29 June 2001

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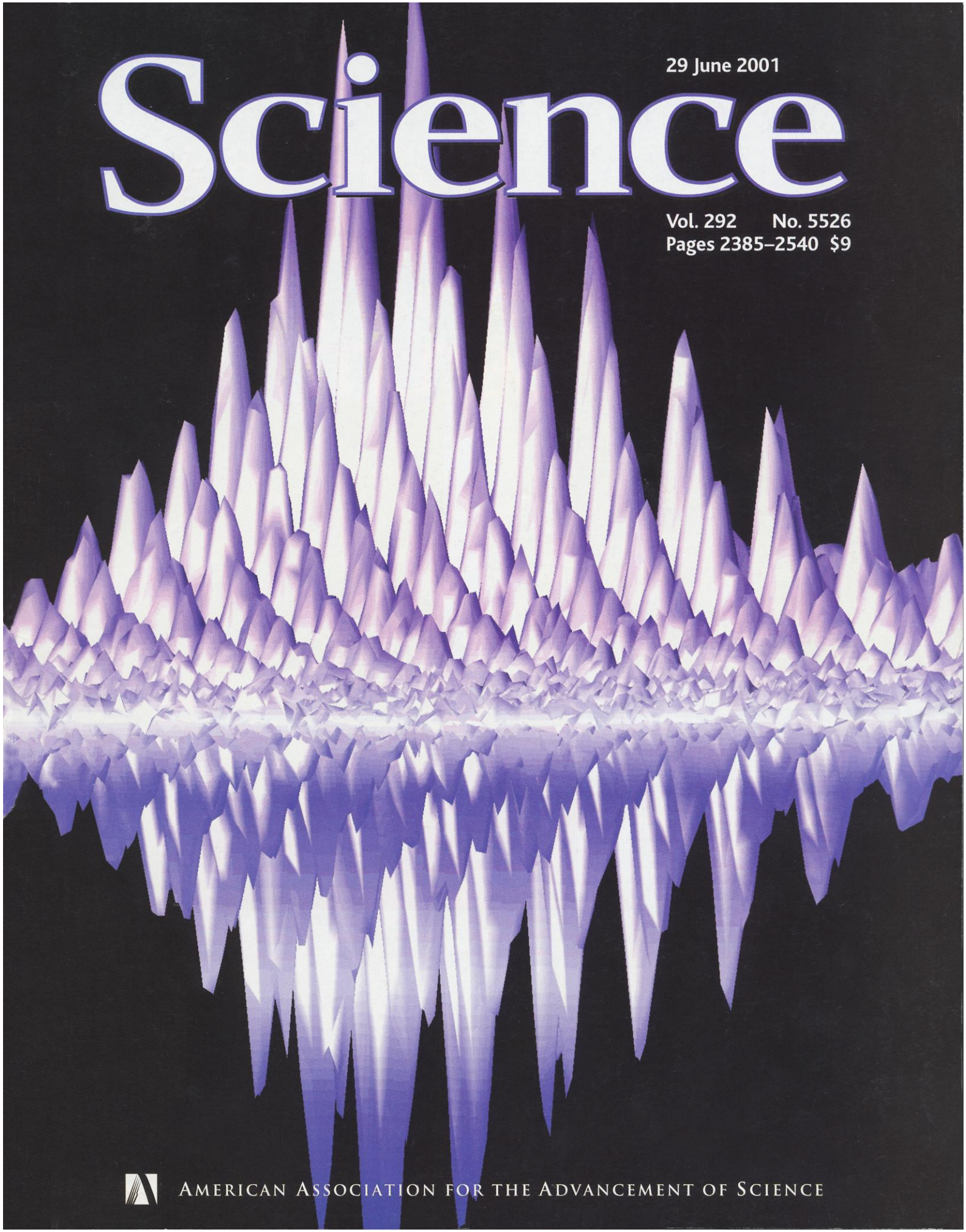

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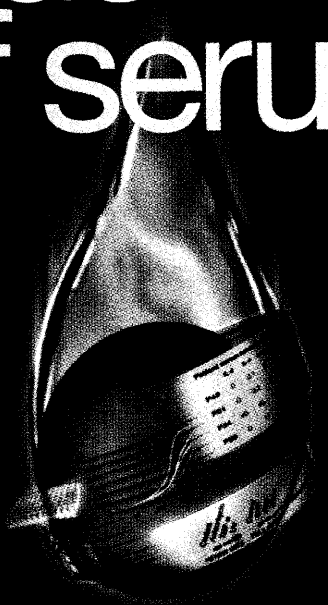

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1. Ogura, Y., Bonen, D.K., Inohara, N., *et al.* A frameshift mutation in NOD2 associated with susceptibility to Crohn's disease. *Nature* **411**, 603-606 (2001).

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Science

Volume 292 29 June 2001 Number 5526

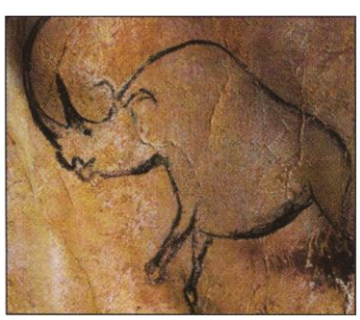
2418
The origins of writing

NEWS

NEWS OF THE WEEK

NEWS FOCUS

SCIENCE'S COMPASS



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The perils of radiocarbon dating

POLICY FORUM

BOOKS *ET AL.*

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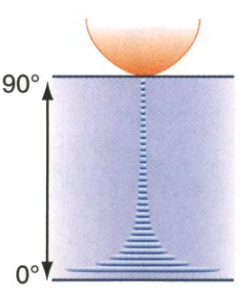
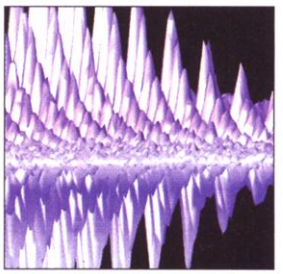
How to avoid the cracks



2486

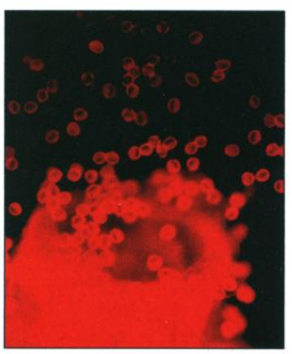
NO signals "ON" for firefly flashing



COVER 2458

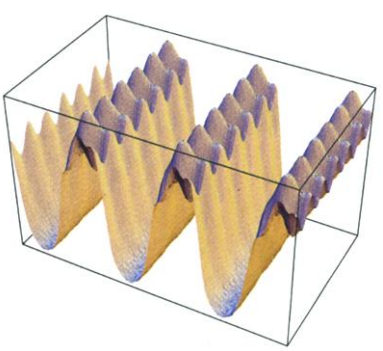
Femtosecond optical pulses allow coherent operations to be performed on electron spins in semiconductors. A pump pulse excites spins whose precession about a magnetic field is recorded by a probe pulse. A third pulse tips the spins as they precess, inducing changes in the precession amplitude, shown here as a function of probe and tipping pulse time delay. Peaks occur when there is an effective torque between the tipping pulse and the electron spin. [Image: J. A. Gupta]

RESEARCH



2482

Pollen grains find a landing



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Finding the mix of polymers and particles

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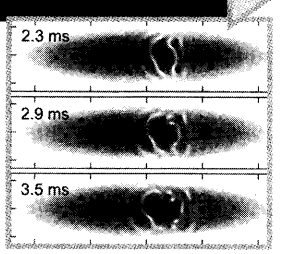

Evolution of defect-induced quantum shock waves in a Bose-Einstein Condensate

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Observation of Quantum Shock Waves Created with Ultra-Compressed Slow Light Pulses in a Bose-Einstein Condensate
Z. Dutton, M. Budde, C. Slowe, L. V. Hau

Ultra-compressed, slow light pulses were used to create small defects in a Bose-Einstein condensate, which were then observed to evolve into large-amplitude sound waves.

Ubiquitination of a New Form of α-Synuclein by Parkin from Human Brain: Implications for Parkinson's Disease H. Shimura *et al.*

A demonstration of interactions between parkin and α-synuclein, two proteins implicated in Parkinson's disease.

TECHNICAL COMMENTS

Mid-Holocene Climate in the South-Central Andes: Humid or Dry?

Using data from fossil rodent middens and wetland deposits from the central Atacama Desert in Chile, Betancourt *et al.* (Reports, 1 Sep. 2000, p. 1542) constructed a 22,000-year precipitation record for the region. One conclusion of the study was that the area was generally wet during the mid-Holocene, in contrast to the prevailing view of an arid climate for the central Andes during that period. In a comment, Grosjean argues that the Betancourt *et al.* interpretation rests on a misreading of the wetland deposits, which provide at best a local signal rather than an indication of regional wetness, and that more regionally sensitive data on such variables as glacial ice accumulation rates, lake levels, and paleosol formation draw "a consistent general picture of multimillennia-scale aridity." Quade *et al.* respond that "the wetland evidence for high water tables" during the period is "more widespread and in more diverse geomorphic settings" than Grosjean suggests, and that the consistency of wetland ages across a range of geomorphic settings suggests regional rather than local patterns.

The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/2391a.

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Review: Signal Integration via PKR B. R. G. Williams

A review of the role of PKR in signal transduction pathways involved in cellular responsiveness to proinflammatory stimuli.

Perspective: PACT and PKR—Turning on NF-κB in the Absence of Virus F. D'Acquisto and S. Ghosh

How and why does PKR activate NF-κB in the absence of infection?

science's next wave www.nextwave.org

Germany: University and Research Financing—Reinventing the Wheel? E. von Ruschkowski

Although the 2002 budget for education and research increased by 4%, Germany needs to find new ways to finance its universities if they are to avoid falling behind. Are foundations a solution?

UK: Homing in on Epilepsy K. Urquhart

The Engineering and Physical Science Research Council has introduced a new grant to help postdoctoral physical scientists apply their training in new areas. We talked to the first recipient about moving from radar research into biomedicine.

US: Learning and Teaching Scientific Ethics K. Cottingham

Stuck teaching an ethics course? Required to take one? Don't fret—you might just discover a new passion!

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THIS WEEK IN Science

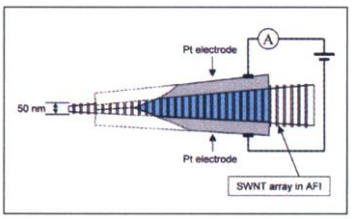
edited by Phil Szuromi

Electrons Dance in the Spotlight

Application of a magnetic field polarizes the spin of an electron in the direction of the magnetic field. The net moment of an electronic ensemble can rotate in response to a varying magnetic field, and methods such as nuclear magnetic resonance can take advantage of this effect to probe the electronic environment of many materials. In semiconductors, however, the lifetime of conduction electrons is on the time scale of the shortest magnetic field pulses and so other techniques are required. Gupta *et al.* (p. 2458; see the cover and the news story by Service) show that an optical tipping pulse can induce an effective magnetic field that causes the precessional dynamics of the magnetic moment to be altered in a controlled and reversible manner. The femtosecond length scales of these optical pulses are so short that electrons could be probed thousands of times in their coherent lifetimes, thus opening applications in quantum computing.

▼2462 Superconducting Carbon Nanotubes

Carbon nanotubes can display semiconducting or metallic properties at room temperature, and recent work has indicated that bundles of small diameter nanotubes may actually be superconducting. Tang *et al.* (p. 2462) have grown individual single-walled carbon nanotubes just 4 angstroms in diameter in the pores of a zeolite crystal and present transport and magnetic data verifying their superconductivity. Moreover, the very small diameter and isolation of each nanotube results in a superconductivity transition at 15 kelvin, well above that observed in the bundles.



Boron Extends Carbon's Reach

In most of its saturated compounds, carbon is bound to four other atoms in a tetrahedral arrangement. Unsaturated carbon compounds have planar structures but have coordination numbers of two or three. Wang and Schleyer (p. 2465) report density-functional calculations which suggest that whole families of hyparenes—hypercoordinated aromatic or anti-aromatic molecules—may be possible. In these structures, carbon is bound to five other atoms in a planar arrangement. The key to their stability is the incorporation of boron into the molecules. No experimental observations of such molecules have been reported to date, but if the borocarbon species detected by mass spectrometry can be isolated and identified, hyparenes may be found.

C Changes

Carbon-14, which has a half-life of about 5700 years, occurs naturally on Earth only because it is continuously produced in the atmosphere through nuclear reactions caused by cosmic rays. Large variations in the atmospheric abundance of ^{14}C are possible if there are changes in its production rate or how it is cycled between the ocean, atmosphere, and land. Beck *et al.* (p. 2453; see the Perspective by Bard) analyzed a stalagmite from the Bahamas and show that large variations in the atmospheric abundance of ^{14}C, greater than could have been caused by modulation of the production rate, occurred during the past 45,000 years. This finding is important for carbon dating because accurate dates depend on precise values for the initial abundance of ^{14}C, and for understanding how ocean circulation and carbon sequestration may have varied during that interval.

Thrown into the Mix

Phase separation at the nanoscale can lead to rich morphologies. Such effects are often seen in diblock copolymers, which can tie together otherwise immiscible polymers, and in mixtures of homopolymers and nanoparticles. What happens when a diblock copolymer is mixed with nanoparticles? Thompson *et al.* (p. 2469) have combined two existing theories, one used to successfully describe polymer thermodynamics, and a second used to describe particle ordering in colloidal systems, to model a diblock copolymer–nanoparticle mixture and predict what kind of morphologies could form. The model not only reproduces results of some recent experiments and simulations, but also predicts a number of novel morphologies. Conditions are also found where the nanoparticles self-assemble into nanowires or nanosheets.

Slab Remnant

Earth's crust is recycled into the mantle at subduction zones; this process not only produces earthquakes but also affects the thermal, chemical, and mechanical structure of the mantle. Chen and Brudzinski (p. 2475; see the Perspective by Green) analyzed thousands of earthquakes along the Tonga subduction zone in the southwest Pacific Ocean near Fiji and inferred the presence of a subhorizontal remnant of a subducted slab of oceanic crust between depths of 400 to 660 kilometers. This remnant slab is from an ancient subduction zone and is detached from the current Tonga subduction zone. This remnant-slab model explains the odd pattern of seismicity, provides a barrier for subduction of the Tonga slab into the lower mantle, and alters the thermal and rheological properties of the upper mantle in this region.

Caching Zinc

Cells of the bacterium *Escherichia coli* contain a total concentration of zinc of about 0.2 millimolar (mM). This abundant metal functions as a cofactor in many enzymes within the cell, so Outten and O'Halloran (p. 2488) were interested to know how much of the element was available free for binding to proteins. They calibrated the zinc-binding properties of two zinc sensor proteins that control synthesis of proteins that regulate zinc uptake or efflux from the cell. These proteins responded to a very narrow and extraordinarily low concentration range for zinc. Zinc binding was saturated at concentrations of 10^{-15} M. Given the volume of a bacterial cell of about 2×10^{-15} liters, one atom per cell would be pre-

CREDIT: TANG *ET AL.*

Published online in *Science* Express

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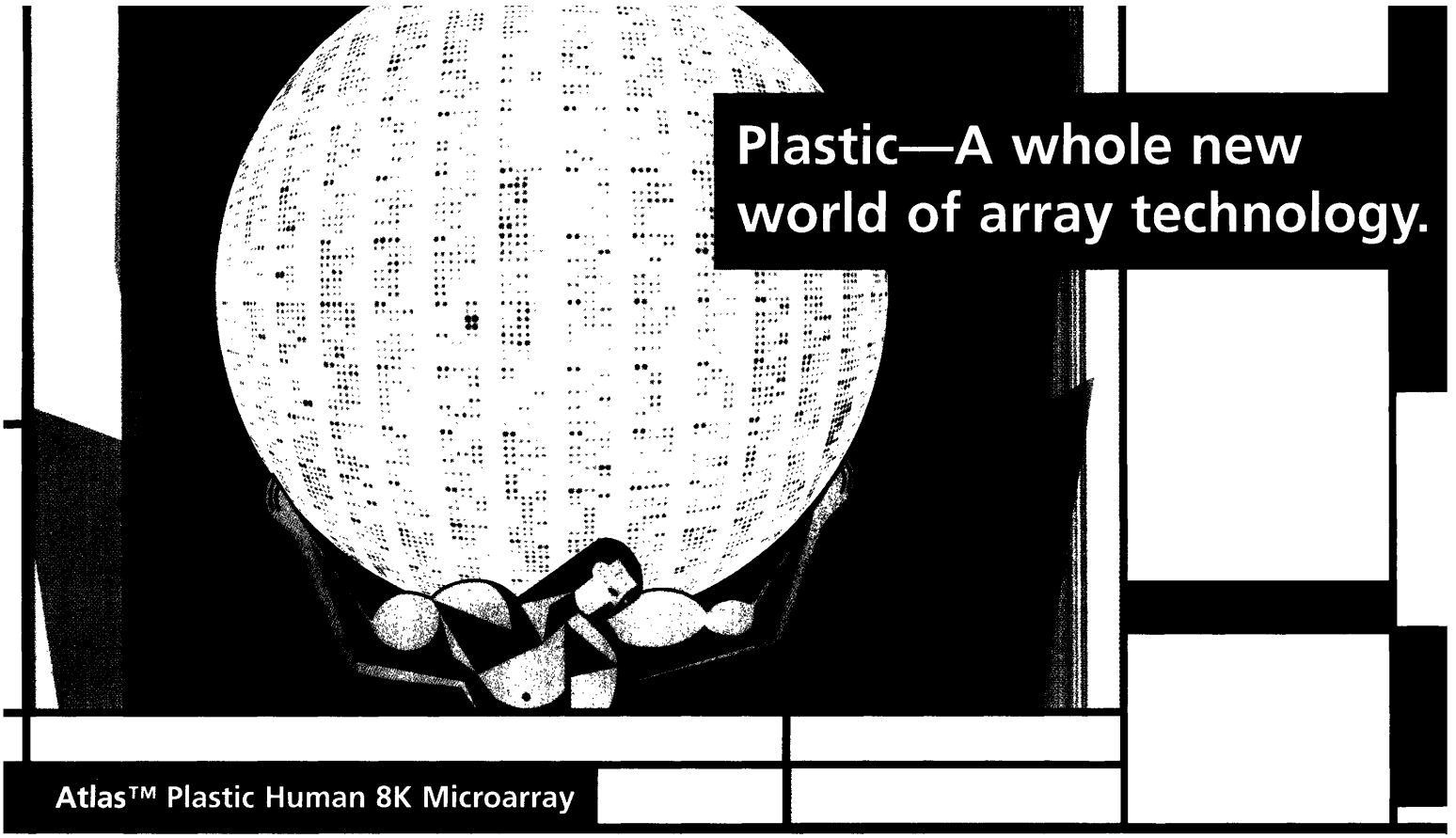

Illustration inspired by the art of Juan Gris (1887–1929) & Piet Mondrian (1872–1944).

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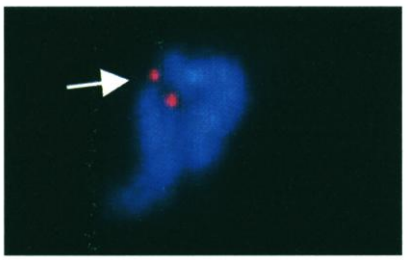
sent at a concentration of 1×10^{-9} M. Because the zinc sensors respond at concentrations that are six orders of magnitude lower, the authors conclude that there are no persistent free zinc ions in the cytoplasm. They propose that chaperone or trafficking proteins may mediate exchange of the metal between proteins, as they do for copper ions.

No Need for Males

Most multicelled animals are diploid (having pairs of chromosomes), but examples are known where the males are haploid (their somatic cells have half the normal chromosome number) but the females are diploid. Weeks *et al.* (p. 2479; see the Perspective by Otto and Jarne) have found a mite in Brazilian coffee plantations that has haploid females. *Brevipalpus phoenicis* apparently has no need for males because it reproduces asexually, but males can be recovered. An endosymbiotic bacterium—no relation to *Wolbachia*, which is known to feminize other insects—has feminized the haploid males. If female mites are treated with antibiotics, about half their progeny become male. These findings suggest that *B. phoenicis* females very recently shed diploidy to become a haploid asexual species.



CREDIT: WEEKS *ET AL.*

NO to Night Lights

The enchanting bursts of light that fireflies emit during courtship depend on a biochemical reaction that occurs in an abdominal light-producing organ, aptly named the lantern. Trimmer *et al.* (p. 2486; see the news story by Pennisi) report that regulation of the flash-producing reaction relies on both oxygen and the free-radical gas, nitric oxide (NO). NO is produced within the lantern and increases the flash rate and locomotion behavior in flies. Upon reaching the mitochondria, NO may alter respiration to increase the level of oxygen, which is known to be the immediate molecular trigger for light production.

A Twist on Nitrogen Fixation

We rely on prokaryotes to fix atmospheric nitrogen, and now Lilburn *et al.* (p. 2495) have added a new group to the list, the spirochetes. This family comprises a large and ubiquitous group of free-living, parasitic, and symbiotic organisms, and finding a new metabolic capacity among them fills a substantial gap in our knowledge of global nitrogen budgets. The survey started with spirochetes in termites, as it was known that nitrogen fixation supplied up to 60% of the total nitrogen in termite biomass, but there was poor evidence for the organisms responsible. Moreover, the reliance on nitrogen fixation is variable and may be regulated, in the termite host at least, by the presence of oxygen and the relative availability of more readily useable nutrients.

Instant Gratification Versus Delayed Reward

In order to obtain a large reward, one sometimes has to make sacrifices or reject the easier option of an immediately available but lesser reward. However, a number of individuals do not seem to see this connection and always go for the instant gratification. To study the neuroanatomical basis of this behavior, Cardinal *et al.* (p. 2499) made excitotoxic lesions in several brain areas of the rat. They found that lesioning the core of the nucleus accumbens initiated a persistent impulsive choice for food rewards. However, selectively lesioning the anterior cingulate cortex or the medial prefrontal cortex, two major afferents to the nucleus accumbens, did not change the animals' choice performance compared to sham-operated controls.

Restoring LTP

Studies with knockout mice lacking an AMPA receptor subunit (glutamate receptor A, or GluR-A) indicate that after the induction of long-term potentiation (LTP), increased transmission at hippocampal synapses is established and maintained by an increased response of AMPA receptors. In this preparation, the lack of AMPA receptors at nonsynaptic sites has been linked to the absence of LTP. Mack *et al.* (p. 2501) used a conditional knockout preparation of AMPA receptors tagged with green fluorescent protein to show that the GluR-A subunit is essential for pairing-induced LTP at mature hippocampal synapses.

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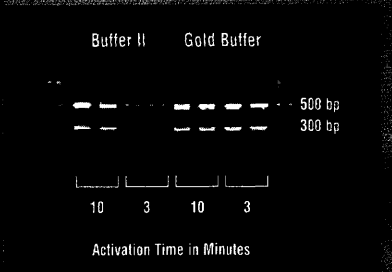

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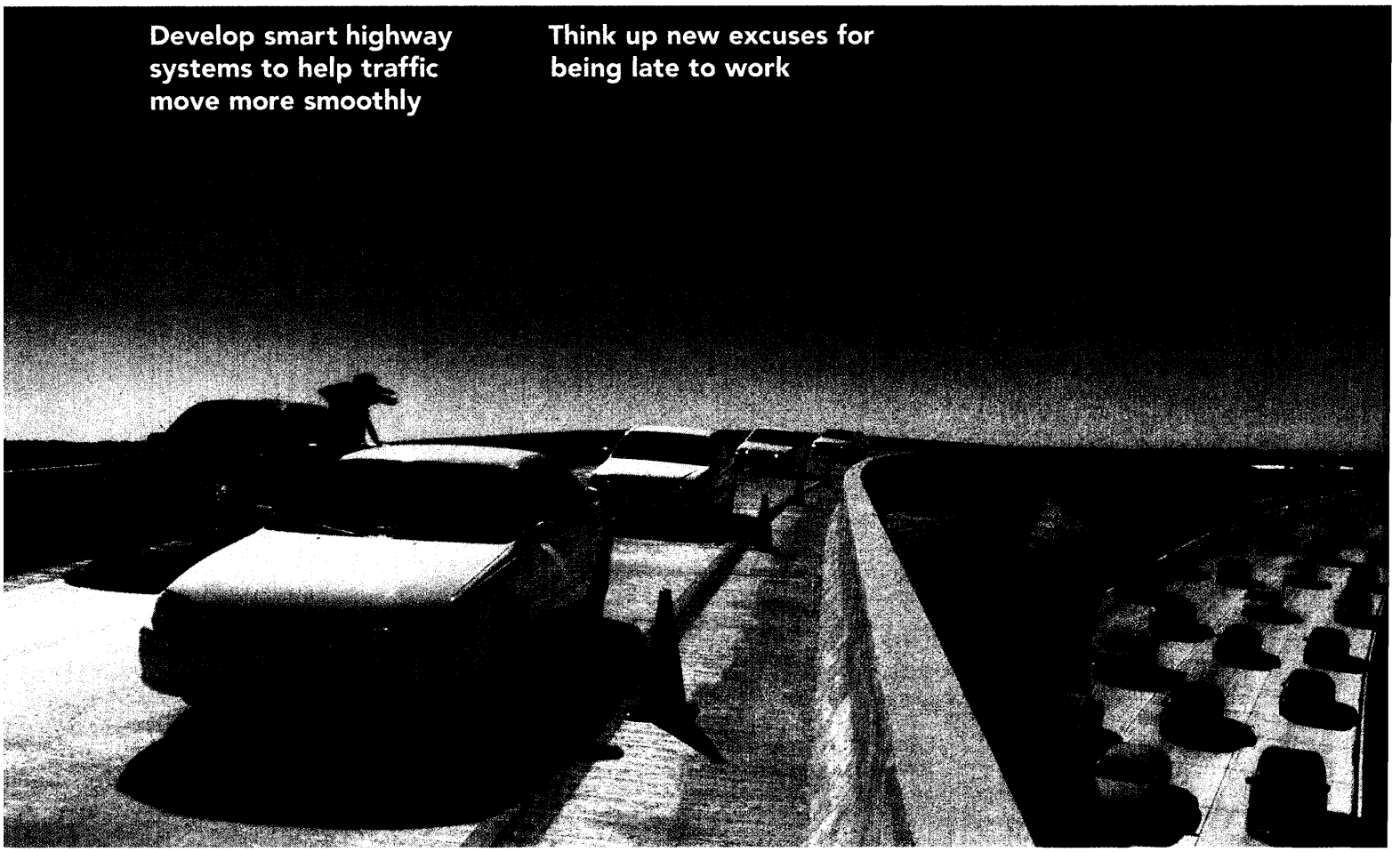

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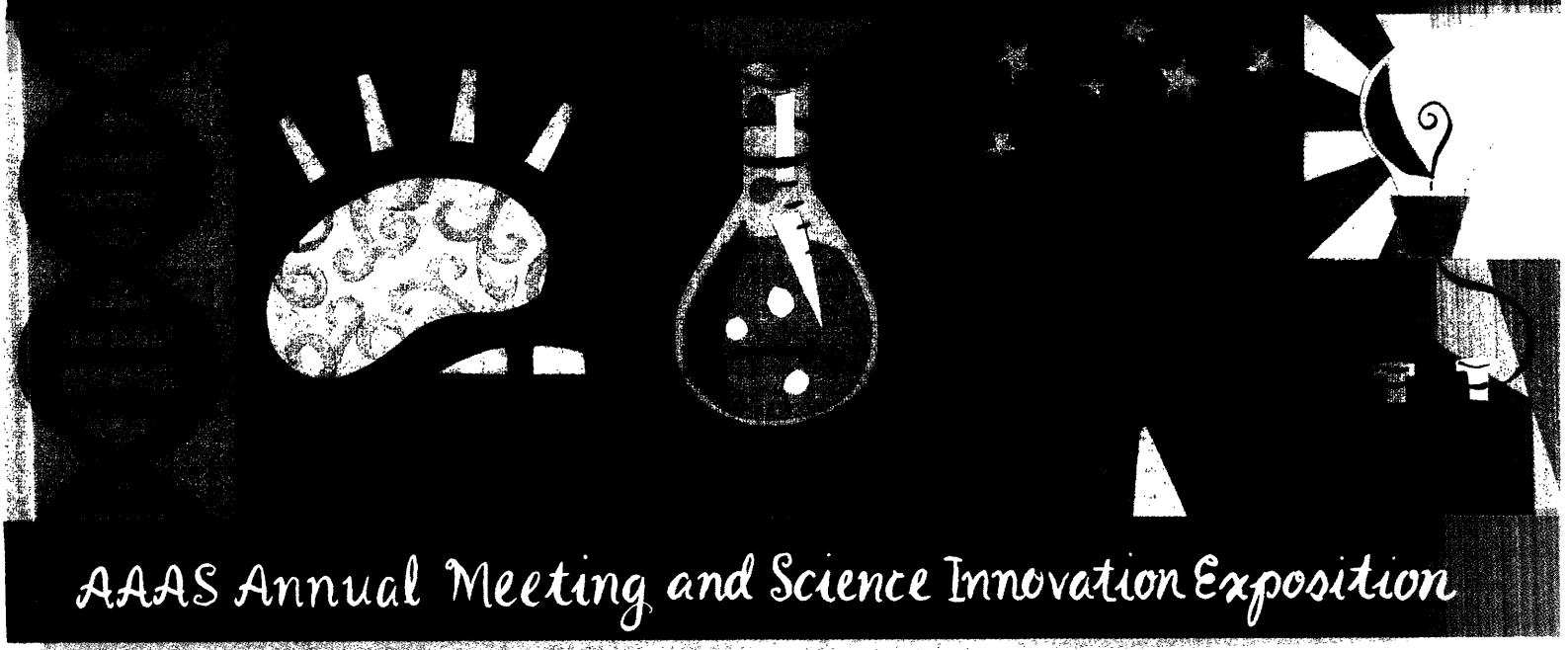

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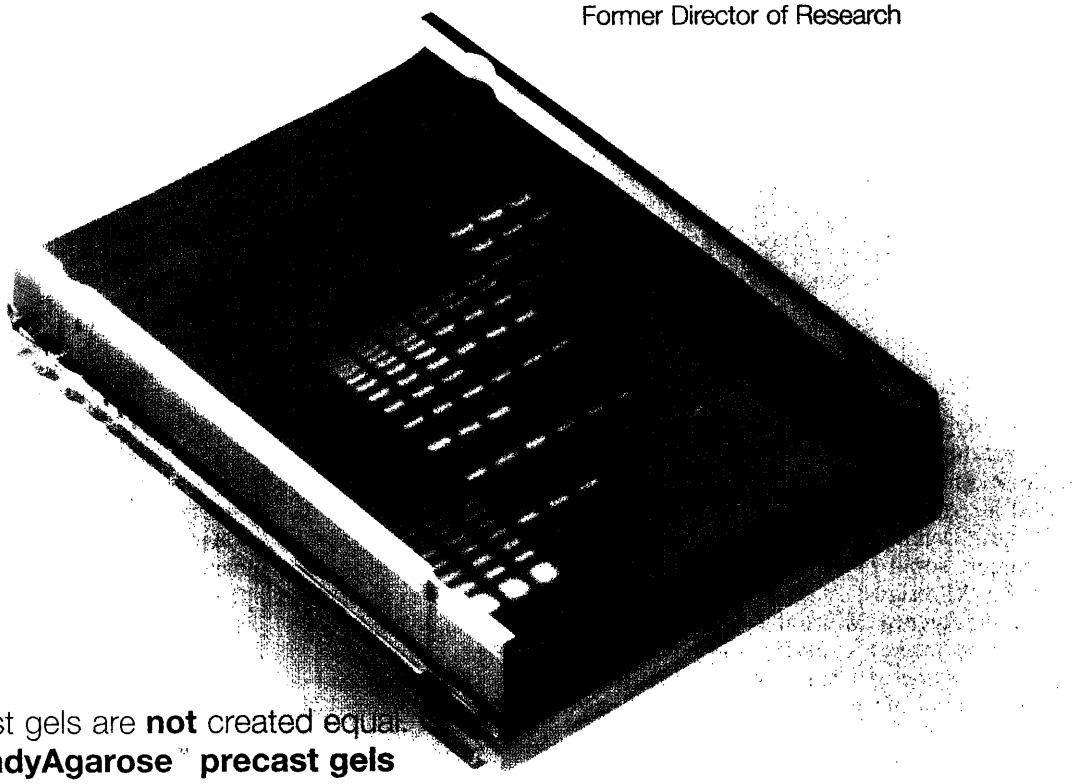

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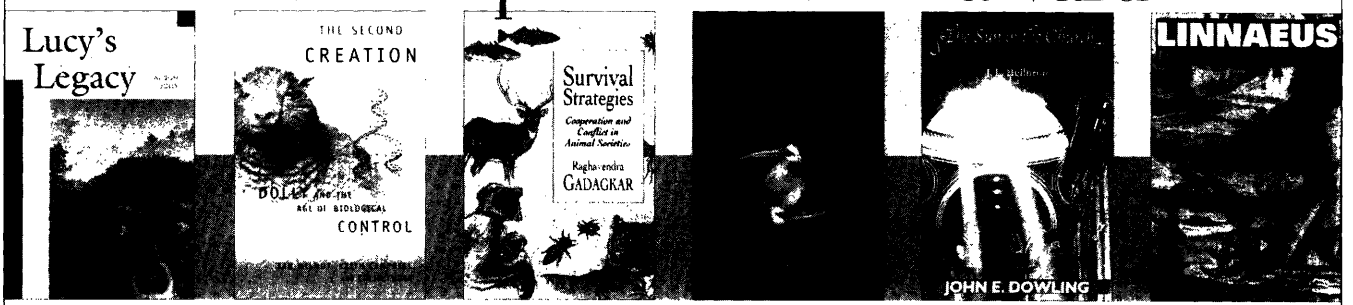

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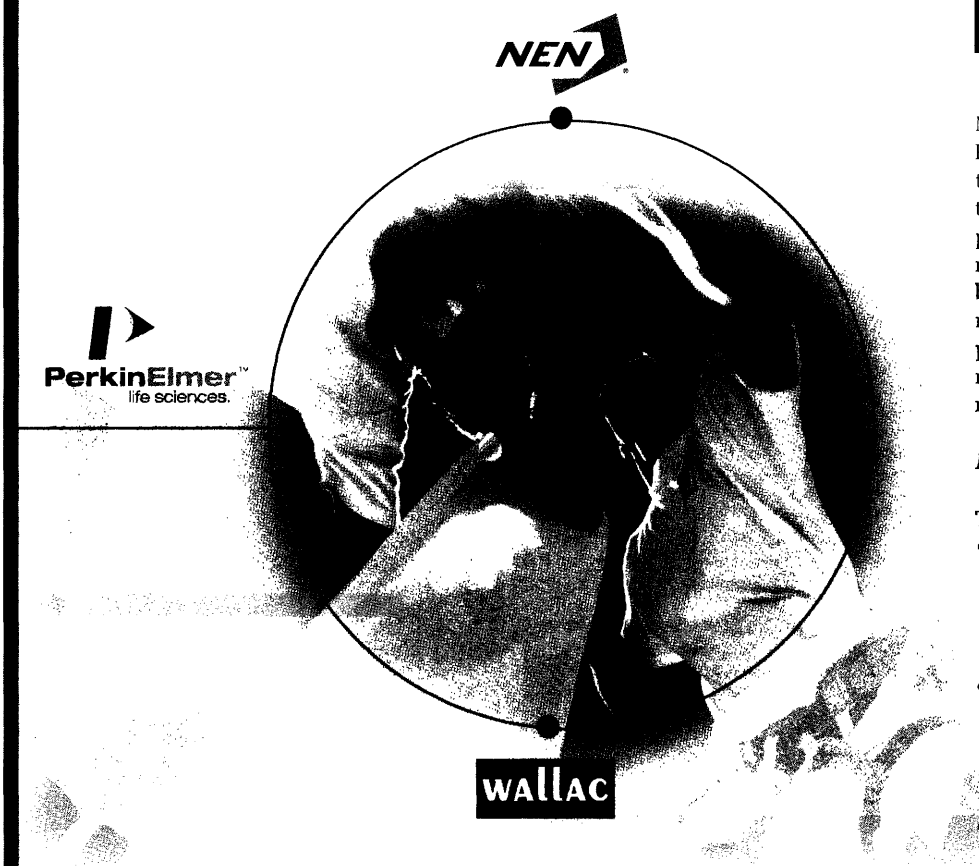

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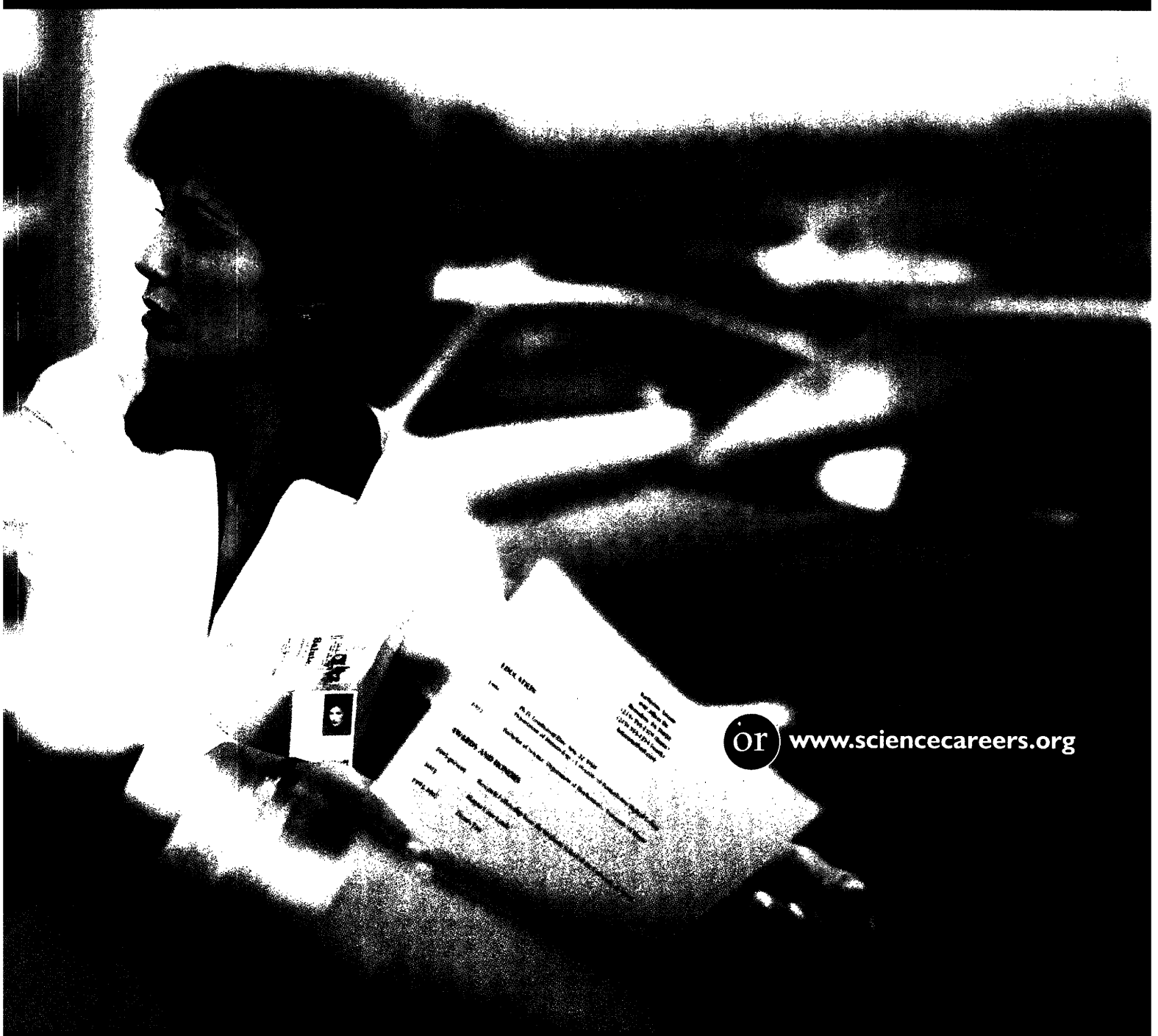

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The Wisconsin Package by Genetics Computer Group (now part of Accelrys, Inc.) is a server-based nucleic acid and protein sequence analysis product containing over 130 specialized software programs. Because many of these were designed with a command-line interface, efforts to improve the user interface have been made. SeqWeb is a collection of server-based scripts that interact with the Wisconsin Package and allow users to control selected programs from within a browser on their personal computer. SeqWeb scripts communicate with the Wisconsin Package programs to submit information for analysis and retrieve calculation results. Subsequently, program output is formatted into Web pages as text or graphics and then sent back to the user's browser for viewing.

SeqWeb provides pages for controlling program operation, viewing results, and managing sequences and preferences. All SeqWeb-accessible programs are available on a navigation bar. For convenience, links to the programs are organized both in a single list and hierarchically, according to function. Comprehensive online help contains literature citations, a description of each program, and a detailed guide of all parameters.

Selected programs are activated on the server by a user pressing a "run" button on the bottom of the SeqWeb browser page. An animated clock indicates the progress of computations. In version 2, SeqWeb introduces the concept of a "job," which represents a user program running on the server, complete with the list of parameters submitted for it. These parameters can be easily modified to simplify resubmission of data for a refined calculation. In addition to computed output, result pages include a program overview, values of parameters used in computations, and other supporting information to facilitate interpretation of results.

SeqWeb improves access to Wisconsin Package programs considerably, but it has several shortcomings. Images shown on the pages are constructed on the server, restricting users from altering color schemes, fonts, size, or magnification. Although this not a big obstacle during ongoing work, static images with a limited resolution present a significant problem for high-quality printing and presentations. Another limitation is the parameter selection page, which provides access to only the most important program parameters. Full control of parameters is available via the command-line and SeqLab (X Windows-based) interfaces to the Wisconsin Package. Lastly, only about 40% of the Wisconsin Package programs are available in version 2 of SeqWeb (up from 25% in the previous version).

Despite its drawbacks, SeqWeb provides an organization convenient access to the Wisconsin Package. It covers basic sequence analysis needs, but lacks database management facilities, extensive interactive capability, and publication-quality graphical output.

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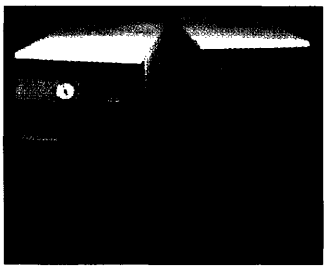
CHILLERS

The new "T" series chillers with turbine pump features tremendous cooling power, compact size, and five models that cover almost all chiller applications. They offer moderate- to high-flow rates with a built-in regulator. The manufacturer's other lines of chillers are the "standard" line with a magnetic drive centrifugal pump that provides good flow at low pressure, offering reliable and quiet use, and the "P" series chillers, which feature a positive displacement pump that offers a stable moderate- to high-flow at varying head pressures.



PerkinElmer
For more information call 800-762-4000 or
circle 141
on the Reader Service Card
www.perkinelmer.com

LUMINESCENCE IMAGING SYSTEM

The LS Imager luminescence imaging system sensitively measures the luminescence of two-dimensional (2D) and three-dimensional (3D) samples of virtually any size. The instrument's charge-coupled device camera technology provides sensitivity, while the Winlight32 software allows for optimal camera positioning and sample measurement. The LS Imager makes locating, counting, measuring, and quantitating samples fast and easy. From microplates, blots, and high-density gels to living animals and plants, the imaging system offers accurate measurements. The software automatically controls the system's height adjustments and focus.

Thermo Shandon
For more information call 800-547-7429 or
circle 142
on the Reader Service Card
www.thermoshandon.com

TRIMMER FOR CASSETTE CLEANING

The Para-Trimmer is designed to clean excess paraffin from cassettes prior to inserting them into the vise or quick release clamp on the microtome. The traditional method involves the manual use of a paring knife to scrape away excess paraffin. Failure to clean the blocks properly can lead to microtome sectioning problems—including chatter and thick and thin sections. In addition, the manual method can cause callous buildup or repetitive stress injury. The Para-Trimmer makes use of a heated surface to improve the cleaning procedure. When the cassette is placed against the top end of the heater plate, the paraffin immediately begins to soften and melt. The cassette is then drawn down the plate, causing the paraffin to drain down the grooves and into the disposable waste container. The left and

CONTINUED ON PAGE 2508

right ends of the grooved area can be used to clean uneven edges of the cassette. The Para-Trimmer can clean multiple cassettes simultaneously.

Appropriate Technical Resources
For more information call 800-827-5931 or **circle 143** on the Reader Service Card www.atrbiotech.com

SMALL SHAKING INCUBATOR

The MINITRON is a shaking incubator with a small footprint for small spaces or small applications. It features variable shaking speed, temperature control, a front-opening door with inspection window, and slide out tray. It can hold 34 250-ml flasks, 8 1-liter flasks, 6 2-liter flasks, or 3 5-liter flasks. Options include refrigeration, humidity control, carbon dioxide control, lighting, slide-out shelf, and stacking base.

Clare Chemical Research
For more information call 888-325-7694 or **circle 144** on the Reader Service Card www.clarechemical.com

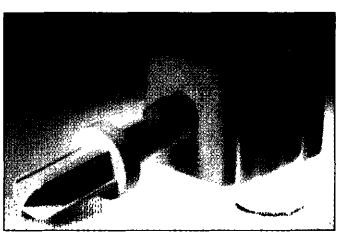
FLUORESCENCE DETECTION

The rugged and portable DR Spot Lamp is for the sensitive detection of various popular fluorophors, including green fluorescent proteins and SYBR-stained DNA. The DR Spot Lamp emits only visible light, so it is safe to use and does not damage biological samples. The efficient optical design enables a greater sensitivity of detection than ultraviolet light for most common fluorophors in the laboratory and rivals that of laser-based systems. The unit is compact and light weight (400 g) and can be powered by an ordinary 9-V alkaline battery, making it suitable for use in remote locations.

Bel-Art Products
For more information call 800-4BEL-ART or **circle 145** on the Reader Service Card www.bel-art.com

SEMI-SOLID SAMPLE COLLECTION

The Sterileware Samplit is a safe, sterile scoop and container system designed for collection and storage of semi-solid materials. The patent-pending design consists of a sturdy polystyrene scoop-lid collection device that is designed to collect the sample and then screw directly back into the 6.5-ounce clear styrene container. The entire system is supplied sterile and individually packaged. Because of the sturdy design of the scoop, the system is ideal for "coring" materials such as cheese. After the sample is taken, the scoop is immediately returned to the vial and capped for storage or for transport.



Gilson
For more information call 800-445-7661 or **circle 146** on the Reader Service Card www.gilson.com

HIGH-THROUGHPUT LIQUID-HANDLING INSTRUMENT

The Constellation 1200 is a high-throughput liquid instrument capable of nanoliter dispensing. Designed for the genomic, proteomic, and drug discovery marketplaces, it has 12 dispensing channels that make use of syringe-solenoid technology for noncontact dispensing of volumes ranging from 50 nl to 500 μl. The 1200 can aspirate from 96- and 384-well microplates and dispense into 96-, 384-, and 1536-well microplates. SmartTip Technology is an on-site automatic tip alignment feature that verifies the exact positioning of each tip and re-aligns any tips that are out of alignment to ensure maximum accuracy. The locater plate on the 1200 features spring-loaded plate positioners to ensure the proper placement of the microplates. The bed of the 1200 holds up to 12 microplates. The addition of the optional Constellation R5 robotic arm and carousel increases plate capacity to more than 120 microplates. An optional chiller is also available.

Brinkmann Instruments
For more information call 516-334-7500 or **circle 147** on the Reader Service Card www.brinkmann.com

MICROINJECTION OF ADHERENT AND SUSPENSION CELLS

The Eppendorf FemtoJet 5247 Microinjector for the injection of liquids into adherent and suspension cells features simple operation, refined technology, portability, and practical features. By combining an integrated compressor with a wide pressure range and finely regulated parameters (injection pressure, injection time, and compensation pressure), the instrument ensures higher productivity while maintaining precision and reproducibility. A computer interface enables fully automated microinjection.

Bioanalytical Systems
For more information call 765-497-8458 or **circle 148** on the Reader Service Card www.epsilon-web.net

ELECTROANALYTICAL PLATFORM

The epsilon e2 is an intuitive, Windows-based device capable of doing potentiostatic, galvanostatic, and potentiometric experiments. The base instrument includes the hardware and Windows interface to perform cyclic (linear sweep) voltammetry, controlled potential electrolysis, chronoamperometry-chronocoulometry, DC potential amperometry, chronopotentiometry, and open circuit potential versus time. The unit can be upgraded via the Internet to do pulse voltammetric determinations and other techniques.

Barnstead/ Thermolyne
For more information call 800-553-0039 or **circle 149** on the Reader Service Card www.barnstead.com

MELTING POINT APPARATUS

The digital Mel-Temp 3.0 is designed for the determination of melting points using glass capillary tubes. The unit is suitable for recording the beginning and ending points of each of three samples. A digital microprocessor with 0.1°C resolution provides fast warm-up and accurate temperature control, and eliminates the need for a mercury thermometer.

Promega
For more information call 608-274-4330 or **circle 150** on the Reader Service Card www.promega.com

LITERATURE

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