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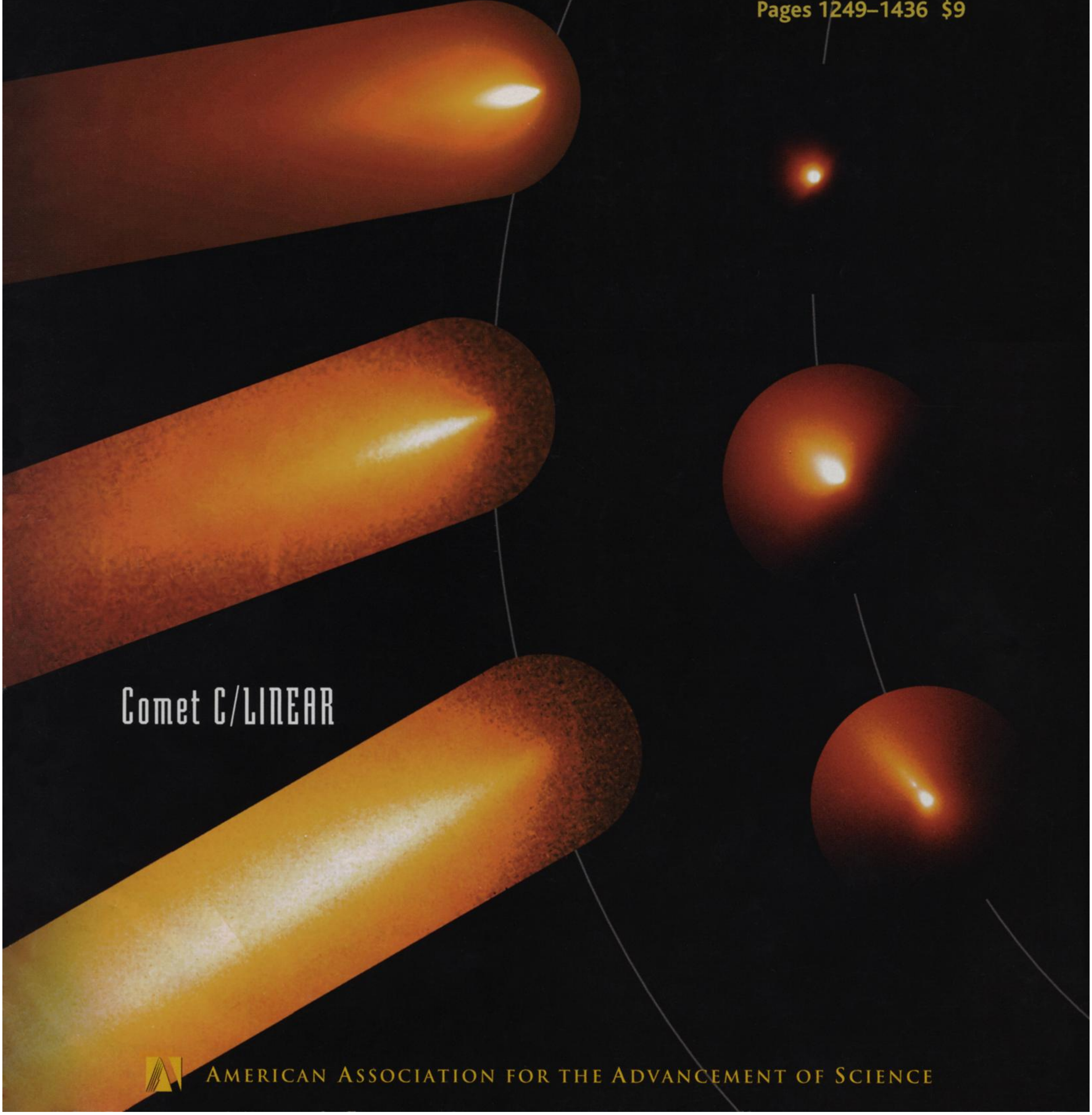

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American Association for the Advancement of Science

Science

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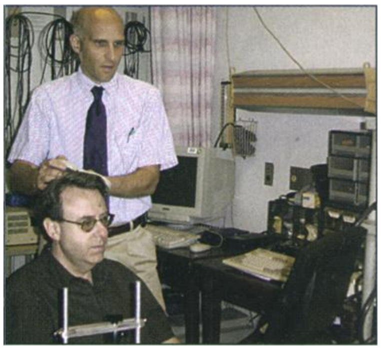

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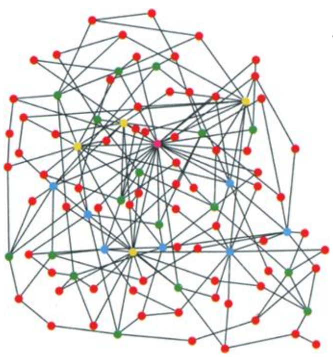

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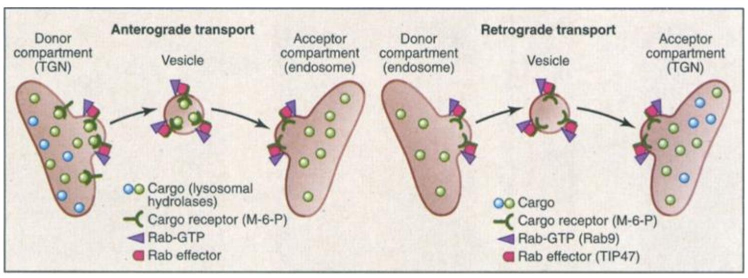

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COVER 1326

The destruction of comet C/1999 S4 (LINEAR). Images from the Hubble Space Telescope on 6 to 8 July (right, top to bottom) show an outburst that culminated in the ejection from the nucleus (within the white area) of a small fragment (smaller white area, bottom). On or about 22 July, the comet nucleus broke into at least 16 large fragments and debris. Images from the Lowell Observatory on 26 and 28 July and from the Perth Observatory on 2 August (left, top to bottom) show the dust from this event spreading out to form a tail. [Images: T. L. Farnham *et al.*, H. A. Weaver *et al.*, NASA]

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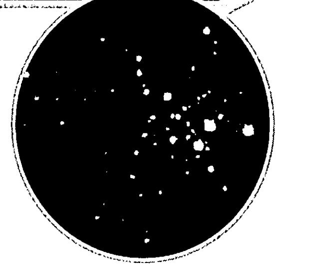
Sun and civilization

HIGHLIGHTS FROM www.sciencexpress.org



Structure of a globular cluster

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High-Resolution X-ray Imaging of a Globular Cluster Core: Compact Binaries in 47Tuc J. E. Grindlay, C. Heinke, P. D. Edmonds, S. S. Murray

An x-ray survey of faint stars in a globular cluster provides information on how such clusters formed some 12 billion years ago and evolved over time.

Exponential Gain and Saturation of a Self-Amplified Spontaneous Emission Free-Electron Laser S. V. Milton *et al.*

The growth and saturation of emitted ultraviolet radiation observed from a high-quality electron beam passed through a slalom of magnets mark a step toward short-wavelength free-electron lasers.

Microbial Genes in the Human Genome: Lateral Transfer or Gene Loss? S. L. Salzberg, O. White, J. Peterson, J. A. Eisen

PERSPECTIVE: **Are There Bugs in Our Genome?** J. O. Andersson and C. L. Nesbø

Analysis indicates that transfer of genes from the bacterial to the human genome may be much less frequent than had been postulated.

SPECIAL FEATURES

Ecology and Evolution of Infection: A Web Supplement

A collection of classic reviews and articles supplementing last week's special issue of *Science*, as well as pointers to selected Web resources on infectious disease, can be found at www.sciencemag.org/feature/data/diseases/index.shtml.

science's stke www.stke.org

Protocol: Targeting Silence—The Use of Site-Specific Recombination to Introduce in Vitro Methylated DNA into the Genome D. Schübeler, M. C. Lorincz, M. Groudine

A method for manipulating and studying DNA methylation in defined genomic sites.

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Canada: Entrepreneurs in Science—How to Turn a Need into a Business G. Chevalier

The lack of good online resources for life science job seekers and employers inspired one Canadian scientist to create her own company.

US: Biotech Buzzwords D. Jensen

If you're agonizing over alphabet soups of annoying acronyms, you're in luck: Our "Tooling Up" columnist's glossary is a gastronomic glory!

US: Mentoring for Postdocs J. Rutter

In this week's Postdoc Network, read about the NIH's efforts to bolster relationships between faculty mentors and postdoctoral fellows.

UK: Ruthless Reading P. H. Dee

If your idea of keeping on top of the literature is standing on a stack of photocopies, you need our columnist's tips for tackling your reading monsters.

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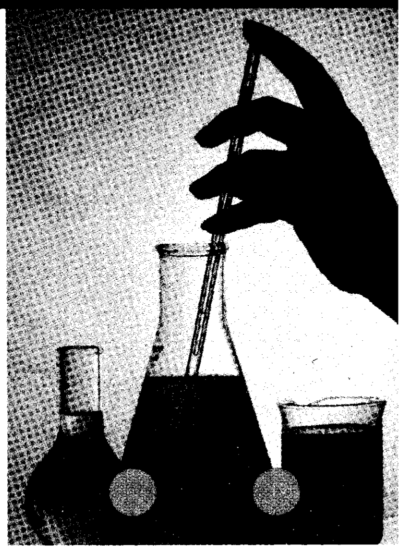


THIS WEEK IN Science

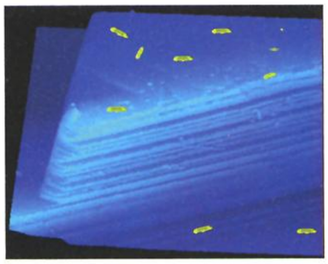
edited by Phil Szuromi

Death of an Uncommon Comet

Comet C/1999 S4 (LINEAR), which passed close by Earth between June and August of 2000, fragmented and "died" as it neared the Sun. Early observations indicated that the comet was depleted in carbon monoxide, methanol, and other hydrocarbons compared with other long-period comets like Hale-Bopp, which are thought to originate in the Oort cloud at the edge of the solar system. This chemical composition suggests Comet C/LINEAR may have originated from the region between Jupiter and Saturn instead. Later observations captured the unexpected fragmentation and complete disintegration of the fragments of this comet. Tidal disruption or solar sublimation are the more typical causes of cometary destruction, but in this case the fragile structure of the comet itself may be to blame. The comet also emitted high-energy x-rays, and observations clarified that x-ray production was caused by charge exchange between solar wind ions and the cometary gases. Six reports (pp. 1326–1353; see the cover and the Perspective by Boehnhardt) in a special issue on C/LINEAR discuss these observations and their implications for the origin of comets and their dynamical interactions in the solar system.

1360 Ironing Out Minerals

When subjected to an oxygen-poor environment, dissimilatory iron-reducing bacteria (DIRM) can conserve energy for growth by using iron oxyhydroxide minerals as their terminal electron receptors, and in doing so they contribute to the biogeochemical cycle of iron. Lower *et al.* (p. 1360) used atomic force microscopy to measure the binding strength between the bacterium *Shewanella oneidensis* and the mineral goethite under aerobic and anaerobic conditions. The attractive force increased under anaerobic conditions, and modeling suggests that a 150-kilodalton iron reductase in the outer membrane of the bacteria reduces the iron present in goethite.



CREDIT: S. K. LOWER *ET AL.*

Two Phases of Confined Carriers

Theoretical studies have suggested that when charge carriers are confined to a two-dimensional plane, the system should be insulating. However, experiments have shown that such systems transform into a metallic phase when the density of charge carriers exceeds a certain level. Most of this experimental work has focused on macroscopic measurements, such as transport properties. Ilani *et al.* (p. 1354) used a single-electron transistor to probe the spatial structure of a two-dimensional electron gas as the carrier density was varied. A complex microscopic structure of coexisting metallic and insulating regions was found to underlie the metal-to-insulator transition.

Controlling Chemical Turbulence

Some chemical reactions couple reaction and diffusion under steady-state conditions in such a way that chemical patterns or waves are set up. For one such "oscillatory" reaction, the oxidation of CO on the (100) surface of platinum, the reaction-diffusion patterns are highly sensitive to changes and concentration, and waves can run into each and set up chemical "turbulence" that can be imaged in the photoelectron microscope. Kim *et al.* (p. 1357) now show that by changing the intensity of global feedback control of one the reactants, CO, not only can turbulence be suppressed, but chaotic regimes of patterns that form and annihilate can be generated, as well as stable cluster patterns and standing waves. Feedback control is facilitated more easily in this case than for a reaction in solution because the change in CO concentration can be made at once across the entire surface.

Too Much Sun

Extended periods of drought could have had significant impacts on primitive cultures, and drought cycles could be caused by increases in the amount of solar energy reaching Earth. However, actually demonstrating a causal connection between solar forcing and a prehistoric civilization is rather difficult. Hodell *et al.* (p. 1367; see the news story by Kerr) have now examined sediment cores from Lake Chichancanab, in the Yucatan Peninsula of Mexico, and found evidence that the three major discontinuities in Mayan culture during the past 2500 years were correlated with long intervals of drought. These droughts were themselves correlated with a 208-year cycle of solar activity.

Older Corn

The beginnings of agriculture in the New World has been traced back to the semi-arid highlands of Mexico, where evidence for the domestication of corn and sunflower are well-preserved in dry caves. Pope *et al.* (p. 1370) have found evidence for the domestication of corn about 5100 calendar years B.C. along the more humid lowlands of Mexico. They analyzed pollen collected from soil samples and sediment cores from the San Andres site, where farmers settled along the beaches and lagoons of the Grijalva River delta on the Gulf Coast of Tabasco. Their results push the timing of corn domestication in Mesoamerica back about 1000 years and also show that farming probably started in the more accessible lowlands.

Making Good Copy in the RNA World

The RNA World hypothesis posits that a crucial step in the evolution of our predominantly DNA- and protein-based world began with self-replicating RNA molecules that fulfilled both the information storage role of DNA and the structural and enzymatic functions of proteins. A critical test for the RNA World hypothesis is the demonstration that an RNA molecule can replicate itself. Johnston *et al.* (p. 1319; see the news story by Davenport) have taken an important step in this direction. They have used "in vitro" selection to "evolve" an RNA molecule (ribozyme) that replicates short stretches of RNA with high fidelity when presented with an RNA template, primer, and nucleotides. The ribozyme has no template or primer sequence specificity and thus is functioning as a general RNA replicase.

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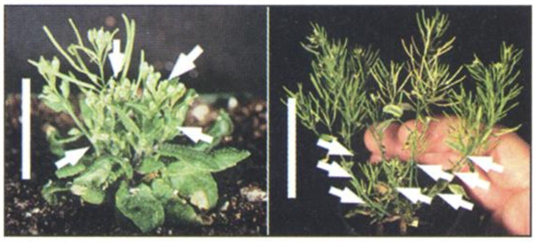
Cargo Selection Devices

The itinerary of the mannose-6-phosphate receptor, the protein that recognizes lysosomal enzymes and delivers them to their target, is quite complex in that it travels between the Golgi, the plasma membrane, and endosomes in almost any order, depending on whether it is loaded with its enzyme cargo. Carroll *et al.* (p. 1373; see the Perspective by Segev) examined the role of a cytosolic protein TIP47 in controlling this itinerary and discovered that in addition to binding the cytoplasmic tail of the receptor, TIP47 also binds to a small GTP-binding protein, Rab9. In the presence of bound Rab9, TIP47 shows increased affinity for the receptor and may thus hold the key to deciding which onward route the receptor takes.

Reversing Neddylation



Posttranslational modification of cellular proteins can play an important role in controlling intracellular processes. Modifications that can be specifically and rapidly reversed would provide a versatility in control that may be the key to normal cellular activities. Two reports, by Schwechheimer *et al.* (p. 1379) and Lyapina *et al.* (p. 1382), examine interactions between a particle known as the signalosome and the SCF ubiquitin ligases (see the 4 May news story by Marx). This system is involved in modifying proteins with the ubiquitin-like molecule, NEDD8. Together, these reports show that neddylation can be reversed, that the signalosome is involved in this NEDD8 removal, and that this mechanism appears to be important in controlling the auxin response pathway in plants. The signalosome and SCFs are widely distributed, and the system is likely to be important in controlling many intracellular signaling pathways in a variety of organisms.

Landmark of Polarity

During development, organisms use preordained polarity markers to regulate and control growth in response to external signals. Even unicellular organisms such as yeast exhibit defined polarity during growth. Yeast select predictable sites in relation to previous bud-site selection decisions. Kang *et al.* (p. 1376) examined how the cell recognizes the site of previous budding decisions, either axial landmarks in haploid cells or bipolar landmarks in diploid cells, in order to control bud site selection. They found that a small guanosine triphosphate/guanosine diphosphate (GTP/GDP) exchange factor, Bud5, was crucial in the recognition of the previous bud site and in defining future bud-site selection.

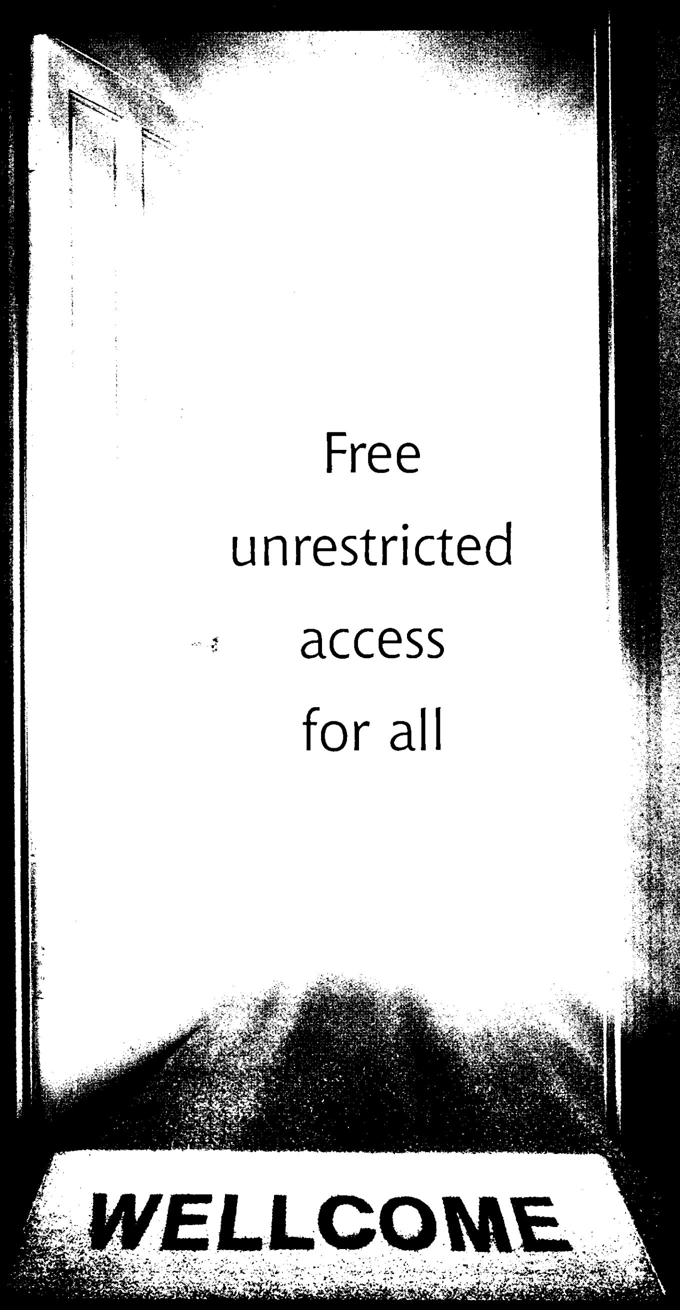
Directing Stem Cell Fate

Embryonic stem (ES) cells have shown the potential to develop into a wide variety of differentiated cells. One challenge has been to direct the ES cells down one particular developmental pathway. Lumelsky *et al.* (p. 1389; see the 27 April news story by Vogel) have now taken mouse ES cells and generated cells that replicate at least some of the functions of the insulin-secreting cells of the pancreas. This preliminary work suggests that ES cells might be a useful source of material to address the challenges of diabetes.

Adaptor Required

More than 70% of circulating low-density lipoprotein (LDL) is removed from the blood by LDL receptor-mediated endocytosis in the liver. Patients with the rare disorder autosomal recessive hypercholesterolemia (ARH) show poor clearance of LDL from the blood and develop coronary artery disease at a young age. Garcia *et al.* (p. 1394; see the Perspective by Goldstein and Brown) identify the gene responsible for ARH and find that it encodes a previously undescribed protein with a sequence motif characteristic of adaptors, proteins that bind to the cytoplasmic tails of endocytic receptors and that are critical for receptor internalization. This newly identified protein is likely to facilitate trafficking of the LDL receptor in liver cells.

CREDIT: C. SCHWECHHEIMER *ET AL.*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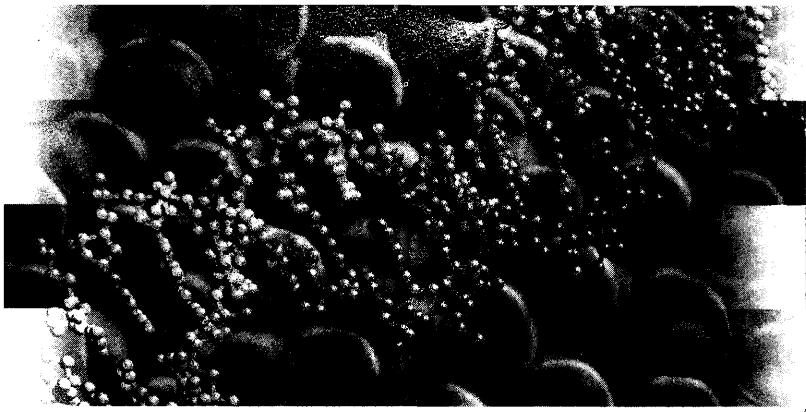

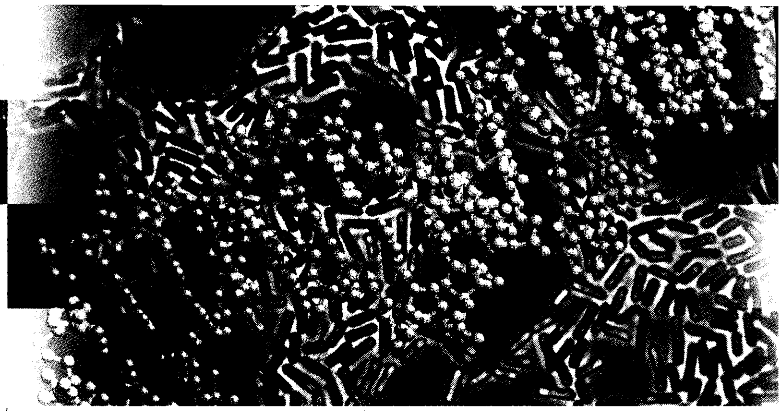

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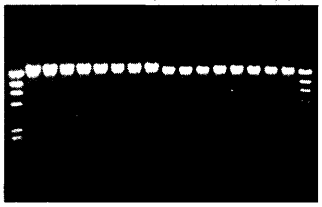

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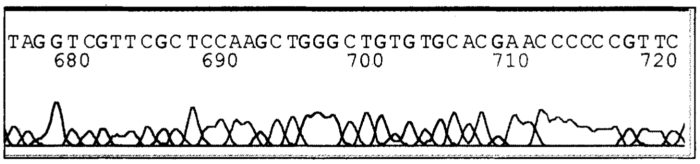

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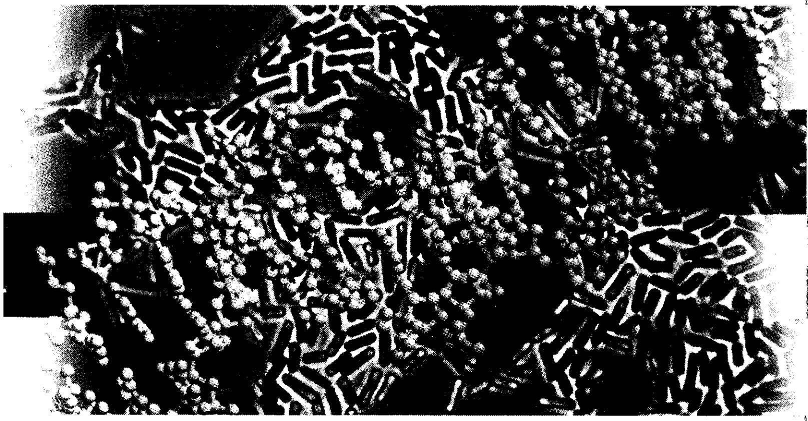

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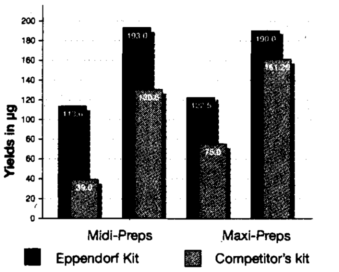

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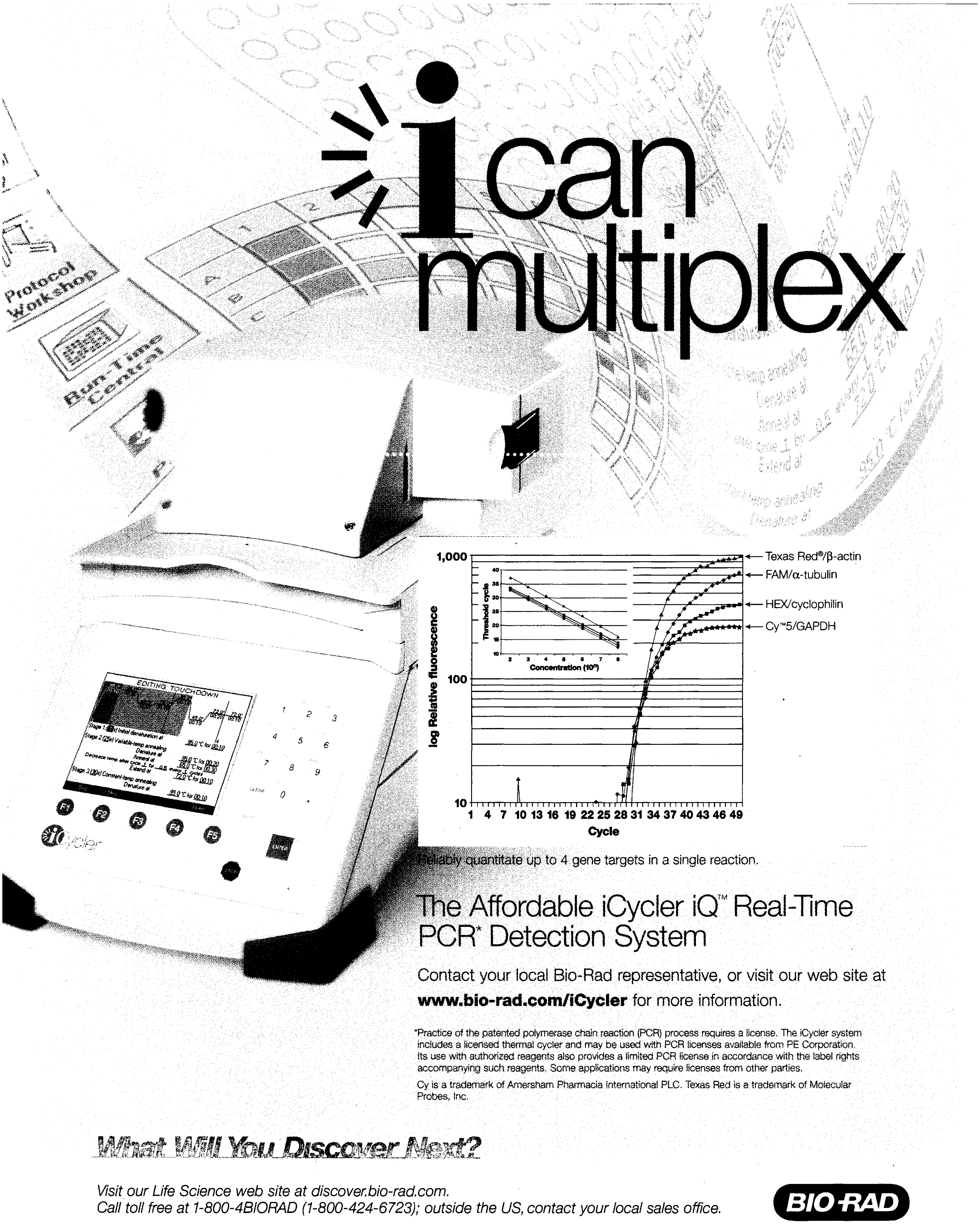

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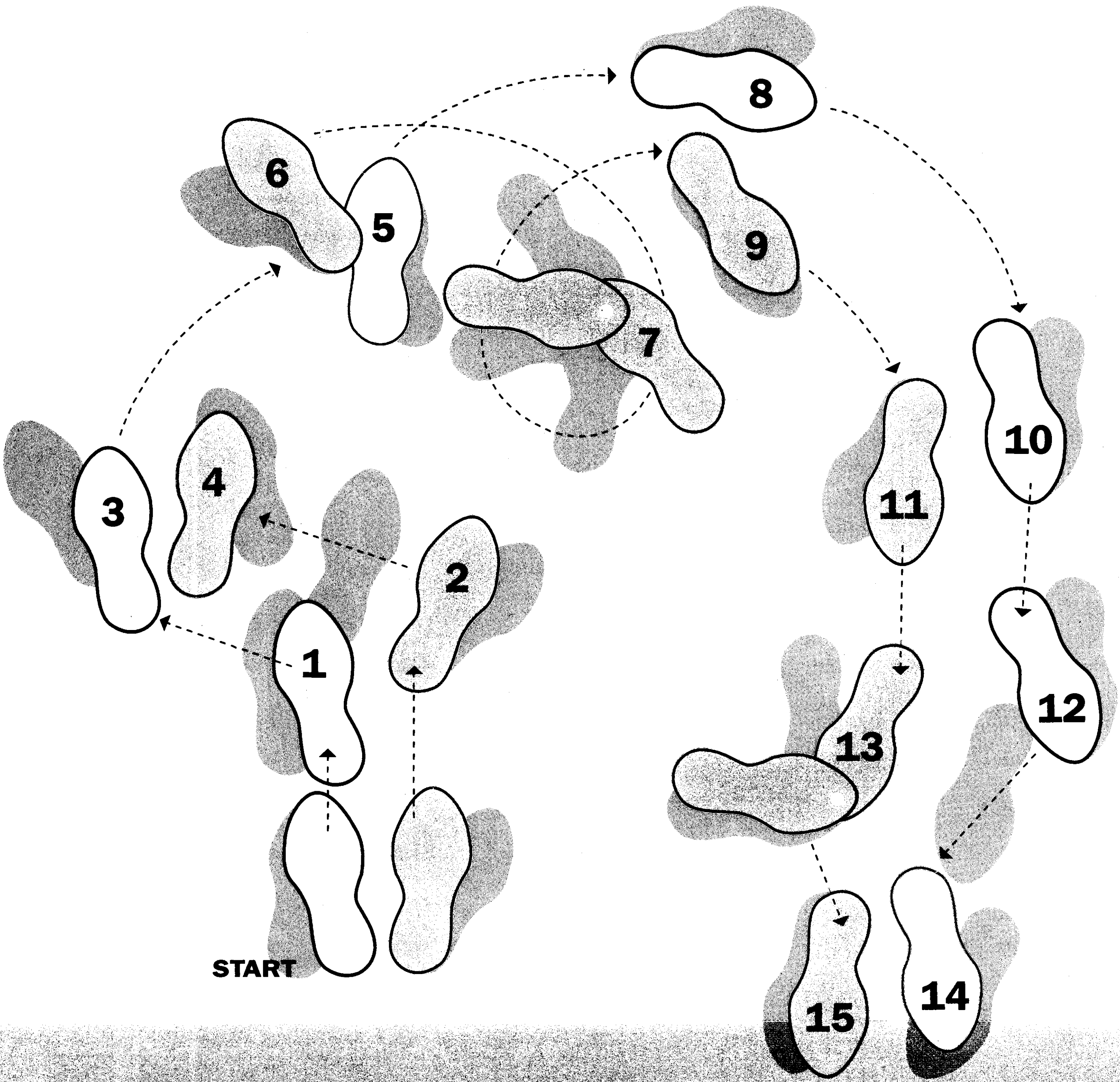

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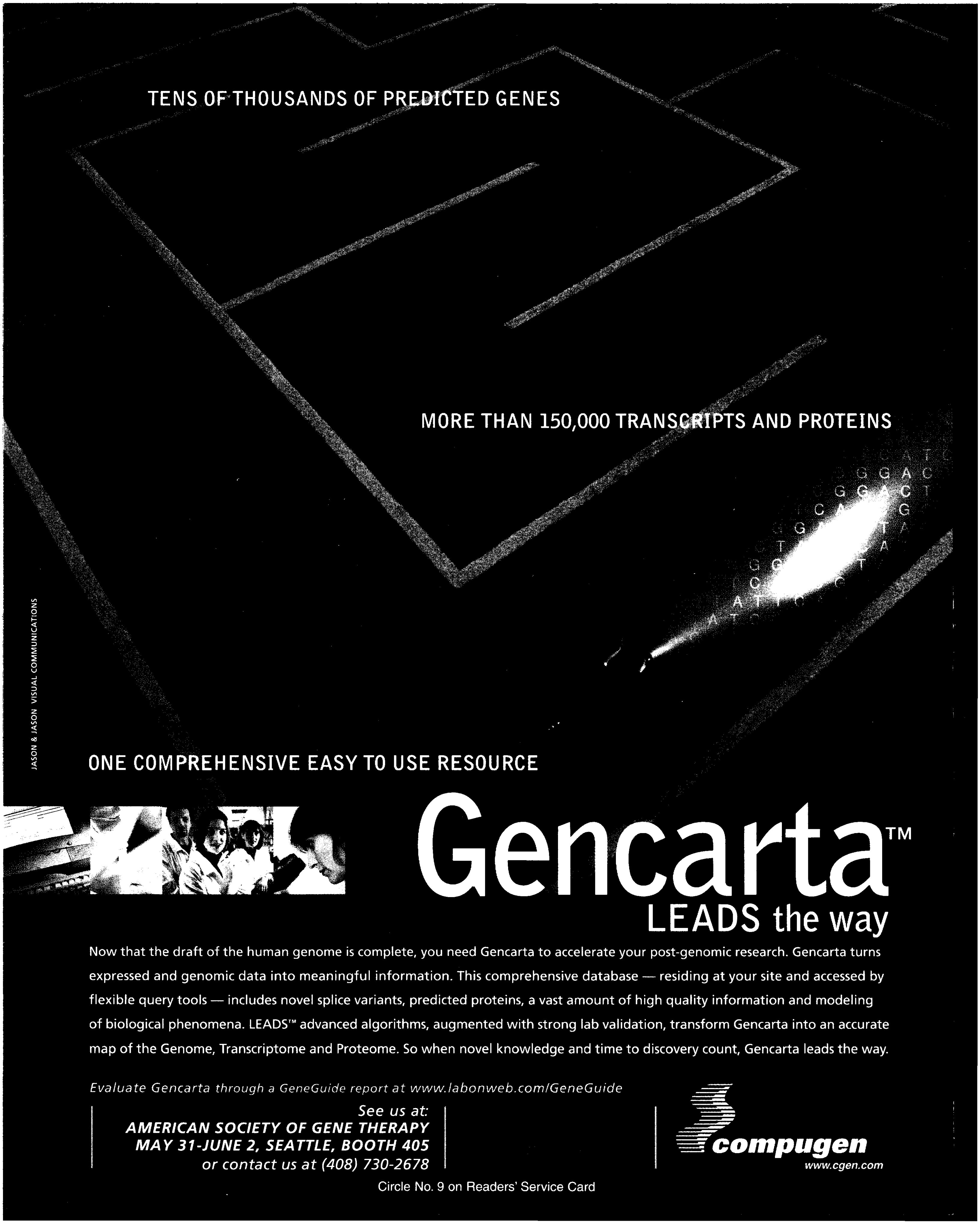
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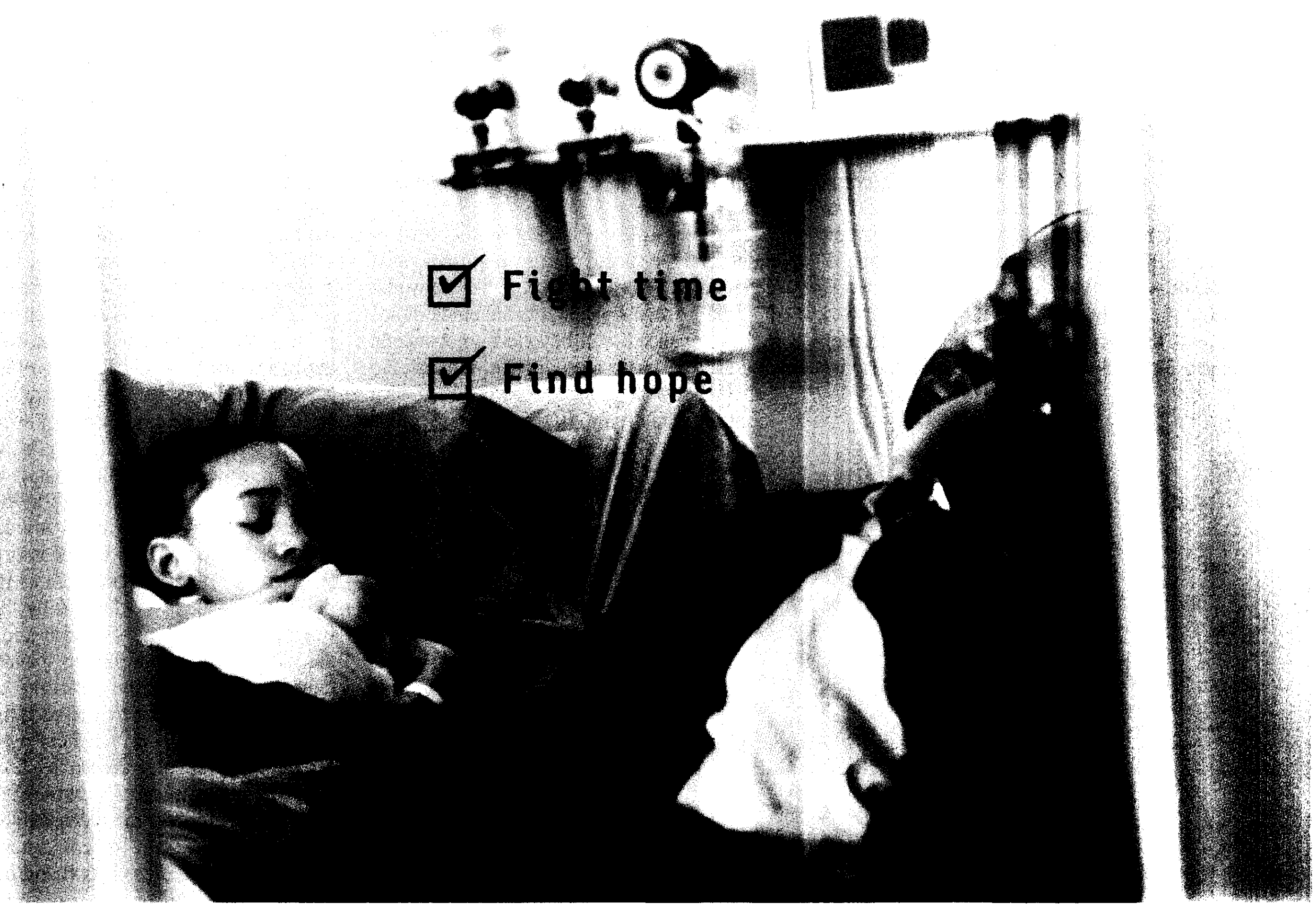
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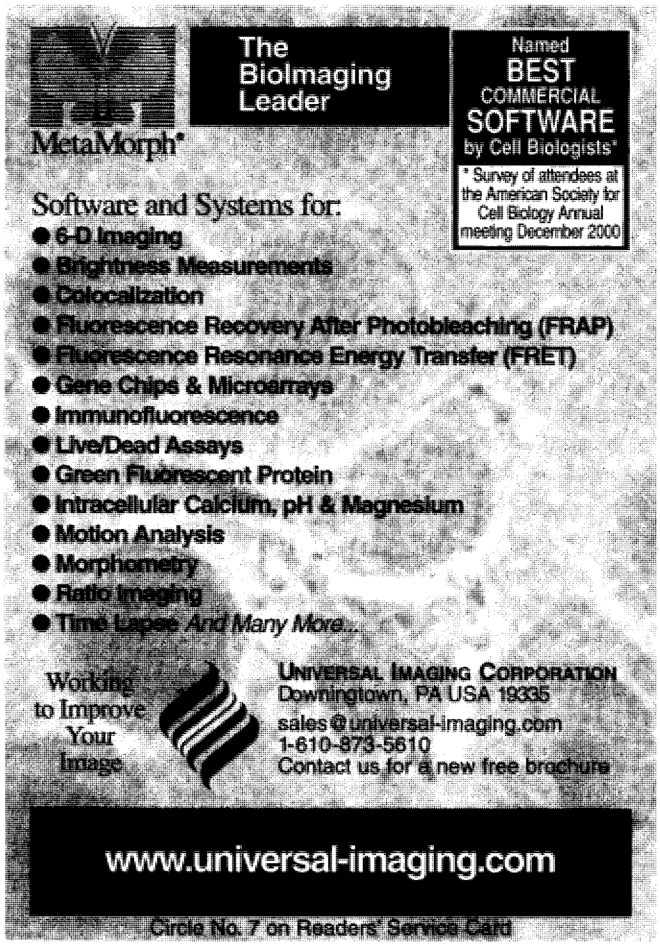
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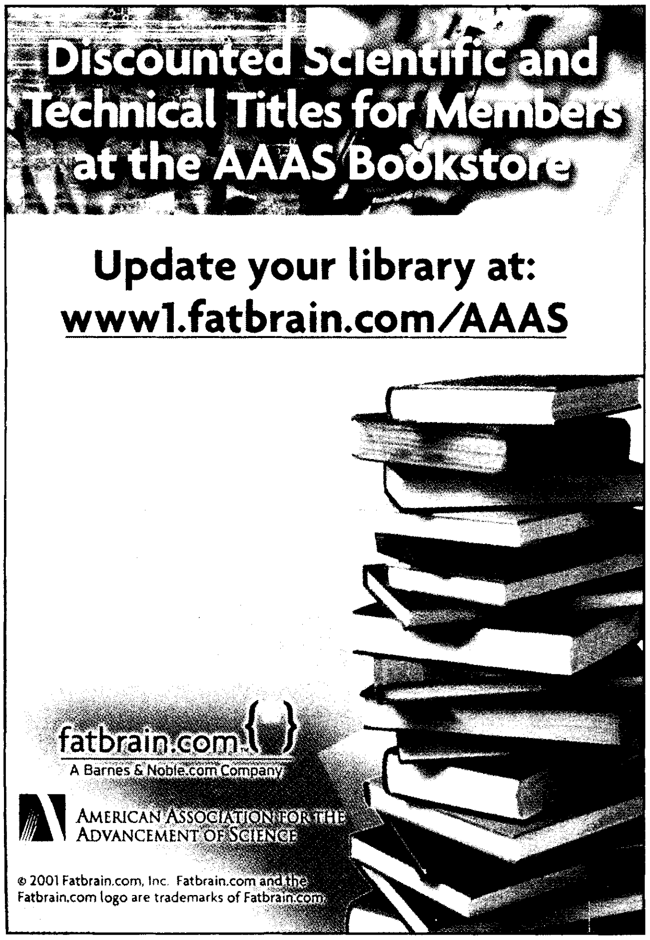
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