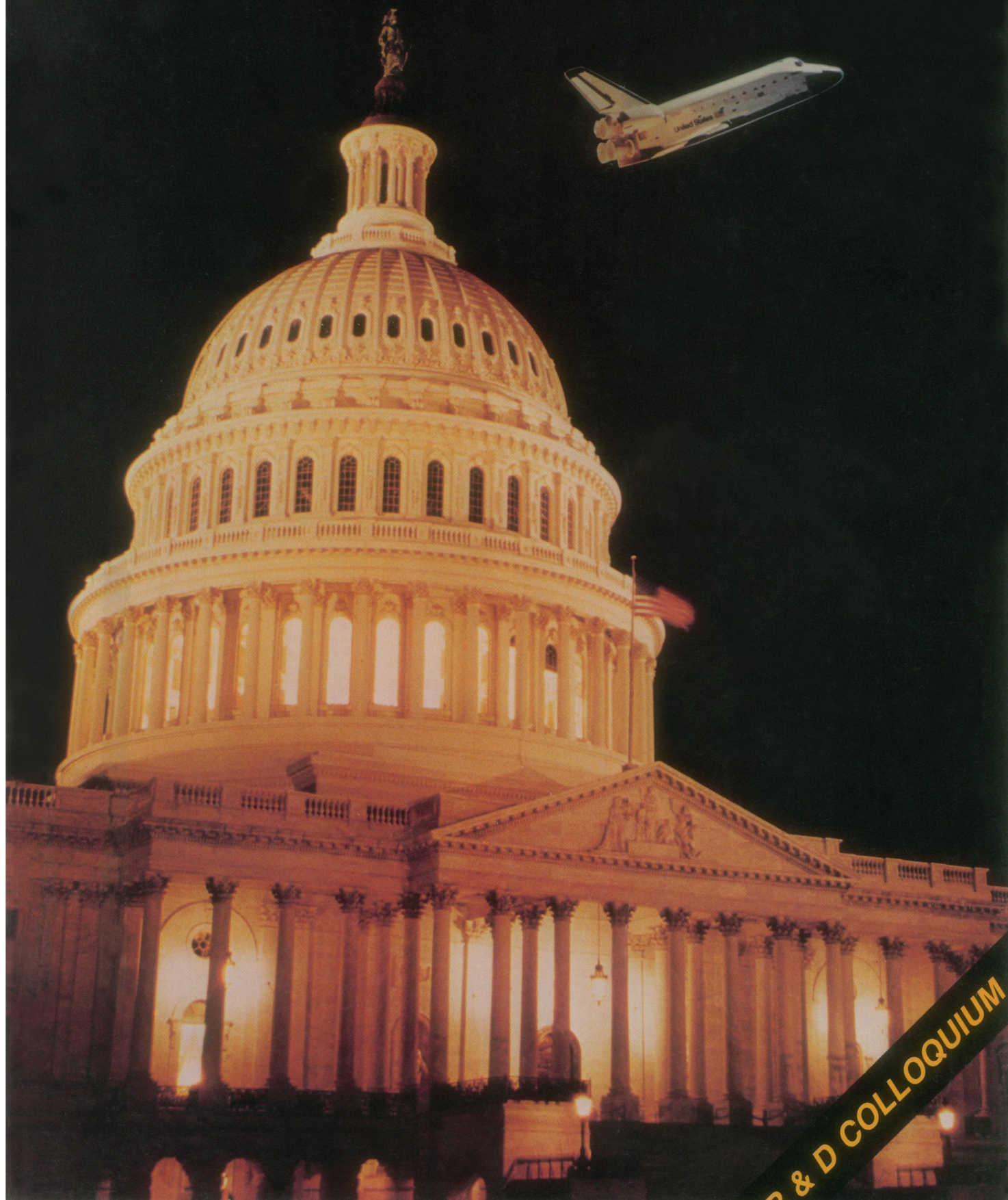


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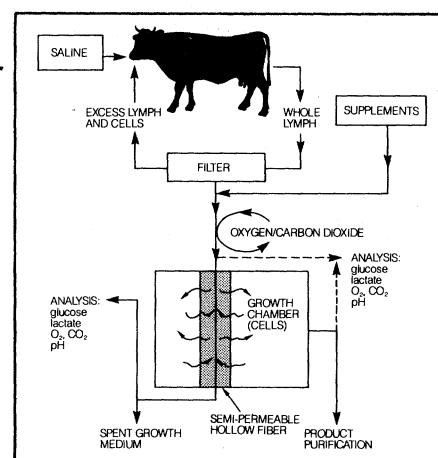
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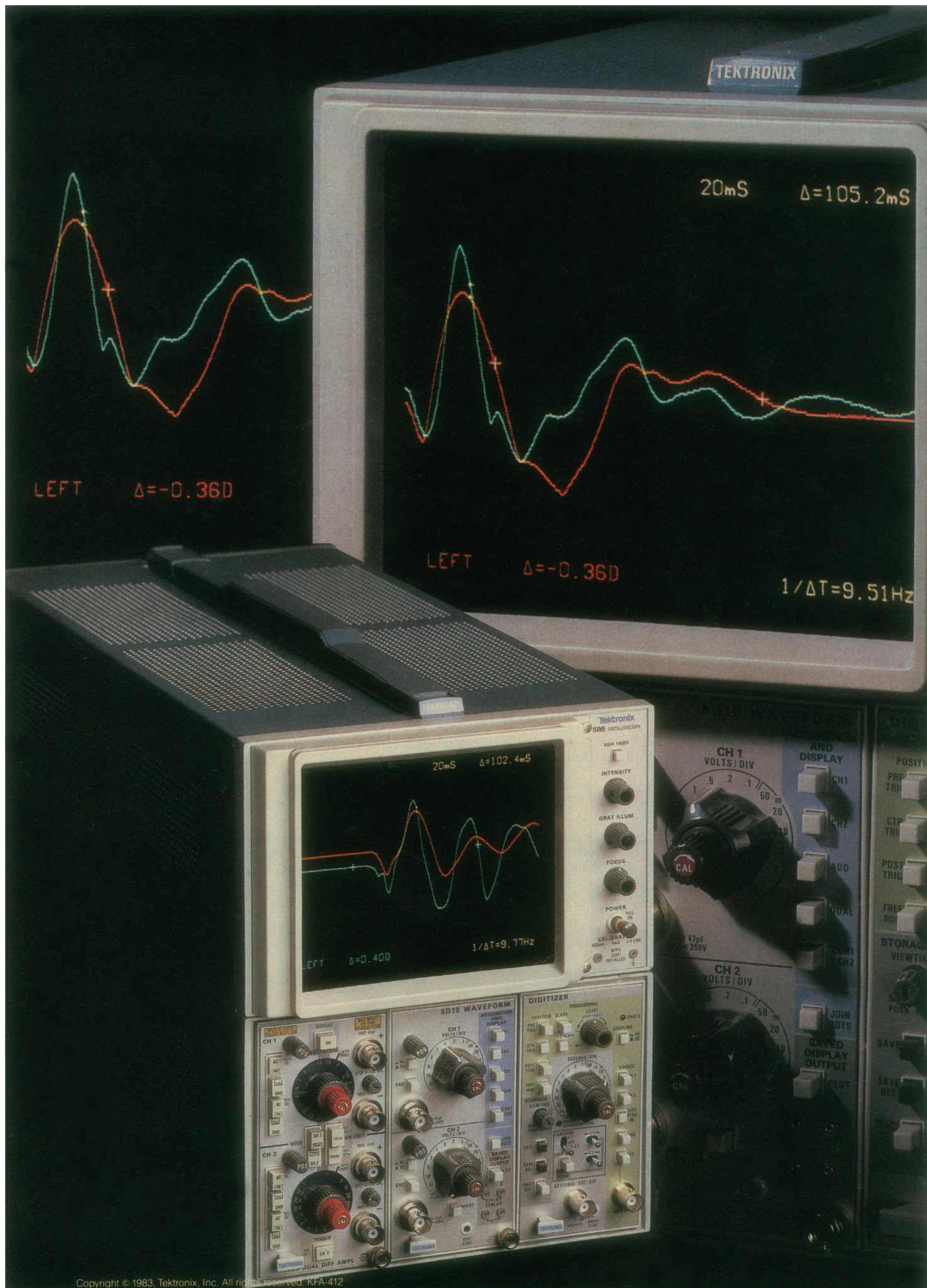
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COVER

Space shuttle Challenger glides past the U.S. Capitol in this composite photograph symbolizing the key role of Congress in the nation's R & D efforts. R & D in the fiscal 1985 budget will be discussed at the Ninth Annual R & D Colloquium, 29 and 30 March 1984, Washington, D.C. See page 679. [Concept and Capitol photo by Albert H. Teich, AAAS. Shuttle photo courtesy of NASA, Washington, D.C.]

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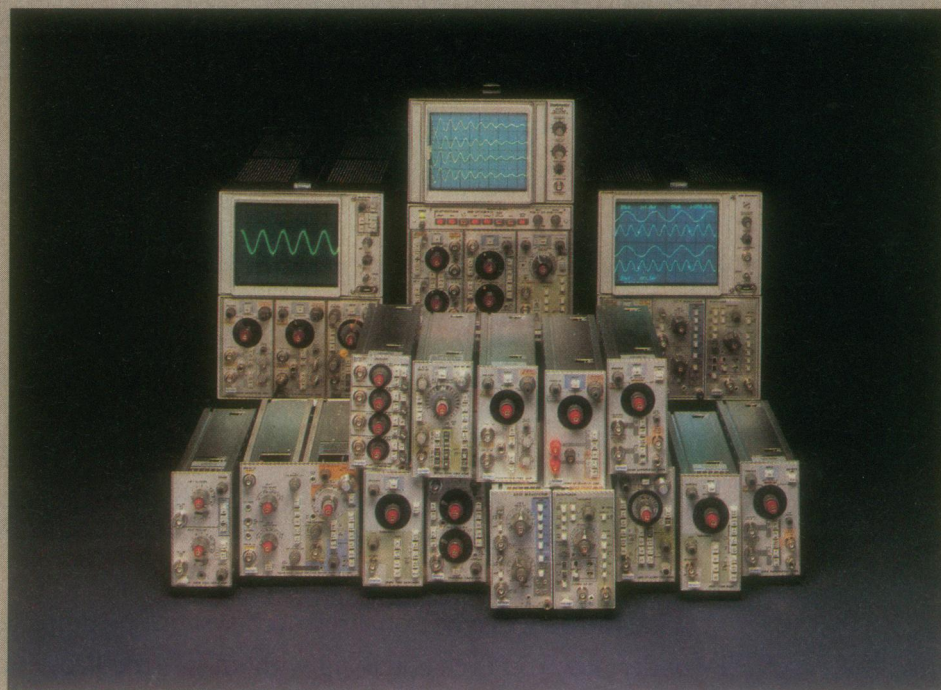
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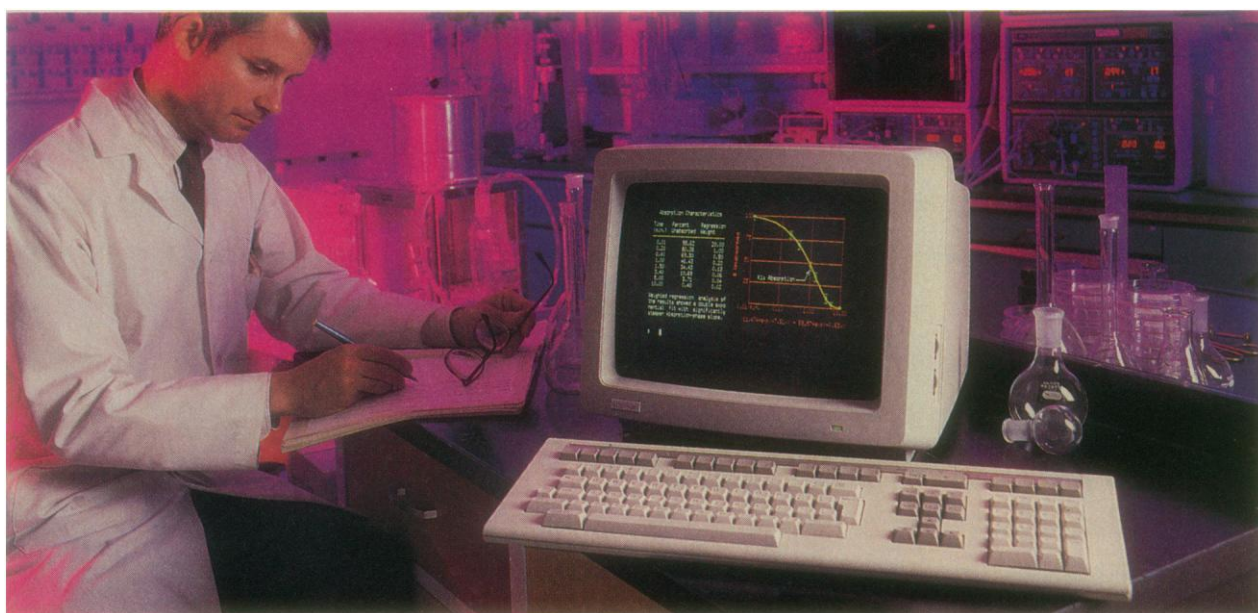
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Extremely sensitive high-speed photodetectors, key components in microwave fiber-optic communications links, have been fabricated by Hughes research scientists. The devices are gallium arsenide Schottky barrier type photodetectors. They have demonstrated a flat frequency response to at least 20 GHz and have the potential to approach millimeter wavelengths. They also have quantum efficiencies as high as 70%, roughly a 2 to 5 db improvement over existing high-speed detectors.

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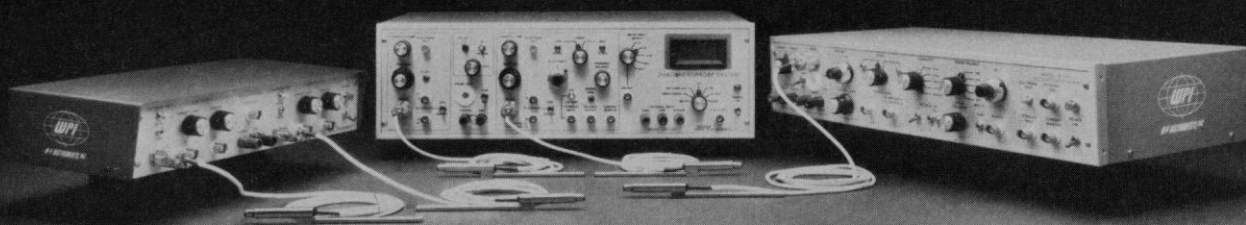
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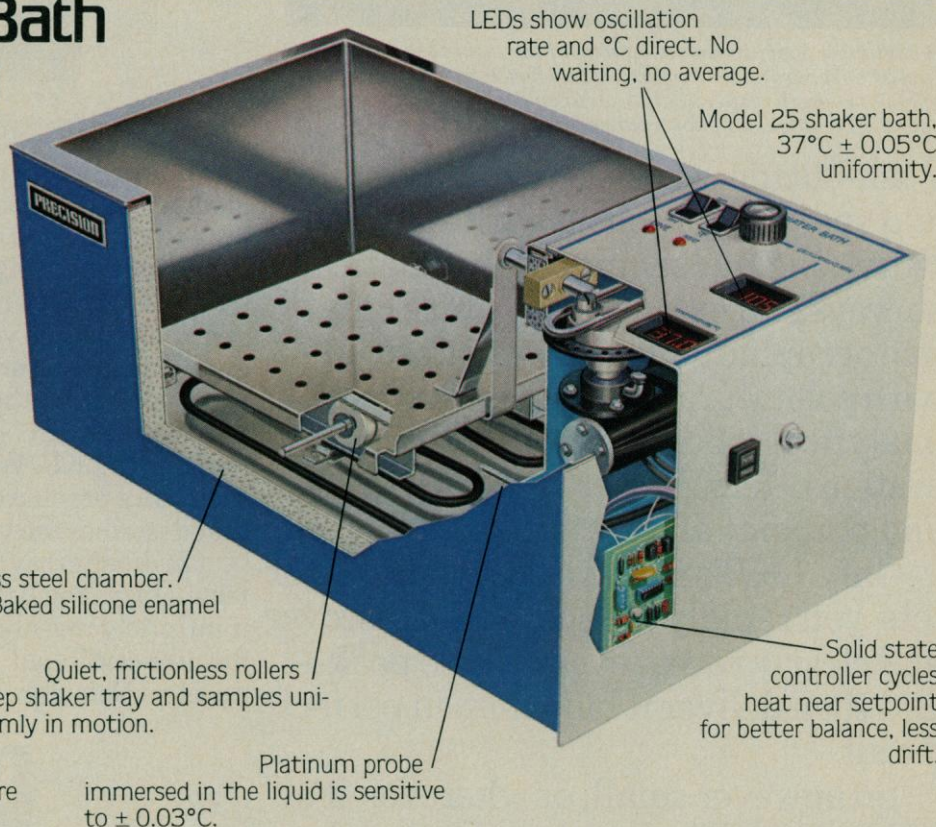
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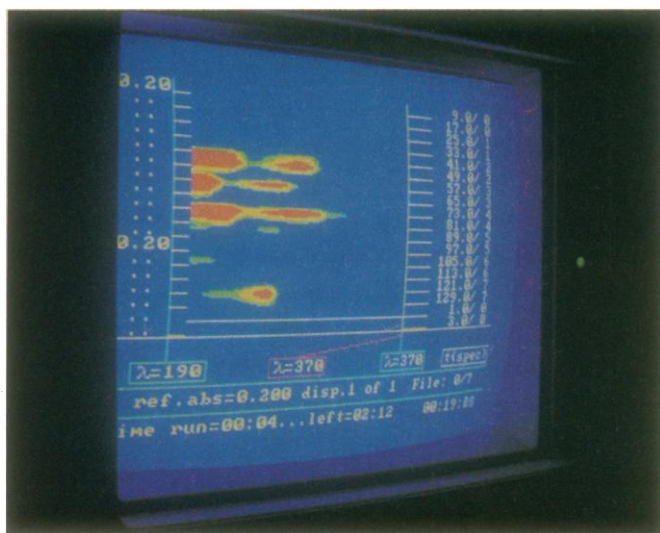


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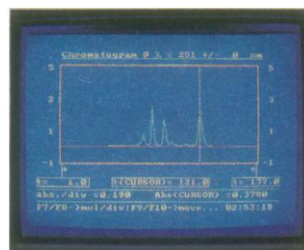


A computer generated contour map of the total absorbance pattern after separation. The vertical and horizontal axes are time and wavelength respectively. Colour coding is used to represent different levels of absorbance for each isogram.

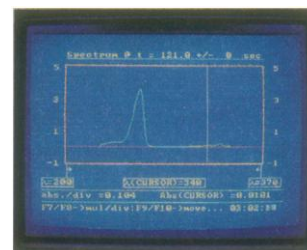
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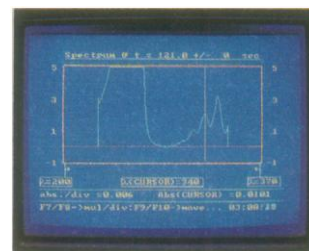
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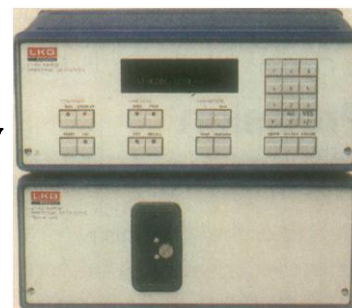


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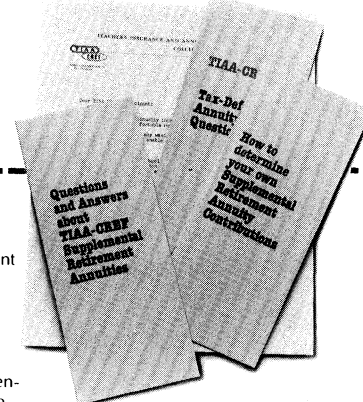
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Fundamental Science in the States

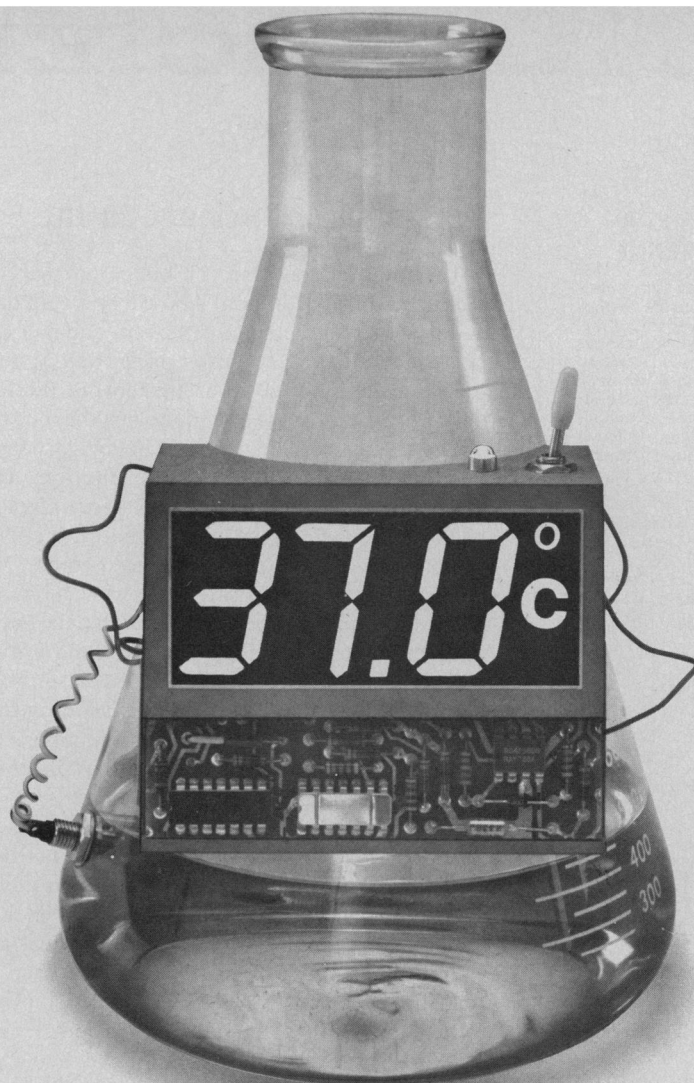
The total federal research budget of the United States for 1983–1984 is approximately \$47 billion. About 14 percent of this (\$6 billion to \$7 billion) is dedicated to fundamental research, and half of this sum is spent at colleges and universities. Campuses in the ten states that are best funded have received the bulk (60 to 65 percent) of the federal research dollars, while only 1 to 2 percent goes to schools in the ten states where the funding is low.

The sophisticated equipment, laboratory facilities, libraries, and the high-quality professionals at the top institutions are a vital part of the relatively good health and status of the U.S. research picture. However, in view of the changing demographics in the country, it may be time to consider a greater distribution of high-quality science centers. Would an increase in research dollars to states that are not well funded and to the poorly funded institutions in the richer states enhance our total science base, improve undergraduate education in science, and provide better graduate education in these locations? Should incentives and opportunities be provided to scientists in these locations to become more competitive? The answer to these questions is affirmative for a number of reasons.

Since the middle to late 1970's there has been a dramatic increase in the number of people who receive Ph.D.'s at the top universities and find employment in the medium-level universities throughout the United States. Their ability to acquire competitive grants from federal agencies is hindered by heavy teaching loads, an inability to develop scientifically compelling grant applications, academic isolation, lack of mentors, and poor local support for scientific research and creative activity. Thus, the total scientific talent of these individuals has not been captured. Their research and teaching effectiveness might be greatly improved by funding their research efforts. To rectify some of these problems, the National Science Foundation in 1980 launched the Experimental Program to Stimulate Competitive Research (EPSCoR) in five states that were at the bottom in total federal research funding: Montana, South Carolina, Arkansas, West Virginia, and Maine. After each state had thoroughly assessed its problems and developed a comprehensive plan, a modest sum of \$2 million to \$3 million was awarded to each state. Since 1980 dramatic strides have been made in upgrading science in these states through speaker programs, extensive extramural peer review of proposals, consultants, infusion of new state and private dollars, and shifting of teaching loads.

In Montana the EPSCoR program, known as MONTs ("Montanans on a New Trac for Science"), has relied on more than 500 peer reviewers in evaluating its scientific proposals. It has supported several hundred seminar speakers and consultants. At present, well over 50 percent of the original MONTs investigators have acquired extramural research funds. These funds have come from federal, state, and private organizations and agencies, and the amounts are nearly double those originally received from NSF. Furthermore, after NSF-EPSCoR funding has ceased, the MONTs program will continue with state funding. In Montana, the unique local and regional land, water, and wildlife resources have been well suited for study by MONTs investigators. For example, MONTs paleontologist John R. Horner, now independently funded by NSF, is continuing to excavate in north central Montana where he discovered extensive dinosaur nesting sites, complete with eggs and young.

Ultimately, increased scientific activity in the EPSCoR institutions strengthens both undergraduate and graduate education. In some cases, political leaders realized that economic development in their area is directly related to the status of research activities at the educational institutions of the state. The achievements made under EPSCoR, with a relatively modest federal investment, show that this approach should be broadened by NSF and other federal and state agencies to advance science and science education nationwide.—GARY A. STROBEL, *MONTs Project Director and R. G. Gray Professor, Montana State University, Bozeman 59717*



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Ninth Annual AAAS Colloquium on R&D Policy

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29–30 March 1984

Budgets: Discussion will be based on *AAAS Report IX: Research and Development, FY 1985*, a timely and comprehensive analysis of the new proposals for R&D in the FY 1985 budget, prepared by AAAS and a group of its affiliated scientific, engineering and higher education associations. Registrants will also receive *Proceedings* following the Colloquium and *Congressional Action on R&D in the FY 1985 Budget* in the fall.

Policies: Trends and prospects for R&D in defense, energy, health, space and other areas will be explored by leaders from industry,

universities, agencies of the federal government, Congress, the White House and the scientific and engineering communities.

Outlooks: Perspectives will be provided on topics such as deficits and the overall budget climate, R&D and economic recovery, implementation of R&D programs, public and private sector roles in applied research, and strategies for industry-university cooperation.

For further details, write:

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Office of Public Sector Programs
1776 Massachusetts Avenue, N.W.
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**9th AAAS R&D Colloquium
Washington, D.C.
29 & 30 March 1984**

**Advance
Registration
Form (S2)**

Thursday & Friday, 29 & 30 March, at The Shoreham Hotel, 2500 Calvert St., N.W., Washington, D.C.

Registrant's Name _____
(last name) (first name and initial)

Affiliation _____

Mailing Address _____
(street and number)

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☐ Please check here if you need special services due to handicap. We will contact you prior to the meeting.

Enclosed is a check, purchase order, or credit card information (see below) for:

- ☐ \$125 Full Registration (sessions, three meals, three publications)
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☐ \$ 45 Student Registration (sessions, three publications; full-time graduate and undergraduate students only)

Separate Meal Tickets: \ Lunches, \$17.50 each; Breakfast, \$5. No refund for meals after 26 March.

☐ Lunch on Thursday, 29th ☐ Continental Breakfast on Friday, 30th ☐ Lunch on Friday, 30th

Packets will be mailed to preregistrants on 16 March. Registrations received after 16 March will be held at the AAAS Registration Desk at The Shoreham Hotel. All registrants will receive *AAAS Report IX: Research and Development, FY 1985* at or before the Colloquium, published *Proceedings* following the meeting, and a supplementary report, *Congressional Action on R&D in the FY 1985 Budget*, in the fall.

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(Reservations received after 28 February cannot be guaranteed)

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Departure: Date _____ Time _____

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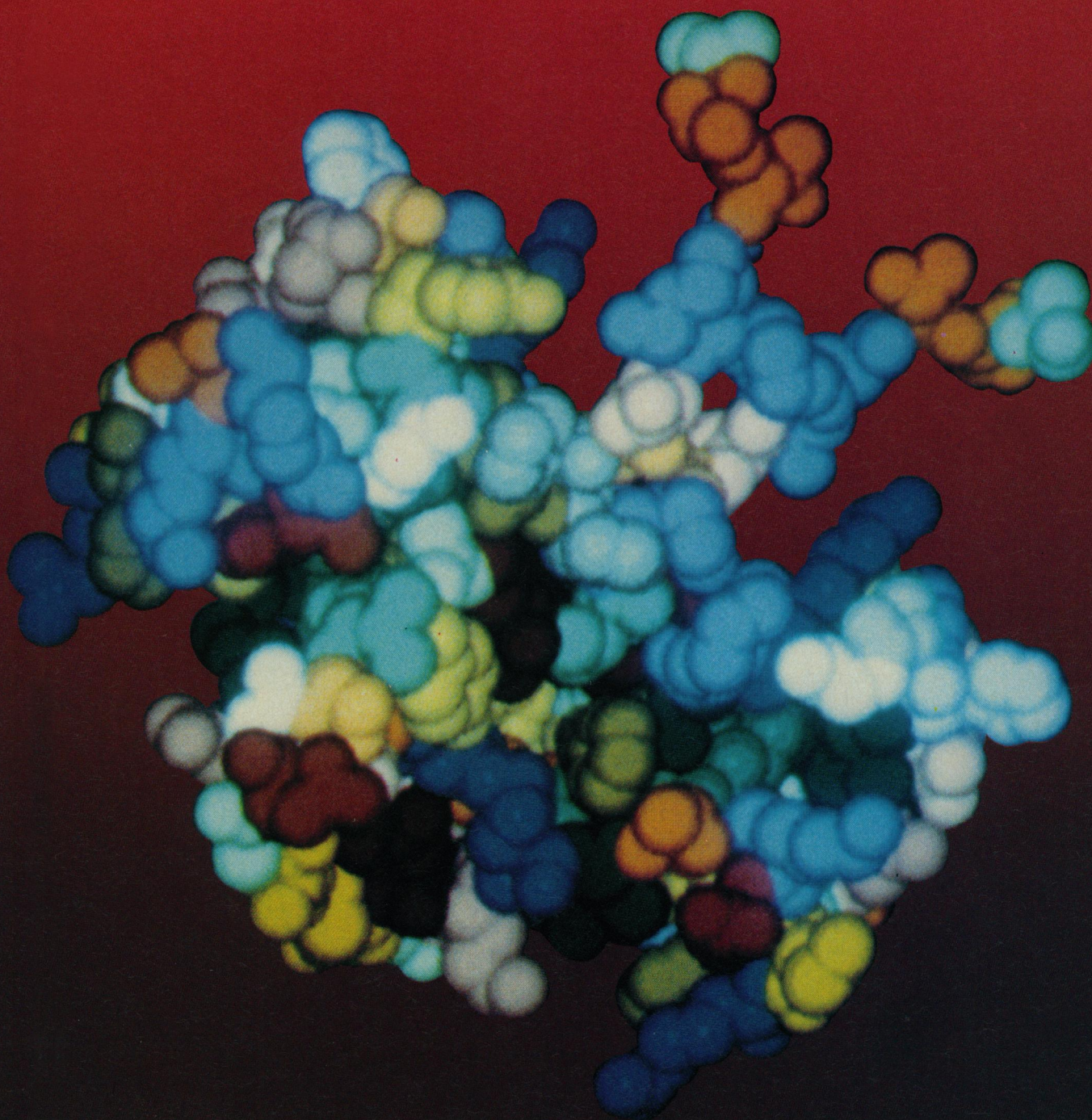
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LKB HPLC systems

revolutionize biology, biochemistry
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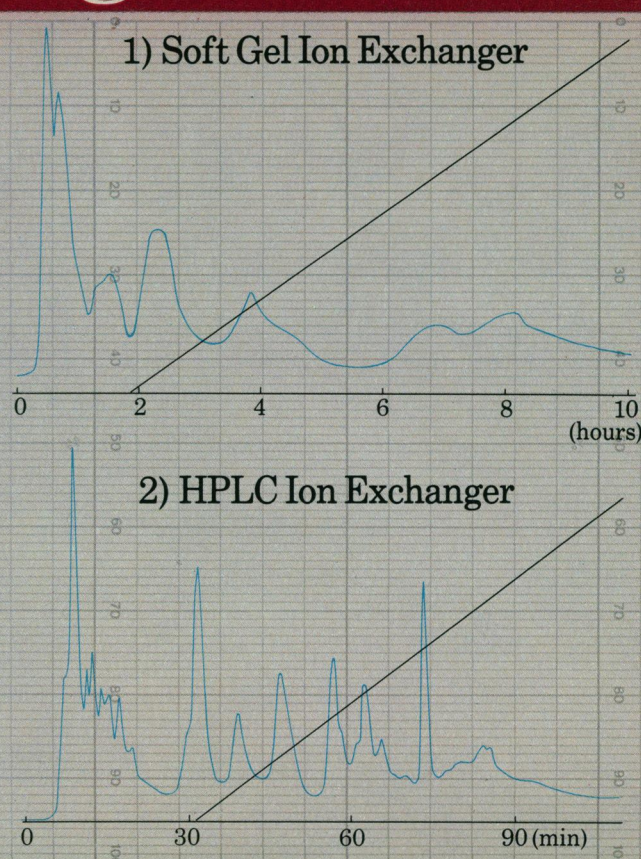
Achieve rapid, high resolution

High resolution

Sample: Tryptic digest of aldehyde dehydrogenase
Detection: 280 nm, 1) 0.1 AUFS; 2) 0.02 AUFS
Gradient: 0—0.1 M NaCl in 0.02 M ammonium acetate, 8 urea, pH 5.0
HPLC Column: CM, LKB 2133-200, 7.5×150 mm

Recent developments in high performance liquid chromatography have brought on a veritable revolution in the life sciences—enabling exploration far beyond the resolution limits of conventional liquid chromatography. These extraordinary improvements in resolution can be attributed primarily to the unique character of new HPLC separation media.

LKB HPLC columns are packed with rigid silica particles of approximately 1/10th the diameter of traditional soft gel media. The rigidity of these particles enables better packing than conventional liquid chromatography techniques. The smaller diameter results in more efficient fractionation, sharper peaks, increased resolving power and higher sensitivity.

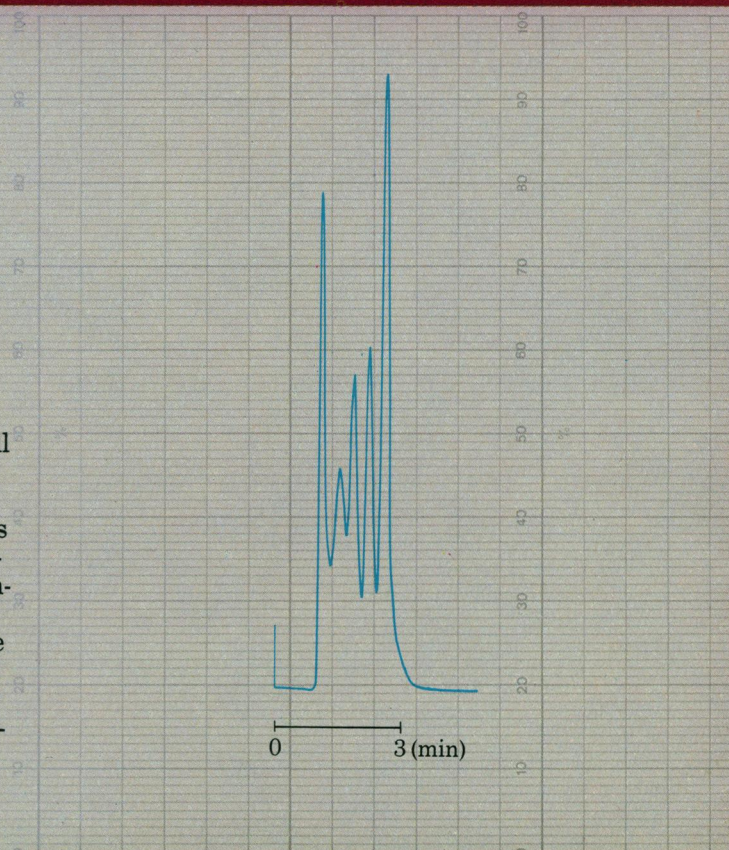


Rapid analysis

Sample: Mixture of thyroglobulin, gammaglobulin, ovalbumin, myoglobin, vitamin B₁₂
Detection: 280 nm, 0.32 AUFS
Eluent: 0.1 M Na-phosphate buffer, pH 6.8
Flow rate: 1.0 ml/min
Column: Gel permeation, LKB 2135-075, 7.5×75 mm

HPLC is the most rapid and efficient method available today for the fractionation of biomolecules. The HPLC separation shown here, for example, would have taken several hours by conventional soft gel chromatography! Like improvements in resolution, shorter analysis times are attributable largely to the rigidity and relatively small diameter of the HPLC media—enabling more rapid mass transfer between the stationary and mobile phases.

As a life scientist you are compelled to seek rapid methods for the fractionation of your samples. Not only are you interested in faster sample throughput, but you are also concerned about the danger to labile molecules of prolonged or drastic treatment, or the short half-life of a radioactive isotope. In addition, many conventional methods require harsh and time-consuming separation procedures. In all these cases, LKB HPLC systems are rapid and highly efficient alternatives.



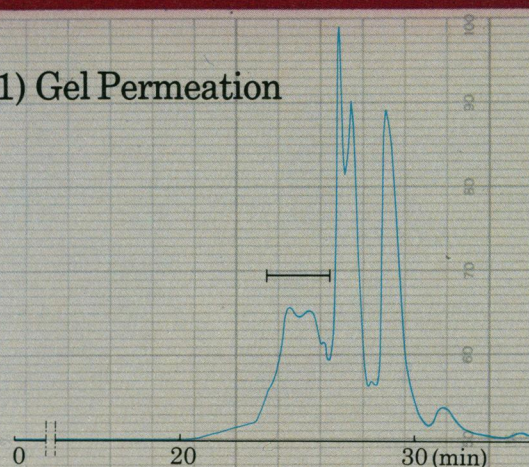
separations of biomolecules

Optimized purification schemes

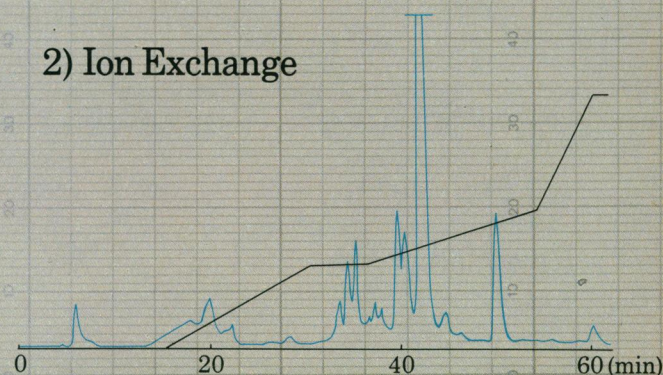
Detection:	254 nm, 1) 0.5 AUFS; 2) 0.1 AUFS
Gradient:	2) 0.03–0.7 M ammonium acetate, pH 6.2
Columns:	1) Gel permeation, LKB 2135-260, 7.5 × 600 mm
	2) DEAE, LKB 2133-100, 7.5 × 150 mm

By combining LKB HPLC techniques and thereby increasing the resolving power and speed of critical steps in a separation process, it is now possible to produce significant improvements in the efficiency of purification schemes. In this example, the entire separation was three times faster than conventional techniques and revealed 3–4 times as many components. An ultrafiltrate from the serum of uremic patients was first resolved by high performance gel filtration chromatography. Components in the molecular weight range 350–2000 (those which accumulate in the blood of uremic patients) were then applied to a high performance ion exchange column and resolved into 22 peaks.

1) Gel Permeation



2) Ion Exchange



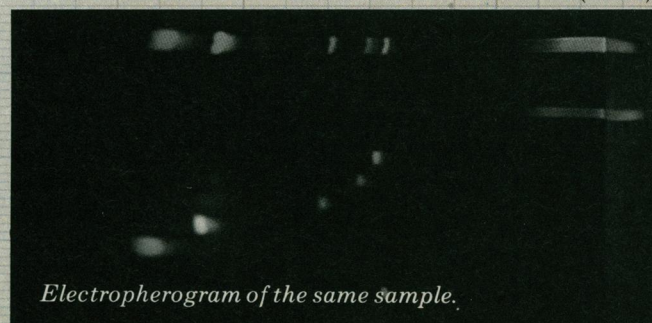
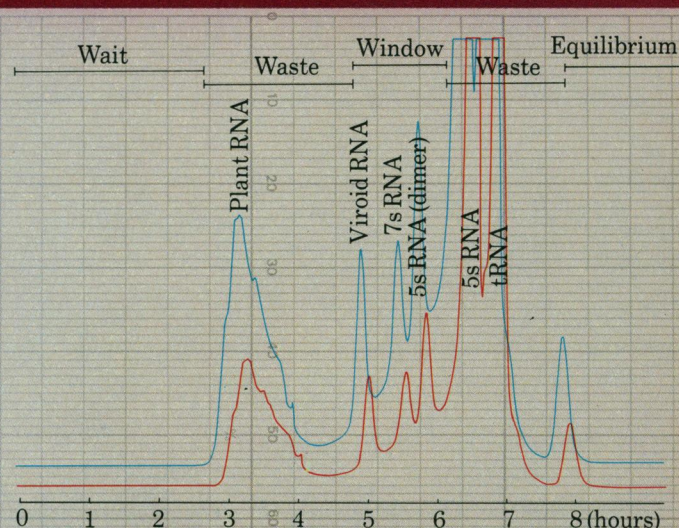
Preparative capabilities

Sample:	RNA from PSTV-infected tomato leaf
Detection:	254 nm, 1.0/2.0 AUFS
Eluent:	0.01 M NaAc, 0.02% NaN_3 0.2 M NaCl, 5 mM MgCl_2 , pH 5.0
Flow rate:	0.4 ml/min
Column:	Gel permeation, LKB 2135-465, 21.5 × 600 mm

Courtesy of Sanger et al, Max-Planck-Institut of Biochemistry, Martinsried

Preparative LKB HPLC systems have proven to be a highly attractive alternative to other methods commonly used to separate complex mixtures of proteins and polynucleotides.

In this example, a preparative LKB HPLC system has been used to resolve a mixture of nucleic acids with a resolution comparable to that of analytical electrophoresis. Fractions of interest were collected automatically by the LKB 2211 SuperRac fraction collector. While electrophoretic methods are the traditional choice for analytical separations of polynucleotides, the preparative application of electrophoresis suffers from drawbacks such as limited loading capacity and extraction procedures which are tedious and often result in a loss of purified material. In this example, 400 OD of viroid RNA was eluted in less than 5 hours, with a recovery of better than 90%.



Select the technique most

LARGE BIOMOLECULES

i.e. proteins
nucleic acids
polysaccharides
lipids

FRAGMENTS

i.e. peptides
oligonucleotides
oligosaccharides

SMALLER BIOMOLECULES

i.e. peptides
amino acids
nucleotides

Gel permeation

Ion exchange

Reversed phase

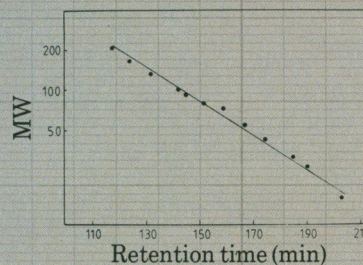
Gel Permeation Chromatography

Sample: ϕ X 174 from RBL incubated with Hinf I
Detection: 257 nm, 0.01/0.02 AUFS
Eluent: 50 mM TEAA, pH 7.0
Flow Rate: 100 μ l/min
Column: LKB 2135-460, 7.5 $\times$ 600 mm

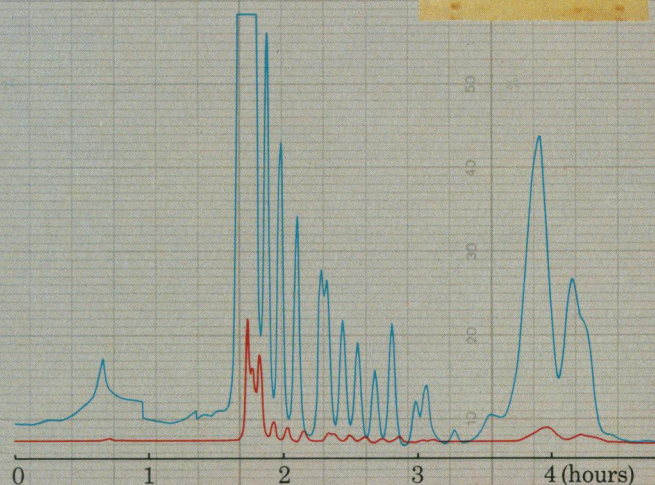
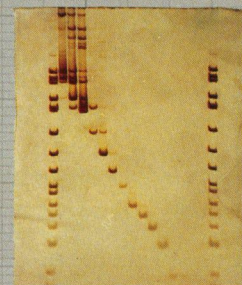
Courtesy of Kruppa et al, Physiol.-Chem. Institut, Hamburg

LKB offers a wide range of analytical and preparative Blue Columns for high performance gel permeation chromatography. The column packing material, a macroporous silica particle support, has been chemically modified to provide an inert and non-adsorptive stationary phase appropriate for high resolution separations of a wide variety of biomolecules as well as for use with most commonly used buffer systems and solubilizing agents. The calibration shown here is just one of several examples of the excellent resolution, linearity and selectivity obtainable with an LKB high performance gel permeation system.

Calibration curve prepared from the chromatogram.



Electropherogram of the same sample.



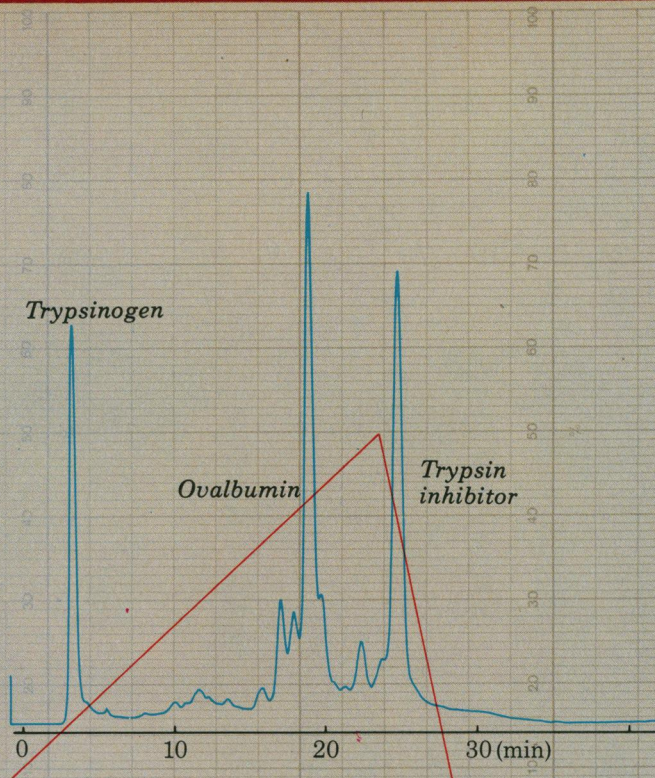
suitable for your sample

Ion Exchange Chromatography

Sample:	Trypsinogen, ovalbumin and trypsin inhibitor
Detection:	280 nm, 0.32 AUFS
Gradient:	0-0.5 M NaCl in 0.05 M Tris-HCl, pH 7.2
Flow rate:	1.0 ml/min
Column:	DEAE, LKB 2133-100, 7.5 × 150 mm

LKB Blue Column DEAE and CM ion exchangers can be used at high pressures and ionic strengths, and with a wide variety of buffer systems. Due to their speed, resolution and wide range of application, high performance ion exchange techniques are rapidly replacing many methods conventionally used for separation and analysis prior to protein sequencing; they are now also used to purify commercially-available proteins for enzyme assays and structural studies.

LKB ion exchange systems, for instance, permit the use of volatile buffer solutions (ammonium bicarbonate or ammonium acetate) for highly efficient peptide separations. For large peptides, the LKB HPLC ion exchange system gives better resolution than traditional reversed phase chromatography.



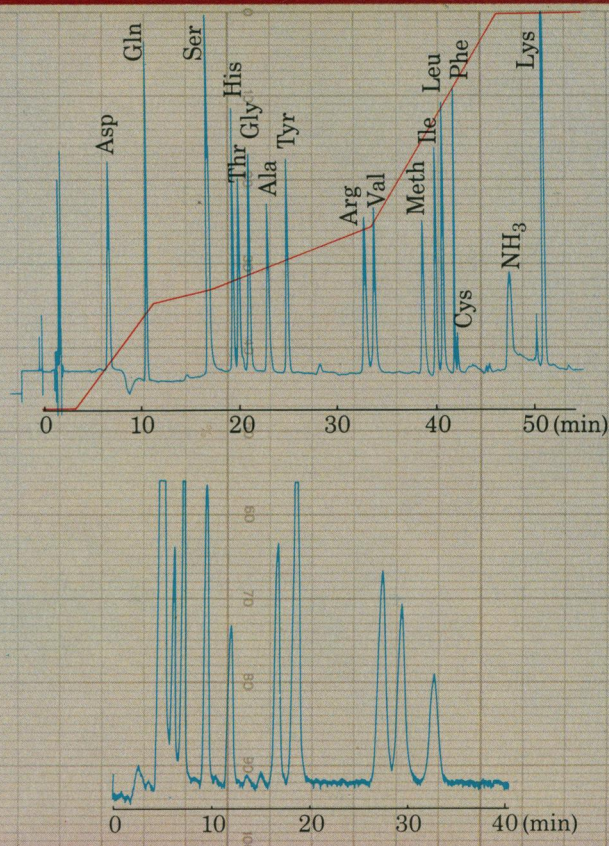
Reversed-phase Chromatography

Sample:	<i>o</i> -phthalaldehyde derivatives of amino acids, 1 nMol each
Detection:	330 nm, 0.04 AUFS
Gradient:	10-50% CH ₃ CN in 12.5 mM Na-phosphate buffer, pH 7.2
Column:	C18 (5 μm), LKB 2134-215, 4 × 250 mm

LKB's high performance reversed-phase chromatography systems provide an accurate, reproducible, rapid and inexpensive method for analyzing smaller biomolecules such as peptides, amino acids, PTH-amino acids and nucleic acid components.

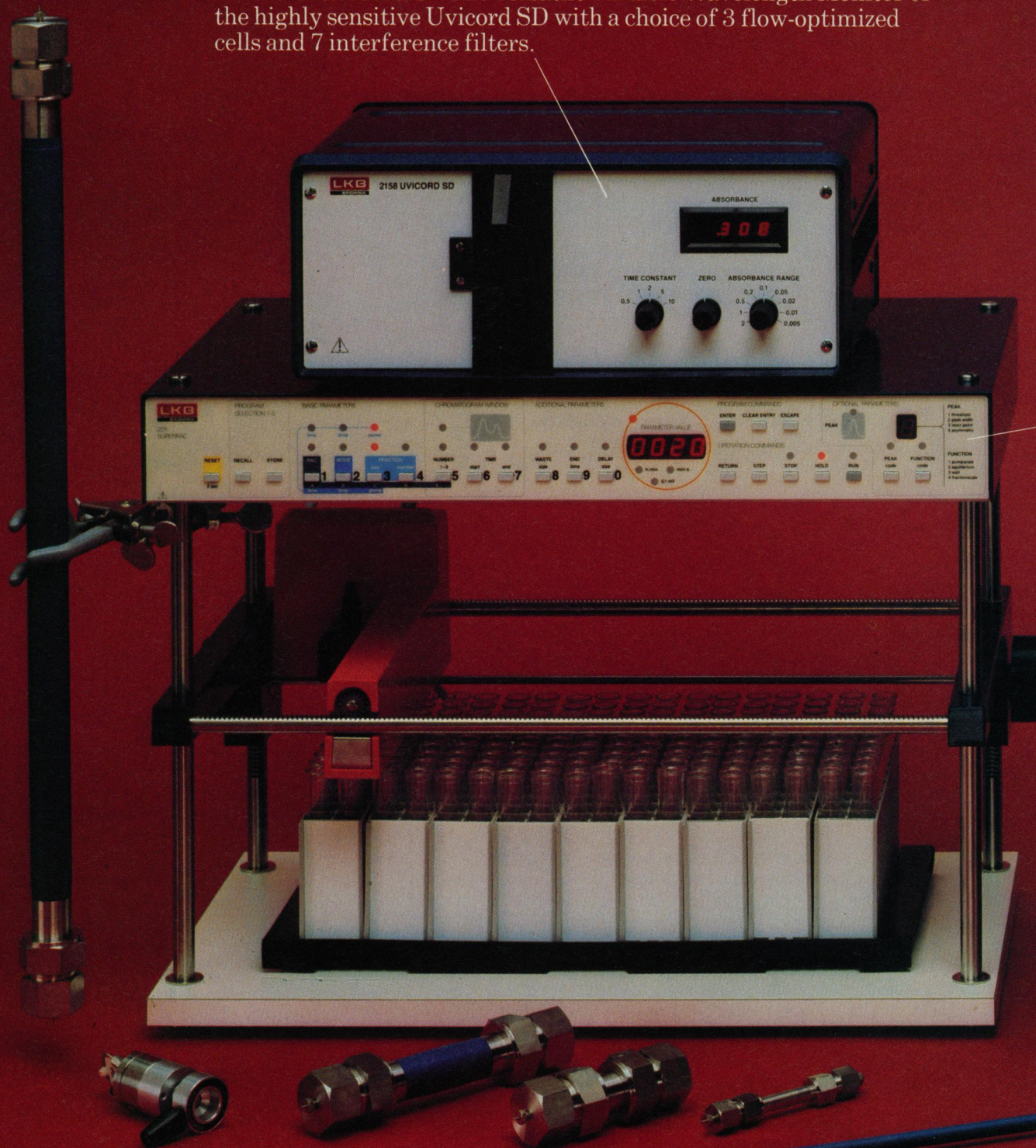
Column dimensions and particle sizes have been selected to give maximum separation efficiency, lower detection limits and a minimum of solvent consumption. An LKB high performance *microbore* system (1 mm ID columns), for example, can achieve up to 14 times lower detection limits and solvent savings of up to 95% compared with conventional HPLC systems.

Sample:	PTH amino acids, 1-5 pMol each
Detection:	254 nm, 0.005 AUFS
Eluent:	CH ₃ CN/THF in NaAc buffer, pH 5.8
Flow rate:	50 μl/min
Column:	C18 (5 μm), LKB 2134-600, 1 × 250 mm



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Ask your LKB representative for more information.

results with HPLC systems

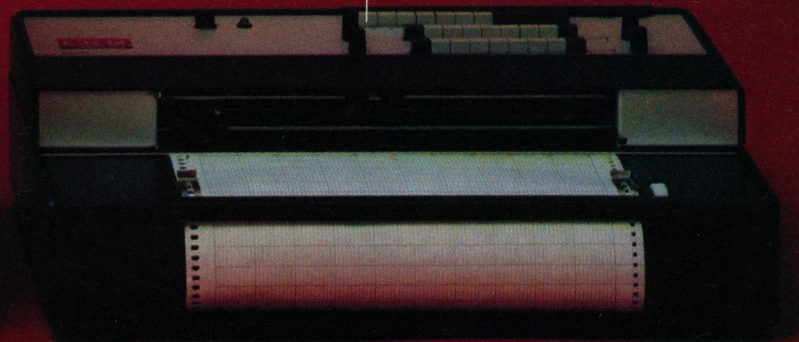
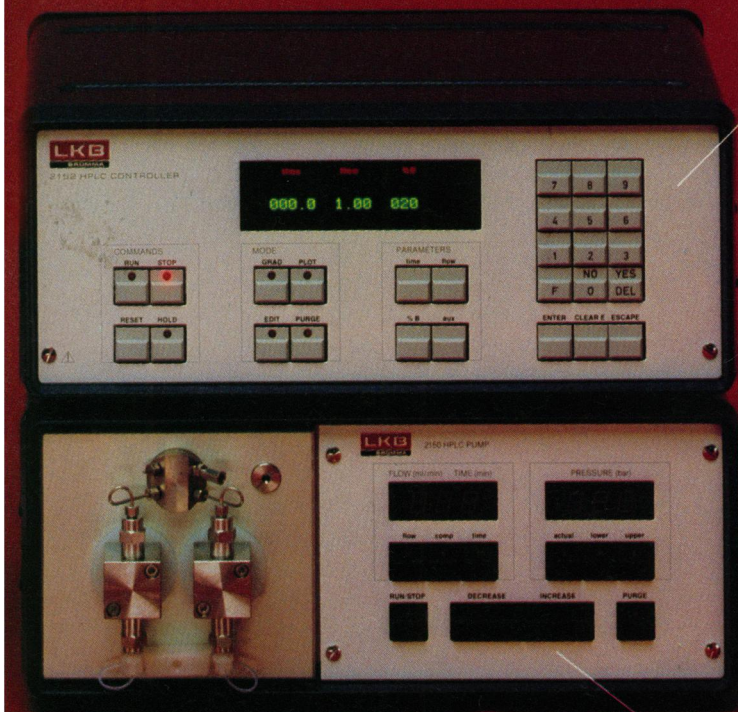
LKB offers the first modular HPLC system designed to meet both today's general requirements in HPLC as well as the special requirements posed by biomolecular research. Given the relatively low diffusion rates of many large biomolecules, the LKB 2150 HPLC Pump is the only HPLC solvent delivery unit capable of flow-optimized gel permeation and ion exchange chromatography. This unique pump teams up with the 2152 HPLC Controller to provide unprecedented precision, accuracy and complete control of gradient formation—even at the extremes of gradients where very low flow rates are required. Both units are microprocessor-controlled for added precision and reproducibility as well as for ease of use—incorporating convenient pushbuttons and bright and easy-to-read digital displays.

The intelligent fraction collector

SuperRac is the most advanced fraction collector available today, with peak-slope detection, window programming, re-cycling capabilities and an extensive memory.

Accurate gradient elution & complete system control—Simple and accurate system control with rescaling function for methods development, extensive memory and gradient plotting.

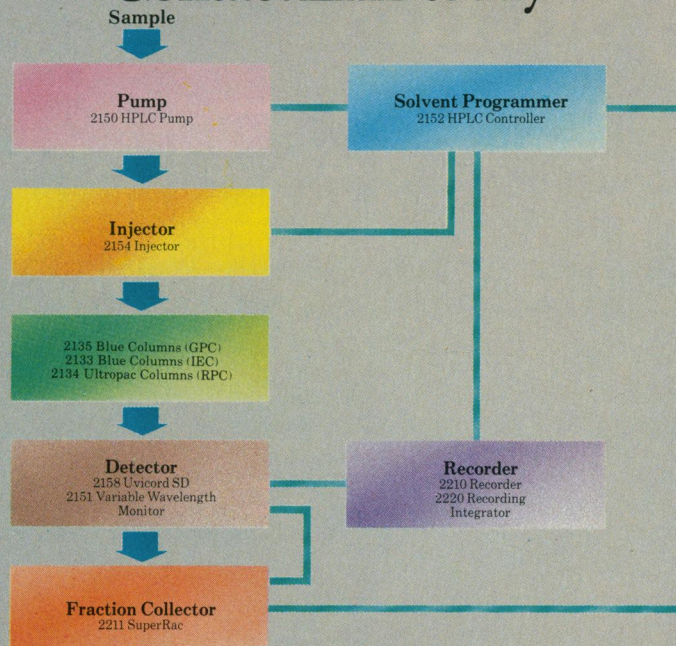
Choice of recorder or recording integrator



Inert pump with excellent flow performance—

A state-of-the-art HPLC pump which assures pulsation-free flow of aqueous and organic solvents—even at low flow rates (for high resolution separations of large biomolecules and microbore HPLC).

Contact LKB today



The LKB HPLC System configuration

LKB can provide you with all the detailed and up-to-date information you need on HPLC instrumentation, techniques and applications for the separation of biomolecules. Apart from **Descriptive Catalogues** and **Product Brochures** for all HPLC instruments and chemicals, LKB also publishes **Application and Technical Notes** to help you realize the full potential of your HPLC instrumentation. **LKB Workshops and Seminars** give you support on the theory and practice of HPLC for the separation of biomolecules, and provide you with an opportunity to discuss techniques with other scientists and LKB specialists. A 64-page Seminar Note booklet entitled **HPLC for the Biochemist** and an accompanying **Slide Set** are also available from your local LKB representative.



LKB—specialists in HPLC for the Biochemist

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