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# SCIENCE

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and Society

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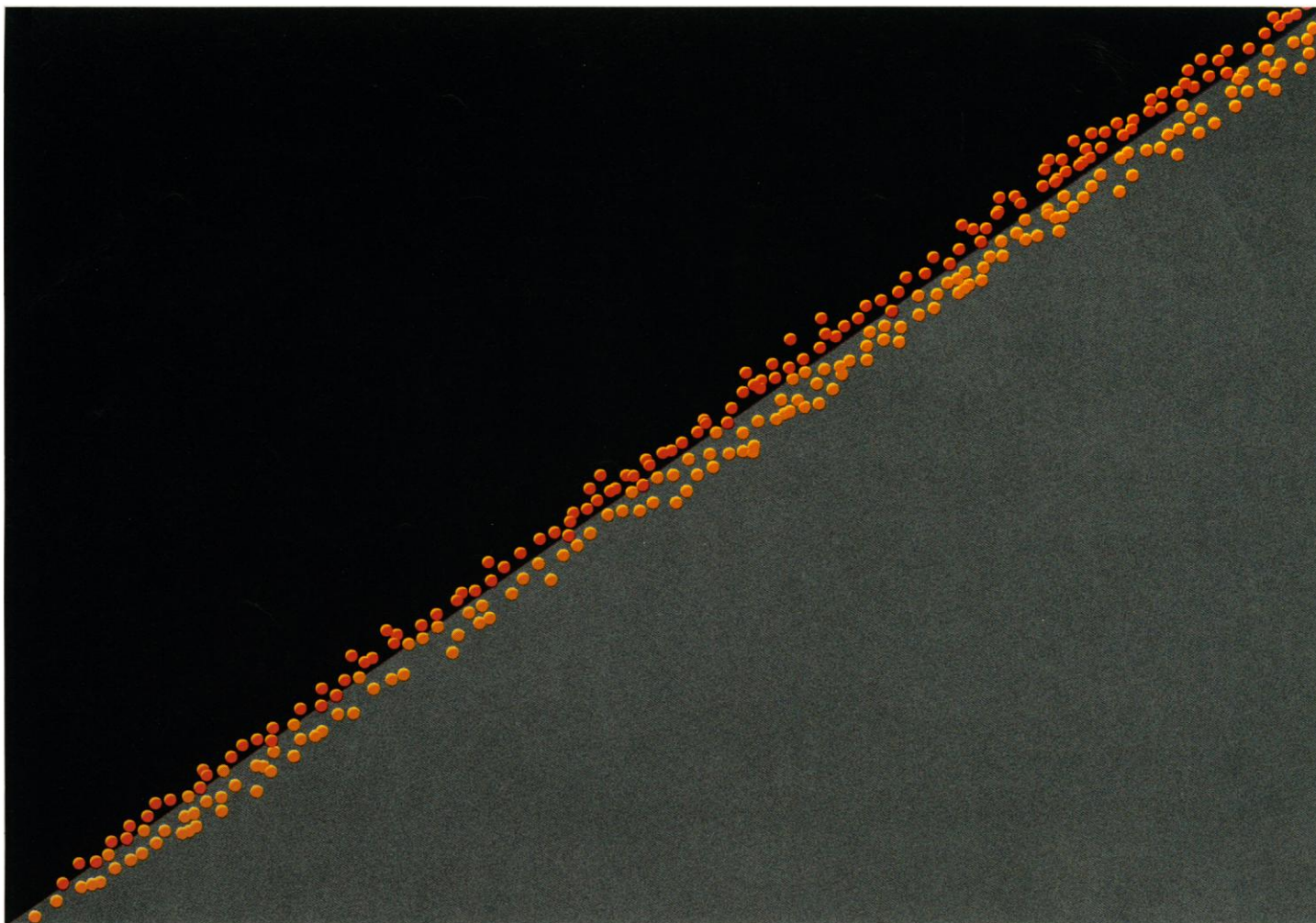
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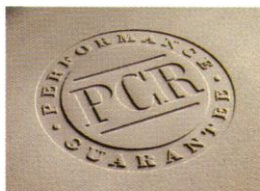
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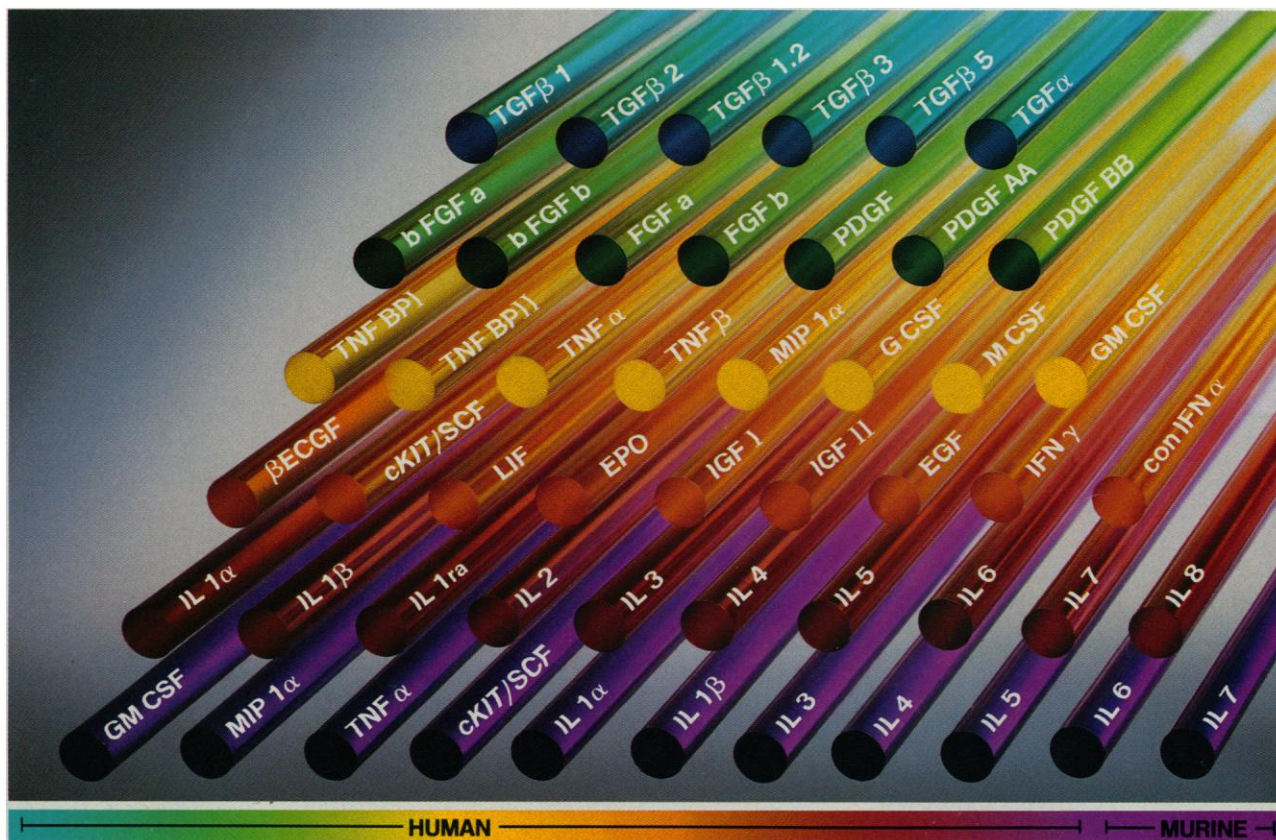
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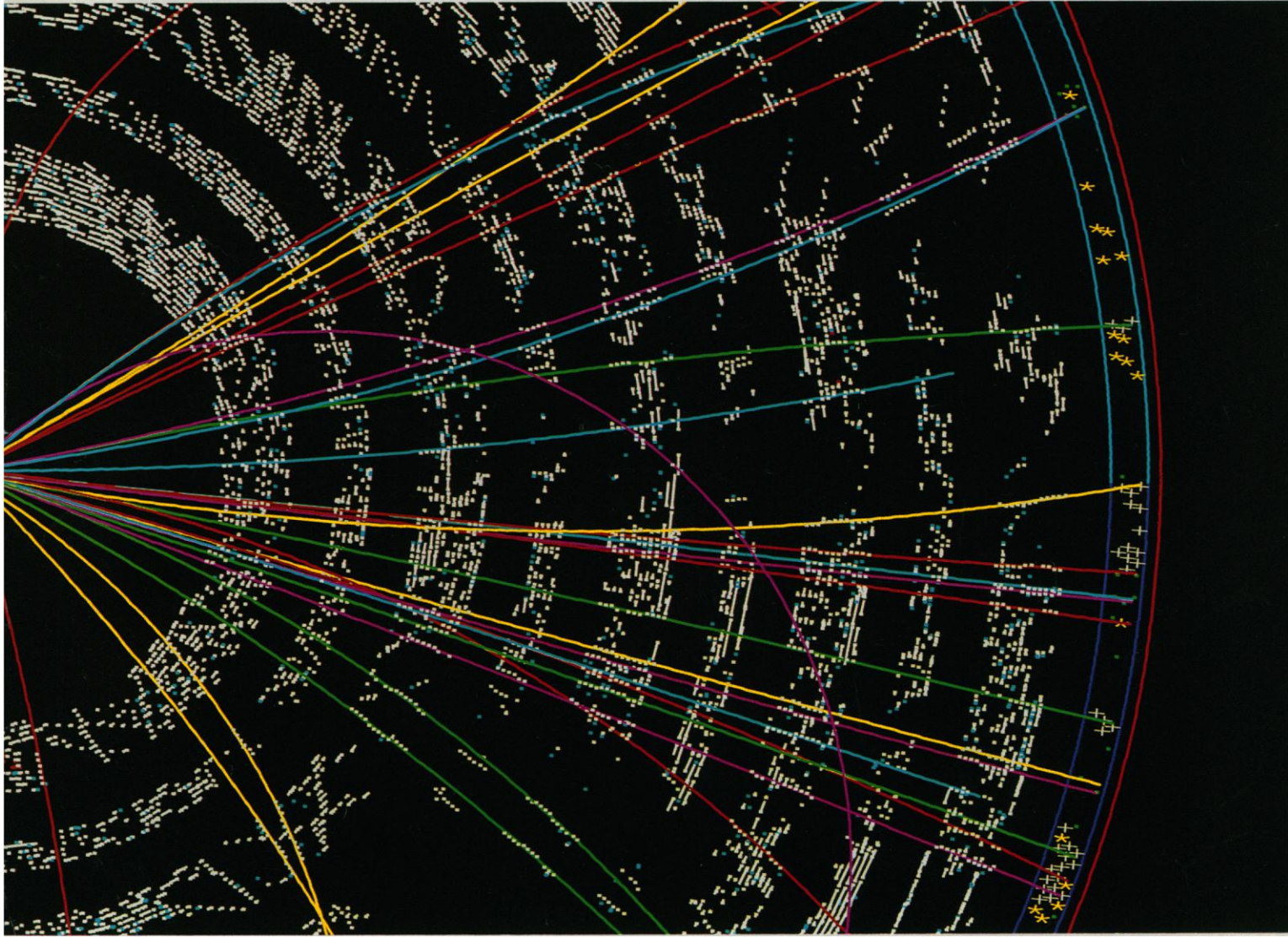
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## Fermilab is tapping a new

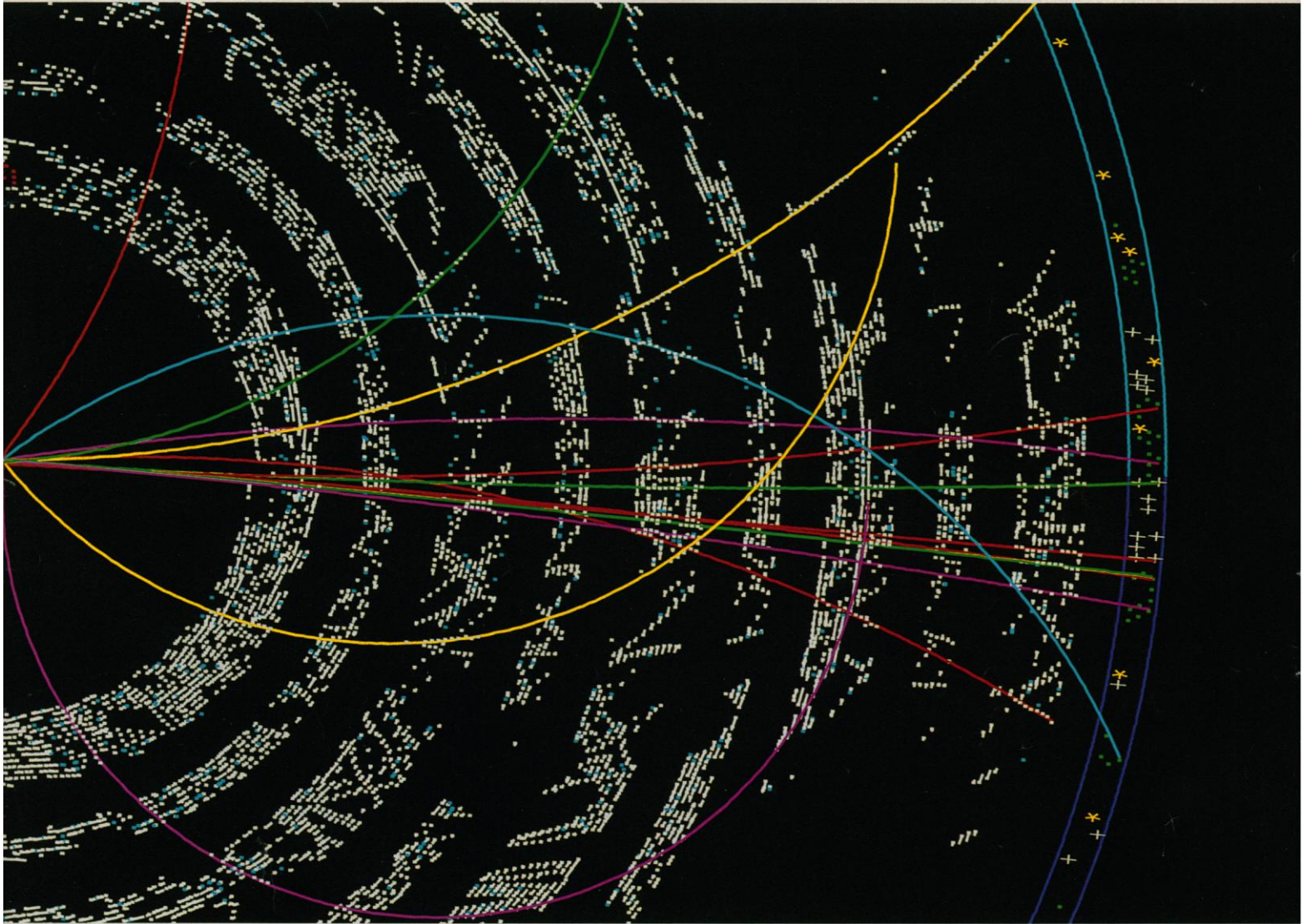
If there's one thing you can count on in science, it's that your data will increase exponentially but your funding won't.

The scientists at Fermi National Accelerator Laboratory (Fermilab) have encountered this problem in a very big way. The data Fermilab processes for subnuclear event reconstruction and modeling has reached 40 terabytes a year. And they've developed an innovative solution to meet their needs.

Instead of relying on supercomputers, Fermilab has distributed a significant part of the workload to clustered IBM RISC System/6000™ workstations. They've combined 108 of them, at latest count, in a LAN-connected



Computer reconstruction of proton/anti-proton collision at Fermilab.



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processor farm. This farm gives Fermilab a full 3,000 MIPS that can be dedicated to a single parallel processing application.

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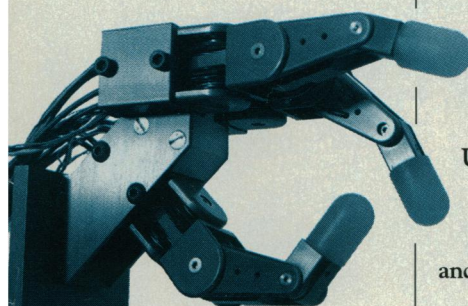
The National Center for Supercomputing Applications in Champaign, Illinois, for example, runs superscalar applications on a cluster of seven RISC System/6000s. High performance and reliability are why they selected the RISC System/6000.

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Exploring the questions of science and education for the future is the theme of AAAS☆93 in Boston from 10 to 16 February 1993. The program of scientific sessions spans the sciences, highlighting the year's advances and speculating on tomorrow's discoveries. A special symposium focuses on educational programs

that aim to elevate scientific literacy and train young scientists to find answers for the future. See page 1511 for a complete program and registration information. [Photo: Darrow Montgomery; taken at Jessie LaSalle Elementary School, Washington, DC]



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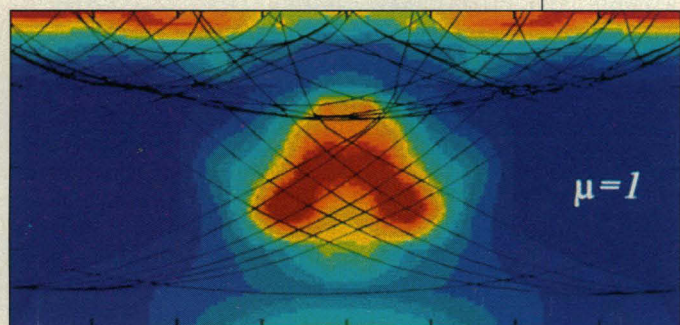
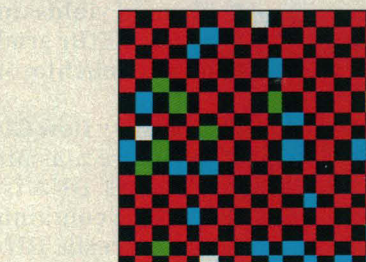
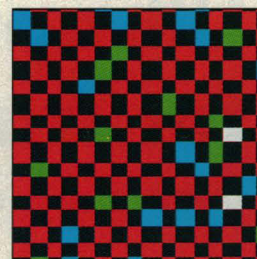
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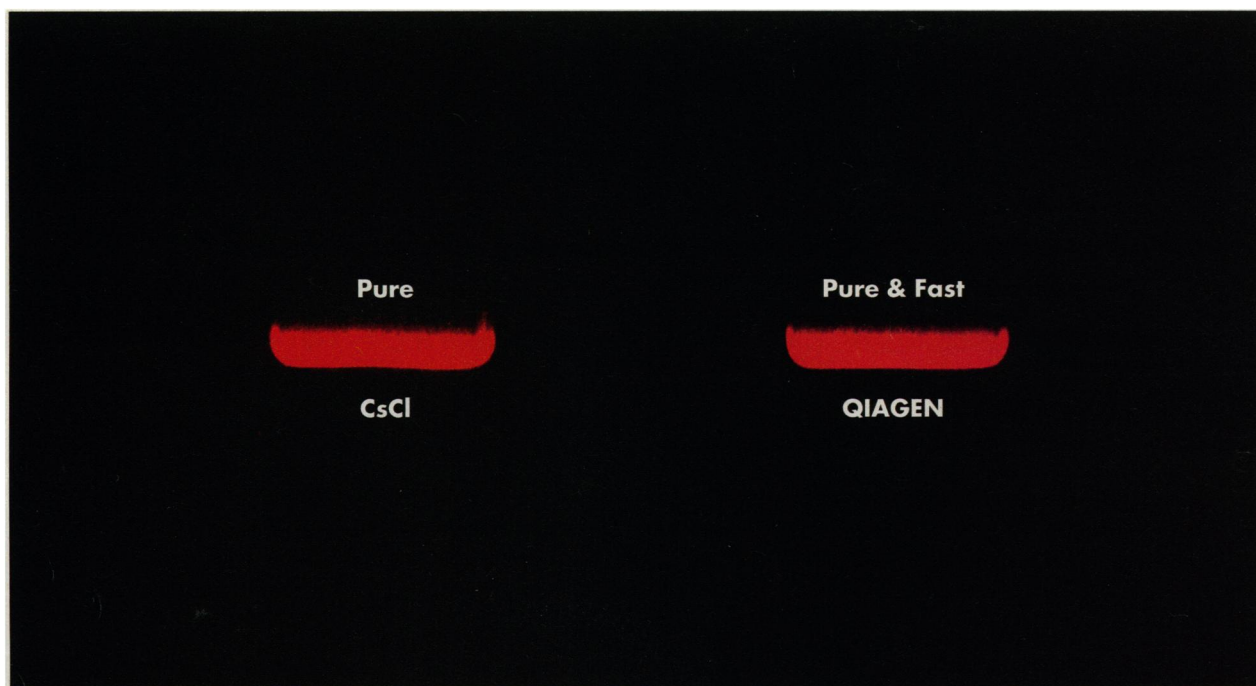
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# Ultrapure Plasmid DNA for Transfections

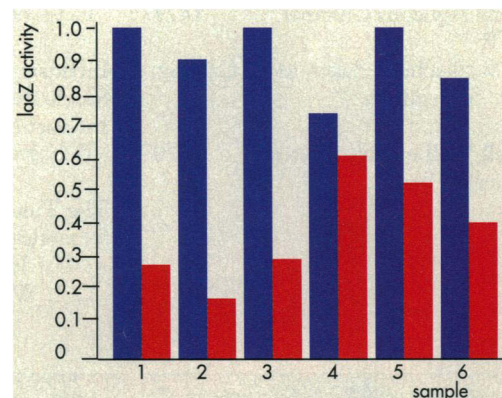
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**QIAGEN purified DNA for transfection:** NIH 3T3 cells were transfected with 1, 2 and 3 µg of the plasmid pRSVlacZ according to the standard calcium phosphate method. Plasmid DNAs used for transfection were prepared with QIAGEN Plasmid Mega Kit (blue bar) or by CsCl gradient centrifugation (red bar). The transfection efficiencies were determined by measurement of β-galactosidase activity. Samples 1 and 2: 1 µg DNA; samples 3 and 4: 2 µg DNA; samples 5 and 6: 3 µg DNA. Data kindly provided by Frauke Ehlert, Institute for Molecular Biology and Tumor Research, Marburg, Germany.

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## DNA-RNA hybrids

Forming stable double and triple helices that combine single strands of RNA and DNA has generally been thought to be a losing proposition, in part because the high propensity of RNA to adopt the A-form helix was thought to be destabilizing. Roberts and Crothers (p. 1463) show that this is not the case; RNA-DNA hybrids are not forced into the A form. In triple helices, RNA is preferred for the third strand and both pyrimidine strands, whereas DNA is favored for the purine strand. In general, stable duplexes are unstable triplexes, and vice versa.

□

## High and low in the Himalayas

Large extensional systems have recently been recognized in the Himalayas that apparently represent crustal weakening in response to the high elevations and thick crust that has developed there. The timing of onset of extension in relation to mountain building and metamorphism have been unclear, however. Hodges *et al.* (p. 1466) present age data on an exposed ancient extensional system in Tibet that suggest that extension at high crustal levels may have accompanied or immediately followed thrusting and metamorphism at deeper levels in the high Himalaya 19 to 22 million years ago.

□

## Forming oceanic crust

A variety of seismic techniques have been used to probe the region of partially melted mantle that underlies mid-ocean ridges and supplies magma to form the new oceanic crust (see Perspective by Mutter, p. 1442). Rather

than looking at the reflection or refraction of seismic waves, Wilcock *et al.* (p. 1470) examined the attenuation of seismic waves through the actively forming oceanic crust on the East Pacific Rise. These data are particularly sensitive to the amount of melt actually present in the mantle as well as the presence of high porosities and thus the extent of hydrothermal fluid circulation in the overlying crust. The data suggest that the magma lens in this spreading center is less than 1 kilometer thick and that it overlies mantle containing only a small amount of melt. The thickness of basaltic crust with high porosity may increase away from the spreading axis.

□

## Charged buckyballs

Many phenomena in chemistry are based on the transfer of electric charge from one molecule to another. Photosynthesis in plants is an example in nature where such transfer is induced by light. One potentially useful

charge transfer molecule is buckminsterfullerene, which can accept as many as six electrons from a variety of donor species. Sariciftci *et al.* (p. 1474) investigated the photoinduced transfer of electrons from conducting polymers by means of optical absorption and electron spin resonance. Charge transfer is reversible and occurs on a time scale of picoseconds. These kinds of charge transfer systems may lead to advances in molecular electronics, energy conversion, and data storage.

□

## Peptide nucleic acid applications

Peptide nucleic acids (PNAs) consist of polyamide backbone and nucleic acid side chains. Such molecules can bind to duplex DNA sequences and displace one of the DNA strands. Hanvey *et al.* (p. 1481) used this property of PNAs to interfere with gene expression in cells. Binding of PNAs could interfere with transcription, reverse transcription, and in vitro translation. Expression of SV40

large T antigen could be suppressed by microinjecting a PNA construct into the cell nucleus.

□

## Virus versus virus

Adeno-associated virus (AAV) has been used by Chatterjee *et al.* (p. 1485) to incorporate antisense molecules into cell lines that can inhibit the expression of HIV-1 genes. There are potential advantages to using AAV instead of a retrovirus as a vector; AAV is a DNA virus that cannot recombine with HIV-1, and it incorporates into the human genome at a specific site. Constructs were made that targeted sequences present in all HIV-1 messenger RNAs; these included the TAR sequence, an RNA loop structure that is critical for transcription and replication, and the polyadenylation signal. Infected CD4<sup>+</sup> T cell lines that expressed this construct showed a greater than 99 percent reduction in HIV-1 production.

□

## Autoimmune energy

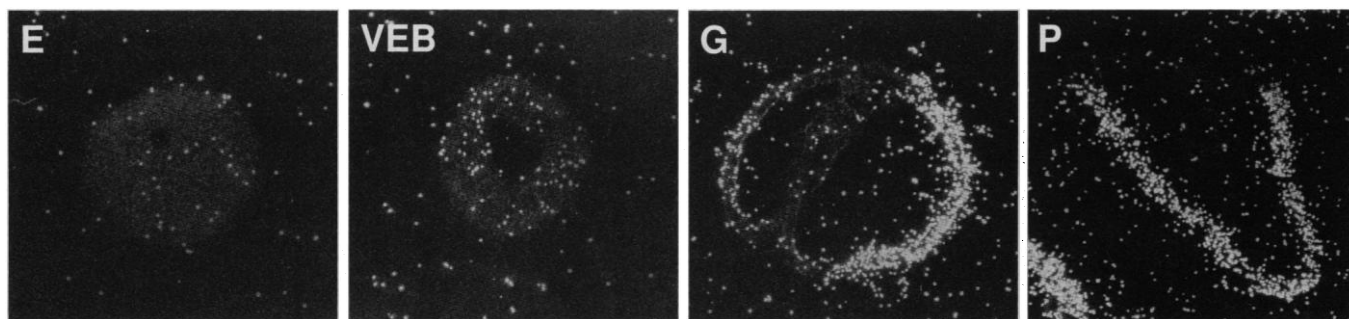
Experimental autoimmune encephalomyelitis (EAE), a disease in mice that serves as a model for multiple sclerosis, is induced by immunization with myelin basic protein (MBP). Gaur *et al.* (p. 1491) show that tolerance against the effects of MBP can be induced by immunizing adult mice with synthetic peptides that correspond to the major immunogenic determinants of MBP, peptides Ac 1-11 and 35-47. Such immunization could prevent the induction of EAE, and similar immunizations after EAE that was induced could halt the progression of EAE. These effects were caused by inducing an anergic state in the T cells specific for MBP.

## Post-transcriptional signals in early T cells

In the thymus, precursor thymocytes that express the  $\alpha\beta$  isotype of the T cell receptor (TCR) pass through a series of developmental stages that are marked by the expression of the co-receptor molecules CD4 and CD8. The formation of CD4<sup>+</sup> or CD8<sup>+</sup> T cells from their CD4<sup>+</sup>CD8<sup>+</sup> precursors is determined by the TCR. Takahama and Singer (p. 1456) show that the TCR is also involved in the early stages of T cell development. Precursors to CD4<sup>+</sup>CD8<sup>+</sup> T cells, CD4<sup>+</sup>CD8<sup>lo</sup> cells, were isolated from fetal mice. In in vitro cultures, these cells are committed to differentiating into CD4<sup>+</sup>CD8<sup>+</sup> T cells. The authors show that cross-linking the TCR molecules on the CD4<sup>+</sup>CD8<sup>lo</sup> cells blocked differentiation by eliminating the messenger RNAs for CD4 and CD8, as well as for the recombination activating genes 1 and 2. The RAG-1 and RAG-2 mRNAs are required for rearranging the TCR $\alpha$  and TCR $\beta$  loci. Post-transcriptional regulation of mRNA synthesis required protein synthesis and appears to be developmentally regulated in that this pathway does not appear to operate in mature T cells. Such processes could help prevent the differentiation of autoreactive CD4<sup>+</sup>CD8<sup>lo</sup> cells.



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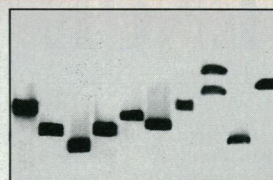






## Shedding Light on Nucleic Acids Detection

### Nucleic acids detection



Analysis of yeast artificial chromosome (YAC) clones: DNA from 10 YAC clones separated by pulsed-field gel electrophoresis and transferred to Hybond™-N, hybridized to probe DNA prepared using ECL random prime labelling and detection system. 30 minute exposure to Hyperfilm™-ECL.

Data supplied by E. Green, M. Ueltzen and R. Tidwell, Washington University Medical School, St Louis, MO, USA.

Choose It

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# 1993-94

## AAAS Fellowships for Scientists & Engineers

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*AAAS Congressional Science & Engineering Fellows Program.*

Fellows spend one year on Capitol Hill working with Members of Congress or congressional committees as special assistants in legislative and policy areas requiring scientific and technical input. Two fellowships will be offered, with annual stipends of \$40,000.

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*AAAS-Sloan Executive Branch Science & Engineering Fellows Program*

Fellows work in the White House Office of Science and Technology Policy (OSTP) for one or two years, providing expertise in industrial research and development, technology transfer, international competitiveness, and related issues. One or two Fellows will be selected. Applications are invited from candidates with a minimum of five years industrial experience, through mid-level and senior executives. Stipends are negotiable, depending on qualifications and experience. Applicants must be U.S. citizens.

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*AAAS Environmental Science & Engineering Fellows Program*

Fellows work as special research consultants with the Office of Research and Development (ORD) of the U.S. Environmental Protection Agency for 10 weeks in the summer. The detailed, future-oriented research assists ORD in assessing the significance of long-range environmental problems. The stipend is \$950 a week. Applicants must be residents of the United States. Ten Fellows will be selected.

*Applicants should be postdoctoral to midcareer scientists and engineers, from any physical, biological, or social science or any field of engineering. The programs are designed to provide each Fellow with a unique public policy learning experience; to make practical contributions to the more effective use of scientific and technical knowledge in the U.S. government; and to demonstrate the value of science and technology in solving important societal problems. All Fellows participate in a rigorous orientation on the relevant congressional and executive branch operations and foreign affairs plus a year-long seminar series on issues involving science, technology, and public policy. The Congressional, Diplomacy, and Executive Branch programs begin in September 1993, and the Environmental program begins in June 1993. All application deadlines are January 15, 1993. For additional program information and application instructions, write:*

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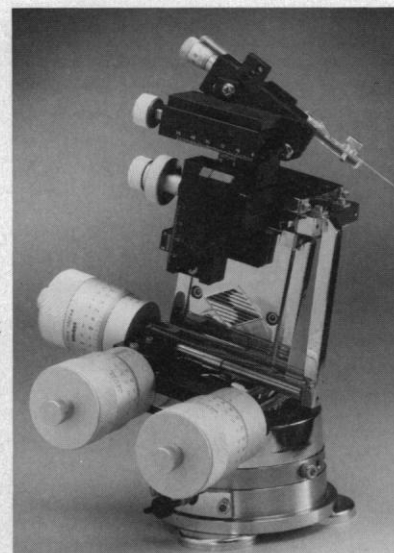
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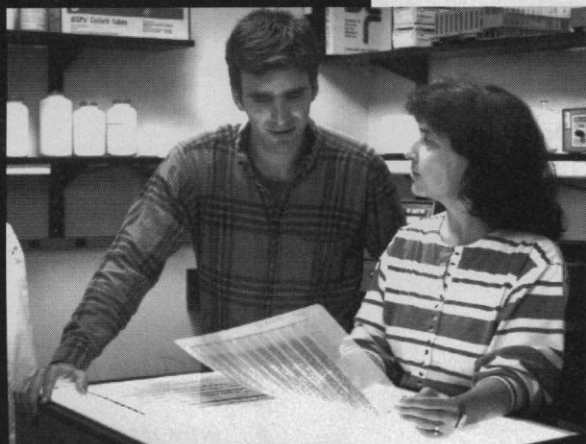


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