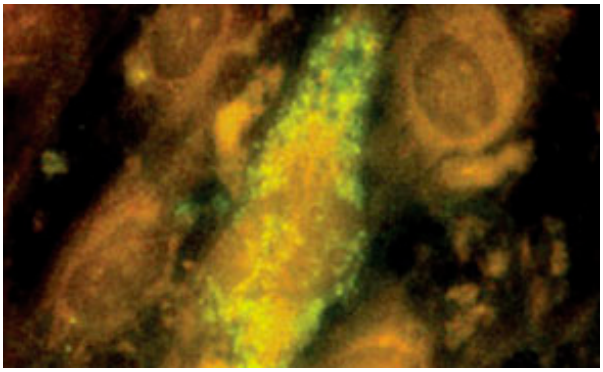
PNAS News Archive: June 23 - 27, 2003

Selected articles appearing in PNAS the week of June 23. . .

Retrovirus May Trigger Fatal Liver Disease


Bile duct cells exposed to infected lymph node tissue from patients with the liver disease PBC show evidence of a retrovirus protein (green).

A retrovirus previously linked with breast cancer may also cause a degenerative liver disease called primary biliary cirrhosis (PBC), according to new research in PNAS. PBC progressively damages bile ducts, eventually necessitating liver transplantation. PBC is considered an autoimmune disease, although previous research suggested that a microbial infection triggers the disease in susceptible individuals. To study the possible role of microbes in PBC, **Andrew Mason** of the **University of Alberta** and colleagues compared liver tissues from three patients with PBC to five patients with other liver diseases. The scientists found evidence of virus-like particles in the bile duct cells from all PBC patients, but only one non-PBC patient. A genetic analysis of the liver samples revealed gene sequences nearly identical to those in murine mammary tumor virus, previously linked with breast cancer. Additional tests showed evidence of retroviral infection in the lymph nodes of PBC patients. Importantly, samples taken from these infected lymph nodes induced PBC-like changes in cultured bile duct cells. These results support the hypothesis that a retroviral infection can cause PBC. Antiretroviral

therapy, suggest the scientists, may help to stem this fatal illness.

"Does a betaretrovirus infection trigger primary biliary cirrhosis?" by Lizhe Xu, Zhiwei Shen, Linsheng Guo, Brent Fodera, Adrian Keogh, Ruth Joplin, Barbara O'Donnell, James Aitken, William Carman, James Neuberger, and Andrew Mason

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When the Brain Blinks

A new computer model attempts to bridge the gap between neuronal activity and the subjective experience of conscious perception. **Stanislas Dehaene** of **Unite Institut National de la Sante et de la Recherche Medicale** and colleagues developed the model, according to new research in PNAS, to explain a well-known psychological phenomena referred to as attentional blink. When two stimuli, such as images or sounds, are presented in rapid succession, a person may fail to consciously perceive the second stimulus, as if the person's attention had "blinked." The French researchers' model, which simulates a large network of brain cells, integrates previous findings about brain anatomy and physiology, brain activity associated with visual processing, and subjective reports of visual perception. According to the model, conscious perception occurs when a stimulus activates a "global brain state" that links together distant areas of the neuronal network. While this global brain state is active (i.e., during conscious processing), a second stimulus may activate a subsection of the network, but cannot achieve global activation. Hence, the second stimulus is not consciously perceived. In addition to successfully simulating the attentional blink phenomena, the computer model makes the novel prediction that attentional blink is all-or-none in nature: the second stimulus is perceived entirely or not at all. Subsequent behavioral tests with human subjects supported this prediction.

"A neuronal network model linking subjective reports and objective physiological data during conscious perception" by Stanislas Dehaene, Claire Sergent, and Jean-Pierre Changeux

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Special Feature: Science and Technology for Sustainable Development

In a special feature, PNAS highlights sustainability science with a series of six articles. This emerging and multidisciplinary field combines environmental studies, social science, public policy, and other areas of research. Recognizing that economic and environmental health are inextricably linked, sustainability science focuses on development that can meet the needs of the present without compromising the ability of future generations to meet their own needs. This special feature surveys the current state of sustainability science, highlights several case studies, and outlines future goals and challenges for sustainable development.

William Clark and **Nancy Dickson** of **The Kennedy School of Government at Harvard University** provide an overview of past and current research in sustainability. The authors stress that although sustainable science is a new field,

science and technology are already helping to reconcile society's developmental goals with the planet's environmental limits over the long term.

"Sustainability science: The emerging research program" by William C. Clark and Nancy M. Dickson

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David Cash of **The Kennedy School of Government at Harvard University** and colleagues discuss the need for an effective exchange between scientists and policy makers before sustainability can be realized. The authors contend that in order for scientific information to influence public policy, stakeholders must perceive the information as credible, salient, and legitimate. The authors review several case studies that illustrate effective systems for linking scientific knowledge with action.

"Knowledge systems for sustainable development" by David W. Cash, William C. Clark, Frank Alcock, Nancy M. Dickson, Noelle Eckley, David H. Guston, Jill Jager, and Ronald B. Mitchell

Read the full text of this article

B. L. Turner of **Clark University** and colleagues offer a framework for assessing the vulnerability of human-environment systems to sudden perturbations, such as hurricanes, and longer-term stresses, such as soil degradation. The authors note that vulnerability analyses must consider both exposure to such hazards and the resilience of the system.

"A framework for vulnerability analysis in sustainability science" by B. L. Turner, Roger E. Kasperson, Pamela A. Matson, James J. McCarthy, Robert W. Corell, Lindsey Christensen, Noelle Eckley, Jeanne X. Kasperson, Amy Luers, Marybeth L. Martello, Colin Polsky, Alexander Pulsipher, and Andrew Schiller

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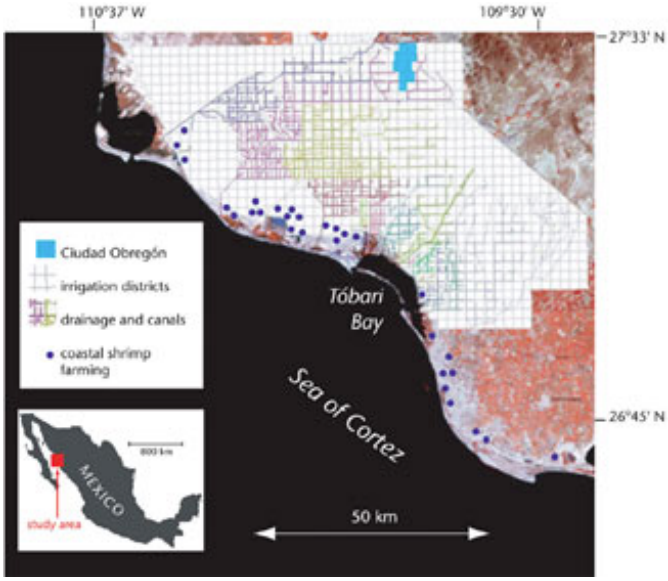
Turner and colleagues apply their vulnerability analysis framework to three case studies in the tropical southern Yucatan, the arid Yaqui Valley of northwest Mexico, and the pan-Arctic. The case studies illustrate the influence of political and economic forces on regional and local land use and coping capacities.

"Illustrating the coupled human-environment system for vulnerability analysis: Three case studies" by B. L. Turner, Pamela A. Matson, James J. McCarthy, Robert W. Corell, Lindsey Christensen, Noelle Eckley, Grete Hovelsrud-Broda, Jeanne X. Kasperson, Roger E. Kasperson, Amy Luers, Marybeth



Sustainability is a major concern for farmers, fisherfolk, and land-water managers in the Yaqui Valley of Sonora, Mexico.

L. Martello, Svein Mathiesen, Rosamond Naylor, Colin Polsky, Alexander Pulsipher, Andrew Schiller, Henrik Selin, and Nicholas Tyler

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Thomas Parris of **ISciences, LLC,** and **Robert Kates** identify some of the goals necessary for a transition to worldwide sustainable development, such as reducing hunger and maintaining freshwater availability. For each goal, the authors propose indicators for measuring success and quantitative targets. The authors further identify major forces that drive towards or away from sustainability goals.

"Characterizing a sustainability transition: Goals, targets, trends, and driving forces" by Thomas M. Parris and Robert W. Kates

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Kates and Parris review a series of long-term trends that might significantly affect prospects for a sustainable future. The authors describe trends in each of 10 major classes of human-environment interaction, such as peace and security and global environmental change. Kates and Parris also give examples on how changes in each trend could slow or speed the transition toward sustainable development.

"Long-term trends and sustainability transition" by Robert W. Kates and Thomas M. Parris

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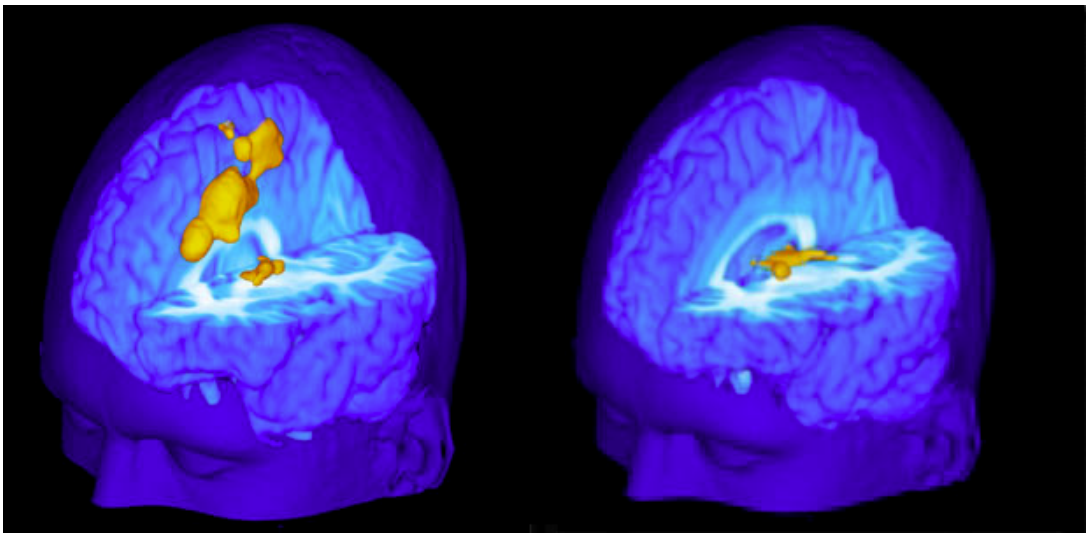
Pain: The Perception Is Real



Pain-induced brain activation in highly sensitive and insensitive people.

People who are very sensitive to pain have different patterns of neural activity than people who are not as sensitive, report the authors of new research appearing in PNAS. It is difficult to objectively measure an experience as subjective or personal as pain. Some people say that they are tolerant of pain, while others claim to be very sensitive. **Robert Coghill** of **Wake Forest University** and colleagues wanted to know if these differences in self reports reflect actual differences in brain activity that can be measured objectively. Using an established scoring method, the researchers asked subjects to rate the intensity of a painful heat stimulus. Some subjects said the heat was intensely painful, while others said it was only mildly painful. The researchers then applied the same painful heat stimulus while measuring brain activity via functional magnetic resonance imaging, or fMRI. The researchers found that people who scored similarly in the subjective portion of the test showed similar neural activation patterns. People reporting intense pain exhibited more activity in the cerebral cortex compared to those reporting mild pain. The correlation between pain perception and cerebral activity suggests that the most effective way of learning about a patient's pain may be to ask.

"Neural correlates of inter-individual differences in the subjective experience of pain" by Robert C. Coghill, John G. McHaffie, and Ye-Fen Yen

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Nine Justices Act Like 4.68

The second Rehnquist court behaves as if it is composed of 4.68 "ideal" justices, according to a mathematic analysis appearing in PNAS. The current Supreme Court, which has had the same composition since 1994, offers a unique opportunity to study patterns in judicial decision making. Mathematician **Lawrence Sirovich** of the **Mount Sinai School of Medicine** defines an ideal justice as one whose views are not swayed by other justices and therefore their decisions are as predictable as a coin toss. To determine how closely the current membership of the Supreme Court approximates this ideal, Sirovich analyzed the pattern of justices who agreed and disagreed with the majority on 468 different court cases. Of the 256 possible combinations of consenting and dissenting votes, only 75 actually occurred. The court voted unanimously about 47% of the time and voted with a five-four majority in about 10% of decisions. The decisions of the court are equivalent to what would be expected if the court were composed of 4.68 ideal justices. Interestingly, an analysis of the second Warren court (1967-1969) produced similar results. Despite the widely-held view of the Rehnquist court as conservative and the Warren court as liberal, Sirovich suggests that the courts' decision-making processes were remarkably similar.

"A pattern analysis of the second Rehnquist U.S. Supreme Court" by Lawrence Sirovich

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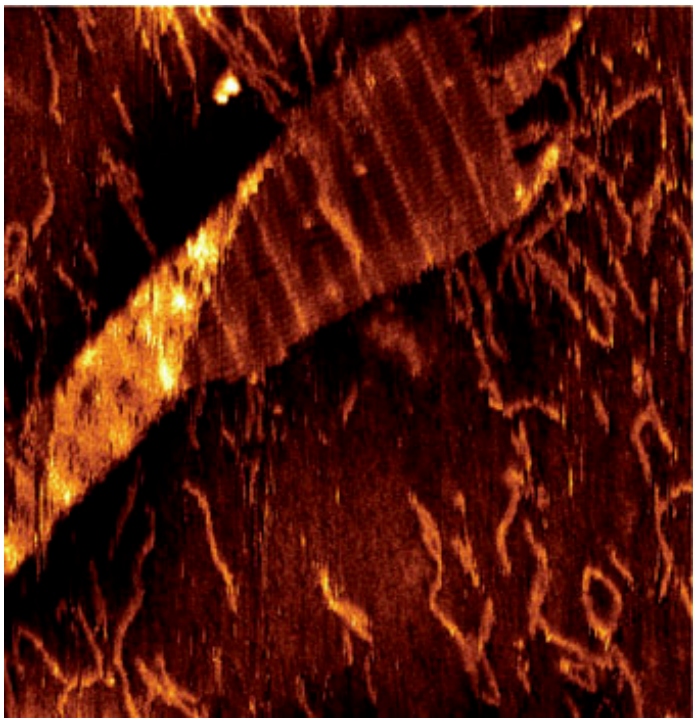
DNA Barcodes

The genetic information in a one-



This DNA ribbon lattice displays a repeating barcode pattern, 10110 from right to left.

dimensional strand of DNA can be used to create an easily readable two-dimensional barcode pattern, according to new research in PNAS. Nanotechnology researchers have proposed that the self-assembling capabilities of DNA make it an ideal material for building tiny, patterned structures, such as molecular-based computing devices. To convert the one-dimensional information of DNA into an easily visualized two-dimensional form, **John Reif** and colleagues of **Duke University** used a single DNA strand as a scaffold for the self-assembly of a lattice structure. Base sequences in the scaffold DNA attracted other strands of DNA that stuck to the scaffold in a precalculated pattern. By designing some of the DNA strands to contain a hairpin loop, the researchers produced a lattice with a barcode-like pattern of protruding bumps. The presence or absence of bumps, easily viewed with advanced microscopic techniques, can be translated into ones and zeroes, similar to the binary code used in computer programming. The authors suggest that DNA barcodes could be used as a source of information for molecular computers.

"Directed nucleation assembly of DNA tile complexes for barcode patterned lattices" by Hao Yan, Thomas H. LaBean, Liping Feng, and John H. Reif

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