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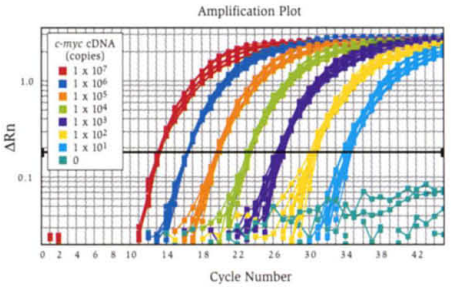

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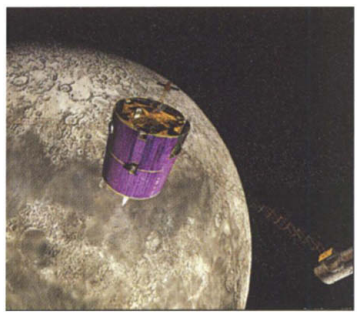

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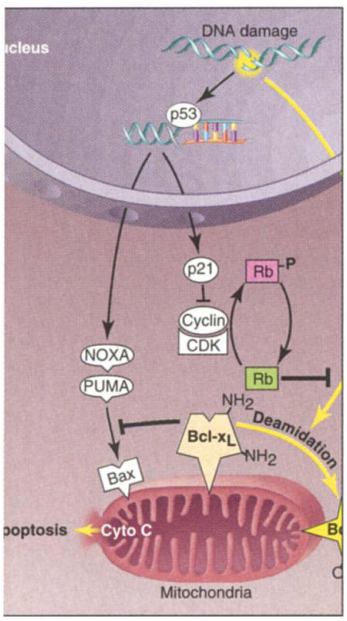

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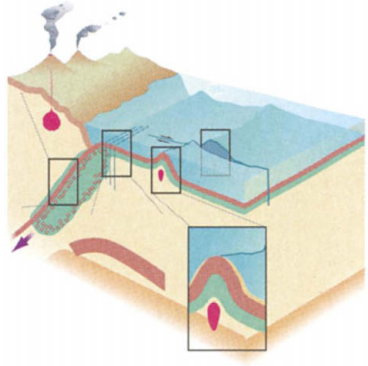

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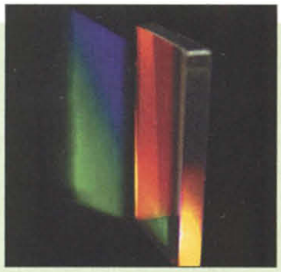
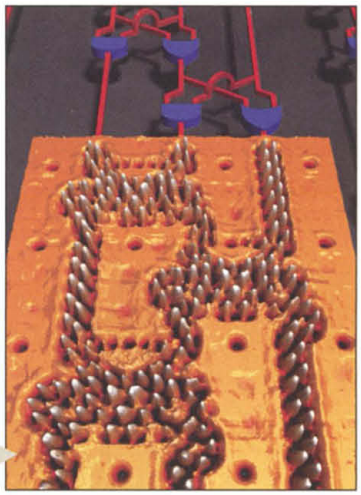


COVER 1353

A crystal with 41 holographic filters. Each filter selects one wavelength channel in the fiber communication system at near-infrared wavelengths. When illuminated with white light, each filter diffracts a slightly different spectral band, creating a blue-to-green color gradient. Optical storage is one example of coherence manipulation highlighted in the special section in this issue. [Photo: D. Psaltis]



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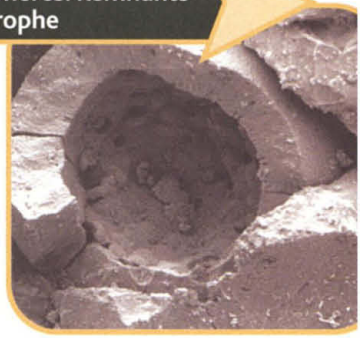

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Evidence for Antibody-Catalyzed Ozone Formation in Bacterial Killing and Inflammation P. Wentworth Jr. *et al.*
1319 Ozone and hydrogen peroxide, produced from the oxidation of water by antibodies, show antibacterial activity in vitro.

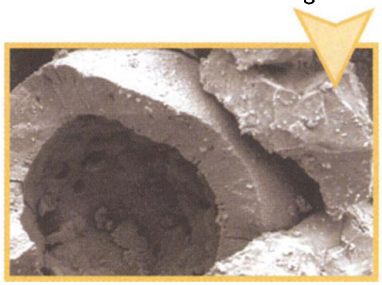
Modulation of ATP-Dependent Chromatin-Remodeling Complexes by Inositol Polyphosphates X. Shen, H. Xiao, R. Ranallo, W.-H. Wu, C. Wu

Regulation of Chromatin Remodeling by Inositol Polyphosphates D. J. Steger, E. S. Haswell, A. L. Miller, S. R. Wente, E. K. O'Shea

Small molecules affect ATP-dependent chromatin remodeling and transcription.

A Late Triassic Impact Ejecta Layer in Southwestern Britain G. Walkden, J. Parker, S. Kelley

An ejecta deposit uncovered in Britain may come from one of the largest impact craters in the Triassic—the Manicouagan crater in Canada.



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career resources for scientists

CANADA: Research Utopia L. McKarney

The Perimeter Institute for Theoretical Physics has set ambitious goals for itself.

US: Postdocs and the Law, Part I—Are Fellowships Taxable? L. Haak

Armed with a variety of nifty tools, the Postdoc Network investigates current laws regulating the taxability of fellowships.

EUROPE: Web Sites to Watch—CERN K. Urquhart

CERN's richly informative Web site has plenty to offer young scientists.

UK: Career Paths—A Guide for the Uninitiated J. Isaac

Before they can plan their career moves, scientists need to understand the process of professional progression.

NETHERLANDS: A Declaration of Interdependence S. Oomes

Science and society would reap mutual benefit if they could only reconnect.

GERMANY: Sharpening the Profile of the Graduiertenkollegs E. von Ruschkowski

Major changes are on the way for Germany's graduate research schools.

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VIEWPOINT: Error Catastrophe in Mutant Mitochondria L. L. Mays Hoopes

Inaccurate polymerase causes a progressive muscle disorder.

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Old immune systems lose first line of defense against invaders.

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CONNECTIONS MAPS: Adrenergic Pathway Y. Xiang and B. K. Kobilka

Canonical signaling emanating from G protein–coupled adrenergic receptors.

CONNECTIONS MAPS: Myocyte Adrenergic Pathway Y. Xiang and B. K. Kobilka

Mammalian myocyte signaling important in heart function and disease.

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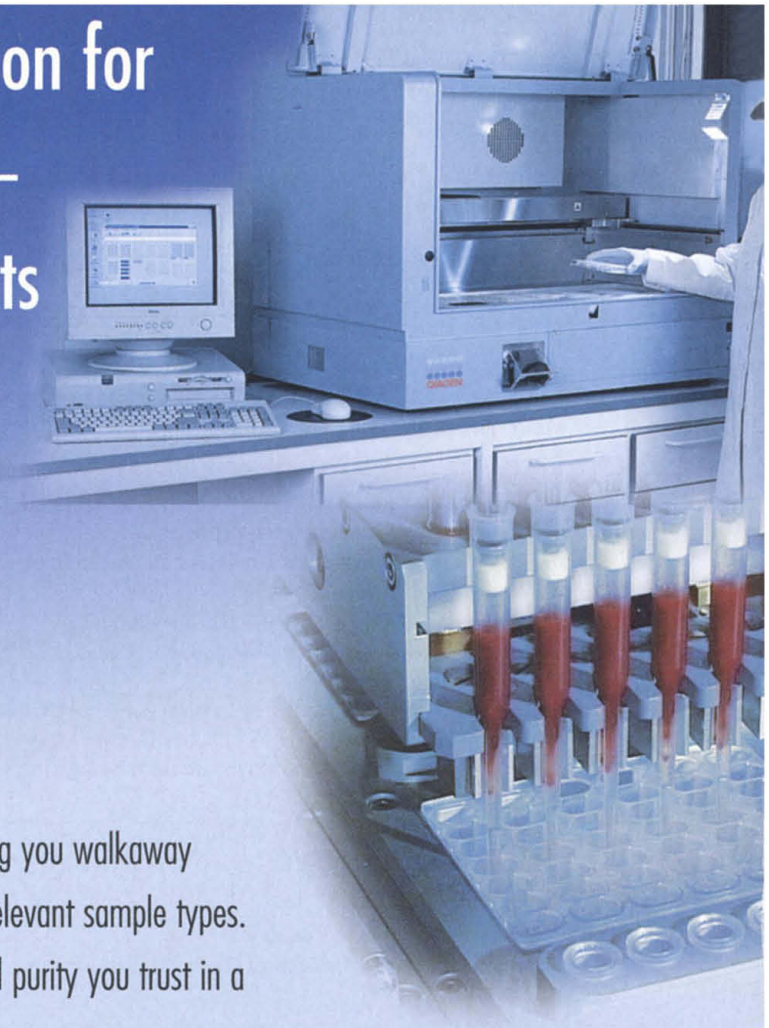

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THIS WEEK IN Science

edited by Phil Szuromi

Calculating with Quantum Cascades

Cascades of hopping by CO molecules on a surface at cryogenic temperatures has been harnessed to perform one-time logic operations. Heinrich *et al.* (p. 1381; see the cover) used a scanning tunneling microscope (STM) to identify isotopically distinct CO molecules on a Cu(111) surface through their inelastic electron tunneling spectra. These molecules were then assembled with the STM into a chevron pattern. A CO molecule at one end was given a shove with the STM tip, and a cascade of induced hops could be observed over a period of a few seconds. Below 6 kelvin, the hopping rates were temperature independent but showed a pronounced isotope effect, both hallmarks of quantum tunneling. The authors used these molecular cascades to perform computation by assigning initial and final positions of CO molecules as 0 or 1, respectively. They created AND and OR gates, and intersecting patterns with multiple inputs could operate as a three-input sorter. 𝒳

Evaporative Losses

The rate of evaporation from a body of water, like a lake or an open pan, is an important parameter of the global hydrological cycle. Intuitively, the large surface temperature increases of the past 50 years should have increased the rate of pan evaporation, but instead the rate has decreased. Roderick and Farquhar (p. 1410; see the Perspective by Ohmura and Wild) attribute this drop to a decrease in sunlight caused by an increase in the extent of cloud cover, or by greater concentrations of atmospheric aerosols. This problem highlights the importance of changes in Earth's surface energy balance caused by anthropogenic activities.

Caught in the Act

Significant insights into transcription have been gained from structural studies on T7 RNA polymerase promoter-bound complexes, including a transcribing initiation complex. However, these studies did not address the elongation phase, and, in fact, any extension of the DNA-RNA complex beyond 3 base pairs was sterically excluded in the initiation complex. Yin and Steitz (p. 1387) have solved the structure of a T7 RNA polymerase elongation complex at 2.1 angstroms. The complex includes 30 base pairs of duplex DNA containing a transcription bubble and a 17-nucleotide RNA transcript. The amino-terminal domain underwent a major refolding compared to the initiation complex. This step completely disrupted the promoter binding site and created a channel that accommodates a 7–base pair heteroduplex and a tunnel that surrounds the RNA transcript after it separates from the heteroduplex. These factors likely account for the enzyme's stability and processivity in the elongation phase. 𝒳

1428 Targeted Vaccination

Policy-makers have been debating how to respond to an intentional release of smallpox in the United States. Halloran *et al.* (p. 1428; see the Perspective by Koopman) generated model communities of 2000 people, interacting within schools and neighborhoods. They looked at the effects of targeted vaccination of those in close contact with smallpox cases relative to mass vaccination carried out before or after the release event. The presence of residual immunity from prior vaccination increased the effectiveness of the targeted strategy more than mass vaccination. Under all strategies, targeted vaccination prevented more cases per dose of vaccine than did mass vaccination.

And in Brevia ...

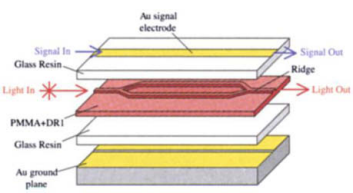
In a mouse model of Alzheimer's disease (AD), Pfeifer *et al.* (p. 1379) find that passive immunization with anti–amyloid beta (Aβ) antibody increases cerebral hemorrhage; this is reminiscent of neuroinflammation seen in some AD patients actively immunized against Aβ.

Express Thyself!

Most T cells that react to self-antigens are deleted in the thymus during development, but how do a multitude of tissue-restricted self-proteins find their way to the thymus in the first place? One proposed solution to this puzzle has been that cells of the thymus also express certain "tissue-restricted" genes. Anderson *et al.* (p. 1395; see the Perspective by Ohashi) show that a transcription factor, termed autoimmune regulator or Aire, controls ectopic gene expression in thymic epithelial cells. In the absence of Aire, mice developed autoimmunity against target organs, such as salivary gland and ovary, with a corresponding loss of expression of target tissue-specific genes by the thymic epithelial cells. 𝒳

High-Speed Polymer Light Modulators

Present technology allows encoding of electrical data onto an optical carrier at the rate of 40 gigahertz. To satisfy the demand for faster communication, links will require increased bandwidth and still faster optical devices that can encode the electrical information sufficiently quickly. Lee *et al.* (p. 1401) present work on the design and fabrication of polymer electro-optic modulators with switching rates in excess of 1.6 terahertz, providing a possible (although likely temporary) solution to the traffic bottlenecks that occur on the information superhighway.



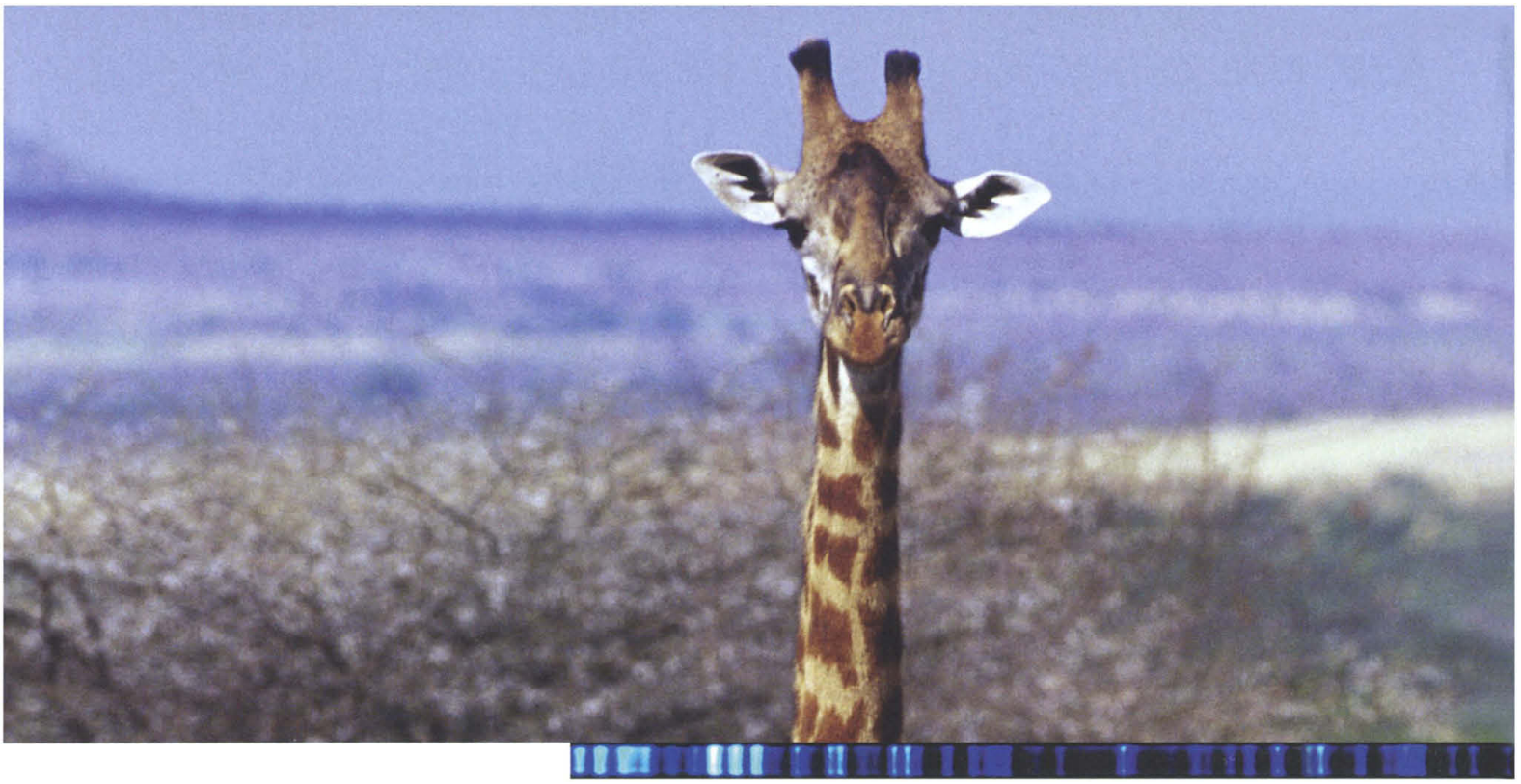
Getting the Shakes While Drying Out?

The mechanics underlying intermediate and deep earthquakes (between 50 to 600 kilometers depth) that occur along subduction zones are poorly understood. Dobson *et al.* (p. 1407; see the Perspective by Kerrick) show in laboratory experiments that dehydration of antigorite generates acoustic emissions at pressures and temperatures relevant to subduction zone conditions. Thus, deeper earthquakes may originate in dehydration reactions.

𝒳 Published online in *Science* Express

CONTINUED ON PAGE 1297

CREDITS: (TOP TO BOTTOM) PFEIFER *ET AL.*; LEE *ET AL.*



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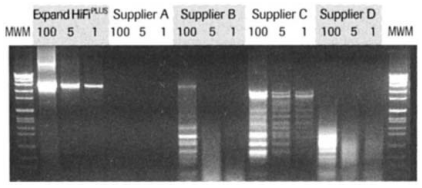

Figure 1: Obtain higher yields than with four other popular enzyme blends. Human genomic DNA template (100, 5, or 1 ng) was used to amplify a 4.8 kb fragment from the tissue plasminogen activator (tPA) gene under each manufacturer's conditions.

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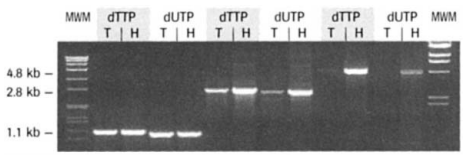

Figure 2: Amplify longer products with greater fidelity and yield when incorporating dUTP for subsequent prevention of carryover contamination. Reactions contain either Taq Polymerase (T) or Expand High Fidelity^{PLUS} PCR System (H) and either dTTP or dUTP.

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Evolution in the Mosquito

The culmination of a nearly 40-year study by Coluzzi *et al.* (p. 1415) of chromosome inversions in the mosquito species *Anopheles gambiae*, the principal malaria vector, and its very near relatives is presented. Polymorphisms were found in some, but not other taxa and populations. The distribution of polymorphisms observed could be related to the prevailing ecological conditions, and, in turn, it is of relevance to malaria transmission. The authors also found evidence for the ongoing formation of new species.

Epilepsy and Excitation Explored

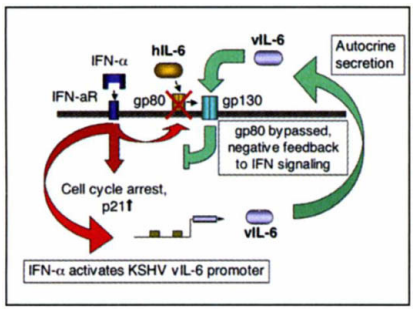
Human temporal lobe epilepsy is a severe and potentially life-threatening disorder. Cohen *et al.* (p. 1418; see the Perspective by Köhling) recorded from neurons in specimens from epileptic patients who had undergone surgery for treatment of the disease. In a brain area called the subiculum, they observed synchronous discharges reminiscent of the patients' EEG records. In a subpopulation of pyramidal neurons from this area, GABAergic input was not inhibitory, but rather depolarizing and, therefore, excitatory.

Holding onto the Transition State

Many RNA enzymes do not employ metal ions as catalytic assistants and must rely on the limited chemical arsenal of nucleic acid bases as compared to the numerous amino acids available to their protein cousins. Rupert *et al.* (p. 1421) present two structures that reflect the transition state and product state of the hairpin ribozyme, in which vanadate was used as the transition-state analog of the pentacoordinate phosphorus formed during the cleavage of a phosphodiester. These results suggest that the ribozyme binds the transition state more tightly than either the starting or product states. Transition-state stabilization may be more common in ribozymes than in protein enzymes, whose functional diversity favors general acid-base catalysis or electrostatic catalysis.

Viral Pusher, Cell Junkie

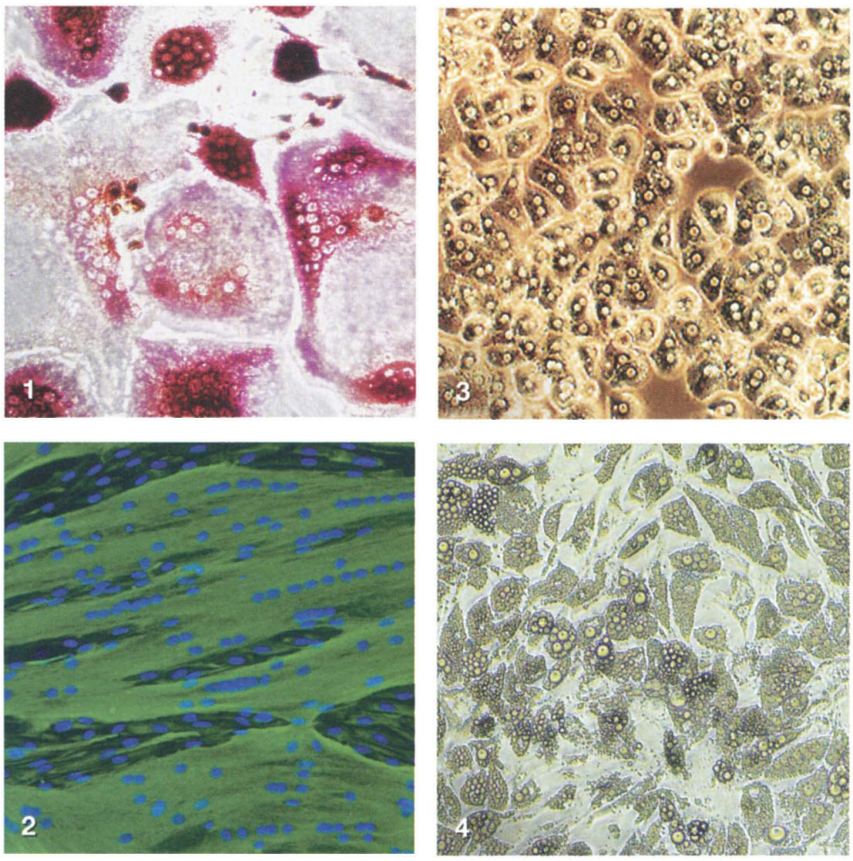
Kaposi's sarcoma herpesvirus (KSHV) causes B cell lymphomas, as well as blood-filled skin tumors in which the virus multiplies along with the tumor cells. Viral infections induce the host to produce interferon-α (IFN-α), a mediator of innate immune responses. Chatterjee *et al.* (p. 1432) show that IFN-α stimulates the KSHV-infected cells to produce a mimic of a host cytokine, interleukin-6 (IL-6). The host's IL-6 binds to two cell surface receptors, gp80 and gp130, but viral IL-6 needs only gp130 to signal the cell. During other virus infections, IFN-α inhibits gp80 expression, preventing IL-6 binding, dooming the infected cells to death by apoptosis, and contributing to clearing the host of infection. By contrast, KSHV IL-6 continues to signal the cell via gp130 alone, effectively immortalizing the cell, and allowing it and the virus to proliferate together.



CREDIT: CHATTERJEE *ET AL.*

Surveying the Damage

Normal cells respond to DNA damage by halting the cell cycle and initiating DNA repair, thereby preventing accumulation of potentially serious genetic abnormalities. Several proteins are important in controlling DNA damage checkpoints, but details about how they cooperate have yet to be worked out. Wang *et al.* (p. 1435) focused their attention on 53BP1, a protein originally identified through its ability to bind the tumor suppressor protein p53. Inhibition of 53BP1 with small interfering RNA (siRNA) prevented the reduction in DNA synthesis and cell cycle progression normally seen after exposure of cells to moderate levels of ionizing radiation (IR). This change corresponded with a partial decrease in phosphorylation of other checkpoint proteins, Brca1 and Chk2, by 53BP1 and the disruption of Brca1 foci formation within the nucleus in response to IR. 53BP1 therefore appears to play a direct role in preserving genomic stability through the regulation of checkpoint control signals and DNA repair machinery.



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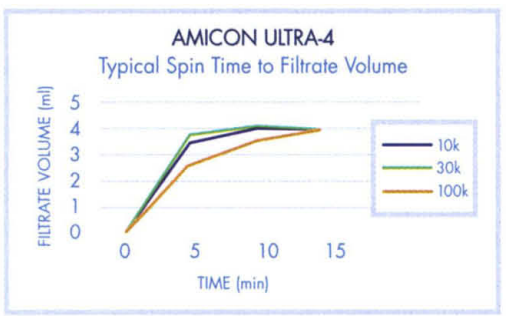

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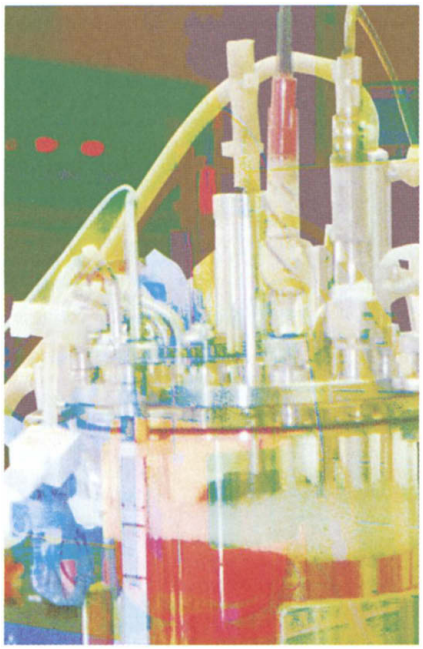

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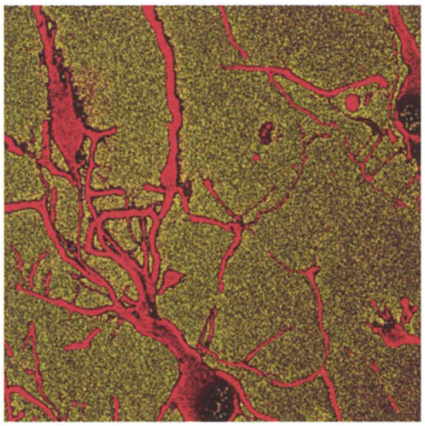

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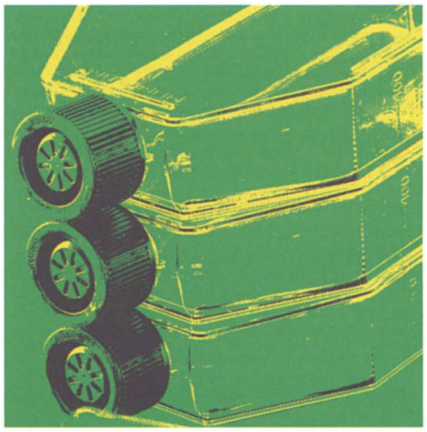

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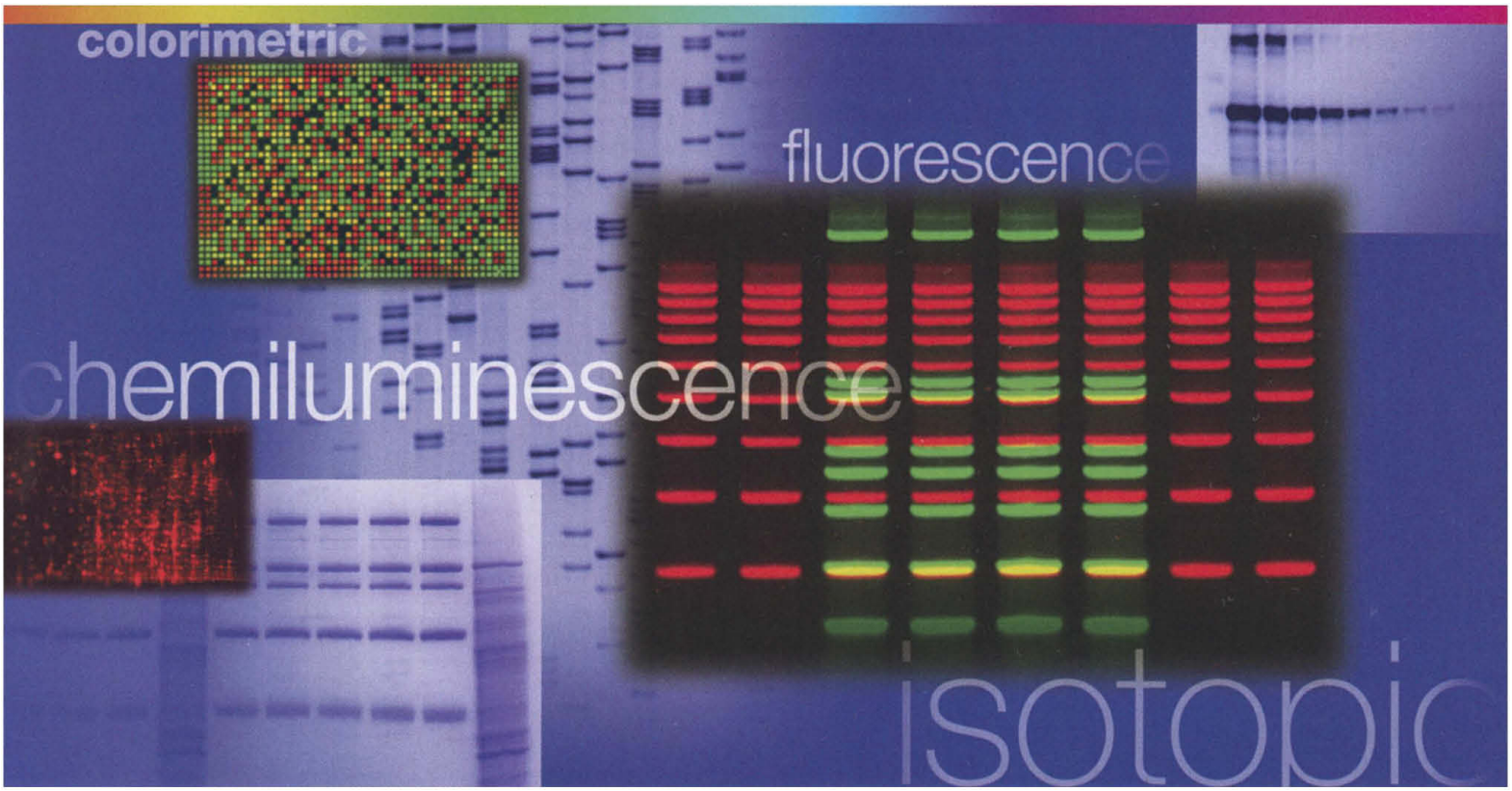

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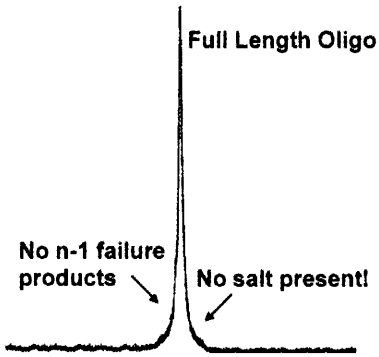

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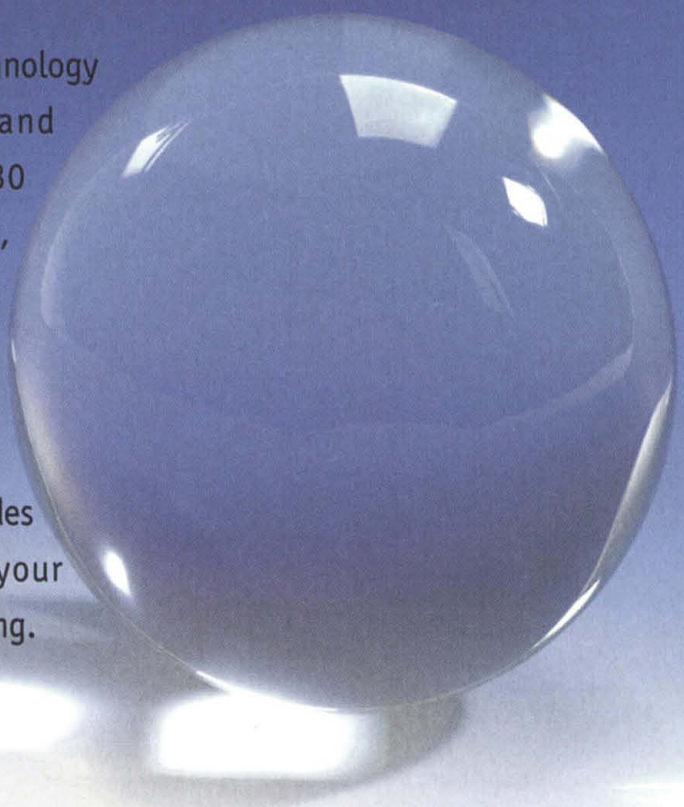

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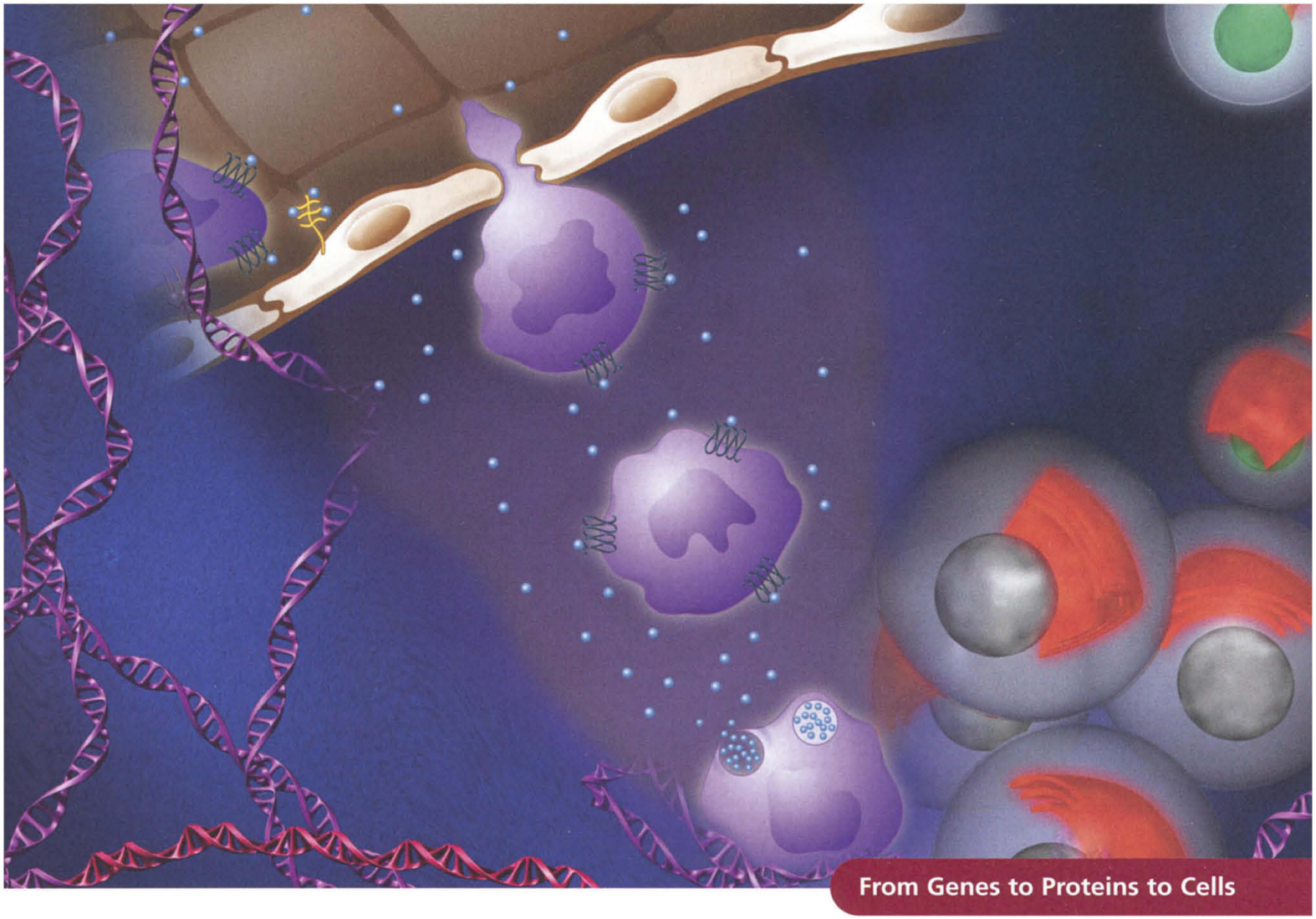

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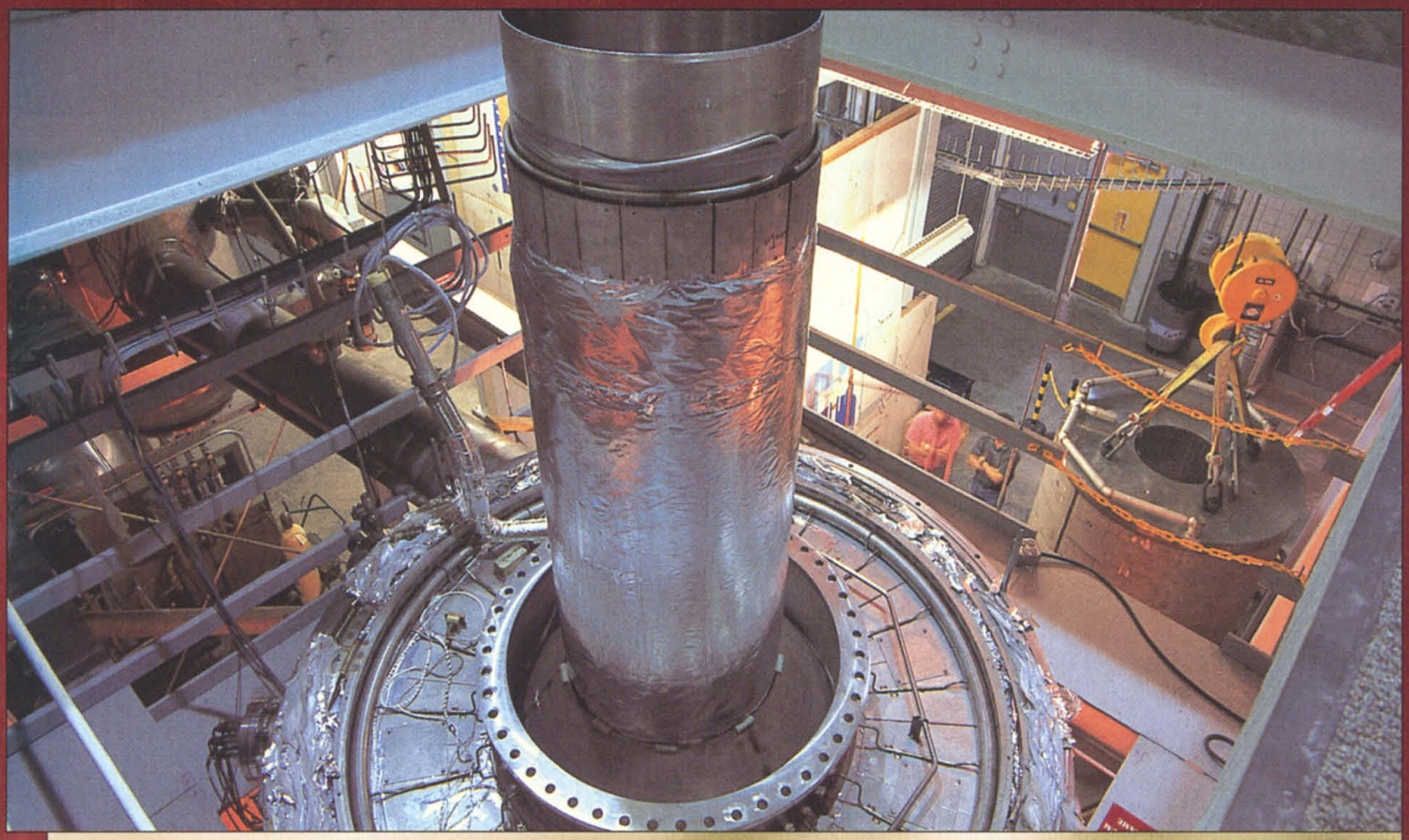

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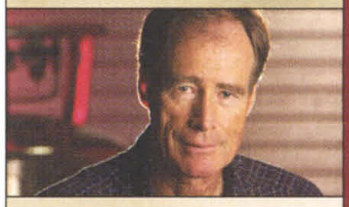
Professor J. Robert Schrieffer, above, Nobel Laureate in Physics



Professor Zachary Fisk, above, Member of the National Academy of Sciences

Professor Jack Crow, below, Director of FSU's National High Magnetic Field Laboratory

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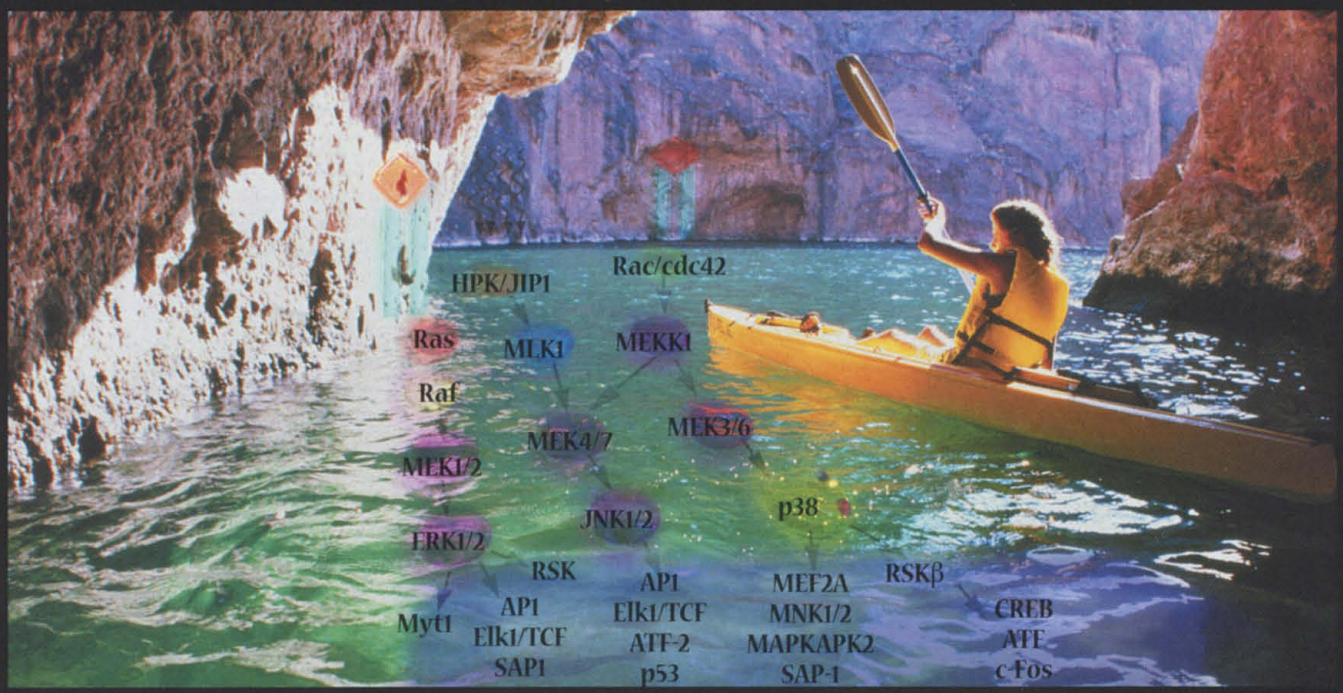

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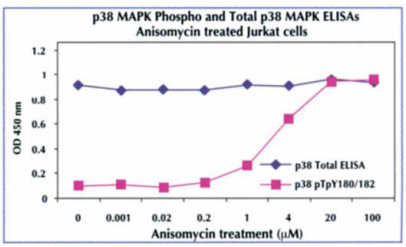
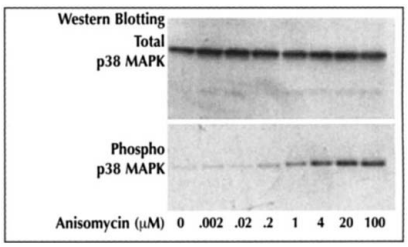


Solid Results



Cell lysates from Jurkat cells treated with various concentrations of anisomycin were tested with Total p38 MAPK ELISA (Cat.#KHO0061), phospho p38 MAPK ELISA (Cat.#KHO0071) and Western blotting. The data show excellent correlation between ELISA and Western blotting.

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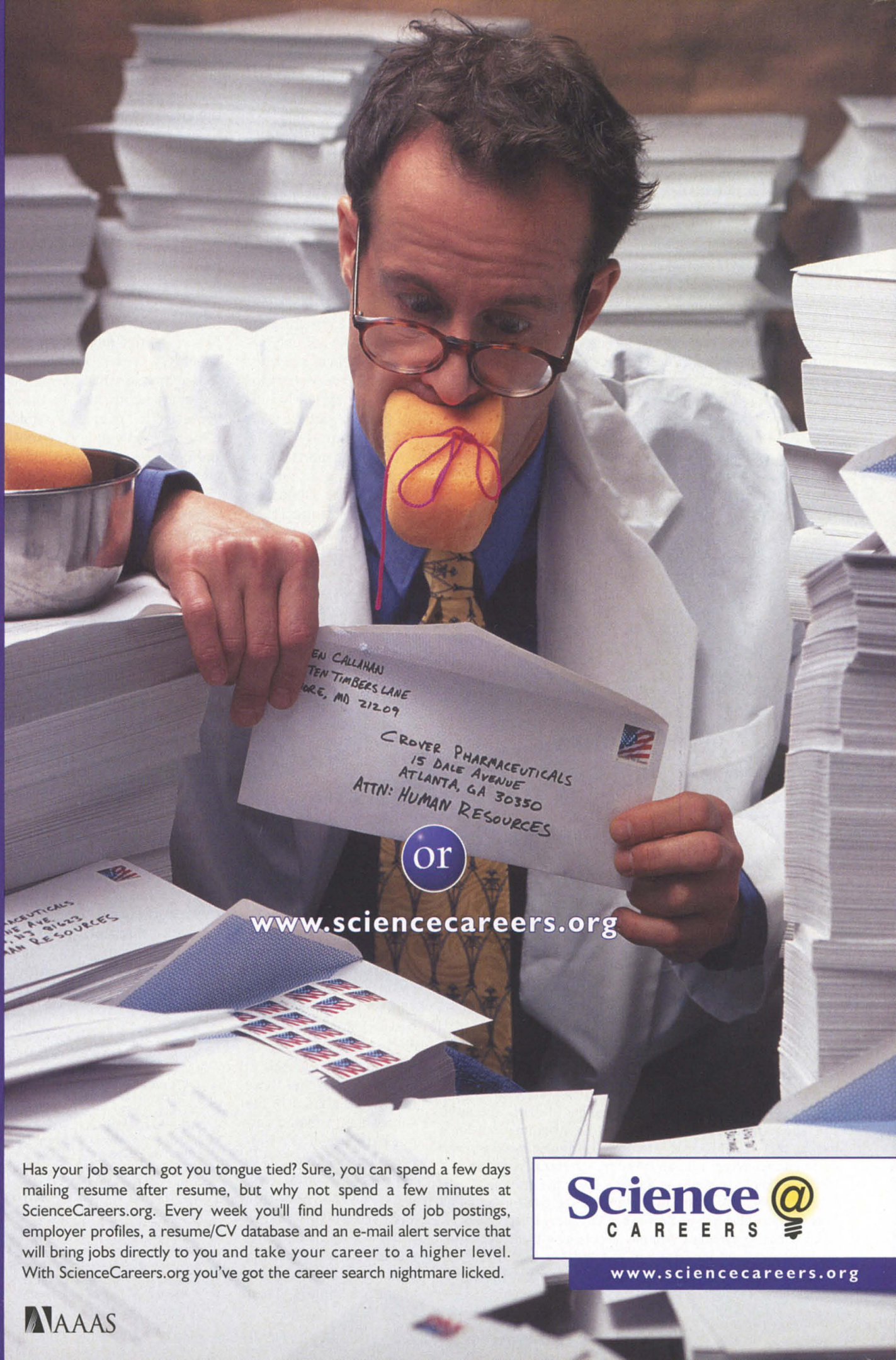

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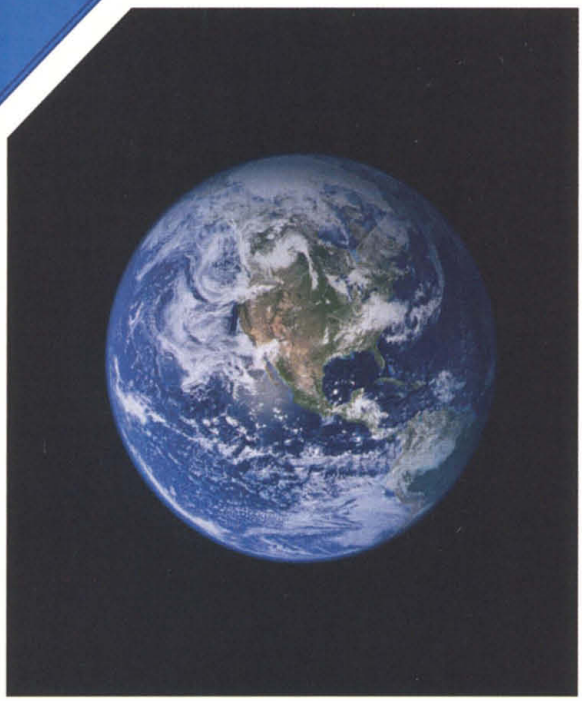

In 1848

SCIENCE ADVANCED WITH A MEETING OF MINDS.

By 1885, AAAS had 1,981 members, including those shown here.

Photo Courtesy of the National Anthropological Archives, Smithsonian Institution

Eighty-seven of the most distinguished members of the nascent American scientific community attended the first AAAS meeting on September 20, 1848. This occasion marked the founding of a national forum linking scientists scattered throughout the U.S.

More than 150 years later, AAAS works for scientists across America and around the world. International programs foster global cooperation. Project 2061 sets science education standards. The weekly journal *Science* publishes seminal research. Other programs promote sound science policy.

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