# 7 May 1999 Vol. 284. No. 5416 Pages 865–1076 \$8 FOR THE ADVANCEMENT OF SCIENCE

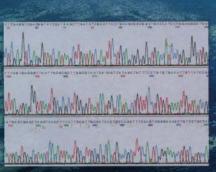
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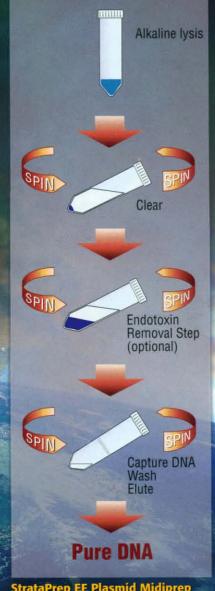
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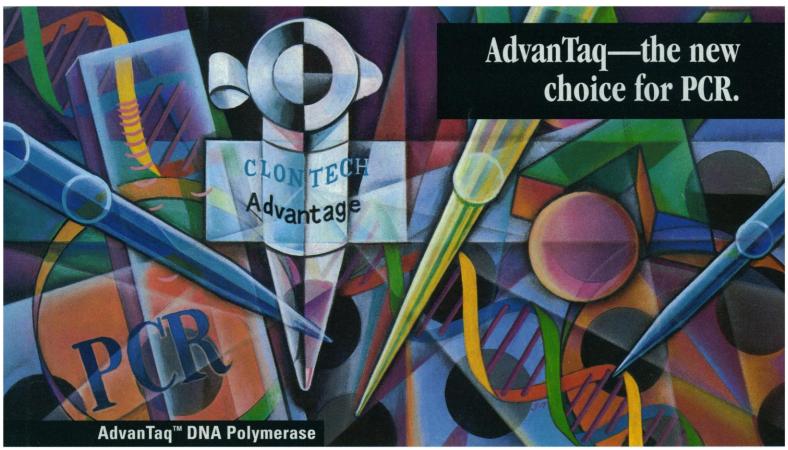
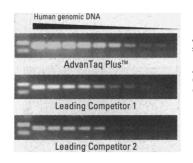


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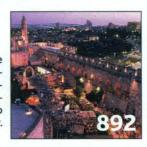
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# Science

COVER Like its capital city, Jerusalem, Israel is a vibrant mixture of old and new. Once known mostly for its oranges and its fabulous antiquities, the country is now turning into a high-tech powerhouse. Much of the credit for this must go to a vast wave of scientists from the former Soviet Union who began pouring into Israel 10 years ago and have reshaped Israeli science and industry. [Photo: FPG]





900 History bogs down

|             | E W 5  |              |  |
|-------------|--|--------------|--|
|             | NEWS OF THE WEEK   | 889          | PLANETOLOGY: Craters Suggest How<br>Venus Lost Her Youth               |
| 882         | DOE LABORATORIES: Spy Inquiry Is Taking                          |              | venus coserier routin  |
|             | Toll on Non-U.S. Researchers                                     | 891          | SCIENTIFIC COMMUNITY: NAS Elects 60 New Members                        |
| ₩883        | MICROBIOLOGY: Gene May Promise New                               |              | THE                                |
| 967         | Route to Potent Vaccines   |              | News Focus   |
| 883         | BIOMEDICAL PATENTS: Startling Revelations in UC-Genentech Battle | 892          | SCIENTIFIC COMMUNITY: Israel Hits Rich<br>Seam in Ex-Soviet Immigrants |
|             | Revetations in OC-Generatech Battle                              |              | In the R&D Sweepstakes, the Lure of a                                  |
| ₩886<br>974 | DIABETES RESEARCH: New Lead Found to a                           |              | Quick Shekel Prevails  |
| 9/4         | Possible 'Insulin Pill'  |              | Science Stronghold Seeks the Big Prize                                 |
| 886         | SWEDEN: Academics Applaud Renewed                                |              |  |
| ui .        | Support  | 897          | TECHNOLOGY: Shoebox-Sized Space<br>Probes Take to Orbit                |
| 888         | WEB TOOLS: Searching Museums From                                | <b>y</b> 900 | ATMOSPHERIC SCIENCE: Digging in the Mire                               |
|             | Your Desktop   | 939          | for the Air of Ancient Times   |
| 888         | SPACE ASTRONOMY: Heaven Can Wait,                                | 901          | SCIENTIFIC MISCONDUCT: ORI Report                                      |
|             | NASA Tells X-ray Telescope                                       |              | Tracks Gun-Shy Feds  |
|             |  |              |  |

## **DEPARTMENTS**

NETWATCH 871

THIS WEEK IN SCIENCE 873

SCIENCESCOPE 885

RANDOM SAMPLES 903

CONTACT SCIENCE 911

NEW PRODUCTS 981

# RESEARCH

NEWS

# REPORTS

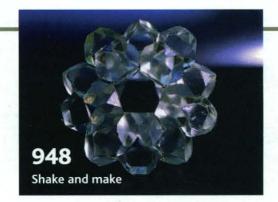
937 Room-Temperature Deintercalation and Self-Extrusion of Ga from Cr<sub>2</sub>GaN M. W. Barsoum and L. Farber

939 Mercury in a Spanish Peat Bog: Archive of Climate Change and Atmospheric Metal Deposition A. Martínez-Cortizas, X. Pontevedra-Pombal, E. García-Rodeja, J. C. Nóvoa-Muñoz, W. Shotyk

943 Direct Experiments on the Ocean Disposal of Fossil Fuel CO<sub>2</sub> P. G. Brewer, G. Friederich, E. T. Peltzer, F. M. Orr Jr.

945 Spectroscopic Determination of the Water Pair Potential R. S. Fellers, C. Leforestier, L. B. Braly, M. G. Brown, R. J. Saykally

948 Design and Self-Assembly of Open, Regular, 3D Mesostructures T. L. Breen, J. Tien, S. R. J. Oliver, T. Hadzic, G. M. Whitesides

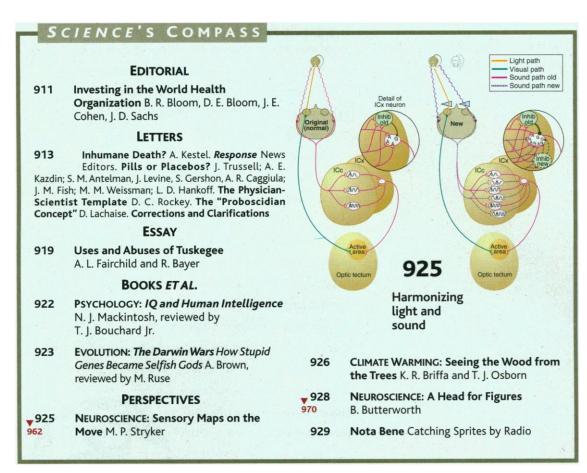


951 Requirement for Type 2 NO Synthase for IL-12 Signaling in Innate Immunity
A. Diefenbach, H. Schindler, M. Röllinghoff, W. M. Yokoyama, C. Bogdan

955 Interaction of Diphtheria Toxin T Domain with Molten Globule-Like Proteins and Its Implications for Translocation J. Ren, K. Kachel, H. Kim, S. E. Malenbaum, R. J. Collier, E. London

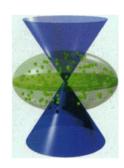


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| 958                | Action of DNA Repair Endonuclease ERCC1/XPF in Living Cells A. B. Houtsmuller, S. Rademakers, A. L. Nigg, D. Hoogstraten, J. H. J. Hoeijmakers, W. Vermeulen | <b>▼974</b><br>886 | Discovery of a Small Molecule Insulin<br>Mimetic with Antidiabetic Activity in<br>Mice B. Zhang, G. Salituro, D. Szalkowski, Z.<br>Li, Y. Zhang, I. Royo, D. Vilella, M. T. Díez, F.<br>Pelaez, C. Ruby, R. L. Kendall, X. Mao, P. |
|--------------------|--|--------------------|--|
| <b>▼962</b><br>925 | Functional Selection of Adaptive<br>Auditory Space Map by GABA <sub>A</sub> -Mediated  |                    | Griffin, J. Calaycay, J. R. Zierath, J. V. Heck, R.<br>G. Smith, D. E. Moller  |
|                    | Inhibition W. Zheng and E. I. Knudsen  | 977                | Roles of Phosphorylation Sites in<br>Regulating Activity of the Transcription  |
| 965                | Inheritance of Resistance to <i>Bacillus</i> thuringiensis Toxin (Dipel ES) in the   |                    | Factor Pho4 A. Komeili and E. K. O'Shea  |
|                    | European Corn Borer F. Huang, L. L.  |                    | TECHNICAL COMMENTS   |
|                    | Buschman, R. A. Higgins, W. H. McGaughey   |                    | Rule Learning by Seven-Month-Old   |
| <b>▼967</b><br>883 | An Essential Role for DNA Adenine Methylation in Bacterial Virulence D. M. Heithoff, R. L. Sinsheimer, D. A. Low, M.   |                    | <b>Infants and Neural Networks</b><br>G. T. M. Altmann and Z. Dienes. <b>Response</b><br>G. F. Marcus  |
|                    | J. Mahan   |                    | www.sciencemag.org/cgi/content/full/284/5416/875a  |
| <b>▼970</b><br>928 | Sources of Mathematical Thinking:<br>Behavioral and Brain-Imaging Evidence<br>S. Dehaene, E. Spelke, P. Pinel, R. Stanescu, S.                               |                    |  |



**958**DNA repair in focus

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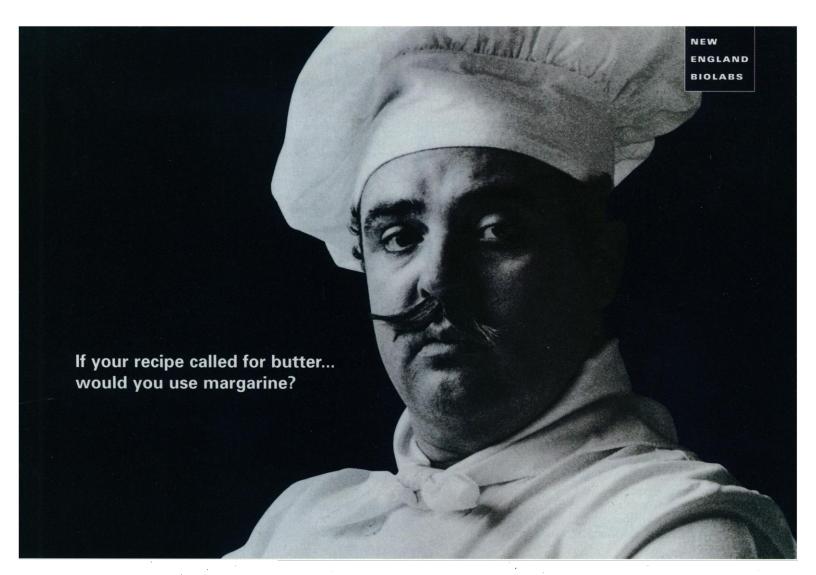
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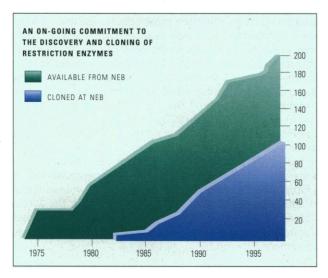
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# THIS WEEK IN SCIENCE edited by PHIL SZUROMI

# **NANO EXTRUDER**

Ternary metal nitrides can exhibit unusual mechanical, thermal, and electrical properties, and thus synthesis of bulk materials is being actively pursued. Barsoum and Farber (p. 937) synthesized bulk Cr<sub>2</sub>GaN and found yet another unusual property—after polishing the surface of these samples and letting them sit 1 or 2 days in air, nanofilaments of gallium several millimeters in length were self-extruded from pores in the crystal. The authors suggest that reaction with oxygen or nitrogen deintercalated gallium from the crystal lattice.

# A WATERY GRAVE FOR CO<sub>2</sub>?

One proposal for removing carbon dioxide from the atmosphere is to inject it into the deep oceans. Using a submersible, Brewer et al. (p. 943) conducted several direct experiments on this approach and show that reaction of CO<sub>2</sub> with water quickly forms a hydrate. At shallow depths (300 meters), the CO<sub>2</sub> hydrate rapidly dissolved. At greater depths (3600 meters), the hydrate formed more slowly and then dissolved slowly. One problem that was identified is that the hydrate has a much greater volume than the pure CO<sub>2</sub> liquid, which may complicate attempts to contain the released CO2.

# A MERCURY PALEOTHERMOMETER?

A detailed record of the atmospheric deposition of mercury during the past 4000 years has been obtained for a peat bog in northwestern Spain. Martínez-Cortizas et al. (p. 939; see the news story by Koenig) show that the type and abundance of mercury compounds preserved in the bog varies mainly with past temperature and to some extent with humidity. Anthropogenic mercury deposition at this site became significant about 2500 radiocarbon years ago, near the time when mining began in the Iberian Peninsula.

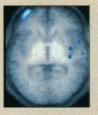
# **SMALL-SCALE ORGANIZATION**

Solid-state chemists often think of many minerals and many porous materials as interconnections of molecular polyhedra at particular edges and faces. Breen et al. (p. 948) have expanded on this idea and show that it can apply to the self-assembly of mesocale (millimeter- to centimeter-sized) objects. Polyurethane objects were formed by molding and coated on

selected surfaces with a low-melting alloy. When agitated in salt solutions that were hot enough to remelt the alloy, the pieces routinely assembled into extended solids; chiral pieces could be assembled into helices.

### IT ALL ADDS UP

How do we add numbers? We might use images of the numbers and arithmetic signs, or we might convert the numbers and signs to words. Dehaene et al. (p. 970; see the Perspective by Butterworth) offer evidence from behavioral and functional brain imaging experiments that we do both. Learning how to compute exact sums in





one language does not help much in performing the same summation in a second language or a new summation in the first language. This finding suggests the use of words, which is consistent with the predominantly left hemisphere activation that was observed. However, making approximations is as easy in a second language, which is consistent with imagery of magnitudes and with the observed bilateral activation of visuo-spatial brain areas during these tasks.

# **CALLING IL-12**

Nitric oxide (NO) is a well-known antimicrobial molecule generated during an infection that can modulate the immune response. Interleukin-12 (IL-12) is also crucial for host defense to bacteria and parasitic infections such as in leishmaniasis. Diefenbach et al. (p. 951) report that mice lacking type 2 NO synthase are more susceptible to Leishmania. The natural killer (NK) cells in these animals were not cytotoxic nor did they produce interferon-y (IFN-γ) in response to IL-12. NK cells appear to require NO to signal in response to IL-12 (to phosphorylate Stat4, activate Tyk2, and induce IFN-γ production) very early in the immune response to the microbes, a function quite distinct from its role as a direct antimicrobial.

### **RELEASING THE STOWAWAY**

Diptheria toxin consists of an A chain, which contains the catalytic domain, that is helped into the cell by its companion B chain, which contains the transmembrane (T) domain. The B chain, which mediates toxin binding and entry to the cell along the endocytic pathway, goes through a low-pH-induced conformational change in the cell's endosomes. This process causes its insertion across the membrane into a transmembrane form, which also causes the translocation of the A chain across the membrane into the cytosol. The precise mechanism of this joint membrane permeation pathway has not been clear. Ren et al. (p. 955) show how any protein that forms a partially unfolded "molten globule" in the low-pH environment of the endosome converts the T domain from a membrane-associated form to an actual transmembrane protein. These results suggest that the T domain chaperones the A chain across the endosomal membrane.

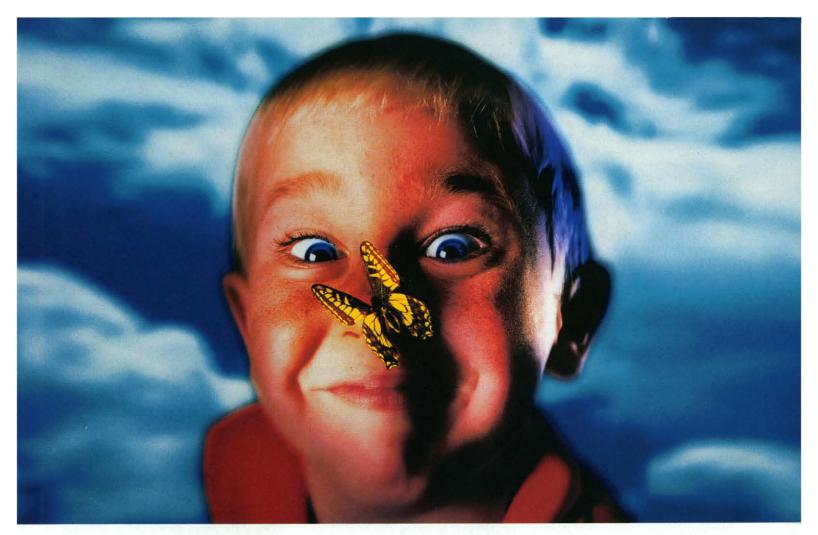
# TEACHING AN OLD OWL OLD TRICKS

Barn owls combine the spatial map obtained from visual input with that calculated from auditory input and interaural time differences. The overlay of these maps can be shifted if the owls' eyes are fitted with prisms that displace the visual fields leftward or rightward; new excitatory neural connections are formed. Zheng and Knudsen (p. 962; see the Perspective by Stryker) show that the old map persists in these bespectacled owls but is effectively masked by neural inhibition. Furthermore, removing the prisms initiates a functional regression that appears to be mediated by increasing inhibition of the learned, displaced map while favoring excitation over inhibition of the original, normal map.

# **RESISTING A NATURAL APPROACH**

Efforts to bioengineer intrinsic resistance to insect pests into crop plants have made use of a natural bacterial toxin, *Bt*, from *Bacillus thuringiensis* Berliner. Plans to thwart the natural tendency of insects to evolve into resistant strains rely on the use of high doses of *Bt* adjacent to refuges in which susceptible insects can propagate without exposure to *Bt*. This strategy depends on the genes encoding resistance to *Bt* being recessive. Huang *et al.* (p. 965) found, however, that resistance to *Bt* is genetically dominant in the European corn borer. The finding of a dominate of the strain of the

CONTINUED ON PAGE 875



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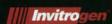
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# THIS WEEK IN SCIENCE

**CONTINUED FROM PAGE 87** 

nant *Bt* resistance trait would suggest that alternative plans should be developed to sustain the insecticidial value of *Bt*-expressing crop plants.

### **DAMMING SALMONELLA**

Salmonella typhimurium is a bacteria that causes gastric illness and death in humans and animals worldwide; antibiotic resistance is a significant and growing problem. Heithoff et al. (p. 967; see the news story by Enserlink) have found that an enzyme that methylates DNA at adenine residues, DNA adenine methylase (Dam), is essential for the pathogenesis of S. typhimurium. Dam regulates expression of at least 20 genes induced during infection by Salmonella. Bacteria containing a mutation in Dam were avirulent and could induce protection against infection of mice by wild-type bacteria, thus making this gene a promising vaccine candidate. The ability of this avirulent strain to provide protection results because the mutant bacteria could grow in the intestinal mucosa but could no longer invade or colonize other tissue sites.

# A RATIONAL APPROACH TO DIABETES

About 10% of the population in the Western world develops some degree of non-insulin dependent diabetes mellitus (NIDDM), and there is a pressing need for more effective therapies. NIDDM is associated with insulin resistance, which is thought to be caused by defects in the insulin signaling pathway. In a targeted approach to drug development, Zhang et al. (p. 974; see the news story by Gura) used a cell-based assay to screen an extensive collection of small molecules for compounds that mimicked the action of insulin. Through this screen, they identified

a fungal metabolite, L-783,281, that selectively induced human insulin receptor tyrosine kinase activation and acted as an insulin mimic in a variety of biochemical and cellular assays. Oral administration of L-783,281 lowered glucose levels in two mouse models of NIDDM. These results suggest that it may one day be possible to develop an "insulin pill" for treatment of diabetes.

# **GROUP EFFORT**

Under high phosphate conditions, the Pho4 protein of budding yeast is phosphorylated at five different sites, and this factor is then exported from the nucleus so that it cannot turn on the expression of its target genes. Komeili and O'Shea (p. 977) now show that, as opposed to a single global function for protein phosphorylation at multiple sites, the individual phosphorylation sites provide distinct functions. When phosphorylated, two sites promote export of Pho4 from the nucleus, one site blocks the protein's import, and a fourth site is necessary for the interaction with another transcription factor for the target gene's regulation; the role of the fifth phosphorylation site is still unknown. Thus, multiple phosphorylation sites within proteins can provide multiple levels of regulation.

# **TECHNICAL COMMENT SUMMARIES**

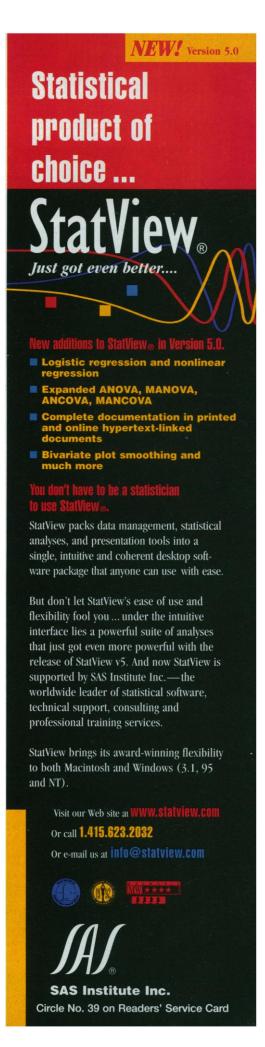
# Rule Learning by Seven-Month-Old Infants and Neural Networks

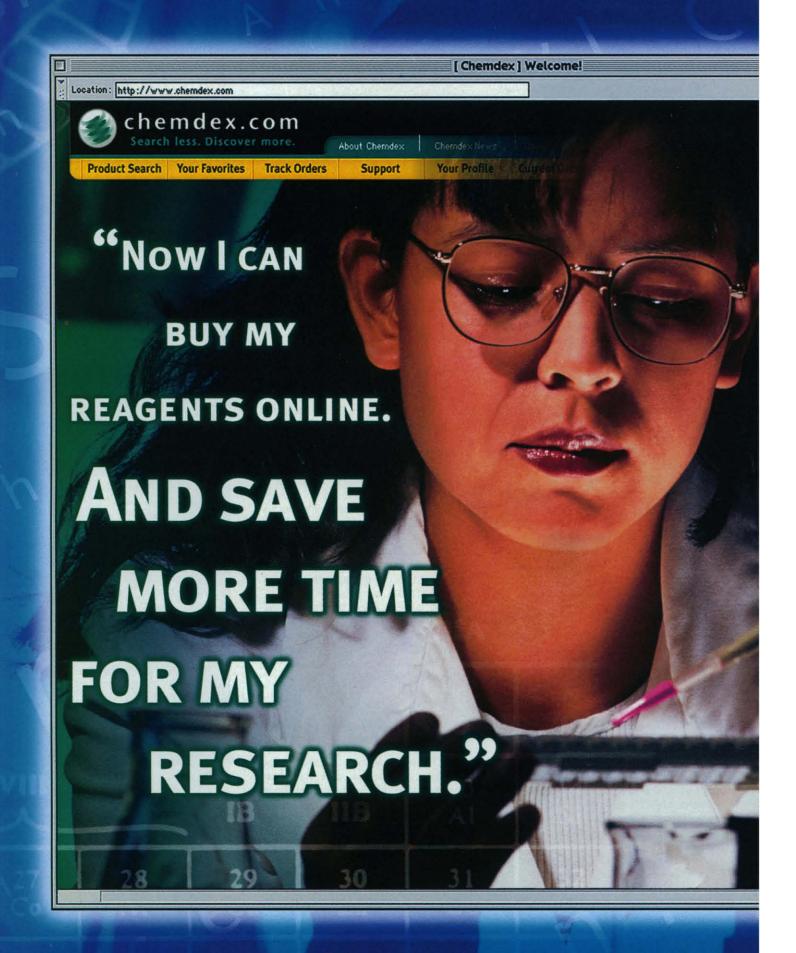
The full text of these comments can be seen at www.sciencemag.org/cgi/content/full/284/5416/875a

G. F. Marcus *et al.* (Reports, 1 Jan., p. 77) found that "7-month-old infants attend longer to sentences with unfamiliar structures than to sentences with familiar structures." Marcus *et al.* stated that their experimental design ensured that the discrimination shown by the infants "could not be performed by counting, by a system that is sensitive only to transitional probabilities, or by a popular class of simple neural network models," citing a model by Dienes, Altmann, and Gao.

G. T. M. Altmann and Z. Dienes comment that their neural network does, in fact, "model precisely the kinds of abstract generalizations exhibited by the infants in the report," as well as "substantially more complex data...."

In response, Marcus concedes that, in the report, he misunderstood the specific neural network model, but still questions its "generality and plausibility." He describes his own brief experiments with the use of that model.







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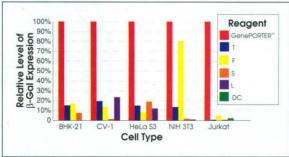
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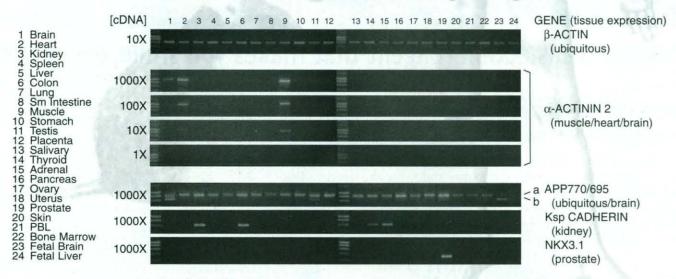
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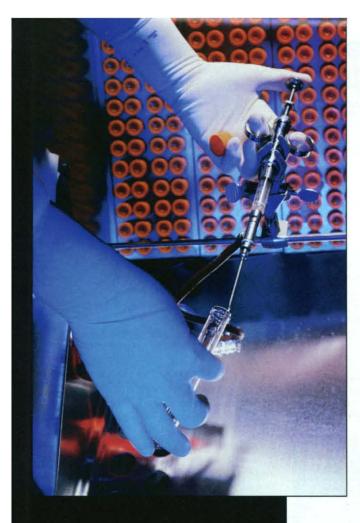
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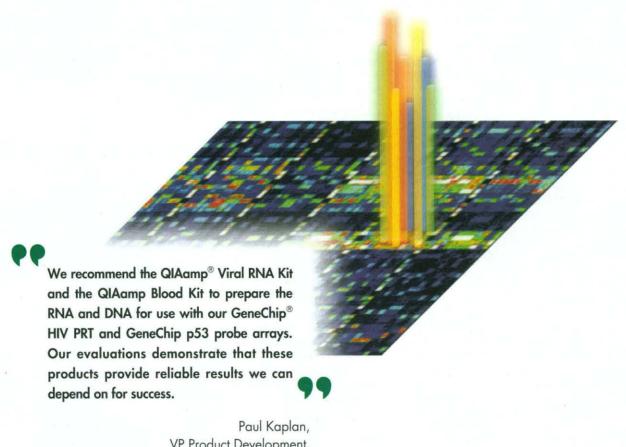
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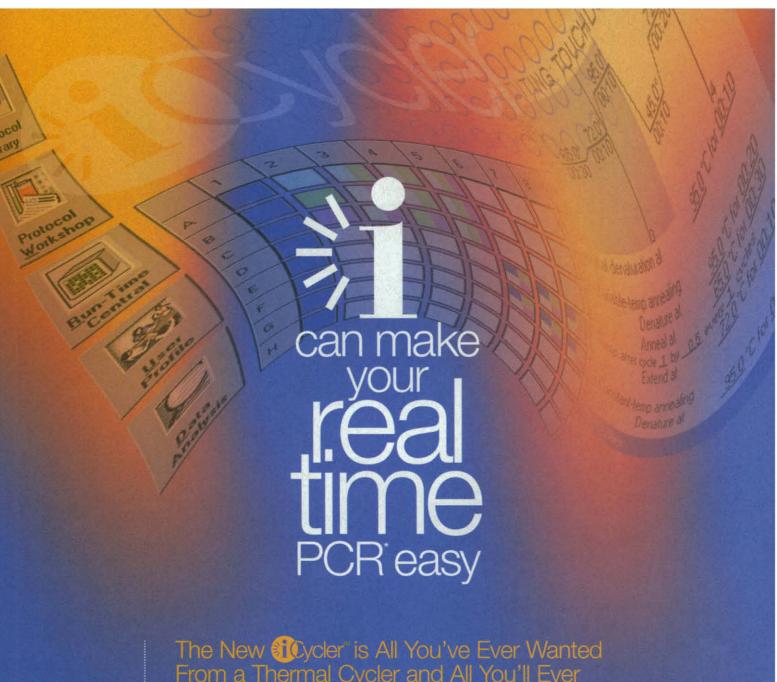




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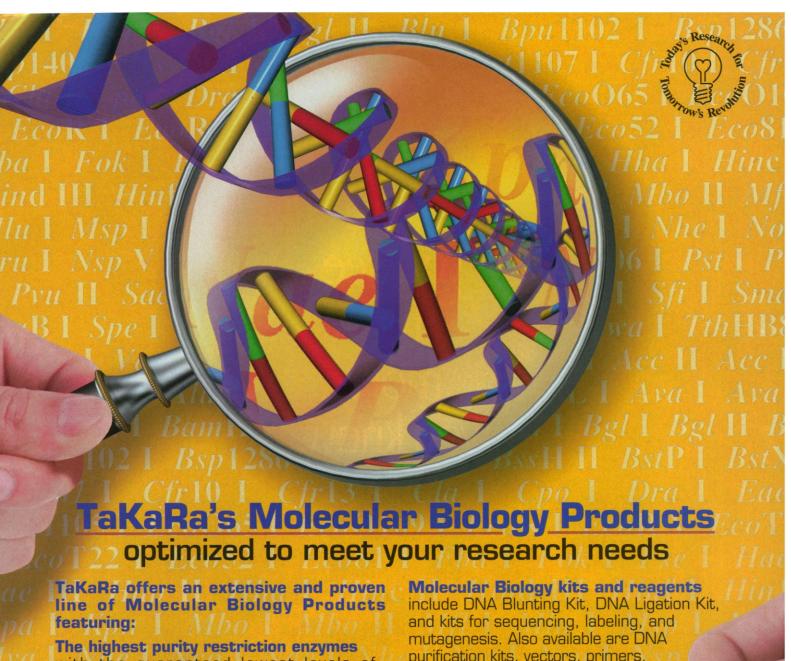
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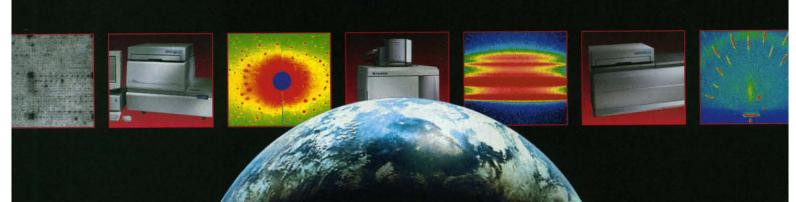
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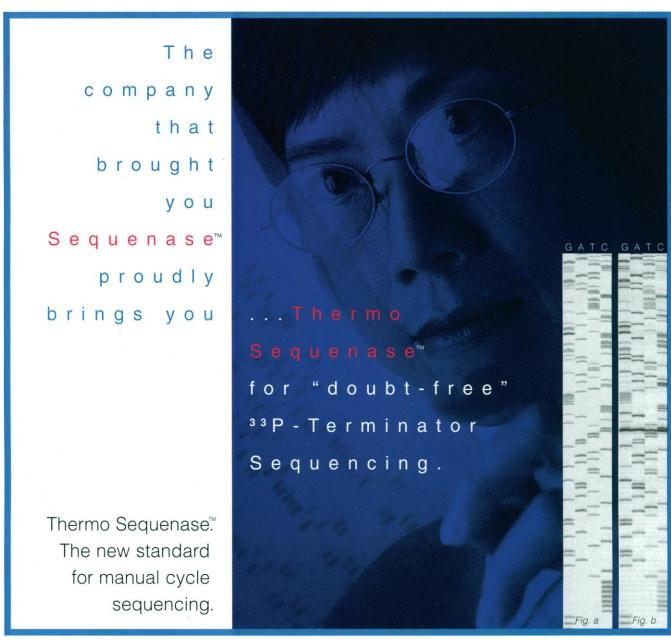
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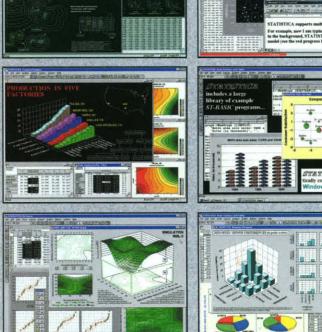
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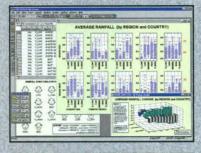
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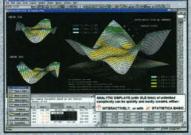
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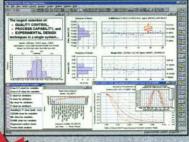


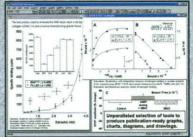
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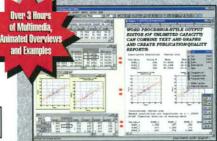














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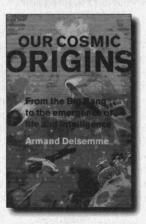


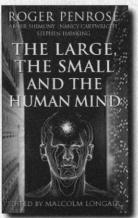
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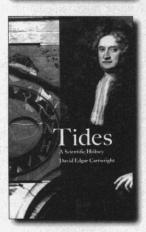
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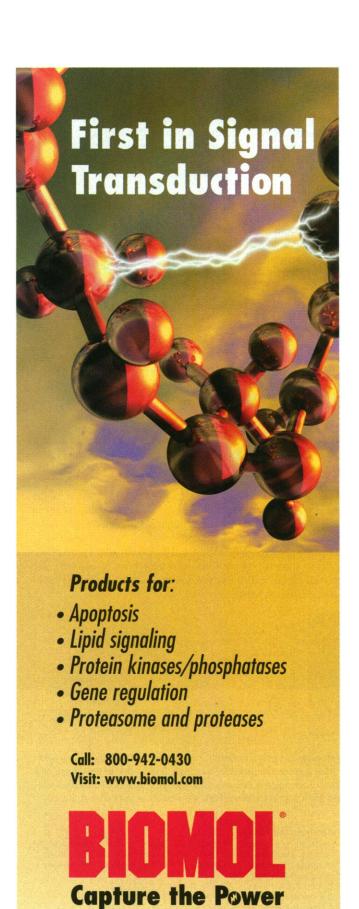
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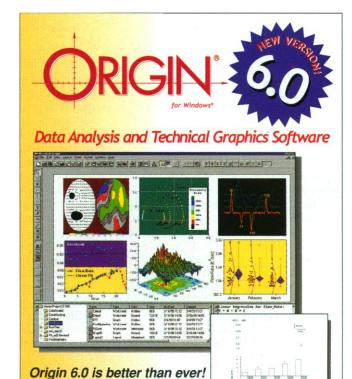
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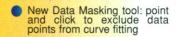
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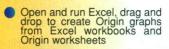




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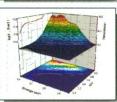


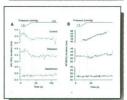




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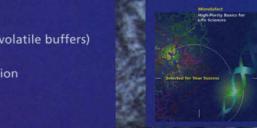
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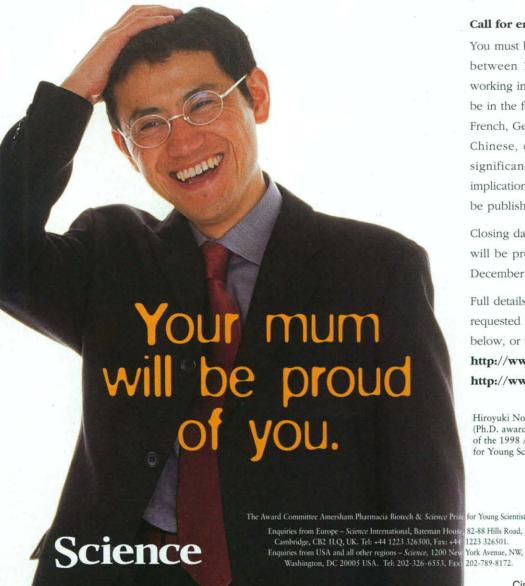


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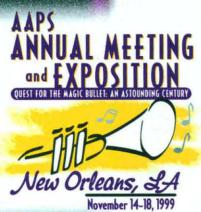
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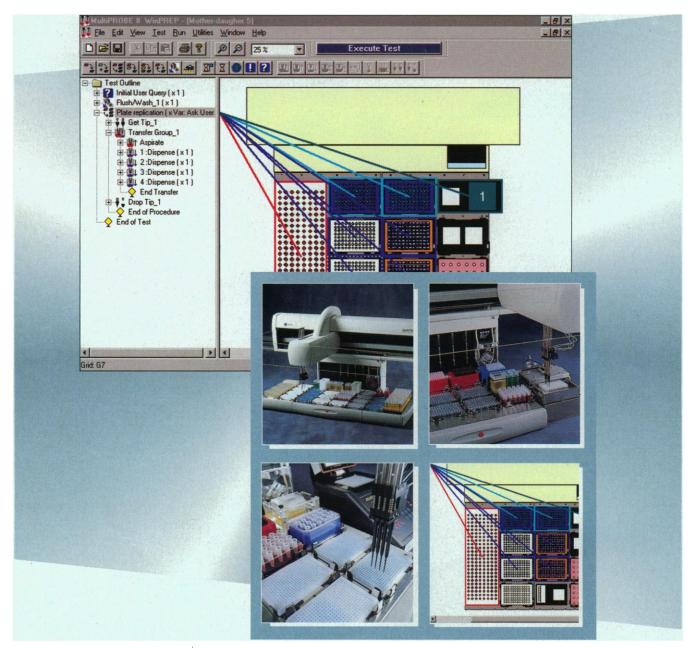
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