Science 25 September 1998

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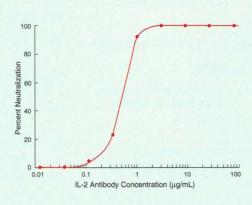
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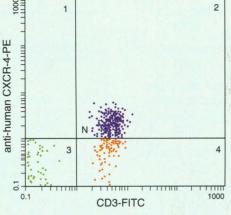
 $\frac{1}{2} \ \, \text{Typical IL-1} \beta \ \, \text{staining using biotinylated} \\ \text{antigen-affinity purified anti-IL-1} \beta \ \, \text{polyclonal} \\ \text{antibody (BAF201) in cultured human blood} \\ \text{mononuclear cells following LPS stimulation.}$



Western blot of anti-TGF- $\beta1$ (MAB240) was used at 1-2 μ g/mL to detect 50 ng, 20 ng and 5 ng per lane of rhTGF- $\beta1$ under non-reducing conditions.



Reutralization Dose₅₀ (ND₅₀) for anti-human IL-2 antibody (AF-202-NA) was determined to be approximately 0.05 - 0.15 μg/mL in the presence of 2.0 ng/mL of rhIL-2, using CTLL-2 cells.



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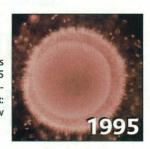
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COVER Two eggs of the red abalone with hundreds of sperm cells attached to the envelope surrounding each egg (inner circle, about 175 micrometers in diameter). Sperm are also trapped in the transparent outermost jelly layer. This special issue discusses the latest theories on sex: how it got started, how it works, and who gets it. See the Vacquier Review and the special section beginning on p.1979. [Photo: V. D. Vacquier]





How to spy on other Earths

DEPARTMENTS

NETWATCH 1919

THIS WEEK IN SCIENCE 1921

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RANDOM SAMPLES 1951

ESSAY ON SCIENCE AND SOCIETY

> by C. E. Koop 1952

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NEW PRODUCTS 2050

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NEWS

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1933	INFRASTRUCTURE GRANTS: Canada to Draw Up Strategic Plans	1942	Interferometry: Getting More for Less IMMUNOLOGY: Fly Development Genes Lead to Immune Find	
1934	SCIENTIFIC PRIZES: Lasker Awards Go to Cancer Researchers	1944	NATIONAL SCIENCE FOUNDATION: The Biocomplex World of Rita Colwell	
1934	U.K. ASTRONOMY: 300-Year-Old RGO Finally to Close	1947	NETWORKS: Fractals Reemerge in the New Math of the Internet	
1935	ECOLOGY: NSF Eyes Biodiversity Monitoring Network	1948	GLOBAL CHANGE: Among Global Thermometers, Warming Still Wins Out	
1936	CITATION ANALYSIS: Harvard Tops in Scientific Impact		EVOLUTION OF SEX	
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RESEARCH

REPORTS

Science-Savvy Diplomats

2011	Ancient Mantle in a Modern Arc: Osmium Isotopes in Izu-Bonin-Mariana Forearc Peridotites I. J. Parkinson, C. J. Hawkesworth, A. S. Cohen
2013 1930 2016	Semiconductor Nanocrystals as Fluorescent Biological Labels M. Bruchez Jr., M. Moronne, P. Gin, S. Weiss, A. P. Alivisatos
2016 1930 2013	Quantum Dot Bioconjugates for Ultrasensitive Nonisotopic Detection W. C. W. Chan and S. Nie
2019	Europa's Differentiated Internal Structure: Inferences from Four Galileo

Encounters J. D. Anderson, G. Schubert, R. A. Jacobson, E. L. Lau, W. B. Moore, W. L. Sjogren

1980 Why Sex? Putting Theory to the Test The Asexual Life

1982 A New Look at Monogamy

1984 A Genomic Battle of the Sexes

REVIEWS

Why Sex and Recombination? N. H. Barton and B. Charlesworth

1990 The Evolutionary Dynamics of Sex Determination I. Marín and B. S. Baker

1995 **Evolution of Gamete Recognition** Proteins V. D. Vacquier

1999 Sexual Selection, Receiver Biases, and the Evolution of Sex Differences M. J. Ryan

Sex and Conflict L. Partridge and L. D. Hurst

See related Editorial on p. 1959.

Origin of Multikilometer Earth- and **v**2022 Mars-Crossing Asteroids: A Quantitative Simulation F. Migliorini, P. Michel, A. Morbidelli, D. Nesvorný, V. Zappalà

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EDITORIAL

1959 A Revolution in Evolution J. Bull and H. Wichman

LETTERS

Telescope Costs R. Giacconi. Cleaning CJD-Contaminated Instruments L. Manuelidis.

Salt Wars C. Lenfant; Response G. Taubes; J. Reed; S. Sepsenwol; M. Barton, T. J. Rabelink, T. F. Luscher; A. Aviv; J. Katz. Quantum Computing A. F. Fahmy. Response J. A. Jones. Crystallography of a Photocycle Intermediate T. E. Meyer, G. Tollin, M. A. Cusanovich. Response B. Perman, M. Wulff, K. Hellingwerf, K. Moffat

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1967 SEISMOLOGY: Monitoring Nuclear Tests
B. Barker, M. Clark, P. Davis, M. Fisk, M.
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BOOKS AND NEW MEDIA

1969 SCIENCE AND RELIGION: Skeptics and True Believers The Exhilarating Connection Between Science and Religion C. Raymo, reviewed by W. M. Richardson



1971

Travels of the asteroids

1970 Browsings

PERSPECTIVES

41971 ASTROPHYSICS: How Asteroids Come to Earth R. Greenberg

1973 QUANTUM OPTICS: Quantum Control of the Inevitable M. O. Scully and S.-Y. Zhu

▼1974 EVOLUTION: Ants, Crops, and History
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▼1975 NEUROSCIENCE: The Saturation Debate T. V. P. Bliss



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2013

Labeling cells with glowing nanodots

The Formation of Substellar Objects
Induced by the Collision of Protostellar
Disks D. N. C. Lin, G. Laughlin, P.
Bodenheimer, M. Różyczka

2027 Bax and Adenine Nucleotide Translocator Cooperate in the Mitochondrial Control of Apoptosis I. Marzo, C. Brenner, N. Zamzami, J. M. Jürgensmeier, S. A. Susin, H. L. A. Vieira, M.-C. Prévost, Z. Xie, S. Matsuyama, J. C. Reed, G. Kroemer

2031 Dorsal-Ventral Signaling in the Drosophila Eye V. Papayannopoulos, A. Tomlinson, V. M. Panin, C. Rauskolb, K. D. Irvine

The Evolution of Agriculture in AntsU. G. Mueller, S. A. Rehner, T. R. Schultz

June 1975
 Impaired Spatial Learning after
 Saturation of Long-Term Potentiation
 E. I. Moser, K. A. Krobert, M.-B. Moser, R. G.
 M. Morris

2042 Protein Kinase C Isotypes Controlled by Phosphoinositide 3-Kinase Through the Protein Kinase PDK1 J. A. Le Good, W. H. Ziegler, D. B. Parekh, D. R. Alessi, P. Cohen, P. J. Parker

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2034
Free-living counterpart of ant-cultivated fungi

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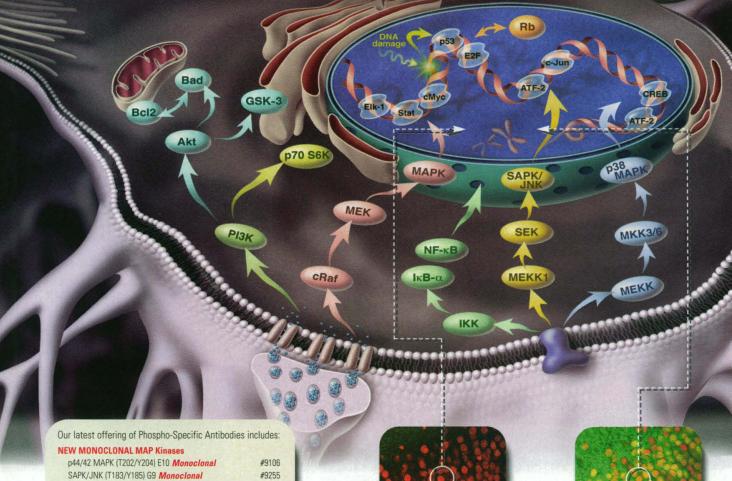
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Confocal images of immunostaining with Phospho-p44/42 MAP Kinase E10 Monoclonal Ab (green) and propidium iodide (red) in rat hippocampus from tissue sections of control and 15 minute transient cerebral ischemia followed by 30 minutes of reperfusion. Photo shows high resolution dentate gyrus (top) and low resolution hippocampus (bottom). Yellow represents overlay of red and green. (Provided by Dr. Bingren Hu, UCSD).

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THIS WEEK IN SCIENCE

edited by PHIL SZUROMI

MELT ME TWICE

Volcanic arcs form above regions where oceanic crust is subducted into the mantle. Heating of the crust as it sinks into the mantle releases fluids, and these fluids in turn flux melting in overlying parts of the mantle to produce the magmas that rise to form volcanoes. This process depletes the mantle in elements that are fractionated into the melt. One of these is rhenium; the isotope rhenium-187 decays to osmium-187. Thus, melting events, which strip away rhenium, can be recorded in osmium isotopic anomalies. Parkinson et al. (p. 2011) have examined the osmium isotopic composition of pieces of the mantle preserved in part of the Izu-Bonin-Mariana arc system, an arc that first formed about 40 to 50 million years ago in the western Pacific Ocean. Surprisingly, the data show that these pieces of mantle seem to record a much earlier melting event, dating to about 1 billion years ago. In contrast, most oceanic crust is younger than about 150 million years ago because it is continually destroyed by subduction. These data may imply that the upper mantle is quite heterogeneous or that subduction zones may harbor very old pieces of the mantle.

NANODOTS FOR BIOLOGICAL DETECTION

Quantum confinement effects in semiconductor nanoparticles lead to narrow emission spectra that can be tuned over a wide range of wavelengths. Their brightness, low toxicity, and the ability to use a single excitation wavelength make them attractive alternatives to organic dyes for biological labeling, but their low water solubility has limited this application. Two different approaches are now reported for modifying core-shell nanocrystals consisting of CdSe cores and CdS or ZnS shells (see the news story by Service). Bruchez et al. (p. 2013) coated the surface of the particles with silica and then derivatized that surface with biomolecules. Chan et al. (p. 2016) directly linked proteins to the ZnS surface using mercaptoacetic acid and showed that nanodots bearing transferrin underwent receptor-mediated endocytosis into HeLa cells.

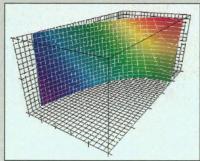
A TAIL OF TWO STARS

Single brown dwarfs have recently been found in several star-forming regions, such as the Pleiades, and models of collisions of disks of young stars, which cause gravitational clumping within each disks, can explain the origin of some of these substellar

objects. Lin et al. (p. 2025) have modeled another potential birth mechanism that requires the collision of two young stars with massive disks, which leads to the formation of a tail of material being ejected away from both stars. The authors found that substellar objects could also accumulate in such a tail and leave a lone brown dwarf that is no longer associated with either of its young parent stars and that is not massive enough to burn hydrogen like a star.

EUROPA: FOUR ENCOUNTERS, THREE LAYERS

Radio Doppler data recorded by the Galileo probe during four close encounters with Jupiter's smallest Galilean satellite, Europa, provide the most accurate gravity data for determining the structure of the interior of



this moon. Anderson et al. (p. 2019) show that their preferred fit to the gravity parameters yields a three-layer interior with an 80- to 170-kilometerthick mixed outer shell of water ice and liquid, a middle shell of rock or a rock-metal mixture, and an iron or mixed iron-iron sulfide core that could have a maximum radius of about 780 kilometers (about 50% of the radius of Europa). A Europan core requires high temperatures in the interior of Europa to separate the iron from the rock mantle early in the moon's evolution. Models of the Galilean satellites will have to be refined to allow for such differentiation.

HOW DID THE ASTEROID CROSS THE EARTH?

Earth-crossing asteroids (ECAs) are a population of bodies whose orbits at some point cross that of Earth. It has been assumed that these bodies come from the main asteroid belt, which lies between Mars and Jupiter, either through collisions or because of orbital perturbations caused

primarily by Jupiter. However, simulation studies have generally shown that strong orbital resonances with other planets actually cause the asteroids to cross the orbits of the terrestrial planets on a very short time scale and head toward the sun. Migliorini et al. (p. 2022; see the Perspective by Greenberg) have found a slightly different mechanism in their simulations that effectively allows multikilometer-diameter asteroids to evolve into Marscrossing asteroids and ECAs. The key to their mechanism is the weak resonant orbits in the main belt that allow asteroids in these resonances to evolve to Marscrossing orbits; eventually these bodies evolve into ECAs. Thus, weak resonances allow large asteroids to achieve a longer lifetime in the inner solar system and may also help to explain the origin of some of the meteorites that have hit Earth.

MITOCHONDRIAL ROUTE FOR CELL DEATH

Many proteins and subcellular organelles conspire to kill a cell in a process known as apoptosis. The proapoptotic protein Bax moves to the mitochondria and can be isolated from mitochondrial membranes along with a complex of proteins that form the mitochondrial permeability pore. Marzo et al. (p. 2027) found that Bax specifically binds to the adenine nucleotide translocator of the pore complex. This interaction was necessary and sufficient for permeabilization of reconstituted membranes. Thus, Bax seems to induce apoptosis by binding to and altering the function of the mitochondrial permeability pore.

TOO OVERSTIMULATED TO LEARN ANYTHING

The relation between long-term potentiation (LTP) of neurons, which can be induced by high-frequency stimulation, and the long-term changes in synaptic plasticity induced by learning has been difficult to establish experimentally. If LTP is part of the learning process, then saturation of neurons in the hippocampus by high-frequency stimulation would block the ability of an animal to learn, but establishing saturation has been experimentally challenging. Moser et al. (p. 2038; see the Perspective by Bliss) ablated part of the hippocampus of rats and used a multielectrode stimulating array to saturate neurons in the input region to the dentate gyrus. After prolonged stimulation, rats were trained in a water maze test. Some of the rats could

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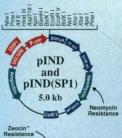
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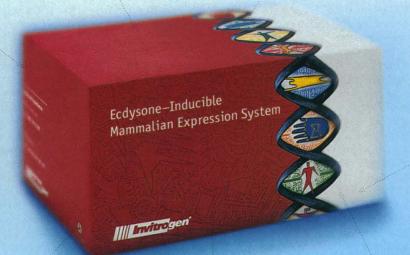
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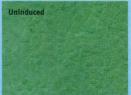
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> > Ponasterone A

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THIS WEEK IN SCIENCE

CONTINUED FROM PAGE 1921

learn the maze and others could not, but the inability to learn the maze was related to the degree to which LTP remained saturated (the amount of LTP that could be induced in the poor learning group after the maze test was ≤10%). These results indicate that saturation of LTP in the hippocampus can impair spatial learning.

SEPARATING EQUALLY

As animals develop, the embryonic cells are often divided into groups, or compartments, that then follow divergent pathways in their further differentiation. Papayannopoulos et al. (p. 2031) show that although the outcome can be as dif-



ferent as an eye and a wing, the molecular mechanisms that define one group of cells as being separate from another can be shared. In this study of *Drosophila*, the central dividing line through the eye is defined by the Notch-signaling system, largely similar to the signaling system that defines the top of the wing as different from the bottom.

FUNGI GOURMETS

Ants, like humans and termites, are farmers, cultivating gardens of fungi. Mueller et al. (p. 2034; see the Perspective by Diamond) reveal, through molecular genetic approaches, the full complexity of ant cultivation. Multiple fungi cultivars were identified, which shows that domestication has occurred on a number of occasions; indeed, evidence suggests that the acquisition of novel cultivars is an ongoing process. There is also a certain eclecticism among the

ants: A single species may farm a diversity of fungi, and yet single cultivars can be shared by distinct lineages of ants.

REGULATION OF PKCS BY PDK1

The protein kinase PDK1 participates in signaling pathways initiated by various receptors that couple to phosphoinositide 3-kinase (PI 3-kinase). Activation of PI 3kinase leads to the generation of phosphatidylinositol 3,4,5-trisphosphate and consequent activation of PDK1. PDK1 in turn activates the protein kinases PKB and p70s6kinase. Le Good et al. (p. 2042) demonstrate that PDK1 also appears to function in regulation of isoforms of protein kinase C (PKC). PKC participates in regulation of many cellular processes, and some isoforms are also regulated by binding of diacylglycerol. Phosphorylation by PDK1 reveals another lipid-dependent regulatory mechanism that functions in control of PKC family members.

LEARNING FROM A LILLIPUTIAN LANDSCAPE

The complex ecosystems of moss-covered rocks have been used to examine one of the most general relations in ecology—the positive correlation between the distribution of a species and its local abundance. Gonzalez et al. (p. 2045) created fragmented landscapes by scraping bare the rock between small patches of moss. Within these isolated patches, a decline in the richness of microarthropod species was observed, but when narrow corridors were left connecting the patches, much of the species richness was retained. This experiment supports the "rescue effect" that dispersal among habitat patches serves to enhance local population size, for example, by buffering temporary lows in numbers and thus permitting occupancy of a wider number of sites.

TECHNICAL COMMENT SUMMARIES

Genome Arithmetic

The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/281/5385/1923a

J. M. Freeman *et al.* presented (Technical Comments, 20 Mar. 1998) data showing that integral functions of the base composition and coding sequence (CDS) directionality could reveal the origin of replication and other key features in nine complete bacterial genomes (www.sciencemag.org/cgi/content/full/279/5358/1827a).

A. Grigoriev describes variations in the genome that "may negatively affect identification" of key sites, and he briefly discusses "evolutionary forces [that] seem to affect AT and GC skew differently," such as sequence inversion.

In response, Freeman *et al.* apply six different types of analysis to the nine genomes studied earlier and find that "the best function to use ... is not a priori clear." They conclude that "quantitative analysis ... of these plots should aid in the understanding of the differing dynamics of genomes in different organisms ... [but] it may well be advisable to combine several methods to attack any specific problem."

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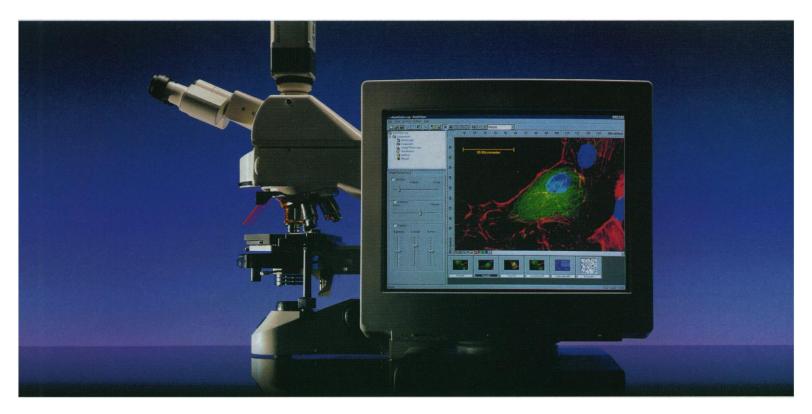
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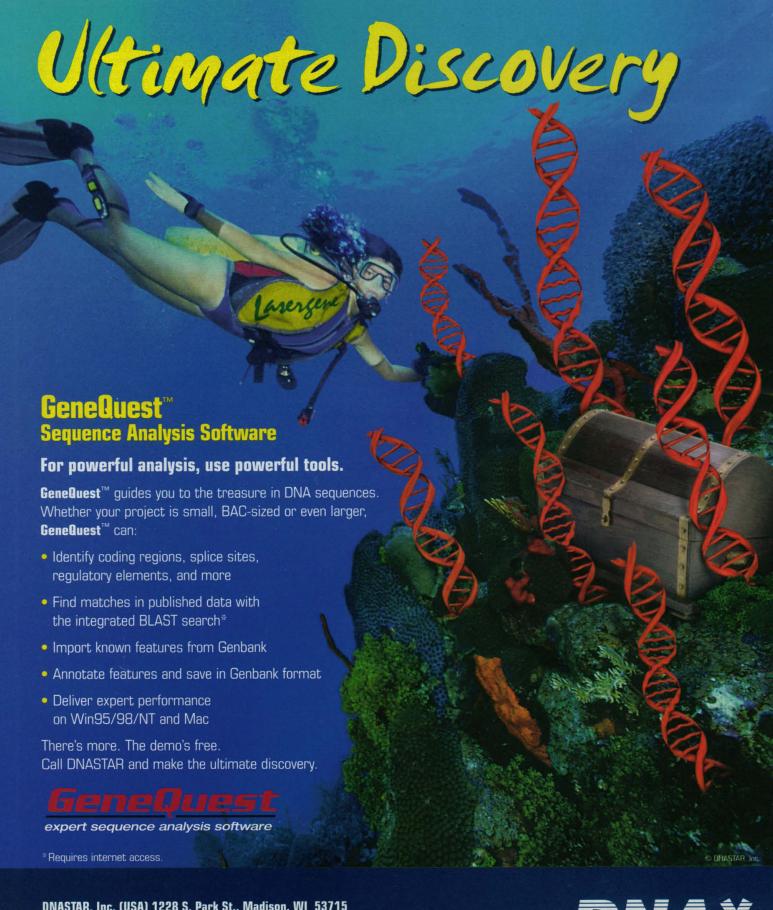
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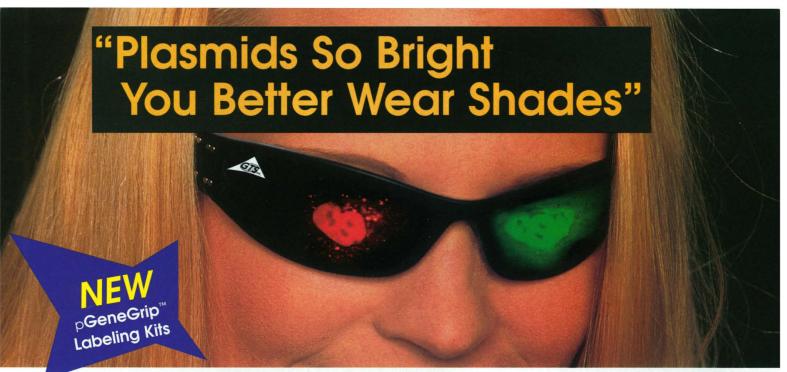
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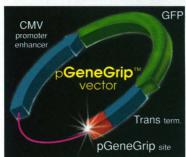
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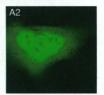
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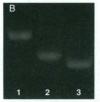
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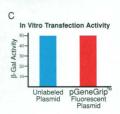
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- A. Fibroblasts transfected with pGeneGrip™ Rhodamine/GFP vector: 1. Rhodamine labeled DNA
 - 2. GFP expression
- B. Electrophoresis of pGeneGrip™ Rhodamine labeled fluorescent vector Lanes: 1. β-gal, 2. GFP, 3. Blank
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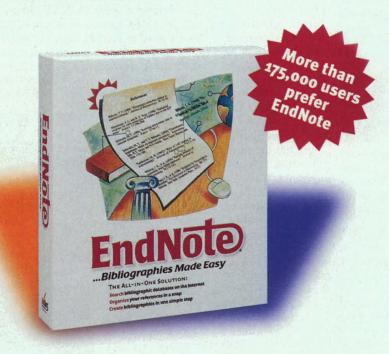
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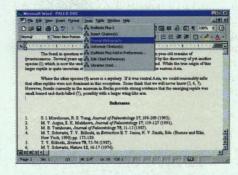
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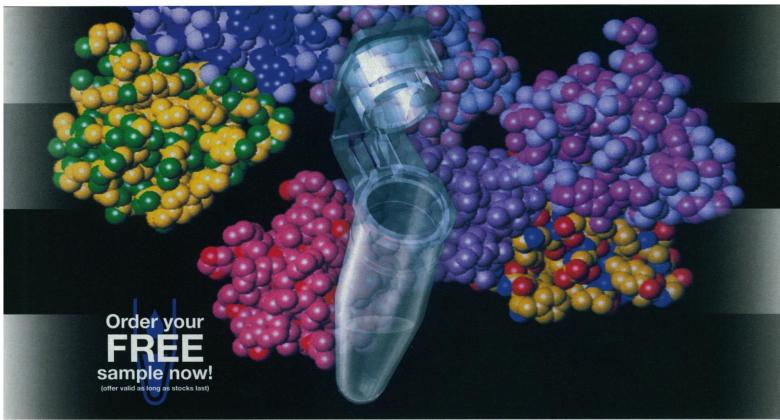
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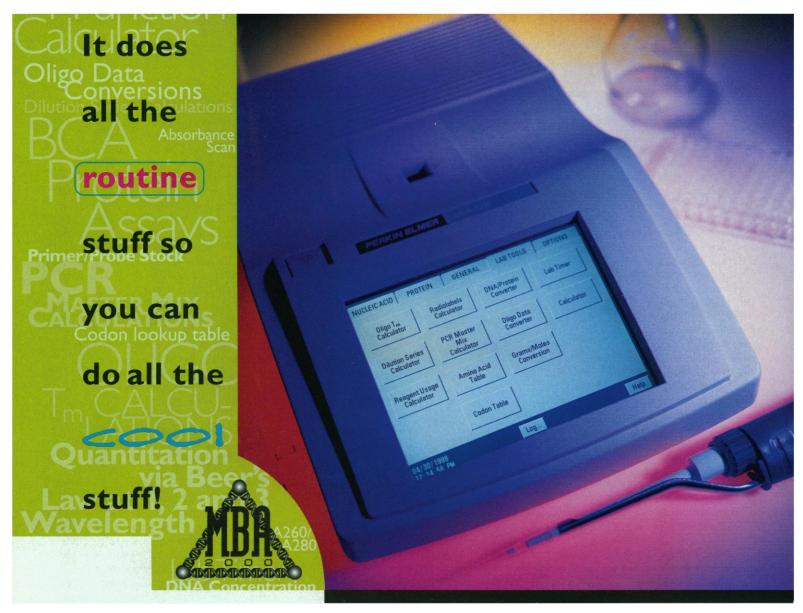
Fig.1: Amplification of a SSU rRNA gene from total genomic algae DNA PCR was performed from genomic algae using different Taq DNA Polymerases. Equal volumes of the PCR reactions were analyzed by real electrophopesis.



 Fig. 2: Amplification of a GAPDH specific DNA fragment from genomic blood DNA PCR was performed from human genomic blood with different Tag DNA Polymerases. Equal volumes of the PCR reactions were

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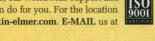
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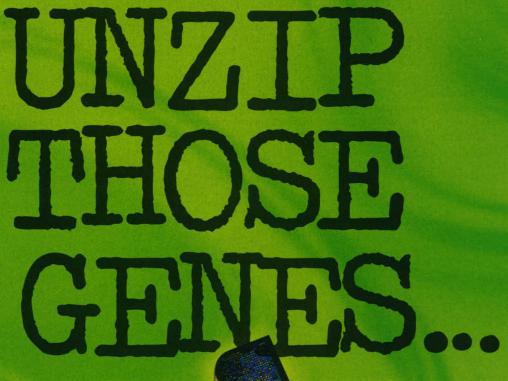


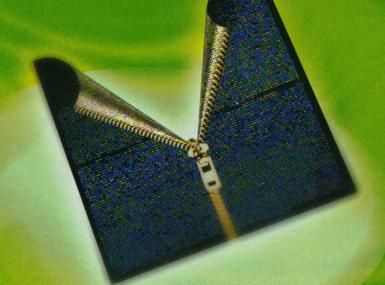
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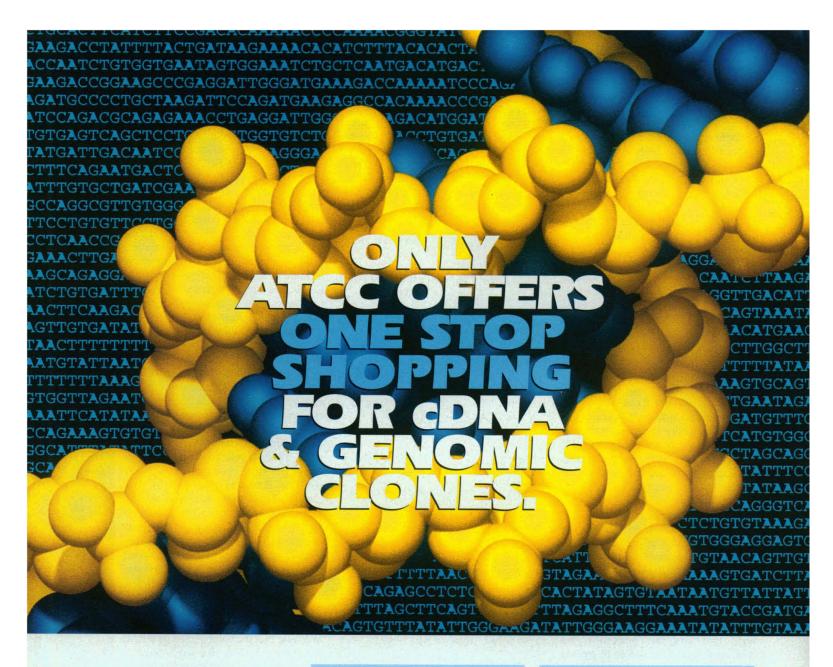
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* Lennon, G., Auffray, C., Polymeropoulos, M., Soares, M.B. 1996. The I.M.A.G.E. Consortium: An Integrated Molecular Analysis of Genomes and their Expression. Genomics 33, 151-152.

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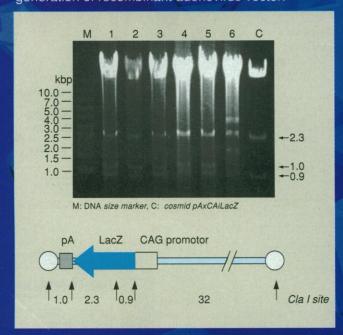
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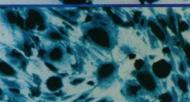


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a: HepG2



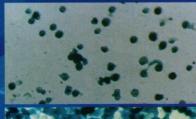
b: CV1



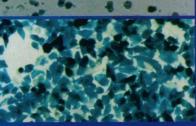
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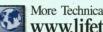
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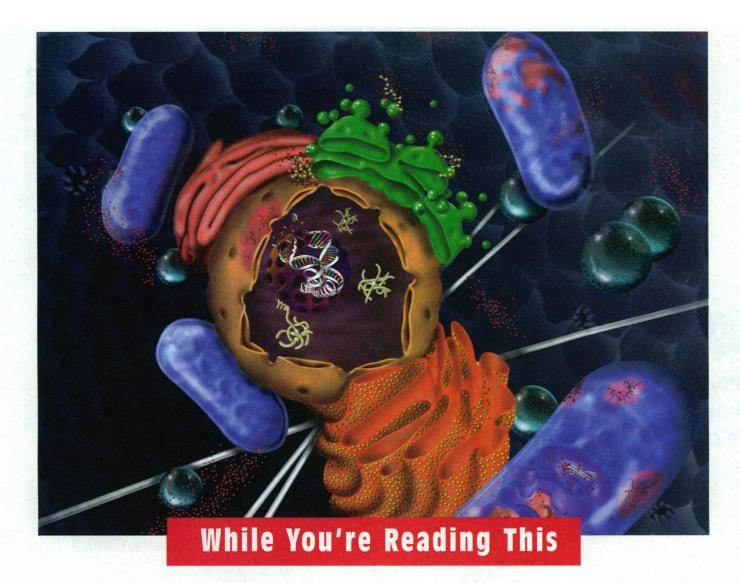
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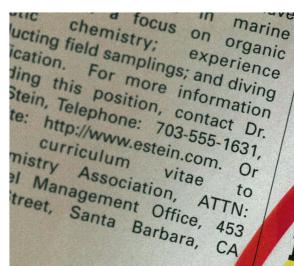
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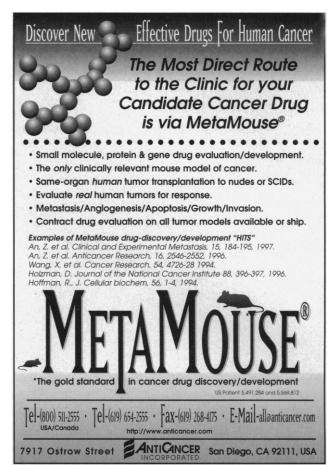


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