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# SCIENCE

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## Big News for the TL-100 Benchtop Ultracentrifuge

The Beckman TL-100 Ultracentrifuge—with a choice of fixed angle, swinging bucket and vertical tube rotors—has become the preferred way to separate small sample volumes, typically taking only one-fifth the time required by floor-model ultracentrifuges.

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Big NEWS! For the complete story on the TL-100 benchtop ultracentrifuge, its rotors, tubes, accessories and applications, write Beckman Instruments, Inc., Spinco Division, 1050 Page Mill Road, Palo Alto, CA 94304. Offices worldwide.



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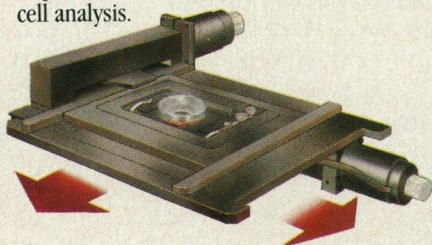
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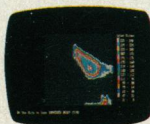
- subpopulations of cells
- mutant cells
- transfected cells

for propagation or analysis.

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Now you can use fluorescence to quantitatively measure

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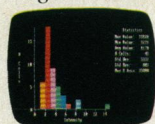
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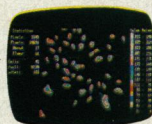
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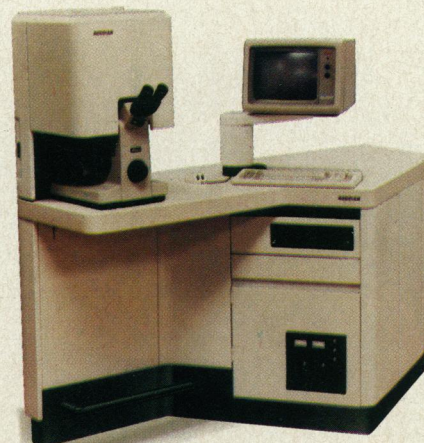
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**COVER** Electron density, at 3.0 Å resolution, of human rhinovirus 14 complexed with the antiviral agent WIN 52084. This and related compounds inhibit viral uncoating after the virus has become attached to the cell and penetrated the membrane. Shown is the molecular interpretation of the electron density which is not seen in the native structure. (The compound consists of a 4-oxazolinyloxy group linked to a 3-methylisoxazole group by a seven-membered aliphatic chain.) The compound binds into a hydrophobic pocket with viral protein 1, lined by residues that are relatively well conserved among picornaviruses. See page 1286. [T. J. Smith *et al.*, Purdue University and Sterling-Winthrop Research Institute]

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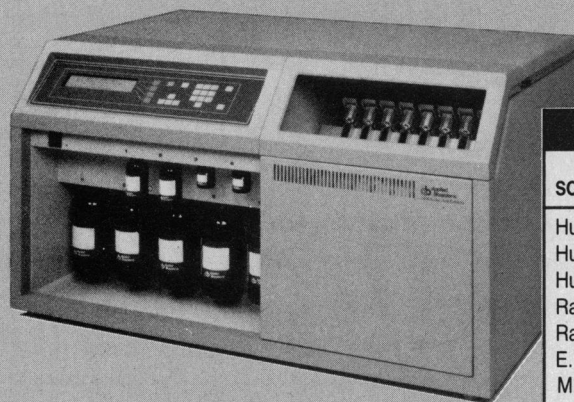
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Human lymphocytes/granulocytes, crude	0.43	1.83
Rat liver nuclei, crude	0.47	1.85
Rat liver, whole homogenate	0.58	1.85
E. Coli, JM 101, log phase	0.45	1.88
M13, mp8, PEG pellet	0.50	1.77
Phage Lambda DNA	0.46	1.83

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\*Patents pending

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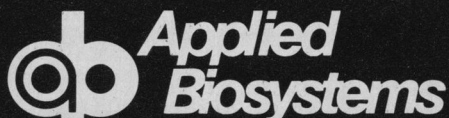
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## This Week in SCIENCE

### Antiviral drugs stymie cold virus replication

**H**ow do antiviral agents work at the atomic level (page 1286)? Two synthetic drugs—called WIN compounds—appear to stabilize the common cold virus (and other viruses with which they interact) and thereby prevent an essential step in viral replication, the uncoating of viral nucleic acids. Smith *et al.* used x-ray diffraction analyses to study interactions of a common cold virus—human rhinovirus 14—with WIN compounds (cover). When virus and drug bind together, one part of the WIN compound lies in a hydrophilic site of the virus where a surface pore opens into a channel; the channel leads to the RNA inside the virus. Another portion of the WIN compound lies in intimate association with a hydrophobic pocket formed by a viral protein. The antiviral effects may involve induction or inhibition of conformation changes in viral proteins, blockage of ion movement through pores, or stabilization of the hydrophobic pocket (the collapse of which is a step in uncoating). Insights into drug and viral interactions should make possible synthesis of even more effective antiviral agents for the cold virus and for other picornaviruses, such as poliovirus, hepatitis A virus, and foot-and-mouth disease virus.

### Adoptive immunotherapy for cancer

**A** combination of TIL cells (tumor-infiltrating lymphocytes), a lymphokine [interleukin-2 (IL-2)], and an immunosuppressant has successfully cured mice of both small metastatic tumors and advanced tumors and will soon be evaluated in clinical trials in humans with advanced cancers (page 1318). The promising antitumor strategy is described by Rosenberg *et al.* and compared with the LAK (lymphokine-activated killer) cell system developed earlier. The TIL technique is 50 to 100 times more potent than the LAK technique, works in some situations in

which LAK cells are completely ineffective, and produces fewer and milder side effects. TIL cells are a subpopulation of lymphocytes that have infiltrated growing tumors; they are isolated from cell suspensions made from the tumors. Cultured in conjunction with IL-2, the TIL cells multiply (while the tumor cells die out) and then are ready for injection along with IL-2 into a tumor-bearing host immunosuppressed either with cyclophosphamide or irradiation. In mice, TIL cells have caused regression of existing tumors and have prevented new tumor growth; in culture, they kill only tumor cells with which they were originally matched. To date, TIL cells have been isolated from human melanomas, renal cell carcinomas, and various adenocarcinomas.

### Alcohol and the fetus

**B**ABIES born to alcoholics can suffer a range of neurologic problems (collectively called fetal alcohol syndrome or fetal alcohol effects), some of which may be due to the exposure of developing brain neurons to alcohol (page 1308). Miller fed pregnant rats a dose of alcohol that would be the daily equivalent (in humans) of the alcohol content of two six-packs of beer and later studied the distribution of neurons in the cerebral cortices of the offspring. The numbers of cells generated each day during brain cell development, the duration and timing of the developmental period, and the distribution of neuronal cells were all abnormal in the experimental rats. Ethanol may have acted both directly on the cells and on the scaffolding, growth factors, and cellular interactions that guide cells to the proper positions in the brain. Early developmental abnormalities in human brains, such as these observed in the rat brain, might account for the mental retardation, cognitive deficiencies, motor dysfunctions, and diminished brain size that characterize children born with fetal alcohol syndrome. As many as 2% of all babies who are born alive in the Western world may be suffering from the effects of alcohol exposure in utero.

### Gas-guzzling bacteria energize mussels

**R**ESIDING in the gills of deep-sea mussels in the Gulf of Mexico are symbiotic bacteria that use as an energy source methane (the principal component of natural gas) that is seeping out of the sea floor (page 1306). The mussels were collected by Childress *et al.* from depths of 600 to 700 meters below the sea surface. Methane consumption in the presence of oxygen by whole organisms and by pieces of the gills exceeded carbon dioxide production, suggesting that needed carbon (an energy source) became available through the oxidation of the gas; methane-derived carbon could be detected throughout the bodies of the mussels, having apparently been transported there from the gills. This methane-based symbiotic relation is similar to previously observed sulfur-based symbioses between bacteria and clams, tubeworms, and other animals living at hydrothermal vents, subduction zones, and brine seeps deep in the world's oceans, where alternatives to photosynthetic pathways are essential for sustaining marine communities.

### Bacteria-guzzling starfish exclude algae

**S**TARFISH and other echinoderms are the predominant animals living among the plankton on the ocean floor in the Antarctic; their larval stages, unlike those of similar echinoderms that live in tropical and temperate waters, do not depend on algae in the planktonic community for nutrition (page 1311). Rivkin *et al.* monitored ingestion of bacteria and algae in the sea water by larvae of an Antarctic asteroid; bacteria were preferentially consumed and algae actively excluded. Because the asteroids' food web is uncoupled from the planktonic web, asteroids can thrive in the ocean throughout the year, while limitations on light and nutrients at various seasons severely curtail the growth of phytoplankton and phytoplankton-dependent organisms.





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## Sigma Xi: Companions in Zealous Research

This is the centennial year of Sigma Xi, an honor society that has included within its ranks many of America's most distinguished scientists and engineers. In the past, the society had a very useful role in promoting collegiality and interdisciplinary research. Now with its 115,000 members and 500 chapters and clubs, it has interesting potential for future significance that an imaginative leadership is seeking to foster.

At the time of the founding of Sigma Xi at Cornell University in 1886, the number of scholars conducting research in this country was small, and they were in need of mutual reinforcement. In their initial statement of their objectives, they emphasized "friendship in science" and went on to say, "While those whose heart and soul is in their work are coping with the great problems of nature, let them remember that the ties of friendship cannot be investigated, but only felt. Let them join heart and hand forming a brotherhood in science and engineering . . ."

Another tradition established by the founding chapter was that Sigma Xi's emphasis should be on honoring capability or achievement in research. In addition, the chapter should conduct meetings "to discuss scientific subjects."

For much of a century, these objectives and procedures sufficed to lead to the creation of many chapters and the formation of clubs. But with the enormous growth in the number of scientists and engineers, the role of Sigma Xi has changed at some institutions. At large research universities, there may be only one local meeting per year of the Sigma Xi chapter, and that to initiate new members. However, at other chapters, there are multiple meetings and additional activities such as fostering secondary level education in science. Some chapters have been experimenting with small group tours. Chapter members have also assisted in selecting recipients for many small research grants to young scientists.

With its many chapters and clubs, Sigma Xi is in an excellent position to tap informed opinions at the grass roots level. Members have been chosen for their excellence in research, and more than 75 percent have Ph.D. degrees. In addition, they are a multidisciplinary group, with a percentage composition as follows: physical and earth scientists, 27; biological scientists, 26; engineers, 21; and health, 8, agricultural, 6, social, 6, and computer scientists, 5.

As part of its centennial celebration, the headquarters staff at Sigma Xi, headed by Executive Director C. Ian Jackson, has queried a sample of the membership concerning attitudes about many questions bearing on the scientific enterprise. For example, responses that were almost unanimous were concerns about the state of precollege education in science and about the ignorance and fear of science that are thought to be present in the general population.

Another recent initiative by the headquarters staff of Sigma Xi led to an innovative use of teleconferencing involving more than 60 Sigma Xi chapters or clubs. The particular event was a cooperative venture with the Department of Energy exploring the global greenhouse effect. The effort was designed to interest students in the phenomenon. Sigma Xi organized the meetings at both the sending and receiving ends. Today, more and more universities are establishing facilities to receive television lectures by satellites. Some have both uplinks and downlinks. In time, teleconferencing is likely to become one of Sigma Xi's important activities.

In the September-October issue of *American Scientist*, Sigma Xi's excellent interdisciplinary journal, Michael Sokal makes the point that to be successful an organization like Sigma Xi must occupy a particular useful niche in the ecology of human organizations. In planning for its centennial, Sigma Xi avoided emphasizing one grand event; rather, it has sought to define an appropriate niche for the society in the late 20th century. Some values will remain, however, including those formulated by the founders with their motto, "Companions in Zealous Research."—PHILIP H. ABELSON



## Hollow-Fiber Cell Culture Research System



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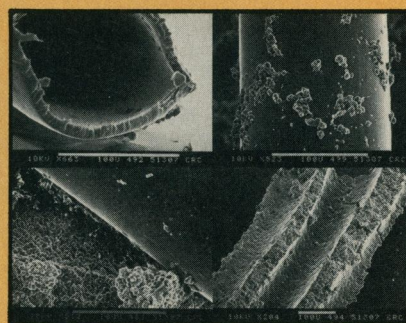
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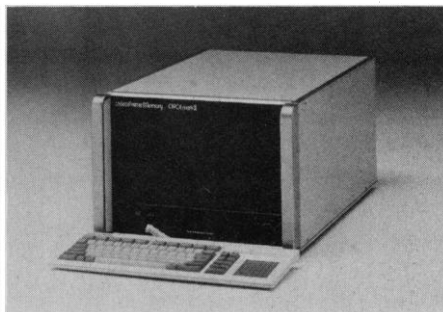
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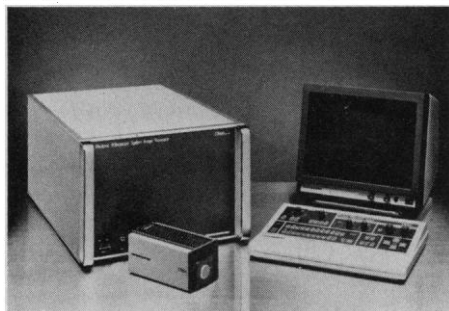


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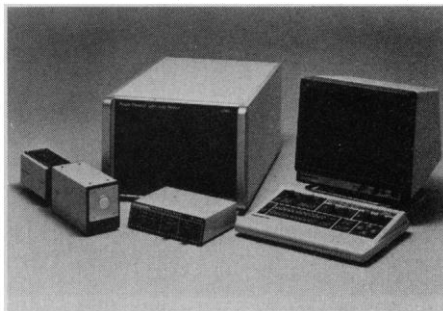


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## Letters

### Stock Prices and Stress

The Research News article "Heart attacks at 9:00 a.m." (25 July, p. 417) may have relevance to a problem in a field very different from medicine. In studies of stock price behavior, it has been found that investor returns on Monday are generally less than returns for other days of the week and, in fact, are usually negative. One explanation for this puzzling difference in day-of-the-week patterns involves higher Monday stress: feeling higher stress, investors will react by selling risky stocks and substituting low-risk bonds or Treasury securities, which results in downward movements in stock prices peculiar to Mondays. With the recent availability of intraday price data, however, it has been found that the negative return behavior is not evenly spaced throughout Monday, but instead takes place wholly within the first 45 minutes of trading (from 10:00 a.m. Eastern Standard Time), leading some to question whether stress is a likely explanation of price movement so early in the day. However, the finding that heart attacks and strokes cluster around 9:00 a.m. seems to salvage the "high stress" idea as an explanation of stock price behavior.

JOAN C. JUNKUS  
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College of Commerce,  
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Chicago, IL 60604-2287*

### Space Policy and Economic Analysis

John M. Logsdon's article "The space shuttle program: A policy failure?" (30 May, p. 1099) provides a description of the sometimes convoluted process by which important U.S. space policy decisions are made. As such, the article provides food for thought as many of these decisions are being reconsidered. In our view, however, the article introduces but does not clearly resolve several important points concerning the role and value of economic analysis in the formulation of space policy. Our comments on this issue are organized into two broad observations.

1) Costs are not irrelevant in the formulation of good policy, since national resources available for space and other activities are inherently limited. As Logsdon's narrative points out, excessively tight budget constraints may lead to undesirable consequences. However, excessively loose constraints also cause problems because they

provide inadequate incentives for making hard choices wisely and for using scarce resources efficiently.

2) Yet, the goal of good policy should be not to minimize costs per se, but to maximize the net of benefits over costs. Achieving this requires not only cost consciousness but also a clear awareness of benefits, including what economists generally refer to as "nonmarket values"—benefits that do not fully or even partially register in the commercial marketplace (such as the amenity value of clean air and water) but are real nonetheless. Economics provides methods for assessing some of these benefits, but in other cases society must rely on the political process for their evaluation. The problems with the shuttle program since its inception appear to be less due to budget consciousness than to a general fragmentation and confusion in the political decision process as a consequence of multiple, poorly articulated objectives.

The conclusion that we draw—from both Logsdon's history and our own observations of the U.S. space program—is that economic analysis broadly construed, as opposed to narrowly preoccupied with costs, can play a valuable role in the policy process. This role consists of helping to clarify the societal choices that must be made for a successful space policy and educating decision-makers and the public about them. Virtues such as "presidential leadership" and "national commitment" may be necessary, but are not sufficient for a well-conceived program. This is not to suggest that economics alone is adequate, or that it cannot be mistaken (for example, by a neglect of nonmarket values) or misused. But many of the conflicts in ends that have arisen in the space program represent exactly the kinds of trade-offs that economic analysis can illuminate and, at least sometimes, help to resolve.

MOLLY K. MACAULEY  
MICHAEL A. TOMAN  
*Energy and Materials Division,  
Resources for the Future,  
Washington, DC 20036*

### Nuclear Strategy

R. Jeffrey Smith's 6 June article "A worrisome shift in nuclear strategy" (News & Comment, p. 1187) is ill-named.

There has been no shift in strategy. The growing pressure for "retaliation" or "launch-on-warning" is the inexorable consequence of the old, all-offense strategy of Mutual Assured Destruction. As Soviet long-range ballistic missiles become more and more capable of destroying our retalia-

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an increase in the birth rate by offering, among other things, financial inducements to mothers. But the Japanese people, over 100 million on a small chain of islands, showed good sense in deciding to stay with their modest population growth rate. That left the government with two choices to solve the coming labor shortage. One was to invite *Gastarbeitern*, as western Europe did, but Japan refused to alter its immigration policies. The only other choice available was to automate, and that the Japanese did with a speed unmatched in other industrial countries.

Japan today has more industrial robots than the rest of the world put together, and *that*, not their managerial expertise or inscrutability, is the key reason for their industrial dominance. Japan had a 10-year head start on the industrialized West with regard to automation. Furthermore, they automated industry with the full support of the workers, who saw automation not as a threat, but as a powerful tool of productivity.

In our country, with its great labor surplus (what else do you call millions without

jobs?), any further attempts at automation will be strongly resisted by workers who see it as a threat, and our attempt to overtake or pull abreast of Japanese industrial and economic growth will never get off the ground. Unless, of course, another 500,000 highly skilled workers are prepared to be laid off.

JAMES S. MELLETT  
Department of Biology,  
New York University,  
New York, NY 10003

#### Effect of Growth Hormone on Cows

An overlooked concern about the potential impact of genetically engineered bovine growth hormone on the dairy industry (News & Comment, 11 July, p. 150) is the effect of daily administrations of this hormone to hyperstimulate cows to produce 20 to 40 percent more milk.

Under present intensive husbandry conditions, the average dairy cow is spent by the time it is 4 to 5 years of age because of so-called production-related diseases. It is high-

ly probable on the large dairy farm that hormone-stimulated cattle will burn out at an even faster rate, hence the concern that this treatment will increase their suffering as well as the incidence and severity of production-related diseases (1).

As for the purported economic savings, these cows will eat more food in order to produce more milk: you don't get something for nothing. Second, with a higher turnover rate of dairy cows, the rate of replacement with young cows would increase as would the cost, since it takes time and money to raise a young calf to maturity. This is one of the hidden costs of this new biotechnology that has so far been overlooked.

MICHAEL W. FOX  
Humane Society of the United States,  
2100 L Street, NW,  
Washington, DC 20037

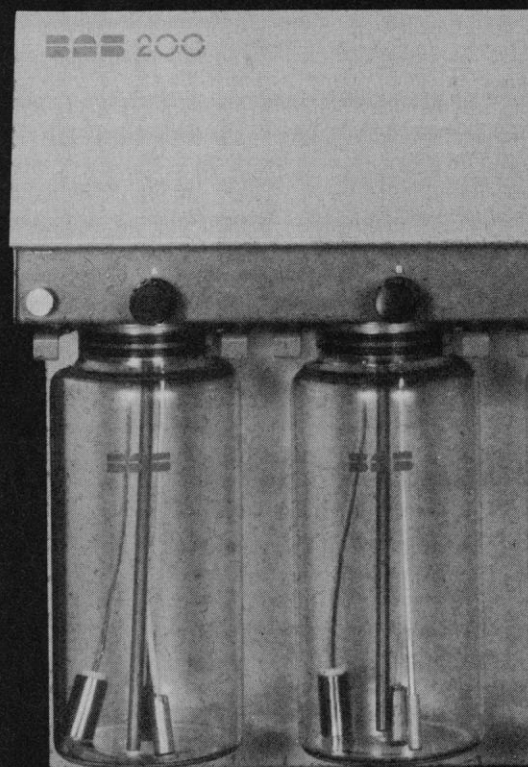
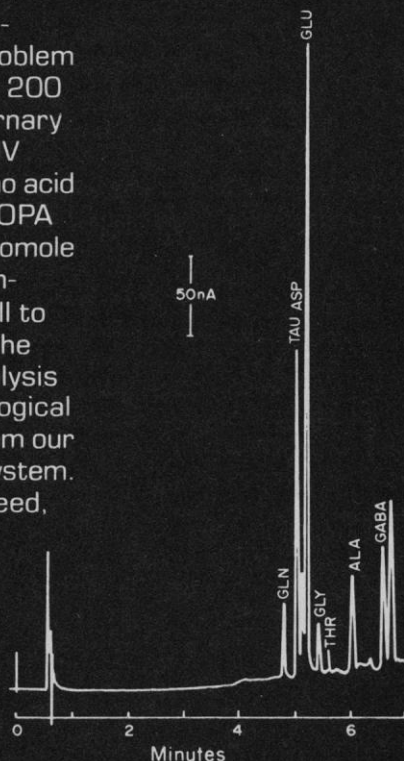
#### REFERENCE

1. M. W. Fox, *Farm Animals: Husbandry, Behavior, and Veterinary Practice* (University Park Press, Baltimore, MD, 1984).

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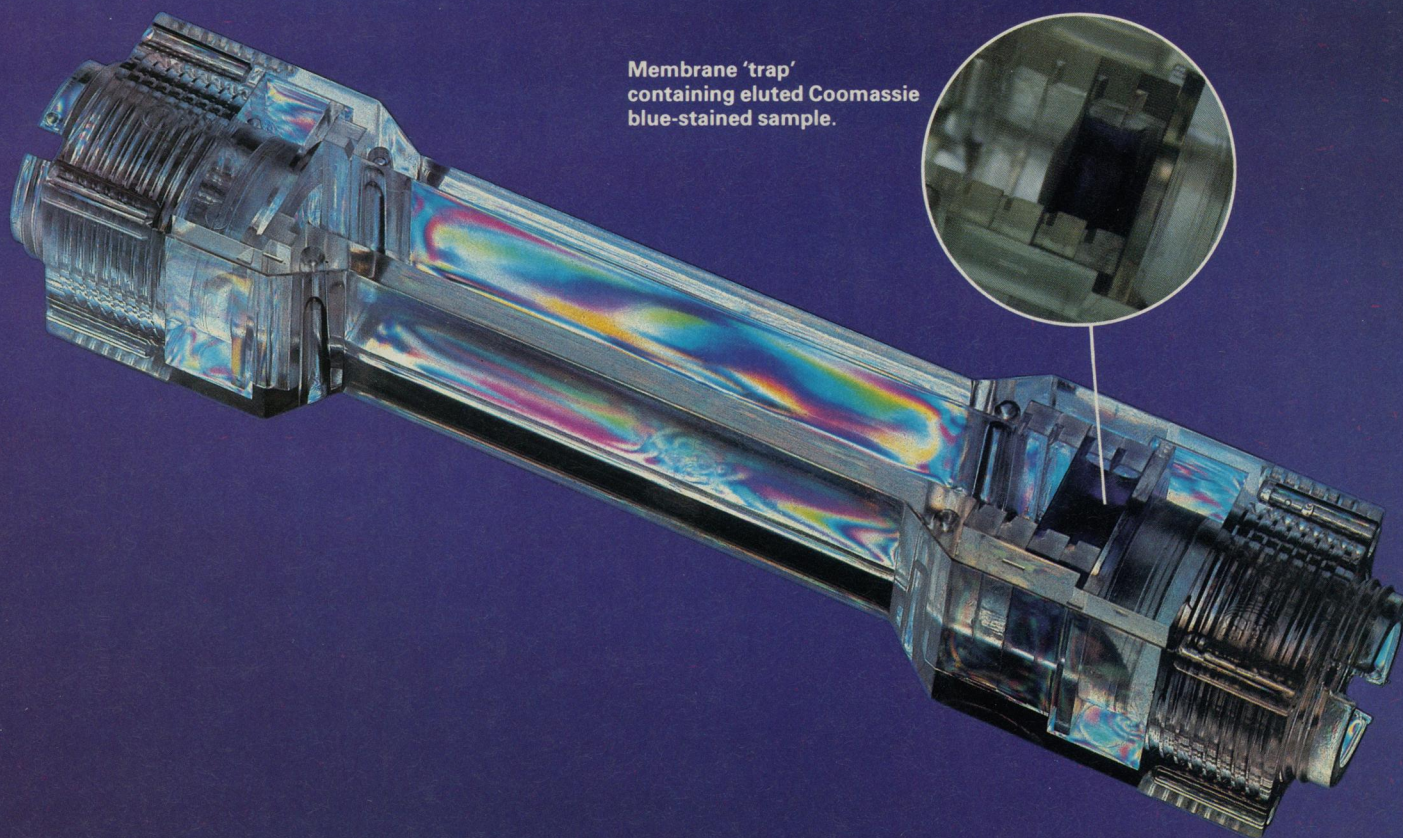
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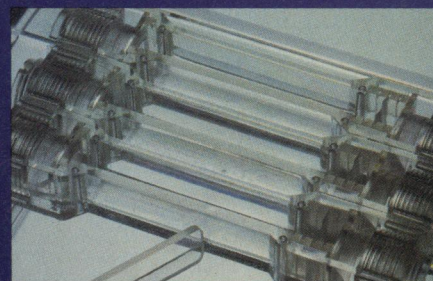
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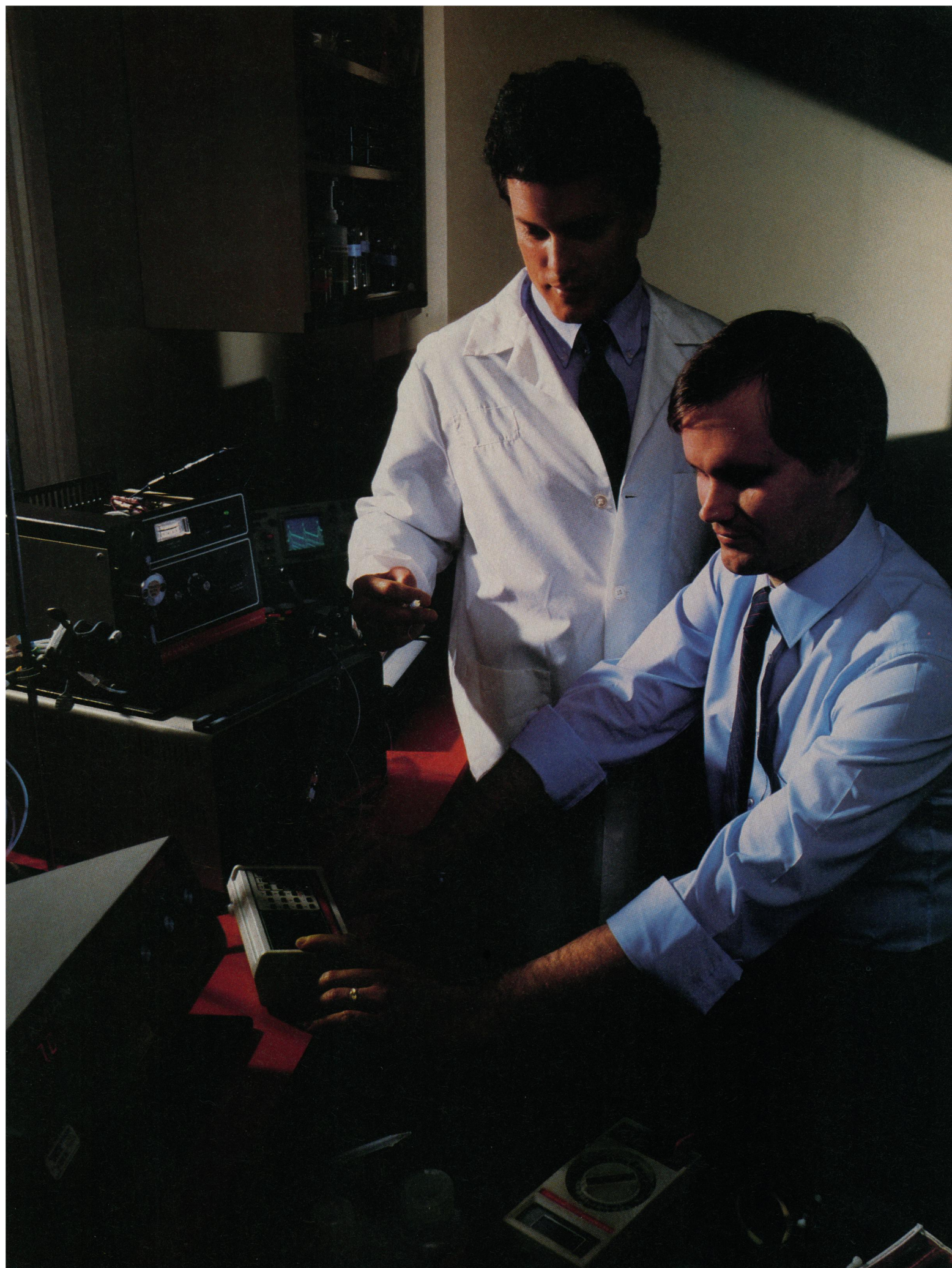
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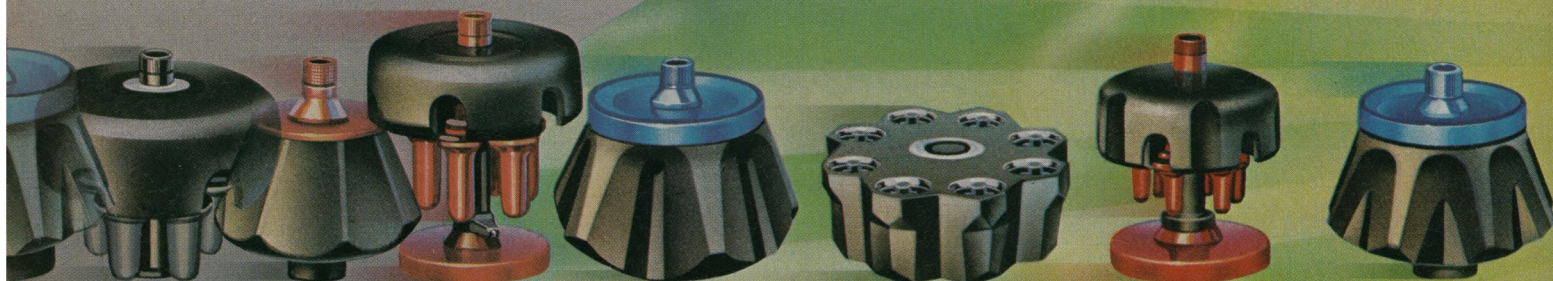




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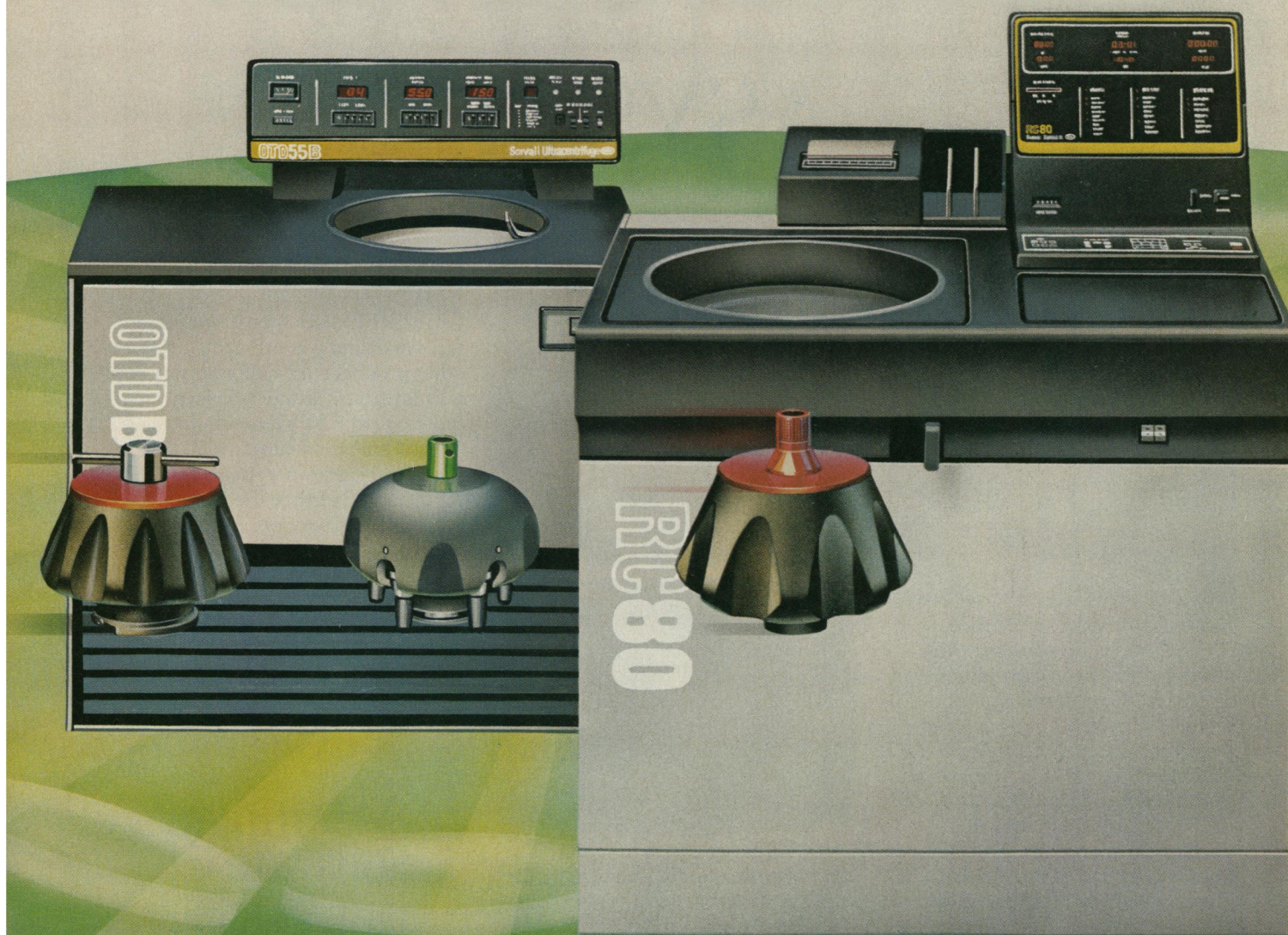




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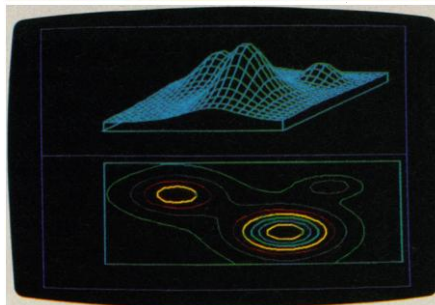
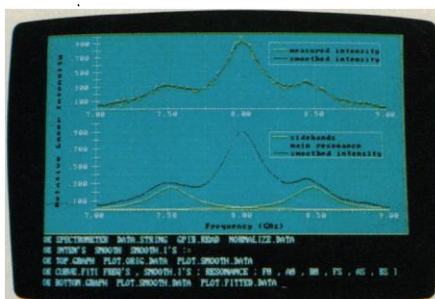


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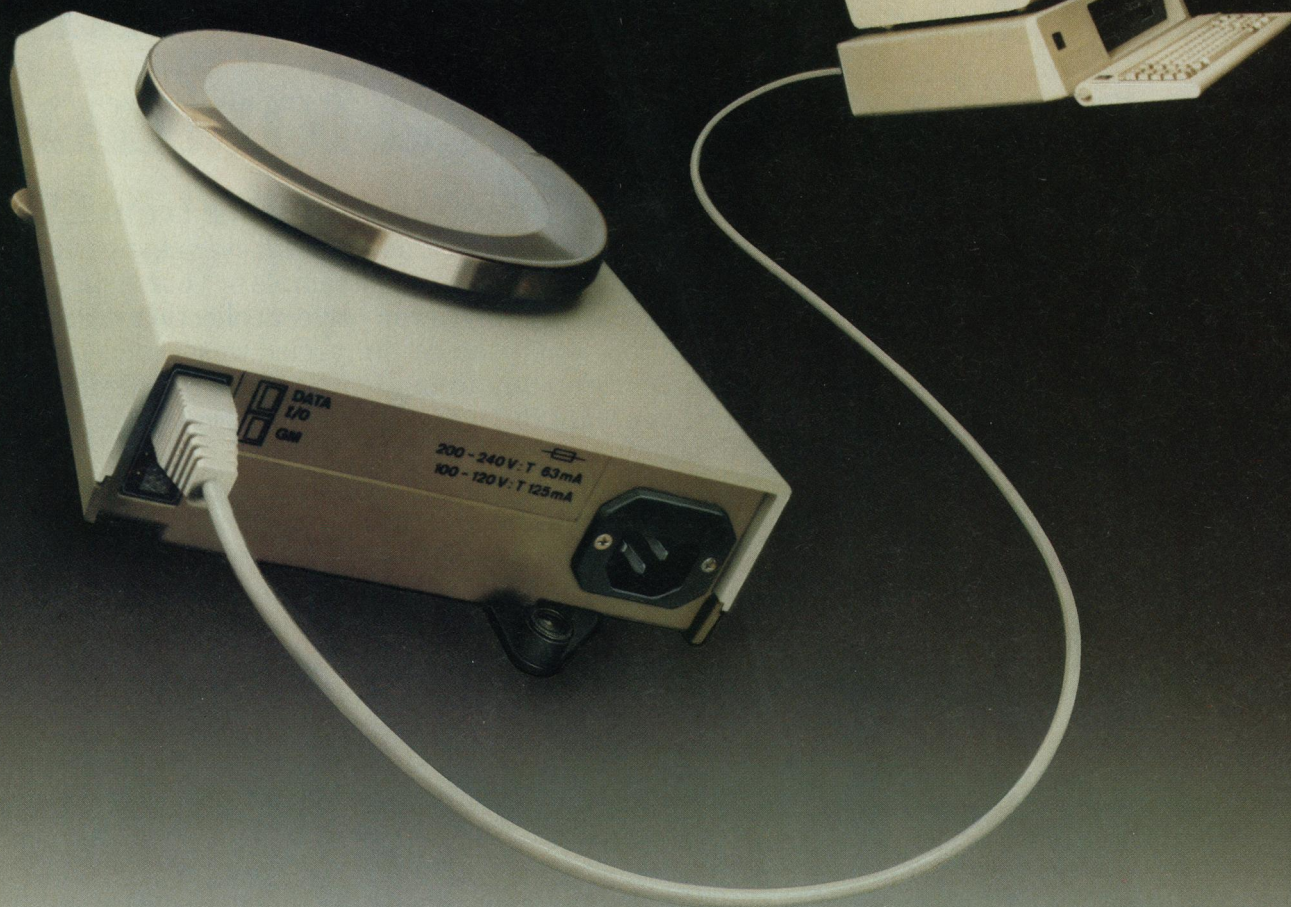
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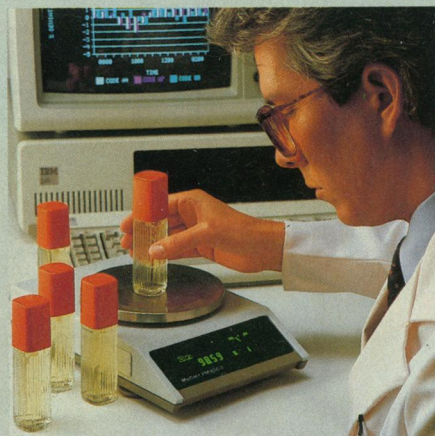
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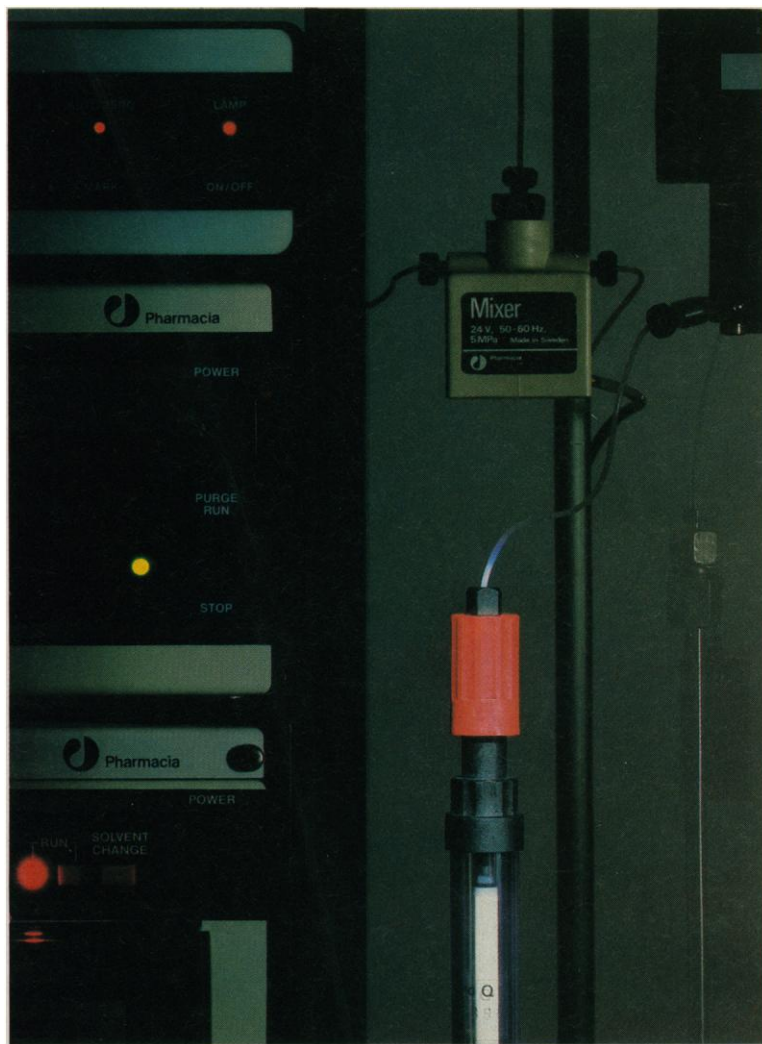
It all began with a bold concept, a chromatography system which would overcome all the challenges of biomolecule separation. This concept became FPLC, a system designed by researchers for researchers. By combining our expertise in biochemistry, synthetic chemistry and instrumentation, we developed a system that meets the demands for biocompatibility, speed, high recovery and high resolution...a system that solves biomolecule separation problems.

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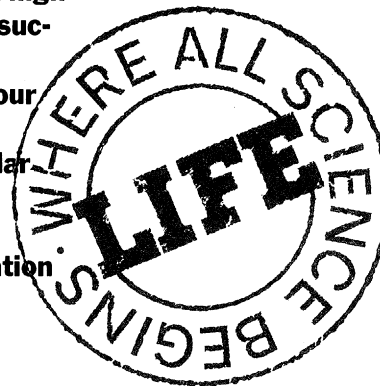
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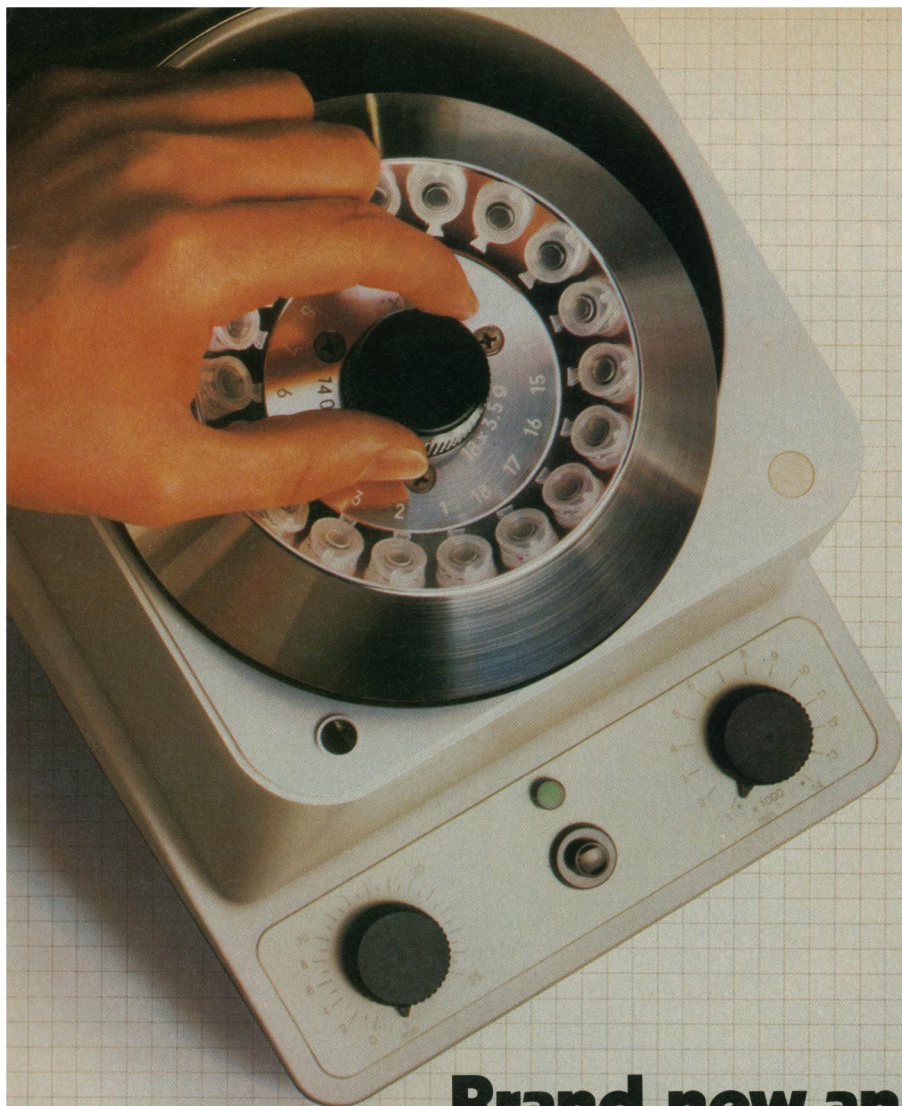
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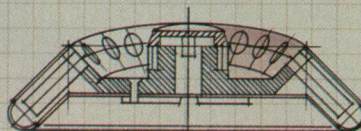
The new 18-place Model 5415 Micro Centrifuge gives you important operating advantages—with unique Eppendorf quality.

### Versatile in use.

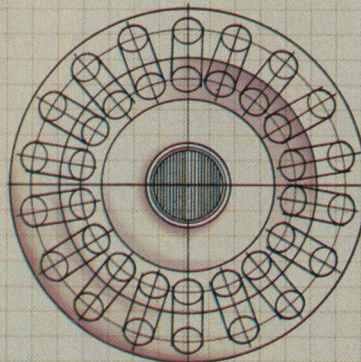
Model 5415 has a variable-speed motor that reaches a maximum of 14,000 rpm with an RCF of 16,000 x g; a 30-minute timer; and a momentary button for short spins. It accepts 1.5 mL, 500  $\mu$ L, 400  $\mu$ L, and 250  $\mu$ L Eppendorf Microcentrifuge Tubes and blood collection microtubes, such as B-D Microtainer\* Tubes.

### New rotor design.

The enclosed rotor design reduces air turbulence for quieter operation. And the new quick-release feature lets you transport the rotor *with* tubes—especially convenient when the centrifuge is run in a cold room.



Enclosed rotor design reduces air turbulence and noise. Tubes are angled precisely at 45° to maximize pellet formation.



Quick-release feature allows the 18-position rotor to be easily transported even when loaded.

\*Microtainer® Tubes is a registered trademark of Becton Dickinson and Company.

### Safe and rugged.

The Eppendorf 5415 Micro Centrifuge is UL listed for safety. It's so rugged that an accidentally unbalanced load won't cause excessive vibration or motor damage. For more information or a demonstration, 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, Ontario M9W 4Y5, Tel: 416-675-7911.

### Specifications

Maximum speed	14,000 rpm
Maximum RCF	16,000 x g
Test-tube capacity	18
Time required for maximum speed	10 sec
Time required to stop	12 sec
Dimensions (L x W x H)	28 x 21 x 28.5 cm

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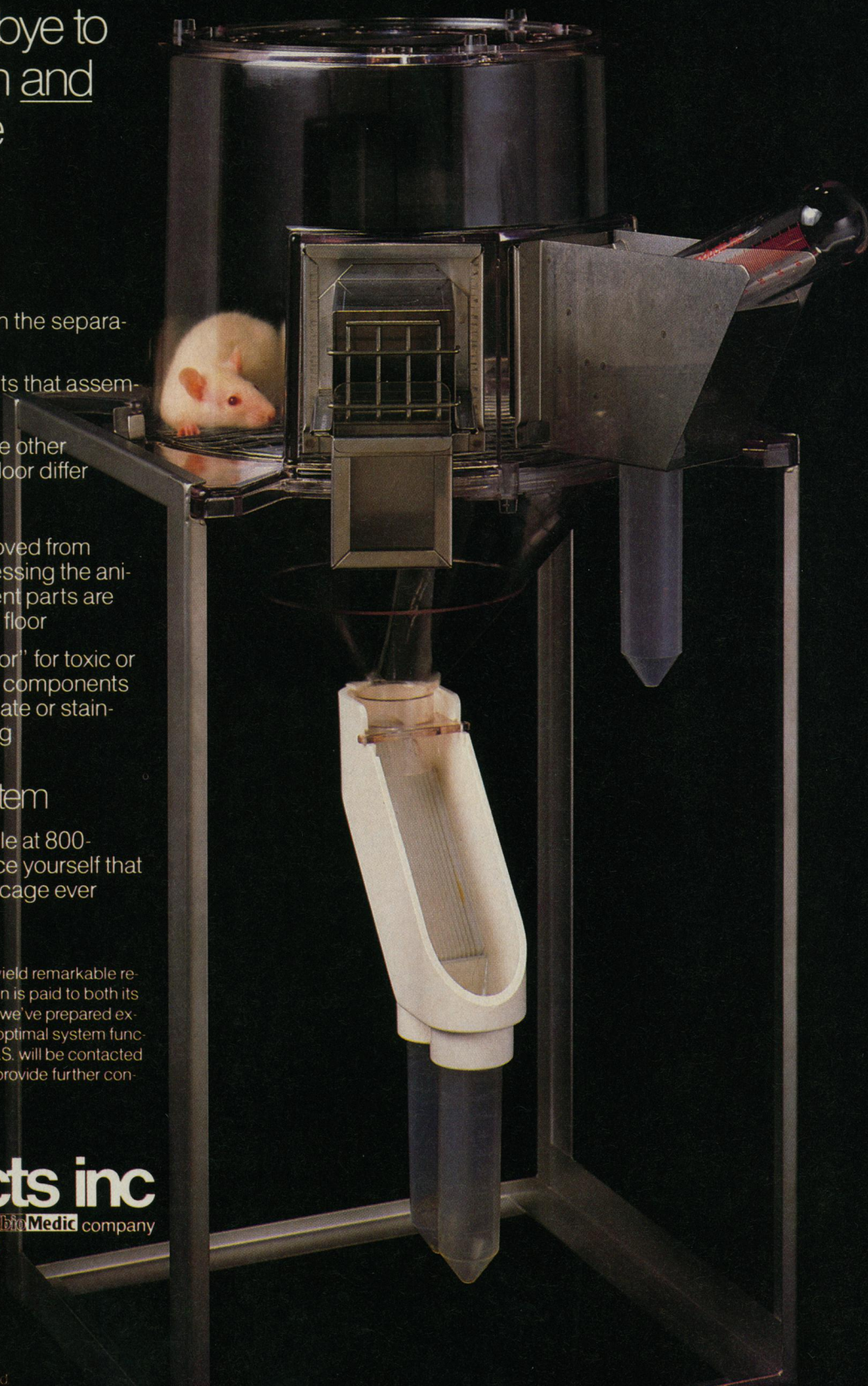
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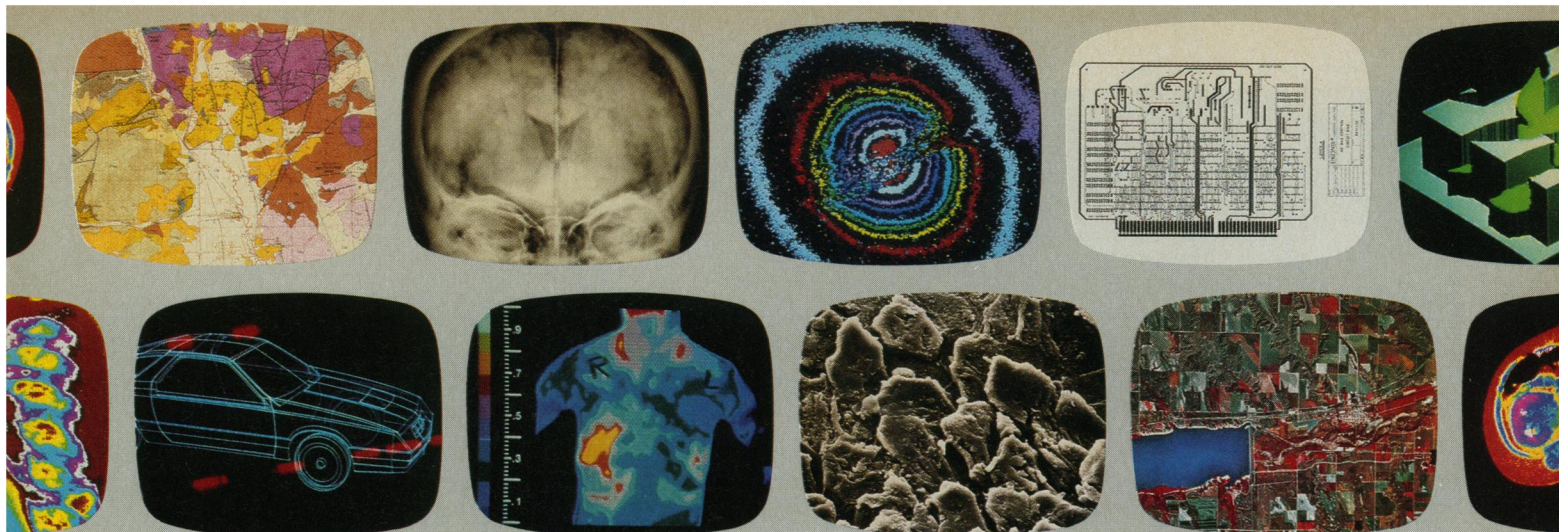
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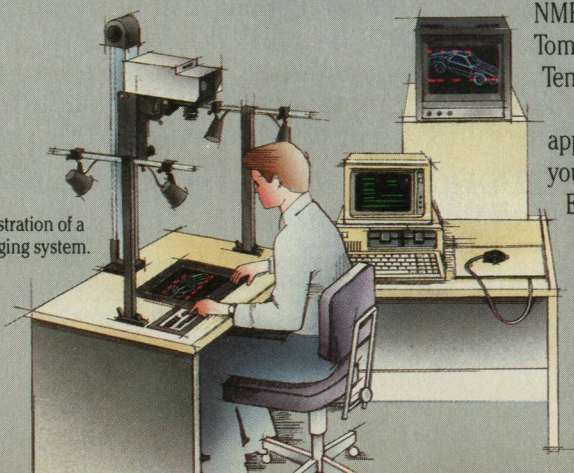
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If you'd like us to focus on your particular application, please call us at (617) 275-5070. If you'd like some literature, simply write to us at Eikonix Corporation, 23 Crosby Drive, Bedford, MA 01730, Telex: 951231.

Illustration of a typical imaging system.



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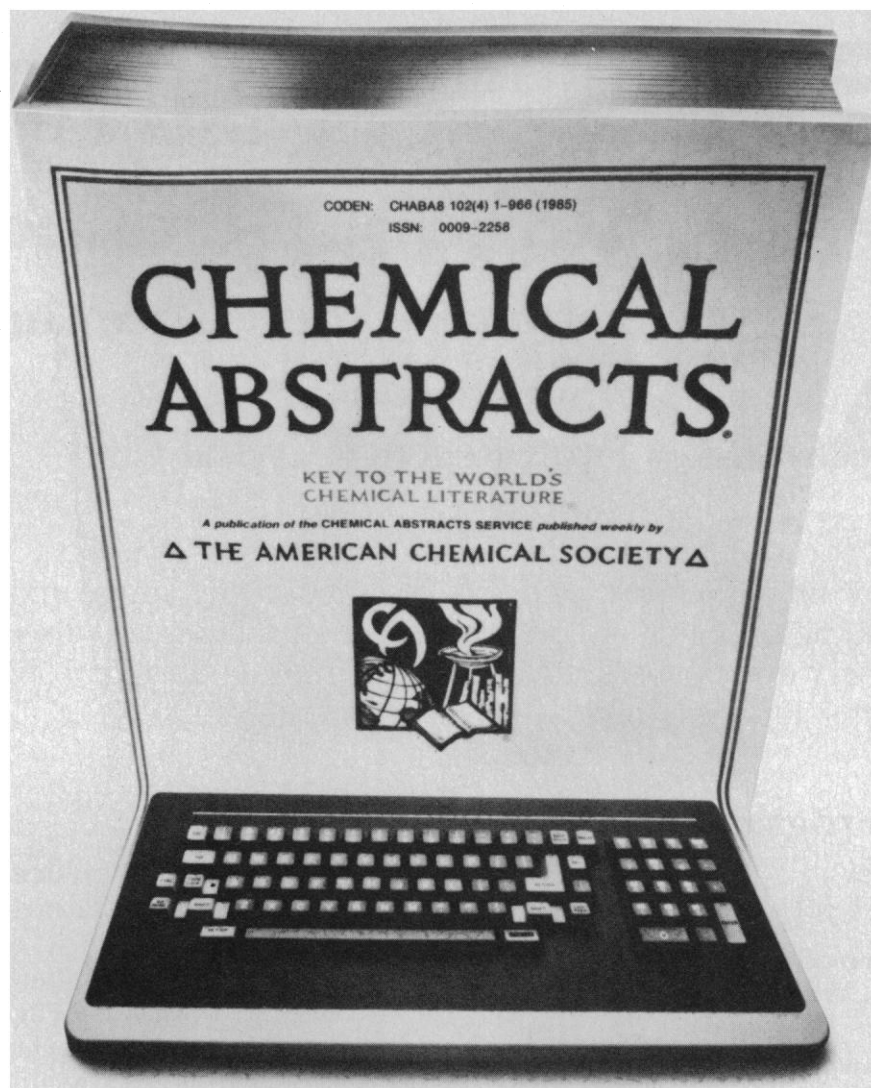
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# National Forum for School Science

**Forum '86: The Science Curriculum**

**November 14–15, 1986**

**Hyatt Regency Crystal City**

The National Forum for School Science is designed to encourage informed, coherent science education policy and practice. Through analysis and discussion of key issues, the annual forum focuses attention on the most enduring problems and the most promising solutions.

## **Forum '86 Program**

### **Keynote Address**

Paul Black, Kings College, London

### **The School Science Curriculum: What We Know, What We'd Like to Know**

F. Joseph Crosswhite, Northern Arizona  
University

Senta Raizen, National Academy of Sciences

Richard Shavelson, Rand Corporation

Iris Weiss, Research Triangle Institute

Pasquale Forgione, Jr., Connecticut Board of  
Education

Daniel Koretz, Congressional Budget Office

Floraline Stevens, Los Angeles Unified  
School District

### **Luncheon Speaker**

Harold Hodgkinson, American Council on  
Education

### **The Future School Science Curriculum**

Margaret MacVicar, Massachusetts Institute  
of Technology

Michael O'Keefe, Consortium for the  
Advancement of Private Higher Education

Mortimer Appley, Harvard University

George Bugliarello, Polytechnic University

Mary Clark, San Diego State University

James R. Johnson, University of Minnesota

Ingram Olkin, Stanford University

### **Forces that Shape the Curriculum: Teachers, Texts, Tests, and Technology**

Rosalie Cohen, Temple University

Robert Hampel, University of Delaware

Mary Budd Rowe, University of Florida

To register, please use the form on the  
facing page.

*For more information, please contact:*

National Forum for School Science

AAAS Office of Science and Technology Education

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**American Association for the Advancement of Science**





# Forum '86: The Science Curriculum

14 – 15 November 1986

Hyatt Regency Crystal City, Arlington, VA  
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☐ \$ 80 Partial registration (registration materials and sessions only)  
☐ \$ 40 Student registration — full-time graduate and undergraduate only (registration materials and sessions only)

Separate Meal Tickets: ☐ Lunch, Friday, 14 November (\$20) ☐ Lunch, Saturday, 15 November (\$20)

All registrants will receive a program, registration badge, and copies of background papers, and *This Year in School Science 1986: The Science Curriculum* after the conference. Registration is limited; preregistration form and payment must be received by **16 October** to ensure receipt of preliminary materials; registrations received after this date will be held at the AAAS Registration Desk in the Hyatt Regency. **Refund policy:** Advance registration fees and meal tickets will be refunded for written cancellations received by **10 November**; no refunds will be made for requests received after this date.

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AAAS Forum '86 ♦ 14 – 15 November 1986

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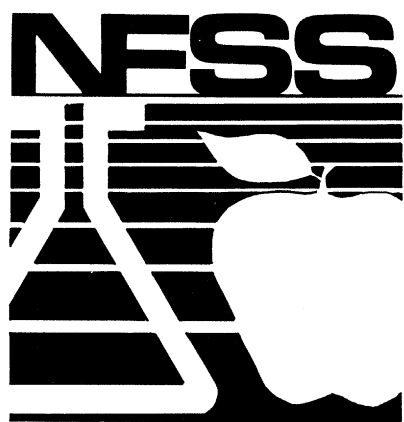
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# National Forum for School Science

## Forum '86: The Science Curriculum

November 14 – 15, 1986

Hyatt Regency Crystal City

### Schedule of Events

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#### Friday, November 14

8:00 am **Registration**

9:00 am **Welcome and Keynote Address**

Lawrence Bogorad, *President, AAAS*  
Paul Black, *Kings College, London*

9:45 am **The School Science Curriculum:  
What We Know, What We'd Like to  
Know**

Panel A: Data producers

F. Joseph Crosswhite, *Northern  
Arizona University*  
Senta Raizen, *National Academy of  
Sciences*  
Richard Shavelson, *Rand Corporation*  
Iris Weiss, *Research Triangle Institute*

Panel B: Data users

Pasquale Forgione, Jr., *Connecticut  
Board of Education*  
Daniel Koretz, *Congressional Budget  
Office*  
Floraline Stevens, *Los Angeles  
Unified School District*

Audience discussion will follow

12:15 pm **Luncheon and Address**

Harold Hodgkinson, *American  
Council on Education*

2:30 pm **The Future School Science  
Curriculum**

A. Goals and structure of AAAS's  
**Project 2061: Education for a  
Changing Future**

Margaret MacVicar, *Massachusetts  
Institute of Technology*

Michael O'Keefe, *Consortium for the  
Advancement of Private Higher  
Education*

B. Common themes evolving from  
Project 2061: What science, math, and  
technology every high school graduate  
should know.

Mortimer Appley, *Harvard University*  
George Bugliarello, *Polytechnic  
University*

Mary Clark, *San Diego State  
University*

James R. Johnson, *3M Company  
(retired) and University of  
Minnesota*

Ingram Olkin, *Stanford University*

Breakout discussions will follow

5:30 pm **Reception**

#### Saturday, November 15

9:00 am **Forces That Shape the Curriculum:  
Teachers, Texts, Tests, and  
Technology**

Joseph Bordogna, *University Of  
Pennsylvania*

Rosalie Cohen, *Temple University*  
Robert Hampel, *University of  
Delaware*

Mary Budd Rowe, *University of  
Florida*

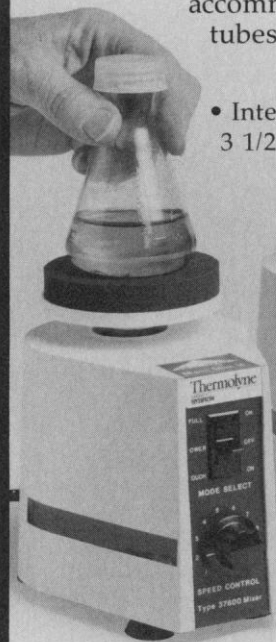
Breakout discussions will follow

12:15 pm **Luncheon and Summary Discussion**



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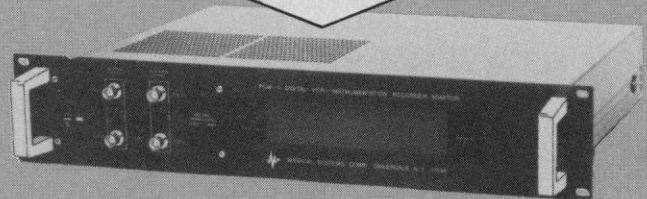
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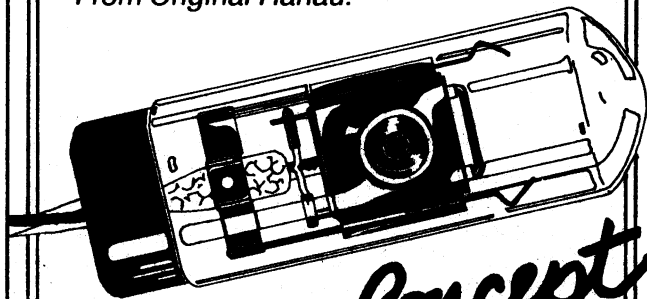
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