

8 January 1982 • Vol. 215 • No. 4529

\$2.50

SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



New Microfuge 11 & 12

The Little Centrifuges with Big Centrifuge Features.

Everyone's familiar with Beckman Microfuge™ centrifuges. They're indispensable in research, clinical, and industrial labs for spinning down small samples fast.

Now Beckman offers two advanced Microfuge models with features you'd expect only in larger centrifuges, plus higher speeds, forces, and increased capacity.

The Microfuge 11 holds tubes in slides, like the Microfuge B. But it generates much higher centrifugal forces—up to 11,600 g with a full load of 18 1.5/1.8 mL tubes.

The Microfuge 12 holds even more tubes—up to 60 of the 1.5/1.8 mL size—and spins them at even higher forces—up to 12,200 g. Its color-coded tube holders are also tube racks, and there is a clever holder/rack for decanting 1.5-mL tubes for such applications as RIA: you simply squeeze the sides of the holder together while inverting the tubes.

Both Microfuge 11 & 12 offer variable speed settings with precise speed control: you set the speed you want, and the 11 & 12 run at that speed no matter what the tube load. Both 11 & 12 have imbalance

detection: the motor shuts off if the rotor has been seriously misloaded. And both models have automatic reset timers, a convenience for repetitive runs.

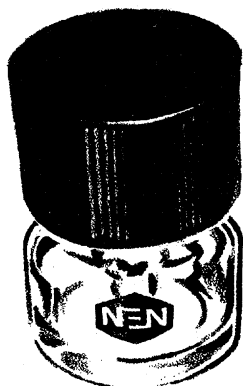
If you're in the market for a microcentrifuge, get one with big centrifuge features. Write for brochure SB-570 to Beckman Instruments, Inc., Spinco Division, 1117 California Avenue, Palo Alto, CA 94304.



Special Offer: As an introductory offer, we'll give you \$200 off the price of a new Microfuge 11 or 12 with trade-in of any Beckman, Eppendorf, or Fisher microcentrifuge, regardless of its condition. Offer limited to one trade-in per new Microfuge 11/12, valid in the U.S. and Canada only; expires June 30, 1981.

BECKMAN

Circle No. 114 on Readers' Service Card

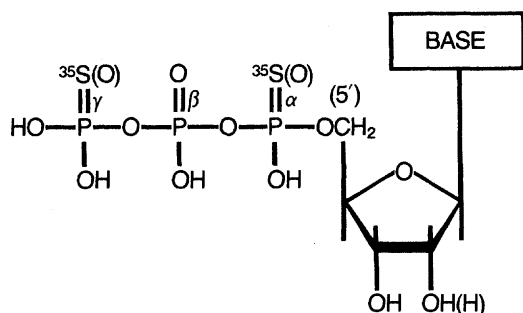


How to break the ^{32}P habit and regain control of your schedule.

^{35}S -Nucleotides ATP $_{\gamma}\text{S}$ GTP $_{\gamma}\text{S}$ dATP $_{\alpha}\text{S}$ ATP $_{\alpha}\text{S}$

The traditional probe for nucleic acid studies has been ^{32}P , one good reason being its high initial specific activity. However, within a short time that advantage dissipates because of ^{32}P 's short half life, and the benefits of using ^{35}S in the first place become very persuasive.

To take advantage of these benefits, NEN has developed ^{35}S -nucleotides for nucleic acid studies. Primarily they introduce versatility and convenience compared to ^{32}P . They also reduce waste and involve the user with less radiation exposure.

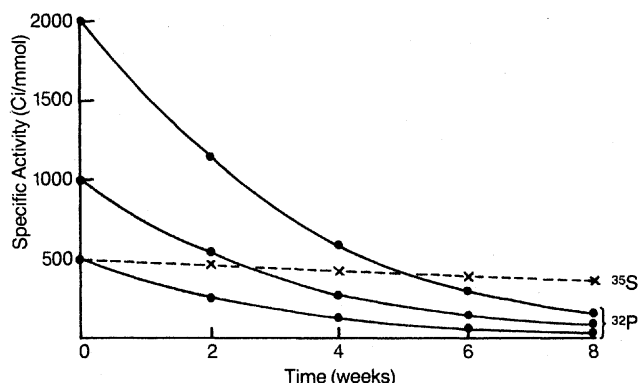


Biological activity—These nucleotides have phosphate replaced by ^{35}S -thiophosphate in the α or γ position. They are biologically active and each may be substituted freely for its natural analog with a variety of enzymes (DNA or RNA polymerase, protein kinase, etc.). However, these compounds and probes prepared from them are resistant to phosphatases and nucleases at the point of thiophosphate substitution, making possible new experiments and techniques.

Longer lived probes—Since ^{35}S has six times the half life of ^{32}P (87 vs. 14 days), you'll need to make your labeled probes much less often, leaving yourself more time for research. Also there'll be less waste and less expense.

High specific activity—All ^{35}S -nucleotides are available from NEN at specific activities approaching 500Ci/mmol. Even more important, the useful specific activity will be maintained longer by nucleic acids and proteins because of ^{35}S 's longer half life (see diagram).

Freedom from production schedules—NEN's ^{35}S -nucleotides are always available from stock. No more planning your work around somebody else's production schedule.



Economy—You'll pay no more for the ^{35}S compounds than for their ^{32}P equivalents. When you count this saving in with the time- and waste-saving advantages described above, you get a powerful argument for making the switch.

Adenosine 5'-(γ -thio) triphosphate, [^{35}S]-

NEG-027H 250-500Ci/mmol

NEG-027 15-60Ci/mmol

Guanosine 5'-(γ -thio) triphosphate, [^{35}S]-

NEG-030H 250-500Ci/mmol

NEG-030 15-60Ci/mmol

Adenosine 5'-(α -thio) triphosphate, [^{35}S]-

NEG-033H 250-500Ci/mmol

Deoxyadenosine 5'-(α -thio) triphosphate, [^{35}S]-

NEG-034H 250-500Ci/mmol

All compounds are shipped in ethanol: 20mM tricine (pH 7.6), 20mM dithiothreitol, 1:1, in dry ice

Free Technical Bulletin

The use of ^{35}S -nucleotide analogs in 5' end labeling, nick translation, and protein kinase studies is described in our technical bulletin, which is yours by circling the readers' service number.

Not for use in humans or clinical diagnosis.



New England Nuclear

549 Albany Street, Boston, Massachusetts 02118
Call toll-free: 800-225-1572 Telex: 94-0996
(In Massachusetts and International: 617-482-9595)

In Europe: NEN Chemicals GmbH, D-6072 Dreieich, W. Germany
Postfach 401240, Tel. (06103) 85034, Telex 4-17993 NEN D

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

SCIENCE

LETTERS	Nuclear Non-Proliferation: <i>E. J. Markey</i> ; Technological Manpower: <i>S. Doniach</i> ; Fetal Alcohol Advisory: <i>R. E. Little</i> ; <i>R. J. Sokol</i> ; Resolution of Phosphorus Chemists: <i>L. D. Quin</i> et al.; Biomedical Research Funding: <i>J. Gross</i>	114
EDITORIAL	Creationism and the Age of the Earth	119
ARTICLES	Catalytic Coal Gasification: An Emerging Technology: <i>R. L. Hirsch</i> et al.	121
	Regional Differences in the Growth of Normal and Neoplastic Cells: <i>R. Auerbach</i> and <i>W. Auerbach</i>	127
	Biological Control in Agroecosystems: <i>S. W. T. Batra</i>	134
	Scientific Exchanges and U.S. National Security: <i>W. D. Carey</i> ; <i>F. Carlucci</i>	139
NEWS AND COMMENT	Where Is the Science in Creation Science?	142
	<i>Briefing</i> : Magazine of the People; Smithsonian Cuts Up Anthropological Film Unit; NSF Finally Gets a Budget for FY 1982; American Scientists Protest Polish Actions	144
	Commerce to Inherit Energy Research	147
	Low Priority for Clinch River	148
	A Star Fades for Entrepreneur Sagan	149
RESEARCH NEWS	High-Resolution Imaging with Soft X-rays	150
	A Metallurgical Tale of Irony	153
BOOK REVIEWS	The Hunters or the Hunted?, reviewed by <i>D. P. Gifford</i> ; The Origins of the Turbojet Revolution, <i>R. P. Hallion</i> ; Solar Flare Magnetohydrodynamics, <i>D. S. Spicer</i> ; Contemporary Microbial Ecology, <i>R. Mitchell</i> ; Paleobotany, Paleocology, and Evolution, <i>K. L. Alvin</i> ; Books Received	154
	Prices of Books	155

BOARD OF DIRECTORS

FREDERICK MOSTELLER
Retiring President, Chairman

D. ALLAN BROMLEY
President

E. MARGARET BURBIDGE
President-Elect

ELOISE E. CLARK
EDWARD E. DAVID, JR.

NANCIE L. GONZALEZ
DAVID A. HAMBURG

CHAIRMEN AND SECRETARIES OF AAAS SECTIONS

MATHEMATICS (A)
Ralph P. Boas
Ronald Graham

PHYSICS (B)
Maurice Goldhaber
Rolf M. Sinclair

CHEMISTRY (C)
Robert W. Parry
William L. Jolly

ASTRONOMY (D)
Owen Gingerich
Donat G. Wentzel

PSYCHOLOGY (J)
George A. Miller
Meredith P. Crawford

SOCIAL, ECONOMIC, AND POLITICAL SCIENCES (K)
James G. March
Gillian Lindt

HISTORY AND PHILOSOPHY OF SCIENCE (L) ENGINEERING (M)
Harry Woolf
Diana L. Hall
Michael Michaelis
Donald E. Marlowe

EDUCATION (Q)
Ann C. Howe
Roger G. Olstad

DENTISTRY (R)
Maynard K. Hine
Harold M. Fullmer

PHARMACEUTICAL SCIENCES (S)
Anthony P. Simonelli
Robert A. Wiley

INFORMATION, COMPUTING, AND COMMUNICATION (T)
George W. Tressel
Madeline M. Henderson

DIVISIONS

ALASKA DIVISION

Vera Alexander
President

T. Neil Davis
Executive Secretary

PACIFIC DIVISION

Robert I. Bowman
President

Alan E. Leviton
Executive Director

SOUTHWESTERN AND ROCKY MOUNTAIN DIVISION

Max P. Dunford
President

M. Michelle Balcomb
Executive Officer

SCIENCE is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. Second-class postage (publication No. 484460) paid at Washington, D.C., and at an additional entry. Now combined with *The Science Monthly* © Copyright © 1981 by the American Association for the Advancement of Science. Domestic individual membership and subscription (51 issues): \$43. Domestic institutional subscription (51 issues): \$80. Foreign postage extra: Canada \$24, other (surface mail) \$27, air-surface via Amsterdam \$55. First class, airmail, school-year, and student rates on request. Single copies \$2 (\$2.50 by mail); back issues \$3 (\$3.50 by mail); classroom rates on request. **Change of address**: allow 6 weeks, giving old and new addresses and seven-digit account number. **Postmaster**: Send Form 3579 to *Science*, 1515 Massachusetts Avenue, NW, Washington, D.C. 20005. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.

REPORTS	Carbon-14 Dates at Grande Pile: Correlation of Land and Sea Chronologies: <i>G. M. Woillard and W. G. Mook</i>	159
	The Coalescence of Two East Australian Current Warm-Core Eddies: <i>G. R. Cresswell</i>	161
	The Chloride Cell: Definitive Identification as the Salt-Secretory Cell in Teleosts: <i>J. K. Foskett and C. Scheffey</i>	164
	Liposomes as Gene Carriers: Efficient Transformation of Mouse L Cells by Thymidine Kinase Gene: <i>M. Schaefer-Ridder, Y. Wang, P. H. Hofschneider</i>	166
	Group B Erythrocytes Enzymatically Converted to Group O Survive Normally in A, B, and O Individuals: <i>J. Goldstein et al.</i>	168
	Luteal Phase Defects Induced by an Agonist of Luteinizing Hormone-Releasing Factor: A Model for Fertility Control: <i>K. L. Sheehan, R. F. Casper, S. S. C. Yen</i>	170
	Actin Distribution Patterns in the Mouse Neural Tube During Neurulation: <i>T. W. Sadler et al.</i>	172
	Wound Tissue Can Utilize a Polymeric Template to Synthesize a Functional Extension of Skin: <i>I. V. Yannas et al.</i>	174
	Tumor Metastasis Is Not Due to Adaptation of Cells to a New Organ Environment: <i>G. L. Nicolson and S. E. Custead</i>	176
	Stereoisomers of <i>N</i> -Allylnormetazocine: Phencyclidine-Like Behavioral Effects in Squirrel Monkeys and Rats: <i>K. T. Brady, R. L. Balster, E. L. May</i>	178
	Specific Chromosome Defect Associated with Human Small-Cell Lung Cancer: Deletion 3p(14-23): <i>J. Whang-Peng et al.</i>	181
	Is the Acetylcholine Receptor a Rabies Virus Receptor?: <i>T. L. Lentz et al.</i>	182
	Insulin Stimulates the Phosphorylation of the 95,000-Dalton Subunit of Its Own Receptor: <i>M. Kasuga, F. A. Karlsson, C. R. Kahn</i>	185
	Origin of the Cholecystokinin-Containing Fibers in the Rat Caudatoputamen: <i>D. K. Meyer et al.</i>	187
	Substance P Analog, DiMe-C7: Evidence for Stability in Rat Brain and Prolonged Central Actions: <i>A. S. Eison et al.</i>	188
	Reduced Sympathetic Nervous System Responsivity Associated with the Relaxation Response: <i>J. W. Hoffman et al.</i>	190
	Integrating Visual Information from Successive Fixations: <i>J. Jonides, D. E. Irwin, S. Yantis</i>	192
	How Do We Avoid Confounding the Direction We Are Looking and the Direction We Are Moving?: <i>D. Regan and K. I. Beverley</i>	194
	<i>Technical Comments: Nonsmokers and Cigarette Smoke: A Modified Perception of Risk: F. G. Bock; J. L. Repace and A. H. Lowrey</i>	197

PRODUCTS AND MATERIALS	Radioimmunoassay Counter; Thin-Layer Chromatography Spotter; Electrophoresis Separation System; Human T-Cell Growth Factor; Preparative System for Fast Chemical Reactions; DNA Sequencing Vectors; Hematology Analyzer; Literature	198
-------------------------------	--	-----

ANNA J. HARRISON
WALTER E. MASSEY

RUSSELL W. PETERSON
HARRIET ZUCKERMAN

WILLIAM T. GOLDEN
Treasurer

WILLIAM D. CAREY
Executive Officer

GEOLOGY AND GEOGRAPHY (E)

Jack A. Simon
J. Thomas Dutro, Jr.

MEDICAL SCIENCES (N)

Morton D. Bogdonoff
Leah M. Lowenstein

STATISTICS (U)

Stephen E. Fienberg
Ezra Glaser

BIOLOGICAL SCIENCES (G)

John A. Moore
Walter Chavin

AGRICULTURE (O)

Martin A. Massengale
Coyt T. Wilson

ATMOSPHERIC AND HYDROSPHERIC

SCIENCES (W)
Julius London
Glenn R. Hilst

ANTHROPOLOGY (H)

Alan R. Beals
Priscilla Reining

INDUSTRIAL SCIENCE (P)

John Diebold
Robert L. Stern

GENERAL (X)

Herman Pollack
S. Fred Singer

COVER

Devil's paintbrush or orange hawk-weed (*Hieracium aurantiacum* L.). Originally from alpine and northern Europe, this ornamental composite was imported for gardens. It has invaded meadows and pastures in northeastern North America and northern Japan, where it spreads by wind-borne seeds and runners. The ecology and natural enemies of this weed are being investigated. The syrphid fly shown here benefits from floral nectar, but the apomictic flowers do not require pollination to set seeds. See page 134. [S. W. T. Batra, U.S. Department of Agriculture, Beltsville, Maryland 20705]

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



The Online Information Service that thinks like a chemist... So you can, too!

Chemists think in structures, and that's just how CAS ONLINE searches and displays the information on over 5 million chemical substances stored in its files.

You Search for Structures. Because substances which share structural features frequently share properties of interest as well.

You Search by Structures. Just describe the structural features you want - and search.

You Get Structures Back. Easy-to-evaluate structure diagrams can be printed online at your terminal or offline by CAS and mailed to you. Send for your free brochure, "The Structure is Your Key," by writing CAS ONLINE - OAS, P.O. Box 3012, Columbus, Ohio 43210.

CAS ONLINE™

The Chemical Substance
Search and Display System From
Chemical Abstracts Service

A division of the American Chemical Society.

© 1981 by the American Chemical Society

Accuracy:
0.1g
Capacity:
4000g
Price:
\$1495.

0.0 g

4000.0g

With a range of 0–4000 g, the Sartorius 1203 Balance meets large capacity requirements for weighing to an accuracy of 0.1 g. At only \$1495, this combination of precision, capacity and fully electronic weighing puts the 1203 in a class by itself.

Other important features include: instant electronic taring memory; large bright 7-segment digital display; reading stability indicator; all-metal balance housing—all these advanced features are part and parcel of the 1203.

At a slight additional cost, the 1203 can be equipped with BCD output to accept Keyboard

Programmers, Data Printers or to connect with Data Processing Equipment.

For lower capacity requirements the Sartorius 1206 (1200g capacity/0.1 g accuracy) at only \$995 or the Dual-Range Sartorius 1213 (300 g/0.01 g and 3000 g/0.1 g) at only \$1595 offer similar exceptional value.

For literature, write Sartorius Balances Division, Brinkmann Instruments, Inc., Subsidiary of Sybron Corporation, Cantiague Rd., Westbury, NY 11590; or call 516/334-7500.

Circle 73 for more information
Circle 74 for demonstration

Those remarkable yellow balances.
sartorius

We appeal to your technical needs.

KODAK Technical Pan Film 2415 helps you record the sun and nearly everything under it.

What do you call a film you can use for solar flare photography, photomicrography, line-scan recording with cathode-ray tubes, lasers, or light-emitting diodes, photographing holographic reconstructions, and also for making black-and-white slides?

We call it KODAK Technical Pan Film 2415. You might call it "a film for all focal lengths," because it has been used rewardingly to record imagery with high-power microscope objectives, astronomical telescopes, and all sorts of camera lenses in between.

This extraordinary film, previously introduced as SO-115, is intended for

a wide range of applications requiring high resolution, extremely fine grain, processing flexibility, high D-max, and relatively flat spectral response through most of the visible spectrum. It is coated on ESTAR-AH Base.

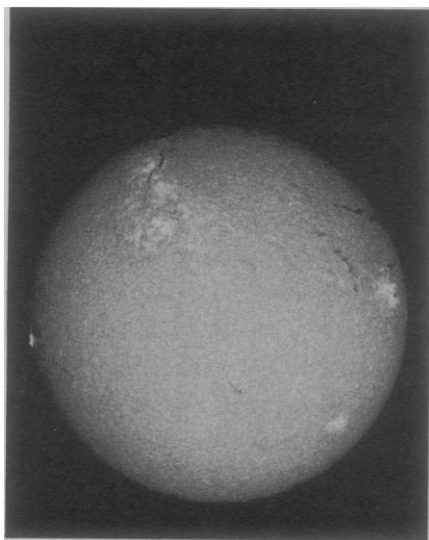
Its unusual combination of performance characteristics allows Technical Pan Film to fill a void in the matrix of black-and-white photorecording films. These characteristics have made 2415 a worthy successor to KODAK Solar Flare Patrol Film (ESTAR-AH Base) SO-392 and KODAK Photomicrography Monochrome Film SO-410—and a valuable alter-

native to KODAK High Contrast Copy Film 5069 in most applications.

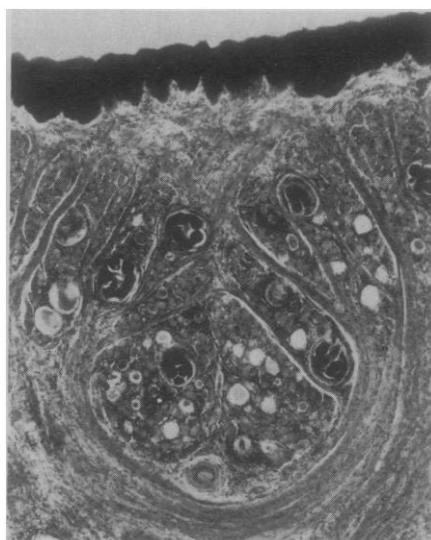
You won't find a Kodak film with a broader range of scientific and technical applications. At the same time, you may wish to load a roll into your 35 mm camera to record some stunning pictorial photography.

For additional information on Technical Pan Film, write to Eastman Kodak Company, Department 412L-153, Rochester, NY 14650. (A brief indication of your application may help us respond more effectively.)

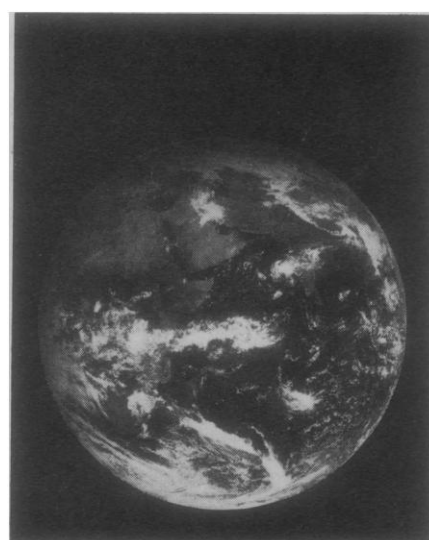
© Eastman Kodak Company, 1981



Hydrogen-alpha photograph of solar flares. Sacramento Peak Observatory. Sunspot, N.M.



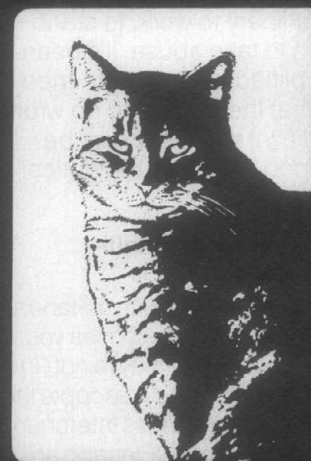
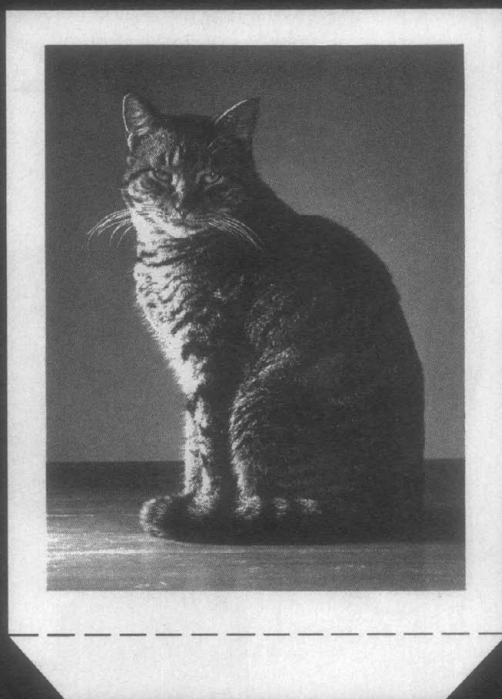
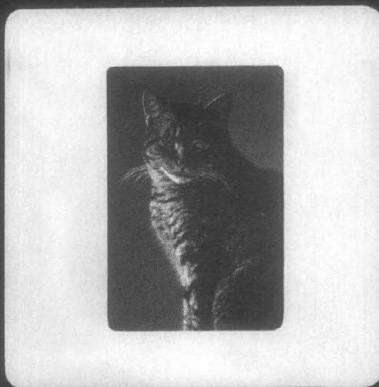
Photomicrograph of *trichinella spiralis* in muscle, 175 $\times$. Tungsten-halogen source (3200 K) with KODAK WRATTEN Filter No. 58.



Meteorological imagery from geostationary satellite. VIZIR laser-beam recording by Société Européenne de Propulsion (France).

**Kodak photographic products.
Capturing the images of science.**





The Bogen Illumitran. More than just another copy cat.

Dupe a slide? Simple.

But crop, flop, enlarge, reduce, increase or decrease contrast, vary shadow coloration or correct color balance, add special effects or titles, create montages or superimpositions, salvage under or over-exposed originals, make inter-negatives, use daylight or tungsten-balanced film?

It's only simple with the Illumitran 3C featuring exclusive contrast control.



With the remarkable Illumitran, your original slide can be duped or used as a starting point for creative enhancement.

Versatile? Flexible? The Illumitran is that and more. Far from the same old copy cat. You might call it the most creative slide duplicator you can own. There's much more that the Illumitran can do for you than we can show you here. Please write for brochure.

Bogen Photo Corp.
100 So. Van Brunt St., P.O. Box 448, Englewood, N.J. 07631.

Please send me
complete information on the
Bogens Illumitran.

Name _____

Address _____

City _____ State _____ Zip _____

SE 1/82

Lester Bogen doesn't sell anything he wouldn't buy himself.

bogen

Circle No. 18 on Readers' Service Card

Worth a second look

Improving with time— the Zeiss Standard.

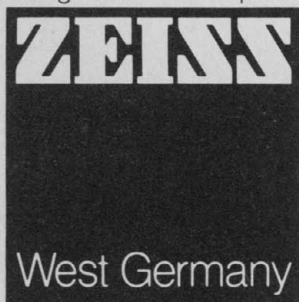
A Zeiss Standard is one thing you can buy that will always get better. It's proven, and has constantly been improved, for thirty years. You can trust the machinery to work, to stand up, even to take abuse. It's been simplified and strengthened, so that there's little to go wrong, and a lot that can't ever be topped—such as the optics!

Compact and small— the most versatile

You can do more with a Standard, because the accessories you need exist *now*; they're not "in preparation." And it accepts the full line of great Zeiss interchangeable optics: put a Planapo on a Standard and it works just as well as when it's on a Universal. Don't take chances—get proven optics, proven engineering, proven worth.

Quality service—Expert dealers.

The great name in optics



First look.

Right from the start you'll be impressed with the time-proven design, the look of quality. Compact. Small. Strong and simple. Constantly improved, proven in use.

Second look.

Look again, and you'll be impressed with its possibilities, how it can grow into a sophisticated research tool with many specialty items and accessories for all known applications.

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

For literature circle reader service number 48
For a demonstration circle reader service number 49

Introducing

THE CENTRIFUGAL FORCE MACHINE



To 110,000 x g (25,000 RPM)

Let's face it. A machine that is used to produce force shouldn't communicate only in terms of RPM. It's somewhat like a car without a speedometer or odometer.

That's why we taught the new MICRO-25 to talk RCF. You simply key in the g-force desired, rotor number, acceleration and deceleration characteristics, run time and temperature. The instrument does the rest. You can even specify the force at any given point in your sample tube. And the continuously displayed $G \times \text{minute}$ parameter gives you a direct readout of the entire centrifugal field applied during the run, enabling straightforward experimental replication.

The MICRO-25's computer and its many operational and computational features are just part of the story. There are significant mechanical innovations as well. Like a speed control system with ± 5 RPM accuracy. And an infrared temperature detector that

enables *rotor* temperature control to $\pm 0.5^\circ\text{C}$.

If you're considering the purchase of a high speed centrifuge, consider a high force machine instead. Send for complete information.

- Up to 50 stored programs ■ Multiple segment program capability for stepped centrifugation
- Continuous display of set and actual run conditions ■ Superior speed control, ± 5 rpm
- Rotor recognition ■ Infrared rotor temperature detector, $\pm 0.5^\circ\text{C}$ control ■ Safety cover interlock system ■ Automatic overspeed protection ■ Delayed start feature ■ Absolute containment



INTERNATIONAL EQUIPMENT COMPANY
A DIVISION OF DAMON

300 Second Ave., Needham Hts., MA 02194

Tel: (617) 449-0800, Telex: 92-2499, INTLEQUIP NEDM.

DAMON/IEC (UK) LTD.,

Unit 7, Lawrence Way, Brewers Hill Road, Dunstable, Bedfordshire, LU6 1BD, England. Tel: (0582) 604660

Circle Reader Service No. 126 for Salesman to call.
Circle Reader Service No. 127 for Literature.

THE SECOND ANNUAL CONGRESS FOR DNA RESEARCH

15-17 FEBRUARY, 1982, LOS ANGELES, CALIFORNIA
THE BILTMORE HOTEL

CO-CHAIRMEN

JOHN D. BAXTER⁽¹⁾, BRIAN J. MCCARTHY⁽²⁾, STEVEN K. NORDEEN⁽¹⁾

(1) University of California, San Francisco; (2) University of California, Irvine

The congress, has been organized jointly by SCHERAGO ASSOCIATES and the journal, DNA and GENETIC ENGINEERING NEWS. (Published by Mary Ann Liebert Publishers, Inc.) Subjects will include:

GENE REARRANGEMENT & DEVELOPMENT
DNA SYNTHESIS
REPETITIVE SEQUENCES AND TRANSPOSONS
GENE TRANSFER, NUCLEAR RNA
TRANSCRIPTION
PLANTS
EXPRESSION OF FOREIGN GENES IN MICRO-ORGANISMS

SPEAKERS (Partial List)

John Baxter

University of California, San Francisco

Marvin Caruthers

University of Colorado

Pierre Chambon

Centre National de la Recherche Scientifique

Gerald Fink

Cornell University

David Goeddel

Genentech

Robert Goldberg

University of California, Los Angeles

Benjamin Hall

University of Washington

Leroy Hood

California Institute of Technology

Timothy Hall

University of Wisconsin

Keiichi Itakura

City of Hope Research Institute

Philip Leder

National Institute of Child Health and Development

Brian McCarthy

University of California, Irvine

Steven Nordeen

University of California, San Francisco

Alex Rich

Massachusetts Institute of Technology

Gordon Ringold

Stanford University School of Medicine

John Shine

Australian National University

Allan Spradling

Carnegie Institute of Washington

Robert Tjian

University of California, Berkeley

Michael Wigler

Cold Spring Harbor Laboratories

Scientists interested in presenting **poster papers** may obtain abstract forms from Steve K. Nordeen, 671 HSE, University of California, San Francisco, CA 94143.

Regular Registration: \$275 (includes Banquet and Subscription to the Journal, DNA

SCI

Student Registration: \$175 (includes Banquet only). Must be verified in writing by Department Head.

Attendance will be limited. Make checks payable to: Scherago Associates, Inc., Recombinant DNA.

☐ Please reserve _____ space(s): Registration fee must be included.

☐ Please send a Registration Application.

☐ Please send Exhibit Information.

Name _____

Dept. _____

Organization _____

Street _____

City _____ State/Country _____ Zip _____

Telephone: () _____

Return to: **DNA, c/o Scherago Associates, Inc.**
1515 Broadway, New York, N.Y. 10036
Tel: (212) 730-1050

The world's leading scientists get it every week and so should you... at ½ price.

Scientists who are leaders in their field and who get to reap the rewards of their achievements are among *Nature's* most eager readers.

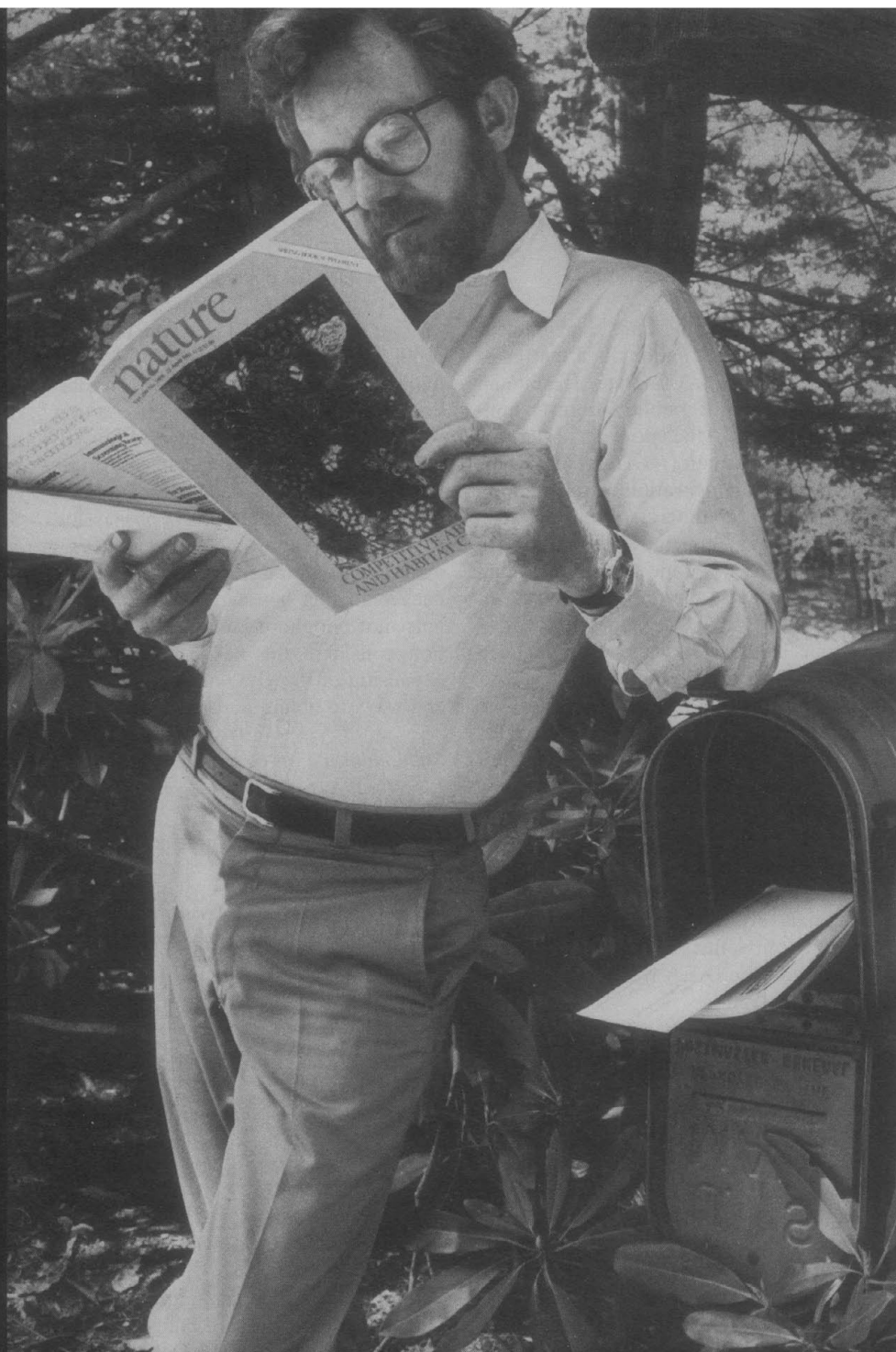
And they are renewing their subscriptions to *Nature* in record numbers.

If, like them, you keep searching for ways to speed up your research, or if you're looking for advancement where you work, or are thinking of moving on to something more stimulating, how can you afford to be without your own personal subscription to *Nature*?

It's the most certain and consistent way to get the research results, news, opinion, and analysis you need, while they're still fresh and can be applied most usefully to your own work.

With your own *Nature*, you'll be well ahead of the monthly journals whose reports often lag a year or more behind ours. And there isn't a science weekly anywhere that covers research developments in as many parts of the world, as fully and authoritatively, as *Nature* does.

The good news is that we've cut *Nature's* personal subscription rate in half and, to top it off, if you subscribe for a full year, we'll send you, free, a copy of *Nature's* new, annual *Directory of Biologicals*. Planned for fall 1981, the *Directory* will be the first



Now: *Nature* at ½ price – plus a bonus book, free

logical products. It will be available only to yearly subscribers (or, for \$45, to buyers of the hardcover version, in bookstores).

A personal subscription to *Nature* has never been more attractive. We urge you to clip and mail the coupon today. For credit-card orders only, **call toll-free now, 24 hrs/day, any day: (800) 824-7888 Ask for Operator 130.**

In California: (800) 852-7777.

Circle No. 39 on Readers' Service Card

SC-10

To: *Nature* 15 East 26th Street,
New York, N.Y. 10010

- ☐ Please send me a year of *Nature* at ½ price, \$99.25, plus my free *Directory of Biologicals*
- ☐ I enclose my personal check
- ☐ Please bill my credit card account

Account No.:

☐ Visa ☐ Master ☐ Amer. Ex. Exp. Date

Name

Address

City

State

Zip

Orders must include personal check or credit card data. Offer good in the U.S. and Canada and is subject to change without notice. In the U.K., send personal check for £42.50, or credit card data, to: *Nature*.



Scientech...The Price/Performance Leader In Electronic Balances

Scientech was first to introduce the beamless electronic balance back in 1968... and the first American company to extend balance capabilities by utilizing microprocessors.

Now Scientech leads again with the introduction of the Series 3300 which sets a new standard for electronic balances in terms of value, accuracy, dependability and ease of use.

There are five models in the series, some with dual ranges. Capacities range from 30g to 5kg with resolutions as fine as 0.001g. All feature instant

electronic tare, digital and analog output, plug-in modular circuit boards for easy field servicing, and Scientech's exclusive circuitry that minimizes "digit flutter."

A universal command keyboard is available to enter and store data for complex conversions, averaging, parts counting and more.

Whatever your field, research, industry, quality control, pharmaceuticals or education, you're sure to find a Scientech balance that will help make you a leader too. Write for our brochure now.

SCIENTECH, INC.

5649 Arapahoe Avenue, Boulder, Colorado 80303 • (303) 444-1361 • TWX 910 940 0994

ZIP BACK THE SACK ON OUR NEWEST ORANGE

Slip a sterile new Corning Cell Wells™ 96 well plate clean from its sack.

You don't need teeth or scissors to open.

Distribute your cell line throughout the 96 wells. Superb for hybridoma/monoclonal antibodies, titrations, toxicity testing, and more.

Every well bottom is on the same plane for quick, accurate microscopic scan. You don't have to readjust constantly.

See how the lid nestles over the plate. Its shape makes certain it only fits one way.

Rings on the lid encircle each well. They collect condensation and keep it from contaminating other wells when you put the lid back on.

Each well on the plate is raised to further reduce contamination from spills seeping into wells nearby.

We letter every rank and number every file boldly on the plate for reference. Between each well is a number and letter to tell you where you are.



Cell Wells 96 well plates, the latest orange. That's disposable labware from Corning.



introducing
CORNING
Cell Wells™
96-well plates

IT'S YOUR PICK.

Get new Cell Wells 96 well plates direct from stock at any Corning Tissue Culture distributor nationwide!

Or, check a box for a sample, **FREE**. Our compliments.



☐ 96 well/
flat bottom/ T.C.

treated/sterile/lid
Corning no. 25860-96



☐ 96 well/
round bottom/ T.C.

treated/sterile/lid
Corning no. 25850-96



☐ 96 well/
round bottom/non-

treated/sterile/no lid
Corning no. 25855-96

Send us this coupon on your letterhead with full mailing instructions.

☐ Please have a Sales Representative call.

Corning Medical and Scientific
Attn: CW MS-21510
Corning Glass Works
Corning, New York 14831

CORNING

For literature circle reader service number 106
For sales representative to call circle reader service number 107

Seeing is believing!

Varian's new UV-Vis-NIR spectrophotometers think, adjust, memorize and calculate for you—in full view.



Never before has spectrophotometry been as easy, produced final answers as fast—or, for that matter, combined ease and speed with such superb quality of your measured results! The new Varian 2200/2300 Series bristles with technical refinement: dual-microprocessor control for unattended operation, a sealed touchkey panel for easy, hassle-free parameter selection, and a CRT screen to display the data and tell you all about the analysis under way. And underneath that technical elegance, you'll still find optics design perfection of Cary renown.

Why do we think the 2200/2300 Series is the last word in UV-Vis-NIR spectrophotometry?

Take operating simplicity: following a cursor on the CRT, you enter the analytical parameters for your analysis and store them for future runs. You may also touch a RAPID key, and a "standard" analysis starts immediately. It couldn't be simpler!

Or, take speed: touch of a key puts the appropriate algorithm into action, and results come back calculated for concentration, kinetics, or signal averaging. To set a wavelength precisely, two touchkeys slew you up or down at the speed of 50 nm/sec in the UV-Vis, 200 nm/sec in the NIR range. Touch another key, and a self-test verifies within seconds that all systems are "go" for peak performance. Zero balance is automatic, too.

As for accuracy, the dual-microprocessor keeps a tight rein on all mechanical and optical functions and "remembers" to make numerous adjustments essential to an accurate photometric measurement. It automatically indexes the chart drive, keeps the baseline flat within 0.0010 Abs, supervises both detectors and sources. The results you get are computed answers you know you can trust.

If operating convenience, analytical speed, and uncompromised measurement accuracy are important in your UV-Vis-NIR work, the new Varian 2200/2300 Series belongs in your laboratory! Circle Reader Service No. 228 for more information; No. 229 to have a Varian representative deliver it in person.



For immediate assistance contact: • Florham Park, NJ (201) 822-3700 • Park Ridge, IL (312) 825-7772 • Houston, TX (713) 783-1800 • Los Altos, CA (415) 968-8141
Or write 611 Hansen Way, Palo Alto, CA 94303. In Europe: Steinhauserstrasse, CH-6300 Zug, Switzerland.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

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

Editorial Board

1982: WILLIAM ESTES, CLEMENT L. MARKERT, JOHN R. PIERCE, BRYANT W. ROSSITER, VERA C. RUBIN, MAXINE F. SINGER, PAUL E. WAGGONER, ALEXANDER ZUCKER

1983: FREDERICK R. BLATTNER, BERNARD F. BURKE, CHARLES L. DRAKE, ARTHUR F. FINDEIS, E. PETER GEIDUSCHEK, GLYNN ISAAC, MILTON RUSSELL, WILLIAM P. SLICHTER, JOHN WOOD

Publisher

WILLIAM D. CAREY
Associate Publisher: ROBERT V. ORMES

Editor

PHILIP H. ABELSON

Editorial Staff

Assistant Managing Editor: JOHN E. RINGLE

Production Editor: ELLEN E. MURPHY

Business Manager: HANS NUSSBAUM

News Editor: BARBARA J. CULLITON

News and Comment: WILLIAM J. BROAD, LUTHER J. CARTER, CONSTANCE HOLDEN, ELIOT MARSHALL, COLIN NORMAN, R. JEFFREY SMITH, MARJORIE SUN, NICHOLAS WADE, JOHN WALSH

Research News: RICHARD A. KERR, GINA BARI KOLATA, ROGER LEWIN, JEAN L. MARX, THOMAS H. MAUGH II, ARTHUR L. ROBINSON, M. MITCHELL WALDROP

Administrative Assistant, News: SCHERRAINE MACK;
Editorial Assistants, News: FANNIE GROOM, CASSANDRA WATTS

Senior Editors: ELEANORE BUTZ, MARY DORFMAN, RUTH KULSTAD

Associate Editors: SYLVIA EBERHART, CAITILIN GORDON, LOIS SCHMITT

Assistant Editors: MARTHA COLLINS, STEPHEN KEPPLER, EDITH MEYERS

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

Letters: CHRISTINE GILBERT

Copy Editor: ISABELLA BOULDIN

Production: NANCY HARTNAGEL, JOHN BAKER; ROSE LOWERY; HOLLY BISHOP, ELEANOR WARNER; JEAN ROCKWOOD, LEAH RYAN, SHARON RYAN, ROBIN WHYTE

Covers, Reprints, and Permissions: GRAYCE FINGER, Editor; GERALDINE CRUMP, CORRINE HARRIS

Guide to Scientific Instruments: RICHARD G. SOMMER
Assistants to the Editors: SUSAN ELLIOTT, DIANE HOLLAND

Membership Recruitment: GWENDOLYN HUDDLE

Member and Subscription Records: ANN RAGLAND
EDITORIAL CORRESPONDENCE: 1515 Massachusetts Ave., NW, Washington, D.C. 20005. Area code 202. General Editorial Office, 467-4350; Book Reviews, 467-4367; Guide to Scientific Instruments, 467-4480; News and Comment, 467-4430; Reprints and Permissions, 467-4483; Research News, 467-4321. Cable: Advancesci, Washington. For "Information for Contributors," write to the editorial office or see page xi, *Science*, 18 December 1981.

BUSINESS CORRESPONDENCE: Area Code 202. Membership and Subscriptions: 467-4417.

Advertising Representatives

Director: EARL J. SCHERAGO

Production Manager: GINA REILLY

Advertising Sales Manager: RICHARD L. CHARLES

Marketing Manager: HERBERT L. BURKLUND

Sales: NEW YORK, N.Y. 10036: Steve Hamburger, 1515 Broadway (212-730-1050); SCOTCH PLAINS, N.J. 07076: C. Richard Callis, 12 Unami Lane (201-889-4873); CHICAGO, ILL. 60611: Jack Ryan, Room 2107, 919 N. Michigan Ave. (312-337-4973); BEVERLY HILLS, CALIF. 90211: Winn Nance, 111 N. La Cienega Blvd. (213-657-2772); DORSET, VT. 05251: Fred W. Dieffenbach, Kent Hill Rd. (802-867-5581).

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

Creationism and the Age of the Earth

For most of the 20th century religion and science in this country have coexisted with relatively little controversy. Scientists did not accept literally the version of beginnings set forth in Genesis, but many were touched with awe when they regarded the order and complexity of nature. They respected the ethical values fostered by organized religion. Some scientists were agnostics but few were atheists. This peaceable relationship has been strained by the people who allege that there is a body of knowledge which they call creation "science" that merits equal treatment with the teaching of evolution in primary and secondary schools.

The creationists also state that the age of the earth is between 6,000 and 10,000 years. In taking this stance they are in conflict with data from astronomy, astrophysics, nuclear physics, geology, geochemistry, and geophysics. In these disciplines an enormous mass of observational and experimental data has been accumulated bearing on the age of the earth and of the universe. Many independent approaches whose results buttress each other are in agreement that the age of the earth is much greater than 10,000 years. Substantial evidence indicates that the age of the solar system is about 4.5 billion years.

In the dating of ancient materials the best values are obtained by radiometric methods. At least five independent radioisotope clocks have been employed. Perhaps the best of these is one that depends on decay of ^{238}U and ^{235}U to the end products ^{206}Pb and ^{207}Pb . By use of this method the ages of rocks 2600 million years old have been determined with a probable error as small as 1 million years. When granitic magma solidifies, zircon crystals (ZrSiO_4) are often formed. The atomic radii of uranium and zirconium are nearly equal, and uranium is usually present in the zircon crystal as a proxy for zirconium in the structure. The radiometric clock starts when the crystal forms. With the passage of time ^{238}U decays to ^{206}Pb and ^{235}U decays to ^{207}Pb . Under favorable conditions both isotopes remain locked in the crystal. Laboratory processing isolates the lead for mass spectrometric determination. In many thousands of instances rocks have been dated by three or more independent clocks and the ages determined have been in good agreement.

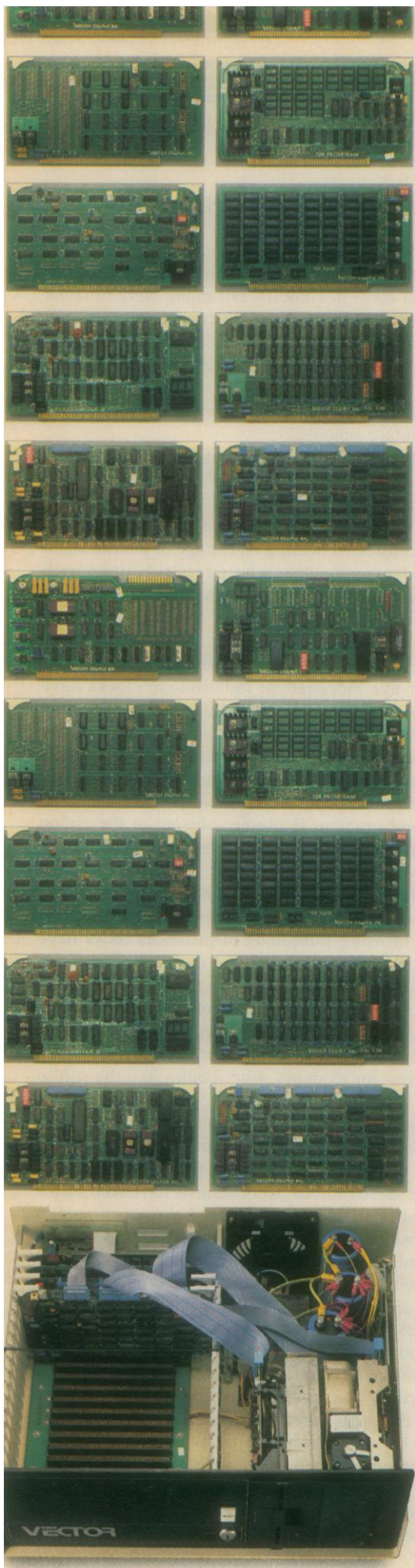
Astronomy and astrophysics have provided a set of distance and time scales that lead to an age for the universe of 10 billion to 20 billion years. This great age is consistent with the times which nuclear physicists calculate are required for stars to evolve—for example, from bodies like the sun to white dwarfs.

Data from geology, geochemistry, and geophysics all testify that the age of the earth is much greater than 10,000 years. For example, geologists have encountered a large number of formations in which the total number of annually deposited layers far exceeds 10,000. Geochemists have studied the decomposition of organic matter to form petroleum. Laboratory studies show that the rate of decomposition is such as to require millions of years to release the hydrocarbons found. Laboratory studies of amino acids found in fossils are also in accord with ages far greater than 1 million years. Geophysicists note that the rate of motion of tectonic plates is such as to require many millions of years for such events as opening of the Atlantic Ocean and raising of high mountains.

The efforts of the tens of thousands of scientists who have produced data relevant to the age of the earth or the universe have been motivated by a search for truth. If the age of the earth were 10,000 years or less, that result would have been proclaimed by many and accepted by all.

In contrast, those who propound creationism have started with a literal interpretation of the Bible. They have no substantial body of experimental data to back their prejudices. Truth is not on their side. In the end their activities must bring only harm to their cause.—PHILIP H. ABELSON

For further reading on creationism see *Science*, 6 November 1981, p. 635; 4 December, p. 1101; 11 December, p. 1224; and 1 January 1982, p. 33; and *Science* 81, December, p. 53.



“We’ve dedicated our lives to science.”

“If you’ve been looking for a highly versatile yet inexpensive way to computerize your scientific or industrial research projects, look no further.

“We are the Vector 2 Series of technical computer systems. And we are solely dedicated to serving your needs when you want an affordable system that can very easily adapt to ever-changing requirements.

“Our designers gave us more modularity than any other systems of our kind. In particular, they gave us a full 18-slot card cage and incorporated two industry standards—the S-100 bus and the CP/M operating system.

“So you can configure and reconfigure us very quickly and easily to be whatever you need us to be. And if you’re on a tight budget, you need this kind of modularity. Simply because it’s the only cost-effective way to go.

“Vector also offers five sophisticated special-purpose boards: a video digitizer, a high resolution graphics board, a precision analog interface, a PROM/RAM board, and a clock/calendar board. Plus there are literally hundreds of high quality S-100 boards available industry-wide that allow you to add virtually any interface or control capabilities you desire.

“Thanks to Vector’s user-oriented approach to system design, we each come equipped with excellent software development tools, including an easy-to-use program editor and debugger. That’s also why we support all the major high-level languages—PASCAL, APL, FORTRAN, COBOL, and BASIC. Because if you’re automating a project, you can’t get your money’s worth if you spend all your time developing software. Of course, if software development is your primary goal, we help you get it done fast.

“To round out our dedication to science and industry, project managers can make excellent use of Vector’s powerful MEMORITE™ word processing and ExecuPlan™ software packages to aid in documentation and in keeping tight control over project costs. After all, to ignore research management is to sharply limit the versatility and cost-effectiveness of any system.

“And to make sure we give you the dependable assistance you’re looking for, we’re supported by a network of 400 dealers world-wide. So when you need help, it’s never far away.

“The Vector 3100 and 3105 both include a CRT terminal and a CPU with a fast 7MHz Z80B® processor, 64K RAM, and an 18-slot chassis. The 3100 has two 630 Kbyte floppy disk drives and costs only \$5795. The 3105—which includes the industry’s first implementation of a 5 Mbyte 5" Winchester hard disk drive plus a single 630 Kbyte floppy—can be yours for as little as \$8495.

“For more information and your local dealer, call us at (805) 499-5831 or (800) 235-3547. In California, call (800) 322-3577. Or write to us at 500 North Ventu Park Road, Thousand Oaks, CA 91320.

“At Vector, we’ve made a science of giving you the ultimate in versatility at a price you can afford.”

VECTOR
Vector Graphic, Inc.

COMPUTERS FOR THE ADVANCEMENT OF SOCIETY.

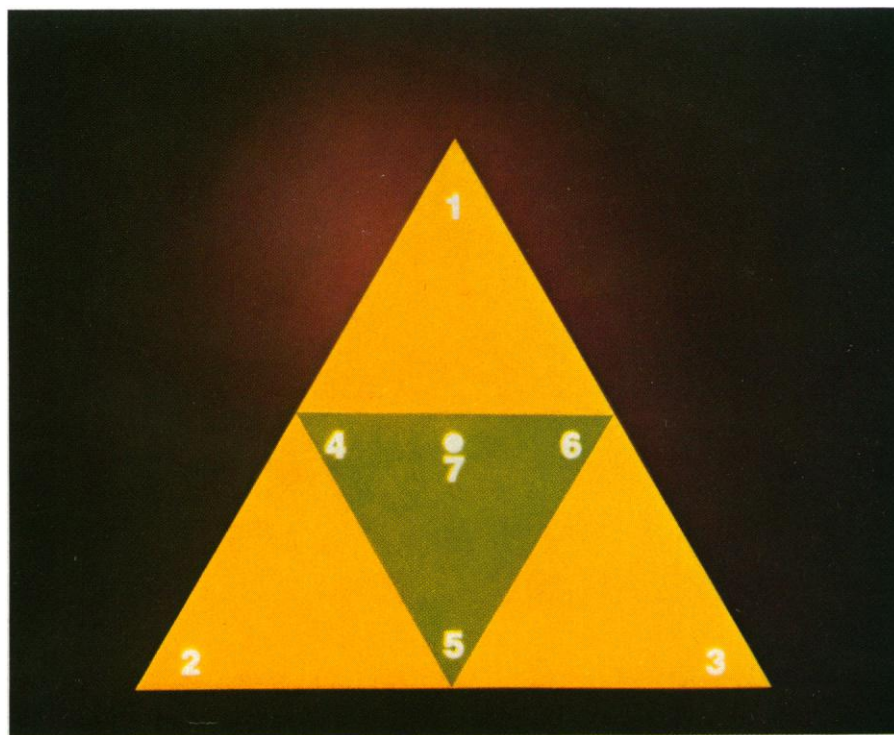
Circle No. 100 on Readers' Service Card

**A glowing new advance for LC
tells you when
your experiment is done.**



DuPont's new 4-solvent, 7-step technique.

Now get LC separations that your



The 4-solvent, 7-step technique can be defined by a triangle. The numbers represent the seven steps, each of which uses varying compositions of two of the solvents. When the seventh step is completed, the separation is done. Solvents are selected with widely differing actions and with water or hexane as a carrier.

DuPont's new 4-solvent, 7-step technique signals a new, more efficient era in liquid chromatography. Not only will your productivity be increased, but results will be more precise, and you will have complete assurance that your experiments are minimized in number. No more gnawing feelings of "just one more run" to get a better separation.

The 4-solvent, 7-step technique is a simple approach to HPLC separations—not a complicated one. Developed in DuPont laboratories by J. J. Kirkland and co-workers, the technique is a proven procedure for methods development routines. By completing the solvent optimization routine with 4 solvents, you arrive at the best possible separation of a mixture. And DuPont has developed a graphics display module that lets you follow visually and control every step of the seven

experiments required by the technique.

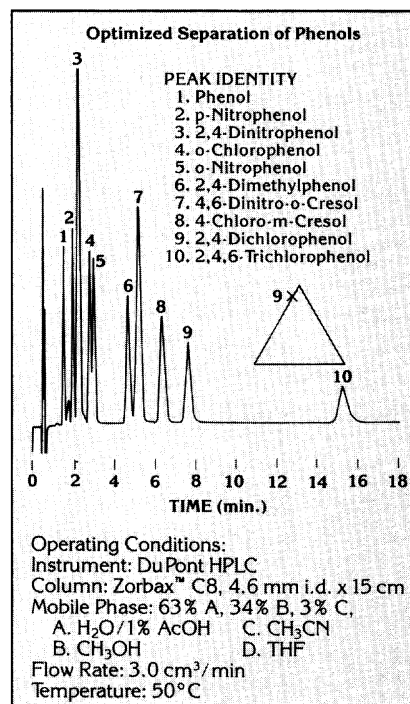
How DuPont Increases Your Productivity

With the 4-solvent, 7-step technique, separation routines that formerly took weeks to develop can now often be completed in a day. When your series of seven experiments is completed and validated, you can introduce the method into quality control, or multigram preparative separation, or purification methods. You have complete assurance that it is statistically valid, optimum and far superior to "just adequate" methods used until now. With the 4-solvent, 7-step technique, you define tightly the parameters of your experiment at the very outset. Time-consuming, repetitive, nonproductive runs that show only incremental improvements are a thing of the past.

See and Control Your Experiment

DuPont's graphics display module gives you a complete visual check on the progress of your experiment. It is a real-time indication of what is happening in the system. The high capacity of the built-in computer lets you review stored methods, modify or display them on the graphics module. At the press of a button, the graphics display converts to tabular form.

The module is another example of DuPont's user-oriented practice of modifying and updating LC equipment by add-on components: your system will not be outmoded, only upgraded. Every design and performance improvement in DuPont HPLC instrumentation, now and in the future, can be used with existing DuPont 8800 systems.



Expand Your LC Capability

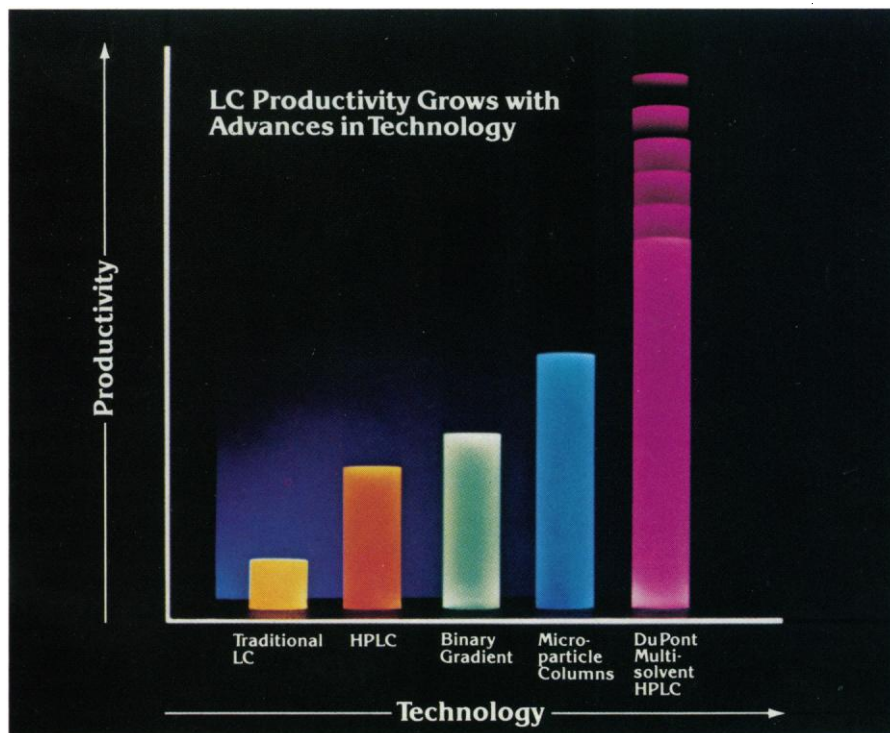
The DuPont Series 8800 is the only commercial HPLC sys-

faster—with assurance method is right.

tem with the pump capability required for 4 solvents. The 8800 series can be used for all traditional HPLC activities as well as for non-routine capabilities: solvent linking—using non-miscible solvents in the same run; concentration-elution runs; preparative runs (up to 40 cm³/min flow); sequential runs of several different separations. With the Series 8800, you can run a total chromatographic experiment—from methods development to collection of pure separated fractions—on the same system, in a sequence that moves smoothly from start to finish.

DuPont: The New Leader in HPLC Technology

DuPont developed the 4-solvent, 7-step technique through its long-term commitment to HPLC: both as a major user of chromatography in its own worldwide laboratories and as the developer



of today's most advanced instrumentation.

The combination of the 4-

solvent, 7-step methodology and powerful capabilities of the Series 8800 will bring new and higher levels of achievement in HPLC technology—limited only by the scope of the chromatographer's imagination.

Compare—and You Will Choose DuPont!

For more information on the 4-solvent technique and how it can be put to work in your laboratory, or for technical discussion, or a demonstration by a DuPont representative, call toll free 800-441-9841. Or write: DuPont, Analytical Instruments Division, Room X39014, Wilmington, DE 19898.

**Please turn the page
for a brief look at
4-solvent, 7-step theory.**



DuPont's graphic display module lets you check each step of your experiment as it progresses.

Analytical Instruments Division



A Brief Look at 4-solvent Theory

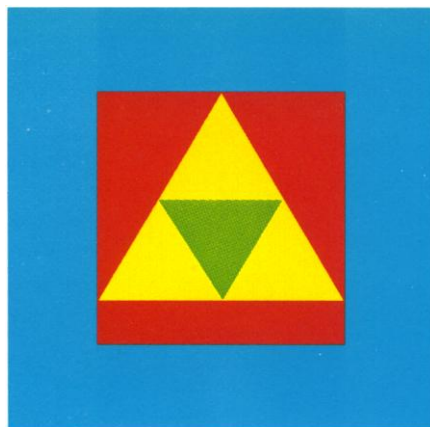
The quality of an HPLC separation is judged by its resolution. Until now, all advances in chromatographic technique have mainly involved column efficiency, retention or capacity. Developing a model or rationale for optimum selection of the mobile phase had not been possible.

This is precisely what J.J. Kirkland and J.L. Glajch have achieved with the 4-solvent, 7-step technique developed in the DuPont laboratories. Their first step was to use the Snyder selectivity triangle⁽¹⁾.

In this triangle, the most common HPLC solvents have been divided into eight major groups, each of which has different selectivity in a separation. Solvent groups are placed within the triangle on the basis of their relative strength as proton acceptors, proton donors, or dipole interaction. Those groups closest to the vertices of the triangle are strongest in these factors. (Fig. 1).

In making a choice of three solvents for optimizing selectivity, solvents are chosen from groups nearest to the three vertices of the triangle, so as to produce the largest differences in solvent action. Finally, the weak or strength-adjusting solvent—water or hexane—is chosen. Therefore, four solvents are required to carry out the optimization routine.

In developing the 4-solvent technique, Kirkland and Glajch⁽²⁾ use a triangle to define the entire selectivity space of a separation, Fig. 2. This triangle may be plotted within the confines of seven



definitive isocratic experiments using combinations of the four solvents selected.

The first of these experiments uses two of the four solvents (methanol-water, for example) which defines one vertex of the optimization triangle. The remaining two vertices are defined by two additional experiments, again using each of the other two solvents, plus water or hexane,

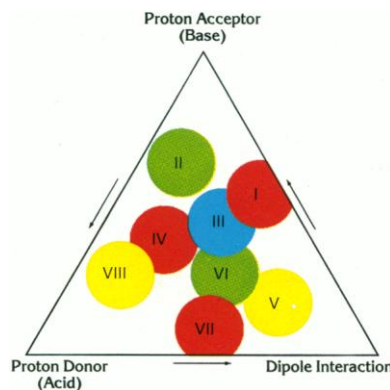


Fig. 1. The Snyder selectivity triangle divides the most common HPLC solvents into eight groups. Position of the groups within the triangle depends on their relative strength as proton acceptors, proton donors, or dipole interaction.

depending on the mode of the experiment. Solvent compositions for the final four experiments are fixed; the blend ratios are defined on the optimization triangle sides and center, Fig. 2.

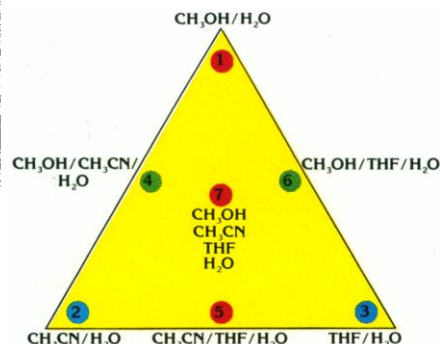


Fig. 2. The 7-steps and defined concentrations of the solvents used for each step are shown in this triangle.

Following these seven chromatographic runs, an optimum solvent region may be defined from visual examination of the chromatograms. Additional refinements may be made for the separation and require one or two additional runs.

Detailed theory and explanation of the optimization technique will be found in references below.

References

1. L.R. Snyder; *J.Chrom. Sci.*, 16 (1978), 223 ff.
2. J.L. Glajch, J.J. Kirkland, K.M. Squire, J.M. Minor; *J. Chromatography* 199 (1980), 57 ff.

Compare—and You Will Choose DuPont!

For more information: call toll free 800-441-9841. Or write: DuPont, Analytical Instruments Division, Room X39014, Wilmington, DE 19898.

Other offices throughout the United States and in Canada; Netherlands; Stevenage, England; Bad Nauheim, Federal Republic of Germany; Paris, Milan, Mexico City, Caracas and Sao Paulo.

Analytical Instruments Division

