24 August 2001

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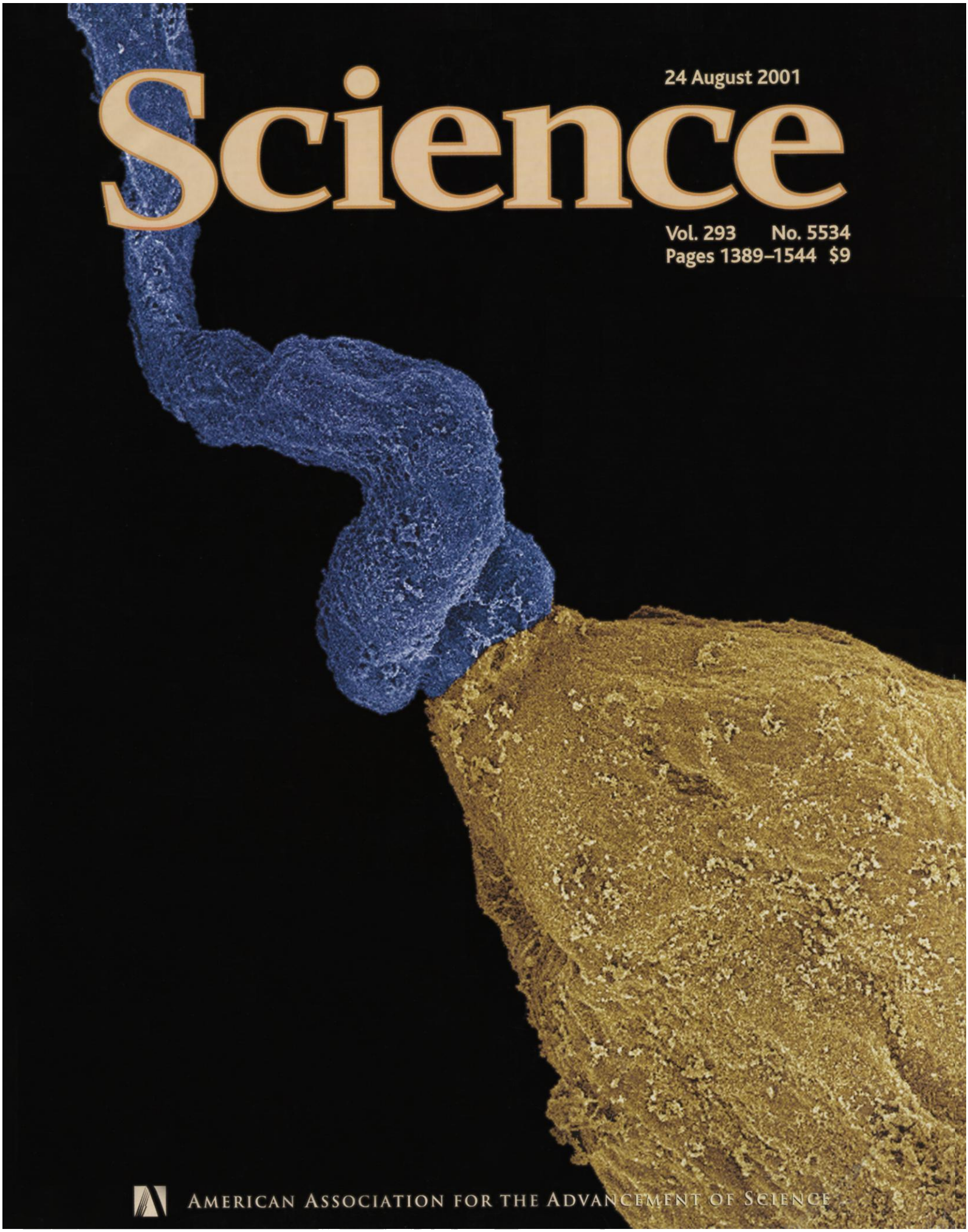
Pages 1389–1544 $9



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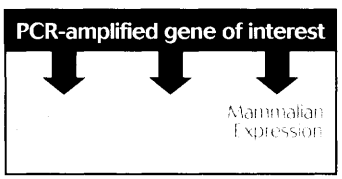

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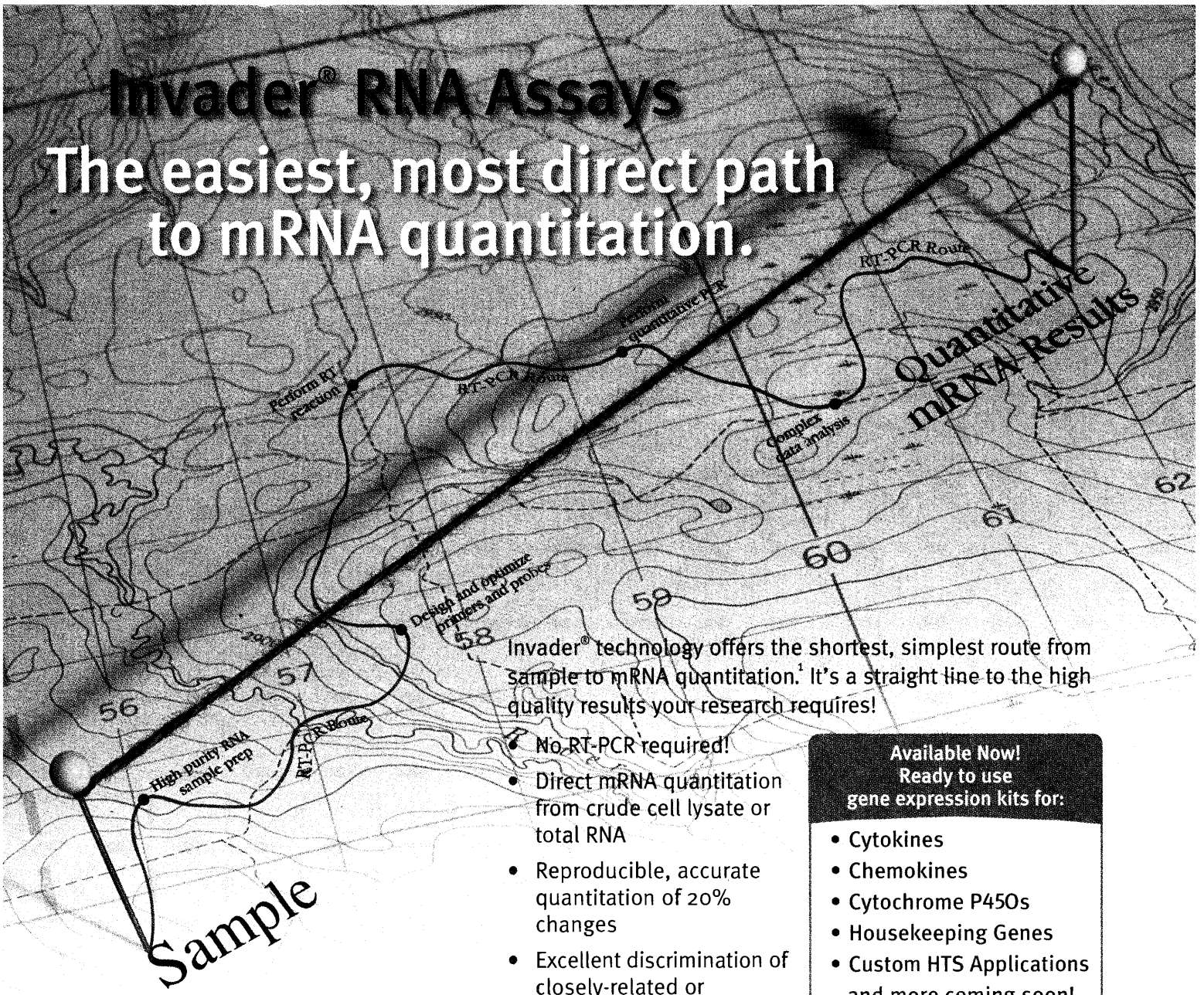

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TECHNOLOGIES

[1]Eis, P.S., Olson, M.C., et al. An invasive cleavage assay for direct quantitation of specific RNAs. Nature Biotechnology (2001) 19:673-676.

Science

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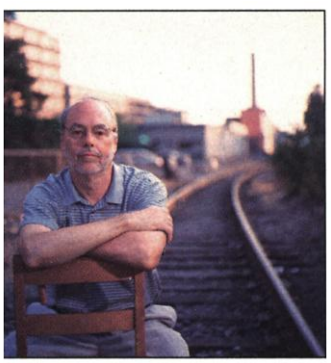
NEWS



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Tracking the brain at MIT

SCIENCE'S COMPASS

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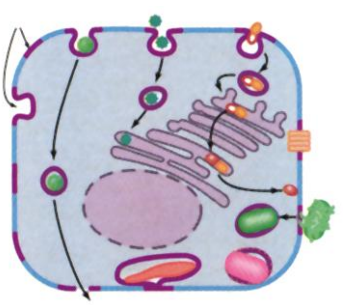
Great map of Great Britain



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Caveolae: more than craters

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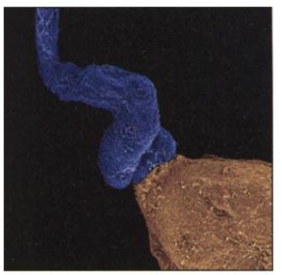
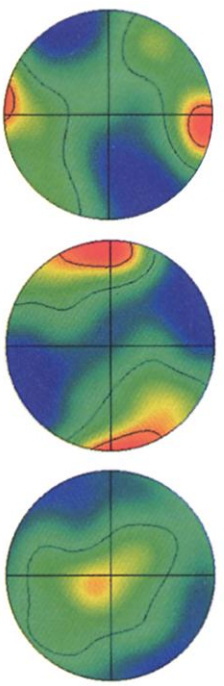
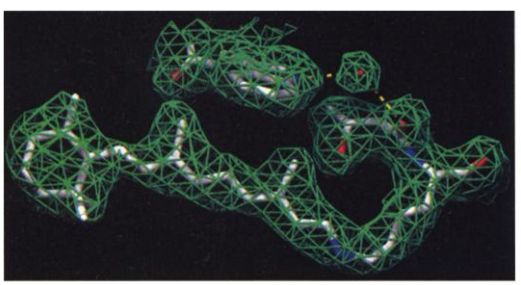


COVER 1480

A pollen tube (blue), 10 μm in diameter, thrusting into the embryo sac (haploid female gametophyte; orange) of the flowering plant *Torenia*. The pollen tube is precisely attracted to the embryo sac by two synergid cells in the sac, enabling successful fertilization. [Scanning electron microscope image: T. Higashiyama and T. Kuroiwa]

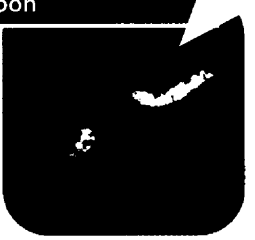


1460
Sound waves altered by wet olivine



1499
A buried sensor

New on *Science* Express Asteroidal fragment with lifeless carbon



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The Tagish Lake Meteorite: A Possible Sample from a D-Type Asteroid T. Hiroi, M. E. Zolensky, C. M. Pieters

The Organic Content of the Tagish Lake Meteorite S. Pizzarello *et al.*

The Tagish Lake meteorite, a unique carbonaceous chondrite, contains unaltered organic matter from a mixture of nebular and interstellar materials and may have been ejected from a D-type asteroid.

Genetic Basis for Activity Differences Between Vancomycin and Glycolipid Derivatives of Vancomycin U. S. Eggert *et al.*

A chemical genetics approach reveals the molecular mechanism for resistance to glycolipid derivatives of vancomycin and confirms that their mechanism of action is distinct from that of vancomycin itself.

TECHNICAL COMMENTS

On the Dynamic Origins of Allosteric Activation

Using nuclear magnetic resonance measurements, Volkman *et al.* (Reports, 23 March 2001, p. 2429) found "a strong correlation between phosphorylation-driven activation of the signaling protein NtrC and microsecond time-scale backbone dynamics." These results, they suggested, imply that functionally important protein motions are likely to be in the millisecond-to-microsecond time regime, because many biological processes occur on that time scale. Wand comments that the Volkman *et al.* study, while reporting "exciting results," inappropriately "discounted an allosteric role for subnanosecond motion" and did not sufficiently acknowledge the potential role of fast side-chain motion as "a contributor to allosteric free energy transduction in proteins." Kern responds that the concepts raised by Wand "are fundamental principles of protein biochemistry with which we have no disagreement," and that "neither our results nor our conclusions are discordant with the issues discussed by Wand."

The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/293/5534/1395a.

science's stke www.stke.org

Perspective: A Hitchhiker's Guide to the Proteasome A. G. von Arnim

How SCF complexes deliver substrates to the proteasome.

Perspective: IKKα on Center Stage J. A. DiDonato

In skin, IKKα has an activity that is independent of NF-κB; in B cells, it plays a role in regulating NF-κB precursor processing.

science's next wave www.nextwave.org

UK: European Science in the 21st Century—The View from the Lab Floor C. Sansom

Our reporter at a recent FEBS satellite meeting in Portugal discovered that a willingness to travel is an essential attribute in today's researchers.

Germany: Genetics, Stem Cells, and Therapeutic Cloning—Debating the Issues H. Maas and A. Fischer

The Social Democrats' minority leader in Saarland's parliament and a Green Party Bundestag member (and former federal minister for health) explain their positions in the ongoing debate.

US: Be Honorable and Strategic C. Golde

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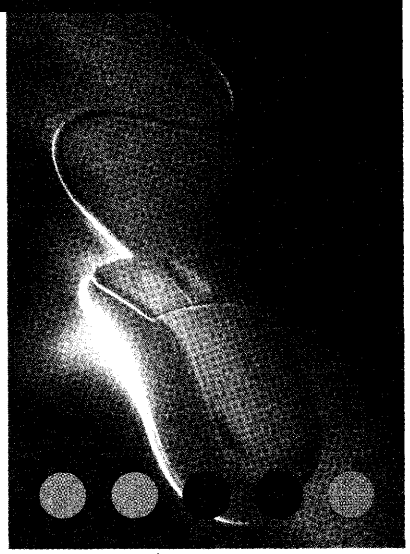

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THIS WEEK IN Science

edited by Phil Szuromi

Dissipating Decoherence

Exploiting macroscopic quantum coherence effects of superconducting systems is thought to be one promising route for developing qubits, the logical devices from which quantum computers will be built. Within this framework, the Josephson junction is one of the key components that requires further study, especially the decoherence dynamics of the junction. Han *et al.* (p. 1457) present time-resolved measurements of the decoherence dynamics of the quantum two-level system that reveal a temperature-dependent decay of the system from the ground state and the first excited state. They also observed a prominent double-exponential decay for intermediate temperatures. The measured decoherence time (>11 microseconds) shows sufficient promise for device applications.

1484 Restoring Vancomycin Efficacy

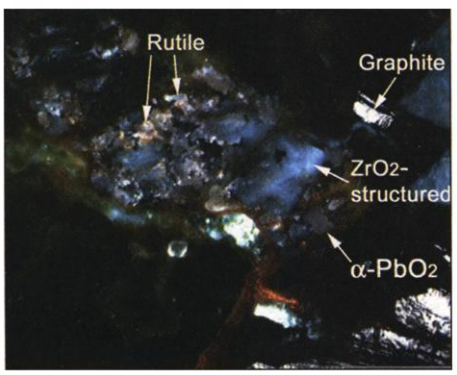
Resistance to the antibiotic vancomycin is a growing threat, especially for hospital-acquired infections. When it works, vancomycin binds to the terminal D-Ala-D-Ala of peptidoglycan building blocks and inhibits Gram-positive bacterial cell-wall assembly. In resistant bacteria, the peptidoglycan precursor termini are changed to D-Ala-D-Lac. Chiosis and Boneca (p. 1484) screened large combinatorial libraries for small molecules that hydrolyze the D-Ala-D-Lac bond, and found that the most promising leads cleaved this bond by nucleophilic attack. The authors designed a small molecule that optimized this chemistry, an N-acylated prolinol derivative, and gave it, in combination with vancomycin, to mice infected with vancomycin-resistant enterococci. Antibiotic sensitivity recovered by an order of magnitude, thus offering a promising approach toward therapeutics.

Deep Earthquakes

The mechanisms that cause a fault plane to rupture at depths greater than 100 kilometers are poorly understood. Wiens and Snider (p. 1463) analyzed three clusters of deep earthquakes along the Tonga subduction zone near Fiji and found that these events created small ruptures at about the same time and same location. This spatial and temporal distribution suggests that thermal shear instabilities cause these kinds of ruptures and that subsequent events can be triggered by the thermal energy of the initial shear that has not had time to dissipate.

Dense Rutile

Rutile (titanium dioxide) is a common accessory mineral in terrestrial rocks and meteorites. The titanium cation is coordinated to four oxygen anions, but with increasing pressure and temperature, more oxygen anions may be coordinated. Now, El Goresy *et al.* (p. 1467) have found an extremely dense phase of rutile in shocked gneisses from the Ries impact crater in Germany. The titanium cation is coordinated to seven oxygen anions, which has not previously been found in natural samples, and provides a useful diagnostic for determining the environment in which rocks and meteorites may have formed.



CREDIT: EL GORESY ET AL.

Underground Activity

The strontium isotopic composition of ocean water is an important indicator of changes in continental weathering in the geologic past that has been used to infer variations in tectonic uplift, the types of rocks eroded, and glaciation. Oceanic Sr budgets are based mostly on river inputs, and have not considered groundwater as a significant source. Basu *et al.* (p. 1470) have measured groundwater Sr fluxes and isotopic ratios and found that groundwater can transport large amounts of Sr with values of $^{87}Sr/^{86}Sr$ similar to those of river water from the Ganges-Bramaputra River delta into the Bengal Basin. Their data suggest that variations of oceanic Sr isotopes that have occurred during the past 40 million years should be interpreted in light of these higher inputs.

Polarized Photodetectors

Quantum confinement effects can lead to polarized photoemission from ellipsoidal quantum dots. However, classical effects also can lead to strongly polarized photoluminescence from relatively wide nanowires (20-nanometer diameter) made of indium phosphide. Wang *et al.* (p. 1455) demonstrate an order-of-magnitude difference in the parallel and perpendicularly polarized emission and explain this difference in terms of dielectric contrast. They exploit these effects to create a polarization-dependent photodector.

Two Elephant Species in One

Elephants in Africa inhabit two major vegetation types—savannah/bush and forest. Forest elephants differ in various aspects of size and morphology from savannah/bush elephants, but—with some dissenting voices—most systematists have regarded them as members of a single species, *Loxodonta africana*. Roca *et al.* (p. 1473; see the news story by Vogel) compared the DNA sequences from the two forms in four nuclear genes and found extensive genetic divergence between them and very little hybridization. The molecular data suggest separate evolution for at least the past 2.5 million years and that the forest and savannah elephants should be classified as two distinct species that require individual attention in conservation programs.

Following Plant Fertilization

In flowering plants, fertilization is facilitated by the pollen tube, which must wend its way from where the pollen grain lands to its target, the female gametophyte, to which the immotile male gamete is delivered. Higashiyama *et al.* (p. 1480; see the cover and the Perspective by Cheung and Wu) have used laser ablation to in-

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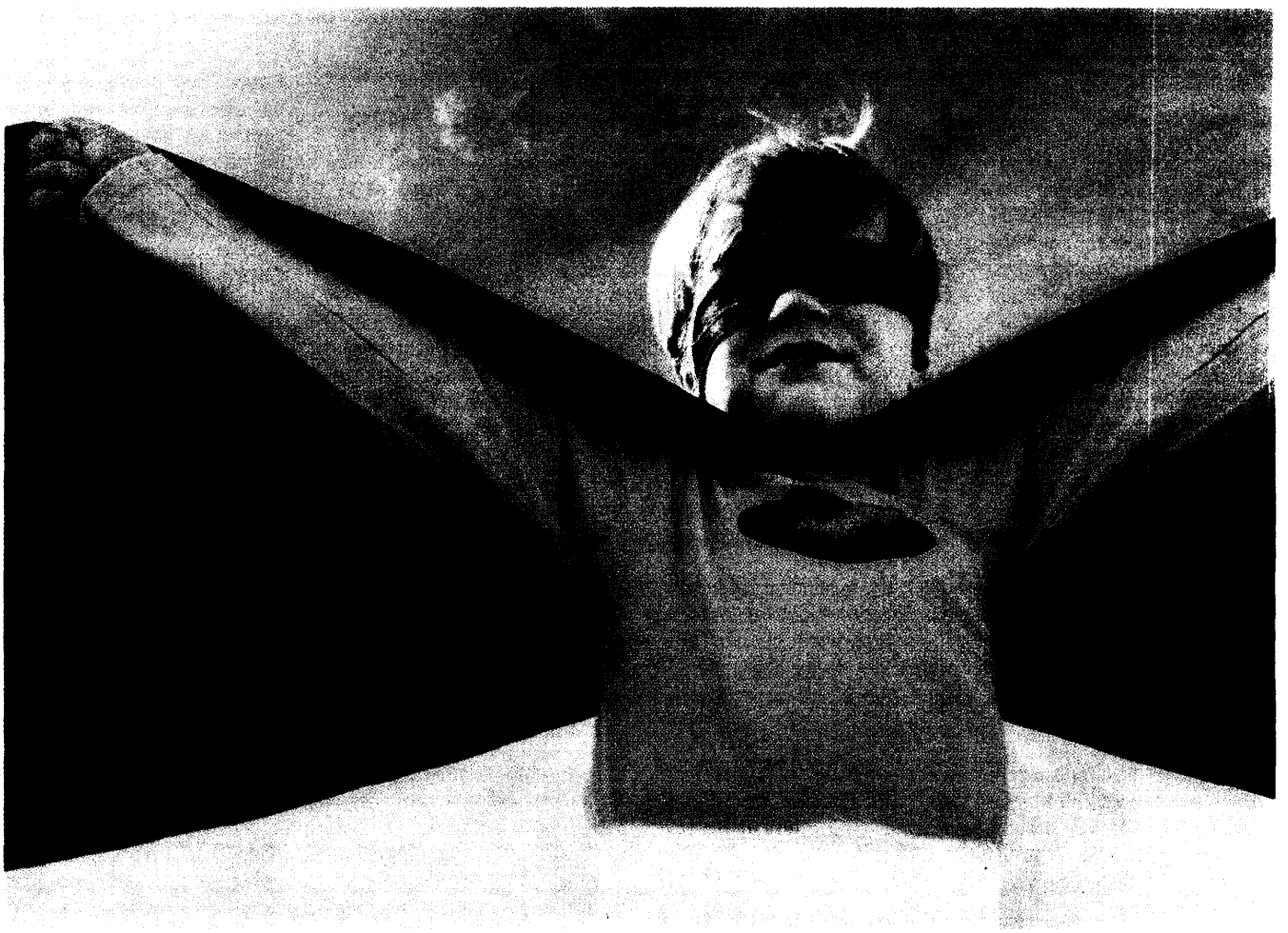
ligation in a flash.



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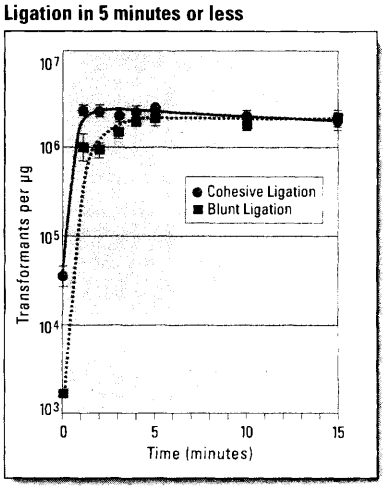

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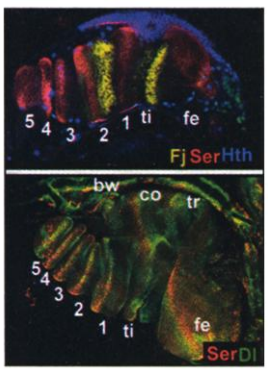
vestigate the sources of signals that guide the growing pollen tube to its destination. Ablation of the two synergid cells only, which lie adjacent to the egg cells, resulted in mistargeted pollen tubes. The synergid cells, which send an attractive signal before fertilization, ceased to be attractive after fertilization, offering one line of defense against supernumerary fertilizations.

Starting With a Leg Up



The ventral appendages of the fruit fly *Drosophila melanogaster*, which include the antennae, legs, genitalia, and analia, are structurally very different from each other. It is known that the selector genes specify the identity of these appendages. Altering the expression of various selector genes will "transform" one appendage into another. Casares and Mann (p. 1477) hypothesized that in the absence of selector gene activity, one could detect a "ground state" appendage. They go on to show that when selector gene function was eliminated, a simple leglike appendage resulted which contained only two segments—a promixal segment and a distal tarsus. This finding suggests that the predecessor of arthropods may have had simpler, unsegmented legs.

Connecting Plaques and Tangles

Controversy still rages over which of the two hallmark pathologies of Alzheimer's disease, amyloid plaques and tau tangles, is the primary cause of neurodegeneration in the brain. Two reports by Lewis *et al.* (p. 1487) and Götz *et al.* (p. 1491) now show that the two pathologies are not unconnected (see the Perspective by Lee). Working with transgenic mice, the two groups independently demonstrate that β-amyloid deposits in the brain influence the formation of tau tangles in areas of the brain known to be affected in Alzheimer's disease.

Sensory Rhodopsin Structure

Retinal (of which vitamin A is the alcohol) is the chromophore of the rhodopsin family of proteins. Haloarchaea contain four members of this family, two of which, halorhodopsin and bacteriorhodopsin, convert solar energy (green-orange light) into transmembrane gradients of chloride and protons, respectively. Luecke *et al.* (p. 1499) describe the crystal structure of a third member, known as sensory rhodopsin II, which mediates avoidance of more energetic and potentially harmful blue light and coordinated repression of bacteriorhodopsin and halorhodopsin under environmental conditions that allow the use of other sources of nutrients and energy. Three points now become clear: (i) How the local environment of the retinal chromophore is tuned to optimize absorbance of shorter wavelength light; (ii) why this family member does not transport ions; and (iii) how this sensor communicates with downstream signaling components.

Priming Speeds Replication

Human immunodeficiency virus (HIV) depends on cellular activation for efficient replication, so the resting state of most T cells is not ideal for viral propagation. Wu and Marsh (p. 1503) observed that two HIV proteins produced early in the HIV replication cycle have the capacity to sensitize T cells toward cellular activation. Remarkably, the two proteins, Nef and Tat, are produced by the selective transcription of the pro-viral DNA before it has integrated into the host genome. This distinctive mode of early cellular activation may be an important means by which the T cell host is primed for HIV replication.

Seeing Shapes Versus Curves

The representation of objects is central to visual perception, yet it has been surprisingly difficult to pinpoint precisely where in the visual processing pathways this occurs. Kourtzi and Kanwisher (p. 1506) present evidence in favor of the lateral occipital complex. By comparing brain activation responses to changes in contours (whilst maintaining the same shape) with responses to changes in shapes (holding contours constant), they conclude that this region of the brain "sees" entire shapes and not merely the constituent curves.

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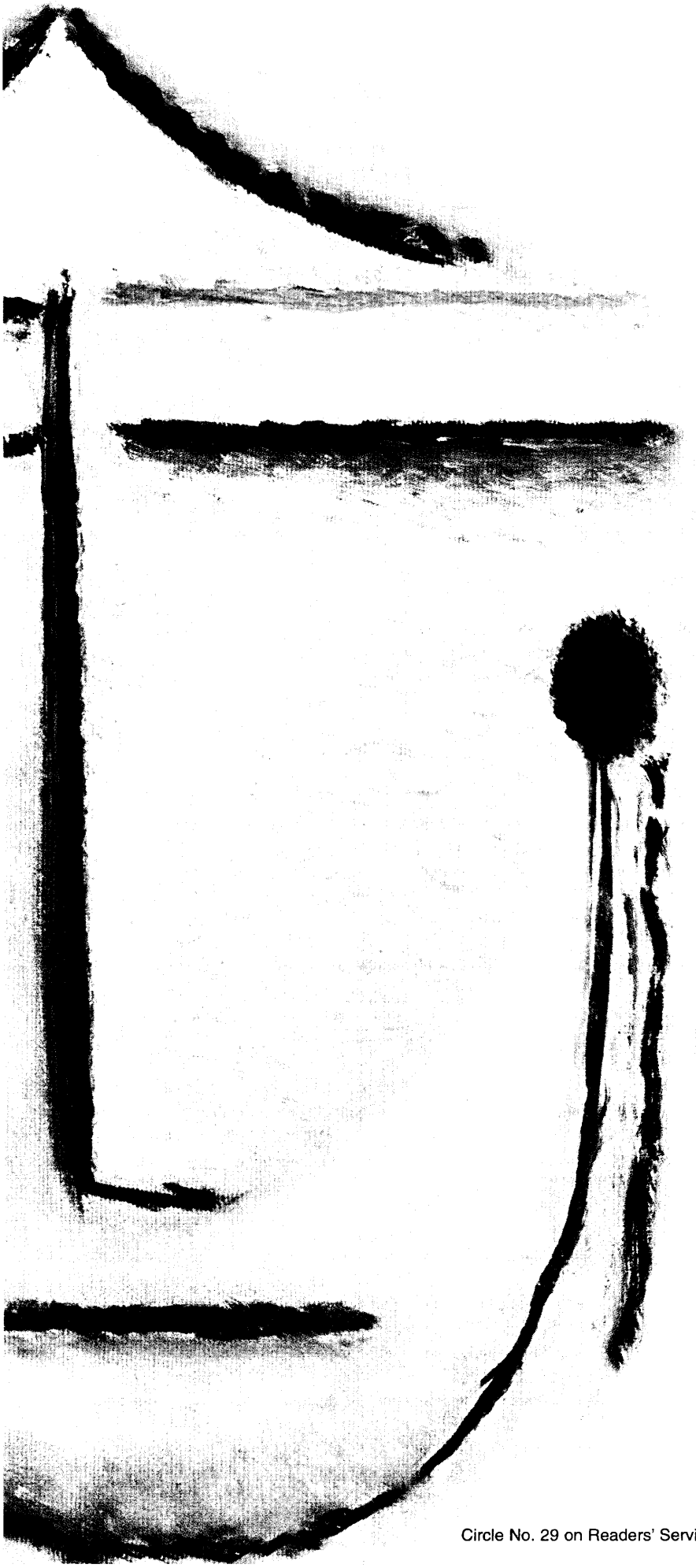

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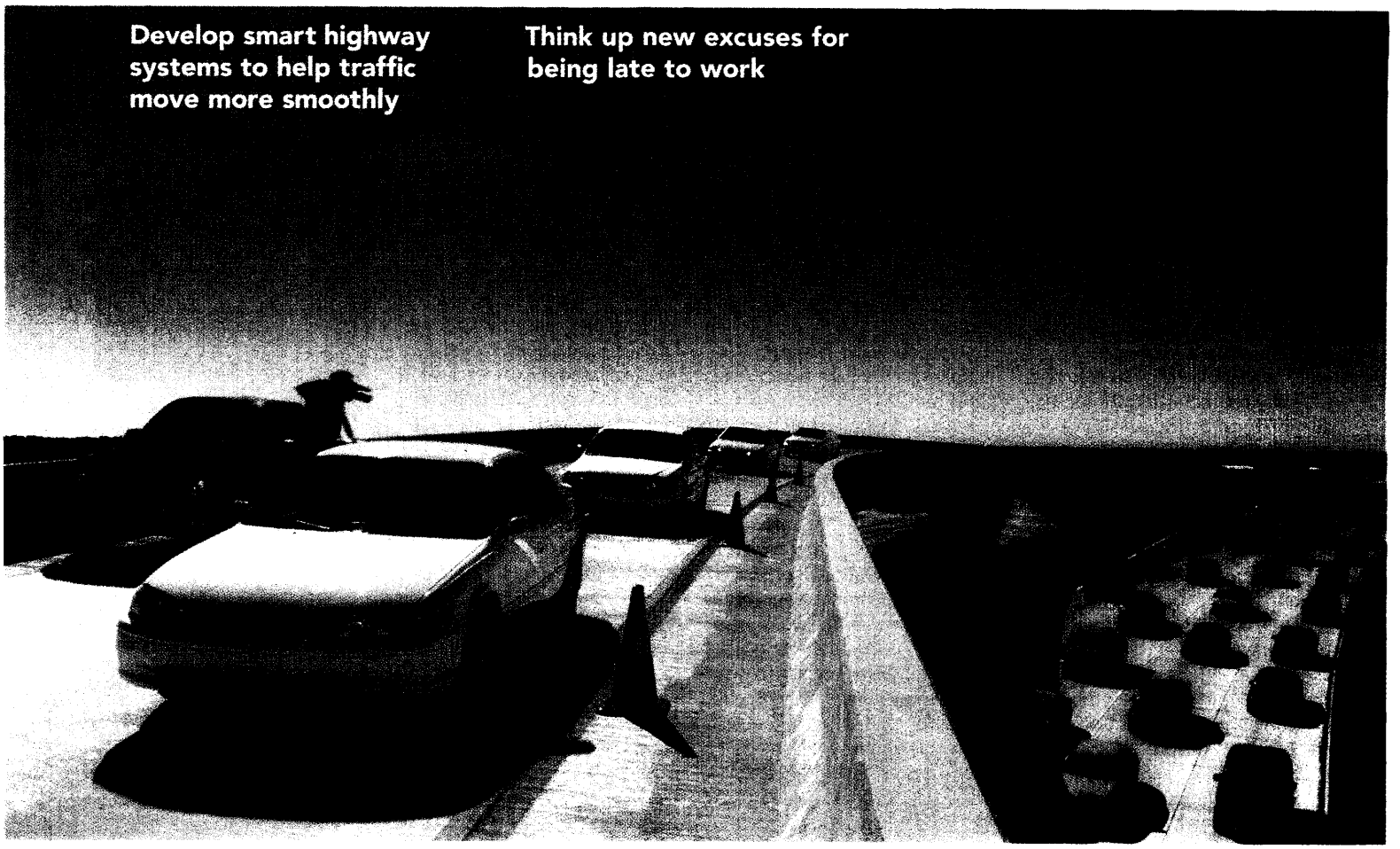

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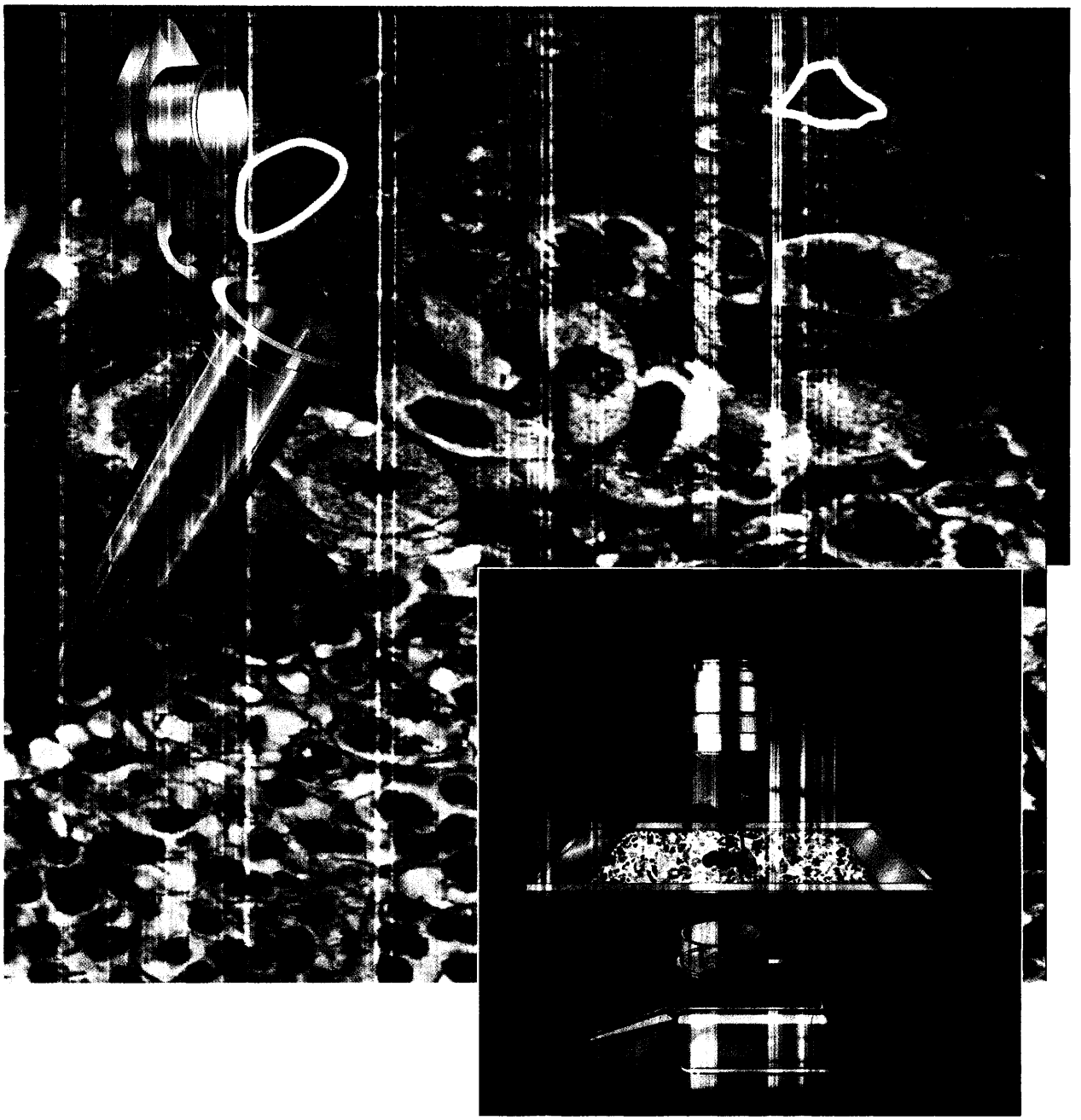

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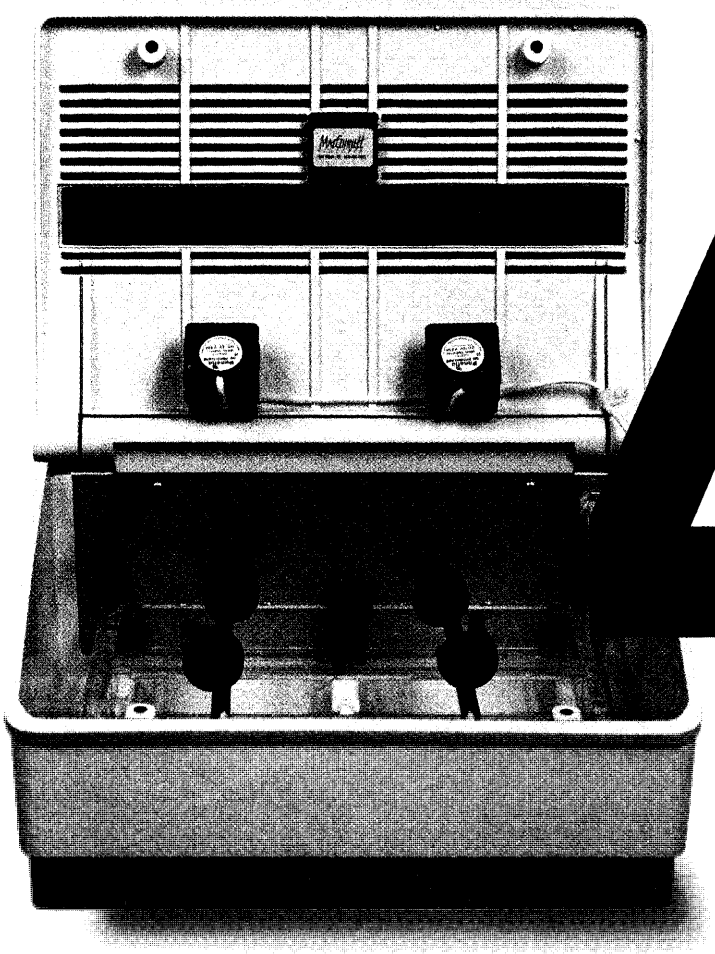

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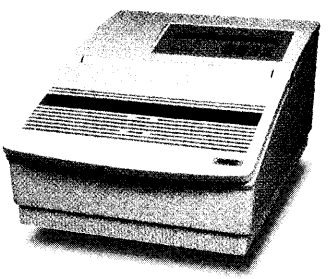

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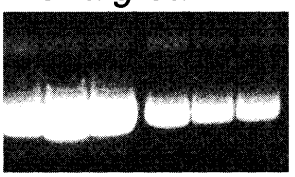

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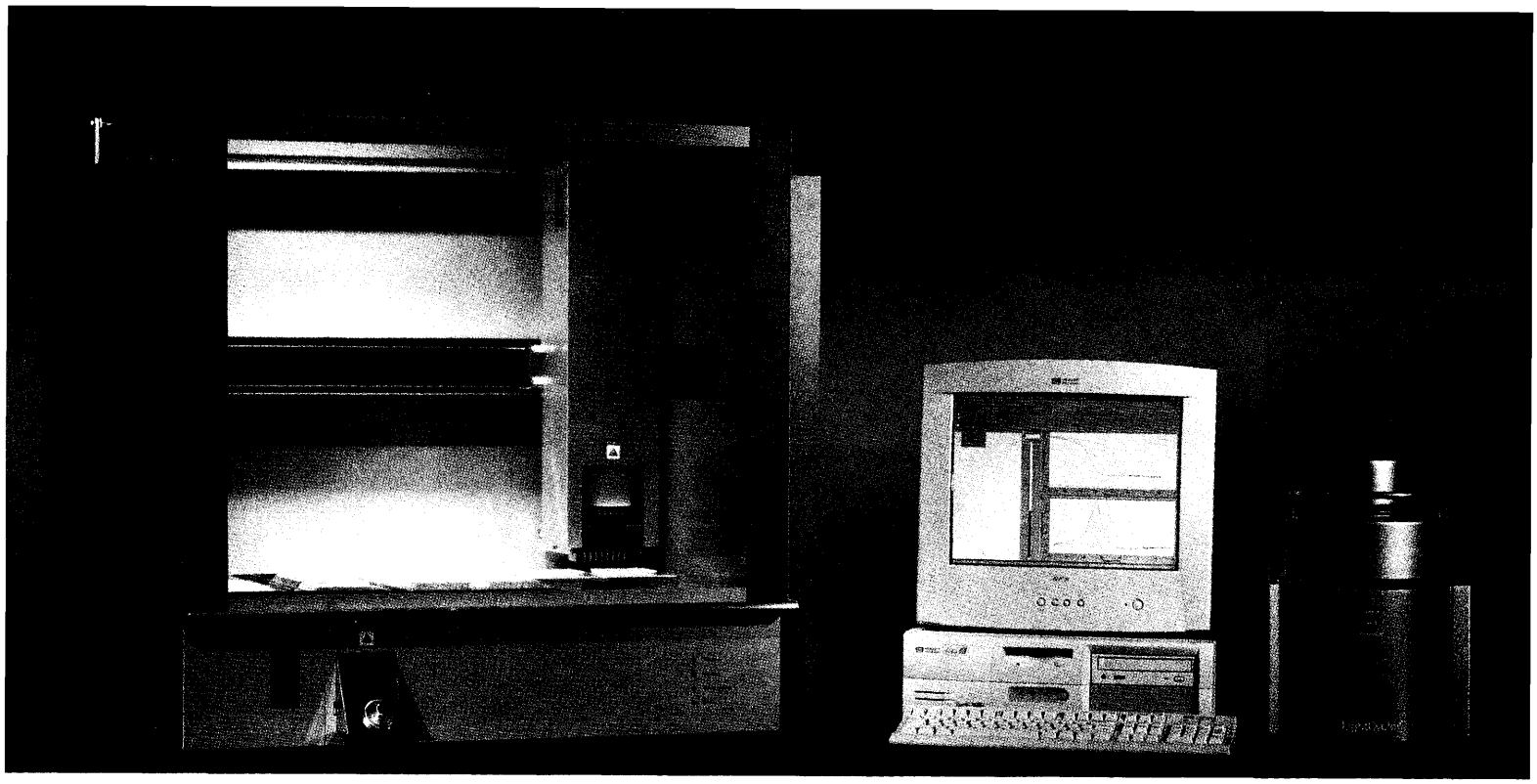

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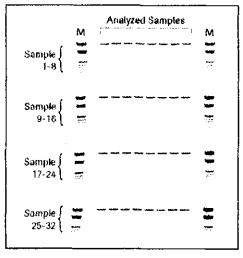

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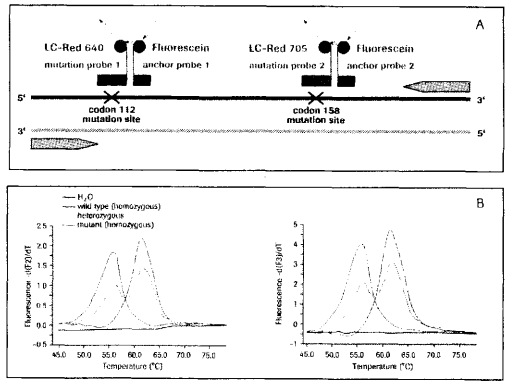

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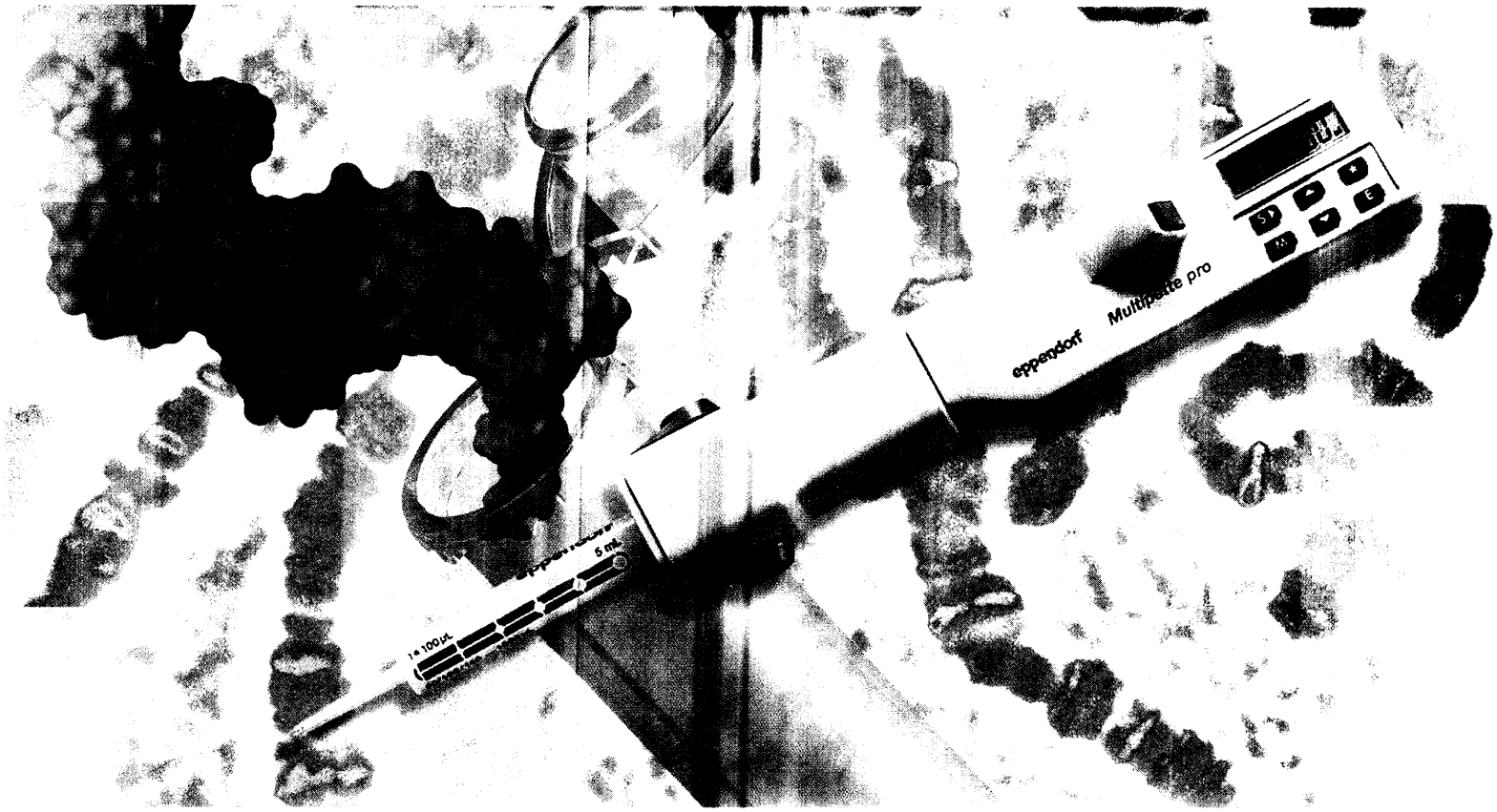

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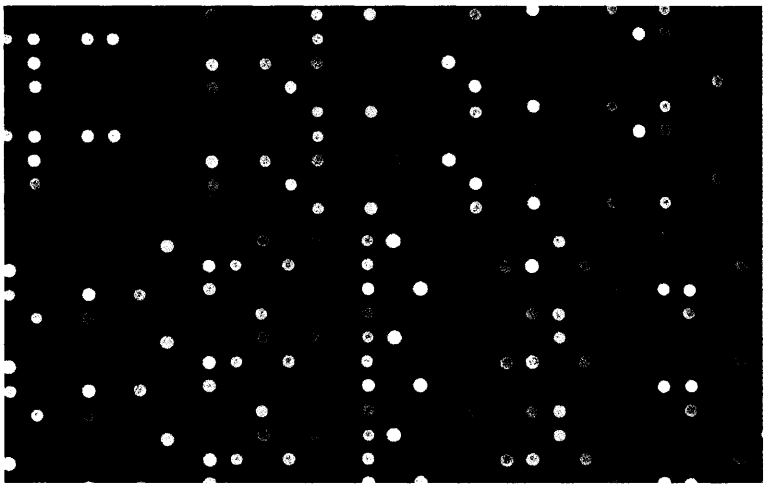

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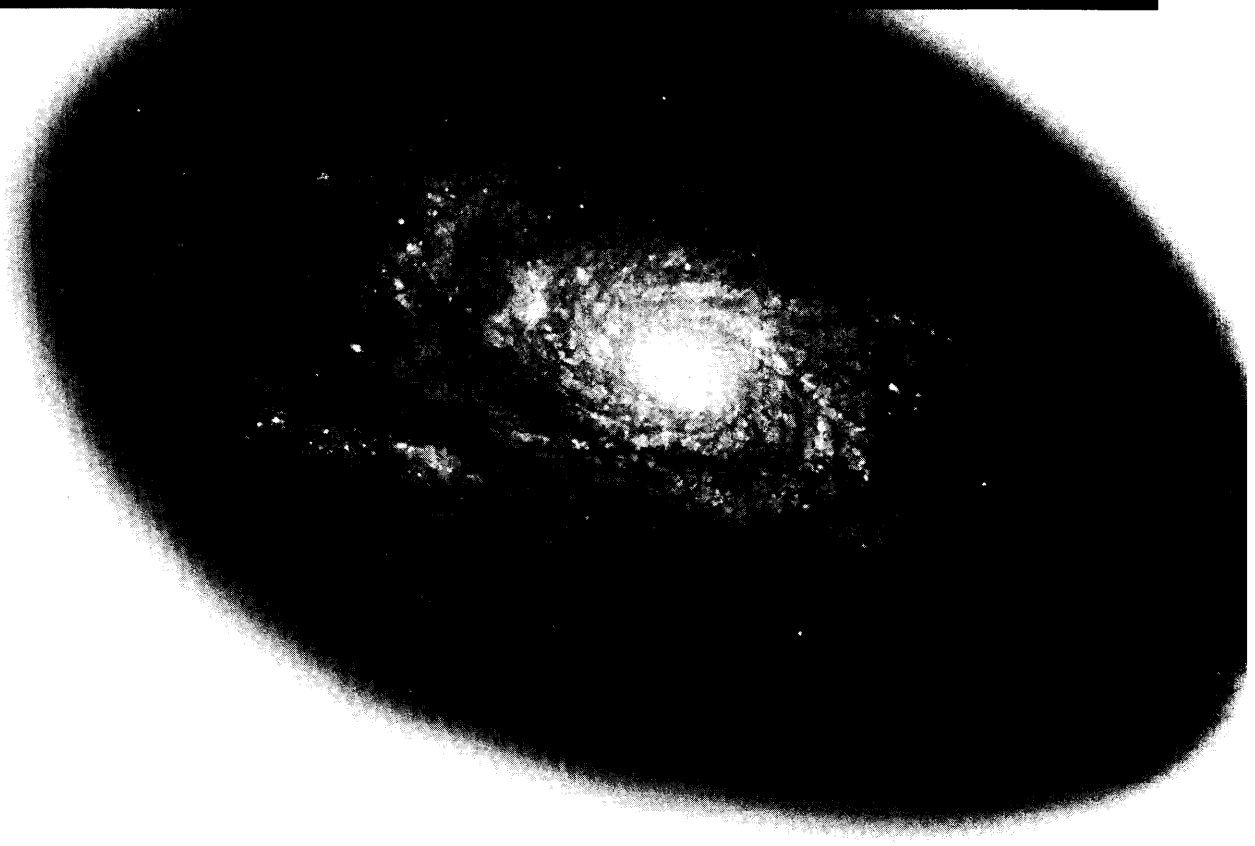

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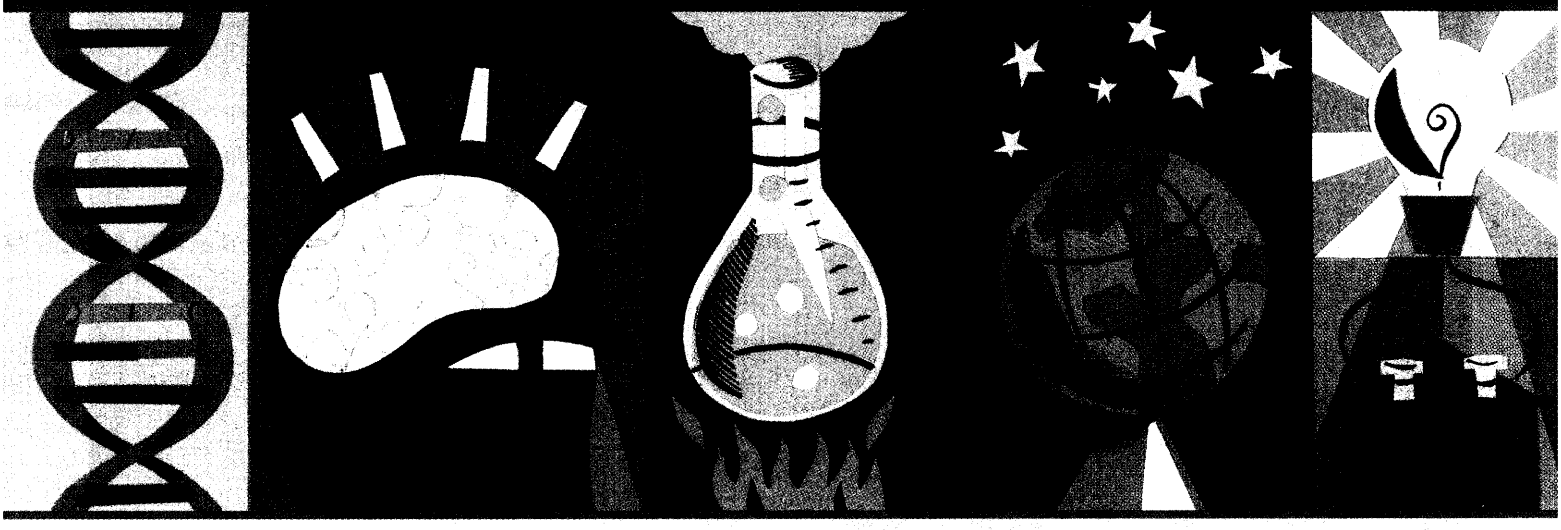

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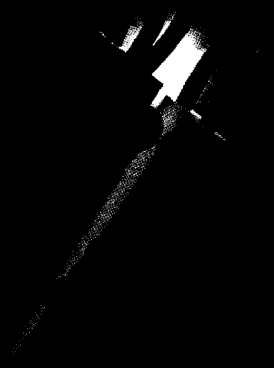

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