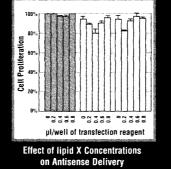
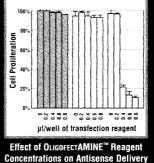


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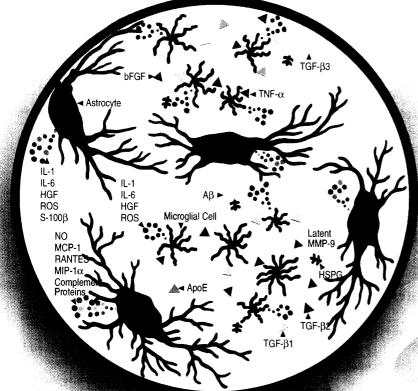
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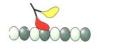
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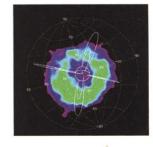
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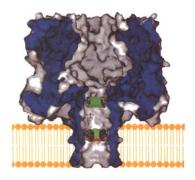


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Earth's ring current, detected by NASA's IMAGE satellite from above the north pole. The circle at the grid's center represents Earth, with representative geomagnetic field lines extending to geocentric distances of 4 and 8 Earth radii. The charge exchange between ring current ions and ambient neutral hydrogen creates energetic neutral atoms that can be used to produce global images of this magnetospheric current system. False color shows the intensity of the neutral atom flux (green, most intense; purple, least intense). [Image processing: D. G. Mitchell and P. C. Brandt]



636 Assembling a molecular trap





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Variability in the El Niño–Southern Oscillation Through a Glacial-Interglacial Cycle A. W. Tudhope, C. P. Chilcott, M. T. McCulloch, E. R. Cook, J. Chappell, R. M. Ellam, D. W. Lea, J. M. Lough, G. B. Shimmield PERSPECTIVE: A Slow Dance for El Niño J. Cole

A 130,000-year coral record shows that ENSO has been most intense in the warm 20th century and least intense during glacial periods.

Hydrogel Control of Xylem Hydraulic Resistance in Plants M. A. Zwieniecki, P. J. Melcher, ▼ N. M. Holbrook

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Notch Inhibition of RAS Signaling Through MAP Kinase Phosphatase LIP-1 During

C. elegans Vulval Development T. Berset, E. Fröhli Hoier, G. Battu, S. Canevascini, A. Hajnal The action of two antagonistic signaling pathways produces different fates in adjacent vulval precursor cells.

TECHNICAL COMMENTS

Is CdtB a Nuclease or a Phosphatase?

Lara-Tejero and Galán (Reports, 13 Oct. 2000, p. 345), studying CdtB, a subunit of the toxin secreted by food-poisoning bacteria, found that the subunit behaves like deoxyribonuclease I and thus may act by causing cell cycle arrest. In a comment, Dlakic raises an alternative possibility—that CdtB may not be a nuclease but rather a phosphatase for one of several proteins "that control tyrosine phosphorylation of the cell cycle regulator Cdc2 kinase." Lara-Tejero and Galán find that possibility "extremely unlikely," however, given CdtB's known nuclease activity in vitro, the specific changes induced by the tox-in in in cultured cells, and uncertainty as to "how a lipid phosphatase could induce G2/M arrest." The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/291/5504/547a

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Protocol: Analysis of Sphingosine 1-Phosphate, Ceramides, and Other Bioactive Sphingolipids by High-Performance Liquid Chromatography-Tandem Mass Spectrometry M. C. Sullards and A. H. Merrill Jr.

Detailed methods for detecting and quantifying bioactive sphingolipids.

Perspective: Membrane Cholesterol, Protein Phosphorylation, and Lipid Rafts M. Edidin How cholesterol content of the plasma membrane influences transmembrane signaling.

science's next wave

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Germany: Financing Your Ph.D. Research W. Adamczak

Practical tips to help navigate the German Ph.D. funding situation—opportunities, application procedures, and mistakes to avoid.

Canada: Calling All Professors! P. Doherty

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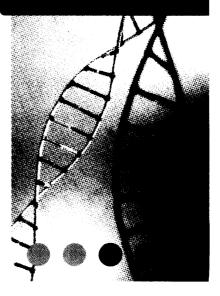
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AD SUPPLEMENT IN THIS ISSUE

LAB TECHNOLOGY TRENDS

Functional Genomics:

this ad supplement looks at topics such as SNPs, DNA sequencing, PCR/DNA cloning, knock-out mice, and information analysis. Look for it on page 680.





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THIS WEEK IN Science

Imaging the Magnetosphere

Earth's magnetosphere, which shields us from the interplanetary magnetic field and the solar wind, is dominated by the geomagnetic field. The magnetosphere is populated by plasma that cannot be seen with typical observing technologies. Now, the IMAGE spacecraft (Imager for Magnetopause-to-Aurora Global Exploration) has overcome these technical challenges and has been imaging the plasma in the magnetosphere since its launch in March 2000. Burch et al. (p. 619; see the cover) show how the magnetosphere changes during several geomagnetic storms and relates these images to our understanding of the sun-Earth interactions that edited by Phil Szuromi

627 Slow Particles Can Also Shine Although the speed of light is constant in a

vacuum, it travels more slowly through matter. If a charged particle can move through a

medium faster than light can, radiation will be emitted. It is this Cherenkov radiation that gives a nuclear reactor its blue glow,

and it is also used in nuclear and high-energy physics to detect, count, and identify relativistic particles. It was previously thought there was a one-to-one relation between the speed of the particle and the cone angle at which radiation was emitted relative to the particle. Theoretical

and experimental work by Stevens *et al.* (p. 627) now show that Cherenkov radiation can also be emitted by particles moving subluminally, or slower than the speed of light.

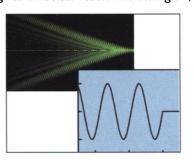
can affect our ground-based and orbiting electromagnetic communications.

Planetary Nebulae Not so Hot?

Planetary nebulae are the highly ionized gaseous shells created during the collapse of a low-mass star (1 to 10 solar masses) to a white dwarf. The surface of the shell is very luminous and thought to be maintained at very high temperatures through the absorption of energetic ultraviolet photons from the still-burning central star and their re-emission at longer wavelengths from recombined hydrogen, helium, and other elements. Johansson and Letokhov (p. 625) suggest that the bright emission is actually a resonance-enhanced two-photon ionization of heavier elements such as silicon by hydrogen Lyman α radiation. This different mechanism to explain the spectral lines observed in planetary nebulae removes the need for high temperatures on the surface of the nebulae and possibly the need for additional fusion in the dying central star.

Droplets Make a Fast Break

Gradients at a surface, such as in temperature or surface energy, can lead to liquid flows. This movement of fluid through unbalanced surface tension, also known as the "tears of wine" or the Maragoni effect, tends to move fluids slowly, however. Daniel *et al.* (p. 633; see the Perspective by Wasan *et al.*) now show that when surfaces designed with a surface energy gradient are exposed to high fluxes of condensing vapor, the droplets that form grow and merge with one another to accelerate their movement. The droplets flow at speeds hundreds to thousands of times



faster than Maragoni flows. This effect could be used to improve the efficiency of heat exchangers and heat pipes.

Silencing Is Replication-Free

Gene silencing is a mechanism by which cells shut down large sections of chromosomal DNA by incorporating it into heterochromatin, a process that is important for the differentiation of the many different cell types during the life cycle of a eukaryotic organism. Silencing of the two yeast mating-type loci, HML and HMR, is established during the S, or DNA synthesis, phase of the cell cycle, and it has therefore been assumed that DNA replication is involved in this process. Kirchmaier and Rine (p. 646)

and Li *et al.* (p. 650) now show that a portion of DNA containing the HMR locus that was excised from the chromosome and thus unable to replicate is nevertheless effectively silenced, which indicates that replication is not required for the establishment of silencing. In a Perspective, Smith and Boeke point out that replication could nevertheless still play a role for the maintenance or inheritance (or both) of the silenced state.

Nanotubes Go with the Flow

The alignment and patterning of individual nanoscale components will be a crucial requirement for developing molecular electronics. Huang *et al.* (p. 630) describe a process for the hierarchical assembly of nanowire and nanotube functional structures based on the combination of fluid flow and chemical patterning of surfaces. They demonstrate alignment of the nanowires with fluid flow on the length scales of nanometers to millimeters and the controlled assembly of grids of crossed nanowires. Complex crossed structures were prepared by using a layer-by-layer strategy in which distinct flows were used for each sequential step.

Dynamics Within Nanocavities

Transmembrane protein pores have previously been fitted internally with cyclodextrin (CD) molecules that can greatly reduce the pore opening and hence their ion conductance. Gu *et al.* (p. 636) now extend this approach by identifying mutants of α hemolysin that can bind two different CDs in different locations along the pore to create a nanocavity with a volume of ~4400 cubic angstroms. Singly charged guest molecules that pass through one CD but not the other can be introduced into the

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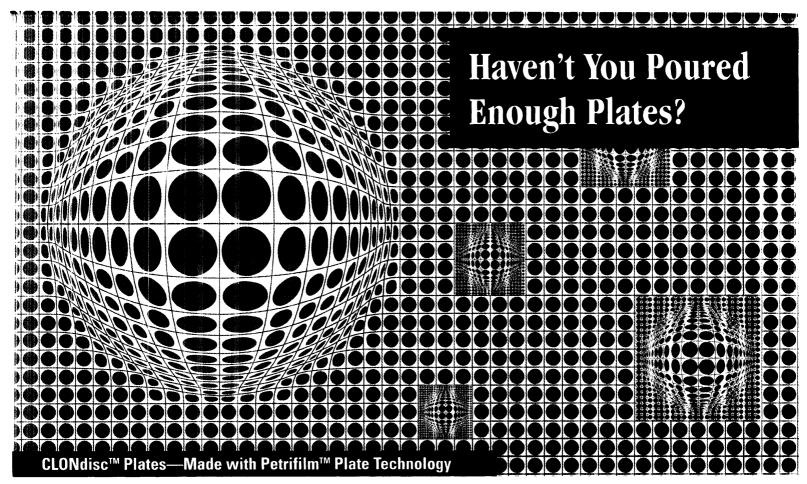
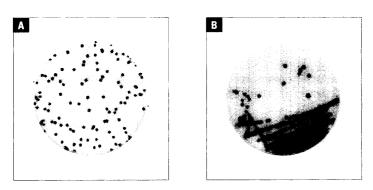


Illustration inspire by the optical art of a ctor Vasarel



Panel A shows a typical CLONdisc plate inoculated with an aliquot of bacterial culture. **Panel B** shows a single colony streaked on a rehydrated CLONdisc plate. *Lac+* colonies appear blue due to the presence of X-gal in the growth matrix. *Lac-* colonies appear red due to the presence of TTC. Both images were obtained using an Epson 836XL flatbed scanner.

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CONTINUED FROM 549 THIS WEEK IN SCIENCE

cavity with an electrical potential, where they reside for hundreds of milliseconds. This process allows the differential trapping of molecules in the cavity.

Ran's Importin Partner

The small guanosine triphosphatase Ran is involved in transport of proteins into the nucleus and has been recognized more recently as a regulator of formation of the mitotic spindle. Wiese *et al.* (p. 653) show that Ran uses the same binding partner, importin- β , to control microtubule formation that it uses to promote protein transport. Importin- β carries cargo proteins to the nucleus and releases them upon interaction with guanosine triphosphate (GTP)-bound Ran. In the case of spindle assembly, importin- β interacts with the NuMA (nuclear-mitotic apparatus) protein, which helps organize microtubules at the spindle poles. Activated Ran causes release of NuMA from importin- β and thus promotes microtubule assembly.

Checking Back?

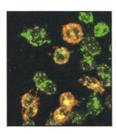
Encoding and retrieval of declarative memories in the primate brain depends on the interaction between the medial temporal lobe system and the neocortex. Naya *et al.* (p. 661) recorded nerve cell activity in awake, behaving monkeys from area 36 of the perirhinal cortex and area TE, two morphologically distinct but mutually interconnected areas of the temporal cortex. During a visual pair-association task, which requires retrieval of a target from long-term memory, they observed not only a perceptual signal that spread in the normal forward direction in the brain but also a memory signal that propagated backward. That may serve to extract stored knowledge about objects.

More than a Supporting Role

Glia are brain cells often described as providing "support" for the less numerous, but more famous, neuronal brain cells. Now, Ullian *et al.* (p. 657; see the news story by Helmuth) show that glia in culture control the number of synapses on neurons and that they are necessary for the maintenance of proper synaptic electrophysiological responses. In the newborn rat, synapses are formed in the superior colliculus at the end of the first week after birth, at precisely the same time that atrocytic glia appear and proliferate. The authors suggest that glia may trigger immature and highly plastic synapses in the developing brain to increase and stabilize in order to lock synaptic circuitry in place.

Exposing Lipids

NK-T cells are a small and unusual class of T cells that recognize lipid, rather than protein-derived antigen. The structures responsible for presenting lipid antigens—the CD1 molecules—have been studied for some time, yet the intracellular requirements for this mode of antigen presentation have not been defined. Prigozy *et al.* (p. 664) report that as for protein antigen, intracellular processing may be an obligate part of presentation of lipids to T cells. Using a precursor of a model glycosphingolipid antigen, the authors observed that only when the enzymatic machinery of the



lysosmal compartment was intact could antigen recognition by NK-T cells take place. This process involved the removal of a terminal sugar group by the enzyme α -galactosidase, thus permitting the association of the modified lipid with the presenting molecule CD1d.

Crawling Along

Motor proteins like kinesin generally possess two "heads" attached to a filamentous tail. The motor proteins use energy to translocate themselves (and any attached cargo) along intracellular tracks known as microtubules. Kawaguchi and Ishiwata (p. 667) have examined this process in isolation using sophisticated biophysical techniques to analyze how and when the head domains use energy from adenosine triphosphate as they crawl along microtubules. Their findings support the notion that, as the motor moves along, alternately one and then two heads are bound to the microtubule.

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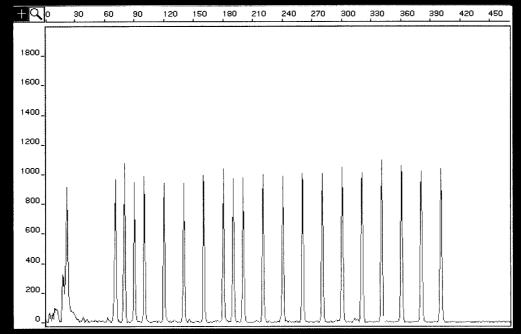
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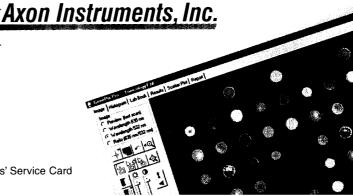
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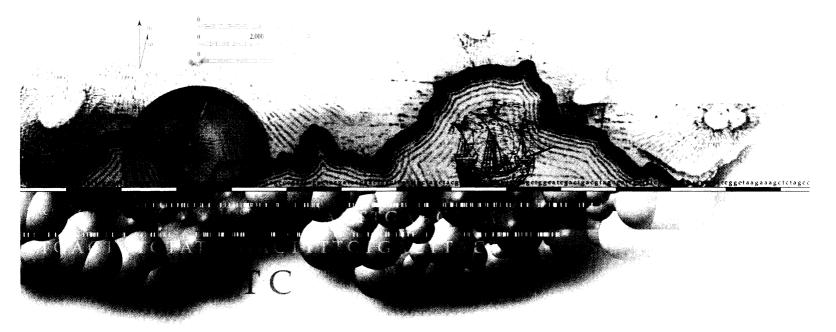


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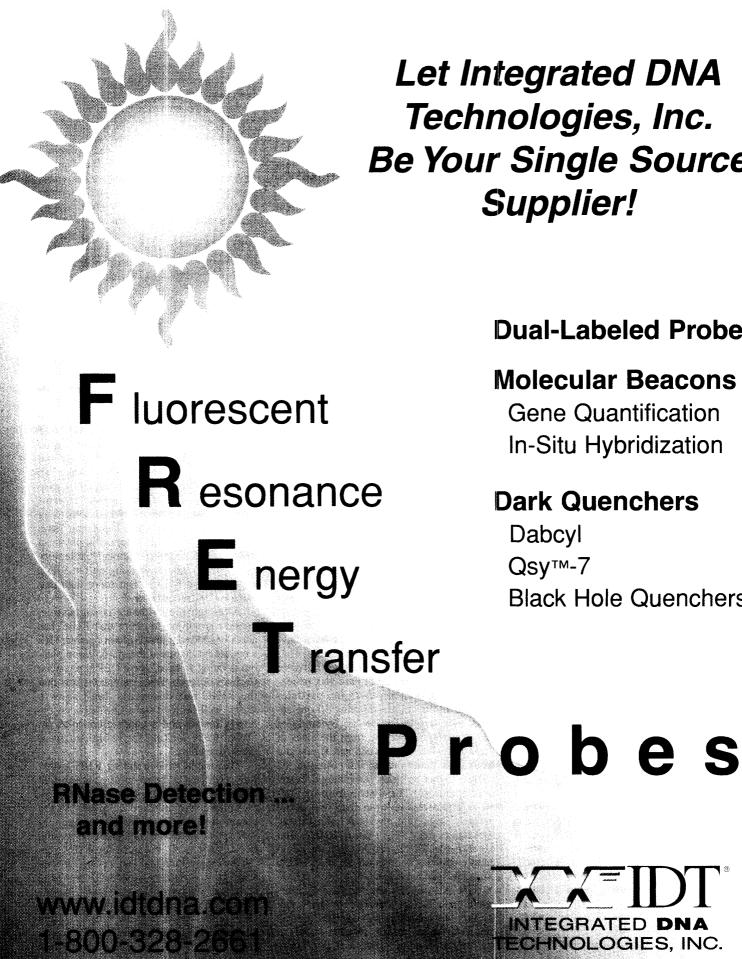
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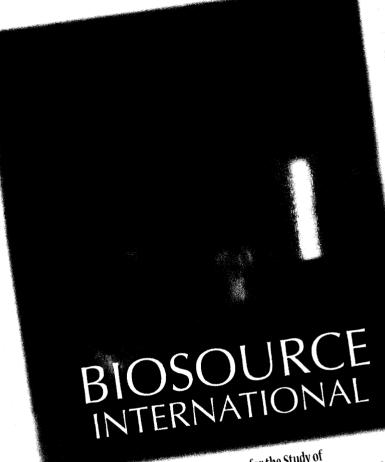
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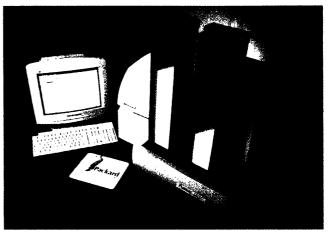


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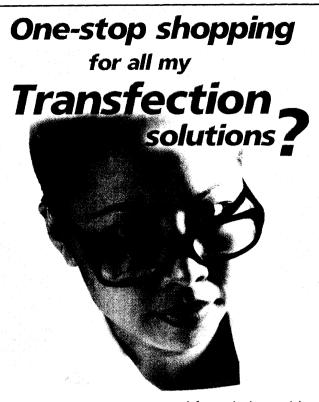


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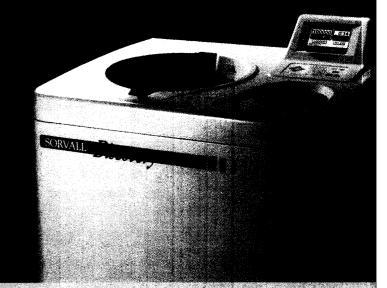
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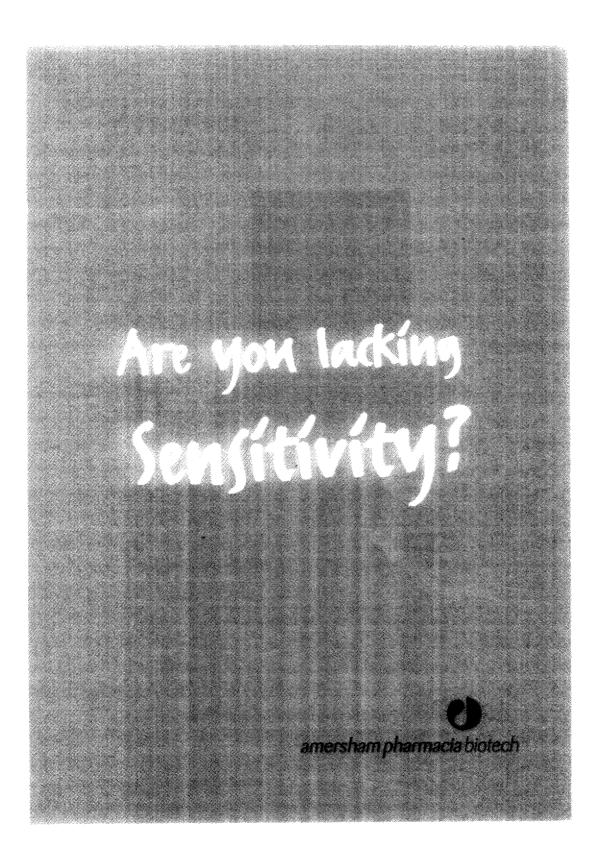


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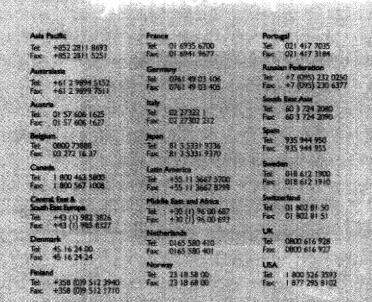


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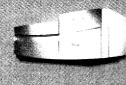
Fluorescently labelled DNA size ladders and PCR products (between 0.25 and 5 fmol per band) loaded in the same lanes were separated in a polyacrylamide gel. Fluorescein (green), Cy^{*3} (yellow), ROX^{**} (blue) and Cy5 (red) labels were used.

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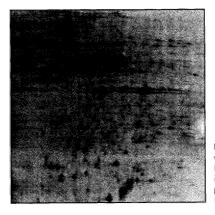
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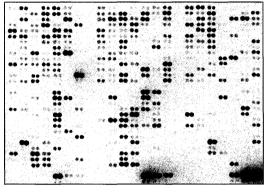


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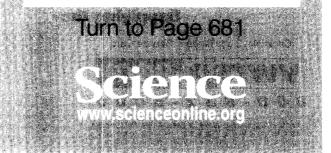




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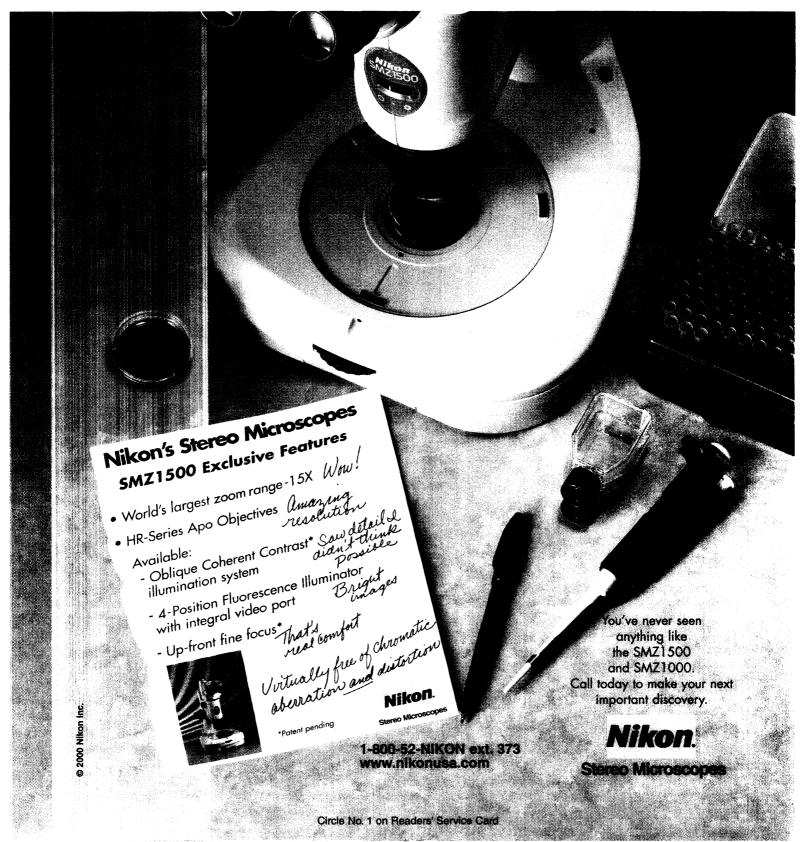
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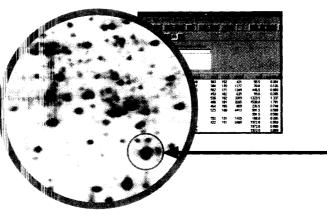


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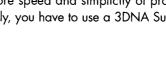
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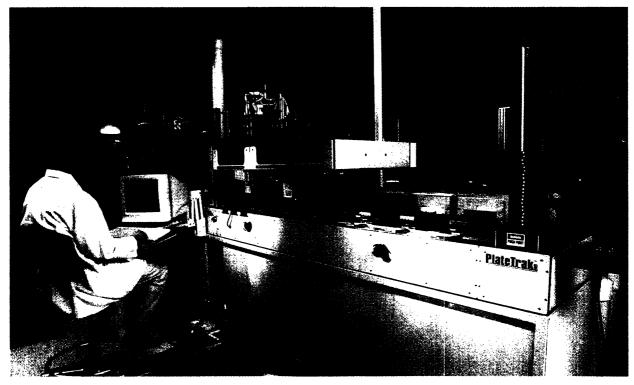
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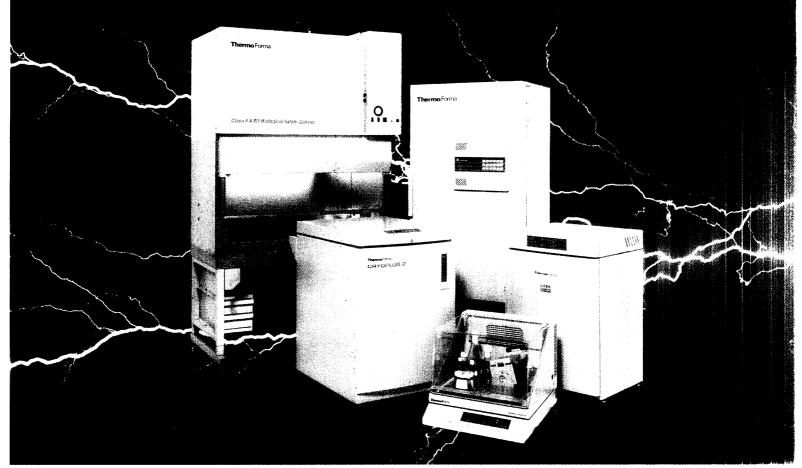




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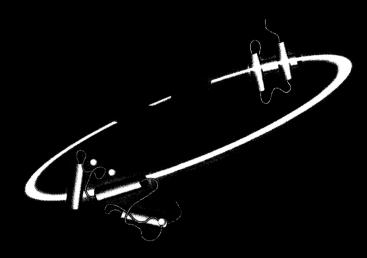
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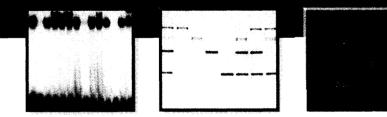
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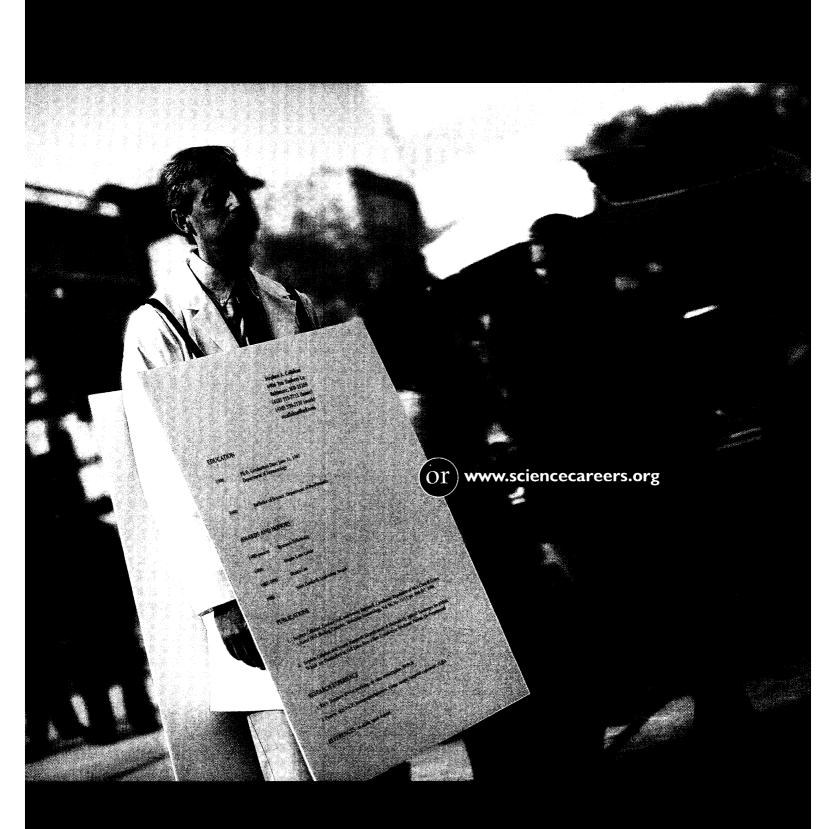


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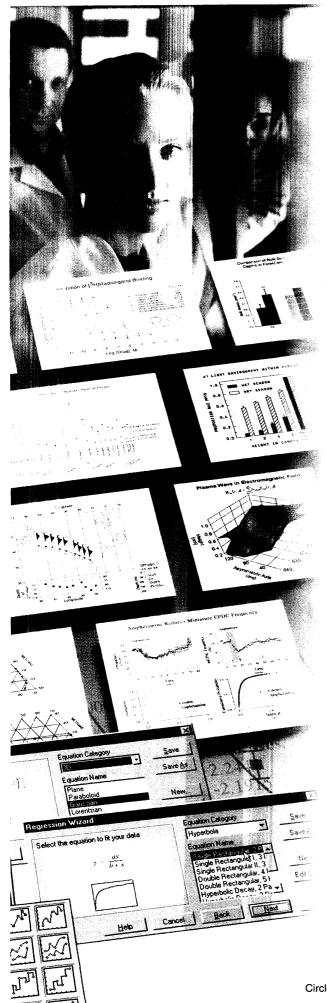
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PCR clean-up.		
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Fig. 1. Fluorescent sequencing results of a 100 bp pUC18 PCR fragment sequenced with a -20 Fwd primer using the DYEnamic ET Terminator Cycle Sequencing Kit (Amersham Pharmacia Biotech). Data generated for USB by Cleveland Genomics (clevelandgenomics.com), a research service com- pany. PCR clean-up performed with: (a) ExoSAP-IT; (b) a column designed for PCR clean-up. Base miscalls in (b) are due to inherently low yields of short PCR products when using columns. Fig. 2. Autoradiograms of a 20.7 kb Lambda PCR fragment sequenced with MBL202 Fwd primer using USB's Thermo Sequencas Radiolabeled Terminator Cycle Sequencing Kit. PCR clean-up performed with: (a) ExoSAP-IT; (b) a column designed for PCR clean-up. GATCCCCGGGETHCCGAG CTCGAATTCGTAATCATGTCATA 30 40 50 60 Fig. 1(a) GATCCCCGGGETHCCGAG C NCGAATTCGTNATCATGTCATA 30 40 50 60 Fig. 1(b)	 One Tube/One Step PCR clean-up 100% recovery of both small and long PCR products Economical for high throughput purification Less hands-on time than other methods Scaleable to handle large volumes 	Rediscover the chemistry

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