

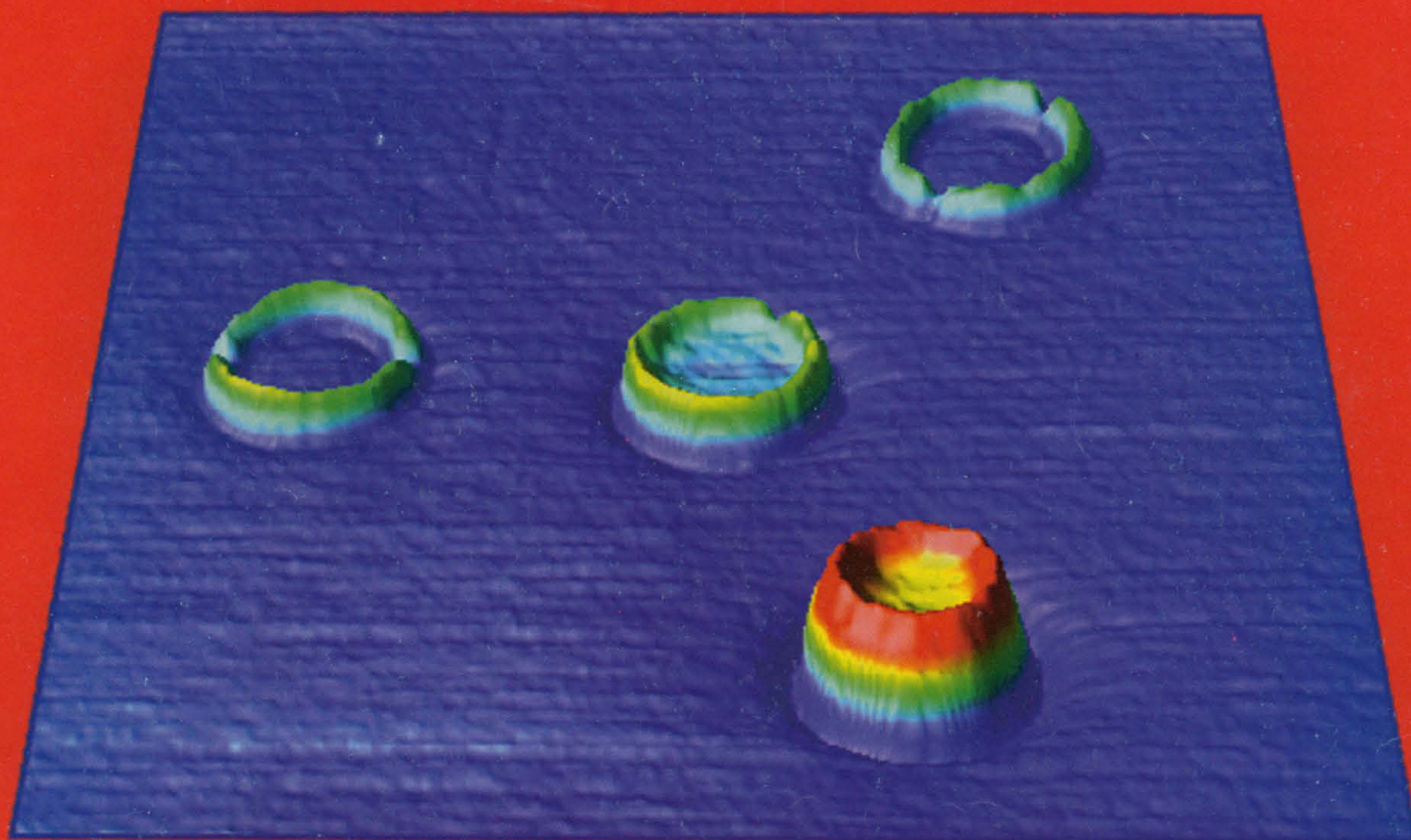


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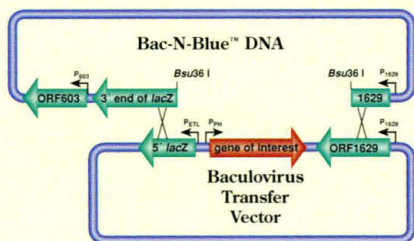
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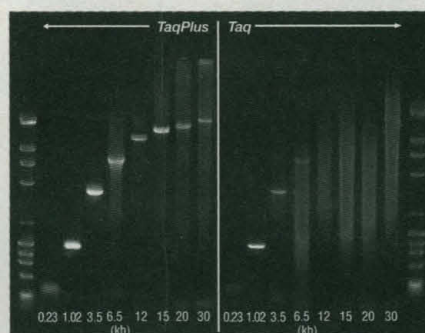


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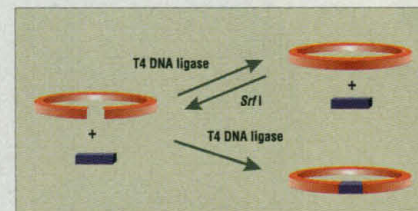


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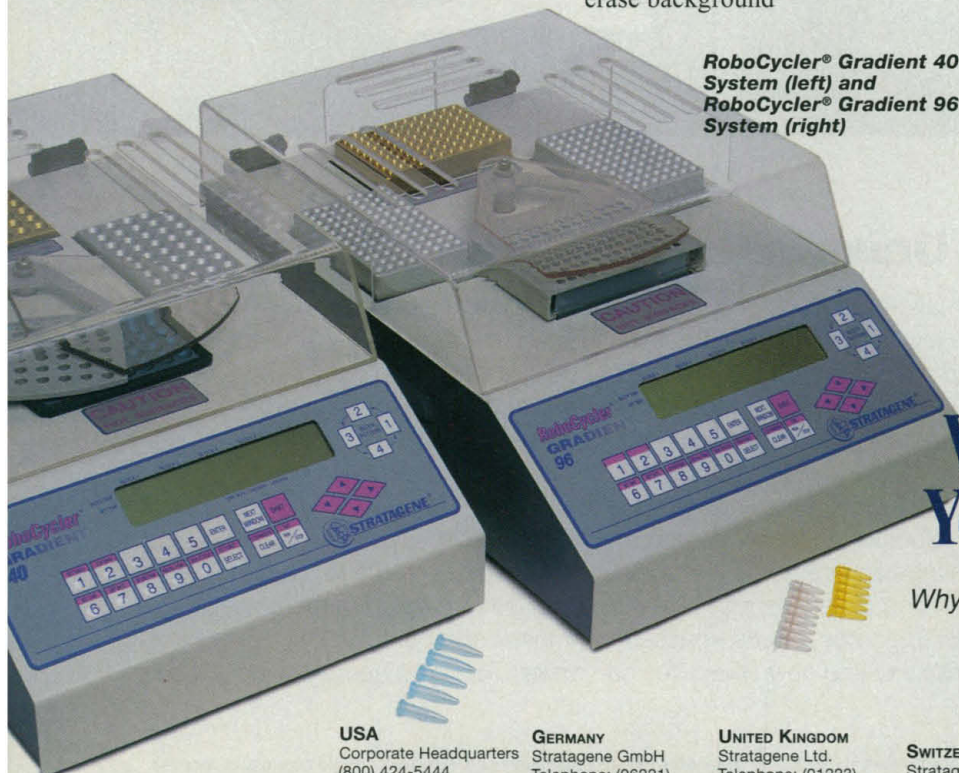
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Serotonin and
crayfish dominance



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Short but folded up

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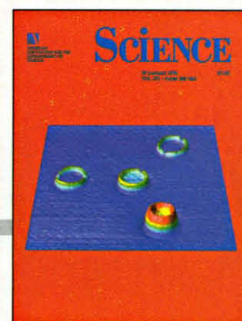
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COVER

Scanning superconducting quantum interface device microscope image of the magnetic field trapped in thin-film rings of a thallium-based cuprate high-temperature superconductor. The lower right control ring is in the one flux quantum state, the center ring is in the one-half

flux quantum state, and the other two rings are in the zero flux quantum state. This result provides strong support for *d*-wave pairing symmetry in high-temperature cuprate superconductors. See page 329 and News story on page 288. [Image: Cliff Pickover]



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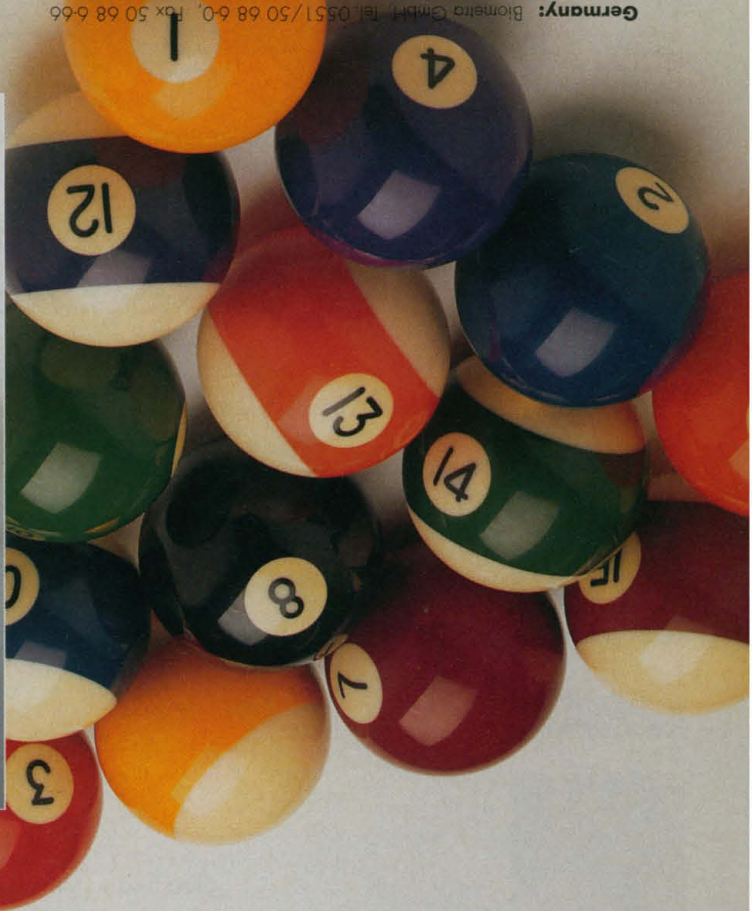
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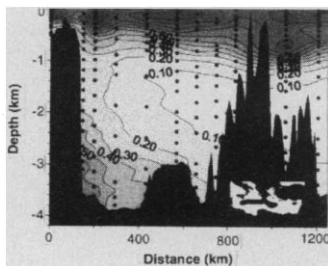
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THIS WEEK IN SCIENCE

edited by PHIL SZUROMI

Sea change

The Mediterranean Sea has vertical, thermohaline circulation like that in the major oceans. Deep water was formed since at least early this century in the Adriatic Sea. Recent surveys described by Roether *et al.* (p. 333) revealed that the pattern changed after 1987. Deep



water is now forming in the Aegean Sea, apparently because of an increase in the salinity of surface waters there.

Leading lights

Materials that exhibit the electro-optic effect, a nonlinear optical property, change their refractive index in response to an applied electric field and could be used to process signals in fiber-optic networks. Ahlheim *et al.* (p. 335) synthesized polymers containing conjugated donor-acceptor chromophores with strongly electron-withdrawing acceptors. After a process that aligns the chromophores, one of these materials had an electro-optic coefficient twice that of lithium niobate at 1.3 micrometers, a wavelength used in telecommunications.

Galactic shapes

Astronomers can only make two-dimensional images of distant objects, a process that loses most shape information. Elliptical galaxies present a particu-

Superconductor symmetry

Experiments determining the pairing symmetry in copper oxide superconductors have strongly suggested *d*-wave pairing symmetry but have not ruled out *s*-wave states. Tsuei *et al.* (p. 329; see the cover and the news story by Clery, p. 288) have determined the pairing symmetry in a tricrystal film of thallium-barium copper oxide. They observed a half-integer quantum flux of spontaneous magnetization only over the intersection of the three grains, a result consistent with $d_{x^2-y^2}$ symmetry.

lar challenge as they could be oblate, prolate, or triaxial. Merritt (p. 337) modeled how stars orbit within elliptical galaxies and found that chaotic trajectories prevent evolution toward triaxial equilibrium. Most such galaxies are likely axisymmetric, that is, prolate or oblate.

CFC destruction

As chlorofluorocarbons (CFCs) are recovered and replaced with more benign substitutes, the problem remains of disposing these normally unreactive gases. Burdeniuc and Crabtree (p. 340) show that passing CFCs over a hot bed of sodium oxalate ($\text{Na}_2\text{C}_2\text{O}_4$) converts them to salts (NaCl and NaF), carbon, and CO_2 . A similar reaction converts saturated fluorocarbons into aromatic species.

Adjuvant internal

The products of acquired immune response, such as antibodies, often exert their effect by enhancing innate mechanisms of immunity, such as phagocytosis. Dempsey *et al.* (p. 348) report that the complement component C3d acts like an adjuvant—its attachment to a protein antigen enhances the antibody response by a factor of up to 10,000, a finding that may prove useful in peptide and protein vaccine development.

Suppressing like Mad

About 90% of human pancreatic cancers display allelic loss at chromosome 18q, a finding that strongly suggests the presence of a tumor suppressor gene. Hahn *et al.* (p. 350; see the news story by O'Brien, p. 294) identified a strong candidate suppressor gene at 18q21.1 that is deleted or mutated in a significant fraction of pancreatic cancers. The *DPC4* gene (for deleted in pancreatic carcinoma), is similar in sequence to the *Drosophila Mad* gene, mutations in which produce abnormalities in midgut morphogenesis, imaginal disc development, and dorsal-ventral patterning. The *Mad* gene has been implicated in a transforming growth factor- β -like signaling pathway.

Putting down patterns

Bone morphogenetic proteins (BMPs) induce the formation of cartilage and bone in mammals. BMP-1 has metalloproteinase activity and is similar to proteins that control morphogenetic patterning in *Drosophila*. Kessler *et al.* (p. 360) report that human BMP-1 is identical to procollagen C-proteinase (PCP), the enzyme that cleaves procollagen into monomers that form collagen fibrils. In addition to its proposed role in activating other BMPs, which are members of the transforming growth factor- β family,

BMP-1 may influence pattern formation by controlling deposition of extracellular matrix.

Endocytosis adaptor

After binding their ligands, certain receptors are internalized. For the β_2 -adrenergic receptor ($\beta_2\text{AR}$), a member of a large family of receptors involved in signal transduction, ligand binding inactivates the receptor for further signal transduction and internalization must occur to reactivate the receptor. Ferguson *et al.* (p. 363) examined the role of the protein β -arrestin, which interacts with $\beta_2\text{AR}$, in this process. The protein can stimulate the internalization and reactivation of mutant receptors that are deficient in these processes. Thus a cytosolic protein that is not part of the constitutive endocytic machinery can specifically modulate internalization.

Zinc and epilepsy

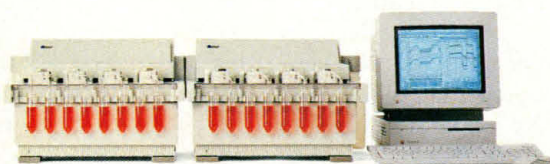
In the brain, synaptic excitation and inhibition must be carefully balanced. Reduced synaptic inhibition results in hyperexcitability and epilepsy. Paradoxically, in an animal model of temporal lobe epilepsy, inhibition mediated by γ -aminobutyric acid (GABA) receptors appears to be increased rather than decreased. Buhl *et al.* (p. 369) found that these GABA receptors are more sensitive to zinc compared to those from normal animals. Zinc can break down the otherwise increased inhibition of neurotransmission mediated by the GABA receptors in temporal lobe epilepsy. Zinc can also be released in the mossy fibers found in the brains of epilepsy patients.

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1. Science 257, 1906-1912, (1992) 2. J. NIH Research 5, 69, (1993)

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Need for Finer, More Detailed Images Puts the Focus on Fluorescence

Until fairly recently, brightfield and phase contrast were the most popular techniques used for microscopic studies. These techniques work well for studies of individual cells, but they are not adequate for imaging smaller entities such as some cellular organelles, proteins, antibodies, microtubules, RNA and DNA. Because fluorescence permits selective imaging and analysis of these substances with resolution down to several nanometers, it is becoming increasingly popular. Recent advances in optics design promise to make it an even more powerful technique.

As biomedical researchers continue to explore smaller and smaller entities, fluorescence microscopy is proving to be an exceptionally powerful tool.

Because fluorescent dyes, or fluorochromes, are absorbed selectively by different substances within a specimen, each substance can be targeted and observed separately. This has made possible techniques such as Fluorescence *in situ* Hybridization (FISH), for example, which has played a key role in identifying chromosomes and determining the number, size and location of specific DNA sequences in mammalian cells.

Smaller objects, finer details

Using fluorescence, scientists can resolve images that cannot be observed with ordinary light. The diameter of a single DNA molecule, for example, is about 2nm, while the finest detail that can be resolved by optical lenses is about 200nm. However, if a fluorescent dye is conjugated with the DNA molecule and the specimen is viewed with a fluorescence microscope, the molecule can be easily detected and measured.

Although it is a very powerful and relatively easy to use tool, fluorescence places extreme demands on the microscope's optics. The near-ultraviolet wavelengths that are used to excite the specimen are very high in energy. At the same time, the light emitted from the specimen is of much lower intensity than the light used to excite it, so the imaging optics must be designed to transmit as much light as possible. Care must also be taken to prevent autofluorescence emissions, which can mask and rob contrast from the image.

Special objectives required

Because today's ultrasensitive techniques place extreme demands on optics, the emitted fluorescence requires specially designed objectives with higher numerical apertures, enhanced brightness and higher UV light transmission than those used with other techniques. The new Nikon CF® PLAN FLUOR Universal Objectives have these characteristics.

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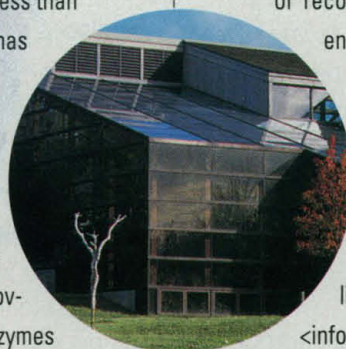
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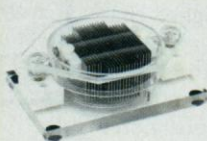
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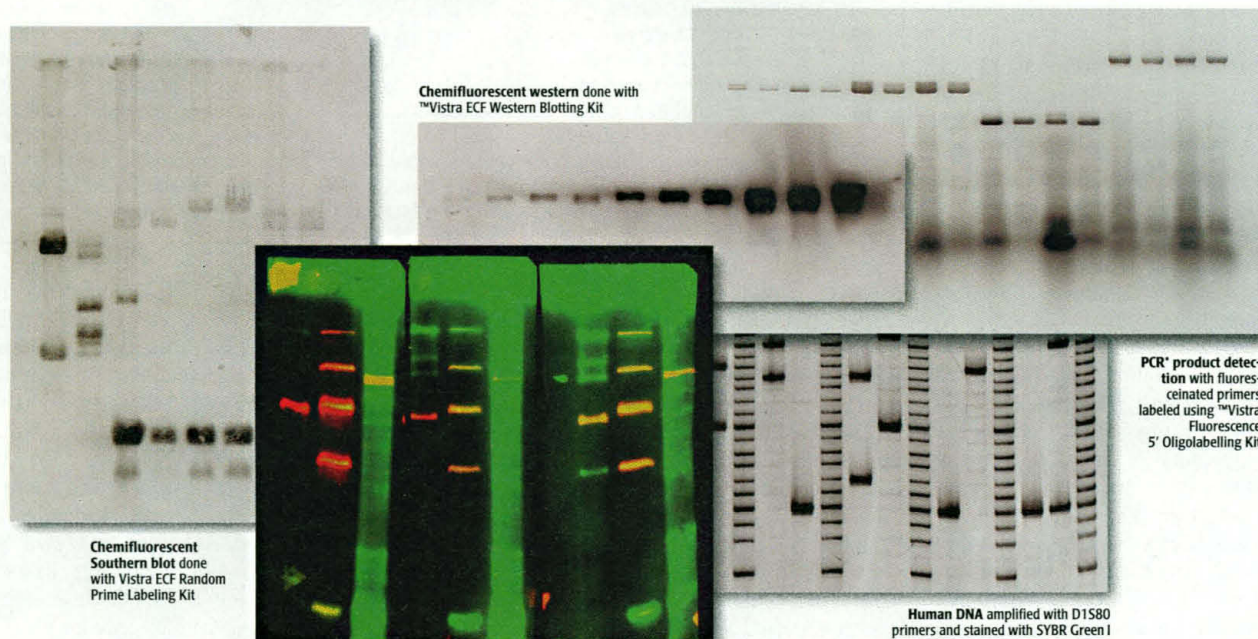
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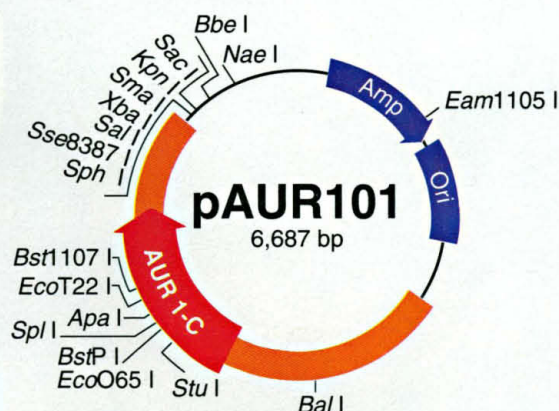
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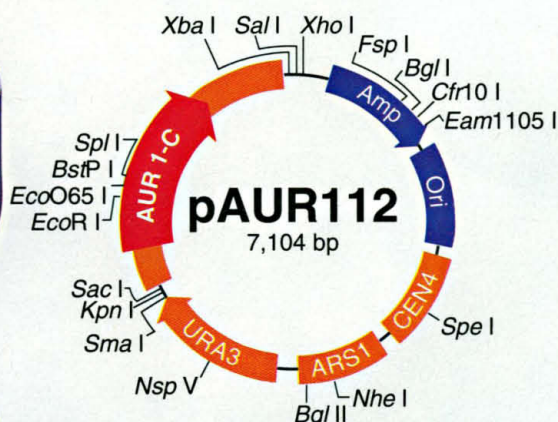
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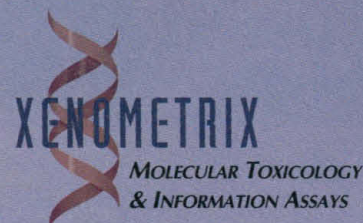
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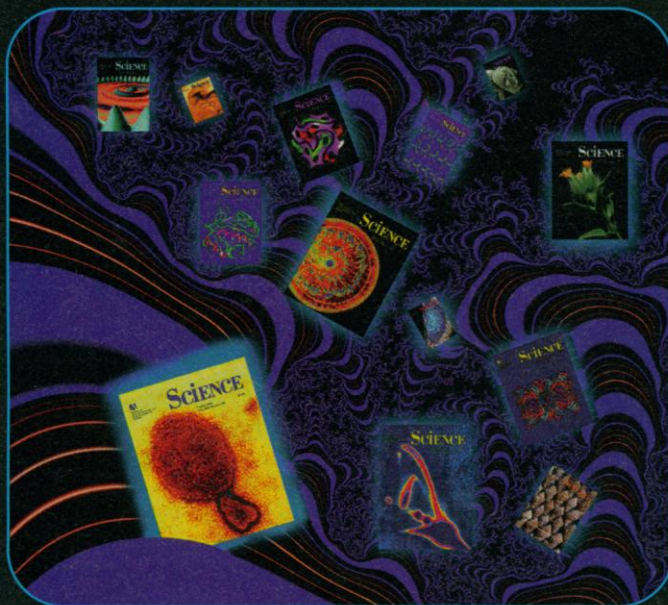
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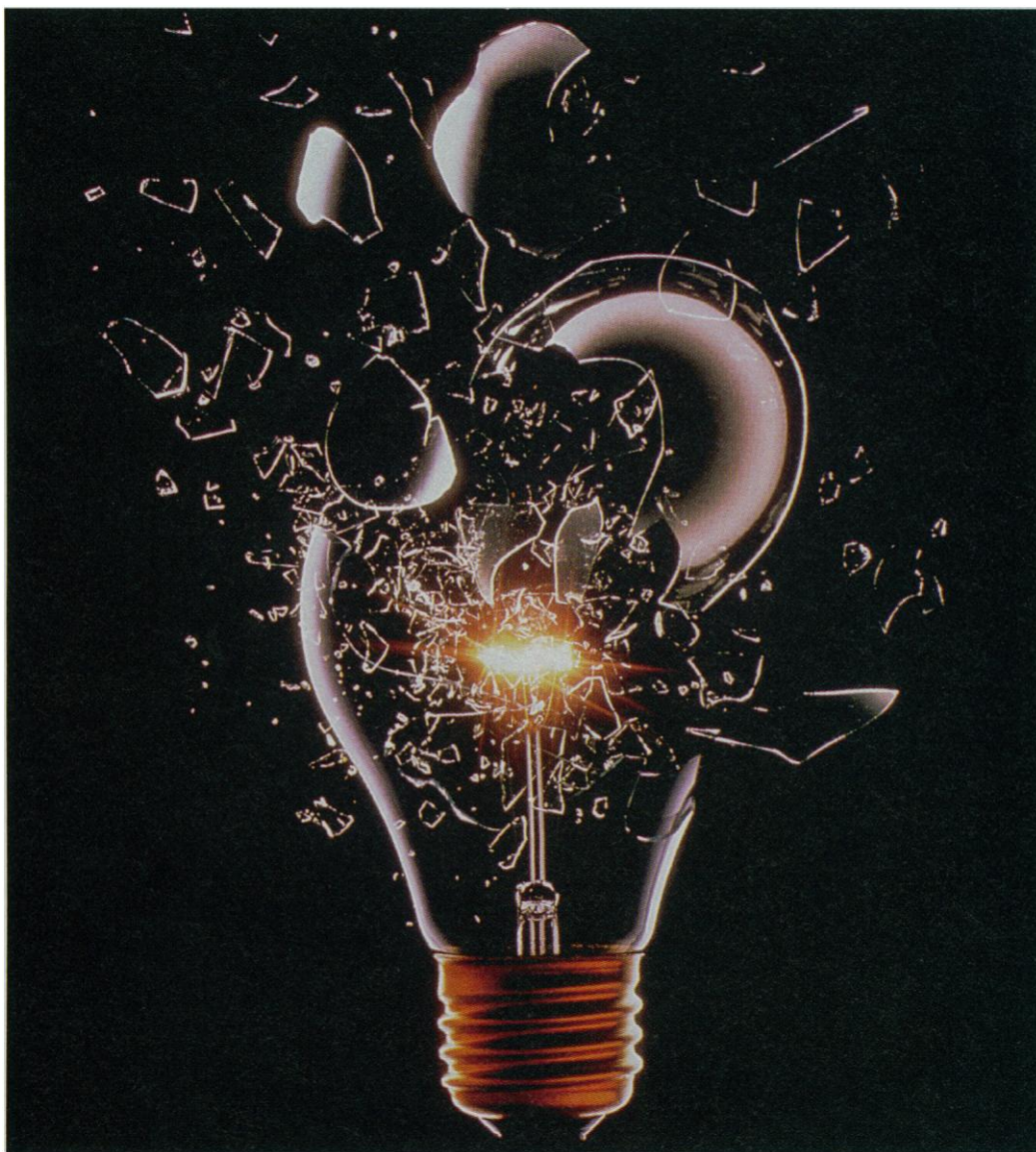
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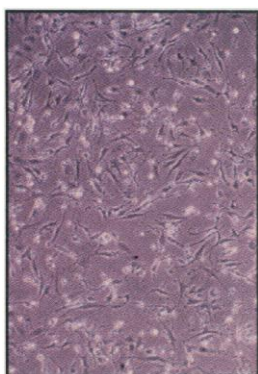
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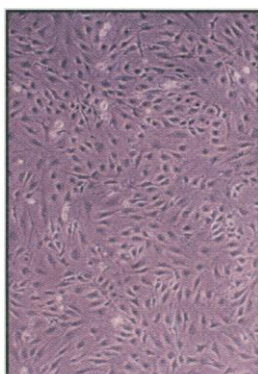


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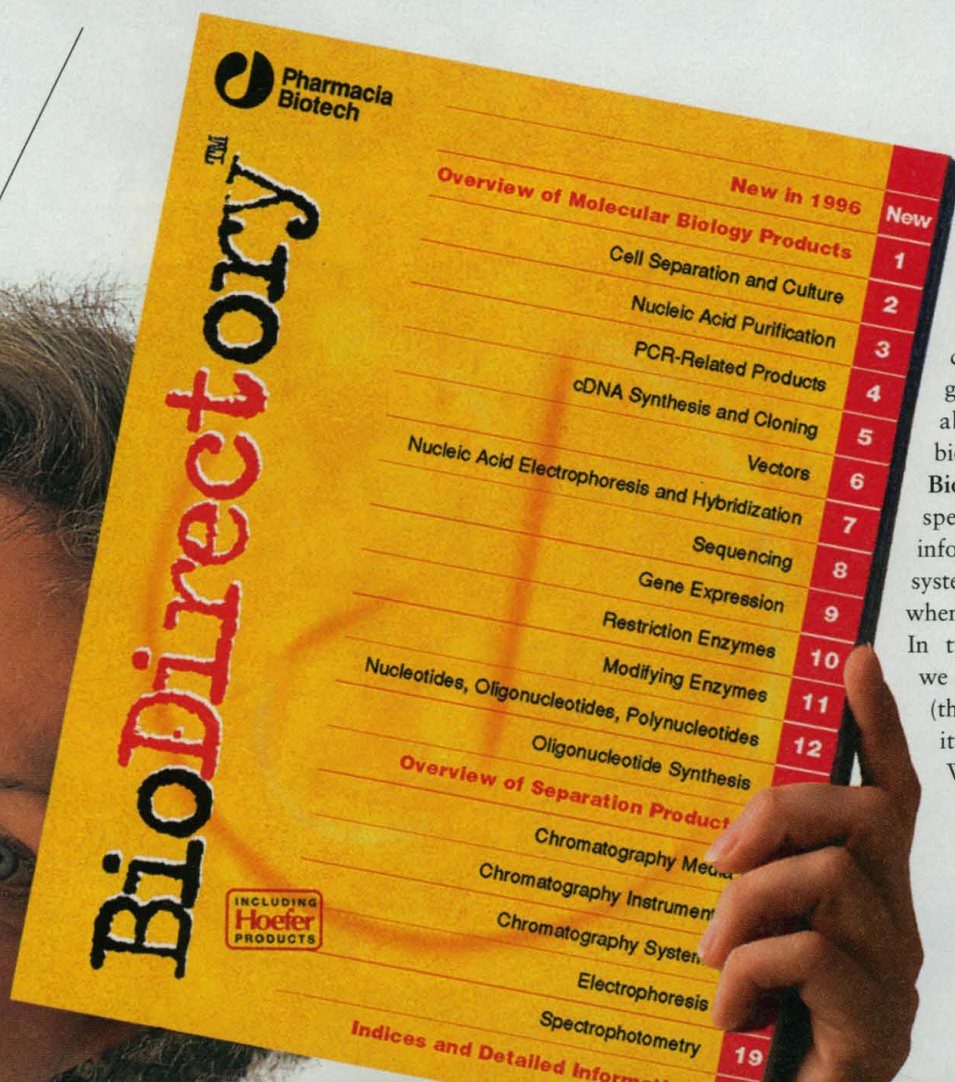
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References

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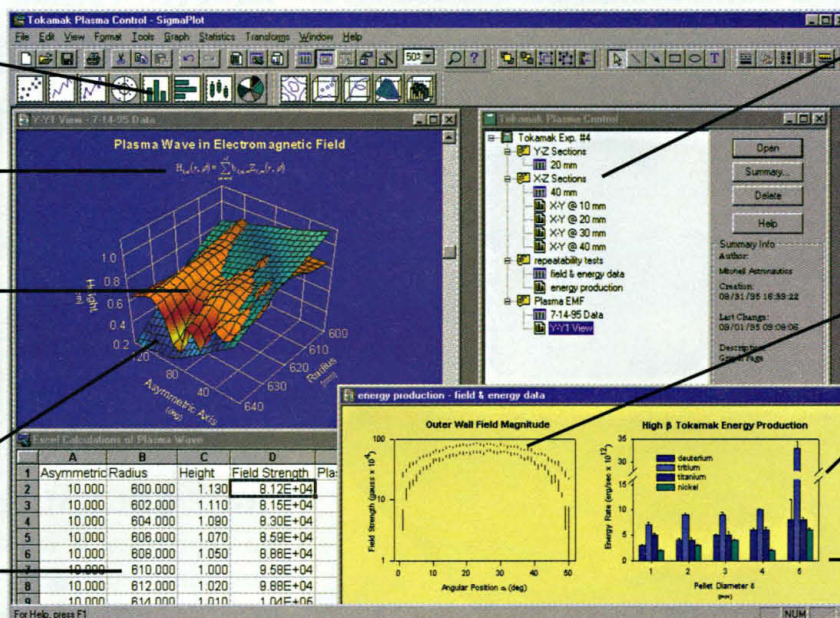
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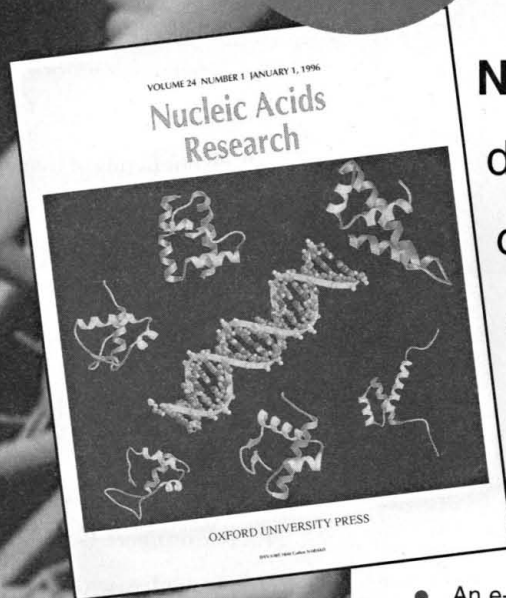
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