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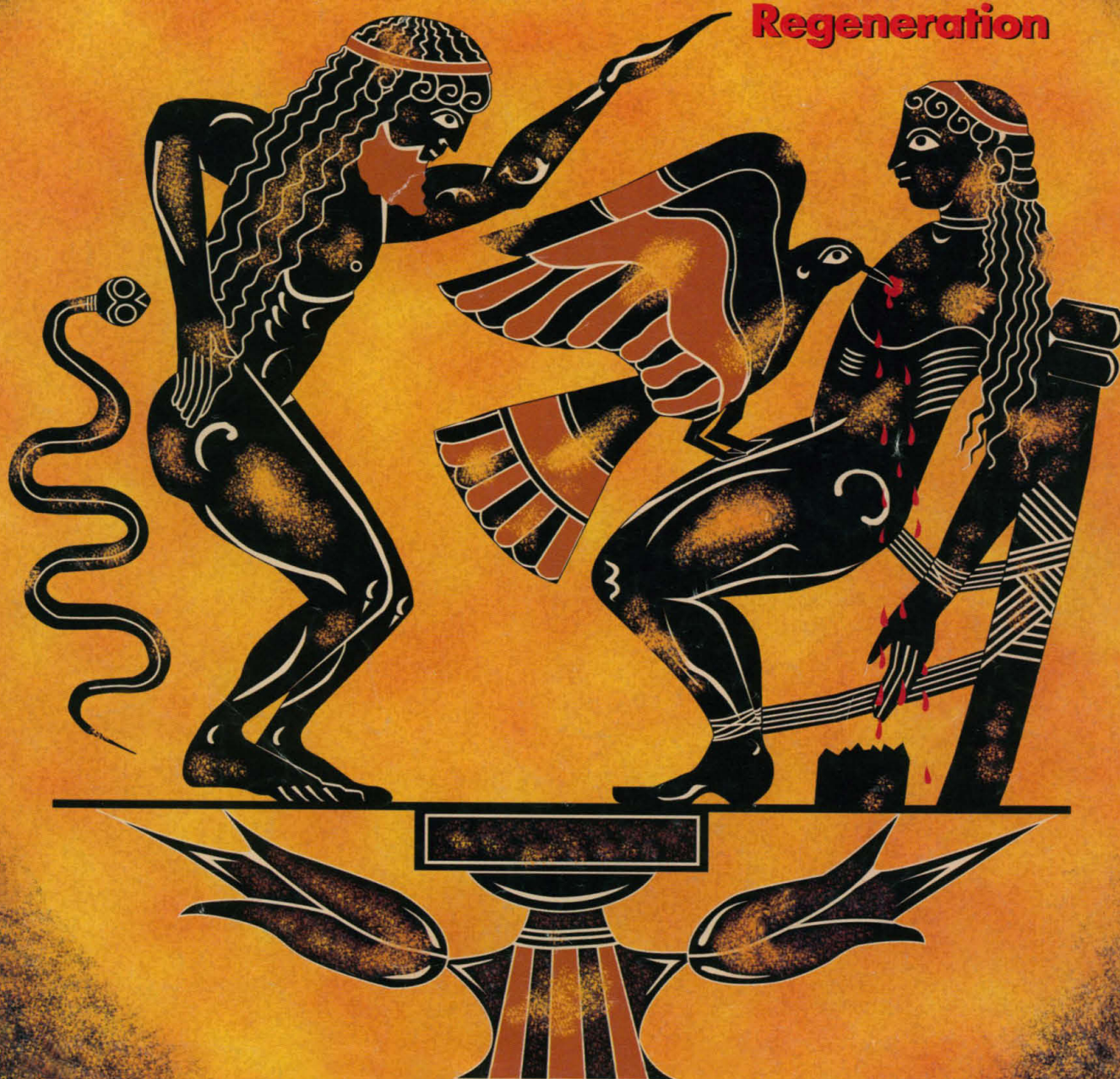
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FRONTIERS IN MEDICINE
Regeneration



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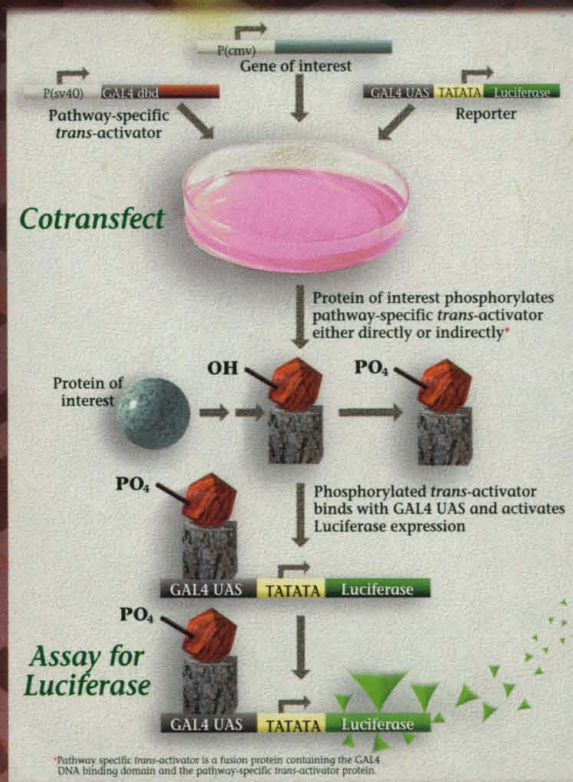
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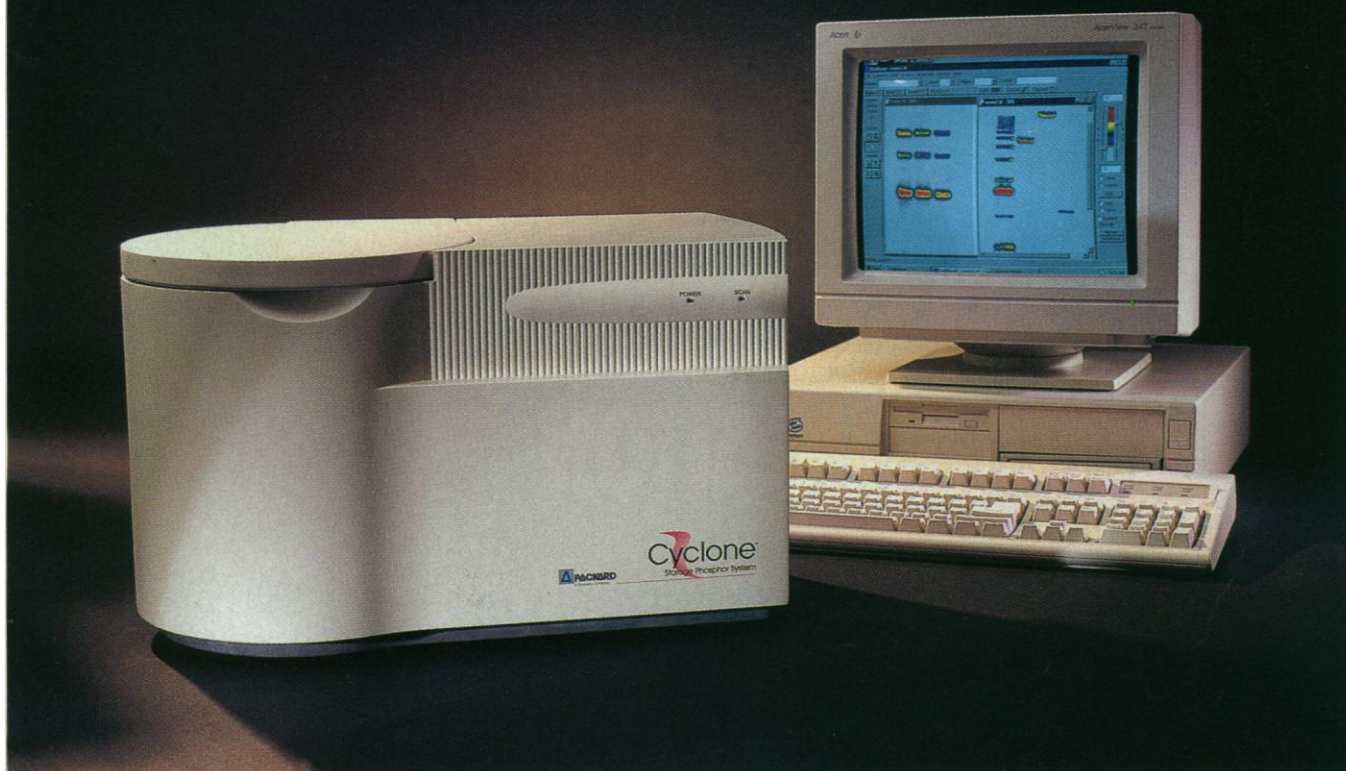
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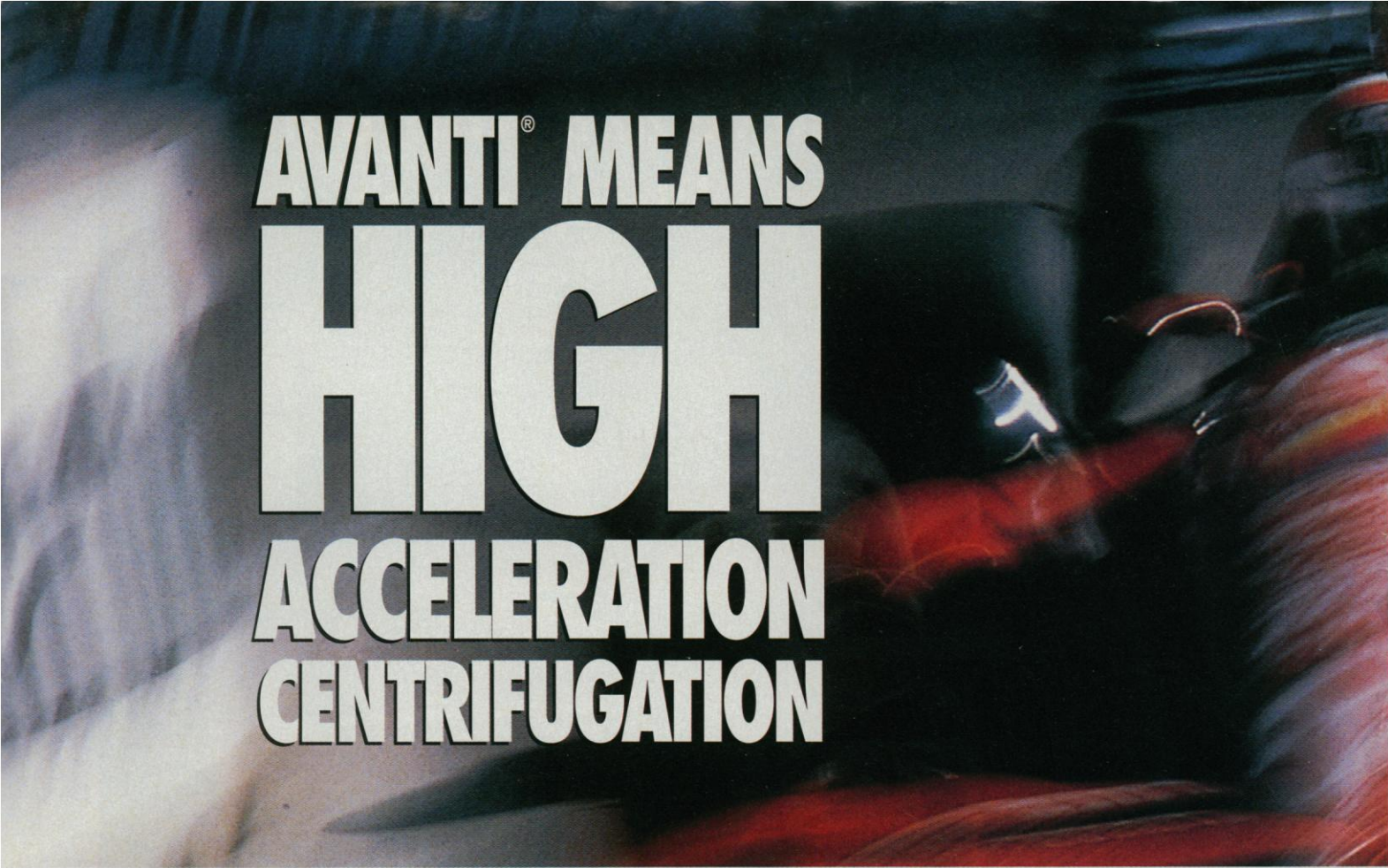


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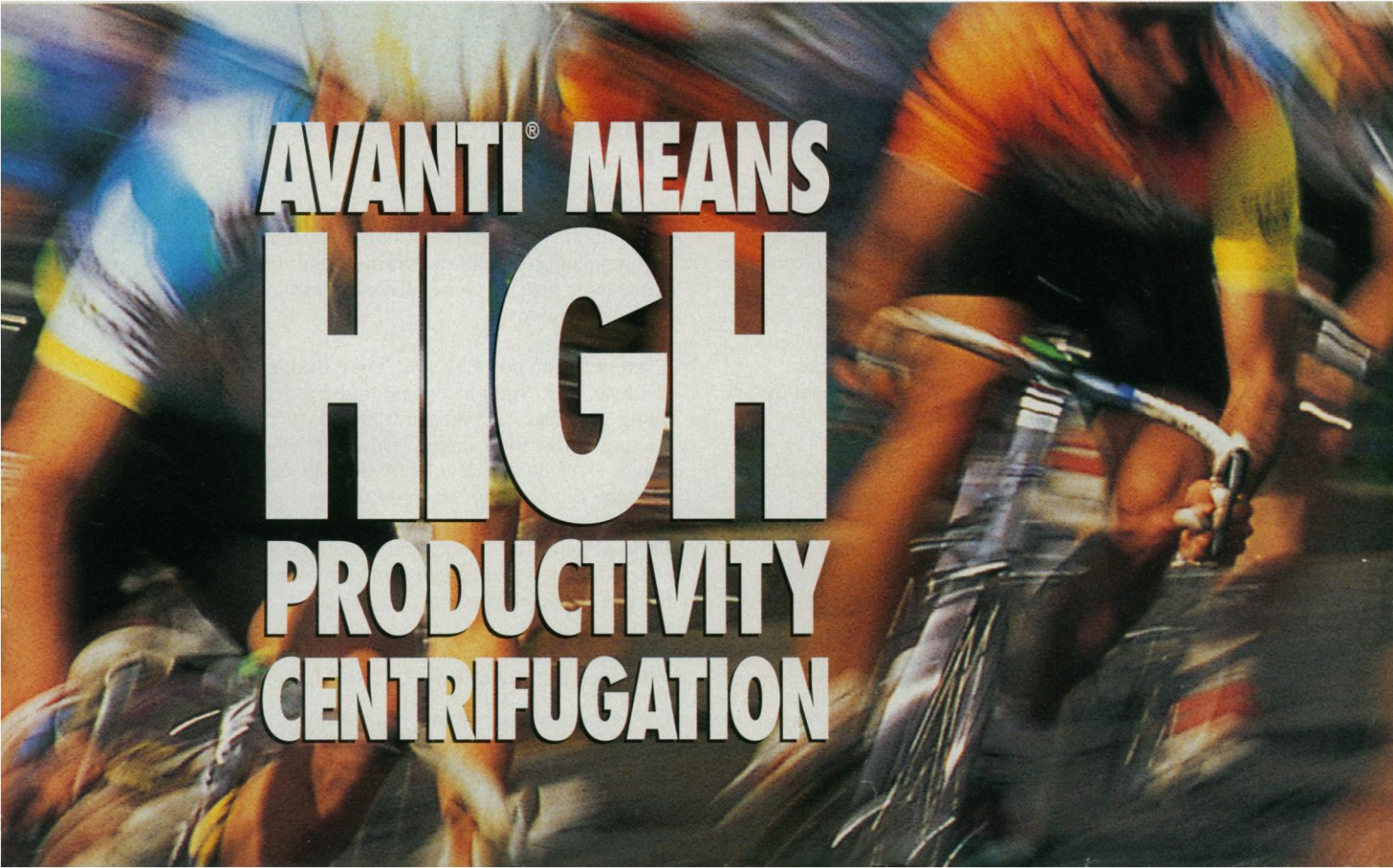


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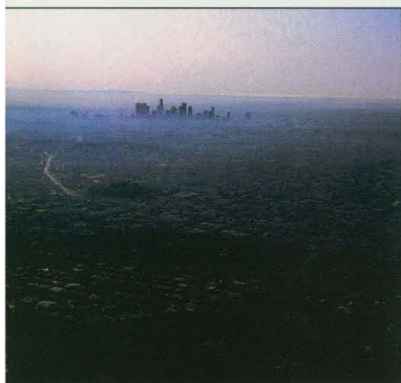
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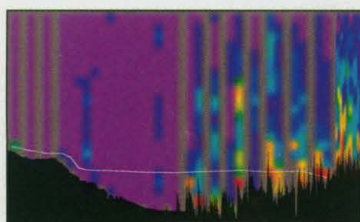
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COVER

After Prometheus stole fire from the gods, Zeus assigned "a long-winged eagle, which used to eat his immortal liver; but by night the liver grew as much again every day" (from Hesiod's *Theogony*). Nowadays, the study of tissue regeneration has become an integrating

interface where molecular and cellular biology explore mechanisms related to whole organ growth. See the special section beginning on page 59 and the editorial on page 15. [Source: Linda A. Shab and George K. Michalopoulos. Illustration: Elizabeth Carroll]



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Fractals, physiology, and
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■ Indicates accompanying feature

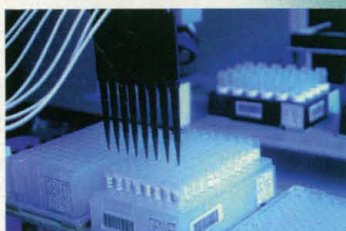
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THIS WEEK IN SCIENCE

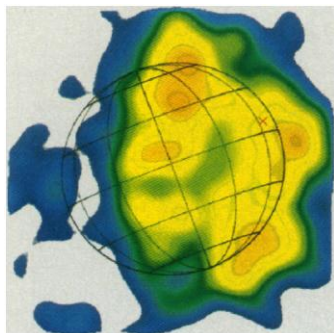
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Abnormal matter

How old are the oldest stars? Visser (p. 88) uses the energy conditions derived from classical general relativity, the currently accepted value for the Hubble parameter (the rate at which the expansion velocity changes with distance in the universe), and observations of old stars to attempt to answer this question. He concludes that no possible combination of normal matter is compatible with the range of accepted values of the Hubble parameter. Either large amounts of abnormal matter or fundamental changes in the theory that describes the early structure of the universe may be required.

Hot, wavy exospheres

The Voyager missions determined that the exospheres of the giant outer planets were hotter than could be explained by any solar mechanism, and the thermal profile of the upper atmosphere derived from Galileo probe data confirmed the presence of a hot jovian exosphere. After further refinements to the probe data, Seiff *et al.* (p. 102) show that wave-like oscillations are persistent in the jovian thermal profile



above the tropopause. Two reports provide explanations for the waves and high temperatures in the jovian exosphere

Structural clues to cis and trans integrase function

Site-specific recombinase enzymes catalyze the exchange of DNA strands. One puzzle that this family of enzymes has presented is that, during the formation of the complex of two DNA strands and four recombinase monomers, some integrases act on the phosphate nearest them (action in cis), whereas others act on the phosphate across from them (action in trans). The crystal structure of the catalytic core of λ -integrase reported by Kwon *et al.* (p. 126) reveals a conservative fold and shows that the attacking nucleophile, tyrosine-342, is located on a flexible loop about 20 angstroms across from a basic groove that contains the other catalytic residues. In a Perspective, Jayaram (p. 49) discusses modeling results which show how different loop lengths could explain why different integrases adopt cis or trans modes of attack on the phosphates.

that could also be applied to the other giant planets, for which there are fewer direct observations. Waite *et al.* (p. 104) suggest the equatorial x-ray emissions observed by the ROSAT satellite are caused by heavy ion precipitation, which would also provide a heating mechanism. Young *et al.* (p. 108) suggest that the observed probe oscillations are consistent with gravity waves and that the viscous dissipation of these waves would produce excess heat.

Aerosols and smog

Organic molecules from gasoline vapor have an important influence on the formation of organic aerosols, an essential factor in urban smog but, to date, detailed information on the aerosol-forming potential of organic mixtures has been limited. Odum *et al.* (p. 96; see the news story by Kaiser, p. 33) irradiated smog chambers containing different mixtures with sunlight and analyzed their aerosol-forming potential. The sum of the contributions from the aromatic fraction of the gasoline vapor can account for the aerosol-forming potential. These results may facilitate

modeling and help in understanding the factors contributing to urban smog.

Deep ocean mixing

The amount and pattern of mixing in the deep ocean affects recycling of chemicals and nutrients and heat flow, but data detailing these processes have been sparse. Polzin *et al.* (p. 93) report results of a large survey to examine deep mixing in the Brazil Basin of the South Atlantic Ocean. Mixing is greatly enhanced near bathymetric features, such as the Mid-Atlantic Ridge, but lower above the smooth abyssal plains.

Alkane metathesis

Metathesis reactions, which involve the exchange of chemical groups between reactants, are well known for alkenes and alkynes. Vidal *et al.* (p. 99) show that metathesis reactions can also occur for the much less reactive alkanes. They used transition metal hydride catalysts to transform linear and branched alkanes into lower and higher alkanes under mild conditions. Such reactions may

be used to transform the relatively abundant light alkanes into higher molecular weight hydrocarbons.

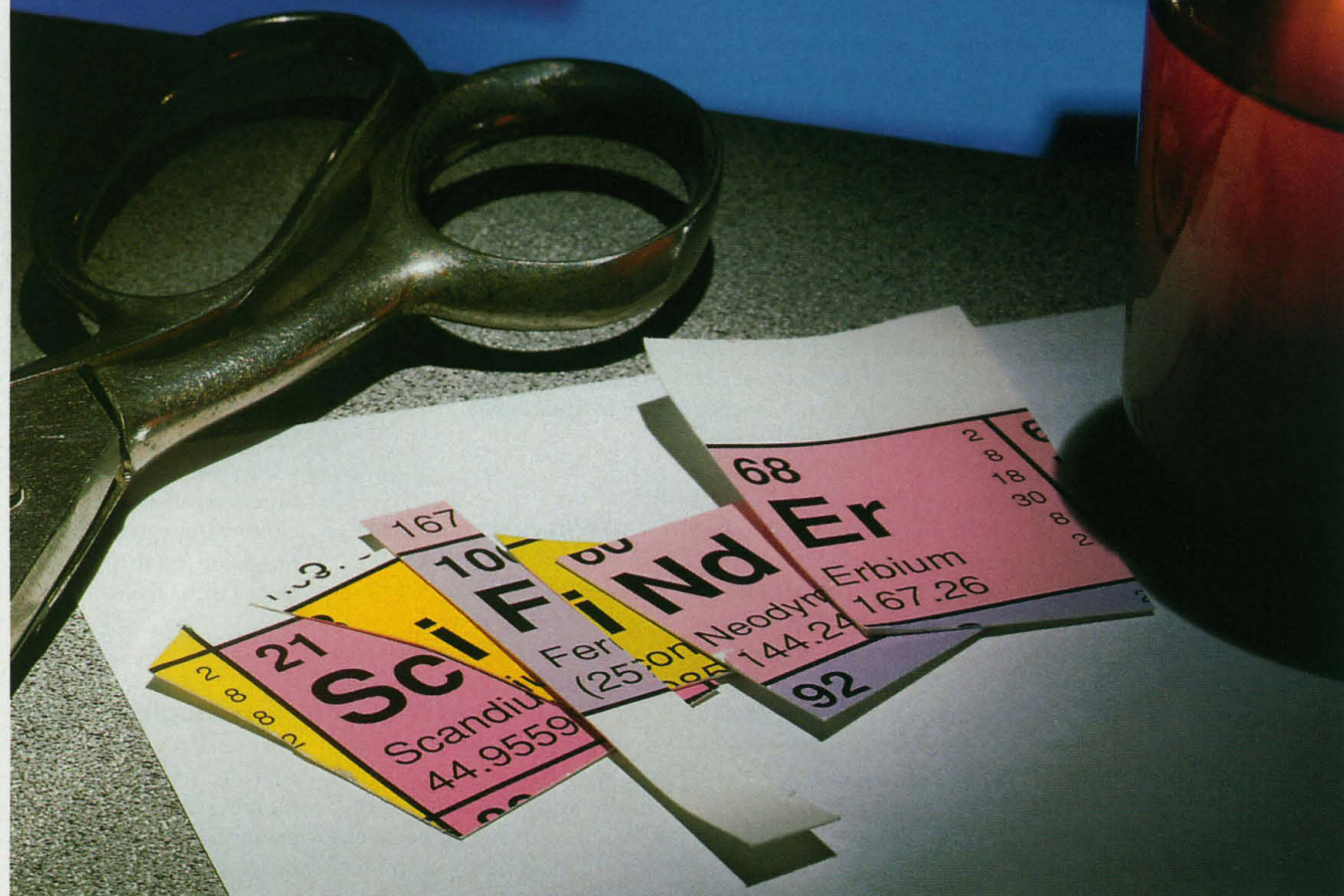
Hot on the TRAIL

Some cytokines, such as tumor necrosis factor (TNF), promote apoptosis or programmed cell death. TRAIL, a member of the TNF family that causes death of transformed cell lines but seems to be expressed without toxicity in many normal human tissues, has attracted attention for possible use in cancer therapy. Pan *et al.* (p. 111) now report the identification of the receptor for TRAIL. Although it shares some similarities with other members of the TNF receptor family, it appears to promote cell death through a distinct mechanism.

Biological scales

Several scaling laws are known that are widely applicable in biology; for example, rates of energy use, cellular metabolism, heartbeat, embryonic growth, population growth, and lifespan all exhibit power-law scaling with body mass. However, the physical origin of these relations has been poorly understood. West *et al.* (p. 122; see the news story by Williams, p. 34) have developed descriptions of biological processes that may provide a general model for allometric scaling laws. They apply it specifically to vertebrate cardiovascular systems but it is anticipated to have relevance to a wide range of other systems. The model is based on a fractal network of branching tubes and makes the central assumption that energy use is minimized.

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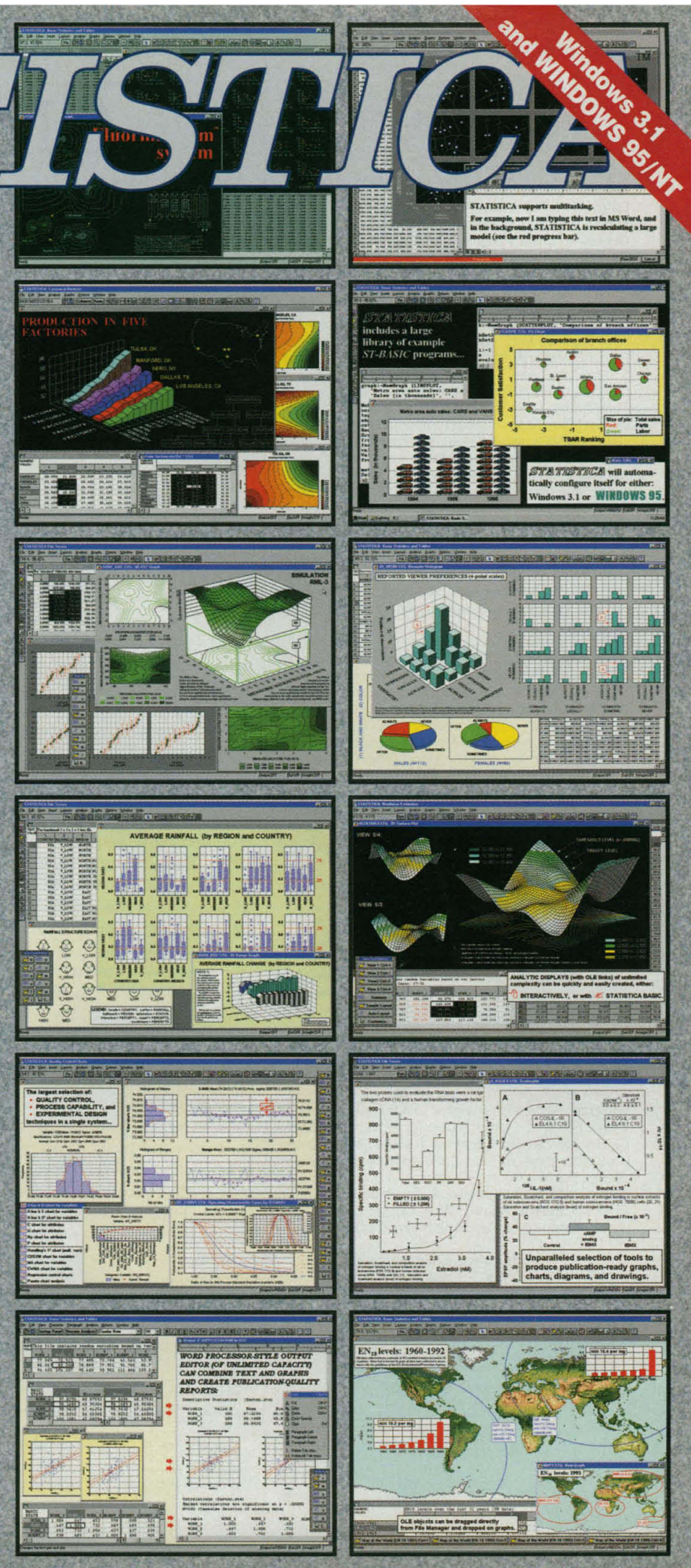
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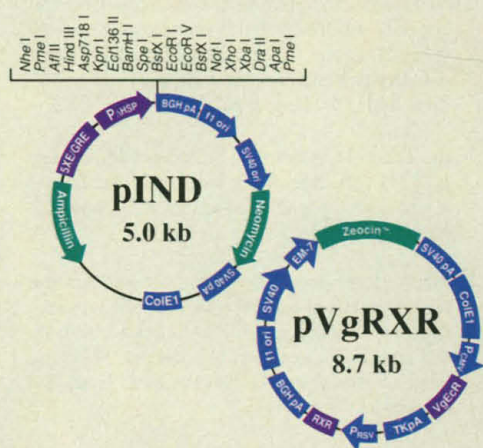
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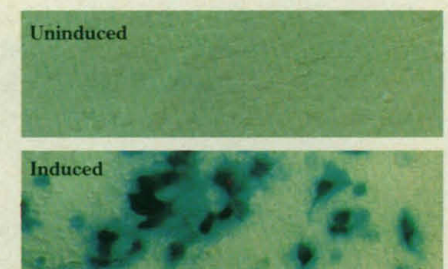
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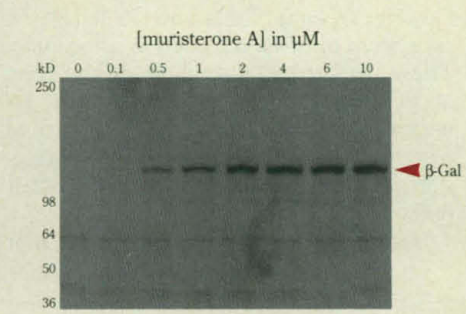
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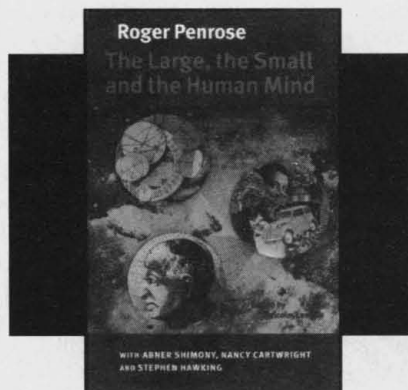
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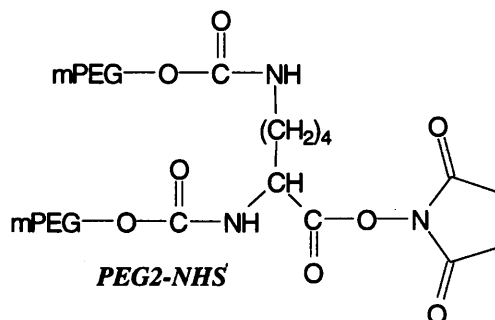
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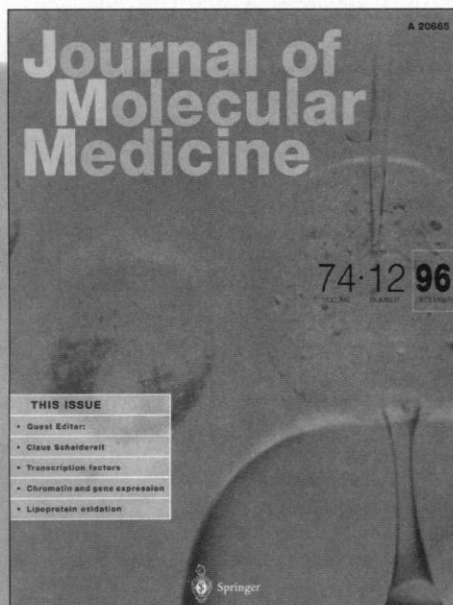
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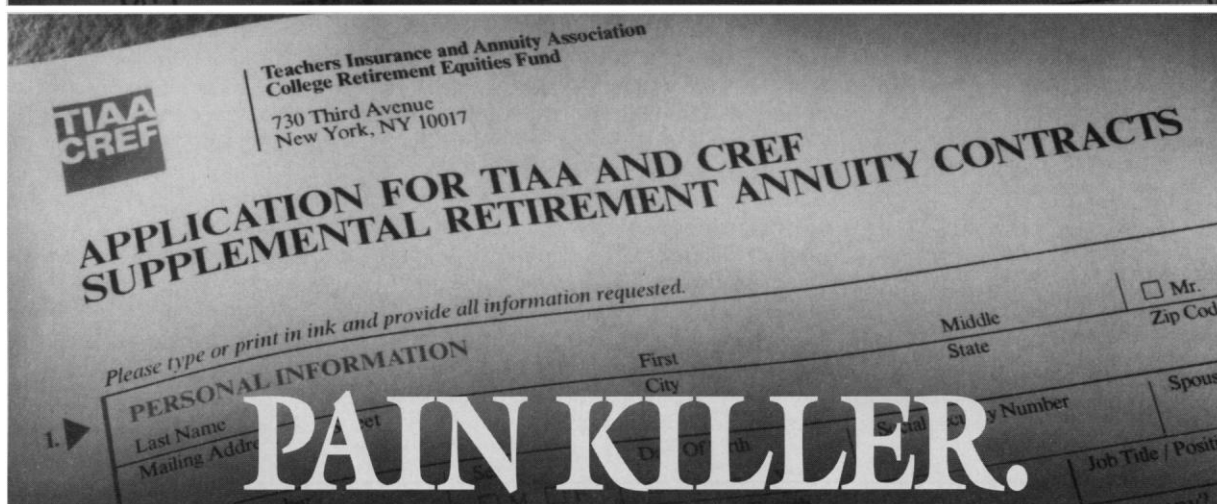
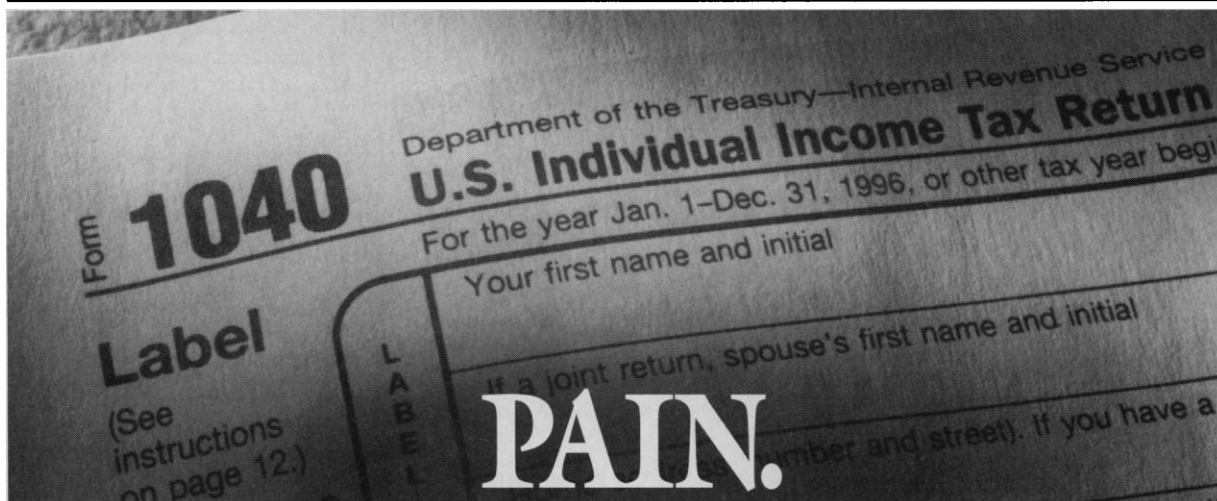
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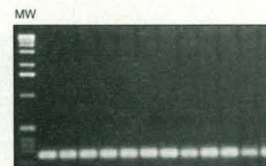


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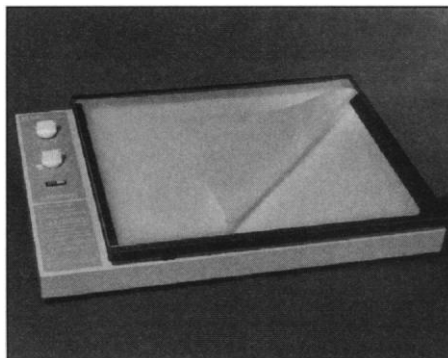
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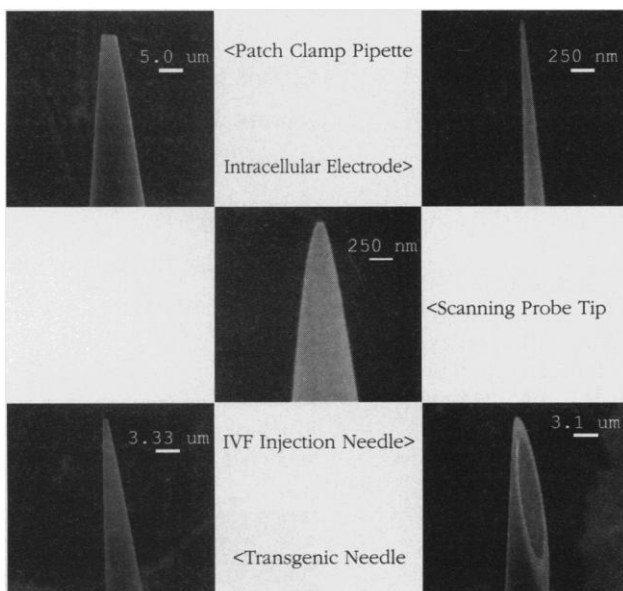
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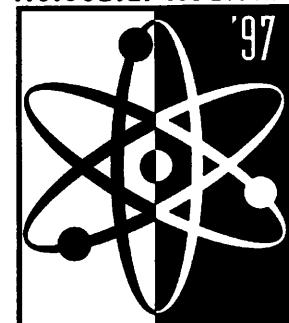
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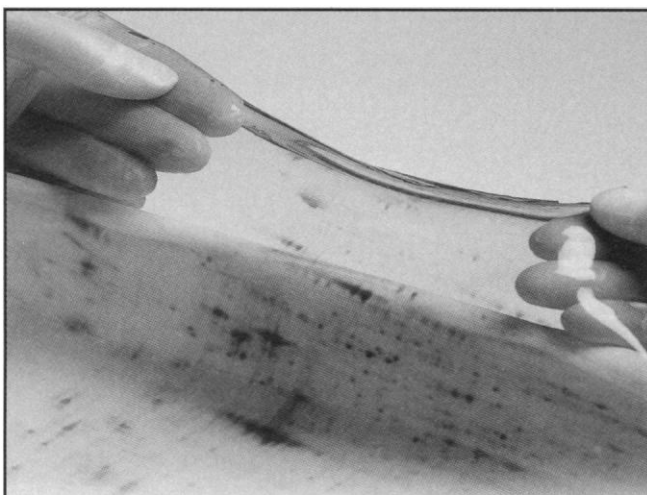
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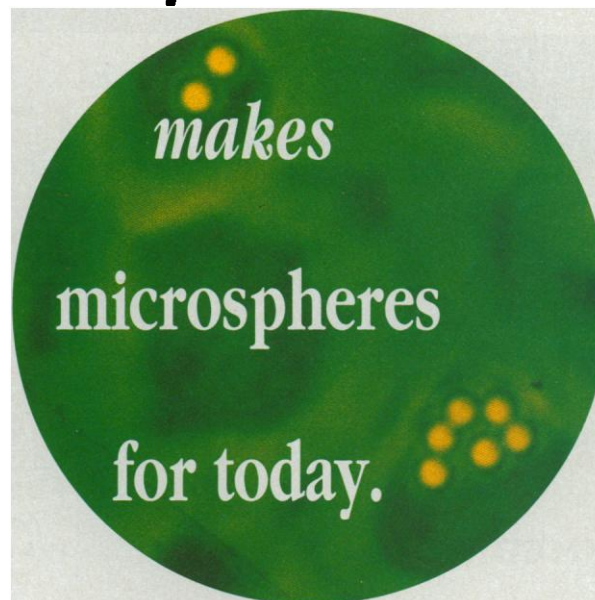
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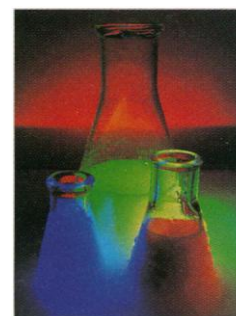
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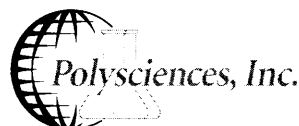
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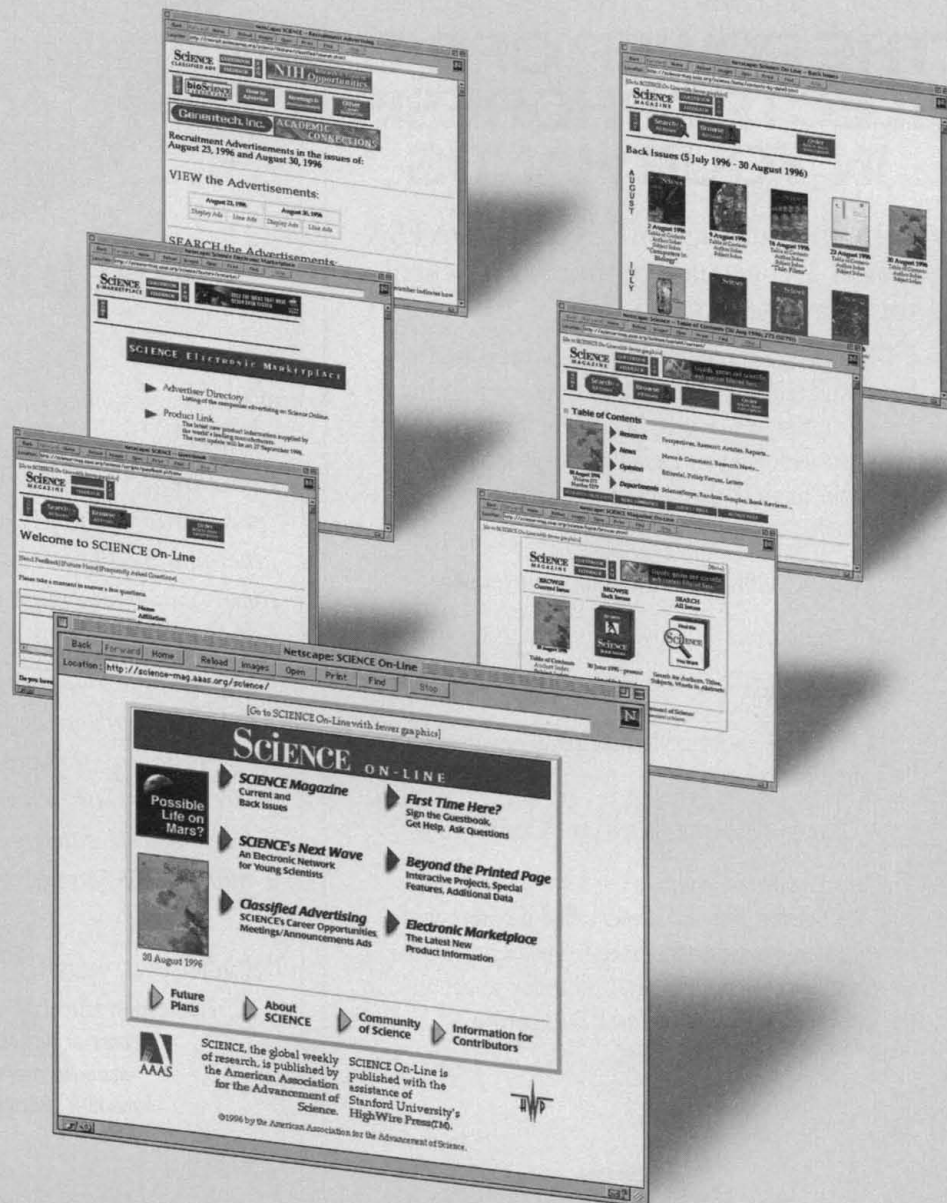
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