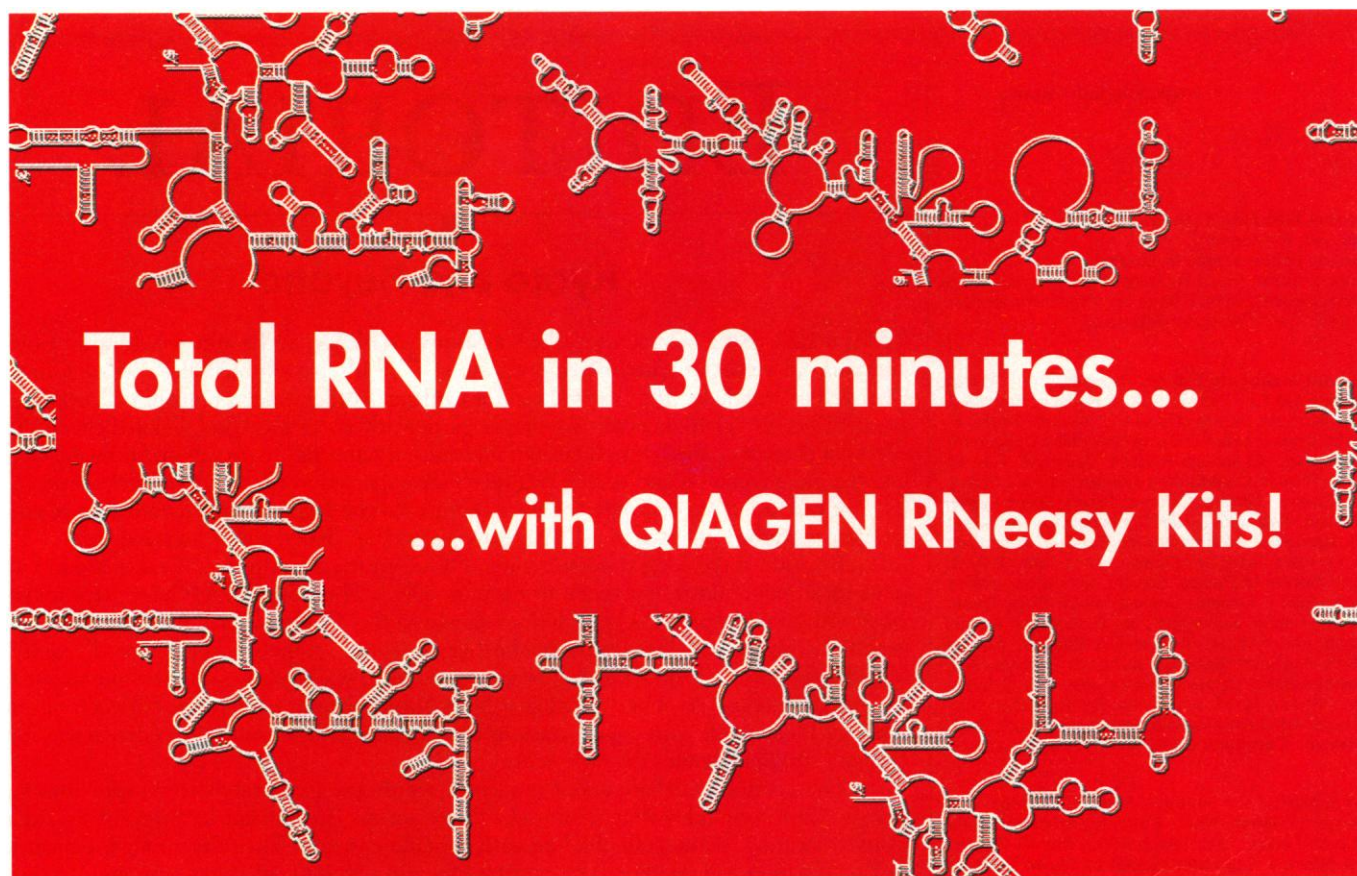
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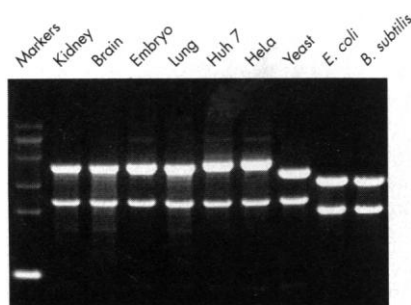
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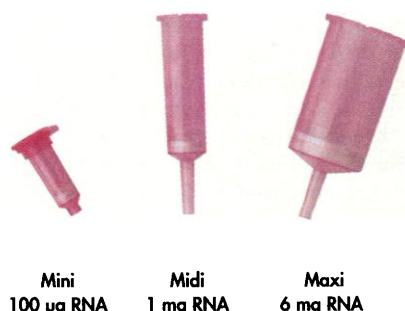
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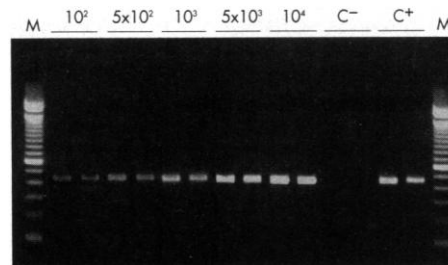


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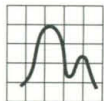
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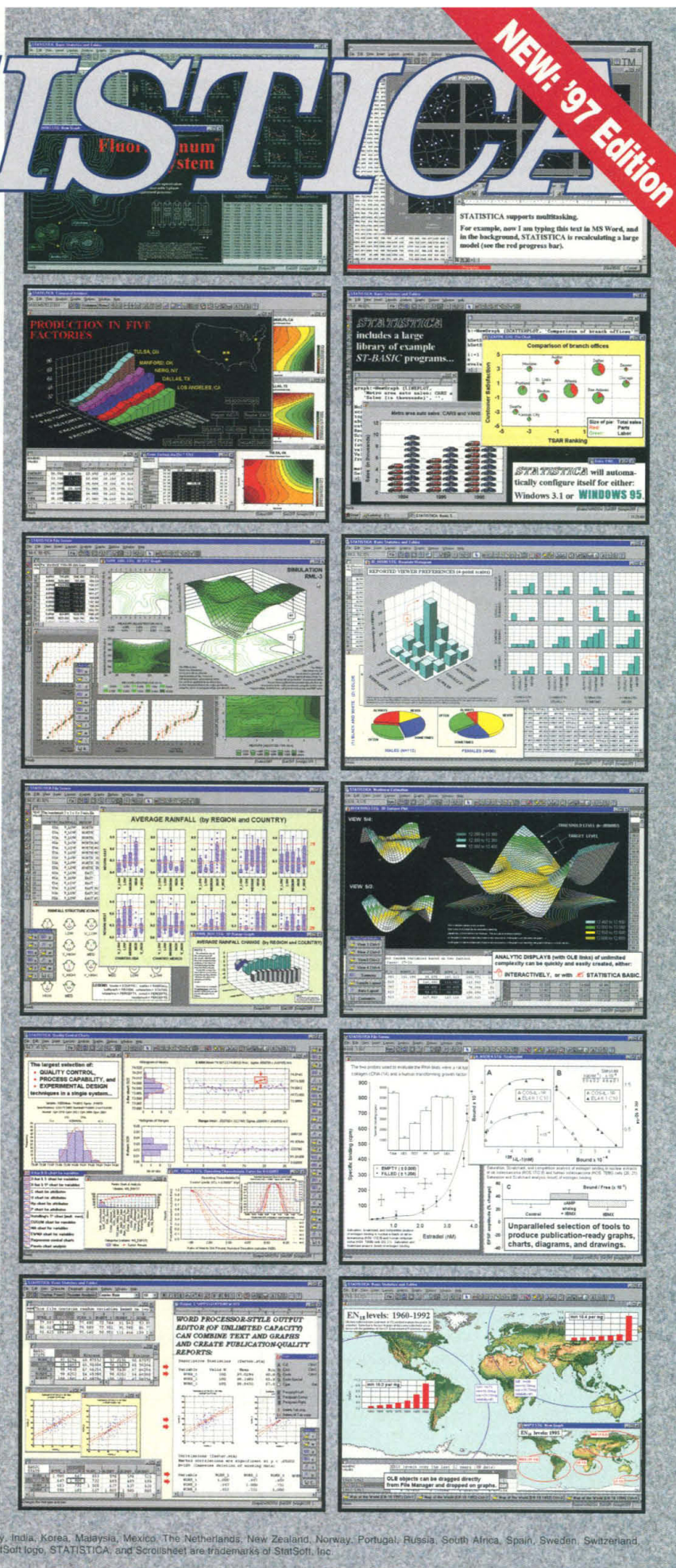
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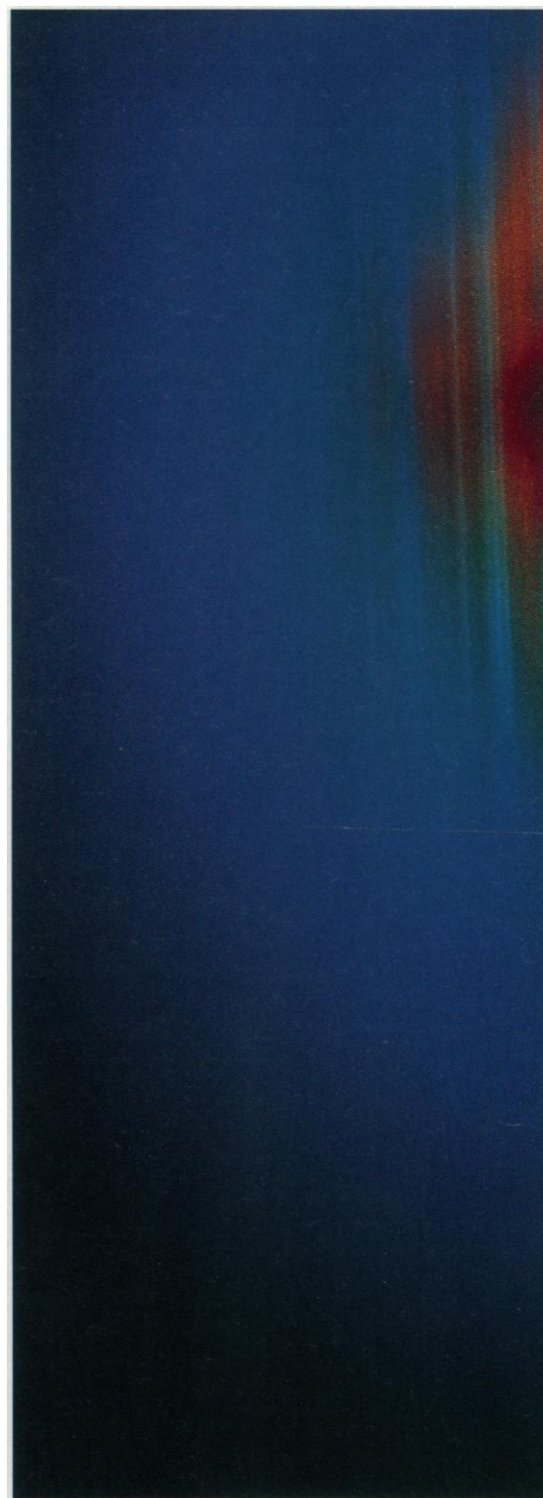
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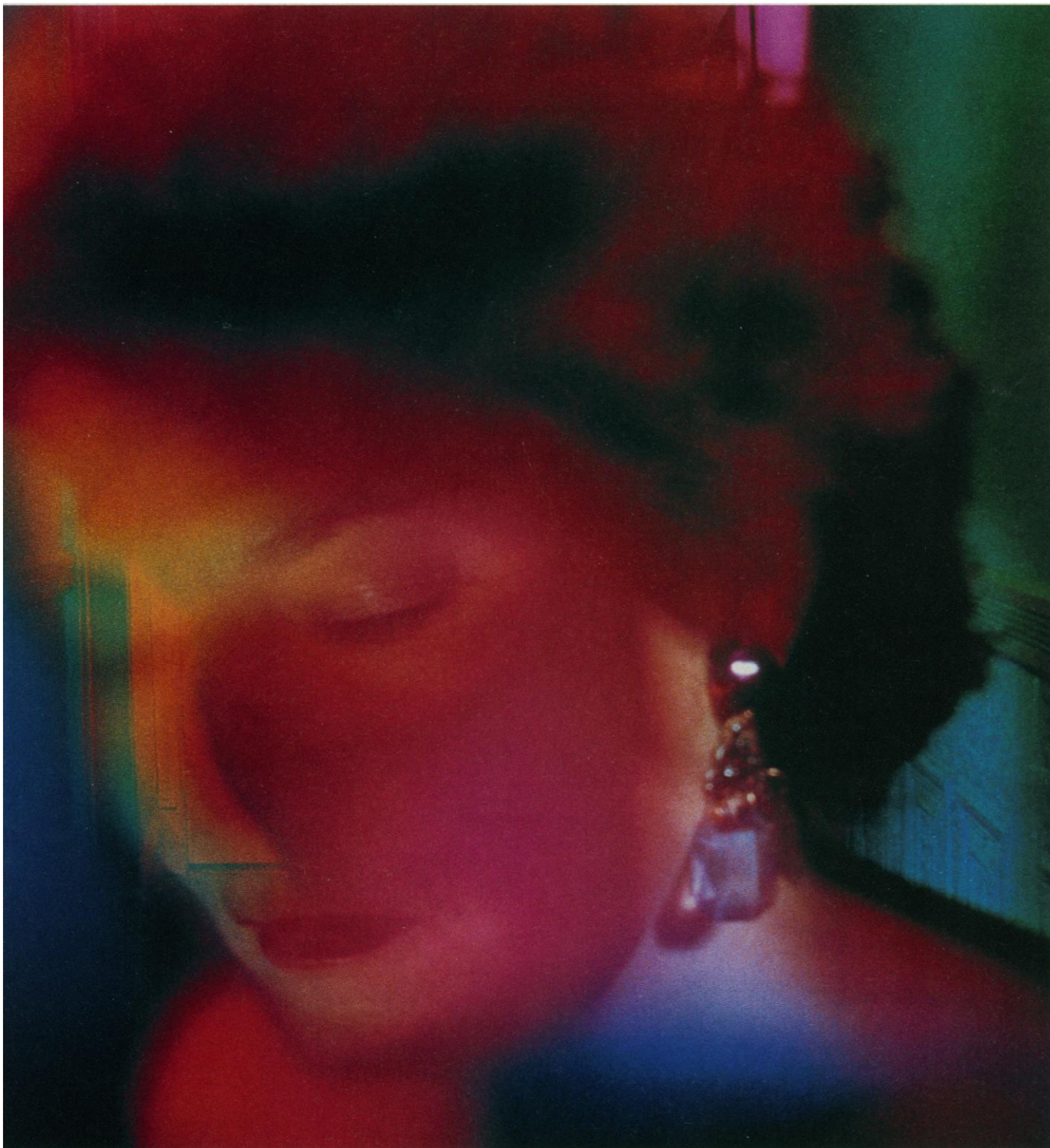
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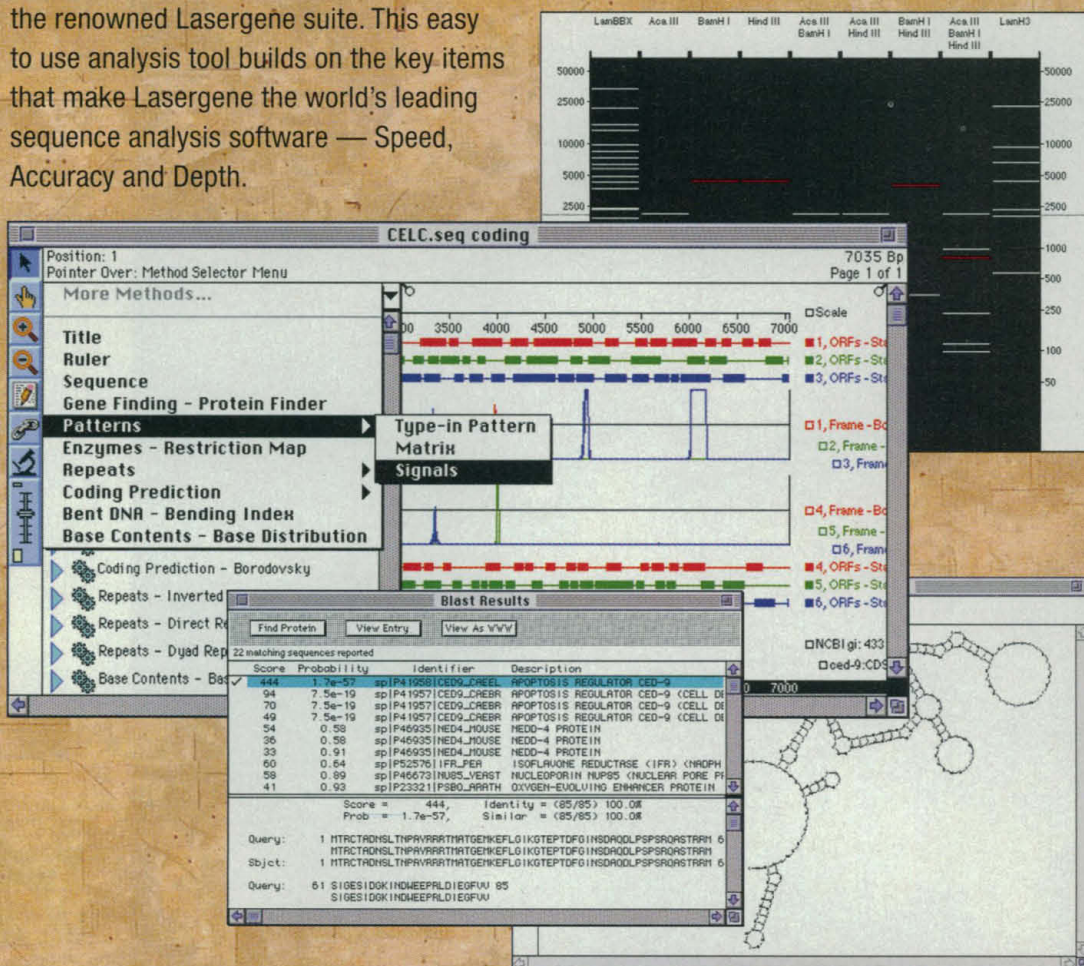
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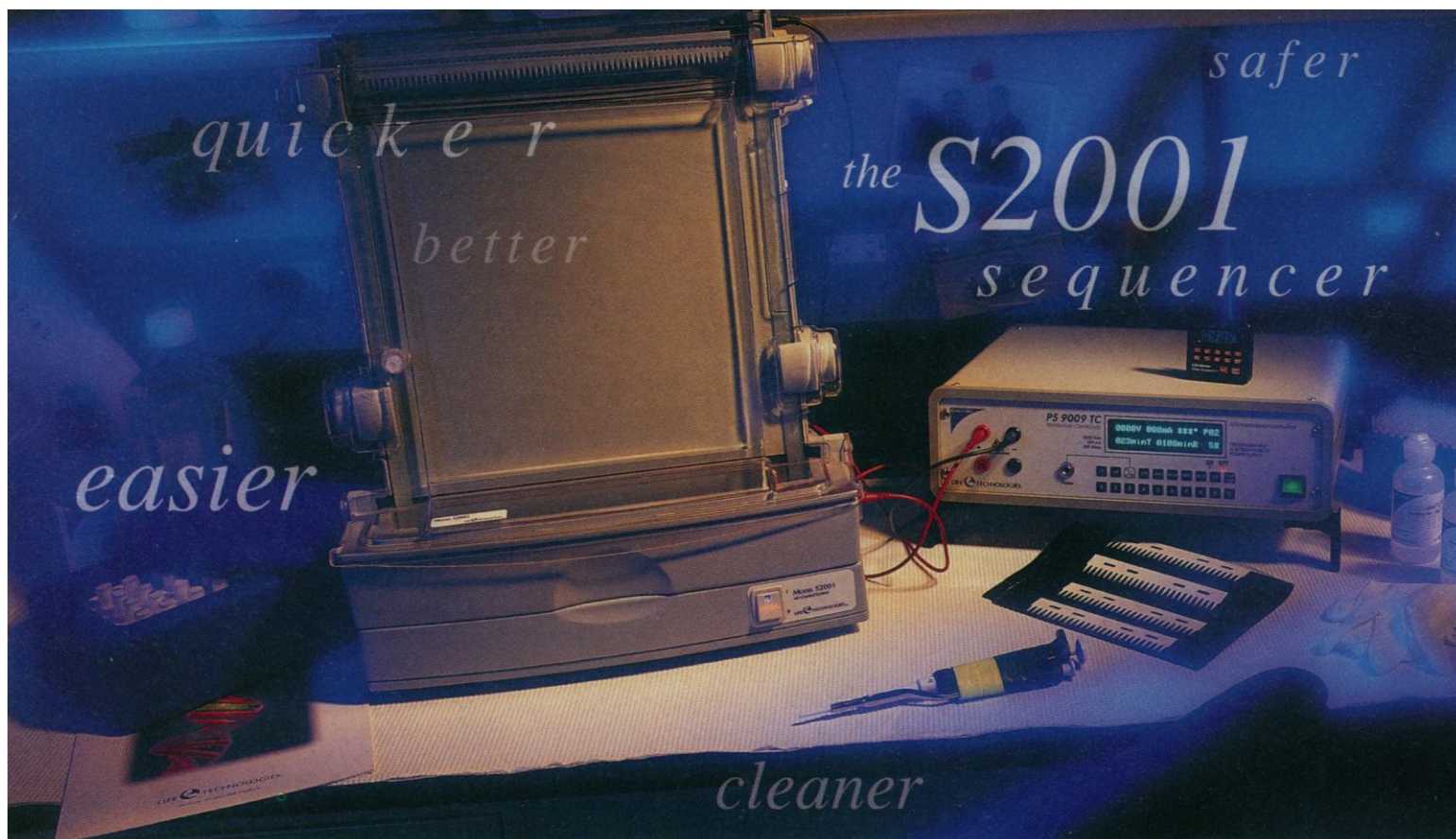
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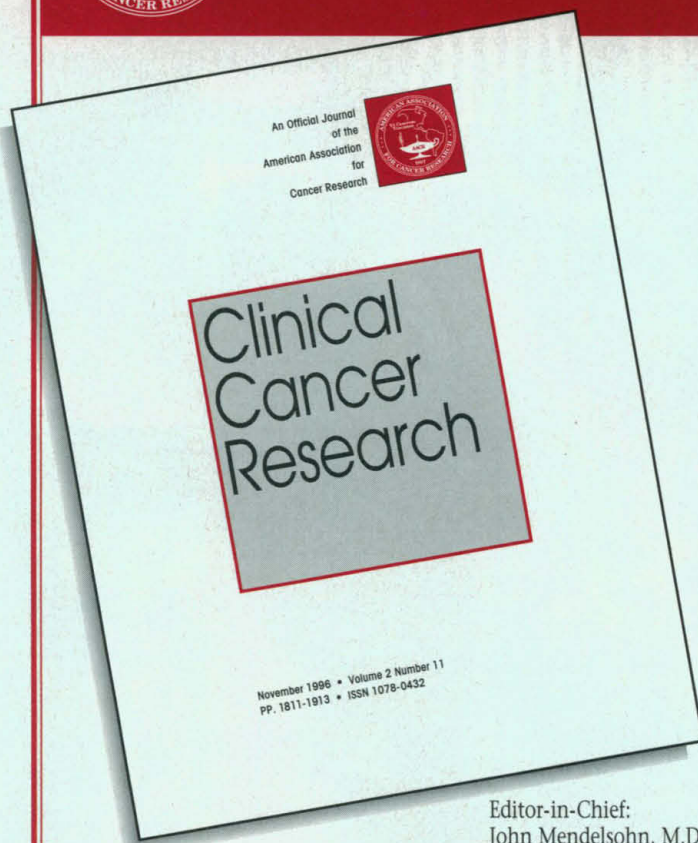
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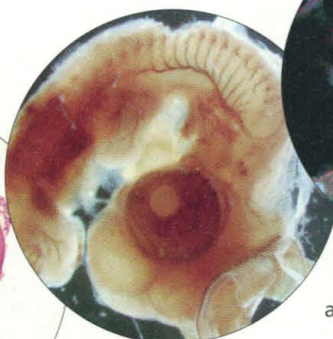
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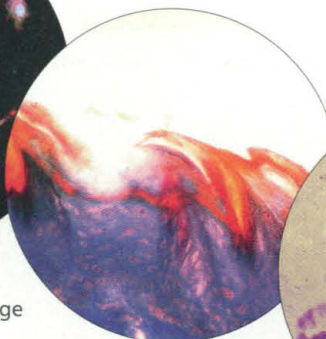
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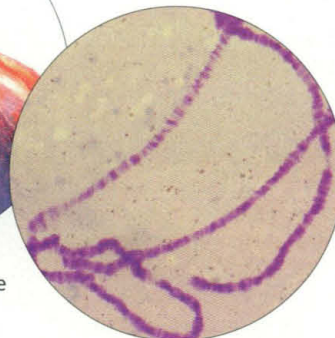
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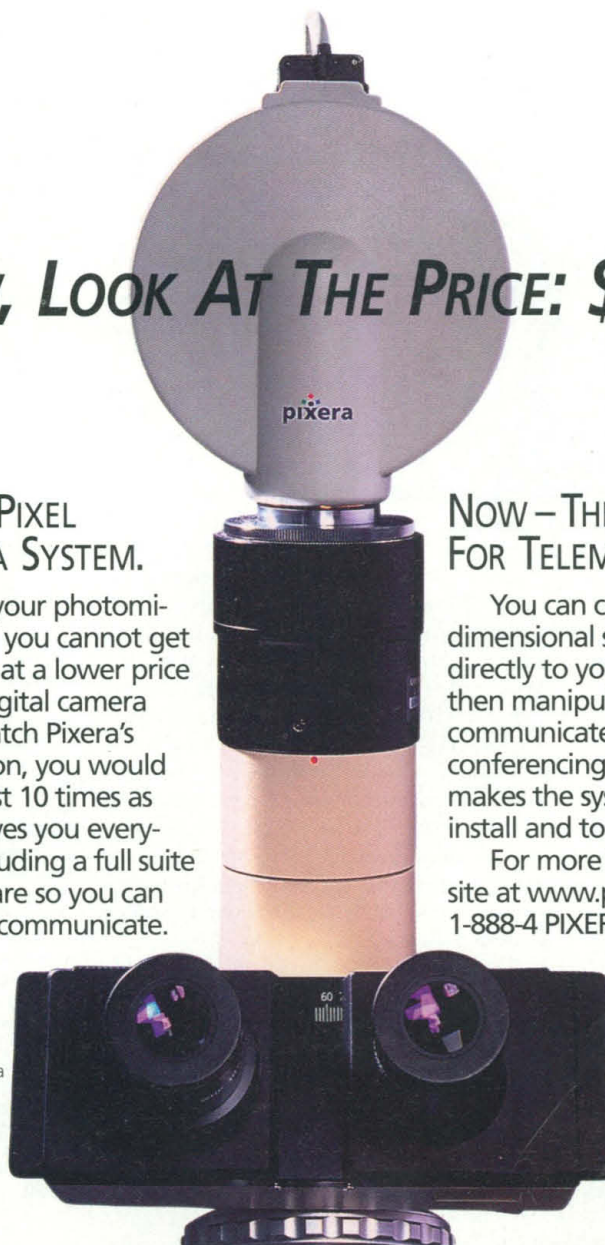
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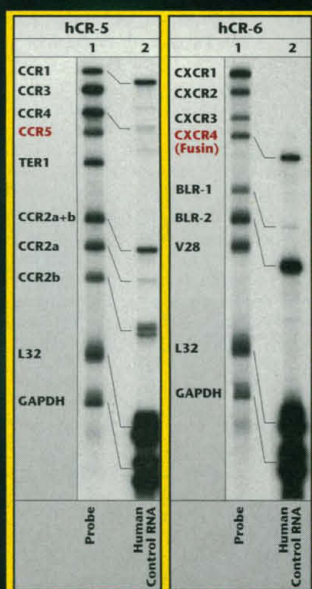
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ganelles, and proteins. The rotor's 37-lb weight is less than that of traditional 6 x 500 ml rotors. **Beckman Instruments.** For information call 800-742-2345 or circle 142 on the Reader Service Card.

### Bioprocess Contaminant Testing

Microtiter plate-based enzyme immunoassays are available for the detection of residual bioprocess contaminants. These kits offer parts-per-billion detection limits, ready-to-use reagents, rapid turnaround time, and accurate results. The kits are available for bovine serum albumin, bovine immunoglobulin G, insulin, human transferrin, human albumin, mouse immunoglobulins, and protein A. **Cygnus Technologies.** For information call 508-769-8739 or circle 143 on the Reader Service Card.

### Personal Organic Synthesizer

The ReacTech organic synthesizer maximizes the speed and efficiency of solution and solid-phase chemistries, allowing chemists to automate reactions traditionally conducted in

round bottom flasks. The instrument combines precise manual control of reactant and reagent delivery with a patented multiple organic synthesis technology including reaction temperatures from -70°C to 150°C, an inert reaction environment, a wide range of agitation strategies, and more. Constructed of chemically resistant Teflon, the ReacTech reactor makes use of bottom filtration for faster, more efficient throughput and is designed to prevent residual resin and reagent contamination. Each reactor includes four independent chambers for the added flexibility of multiple, independent control of reaction strategies for every 10 reactor wells. **Advanced ChemTech.** For information call 800-456-1403 or circle 144 on the Reader Service Card.

### Gene Expression Assay

The in situ mRNA Cytostar-T mRNA detection kit eliminates the need to extract RNA from cells and, with all manipulations taking place in the same plate, greatly increases both throughput and reproducibility. The high sensitivity of the assay means ex-

(continued on page 1819)



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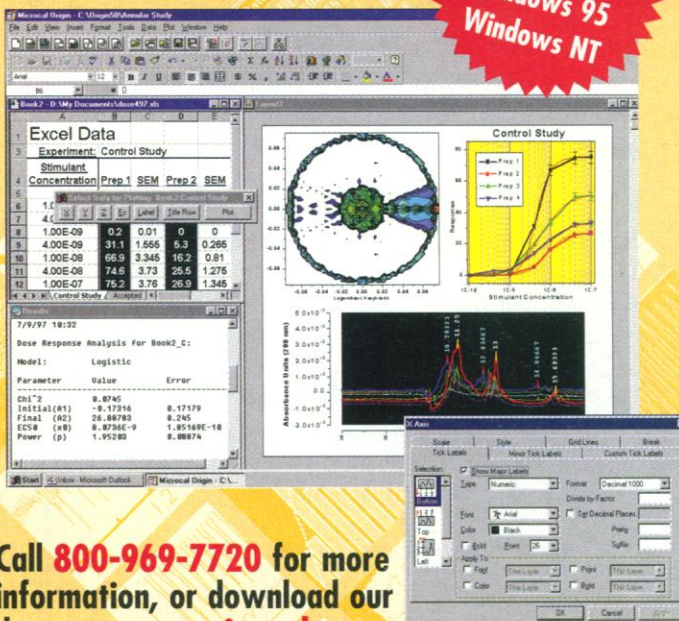
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(continued from page 1817)

pression of low level transcripts can be monitored with confidence. The assay allows the detection of 20 to 30 transcript copies per cell in cell cultures actually grown in Cytostar-T microplates. The assay offers advantages in speed, sensitivity, reproducibility, and assay throughput compared with analysis techniques such as protein immunoblotting, reverse-transcriptase polymerase chain reaction, and ribonuclease protection. **Amersham International.** For information call 847-593-6300 or circle 145 on the Reader Service Card.

### Flash Point Analyzer

The FP92 5G Automatic Cleveland Flash Point Analyzer automatically determines the flash point of volatile materials. Features include automatic lighting of the test flame, preset and programmable test methods, a standard pre-heating option, automatic barometric correction of results, and auto-



matic calibration with frequency tagging. A warning message appears when the results are out of the specifications. Gas is automatically suppressed at the end of the test, and an overheating detection device quickly shuts down the system. **ISL North America.** For information call 800-444-8378 or circle 146 on the Reader Service Card.

### Molecular Biology Software

Four new modules have been added to the WebLab Gene Explorer family. The modules—Restriction Analysis, DNA Similarity Search, Protein Similarity Search, and Virtual Mutagenesis—continue the development of Gene Explorer into a suite of soft-

ware modules that will satisfy many of the computational needs of molecular biologists. Restriction Analysis analyzes DNA sequences for restriction enzyme sites, automatically computing feasible sub-clone strategies. DNA Similarity Search applies multiple pre-configured search strategies to a sequence in order to identify similar DNA and protein sequences. Protein Similarity Search finds proteins homologous to a sequence in a similar way, although this module also includes protein threading technology to identify homologs when sequence similarity alone is insufficient. Virtual Mutagenesis graphically displays the predicted implications of amino acid mutations. **Molecular Simulations.** For information call 619-458-9990 or circle 147 on the Reader Service Card.

### Apoptosis Detection Kits

Twelve new apoptosis detection kits include both Klenow- and TdT-based in situ kits available with blue label, DAB, or fluorescence detection; apoptotic DNA laddering kits with optional labeling and detection reagents that make this assay approximately 100 times more sensitive than the standard ethidium bromide procedure; and complete fluorescein- and biotin-based annexin V kits for indicating early apoptosis via flow cytometry and microscopy. **Genzyme Diagnostics.** For information call 800-332-1042 or circle 148 on the Reader Service Card.

### Literature

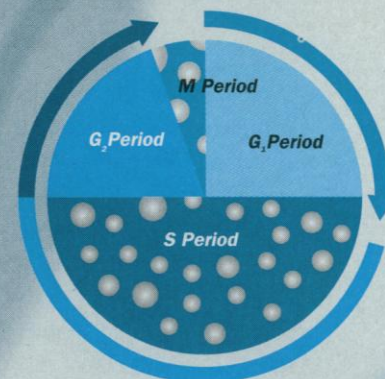
*AMRAD Biotechnology Catalogue 1997/1998* covers the subjects of monoclonal antibodies, polyclonal antibodies, flow cytometry, immunohistochemistry, immunofixation, epitope tagging, and mammalian and yeast expression systems. **AMRAD Biotech.** For information call 888-252-6723 or circle 149 on the Reader Service Card.

*Gilson Personal Synthesizer System* explains in detail how this integrated, automated system's High Throughput Organic Synthesis technique accelerates drug discovery. This instrument is designed for both lead generation and lead optimization libraries. It can handle both solution- and solid-phase combinatorial chemistry techniques. **Gilson.** For information call 800-445-7661 or circle 150 on the Reader Service Card.

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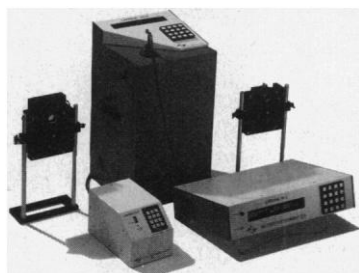
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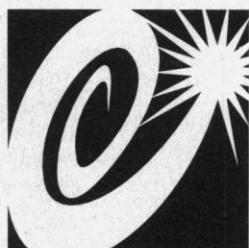


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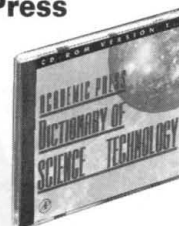
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