AMERICAN
ASSOCIATION FOR THE
ADVANCEMENT OF
SCIENCE

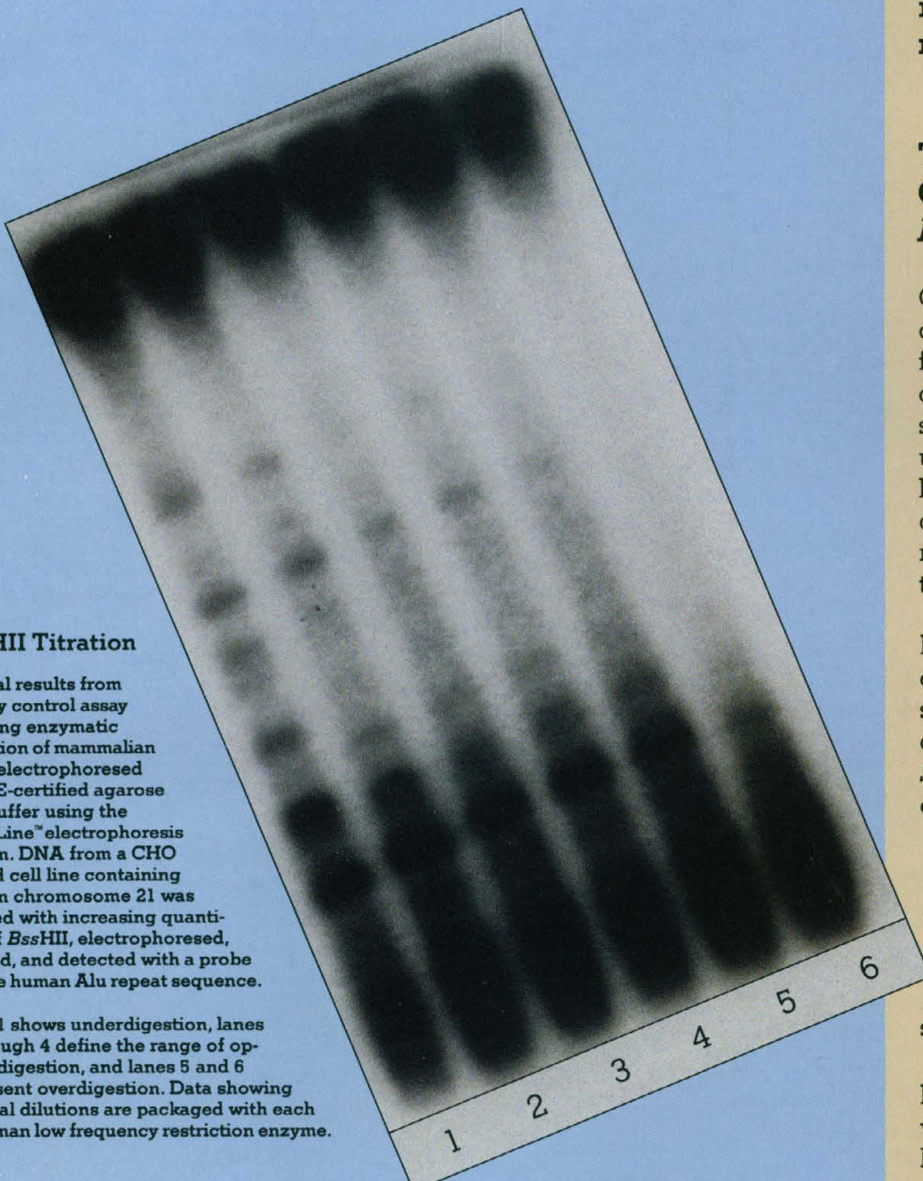
SCIENCE

4 NOVEMBER 1988 $3.00
VOL. 242 ▪ PAGES 633–828

Frontiers in Neuroscience

PFE Users: Do You Realize What's At Risk?

Volumes of precious sample. Hours of labor. Days of instrument tie-up. Not to mention frustration.



*Bss*HII Titration

Typical results from quality control assay showing enzymatic digestion of mammalian DNA electrophoresed in PFE-certified agarose and buffer using the GeneLine™ electrophoresis system. DNA from a CHO hybrid cell line containing human chromosome 21 was cleaved with increasing quantities of *Bss*HII, electrophoresed, blotted, and detected with a probe for the human Alu repeat sequence.

Lane 1 shows underdigestion, lanes 2 through 4 define the range of optimal digestion, and lanes 5 and 6 represent overdigestion. Data showing optimal dilutions are packaged with each Beckman low frequency restriction enzyme.

GeneLine™ design allows DNA transfer *and* blotting in same chamber.

The Beckman PFE Reagent line now includes *new* standard markers.

Circle No. 123 on Readers' Service Card

Turn to Beckman...for Optimal Results the *First* Time

Our dependable reagents are certified exclusively for pulsed field electrophoresis. Tested for optimal restriction cutting and separations on mammalian DNA using a PFE system, they provide lot-to-lot reproducibility and standardized performance to eliminate repeat experiments and save you troubleshooting.

Beckman's complete line of PFE-certified reagents now includes standard markers—lambda DNA concatemers, *S. cerevisiae,* and *S. pombe*. Low frequency restriction enzymes (*Not*I, *Mlu*I, *Sac*II, *Sal*I, *Bss*HII, and *Sfi*I) are packaged with optimal dilution data, as shown to the left. Agarose and buffer round out the line—all performance tested—to provide you with a single, reliable source for all your PFE supplies.

Extensive applications and service support is available from Beckman worldwide. Plus the most advanced electrophoresis unit—the GeneLine™ Transverse Alternating Field Electrophoresis System.

Find out more! Call toll-free 800/742-2345, or write to Beckman Instruments, Inc., Spinco Division, 1050 Page Mill Rd., Palo Alto, CA 94304. Offices in major cities worldwide.

BECKMAN

A SMITHKLINE BECKMAN COMPANY

Circle No. 7 on Readers' Service Card

AMERICAN
ASSOCIATION FOR THE
ADVANCEMENT OF
SCIENCE

SCIENCE

ISSN 0036-8075
4 NOVEMBER 1988
VOLUME 242
NUMBER 4879

■ **SCIENCE is published weekly on Friday, except the last week in December, and with an extra issue in February by the American Association for the Advancement of Science, 1333 H Street, NW, Washington, DC 20005.** Second-class postage (publication No. 484460) paid at Washington, DC, and at an additional entry. Now combined with **The Scientific Monthly®** Copyright © 1988 by the American Association for the Advancement of Science. The title SCIENCE is a registered trademark of the AAAS. Domestic individual membership and subscription (51 issues): $70. Domestic institutional subscription (51 issues): $110. Foreign postage extra: Canada $32, other (surface mail) $32, air-surface via Amsterdam $85. First class, airmail, school-year, and student rates on request. Single copies $3.00; back issues $5.00; Biotechnology issue, $5.50 ($6 by mail); classroom rates on request; Guide to Biotechnology Products and Instruments $16 ($17 by mail). **Change of address:** allow 6 weeks, giving old and new addresses and seven-digit account number. Authorization to photocopy material for internal or personal use under circumstances not falling within the fair use provisions of the Copyright Act is granted by AAAS to libraries and other users registered with the Copyright Clearance Center (CCC) Transactional Reporting Service, provided that the base fee of $1 per copy plus $0.10 per page is paid directly to CCC, 21 Congress Street, Salem, Massachusetts 01970. The identification code for *Science* is 0036-8075/83 $1 + .10. **Postmaster:** Send Form 3579 to *Science*, 1333 H Street, NW, Washington, DC 20005. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.
■ 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.

COVER False color map of intracellular calcium concentration in a guinea pig cerebellar Purkinje cell at the onset of a wave of complex spike activity. A high calcium concentration is observed in the distal dendritic tree. The map was produced from microfluorometric imaging of the fluorescent calcium indicator fura-2. See page 773. [D. W. Tank and J. A. Connor, Molecular Biophysics Research Department, AT&T Bell Laboratories, Murray Hill, NJ 07974; M. Sugimori and R. R. Llinás, Department of Physiology and Biophysics, New York University School of Medicine, New York, NY 10016]

Reports

Book Reviews

Products & Materials

This Week in SCIENCE

Mountain building thermodynamics

THE thermodynamic efficiency of brittle frictional mountain building on Taiwan is about three or four times less than that of a nuclear power plant (page 749). This comparison, made by Barr and Dahlen, is based on energy balance equations that describe what fraction of the mechanical and heat energy supplied from external sources is expended in the performance of useful work—the uplift of rocks against gravity—so that the mountain topography is maintained despite erosion. Taiwan was chosen as a prototype for calculating mountain building thermodynamic efficiency because the geometry of the region of deformation is well known and there is abundant geophysical data on heat flow, pore fluid pressure, and plate velocities; the island is situated where the Eurasian and Philippine Sea plates collide. Most of the mechanical energy that drives deformation and mountain uplift comes from the sinking Eurasian slab, although minor contributions are made by heat from the heat of accreting rocks and from radioactive decay; much of this energy is lost out of the boundaries as heat. This and other fold-and-thrust belts provide insights into thermal convection processes in the earth's interior.

Gene abnormalities in muscular dystrophies

MUTATIONS in the X chromosome gene BMD/DMD produce muscular dystrophies that range from the mildest forms (Becker) to the most severe (Duchenne). The classification for any patient reflects the rapidity with which muscle deterioration proceeds and the age at which he—usually males are affected—becomes wheelchair-bound. Over 50% of all muscular dystrophy patients have deletions in BMD/DMD, and characteristics of such deletions have now been studied. Boundaries of the first ten exons (the nucleic acid segments that get translated) on BMD/DMD with intervening nontranslated sequences (introns) were determined (page 755). Deletions occurred in exons 3 to 7 in patients diagnosed with mild, intermediate, and severe Becker; thus, a simple correspondence of disease severity with the size or location of the deletion was not found. Malhotra *et al.* therefore propose that what may distinguish those patients with mild clinical profiles from those with severe disease may be the ability of their cellular machinery to restore translation with a "start" signal downstream from the deletion so that a partially functional dystrophin protein can be produced from BMD/DMD and disease will be mild.

Fetal tissue transplants

IT might be possible, through the transplantation of fetal neural tissues, to restore neurologic function to people who have neurodegenerative disorders such as Parkinson's disease; in monkeys, signs of parkinsonism have been reversed with neural tissue transplants. However, for such transplants to be safe, it is necessary to characterize the tissues—to type them, assess their viability, and evaluate them for contaminating microorganisms—and, while these procedures are being carried out, the tissues must be stored. Redmond *et al.* report that neural tissue fragments from human fetuses can be preserved in liquid nitrogen for many weeks; the tissues survived freezing and thawing and transplantation into the brains of immunosuppressed monkeys (page 768). At 10 weeks post grafting, good growth of neural cells with dopamine receptors was observed in the recipient animals. These banking and testing procedures will be assets to both clinical and basic research.

Purkinje cell studies

EVIDENCE of the electric activity of Purkinje cells, the large branching nerve cells in the brain, can be seen in dramatic fluorescent microscopic images (cover). Calcium ions flow into neurons through channels in conjunction with spontaneous and evoked electric activities; the locations of ion influxes were mapped in single cells by Tank *et al.* with the fluorescent indicator fura-2 (page 773). At the beginning of excitation, intracellular calcium was associated with the more distal (tertiary) branches of the dendritic tree; later, secondary and primary regions of the tree that are close to the cell body filled with calcium. The imaging results are in accord with electrophysiological studies and strengthen the notion that electric conductance in neurons is fine tuned in time and space by calcium ions.

Lens development

THE normal lens is a transparent refractile optical element that lacks blood vessels and nerves and is rich in protein. Lens development in the body proceeds in an uneven (oscillatory) rather than steady fashion. Brewitt and Clark have developed an organ culture system in which the effects of various growth factors on lens growth and development can be assessed (page 777). The lenses of 3-day-old rats developed normally in culture when they were exposed to pulses of platelet-derived growth factor (PDGF); this factor, which has been observed as a component of the aqueous humor that normally bathes the lens in vivo, stimulated growth and increased the soluble protein content of the lens. When lens tissue was continuously exposed to PDGF or exposed only to culture medium, cataracts formed, soluble proteins were lost, and lenses stopped growing; similar changes accompany in vivo cataract development.

Neuroscience

The lead articles and a number of the reports in this issue address the structure, development, activities, and relations of the brain and other tissues of nervous systems (pages 641, 692 to 745, 762, 768, 771, and 773).

SCIENCE

4 NOVEMBER 1988
VOLUME 242
NUMBER 4879

Frontiers in Neuroscience

The human brain contains about 10^{12} neurons, many of which have more than 10,000 connections with other neurons. This incredibly sophisticated supercomputer presents an enormous intellectual challenge. Elucidating its function will be of great importance to the understanding of human behavior and the support of mental health. In this issue, assembled with the expertise of Katrina Kelner, eight articles cover selected aspects of modern neurobiology and illustrate the power of new concepts and new experimental tools.

Memory is of course one of the most intriguing areas of study in the brain, and describing the physiological changes in neurons that generate long-term memory is a first step in understanding all subsequent learning processes. Major developments in this area are discussed by Brown and co-workers, who have used the technique of long-term potentiation, that is, a long-lasting change in a neuron as a result of repetitive stimulation. Indications of Hebbian feedback behavior in these stimulated neurons combine modern molecular biology with classical postulates of psychology.

Learning also involves complex motor patterns such as hitting a baseball moving at 150 kilometers per hour. This action requires the training of motor skills so that a rudimentary native ability is converted to a more precise learned ability, as described by Lisberger. Moreover, as discussed by Wise and Desimone, correlation of movements with visual stimuli requires groups of neurons that can select objects and also constantly adjust to the fact that limbs grow, muscle mass changes, and visual experience accumulates.

How neurons make connections to develop the complex wiring diagram of the brain is discussed in three papers. To the dismay of some who may like to think that humans are appreciably more worthy than insects, the development of neuronal interconnections in a grasshopper is not so different from that of so-called higher species. It appears that neurons making distant connections follow predetermined pathways by groping along structural elements that contain molecular signposts in the form of proteins on the surface of cells. They also may use chemical gradients that attract or repel the advancing tip of the neuron, the growth cone. Moreover, these extensions have feedback mechanisms that allow them to withdraw from incorrect surfaces and fasten tightly to the correct ones. Dodd and Jessell focus on vertebrate glycoproteins that provide a guidance system in nonspecific parts of the developing neuron and discuss axon guidance by contact inhibition. Harrelson and Goodman discuss the same subject with emphasis on fasciculation in invertebrates, particularly as mediated by fasciclin II, a member of the immunoglobulin superfamily. These immunoglobulin-like molecules are structurally homologous to guidance molecules in the vertebrate neural system. Finally, Smith discusses the mechanics of cell motility during neuron development and identifies actin polymerization as the force behind the protrusion of the growth cone while the actin-myosin system, fueled by adenosine triphosphate, appears to drive growth cone retraction.

Koob and Bloom discuss the currently prominent issue of drug dependence from the molecular point of view. The drug problem will not be solved solely by elucidating the biochemical mechanisms, but understanding the molecular basis of tolerance and withdrawal will help. Such findings may also help explain why people become addicted to drugs and lead to the development of better procedures for detoxification.

Churchland and Sejnowski consider some aspects of theoretical computer programs that show computation patterns analogous to those of the brain. Some experimenters regard such theoretical programming as too esoteric to be of much practical use in understanding brain function. Nevertheless, there are principles applied in algorithms that are functionally similar to mechanisms in the human brain. In fact, insight into new types of information processing is leading to an entire industry in which the simulation of neuronal activity in an algorithm is being used to attract venture capital. The brain is becoming big business, as well as a big intellectual challenge.

Sometimes intellectual challenges are fascinating but of debatable value such as the design of new weapons or the breaking of secret codes. Understanding the brain is a monumental puzzle, the solution of which can provide great humanitarian advances. This issue presents some beginnings at unraveling that Gordian knot.

—DANIEL E. KOSHLAND, JR.

A TURN FOR THE BEST IN LABORATORY CENTRIFUGES

The company that developed the first laboratory centrifuge now introduces a whole new generation of medium and high speed systems. Eight high performance models which completely redefine the capabilities you can expect from today's centrifuge. More power. More productivity. Greater accuracy, convenience and utility than ever before.

If you're in the market for a new centrifuge system, turn to the only logical source . . . IEC. After all, we've been building the best in laboratory centrifuges since the turn of the century.

IEC 88 1901–1989 years of quality

INTERNATIONAL EQUIPMENT COMPANY

CENTRA®-8
GENERAL PURPOSE

CENTRA®-8R
REFRIGERATED

The most powerful bench top systems available . . .
three liter sealed horizontal rotor to nearly 5000 xg;
accepts 12 different floor model rotors.
Digital controls for accuracy and simple operation.

C-6000
GENERAL PURPOSE

CR-6000
REFRIGERATED

Compact, economical, yet amazingly versatile floor model systems.
Hundreds of accessory combinations for routine and specialized applications.
Speeds to 6000 rpm; capacities to four liters or continuous flow.

Circle R.S. No. 200

Circle R.S. No. 201

World's largest selection of accessories

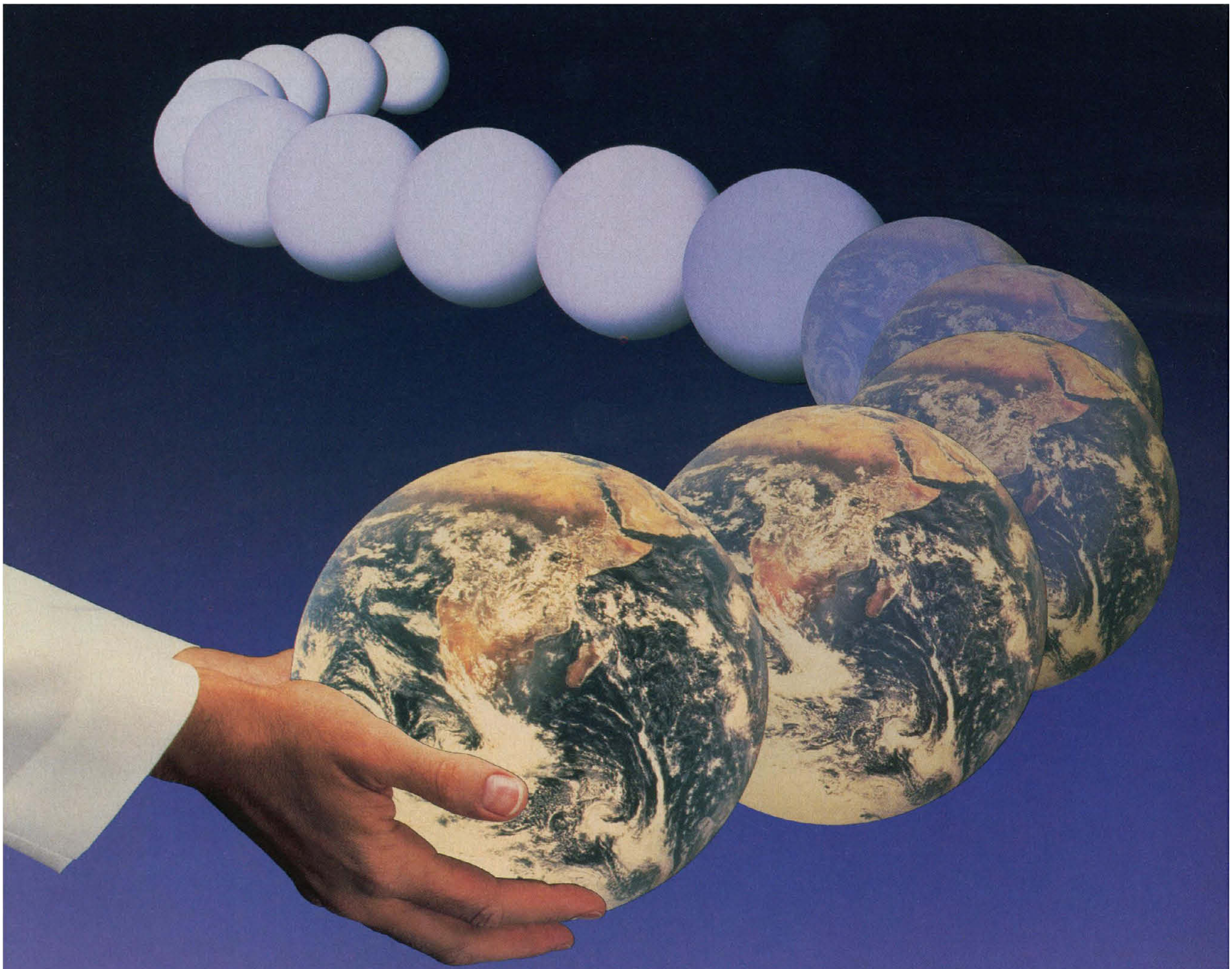
IEC makes the most accommodating centrifuges you can buy. Rotors feature a wide choice of adapters for virtually any requirement, sealed accessories for maximum safety and a full seven year warranty.

Programmable PR-7000M and B-22M

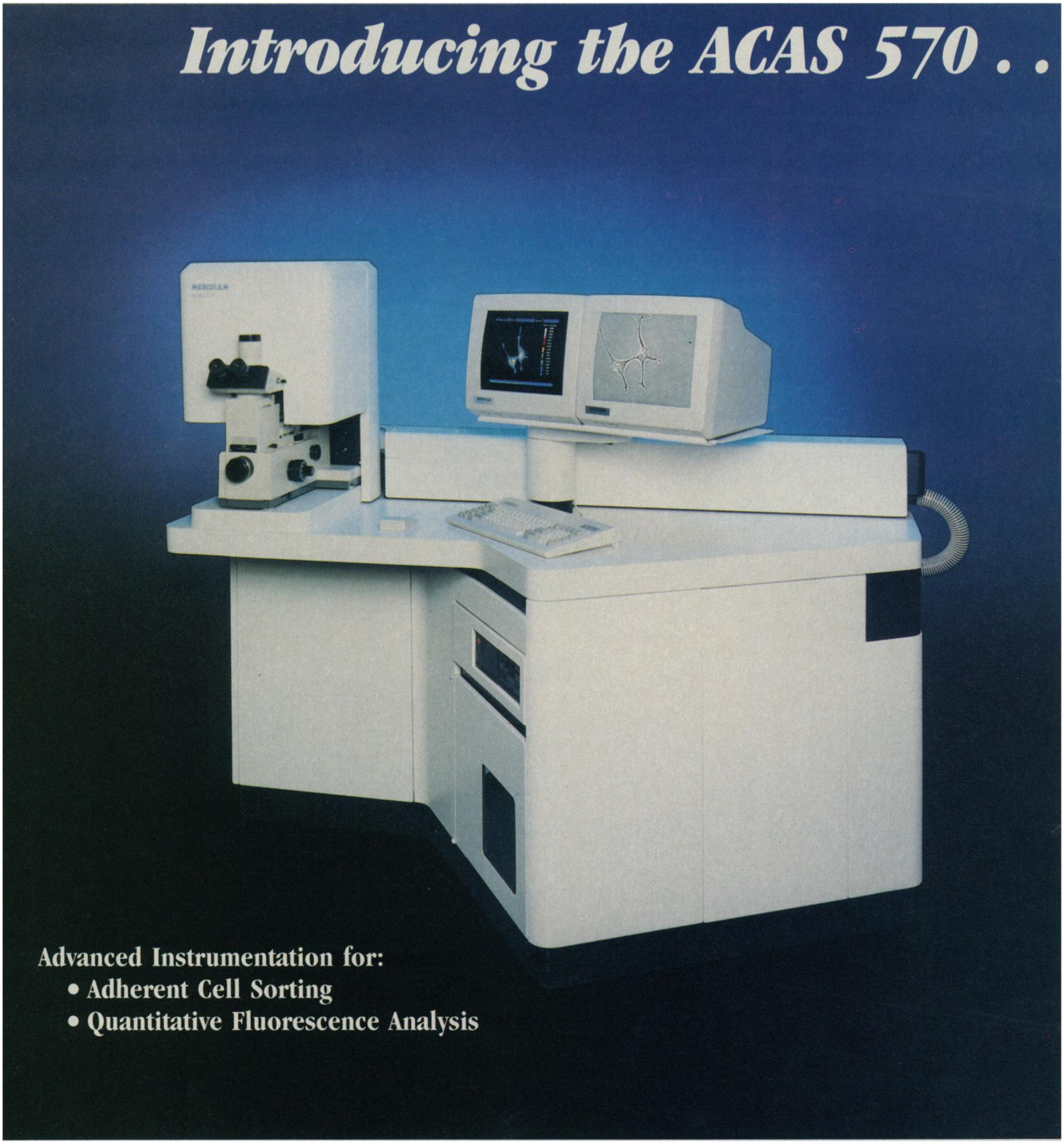
Featuring a unique approach to centrifuge control, set and actual conditions are displayed at all times. Operation by rpm or RCF, run time or ω^2t; internal program storage; service diagnostics and many other advanced features.

INTERNATIONAL EQUIPMENT COMPANY
A DIVISION OF DAMON
300 Second Ave., Needham Hts., MA 02194 U.S.A.
Tel: (617) 449-0800, Telex: 174299, INTLEQUIP,
Fax: (617) 444-6743

DAMON/IEC (UK) LTD.
Unit 7, Lawrence Way, Brewers Hill Road, Dunstable, Bedfordshire, LU6 1BD, England. Tel: (0582) 604669 Telex: 825942 IEC UK G



New Advances in Interactive Laser Cytometry



Introducing Promega's New TaqTrack™ Sequencing System:

The solution to sequencing difficult DNA templates.

- **Sequence at 70°C to 95°C with thermostable *Taq* DNA polymerase**
- **Solve difficult template problems**
  - **GC rich regions**
  - **long hairpins**
  - **long poly(A) tails**
- **Sequence lambda dsDNA**
- **Observe consistent band intensity**
- **Actually read from 1–500 bases**
- **Avoid lengthy chemical methods**

With capabilities like this, consider the advantages of using the TaqTrack System for routine sequencing!

Circle No. 128 on Readers' Service Card

Call 1-800-356-9526 for more information.

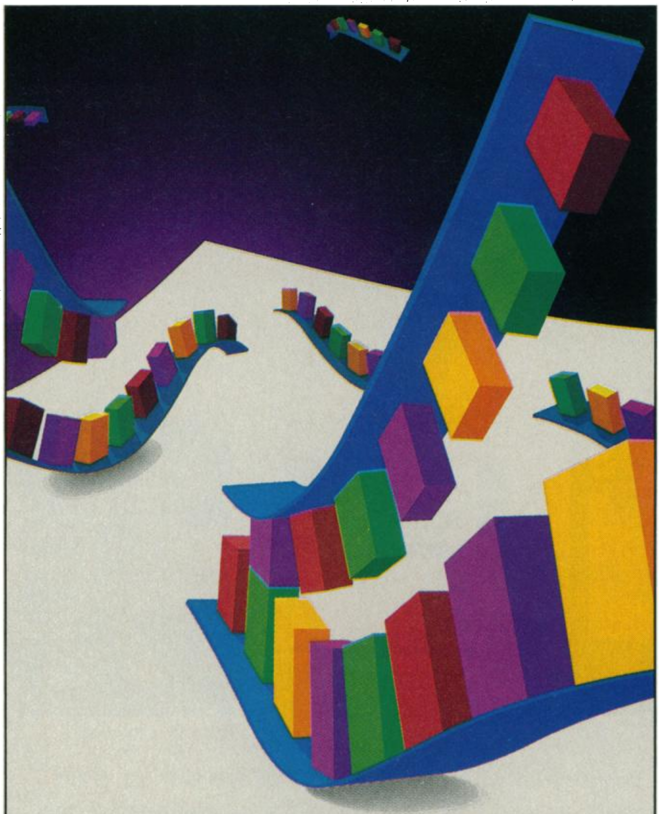

```
 G-C
T   A
 CG
 CG
 AT
 GC
 CG
 TA
 GC
 CG
 CG
 TA
 AT
 GC
 GC
 CG
 CG
 CG
 CG
 TA
 TA
 AT
 AT
GTGCGT
```

Nucleotide sequence of the large GC-rich hairpin of the multiple cloning site of Ml3mp7.

Autoradiograph showing the products of sequencing Ml3mp7 with the TaqTrack™ Sequencing System. The figures show the sequence of the multiple cloning site region, which contains a GC-rich, perfectly inverted repeat of 24 base pairs. A reaction temperature of 70°C simplifies polymerization through highly structured templates. The DNA polymerase isolated from *Thermus aquaticus* exhibits a consistent band intensity and a high degree of accuracy when used for sequencing. This thermostable enzyme lacks intrinsic exonuclease activity, which results in a low gel background. In addition, the analogue 7-deaza dGTP can be used to resolve gel artifacts associated with GC-rich regions, as shown.

Promega Corporation	
2800 S. Fish Hatchery Road	
Madison, WI	53711-5305 U.S.A.
To Order	800-832-6362
In Wisconsin	800-236-9526
Telephone	608-274-4330
FAX	608-273-6967
TWX/Telex	910-286-2738

Promega



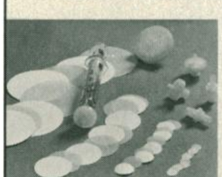
EFFECTIVE IMMOBILIZATION

Zetabind® transfer membrane gives researchers a powerful analytical tool for blotting applications. Since 1982, this positive-charge modified nylon membrane has replaced nitrocellulose and unmodified nylon in DNA, RNA and protein transfers, plaque lifts, dot blots, etc. Zetabind membrane's unique properties make it ideal for capillary or electroblotting and alkaline transfer methods by providing these advantages:

■ Greater sensitivity increases probability of detection, because Zetabind membrane has five times the binding capacity of nitrocellulose.

■ Molecules aren't transferred through or washed off Zetabind membrane because they're tightly bound even before baking or UV light exposure—important for detecting small fragments (10–20 bp) and in reprobing where sample is retained for $\geq$ 10 hybridizations.

■ Zetabind membrane is more flexible than nitrocellulose even after baking or alkali treatment.



Zetapor® disposable syringe filters and nylon discs: ■ minimize sample loss and cost by matching filter size to volume ■ solvent-resistant ■ hydrophilic ■ low extractables ■ 0.45um and 0.2um

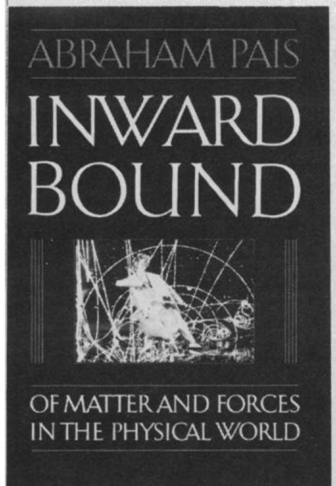
ZetaPlus® disposable prefilters: ■ fast and easy debris removal from culture supernatants, lysates, and serum ■ replaces centrifugation and cloth filters ■ extends life of 0.2um filters

For more information call 1-800-231-2259. In Connecticut, 238-8974.
Or write CUNO Life Sciences Division
400 Research Parkway, Meriden, CT 06450.

CUNO
Life Sciences Division

Circle No. 149 on Readers' Service Card

Particles and principles of the Universe



INWARD BOUND

Of Matter and Forces in the Physical World
ABRAHAM PAIS

"A sweeping narrative of the history and present state of atomic physics....Written from a deep love of the subject, a desire to make it intelligible, and a zest for describing the actors in his story."
—*The New York Review of Books*

"An important and groundbreaking contribution to the history of particle physics."
—*The Boston Globe*

"A book that soars....A landscape of physics, peopled by the pivotal characters who were driven to understand how and why the world works....An odyssey of physics that is beautifully told and can be appreciated at a variety of levels."
—*Kirkus Reviews*

688 pp. paper $17.95

THE ANTHROPIC COSMOLOGICAL PRINCIPLE

JOHN D. BARROW and FRANK J. TIPLER
with a Foreword by John A. Wheeler

"A marvelous treasure trove. ...A joy to all cosmologists and would-be cosmologists."
—*Science*

"A clearly, exhaustively researched book....[It] impels the reader to think, and it may alter the terms of discourse within which it will be judged."
—*The New York Times Book Review*

"Fascinating....An extremely interesting work, and I highly recommend it to anyone with a serious interest in science or in questions relating to the universe and our existence."
—*Sky & Telescope*

736 pp.; line diagrams paper $15.95

At better bookstores or directly from

OXFORD PAPERBACKS
Oxford University Press
200 Madison Avenue • New York, NY 10016

Circle No. 49 on Readers' Service Card

THE NEW SYSTEM 1400™ LSC

SYSTEM 1400™ is the latest liquid scintillation counter from the technology leaders. It is designed for all users and all types of application. Founded on new ideas and new technology, SYSTEM 1400 is packed with innovative features to make results more reliable and work more productive.

Confirming Technology Leadership

DOT-DPM™

- Digital Overlay Technique
- true colour correction
- Quench Data Library

Superior results with less effort

Easy Count

- fast DPM

Single button results

Chemiluminescence correction

- spectrum stripping
- no settings or calibration

Fully automatic and reliable

Ten instruments in one

- 10 individual workspaces
- up to 10 protocols for each workspace
- total positive sample identification

Every user's "own instrument"

FlexiRack™

- sample capacity from 336 to 1248
- from 20 ml standard vials to microfuge tubes

For all types of vial used in LSC

ScoreBoard™

- built-in spreadsheet formatting
- alphanumeric and graphic

Best possible results presentation

SystemMaster™

- visual control of protocols, isotopic spectra and results
- non-slave PC for application programs

Complete PC freedom even while counting

Circle No. 62 on Readers' Service Card

LKB WALLAC

Pharmacia

Pharmacia-LKB Nuclear Inc., 9319 Gaither Rd., Gaithersburg, Maryland 20877.
Telephone 1-301-9633200. Telex 64634 lkbin. Telefax 1-301-9637780.

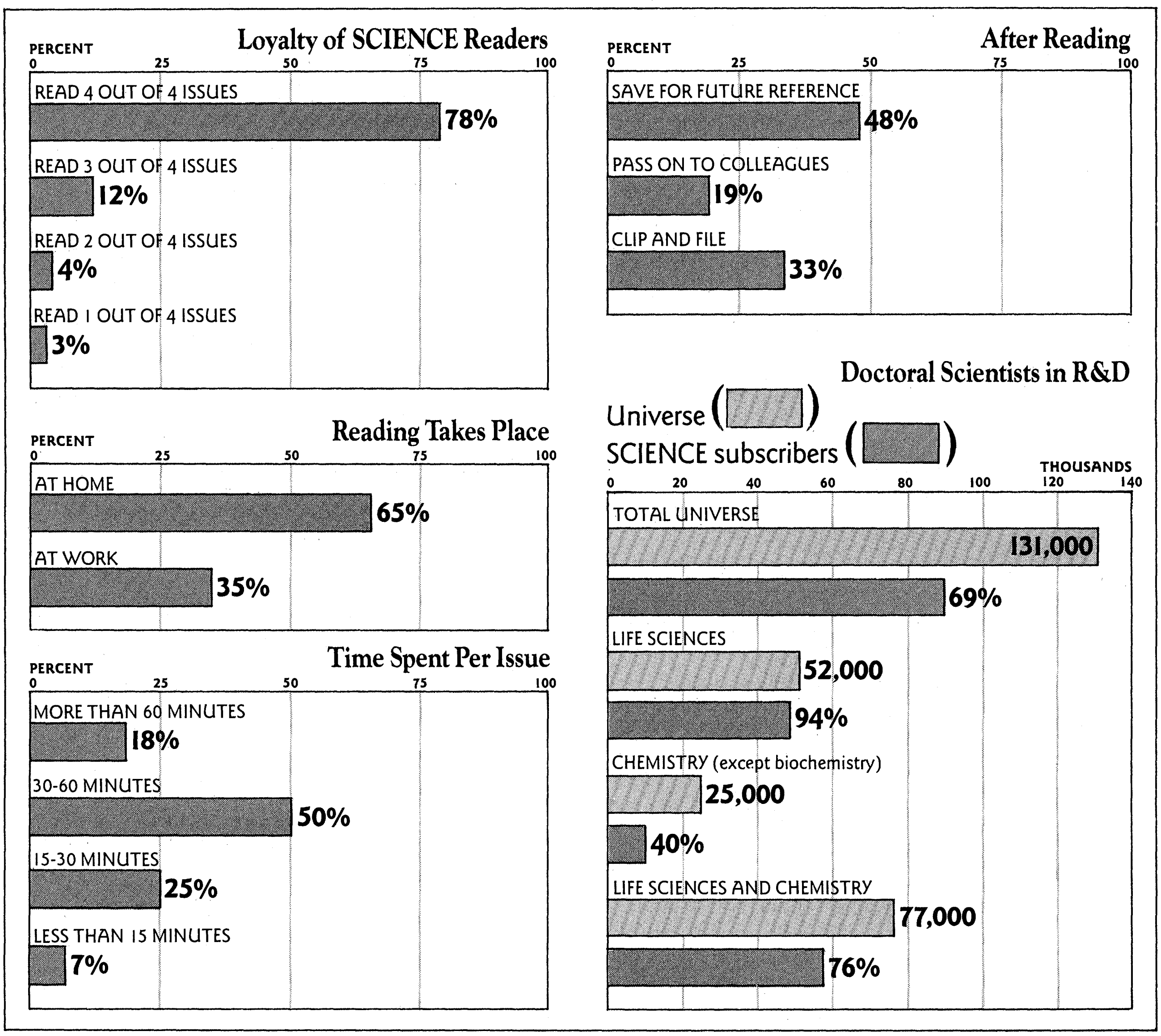
The Science of Advertising

Advertising isn't quite a science. But the scientific approach has already led most companies serving the scientific community to choose SCIENCE to carry their messages.

Research has proven that SCIENCE reaches the largest segment of the life sciences universe. It's read intensively by more NIH grant recipients, more doctoral scientists doing R&D and more science policy leaders than any other publication in its field.

The conclusion is obvious: SCIENCE reaches science decision-makers more effectively and with greater cost-efficiency than any other journal.

If you have a product or service to sell to life scientists, there's no need for research or experimentation. The clear and only choice is SCIENCE.



THE GLOBAL WEEKLY OF RESEARCH

SCIENCE

ADVERTISING REPRESENTATIVES
SCHERAGO ASSOCIATES, INC.
1515 Broadway, New York, N.Y. 10036 • (212) 730-1050

New Titles from Cambridge University Press

Memory Traces in the Brain
Daniel L. Alkon
Providing the first glimpse of how associative memories are actually established in the brain, this book describes a research strategy for unravelling the mystery of memory and learning.
1988 / 185 pp. / 24735-7 / Cloth $39.50 / £27.50
35867-1 / Paper $14.95 / £ 9.95

Human Organic Memory Disorders
Andrew R. Mayes
Advances a taxonomy of elementary memory disorders and, for each in turn, reviews both the specific processes that are disrupted and the lesions responsible for the disruption.
1988 / 324 pp. / 34418-2 / Cloth $49.50 / £30.00
34879-X / Paper $18.95 / £10.95

Computer Models of Mind
Computational Approaches in Theoretical Psychology
Margaret A. Boden
Details how computer models are used to study many psychological phenomena—including vision, language, reasoning and learning. It also shows that computer modeling involves differing theoretical approaches.
1988 / 310 pp. / 24868-X / Cloth $42.50 / £30.00
27033-2 / Paper $15.95 / £10.95

Now in paperback...

Dynamics of Proteins and Nucleic Acids
J.A. McCammon and S.C. Harvey
"McCammon and Harvey's account is easily read and at the same time rewarding to those seeking deeper insight. With its comprehensive and well-balanced list of references, and its review of all the main developments, it will be an invaluable companion to those interested in the dynamics of biological macromolecules."—*Nature*
1988 / 234 pp. / 35652-0 / Paper $19.95 / £11.95

New Directions in Ecological Physiology
Edited by Martin E. Feder, Albert E. Bennett, Warren W. Burggren and Raymond W. Huey
Twenty leading ecological physiologists and evolutionary biologists offer novel conceptual approaches that will stimulate the continued growth of this field.
1988 / 304 pp. / 34138-8 / Cloth $49.50 / £30.00
34938-9 / Paper $19.95 / £12.50

North American Terrestrial Vegetation
Edited by Michael G. Barbour and William Dwight Billings
This original and detailed summary describes the major vegetation types from the arctic tundra of Alaska and Canada to the tropical forests of Central America.
1988 / 448 pp. / 26198-8 / Cloth $49.50 / £45.00

Physics at Surfaces
A. Zangwill
A unique graduate-level introduction to the physics and chemical physics of solid surfaces and of atoms and molecules that interact with solid surfaces.
1988 / 454 pp. / 32147-6 / Cloth $69.50 / £40.00
34752-1 / Paper $27.95 / £15.00

Public Policy and the Misuse of Forest Resources
Edited by Robert Repetto and Malcolm Gillis
"The authors convince us that the impact of ill-conceived government subsidies may be at least as big a factor in forest destruction as population growth and escalating demands for farmland. The good news is that these policies can be improved and this book shows how."
—Peter Raven, Director, Missouri Botanical Garden.
1988 / 200 pp. / 34022-5 / Cloth $69.50 / £45.00
33574-4 / Paper $27.95 / £19.50

Water and the Arid Lands of the Western United States
Edited by Mohamed T. El-Ashry and Diana C. Gibbons
Explores the nature of water demands in the agricultural and municipal sectors and sets forth prescriptions for the West to move away from its historical reliance on expensive supply-side projects and toward better management of existing supplies.
1988 / 475 pp. / 35040-9 / Cloth $59.50 / £40.00

Superstrings: A Theory of Everything?
P.C.W. Davies and J. Brown
Based on the original transcripts of a BBC Radio 3 documentary, this book contains a clear and concise introduction to superstring theory that explains in non-mathematical terms the developments that led to the emergence of the theory and the profound consequences for physics if it should prove to be the "Theory of Everything."
1988 / 234 pp. / 35462-5 / Cloth $34.50 / £20.00
35741-1 / Paper $10.95 / £ 6.95

Crystal Chemistry and Refractivity
Howard W. Jaffe
The author examines the architecture of natural and synthetic crystalline materials, paying particular attention to the arrangement of atoms in a crystalline array and the nature of their chemical bonding in minerals.
1988 / 335 pp. / 25505-8 / Cloth $75.00 / £55.00

Introduction to Crystal Chemistry
Student Edition
Howard W. Jaffe
This textbook covers the first eleven chapters of *Crystal Chemistry and Refractivity*.
1988 / 161 pp. / 36985-1 / Paper $24.95 / £15.00

Numerical Recipes in C
William H. Press, Brian P. Flannery, Saul Teukolsky and William T. Vetterling
From the authors of the highly successful *Numerical Recipes* comes this new version of the book. It fills a long-recognized need for a practical, comprehensive handbook of scientific computation, presenting more than 200 of the most important numerical algorithms for scientific work.
C Version: *1988 / 733 pp. /35465-X / Cloth $44.50 / £27.50*
FORTRAN/Pascal Version:
1986 / 818 pp. / 30811-9 / Cloth $44.50 / £25.00

Also available are accompanying example books and software for IBM PC/XT/AT and Apple Macintosh. Other formats (including UNIX and VAX/VMS) and license arrangements are available from ***Numerical Recipes Software***, P.O. Box 243, Cambridge, MA 02238. For further information, please contact Clay Gordon at the address below.

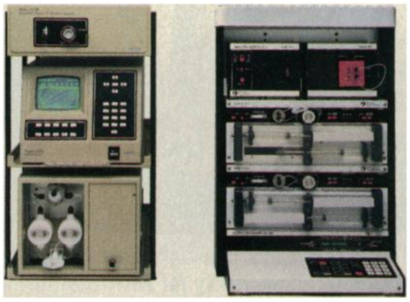
At bookstores or order from

Cambridge University Press

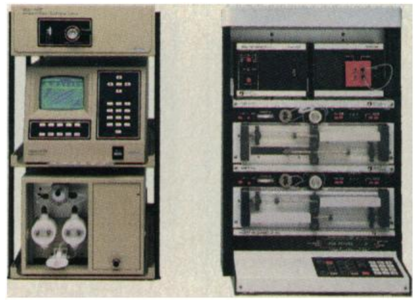
32 East 57th Street, New York, NY 10022. Cambridge toll-free numbers for orders only: 800-872-7423, outside NY State. 800-227-0247, NY State only. MasterCard and Visa accepted.

Circle No. 50 on Readers' Service Card

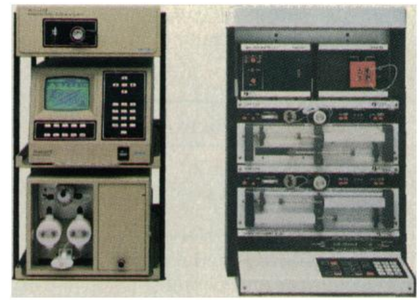
There's only one real choice in fast protein LC. The Waters 650.



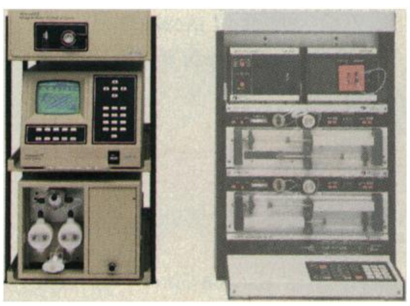
If you want to transfer and scale up your open column methods on an automated LC with the convenience of storing up to 15 protocols, there's only one real choice.



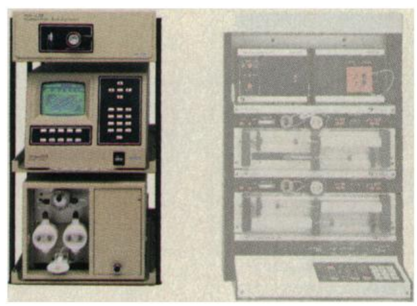
If you need one instrument to isolate micrograms to grams of purified protein using any FPLC,® Protein-Pak™ or self-packed preparative column, there's only one real choice.



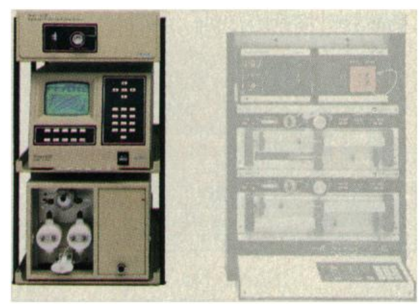
If you're looking for complete system control and fast, error-free programming with a full screen CRT display, there's only one real choice.



If you want versatile methods optimization using linear or non-linear gradients with up to four buffers, there's only one real choice.



If you prefer a full range of UV detection options that includes programmable, tunable or fixed, there's only one real choice.



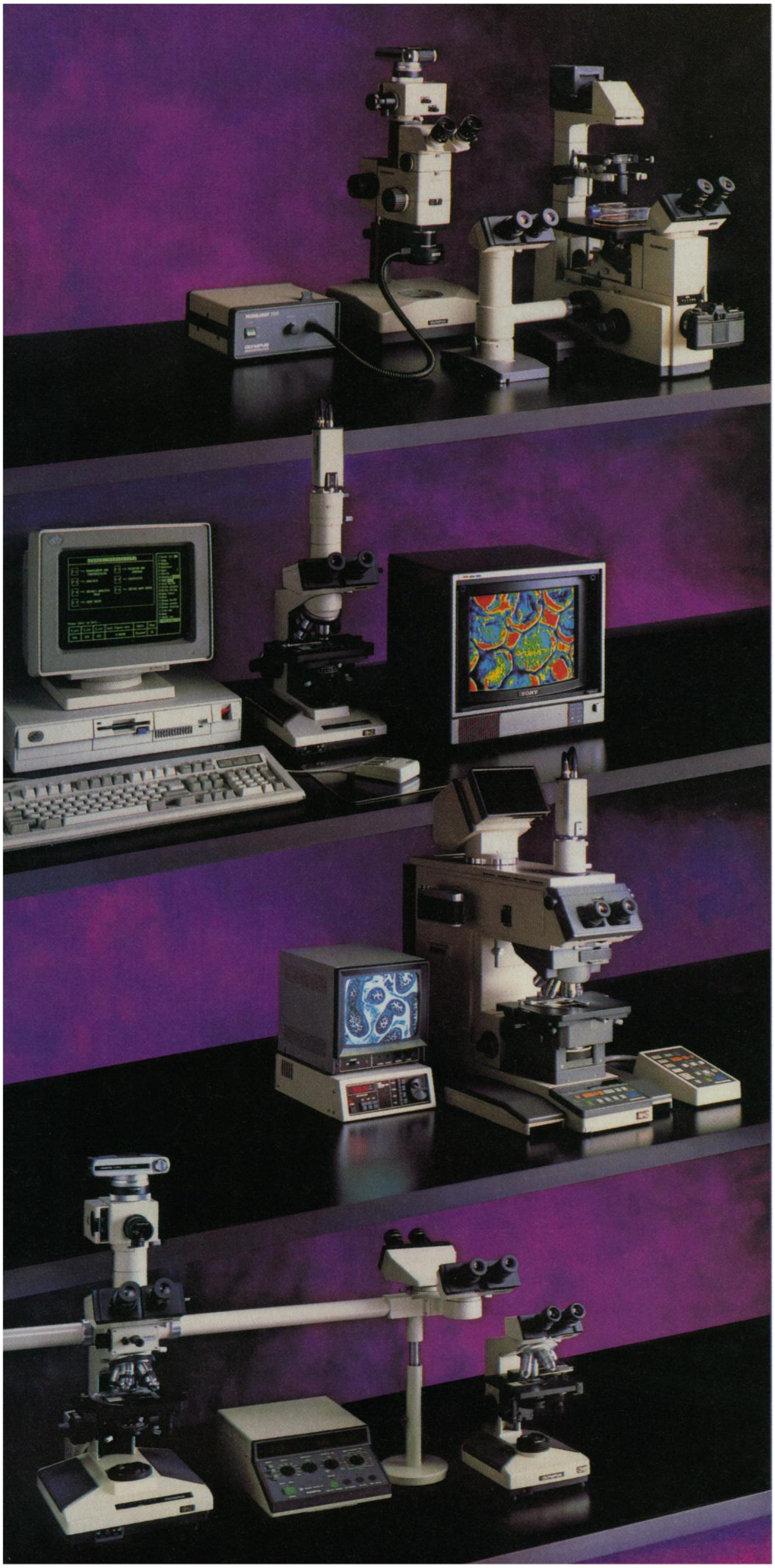
If you require complete methods documentation using either a personal computer or a recording integrator, there's only one real choice.

And if you're looking for a faster, better way to purify proteins, there's only one real choice—**Waters™ 650 Advanced Protein Purification System.**

For more information circle the Reader Service Card, or call (617) 478-2000, extension 2777.

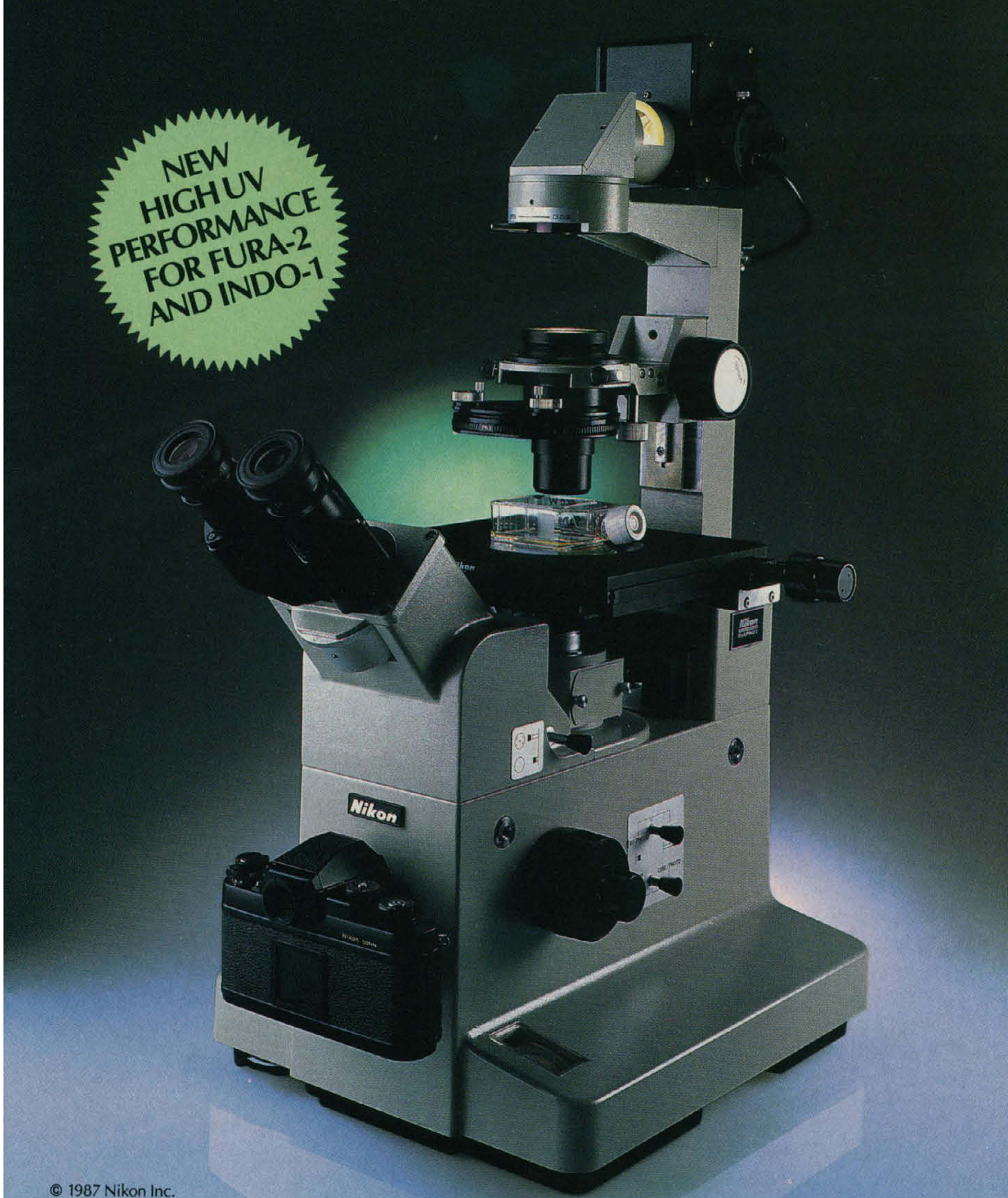
Waters
Division of MILLIPORE

Circle No. 116 on Readers' Service Card




7.5 good reasons
to try ASYSTANTGPIB.
1 ASYSTANT GPIB Software hands you control of your IEEE-488 instruments.
2 No programming required—be up and running from day one.
3 Now you can store, plot, reduce, analyze, compare, archive, characterize, and calculate your data.
4 Pick from a menu to create automated routines that bring your data from source to solution—even when you're not there.
5 ASYSTANT GPIB supports most IEEE-488 interface boards.*
6 You can generate hard copy records, both tables and plots, with a single keystroke.
7 Full technical support is never more than a phone call away.
7.5 30-day money-back guarantee.
This is only half a reason, because we know you'll find ASYSTANT GPIB indispensable.
* For the IBM PC and IBM PS/2. ASYSTANT GPIB supports over 20 GPIB interface boards manufactured by:
■ AdvanTech
■ B&C
■ BBS
■ Capital Equipment Corporation
■ Contec
■ Hewlett-Packard
■ IBM
■ ICS
■ IOtech
■ MetraByte
■ National Instruments
■ Qua Tech
■ Scientific Solutions
■ Ziatech
For technical details, call 1-800-348-0033.
New—Call for free demo disk!
Circle No. 105 on Readers' Service Card
ASYST
SOFTWARE TECHNOLOGIES, INC.
100 Corporate Woods
Rochester, NY 14623
1-800-348-0033
(or 716-272-0070)
©1988 Asyst Software Technologies, Inc.
ASYSTANT is a trademark of Asyst Software Technologies, Inc. Other brand and product names are registered trademarks or registered trademarks of their respective holders.

Everything you've heard is true.



The astonishingly bright, high-contrast image. The wide selection of quality accessories. The large stationary stage for maximum stability. The very modest price.

The renowned Diaphot.

It's the inverted microscope from Nikon that's designed to meet *all* the requirements of your research laboratory.

The Diaphot utilizes Nikon's exclusive CF optics, famous for their crisp, clear images. These optics deliver the extra edge that's needed in today's research and clinical laboratories.

A wide selection of accessories allow you to meet *all* the documentation requirements of your laboratory—from 35mm to large format and Polaroid®, CCTV and cinemicrography. With special CF objectives ranging from 4X through 100X, the Diaphot has complete capability in phase contrast, fluorescence and Nomarski DIC.

The Nikon Diaphot is engineered for functional performance and reliability. For maximum stability, its solid die-cast body has a very low center of gravity and the fixed stage makes Diaphot ideal for micromanipulation. And in addition to everything you heard, the Diaphot's striking superiority is available at a very modest price.

To learn even more about the renowned Diaphot, contact: Nikon Inc., Instrument Group, 623 Stewart Avenue, Garden City, NY 11530. (516) 222-0200.

NIKON DIAPHOT

INVERTED MICROSCOPE

For information circle reader service number 90
For demonstration circle reader service number 91

Nikon
Extending Man's Vision

FOUR WORDS WILL CHANGE THE WAY YOU LOOK AT THE BIOMEDICAL LITERATURE.

CURRENT CONTENTS ON DISKETTE™

Current Contents on Diskette is published every week, bringing you tables of contents from the most influential journals in the life sciences.

You're Always in Complete Control

This new medium makes searching and manipulating bibliographic information simpler than ever--allowing you more options than ever. You can scan contents pages at high speed or browse through electronically at your own pace. And creating custom search profiles using key terms, authors and institutional names is effortless.

No more typing reprint forms by hand. *Current Contents on Diskette* automatically fills in the reprint author's name, your name and address, and the complete reference. Right on special ISI Request-A-Print® forms!

Another quick command and you're generating and printing orders for The Genuine Article™, ISI's 48-hour document delivery service.

Need to print out or export references, contents pages, or search results for your personal database? Click the mouse or touch a key and it's done. Fast.

IBM & Compatibles, Macintosh

There's a *Current Contents on Diskette* for everybody. The IBM PC and 100% compatibles version comes with retrieval software designed by ISI and is available in 5 1/4" and 3 1/2" disk formats. This version requires a hard disk and 512K RAM.

The Macintosh version runs on MAC Plus, SE or II. A hard disk drive and Hypercard® are required.

Special Price for CC® Subscribers

The annual subscription price for *Current Contents on Diskette* is $380*. But if you subscribe to the print CC, you pay just $250* for the diskette edition--and save $130!

To change the way you look at the literature...call toll-free 800-523-1850, extension 1483. Outside the U.S. and Canada, call 215-386-0100, ext. 1483. Ask for operator 512. Or write us at one of the addresses below.

**Includes shipping to U.S. destinations. Slightly higher elsewhere.*

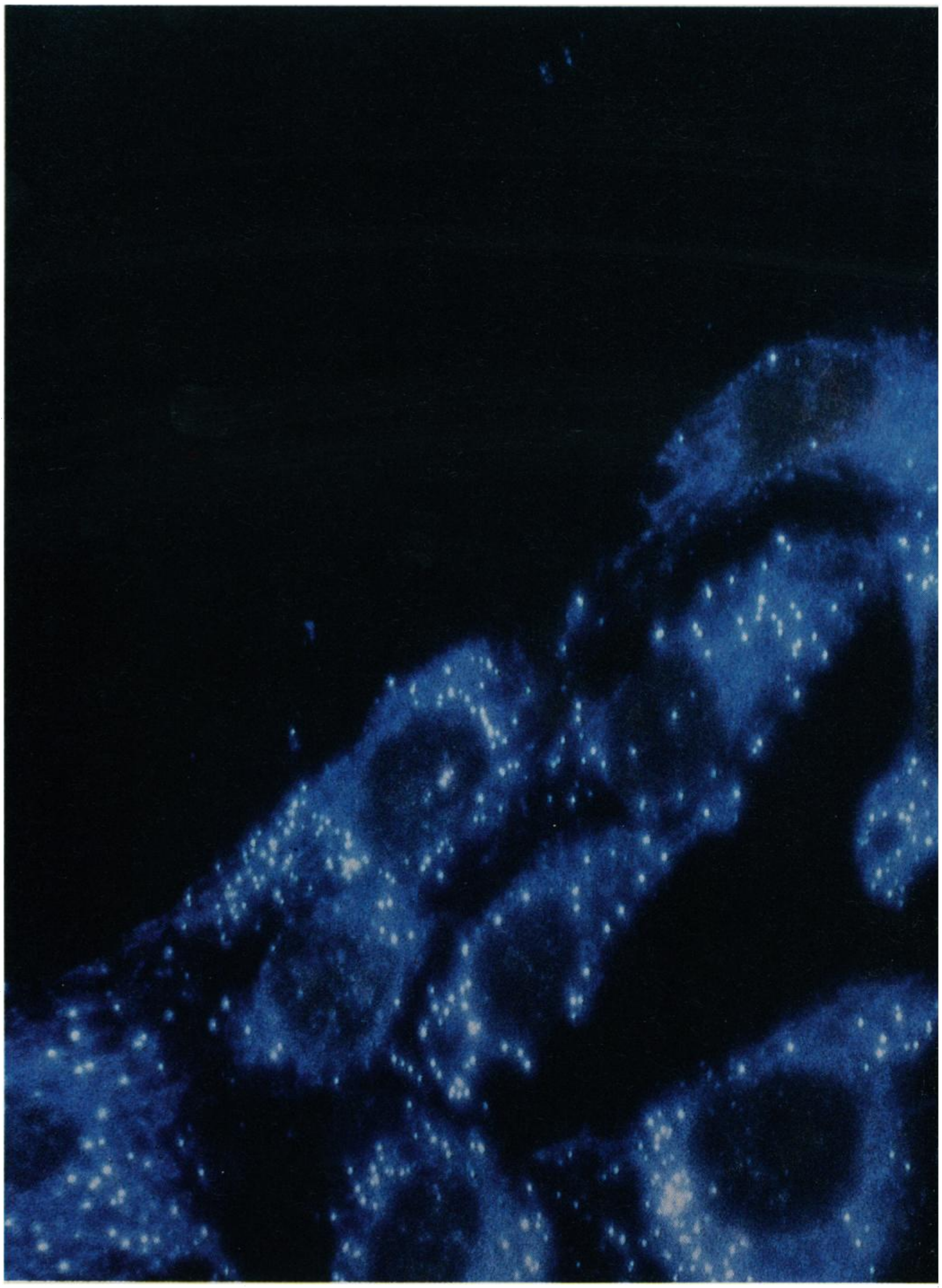
CURRENT CONTENTS *on Diskette*™ Institute for Scientific Information®

3501 Market Street Philadelphia PA 19104
Europe: 132 High Street Uxbridge
Middlesex UB8 1DP UK

S-29-5512

Circle No. 103 on Readers' Service Card

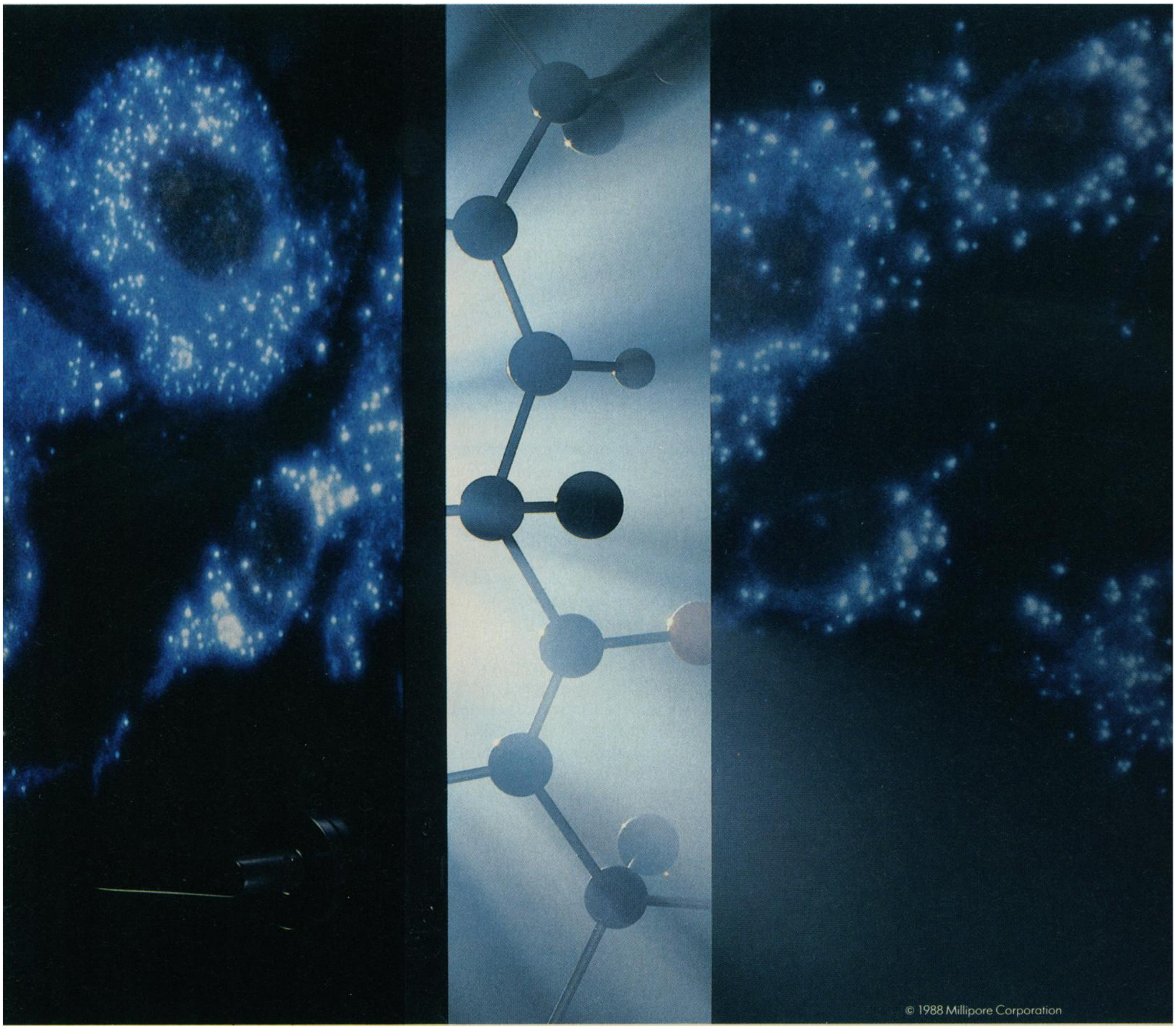
Unlocking the unknown.



In bioscience research, every step is a journey into the unknown. At Millipore, we have the tools and technologies to help you find the answers faster.

MilliGen/Biosearch synthesis and sequencing. With the widest range of reagents and instrumentation, we're putting new discovery power into labs of all sizes. Our H-Phosphonate and patented β-cyanoethyl chemistries are producing purer oligomers in less time, and the affordable Cyclone™ brings reliable DNA synthesis within the reach of almost any facility. MilliGen/Biosearch PepSynthesizers™ let you choose Fmoc or t-Boc protocols. And Covalent Sequencing of our ProSequencers™ opens the door to new levels of performance.

Waters™ high performance liquid chromatography. Advanced chemistries and equipment from Waters offer fast analysis and purification of proteins, peptides and nucleic acids. For example, the Waters Pico·Tag® System determines the composition of 50 times less protein than traditional methods. Preparative


© 1988 Millipore Corporation

gists with their subject matter was manifested during a symposium on population dynamics that focused heavily on Scottish seals and salmon. Students of salmon biology tended to neat tweeds, conservative politics, and pipe smoking whereas students of seals were kilted, bearded, and reddish. Out of intellect and passion there has developed a British, and generally Old World, tradition of painstaking, long-term, field investigation, which, though it may not have high prestige among the hot sciences of the universities, has enormous value.

At a deeper level, ecology is intractable in contrast with, say, traditional branches of physics, the epitome of intellectual tractability. Physics is free to decide what is or is not within its own domain. Meteorology and most nonlinear hydrodynamics were banished as non-physics for most of this century and permitted in only when a promising theoretical methodology became available. Sciences whose domains are defined by their capacities are tractable in a way that is impossible for sciences defined by a domain of subject matter. Ecology, geology, medicine, and other intractable sciences must wrestle with a preassigned subject matter as best they can, often by focusing on expensive test cases. But their subjects are ones of enormous importance. Major advances in intractable sciences can only be expected from new technologies, adequate funding, and intelligent administration, with constant reexamination of current state and pattern of progress. We cannot rely on rigid administration, proclamations, low funding, and the hope that somehow the problems will solve themselves.

We know that current applied ecology is mired in litigation and suffers a shortage of relevant data, at every scale from local water supplies to global wood supplies. We are not doing the obvious things that need doing. We know, for example, that satellites can provide ecologically important observations if their eyes are turned toward Earth and the resultant data are made generally available. This ought to be considered while NASA gropes for a post-shuttle mission. We know that ecotoxicology requires doing and isn't being done; and so on. Certainly scientific societies ought to be facing these various problems, and perhaps this volume can provide suggestions of how scientific societies can and cannot function. We must show better progress in the next 75 years, lest the problem becomes moot in the 75 years after that.

L. B. Slobodkin
Department of Ecology and Evolution,
State University of New York,
Stony Brook, NY 11794

Uses of Biology

Racial Hygiene. Medicine under the Nazis. Robert Proctor. Harvard University Press, Cambridge, MA, 1988. xii, 414 pp., illus. $34.95.

Since the Nazi period there have been a variety of books concerned with the so-called "roots," or at least background, of National Socialism. Proctor's intensively researched work is the most thoroughgoing yet with regard to the so-called scientific background of a movement that often declared itself to be "scientific" in the application of what it liked to call the "laws of life" to human affairs. It is a deeply disturbing book, concerned as it is with how fine scientific minds, many of which were at least formally committed to the practice of healing, not only "sold themselves to the devil" but, through their own theoretical musings and prejudice-tinctured social concerns, anticipated his arrival. It is an at times passionate exegesis on how "value-free" science is a disingenuous contradiction in terms and, more important, on how people who believe in so chimerical an enterprise could and can contribute to social pathology.

Proctor does not view the emergence of "racial hygiene" as an aberration. Indeed, one of the most valuable aspects of his work is his placement of this notion within the context of Western scientific traditions, the most important of which was that concerned with racial betterment. Here, Proctor points out that eugenics, not necessarily racist in nature or application, was a crucial concern not only of individuals who could be identified as "right-wing" in nature but of a panoply of left-wing or "progressive" thinkers as well as social reformers, including, among others, Margaret Sanger. Indeed, during the early years of the 20th century, individuals such as Alfred Ploetz, Wilhelm Schallmayer, and Ludwig Woltmann, who would later be seen as groundbreakers for the application of the Nazi scientific vision to human affairs, were "cautious advocates of certain forms of progressive social reform" (pp. 21–22). The application of presumably well-established biological laws (in part resulting from the overthrow of Lamarckian hypotheses by genetics) to social issues was part of the ideational environmental of Western civilization. Eugenics, and radical articulations of it such as forced sterilization of "defective" or "criminal" types, had found legal expres-