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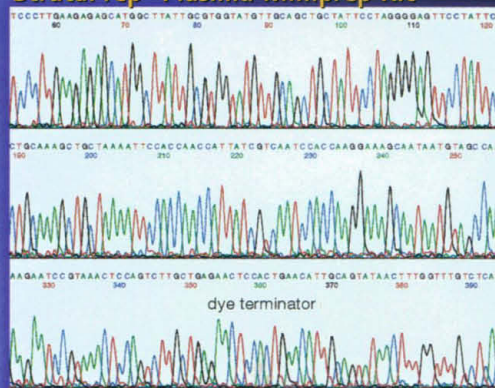
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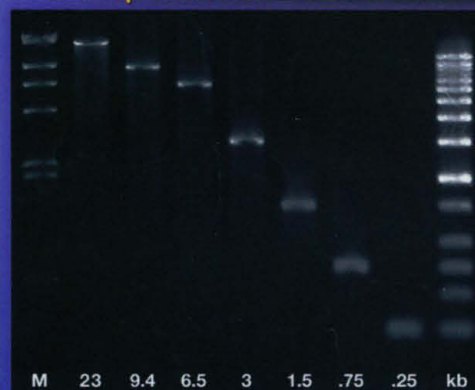
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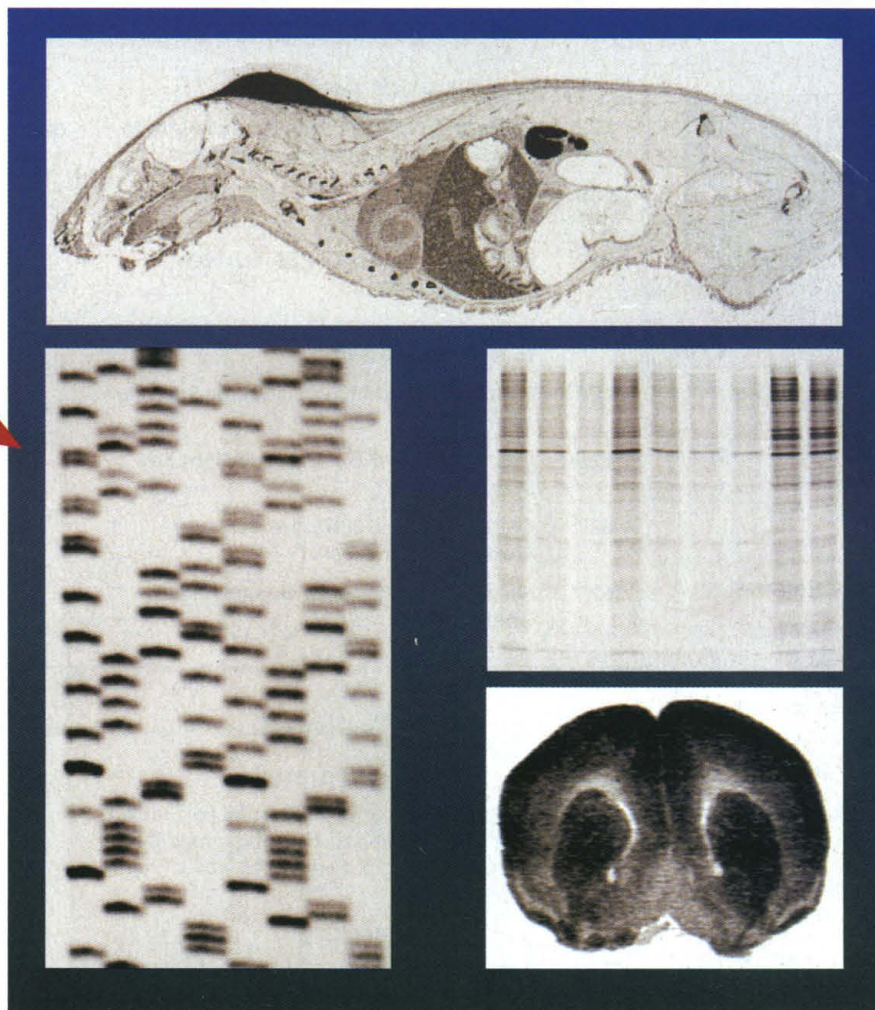
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COVER The structure of three-dimensional chaotic flow of a viscous liquid in a mixing tank is revealed by the intersections of fluorescent dye lines with a laser sheet. The dark islands (regions of poor mixing) are cuts of tori that may wind around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



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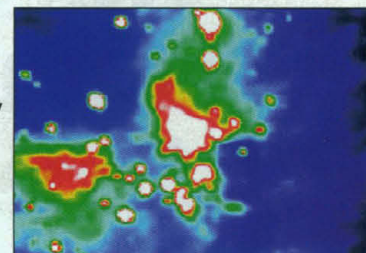
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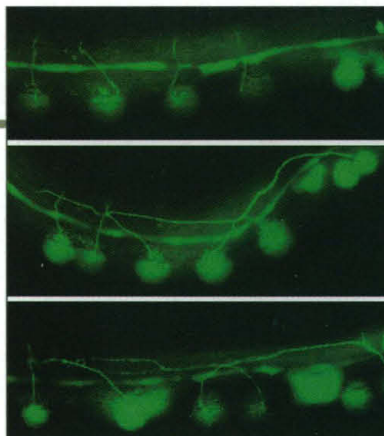
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NO HELP FROM PROTEINS

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 23S 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 23S 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 MgSiO₃ perovskite to 8 gigapascals and 800 kelvin using ultrasonic interferometry. They infer that the lower mantle is composed of perovskite, magnesiowüstite,

and some SiO₂. 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 inhomogeneously 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 stem 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-3 α and -3 β 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

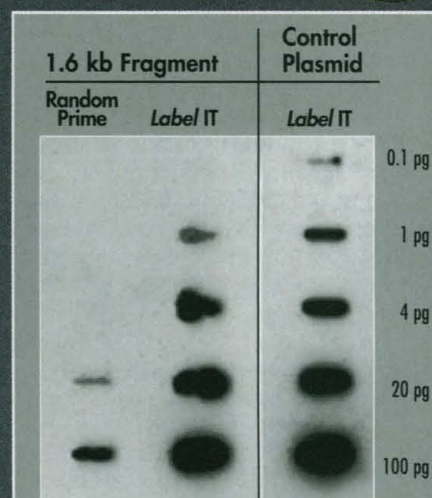
Hurricane Lili struck the Exumas islets in the Bahamas on 19 October 1996, just after a group of ecologists had completed a census of organisms there. Some of the islets bore the full force of the hurricane. Spiller *et al.* (p. 695) repeated the census immediately after the hurricane and then again 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

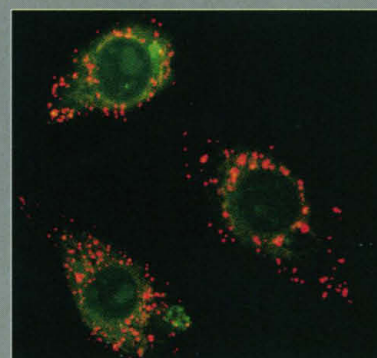
Secretory and membrane proteins are synthesized and imported into the endoplasmic reticulum (ER), from which they travel through the organelles of the secretory pathway. This process involves the budding of transport vesicles from one organelle and its subsequent fusion with a target organelle. Springer 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

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THIS WEEK IN SCIENCE

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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

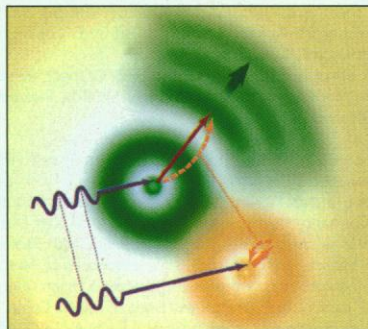
Targeted membrane fusion occurs during intracellular transport, for example, after endocytosis when endocytic vesicles fuse to form endosomes and lysosomes. In yeast, the functional equivalent of the lysosome is the vacuole. Using solubilized vacuole membrane components, Sato and Wickner (p. 700) were 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 motoneurons 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 oxy-



gen 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

Learning and the Sensorimotor Synapse in *Aplysia*

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

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 withdrawal reflex in *Aplysia* involves Hebbian LTP, we agree with Hawkins that other processes could contribute to this form of learning."

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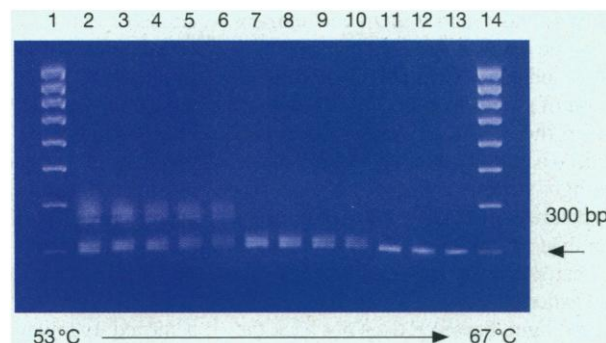
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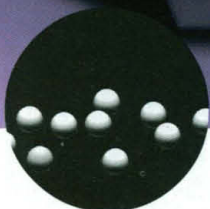
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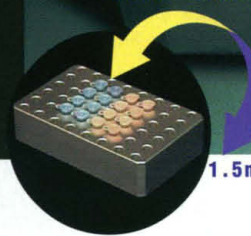
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the activities of dideoxy-terminator sequencing, including pre-run setup, sample denaturation, gel replenishment, injection and separation, and final determination of base sequence, with little human intervention. The unit's dideoxy-terminator cycle sequencing with four dyes per capillary delivers fast turnaround and high throughput. The

CEQ 2000 provides a final report calling more than 500 bases on eight samples in just 2 hours and on a complete 96-well plate in 24 hours. The unit's software measures the accuracy of each base call.

GENE EXPLORER SOFTWARE

Gene Explorer 1.4 software has new features to help molecular biologists with gene research. The software can search several major genomic database systems, including those from Incyte Pharmaceuticals, Pangea Systems, PE Molecular Informatics, GCG, NCBI, PDB, and SRS. The software automatically tells the user when new database hits for previous experiments

Molecular Simulations

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are found in database updates. It also helps identify protein homologs by using secondary structure to augment conventional sequence similarity technologies.

FATIGUE TESTING SYSTEM

The DynaMight fatigue testing system is suitable for evaluating the durability of biomedical components and devices at low forces of less than 200 lb. DynaMight is designed to simulate the forces and deflections that occur within the human anatomy. Motions such as turning a dial or pushing a button can be replicated for tests on medical components such as tendons, muscles, sutures, implants, forceps, and other materials.

Instron

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CENTRIFUGAL FILTER TUBES

A comprehensive range of filter inserts is available for centrifuge tubes for concentration, purification, or desalting of various types of samples. The filter tubes are available in three volumes—0.5, 4.0, and 15 ml—and in six cut-off sizes, ranging from 4 kD to 0.45 μ m. These sizes cover all relevant applications, from the concentration of peptides to bacteria and cell harvesting. The membranes are characterized by low affinity for protein or nucleic acids and correspondingly high recovery rates. The special construction of the in-

Eppendorf

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serts ensures reliable sealing of the tubes during centrifugation.

DNA AND RNA ISOLATION SYSTEM

The Model NA 2000 automates the extraction and purification of genomic DNA or RNA from animal cultured cells and tissues. The system, which is totally automated and requires no manual intervention, produces high-quality nucleic acids with yields comparable to manual methods. The instrument will isolate nucleic acids from a variety of sources.

AutoGen

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MONOCLONAL ANTIBODIES

A monoclonal antibody is available directed against DNA polymerase, a 39-kD β enzyme that fills single nucleotide gaps produced by the base excision repair pathway of mammalian cells. The antibody binds DNA polymerase β from human, cow, mouse, rat, hamster, and *Xenopus*, and does not inhibit polymerase activity.

Kamiya Biomedical

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The mouse anti-human B cell, CD79 α , Clone JCB117 antibody is for use on formalin-fixed, paraffin-embedded tissue sections, frozen sections, and cell preparations. CD79 α is found in the majority of acute leukemias of precursor B cell type, in B cell lines, in B cell lymphomas, and in some myelomas. A new monoclonal anti-progesterone receptor, clone PgR 636, gives localized nuclear staining with no cytoplasmic staining. It can be used on formalin-fixed, paraffin-embedded tissue sections.

Dako

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