3 March 2000

# Science

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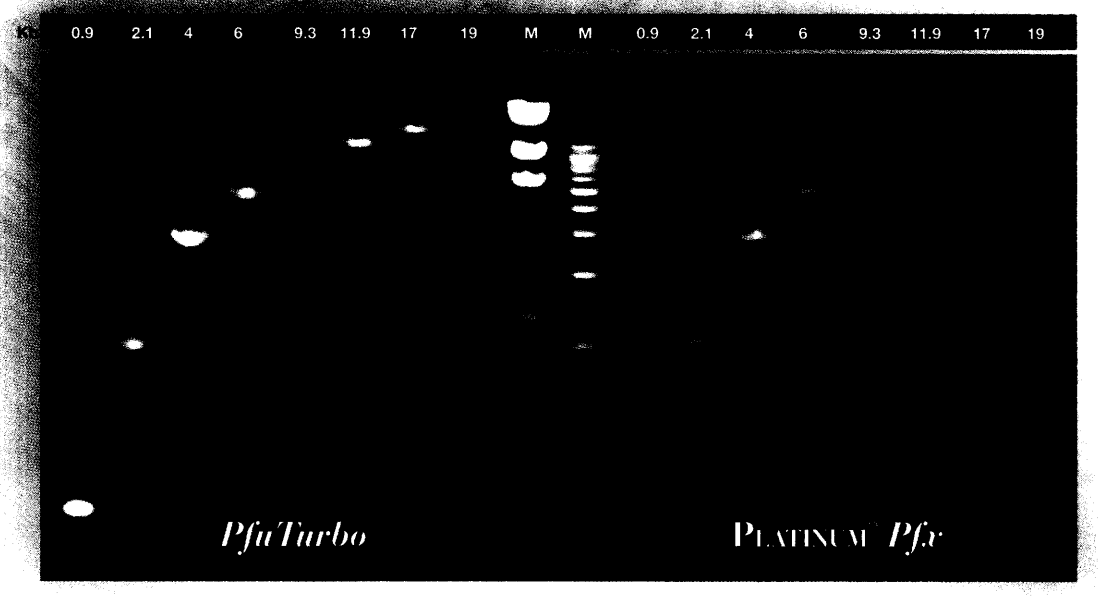


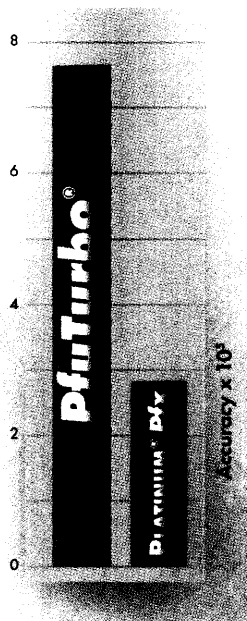


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* U.S. Patent No. 5,545,552 and 5,866,395 and 5,948,663 and patents pending

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**COVER** Opposing sides of a bifacially flaked large cutting tool (~803,000 years old) from the Bose basin, South China. The specimen (Bogu 91001, number 1; 20.7 cm in length) is representative of in situ tools recovered in a single stratum and associated with Australasian tektites and burned wood. The Bose artifacts provide the oldest known evidence of stone technology in eastern Asia equivalent to Acheulean handaxe technology in Africa and western Eurasia. [Photo: R. Potts and W. Huang]

**1576**
How vertebrates evolved

## NEWS

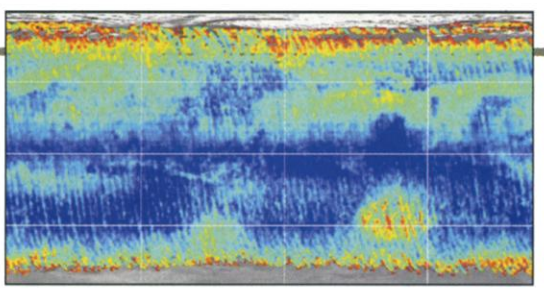
### NEWS OF THE WEEK



### NEWS FOCUS



## RESEARCH



**1626**
Mapping martian volcanism

### RESEARCH ARTICLES



### REPORTS



### DEPARTMENTS



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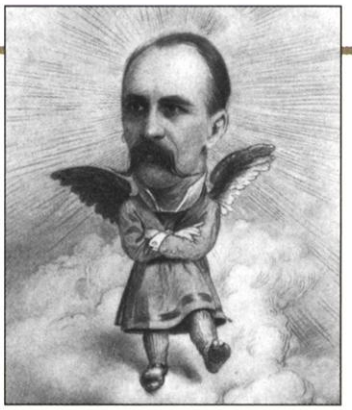

**1599**
The very good doctor







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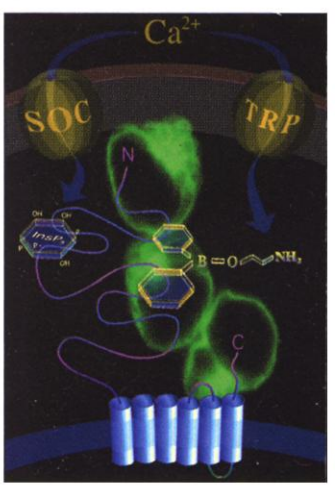


**1647**
Store-operated channels come clean


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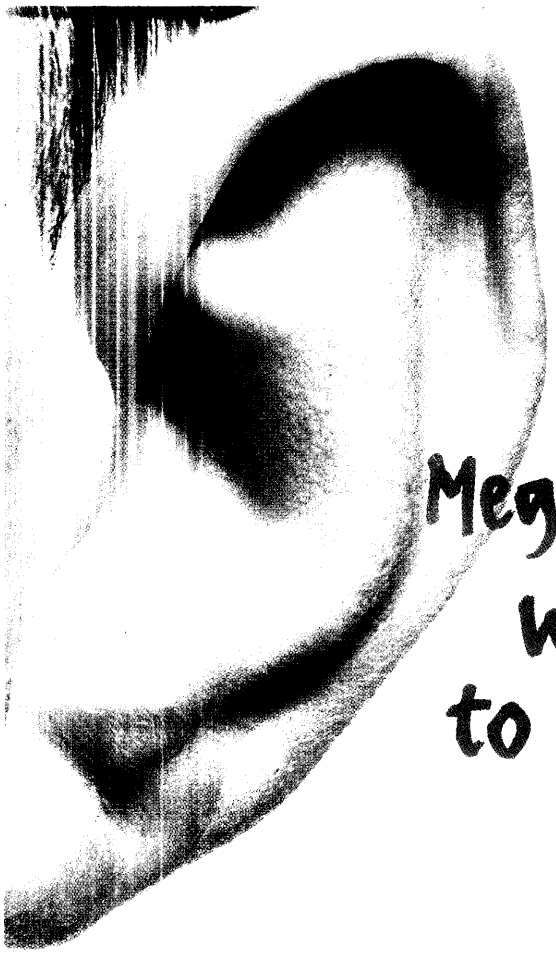

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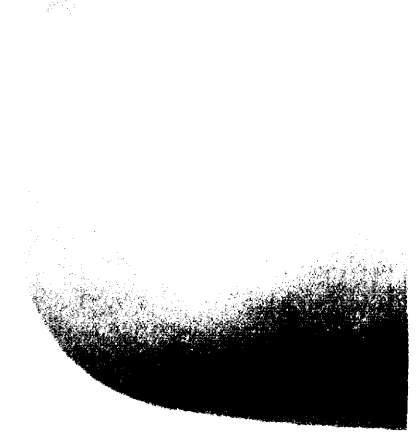

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### OLD STONE TOOLS IN CHINA

A variety of large tools, including hand axes and cleavers, referred to as Acheulean technology, have been found in Africa and Europe in the early Pleistocene (about 500,000 to 1,000,000 years ago). It was not clear whether Acheulean technology (or comparable tools) extended far to the east. Yamei *et al.* (p. 1622; see the cover and the news story by Gibbons) now describe an assemblage of Acheulean-like tools from the Bose Basin, South China. The tools are dated to 800,000 years ago (by dating of tektites associated with the tool deposits) and imply that comparable technologies arose or were present in the east and west by this time.

### MARS, NORTH AND SOUTH

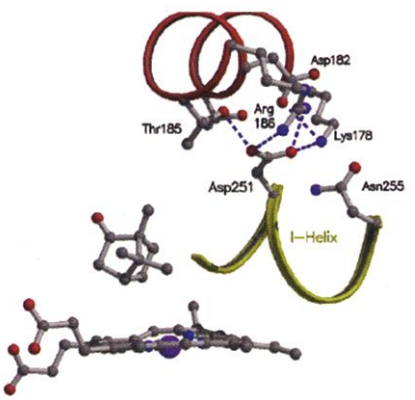
Martian surface spectra gathered by the thermal emission spectrometer onboard the Mars Global Surveyor have been used by Bandfield *et al.* (p. 1626; see the Perspective by Mittlefehldt) to evaluate the composition of the crust in 25 locations of relatively dark terrain. The older terrains in the southern hemisphere appear to be basaltic and resemble terrestrial basalts formed by primary melting at mid-oceanic ridges. The younger terrains in the northern hemisphere are more andesitic and resemble terrestrial volcanic rocks formed by mixed melting (basalt plus a more silica-rich continental crustal component) at subduction zones. The basaltic martian crust provides a better estimate of the composition of the mantle, whereas the andesitic rocks indicate that additional tectonic processes must have occurred during the planet's history to produce these more differentiated volcanic deposits.

### ANCIENT OXYGEN

The oxygen content of air (~21%) is maintained by a complicated array of physical, chemical, geological, and biological processes. Berner *et al.* (p. 1630) examined the response of atmospheric oxygen levels to the dramatic changes in the Earth's tectonics, flora, and climate during the past 600 million years. Their reexamination of the existing carbon- and sulfur-isotopic geological records was based in part on experiments they performed which show that terrestrial plants fractionate carbon by different amounts depending on the oxygen content of the atmosphere in which they grow. They then constructed a history of atmospheric concentrations that stays within existing biological and physical constraints. For most of this period, atmospheric oxygen levels were roughly what they are today or even lower, but during the Carboniferous period 300 million years ago, when many insects were gigantic and thick forests covered much of the globe, the concentration of atmospheric oxygen was nearly 35%.

### WATCHING A SLOW BURN

**Cytochrome P450 enzymes participate in the biosynthesis of steroids and lipids and also in the detoxification of foreign molecules. They can oxidize saturated hydrocarbons, a reaction that normally requires combustion conditions, by splitting molecular oxygen and using one of the oxygen atoms to form a hydroxyl group on the substrate molecule. Schlichting *et al.* (p. 1615) have cleverly adapted an x-ray crystallography approach to obtain evidence for the structures of several intermediates in the reaction, most notably the long-sought ferryl-oxygen species. After obtaining the diffraction pattern of the crystallized enzyme-substrate complex with short-wavelength x-rays, they used long-wavelength x-rays to cleave a water molecule. This step released the essential second electron that splits the bound dioxygen and to yield the proposed ferryl(IV)-oxygen species. This intermediate then inserts the oxygen atom into a carbon-hydrogen bond of the substrate in the hydroxylation step.**




### GREENER ROUTE FOR ALCOHOL OXIDATION

Alcohols are among the organic chemist's most versatile starting materials, as their oxidation can yield aldehydes, ketones, and acids. Unfortunately, the inorganic oxidants used in these conversions are not catalysts (and thus generate heavy-metal wastes) and are often run in chlorinated solvents. Ten Brink *et al.* (p. 1636; see the news story by Service) report that a water-soluble palladium complex can use pressurized air (30 bar) to oxidize a variety of alcohols at 100°C. The reactions are highly selective and proceed in high yield, and in many cases the rate is limited mainly by the solubility of the alcohol in water.

### TRANSLATING AN EDITED COPY

The kinetoplast of trypanosomes is an extranuclear DNA-containing organelle associated with the mitochondrion. Some messenger RNAs (mRNAs) of the kinetoplast are edited, which creates open reading frames for genes that otherwise encode nonsense mRNAs. However, the actual translation of these edited mRNAs—or, in fact, translation of any kinetoplast mRNA—has not been observed. Through sequencing the kinetoplast-encoded protein apocytochrome B, Horváth *et al.* (p. 1639) demonstrate translation of a kinetoplast-mitochondrion–edited mRNA. Translation of edited mRNA may represent a mechanism for mitochondrial gene regulation in trypanosomes.

### A VIRUS THAT CHANNELS

Potassium channels, once thought to occur only in eukaryotic cells, have recently been found in bacteria as well. Plugge *et al.* (p. 1641) now describe a gene in the chlorella virus PBCV-1 that encodes a $K^+$ channel. This channel, named Kcv, does not seem to belong to any of the other $K^+$ channel families described so far. However, it is a fully functional channel displaying several of the well-known characteristics of all the other $K^+$ channels. It is also an extremely small protein and may thus be of help for the better understanding of the basic principles of $K^+$ channel function and of ion channel function in general.

### MINDING THE STORE

Many cell functions are regulated through changes in the concentration of intracellular free calcium ($[Ca^{2+}]_i$). Often, stimuli that cause release of $Ca^{2+}$ from intracellular stores later cause influx of $Ca^{2+}$ through channels in the plasma membrane. However, the identity of these so-called store-operated channels (SOCs) in the plasma membrane and the mechanisms by which they are coupled to emptying of intracellular stores have

CONTINUED ON PAGE 1555

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# THIS WEEK IN *SCIENCE*

CONTINUED FROM PAGE 1553

remained unclear. Ma *et al.* (p. 1647; see the Perspective by Berridge *et al.*) took advantage of a new inhibitor of inositol trisphosphate (IP3) receptors to show that the IP3 receptor channels (which mediate release of $Ca^{2+}$ from intracellular stores) are required for both activation and maintaining conductance of store-operated channels (SOCs) in the plasma membrane. The effects of the IP3 channel inhibitor are not the result of alterations in $Ca^{2+}$ release. The results also distinguish the SOCs from TRP channels, which have been considered to be another candidate to mediate $Ca^{2+}$ influx after depletion of intracellular stores.

### MONITORING BACTERIAL MOTORS

New methods now allow biochemical studies to be performed on single cells rather than on populations of cells. Cluzel *et al.* (p. 1652) used optical spectroscopy to follow the output of the flagellar motor of individual bacteria in response to changes in the concentration of a chemotactic signaling molecule CheY phosphate (monitored through time-correlation fluorescence). The cell's response changed dramatically with CheY phosphate concentration because this signal appears to be amplified by the properties of the motor itself.

### *SALMONELLA* SURVIVAL TACTICS

Macrophages can destroy invading organisms such as *Salmonella* with reactive oxygen species produced by nicotinamide adenine dinucleotide phosphate (NADPH) oxidase. Vazquez-Torres *et al.* (p. 1655) describe how virulent forms of *Salmonella typhimurium* can survive in macrophages—they secrete a defense system into the host vacuole that surrounds them. Somehow the defense system prevents the delivery of NADPH oxidase to the sites of invading *Salmonella*, which then go on to divide and cause disease.

### SEEKING DAMAGES

Most of the energy deposited by ionizing radiation in living tissues is channeled into the production of secondary electrons with energies between 1 and 20 electron volts. Boudaïffa *et al.* (p. 1658; see the Perspective by Michael and O'Neill) show that these electrons, which are much lower in energy than the ionizing radiation and thus has been thought to be innocuous, can induce unexpectedly high levels of DNA damage in the form of single- and double-strand breaks. These results suggest that the traditional picture of radiolysis may need to be reevaluated.

### STOPPING EBOLA VIRUS

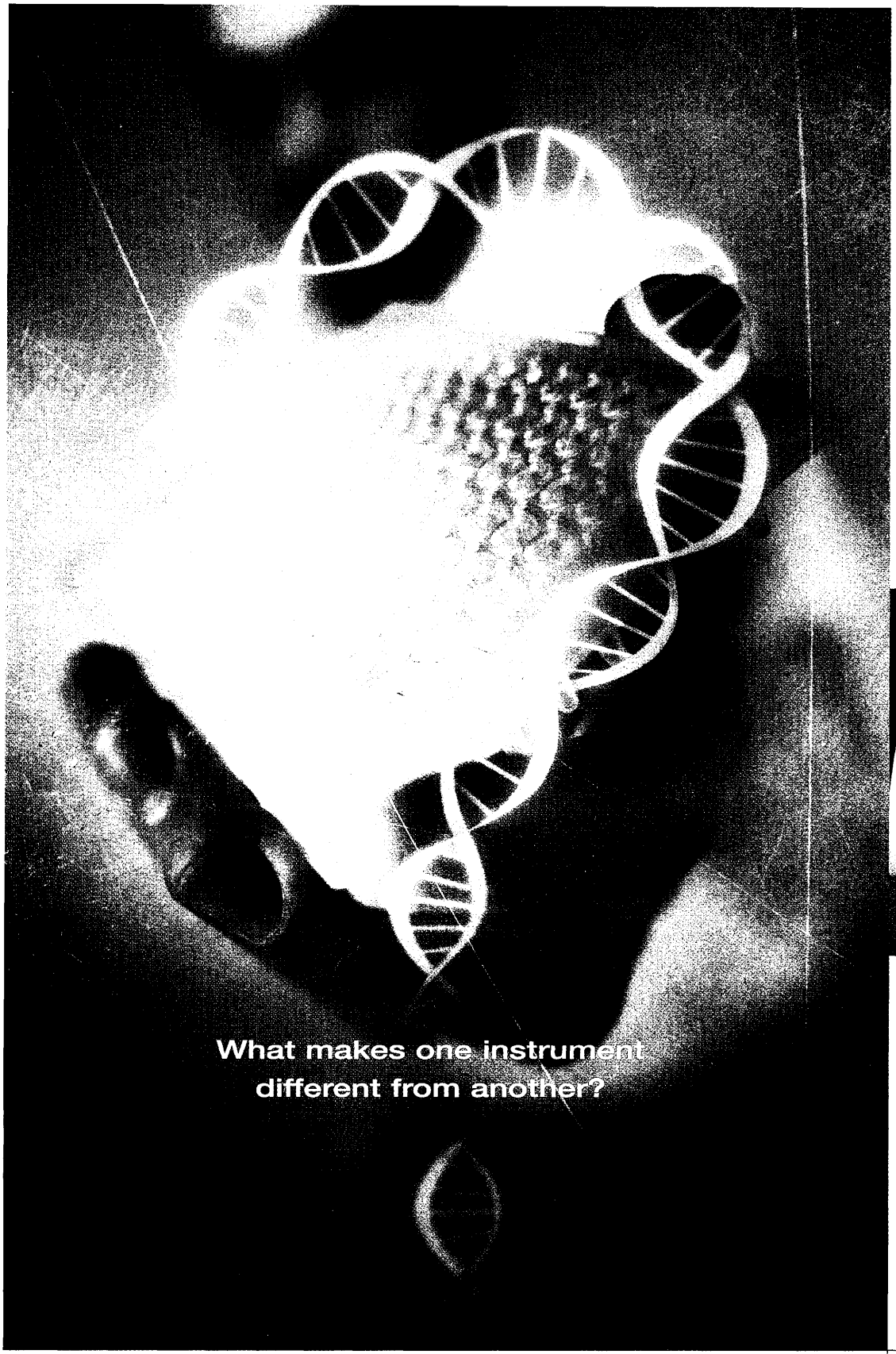
Ebola virus causes a highly contagious, lethal hemorrhagic disease that has killed hundreds of people since it was first reported. There has been conflicting data regarding the ability of antibodies to provide immunity to the virus. Wilson *et al.* (p. 1664) identified protective monoclonal antibodies directed at three linear and two discontinuous epitopes on the glycoprotein of an Ebola virus. Mice were protected from the effects resulting from exposure to a mouse-adapted virus if they were treated 24 hours before exposure and even up to 2 days after challenge (a time when virus replication is occurring). Some of the antibodies tested were able to bind with all Ebola viruses known to cause disease.

## TECHNICAL COMMENT SUMMARIES

The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/287/5458/1555a

### Hepatitis C Virus, the E2 Envelope Protein, and α-Interferon Resistance

In a Report (2 July), Taylor *et al.* demonstrated that the envelope protein E2 of genotype 1 of the hepatitis C virus (HCV) can inhibit the activity of PKR, an interferon-inducible protein kinase, in cultured cells. They linked this result to the similarity in genotype 1 of the PKR-eIF2α phosphorylation homology domain (PePHD)—a 12–amino acid sequence on the E2 protein—with that of the cellular PKR autophosphorylation site and the eIF2α phosphorylation site. "This interaction of E2 and PKR," concluded Taylor *et al.*, "may be one mechanism by which HCV circumvents the antiviral effect of interferon." Abid *et al.* note, however, that HCV isolates from 15 patients they studied—eight infected with genotype 1 and seven with genotype 3—showed within-genotype variations in IFN resistance, despite identical or near-identical PePHD patterns in isolates from a given genotype. Taylor *et al.* respond that the E2-PKR interaction "cannot explain the sensitivity or resistance of different isolates within the same genotype," and that HCV uses "a multi-pronged approach" to develop IFN resistance, of which the E2-PKR interaction is one element.

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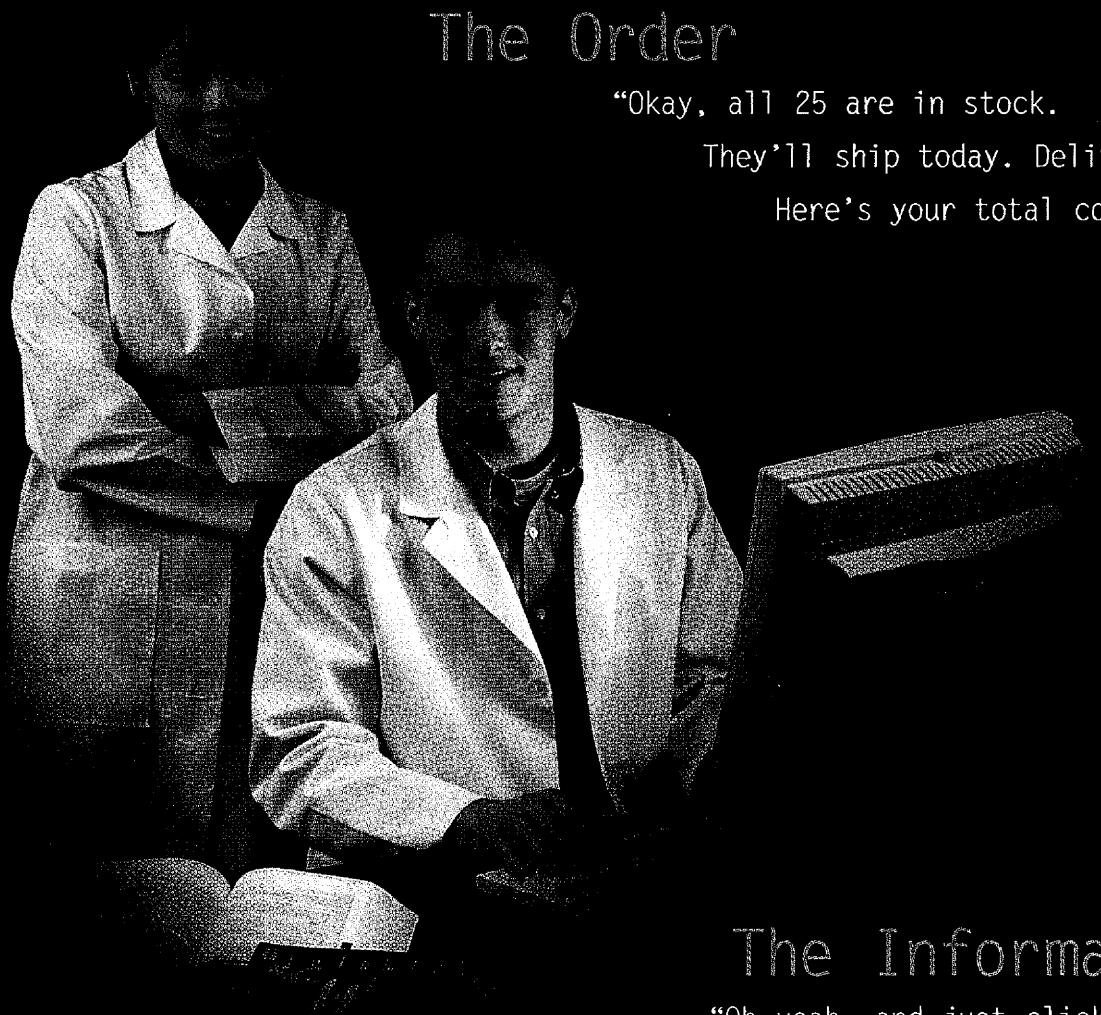


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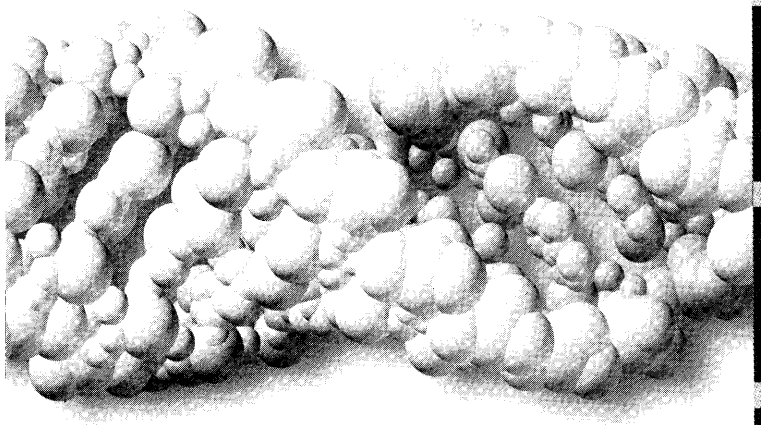

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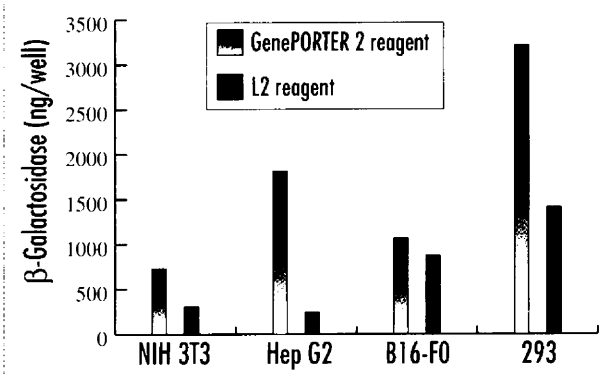


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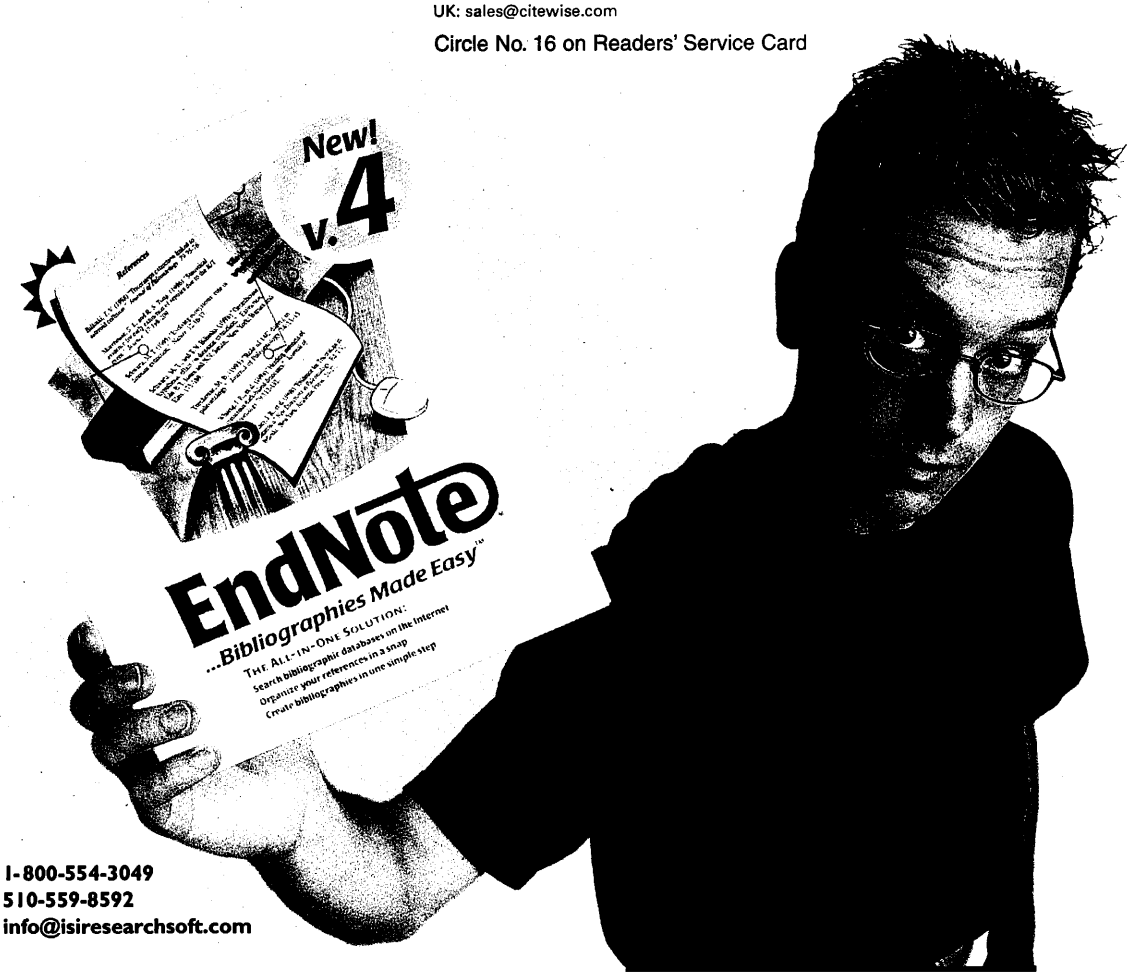


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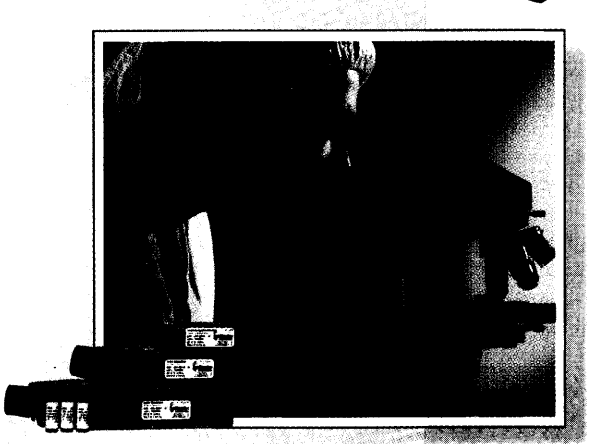

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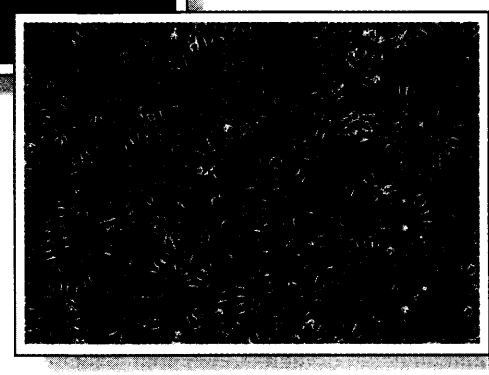

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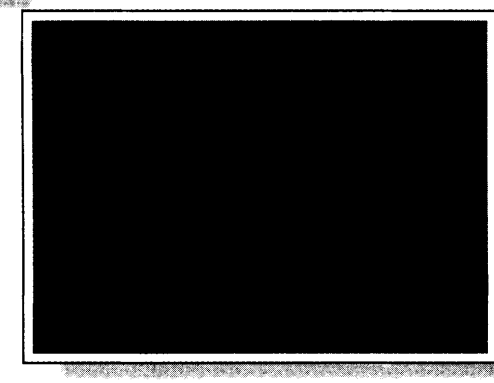

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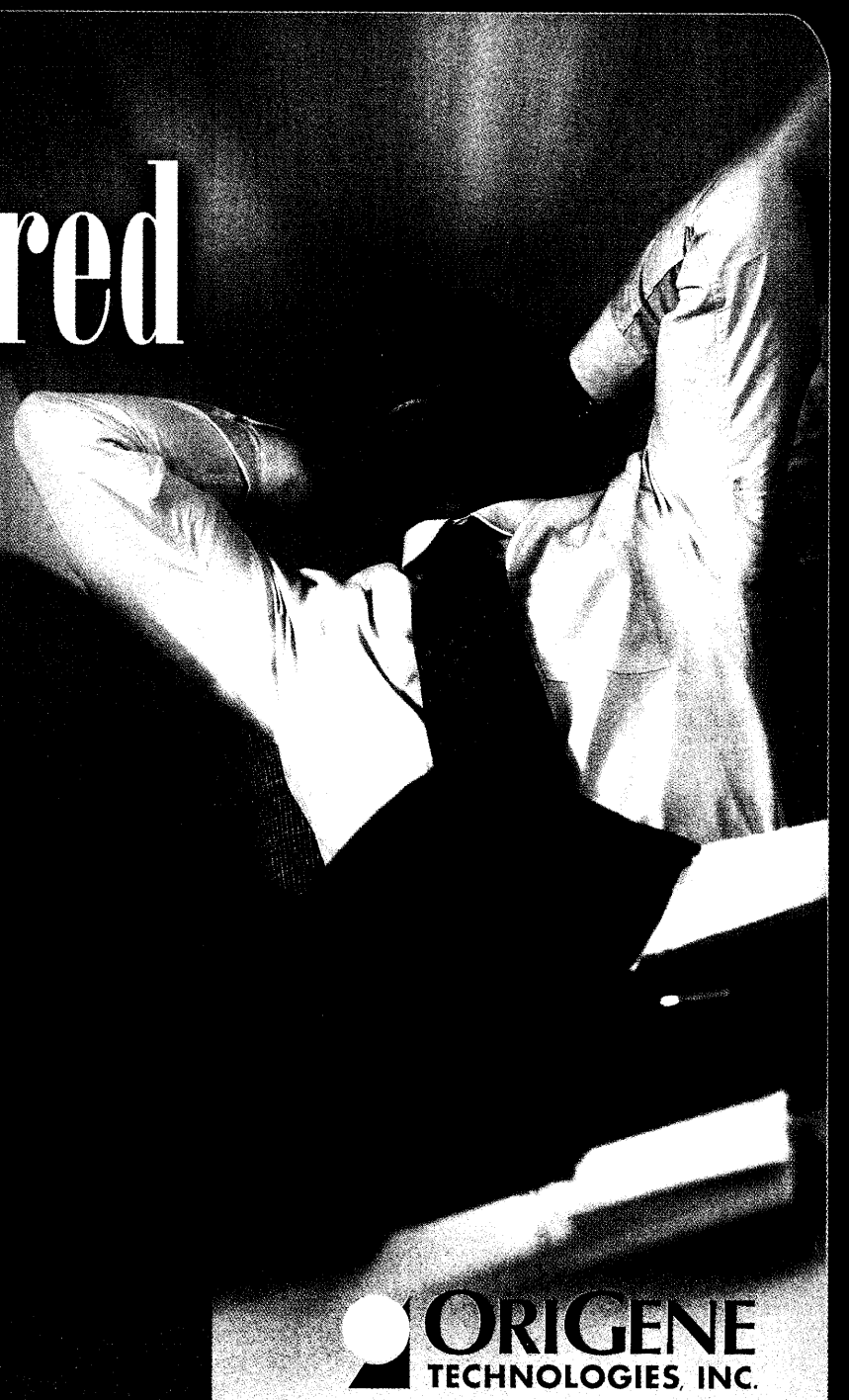

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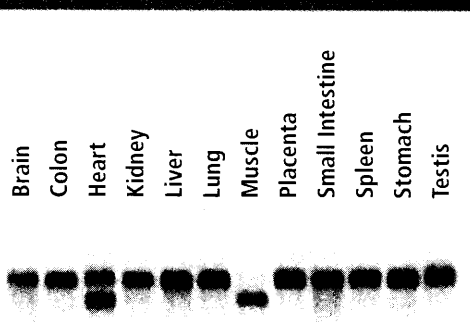


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**Mouse 12 major tissues**
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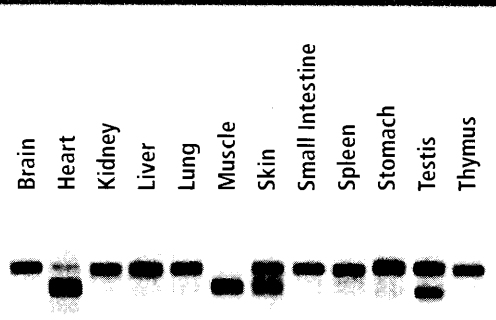


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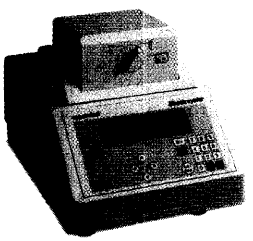

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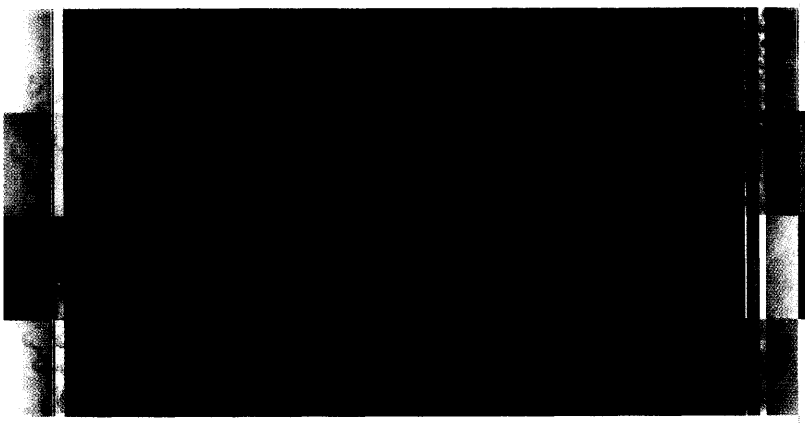

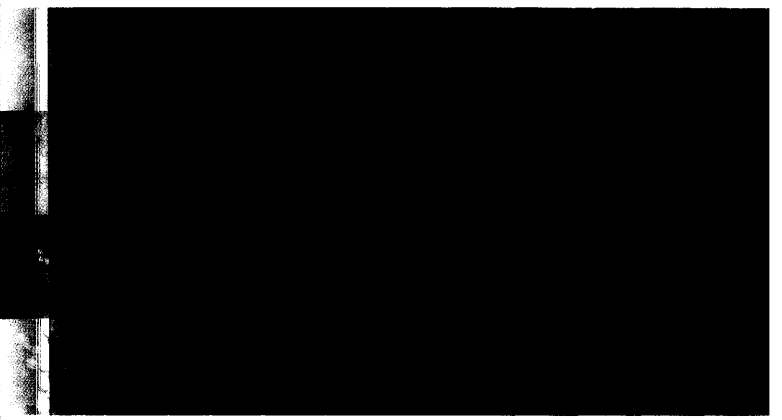

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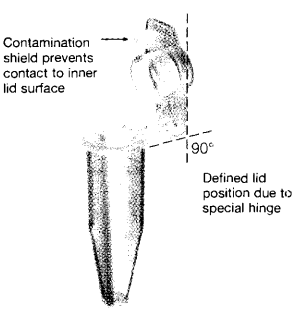


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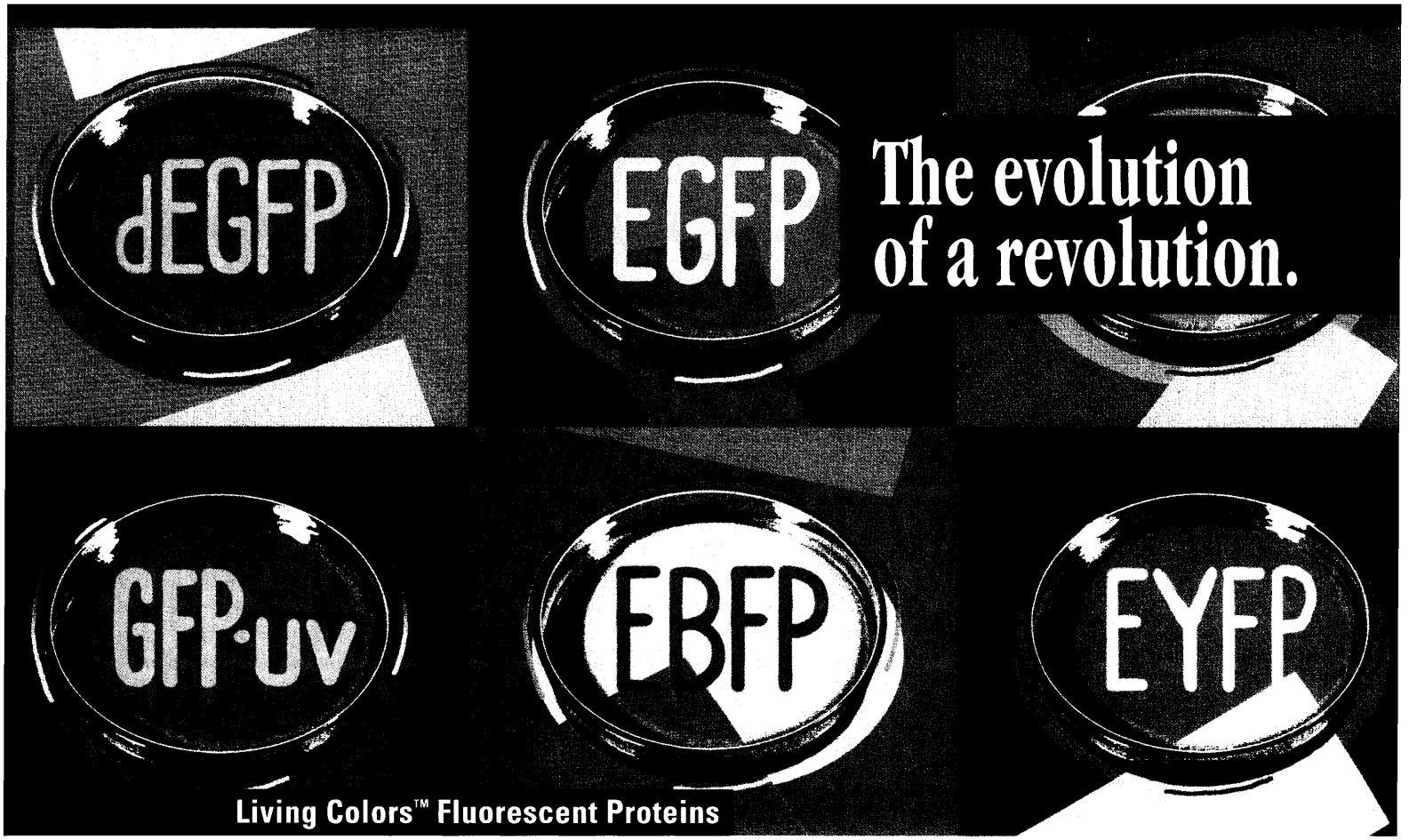


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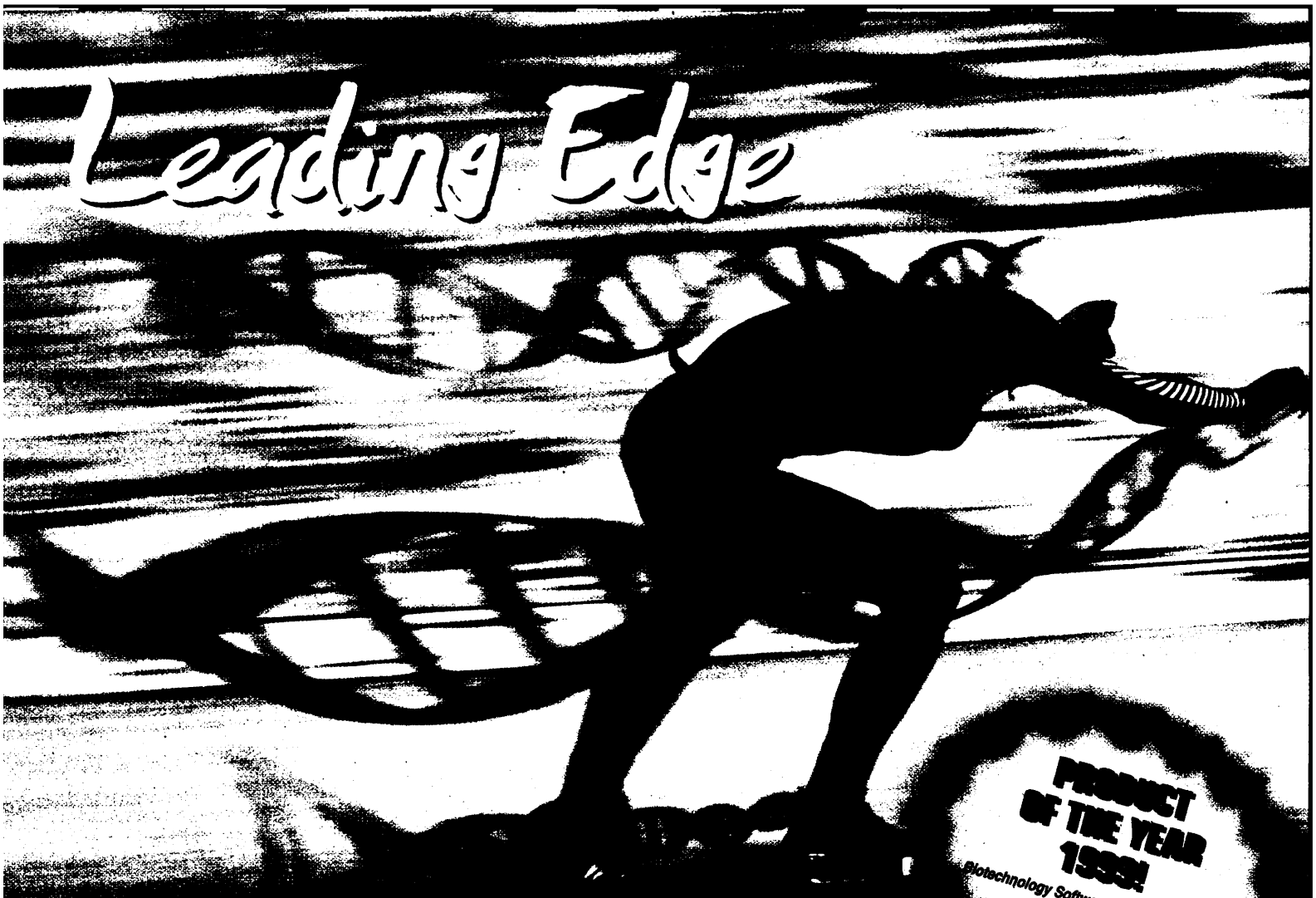


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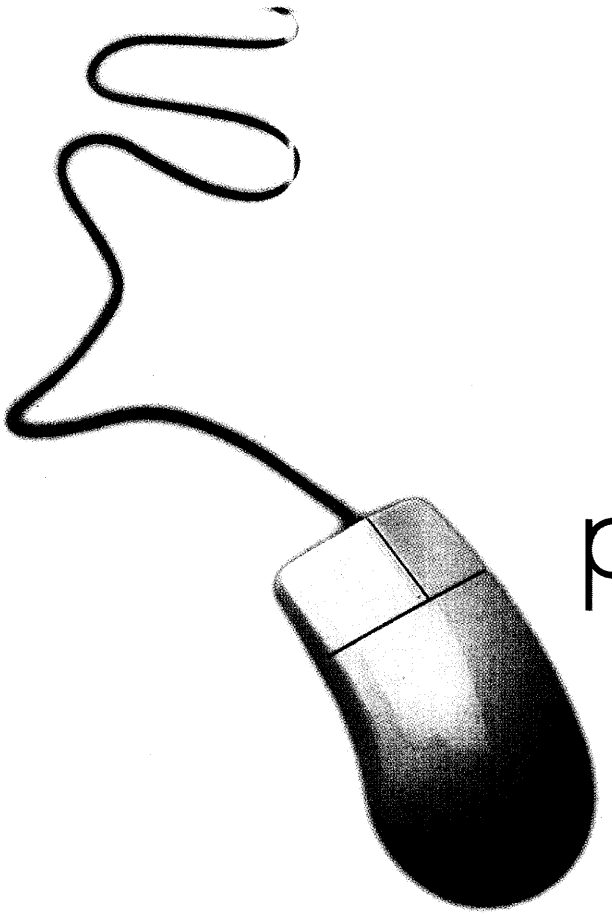

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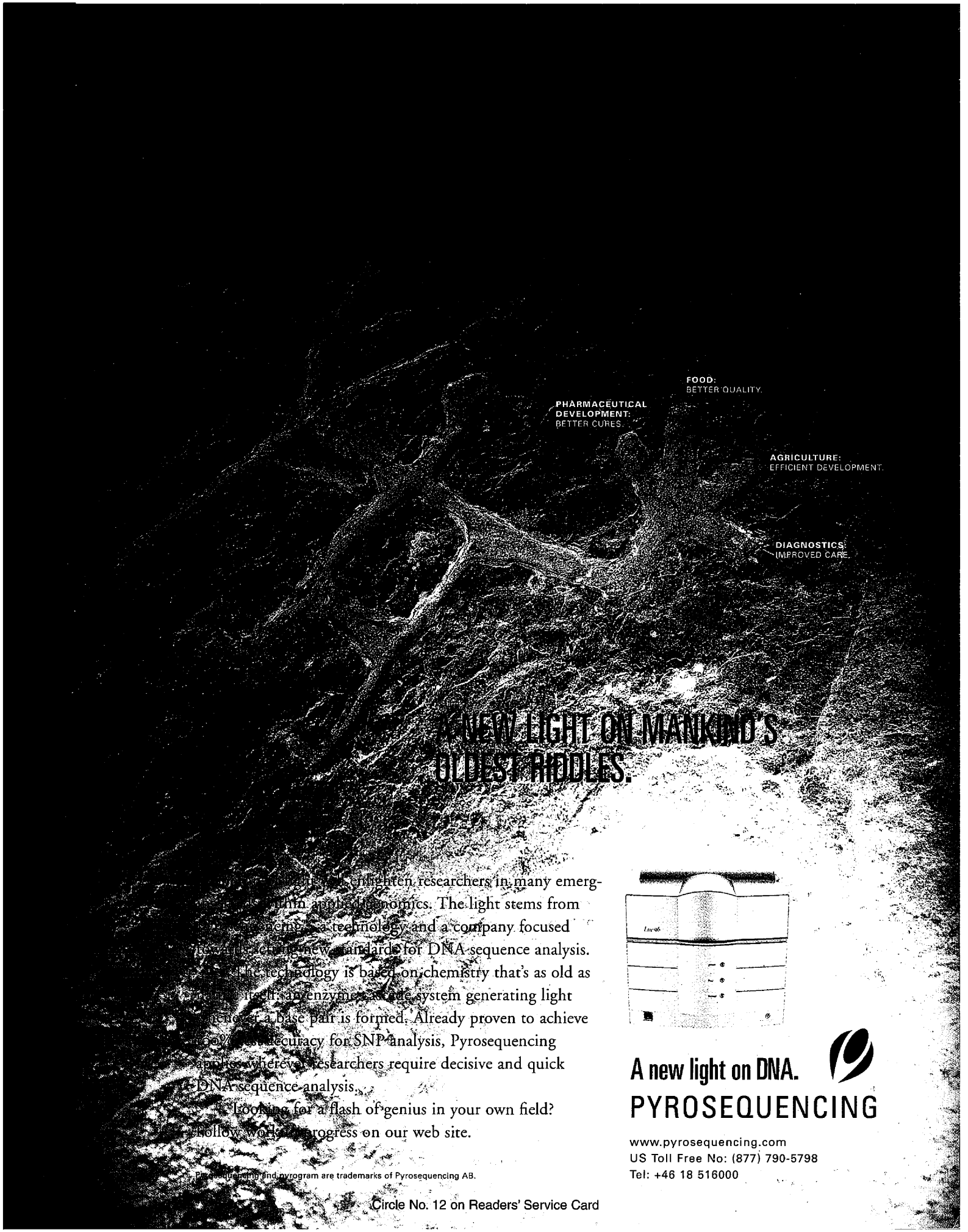
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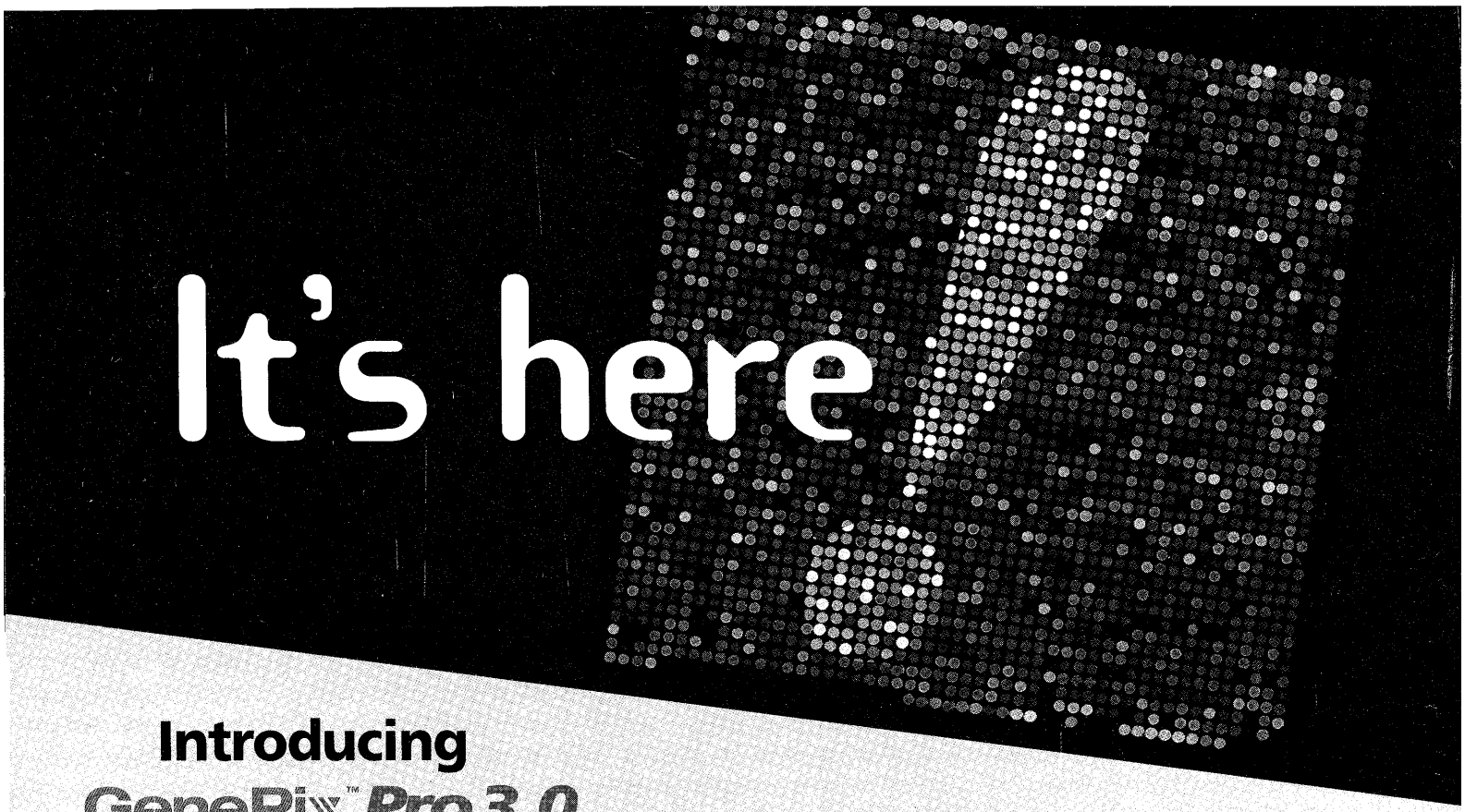


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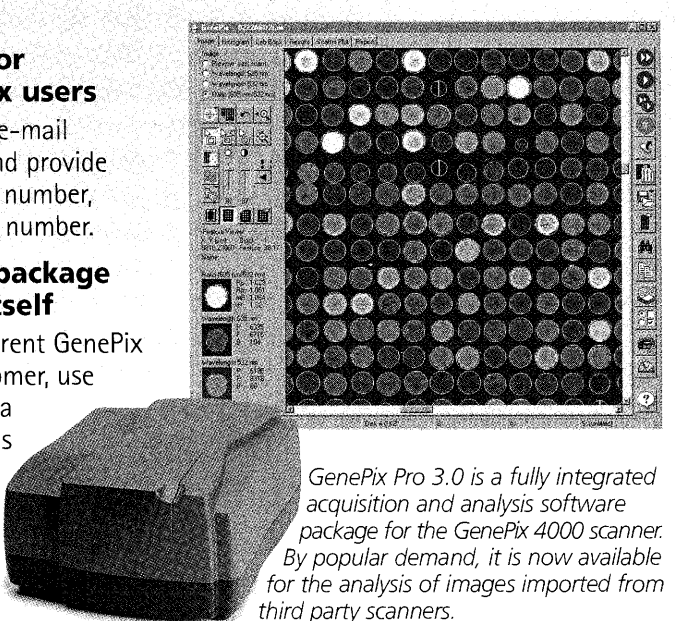

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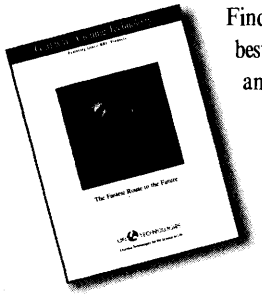

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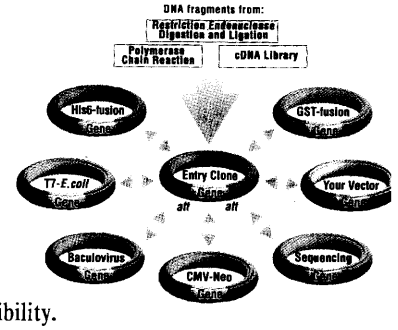


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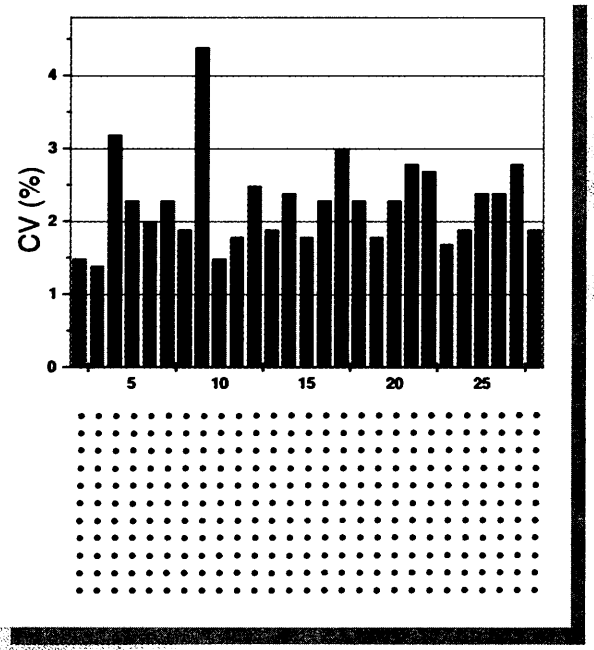


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