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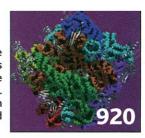
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COVER Four representations looking into the active site cleft of the large ribosomal subunit of Haloarcula. Synthesis of peptide bonds is catalyzed by ribosomal RNA in the active site, which contains the aminoacyl ends of the transfer RNAs (in contrasting colors). Clockwise from upper left: RNA (orange and white) and protein (blue), RNA domains coded by color, conserved proteins (yellow), and universally conserved RNA structure (blue). [Images: P. Nissen et al.]



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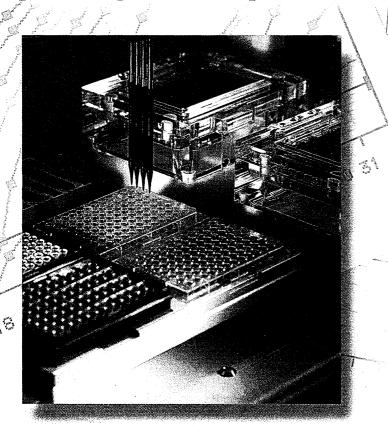
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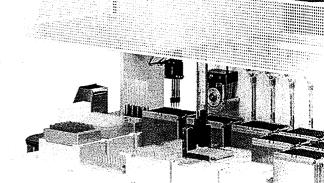
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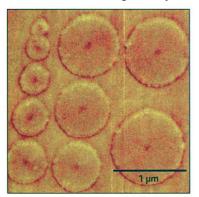


#### THIS WEEK IN SCIENCE

edited by PHIL SZUROMI

#### IMAGING A MAGNETIC VORTEX CORE

The magnetization of thin ferromagnetic films tends to break up into domains within which the magnetization is oriented in the same direction and is in the plane of the film. As the geometry of the



film is further restricted to form discs, theory predicts that a single domain should exist in which the magnetization takes a swirling-like form called a vortex, and that the magnetization at the center of the domain stands perpendicular to the plane of the film. Using a sensitive magnetic force microscope, Shinjo et al. (p. 930) have verified the existence of these perpendicularly oriented magnetic cores in permalloy dots that are 50 nanometers thick and have diameters of 0.3 to 1 micrometer.

#### **SQUEEZING EUROPA**

The morphology of Europa, an icy moon of Jupiter, suggests that large regions of its surface are under tension. Spreading ridges and opening cracks observed in such regions by the Galileo spacecraft have been related to tidal forces, but no features related to compression were observed. This situation creates a problem because the tensile features should be generally balanced by compressive features to maintain the moon's overall size and shape. Prockter and Pappalardo (p. 941) have identified folds and ridges related to compression arising from tidal stress within a smooth band called Astypalaea Linea in Galileo images. The authors provide important support for a standard tectonic model—when Europa's crust gets pulled apart somewhere, it will be squeezed together somewhere else.

#### **WET VERSUS DRY DYNAMICS**

After an electron in a molecule is excited by a photon, relaxation processes may transfer it to another atom or functional group. Such electron transfers are the basis of many photoreactions, including those that drive photosynthetic reaction centers. In the condensed phase, such photo-induced charge transfer processes may either be purely intramolecular or may be affected by the surrounding solvent molecules—it is often difficult to distinguish between these different effects. Yeh et al. (p. 935) have used ultrafast spectroscopy to study the dynamic response of a transition metal complex.  $[Ru(bpy)_3]^{2+}$  (where bpy is 2,2'-bipyridine), to photo-induced charge transfer in various solvents. The data allow them to convincingly distinguish pathways that are mediated by solvent and those that are strictly intramolecular processes. Charge localization onto a single bpy ligand depends on solvation dynamics, but the evolution of the initially formed delocalized excited state appears to occur independent of solvent.

#### FREE ELECTRON LASERS DOUBLE UP

Although synchrotrons provide bright sources of x-ray radiation, their output is generated by numerous independently radiating electrons, and thus is not coherent. One approach for developing bright, coherent, short-wavelength light sources is to take advantage of free electron lasers (FELs). Yu et al. (p. 932) describe an approach in which the output from a conventional laser is used to generate harmonics from an FEL. In a proof-ofprinciple study, they coherently modulated the energy of the electron beam of the FEL with that of a 200-picosecond pulse from a low-power CO2 seed laser operating in the infrared (a wavelength of 10.6 micrometers). After the electron passed through a dispersion magnet, it was fed through another undulator (the radiator), which was tuned to the second harmonic of the seed layer source and generated laser light at 5.3 micrometers. The authors suggest that a cascade process might be used to access shorter wavelengths in the ultraviolet and ultimately into the x-ray regime.

CONTINUED ON PAGE 831

#### **MAKING PROTEINS TAKES A RIBOZYME**

It would seem that proteins make the world of the cell go around. They regulate the intake of nutrients, some of which are combusted to produce energy; other nutrients are used as building blocks to make genetic components such as DNA and RNA or to make structural and storage materials such as lipids and carbohydrates. All of these processes are catalyzed by proteins. Now we learn that proteins themselves are made in the ribosome, a large complex of proteins and RNA, by reactions

catalyzed by ribosomal RNA (rRNA). The high-resolution structure of the large subunit of the ribosome is described by Ban et al. (p. 905). This subunit, made of approximately 3000 ribonucleotides and 30 distinct proteins, catalyzes the synthesis of the peptide bond, which is the linkage that joins amino acids in proteins. The active site for this reaction is entirely surrounded by rRNA; the main role of the protein components appears to be that of lending structural stability. The structure of the subunit complexed with



substrate analogs, described by Nissen *et al.* (p. 920; see the cover), confirms that the substrate binding-site interactions are mediated by rRNA. A universally conserved adenine base is positioned to act as a general acid-base catalyst for the synthesis reaction. The role of this adenine is further characterized by Muth *et al.* (p. 947). It displays a substantial shift in its acidity constant as a result of its nearneighbor interactions within the active site (a catalytic resource thought previously to be possessed only by proteins). The biochemical aspects of the proposed mechanism (which appears indistinguishable from that of serine proteases, except that it acts in reverse) and evolutionary implications are discussed in a Perspective by Cech.

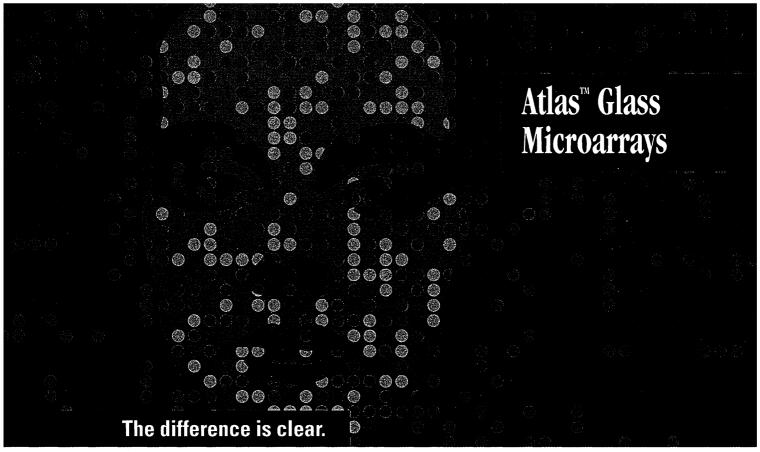
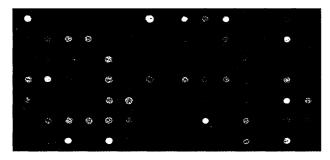


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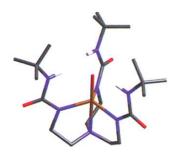
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#### THIS WEEK IN SCIENCE

**CONTINUED FROM PAGE 829** 

#### CREATING THE RIGHT ENVIRONMENT

Many biochemical oxidation reactions are performed by iron enzymes. Mononuclear iron species which contain a terminal oxo ligand have been proposed as key intermediates in these reactions. Model studies that attempt to mimic this chemistry with small metal complexes have been hampered by the propensity of Fe(III) complexes to form multinuclear species



with oxo ligands that bridge the Fe centers. MacBeth et al. (p. 938; see the Perspective by Thorp) now report on the synthesis, structure, and properties of an Fe(III)—O species and its Fe(III)—OH analog that are formed from Fe(II) species by reaction with O<sub>2</sub>. A specially designed ligand creates a hydrogen-bonded cavity around the iron center that allows an unprotonated Fe—O species to form and that inhibits the formation of oxo bridged species.

#### STOPPING OFF ON THE TRIP OUT

Hominids migrating out of Africa would have had to pass through the Middle East, yet records and sites from this key area are rare. One is at Gesher Benot Ya'aqov in the Dead Sea Rift, which apparently records a Pleistocene migration and includes Acheulean tools. Goren-Inbar et al. (p. 944) show that the artifacts at this site date to about 780,000 years ago, considerably earlier than previously thought, and earlier than the dates associated for such tools arising throughout Europe. The technologies associated with this site are more advanced than those associated with other sites in the Levant that date to 1 million years ago or older.

#### **ESCHEWING THE FAT**

With the rising incidence of obesity and type II diabetes, there is heightened interest in understanding how fat cells, or adipocytes, are produced from their precursor cells. Conventional views in the field have emphasized the notion that adipocyte differentiation is driven by ex-

tracellular inducing signals. Ross et al. (p. 950) challenge this notion by showing that adipogenesis is regulated by a repressive rather than an inductive mechanism. Pre-adipocytes in culture are maintained in an undifferentiated state by the action of the Wnt pathway, a signaling pathway already known to play a critical role in cell growth and differentiation in other tissues. When Wnt signaling was inhibited in pre-adipocytes, the cells spontaneously differentiated into fat cells. Disruption of Wnt signaling in muscle cell precursors, or myoblasts, also resulted in their conversion to adipocytes, which suggests that this may be a common mechanism for switching mesodermal cell fate.

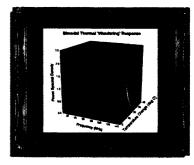
#### **A HIGHLY SENSITIVE TRIGGER**

Neurotransmitter release from vesicles in the presynaptic terminal is triggered by a brief increase in calcium. There has been a long debate concerning the sensitivity of the vesicular calcium sensor for mammalian central synapses and the minimal calcium concentration that is necessary to start the subsequent molecular events that lead to vesicle fusion with the plasma membrane. Bollmann et al. (p. 953) measured laser-induced release of caged calcium in a rat auditory brainstem synapse and found that increases in calcium concentrations of 1 micromolar evoked release. The authors' analysis indicates that a brief spike of 10 micromolar calcium would be sufficient to match the rate of synaptically evoked neurotransmitter release. This result implies that the calcium sensor in the presynaptic terminal has a high calcium affinity.

#### A PHOSPHATE TRANSPORTER ALSO HAULS GLUTAMATE

One of the most important neurotransmitters, glutamate, has long held a secret from the research community—the identity of its transporter into synaptic vesicles. Bellochio et al. (p. 957; see the news story by Helmuth) now report that a protein previously thought to play a role in transporting inorganic phosphate across the plasma membrane, the brain-specific Na<sup>+</sup>-dependent inorganic phosphate transporter (BNPI), also acts as the glutamate transporter. Now bearing a second moniker, the vesicular glutamate transporter (VGLUT1), its role may be a function of its environment. The authors suggest that at the plasma membrane, it may function as BNPI, whereas in synaptic vesicles it functions as VGLUT1.

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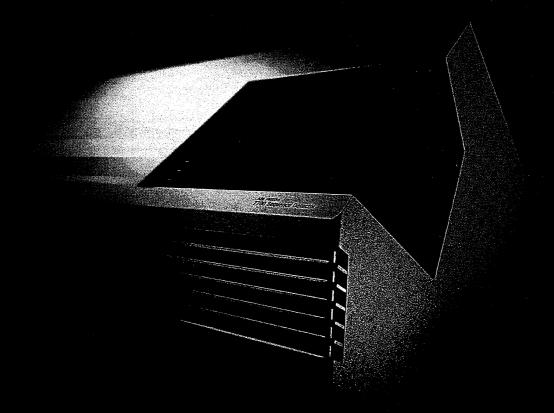
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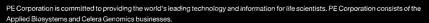
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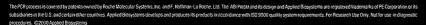
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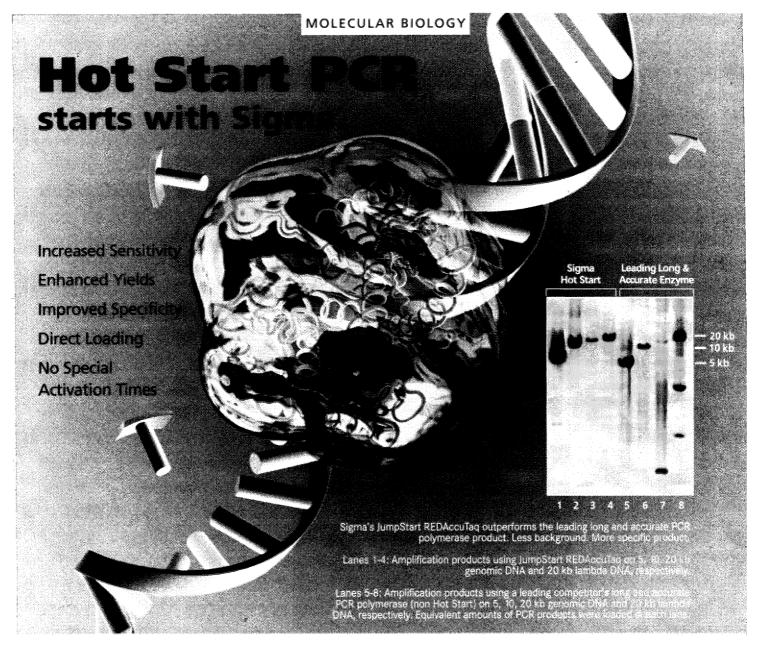












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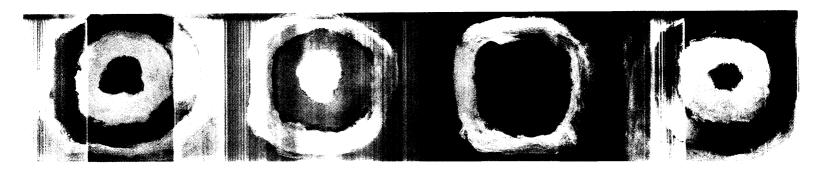
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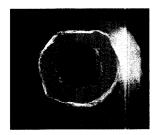
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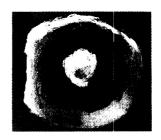


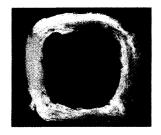
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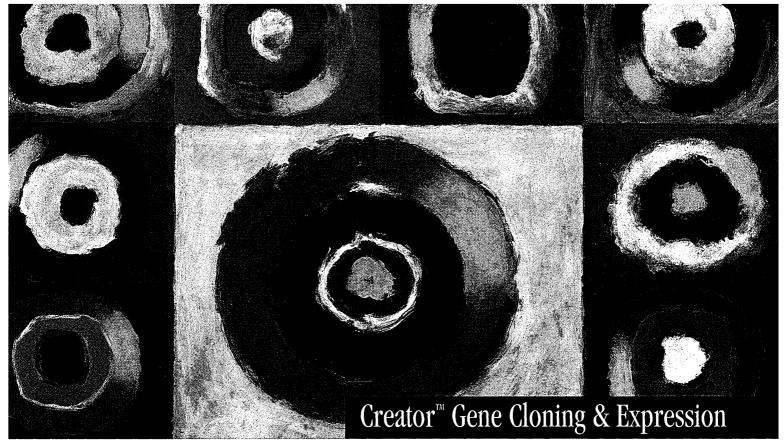
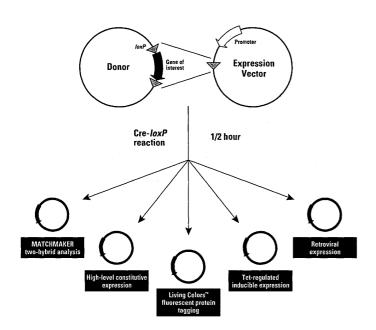


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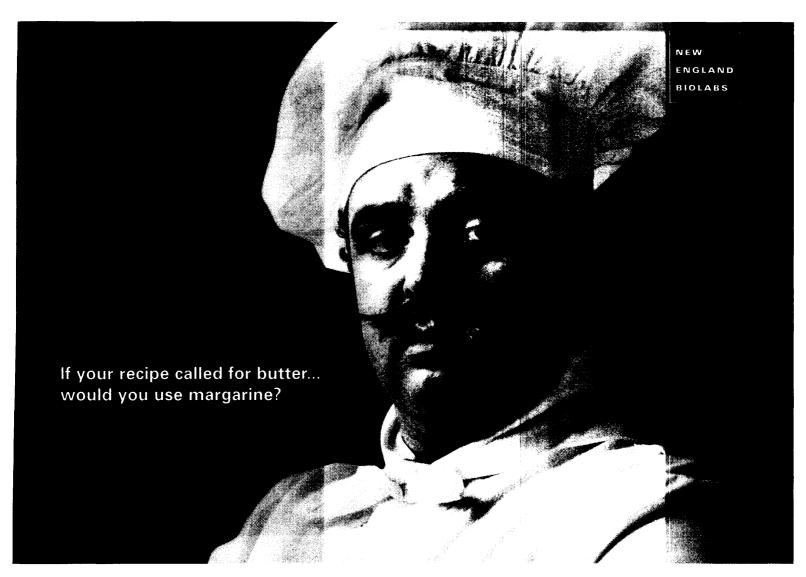
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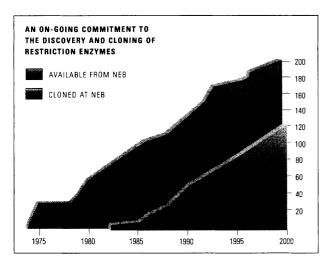
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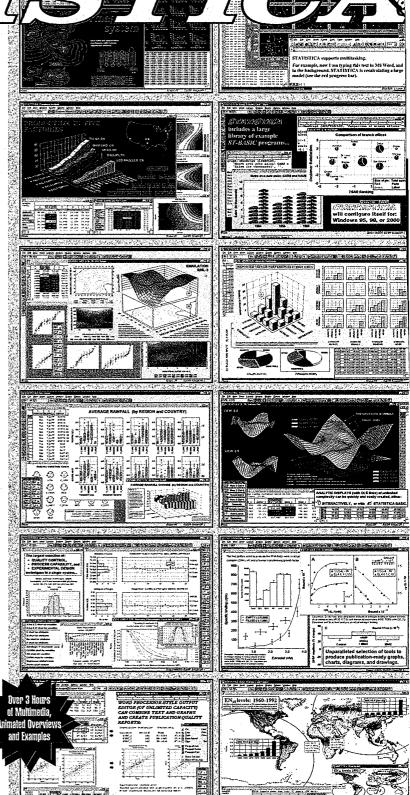
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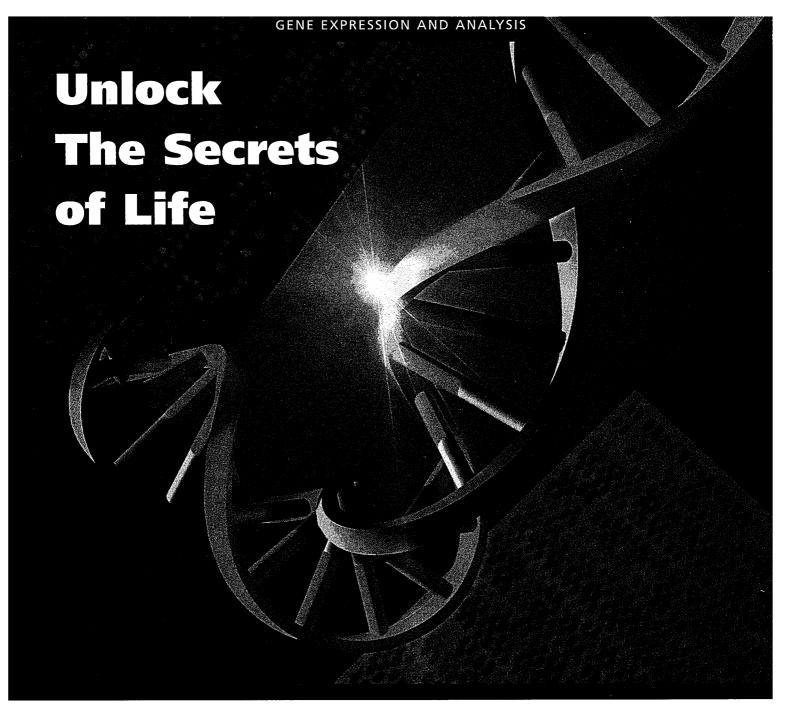


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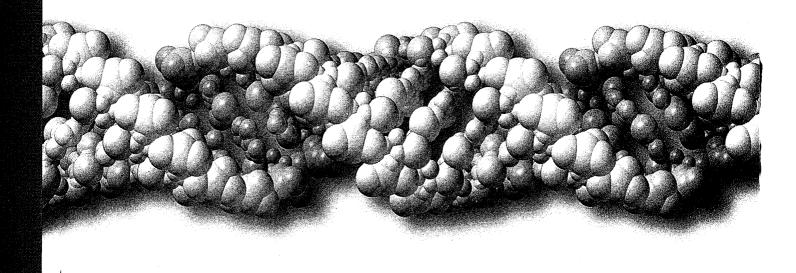
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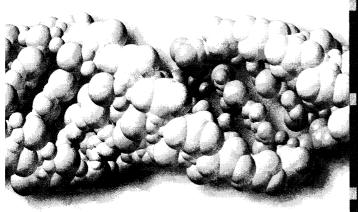
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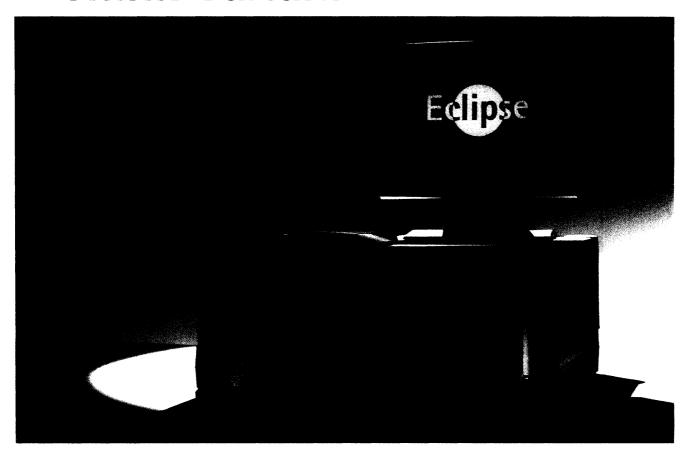


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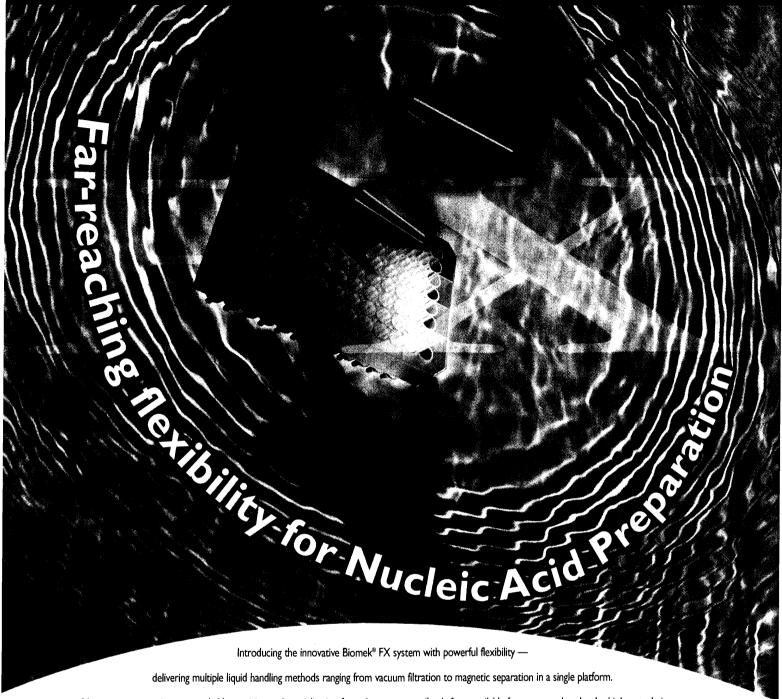
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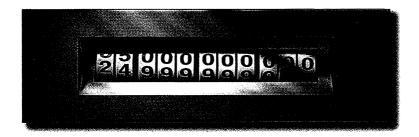
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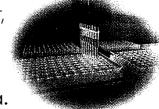
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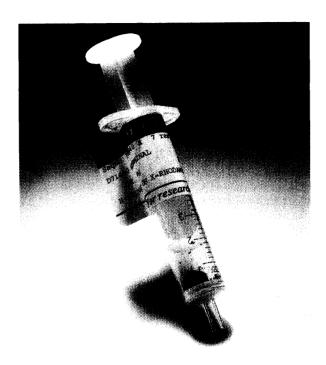
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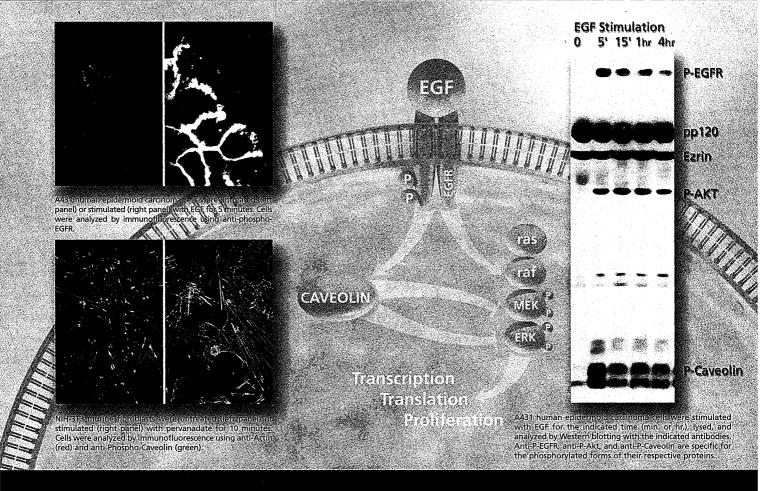
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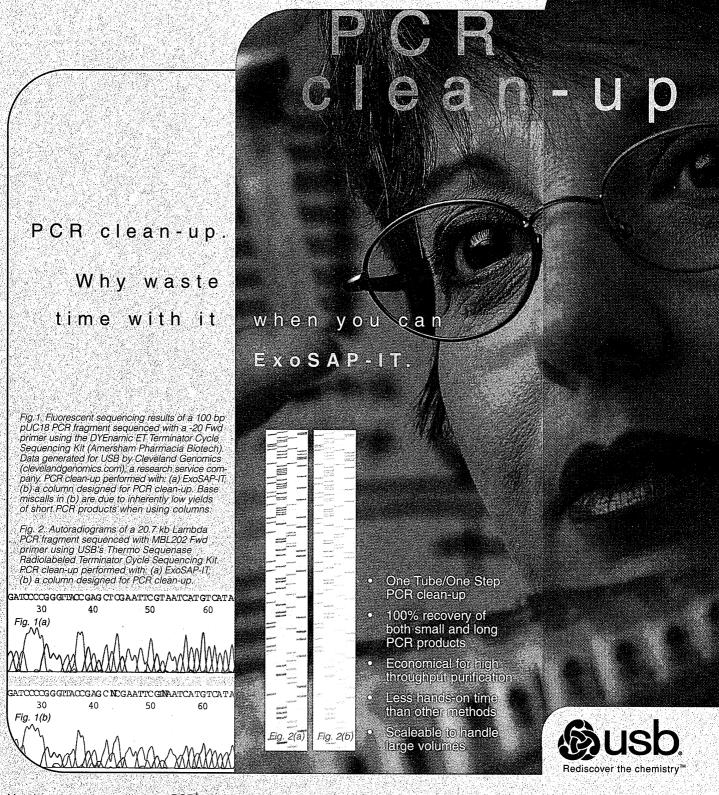
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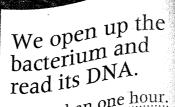
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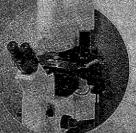
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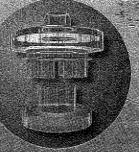
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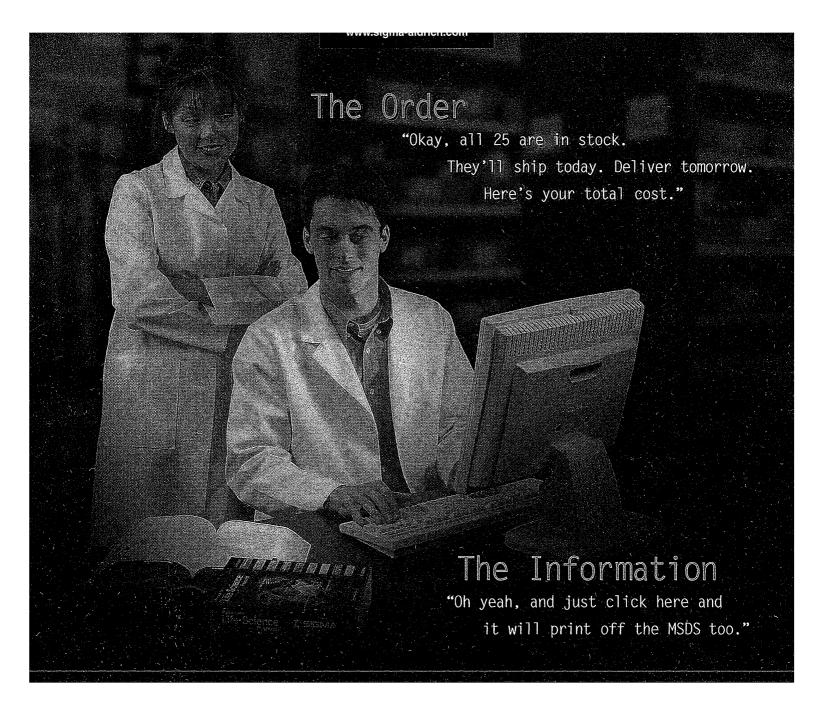
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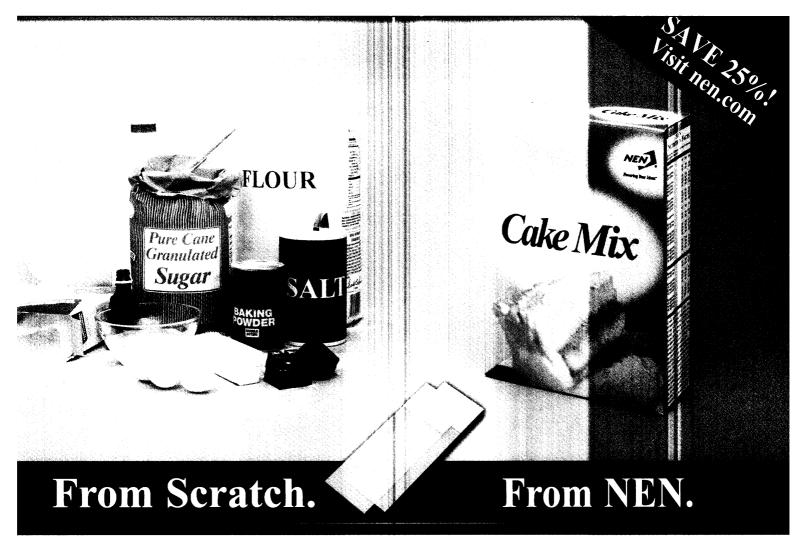
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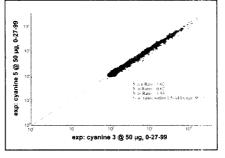
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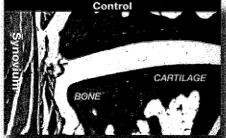
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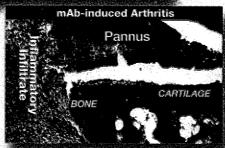
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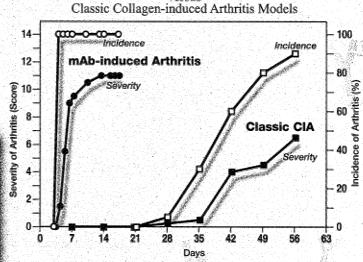
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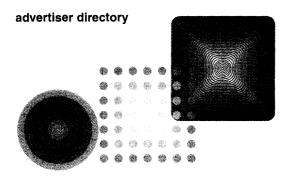
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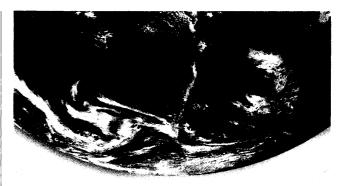


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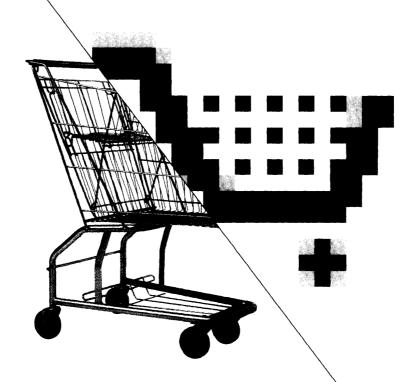
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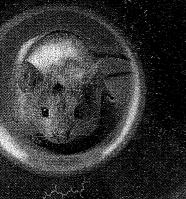
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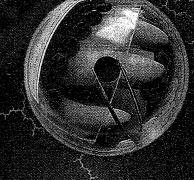
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