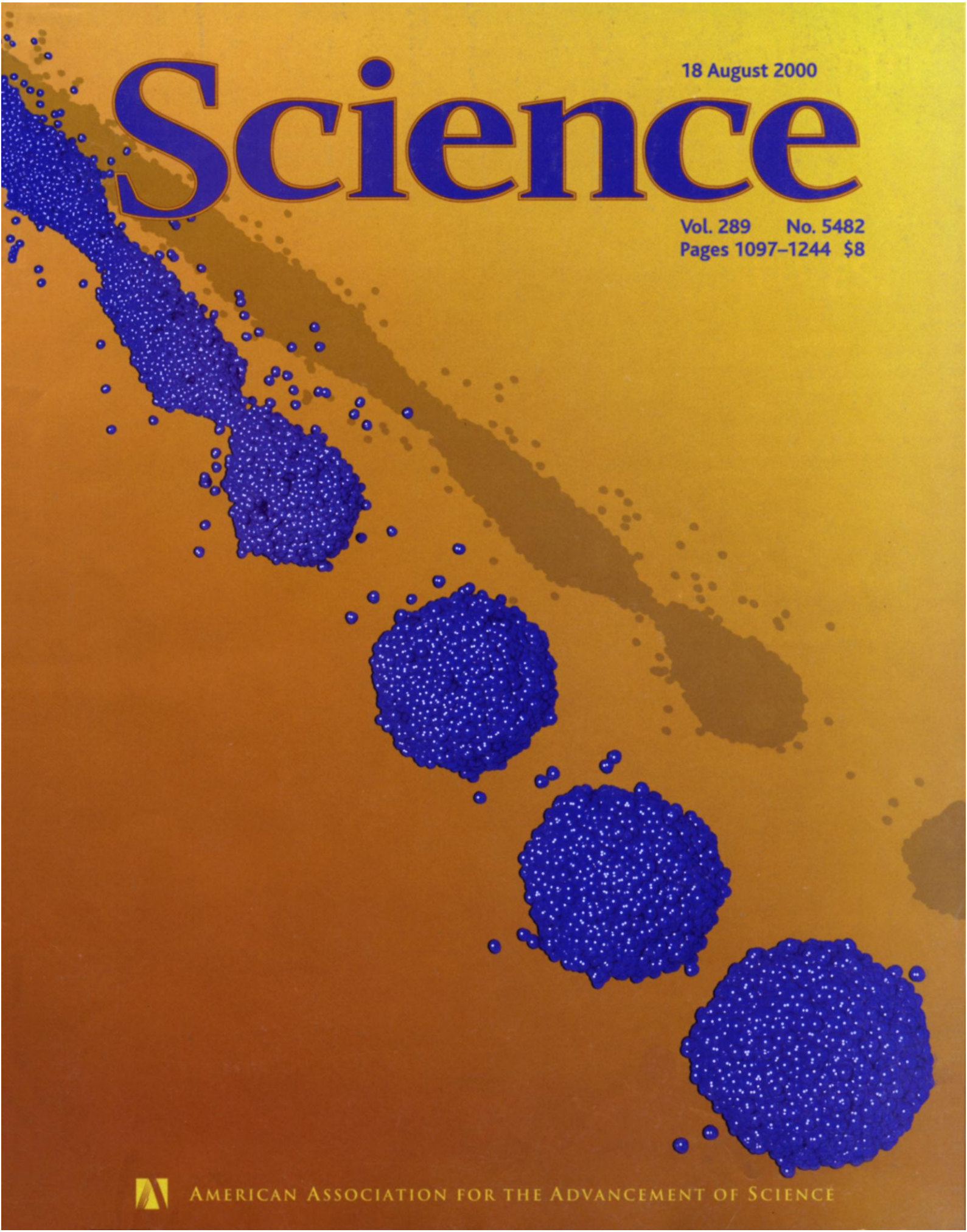


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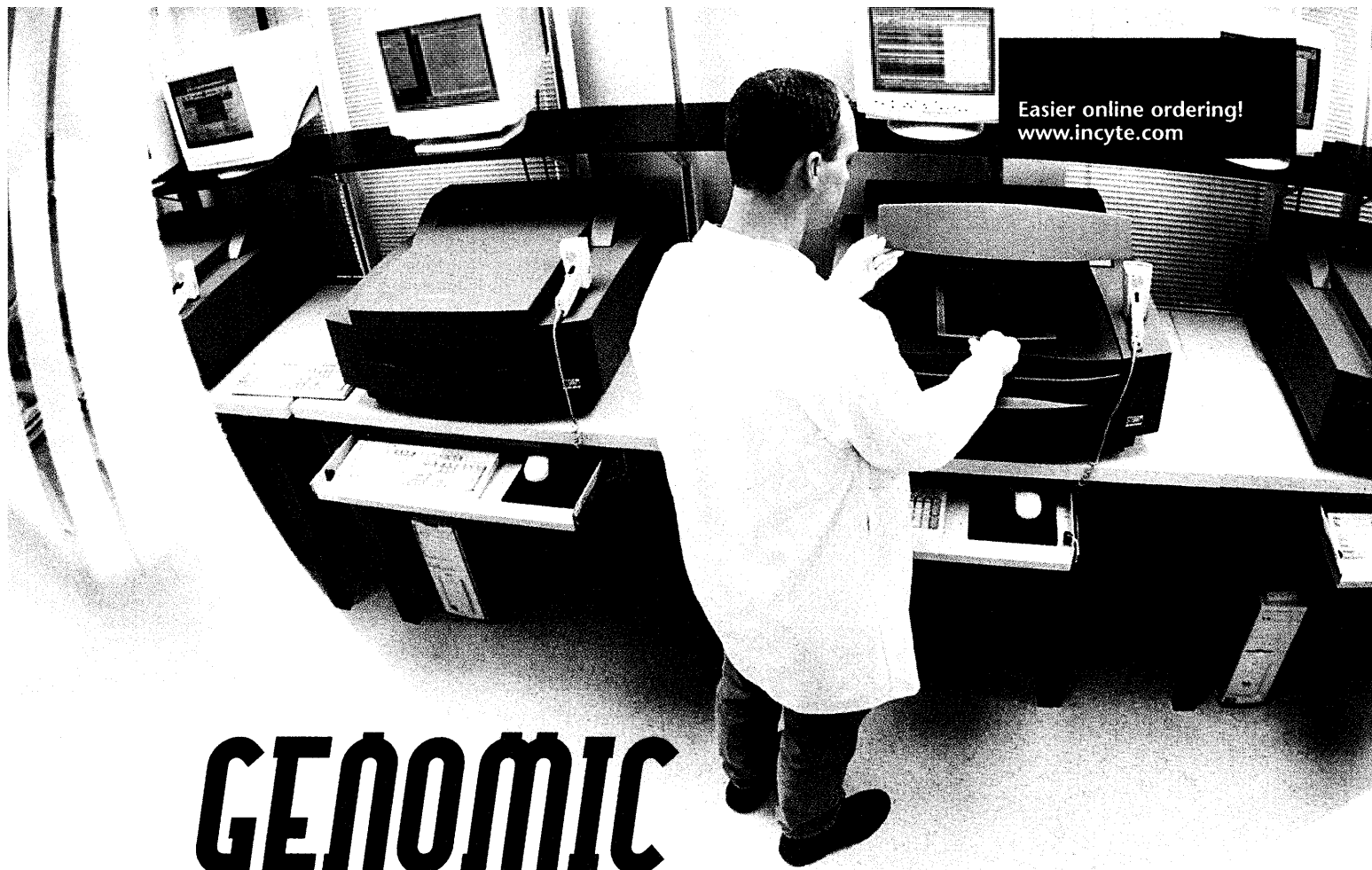
Science

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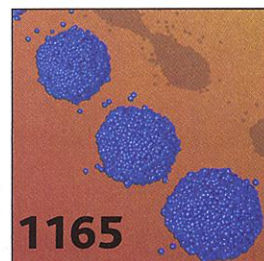
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COVER Atomistic simulations of liquid nanojets extend hydrodynamics to the nanoscale. The image shows the leading part of a 6-nm-wide, 200-nm-long propane jet propagating in vacuum at 200 m/s (individual molecules, small blue spheres). Molecular evaporation and thermal stress fluctuations that accelerate neck-shaped instabilities lead to droplet formation. Such nanojets may find use in patterning, printing, and biotechnology. [Image: U. Landman, M. Moseler, M. D. Wolf]



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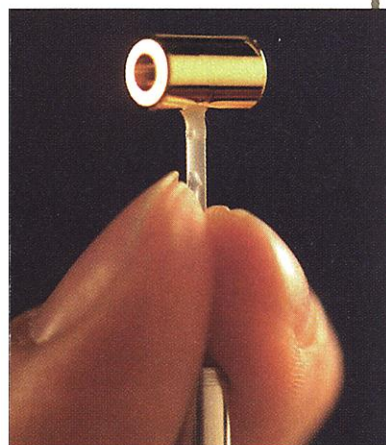
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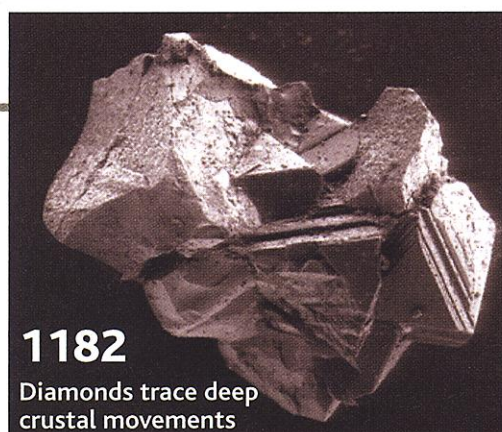
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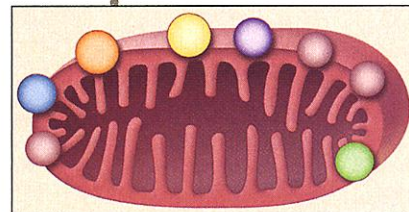
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The Position of Moving Objects

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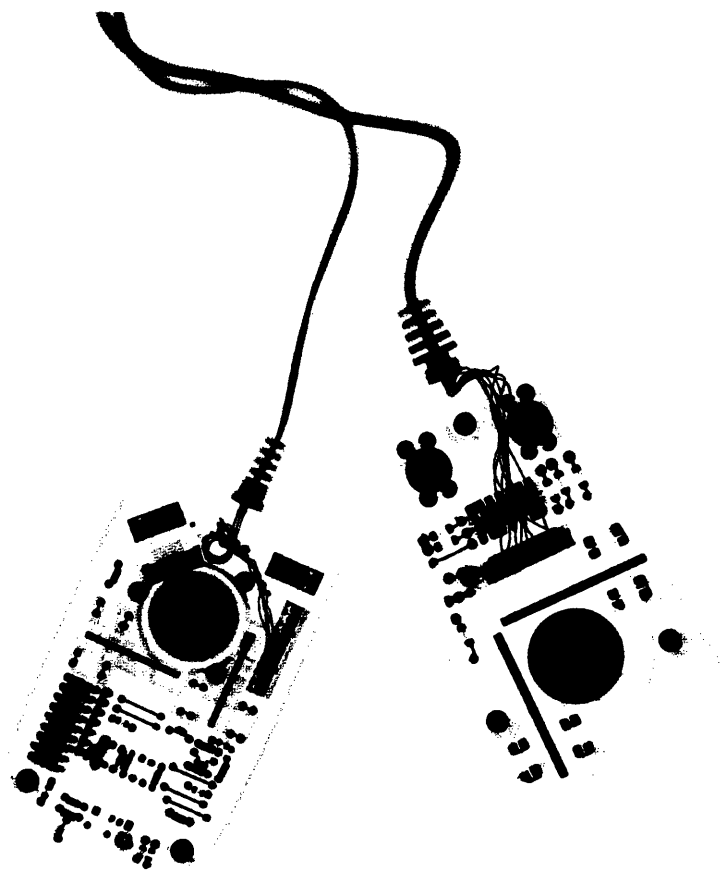


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Dying bacteria

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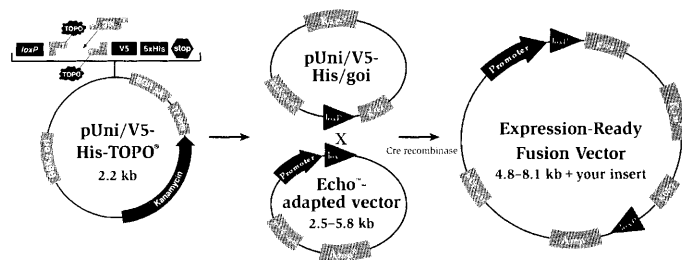
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A REALLY FINE SPRAY

The formation of a fluid jet from a nozzle and its breakup into smaller droplets is a venerable problem (Lord Rayleigh developed one of the first thorough treatments). Nanometer-scale fluid jets also have been considered, but hydrodynamic theories begin to break down when the size of the nozzle orifice narrows to a few multiples of molecule diameters. Moseler and Landman (p. 1165; see the cover) now present molecular dynamics simulations of liquid propane forced through gold nozzles several nanometers in diameter and show how heating and wetting of the nozzle can prevent blocking of the orifice. By integrating their results with continuum hydrodynamic models, they show that thermally triggered fluctuations play an important role in the breakup and evolution of the nanojets.

SWITCH HIGH, READ LOW

A magnetic bit is read at much lower fields than are needed for the writing operations that actually switch the spin direction—in this way, a bit can be set once, read several times, and then reset. Collier *et al.* (p. 1172) have developed a solid-state electronic switch that exhibits similar hysteresis—it can be opened with a +2-volt (V) pulse, closed with a -2 V-pulse, and read between 0.1 and 0.3 V. The larger voltage pulses oxidize or reduce a tetrathiofulvalene group in one ring of a [2]catenane molecule and force that ring to rotate within the other ring. This isomerization changes the potential of the junction.

A CHANGE IN THE WEATHERING

The stable isotopic compositional history of calcium in the ocean reflects how its calcium inventory has changed in response to weathering of rocks and calcium carbonate sedimentation. These same two processes control the concentration of atmospheric CO₂, the most important trace greenhouse gas, over geological time scales. De La Rocha and DePaolo (p. 1176) report significant variations in the isotopic composition of marine calcium during the past 80 million years, and these measurements coupled with estimates of oceanic pH should allow atmospheric CO₂ content to be calculated.

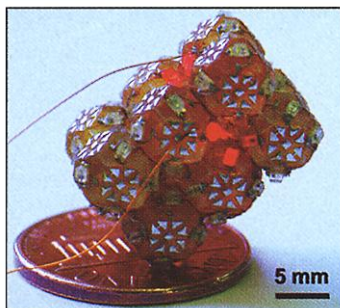
A QUIETER HAYWARD FAULT?

The northern Hayward fault runs through Berkeley, California, and has been assigned the highest probability of a mag-

nitude 7 earthquake during the next 30 years within the San Francisco Bay area. Bürgmann *et al.* (p. 1178; see the Perspective by Simpson) developed a model of the amount and type of slip on the northern Hayward fault by combining global positioning system and interferometric synthetic aperture radar surface deformation measurements with microearthquake data and field measurements of aseismic creep along the fault. They found that the northern segment of the fault, to a depth of about 6 kilometers, creeps along slowly without producing seismicity, and thus its seismic hazard probably should be downgraded.

SELF-ASSEMBLED 3D CIRCUITS

Although self-assembly normally is associated with molecular-scale objects, the principles of recognizing shape and forming bonds selectively can be applied to macroscopic objects and used to assemble chips on flat substrates. Gracias *et al.* (p. 1170) show how elec-



trical circuits in three dimensions can be built up from millimeter-scale polyhedra that were patterned with wires, light-emitting diodes, and solder dots. When placed in solution just warm enough to melt the solder, the polyhedra assembled into larger structures in a manner determined by the placement of the dots and wires.

YOUNG MELTS IN OLD CRATONS

Cratons represent fragments of the oldest continental crust, which formed more than 3 billion years ago. Jacob *et al.* (p. 1182) analyzed the trace element and isotopic characteristics of garnet inclusions in polycrystalline diamonds from a kimberlite within the South African craton and found evidence for remobilization of the craton about 533 million years ago. Their analyses reveal the mixing of a carbonatitic melt

with eclogite to produce these diamonds and suggest that cratons may have been deformed by recent tectonism.

MOVING IN FOR A KILL

The TR3 protein (also named nur77 or NGFI-B) is a member of the nuclear hormone receptor family and is required for T cell receptor-induced apoptosis. These receptors are thought to act primarily as ligand-dependent transcription factors. However, Li *et al.* (p. 1159; see the Perspective by Brenner and Kroemer) found that TR3 function does not require the DNA binding domain of the protein. Instead, TR3 promotes apoptosis by translocating to the mitochondria, where it causes release of cytochrome c.

KILLING BACTERIA

Neutrophils kill invading bacteria with a variety of cellular weapons. Belaaouaj *et al.* (p. 1185) report that an enzyme known as neutrophil elastase (NE) specifically cleaves one of the bacterial outer membrane proteins, OmpA, damaging membrane integrity and causing bacterial cell death. This finding is of note both as a potential antibacterial target and because NE has been considered for use in treating cystic fibrosis.

SWINGING OUT OF THE WAY

Thioredoxin reductase (TrxR) transfers reducing equivalents from NADPH (the reduced form of nicotinamide adenine dinucleotide phosphate) to thioredoxin via a flavin adenine dinucleotide (FAD) cofactor and an enzyme disulfide. Lennon *et al.* (p. 1190) have determined the structure of the flavin-reducing conformation of *Escherichia coli* TrxR and show that the nucleotide binding domain rotates by almost 70° between cycles of reduction and reoxidation of FAD. A homologous enzyme, glutathione reductase, acts on small molecule substrates and does not undergo a conformational transition, which may have evolved to allow access of a large protein substrate to the active site.

PIGS FROM PIGSKIN

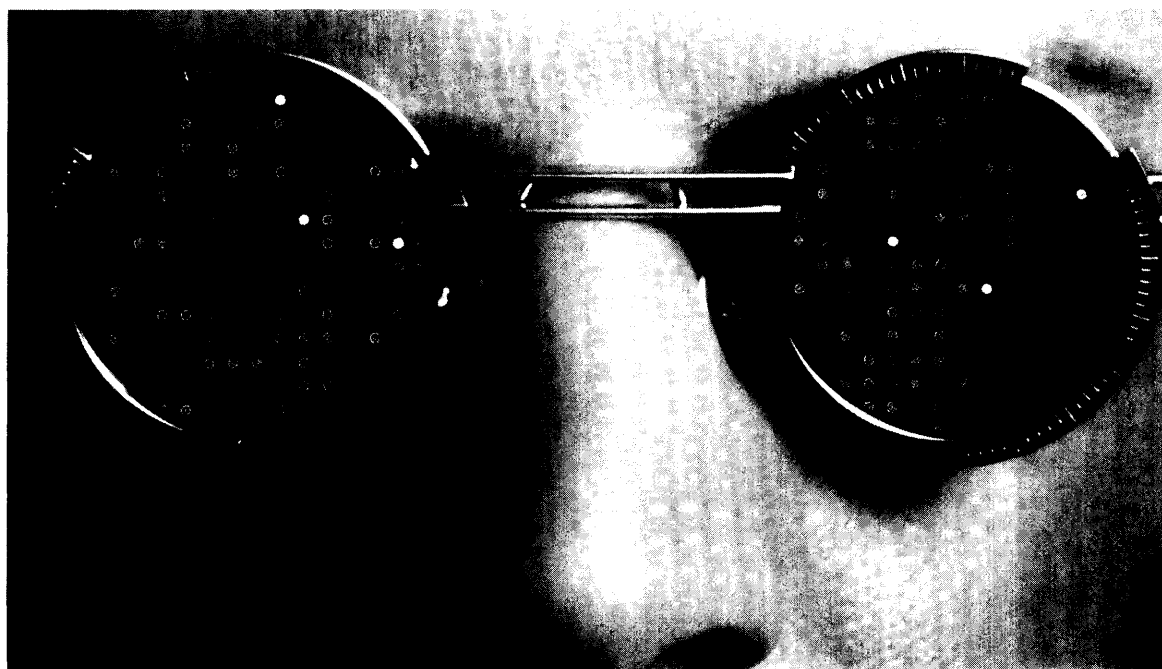
The ability to clone pigs from differentiated cells has implications in animal husbandry and in generating genetically modified organs for xenotransplantation. Although animals from other species have been cloned from somatic cells, Onishi *et al.* (p. 1188; see the news story by

CONTINUED ON PAGE 1107



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THIS WEEK IN SCIENCE

CONTINUED FROM PAGE 1105

Normile and Pennisi) have generated a cloned pig by microinjecting skin fibroblast nuclei into enucleated oocytes, stimulating them to develop with electrical pulses, and transferring the embryos in large numbers to surrogate mothers.

VASCULAR SIGNATURES

Tumors require a blood supply for growth, and several cancer therapies now in clinical trial are designed to disrupt that blood supply by targeting the tumor vasculature. In a comprehensive analysis, St. Croix *et al.* (p. 1197; see the news story by Marx) found that the blood vessels in tumors and normal tissue show qualitative differences in the expression of 79 genes. Most of the genes differentially expressed in the tumor vessels are of unknown function; the majority of the known genes play a role in extracellular matrix formation. The genes marking the tumor vessels were expressed in tumors derived from a variety of tissue types and, importantly, were also expressed in vessels induced by other pathophysiological states, such as wound healing.

CUT AND DRIED UP

During inflammation, leukocytes are recruited to target areas in response to chemokines. However, cessation of this response is important for tissue healing and wound repair. McQuibban *et al.* (p. 1202) propose that matrix metalloproteinases (MMPs) are key effectors of down-regulating chemokine activity. When the

chemokine monocyte chemoattractant protein (MCP)-3 is cleaved by the MMP gelatinase A, it is converted from a chemokine receptor agonist to an antagonist. This conversion blocks the response of leukocytes to a variety of chemoattractants that utilize the same receptors.

A SPREADING SIGNAL

The gene encoding the *adenomatous polyposis coli* tumor suppressor protein (APC) is mutated in most colon cancers, so there is much interest in determining the cellular signaling pathways through which it functions. Kawasaki *et al.* (p. 1194) show that APC binds to a guanine nucleotide exchange factor called Asef, stimulating cell spreading, membrane ruffling, and lamellipodia formation. These results suggest that disruption of the APC-Asef complex may inhibit normal migration of colon epithelial cells.

A TOUCHY SUBJECT

What mechanism underlies the phenomenon in which touching one's hand can improve vision in the nearby area? In a functional magnetic resonance imaging study, Macaluso *et al.* (p. 1206; see the Perspective by de Gelder) showed that a sudden touch enhances activity in a brain area called the visual cortex. This enhancement is the result of neuronal input from higher multimodal association cortex areas back-projecting onto the visual cortex.

TECHNICAL COMMENT SUMMARIES

The Position of Moving Objects

The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/289/5482/1107a

Eagleman and Sejnowski (Reports, 17 March, p. 2036), studying the visual illusion known as the flash-lag effect, framed a "postdictive" model in which the flash resets motion integration in the visual system and "the percept attributed to the time of the flash is a function of events that happen in the ~80 milliseconds after the flash." Their results, they suggested, do not support the two previously proposed models, predictive motion extrapolation and differential latency.

Krekelberg and Lappe agree that "the flash-lag effect is due to motion ... after the flash," but argue that there is no reason to assume that the flash resets motion integration. "That motion after the flash influences the percept generated by the flash," they conclude, "merely shows that visual processing takes time." In a separate comment, Whitney and Cavanagh note that the arguments of Eagleman and Sejnowski against a differential-latency model assume that the flash-lag effect and another visual illusion, the Fröhlich effect, are caused by the same mechanism. Whitney and Cavanagh present data that suggest that "the two phenomena are actually caused by distinct mechanisms," and maintain that postdiction can explain neither phenomenon. The differential-latency model, in their judgment, "remains a viable explanation of flash-lag data." In response, Eagleman and Sejnowski present additional data to argue that the observations in both comments "can be explained within the postdictive framework we have proposed."

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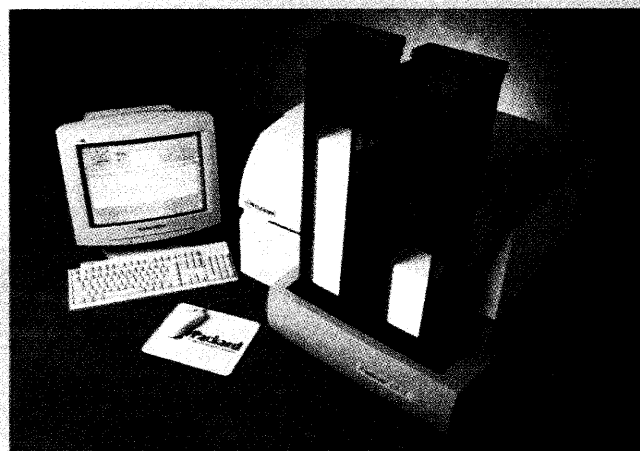
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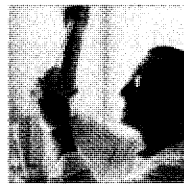
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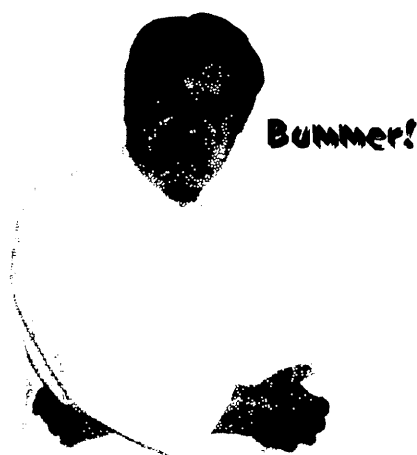


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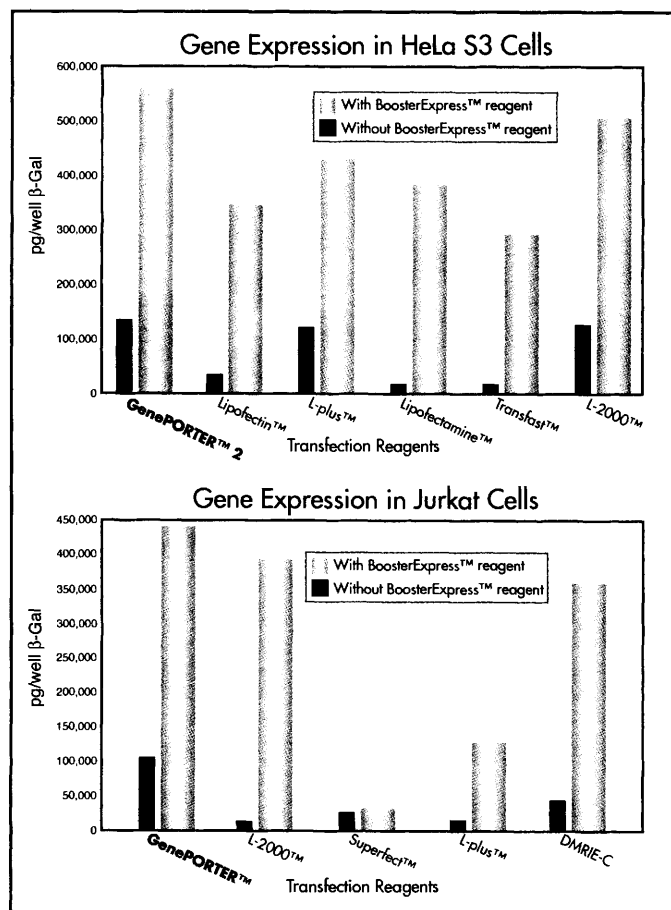
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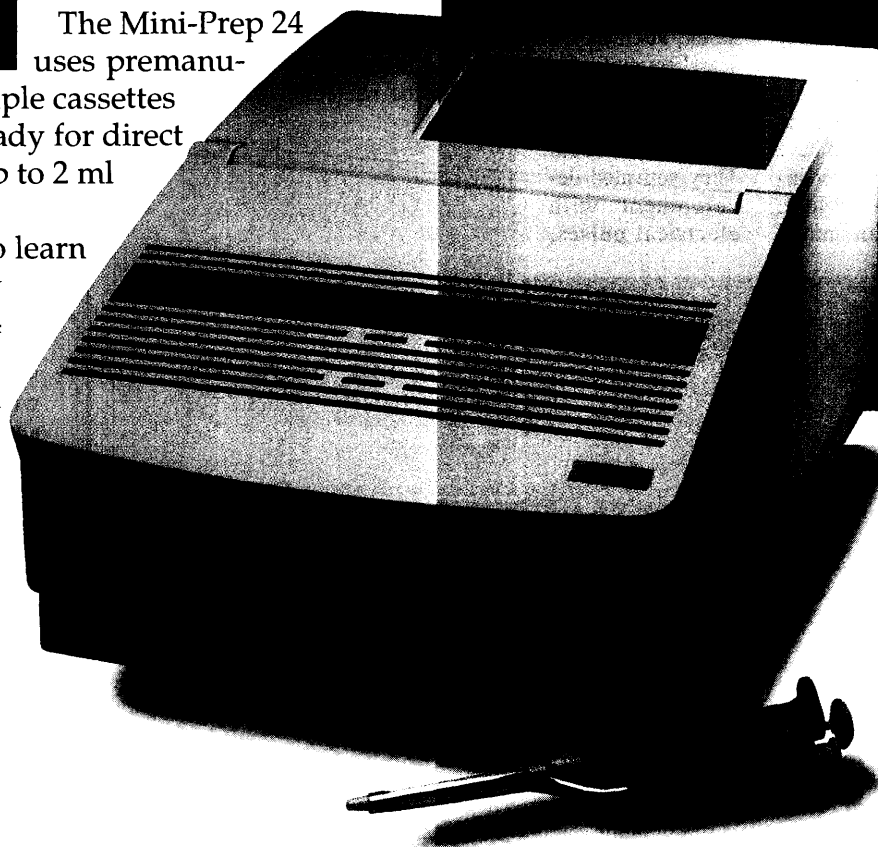
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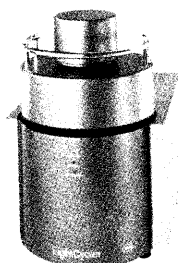
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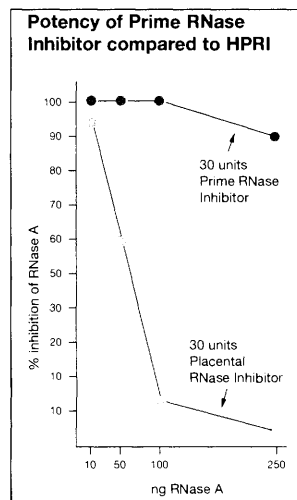
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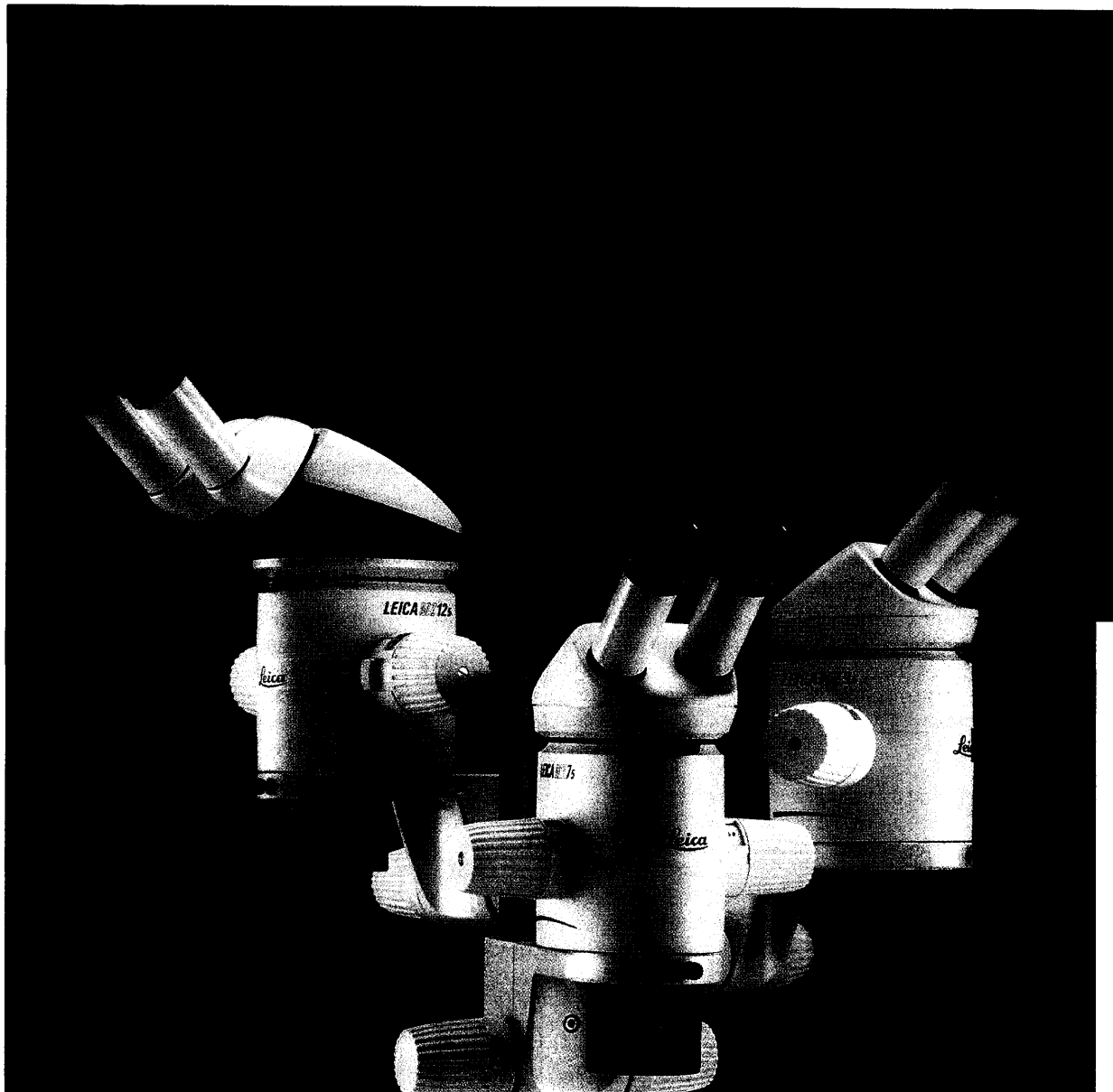
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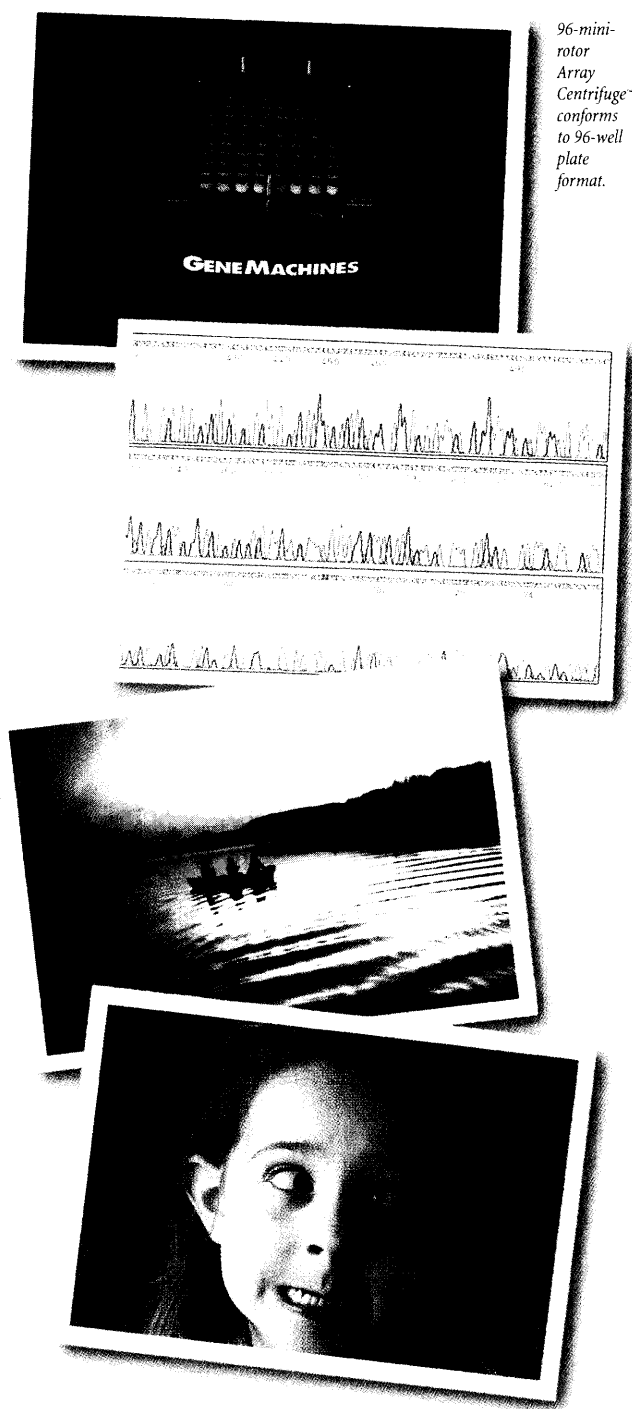
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