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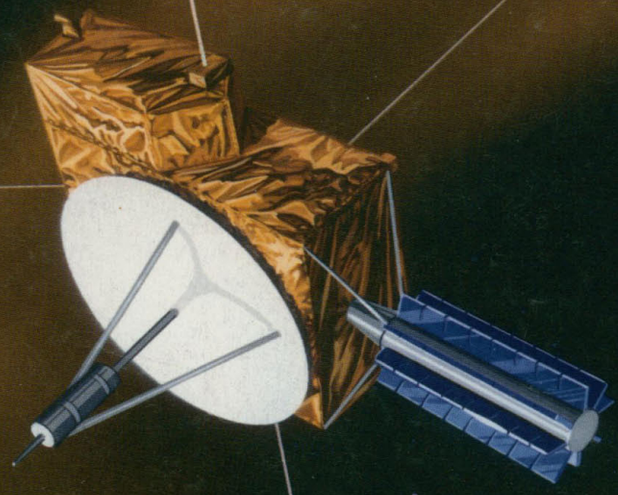
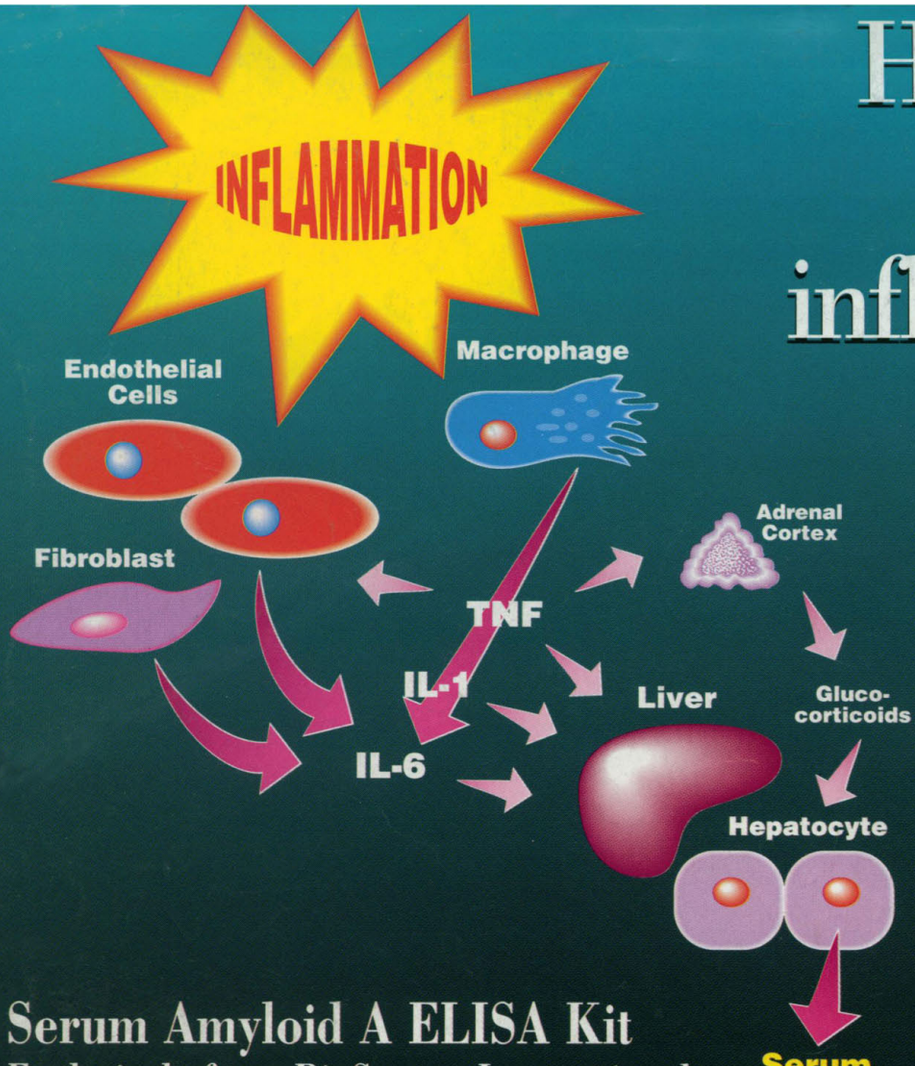


Ulysses at Jupiter

How are you measuring inflammation?



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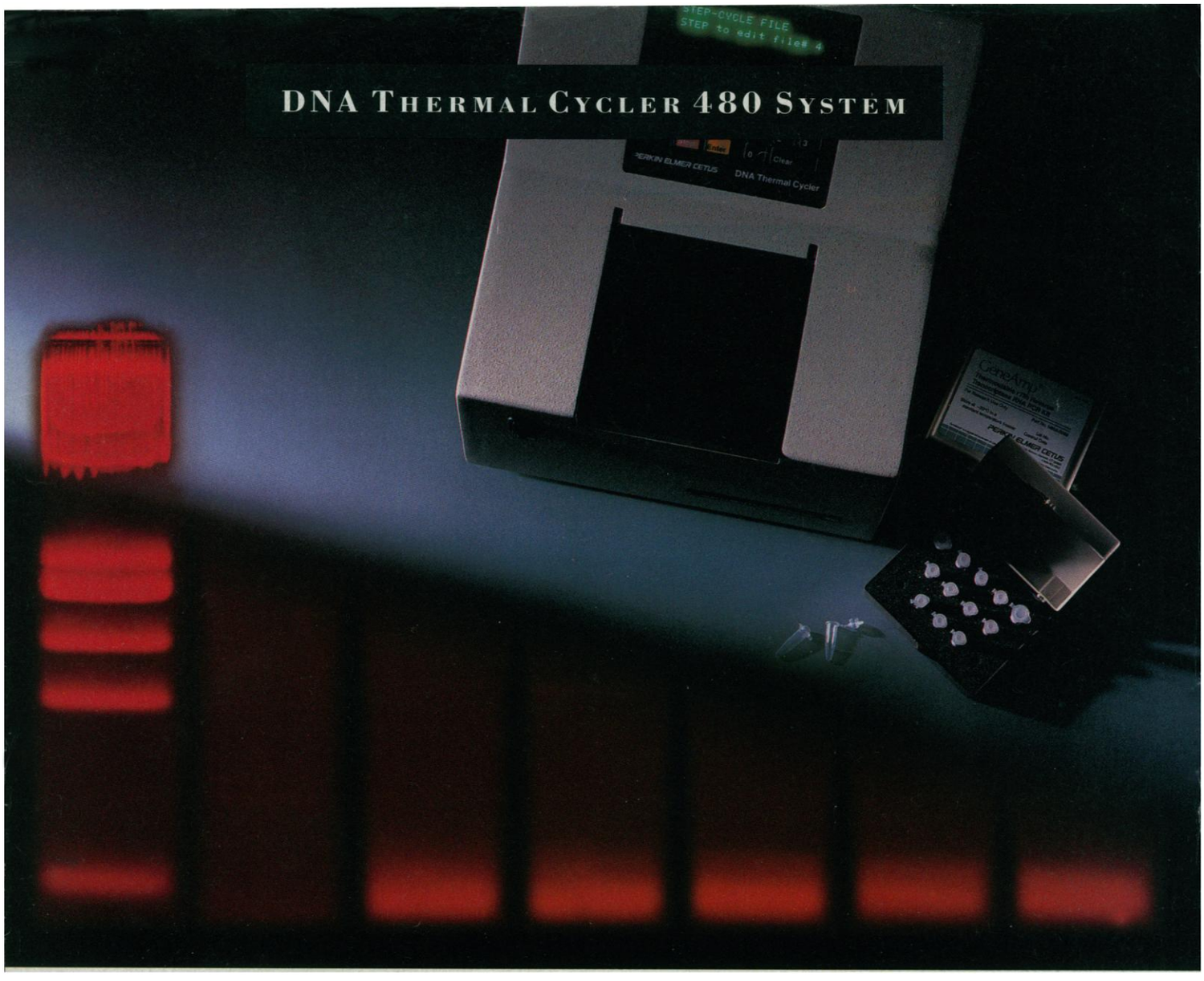

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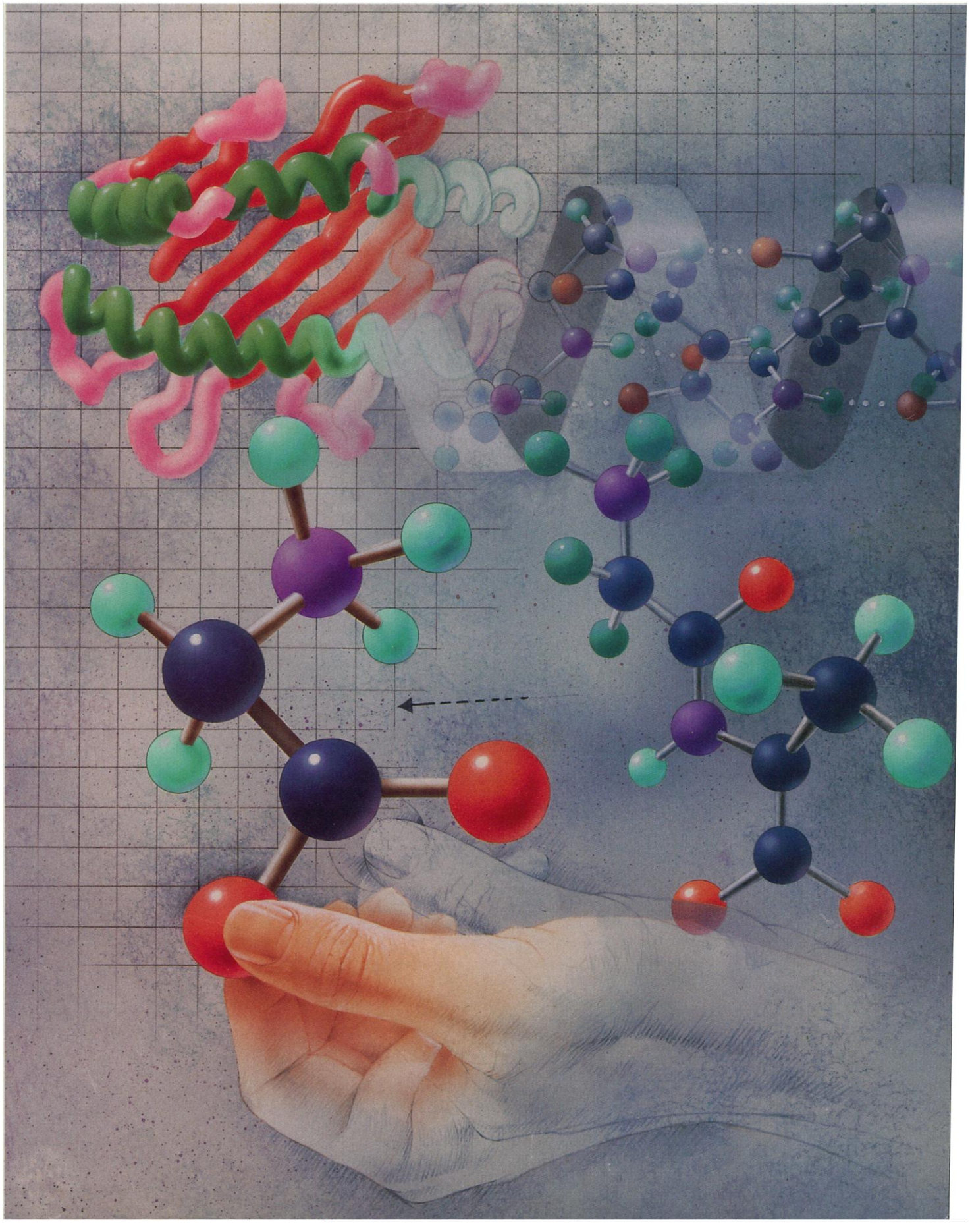

PROTEINS

How innovative technologies solve today's problems.

Today's protein research environment is more exciting and demanding than ever before. With each breakthrough, researchers discover new challenges as they strive to do more in less time with smaller amounts of material. In many cases, they are solving these problems with the application of alternate technologies.

PROTEIN QUARTERNARY STRUCTURE: WHERE DO TRADITIONAL TECHNIQUES FALL SHORT?

Quantification of stoichiometry and binding affinities is critical, both in quality control of recombinant proteins and in anti-viral drug development. Yet direct measurement of these thermodynamic properties has been hampered by empirical methods that rely on molecular weight standards and unjustified assumptions or methods that interfere with equilibrium between associated and non-associated protein moieties. To avoid such problems, Beckman Instruments now offers a modern analytical ultracentrifuge described by Dr. Preston Hensley of SmithKline Beecham:

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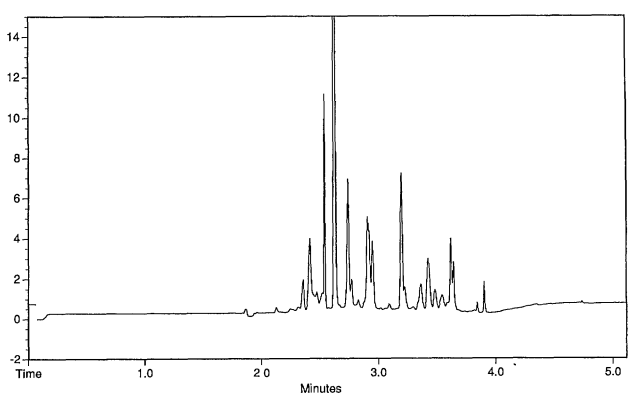

Tryptic digest of ß-lactoglobulin analyzed with CE. (700 attomoles injected.)

For more information about applications of the techniques discussed in this article, the Beckman Plus, or for information and dates on Beckman's worldwide Protein Discovery Tour, write to Beckman Instruments, Inc., Bioanalytical Systems Group, 2500 Harbor Boulevard, Fullerton, California 92634-3100. Or call, toll-free in the U.S.A. 1-800-742-2345.

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SCIENCE

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SCIENCE

1476
Red tide on the rise

NEWS & COMMENT

RESEARCH NEWS

PERSPECTIVES

ARTICLE

1491
Evolution of carnivorous plants

RESEARCH ARTICLE

DEPARTMENTS

COVER

Drawing of the Ulysses spacecraft as it left Jupiter traveling southward in the previously unexplored dusk sector, showing the large Io plasma torus (yellow ring) and a small auroral oval (violet). In February 1992, Ulysses flew past Jupiter to take advantage of the gravity assist that redirected it toward the sun's polar regions. The scientific results obtained during this encounter with Jupiter are presented in a series of reports beginning on page 1503; see also the Perspective on page 1487 and the News story on page 1478. [Illustration: Jet Propulsion Laboratory]

REPORTS

ULYSSES AT JUPITER

1563 How do we detect motion?

◩ Indicates accompanying News story or Perspective

■ **SCIENCE (ISSN 0036-8075) is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1333 H Street, NW, Washington, DC 20005**. Second-class postage (publication No. 484460) paid at Washington, DC, and additional mailing offices. Domestic individual membership and subscription (51 issues): $82 ($50 allocated to subscription). Domestic institutional subscription (51 issues): $150. Foreign postage extra: Canada $46, other (surface mail) $46, air freight $90. First class, airmail, school-year, and student rates on request. Canadian GST Number: 125488122. **Change of address:** allow 6 weeks, giving old and new addresses and 11-digit account number. **Postmaster:** Send change of address to *Science*, P.O. Box 1723, Riverton, NJ 08077. **Single copy sales:** $6.00 per issue prepaid includes surface postage; Guide to Biotechnology Products and Instruments, $20. Bulk rates on request.

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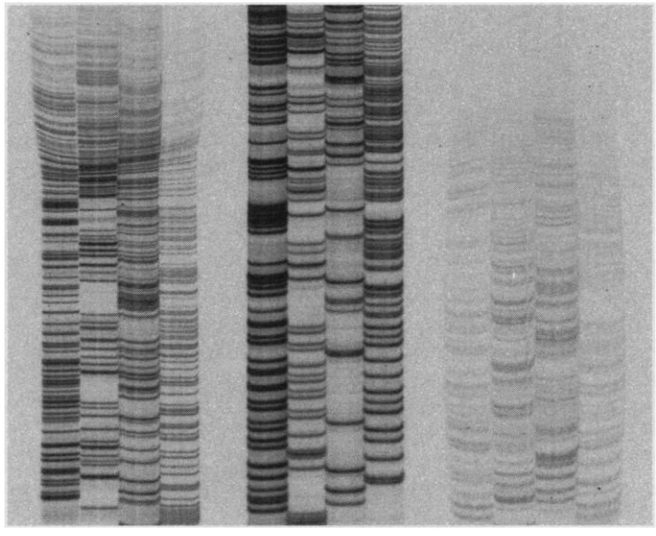

An unpurified 20-mer oligonucleotide was 5'-end labeled using [γ-^{33}P] ATP (Cat. No. NEG-302H) and subsequently used as a primer in a cycle sequencing reaction with λgt11 DNA clones. Film exposure: 12h. Sequencing gel courtesy of T. Iwata, LMOD, National Eye Institute, Bethesda, MD.

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THIS WEEK IN SCIENCE

edited by PHIL SZUROMI

Introns as failed exons?

In eukaryotic organisms, genes are arranged into exons and introns; the messenger RNA from exons encode amino acids, whereas the mRNA from introns is skipped in protein synthesis through splicing. In a Perspective, Seidel *et al.* (p. 1489) argue that exons were originally "microgenes" that coded for short peptide sequences, which then assembled as multimers to form proteins. Proximity of these gene sequences along a stretch of DNA would have improved the chances of encoding all of the peptides needed to form a functional protein. However, if the stop codons mutated and were then read through, two peptides could link up through a continuous chain. Thus, the consensus sequence at the end of exons (..AG) may result from mutation of the codon that stops protein synthesis, TAG, and the similar consensus code at the end of introns may indicate that they are exons that ceased to be essential for making a functional protein.

□

Tracing traps

Carnivorous plants show a diversity of specialized forms to catch their prey and then digest them. Attempts at understanding their evolution and specialization trace back to the work of Darwin. Albert *et al.* (p. 1491) review the development of these ideas and then present sequence analyses of the gene encoding the large subunit of ribulose-1, 5-bisphosphate carboxylase/oxygenase (RuBisCO) for carnivorous plants to address the phylogenetic patterns. Carnivorous plants apparently originated from various lineages of angiosperms. For example, flypaper traps seem to have five separate origins but also appear in lineages with all other trap forms.

Ulysses at Jupiter

On its way to study the sun, the Ulysses spacecraft took advantage of Jupiter's gravity to steer the proper course. This brief side trip afforded the best opportunity since the Voyager missions of the 1970s to collect data on the rich plasma environment that pervades the Jovian system (pp. 1503 to 1557). Ions, mostly sulfur and oxygen, are emitted from Io to form a large plasma torus along its orbit. Unlike Voyager, Ulysses was able to penetrate the torus and probe its properties. Observations from ground-based instruments and the Hubble Space Telescope were also made during the flyby that help fill in the picture. Among the new results is the observation that very narrow beams of ions and electrons are streaming along Jupiter's magnetic field; energetic bursts of field-aligned protons were also discovered. Past missions have shown Jupiter's magnetosphere to be a dynamic object; it can expand or contract like a balloon, depending on the pressure of the solar wind. Ulysses found that during the flyby, the magnetosphere had inflated to a size greater than that seen during Voyager. Also, a number of plasma wave modes, both old and new, were seen by Ulysses' radio antennas. The radio signals showed the plasma torus to be patchier than originally thought. Ulysses also found Jupiter's environs to be relatively dust-free, owing to the intense charged particle fluxes. An overview of the encounter is given by Smith *et al.* (p. 1503), and a summary of the findings is provided in the Perspective by Barbosa and Kivelson (p. 1487) and an outline of the future of the Ulysses mission is given by Appenzeller (news story on p. 1478).

Potential differences in protein folding

Many cellular functions are performed in the endoplasmic reticulum (ER), including certain steps in steroid biosynthesis and production of transmembrane and secreted proteins. Hwang *et al.* (p. 1496) show that the electrochemical or redox environment within the ER is relatively oxidizing compared with the cytoplasm, and that glutathione acts as the principal redox buffer. The redox potential is reflected in the relative ratio of reduced glutathione to glutathione disulfide. The peptide *N*-Acetyl-Asn-Tyr-Thr-Cys-NH_2 (NYTC) was used to probe the redox state of the ER; it undergoes glycosylation in the ER and becomes trapped. The redox state of its Cys residue then acts as a reporter. The more oxidizing environment of the ER may accelerate the proper folding of proteins with disulfide linkages.

Moving account

Microtubules serve a variety of functions as subcellular components—they are intrinsic to cilia and flagella, which control cell motility. Microtubules also act within the cell as the network along which subcellular vesicles are transported. Smith and Sale (p. 1557) studied flagella of the single-celled motile alga *Chlamydomonas* in order to understand how the activity of microtubules is regulated. Analysis of both wild-type and mutant flagellar extracts in an in vitro assay of microtubule sliding indicates that the radial spokes of the flagellar axoneme activate the dynein adenosine triphosphatase of the inner arms.

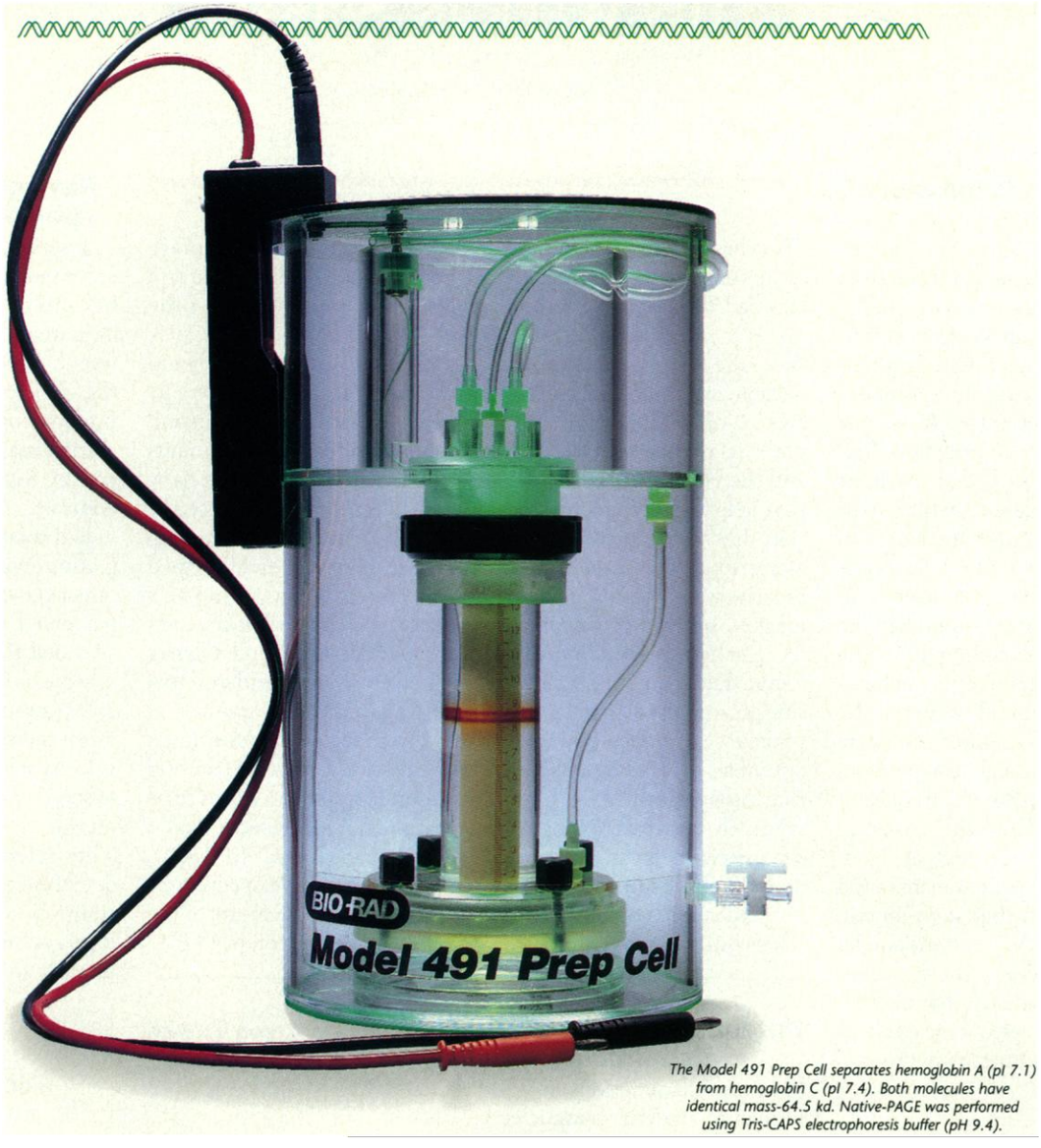
Paying attention and perceiving motion

In a series of visual perception experiments, Cavanagh (p. 1563) has shown that the perception of motion can occur in two different ways. Observers judged the velocity of oppositely rotating gratings, in which a color grating masked a luminescence grating that could be varied in contrast. Although the individual bars of the luminescence grating could not be seen, its direction of motion could be perceived when the observer attended to the grating. In another experiment, the rotating color grating, which appears to move more slowly than its true velocity at low contrast, appeared to speed up when individual bars on the wheel could be tracked. This attention-based motion detection appears to operate in addition to the familiar low-level system that we usually use in order to see movement.

□

Pictures past and present

Like many other inventions, the practical value of the daguerreotype for recording images was not lost on the scientists of the last century. Hackmann (p. 1569) reviews *The Daguerreotype. Nineteenth-Century Technology and Modern Science*, by Barger and White and discusses the history and science of this method that allowed light-sensitive silver nitrate images to be "fixed." The daguerreotype found use in naturalist and anthropological studies and was also used to record astronomical images and to map geological formations. Its detection capabilities for ultraviolet light opened up new areas of spectroscopy. Also discussed are how these images are formed and what can be done to preserve and restore them.



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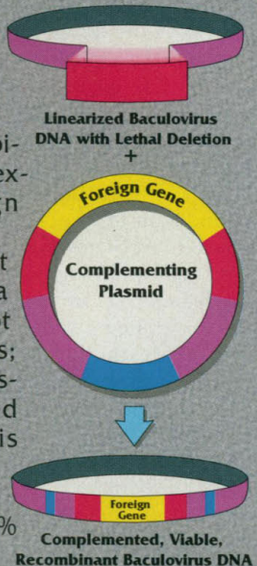

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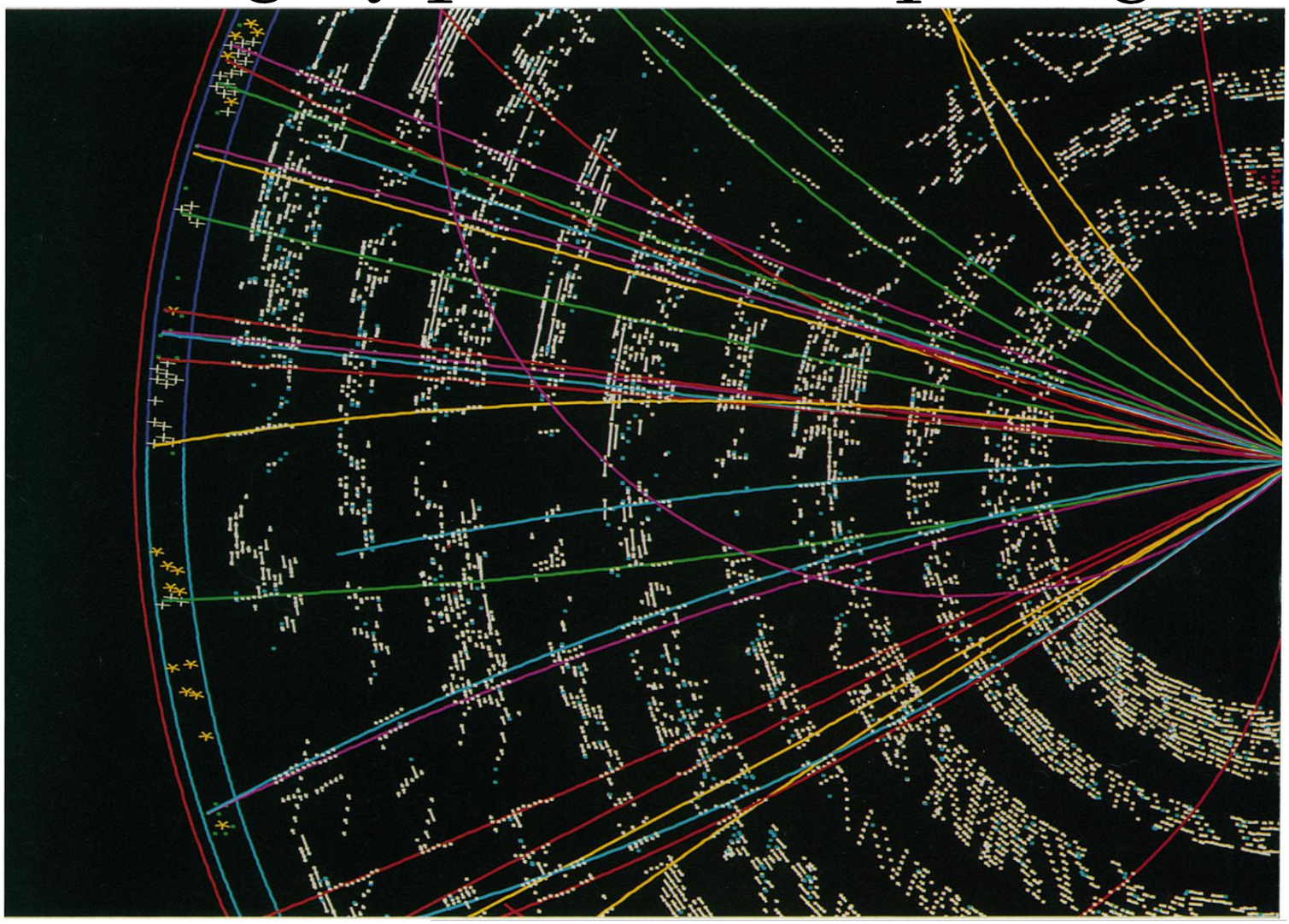

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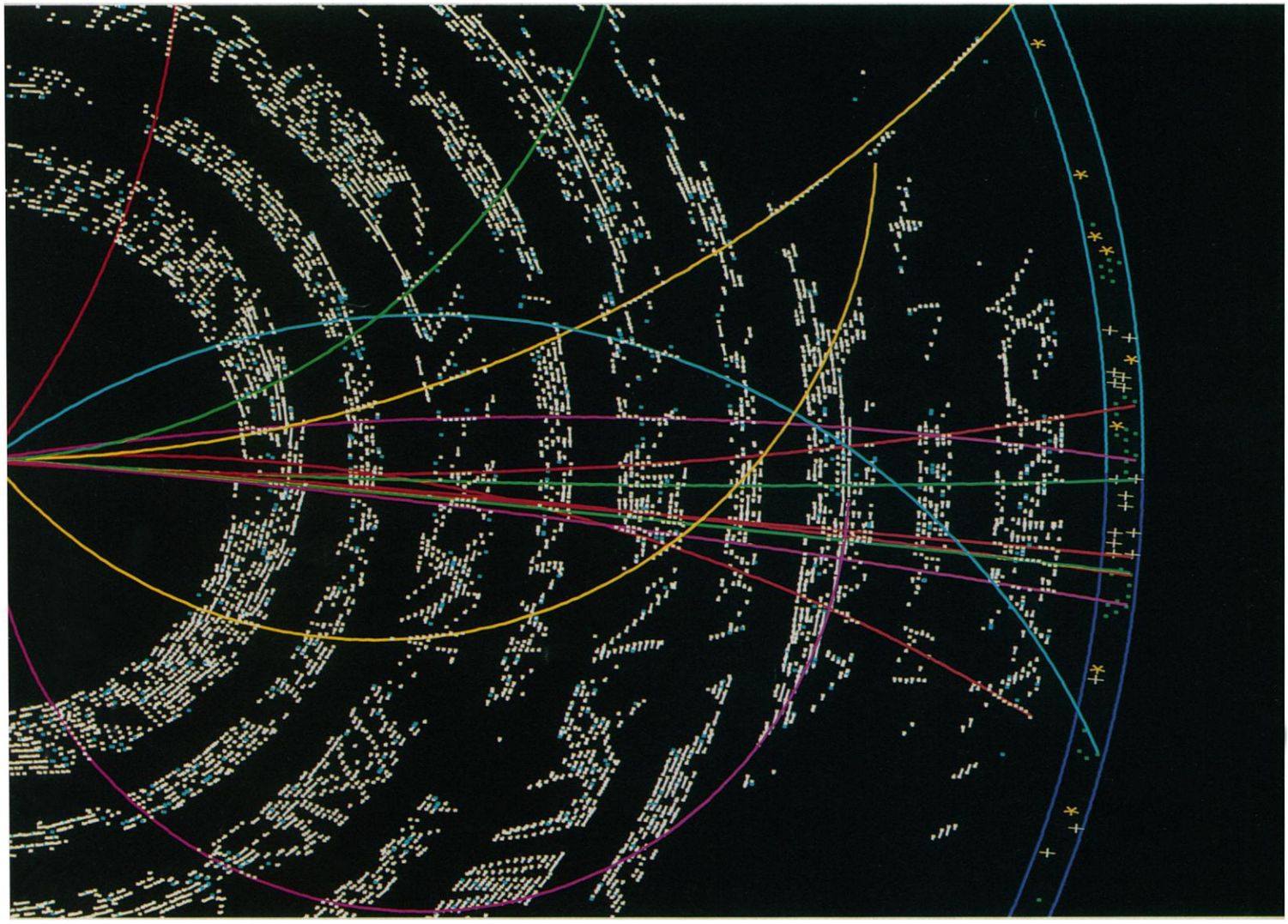
Computer reconstruction of proton/anti-proton collision at Fermilab.



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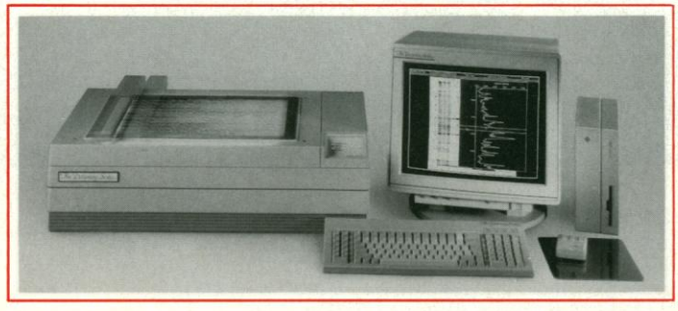

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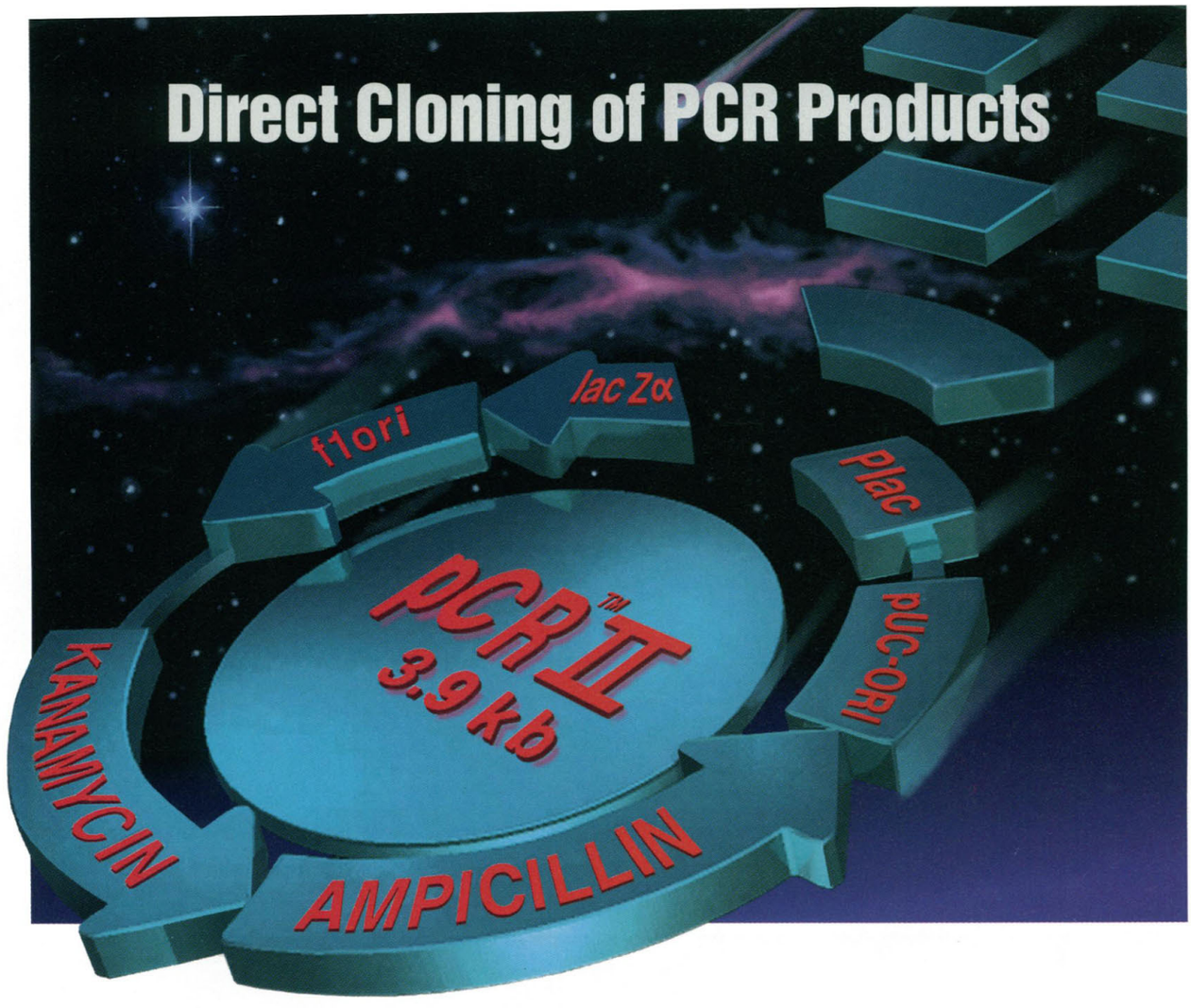

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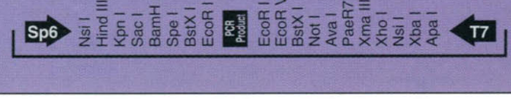

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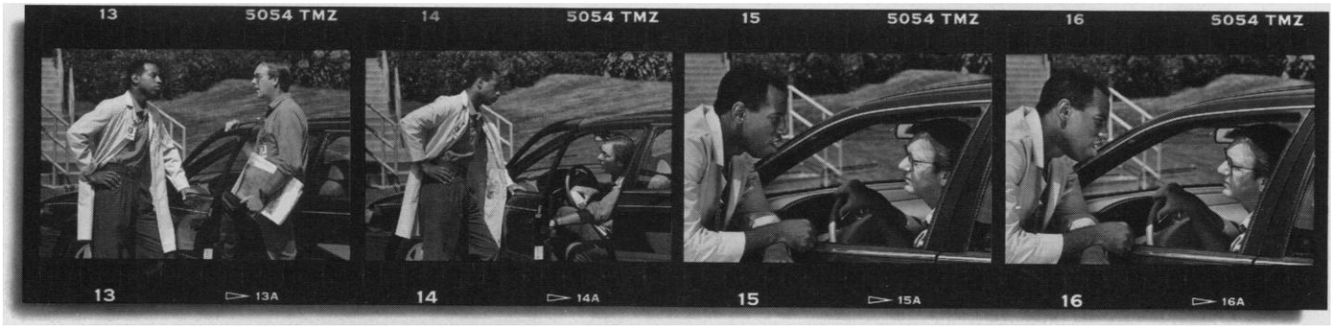

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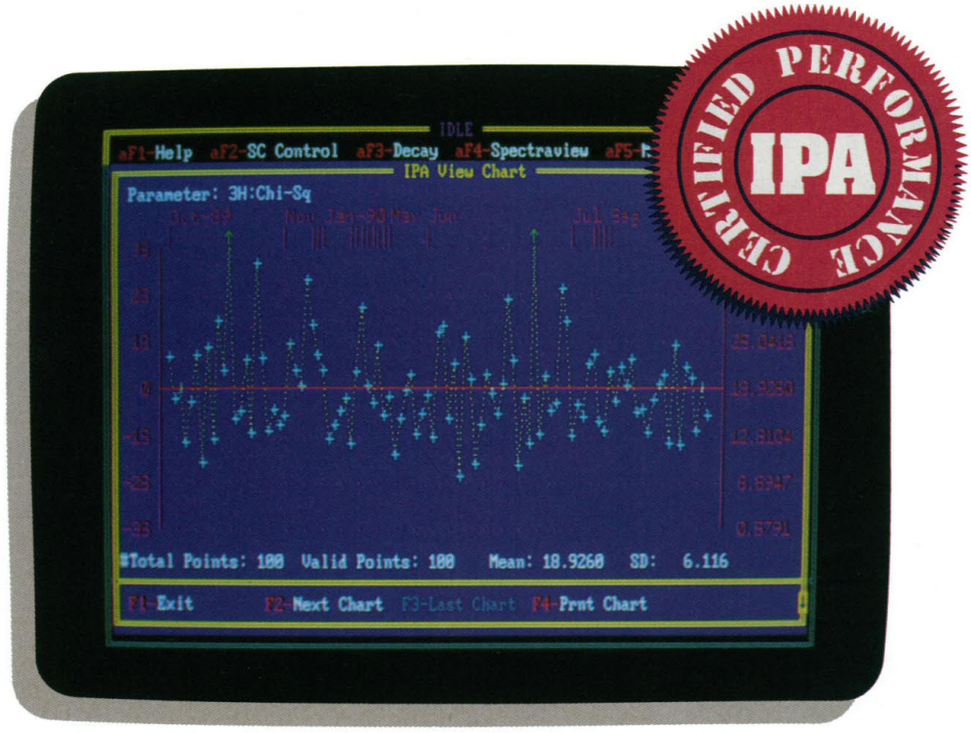

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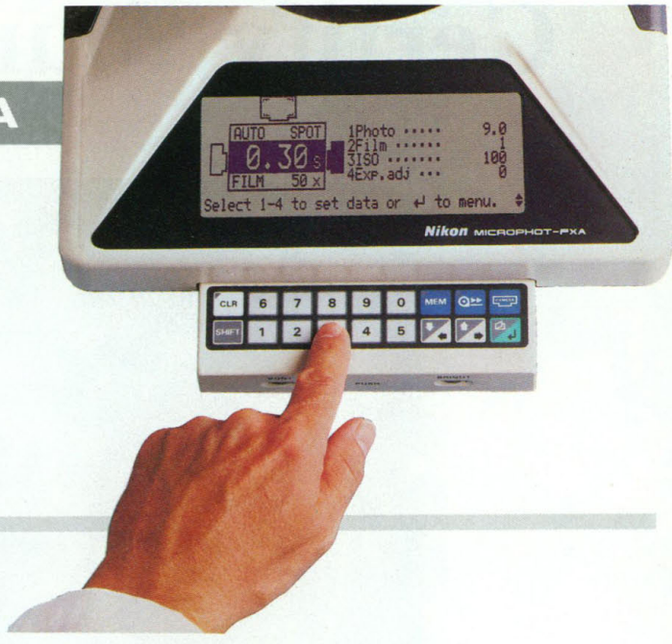

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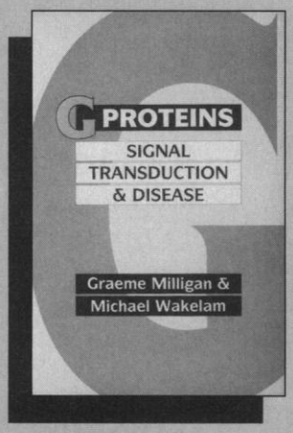

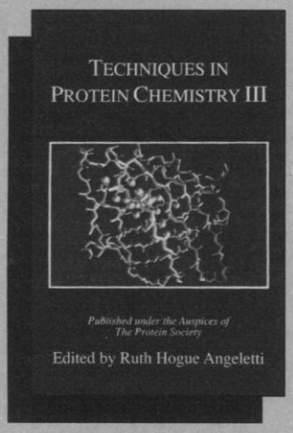

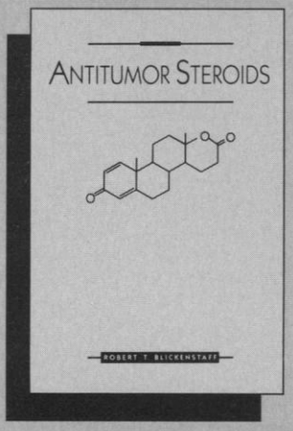

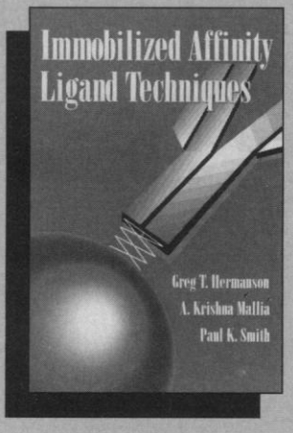

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