16 October 1998

Science

Vol. 282 No. 5388
Pages 369–580 $7

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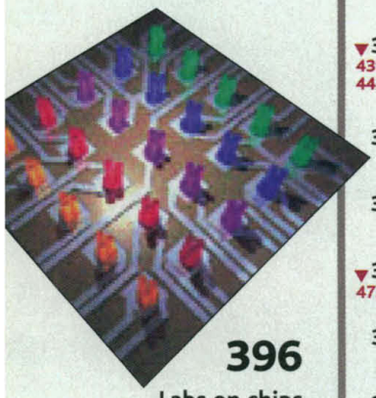
COVER Killer whales in the North Pacific. Recently increased predation by these apex predators has driven sea otter populations sharply downward, thus creating an ecological chain reaction in nearshore ecosystems. Dwindling harbor seal and Steller sea lion populations apparently induced killer whales to begin eating large numbers of sea otters. [Photo: G. Ellis]



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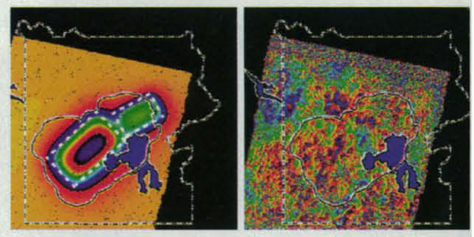
Monitoring Yellowstone caldera magma movements from the surface



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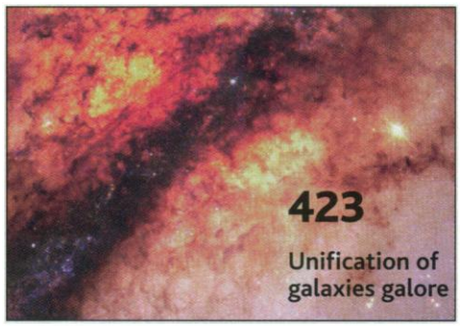

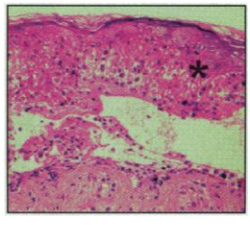

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Treatment for drug-induced skin degeneration

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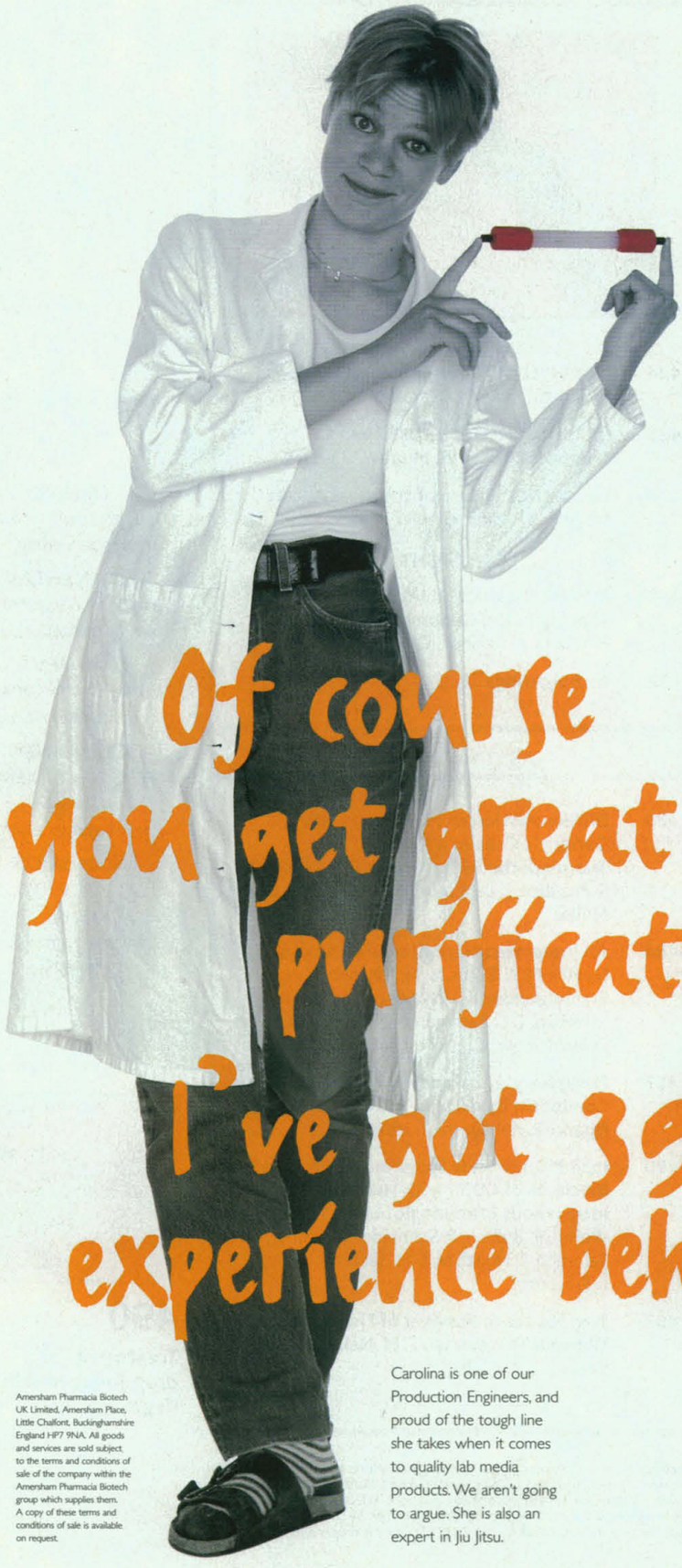

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FLAT NANOMAGNETS

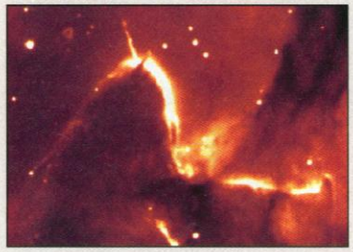
Although making ferromagnetic particles smaller would appear to be an ideal way of increasing device memories, one concern is that the shape would dominate the preferred magnetization direction and that the closeness of the boundaries would cause domains to form within the particle. Such results have been seen previously for flat particles magnetized perpendicular to the plane of the particle. Stamm *et al.* (p. 449) show that thin films of cobalt (2 to 10 atomic layers in thickness), laterally patterned to small sizes (from 1 millimeter down to 100 nanometers), did not form domains when magnetized within the plane. They could also switch the magnetization of one particle without affecting a nearby neighbor, as would be desired for magnetic recording.

CARBON BUDGET CONSIDERATIONS

Three reports focus on recent studies of the carbon budget, which is critical for determining both natural and anthropogenic sinks and sources of greenhouse gases such as carbon dioxide (CO_2) (see the related news story by Kaiser). Frankignoulle *et al.* (p. 434) measured CO_2 emissions from a wide range of European estuaries and estimate that they emit between 5 and 10% of the total anthropogenic CO_2 emissions for Western Europe. Similarly high values can be expected worldwide. The importance of carbon accumulation in old-growth tropical forests has been controversial. Phillips *et al.* (p. 439) performed wide-scale, long-term monitoring of hundreds of permanent sample plots across the tropics. Overall, and in the large majority of neotropical sites, tree growth exceeded tree loss, while there was no detectable change in the paleotropical sites (specifically, those in Africa and Asia). Old-growth neotropical forest, particularly in Amazonia, may indeed be an important terrestrial carbon sink, which suggests that differences between neotropical and paleotropical sites might be explained by climate factors or human disturbance. In recent years, several studies have pointed to the existence of a large terrestrial carbon sink in the Northern Hemisphere, but the location of this sink has been hard to establish, as most studies could only constrain the data in a north-south rather than an east-west direction. Fan *et al.* (p. 442) have now used a high-resolution atmospheric CO_2 data set from 1988 to 1992, together with CO_2 emission data and estimates of oceanic uptake, to estimate the terrestrial sinks for North America, Eurasia, North Africa, and the rest of the world's land surface. A significant sink in North America is suggested, whereas the other regions are less well constrained.

CATCHING YOUNG STARS

Stellar birth is assumed to proceed in clouds of unstable dust and gas that collapse into massive, very dense condensations. Cernicharo *et al.* (p. 462) used radio and optical ground-based telescopes and the infrared space observatory (ISO) to obtain detailed observations of the very young galactic Trifid nebula (age less than 100,000 years). The Trifid nebula is an HII region that consists of an ionized shell of H^+, other ionized elements, and dust around a young, central star. The authors observed one bright condensation and four point-like sources in the nebula, which they interpret as stars in the act of formation. These protostars were formed in the ionizing bubble of gas and dust of the central star, and once they are fully developed, they will probably trigger further star formation.



ICE SHEETS THEN AND NOW

Large ice sheets suddenly began to grow in the Northern Hemisphere about 4 million years ago, but the trigger that led to this change in climate has been uncertain. One notion is that the ocean thermohaline circulation (driven by density changes produced by variations in temperature and salinity of ocean water) increased at this time when the Isthmus of Panama closed, which may have led to more precipitation at northern latitudes. However, intensification of the Gulf Stream would also warm the North Atlantic and hinder ice sheet growth. Driscoll and Haug (p. 436) suggest instead that increased precipitation over Europe would have led to a large flux of freshwater into the Arctic Ocean that would freeze more readily than seawater. One of the major uncertainties in assessing current and future sea level rise is the mass balance from ice sheets in Antarctica. Construction of a mass balance requires accurate measurements of elevation and snowfall over time. Wingham *et al.* (p. 456; see the Perspective by Bindschadler) now present satellite altimetry data for most of Antarctica from 1992 to 1996. There appears to be only a slight negative mass imbalance from accumulation at the interior of the continent.

NAO THEN AND NOW

The North Atlantic oscillation (NAO) is a much less dominant, and much less regular, climate phenomenon than the larger and more familiar El Nino–Southern Oscillation (ENSO) in the Pacific, but it still has a strong influence on the climate in Europe, the Mediterranean, and North Africa. Appenzeller *et al.* (p. 446) used ice core data from Greenland to reconstruct a proxy NAO index for the last 350 years and show that, in contrast to ENSO, the NAO has been an intermittent phenomenon during this time, with active and passive phases. This result may have implications for climate predictability.

UNREST UNDER YELLOWSTONE

Best know for its hydrothermal activity, Yellowstone National Park is also the site of an active volcanic caldera that bears close watch: About 600,000 years ago, it released a thousand times more magma than Mount St. Helens did in 1980. Wicks *et al.* (p. 458) used satellite radar interferometry to observe the surface deformation associated with magma flow at Yellowstone caldera since 1992. The caldera area was subsiding until about mid-1995. The northeast corner of the caldera then began to inflate, and the inflation migrated to the southwest corner of the caldera. A model of this detailed surface deformation suggests that a vertical pulse of fluid-rich magma entered a horizontal tabular reservoir (sill) at a depth of about 8 kilometers beneath the northeast corner of the caldera and then migrated laterally into a larger sill to the southwest.

BIG VESSELS

Angiopoietins are proteins that have been implicated in the development and maturation of blood vessels. Suri *et al.* (p. 468) show that transgenic overexpression of angiopoietin-1 in mouse skin produces blood vessels that are larger, more numerous, and more highly branched than those in wild-

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THIS WEEK IN *SCIENCE*

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type mice. Understanding the molecular regulation of blood vessel development has clinical implications, as it may lead to better therapies for limb or heart ischemia.

CUCKOO MATING STRATEGIES

Cuckoos lay their eggs in the nests of other birds, but little else has been known about their mating behavior and host specificity—because parents do not attend nests, they are particularly difficult to study. Marchetti *et al.* (p. 471; see the news story by Morell) obtained samples from the Japanese common cuckoo population for analysis with microsatellite DNA markers. Mist nets were used to capture the majority of adults, and eggs were hatched in the lab before returning the nestlings to their nests. Males and female cuckoos both proved to be polygamous, but while female cuckoos were host-specific, the males did not restrict themselves to mating with just one race of females. This behavior may explain why there are different host races of the common cuckoo but not different species: Host specialization by females sets the stage for speciation, but this process is circumvented by gene flow through the male line.

REENDANGERED SEA OTTERS

Twenty-five years ago, Estes and Palmisano reported on the keystone role of sea otters in Western Alaska. Previously hunted nearly to extinction, their numbers were recovering and, by limiting the distribution of herbivorous sea urchins, their comeback had a positive effect on kelp forest development. Now Estes *et al.* (p. 473; see the cover and the news story by Kaiser) update the story: Otter populations have undergone precipitous declines in the 1990s, apparently as a result of predation by killer whales. This switch in the diet of the killer whales has likely been caused by the disappearance of their usual prey, sea lions and seals, which in turn appears to have been caused by human impacts that have led to a decline in fish stocks. Sea urchin populations are now expanding dramatically and the kelp forest is declining, illustrating the wide range of ecosystem disruption.

DNA VACCINE ACTIVITY

The success of "naked" DNA in inducing antibody or T cell responses in animal models has sparked hope that it will be an important new method of vaccine delivery. Although DNA vaccines have been tested in HIV-infected individuals, their immune status is so abnormal that the results could not be extrapolated to normal individuals. As a step toward making an effective vaccine for malaria, Wang *et al.* (p. 476) demonstrate that DNA encoding the *Plasmodium falciparum* circumsporozoite protein induces a cytotoxic T cell response in healthy human volunteers.

SEQUENCING ON A SINGLE CHIP

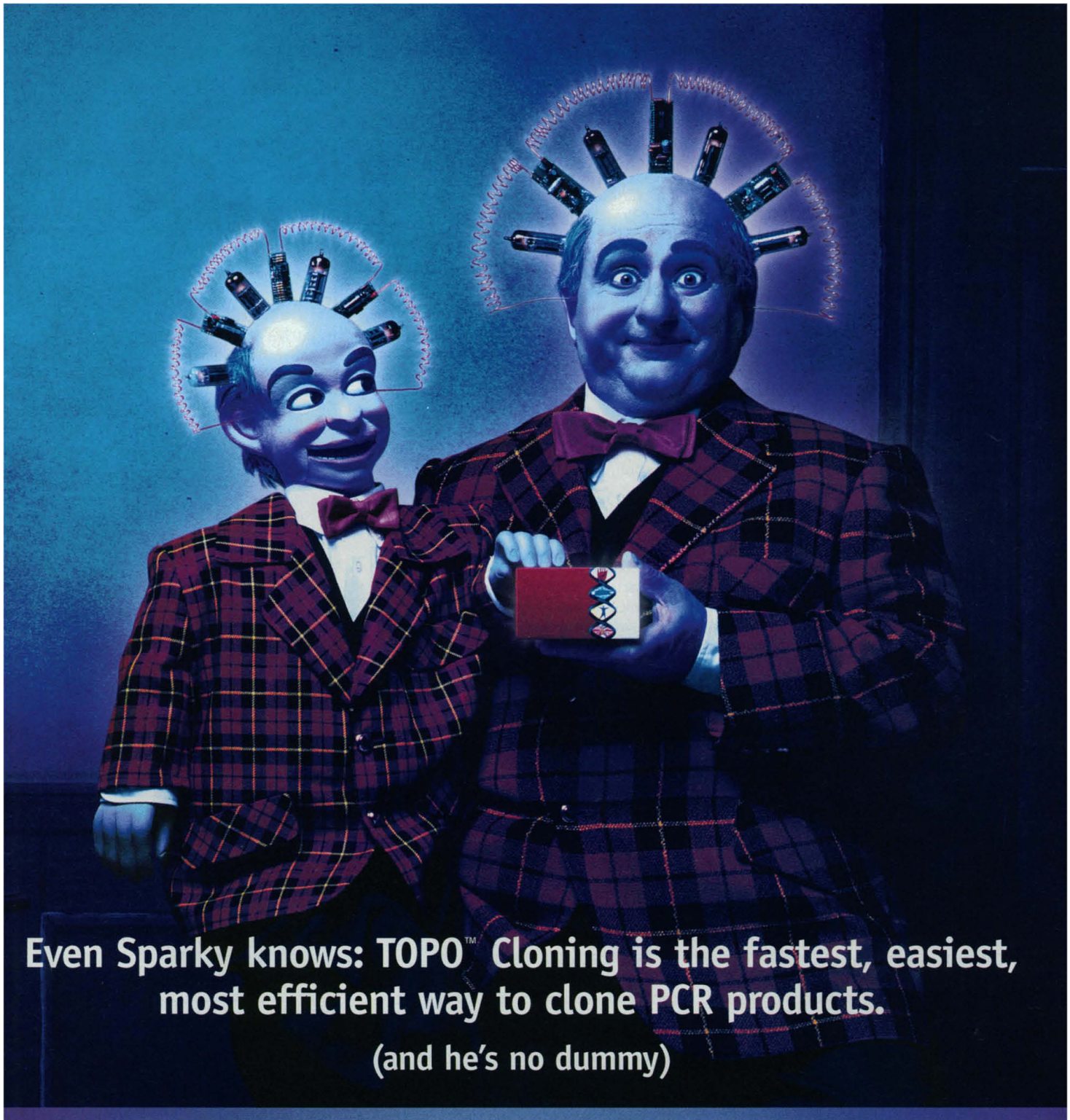
Comparisons among the genomes of different individuals and species would be greatly facilitated by fully automated technologies for analysis of small samples of DNA. Burns *et al.* (p. 484) have used photolithographic techniques to produce a silicon-based device that can remove a 120-nanoliter drop from a sample, mix it with reagents, perform a DNA amplification reaction, load the sample on an electrophoresis gel, and detect the migrating DNA bands. See also the news story by Service and Tech.Sight by Sikorski and Peters.

DENDRITIC CELL ORIGINS

To start an immune response, dendritic cells pick up antigen and travel with it to the lymph nodes, where they come in contact with lymphocytes. Where, then, do the dendritic cells come from? Monocytes cultured in vitro with certain cytokines can differentiate into dendritic cells in about 1 week. Randolph *et al.* (p. 480; see the Perspective by Shortman and Maraskovsky) found that monocytes cultured for 2 days with a monolayer of endothelial cells and particles for phagocytosis will beget a population of dendritic cells that reemerge from beneath the monolayer. Thus, the source of dendritic cells may be blood monocytes that are exposed to particulate stimuli in the subendothelial milieu.

THE CIRCLE(S) OF LIFE

In most organisms, the DNA at chromosome ends (telomeres) consists of short repeats that are synthesized by the enzyme telomerase. In the absence of telomerase, fission yeast cells progressively lose their telomeres and their viability. A small subpopulation of cells survive, however, and continue to divide. Nakamura *et al.* (p. 493) show that these cells survive by circularizing their chromosomes or by lengthening their telomeres through recombination. The recombination mode of survival predominated when the telomerase-deficient cells were also deficient in the telomere binding protein Taz1p. These results suggest that the two proteins work in concert to maintain telomere integrity.



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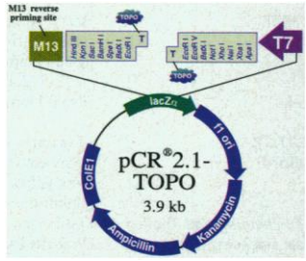

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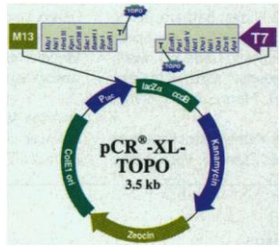

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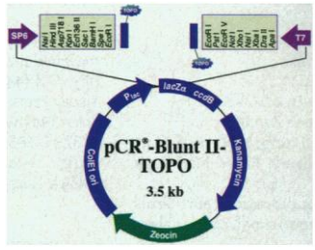

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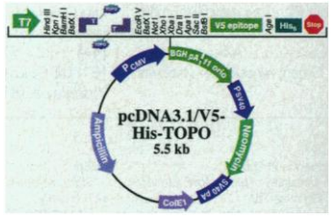

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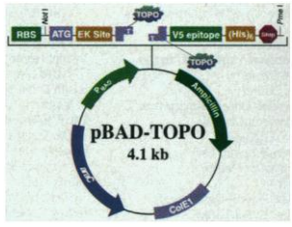

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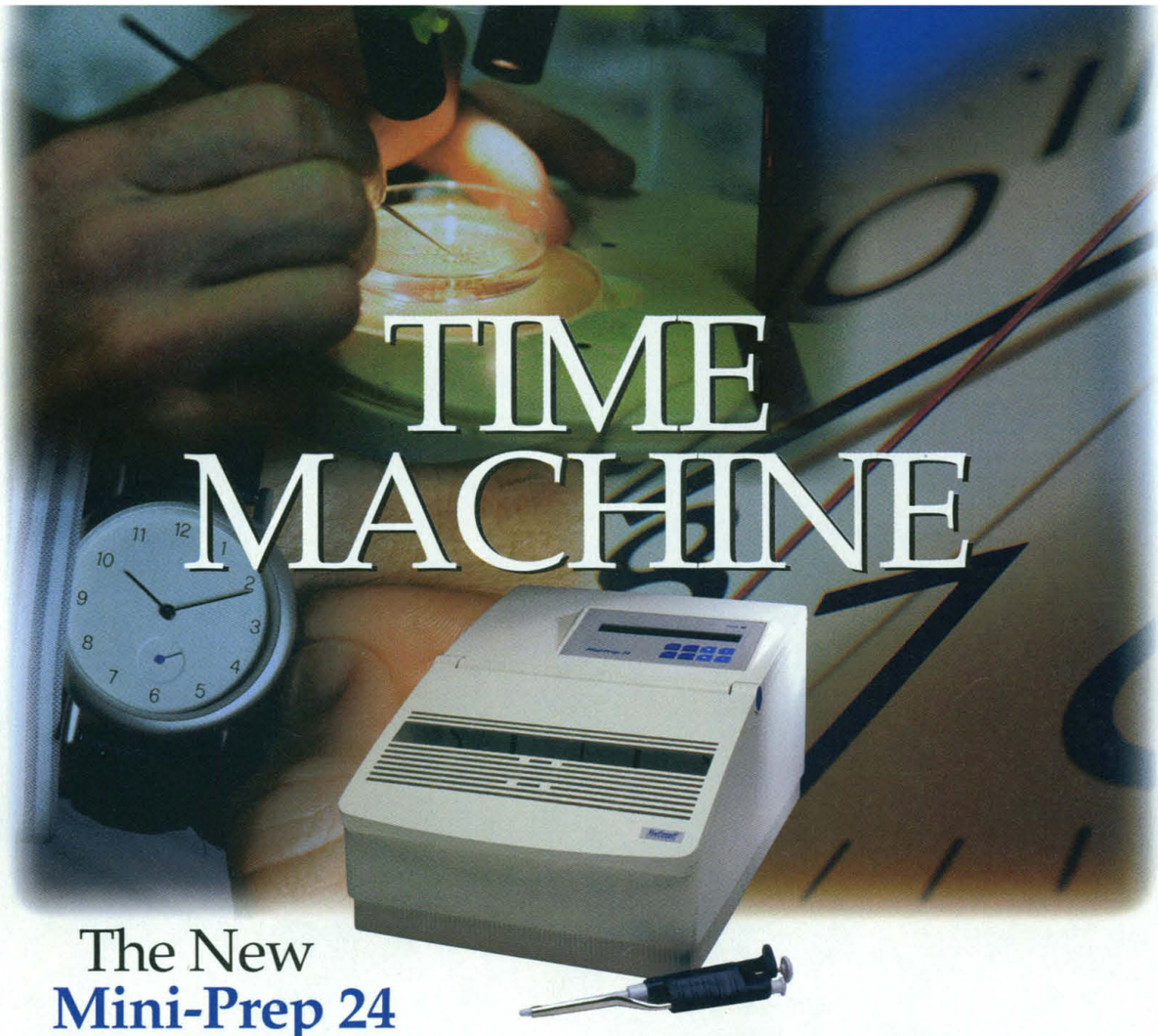

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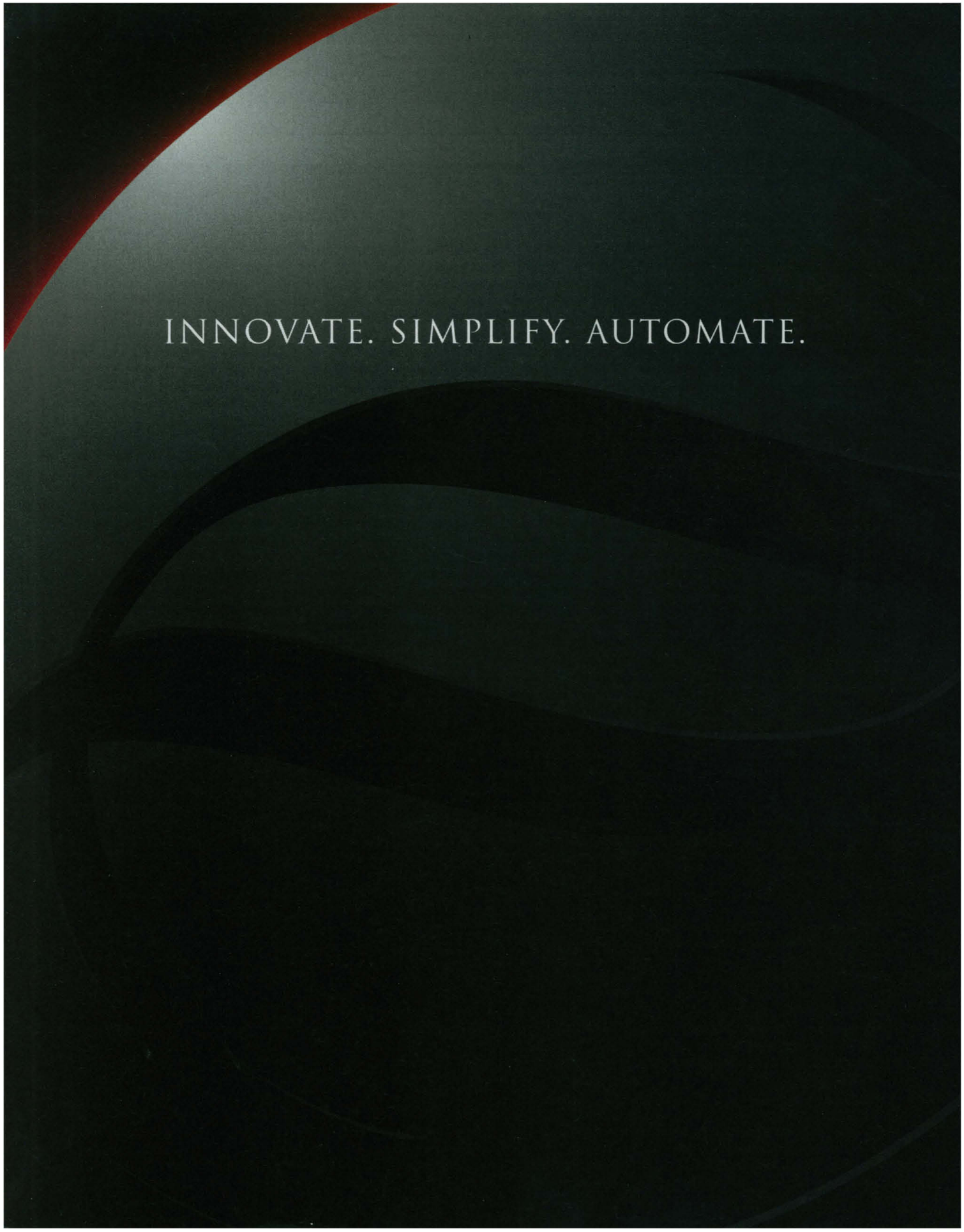
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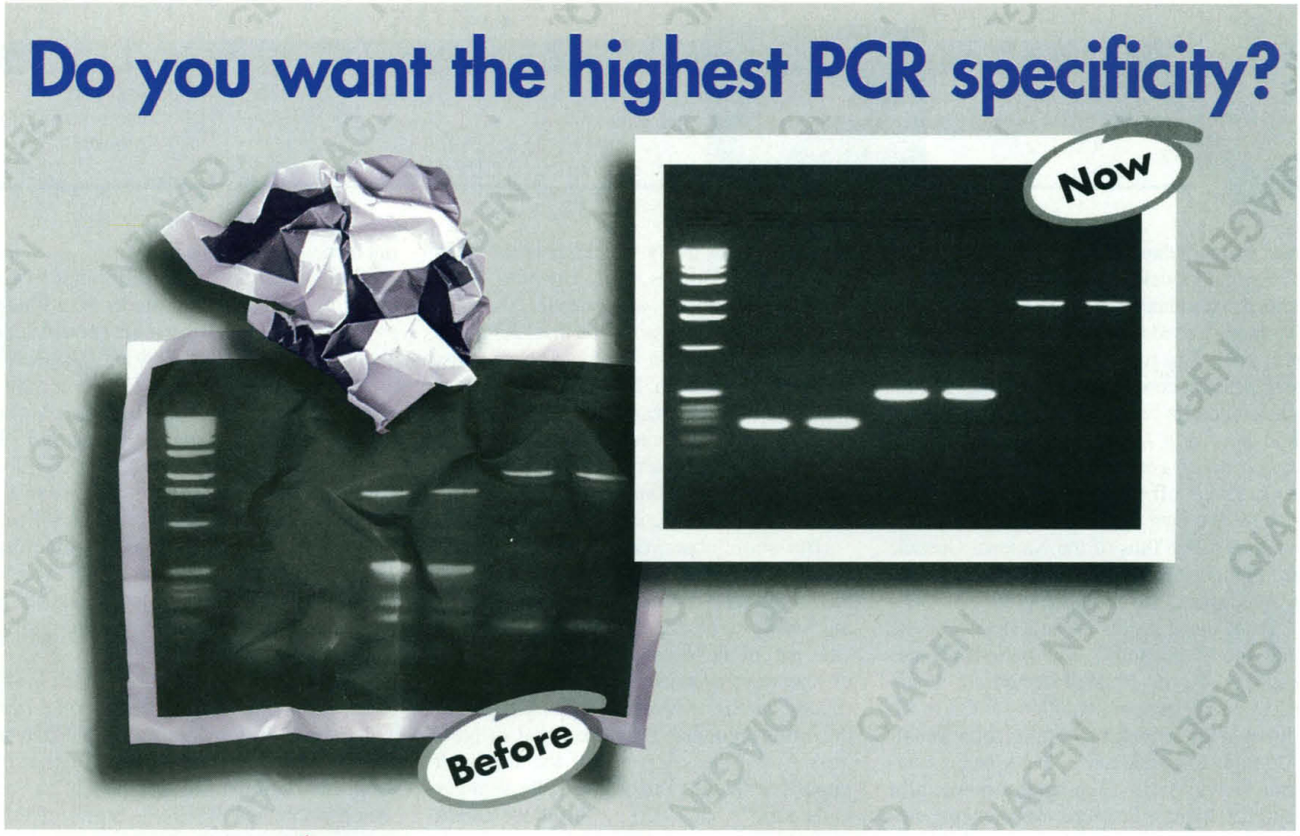

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- Reduced nonspecific amplification
- Maximized yield
- Easy handling

HotStarTaq DNA Polymerase is activated only after 15 minutes incubation at 95°C, preventing extension of nonspecifically annealed primers during the first cycle.

High specificity is then maintained by our optimized PCR Buffer, which reduces nonspecific primer annealing throughout PCR.

The result — fewer nonspecific products, less primer–dimer formation, and less background.

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HotStarTaq DNA Polymerase — for specificity from the first to the last cycle!

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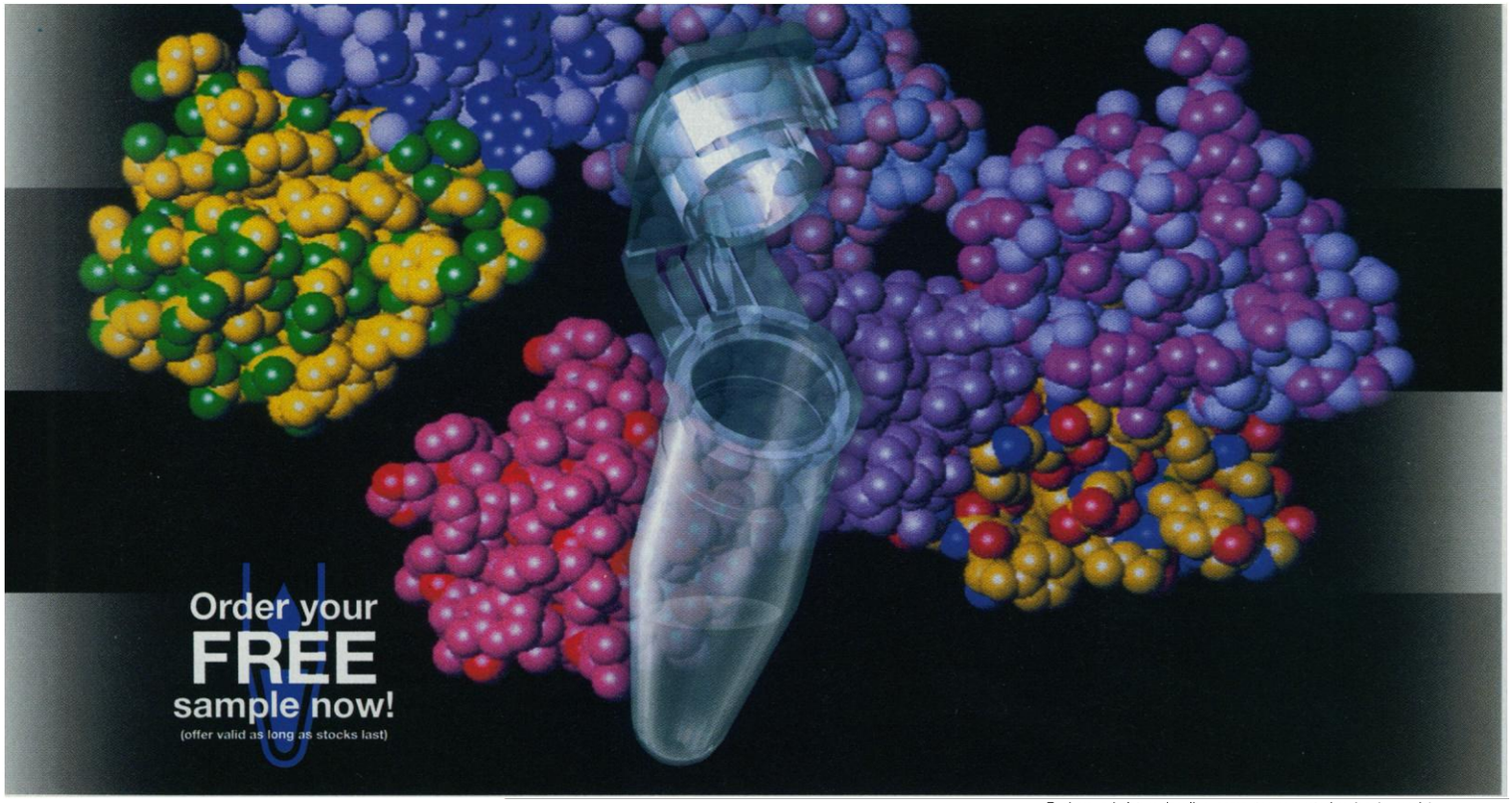


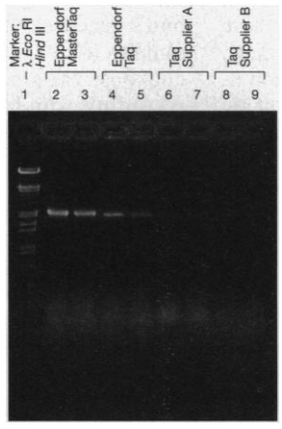
Background picture: Insuline, computer generated molecular model

When the going gets tough, MasterTaq gets going

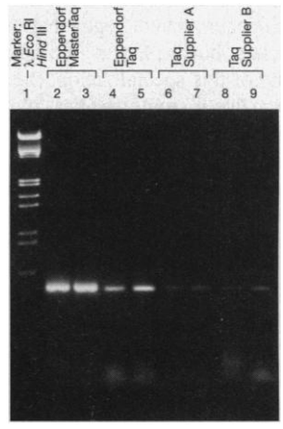
LICENSED FOR PCR

The Eppendorf **MasterTaq Kits** are designed to ensure improved yield and reliable PCR products.
The TaqMaster (5x PCR Enhancer) has been specially developed to improve the amplification of difficult templates by stabilizing the enzyme during the reaction procedure. TaqMaster improves the thermostability of the Eppendorf Taq DNA Polymerase and makes it less sensitive to exogenous PCR-inhibiting contaminations. Impure and GC-rich templates show increased yields and reproducible results.

The Eppendorf MasterTaq Kit includes the TaqMaster (5x PCR Enhancer), Eppendorf Taq DNA Polymerase, Reaction Buffer (10x) and $MgCl_2$ Solution.



● **Fig.1: Amplification of a SSU rRNA gene from total genomic algae DNA**
PCR was performed from genomic algae using different Taq DNA Polymerases. Equal volumes of the PCR reactions were analyzed by gel electrophoresis.



● **Fig. 2: Amplification of a GAPDH specific DNA fragment from genomic blood DNA**
PCR was performed from human genomic blood with different Taq DNA Polymerases. Equal volumes of the PCR reactions were analyzed by gel electrophoresis.

The Polymerase Chain Reaction (PCR) is protected by patent. The patent is held by Hoffmann-La Roche. Products marked "licensed for PCR" are sold under licensing arrangements with F. Hoffmann-La Roche Ltd., Roche Molecular Systems, Inc. and The Perkin-Elmer Corporation.

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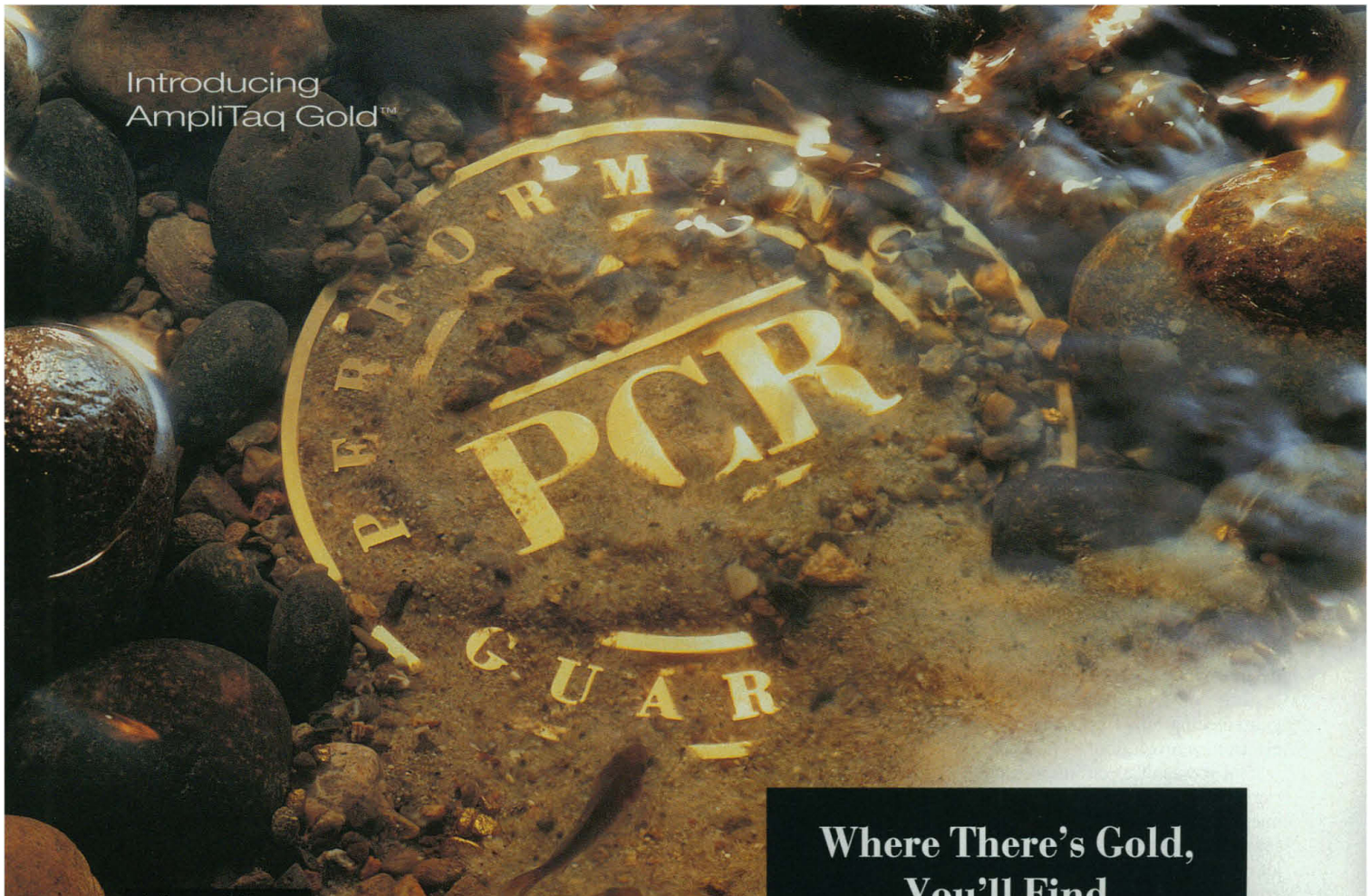

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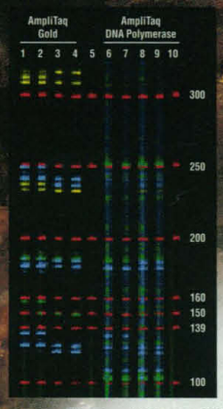

Co-amplification of 8 human STR loci. L1, 2: male control DNA; L3, 4: female control DNA; L5: AmpliTaq negative control; L6, 7: male control DNA; L8, 9: female control DNA; L10: negative control.

Amplification of HIV-1 Control DNA. L2: 0 copies, AmpliTaq DNA Polymerase, No Hot Start; L3: 10 copies, AmpliTaq DNA Polymerase, No Hot Start; L4: 10 copies, AmpliTaq DNA Polymerase, manual Hot Start; L5: 10 copies, AmpliTaq Gold.

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Perkin-Elmer PCR reagents are developed and manufactured by Roche Molecular Systems, Inc., Branchburg, New Jersey, U.S.A.

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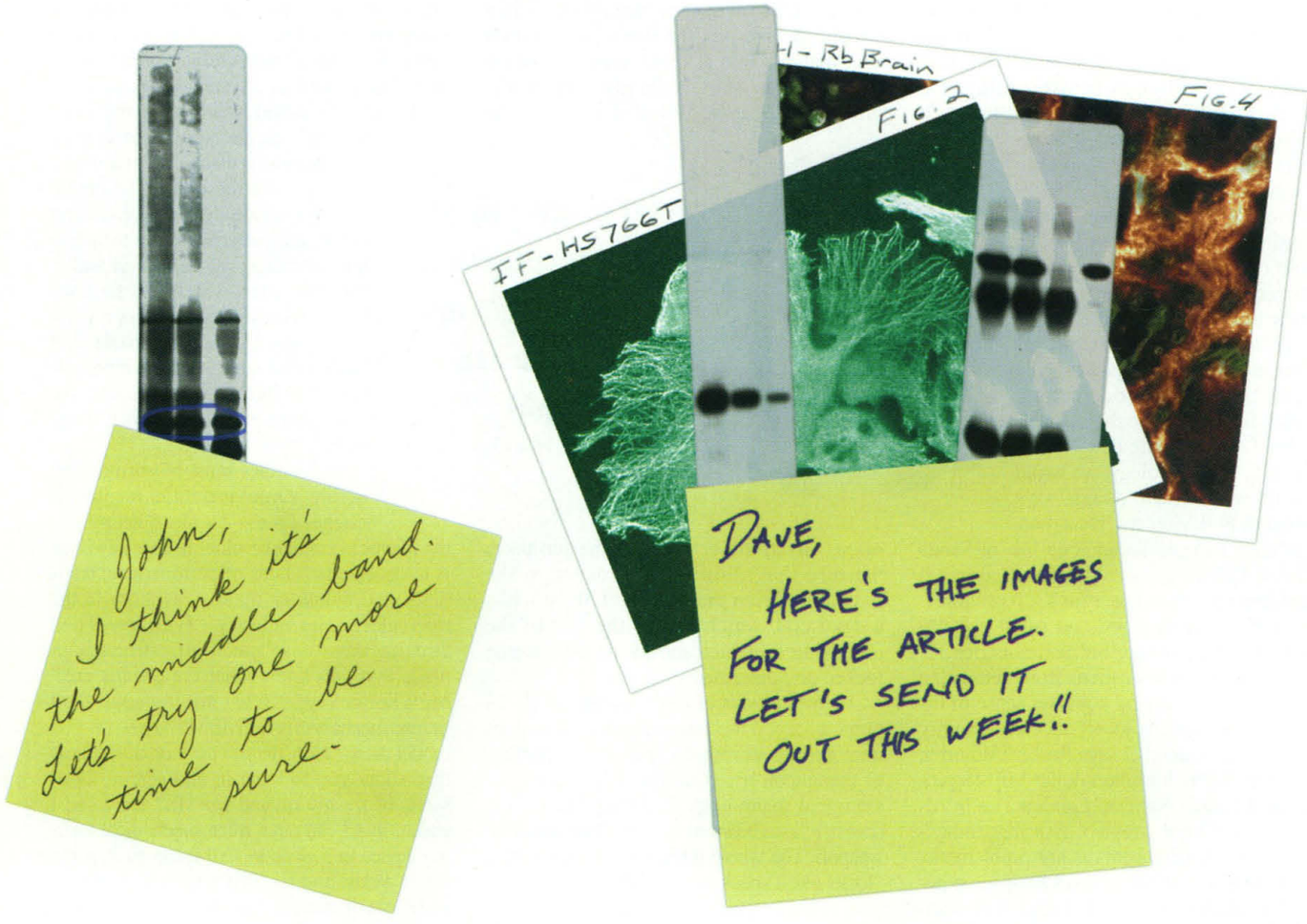

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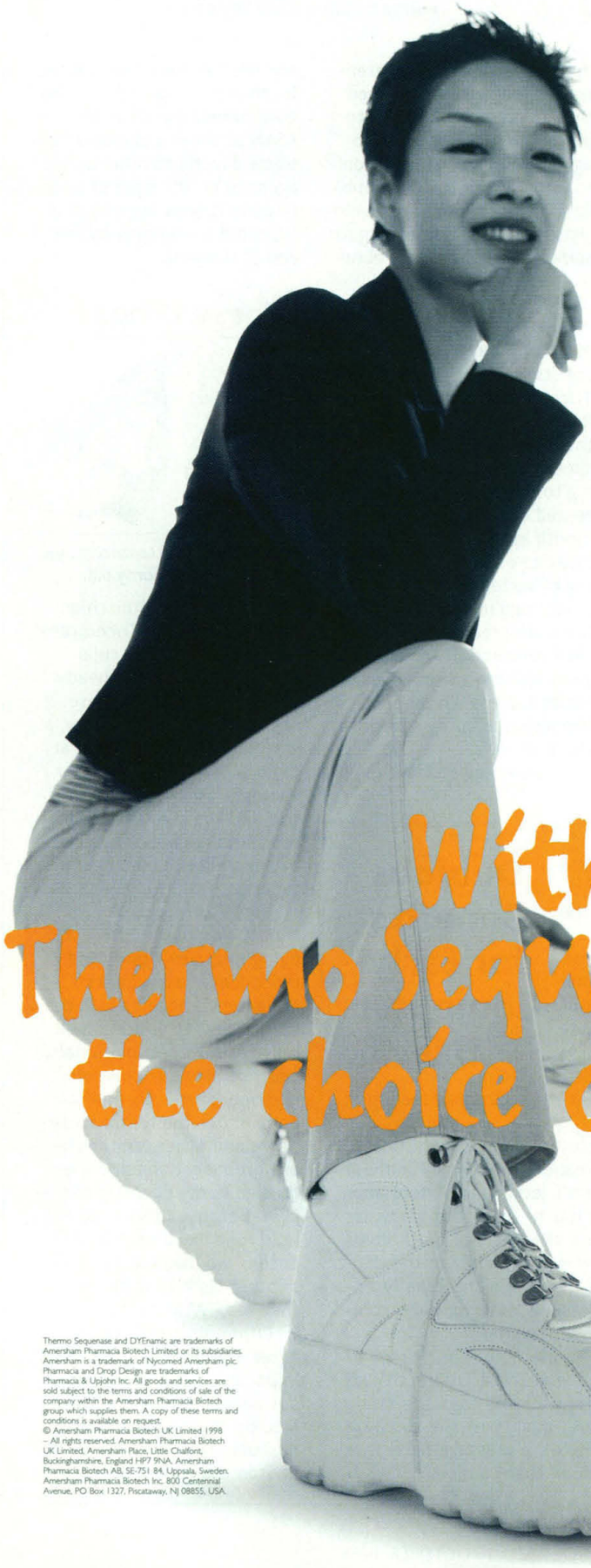

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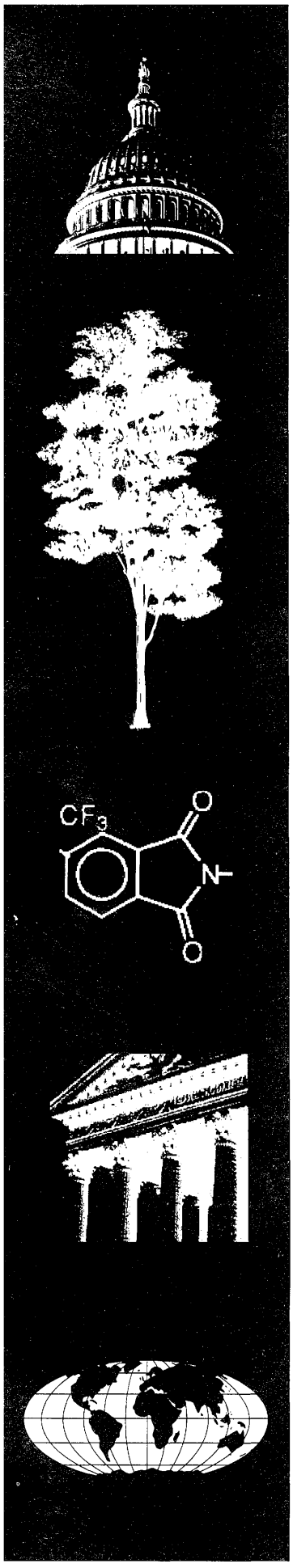

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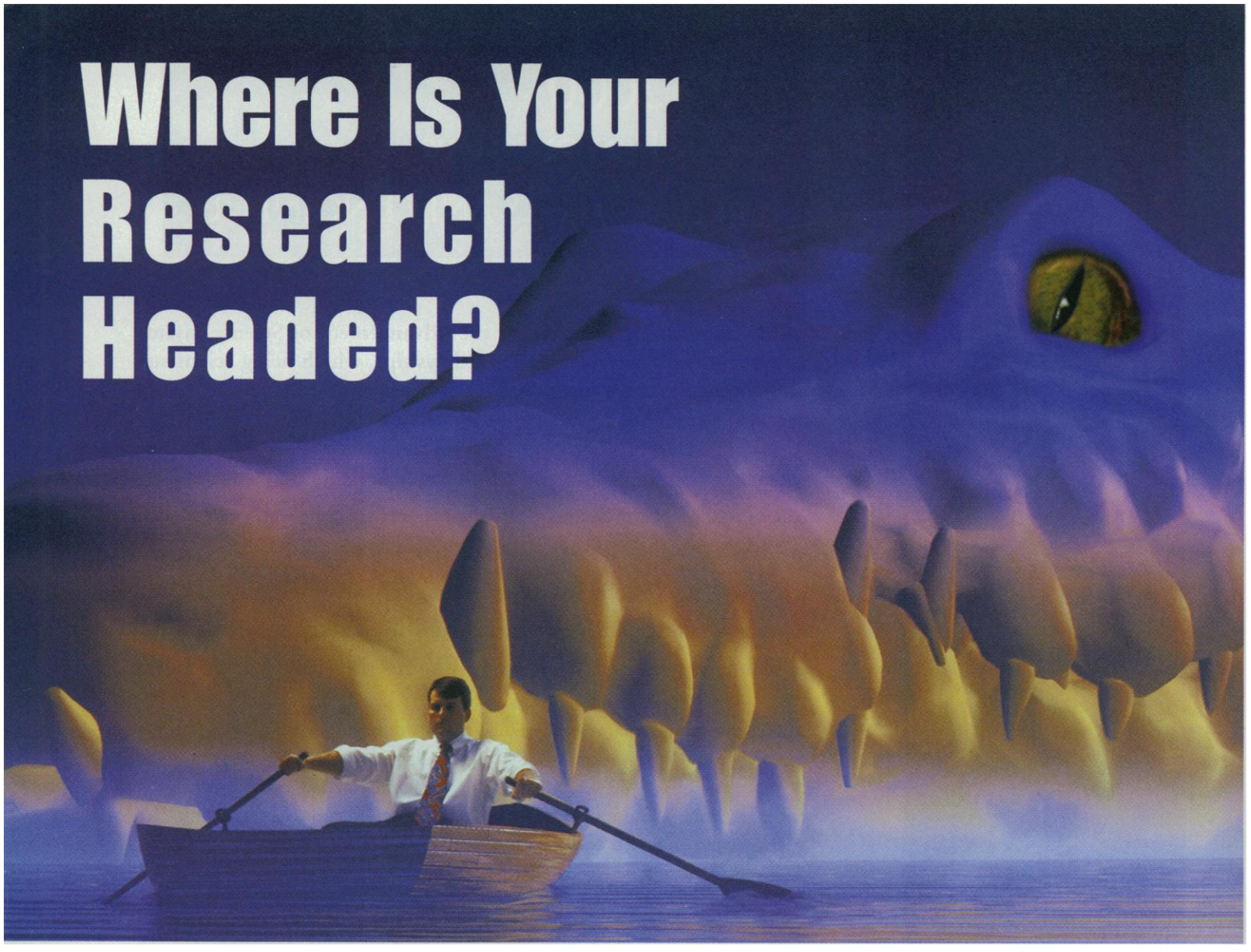

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