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# Science

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## Regulation of Body Weight

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# SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
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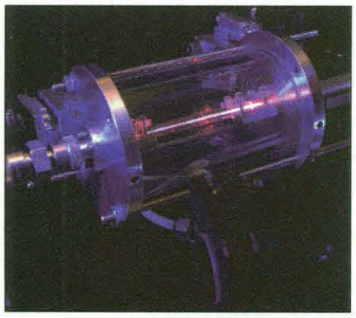
**1342**
**Australian prehistory's future**



**1348 & 1412**
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## NEWS & COMMENT



## RESEARCH NEWS



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### NEWS



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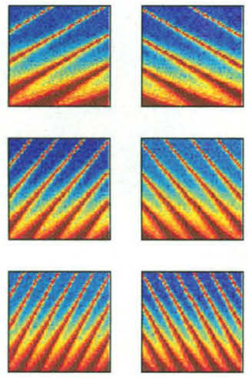
COVER

Although a nursery rhyme would have us believe otherwise, the regulation of body weight is a complex process involving environmental, physiological, and behavioral factors (depicted whimsically around a feasting Mr. and Mrs. Jack Spratt). These factors and advances in preventing and treating disorders of weight regulation are discussed in the special section beginning on page 1363. Hidden in the illustration are the names of 13 proteins associated with weight regulation (answers on page 1363). [Illustration: David Galchutt]



**1402 & 1439**
**Decomposing sounds**

**1350 & 1455**
**Noggin and skeletal development**

◩ **Indicates accompanying feature**

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edited by PHIL SZUROMI

## Cold dark matter heats up

Density fluctuations present just after the big bang eventually resulted in the large-scale structure of the universe we see today. Gawiser and Silk (p. 1405) examined how 10 different cosmological models would predict the evolution of cosmic microwave background (CMB) fluctuations, less than one part in $10^5$, into the large-scale structure of the galaxies. They found that only a universe composed of about 70 percent cold dark matter, 20 percent hot dark matter, and 10 percent ordinary matter can fit the data. In related commentaries, Kamionkowski (p. 1397) explains how the CMB, which represents remnants of particles scattered right after the big bang before any galaxies formed, provide a crucial glimpse of the geometry of the early universe, and Primack (p. 1398) relates how hot dark matter (fast moving particles consisting mostly of massive neutrinos that were swirling around the universe just after the big bang) may represent a significant mass contribution compared to the abundant cold dark matter (slower moving particles just after the big bang).

## Converting infrared light into soft x-rays

Nonlinear optical materials such as lithium niobate are routinely used to convert laser light to higher frequencies; efficient conversion requires phase matching, that is, both the input and output colors must travel through the material at the same speed (have the same refractive index), or the beams will get out of phase and cease to couple. Few solid materials are transparent at wavelengths below 200 nanometers, so phase matching techniques have been limited at high frequencies. Rundquist *et al.* (p. 1412; see the news story by Kestenbaum, p. 1348) show that gases can be used as the nonlinear medium if they are surrounded by a wave guide; this confinement creates an additional geometrical parameter for matching the phase velocities of the input laser light and the emitted x-rays in the gas. This approach allowed infrared light at 800 nanometers to be converted to coherent soft x-rays in the 17- to 32-nanometer range.

■

## Conductivity two-step

Models of the electrical conductivity of Earth's mantle are used to understand the propagation of the geomagnetic field to the surface and can also constrain mantle models derived from seismic and mineralogical data. Several models can fit the existing data and show either two or three discontinuities in the bulk electrical conductivity of the mantle in the transition zone (depths of 410 to 660 kilometers). Xu *et al.* (p. 1415) devised a molybdenum electrode assembly to measure directly the conductivity of mantle minerals at high pressures (up to 20 gigapascals) and temperatures (1400° Celsius). The conductivities of a magnesium (Mg)-rich wadsleyite and a Mg-rich ringwoodite (high-pressure polymorphs of olivine, the most abundant mineral phase in the upper mantle) were similar and much higher than the conductivity of an Mg-rich olivine. Modeling using these data is consistent with the two-step geophysical conductivity model. Lateral temperature variations of about 100° Celsius would not change the conductivity of these minerals by an amount that might be remotely detected in the bulk mantle.

■

## From dust we are formed

Micrometer-sized graphite grains in a chondrule-free fragment from the unequilibrated ordinary chondrite, Khohar, show unusually large deuterium and nitrogen-15 isotopic excesses that are greater than those measured in other chondrites and interplanetary dust particles. Mostefaoui *et al.* (p. 1418) argue that these isotopic excesses represent a distinctive signature of an interstellar molecular cloud, possibly the cloud that later formed the solar system. Iron-nickel—rich grains in the fragment do not show the same isotopic characteristics but instead may represent unequilibrated metal particles formed in the solar nebula.

■

## An extra step in 2D melting

The physics of materials in two dimensions differs from that of normal materials; for example, theory predicts that melting of a two-dimensional solid to an isotropic liquid passes first through an intermediate hexatic phase that has long-range order of molecular orientation and short-range positional order. However, experimental studies revealing the hexatic phase do not meet all of the theoretical predictions; instead of a continuous Kosteritz-Thouless (KT) transition, strong thermal signatures are seen. Chou *et al.* (p. 1424) revisit this problem for freely suspended films of a smectic liquid crystal (whose smectic phase is the free liquid in this context) by performing electron diffraction, heat capacity, and optical scattering experiments. Their conclusion is that there

are actually two phases between the solid and the isotropic liquid, a hexatic phase and a secondary smectic phase that has more positional order than the normal smectic phase. The large divergence in heat capacity is seen between these two smectic phases (a first-order transition), rather than between the hexatic phase and the smectics, which may be exhibiting KT behavior.

■

## An icy Centaur

Centaurs, objects with dynamically unstable orbits that cut across the orbital paths of the Jovian planets, are thought to represent relatively primitive components of the outer solar. Twelve Centaurs have been detected, which indicates that these objects must be replenished from the boundaries of the solar system, either from the Kuiper Belt, the Oort Cloud, or beyond. Brown *et al.* (p. 1430) identified traces of water ice on the surface of Centaur 1997 CU26 from near-infrared spectroscopic observations with the Keck Telescope. Water ice has also been detected on Pholus, but has not been detected on Chiron, the only two other Centaurs whose composition has been measured. Centaurs may be compositionally diverse, complicating a determination of their source region,

*(Continued on page 1323)*

(Continued from page 1321)

and may not be related to observed Kuiper Belt objects, which have exhibited surfaces that are hydrocarbon rich.

■

## Diamond origins

Most diamonds are brought to Earth's surface by magmas from deep in the mantle. Diamonds can be separated into two main types (peridotitic and eclogitic) on the basis of their inclusions and chemistry. The large range of carbon isotope values for eclogitic diamonds suggests that the carbon producing these diamonds was introduced into the Earth's mantle by ancient subduction and recycling of shallow crust and organic-rich sediments. To test this hypothesis, Cartigny *et al.* (p. 1421) examined paired nitrogen and carbon isotopes in 40 diamonds. The nitrogen isotopic values are not consistent with derivation from ancient sediments, and the range of carbon isotope values can be produced by reactions in the mantle source regions.

■

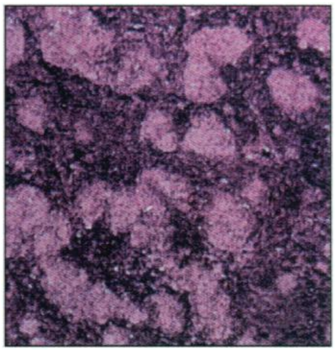
## Superhelix formation

The chirality of molecules can be used to direct their supramolecular assembly, which may in turn affect properties such as the optical responses of these larger structures. Nanosized supramolecular chiral structures such as helices have been shown to form from relatively small molecular building blocks. Cornelissen *et al.* (p. 1427) apply this concept to larger, block copolymer building blocks and show that the morphology of the supramolecular structures can be controlled through varying the polymer properties; among other structures, large superhelices formed from helical subunits were observed.

■

## $T_H1$ role in immunity

A new human genetic immunodeficiency is reported by Altare *et al.* (p. 1432) and de Jong *et al.* (p. 1435). Patients particularly susceptible to *Salmonella* and *Mycobacteria* infections were deficient in the interleukin-12 receptor, a protein that initiates a type 1 T helper cell ($T_H1$) response, that is, cell-mediated immunity. The patients formed granulomas, which normally control the infections, but in these cases the infection still disseminated. The



phenotype was milder than what might have been expected (childhood viral and bacterial infections were apparently handled normally), given what is known about mouse deficiencies in IL-12 and interferon-γ receptors. This result then raises questions about the real role of $T_H1$ cells in immunology.

■

## Audio bars

Although the stimulus-response properties of neurons early in the auditory processing pathway are known (such as frequency and intensity), the features characterizing mammalian auditory cortical neurons, analogous to the moving, oriented bar within a visual cortical neuron's receptive field, are not. deCharms *et al.* (p. 1439; see the commentary by Young, p. 1402) use a reverse correlation approach to search for "best stimulus" features for auditory cortical neurons in the owl monkey. They find that these neurons preferentially respond to stimuli with time-varying frequencies and "edges" in frequency and in time.

■

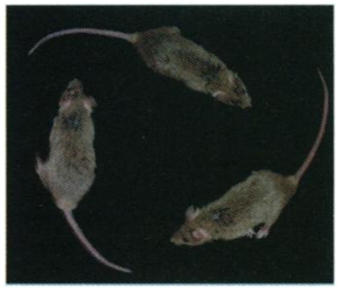
## Predicting RNA shape over time

It is difficult to predict the three-dimensional structure of a protein from its primary structure (amino acid sequence). Fontana and Schuster (p. 1451) tackle the somewhat more computationally tractable problem of connecting RNA sequence and secondary structure with the wrinkle of examining this relation over time. Beginning with a population of sequences of fixed length but random shapes, they simulate the progression toward a transfer RNA-like target shape. They find that changes in the nucleotide sequence occur throughout but that changes in the secondary structure appear in a punctuated manner.

■

## Myosin and deafness

A pair of reports by Probst *et al.* (p. 1444) and Wang *et al.* (p. 1447) discuss how mouse models and human family trees have been used to pinpoint a human gene, *DFNB3*, associated with a form of nonsyndromic recessive deafness (see the commentary by Steel and Brown, p. 1403). Synteny between mouse and human chromosomes had previously been used as the basis of suggesting that there might be homology between *shaker-2* and



*DFNB3* mutations, respectively. *Shaker-2* mice are deaf and exhibit abnormal circling behavior. DNA from the region of mouse chromosome 11 thought to be critical for the phenotype was inserted into bacterial artificial chromosomes (BACs) and injected into fertilized eggs of mutant mice. Transgenic mice that could hear and did not circle were found to contain a gene for an unconventional form of myosin designated MyO15. Affected individuals from three unrelated human families had mutations in the human form of this gene that were associated with deafness. MyO15 is expressed in a number of tissues, including those in the inner ear.

■

## Joint developments

From the undifferentiated limb buds form the intricately constructed bones, joints, tendons, and ligaments of the mature vertebrate limb. Brunet *et al.* (p. 1455; see the news story by Dickman, p. 1349) show that the formation of the joints depends on *Noggin*, also known for its dorsalizing activity early in development. In mice lacking *Noggin*, the limbs and the joints are poorly specified. Correct specification of joint location and structure seems to depend on a delicate balance between BMP signaling factors and *Noggin*, acting antagonistically.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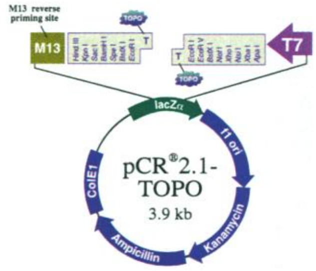


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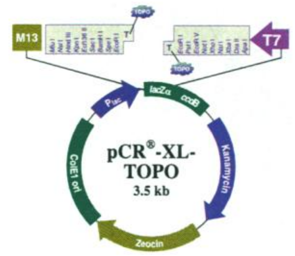


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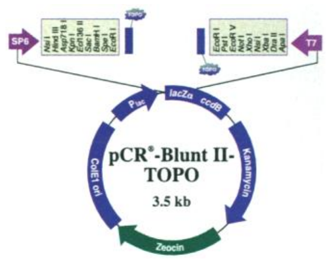


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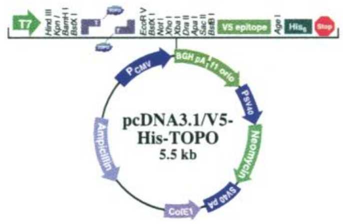


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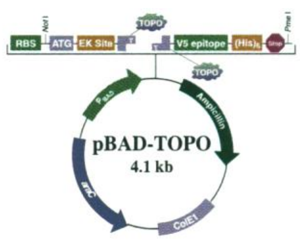


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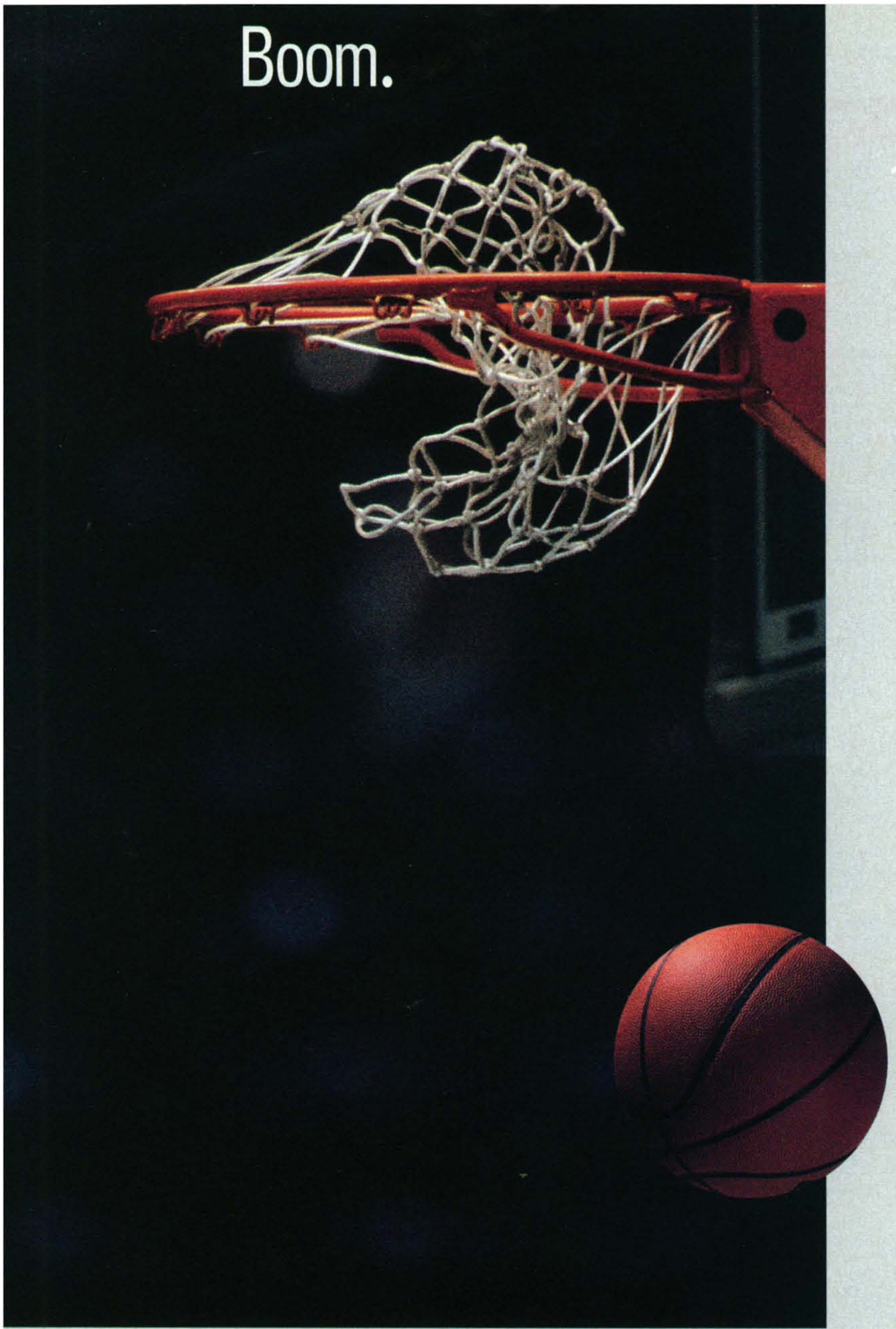
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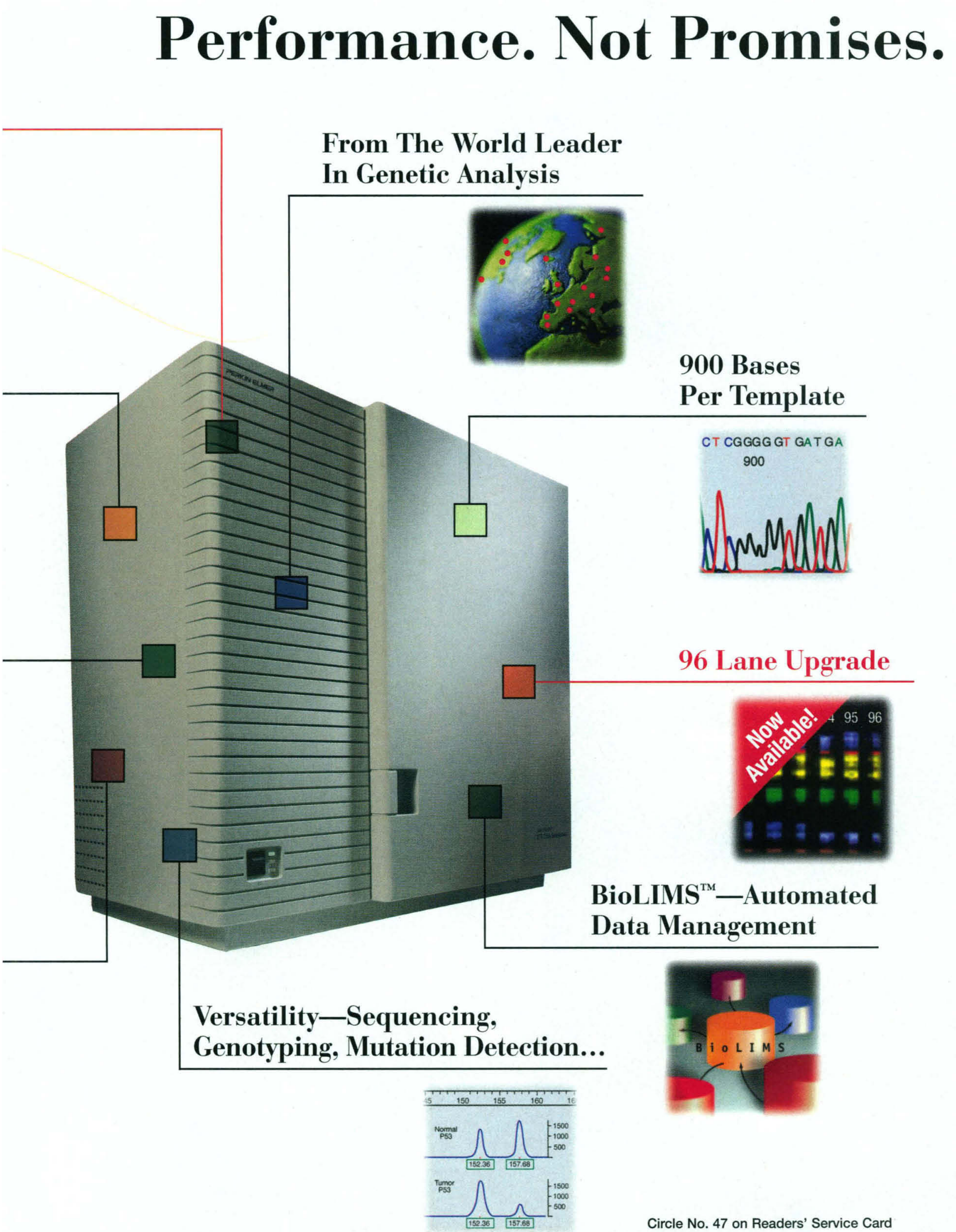
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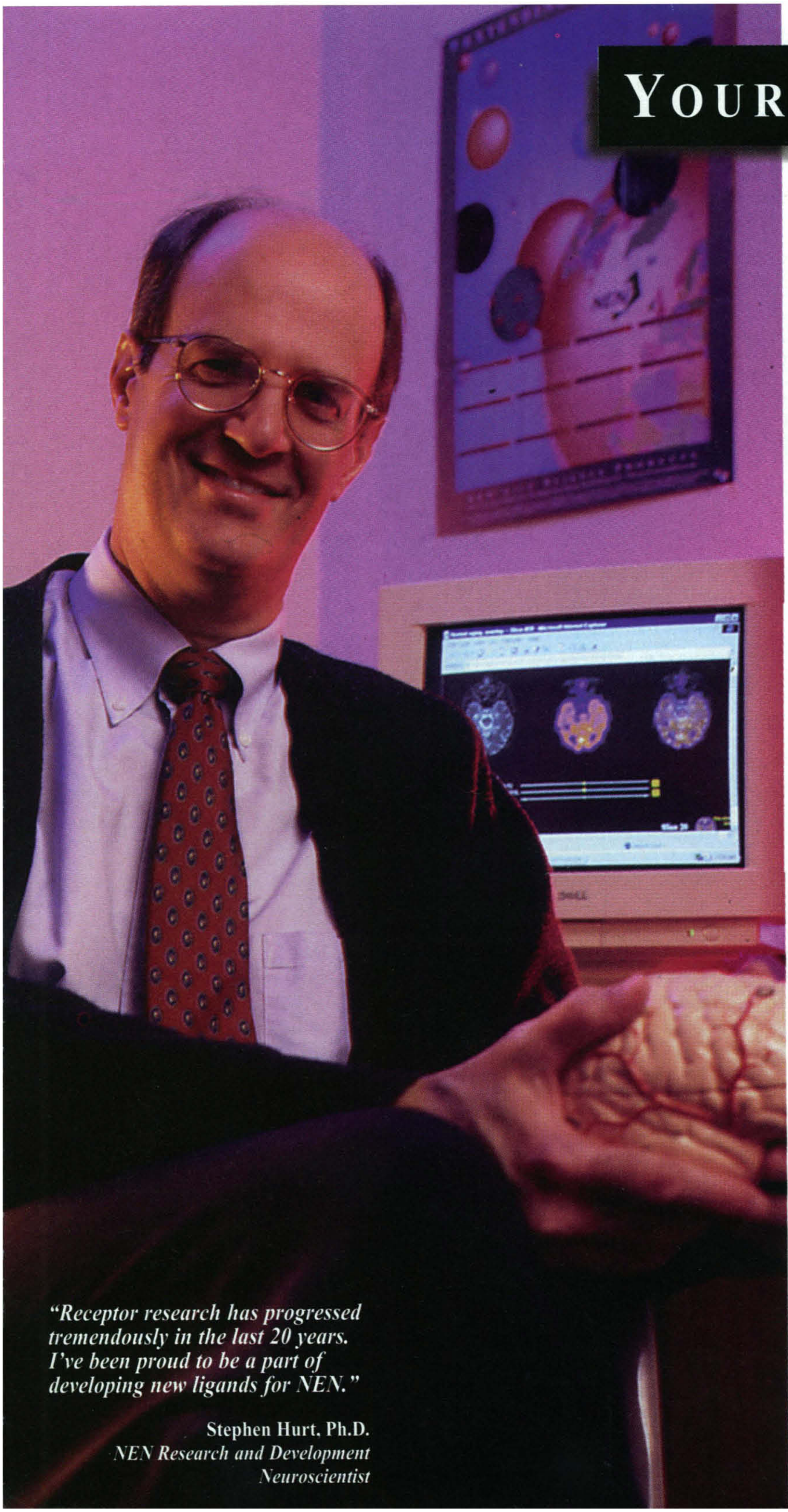
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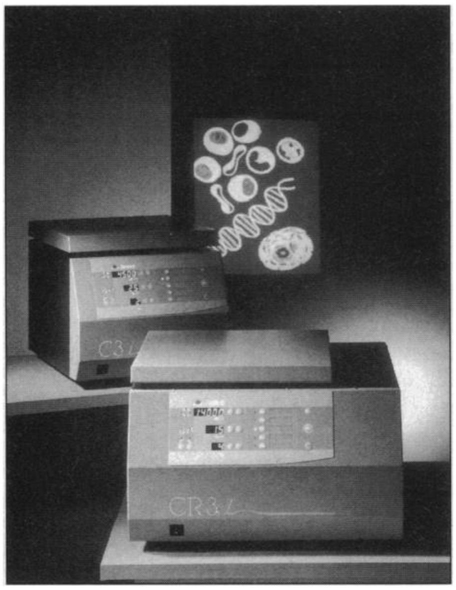

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### Apoptosis by PCR

A kit is available with a multiplex reverse transcriptase–polymerase chain reaction technique that can be used to simultaneously amplify bcl-2, bax, and β-actin mRNAs. Changes in bcl-2 to bax ratio provide a quantitative measure of apoptosis. **Oxford Biomedical Research. For information call 800-692-4633 or circle 148 on the Reader Service Card.**

### High Recovery Vials

The new High Recovery Vials feature a one-piece design with conical bottoms for complete sample recovery. The vials are available in Type 1 borosilicate glass. Reactions and concentrations can be performed directly in

the sampling vial, thereby eliminating the need for sample transfer. The 12 mm by 32 mm vials, with an opening 40% larger than standard vials, have a 1.5-ml capacity. They are available with an 11-mm Snap Seal or 9-mm screw threads. Screw thread vials with a 3.1-ml capacity are also available. **J.G. Finneran Associates. For information call 800-552-3696 or circle 149 on the Reader Service Card.**

### Literature

*ODS-IIIE MICRA NPS Endcapped Column* describes columns designed for fast analysis and excellent resolution of basic compounds. **Micra Scientific. For information call 800-55-MICRA or circle 150 on the Reader Service Card.**

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