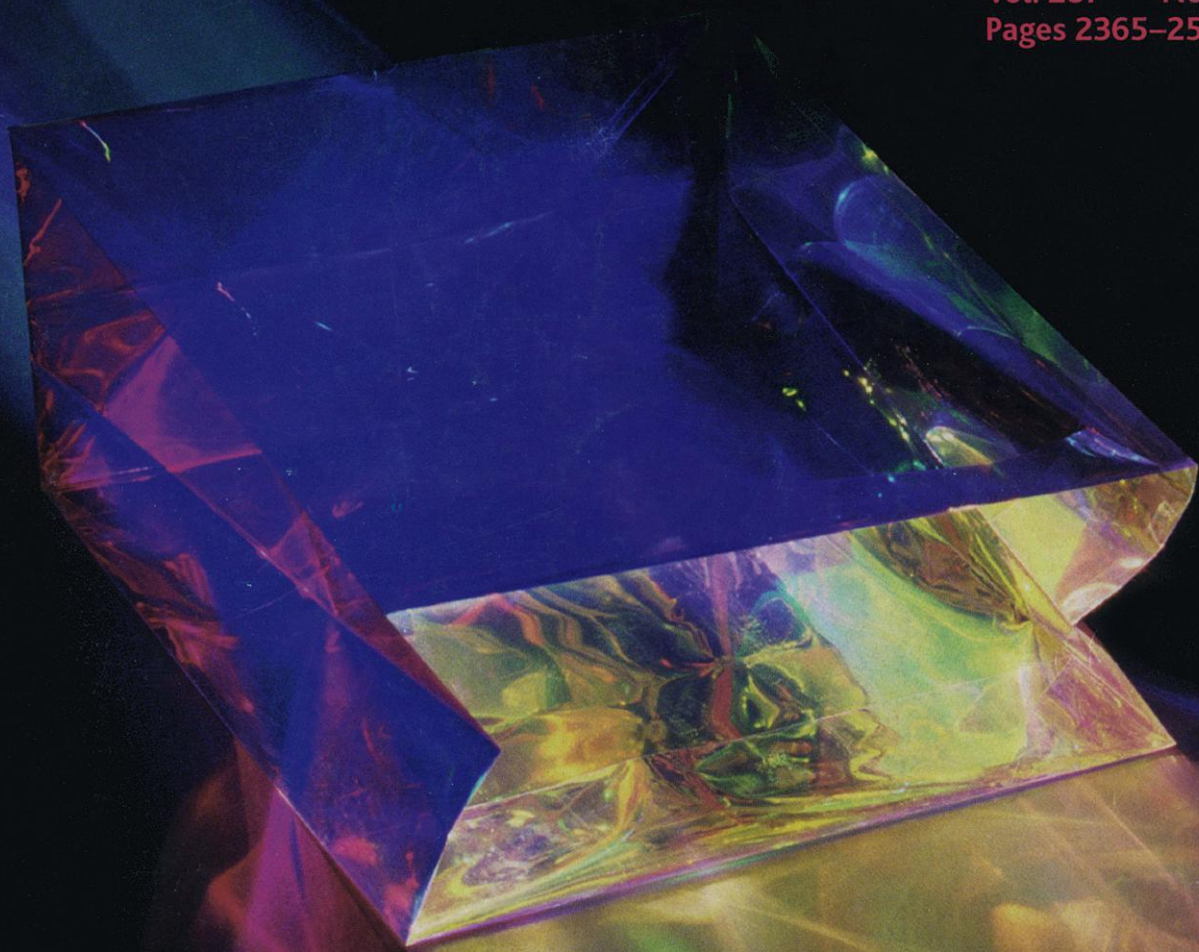


# Science

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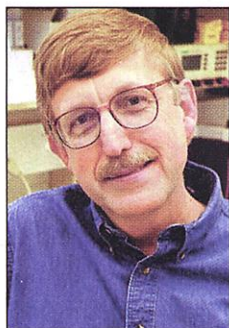
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**COVER** A bag made of 3M-pioneered, multilayer-polymer color mirror is externally illuminated through the front opening with white light. The startling reflective properties, outstanding color tunability, and superb angular performance of this family of thin, flexible mirrors will have applications in signage, optoelectronics, and energy control. [Photo: Don Pitlik, Pitlik Studio]



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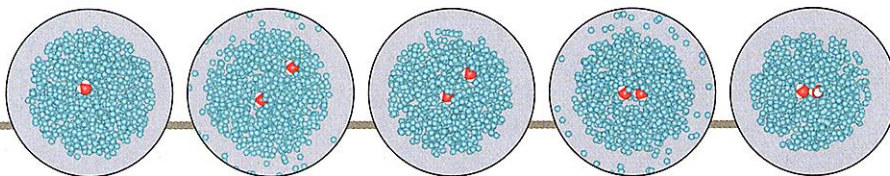
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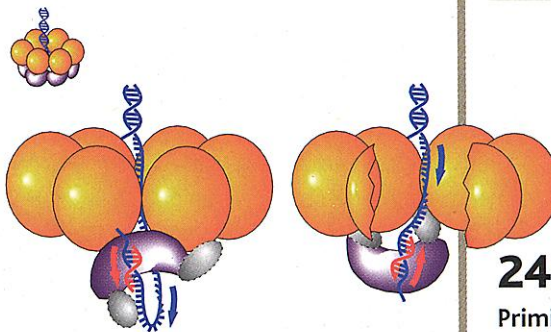
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# 2482

Priming the replisome

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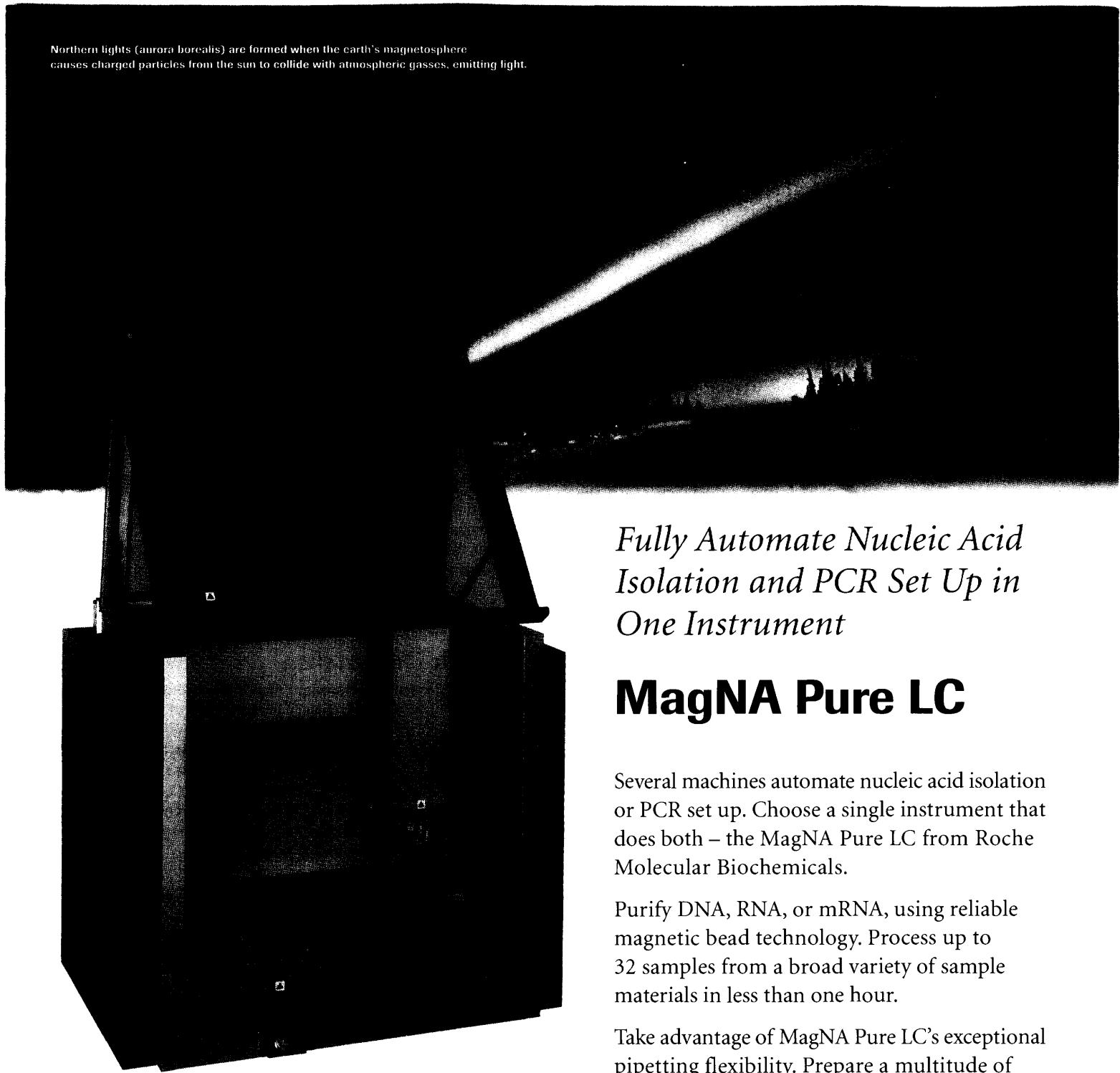
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## UPON SEVERAL LAYERS OF REFLECTION

Mirrors are made conventionally by coating a substrate with a reflective metal, but in more advanced designs, multiple layers of transparent dielectric materials can be assembled and designed to give very high reflectivity or wavelength selectivity. Such multilayer mirrors usually have an Achilles heel that arises from Brewster's Law—while such mirrors exhibit very high reflectivity for p-polarized light at normal incidence, they rapidly lose reflectivity when viewed at an angle. Weber *et al.* (p. 2451; see the cover and the news story by Service) show that multilayer stacks of alternating birefringent and optically isotropic polymer layers (in some cases, hundreds of layers of submicrometer thickness) can create broadband and color mirrors that are highly reflective at all angles, as well as polarizers that work in reflection.

## SOLAR CONVECTION

The sun is divided into a hot inner core, a radiative zone, a convective zone, a photosphere, and a very hot outer atmosphere. The thin boundary between the radiative and convective zones, called the tachocline, is assumed to generate the solar dynamo by rotational shear that produces strong magnetic fields. Howe *et al.* (p. 2456; see the Perspective by Gough) have detected variations in the rate of rotation at the tachocline by combining 4 years of data on modes of oscillations derived from the ground-based observatories of the Global Oscillation Network Group (GONG) and the space-based Michelson Doppler Imager (MDI) on the Solar Heliospheric Observatory (SOHO) spacecraft. The rotation of the sun near the tachocline varies at low latitudes over a period of 1.3 years and may indicate dynamic coupling between the radiative and convective zones.

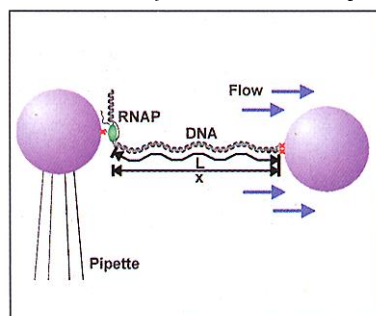
## MINIMAL HYDRATION

Scientists studying ion hydration often resort to investigating how just a few water molecules interact with the ion in the gas phase. In conjunction with theoretical studies, this approach can yield insights into the structure of the hydration shell and interactions in the condensed phase. Weber *et al.* (p. 2461; see the Perspective by Scoles and Lehmann) used cluster spectroscopy and *ab initio* theory to establish the detailed structure of the hy-

dratation shell around the superoxide anion,  $O_2^-$ . The minimum hydration shell involves just four water molecules, each of which is engaged in a single hydrogen bond to the superoxide.

## CAUGHT IN THE ACT

To better understand how genes are regulated, it is important to understand the kinetics behind transcription (the mechanism by which the DNA template is converted into RNA), but this generally has relied on bulk experiments where events are averaged. These analyses do not readily allow for the dissection of the various stages encountered by an



elongating complex. Davenport *et al.* (p. 2497; see the Perspective by Buc) have used an optical trap method and video microscopy to map in real time the transcription stages and rates of single molecules of *Escherichia coli* RNA polymerase. The paused state is shown to be a kinetic intermediate between transcription elongation and arrest. The presence of a switch between transcriptionally competent states may provide a target for gene regulation.

## BY LAND OR BY SEA

Fossil fuel burning currently adds about 6 billion tons of carbon dioxide ( $CO_2$ ) to the atmosphere each year. Half of that is incorporated into the oceans and the land biosphere, but how much  $CO_2$  does each of those sinks absorb? Battle *et al.* (p. 2467) address that question by combining two methods of determining the net  $CO_2$  fluxes into and out of the terrestrial biosphere by measuring the change of  $O_2/N_2$  in the atmosphere and by measuring stable carbon isotopic composition of atmospheric  $CO_2$ . The highly variable fluxes they find for the

land biosphere between 1991 and 1997 are a stark contrast to the stable behavior of the 1980s.

## HOT AND DRY IN TIBET

Xenoliths are foreign fragments of rock with textures and compositions different than those of their host rocks. Some xenoliths represent samples of the lower crust or mantle rapidly brought to the surface in volcanic eruptions. Hacker *et al.* (p. 2463) studied a suite of mafic and metasedimentary xenoliths found in Tibetan lavas and determined that these xenoliths had seen high temperatures (about 800° to 1000°C) under anhydrous conditions. These results suggest that the metasedimentary xenoliths indicate a dry, but hot lower crust that mixed with mafic xenoliths from deeper mantle melts. Such a model calls into question the possibility of a regionally extensive hydrous melt zone in the lower crust beneath the Himalayas formed by convective thinning of the underlying mantle.

## CONTROLLING INSECT PESTS

The sterile insect technique (SIT) is a popular method for controlling insect pests and disease vectors; large numbers of sterile males are bred and released to compete with wild males for females, thus reducing the population of the next generation. However, breeding insects on the required scale is often expensive and problematic. Thomas *et al.* (p. 2474) describe a major improvement to SIT using a transgenic *Drosophila* system that can provide both the efficient sexing and the female-specific lethality required. When transferred to other systems, this new technique is likely to become an important weapon in the armory used against insect pests.

## USE IT OR LOSE IT

Monocular deprivation studies have established that during early postnatal development there are periods of plasticity in the visual system; activity-dependent refinement of neuronal connections from earlier, more diffuse stages occurs. It has been thought that these connections, once established, are maintained throughout life. However, Chapman (p. 2479) shows that blockade of retinal activity abolishes existing ocular dominance structures in the lateral geniculate nucleus of the ferret. This result implies that

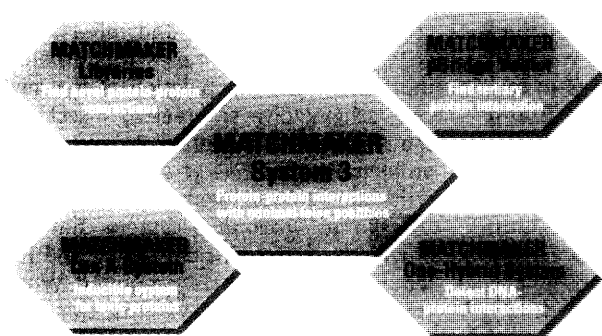
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# THIS WEEK IN SCIENCE

CONTINUED FROM PAGE 2373

activity-dependent competition is necessary not only for the establishment of specific connections in the visual system, but also for their maintenance.

## A DETERIORATION OF DIVISION

What happens inside cells as we age? High-density oligonucleotide arrays analysis of messenger RNA from young, middle-aged, and old humans for over 6000 genes reveal classes of genes that are altered in dividing fibroblasts. Ly *et al.* (p. 2486; see the news story by Marx) report that with age, many of the genes with altered expression are involved in the G<sub>2</sub>-M phase of the cell cycle. The authors suggest that a decreased ability to replicate properly with age would lead to higher rates of somatic mutation that then would affect the expression of specific genes contributing to the aging phenotype.

## TAKING UP RESIDENCE

In brucellosis, the pathogenic bacterium *Brucella abortus* invades and establishes a long-lasting interaction with the host mammalian cell. In leguminous plants, the symbiont *Rhizobium meliloti* invades and takes up residence in root nodule cells. LeVier *et al.* (p. 2492) now report that these very different host-bacterial relationships both require a putative membrane transporter encoded by the

*bacA* gene. The BacA protein may assist the invading bacteria to evade the host cell's defense mechanisms.

## THE SOUND OF SILENCE

Double-stranded RNA is able to regulate gene expression by sequence-specific post-transcriptional interference (RNAi). Grishok *et al.* (p. 2494; see the Perspective by Sharp and Zamore) show that in *Caenorhabditis* this RNAi phenomenon can be transmitted to the offspring, and they identify the genes involved. Their findings suggest the existence of a sequence-specific silencing factor, which may be a small RNA (20 to 23 nucleotides long), and implicate the genes *rde-1* and *rde-4* in its formation.

## IDENTITY CRISIS

Most of the time, our self proteins remain unnoticed by our immune systems. Autoimmune responses occur when this tolerance of self is broken. When B cells become activated instead of tolerant, they produce antibodies. Kouskoff *et al.* (p. 2501) now report a system in which B cells are tolerant to self until a bacteriophage carrying an epitope recognized by the B cells (but not similar in sequence to the self-antigen recognized by those B cells) is introduced into the mouse. This T cell-independent activation of formerly tolerant B cells raises the question of how B cells are normally able to distinguish self-antigens from foreign, T cell-independent antigens.

## TECHNICAL COMMENT SUMMARIES

### Middle Miocene Hominoid Origins

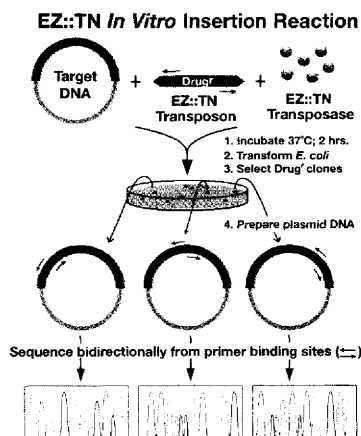
The full text of these comments can be seen at [www.sciencemag.org/cgi/content/full/287/5462/2375a](http://www.sciencemag.org/cgi/content/full/287/5462/2375a)

Drawing on fossil material from the Tugen Hills, north central Kenya, Ward *et al.* (Reports, 27 Aug.) identified a new Middle Miocene hominoid genus, *Equatorius*, that incorporates all material previously referable to *Kenyapithecus africanus* and that may cast new light on the origin of the great ape-human clade. Begun argues that the samples attributed to *Equatorius* cannot be reliably distinguished from the Eurasian genus *Griphopithecus*, and that the biogeographic pattern marked by the fossil record suggests that "African Middle Miocene hominoids represent successive radiations of forms dispersing from Eurasia." Kelley *et al.* respond that *Equatorius* and *Griphopithecus* differ in some key details of dental morphology and question Begun's "out-of-Eurasia hypothesis" in light of imprecise fossil age dating and the lack of Eurasian Early Miocene catarrhine lineages.

Separately, Benefit and McCrossin suggest that Ward *et al.* included in the *Equatorius* hypodigm two genera—*Nacholapithecus kerioi* and *K. africanus*—that differ in their morphologies, adaptations, and relationships with other hominoids. The samples analyzed by Ward *et al.*, Benefit and McCrossin conclude, may represent not a new hominoid genus but a combination of *Kenyapithecus* and *Nacholapithecus*. Kelley *et al.* acknowledge the separate taxonomic status of *N. kerioi*, but stress that "the material now included in *Nacholapithecus* did not contribute to the formal diagnosis of *Equatorius*." Thus, they argue, "differences between *N. kerioi* and '*K. africanus*'... have no bearing on the validity of *Equatorius*, other than to better characterize the distinctiveness of the latter."

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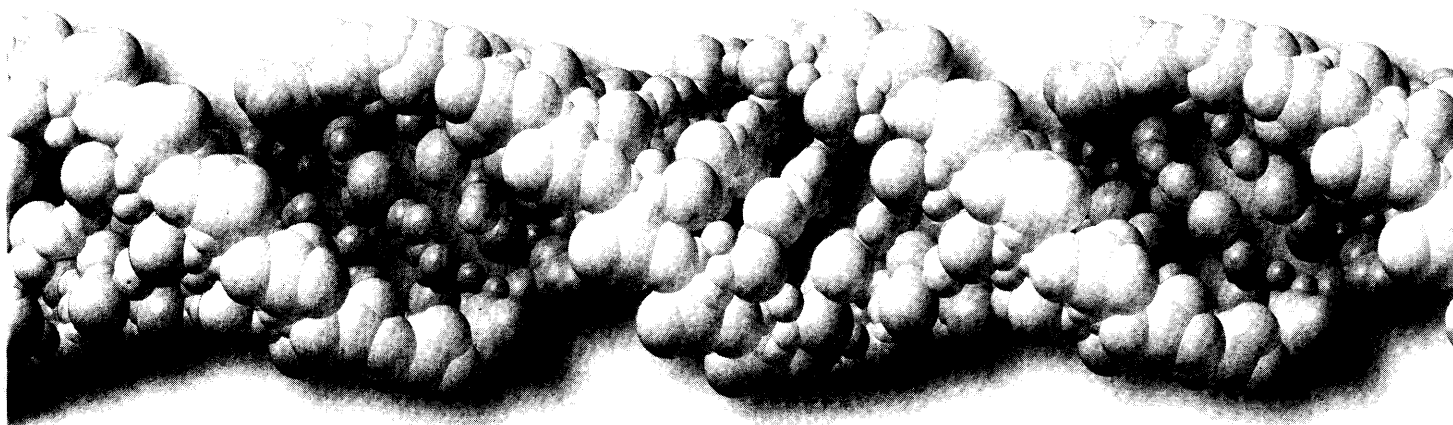
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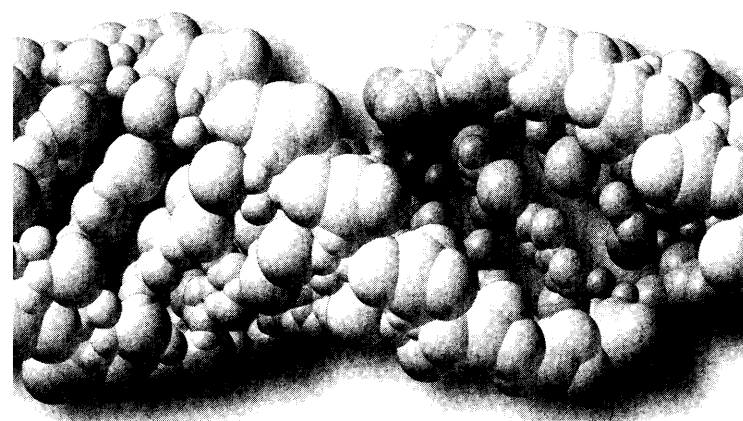
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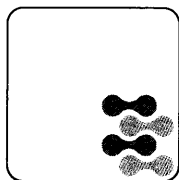
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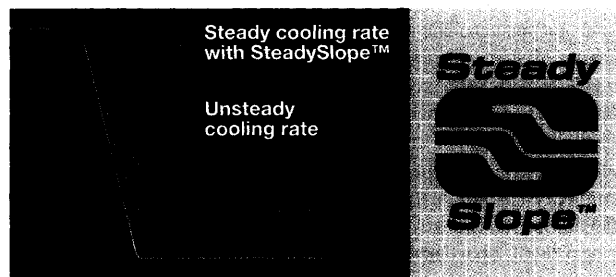
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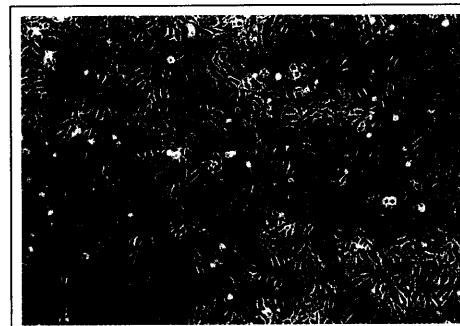
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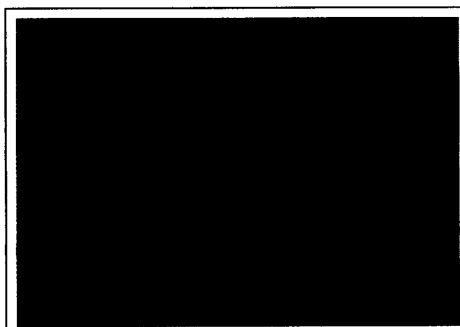
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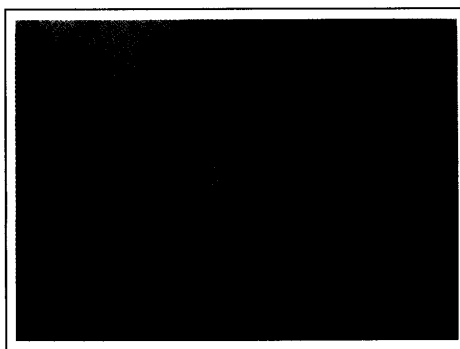


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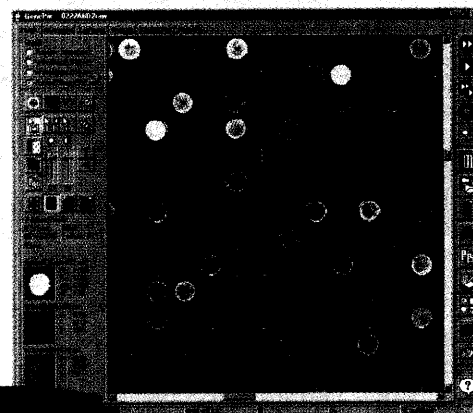
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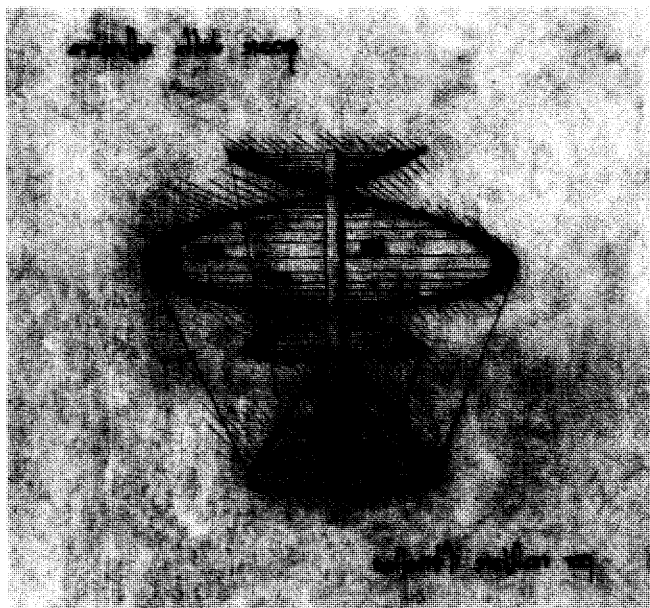
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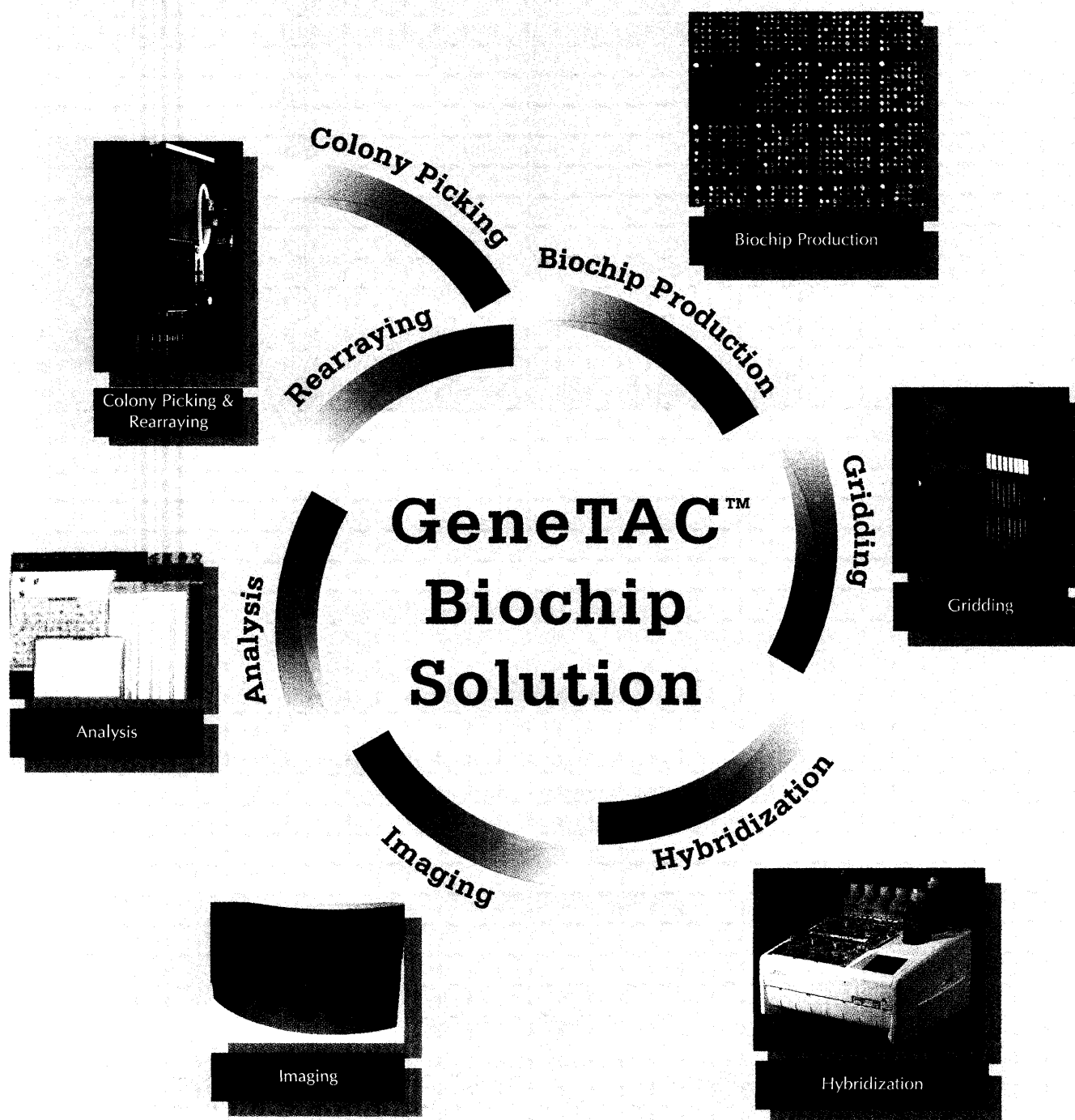
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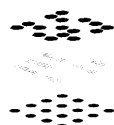
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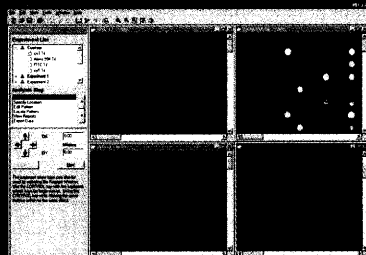
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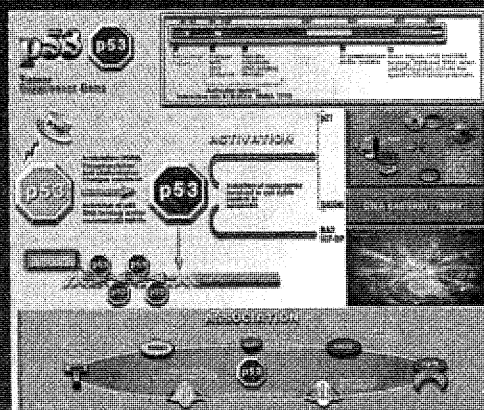
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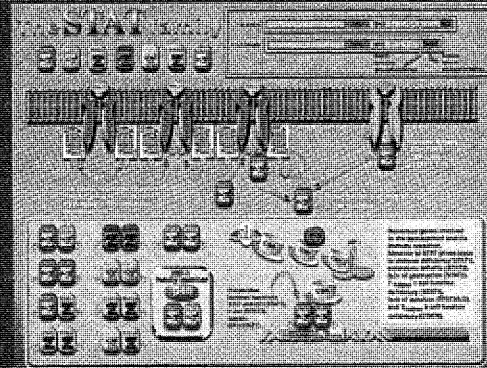
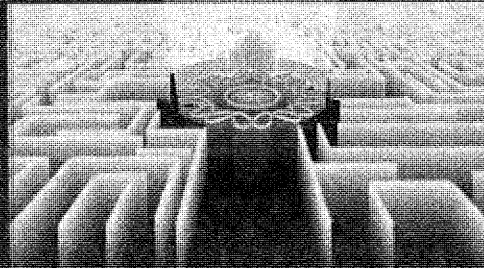
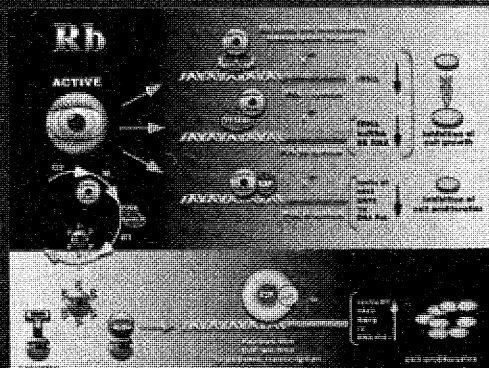
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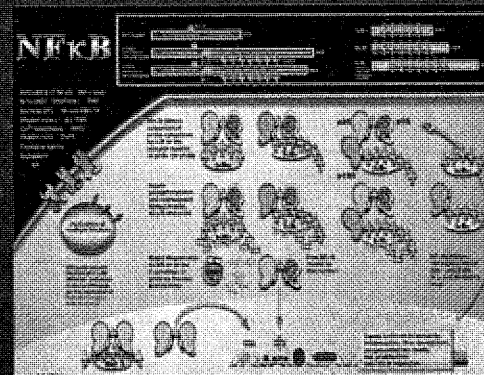
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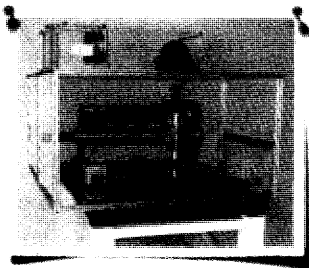


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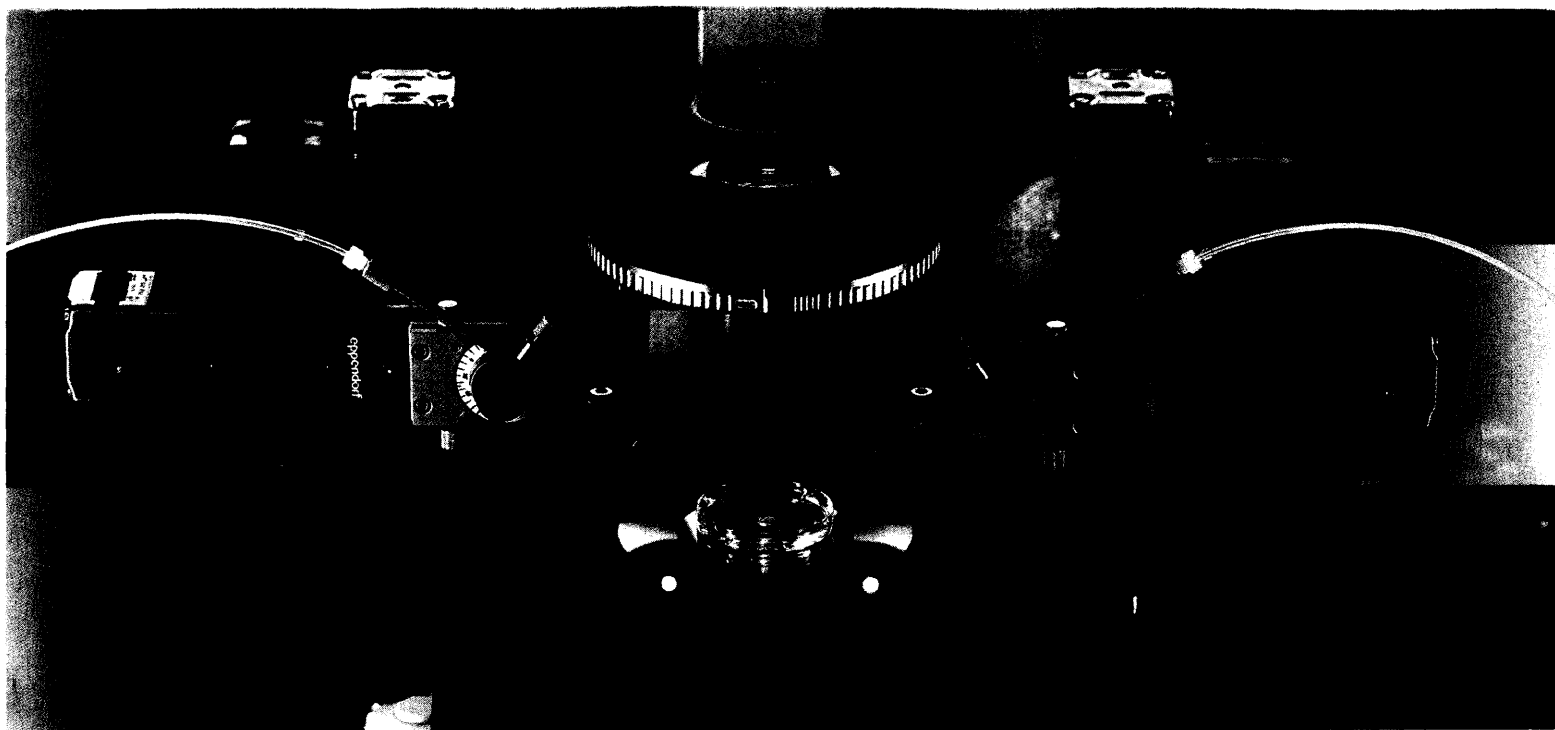
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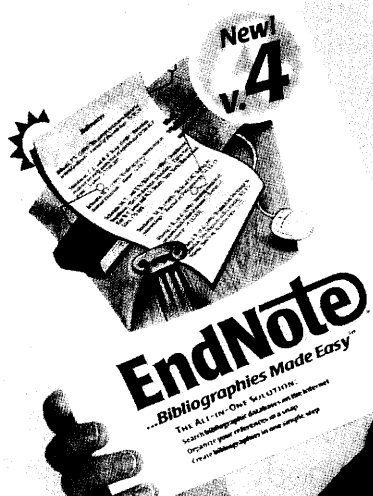
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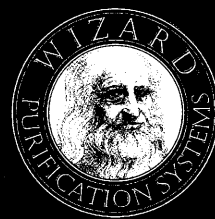
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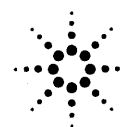
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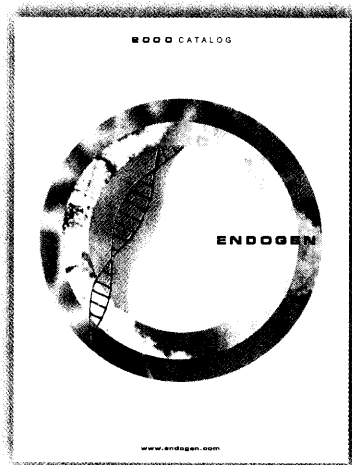
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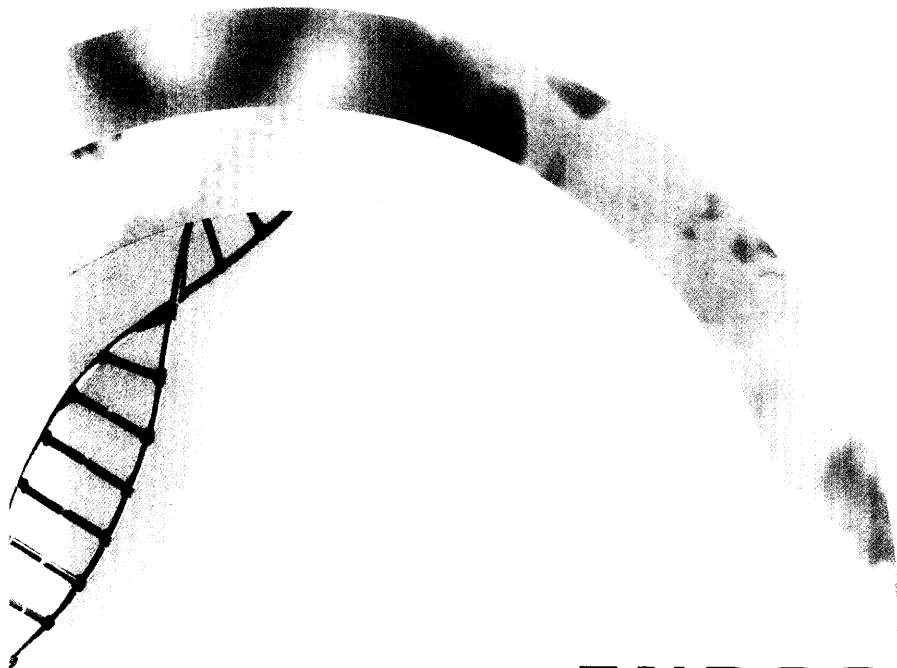
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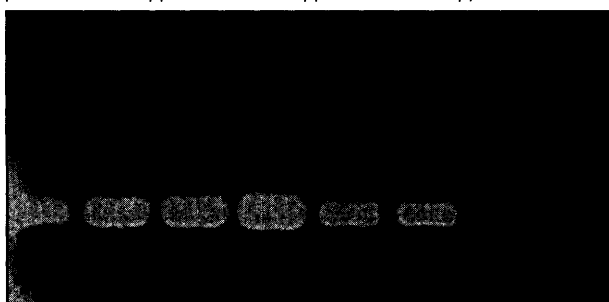
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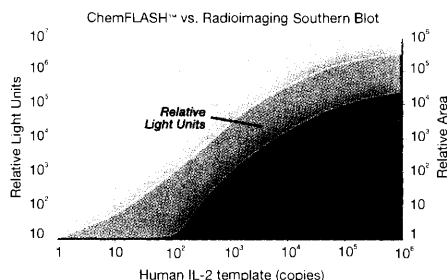
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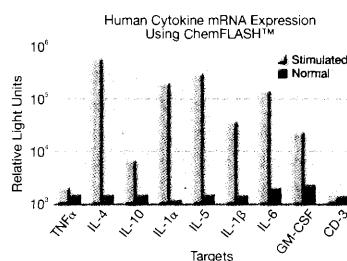
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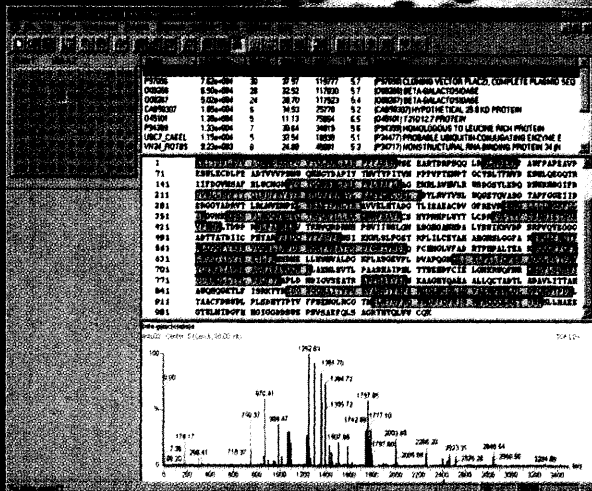
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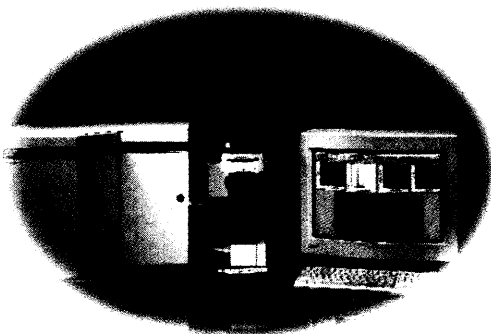
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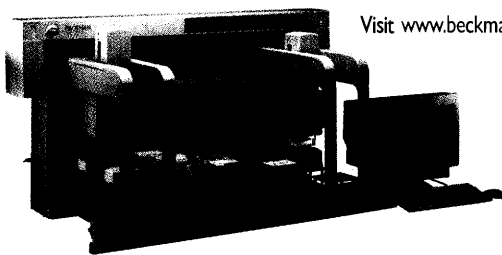
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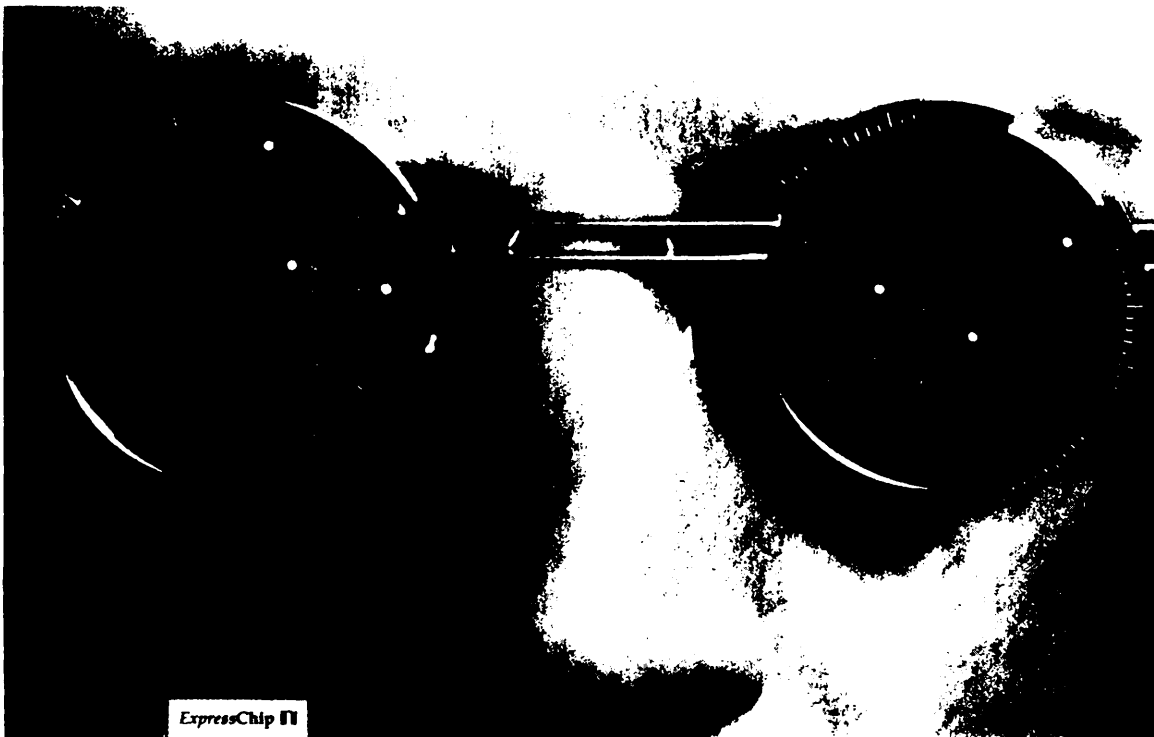
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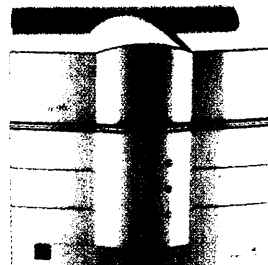
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The hTERT-RPE1 Cell Line is a human retinal pigment epithelial (RPE) cell line that stably expresses human telomerase reverse transcriptase (hTERT). The expression of hTERT in primary RPE cells allows them to grow indefinitely while remaining phenotypically and functionally normal. The hTERT-RPE1 cells divide at the rate of young primary cells—even after 300 doublings. The hTERT-RPE1 Cell Line can be used in place of primary or transformed cell lines for long-term studies of biochemical and physiological aspects of cell growth. Because primary cells divide only

### CLONTECH Laboratories

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CONTINUED ON PAGE 2506

# DNA Isolation

**DNazol**

**DNazol ES**

**DNazol BD**

**BACTOzol**

41-0000 Fax 41-0000

20 to 100 times before they reach senescence and immortal transformed cells tend to be genetically unstable and exhibit abnormal gene expression profiles, hTERT-RPE1 cells are an attractive alternative for cell-based assays.

### ULTRAVIOLET CURING DEVICES

Two types of comprehensive ultraviolet (UV) spot curing systems are available.

#### Xenon

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The XLS 240 is a continuous wave, mercury unit that features microprocessor settings for controlled, repeatable cures. It is suitable for high-intensity, small-area UV curing applications.

The RC 250 is for challenging curing applications requiring pulsed UV. The XLS 240 is housed in a sturdy

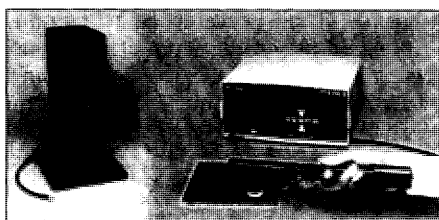
cabinet with a tower configuration that allows the unit to be removed from its base and wall mount. The RC 250 high-intensity pulsed system is a hand-held spot curing system with a cure area up to 1 inch by 2.5 inches. It can accommodate one or two light guides and is suitable for field use.

### MICROAEROBIC WORKSTATION

The VA500 atmosphere-controlled workstation permits the isolation and study of microaerophilic organisms such as the human pathogens *Campylobacter* and *Helicobacter pylori*. It provides up to four gasses to be combined under microprocessor control to provide a suitable culture environment for these organisms. The VA500 is part of a family of gloveless, atmosphere-controlled microbiological workstations offering a modular and upgradeable approach for anaerobic and microanaerobic applications. The low-maintenance design requires only annual catalyst removal when used as an anaerobic workstation.

#### Microbiology International

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### LITERATURE

*2000 Guide to Products and Services* is a 60-page guide that describes more than 100 Murine Pathogen Free (MPF) rats and mice and includes 16 new traditional and transgenic models. It includes descriptions for all Taconic MPF animals, including origin and profile. An exciting new model is the combination knockout and microinjected CD4 "humanized" model. New Traditional Models include outbred rhino and inbred SJL mice. There are also details of Taconic's Special Breeding Services for transgenic mice that provide investigators with the ability to define a health and genetic profile for their own line of rats and mice.

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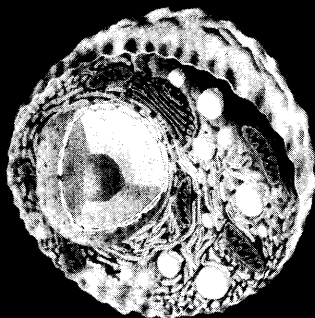
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## Scientific Integrity

An Introductory Text with Cases, 2nd Edition

Author: Francis L. Macrina, Virginia Commonwealth University

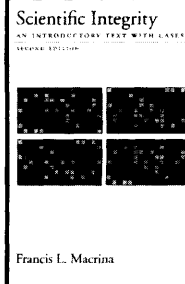
The first edition of this best selling title has been adopted at numerous institutions as a text for teaching responsible research conduct. Significantly revised and refined based on the experience gained from its use in the classroom, *Scientific Integrity, 2nd Edition* once again is the definitive single source for teaching this important topic.

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