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Science

Vol. 287 No. 5459
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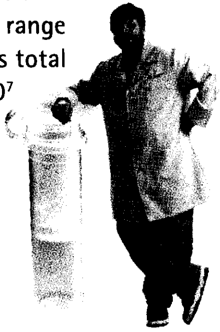

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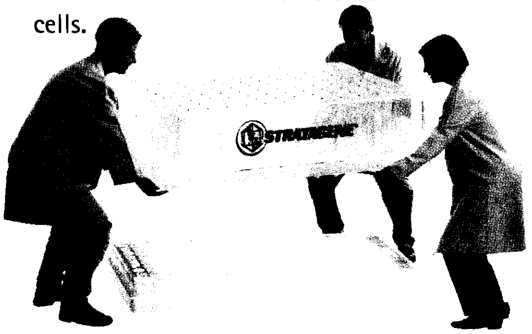

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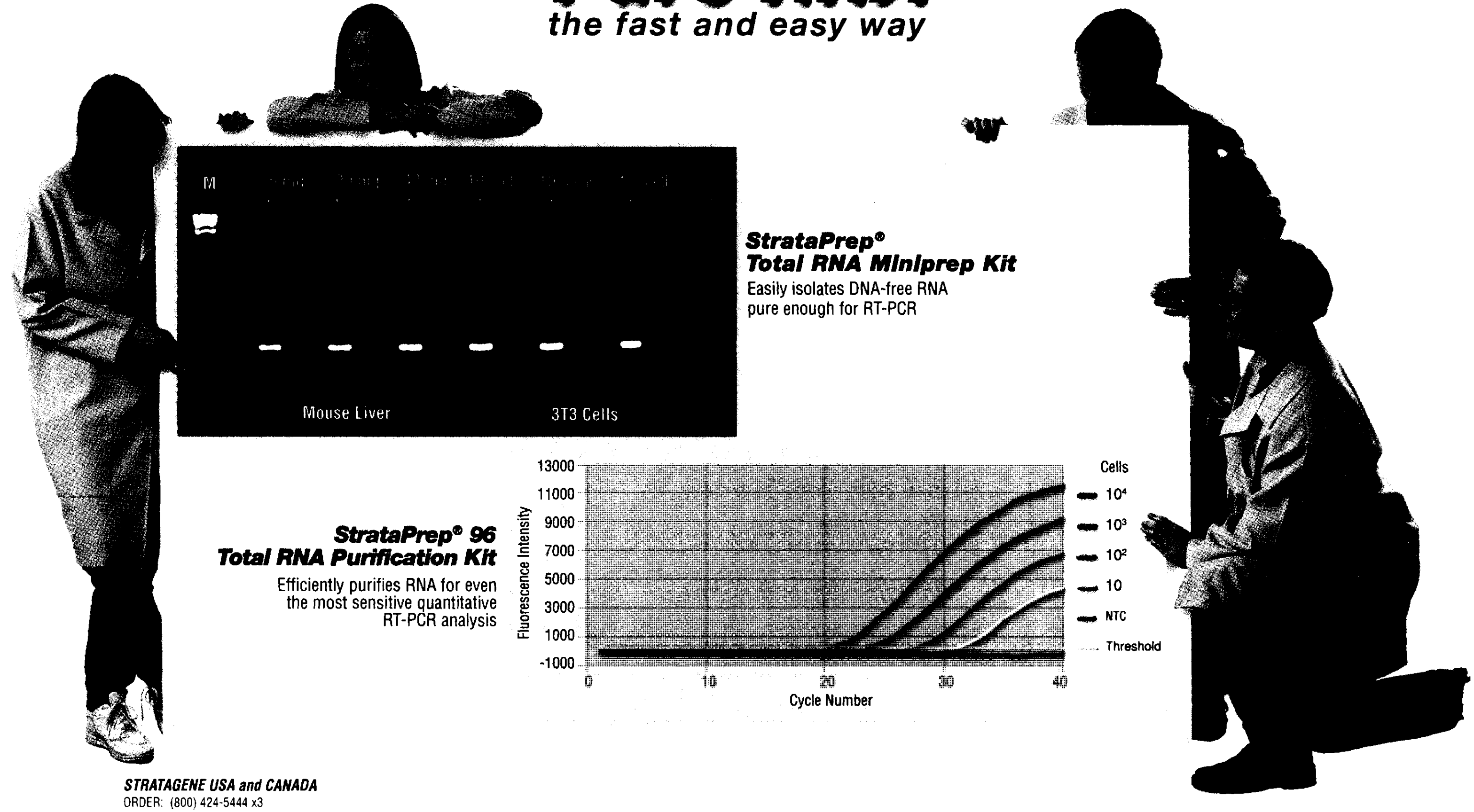

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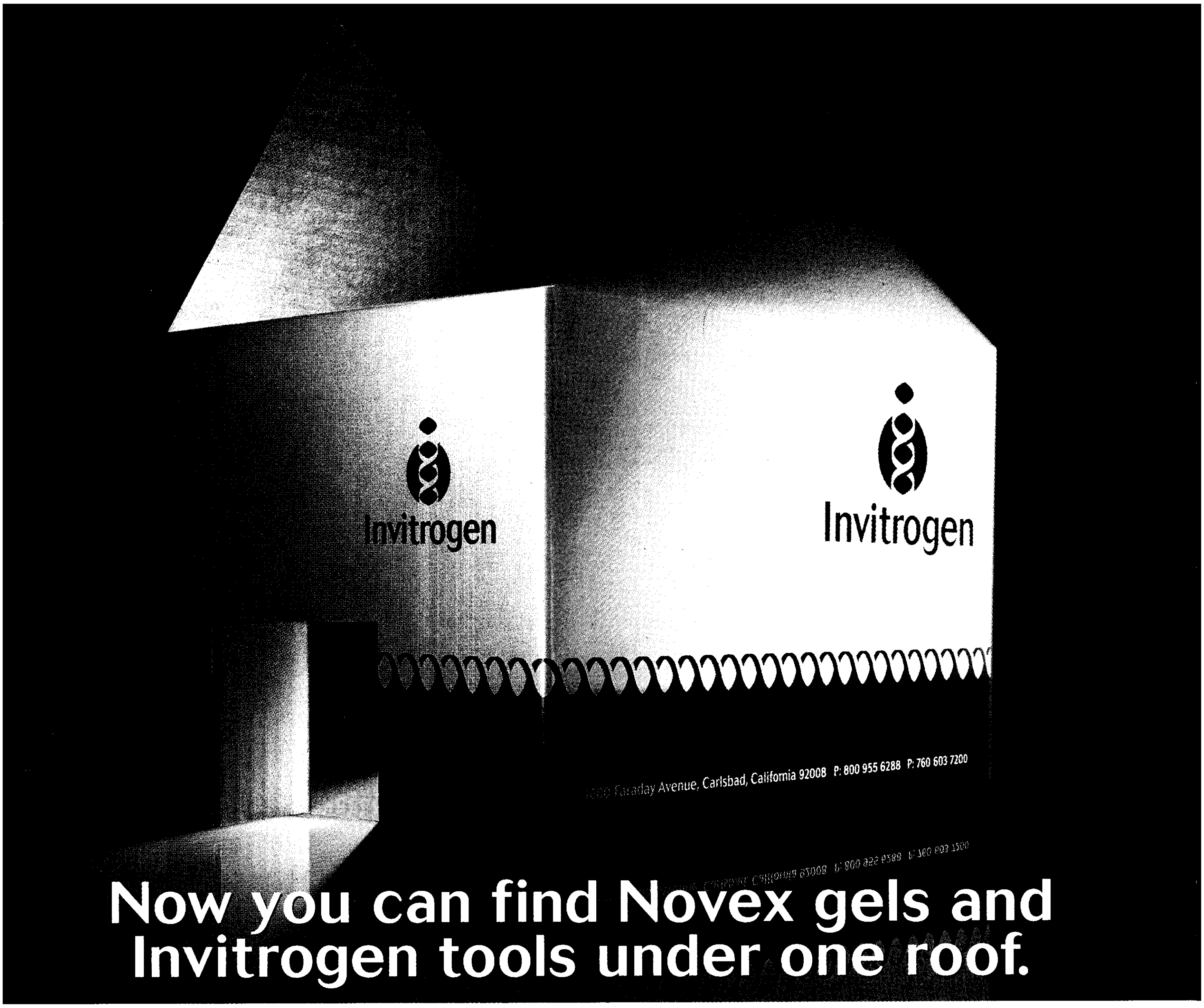

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COVER Acid-tolerant slime streamers (biofilms) inhabit a subsurface tunnel at an unused copper mine in northern California; the stream shown here is about 1 meter wide. A previously unknown, iron-oxidizing Archaeon that is extremely acidophilic was found to dominate the microbial population within such biofilms, contributing to pyrite dissolution and the production of acid mine drainage. [Photo: K. J. Edwards]

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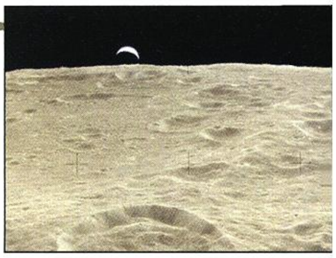

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SCIENCE (ISSN 0036-8075) is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1200 New York Avenue, NW, Washington, DC 20005. Periodicals Mail postage (publication No. 484460) paid at Washington, DC, and additional mailing offices. Copyright © 2000 by the American Association for the Advancement of Science. The title SCIENCE is a registered trademark of the AAAS. Domestic individual membership and subscription (51 issues): $112 ($62 allocated to subscription). Domestic institutional subscription (51 issues): $340; Foreign postage extra: Mexico, Caribbean (surface mail) $55; other countries (air assist delivery) $90. First class, airmail, student, and emeritus rates on request. Canadian rates with GST available upon request, GST #1254 88122. Publications Mail Agreement Number 1069624. **Printed in the U.S.A.**

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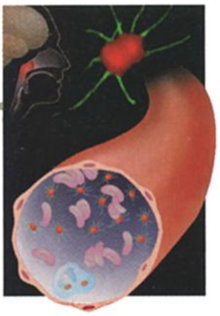

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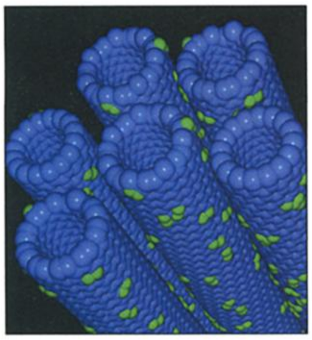

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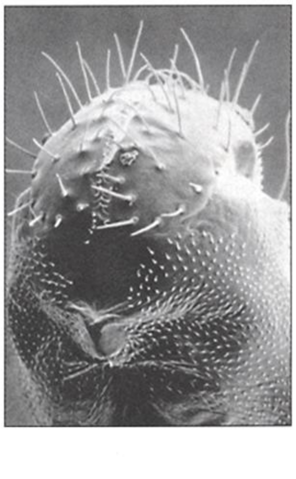

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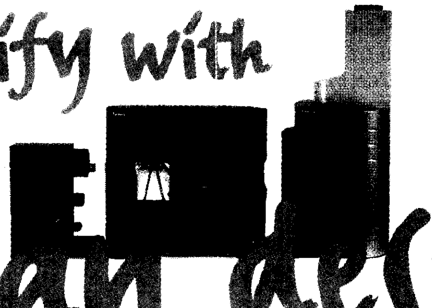

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THIS WEEK IN *SCIENCE*

edited by PHIL SZUROMI

SURVIVING THE ACID TEST

Bacteria and archea are increasingly being found in extreme environments, where they often play an important role in chemical reactions. Edwards *et al.* (p. 1796; see the cover and the news story by Pennisi) now describe an archeon that thrives at low pH (as low as zero) and that is likely to be important in mobilizing metals and generating the acidic ground water that characterizes acid mine drainage. The organism, which lacks an outer cell wall and thus has an exposed cell membrane, dominates acid-generating sites in Iron Mountain, California, and may be widespread in the subsurface elsewhere.

THE OTHER SUNNY SIDE

Direct observations of the sun from Earth are limited to the near side. Although the sun rotates and all sides eventually come into view, remote imaging of the far side would lead to a better understanding of the sun's activity and may allow forecasting of potential space weather hazards from solar wind ejections. Lindsey and Braun (p. 1799; see the news story by Irion) used observations from the SOHO spacecraft to image the structure on the far side of the sun. They used helioseismic holography to detect magnetically induced acoustic reflection anomalies on the far side. Thus, solar physicists can now follow the evolution of sunspots as they rotate out of our field of view by sampling sound wave anomalies that travel through the sun's interior.

THE INSIDE SCOOP ON MARS

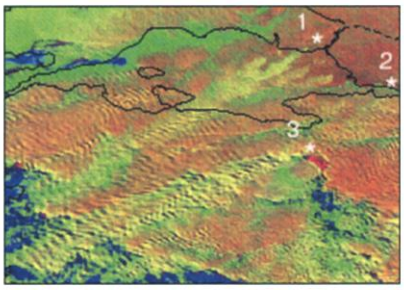
Mars Global Surveyor has been recording the topography and gravity of Mars for about 1 year, and the amount of global data coverage is now sufficiently accurate to estimate the thickness of the crust and major internal structures. Zuber *et al.* (p. 1788; see the news story by Kerr) have derived high-resolution models of martian gravity and the topography. They infer that a region of high heat flow below the northern hemisphere, perhaps related to a plume, had formed early in Mars' history. They also find evidence of large buried channels in the northern lowlands related to the northward transport of water and sediment to the lowlands.

LUNAR CRATERING RATES

The moon has recorded the size and distribution of objects (mainly asteroids and comets) that have passed near Earth, because any impact events remain imprinted on the nontectonic and uneroded lunar surface. The only problem with counting craters on the moon is that the age of the impact events is not well constrained, and so the timing of these events is only estimated. Culler *et al.* (p. 1785; see the Perspective by Ryder) provide age constraints on lunar impact rates by measuring the ^{40}Ar/^{39}Ar ages of 155 glass spherules from an Apollo 11 soil sample. The spherules represent melted droplets from different impact events and thus record their temporal distribution. They find a decrease in the impact rate between 3.5 billion and 500 million years ago and an increase in the impact rate within the last 400 million years.

WHO'LL STOP THE RAIN?

The effects of industrial air pollution on the quality of rainwater, particularly its acidity, are well known, but its effect on the quantity of rain has been debated vigorously. Having shown that smoke from burning vegetation in the tropics suppresses warm rain, Rosenfeld (p. 1793; see the Perspective by Toon) now finds that urban and industrial air pollution in temperate regions also suppresses rain and snow. The author used satellite measurements of cloud temperatures and droplet size to show that the coalescence of moisture into raindrops and ice is inhibited in pollution tracks from a variety of point sources. These results indicate that human activity may be affecting patterns of precipitation on a global scale.



AIR-SENSITIVE NANOTUBES

The conductivity of single-walled carbon nanotubes, which can approach that of an ideal one-dimensional quantum wire, depends on the diameter and chirality of the tube. Collins *et al.* (p. 1801) now show that sample history, in the form of air or oxygen exposure, can also have dramatic effects not only on conductivity but on the thermopower and local density of states of individual nanotubes. Oxygen exposure generally converted semiconducting tubes into apparent metals, especially if they were in contact with other nanotubes and could reverse the sign of their thermopower. While such sensitivity may find use in sensing applications, the results suggest that fundamental studies of nanotube properties must include careful control of environmental conditions.

BIODIVERSITY FORECAST

Global biodiversity is changing at an unprecedented rate, mostly as a result of human activity. Like potential changes in climate and greenhouse gases, biodiversity changes are just as important for the future functioning of ecosystems and the well-being of humans, but there have been no comparable attempts to forecast the magnitude of these changes. Sala *et al.* (p. 1770) review global scenarios of biodiversity change for the major biomes of Earth for the year 2100. Their scenarios are based on projected changes in environment and land use and on the current understanding of the sensitivity of biodiversity in each terrestrial biome to these global changes.

STEMMING THE STEM CELLS

Hematopoietic stem cells are usually quiescent, but they proliferate when activated and differentiate into cells of all hematopoietic lineages. Cheng *et al.* (p. 1804) engineered mice to be deficient in the cyclin-dependent kinase inhibitor p21$^{cip1/waf1}$, which regulates the G$_1$ cell cycle checkpoint. The proliferative potential of hematopoietic stem cells from these mice increased and the stem cell pool became depleted such that the mice could no longer withstand toxic injury to the bone marrow. Thus, p21 prevents premature exhaustion of the stem cell pool.

PROFILING A PATHOGEN

The use of whole-genome sequencing to develop new strategies to fight infectious diseases is the focus of two reports (see the Perspective by Nassif). *Neisseria meningitidis* causes septicemia and meningitis and is responsible for epidemics in sub-Saharan Africa as well as deaths and disability worldwide. Tettelin *et al.* (p. 1809) report the complete genome sequence of a strain of *N. meningitidis* that belongs to serogroup B. Analysis of the genome revealed possible viru-

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THIS WEEK IN *SCIENCE*

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lence-associated genes and ways in which the bacterium can evade host defense mechanisms. Pizza *et al.* (p. 1816) analyzed the sequence to predict open reading frames that could encode proteins that might be found on the surface of the bacterium or be exported and thus serve as potential vaccine candidates. A total of 350 such candidates were expressed in *Escherichia coli*, and the proteins were assayed for surface expression and for their ability to induce a bacteria-killing immune response in mice. Five proteins that tested positive in these assays showed sequence conservation, which suggests that they might induce immunity against a variety of serogroups and species of *Neisseria.*

OUT OF CIRCULATION

There is currently great interest in identifying the genes that control the development of the vascular system in the early vertebrate embryo. Zhong *et al.* (p. 1820) studied a mutation in zebrafish, called *gridlock* (*grl*), that specifically perturbs assembly of the aorta and prevents blood circulation to the posterior trunk and tail. The *grl* gene in the mutant encoded an aberrant form of a basic helix-loop-helix protein with homology to Hairy-related proteins. In other systems, these proteins function as transcriptional regulators that help determine cell fate.

KEEPING P53 IN CHECK

A new link in the chain of events that cause cells with damaged DNA to pause in the cell cycle until the DNA is repaired or to undergo apoptosis is described by Hirao *et al.* (p. 1824; see the Perspective by Carr). This DNA damage–induced checkpoint requires activation of the transcription factor p53. The authors' analysis of checkpoint function in mouse cells lacking the protein kinase Chk2 indicates that Chk2 is required for stabilization of p53 in response to DNA damage. They also show that Chk2 can directly phosphorylate p53. Failure of this checkpoint pathway can lead to cancer.

KEPT IN THE CAT

Feline leukemia viruses (FeLV) are considered to be "simpler" retroviruses than the human immunodeficiency virus (HIV) and its simian counterpart SIV. However, Anderson *et al.* (p. 1828) show that a cytopathic variant of FeLV that infects T cells requires a classical cell receptor (PIT-1) and a second factor to initiate a productive infection. The second factor is an endogenously expressed protein that resembles the envelope glycoprotein of FeLV. This protein, called FeLIX, may represent the remains of an ancient form of the virus that became part of its host.

THE BUZZ ON SLEEP AND TASTE

The well-characterized genetics of the simple fruit fly, *Drosophila melanogaster*, has proved of great value in dissecting the molecular basis of learning and memory. Now it seems that *Drosophila* will open the door to another of the brains' mysteries—the basis of sleep—as well as provide insight into the molecular basis of taste. Shaw *et al.* (p. 1834) show that during periods of time in which flies are immobile, they are actually showing many of the biochemical signs of sleep that have been seen in mammals. As in mammals, caffeine decreased sleep time in flies, and antihistamines increased it. Expression of genes such as *Cytochrome oxidase c* subunit 1 and *BiP* were depressed during sleep in both flies and mammals. In addition, alteration of the monoamine system altered the flies' sleep cycles, which may also occur in mammals. Clyne *et al.* (p. 1830) have identified a large and diverse family of putative taste receptors by using a computer algorithm to screen the *Drosophila* genome database. The algorithm identifies sequences that encode proteins with the structural characteristics of G protein–coupled receptors that other sensory neurons use in vision and olfaction. The taste receptor genes are not homologous to any other known genes, including the two known mammalian taste receptors, and receptor expression was specific to *Drosophila* taste organs. The isolation of these numerous taste receptor genes will help define information processing in taste perception.

DEFEATING POLYGLUTAMINE REPEATS

A number of neurodegenerative conditions, including Huntington's disease, are characterized by a defective protein with an abnormally long string of polyglutamine amino acids. The defective proteins form aggregates that are toxic to neurons. Kazemi-Esfarjani and Benzer (p. 1837) have designed a fly model of Huntington's disease—flies carrying long strings of polyglutamines in a retinal protein have severe external eye abnormalities. A screen identified two genes that could suppress the neurotoxicity of polyglutamine repeats.

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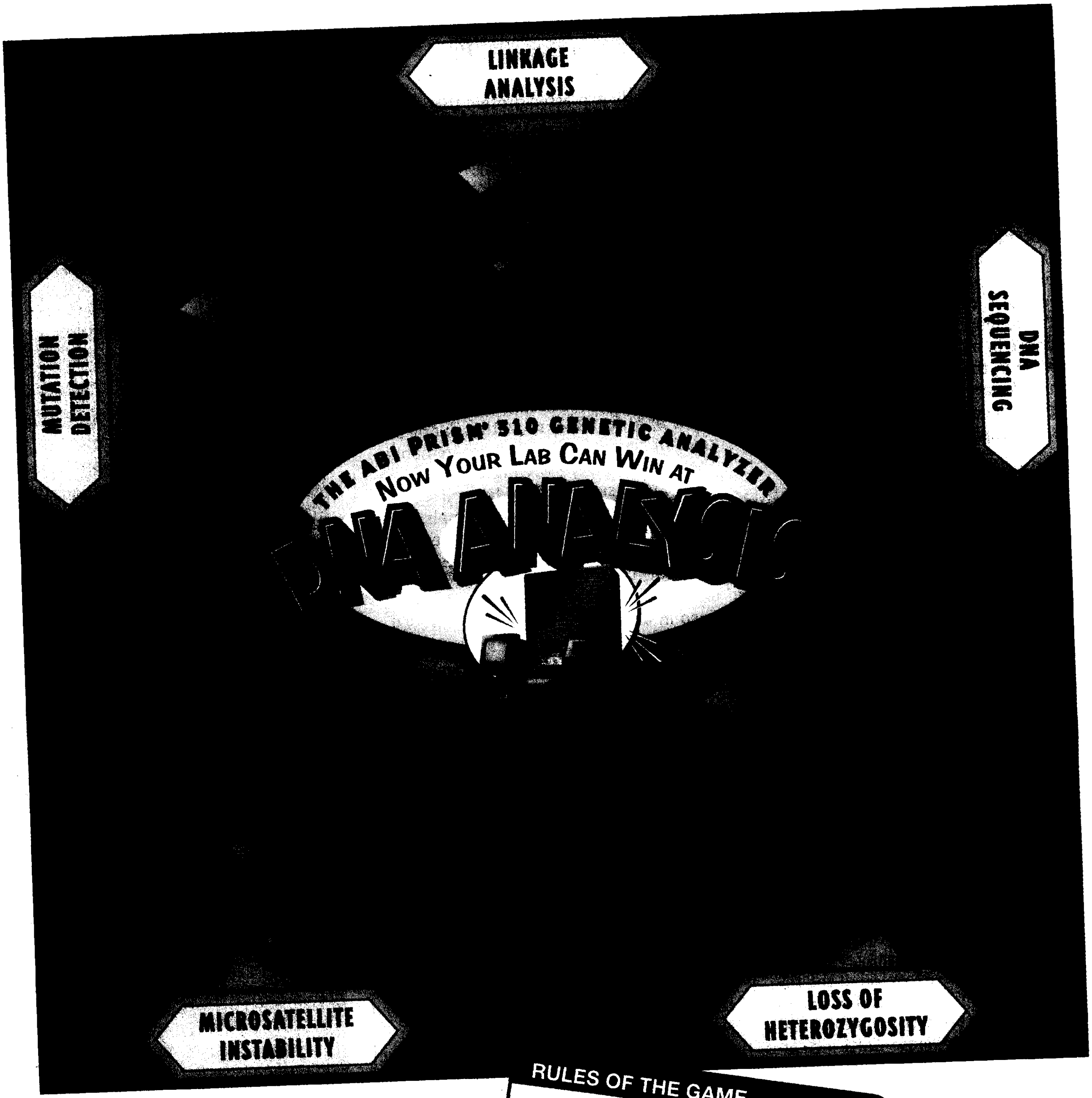

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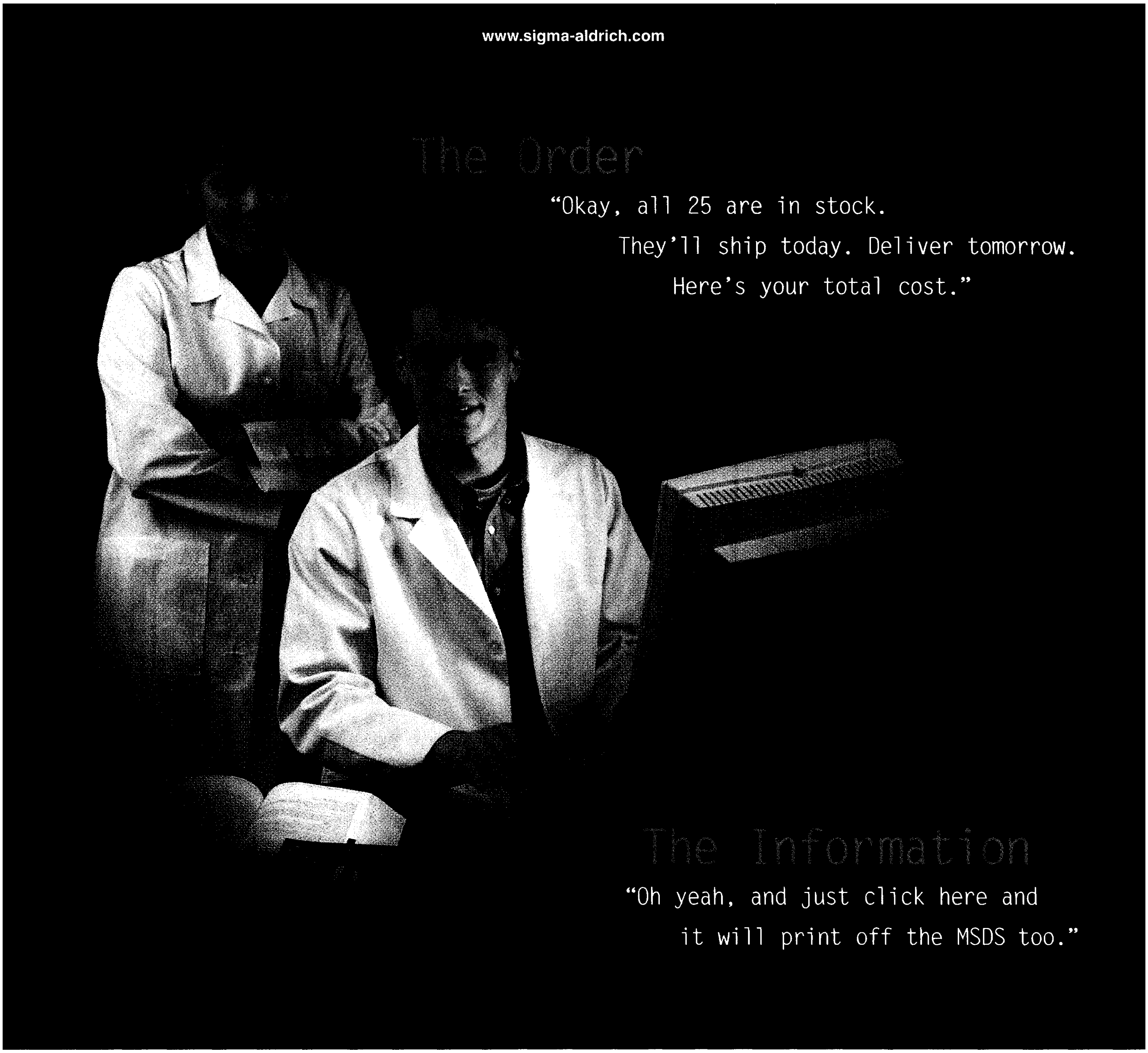

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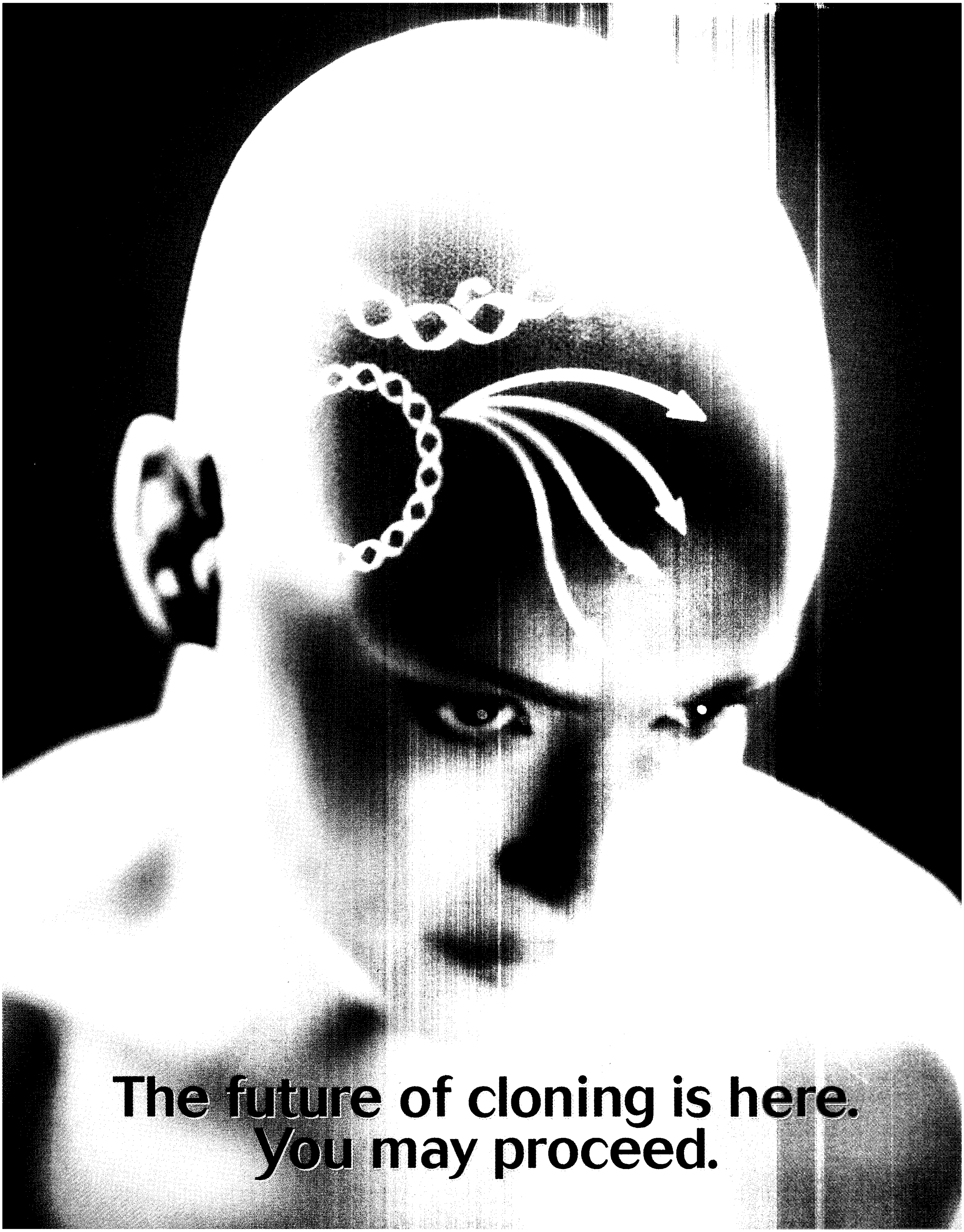
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Figure 1-Rapid Cloning of the Gene of Interest Using the Echo™ Cloning System

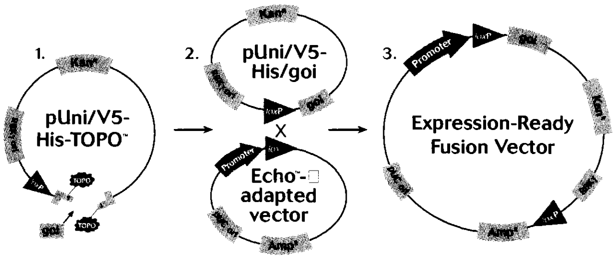

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Table 1-Echo™-Adapted Expression Vectors

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YEAST	pYES2.1-E	High-level, regulated expression in *Saccharomyces cerevisiae*
	pYC2-E	Regulated expression in *S. cerevisiae* from a low-copy number plasmid
INSECT	pIB-E	Stable expression with the InsectSelect™ System
	pBlueBac4.5-E	High-level expression with the MaxBac® Baculovirus Expression System
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	pcDNA4/HisMax-E	QBI SP163-enhanced expression from the CMV promoter
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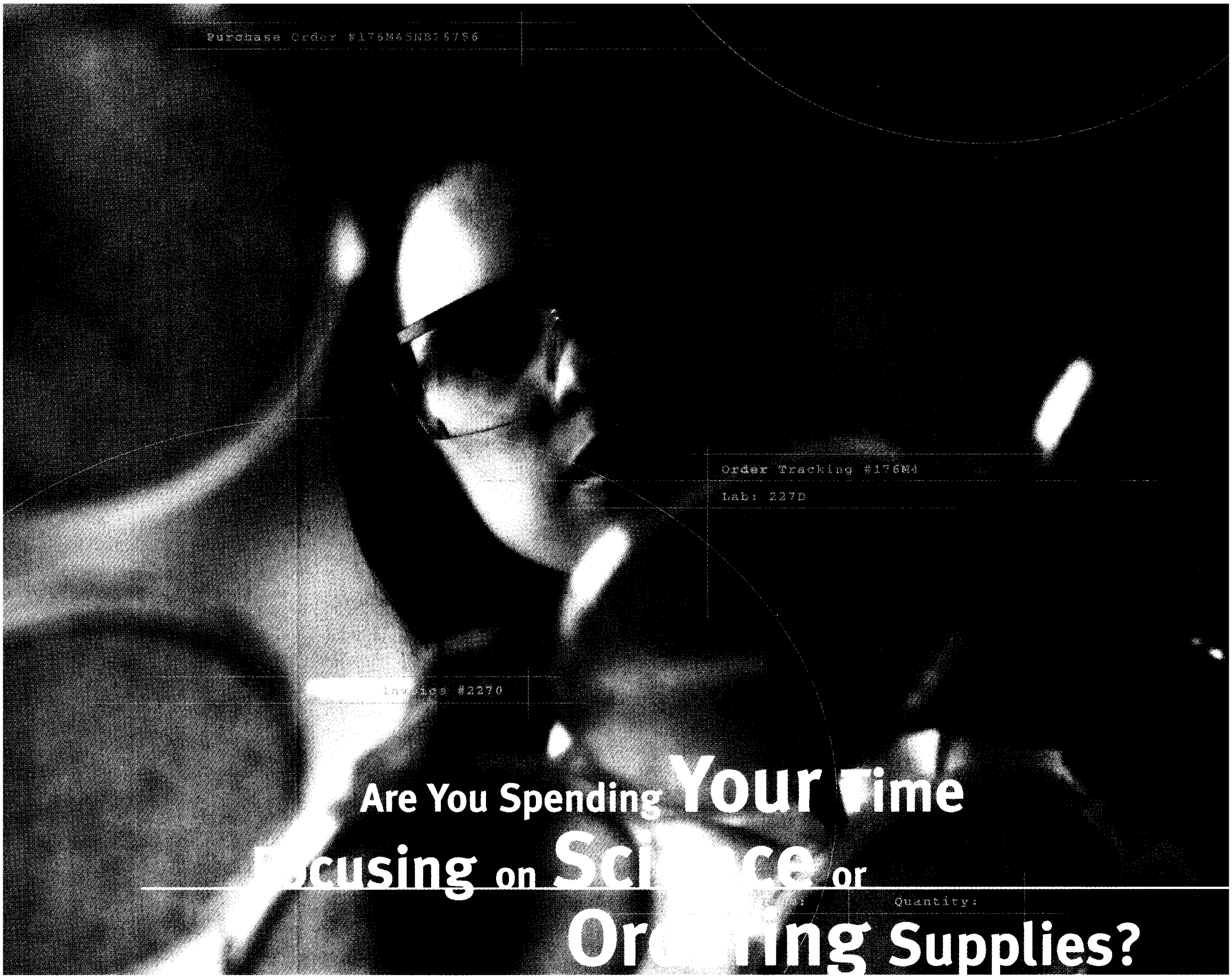

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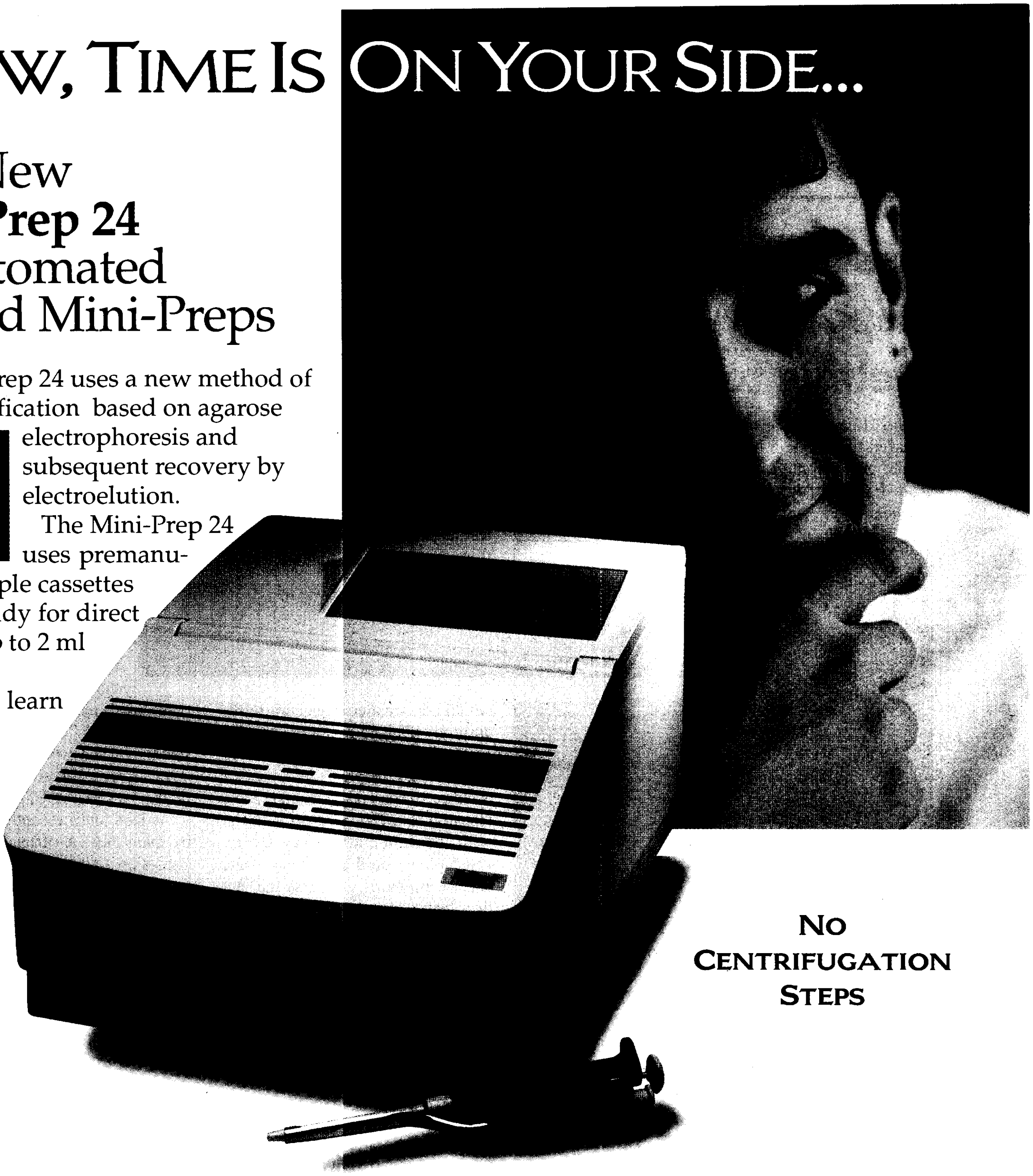

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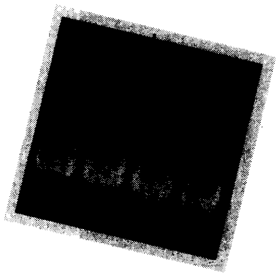

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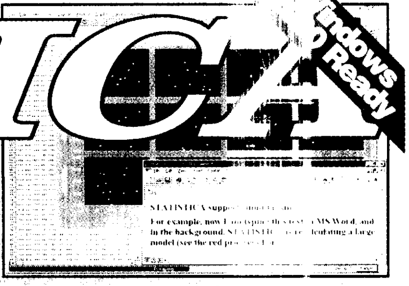

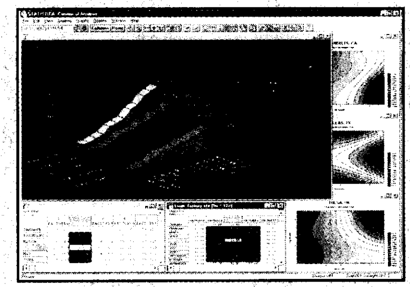

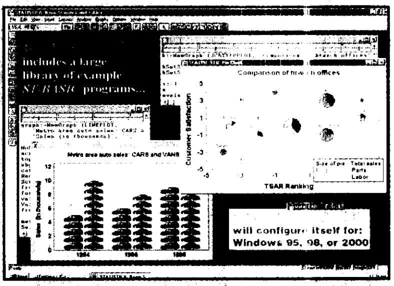

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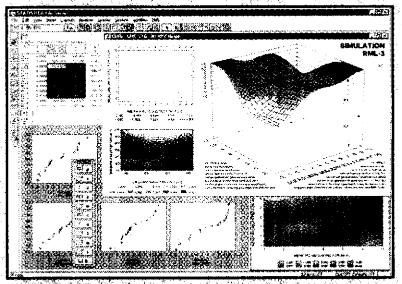

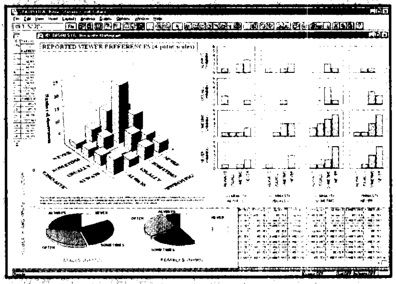

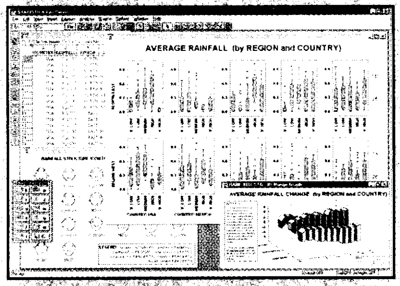

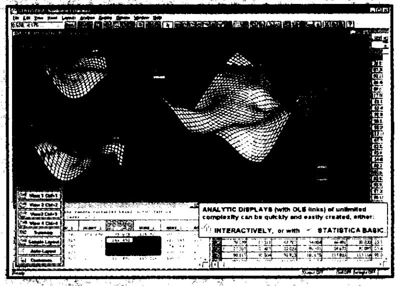

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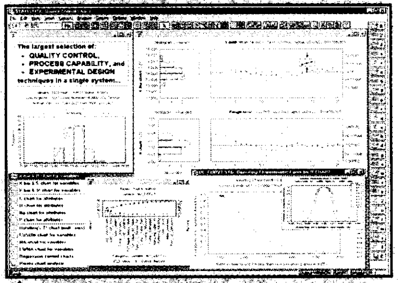

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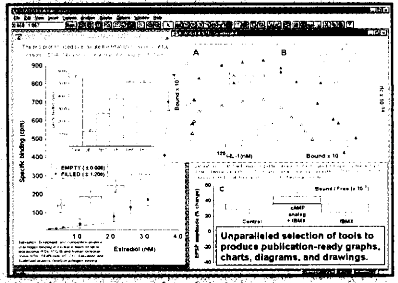

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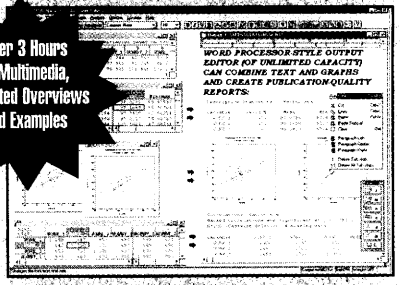

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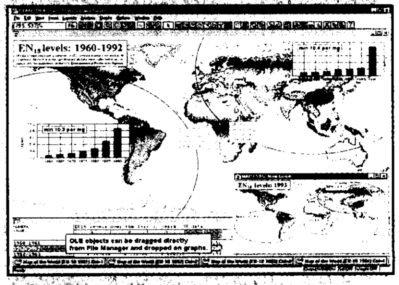

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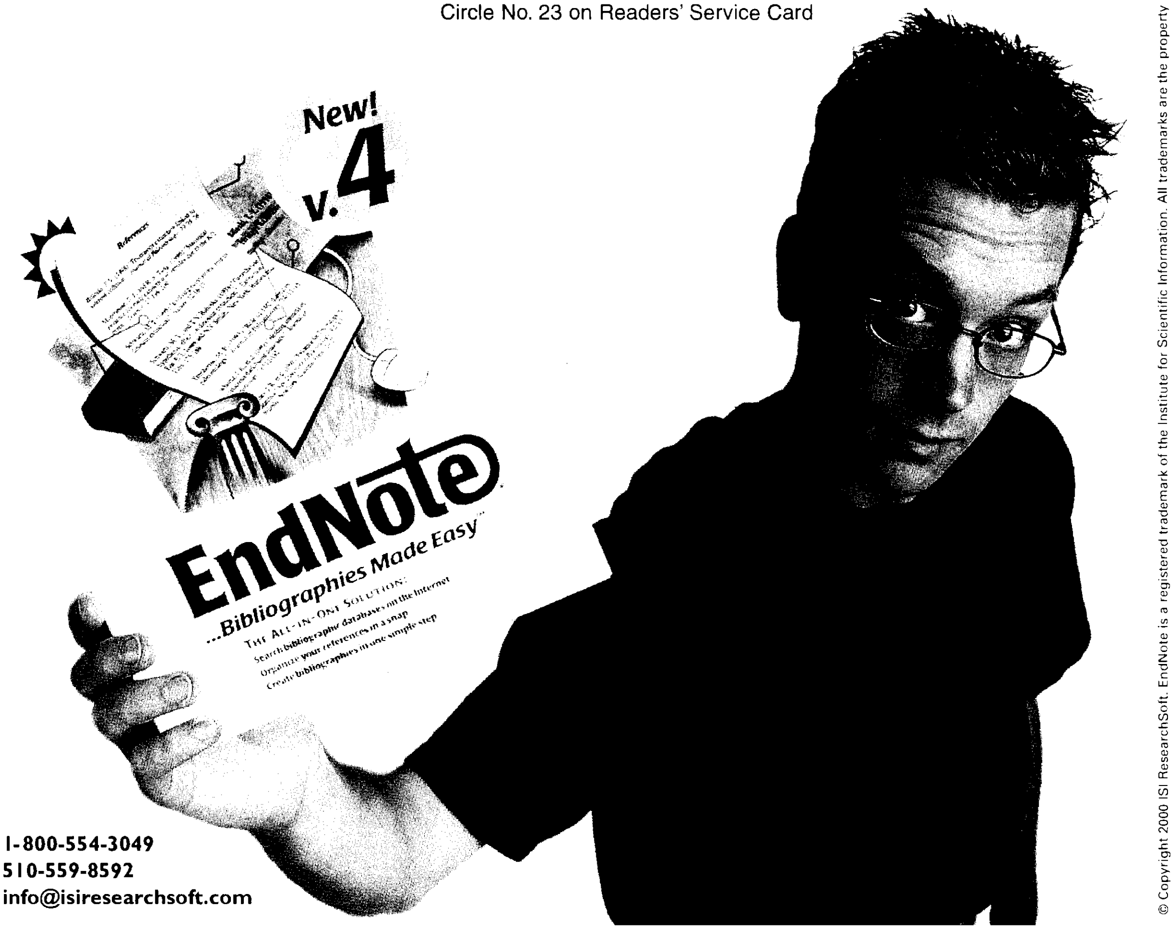

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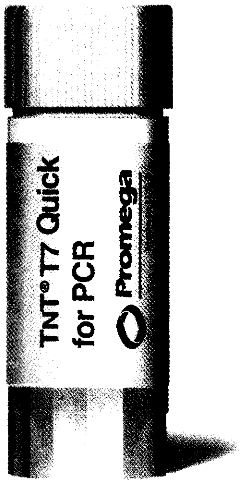

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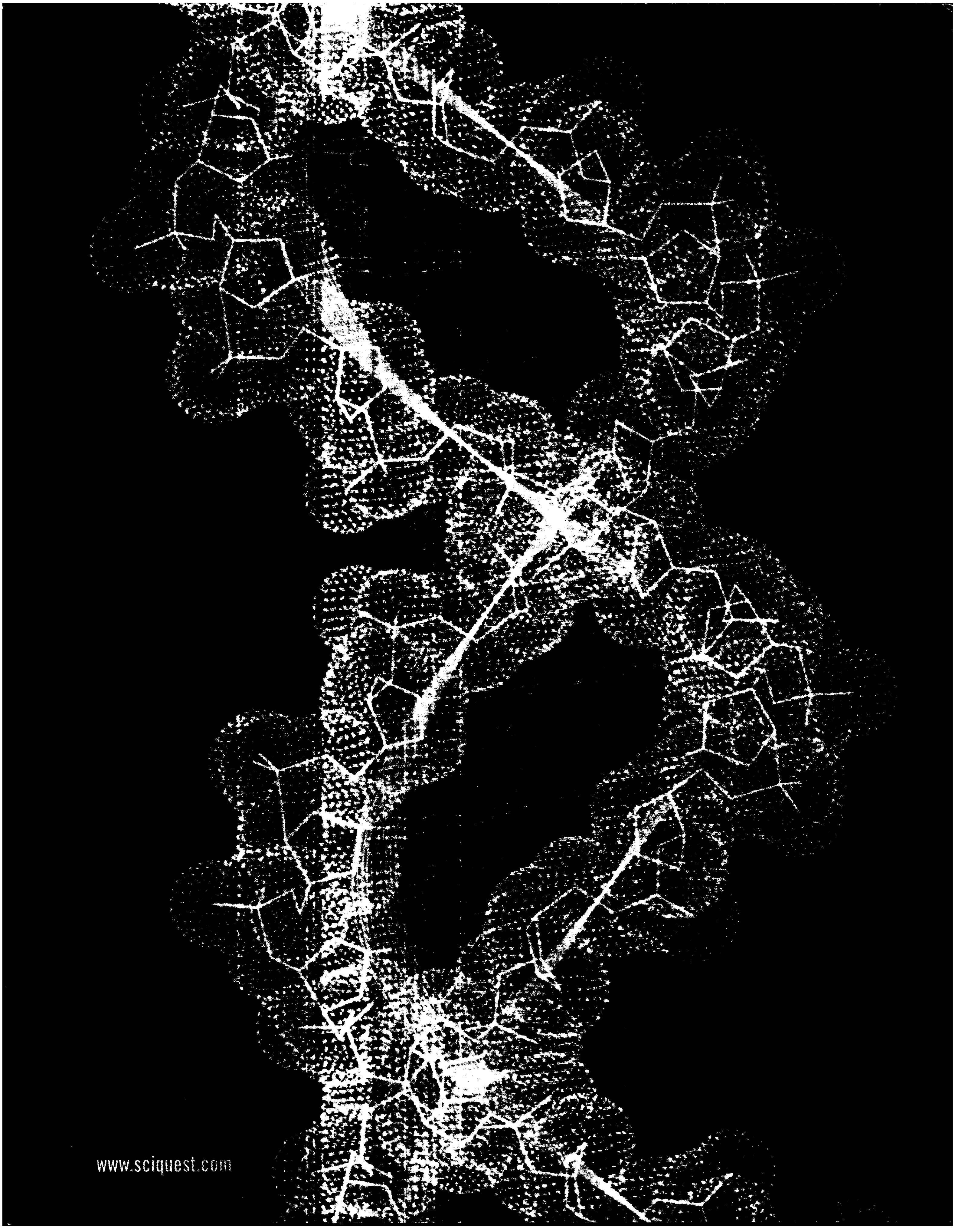

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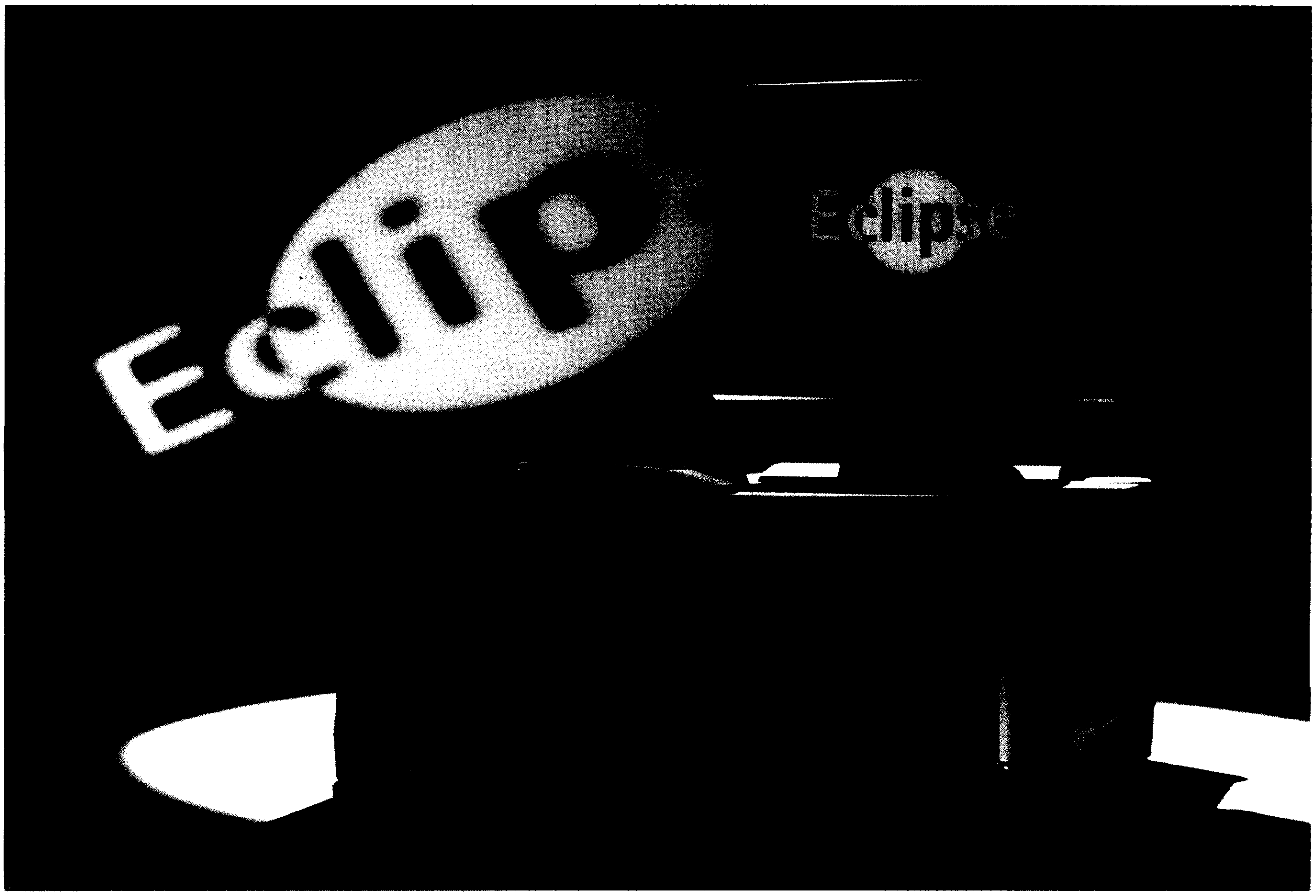

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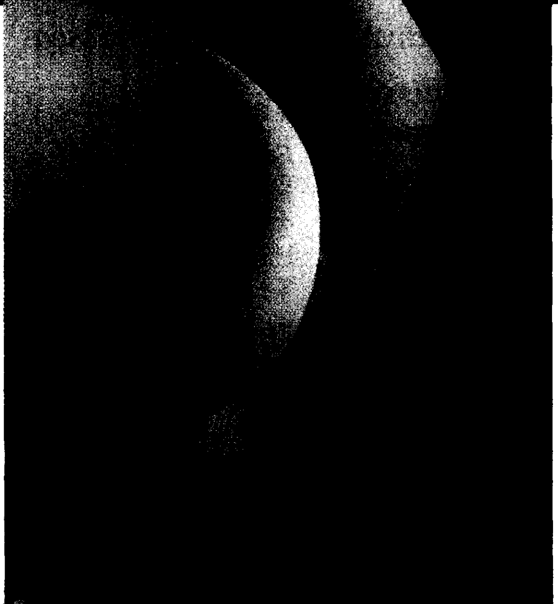

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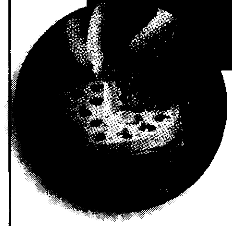

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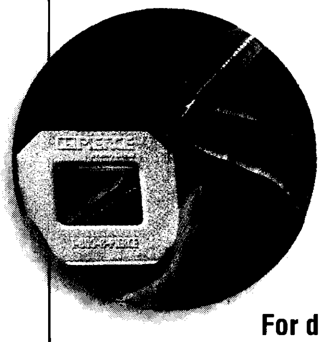

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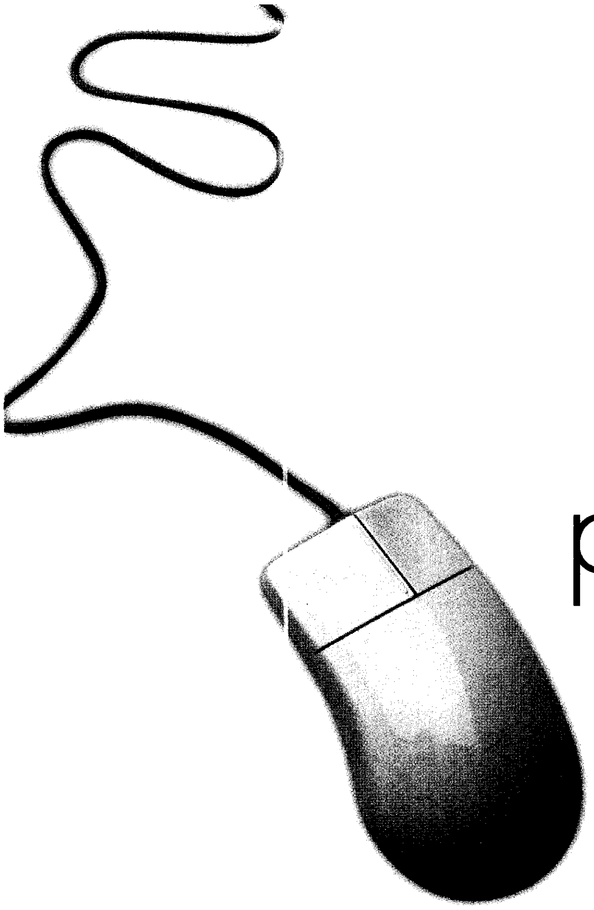

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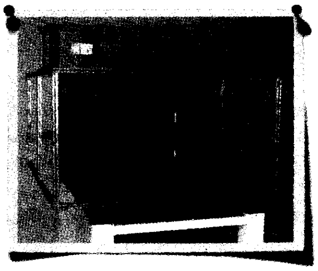

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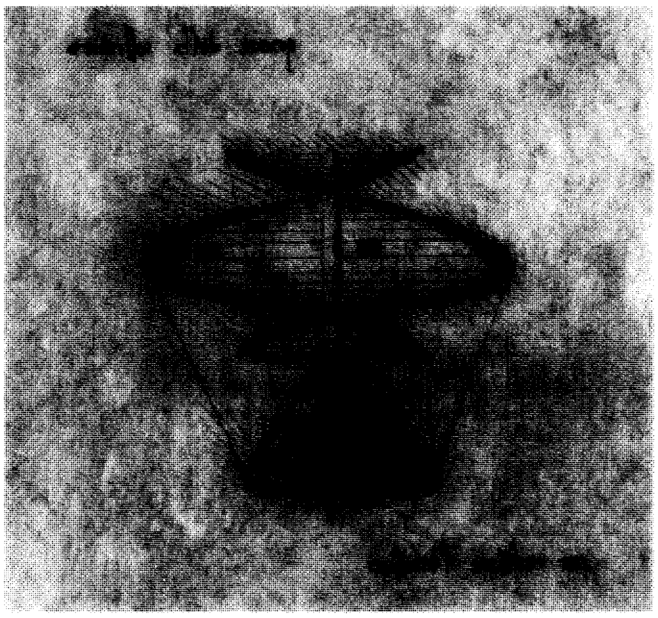

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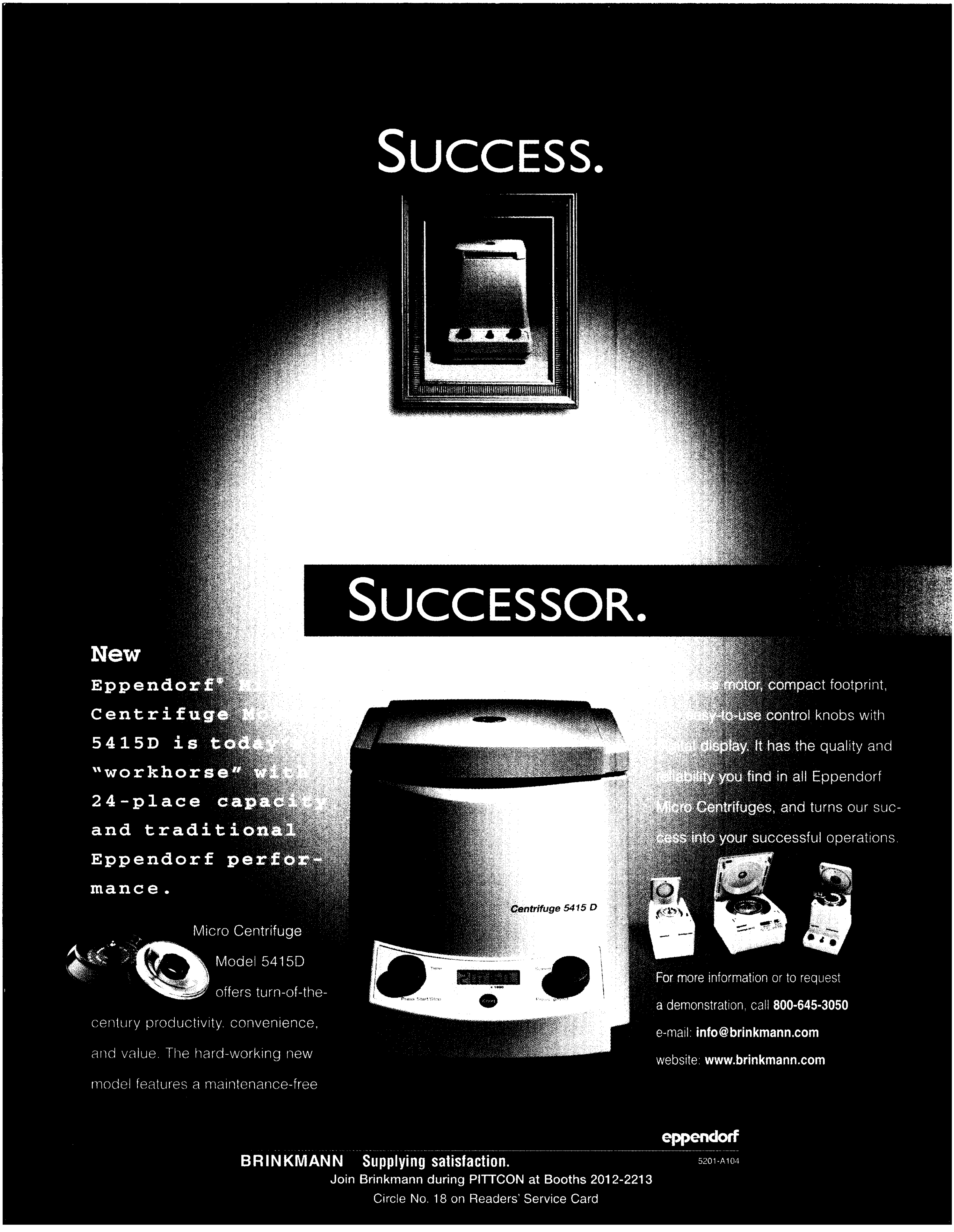

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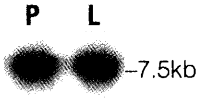

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