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COVER The image of a single crystal of the amino acid DL-leucine reveals the individual methyl groups at the end of each amino acid molecule as white spots. It was taken with an atomic force microscope. See page 209. [Photograph by Scot Gould, Department of Physics, University of California, Santa Barbara, CA 93106]

Reports

Book Reviews

Products & Materials

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Presidential candidates discuss science

THE contenders for the presidency of the United States, Michael Dukakis and George Bush, face off on page 173—Bush on the left and Dukakis on the right (sides of the page). Each was asked questions about what his science policies would be if he is elected president in November. The candidates considered such issues as how priorities between big and little science will be decided, how priorities will be set for spending in biomedicine, space, and applied research and development, whether the current level of spending for science in this country is appropriate, what the role and status of the science adviser will be in the next administration, how technologic advances that affect the competitiveness of the United States in the world marketplace will be promoted, and how science and math education in the United States will be improved.

Normal and reversed fields

PALEOMAGNETIC data from deep-sea sediment cores taken close to the equator in the Indian, Atlantic, and Pacific oceans have provided new information on the nature of the dynamo in the earth's core, which produces the earth's magnetic field (page 252). Schneider and Kent analyzed 89 cores containing sediments deposited during the past 5 million years. Significant differences in the strength of the nondipole field component were evident during episodes of normal versus reversed magnetic fields: the axial quadrupole component was always greater during reversed-field epochs, and it may make a substantial contribution to the total field at reversals, when the main dipole field collapses. One explanation of the data is that the magnetic field has a nonreversing component as well as the well-documented reversing component that is associated with the main dipole field. The source of the nonreversing standing field is not known. The data support an important assumption in many paleomagnetic studies that the time-averaged geomagnetic field remains symmetric about the spin axis of the earth.

Diverse vasoconstrictors

LETHAL snake venoms (sarafotoxins) and a naturally occurring heart peptide (endothelin) have similar biologic effects and strong sequence homology (page 268). Both cause constriction of heart blood vessels and both have 21 amino acids, 15 of which are identical. Kloog *et al.* found that sarafotoxins bind with high affinity to brain and heart membranes of rats. Binding leads to hydrolysis of phosphoinositides in the tissues, and a second messenger for the mobilization of intracellular calcium ions is produced; calcium mobilization is crucial to the vasoconstriction, transient hypertension, and other actions of the toxins. It remains to be seen whether the small differences in structure, concentration differences, or differences in how activities of these substances are regulated will account for the large biologic differences of these two peptides—the venoms can kill mice in minutes whereas endothelin appears to serve as a normal modulator of ion channels in the endothelium. An increase in the production of endothelin might be a factor in the development of hypertension and other diseases that involve aberrant vasoconstriction.

Acetaldehyde and fetal alcohol syndrome

IN the Western world, fetal alcohol syndrome is a major cause of congenital anomalies, mental retardation, and delayed in utero growth. In humans, the extent of fetal injury may be related to the level of acetaldehyde in the maternal circulation; this substance is the most toxic metabolic product of ethyl alcohol (ethanol) for cells. Karl *et al.* show, using a perfusion model, that the human placenta transfers acetaldehyde from the maternal to the fetal circulation. Furthermore, the placenta can oxidize ethanol to acetaldehyde; thus, when ethanol but not acetaldehyde is present in the maternal circulation, the fetus can still be exposed to acetaldehyde (page 273). Human placentas oxidized both high and moderate levels of ethanol, indicating that fetuses of both heavy and "social" drinkers are at risk. The liver of the fetus has a low capacity for eliminating acetaldehyde, and therefore this substance may persist and produce pathogenic effects.

Lactation-associated peptide

DURING lactation, normal mammary tissues produce a peptide that closely resembles a molecule found in tissues of patients with humoral hypercalcemia of malignancy called parathyroid hormone–like peptide (PTH-LP). Thiede and Rodan report that, shortly after the birth of a litter and in association with lactation, messenger RNA molecules for PTH-LP appear in rat mammary glands (page 278). PTH-LP expression was induced by nursing, and, if the litter was taken away from the mother, expression soon stopped. The mammary tissues of nonlactating females did not produce PTH-LP. PTH-LP is known to have potent effects on calcium metabolism; its newly identified association with lactation reinforces the notion that it may act as a hormone for mobilizing or transferring calcium from bones into milk.

Instrumentation

The feature articles and editorial this week report on four instruments that are being used in the biomedical, biochemical, and physical sciences. The authors discuss how each state-of-the-art instrument works, applications for which each is suited, and ways in which the new instruments surpass their precursors in design and performance (pages 165, 209, 217, 224, and 229).

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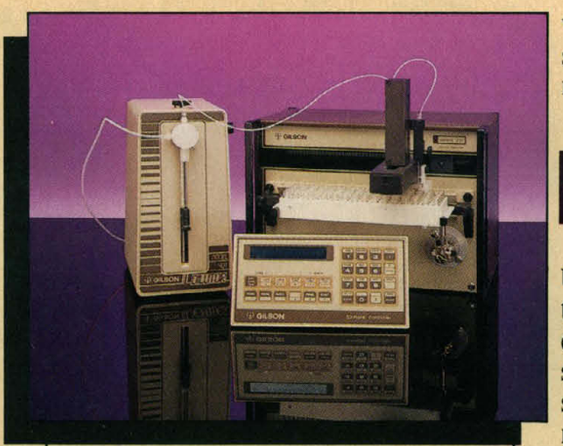

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SCIENCE

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Advances in Instrumentation

Scientific progress and instrumentation have become inextricably intertwined. The discovery of new phenomena can lead to new ways of characterizing or quantifying the systems scientists study, and advances in instrumentation can open up new ways for conducting scientific research.

Instrumentation affects research in a variety of ways. New measurements reveal previously unknown phenomena; quantities can be measured more precisely, accurately, and rapidly. Each of these aspects leads to increased productivity and in many cases to the ability to solve new problems. In addition to these traditional measures of value, however, are hidden or less quantifiable ones. An especially critical aspect of improved instrumentation is the ability to catch errors and wrong assumptions quickly. An incorrect assumption may lead to extended efforts that ultimately prove futile. Modern instrumentation often allows the recognition that one is on the wrong path and thus saves the experimenter from a long and unproductive journey. Also, more alternatives can be explored with less extensive effort. The consequent increase in productivity in some fields has been remarkable.

Instruments come in a variety of styles, shapes, and prices. Commercial instruments have costs that range from thousands to hundreds of thousands of dollars. For many scientists, commercially available instruments such as Fourier transform infrared, nuclear magnetic resonance, electron paramagnetic resonance, x-ray, and mass spectrometers, and the mutual coupling of these instruments with various separation technologies, have revolutionized the nature and complexities of the problems on which they work. One-of-a-kind instruments—accelerators, synchrotron light sources, neutron sources, free electron lasers—lie at the other end of the scale. These generally are used to make measurements that simply cannot be made in any other way.

Between these two extremes we have a most interesting area—instruments that are still in the process of laboratory development. Their impact derives in part from applications to immediate tasks in the laboratory of their developers. But there is also the possibility that these instruments will become widespread in their availability and usefulness, and join the ranks of commercially available instruments used routinely in many laboratories and in the field. The instruments described in this issue fall largely into this category. We present a selection, from many that might have been chosen, of state-of-the-art techniques that have the promise of being seen in many laboratories during the next few years.

Hansma, Elings, Marti, and Bracker describe scanning tunneling microscopy (STM) and atomic force microscopy (AFM). These techniques were recognized immediately for their ability to provide direct views of the atomic domain. Surface details at the atomic level of graphite, organic conductors, and adsorbed atoms are displayed. Thin conductive metal coatings allow viewing of biological materials. The AFM provides a nondestructive view of organic materials that are nonconducting. Possible future applications, including dynamic studies, are described.

Clarke and Koch describe progress in SQUID magnetometers, which are among the most widely used superconducting devices. This is probably the first application in which high-temperature superconductors are playing a role. In this article the advantages and disadvantages in the applications of this new technology are discussed.

Gordon, Huang, Pentoney, and Zare describe capillary electrophoresis. The resolving power in separation and the great sensitivity of this new, relatively simple methodology make it almost certain that it will become a mainstay of the analytical community.

Finally, Landergren, Kaiser, Caskey, and Hood describe the area of DNA diagnostics. Molecular science and the ability to perform automated analyses are making it possible to undertake the solution of a very large number of important, disease-related problems.

Zare, quoting Joshua Lederberg, points out the often unacknowledged role which instrumentation plays in research. This issue of *Science* acknowledges that role and shows that the way in which we are able to carry out our science has a profound impact on the science that we are able to do. Advances in instrumentation continue to open new horizons.

—JOHN I. BRAUMAN, *Department of Chemistry, Stanford University, Stanford, CA 94305*

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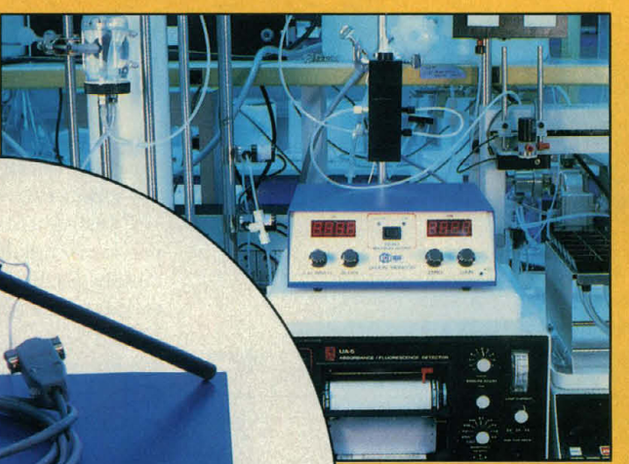

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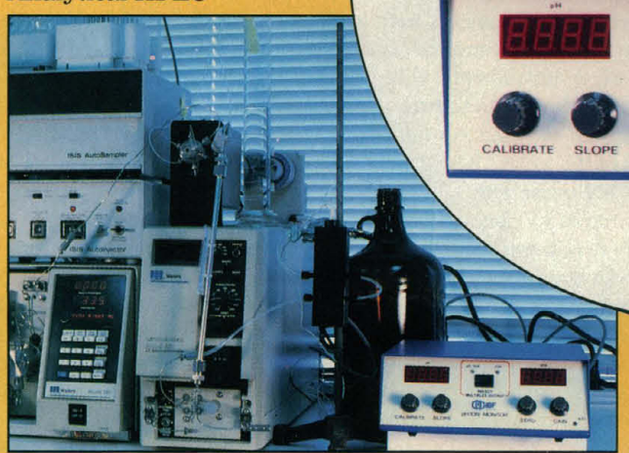

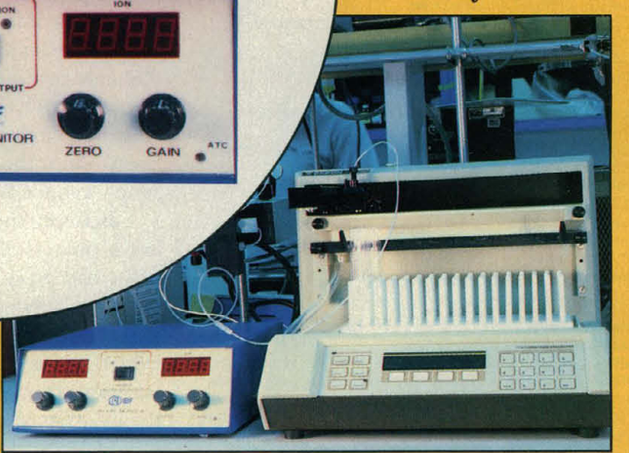

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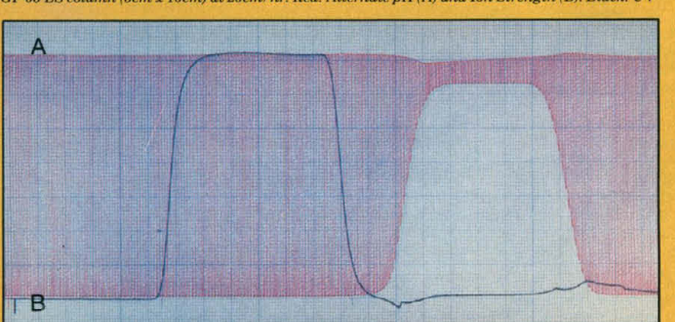

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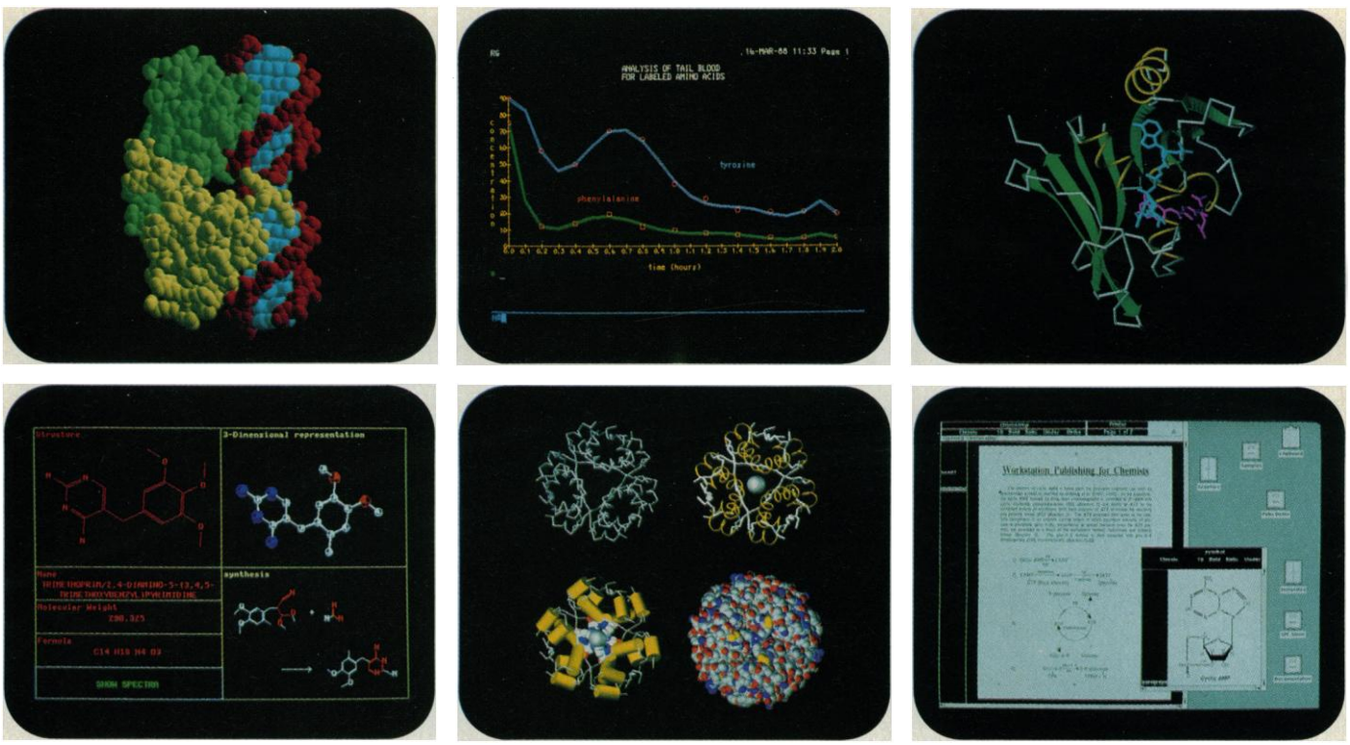

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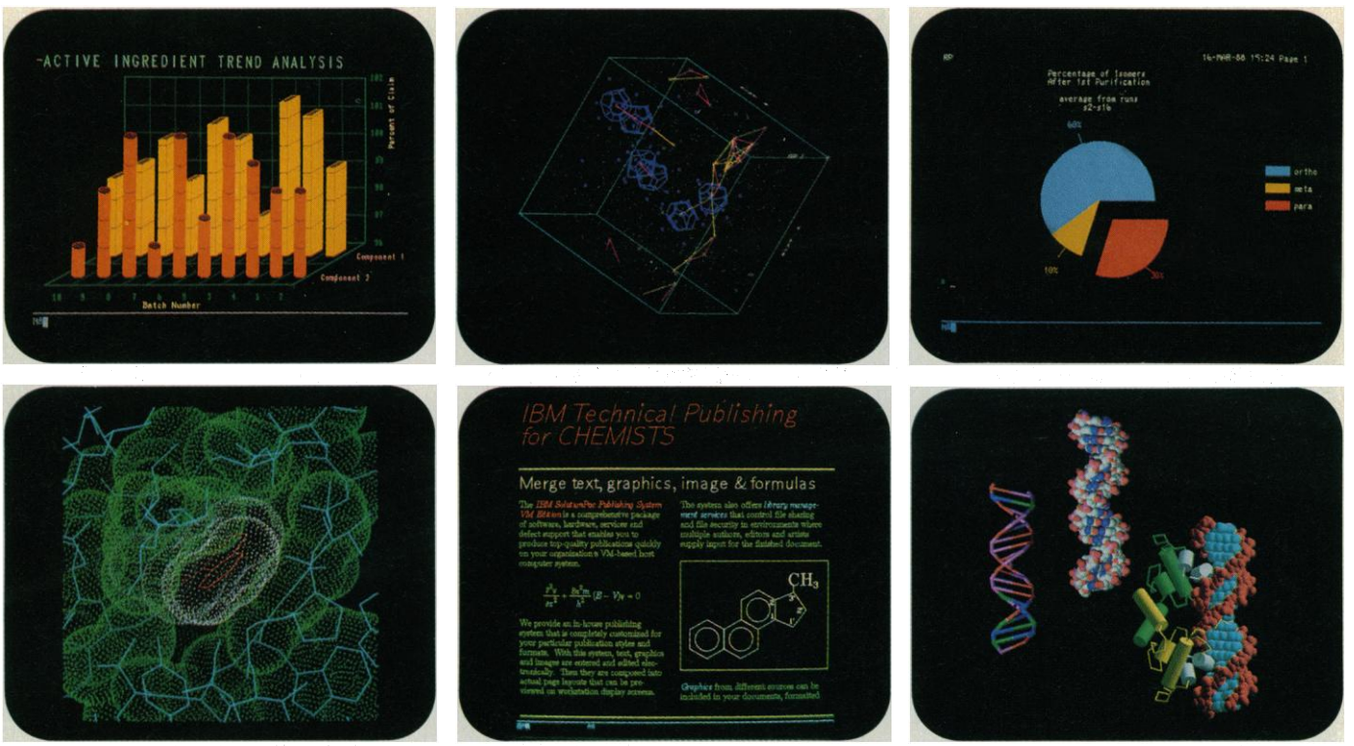

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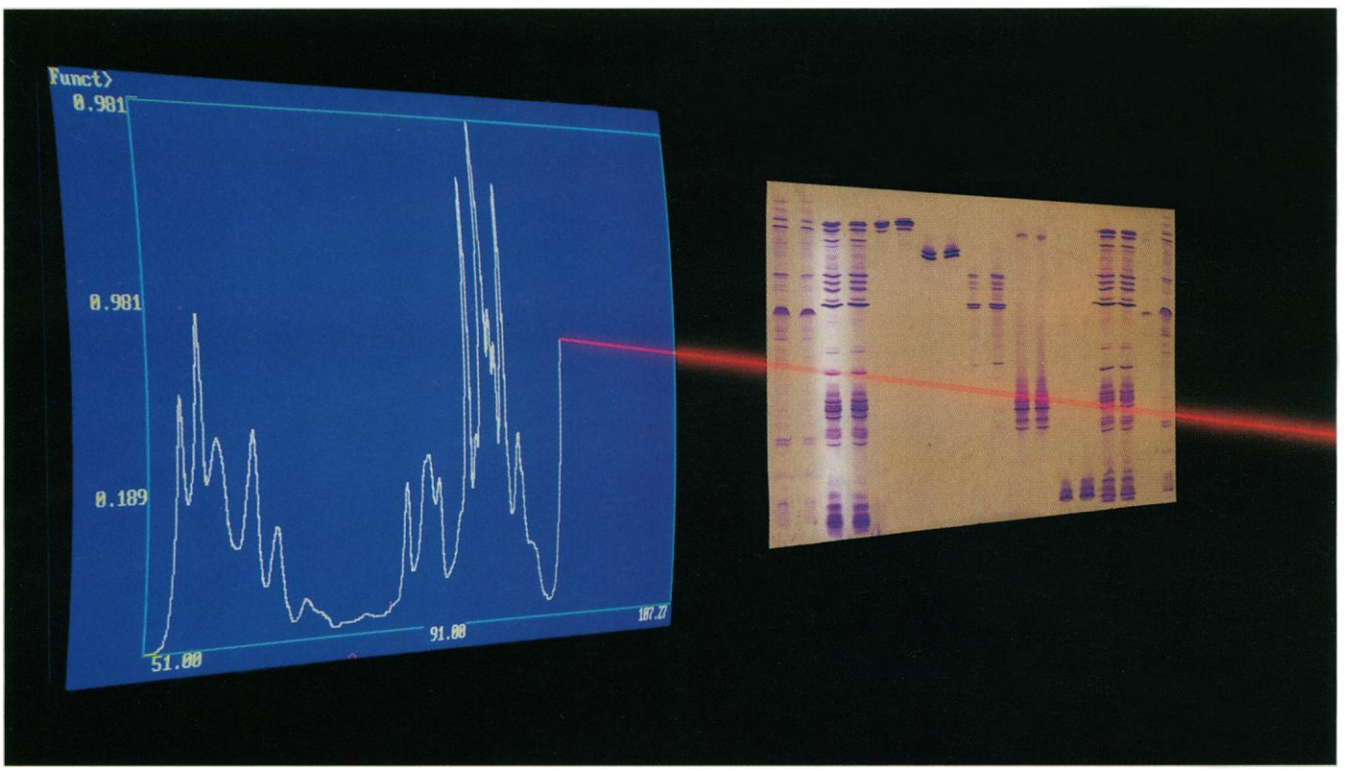

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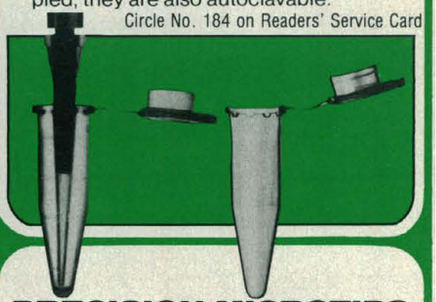

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- Expanded PVC construction
- Acrylic racks for 1.5ml or 0.5ml tubes

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BETA RACK

The new Beta Rack, constructed of 10mm acrylic, is ideal for storage of low level radioisotopes on the lab bench. Unique to the Beta Rack are removable inserts for 32 x 1.5ml or 32 x 0.5ml centrifuge tubes. With the rack removed, the box can be used for storage of radioactive waste or chemicals.

FEATURES

- Hinged lid
- Excellent optical properties
- Removable rack insert

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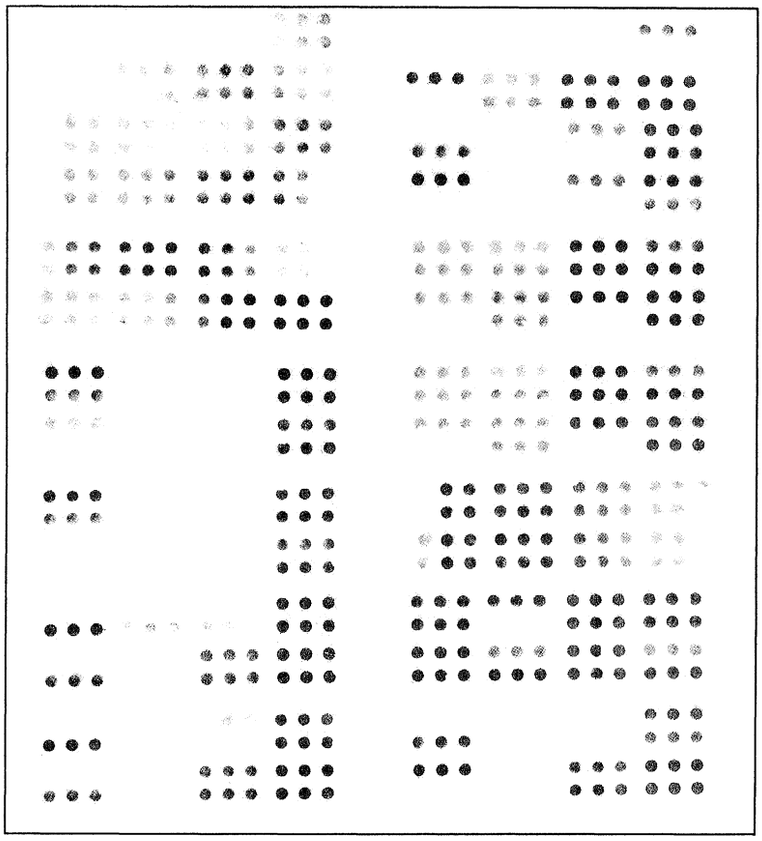
Before You Choose a Densitometer, Try Scanning This Ad.



With a conventional densitometer, it takes 10 hours to scan the dot blot shown above. Molecular Dynamics' new 300A Computing Densitometer takes less than 3 minutes.

That's 200 times faster.

Why? Advanced spatial imaging technology and a high-efficiency light collection cylinder are the keys to the 300A's speed and accuracy. It scans the entire sample, not just a single track at a time.

Not only do you get results faster, you also get increased dynamic range and better than 1% accuracy.

And once you've collected the data, it's easy to analyze it using the 300A's "Windows"™ based analysis software. Display and expand sections of the data for better viewing. Use the mouse to select and plot line graphs. Determine molecular weights. Automate quantitative 1-D and 2-D analyses. Integrate peak volumes and transfer the results to a spread sheet for statistical analysis. And do it all without re-inputting data or re-running samples.

So, if you're in the market for a densitometer, send for our free booklet, *How to Choose a Densitometer,* and save a lot of time.

Molecular Dynamics

Innovative Optical Systems for Molecular Biology

Molecular Dynamics, 240 Santa Ana Court, Sunnyvale, CA 94086, (408) 773-1222

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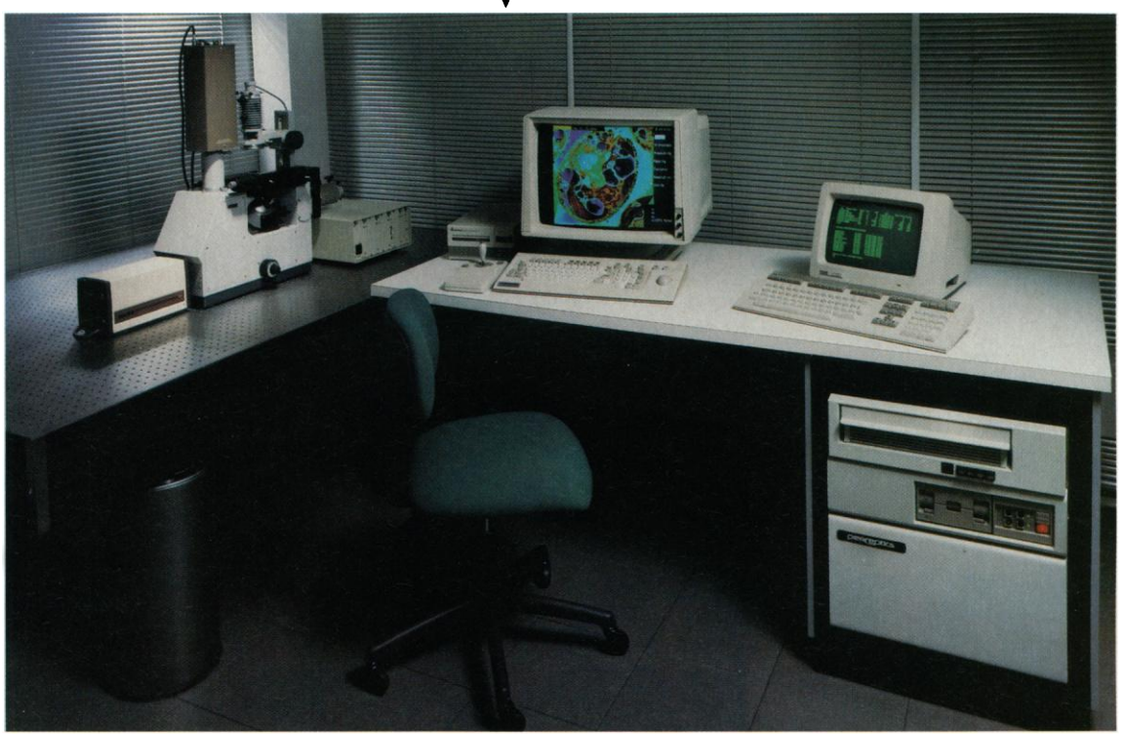

BioVision, a Complete, Integrated Imaging Microscope Workstation Designed Especially for Cell, Developmental, and Molecular Biology.

▲ BIOVISION SYSTEM

One of the newest revolutions in biology is the capability to detect and quantify molecules and characterize physiological properties of living cells and tissues using antibodies, DNA/RNA hybridization probes, functional fluorescence analogs, and physiological indicators. BioVision is your entree into this revolution.

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- **Microscope**
- **Stage, Shutter, and Filter Automation**
- **Vidicon and CCD Imagers**
- **Host Computer**
- **Real-Time Image Processor**
- **High-Resolution Color Monitor**
- **Mass Storage Device**
- **Hardcopy Output Device**
- **Biological Application Software**
- **Multiprobe Custom Filter Set**

▲ BIOLOGICAL SOFTWARE

BioVision combines an intuitive, interactive user interface with over 20 man-years of biological application software development to provide an extensive set of software functions, including

- **Multiprobe Fluorescence Analysis™**
- **Ratio imaging**
- **Automated image acquisition and microscope controls**
- **Noise reduction and illumination correction functions**
- **Real-time background subtraction, averaging, and histogram processing**
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All software functions are controlled via a menu conveniently displayed on one side of the screen or by single-stroke command keys. User-specific functions can be added via the host computer and the Perceptics Command Language.

▲ CUSTOMER SUPPORT

Perceptics provides complete support for installation, on-site training, hardware/software update services, and consulting services. Each BioVision system comes with thorough documentation, including a Technical Manual and User's Guide, and a one-year membership to the Perceptics Certified Users' Program.

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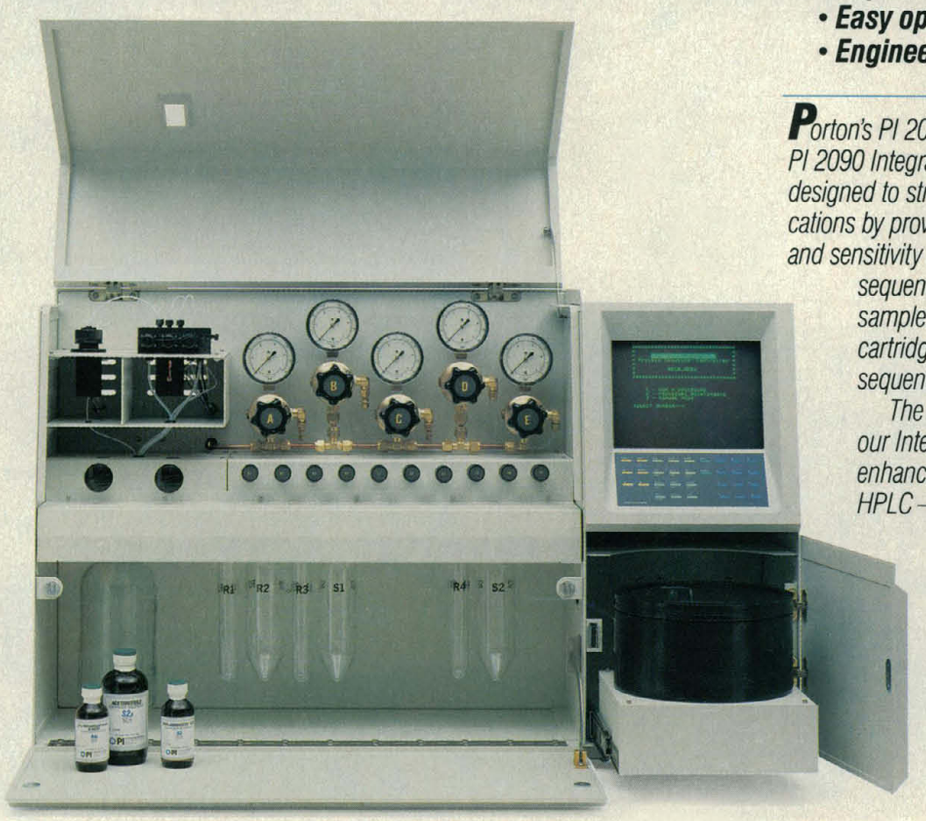

Porton's PI 2020 Protein/Peptide Sequencer and PI 2090 Integrated Micro-Sequencing System are designed to streamline your protein sequencing applications by providing exceptional performance, reliability and sensitivity at a price you can afford. With our sequencer's integrated fluid delivery system,† sample support† and self-sealing reaction cartridge,† we can help simplify your micro-sequencing processes.

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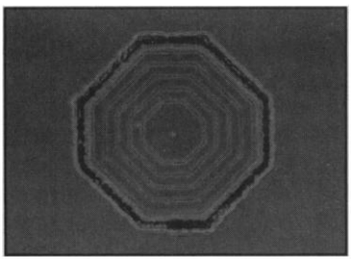
Reason #1 Interactive Laser Cytometry



CHO cell isolated by "Cookie Cutter" technique. (Courtesy of Dr. Margaret Wade, Meridian Instruments)

Only the ACAS lets you harness the power of the laser for interactive experimentation with adherent cells. Interactive techniques include: photobleaching of fluorescent probes to make real time measurements of cellular dynamics (for example, receptor membrane mobility, endosomal movement, and intercellular communications); microsurgery of cellular components; ablation of cells; and sorting of cells.

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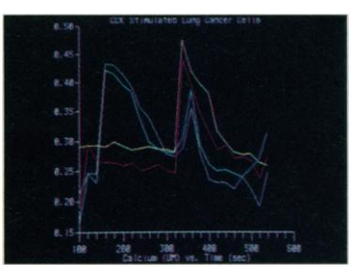
When you want interactive laser cytometry you need the ACAS 570 Interactive Laser Cytometer.

Reason #2 Quantitative Fluorescence Measurements



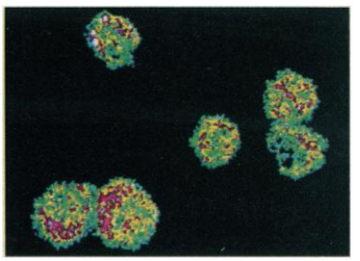
Cholecystokinin induced increase in intracellular calcium levels in human small cell lung cancer cells. Only 2 cells responded to cholecystokinin, whereas all 4 cells responded to carbachol as evidenced by the later peaks. (Courtesy of Dr. Ronald Barrett, Abbott Laboratories.)

Only the ACAS provides precisely targeted and controlled laser illumination to give you maximal fluorescence signal with minimal photobleaching for optimal quantitation.

The ACAS 570 unleashes the power of fluorescence providing you with reproducible quantitative assays of cellular biochemical and physical activity. Single or multiple measurements and ratioing of simultaneous emissions give you real numbers for quantitation ranging from DNA to pH, and cytosolic Ca^{2+}.

When you want to make quantitative fluorescence measurements you need the ACAS 570 Interactive Laser Cytometer.

Reason #3 Sensitive Fluorescence Measurements

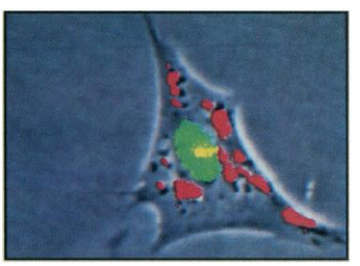


Detection of 30-60 copies of ABL mRNA by in situ *hybridization in the leukemia cell line, K562. (Courtesy of Dr. Joel Bresser, M.D. Anderson Hospital.)*

The ACAS 570 uses a focused laser spot and advanced photometric detection to give you the sensitivity needed for fluorescence analysis of cells. With the ACAS you can label cells with the lowest detectable dye concentrations, to minimize interference with normal cellular functions; perform multiple measurements on the same cell with little or no photobleaching; and detect fluorescence when only a small number of sites are labeled.

When you want to make sensitive fluorescence measurements you need The ACAS 570 Interactive Laser Cytometer.

Reason #4 Versatile Integrated Instrumentation



Overlay of phase contrast and two fluorescence images of a 3T3 cell labeled with acridine orange (Green: nucleus; Red: lysosomes). (Courtesy of Dr. Margaret Wade, Meridian Instruments.)

From cloning cells, to fluorescence imaging, and measuring rapid calcium fluxes, the ACAS Interactive Laser Cytometer is the only instrument that provides you with such a broad range of cell and molecular biology applications. The model 570 with advanced computer and detection systems offers you even more power and versatility with new options such as confocal fluorescence imaging and video processing.

When you want versatile integrated instrumentation you need the ACAS 570 Interactive Laser Cytometer.

Reason #5 Exceptional Technical Support

Answers to your questions about applications or instrumentation are immediately available with a call to our dedicated group of cell biologists, engineers, and computer scientists.

When you want exceptional technical support you need the ACAS 570 Interactive Laser Cytometer.

These are only five of the many reasons why the ACAS 570 is The Cytometer For All Reasons.

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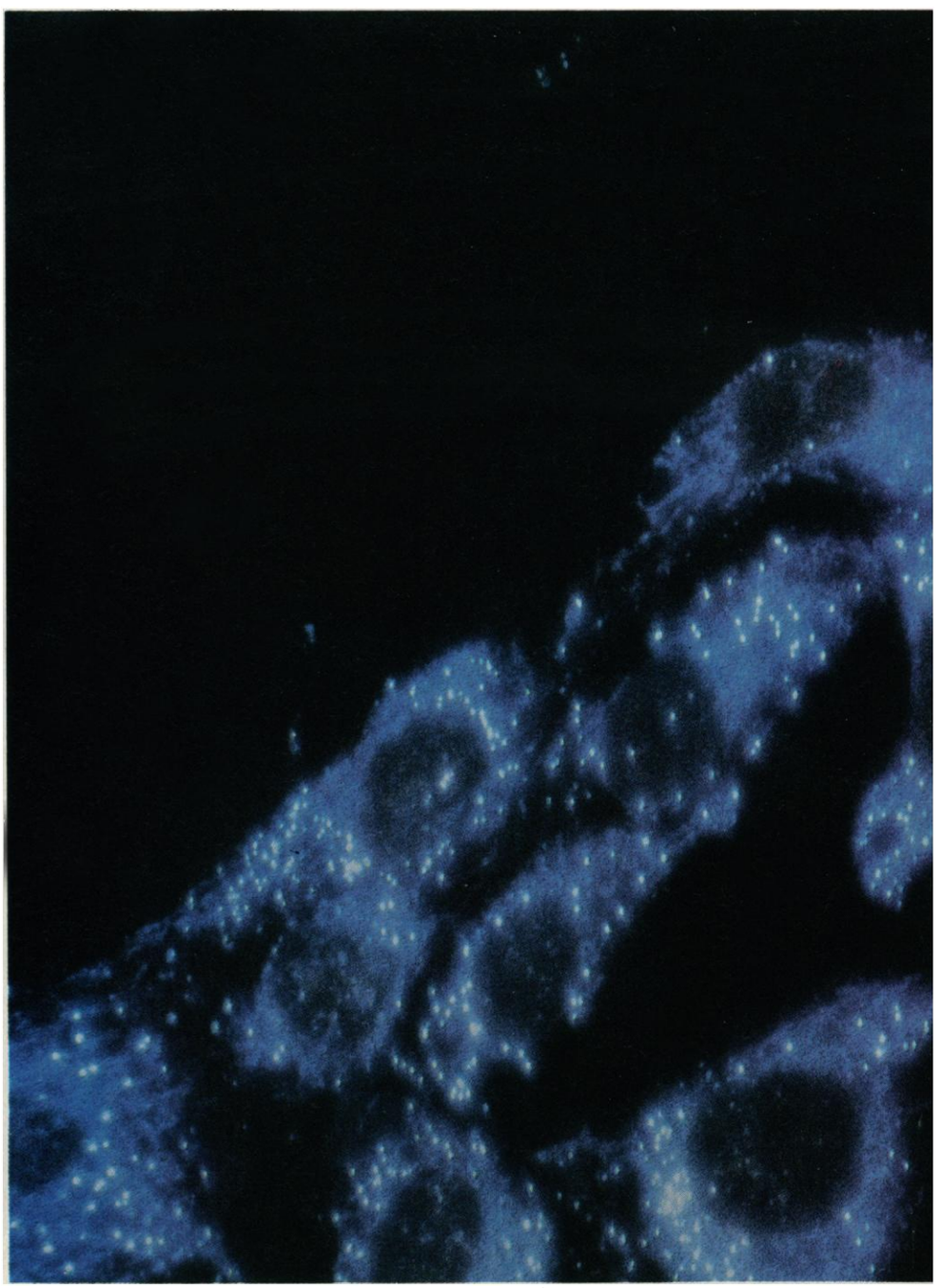

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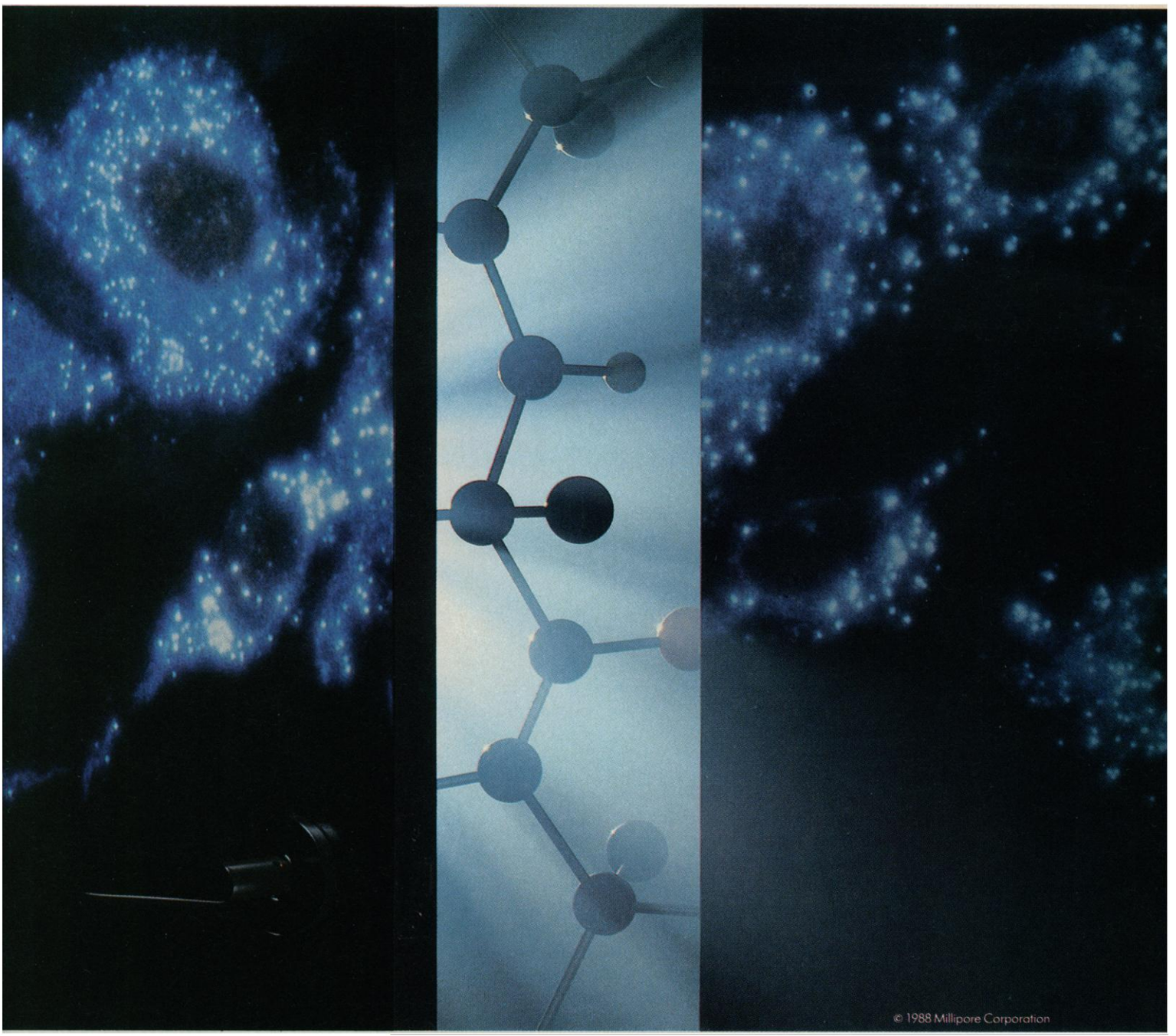

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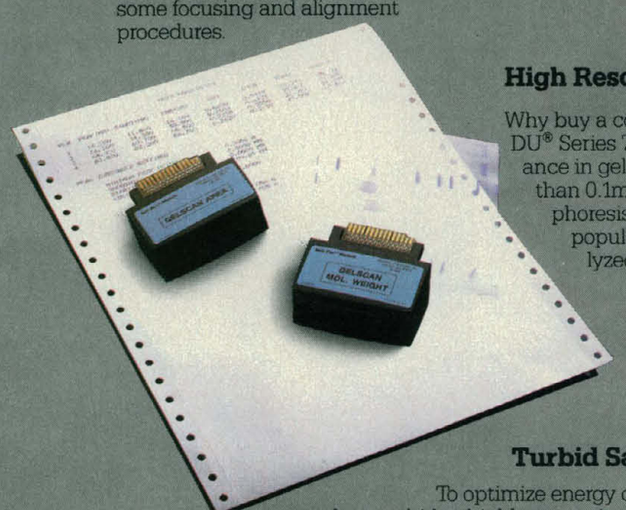

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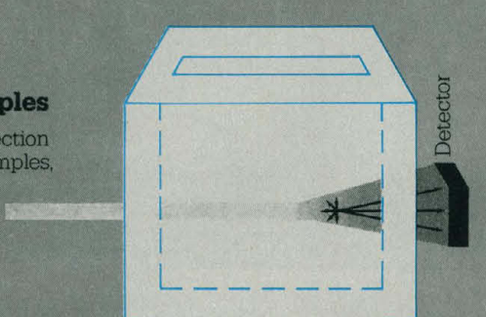

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2.0000	0.0460	0.4560	0.8760	0.4940	2.0244	7.7611	37.447
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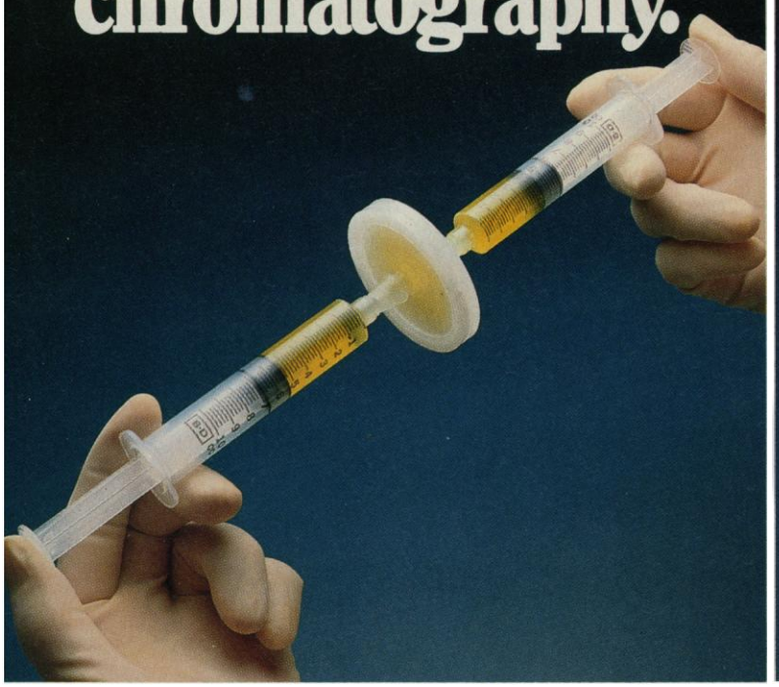
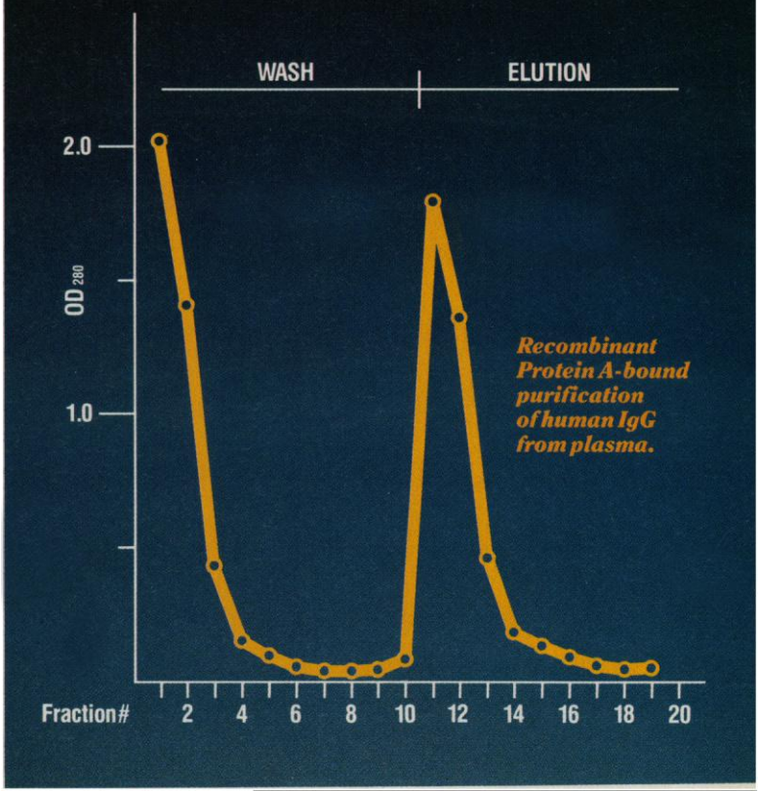


This is why.



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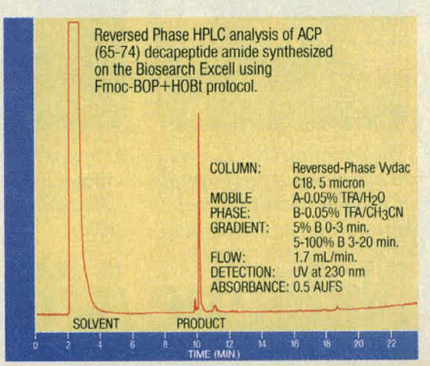

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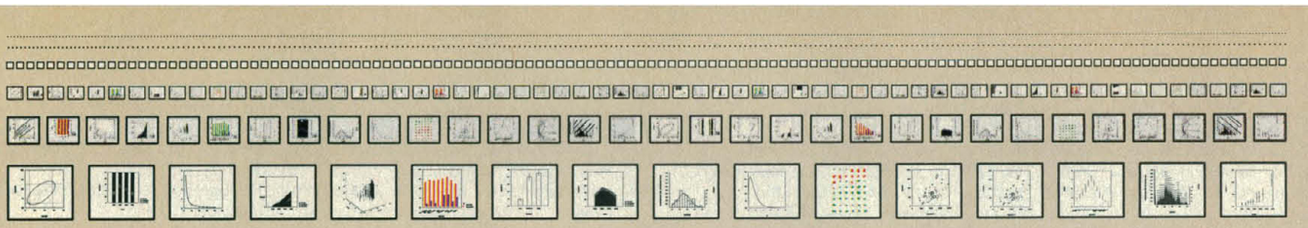

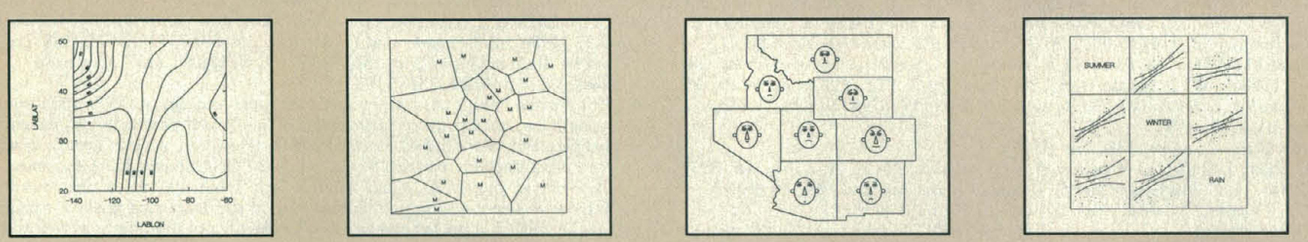

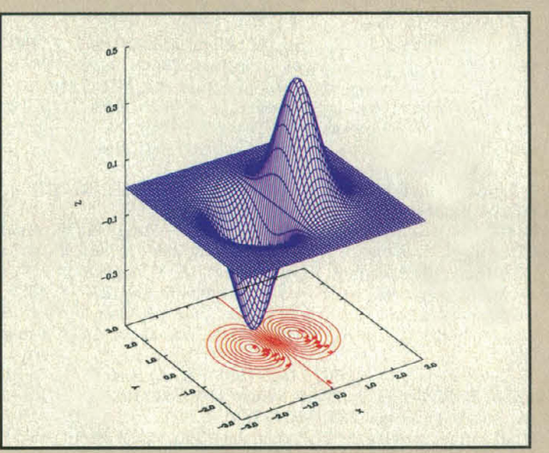

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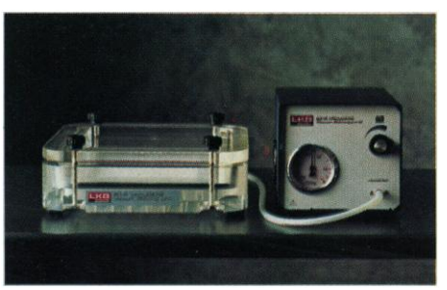
VacuGene is hard to beat for economy. Running costs are extremely low, because reagent requirements are the smallest possible, and reagents can even be recycled.

For more information about the VacuGene system, please ask your local Pharmacia-LKB representative for a brochure.
It's time to stop cutting paper.
Cut blotting time instead.



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Linking Value to Performance in Biochemistry.

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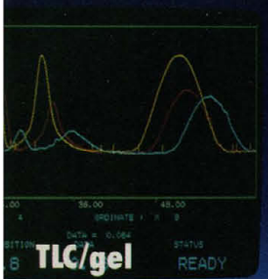

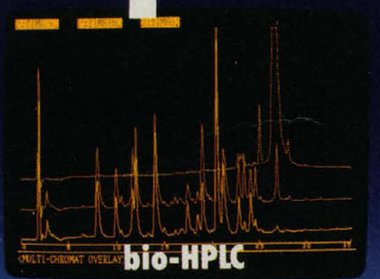

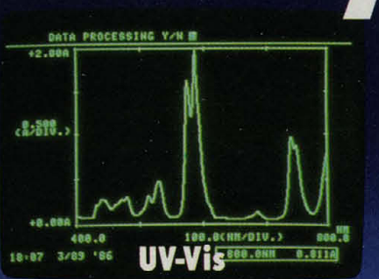

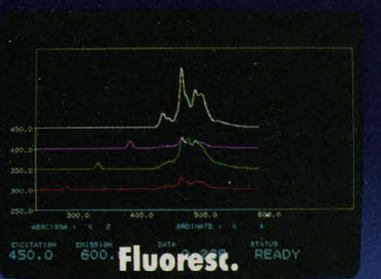

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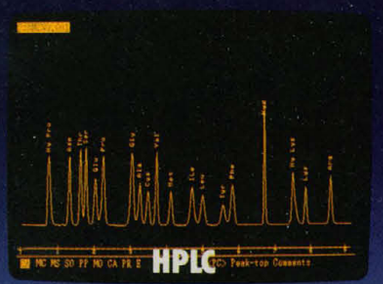

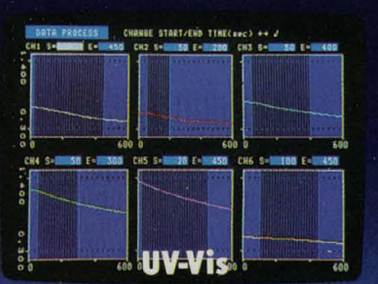

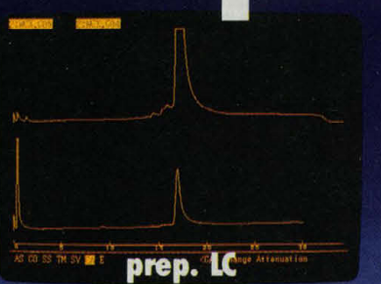

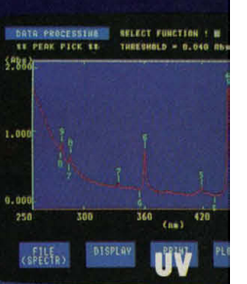

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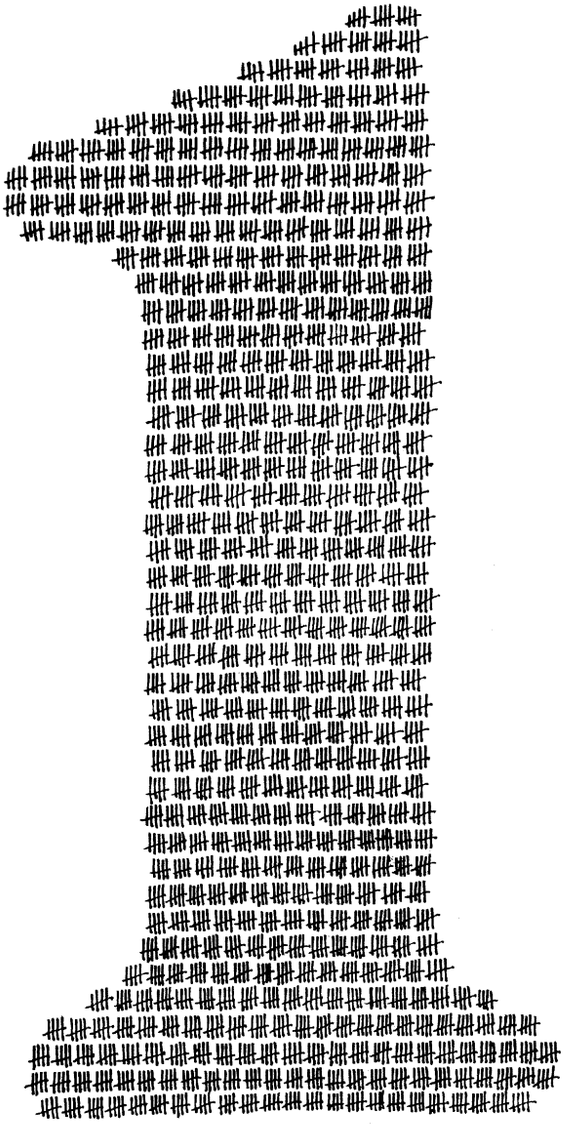

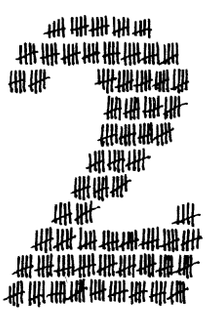

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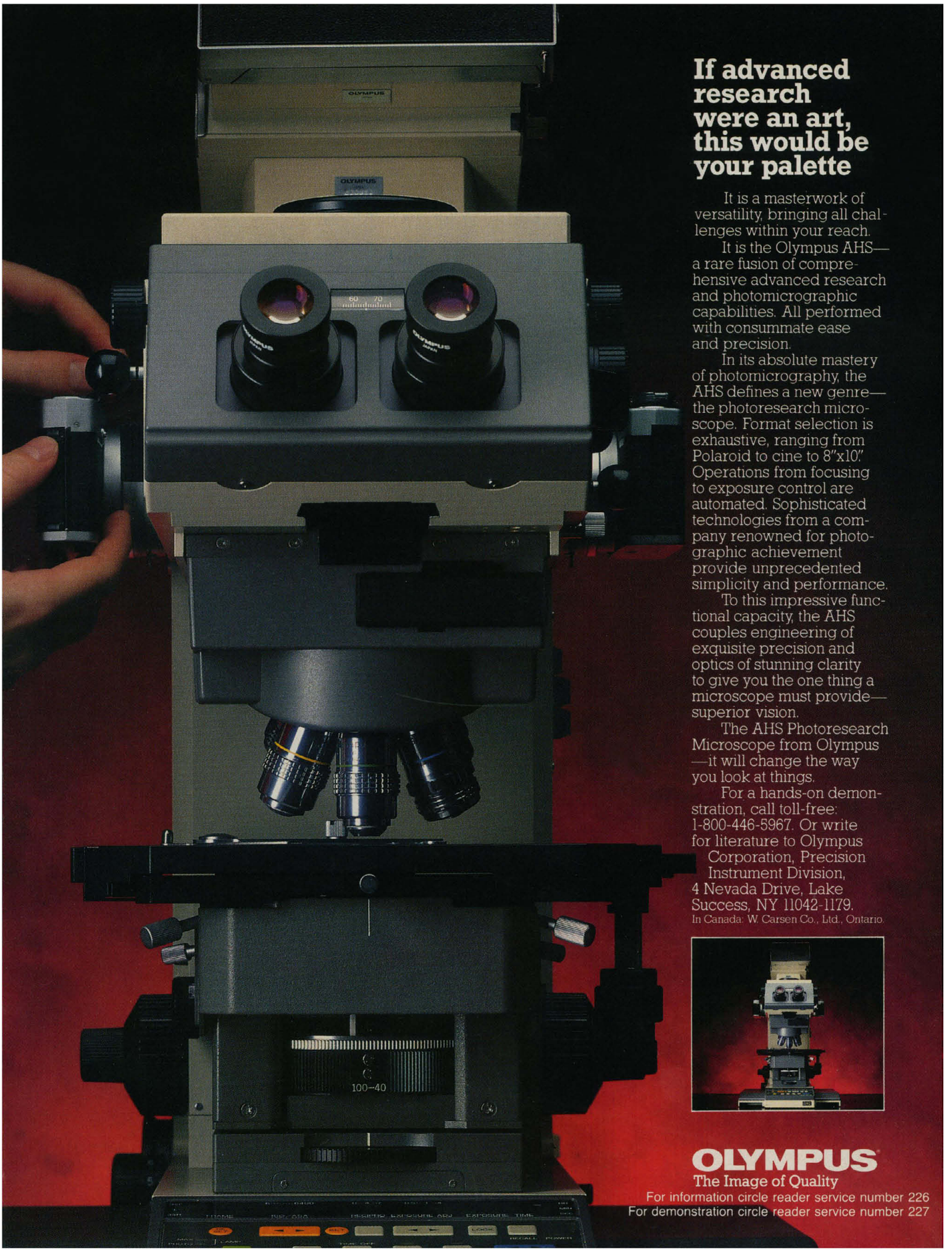

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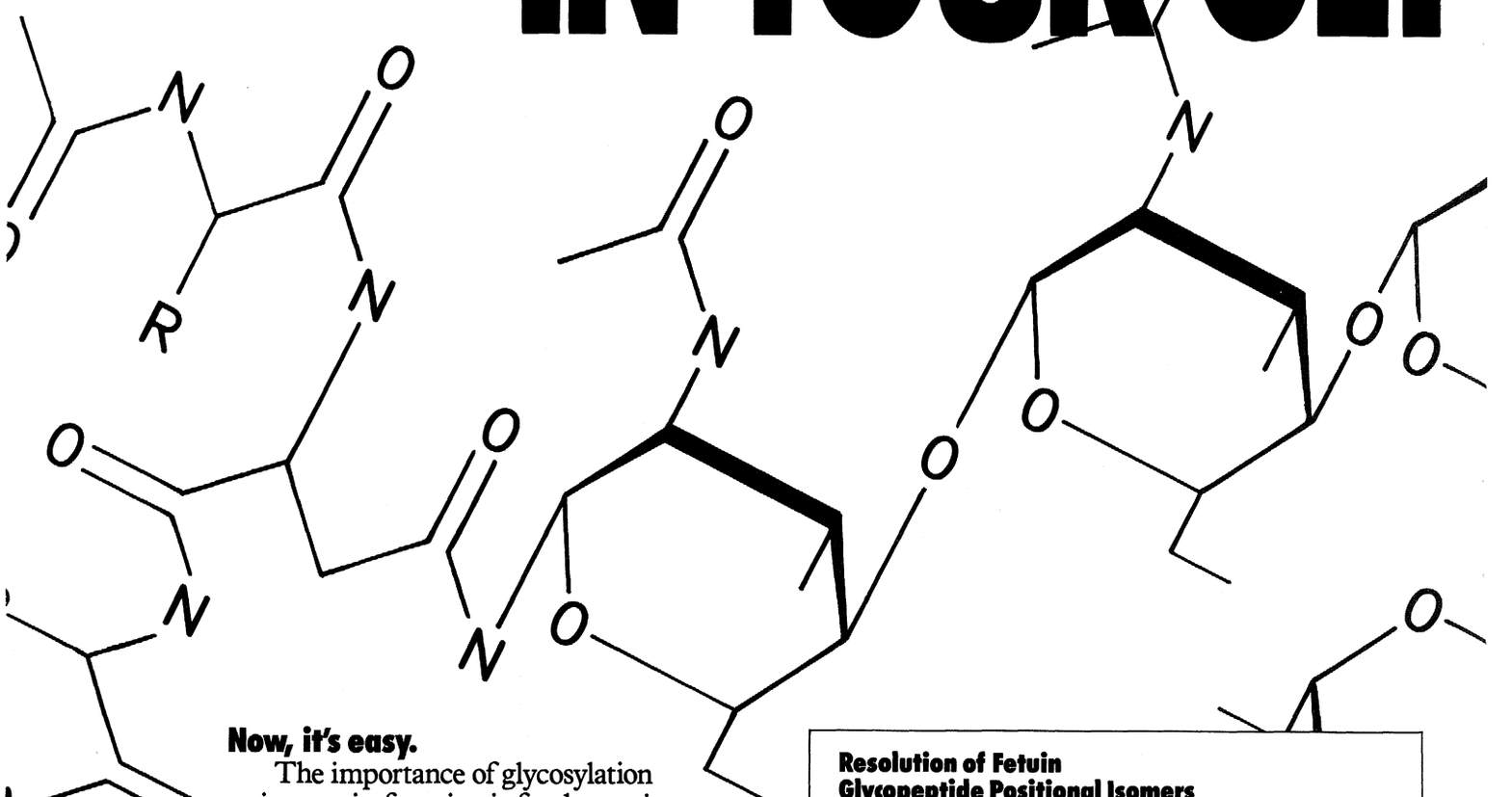

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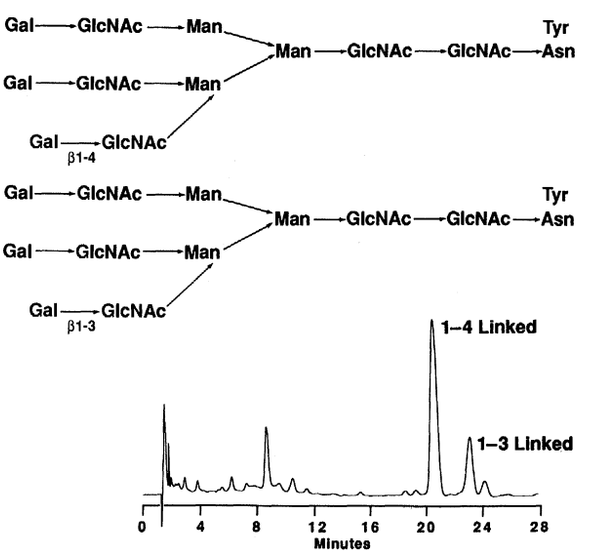
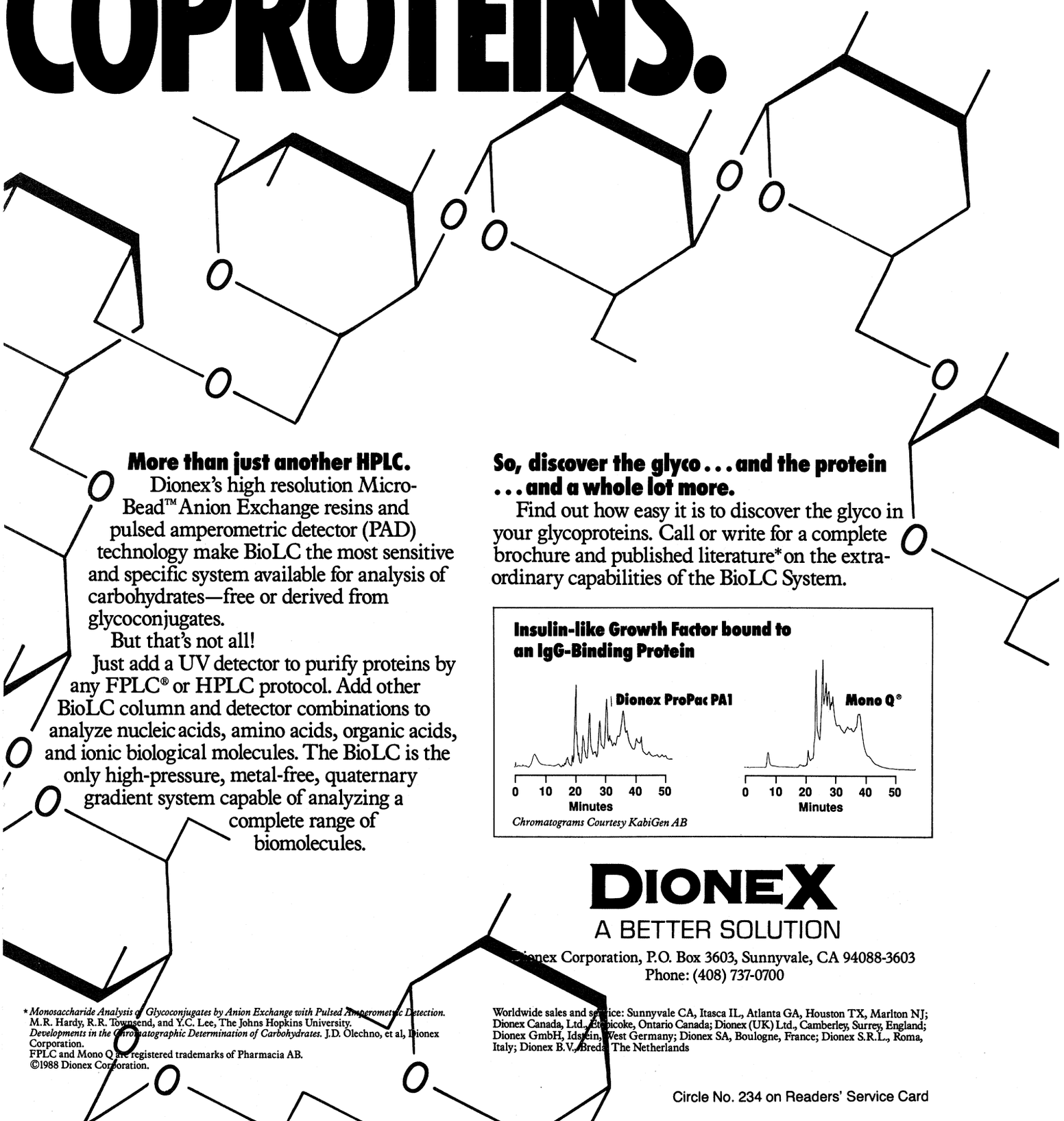
Resolution of Fetuin Glycopeptide Positional Isomers



Sample Courtesy of Dr. R. Townsend, Biology Dept., The Johns Hopkins University, Baltimore, MD

THE GLYCO COPROTEINS.



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* *Monosaccharide Analysis of Glycoconjugates by Anion Exchange with Pulsed Amperometric Detection.* M.R. Hardy, R.R. Townsend, and Y.C. Lee, The Johns Hopkins University.
Developments in the Chromatographic Determination of Carbohydrates. J.D. Olechno, et al, Dionex Corporation.

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A simple and versatile animal housing system that offers greater microbiological control than complex barrier rooms... but without the inconvenience and inefficiency that barrier rooms impose by limiting the movement of people and animals.

The Principle

In effect, the MICRO-ISOLATOR System involves the use of durable filter-topped cages that function as "giant Petri dishes," which are only opened within a Class 100 workbench by personnel who observe aseptic technique at all times.* There are many benefits to this unique miniaturization strategy. For example, animals from multiple sources with different microbiological profiles have been housed in the same room without cross contamination. Likewise, investigators can experimentally infect animals in different MICRO-ISOLATORS within the same room without interfering with one another's research... and all of this can be accomplished without the inconvenience of requiring personnel to shower into or out of the room. Also, since all manipulations are conducted in a Class 100 workbench, individuals allergic to animals are protected from dander and therefore are able to work in comfort.

The complete MICRO-ISOLATOR System consists of the individual MICRO-ISOLATOR housing units, the STAY-CLEAN™ Laminar Flow Workbench, and the service cart.

The MICRO-ISOLATOR Units

This system consists of an autoclavable plastic cage and plastic filter frame with a static filter (now designed for rapid replacement of the filter material), plus the usual cage accessories. The plastic filter frame overlaps the bottom portion of the cage and effectively forms a giant Petri dish-like structure. Result: there is an effective protection against microbial contamination while still allowing for substantial gaseous interchange. The MICRO-ISOLATOR is, in other words, a protected microenvironment within any insect-controlled macroenvironment.

MICRO-ISOLATOR units, fabricated of autoclavable plastic material, are now available for mice, rats, hamsters, and guinea pigs.

* Please complete coupon for the MICRO-ISOLATOR System "Products, Principles, and Procedures Manual."

The Service Cart

The service cart completes the MICRO-ISOLATOR System by simplifying the movement of all necessary supplies to the laminar flow workbench for servicing the MICRO-ISOLATOR units.

For More Information

Write or call Lab Products, Inc., 255 West Spring Valley Avenue, P.O. Box 808, Maywood, New Jersey 07607 or complete the coupon. Phone 201/843-4600 or 800/526-0469.

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The STAY-CLEAN Laminar Flow Workbench

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The STAY-CLEAN Laminar Flow Workbench is compact, moveable, and includes state-of-the-art monitoring instrumentation to assure proper operation.

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Patents applied for on the MICRO-ISOLATOR units and other elements of the complete system.

MICRO-ISOLATOR and STAY-CLEAN are trademarks of Lab Products, Inc.

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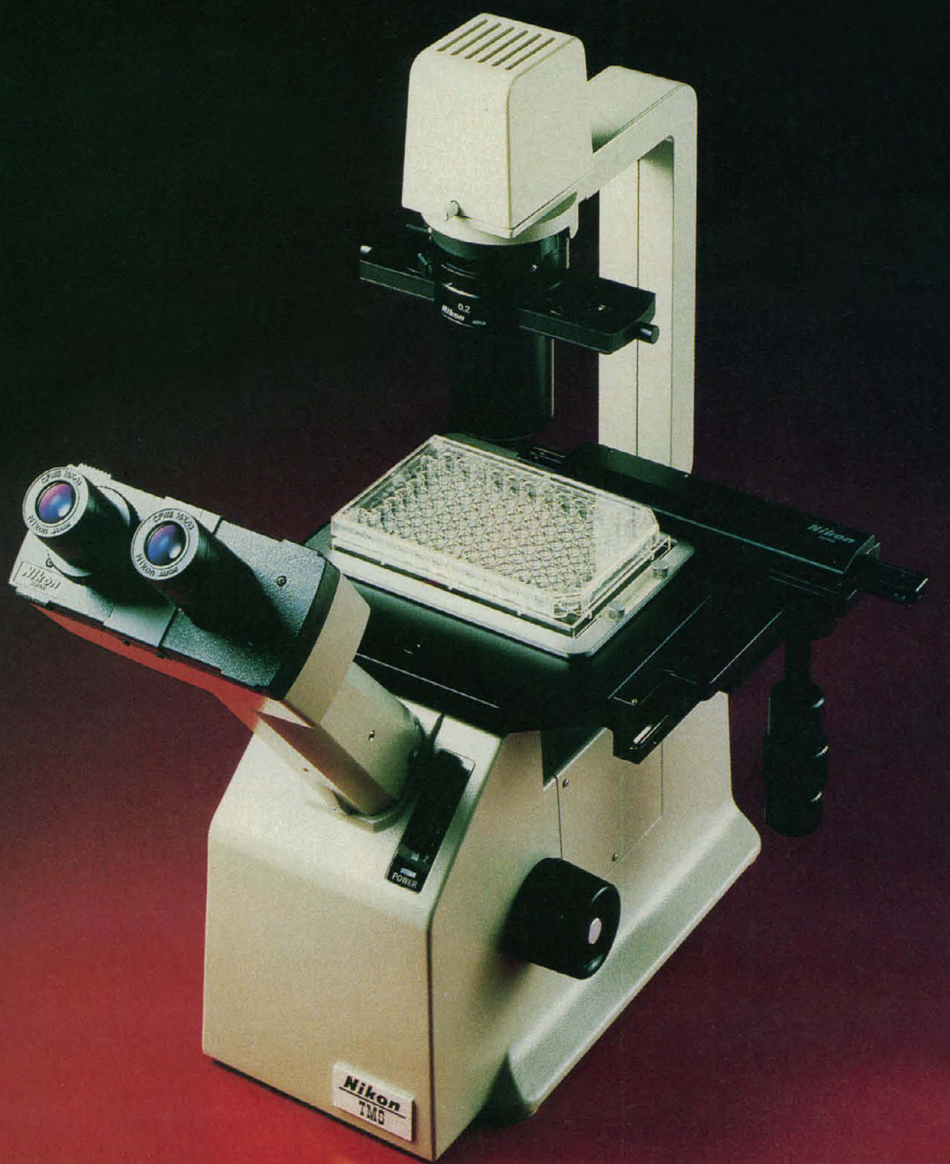

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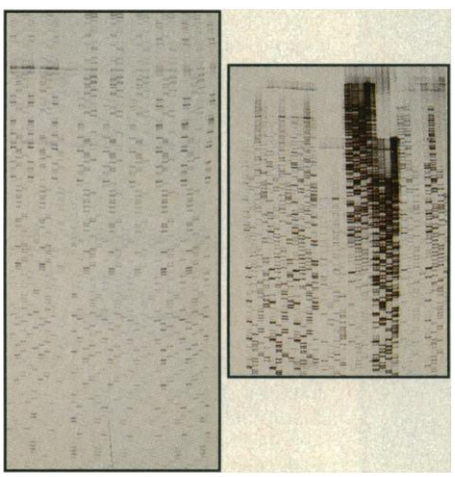
Base Runner™ nucleic acid sequencer from IBI gives you simple, dependable sequencing performance run after run.



60cm Gel 45cm Gel

Take the variability and headaches out of nucleic acid sequencing. Base Runner gives you faster set up, more reproducible results and greater flexibility over conventional sequencers with its unique combination of innovative design (four patents pending) and proven sequencing technology.

Select from 30, 45 and 60cm gel plates.

Run conventional 45cm × 20cm gels, or optimize your results with longer or shorter plates. The taller 60cm gels give you more bases from each run. The smaller 30cm gel plates let you set up short test runs quickly and easily. And with Base Runner, you can run two different gels simultaneously to explore different options or reinforce ongoing sequencing results.

Patented buffer tank design ends cracked plates and buffer leaks.

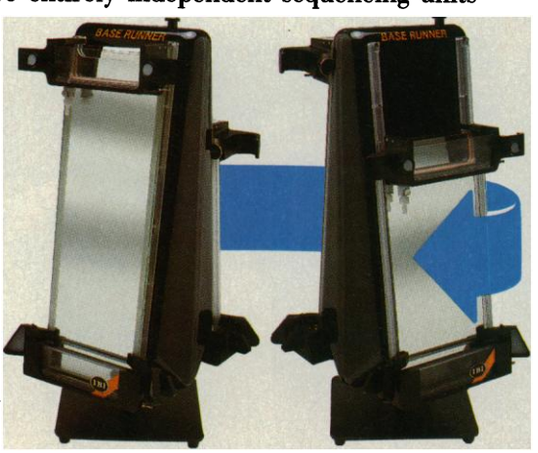
Our new Base Runner buffer tank slides firmly into place and clamps into position with unique spring levers. There are no screws or clamps to tighten and no danger of cracked plates. Tanks fit only in one position — the correct one — so you don't have to worry about improper installation and leaking.

One person can easily remove the Base Runner tanks for buffer disposal, decontamination and cleaning. The upper tank features a trigger valve for draining buffer neatly before tank removal, and a protective tank cover for increased operator safety.

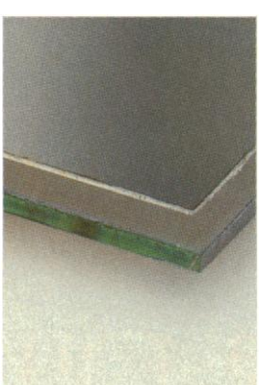
Both tanks contain pure platinum electrodes for long dependable performance.

Run two different gels simultaneously.

You get two entirely independent sequencing units capable of handling gels up to 60cm tall and 20cm wide in one space-saving unit with Base Runner. Run individual gels or two entirely different gels. Independent electrical hookups and buffer tanks let you run dissimilar protocols, electrical parameters and gel sizes at the same time on a single Base Runner unit.



Another innovation lets you rotate the Base Runner for easy access to either side, so you get more working area out of the same bench space. A locking mechanism holds the sequencer firmly in place while you work.



Get fast warm up and smile-free performance.

Base Runner uses a thin, highly thermally conductive aluminum thermoplate to heat gels quickly and evenly. Warm up is fast — less than 10 minutes to heat a 0.4cm gel to 60°C. And heat dissipates horizontally to ensure

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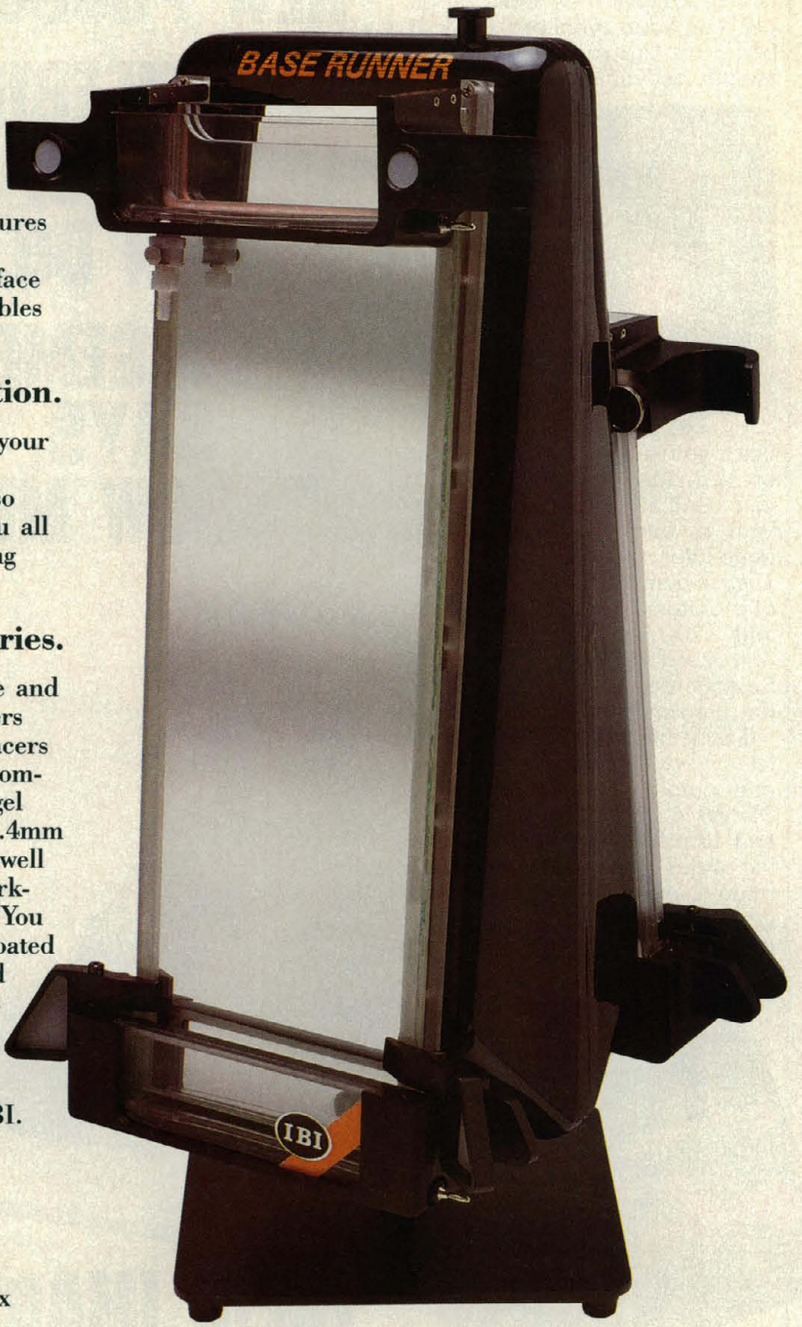

that gels remain evenly heated from edge to edge. That helps eliminate "smiles" and gel artifacts and makes data easier to read.

The quality cast and finished thermoplate ensures uniform contact across the entire gel sandwich to eliminate isolated hot or cool spots. A mirror surface on the inner plate makes it easier to identify bubbles and follow tracking dye.

Angled gel assembly simplifies operation.

You don't need an extra set of hands to hold your gel plates while you set up or take down a Base Runner. We angled the gel assembly just slightly so plates stay in place without clamps. That gives you all the visibility of a vertical display with the handling convenience of a horizontal sequencer.

Includes a variety of valuable accessories.

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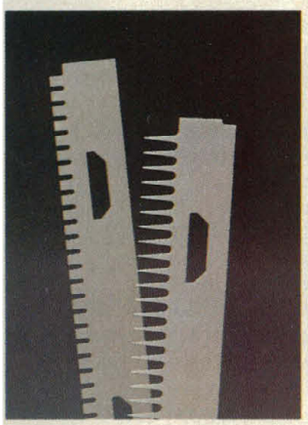

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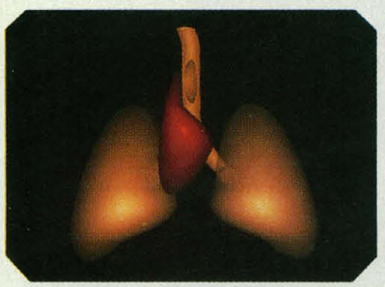

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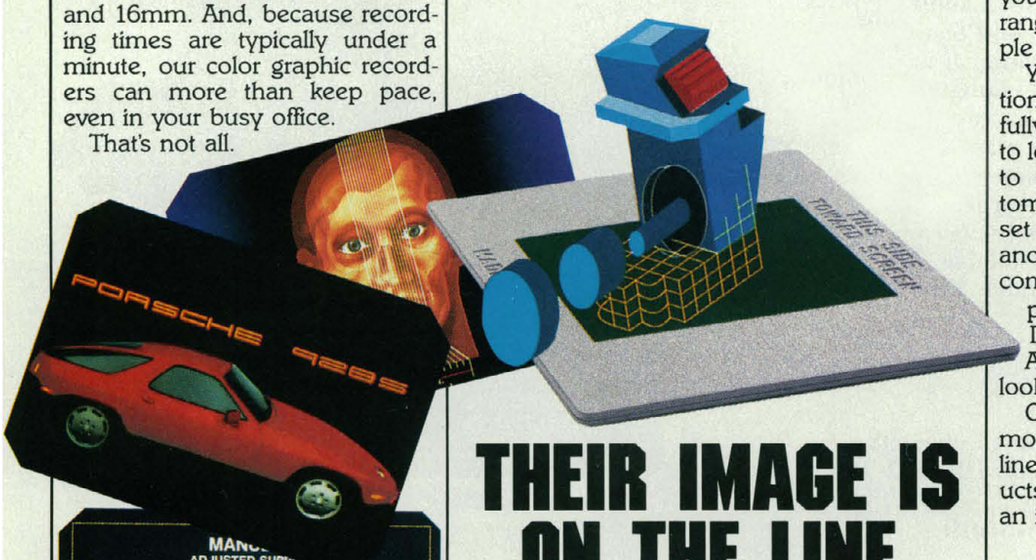

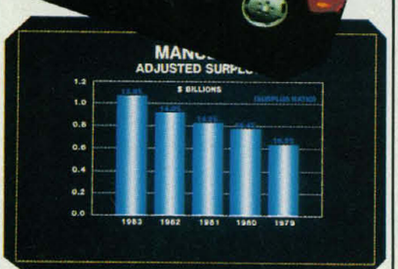

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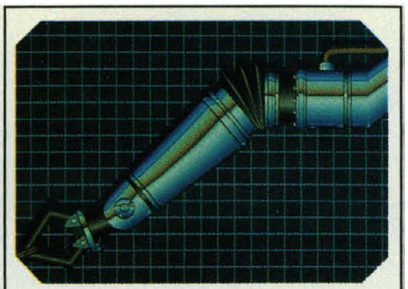

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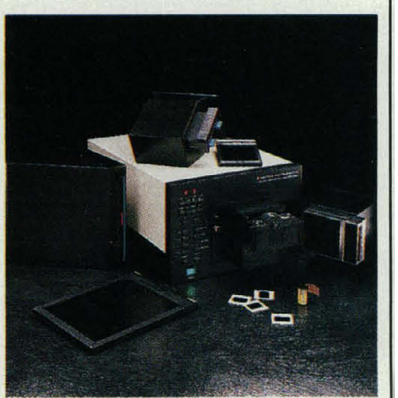

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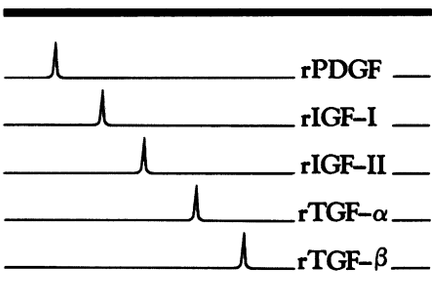

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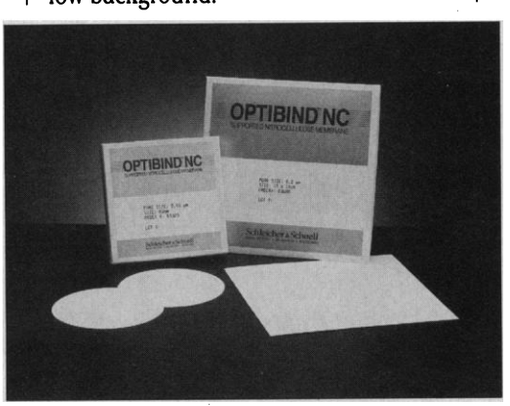

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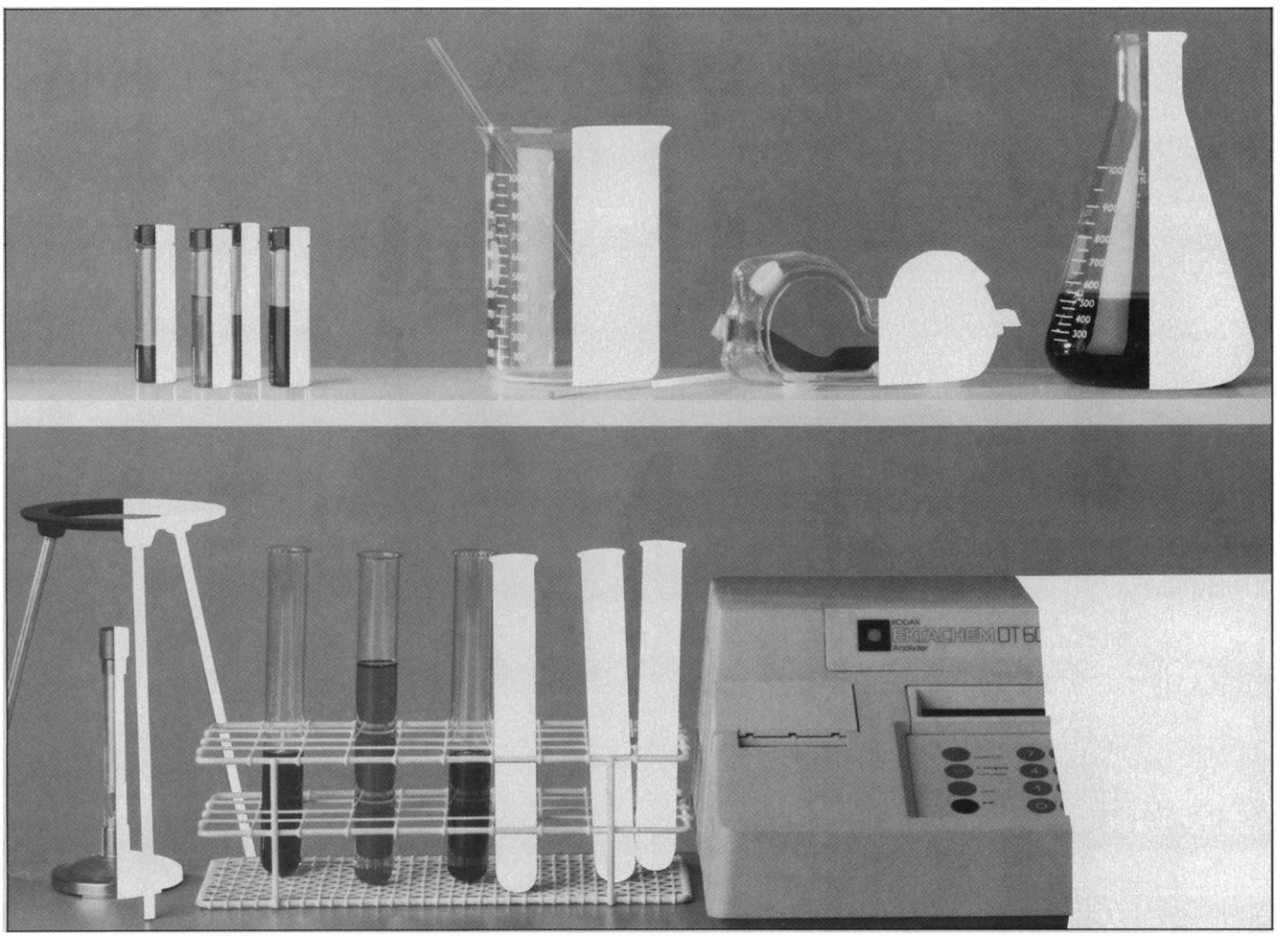

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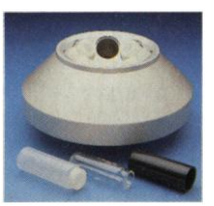

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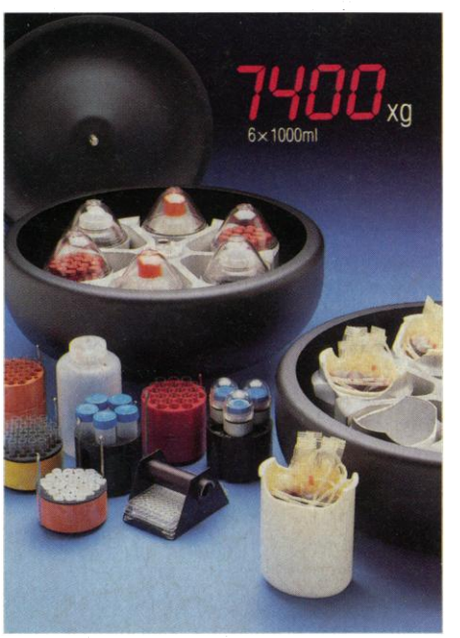

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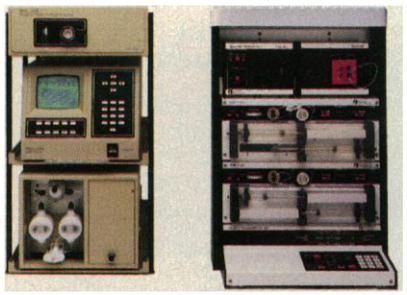

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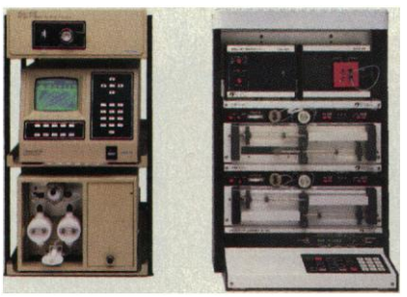

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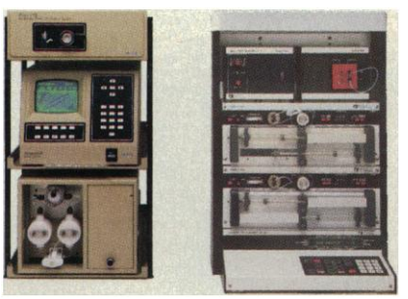

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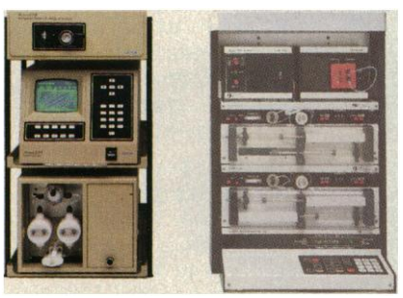

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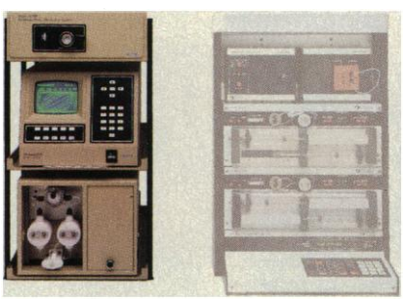

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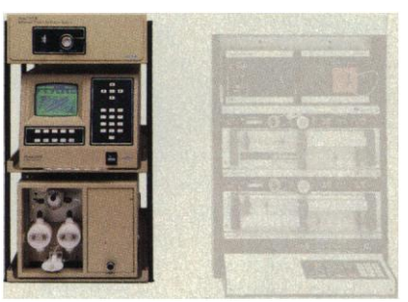

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homemakers are married (a possibility not specified in the models). Despite the repeated assertion of the salience of economic factors in the first-birth process, the same model includes no variable indicating husband's income or household income, preventing the authors from testing a major economic explanation of fertility. The instability of fertility intentions over time is analyzed without indication of whether marriage in the interim is associated with changing plans about parenthood.

Though the matter of the role of marriage in the timing of parenthood is troublesome, there is no doubt that this book provides a dramatic point of departure for future demographic studies of fertility. Its analytic framework will be widely adopted, and the authors' mastery of demographic data and methods provides a standard that other fertility researchers would do well to emulate.

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Department of Sociology and Population Issues Research Center, Pennsylvania State University, University Park, PA 16802

Allegiances in Education

Ed School. A Brief for Professional Education. GERALDINE JONÇICH CLIFFORD and JAMES W. GUTHRIE. University of Chicago Press, Chicago, 1988. xii, 413 pp. $24.95.

This provocative book by two professors of education at the University of California at Berkeley argues that "schools of education, particularly those located on the campuses of prestigious research universities, have become ensnared improvidently in the academic and political cultures of their institutions and have neglected their professional allegiances" (p. 3). By seeking status through the academic disciplines, schools of education in the research universities have lost a sense of purpose. They "have seldom succeeded in satisfying the scholarly norms of their campus letters and science colleagues, and they are simultaneously estranged from their practicing professional peers" (p. 3). The more scholarly such schools become, the more distant they are from the public schools; on those few occasions where they have made systematic efforts to address the problems of the public schools, they have been placed at risk on their research-dominated campuses.

The authors make their case largely through integrated histories and case examples drawn from ten schools of education in elite, graduate-oriented research universities—including Harvard, Stanford, Yale, Michigan, Duke, Chicago, and Columbia—during the 20th century, showing how these schools became the model type toward which other institutions gravitated. Their affiliation with elite universities, the emphasis on the scientific principles of education to be discovered by researchers, and the prominence given to preparing educational leaders (defined primarily as administrators and professors of education) increased their status at the expense of normal schools and state teachers' colleges. Yet on their own campuses these same schools of education were second-class citizens.

Facing "status deprivation" as vocational schools in an academic milieu the education schools adopted "dysfunctional coping strat-

egies" (p. 332) of appeasement and accommodation, including the appointment of discipline-oriented scholars with little interest in the practical problems of schools, the exaltation of the Ph.D. degree over the more clinical and applied Ed.D. degree, and the emphasis on social science educational policy research rather than on the problems facing the predominantly female teaching force. Imitative rather than initiative, the accommodations served only to confirm the second-class status of schools of education, which were tolerated on their campuses only because they allowed universities to show concern for education and because their students brought tuition income.

Clifford and Guthrie believe that schools of education can improve themselves through a commitment to professional education rooted in the practical problems that confront teachers. In keeping with the thrust of recent reports on the teaching profession, they believe that the undergraduate education major should be eliminated and that national professional standards for entering teaching should be established. But their essential recommendation is more fundamental: "Schools of education must take the profession of education, not academia, as their main point of reference" (p. 349). One consequence of this is the recommendation that the Ph.D. degree in education be abandoned in favor of an Ed.D. degree that includes "knowledge of and appreciation for academic research" but is not "oriented primarily toward academic inquiry" (p. 358).

Ed School is a powerfully argued case against almost every major trend in education schools for more than 50 years. As such, it should be a center of discussion for those inside and outside education schools. But powerfully argued as it is, *Ed School* is deeply flawed. Clifford and Guthrie appear to have been much affected by the near closing of the school of education at Berkeley (in the saving of which they were active players). They imply that the arts and sciences disciplines were at the heart of the problem at Berkeley, that the education school tried to be too much like those disciplines and was treated contemptuously for the effort. That is only one reading of what occurred at Berkeley, and it distorts Clifford and Guthrie's reading of schools of education more broadly. Their call for a more extensive research agenda rooted in educational practice is right on target; their positing of academic research as the enemy is not. Schools of education need the tension of multiple points of view and the stimulus of scholarly dialogue, and it is essential that scholars in education schools partake in the research mission of their university colleagues. Clifford and Guthrie depreciate the