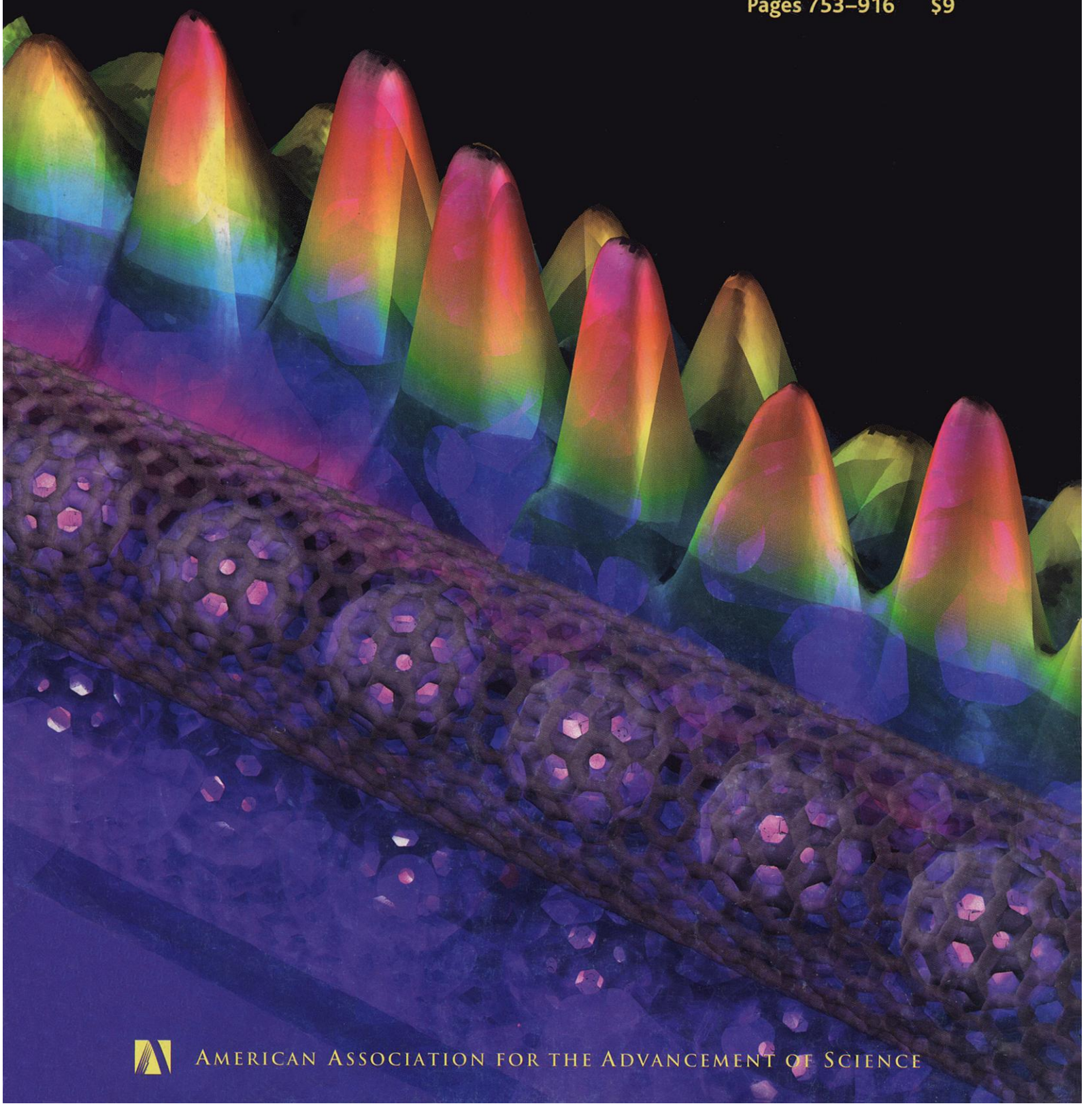
1 February 2002

Science

Vol. 295 No. 5556
Pages 753–916 $9



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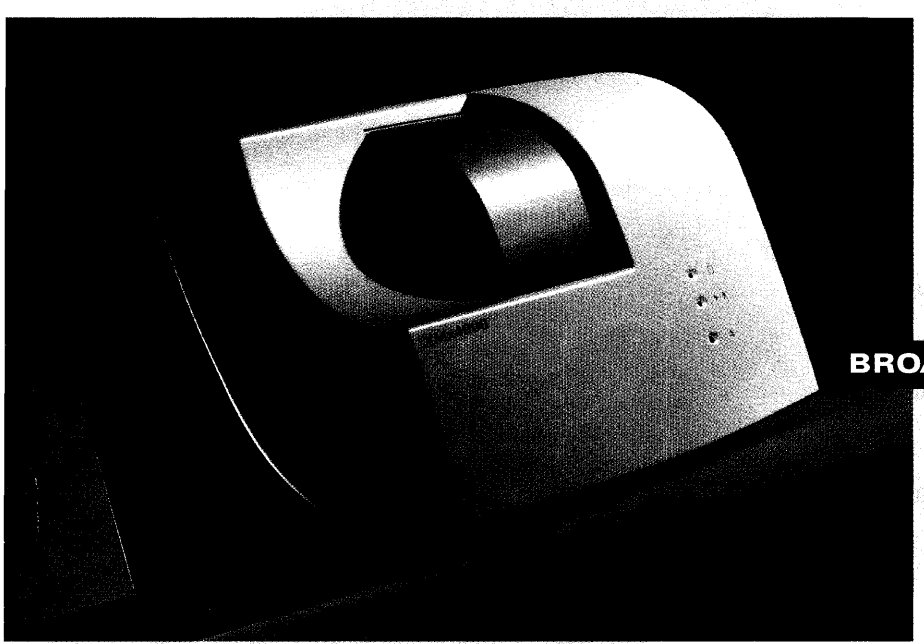

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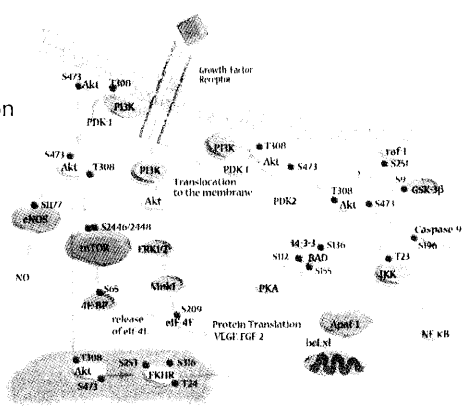

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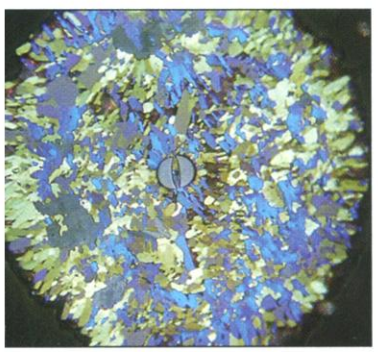
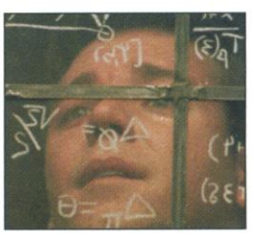
NEWS



786
Superconductor powers ahead



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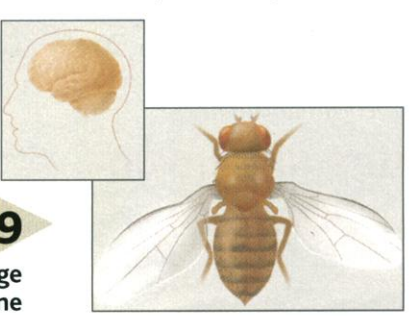
Helping *A Beautiful Mind*

SCIENCE'S COMPASS

800
Galen of Pergamum



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The advantage of a chaperone

RESEARCH

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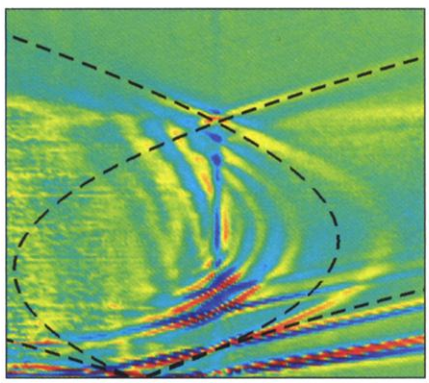
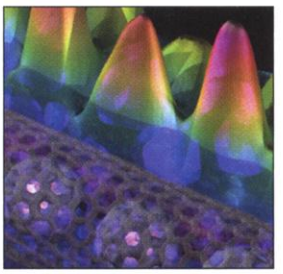
RESEARCH ARTICLE



825

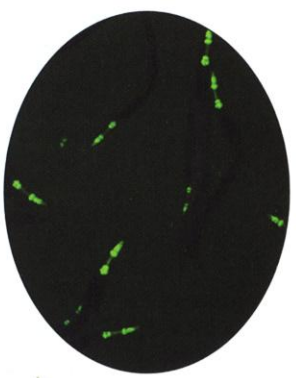
Excitations of a one-dimensional wire

REPORTS



COVER 828

C_{60} molecules encapsulated in a single-wall carbon nanotube peapod. In the background are the electron waves in this one-dimensional nanostructure, mapped with a scanning tunneling microscope (higher peaks represent higher tunneling conductance). Encapsulation of molecules is a viable route to tuning the electronic properties of carbon nanotubes, which form the heart of many proposed nanoscale devices. [Image: D. J. Hornbaker and A. Yazdani]



821

PHA-4 rules worm pharynx

New on *Science* Express Pheromones and sex discrimination in mice

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CONTENT HIGHLIGHTS AS OF 1 FEBRUARY 2002

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Loss of Sex Discrimination and Male-Male Aggression in Mice Deficient for TRP2 L. Stowers, T. E. Holy, M. Meister, C. Dulac, G. Koentges

▼ 782 Male mice that are genetically deficient in a protein expressed exclusively in the vomeronasal organ cannot detect pheromones and exhibit unusual behavior toward other males.

Instability of Glacial Climate in a Model of the Ocean-Atmosphere-Cryosphere System A. Schmittner, M. Yoshimori, A. J. Weaver

In an improved climate model, interactions between the ocean–atmosphere–sea ice system and continental ice sheets affect the stability of the North Atlantic thermohaline circulation, which may provide a mechanism to explain rapid millennial-scale warming events of the last glacial period.

Constraints in the Evolution of Sex Ratio Adjustment S. A. West and B. C. Sheldon

The mechanism of sex determination cannot explain all observed variation in sex ratio adaptation in animals: The ability of parents to predict their offspring's environment is an important factor.

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career resources for scientists

Global Feature: Careers in Science Editing Edited by R. Weibl

No manuscript is finished until the editor says so. But who are these editors, where do they come from, and why do they do what they do?

US: An Educated Woman M. P. DeWyse

Join Next Wave's newest columnist as she begins her journey through graduate school

US: What Do Postdocs Want? L. Haak

An informal poll on the Postdoc Network Listserv points to two clear priorities for federal legislators—implementing minimum standards for postdoc salaries and health benefits.

Singapore: Funding Resources for Scientific R&D J. Wong

A special feature on research grants and fellowships for Singapore's scientists.

Germany: Stem Cell Showdown E. von Ruschkowski

This week's vote by the Bundestag on whether to allow import of human embryonic stem cells is likely to have profound consequences for German science.

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Trash Talk R. J. Davenport

AGEs might participate in cell-death signaling.

Summertime—and the Learnin' Is Easy J. Toy

Students rave about courses on aging.

science's stke www.stke.org

signal transduction knowledge environment

Protocol: The Use of Gα COOH-Terminal Minigene Vectors for Studying the Role of Heterotrimeric G Proteins A. Gilchrist, A. Li, H. E. Hamm

Specific cellular inhibitors of G protein signaling.

Perspective: Phototropin Blue Light Receptors and Light-Induced Movement Responses in Plants C. Lin

Photoreceptors that have protein kinase activity participate in physiological processes in plants.

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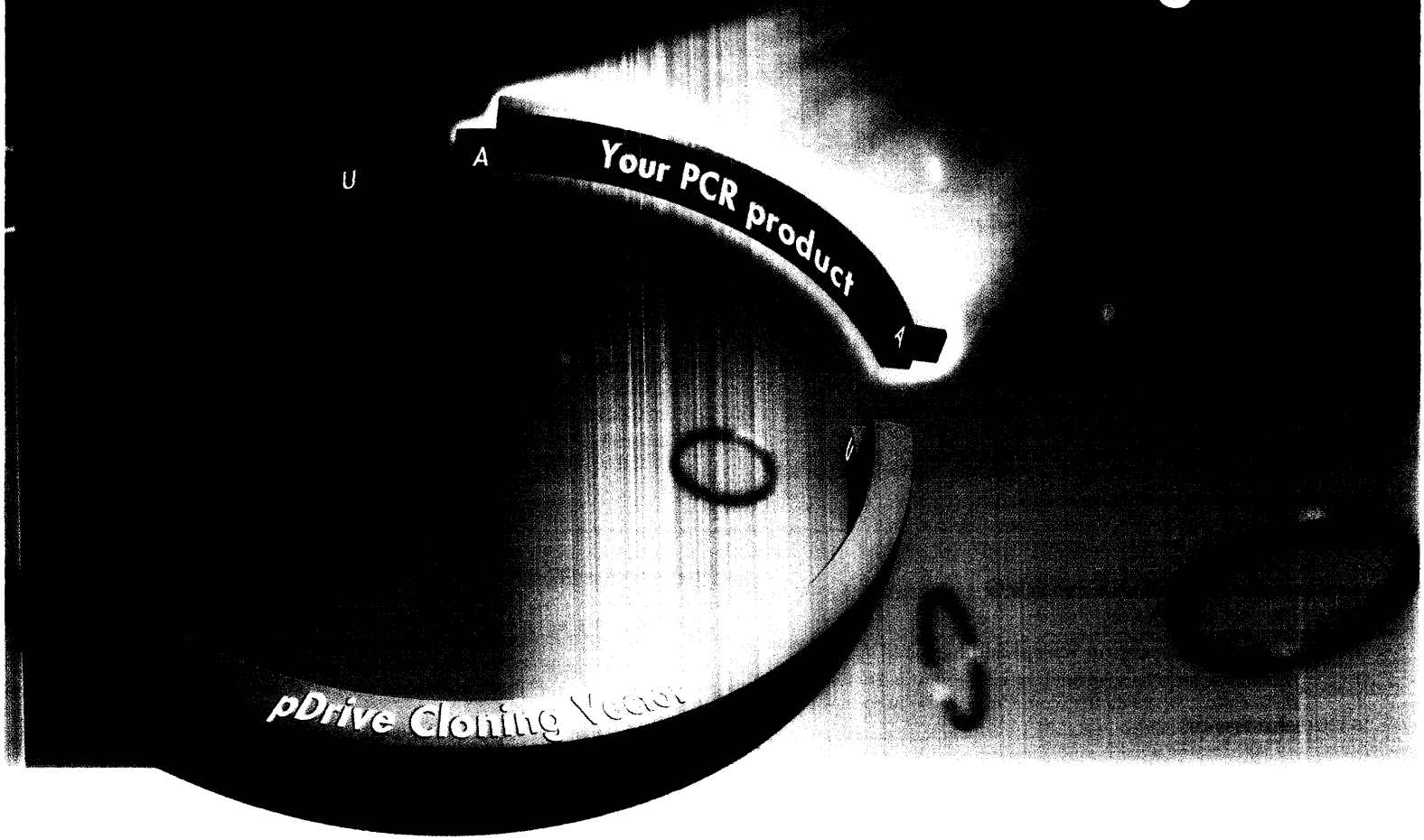

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THIS WEEK IN Science

edited by Phil Szuromi

Collective Action

Theory suggests that when electrons in metals are confined in a one-dimensional wire, they interact collectively, instead of independently as they do in bulk metals. The verification of these predictions has proven difficult experimentally. Auslaender *et al.* (p. 825; see the Perspective by Zülicke) have observed the electronic excitations in a pair of parallel wires, one with a gap along its length, as they studied the transport of electrons in the complete wire. The electrons can only get into the wire by tunneling from the broken wire, but only if the electronic states match up. The dispersion relation of the elementary excitations that they mapped by varying the energy (with a voltage bias) and momenta (with a magnetic field) of the injected electrons is in agreement with collective behavior.

828

Value-Added Peapods

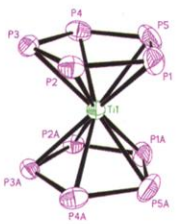
Recent work has shown that hybrid structures consisting of single-walled carbon nanotubes filled with C_{60}, known as "peapod" structures, can be prepared. A scanning tunneling microscopy study by Hornbaker *et al.* (p. 828; see the cover) of these peapod structures indicates that the electronic density of states of the nanotube are altered by the addition of the C_{60} molecules. The periodic distribution of the C_{60} within the nanotube and the ability to move the fullerenes may offer the possibility to tune the orbital hybridization and to form structures with desirable electronic properties not available to the individual constituents.

And in Brevia ...

Parthenogenesis, the process by which an egg can develop into an embryo in the absence of sperm, has been used by Cibelli *et al.* (p. 819) to derive embryonic stem cell lines (from the primate *Macaca fascicularis*) that can differentiate into a range of cell types, including cardiomyocyte-like cells, smooth muscle cells, adipocytes, ciliated epithelium, and neurons.

Metallocenes Sans Carbon

Ferrocene is a "sandwich" compound in which an iron atom is bound to two aromatic cyclopentadienyl ($C_5H_5^-$) rings. Like benzene, ferrocene and many other metallocenes show thermal stability and reactivity reminiscent of benzene and have found several uses, such as polymerization catalysts. The ability of this structure to stabilize aromatic species has allowed the synthesis of aromatic phosphorus compounds in which one $C_5H_5^-$ ring is replaced by P_5^- (P being isoelectronic with CH). Urnéžius *et al.* (p. 832) now report the "one-pot" synthesis of $[(\eta^5\text{-}P_5)_2Ti]^{2-}$ from highly reduced Ti complexes and white phosphorus. Despite its electron-deficient character, salts of this compound show remarkable stability toward air and heat.



Gut-Level Genomics

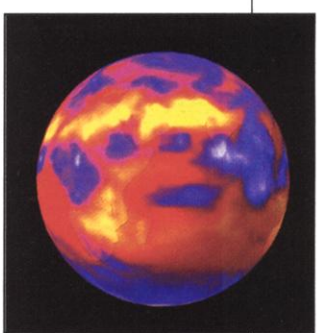
The FoxA family of transcription factors, which includes the *pha-4* gene of *Caenorhabditis elegans*, is critical for the development of the digestive organs in a wide range of species. Using a genomics-scale approach, Gaudet and Mango (p. 821) compared microarrays from *C. elegans* embryos lacking a pharynx with microarrays from embryos having excess pharyngeal tissue. This analysis identified 240 genes that were preferentially expressed in the pharynx, and PHA-4 directly regulated almost all of the pharynx-specific genes that were examined in detail. Furthermore, the relative affinity of PHA-4 for different DNA sites linked to these genes correlates with the time the genes are activated in vivo.

Glancing Goals

Saccades, small rapid eye movements when jumping from one fixation point to another, are mostly controlled by the frontal cortex. Seidemann *et al.* (p. 862) combined electrical microstimulation and optical imaging to study the mechanisms underlying the planning and execution of saccades in the frontal eye field and cortical area 8Ar in its direct vicinity. Stimulation of these regions sufficient to evoke saccades produces a concomitant wave of depolarization succeeded by a large and prolonged hyperpolarization. The direction and amplitude of the evoked eye movements depend on the time point of saccade initiation with respect to this sequence. If a saccade is initiated during depolarization, it will be contralateral (eye movement to the opposite side of the body), but if it is initiated during hyperpolarization, it will be ipsilateral (to the same side). Saccade amplitude is correlated to the relative magnitude of the depolarization or hyperpolarization state.

The State of Atmospheric Flux

Satellite data have been used to understand primary processes that affect the Earth's radiation and to observe long-term flux trends. Aerosols can affect Earth's albedo (reflectivity) directly, by reflecting or absorbing radiation, or indirectly through their effects on cloud formation. Bréon *et al.* (p. 834) have compared satellite measurements of cloud droplet radii to the amount of small aerosols in the atmosphere in order to construct a global view of how aerosols affect cloud droplet size. They find distinct differences in the properties of clouds over land and over oceans, and suggest that anthropogenic emissions may be responsible for much of this variability on a global scale. Significant interannual variations in Earth's radiative flux linked to large-scale atmospheric circulation changes, such as the El Niño–Southern Oscillation (ENSO), are particularly evident in the tropics. Recent satellite measurements have detected even longer term trends (see the Perspective by Hartmann). Analysis by Chen *et al.* (p. 838) of data for the



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CONTINUED ON PAGE 763

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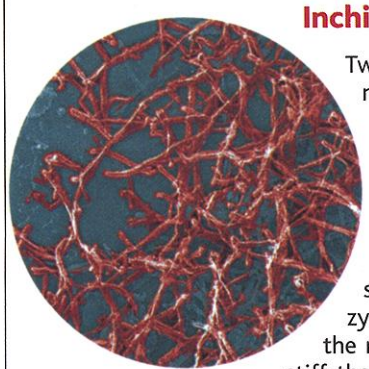
past 15 years on the fluxes of emitted thermal and reflected solar radiation shows that the observed decadal positive trend in outgoing longwave radiation is the result of stronger Hadley-Walker circulation. This general strengthening of tropical circulation, which occurred primarily during the first half of the 1990s, could be the result of either natural climate variability or anthropogenic forcing. Wielicki *et al.* (p. 841) present a compilation of tropical top-of-atmosphere radiative-flux data from two decades of satellite measurements which shows that the energy budget is much more dynamic and variable than was previously believed. Radiative flux variations of 1 watt per square meter (W/m^2) can influence the output of climate models. They report rapid changes in longwave radiation, often related to ENSO or large volcanic eruptions, of as much as 8 W/m^2, seasonal variations of 5 W/m^2 in shortwave fluxes, and decadal drifts of 2 to 4 W/m^2.

Inching Along



Two different mechanisms have been proposed for the movement of kinesin along microtubules in 8-nanometer steps, a "hand-over-hand" mechanism, where the two kinesin heads alternately move past each other, and an "inchworm" mechanism, where the two heads do not swap places. Hua *et al* (p. 844; see the news story by Couzin) immobilized kinesin molecules through the carboxyl-terminal end of the neck domain and measured orientations of microtubules moved by single enzyme molecules. The kinesin-mediated linkage between the microtubule and the surface was sufficiently torsionally stiff that hand-over-hand stepping would produce 180° rotations of the microtubule relative to the immobilized neck. No 180° microtubule rotations were observed, and the results instead support an inchworm mechanism.

Chaperoning Neuronal Degeneration

In a fly model of Parkinson's disease, Auluck *et al.* (p. 865; see the Perspective by Helfand) have demonstrated a role for the molecular chaperone Hsp70 in protecting dopaminergic neurons in the presence of pathological levels of α-synuclein. When the authors went on to examine Lewy bodies in postmortem samples from human patients, these characteristic pathological lesions also contained high concentrations of molecular chaperones. These results suggest that modulating the activity of chaperone proteins may help in treating this debilitating disease.

A Green Light for Transgenes

Silencing of retroviral sequences during embryonic development is believed to be a developmental safeguard against uncontrolled expansion of these parasites. However, this shut-off of gene expression has represented a major obstacle for scientists trying to create transgenic animals. Lois *et al.* (p. 868) have shown that transgenic mice and rats can be generated at high frequencies by infection of single-cell embryos with recombinant lentiviral vectors. The transgene (in this case, green fluorescent protein) was expressed at high levels and could be made tissue-specific by coupling it to an appropriate promoter. The transgene was transmitted through the germ line to the next generation. Although it is not proposed that this approach replace other methods, it may be especially useful for quickly and inexpensively developing many transgenic lines and for other species in which pronuclear injection or other methods have not worked.

Bacterial Amyloids

Amyloid fibers are associated with a variety of disease states, including prion diseases and systemic amyloidosis. Chapman *et al.* (p. 851) now show that extracellular fibers expressed by the bacterium *Escherichia coli* are a bacterial form of amyloid. Curli fibers possess several amyloid-specific characteristics—for example, they aggregate to form fibers that bind to the dye Congo red. However, in the intact bacterium, the expression of curli requires the concerted action of several gene products. Understanding how curli are assembled may help in our understanding of pathological amyloids in human disease.

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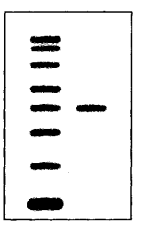

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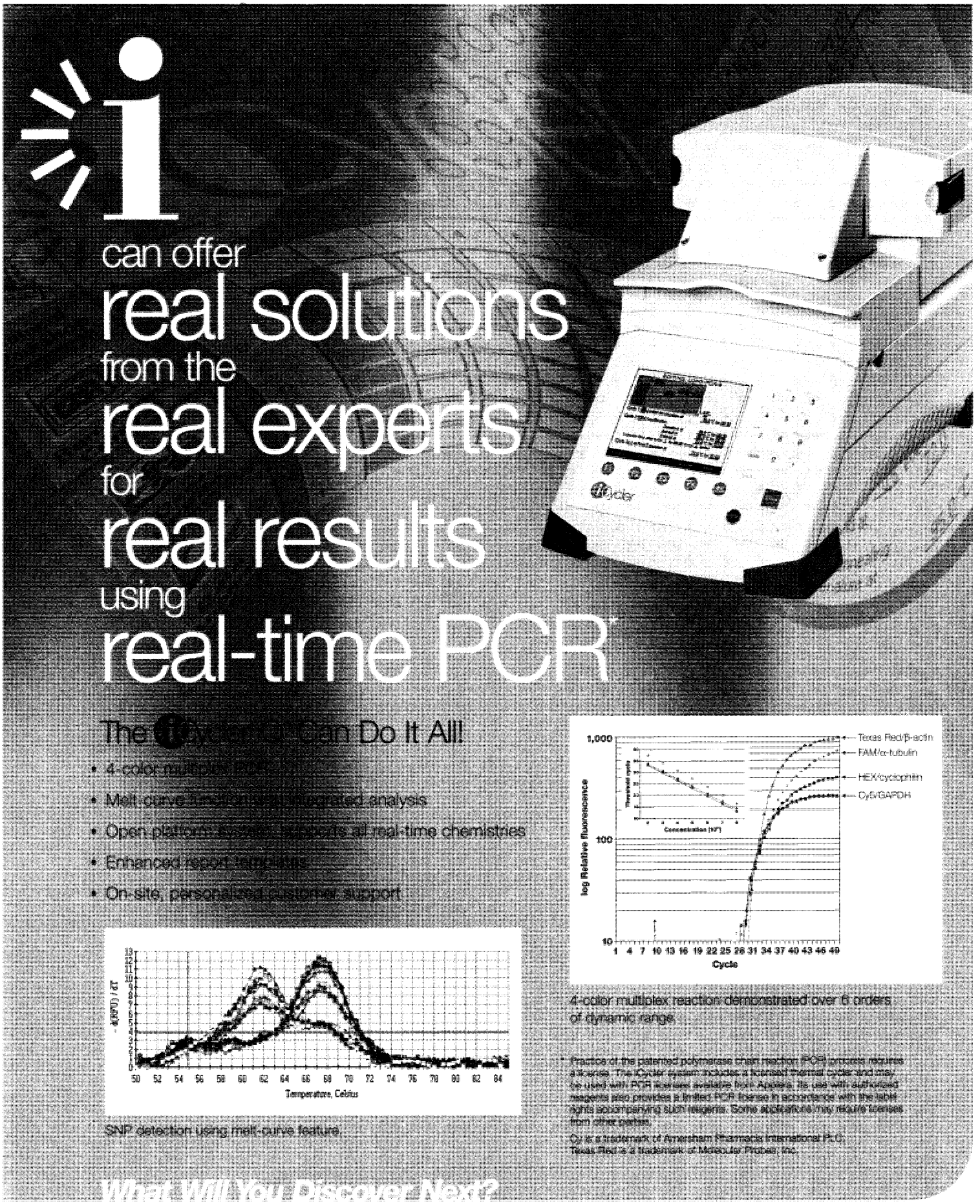

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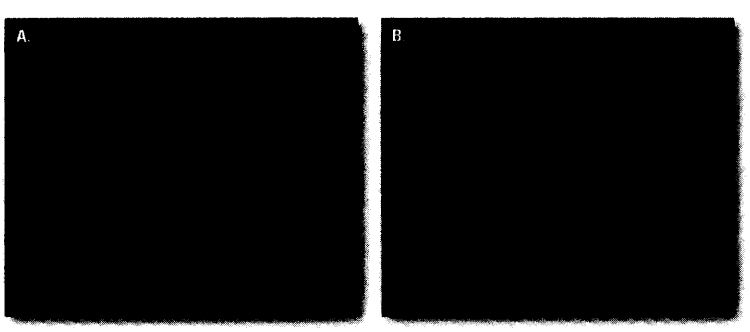

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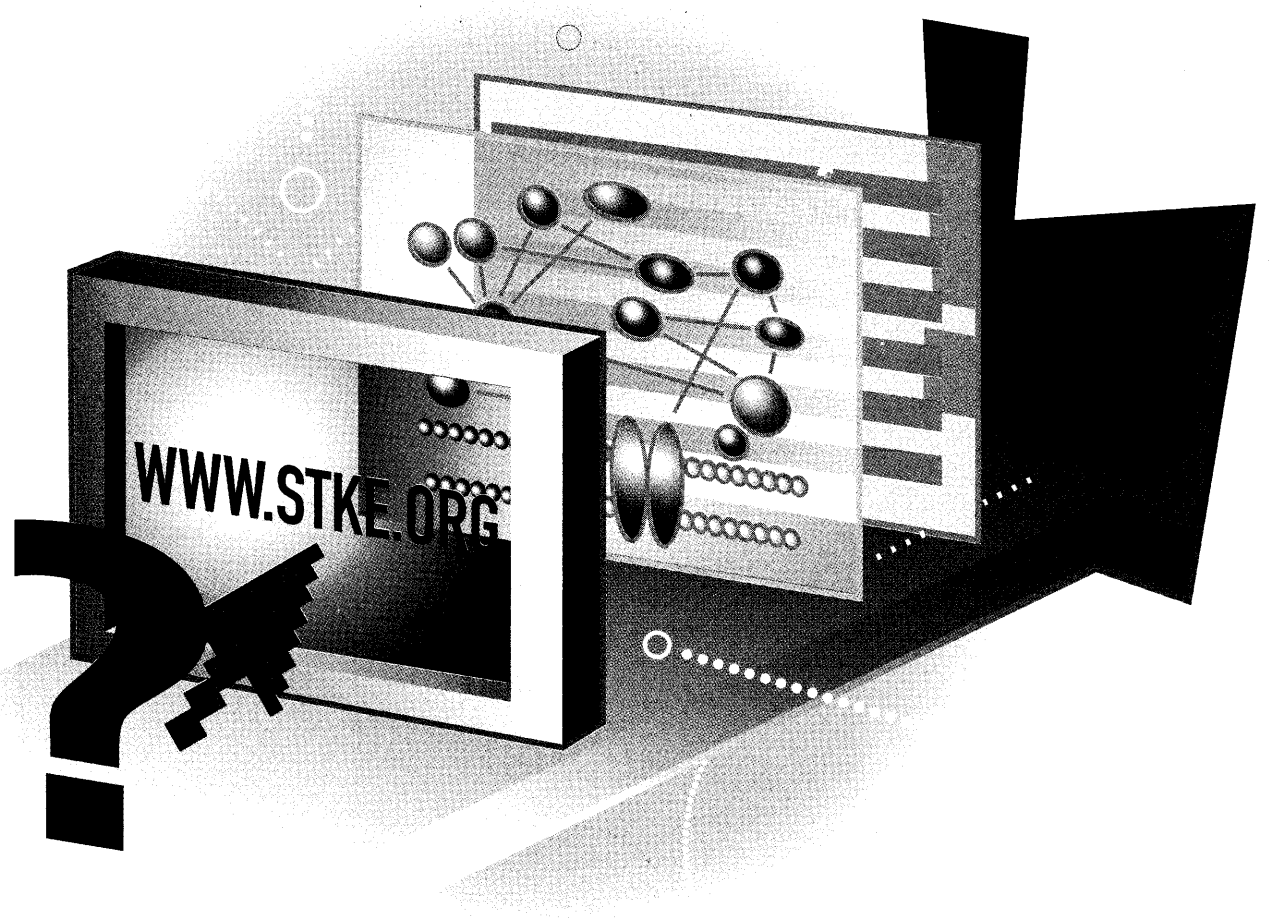

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