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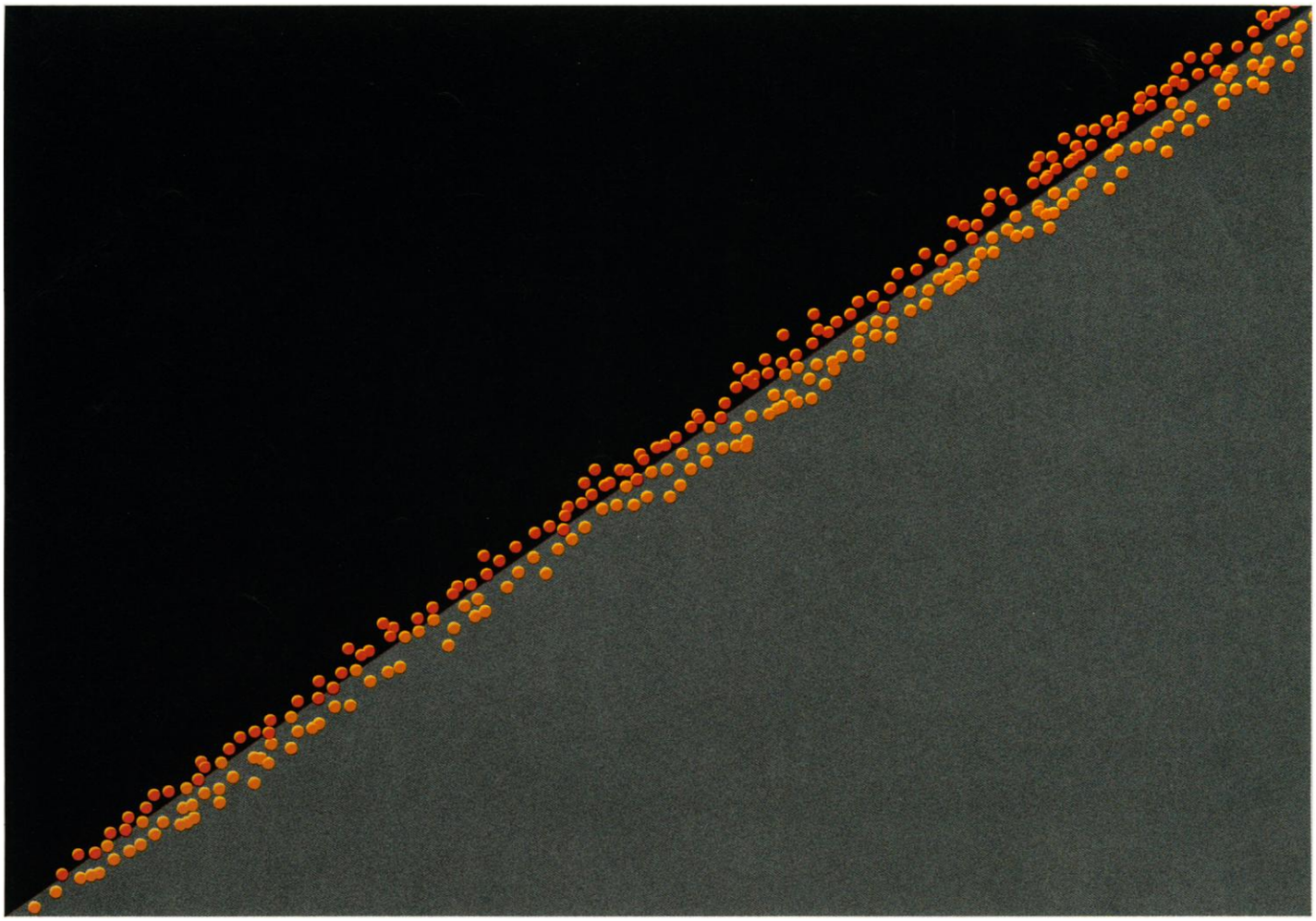

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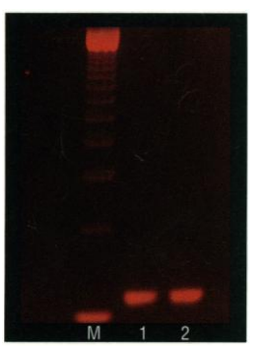

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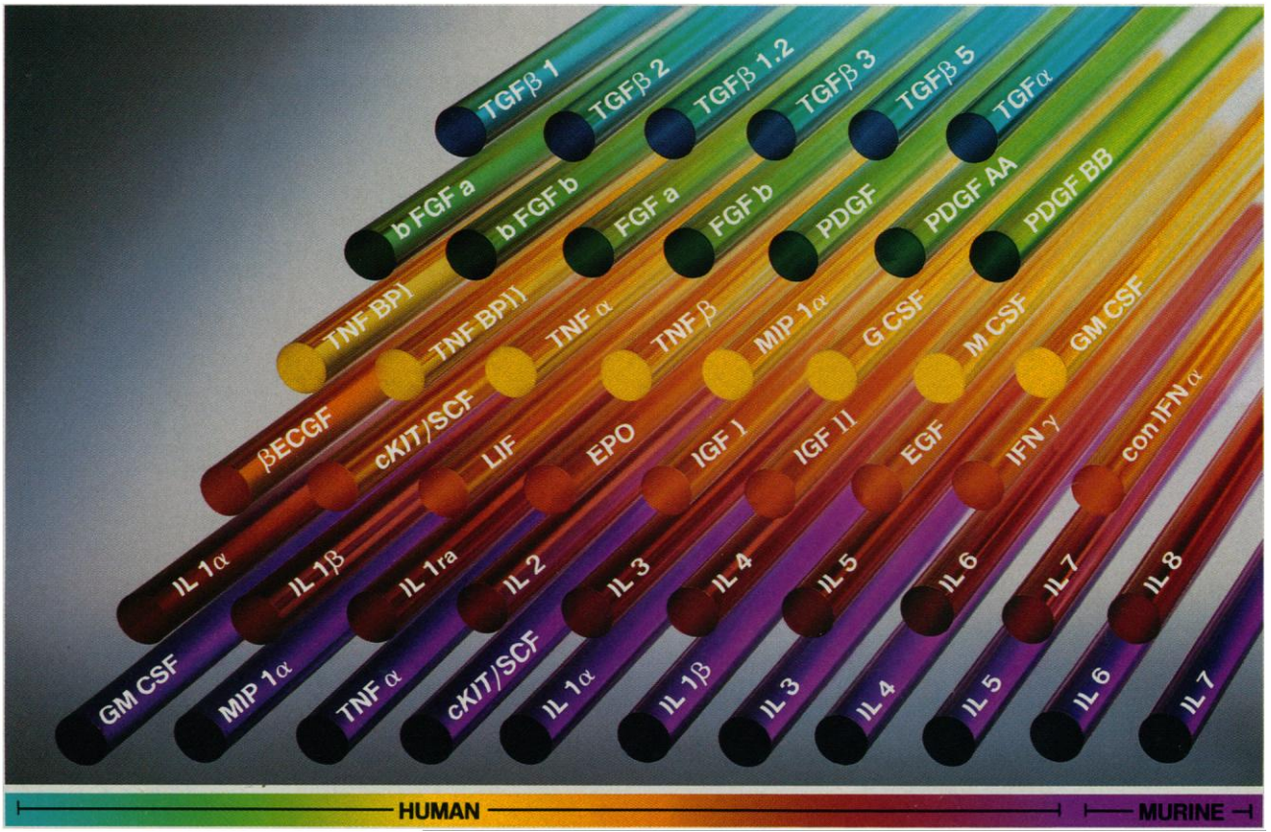

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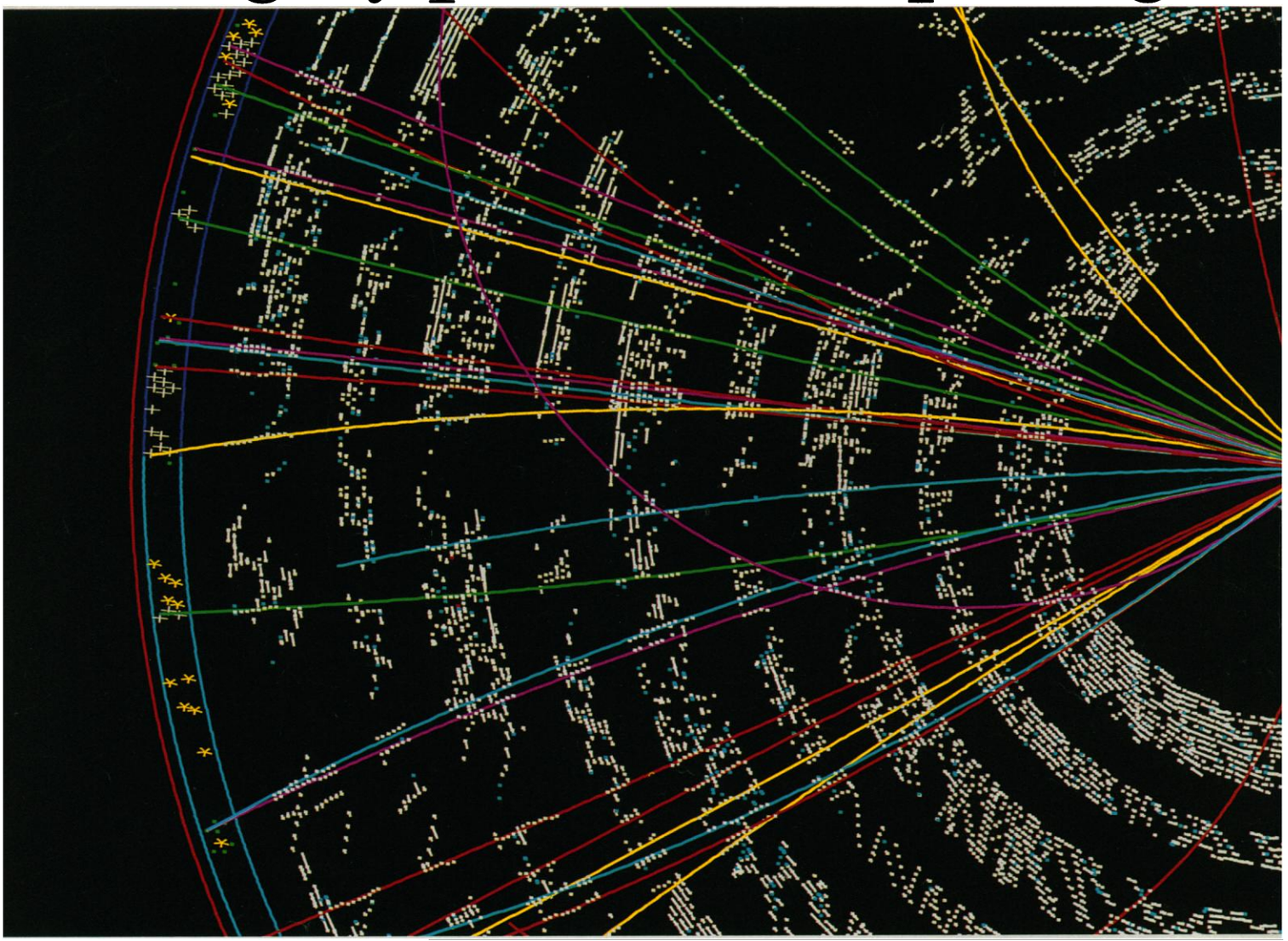
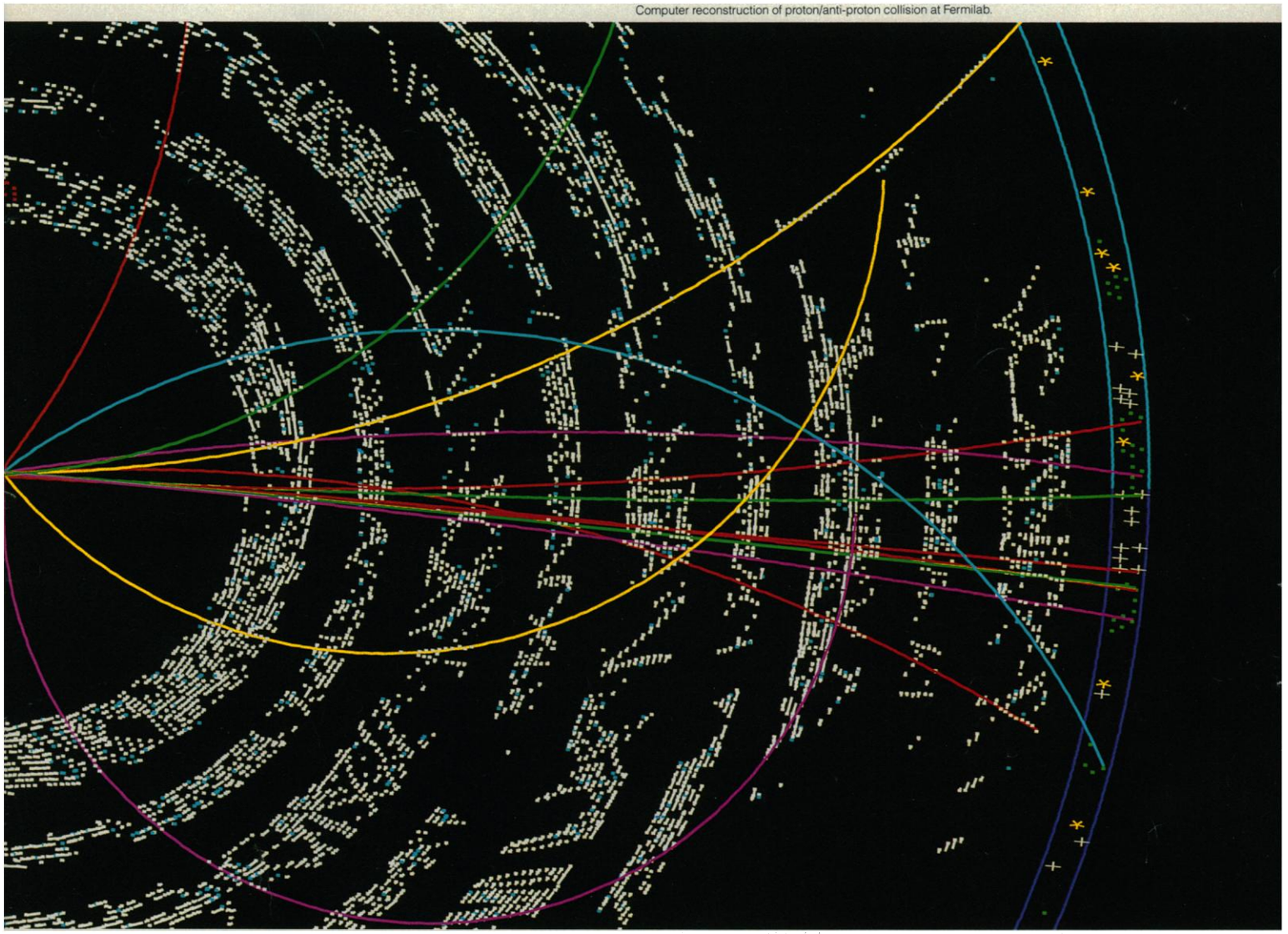


Fermilab is tapping a new

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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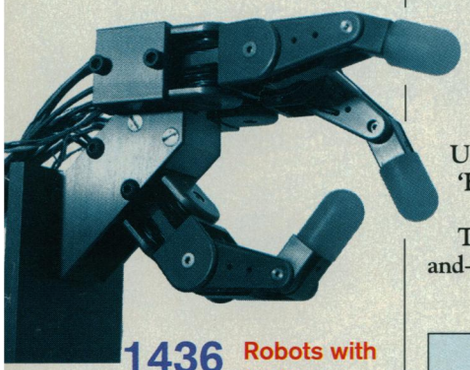


1436 Robots with feeling fingers

NEWS & COMMENT

RESEARCH NEWS

PERSPECTIVE

ARTICLES

RESEARCH ARTICLE

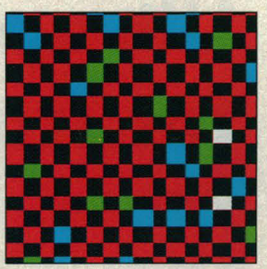
DEPARTMENTS

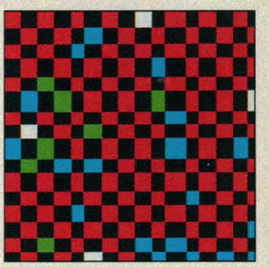
COVER

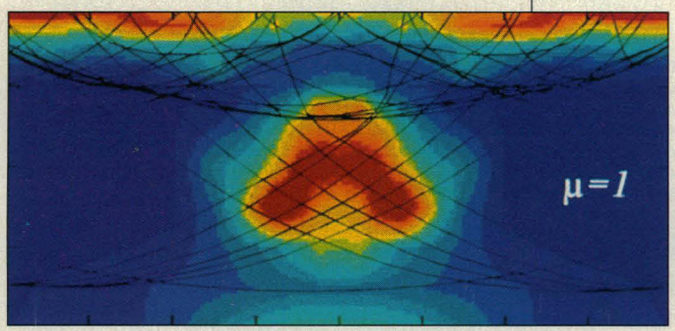
Exploring the questions of science and education for the future is the theme of AAAS☆93 in Boston from 10 to 16 February 1993. The program of scientific sessions spans the sciences, highlighting the year's advances and speculating on tomorrow's discoveries. A special symposium focuses on educational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

REPORTS

1494
Stochastic behavior of glutamate receptors







1442 & 1470
Magma on the rise

◩ Indicates accompanying feature

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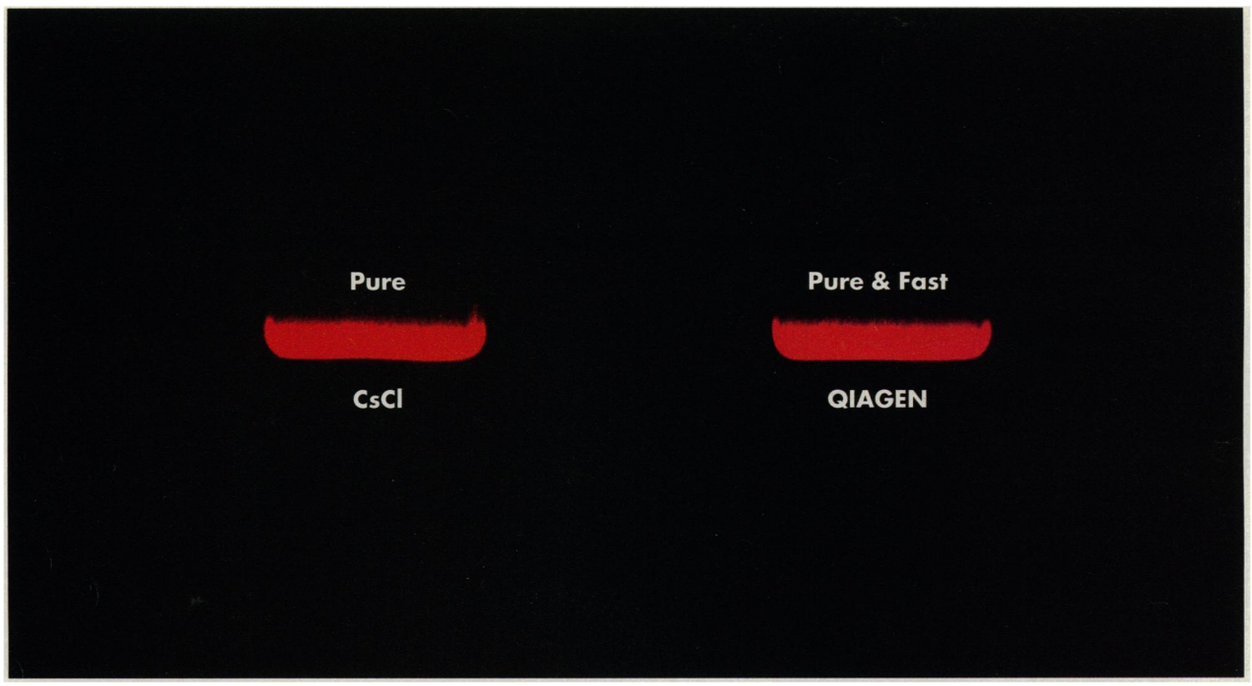
■ The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objectives are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of human welfare, to advance education in science, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.



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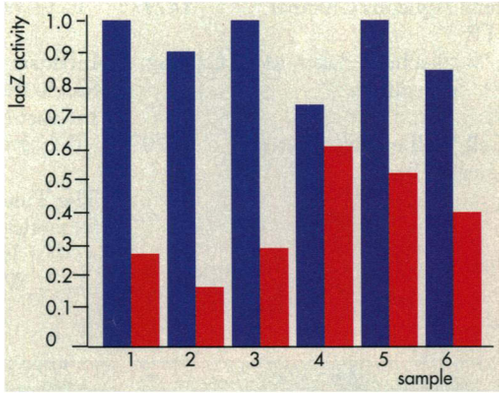

QIAGEN purified DNA for transfection: *NIH 3T3 cells were transfected with 1, 2 and 3 µg of the plasmid pRSVlacZ according to the standard calcium phosphate method. Plasmid DNAs used for transfection were prepared with QIAGEN Plasmid Mega Kit (blue bar) or by CsCl gradient centrifugation (red bar). The transfection efficiencies were determined by measurement of ß-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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edited by PHIL SZUROMI

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 $CD4^+$ T cell lines that expressed this construct showed a greater than 99 percent reduction in HIV-1 production.

Autoimmune anergy

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 αβ 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 $CD4^+$ or $CD8^+$ T cells from their $CD4^+CD8^+$ 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 $CD4^+CD8^+$ T cells, $CD4^-CD8^{lo}$ cells, were isolated from fetal mice. In in vitro cultures, these cells are committed to differentiating into $CD4^+CD8^+$ T cells. The authors show that cross-linking the TCR molecules on the $CD4^-CD8^{lo}$ 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 TCRα and TCRβ 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 $CD4^-CD8^{lo}$ cells.

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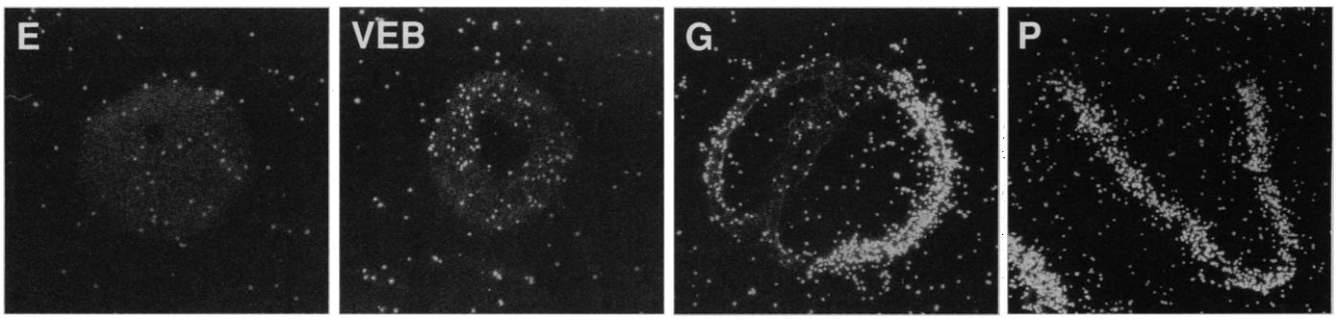

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[∝-^{33}P]UTP (Cat. No. NEG-307H) was used to label an RNA sequence complementary to a developmentally regulated mRNA expressed in sea urchin embryonic ectoderm (see Hardin *et al.*, J. Mol Biol. 202, 417-431, 1988). The 4 figures show hybridizations to egg (E), very early blastulae (VEB), gastrula (G) and pluteus (P) stage embryos. Exposures were developed after 2 weeks using Kodak NTB-2 emulsion; probe specific activity was 1x10^{8}dpm/μg. At this long exposure, very little background is seen in the egg control (E). During very early development (VEB), faint signals can easily be seen over background making ^{33}P the isotope of choice for studying developmental models by *in situ* hybridization. Data courtesy of Dr. Lynne Angerer, University of Rochester.

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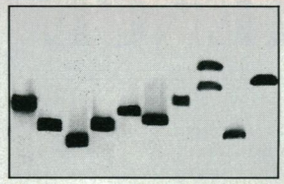

Analysis of yeast artificial chromosome (YAC) clones: DNA from 10 YAC clones separated by pulsed-field gel electrophoresis and transferred to Hybond™-N, hybridized to probe DNA prepared using ECL random prime labelling and detection system. 30 minute exposure to Hyperfilm™-ECL.
Data supplied by E. Green, M. Ueltzen and R. Tidwell, Washington University Medical School, St Louis, MO, USA.

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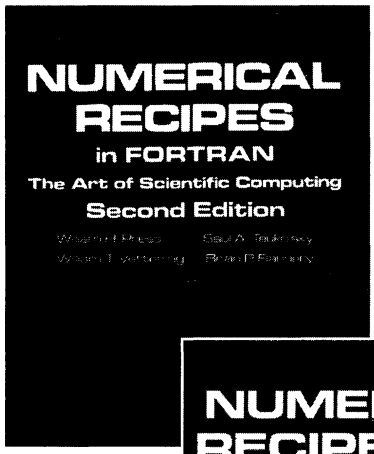

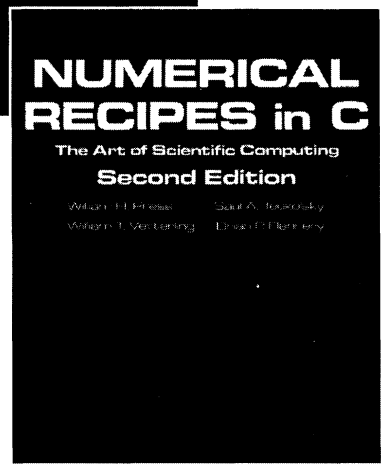

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