17 February 1984 • Vol. 223 • No. 4637 $2.50

SCIENCE

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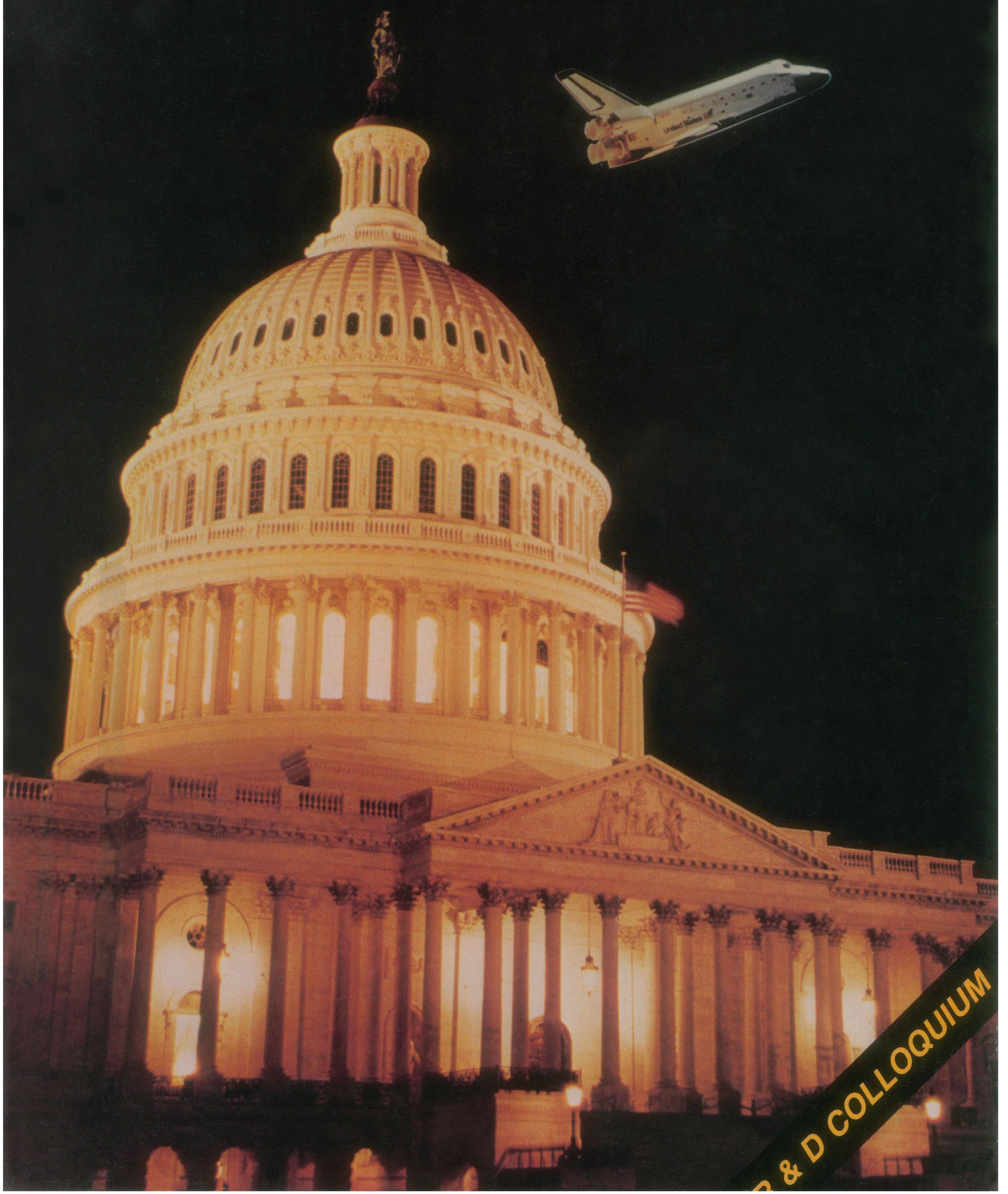

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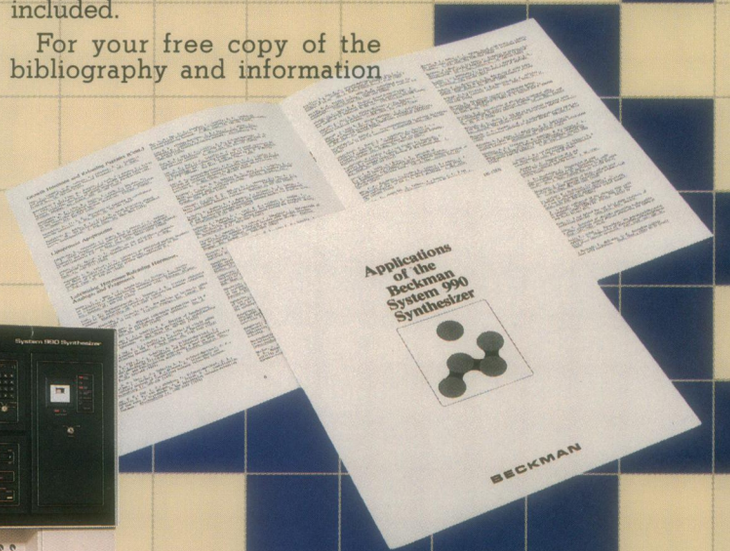

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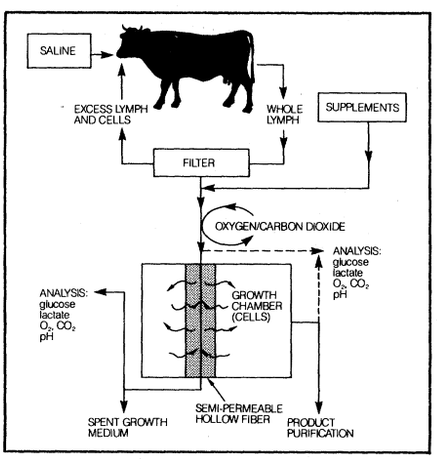

Insufficient quantities of desired peptides are a key cause of expensive research and production delays. The MCT system is a *new* and *unique* mammalian cell culturing process designed to overcome the obstacle of insufficient quantities of peptides by delivering the quantity you need... *when you need it!* Additionally, every step in MCT production has been developed to contain costs now and in the future while maintaining exceptional purity and quality in mammalian cell proteins.

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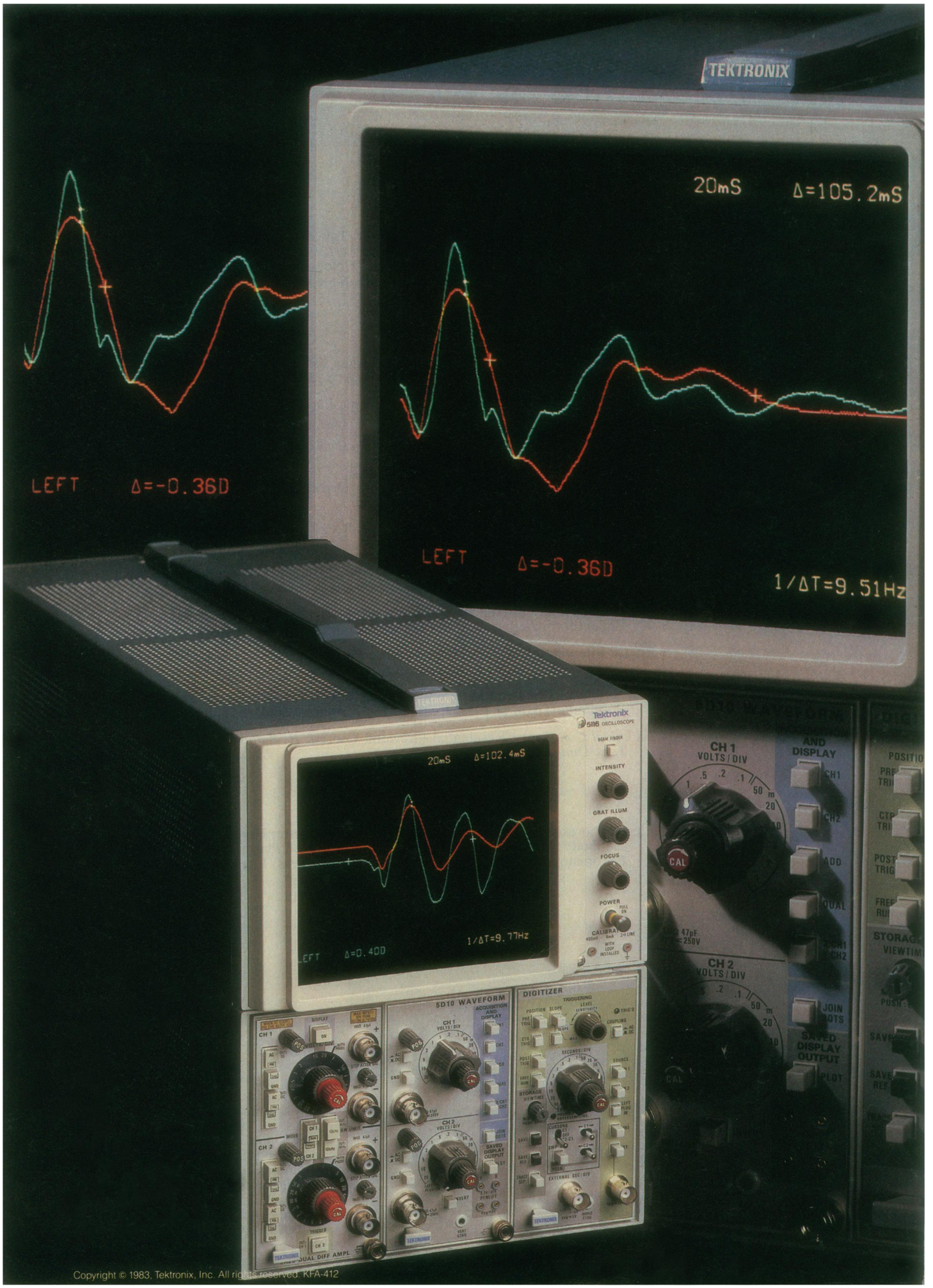
COVER

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.]



TEK 5116 COLOR OSCILLOSCOPE

THE ANSWER BY ANY MEASURE

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The Tek 5116 introduces Tek's proprietary color shutter technology: a remarkable liquid crystal color switch that adds yet another productive dimension to the Tek 5000 oscilloscope series.

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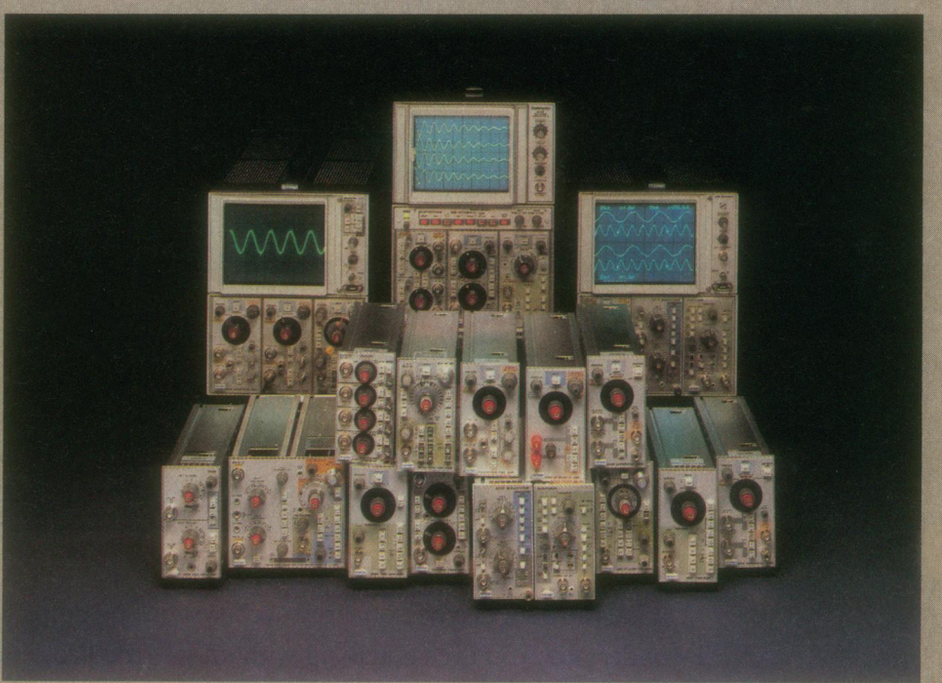
Unlike other color technologies, Tek's new color shutter requires no shadow mask or color phosphors, thus minimizing flicker and eliminating misconvergence problems. It can bring high-resolution color to oscilloscopes and other small-screen instrument displays where it has never been practical before.

The 5116 lets you interpret and compare signals with new speed and confidence. Its enhanced display clarity can be especially valuable in evaluating waveforms of the non-repetitive, transducer-type measurements that the 5000 Series is often called upon to perform.

You can use the full screen to display both channels—with remarkable clarity. Or, clarify test procedures for line workers with waveforms color-coded to probes and test points. The 5116's three liquid crystal colors have been chosen for excellent contrast and easy viewing.



Color is just one more way the Tek 5000 Series responds uniquely to a range of application needs. Tek 5000 Series monochrome mainframe/plug-in combinations operate in bandwidth ranges from dc to 50 MHz, sampling to 1 GHz. Choose from a variety of amplifier and time base plug-ins to match your application. Or select special-purpose plug-ins like curve tracer, spectrum analyzer or dual trace samplers.

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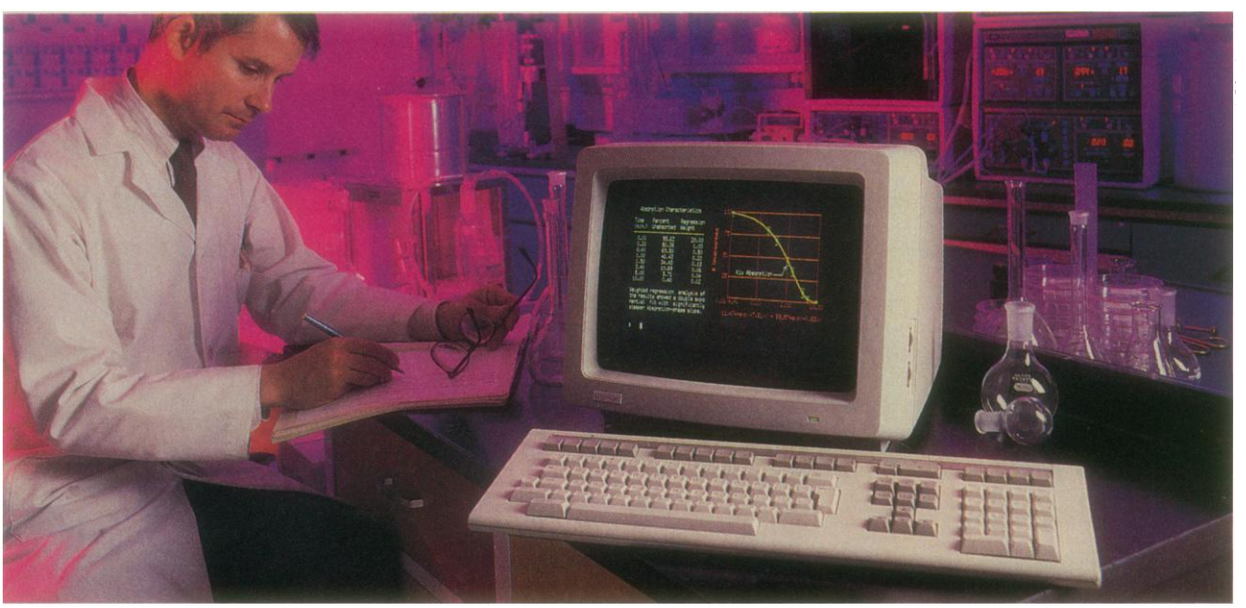

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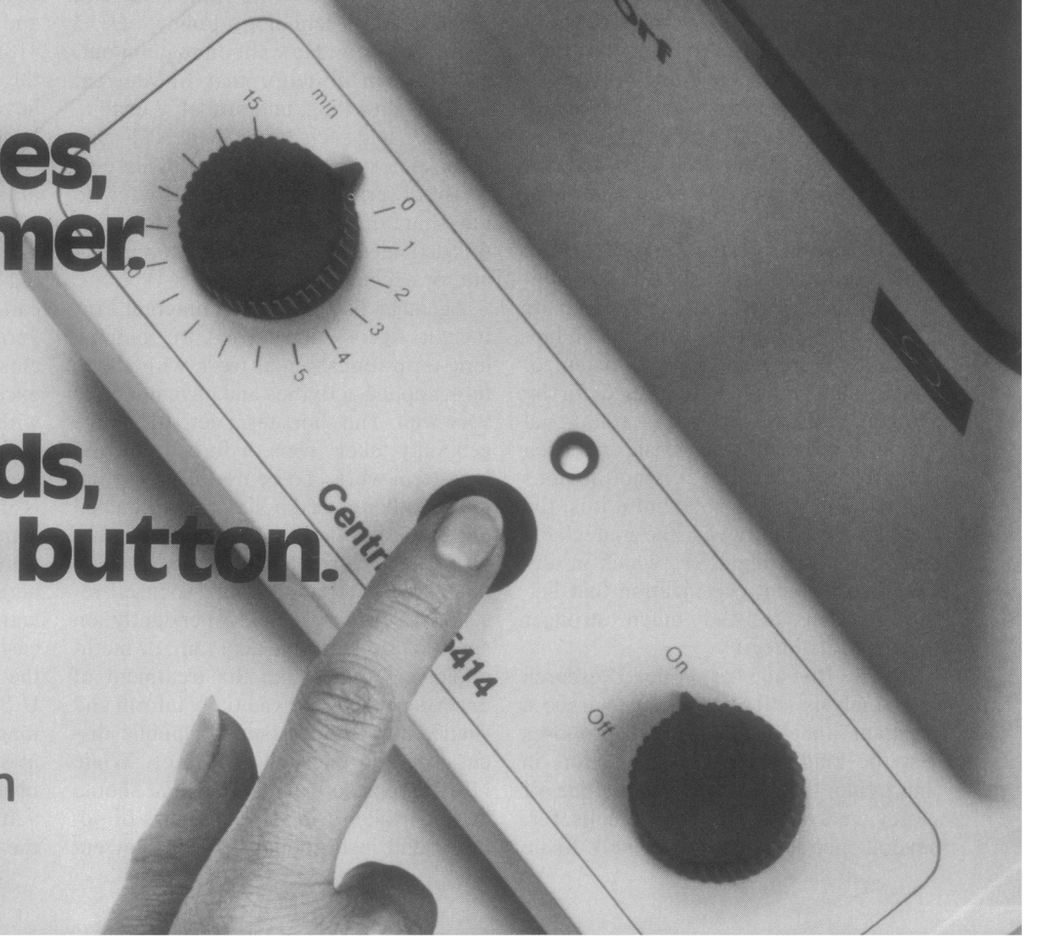
To spin for minutes, set the timer.

To spin for seconds, touch the button.



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SCIENCE/SCOPE

Weather satellites help airlines save $700 million in fuel bills, thanks to timely pictures and other data. Meteorologists who plan trips for airlines use satellite information to find efficient travel routes. For example, normally the route between Los Angeles and Hawaii is about 2300 miles. In case of a headwind, the airline will select an alternate route. Even though the new route may be 2500 miles long, better flying conditions could save the airline $1500 in fuel. The latest three spacecraft in the Geostationary Operational Environmental Satellite (GOES) system were built by Hughes Aircraft Company. The sensing devices, which provide the daytime and nighttime pictures shown on TV and printed in newspapers, were built by a Hughes subsidiary, the Santa Barbara Research Center.

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.

Approximately 2900 U.S. and foreign patents have been granted to Hughes inventors in the last 15 years. To honor its best and brightest talent, the company each year presents the Lawrence A. Hyland Patent Award to a handful of its outstanding inventors. The award, which includes an honorarium, is named for the company's retired chairman of the board. A leading electronics inventor and radar pioneer, Mr. Hyland was granted nearly 40 patents. Among his earliest was the one for the first shielded spark plug that permitted radio equipment to be used effectively aboard aircraft. To date 104 inventors have received the Hyland award.

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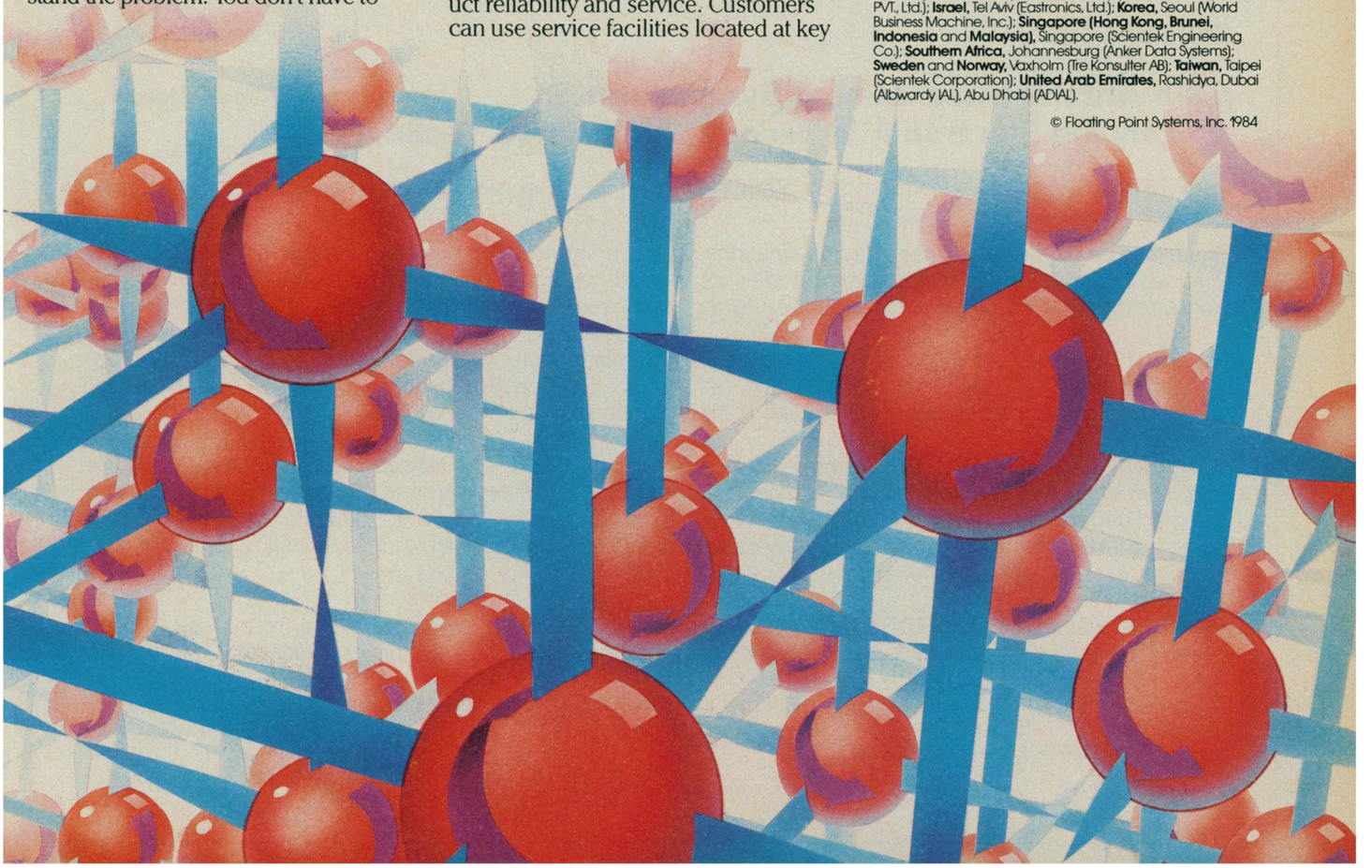

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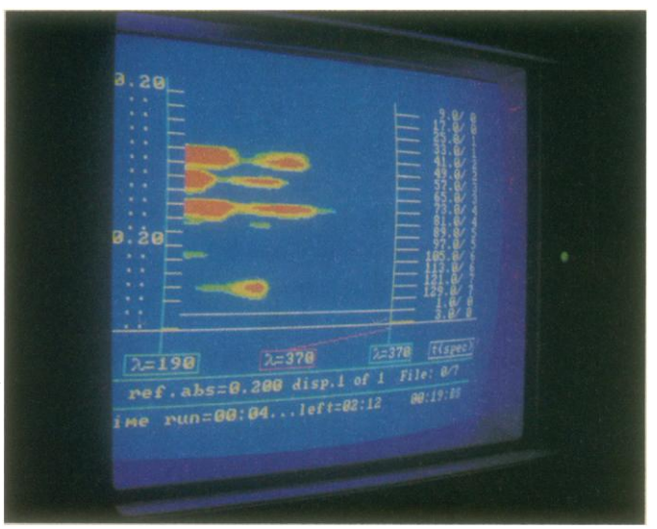
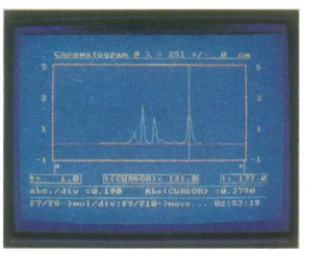
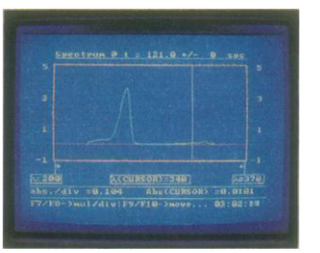


A computer generated contour map of the total absorbance pattern after separation. The vertical and horizontal axes are time and wavelength respectively. Colour coding is used to represent different levels of absorbance for each isogram.



Drive the cursor through the isograms to access chromatograms...



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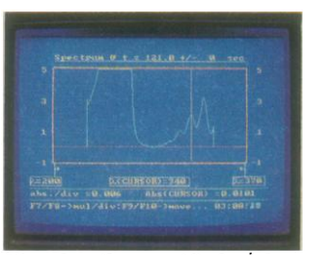

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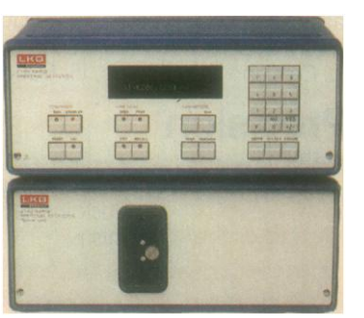

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The Second Conference on Computers in Science, sponsored by Science Magazine, in conjunction with Scherago Associates, will be held in Washington DC. from 28 October – 1 November 1984. The conference will emphasize the use of the workstation for the scientist. There will be invited talks in a number of areas including Biology Workstations, Computer Aided Molecular Design, Workstation Hardware, Artificial Intelligence, Databases, Laboratory Automation and Robotics, and Management of the Electronic Laboratory. In addition there will be submitted poster talks, workshops in a number of areas and a large vendor exhibition. Prospective authors should send for an abstract form, registration and hotel information to Ed Ruffing, Scherago Associates, 1515 Broadway, New York, New York 10036 (212) 730-1050. Completed abstracts should be sent to the conference chairman, Dr. Stephen R. Heller, EPA, PM-218, Washington DC 20460 (202) 382-2424.

17 February 1984, Volume 223, Number 4637 **SCIENCE**

Fundamental Science in the States

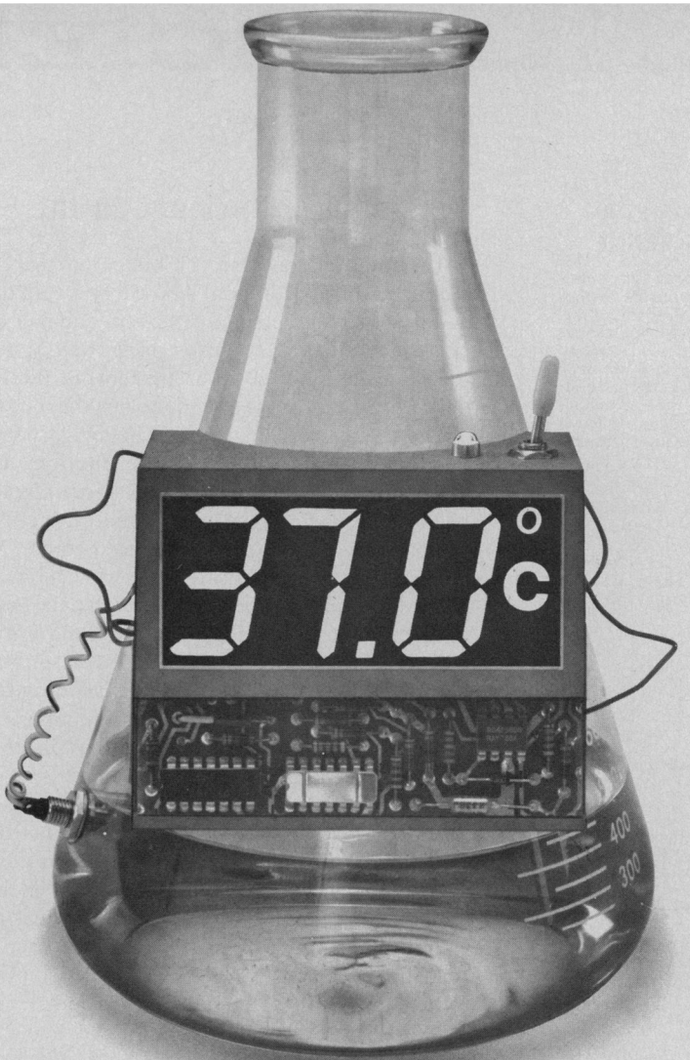
The total federal research budget of the United States for 1983–1984 is approximately $47 billion. About 14 percent of this ($6 billion to $7 billion) is dedicated to fundamental research, and half of this sum is spent at colleges and universities. Campuses in the ten states that are best funded have 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 demographies 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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Lauda advances also include a proportionally integrated differential control, which adjusts heater wattage according to heat load and automatically compensates for set-point drift.

And two models feature a built-in microprocessor-based programmer, which further assures accuracy and precision with a number of predetermined functions.

Lauda controls temperatures in other ways, too. For example, unique safety features like variable over-temperature controls and low-liquid-level indicators interrupt power should a problem occur. Zero crossover switching/RFI suppression eliminates the possibility of electrical interference with other instruments in the lab. And built-in flow control varies the rate of external circulation.

Dependable accuracy and precision are just part of the benefits of being Lauda. To learn more about the others, contact your Brinkmann representative; or call or write Brinkmann Instruments Co., Division of Sybron Corporation, Cantiague Road, Westbury, NY 11590, Tel: 800-645-3050; in New York, 516-334-7500. In Canada: 50 Galaxy Blvd., Rexdale, Ont. M9W 4Y5, Tel: 416-675-7911.

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BRK-5081

R&D in FY 1985: Budgets, Policies, Outlooks

Ninth Annual AAAS Colloquium on R&D Policy

Shoreham Hotel • Washington, D.C.

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:
R&D Colloquium, AAAS
Office of Public Sector Programs
1776 Massachusetts Avenue, N.W.
Washington, D.C. 20036

Sponsored by the
AAAS Committee on Science,
Engineering, and Public Policy

American Association for the Advancement of Science

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)

_____
(city) (state and zip) (telephone number)

☐ 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)
☐ $ 90 Partial Registration (sessions, three publications)
☐ $ 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.

Charge to my ☐ **VISA or** ☐ **MASTERCARD** Number _____ Expires _____

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Return both top & bottom forms (full page) to the following address:
AAAS Meetings R&D, 1515 Massachusetts Ave., N.W., Washington, D.C. 20005

Shoreham Hotel Reservation—AAAS Colloquium (29 & 30 March 1984)

(Reservations received after 28 February cannot be guaranteed)

Names and Addresses of All Occupants of Room:

Name _____
Address _____
City _____ State _____ Zip _____

Name _____
Address _____
City _____ State _____ Zip _____

Room: _Single ($78*) _Double ($94*) _Twin ($94*)

(*Plus 10% D.C. sales tax and $1 occupancy tax.)

Arrival: Date _____ Time _____

Departure: Date _____ Time _____

Be sure to list definite arrival and departure date and time. Hotel reservations will be held only until 6 p.m. unless otherwise specified. Check-out time is 1:00 p.m.

Please indicate any special housing needs due to handicap _____

Enclose separate check, made out to The Shoreham Hotel, for first night's room deposit **or** indicate major credit card number:

Credit Card Name _____ Number _____ Expires _____

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LKB
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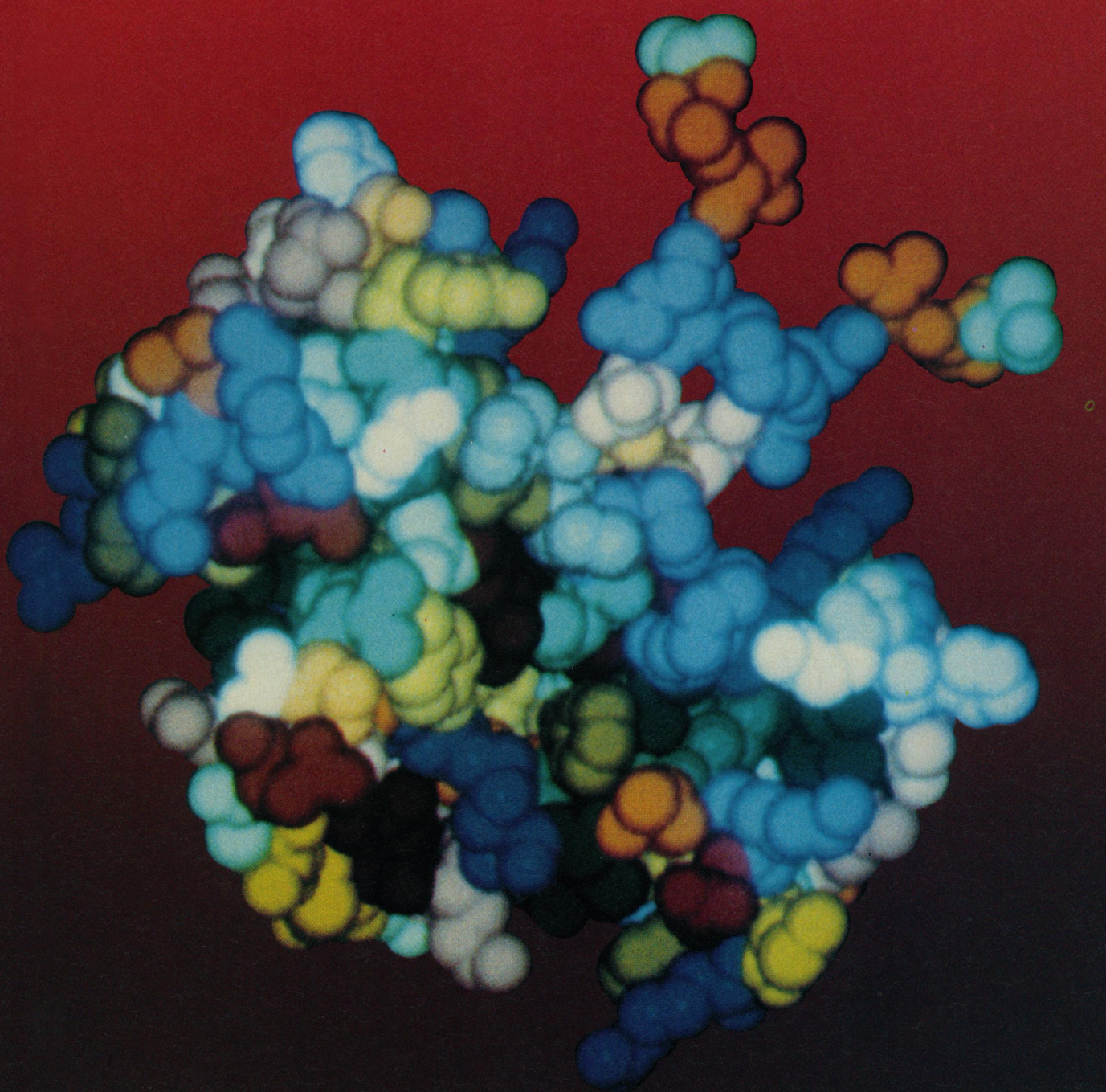
LKB HPLC systems

revolutionize biology, biochemistry and biotechnology.



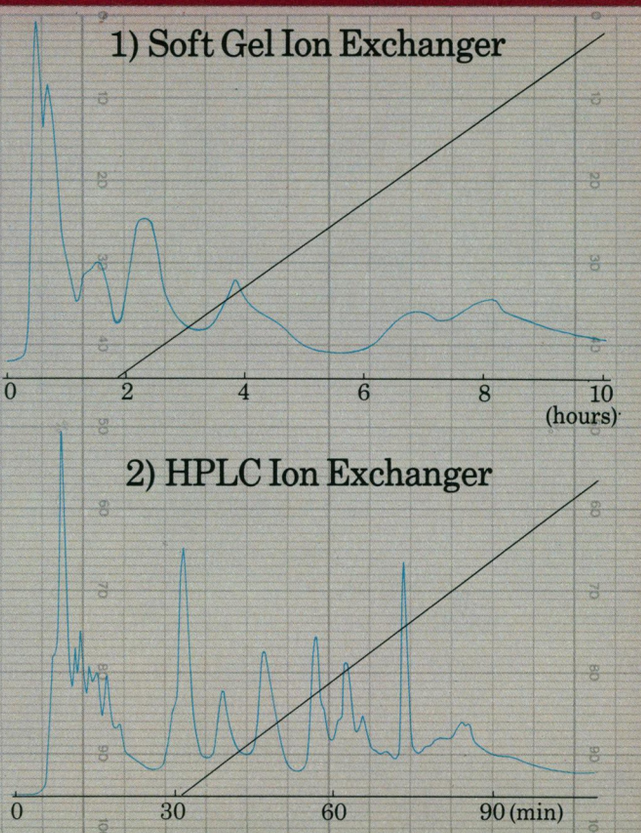
99 98 0432

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

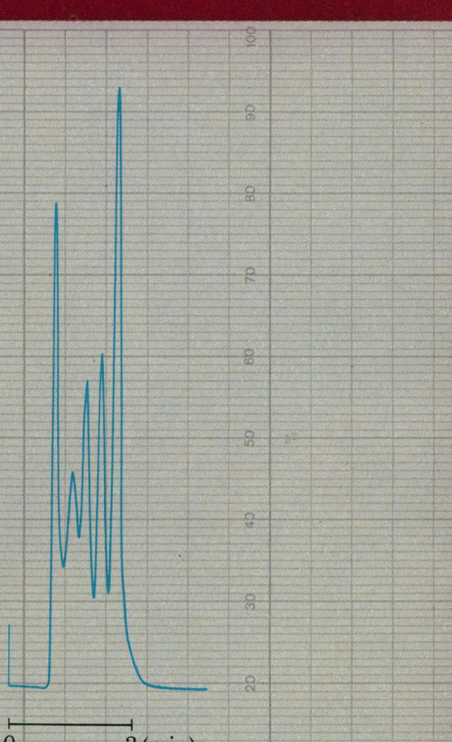
Recent developments in high performance liquid chromatography have brought on a veritable revolution in the life sciences—enabling exploration far beyond the resolution limits of conventional liquid chromatography. These extraordinary improvements in resolution can be attributed primarily to the unique 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 B_{12}
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.

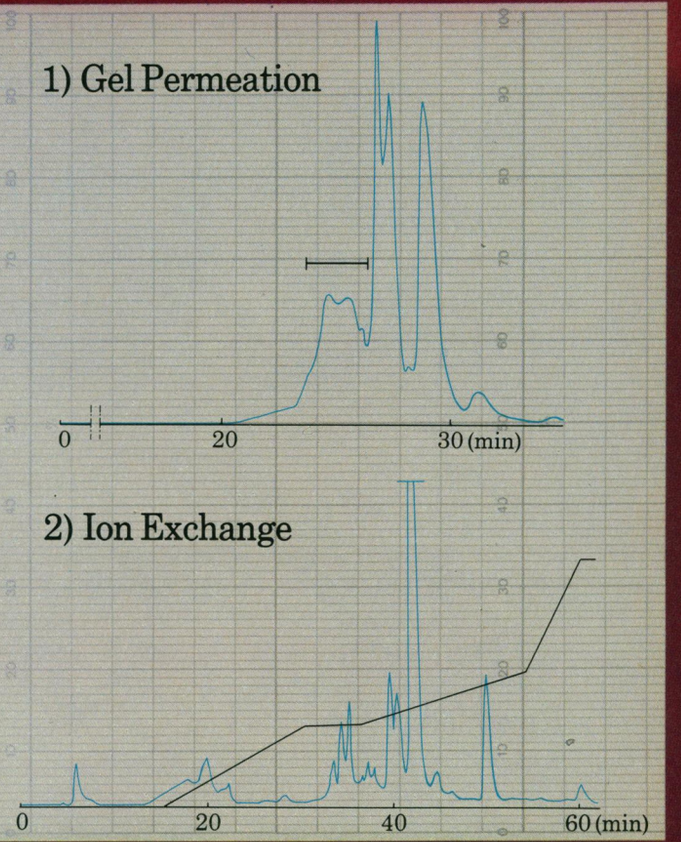


separations of biomolecules

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.

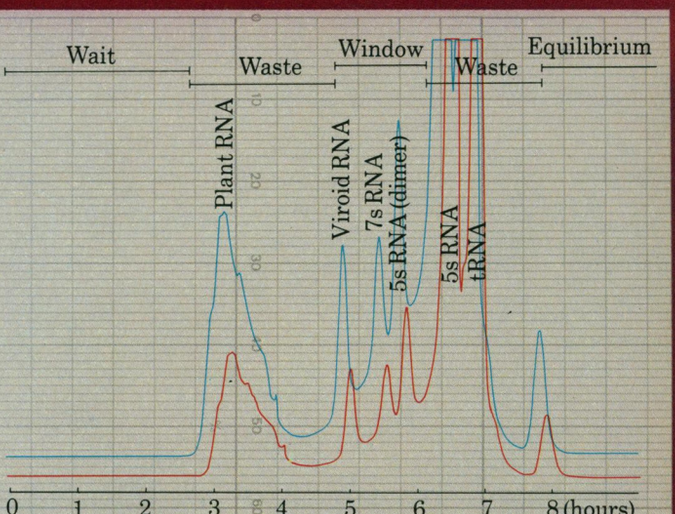


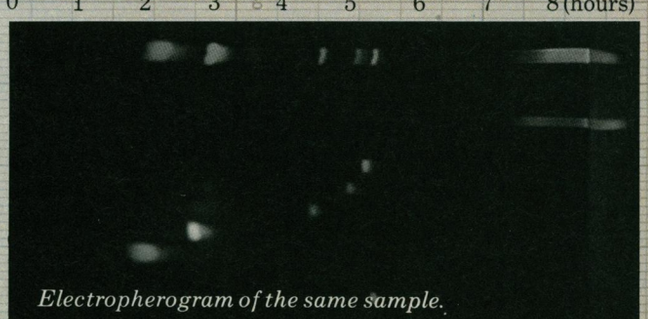
Preparative capabilities

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 Sänger 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%.





Electropherogram of the same sample.

Select the technique most

LARGE BIOMOLECULES	FRAGMENTS	SMALLER BIOMOLECULES
i.e. proteins nucleic acids polysaccharides lipids	i.e. peptides oligonucleotides oligosaccharides	i.e. peptides amino acids nucleotides

Gel permeation

Ion exchange

Reversed phase

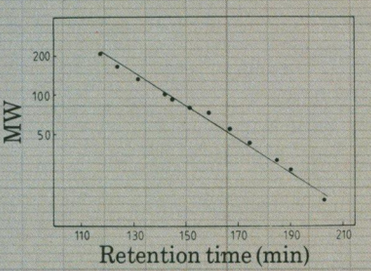
Gel Permeation Chromatography

Sample:	ϕX 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 µl/min
Column:	LKB 2135-460, 7.5×600 mm

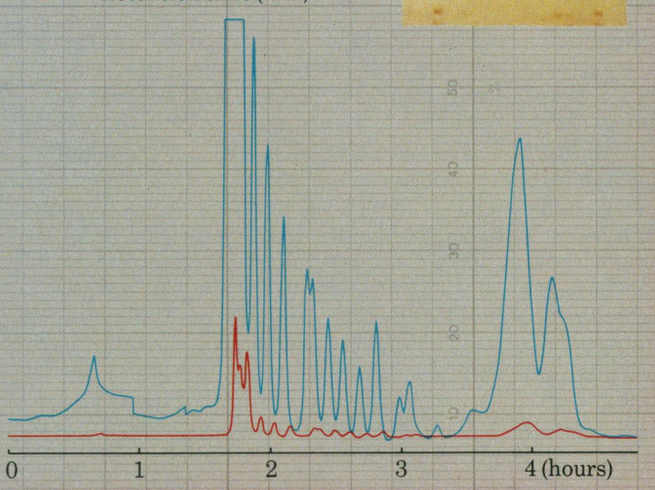
Courtesy of Kruppa et al, Physiol.-Chem. Institut, Hamburg

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.

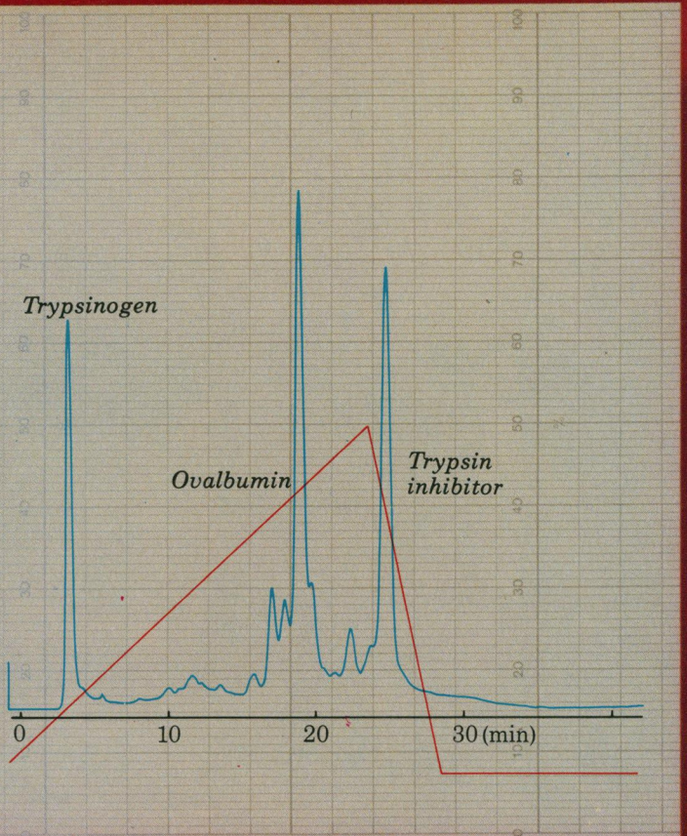


suitable for your sample

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.

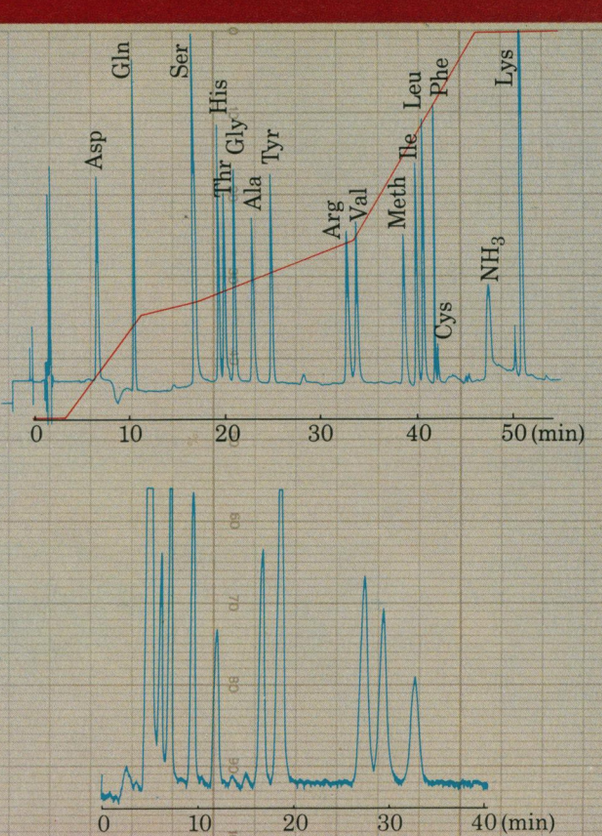


Reversed-phase Chromatography

Sample:	*o*-phthalaldehyde derivatives of amino acids, 1 nMol each
Detection:	330 nm, 0.04 AUFS
Gradient:	10—50 % CH_3CN in 12.5 mM Na-phosphate buffer, pH 7.2
Column:	C18 (5 μm), LKB 2134-215, 4×250 mm

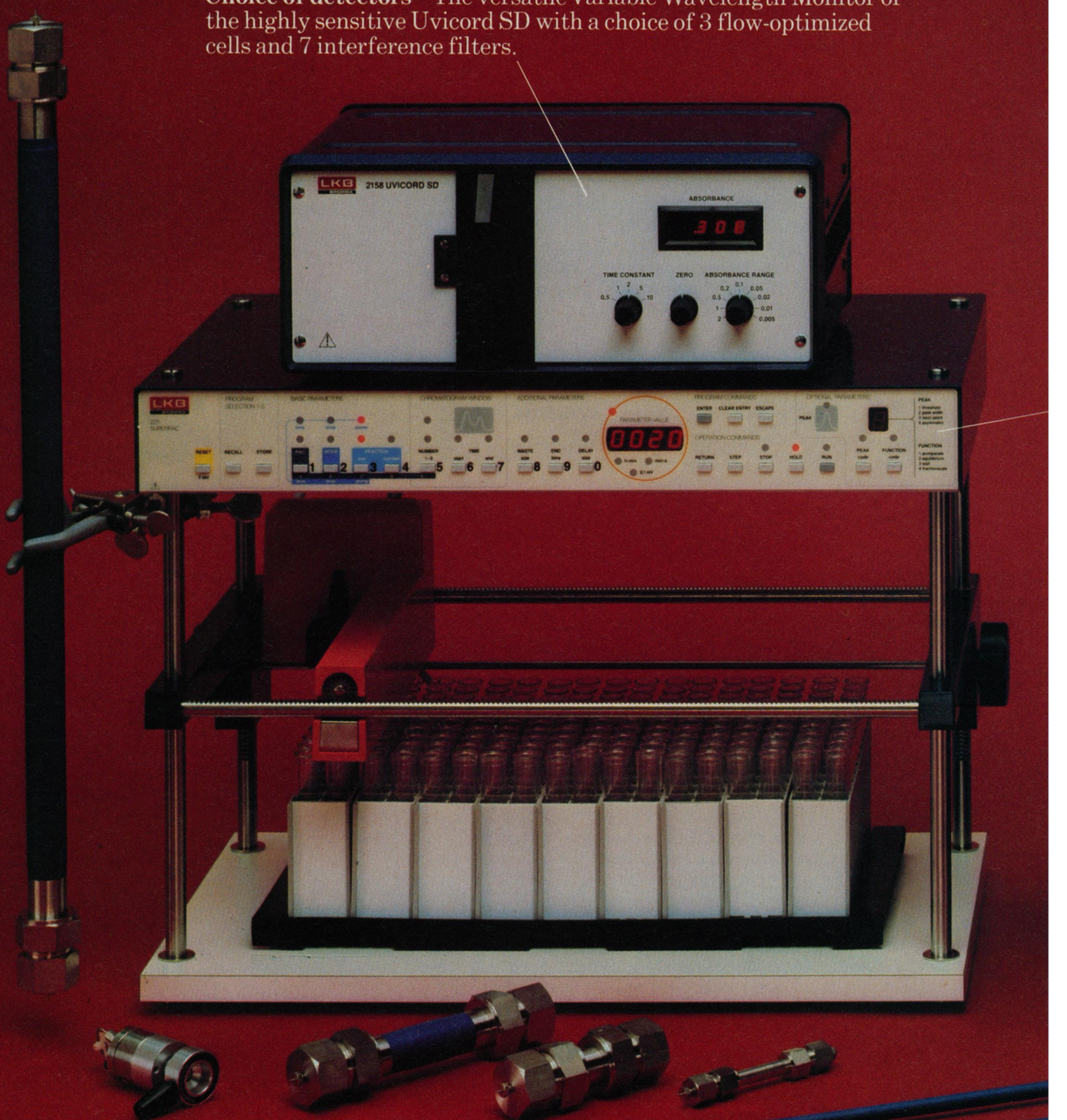
LKB's high performance reversed-phase chromatography systems provide an accurate, reproducible, rapid and inexpensive method for analyzing smaller biomolecules such as peptides, amino acids, PTH-amino acids and nucleic acid components.
Column dimensions and particle sizes have been selected to give maximum 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_3CN/THF in NaAc buffer, pH 5.8
Flow rate:	50 μl/min
Column:	C18 (5 μm), LKB 2134-600, 1×250 mm



Optimize your LKB's modular

Choice of detectors—The versatile Variable Wavelength Monitor or the highly sensitive Uvicord SD with a choice of 3 flow-optimized cells and 7 interference filters.



Extensive range of columns and accessories
Prepacked gel permeation, ion exchange and reversed-phase columns with a choice of particle size and column dimensions (for preparative or analytical applications), injector, capillaries & fittings.

NEW—an expanded range of ion exchange columns.
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.

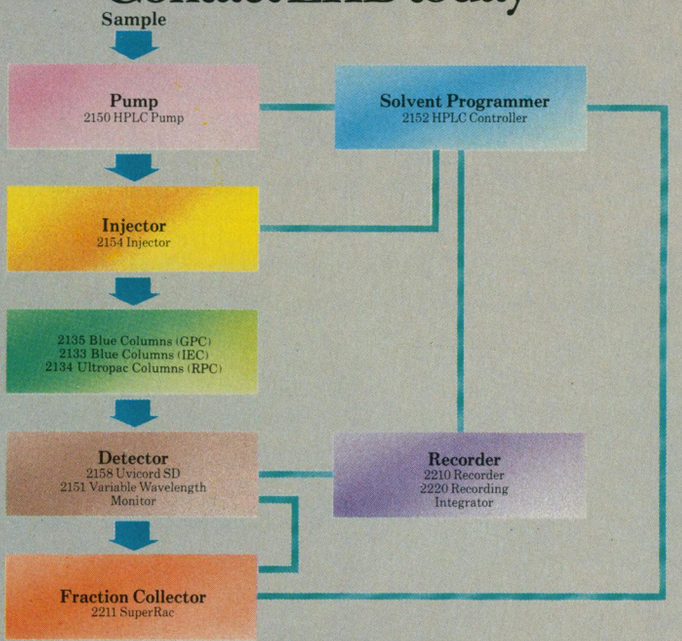
The intelligent fraction collector
SuperRac is the most advanced fraction collector available today, with peak-slope detection, window programming, re-cycling capabilities and an extensive memory.

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

LKB

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