

A detailed electron micrograph of a mitochondrion, showing its characteristic internal structure. The outer membrane is smooth, while the inner membrane is highly folded into cristae, which are visible as dark, parallel lines. The matrix is the lighter, granular interior. The surrounding cytoplasm contains various other organelles and vesicles.

Science

5 March 1999

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Mitochondria



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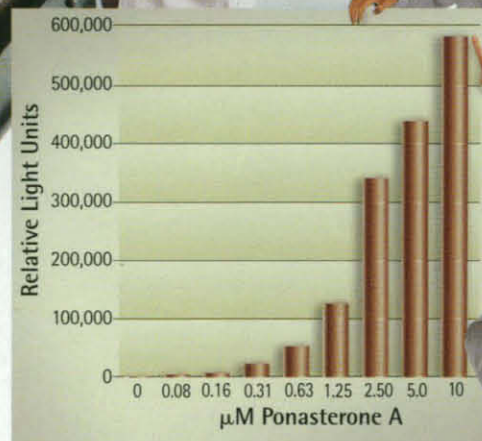
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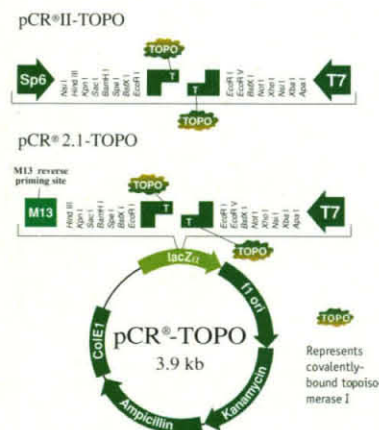
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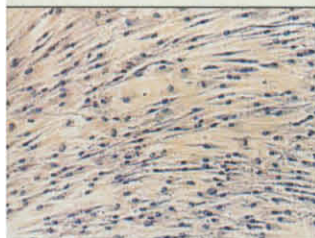
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COVER Pancreatic cell mitochondrion (~2 micrometers in length). This classic image, captured by pioneering electron microscopist Keith R. Porter (1912–1997), reveals the organelle's highly folded inner membrane. Interest in mitochondria, the cell's "powerhouse," has been invigorated by new discoveries relating to their role in cell death, human disease, evolution, and energy metabolism (see the special section beginning on p. 1475). [Image: K. R. Porter/Photo Researchers, Inc.]



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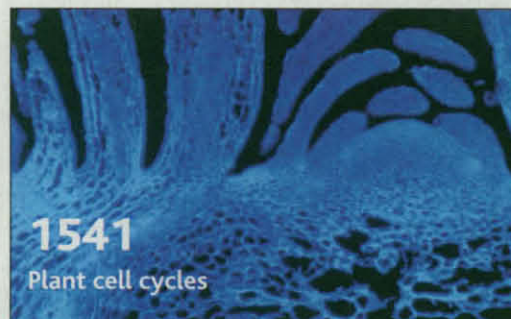
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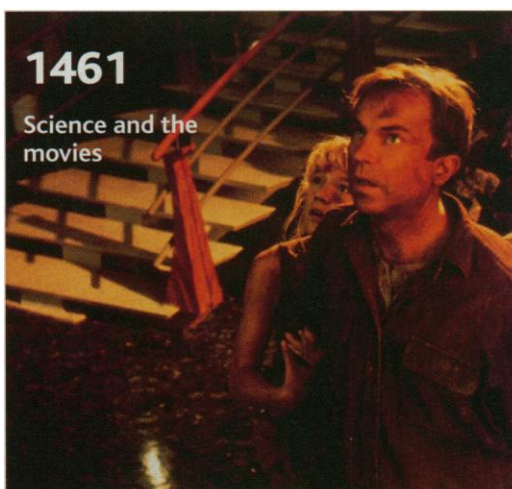
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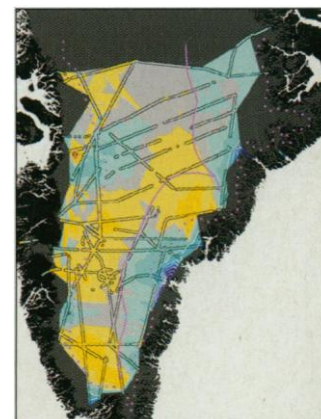
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Greenland ice creeping away

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INCIDENTALLY POROUS

Amorphous solid water (ASW), a metastable phase of water that forms at low temperatures, is believed to be abundant in astrophysical environments and has also attracted attention as a model system for supercooled liquids. Its formation and properties depend strongly on deposition and annealing conditions. Stevenson *et al.* (p. 1505) report a new twist: Decreasing the incident angle at which water molecules arrive at the surface during growth to more glancing angles creates a highly porous material. Discrepancies in density and surface area measurements in previous studies may be resolved by these measurements.

FROM WOBBLES TO WALLOP?

The Yarkovsky effect is a subtle thermal radiation force that perturbs the orbit of a spinning object because of its nonuniform surface temperature. Although it has been assumed that this effect is negligible for the orbits of asteroids and planets, orbital dynamic simulations by Farinella and Vokrouhlicky (p. 1507) performed on objects with radii between 1 to 10 kilometers show that the Yarkovsky effect can alter the semimajor axes. Such small perturbations may push asteroids into orbits where other forces initiate larger perturbations that eventually transport asteroids into Earth-crossing orbits.

CARBON-BASED QUARTZ

Quartz contains tetrahedra of oxygen atoms covalently bonded to silicon. Iota *et al.* (p. 1510) have synthesized a quartz-like polymorph of carbon dioxide (CO₂). Liquid CO₂ was laser heated to 1800 kelvin and pressurized in a diamond anvil cell to 40 gigapascals. The recognition of a transition of a simple molecular species, CO₂, to an extended, covalently bonded phase is unexpected and may fundamentally alter ideas about simple molecular oxide chemistry. The quartzlike CO₂ may also have useful applications because of its high thermal conductivity and high energy density.

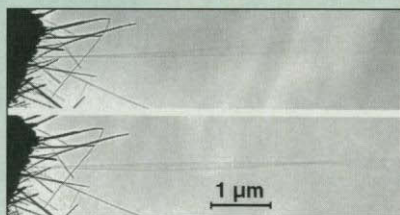
NOW YOU SEE IT ...

Whether the Antarctic and Arctic ice sheets are actually increasing or decreasing in size remains a subject of debate; it is also of crucial importance to global climate change and future sea-level changes. Altimetry surveys measure the elevation across the ice sheet and thus capture the entire volume of the ice sheets at different

times, but such data are limited. For example, satellite techniques are useful only for determining elevations above about 1700 meters. In 1998, Krabill *et al.* (p. 1522) performed an altimetry survey from aircraft of the Southern Greenland Ice Sheet, which resurveyed the same flight lines flown in a 1993 survey. Comparison of the two data sets indicates that thinning and thickening of the ice sheet depends on altitude and location, but that the overall mass balance is negative—the ice sheet is diminishing.

SHAKE YOUR NANOTUBE

One measure of the mechanical strength and response of an object is its resonant frequencies (as exemplified in the resonant failure of the Tacoma Narrows Bridge). Poncharal *et al.* (p. 1513) have now imaged resonances of carbon nanotubes. The nanotubes were mounted in a transmission elec-



tron microscope (TEM) so that they could be charged, and a time-dependent electric field was used to apply an oscillatory force. The deflections, including first and second harmonic resonances, could be imaged with the TEM. The elastic bending moduli decreased an order of magnitude as the tube widths increased from 8 to 40 nanometers. Nanoparticles could be attached to the end of the nanotube and their mass determined from the change in resonant frequency.

LONG-TERM GROWTH

The formation of the continents and the oxidation of Earth's atmosphere both affected the recycling of certain elements back into the mantle. Hence, the history of continent formation and atmospheric evolution might be inferred from the accumulation or depletion of these elements in the mantle over time. Collerson and Kamber (p. 1519) examined thorium, uranium, and niobium in volcanic rocks believed to be derived from the mantle since 3.8 billion years ago. The data imply that conti-

nents grew variably with time and that Earth's atmosphere became significantly oxidized about 2.0 billion years ago.

FAULT FINDING

Earthquakes on blind thrust faults, so named because they do not extend to the surface, have been responsible for much recent damage in the Los Angeles area, but their hazard potential has been difficult to assess. Shaw and Shearer (p. 1516) used a new seismic velocity model for the Los Angeles Basin and data from drill cores in the region to map the extent of a major blind thrust fault in the basin. The fault they found was responsible for the Whittier Narrows Earthquake in 1986 (magnitude 6.0). The extent of the fault implies that it could be associated with a larger earthquake.

A REDUCING PLAN FOR LIFE

Making and breaking bonds to carbon is central to the chemistry of life. A critical step in the current scenarios of the evolution of biomolecules is the replacement of the ribose 2'-hydroxyl with a hydrogen, which converts a ribonucleotide into a deoxyribonucleotide. Logan *et al.* (p. 1499) describe the structure of a class III ribonucleotide reductase (RNR), an enzyme that uses a glycine-derived free radical to accomplish this difficult chemical step. On the basis of structural homologies to other RNR classes and to other radical reactions involving simple metabolites, they propose that this enzyme may be the closest extant ancestor of the original reductase.

MIMICKING OXYGEN EVOLUTION

Plants and cyanobacteria generate O₂ through photosystem II at the oxygen-evolving complex, which contains a cluster of four manganese (Mn) atoms bridged by oxygen atoms. Limburg *et al.* (p. 1524) have now synthesized a small complex, in which two Mn atoms are bridged by two oxygen atoms that mimic O₂ evolution. Although NaOCl must be used as the oxidant to drive this reaction, labeling studies show that water is the source of oxygen atoms in the O₂ produced.

"JUNK" VEHICLES STILL RUNNING

Most of the sequences composing the human genome have been termed "junk" DNA because these sequences do not encode functional genes. Instead, they contain elements such as introns, repeats, and transposons. Moran *et al.* (p. 1530; see the Perspective by Eickbush) have examined

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THIS WEEK IN SCIENCE

CONTINUED FROM PAGE 1413

the most abundant retrotransposons, the long interspersed nuclear elements (L1s). Here, they report that L1s can retrotranspose into transcribed genes, they can mobilize 3' flanking DNA into new genomic locations, and they can generate new genes by exon shuffling. Hence, L1s represent a vehicle for genome evolution.

STICKING BY MIMICKING

The yeast *Candida albicans* opportunistically severely infects some immunocompromised patients, and filamentous forms can embed themselves in host tissue. Staab *et al.* (p. 1535) show that a surface protein of the yeast's hyphae, Hwp1, can serve as a substrate for mammalian transglutinases, which cross-link epithelial cell proteins to create the keratinized barrier layer. Yeast lacking Hwp1 could not attach stably to human buccal cells and were less able to cause systemic candidiasis in mice.

NONLINEAR FISH DYNAMICS

The relation between egg production, larval supply, and recruitment is important but currently opaque to fisheries assessors and population ecologists alike. Now Dixon *et al.* (p. 1528), using biological and physical oceanographic time series, demonstrate a distinct nonlinear signature in the larval record of an Australian reef fish and identify wind turbulence as a critical nonlinear factor affecting larval survival. This case study illustrates how the use of nonlinear techniques and a top-down systems approach can shed light on a natural system.

REVEALING ROTÉ'S ROOTS

One popular method for learning new facts is to use repetition to increase familiarity; another is to use an aide-mémoire, where something familiar is asso-

ciated with the new item, like a string tied around the finger. The expected neural correlates of these methods are that brain-processing effort would diminish as the fact became familiar and that brain processing in two regions would become more tightly connected as the association was learned. Büchel *et al.* (p. 1538) used functional brain imaging to find both of these correlates and to observe that the rate of learning was reflected in the increase of connection strength.

MAKING PLANTS GROW

Cell proliferation is one of the responses to the plant hormone cytokinin. Riou-Khamlichi *et al.* (p. 1541) found that cyclin D3 is part of the early molecular response to cytokinin. Thus, development and senescence, phases that are coordinately regulated by hormonal control of cellular proliferation, may both depend on cyclin D3.

ESCHEWING THE FAT

Can animals eat a high-fat diet and still resist weight gain and loss of sensitivity to insulin? Elchebly *et al.* (p. 1544; see the news story by Ferber) report that mice in which the gene encoding protein tyrosine phosphatase-1B (PTP-1B) has been disrupted can indeed do so. PTP-1B inhibits insulin signaling, possibly by dephosphorylating the insulin receptor. Mice lacking the phosphatase had enhanced insulin sensitivity in muscle and liver but not in adipose tissue. When fed a diet high in fat, mice heterozygous for the disrupted allele and those completely lacking PTP-1B were both resistant to weight gain and protected from loss of insulin sensitivity. PTP-1B, thus, may represent an effective target in the development of therapies for obesity and type 2 diabetes.

TECHNICAL COMMENT SUMMARIES

Polarized Stellar Light

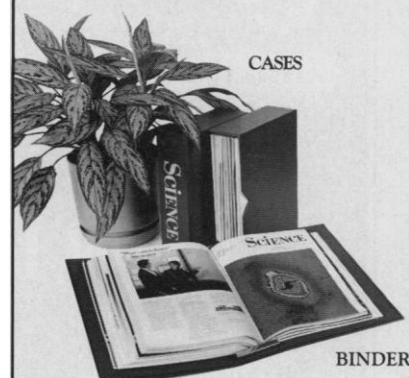
J. Bailey *et al.* (Reports, 31 July, p. 672) stated that "circular polarization at shorter wavelengths might have been important in inducing chiral asymmetry in interstellar organic molecules that could [have been] subsequently delivered to the early Earth by comets, interplanetary dust particles, or meteors."

E. Rubenstein *et al.* comment that circular polarization can also occur in high-frequency radiation that is "emitted along the axis parallel to the magnetic field." They state that "optical synchrotron radiation from the Crab Nebula has been observed ... [and] circularly polarized ultraviolet synchrotron radiation must also be present."

In response, Bailey states that the situation described in the comment is correct "only for low electron energies ... In the highly relativistic case (synchrotron radiation), relativistic beaming means that radiation is not emitted parallel to the magnetic field."

The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/283/5407/1415a

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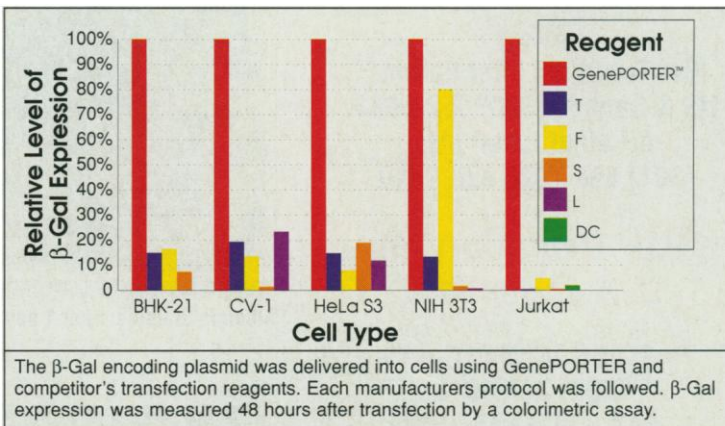
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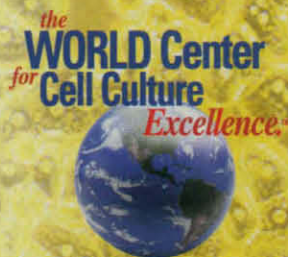
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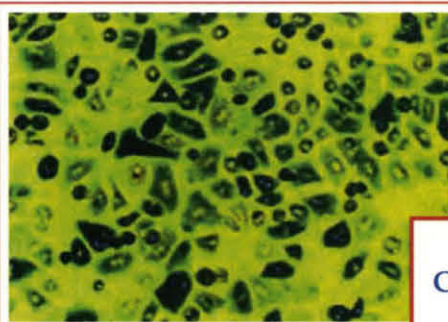
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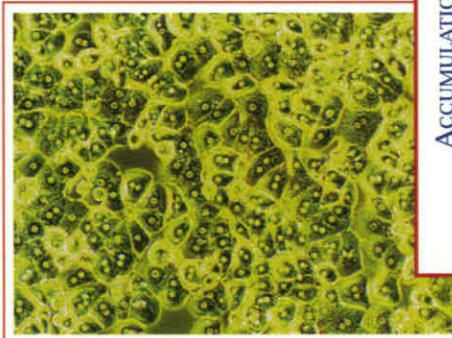
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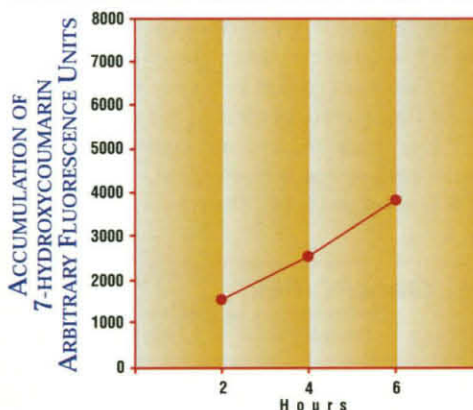


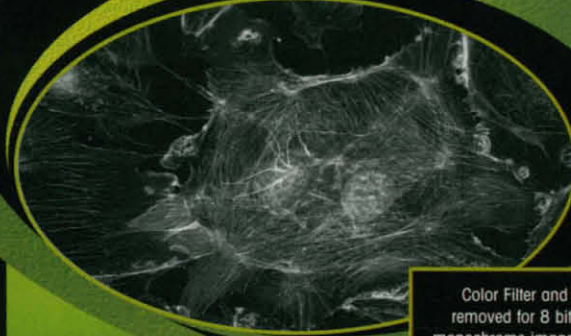
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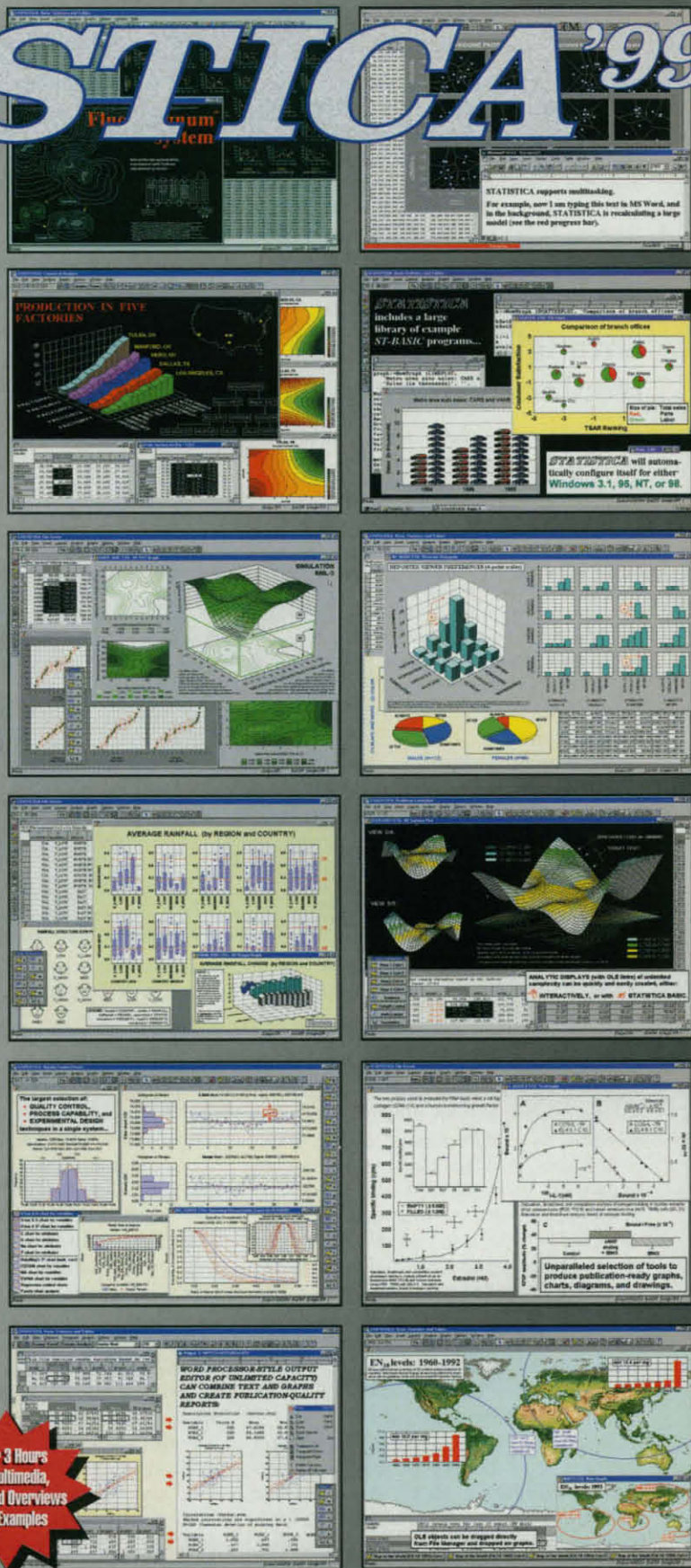
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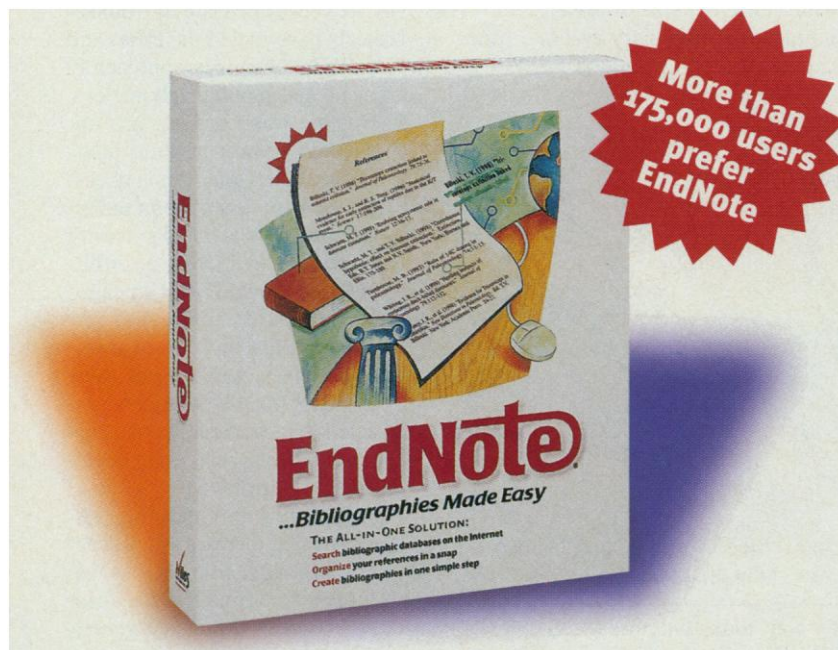
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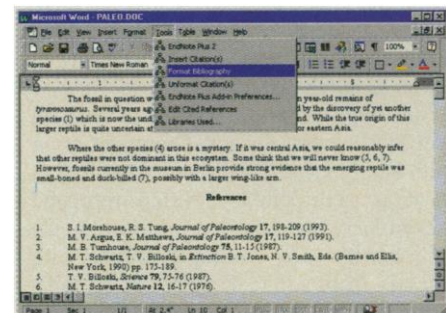


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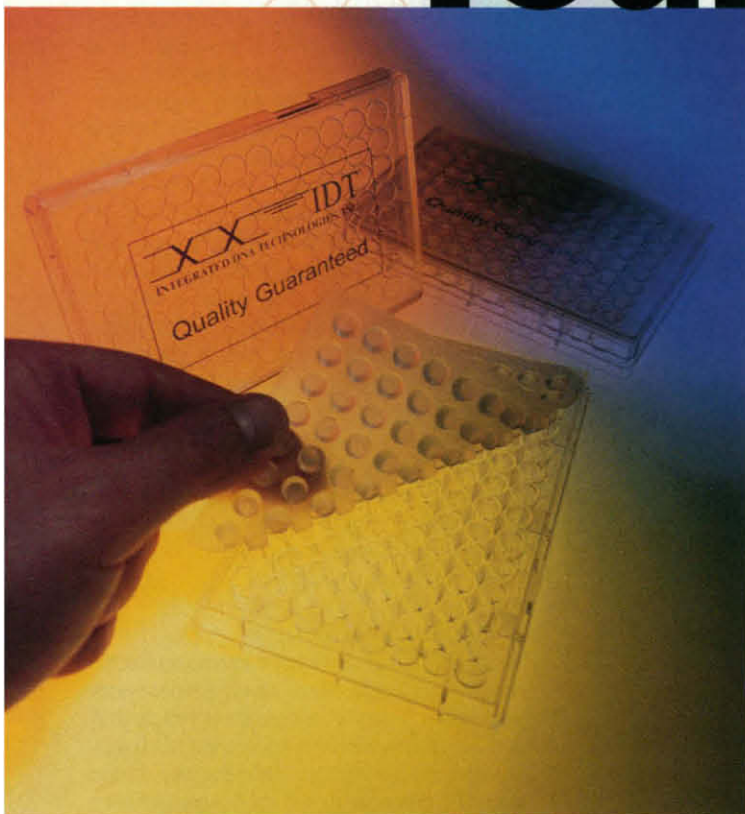
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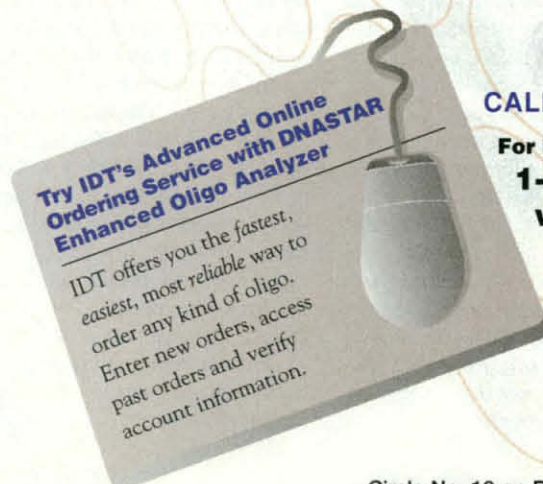
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The Mammalian Genotyping Service is funded by the National Heart, Lung, and Blood Institute to assist in linkage mapping of genes which cause or influence disease. Genotyping is carried out using short tandem repeat polymorphisms at Marshfield, Wisconsin under the direction of Dr. James Weber. Capacity of the Service is currently about 5,000,000 genotypes (DNA samples times polymorphic markers) per year and growing. Although the Service was initially established for genetic projects dealing with heart, lung, and blood diseases, the Mammalian Genotyping Service will now consider all meritorious applications.

To ensure that the most promising projects are undertaken, investigators must submit brief applications that are evaluated by a scientific advisory panel. At this time, only projects involving human, mice or rat samples, and only projects with $\geq 10,000$ genotypes, will be considered. There are no genotyping fees for approved projects. Application deadlines are every six months.

Upcoming Application Deadlines

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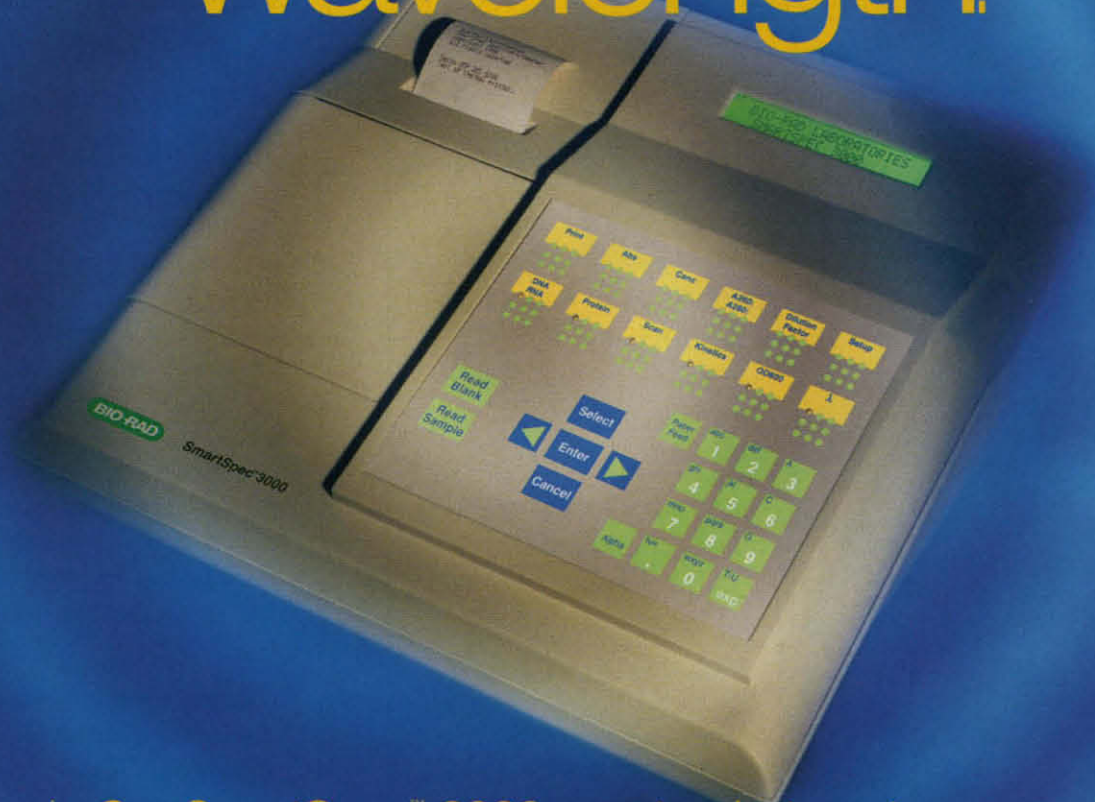
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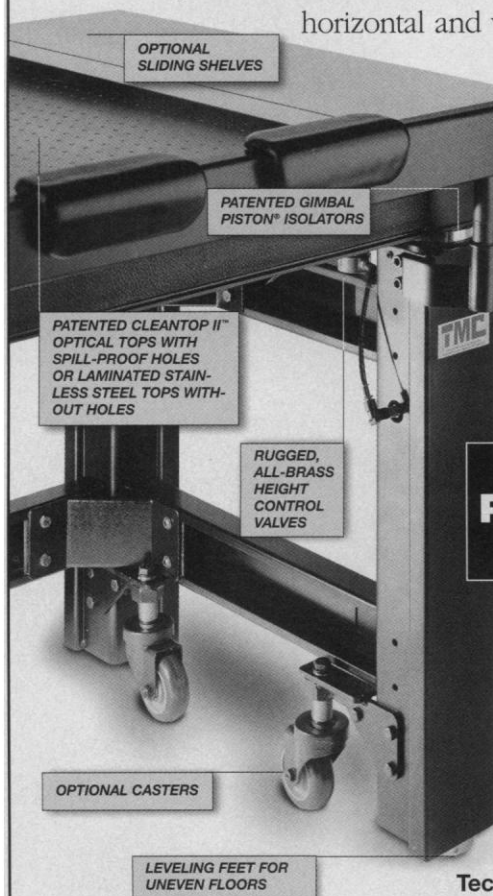
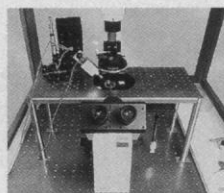
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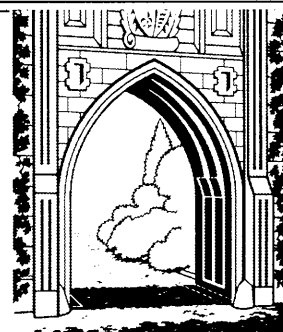
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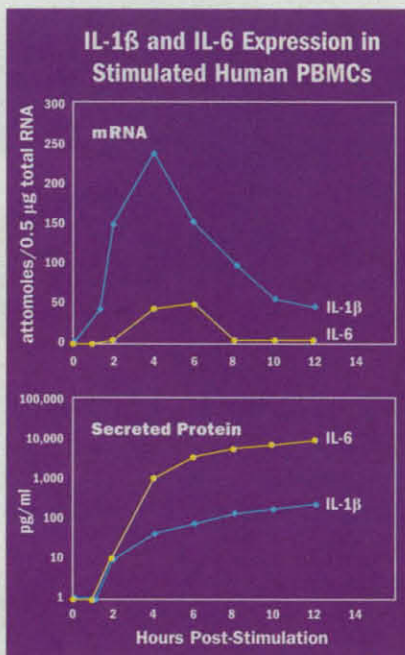
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COLLOQUIUM ANNOUNCEMENT

"AUTOMATION IN THREAT REDUCTION AND INFECTIOUS DISEASE RESEARCH: NEEDS AND NEW DIRECTIONS"

APRIL 29-30, 1999

THE NATIONAL ACADEMY OF SCIENCES AUDITORIUM, WASHINGTON, DC

Organizers Kumar Patel, Tony J. Beugelsdijk, Scott P. Layne

DESCRIPTION

To make headway in many problems in medicine and biology requires enormous quantities of laboratory-based data. The limiting factor often is the fact that humans, unaided, are not capable of generating such vast inventories of data. Today, for the first time, various scientific disciplines and powerful technologies can be brought together to level the playing field against a number of the important problems facing society.

The scientific side of the Colloquium will focus on the needs for measuring, detecting, and monitoring in areas such as: 1) recognizing and addressing established and emerging infectious diseases; 2) ensuring a safe food supply; 3) averting catastrophic bioterrorism and biowarfare; and 4) advancing human genetics and molecular medicine. The technological side of the Colloquium will focus on the various automation, robotic, computer, information, Internet, and microscale laboratory technologies that are available for supporting such scientific needs. The objective is to identify specific scientific needs, assess current research practices and their limitations, and then consider strategic ways for integrating new high-throughput laboratory tools and technologies.

- **Infectious Diseases.** As we move into the 21st century, infectious diseases will pose formidable challenges from a variety of directions. The Colloquium will therefore consider scientific needs for such infectious diseases as influenza, tuberculosis, HIV/AIDS, and other drug-resistant infections; and routes toward developing high-throughput laboratory resources that can accelerate basic science, clinical trials, and public health/epidemiology investigations throughout the world.

- **Food Supply.** Pathogenic food-borne infections are increasing in the U.S. and elsewhere, demanding stringent public health monitoring. The Colloquium will consider scientific needs for protecting the food supply and environment, and ways to engineer high-throughput laboratory resources for improving public health efforts.

- **Biowarfare and Bioterrorism.** The malicious release of hazardous infectious agents poses significant threats to national and global security. The Colloquium will consider the needs for conventional laboratory automation and the development and integration of newer microscale technologies for carrying out a broad range of activities.

- **Further Applications.** The Colloquium encourages participation and interest from a widespread scientific constituency. Its multidisciplinary approach entails broad-based participation from academic, governmental, and industrial sectors.

In addition, the two-day program of presentations and panel discussions has an educational component that should be of interest to policy makers. In order to facilitate tangible outcomes from the Colloquium, a "cross-cutting" approach will be emphasized. This approach recognizes that new tools and technologies from one scientific discipline can be carried over to others, and that the synthesis will result in synergy.

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SPEAKERS

INTRODUCTION

Kumar Patel, University of California, Los Angeles, CA

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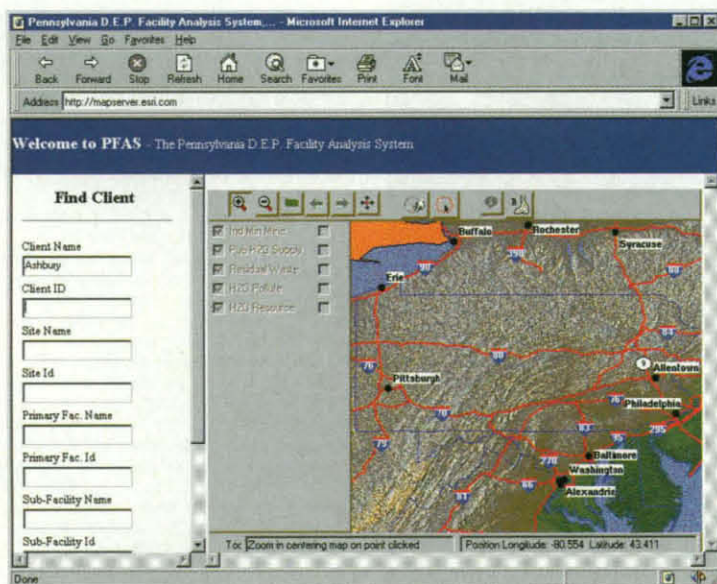
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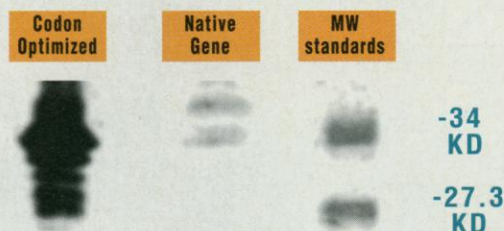

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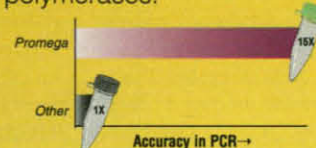
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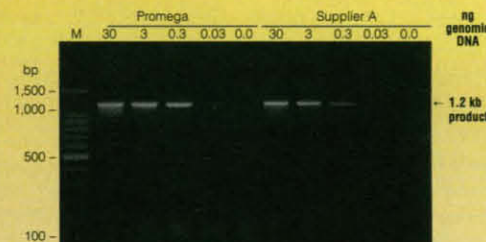
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