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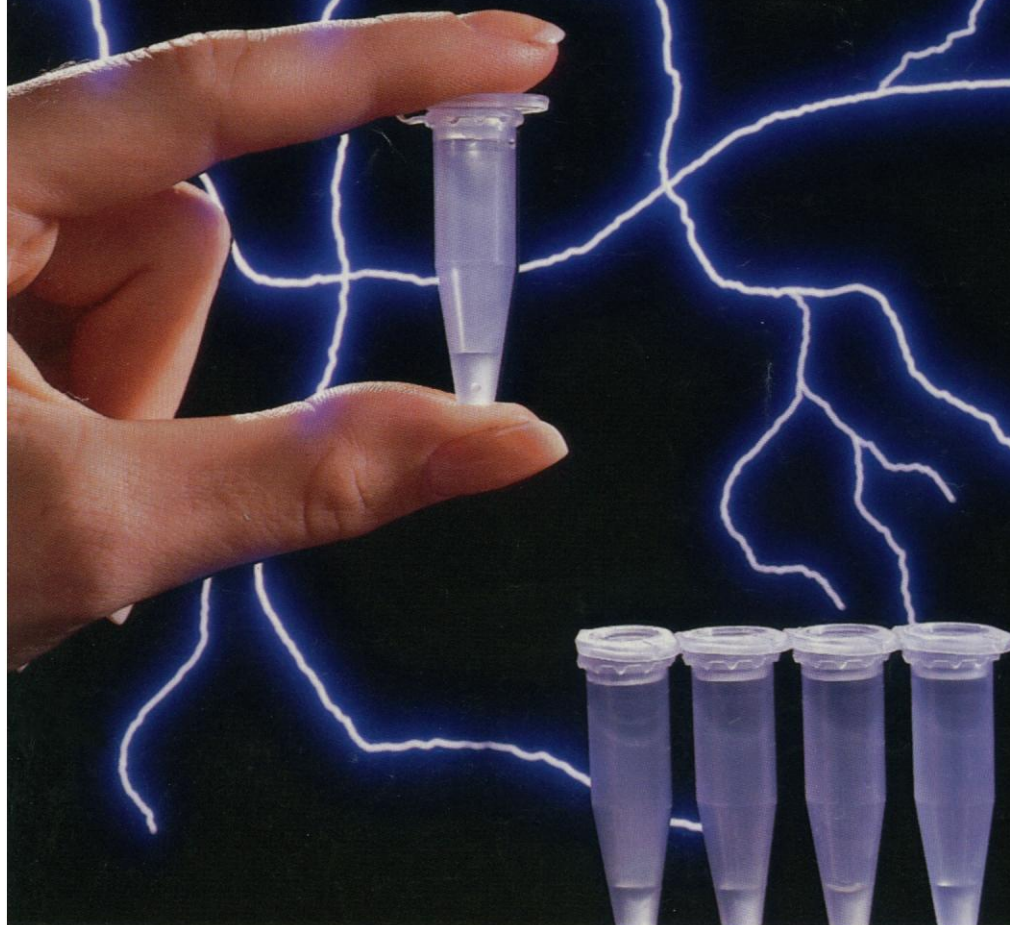
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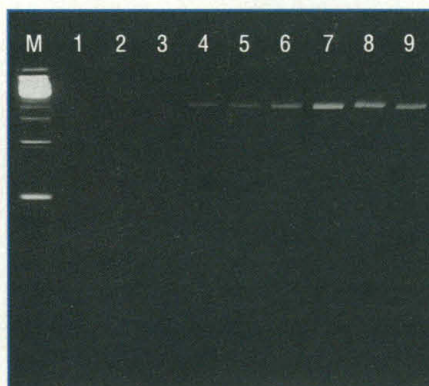
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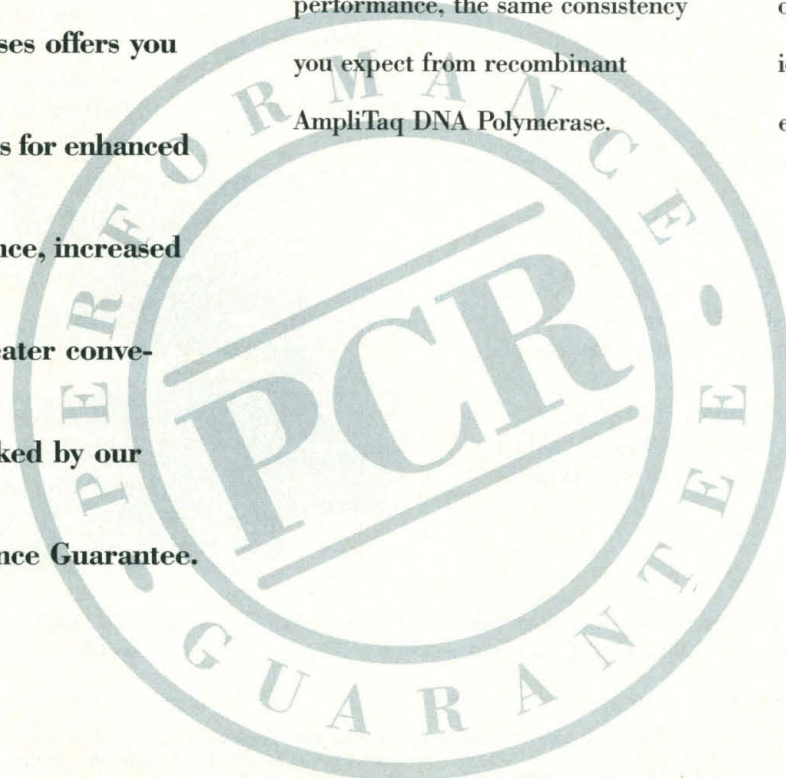
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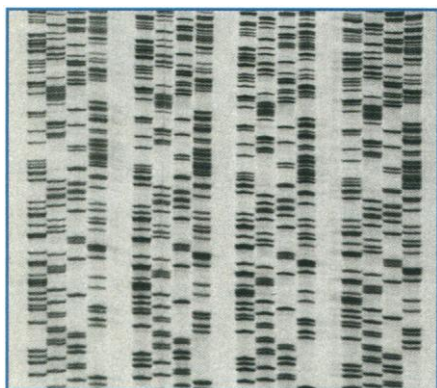


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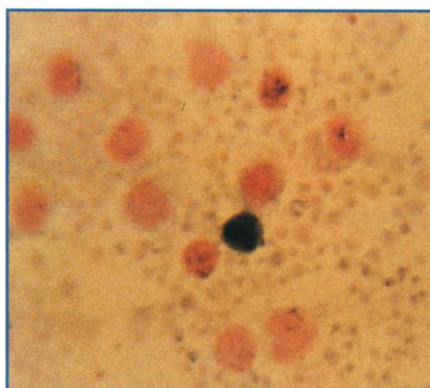


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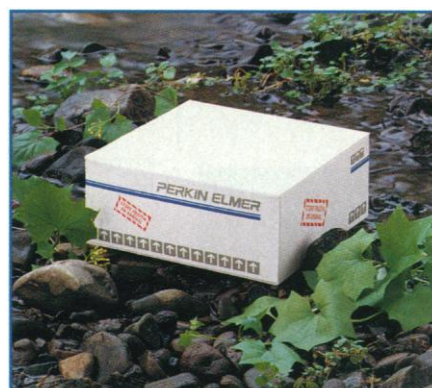
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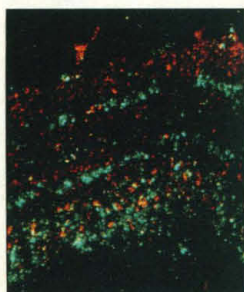
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780
Layers of
synapses

825

Getting used to smells ...
desensitization



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COVER

Displaying *Archaeopteryx* in a Late Jurassic ginkgo tree. Although *Archaeopteryx* has been envisioned as a cursorial predator, evidence from claw geometry suggests that *Archaeopteryx* was primarily an arboreal

bird and a trunk-climber and does not represent a terrestrial stage in the evolution of avian flight and feathers. See page 790. [Acrylic painting: John P. O'Neill]



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A tough shell

■ Indicates accompanying feature

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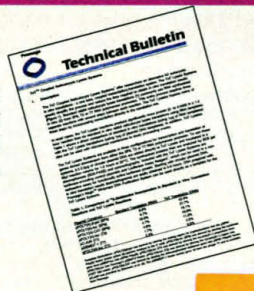
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Gas from the past

The isotopic compositions of noble gases measured in volcanic gases suggest that some noble gases still derive from Earth's interior despite their high diffusivity and Earth's long history of degassing. One possibility is that the noble gases are being slowly released from Earth's iron core. To evaluate whether the noble gases might have originally fractionated into the core during its formation, Matsuda *et al.* (p. 788) determined the partition coefficients of neon, helium, xenon, krypton, and argon between iron metal and silicate glass at pressures up to 10 gigapascals. Fractionation of noble gases into the iron metal decreased significantly with pressure, suggesting that if the core formed under equilibrium conditions, then its noble gas content should be low.

□

Liquid structure

Recent developments in high-temperature nuclear magnetic resonance spectroscopy (NMR) have allowed direct investigation of the chemical structure and dynamics of liquids at temperatures characteristic of natural magmas. Poe *et al.* (p. 786) used a laser NMR technique coupled with ion dynamics simulations to investigate the aluminum (Al) coordination in MgAl_2O_4 and CaAl_2O_4 at temperatures up to 2500 K; Al is a major component of natural magmas, and its average coordination affects the physical properties of the magma, such as the density and viscosity, as well as the crystallization behavior. The results suggest that substitution of Mg for Ca in these liquids increases the abundance of five-coordinated Al in MgAl_2O_4 and thus the average Al coordination at high temperatures.

Crystal texture in biominerals

Mineralized tissues can consist of arrays of well-aligned mineral crystals, as is found in mollusk shells, or as structures made of one single crystal, such as spirillinid foraminifera shells. Their mechanical properties, such as brittleness, can be very different from the same mineral derived from inorganic source, presumably because of the effect of occluded protein molecules on fracture. Berman *et al.* (p. 776) used high-resolution x-ray diffraction to measure the mosaicity (angular spread between perfect domains) and coherence length (size of perfect domains) of calcite crystals from inorganic sources and from several types of marine organisms. They show that different growth strategies can lead to large differences in crystal texture. In some cases, the disordering was anisotropic with respect to crystal orientation, which would result from preferential occlusion of proteins on particular growth planes.

Superconducting NMR microscope

The quality of nuclear magnetic resonance (NMR) images is inherently degraded by noise from the sample and from the radio-frequency (RF) electronics in the apparatus. If the sample can be made small enough, then only the antenna noise dominates. Black *et al.* (p. 793) find that by making the RF receiver coil from high-temperature superconducting materials, the signal-to-noise ratio can be improved by a factor of 10. The authors have constructed a superconducting magnetic resonance imaging system and present preliminary spin-echo images in an effort to probe the ultimate limits to signal-to-noise improvement.

□

Film phenomena

Thin films made by the Langmuir-Blodgett technique are of interest for molecular electronics and biosensors, but the connection between molecular structure and positional order in these systems is not completely understood. Bourdieu *et al.* (p. 798) investigated films of barium arachidate with an atomic force microscope (AFM).

After preparation, the films exhibit hexagonal ordering, and the relation between ordering and defects was studied. After heating, the films condense to an unusual state that the authors interpret as having a rectangular crystallographic structure. Height modulation revealed by the AFM also suggests that the films are subject to buckling.

□

Unnatural amino acids and Ras

Point mutations in the protein Ras that decrease its ability to switch from an inactive state (in which it binds guanosine diphosphate or GDP) to the active GTP-bound state are associated with oncogenic activity. Chung *et al.* (p. 806) show that the distinctive structural and catalytic roles of these residues can be reproduced by using a variety of unnatural amino acids. These amino acids have unusual main chain conformations, association constants, hydrogen-bonding properties, and steric features. These results provide additional mechanistic insights into the role of residues in the switch II region and suggest that the phosphate-

binding L1 loop may play a role in the activation of Ras by effector molecules.

□

Molecular editing

RNA editing, the alteration of an RNA sequence after transcription, has been described for mRNAs and RNAs of organelles. Lonergan and Gray (p. 812) find that at least four of the mitochondrial tRNAs of an amoeboid protozoan are also edited. This tRNA editing consists of single nucleotide conversions in the acceptor stem region of the tRNAs. Without this editing, these tRNAs would have mismatched base pairs in the acceptor region and presumably would be nonfunctional.

□

Motor control

The basal ganglia are critically involved in the control of voluntary movement; Parkinson's disease is a striking example of basal ganglia dysfunction. The caudate and putamen of the basal ganglia receive input from the cerebral cortex; the thalamus receives output signals from the basal ganglia and projects back to the cortex, thus forming signal loops. Hoover and Strick (p. 819) mapped pathways in this region of monkey brains by following the transsynaptic retrograde transport of herpes simplex virus type 1. The globus pallidus, one of the output nuclei of the basal ganglia, contains separate regions that project to the primary motor cortex, the supplementary motor area, and the ventral premotor area by way of the thalamus. Because each of these cortical areas also project to the spinal cord, the basal ganglia may directly influence the control of motor function.

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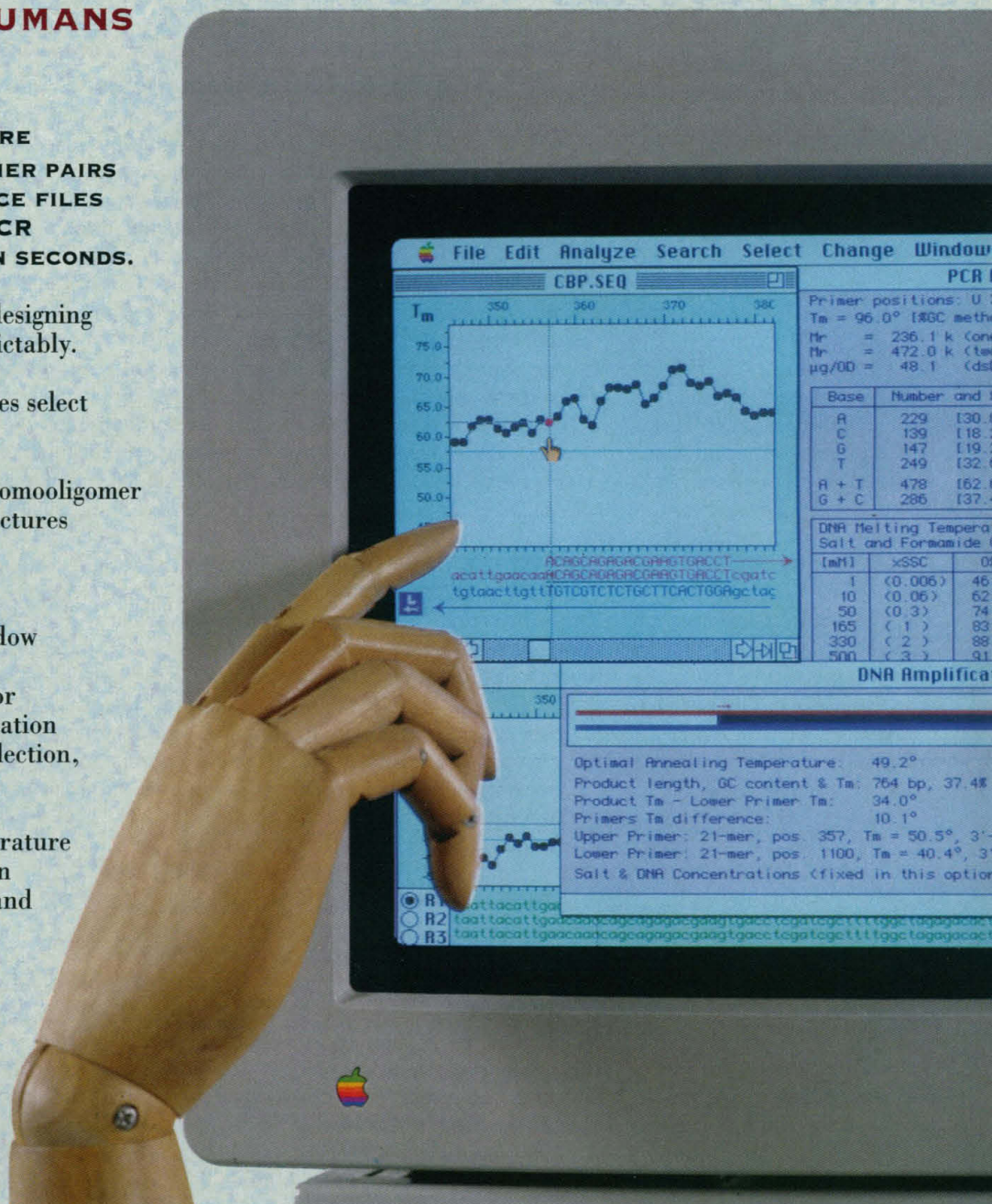
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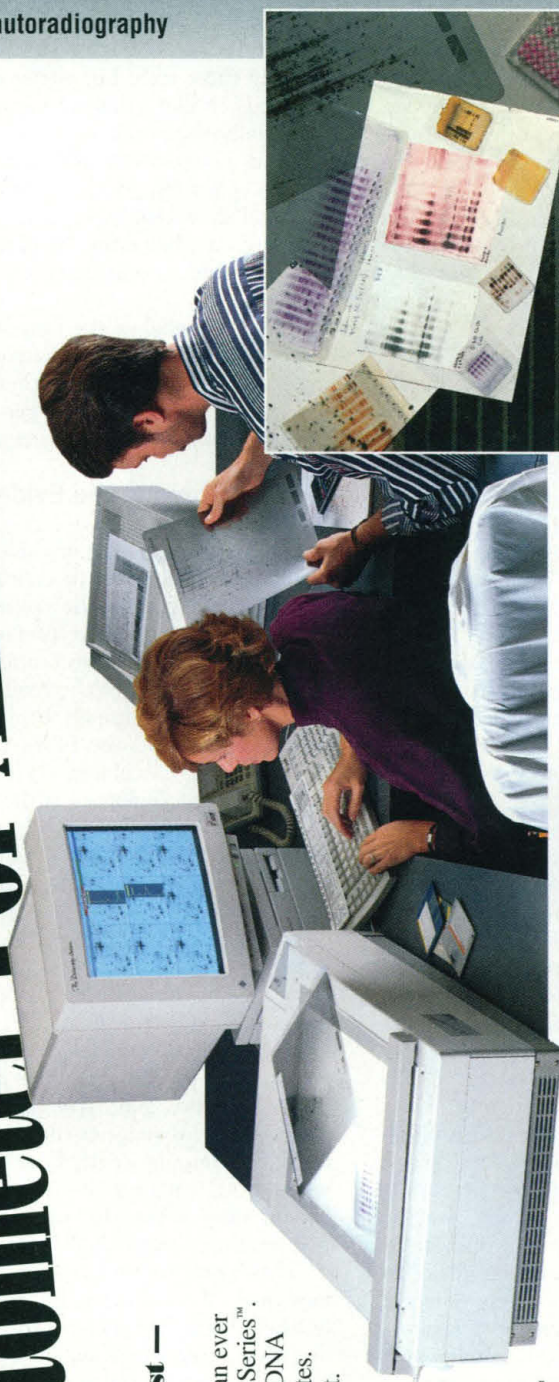
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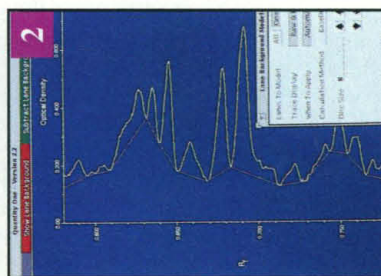
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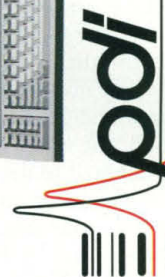
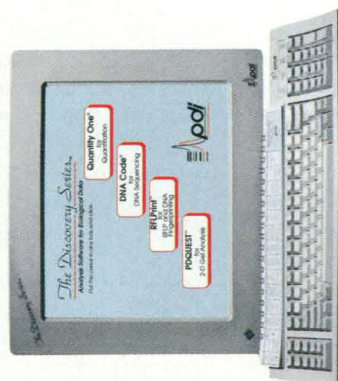
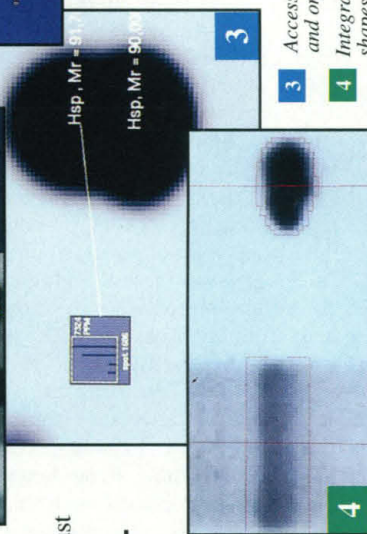
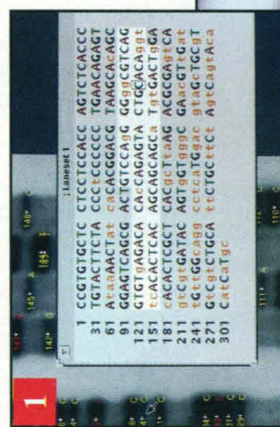


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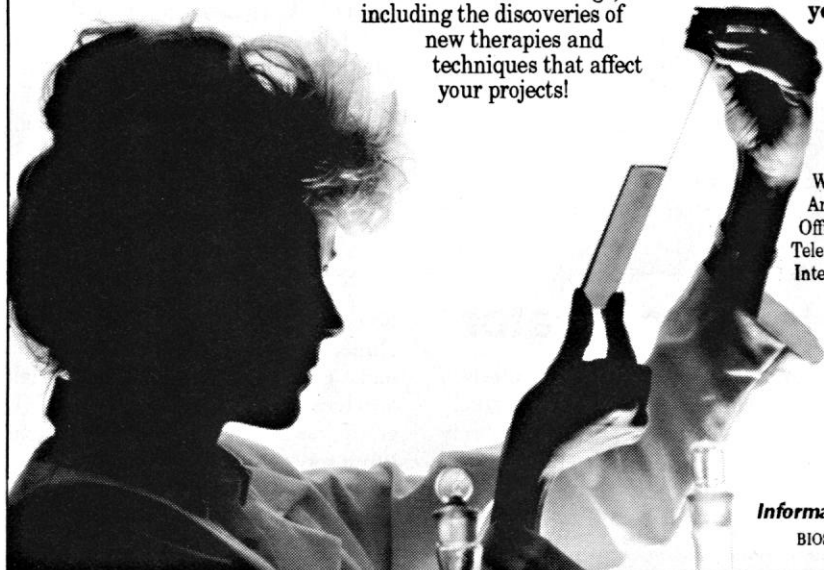
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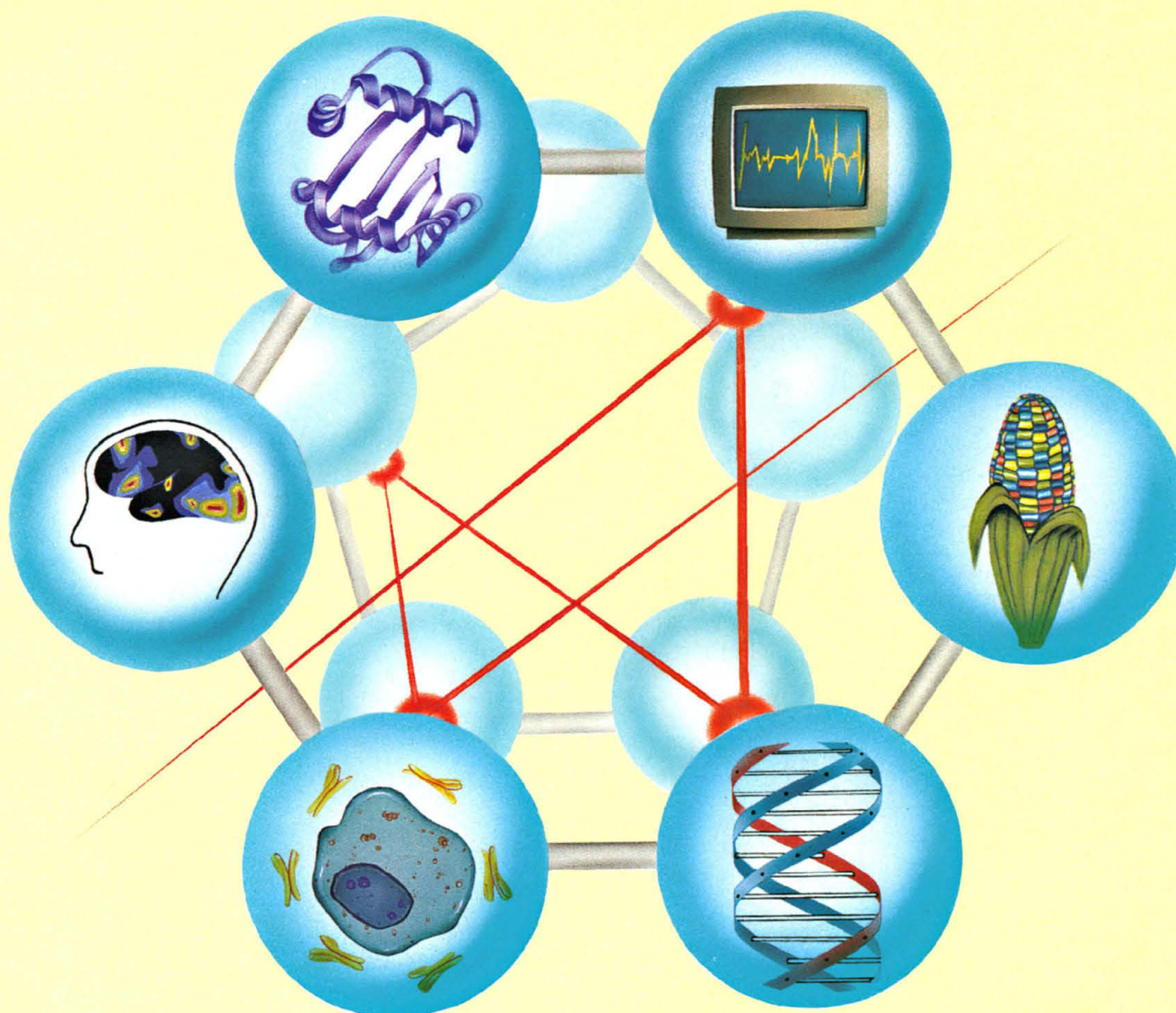
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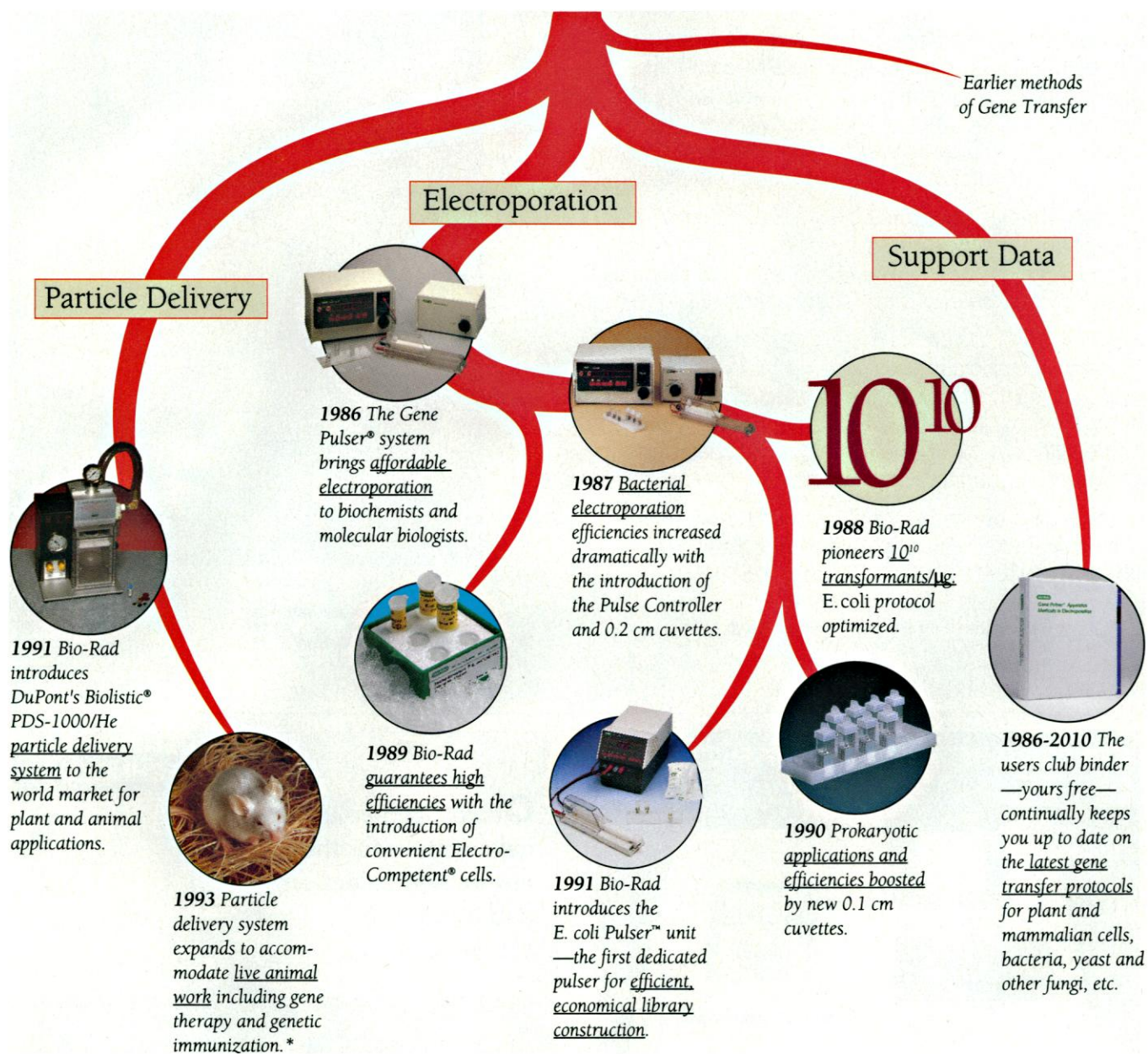
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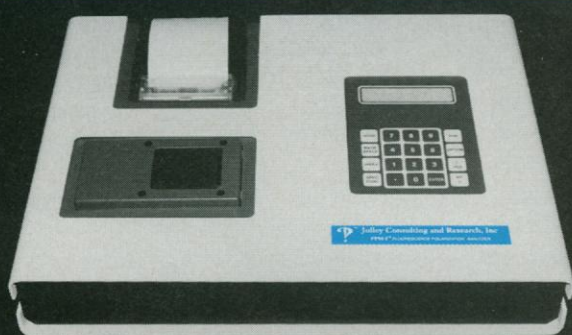
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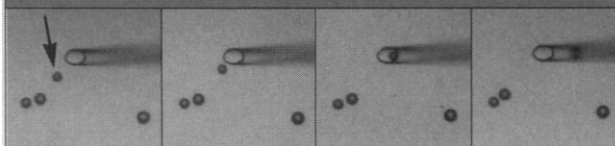
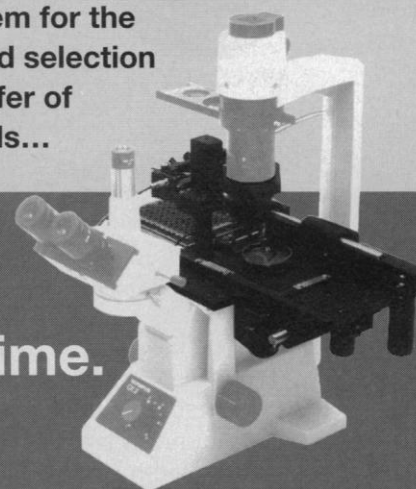
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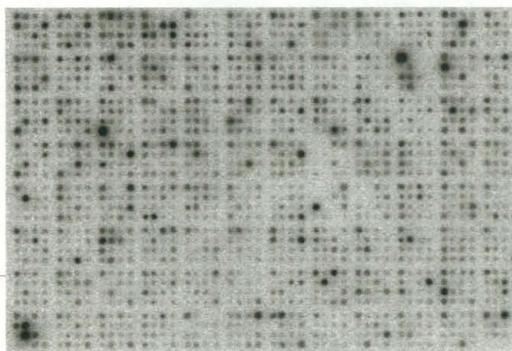
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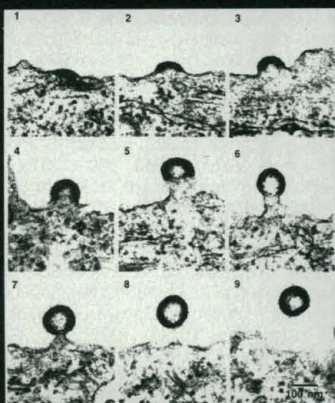


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