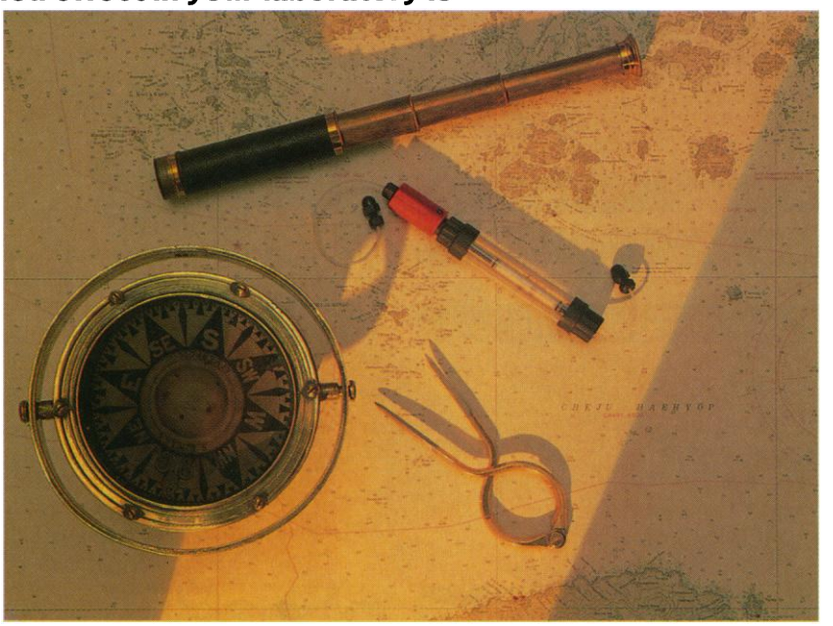
American Association for the Advancement of Science

SCIENCE

15 MAY 1987 $2.50
VOL. 236 ■ PAGES 753–884

NAVIGATING FOR SUCCESS

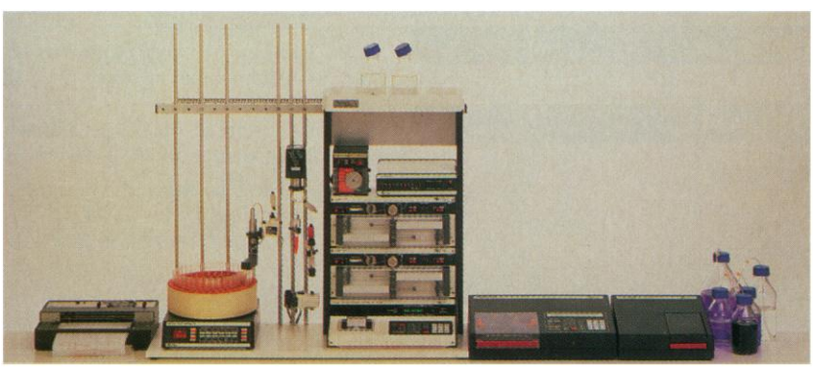
To help find your way through the often uncharted seas of protein purification, Pharmacia presents a powerful combination: FPLC® and PhastSystem.™ Their combined effect in your laboratory is more than ordinary research equipment. It's an explorer's dream! Why?



Navigation. PhastSystem characterizes your sample fast: high resolution SDS-PAGE or IEF in 30 minutes, coomassie staining in 30 minutes. Use PhastSystem first to learn the electrophoretic characteristics of your sample. Speed is what makes PhastSystem a perfect navigational aid for charting the course *and* monitoring the progress of protein separations. Then turn to FPLC with optimal conditions in hand. The speed, resolution and biological recovery of FPLC is maximized by the information gained from each previous electrophoretic step. Use PhastSystem at each stage of your chromatographic journey, gathering more information after each separation step. After the separations, a final purity check will assure you that you've arrived.

With FPLC and PhastSystem, you save time at each high resolution chromatographic and electrophoretic step. By selecting the right course for your separation, you'll never drift around in a sea of possible separation conditions.

Set your sails for success. Plot a course for your Pharmacia representative today.



FPLC AND PHASTSYSTEM:
THE HIGH-PERFORMANCE COMBINATION.

Pharmacia

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

Circle No. 98 on Readers' Service Card

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

SCIENCE

ISSN 0036-8075
15 MAY 1987
VOLUME 236
NUMBER 4803

■ **SCIENCE is published weekly on Friday, except the last week in December, and with an extra issue in February by the American Association for the Advancement of Science, 1333 H Street, NW, Washington, DC 20005.** Second-class postage (publication No. 484460) paid at Washington, DC, and at an additional entry. Now combined with **The Scientific Monthly®** Domestic individual membership and subscription (51 issues): $65. Domestic institutional subscription (51 issues): $98. Foreign postage extra: Canada $32, 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; Guide to Biotechnology Products and Instruments $16 ($17 by mail). **Change of address:** allow 6 weeks, giving old and new addresses and seven-digit account number. The identification code for *Science* is 0036-8075/83 $1 + .10. **Postmaster:** Send Form 3579 to *Science*, 1333 H Street, NW, Washington, DC 20005. *Science* is indexed in the *Reader's Guide to Periodical Literature* and in several specialized indexes.

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

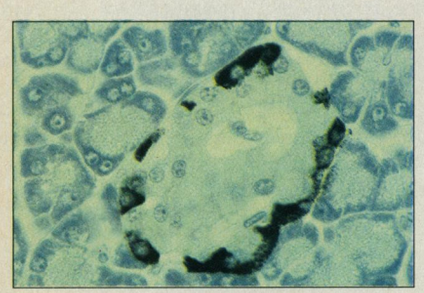
COVER The bat *Pteronotus parnellii* detects, identifies, and catches flying insects by hearing variations in the echoes of the ultrasonic sounds that it emits. Auditory pathways to frontal cortex may play a role in this mammal's ability to use hearing as the chief sensory basis for spatial navigation. See page 824. [The photograph was taken in the laboratory of O. W. Henson, Jr., at the University of North Carolina, Chapel Hill, by Russell Hansen. The moth was tethered to a string for the purpose of the photograph]

Brighten a small world...

AuroProbe™ LM will illuminate your antigens and cell structures with unprecedented clarity

In your small world of antigens and cells there are no stains that can illuminate your targets as well as **AuroProbe* LM**... in defining cell structure and surface using light microscopy, no immunostains offer such unmatched contrast and sensitivity.

AuroProbe LM immunoprobes contain secondary antibodies or streptavidin linked to 5 nm colloidal gold particles. The colloidal gold signal is strongly enhanced with **IntenSE***, Janssen's new and easy to use silver enhancement kit. **IntenSE** silver enhancement can be performed in natural light and does not require any special changes in your protocols.



Rat pancreas. Islet of Langerhans stained with **AuroProbe LM** for glucagon. Paraffin section counterstained with hematoxylin. (Courtesy of Drs. in't Veld and C.F.M. Van Schravendijk, VUB, Belgium)

Human prostate. Benign hyperplasia stained with **AuroProbe LM** for prostatic acid phosphatase. Paraffin section counterstained with hematoxylin-eosin.

Light up your research with **AuroProbe LM** and **IntenSE**, the most advanced immunocytochemical stains available.

* Trademark

JANSSEN
LIFE SCIENCES PRODUCTS

40 Kingsbridge Road,
Piscataway, NJ 08854
Toll free: 1-800-624-0137
Telex: 6853051

Turnhoutseweg 30,
B-2340 Beerse BELGIUM
Tel.: 014/60.33.85
Telex: 32.540

Circle No. 10 on Readers' Service Card

JANSSEN *pioneering in Life Sciences technology*

This Week in
SCIENCE

Cloning large DNA segments

THE mapping of the human genome or other complex chromosomes would be greatly facilitated if large pieces of DNA could be easily cloned (page 806). Burke *et al.* have now developed techniques that increase tenfold (to 500 kilobases or more) the size of clonable pieces of DNA. Linear molecules of DNA were generated in vitro and ligated into a yeast vector; these were inserted into yeast cells in which they were maintained as linear artificial chromosomes. In the prototype experiments, pieces of yeast DNA with 40 to 130 kilobases and pieces of human DNA with more than 400 kilobases were successfully cloned. The sizes of the cloned segments were verified by pulsed-field gel electrophoresis. Manageable DNA libraries may now be generated from complex chromosomes and large DNA sequences whose specific functions are of interest may be cloned. Both mapping efficiency and fidelity are expected to be improved by this new cloning strategy.

Allelic exclusion

ALLELIC exclusion is a puzzling phenomenon: in any immunoglobulin-producing cell, only one set of immunoglobulin genes (there are two sets per cell, one from each parent) will be expressed (page 816). The gene that is expressed for immunoglobulin heavy chain (in this study, the μ heavy chain of IgM molecules) is thought to prevent the expression of the other allele. Nussenzweig *et al.* used transgenic mice to study whether, in cells capable of producing only membrane-bound immunoglobulin, allelic exclusion would occur. The transgenic mice carried an altered human gene that lacked the signals for making secretory IgM; secretory molecules are normally made in immunoglobulin-producing cells along with the membrane-bound form of the molecules. In spleen cells expressing the human gene and producing only membrane-bound μ chains, production of normal mouse IgM was inhibited; in those expressing the mouse μ chain, human μ chain was not produced. In addition, the messenger RNA molecules of only the expressed μ chains were made. That allelic exclusion pertains for a combination of human and mouse genes implies that molecular structures and signals that are crucial to this process are common to these two species.

New archaebacteria

A third branch has been identified within the archaebacterial kingdom: it consists of bacteria that grow well in extreme heat, derive energy from the reduction of sulfate, and contain a novel form of RNA polymerase (page 822). Stetter *et al.* isolated the distinctive bacteria from hot sediments collected at two marine hydrothermal systems off the coast of Italy. The organisms are irregular spherical motile bacteria. Their optimum growth occurred in extreme heat (83°C). It depended on the availability of sulfate, which was reduced to hydrogen sulfide and carbon dioxide; some methane was also produced. The phylogenetic uniqueness of the organisms suggests that their origins, like those of other archaebacteria, are ancient. Although the oceans were not rich in sulfur during Archean time (early in earth history), local hydrothermal vents would have been rich in sulfate (from magma) and could have provided suitable substrates for the growth of these organisms. The discovery of organisms combining a sulfate-reducing metabolic pathway with optimum growth in high temperatures may account for the finding of hydrogen sulfide–rich "sour oil" as a contaminant of geothermally heated oil wells.

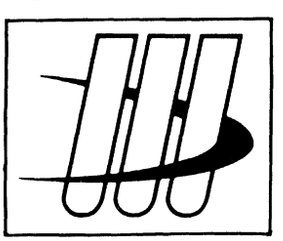
Hearing in echolocators

PATHWAYS in the brain by which sounds are processed have been studied in mustache bats (*Pteronotus parnellii*) which have well-developed auditory senses (cover and page 824). The bats use hearing to orient in space, find and intercept prey, and avoid obstacles. They emit pulses of sound, scan their environment for returning sound waves, and respond with movements of pinnae (the external, cartilaginous ear flaps), head, and body. Injected tracer substances highlighted neuronal pathways for processing sounds as the tracers were transported along firing axons. The frontal lobe of the cerebral cortex was involved in the response to acoustic stimulation: signals entered it from regions of the thalamus (having entered the thalamus from the medulla); signals traveled out from the cortex to the superior colliculus, a region from which motor signals directing head and pinnae movements occur. Kobler *et al.* speculate that sensorymotor connections in the frontal cortex may develop in accordance with and reflect the sensory needs of the animal: those animals that rely heavily on hearing, therefore, would have well-developed links between auditory input and motor output regions; those relying more on sight would develop stronger connections between visual input and motor output centers.

Food for thought

EATING enhances memory (page 832). Groups of mice subjected to different feeding regimens were taught how to run a maze. The ability to remember the right route was best in those animals that ate voraciously after learning. The effect was found to be mediated by cholecystokinin, a neuropeptide that is normally secreted by the stomach during eating and is one of several peptides that sends signals to stop eating to the central nervous system. Cholecystokinin acts on vagus nerve fibers; when the vagus nerve was experimentally severed, the memory effect did not take place. Flood *et al.* speculate that the association of eating with memory may have given wild animals a survival advantage: eating caused release of gastric peptides, stimulation of the vagus nerve, and enhanced memory, perhaps of the strategy that had been used in the successful attempt to find food.

INTRODUCING AN UNPRECEDENTED CONCEPT IN THE LITERATURE OF SCIENCE:



THE ISI ATLAS OF SCIENCE®

INNOVATIVE. TIMELY. UNIQUE.

That's the *ISI Atlas of Science,* an exciting new series of publications that explores the present and future direction of research in science, medicine, and technology. The *Atlas* combines the power of computerized citation analysis with the expert interpretation of leading researchers to guide you through the landscape of science, helping you understand what is happening in science research today . . . and where it might lead tomorrow.

The *Atlas* series will consist of 12 sections, each focusing on a distinct area of scientific research. The first section, the *ISI Atlas of Science: Pharmacology,* is available now. Over the next four years, 11 additional *Atlas* sections will begin regular publication.

A yearly subscription to each *Atlas* section consists of four quarterly issues, each containing 20-30 surveys analyzing the latest research in the topic covered. Institutional subscriptions also include an annual cumulation containing all surveys for that year, plus extensive indexes and reference materials.

Flexible . . .

A variety of subscription options are available for the *ISI Atlas of Science,* designed to meet the research and budgetary needs of individuals, departments, and small or large libraries. And, for a limited time, subscribers can take advantage of our Charter Subscription Program and receive all 12 sections of the *Atlas* as they become available . . . at significantly reduced rates!

Explore your options . . .

To explore the variety of *ISI Atlas of Science* options available, call toll-free, 1-800-523-1850, extension 1405. In Pennsylvania and outside the United States, call 215-386-0100, extension 1405. We'll send you a complimentary information package, including a detailed brochure and sample articles from the *ISI Atlas of Science: Pharmacology* . . . at no obligation.

FROM THE PUBLISHERS OF CURRENT CONTENTS® AND THE SCIENCE CITATION INDEX®.

ISI®

Institute for Scientific Information®
3501 Market Street, Philadelphia, PA 19104 U.S.A., Telephone: (215) 386-0100, ext. 1405, Cable: SCINFO, Telex: 84-5305
European Branch: 132 High Street, Uxbridge, Middlesex UB8 1DP, United Kingdom, Telephone: 44-895-70016, Telex: 933693 UKISI

SCIENCE

15 MAY 1987
VOLUME 236
NUMBER 4803

Ice Minus and Jobs Minus

The coincidence of an actual field test of a genetically engineered organism with the arrival in Washington of Prime Minister Yasuhiro Nakasone to discuss trade imbalances generated some cerebral turbulence. The field test occurred 4 years after a committee of experts of the National Institutes of Health had declared the experiment safe. The delay was caused by lawsuits, hearings, and court appeals in various localities. As Russell Baker commented, the country is "dying of terminal jurisprudence."

To be fair, scientists are not being discriminated against selectively. Litigious delays are inflicted with magnificent sameness upon baseball teams, malpractice cases, antitrust suits, and worker injuries, to name a few other examples. Moreover, any reader of newspapers is well aware that cases usually travel by multiple appeals through ever ascending courts until the Supreme Court settles the matter, at least temporarily. The testing of the "ice minus" organisms, however, is illustrative of the special problems of scientists. Of all organisms that scientists plan to release into the environment, this is probably one of the safest. It already exists in nature in a slightly different form, and the natural form has been shown not to take over in preference to existing species. The engineering involved the removal of a protein, not the addition of one. In the interminable legal delays, not one serious scientific fact was added to the initial body presented to the NIH committee. Judges can, and indeed do, throw cases out of court for lack of merit. But in these cases, presumably public outcry generated by mediawise groups convinced judges to consider seriously issues that had little scientific substance. The question arises whether that is a good way to proceed and whether in an increasingly competitive world, the United States can afford such leisurely undertakings.

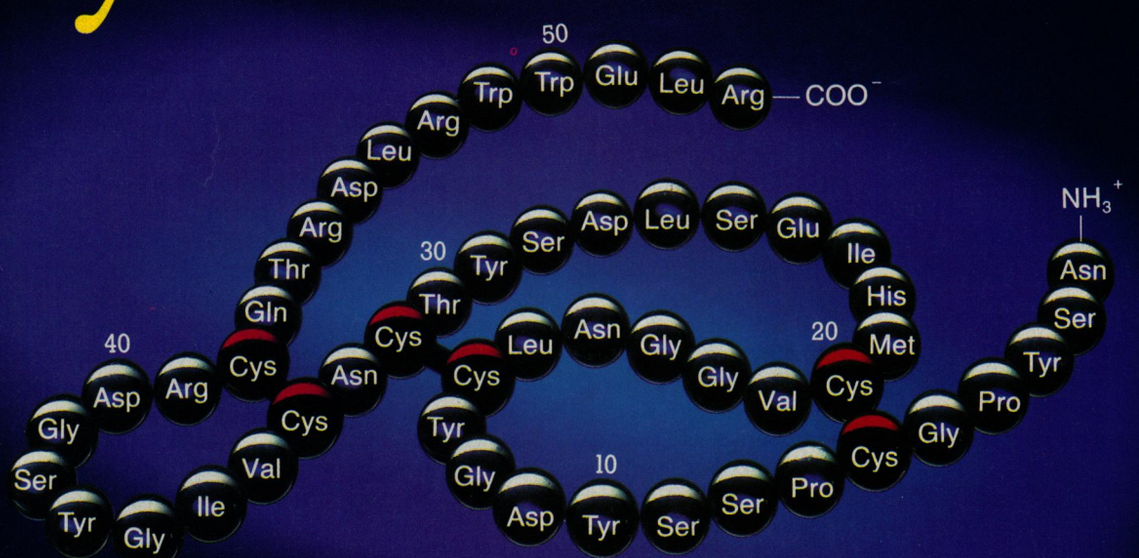
Scientists have an obligation to inform the public, particularly when a new and mysterious technology is introduced. But the public also has some responsibility to make minimal efforts to learn. In some of the media accounts it was implied that local groups knew nothing about what was going to happen because the scientists had not come and personally explained the experiment. Yet, newspapers these days contain stories explaining the uses of recombinant DNA in a variety of medical, scientific, and agricultural advances. The need for the federal government to avoid multiple considerations of the same subject was discussed (Editorial, 2 May 1986, p. 561) and to a large extent Washington has done just that. The next question is whether the post-Washington period can be streamlined not just for recombinant DNA, but also for other complex scientific subjects.

The time may have arrived when specialized judges with scientific training are a necessity. We are living in an increasingly technological society, and increasing numbers of lawsuits involve matters in which a rudimentary knowledge of science is essential. Lawyers specialize in areas such as commercial law, family law, tax law, and patent law, and in certain cases judges with specialized knowledge can be requested by mutual consent of the litigants. The concept of a judiciary some of whom are trained in scientific methods and to whom cases are routinely assigned is even more appropriate to our times. The administration could have many forms, from a deliberate introduction of a certain fraction of scientifically oriented judges per state to a few central locations in which a scientifically trained judiciary was used as a referral service for scientific cases.

The argument that local conditions will require local hearings is reasonable if there are local specifics relevant to the case. The arguments made on television and in the newspapers by opponents of the "ice minus" tests were the usual ones of "this experiment represents the first step in biological warfare," "the chance of an Andromeda strain," and "danger of an uncontrolled spread in the environment." The particular environmental conditions of Monterey versus Napa Valley versus Contra Costa County were not factors and yet each locality required hearings. Public forums are desirable in all cases, but new legal actions are not a necessary concomitant of better education.

The introduction of new organisms into the environment is a serious matter, and some future ones will require much more serious deliberation than the "ice minus" debate. The NIH committee by law contains both experts and public representatives. But repetition of the same arguments at ever lower levels of sophistication cannot ensure additional safety. These litigious delays can only lead scientific industries to select more future-oriented countries. The hazards will go but so will the jobs.—DANIEL E. KOSHLAND, JR.

The Peptide Synthesizer...

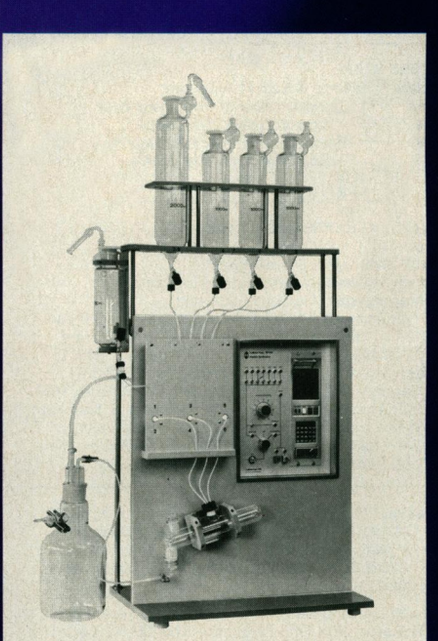


...you have been looking for.

Semi-automated instrument for t-Boc and Fmoc chemistry and all known coupling procedures.

- easy to program
- reliable
- versatile
- different reactor sizes (up to 30 grams of peptide)
- solid construction
- low price

Please, ask for information and prices.



Labortec AG

Hauptstrasse 144 CH-4416 Bubendorf/Switzerland Phone 061/952333 Telex 966081 Telefax 061/952549

Circle No. 155 on Readers' Service Card

As exciting and revealing as these new technologies are, they still involve considerable uncertainties, which I believe probably conceal significant resources. Furthermore, as we and others go back into known oil fields, we continue to discover areas that were overlooked and horizons that were drilled through without noting significant accumulations of oil.

The larger question is, What production will be possible from these various sources at what oil price? At $18 per barrel, U.S. production could continue to decrease at maybe 8% to 10% per year. At, say, $35 per barrel, the United States could probably regain or surpass our early 1980s production and maintain it for decades. Eighteen dollars appears to be reality; $35 does not appear likely.

Lovins makes a number of points; I will comment on two. First, he argues that continued improvements in efficient energy utilization are possible, desirable, and inadequately covered in my article. I totally agree. The DOE Energy Research Advisory Board (ERAB) has projected possible further U.S. energy efficiency gains of 20% to 30% by the year 2000, and I believe such improvements are physically attainable. The original draft of my paper had a much longer section on conservation, quoting ERAB.

The answer to Lovins' questions about why "oil companies [aren't] spending more on exploration" is the same as to the question of why the drive for greater U.S. energy efficiency has stalled and even reversed [the 65 mile-per-hour speed limit, CAFE (Corporate Average Fuel Economy) relief, and so forth]. The problems are low oil prices and government policies.

Low oil prices severely limit the exploration that can be economically justified under the current U.S. tax structure. That tax structure was basically established during the high profit period of the late 1970s and early 1980s. It has not been revised to accommodate the new realities that followed the 1986 oil price collapse. Tax structure changes could lower effective costs and thereby stimulate a dramatic expansion of new U.S. exploration and production.

Low oil prices also severely dampen the economic driving force for additional energy conservation. The only possible counter to that situation is government policy change, which could mandate continued energy efficiency improvements. When the stakes are as high as they are in energy, an either-or policy seems to me to be foolhardy. I believe that both increased U.S. exploration-production and increased energy efficiency are in the national interest, and I favor policies that would stimulate both.

ROBERT L. HIRSCH
ARCO Oil and Gas Company,
2300 West Plano Parkway,
Plano, TX 75075

Erratum: In Constance Holden's article "NIMH finds a case of 'serious misconduct' " (News & Comment, 27 Mar., p. 1566), the location of the Oakdale Regional Center for Developmental Disabilities was incorrectly given as Illinois. The center is in Oakdale, Michigan.

Erratum: In the 1 May AAAS News (p. 610), four paragraphs that should have appeared under the heading "Pacific Division meets in San Diego, 14–18 June," incorrectly appeared under the heading "*SB&F* focuses on science in the middle grades." The misplaced text (p. 611) begins, "In addition, several field trips are scheduled. . . ." and ends, "or call 415-752-1554."

Erratum: In Jean L. Marx's Research News article "Oxygen free radicals linked to many diseases" (30 Jan., p. 529), Benedict Lucchesi (whose name was misspelled) was incorrectly described as expecting to initiate clinical trials of superoxide dismutase and catalase in human heart attack patients who undergo reperfusion therapy.

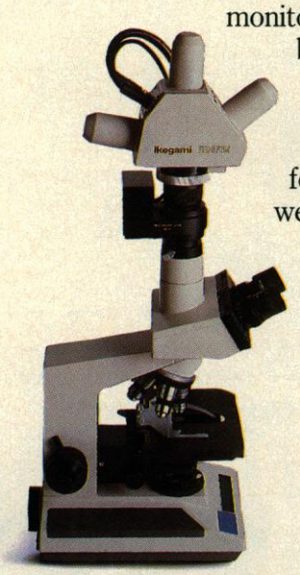
Are You Enjoying Every Advantage of Video Technology?

A Free Needs Analysis Lets You Know.

Video technology has fast become an indispensable tool in research & development, test and measurement, semi-conductor, and general science. For documentation, training, on-line inspection, teaching or research, video communicates best.

We know. Many of the recent technological innovations in broadcast television cameras and monitors have been developed by Ikegami engineers.

So, as we introduce our full line of video imaging systems for science and industry, we want to be certain that you are in a position to fully benefit from our products.



Fill out and mail today for your Free Video Needs Analysis

One of Our Fine Video Products

Ikegami engineers a full line of color and monochrome cameras and monitors designed exclusively for science and industry. The ITC-370M color camera* is just one example. This 3-tube camera achieves superb image quality combined with new advanced automatic functions, controlled by microcomputer. The ITC-370M is rugged, lightweight, and simple to operate. The microcomputer eliminates the need for special adjustments. Auto white balance, auto black balance and auto centering functions enable the camera to be operated easily by any user to produce optimal results.

**ITC-370M does not come equipped with a microscope.*

Circle No. 51 on Readers' Service Card

That's why we're offering our free needs analysis. It's yours by simply filling out the card below and returning it in your company envelope. Upon receipt, we will review it and offer specific recommendations based on your particular needs. For an immediate response, please call our regional office for the dealer nearest you.

Ikegami®

Ikegami Electronics (USA), Inc., 37 Brook Avenue, Maywood, NJ 07607
East Coast: (201) 368-9171; West Coast: (213) 534-0050; Midwest: (312) 834-9774

Please mail to: **Ikegami Electronics, 37 Brook Avenue, Maywood, NJ 07607**

YES: I'd like to receive your free video needs analysis. I understand this is a no-obligation offer.

NAME _____

COMPANY _____

TITLE _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

PHONE NO _____

JOB RESPONSIBILITIES: _____

PRESENT VIDEO EQUIPMENT USED: _____

_____

FOR WHAT APPLICATION: _____

WHAT OTHER APPLICATIONS ARE YOU CONSIDERING? _____

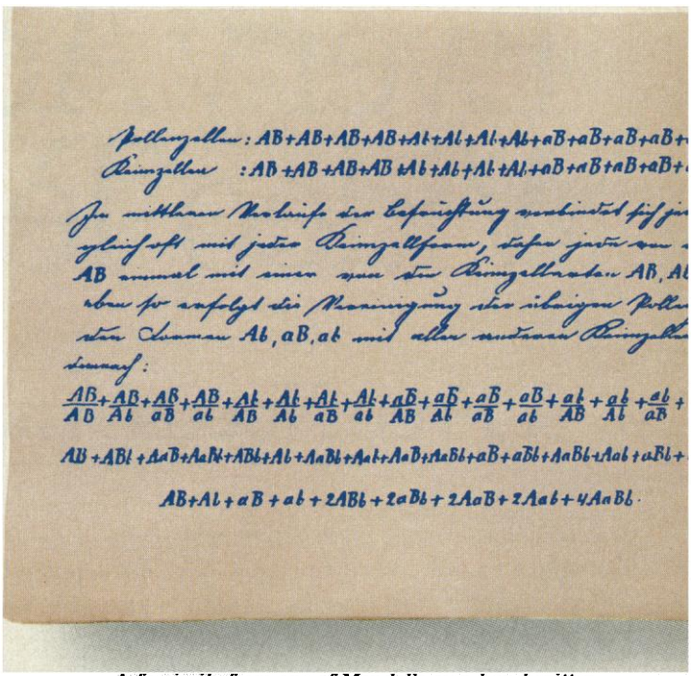
_____

WHAT IS YOUR BUDGET FOR VIDEO EQUIPMENT? _____

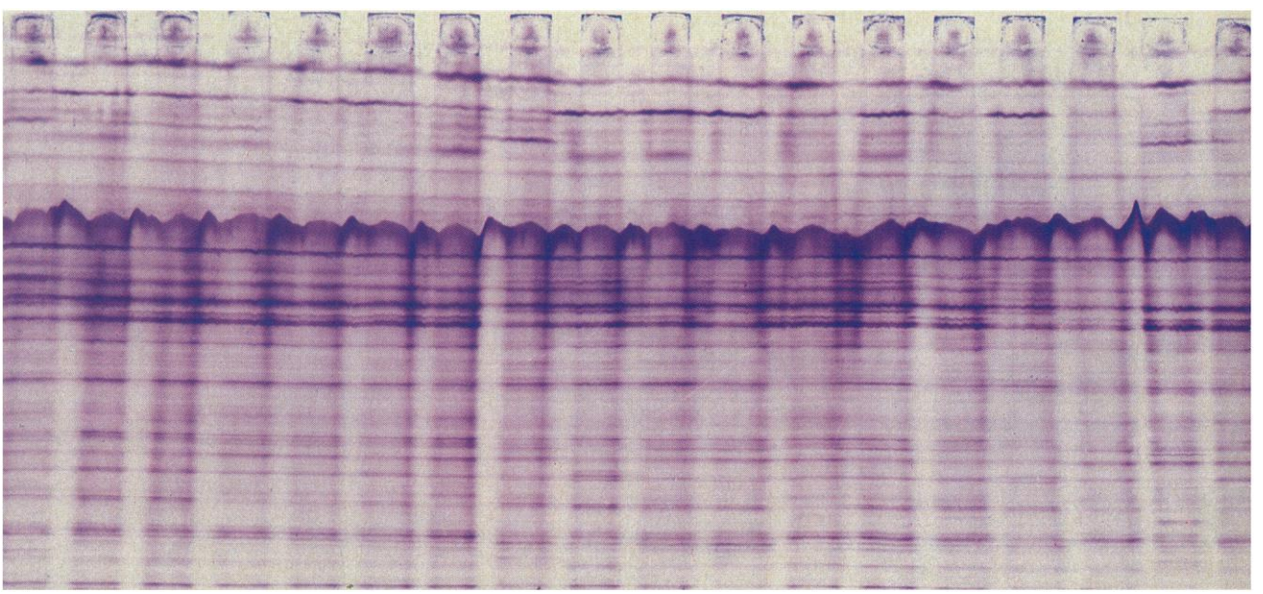
ARE YOUR NEEDS ☐ IMMEDIATE ☐ 3 MONTHS ☐ 6 MONTHS ☐ OTHER _____

THANK YOU

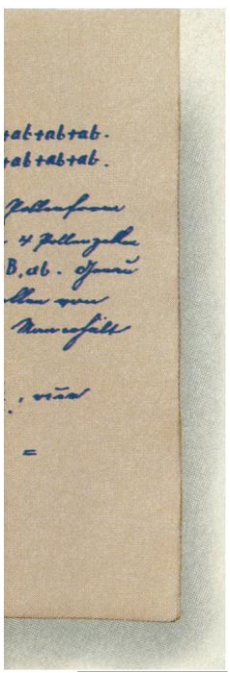
The tools of Mendel's study were the colors, textures and shapes of plants, such as this preserved pea, Pisum sativum, pressed in 1853 at the Botanical Garden of the University of Uppsala, Sweden.



A facsimile from one of Mendel's own handwritten manuscripts, in which he sets forth the Mendelian laws.



Seed proteins of 20 different pea variants (Pisum sativum), focused on Immobiline DryPlate pH 4—7. The gel was rehydrated with 8M urea, 15% glycerol and 10 mM DDT. (A. Görg et al, in Electrophoresis '86, ed. M.J. Dunn; VCH Verlagsgesellschaft mbH, Weinheim F.R.G. 1986, 435—449.)



Imagine what Mendel could have done with the gel techniques of today!

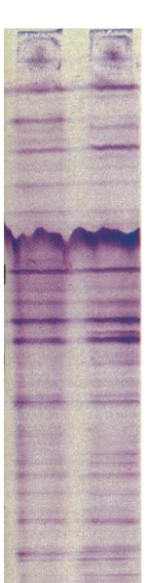
The most creative years of Gregor Mendel's lifetime were the 14 he spent cross-fertilizing and hybridizing peas, and beans in an Austrian monastery garden. Yet, while Mendel made monumental discoveries there, he also tasted defeat. Some scholars believe, in fact, that the impossibility of verifying his early results with hawkweeds is what finally discouraged him from continuing his pioneering work.

Think what Mendel could have done with today's gel techniques!

Whereas Mendel was limited to studying the colors, textures and shapes of plants, modern genetics uses high resolution electrofocusing advantageously to study minute variations on the protein level.

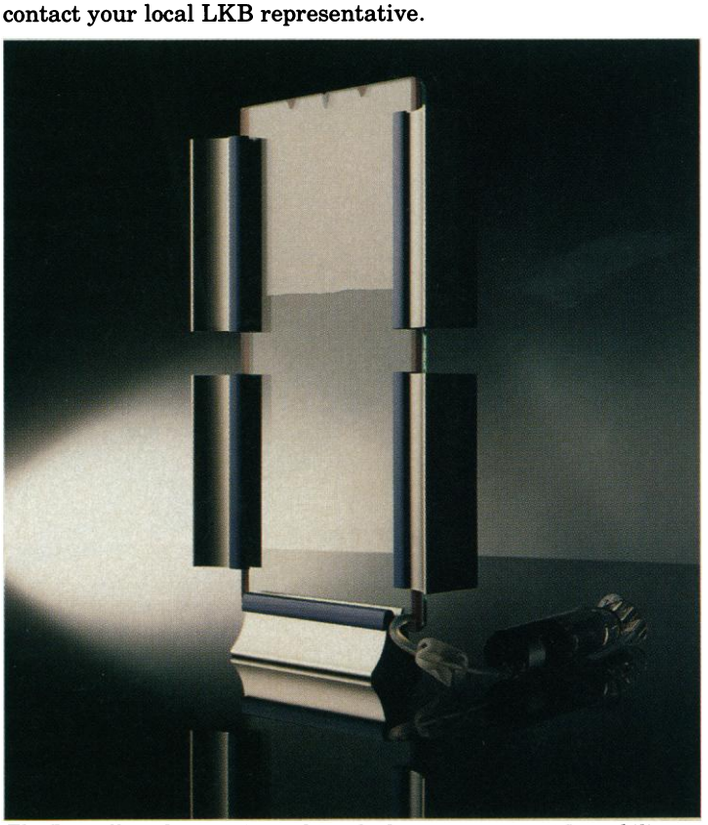
From genetics, electrofocusing has spread now to agriculture and the cereal trade. In agriculture it is used in the breeding and testing of cultivars, and in the cereal trade to check the quality of seed lots purchased for milling, baking, malting and brewing.

Immobiline DryPlates, the most recent addition to LKB's family of electrofocusing gels, combine high resolution and reproducibility with the convenience of a dried-down, precast gel. Carefully washed before packaging, to ensure that no unpolymerized monomers remain, they are so safe that you can handle them barehanded. Any solution can be used for rehydration — and any additive your experiment requires can be included.



Available in five pH ranges, Immobiline DryPlates are ideal for routine analyses of proteins and for the first dimension in 2-D work.

LKB pioneered the electrofocusing technique too late for Mendel, but in time to enrich the creative years of your own research. For complete information about Immobiline DryPlates and other outstanding electrofocusing gels, please contact your local LKB representative.

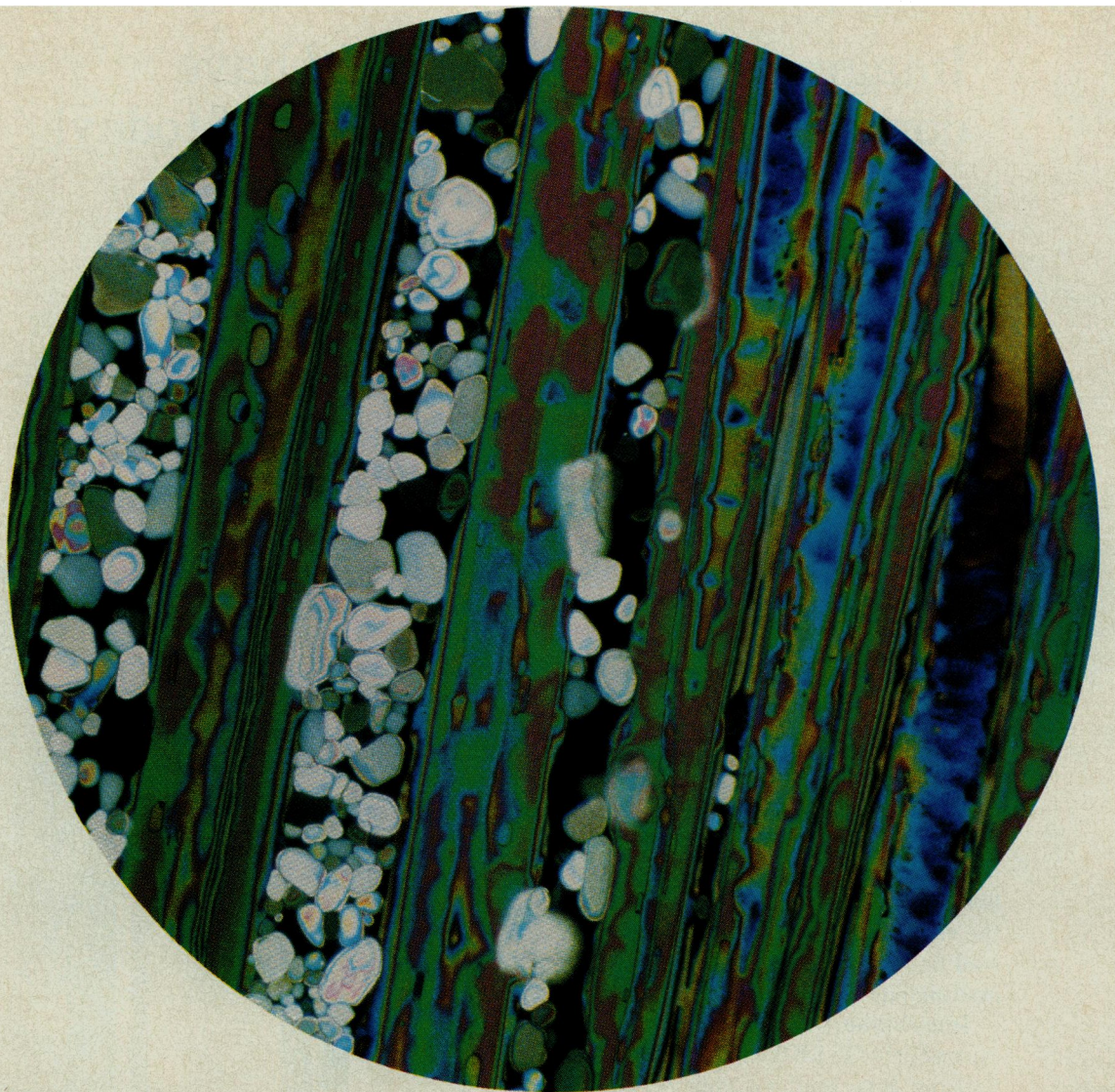


The Reswelling Cassette is used to rehydrate your pre-cast Immobiline DryPlate. It is specifically designed for fast, convenient filling with any rehydration liquid required.

LKB

Electrophoresis Division

LKB-Produkter AB, Box 305, S-161 26 Bromma, Sweden. Tel. 08-799 80 00, telex 10492
Antwerp (03) 218 93 35 • **Athens-Middle East** + 30 (1) 894 73 96 • **Beijing** 89 06 21 • **Copenhagen** (01) 29 50 44 • **HongKong** (852) 5-814 84 21
London (01) 657 88 22 • **Lucerne** (041) 57 44 57 • **Madras** (044) 45 28 74 • **Moscow** (095) 255-6984 • **Munich** (089) 85 830 • **Paris** (01) 64 46 36 36
Rome (06) 39 90 33 • **Sao Paulo** (011) 578 41 38 • **Stockholm** (08) 764 75 50 • **Tokyo** (03) 293 -5141 • **Turku** (021) 678 111 • **Vienna** + 43 (222) 92 16 07
Washington (301) 963 3200 • **Zoetermeer** (079) 31 92 01 Over 60 qualified representatives throughout the world.



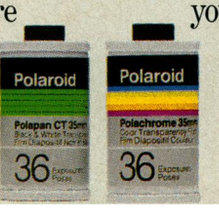
Research

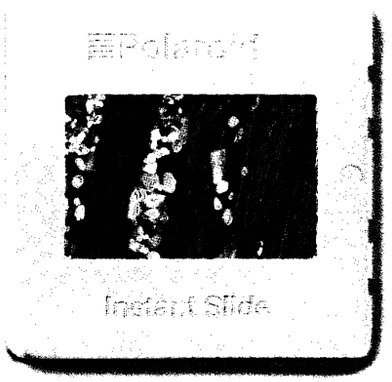
Get the results you want instantly with the Polaroid 35mm Instant Slide System.

If you're looking for the perfect way to keep track of every twist and turn in your R&D programs, here's the instant answer. Polaroid 35mm instant slides.

There's simply no more convenient way to document what you're doing. And, when the need arises, no quicker way to present your findings.

Use Polaroid 35mm instant slide film with *any* 35mm camera to photograph those objects or procedures you need to capture on the spot. Use it with your most sophisticated test equipment – from CRT screens to microscopes. Or with a copy stand for slides of small objects or flat art. Capture each phase of step-by-step procedures so you can review them as soon as necessary. Polaroid films let you see your findings in the best light, too. Whether your demand is for black and white slides, high contrast or continuous tone – or for color – we have what you need for virtually any type of documentation or





and developm

presentation.

Better still, you can do all your own photography, from start to finish, yourself. In house, in complete confidentiality. Without the delays that outside services create.

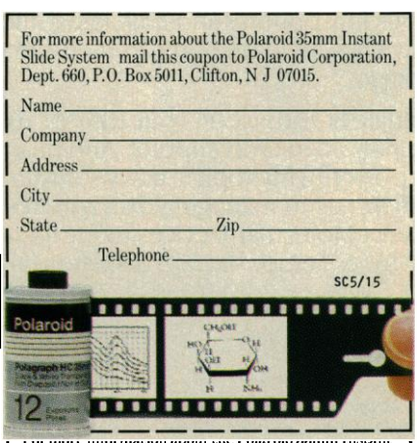
Which means when it comes to documentation, review, and presentation, there's really no need to experiment with anything else.

In fact, no matter where your research takes you, you can be certain there's a Polaroid imaging solution to handle any development.

Instantly.

For the Polaroid Professional Film Center nearest you, call toll-free **800-526-7843** ext. 400. In New Jersey, call 800-522-4503 ext. 400.

Polaroid


For more information about the Polaroid 35mm Instant Slide System mail this coupon to Polaroid Corporation, Dept. 660, P.O. Box 5011, Clifton, N J 07015.

Name _____

Company _____

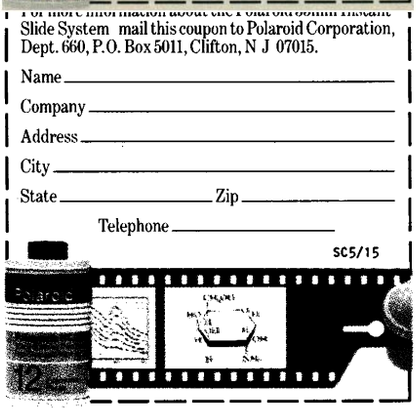
Address _____

City _____

State _____ Zip _____

Telephone _____

SC5/15


Slide System mail this coupon to Polaroid Corporation, Dept. 660, P.O. Box 5011, Clifton, N J 07015.

Name _____

Company _____

Address _____

City _____

State _____ Zip _____

Telephone _____

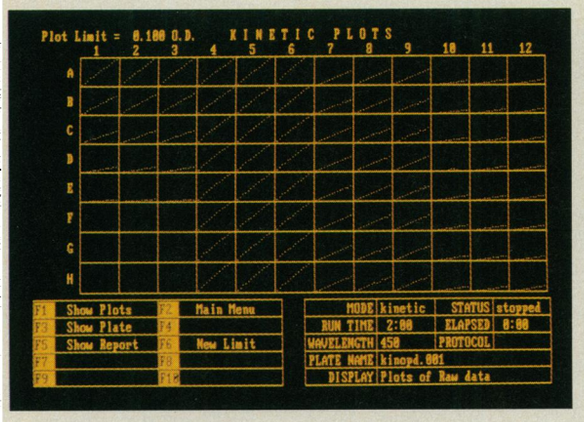
SC5/15

Circle No. 134 on Readers' Service Card

Don't buy any microplate reader until you've seen its software.

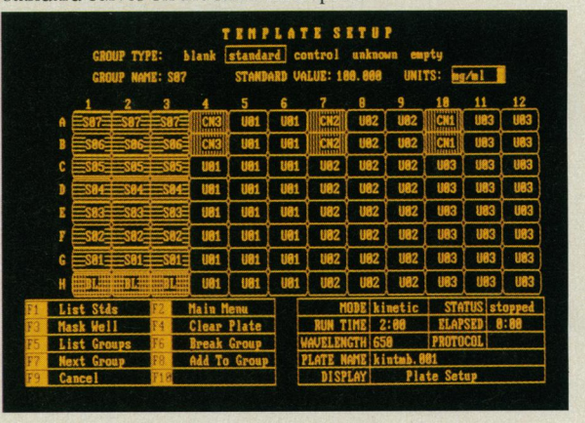
Watch all 96 kinetic plots appear as the reactions proceed.

Adjust your OD plot limit (y-axis): shorten it for fast reactions, extend it for slower ones. SOFTmax™ will replot the data and recalculate rates using only the initial linear portion of the reaction.



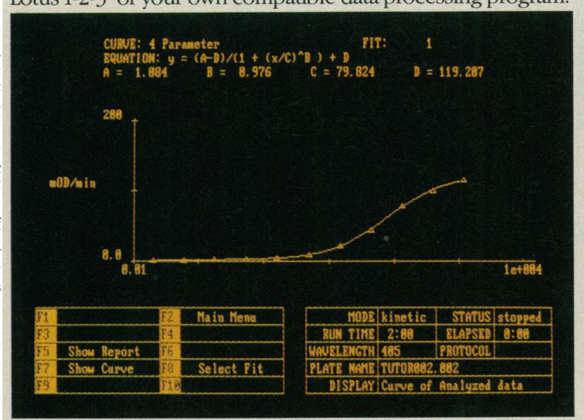
TEMPLATE SET-UP works like a chemical spreadsheet.

Assign wells to group types (blank, standard, control, unknown, empty). Run your assay or overlay the template on existing data and recalculate. Use it to mask outliers and set up multiple standard curves on the same microplate.



For quantitation, try any of 5 standard curve-fitting algorithms.

Linear. Quadratic. Semi-log. Log/logit. 4-parameter logistic. SOFTmax can also format your data in ASCII for use with Lotus 1-2-3® or your own compatible data processing program.



Flexible data displays.

Use Grey Scale for cytoproliferation studies, Ranged data for hybridoma screening, Threshold display for serology. All display options may be used with kinetic and endpoint data.

Moving from data to results requires more than instrumentation. The new SOFTmax™ controls the Vmax™ Kinetic Microplate Reader, collects and analyzes endpoint and kinetic data, and delivers many useful options for computing, plotting, displaying, printing and managing microplate assay data. All in one simple, menu-driven package.

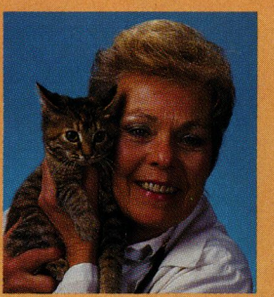
Evaluate SOFTmax on your IBM® or IBM® compatible microcomputer. And find out how our powerful microplate assay software can make a difference in managing data *and* results. Contact Molecular Devices today for a free SOFTmax demonstration diskette.

Molecular Devices

Molecular Devices Corporation
3180 Porter Drive
Palo Alto, CA 94304
(415) 493-0166
(800) 635-5577
(800) 635-5588 (within California)

Gentle, dry, uniform warmth for consistent cultures ...plus low initial investment

"You know, your incubator's a little like the care people expect here. Just like holding a kitten in your hands, so cuddly and warm, you know?"



We know. That's the way we build them. They surround your culture gently with a blanket of unvarying warmth at a temperature usually between 30°C and 50°C. They hold those temperatures within ±0.2°C and uniform within the chamber less than ±0.5°C at 37°C.

NAPCO is so well known for CO_2 incubators that many scientists forget we make these conventional incubators, too. If you're just trying to turn out the work and don't need the enhancement of CO_2, this is the economical and practical way to go.

The Model 301 and Model 303, for example, offer you the choice of 5.58 or 11.1 cu. ft. capacity and up to 19+ sq. ft. of shelf space in the 301 or 9+ sq. ft. in the double door 303 using optional extra shelves. Or, you can get the same capacities plus digital readout and microprocessor based control of temperature in the Model 521 and 523.

If you have high volume needs, look at our 30 cu. ft. Model 3512 or the Roller Culture incubator Model 3612. You'll find that these incubators do the basics very well, and at a very economical purchase price. It's part of NAPCO's plus values to keep you more than satisfied.

Ask your NAPCO laboratory distributor or call 800-547-2555 (In OR 503-692-4686). NAPCO Scientific Company, P.O. Box 1000, Tualatin, OR 97062.

napco®

A HEICO Company

Research quality results ...every time

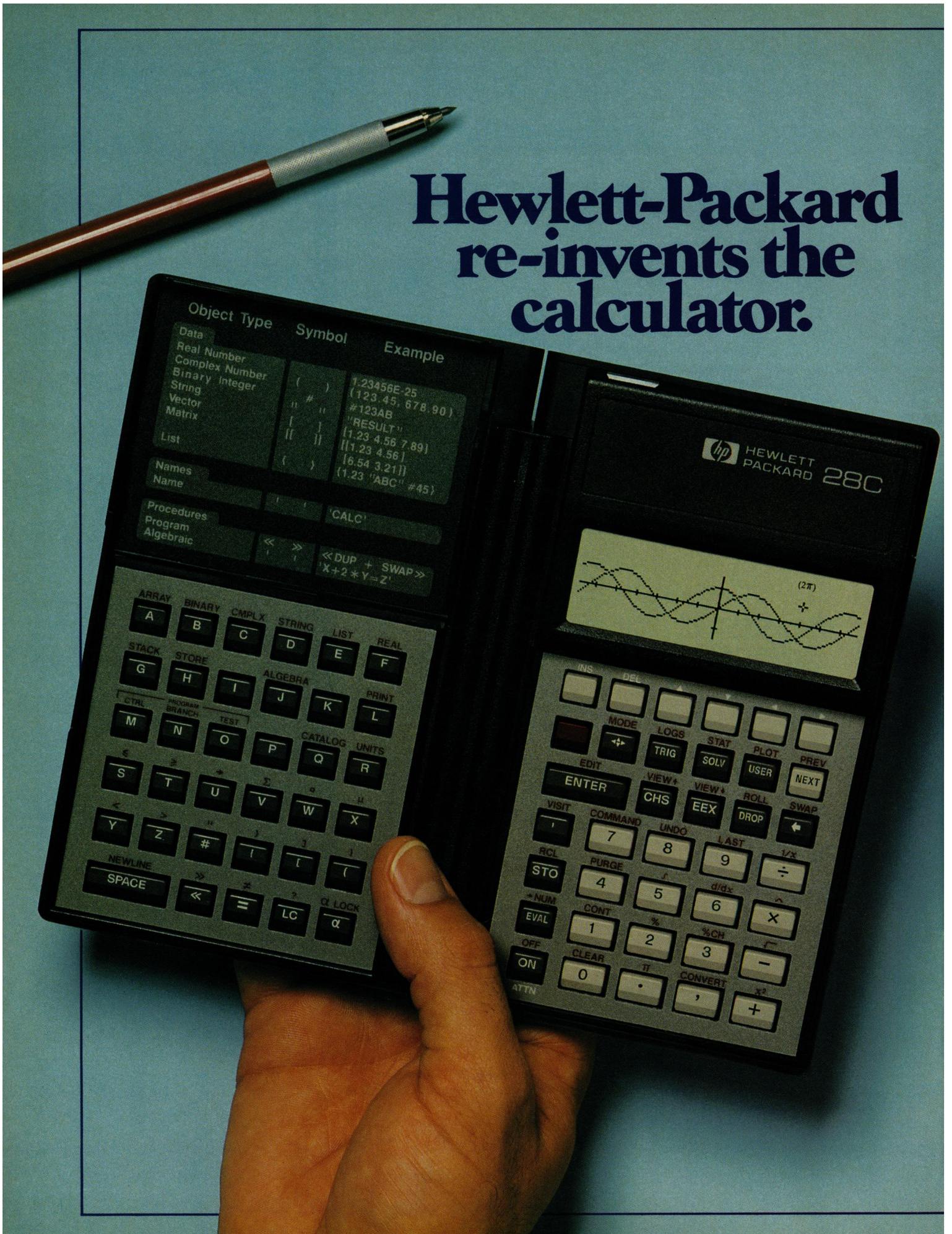
Model 3612 High volume roller culture 30 cu. ft. incubator

Model 303 Double door economical laboratory incubator

Model 521 Microprocessor controlled, digital readout incubator

NAPCO products are distributed by: American Scientific Products, Curtin Matheson Scientific, Fisher Scientific, Sargent-Welch Scientific and Thomas Scientific

Circle No. 100 on Readers' Service Card


Hewlett-Packard re-invents the calculator.
Object Type
Symbol
Example
Data
Real Number
Complex Number
Binary Integer
String
Vector
Matrix
List
1.23456E-25
(123.45, 678.90)
#123AB
"RESULT"
[1.23 4.56 7.89]
[[1.23 4.56]
[6.54 3.21]]
{1.23 "ABC" #45}
Names
Name
Procedures
Program
Algebraic
'CALC'
≪DUP + SWAP≫
'X+2*Y=Z'
HEWLETT PACKARD 28C
ENTER
SPACE
NEWLINE

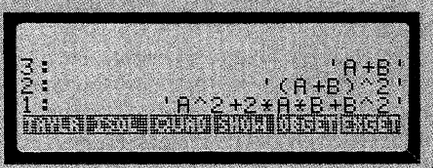
ENGINEERING RESPONSIBILITY ☑ SEPIA ☑

D-00028-40001-1

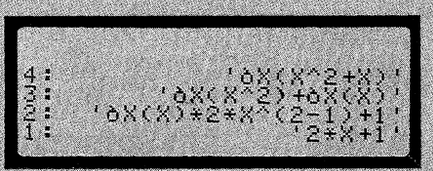
SYM	REVISIONS	APPROVED	DATE
A	AS ISSUED	DRE	9/8/86

THE NEW HP-28C DOES THINGS NO OTHER CALCULATOR CAN. AND IT DOES MORE THINGS THAN ANY OTHER CALCULATOR CAN, MORE THAN THE UNIQUE FUNCTIONS DISPLAYED ON THE LEFT, THE HP-28C ALSO BRINGS TOGETHER SUCH FEATURES AS KEYSTROKE PROGRAMMABILITY; RPN LOGIC WITH ALGEBRAIC EXPRESSION ENTRY; 120 UNIT CONVERSION FACTORS; HEX, OCTAL AND BINARY MATH--AND CONVERSIONS; ADVANCED STATISTICS; AND THE ABILITY TO USE AN OPTIONAL PRINTER VIA INFRARED BEAM. FOR A DEMONSTRATION,

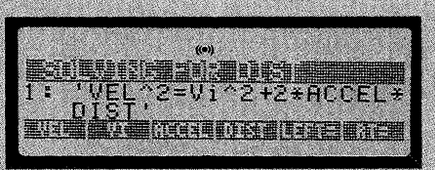
THE FIRST CALCULATOR THAT DOES SYMBOLIC ALGEBRA



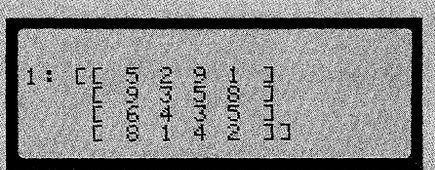
THE FIRST CALCULATOR THAT DOES SYMBOLIC CALCULUS



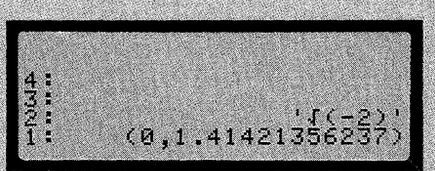
THE FIRST SCIENTIFIC CALCULATOR THAT ACCEPTS YOUR OWN FORMULAS, THEN SOLVES FOR ANY UNKNOWN



THE FIRST CALCULATOR THAT PERFORMS MATRIX OPERATIONS AS EASILY AS FOUR-FUNCTION MATH



THE FIRST CALCULATOR THAT DOES COMPLEX NUMBER ARITHMETIC AS EASILY AS FOUR-FUNCTION MATH



CALL 1-800-367-4772, EXT. 139 A AND ASK FOR THE NAME OF YOUR NEAREST HP DEALER. THEN SEE QUOD ERAT DEMONSTRANDUM.

Q.E.D.

HEWLETT PACKARD

DO NOT SCALE THIS DRAWING			© 1987 Hewlett-Packard Company	PG12611		SEE NOTE
	ITEM	QTY.	PART/MATERIAL-DESCRIPTION	MAT'L-PART NO.	MAT'L-DWG. NO.	MAT'L-SPEC.

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES.	JERRY STEIGER DRAWN BY	4/20/86 DATE	TOPCASE-NUMERIC TITLE	00028-40001 PART NUMBER
TOLERANCES .XX±.02 .XXX±.005	JERRY STEIGER ENGINEER/CHECKER	4/20/86		
	RELEASE TO PROD.			
SEE CORP. STD. 608	SUPERSEDES DWG.		2X SCALE / SHEET 1 OF 1	D-00028-40001-1

The Olympus BH-2 Series. Superlative versatility for education, routine and research microscopy.

The quality of any microscope system relies on the interrelationship of optical performance, mechanical capability and a component system that increases its versatility as your needs grow. That is the Olympus advantage.

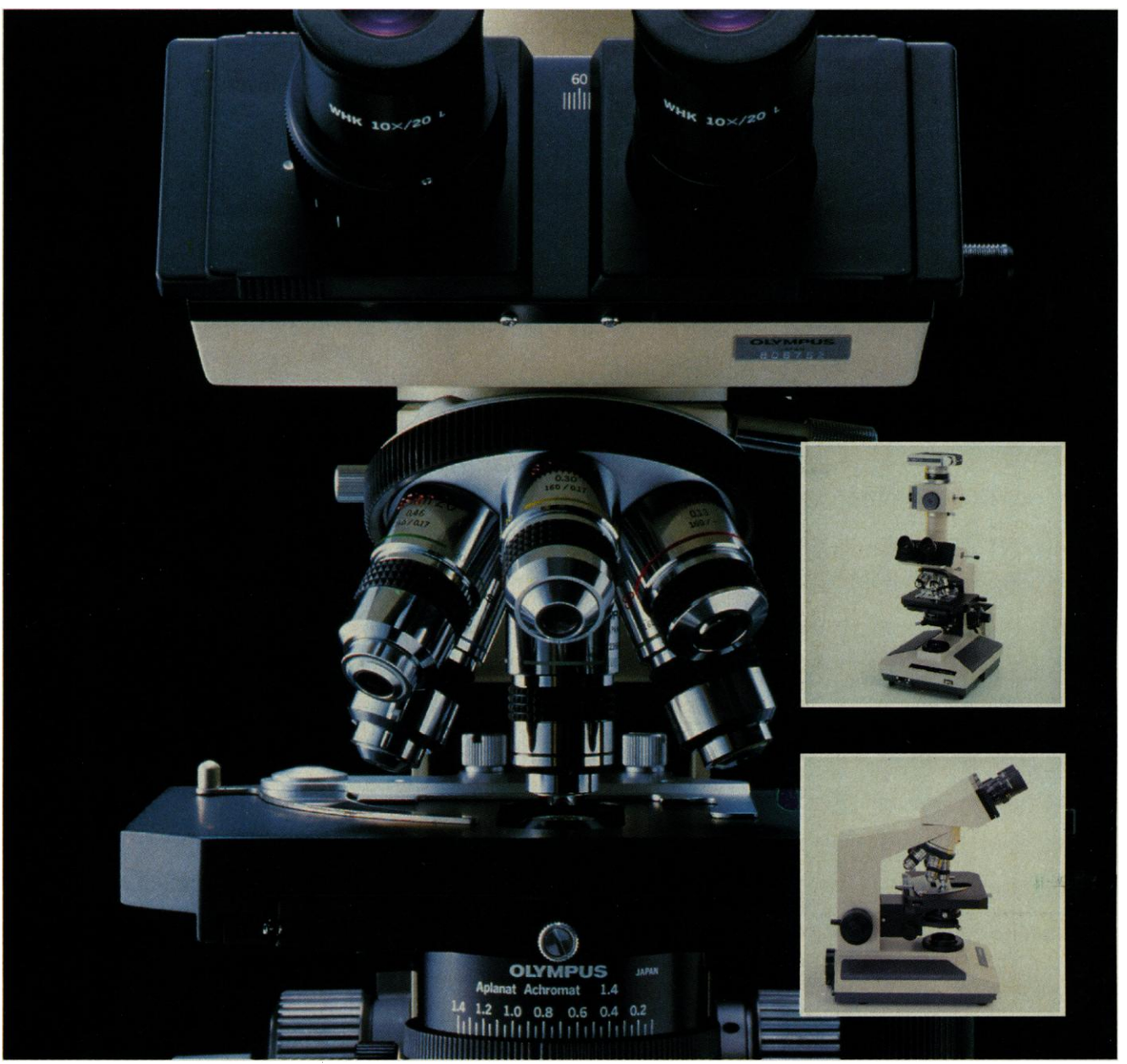
The widely acclaimed BH-2 Series expresses that advantage to its fullest. With a comprehensive array of modules, stands and objectives, it's capable of a vast range of microscopic applications. Observation is readily available in brightfield, darkfield, phase-contrast, differential interference contrast, reflected and transmitted light fluorescence, and polarized light modes. Attachments also permit multi-person viewing and superb photomicrography in 35mm, large format and cine formats.

Its performance is as impressive as its versatility. From sophisticated S Plan Apochromats to economical D Achromats, there is a selection of LB Series objectives and eyepieces that offer exceptional resolution, contrast and field flatness across a broad range of magnifications, including super widefield with F.N. 26.5. The uniform brilliance of Koehler illumination maximizes these qualities both in the Model BHS, with its 12V 100W halogen lamp, and the models BHT and BHTU, with 6V 20W lighting.

From the sturdy, vibration-free stands and high-eyepoint eyepieces to the placement and precision of stage and focusing adjustment controls, the ergonomic design of the BH-2 Series provides superior ease and efficiency of operation.

For a demonstration of the extraordinary BH-2 Series microscopes, call toll-free: 800-446-5967. Or write Olympus Corporation, Precision Instrument Division, 4 Nevada Drive, Lake Success, NY 11042-1179.
In Canada: W. Carsen Co., Ltd., Ontario.

OLYMPUS®



For literature circle reader service number 85
For demonstration circle reader service number 86

MACSYMA

automates symbolic mathematics. And yields enormous improvements in speed, accuracy and modeling power.

If you work with quantitative models in scientific or engineering disciplines, MACSYMA can increase your modeling power. MACSYMA combines symbolic and numeric computation. And enables you to accurately manipulate symbolic expressions in a fraction of the time required manually.

Wide range of capabilities

MACSYMA offers the widest range of capabilities for symbolic computations in applied mathematics of any commercially available program. For example:

Algebra: MACSYMA can manipulate large expressions, expand, simplify and factor expressions, handle matrices and arrays, and solve systems of equations.

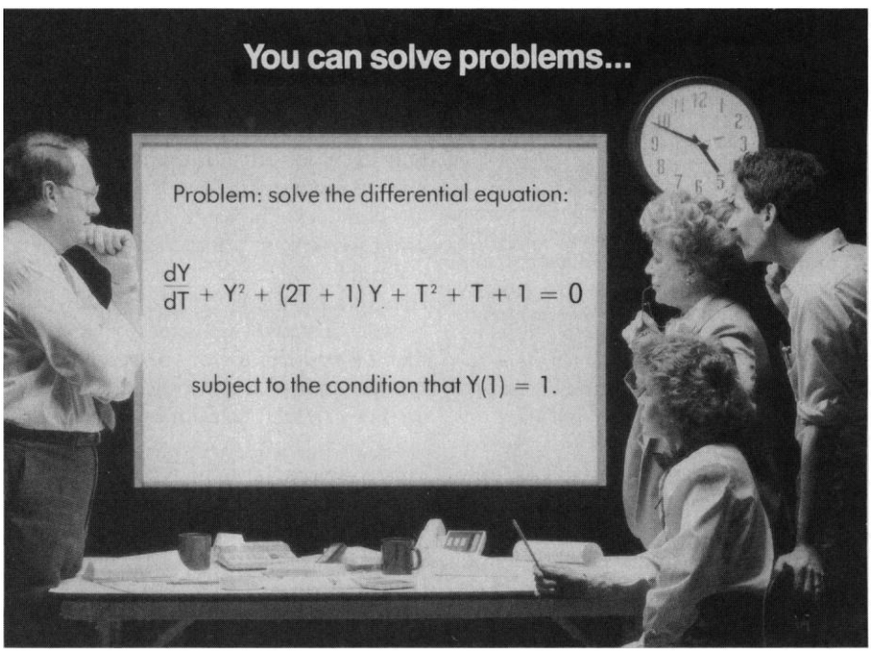
Calculus: MACSYMA can differentiate, perform definite and indefinite integration, take limits, expand functions in Taylor or Laurent series, solve differential equations, and compute Laplace transforms.

Numerical analysis: You can perform numerical analysis using MACSYMA® language, compute with arbitrary precision arithmetic, use a library of numerical analysis routines, and generate FORTRAN code.

Graphics and interfaces: MACSYMA can generate report-quality graphics in 2D or 3D, with perspective, hidden line removal, and captions. MACSYMA also interfaces with the mathematical text processors 'TeX' and 'troff'.

Broad base of applications

Throughout the world thousands of scientists, engineers and mathematicians are using MACSYMA in such diverse applications as aeronautical design, structural engineering, fluid mechanics, acoustics, CAD, electronic and VLSI circuit design, electromagnetic field problems, plasma physics, atomic scattering cross sections, control theory, maximum likelihood estimation, genetic studies, and more.



Symbolically...

```
(C1) DEPENDS(Y,T)$
(C2) DIFF(Y,T)+Y^2+(2*T+1)*Y+T^2+T+1;
```

$$(D2) \quad \frac{dY}{dT} + Y^2 + (2T + 1)Y + T^2 + T + 1$$

```
(C3) SOLN:ODE(D2,Y,T);
```

$$(D3) \quad Y = -\frac{\%C\,T\,\%E^T - T - 1}{\%C\,\%E^T - 1}$$

```
(C4) SOLVE(SUBST([Y=1,T=1],D3),%C),NUMER;
(D4)    [%C = 0.5518192]
(C5) SPECIFIC_SOLN:SUBST(D4,SOLN);
```

$$(D5) \quad Y = -\frac{0.5518192\,T\,\%E^T - T - 1}{0.5518192\,\%E^T - 1}$$

and Numerically.

```
(C6) FORTRAN(D5)$
      Y = -(0.5518192*T*EXP(T)-T-1)
     1      /(0.5518192*EXP(T)-1)
```

Available on many computer systems

Current systems include:

- Symbolics 3600™ Series
- VAX & MicroVAX II
- SUN-2 & SUN-3
- Apollo
- Masscomp

Other versions will be following soon.

For an information kit about all the ways MACSYMA can work for you, just call

1-800-MACSYMA.

In Mass., Alaska or Hawaii only, call (617) 577-7770.

Or please write to us at

Computer Aided Mathematics Group
Dept. M-SI4
Symbolics, Inc.
Eleven Cambridge Center
Cambridge, MA 02142

MACSYMA

The most comprehensive software for mathematical computing.

symbolics™

Circle No. 154 on Readers' Service Card