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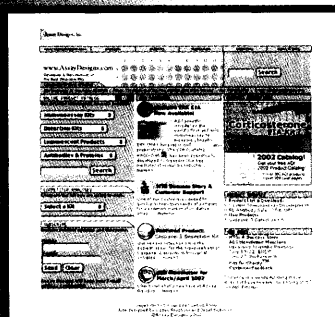
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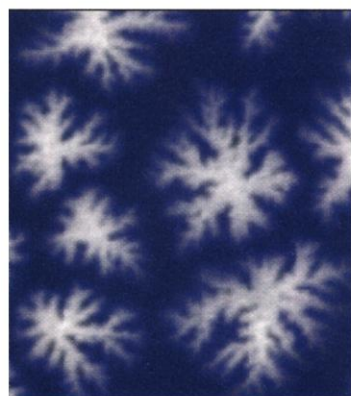
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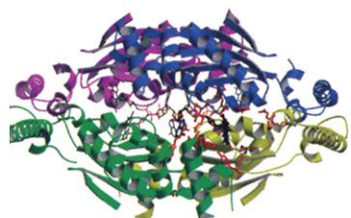
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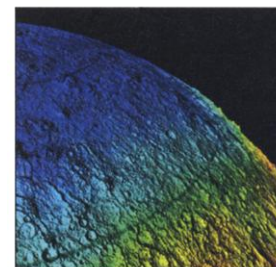
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The south polar region of Mars is highly enriched in hydrogen (blue) in the form of water ice buried less than a meter beneath the surface, as revealed by the Mars Odyssey Gamma-Ray Spectrometer measurements of gamma-ray and epithermal neutron flux. The topographic relief (exaggerated) is from the Mars Orbiter Laser Altimeter. Three reports in this issue focus on martian hydrogen distribution. [Image: G. Shirah, Goddard Space Flight Center; W. Boynton and W. Feldman]

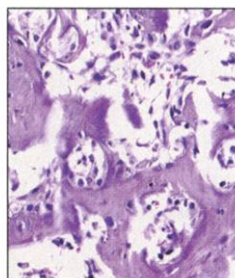
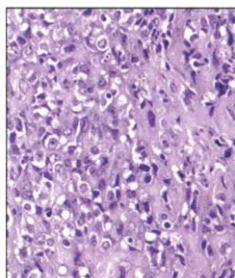


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Switching oncogenes off and on



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A transcription factor that is also a photoreceptor



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SCIENCE EXPRESS

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White Collar-1, a Circadian Blue Light Photoreceptor, Binding to the frequency Promoter A. C. Froehlich, Y. Liu, J. J. Loros, J. C. Dunlap

White Collar-1, a DNA Binding Transcription Factor and a Light Sensor Q. He, P. Cheng, Y. Yang, L. Wang, K. H. Gardner, Y. Liu

In the fungus *Neurospora crassa*, a component of the circadian clock, White Collar-1, is revealed to be a FAD-utilizing photoreceptor as well as a transcription factor.



Use of Ionic Liquids for π -Conjugated Polymer Electrochemical Devices

W. Lu *et al.*

Combining conducting polymers with ionic liquids is shown to lead to a lifetime extension of actuators and other electrochemical devices.

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career resources for scientists

GLOBAL: From Benchtop to Blackboard—Scientists in Schools
Edited by J. Austin

Many nations have a shortage of science teachers and an abundance of young scientists who are eager to teach, but filling those jobs with those scientists isn't always easy.

GERMANY: The Never-Ending Debate S. Steghaus-Kovac

A continuing discussion on the effects that university reform will have on the careers of young scientists.

UK: Biotechnology in Britain—Growth and Opportunities E. Pain

At the BiologyInBusiness network, Chris Lowe, director of the Institute of Biotechnology, paints an optimistic picture of the UK biotech industry.

EUROPE: Who Cares About Slovak Ph.D. Students? G. Gregušová

Despite poor stipends and the prospect of low wages upon qualification, Ph.D.'s are increasingly popular in Slovakia.

US: Postdoc Parents See Room for Improvement J. C. Reddy

A physician-scientist describes how parenthood turned her into an agent for change.

AUSTRALIA: Contract Versus Tenure—Which Way to Go? T. J. Piva

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Protocol: Screening for Gene Regulation Mutants by Bioluminescence Imaging V. Chinnusamy, B. Stevenson, B. Lee, J.-K. Zhu

A method for identifying plants with defective stress responses.

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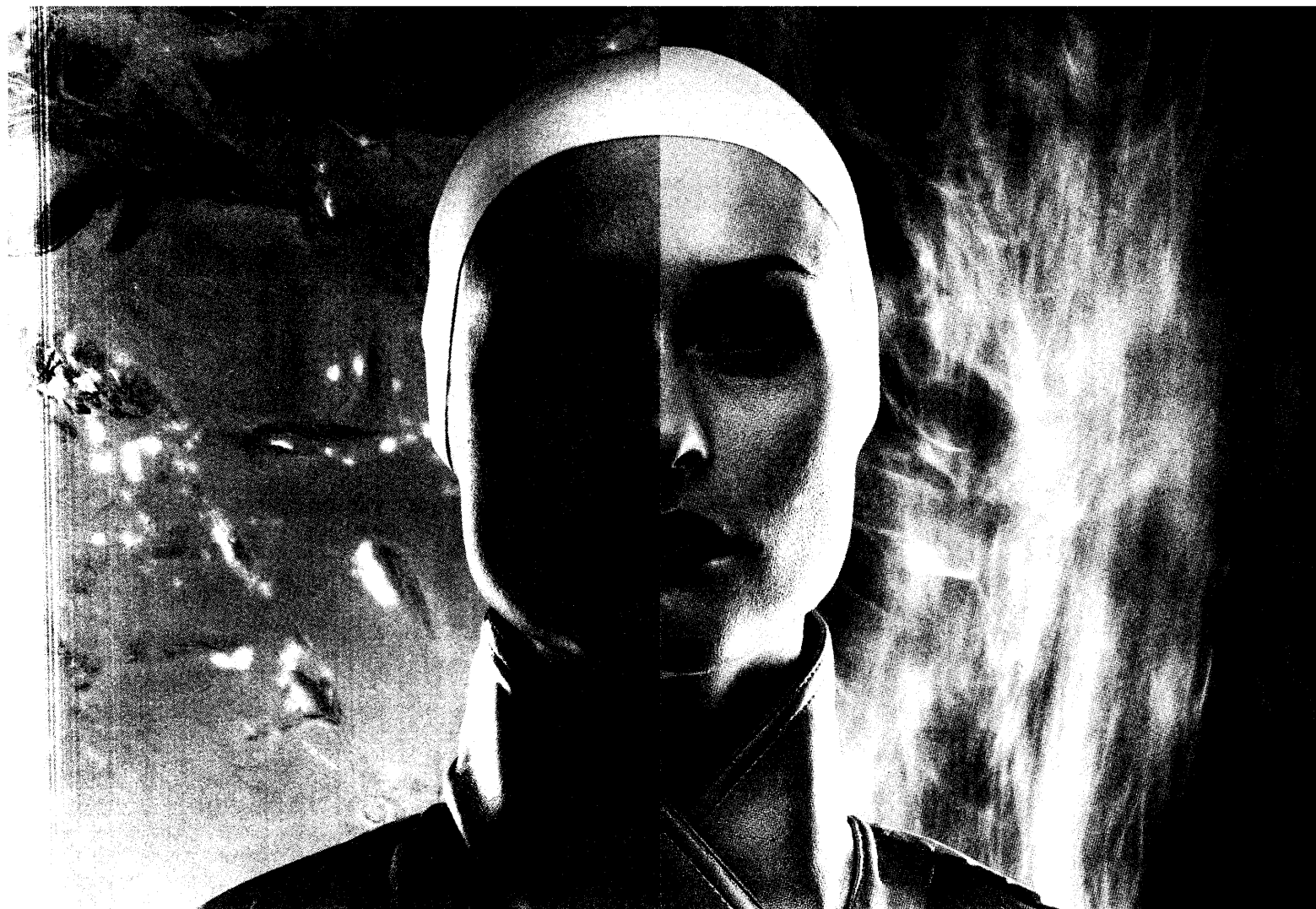
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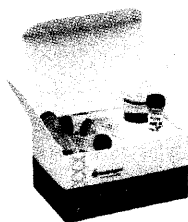
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THIS WEEK IN Science

edited by Phil Szuromi

RecA Resists for Nanowiring

One approach to wiring together nanometer-scale electronics relies on using DNA as a template—the ends of a long DNA molecule are designed to hybridize to components bearing complementary strands, and the DNA is then metallized. Keren *et al.* (p. 72; see the Perspective by Niemeyer) show that the major protein responsible for homologous recombination in *Escherichia coli*, RecA, can be used to pattern metallized DNA. RecA was polymerized on single-stranded DNA molecules, which were then hybridized to double-stranded DNA substrate molecules. RecA could be used either lithographically to create nonmetallized gaps in the DNA, or to perform recombination reactions that created branched networks.

More from Dmanisi

Studies at Dmanisi, Georgia, have shown that early *Homo* migrated out of Africa by 1.75 million years ago. Vekua *et al.* (p. 85; see news story by Balter and Gibbons) now report a new hominid skull and mandible from this site. Together, these fossils represent the largest collection of individuals from any one site older than about 800,000 years ago. The specimens may even have been from a common group. Regardless, their diversity may provide a view of the variation in morphology of early hominid species. This newly discovered hominid has a relatively small brain, implying that evolution in brain size may not have determined when migration out of Africa occurred.

Getting to the Root of It All

Despite decades of phylogenetic research, the position of the root of the eukaryotic tree has remained controversial. Stechmann and Cavalier-Smith (p. 89) have used a gene fusion that is almost certainly derived and compared it to the ancestral bacterial condition to show that the root must lie below the divergence point between opisthokonts (animals, fungi, and Choanozoa) and biciliated eukaryotes (which include plants, chromists, and almost all protozoa). This new evidence is congruent with a simple interpretation of the evolution of the eukaryotic cytoskeleton and a basic divergence in mitochondrial structure, and is the most substantial advance to date in clarifying the position of the root and the nature of the first eukaryote.

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78
81

Subsurface Martian Water

Since February 2002, the Gamma-Ray Spectrometer, Neutron Spectrometer, and High Energy Neutron Detector on board the 2001 Mars Odyssey mission have been used to map the flux of gamma rays and secondary neutrons, which are attributed to hydrogen concentrations in the top meter of the martian surface. Results from just 30 to 60 days of data presented by Feldman *et al.* (p. 75; see the cover), Mitrofanov *et al.* (p. 78), and Boynton *et al.* (p. 81) indicate that, at high latitudes ($>60^\circ$) near both poles, a putative water ice-rich layer exists about 30 to 60 centimeters below the surface (see the Perspective by Bell). This layer, which is tens of centimeters in thickness, may contain 20 to 35% by weight of water ice, and this ice would fill in most of the estimated porous regolith at this depth. Nearer the equator, the depth of this layer increases to about 100 centimeters, and the amount of possible water ice in the layer decreases. Thus, Mars may have collected and concentrated a significant amount of water just below the surface at both poles. The presence of water is consistent with a wetter past, seasonally modulated water transport, current gully formation by subsurface water-ice erosion, and the potential for a higher concentration of water than expected beneath the martian surface. $\times$

And in Brevia ...

A technique developed by Park *et al.* (p. 65) allows refractory oxides, such as zirconium oxide, to be grown as crystalline thin films at low temperatures ($\sim 130^\circ\text{C}$) and on plastic substrates.

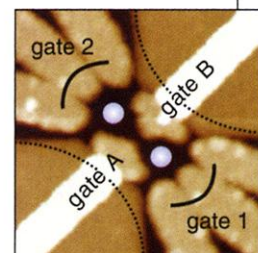
An On/Off Switch for Oncogenes

Among the many new strategies being developed for cancer therapy are drugs that inhibit the function of oncogenes that are involved in tumorigenesis. Such drugs might be toxic if used chronically, yet they might be ineffective in the short term because of possible reactivation of the oncogene once treatment is stopped. To investigate the latter possibility, Jain *et al.* (p. 102; see the Perspective by Weinstein) used a sophisticated mouse genetic model to examine what happens to *MYC*-induced tumors when the *MYC* oncogene is briefly inactivated and subsequently reactivated. Surprisingly, they found that transient *MYC* inactivation leads to permanent loss of the neoplastic phenotype. When *MYC* was removed, osteogenic sarcoma cells differentiated into bone cells; re-expression of *MYC* did not restore the cells' tumorigenic potential but, rather, caused the cells to undergo apoptosis. These results suggest that brief inactivation of an oncogene may permanently

change the epigenetic context of a tumor cell so that it cannot revert to its original malignant behavior.

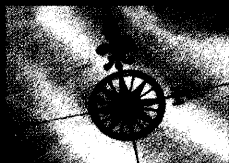
Quantum Dot Molecules

Quantum dots, like molecules, have discrete energy levels that can be tuned by varying their size and composition. Holleitner *et al.* (p. 70) have controlled the coupling between two quantum dots with a technique based on cotunneling of electrons through each of the dots. They then probe the development of energy spectra analogous to the formation of molecular levels.



Block That Catch?

Fisheries management is based mainly on population dynamics, but in response to predation, it is conceivable that populations might evolve rapidly, which could lead to diminished yields. Conover and Munch (p. 94) harvested large, small, or randomly sized members of an exploited fish, the Atlantic silverside (*Menidia menidia*), from captive populations over four generations. Harvesting large individu-

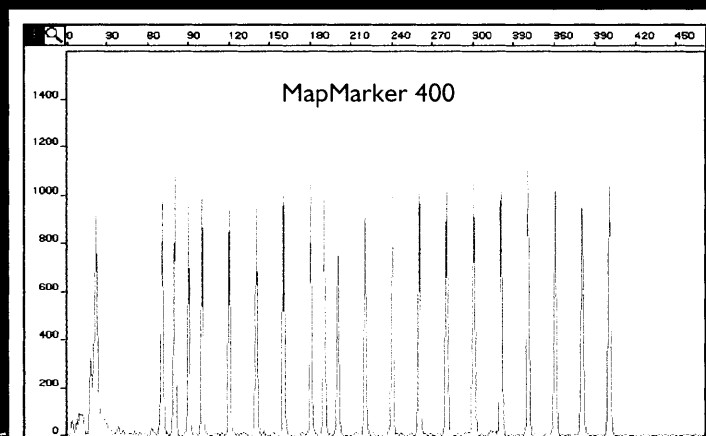


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als initially increased overall catch but quickly led to lower yields, as slow-growing phenotypes began to dominate. The authors suggest that creating no-take reserves or enforcing a maximum size limit may preserve the genetic variability in wild populations.

Second-Sourcing Thymidylate

It might be assumed that mechanisms for the biosynthesis of essential DNA precursors would be conserved in all organisms. However, Myllykallio *et al.* (p. 105) show that a large class of proteins that do not have sequence similarity with the classic thymidylate synthase (ThyA) synthesizes thymidylate by a different mechanism. These enzymes (ThyX) are mainly limited to microbial genomes that lack ThyA and are an important drug target as they occur in several human pathogens. In a Perspective, Murzin comments on a rare confluence of events in which the functional characterization is complemented by the recent structural characterization of ThyX by the Joint Center for Structural Genomics. *X*

Compensating for Nonsense

Mutations that introduce premature termination codons (nonsense) can affect alternative splicing of transcripts by disrupting exonic splicing enhancers. Wang *et al.* (p. 108) have examined a T cell receptor (TCR) gene that acquires nonsense codons at high frequency during normal T cell development. In contrast to previous explanations, they show that nonsense-associated altered splicing (NAS) is enhancer independent. Instead, it appears that nonsense codons up-regulate alternatively spliced messenger RNA by a translation-like mechanism.

Sticking with It

Specification of cell lineage requires early decisions that, in some cases, may be reversible. The transcription factor Pax5, is required for entry into the B cell lineage via the repression of non-B cell genes and establishment of the B cell-specific gene profile. After conditionally inactivating the *Pax5* gene, Mikkola *et al.* (p. 110) observed that the developmental program of committed early B cells could be reset. As a result, other myeloid and lymphoid lineages could be derived from these cells in vivo and in vitro. This type of persistent control over early lineage preservation may prove an important general principal in upholding cell fate decisions.



Taking Degradation to Heart

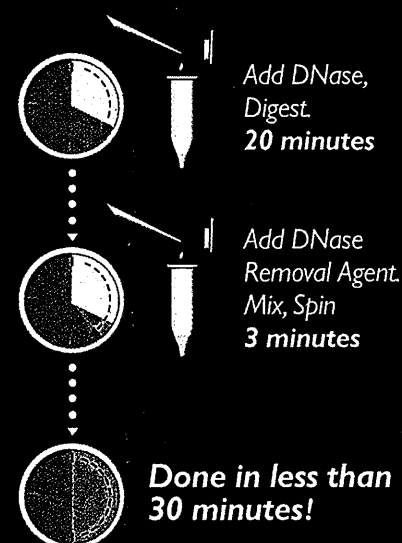
The ubiquitin pathway of protein degradation has gained prominence as a major regulatory network in mammalian cells. Arginine is commonly conjugated to the amino-terminus of proteins during ubiquitin-dependent degradation, but the physiological functions of arginylation are unknown. Kwon *et al.* (p. 96) generated mice genetically deficient in one of the Arg-tRNA-protein transferases catalyzing this modification (ATE-1) and found that the embryos die from defects in heart development and angiogenesis. The authors also discover a possible mechanism for the early cardiac defects: Amino-terminal cysteine is oxidized prior to its arginylation by ATE-1, suggesting that the amino-terminal arginylation may function as an oxygen sensor.

Breaking the Mold

Drosophila protect themselves against bacterial and fungal infection by secreting antimicrobial peptides from the fat body, the insect equivalent of the liver. One mechanism required for initiating this in response to Gram-positive bacteria and fungi is provided by the Toll pathway, which is activated via binding of a proteolytically cleaved form of its ligand Spaetzle. Using mutagenesis screening, Ligoxygakis *et al.* (p. 114) identified mutants for a serine protease gene named *persephone*, which suppressed the Toll-dependent antifungal response. Unlike other activators of the Toll pathway, *persephone* has no inherent microbial recognition domain, which suggests that it depends on an upstream fungal receptor to initiate its cleavage of Spaetzle.

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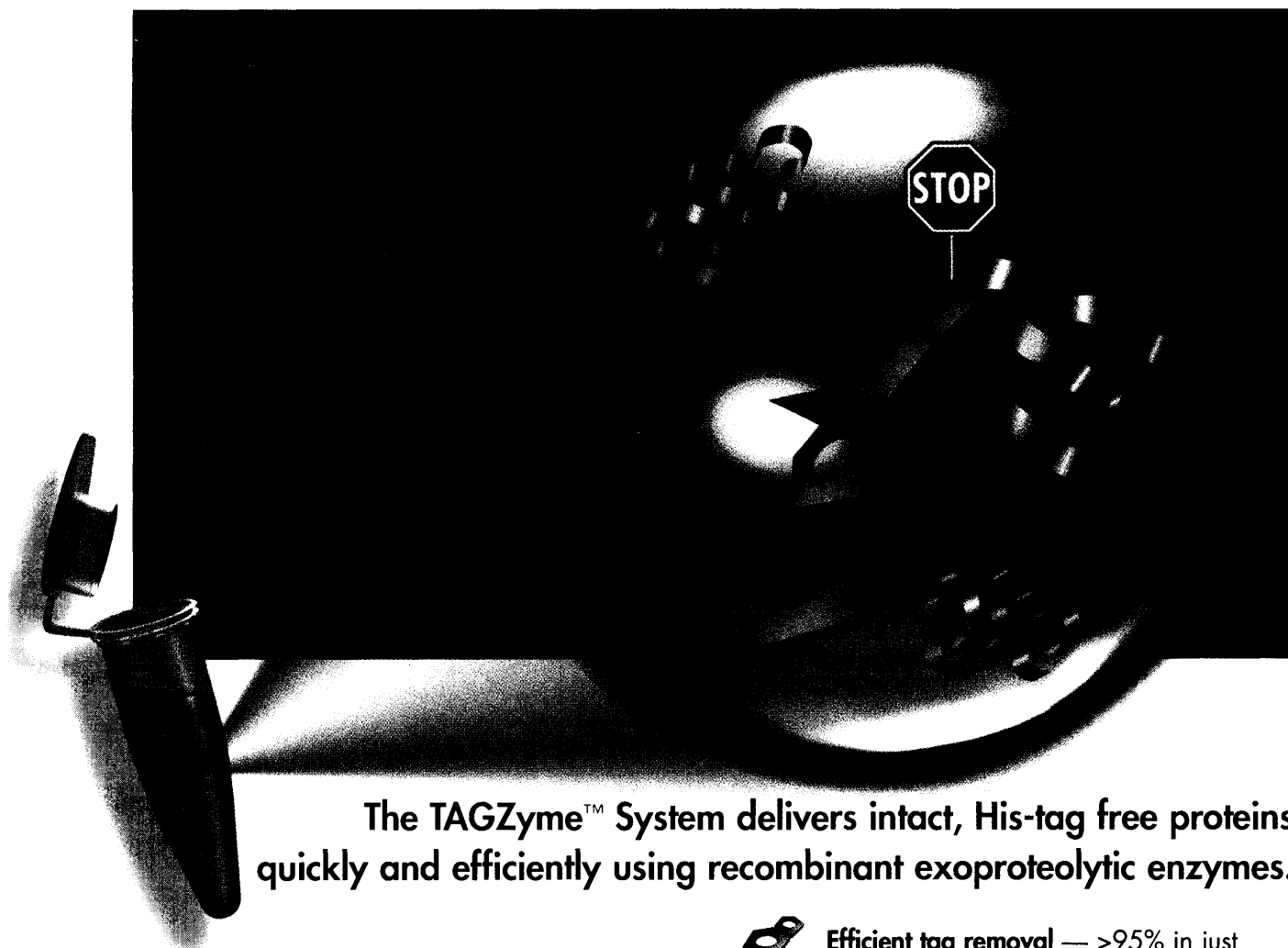
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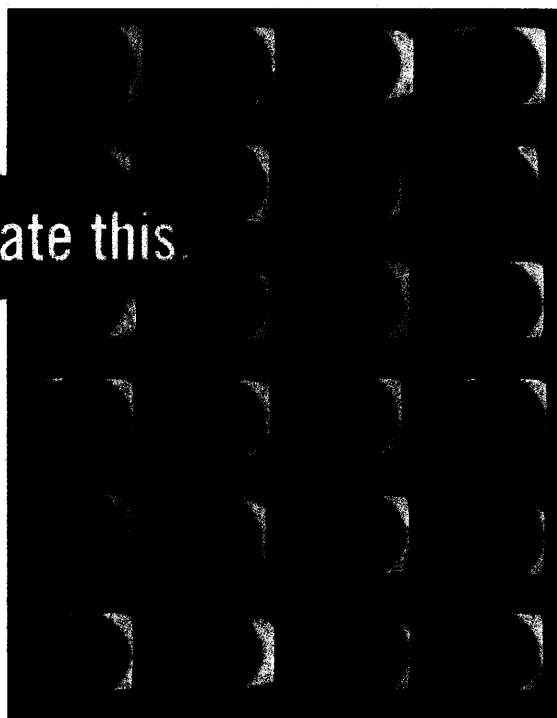
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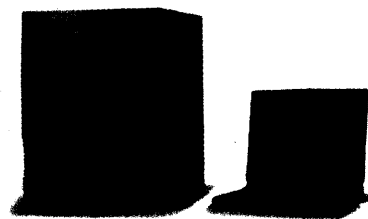
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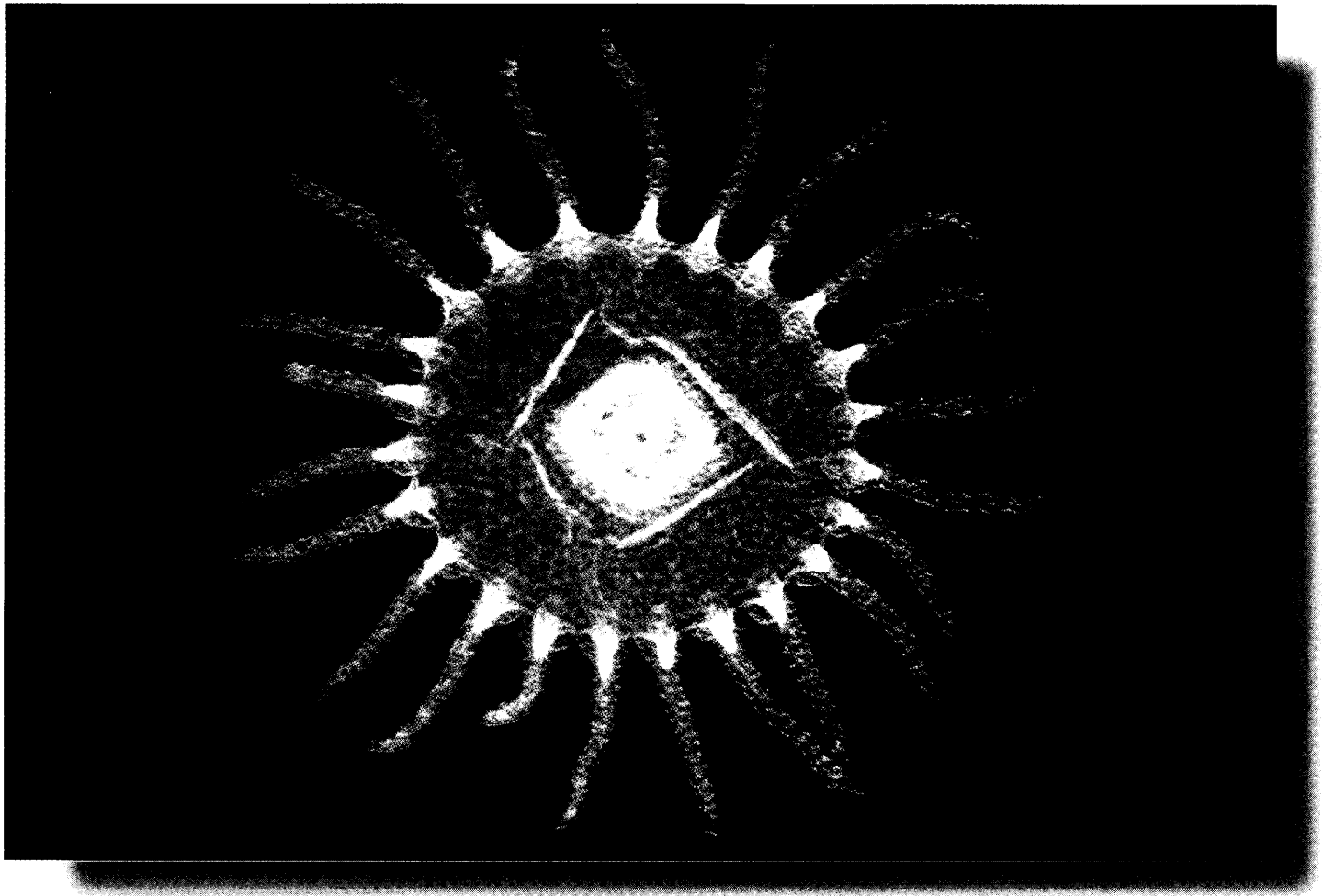
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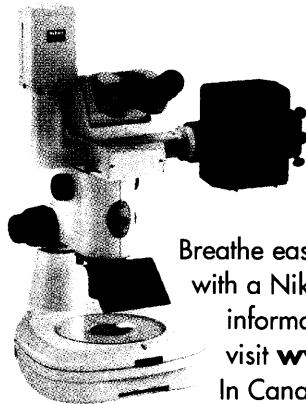
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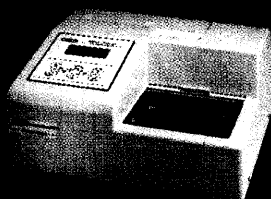
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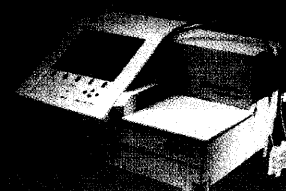
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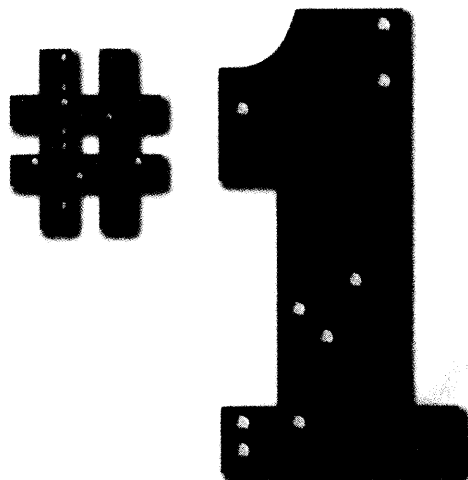
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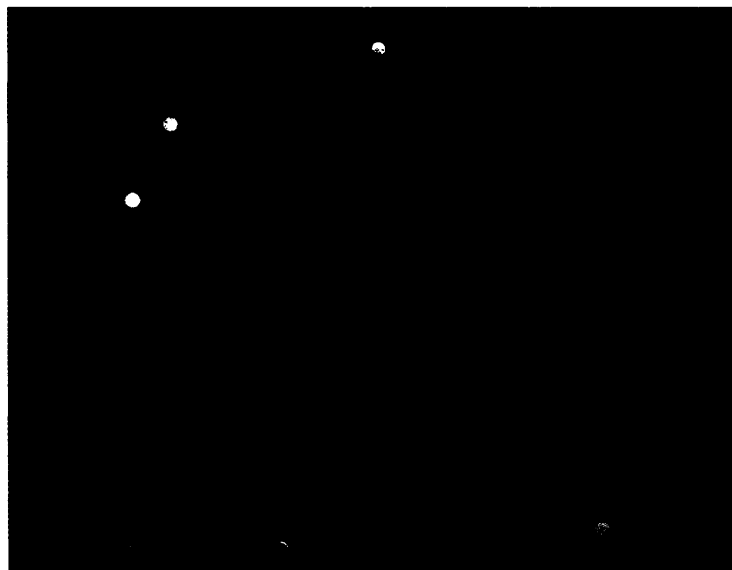


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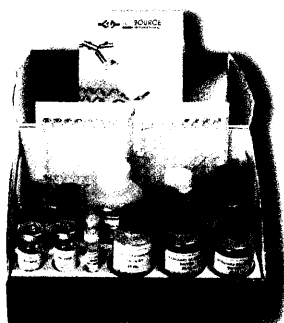
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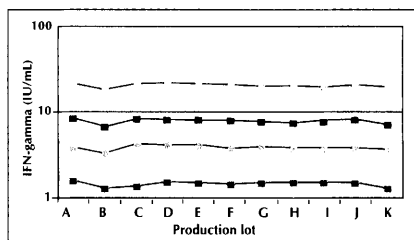
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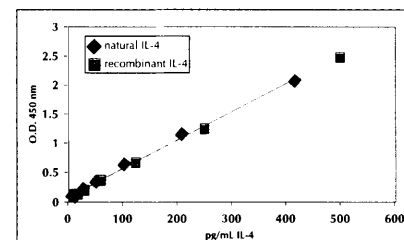
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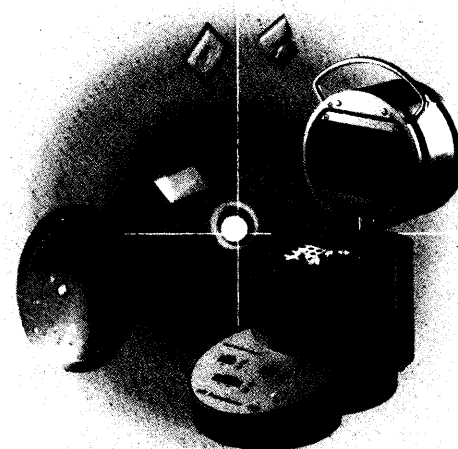
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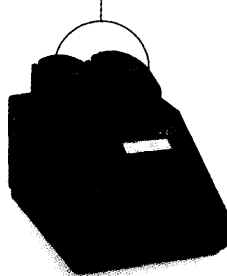




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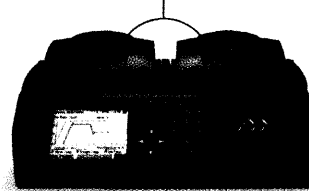
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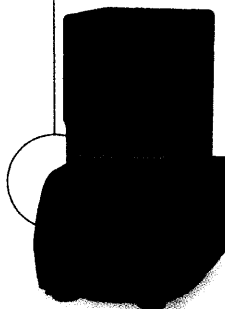
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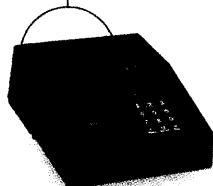
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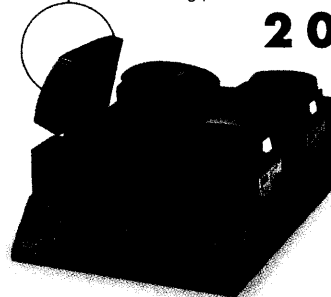
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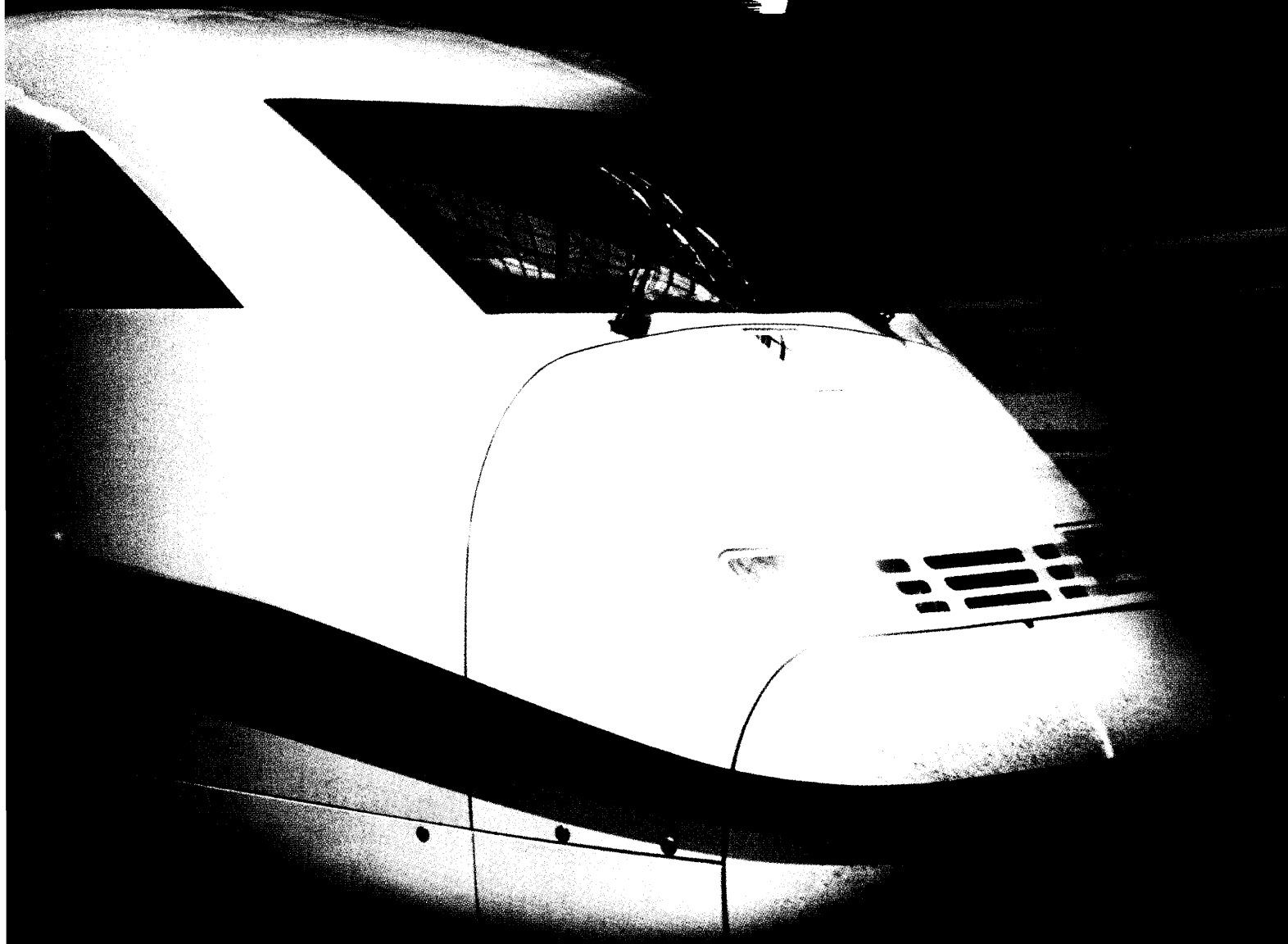
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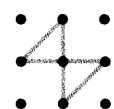
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* For the purpose of this prize, molecular biology is defined as "that part of biology which attempts to interpret biological events in terms of the physico-chemical properties of molecules in a cell" (McGraw-Hill Dictionary of Scientific and Technical Terms, 4th Edition).

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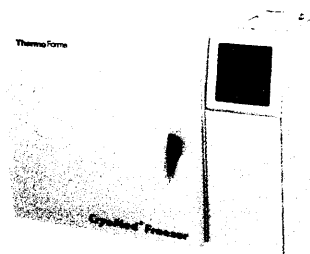
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