SCIENCE

18 October 1974

Vol. 186, No. 4160

Instrument Issue

Now your rat count won't drown in high water.

Handifluor™ *ScintillAR*® brings you 50 to 100% more counting efficiency at 30 to 50% water content.

You'll like its performance at five per cent water content. At 50% you'll love it. And that includes the tough jobs, like tritium at low concentrations.

A complete cocktail for scintillation counting, *Handifluor ScintillAR* gives you brilliant clear solutions or firm translucent gels on aqueous or non-aqueous samples. Counting efficiency stays high at both low and ambient temperatures.

In case you'd like proof of that efficiency claim, here's how *Handifluor* performed against the two leading competitive cocktails:*

GENERAL AQUEOUS SAMPLES

Ml Aqueous Phase Per 10 ml Base	Approx. Water Percent By Vol.	Absolute Tritium Efficiency (Percent)		
		Handifluor Cocktail Base	Cocktail Base A	Cocktail Base B
None	—	53.7	48.9	50.8
0.5	5	44.5	42.9	44.5
1.0	9	40.5	37.1	39.5
1.5	13	37.5	35.6	36.6
2.5	20	35.0	34.1	32.9
3.5	26	31.0	31.3	32.3
5.0	33	29.8	19.9	28.2
7.5	43	24.1	10.7	22.4
10.0	50	20.7	9.8	19.6

*10 ml of base, tritium equal to 2,000 dpm and aqueous phase giving the indicated percentage of the total cocktail combined and counted by a Packard Model 2425 Tri-Carb® Liquid Scintillation Spectrometer. Instrument efficiency for ^{3}H by A.E.S. was 97-99%, representing 58-60% absolute tritium efficiency vs. sealed standards. Data represents averages of four successive 10 minute counts. Efficiencies are expressed as percent of the theoretical decompositions per minute actually counted.

After you've read the chart, what more can we say except that it's ready to be delivered to you in Safemor® gallon jugs from your local Mallinckrodt distributor. Catalog No. 4022. If you'd like even more data, ask for our complete comparative data sheet.

Mallinckrodt®

SCIENCE PRODUCTS DIVISION
Saint Louis, Missouri 63147

Circle No. 332 on Readers' Service Card

First at the top.

On April 6, 1909, Robert Edwin Peary and his assistant Matthew Henson reached the top of the world after crossing more than 400 miles of drifting and broken ice. Against seemingly insurmountable obstacles they were finally successful in reaching the North Pole.

Almost 30 years later Revco began manufacturing freezers. Since then Revco has grown until today they, too, are "first at the top". Advanced concepts in design and engineering have made Revco the world's largest manufacturer of ULTra-low® temperature equipment. This, plus a world-wide renown for dependability and economy, is your guarantee of the finest that modern technology can produce. When you specify Revco, you've bought the best.

For more information on Revco uprights, chest freezers and nation-wide service centers, write for our latest catalog or contact: Scientific Products, VWR, Fisher Scientific, Curtin-Matheson. In Canada: Allied Scientific, Fisher Scientific, Can Lab.

REVCO, INC. The world's leader in ULTra-Low® temperature freezers.

1100 Memorial Drive, West Columbia, S.C. 29169 Telephone: 803/796-1700 TWX: 810-666-2103 Cable: Revco

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18 October 1974

Volume 186, No. 4160

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. Member rates on request. Annual subscription $40; foreign postage: Americas $6, overseas: $8, air lift to Europe $20. Single copies $1 (back issues, $2) except Guide to Scientific Instruments which is $4. School year subscription: 9 months $30; 10 months $33.50 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

Parallel dendritic drainage pattern. A reduced transparency of this drawing was analyzed on an optical diffraction analysis (ODA) system incorporating a standard petrographic microscope. Results were almost identical with those results obtained by using a conventional ODA system. See page 234.

GCA/PRECISION SCIENTIFIC

VacTorr® 20 New Direct-drive Vacuum Pump

Readily portable—size just 4½" x 7" x 10", weighs only 17 pounds. High efficiency performance—20 liters/min. free air capacity, 5 microns Hg (5 x 10^{-3} Torr) ultimate vacuum. Quiet—75 decibels ("A" Scale) 3" from pump. Safe—no external moving parts.

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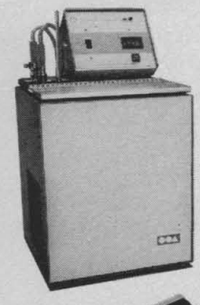

New Temptrol Model 254

Dual-purpose bath and circulating system saves time with new direct dial temperature control that you can set and forget. Operating range is −15°C to +150°C. Bath volume is 2¾ gals., pumping capacity 260 GPH, circulates up to 15-foot head.

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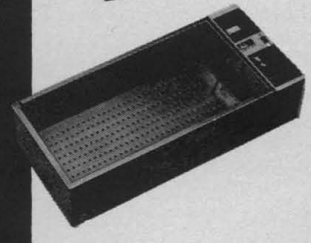

Shaker Baths

Temperature control to ±.03°C and variable oscillation for all types of chemical/biochemical reactions. Latest solid-state technology — automatic 37°C set button. Accommodates any combination of glassware. Gassing hoods, cooling coils available. Guaranteed 5 years or 50 million oscillations.

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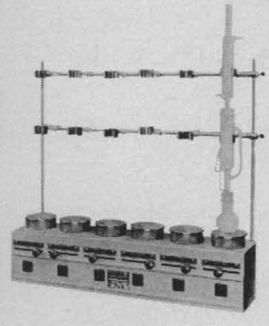

Extraction Racks

Six-unit and two-unit models, 300-watt individually controlled heaters, temperature range—390° to 775°F. Complete with support rods and clamps. In applications requiring the dichromate oxygen demand (COD) test, their 300-watt heaters are ideal.

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Thelco® Ovens and Incubators

Reliability and uniformity have kept Thelco the leading name in constant temperature equipment for 50 years. Mechanical or gravity convection and vacuum models for every need. Our published thermocouple performance tests of uniformity are guaranteed.

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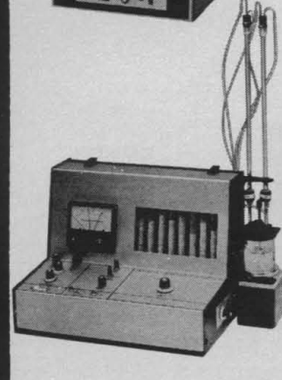

Auto-Aquatrator®

Performs KF titrations automatically. Auto-Aquatrator handles any organic or inorganic giving quick, accurate and consistent results reproducible to ±0.025 ml. of titrant. Non-automatic Aquatrator® offers same accuracy—plus economy.

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Thelco® Baths

Gravity convection gives gentle mixing and long service—no moving parts to wear out. Temperatures from ambient to 100°C with uniformity an excellent ±0.3° or better at 56°C. Six different models available.

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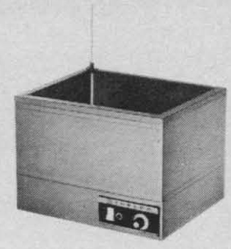

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The VacTorr line is your source for all your vacuum equipment—quiet mechanical pumps, diffusion pumps, fittings, gauges, traps, pumping station and associated system elements, supplies and accessories.

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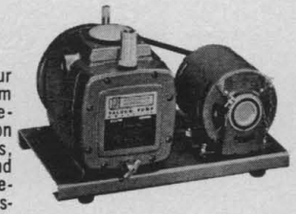

Problem Solvers

Freas® Low Temp Incubators/BOD Cabinets

Great capacity—full 17 cu. ft. Solid-state controls — utmost dependability. Wide temperature range—from −10°C to 50°C. Uniformity—a precise ±0.3° at 20°C. Models available for photosynthesis and diurnal simulation.

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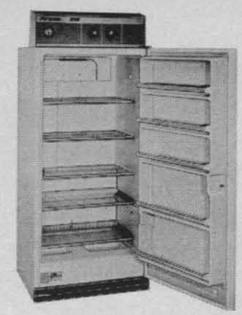

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You name it . . . Precision's got it! A complete line with the right clamp for every laboratory need. Also unique Lab-Frames® for sturdy, versatile set-ups. All constructed of PS Alloy® for strength, durability and corrosion resistance.

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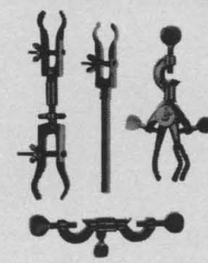

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Sturdy, adjustable platform for heavy flasks, hot plates, heating mantles, baths or complicated glassware set-ups . . . precisely controlled lifting up to 100 lbs. Little Jack is designed for micro and semi-micro work.

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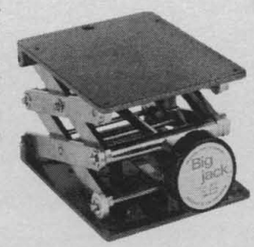

Lab Apparatus Catalog

Get your copy of the complete GCA/Precision Scientific Laboratory Apparatus Catalog. It's a hard cover book with 260 pages of detailed information, illustrations and prices of over 1200 items. To get a free copy, use Reader Service Card or write.

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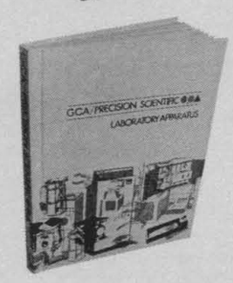

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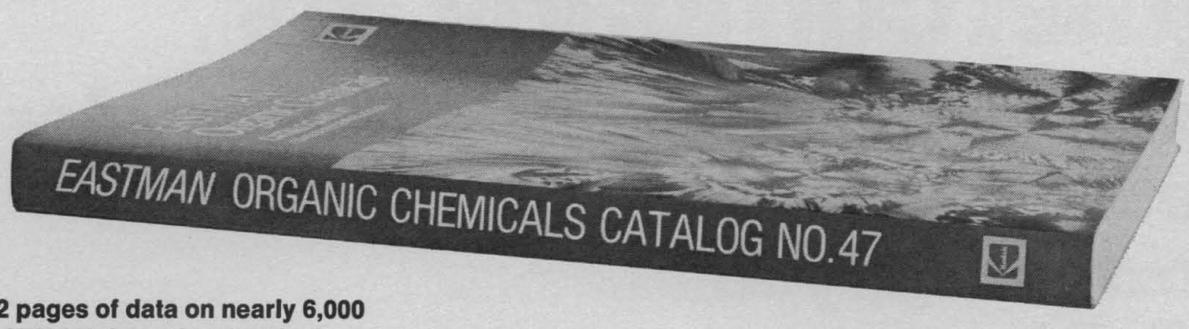
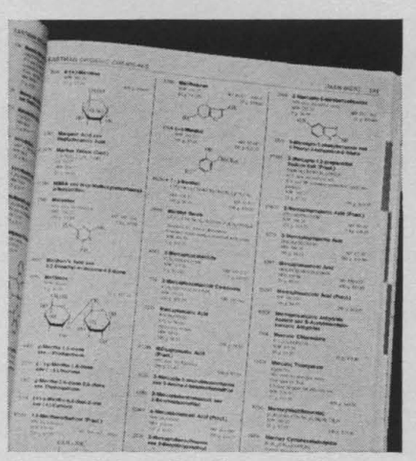
Eastman Organic Chemicals News

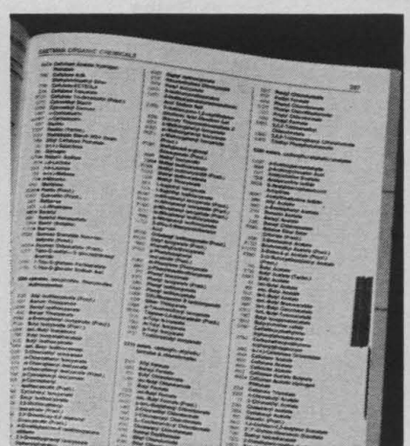
THE NEW *EASTMAN* ORGANIC CHEMICALS CATALOG, NUMBER 47.



332 pages of data on nearly 6,000 EASTMAN Organic Chemicals



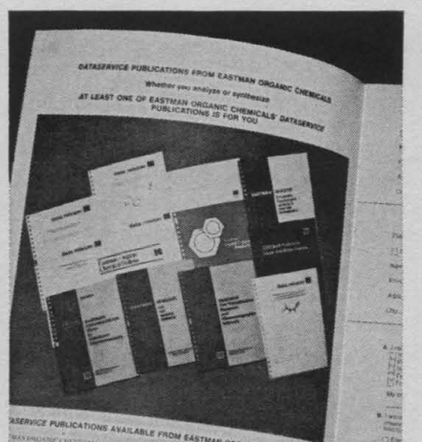
Structural formulas illustrated for more than 1,000 of the chemicals.



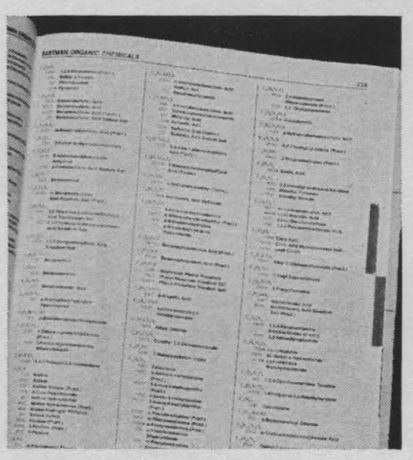
A functional group listing.

Color coding on all pages to help you find what you need fast.

Reader service postcards enabling you to request additional literature, quotes on bulk and custom chemicals, and other information.



Details on the EASTMAN **Dataservice** Publications Program and how you can participate in it.



An empirical formula index.

This new catalog has been sent to everyone on our mailing list. If you don't yet have a copy, we probably don't have your name. To request your own copy, simply return the coupon.

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Kodak

10-65

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* We've been so quiet about our accomplishments, that you probably have never heard of us. We'd like to get to know you.

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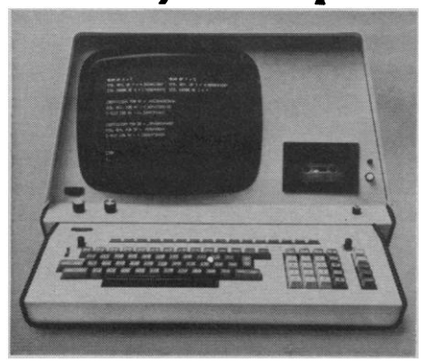
Canadian Marconi Co. AEI Scientific Apparatus Dept. Montreal Que. H3PIY9
AEI Scientific Apparatus, Inc., 500 Executive Blvd., Elmsford, N.Y. 10523

AEI scientific apparatus
A GEC-MARCONI ELECTRONICS COMPANY

What would you do with a Statistics and Number-Crunching Computer that starts at $7,400,* has 16K Hardwired Basic Language and 28 Major Peripherals?



Plenty!

The new Wang System 2200 is a System. It gives you the raw power and the peripherals you must have for a wide range of problem solving. For under $7,500 you get a CPU with 16K bytes of BASIC language instructions hardwired into the electronics . . . plus a 4K operating memory. You also get a big 16 lines (of 64 characters each) CRT display, a console mag tape drive and your choice of either alpha or BASIC Keyword keyboards.

Some Words About Language: The hardwired MOS ROM language in your System 2200 finally ends your dollar tradeoffs . . . economy systems that are costly to program or very expensive systems that are relatively easy to program. Many, if not most, of your people already know BASIC. They'll be solving problems the day your system is delivered (and, we can deliver in about two weeks). Most of your budget will go into problem solving; not system support.

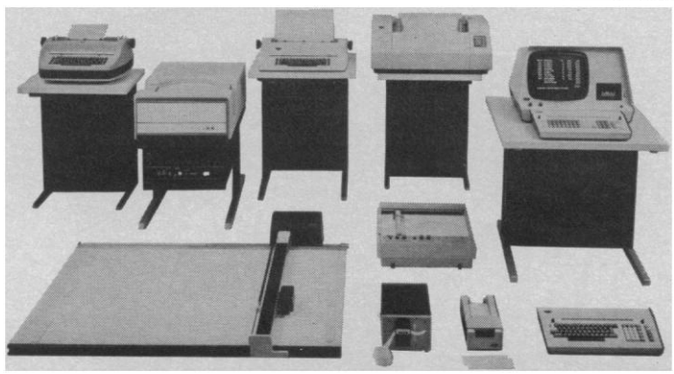
Try To Out-Grow It: Main memory is field expandable in 4K increments (at $1,600 per 4K). Up to 32K. You can choose from three kinds (and 7 price ranges) of printers . . . one even has a stepping motor for very precise 4-quadrant incremental plotting. Speaking of plots, we have a new, very large flatbed (31" × 48") for only $8,000 or a smaller one if you plot small. Both print alphanumerics and plot under full program control. Been appalled lately by disk prices? Starting at just $4,500, we offer you our new "floppy" disk in single, double and triple disk configurations (.25, .50 and .75 MB's). For big disk power, you can have 1, 2 or 5 megabyte fixed/removable disk systems. All peripherals, including punched or mark sense hopper card readers, paper tape readers and on- line BCD or ASCII controllers are easily added-on in the field so your System 2200 will grow with your needs.

The Wise Terminal: If you are now or may soon be getting into terminals, we have several new products that will instantly upgrade your System 2200 for telecommunications with any other System 2200 or a mainframe computer. And, you still have a powerful stand-alone system. Another approach, of course, is to justify it as a powerful terminal and get a "free" stand-alone computer. Wise?

We Do A Lot For You: System 2200 is backed by over 250 factory-trained Wang Service Technicians in 105 U.S. cities. Naturally, we guarantee or warranty everything you buy from us. If you want, there are free programming/operating schools here in Tewksbury, Massachusetts, almost every week. We have a growing program library on a wide range of statistics and math/science applications. Our user group (with the unlikely name of "SWAP") could help you cut programming costs even further. We do a lot for you.

* All prices U.S. List. If you're the entrepreneur type, we've just announced a new 7-module Basic Accounting System software package for the business end of your business like payroll, invoicing, inventory, receivables and some really fancy management reports.

WANG



Even if you call the Wang System 2200 a small system . . . you have to admit it's a big idea. S-10

☐ Please send literature

☐ Please have your representative phone me:_____

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Whether you make photomicrographs, CRT recordings or just quick photos for record purposes, Polaroid's Type 105 Land film will back up your equipment with a kind of flexibility you've never had before.

With Type 105 you get an instant photograph with superb tonal gradation and sharp detail, ready for immediate use. And you also get an instant professional-quality negative.

Without a trip to the darkroom.

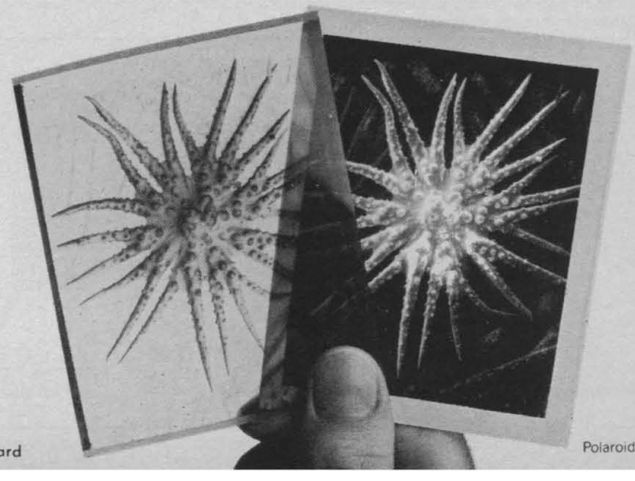
After a simple clearing and washing of the negative, you can make as many copies and enlargements as you need.

Type 105 comes in a 3¼ x 4¼ inch film pack that fits any instrument or camera that accepts a Polaroid pack film back. And with our Model 405 pack film holder our film can be used with most 4 x 5 inch cameras and instruments. In addition, pack film is economical and easy to use. And since it develops outside the camera, you don't have to waste time between shots. Speed is a convenient 75 ASA.

With our 105 you know what you've got when you've got it. And thanks to the instant negative, you can get as many copies and enlargements as you want when you want them.

See your photo dealer for more details.

Polaroid Type 105 positive/negative film.



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Nikon is involved.

These two members of the class of 1974 have their eyes on the future. Their goal is a career in medicine. Both are determined to make their lives count by serving the health care needs of others.

Nikon makes microscopes that they will use during medical school, internship and afterwards.

The Nikon CL Classic, known as the "student microscope," is a rugged model with a reasonable price tag. Stands up under constant use day after day, year after year.

The Kt Compact laboratory microscope features an in base transformer, Koehler-type illumination, and continuously variable light intensity control.

Both microscopes are representative of the high quality one expects from Nikon. Just as both graduates represent the high ideals of those who enter the medical profession.

Whenever circumstances require the finest teaching aids...Nikon is involved.

Nikon Instrument Group, Ehrenreich Photo-Optical Industries Inc.,
623 Stewart Avenue, Garden City, New York 11530 (516) 248-5200

Extending man's vision in education.

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TRI-CARB®

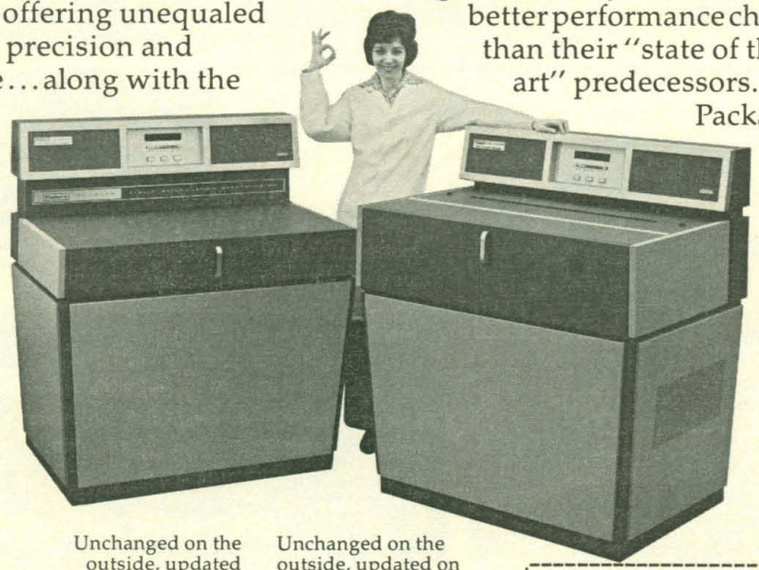
LIQUID SCINTILLATION

HOW WE'VE MADE SOMETHING VERY GOOD EVEN BETTER!

Packard introduced the world's first Tri-Carb Spectrometer System over twenty years ago. And ever since, we've been continually refining such systems to better meet the continually expanding needs of liquid scintillation counting.

Take our 2425 and 2450 Tri-Carbs for example. When they were introduced, both systems represented a major advance in liquid scintillation counting by offering unequaled total-system precision and performance... along with the unique, unmatched operating simplicity and convenience of SERVO-TRAY® sample handling (each individual 50-vial tray can be used and programmed for a separate assay by as many as 9 individual users).

Now, we've done it again. The current versions of the 2425 and 2450 may look unchanged on the outside, but they incorporate a series of development advances on the inside which give these second generation systems even better performance characteristics than their "state of the art" predecessors. Again, Packard leads the way in liquid scintillation counting.



Unchanged on the outside, updated on the inside: The 150-sample capacity Model 2425 Tri-Carb/**Request Bulletin 1117.**

Unchanged on the outside, updated on the inside: The 450-sample capacity Model 2450 Tri-Carb/ **Request Bulletin 1177.**

Please send information on:

- ☐ Model 2425 Tri-Carb (150 sample)
- ☐ Model 2450 Tri-Carb (450 sample)

*Name*_____

*Title*_____

*Institution*_____

*Address*_____

*City*_____

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Packard

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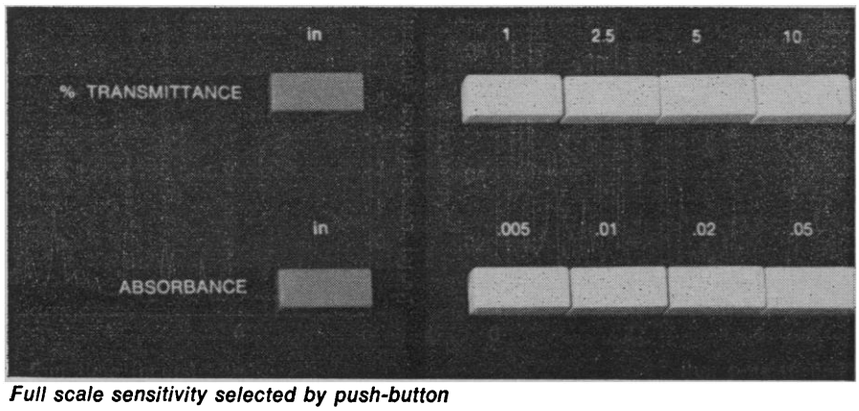
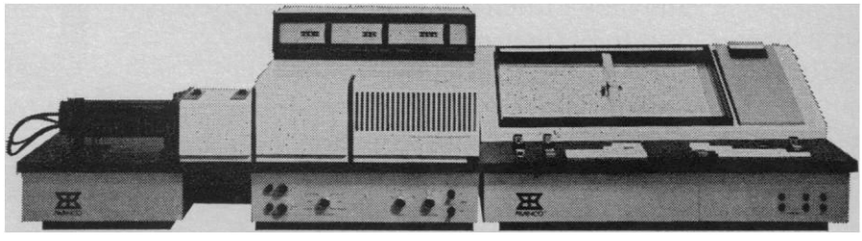
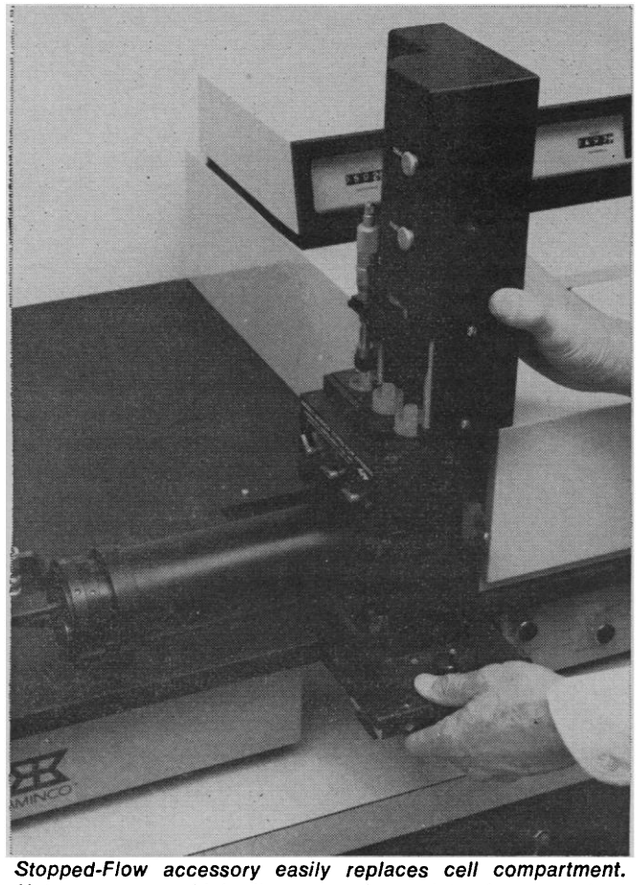


Full scale sensitivity selected by push-button

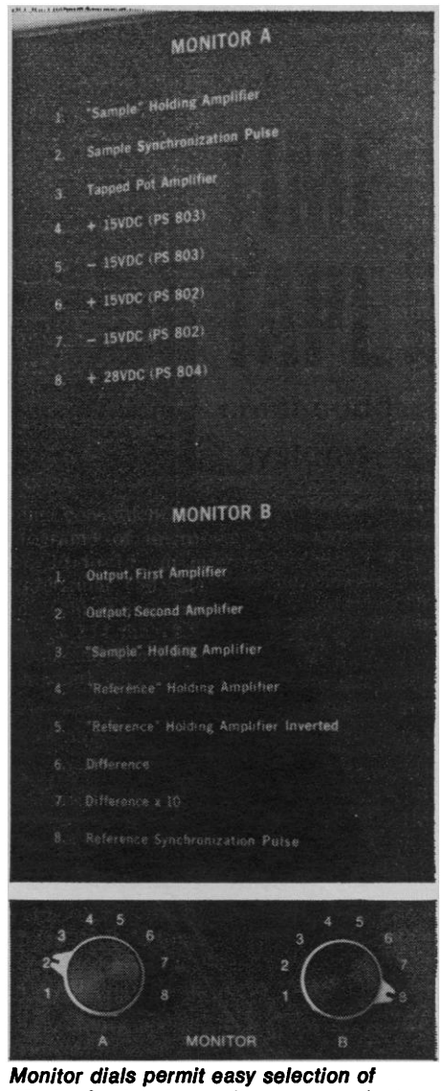
Take a close look at the DW-2™

UV-VIS Spectrophotometer



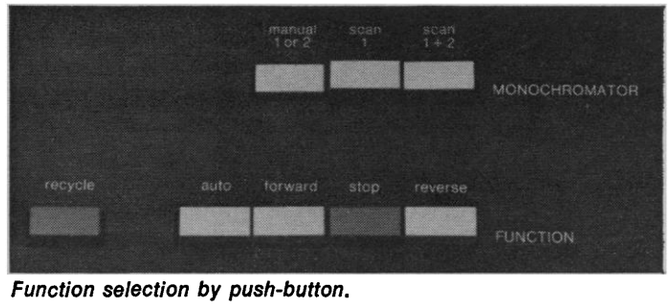


Stopped-Flow accessory easily replaces cell compartment. Note open area which allows use of a variety of accessories.



Monitor dials permit easy selection of 16 checkpoints for oscilloscope readout.

AMINCO®



Function selection by push-button.

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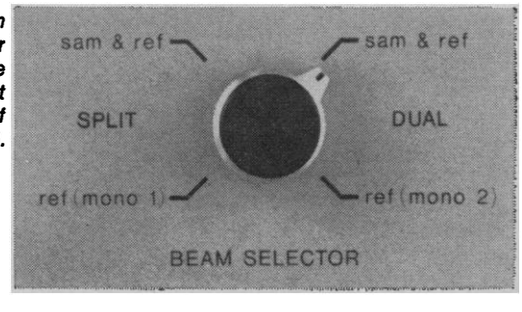

Science and Man in the Americas Audiotapes

For two weeks last summer (June 20-July 4, 1973) a significant international scientific meeting took place in Mexico City. "Science and Man in the Americas" was attended by more than 5000 scientists, engineers, government officials, representatives of business and industry, science journalists, students, educators and laymen from scores of countries. They deliberated a wide range of topics central to the future development and well-being of the Western hemisphere. The meeting, co-sponsored by AAAS and the Consejo Nacional de Ciencia y Tecnologia of Mexico, was created in the belief that science is of overriding importance in the world today and that, being universal, it transcends national boundaries. Here now, captured on audiotape, are many of the most compelling sessions, available for listening, study, and reflection in your home, library, laboratory, automobile. Another service of the AAAS. (Simultaneous translations accompany portions of symposia where necessary.)

148M-73

NON-NUCLEAR ENERGY FOR DEVELOPMENT: Arranged by Edmundo de Alba and J. Frederick Weinhold.

Session I ☐ **The World's Energy Situation:** David Freeman, Jean C. Leclercq

Session II ☐ **Energy in the Americas:** J. Frederick Weinhold, Fernando Hiriart, Gordon McNabb, Guillermo O. Zubaran, et al.

Session III ☐ **Energy for Rural Communities:** Francisco Monteverde, Thomas Venables, J. Neal Thompson.

Session IV ☐ **Wind and Solar Energy:** Edmundo de Alba, Julio Hirschmann, Peter Glaser, Robert Axtmann, et al.

Session V ☐ **Geothermal Power:** Federico Mooser, Robert Decker, Richard Stoiber.

Session VI ☐ **Relationship Between Environmental Protection and Energy:** Juan Eibenschutz, Miguel Angel Garcia Lara, et al.

149M-73

EARTHQUAKE AND EARTHQUAKE ENGINEERING: Arranged by Don Tocher and Enrique del Valle C.

Session I ☐ **The 1972 Managua Earthquake:** Emilio Rosenblueth, R. B. Matthiesen, John A. Blume, Enrique del Valle C., et al.

Session II ☐ **Seismicity:** Alan Davenport, Luis Esteva, Donald E. Hudson, William Milne, and Jose Grases.

Session III ☐ **Earthquake Engineering:** Julio Kuroiwa, Joseph Penzien, Jorge Prince, Patrico Ruiz, Roberto Meli, et al.

Session IV ☐ **Seismic Intensity and Smooth Spectra, Zoning and Structural Design:** Enrique del Valle C., R. B. Matthiesen, Arturo Arias, et al.

151M-73

CIVILIZATION'S FUTURE: WAS MALTHUS CORRECT?

Session I ☐ Lecture by Norman E. Borlaug

152M-73

THE SEA AND ITS RESOURCES: Arranged by Agustín Ayala-Castañares, and Arthur E. Maxwell

Session I ☐ **Introduction, Coastal Zone Resources, Ocean Effects and their Management:** Harris B. Stewart, Jr., Bostwick H. Ketchum, and Julian Adem.

Session II ☐ **Resources of the Sea:** Robert R. Lankford, Martha Vannucci, and Warren S. Wooster.

Session III ☐ **Coastal Resources:** Bostwick H. Ketchum, Hermann Ugarte, Richard G. Bader, Robert Warren, et al.

Session IV ☐ **Ocean Effects on Weather and Climate:** Julian Adem, Donald Gilman, R. Simpson, J. Kuettner, Jay S. Winston, and Kirk Bryan.

Session V ☐ **Non-Renewable Resources:** Robert R. Lankford, Fred B. Phleger, Alberto G. Lonardi, John P. Albers, Melvin Peterson, et al.

Session VI ☐ **Living Resources:** Martha Vannucci, Mario Ruivo, Paul E. LaViolette, James Joseph, A. Novak, et al.

Session VII ☐ **Ocean Affairs:** Warren S. Wooster, John A. Knauss, Jorge A. Vargas, Harris B. Stewart, Geoffrey Kesteven, et al.

153M-73

THE IMPORTANCE OF EDUCATION IN DEVELOPMENT: Arranged by Albert V. Baez and Guillermo Massieu.

Session I ☐ **Educational Technology:** Alfonso Ocampo Londono, Albert V. Baez, Sam Castleberry, Joseph Lagowski, et al.

Session II ☐ **Laboratory Materials and Teaching Aids:** Nahum Joel, Ernst Hamburger, Rafael Ferreyra, Thomas Taylor, David Lockard, et al.

Session III ☐ **Motivation and Learning Processes:** David Ehrenfreund, Mary Budd Rowe, Felix Morales, Claudio Dib, et al.

Session V ☐ **Toward Qualitative Educational Planning:** Don Adams, Manual Bravo Jimenez, Hernan Vera, William Platt, Douglas Wright, Bernard Kaplan, et al.

Session VI ☐ **The Improvement of Teachers Education:** Ernst Hamburger, Nahum Joel, Carlos Gomez, Olac Fuentes, Luis S. Capurro, et al.

154M-73

DESERTS AND ARIDS LANDS: Arranged by Harold E. Dregne and Fernando Medellín Leal.

Session I ☐ **Planning Problems and Dilemmas in the Development of Arid Zones:** Fernando Medellín Leal, Enrique Beltran, and Thomas Maddock, Jr.

Session II ☐ **Solar Energy in Arid Lands:** Hector Ruiz Elias, Gustavo del Castillo, Adam B. Meinel, Marjorie P. Meinel, Edward F. Haase, et al.

Session III ☐ **Water Use Efficiency in Arid Regions:** Terah L. Smiley, Jose Lizarrage Reyes, Ronald F. Probstein, Hasan Qashu, Lloyd E. Myers, et al.

Session IV ☐ **Educational and Cultural Needs of Desert Zone Inhabitants:** Richard B. Woodbury, Patricio Dreckman, Everett D. Edington, Theodore Downing, Marion F. Baumgardner, Carl N. Hodges, et al.

Session V ☐ **Storage and Retrieval of Arid Zone Data:** Dean F. Peterson, Antonio J. Prego, Patricia Paylore, Guadalupe Carrion, et al.

157M-73

SCIENCE, TECHNOLOGY, AND DEVELOPMENT: A NEW WORLD OUTLOOK:

Session I ☐ **A lecture by Glenn T. Seaborg.**

159M-73

THE EARTH SCIENCES IN WORLD DEVELOPMENT: Arranged by Guillermo P. Salas and Earl Ingerson.

Session I ☐ **Earth Sciences and Energy and Environmental Problems:** Charles F. Park, P. T. Flawn, P. S. Stepanicic, Eduardo J. Guzman, et al.

Session II ☐ **Geologic Research, Exploration and Development in Mexico, Central and South America:** Diego A. Cordoba M., Carlos Ruiz Fuller, and Enrique Levy.

Session III ☐ **Application of Earth Sciences in the Development of Civilization:** Charles F. Park, P. T. Flawn, Eduardo J. Guzman, et al.

Session IV ☐ **Interrelations of the Sciences in the Solution of Socio-Economic Problems:** Guillermo P. Salas, Earl Ingerson, Charles F. Park, et al.

160M-73

SCIENCE, DEVELOPMENT AND HUMAN VALUES: Arranged by Harrison Brown and Victor L. Urquidi.

Session I ☐ **Where Have the Rich Nations Gone Wrong? Where Have the Poor Nations Gone Wrong?** Guillermo Massieu, Hollis Chenery, Kenneth E. Boulding, et al.

Session II ☐ **Knowledge and Development in Latin America:** Renee C. Fox, Carlos A. Mallman, Richard Griego, and Luis Villoro.

Session III ☐ **Research Priorities for Economic Development in Latin America:** Jose Valenzuela, David Ibarra, and Norman Borlaug.

Session IV ☐ **The Value of Science and Technology to Human Welfare:** Luis Manuel Penalver, Gerhard Jacob, George Bugliarello, Joseph B. Platt, et al.

Session VI ☐ **Science, Technology, and Human Values:** Victor Urquidi, Harrison Brown, et al.

161M-73

VIOLENCE AND BEHAVIOR: Arranged by Santiago Genovés and J. P. Scott.

Session I ☐ **Subcultures of Violence and Social Class as Determinants of Interpersonal Violence:** Berenice A. Carrol, Sandra Bell Rokeach, John Saxe-Fernandez, Osvaldo Sunkel, et al.

Session II ☐ **External Dependency Structure and Scientific Development:** Chadwick F. Alger, Marcos Kaplan, Sylvia Wynter Carew, et al.

162M-73

HURRICANES: Arranged by Julián Adem, and Louis J. Battan.

Session I ☐ **New Techniques of Hurricane Observation:** Stanley Rosenthal, Luis Le Moyne, Michael Garstang, Sergio Serra-Castelan, et al.

Session II ☐ **Hurricane Prediction and Modification Techniques:** Pedro Mosino, Robert H. Simpson, Hector Grandoso, Cecil Gentry, et al.

163M-73

TRANSFER OF TECHNOLOGY AND NATIONAL ECONOMIC DEVELOPMENT: Arranged by Jordan J. Baruch and Miguel S. Wionczek.

Session I ☐ **Economic Impact of Technological Change:** Anne Carter, Jorge A. Katz, Jack Baranson, Alejandro Nadal, Alan MacAdams, et al.

Session II ☐ **Social Impact of Current Rate of Technological Change:** Miguel S. Wionczek, Jerome Rotherberg, C. J. Meechan, Edmundo Fuenzalida, et al.

Session III ☐ **Current Vehicles of Technological Trade I:** C. J. Meechan, Robert B. Staubaugh, Ronald Muller, K. D. N. Singh, et al.

Session IV ☐ **Current Vehicles of Technological Trade II:** Mark S. Massel, Luis Soto Krebs, Enrique Aguilar, Luis Figueira Barbosa, et al.

Session V ☐ **Determinants of Technological Policy I:** Francisco R. Sagasti, Manuel Bravo Jimenez, Rodrigo Medellin, Shlomo Argov, Alejandro Nadal, et al.

Session VI ☐ **Determinants of Technological Policy II:** Maximo Halty Carrere, Carlos Bazdresch, Jorge Sabato, Michael Michaelis, et al.

164M-73

APPLICATIONS OF EDUCATIONAL TECHNOLOGY AND NEW METHODS AND EQUIPMENT IN SCIENCE TEACHING: Arranged by Alfonso Bernal Sahagun, Robert Branson, Thomas E. Taylor, et al.

Session III ☐ **Program Development:** Alvaro Galvez y Fuentes, Jay Young, Robert Pecsok, Horacio Gomez Junco, Maria del Carmen Millan, et al.

Session IV ☐ **Television, Wide Territorial Coverage:** Maria del Carmen Millan, Fidel Villarreal, Robert Branson, Isaias Raw, et al.

165M-73

PSYCHODYSLEPTICS AND ADDICTION—MARIHUANA: Arranged by Wallace L. Guess and Oscar Dominguez Vargas.

Session I ☐ **Psychodysleptics, the Botany, Chemistry and Pharmacology of Narcotic Drugs and Marihuana:** Maynard V. Quimby, Carlton E. Turner, Solomon H. Snyder, Harold T. Conrad, Richard B. Resnick, et al.

167M-73

EDUCATIONAL PLANNING: Arranged by Don Adams and Manuel Bravo Jiménez.

Session I ☐ **Quantitative Aspects of Educational Planning:** Juan Chong, Cicily Watson, Jose Antonio Carranza, Hector Correa, et al.

Session II ☐ **Implementing Educational Change:** Guy Benveniste, Jaime Castrejon Diez, Paul Watson, Antonia Ramos, et al.

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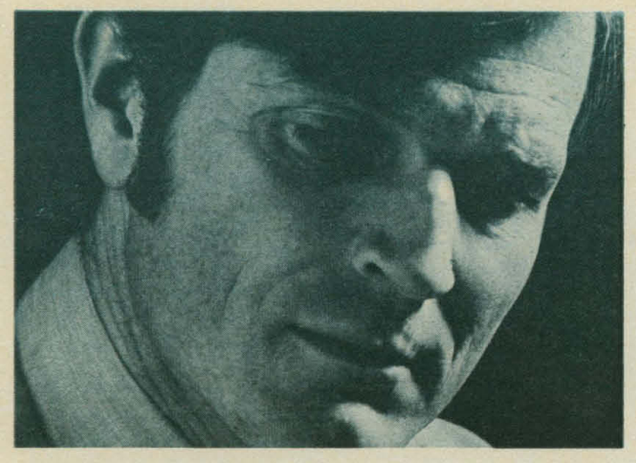

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	$70,000 SEM	$50,000 SEM	$35,000 SEM
10′ x 10′ (100 sq. ft.) room @ 60¢ per sq. ft.	$ 720	$ 720	$ 720
Supplies	5,000	5,000	5,000
Typical Direct Personnel cost	30,000	30,000	30,000
Typical Indirect Personnel cost	8,000	8,000	8,000
SEM per year @ 7-year depreciation	10,000	7,143	5,000
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a refractive index equal to one of the indexes of the fibers as an analyzer. They suggested that such a structure was the basis of biological detection of polarized light. The suggestion seems plausible. Has it been confirmed or refuted?

N. W. PIRIE

Rothamsted Experimental Station, Harpenden, Hertfordshire, England, AL5 2JQ

References

1. A. N. Fankuchen and I. Fankuchen, *Nature (Lond.)* **182**, 1372 (1958).

Aldrin and Dieldrin

In the report (News and Comment, 16 Aug., p. 601) of the suspension of the manufacture of aldrin and its metabolite dieldrin by the Environmental Protection Agency (EPA), it is not mentioned that the EPA will continue to permit the use of these compounds against termites, as a dip for roots and tops of nonfood plants, and against clothes moths under certain circumstances (*1*). As a result of these exemptions, aldrin and dieldrin will in all likelihood continue to be manufactured.

DAVID L. WOOD

Division of Entomology and Parasitology, University of California, Berkeley 94720

References

1. Environmental Protection Agency, "Aldrin and dieldrin may be used for termite control and two other uses" (News Release R-558, EPA Information Section, Washington, D.C., 1974).

Evaluating Acupuncture

It was refreshing to read Clark and Yang's report (7 June, p. 1096) attempting to objectively evaluate a procedure used in acupuncture. Although I have no scientific evidence to support or refute the use of acupuncture as an analgesic, I have had the opportunity of seeing many unfortunate individuals from various parts of the United States who were "treated" with acupuncture for a neural hearing loss, and I have yet to see a change for the better. I might add that such evidence has not slowed down those who benefit financially from the practice of acupuncture for "nerve deafness."

DARRELL E. ROSE

Section of Audiology, Mayo Clinic, Rochester, Minnesota 55901

Clark and Yang suggest that many studies similar to theirs must be done "before it can be concluded that acupunctural analgesia is a myth." No one thinks acupunctural analgesia is a myth any more than many other unknowns, such as the placebo effect, hypnosis, and the workings of some analgesic medications that we cannot explain, are a "myth." They are real, and the only myths are some of the explanations for them. This is an important distinction. Highly useful techniques may remain unused because adequate physiological explanations for them do not exist.

ROGER PEELE

Saint Elizabeths Hospital, National Institute of Mental Health, Washington, D.C. 20032

Success in Graduate School

As a recent graduate in the biological sciences, I read with interest Warren Willingham's "Predicting success in graduate education" (25 Jan., p. 273). However, I believe it is virtually impossible to predict success in graduate education with any reasonable degree of surety. The data in Willingham's Table 2 indicate that no predictor currently employed is a valid indicator of success in graduate education in biology. This is especially true today, when so many seemingly equally qualified students are entering graduate programs, but not all are attaining a degree.

Perhaps the emphasis of graduate schools, in the absence of any predictor that can measure the myriad intangibles that make successful graduate students, should be on developing valid criteria for judging success. I note with dismay the scarcity of data on the use of departmental qualifying examinations as a criteria of success. As Willingham notes, this "could provide the most reliable and valid criteria of subject competence."

A properly constructed examination, consisting of both objective and subjective written and oral portions and prepared by a well-chosen doctoral committee, serves several functions. First, it provides the student with an opportunity to demonstrate the wealth of important factual knowledge he or she possesses. Second, it provides the doctoral committee, if well chosen, an opportunity to evaluate how well the student can integrate and synthesize the

factual and theoretical knowledge of the subject matter. Third, putting the "bits and pieces" from various sources together allows the student to see, perhaps clearly for the first time, that these bits and pieces can be assembled into a coherent whole. Last, a qualifying examination provides the firm factual and theoretical base needed for the student to begin the next phase of his education; demonstrating his or her ability to think independently by conducting independent research, the ultimate goal of graduate education.

Until the test-makers can provide predictors to measure the numerous "unmeasurables" that make certain graduate students successful, perhaps more emphasis should be placed on proper development of qualifying examinations, one of the two most valuable and reliable criteria of success in graduate school.

RONALD LINDAHL

Division of Biological and Medical Research, Argonne National Laboratory, Argonne, Illinois 60439

As chairman of our department's admissions committee, I should like to respond to Willingham's article, to what it says and to what it doesn't say.

My primary reservation about what *is* said concerns the validity studies which provide the basis for Willingham's conclusions. As he tells us, the data in his Tables 1 and 2 are summarized from 43 studies with a variety of sample sizes (20 to 1479 students), done over a 20-year span, in a variety of settings. If there is any reason to assume these studies have comparable results, this reason is not presented to us. And, in fact, the author states, "The studies represented in Table 1 vary widely in quality and scope. Some are based on small samples, making individual correlations unreliable." He concludes, however, that these widely varying studies may be advantageously combined. Perhaps. The idea that the results from two or more studies of dubious value become valid by their combination is not on the face of it a compelling argument. Obviously, if one does not accept the data, one does not accept the conclusion drawn from them.

In that regard, the author proposes an incomplete model of the admissions procedure. Standard test scores, recommendations, background information, transcripts, and the personal interview whenever possible are all used in attempting to evaluate each applicant. The weighting schemes used are complex and not explicitly formulated. They relate to a pattern recognition on the part of the assessor ("A student much like this one did well here"). Moreover, these procedures may be sequential, involving successive screenings of applicants. An analysis of this process would be most interesting, particularly with regard to the impact of political and psychological factors.

More significantly, the attempt to correlate tests scores and "success" measures seems rather misleading. At best, these tests may measure some aspect of a student's potential to comprehend certain material by virtue of his mastery of English or arithmetic skills. They clearly do not measure his motivation, his tenacity, his response to program demands, his response to personal problems, or his response to changes in the employment market. These are factors which bear heavily on the likelihood of student "success." And, it is these things which point out the impossibility of admitting only "successful" students.

Beyond approaching these tasks rationally and with goodwill, and convincing the university bureaucracy not to lose chosen applicants through oversight, I frankly don't know which way to go. How welcome a system that eliminates the need to make painful decisions would be.

MARTIN ROSENZWEIG

Department of Biometrics, Temple University School of Medicine, Philadelphia, Pennsylvania 19140

I find no quarrel with most of the points raised in the two letters concerning my article, but I would note that studies on any given topic usually vary in quality and importance. This is certainly true in the case of research on predicting success in graduate education, although work of "dubious value" was not included in the review. The qualification expressed in my article referred especially to the small samples in some studies. Summarizing a set of correlations that may be individually unstable is a routine procedure for estimating the strength of a relationship. While the authors cited in my article did not study other topics, such as student motivation or the nature of the admissions process, I certainly agree that these are interesting and important problems.

WARREN W. WILLINGHAM

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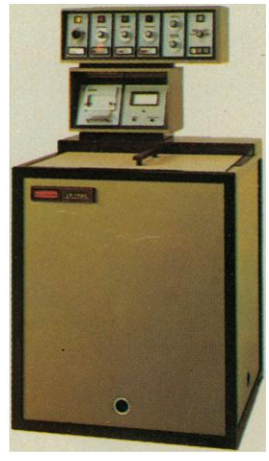

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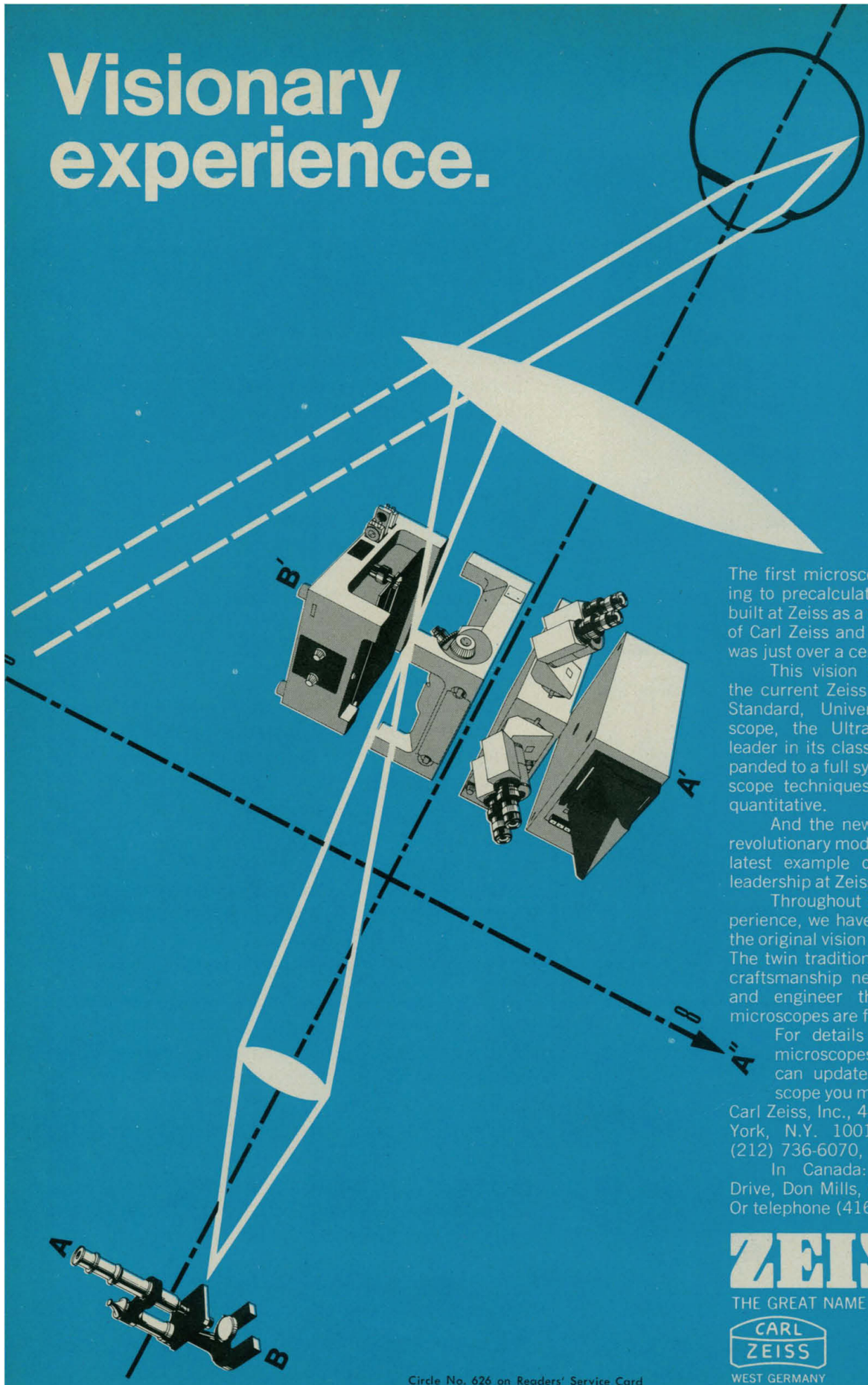

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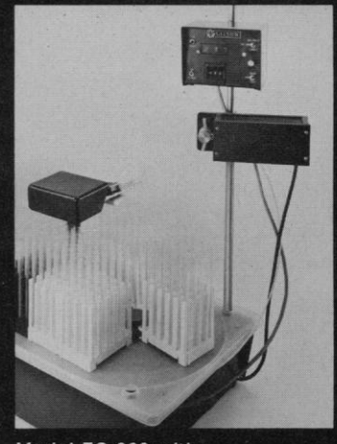

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18 October 1974, Volume 186, Number 4160 **SCIENCE**

Global Effects of Man's Production of Energy

Until recently consumption of energy was expanding rapidly. At the moment the increase is at a slower rate. However, there are great unsatisfied wants in many lands. When it becomes feasible to produce larger amounts of energy the former rate of increases might be resumed and even exceeded. Man now produces energy at the rate of 500×10^{17} calories per year. This represents 1/20,000 of the total energy received by the earth from the sun, 1/5,000 of the total energy received by the earth's land mass. Man was increasing his production of energy by about 5 percent a year; within 200 years, at this rate, he would be producing as much energy as he receives from the sun. Obviously, long before that time man would have to come to terms with global, climatological limits imposed on his production of energy. Although it is difficult to estimate how soon we shall have to adjust the world's energy policies to take this limit into account, it might well be as little as 30 to 50 years.

Unfortunately, the science of climatology is unable to predict the ultimate consequences for the earth's climate of man's production of energy. At what rate of energy production would the ice caps melt? Will the carbon dioxide or dust thrown into the atmosphere by the burning of fossil fuel threaten the stability of the weather system? How does the geography of man's energy production affect weather in various parts of the world?

Some attempts to answer these and similar questions have been made, for example, by computer modeling at the National Center for Atmospheric Research. Not enough is known to place too much confidence in such studies; yet answers to these questions may eventually dominate long-term energy policy. In the absence of such answers, how can we formulate intelligent policy?

Two things should be done. First, climatologists should recognize the profound implications of this question and do the basic research in global modeling, in the dynamics of atmospheric circulation, and in increasing our general understanding of our global climate so that, say 20 years from now, we can base our energy policy on a much sounder understanding of this limit than we now possess.

But this is not enough. The problem of global effects of energy production, like so many long-range environmental problems, is everyone's problem, and therefore no one's problem. I propose, therefore, that an institute (or even institutes) of climatology be set up with a long-term commitment to establishing the global effect of man's production of energy. Such an institute should be assured long-term stability, since the question is a long-range one that simply will not go away. The institute would naturally serve to focus the efforts of smaller groups of climatologists, working on more general, basic aspects of climatology; but the institute itself would also contribute to our general understanding of the dynamics of the world's climate.

I would hope that as part of our newer appreciation of the necessity for truly long-range planning in energy, a strong, long-term effort along the lines I suggest will be launched.—ALVIN M. WEINBERG, *Director, Energy Research and Development Office, Federal Energy Administration, Washington, D.C. 20461*

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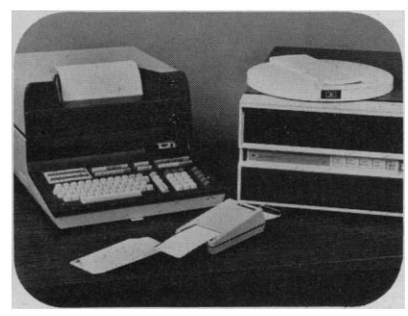

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(Continued from page 256)

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