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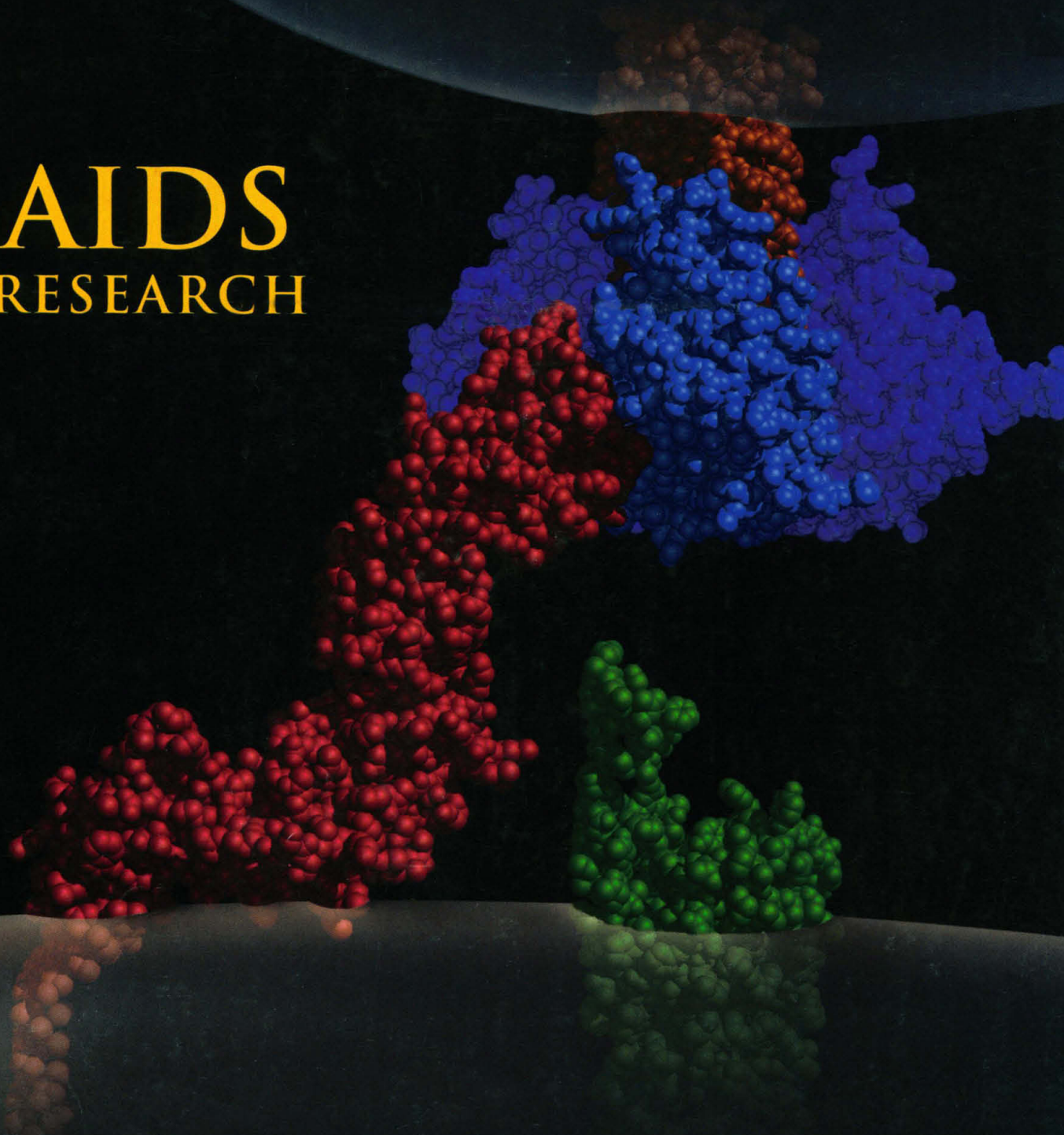
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AIDS
RESEARCH





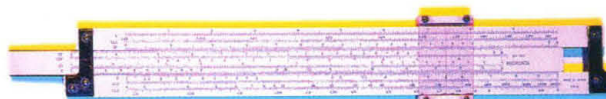
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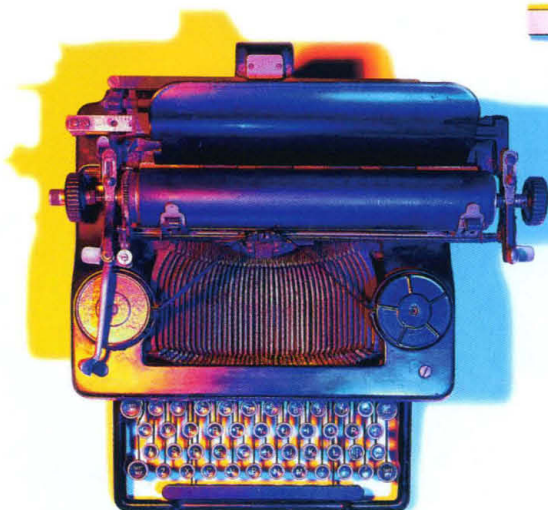
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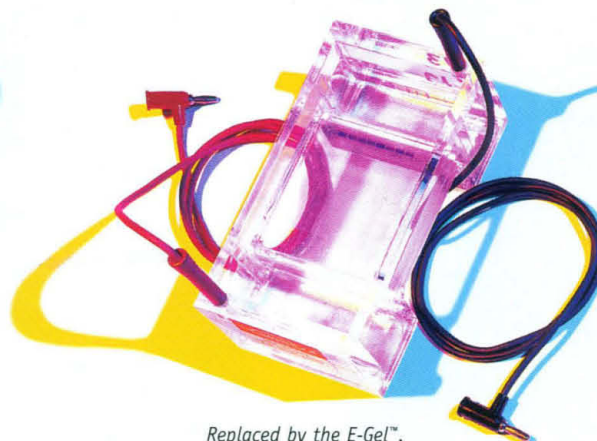
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COVER

The molecules involved in HIV-1 entry into cells are the envelope glycoproteins gp 120 (blue; lacking variable loops) and gp41 (yellow) and cellular receptors CD4 (red) and chemokine receptor (green; hypothetical model). Progress against AIDS requires a clear view of

the known, the uncertain, and the deficiencies in research, resources, and societal and governmental commitment. See the special section beginning on p. 1855 and related items on pages 1815, 1844, 1905, and 1949. [Image: R. Wyatt and J. Sodroski; enhanced by K. Sutcliffe]



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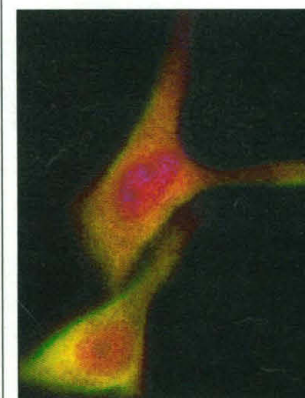
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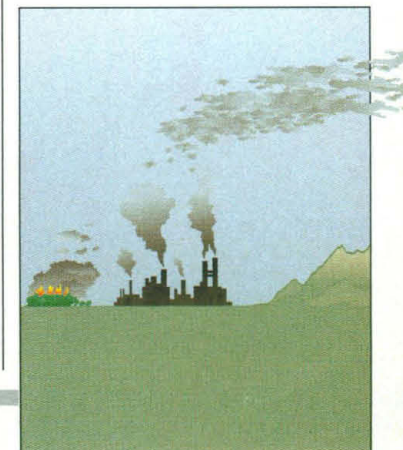


1954

Inside the cellular machine

1903

Where the black carbon goes



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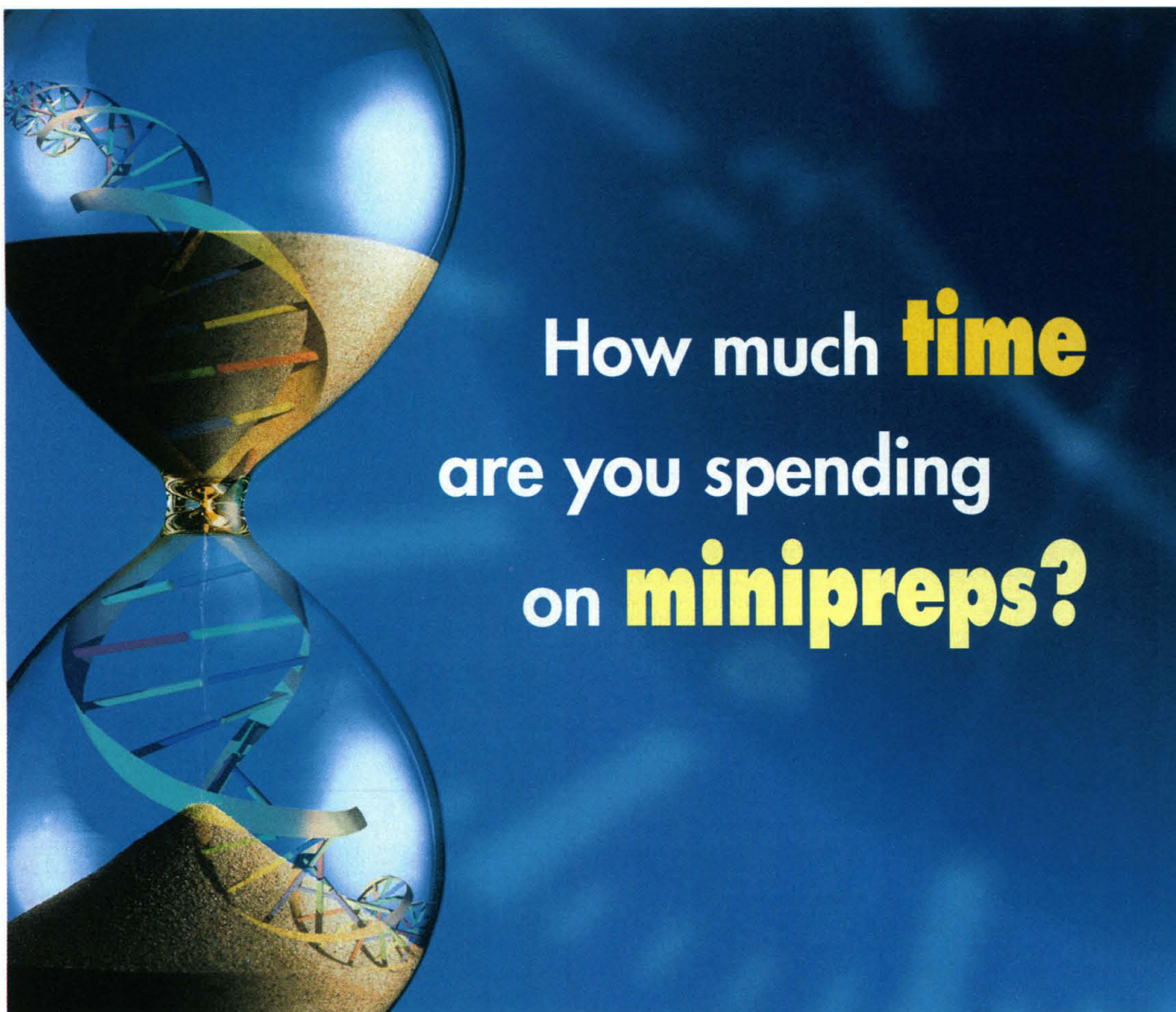
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THIS WEEK IN SCIENCE

edited by PHIL SZUROMI

Reducing risky HIV behavior

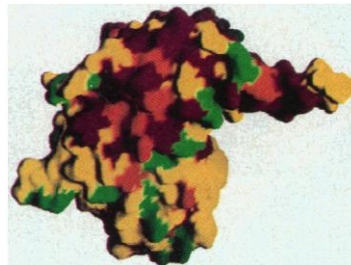
Although there has been considerable progress in HIV therapeutics, infection of adolescents and increases in heterosexual transmission highlight the need for more effective prevention strategies in the United States. The National Institute of Mental Health (NIMH) (p. 1889; see the commentary by Hein, p. 1905) conducted a study in which more than 1800 high-risk individuals attended seven risk-reduction sessions, based on raising individuals' awareness of vulnerability to HIV, promoting benefits of condom use, and teaching skills necessary for safe sex. During a 12-month follow-up period, there were significant decreases in self-reports of risky sexual behaviors, increases in self-reports of condom use, and decreases in incidence of gonorrhea, relative to a control group.

Periclase pliability

Periclase (MgO) is a basic oxide that has been used as a pressure calibrant and is an important component of Earth's lower mantle. Chen *et al.* (p. 1913) used a multi-anvil apparatus combined with a synchrotron x-ray source (to monitor the pressure-volume-temperature conditions) and an ultrasonic interferometer to measure the effect of increasing temperature (to 1600 Kelvin) on the compressional and shear moduli of single-crystal MgO (to pressures of 8 gigapascals). The compressional modulus changes while the shear modulus does not change when the temperature is increased. Thus, hot MgO will alter sound wave speeds differently at different pressures, and this anisotropy should be considered in models of lower mantle dynamics.

Conserved gp120 regions contacting a coreceptor

Among the advances in understanding how HIV interacts with host cell receptors has been a recent crystal structure of the HIV gp120 core in a complex with CD4 and a neutralizing antibody. Rizzuto *et al.* (p. 1949; see the news story by Balter, p. 1833), representing some of the groups involved in the crystallographic study, used the information gained from the structure to design a series of gp120 mutants that could provide insight into the biochemistry of the gp120 interaction with the coreceptor CCR5. A conserved region of gp120, a bridging sheet that connects the inner and outer domains, was identified that binds to CCR5 and could be recognized by antibodies neutralizing diverse strains. Use of gp120 in designing vaccines has been limited until now by the enormous variability of the regions thought to be most critical for interactions with the host cell.



Where the smoke goes

Biomass and fossil fuel burning produce abundant small particles of carbon. This black carbon makes up about 6 percent of the organic carbon stored in the oceans. Masiello and Druffel (p. 1911; see the commentary by Kuhlbusch, p. 1903) used radiocarbon ages of black carbon in two remote ocean sites to examine the origin and transport of this carbon to the ocean. The black carbon is up to nearly 14,000 years older than other organic carbon deposited at these sites, implying that much of it is stored in an intermediate reservoir, perhaps in soils.

Trilobites exiting and diversifying

Trilobites were among the most abundant shelly animals in the ocean 550 to 440 million years ago. They became less dominant during the Ordovician radiation, the largest increase in the diversity of life,

and after the major extinction at the end of the Ordovician at about 440 million years ago. Adrain *et al.* (p. 1922; see the news story by Irion, p. 1837) were able to identify two different groups of trilobites. One participated in the radiation and was affected little by the extinction. The other declined and was eliminated by the extinction.

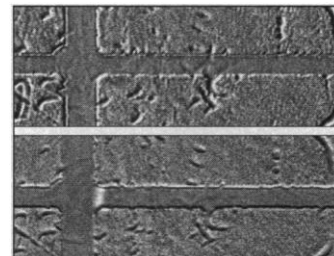
Invisible pattern

Research into patterned media for magnetic storage often makes use of magnetic dots or pillars that are formed either by deposition or by etching on a suitable substrate. However, these materials, which are not planar, pose some problems in the implementation in practical devices, for example, because of optical contrast generated by the nonplanarity. Chappert *et al.* (p. 1919) used ion irradiation to pattern the magnetic properties of cobalt-platinum multilayers without affecting the surface roughness of the

samples. Although the feature sizes are somewhat large at this point, the optical uniformity of the samples shows promise for future implementation of smooth patterned magnetic media.

A localized metal to insulator transition

Some of the manganese oxides of interest as magnetoresistive materials exhibit metal to insulator transitions that correspond to ferromagnetic and antiferromagnetic spin ordering. In some cases, this transition to the metallic phase can be driven by light, and for the compound $\text{Pr}_{0.7}\text{Ca}_{0.3}\text{MnO}_3$, there is evidence that this transition occurs locally in the sample. Fiebig *et al.* (p. 1925; see the commentary by Keimer, p. 1904) performed reflectance imaging on



such samples to show that this transition indeed occurs locally. When a thin film sample under an electric field was illuminated with short infrared laser pulses, conductive paths formed locally between the electrodes and left the rest of the sample insulated. Different conductive paths could be induced in the same film, suggesting possibilities for optical switching.

Taken all together

Feedbacks between the oceans and the biosphere, in conjunction with changes in solar irra-

(Continued on page 1811)

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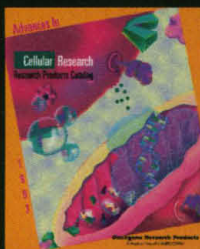
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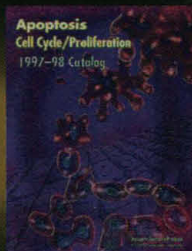
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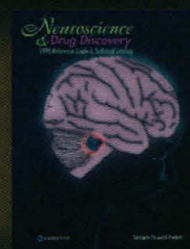


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(Continued from page 1809)

diancance due to changes in the Earth's orbital cycle, make it difficult to identify the exact role of CO₂ and other greenhouse gases in global climate conditions of past and present climates. Ganopolski *et al.* (p. 1916) have used a relatively coarse paleoclimate model to simulate the synergistic effects of the atmosphere, oceans, and vegetation about 6000 years ago. At that time, CO₂ concentrations were near those just before the Industrial Revolution but climate differed distinctly; North Africa was wetter and the mid- to high latitudes of the Northern Hemisphere were generally warmer. Only when all three factors—atmosphere, oceans, and biosphere—were considered together could the main climatic features be reproduced.

Stabilizing mRNA in T cells

Stimulation of T cells of the immune system through the T cell receptor results in both increased synthesis of messenger RNA (mRNA) encoding the cytokine interleukin-2 (IL-2) and stabilization of the normally unstable mRNA. Chen *et al.* (p. 1945) show that the stabilization of IL-2 mRNA is mediated in part through the activation of the c-Jun amino terminal kinase, which also contributes to transcriptional control of the IL-2 gene. They also identified regions within the IL-2 transcript—in untranslated regions on both the 3' and 5' ends of the mRNA—that confer sensitivity to multiple signals generated during T cell activation. Combinatorial control of mRNA stability, like that of transcription, appears to be

conferred through multiple domains within the mRNA sequence that respond to distinct signaling pathways.

Calcium rescuing plants from sodium

Salinity is one of the major stressors that can inhibit plant growth. Mutagenesis studies have identified certain genes that, when defective, leave the



plant even more sensitive to salt. Liu and Zhu (p. 1943; see the commentary by Epstein, p. 1906) have cloned one of these genes, the SOS3 gene from *Arabidopsis*. The gene encodes a protein with sequence similarity to calcineurin, thus hinting at how external calcium can have a protective effect when the plant is challenged with excess sodium.

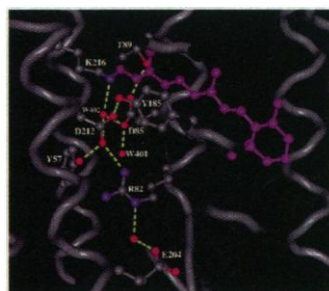
A quality call

The question of the "good genes" hypothesis is a simple but contentious one: By mating with particular males, do females receive genetic benefits that increase the fitness of their offspring? Welch *et al.* (p. 1928; see the news story by Pennisi, p. 1837) have addressed the question experimentally using gray tree frogs (good study organisms because of their large clutch size and external mode of fertilization). Females are known to prefer male calls of long duration, so the performance of maternal half-siblings (off-

spring with the same mother, and fathers that produce either short or long calls) was compared. Relative call duration in sires did correlate with higher fitness in offspring, suggesting that, at least in this case, male courtship display does advertise genetic quality.

Proton pump

The covalently bound retinal of bacteriorhodopsin absorbs photons, and the enzyme uses this energy to pump protons across the outer membrane of the halobacterium. A recently developed approach to crystallization of membrane proteins made possible a determination of its structure at a resolution of 2.5 angstroms. Luecke *et al.* (p. 1934) present a higher resolution structure at 2.3 angstroms that offers a closer look



at the proton pathway and at the water molecules involved both in the transport reaction and in the conformational changes coupling it to excitation of the retinal.

Switching coats to suit the host

Relapsing fever, a disease first described at the time of Hippocrates, is caused by the spirochete *Borrelia*, which is transmitted to humans by tick bites. Within the mammalian host, these spirochetes periodically replace one outer surface anti-

gen with another, a process that presumably allows evasion from the immune response. In studies of *Borrelia hermsii*, Schwan and Hinnebusch (p. 1938) show that an antigenic switch also occurs when the spirochete moves from the mammalian to the tick host, and this switch appears to be controlled by temperature.

Managing perception

Sensory perception has been explained as the transition of stimuli from unconscious detection to above-threshold awareness and has been equated to an increasing proportion of active neurons in higher visual processing areas. Lumer *et al.* (p. 1930) use functional brain imaging to dissociate changes in perception from changes in stimuli. They find that activity in frontal and parietal brain areas co-vary with the perceptual changes while activity in the visual processing areas also vary with stimulus changes, suggesting that top-down influences mediate perception.

Signaling in LTP

Long-term potentiation or LTP, the strengthening of synaptic contacts after repeated synaptic activity, is thought to be the electrophysiological correlate of learning and memory in the hippocampus. A variety of signal transduction pathways have been shown to affect the production of successful LTP in the hippocampus. Blitzer *et al.* (p. 1940) now demonstrate a role for a cyclic adenosine monophosphate (cAMP)-dependent pathway through an endogenous phosphatase inhibitor to gate calcium/calmodulin protein kinase II-dependent signaling during LTP formation.

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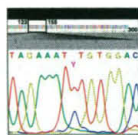
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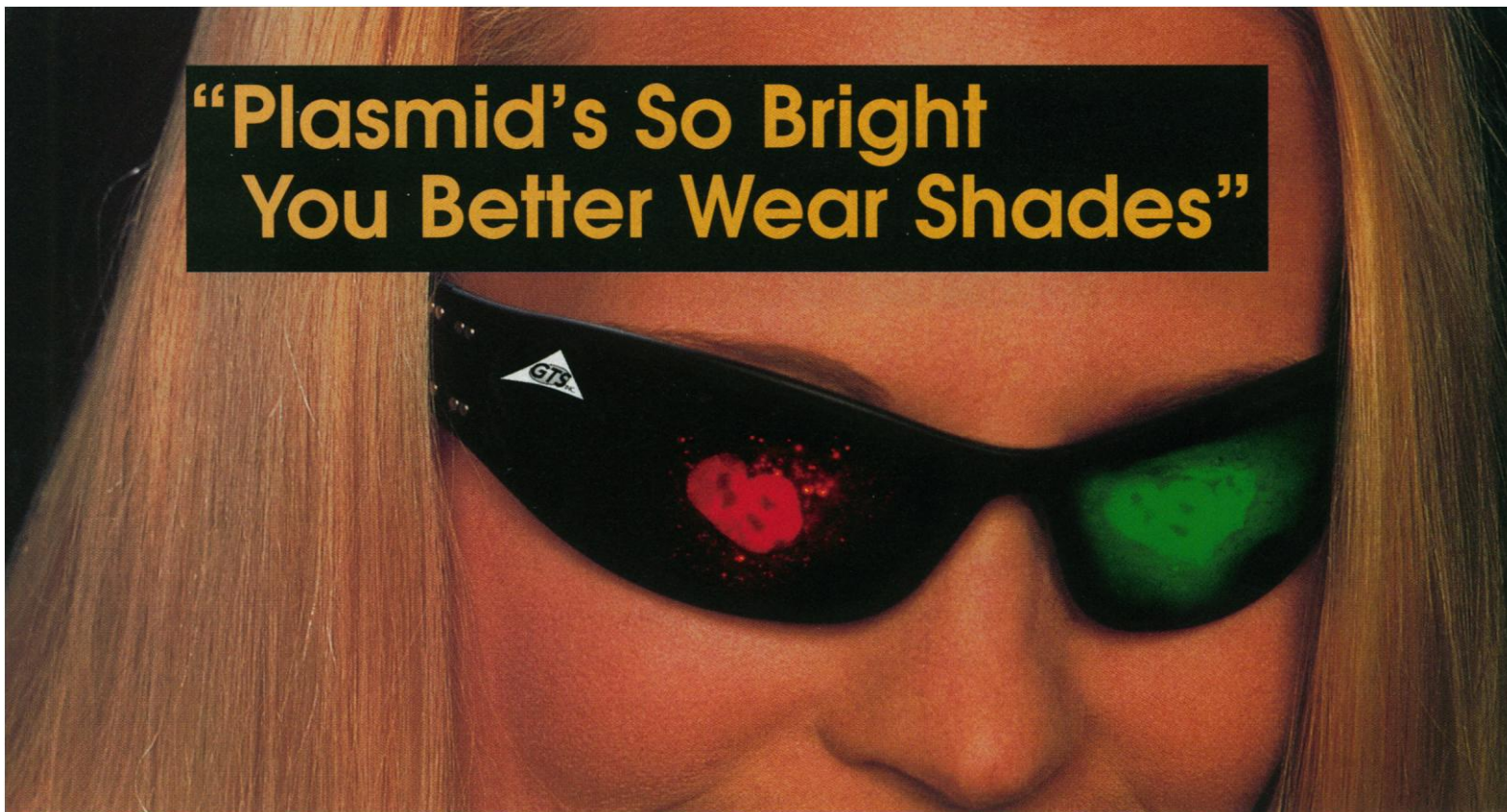
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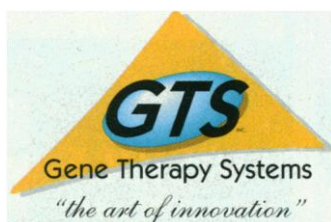
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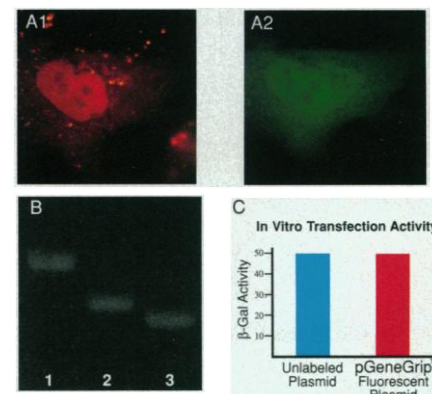
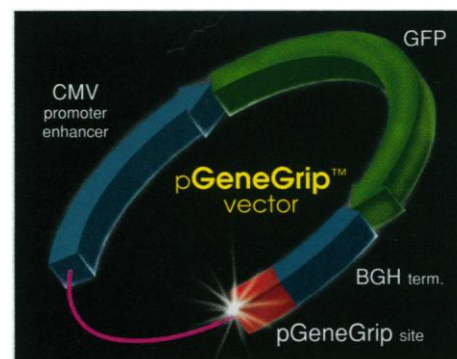
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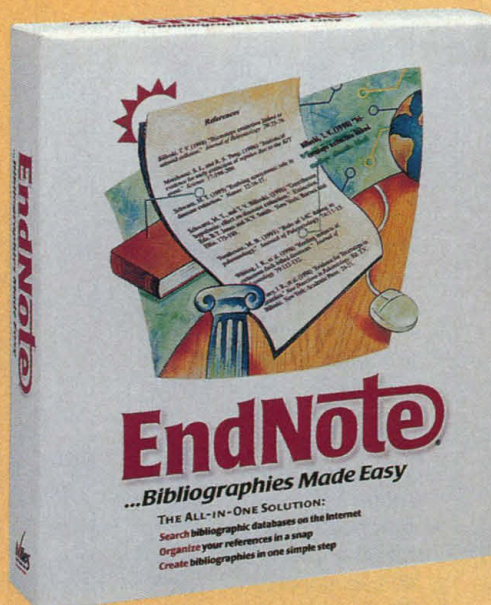
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- A.** Fibroblasts transfected with pGeneGrip™ Rhodamine/GFP vector:
1. Rhodamine labeled DNA
2. GFP expression
- B.** Electrophoresis of pGeneGrip™ Rhodamine labeled fluorescent vector
Lanes: 1. β -gal, 2. GFP, 3. Blank
- C.** Plasmid expression with and without fluorescent label.

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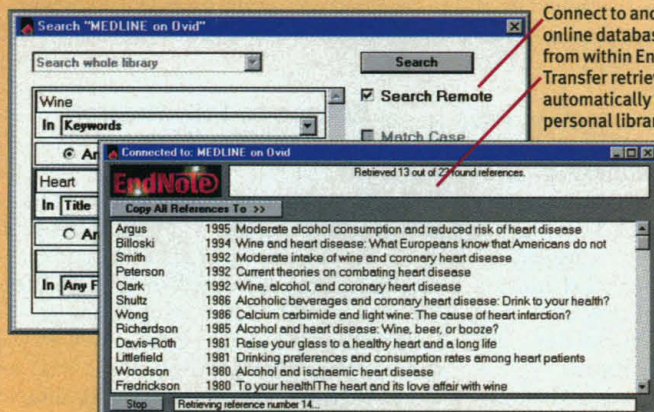


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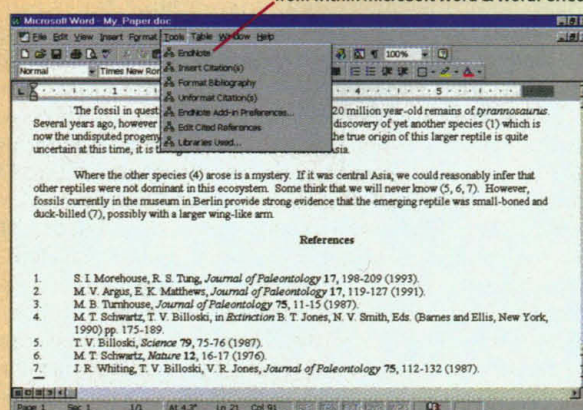
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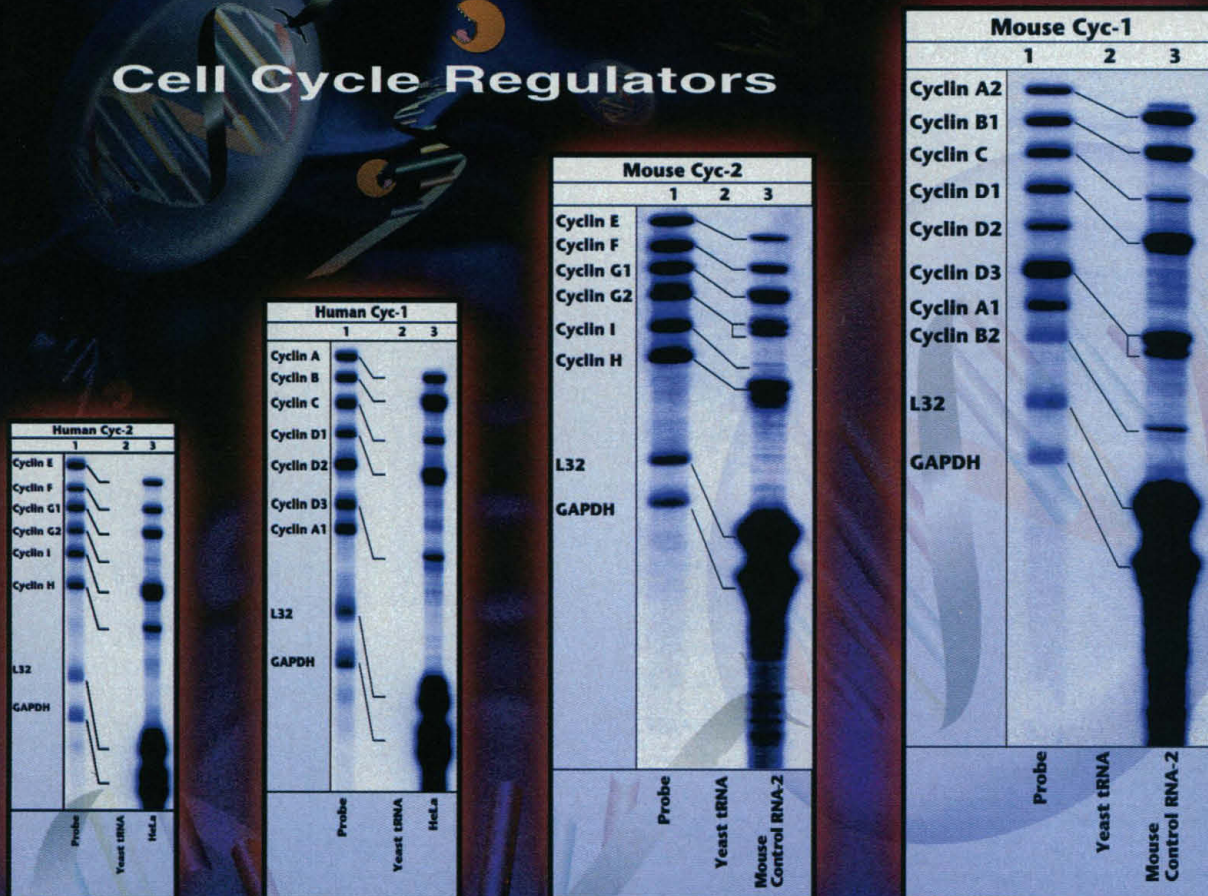
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L32
GAPDH

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Cyclin D3
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Cyclin G1
Cyclin G2
Cyclin I
Cyclin H
L32
GAPDH

hCC-1

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Cdk2
Cdk3
Cdk4
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p21
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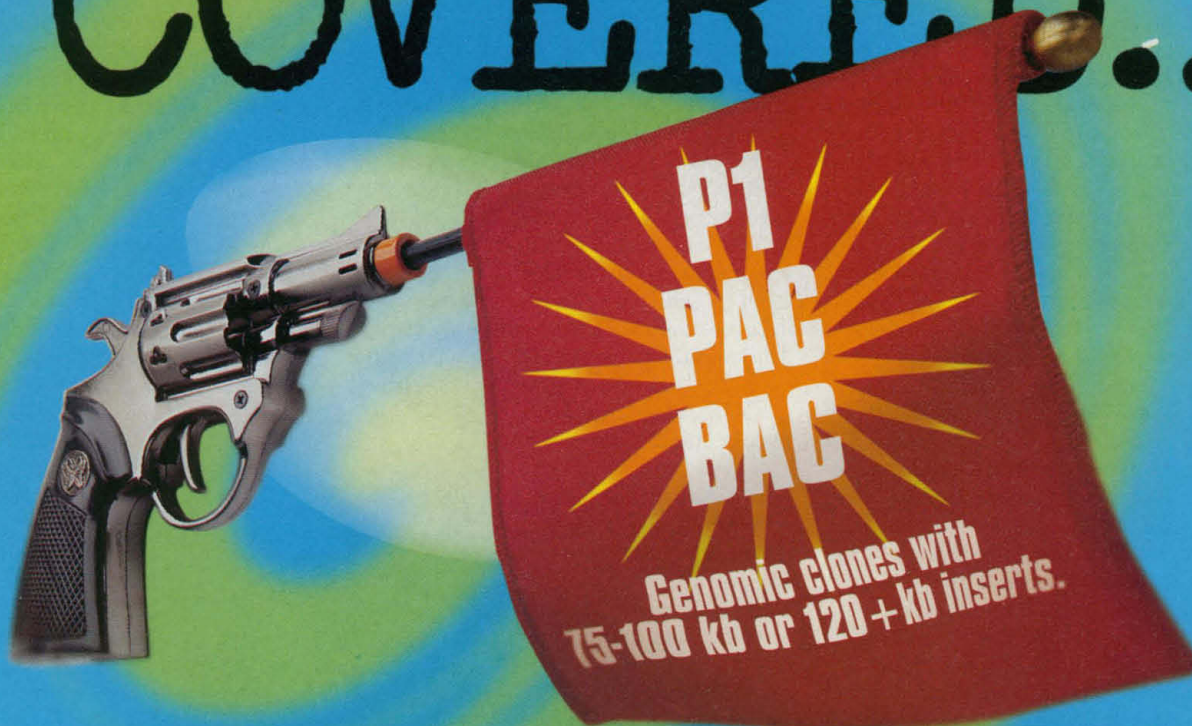
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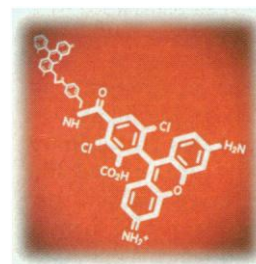
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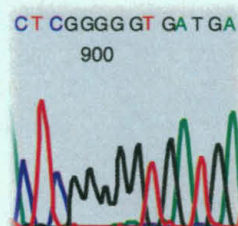


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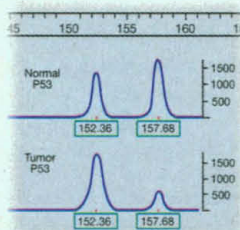
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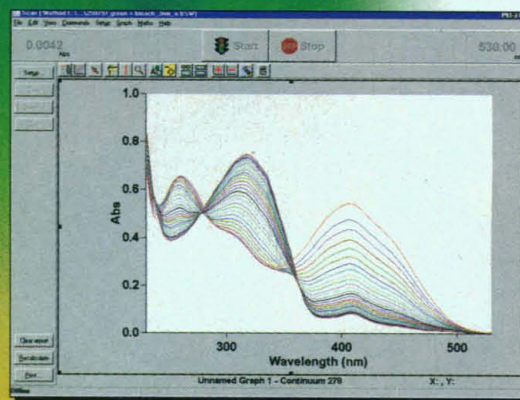


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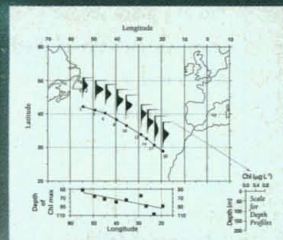
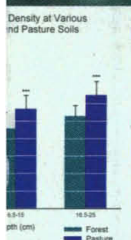
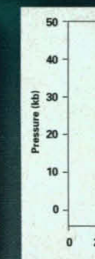
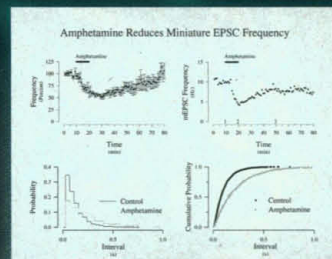
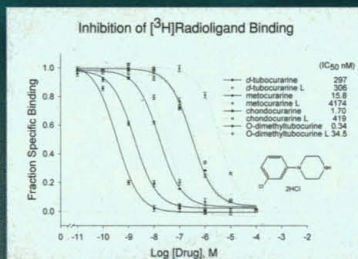
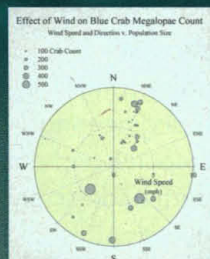
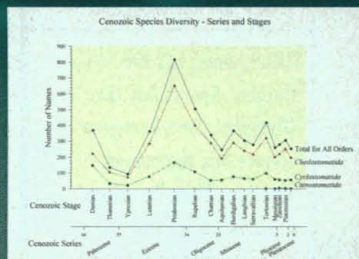
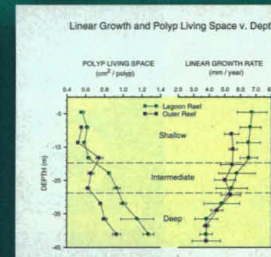
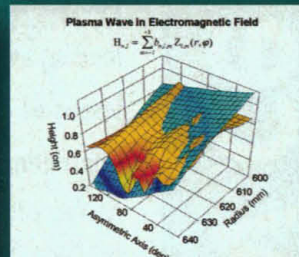
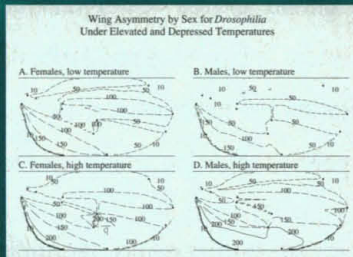
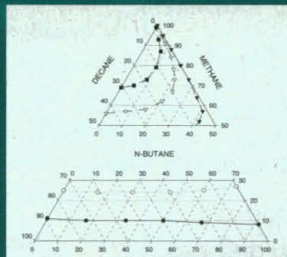
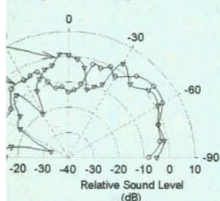
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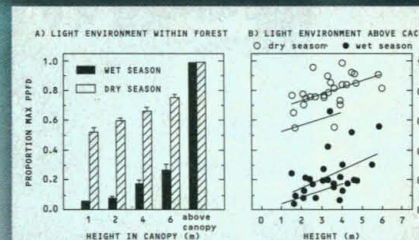
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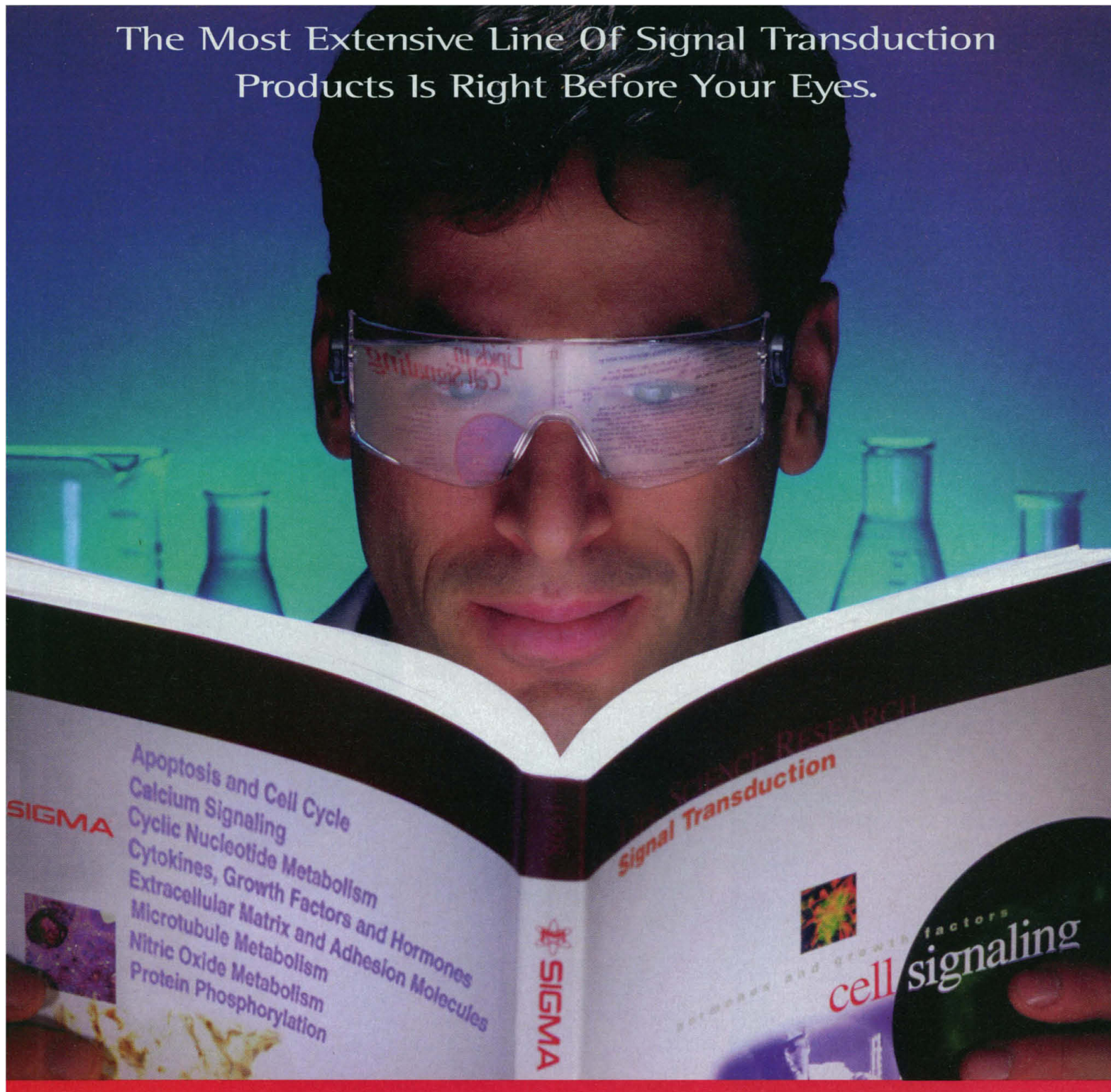
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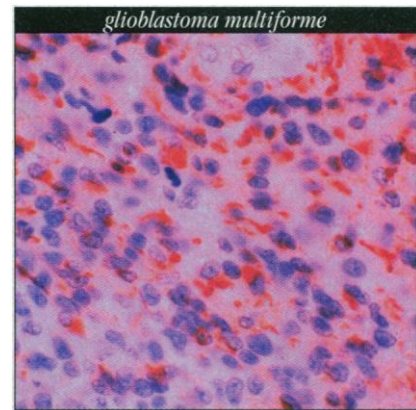
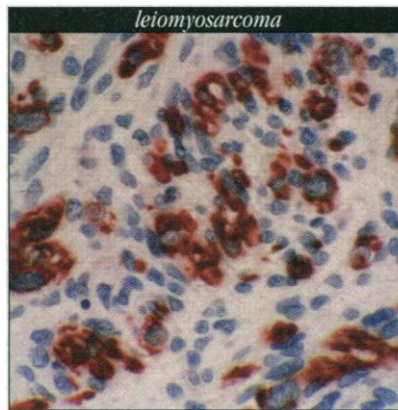
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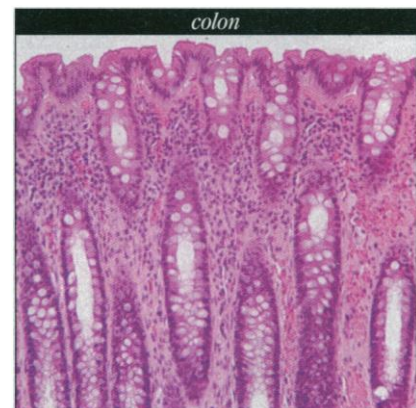
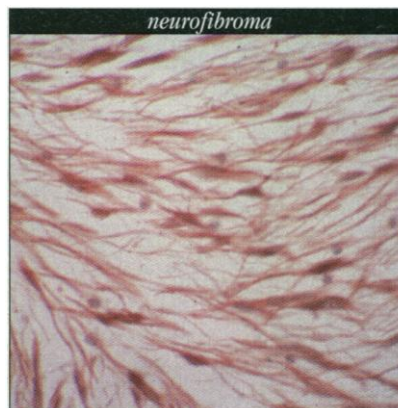
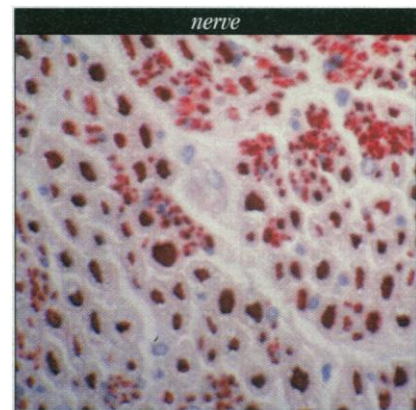
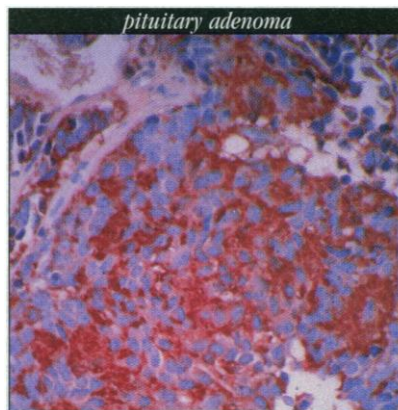


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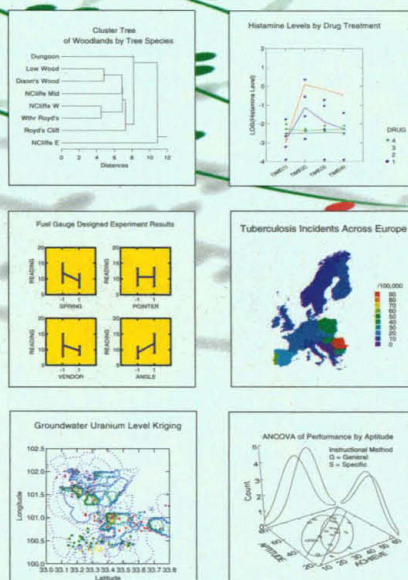
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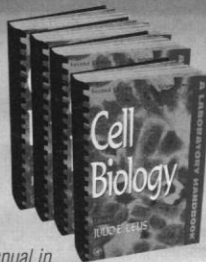
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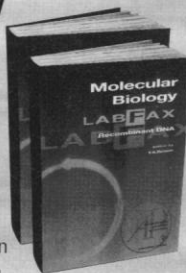
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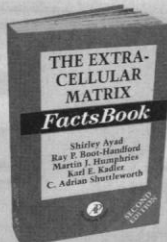
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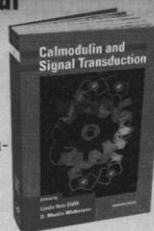
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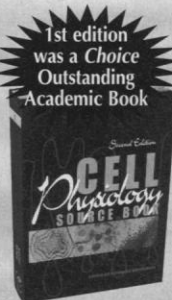
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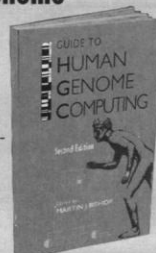
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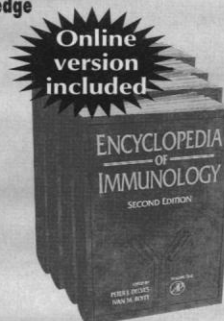
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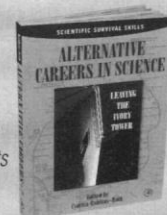
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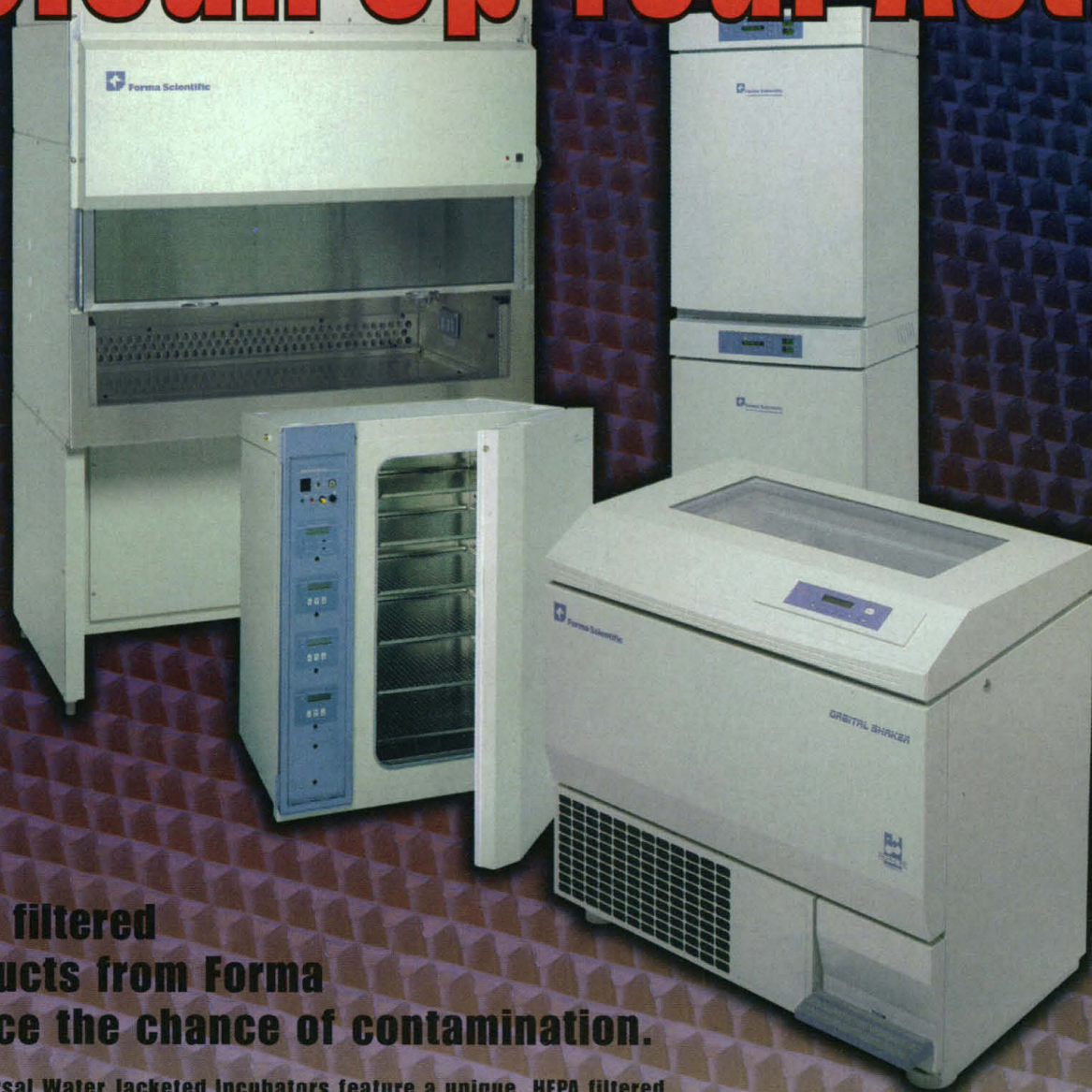
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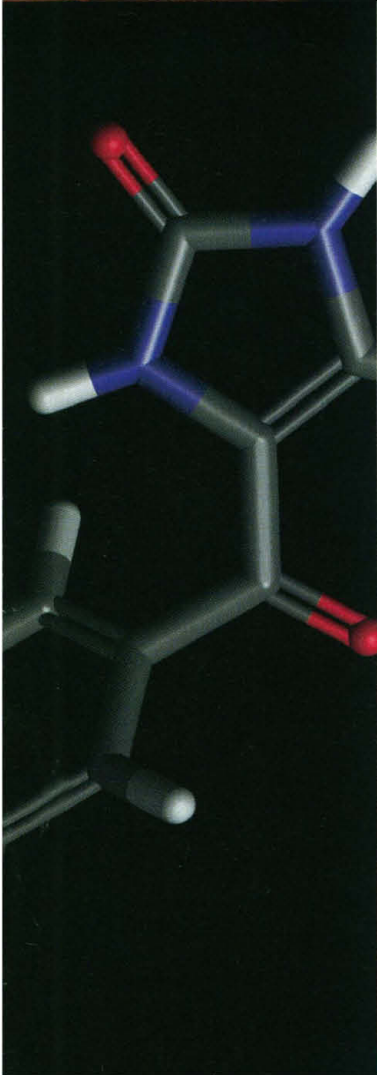
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