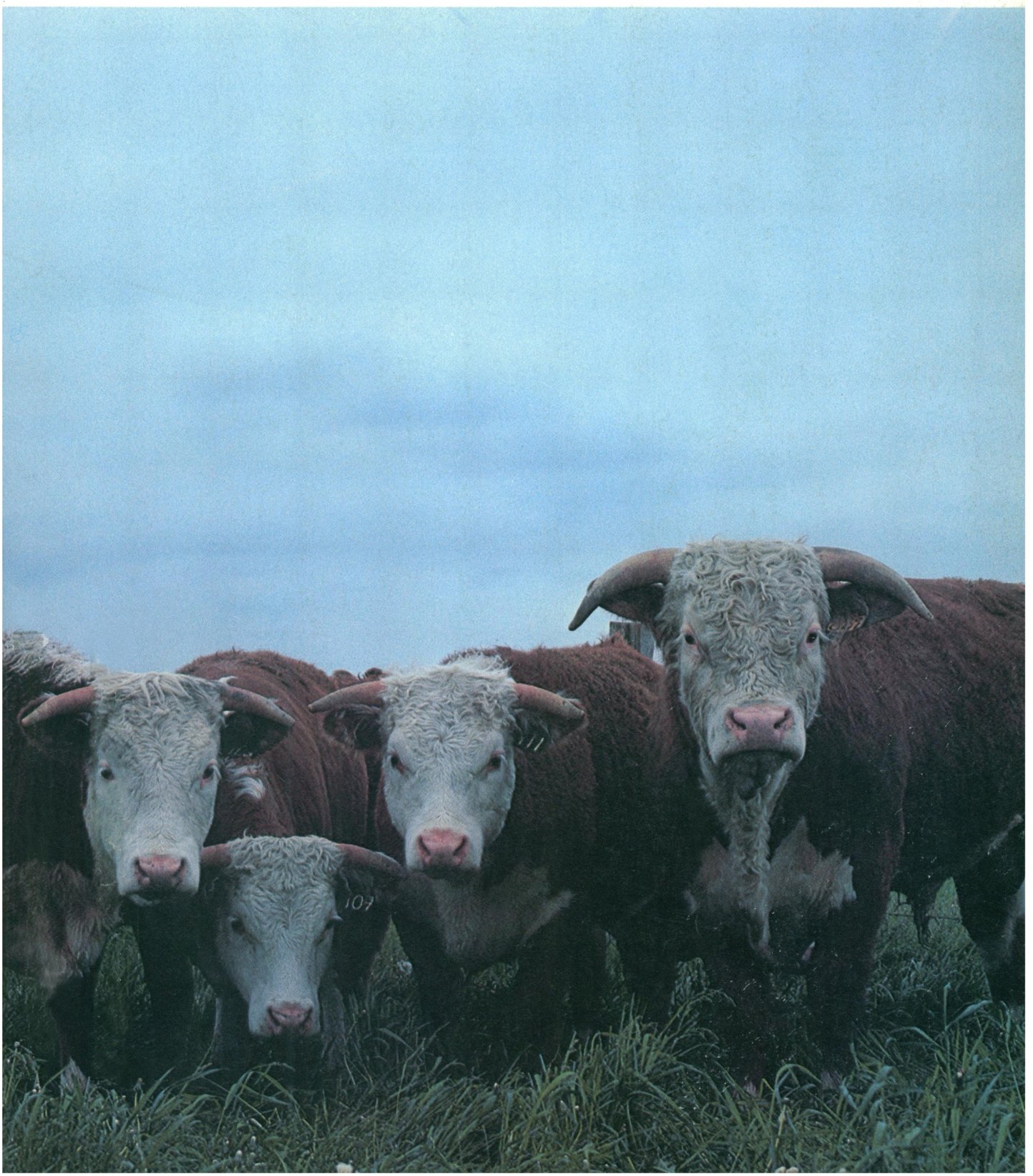
18 MARCH 1983 · VOL. 219 · NO. 4590

$2.50

SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Fidia Research Series
Frontiers in Neuroscience

17, 20 July, 1983
Harrison Hot Springs, (B.C.) Canada

International Society
for Neurochemistry
Satellite Meeting

**Physiological Role of
Phospholipids in
the Nervous System**

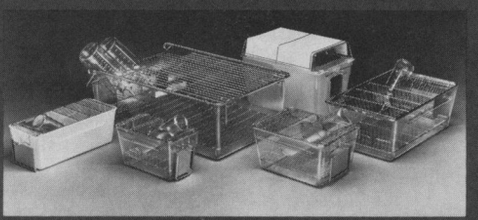
First Announcement

When you receive announcements such as the above be aware that the initiative has been accepted in the series "Frontiers in Neuroscience."
Such acceptance is based on review and favourable advice by three independent scientists of international reputation.
The FIDIA Research Series "Frontiers in Neuroscience" is a new expression of our constant efforts to link basic research progress to human therapeutic benefit.

FIDIA Research Laboratories

These new Nalgene cages are cost-efficient because they're made to last. Bodies are molded of rugged, autoclavable polycarbonate or polypropylene. All metal parts are rustproof stainless steel—electropolished, not just plated, so they won't chip or corrode.

They're practical, too, with rounded corners for easy cleaning and minimal food contamination.



Lids lock tightly to assure animal containment. Optional filter covers fit snugly over lids to help control temperature, humidity, drafts and airborne contamination.

You get the same features in all 7 of our cage sizes—for mice, rats, gerbils, hamsters and guinea pigs. And they all meet NIH size-guidelines.

Ask for our detailed brochure, available from your authorized Nalgene labware dealer. Or write Nalge Company, Box 365, Rochester, NY 14602.

ONE-ROOM EFFICIENCY

Nalgene® Plastic Animal Cages

PROTECTED ENVIRONMENT

EXCLUSIVE LID LOCK LUGS

DURABLE STAINLESS STEEL CONSTRUCTION

BODIES IN POLYPROPYLENE OR CLEAR POLYCARBONATE

RAISED WIRE FLOOR

DATA CARD HOLDER

NALGENE

ROUNDED CORNERS

MEETS NIH GUIDELINES

SYBRON | Nalge

Circle No. 295 on Readers' Service Card

ISSN 0036-8075

18 March 1983

Volume 219, No. 4590

SCIENCE

SCIENCE is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. Second-class postage (publication No. 484460) paid at Washington, D.C., and at an additional entry. Now combined with **The Scientific Monthly**® Domestic individual membership and subscription (51 issues): $48. Domestic institutional subscription (51 issues): $85. Foreign postage extra: Canada $24, other (surface mail) $27, air-surface via Amsterdam $55. First class, airmail, school-year, and student rates on request. Single copies $2.50 ($3 by mail); back issues $3 ($3.50 by mail); Biotechnology issue, $5 ($5.50 by mail); classroom rates on request. **Change of address:** allow 6 weeks, giving old and new addresses and seven-digit account number. Authorization to photocopy material for internal or personal use under circumstances not falling within the fair use provisions of the Copyright Act is granted by AAAS to libraries and other users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that the base fee of $1 per copy plus $0.10 per page is paid directly to CCC, 21 Congress Street, Salem, Massachusetts 01970. The identification code for *Science* is 0036-8075/83 $1 + .10. **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.

COVER

Hereford beef cattle in pasture in Winnebago, Minnesota. A new peptide growth factor has been extracted from bovine kidneys and salivary glands and used for the first time for experimental wound healing. See page 1329. [Thomas A. Sporn, Georgetown University School of Medicine, Washington, D.C.]

EXPAND YOUR SCIENTIFIC HORIZONS...

WASTES IN THE OCEAN
Volume 1: Industrial and Sewage Wastes in the Ocean
Edited by Iver W. Duedall, Bostwick H. Ketchum, P. Kilho Park, & Dana R. Kester

A comprehensive presentation of the oceanographic, chemical and biological processes and environmental effects of disposing industrial waste and sewage in the ocean. Leading scientists discuss the impact of ocean waste disposal on humans and on the marine biota, and outline strategies for achieving optimal ocean waste disposal management.

approx. 448 pp. (1-09772-1) March 1983 $54.95

WASTES IN THE OCEAN
Volume 2: Dredged-Material Disposal in the Ocean
Edited by Dana R. Kester, Bostwick H. Ketchum, Iver W. Duedall, & P. Kilho Park

Comprehensive coverage of the science, technology, and regulation involved in dredged-material disposal in the ocean by leading authorities. Includes the implementation of federal regulations and case studies.

320 pp. (1-09771-3) March 1983 $39.95

WASTES IN THE OCEAN
Volume 3: Radioactive Wastes in the Ocean
Edited by P. Kilho Park, Iver W. Duedall, Bostwick H. Ketchum, & Dana R. Kester

The first work devoted exclusively to radioactive wastes in the ocean. Interrelates oceanographic properties and processes with waste disposal practices.

approx. 624 pp. (1-09770-5)
September 1983 $69.50

INSTRUMENTATION FOR ENVIRONMENTAL MONITORING
Volume 1: Radiation, 2nd Ed.
Lawrence Berkeley Laboratory Environmental Instrumentation Survey

An in-depth study of the sources and effects of ionizing radiation and the instruments used for its detection and measurement.

approx. 1,016 pp. (1-86880-9)
April 1983 $150.00

CELL INTERACTIONS AND DEVELOPMENT
Molecular Mechanisms
Edited by Kenneth M. Yamada

A state-of-the-art review of current knowledge in a number of highly active areas of research concerning the mechanisms of cell interactions during embryonic development.

287 pp. (1-07987-1) 1982 $39.95

GROWTH AND MATURATION FACTORS, VOLUME 1
Edited by Gordon Guroff

The first volume in a series surveying growth factor research. Examines the structures and mechanisms of those peptides that exert long-term effects on the growth, survival, and differential functions of cells.

352 pp. (1-09709-8)
April 1983 $54.50

STATISTICS FOR RESEARCH
Shirley Dowdy & Stanley Wearden

A practical guide for applying the most commonly used techniques of statistical analysis. Explains how to carry out a procedure and interpret results, and why the procedure works. Discusses inferential, probability, and descriptive statistics.

approx. 598 pp. (1-08602-9)
March 1983 $34.95

A SYMMETRY PRIMER FOR SCIENTISTS
Joe Rosen

Presents the fundamentals of symmetry theory and its applications in a single, unified account. Discusses group theory, the mathematical language of symmetry, and applications. Covers the six major principles of symmetry.

approx. 208 pp. (1-87672-0)
March 1983 $26.95

ENCYCLOPEDIA OF COMPOSITE MATERIALS AND COMPONENTS
Edited by Martin Grayson

Articles by 75 leading authorities cover virtually every aspect of composite materials and provide a wealth of detailed information on methods of manufacturing, properties, and uses of composite materials and components.

approx. 1,000 pp. (1-87357-8)
April 1983 $99.50

DICTIONARY OF INFORMATION TECHNOLOGY
Edited by Dennis Longley & Michael Shain

This useful reference defines over 6,000 terms embracing all aspects of information technology, including audio-visual, computing, and communications systems. Essays explore word processing, viewdata networks, micro electronics, typesetting, computer programming, educational technology, and consumer electronics.

379 pp. (1-89574-1) 1983 $34.95

ENCYCLOPEDIA OF STATISTICAL SCIENCES
Edited by Samuel Kotz & Norman L. Johnson

For all who deal with statistics, this eight-volume work will provide sound information and practical guidance, especially for those who may not be specialists in a particular topic. Its scope embraces agriculture, statistical mechanics, crystallography, zoology, and scores of other disciplines that use statistics. It will be published over four years—two volumes per year. The thousands of entries by eminent contributors will comprise some three million words. Volumes 1 and 2 published 1982. Volume 3 (F Distribution—Hypothesis Testing) and Volume 4 (Icing the Tails—Lyapunov Inequality) due 1983.

Vol. 1	(1-05546-8)	480 pp.	1982	$75.00*
Vol. 2	(1-05547-6)	613 pp.	1982	$75.00*
Vol. 3	(1-05549-2)	approx. 800 pp.	May 1983	$79.95*
Vol. 4	(1-05551-4)	approx. 800 pp.	July 1983	$79.95*

**15% subscription discount applicable to all volumes when "Subscription" is indicated on order.*

Prospectus available on request. Write to J. Kazimir.

WITH THESE MAJOR NEW WILEY BOOKS

COMPARATIVE ENDOCRINOLOGY
Aubrey Gorbman, Walton W. Dickhoff, Steven R. Vigna, Nancy B. Clark, Charles L. Ralph

This highly accessible text offers a broadly comparative approach to endocrinology not limited to mammals.

approx. 592 pp. (1-06266-9)
March 1983 $34.95

MUSCLES AND THEIR NEURAL CONTROL
Graham Hoyle

The only up-to-date survey of research on the fine structure and function of diverse muscles, their neural control, development, and malfunctioning in disease.

approx. 672 pp. (1-87709-3)
February 1983 $59.95

MULTIDIMENSIONAL SCALING
Mark L. Davison

This versatile text shows what multidimensional scaling (MDS) is, explains in detail how to use the major MDS techniques, and prepares researchers to read the more technical literature in the field.

approx. 256 pp. (1-86417-X)
March 1983 $25.95

INTERACTION AND COEVOLUTION
John N. Thompson

A clear, concise synthesis of patterns in the evolution of interactions and the conditions likely to favor coevolution among interacting species.

179 pp. (1-09022-0) 1982 $27.50

BYPASSES
A Simple Approach to Complexity
Z. A. Melzak

This unique new approach to the theory of transformations demonstrates how to "bypass" a complex problem by breaking it down into several less complex conjugant questions.

approx. 272 pp. (1-86854-X) April 1983 $34.95

CONTROLLED-RELEASE TECHNOLOGY
Bioengineering Aspects
Edited by K.G. Das

This authoritative collection of essays presents for the first time a comprehensive, up-to-date analysis of all the relevant aspects that are essential to the development of any controlled-release system.

225 pp. (1-08680-0) 1983 $50.00

STATISTICAL GRAPHICS
Design Principles and Practices
Calvin F. Schmid

This interdisciplinary study of the principles and practices of chart design uses actual cases to demonstrate common errors and pitfalls and shows how charts may be redesigned for greater efficiency.

approx. 224 pp. (1-87525-2) April 1983 $24.95

HANDBOOK OF ENERGY TECHNOLOGY AND ECONOMICS
Edited by Robert A. Meyers

Provides all the engineering and economic data needed to evaluate the potential economic impact of a wide range of energy technologies. It allows the reader to compare different technologies, as well as different strategies for the same technology.

approx. 1,089 pp. (1-08209-0)
1983 $62.95

BLACK HOLES, WHITE DWARFS AND NEUTRON STARS: THE PHYSICS OF COMPACT OBJECTS
Stuart L. Shapiro & Saul A. Teukolshy

A self-contained study of the physics of compact objects, filling the need for a text/reference. Details the latest observational and theoretical developments in the field.

approx. 688 pp. (1-87317-9)
April 1983 $39.95 Cloth
approx. 688 pp. (1-87316-0)
April 1983 $24.95 Paper

CALCIUM-ANTAGONISM IN HEART AND SMOOTH MUSCLE
Experimental Facts and Therapeutic Prospects
Albert Fleckenstein

The first comprehensive documentation of the origin and physiological, pharmacological, and therapeutic effects of the new family of Ca-antagonists, developed in the author's laboratory.

approx. 416 pp. (1-05435-6) March 1983 $60.00

THE MOLECULAR BIOLOGY OF ENZYME SYNTHESIS
Regulatory Mechanisms of Enzyme Adaptation
Roy Walker

This comprehensive review of the regulation of enzyme synthesis in bacterial and animal cells incorporates the latest developments in the molecular biology of gene expression.

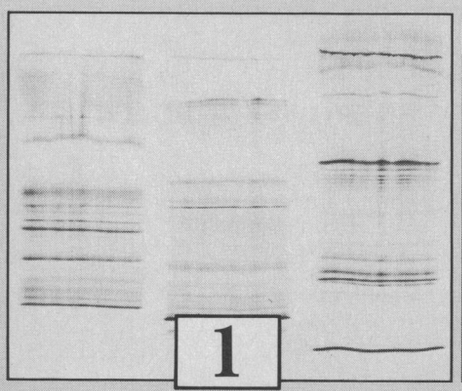
381 pp. (1-06051-8) 1983 $49.95

Order through your bookstore or write to: Nat Bodian, Dept. 3-1029. Order Code # 3-1029.
FOR BOOK ORDERS ONLY:
CALL TOLL FREE (800) 526-5368.
In New Jersey call collect (201) 797-7809.

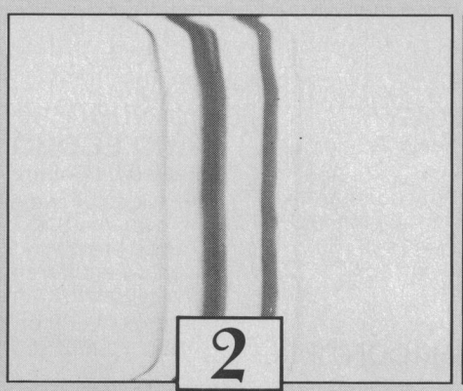
WILEY INTERSCIENCE
a division of John Wiley & Sons, Inc.
605 Third Avenue, New York, N.Y. 10158
In Canada: 22 Worcester Road,
Rexdale, Ontario M9W 1L1

Prices subject to change without notice. 092 3-1029

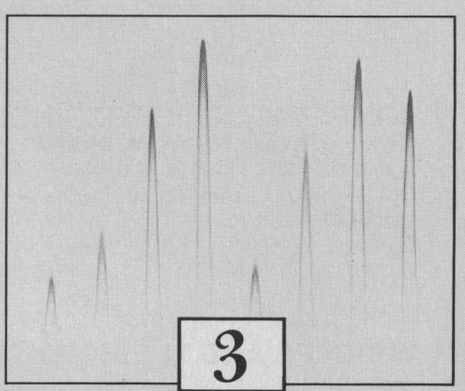
Six reasons to buy a Multiphor



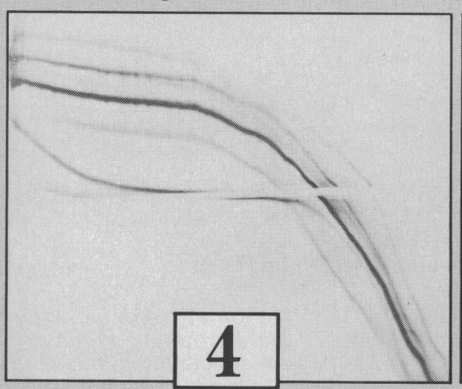
Obtain superior electrofocusing results for a fraction of the cost and time of running older systems. High performance electrofocusing lets you analyze well over 600 samples per bottle of Ampholine with improved resolution due to the elimination of thermal gradients in the gel.



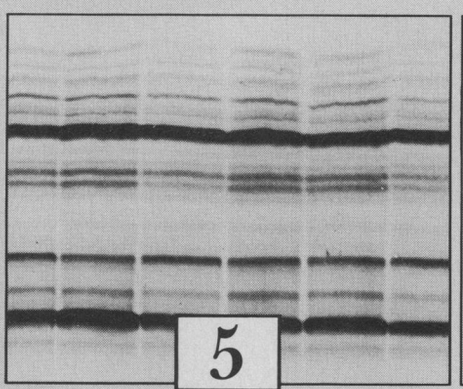
Choose between two preparative techniques. Purify up to gram quantities of even crude samples with preparative electrofocusing. Alternatively, try preparative isotachophoresis with its stacking principle to get good resolution at much lower cost.



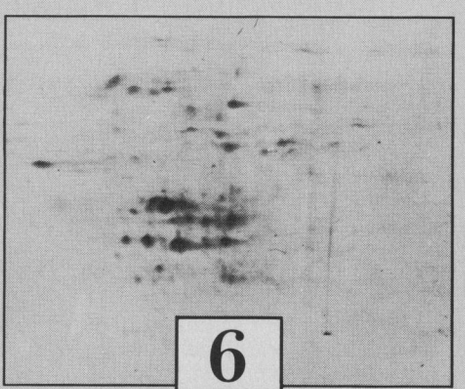
Quantitate proteins by Laurell rockets or run any popular immunoelectrophoretic technique. The new Mini Electrophoresis Kit costs only half the price of the original kits yet gives you everything you need to get started with agarose and immunoelectrophoresis.



Produce titration curves of your sample mixtures to gain information about stability, heterogeneity, interactions, pI, and the best pH for purification. Simultaneously display the electrophoretic mobility versus pH of every component in a single experiment with the new Titration Curve Kit.



Determine the molecular weights of native proteins with high resolution using ultrathin-layer gradient gel electrophoresis and our new miniature gradient former. Or perform conventional SDS and polyacrylamide gel electrophoresis with the original SDS/PAGE Kit.



Map complex protein and peptide mixtures with two-dimensional electrophoresis. Combine high performance electrofocusing in the first dimension with ultrathin-layer gradient gel electrophoresis in the second, using the latest procedure developed by Görg et.al. and the new 2-D and Gradient Gel Kit.

Results 5 and 6, courtesy of Dr. Angelika Görg, Technische Univ. München

When you want the versatility to perform a wide variety of electrophoretic techniques, you need the Multiphor System. Now with an expanded range of capabilities, the Multiphor provides unparalleled flexibility, superior design and complete technical support.

Chosen by more researchers throughout the world than any other, the Multiphor System offers unbeatable value for money.

Isn't it time to update your present Multiphor or to consider adding a second system this year? Contact your local representative today and discover how little it costs to gain a lot of versatility.

LKB

Circle No. 158 on Readers' Service Card

Head office: LKB-Produkter AB, Box 305, S-161 26 Bromma, Sweden. Tel. 08-98 00 40, telex 10492
Main US sales office: LKB Instruments, Inc. 12221 Parklawn Drive, Rockville, MD 20852. Tel. 301-881 25 10, telex 230 89 682
UK sales office: LKB Instruments Ltd., 232 Addington Road, S. Croydon, Surrey CR2 8YD, England. Tel. 01-657 8822, telex 264414
Other sales offices in: Athens (for Middle East), Copenhagen, Ghent, The Hague, Hong Kong, Munich, Paris, Rome, Turku, Vienna

A little Computer will set you free.

Where is it written that computers should keep you chained to a desk? After all, ideas and problems are dynamic; likely to occur just about any time, anywhere. It stands to reason that your computer should be available whenever and wherever it's needed.

It stands to reason your computer should be Attache™ from Otrona.

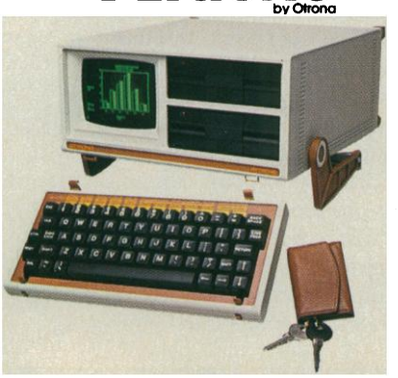
At a mere 18 lbs. and just a half cubic foot, Attache gives you briefcase convenience. It's unique dual-processor design, 64K byte user memory and 720K diskette storage give you power to solve some of the toughest scientific and engineering problems.

Yet these statistics don't begin to express Attache's full dimension. Integrated communications let you talk to a computer across the hall or around the world. High-resolution graphics and Charton™ software help you create useful graphs and charts.

Attache gives you Wordstar® for creating professional reports; Basic-80® for programming; and CP/M® for access to programs ranging from electronic spread- sheets to data base management systems.

And those are just standard Attache features. Your dealer can show you a wide range of compilers, peripherals, and software to tailor Attache to your special application.

Attache™ by Otrona



To learn how a little computer can set you free, call for more information and the name of the dealer nearest you. Otrona Corp., 4755 Walnut, Boulder, Colorado 80301.

(800) 525-7550

8:00 A.M. to 6:00 P.M. MDT
In Colorado, Alaska, or Hawaii, call
(303) 444-8100

Circle No. 352 on Readers' Service Card

Digital Precision and the Analog Animal

The study of physiological phenomena in laboratory animals has developed into a precise science involving exacting test techniques. Until recently however, the experimentalist has been severely limited by available instrumentation. Whether studying a transient muscle twitch or repetitive heart pulse, the analog oscilloscope and chart recorder have been the standard tools. Recording of data on such instruments is, at best, a rough and ready technique. Today, Nicolet digital oscilloscopes offer a total solution to your measurement problems. They are extremely accurate and easy-to-use. Signals

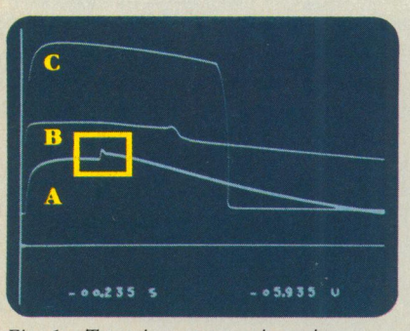


Fig. 1—Tetanic response in avian embryonic muscle after 15 days (A), 17 days (B), and 19 days (C) in ovo.

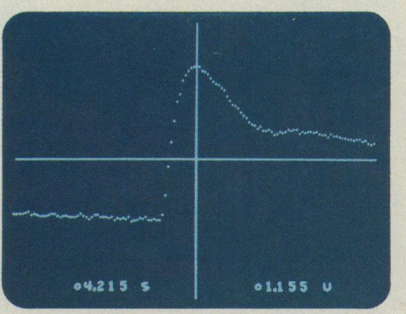


Fig. 2—Expansion of selected area for detailed analysis (up to X 256)

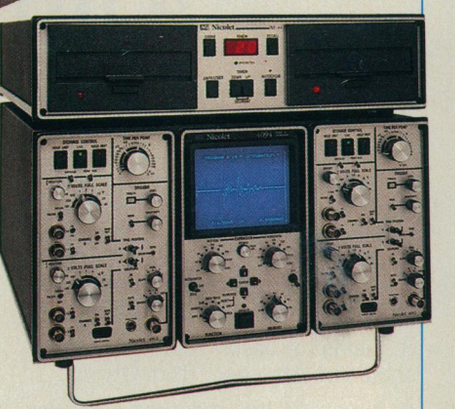
can be viewed live, compared to a reference waveform or stored in both report-ready and computer-compatible formats.

Figure 1 shows tetanic responses from an embryonic chicken muscle after 15, 17 and 19 days in ovo. These responses were captured and stored on a Nicolet digital oscilloscope then recombined on the screen for comparison. The high resolution and expansion capabilities allow detailed examination of small changes as shown in Figure 2. Cursor-interactive coordinate display eliminates the need to estimate amplitude or latency values of a waveform feature. Stored waveforms can be displayed or plotted in XY or YT format, transferred to internal disk memory for permanent storage or output to other computing devices via industry standard interfaces.

Consider the savings in dollars and people.

Nicolet digital oscilloscopes can replace your analog instrumentation and eliminate much of the human effort between the experiment and the final result.

To find out how Nicolet can help you solve your measurement problems, simply circle the reader service card or call 608/271-3333. Or write, Nicolet Instrument Corporation, Oscilloscope Division, 5225 Verona Road, Madison, Wisconsin 53711. In Canada: call 416/625-8302.



NICOLET INSTRUMENT CORPORATION
OSCILLOSCOPE DIVISION

Sales and Service Offices Worldwide

NOTE: Nicolet Oscilloscopes should not be used for direct connection to human subjects.

For literature circle reader service number 321
For a demonstration circle reader service number 322

suggest that 200 $\mu g/m^3$ is appropriate and byssinosis symptoms suggest 500 $\mu g/m^3$.

Turning to the testimony of one of us (H.W.) at the OSHA hearing in 1977, our research findings, as summarized above, demonstrate a range of dust levels within which a prudent permissible cotton dust exposure limit should be established. This range reflects the scientific uncertainties that frequently must be accepted in public policy decision-making. Indicating that this range is 200 to 500 $\mu g/m^3$ does *not* say that the upper value should be used to promulgate the standard, nor that the lower level is inappropriate; we have said neither, then or since. Quite to the contrary, we have supported the standard and have never suggested a more permissive revision, a fact recently reported in an editorial by an investigator (*4*) whose data and conclusions are heavily supported by Frumin.

The following excerpts from H.W.'s testimony, which Frumin does not quote, conflict with his characterization of this testimony (*5*):

> There is a dose-response relationship between exposure to cotton dust and a biologic effect, measured either with the questionnaire or pulmonary function testing. (page 314)

> I strongly favor the prevention of the demonstrated reduction in air flow as measured spirometrically or obtained through the questionnaire responses. Because, ultimately, [by] preventing the bronchial constrictive effect, I think we will probably prevent the chronic disease. (page 317)

> Assuming that there is a relationship between the acute and chronic response, and I have no reason to believe there is not, then the detection of such a response or reaction is obviously highly desirable, because it allows an individual to modify his or her exposure in order to effect prevention of further changes. (pages 363–364)

> I don't know how to assess the contribution, say, of cigarette smoking in an individual like that and dust exposure, and I think probably, as has been done in other industries, the presumption may have to be made that that exposure may have played a role and, therefore, further exposure is contraindicated. (page 387)

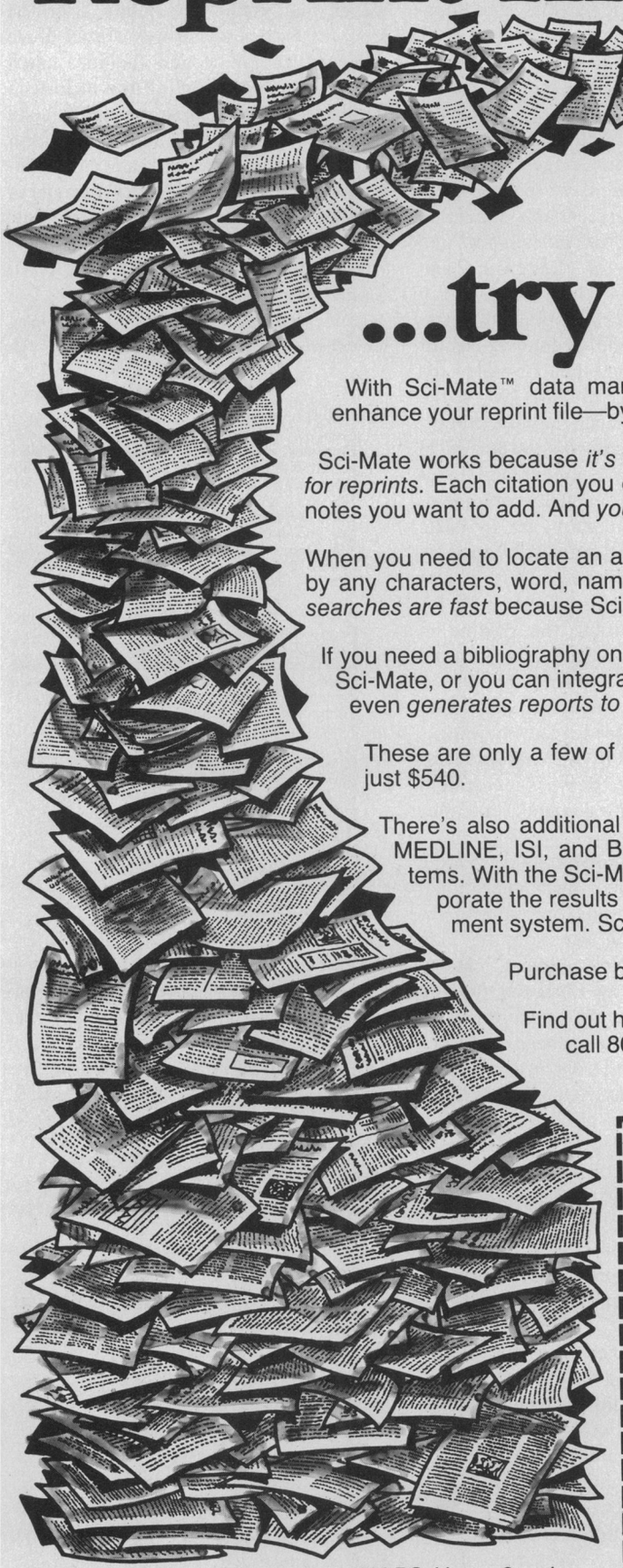
> I've said throughout that the dust effect is real and it's there, but in addition to a dust effect there is also an influence exerted by something else which we're not measuring having to do with mill. . . . (page 432)

Neither science or occupational health benefits from misleading descriptions of research findings or publicly stated views on public policy issues.

HANS WEILL
JOHN E. DIEM

Department of Medicine,
Pulmonary Diseases Section,
Tulane University School of Medicine,
New Orleans, Louisiana 70112

Reprint file entropy?



...try Sci-Mate!

With Sci-Mate™ data management software and your microcomputer, you can enhance your reprint file—by turning it into an easily accessible, personal data base.

Sci-Mate works because *it's the first data management system designed especially for reprints.* Each citation you enter can be any length and can include any descriptive notes you want to add. And *you communicate with Sci-Mate in plain English!*

When you need to locate an article, you're not limited by "keywords"—you can search by any characters, word, name, or phrase that might be anywhere in any entry. *Your searches are fast* because Sci-Mate's random access storage provides rapid retrieval.

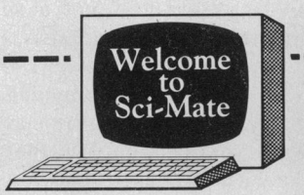
If you need a bibliography on a specialized subject, you can print it out in minutes with Sci-Mate, or you can integrate it into your existing word processing system. Sci-Mate even *generates reports to your specifications.*

These are only a few of the features that make Sci-Mate invaluable. And it costs just $540.

There's also additional software that takes you through searches on DIALOG, MEDLINE, ISI, and BRS even if you don't know the languages of those systems. With the Sci-Mate universal online searcher, you can immediately incorporate the results of your online searches into your Sci-Mate data management system. Sci-Mate's universal online searcher costs $440.

Purchase both at one time and pay $880—a $100 savings.

Find out how Sci-Mate can help reduce entropy in *your* reprint file—call 800-523-4092, or mail the coupon below.



☐ **Sci-Mate is just what I've been looking for! Please send me more information.**

To order, call 800-523-4092.

name _____ title _____

organization _____

address _____

city _____ state/province _____

ZIP/postal code _____ country _____

area code _____ telephone _____

(Sci-Mate is available for Apple II, IBM PC, Vector 3 or 4, TRS 80 model II, and CP/M-80 systems with standard 8″ disks.)

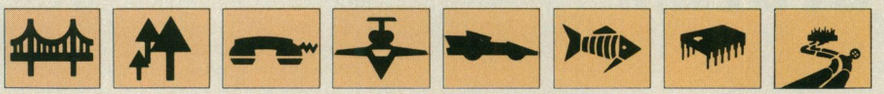
ISI® Institute for Scientific Information®
3501 Market Street, University City Science Center
Philadelphia, PA 19104 U.S.A., Telephone: (215) 386-0100
Cable: SCINFO, Telex: 84-5305

 29-3043

Hewlett-Packard on low-budget data logging...

Here's a system that goes wherever you go... and it goes for less than $3100.*

This low-cost traveler can help bridges, forests, telephones, automobiles, schools, pipelines, solar systems...and you.



Now there's a sensible answer for small data logging projects. Whether they take you to the engineering lab, a plant, or the field. It's a portable system based on HP's new 3421A Data Acquisition/Control Unit. We combine this portable powerhouse with HP's 41CV handheld computer and peripherals to give you a low-cost data logger that offers surprising performance.

For example, this system can automatically scan up to 30 channels, measure ac or dc volts, make 2- or 4-wire resistance measurements, monitor digital inputs, and even provide digital outputs.

Sensitivity of 1 μV and 300,000 count resolution let you detect small signals from transducers such as RTD's, thermocouples and thermistors. High accuracy (0.01% full scale), excellent noise rejection (120 dB), and electronic calibration mean you get answers you can trust... even in noisy industrial environments. What's more, reference junctions and software programs simplify measurements by giving you results directly in engineering units.

But you also need flexibility in a portable data logging system. That's assured by the convenient HP-IL interface and 3421A adaptability. With the 41CV, you can easily program the system to do your measurements your way. HP's Digital Cassette Drive lets you store programs for easy recall. And you can also store data for later analysis in the lab. With HP's Thermal Printer/Plotter, you can see measurement results immediately. With the 3421A, you can trade accuracy for speed. Choose 5½-digit resolution to detect small changes. Or, if you're interested in speed, select a fast 30 readings per second with 3½-digit resolution. When ac power is available, you can plug into an outlet, but if power fails you have battery backup for uninterrupted operation. In remote locations, you can operate totally from battery power. A "sleep" mode conserves power by putting system components on standby until needed. With HP-IL you can even upgrade to the more powerful HP85 personal computer for tougher data-logging tasks.

We're into applications you wouldn't have dreamed of.

This new system opens the door to countless data logging tasks you'd have previously tackled manually...if at all. For example, in the electronics lab you can check PC-board temperature profiles. In process plants you can quickly do spot checks on levels, pressures, temperatures, and flow rates. Civil engineers can do life tests on structures such as bridges by measuring the galvanic effect on reinforcing rods.

A data logger in a fish hatchery? Yes, this system can monitor water level, flow rates, and temperature to produce the best mixture of stream and well water for optimum fish growth. The forest industry could even put this system to work in studying the effects of clear cutting on seedling mortality by monitoring soil temperature in various locations.

Whether you're in a manufacturing plant, research lab, solar powered building, ship, airplane, or balloon... HP's new portable data logging system can give you precision measurements at low cost. A complete system, including the 3421A, 41CV, Digital Cassette Drive, Thermal Printer/Plotter, and HP-IL interface, goes for less than $3100.* So pack this system up in its convenient carrying case and take it along... wherever you go.

Get all the details by calling your local HP sales office listed in the telephone directory white pages. Ask for a sales engineer in the electronic instruments department.

HEWLETT PACKARD

* Prices shown are suggested USA list prices

HP-IL

DESIGNED FOR HP-IB SYSTEMS

HP-IB: Not just IEEE-488, but the hardware, documentation and support that delivers the shortest path to a measurement system.

0901302

Circle No. 343 on Readers' Service Card

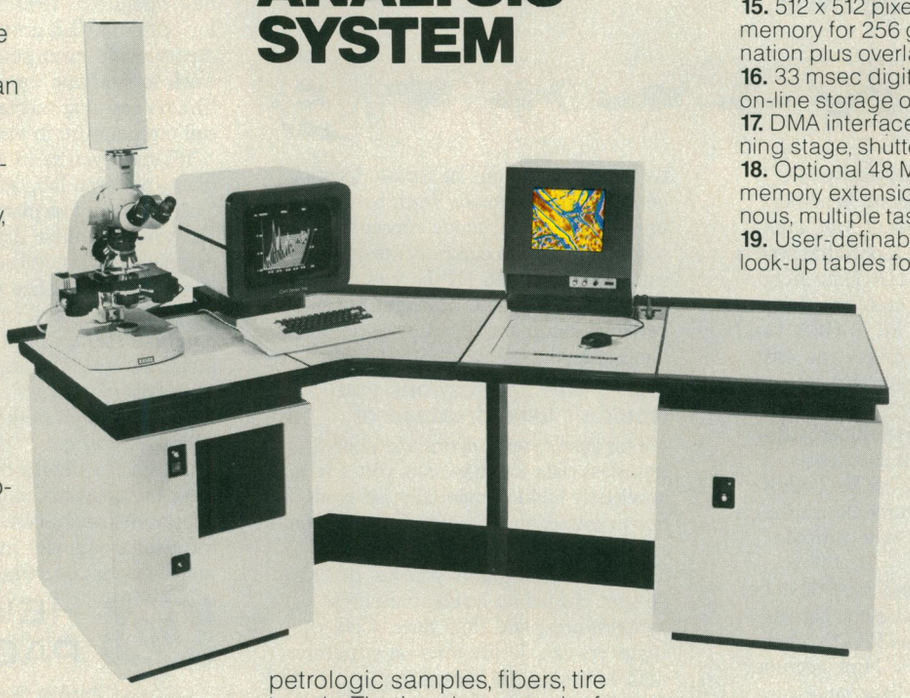
IBAS

A FULLY AUTOMATIC, YET INTERACTIVE IMAGE ANALYSIS SYSTEM

There's nothing like IBAS.

No other image analysis system has everything that IBAS has. In one unit, you get two computers: on the left, a 64 Kbyte RAM micro for fast calculation of image-extracted data; on the right, a 1 Mbyte image array processor that not only lets you manipulate the image as *you* wish, but stores it on-line as well as on disk for recall! Displayed images can be enhanced to make subtleties more apparent to visual interpretation.

What's more, IBAS is both interactive AND automatic. How? Why? When you tell it to do so, IBAS will automatically execute an analysis routine more rapidly and accurately than can be accomplished manually. Most often, further operator interaction won't be necessary, but the choice is yours. Your every wish can be IBAS' command.



What kind of images?

All kinds. Submicro, micro, and macro. The IBAS input can be photographs, X-rays, prints and drawings, projected images, or any direct video image. A TV camera can also operate directly through a light microscope or TEM. Or the input can be drawn from a photometer or SEM/STEM. Whatever the image, IBAS can enhance it and tell you what you need to know about it.

Who can use it?

Just about anyone. One day's instruction is all that's usually required where there's a clearly defined problem. If you want to write your own programs, or define your own feature-specific parameters, you can freely do so. But, because there's so much software available right now, your application would have to be pretty arcane to require it.

You can put IBAS right to work for such applications as quality control of CMOS wafers and photomasks, analyzing particles, petrologic samples, fibers, tire treads. That's only a sample; for routine applications or highly specialized ones, IBAS can tell you more and tell you faster.

Twenty-one key features—count' em, Twenty-one!

1. 64 Kbyte RAM microcomputer, freely programmable, with CP/M*-based universal operating system.
2. Dual 8" floppy disk drives for 1 Mbyte storage/disk of programs, data, images, routines.
3. High resolution color video monitor for image display.
4. B&W data monitor for operator-instrument dialog.
5. 68μ resolution digitizer tablet for interactive measurements and image manipulations, with menu-field for function selections.
6. Cross-hair cursor or ball-point stylus for flexibility.
7. Full ASCII keyboard for inputs, programming, feature selections.
8. 1 Mbyte array processor, expandable to 16 Mbyte, for real-time image storage and manipulation, fast calculations, on-line program storage.
9. Operator-instrument interactive operation for image editing, feature-specific parameter selection.
10. Fully automatic operation for real-time image processing and analysis; task-specific turnkey protocol.
11. 500 nsec random memory access for fast recall of routines.
12. 20 MHz analog to digital convertor for video signal processing, slow-scan input, photometric input.
13. Supplemental I/O ports for interface of peripherals; data transmission.
14. Versatile operating system support for user programming.
15. 512 x 512 pixels x 8+ 1 bit image memory for 256 greylevel discrimination plus overlay.
16. 33 msec digitization rate for on-line storage of video images.
17. DMA interface for driving scanning stage, shutters, auto-focus, etc.
18. Optional 48 Mbyte hard disk memory extension for more voluminous, multiple tasks.
19. User-definable pseudo-color look-up tables for meaningful display of processed images—feature discrimination.
20. Exceptionally attractive, functional, convenient table arrangement.
21. Quality service.

What's next?

Call or write for detailed literature or an applications analysis.

*Trademark of Digital Research, Inc.

Carl Zeiss, Inc.
One Zeiss Drive
Thornwood, NY 10594
(914) 747-1800

ZEISS
West Germany

For literature circle reader service number 339
For demonstration circle reader service number 340

18 March 1983, Volume 219, Number 4590 **SCIENCE**

Whither the Price of Oil?

Virtually all the experts agree that the price of petroleum will drop. But uncertainty prevails about how much it will fall or when. This is a trillion-dollar matter. The world's economy grew vigorously in the decades before the first big rise in the cost of oil in 1973–1974. The world has experienced inflation and recession since the further rise in 1978–1979.

A major lesson of the past decade is that in the short term (a year) demand for petroleum is inelastic. The price increases of 1978–1979 had little immediate effect on consumption. However, since 1979 profound changes have occurred in the availability and use of hydrocarbons. Consumption of oil has dropped while production in countries other than those of the Organization of Petroleum Exporting Countries (OPEC) has increased. As a result, OPEC countries are selling only about half as much oil as they did in 1978, and they have a large idle capacity. The incremental cost of producing additional barrels of oil in many instances is of the order of a dollar or two or less. Countries in or out of OPEC that urgently need money will tend to increase production, shaving the price if necessary, to sell their oil. Since in the short term demand is quite inelastic, the probability is substantial that a chaotic downward price movement will occur. Through strenuous efforts the cartel may be able to slow the move, but this would only lead to a continuing decrease in the use of oil and a longer period of price instability. After 5 to 10 years of lower prices, demand will probably increase substantially, and production capacity for oil will fall due to gradual exhaustion of wells. The stage would then be set for increasing prices.

However, the circumstances that made possible the great increases of the 1970's are not likely to return soon. For example, since 1978 imports of petroleum and its products into the United States have dropped from 8.4 million to about 4.5 million barrels of oil a day. Part of this decrease is due to recession, but most is due to conservation, greater energy efficiency, and substitution of other energy sources for oil. Initial responses to higher fuel prices were followed by more enduring changes. Homes were insulated. The energy efficiency of industry was gradually improved. New automobiles and airplanes require less fuel. Efforts to achieve greater energy efficiency will not be stopped by small changes in the price of oil.

In the United States, and especially in Western Europe, substantial quantities of oil were burned merely to make heat. Often, as in the generation of electricity, coal can be employed. Its energy cost is usually far less than that for oil. A decade ago, 2.1 million barrels of oil a day were burned in the United States to make electricity. Now less than 1 million barrels a day are used, and the trend is downward as more coal-fired and nuclear plants come on line. The forest products industry has curtailed its use of oil and instead is burning wood wastes. Home heating oil faces future competition from electrically driven heat pumps. Another factor leading to less consumption of petroleum is that refiners now obtain more gasoline and heating oil from a barrel of crude oil. What was once burned as cheap residual oil is now being converted to premium products.

The momentum of efforts to reduce consumption of oil in the United States is considerable. It will not be stopped quickly. A drop in price to $20 a barrel would have little effect on the competition of oil with coal. However, it would affect the market for natural gas. Some gas might be replaced by oil. Research and development related to alternative energy sources would be further curtailed and exploration for gas and oil would be slowed, leading to later shortages. But for the shorter term, a drop in price to $10 or less a barrel would be required to make a substantial change in U.S. consumption of oil. In other countries, circumstances differ. For example, in Western Europe, coal is relatively more expensive than it is here. Oil would compete successfully at about $20 a barrel. But on a worldwide basis, a short-lived drop in the price of oil to $15 a barrel or less is a lively possibility.—PHILIP H. ABELSON

Sartorius accuracy in 0.1 second flat!

Sartorius Series 1400 Toploading Balances

High-technology electronics, faster weighing, new built-in keyboard capabilities, unique "Autocheck" ...starting at $1,150.

Great things come in these small packages: Sartorius Series 1400 toploaders, bringing you the latest technology...very large-scale integration in low-profile electronic weighing systems. Now new microprocessors, MP-7 and soon-to-come MP-8, control weighing functions previously done by many integrated circuit components.

While size has decreased, speed and reliability have improved. Electronic weighing has never been faster (with an update time as little as 0.1 second in the MP-8) or had fewer components. And decreasing the size has decreased the cost of owning a 1400 MP-7/MP-8...perfect for all your weighing needs even in less than perfect conditions.

The new 1400 Series toploaders simplify many weighing operations—counting, conversions, and animal weighing. These optimal program capabilities are all accessed through a new, convenient, built-in keyboard—another exclusive from Sartorius.

Convenience, in this case, means confidence. A unique "Autocheck" feature reviews and verifies the functioning of all electronic circuits *automatically.* Convenience and confidence in a compact, affordable weighing system from the company that brought you the first microprocessor-controlled balance—Sartorius.

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.

Sartorius electronic weighing systems

Brinkmann

SYBRON

BRK-5010

Circle No. 291 on Readers' Service Card

AAAS Annual Meeting
Detroit, 26–31 May 1983
Tours

General Tour Information

Tours are limited to meeting registrants only. To order tickets, please complete the form on the next page.

Since some of the tours are taking place in nonpublic, restricted facilities, it is requested that persons of foreign nationality (visitors as well as U.S. residents) give their place and date of birth, in addition to name and address, in the appropriate space provided on the order form.

Tickets will be mailed to you directly. Orders received after 20 May 1983 will be held at the AAAS Ticket Desk in the Westin Hotel. Tickets may be refunded for full value up to 24 hours before tour departure; no refunds will be made after that time. Handicapped persons who need assistance with tours should consult the staff at the Resource Center for Disabled Registrants in the Westin Hotel.

All tours depart from and return to the Westin Hotel. Comfortable walking attire is recommended.

1. General Motors Proving Grounds Headquarters. Friday, 27 May, 8:00 a.m.–12:30 p.m. (Limit: 42 persons)

The GM Proving Grounds incorporate the most modern and complete facilities available for vehicle testing, covering more than 4,000 acres with a road network of more than 128 miles. Test roads include Belgian block, concrete block, engineered pothole, and other special surfaces; water and mud baths; vehicle handling test roads; hill test sections of up to 21 percent grade; and a 4.5 mile perfect circle for high-speed testing.

2. General Motors Technical Center. Friday, 27 May, 8:30 a.m.–12:30 p.m. (Limit: 42 persons)

The Tech Center is where GM brings its scientific and technical resources together. Areas of interest include the Semiconductor Clean Room, Metal Physics Laboratory, Engine Test Cells, robotics testing and development facilities, and the first full-scale automotive aerodynamics wind tunnel in the Western Hemisphere.

3. Warner-Lambert, Inc. Pharmaceutical Research Division. Friday, 27 May, 8:00 a.m.–2:00 p.m. (Limit: 42 persons)

This tour will visit pharmacology and chemistry laboratories, and follow the course of a new drug candidate through these and other departments. Company representatives will be available at a "Q&A" session. The scientific and administrative support required to market a new drug will be explained, and the effects of drug regulations will be discussed.

4. Detroit Arsenal Tank Plant (USATACOM). Friday, 27 May, 12:30–3:30 p.m. (Limit: 42 persons)

The M1 tank is built in this plant. Visitors will see the interior of the M1 and its predecessor, the M60 tank, and the M1 manufacturing process. The M1 design incorporates a digital computer ballistics system, neodymium laser range finder, a special armor capability, and a number of electronic control components.

Restricted tour; some foreign nationals may not participate.

5. Ford Motor Company. Friday, 27 May, 1:00–4:00 p.m. (Limit: 42 persons)

Ford's two newest research and development facilities: the Diversified Products Operations Technical Center, which concentrates on automotive electronic research and development, and the Robotics Center, designed to assist Ford facilities throughout the world in identifying the most sophisticated robotics and automation equipment for computer-aided manufacturing.

6. Stroh Brewery, Inc. Friday, 27 May, 6:00–9:00 p.m. (Limit: 120 persons)

Dinner at the famous Strohaus, followed by a tour of the brew house and packaging area. The featured speaker of the evening will be Dr. Morten Meilgaard, Vice President for Research and Development, who will talk about the chemistry of beer flavor. More than 240 separate flavor elements, each one linked to specific chemistry, contribute to the distinctive flavor of different beers. *This tour is of particular interest to biologists.*

7. Greenfield Village/Henry Ford Museum. Saturday, 28 May. Buses depart hourly, 8:30 a.m.–3:30 p.m.

Greenfield Village is a living history book, with 19 historic homes and shops, such as Thomas Edison's Menlo Park laboratory and Orville and Wilbur Wright's Cycle Shop, that have been removed from their original sites and carefully reconstructed at the Village. Walk through the Village at your own speed, following a map provided, or take advantage of the trains and horse-drawn carriages.

The Henry Ford Museum features 12 acres of historical collections, including carriages, bicycles, motorcycles, automobiles, trains, and aircraft. Artisans frequently give demonstrations of 19th-century machinery.

Separate tickets are required for the Village and the Museum (see order form).

8. University of Michigan. Saturday, 28 May, 9:00 a.m.–2:30 p.m. (Limit: 42 persons)

This guided tour of the University's Ann Arbor campus will include visits to the Highway Safety Research Institute, the Gerald R. Ford Presidential Library, biological science laboratories, and SCRIPT, a computer-aided subject information data bank. There will be a hosted luncheon at the Michigan Student Union restaurant.

9. Wayne State University Campus. Saturday, 28 May, 8:30 a.m.–1:00 p.m. (Limit: 42 persons)

This tour will include the Walter Reuther Library; the Van de Graaff accelerator/positron experiments; non-linear optics and photoacoustics experiments; laser facilities used for art verification, analytical tools, and laser chemistry; the Radiation Oncology Laboratory and x-ray crystallography work; electron microscopy; and the University's safety automatic sled crash tester. A buffet luncheon will be served.

10. Greenfield Village/Henry Ford Museum. Sunday, 29 May. Buses depart hourly, 8:30 a.m.–3:30 p.m.

For details, see Tour No. 7.

11. Detroit Medical Center/Wayne State Univ. Medical School. Sunday, 29 May, 1:30–4:30 p.m. (Limit: 42 persons)

The Detroit Medical Center is one of the largest and most widely-recognized institutions of its kind in the nation. Included in this tour will be the Wayne State University School of Medicine; the emergency medicine department of Detroit

Receiving Hospital; the Radiation Oncology Center; the Comprehensive Cancer Center of Metropolitan Detroit; the Wayne State University Comprehensive Sickle Cell Center; and the Kresge Eye Institute.

12. Enrico Fermi 2 Nuclear Power Plant. Monday, 30 May, 12:30–5:00 p.m. (Limit: 42 persons)

Scheduled for completion in 1983, the Fermi 2 nuclear power plant is now under construction near the historic Fermi 1 development fast breeder reactor. Conventional electric generating processes and equipment are combined with a boiling water reactor to generate up to 1,100,000 kw—enough electricity for a city of 1 million people. *Due to safety regulations, no one under the age of 14 will be permitted on this tour.*

Restricted tour; some foreign nationals may not participate.

13. Michigan State University. Monday, 30 May, 1:00–9:00 p.m. (Limit: 42 persons)

Some 16,000 plantings—7,800 species and varieties of trees and shrubs—make the MSU campus a botanical showplace, especially in the month of May. This tour will include Beal Botanical Gardens, the oldest continually operated teaching facility of its kind in the nation, with 6 acres of more than 5,000 plant species; the Horticultural Gardens; and the new Wharton Center for the Performing Arts. In addition, there are optional tours of the National Superconducting Cyclotron Laboratory, the Mass Spectrometry Facility, the Energy Plant Research Laboratory, and the experimental farms. An authentic midwestern barbecue will be served (outdoors, weather permitting) at the end of the tour. .

14. General Motors Assembly Plant. Tuesday, 31 May, 8:30 a.m.–1:00 p.m. (Limit: 42 persons)

A firsthand view of the state-of-the-art technology and processes used to assemble Buick Skylarks and Oldsmobile Omegas, and the people who make it all work. Visitors will see the complex conveyor system that carries car chassis, bodies, and components to the appropriate point in the assembly process; the parts inventory and storage systems that keep assembly operation running without delays; and the complete automotive assembly process in operation.

Tour Tickets Order Form

Name _____

Institution or Company _____

Street Address _____

City _____ **State** _____ **Zip Code** _____

Foreign Nationals, please list: Place of Birth _____ Date of Birth _____

Indicate any special requirements due to a handicap: _____

Tour No.	Ticket Price	No. of Tickets
1. GM Proving Grounds Headquarters (27 May)	$ 9.00	
2. GM Technical Center (27 May)	9.00	
3. Warner Lambert, Inc. (27 May)	9.00	
4. Detroit Arsenal Tank Plant (27 May)	9.00	
5. Ford Motor Company (27 May)	9.00	
6. Stroh Brewery, Inc. (27 May)	13.75	
7. Greenfield Village *or* Henry Ford Museum (28 May)	10.00	
Additional ticket to Village *or* Museum) *Specify departure time:	6.50	
8. University of Michigan (28 May)	9.00	
9. Wayne State University Campus (28 May)	$ 9.00	
10. Greenfield Village *or* Henry Ford Museum (29 May)	10.00	
Additional ticket to Village *or* Museum) *Specify departure time:	6.50	
11. Detroit Medical Center (29 May)	9.00	
12. Enrico Fermi 2 Nuclear Power Plant (30 May)	9.00	
13. Michigan State University (30 May)	14.00	
14. GM Assembly Plant (31 May)	9.00	

*Buses depart hourly, from 8:30 a.m. to 3:30 p.m., for tours 7 and 10.

Charge to my ☐ VISA or ☐ MASTERCARD. Enclosed is my check ☐ Total amount enclosed or charged: $_____

Total No. of tickets ordered: _____

Account No. _____ Cardholder's Name _____

Expiration Date _____ Signature _____

MAIL TO: Tours, AAAS—Dept. R, 1515 Massachusetts Ave., N.W. Washington, D.C. 20005