

24 November 1978 • Vol. 202 • No. 4370

\$1.50

SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

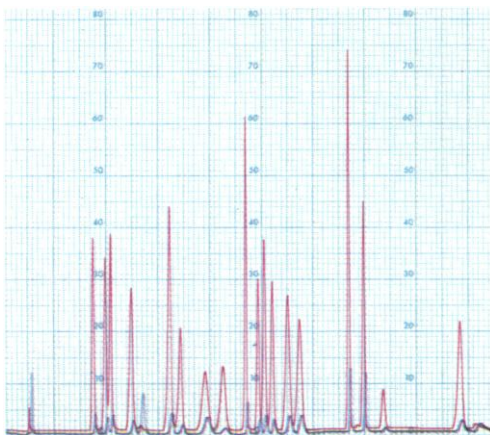


AAAS ANNUAL MEETING—Preconvention Issue

The sensible analyzer

The 119CL is the sensible amino acid analyzer that gives you fast, accurate results with simple programming and automatic operation—all at moderate cost. Beckman representatives install your analyzer, then thoroughly train you on your own instrument. Illustrated guides show you how to set up various runs. And the proven components of the Model 119CL assure you of reliable operation.

From a performance standpoint, the 119CL comes close to analyzers costing twice as much. For instance, its sensitivity of 0.5 nanomole means accurate analy-



sis of very small samples. Solid-trace recordings are linear with concentration for easy quantitation. Fast run times

give complete single-column hydrolyzate analyses in only 1½ hours (see chromatogram) and single-column physiological separations in only 4½ hours—times which include regeneration and equilibration. And, if you want to eliminate tedious manual calculations entirely, just add the companion Model 126 Data System.

Send for literature on the sensible 119CL: the best-selling analyzer in the world. Ask for SB-428 from Spinco Division, Beckman Instruments, Inc., 1117 California Ave., Palo Alto, CA 94304.

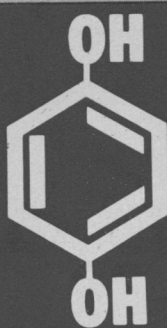


BECKMAN®

Circle No. 88 on Readers' Service Card



EASY ROUTE



Take the easy route to new product development.

Whether you're developing a new pharmaceutical or agricultural chemical, or looking for an easier route to an existing product, head straight for Eastman® p-benzoquinone or TECQUINOL® hydroquinone.

Both of these Eastman intermediates are highly reactive, versatile and can be conveniently annulated to produce building blocks for more complex structures.

Because hydroquinone readily undergoes electrophilic substitutions such as the Mannich and Friedel Crafts reactions, it just might eliminate several steps of a synthesis. One enterprising chemist used it as an intermediate in the

preparation of liquid crystal polymers. A real short cut.

Eastman p-benzoquinone is highly electrophilic and can be reacted with a variety of nucleophiles to form tri- and tetra-functional aromatic compounds. And it provides a quick, easy route to dihydroxybenzoquinone.

For your free sample of TECQUINOL hydroquinone or Eastman p-benzoquinone, along with one of the most complete literature searches available, write on your company letterhead to Eastman Chemical Products, Inc., a subsidiary of Eastman Kodak Company, Industrial Chemicals Division, Kingsport, Tennessee 37662.



Circle No. 25 on Readers' Service Card

SCIENCE

LETTERS	Guayule Development: <i>G. E. Brown, Jr.</i> ; Nuclear Power Economics: <i>C. Komanoff</i> ; <i>G. A. Huhn</i> ; <i>A. D. Rossin</i> and <i>T. A. Rieck</i> ; The Free-Electron Laser: <i>J. M. J. Madey</i> ; Curve-Fitting: <i>R. M. Hazen</i> ; <i>D. W. Roubik</i> . . .	818
EDITORIAL	Your Annual Meeting: <i>A. Herschman</i>	829
ARTICLES	Coral Reef Morphogenesis: A Multidimensional Model: <i>W. H. Adey</i>	831
	Energy and Labor in the Construction Sector: <i>B. Hannon</i> et al.	837
NEWS AND COMMENT	Electronics Industry Takes to "Potting" Its Products for Market	848
	1976 Swine Flu Campaign Faulted Yet Principals Would Do It Again	849
	NAS Saccharin Report Sweetens FDA Position, But Not by Much	852
	Librarian Turned Entrepreneur Makes Millions Off Mere Footnotes	853
RESEARCH NEWS	Computer Science: Surprisingly Fast Algorithms	857
	The 1978 Nobel Prize in Economics: <i>J. G. March</i>	858
	Weather Modification: A Call for Tougher Tests	860
ANNUAL MEETING	Science and Technology: Resources for Our Future: <i>A. Herschman</i> ; Meeting Information; Preconvention Program; Registration and Housing Forms.	863
BOOK REVIEWS	Science Policy, reviewed by <i>R. Amann</i> ; Genetic Interaction and Gene Transfer, <i>T. Friedmann</i> ; Many Degrees of Freedom in Field Theory, <i>J. L. Challifour</i> ; Many Degrees of Freedom in Particle Theory, <i>L. Dolan</i> ; Solitons, <i>G. E. Watson</i> ; Books Received	876

BOARD OF DIRECTORS

EMILIO Q. DADDARIO
Retiring President, Chairman

EDWARD E. DAVID, JR.
President

KENNETH E. BOULDING
President-Elect

ELOISE E. CLARK
MARTIN M. CUMMINGS

RENEE C. FOX
BERNARD GIFFORD

CHAIRMEN AND SECRETARIES OF AAAS SECTIONS

MATHEMATICS (A)
Mark Kac
Ronald Graham

PHYSICS (B)
D. Allan Bromley
Rolf M. Sinclair

CHEMISTRY (C)
William E. McEwen
William L. Jolly

ASTRONOMY (D)
Paul W. Hodge
Donat G. Wentzel

PSYCHOLOGY (J)
Brenda Milner
Meredith P. Crawford

SOCIAL AND ECONOMIC SCIENCES (K)
Kurt W. Back
Gillian Lindt

HISTORY AND PHILOSOPHY OF SCIENCE (L)
Robert S. Cohen
Diana L. Hall

ENGINEERING (M)
Robert B. Beckmann
Donald E. Marlowe

EDUCATION (Q)
Marjorie H. Gardner
James T. Robinson

DENTISTRY (R)
Sholom Pearlman
John Termine

PHARMACEUTICAL SCIENCES (S)
John G. Wagner
Raymond Jang

INFORMATION, COMPUTING, AND COMMUNICATION (T)
Eugene Garfield
Madeline M. Henderson

DIVISIONS

ALASKA DIVISION

Donald H. Rosenberg
President

Keith B. Mather
Executive Secretary

PACIFIC DIVISION

Glenn C. Lewis
President

Alan E. Leviton
Secretary-Treasurer

SOUTHWESTERN AND ROCKY MOUNTAIN DIVISION

James W. O'Leary
President

Lora M. Shields
Executive Officer

SCIENCE is published weekly, except the last week in December, but with an extra issue on the third Tuesday in September, by the American Association for the Advancement of Science, 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Now combined with *The Scientific Monthly*. Second-class postage paid at Washington, D.C., and additional entry. Copyright © 1978 by the American Association for the Advancement of Science. Member rates on request. Annual subscriptions \$65; foreign postage: Canada \$10; other surface \$13; air-surface via Amsterdam \$30. Single copies \$1.50; \$2 by mail (back issues \$3) except *Guide to Scientific Instruments* \$6. School year subscriptions: 9 months \$50; 10 months \$55. Provide 6 weeks' notice for change of address, giving new and old addresses and postal codes. Send a recent address label, including your 7-digit account number. Postmaster: Send Form 3579 to *Science*, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

REPORTS	Carbon-14 Dating: A Comparison of Beta and Ion Counting: <i>M. Stuiver</i>	881
	Strain in Southern California: Measured Uniaxial North-South Regional Contraction: <i>J. C. Savage et al.</i>	883
	Stone Tools from Mid-Pleistocene Sediments in Java: <i>T. Jacob et al.</i>	885
	Regional Implications of Triassic or Jurassic Age for Basalt and Sedimentary Red Beds in the South Carolina Coastal Plain: <i>G. S. Gohn et al.</i>	887
	Australopithecine Enamel Prism Patterns: <i>E. S. Vrba and F. E. Grine</i>	890
	Rapid Changes in Brain Benzodiazepine Receptors After Experimental Seizures: <i>S. M. Paul and P. Skolnick</i>	892
	The Red Cell as a Fluid Droplet: Tank Tread-Like Motion of the Human Erythrocyte Membrane in Shear Flow: <i>T. M. Fischer, M. Stöhr-Liesen, H. Schmid-Schönbein</i>	894
	Human Flicker Sensitivity: Two Stages of Retinal Diffusion: <i>D. H. Kelly and H. R. Wilson</i>	896
	Cultural Transmission of Enemy Recognition: One Function of Mobbing: <i>E. Curio, U. Ernst, W. Vieth</i>	899
	Light Stimulates Tyrosine Hydroxylase Activity and Dopamine Synthesis in Retinal Amacrine Neurons: <i>P. M. Iuvone et al.</i>	901
	Paper-Marking Test for Chimpanzee: Simple Control for Social Cues: <i>D. Premack, G. Woodruff, K. Kennel</i>	903
	Memory Impairment in Korsakoff's Psychosis: A Correlation with Brain Noradrenergic Activity: <i>W. J. McEntee and R. G. Mair</i>	905
	Fractional Factorial Analysis of Growth and Weaning Success in <i>Peromyscus maniculatus</i> : <i>W. P. Porter and R. L. Busch</i>	907
	Detection of Auditory Nerve-Activating Substance: <i>W. F. Sewell et al.</i>	910
	Technical Comments: Use of Indigenous Rubidium to Trace Potassium Fertilizer in the <i>Pinus resinosa</i> Ecosystem: <i>D. F. Ryan and S. Miller; E. L. Stone</i>	912
PRODUCTS AND MATERIALS	Carbon Dioxide Incubators; Programmable Diagnostic Ultrasound Imaging System; Mössbauer-Effect Sources; Micro Kjeldahl Analyzer; Infrared Data Station for Computerized Dispersive Spectroscopy; Dew-Point Hygrometer; Kilowatt- Hour Meter; Literature	914

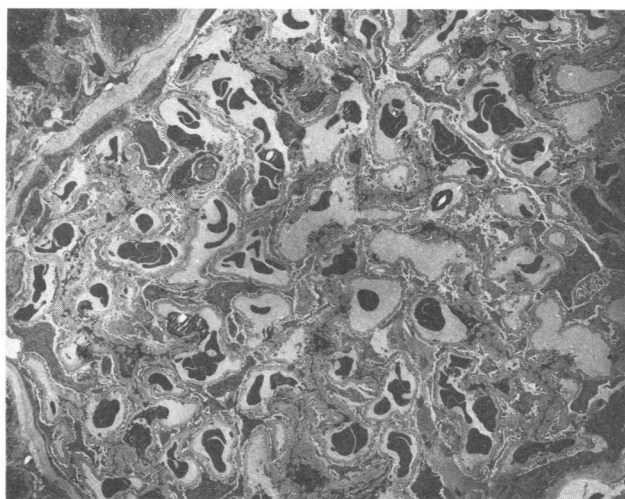
MIKE MC CORMACK FREDERICK MOSTELLER	RUSSELL W. PETERSON CHEN NING YANG	WILLIAM T. GOLDEN Treasurer	WILLIAM D. CAREY Executive Officer
GEOLOGY AND GEOGRAPHY (E) Gerald M. Friedman Ramon E. Bisque	BIOLOGICAL SCIENCES (G) Ursula K. Abbott Walter Chavin	ANTHROPOLOGY (H) June Helm Priscilla Reining	
MEDICAL SCIENCES (N) Leon O. Jacobson Leah M. Lowenstein	AGRICULTURE (O) James B. Kendrick Coyt T. Wilson	INDUSTRIAL SCIENCE (P) David B. Hertz Robert L. Stern	
STATISTICS (U) Samuel W. Greenhouse Ezra Glaser	ATMOSPHERIC AND HYDROSPHERIC SCIENCES (W) Kenneth C. Spengler Glenn R. Hilst	GENERAL (X) Allen V. Astin Joseph F. Coates	

COVER

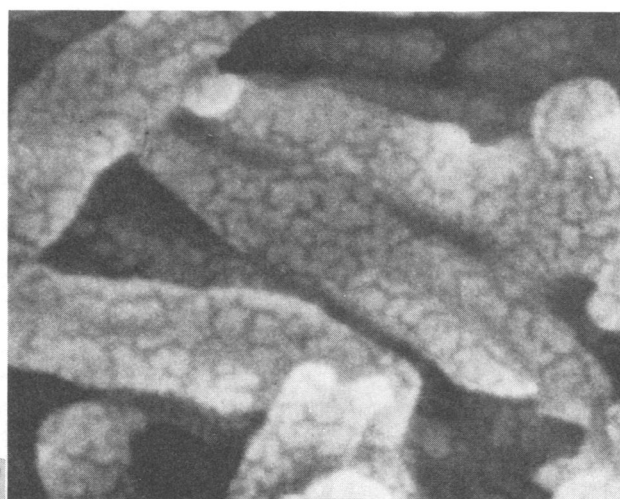
The Lookout by Frederick Remington, 1887. [From the Hogg Brothers Collection, courtesy of Museum of Fine Arts, Houston, Texas] See page 862, AAAS Annual Meeting, 3-8 January 1979.

The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to foster scientific freedom and responsibility, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

Hitachi/Perkin-Elmer introduces H-300 the world's first Universal Electron Microscope (UEM)



Mouse glomerules at 700X, full frame; wider field of view, with full frame, obtainable at 250X.



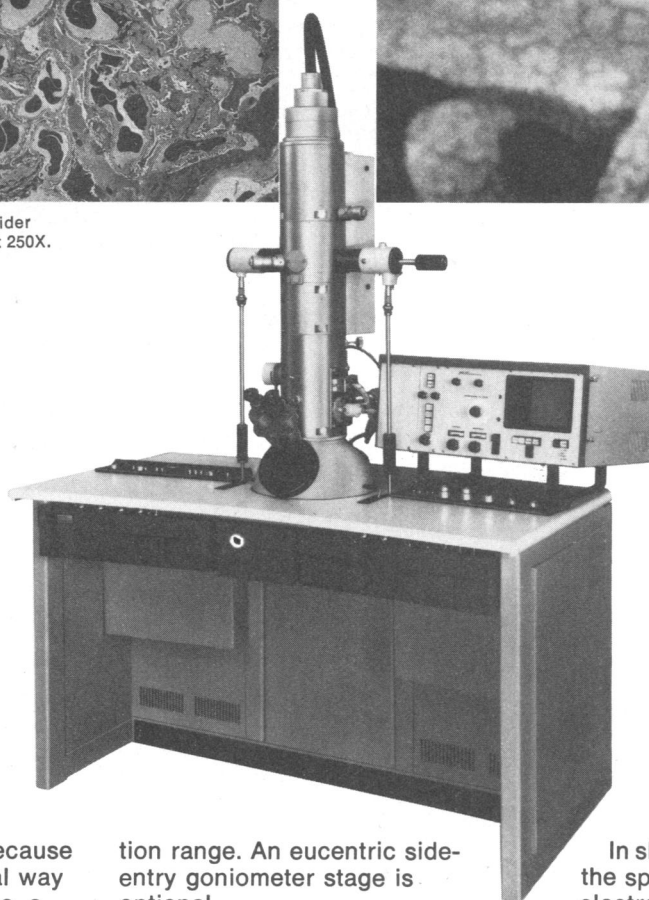
Magnetic tape, Au coated @ 100,000X.

It's a TEM

4.5Å guaranteed
75 kV
250X-100,000X

It's a SEM

100Å guaranteed
20 kV
50X-100,000X



We call the H-300 a UEM because there's simply no conventional way to describe it. For the first time, a full-fledged TEM and a full-fledged SEM are packaged in a common console—without compromising performance in either mode.

The TEM mode, for example, includes a wide field, low mag image free of peripheral blur. This eliminates tedious montaging. You also get zoom over the entire magnifica-

tion range. An eucentric side-entry goniometer stage is optional.

As an SEM, the H-300 is just as versatile, easily handles bulk specimens. You can also add options like Mode Control with EDX interface, an energy dispersive X-ray spectrometer and Automatic Data Display. Plus Hitachi-patented Dual Magnification: using a single CRT, you can switch from a low mag view of your specimen to a high mag view of a specific field of interest.

In short, the H-300 gives you, in the space of one instrument, a total electron microscopy capability.

Best of all, you can get the UEM package for under \$70K. Or, buy it as a TEM for under \$50K, integrate the SEM later. For full details and/or a demonstration, call or write: Perkin-Elmer, Instrument Marketing Division, 411 Clyde Avenue, Mountain View, California 94043. Phone (415) 961-0461.

PERKIN-ELMER

Circle No. 152 on Readers' Service Card



GIANT KEYHOLE LIMPET (*Megathura crenulata*) shot in environs off La Jolla, California. The Keyhole Limpet is used in the preparation of Hemocyanin. Also pictured is the Garibaldi, the California State Fish.

**Ask
for our new
1979 catalog...
yours
for the asking.**

Ask for the new Calbiochem-Behring Biochemical and Immunochemical catalog. Our 1979 edition contains over 2,000 product listings, including many new products. Each product, wherever possible, is referenced to the new Merck Index. So you can find background information quickly and easily.

Ask for our new catalog if you are not on the mailing list now. It's free

and it's the kind of good reference book your lab shouldn't be without. Write or call 800-854-2171 toll free.

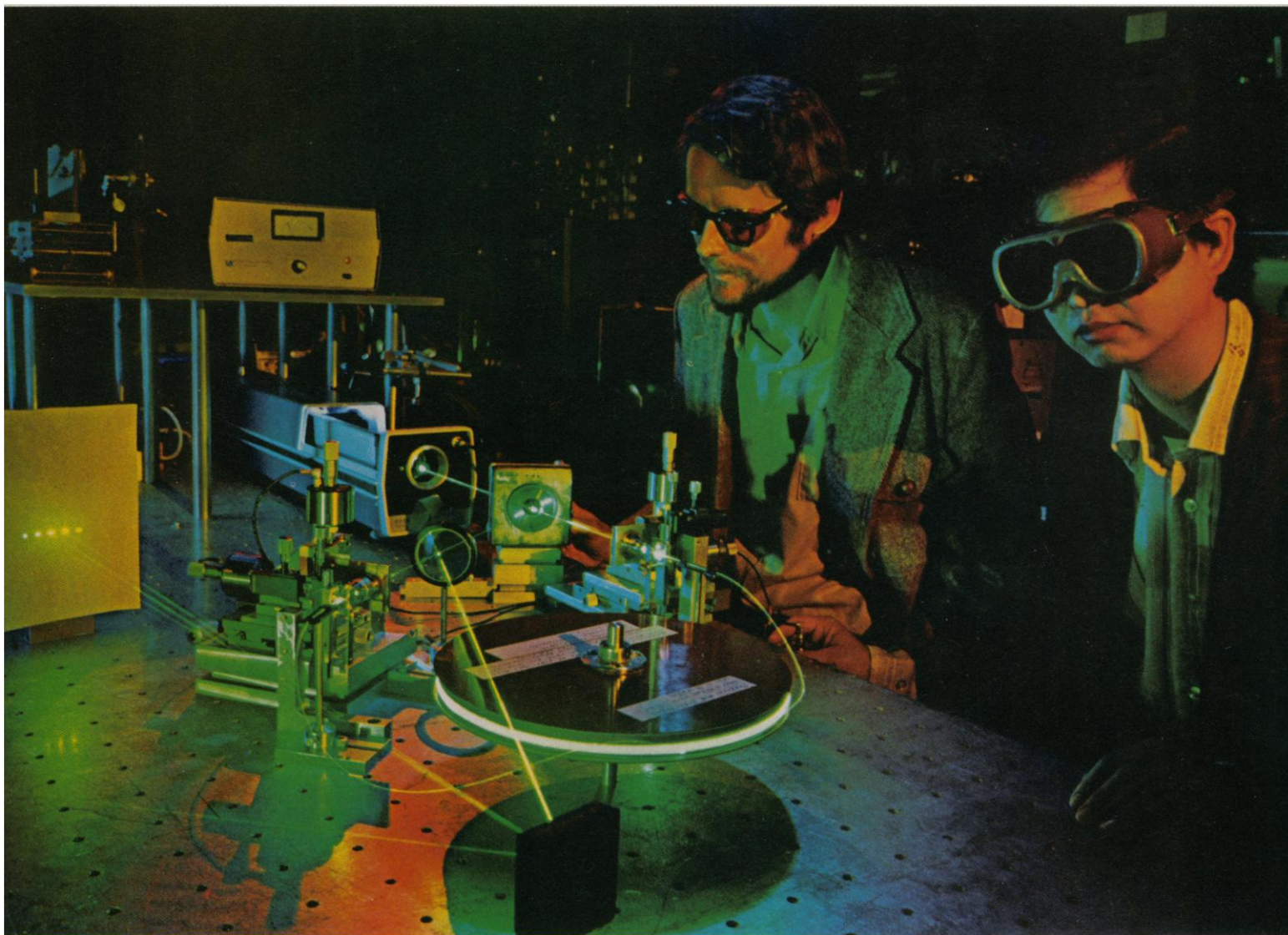


REG. TM HOECHST AG

CALBIOCHEM-BEHRING CORP.
10933 North Torrey Pines Rd., La Jolla, CA 92037

Circle No. 128 on Readers' Service Card

The longest in our long line of laser firsts...



Bell Laboratories
Murray Hill, New Jersey 07974

Bell Labs scientists Roger Stolen and Chinlon Lin work with a fiber Raman laser, one of a new class of light sources that use optical fibers—up to a kilometer long—to produce tunable laser light. At left, the laser's output—which contains multiple Raman-shifted wavelengths—is taken off a beam splitter and dispersed by an external grating to show the broad range of wavelengths that can be tuned.

Bell Labs has developed some of the world's most transparent glass fibers to *carry* light for communications. We've also devised a way to make these highly transparent glass fibers *generate* light. In fact, they are the basis for a new class of tunable light sources called fiber Raman lasers. They're among the latest, and by far the longest, of many lasers invented at Bell Labs, beginning in 1957 with the conception of the laser itself.

Since the new fiber lasers work best at wavelengths at which they are most transparent, we can make them very long. The longest active lasing medium ever built, in fact, was a fiber Raman laser over a kilometer in length. Studying the ways light and glass interact over such distances is part of our research in lightwave communications.

In these new light sources, a glass fiber with high transparency and an extremely thin light-guiding region, or core, is excited by a pump laser. The pump light, interacting with the glass, amplifies light at different wavelengths through a phenomenon known as stimulated Raman scattering. This light is fed back into the fiber by a reflecting mirror. If gain exceeds loss, the repetitively amplified light builds up and "lasing" occurs.

Fiber Raman lasers have conversion efficiencies of about 50%, operate in pulsed and continuous wave modes, and are easily tunable over a broad wavelength range in the visible and near infrared regions of the spectrum.

We've used these lasers to measure the properties of fibers and devices for optical communications; and studies of the lasers themselves have revealed a wealth of information on frequency conversion, optical gain, and other phenomena. Such knowledge could lead to a new class of optoelectronic devices made from fibers, and better fibers for communications.

Looking back

These long lasers come from a long line of Bell Labs firsts:

1957: The basic principles of the laser, conceived by Charles Townes, a Bell Labs consultant, and Bell Labs scientist Arthur Schawlow. (They later received the basic laser patent.)

1960: A laser capable of emitting a continuous beam of coherent light—using helium-neon gas; followed in 1962 by the basic visible light helium-neon laser. (More than 200,000 such lasers are now in use worldwide.) Also, a proposal for a semiconductor laser involving injection across a p-n junction to generate coherent light emitted parallel to the junction.

1961: The continuous wave solid-state laser (neodymium-doped calcium tungstate).

1964: The carbon dioxide laser (highest continuous wave power output system known to date); the neodymium-doped yttrium aluminum garnet laser; the continuously operating argon ion laser; the tunable optical parametric oscillator; and the synchronous mode-locking technique, a basic means for generating short and ultrashort pulses.

1967: The continuous wave helium-cadmium laser (utilizing the Penning ionization effect for high efficiency); such lasers are now used in high-speed graphics, biological and medical applications.

1969: The magnetically tunable spin-flip Raman infrared laser, used in high-resolution spectroscopy, and in pollution detection in both the atmosphere and the stratosphere.

1970: Semiconductor heterostructure lasers capable of continuous operation at room temperature.

1971: The distributed feedback laser, a mirror-free laser structure compatible with integrated optics.

1973: The tunable, continuous wave color-center laser.

1974: Optical pulses less than a trillionth of a second long.

1977: Long-life semiconductor lasers for communications. (Such lasers have performed reliably in the Bell System's lightwave communications installation in Chicago.)

Looking ahead

Today, besides our work with tunable fiber Raman lasers, we're using other lasers to unlock new regions of the spectrum in the near infrared (including tunable light sources for communications), the infrared, and the ultraviolet.

We're also looking to extend the tuning range of the free electron laser into the far infrared region—where no convenient sources of tunable radiation exist.

We're working on integrated optics—combinations of lightwave functions on a single chip.

Lasers are helping us understand ultrafast chemical and biological phenomena, such as the initial events in the process of human vision. By shedding new light on chemical reactions, atmospheric impurities, and microscopic defects in solids, lasers are helping us explore materials and processes useful for tomorrow's communications.

Also under investigation is the use of intense laser irradiation in the fabrication of semiconductor devices. The laser light can be used to heat selective areas of the semiconductor and anneal out defects or produce epitaxial crystalline growth. Laser annealing coupled with ion implantation may provide a unique tool for semiconductor processing.

We've played an important part in the discovery and development of the laser—an invention making dramatic improvements in the way our nation lives, works and communicates.



Bell Laboratories

From Science : Service

SOLAR ENERGY IN AMERICA

William D. Metz and Allen L. Hammond

An authoritative
book that documents
where solar energy has
been and where it is going.

Based on in-depth reporting for SCIENCE magazine, **Solar Energy in America** is a thorough assessment of our progress in tapping the ultimate energy source — the sun. While no single energy source may meet all future demands, solar energy seems to have the greatest potential. It is technically feasible, environmentally attractive, and rapidly becoming commercially sound. **Solar Energy in America** details the diverse technologies that depend upon the sun as their energy source, evaluates the potential and the problems of each, and alerts the reader to both the short-term and long-range prospects. The authors find that the field of solar energy is undergoing an unparalleled technical revival, and that there is no reason why many solar technologies cannot begin to be used at once. **Solar Energy in America** — the latest edition of the expanding SCIENCE Report series* — will be a useful publication for solar energy enthusiasts as well as skeptics, for college students as well as policy analysts. It is a AAAS book for everyone who wants a broad and thorough perspective on solar energy today.

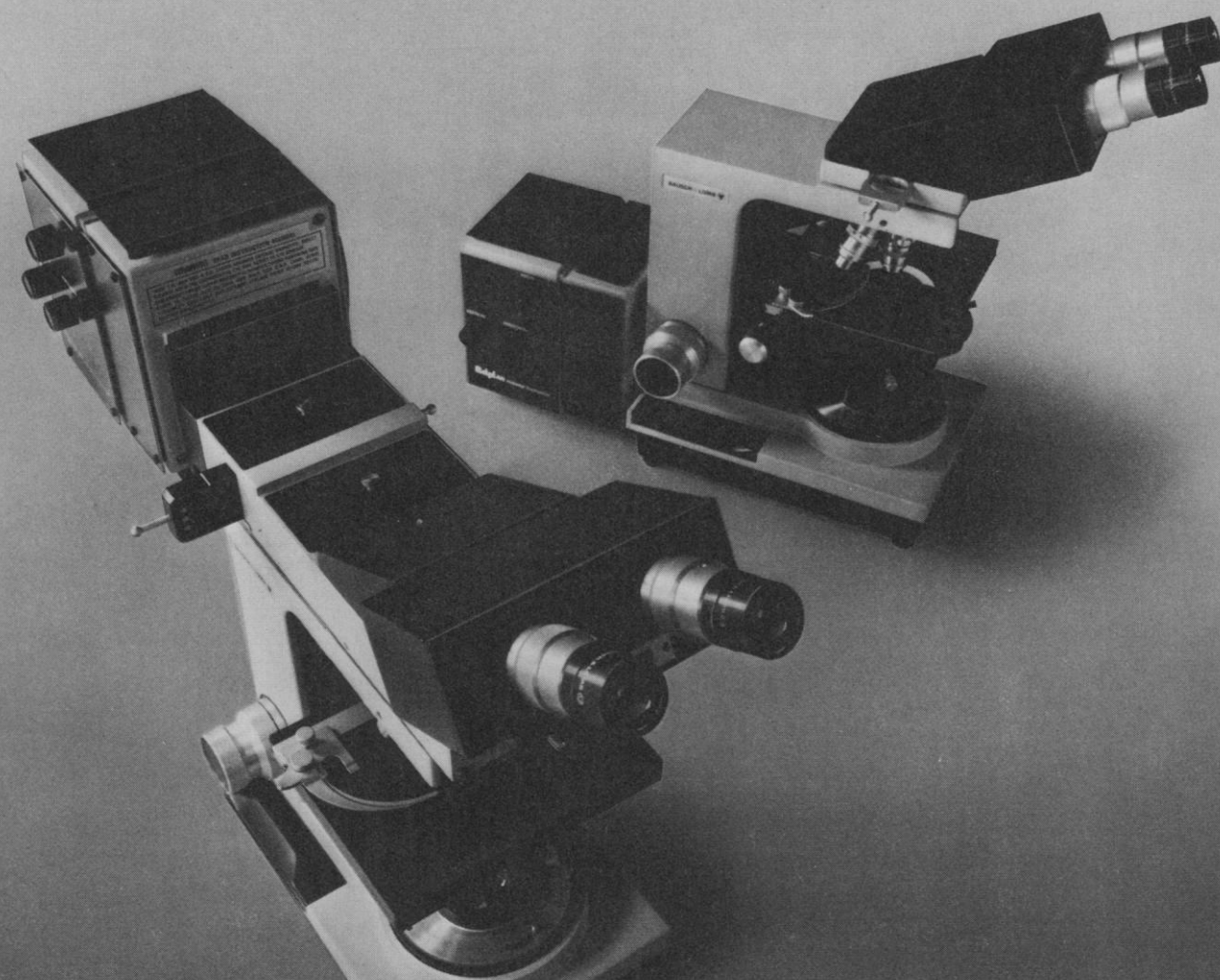
Solar Energy In America; by William D. Metz and Allen L. Hammond. 1978, xvi + 218 pages, index.
Retail price: \$18.50 (casebound), \$8.50 (paperbound).

*The first title in the series is Combating the #1 Killer: The SCIENCE Report on Heart Research, by Jean L. Marx and Gina Bari Kolata. xi + 205 pages. \$17.00 (casebound), \$7.50 (paperbound). AAAS members deduct 10% from retail price.

To order your copy of **Solar Energy in America**, please send your name and address to AAAS, Department ES-1, 1515 Massachusetts Avenue, NW, Washington, DC 20005. Remittance must accompany all orders under \$10.00. AAAS members deduct 10% from retail price. Please allow 6-8 weeks for delivery.



American
Association
for the
Advancement
of Science



Shedding new light on a darkfield problem

... with Bausch and Lomb's New Balplan[®] Fluorescence Microscopes.

It took Bausch and Lomb to design fluorescence microscopes with the features and performance you'd only expect to find in models costing up to thousands of dollars more. That's why we say that no competitively priced microscope will help you see better or perform incident and darkfield fluorescence tests easier than the New Balplan Incident and Transmitted Light Fluorescence Microscopes.

SEE FOR YOURSELF. The best way to appreciate superior Bausch and Lomb craftsmanship and engineering is to test one for yourself. First, notice that our microscope looks good. It should. Because Balplan Fluorescence Microscopes are designed especially for fluorescence testing. Nothing is "added on." And that means unmatched stability for total image clarity. Now look into our microscope at the widest field of view you can find in fluorescence anywhere . . . 20mm flat fields, in-focus from edge-to-edge. In addition, you see brighter images through

our multi-film optical coatings that greatly improve light transmission.

BALPLAN FLEXIBILITY SAVES YOU MONEY. Some ImmunoFluorescence tests can best be performed with the new, efficient incident light techniques. Others still require transmitted light. With our exclusive Balplan modular design, one basic microscope can be equipped to handle both incident and transmitted light techniques using only one lamphouse . . . and the cost is far below the price of two microscopes.

EASY TO USE. With some microscopes, transmitted light testing can be very messy and time consuming. That's why Bausch and Lomb offers our "quickset substage auto-focus stop" that prevents slide popping and provides just the right amount of oil contact every time. There's even a handy condenser oil well that catches excess drippings.

And for incident light use, the New Balplan Fluorescence Microscope gives you totally

efficient operation and bright, sharp images, especially at high powers.

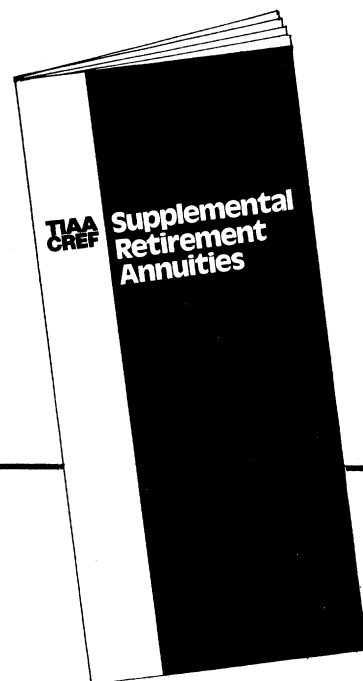
CONVENIENCE BUILT-IN. The New Balplan Fluorescence Microscopes are engineered to take the guesswork and inconvenience out of fluorescence testing. From cool running, interchangeable 50W UV/100W T-H lamphouses and reversed nosepieces that make slide handling easier, to luminous raised dot indicators that help you select proper filter combinations quickly and accurately, our microscopes let you do your job with less hassle . . . at a price that's surprisingly affordable. Find out more about these remarkable new microscopes today. Just write or call your nearest Bausch and Lomb dealer for additional information or a demonstration.

BAUSCH & LOMB
Scientific Optical Products Division

**Image
Excellence**

Write Bausch & Lomb, Scientific Optical Products Division, N. Goodman St., Rochester, N.Y. 14602.
Available on GSA contract. Consult the Yellow Pages for your local Authorized Bausch and Lomb dealer.
Circle No. 62 on Readers' Service Card

TIAA-CREF Supplemental Retirement Annuities



for tax-deferred annuity programs

Supplemental Retirement Annuities (SRA's) are new forms of TIAA and CREF contracts designed expressly for use by persons who want to set aside tax-deferred retirement funds over and above amounts being accumulated under their institution's basic retirement plan. They are available for employees of colleges, universities, private schools and certain other nonprofit educational organizations with tax-deferred annuity (salary-or-annuity option) programs. Through a properly drawn agreement with their institution, staff members may divert part of their compensation before taxes to the purchase of these new contracts.

And SRA's are cashable at any time. This means that if the money accumulated by salary reduction is needed before retirement, the SRA contracts can be surrendered for their cash value. Benefits, whether payable in cash or as income, are taxable as ordinary income when received.

For more information and answers to questions send for your copy of the booklet on Supplemental Retirement Annuities.

Send me a booklet describing
TIAA-CREF Supplemental Retirement Annuities.



Name _____ Date of Birth _____

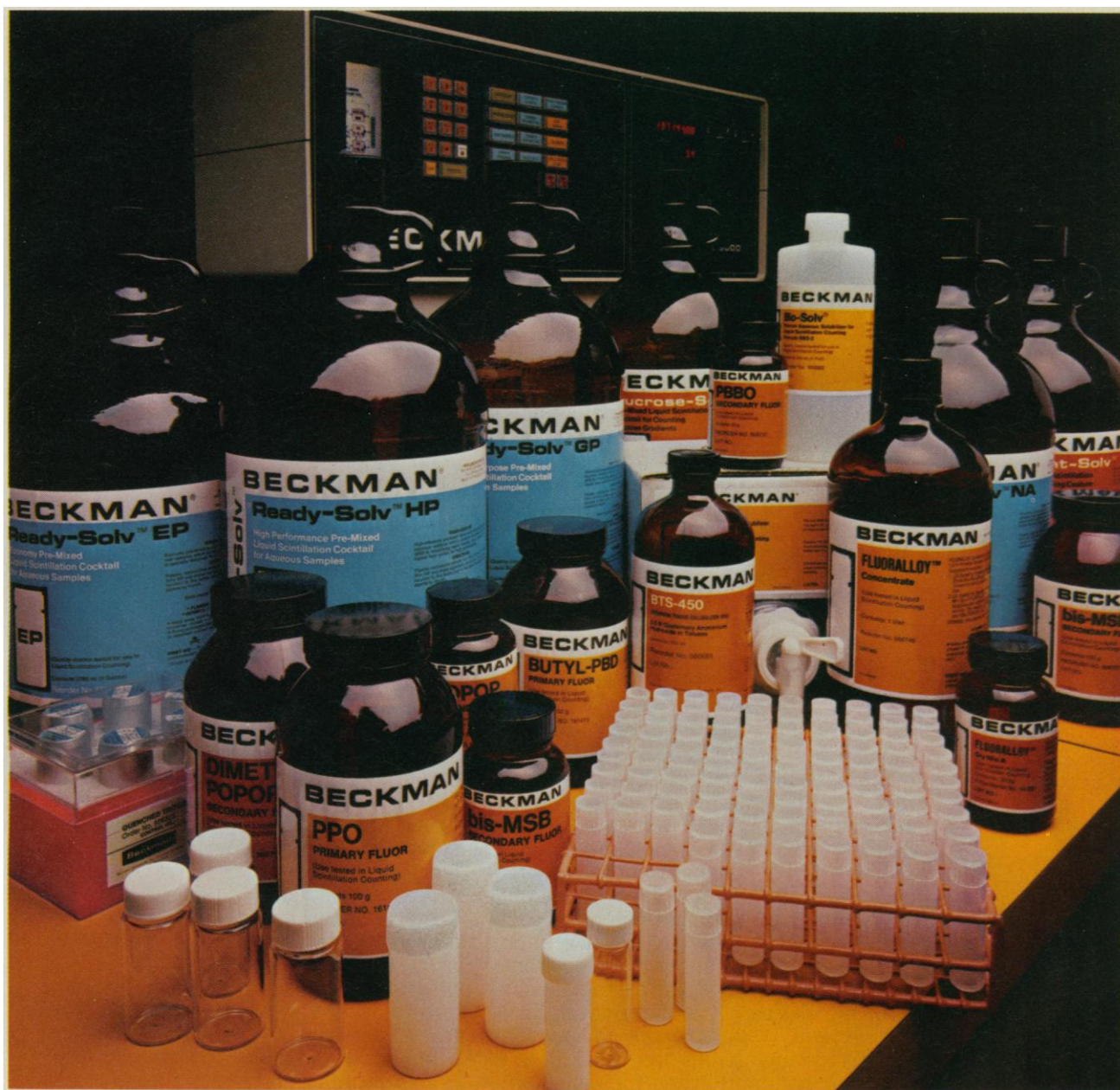
Address _____
Street

City _____ State _____ Zip _____

Nonprofit
Employer _____

Teachers Insurance and Annuity Association
730 Third Avenue, New York, New York 10017

wi



Why are the world's most advanced LS instruments tested with these nuclear supplies?

The Beckman total nuclear supply capability evolved along with our LS counting instruments to give us a constant source of

fully quality-controlled cocktails, solubilizers and counting vials.

Today, the same supplies we used in our own state-of-the-art instrument R&D programs are available to LS researchers nationwide.

And whether or not you own a Beckman Instrument you'll benefit from optimized counting efficiencies, superior reliability, and the convenience of one expert source for all your nuclear needs.

Right now, orders of premixed cocktails, cocktail ingredients, and counting vials are available with 24-hour response times from a national network of

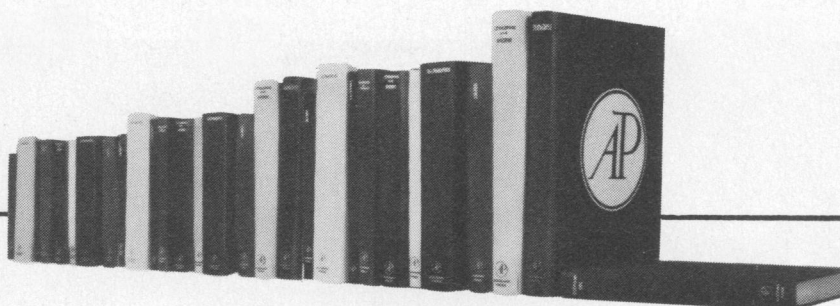
shipping depots. And major cost reduction programs have been designed to meet the individual requirements of research facilities both small and large.

So contact your local Beckman representative now and ask about our special nuclear supplies introductory programs.

Or contact Scientific Instruments Division, Beckman Instruments, Inc., P.O. Box C-19600, Irvine, CA 92713.

Innovation you can count on.

BECKMAN®



CELL BIOLOGY

A Comprehensive Treatise

VOLUME 2/STRUCTURE AND REPLICATION OF GENETIC MATERIAL

Edited by DAVID M. PRESCOTT and LESTER GOLDSTEIN

FROM THE PREFACE:

Cell biology is now a truly mature science; research that a decade or two ago appeared to be aimless gropings into the unknown has now to a great extent been replaced by theoretically well-grounded investigations that provide useful answers to questions on cell function. Moreover, contemporary investigations can draw on a large resource of well-documented facts about

cells. This is a comprehensive treatise on cell biology that will serve for the next decade or two as a single source of information on many areas of this discipline. *Cell Biology* should be a source of fundamental knowledge for graduate students, investigators working in peripheral areas, and for anyone else in need of information on some particular phase of cell biology.

1977, in preparation ISBN: 0-12-289502-9

ASBESTOS AND DISEASE

By IRVING J. SELIKOFF and DOUGLAS H. K. LEE

A Volume in the ENVIRONMENTAL SCIENCES Series

Asbestos and Disease presents a comprehensive, critical review of current knowledge on the relationship of exposure to asbestos and the subsequent development of disease. Based on the authors' extensive investigations over more than fifteen years at Mount Sinai School of Medicine, the book sets forth a model approach to consideration of disease production by an environmental agent. Proceeding systematically from the extraction and processing of the mineral, it goes on to review the various manufacturing processes of asbestos and opportunities for exposure; its distribution in the environment; the etiology, prevalence, and clinical features of the resultant disease processes; the cellular mechanisms of pathogene-

sis; and the various legal and engineering procedures involved in prevention and control. Criteria for establishing cause-and-effect relationships of a presumptive agent are developed by modifying and extending Koch's postulates to meet multifactor situations. On the basis of these criteria the authors establish the etiology of four pathogenic processes—parenchymal asbestosis, pleural asbestosis, mesothelioma, and asbestos-associated carcinoma. The text is supplemented by more than 800 references and is illustrated with diagrams, graphs, microphotographs, and radiographs, including four pages in color.

1978, 544 pp., \$39.50 ISBN: 0-12-636050-2

Benchmark Papers In Behavior, A Benchmark® Book Series, Volume 12

CRITICAL PERIODS

Edited by JOHN PAUL SCOTT

SECTION HEADINGS: Critical Periods in Embryonic Development: Discovery of the Phenomenon and Early Statements of the Concept. Critical Periods in Behavioral Development. Critical Pe-

riods in the Development of Social Attachment. Critical Periods for Learning. Critical Periods in Physiological Organization. The Theory of Critical Periods.

1978, 400 pp., \$29.50 ISBN: 0-12-787453-4

Published by Dowden, Hutchinson & Ross, Inc.

Distributed Worldwide by Academic Press, Inc.

Send payment with order and save postage and handling charge.

Prices are subject to change without notice.

Academic Press, Inc.

A Subsidiary of Harcourt Brace Jovanovich, Publishers

111 FIFTH AVENUE, NEW YORK, N.Y. 10003
24-28 OVAL ROAD, LONDON NW1 7DX

FPS Expands the Scientific Universe of PDP-11 Applications



FPS MAKES GREAT COMPUTERS BETTER

The FPS AP-120B Array Processor

A great contribution to technology, the DEC PDP-11*, but it can't give you the computational power required for many scientific applications. That's why FPS developed the AP-120B Array Processor.

The AP-120B Array Processor gives economical minicomputer systems the extraordinary computational power of large scientific computers. For example, an AP-120B has been used in a PDP-11/34 system to reconstruct and analyze complex digital images. Without the AP-120B, the task would take more than two hours. With the AP-120B, it takes less than thirty seconds — that's a 240X improvement!

A PDP-11/70 and AP-120B would offer

even greater data handling capabilities.

The FPS architecture is no secret. Internally synchronous operation and seven parallel data paths provide unequalled cost/performance, reliability, and programmability. Programmable I/O units also enable exceptional features, such as direct control of disc storage and real time data flow.

Controlled by simple subroutine calls from a FORTRAN program in the PDP-11, or other host computer, FPS Array Processors can be programmed by selecting routines from the extensive FPS Math Library, by writing new routines in the relatively simple AP Assembly Language, or through use of the AP FORTRAN Compiler.

Hundreds of FPS Array Processors are in use today by people who want to retain the hands-on control and affordability of a minicomputer system, but require the exceptional throughput of a large mainframe for their application.

Find out how this new power in computing (typically under \$50K complete) can benefit your application. For more information and an FPS Array Processor brochure, use the reader response number or coupon below. For immediate consultation, contact Floating Point Systems directly.

*DEC and PDP-11 are registered trademarks of Digital Equipment Corporation.

Circle No. 125 on Readers' Service Card

The Age of Array Processing Is Here... and FPS Is The Array Processor Company.



CALL TOLL FREE 800-547-9677
P.O. Box 23489, Portland, OR 97223
TLX: 360470 FLOATPOINT PTL
In Europe & UK: Floating Point Systems, SA Ltd.
7 Rue du Marche, 1204 Geneva, Switzerland
022-280453, TLX: 28870 FPSE CH

Floating Point Systems, Inc.

FPS Sales and Service Worldwide: Boston, Chicago, Dallas, Denver, Detroit, Houston, Huntsville, Los Angeles, New York, Orlando, Ottawa, Philadelphia, Portland, San Francisco, Washington, D.C. International offices: Geneva, London, Munich, Paris, Tel Aviv (Eastronix, Ltd.), Tokyo (Hakuto Co. Ltd.)

Please send me an FPS Array Processor brochure.

Name Title

Company Phone

Address

City State Zip

My Computer System is My Application is

It's not an easy puzzle!

HEALTH CARE: REGULATION, ECONOMICS, ETHICS, PRACTICE

Physicians have at their command a continually improving understanding of many facets of health care. New diagnostic techniques, including powerful instrumentation, have become available. Progress has been especially marked in treatment and research bearing on mental illness. The use of antibiotics, immunization, and detection of genetic defects has become commonplace. But these are just a few of the many pieces that one must fit together to form the complete picture of health care and maintenance in the United States today.

The 39 chapters in **HEALTH CARE: REGULATION, ECONOMICS, ETHICS, PRACTICE**, the seventh publication in the AAAS Science Compendia Series, will help the professional and lay person understand not only recent advances in medical practice, but also the hidden yet vital pieces of our health care system. What is, or should be, the role of government in regulating and funding medical care and research? Can we as a nation afford health care for all? Does public education and preventive medicine lower costs while improving the general level of well-being? What are the problems in evaluating new techniques, new trends? What are the ethical questions involved in medical practice and research?

Each of us—policymaker, physician, technician and lay person—controls a sizable portion of the entire picture. **HEALTH CARE: REGULATION, ECONOMICS, ETHICS, PRACTICE** helps define and clarify the many pieces of the health care puzzle.

HEALTH CARE: REGULATION, ECONOMICS, ETHICS, PRACTICE—essential reading for both the providers and the recipients of health care today.



To order your individual copy of **HEALTH CARE: REGULATION, ECONOMICS, ETHICS, PRACTICE** send your name and address to AAAS.

Department HC-1, 1515 Massachusetts Avenue, NW, Washington, DC 20005.
Remittance must accompany all orders under \$10.00. Please allow 6-8 weeks for delivery.

Casebound \$14.00 Paperbound \$6.00 AAAS members deduct 10%

THINK BAUSCH & LOMB

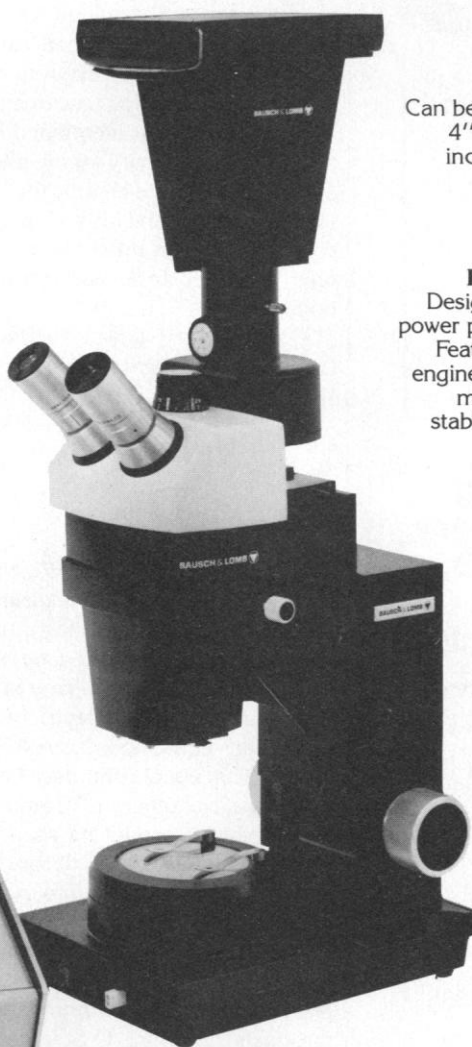
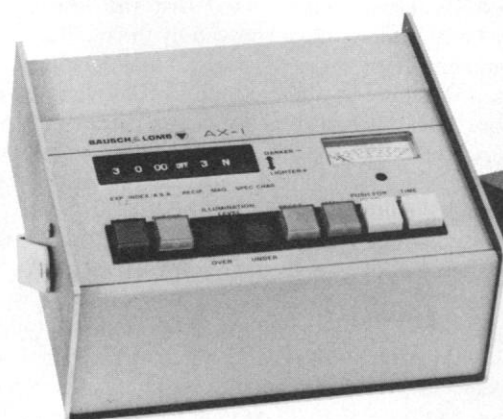
...when your research demands the total package
of precision components for lifelike stereoscopic viewing
and photomicrographic documentation.

StereoZoom 7 Power Pod.

The heart of the optical system featuring brilliant, high resolution imagery and a wide, 2.5× to 280× magnification range. Unique flip-flop mirror system lets you study your specimen through the eyepiece even while you photograph it.

AX-1 Automatic Exposure Controller.

Takes the guesswork out of selecting proper camera settings and exposure times. No more wasted film or lost photographs.



StereoZoom 7
Photomicrographic
Microscope System

Choice of Camera Attachments.

Can be used with 3¼" x 4¼" x 4" x 5" or 35mm formats, including almost every SLR camera available today.

Heavy-Duty "R" Stand.

Designed specifically for high power photomicrographic work. Features the same advanced engineering of the BALPLAN™ microscope stand for total stability and precise focusing action.

WRITE US . . .

and ask for a demonstration or complete information. Or call your nearest authorized Bausch & Lomb dealer. Consult the Yellow Pages under "Microscopes".

ROCHESTER, NEW YORK 14602 USA, 716-338-6000, TWX 510-253-6189, TELEX 97-8231, CABLE: BAUSCH & LOMB

BAUSCH & LOMB 
Scientific Optical Products Division

Free New Catalog

**J.T. Baker,
the world's leading
supplier of high-quality
laboratory reagents,
now offers 3300
high-quality reagents
for the bioscientist.**



J.T. Baker Chemical Company
Phillipsburg, New Jersey 08865

Name	_____
Title	_____
Dept.	_____
Organization	_____
Address	_____
Telephone	_____ Zip _____
Area Code	_____

Circle No. 23 on Readers' Service Card

LETTERS

Guayule Development

I share the concerns expressed by some of those interviewed for William J. Broad's article on guayule commercialization (News and Comment, 27 Oct., p. 410). Had I been asked to respond to these concerns, I would have mentioned plans for a vigorous oversight and a quick transfer to the private sector as soon as needed basic feasibility and process improvement research has been done. I would also have pointed out that the funding of this program at \$30 million over 4 years is \$20 million less than the congressional budget office estimate of funding necessary to carry out the original commercialization research program.

On another point mentioned in the article, the only activity taking place in my district that may be eligible for funding is plant research, and this is subject to a competitive grant process that is, thankfully, removed from political manipulation.

GEORGE E. BROWN, JR.
*U.S. House of Representatives,
Washington, D.C. 20515*

Nuclear Power Economics

A. D. Rossin and T. A. Rieck, in their article "Economics of nuclear power" (18 Aug., p. 582), have shown that nuclear power plants installed by the Commonwealth Edison Company in the early 1970's are producing electricity at lower cost than contemporaneous fossil-fuel plants. This conclusion may be of interest to the customers of Commonwealth Edison, but it should be accorded little weight in the national debate over the merits of building *additional* power reactors.

The relative costs of Commonwealth Edison's existing nuclear and coal-fired plants are grossly unrepresentative of the costs of future U.S. plants for the following reasons.

1) Commonwealth Edison's six major nuclear units were completed in the years 1970 through 1974, and thus predate the cost escalation that has befallen nuclear plants starting in the middle 1970's. Indeed, four units (Dresden units 2 and 3 and Quad Cities units 1 and 2) were "turnkey" units subsidized by General Electric to stimulate the reactor market. Rossin and Rieck state in their table 1 that the average cost of the six units was only \$200 per kilowatt of ca-

capacity. Yet nuclear plants completed in the United States during 1975 through 1977 had an average cost of roughly \$500 per kilowatt (1, table 1), indicating a 150 percent cost increase in only a 4-year period (87 percent in constant dollars). This exceeds the escalation in coal capital costs, the addition of scrubbers notwithstanding.

2) Commonwealth Edison frequently operates its coal units at reduced levels when electric demand is low, in deference to nuclear units with lower running costs. This inflates the per-kilowatt-hour fixed charges for coal units presented by Rossin and Rieck. Future coal units of other utilities are less likely to "load follow" to such an extent because of lower reserve margins, lesser percentages of nuclear capacity, and efforts to better manage loads presently under way or planned. Moreover, Commonwealth Edison's coal units are out of service more frequently than comparable units of other utilities (2), further inflating their fixed charges per kilowatt-hour.

3) Because of the several-year lead time in nuclear fuel procurement, Rossin and Rieck's fuel cost data capture little of the recent increases in the costs of uranium ore and enrichment, while reflecting nearly all of the increase in coal prices which followed the 1973-74 oil embargo.

In short, Rossin and Rieck's article is but one of many attempts to premise future energy policy on historical data that bear little relation to economic reality at the margin of selection of energy technology. A more realistic appraisal of the economics of nuclear power would have emphasized that the low capital costs once enjoyed by the nuclear industry are unavailable to new plants, largely because of the proliferation of expensive safety measures necessary to correct deficiencies revealed by operating units. Such an analysis would have acknowledged that the average cost of nuclear plants completed in 1974-77 was 73 percent greater than that of coal plants in the same period (1, p. 1) (Rossin and Rieck project future nuclear capital costs to be only 8 percent higher than those of coal, even though scrubbers add only 15 to 20 percent to coal costs while cost-increasing regulatory requirements are continuing to be added for nuclear plants).

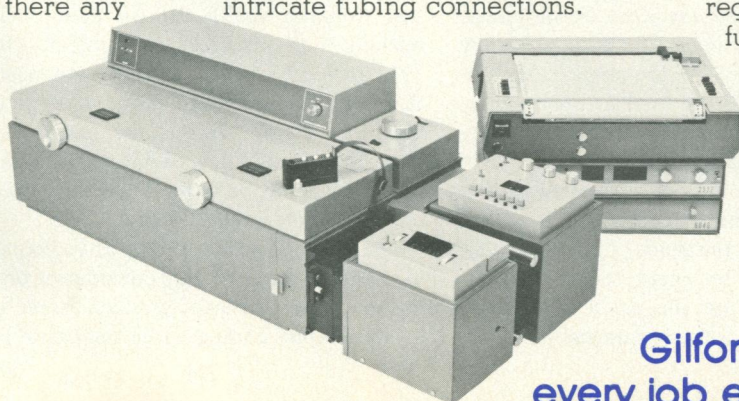
Projection of either a 40 percent capital cost differential or a 10 percentage point capacity factor differential, both of which appear conservative based on recent data (3), eliminates the cost advantage projected for future nuclear plants

For temperature-dependent assays like this thermal melt, temperature control is as vital as photometric accuracy.

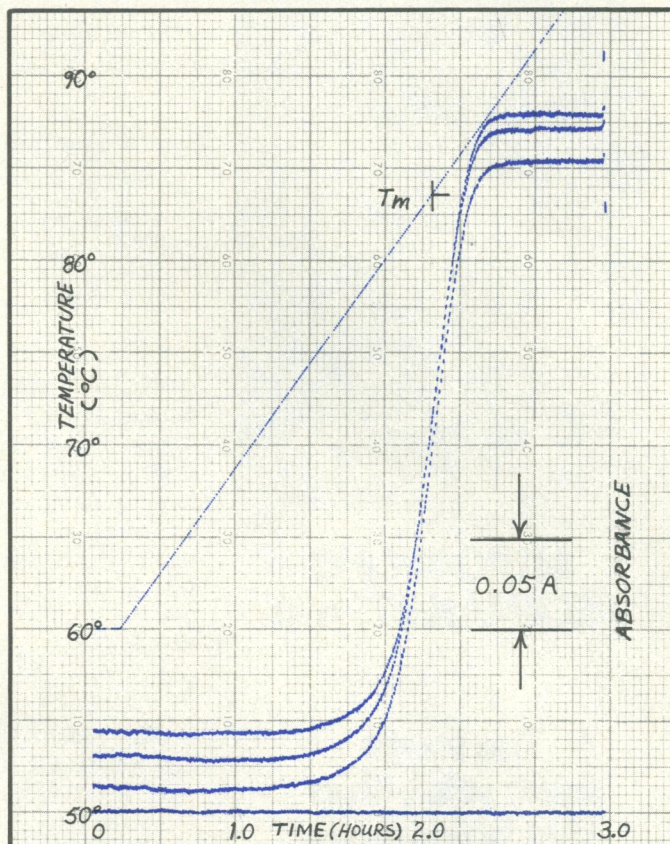
Gilford's new Thermoprogrammer is an all-electronic system for maintaining or scanning temperature anywhere in the 0 - 100°C range.

Convenient Sample Handling

Individual quartz cuvettes, easy to fill and empty, are available in sizes selected for thermal melts, enzyme analysis, microtubule studies, and similar applications. Setup is easy: for fixed temperatures, you adjust two controls; for scanning, you just set the limits for the required temperature range and select scan speed -- 0.25, 0.5, or 1.0°C per minute. And with thermoelectric sample temperature control, you use neither heated nor refrigerated circulating baths, nor are there any intricate tubing connections.



Three simultaneous assays of *M. lysodeikticus* DNA versus a buffer blank at 260 nm. Calculated T_m was 83.75°C, with all three samples agreeing within $\pm 0.04^\circ\text{C}$. The Thermoprogrammer, using quartz cuvettes, provided linear temperature scanning at 0.25°C per minute, with the Reference Compensator producing the indicated baseline flatness. The Analog Multiplexer allowed recorder presentation of temperature and absorbance.



Significant Savings in Time

You no longer wait for temperature of a circulating liquid to stabilize; thermoelectric control is much faster. Samples from the refrigerator reach operating temperature in seconds. You can reduce temperature quickly -- as fast as 28°C per minute -- and change from 4°C to 37°C and back to 4°C in as little as a minute and a half.

Greater Accuracy

Thermoelectric (Peltier) devices in close contact with the sample provide surer, quicker heating and cooling, faster response. Continuously displayed to within 0.1°C, temperature is regulated to within $\pm 0.05^\circ\text{C}$ regardless of ambient temperature or humidity. For further convenience, there are outputs for monitoring temperature on a printer or multiplexing it in sequence with absorbance on a recorder.

gilford
INSTRUMENT

Oberlin, Ohio 44074
Paris (Malakoff), France
Düsseldorf, W. Germany
Teddington, Middx., England
(216) 774-1041 Telex: 98-0456

Circle No. 78 on Readers' Service Card

**Gilford Research Spectrophotometers:
every job easier, every result more accurate**



INTRODUCING BECKMAN BTS-450.

The tough tissue solubilizer that holds more than its own.

To solubilize tough tissue such as nerve fiber, hair and cartilage, you need a tough tissue solubilizer. To eliminate phasing, you need a solubilizer with high water-holding capacity. Enter Beckman's new BTS-450, the rapid, reliable and economical digester. Ideal for a wide variety of proteinaceous tissue and tissue homogenates, including the difficult ones. As well as polyacrylamide gel applications. One ml dissolves up to 450mg of water. And samples solubilized with BTS-450 are perfectly suited for use with Beckman's READY-SOLV™ NA liquid scintillation cocktail or other toluene-based cocktails.

Twenty-four hour response time from Beckman's national network of shipping depots guarantees prompt delivery. And Beckman's money-back offer guarantees satisfaction. Call your local Beckman representative or write: Scientific Instruments Division, Beckman Instruments, Inc., P.O. Box C-19600, Irvine, CA 92713. **Innovation you can count on.**

BECKMAN

Circle No. 92 on Readers' Service Card

820

by Rossin and Rieck, in nearly all regions. Projection of *both* differentials puts nuclear at a decided disadvantage vis-à-vis coal.

CHARLES KOMANOFF
Komanoff Energy Associates,
475 Park Avenue South,
New York 10016

References

1. C. Komanoff, "An analysis of nuclear and coal capital costs," (Komanoff Energy Associates, New York, 17 July 1978).
2. —, *Power Plant Performance*, (Council on Economic Priorities, New York, 1976), pp. 88 and 98.
3. —, *Nuclear Plant Performance Update 2* (Komanoff Energy Associates, New York, June 1978), chap. 6.

Rossin and Rieck have done an excellent job presenting the economics of nuclear power.

Now if they would explain to utility customers just why those utilities which have concentrated on nuclear power command higher rates compared to those whose power is derived mainly from coal.

GEORGE A. HUHN
Waterloo and Beaumont Roads,
Devon, Pennsylvania 19333

The economics discussion in our article was clearly divided into two distinct parts: actual historical costs and the best estimated future investment and energy costs for nuclear or coal plants that might be ordered today.

In previous articles (1) we have criticized Komanoff's use of historical data. Commonwealth Edison's actual experience is useful; it tells us how regulations and costs are changing, as well as that capacity factors for coal and nuclear units are not likely to be vastly different.

Responding to Komanoff's points:

1) It is no secret that costs on the Dresden and Quad Cities "turnkey" (fixed-price) projects exceeded their price, and therefore the manufacturer paid a portion of the cost. Perhaps Commonwealth Edison's management in the 1960's (before we joined the company) deserves plaudits because the result has been substantial savings to our customers.

We compared the cost of our large units by correcting for inflation as if they all had been built in the same year. The result *increases* the nuclear cost *advantage* by an additional 1 mill per kilowatt-hour (2). In addition, the data we gave in the article (investment per kilowatt in table 1 and annual carrying charges in table 2) allows the reader to test the sensitivity of current energy costs to whatever price he or she wishes to hypothesize for the turnkey contracts.

2) Commonwealth Edison reduces the power output of its large coal units occasionally when the load is lighter. We have attempted to calculate the effect on coal unit capacity factors, but it is complex because the output of these units is controlled to the second by the load dispatcher's computer to minimize system generation costs. Obviously, we regulate the coal units because they are more costly to run than the nuclear units. Our figure 1 showed clearly that, even with much higher capacity factors, our coal units can hardly match the nuclear units. As we pointed out, our objective is economical electric power from a *system*, not high capacity factors per se. Actually, any future coal units Commonwealth Edison purchases will be designed for cycling service.

The extent to which certain coal units were out of service in past years reflects operating problems related to weather and the use of equipment to handle and burn coal. For our future plant cost estimates we assumed equal capacity factors for coal and for nuclear units.

3) Komanoff adds emphasis to an inherent advantage of nuclear power. Because mining and fabrication take a year and the fuel spends 3 to 7 years in the core, nuclear fuel cost increases take several years to flow through to the customer. Escalation in coal costs hits the consumer within weeks. Thus nuclear has an inherent advantage during a period of inflation. However, our assumptions for future fuel costs do not use this advantage for nuclear because our tables 7 and 8 on fuel costs are in constant 1977 dollars.

As to his last point, Komanoff is right: it would take a 40 percent increase in nuclear capital cost relative to coal (highly unlikely with scrubbers) or a net change of 10 percentage points in capacity factor difference in favor of coal (which is more likely to go the other way) to bring projected costs of coal power *down* to be equal with nuclear in our region of the country!

Huhn asks about electricity rates. We explained in our article why our customers pay less than they would be paying had Commonwealth Edison built coal-burning units instead of nuclear. (In 1977 this added cost would have been \$200 million—10 to 15 percent of each customer's bill.) This is the real question Huhn should ask: What rates would nuclear utilities have to charge had they *not* built their nuclear plants?

The report (3) Huhn may be referring to misleads the reader by considering only those rate increases granted formally by state utility commissions and omitting

SCIENCE, VOL. 202

the portion of the rates resulting from the fuel adjustment clause. This portion reflects fossil fuel cost increases and forms a significant part of the rates in most states.

Of real importance is the price the ratepayers actually had to pay for electric service. Over the 5-year period from 1972 through 1977, electric rates rose dramatically. The primary driving force was the sudden increase in oil prices. Increases in coal and uranium prices followed. (Those few utilities that could meet their entire needs from existing hydroelectric power stations were protected from these increases.) The average annual price increase to the electric utility consumer (per kilowatt-hour used) over this 5-year period is shown below (4).

Nuclear (%)	Average annual increase to rate payer (%)
>50	8.9
>33	10.5
>25	12.2
>15	12.4
All utilities	12.6

At rate hearings, consumers tell us that what they are most concerned about is the price they actually pay for their electricity.

A. DAVID ROSSIN
TERRANCE A. RIECK

Commonwealth Edison Company,
Post Office Box 767
Chicago, Illinois 60690

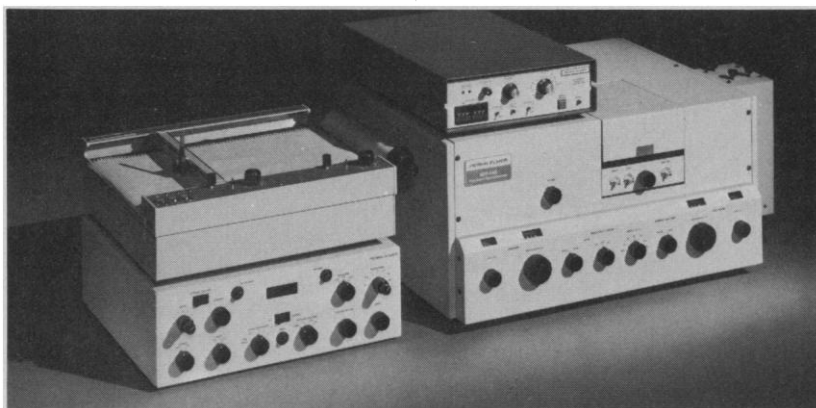
References

1. A. D. Rossin, T. A. Rieck, D. J. Legenski, G. B. Ackerman, "A critique of the report 'Power plant performance'" (30 November 1976) (available from A.D.R.); *Public Util. Fortnight.*, 16 March 1978, p. 37.
2. A. D. Rossin, "Reliability and economics of nuclear power" (ANS White Paper, American Nuclear Society, 555 North Kensington, La Grange, Ill., 1975).
3. "Nuclear power boosts electric bills, study shows" (news release) (Critical Mass Energy Project and Environmental Energy Project, Washington, D.C., 30 June 1978); "Nuclear power and utility rate increases" (Critical Mass Energy Project and Environmental Energy Project, Washington, D.C., 1978).
4. F. T. Stetson (Infowire, Atomic Industrial Forum, Washington, D.C., 6 July 1978); "Comments on the report of the Critical Mass Energy Project and Environmental Action Foundation entitled 'Nuclear power and utility rate increases,'" (Edison Electric Institute, New York, 8 July 1978).

The Free-Electron Laser

I would like to comment on the article "Seeing with a new light: Synchrotron radiation" by R. E. Watson and M. L. Perlman (24 Mar., p. 1295). Although it provided an excellent review of synchrotron radiation, there was a point of

HOW WE MADE THE BEST IN FLUORESCENCE BETTER.



INTRODUCING THE MPF-44B.

For years, no other research grade fluorescence instrument could touch our Model MPF-44A in performance, operating convenience, or dollar value.

That's why the new MPF-44B is so important. In addition to its predecessor's proven advantages, it brings to you benefits that are the product of our long-time experience.

New optics and electronics.

The 150W xenon lamp is ozone-free, hermetically sealed in a special ceramic housing. For optimum efficiency, it's easy to focus. For better performance, both monochromators have a new high-efficiency grating which results in a significant improvement in sensitivity.

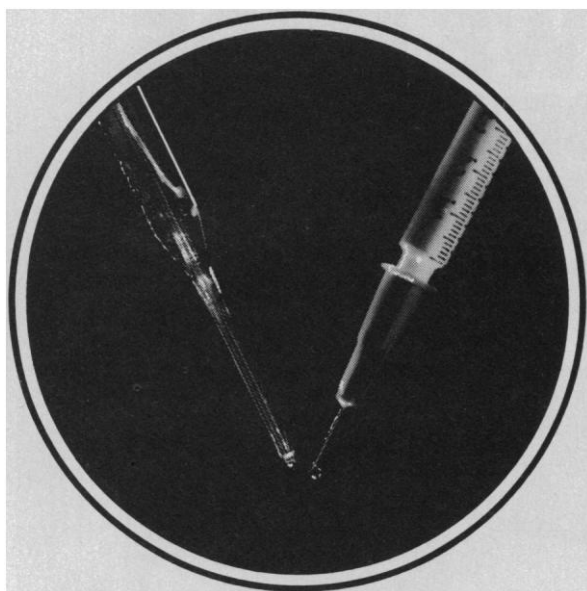
The 3½-digit display gives you instantaneous readings of fluorescence intensity, dynode voltage or concentration readout. Integration circuitry permits high-precision intensity measurement by averaging readings accumulated over selected time periods. And there's an X-Y recorder interface with a built-in time drive and X-coordinate expansion capability.

The new DCSU-2. This advanced differential corrected spectra unit is a microprocessor accessory with many capabilities. Besides corrected and differential spectra, it gives you automatic polarization and anisotropy spectra or calculations, plus first and second derivative spectra.

More accessories. You can add more than 20 other accessories to the MPF-44B to widen its range. You can convert it to an LC detector, select TLC, low temperature luminescence (phosphorescence), polarization, and solid sampling, for example. All the MPF-44A accessories will work on the MPF-44B.

Compare and decide. Send for our literature on the MPF-44B and compare it with any other fluorescence spectrophotometer, feature by feature. If you have any questions about a specific application, call us now at (203) 762-6095. Or write Perkin-Elmer Corp., MS-12, Main Ave., Norwalk, CT 06856.

PERKIN-ELMER
Expanding the world of analytical chemistry.



The only combination
electrode probe available
to measure pH of droplets
at the source!

A NEW
TECHNOLOGY
FOR
pH AND IONS

MICROELECTRODES, INC.
Grenier Industrial Village, Londonderry, New Hampshire 03053 USA (603)668-0692

Circle No. 115 on Readers' Service Card

PHORBOL ESTERS for TUMOR PROMOTION studies (prices effective Jan. 2, 1979)

PHORBOL-12-MYRISTATE-13-ACETATE	10 mg	\$40.00
(ALSO: PMA or TPA); highly potent tumor promoter and mitogen; active principle of croton oil	50 mg	\$180.00
	1000 mg	\$3400.00
PHORBOL-12,13-DIDECANOATE	10 mg	\$40.00
(ALSO: PDD) potent tumor promoter and mitogen		
Phorbol	10 mg	\$25.00
	1000 mg	\$2125.00
Phorbol-12-monoacetate	10 mg	\$45.00
Phorbol-13-monoacetate	10 mg	\$40.00
Phorbol-12,13-diacetate	10 mg	\$40.00
Phorbol-13,20-diacetate	10 mg	\$40.00
	50 mg	\$180.00
	1000 mg	\$3400.00
Phorbol-12,13,20-triacetate	10 mg	\$40.00
Phorbol-12-monomyristate	10 mg	\$45.00
Phorbol-12,13-dibenzoate	10 mg	\$40.00
Phorbol-20-oxo-20-deoxy-12-myristate-13-acetate (also: 20-oxo-PMA)	10 mg	\$60.00
Phorbol-12-monodecanoate	10 mg	\$45.00
Phorbol-13-monodecanoate	10 mg	\$45.00

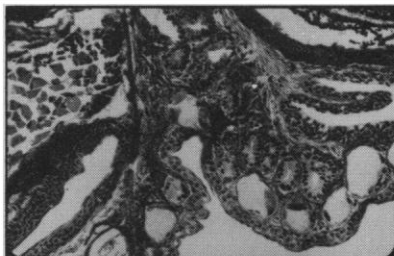
Peter Borchert, Dipl.-Chem., Ph.D.
Chemist & Oncologist

Consultant for
CHEMICAL CARCINOGENESIS

7752 Mitchell Road
Eden Prairie, Minnesota 55344

Lab: 944-3171
612- or 376-1330

Circle No. 153 on Readers' Service Card



Cat tongue, cross-section
of glandular tissue.

This is the most versatile research microscope system ever developed. Naturally, by Olympus. Modern design, rugged squareline stand with the broadest choice of application-oriented options that let you custom-design your microscope to your need.

Choose transmitted and/or reflected light, bright or dark field, phase contrast, polarized light, fluorescence, differential interference contrast or Hoffman

modulation contrast. Select a tungsten, halogen or mercury arc light source.

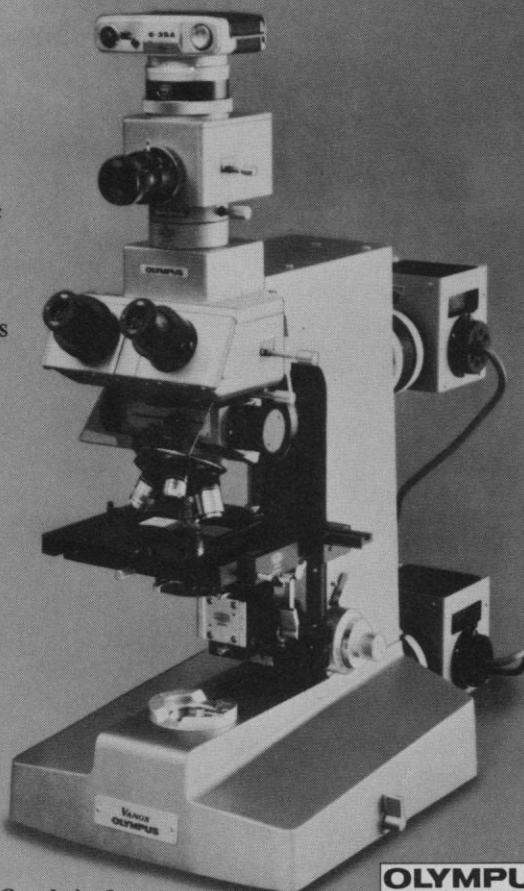
Use any of a wide range of color-corrected, hard coated achromats, fluorites, apochromats or plan achromats. Or combine with our automatic camera system, the PM-10.

It's a virtually unlimited system designed with you and your applications in mind. And all this at unprecedented economy. For complete details, write: Olympus Corporation of America, 4 Nevada Drive, New Hyde Park, N.Y. 11040.

The Olympus Vanox.

Modular concept, universal research microscope system.

In Canada: W. Carsen Co., Ltd., Ontario.



OLYMPUS
SEEING BEYOND MAN'S VISION

misinformation. Watson and Perlman stated: "There has been an attempt at Stanford University to induce laser action in such a device . . ." [a helical magnet]. I wish to point out that, contrary to the implication of the article, the "attempt" was successful. The free-electron laser has been run successfully both as a laser amplifier (1) and as a laser oscillator (2, 3). Perhaps the most noteworthy result of the experiment was the power output, which exceeded the spontaneous synchrotron radiation by a factor of 10^8 when the laser was run above threshold. We note that these results were reported in the reference (2) to the free-electron laser cited by Watson and Perlman.

JOHN M. J. MADEY

Department of Physics,
Stanford University,
Stanford, California 94305

References

1. L. R. Elias, W. M. Fairbank, J. M. J. Madey, H. A. Schwettman, T. I. Smith, *Phys. Rev. Lett.* **36**, 717 (1976); *Phys. Today* **29**, 17 (February 1976).
2. D. A. G. Deacon, L. R. Elias, J. M. J. Madey, G. J. Ramian, H. A. Schwettman, T. I. Smith, *Phys. Rev. Lett.* **38**, 892 (1977).
3. *Sci. Am.* **236**, 63 (June 1977).

Curve-Fitting

The rather fanciful curve-fitting of Roubik (Reports, 15 Sept., p. 1030, Fig. 1) has prompted me to propose an alternative interpretation of his data (see below).

ROBERT M. HAZEN

Geophysical Laboratory,
Carnegie Institution of Washington,
Washington, D.C. 20018

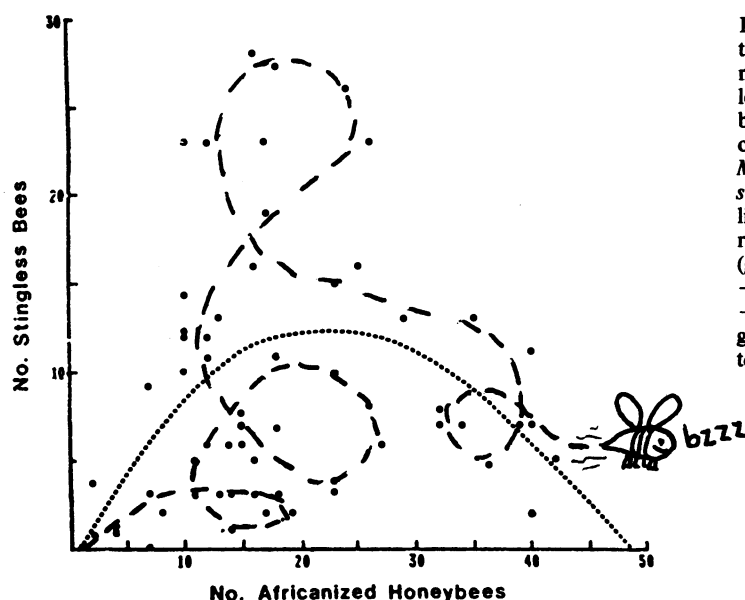
I applaud Hazen's skepticism about the validity of the fitted curve. The curve is a broken line. Conventionally, this means that it is not a statistically significant predictor of the exact value of the y-variable as a function of the x-variable, as stated in my reference 7. The utility of this graph is certainly not to be found in the expected wide values it generates, but rather in the biological information it contains.

The statistical facts on which my conclusions rest are given as the results of the analyses of variance of forager numbers in patches of flowers in my experiments. Supplemental information is provided in the graph of bee abundances on *Melochia villosa*. This is useful because it (i) shows the numbers of bees actually counted; (ii) gives the reader a picture of forager dynamics on this flowering plant; (iii) contrasts with the straight lines, fitted by using the same computer program, to bee abundances where analysis of variance did not reveal the effect of competition; and (iv) provides a fitted curve that shows the general trend in the scatter of points.

My intention was to present the facts in a straightforward manner, not to give a mathematical formula to predict the densities of bees in this patch of flowers. When confronted with an array of points with a line drawn through it, I too am thoughtful about the significance of that line. Graphical analysis is a heuristic tool. And, judging from the alternative interpretation of my data given by Hazen, it is often most reasonably performed with the aid of a computer.

DAVID W. ROUBIK

Department of Entomology,
University of Kansas, Lawrence 66045



Counting a gel is like choosing a wine

You may not get a satisfactory result unless you know your polymers as well as your vineyards. Yet the number of different gels used for electrophoresis in biomedical research is almost infinite. So to avoid gel counting errors before they happen, call or write our LSC Applications Laboratory, where helping with counting problems is the staff's principal activity.

Meanwhile consider eluting the radioactivity from the gel as an alternative to solubilization. We have developed a procedure using our PROTO SOL® and ECONO FLUOR™ which is very simple and avoids problems that sometimes arise in preparing homogeneous samples. Ask us to send you LSC Application Note #22, by Dr. Yutaka Kobayashi.

NEN New England Nuclear

549 Albany Street, Boston, Mass. 02118
Call toll-free: 800-225-1572
(In Massachusetts and International:
617-482-9595)

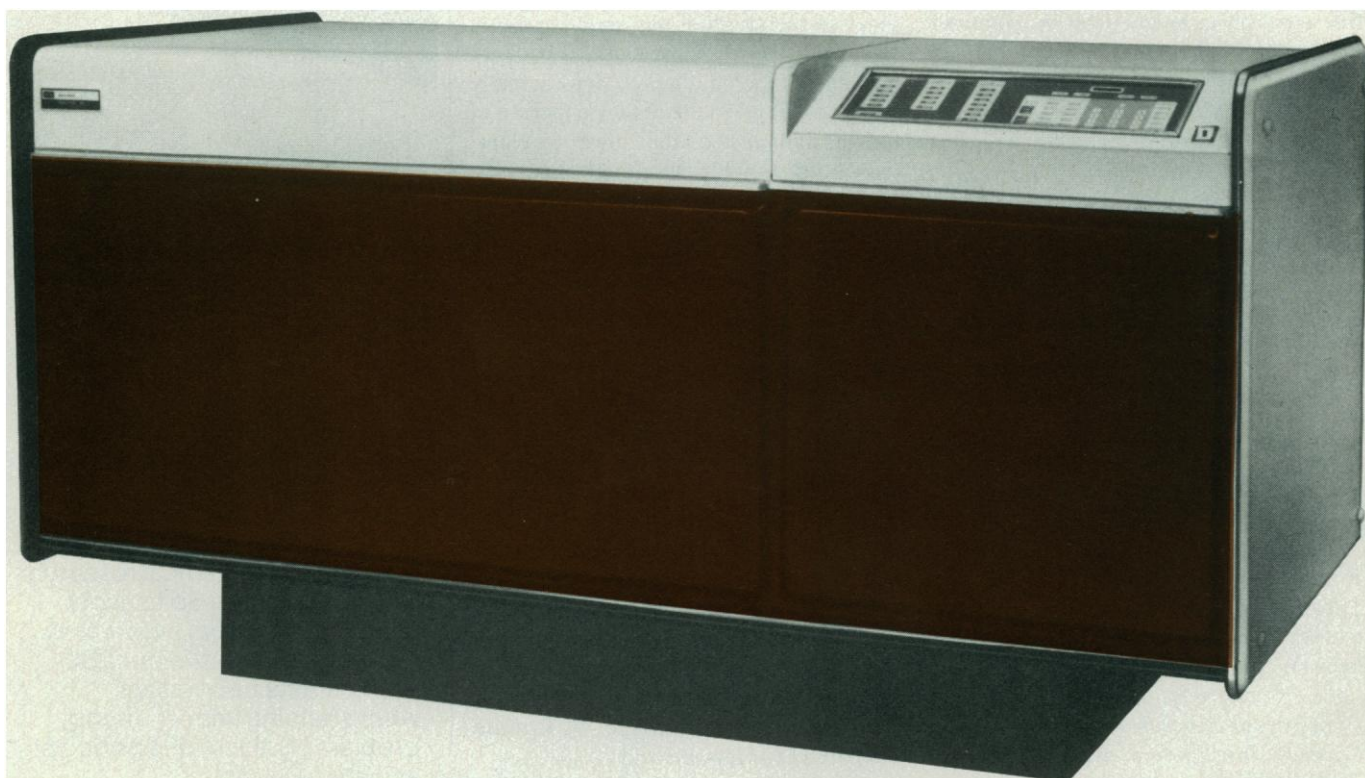
NEN Chemicals GmbH: D-6072 Dreieich, W. Germany,
Daimlerstrasse 23, Postfach 401240,
Telephone: (06103) 85034, Telex: 4-17993 NEN D

NEN Canada Ltd., 2453 46th Avenue,
Lachine, Que. H8T 3C9,
Telephone: 514-636-4971, Telex: 05-821808

Circle No. 45 on Readers' Service Card

**REDUCE
COUNTING TIME
UP TO 5 HOURS
PER LOAD**

**ANALYTIC
6892
FASTEST
EASIEST
MULTI-USER
LIQUID
SCINTILLATION
COUNTER**



The ANALYTIC 6892 measures quench in exactly 0.8 minutes using the fixed count time method. Compare this with a counting time of 1.5 to 3.5 minutes required by the quench search method. The 6892 saves you approximately 1 minute per sample, or 300 minutes per full load. The 6892 is much easier to program and operate. You will save another 30-40 minutes in programming time each day when in multiple-user operation. Add to these advantages, excellent precision in counting due to digital window programming and the overall flexibility of micro-processor control. Compare the 6892 with any other automatic liquid scintillation counter for speed, precision and price.

WRITE FOR BROCHURE

Circle No. 99 on Readers' Service Card

Tracor Analytic

Tracor Analytic, Inc.

Formerly Searle Analytic/Nucléar-Chicago

P.O. Box 66217, AMF O'Hare
Chicago, IL 60666
Toll Free 800-323-9830/9831
Illinois 312/635-3770/3768

Europe/Africa/Near East
Building 70, Schiphol Airport
Amsterdam, The Netherlands

THIRD DIMENSION IN LIQUID SCINTILLATION

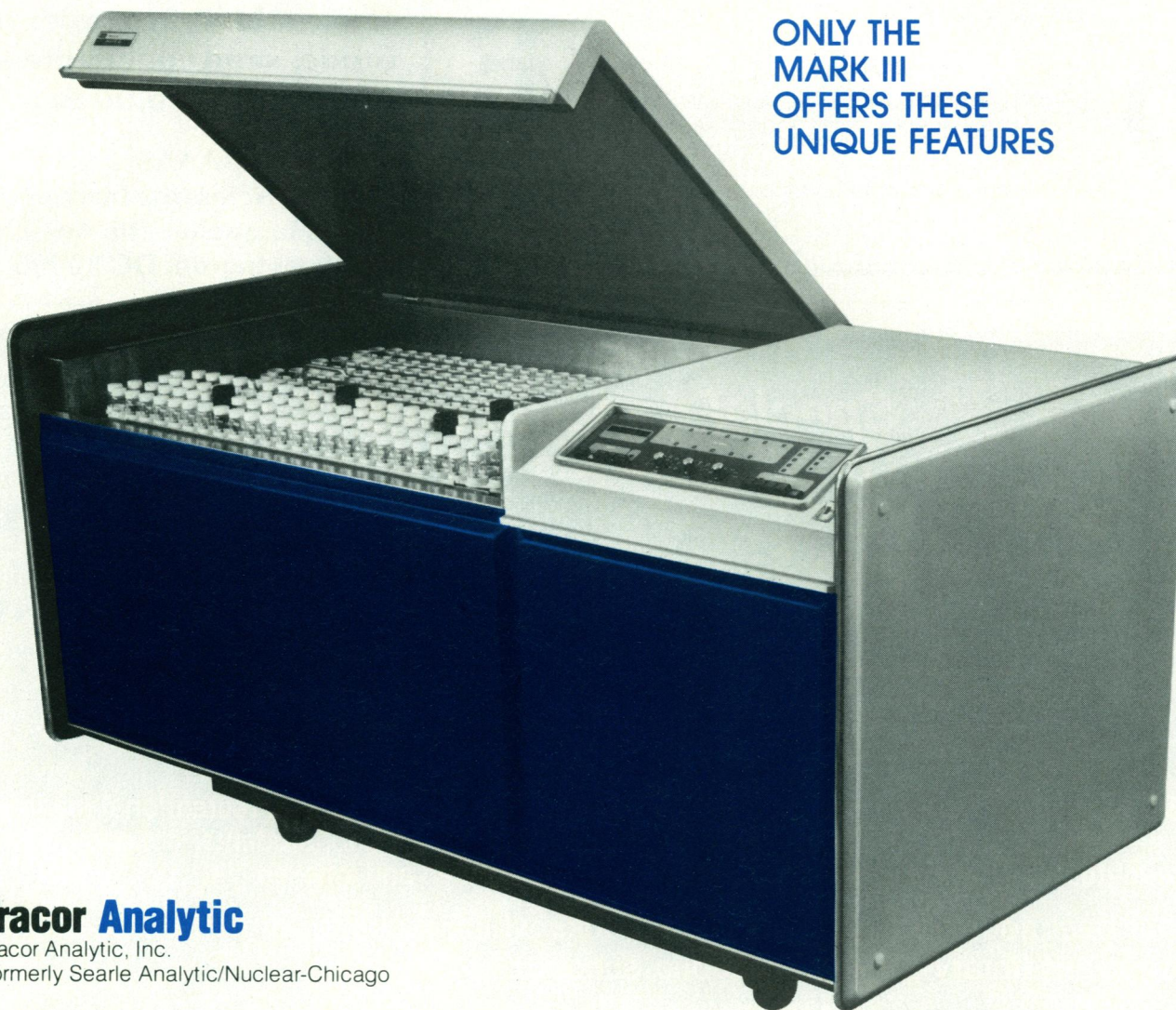
ANALYTIC
MARK III
MOST
PRECISE
ACCURATE
REPRODUCIBLE

I. The Mark III ESP (External Standard Pulse) measures the entire spectral distribution of the system's reference standard. This prevents errors due to the non-linear response of different isotopes to quenching.

II. The Mark III Universal Energy Windows change lower and upper limits independently with the quench level, changing the width as well as shifting the window. This provides significantly more accurate counting than fixed width windows.

III. The Mark III Spectral Storage and Analysis eliminates errors inherent in a mathematical curve fit calculation. Spectral distributions are stored and analyzed, so as to calculate the true DPM more accurately.

ONLY THE
MARK III
OFFERS THESE
UNIQUE FEATURES



Tracor Analytic

Tracor Analytic, Inc.
Formerly Searle Analytic/Nuclear-Chicago

P.O. Box 66217, AMF O'Hare
Chicago, IL 60666
Toll Free 800-323-9830/9831
Illinois 312/635-3770/3768

Europe/Africa/Near East
Building 70, Schiphol Airport
Amsterdam, The Netherlands

WRITE FOR BROCHURE

Circle No. 98 on Readers' Service Card

1
9
7
9

The **AAAS Calendar for 1979**, the second in an annual series, is beautifully adorned by color and black & white covers from *Science*. In a new 12" x 13" format, the **1979 Calendar** presents high quality reproductions on a heavy, glossy paper stock.

Order your **Calendar** today and be prepared for the year ahead!

For your copy of the **1979 AAAS Science Cover Calendar**, which will be mailed in November, send your name and address, plus \$5.00* per calendar, to

AAAS Calendar
1515 Massachusetts Avenue, NW
Washington, D.C. 20005

*AAAS members deduct 10% off retail price

GUIDE

to Scientific Instruments

A special issue of *Science* published in the fall of each year, the **Guide to Scientific Instruments** gives you the names and addresses of over 1900 manufacturers of laboratory instruments and equipment. If you are not a subscriber to *Science* and you would like to order the **Guide**, send your name and address plus \$6.00 to

AAAS
Guide to Scientific Instruments
1515 Massachusetts Ave., NW
Washington, DC 20005

Special Announcement **To Science Readers From AAAS**

The AAAS Science Book List Supplement **Is Now Available**

2842 recommended titles of reference and collateral texts and books for recreational reading in all fields of science and math for junior and senior high school students, college undergraduates, teachers, and the general reader. Fully annotated and indexed.

Your best source for those science books which make a permanent contribution to any library—personal, public, school, or college.

AAAS Science Book List Supplement

Retail Price: \$16.50

AAAS Member Price: \$15.00

Please allow 6-8 weeks for delivery.

Send orders with check or money order to

AAAS, Department W-2, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005

Introducing 6 new multi-volume Eppendorf® Pipettes.

Now one pipette takes the place of three.



The new Eppendorf System 4700 multi-volume pipettes are actually three pipettes in one.

While multi-volume models have the same dimensions, similar accuracy and built-in tip ejector as fixed-volume models, a partial twist of the operating button adjusts them for any of 3 different volumes, and without need to calibrate each setting. (A ratchet-type stop assures positive engagement of the desired setting and prevents accidental change of volume).

There are six multi-volume models to choose from: 10/20/25 μ l, 20/25/50 μ l, 50/75/100 μ l, 100/200/250 μ l, 200/300/500 μ l and 500/750/1,000 μ l. Each fits the hand perfectly; a finger rest at the top provides positive support during use and prevents rolling off the workbench

when laid down. As on all new System 4700 pipettes, filling, pipetting and tip ejection are controlled by depressing a single button through a series of distinct, positive stops, without changing the grip position.

Multi-volume pipettes are part of the new Eppendorf Pipetting

System, fully described in an informative brochure. For your copy, write: Eppendorf Division, Brinkmann Instruments, Cantiague Road, Westbury, N.Y. 11590. In Canada: 50 Galaxy Boulevard, Rexdale (Toronto), Ont.

**A single button does it all...
sample pick-up, pipetting, tip ejection
and volume adjustment.**



Eppendorf Pipetting System

Circle No. 43 on Readers' Service Card

**Whether you need
Mid-IR,
GC-IR,
LC-IR,
Near-IR or
Far-IR measurement capabilities
NICOLET COVERS THE FT-IR SPECTRUM
FROM 10 cm⁻¹ to 20,000 cm⁻¹.**

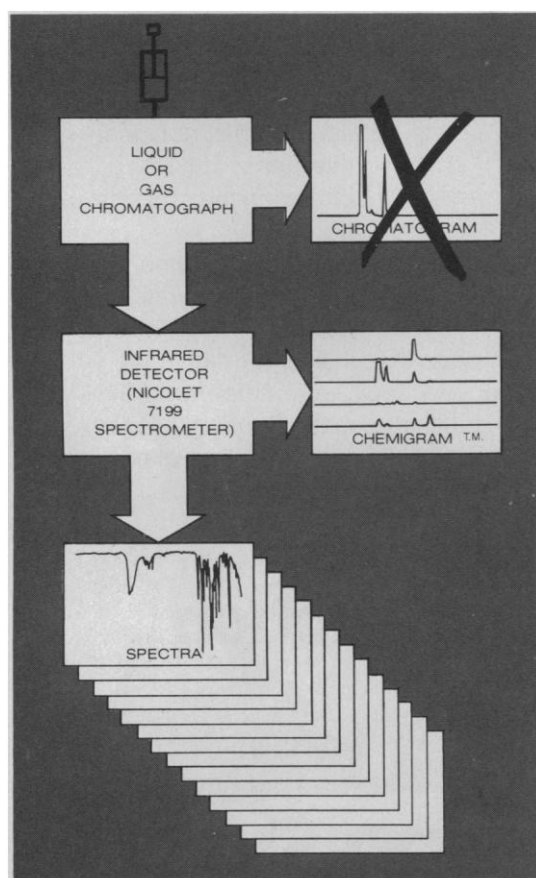
SENSITIVITY — Variable mirror scan rates from 0.05 cm/sec to 4 cm/sec optimize the system for highest signal-to-noise ratio (sensitivity) in a given measurement time.

RESOLUTION — Routinely achieves 0.06 cm⁻¹ resolution.

SUBTRACTION — Spectral stripping (subtraction) is easily used to extract solvent or aqueous background features from spectra. In many cases this allows the sample to be measured "in situ" without chemical extraction.

PREPROGRAMMED EXPERIMENTS — A macro-programming capability allows the user to easily design complicated experiments which are then implemented by pushing one button. This automates the experiment from sample insertion to automatic results plotting.

USING THE NICOLET 7199 FT-IR AS AN 'INTELLIGENT DETECTOR'



**The Advantages of the
Nicolet CHEMIGRAM™**

- True "on-the-fly" operation.
- Automatic storage of spectra.
- Real-time spectrally separated chromatograms (CHEMIGRAMS).
- Total history of elution preserved.
- High sensitivity.
- Rapid changeover from IR to GC-IR or LC-IR.
- Spectrometer and data system from one manufacturer.

For more details refer to Coffey, P., Mattson, D. & Wright, J., "A Programmable GC/FT-IR System," *American Laboratory*, May 1978 (in publication).

(Nicolet also offers field-proven, FT-IR data systems with complete software packages to upgrade existing spectrometers.)

For more details on the world's finest FT-IR system please phone or write Nicolet.

**NICOLET
INSTRUMENT
CORPORATION**

5225 Verona Road
Madison, Wisconsin 53711
Telephone: 608/271-3333

Circle No. 51 on Readers' Service Card

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

Science serves its readers as a forum for the presentation and discussion of important issues related to the advancement of science, including the presentation of minority or conflicting points of view, rather than by publishing only material on which a consensus has been reached. Accordingly, all articles published in *Science*—including editorials, news and comment, and book reviews—are signed and reflect the individual views of the authors and not official points of view adopted by the AAAS or the institutions with which the authors are affiliated.

Editorial Board

1978: RICHARD E. BALZISER, JAMES F. CROW, HANS LANDSBERG, EDWARD NEY, FRANK W. PUTNAM, MAXINE SINGER, PAUL E. WAGGONER, F. KARL WILLENBROCK

1979: E. PETER GEIDUSCHEK, WARD GOODENOUGH, N. BRUCE HANNAY, MARTIN J. KLEIN, FRANKLIN A. LONG, NEAL E. MILLER, JEFFREY J. WINE

Publisher

WILLIAM D. CAREY

Editor

PHILIP H. ABELSON

Editorial Staff

Managing Editor

ROBERT V. ORMES

Assistant Managing Editor

JOHN E. RINGLE

Business Manager

HANS NUSSBAUM

Production Editor

ELLEN E. MURPHY

News and Comment: BARBARA J. CULLITON, *Editor*; WILLIAM J. BROAD (intern), LUTHER J. CARTER, CONSTANCE HOLDEN, ELIOT MARSHALL, DEBORAH SHAPLEY, R. JEFFREY SMITH, NICHOLAS WADE, JOHN WALSH. *Editorial Assistant*, SCHERRAINE MACK

Research News: ALLEN L. HAMMOND, *Editor*; RICHARD A. KERR, GINA BARI KOLATA, JEAN L. MARX, THOMAS H. MAUGH II, WILLIAM D. METZ, ARTHUR L. ROBINSON. *Editorial Assistant*, FANNIE GROOM

Associate Editors: ELEANORE BUTZ, MARY DORFMAN, SYLVIA EBERHART, JUDITH GOTTLIEB

Assistant Editors: CAITLIN GORDON, RUTH KULSTAD, LOIS SCHMITT, DIANE TURKIN

Book Reviews: KATHERINE LIVINGSTON, *Editor*; LINDA HEISERMAN, JANET KEGG

Letters: CHRISTINE KARLIK

Copy Editor: ISABELLA BOULDIN

Production: NANCY HARTNAGEL, JOHN BAKER; YA LI SWIGART, ELEANOR WARNER; JEAN ROCKWOOD, LEAH RYAN, SHARON RYAN

Covers, Reprints, and Permissions: GRAYCE FINGER, *Editor*; CORRINE HARRIS, MARGARET LLOYD

Guide to Scientific Instruments: RICHARD SOMMER

Assistant to the Editors: RICHARD SEMIKLOSE

Membership Recruitment: GWENDOLYN HUDDLE

Member and Subscription Records: ANN RAGLAND

EDITORIAL CORRESPONDENCE: 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Area code 202. General Editorial Office, 467-4350; Book Reviews, 467-4367; Guide to Scientific Instruments, 467-4480; News and Comment, 467-4430; Reprints and Permissions, 467-4483; Research News, 467-4321; Cable: *Advances*, Washington. For "Instructions for Contributors," write the editorial office or see page xi, *Science*, 29 September 1978.

BUSINESS CORRESPONDENCE: Area Code 202. Business Office, 467-4411; Circulation, 467-4417.

Advertising Representatives

Director: EARL J. SCHERAGO

Production Manager: MARGARET STERLING

Advertising Sales Manager: RICHARD L. CHARLES

Marketing Manager: HERBERT L. BURKLUND

Sales: New York, N.Y. 10036: Steve Hamburger, 1515 Broadway (212-730-1050); SCOTCH PLAINS, N.J. 07076: C. Richard Callis, 12 Unami Lane (201-889-4873); CHICAGO, ILL. 60611: Jack Ryan, Room 2107, 919 N. Michigan Ave. (312-DE-7-4973); BEVERLY HILLS, CALIF. 90211: Winn Nance, 111 N. La Cienega Blvd. (213-657-2772); DORSET, VT. 05251: Fred W. Dieffenbach, Kent Hill Rd. (802-867-5581)

ADVERTISING CORRESPONDENCE: Tenth floor, 1515 Broadway, New York, N.Y. 10036. Phone: 212-730-1050.

Your Annual Meeting

In its 130-year history, the AAAS has had 144 national meetings, usually annually, although some war years were missed and in other years both winter and summer meetings were held. The forthcoming Annual Meeting in Houston (3 to 8 January 1979) will be our 145th National Meeting.

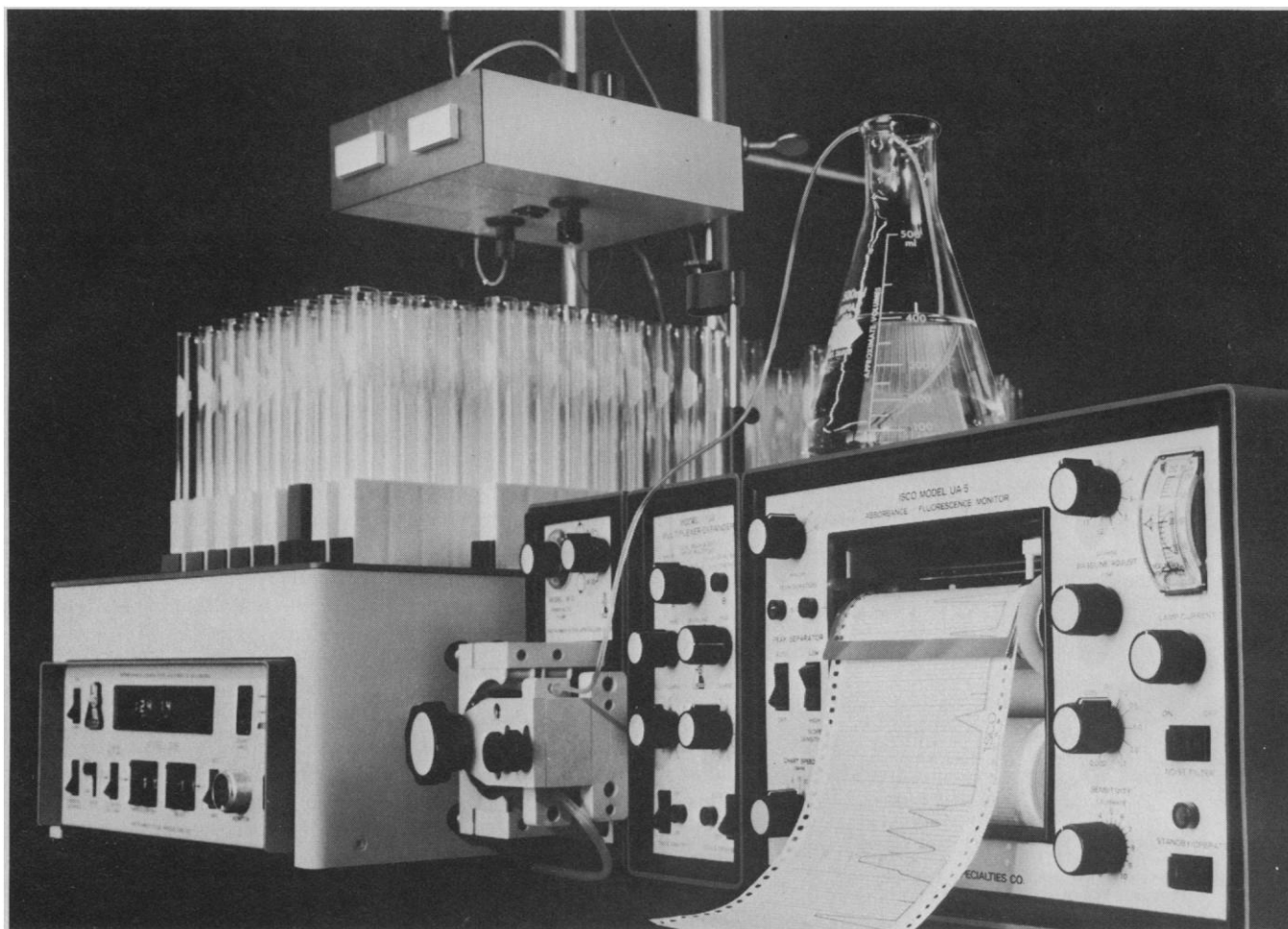
During our formative years (the first 50 or so), as the various specialties of science were just beginning to be recognized, our national meetings provided the principal forum for the interchange of information among all U.S. scientists. As these various specialties matured and formed their separate associations, both here and abroad, our national meeting went through an extended transition until, just after our own centennial (in 1948), a new policy was adopted. It was decided that the AAAS would hold meetings "at which one branch of science is interpreted to the other branches of science, meetings at which are stressed the interrelations between the branches of science, meetings at which the unifying theme would be central problems whose treatment requires the attack of several disciplines."

The Houston meeting, "Science and Technology: Resources for Our Future," follows this paradigm and addresses such a central problem. The world now stands at a crossroads, all of the fledgling disciplines of a century ago have grown into "big science," and the mostly rural and agrarian cultures in which they began have become the modern urbanized-industrial nations of today. These are the nations whose growth and development consumed prodigious amounts of the world's depletable resources and whose further momentum appears to require an even greater consumption; these are the nations whose peoples have been freed from a marginal existence, sparking equal hopes among the billions of their less fortunate brethren; and these are the nations whose leaders grope for a path to bridge the gap between the reality of a world's declining material resources and the hopes of a world of rising human expectations. The future of these nations, and of the world society of which they are as yet only the smaller part, depends in considerable measure on whether the needed resources can be found.

At such a crossroads, the intellectual resources of the big sciences we have nurtured must not be overlooked, and that is the central problem we address in Houston. These are unique resources that are depleted through neglect rather than use, and they are the resources that, with prudent management, can help chart the path between the hope and the reality. In nine public lectures and 138 symposia, the Annual Meeting will deal with many of these resources and the successes and failures in their application. The full program of the meeting (see page 865) is rich and extensive and deserves your careful attention. However, some of its substance can be conveyed by focusing on a few symposia in the "general interest" category.

In "Frontiers of the Natural Sciences" and "Frontiers of the Social Sciences," nine eminent scientists—from mathematics, physics, chemistry, astronomy, biology, geology, anthropology, psychology, and sociology—will examine, concisely and without jargon, the outer limits of knowledge as it now exists in their respective disciplines. In other symposia in this category, scholars will address the questions of whether there are, in fact, physical or social limitations to usable knowledge; what the role of industry is in promoting scientific innovation (and application); what the space program has achieved in this tenth year since the lunar landing; and what the economic, esthetic, and technological problems of macroengineering projects are likely to be. As a group, these symposia represent a "microcosm" of the meeting—dealing with the extent of our scientific knowledge, its possible limits, and the problems found or anticipated in its application. Yet throughout runs the thread of the interrelations among and the needed interpretations between the branches of science in addressing our central problems.

As concerned citizens and scientists, it behooves us all to lend our voices to the discussions in Houston this January. It is your Annual National Meeting.—ARTHUR HERSCHMAN



Let an ISCO UA-5 monitor do it all for you.

Primarily, the UA-5 is a sensitive absorbance and fluorescence detector for conventional or high performance LC. But if you're a life scientist, it's much more than that: it's the key part of an integrated system, able to perform many functions in your lab.

A low cost accessory turns the UA-5 into a dual beam gel scanner. Gels electrophoresed in quartz tubes can be UV-scanned during separation. After electrophoresis, they may be stained and scanned at visible wavelengths with sensitivity and resolution comparable to gel-scanning spectrophotometers.

Samples being electrophoresed in an ISCO density gradient column can be repetitively scanned during separation, a real advantage for

isoelectric focusing. Drop-in cuvettes allow recording of many reactions and take the load off your spectrophotometer for many routine jobs.

Accessory fractionators for centrifuged density gradients

easily resolve zones undetected by other methods, and plot their exact locations.

But the UA-5 is still the best all-around column monitor: it offers you a built-in recorder, simultaneous monitoring of two columns or any two of 13 available wavelengths, automatic scale expansion, and an exclusive Peak Separator which controls a fraction collector to put each peak in its own tube.

A versatile UA-5 costs no more than a single-purpose L/C monitor. Learn more about what it can do for you: send for your ISCO catalog today. Or dial direct, toll free (800) 228-4250 (continental U.S.A. except Nebraska). Instrumentation Specialties Company, Box 5347, Lincoln, Nebraska 68505.



**Instruments
with a difference**

Circle No. 80 on Readers' Service Card