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# Science

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# Science

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**Cover** The head of an alligator snapping turtle (*Macroclemys temminckii*), about actual size. This heavily armored species resembles an alligator when partly submerged. The similarity has been thought to be the result of adaptive convergence. However, data from multiple genes now support an evolutionary link between turtles and crocodilians, challenging the long-held view that birds are the closest living relatives of crocodilians. [Photo: Wayne Van Devender]


## NEWS

**920**
Artists of the caves

### NEWS OF THE WEEK



### NEWS FOCUS



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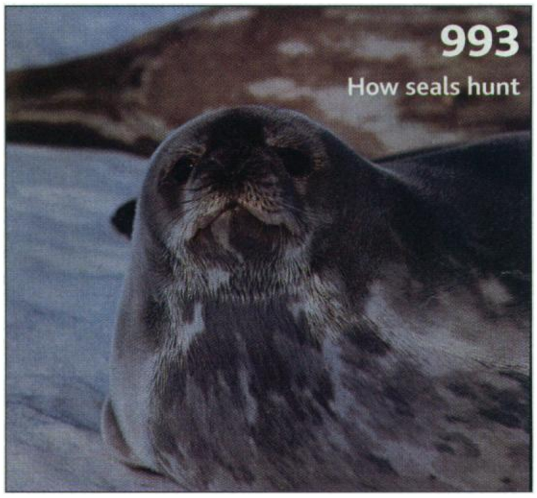




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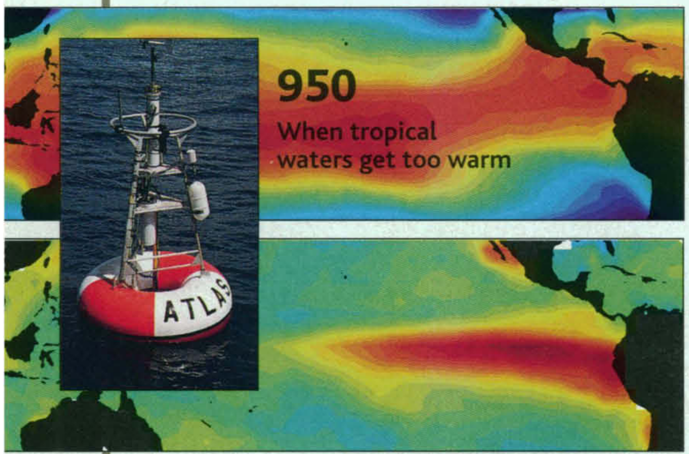


950
When tropical waters get too warm

### EDITORIAL



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### BOOKS *ET AL.*



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### REVIEW





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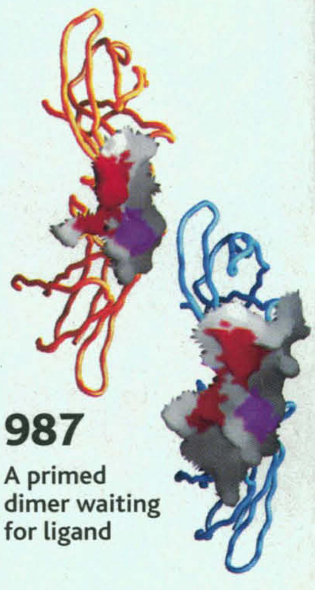

987
A primed dimer waiting for ligand

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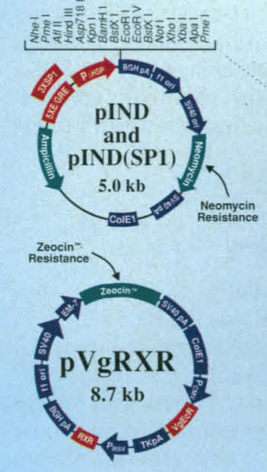


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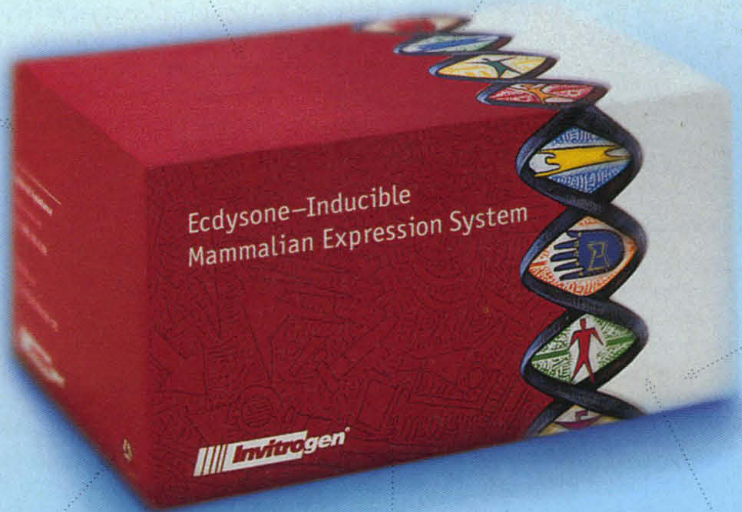


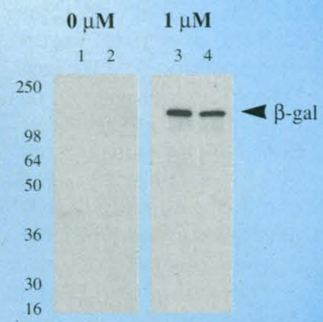


**INDUCE WITH PONASTERONE A OR MURISTERONE A**
CHO cells stably transfected with pIND(SP1)/Hygro/*lacZ*.
Lanes 1 and 2: Uninduced
Lane 3: Induced with Muristerone A
Lane 4: Induced with Ponasterone A

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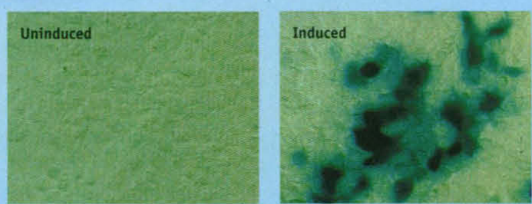


Uninduced and induced transiently transfected 293 cells stained with X-gal.

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### BIRTH OF A ZEOLITE

The process by which microporous zeolites are created instead of densely packed materials has been difficult to follow, especially under hydrothermal reaction conditions. Mintova *et al.* (p. 958) were able to visualize zeolite formation for synthesis with pore-directing templates at room temperature. Clear solutions allowed particle size distributions to be followed with light scattering, and low-dose, high-resolution transmission electron microscopy revealed the formation of zeolite particles within the precursor gel particles.

### POLYMER HEAVYWEIGHTS

Surfactants can be made by attaching short sections (tens of monomer units) of poly(ethyleneoxide) (PEO) to short chains of hydrocarbon polymers such as poly(butadiene) (PB). Won *et al.* (p. 960) now show that larger analogs (with about 50 monomer units in each block, with molecular weights in the thousands) assemble into long "wormlike" micelles in water at low concentrations (5% by weight). Free-radical polymerization stitches the micelle together through chemical cross-linking, which preserves their morphology but converts them from liquidlike to rubbery objects. Whereas typical synthetic polymers have molecular weights in the $10^6$'s, these single polymer molecules have molecular weights in the $10^9$'s.

### POLYMER PORES TO ORDER

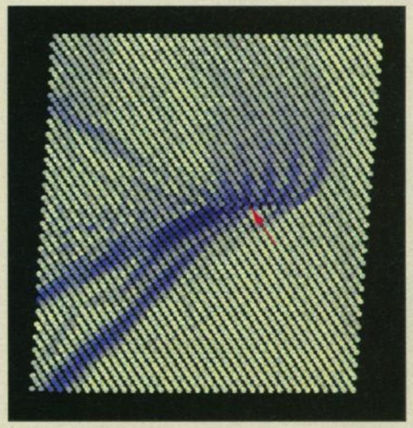
Nanometer-scale polymer particles have served as templates for porous inorganic materials. Now Johnson *et al.* (p. 963) show that silica particles can be fused into an ordered lattice and used as a template for making nanoporous polymers. A range of pore sizes can be tuned continuously (from 15 to 35 nanometers) by using mixtures of polymers—one that maintains the template spacing and one that shrinks after the template is removed. The "shrunken" polymers can then be used as templates to make smaller replicas of the original silica templates.

### UNSTABLE CLIMATE CONDITIONS

It has been shown that the last glacial period (approximately 100,000 to 20,000 years ago) was characterized by millennial-scale temperature variability as well as major iceberg discharges and faunal shifts. The amplitude of this variability was larger during the last glacial period than during the present interglacial. McManus *et al.* (p. 971) have analyzed marine sediments from the North Atlantic and show that similar variability occurred in the previous glacial and interglacial periods of the last 500,000 years, and that the variability tends to be greater in glacial than in interglacial periods. They propose a model in which threshold ice volume and sea-level conditions exist for high-amplitude climate variability. These conditions represent a relatively small departure from our present ice-sheet and sea-level conditions.

### SUPERSONIC DISLOCATIONS

When a material is deformed, dislocations form and move through it. Under normal deformation conditions, dislocation motion is determined by thermally activated processes and remains relatively slow, but under high strain they can speed up significantly.



According to elasticity theory, the speed at which they can move is limited by a characteristic sound barrier of the material. Theory also predicts a single supersonic state, but it has been unclear whether the sound barrier can be overcome to reach it. Gumbsch and Gao (p. 965) have performed molecular dynamics simulations of a moving edge dislocation in a crystalline solid. They show that if the dislocation is created while the material is under high-strain conditions, then the dislocation moves at high speed right after nucleation, overcoming the sound barrier. The dislocations can move at a range of velocities above the sound barrier rather than at a single supersonic velocity and require energy to be drawn from the applied strain field.

### POLAR STRATOSPHERIC CLOUDS

Ozone loss in the polar stratosphere is linked to the formation of polar stratospheric clouds (PSCs); reactions on their surfaces help catalyze ozone destruction. PSCs only form at the very low temperatures found in the polar spring. Insights into their phase and composition have been gained from indirect measurements both from the ground and aboard aircraft or balloons, as well as from laboratory studies and models, but direct chemical analysis has proved difficult. Schreiner *et al.* (p. 968) have used a recently developed analysis instrument aboard a balloon gondola to capture PSC particles and analyze them by mass spectrometry while the balloon was airborne. Insights into the particle composition provide important information that help test models of PSC formation.

### UNDERSEA ORE DEPOSITS

Major deposits of gold, silver, zinc, lead, and copper sulfides are found to be associated with basaltic (silica-poor) volcanoes and hydrothermal systems along mid-ocean ridges. Iizasa *et al.* (p. 975) now report the discovery of a similar polymetallic sulfide deposit associated with a large silica-rich, submarine volcanic center off the coast of Japan. The deposit is in the center of a large caldera at a depth of about 1400 meters below sea level. Submersible observations imply that mineralization may have kept up with deposition of volcanic ash in the caldera; even the exposed part of the ore makes it one of the largest known massive sulfide ore deposits. Other submerged volcanoes may host similar deposits.

### CELLULAR ENERGY AND INSULIN SECRETION

Control of the glucose concentration in blood is highly dependent on secretion of insulin from pancreatic β cells. Insulin release from these cells is sensitive to metabolism of glucose in the cytosol and mitochondria of these cells. Eto *et al.* (p. 981) studied this process in pancreatic islets in which they had eliminated the function of the shuttles that normally transfer NADH (nicotinamide adenine dinucleotide, which is generated by glycolysis in the cytoplasm) into mitochondria (where it promotes oxidative metabolism and generation of adenosine triphosphate). This shuttle system is required for

CONTINUED ON PAGE 903

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glucose-stimulated insulin release from pancreatic cells. Such findings raise the possibility that defects in the NADH shuttle system could contribute to non–insulin-dependent (type 2) diabetes.

### EXTENDED MEDIATORS

The protein complex Mediator is important for activated transcription by yeast RNA polymerase II. Mediator is composed of nearly 20 proteins. Asturias *et al.* (p. 985) used electron microscopy to determine the structure of Mediator alone or of its holozyme (its complex with the RNA polymerase II). Mediator alone is in a compact state, but in the holoenzyme it displays an extended state that embraces the polymerase. Similar structures were observed with the related mammalian complex.

### COPPER COFACTOR FOR THE ETHYLENE RECEPTOR

Gaseous signal molecules affect a range of physiological and developmental processes in plants and animals. Investigating the activities of the ethylene receptor in plants, Rodríguez *et al.* (p. 996) found that a copper ion serves as a critical cofactor. A similar protein in cyanobacteria, organisms thought to be related to the original precursors of plant chloroplasts, also binds ethylene. Comparison of the two proteins suggests a structure for the receptors.

### PROTEASOME PARTNER

Proteasomes degrade cellular proteins and thus contribute to the regulation of the life-span of many proteins and also provide a source of peptides for class I major histocompatibility proteins. Geier *et al.* (p. 978) found that mammalian cell lines contain another large structure in their cytoplasm that can degrade proteins. Fifty-nanometer-long rods comprised of only tripeptidyl peptidase II (TPPII) had both exo- and endoproteolytic activity. These complexes may contribute to the cell's survival when proteasomes are inactivated.

### POISED FOR ACTION

Erythropoietin (EPO) is a peptide hormone that regulates the growth of red blood cells. It acts by bridging the extracellular portions of two membrane-bound EPO receptors; the juxtaposition of the cytoplasmic portions leads to activation of an intracellular phosphorylation pathway. Livnah *et al.* (p. 987) describe the crystal structure of an unliganded dimer of the EPO receptor in which many of the interfacial contacts are those that would normally be used to bind EPO. In this dimer, the intracellular domains point away from each other. Could this inactive dimer exist on the surfaces of intact cells, exquisitely responsive to the low circulating concentrations of EPO? Remy *et al.* (p. 990) present evidence for these preformed dimers by measuring the separation of the intracellular domains with an assay for recovery of enzyme activity.

### A'HUNTING DOWN BELOW

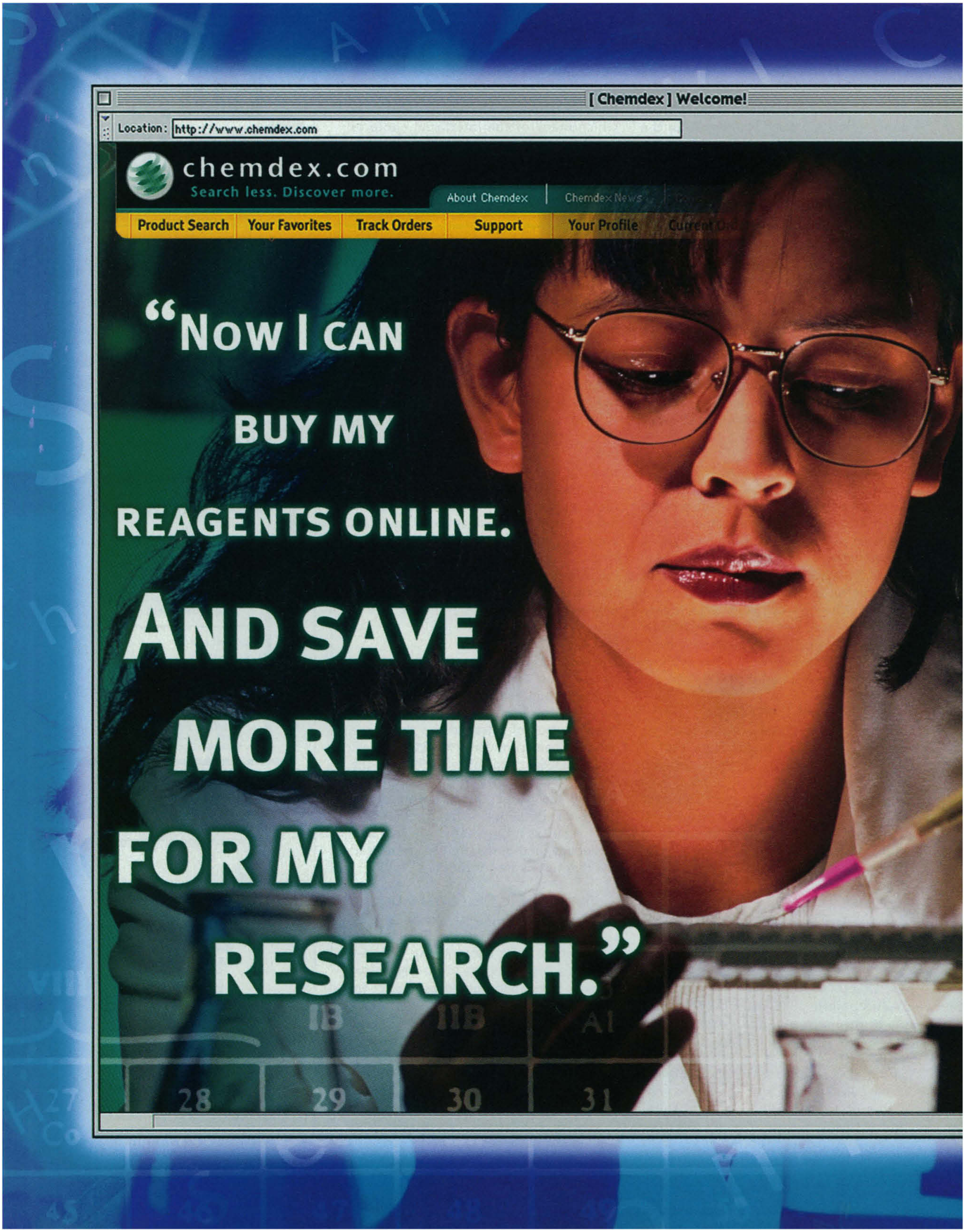
Little is known about the hunting behavior of marine mammals, particularly in the inhospitable depths of the Antarctic. To shed light on the subject, Davis *et al.* (p. 993) have developed a near-infrared–based video observation system. Attached to the backs of Weddell seals, the system records video images of the seal's head and immediate environment while data loggers record time, depth, water speed, compass bearing, flipper stroke frequency, and sound. This approach to data acquisition could lead to a better understanding of the navigation and foraging behavior of large marine predators.

### THE TURTLE'S PLACE

The phylogeny of reptiles and their relation to birds have been poorly resolved. Of the reptiles, the placement of turtles has been particularly problematic and important for the evolution of tetrapods, as they have generally been considered to be the earliest reptiles. Hedges and Poling (p. 998; see the cover and the Perspective by Rieppel) present an analysis of a variety of molecular data on all of the major groups of reptiles. The results imply that turtles and crocodiles (and birds) are closely related and that turtles are not the basal reptile.

### OVERCOMING DIMER DAMAGE

Thymine-thymine dimers are mutagenic lesions in DNA that are induced by ultraviolet radiation. Upon encountering these lesions in a DNA template, most DNA polymerases stop replicating. Johnson *et al.* (p. 1001) have discovered a new DNA polymerase in yeast, encoded by the *RAD30* gene, that copies past these lesions at remarkable efficiency, apparently by inserting the correct nucleotides (adenines) opposite the dimers. This enzyme, DNA polymerase ε, represents another potential mechanism by which cells can protect themselves from environmentally induced DNA damage.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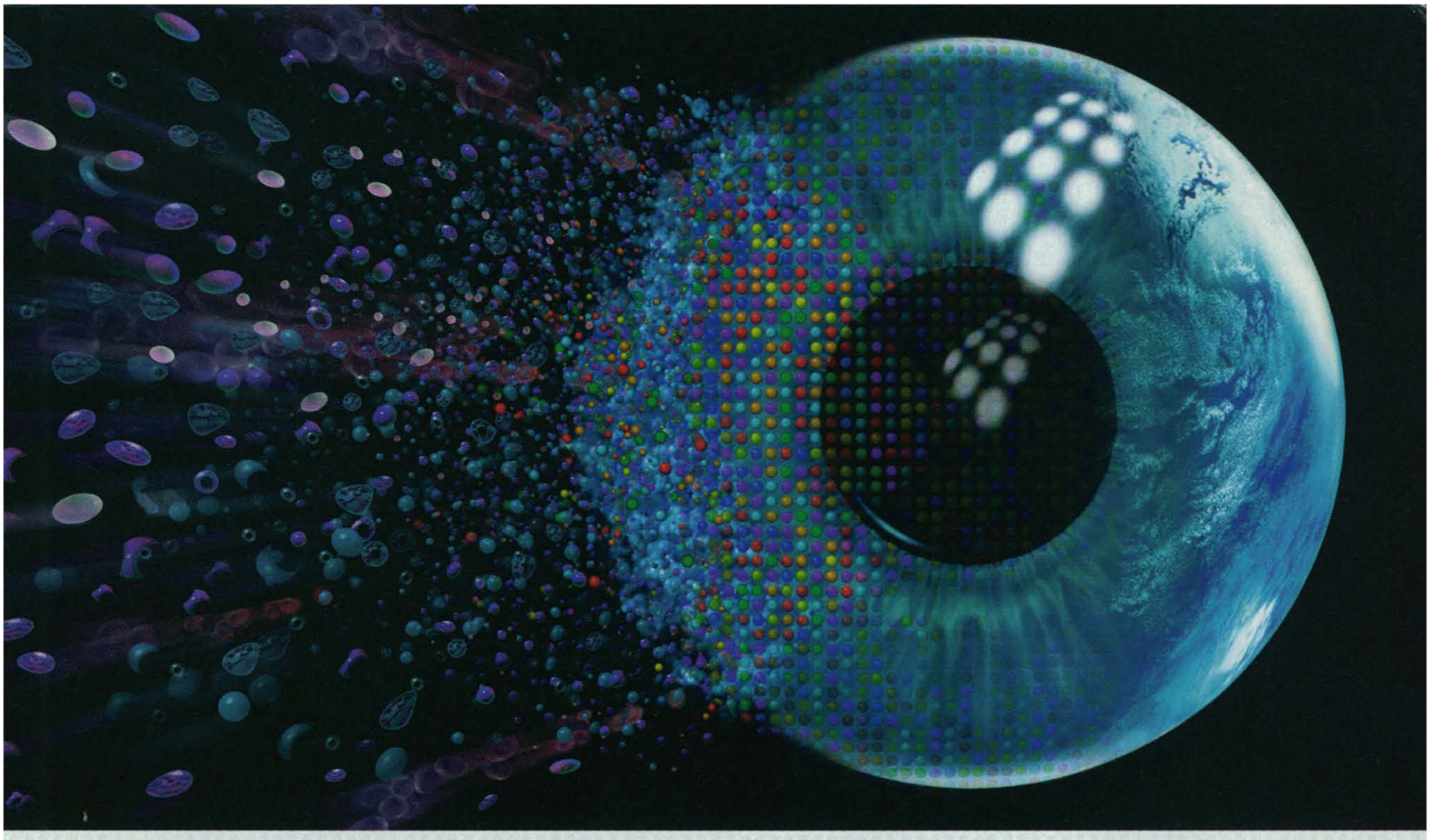

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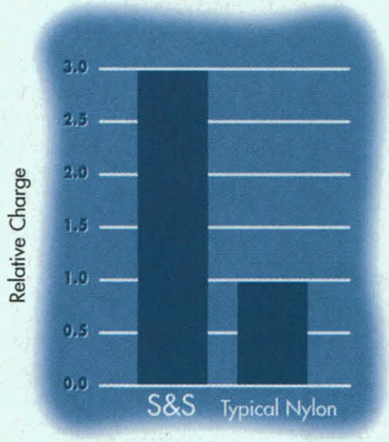


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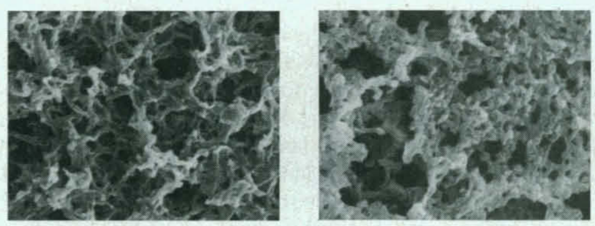

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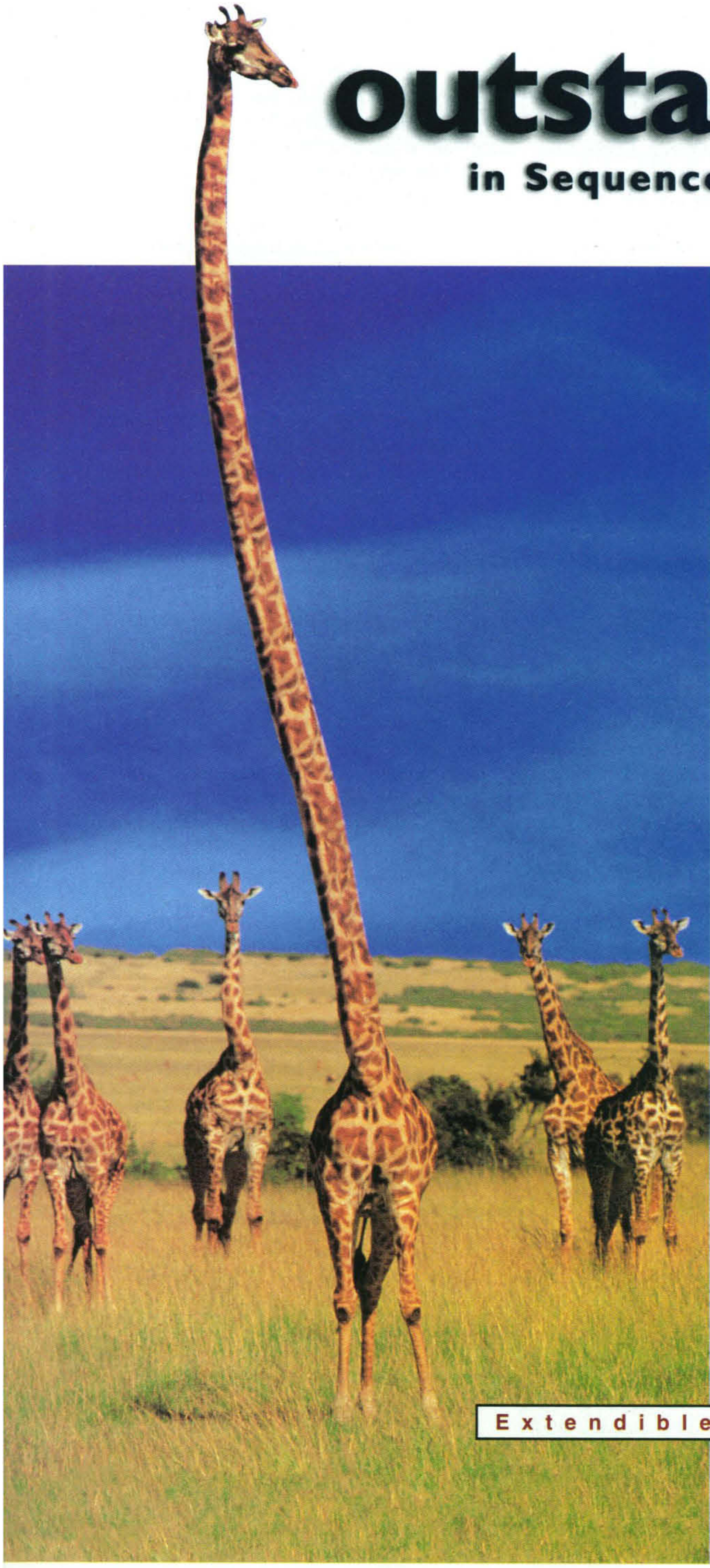

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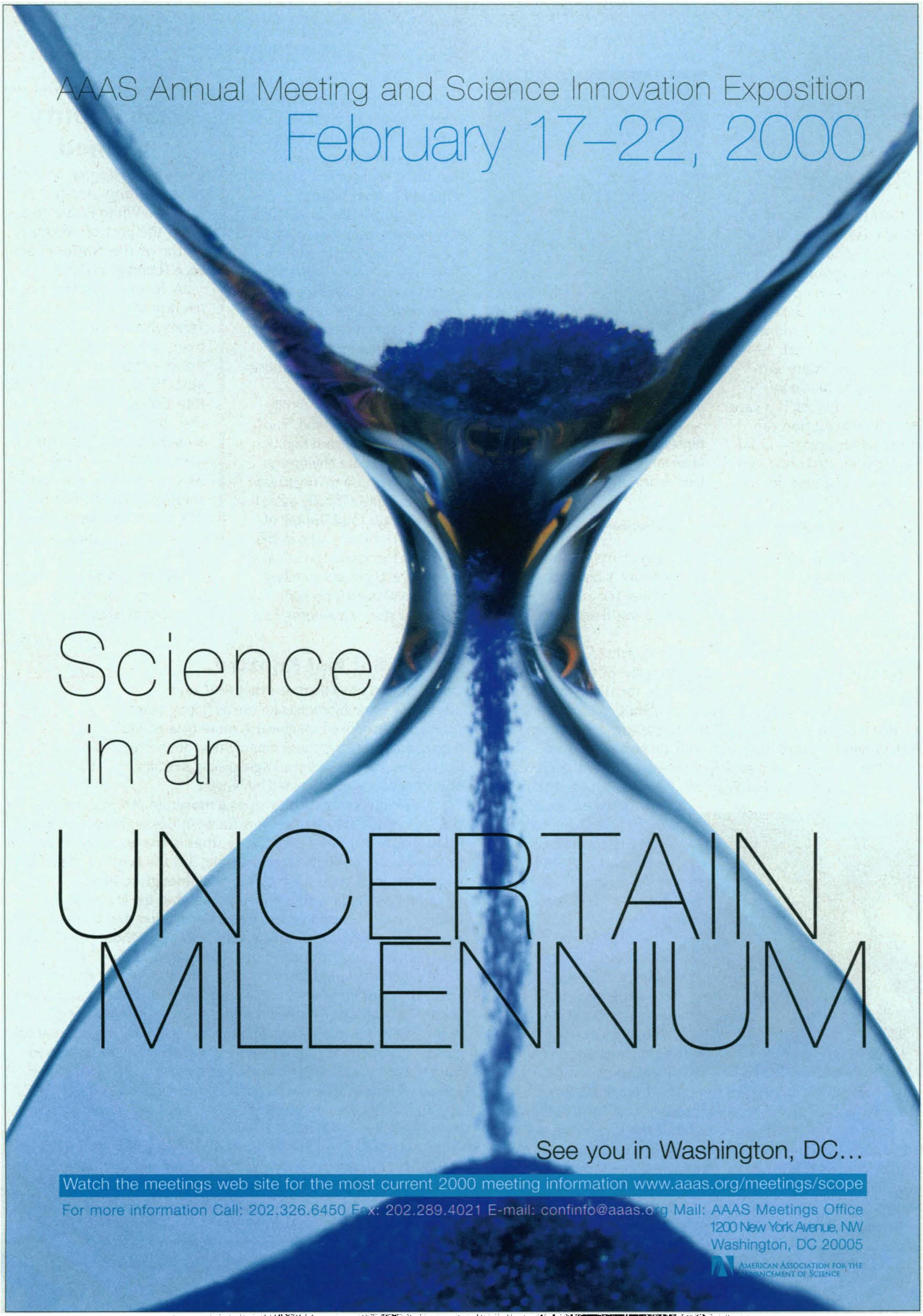

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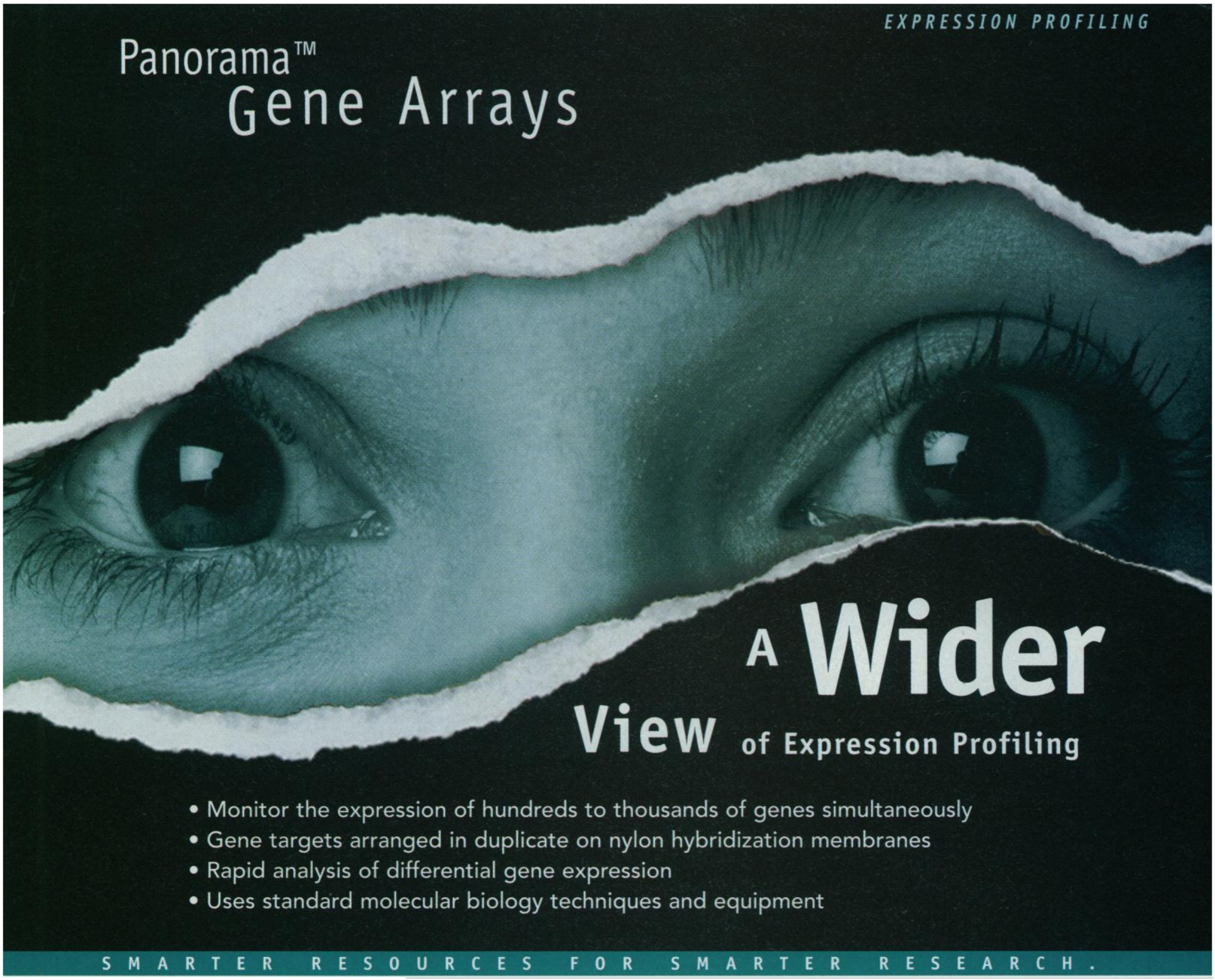


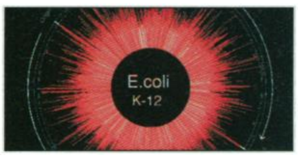


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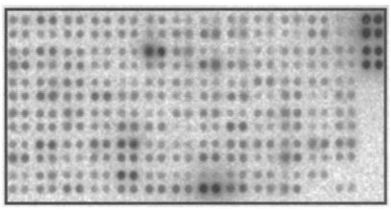

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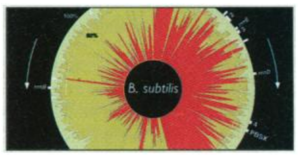


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The TNT® SP6 Quick System works in all the applications of the original TNT® SP6 System including molecular interaction studies, verification of clones, and analysis of mutants.

**Quicker:** One Master mix, fewer pipetting steps.

**Easier:** Translates directly from plasmid DNA.

**Better:** Higher protein yields with many genes and flexibility to optimize for a specific gene.

### Ordering Information

| Product | Size | Cat.# |
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| TNT® SP6 Quick Coupled Transcription/Translation System | 40 reactions | L2080 |
| TNT® SP6 Quick Coupled Transcription/Translation System, Trial Size | 5 reactions | L2081 |
| TNT® T7 Quick Coupled Transcription/Translation System | 40 reactions | L1170 |
| TNT® T7 Quick Coupled Transcription/Translation System, Trial Size | 5 reactions | L1171 |

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*Contact your local Promega Branch Office or Distributor to receive a free copy of the In vitro Expression Guide (BR053). For more information about Promega technical literature and products visit our Home Page at www.promega.com.*

U.S. Pat. No. 5,283,179 and other patents.
U.S. Pat. Nos. 5,492,817, 5,665,563 and other patents.
U.S. Pat. No 5,552,302 and other patents. Inhibitors of Angiogenin, which comprises a segment of human PRI, is the subject of U.S. Pat. No. 4,966,964 and other patents assigned tot he President and Fellows of Harvard College and exclusively licensed to Promega Corporation.
The method of recombinant expression of Coleoptera luciferase is covered by U.S. Pat. Nos. 5,583,024, 5,674,713 and 5,700673.

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