25 OCTOBER 1985 · VOL. 230 · NO. 4724 $2.50

SCIENCE

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

ISSN 0036-8075

25 October 1985

Volume 230, No. 4724

SCIENCE

SCIENCE is published weekly on Friday, except the last week in December, by the American Association for the Advancement of Science, 1333 H Street, NW, Washington, D.C. 20005. Second class postage (publication No. 484460) paid at Washington, D.C., and at an additional entry. Now combined with **The Scientific Monthly®** Domestic individual membership and subscription (51 issues): $60. 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 $3 ($3.50 by mail); Biotechnology issue, $5 ($5.50 by mail) classroom rates on request. **Change of address**: allow 6 weeks, giving old and new addresses and seven-digit account number. **Postmaster:** Send Form 3579 to *Science*, 1333 H Street, NW, Washington, D.C. 20005. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

COVER

Sediment plume of the Mississippi River as it disperses into the Gulf of Mexico, seaward of Southwest Pass. The lower river carries about 5 tons of suspended sediment per second, providing abundant sites for uptake and transport of contaminants. Recent data support a decrease in the lead burden of the river. See page 439. [Nenad Iricanin, Department of Oceanography and Ocean Engineering, Florida Institute of Technology, Melbourne 32901]

Now, even your PC can find signals buried in noise.

Get lab-quality data acquisition capability for your PC with the HP 3055S.

With the new HP 3055S system software, your personal computer can be the center of a powerful, lab-quality data acquisition system that automatically measures signals buried in noise, then stores and analyzes your data. By automating measurement of temperature, pressure, level and more, you can concentrate on the implications of the data gathered, instead of the gathering.

Compatible with the HP Touchscreen and Touchscreen MAX, IBM PC, IBM PC/XT and IBM PC/AT, HP 3055S system software lets you use your PC with either of HP's two popular data acquisition instruments: the HP 3421A for up to 30 discrete data channels, and the HP 3497A (shown below) for as many as 100 (1,000 with extenders).

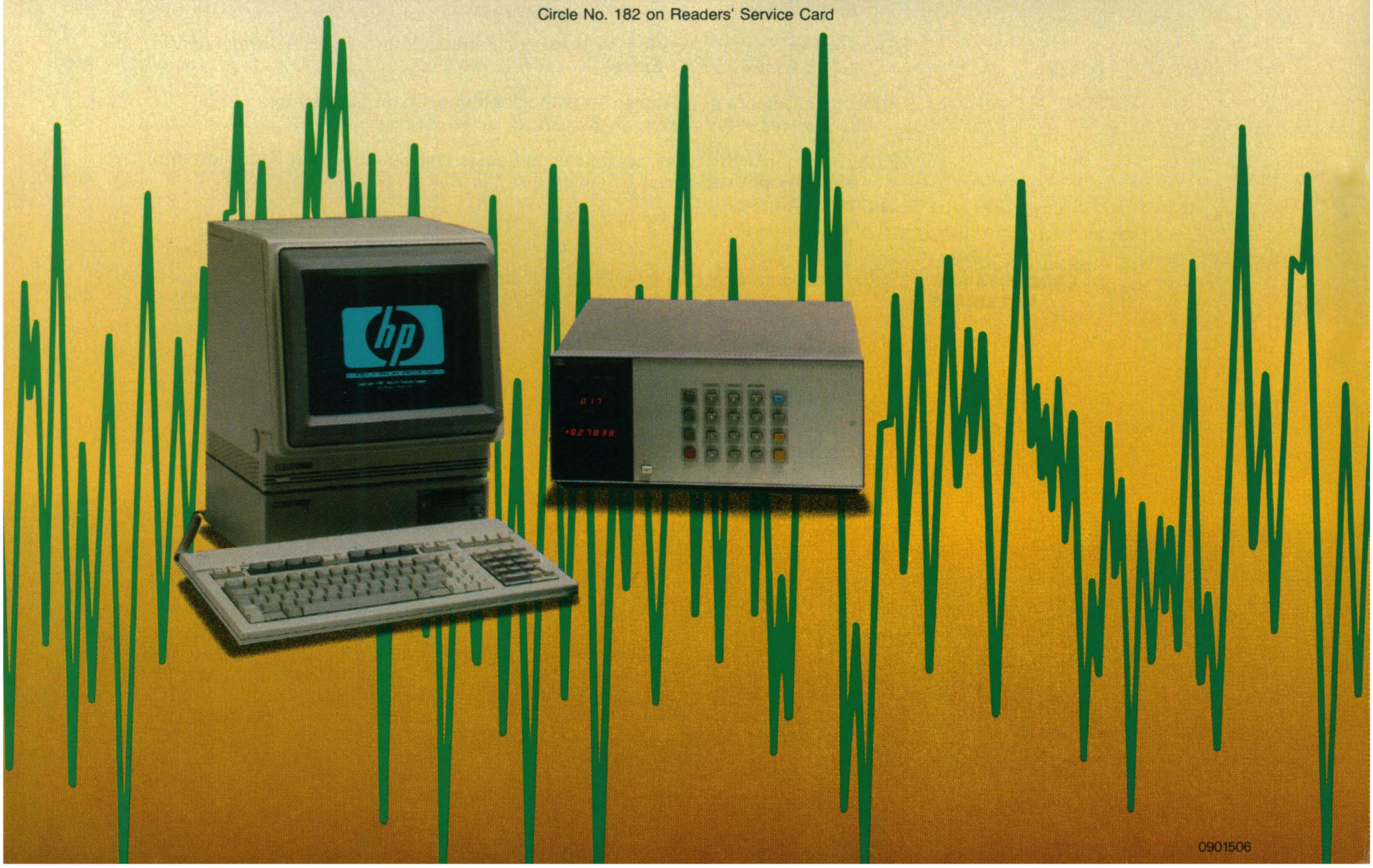
Both feature integrating A/Ds, one microvolt sensitivity and isolated inputs that let your PC detect and measure signals with precision even in the presence of common mode and/or normal mode noise. They feature complete HP-IB (IEEE-488) compatibility, too.

Our software is menu-driven and easy to use. It even has built-in analysis and graphics capabilities so you can easily manipulate and display your data.

Call your local HP sales office today for all the facts. You'll find it listed in the white pages of your telephone directory. Or, for immediate details, call **1-800-566-1234**, ext. 461. In California, call **1-800-441-2345**, ext. 461.

HEWLETT PACKARD

Circle No. 182 on Readers' Service Card



0901506

Structure of cancer drug bound to DNA

An x-ray crystallographic study shows how cisplatin, one of the most widely used anticancer drugs, binds to bases in DNA (page 412). When cisplatin is bound to a synthetic dinucleotide that is similar to its most common target in DNA, adjacent bases are cross-linked and their normal stacking is disrupted. Sherman *et al.* theorize that the normal DNA repair mechanisms may not operate on cisplatin-disrupted DNA because the disruptions are highly localized; in addition, in cancer cells the repair enzymes may be repressed. Without repair, DNA replication will be inhibited, and the cells will die, thus accounting for the drug's lethal effect. The "trans" analog of cisplatin cross-links in a different way, connecting bases that are not adjacent. Although it also disrupts DNA, it is not an effective anticancer agent, perhaps because the disruptions are more obvious and can, more effectively, attract available repair enzymes.

Canadian astrobleme

New geochemical evidence supports the interpretation that the Sudbury Igneous Complex in Ontario, Canada, may be an astrobleme, a structure formed by the impact of a meteorite (page 436). The complex is the source of about one fifth of the world's nickel supply, large amounts of copper, and many other metals. Faggart, Basu, and Tatsumoto analyzed isotopes of neodymium (Nd) and concentrations of samarium (Sm) and Nd, both rare earth elements, in rock samples from the Sudbury basin. Rocks from the earth's crust can be distinguished from those in the underlying mantle by the ratio of Nd isotopes; the amounts of Nd and Sm also differ in these layers. Only patterns representative of crustal material were found in Sudbury igneous rocks, indicating that these rocks did not originate in the mantle (the usual source of crustal rocks). The presence of shatter cones in surrounding rocks and other structures that form only from strong impacts also support the meteorite theory. The impact of a meteorite 1840 million years ago would have caused extensive melting of rock in the crust and the formation of magma. The magma would have been emplaced in the crust where, today, the signature of crustal materials is found in the ores.

Lead load lowered

Regulations that were instituted 10 years ago to limit the amount of lead added to gasoline and in that way to diminish environmental lead pollution seem to be paying off (page 439). The amount of pollutant lead transported to the Gulf of Mexico by the Mississippi River in 1982 and 1983 was less than the amount transported a decade earlier, with an overall reduction of 40 percent. The river carries at least half the total sediment load and water transported by U.S. rivers and deposits much of that sediment and associated contaminants in the delta. Trefry *et al.* analyzed the metal in water, suspended matter, and sediment from the river and its delta. The lead record showed that lead deposition was stable until the later 1800's, when, as a result of lead mining and the industrial revolution, it began to rise. In the 1920's, even more lead was introduced into the environment as lead was added to gasoline. The lead record in the river, together with studies showing decreased amounts of lead in the atmosphere, in soil, and in blood, indicates that environmental lead pollution is decreasing.

Hydrotropism studies take root

Roots of a mutant pea plant can grow straight up into the air for several centimeters in their quest for water as long as the plants are in a chamber with high relative humidity (page 445). This attraction to water, hydrotropism, has now been documented in the laboratory after a century of inconclusive analyses complicated by the powerful and often conflicting force of gravity. In a study of the mutant pea plant 'Ageotropum,' which does not respond to gravity when grown in the dark, Jaffe *et al.* found that roots will grow up, down, or sideways as long as they sense a gradient of water. The sensor was localized to the root cap, the cover at the tip of the root that protects fragile root cells from mechanical injury inflicted by objects in the soil. Roots could continue to elongate without their caps, but, capless, the direction in which they grew was not dependent on a water gradient. This tropism can now be studied further, isolated from other tropisms (touch, light, gravity) to which plant roots are known to respond.

Synthetic immunosuppressor

Immunosuppressive effects can be produced in culture by a small synthetic peptide fashioned after a membrane component that is common to a number of mammalian retroviruses (page 453). The peptide synthesized by Cianciolo *et al.* is identical in amino acid composition to a portion of the p15E protein found on the surface of the mouse leukemia virus; homologous proteins are also part of the surfaces of human, cat, and cattle retroviruses. In two separate assays, the synthetic peptide was shown to produce immunosuppressive effects similar to effects produced by natural p15E molecules. During retroviral infections, the immunosuppressive component might suppress the host's immune system, allowing tumor cells to grow in the host unchecked by antibodies or immune cells. Whether the gene for the suppressive substance is introduced into the cell during viral infection or is a host component that is activated by the virus is not known. In either case, its activation at the time of infection or neoplastic transformation could account for the immune suppression that is known to accompany retroviral infections, including the one associated with AIDS.


WHAT IS E-Z SCREEN?
A new technology to
DETECT AND MONITOR
for the presence of
TOXIC AND HAZARDOUS
SUBSTANCES IN:
● FOOD
● WATER
● LIVESTOCK
and many other
applications for
screening samples
in the field,
office or
laboratory.
S
C
Control
Sample
NEOMYCIN
QUIK-CARD PROCEDURE
1. Crush blue ampule (substrate) and shake for 20 seconds.
Let each drop absorb before proceeding
2. Place 1 drop of green (control) on C.
3. Place 2 drops of sample on S.
4. Place 1 drop of red (enzyme) on C and 1 drop on S.
5. Wipe off excess fluid around each hole.
6. Place 2 or 3 drops of blue (substrate) on both C and on S.
7. Interpret results after 2 minutes (see reverse).
ENVIRONMENTAL DIAGNOSTICS INC.
● RAPID RESULTS in five minutes or less.
● HIGH SENSITIVITY ppb or less.
● SPECIFICITY unique immunoassay
● INEXPENSIVE
● EASY-TO-USE
● NO INSTRUMENTATION
● REQUIRES ONLY 1 OR 2 DROPS of sample or reagent.
CURRENT E-Z SCREEN kits include:
Sulfamethazine – 100 ppb
Chloramphenical – 50 ppb
Parathion – 25 ppb
Paraquat – 200 ppb
Plus four others with sixteen under development.
Easy to interpret results.
ENVIRONMENTAL DIAGNOSTICS, INC.
Technical service: (714) 261-7267.
Exclusive Sales/Order entry:
Granite Diagnostics, Burlington, NC 27215
(800) 334-1116 or (800) 672-3117 (NC)
Circle No. 170 on Readers' Service Card

Biotechnology Issues

I would like to clarify some points in relation to the U.S. Department of Agriculture's handling of biotechnology issues as related to Agracetus's efforts to field test tobacco plants made disease-resistant by genetic engineering (News and Comment, 16 Aug. p. 634).

The federal government is involved in a very positive manner in an almost singularly unique situation of combining all agency guidelines and regulations in biotechnology in one document. This was done by the Cabinet Council on Biotechnology through the President's Office of Science and Technology Policy (OSTP) and published as a comprehensive statement in the *Federal Register* of 31 December 1984. Comments have been received from the public on both regulation and research in biotechnology for the entire federal government. As a result, a totally coordinated effort in the review process of biotechnology is evolving that should be to the benefit of all research scientists, industry, and the users of the products of biotechnology.

The Department of Agriculture has a logical distribution of responsibilities. All regulatory aspects of biotechnology are under the purview of the Animal and Plant Health Inspection Service (APHIS). For research issues, I chair the Department of Agriculture's Agriculture Recombinant DNA Research Committee, which reviews recombinant DNA research proposals in agriculture. This committee is department-wide and located in Science and Education under assistant secretary Orville G. Bentley; it is not a part of the Agricultural Research Service. The committee has representatives from all appropriate agencies in the Department of Agriculture, including the Agricultural Research Service, the Cooperative State Research Service, the Office of Grants and Program Systems, and APHIS, as well as representatives from the National Institutes of Health and the National Science Foundation. The entire federal structure for regulation and assessment of biotechnology of which this committee is a part is evolving through the leadership of Bernadine Healy of OSTP and now David T. Kingsbury of NSF, and it promises to function well. During the early evolutionary phases of the expanded recombinant DNA responsibilities, there may be some delays; but in the end it is anticipated that there will be a well-coordinated total federal system in place to the benefit of all parties concerned. A considerable amount of time and consideration has been given to bringing this program to fruition.

JOHN PATRICK JORDAN
Office of the Administrator,
Cooperative State Research Service,
U.S. Department of Agriculture,
Washington, D.C. 20250

Crystals in Space

Having many years of experience growing crystals of biological macromolecules, I would like to express my skepticism about growing crystals in space (Research News, 26 July, p. 370).

The problems associated with growing crystals of biological macromolecules for diffraction studies are finding solvent conditions for the production of well-ordered single crystals of a suitable habit and a certain minimum size.

If we look at these problems in relation to the (rather meager) data (*1*) so far presented by the proponents of the space program, we might be able to decide whether it makes "scientific sense."

Each biological macromolecule is unique and, although we have certain general principles (*2*), the conditions for crystal-growing for each new system must be determined ab initio. Needle-shaped or thin-plate crystals present problems to the crystallographer who prefers "chunky" crystals. Given an undesirable habit, it is necessary to search for other conditions to produce other crystal forms, as Blundell indicates. This may require many experiments changing a number of solution variables. Since the β-galactosidase crystals shown by Littke and John (*1*) are long thin needles, one would think the first priority would be to try to obtain different crystal forms rather than larger ones of the same form.

Most of the emphasis of the space program seems to be on the size of crystals, and Bugg might be correct in that convective currents prevent the growth of large crystals; but how large should they be? More than 30 years ago Low and Richards (*3*) described the growth in gelatin gels of β-lactalbumin crystals weighing up to 50 milligrams (about 30 cubic millimeters), and Lewin (*4*) grew crystals of mercury mercaptalbumin derivatives 7 mm long. A requirement for high resolution neutron diffraction is large crystals, and for this purpose lysozyme crystals up to 20 mm^3 have been obtained (*5*). On the other hand, the advent of synchrotron x-ray sources has

meant that the x-ray crystallographer can use much smaller crystals, say 0.01 to 0.1 mm^3.

There are various problems associated with disorder in crystals of macromolecules, and what probably concerns us here are lattice defects, which have been attributed to rapid growth. So although Bugg is encouraged by the growth of large lysozyme crystals in only 5 days in space, neither he nor Littke and John (*1*) provide diffraction evidence that their crystals are better ordered.

It is clear that we need to know how to crystallize and grow diffraction-quality crystals of biological macromolecules. The amount of data now available provides no justification for the enormous costs of a space program to acquire this knowledge. The funds (or a fraction thereof) would be better invested in supporting programs aimed at the determination of the mechanics of crystal growth of biological macromolecules on Earth.

R. LEBERMAN
Grenoble Outstation,
European Molecular Biology
Laboratory, c/o I.L.L., 156X,
38042 Grenoble, Cedex, France

References

1. W. Littke and C. John, *Science* **225**, 203 (1984).
2. A. McPherson, *Preparation and Analysis of Protein Crystals* (Wiley, New York, 1982).
3. B. W. Low and F. M. Richards, *J. Am. Chem. Soc.* **76**, 2511 (1954).
4. J. Lewin, *ibid.*, **73**, 3906 (1951).
5. G. A. Bentley, E. D. Duee, S. A. Mason, A. C. Nunes, *J. Chim. Phys.* **76**, 817 (1979).

We would like to put the protein crystal growth experiment described in Kolata's article "The great crystal caper" in perspective. We agree with Blundell that "there have been very, very few advancements (in the art of making crystals) over the past 20 years. We need a concerted approach." This is precisely why this project was undertaken. A team including fluid physicists, physical chemists, and protein chemists from the Marshall Space Flight Center and the University of Alabama in Huntsville with considerable experience in growing small molecule crystals, both on Earth and in space, has been combined with protein crystallographers from the University of Alabama at Birmingham and other leading institutions in this field to mount an interdisciplinary attack on this important problem.

At present, there are fewer than a dozen papers in the literature that deal with the processes involved in the growth of macromolecular crystals. Our ground-based research and the few papers in the literature strongly suggest that the growth of most macromolecular systems is controlled by surface kinetics. Calculations indicate that transport of solute to the growth interface of a typical protein crystal in Earth's gravity is dominated by solutal convection after the crystal becomes larger than a few tens of microns. It can also be shown that such transport is sufficient to maintain an excess of solute at the growth interface so that growth is limited by the rate at which the solute can be incorporated into the lattice. By taking away gravity this convective transport can be eliminated, and the growth rate will eventually be controlled by diffusive transport instead of surface kinetics. We conjecture that this should result in a slower growth rate for a given solute concentration, which usually improves the degree of perfection, and a more compact growth habit because of the spherical symmetry of the diffusion field. There are also other advantages of growth in a microgravity environment. The growing crystal can remain suspended in a liquid droplet, which provides a more uniform growth environment that should improve its quality. Also, fewer nucleation events seem to occur in a quiescent supersaturated fluid than in one that is stirred by convection. The larger crystals grown in space by Littke and John (*1*) at least partially resulted from the fact that fewer crystals nucleated in the flight samples, which meant less competition for solute among the growing crystals.

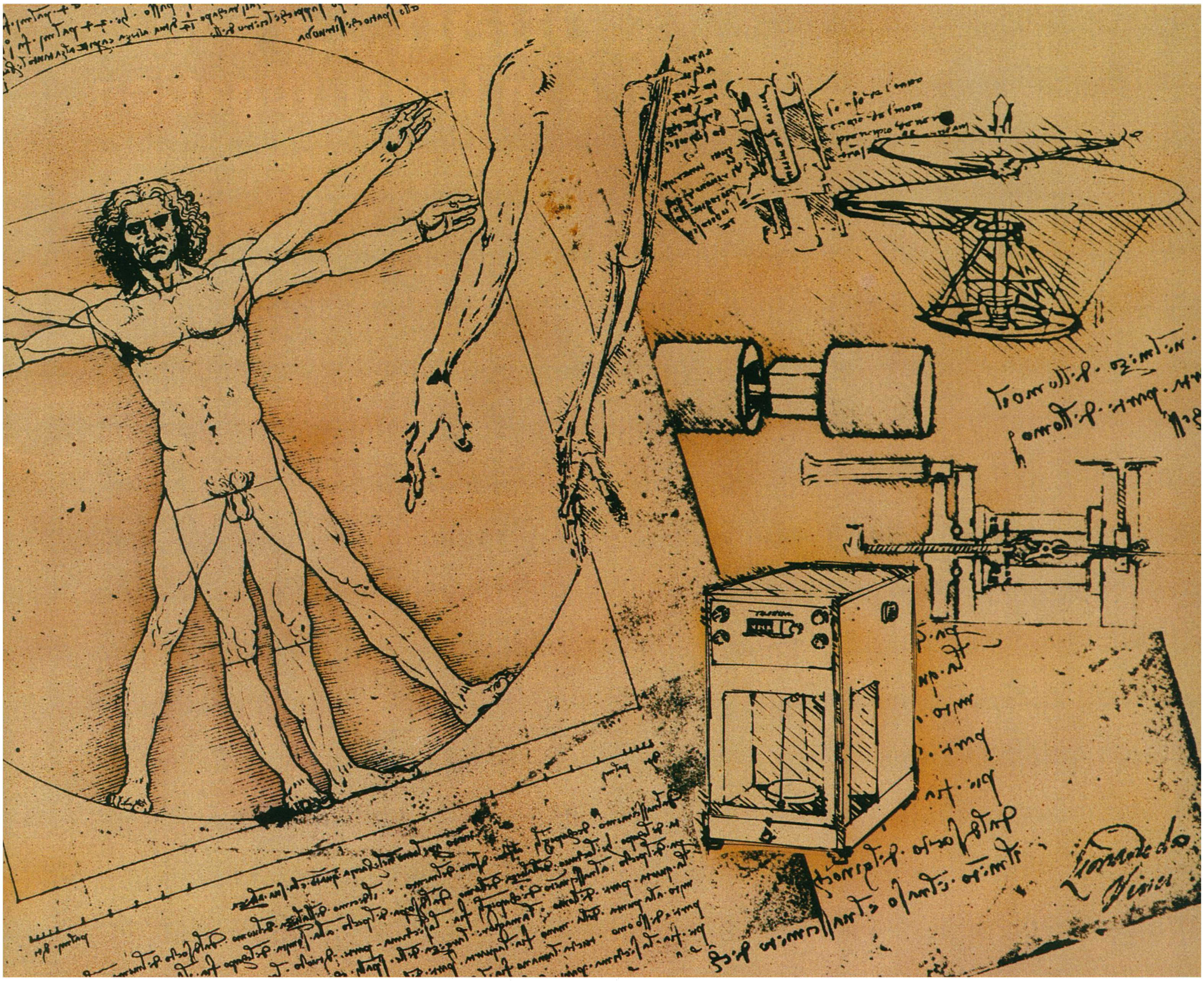
The description of the experiment in Kolata's article leaves the impression that liquid diffusion is the only growth technique being considered. Our primary emphasis is on the vapor diffusion method, which is a space version of the widely used hanging drop technique. However, we are also exploring the dialysis method along with liquid diffusion.

The experiment performed on shuttle flight 51-D was a simple test of the concept of growing crystals in droplets suspended from syringes under microgravity conditions. One of the major issues was the proper design of the syringe tips to maintain such droplets under the combined effects of interfacial forces and low-level transient accelerations. The unscheduled pursuit of the errant Syncom satellite involved firing of the primary thrusters, which resulted in far greater accelerations than were anticipated. We believe most of the droplets were lost during these maneuvers. We have used what was learned in this flight to redesign the syringe tips to provide for a more stable droplet configuration. Small, inexpensive experiments such as

THIS METTLER IS JUST ANOTHER BALANCE...

LIKE DAVINCI WAS JU

ST ANOTHER ARTIST.



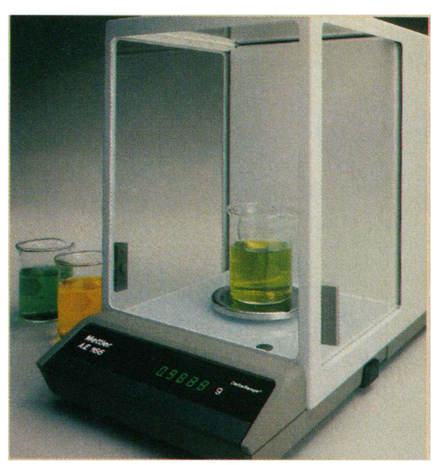
"Learn how to see," counseled Leonardo DaVinci, "dare to think." With pad and pen, he recorded the flight of birds, the flow of water, the motion of man—advancing the art of thinking with his scientific method. His insight brought knowledge that will stand for all time.

His method is still the method of science. But the scientist has grown increasingly distant from the world. Where once a keen eye and steady hand were enough, now complex precision instruments intercede.

At Mettler, we keep the scientist close to his world. Our electronic analytical balances have advanced the art of weighing. With one touch operation, they are easy to use. Fast—four times faster than a mechanical. Accurate, everytime, as only a Mettler can be. To make them dependable, we test each one for 400 hours, then back it with Mettler technical service.

Because at Mettler, we don't want you to have to think about your balance. We believe, no matter how complex, your tools should never interfere with your greatest tool, your mind.

For the latest information on our electronic analyticals, contact Mettler Instrument Corporation, Box 71, Hightstown, NJ 08520, 800-257-9535.



Mettler®

Circle No. 105 on Readers' Service Card

Jouan . . . a better choice in Centrifugation

Over 60 years of manufacturing and marketing worldwide has taught us that centrifuge users look for performance, versatility, reliability, and an affordable price in their centrifuges.

At Jouan, performance means delivering the RCF to accomplish separations quickly and efficiently. Versatility means the flexibility to work with many sizes and types of samples, and reliability means quality that gives years of quiet, trouble-free operation.

That's what Jouan delivers. Every time.

Each centrifuge is priced to be easy on your budget and covered by our extraordinary warranty program.

Bench top, floor model, refrigerated or ventilated, no matter what the style, if you're looking for a centrifuge, don't stop until you see the better choice in centrifugation — from Jouan.

Call 800/662-7477 (VA 703/665-0863) or write Box 2716, Winchester, VA 22601.

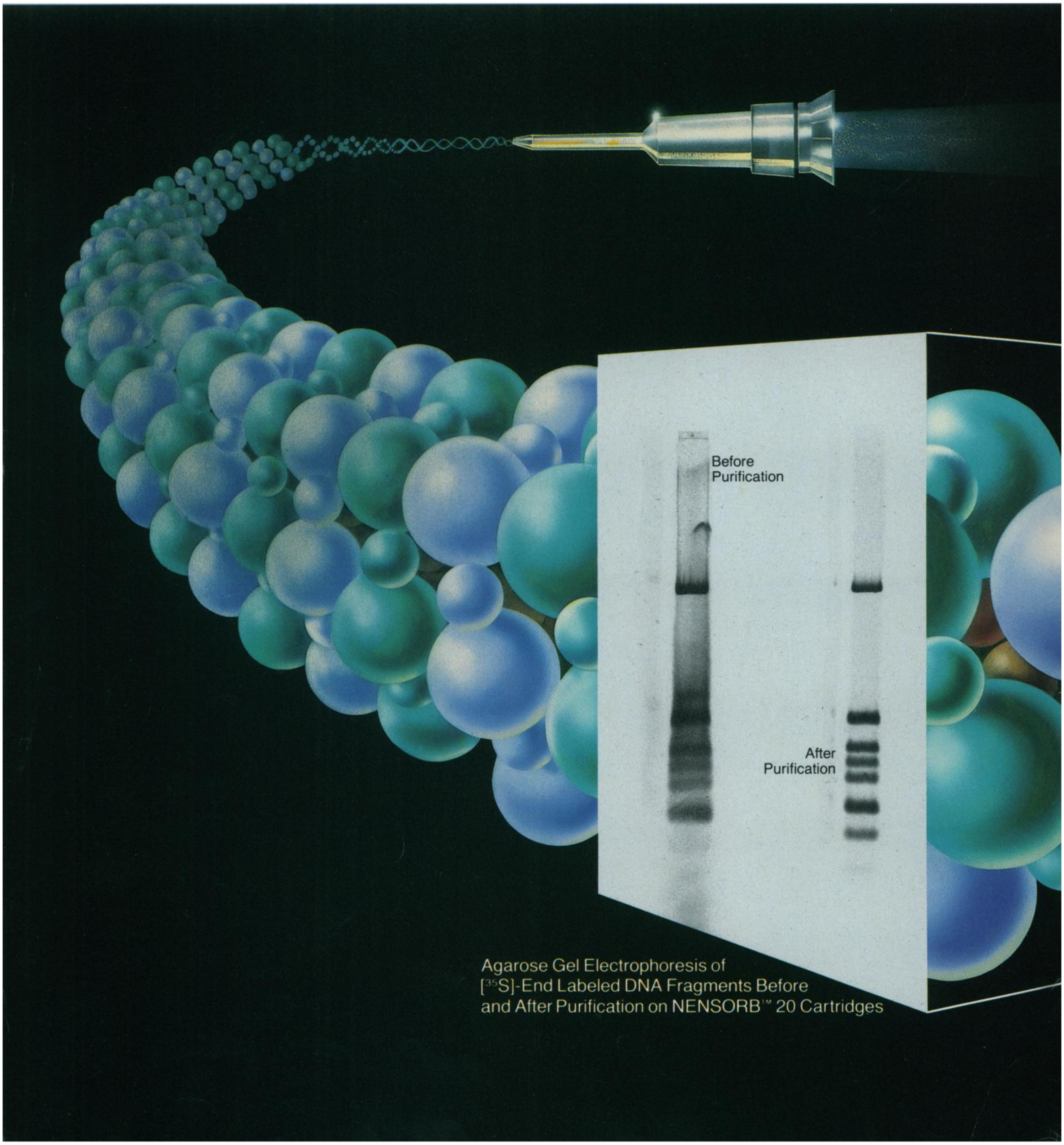
Jouan, Inc.

Serving science worldwide for more than 60 years.

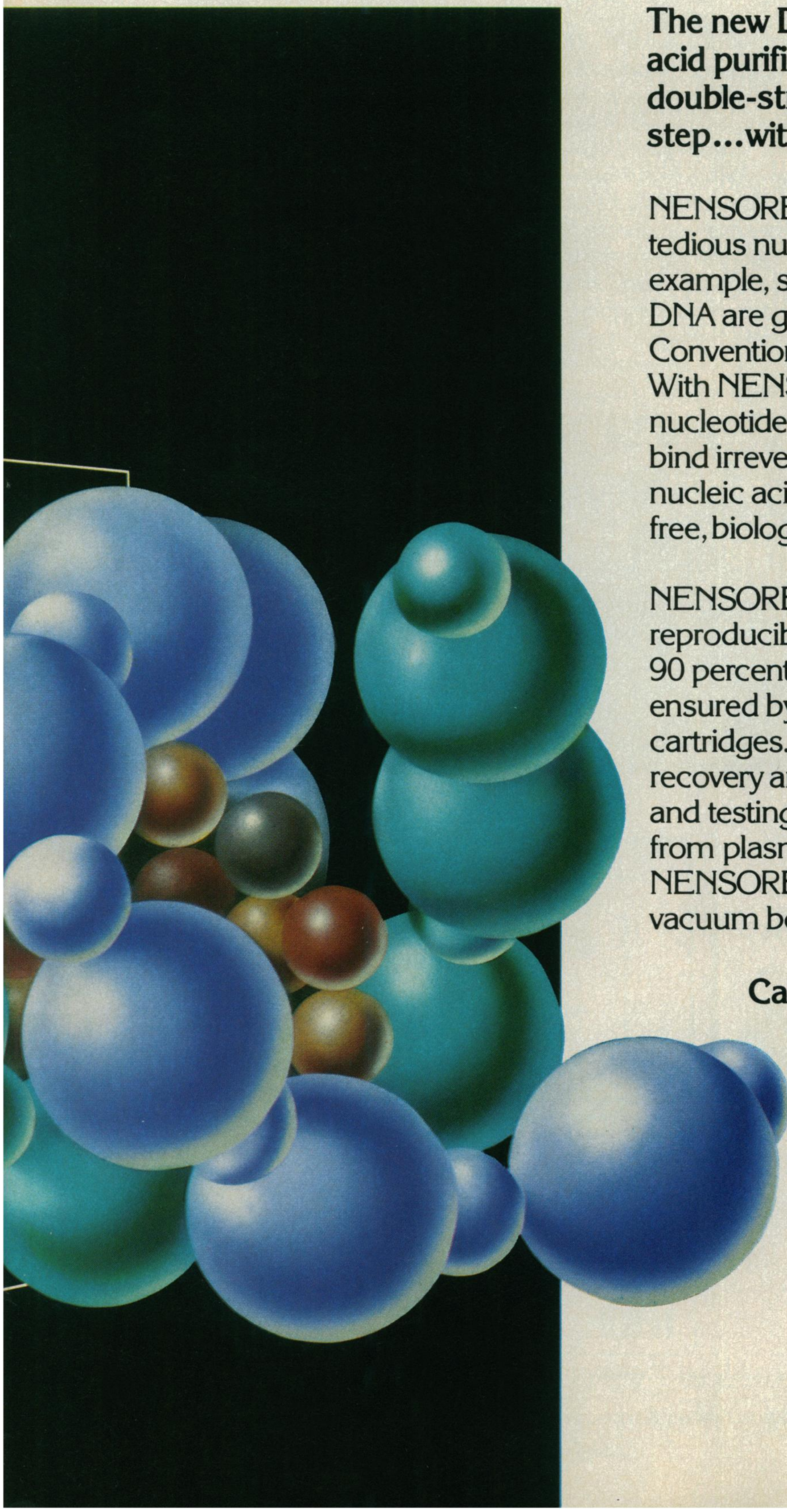
Circle No. 93 on Readers' Service Card

 Circle No. 58 on Readers' Service Card

Get purified, salt-free < 15 minutes with new



DNA or RNA in NENSORB™ 20 cartridges



The new Du Pont NENSORB™ 20 nucleic acid purification cartridge purifies single or double-stranded nucleic acids in one simple step...without salt or ethanol precipitation.

NENSORB™ 20 is the first effective alternative to tedious nucleic acid purification methods. For example, samples with 1 ng to 20 μg of RNA or DNA are generally purified in less than 15 minutes. Conventional methods can take 30 to 60 minutes. With NENSORB™ 20, salts and unincorporated nucleotides pass through the cartridge; the proteins bind irreversibly to the cartridge bed; and the nucleic acid is eluted. It's that simple. You have salt-free, biologically-active samples.

NENSORB™ 20 cartridges offer exceptional reproducibility and recovery ranging from 60 to 90 percent. Reproducibility and recovery are ensured by extensive quality control on every lot of cartridges. This testing includes measuring sample recovery and biological activity of purified DNA, and testing that restriction enzyme is separated from plasmid DNA. The convenient, disposable NENSORB™ 20 cartridge can be used with syringe, vacuum box or automated processor.

Call 1-800-237-8400

For more technical information on NENSORB™ 20 call Du Pont at 1-800-237-8400, or write Du Pont Company, Biotechnology Systems, Leadtrack Room 20, 595 Colonial Park Drive, Roswell, GA 30075.

NEN Research Products
Biotechnology Systems

DU PONT

REG. U.S. PAT & TM. OFF

NAPCO'S SERIES 6000 WATER-JACKETED CO_2 INCUBATORS.

WHEN ABSOLUTE CHAMBER CONTROL IS AN ABSOLUTE MUST.

When your incubation technique requires absolute accuracy in environmental control, your equipment must be able to deliver. Completely. NAPCO Series 6000 incubators can.

Series 6000 incubators are water-jacketed CO_2 units specifically designed to maintain precise temperature and CO_2 control and high relative humidity in applications that can't tolerate "almost."

A dual-temperature sensing system is responsible for precise chamber monitoring. Sensors are positioned not only in the water jacket but *in each separate chamber* as well. Should temperature drift, audible and visible alarms sound an alert.

But, precise temperature control is only part of the story. A unique air-flow system assures very high relative humidity levels. And, an automatic CO_2 closed-loop control system keeps CO_2 tension within 0.1%.

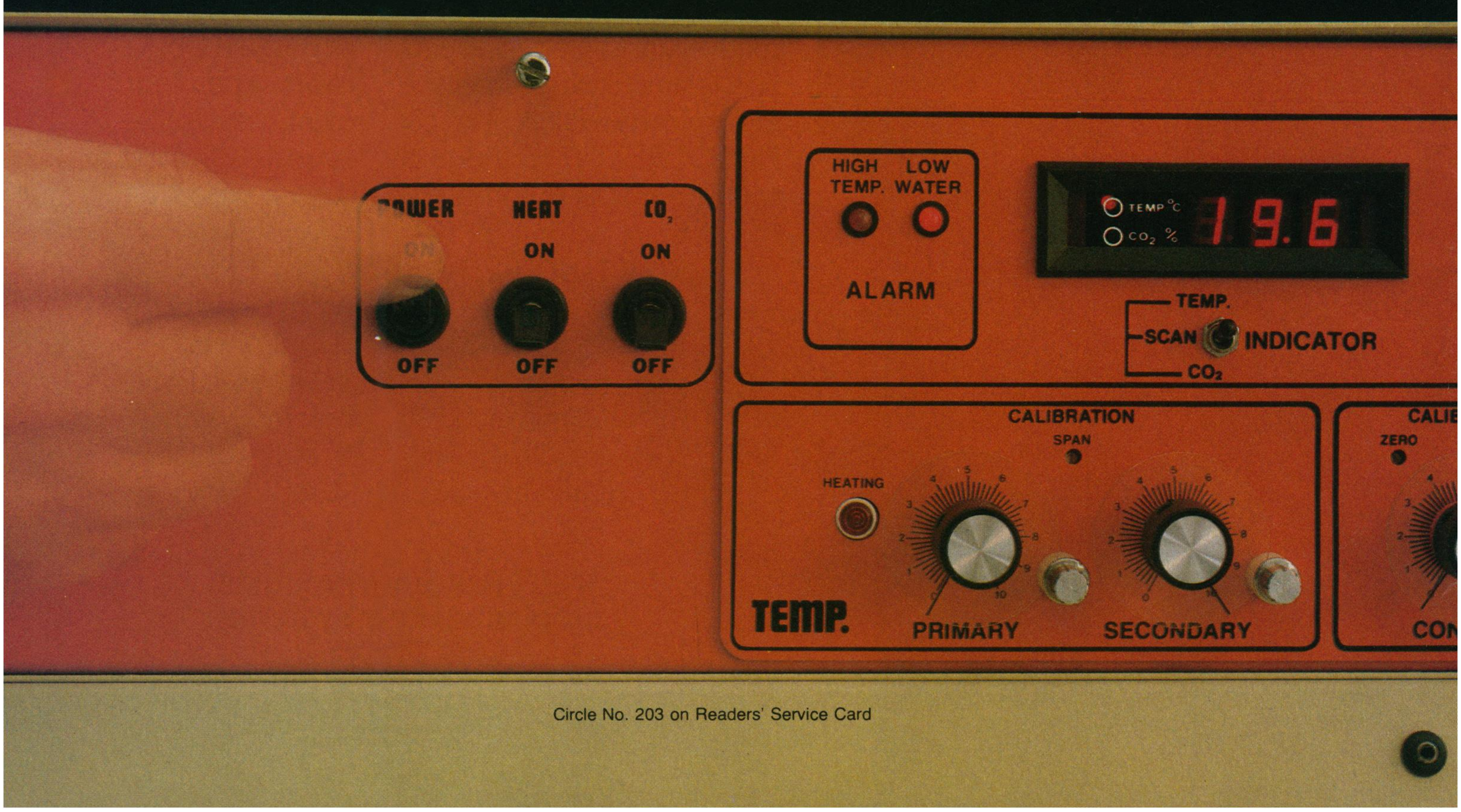
To further discourage contamination, the 6000 series employs a strict modular design. The double-walled interior chamber bolts into an insulated exterior assembly, effectively isolating it from ambient conditions.

The 6000 series CO_2 incubators from NAPCO. When absolute integrity is a must.

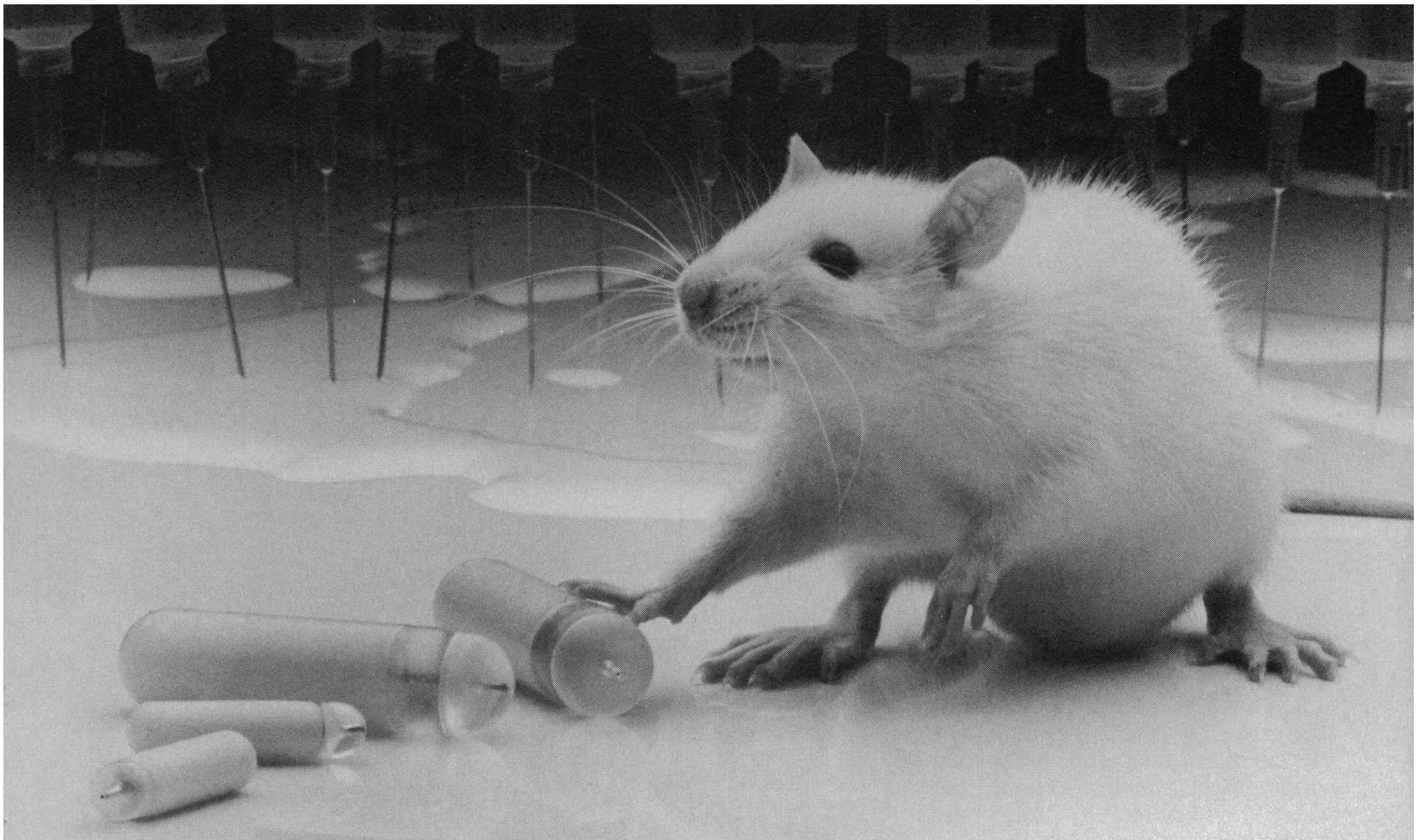
Call or write for more information.

napco®

NATIONAL APPLIANCE COMPANY
10855 S.W. Greenburg Road
Portland, OR 97223-0002
Toll-free phone: 800-547-2555
Phone: 503-639-3161
Telex: 151144



Circle No. 203 on Readers' Service Card

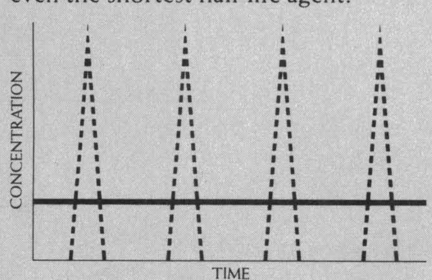


THE BLUNT TRUTH

FOR CONTINUOUS DOSING, CONVENIENCE, AND RESULTS... ALZET® OSMOTIC PUMPS DELIVER:

CONTINUOUS DOSING

Alzet Osmotic Pumps offer the choice of 1-4 weeks of delivery, night and day, for continuous presence of even the shortest half-life agent.



CONVENIENCE

Implantation can be completed in less than one minute. It is easily mastered. ALZA Corporation loans free of charge a videocassette showing subcutaneous and other implantation procedures.

RESULTS

Multiday infusions insure that you measure the fully-developed actions of your test agent in the steady-state. Single-dose studies are useful, but the actions of many agents are far from fully developed by a single dose. The Alzet Osmotic Pumps have demonstrated their ability to deliver good results in nearly a thousand publications.

NEW APPLICATIONS

Alzet Osmotic Pumps are now being used for direct tissue microperfusion with labelled amino acids and other precursors to demonstrate *in vivo* biosynthesis. Another new application of the pumps is localized drug delivery to the rat kidney via renal arterial infusion.

To place an order, call toll-free 800-227-9953. In California, Alaska & Hawaii call collect (415) 494-5067. For more information mail the coupon below.

alzet® OSMOTIC PUMPS B-SCI

Please send me information on the Alzet Osmotic Pumps.

Name________

Affiliation________

Address________

City________ State________ Zip________

Mail to: ALZA Corporation
Dept. Y, P.O. Box 10950
950 Page Mill Rd.
Palo Alto, CA 94303-0802

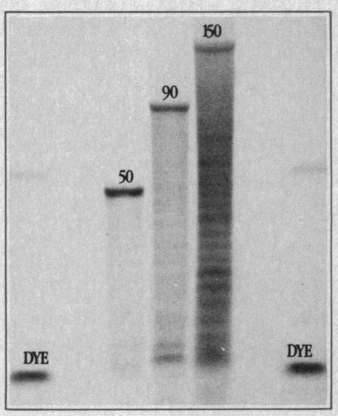
Circle No. 82 on Readers' Service Card

BIOSEARCH
A NEW BRUNSWICK SCIENTIFIC COMPANY

Now you can synthesize DNA by β-cyanoethyl amidite or phosphotriester chemistries on a single system.

The Model 8600 DNA Synthesizer from Biosearch is preprogrammed for both synthesis protocols. Choose the one best suited to your needs and optimize DNA fragment length or synthesis cycle time.

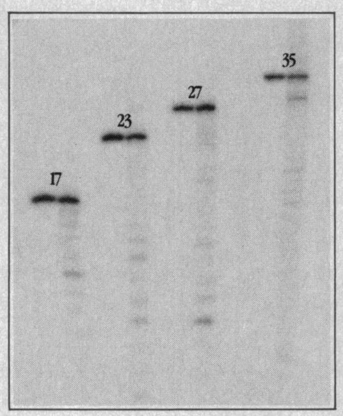
If your requirements call for long DNA fragments, Biosearch's β-cyanoethyl amidite chemistry makes it possible to synthesize fragments well in excess of 150 bases with 250 O.D. or more of product–and a cycle time less than 6 minutes. These long fragments can be used to synthesize whole genes more easily by reducing the number of enzymatic ligations required, with a concomitant decrease in the number of purification steps.



Electrophoresis gel results for 150-base polynucleotide synthesized by β-cyanoethyl amidite chemistry.

On the other hand, if your need is for rapid, economical short-chain syntheses, Biosearch's new optimized phosphotriester chemistry can simplify the routine synthesis of oligonucleotide fragments up to 50 bases. You can expect reliable results in a cycle time of less than 7 minutes, with fewer steps and fewer reagents utilized.

And you're not limited to these two protocols. Since the 8600 is fully programmable, you can modify stored chemistries or develop your own as required. This flexibility will allow you to keep abreast and take advantage of new advances in DNA synthesis.



Electrophoresis gel results for 35-base oligonucleotide synthesized by optimized phosphotriester method.

Whatever method you choose, you'll find that the 8600 makes it easier to obtain higher yields and faster cycles with automated mixed probe synthesis, automatic deprotection and cleavage, and simultaneous, four-column synthesis.

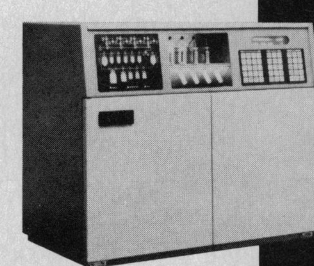
Biosearch also provides high-purity, high-stability reagents for both β-cyanoethyl amidite and phosphotriester chemistries. Moreover, each 8600 system is supported by a worldwide network of experienced technical personnel.

Biosearch–better ways to synthesize biomolecules.

For complete information on the Model 8600 DNA Synthesizer, contact Biosearch at one of the numbers listed below.

In U.S. and Canada
BIOSEARCH, Inc.
2980 Kerner Blvd.
San Rafael, California 94901 USA
Telephone: Toll Free (800) 227-2624
In California (415) 459-3907

In Europe
New Brunswick Scientific (UK) LTD.
6 Colonial Way
Watford
Hertfordshire WD2 4PT, England
Telephone: 0923 23293
Telex 894187 Brunco G



Model 8600 DNA Synthesizer

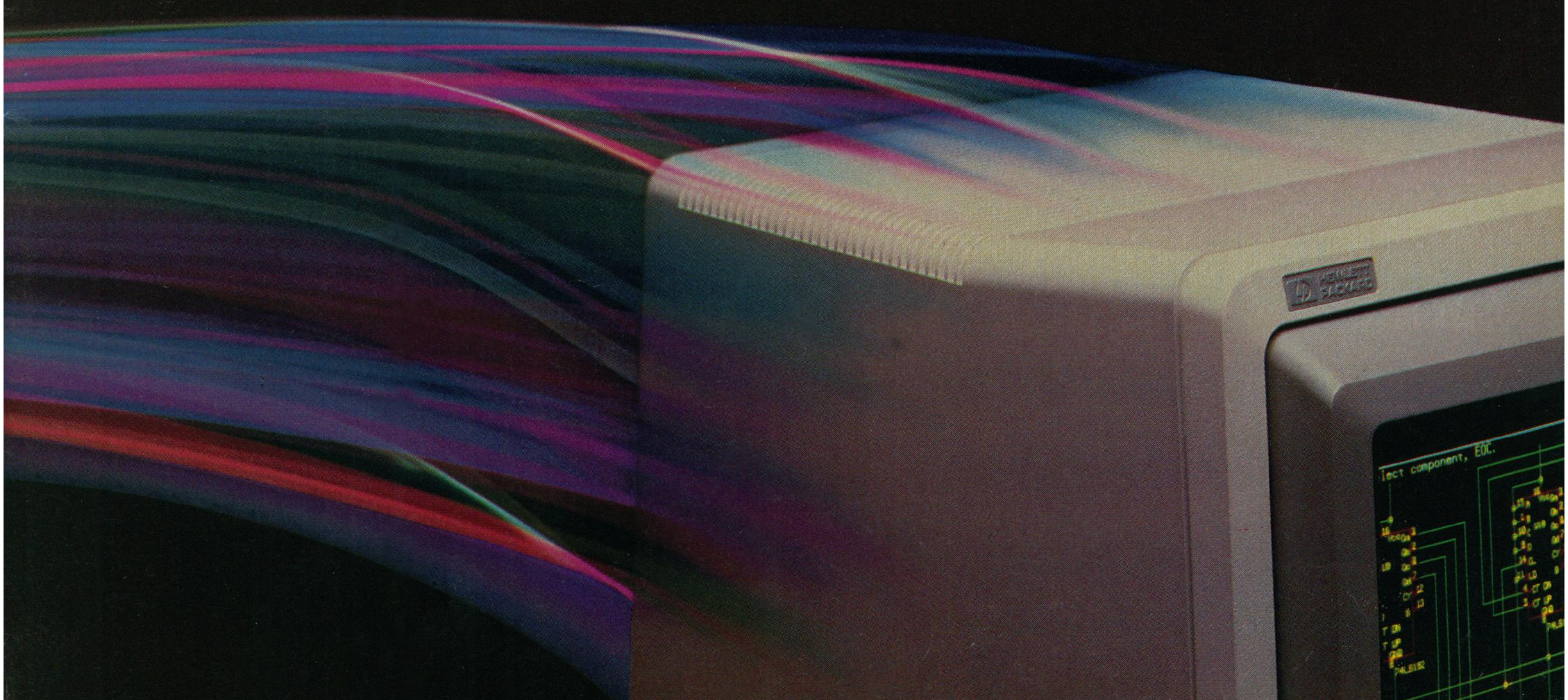
Circle No. 120 on Readers' Service Card

Name the computer that's so modular and expandable it lets you upgrade from 16-bit to 32-bit processing...

Expand from .5 to 7 Mbytes of memory...

Or go from monochrome display to high-resolution color graphics...

All in a snap...



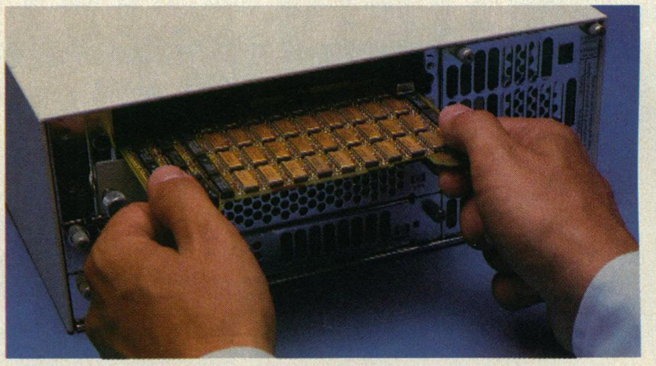
Introducing the HP 9000 Series 300

The computer that

Starting right now, HP is going to change your thinking on the ways that computers can change. Because now, there's a computer system so easy-to-configure that it meets today's application requirements quickly and cost-effectively, and so modular and expandable that it embraces future application needs as well. Whatever the job at hand — advanced CAD and measurement automation, or word processing, spread sheets, and database management — the new HP 9000 Series 300 is equal to the challenge.

Your pick of processing power.

The Series 300 offers you the appropriate processing power for the job, running your choice of two Motorola microprocessors: the 68010 16/32 bit and the 68020 32 bit. You can start with the 68010 and easily upgrade to the 68020 when more processing power is required. Just as important, you have complete object code compatibility across the product line. So when you change processors, there's no need to recompile.



Changing CPUs in the HP 9000 Series 300 is a snap. You simply plug in a new card set and, with object code compatibility, you shift from a 68010 running at 10 MHz to a 68020 running at 16.6 MHz.

Adding peripherals is easy.

The Series 300 has the built-in interfaces to handle HP's large, fully compatible family of peripherals. There are many compatible monitors of varying resolution, too, so you can go from 12-inch monochromatic display all the way to high-speed, high-resolution color graphics.

loves changes

In addition, there are a number of HP peripherals for you to choose from: input and mass storage devices, plotters, printers, and more.

Productive programming language options.
You also have a complete set of programming language tools to work with, to help you better meet the needs of your application. For instance, the Series 300 runs HP BASIC, as well as HP-UX — HP's robust version of AT&T's System V UNIX™ operating system. And HP-UX supports industry standard programming languages, too — FORTRAN 77, Pascal, and C.

Link entire systems, not just users.
The Series 300 is designed to be linked with other systems. Your initial application may call for a simple, single-user system. But the Series 300 has what it takes to grow into a sophisticated 100-node LAN based on IEEE 802.3 or Ethernet™. With LAN, the Series 300 can share data with the Series 200 and 500 computers in the HP 9000 family, plus the popular HP 1000 and 3000 family.

Consistent HP quality.
With the HP Series 300, you can count on cost of maintenance below 4 percent, the result of exceptional HP product quality, uniformly maintained with exacting tests in temperature, shock, humidity, altitude, and many others. Couple this with our complete service and support package and you have still more reasons to go with HP.

Call us today!
Choose the system that will change to meet the application requirements of you, your users, and your customers today and tomorrow. Call your local HP sales office listed in the white pages. Or call 1-800-522-FAST (in Colorado, 223-9717 collect) for the number of the sales office nearest you.

Now, get data on-line, 24 hours a day!
For immediate information, use your computer and modem and dial 1-800-367-7646 (1200 baud, 7 bits even parity, 1 stop bit). In Colorado call 1-800-523-1724.

Circle No. 167 on Readers' Service Card

HEWLETT PACKARD

DS15514

The new MICRO-ISOLATOR™ System: A revolutionary breakthrough in animal housing.

A simple and versatile animal housing system that offers greater microbiological control than complex barrier rooms . . . but without the inconvenience and inefficiency that barrier rooms impose by limiting the movement of people and animals.

The Principle

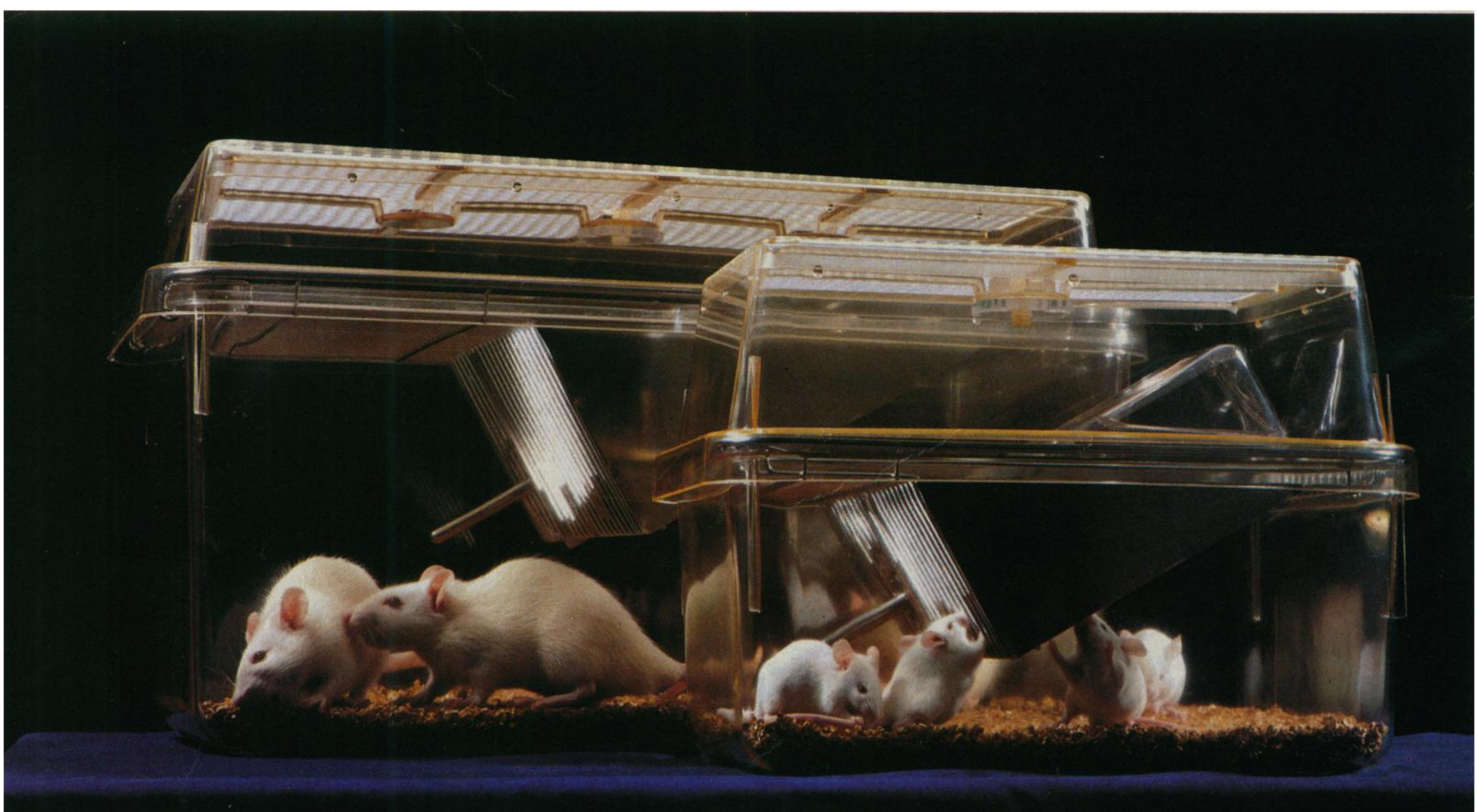
In effect, the MICRO-ISOLATOR System involves the use of durable filter-topped cages that function as "giant Petri dishes," which are only opened within a Class 100 workbench by personnel who observe aseptic technique at all times.* There are many benefits to this unique miniaturization strategy. For example, animals from multiple sources with different microbiological profiles have been housed in the same room without cross contamination. Likewise, investigators can experimentally infect animals in different MICRO-ISOLATORS within the same room without interfering with one another's research . . . and all of this can be accomplished without the inconvenience of requiring personnel to shower into or out of the room. Also, since all manipulations are conducted in a Class 100 workbench, individuals allergic to animals are protected from dander and therefore are able to work in comfort.

The complete MICRO-ISOLATOR System consists of the individual MICRO-ISOLATOR housing units, the STAY-CLEAN™ Laminar Flow Workbench, and the service cart.

The MICRO-ISOLATOR Units

This system consists of an autoclavable plastic cage and plastic filter frame with a static filter (now designed for rapid replacement of the filter material), plus the usual cage accessories. The plastic filter frame overlaps the bottom portion of the cage and effectively forms a giant Petri dish-like structure. Result: there is an effective protection against microbial contamination while still allowing for substantial gaseous interchange. The MICRO-ISOLATOR is, in other words, a protected microenvironment within any insect-controlled macroenvironment.

MICRO-ISOLATOR units, fabricated of autoclavable plastic material, are now available for mice, rats, hamsters, and guinea pigs.



* Please complete coupon for the MICRO-ISOLATOR System "Products, Principles, and Procedures Manual."

The Service Cart

The service cart completes the MICRO-ISOLATOR System by simplifying the movement of all necessary supplies to the laminar flow workbench for servicing the MICRO-ISOLATOR units.

For More Information

Write or call Lab Products, Inc., 255 West Spring Valley Avenue, P.O. Box 808, Maywood, New Jersey 07607 or complete the coupon. Phone 201/843-4600 or 800/526-0469.

lab products inc

a bioMedic company

The STAY-CLEAN Laminar Flow Workbench

Whenever a MICRO-ISOLATOR unit is being serviced (that is, when animals or the contents of the unit are being manipulated), these activities must take place within a Class 100 environment. The STAY-CLEAN Laminar Flow Workbench is a specialized unit developed for such cage and animal manipulation. It has been designed to achieve two goals: (1) to prevent ambient contagion from entering the workbench and any of the components, and (2) to limit the escape of animal dander and other particulate matter from the work area.

The STAY-CLEAN Laminar Flow Workbench is compact, moveable, and includes state-of-the-art monitoring instrumentation to assure proper operation.

Circle No. 96 on Readers' Service Card

Patents applied for on the MICRO-ISOLATOR units and other elements of the complete system.

MICRO-ISOLATOR and STAY-CLEAN are trademarks of Lab Products, Inc.

Lab Products, Inc.
255 West Spring Valley Avenue
P.O. Box 808
Maywood, New Jersey 07607

I would appreciate:

- ☐ Your new MICRO-ISOLATOR System "Products, Principles, and Procedures Manual."
- ☐ Information on your other environmental control products.
- ☐ Your comprehensive catalog of animal housing and care systems and accessories.
- ☐ Seeing your local representative. Please call and set up an appointment.

Area Code ______ Number ______ Ext. ______

Name ______

Title ______

Organization ______

Address ______

______ Zip ______

25 October 1985, Volume 230, Number 4724

SCIENCE

Scientific Literacy

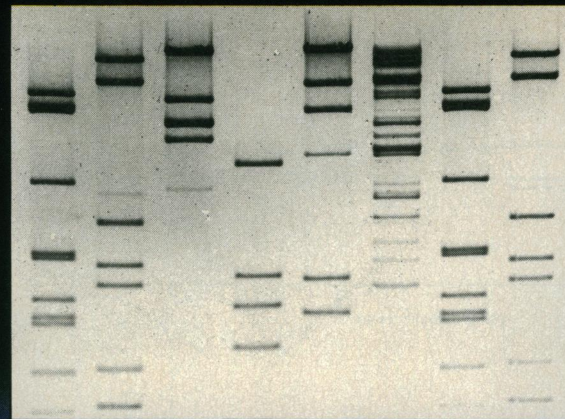
It is time to consider the problem of biconceptual education. The world today is divided into two conceptual groups, the scientist and the nonscientist, and the communication gap between them is wide and serious. It is not a problem of respect for scientists. We scientists get all the respect we need—any more is likely to make us candidates for television commercials. I am not saying that lawyers should start reading the *Physical Review Letters* or mayors the *Journal of the American Chemical Society*. What concerns me is that some of the fundamental concepts and methodologies of science are outside the understanding of the vast majority of the population, including its opinion-makers.

For example, scientists in every discipline understand that certain decisions that must be made are associated with some level of risk, but we watch with consternation as society acts as if zero risk could be achieved. The same parents, for instance, who drive their children to school without seat belts demand a flat statement of certainty about the risk posed to their children by being in school with a child with AIDS. The ever-rising levels of malpractice awards are based on the premise that if doctors are punished enough they will become perfect, but ignore the possible outcome that the consequent fee increases will inhibit those with marginal incomes from going to the doctor. Living near a nuclear power plant may be safer than attending a rock concert, but what television viewer would believe that?

A second example is the methodology of "the control." When Pasteur was ready to test his anthrax vaccine he infected both the previously immunized sheep and some nonimmunized controls. The fact that the former lived and the latter died showed that he had made an effective vaccine. Political and civic decisions are frequently made, however, with no attempt to obtain a control sample, which would help determine the efficacy of a course of action. I attended a school board meeting at which a new math program was proposed. A board member suggested that students be divided by lot into two groups, one group to be taught by the new math and one by the old math, with some evaluation at the end of the year. He was denounced by almost everyone at the meeting because one should not conduct "a lottery with students' lives." Prison programs on rehabilitation, medicare programs to balance costs, bilingual education programs, and many other worthy enterprises might be better handled, and more readily improved, if the initial experiments had appropriate controls.

These two examples of scientific concepts are directly transferable to public policy and should be taught to students at the elementary, high school, and college levels. They should be part of a screening test for television anchors, judges, and gubernatorial candidates. Instead, most schools today are diminishing science requirements. Even at the college level, the few universities that have general education requirements allow them to be satisfied by tourist-bus surveys of the wonders of astronomy or the marvels of the body, rather than by a more demanding course in the simple logic of science. Judges and legislators with little or no scientific training are making sweeping decisions on risks to the environment and from nuclear war and industrial accidents. Common sense would argue that an organization such as the Environmental Protection Agency should list the major hazards to health and evaluate them systematically, taking the most important first instead of the most recent headline case.

Scientists will be denounced for trying to introduce cold-blooded reason into an area in which warm-blooded humanity is supposed to reign supreme. But warm emotion frequently gives way to hot-headed anger and even bigotry. The scientific method has been the most effective means of overcoming poverty, starvation, and disease. Even those who are not professional scientists can understand its fundamental concepts, which will aid their decision-making in an increasingly difficult and technological world. It is time to bridge the "concept gap" by improving scientific literacy.—DANIEL E. KOSHLAND, JR.



A better way to get uniform band spa

Wedge-shape