6 July 2001

Science

Vol. 293 No. 5527
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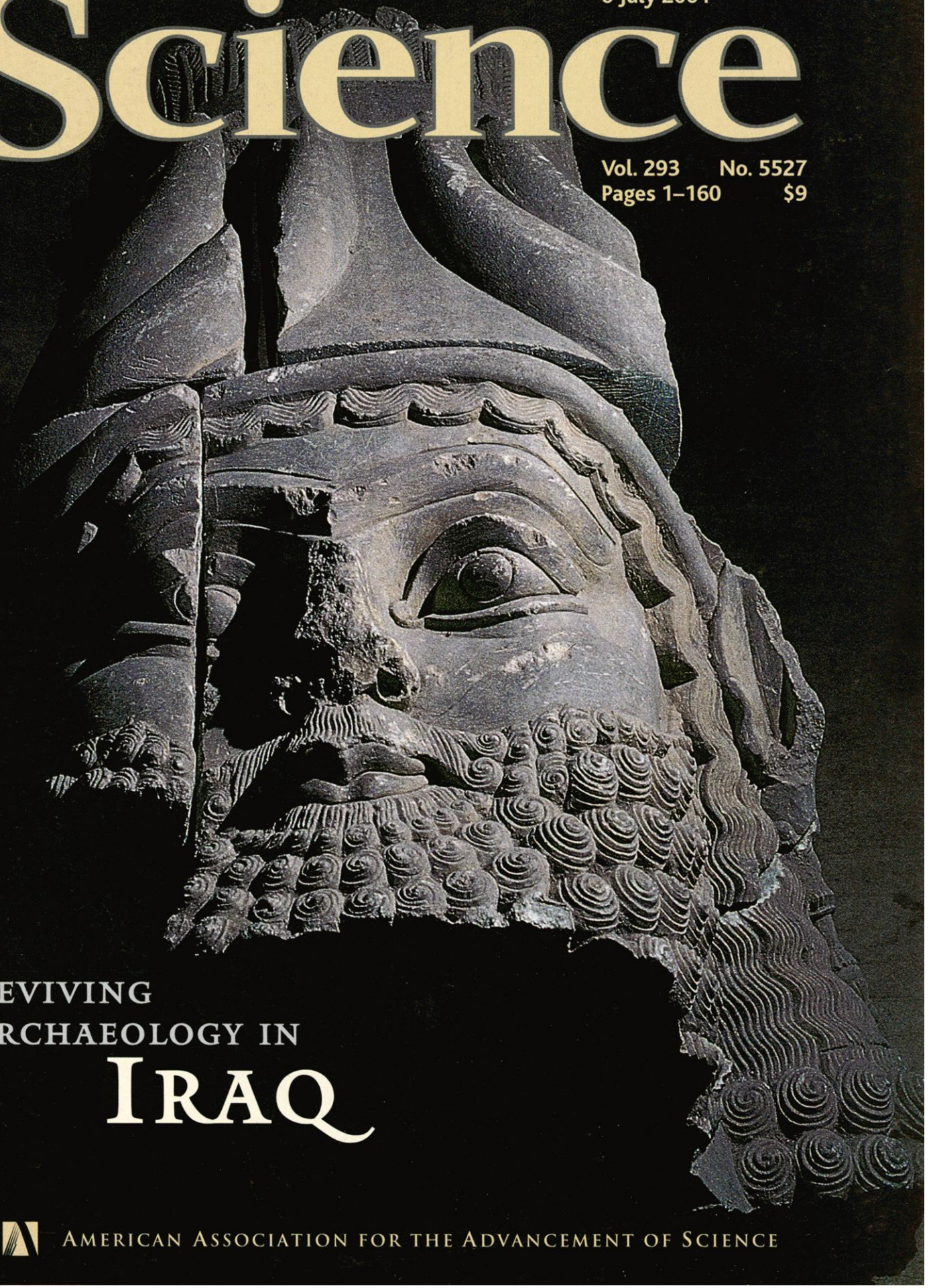

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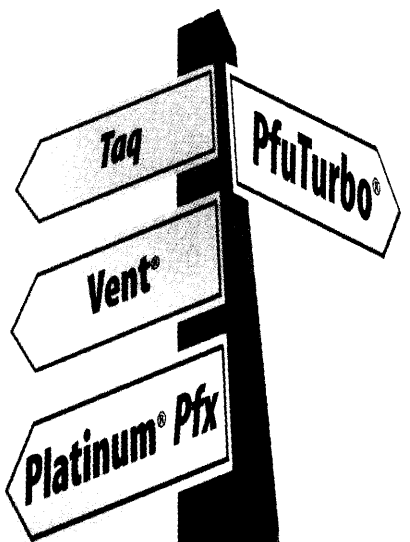

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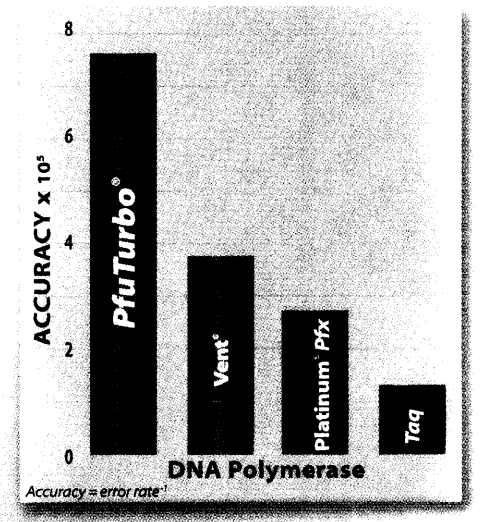

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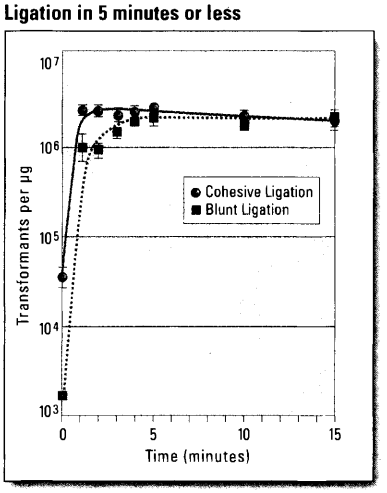

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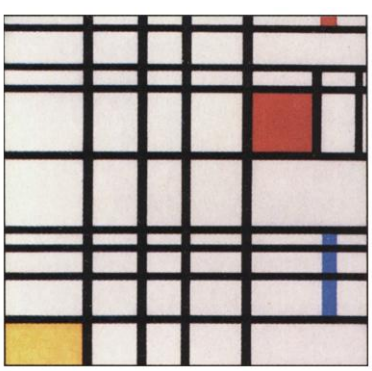

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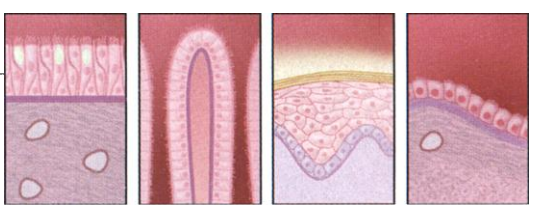

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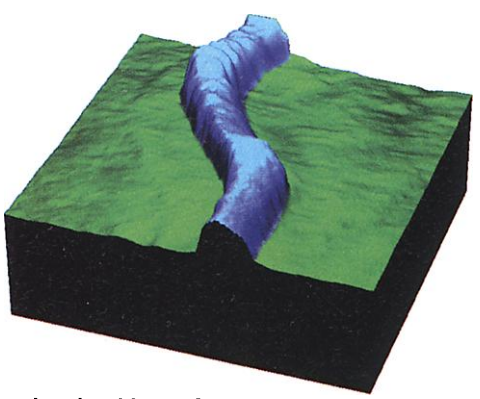

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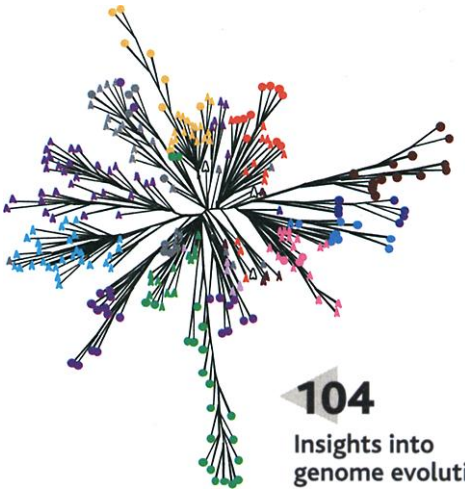

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Insights into genome evolution

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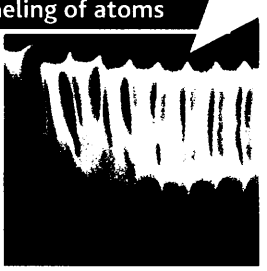
A 2700-year-old stone head from King Sargon II's capital of Dur-Sharrukin, today's Khorsabad in northern Iraq. Looters sawed the head off a statue in 1997, then sliced it into smaller pieces to smuggle it out of the country. In 1999, Iraqi police captured and executed 10 of the looters. The severed head, shown here in Baghdad's Iraq Museum awaiting restoration, was recovered. But thousands of other objects have been irretrievably lost in the past decade. [Photo: John Russell]

New on *Science* Express Chaos-assisted tunneling of atoms



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Observation of Chaos-Assisted Tunneling Between Islands of Stability D. A. Steck, W. H. Oskay, M. G. Raizen

PERSPECTIVE: **No Mere Anarchy** S. Habib

A cloud of cold cesium atoms is used to show that chaotic motion of the atoms can assist tunneling of atoms between symmetric and antisymmetric momentum states.

NPAS2: An Analog of Clock Operative in the Mammalian Forebrain M. Reick, J. A. Garcia, C. Dudley, S. L. McKnight

Regulation of Clock and NPAS2 DNA Binding by the Redox State of NAD Cofactors J. Rutter, M. Reick, L. C. Wu, S. L. McKnight

PERSPECTIVE: **Chronobiology—Reducing Time** U. Schibler, J. A. Ripperger, S. A. Brown

An unexpected molecular link between circadian rhythms and cellular metabolism is revealed by in vitro studies of the transcription factors that regulate the circadian clock.

science's stke www.stke.org

Review: Physiology, Phylogeny, and Functions of the TRP Superfamily of Cation Channels C. Montell

Physiological processes that are controlled by TRP channels.

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Global: Out of this World . . .

In this month's feature, Next Wave boldly goes on an exploration of careers in the space sciences. We combine the insights of our essayists—promising space scientists with backgrounds in physics, engineering, materials science, and biology—with the latest on space research funding and a resource page stuffed with links to other useful Web sites.

US: Tips for Budding Scientist–Entrepreneurs K. Cottingham

Don't just think about starting your own business—do it! But first, check out this overview and its links to many of Next Wave's articles on entrepreneurship and the business culture.

US: GrantsNet Funding News K. Cottingham

"Yes, but you need to bring your own funding . . .": These words can strike fear in the hearts of grad students and postdocs. But if your bent is biomedicine, never fear: GrantsNet's Funding News gives you the latest information on fellowships and grants across the discipline.

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SPECIAL AD SECTION / 13 JULY ISSUE

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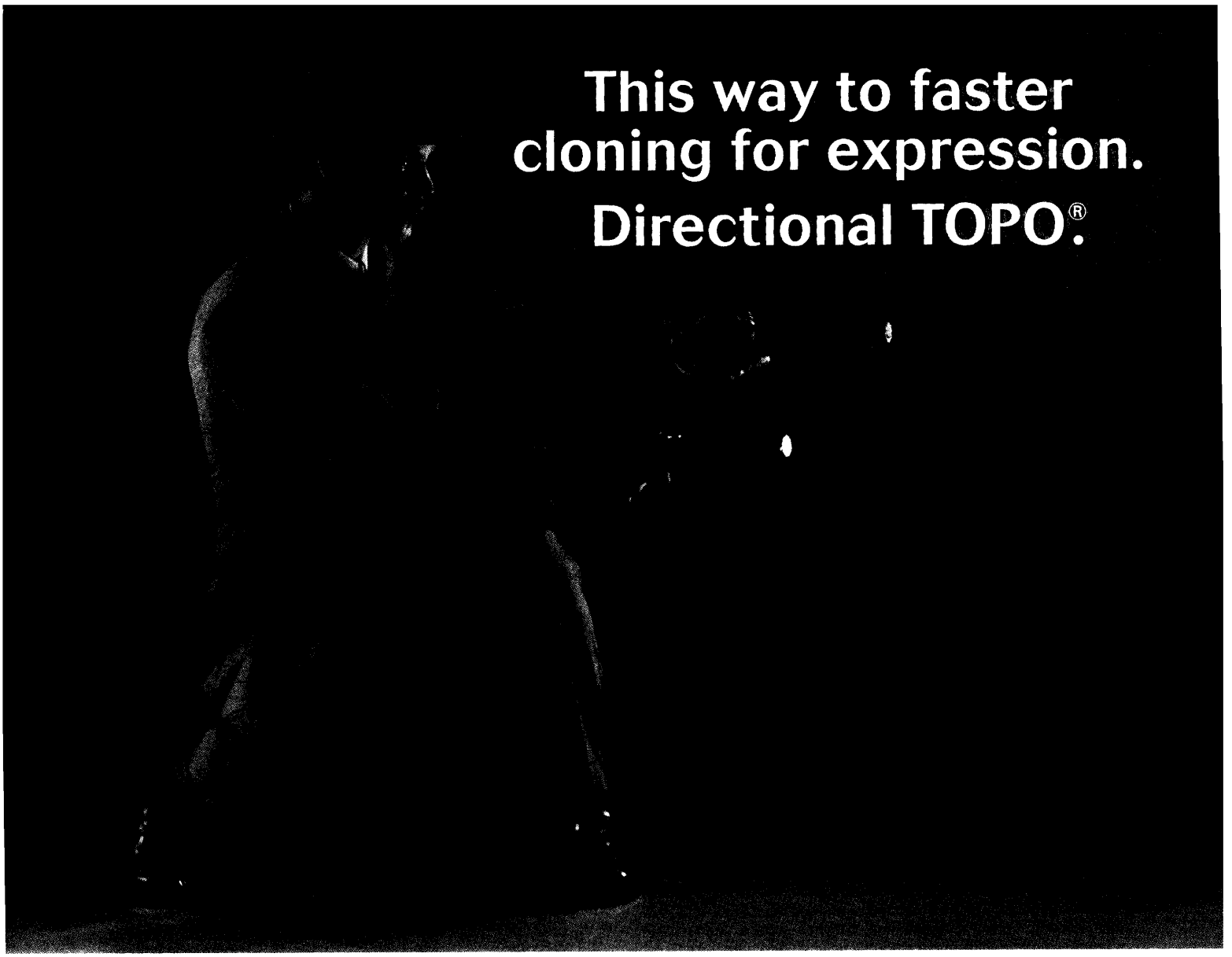
Advances in Immunology and AIDS Research:
This special advertising section will focus on technologies used in AIDS research and will detail current areas of immunology. Look for it in the 13 July issue.



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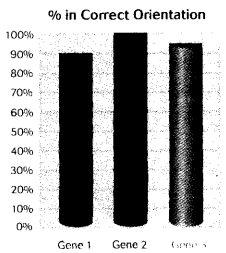

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THIS WEEK IN Science

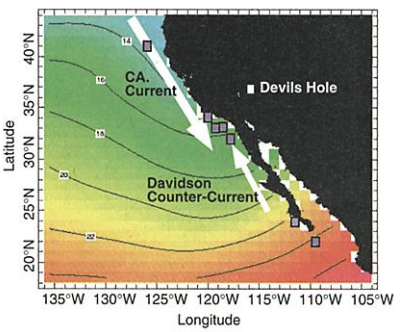
edited by Phil Szuromi

Twisting Molecules into SETs

A single electron transistor (SET) comprises a small island with discrete energy levels (a quantum dot or a molecular structure) connected to metallic leads by tunnel junctions. Although some SET configurations have shown room-temperature operation, they have been difficult to control, and so most devices operate at cryogenic temperature. Postma *et al.* (p. 76) used a scanning probe to form kinks in a metallic carbon nanotube in two places to create the island bracketed by two junctions. The resultant distorted nanotube behaves as a room-temperature SET.

71 Early Warming System

The periods of climate warming that terminated Quaternary glaciations are commonly understood in terms of Milankovich theory—changes in solar insolation were produced by variations in Earth's orbit around the Sun. However, different regions did not always warm synchronously. Herbert *et al.* (p. 71; see the Perspective by Lea) present a collection of sea surface temperature records from the California margin for the past 550,000 years. Surface-water warming preceded changes in global ice volume by 10,000 to 15,000 thousand years for each of the past five glacial terminations. These results provide a way to reconcile the climate record from Devils Hole, Nevada, with the idea of orbital forcing, which has been a particularly difficult task for proponents of Milankovich theory.



CREDIT: HERBERT *ET AL.*

Fully Conjugated Porphyrin Tapes

Porphryin groups can be assembled into long chains, but these groups still tend to be electronically isolated from one another. Tsuda and Osuka (p. 79) have taken Zn(II) porphyrin oligomers (containing up to 12 groups) and fused the ring system into one large conjugated molecule. The conjugated entity is so large that the electronic absorption bands, which are normally in the ultraviolet-to-visible wavelengths, are pushed down into the near-infrared. Such molecules have a number of potential electronic and optical applications.

Ring Around the World

The Northern Hemisphere annular mode (NAM), a large-scale pattern of climate variability, is characterized by differences in the strength of zonal winds of opposing directions centered at about 35° and 55°N that dominate climate variability at latitudes between about 20° and 45°N. It affects temperature, rainfall, storm tracks, wind patterns, and the frequency of extreme weather events. Traditionally, the variability associated with this pattern has been thought of as mostly restricted to the North Atlantic and Europe. Thompson and Wallace (p. 85) show that the NAM influences all longitudes of the Northern Hemisphere and that the two modes of the NAM produce characteristic patterns of both mean climate and anomalous weather events.

Cooler Cretaceous Archaea

During the mid-Cretaceous, about 88 to 155 million years ago, there were periods of exceptional volcanic activity that released so much CO_2 into the atmosphere that oceans often became anoxic, possibly through the overgrowth of plankton. When the plankton died and fell to the ocean floor, deep sediments formed that became distinctive black shales recently discovered during the Ocean Drilling Project in the North Atlantic. Kuypers *et al.* (p. 92; see the Perspective by Smith) have found that the early Albian black shales have the chemical signature of bacterial membrane lipids of chemoautotrophic Crenarchaeota that were adapted to nonhyperthermal environments. This finding pushes back the archaean expansion into cooler climes back by about 60 million years.

Snow Weigh

Japan has a dense Global Positioning System (GPS) network to monitor changes in surface deformation related to subduction zone–induced earthquakes and volcanic eruptions. Heki (p. 89) shows that seasonal variations in the surface deformation pattern in northeastern Japan are the result of snow accumulation along the western flank of the main mountain range that crosses northeastern Japan. Thus, in order to understand the buildup of strain beneath the island related to the subduction zones, the effect of the snow load needs to be subtracted.

Consequences of Cloning

The safety of nuclear transfer technologies that have been used to clone animals has been controversial. Humpherys *et al.* (p. 95) suspected that epigenetic alterations might be responsible for low success rates, even when nuclei from embryonic stem (ES) cells are used. In contrast to normal zygotes that had been transferred to surrogate mothers, cloned mice showed highly variable levels of methylation and expression of imprinted genes. This variability was caused not only by faulty reprogramming during cloning but also reflected a loss of imprinting in the donor cells. However, the survival of animals with clear imprinting abnormalities indicates that they may be more tolerant of such dysregulation during development than had been suspected.

Don't Leave a Wake

How do large marine predators detect their prey when waters are dark or turbid? Dehnhardt *et al.* (p. 102; see the news story by Zimmer) found that harbor seals can detect the trails of turbulent water left by escaping prey. Seals accurately followed the hydrodynamic trail left by a small submarine in a pool, apparently by using their sensitive whiskers.

Published online in *Science* Express

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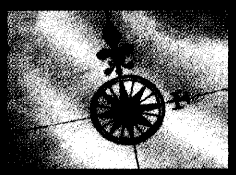

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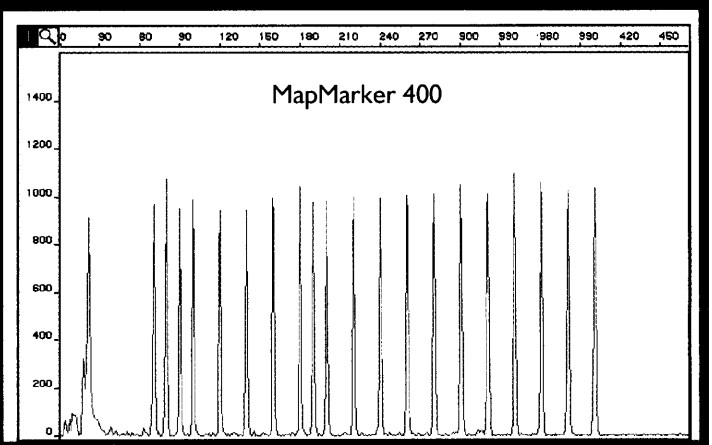

Above is an example of Rhodamine-X labeled MapMarker 70-400 sizing standard run on ABI model 310 Genetic Analyzer™. Marker bands are 70, 80, 90, 100, 120, 140, 160, 180, 190, 200, 220, 240, 260, 280, 300, 320, 340, 360, 380, and 400 nucleotides long.

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The Tail's Tale

The normal function of the amyloid-β precursor protein (APP) implicated in Alzheimer's disease is uncertain. Given APP's tantalizing similarities to the cell-surface protein Notch (for example, clipping of both proteins' cytoplasmic tails requires presenilin), Cao and Südhof (p. 115; see the news story by Marx) tested whether APP's cytoplasmic tail might activate transcription. APP's tail in fact formed a multimeric complex with two nuclear proteins, the adapter protein Fe65 and the histone acetyltransferase Tip60. When a heterologous Gal4 or LexA DNA-binding domain was included, the complex could activate gene expression.

Separating Back from Front

The retinotectal system is a well-studied model for the development of topographic maps with clearly defined neuronal connections in the central nervous system. A prerequisite for retinotectal patterning is the acquisition of positional cues within the developing retina along the anterior-posterior and dorsal-ventral axes. Sakuta *et al.* (p. 111) identified a molecule, Ventroptin, with a specific expression pattern in the retina that seems to have two different functions. In the dorsal-ventral axis, it prevents dorsalization of the eye by antagonizing bone morphogenetic protein 4 in ventral retinal regions. Along the anterior-posterior axis of the eye, it regulates the expression of ephrin A2.

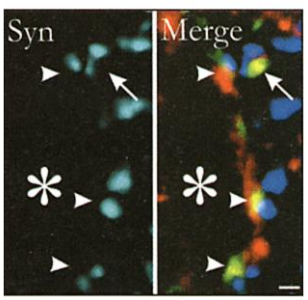
Vision and Memory

The prefrontal cortical system is usually associated with working memory. Could other areas involved in much earlier steps of sensory processing also participate in working memory? Supèr *et al.* (p. 120; see the news story by Helmuth) made recordings in the primary visual cortex (area V1) of awake and behaving monkeys during a delayed-response task. Neuronal activity in area V1 was correlated with performance in a memory task. This neural correlate of working memory seems to be a continuation of the sensory signal processing. The authors propose that contextual modulation in the primary visual cortex is a correlate of the process that forms a bridge between sensory activity and working memory.

A Hepatitis Virus Shows NELF Awareness

Hepatitis delta virus (HDV) is an RNA virus that increases the pathology associated with the hepatitis B virus. Previous studies have implicated the hepatitis delta antigen (HDAg) in both HDV replication and transcription by the virus' host RNA polymerase II (RNAPII), but the molecular mechanisms are largely unknown. Yamaguchi *et al.* (p. 124) show that HDAg has a sequence that is similar to the smallest subunit of NELF, a human factor that inhibits transcription elongation by RNAPII. HDAg activates transcription by directly interacting with RNAPII in a NELF-dependent and NELF-independent manner. These findings shed light on the mechanism of action for HDAg in regulating HDV RNA synthesis via RNAPII and may assist efforts in drug design.

Tuning into the Right Channel



CREDIT: DAVARE *ET AL.*

Clustering of signaling proteins in highly ordered complexes continues to be a major theme in studies of signal transduction. Davare *et al.* (p. 98; see the Perspective by Laporte *et al.*) report that L-type Ca^{2+} channels from rat neurons are tightly linked to the β_2 adrenergic receptors (β_2ARs) that control channel conductance. The authors characterized a signaling complex that contains all of the intermediates for signaling from the receptor to the channel: The β_2AR itself, the heterotrimeric guanine nucleotide binding protein $G\alpha_{ss}$, the adenylyl cyclase activated by the G protein to produce cyclic adenosine monophosphate (cAMP), and the cAMP-dependent protein kinase, which controls the channel through covalent phosphorylation. This close association appears to restrict signaling by β_2AR to those channels that are in the receptor complex. Patch clamp recordings from a tiny portion of the cell membrane showed that local application of an agonist (within the pipette) could activate the calcium channel, but that the application of the same stimulus to the rest of cell did not activate the channels within the patch.

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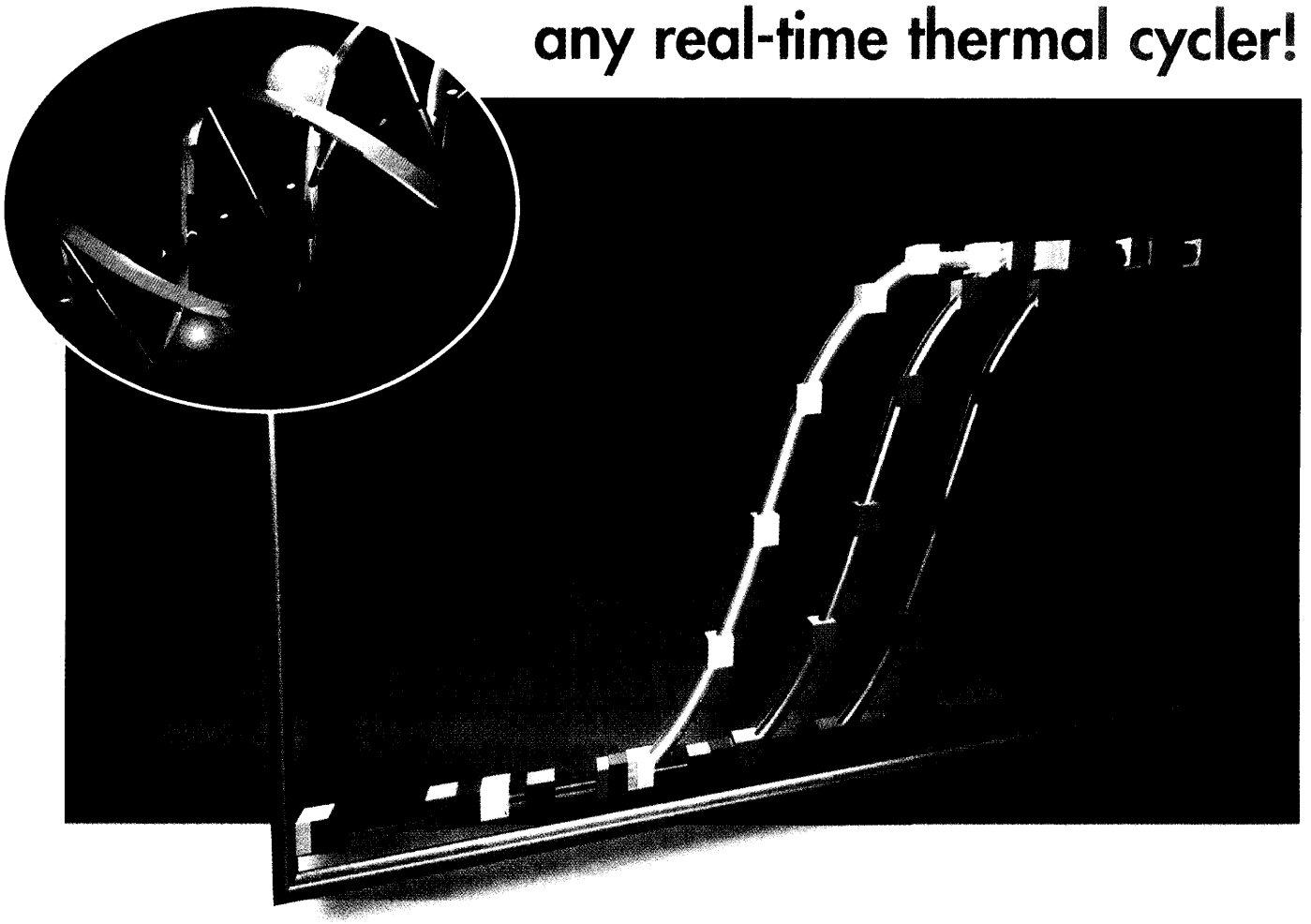

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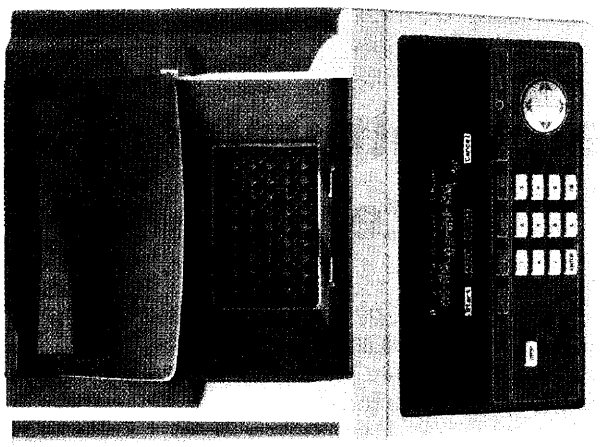

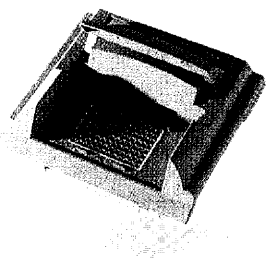

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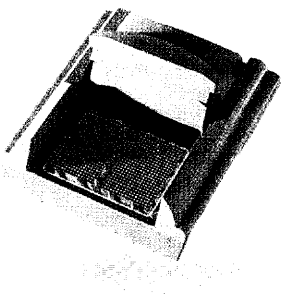

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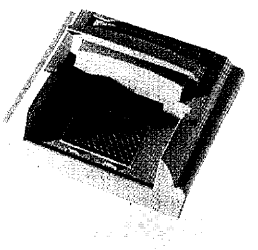

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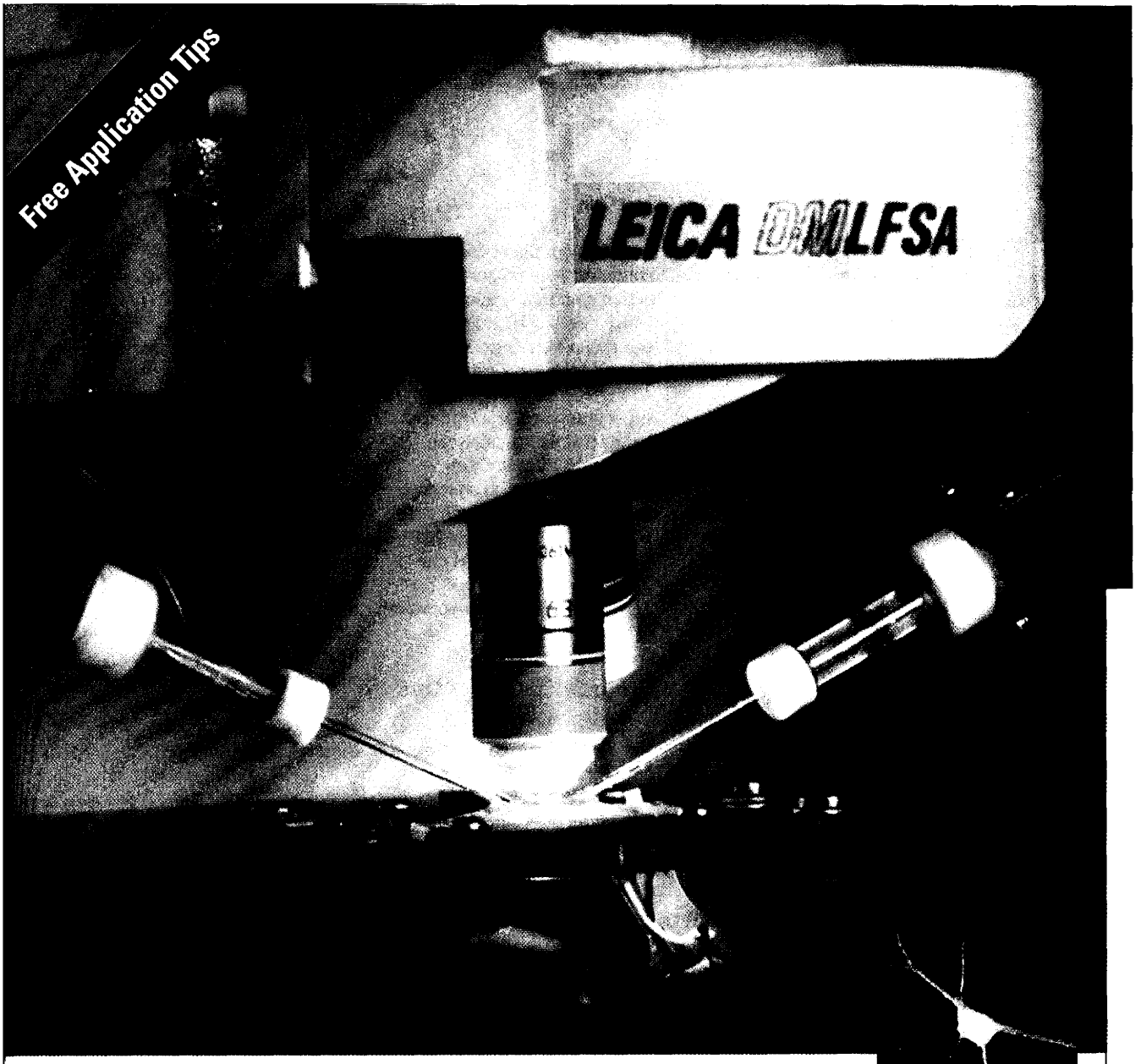

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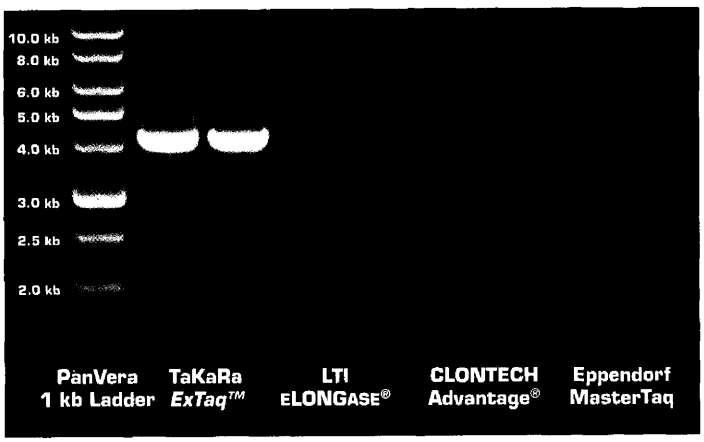

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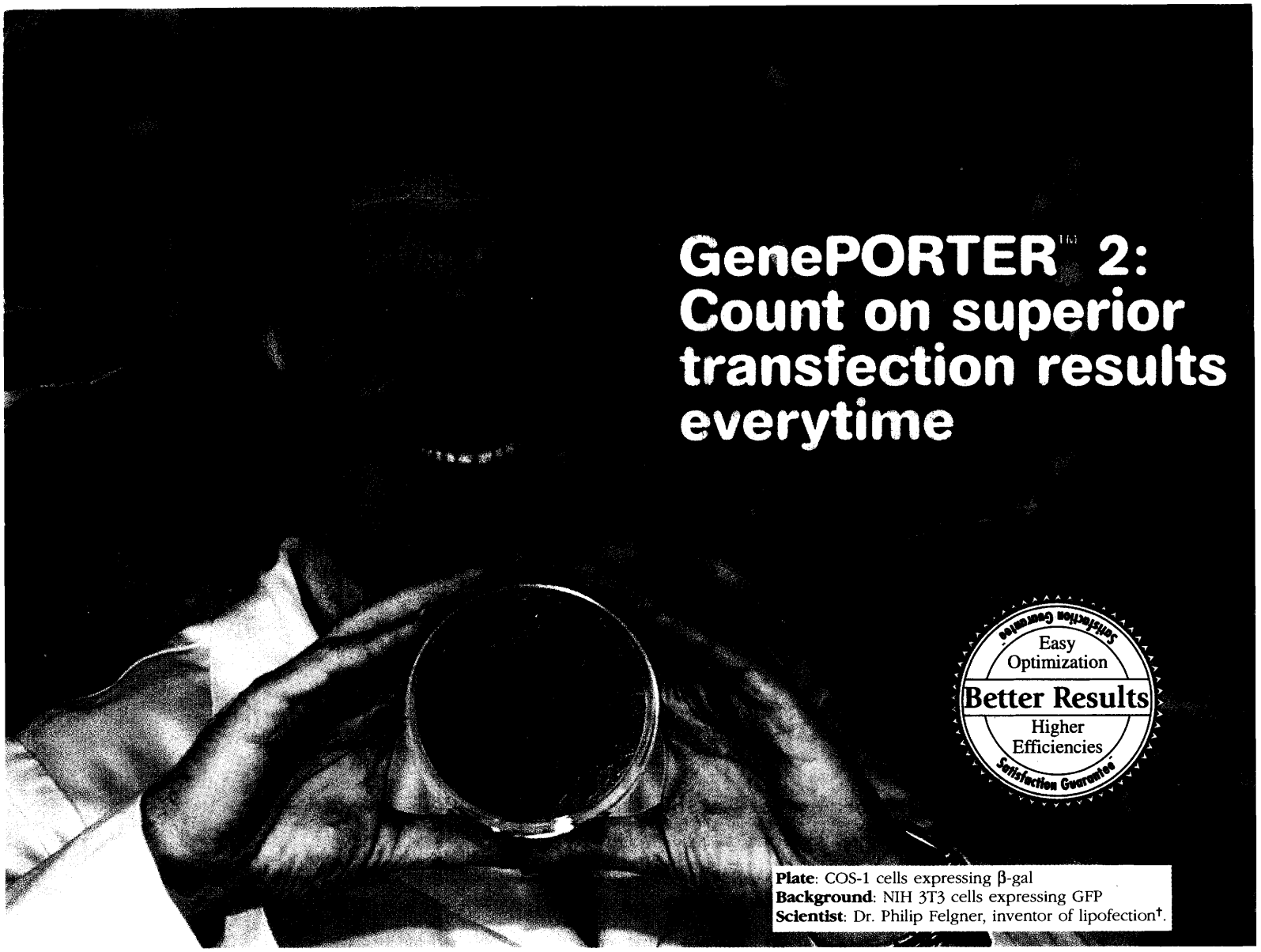

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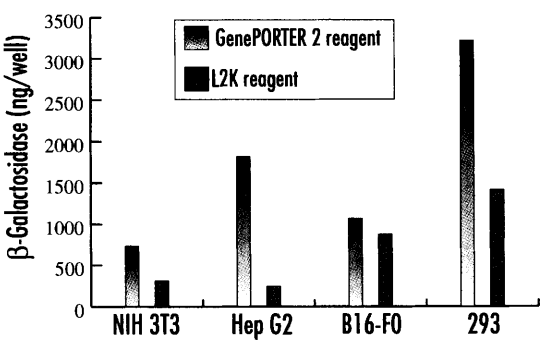

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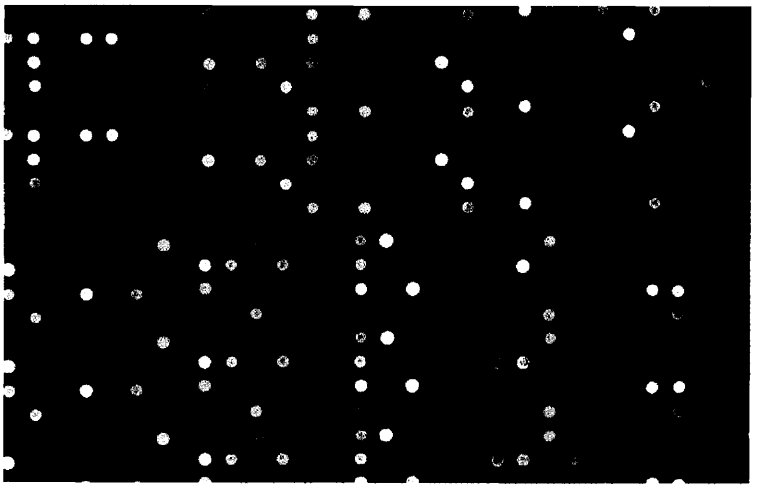

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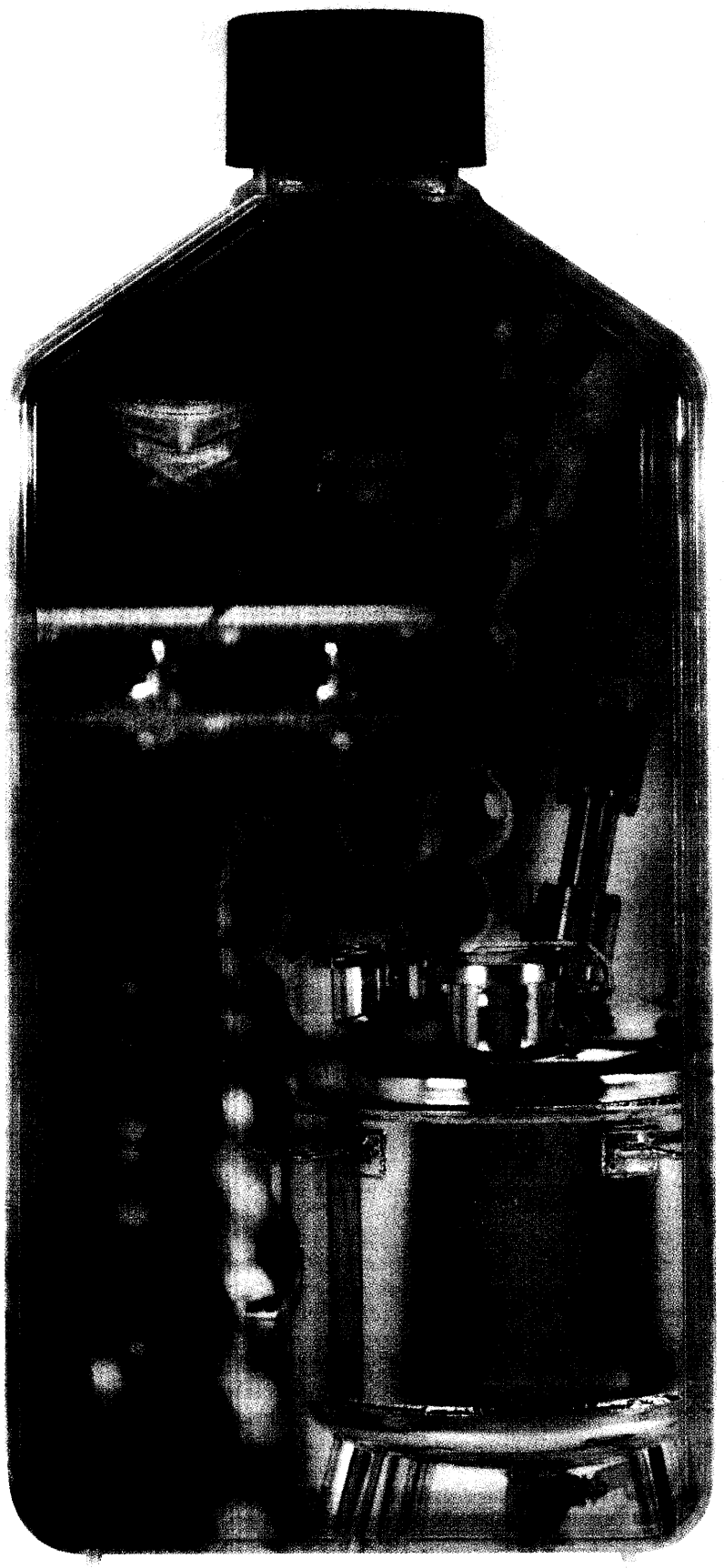

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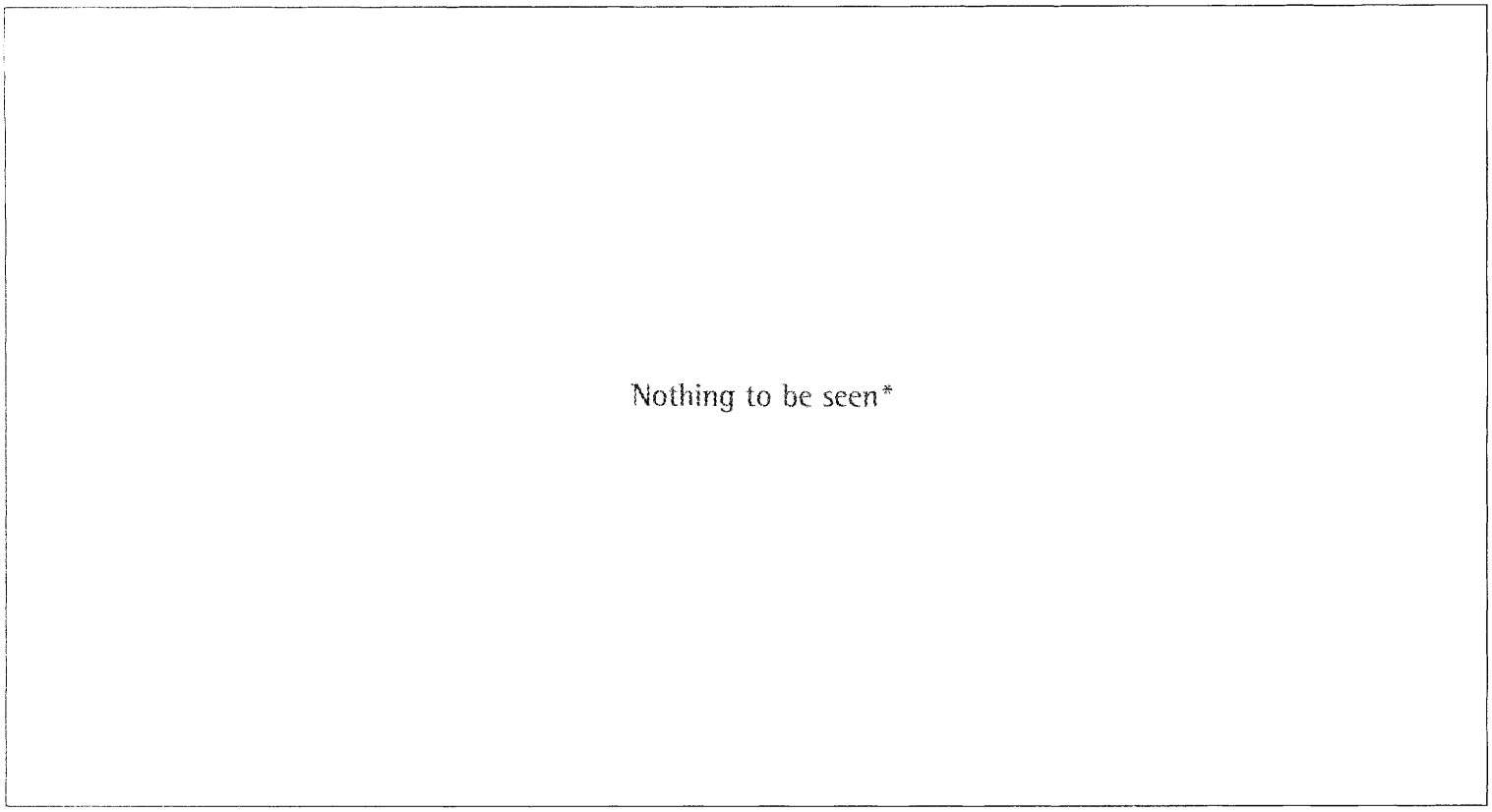

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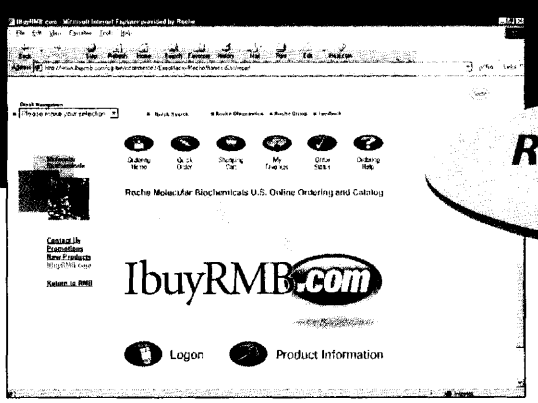

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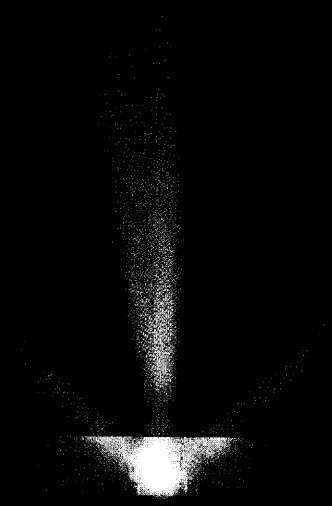

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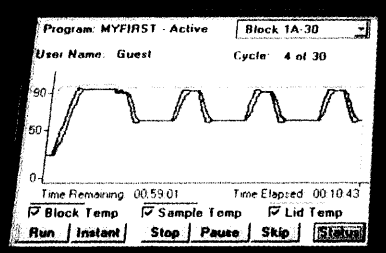

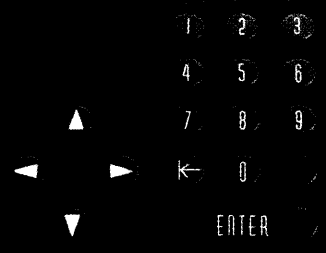

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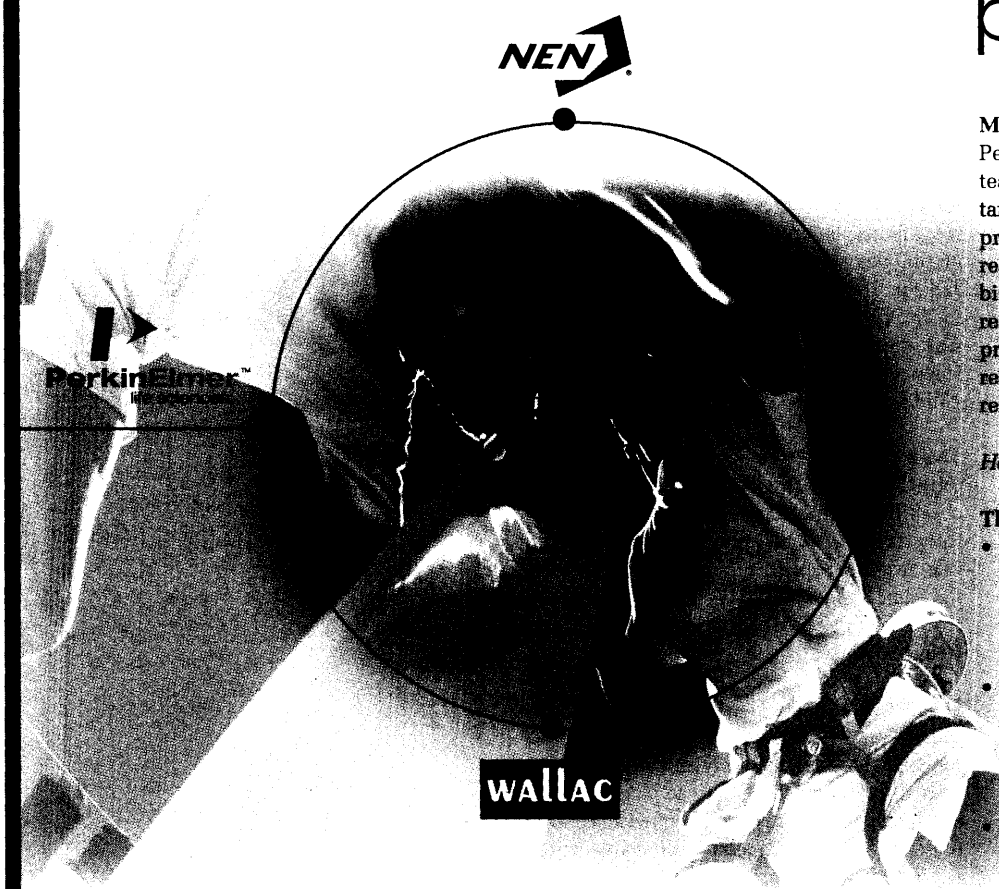

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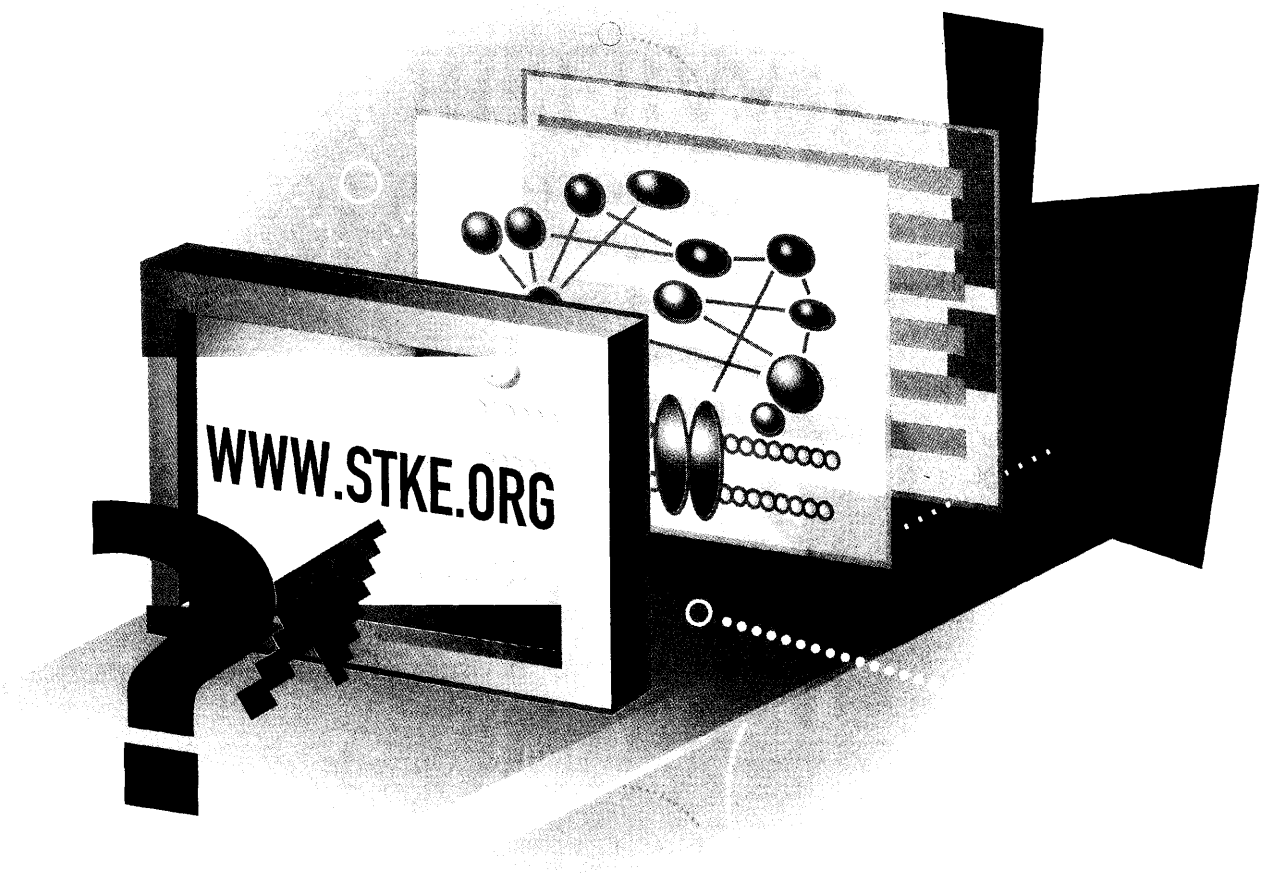

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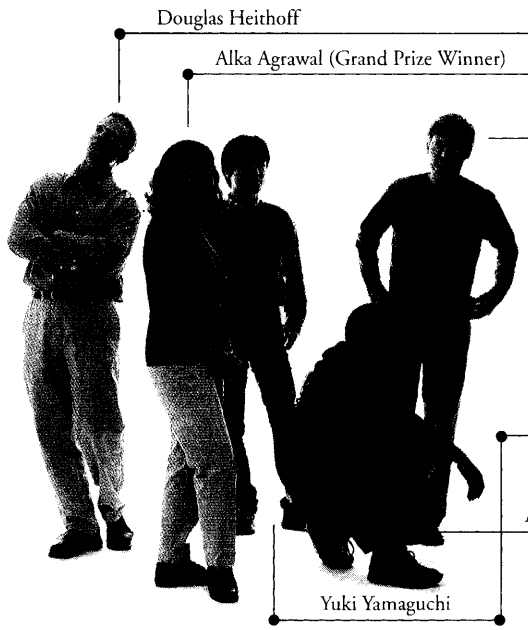

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* For the purpose of this prize, molecular biology is defined as "that part of biology which attempts to interpret biological events in terms of the physico-chemical properties of molecules in a cell" (McGraw-Hill Dictionary of Scientific and Technical Terms, 4th Edition).

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