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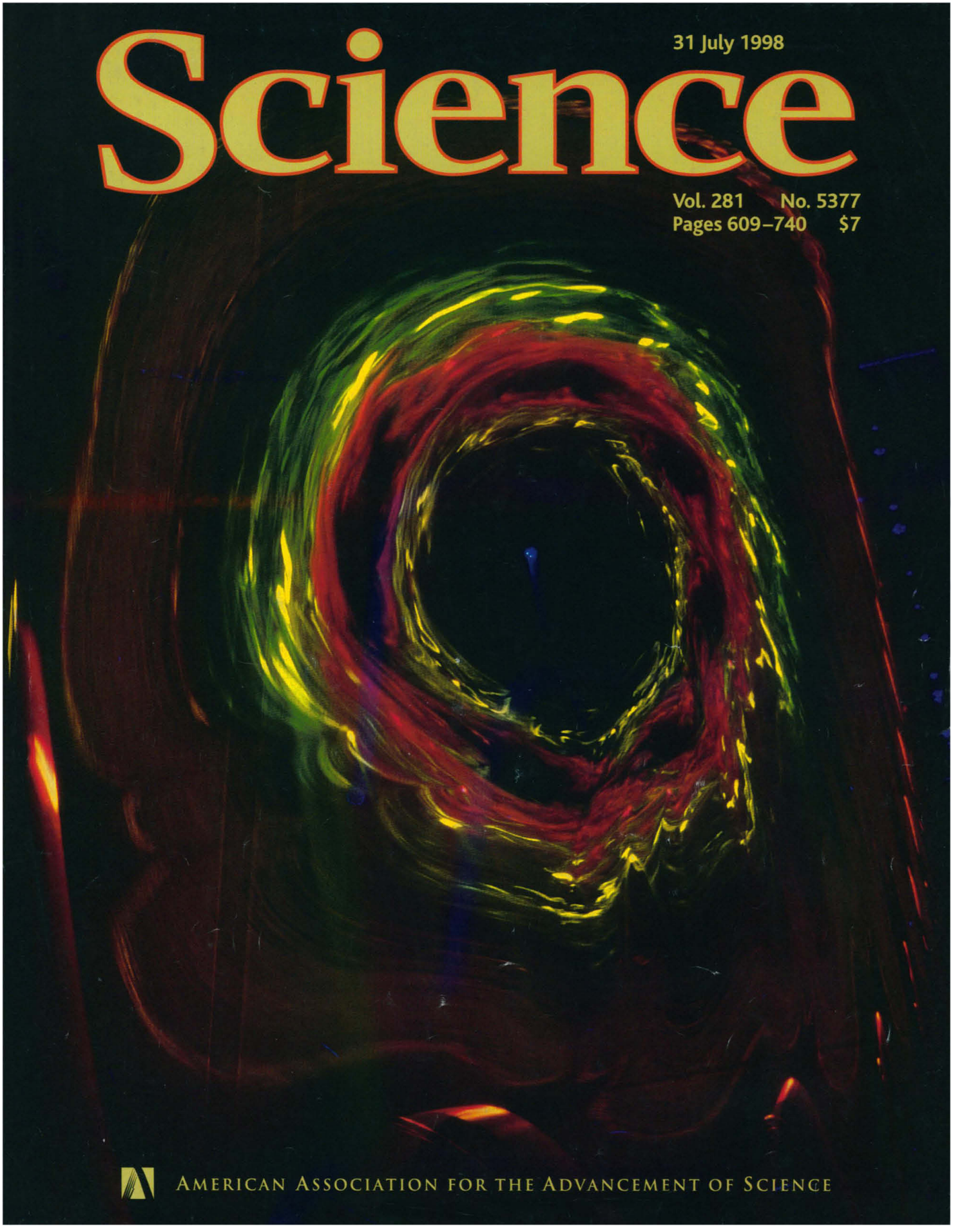

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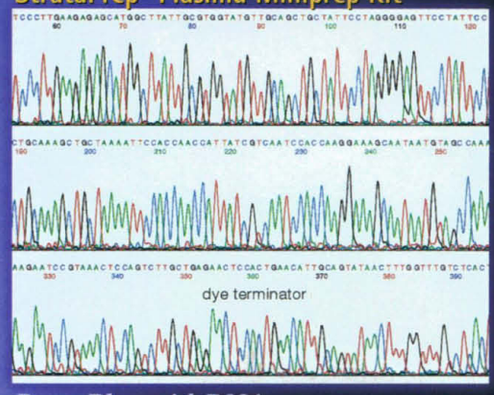

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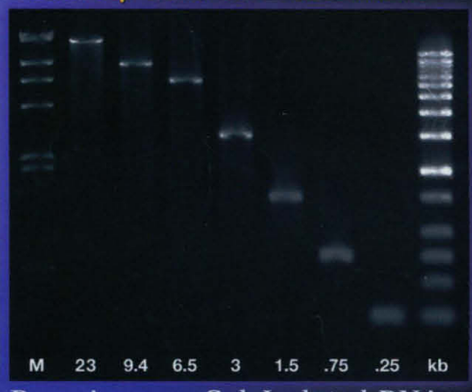

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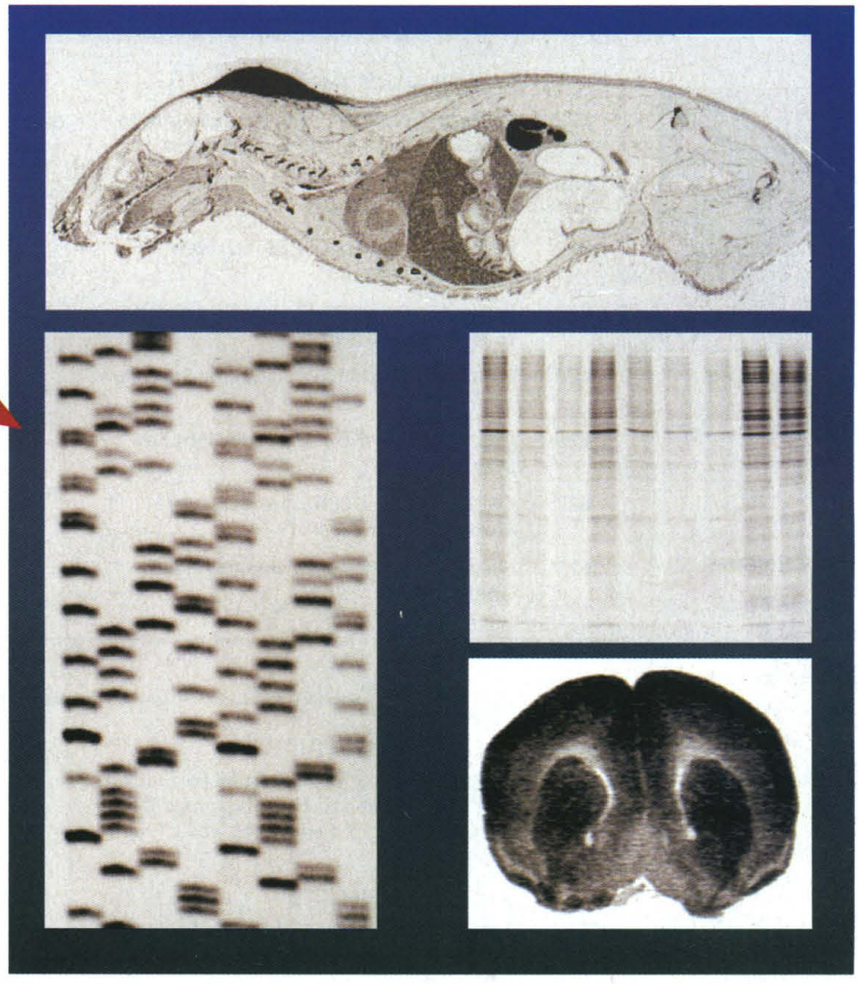

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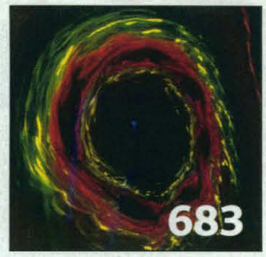

COVER The structure of three-dimensional chaotic flow of a viscous liquid in a mixing tank is revealed by the intersections of fluorescent dye lines with a laser sheet. The dark islands (regions of poor mixing) are cuts of tori that may wind around the tank several times. Chaotic regions with good mixing appear as highly stretched and folded dye streaks surrounding the islands. [Image: G. Fountain, D. Khakhar, J. M. Ottino]

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Trouble ahead for a vaccine

NEWS

NEWS OF THE WEEK

NEWS FOCUS

RESEARCH

RESEARCH ARTICLE

REPORTS

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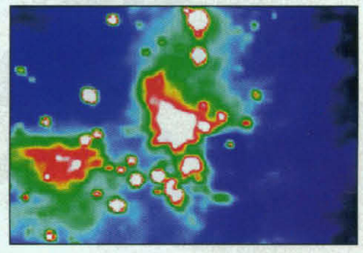
Left in space: Homochirality and the Orion star-forming region



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SCIENCE'S COMPASS

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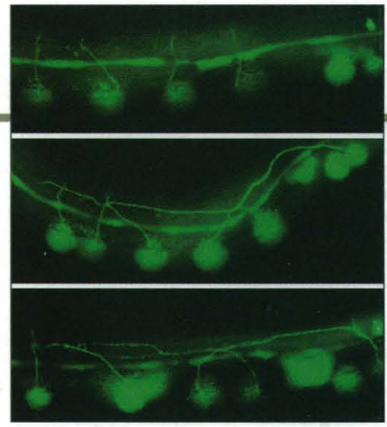
Growth factor molecule guides developing axons



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NO HELP FROM PROTEINS

Ribosomes are complexes of protein (50 to 60 species) and RNA [three to four ribosomal RNAs (rRNAs)] that translate messenger RNA into polypeptides. The largest rRNA in *Escherichia coli* is known as 23*S* rRNA, and it has been suggested to form a central part of the amino acid ligation machinery. Nitta *et al.* (p. 666; see the Perspective by Schimmel and Alexander) show that of the six domains of 23*S* rRNA, only one catalyzes peptide bond formation by itself. Compensatory mutations and antibiotic inhibition support the proposal that this reaction is essentially similar to that observed in intact ribosomes and may reflect an ancestral catalytic rRNA.

HELP FROM AMINO ACIDS

One important step in the early chemical evolution of molecules needed for life was likely the activation of amino acids to form peptides. In a series of experiments, Huber and Wächtershäuser (p. 670; see the news story by Vogel) reproduce this step starting with amino acids, carbon monoxide, and nickel-iron sulfide particles. Reaction occurs at high temperatures (100°C) and moderate pH. These conditions are representative of those in hydrothermal systems in the crust and at ocean ridges.

HAND IT TO THE YOUNG STARS

Organisms are composed of proteins built mainly from left-handed amino acids (L–amino acids). The origin of this homochirality remains unknown; it may reflect an initial bias in the handedness of primordial molecules delivered to Earth. Bailey *et al.* (p. 672; see the news story by Irion) have observed infrared circular polarization from linearly polarized light scattered by dust in reflection nebulae in the Orion OMC-1 star-forming region. The authors, through simulations, suggest that ultraviolet circular polarization could induce an L–amino acid excess in interstellar organic molecules.

WHAT'S REALLY DOWN THERE?

Determining the composition of the mantle requires matching seismic observations with experimental data on properties of minerals. Sinelnikov *et al.* (p. 677) measured the shear-wave velocities of $MgSiO_3$ perovskite to 8 gigapascals and 800 kelvin using ultrasonic interferometry. They infer that the lower mantle is composed of perovskite, magnesiowüstite, and some SiO_2. Li *et al.* (p. 675) measured the elastic moduli of wadsleyite, which forms from olivine at high pressure. Their data provide two possible upper mantle olivine contents.

ORIGINS OF LYME ARTHRITIS

Most cases of Lyme disease resolve after the eradication of the spirochete *Borrelia burgdorferi*. Those cases that do not are classified as antibiotic treatment–resistant Lyme arthritis. Many of these patients share the same HLA-DR4 allele. Gross *et al.* (p. 703; see the news story by Dickman) used an algorithm that predicts peptides that bind to DR4 to find the particular peptide of the *B. burgdorferi* protein OspA that was activating most of the helper T cells in the synovial fluid. The human, but not the mouse, LFA-1 protein contained a similar sequence, which, when tested, also bound to DR4 and activated the synovial T cells. They speculate that the initial infection activated inflammatory cytokine-secreting T cells that were then continually recruited and stimulated by the autoantigen. This finding could help explain the arthritic condition in humans as well as the lack of long-term symptoms in the mouse.

ULTRASLOW RELAXATION

Electron spins can be aligned with magnetic fields in semiconductors, but such alignment usually relaxes rapidly (in picoseconds). Kuzma *et al.* (p. 686; see the Perspective by Kikkawa and Awschalom) studied spin dynamics in a two-dimensional electron gas, which at very low temperatures forms a fractional quantum Hall effect ground state ($\nu = 1/3$). Optically pumped nuclear magnetic resonance spectra of gallium-71 exhibited both broadening and narrowing due to the presence of spin-reversed electrons. Regions of spin-reversed electrons appear to be inhomogenously distributed, which slows down the relaxation times to between 0.1 and 500 milliseconds.

NOT QUITE MIXED UP

Most experiments of chaos associated with mixing have been in two-dimensional flows, and thus much of our understanding of chaos in complex geometries has been based on theoretical and computational studies. Fountain *et al.* (p. 683) now present an experimental system in which chaotic flows can be observed in three dimensions.

SKATE ON THE EDGE

It is generally held that marine extinctions are rare and are largely restricted to invertebrates in vulnerable coastal habitats or to larger vertebrates subject to deliberate fishing. However, the barndoor skate, which fits neither of these criteria, may be headed toward extinction, according to the long-term dataset compiled by Casey and Myers (p. 690). Initially common, this species has no refuge from commercial fishing (it is taken as by-catch); it is long-lived, slow to reproduce, and large enough to make it vulnerable to commercial trawls.

CONTROLLING INSULIN

Embryoid bodies derived from mouse embryonic stems cells were used by Duncan *et al.* (p. 692) to find a "master regulator" of a transcription network involved in control of cellular differentiation and metabolism. A balance between hepatocyte nuclear factors HNF-3α and -3β regulates a pathway that appears to be connected to insulin control and contains genes that are mutated in an early-onset form of diabetes.

RECOVERING FROM CATASTROPHE

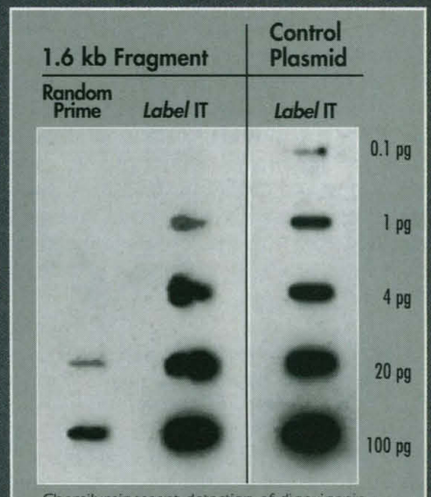
Hurricane Lili struck the Exumas islets in the Bahamas on 19 October 1996, just after a group of ecologists had completed a census of organisms there. Some of the islets bore the full force of the hurricane. Spiller *et al.* (p. 695) repeated the census immediately after the hurricane and then again 1 year later to assess the effects of moderate and catastrophic disturbance. The data support the notions that larger organisms, larger populations, and species that disperse more readily are more resistant to these natural disasters.

SELECTING CARGOES

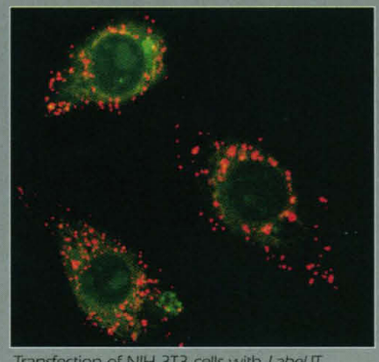
Secretory and membrane proteins are synthesized and imported into the endoplasmic reticulum (ER), from which they travel through the organelles of the secretory pathway. This process involves the budding of transport vesicles from one organelle and its subsequent fusion with a target organelle. Springer and Schekman (p. 698) examined the mechanisms by which ER transport vesicles select their cargo for traffic through the cell. Specific proteins involved in forming coats that help vesicular budding are also involved in selecting the

CONTINUED ON PAGE 619

At last, One Step DNA Labeling.



Chemiluminescent detection of digoxigenin and digoxin* labeled DNAs. Lanes 1 and 2, labeling of a 1.6 kb linear DNA fragment; lane 3, labeling of a 5.8 kb supercoiled plasmid.



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THIS WEEK IN *SCIENCE*

CONTINUED FROM PAGE 617

cargo molecules. Previously, these proteins were thought to be involved only in the mechanics of vesicle budding rather than in the sorting process.

FUSION RECONSTITUTED

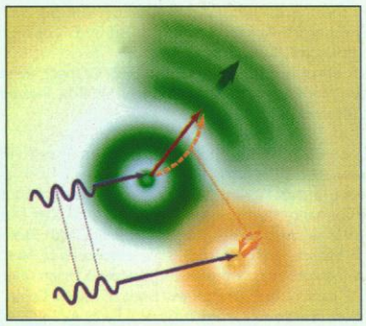
Targeted membrane fusion occurs during intracellular transport, for example, after endocytosis when endocytic vesicles fuse to form endosomes and lysosomes. In yeast, the functional equivalent of the lysosome is the vacuole. Using solubilized vacuole membrane components, Sato and Wickner (p. 700) were able to reconstitute experimentally the fusion process having the appropriate energy and temperature characteristics. They could then dissect the importance of particular proteins in the simplified fusion system.

AXON GUIDANCE AND TGF-β

Proteins of the transforming growth factor–β (TGF-β) family are involved in a great variety of developmental processes. Colavita *et al.* (p. 706) linked TGF-β signaling pathways with axon guidance in *Caenorhabditis elegans*. Analysis of the *unc-129* gene shows that it encodes a member of the TGF-β family, thereby implicating the related signaling mechanisms in the guidance of motorneurons to their target muscles.

RESONANCE BETWEEN ATOMS

High-brightness synchrotron x-ray sources allow effects that require tuning of the x-ray frequency to be more readily explored and exploited. Kay *et al.* (p. 679) show that an analog of single-atom resonant photoemission of electrons can be observed between atoms in several transition metal oxides. The x-ray frequency is chosen to excite a strong transition in a metal atom, which can then come into resonance with photoemission from states in the oxygen atom and lead to increased intensity. This effect might be used to identify both chemical states and bonding interactions in a variety of samples.



KEEPING SPECIES APART

Gamete recognition systems form one of the barriers that separate species of animals. Swanson and Vacquier (p. 710) analyzed receptors from several abalone species. These receptors reside on the egg surface and bind the sperm lysin protein. The egg's receptor contains a series of repeated sequences that may promote homogenization of sequences within a species and divergence between species.

TRANSCRIPTION UPDATE

The sequence encoded in DNA gets converted into RNA in a process called transcription. After each base is added, the transcription complex must decide whether to next add another base, release the nascent transcript, or correct a misincorporated base. Using the *Escherichia coli* RNA polymerase complex as a model, von Hippel (p. 660) reviews developments that have allowed a better understanding of this decision-making stage and offers an integrated model of transcription that incorporates thermodynamic, structural, and kinetic data.

TECHNICAL COMMENT SUMMARIES

The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/281/5377/619a

Learning and the Sensorimotor Synapse in *Aplysia*

G. G. Murphy and D. L. Glanzman studied (Reports, 17 Oct., p. 467) long-term potentiation (LTP), "an important neuronal mechanism of learning and memory." They found that "classical conditioning in [the marine snail] *Aplysia* appears to be mediated, in part, by LTP due to activation of [*N*-methyl-D-aspartate] NMDA-related receptors.

R. D. Hawkins comments that the experimental design of the study "appears not to support strong conclusions about the relative contributions of Hebbian LTP and activity-dependent presynaptic facilitation by a modulatory transmitter."

In response, Murphy and Glanzman present new data from "a series of conditioning experiments involving differential training." They conclude that "although our data indicate that classical conditioning of the withdrawl reflex in *Aplysia* involves Hebbian LTP, we agree with Hawkins that other processes could contribute to this form of learning."

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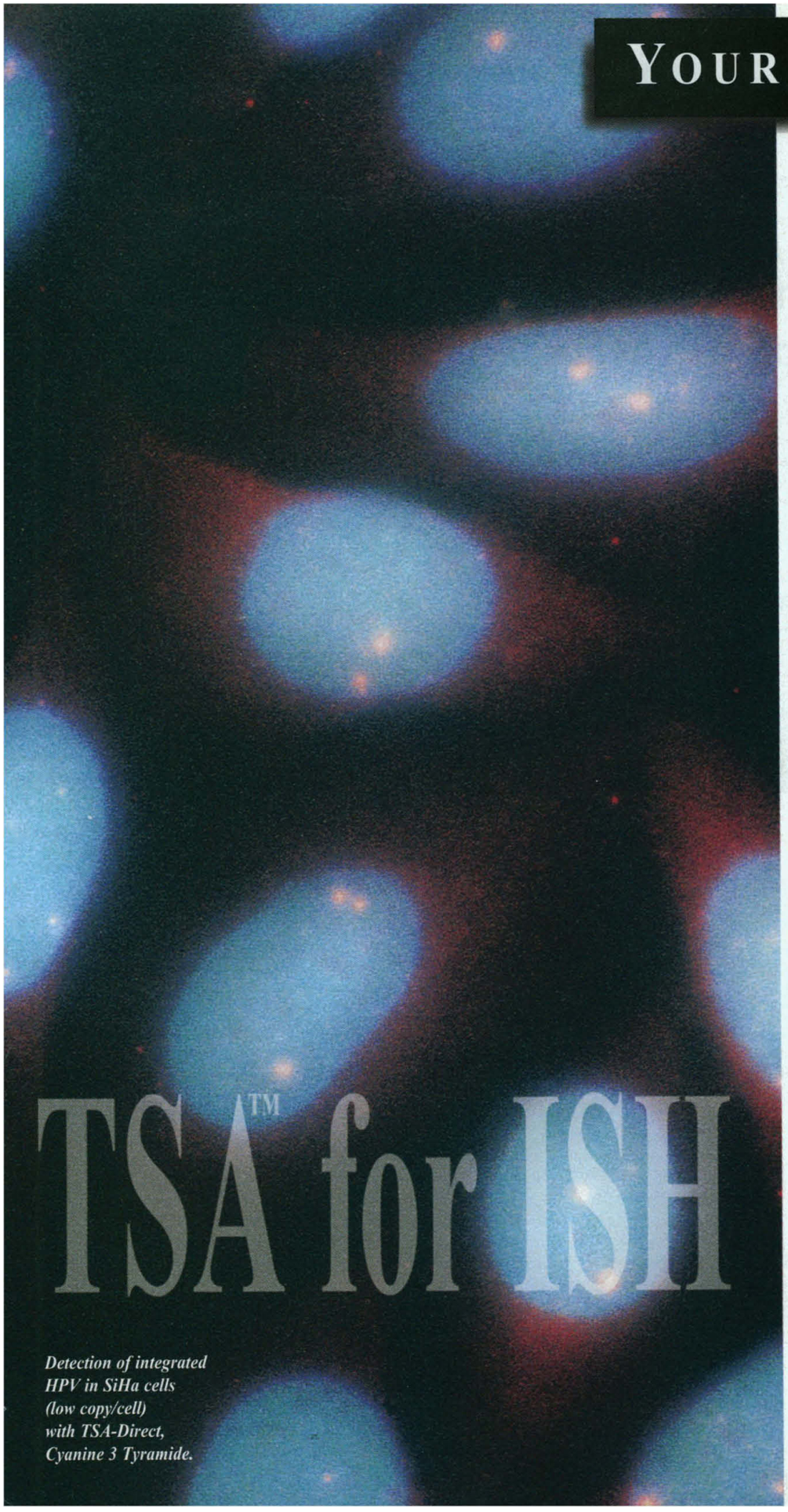

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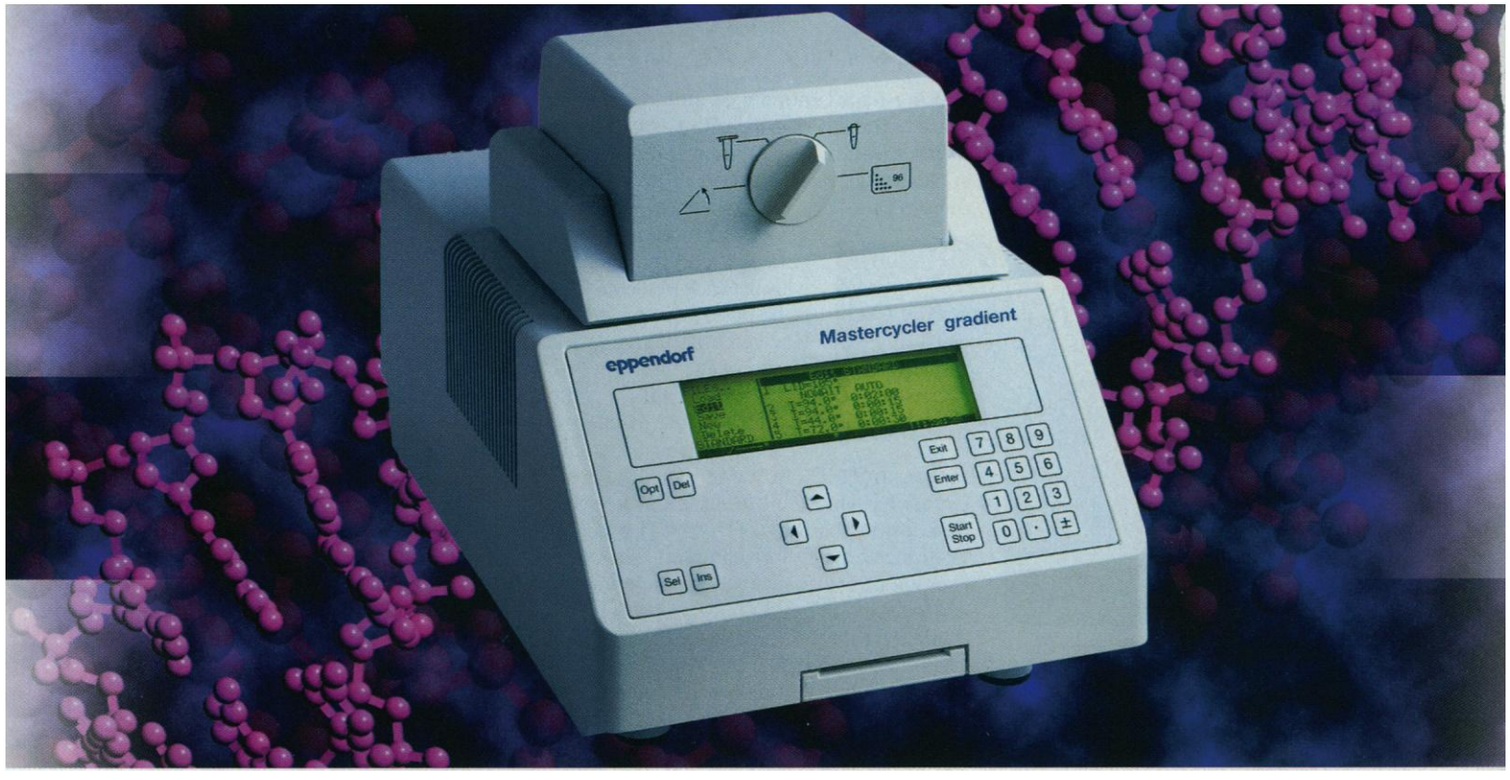

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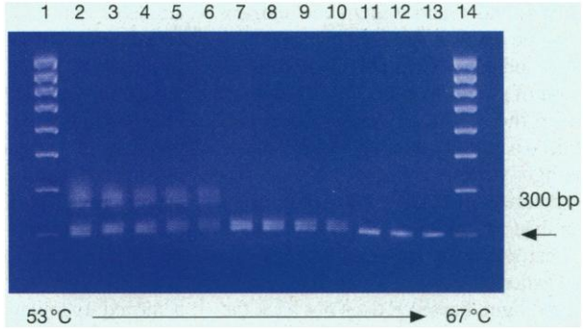

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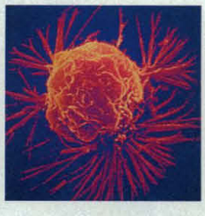



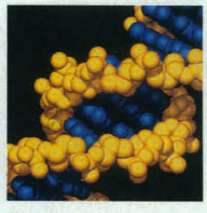

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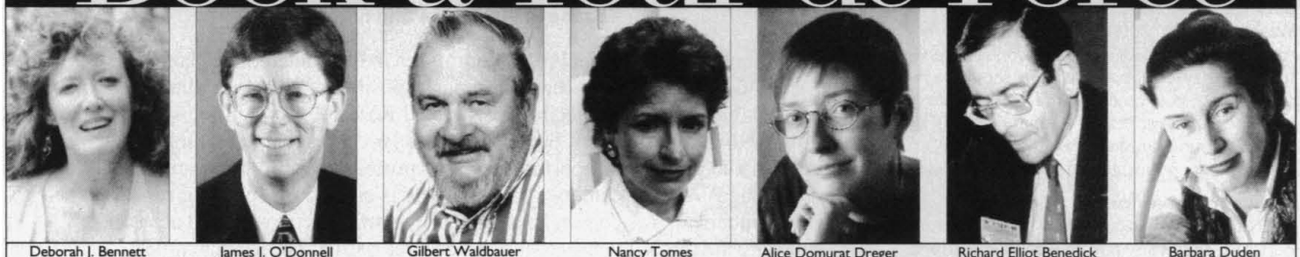

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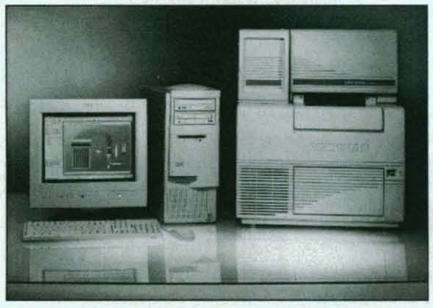

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