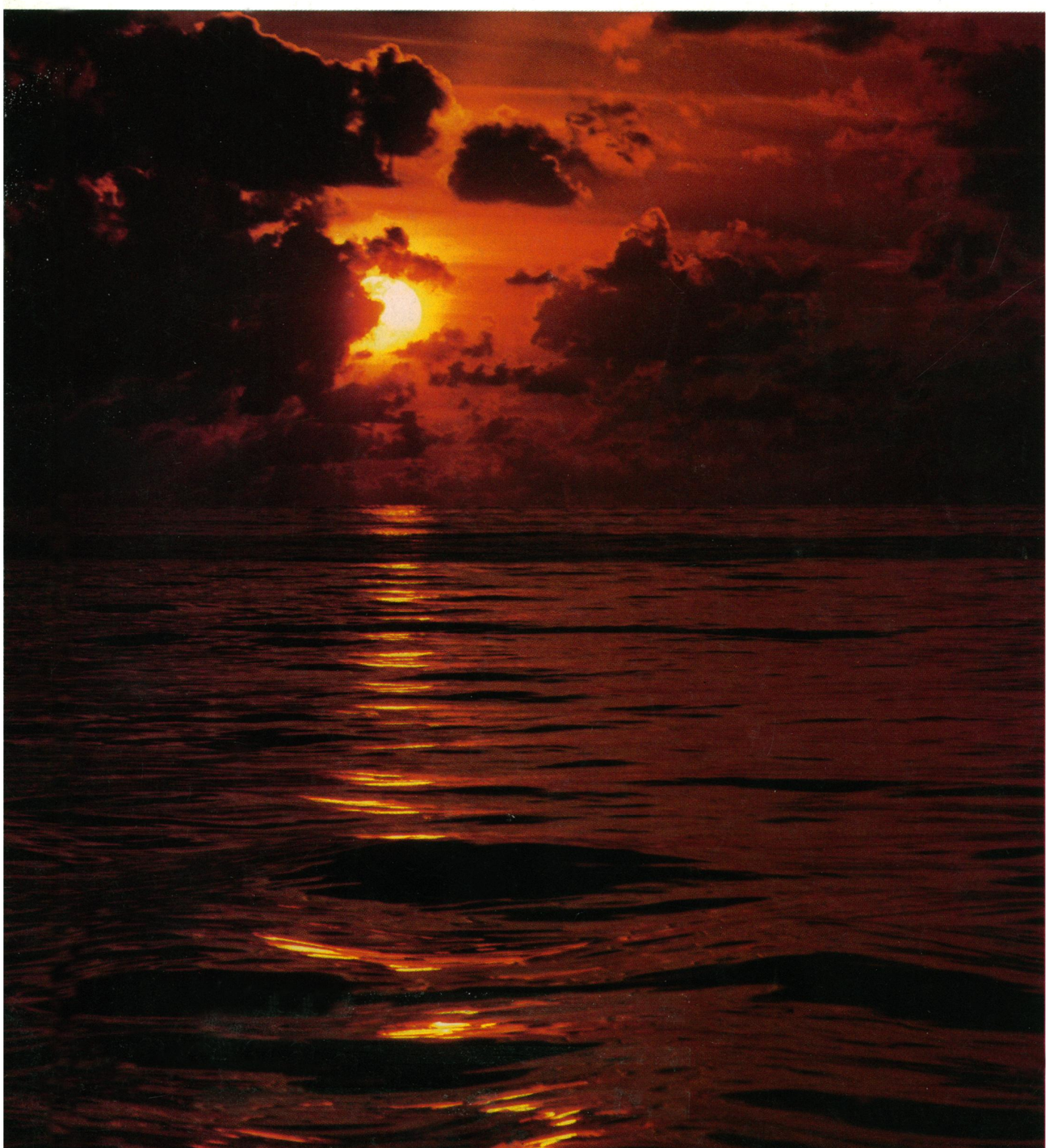
American Association for the Advancement of Science

SCIENCE

2 MAY 1986 $2.50
VOL. 232 ■ PAGES 553–684



INTRODUCING THE MICROASSAY SYSTEM...

FULFILLING THE PROMISE OF LABORATORY AUTOMATION.

■ The Microassay System from HP Genenchem gives you the ability to perform assays with new levels of accuracy and repeatability. ■ The system is a complete user solution optimized for microassay automation. ■ HP Genenchem is your single supplier for the entire Microassay System–so everything interfaces properly. ■ HP Genenchem and Hewlett-Packard supply worldwide post-sales service and applications support. ■ For more information, call the HP office listed in your white pages and ask for an analytical product representative. ■ 460 Point San Bruno Blvd., South San Francisco, California 94080.

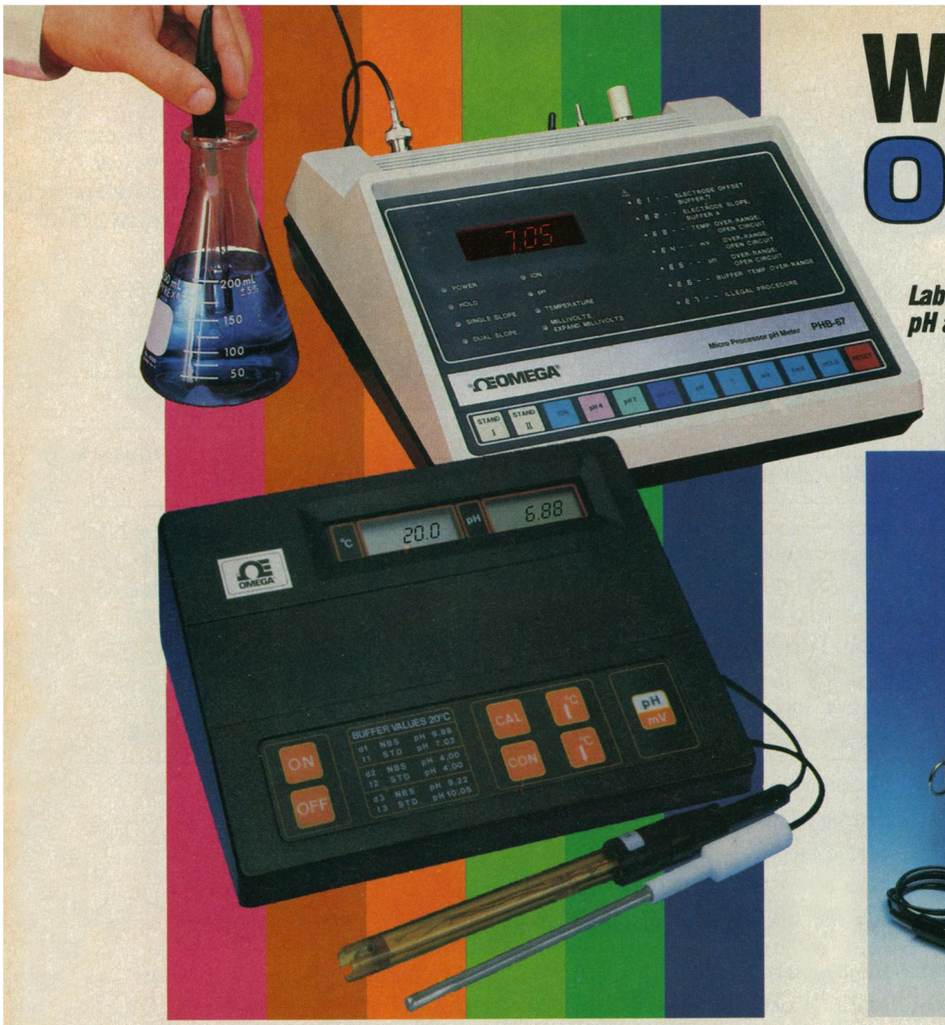
HP GENENCHEM

CAUCCUUGAGGUGAAAAUGAGAACUGUCACGAAAUG

Circle No. 48 on Readers' Service Card

With OMEGA®

Laboratory Benchtop pH and Specific Ion Readout

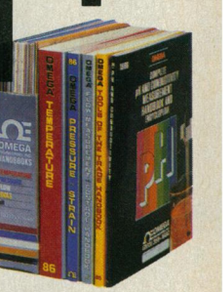


Microprocessor Based Laboratory Benchtop pH Meter

Conductivity and pH Meter/Calibration Kits

Three of the Hundreds of pH Products in this Handbook!
Largest Selection of pH Products in the World!

Nothing in pH is Beyond Measure



- ***ALL NEW! ALL FREE!***
- ***FULL COLOR!***
- ***PRICES INCLUDED!***
- ***OFF-THE-SHELF FOR IMMEDIATE DELIVERY!***

OMEGA ENGINEERING, INC.

(203) 359-RUSH

One Omega Drive, Box 4047, Stamford, CT 06907
Telex 996404 Cable OMEGA FAX (203) 359-7700

For placing orders, dial (203) 359-1660!

Circle Reader Service Number
to Receive Your NEW! FREE! Handbooks.

Circle No. 36 on Readers' Service Card

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SCIENCE

ISSN 0036-8075
2 MAY 1986
VOLUME 232
NUMBER 4750

■ **SCIENCE is published weekly on Friday, except the last week in December, and with a plus issue in May 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®** Domestic individual membership and subscription (51 issues): $65. Domestic institutional subscription (51 issues): $98. Foreign postage extra: Canada $24, other (surface mail) $27, air-surface via Amsterdam $65. First class, airmail, school-year, and student rates on request. Single copies $2.50 ($3 by mail); back issues $4 ($4.50 by mail); Biotechnology issue, $5.50 ($6 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*, 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 The open ocean is a potential source of cobalt, a strategic metal. Cobalt-rich ferromanganese crusts on the floor of the huge, new United States Exclusive Economic Zone are attracting interest as a potential mineral resource. See page 600. [Photograph courtesy of Dann S. Blackwood, U.S. Geological Survey, Woods Hole, Massachusetts 02543]

Designed To Freeze. Built To Work Hard. Priced To Sell.

BioFreezers. Zero To -120°C From Forma

If you need to purchase or replace an ultra-low temperature storage freezer, here's something to think about.

Some companies hurry to make freezers stuffed full of new technology and surprises. Patented mysteries.

Exciting freezers that warm-up, without warning and for no apparent reason.

Because the companies who build them aren't sure how they work to begin with.

So when their freezers freeze, nobody knows for how long. And when their freezers warm up, nobody knows why.

At Forma, we know our refrigeration systems very well. We develop new technologies for performance and durability. Test them with patience. Then guarantee them to work longer, harder and quieter . . . now, as cold as -120°C.

Which is why the real beauty is in the performance. And in your laboratory, that's all the excitement you'll ever need.

Call Us!

Free Offer!
Let us tell you more about our low prices and extended warranty protection.
A handcrafted silk rose, for your time and interest in the energy efficient upright and chest freezers from 0°C to -120°C.

Call us today, toll-free.

Forma Scientific
DIVISION OF MALLINCKRODT, INC.
BOX 649 MARIETTA, OH 45750 TELEX 29-8205

Toll-Free USA 800-848-3080 In Ohio 800-421-3080 In Canada 800-327-3080

Circle No. 42 on Readers' Service Card

This Week in
SCIENCE

Muscles flexed by flexible hormone

OXYTOCIN, a peptide hormone, induces uterine contractions during childbirth and the release of milk in lactating mammals (page 633). The key to the hormone activity that activates receptors in the body so that smooth muscle contractions are promoted may lie in the flexibility of oxytocin's three-dimensional structure. Wood *et al.* studied crystals of synthetic derivatives of oxytocin; the partially hydrophobic conditions within the crystal were considered similar to the environment within the body in which oxytocin interacts with its receptors. Oxytocin's conformation, stabilized by hydrophobic interactions and hydrogen bonding, is flexible with regard to the handedness of the single disulfide bond between amino acids in the molecule; the receptor may be similarly flexible and able to respond by activation to strong agonists (those having a left-handed bond) and by inactivity to (right-handed) antagonists. The two forms of the hormone may be in equilibrium, with the favored conformation dependent on the local environment. From these structural data, potent synthetic derivatives of oxytocin, even more pharmacologically active than those already available, may be designed.

Foot-and-mouth disease vaccine

A synthetic peptide vaccine that encompasses portions of the foot-and-mouth disease (FMD) virus elicits an immune response in cattle (page 639). DiMarchi *et al.* chemically synthesized a relatively small peptide having amino acid sequences found in the two most immunogenic regions of coat proteins of FMD virus. A two–amino acid spacer in the middle of the peptide bent the immunogenic regions toward each other; polymerization of the peptides into larger molecules was favored by positioning cysteines at both ends of the peptide so that disulfide bonds could form between two molecules. The simple vaccine, uncomplicated with carrier molecules or other immunogenic structures, induced long-lasting antibodies in cattle, and even a single vaccination protected some cows against infections by direct viral challenge. Complete protection was achieved with a booster immunization. Because FMD can cause extensive morbidity in a herd and can be economically devastating, a highly immunogenic vaccine, not containing live virus or extraneous immunogens, is desirable for FMD control.

Changing climates

CORE samples from two marine sites along the western coast of Africa indicate that major climate changes occurred on the earth 300,000 to 400,000 years ago (page 619). In the Northern Hemisphere, the climate shifted to more glacial conditions, and the earth became more arid as less moisture returned to the atmosphere by evaporation; in the Southern Hemisphere, an opposite trend brought a halt to the severe cold, and a humid interglacial period ensued. The changes in regional climate documented at these two sites are supported by changes in other marine and continental records—protozoa (foraminifera, radiolarians), algae (diatoms), pollen, rocks, sediments, carbonates, and lake salinity—from the period. Jansen *et al.* suggest that astronomically driven perturbations to the earth's orbit, periodic events that occur every 4.13×10^5 years, may have induced the global climate changes.

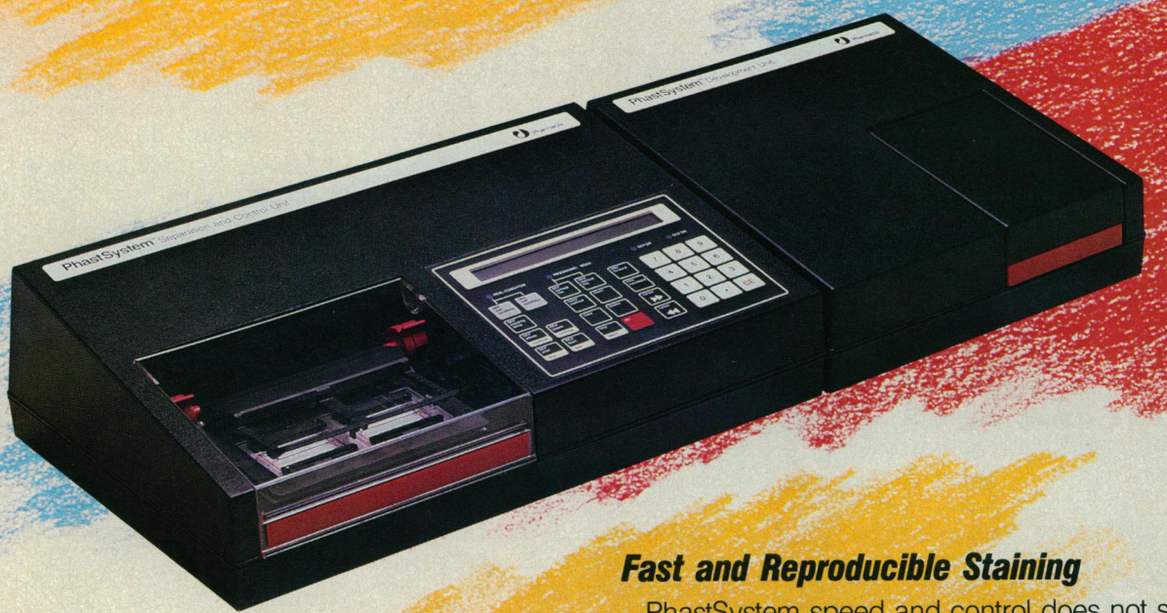
Gradual extinction of dinosaurs

EIGHT million years before the end of the Cretaceous Period, 30 species of dinosaurs lived in the northern Great Plains region; within 1 million years their extinction had begun, and by the end of the Cretaceous only 12 species remained (page 629). Between 7 and 11 species survived into the Tertiary Period, whose boundary with the Cretaceous is marked stratigraphically by an unusual abundance of the element iridium. Dinosaur teeth excavated together with pollen and teeth of the earliest Tertiary mammals in Montana, Wyoming, and Alberta date from some 40,000 years after the Cretaceous/Tertiary boundary. Thus the impact of an asteroid on the earth (to which the iridium anomaly has been attributed) seems to have been responsible for the extinction of only one to five species of dinosaurs. Sloan *et al.* attribute gradual extinction to a drop in global temperature during the final 15 million years of the Cretaceous, lowering of sea level and a concomitant increase in seasonality, major deterioration of flora as a result of climate changes, and competition between the dinosaurs and mammals for the flora that remained.

Alzheimer's disease protein

NERVE cells in the brains of patients with Alzheimer's disease contain large amounts of a protein, Alz-50, that does not appear to be a component of normal brains (page 648). Through immunization of mice with a homogenate of forebrain tissue from people who had Alzheimer's disease, Wolozin *et al.* were able to generate monoclonal antibodies that were specific for Alz-50. The antibody to Alz-50 was then used for identifying the protein in brain slices from normal and diseased human brains. It reacted best with tissue from the diseased temporal cortex, a portion of the brain that develops lesions (tangles and plaques) as neuronal degeneration progresses and intellectual functions are lost in Alzheimer's disease. The antibodies to Alz-50 showed less reactivity with other brain regions that develop lesions and little reactivity with normal brains or with regions of the Alzheimer's brain not involved in the disease. The source and function (if any) of Alz-50 are not known.

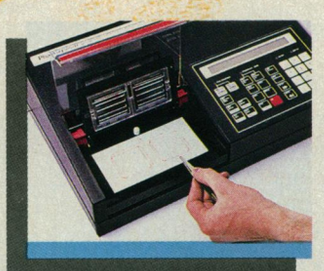
Electrophoresis at the speed of biotechnology.



Technology moves fast. Biotechnology moves faster yet. Chromatographic separations that once took days are done in minutes. Now that same speed and accuracy is available for electrophoresis.

20 Minute Electrophoresis

PhastSystem uses a futuristic combination of preformed, ultra-thin, microelectrophoresis gels and computer-controlled instruments to effect absolutely unmatched speed and reproducibility in electrophoretic separations. Automated sample application creates a perfect volume and width of sample application zone. An internal power supply with volt-hour integration control assures "same-condition" reproducibility from one gel to the next. Preformed PhastGel™ Gradient runs SDS and native PAGE in less than 30 minutes. PhastGel™ IEF, in any of 3 popular pH ranges, runs in less than 20 minutes.



Fast and Reproducible Staining

PhastSystem speed and control does not stop at gel running. Staining, destaining and general gel development control is also commanded by PhastSystem. Done in a sealed "spin" compartment, automated temperature and solvent exchange programming takes detection to new levels of ease and reproducibility.

Now, with PhastSystem, your electrophoresis results come up to speed with the rest of your laboratory. Isn't it about time you found out more about PhastSystem?

PhastSystem™
IT'S ABOUT TIME

Pharmacia

Laboratory Separation Division
Piscataway, New Jersey 08854
Information: (800) 526-3618
In NJ: (201) 457-8000

553

Pharmacia products will be on display at ASBC - Booths E46, E48, E50, E52, F45, F47, F49, F51

Circle No. 57 on Readers' Service Card

SCIENCE

2 MAY 1986
VOLUME 232
NUMBER 4750

A "One License–One Hearing" Policy

A landmark in the development of modern genetics was the "one gene–one enzyme" hypothesis. A "one license–one hearing" policy might provide a helpful impetus to the regulation of genetic engineering.

The development of a new biotechnology industry stands at a crossroad. The path traveled in developing new technologies has often been filled with recriminations between those who think we are going too slowly and those who think we are going too fast. Today, industrial advocates say that the new biotechnology industry is a fragile infant whose health is being impaired by the burden of bureaucratic red tape and unconscionable delays in litigation. Environmental groups say we are tampering with fundamental natural processes and that the hazards are too great to justify speed.

The vast majority of individuals on both sides are trying to do "the right thing." A good, safe destination is everyone's goal. However, different travelers use different premises and arguments on the most appropriate pathway. Science attracts adventurous souls who by nature are impatient with obstacles. Regulators are more cautious types, reasoning that change involves risk and that risk is more likely to lead to harm than to benefits.

An application for biotechnology experimentation can face interminable delays in multiple agencies in Washington, further delays in states and localities, and still be subject to lawsuits. Can scientists and environmentalists find a more direct and well-lighted path to safety and goodness? It seems possible that, with ingenuity and reasonableness, we can.

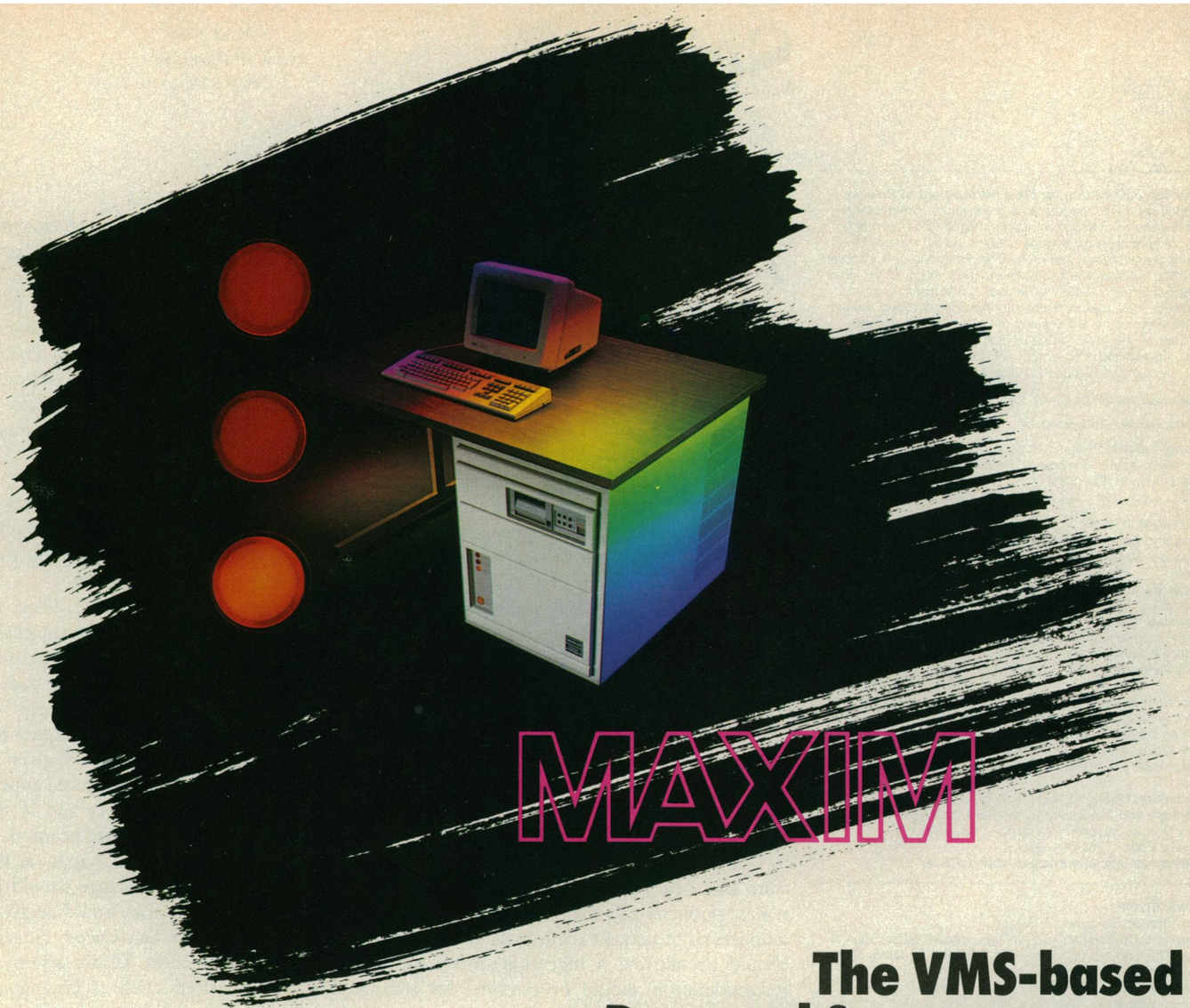
There are already a number of regulatory bodies in Washington with power to authorize genetic engineering applications and research. At the federal level each request for a license could be assigned to the agency most appropriate for that case, with notice given to all other regulatory bodies having overlapping interest or authority. The latter could appear as friends of the "court," posing questions to the primary regulatory agency and to the applicant; they might add words of wisdom, but they could not hold separate hearings.

After the federal regulatory decision is reached, similar processes would apply at the state and local levels but with a "one state–one hearing" limit also. Hearings should be widely publicized so that all interested parties could have a say. Protestors would be given ample time to present their cases, but unreasonable delays would not be allowed. No side should be allowed a rehearing under another regulatory jurisdiction. Court action or reconsideration should be reserved for serious substantive matters such as findings of erroneous or concealed data; suing parties should be liable for financial damages when legal delays are frivolous or ill-considered.

Some will argue that this is not the American way, that we are entitled to litigious and chaotic behavior patterns. Nonetheless, the public appears fed up with excessive lawsuits that are closing playgrounds, preventing parades, and bankrupting city governments. More rational procedures will require good will and superior imagination on all sides. The public is apprehensive regarding this new technology and determined to be vocal in the decision-making; impatient scientists and industry have to listen. In turn, biotechnologists can expect laypersons to make their arguments in a timely manner. Furthermore, responsible industrialists should be willing to blow the whistle on colleagues who push experiments or field trials too rapidly just as environmentalists should blow the whistle on colleagues who use excessive delaying tactics. By having one well-organized hearing for a federal license and one hearing for a state license, both accountability and deliberate speed can be accommodated.

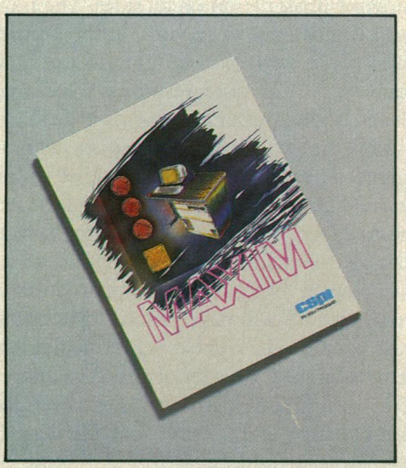
We are entering the era of a global economy. No country can afford to have the senseless procedures and unproductive delays that are the hallmarks of the present system. Since biotechnology regulatory machinery is just being developed, rational procedures can more readily be instituted now rather than later when staff and jurisdictions have become entrenched. It has been said that society will always come to the right conclusion after it has exhausted every other possible alternative. In the present case, we cannot afford to grope to conclusions by legal trial and bureaucratic error. By opting for a path not taken heretofore, we can protect both the environment and an infant industry, and possibly find that a genetic analogy may lead to the survival of the fittest regulatory procedure.

—DANIEL E. KOSHLAND, JR.



The VMS-based Personal Supercomputer

MAXIM brings supercomputer power to the office of the individual scientific researcher. MAXIM is a VMS-based system where a powerful CSPI array processor—either single or double precision—is synergized with Digital Equipment Corporation's MicroVAX II to boost computational speed. The result? Performance up to 50 times faster than a VAX 11/780. Plus total independence for the researcher. FORTRAN compatibility. A VMS-development environment. And economy of space and dollars.



Ask for your free MAXIM brochure today.

MAXIM Action...Here's how to get it.

Call Toll Free 1 800 325-3110
(In Massachusetts call 1 617 272-6020)

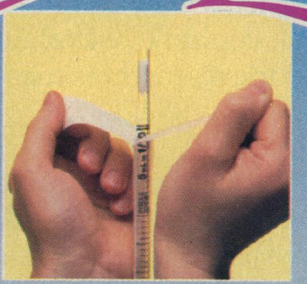
cspi
COMPUTATIONAL SPEED FOR SCIENCE AND ENGINEERING

40 Linnell Circle, Billerica, Massachusetts 01821

VMS, MicroVAX II, and VAX 11/780 are trademarks of Digital Equipment Corp. MAXIM is a trademark of CSP Inc.

The PYREX® PEEL & SNAP CHALLENGE

When you use disposable pipets, you deserve all the convenience you can get. You deserve our new Steri-View™ wrap, exclusive with PYREX brand pipets.



Part paper, part plastic, totally convenient.

We challenge you to see for yourself.

See the whole pipet for quick identification. Just pull the generous tabs and peel open. Or hold the tabs and snap open.

Either way, it's easy. No static cling. No nuisance to compromise sterility. Why settle for less?

Another exclusive is the slender tapered tips for easy entry into tight spots. Fire polished, of course!

Available from authorized Corning dealers. Also available under the FISHERbrand and CMS Labcraft labels. Individual wrap, multi-pack or bulk.

More Good News From Corning

THE PYREX® PEEL & SNAP BONUS

☐ Buy 2 cases of our disposable pipets and receive a "More Good News From Corning" collector's beaker mug free.
☐ Buy 5 cases and receive a Thermique® coffee server free.

Just send this coupon with Proof of Purchase attached to your letterhead with name, title and address. Mail to Corning Science Products, P.O. Box 1150, Elmira, N.Y. 14902-9944. Proof of Purchase can be an invoice, packing slips or case labels. Start accumulating your orders now. Offer expires October 31, 1986.

The Most Trusted Tools Of Science

SE-05-86-PL

CORNING

Circle Reader Service No. 64 For Brochure and Corning and Pyrex Pipets.

Science Products a **CORNING** Laboratory Sciences Company

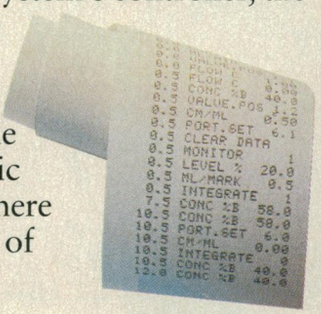
THE CURIOUS CASE OF

Recently a group of researchers encountered an unusual problem. While investigating the biological function of proteins with an FPLC® System, the group discovered extra peaks, peaks that couldn't be explained.

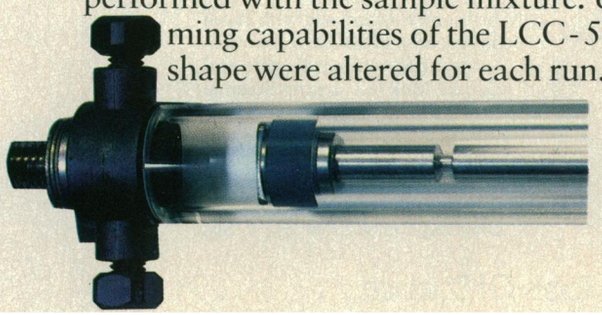
This FPLC case history explains how the researchers turned their chromatography problem into a discovery.

SEVEN PEAKS INSTEAD OF TWO. During the early stages of the project, the group invited a Pharmacia representative to come and demonstrate the FPLC System. The system was quickly assembled. Knowing the approximate characteristics of the sample's proteins (pI, stability and size), the representative consulted Pharmacia's comprehensive library of FPLC methodology. Conditions for the separation, including column type, monitor wave length, and buffer system, were thereby determined.

Next a separation run on a column prepacked with Mono Q™, an anion exchanger, was programmed into the system's controller, the LCC-500. The sample was then injected automatically by the MV-7 motorized valve. In the course of ten minutes, a totally unexpected chromatographic pattern had appeared on the controller's printout. The sample contained two specific proteins that should have given rise to two peaks. But here were seven peaks – casting some doubt upon the merit of this high performance liquid chromatography system.



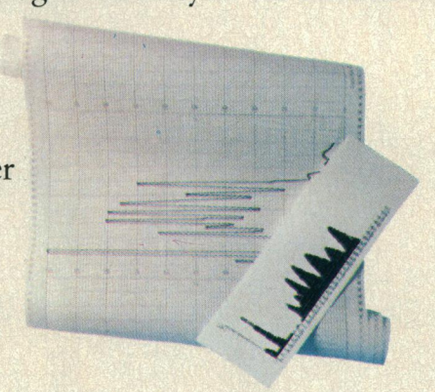
SAME UNEXPLAINED RESULTS. That same day, several separations were performed with the sample mixture. Using the simple, automatic programming capabilities of the LCC-500, other conditions such as gradient shape were altered for each run. Because of the great speed of the system – 10 minutes per run in this case – many runs could be completed. Yet the same results appeared every time.



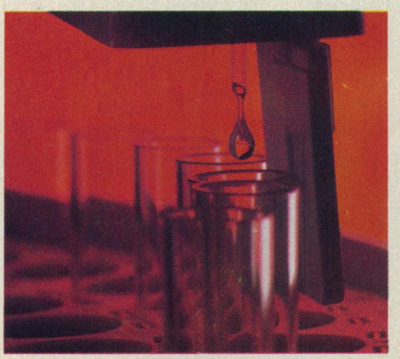
THE FIVE EXTRA PEAKS

THE BREAKTHROUGH. The reproducible results from the FPLC System convinced the researchers to take a second look at the seven peaks. After several days of further investigation they again contacted Pharmacia – the peaks were revealed to be iso-forms. No other high performance liquid chromatography system had been able to isolate these particular iso-forms, let alone in just ten minutes.

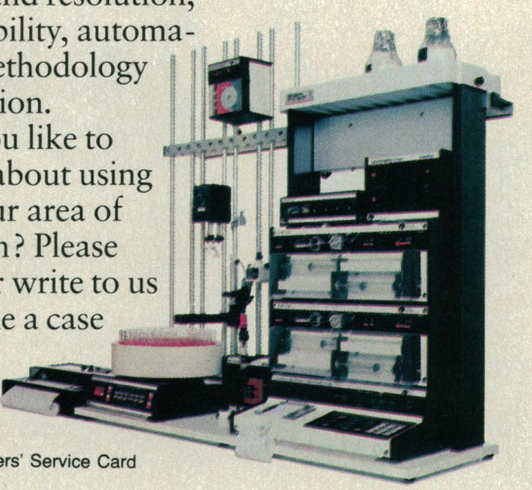
Central to the breakthrough was the system's biocompatibility, which enabled the researchers to maintain the biological activity of the collected fractions. This activity also permitted the study of the immunoregulatory activity of the fractions. The peaks were found to represent different immunostimulants and immunosuppressants, which had never before been so well separated and characterized. The FPLC System has enabled the group to extend their investigations into unexplored areas of biomedical research.



DISCOVER MORE. You can extend your own investigations, too. If your work involves the separation and purification of proteins, peptides, and other biomolecules, the FPLC System can provide you with advantages that turn problems into discoveries. Like the advantages that created success in this case history: high speed and resolution, biocompatibility, automation, and methodology documentation.



Would you like to learn more about using FPLC in your area of investigation? Please contact your Pharmacia representative or write to us at the address below. Maybe we can make a case for having an FPLC in your laboratory.



Circle No. 58 on Readers' Service Card

Pharmacia

Laboratory Separation Division
Piscataway, New Jersey 08854
Information: (800) 526-3618
In NJ: (201) 457-8000

Pharmacia products will be on display at ASBC - Booths E46, E48, E50, E52, F45, F47, F49, F51

Now, get the SORVALL® Ultra Beckman rotors in it: Du Pont

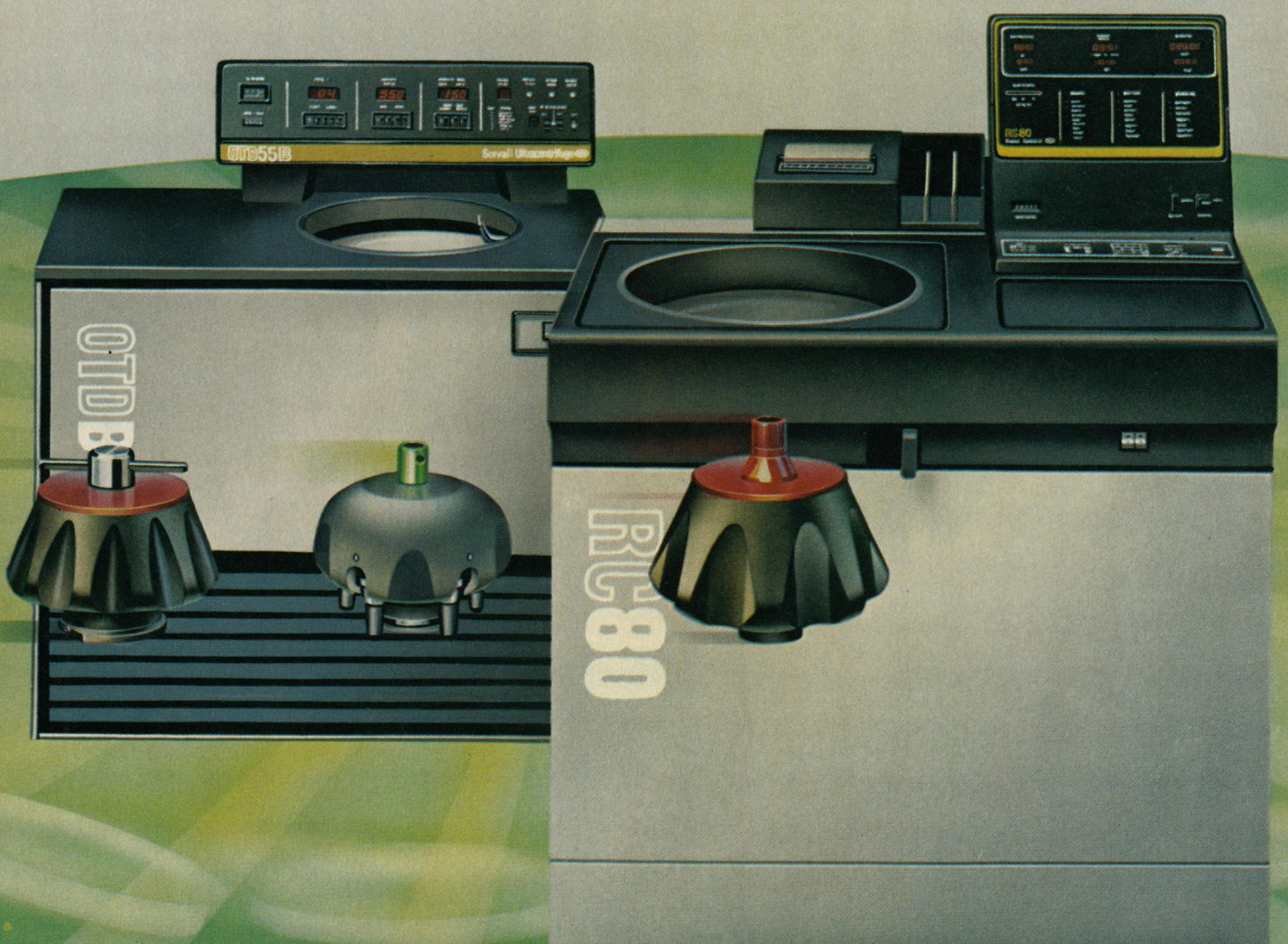
Your Beckman ultraspeed rotor inventory retains its value when you buy a SORVALL® Ultracentrifuge.

When you move up to a SORVALL OTD-B or RC-Ultra, you get new freedom to choose the rotors best suited to your needs without risking your warranty protection. You know you can choose from among the ultra rotors in the comprehensive SORVALL line. *But,* you also can interchange most Beckman rotors in a SORVALL Ultra without worrying about which rotors you use or which instrument they're used in, because Du Pont assumes the remainder of the warranties.

you really want and use your assumes their warranties.

Du Pont devised this liberal rotor warranty to provide you with the maximum centrifugation versatility possible. With a SORVALL®, you keep your rotors active.

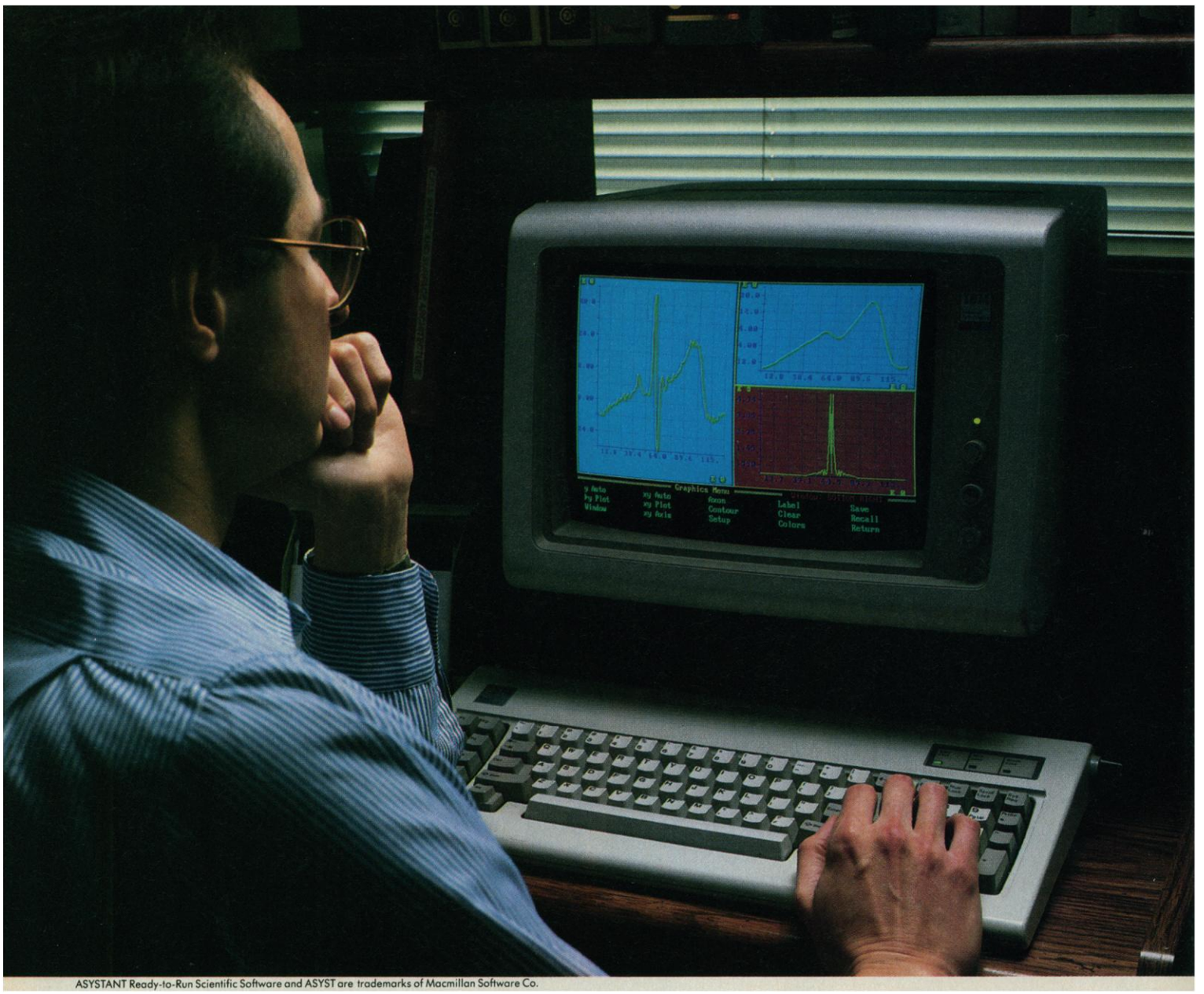
For information on this SORVALL warranty policy and a brochure on SORVALL Ultracentrifuges (six models, from economy to the most automated), **phone toll free (800) 345-8600, Ext. 500,** or write: Du Pont Company, BRML #162210, Wilmington, DE 19898. In Canada **call (416) 745-9870.**



Sorvall® Centrifuges
We've got a centrifuge that's just your speed

DU PONT
REG U.S. PAT & TM OFF

Circle No. 117 on Readers' Service Card



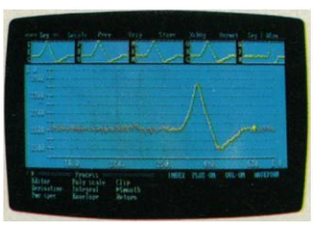
ASYSTANT Ready-to-Run Scientific Software and ASYST are trademarks of Macmillan Software Co.

Now choose from a menu.

Two scientific software systems for the way you do research.

New ASYSTANT
Ready-to-Run Scientific Software.™

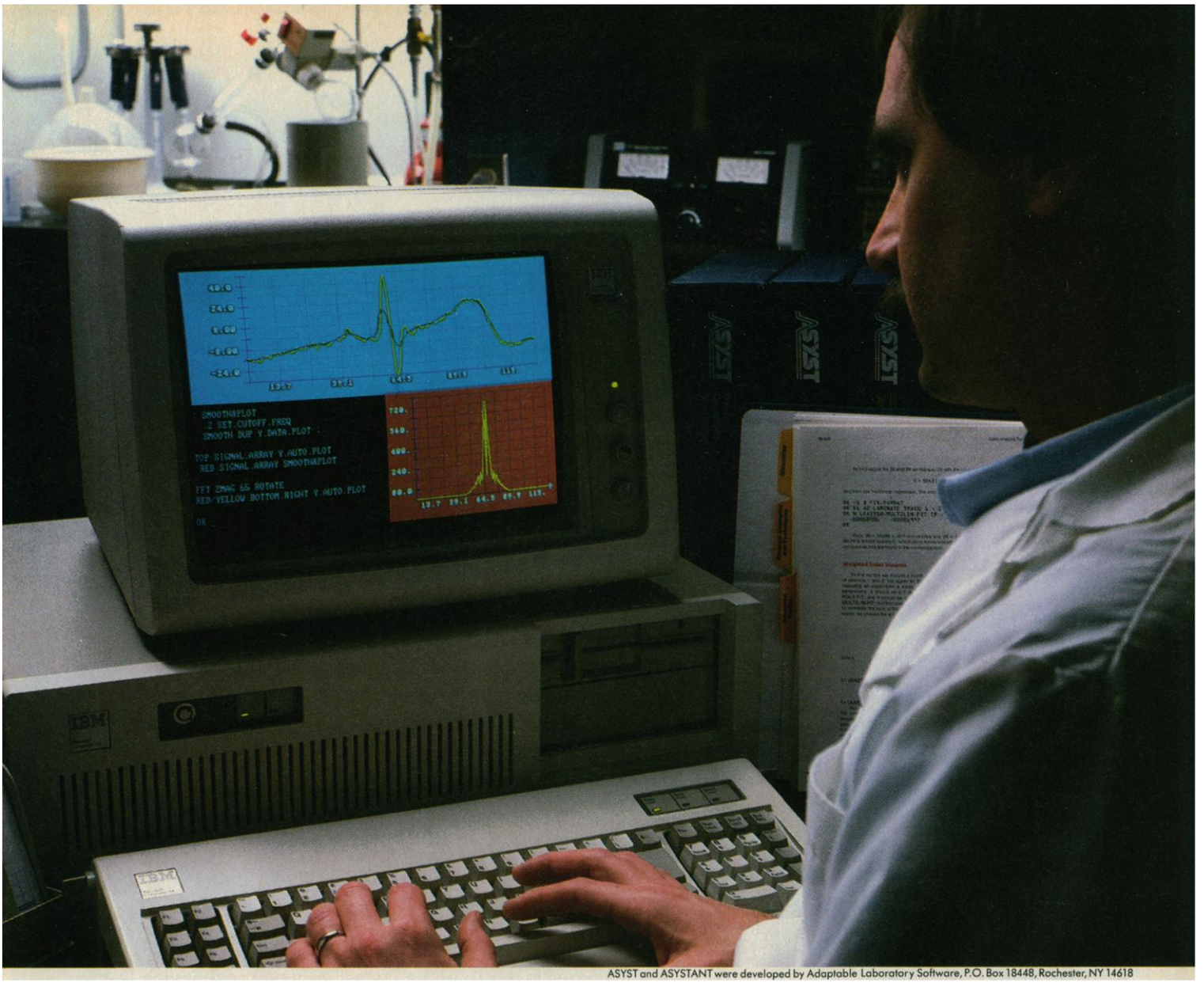
Macmillan Software proudly introduces ASYSTANT **menu-driven** software. The first scientific software that lets you acquire, reduce, analyze, and graph data—without programming!



ASYSTANT is a comprehensive, fully-integrated research system—so you won't waste time flip-flopping data from one package to another to get the results you need. Only ASYSTANT gives you a wide range of one-touch reduction/analysis functions supported by interactive graphics that guide you every step of the way. Built-in functions include FFT, smoothing, integration, differentiation, curve fitting, statistics, differential equations, and matrix and polynomial operations.

Only ASYSTANT offers all this power—plus optional menu-driven data acquisition for push-button control of lab equipment—at prices starting **as low as $495!**

For information on ASYSTANT, circle 61.



ASYST and ASYSTANT were developed by Adaptable Laboratory Software, P.O. Box 18448, Rochester, NY 14618

Or make it to order.

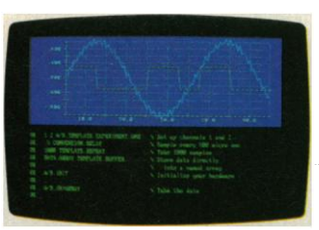
ASYST.™

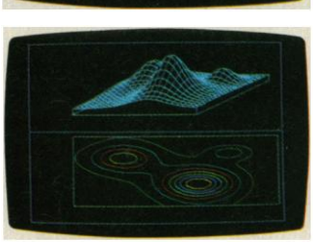
More interfacing, analysis, and graphics capabilities than any other PC software.

Macmillan's widely-acclaimed ASYST™ Scientific Software offers an interactive **programming environment** with the built-in functions of ASYSTANT—plus many more.

ASYST's unique capabilities provide the building blocks that let you assemble scientific applications—fast. Sophisticated functions that would take hours using standard programming languages take only minutes with ASYST. And full-scale systems that would take months to develop can now be created in just a few days.

RS-232 and optional A/D and GPIB/IEEE-488 support offer more interface versatility than any other scientific software. All hardware support functions integrate seamlessly with the full range of ASYST capabilities.





Try ASYST or new ASYSTANT for 30 Days.

CALL 1-800-348-0033

In New York state, (212) 702-3241.

Macmillan Software Co.

An affiliate of Macmillan Publishing Company
866 Third Avenue, New York, NY 10022

For information on ASYST, circle 62.

For information on both products, circle 63.

SCIENCE/SCOPE®

Electronics engineers and doctors have created an implant to improve the hearing of profoundly deaf people. The device uses a microphone and pocket-sized signal processor to convert sound waves to electrical impulses. A transmitter behind the ear sends these electrical signals through the skin to a nickel-sized receiver/stimulator implanted in the mastoid cavity. From there, signals travel along an electrode array threaded to the snail-like cholea of the inner ear. Auditory nerve fibers receive these electronic signals and transmit them to the brain—tricking it into thinking the ear can hear normally. The electrode of the electronic ear is protected by a plastic coating material, which must provide electrical reliability and long life. Since most polymer insulations tend to lose adhesion in body fluids after a period of time, the National Institutes of Health has asked Hughes Aircraft Company to subject three coating materials to intensive testing. One plastic was created by Hughes, originally for high-temperature electronic and structural uses; the others were developed by Union Carbide and Dupont.

The last in a series of three spacecraft for AT&T is carrying telecommunications throughout the United States. Telstar 3B can handle 21,600 long-distance telephone calls simultaneously or a mix of voice, video, and high-speed data services. It carries 24 transponder channels, which can be switched by ground command to various combinations of regional coverage across the continental U.S. and Hawaii, Alaska, or Puerto Rico. The cylindrical satellite measures 7 feet 2 inches in diameter and 22 feet 5 inches high and is based on the Hughes HS 376 model. It is the world's most successful commercial communications satellite, with 30 spacecraft ordered to date.

A cryogenic refrigerator designed to cool infrared sensors has passed a test equivalent to operating three years in space. The Vuilleumier cycle cooler, set in operation at twice its normal speed in order to simulate a design life of five years, has passed the year-and-a-half point of flawless operation. The device will be used with infrared sensors in space for applications such as defense and geological surveys. The sensors must be chilled to near absolute zero to maintain adequate sensitivity to low-temperature thermal radiation. The VM cooler, developed by Hughes, is believed to be the only one of its type to have performed this long at such low temperatures.

An experimental digital-to-analog converter chip is 10 times faster than the fastest conventional device. The chip, being developed at Hughes for advanced airborne radars, uses gallium arsenide as the substrate material. It has a settling time of 200 picoseconds, about an order of magnitude faster than a record-holding 6-bit Hughes silicon device. The new converter so far outdistances commercial devices that design engineers are developing special interfaces so that the device can be hooked up in data conversion systems for further testing and analysis.

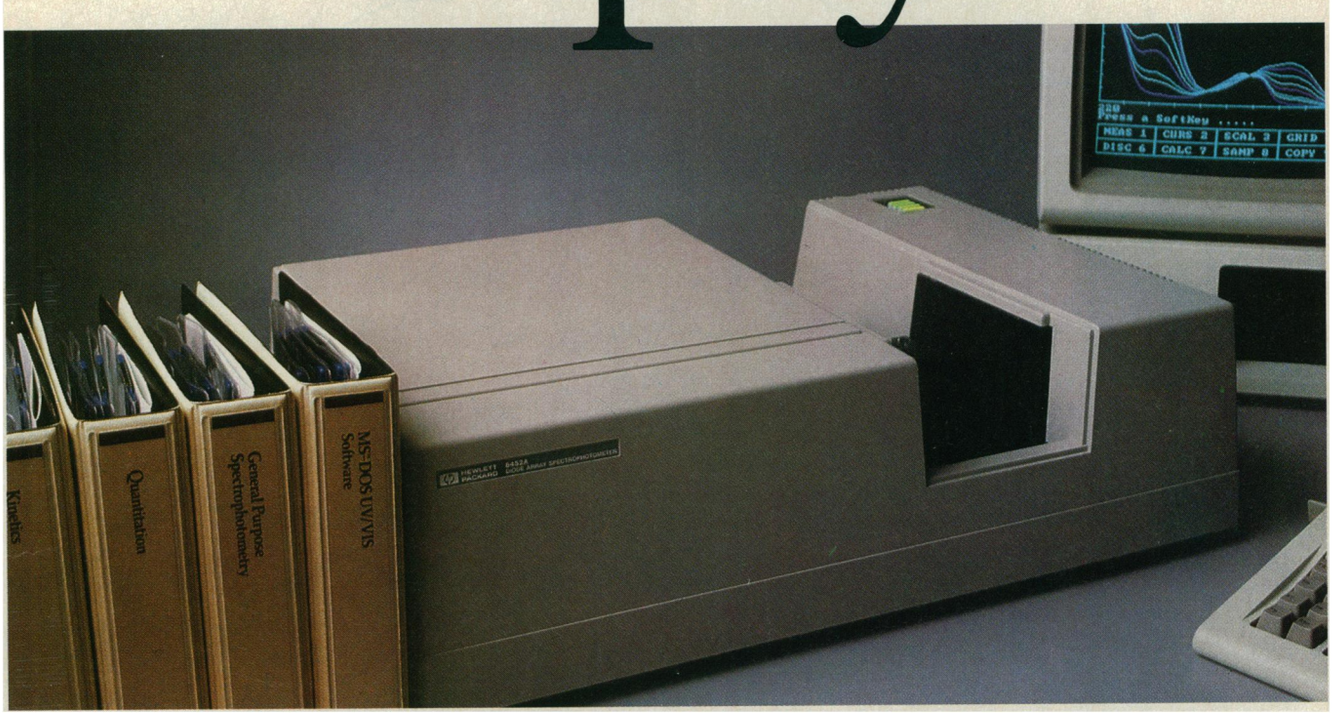
Hughes Ground Systems Group is applying its airspace management experience to the exciting challenges of worldwide air traffic control. These systems will be designed to ensure service 24 hours a day, 7 days a week. They will support distribution of processing among multiple computers linked via local area networks. The many challenges include design and development of hardware and software to support advanced display and man-machine interface technology, and using satellite technologies for future ATC applications. To help design the next generation of air traffic control systems, send your resume to Hughes Ground Systems Group, Employment Dept. S2, P.O. Box 4275, Fullerton, CA 92634. Equal opportunity employer. U.S. citizenship required.

For more information write to: P.O. Box 45068, Los Angeles, CA 90045-0068

HUGHES
AIRCRAFT COMPANY

Subsidiary of GM Hughes Electronics

Small price to pay.

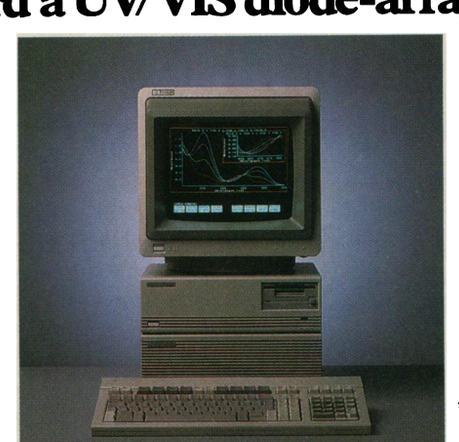


Now, any lab can afford a UV/VIS diode-array spectrophotometer.

HP's low-cost spectrophotometer is now available with a choice of controllers, so any lab, regardless of budget, can reap all the benefits of advanced diode-array technology. Greater precision and accuracy. More speed and reliability.

If you already own an IBM PC, you can purchase the HP 8452A and generic MS-DOS UV/VIS software for only $7650. If you qualify for our 15 percent educational discount, it's only $6502.*

Software available includes general scanning, quantitation, and kinetics.



The HP UV/VIS ChemStation gives you a broad selection of software and peripherals.

For maximum capabilities, including full automation, you'll want the UV/VIS ChemStation. It's so easy to use, you don't even need an operator's manual.

For more information, call the HP office listed in your telephone directory white pages and ask for an analytical product representative. Or write Hewlett-Packard Analytical Group, 1820 Embarcadero Road, Palo Alto, CA 94303.

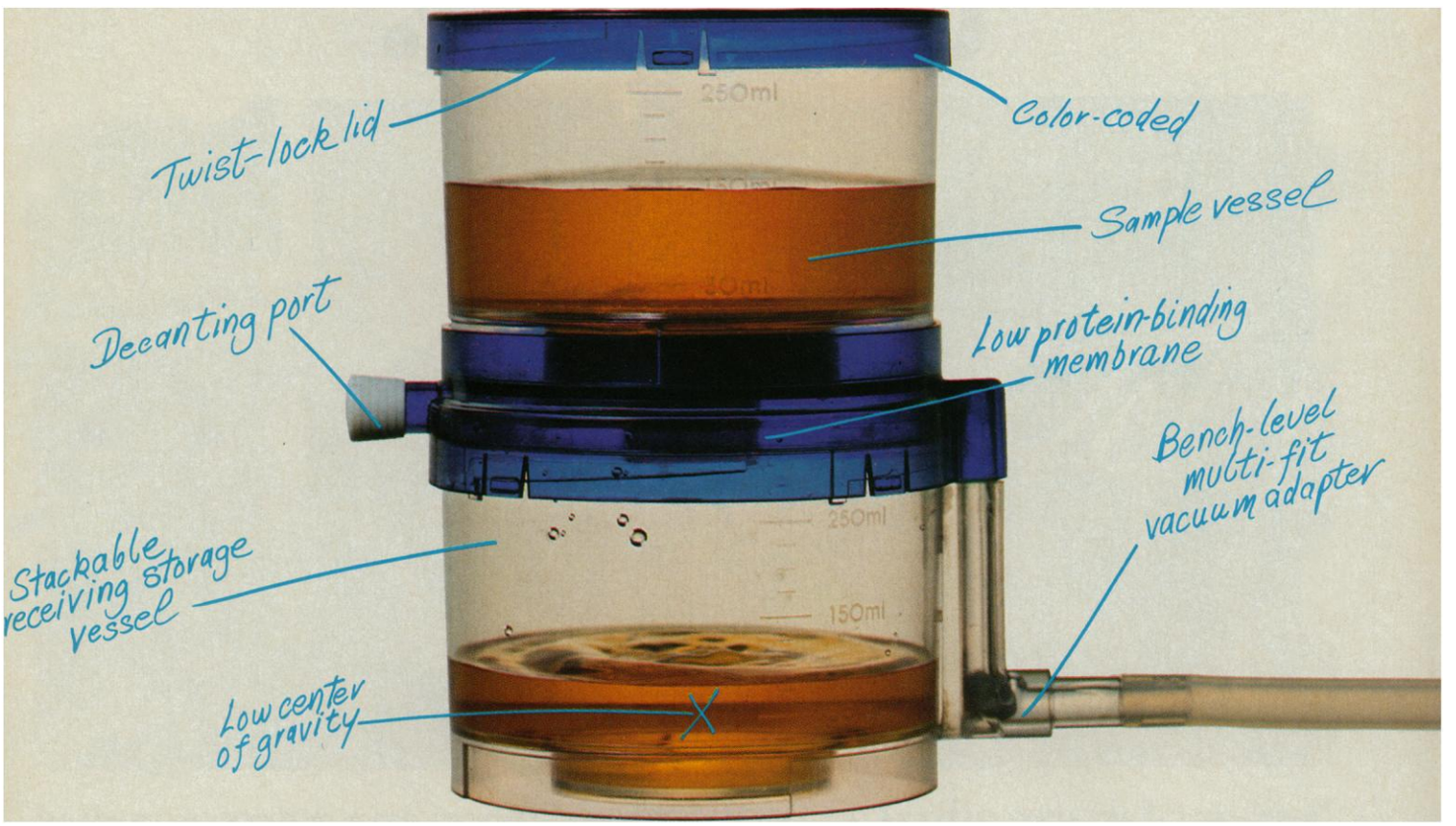
* U.S. domestic prices only.
MS-DOS is a U.S. registered trademark of Microsoft, Incorporated.

HEWLETT PACKARD

AGO4601

For literature circle reader service number 93
To have an HP Representative contact you circle reader service number 94

NO TIPPING ALLOWED.

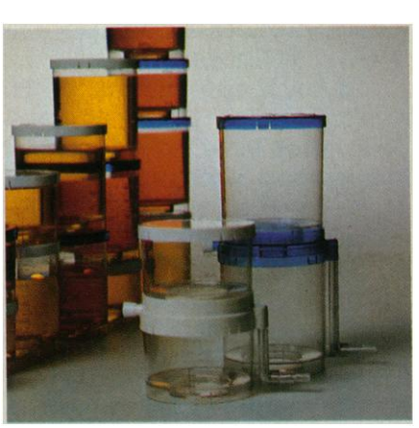


Introducing Vacuflo,™ the only disposable vacuum filter designed to stand on its own.

Schleicher & Schuell design engineers decided to take a stand on a costly and very common problem: the all-too-easily tipped over vacuum filtration device.

Their solution is the innovative new Vacuflo unit. Take a look at the thinking that's gone into it. Low center of gravity. Bench-level multi-fit vacuum port. And many other features. You'll have to agree it's based on a foundation of solid, unique design ideas.

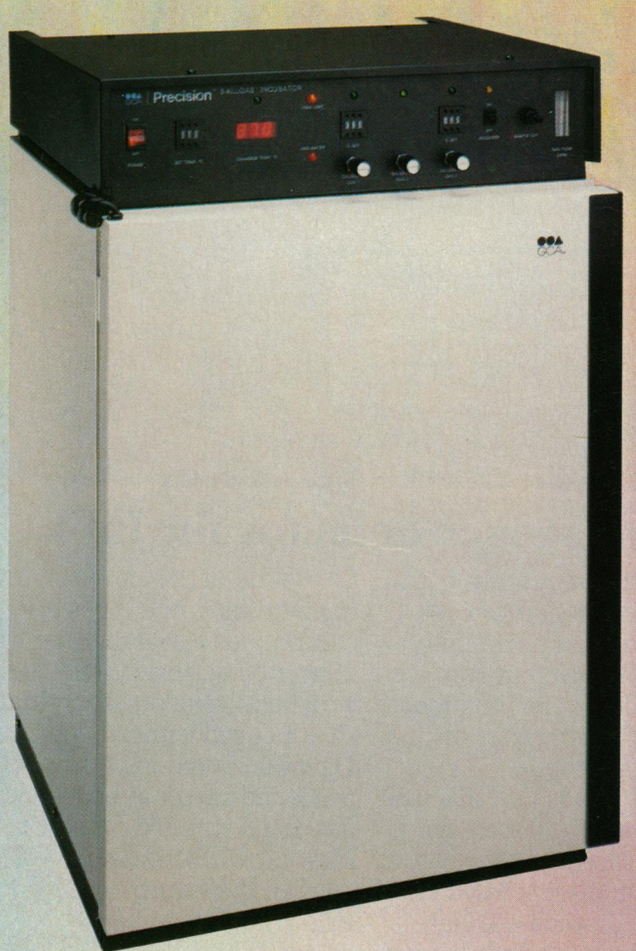
The disposable Vacuflo filter is available in 250 or 500 ml sizes. It's gamma sterilized (no ETO residues) and ideal for sterile filtration of biologicals, sera or serum-free media. And, a glass fiber prefilter (your option to use or not) is included in each package. For technical information, contact Schleicher & Schuell's Customer Services Department.



Schleicher & Schuell

Schleicher & Schuell, Inc., Keene, N.H. 03431 800-245-4024 • 603-352-3810 **Innovators in Separation Science**

Circle No. 87 on Readers' Service Card



FINE TUNE YOUR ATMOSPHERE WITH PRECISION

Gas densities impact flow rates in the time/flow incubators of today. That's why we put three sensitive needle valves on the new Precision Three Gas Incubator to let you fine tune each gas for optimum flow.

This exclusive fine tuning lets you be sure your cultures experience the atmosphere you select.

And the choice is yours. Set % O_2, CO_2, N_2, or whatever gas you need for an accurate in vitro modeling of your in vivo conditions.

You get precise °C control as well. Two heaters in the water jacket, above and below, hold 37°C ±0.1°C. No condensation on top. No chamber 'rain' to contaminate samples. Platinum probe right inside reacts to the same environment as your cells.

For distribution, pricing and ordering information, call **1-800-524-9482.** Or return coupon.

I'M HOT FOR MORE

- ☐ Send details on the new Precision Three Gas Incubator
- ☐ Have a sales representative call
- ☐ Send details on how to receive the new 1985 Precision constant temperature catalog.

Mail coupon on your letterhead with name, title, and address to Precision Scientific, 3737 West Cortland Street, Chicago, Illinois 60647.

Precision® Scientific

MEMBER SAMA SCIENTIFIC APPARATUS MAKERS ASSOCIATION

For literature circle reader service number 106
To have a Sales Representative call circle reader service number 107

Selective.

The programmable fluorescence detector for HPLC.

Like you perhaps, Sarah works in a biochemistry lab where her primary responsibility is analyzing amino acids in the low picomole range. She needs sensitivity—without trading off selectivity.

Finally she's found a fluorescence detector that lets her time-program the optimum sensitivity and selectivity for each derivitized amino acid. What's more, the HP 1046A gives Sarah the opportunity to use phosphorescence and chemiluminescence detection at no extra cost.

She can time-program both excitation and emission wavelengths, automatically switching wavelengths for different compounds. The detector's functional keyboard and 32-character display make it very easy to use.

The best part is that this new detector gives Sarah all these features for little more than the cost of an ordinary fluorescence detector.

And it is so small and lightweight it can be moved easily from one HPLC to another as needed. It is fully compatible with any HPLC system.

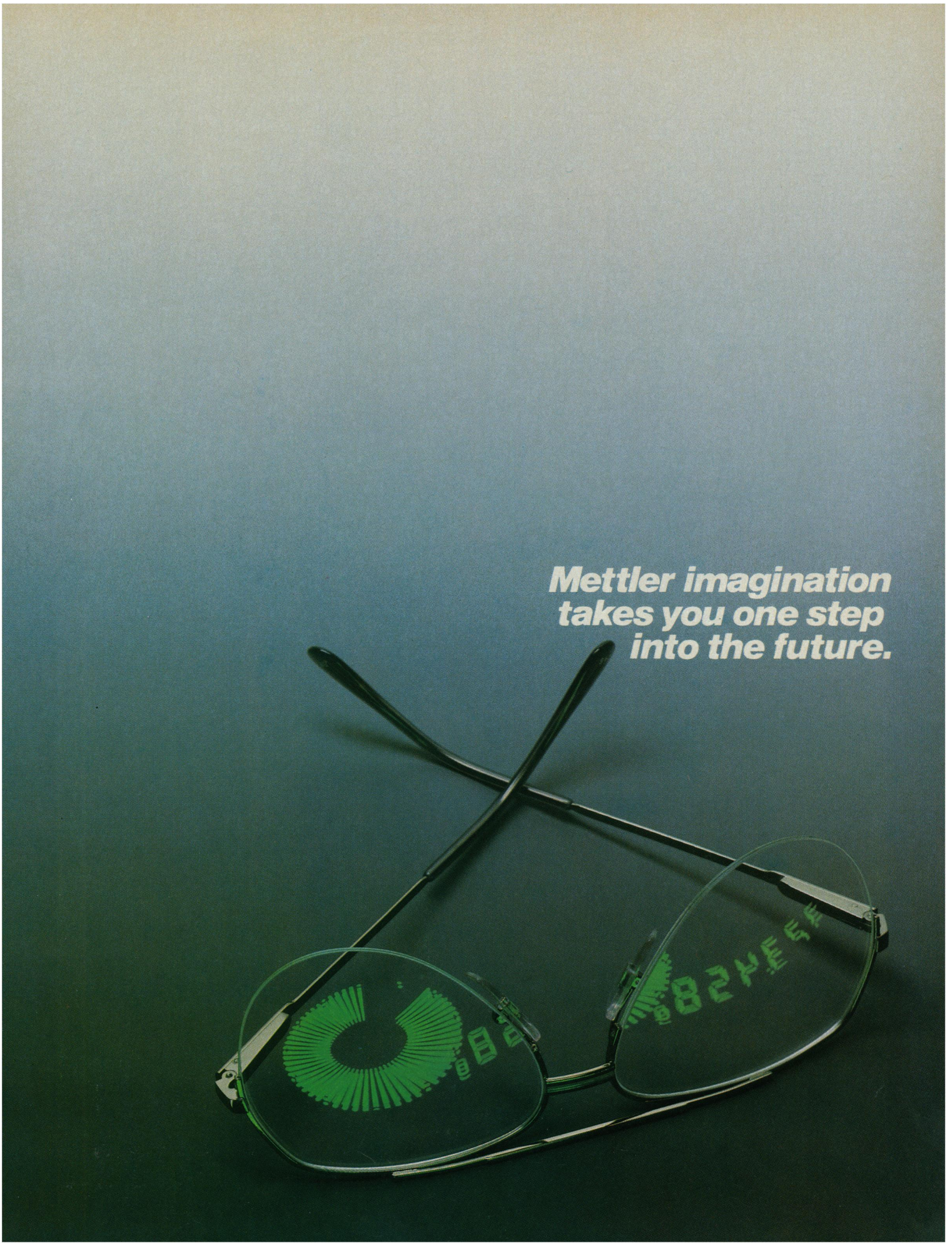
Whether or not you're working with the same types of compounds as Sarah, there's a Hewlett-Packard system to match your requirements. Exactly.

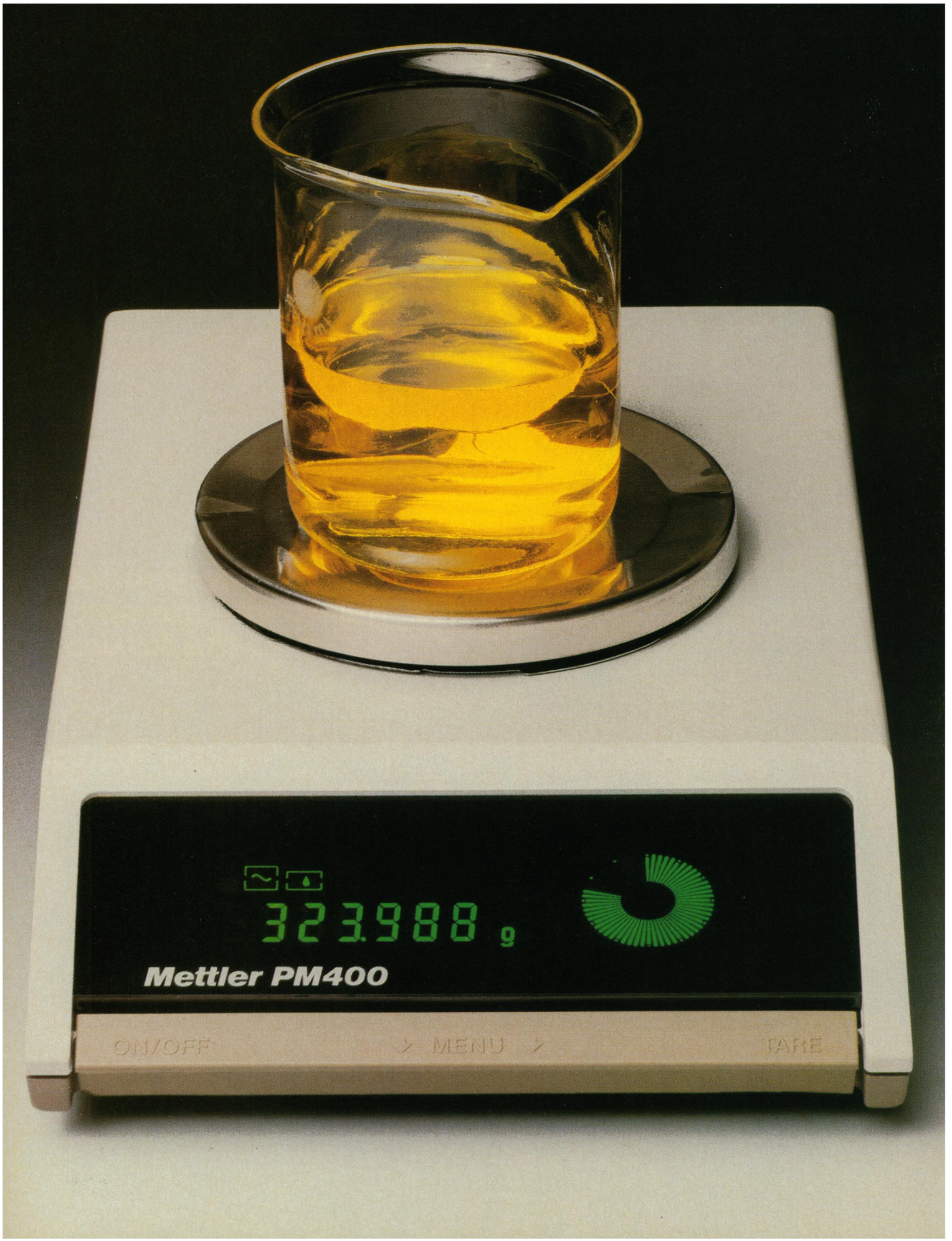
For more information, call the HP office listed in your white pages and ask for an analytical product representative. Or write Hewlett-Packard Analytical Group, 1820 Embarcadero Road, Palo Alto, CA 94303.

HEWLETT PACKARD

AG04516

For literature circle reader service number 95
To have an HP Representative contact you circle reader service number 96


Mettler imagination
takes you one step
into the future.


323.988 g
Mettler PM400
ON/OFF
MENU
TARE

Introducing the new Mettler PM with DeltaTrac. Designed to keep you and your weighing on track.

New electronics give you new opportunities.

The new Mettler PM precision balance with DeltaTrac prepares your lab for the future. From simple weighing today, to sophisticated robotic systems tomorrow, the PM is all the balance you need.

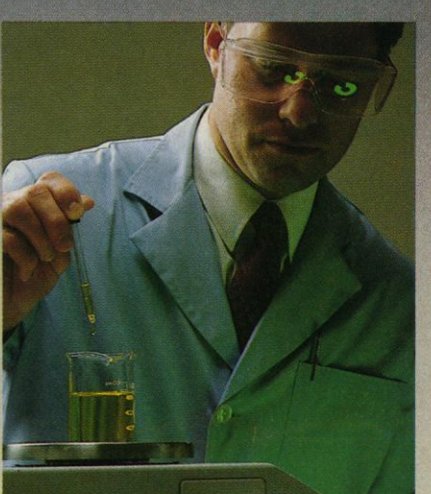
The PM introduces Mettler DeltaTrac. DeltaTrac's active display monitors balance capacity and guides you through the weighing process. Making your work easier. Keeping you and your weighing on track.

Formulating is fast and accurate. DeltaTrac's new electronics virtually eliminate lag-time. You get a true reading while you pour, not while you wait.

Inside the PM's rugged shell we've loaded the latest advances from Mettler imagination. Like built-in bidirectional interface for Mettler Application Pacs, computer and robotic applications. And built-in application software for check-weighing, percentage determination, piece counting, and unit conversions.

For simple weighing or integrated into an automated lab, the Mettler PM with DeltaTrac gives you unlimited opportunity.

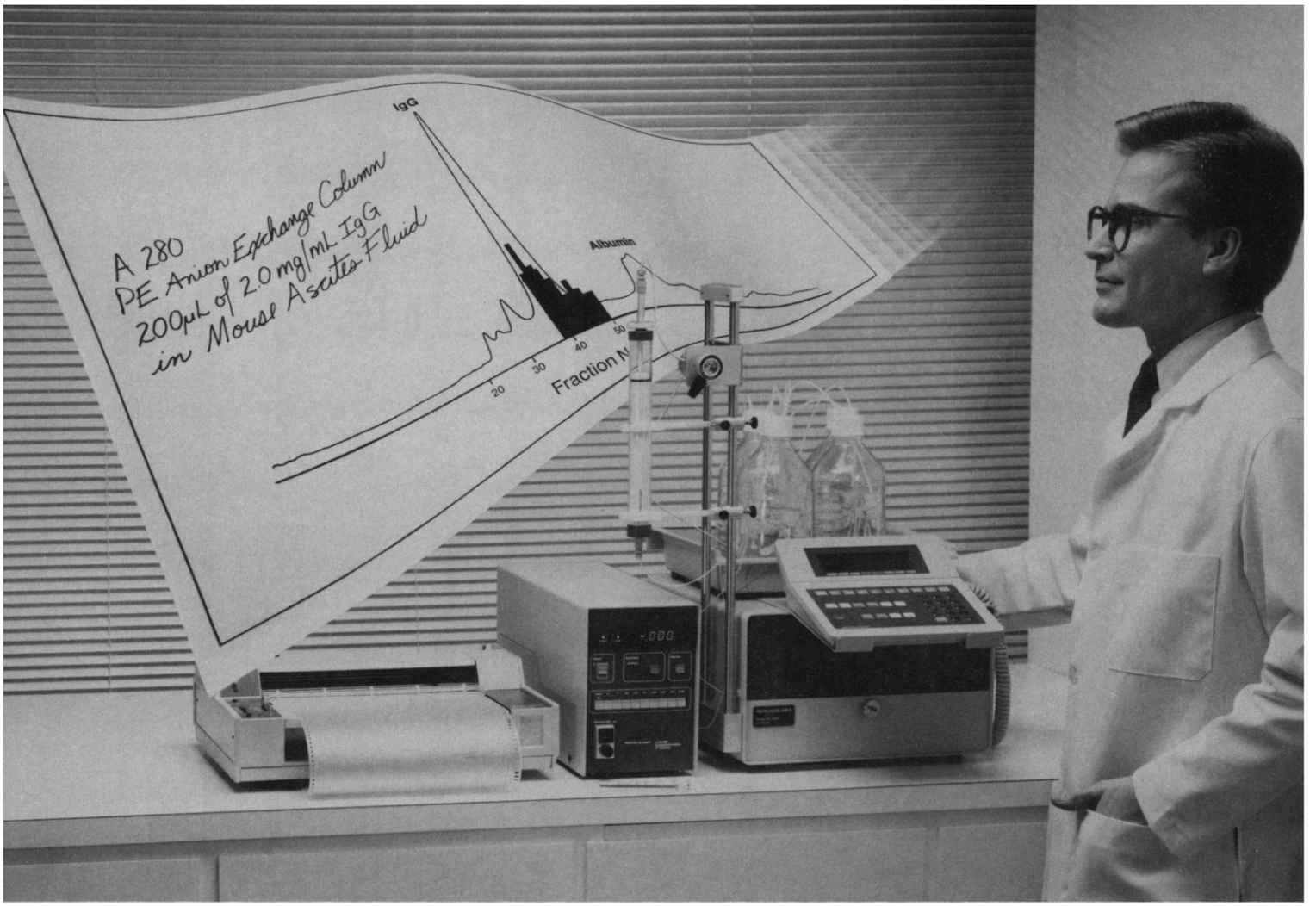
Take a step into the future with the new Mettler PM. Nine models, capacities from 110 to 4100 g, readabilities from 0.001 g to 0.1 g. **For a copy of our 24 page PM series balance brochure contact Mettler Instrument Corporation, Box 71, Hightstown, NJ 08520. Tel. 1-800-257-9535.**



Mettler®

Analytical and Precision Balances ☐ Industrial Precision Scales ☐ Thermal, Titration and Density Instruments ☐ Nationwide Service

Circle No. 108 on Readers' Service Card



For high speed, high resolution separations of proteins, polypeptides and polynucleotides, talk to us.

Introducing the Perkin-Elmer IsoPure™ LC System.

The IsoPure™ Liquid Chromatography System, with its totally inert flow path, ensures the integrity of your sample throughout the separation process. The fluid stream contacts only pure titanium, fluorocarbon, sapphire, or TEFLON® surfaces, providing high resistance to corrosion.

Low, medium and high pressure columns—and high speed LC—in one system.

The IsoPure LC System connects easily to most low, medium or high pressure columns. Crude extracts can be purified by economical soft gel chromatography in low pressure columns, followed by high performance chromatography, all using the same system. Typically, up to 2 grams of biological material can be applied in a single run. The compatibility of the system with ion exchange, reversed phase, hydrophobic interaction, gel permeation and affinity columns lets you purify almost any biological molecule, from polypeptide to polynucleotide. Its 41.4 MPa (6,000 psi) maximum pressure limit handles today's highest resolution columns, for complete flexibility in designing your own optimum purification strategy.

Plus convenience and ease-of-use.

No leaky syringe pumps to readjust, or fittings to flange. The IsoPure LC System automatically runs gradients and, if desired, cleans your columns with one or two additional solutions. You can even modify analytical conditions for runs in progress with the multi-tasking software and remote controller.

To learn more, please contact your Perkin-Elmer representative. Or, for literature in the U.S., call 1-800-762-4000.

Perkin-Elmer Corp., 761 Main Ave., Norwalk, CT 06859-0012 U.S.A. Tel: (203) 762-1000. Telex 965-954.

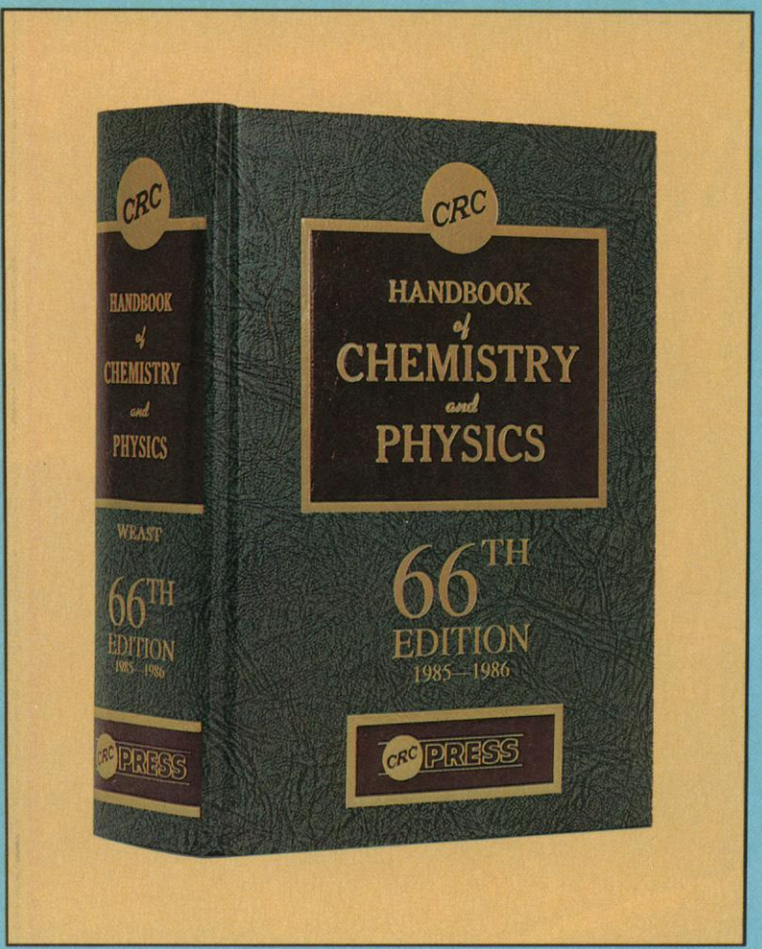
Bodenseewerk Perkin-Elmer & Co., GmbH, Postfach 1120, 7770 Ueberlingen, Federal Republic of Germany. Tel: (07551) 811.

Perkin-Elmer Ltd., Post Office Lane, Beaconsfield, Bucks HP9 1QA, England. Tel: Beaconsfield (049 46) 6161.

® TEFLON is a registered trademark of E.I. du Pont *de Nemours & Co.*
(TM) IsoPure is a trademark of The Perkin-Elmer Corporation.

PERKIN-ELMER

Circle No. 86 on Reader Service Card for more information on our Isopure™ LC System



SAVE 53%

The most recent edition of the *CRC Handbook of Chemistry and Physics* is being offered for a limited time only at less than half price — that's $35.00 off the regular price of $64.95.

Each year *The Handbook* is reviewed and revised by an international panel of authorities, placing it among the most complete and up-to-date references available to scientists worldwide.

You'll quickly find what you're looking for in this comprehensive resource of over 2300 pages of graphs, tables, formulas, and property information.

NOW ONLY $29.95

ORDER FORM

Rush me the 66th Edition of the *CRC Handbook of Chemistry and Physics* for only $29.95* (regularly $64.95).
To qualify for this special offer, each order should:

- be postmarked by June 15, 1986
- specify catalog no. 466KFN
- be prepaid by check, money order, or charged to one of the credit cards below

Enclosed is my check/money order for $_____

☐ American Express ☐ MasterCard ☐ Visa

Account # (include all digits)

Name_____

Co./Inst._____

Address_____

City_____ State_____ Zip_____

Expiration Date_____ Validation Date (AMEX) _____

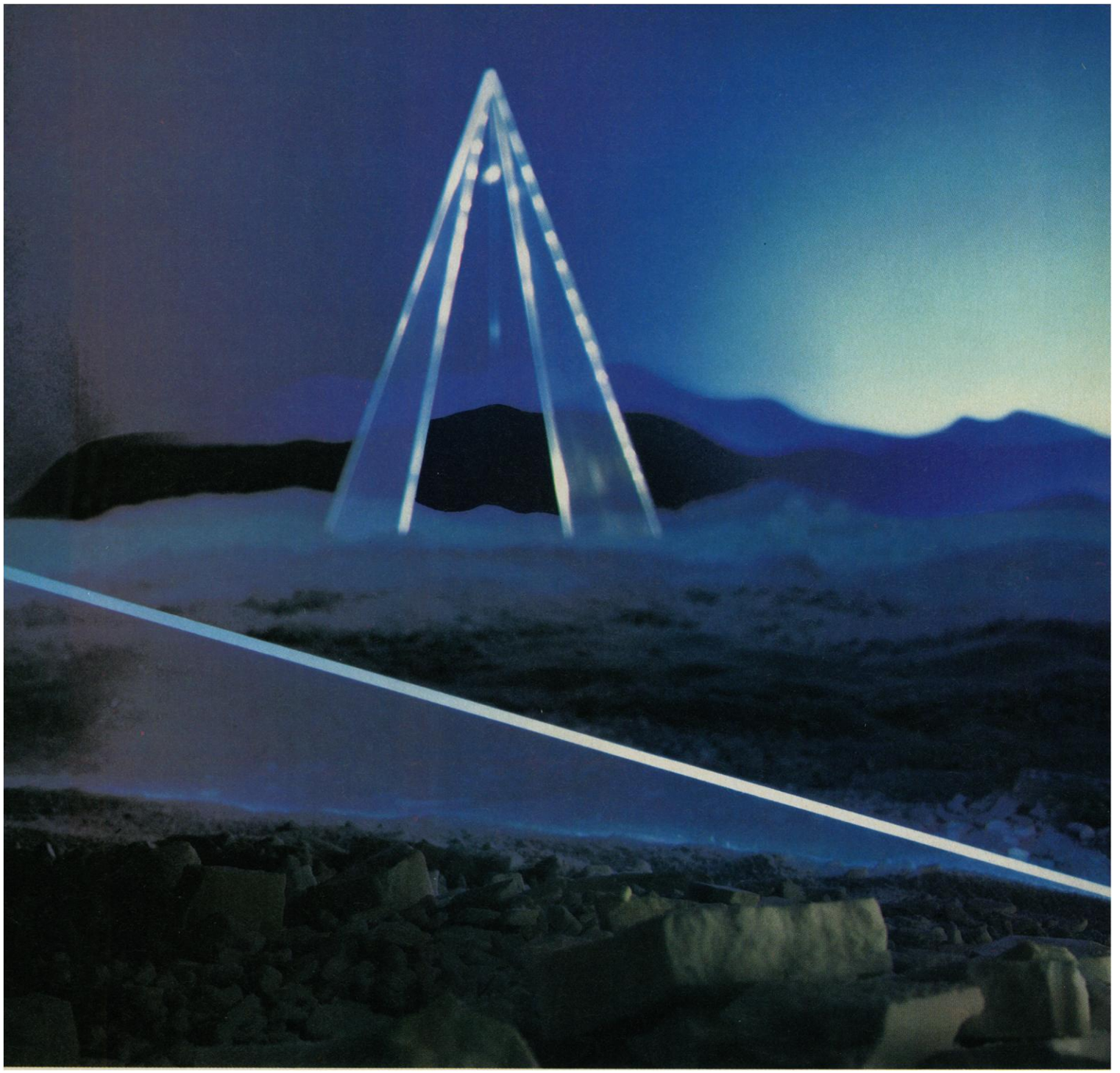
_____
Signature (required for credit card orders). Please use ink.

*Outside U.S., $34.95 per copy. Payable in U.S. currency or draft on a U.S. bank. Florida residents add 5% sales tax.

_____
Please print name appearing on credit card.

Order **TOLL FREE** 1-800-272-7737 • Monday-Friday • 8:30 a.m. to 5 p.m. (In Florida call collect: 1-305-994-0563.)

CRC PRESS, INC. 2000 Corporate Blvd., N.W. Boca Raton, Florida 33431



NOW...THE DAWN OF A NEW

Whenever Zeiss has turned its hand to the very fundamentals of microscopy, microscopy has changed.

In 1846 and the years following, the reputation of the Carl Zeiss workshop was established based upon microscopes of unparalleled mechanical precision, optical quality and reliability.

In 1866 Ernst Abbe, working with Zeiss, formulated his "Theory of Image Formation in the Microscope," which made possible the series production of high-quality microscopes.

In ensuing decades Zeiss has pioneered many of the major advances in microscope production and technique.

Now in 1986 a wider chapter in the history of Zeiss microscopy begins: Zeiss presents microscopes with entirely new infinity color-corrected "ICS Optics" and unique system-integrated "SI Architecture."

ZEISS AGE IN MICROSCOPY.

At last, one microscope can perform all microscopic techniques without complicated restructuring of the instrument. And, most important, with flawless image quality and a consistent wide field of 25 mm.

For biology, medicine, the material sciences and the semiconductor industry, the "Pyramids of Zeiss," the new AXIOPLAN, AXIOPHOT and AXIOTRON microscopes, open exciting prospects for the future.

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

ZEISS
West Germany

The Pyramids of Zeiss:
The New Geometry for Microscopes.

For literature circle reader service number 55
For a demonstration circle reader service number 56

When there's only one chance there's only one choice: MASSCOMP

For the first time in 4.5 billion years, mankind is finally ready to tackle the mysteries of Halley's Comet.

Some of the most significant data, such as the actual chemical composition of the comet's tail, will lead to a better understanding of the origins of our solar system. MASSCOMP is providing computer technology to better equip scientists as they unlock these secrets.

An MC5500 Micro Supercomputer has been working since late 1985 as the heart of real-time analysis to examine the distribution of solar and cometary particles and how they mix to produce the tail.

Thanks to MASSCOMP's real-time version of the UNIX operating system (RTU)™ and real-time transparent multiprocessing technology, the Johnstone Plasma Analyzer experiment presented critical data to the entire scientific world. In real-time, data from the plasma analysis is separated by the first CPU from the stream of telemetry and stored on disk. The second CPU concurrently calculates plasma moments, yielding information about average particle size, temperature and three-dimensional velocity.

MAXIMUM CPU PERFORMANCE
- 10 MIPS
- 12,000K Whetstones/second
- 13 Mflops
- 4 CPUs

SUPERIOR DATA ACQUISITION CAPABILITIES
- One million samples per second
- Multiple fast busses
- High data throughput
- Real-time UNIX™ operating system

OUTSTANDING SYSTEM FEATURES
- Transparent multiprocessing
- 68020 performance
- Industry standards
- Graphics family
- High reliability
- Low cost: $15,000-$250,000

Write for your FREE copy of MASSCOMP's HALLEY'S COMET APPLICATION NOTES.

When there's only one chance for success, you need all the supercomputing power you can get. MASSCOMP.

MASSCOMP
The Micro Supercomputer Company

One Technology Park, Westford, MA 01886 (617)692-6200

800-451-1824

Circle No. 119 on Readers' Service Card

KUWAIT FOUNDATION FOR THE ADVANCEMENT OF SCIENCES (K F A S)

INVITATION OF NOMINATIONS FOR KUWAIT ANNUAL PRIZES

The Kuwait prizes were institutionalized to recognize distinguished accomplishments in the arts, humanities and sciences.

The prizes are awarded annually in the following categories:

A. Basic Sciences
B. Applied Sciences
C. Economic and Social Sciences
D. Arts and Letters
E. Arabic and Islamic Culture

The prizes for 1986 will be awarded in the following fields:

A. Computer Science
B. Electrical Engineering
C. Food Sufficiency for the Arab World
D. Literary Translation
E. Chemistry and Pharmacology in Arab Heritage

BACKGROUND

1. Two prizes are awarded in each field: a prize to recognize the scientific research of a distinguished Kuwaiti and a prize to recognize the scientific research of a distinguished Arab.
2. Nominations for these prizes are accepted from academic and scientific centers, learned societies, past recipients of the prizes, and peers of the nominees. No nominations are accepted from political entities.
3. The scientific research submitted must have been published during the last ten years.
4. Each prize consists of a cash sum of K.D. 10,000/- (appr. U.S. dollars 35,000), KFAS Shield and a Certificate of Recognition.
5. Nominators must clearly state what distinguished work qualifies their candidate for consideration.
6. The results of KFAS findings regarding the selection of winners are final.
7. The papers submitted for nominations will not be returned regardless of the outcome.
8. Each winner is expected to deliver a lecture concerning the contribution for which he was awarded the prize.

Nominations, including complete curriculum vitae and updated lists of publications by the candidates and four copies of each paper published, should be addressed before **October 31, 986** to:

DIRECTOR GENERAL
KUWAIT FOUNDATION FOR THE ADVANCEMENT OF SCIENCES
P.O. BOX 25263, SAFAT,
13113, KUWAIT