20 November 1998

Science

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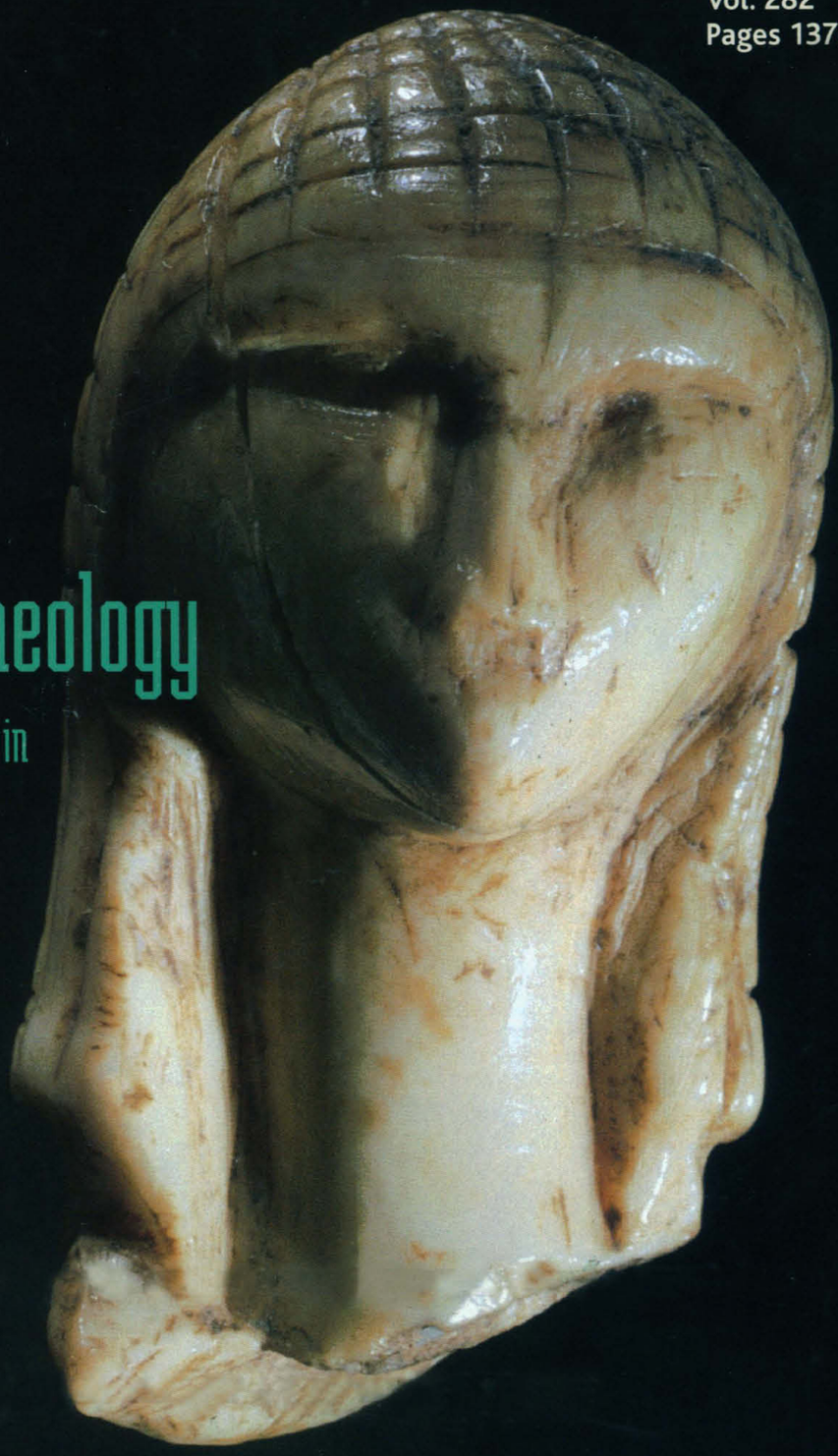
Pages 1373–1600 $7



Archaeology

Transitions in Prehistory

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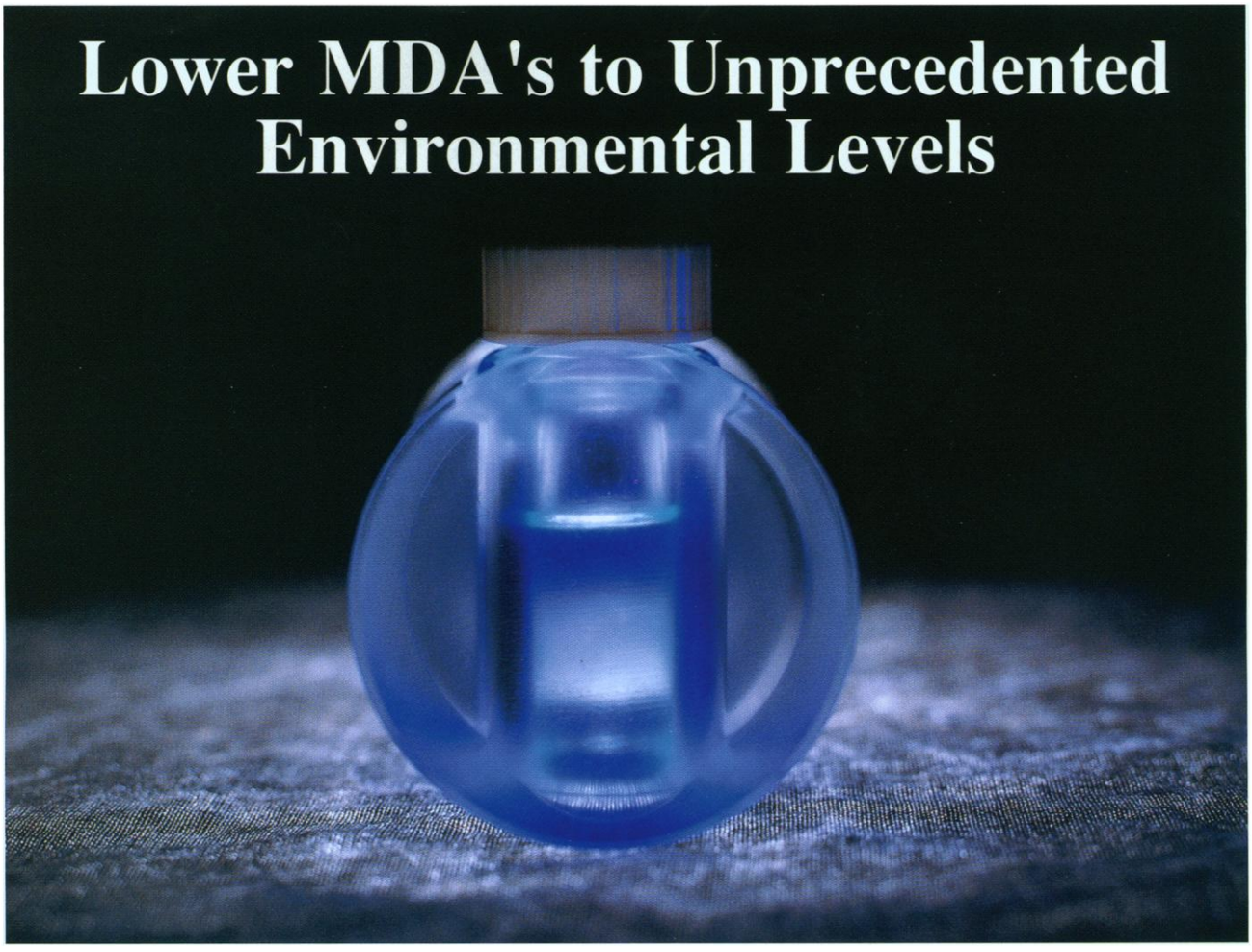

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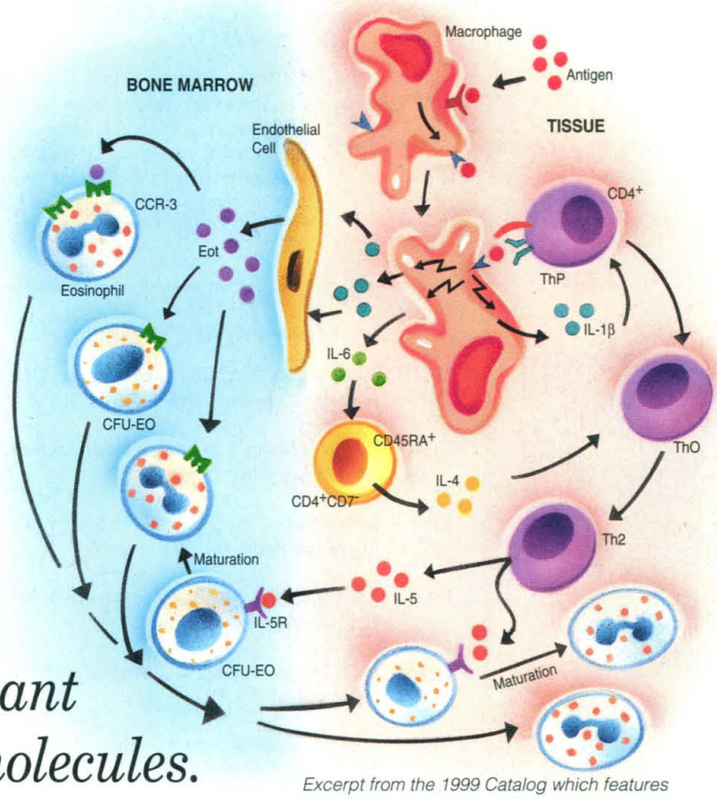

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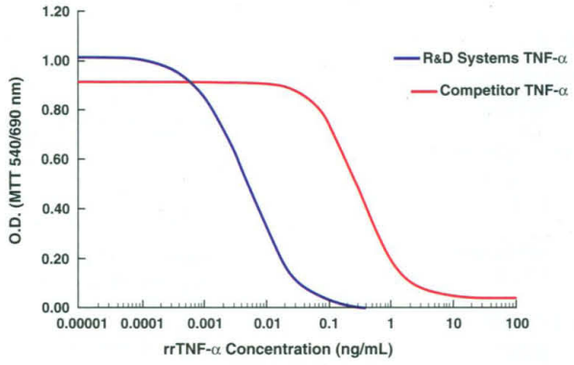

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Science

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COVER La Dame à la Capuche, a 25,000-year-old statuette (3.65 centimeters tall) made of mammoth ivory from the site of Brassempouy, France. It is one of many female figurines dating from the Gravettian period, 28,000 to 22,000 years ago. The explosion of artistic creativity in ice age Europe is one of the watersheds in prehistory explored in the special News report beginning on page 1441. [Photo: Randall White/Musée des Antiquités Nationales]

1398
Fade-out for Mars fossils

NEWS

NEWS OF THE WEEK

NEWS FOCUS

ARCHAEOLOGY: TRANSITIONS IN PREHISTORY

NEWS

RESEARCH

RESEARCH ARTICLES

REPORTS

DEPARTMENTS

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SCIENCE'S COMPASS

1423
Biological Weapons Convention: A call from U.S. industry

1476
Guiding light: More than pretty patterns

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1494
***E. coli* in the urinary tract**

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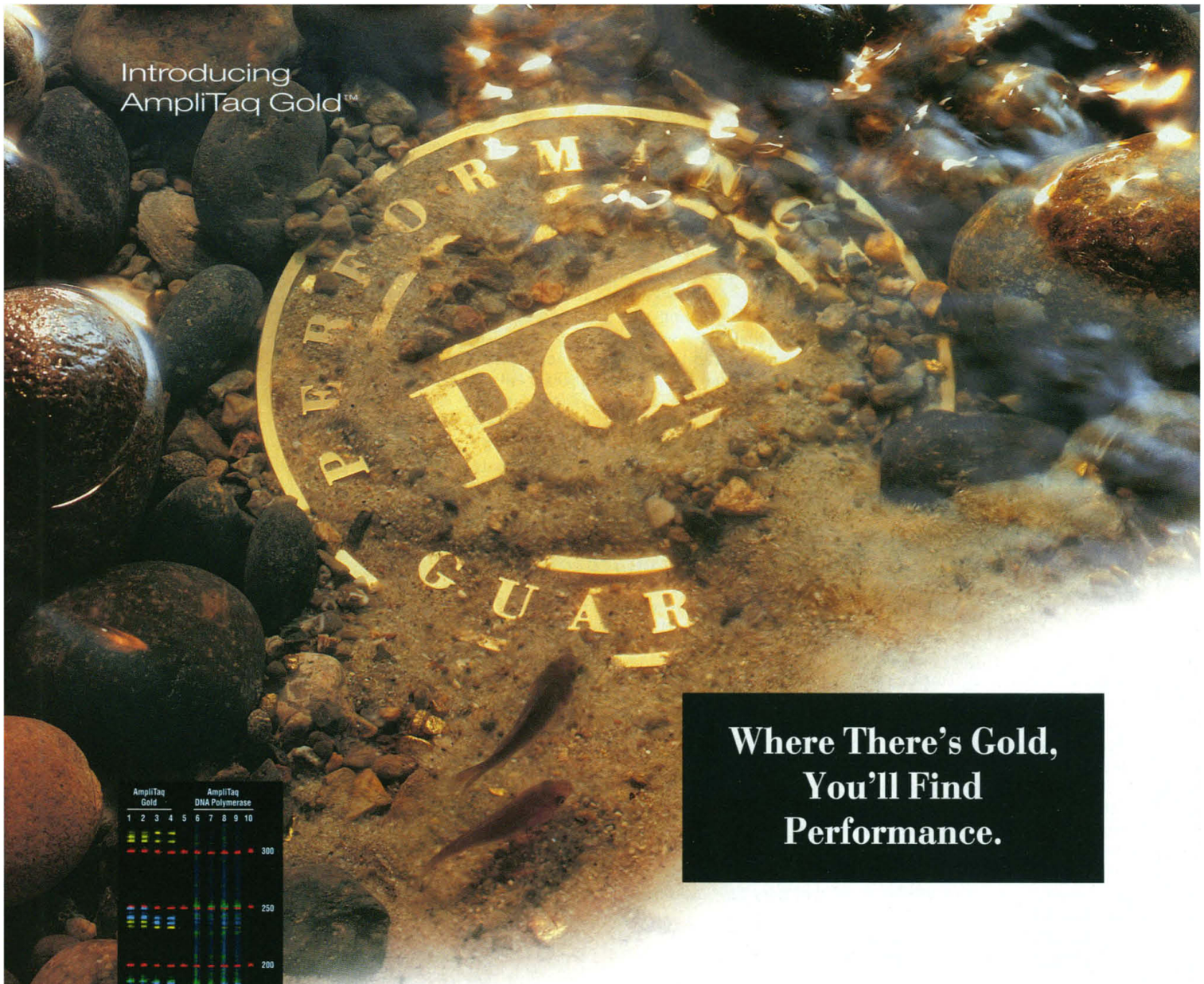

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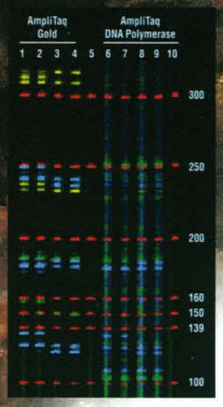
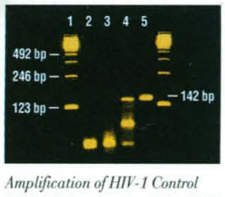


Co-amplification of 8 human STR loci. L1, 2: male control DNA; L3, 4: female control DNA; L5: AmpliTaq negative control; L6, 7: male control DNA; L8, 9: female control DNA; L10: negative control.



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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HAD MILK

Although our earliest written records refer to the practice of dairying, it has been difficult to determine from ancient samples when this practice began. One problem is that the chemical composition of milk fats that might be preserved on pot shards is easily altered with time and burial or exposure. Dudd and Evershed (p. 1478; see the news strory by Pringle in the special news section on archaeology) show that carbon isotope analysis of specific compounds can be used to identify milk fat residues. Dairying in prehistoric Britain was under way by the Iron Age.

CONTROLLING OXYGEN

The oxidation-reduction (redox) reactions of sulfur species in the ocean, along with those of carbon, have been thought to provide the main control of Earth's atmospheric oxygen budget. Analysis of sulfur isotopes in the ocean through time may reveal how Earth's atmosphere has evolved. Most efforts have been aimed at measuring sulfur isotopes in evaporites, but these formed only at certain times and may be altered by diagenesis or infiltration of younger fluids. Paytan *et al.* (p. 1459; see the Perspective by Berner and Petsch) now provide a record of sulfur isotopes in seawater sulfate from marine barite that extends throughout the Cenozoic (since 65 million years ago) at a resolution of 1 million years. Variations in the sulfur isotope record do not seem to correlate with variation in the carbon isotope record, which suggests that the phosphate cycle may provide another important control on atmospheric oxygen.

LOW-VOLTAGE DIAMOND CATHODES

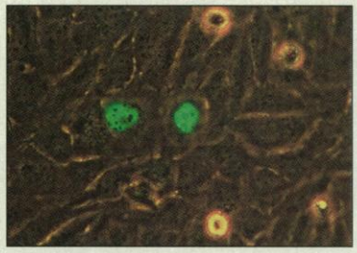
Undoped diamond is an insulator and normally thought to be unsuitable as cathodes for use in flat-panel emissive displays. Zhu *et al.* (p. 1471) found that films made from commercially available, undoped nanodiamonds (10 to 100 nanometer diameters) are efficient electron emitters. The particles are activated by heat treating in a hydrogen plasma; their high defect concentration and low electron affinity lead to current densities of 10 milliamperes per square centimeters at fields of only 3 to 5 volts per micrometer.

TO THE GUIDING LIGHT ...

Optical communication systems require a method for guiding the signal from one place to the other. Almost all optical waveguides have confined the light to a region of higher refractive index than its surroundings; in an optical fiber, total internal reflection guides the light. Knight *et al.* (p. 1476) demonstrate a new type of waveguide based on a photonic band gap effect, where the periodic structure of the fiber prohibits the propagation of a certain band of wavelengths but allows the propagation of others. They made an optical fiber with a hollow honeycomb structure that localizes a narrow band of wavelengths to the center of the fiber core.

RHYTHM AND BLUES (AND REDS)

Circadian rhythms are entrained in both plants and animals by mechanisms that remain poorly understood. Somers *et al.* (p. 1488) now show that in plants, phytochromes, the red-light photoreceptors, and cryptochromes, the blue-light photoreceptors, work in



concert to signal the course of the daily rhythm. Fine-tuned responsiveness to high- or low-intensity light is achieved through different combinations of receptors. Using gene inactivation technology, Thresher *et al.* (p. 1490) investigated whether cryptochromes function as mammalian circadian photoreceptors. Mice deficient in one of these cryptochromes (Cry2) showed both biochemical and behavioral alterations in circadian responses, consistent with the notion that Cry2 is involved in transducing the light signal to the clock.

UNMIXED MANTLE

Basalts from any one oceanic volcanic island and the mid-ocean ridge system tend to have similar lead isotopic compositions, but large variations are seen among the islands, implying that the mantle is heterogenous on a large scale. Saal *et al.* (p. 1481) now show that melt inclusions from individual islands (for both Mangaia and Tahaa in the eastern Pacific Ocean) can show a huge range in lead isotope compositions, up to nearly half of the global distribution, which implies that mantle is even more locally heterogenous.

TWIST TO THE RIGHT

Efforts to design proteins have focused largely on optimizing side-chain interactions while keeping backbone interactions fixed in wild-type conformations. Harbury *et al.* (p. 1462) have now designed α-helical bundle proteins with a right-handed superhelical structure using a modeling approach that allows for both side-chain and backbone flexibility. They successfully predict the formation of dimer, trimer, and tetramer bundles and show that the tetramer structure determined by x-ray crystallography closely matches the predicted structure in atomic detail. The trimeric and tetrameric bundles represent a type of fold not previously seen in natural or designed proteins.

A MODIFIED VIEW OF TELOMERES

The length of human telomeres (DNA sequences at the ends of chromosomes) is regulated by TRF1, a specific telomere binding protein. Smith *et al.* (p. 1484; see the news story by Pennisi) identified a protein, which they call tankyrase, that binds to TRF1 and is localized at telomeres in metaphase chromosomes. Tankyrase has 24 ankyrin repeats and is homologous to poly(ADP-ribose) polymerase (PARP), an enzyme that catalyzes the synthesis of poly(ADP-ribose) onto protein acceptors in response to DNA damage. Tankyrase has PARP activity in vitro, with TRF1 and tankyrase itself serving as substrates. These results suggest that this protein modification may have an important role in telomere biology.

EVADING ANTIBIOTICS

Bladder infections affect over 7 million people annually in the United States alone. *Escherichia coli* is the major cause of infection, and the virulent forms have fibers extending from them called type 1 pili. Mulvey *et al.* (p. 1494) now show that these pili are required to make direct contact with the uroplakin "shield" that covers the surface of the bladder epithelium. Once contact was made, the outer epithelium (umbrella cells) underwent apoptosis, decreasing the bacterial load. However, those bacteria not swept away burrowed into the underlying urothelium and could persist even in the presence of antibiotic, suggesting that recurrent urinary

CONTINUED ON PAGE 1383

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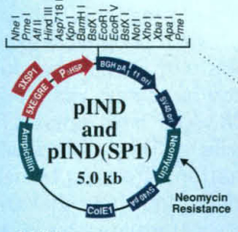

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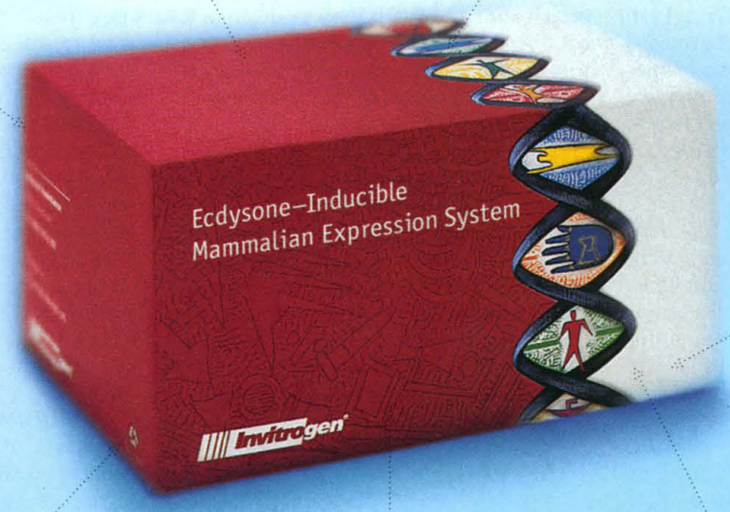

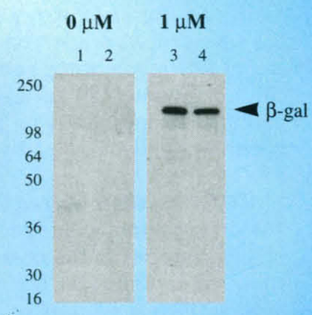

INDUCE WITH PONASTERONE A OR MURISTERONE A

CHO cells stably transfected with pIND(SP1)/Hygro/*lacZ*.
Lanes 1 and 2: Uninduced
Lane 3: Induced with Muristerone A
Lane 4: Induced with Ponasterone A

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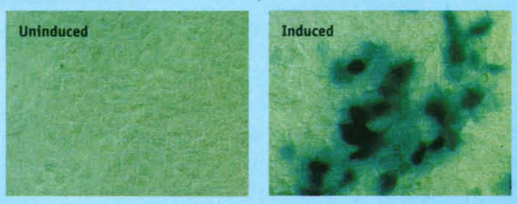

Uninduced and induced transiently transfected 293 cells stained with X-gal.

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CONTINUED FROM PAGE 1381

tract infections may be result from lingering chronic infections, rather than reintroduction of the pathogens.

NO CHECKPOINT WITHOUT P21 AND P53

Cells have a checkpoint mechanism that causes arrest of the cell division cycle in the presence of DNA damage. Increased synthesis of the cyclin-dependent kinase inhibitor p21 in response to the tumor suppressor protein p53 contributes to arrest at the transition from G_1 to S phase of the cell cycle, but other mechanisms were thought to control arrest at the transition from G_2 phase to mitosis. Bunz *et al.* (p. 1497) report that, although delay of the cell cycle in response to DNA damage does occur in their absence, p21 and p53 are required for the sustained delay at the G_2 checkpoint that occurs in normal cells.

HOMEOBOXES ON THE RUN

Many studies of homeodomain proteins, which often function as transcription factors, have focused on their similarities across species. Ting *et al.* (p. 1501; see the Perspective by Nei and Zhang) have considered genes that have rapidly diverged. They identified a rapidly evolving homeobox gene in *Drosophila* at the *Odysseus* locus, which is responsible for reproductive isolation between sibling species of *Drosophila*. Although related genes are found from mammals through *Drosophila*, the gene shows a remarkable rate of divergence between species of *Drosophila*. Thus, both development and speciation may be dependent upon homeobox genes.

NUANCES OF NEURONAL PLASTICITY

Local inhibitory circuits play an important role in the well-known phenonema of ocular dominance shifts after brief periods of monocular deprivation. Most experiments that have analyzed the inhibitory interactions in the visual cortex in detail have produced ambiguous results. Hensch *et al.* (p. 1504) show that in mice missing one isoform of GABA (γ-aminobutyric acid)–synthesizing enzyme, the normal plasticity during the critical period is disturbed. The same animals show no other defect during development, and other forms of plasticity, such as long-term potentiation, are unaffected. These results argue for a delicate balance between intrinsic neuronal excitation and inhibition for fine-tuning experience-dependent plasticity in the neocortex.

WINNER TAKES ALL

The mammalian nervous system develops first with an excess of connections, which are later sorted out to retain the functional connections that form the mature nervous system. Gan and Lichtman (p. 1508) closely observed this pruning process at the mouse neuromuscular junction. Most junctions go from multiple to single innervation within a few weeks of birth. Terminal connections of the competing axons at first form overlapping fields. Later, these fields sort out from each other, and finally, in a process that is undetermined until the last moment, one axon wins.

OF FORKS AND FACTORIES

During DNA replication, does DNA polymerase move along the DNA like a train on a track, or is the polymerase anchored in place like a factory, as the DNA is pulled through? In a study of the bacterium *Bacillus subtilis*, Lemon and Grossman (p. 1516; see the Perspective by Losick and Shapiro) provide evidence consistent with a factory model. They visualized DNA polymerase and other replication fork proteins in living cells and found that the proteins localize to discrete intracellular positions, which suggests that they are anchored in place.

TECHNICAL COMMENT SUMMARIES

How Pervasive is "Fishing Down Marine Food Webs"?

The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/282/5393/1383a

D. Pauly *et al.* analyzed global fisheries statistics from the Food and Agricultural Organization (FAO) of the United Nations and found that "the mean trophic level of the species groups ... declined from 1950 to 1994" (Reports, 6 Feb., p. 860).

J. F. Caddy *et al.* comment that Pauly *et al.* "greatly oversimplify the situation with their hypothesis and may have misinterpreted the FAO statistics." A figure suggests that "the increasing contribution of aquaculture [like the farming of shellfish] to total production" might account for the findings in the report.

In response, Pauly *et al.* discuss the considerations raised in the comment and provide a figure showing trophic level trends "after removal of mariculture production data" to support their earlier conclusion.

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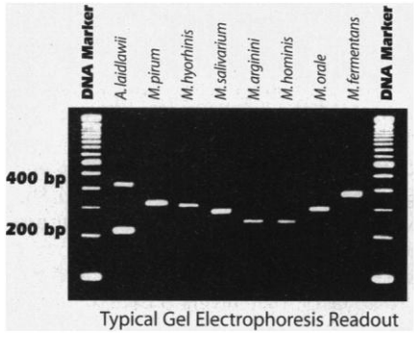

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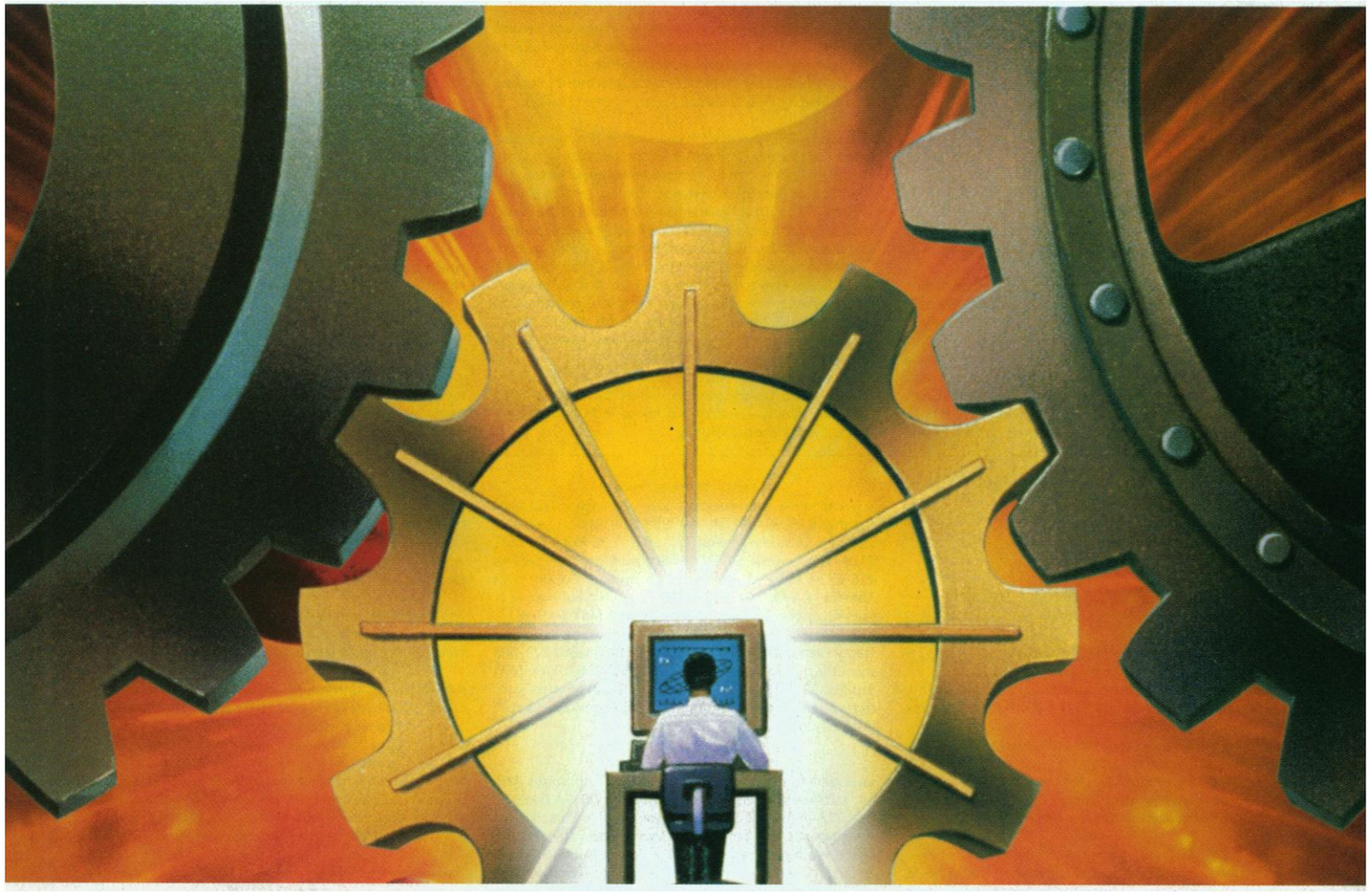

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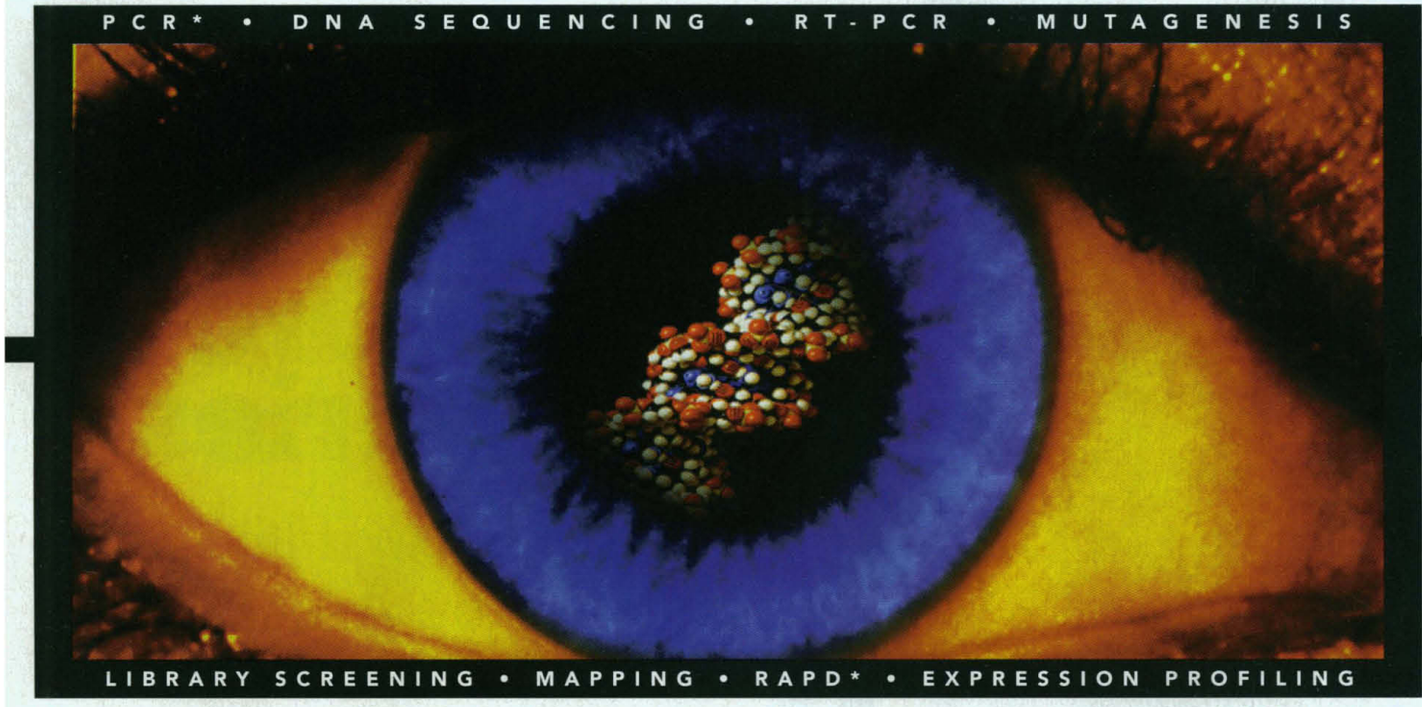

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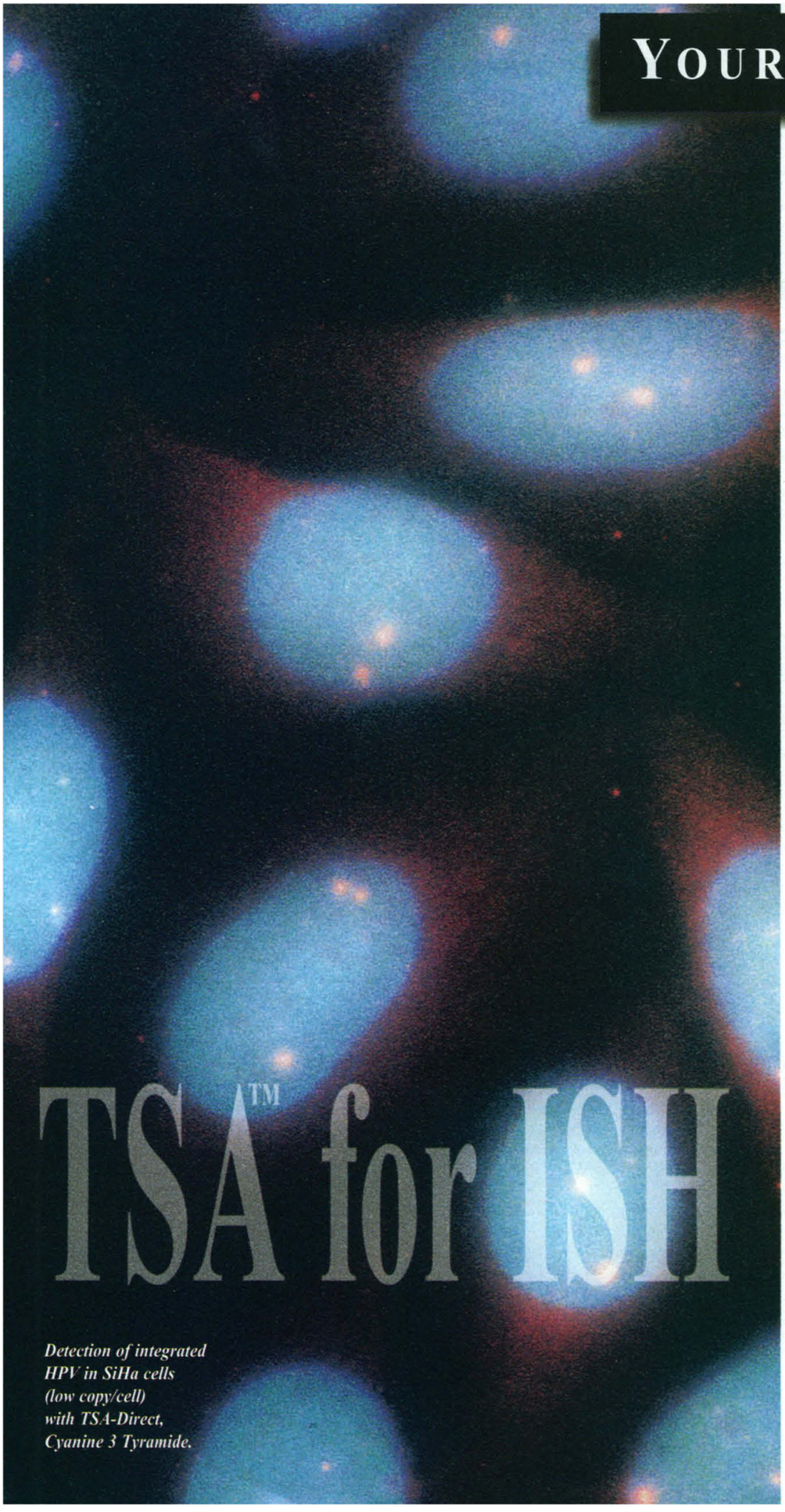

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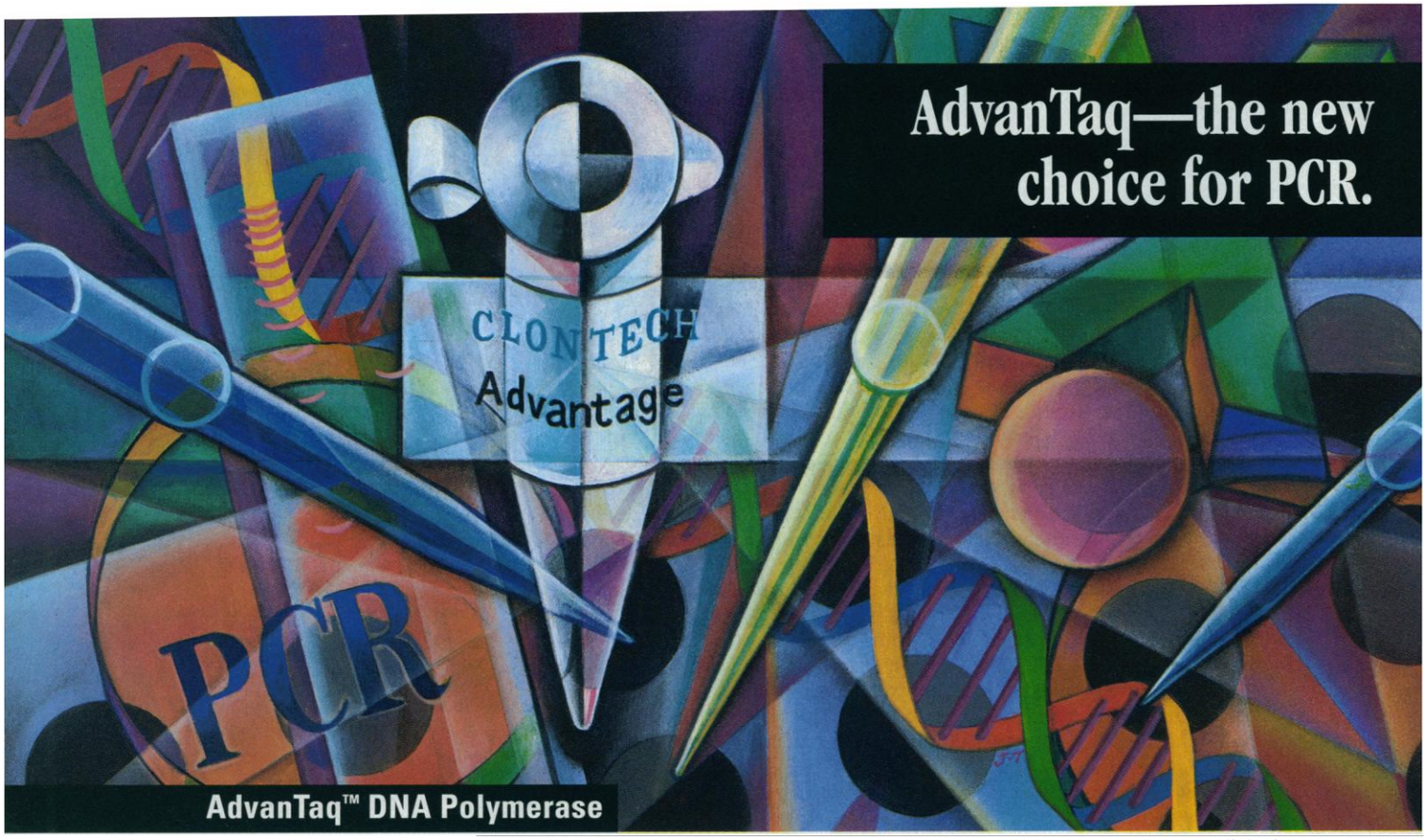

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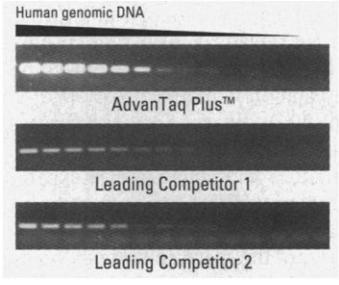

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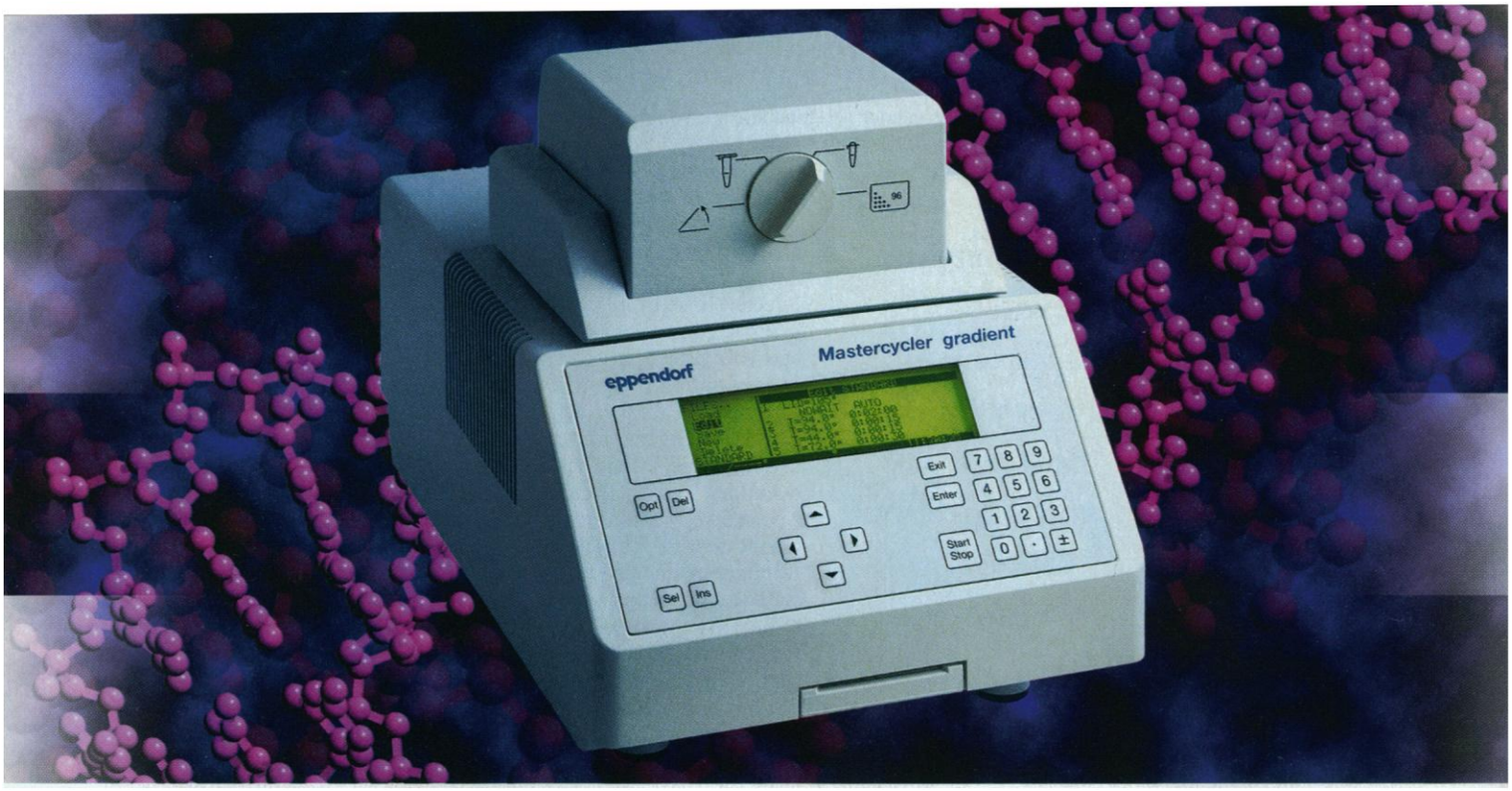

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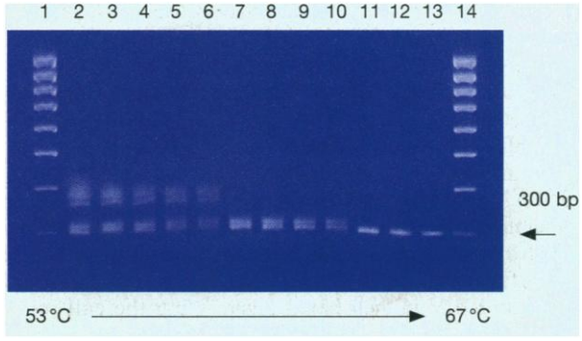

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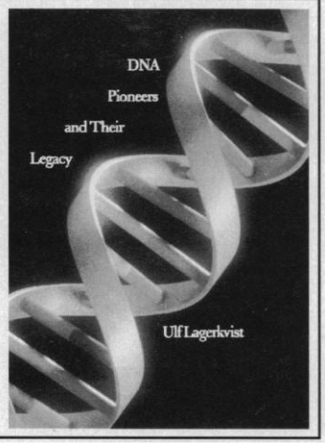

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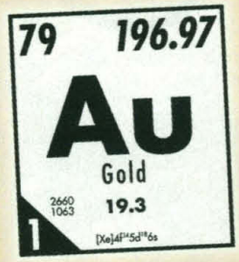
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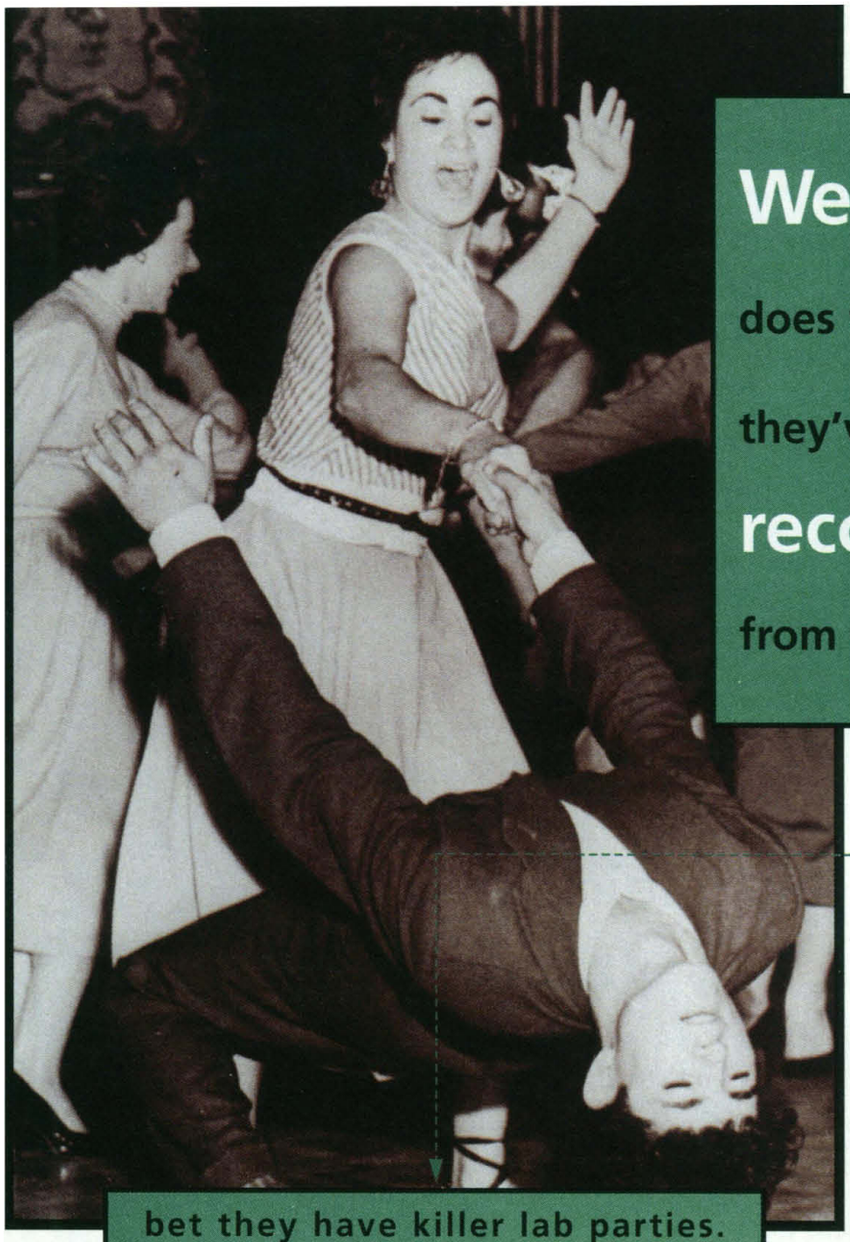

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March 22, 1999

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