American Association for the Advancement of Science

SCIENCE

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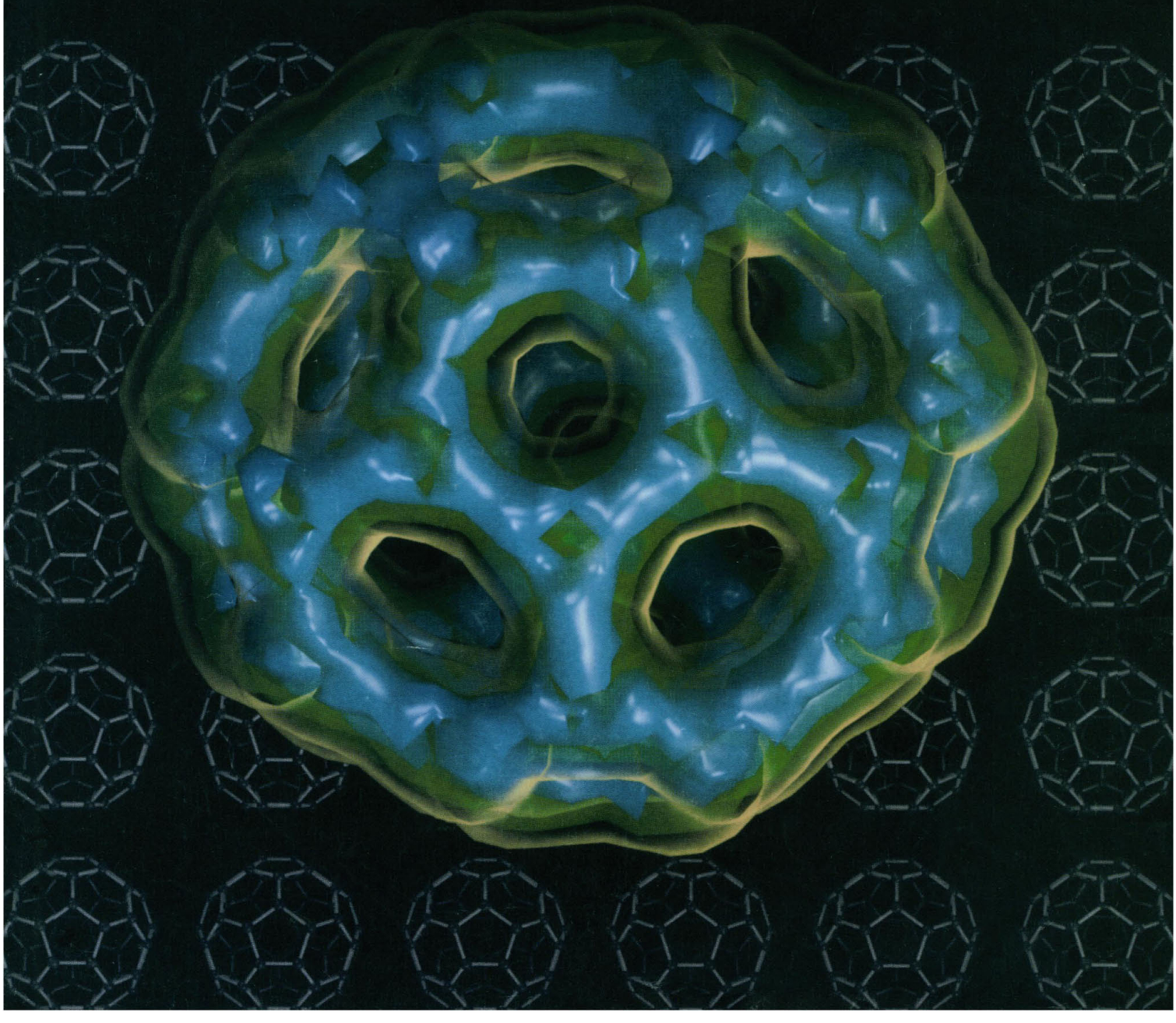
MOLECULE OF THE YEAR



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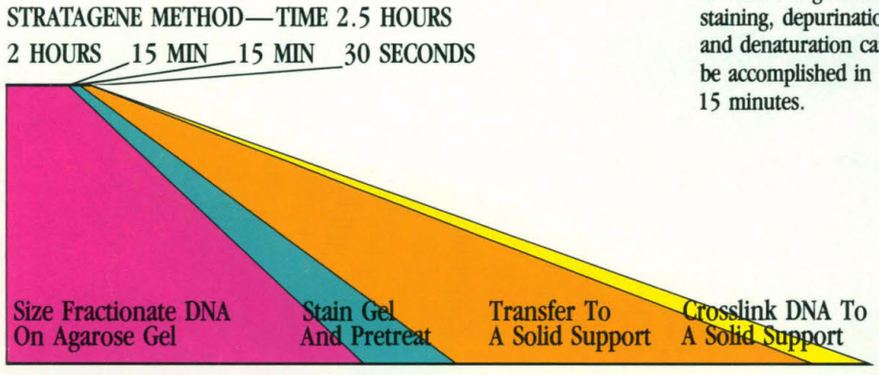


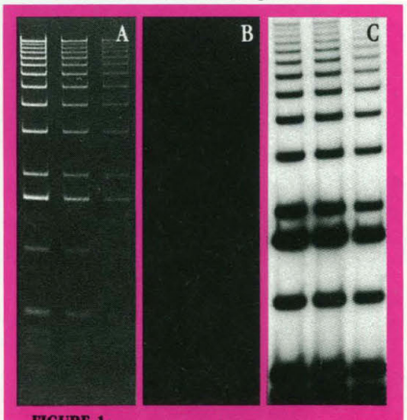
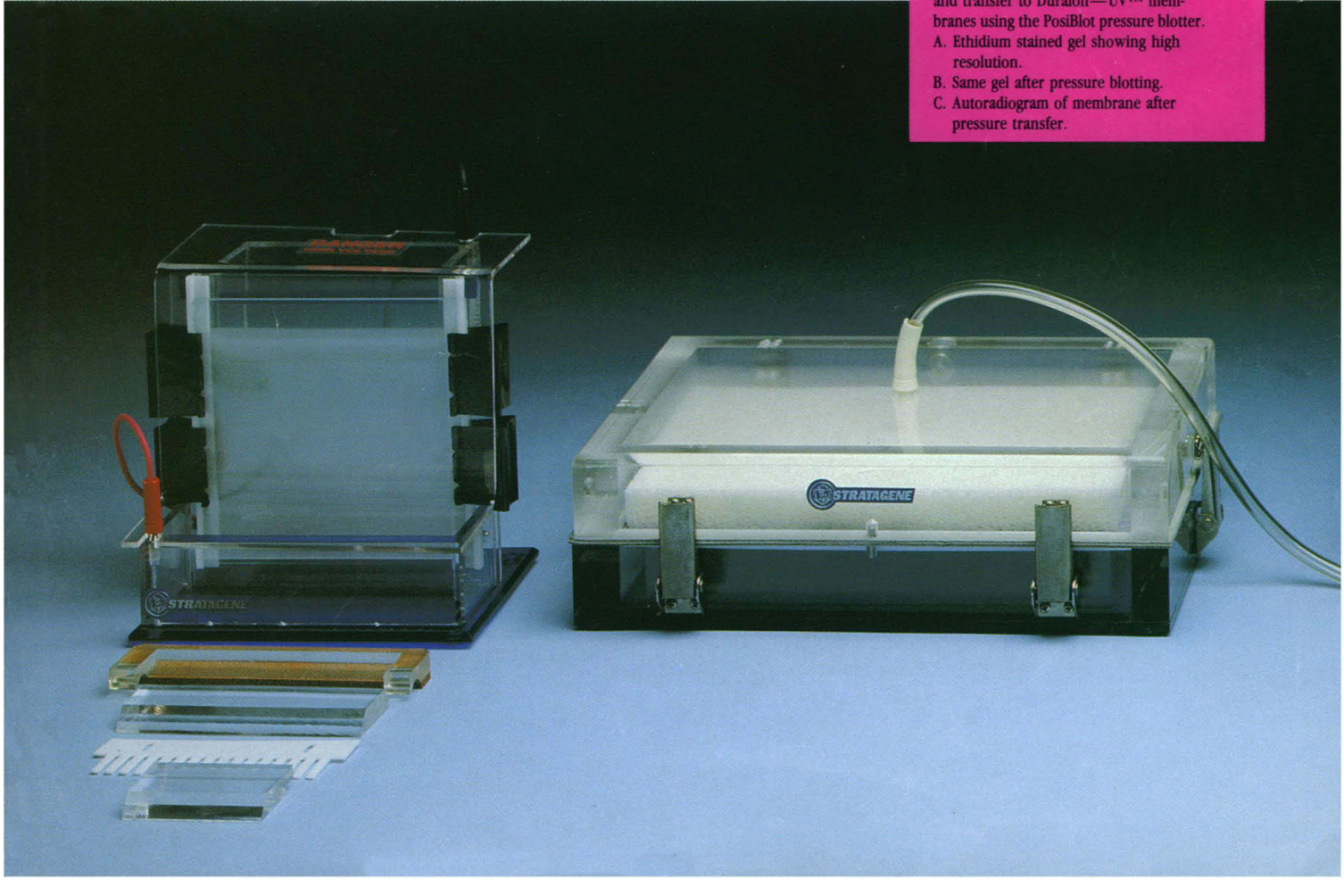


FIGURE 1:
Figure Legend: Fractionation of end labeled DNA markers on 3mm thick 0.8% agarose by the VAGE apparatus and transfer to Duralon—UV™ membranes using the PosiBlot pressure blotter.
A. Ethidium stained gel showing high resolution.
B. Same gel after pressure blotting.
C. Autoradiogram of membrane after pressure transfer.



PosiBlot™* Pressure Blotter

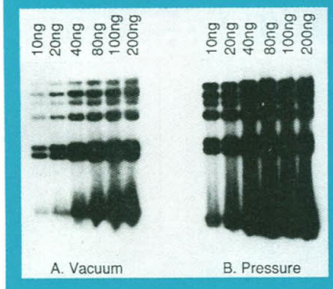


FIGURE 2:
Figure Lengend: ^{32}P end-labeled lambda Hind III markers were electrophoresed in 0.8% agarose. The DNA was then transferred to a nylon membrane with a vacuum blotter at 30mm Hg below atmospheric or with the PosiBlot pressure blotter at 100mm Hg above atmospheric. Both transfers were carried out for 15 minutes. As can be seen, pressure blotting transferred significantly more DNA in the same period of time, especially in the higher molecular weight range (largest band is 23 kilobases).

The PosiBlot™ positive pressure blotter permits the transfer of nucleic acids in 1/3 the time of vacuum blotters and 1/50 the time of capillary blotting (Figure 2). Pressure blotting does not dehydrate gels as do other methods. This allows the use of substantially higher pressure differentials, compared with vacuum blotting, without gel collapse. The PosiBlot apparatus reduces blotting time to 15 minutes.

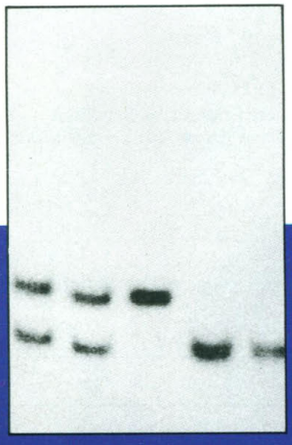


FIGURE 3:
Figure Legend: Autoradiogram showing the resolution of 2.8 and 1.3 Kb Msp I RFLP alleles revealed by a cystic fibrosis human DNA probe using the VAGE, PosiBlot and Stratalinker all in 2.5 hours.

Stratalinker™* UV Crosslinker

The Stratalinker™ UV Crosslinker fixes nucleic acids to solid supports such as nitrocellulose or nylon membranes, in less than one minute. This compares favorably to vacuum baking, which requires 2 hours. The Stratalinker actually monitors the ultra violet energy flux and deactivates the light source upon reaching the user-programmed energy level (Figure 4). Figure 3 shows an autoradiogram of a human genomic Southern blot performed using the VAGE, PosiBlot and Stratalinker all in 2.5 hours.

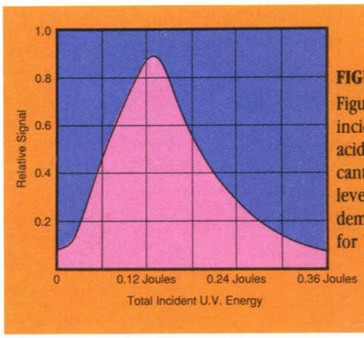


FIGURE 4:
Figure Legend: The effects of altering the incident energy for crosslinking nucleic acids to nylon membranes. The significant drop in signal intensity at energy levels below and above 0.12 Joules demonstrates the limited optimal range for UV treatment.

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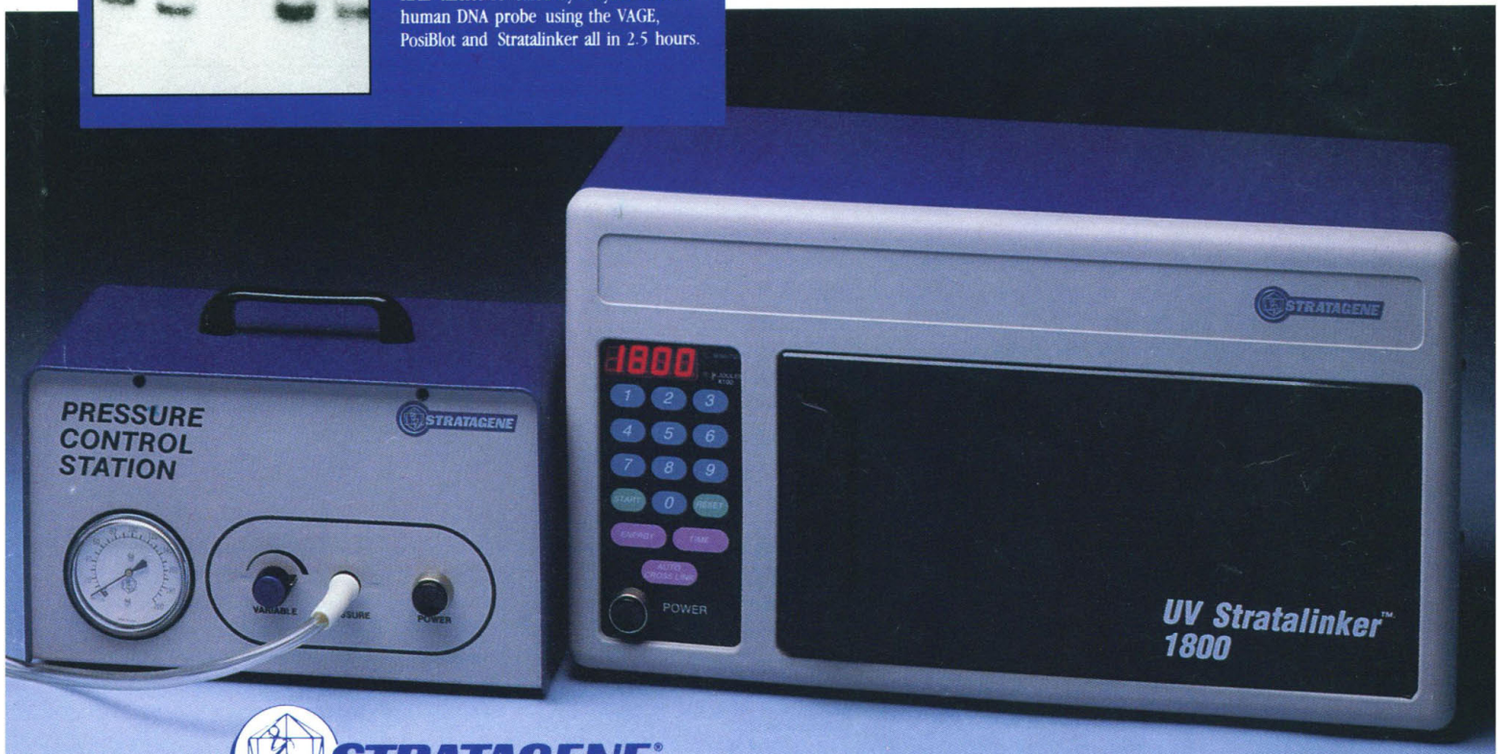

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COVER Electron distribution in C_{60} (buckminsterfullerene) at 1000 kelvin (foreground: diameter, 7.1 angstroms), obtained from quantum molecular dynamics simulations. The colors yellow, green, and blue denote regions of successively greater electron density. The atomic structure of C_{60} (background) consists of five- and six-membered rings arranged in the shape of a soccer ball. See Editorial, page 1705, and Molecule of the Year, page 1706. [Simulations and image by J. Bernholc, Q.-M. Zhang, J.-Y. Yi, and C. Brabec, North Carolina State University, and T. Palmer, North Carolina Supercomputing Center]

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This Week in

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DNA fingerprinting

Forensic scientists are using DNA typing as a way to conclusively link a suspect to a crime, including the use of variable number of tandem repeats (VNTRs). Lewontin and Hartl (p. 1745) contend that until more extensive sampling of VNTR frequency distributions is done in various ethnic groups, probability estimates of a match between an individual and evidence from a crime scene, as currently calculated, may not be reliable. In a Perspective, Chakraborty and Kidd (p. 1735) argue that courtroom applications of DNA typing, when done with care, can provide overwhelming evidence that cannot be coincidental [see news story by Roberts (p. 1721)].

Surface kinetics

Oxidation of CO to CO_2 by O_2 might seem to be a simple chemical reaction, but in a review Ertl (p. 1750) shows that this reaction displays nonlinear, time-dependent kinetics when catalyzed by the Pt (110) surface. Depending on temperature and reactant partial pressure, the oxidation rate can become oscillatory or even chaotic. Imaging with a photoemission electron microscope revealed chemical wave phenomena, such as spiral wave patterns and solitary waves.

Diabetes

Type I, or autoimmune, diabetes appears to be associated with a lack of expression of major histocompatibility complex (MHC) class I molecules on pancreatic islet cells. Faustman *et al.* (p. 1756) observed deficient expression of MHC class I molecules in prediabetic and hyperglycemic nonobese diabetic (NOD) mice, in β_2-microglobulin-deficient mice, and in humans. In the NOD mouse a mutation occurs in an MHC class II–linked gene, but that mutation is in the putative transporter for MHC class I peptide. In genetically identical human twins, the defect appears to be with the antigen presenting cell. In another study, Lacy *et al.* (p. 1782) describe how the implantation of encapsulated donor islet cells under the skin of diabetic mice can be used to maintain normal blood sugar levels. The islet cells were encapsulated in a gel and loaded in hollow acrylic fibers. The freely permeable sodium alginate gel prevented the aggregation of islet cells that could lead to a loss of function.

Dimer regulation

Formation of the active, dimerized form of a mammalian homeodomain protein, hepatocyte nuclear factor–1α (HNF-1α), appears to be regulated by a cofactor, DCoH. Mendel *et al.* (p. 1762) describe the purification, cloning, and characterization of DCoH, which copurifies with HNF-1α from liver extracts. Rather than binding to DNA by itself, DCoH promotes dimerization of HNF-1α by formation of tetrameric complexes. The transcriptional activity of HNF-1α is enhanced by DCoH dimerization even though the DNA binding of HNF-1α is left unchanged. Association of HNF-1α with DCoH may reveal an activation surface that is not present in its absence.

Fullerene isomers

Unlike the other fullerenes, C_{78} can occur in two different geometrical arrangements. Diederich *et al.* (p. 1768) isolated C_{78} and found a major component with symmetry C_{2v} and a minor component with symmetry D_3, as determined by carbon-13 nuclear magnetic resonance. Theoretical calculations had predicted a single isomer of symmetry D_{3h}.

Doppler radar

Measurements of vertical motions of the atmosphere are needed to study the effects of the solar energy budget, clouds, and rainfall on large-scale circulation of the troposphere and stratosphere and mass exhange across the tropopause. Gage *et al.* (p. 1771) used Doppler radar to show that motion in the troposphere is upward in the western Pacific, above Phompei, and downward above Christmas Island, in the central Pacific Ocean, but that an opposite pattern is evident in the stratsophere. This pattern shifts during El Niño; cirrus clouds form over Christmas Island and act to expand the region of downward motion in the lower troposphere and inhibit vertical motion in the stratosphere.

Low affinity

The low affinity of T cell receptors (TCRs) for their antigens makes measurement of their dissociation constants difficult, but an assay developed by Matsui *et al.* (p. 1788) has yielded values of 4×10^{-5} to 6×10^{-5} molar. The ligands for the TCR are peptides bound to the major histocompatibility complex (MHC). The concentration of membrane-bound MHC is hard to quantitate, but the use of soluble MHC molecules allowed a competition assay to be performed. The low affinity suggests that antigen-independent adhesion between the T cell and the targeted cell precedes antigen recognition.

Transposable element

An active human transposable element encodes reverse transcriptase (RT) activity. Dombroski *et al.* (p. 1805) isolated a long interspersed (L1) element that had caused a recent mutation to hemophilia A by inserting into the factor VIII gene. This L1 element contains two open reading frames that can each produce a protein product. Mathias *et al.* (p. 1808) used yeast genetics to show that one of these products has RT activity. Thus, L1 elements may represent a source of RT for retrotransposition in a number of RNA-mediated processes [see news story by Holzman (p. 1728)].

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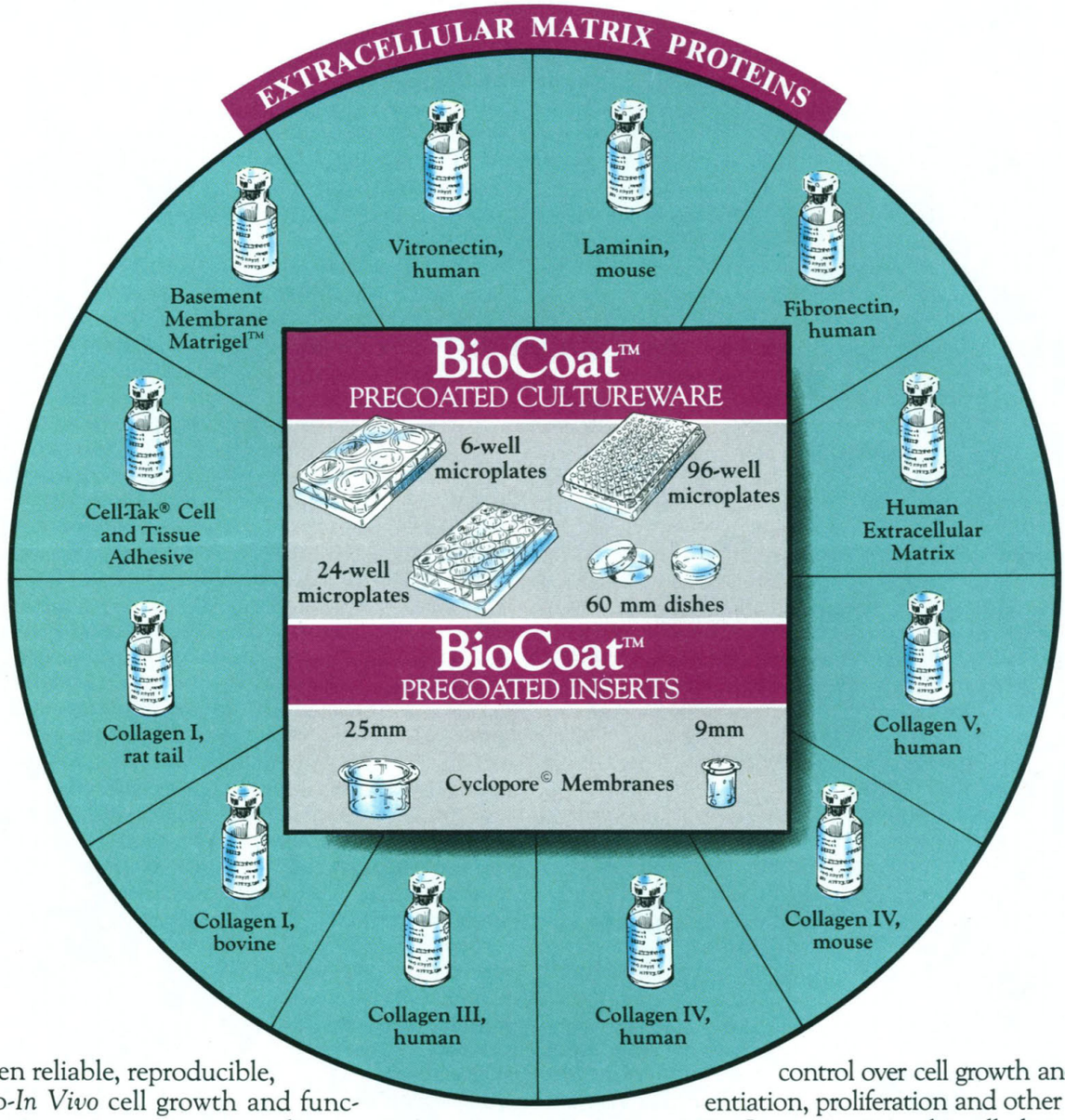

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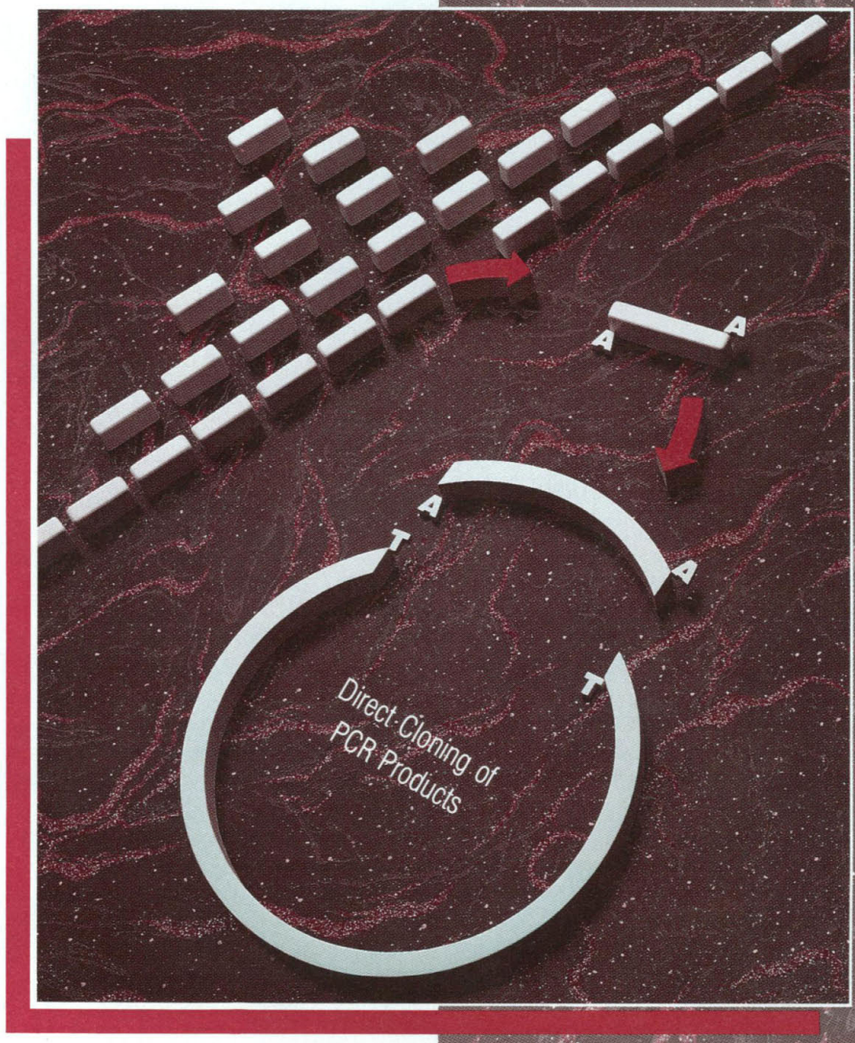

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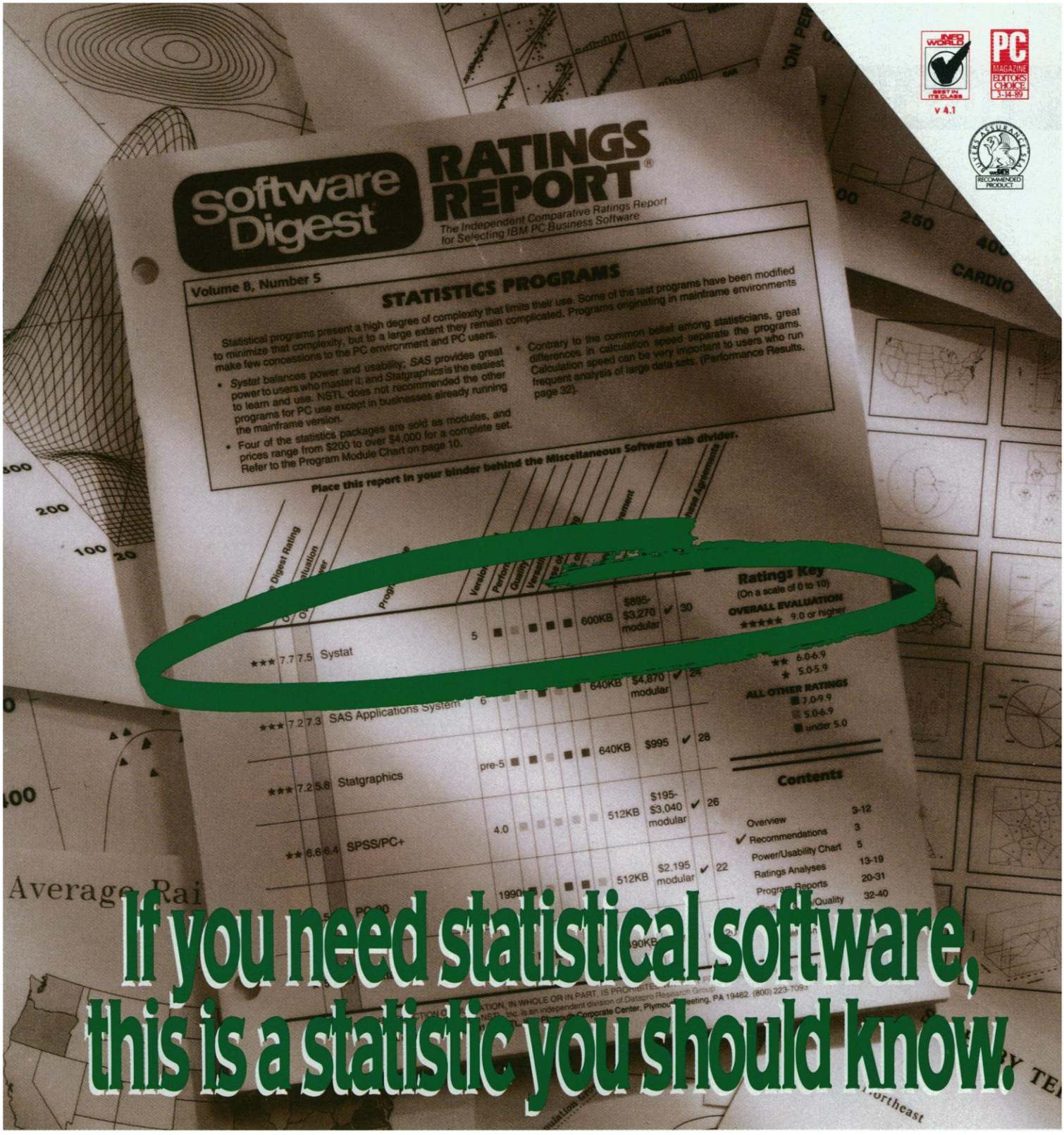

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