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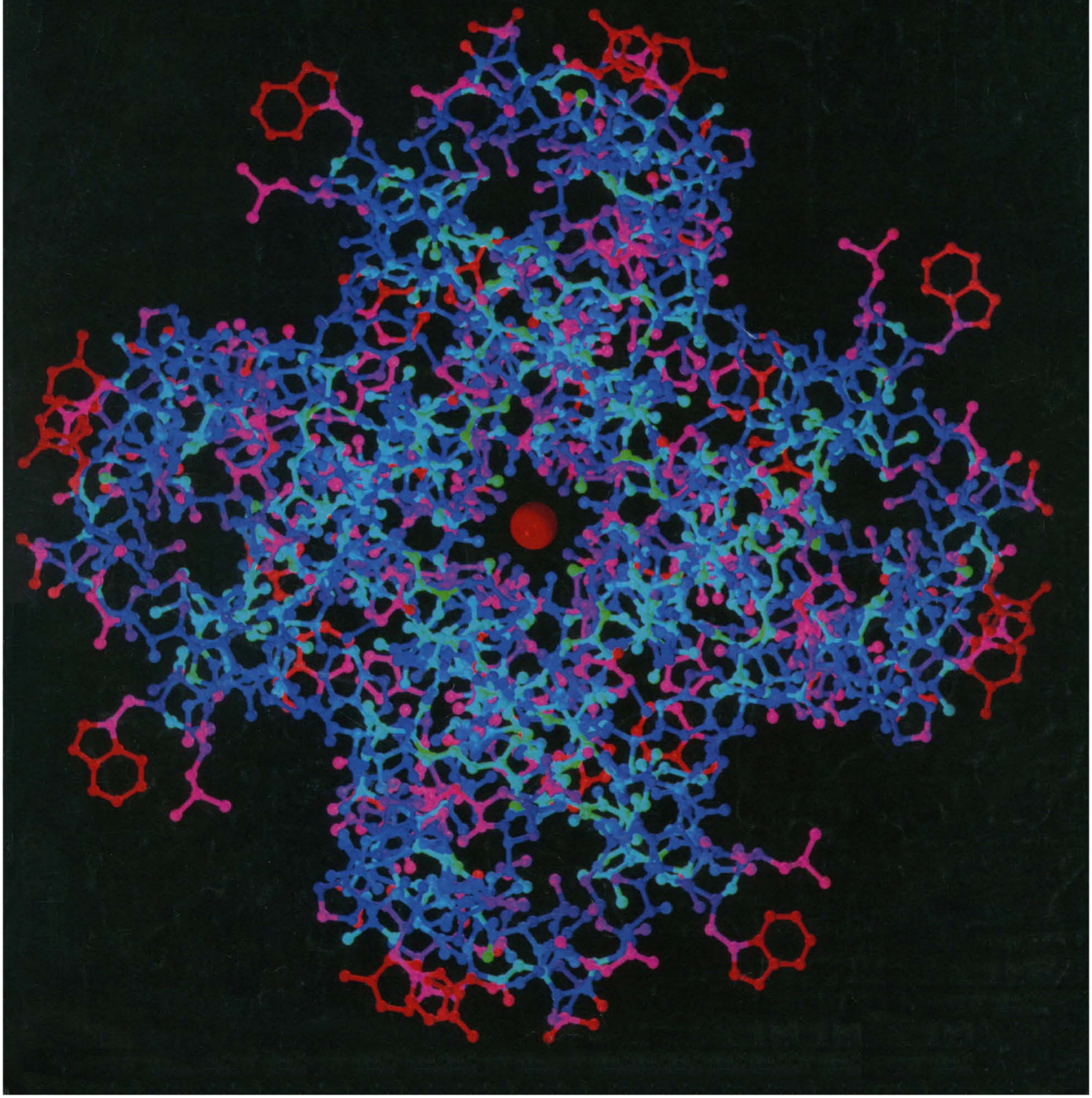

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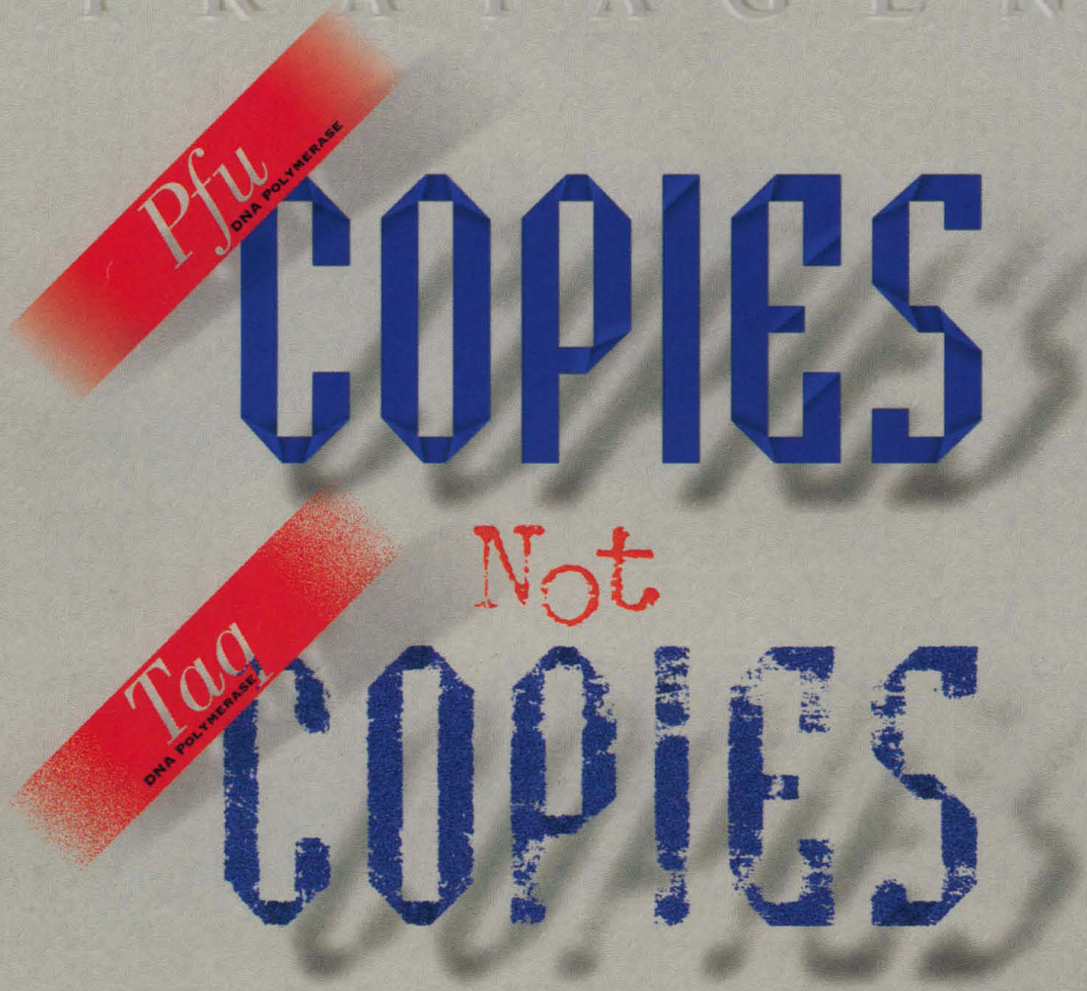

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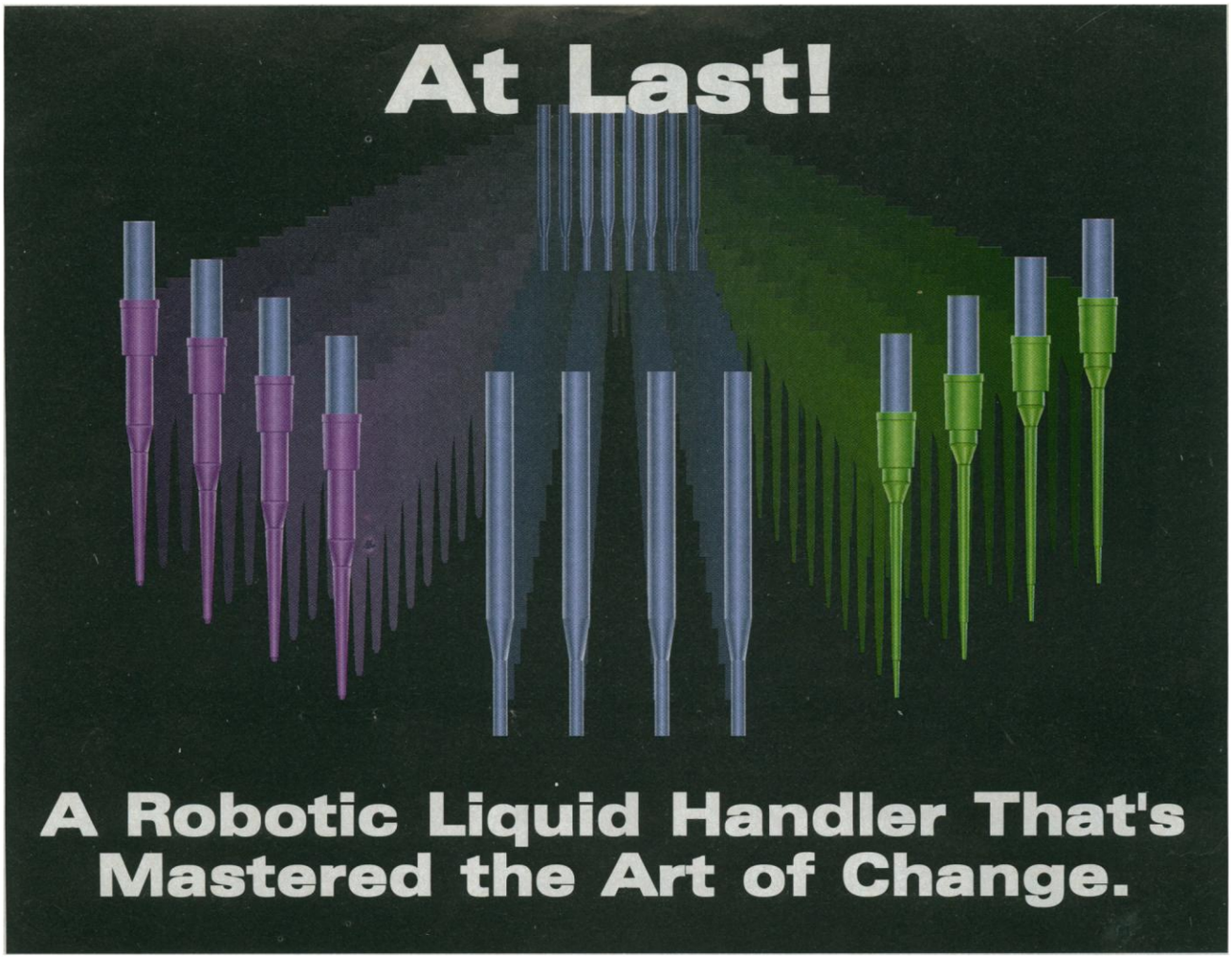

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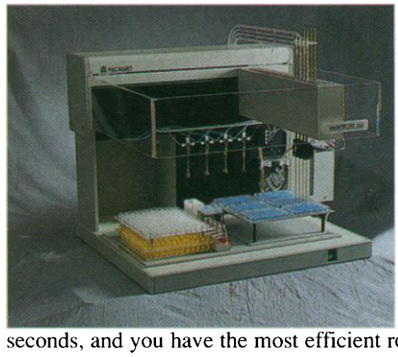

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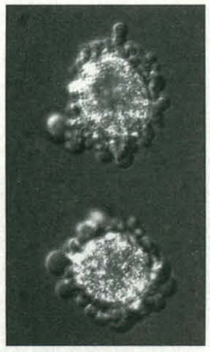

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NEWS & COMMENT

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COVER

Ball-and-stick model of a potassium channel from the bacterium *Streptomyces lividans* looking down the pore, which has a potassium ion (red sphere) positioned inside it. The protein is composed of four identical subunits surrounding a central pore. The overall molecular architecture is expected to be preserved in all known potassium channels. See page 69, the Research commentary on page 56, and the related Report on page 106. [Image: R. MacKinnon]

RESEARCH ARTICLES

REPORTS

TECHNICAL COMMENTS

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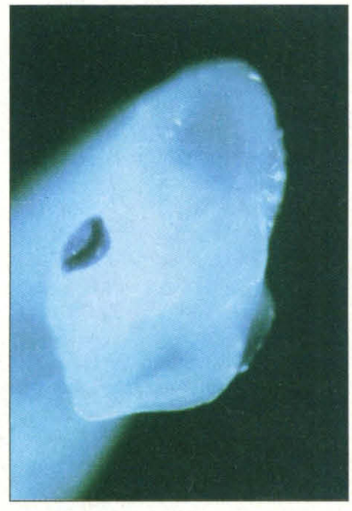

115
Chick lens factor

◩ Indicates accompanying feature

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On the Web

NetWatch debuts: Get your Net news fix (see p. 7), and visit the redesigned Next Wave

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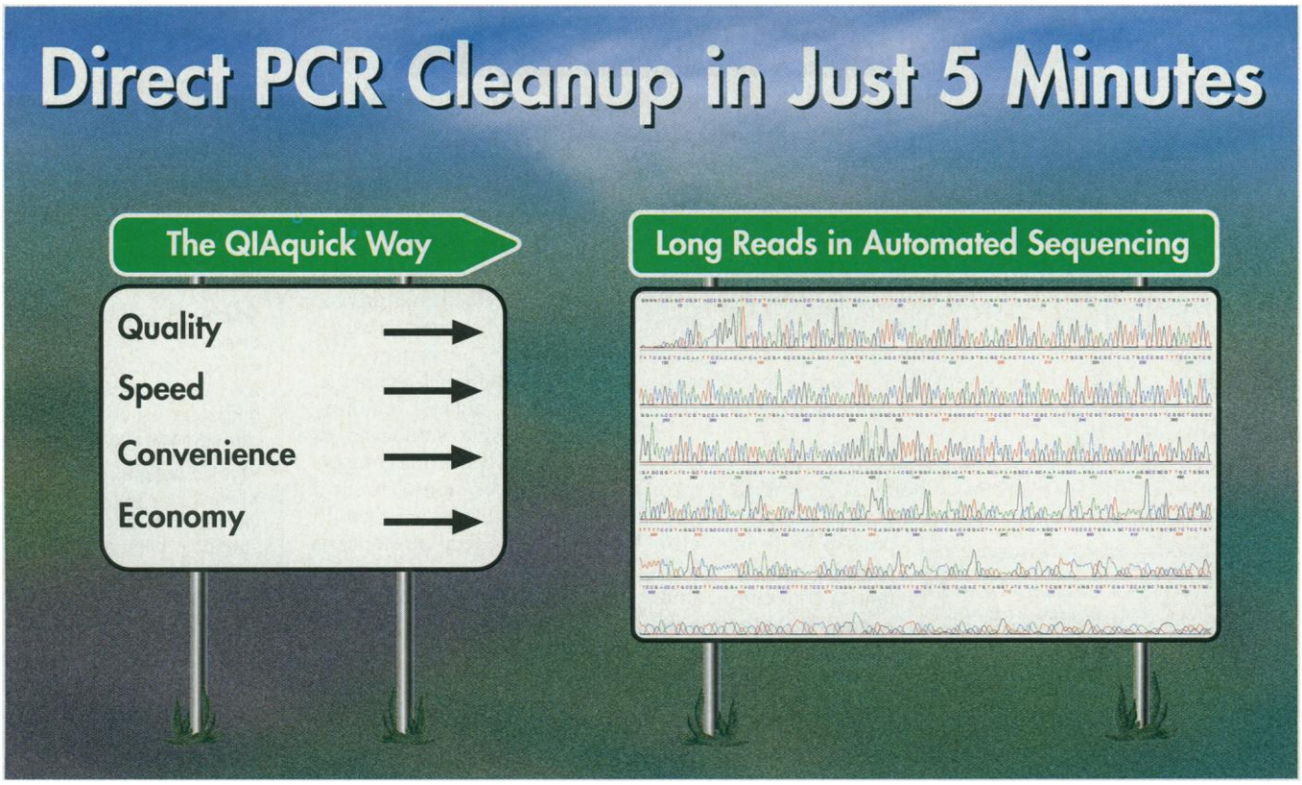

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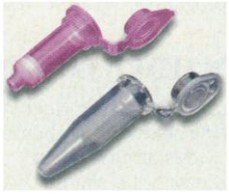

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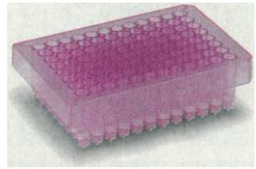

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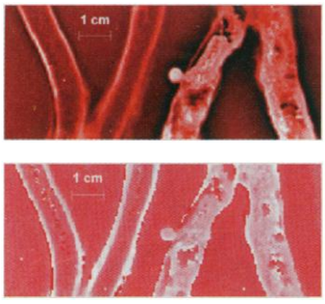
edited by PHIL SZUROMI

Mechanical imaging with ultrasound

The mechanical properties of an object can be determined by its vibrational frequency, which is normally in the acoustic range. Fatemi and Greenleaf (p. 82) have developed an ultrasound technique in which beams at two slightly different frequencies are focused to a



point and scanned over the object. The interference of the beams produces a sinusoidal variation of the ultrasound energy, effectively vibrating the object. The object's vibrational response can then be recorded acoustically and converted into an image. The method can distinguish between identical materials with different mechanical properties (tuning forks of different pitches) and detect small hard objects in a soft background (glass beads in latex). Images of excised arteries reveal calcified versus noncalcified regions.

■

Ancient pollinators

The evolution of angiosperms (flowering plants) corresponded with the evolution of pollinating insects, as discussed in a research commentary by Labandeira (p. 57). Angiosperm fossils are first seen in the fossil record perhaps in the Early Cretaceous (about 120 million years ago), although their exact origin is debated. Some of the earliest insect pollinators were flies, wasps, and beetles. Ren (p. 85) describes fossils of several Brachycera flies preserved in rocks that may be as old as Late Jurassic (about 145 million years ago) in age from the Yixian Formation, China. The flies have a long mouthpart designed for extracting nectar, perhaps from flowers.

■

Inside view of a potassium channel

Ion channels are protein gates that permit certain ions rapid passage into and out of cells. Our understanding of their structure, which has been frustratingly indirect, has been largely derived from mutagenesis studies. Doyle *et al.* (p. 69; see the cover) now present the x-ray structure of a potassium channel from the bacteria *Streptomyces lividans*, which reveals an architecture of the pore itself that can be applied to all potassium channels (see the commentary by Armstrong, p. 56). A ring of main chain carbonyl oxygen atoms allows the passage of potassium but not sodium ions through the pore. An enlarged chamber within the pore at the center of the membrane bilayer plus helix dipoles allow the ions to easily traverse the electrostatic forces in the bilayer. Localization of two potassium ions within the selectivity filter indicates that the pore promotes rapid throughput of many ions by exploiting interion repulsive forces to overcome the attraction between potassium and the selectivity filter. MacKinnon *et al.* (p. 106) report that a toxin from scorpion venom (agitoxin2) that binds to the pore vestibule of the *Streptomyces* channel was shown by modeling studies to also bind the similar eukaryotic channels, verifying that the prokaryotic potassium channel has the same pore structure as eukaryotic channels.

A ring around Jupiter

The dust detector on the Galileo spacecraft measures the impacts of particles and allows the mass and velocity of each particle to be estimated. Colwell *et al.* (p. 88) used these impacts to identify a faint ring around Jupiter. The ring is composed of 0.5- to 1.5-micrometer particles, mostly in retrograde orbits from 3 to 20 Jupiter radii away from the planet with relatively low eccentricities but a wide range of inclinations. They believe this ring was formed mostly from interplanetary dust with some minor interstellar dust. It is also possible that random events, such as the collision of comet Shoemaker-Levy 9 with Jupiter, added material to this ring.

■

Crawling the Web

The World Wide Web has become both research tool and arena for studies of research behavior. Most users navigate the Web via one or more search engines, but how much of the Web do these utilities actually encompass? Lawrence and Giles (p. 98) have analyzed the coverage and freshness of some of the more popular search tools and find that no one engine indexes more than about one-third of the Web; strategies that combine results of many search engines yield far better results. How do users actually surf the Web? Huberman *et al.* (p. 95) have studied patterns of behavior as information foragers move from one hyperlinked document to the next. The authors find strong regularities in surf behavior that may find applications in better Web design for specific research communities.

Earth's initial interior conditions

Mantle convection models have improved to include depth-dependent viscosity, mineral phase changes, heating from the core, and, perhaps most importantly, the coupling of mantle motions to tectonic plate motions. However, because we do not know the velocity and geometry of tectonic plates beyond 119 million years ago with enough accuracy, it has been difficult to model how patterns of convection in the mantle have changed over time. Bunge *et al.* (p. 91) have modeled time-dependent convection by starting with the plate motions from 119 to 100 million years ago and running their convection model forward for 2 billion years to establish some initial convection conditions. They then run their model using the current plate motions and these initial convection conditions for 500 million years to provide a simulated snapshot of the convection in the mantle today. Their final convection model is consistent with global tomography models except that the convection model does not produce large, hot thermal anomalies at the core-mantle boundary as predicted by tomography. These differences may require a reinterpretation of the global tomography models, specifically whether slow velocity anomalies represent thermal or chemical anomalies at the core-mantle boundary.

■

Stimuli awareness and memory

The hippocampus is necessary for declarative memory—the conscious recollection of facts and events—and is not required for classical conditioning, a sim-

(Continued on page 11)

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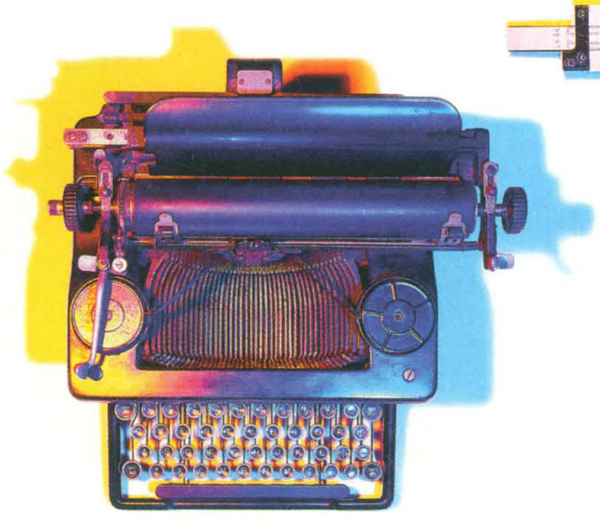

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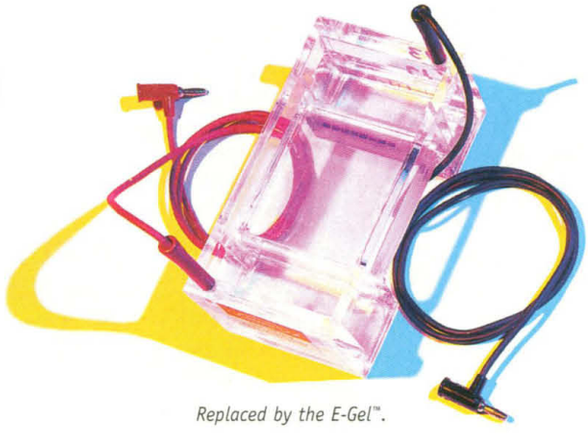

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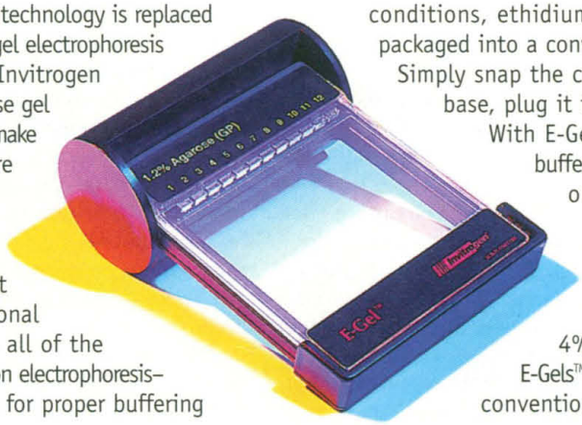

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(Continued from page 9)

ple form of associative learning in which a tone that is paired with a puff of air acquires the power to elicit an eyeblink even without the air puff. Trace conditioning, a variant paradigm in which a short interval (of about 1 second) is interposed between the tone and the air puff, is known to require an intact hippocampus. Clark and Squire (p. 77; see the commentary by Schacter, p. 59) present data that explain this puzzle by examining the performance and awareness of amnesic patients (with hippocampal damage) and normal subjects during classical and trace conditioning tasks. They find that the hippocampus is required for the development of conscious knowledge of the relation between the stimuli; thus the patients do not acquire trace conditioning because they never learn the relation of events.

■

Repressing transcription

Regulation of gene expression involves multiple protein-protein and protein-DNA interactions. To better understand the mechanism of transcription inhibition by two short-range repressors in the *Drosophila* early embryo, Knirps and Snail, Nibu *et al.* (p. 101) have identified a protein that interacts with these repressors in vitro. Additional support for these interactions is gained through in vivo gene-dosage analyses. The identified corepressor is a homolog of the human CtBP protein, which interacts with the adenovirus E1A protein to inhibit E1A-mediated transcription activation and tumorigenesis. Thus, a conserved mechanism of transcription repression is found in humans and *Drosophila*.

Cold-hardy plants

Like heat shock, cold shock induces physiological changes in plants that make them better able to tolerate subsequent temperature extremes further along the thermometer. Jaglo-Ottosen *et al.* (p. 104; see the news story by Pennisi, p. 36) have shown that overexpression of a single transcription factor, CBF1, in *Arabidopsis* plants can induce the expression of a suite of cold-

responsive genes even in the absence of the normal stimulus of low temperatures. These transgenic plants are also more resistant to the damaging effects of low temperatures than are unmodified plants.

■

Ras and PKC signaling

Members of the protein kinase C (PKC) family contribute to cellular responses to a broad spectrum of signals and control multiple cellular processes, including cell growth and differentiation. Many actions of PKC are brought about by activation of mitogen-activated protein (MAP) kinases. However, the mechanism by which PKC influences activity of MAP kinases has been unclear. Marais *et al.* (p. 109) found that the small guanine nucleotide binding protein Ras is required for this process. The proto-oncogene product Ras is known to mediate activation of MAP kinases in response to receptor tyrosine kinases, but the authors show that activation of Ras in response to PKC occurs by a different mechanism than that initiated by the receptor tyrosine kinases.

■

Less means more

Agricultural intensification in developing regions continues apace, but management practice is poorly developed, and environmental consequences have not been well studied. Matson *et al.* (p. 112) have assessed the biogeochemical, socioeconomic, and crop yield implications of alternative strategies for inorganic nitrogen application in Mexico's Yaqui Valley. One approach, involving the addition of fertilizer in lower quantities and later in the crop cycle than typical farmer practice, proved to be a winner: Crop yield was maintained in concert with reductions in nitrous and nitric oxide emissions and significant cost savings for farmers.

■

Lens formation

Development of the eye requires the participation of multiple proteins in a genetic cascade. Several transcription factors have been shown to be involved in eye formation. Ogino and Yasuda (p. 115) report the identification of a novel chick lens-specific gene that is homologous to the maf proto-oncogene family; hence, the name *L-maf* (lens-specific maf). *L-maf* induces lens differentiation through binding to lens-specific genes. Unlike other genes involved in eye development, *L-maf* is expressed almost exclusively in the lens.

Technical Comment Summaries

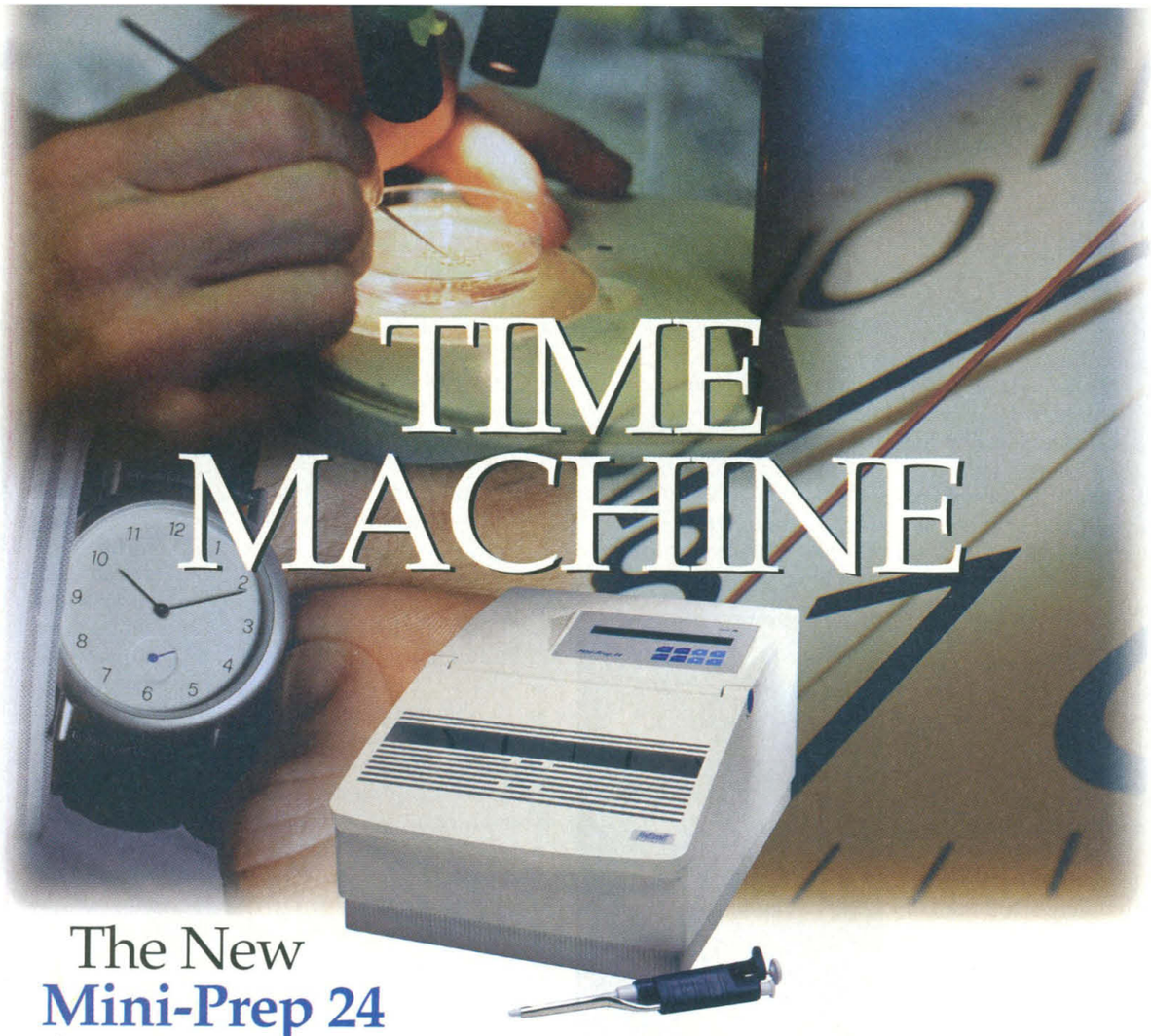
Quasiparticles and Thermal Conductivity

K. Krishana *et al.* (Reports, 4 July, p. 83) studied the behavior of the excited-state "quasi-particles" (QP) of the superconductor $Bi_2Sr_2CaCu_2O_8$ in a magnetic field by measuring thermal conductivity. They observed evidence of "phase transition of the condensate to a state in which the QP current is zero (the system remains superconducting)."

H. Aubin *et al.* replicate the results in the report and go on to ask, "Is the field-independent thermal conductivity of the high-field state insensitive to the way the magnetic field is applied?" They study the thermal conductivity of a single superconducting crystal as a function of a variable magnetic field, and focused on hysteresis effects, or how thermal conductivity depends on the manner in which the magnetic field is applied. Their results indicate that the background thermal conductivity "depends on the field profile of the sample" as it relates to the vortex scattering of photons.

In response, Krishana *et al.* provide further data so as "to look at the hysteresis in perspective." They state that it seems unlikely that "the plateau feature could depend in an essential way on the phase of the vortex system or the magnetization history of the sample."

The full text and figures of these comments can be seen at www.sciencemag.org/cgi/content/full/280/5360/11a



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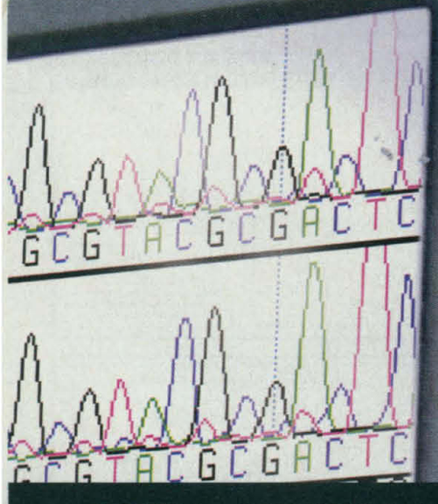

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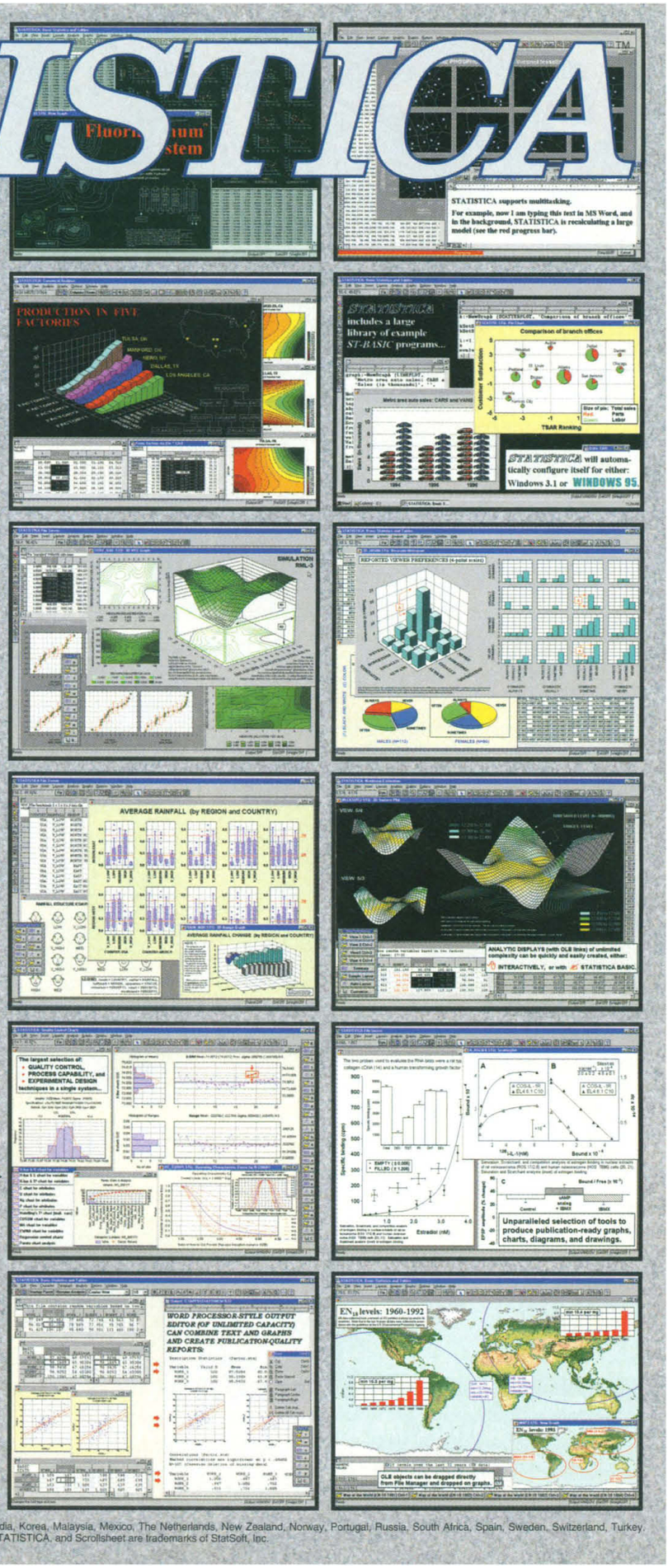

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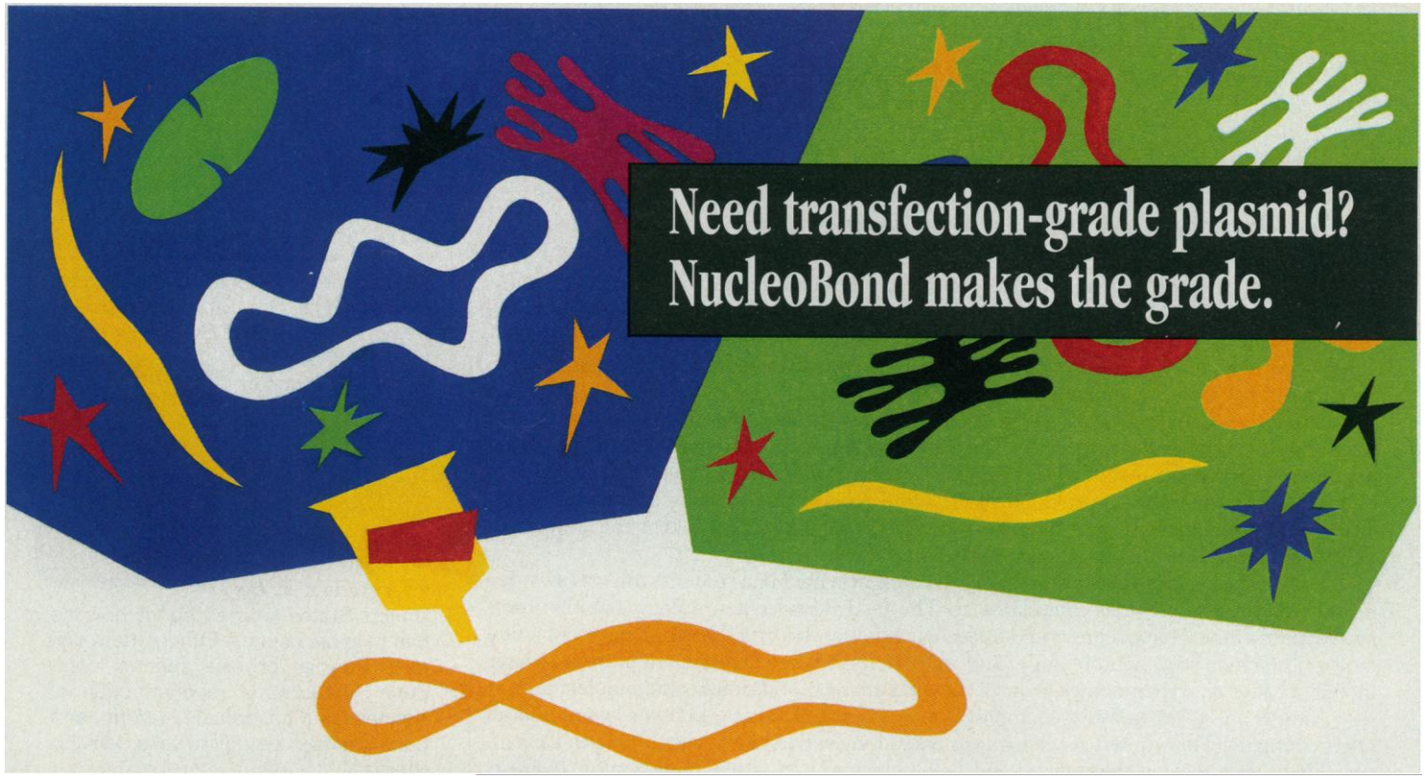

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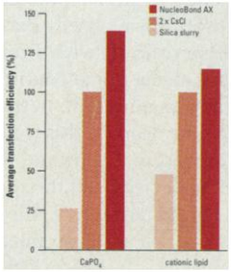

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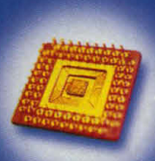

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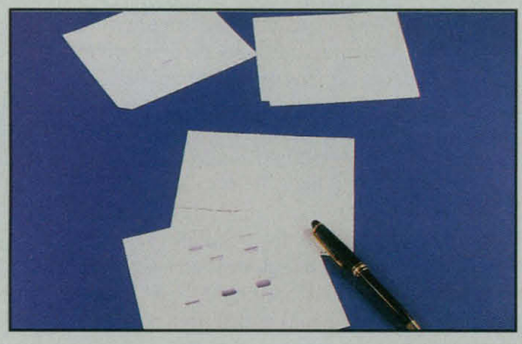

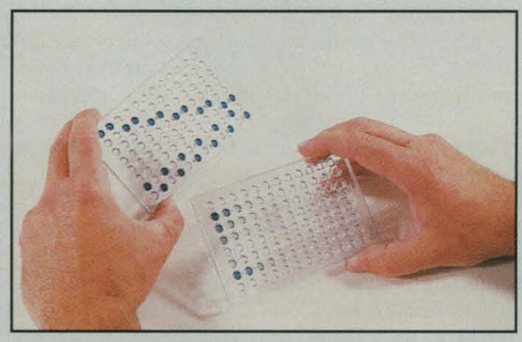

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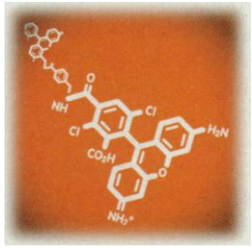

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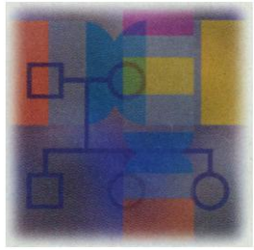

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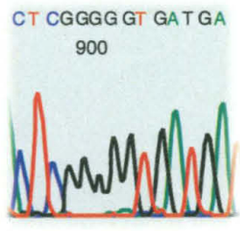

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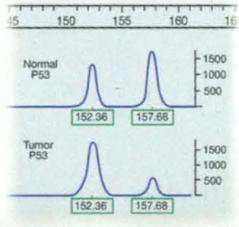

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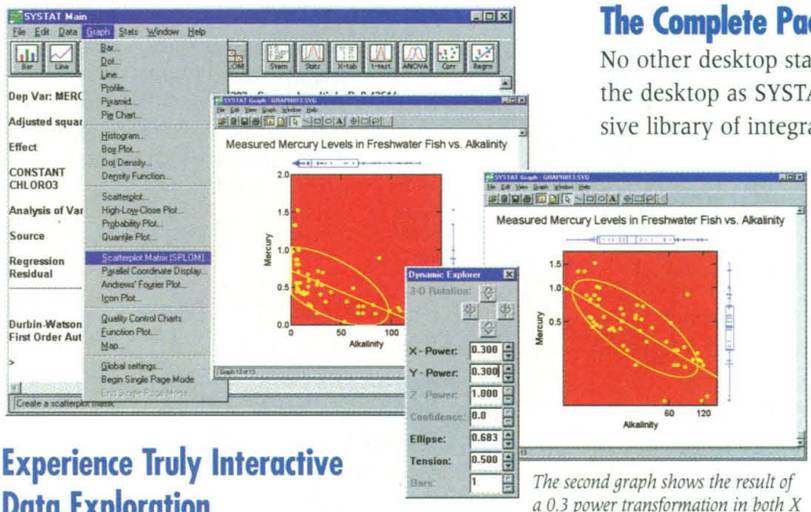

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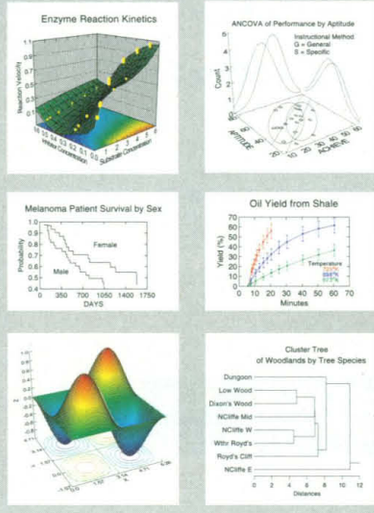

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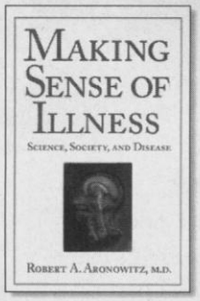

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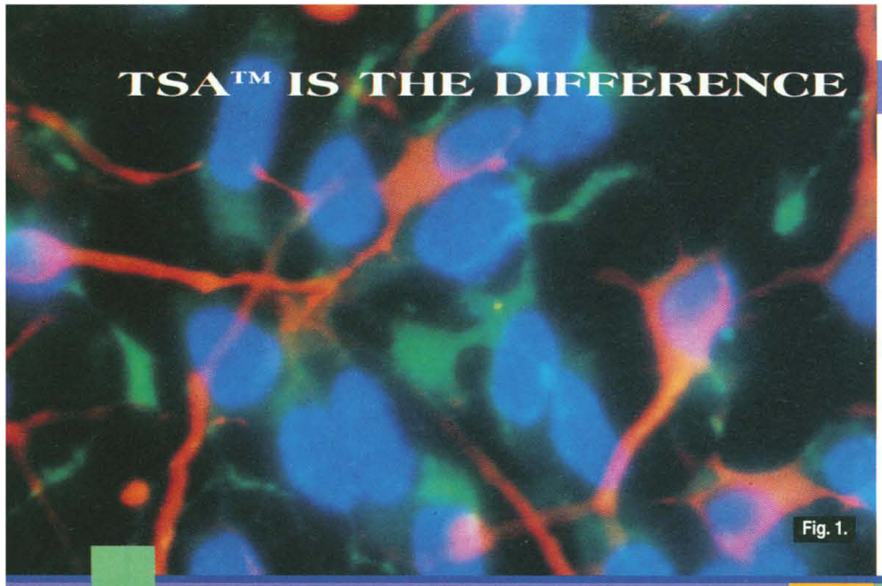

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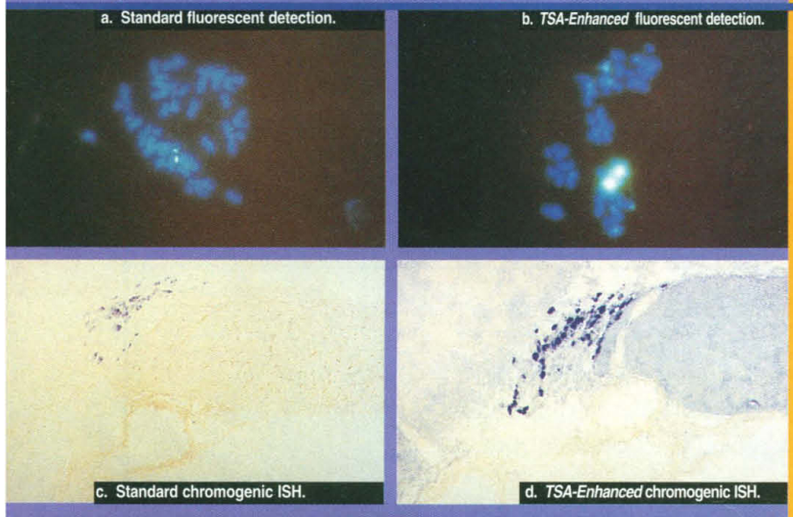

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Figs. 2 a-b. Fluorescent detection of chromosome centromere probes in metaphase spreads.
Figs. 2 c-d. In situ chromogenic detection of oxytocin in rat brain tissue sections.

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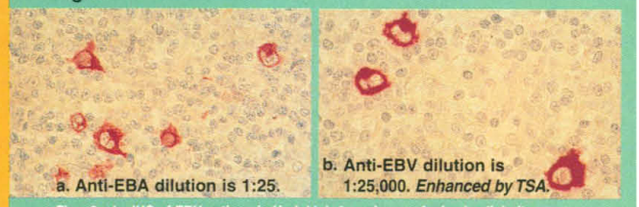
Fig. 3



Figs. 3 a-b. IHC of EBV antigen in Hodgkin's Lymphoma of mixed cellularity.
Courtesy of R. Von Wasielewski and S. Gignac, Pathologisches Institut de Medizinischen Hochscule, Hannover, Germany.

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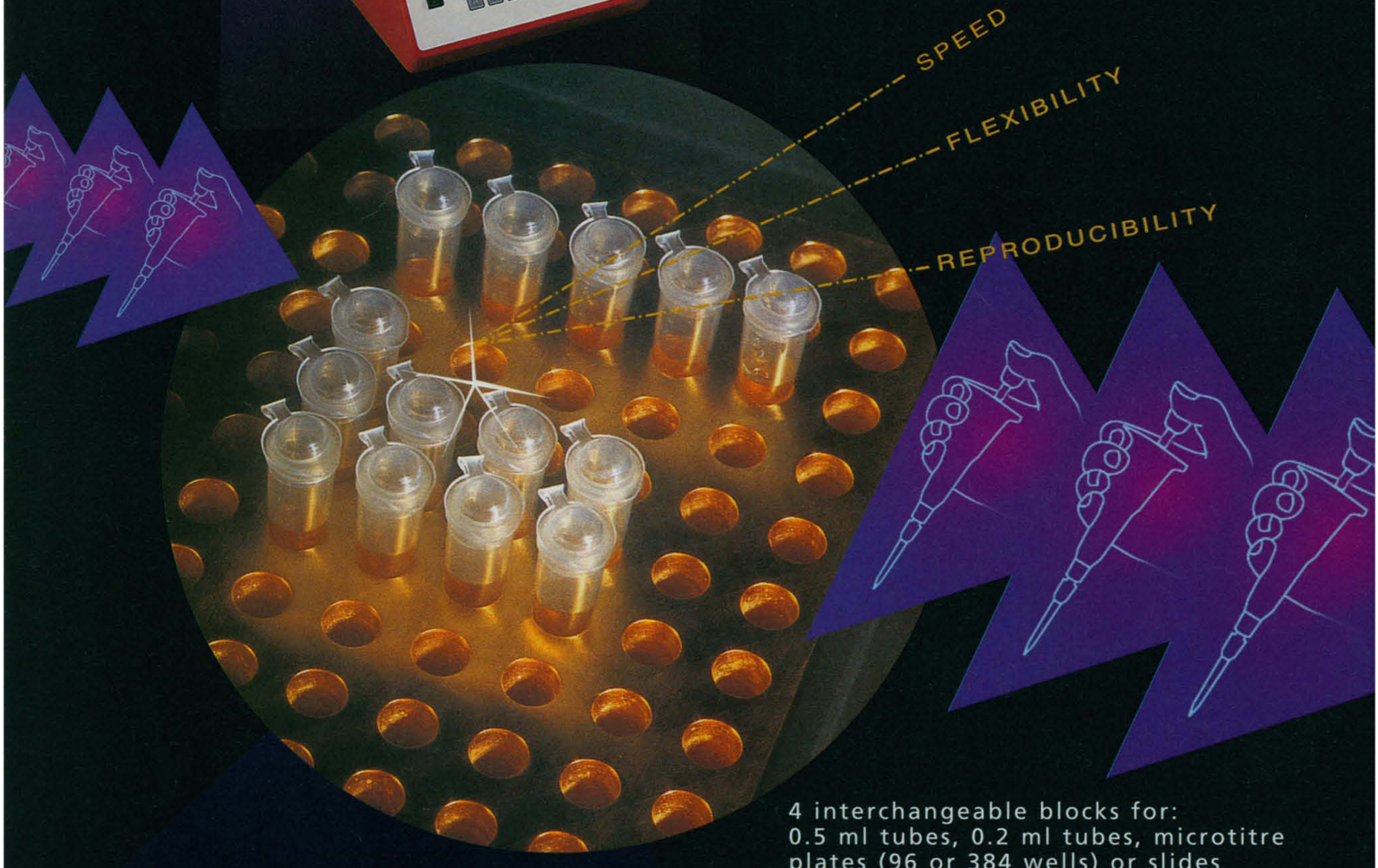

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