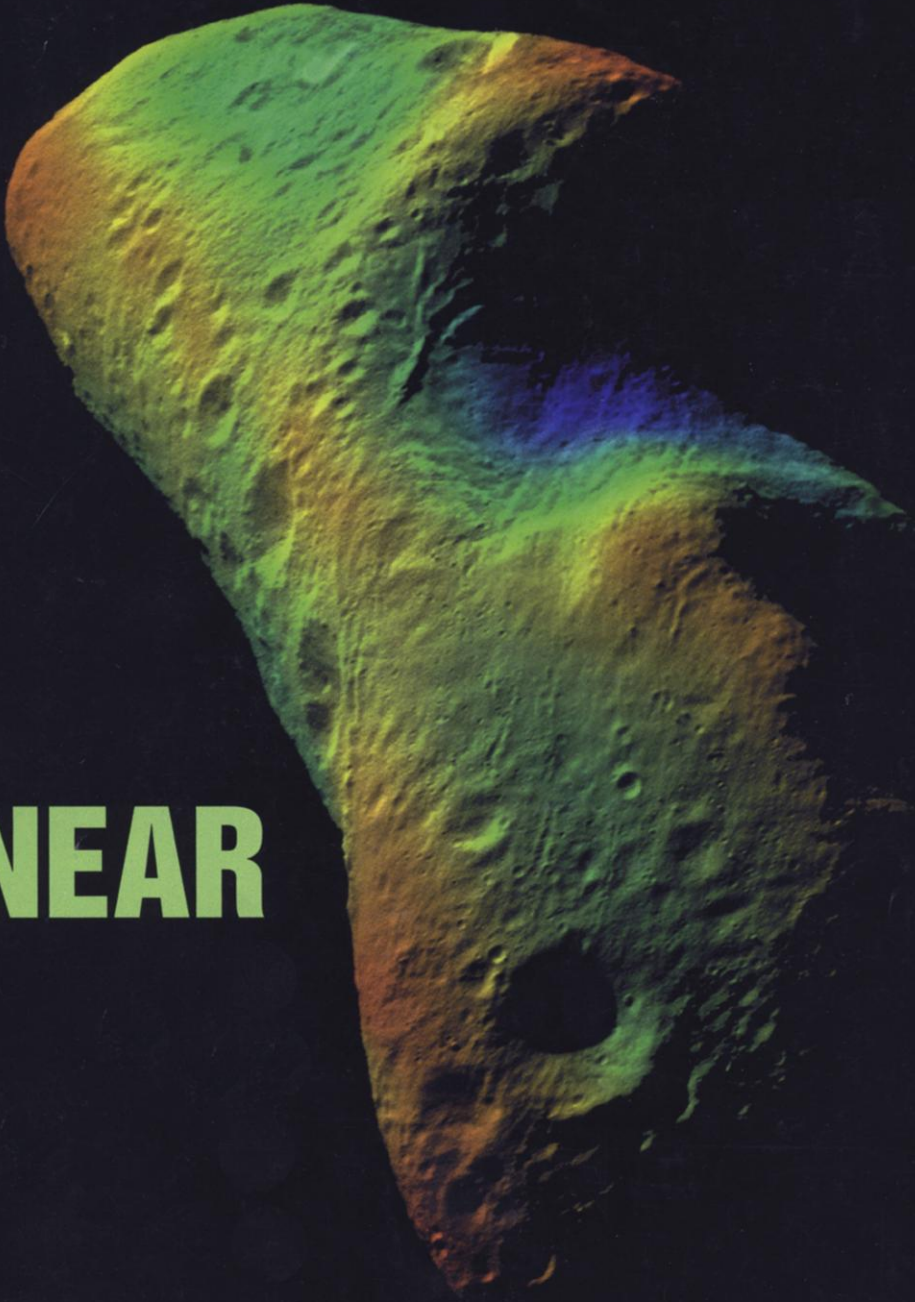


Science

22 September 2000

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NEAR



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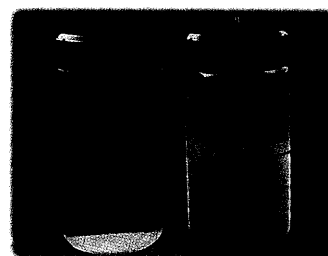
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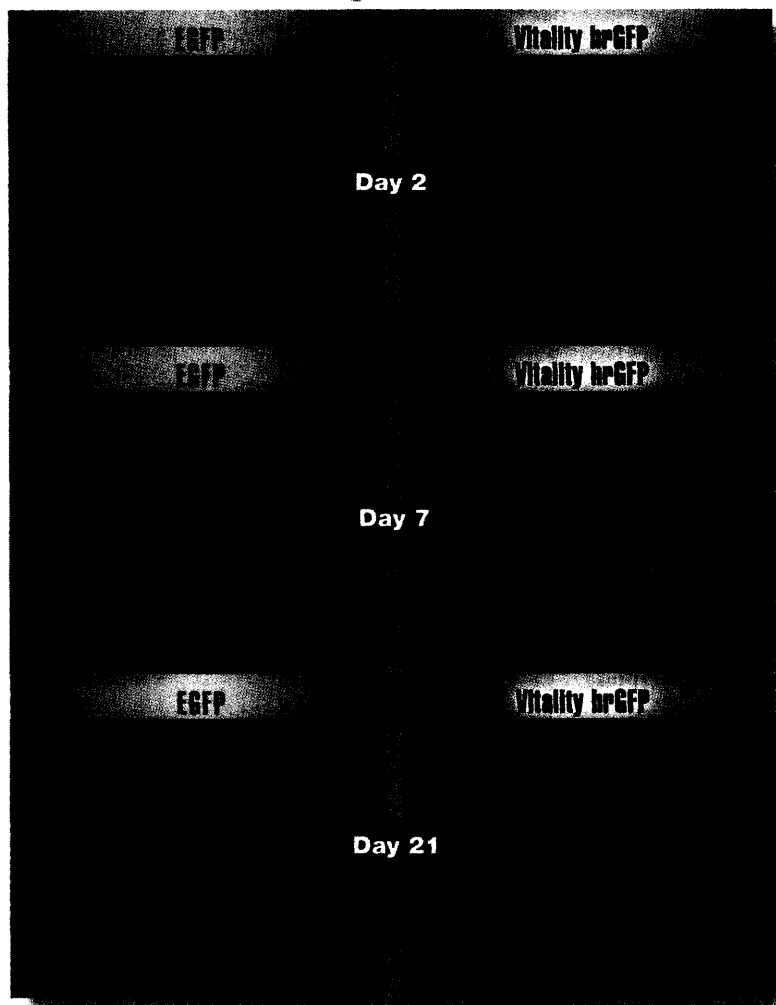
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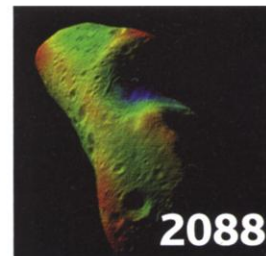
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Science

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COVER Global view of asteroid 433 Eros obtained by the NEAR-Shoemaker spacecraft on 12 March 2000 from a distance of 200 kilometers. Color contours have been added to show relative gravitational heights, ranging from red (highest) to blue (lowest). Gravitationally, the lowest region on Eros lies within the huge 10-kilometer-wide depression at the top right. [Image: Jonathan Joseph for NASA NEAR Project]



NEWS

NEWS OF THE WEEK

- 2014 PARTICLE PHYSICS: CERN Gives Higgs Hunters Extra Month to Collect Data
- 2015 NIH: Imaging Institute Picks Up Momentum
- 2017 VIROLOGY: Canine Virus Blamed in Caspian Seal Deaths
- 2018 U.S. SPACE SCIENCE: Earmarks, Rising Costs Threaten NASA Missions
- 2019 SPACE SCIENCE: Europe Set to Work on Hubble's Replacement
- 2019 EUROPEAN SCIENCE: Research Behemoth Slated for Overhaul
- ▼2020 2114 BIOPHYSICS: For Certain Shrimp, Life's a Snap
- 2021 ARCHAEOLOGY: A Victim of the Black Sea Flood Found

- 2021 BROOKHAVEN LAB: Forbes Loses in Fallout From Reactor Fight
- 2023 MEDICAL ETHICS: Moratorium Urged on Germ Line Gene Therapy
- 2023 PLANETARY SCIENCE: Twins for the Themis Asteroid Family

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- 2029 MOLECULAR BIOLOGY: New Way Found to Study Closely Related Proteins
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- 2033 DUTCH SCIENCE: On a Slippery Slope to Mediocrity?



2020

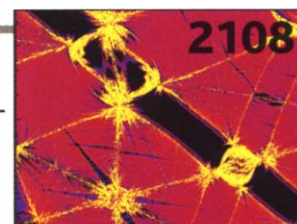
What makes shrimp snap

RESEARCH

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- ▼2085 2065, 2088 2097, 2101 Radio Science Results During the NEAR-Shoemaker Spacecraft Rendezvous with Eros D. K. Yeomans, P. G. Antreasian, J.-P. Barriot, S. R. Chesley, D. W. Dunham, R. W. Farquhar, J. D. Giorgini, C. E. Helfrich, A. S. Konopliv, J. V. McAdams, J. K. Miller, W. M. Owen Jr., D. J. Scheeres, P. C. Thomas, J. Veverka, B. G. Williams
- ▼2088 2065, 2085 2097, 2101 NEAR at Eros: Imaging and Spectral Results J. Veverka, M. Robinson, P. Thomas, S. Murchie, J. F. Bell III, N. Izenberg, C. Chapman, A. Harch, M. Bell, B. Carcich, A. Cheng, B. Clark, D. Domingue, D. Dunham, R. Farquhar, M. J. Gaffey, E. Hawkins, J. Joseph, R. Kirk, H. Li, P. Lucey, M. Malin, P. Martin, L. McFadden, W. J. Merline, J. K. Miller, W. M. Owen Jr., C. Peterson, L. Prockter, J. Warren, D. Wellnitz, B. G. Williams, D. K. Yeomans
- ▼2097 2065, 2085 2088, 2101 The Shape of 433 Eros from the NEAR-Shoemaker Laser Rangefinder M. T. Zuber, D. E. Smith, A. F. Cheng, J. B. Garvin, O. Aharonson, T. D. Cole, P. J. Dunn, Y. Guo, F. O. Lemoine, G. A. Neumann, D. D. Rowlands, M. H. Torrence

Web designs—
from order to
chaos



- ▼2101 2065, 2085 2088, 2097 The Elemental Composition of Asteroid 433 Eros: Results of the NEAR-Shoemaker X-ray Spectrometer J. I. Trombka, S. W. Squyres, J. Brückner, W. V. Boynton, R. C. Reedy, T. J. McCoy, P. Gorenstein, L. G. Evans, J. R. Arnold, R. D. Starr, L. R. Nittler, M. E. Murphy, I. Mikheeva, R. L. McNutt Jr., T. P. McClanahan, E. McCartney, J. O. Goldsten, R. E. Gold, S. R. Floyd, P. E. Clark, T. H. Burbine, J. S. Bhangoo, S. H. Bailey, M. Petaev

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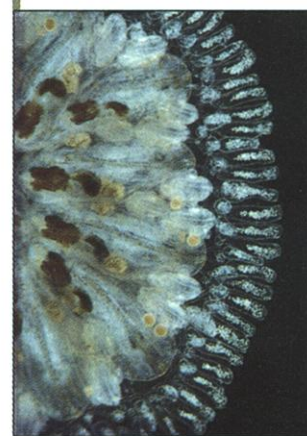
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Hana Simková, Ph.D., a postdoctoral fellow at the
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LIVING ON THE EXTREME

Could climate change bring about greater occurrences and more severe droughts, floods, heat waves, and storms? The economic impact of these extreme events is evident in the daily news and is likely to be much more important than changes in the average temperatures or weather of regions. In a Review, Easterling *et al.* (p. 2068) analyze both past trends and climate model results relating to these extreme weather events, which may impact both society and ecosystems. In a related Policy Forum, Changnon and Easterling point out how government policies have changed with respect to dealing with weather-related disasters and suggest how further changes are still needed.

A RENDEZVOUS WITH EROS

The Near Earth Asteroid Rendezvous (NEAR)—Shoemaker spacecraft has been mapping the structure and chemistry of the near-Earth asteroid 433 Eros since 14 February 2000. Four reports [Yeomans *et al.* (p. 2085), Veverka *et al.* (p. 2088; see the cover), Zuber *et al.* (p. 2097), and Trombka *et al.* (p. 2101)] summarize the key results from a variety of instruments. Eros has a bulk density of about 2.67 grams per cubic centimeter, similar to crustal rocks on Earth, and has a relatively homogeneous interior with no major mass anomalies detected so far. The surface is littered with large- to medium-sized impact craters, but the number of small craters is lower than expected. Linear ridges and grooves are prominent on the surface and extend for long distances; these features are probably related to impact processes. Boulders from 30 to 100 meters in length are nonuniformly strewn on the surface and are probably ejecta from impacts. Spectra suggest that Eros has a composition similar to ordinary chondrites, a finding that could help solve the mystery of a source for the abundant ordinary chondrites found on Earth. In a Perspective, Binzel discusses the compositional links between asteroids and meteorites.

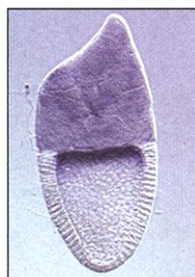
FULLY DEVELOPED KONDO EFFECT

In the Kondo effect, the influence of a localized spin impurity (such as one on a magnetic atom) changes at low temperature because the conduction electrons can interact collectively and "screen" the influence of the spin on transport properties. A quantum dot connected to two electrical leads (which creates two tunnel barriers) represents a system for studying a tunable Kondo effect by varying the applied electrical

potential and magnetic field. Van der Wiel *et al.* (p. 2105; see the Perspective by von Delft) show that when phase coherence is preserved, the localized electron spin on the dot can be perfectly screened, and the conductance reaches its maximum possible value (the unitary limit of the Kondo resonance), bracketed by highly resistive valleys.

MOVING RNA ACCORDING TO PLAN

During development, the production of a complex body plan requires the asymmetric distribution of messenger RNA (mRNA) and protein components. In *Drosophila* oocytes, developmentally regulated mRNAs like *bicoid* are located in the anterior region, whereas others, such as *oskar* mRNA, localize to the posterior.



It is the distribution of these two particular RNAs that is key in establishing the anterior-posterior axis. Brenda *et al.* (p. 2120)

now describe the molecular motor likely to be responsible for transporting *oskar* RNA in association with the Staufen protein to the posterior of the cell. The motor protein, kinesin I, has previously been shown to play a role in transporting a variety of cargoes along microtubules in multiple cell types.

IMAGINE CHAOS

The orbits of the planets around the sun is one example of a many-body problem that is highly sensitive to perturbations, and there is much interest in determining the long-term behavior of such systems. Froeschlé *et al.* (p. 2108) have developed an efficient graphical representation of the transformation from order to chaos of an integrable system of a quasi-integrable dynamical system, the so-called Arnold web, caused by a small perturbation. Using a fast Lyapunov integrator that they developed, they imaged the transition from a system full of regular resonant motions to small islands of regular motions within a sea of chaotic zones.

PROTEIN LINKING RINGS

The capsid shells of bacteriophage HK97 are very stable and cannot be disassembled by denaturation. Now Wikoff *et al.* (p.

2129) have determined the structure of the mature empty capsid at 3.6 angstrom (Å) resolution. The capsid is an icosahedron with a diameter of 660 Å and a shell thickness of 18 Å. It is comprised of 420 monomers that are covalently linked into pentameric and hexameric rings. These rings loop through each other to form topological links, or catenanes. This "protein chain mail" explains how the very thin capsid is stabilized.

POLYMORPHISMS AND COMPETING GROUPS

The evolution of highly polymorphic allelic self/nonself recognition systems, such as the vertebrate major histocompatibility complex, is a classic question in evolutionary biology, immunology, and behavior. One hypothesis that has gained currency in recent years is that variation at these loci relates to mating patterns, such that females prefer males with rare or disparate alleles. Grosberg and Hart (p. 2111), in a series of formal experimental tests of this hypothesis with two species of colonial marine invertebrates, show that no mating biases exist. Hence, mating preferences are not essential to the maintenance of these polymorphisms. Instead, it seems that the function of the system is in controlling outcomes of competitive interactions between colonies with different degrees of relatedness.

BUBBLE AND SNAP

The ocean is a noisy place. The largest source of background noise in shallow waters is the snapping shrimp, whose crackling reports bedevil studies of marine acoustics and can interfere even with submarine communication. Versluis *et al.* (p. 2114; see the news story by Brown) use a combination of high-speed film and theoretical modeling to show how this noise is generated. When the shrimp's claw snaps shut, a water jet is created that produces a cavitation bubble; the noise is the collapse of the bubble. The noise that is generated may function in defense and predation by stunning small animals in the immediate vicinity of the shrimp.

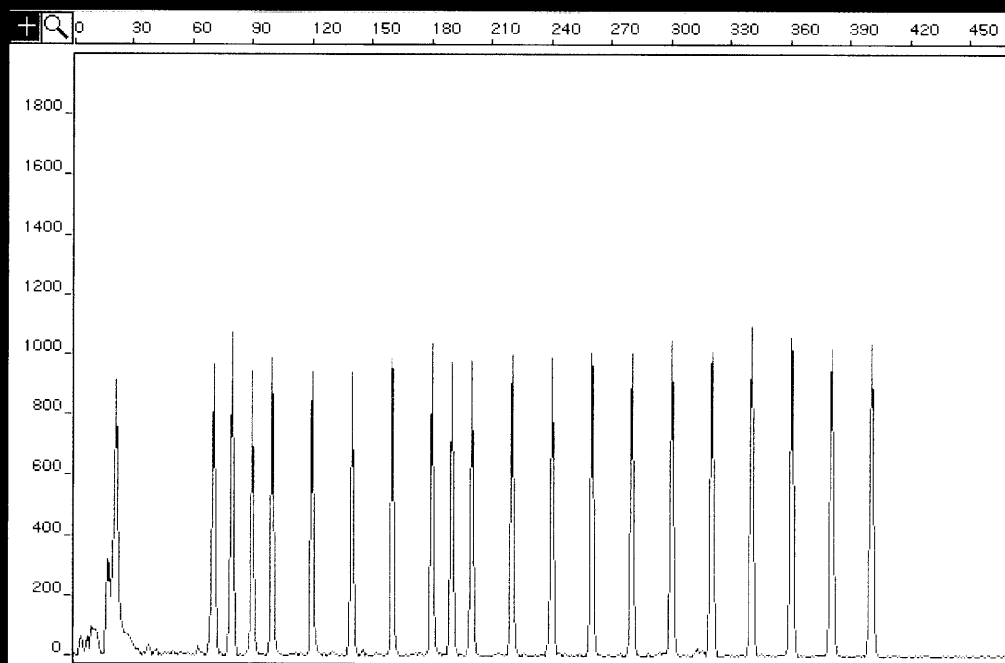
A HARSH CELLULAR ECONOMY

Survival of a species usually requires overproduction of young to ensure that some fraction survive to maturity. This approach to survival appears to apply even to a cell trying to produce proteins. Polypeptide chains emerging from the ribosome are not fully folded, and thus in some ways re-

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THIS WEEK IN SCIENCE

CONTINUED FROM PAGE 2001

semble the misfolded or damaged proteins that are the target of the ubiquitin degradation system. Turner and Varshavsky (p. 2117), using a "ubiquitin-sandwich" technique, show that more than 50% of the polypeptides that bore an amino-terminal degradation signal were degraded before they ever reached their fully folded form.

PRIMED AND READY TO GO

A dividing cell must pass through a series of "checkpoints" that monitor if the mechanics of the various basic steps are occurring in the appropriate manner. For example, the replication checkpoint ensures that DNA has been duplicated. How is the checkpoint enforced? Michael *et al.* (p. 2133) show that it is the binding of one of the major DNA synthesizing enzymes, DNA polymerase α , to chromatin that indicates that replication is ongoing. Yet the checkpoint is not sensing DNA replication itself, but rather the primase activity of the polymerase—the activity that has to generate short stretches of RNA that prime the synthesis of the so-called Okazaki fragments on the lagging strand of DNA. Given that these transient species are produced constantly during replication, they are an excellent indicator of the state of replication.

INSULIN ON THE BRAIN

The hormone insulin controls the metabolism of glucose, fats, and proteins. Alterations in insulin production and response can lead to type II diabetes, a disorder that affects more than 100 million people worldwide. A growing body of evidence has suggested that insulin signaling may also play an important role in the cen-

tral nervous system. Brünig *et al.* (p. 2122; see the Perspective by Schwartz) have separated the brain action of insulin from its other actions by creating mice that are selectively deficient in the brain insulin receptor. Mutant mice showed modest diet-induced obesity and insulin resistance as well as a significant reduction in fertility, the latter attributable to impaired hypothalamic regulation of luteinizing hormone. These findings may enhance understanding of the complex metabolic disorders often associated with type II diabetes.

EAT LESS, LIVE LONGER

Severely restricting a rat's daily intake of calories helps prolong its life. This regimen that works in primates and even yeast. Now Lin *et al.* (p. 2126; see the Perspective by Campisi) have recreated this so-called caloric restriction in yeast and identified some of the genes required for its effects on longevity. These include the chromatin-silencing gene *SIR2* and a gene for an enzyme in the synthesis pathway of the metabolic intermediate NAD (the oxidized form of nicotinamide adenine dinucleotide). Because Sir2p is allosterically regulated by NAD, a decreased metabolic rate included by caloric restriction could cause altered NAD levels and thus maintain the ability of Sir2p to silence the expression of deleterious genes (in this case, the expression of ribosomal DNA that can be toxic to yeast cells). This connection between silencing and prolonged life induced by caloric restriction suggests that proteins that silence gene expression may prove to be useful targets for drugs that modulate life-span.

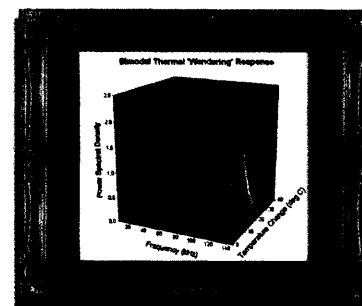
TECHNICAL COMMENT SUMMARIES

Viral Escape and the Failure of Cellular Immune Responses

The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/289/5487/2003a

Farci *et al.* (Reports, 14 April, p. 339), studying the evolution of sequences in the envelope genes of the hepatitis C virus (HCV), found that HCV evolved rapidly and showed much more genetic diversity in patients who developed the chronic form of the disease than it did in patients who ultimately cleared the virus. The data, they concluded, "indicate that the evolutionary dynamics of the HCV quasispecies during the acute phase of hepatitis C predict whether the infection will resolve or become chronic." Klenerman *et al.*, while acknowledging that reduced viral diversity indeed probably constitutes "a feature of more successful immune responses," argue that "an appropriate balance between cellular and humoral immune responses"—i.e., between the early response by CD8⁺ cytotoxic T lymphocytes (CTLs) and subsequent pressure from neutralizing antibodies—is another important, and often overlooked, element of immune system success against this virus. Farci *et al.*, in their response, agree that "the cellular and humoral components of the immune system together induce definitive viral clearance," in marked contrast to "the reductionist theories of either CTL dominance or antibody dominance that have hitherto prevailed in studies of sterilizing immunity."

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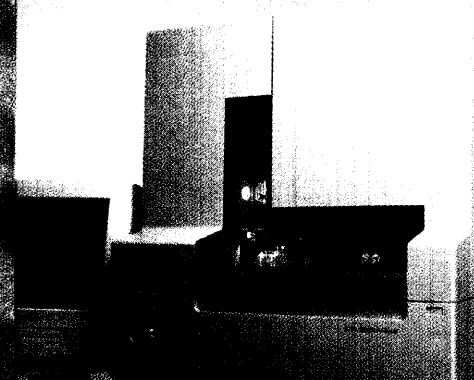
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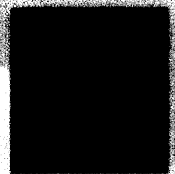
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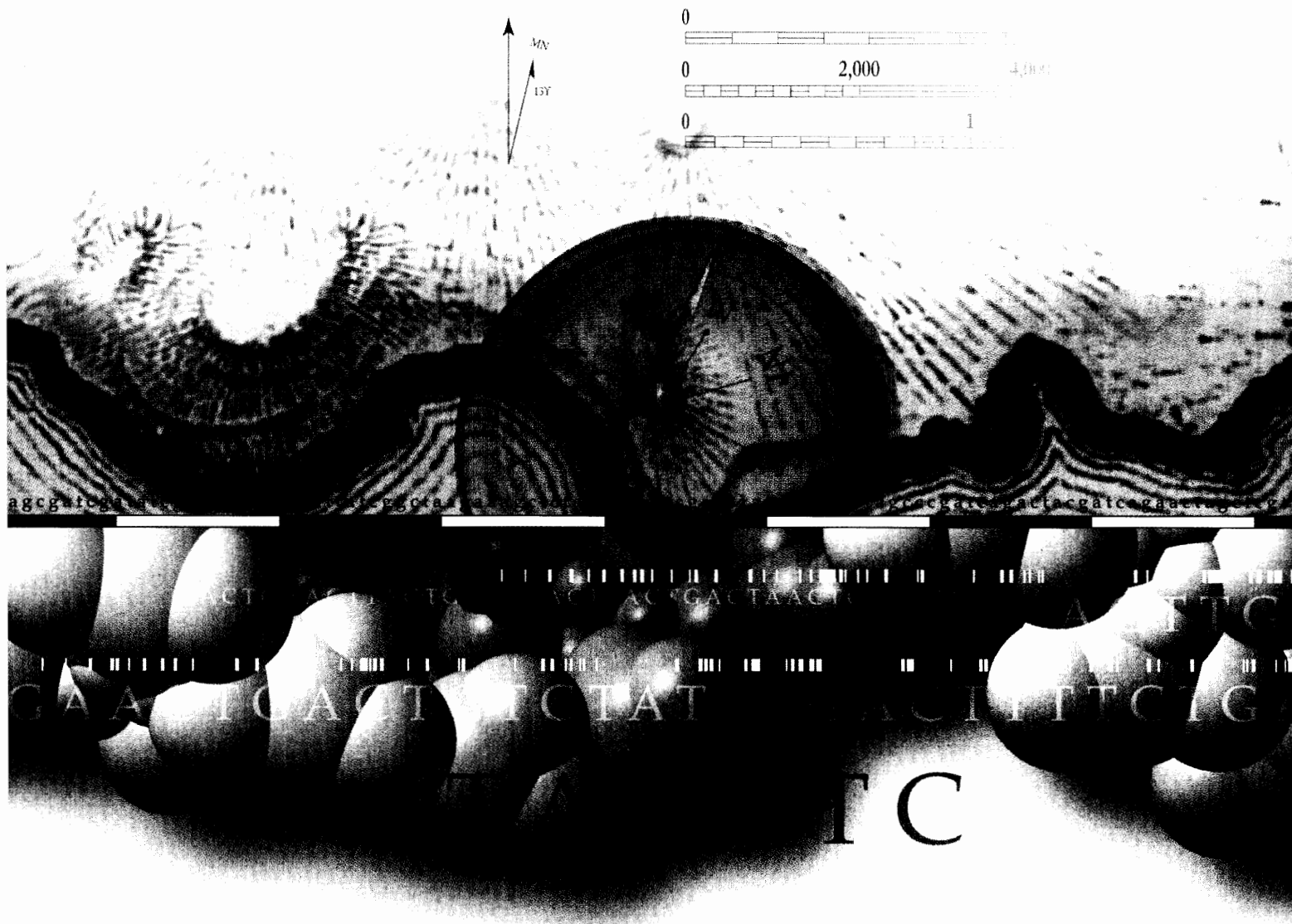
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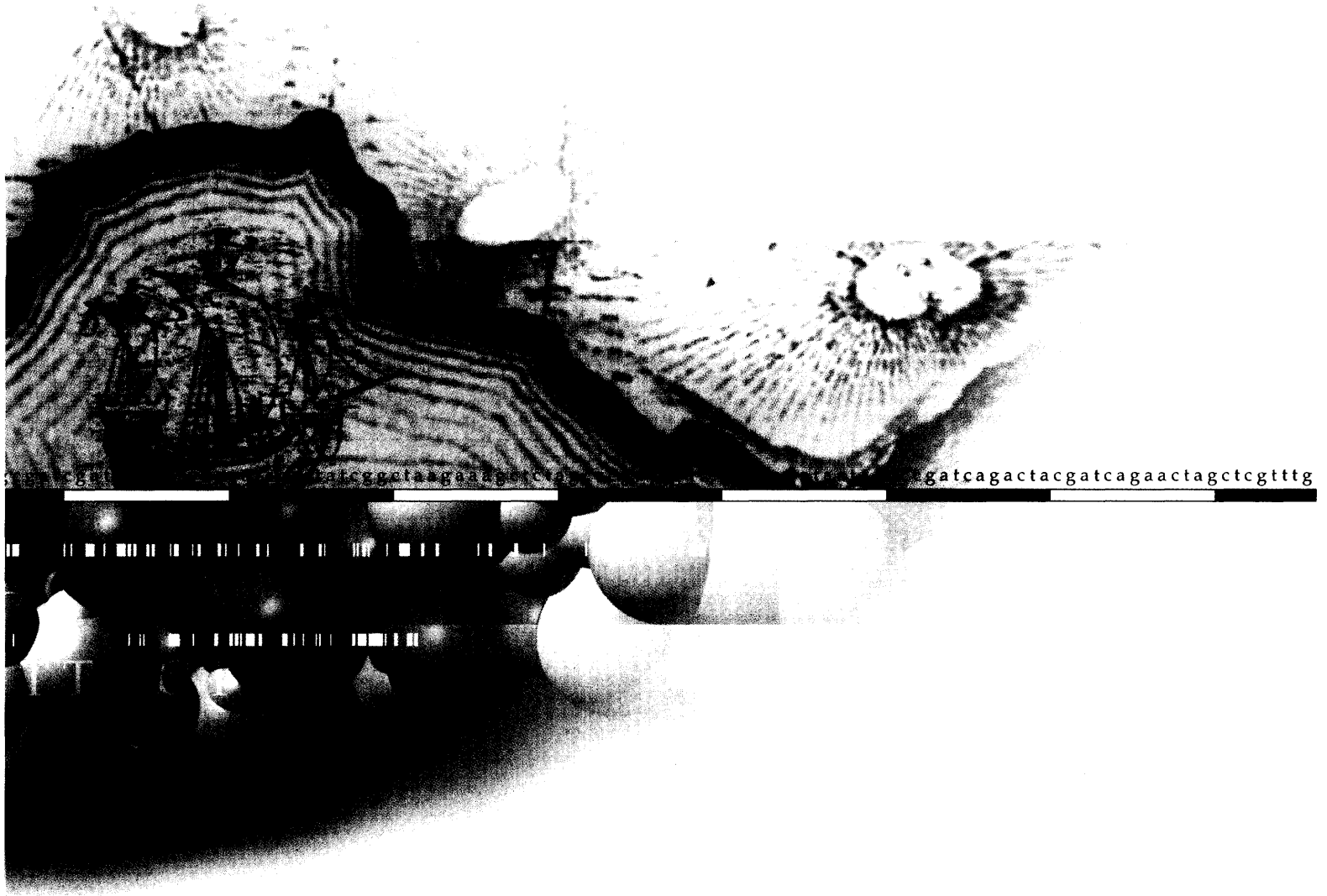


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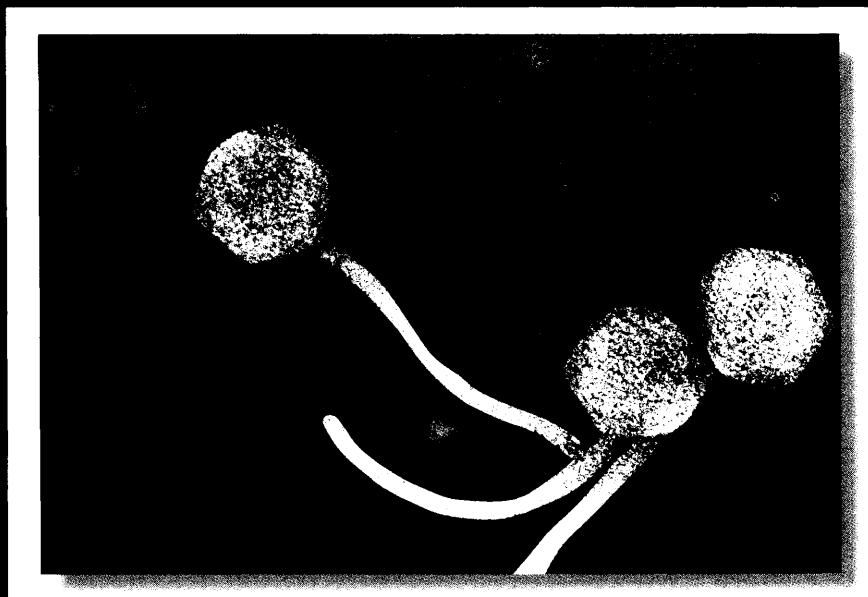
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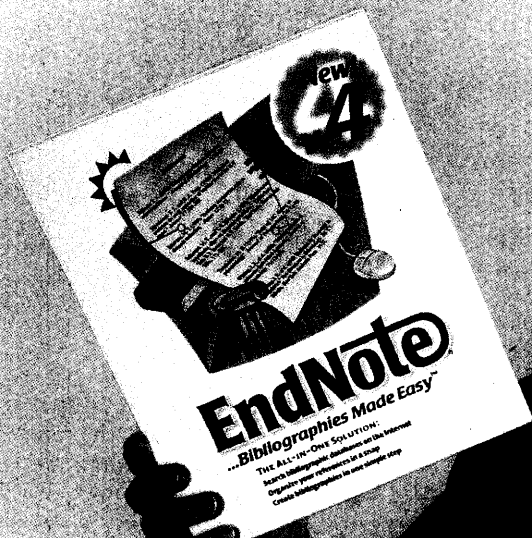
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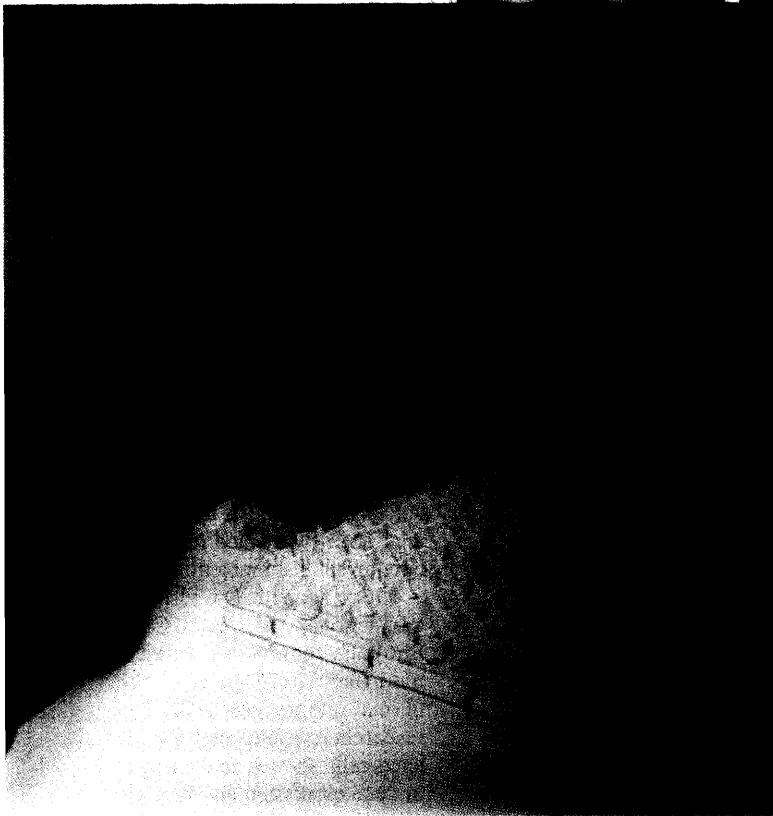
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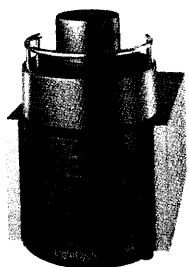
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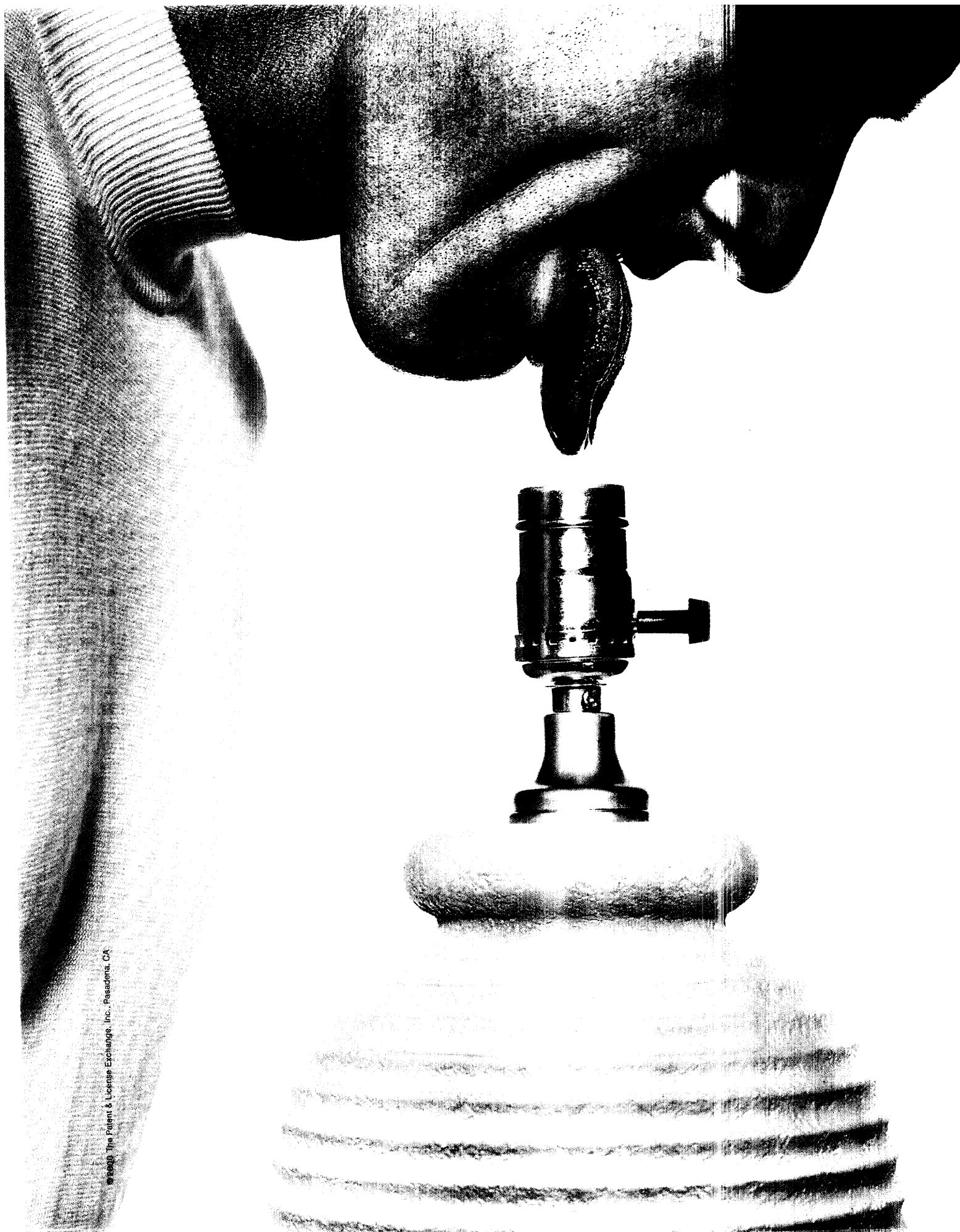
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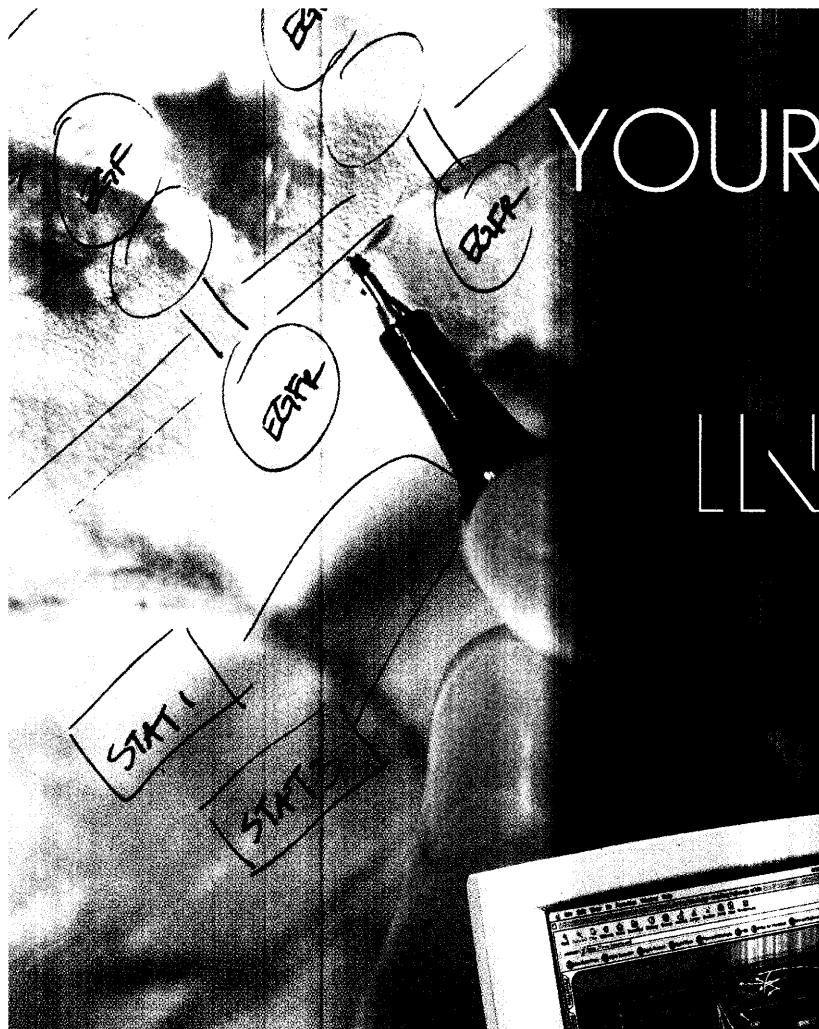
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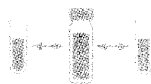
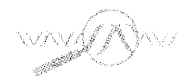
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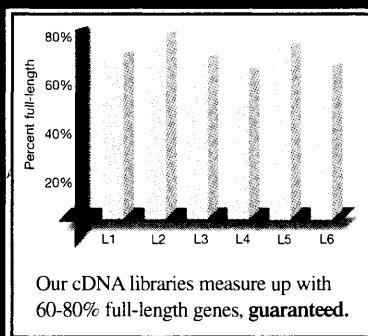
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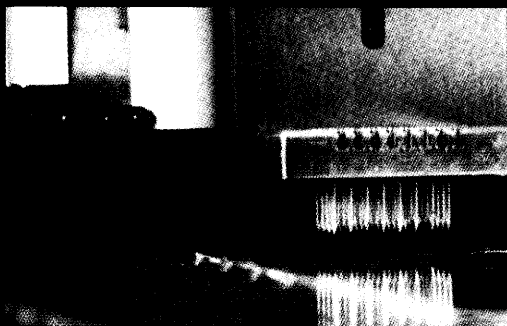
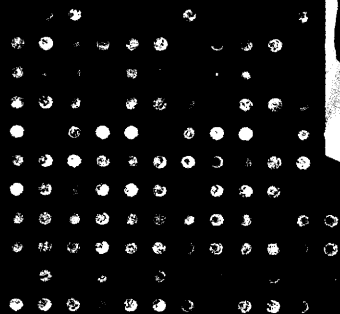
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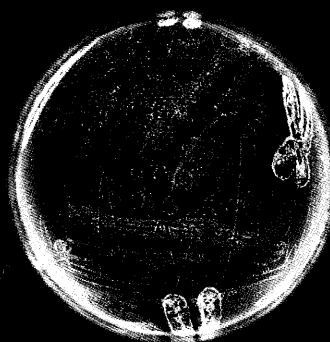
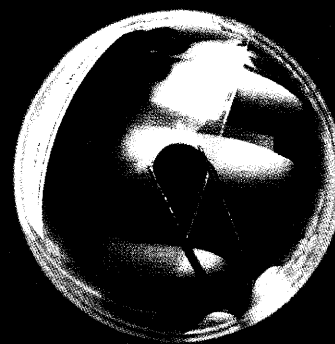
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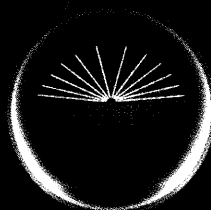
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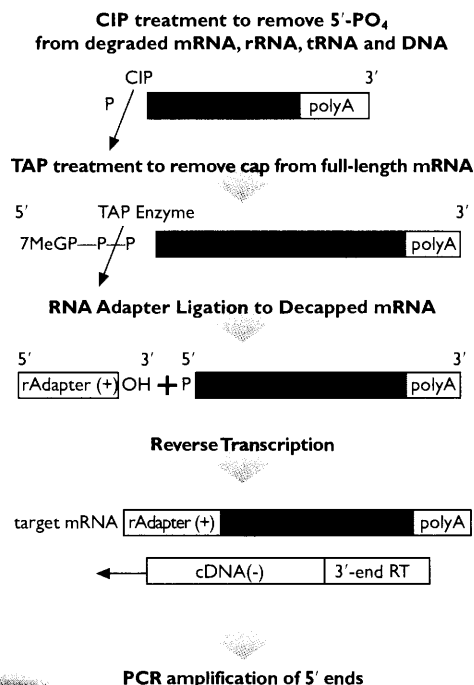
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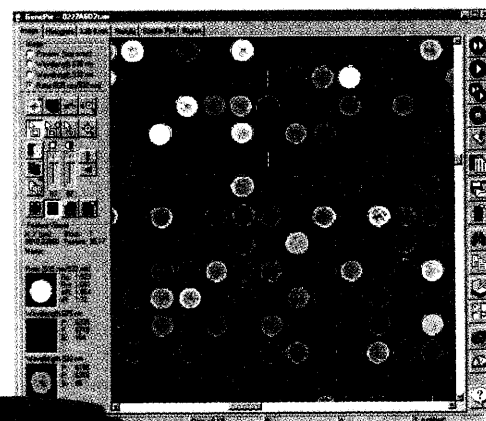
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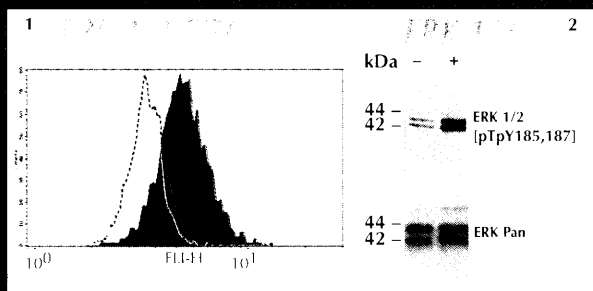
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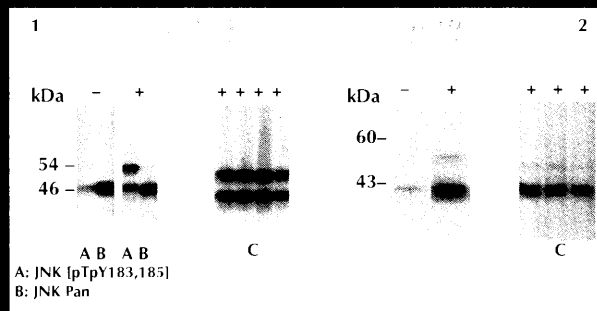
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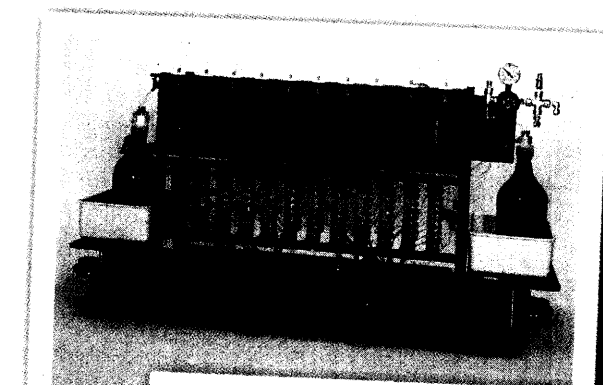
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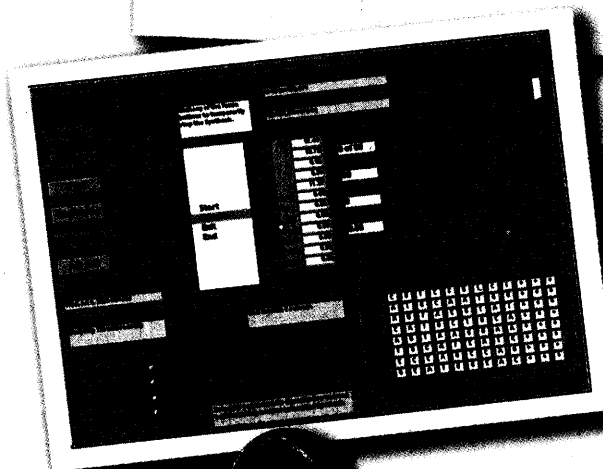
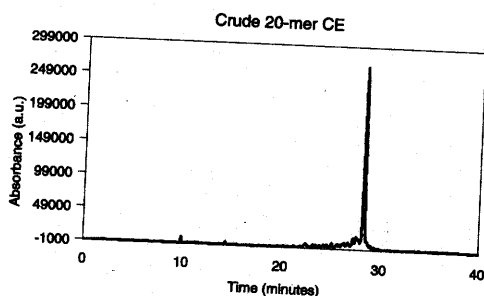
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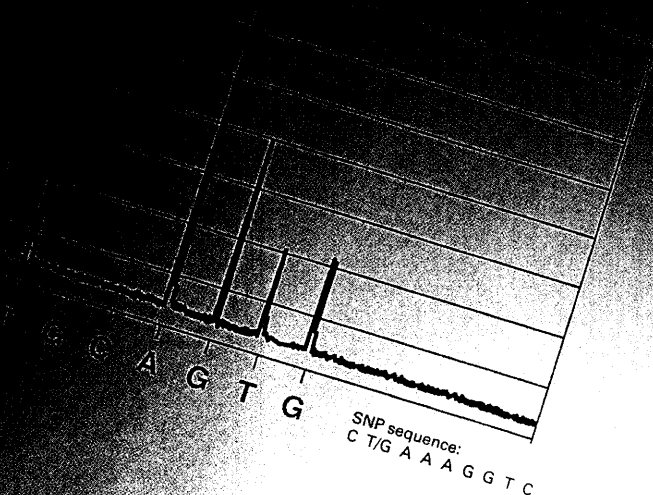
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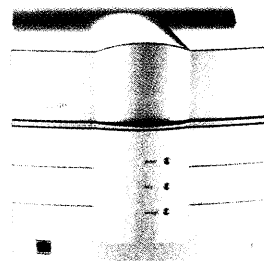


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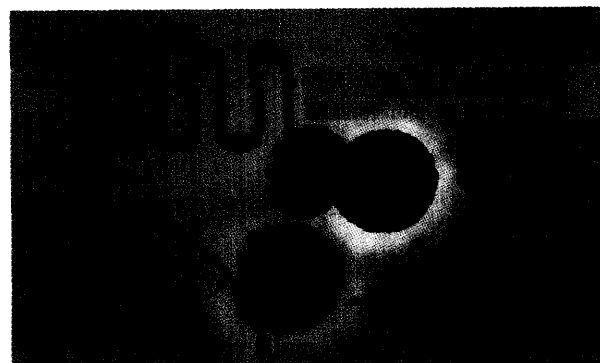
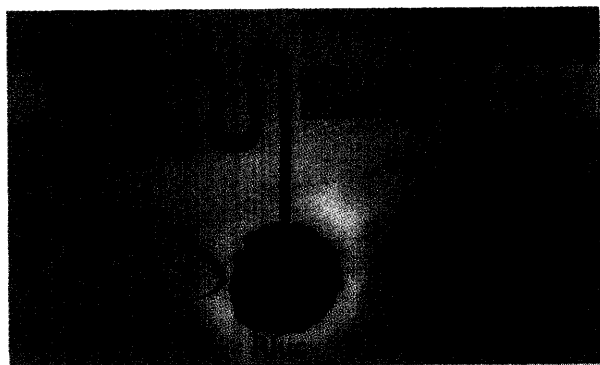
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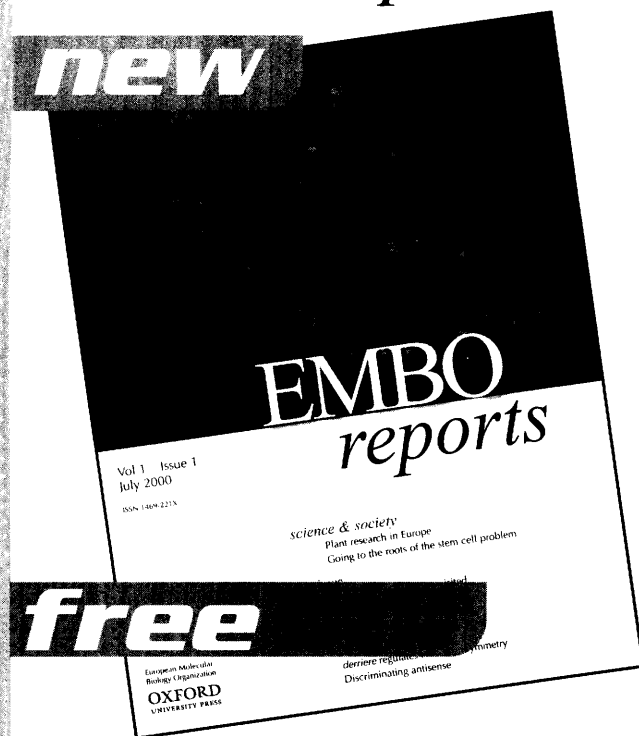
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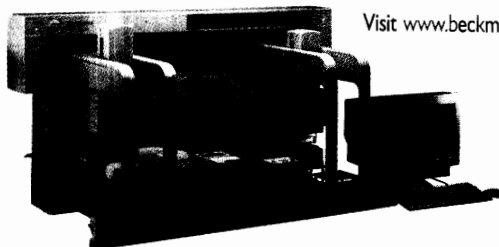
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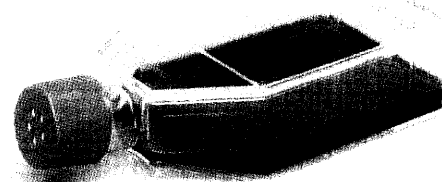
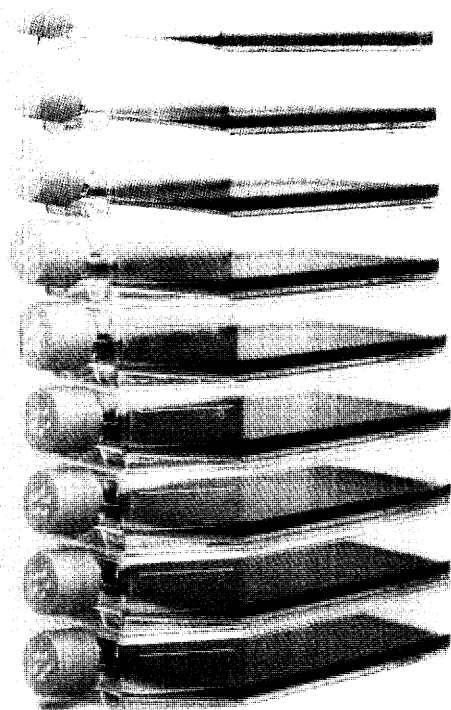
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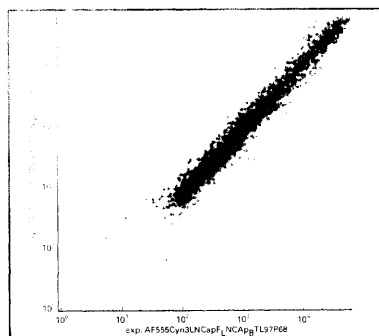
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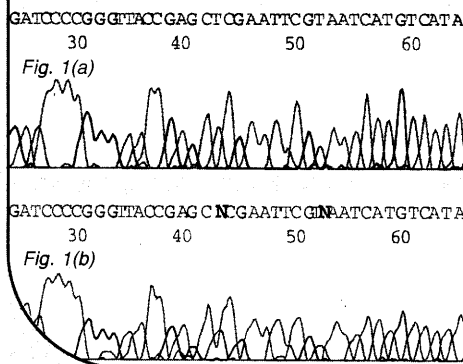
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Fig. 1. Fluorescent sequencing results of a 100 bp pUC18 PCR fragment sequenced with a -20 Fwd primer using the DYEnamic ET Terminator Cycle Sequencing Kit (Amersham Pharmacia Biotech). Data generated for USB by Cleveland Genomics (clevelandgenomics.com), a research service company. PCR clean-up performed with: (a) ExoSAP-IT; (b) a column designed for PCR clean-up. Base miscalls in (b) are due to inherently low yields of short PCR products when using columns.

Fig. 2. Autoradiograms of a 20.7 kb Lambda PCR fragment sequenced with MBL202 Fwd primer using USB's Thermo Sequenase Radiolabeled Terminator Cycle Sequencing Kit. PCR clean-up performed with: (a) ExoSAP-IT; (b) a column designed for PCR clean-up.



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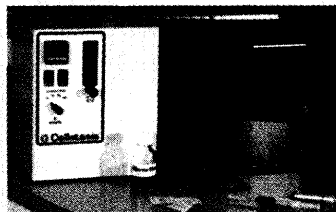
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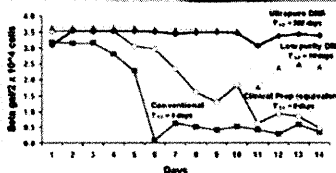
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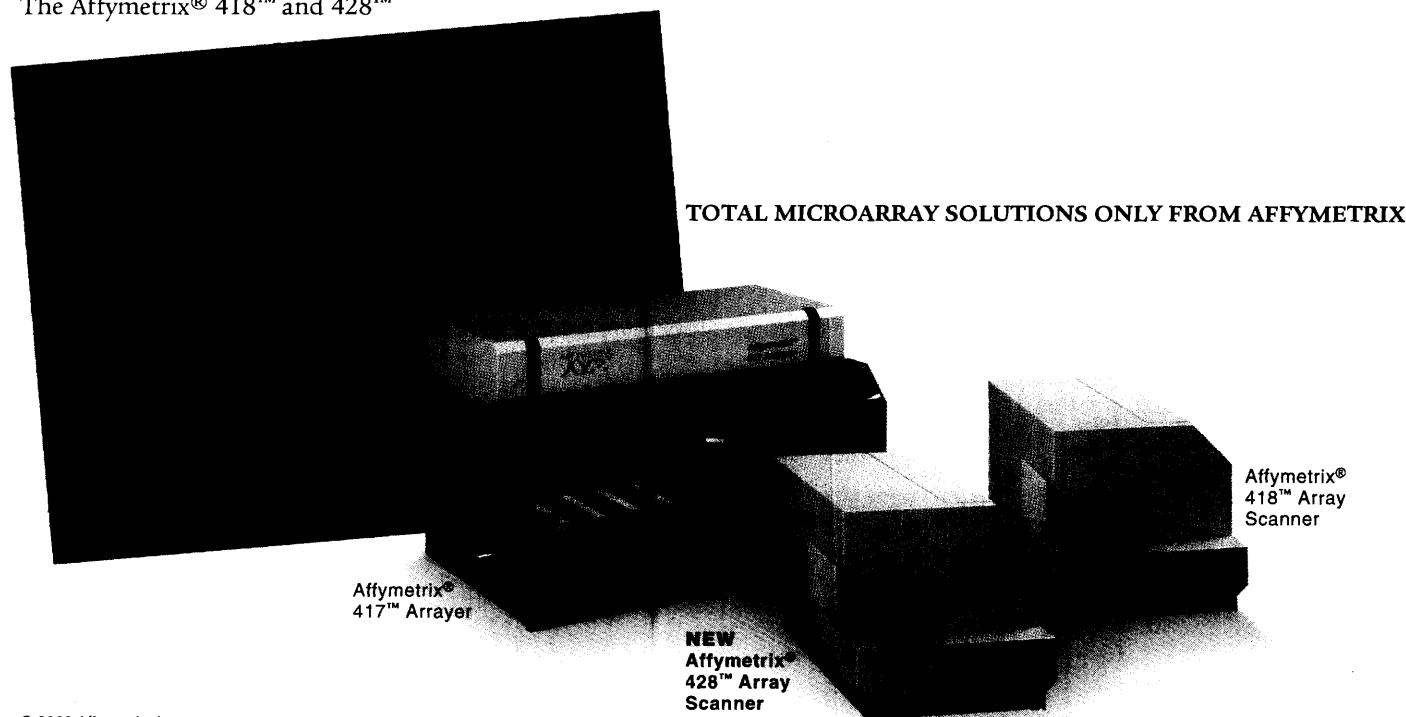
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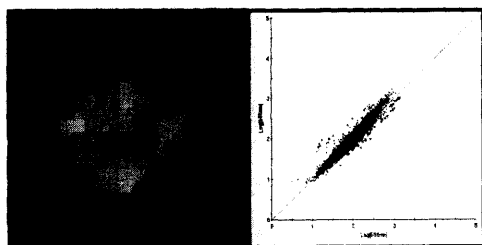
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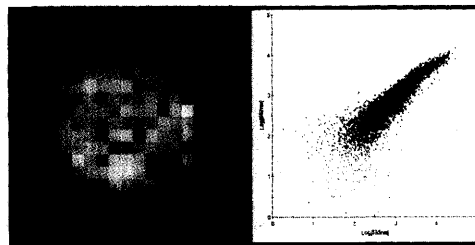
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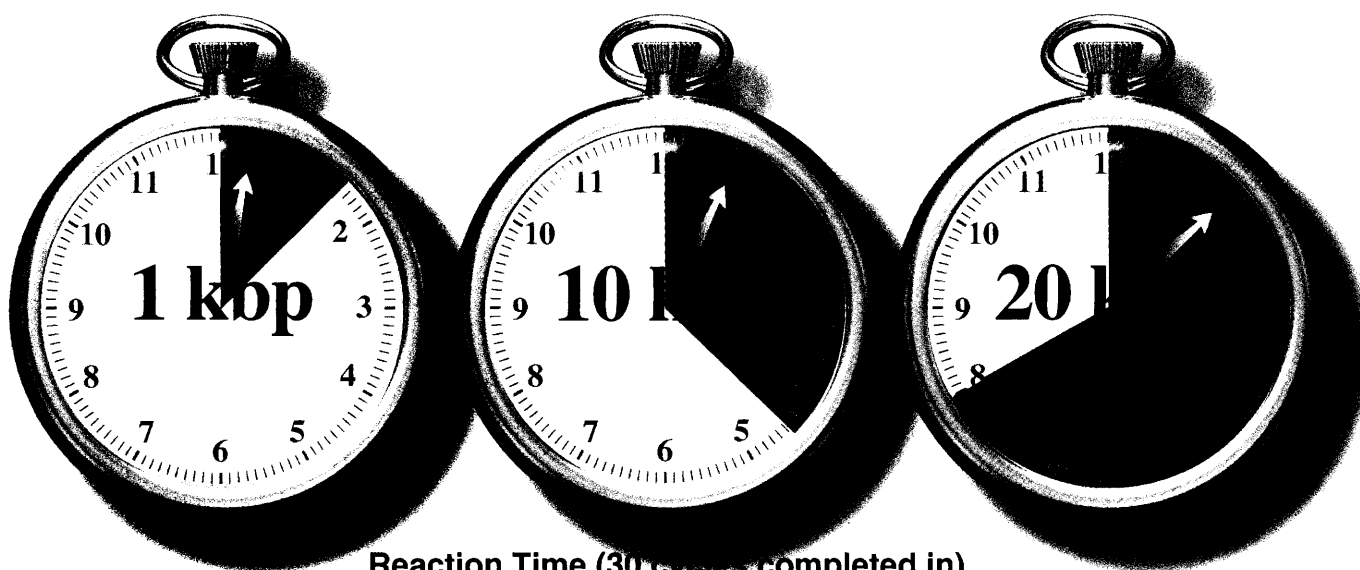
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