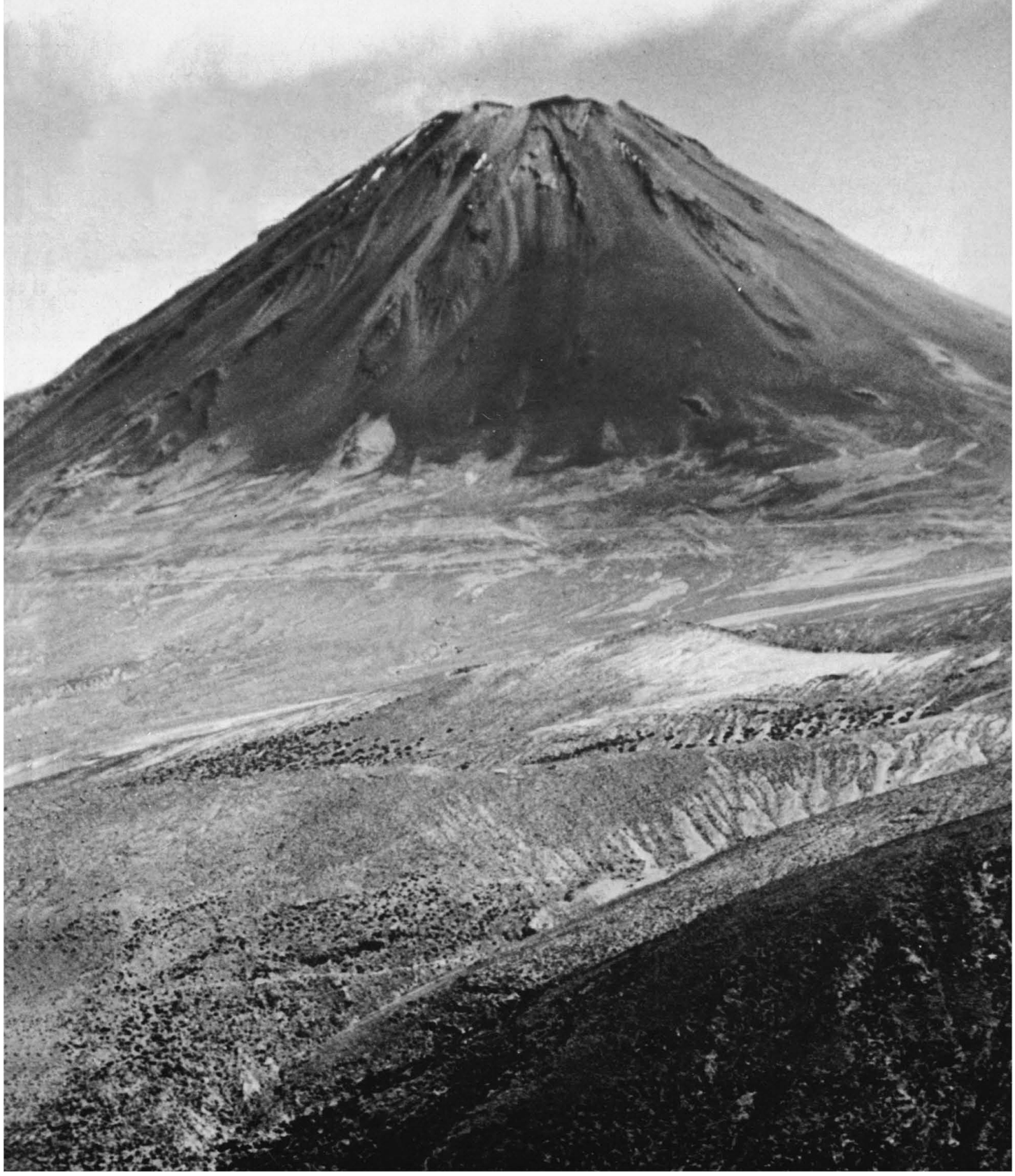
SCIENCE

17 September 1976

Volume 193, No. 4258

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

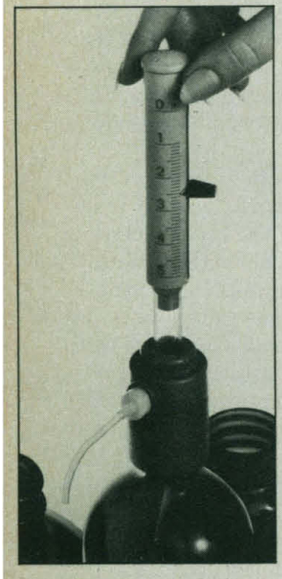


NOW AVAILABLE IN ADJUSTABLE 50, 25 & 0.5 ml MODELS!

The difference between a Dispensette® and other bottle-top dispensers:

Nothing to break off on the outside.

Nothing to wear out on the inside.



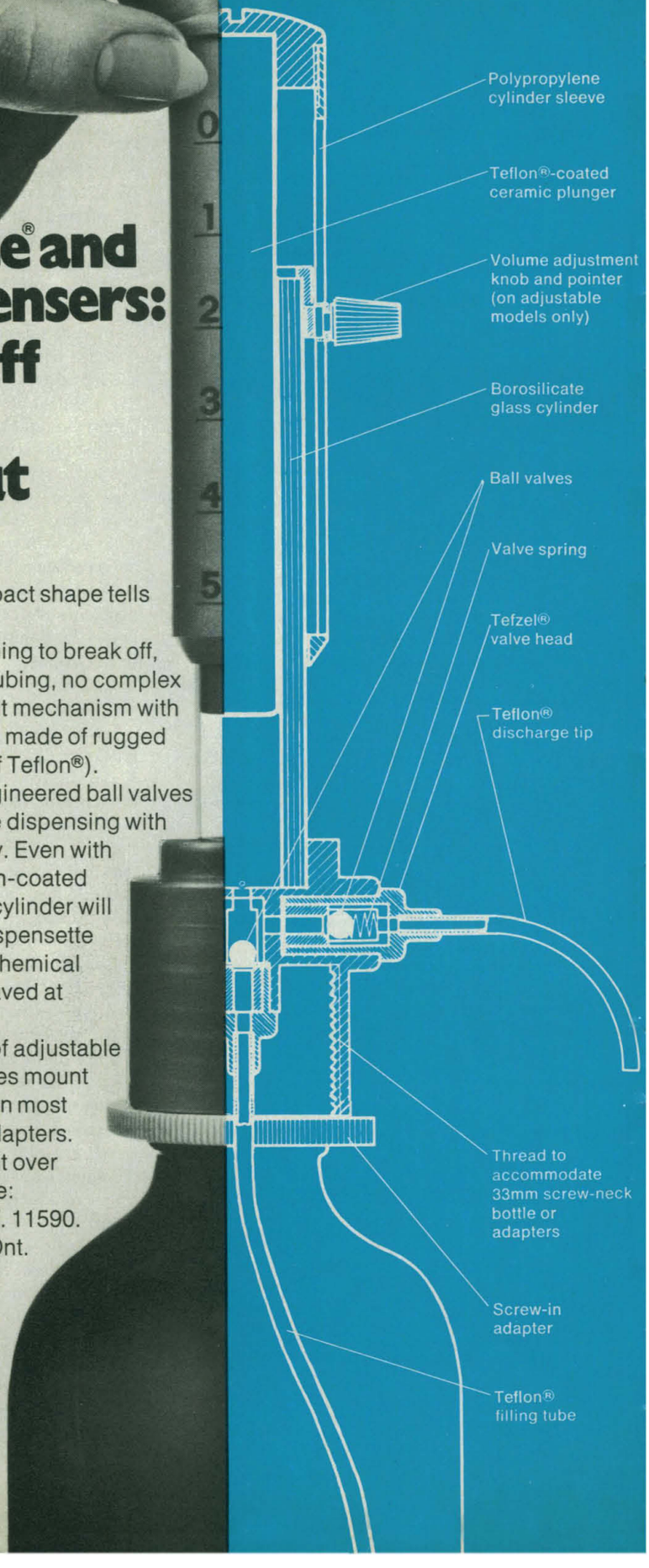
One glance at its slim, compact shape tells you a lot about a Dispensette.

On the outside, there is nothing to break off, chip or crack. No fragile glass tubing, no complex springs, no awkward adjustment mechanism with magnifier. (The outer housing is made of rugged polypropylene, the flexible tip of Teflon®).

On the inside, precision engineered ball valves and spring permit fast, accurate dispensing with better than 0.1% reproducibility. Even with strong alkalis, the smooth Teflon-coated plunger and borosilicate glass cylinder will not freeze together. In fact, a Dispensette may be used with any reactive chemical (except HF) and may be autoclaved at 120°C without disassembling.

Available in a wide variety of adjustable and fixed-volume models from 0.5 to 50ml, Dispensettes mount directly on any 33mm screw-neck reagent bottle and on most other size bottles, cans or containers using optional adapters.

Inside and out, Dispensette is a major improvement over conventional bottle-top dispensers. For literature, write: Brinkmann Instruments, Cantiague Rd., Westbury, N.Y. 11590. In Canada: 50 Galaxy Boulevard, Rexdale (Toronto), Ont.



Brinkmann Dispensette

Available from: Ace Scientific / Bio-Rad Laboratories / Cole-Parmer Instrument Co. / Curtin Matheson Scientific / Fisher Scientific Preiser Scientific / Sargent Welch / Scientific Products / SGA Scientific Arthur H. Thomas Co. / VWR Scientific.

Circle No. 53 on Readers' Service Card

17 September 1976

Volume 193, No. 4258

SCIENCE

SCIENCE is published weekly, except the last week in December, but with an extra issue on the fourth Tuesday in November, 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. Member rates on request. Annual subscription $50; foreign postage: Canada $10, other $13, air lift to Europe $30. Single copies $2 (back issues $3) except Materials Issue (20 Feb. 1976) is $3 and **Guide to Scientific Instruments** is $6. School year subscription: 9 months $37.50; 10 months $41.75. Provide 6 weeks' notice for change of address, giving new and old address and zip codes. Send a recent address label. **Science is indexed in the Reader's Guide to Periodical Literature.**

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

El Misti, a young (Pleistocene) stratovolcano in southern Peru. The volcano is composed of andesites bearing a 300-million-year strontium isotopic age imprint inherited from ancient sub-Andean lithosphere. See page 1086. [C. Brooks *et al.*, Carnegie Institution of Washington, Washington, D.C.]

aaas SALE

INVENTORY REDUCTION

of selected symposium volumes

Since January 1934, AAAS has published symposium volumes based on materials presented by renowned scientists at its annual meetings. The AAAS Publications Committee has selected for publication symposia that are comprehensive, timely, and well-documented. In addition, the Association has published books based on material presented at special conferences and meetings. Now, the Association is offering ten of these volumes at a special, reduced, price.

☐ **Research in the Antarctic.** Edited by Louis O. Quam. A report of the extensive research conducted in the Antarctic since the International Geophysical Year and the global significance of those efforts. Topics such as glaciology, cold poles and heat balances, ocean dynamics and ecosystems are covered. 784 pages (41½" x 56" map included), 1971.

List Price: ~~$24.95.~~ $14.00

☐ **Air Conservation.** The Report of the AAAS Air Conservation Commission. Authorities in conservation, pollution control, pollutants and their effects, law economics, meteorology, public health and government present a wealth of information. 348 pages, 1965; third printing 1970.

List Price: casebound ~~$8.00~~ $5.00
paperbound ~~$4.95.~~ $3.00

☐ **Separation and Depression.** Edited by John Paul Scott and Edward C. Senay. Contributions were gathered from behavior biology, animal behavior studies, clinical pharmacology, psychoanalysis and social systems, bridging the gap between animal behavior models and the human clinical condition. 256 pages, 1974.

List Price: ~~$19.95.~~ $14.00

☐ **The Maturing of American Science.** Edited by Robert H. Kargon. This unique volume traces the development of science in America during the past 50 years by drawing together a selection of AAAS presidential addresses. 250 pages, 1974.

List Price: ~~$15.95.~~ $8.00

☐ **Folk Song Style and Culture.** Edited by Alan Lomax. Working with a sample of recorded songs and filmed dances from all world cultures, the Cantometrics Project discovered ways in which song and dance style vary by culture. 384 pages, 1968; second printing 1971.

List Price: ~~$16.75.~~ $10.00

☐ **Ground Level Climatology.** Edited by Robert H. Shaw. Investigators from a variety of scientific fields concerned with ground level climatological problems meet in this volume and explore the effects of climate on particular plants and animals; the effect of ground level climate on forest fires; the relationship between climate and animal husbandry; and the reaction of plants and animals to various environments. 408 pages, 1967; second printing 1970.

List Price: ~~$12.50.~~ $6.50

☐ **Agriculture and the Quality of Our Environment.** Edited by Nyle C. Brady. This volume brings together the pertinent and essential facts about how agriculture affects and is affected by the quality of our environment. 476 pages, 1967; second printing 1970.

List Price: ~~$13.50.~~ $8.50

☐ **Man, Culture, and Animals.** Edited by Anthony Leeds and Andrew P. Vayda. The papers gathered in this volume represent the research that anthropologists and geographers conducted on the uses people make of particular animals and their products, the characteristics of these animals, and the effects that using or having to use the animals has upon cultural patterns and social organizations. 304 pages, 1965; third printing 1970.

List Price: ~~$8.00.~~ $5.50

☐ **Arid Lands in Transition.** Edited by Harold E. Dregne. Contains papers presented at the 1969 international conference on "Arid Lands in a Changing World." The papers explore the use of arid lands in different parts of the world. 538 pages, 1965; third printing 1970.

List Price: ~~$15.75.~~ $9.50

☐ **Oceanography.** Edited by Mary Sears. Presented at the International Oceanographic Conference (1959), papers collected in this volume emphasize the interrelationships between the scientific disciplines underlying oceanography. 654 pages, 1961; fifth printing 1969.

List Price: ~~$14.75.~~ $8.50

ORDER FORM

Please send the following at the reduced prices:

___ Research in the Antarctic—**$14.00**
___ Air Conservation (CB)—**$5.00**
___ Air Conservation (PB)—**$3.00**
___ Separation and Depression—**$14.00**
___ The Maturing of American Science—**$8.00**
___ Folk Song Style and Culture—**$10.00**
___ Ground Level Climatology—**$6.50**
___ Agriculture and the Quality of Our Environment—**$8.50**
___ Man, Culture, and Animals—**$5.50**
___ Arid Lands in Transition—**$9.50**
___ Oceanography—**$8.50**

TOTAL AMOUNT ENCLOSED _____

Check or Purchase Order must accompany all orders. **DO NOT SEND CASH**

Name _____

Address _____

City, State, Zip _____

Mail to:

AAAS, Dept. J1
1515 Massachusetts Ave., N.W.
Washington, D.C. 20005

(Please allow 6–8 weeks for delivery)

"When the heat's justify timesharing with paper."

Problem: Pressure. Temperature. Time. Until you define influential variables, your process is out of control.

Trouble is, timeshare costs can also be an unknown quantity. And analyzing pounds of printout can bog you down for days. After all, the challenge in hundreds of programs and models lies in rapidly defining how each variable influences the end result. In finding the optimum operational range.

Solution: Tektronix' desktop Graphics system comes straight to the point.

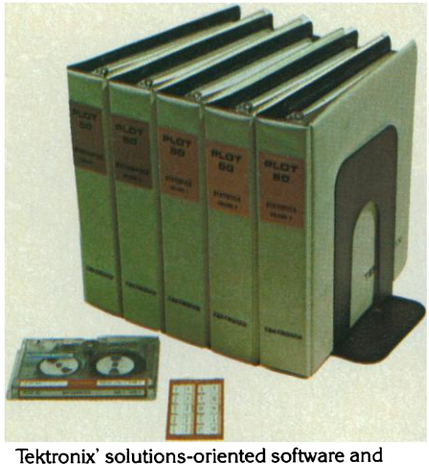
The 4051 speaks a graphically beefed-up BASIC ... supported by software packages like statistics, that lets you explore analyses of variance and linear and non-linear regression techniques with unequalled simplicity and interactivity. In integrated circuit production. Chemical analysis. Mathematical modelling. You name it.

The 4051 puts you in command of up to 32K of problem-solving power, with 300K bytes of built-in mag tape storage and optional on-line capability. You proceed directly from inputting data to outputting time plots, histograms, even three-dimensional renderings—without waiting for a processor or wading through printout.

TEKTRONIX®

Circle No. 99 on Readers' Service Card

on, I can't and I can't wrestle



Tektronix' solutions-oriented software and library of graphics applications programs let you work at your own pace while you exploit the full interactivity of the 4051.

The 4051 Graphic Computing System is complemented by a complete line of plug-in peripherals like plotters, printers, hard copy and tape storage devices, memory extenders and data communications interfaces.

Seeing is the simplest language of all. Results you can see are results you can use ... immediately. You can explore more options, keep closer to the experiment. You can communicate graphic concepts more quickly, save them more compactly. It figures that Tektronix would be first to combine Graphics with desktop intelligence, since we've been the Graphics leaders for years.

Take the heat off. Personal 4051 Graphics starts at just $6995.* Your local Tektronix Sales Engineer can show you Graphics applications already underway in your field.

Tektronix, Inc.
Information Display Group
P.O. Box 500
Beaverton, Oregon 97077
Tektronix Datatek NV
P.O. Box 159, Badhoevedorp
The Netherlands

Get the picture. Get total results.

*U.S. Domestic Price Only

Your New Balplan® Conference Microscope...

What it means, and what it is.

It means that up to five people can see the same sharp, quality image they would see in an individual microscope. It means that they can make photomicrographs at the same time. It means faster understanding through a movable, illuminated pointer visible to each person at the same time.

It means more accurate interpretation since each viewer has its own focusing control. And it means retention of all of the details lost in diffused, projected images . . under normal room lighting situations.

It is the logical extension of Bausch & Lomb's widely-accepted Balplan modular microscope.

You can build the Conference Microscope from your present Balplan . . . or purchase a new Balplan with from one to five viewing heads. These are available in:

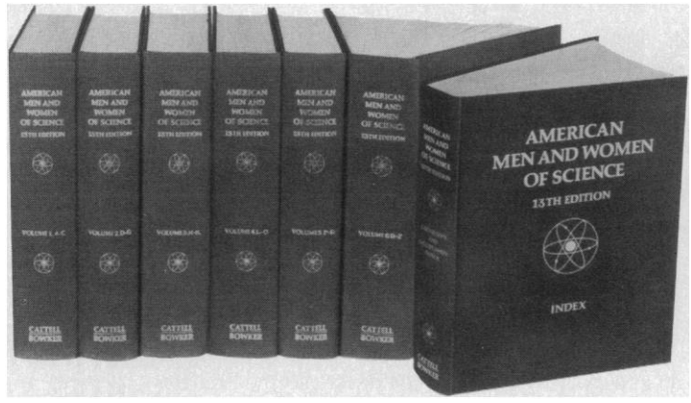
30° and 45° inclined binocular units
30° inclined monocular units
30° inclined triocular units (for photomicrography).

All heads are interchangeable.
All may be rotated 360°.

The new Balplan Conference Microscope . . . another innovative change in microscopy from Bausch & Lomb. Write for our catalog and ask for a demonstration. No obligation, of course.

Write to Bausch & Lomb, Scientific Optical Products Division, 20709 North Goodman St., Rochester, N.Y. 14602.

All seven volumes of the new 13th edition of AMERICAN MEN AND WOMEN OF SCIENCE will be published at once—in October



Since the 12th edition appeared, the world of science has altered dramatically. This new edition records all the changes and captures all the new scientists and projects. It provides the only comprehensive access to scientists active in universities, industries, foundations, government projects in every state of the union and Canadian province.

Prepared with the help of a distinguished advisory board the 13th edition has —

■ current, concise, in-depth biographies of some 110,000 U.S. and Canadian scientists working and teaching in 1,000 areas of the physical, biological and selected social sciences...

■ alphabetically-arranged entries—including full name, discipline, education, professional experience, memberships, areas of research, specialization and address...

■ a separate index volume listing the scientists by city and state, province, or country if working abroad, and by 79 major subject headings. (Almost 30 percent of the names are listed under more than one subject area.)

AMWS is indispensable for finding out who's doing what in which scientific areas now ... and what they've done in the past.

It belongs in every institution where scientists must be contacted, evaluated, researched, written about.

Edited by Jaques Cattell Press, ISBN 0-8352-0865-6, ISSN 0065-9347. LC 6-7326. 8½"x11". Approx. 7,000 pages in 7 volumes. $50 per volume. $300t set price. ($250 per complete set through September 30, 1976.)

SPECIAL OFFER!

For a limited time–Save $100.

Order the complete set now and you'll get all seven volumes (the six biographical volumes and the index) for $250. After September 30, 1976 the complete set will cost $300t, or when ordered individually, $50 for each of the seven volumes.

R. R. Bowker Order Dept. P.O. Box 1807 • Ann Arbor, Michigan 48106 SC92

☐ Yes! I want____ set(s) of AMERICAN MEN AND WOMEN OF SCIENCE, 13th Edition (0-8352-0865-6) at the special prepublication price of $250. (After Sept. 30, 1976 the set price will be $300t) We pay postage and handling on all prepaid or charged orders.

☐ Do not send me the complete set, but send the following individual volume(s) @ $50 each:

☐1. A-C (0-8352-0866-4)
☐2. D-G (0-8352-0867-2)
☐3. H-K (0-8352-0868-0)
☐4. L-O (0-8352-0869-9)
☐5. P-Sr (0-8352-0870-2)
☐6. St-Z (0-8352-0871-0)
☐7. AMWS Geographic and Disciplinary Index 13th Edition (0-8352-0872-9)

☐ My check (money order) for $____ is enclosed. (Please include sales tax where applicable.)

☐ Please charge the books indicated to my ☐Master Charge ☐BankAmericard (Please indicate the card you are using.) ☐ American Express

Account # ____ Valid through ____ Interbank # ____ (Master Charge only)

Name ____ (Please print) Signature ____

Address ____ City/State/Zip ____

Satisfaction Guaranteed! *Books in salable condition may be returned for any reason within 14 days of receipt. Prices are subject to change and slightly higher outside the U.S. and possessions. Outside Western Hemisphere: Order from Bowker, Erasmus House, Epping, Essex, England.*

BOWKER
NEW YORK & LONDON

NEW FROM MILES RESEARCH PRODUCTS

MILES RESEARCH PRODUCTS

AFFINITY CHROMATOGRAPHY

SPACER GELS

CHARGE-FREE SPACER GELS

The preparation of hydrazide agarose by a one step procedure was described by Lamed, Levin and Wilchek in 1973. This gel offers an amine-containing spacer support that is free of charges at neutral pH. Although particularly suited to nucleotide immobilization, it can be further derivatized to increase its versatility.

Capitalizing on the advantages of the hydrazide materials, Wilchek and Miron in 1974 published on a further refinement using polyacrylic hydrazide. This hydrazide derivative retains the properties of acrylamide polymers, as well as of agarose in that it lacks charged groups even after coupling of the ligand. Through use of this material a multipoint attachment is possible thus reducing leaching difficulties.

1. ADIPIC-HYDRAZIDE-AGAROSE
   Has hydrazide groups on a C_6 spacer for coupling of ligands containing free carboxylic groups or insolubilization of periodate oxidized nucleotides.
2. SUCCINYL-ADIPIC-HYDRAZIDE AGAROSE
   Succinyl derivative with carboxylic groups for coupling to ligands containing free amino groups.
3. POLYACRYLIC-HYDRAZIDE-AGAROSE
   Has hydrazide groups on a linear polymer of polyacrylate.
4. SUCCINYL-POLYACRYLIC-HYDRAZIDE AGAROSE
   A carboxylic derivative of the above referenced product for coupling of ligands with free amino groups.

Description	Code No.	Pkg. Size
Adipic Hydrazide Agarose	62-074-1	*50 ml
Succinyl Adipic Hydrazide Agarose	62-075-1	*50 ml
Polyacrylic Hydrazide Agarose	62-076-1	*50 ml
Succinyl Polyacrylic Hydrazide Agarose	62-077-1	*50 ml

*Settled gel volume

SPACER GELS

MULTIVALENT HYDROPHILIC SPACER GELS

In 1973 Wilchek described the preparation and use of poly-L-lysine agarose and poly-DL-alanine poly-L-lysine agarose derivatives. These gels offer the advantages of introducing a multi-point attached hydrophilic spacer arm. Thus, spacer-ligand leaching is reduced and non-specific interactions with the gel are minimized.

1. POLY-L-LYSINE AGAROSE (PL-AGAROSE)
   Has free amino groups for coupling to ligands containing carboxylic groups.
2. SUCCINYL-POLY-L-LYSINE AGAROSE (SPL-AGAROSE)
   Has free carboxyl groups to enable coupling to ligands containing free amino groups.
3. POLY-DL-ALANINE POLY-L-LYSINE AGAROSE (PAL-AGAROSE)
   Multivalent, hydrophilic spacer gel with amino groups far removed from the matrix.
4. SUCCINYL-POLY-DL-ALANINE-POLY-L-LYSINE AGAROSE (SPAL-AGAROSE)
   Carboxyl derivative for coupling to ligands containing free amino groups.

Description	Code No.	Pkg. Size
PL-AGAROSE	62-070-1	*50 ml
SPL-AGAROSE	62-071-1	*50 ml
PAL-AGAROSE	62-072-1	*50 ml
SPAL-AGAROSE	62-073-1	*50 ml

*Settled gel volume

SHALTIEL HYDROPHOBIC CHROMATOGRAPHY KITS

Prof. Shaltiel and co-workers at the Weizmann Institute of Science have introduced the use of homologous series of hydrocarbon-coated agaroses* for separation and purification of proteins. This approach makes use of differences in sizes and distribution of available hydrophobic pockets or regions in proteins, and of lipophilic interactions between these pockets and hydrocarbon chains in the agarose beads.

Kit I. Alkyl-Agaroses
The kit consists of six pre-packed columns containing 1 ml of an alkyl agarose of the general formula Agarose-$(CH_2)_n$-H, where n = 0, 2, 4, 6, 8 and 10.

Kit II. ω-Amino Alkyl Agaroses
The kit consists of five pre-packed columns containing 1 ml of an ω-amino alkyl agarose of the general formula Agarose-$(CH_2)_n$-NH_2 where n = 2, 4, 6, 8 and 10, and one underivatized agarose control column. Each kit contains detailed instructions and can be used to determine the appropriate gel for preparative work. Individual components are available in larger quantities. Please inquire concerning your specific needs.

Description	Code No.	Pkg. Size
Hydrophobic Chromatography Kit I.	62-060-1	1 Kit
Hydrophobic Chromatography Kit II.	62-085-1	1 Kit
Each kit contains 6 columns		

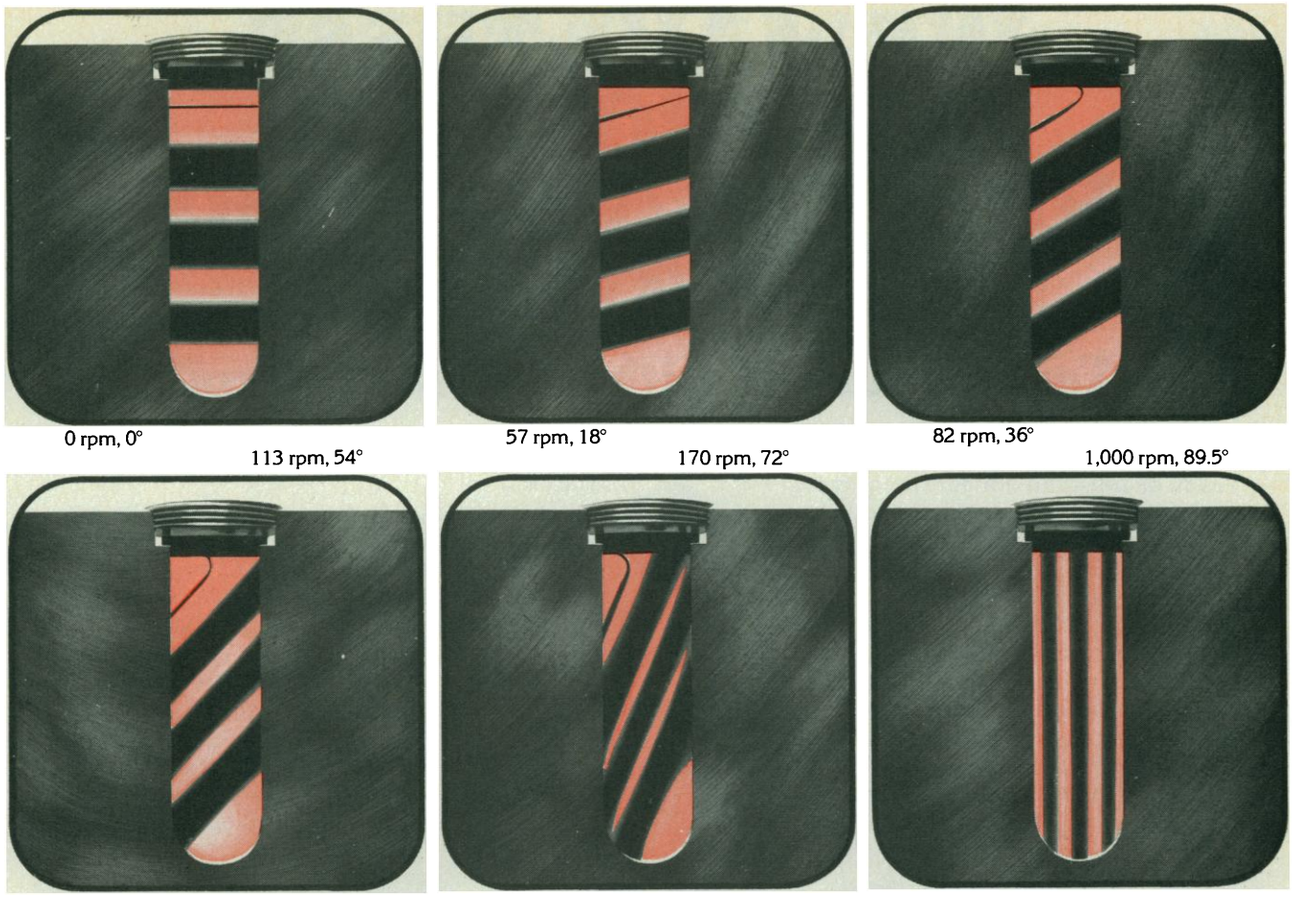
*U.S. Patent No. 3,917,527

RESEARCH PRODUCTS

MILES

Research Products
Miles Laboratories, Inc.
Elkhart, Indiana 46514
Phone: 219-264-8804

Miles Laboratories, Ltd.
Post Office Box 37, Stoke Poges
Slough, England SL 2 4 LY
Phone: Farnham Common 2151

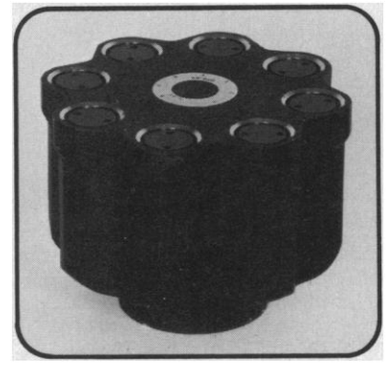


The new Sorvall® vertical rotor can slash density gradient spin time by cutting particle path length.

The new Sorvall® vertical rotor holds the tube at a fixed angle of 0° while the gradient reorients from horizontal to vertical. The calculated speeds and angles are illustrated above. As the rotor decelerates, the contents return to horizontal without mixing the gradient.
The vertical rotor reduces spin time because a particle must travel only the width of the tube and not the length. It also improves resolution by increasing the surface area and decreasing the depth of the starting zone. In fact, the K factor calculated for the highest performance ultraspeed swinging bucket rotor is 45, while the K factor calculated for the Sorvall® TV865 vertical rotor is only 10.

Even better results can be expected when the vertical rotor is spun in a Sorvall® OTD ultracentrifuge with oil turbine drive and an automatic rate controller, because the soft start and soft stop characteristics of the ARC and Reograd mode of deceleration prevent disturbance of the gradient during acceleration and deceleration.

The new Sorvall® vertical rotor is available in two models for ultraspeed work and one for superspeed separations. All three spin more sample than



comparable swinging bucket rotors because they hold more tubes. For more information, write to Du Pont Instruments, Room 24023, Wilmington, DE 19898.

Du Pont Instruments

DUPONT
REG U.S. PAT. & TM. OFF.

Circle No. 196 on Readers' Service Card

WE MAKE THESE ELECTROSTATIC PRINTER/PLOTTERS EASIER TO READ.

Test it yourself with a free sample roll.

Graphic Controls electrostatic paper reads easier than conventional types. Because it's obviously whiter...giving a sharper, blacker look to letters, numbers, dots and lines.

We **should** be able to produce a better paper. Making specialty papers is our ONLY business. We produce both report and translucent grades that fit all **Gould, Varian and Versatec** electrostatic printer/plotters in both roll and fanfold form.

In the wider roll sizes we offer the unique feature of rolls cross-perforated every 11 inches for easy fanfold stacking.

As a standard feature, we sequentially page number all of our fanfold packs for increased operating efficiency and ease of information retrieval. For your specialized applications, roll and fanfold paper is available with preprinted formats in your choice of color.

All this and...priced significantly below your present supplier.

For more information—or a free sample to make your own reading test—use the coupon. Or call Sales Service Dept. Phone: (716) 853-7500, Ext. 378.

Gould Versatec Varian

S-9-76

☐ Send me more information on your electrostatic paper, including prices. Estimated annual usage: _____ rolls.

☐ I'd like a free sample to make my own reading test on my _____ machine. Chart No. _____.

☐ Have your representative call.

Name _____

Company _____

Address _____

City _____ State _____ Zip _____

COATED PRODUCTS DIVISION
GRAPHIC CONTROLS CORPORATION
189 VAN RENSSELAER STREET, BUFFALO, NEW YORK 14210

See what you measure while you measure.

The Microscope-Photometer 03 is the only system in its price class that offers these advantages:

1. You can observe the full field and the measuring spot simultaneously *during* measurement.

2. You are always sure you're measuring *exactly* the area you have selected.

3. You can direct *100%* of the light intensity to either detector or observer for maximum sensitivity, or you can share it between the two.

The MPM 03 System has great versatility, too.

The versatility starts, of course, with either a Zeiss Universal or, if you want a built-in, completely automatic 35 mm camera system, a Zeiss Photomicroscope (shown here.)

And the versatility grows with:

Tube heads for visible light, in fact, down to 350nm, or for UV/IR with image converters.

Interchangeable measuring inserts for specific tasks.

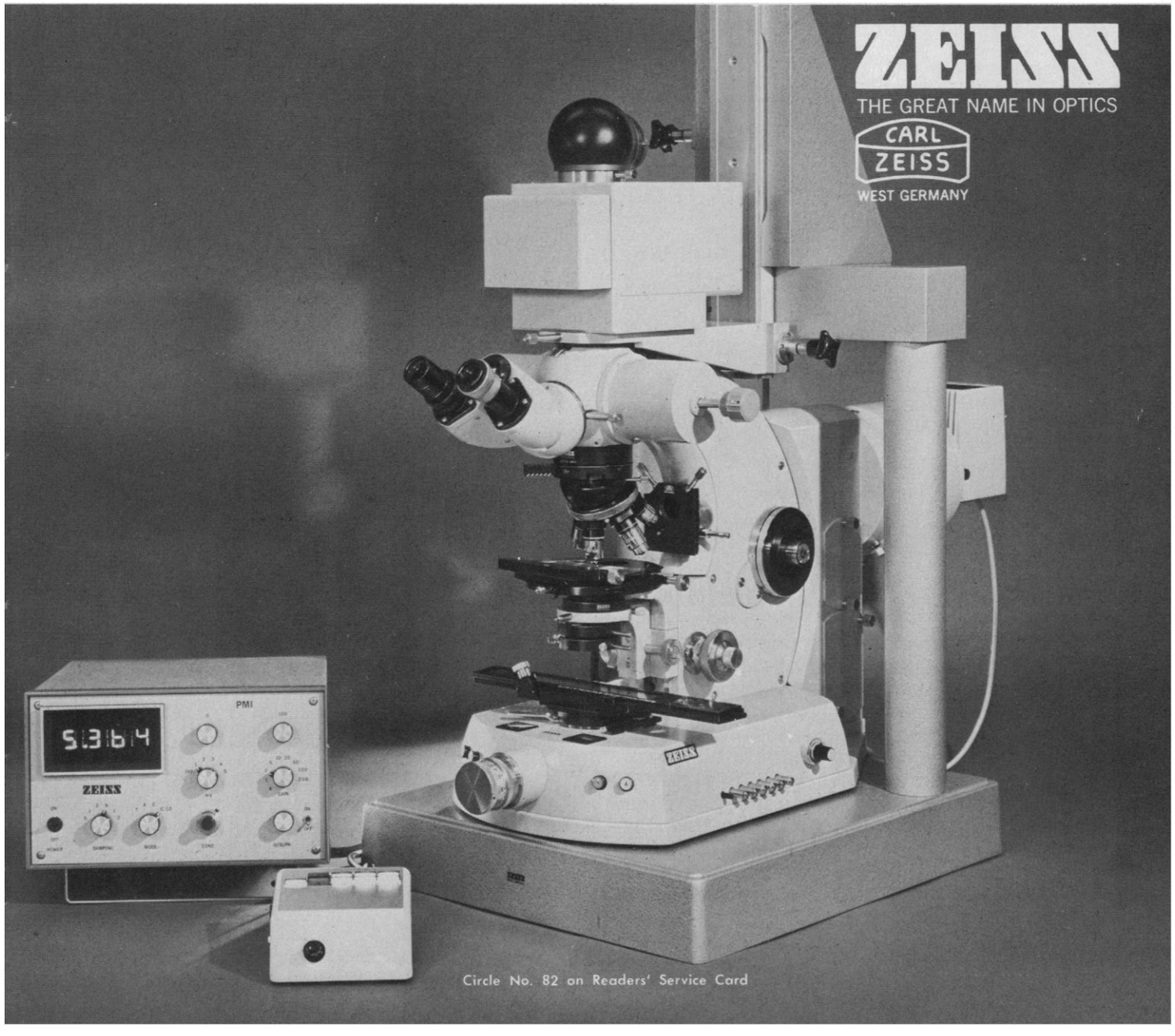
Recorders, printers, TV, and many other accessories.

Computer-controlled scanning packages with wide selection of software for advanced data processing.

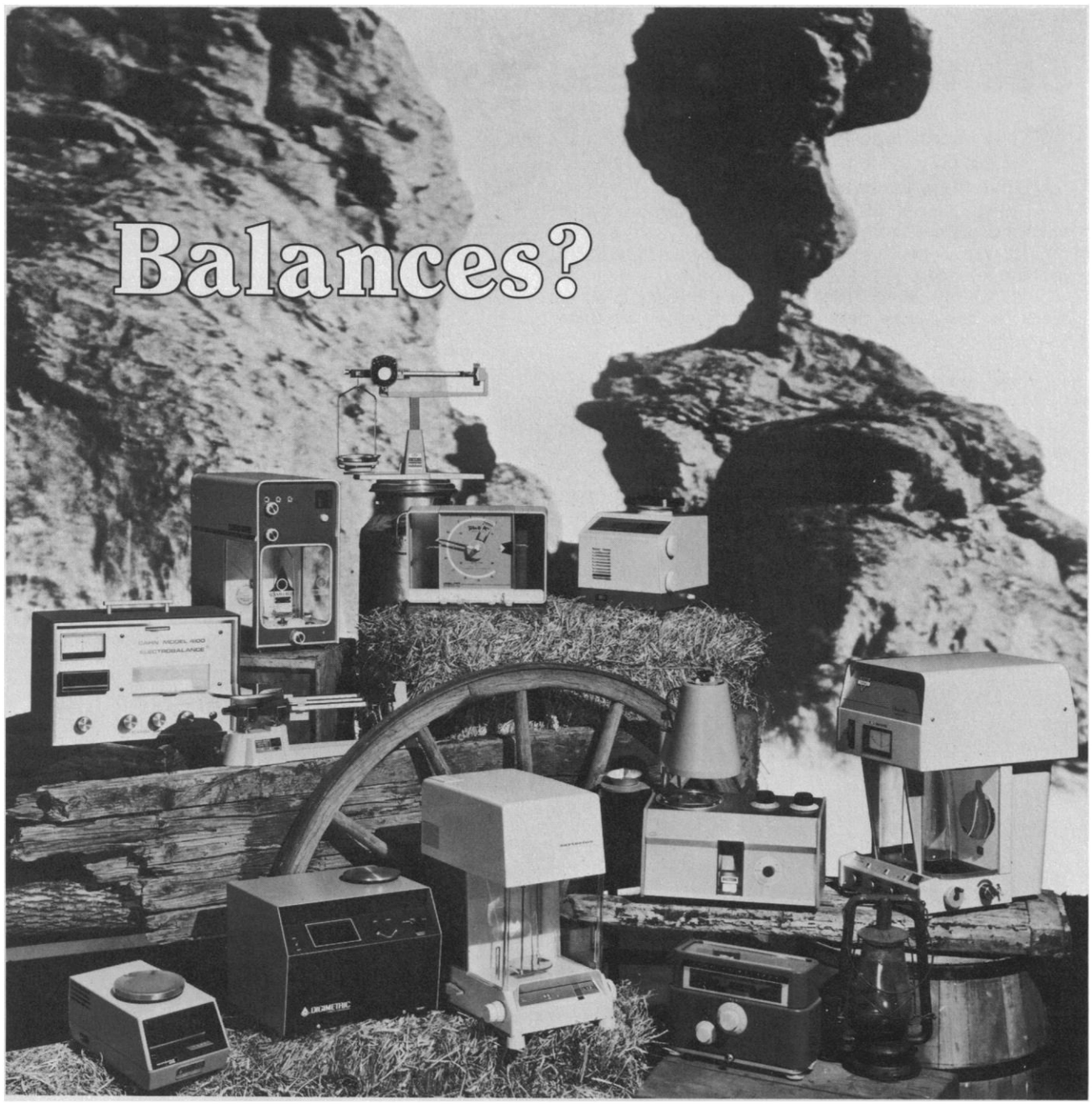
The 03 system is part of a full line of Zeiss Microscope Photometers, including the low-priced 01K and the ultra-sophisticated Axiomat Photometer System. Write today for literature or a demonstration.

Nationwide Service.

Carl Zeiss, Inc., 444 5th Avenue, N.Y., N.Y. 10018 (212) 730-4400. Branches in: Atlanta, Boston, Chicago, Columbus, Houston, Los Angeles, San Francisco, Washington, D.C. In Canada: 45 Valleybrook Drive, Don Mills, Ont., M3B 2S6. Or call (416) 449-4660.



Circle No. 82 on Readers' Service Card



..we have the right model for you--whatever your weighing need!

Shown are just twelve of the one-hundred-two-plus balances we stock. Balances by such outstanding makers as Ainsworth, Biolar, Cahn, Digimetric, Ohaus, Sartorius, Sauter, Torsion and Voland. We supply balances covering the spectrum of laboratory weighing from a particle to a mass; balances for every purpose from routine work to a host of highly specialized needs: analytical balances, animal balances, air pollution balances, assembly-line balances, digital balances, electrobalances, direct-reading balances, micro balances, macro balances, moisture balances, student balances, research balances.

Literature pertaining to your particular balance requirements will be sent on request.

SGA

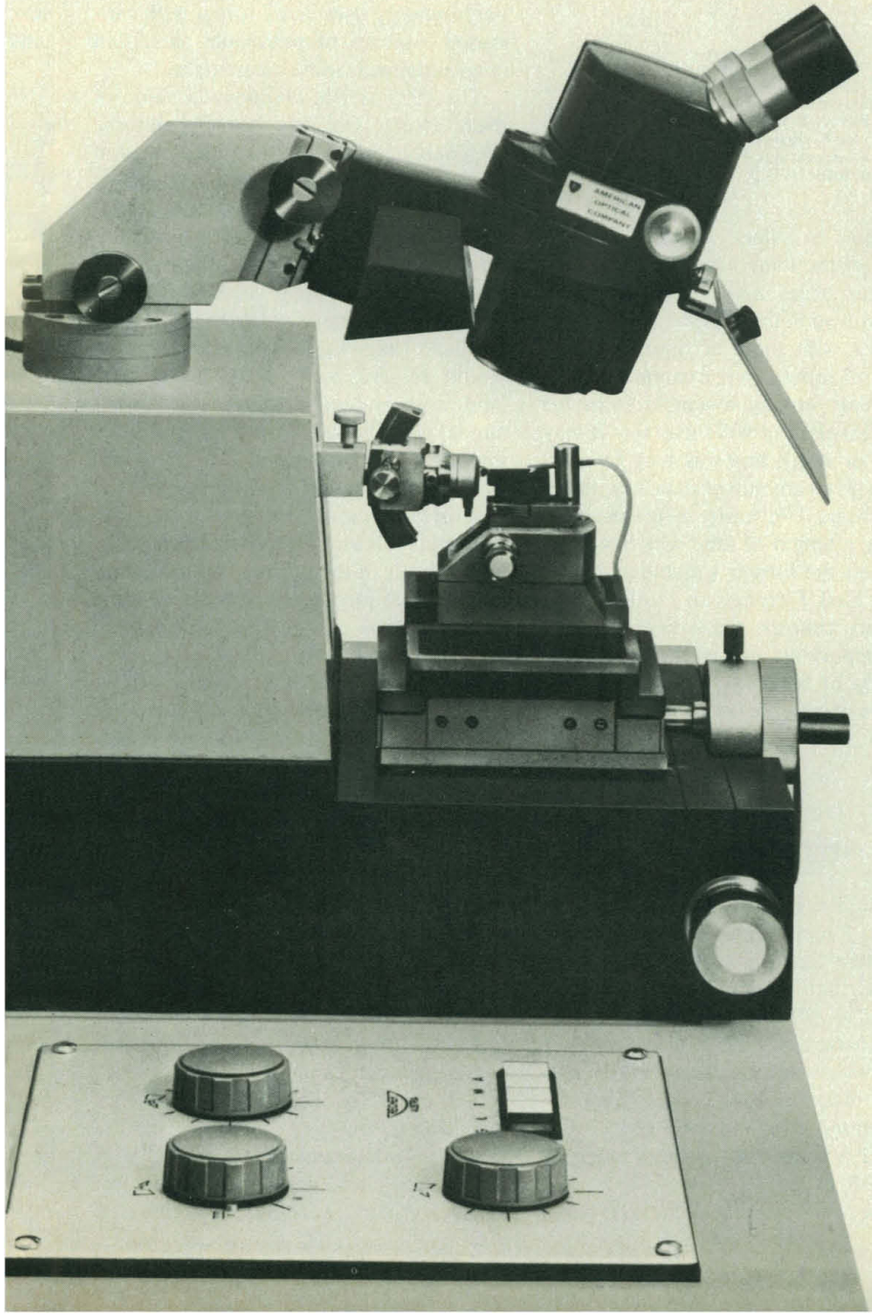
SCIENTIFIC

BLOOMFIELD, N. J. 07003

Laboratory apparatus • instruments
chemicals • glassware

Branches: Boston, Mass./Elk Grove Village, Ill./Fullerton, Calif./New Haven, Conn./Philadelphia, Pa./Silver Spring, Md./Syracuse, N.Y.

What do users like most about the Reichert OmU3 Ultramicrotome?



- ☐ **easiest to use...easiest for training.**
- ☐ **exclusive built-in remote liquid level control.**
- ☐ **exclusive darkfield knife alignment.**
- ☐ **built-in vibration dampening system.**
- ☐ **independent cutting and recycle controls.**
- ☐ **all of the above.**

If you guessed "all of the above," you're right. The Reichert OmU3 Ultramicrotome has gained wide acceptance because of its all-around superior performance.

We attribute this popularity to its many exclusive features that contribute to speed, precision, control and simplicity.

The OmU3 saves time in the lab. Operation can be quickly mastered. Section accurately and fast with a minimum of effort.

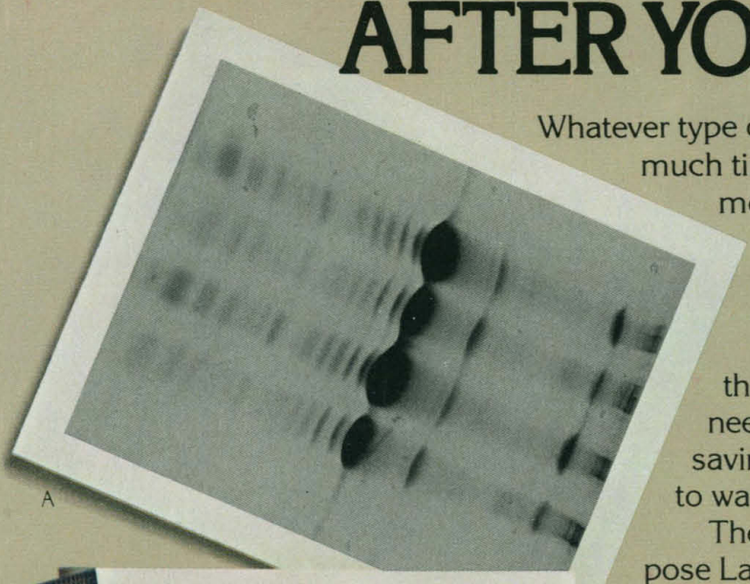
You've got to see the OmU3 in action to really appreciate what it will do for you.

Write for more information on the OmU3 and our complete line of EM equipment. American Optical, Reichert Products, Eggert Road, Buffalo NY 14215.

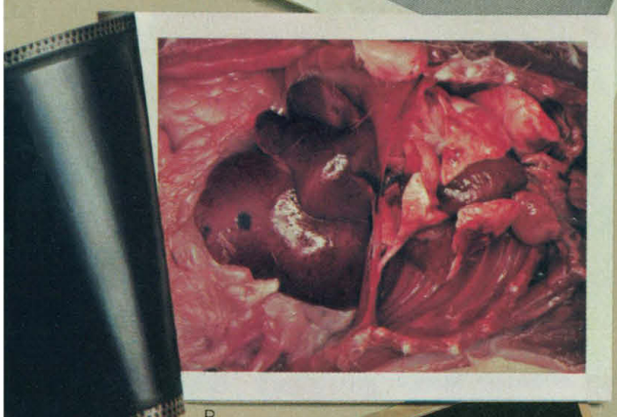
AO® American Optical **Reichert Products**

Circle No. 276 on Readers' Service Card

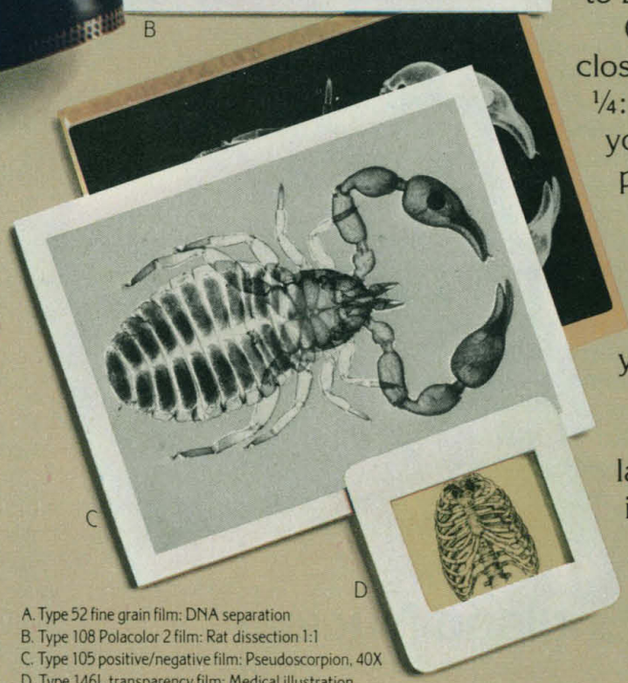
HAVE A RECORD OF IT SECONDS AFTER YOU SEE IT.



A



B



C

D

A. Type 52 fine grain film: DNA separation
B. Type 108 Polacolor 2 film: Rat dissection 1:1
C. Type 105 positive/negative film: Pseudoscorpion, 40X
D. Type 146L transparency film: Medical illustration

Whatever type of work you do, you probably spend too much time making a record of it. If it takes more than seconds, you're wasting time.

Polaroid has two versatile camera systems that can introduce you to the world of instant laboratory photography.

Both systems let you know right away that you're getting the permanent record you need. Without using a darkroom. And you'll be saving time and money because you don't have to wait hours or days to get it.

The MP-4 Multipurpose Land camera is a complete photographic studio in itself. It uses 14 different Polaroid self-developing films and does copying, close-up and macrophotography, photomicrography, and reductions. Also, its modular design and interchangeable lenses give you the freedom to build—and pay for—only the accessories you need.

CU-5 CLOSE-UP CAMERA

Our CU-5 Land camera is designed specifically for close-up and detail work, reproducing subjects from ¼: 1 to 3 times life size. Lightweight and hand-held, you can even take it out in the field with its portable power supply.

Two easy-to-use systems (almost anyone can learn to use them after a few minutes' instruction), both giving you what you want. Instantly. And the less time you spend making a record of your work, the more time you'll have for your work.

We'd like to show you right in your own lab how quickly and easily you can make instant records. Our representative will demonstrate them for you. Just write to: Polaroid Corporation, Dept. A344, Cambridge, Mass. 02139. Or call us collect: 617-547-5176.

MP-4 MULTIPURPOSE CAMERA

Polaroid
Instant Laboratory Pictures

"Polaroid" and "Polacolor" ®

Cancer Research

We don't make every suspected cancer-causing agent in the world, but we make some nobody else does.

NEC-528	**Acetyl-2-aminofluorene, *N*-**[9-^{14}C]-
NEC-656	**Benzidine,** [^{14}C(U)]-
NET-412	**Dibenz [a,h]anthracene, 1,2,5,6-**[^{3}H(G)]-
NEC-639	**Dimethylbenz[a]anthracene, 7,12-**[*dimethyl*-^{14}C]-
NEC-700	**Dinitrosopiperazine, *N,N'*-**[^{14}C(U)]-
NEC-694	**Ethyl-*N*-nitrosourea, *N*-**[*ethyl*-1-^{14}C]-
NEC-198	**Methylcholanthrene, 3-**[6-^{14}C]-
NEC-705	**Methyl-*N'*-nitro-*N*-nitrosoguanidine, *N*-**[*methyl*-^{14}C]-
NEC-282	**Methyl-*N*-nitroso-*p*-toluenesulfonamide, *N*-**[*methyl*-^{14}C]-
NEC-693	**Methyl-*N*-nitrosourea, *N*-**[*methyl*-^{14}C]-
NET-408	**Methyl-*N*-nitrosourea, *N*-**[*methyl*-^{3}H]-
NEC-702	**Nitrosodiethylamine, *N*-**[*ethyl*-1-^{14}C]-
NEC-631	**Nitrosodimethylamine, *N*-**[*methyl*-^{14}C]-
NET-527	**Nitroso-di-*n*-propylamine, *N*-**[2,3-^{3}H]-
NEC-703	**Nitrosoethylmethylamine, *N*-**[*ethyl*-1-^{14}C]-
NEC-701	**Nitrosonornicotine, *N'*-**[*pyrrolidine*-2-^{14}C]-
NEC-698	**Nitrosopiperidine, *N*-**[2,6-^{14}C]-
NET-526	**Nitrosopiperidine, *N*-**[3,4-^{3}H]-
NET-525	**Nitrosoproline, *N*-**[3,4-^{3}H(N)]-
NEC-697	**Nitrosopyrrolidine, *N*-**[2,5-^{14}C]-
NET-524	**Nitrosopyrrolidine, *N*-**[3,4-^{3}H]-

Caution: Not for use in humans or clinical diagnosis.

NEN **New England Nuclear**

549 Albany Street, Boston, Massachusetts 02118
Customer Service 617-482-9595

Canada: NEN Canada Ltd., 2453 46th Avenue, Lachine, Quebec, H7T 3C9. Tel: 514-636-4971. Telex: 05-821808
Europe: NEN Chemicals GmbH, D-6072 Dreieichenhain, W. Germany. Daimlerstrasse 23. Postfach 1240. Tel: (06103) 85034.

Circle No. 94 on Readers' Service Card

preservation, and storage. Elimination of waste in processing can also increase yields substantially. While serious technological and economic problems make it difficult to predict the future for aquaculture, the possibility of significant increases by the year 2000 (or later) cannot be discounted.

In other words, a 200-million-ton catch appears quite possible by the year 2000; it could provide at least 28 million tons of protein. A 300-million-ton catch could provide at least 42 million tons of protein, about equal to the amount projected for livestock in 2000.

A last thought relates to the fossil energy needs for catching fish. Estimates given by Pimentel *et al.* are at odds with Steinhart and Steinhart's estimates (*2*) that coastal fishing breaks even on calories expended versus the calorie yield, and that even relatively inefficient distant water fishing consumes less than 20 calories for each calorie of yield; they also conflict with Hirst's conclusion (*3*) that fish is one of the most efficient of several major food groups in terms of the ratio of primary energy use to protein content.

In sum, Pimentel *et al.* have probably seriously underestimated the contribution that aquatic foods can make to the world food supply.

ROBERT W. SCHONING

National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Department of Commerce, Washington, D.C. 20235

References

1. United Nations, World Food Conference. *Assessment of the World Food Situation: Present and Future* (FAO, Rome, November 1974), p. 116.
2. J. S. Steinhart and C. E. Steinhart, *Science* **184**, 307 (1974).
3. E. Hirst, *ibid.*, p. 134.

The projection by Schoning of a total annual fish yield of 200 million metric tons for the year 2000 is about double that of other projections (*1*). We hope Schoning's projection is correct.

Schoning questions the 20 calories energy input per calorie of fish-protein output. In spite of "Hirst's conclusion," Hirst (*2*) reported an input of 27 calories energy input per calorie of fish-protein output. Hirst's estimate is actually higher than the estimate we quoted (*3*) of 20 calories input per fish-protein calorie and the estimate of Edwardson (*4*) of about 21 calories input per fish-protein calorie. A recent analysis by Rochereau and Pimentel (*5*) concerning the Northeast fisheries of the United States suggests that Northeast fisheries are far more efficient than other fisheries. For the Northeast

fisheries which use small fishing vessels, we calculated 5 calories input per calorie of fish-protein produced or at least ¼ the energy expenditure of the other fisheries mentioned.

Gordon and Pryor are concerned about our extrapolations. We emphasized in our 1975 article that extrapolations which involve the interdependencies of food, population, energy, land, water, and other environmental resources are fraught with many difficulties. This is especially so when no one set of acceptable assumptions exists for any of the factors. Our assumptions were stated and the resulting extrapolations were made to provide some perspective about energy and land constraints as they relate to feeding a rapidly growing world population. Based on our selected set of assumptions, we projected that "*If* petroleum were the only source of energy for food production and *if* we used all the petroleum reserves solely to feed the world population [4 billion], the 66,053 billion liter reserve would last a mere 13 years."

With another set of assumptions or coefficients, the 13 years might have been doubled to 26 years. Extending the supply of a resource from 13 years to 26 years might be consoling to our generation, but neither projection is consoling for future generations. As we stated in our articles, "Numerous estimates . . . are possible with the use of various combinations of population size, dietary standards, and production technology," but the one selected sufficed "as an *example* of the limitations" that face mankind.

We fully recognized the fact in both our articles that about half of the energy budget for corn replaces labor, and the other half is for productivity (see also *6*). This is documented and was the reason we focused much of our attention on labor inputs and alternatives.

Petroleum and natural gas are the two important energy resources utilized by agriculture. The reserves of both of these resources are in short supply. Petroleum was often used because it is a convenient, familiar measure. Coal, if used for agriculture in the future, will compete with agriculture for a vital agricultural resource—land (*6*).

Gordon and Pryor question our using corn as an average crop for an energy input-output analysis and extrapolation. They base their argument strictly on the fact that corn requires 2.5 times more nitrogen than the average of other crops. They apparently did not examine any of the data in our table 1 of our 1975 article. If they had, Gordon and Pryor would

have found that corn requires "roughly 1 gallon of gasoline per bushel of corn"; oats, 0.6; wheat, 1.2; and soybeans, 1.6 gallons per bushel. More crops could be mentioned, but the point is that when *all* the inputs are taken into consideration and not just nitrogen, corn is a good average crop.

Gordon and Pryor attribute to us the conclusion that "population control in densely populated, low-income regions is of the highest priority." This is *not* our conclusion. We stated that overpopulation is a problem for the world as a whole including the developed regions.

Then turning to energy used in the U.S. food system, Gordon and Pryor claim that only "one-quarter" of the energy in the "food system" is used in agricultural production. They give as their source an estimate that was published in 1974 (*7*), but this estimate is based on no better data than our estimate of "one-third." In addition, the U.S. Senate Committee on Agriculture and Forestry (*8*) reported that food production is more energy-intensive than either food processing or food distribution based on the percentage of energy costs compared with total costs of the activity.

Our extrapolations, although "simple," were based on "realistic coefficients" that were selected to call attention to the fact that high energy-intensive U.S. agricultural technology is generally inappropriate for "green revolution agriculture." We hope that others will examine the relationships that exist among food, energy, and population, using the "numerous estimates" or coefficients that are available. Unfortunately, no matter how the coefficients are manipulated either by Gordon and Pryor, by us, or by others, the "real problems of the real world" will not disappear.

DAVID PIMENTEL
JOHN KRUMMEL
WILLIAM DRITSCHILO

College of Agriculture and Life Sciences, Cornell University, Ithaca, New York 14853

References

1. Institute of Ecology, *Man in the Living Environment* (Univ. of Wisconsin Press, Madison, 1972); L. R. Brown and E. P. Eckholm, *By Bread Alone* (Praeger, New York, 1974).
2. E. Hirst, *Science* **184**, 134 (1974).
3. G. Leach, in *The Man-Food Equation*, A. Bourne, Ed. (Academic Press, New York, in press).
4. W. Edwardson, *Energy Analysis and the Fishing Industry, Report of the Energy Analysis Unit* (Univ. of Strathclyde, Glasgow, 1975).
5. S. Rochereau and D. Pimentel, in preparation.
6. D. Pimentel, *Sci. Tec.*, in press.
7. J. S. Steinhart and C. E. Steinhart, *Science* **184**, 307 (1974).
8. U.S. Senate, Committee on Agriculture and Forestry, *The U.S. Food and Fiber Sector: Energy Use and Outlook* (Government Printing Office, Washington, D.C., 1974).

biosem™: designed for totally flexible specimen handling

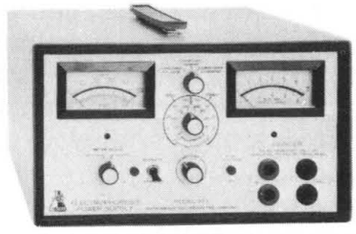
Now the world's most versatile scanning electron microscope—the Etec Autoscan—can be tailored to meet your most exacting biological research requirements.

Etec Corporation has developed a system, Biosem, that will allow you to quick freeze and transfer a specimen to the Autoscan cold stage with a minimum of atmospheric contamination . . . perform controlled sublimation, revealing specimen detail . . . ion etch . . . perform microdissection . . . evaluate the specimen through video information storage and processing before coating, thereby minimizing electron beam damage to delicate specimens . . . coat a specimen with metal or carbon before or after examination without exposing it to atmosphere . . . perform scanning or combined scanning-transmission microscopy . . . and conduct X-ray and secondary ion analysis.

For more complete information, write for the free booklet, Biosem: The Biological Scanning Electron Microscope.

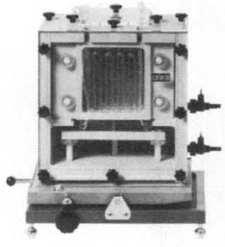
Instruments for Electrophoresis from ISCO

Power supplies



Pulseless constant power (wattage) prevents overheating due to variations in systems resistance, while still maintaining the highest possible separation speed. Superior line and load regulation suits the Model 493 for precise analytical electrophoresis; 200 watt capacity accommodates the largest preparative apparatus.

Preparative Gel Electrophoresis Apparatus



Colora UltraPhor®

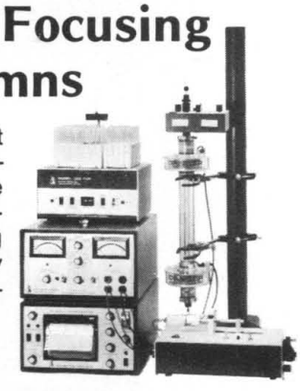
The exclusive dual buffer elution system of this large slab apparatus produces a greater sample yield and one-tenth the dilution common in other apparatus. Developing preparative procedures is greatly simplified as they may be derived from analytical separations performed on the same equipment.

ELECTROSTAC®

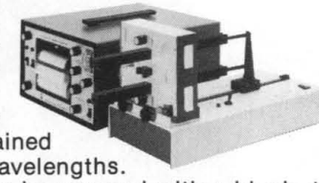
By combining the separating power of gels with the zone storage and retrieval convenience of density gradients, the ISCO ELECTROSTAC® separator provides the least dilution of any available micro-preparative electrophoresis technique.

Density Gradient and Isoelectric Focusing Columns

ISCO density gradient electrophoresis columns provide the researcher with the means of periodically scanning zone separation during electrophoresis and precisely recovering zones with minimal loss of resolution.

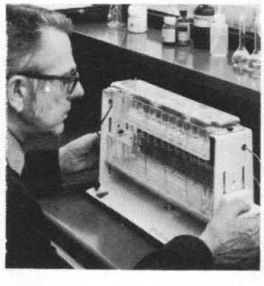


Gel Scanner



Gels electrophoresed in quartz tubes can be scanned at UV wavelengths during separation, and after electrophoresis they may be stained and scanned at visible wavelengths. A gel may simultaneously be scanned with a blank, to remove background ampholyte absorbance in isoelectrically focused gels.

Analytical Gel Electrophoresis Apparatus



Suitable for both electrophoresing gels and destaining, the Model 1270 features a linear alignment of gel tubes and a bottom tank which can be easily lowered for access to all the tubes. Unlike circular units, this configuration does not require removal and emptying of the upper tank when changing tubes.

Literature

Applications research bulletins describing ISCO instruments are yours for the asking. For a look at the entire line of biochemical research instruments, send for the new 64-page catalog; and if you'd like a handy booklet of hard-to-find data and tables, ask for a free copy of ISCOTABLES.

ISCO

Box 5347 Lincoln, Nebraska 68505 Phone (402) 464-0231

Circle No. 233 on Readers' Service Card

17 September 1976, Volume 193, Number 4258 **SCIENCE**

Federal R & D and the Economy

Hearings cross the congressional firmament like shooting stars. Most are only a momentary glimmer. A few signal the existence of larger issues. The hearings held in April and May by the Thornton subcommittee of the House Committee on Science and Technology were of the latter type. The subject was "Federal R & D Expenditure and the National Economy."

The issue revolves around the unanswered question whether the federal government should assure stable, long-term support for commercially oriented R & D. Some think such intervention is essential to the health and international competitiveness of the national economy. Yet most of our understanding of the relationship between R & D and the economy, with the important exception of agriculture, comes from 35 years of experience with defense- and space-oriented projects—of which the Manhattan and Apollo projects were spectacular examples—in which the federal government was both the funder and principal consumer of the R & D output.

There were four persistent themes in these hearings. One was that government and business operate in a climate of distrust, if not of hostility. Another was that R & D expenditures seem a weak and imperfect tool in comparison with tax, subsidy, antitrust regulation, education, and procurement policies. A third theme was the perceived negative effect of federal organization and management of its own R & D enterprises on several dependent sectors of the economy. Finally, the need for federal support of fundamental research was a clear and consistent theme. Every witness, regardless of philosophy, expressed deep concern for the health of the fundamental research effort. Apparently the case still has not been made that investment in fundamental research is not a discretionary societal luxury but an essential component of continued economic viability.

The sense of these hearings was that specific government intervention through R & D expenditure to stimulate the private sector is liable to be of limited effectiveness. There is little understanding or guidance available regarding what to do to achieve a particular desired result. Some opportunities stood out for analysis and perhaps experiment:

- Firms that perform R & D exclusively appear to play a critical role in the process of innovation. Differences in performance between firms created through federally supported R & D need to be explored.
- Small, highly innovative firms are important contributors of new products and processes, but are also most subject to failure in the course of normal economic fluctuations. Some alternatives need to be considered to cushion this impact.
- Policies and programs of other industrial countries are admired, but none has been tested in this country. Some selective, controlled experiments ought to be possible, at least on a limited basis.
- Innovation in the private, profit-making sector is a reasonably well-understood process. Similarities and differences in public sector innovation are not nearly as well described or explained.

What seems to be foreshadowed by the kinds of questions raised in these hearings is the broad issue of a national technology policy. Given our penchant in the United States for pluralistic, decentralized approaches to complex and important policy issues, clear-cut institutional structures or guidelines to action are not likely to appear. The least we should expect, however, is that existing centers of authority and initiative begin to review and refine their objectives. This would include the Departments of Agriculture, Commerce, and Defense. The mission agencies—ERDA, NASA, and NIH—also are important constituents. Where these lead, others will follow.—T. DIXON LONG, *Provost, Western Reserve College, Case Western Reserve University, Cleveland, Ohio 44106*

This editorial has been abstracted from a review of the hearings prepared by a subcommittee of the AAAS Science and Public Policy Committee. In addition to Mr. Long, its chairman, the subcommittee included John M. Logsdon and Edward E. David, Jr.

Sartorius proudly introduces "affordable" electronic weighing; a completely new series of compact, fully electronic balances in the most popular weighing ranges, priced from $1,795.

The new Series 3700 balances have no beam, no knife edges, no knobs, no dials and no mechanical zero adjustment. To weigh, just place the sample on the pan; in 1-2 seconds the readout is shown on a large, bright 7-segment digital display. Just touch the sensor bar for instant electronic taring (or zero adjustment) over the entire weighing range.

Other advanced features of the Series 3700 include a unique "stable reading" indicator and an electronic filter to eliminate the effects of high frequency vibration. Analog and digital outputs permit interfacing with printers, recorders, calculators and data processing equipment.

Check this table for the cost of the model with the weighing range and readability you need. You'll be amazed at the savings (Model 3706 costs little more than comparable mechanical top loaders).

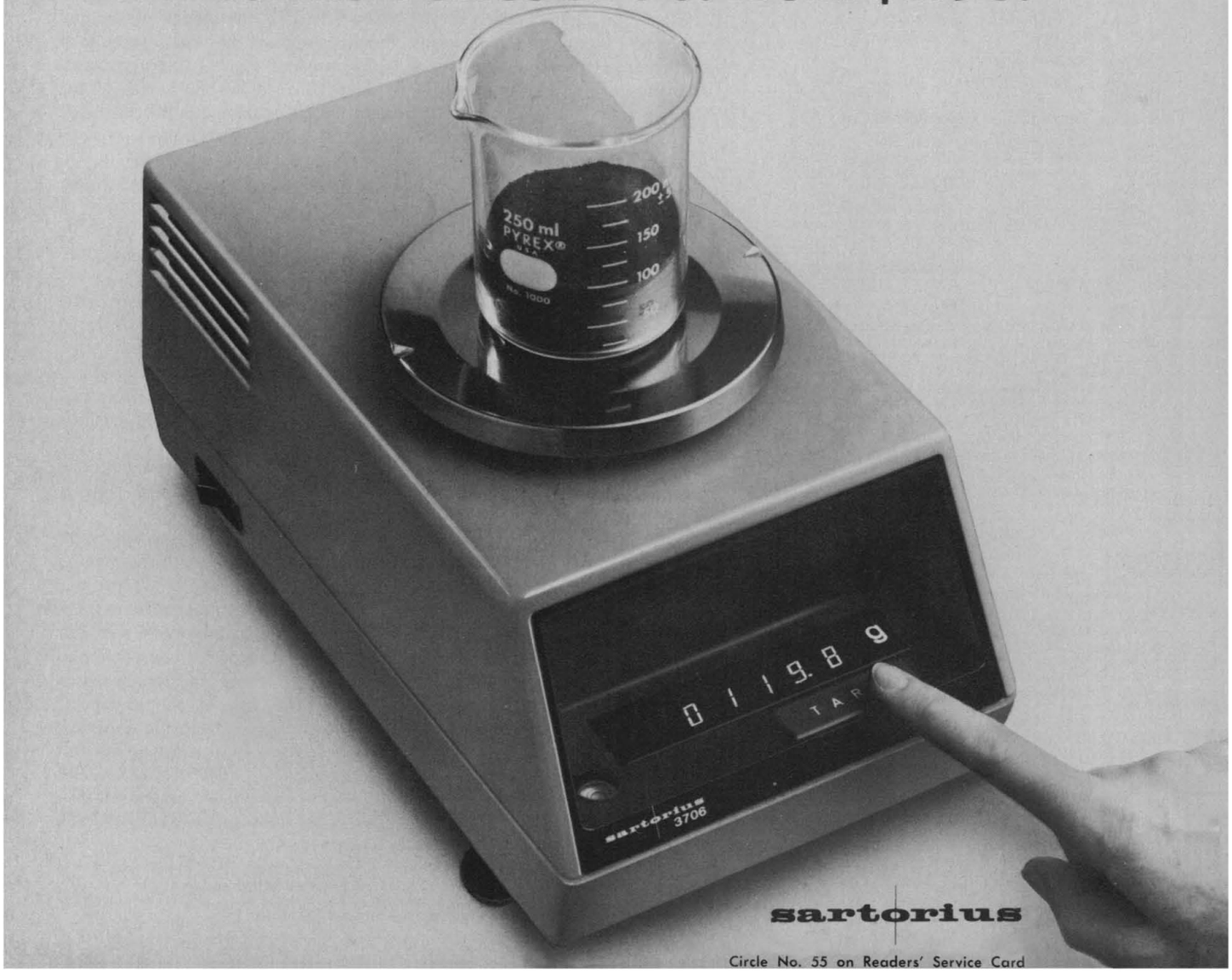
Model	Weighing Range	Readability	Price
3705	0-160g	0.001g	$2795
3704	0-1200g	0.01g	2795
3716*	a) 0-120g b) 0-1200g	a) 0.01g b) 0.1g	2245
3706	0-1200g	0.1g	1795
3703	0-3000g	0.1g	2450

*Dual Range

For an informative folder on these revolutionary balances, write: Sartorius Balances Division, Brinkmann Instruments, Cantiague Road, Westbury, N.Y. 11590.

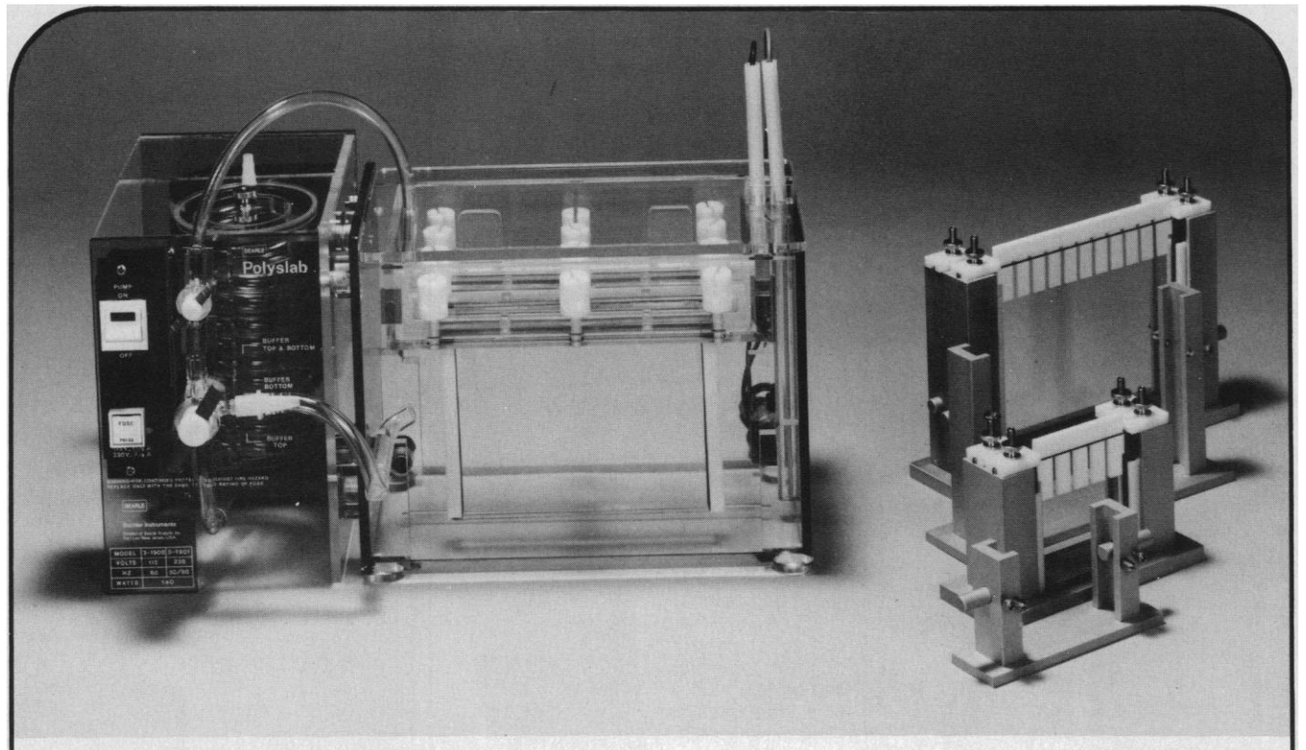
The first fully electronic balances with the accuracies you want, in the ranges you need, at a price you can afford.

Sartorius Series 3700. From $1795.



sartorius

Circle No. 55 on Readers' Service Card



Now, one P.A.G.E. unit that can handle all four investigative techniques.

Analytical

Preparative

Two Dimensional

Gradient

The Buchler Polyslab for gel electrophoresis.

Circle No. 102 on Readers' Service Card

For several months Buchler engineers analyzed every facet of P.A.G.E. technology. They listened and learned as feedback kept coming in from independent investigators like yourself. They discovered what your P.A.G.E. resolution problems were, and they worked to resolve them. The result is a gel electrophoresis instrument that outperforms anything in the field today.

Buchler's Polyslab can actually handle all four polyacrylamide electrophoresis techniques: analytical, preparative, two dimensional and polyacrylamide gradient electrophoresis. And its mounting and polymerization apparatus has been precision engineered for easier gel preparation. Just ask your Buchler dealer to give you a close look at the Polyslab today. You'll find Buchler put a lot of good thinking into the Polyslab, so you can get better results out of it.

Features include: Choice of two gel sizes; precision tooled mounting and polymerization stands; 3-way buffer circulation; optional tube adapters; heat transfer coil; and interlocking electrode plugs.

SEARLE

Buchler Instruments

Division of Searle Analytic Inc.
1327 Sixteenth Street
Fort Lee, New Jersey 07024
(201) 224-3333

a BRIGHT outlook for Cryomicrotomy–

Internationally famous...

BRIGHT CRYOSTATS are available for use with your favorite microtome. BRIGHT features and options allow a wide choice of specifications for research and routine applications – – including

- **temperatures -30, -40, -45 and -80° Cels**
- **U.V. sterilization plug**
- **press button motorized automatic section delivery**
- **quick freezer (eliminates CO_2) for knives, object-holders and specimens**
- **free standing and bench models for rotary microtomes**
- **open top cabinet models for sliding microtomes - - plus electrolinear drive.**

BRIGHT Cryostats are especially renowned among workers in enzyme and analytical histochemistry, immuno-histology and whole body autoradiography. They are the only cryostats approved by the Royal College of Surgeons.

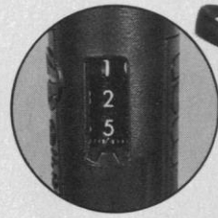
H/I Hacker Instruments Inc.
Box 646
Fairfield, N.J. 07006
(201) 226-8450

Circle No. 69 on Readers' Service Card

With the new

PIPETMAN™

You're all set...



...DIGITALLY

Set ANY VOLUME (even odd volumes like 11.5 µl, 113.6 µl, or 2,254 µl) with micrometer precision and pipette with consistent accuracy — better than 0.2 to 1.0% of full range.

Four digital microliter pipettes, continuously adjustable over their entire range, permit optimal accuracy and reproducibility in critical pipetting. Each model can replace 30 or more fixed range units.

Comfort-contoured body of high impact plastic has low thermal coefficient insuring excellent repeatability even with long-term, hand-held operation.

Built-in Tip Ejector (Models P-20, 200, 1000) permits safe, non-contact disposal.

Model No.	Recommended Ranges	Price
P-20D	0 - 20 µl	$ 99.50
P-200D	20 - 200 µl	99.50
P-1000D	200 - 1000 µl	99.50
P-5000D	500 - 5000 µl	125.00

All models supplied with 10 disposable tips.

RAININ INSTRUMENT CO. INC.

94 Lincoln Street • Brighton, MA 02135
(617) 787-5050 • TELEX 94-0687

Circle No. 149 on Readers' Service Card

Costs little, cools a lot.

Compared to tap water cooling, a Coolflow Recirculating Cooler will pay for itself in the first year of operation. You eliminate tap water downtime problems—from unstable water pressure, temperature extremes, etc. And in a constantly operating cooling system with 1 gpm flow, you can save a half million gallons of water a year! If you have a problem, phone or write for application assistance.

COOLFLOW recirculators

NESLAB INSTRUMENTS, INC.
871 Islington St., Portsmouth, N.H. 03801
Tel. (603) 436-9444

Circle No. 15 on Readers' Service Card

ENERGY:

Use, Conservation, and Supply

Interested in understanding the energy problems we face, in finding practical solutions to these problems? Then you're sure to want a personal copy of this AAAS compendium. It presents a collection of enduring and readable articles that originally appeared in *Science* during 1973–1974—articles providing a wealth of information for everyone concerned with the profound and far-reaching effects of the energy problems that continue to alter our traditional modes of supply and patterns of usage.

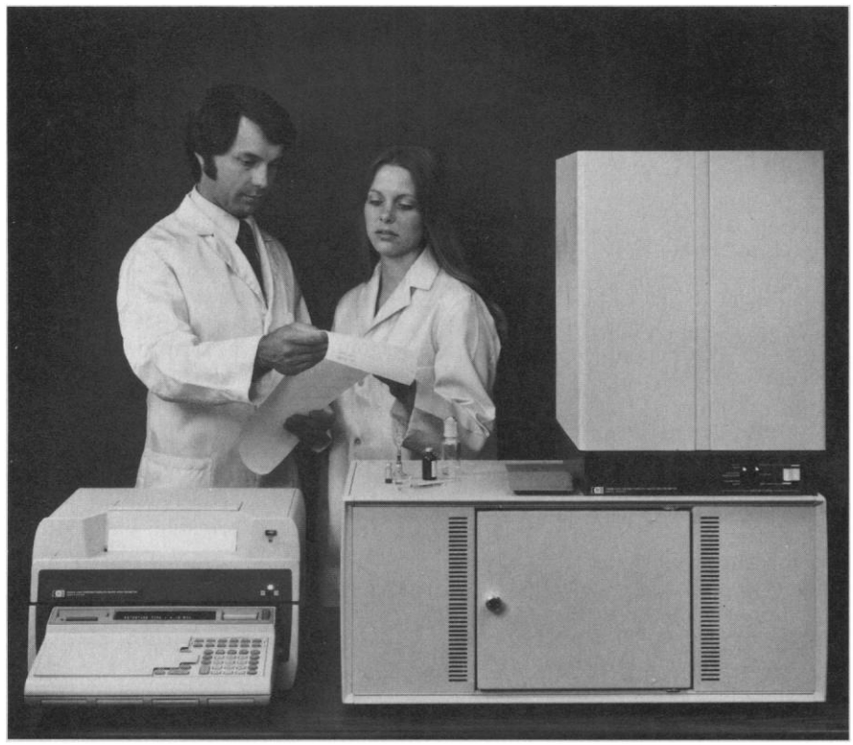
Edited by and with an introduction by Philip H. Abelson. Retail price: Casebound, $12.95; Paperbound, $4.95. AAAS member price, prepaid: Casebound, $11.95; Paperbound, $4.45.

Send orders to Dept. E-6
AMERICAN ASSOCIATION for the ADVANCEMENT OF SCIENCE
1515 Massachusetts Avenue, N.W.
Washington, D. C. 20005
(Please allow 6 to 8 weeks for delivery)

HEWLETT PACKARD
Analytical Advances
MEASUREMENT AND COMPUTATION FOR THE ANALYTICAL LABORATORY

New Benchtop GC/Mass Spectrometer System

with calculator control, hyperbolic quadrupole filter, and automatic tuning



Hewlett-Packard announces the 5992A Gas Chromatograph/Mass Spectrometer system, the first such system that can be conveniently added to a laboratory just by placing it on a benchtop, yet with performance features comparable to (and often exceeding) those of much larger floor-mounted systems.

These features include a microprocessor-controlled gas chromatograph as an integral part of the system, an efficient hyperbolic rod quadrupole mass analyzer, and automatic tuning of the mass spectrometer components.

The analyzer module (right, in the photograph) contains the gas chromatograph and mass spectrometer, including all necessary pumping systems. It has none of the usual knobs or switches to set, but is controlled by a 9825A Programmable Calculator, which uses a combination of keystroke instructions and stored programs for efficient operation of the entire system.

For example, after admitting a reference compound, the program AUTOTUNE automatically finds and sets the optimum tuning parameters for the ion source, the mass filter, and the ion detector, then produces a standard mass spectrum with a calibrated mass scale. The use of AUTOTUNE ensures consistent analytical results.

The 5992A's quadrupole mass filter uses hyperbolic rods, the theoretically ideal shape for this type of filter. Improved peak shapes and higher sensitivity, compared to round-rod filters, are direct consequences of this geometry. For 1 nanogram of methyl stearate, scanned at 600 atomic mass units (amu) per second, the system produces a signal to noise ratio of 10:1. Total mass range is 10 to 800 amu.

The entire mass spectrometer assembly is mounted on a single flange and suspended in the core of an HP designed diffusion pump. Only one gasket, maintained at room temperature, is required. Troublesome flange bolts have been completely eliminated. Pumpdown and vacuum venting cycles are completely automated to preclude inadvertent damage to spectrometer components. Indicator lights show when the system is ready to be operated or disassembled.

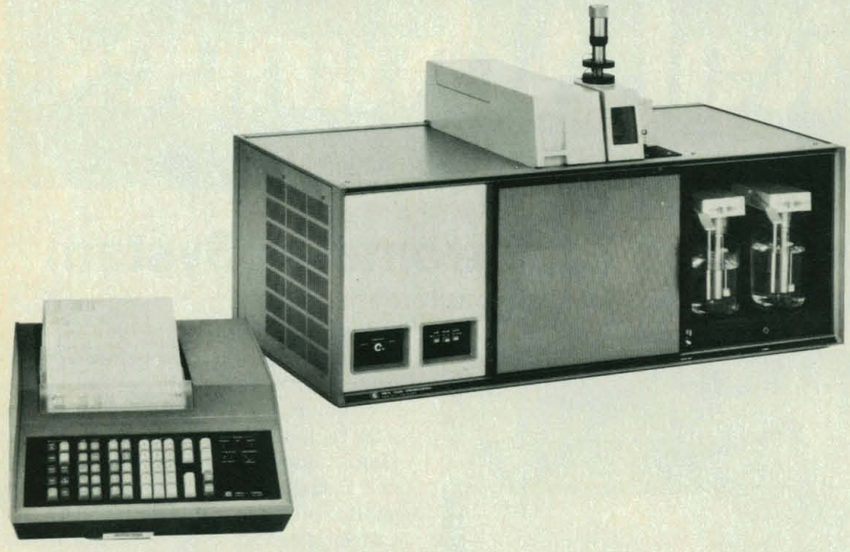
A membrane (standard) or jet (optional) separator interfaces the gas chromatograph to the mass spectrometer. The dual-filament electron-impact ion source incorporates a Turner-Kruger lens to improve the transfer of higher mass ions into the mass filter.

Standard data acquisition and display software provides normal spectrum generation, total ion chromatograms, tape cartridge storage and later display of individual spectra, and selected ion monitoring. Standard data output is to a thermal printer/plotter mounted on top of the 9825A calculator. A flatbed X-Y plotter is available as an option. The 9825A calculator may be used as a free-standing computation device when it is not functioning as the system controller.

A new product bulletin describes the benchtop GC/Mass Spectrometer in greater detail. Please check 5992A GC/MS System on the Reply Card for your copy.

IN THIS ISSUE
Fall 1976

See What's Happening with HP 1080 Liquid Chromatographs



A lot goes on inside a liquid chromatograph, particularly during gradient operation, but very little of it shows. Yet a close look at some of those internal variables can be of great help when creating and optimizing an analytical procedure. That's why the 1080's have a key labeled PLOT; it lets you display on the printer/plotter any of these quantities

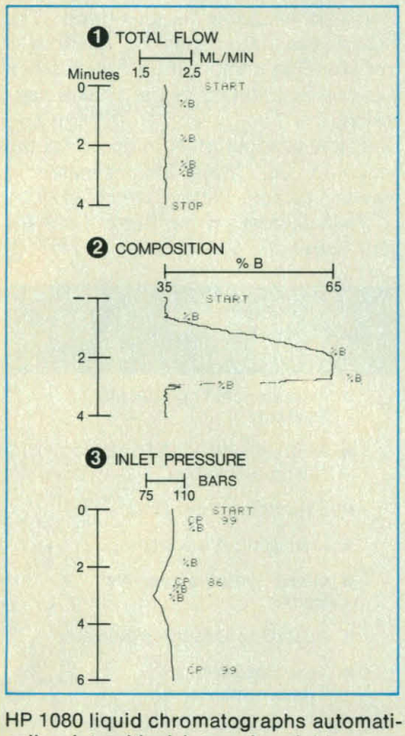
- Total flow, the sum of the *measured* outputs of the two pump heads
- Individual pump head deliveries
- Mobile phase compositon, expressed as the percentage of the B solvent. Again this is calculated from the measured flows
- Column inlet pressure
- Solvent reservoir temperatures
- Detector output, either the differential signal or the individual cell outputs

and several others.

The figures show some of the possibilities. The gradient program calls for an initial isocratic period (at 35% B) followed by a fairly steep rise to a second isocratic period at 65% B; composition then returns to the starting value to regenerate the column for the next run. The figures are instrument-produced plots of the total measured flow (1), the mobile phase composition (2), and the pressure in bars at the column inlet (3) (solvent B is of lower viscosity than solvent A so the pressure profile is inverted relative to the composition profile). The time offset between the composition and pressure profiles is due to the hold-up volume of the column and the chemical equilibration time.

Note that the column pressure returns to its original value at the end of the plot (the three pressure printouts were produced with the LIST COL P keys). This indicates that the regeneration time chosen is adequate for this column/solvent combination.

The utility of the PLOT function in troubleshooting is obvious. Obstructions in the capillary flow lines, plugging or deterioration of the column, accumulated deposits in the detector cells; these are all readily detected by plotting the appropriate variable. A data sheet containing further information on these and other capabilities of the 1080 Series Liquid Chromatographs may be obtained using the Reply Card.



HP 1080 liquid chromatographs automatically plot critical internal variables.

Blow Up Your Chromatogram!

There's no substitute for a picture when you develop an analytical method or encounter problems with an established one. But the picture need not be on a piece of paper; Figure 1 shows a chromatogram displayed on a 3354 Lab Automation System terminal.

It's done using a program called CGRAM and a Tektronix 4006-1 graphics display. CGRAM examines the raw data file for the analysis (which contains every reading taken from the analyzing instrument) and reconstructs the chromatogram, scaled to the largest peak in the run. You can examine the entire analysis or any selected portion; scaling remains the same so that valid comparisons can be made.

But notice the blurred print in the lower left part of Figure 1. The system attempted to plot several very small peaks, too small to be seen, which are very close together. By expanding the time axis (plotting only the first minute) and the vertical axis (entering an enlargement factor of 350) we obtain Figure 2, which clearly shows these previously invisible small peaks. This can be repeated as often as desired. The effect is much like running the analysis at many chart speeds and attenuations, with the important difference that you only make one actual run!

For more information on CGRAM and the 3354 System which uses it, please check 3354 Lab Automation System on the Reply Card.

Figure 1.

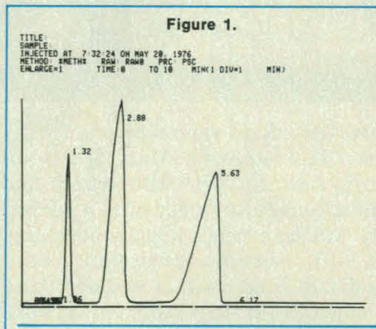
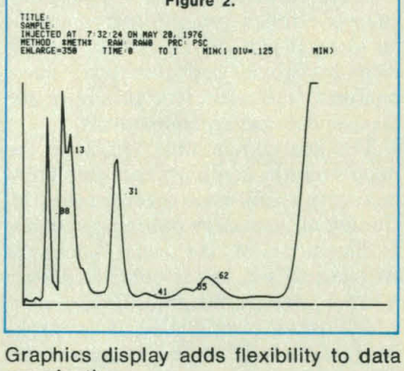


Figure 2.



Graphics display adds flexibility to data examination.

Managing Lab Work Loads with the 3354 Lab Automation System

A sample comes into the lab, all required tests are performed, and the report goes back out. That's the ideal situation; the real one is seldom so simple. Generally there are many samples in progress, often with different sets of tests to be run, and all at different stages of completion. Keeping track of sample progress can be a very difficult but necessary task in effectively running a laboratory.

However, it can be done quite simply using LAB BASIC II programming. Here's how:

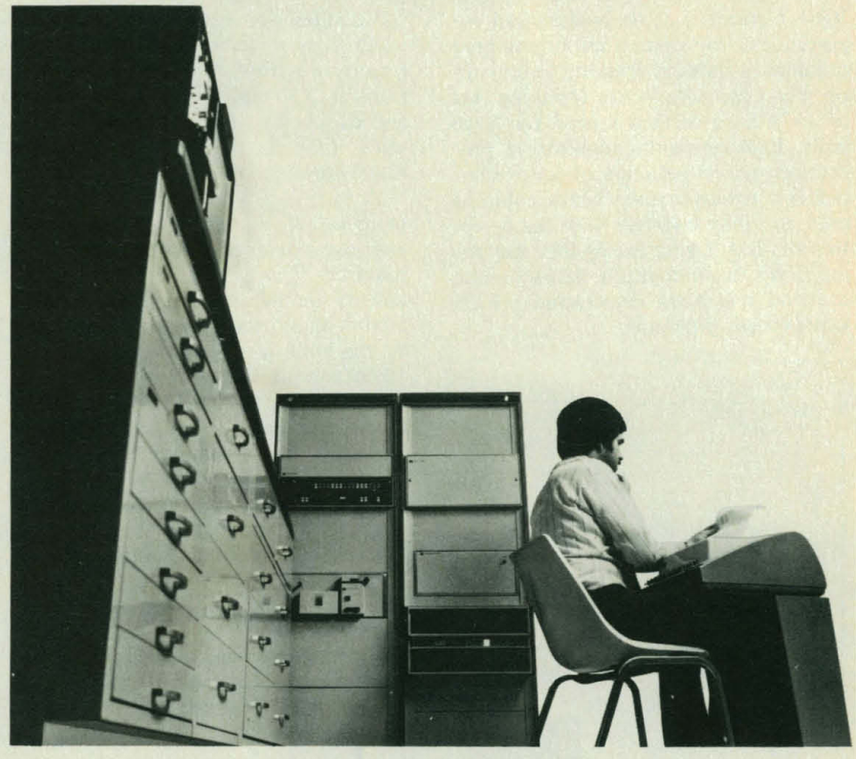
1. As samples arrive in the lab, run LOGGER and enter the pertinent data. Terminate with /E.

```
SAMPLE NAME? GAS22F
TESTS REQUIRED? H6,A2,P4,H3,O6

SAMPLE NAME? /E
```

2. Whenever you need to know sample progress, run REPORT. You'll receive this three-part report.

```
                SAMPLE PROGRESS REPORT

SAMPLE:    GAS22F
     TESTS COMPLETED:    H6  A2  P4
     TESTS PENDING:      H3  O6

SAMPLE:    SOLV5581
     TESTS COMPLETED:
     TESTS PENDING:      A4  H3  K9

SAMPLE:    REM906D
     TESTS COMPLETED:    F6  H6
     TESTS PENDING:      L8  D7  U7

SAMPLE:    REM906E
     TESTS COMPLETED:    F6
     TESTS PENDING:



                   BACKLOG REPORT

     TEST              SAMPLES PENDING

      H3               GAS22F
                       SOLV5581
      O6               GAS22F
      A4               SOLV5581
      K9               SOLV5581
      L8               REM906D
      D7               REM906D
      U7               REM906D


                 COMPLETED SAMPLES

     WORK ON THE FOLLOWING SAMPLES WAS COMPLETED
     SINCE THE LAST STATUS REPORT.  DATA ON THESE
     SAMPLES HAS BEEN REMOVED FROM SYSTEM MEMORY.

SAMPLE NAME      TESTS PERFORMED

REM906E          F6
```

The first portion gives the current status of every sample logged into the system. Part two, the backlog report, shows the sample load and can give advance warning of possible trouble



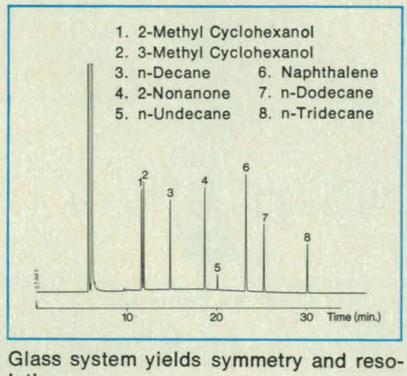
areas. The completed samples report "logs off" a sample when all tests are finished.

The difficult work is performed by a third program called LOGUP (for update). This runs at the end of each analysis to determine the sample name and the test performed from the run data itself, then updates the information in system memory to reflect this status change. Notice that this is completely automatic; there is no need for you to inform the system that the test has been run.

This is just one example of the laboratory management aspect of the 3354 Lab Automation System. To learn more, please use the Reply Card.

No Volume+No Surface=Perfect Peaks

That's hardly a practical way to approach chromatography, but if we modify the requirements a bit we can come surprisingly close. Instead of "no volume" we'll use "no unswept volume", and we'll substitute "low surface activity" for "no surface". The chromatogram shows what can be achieved under these somewhat relaxed (but more realistic) rules.



Glass system yields symmetry and resolution.

Note the symmetry of the hydrocarbon peaks (3,5,7,9). This demonstrates that there is little or no unswept volume in this all-glass system. Low surface activity is shown by the very small degree of tailing on the alcohol (1,2), ketone (4), and aromatic (6) compounds.

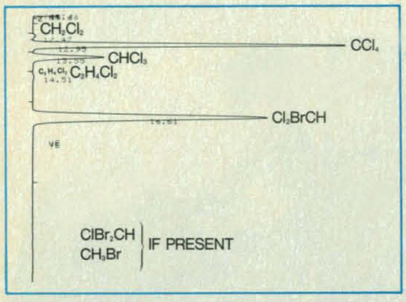
This separation was performed using the all-glass capillary injector designed for the HP 5700 and 5800 Gas Chromatographs. A glass capillary column was essential, of course, so that the benefits of this component would not be negated by the effects of a metal capillary wall.

For additional information on the injector and instruments in which they are used check All-Glass Systems on the Reply Card.

Solving Problems with the 5840A:

1. Volatile Organics in Water

Recent evidence of the widespread occurrence of chlorinated and brominated organics in finished drinking water supplies and the Safe Water Drinking Act of 1974 have created a need for large scale, high sensitivity monitoring procedures. Direct injection of water samples is injurious to many of the columns used and may interfere with the detection process. Using the 5840A Reporting Gas Chromatograph, an automatic method has been developed which avoids these problems.

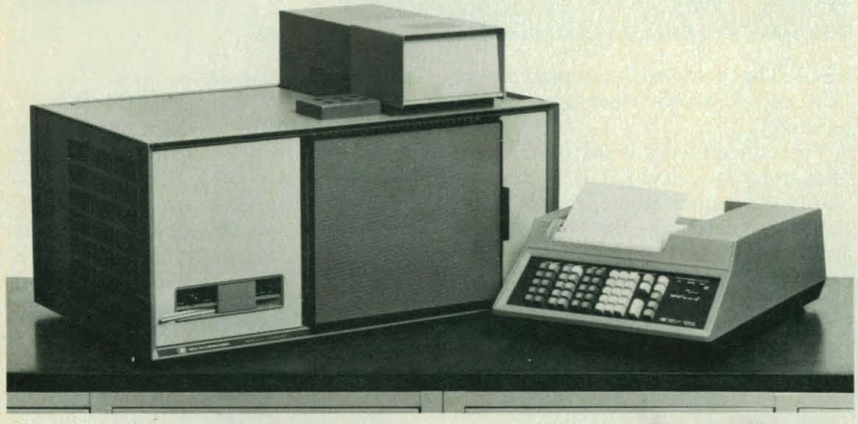


Automated procedure analyzes halocarbons in water.

Volatiles are transferred from the water sample to a room temperature trap by a stream of carrier gas. When transfer is complete the trap is heated and backflushed into the analyzing column. Trap regeneration occurs automatically while the analysis proceeds.

A total of 8 valve operations and 4 temperature changes (in addition to any oven temperature program) are required. This would be a formidable task by manual operation, but with the 5840A all of these events are controlled by the built-in microprocessor. With a 10 ml sample and electron capture detection, a part-per-million analysis of the seven compounds of major interest is obtained in 30 minutes.

An Application Note is now available which discusses this procedure in detail. For your copy please check Water Analysis on the Reply Card.



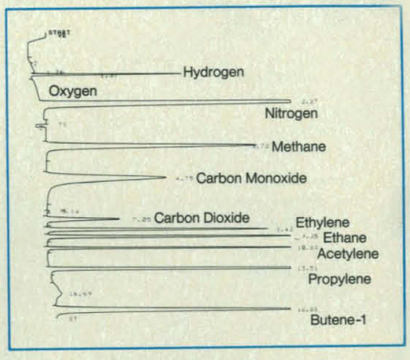
HP 5840 A Reporting Gas Chromatographs with microprocessor control of internal and external events permit ready automation of difficult analytical procedures.

2. Gas in Transformer Oils

Large oil-filled power transformers have very low failure rates. However, if failure should occur the repair is likely to be both expensive and time consuming. Most incipient failures (overheating, sparking, arcing, etc.) produce decomposition gases which are characteristic of the type of fault. Analysis of the gases can detect a problem long before serious damage occurs, and can indicate the extent of disassembly necessary to correct the fault.

The Model 5840 Reporting Gas Chromatograph with Option 835 is fully equipped with the appropriate columns, valves, reactors and other components necessary for the gas analysis. The sample may be either the headspace gas above the oil or dissolved gases extracted from it. The latter type of sample is preferred since the gases of interest are highly soluble in oil.

As can be seen from the chromatogram, the same system is applicable to a number of other gas analysis problems. A check mark by Transformer Oil Gas will bring you a recently published Application Note on this analysis, plus information on the 5840A itself.



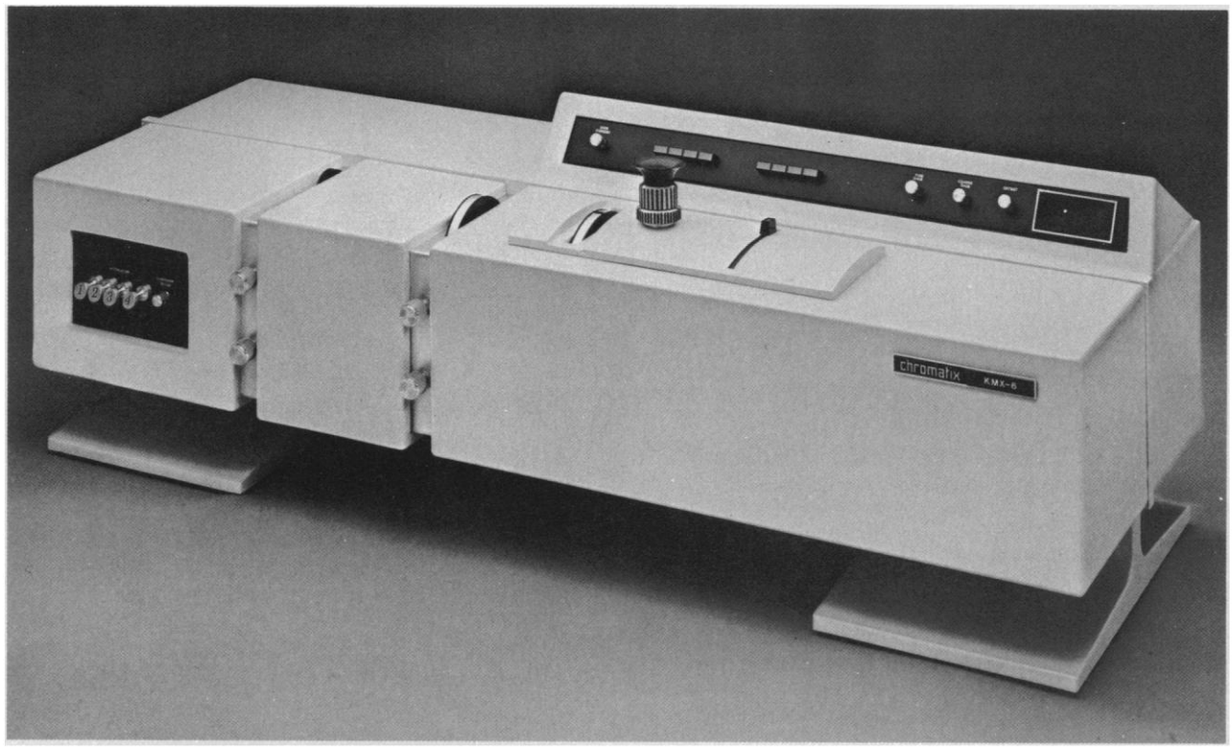
Dissolved gases in transformer oils help diagnose possible problems.

HEWLETT hp PACKARD

Sales and service from 172 offices in 65 countries.
Route 41, Avondale, Pennsylvania 19311

43605

For more information call your local HP Sales Office or **East** (301) 948-6370 • **Midwest** (312) 677-0400 • **South** (404) 434-4000 • **West** (213) 877-1282 • **Canada** (416) 678-9430. Or write Hewlett-Packard, 1501 Page Mill Road, Palo Alto, CA 94304. **In Europe:** Hewlett-Packard S.A., P.O. Box 85, CH-1217 Meyrin 2, Geneva, Switzerland. **In Japan:** Yokogawa-Hewlett-Packard, 1-59-1, Yoyogi, Shibuya-Ku, Tokyo, 151.



NEW! RAPID MOLECULAR WEIGHT OF BIO-POLYMERS · Microsamples · Easy Clarification · Absolute Calibration

Chromatix, world leader in tunable lasers, announces the KMX-6, a unique instrument with absolute calibration that permits rapid direct measurement of molecular weight. The KMX-6 is a low-angle light scattering photometer which may be used with a variety of flow, mixing, or microsample cells. The rapid direct measurement capability of the KMX-6 not only permits determination of molecular weight on pure liquids and solutions, but also allows real-time measurement of molecular weight changes in kinetic systems as well.

Revolutionary in design, the Chromatix KMX-6 capitalizes on the spatial characteristics of laser illumination to overcome the classical problems encountered with light scattering measurements. In particular, the excellent sensitivity of the KMX-6 allows the use of very small and dilute samples. Also, requirements for sample clarification are greatly relaxed due to the extremely small volume illuminated by the laser.

Capability of the KMX-6 covers molecular weights from 1000 to 3 x 10^9. Applications extend to a wide variety of areas, including biochemistry, photochemistry, immunology, pharmacology, polymers, elastomers, and foods.

chromatix

1145 Terra Bella Avenue
Mountain View, CA 94043
Phone: (415) 969-1070
Telex: 910-379-6440

Central:
5109 Brown St.
Skokie, IL 60076
Phone: (312) 679-4006

East:
Tarragon Building – Rm. 122
811 Church Road
Cherry Hill, NJ 08002
Phone: (609) 662-9350

In Europe:
D6903 Neckargemünd 2
Unterestrasse 45a
West Germany
Phone: (06223) 7061/62
Telex: 461691

Circle No. 145 on Readers' Service Card

The littlest toploader.

Indeed, it's the littlest toploader on this planet, the new Fisher Model 200. Measures just 6″x9″x3″H. Weighs in (barely) at 5 pounds. Goes and works anywhere there's electricity. Fits into a briefcase.

And, if the size isn't news enough — how about this price?

Beyond price and size, Model 200 brings you simple touch-bar operation with instant, automatic taring.

There's no set-up fuss. No dials. Simply turn it on, touch the tare bar, and weigh. Answer appears in 3 seconds on readout — large ½″ digits, easy to read in any kind of light.

For the folks who want specifications, consider these: accuracy ±0.01g; reproducibility 0.005g; sensitivity and readability 0.01g; and capacity 200g.

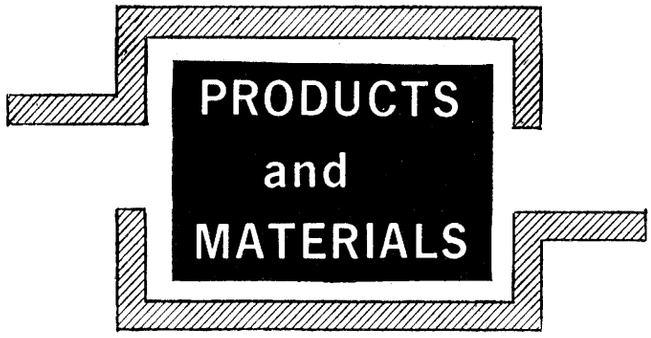
Send for detailed information on today's littlest and most economical toploader. Just **$695**

Catalog No. 1-913-260

Fisher Scientific Company

Circle No. 127 on Readers' Service Card

1114h



Syringe Needle Cleaning Kit

Each kit contains five wire sizes in tubes of ten wires each. The wires range in diameter from 0.00350 to 0.0120 inch. Also included are 75 milliliters of cleaning solution concentrate, flat-nosed tweezers, and a booklet of instructions. The cleaning solution contains no alkaline substance or harmful detergents, is nonflammable, and will not etch glass or metal. Unimetrics. Circle 678.

Analog-Specific Ion Meter

Model 407A formerly was available only as a portable unit for field use. Now it has been redesigned for bench-top operation. The two-decade logarithmic scale permits precise direct measurement of concentrations of ions or dissolved gases. Known addition and known subtraction scales simplify the use of increment methods. Titrations and measurements of oxidation-reduction potential may be performed with the millivolt scales. The meter also has a scale for routine *p*H measurements and an adjustable recorder output. Orion Research. Circle 680.

Fluid Dispenser

The Sequential fluid dispenser is for filling scintillation vessels with counting solution. The device is rapid at 25 cycles per minute and accurate to within ±1.0 percent. It dispenses from 2 to 10 milliliters per vessel into counting containers. It is suitable for use with any scintillation medium. It features hand operation. Isolab. Circle 682.

Newly offered instrumentation, apparatus, and laboratory materials of interest to researchers in all disciplines in academic, industrial, and government organizations are featured in this space. Emphasis is given to purpose, chief characteristics, and availability of products and materials. Endorsement by *Science* or AAAS is not implied. Additional information may be obtained from the manufacturers or suppliers named by circling the appropriate number on the Readers' Service Card (on pages 1066A and 1162A) and placing it in the mailbox. Postage is free.

—RICHARD G. SOMMER

Melting Point Instrument

The model FP61 reads to within 0.1°C over a range from 0° to 300°C. After a capillary tube has been prepared with a sample, the operator selects a starting temperature and one of five heating rates. The capillary is then inserted in the furnace and the "start" button is pressed. The determination is then made. Linear temperature increase is continuously displayed. Heating stops when the sample is melted. The final result is displayed until the unit is turned off or another run is started. A recorder may be attached to produce graphic results of the process. Heating or cooling may be selected from 0.2°, 1°, 2°, 3°, or 10°C per minute. With the 0.2°C per minute rate, accuracy is ±5°C up to 200°C and decreases to ±0.8°C at 300°C. Mettler Instrument. Circle 679.

Concentrator-Evaporator

The Speed Vac Concentrator is designed for rapid solvent, phase elimination. The solid residue or solute is held by centrifugation at the bottom of the tube while the process of evaporation takes place without the bumping of the sample. It is suitable for both aqueous and organic solvents including water, hydrochloric acid, trichloroacetic acid, or ammonium hydroxide. Anhydrous samples may be obtained quickly without the loss of solute. Applications include hydrolysis, silylation, and peptide analysis. Savant Instruments. Circle 681.

Liquid Chromatograph

A new gradient system is available for high-performance liquid chromatography. It utilizes two metering pumps with electronic pulse correction for precise flow rates up to 10 milliliters per minute at 10,000 pounds per square inch. An optional version offers up to 28 milliliters per minute at 3,000 pounds per square inch. Two modes of operation permit constant flow for maximum chromatogram reproducibility or constant pressure where column or packing pressure limits override flow considerations. The solvent programmer can be used to program flow rate or gradient profiles up to 18 hours long. Operating mode selections include manual solvent scouting, up to a 60-minute hold at final gradient concentration, and automatic column equilibration. An ultraviolet-visible detector with an 8-microliter flow cell and wavelength range from 254 to 660 nanometers completes the system. Altex Scientific. Circle 690.

Dialysis Tubing

Spectrapor dialysis tubing is available with a cutoff at a low molecular weight. It comes in a range of flat-width sizes of 10 to 45 millimeters. It is packaged in rolls 10 meters long. Molecular weight cutoff is 2000. Spectrum Medical Industries. Circle 683.

Literature

Severe Environment Products describes computer subsystems and peripherals for use in hostile environments. Electronic Memories and Magnetics. Circle 684.

Continuous Water Still depicts a unit that provides more than 2 liters per hour. Included are a redistillation option and a 5-gallon, automatically controlled reservoir. Kontes. Circle 685.

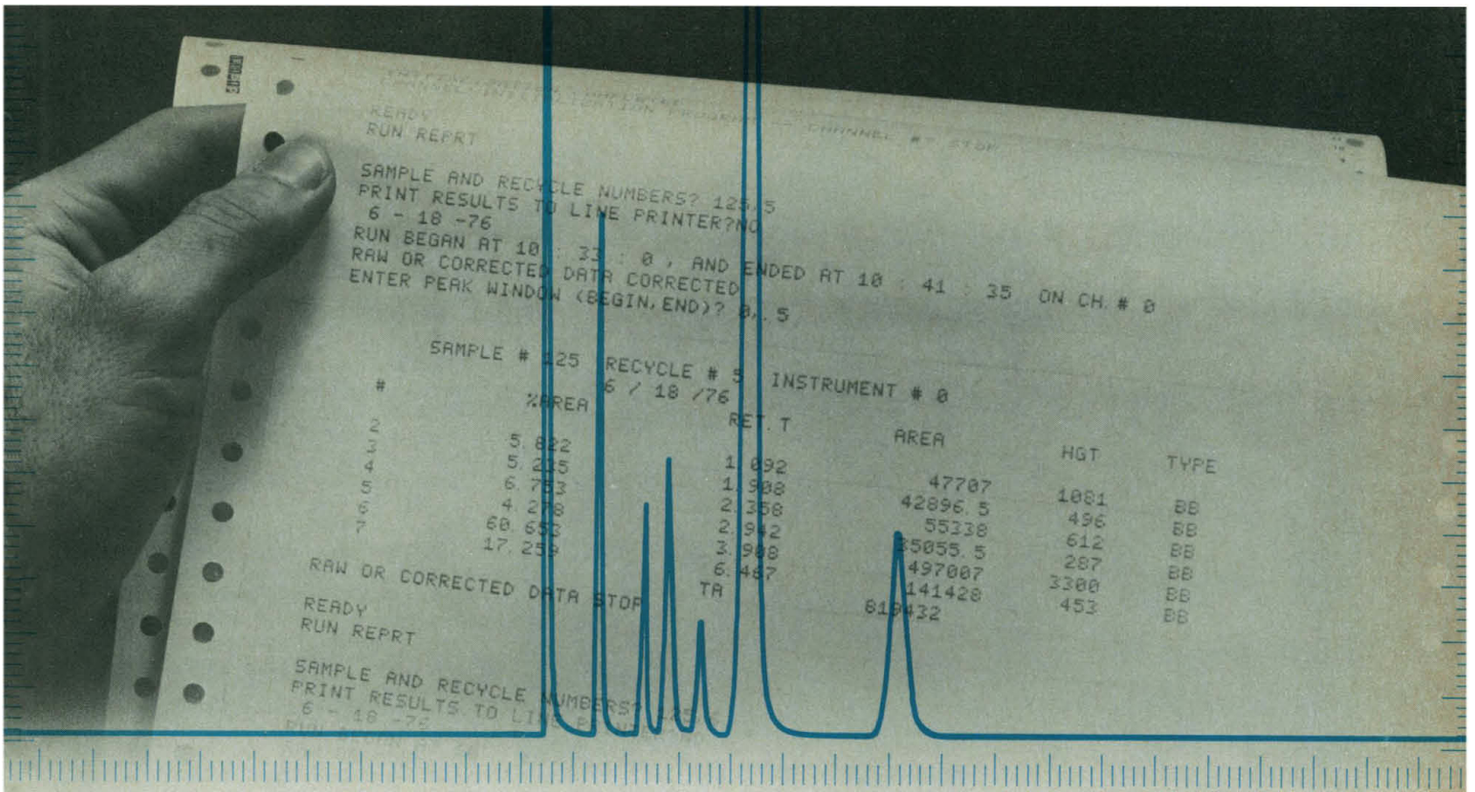
Paired-Ion Chromatography is an alternative to ion exchange. It is described in a 16-page publication that gives details for separating and analyzing ionic compounds and mixtures of ionized and nonionized materials. Waters Associates. Circle 686.

Photrex Solvents for Spectrophotometry includes 20 new solvents that brings the total available in this line to 35. J. T. Baker Chemical. Circle 687.

Standards Catalog features standards and publications for a wide variety of materials and techniques. American National Standards Institute. Circle 688.

Exploring Molybdenum and Tungsten includes physical and mechanical properties and illustrates a number of applications for these materials. Amax Specialty Metals. Circle 689.

SelectaSol Solvent Selector System describes a chromatographic system. It includes hardware, instructions, and suggested applications. Schleicher & Schuell. Circle 691.



PEAK-11...designed to help you automate your laboratory without telling you how to run it.

Some laboratory systems only work one way. But if you need a system that handles a variety of tasks, the Digital PEAK-11 system is designed for you.

FLEXIBLE—PEAK-11 lets you process raw data, reprocess peak data, store it, update it, analyze and file it, all while the system is busy collecting data. In fact, PEAK-11, with its own foreground/background operating software, lets you automatically collect, process and simultaneously analyze data from up to 16 different peak-producing devices, such as GC, LC, AA, IR and UV-VIS instruments.

INTERACTIVE—PEAK-11 also lets you control what you collect. You set up your parameters and Digital's lab system will do the rest. It handles tasks like perpendicular drop and tangential skim, automatically. With Digital's multi-terminal BASIC, you decide on the best way to analyze and present the data. This system provides *simultaneous timesharing* for your other general computational needs.

ECONOMICAL—You can get peak performance without paying high prices. A complete PEAK-11 system with a proven PDP-11/34 processor, twin disk packs, and a terminal costs *less than $2,800 a channel* (or you can leasepurchase the system for under $70 a month per channel).

EXPANDABLE—PEAK-11 is designed to grow as your laboratory grows. You can start with a basic system and expand later up to 124K words of memory, 8 removable disks, more terminals, and even a floating-point processor.

Interested? If you really want your lab to run at peak efficiency, contact your nearest Digital sales office to find out more about PEAK-11. Or send the coupon to Digital Equipment Corporation, MR2-4/M38, Marlborough, Mass. 01752; telephone 617-481-9511, extension 6949 or 6942. European headquarters: 81 route de l'Aire, 1211 Geneva 26. Tel: 42 79 50. In Canada: Digital Equipment of Canada, Ltd.

digital

50,000 Computers Saving Managers Millions.

Digital Equipment Corporation, MR2-4/M28, Marlborough, MA. 01752.

☐ I am interested. But my need is long-range. Please send me literature.

☐ I am interested. Please have a sales engineer contact me as soon as possible.

Name_____ Title_____

Company_____ Phone_____

Address_____

City_____ State_____ Zip_____

S96

Circle No. 135 on Readers' Service Card

BOOKS RECEIVED

(Continued from page 1116)

Evolution of Crop Plants. N. W. Simmonds, Ed. Longman, New York, 1976. xii, 340 pp., illus. $35.

Experimentation in Biology. An Introduction to Design and Analysis. W. J. Ridgman. Halsted (Wiley), New York, 1976. x, 234 pp. Paper, $10.95. Tertiary Level Biology.

Festkörperphysik. Konrad Kreher. Vieweg, Braunschweig, Germany, 1976. 224 pp., illus. DM 22.80. Reihe Wissenschaft.

Financial Analysis and Business Decisions on the Pocket Calculator. Jon M. Smith. Wiley-Interscience, New York, 1976. xxiv, 318 pp., illus. $12.95. Wiley Series on Systems and Controls for Financial Management.

First Inter-American Conference on Conservation and Utilization of American Nonhuman Primates in Biomedical Research. Lima, Peru, June 1975. Pan American Health Organization, Washington, D.C., 1976. xx, 252 pp., illus. Paper, $8. Scientific Publication No. 317.

From Neuron to Brain. A Cellular Approach to the Function of the Nervous System. Stephen W. Kuffler and John G. Nicholls. Sinauer, Sunderland, Mass., 1976. xiv, 490 pp., illus. Cloth, $18; paper, $12.

Fundamentals of Complex Analysis for Mathematics, Science, and Engineering. E. B. Saff and A. D. Snider. Prentice-Hall, Englewood Cliffs, N.J., 1976. xvi, 444 pp., illus. $18.75.

Fundamentals of Finite Mathematics. Robert L. Childress. Prentice-Hall, Englewood Cliffs, N.J., 1976. xvi, 544 pp., illus. $12.95.

Gardening with Perennials. Month by Month. Joseph Hudak. Quadrangle (New York Times), New York, 1976. xvi, 398 pp., illus. + plates. $12.50. A Demeter Press Book.

General Chemistry. William H. Nebergall, Frederic C. Schmidt, and Henry F. Holtzclaw, Jr. Heath, Lexington, Mass., ed. 5, 1976. xxii, 986 pp., illus. + index. $14.95.

Genetic Diversity and Human Equality. Theodosius Dobzhansky. Basic, New York, 1976. xii, 128 pp. Paper, $3.95. The John Dewey Lecture, No. 13. Reprint of the 1973 edition.

Geologic Time. Don L. Eicher. Prentice-Hall, Englewood Cliffs, N.J., ed. 2, 1976. viii, 152 pp., illus. Cloth, $7.95; paper, $4.25. The Prentice-Hall Foundations of Earth Science Series.

The Great Instauration. Science, Medicine and Reform 1626–1660. Charles Webster. Holmes and Meier, New York, 1976. xvi, 630 pp. $29.50.

The Handling of Chromosomes. C. D. Darlington and L. F. La Cour. Revised by L. F. La Cour. Halsted (Wiley), New York, ed. 6, 1976. 202 pp. + plates. $14.50.

Health and the Environment. John Lenihan and William W. Fletcher, Eds. Academic Press, New York, 1976. x, 166 pp., illus. $14.50. Environment and Man, vol. 3.

Herbicides. Chemistry, Degradation, and Mode of Action. Vol. 2. P. C. Kearney and D. D. Kaufman, Eds. Dekker, New York, ed. 2, 1976. xiv + pp. 501–1036. $37.50.

Heteroaromatic Nitrogen Compounds. The Azoles. K. Schofield, M. R. Grimmett, and B. R. T. Keene. Cambridge University Press, New York, 1976. x, 438 pp., illus. $49.50.

Historia de la Etnología: Los Evolucionistas. Angel Palerm. Centro de Investigaciones Superiores, Instituto Nacional de Antropología

e Historia, Tlalpan, Mexico, 1976. 214 pp. Paper, $5. Historia de la Etnología, 2.

Horizons in Clinical Pharmacology. Papers from a symposium, Miami. Roger F. Palmer, Ed. Dekker, New York, 1976. viii, 260 pp., illus. $24.50. Modern Pharmacology-Toxicology, vol. 6.

How to Solve General Chemistry Problems. C. H. Sorum and R. S. Boikess. Prentice-Hall, Englewood Cliffs, N.J., ed. 5, 1976. xiv, 302 pp. Paper, $5.95.

The Human Pedigree. Anthony Smith. McGraw-Hill, New York, 1976. 308 pp. Paper, $3.95. Reprint of the 1975 edition.

In Search of Noah's Ark. Dave Balsiger and Charles E. Sellier, Jr. Sun Classic Books, Los Angeles, 1976. vi, 218 pp. + plates. Paper, $1.95.

Information Systems. Robert W. Llewellyn. Prentice-Hall, Englewood Cliffs, N.J., 1976. xvi, 348 pp., illus. $14.95.

Inorganic Biochemistry. Springer-Verlag, New York, 1976. iv, 228 pp., illus. $27.90. Topics in Current Chemistry, vol. 64.

Intercellular Communication in Plants. Studies on Plasmodesmata. B. E. S. Gunning and A. W. Robards, Eds. Springer-Verlag, New York, 1976. xvi, 390 pp., illus. $29.60.

International Zoo Yearbook. Vol. 16. P. J. S. Olney, Ruth Biegler, and Pat Ellis, Eds. Zoological Society of London, London, 1976. xii, 484 pp., illus. Cloth, $26.40; paper, $19.80.

Interplanetary Dust and Zodiacal Light. Proceedings of a colloquium, Heidelberg, Germany, June 1975. H. Elsässer and H. Fechtig, Eds. Springer-Verlag, New York, 1976. xii, 498 pp., illus. Paper, $16. Lecture Notes in Physics, vol. 48.

The Intrapsychic Self. Feeling and Cognition in Health and Mental Illness. Silvano Arieti. Basic, New York, 1976. xvi, 350 pp. Paper, $4.95. Abridgment of 1967 edition.

Japanese International Biological Program. University of Tokyo Press, Tokyo, 1975 (U.S. distributor, International Scholarly Book Services, Forest Grove, Ore.). 13 vols., illus. Vol. 1, Comparative Studies on Human Adaptability of Japanese, Caucasians and Japanese Americans. S. M. Horvath, S. Kondo, H. Matsui, and H. Yoshimura, Eds. xii, 184 pp. (Human Adaptability, vol. 1.) Vol. 2, Anthropological and Genetic Studies on the Japanese. S. Watanabe, S. Kondo, and E. Matsunaga, Eds. x, 338 pp. (Human Adaptability, vol. 2.) Vol. 3, Physiological Adaptability and Nutritional Status of the Japanese, Part A. H. Yoshimura and S. Kobayashi, Eds. xii, 276 pp. (Human Adaptability, vol. 3.) Vol. 4, Physiological Adaptability and Nutritional Status of the Japanese, Part B. K. Asahina and R. Shigiya, Eds. x, 250 pp. (Human Adaptability, vol. 3.) Vol. 5, Gene Conservation. T. Matsuo, Ed. xvi, 230 pp. (Use and Management of Biological Resources, vol. 1.) Vol. 6, Adaptability in Plants. T. Matsuo, Ed. x, 218 pp. (Use and Management of Biological Resources, vol. 2.) Vol. 7, Approaches to Biological Control. K. Yasumatsu and H. Mori, Eds. viii, 142 pp. (Use and Management of Biological Resources, vol. 3.) Vol. 8, Studies in Conservation of Natural Terrestrial Ecosystems in Japan, Part 1. M. Numata, K. Yoshioka, and M. Kato, Eds. x, 158 pp. Vol. 9, Studies in Conservation of Natural Terrestrial Ecosystems in Japan, Part 2. M. Numata, K. Yoshioka, and M. Kato, Eds. viii, 92 pp. Vol. 10, Productivity of Communities in Japanese Inland Waters. S. Mori and G. Yamamoto, Eds. viii, 436 pp. Vol. 11,

Crop Productivity and Solar Energy Utilization in Various Climates in Japan. Y. Murata, Ed. x, 244 pp. (Production Processes, vol. 1.) Vol. 12, Nitrogen Fixation and Nitrogen Cycle. H. Takahashi, Ed. viii, 162 pp. (Production Processes, vol. 3.) Vol. 13, Ecological Studies in Japanese Grasslands. M. Numata, Ed. xii, 276 pp. The 13-volume set, paper, $230.

Keeping Reptiles and Amphibians. Alfred Leutscher. Scribner, New York, 1976. 164 pp., illus. $7.95.

Land-Grant Universities and Their Continuing Challenge. G. Lester Anderson, Ed. Michigan State University Press, East Lansing, 1976. viii, 354 pp. + tables. $15.

Landscaping the Saudi Arabian Desert. Kathleen Kelly and R. T. Schnadelbach. Delancey Press, Philadelphia, 1976. x, 182 pp., illus. $22.50.

Making Inequality. The Hidden Curriculum of High School Tracking. James E. Rosenbaum. Wiley-Interscience, New York, 1976. xviii, 238 pp. $13.95.

The Management of Respiratory Care Services. Roman L. Yanda. Projects in Health, New York, 1976. vi, 248 pp. Spiral bound, $14.50.

Maternofoetal Transmission of Immunoglobulins. Proceedings of a symposium, Bangor, Wales. W. A. Hemmings, Ed. Cambridge University Press, New York, 1976. xx, 462 pp., illus. $29.50. Clinical and Experimental Immunoreproduction, 2.

Mathematical Models for Environmental Problems. Proceedings of a conference, Southampton, England, Sept. 1975. C. A. Brebbia, Ed. Halsted (Wiley), New York, 1976. viii, 538 pp., illus. $39.50.

The Measurement of Interpersonal Values. Leonard V. Gordon. Science Research Associates, Chicago, 1975. xii, 122 pp. Cloth, $9.50; paper, $6.50.

Men Who Dared the Sea. The Ocean Adventures of the Ancient Mariners. Gardner Soule. Crowell, New York, 1976. x, 262 pp., illus. $9.95.

Methods for Ecological Bioenergetics. W. Grodzinski, R. Z. Klekowski, and A. Duncan, Eds. Blackwell, Oxford, England, 1975 (U.S. distributor, Lippincott, Philadelphia). xiv, 368 pp., illus. Paper, $24. IBP Handbook No. 24.

Methods in Experimental Biology. Robert Ralph. Halsted (Wiley), New York, 1976. viii, 142 pp., illus. Paper, $7.95. Tertiary Level Biology.

The Microbial World. Roger Y. Stanier, Edward A. Adelberg, and John L. Ingraham. Prentice-Hall, Englewood Cliffs, N.J., ed. 4, 1976. xx, 872 pp., illus. $19.95.

Microbiological Laboratory Techniques. Arnold I. Miller. Heath, Lexington, Mass., 1976. xvi, 234 pp., illus. Spiral bound, $7.95.

Middle Mississippi Exploitation of Animal Populations. Bruce D. Smith. University of Michigan Museum of Anthropology, Ann Arbor, 1975. xii, 234 pp., illus. Paper, $4. Anthropological Papers, No. 57.

Occupational Safety, Health and Fire Index. A Source Guide to Voluntary and Obligatory Regulations, Codes, Standards and Publications. David E. Miller. Dekker, New York, 1976. Unpaged. $35. Occupational Safety and Health, 1.

Ökonomische Gesetze des Sozialismus und ihre Ausnutzung. Teil 3. Proceedings of a meeting, Berlin, June 1974. Helmut Koziolek, Ed. Akademie-Verlag, Berlin, 1975. 296 pp. Paper, 18 M. Sitzungberichte der Akademie der Wissenschaften der DDR, 12/3.

Personality and Educational Achievement. F. D. Naylor. Wiley, New York, 1976. viii, 162 pp. Paper, $3.50. Educational Achievement.

The Philosophy of Karl Popper. Robert John Ackermann. University of Massachusetts Press, Amherst, 1976. xii, 212 pp. $15.

Poly(ethylene Oxide). F. E. Bailey, Jr., and J. V. Koleske. Academic Press, New York, 1976. x, 174 pp., illus. $13.

Polypeptide Hormones. Molecular and Cellular Aspects. Proceedings of a symposium, London, July 1975. Elsevier/Excerpta Medica/North-Holland, New York, 1976. xii, 388 pp., illus. $27.75. Ciba Foundation Symposium 41 (new series).

Precipitation History of the Rocky Mountain States. Raymond S. Bradley. Westview Press, Boulder, Colo., 1976. xxii, 334 pp., illus. $13.50. Westview Special Studies: Institute for Arctic and Alpine Research—Studies in High Altitude Geo-Ecology.

Preventive Medicine USA. Health Promotion and Consumer Health Education. A Task Force Report sponsored by the John E. Fogarty International Center and the American College of Preventive Medicine. PRODIST (Neale Watson), New York, 1976. viii, 256 pp. Paper, $4.95.

Primate Atherosclerosis. G. A. Gresham. Karger, Basel, 1976. viii, 102 pp., illus. Paper, $20. Monographs on Atherosclerosis, vol. 7.

The Principles and Techniques of Engineering Estimating. Granville Calder. Pergamon, New York, 1976. x, 168 pp., illus. Paper, $6.

Principles of Seed Science and Technology. L. O. Copeland. Burgess, Minneapolis, 1976. xiv, 370 pp., illus. $14.95.

Proceedings of the Wingspread Conference on Advanced Converters and Near Breeders. Racine, Wis., May 1975. Pergamon, New York, 1976. x + pp. 689–850, illus. $20. Reprinted from *Annals of Nuclear Energy*, vol. 2, Nos. 11/12.

Professionals in Chemistry: 1975. American Chemical Society, Washington, D.C., 1976. viii, 120 pp. Paper, $10; to members, $5.

Progress in Fatigue and Fracture. Freudenthal Anniversary Volume. Harold Liebowitz, Ed. Pergamon, New York, 1976. vi, 300 pp., illus. $35. Originally published as a special issue of *Engineering Fracture Mechanics*, vol. 8, No. 1.

Progress in Toxicology. Special Topics. Vol. 2. Gerhard Zbinden. Springer-Verlag, New York, 1976. vi, 120 pp., illus. $7.40.

The Psychology of Teaching Methods. The Seventy-fifth Yearbook of the National Society for the Study of Education, Part 1. N. L. Gage, Ed. National Society for the Study of Education, Chicago, 1976 (distributor, University of Chicago Press, Chicago). xii, 436 pp. $13.

Radio and Microwave Spectroscopy. David J. E. Ingram. Halsted (Wiley), New York, 1976. viii, 168 pp., illus. $12.95.

Review of Research in Education. Vol. 3. Fred N. Kerlinger, Ed. Published for the American Educational Research Association by Peacock, Itasca, Ill., 1975. vi, 306 pp. $13.50.

Russell W. Porter. Arctic Explorer, Artist, Telescope Maker. Berton C. Willard. Bond Wheelwright, Freeport, Me., 1976. xiv, 274 pp., illus. $12.50.

Science and Civilisation in China. Vol. 5, Chemistry and Chemical Technology. Part 3, Spagyrical Discovery and Invention: Historical Survey, from Cinnabar Elixirs to Synthetic Insulin. Joseph Needham with the collabo-

ration of Ho Ping-Yü and Lu Gwei-Djen. Cambridge University Press, New York, 1976. xxxvi, 482 pp. illus. + plates. $42.

Science and Epilepsy. Neuroscience Gains in Epilepsy Research. James L. O'Leary and Sidney Goldring. Raven, New York, 1976. xvi, 288 pp., illus. $18.50.

Scientific and Engineering Problem-Solving with the Computer. William Ralph Bennett, Jr. Prentice-Hall, Englewood Cliffs, N.J., 1976. xxii, 458 pp., illus. $17.95. Prentice-Hall Series in Automatic Computation.

Seri Prehistory. The Archaeology of the Central Coast of Sonora, Mexico. Thomas Bowen. University of Arizona Press, Tucson, 1976. 120 pp., illus. Paper, $4.95. Anthropological Papers of the University of Arizona, No. 27.

Sex, Society, and History. Vern L. Bullough. Science History Publications (Neale Watson), New York, 1976. x, 186 pp. Cloth, $10; paper, $4.95.

Sexuality, Pairing, and Family Forms. Duane Windemiller. Winthrop, Cambridge, Mass., 1976. xii, 412 pp., illus. $10.95.

The Sirius Mystery. Robert K. G. Temple. St. Martin, New York, 1976. xiv, 290 pp., illus. + plates. $10.95.

XVIth International Congress of Logopedics and Phoniatrics. Interlaken, Switzerland, Aug. 1974. E. Loebell, Ed. Karger, Basel, 1976. xiv, 550 pp., illus. $72.75.

Sleep, Nutrition and Mood. A. H. Crisp and E. Stonehill. Wiley, New York, 1976. x, 174 pp., illus. $15.95.

Solid State Pulse Circuits. David A. Bell. Reston (Prentice-Hall), Reston, Va., 1976. xii, 434 pp., illus. $16.95.

The Space-Gods Revealed. A Close Look at the Theories of Erich von Däniken. Ronald Story. Harper and Row, New York, 1976. xx, 140 pp., illus. $7.95.

Steel Production. Processes, Products, and Residuals. Clifford S. Russell and William J. Vaughan. Published for Resources for the Future by Johns Hopkins University Press, Baltimore, 1976. xx, 328 pp. $16.50.

Strange Artifacts. A Sourcebook on Ancient Man. Vol. M-2. Compiled by William R. Corliss. The Sourcebook Project, Glen Arm, Md., 1976. vi, 288 pp., illus. In looseleaf binder, $7.95.

Structured Programming in APL. Dennis P. Geller and Daniel P. Freedman. Winthrop, Cambridge, Mass., 1976. xxii, 324 pp. Paper, $8.95. Winthrop Computer Systems Series.

Suicidology. Contemporary Developments. Edwin S. Shneidman, Ed. Grune and Stratton, New York, 1976. xviii, 572 pp. $27.50. Seminars in Psychiatry.

Sweeteners. Issues and Uncertainties. Proceedings of a forum, Mar. 1975. National Academy of Sciences, Washington, D.C., 1975. viii, 260 pp., illus. Paper, $8.

Les Syndromes de Disconnexion Calleuse chez l'Homme. Papers from a colloquium, Lyon, 1974. F. Michel and B. Schott, Eds. Available from F. Michel, Hôpital Neurologique, Lyon, 1976. 416 pp., illus. cloth.

A System of Complete Medical Police. Selections from Johann Peter Frank. Translated from the third German edition (Vienna, 1786). Erna Lesky, Ed. Johns Hopkins University Press, Baltimore, 1976. xxiv, 470 pp. $18.50.

A Technology of Reading and Writing. Vol. 1, Learning to Read and Write: A Task Analysis. Donald E. P. Smith. Academic Press, New York, 1976. xii, 164 pp., illus. $9.95. Educational Psychology.

Theory and Practice of Events Research. Studies in Inter-Nation Actions and Interactions. Edward E. Azar and Joseph D. Ben-Dak, Eds. Gordon and Breach, New York, 1975. xxii, 304 pp. $34.50.

A Theory of Group Structures. Kenneth D. Mackenzie. Gordon and Breach, New York, 1976. Two volumes. Vol. 1, Basic Theory. xviii + pp. 1–266, illus. + index. $17.50. Vol. 2, Empirical Tests. xvi + pp. 267–494, illus. + index. $15.50. The set, $28.

The 2 × 2 Game. Anatol Rapoport, Melvin J. Guyer, and David G. Gordon. University of Michigan Press, Ann Arbor, 1976. x, 462 pp., illus. $14.50.

Umweltbiophysik. Papers from a meeting, Kühlingsborn, Oct. 1973. Roland Glaser, Kurt Unger, and Manfred Koch, Eds. Akademie-Verlag, Berlin, 1976. iv, 316 pp., illus. 74 M. Abhandlungen der Akademie der Wissenschaften der DDR.

Waste Recovery by Microorganisms. Papers from a meeting, Kuala Lumpur, Malaysia, May 1972. Ministry of Education, Malaysia, Kuala Lumpur, 1975 (U.S. distributor, Unipub, New York). xii, 222 pp., illus. Paper, $12.

Water and Plants. Hans Meidner and David W. Sheriff. Halsted (Wiley), New York, 1976. x, 148 pp., illus. Paper, $5.95. Tertiary Biology Series.

The Web of Adaptation. Bird Studies in the American Tropics. David W. Snow. Quadrangle (New York Times), New York, 1976. xiv, 176 pp., illus. $8.95. A Demeter Press Book.

Women and World Development. An Annotated Bibliography. Mayra Buvinić with Cheri S. Adams, Gabrielle S. Edgcomb, and Maritta Koch-Weser. Prepared under the auspices of the American Association for the Advancement of Science and published by Overseas Development Council, Washington, D.C., 1976. xii, 162 pp. Paper, $2.50.

Women and World Development. Papers from a AAAS seminar, Mexico City, June 1975. Irene Tinker and Michèle Bo Bramsen, Eds. Prepared under the auspices of the American Association for the Advancement of Science and published by Overseas Development Council, Washington, D.C., 1976. xii, 228 pp. Paper, $3.50.

World Modeling. A Dialogue. C. West Churchman and Richard O. Mason, Eds. North-Holland, Amsterdam, and Elsevier, New York, 1976. xvi, 164 pp., illus. Paper, $12.50. North-Holland/TIMS Studies in the Management Sciences, vol. 2.

Book Order Service

A Science *Book Order Service, based on the Books Received column, has been established. It is scheduled for each issue in which there is a Readers' Service Card. To order any of the books listed, circle the corresponding number on the Readers' Service Card (pages 1066A and 1162A); the participating publisher(s) will ship the title(s) ordered and send you a bill.*

Advances in Carbohydrate Chemistry and Biochemistry. Vol. 32. R. Stuart Tipson and Derek Horton, Eds. Academic Press, New York, 1976. xii, 440 pp., illus. $42. *To order this book circle No. 415 on Readers' Service Card*

Advances in Chemical Physics. Vol. 34. I.

Prigogine and Stuart A. Rice, Eds. Interscience (Wiley), New York, 1976. xii, 324 pp., illus. $28.95. *To order this book circle No. 416 on Readers' Service Card*

Advances in Chemical Physics. Vol. 35. I. Prigogine and Stuart A. Rice, Eds. Interscience (Wiley), New York, 1976. x, 358 pp. $29.75. *To order this book circle No. 417 on Readers' Service Card*

Advances in Information Systems Science. Vol. 6. Julius T. Tou, Ed. Plenum, New York, 1976. xiv, 210 pp., illus. $25. *To order this book circle No. 418 on Readers' Service Card*

Biophysical and Physiological Systems Analyses. Based on Lectures to Graduate Students. Erol Başar. Addison-Wesley, Reading, Mass., 1976. xviii, 430 pp., illus. Cloth, $24.50; paper, $12.50. *To order this book circle No. 419 on Readers' Service Card*

Cancer Enzymology. Proceedings of a symposium, Miami, Jan. 1976. J. Schultz and F. Ahmad, Eds. Academic Press, New York, 1976. xiv, 348 pp., illus. $15. Miami Winter Symposia, vol. 12. *To order this book circle No. 420 on Readers' Service Card*

The Ceaseless Wind. An Introduction to the Theory of Atmospheric Motion. John A. Dutton. McGraw-Hill, New York. 1976. xx, 580 pp., illus. $25. *To order this book circle No. 454 on Readers' Service Card*

Cell Division in Higher Plants. M. M. Yeoman, Ed. Academic Press, New York, 1976. x, 542 pp., illus. $41. Experimental Botany, vol. 7. *To order this book circle No. 455 on Readers' Service Card*

Current Topics in Membranes and Transport. Vol. 8. Felix Bronner and Arnost Kleinzeller, Eds. Academic Press, New York, 1976. xii, 272 pp., illus. $28.50. *To order this book circle No. 421 on Readers' Service Card*

The Early History of the Earth. Proceedings of a NATO Advanced Study Institute, Leicester, England, Apr. 1975. Brian F. Windley, Ed. Wiley-Interscience, New York, 1976. x, 620 pp., illus. $45. *To order this book circle No. 422 on Readers' Service Card*

Erosion by Liquid Impact. George S. Springer. Scripta, Washington, D.C., and Halsted (Wiley), New York, 1976. xx, 264 pp., illus. $27.50. *To order this book circle No. 423 on Readers' Service Card*

Filtering in the Time and Frequency Domains. Herman J. Blinchikoff and Anatol I. Zverev. Wiley-Interscience, New York, 1976. xviii, 494 pp., illus. $27.50. *To order this book circle No. 424 on Readers' Service Card*

Frontiers of Astrophysics. Eugene H. Avrett, Ed. Harvard University Press, Cambridge, Mass., 1976. x, 554 pp., illus. Cloth, $20; paper, $8.95. *To order this book circle No. 425 on Readers' Service Card*

A History of Clinical Psychology. John M. Reisman. Irvington, New York, and Halsted (Wiley), New York, 1976. x, 420 pp. $15.95. Revision of *The Development of Clinical Psychology*. The Century Psychology Series. *To order this book circle No. 426 on Readers' Service Card*

Horizons in Biochemistry and Biophysics. Vol. 2. E. Quagliariello, F. Palmieri, and Thomas P. Singer, Eds. Addison-Wesley, Reading, Mass., 1976. xviii, 340 pp., illus. Cloth, $15; paper, $7.75. *To order this book circle No. 427 on Readers' Service Card*

Hyperactivity. Research, Theory, and Action. Dorothea M. Ross and Sheila A. Ross. Wiley-Interscience, New York, 1976. xiv, 386 pp., illus. $18.95. Wiley Series on Personality Processes. *To order this book circle No. 428 on Readers' Service Card*

Hypothalamus and Endocrine Functions. Proceedings of a symposium, Quebec City, Sept. 1975. Fernand Labrie, Joseph Meites, and Georges Pelletier, Eds. Plenum, New York, 1976. xii, 508 pp., illus. $32. Current Topics in Molecular Endocrinology, vol. 3. *To order this book circle No. 429 on Readers' Service Card*

International Review of Cytology. Vol. 45. G. H. Bourne, J. F. Danielli, and K. W. Jeon, Eds. Academic Press, New York, 1976. xii, 424 pp., illus. $36.50. *To order this book circle No. 430 on Readers' Service Card*

Introduction to Geophysical Prospecting. Milton B. Dobrin. McGraw-Hill, New York, ed. 3, 1976. x, 630 pp., illus. $19.95. *To order this book circle No. 431 on Readers' Service Card*

Introductory Economic Statistics. Anne C. Mayes and David G. Mayes. Wiley, New York, 1976. x, 224 pp., illus. Cloth, $15.95; paper, $8.50. *To order this book circle No. 432 on Readers' Service Card*

Invertebrate Tissue Culture. Applications in Medicine, Biology, and Agriculture. Proceedings of a conference, Mont Gabriel, Quebec, Canada, June 1975. Edouard Kurstak and Karl Maramorosch, Eds. Academic Press, New York, 1976. xviii, 393 pp., illus. $21. *To order this book circle No. 433 on Readers' Service Card*

Language and Perception. George A. Miller and Philip N. Johnson-Laird. Belknap Press of Harvard University Press, Cambridge, Mass., 1976. xii, 760 pp. $20. *To order this book circle No. 434 on Readers' Service Card*

Managing High-Technology Programs and Projects. Russell D. Archibald. Wiley-Interscience, New York, 1976. x, 278 pp., illus. $18.95. *To order this book circle No. 435 on Readers' Service Card*

Managing Innovation. Edwin A. Gee and Chaplin Tyler. Wiley-Interscience, New York, 1976. xvi, 268 pp., illus. $19.95. Wiley Series on Systems and Controls for Financial Management. *To order this book circle No. 436 on Readers' Service Card*

Metallogeny and Global Tectonics. Wilfred Walker, Ed. Dowden, Hutchinson and Ross, Stroudsburg, Pa., 1976 (distributor, Halsted [Wiley], New York). xvi, 416 pp., illus. $27. Benchmark Papers in Geology, vol. 29. *To order this book circle No. 437 on Readers' Service Card*

Microbiology in Agriculture, Fisheries and Food. Papers from a symposium, Aberdeen, Scotland, July 1974. F. A. Skinner and J. G. Carr, Eds. Academic Press, New York, 1976. xvi, 274 pp., illus. $22.75. The Society for Applied Bacteriology Symposium Series No. 4. *To order this book circle No. 438 on Readers' Service Card*

Pharmacology of Behavior and Memory. R. Yu. Il'yuchenok. Translated from the Russian edition (Novosibirsk, 1972). Hemisphere, Washington, D.C., and Halsted (Wiley), New York, 1976. viii, 216 pp. $22.50. *To order this book circle No. 439 on Readers' Service Card*

The Physics and Chemistry of Minerals and Rocks. Proceedings of a NATO Advanced Study Institute, Newcastle upon Tyne, England, Apr. 1974. R. G. J. Strens, Ed. Wiley-Interscience, New York, 1976. xvi, 698 pp., illus. $45. *To order this book circle No. 440 on Readers' Service Card*

Practical Electron Microscopy for Biologists. Geoffrey A. Meek. Wiley-Interscience, New York, ed. 2, 1976. xxii, 528 pp., illus. $34. *To order this book circle No. 441 on Readers' Service Card*