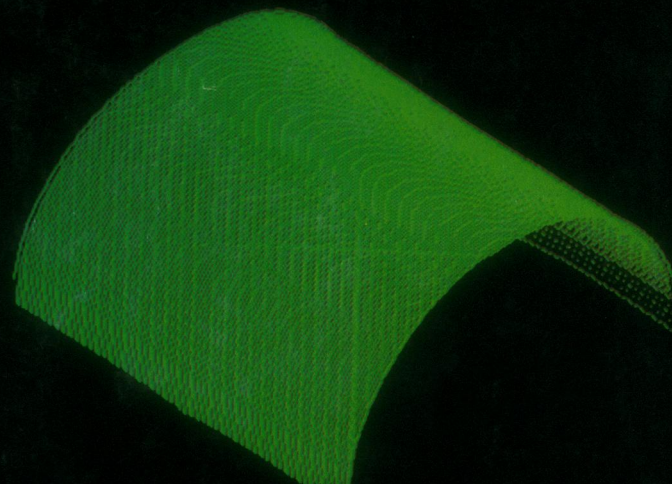
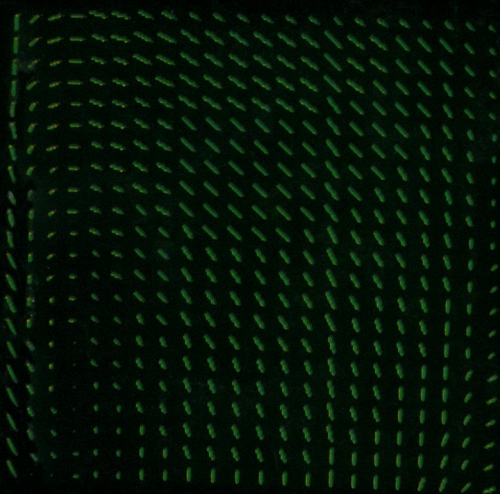
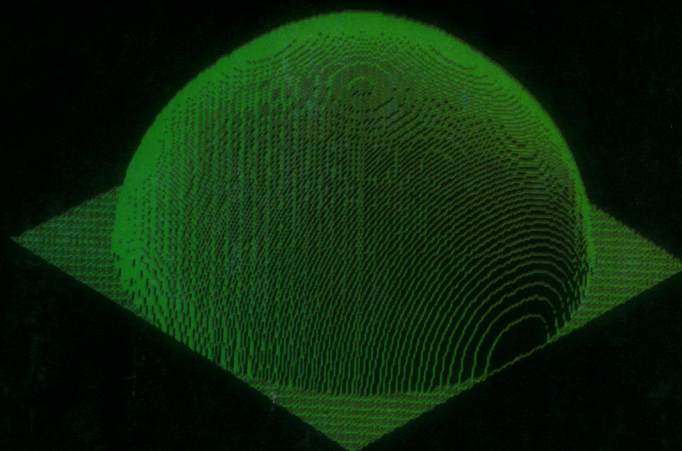
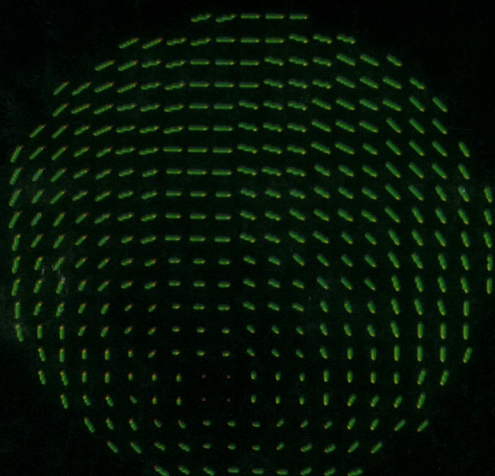


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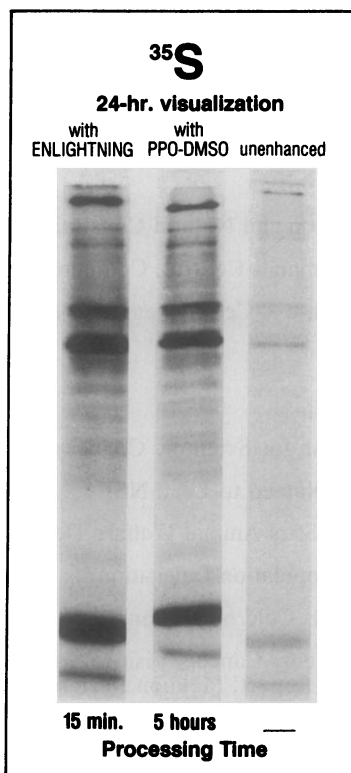
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EDITORIAL	Chemistry Without Test Tubes	129
ARTICLES	Computer Vision and Natural Constraints: <i>C. M. Brown</i>	129
	Strategic Command, Control, Communications, and Intelligence: <i>C. A. Zraket</i>	130
	The Interleukin-2 T-Cell System: A New Cell Growth Model: <i>D. A. Cantrell</i> and <i>K. A. Smith</i>	131
NEWS AND COMMENT	A Political Push for Scientific Cooperation	131
	IBM's Bloch Named to Lead NSF	131
	Lab Break-In Stirs Animal Welfare Debate	131
	A "Prolife" Population Delegation?	132
	Congress Turns Cold on Fusion	132
	<i>Briefing</i> : Academy Cancels Visit to Soviet Union; Environment 1984 Gets Mixed Marks by Report; Melmon Resigns Stanford Chairmanship	132
RESEARCH NEWS	New Neurons Form in Adulthood	132
	Why Is Development So Illogical?	132
	Unusual Bimetallic Catalyst Synthesized	132

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REPORTS	Paleoceanographic Events and Deep-Sea Ostracodes: R. H. Benson, R. E. Chapman, L. T. Deck	1334
	Community Recovery After Storm Damage: A Case of Facilitation in Primary Succession: L. G. Harris et al.	1336
	Bishop Tuff Revisited: New Rare Earth Element Data Consistent with Crystal Fractionation: K. L. Cameron	1338
	The Association of Iron and Manganese with Bacteria on Marine Macroparticulate Material: J. P. Cowen and M. W. Silver	1340
	Adenovirus E1a Gene Product Expressed at High Levels in <i>Escherichia coli</i> Is Functional: B. Ferguson et al.	1343
	Potentiation of Bleomycin Lethality by Anticalmodulin Drugs: A Role for Calmodulin in DNA Repair: J. G. Chafouleas, W. E. Bolton, A. R. Means	1346
	Autoantibodies to a 64-Kilodalton Islet Cell Protein Precede the Onset of Spontaneous Diabetes in the BB Rat: S. Baekkeskov, T. Dyrberg, A. Lernmark	1348
	Wolves, Moose, and the Allometry of Population Cycles: R. O. Peterson, R. E. Page, K. M. Dodge	1350
	Competition Controls the Growth of an Identified Axonal Arborization: R. K. Murphy and C. A. Lemere	1352
	Is There an Evoked Vascular Response?: C. A. Sandman, J. P. O'Halloran, R. Isenhardt	1355
	Predator-Induced Defense in a Marine Bryozoan: C. D. Harvell	1357
	Decreased Neuronal Inhibition in Vitro After Long-Term Administration of Ethanol: D. Durand and P. L. Carlen	1359

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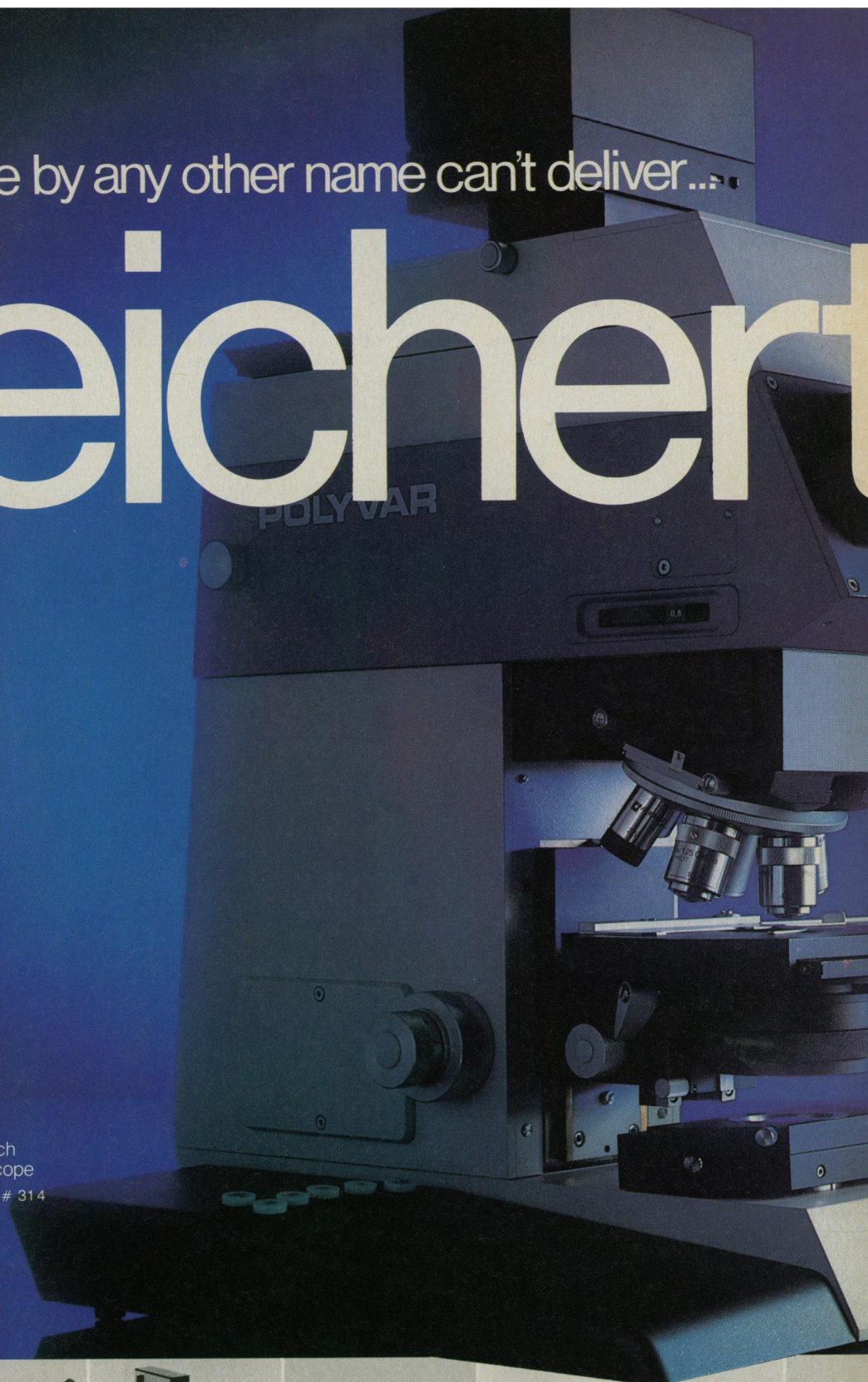
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(Left) Optic flow images (retinal pattern velocities caused by scene motion) from a rotating sphere and cylinder. (Right) Shapes causing the images, as derived by a computational vision process. Such processes use mathematical models of physical laws and assumptions about nature to recover physical information about scenes from input images. See page 1299. [John Aloimonos, Computer Science Department, University of Rochester, Rochester, New York 14627]

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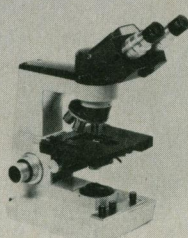
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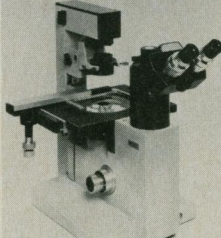
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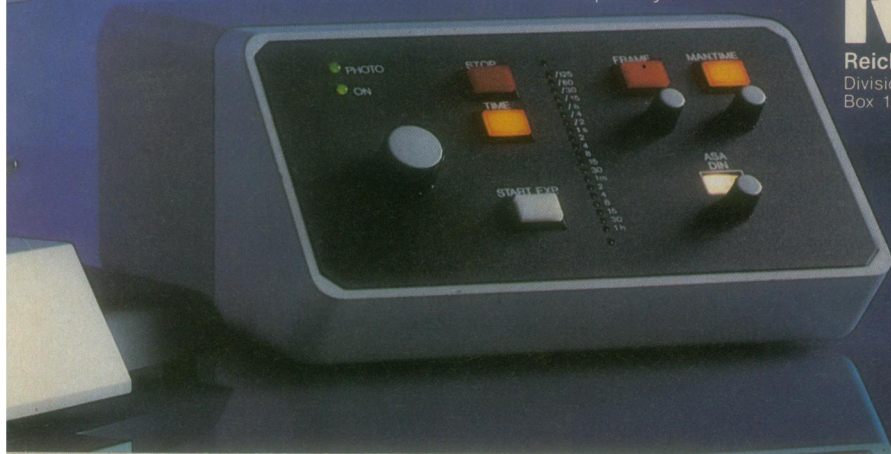
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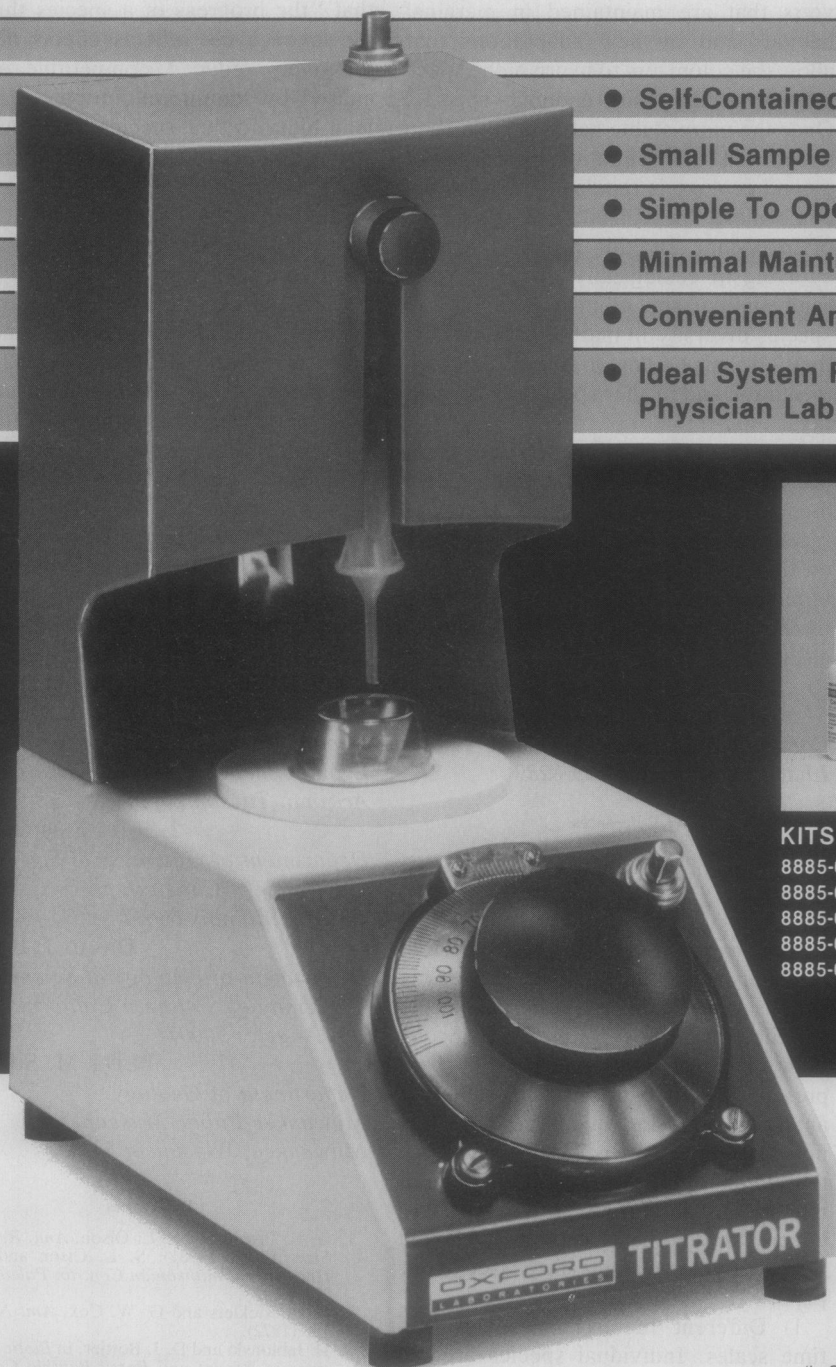
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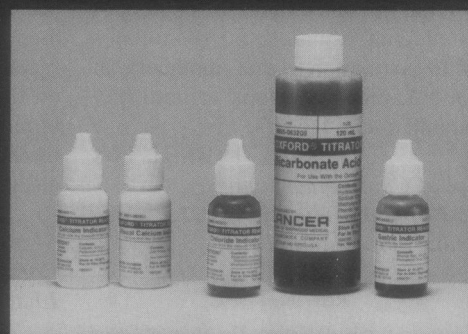
						
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Chemistry Without Test Tubes

To those whose experience in chemical research laboratories was 20 years ago or more the modern counterpart is a strange place. New instrumentation with electronic components has revolutionized analytical capabilities. It has also made accessible crucial experiments and theoretical calculations that could not previously be performed. Some present-day measurements can be made with speeds and sensitivities that are five to ten orders of magnitude better than those of two decades ago.

In a symposium at the recent AAAS meeting in New York and in an earlier report,* leading chemists were enthusiastic about new opportunities for research that have been created. They emphasized three major frontiers. The first is the opportunity to understand, in the most fundamental sense, chemical reactivity and how to control it. The second is to improve understanding of catalyses. The third is to extend to the molecular level understanding of life processes. A few examples are appropriate.

The study of why and how chemical changes take place has been especially facilitated by new instrumentation. Lasers, computers, molecular beams, ion cyclotron resonance, and many more tools have opened and facilitated new research approaches. Of these, lasers have been particularly helpful. Their short pulse durations permit probing of chemical reactions in times ranging from 10^{-6} to 10^{-12} seconds. Lasers also provide tunable, extremely narrow, frequency light sources and thus greater diagnostic sensitivity and selectivity. With high-power sharply tunable lasers it is possible to excite one particular degree of freedom of many molecules in a sample. During the interval in which these excited states persist, such molecules react as if that particular degree of freedom is at a high temperature while all the rest of the degrees of freedom of the molecule are cold. Today we know much about the chemistry of molecules at the ground state. The study of their behavior under excitation will greatly improve our understanding and ability to devise important applications.

Catalysts are already important technologically. It is estimated that 20 percent of the gross national product is generated through their use. Much of the present art was developed through empirical research. New equipment facilitating fundamental studies of processes on a molecular level is now available. One result is the rapid development of surface science. Because of the unsatisfied bonding capability of atoms at surfaces, the chemistry there is different from that of reactants brought together in solution or as gases. When chemists are able to identify molecular structures on the surfaces they will be able to understand and control events there.

Other frontiers of research include homogeneous catalyses, metal cluster chemistry, and stereoselective catalysts. An important branch of homogeneous catalysis has developed from research in organometallic chemistry. An example is rhodium dicarbonyl diiodide employed in the commercial production of acetic acid from methanol and carbon monoxide. Stereoselective catalysts now being discovered will surely have important applications in the synthesis of biological molecules. If a complex molecule has many chiral carbon atoms and a synthetic process produces all of them, only a tiny fraction of the product is likely to have the desired biological activity.

The chemists state, and rightly so, that their science has been underfunded relative to other major disciplines. They point to many new research opportunities and to the needs of the \$175-billion chemical industry for new knowledge and trained people. They remind us that although chemicals now produce a favorable balance of payments of \$12 billion a year, leadership in some areas of research has moved to other countries. Their pleas for funds to enable them to purchase state of the art instrumentation should be granted, and their efforts to support training of the next generation of chemists supported.—PHILIP H. ABELSON

*Research Briefing Panel on Selected Opportunities in Chemistry, in *Research Briefings 1983* (National Academy Press, Washington, D.C., 1983).

SCIENCE / SCOPE

NASA's Project Galileo may provide clues to the origins of the solar system when it explores the planet Jupiter later this decade. Project Galileo is scheduled to be launched from the space shuttle in May 1986 and arrive at the giant planet in August 1988. The mission consists of two spacecraft. One is an orbiter that will circle Jupiter for 20 months. The other is a Hughes Aircraft Company-built probe that will plunge into the planet's brightly colored clouds and relay data about the atmosphere. The probe is expected to operate for about 50 minutes before succumbing to temperatures of thousands of degrees, limited battery capacity, and pressures up to 10 times that of Earth's at sea level. Because some scientists believe that Jupiter's atmosphere is a sample of the original material from which stars are formed, the probe's findings will be closely studied.

Residents in central Indiana are the first in the U.S. to receive television programs in their homes broadcast directly from a satellite. Last November, United Satellite Communications Inc. began the first direct broadcasting satellite (DBS) transmissions to homes in 33 counties surrounding Indianapolis. Transmissions were relayed via Anik C2, designed and built by Hughes for Telesat of Canada. Homes receive the signals through antenna dishes that are less than three feet in diameter and sell for about \$300. The more familiar satellite receiving dishes found in rural areas of the U.S. average four to five feet in diameter and sell for more than \$2,000. Initial programming includes two satellite movie channels and the ESPN sports network.

A network of small "smart" radios will let U.S. troops and their commanders know where they and friendly forces are located at all times. With the Position Location Reporting System (PLRS), combat troops will no longer have to seek landmarks to pinpoint their location. PLRS automatically supplies position and navigation data in digital form through a computerized communications network that displays data on a small hand-held box. PLRS units can be mounted on vehicles, aircraft, and helicopters. All units serve as automatic relay stations, so that units far away from a master station can stay in touch regardless of terrain or weather. Hughes is producing PLRS for the U.S. Army and Marine Corps.

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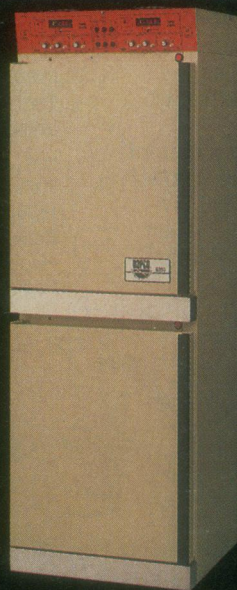


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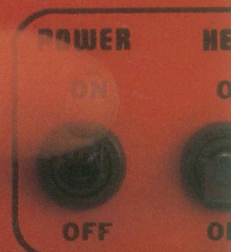
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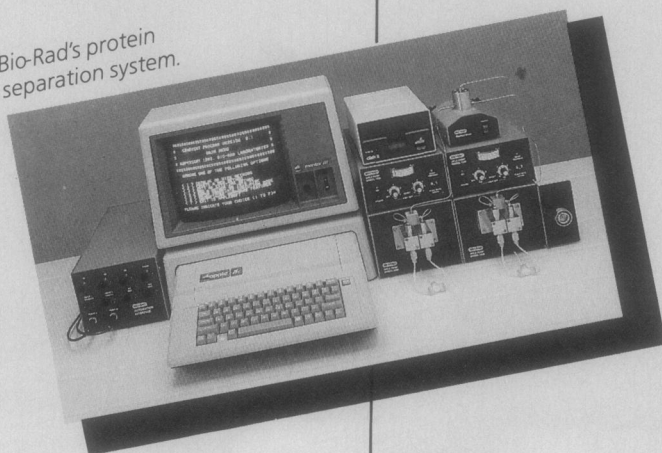


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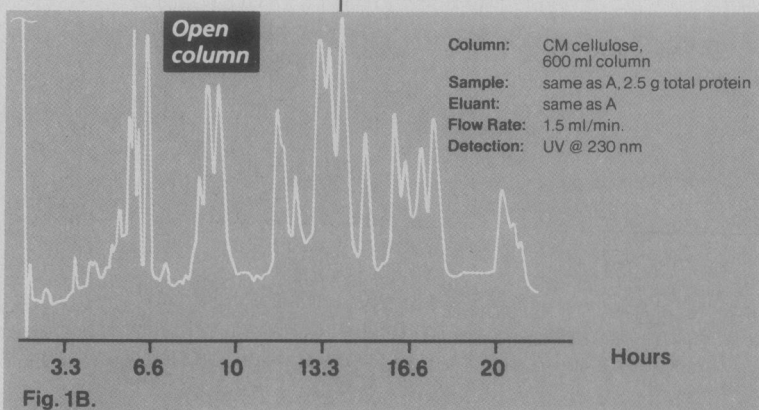
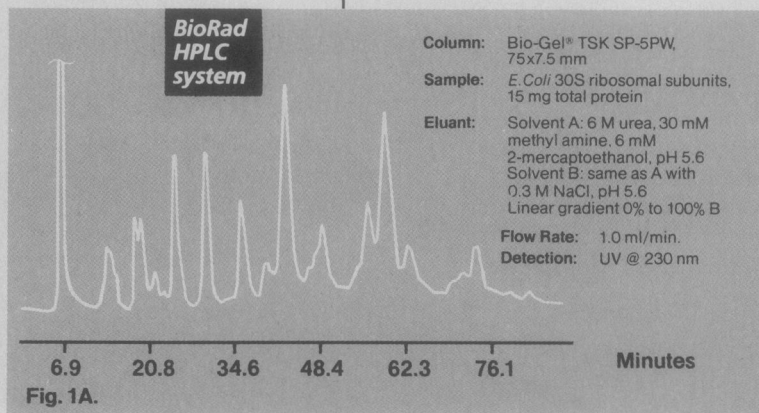
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Data provided by Malcolm S. Capel, Dept. of Molecular Biophysics and Biochemistry, Yale University.

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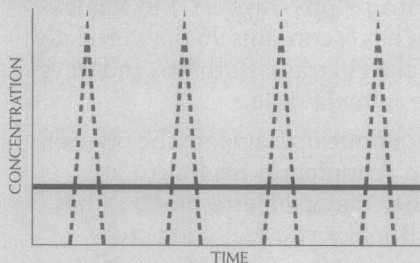
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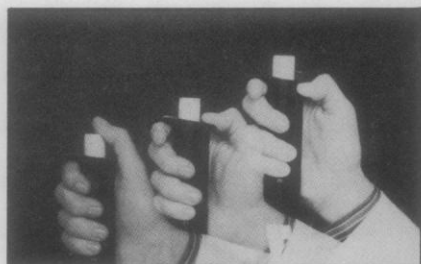
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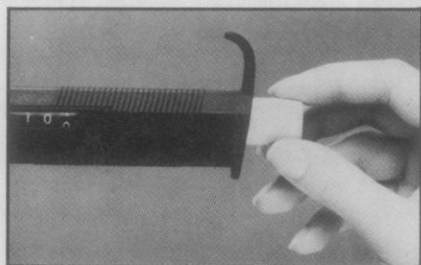
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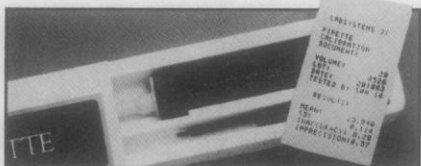


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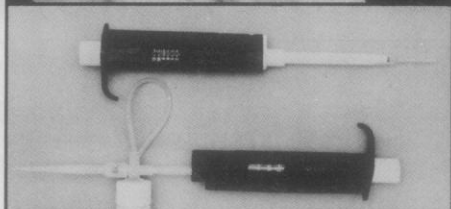
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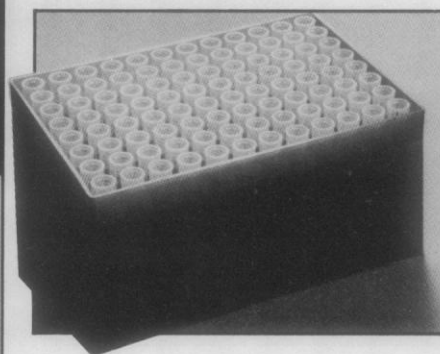


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
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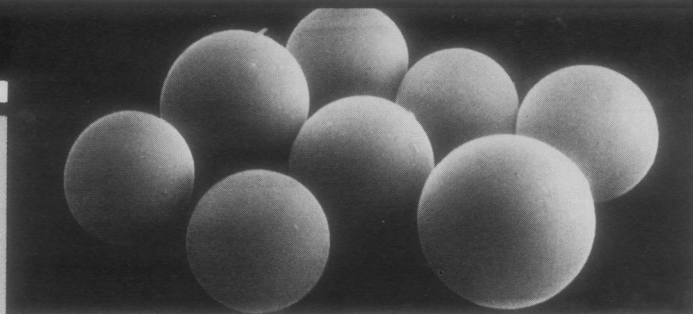
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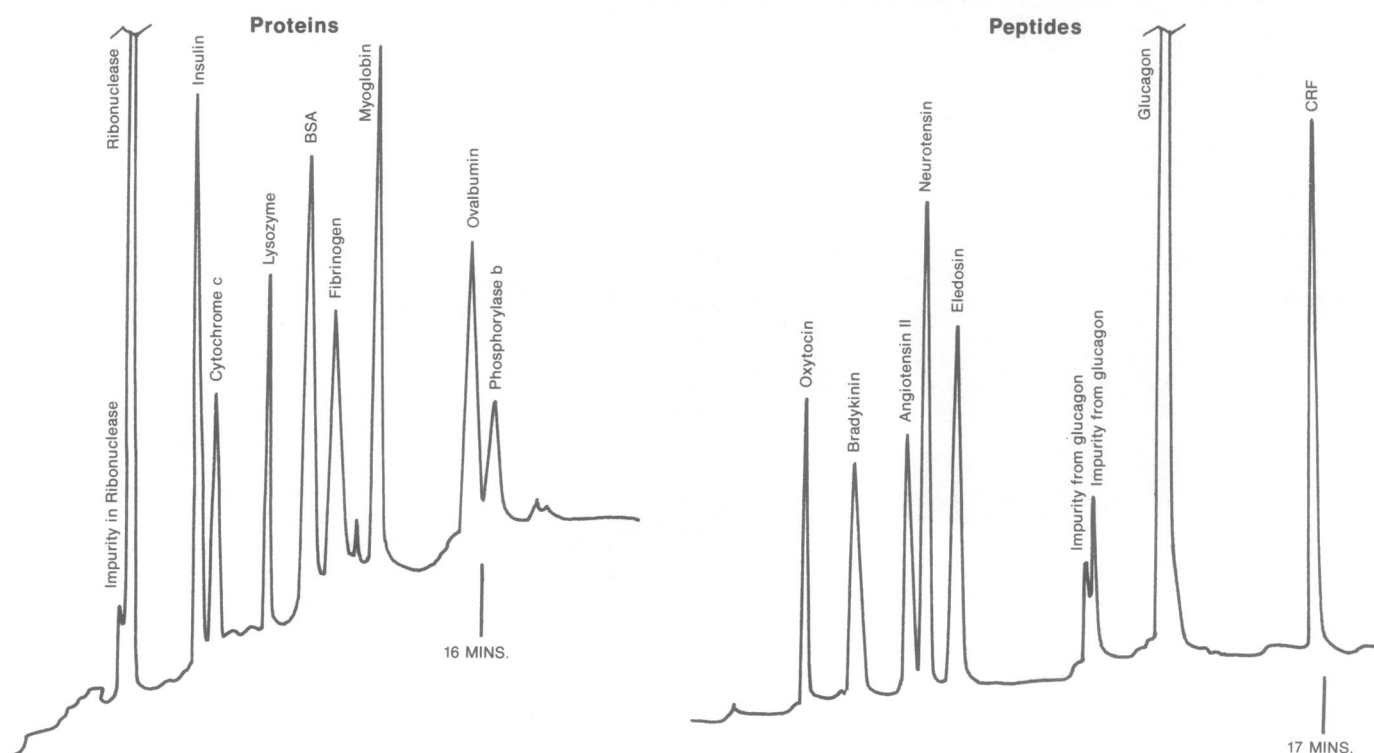
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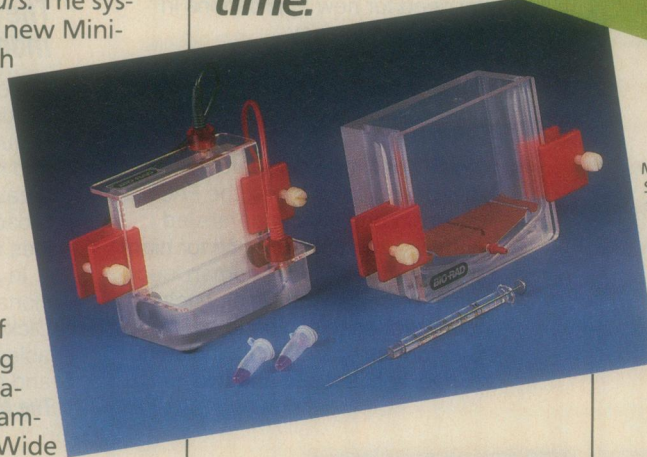
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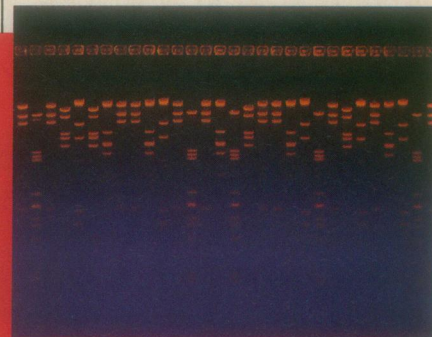
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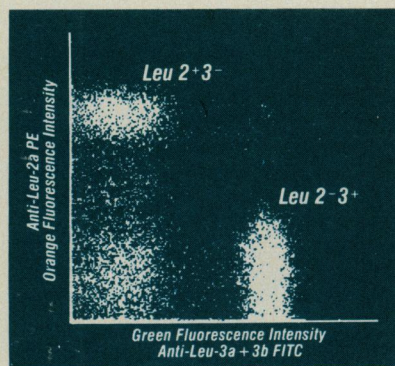
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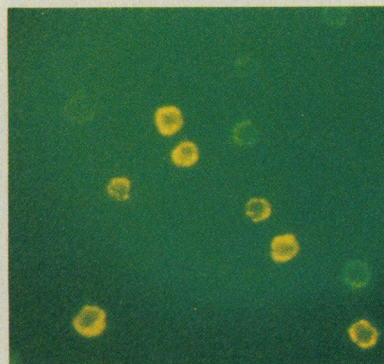
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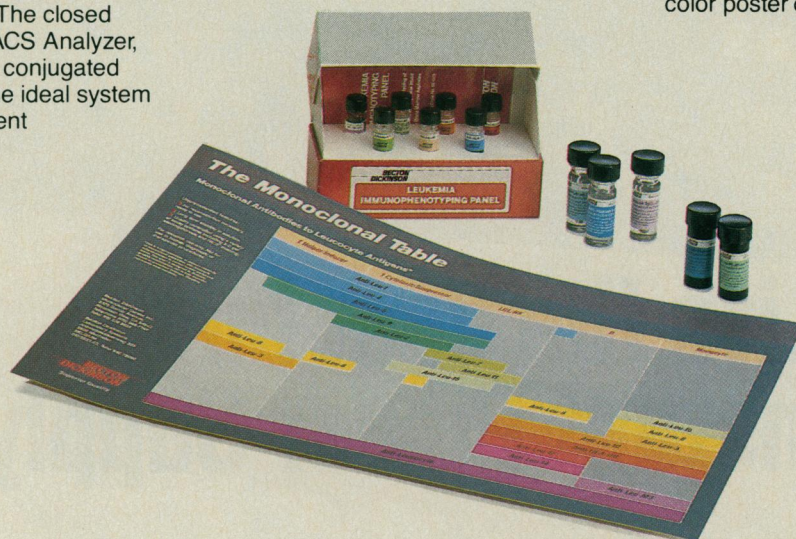
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