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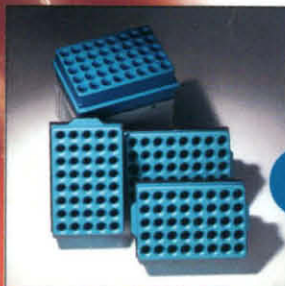


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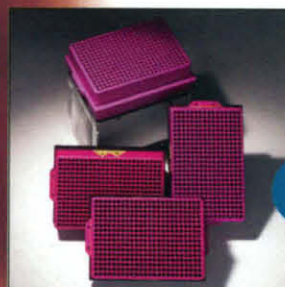
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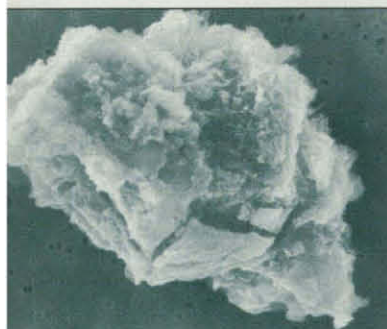
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2.9 billion bases to go



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Tracking dust buildup

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COVER

Plant growth depends on the uptake of potassium from soil. The degree to which inward-rectifying potassium channels participate in this process was tested by a combination of genetics and electrophysiology in the root of *Arabidopsis thaliana* (pictured).

Unexpectedly, membrane potentials more negative than -230 millivolts enabled the channels to take up potassium from external solutions as dilute as 10 micromolar. See page 918. [Image: E. P. Spalding]



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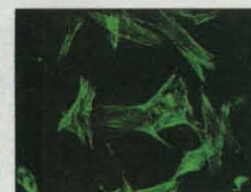
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Indicates accompanying feature

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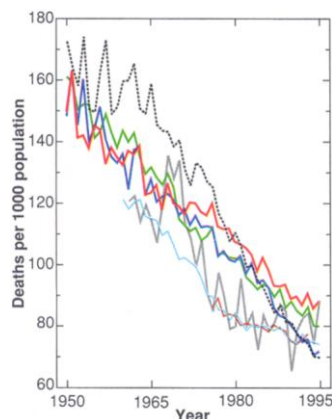
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THIS WEEK IN SCIENCE

edited by PHIL SZUROMI

Living longer

Death rates for many organisms—worms, yeast, and humans—decelerate with increasing age, and in recent years



human mortality at older ages has decreased substantially. Vaupel *et al.* (p. 855) review longevity research and focus on insights from biodemographic data. Although genes exist that explicitly control longevity, non-genetic changes account for increased human life-spans.

Dust to Earth

Every year about 10^7 kilograms of interplanetary dust particles (IDPs) fall to Earth from the tenuous cloud of dust (called the zodiacal cloud) orbiting the sun in the inner solar system. Kortenkamp and Dermott (p. 874; see the news story by Kerr, p. 828) have modeled the flux of IDPs to Earth during the last 1.2 million years; they assumed that the bulk of this material is derived from the Eos, Themis, and Koronis asteroid families. A maximum flux of IDPs occurred every 100,000 years, consistent with control by variations in Earth's eccentricity and the idea that the 100,000-year peak in helium-3 concentrations in sea-floor sediments are controlled by the IDP flux. They also expect that large fluxes may

Speaking more freely about risky behaviors

Surveys of risky behavior [such as sexual relations or intravenous (iv) drug use], particularly in adolescents, have often been compromised by the hesitancy of subjects to reveal illegal or socially unacceptable activities and by problems in administering tests to illiterate or poorly educated subjects. Turner *et al.* (p. 867; see the Policy commentary by Bloom, p. 847) apply a new approach, using a voice and written questionnaire on a computer, to assess adolescent sexual behavior and iv drug use in 1690 males in the United States, and compared results with a traditional interview and written survey. Reported incidences of many behaviors increased by a factor of 3 or more: 5.5 percent of respondents had engaged in male-male sex, 5.2 percent had used iv drugs, and 12 percent had carried a gun.

occur every 10^7 years because of collisions between asteroids in the asteroid belt.

Magnets in bacteria

Many magnetotactic bacteria produce an intercellular iron sulfide mineral, greigite. Understanding the mineralogy and origin of the greigite and other minerals is important for resolving the origin of these bacteria and their behavior and biomagnetism in general. Pósfai *et al.* (p. 880) used transmission electron microscope to show that the greigite, which is magnetic, actually forms in magnetotactic bacteria over a few days to weeks from another iron sulfide mineral, mackinawite, which is nonmagnetic.

Xenon and Earth's atmosphere

Measurements of the xenon isotopes provide information on the time for accretion, mantle degassing, and the evolution of Earth's atmosphere. However, because of the small isotopic enrichments and the complications that some xenon isotopes result from multiple decay schemes, resolution of the anomalies has been difficult. Kunz *et al.* (p. 877; see the commen-

tary by Kaneoka, p. 851) have now succeeded in isolating the effects of production of xenon from plutonium and uranium fission (xenon is also produced from decay of iodine) in measurements of mantle gases trapped in mid-ocean ridge basalts. The data imply that 32 percent of the xenon-136 in Earth's atmosphere is from plutonium fission (half-life of 82 million years) and that Earth's mantle began to retain gases within 50 to 70 million years after formation of the solar system, soon after a giant impact is thought to have hit the Earth and formed the moon.

Smooth and thin

Thin, smooth films with uniform properties are important in many applications ranging from bioadsorption studies to microelectronics. However, they are often difficult to fabricate. Many of the methodologies currently under investigation focus on self-assembly processes. Esker *et al.* (p. 892) pursued a different route. They used the well-known Langmuir-Blodgett technique for making multilayer assemblies through layer-by-layer transfer of polyelectrolyte monolayers formed at an air-water interface; posttransfer modification formed cross-

linked multilayers with high regularity, smoothness, and stability. The method should facilitate chemical derivatization of the films and the assembly of composite structures that differ by as little as a monolayer.

Highly flexible

Certain materials contract when heated, and this counterintuitive behavior has been rationalized in terms of the high flexibility of the molecular framework in these materials. Theoretical studies have suggested that such materials may become amorphous under pressure and that the two properties may have a common origin. Perottoni and da Jornada (p. 886) investigated the structural behavior of ZrW_2O_8 , a material with a particularly large temperature range over which contraction occurs, under increasing pressure. Amorphization occurred gradually at relatively low pressures.

Tripping the dark fantastic

In nonlinear optical materials, intense laser beams can become "self-trapped," that is, the light changes the index of refraction so as to produce a lens effect, which concentrates and traps the light energy as it propagates. Trapping of dark beams—light beams with holes in the intensity profile—has also been observed. Chen *et al.* (p. 889) report that this dark trapping can occur with incoherent light through an unexpected mechanism. The results raise the possibility that high-power laser light can be controlled with low-power optical sources such as light-emitting diodes.

(Continued on page 799)

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(Continued from page 797)

To be or not to be

In response to the hormone progesterone, oocytes of the frog *Xenopus laevis* undergo maturation into unfertilized eggs. In this process, a variable stimulus—the concentration of progesterone—is converted to an all-or-none response of the oocyte. Ferrell and Machleder (p. 895; see the commentary by Koshland, p. 852) reveal the nature of the biochemical switch that accounts for this phenomenon. Maturation is caused by activation of a series of protein kinases known as the mitogen-activated protein kinase (MAPK) cascade. Activation of MAPK through this mechanism in vitro shows a highly cooperative response, and MAPK activation in oocytes showed similar ultrasensitivity. The cooperative nature of MAPK activation, along with positive feedback from MAPK to promote accumulation of one of the enzymes that leads to its activation, appear to account for the switchlike behavior of the maturation process.

Cell shape effects

Changes in cell shape occur in critical biological processes that include formation of normal tissues during development and invasive behavior of tumor cells. Such changes in cell morphology are coupled to changes in gene expression. Kheradmand *et al.* (p. 898) explored a signaling pathway through which expression of the collagenase-1 gene is regulated in rabbit synovial fibroblasts. Treatment of these cells in culture with antibodies to a protein that mediates cell adhesion—the integrin $\alpha 5 \beta 1$ —caused reduced adhesion of the cells to the culture plate, cell rounding,

and increased expression of the collagenase-1 gene. The altered gene expression resulted from activation of the small guanine nucleotide binding protein Rac1, generation of reactive oxygen species, and consequent activation of the transcription factor NF- κ B.

Spoken and written language

Aspects of the modular organization of language have been uncovered by Baynes *et al.* (p. 902; see the news story by Strauss, p. 827), who examined writing and speaking abilities in a left-handed female who had undergone surgical resection of the corpus callosum. Prior to surgery, she was able to write with her left hand and speak normally. After surgery, she could speak words shown to her right visual field (left visual cortex) but not write them with her left hand (right motor cortex), and she could write words shown to her left visual field but not speak them. This dissociation suggests a hemispheric lateralization of orthographic and phonographic aspects of language in sinistrals.

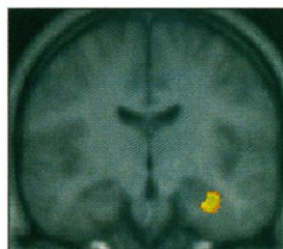
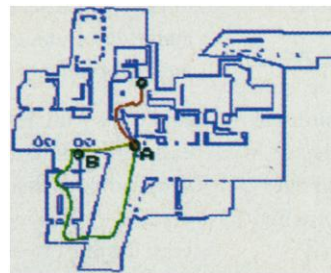
Pre-TCR processes

Lymphocytes reorganize their genomes to create heterodimeric antigen receptors. Rearrangement is an ordered process—the first locus must be successfully rearranged before rearrangement of the other locus begins—that is coordinated with other phenotypic changes. T cells control this developmental checkpoint with a “precursor” T cell antigen receptor, the pre-TCR, comprising a rearranged TCR β chain and the pre-T α , which will later be replaced by a rearranged α

chain. Irving *et al.* (p. 905) examined if binding to an extracellular ligand was necessary for the pre-TCR to send the cell developmental signals. They used a truncated pre-TCR that expressed no extracellular immunoglobulin domains and showed that these domains were not needed for the pre-TCR to transduce a transient signal or for an immature T cell to pass the checkpoint. Stable expression of the truncated pre-TCR was sufficient to do both.

Making our way

Way-finding or navigation requires that we integrate the relations of parts of the environment to each other (allocentric) and the directions of body movements toward the target (egocentric). Maguire *et al.* (p. 921) provide evidence for a network of brain regions on the



basis of the results of a functional imaging study in which humans traveled through a virtual reality town. Activation in the right hippocampus (coding for allocentric representation of space) and the right inferior parietal lobe (coding for egocentric positioning) brain regions correlated with the accuracy of navigation, while activation in the right caudate was correlated with speed of travel.

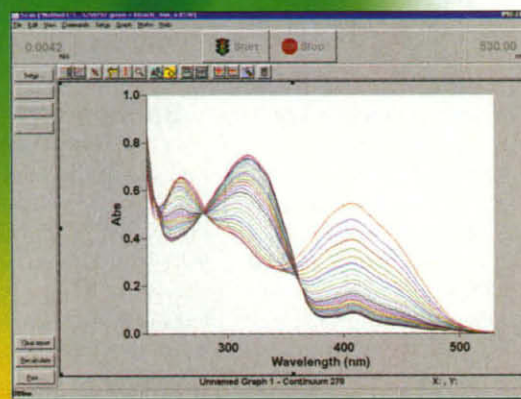
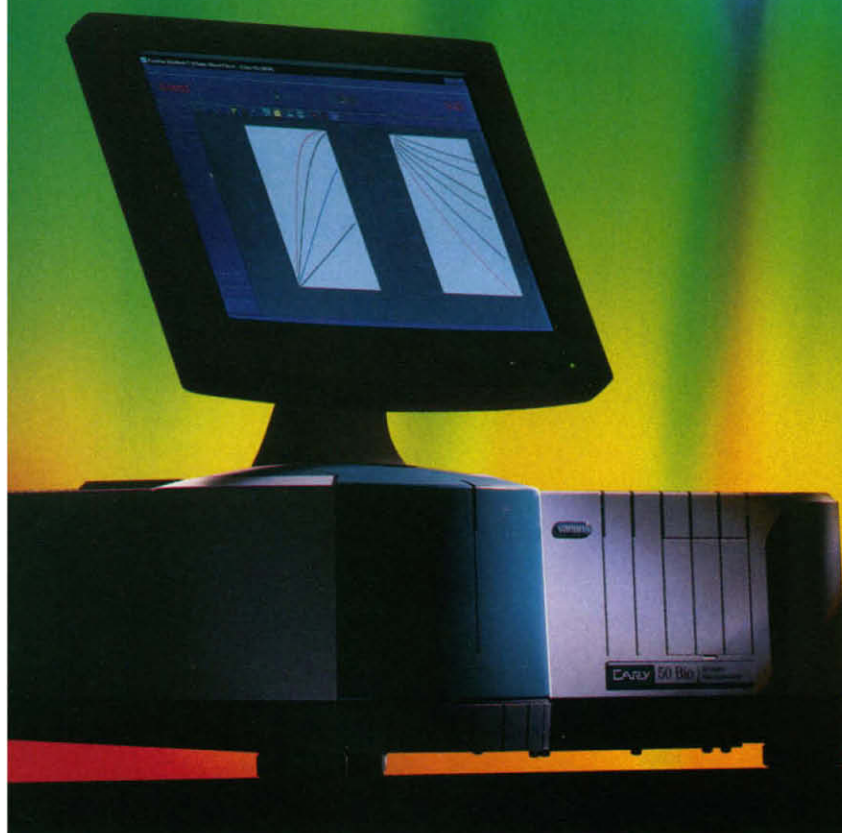
Triple-bond chemistry in plants

The biochemistry behind the carbon-carbon triple bond found naturally in some fatty acids has resisted insight. Now, searching for fatty acid-modifying enzymes first in the moss genome, and confirming their results in *Arabidopsis*, Lee *et al.* (p. 915) have found genes encoding an acetylenase and an epoxygenase. Although these two catalytic reactions have rather different effects on their fatty acid substrates, the DNA sequences encoding the enzymes show some intriguing similarities. Fatty acids and their vast array of derivatives find commercial utility as plasticizers, lubricants, varnishes, and many other products.

Potassium in plants

Potassium channels, better known for their functions in neurons, are also found in plants. Hirsch *et al.* (p. 918; see the cover) elucidated the actions of a plant Shaker-like K⁺ channel encoded by the AKT1 gene in *Arabidopsis*. The properties of the channel are such that, at negative membrane potentials and in the presence of low concentrations of external K⁺, it may allow passive uptake of K⁺ ions into plant root cells.

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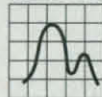
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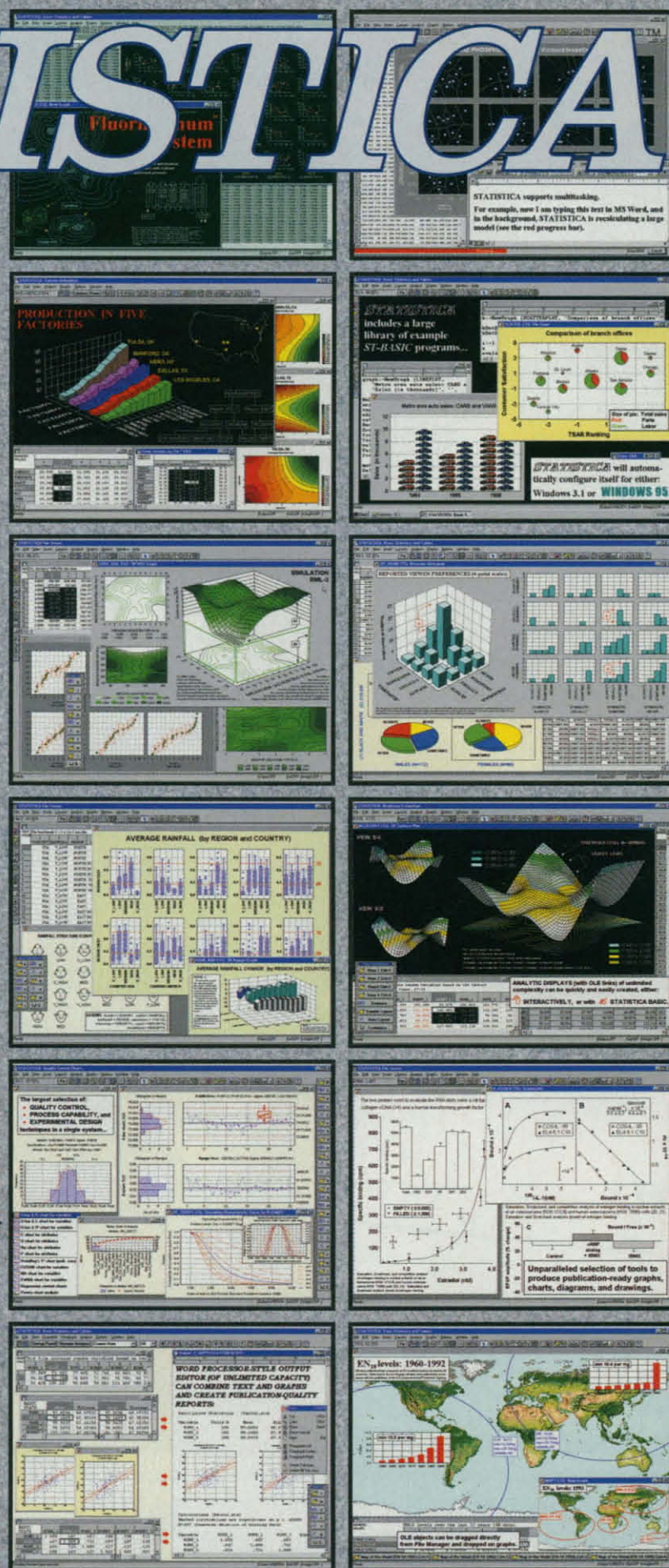


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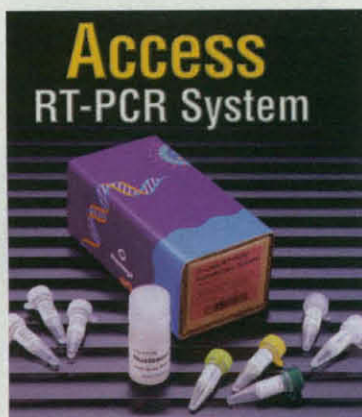
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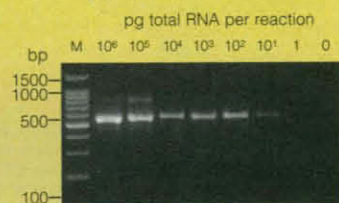
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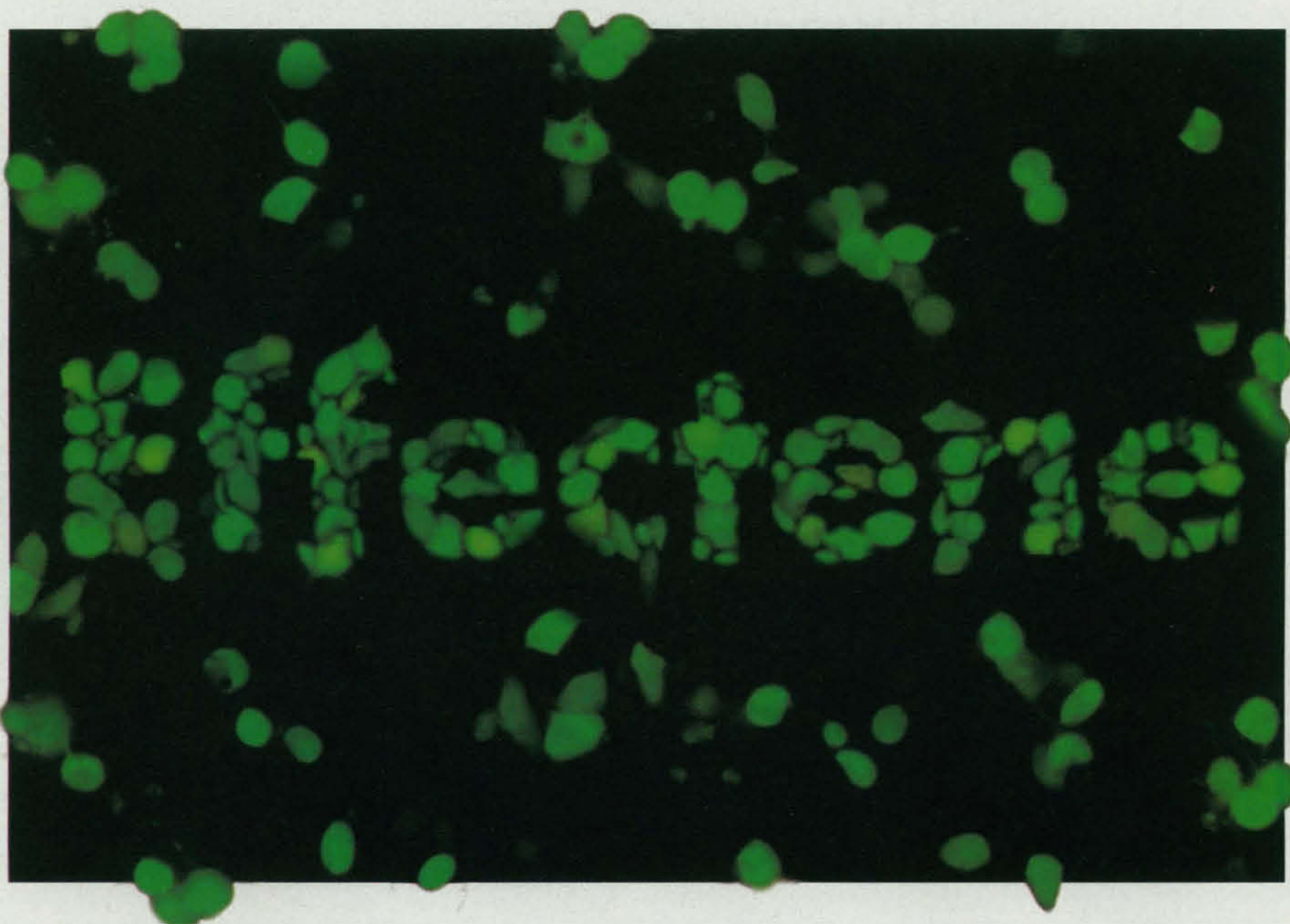
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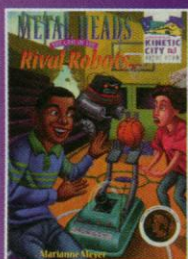
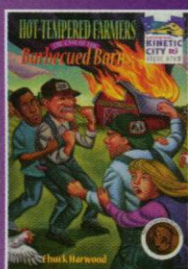
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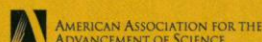
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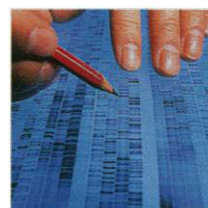
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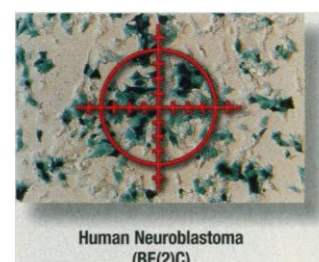
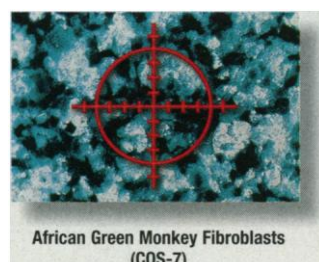
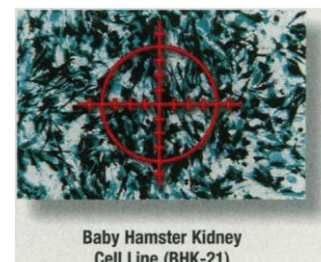
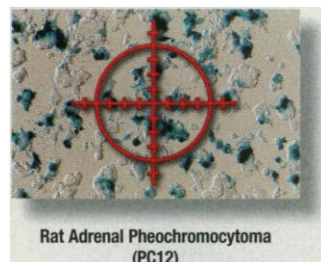
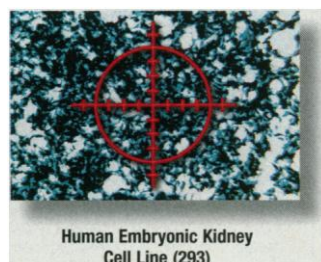
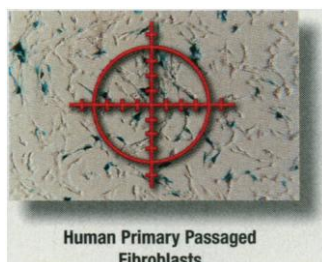


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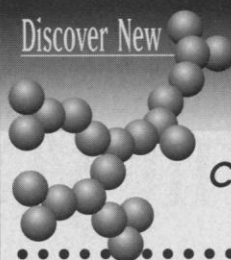
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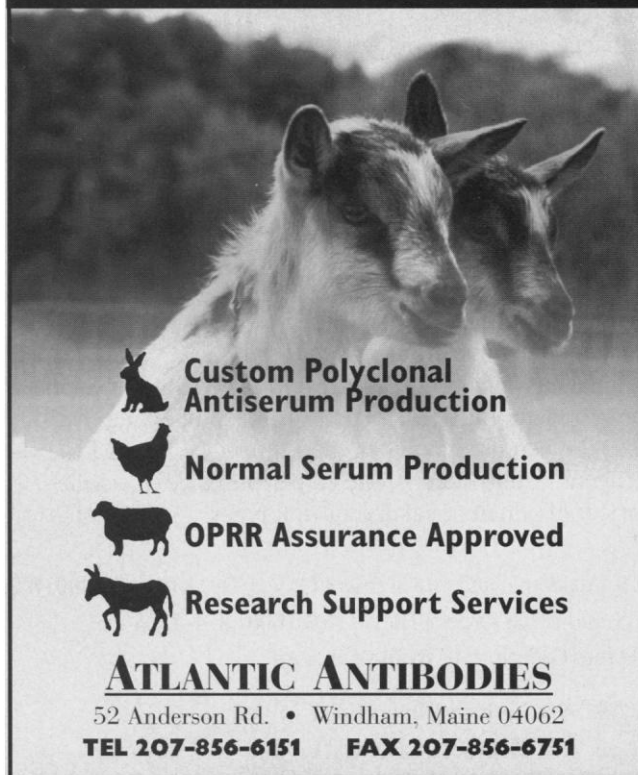
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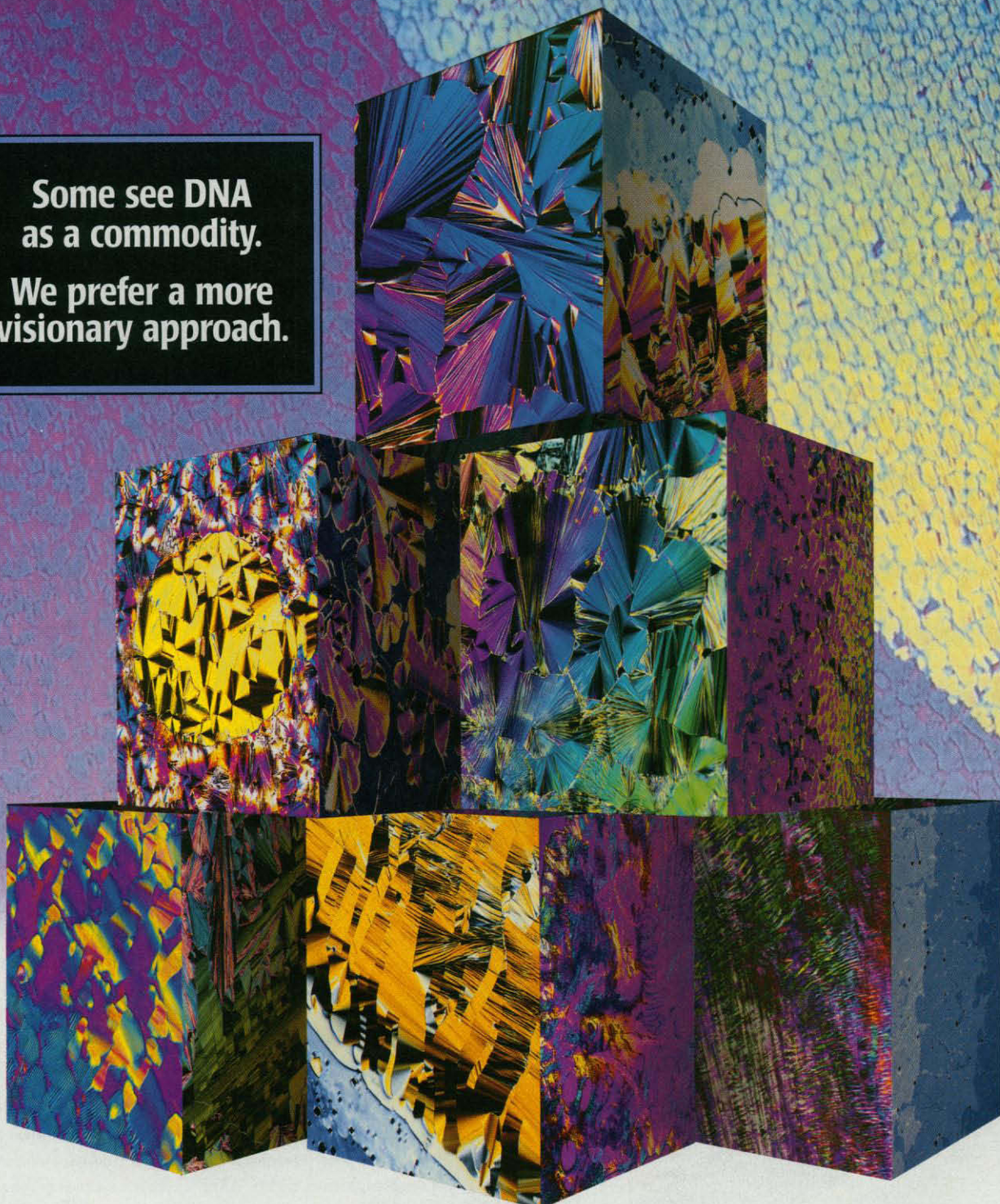
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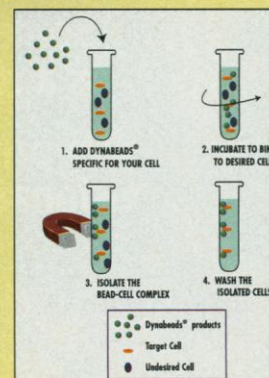
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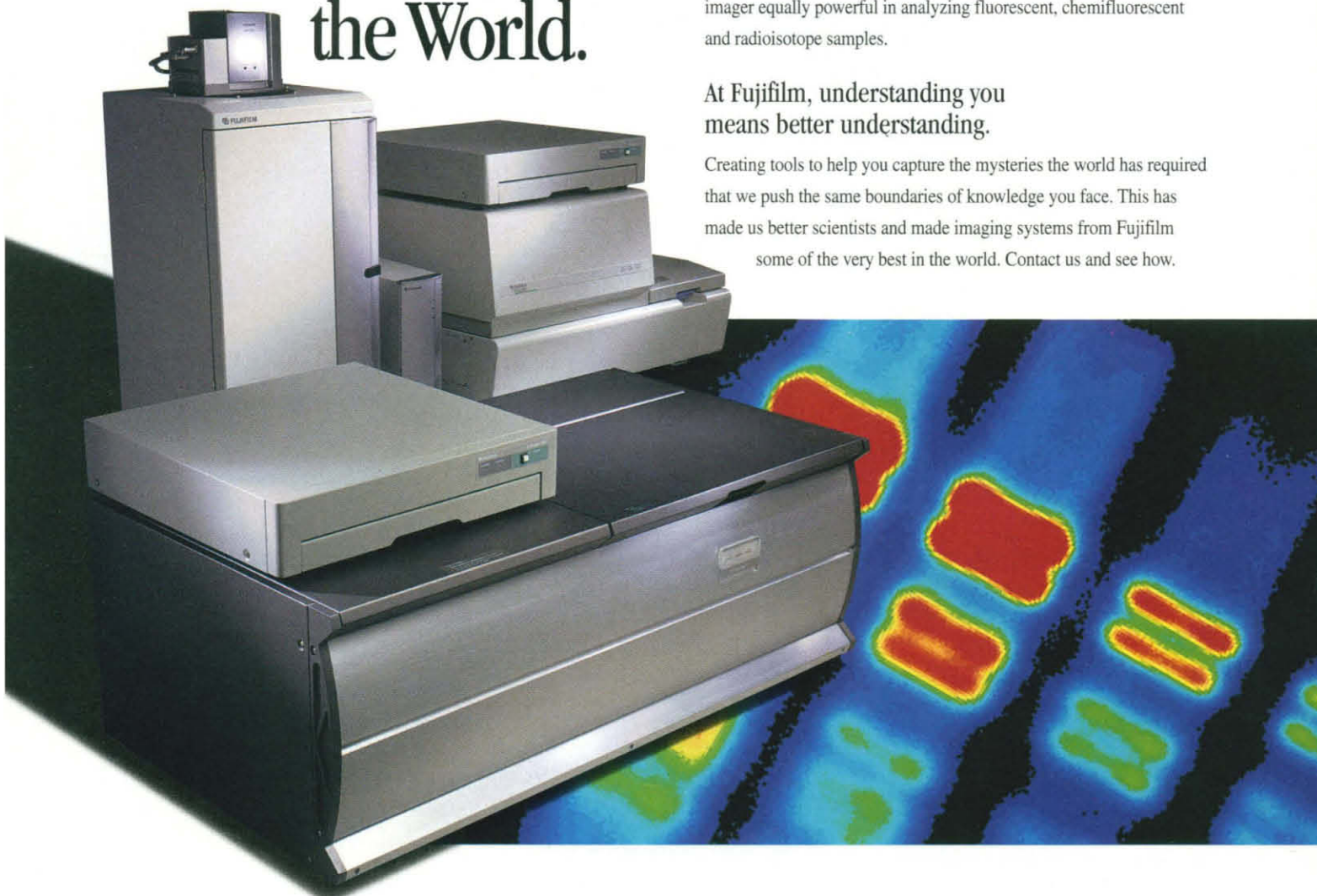
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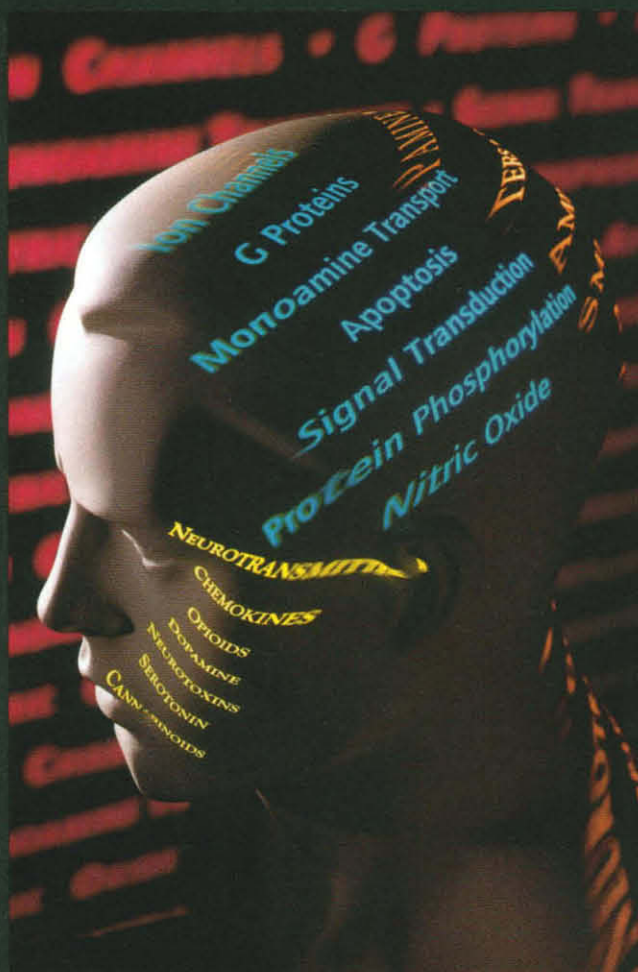
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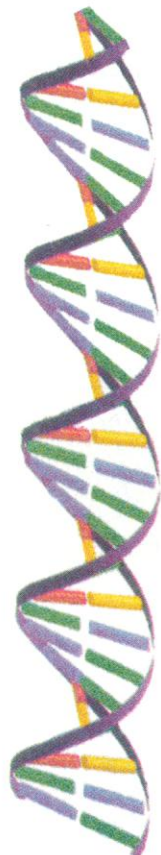
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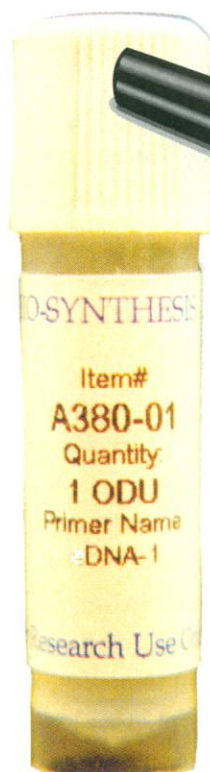
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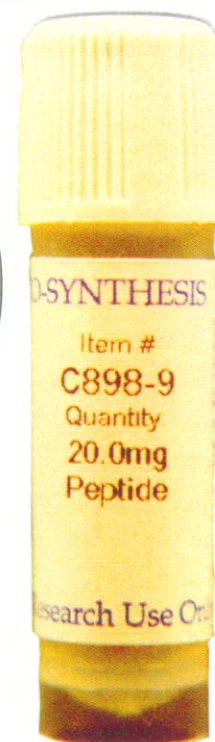
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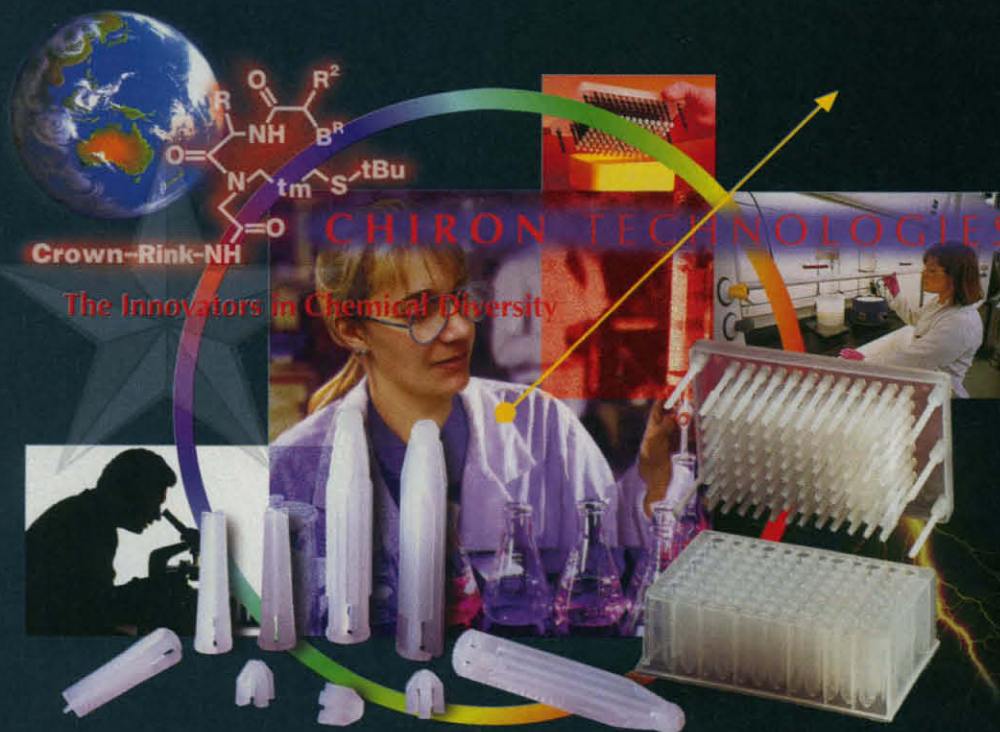
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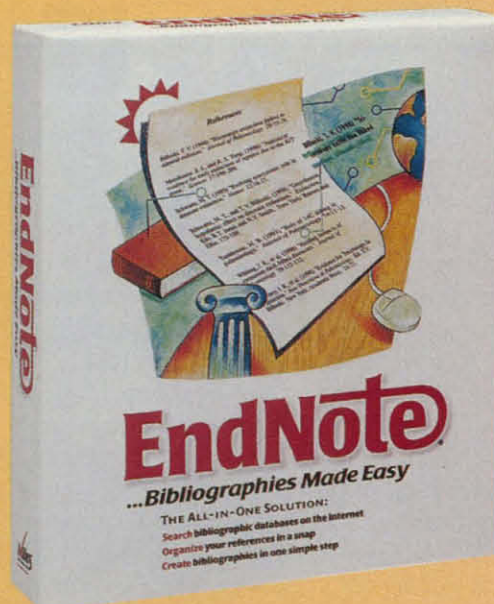


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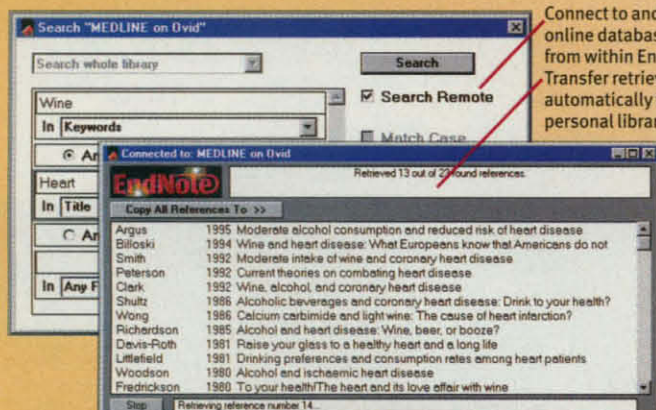
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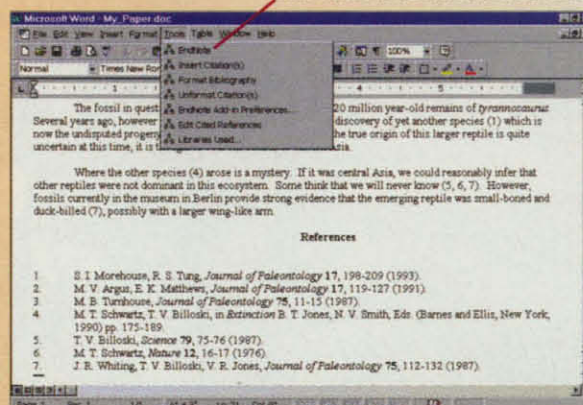
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