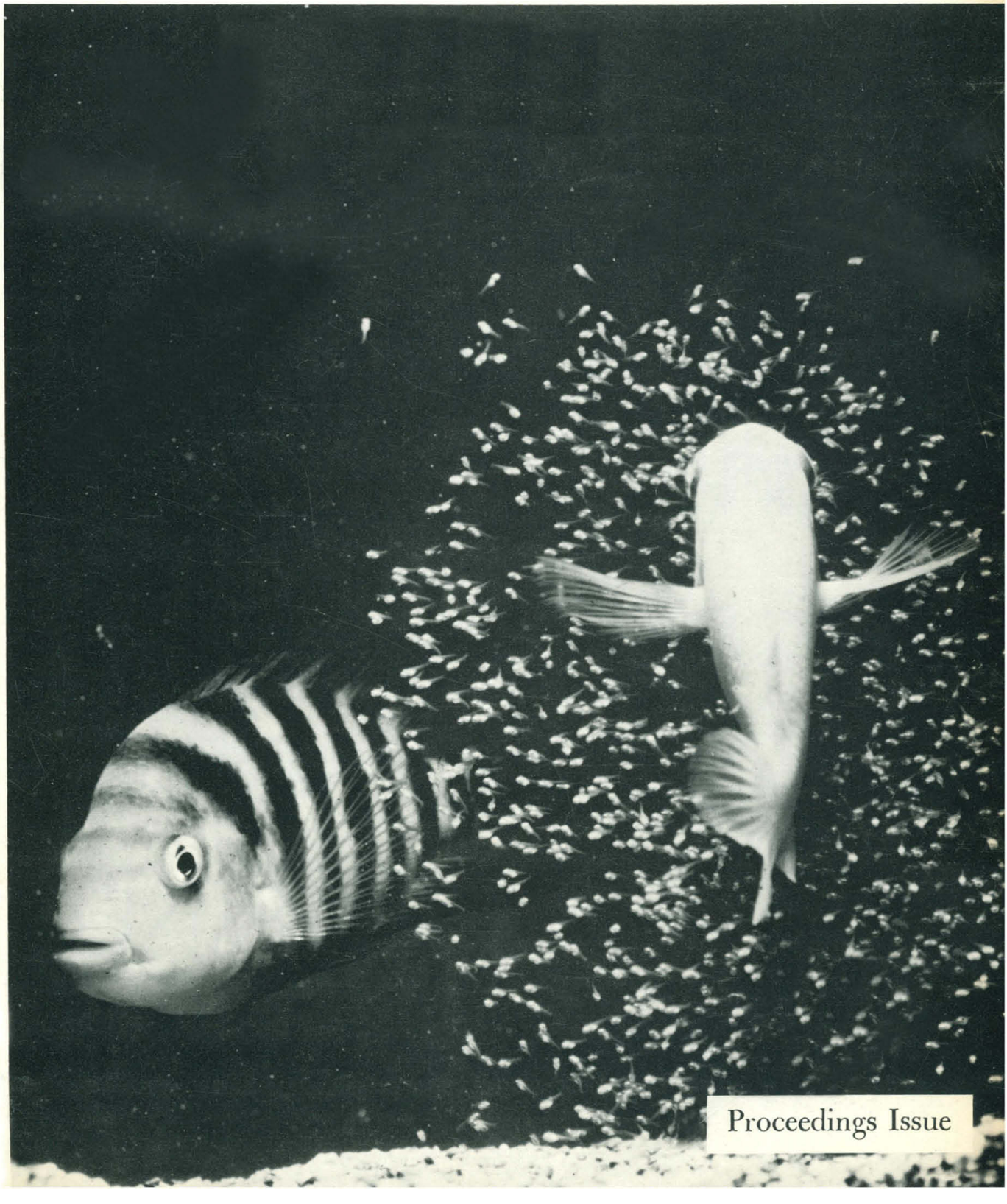
SCIENCE

23 February 1973

Vol. 179, No. 4075

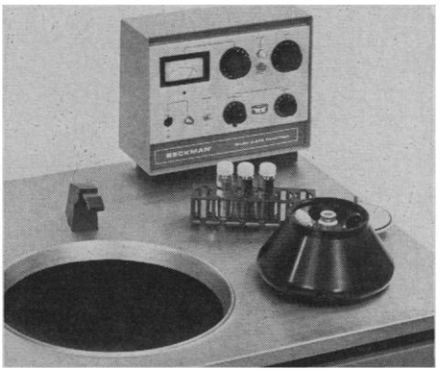
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Proceedings Issue

New Beckman J-21B

Centrifuge



The technical superiority is there—as you would expect from the people who make most of the world's ultracentrifuges. But that's not all the new J-21B Refrigerated Centrifuge offers.

The first thing you'll notice is the relative quiet. This 21,000 rpm centrifuge cuts down amazingly on the whine and noise you've had to live with before. Sound tests in a laboratory environment showed that lab personnel were subjected to only a fraction as much noise from the J-21B as from its major competitor.

Of course, the J-21B's clean styling is immediately apparent. But the good looks have a purpose, too. This design gives you free working space on the instrument itself to load or unload rotors. Now we've made it stainless steel for added utility.

One thing you don't see is the J-21B's partial vacuum which cuts wind friction dramatically. J-21B rotors don't have to fight their way to top speed—they get there quickly. And they get your work done faster.

For even larger volume separations, there is the remarkable JCF-Z rotor with interchangeable cores for separations by continuous flow, zonal and reorienting gradient techniques. It gives ultracentrifuge-like results, but is simpler to use.

The touches of color we added just for you to enjoy—like the quiet that surrounds this superior machine.

Brochure SB-366C describes the new J-21B. Send for your copy to Beckman Instruments, Inc., Spinco Division, 1117 California Avenue, Palo Alto, Calif. 94304.

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Its superiority is something you also see and hear

Beckman
INSTRUMENTS, INC.

23 February 1973

Volume 179, No. 4075

SCIENCE

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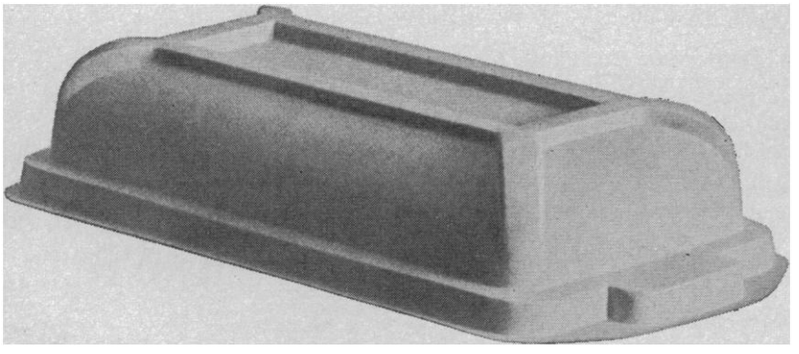
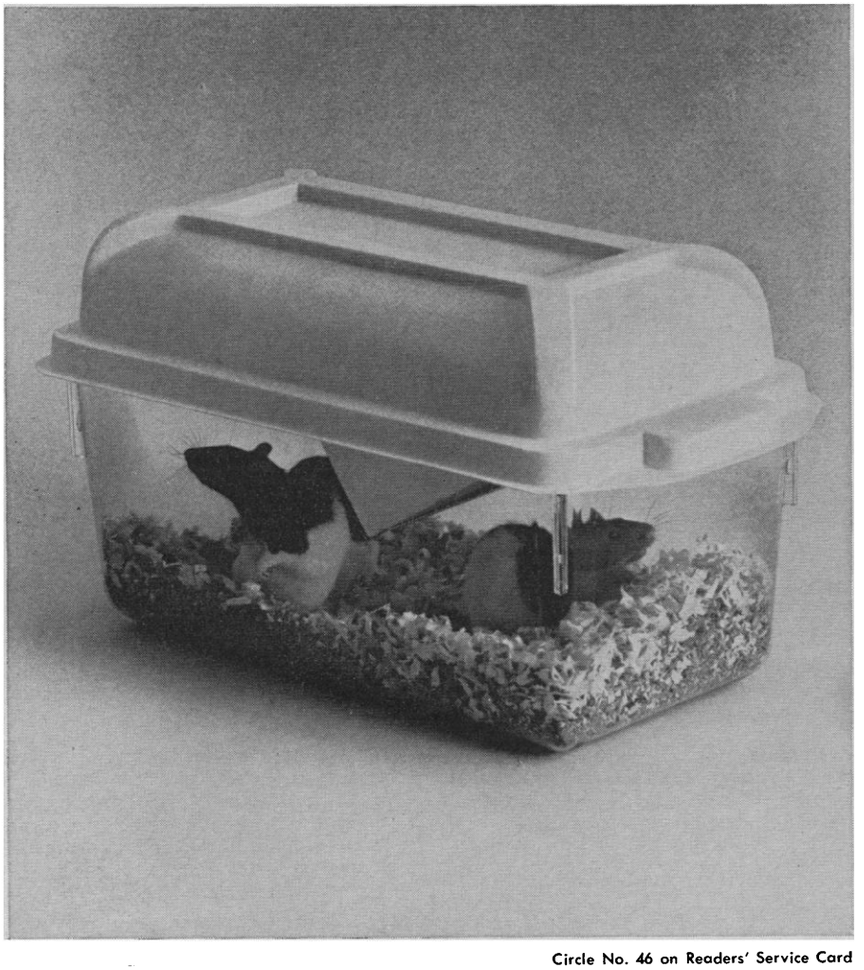
The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding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

COVER

Polychromatism occurs (although infrequently) in many widely unrelated fishes, especially gold morphs. The condition is relatively common, however, in both sexes of the Midas cichlid in and around lakes Nicaragua and Managua in Nicaragua. The female of the illustrated pair is gold. Their fry have been swimming for 1 day. See page 806. [George W. Barlow, University of California, Berkeley]

New Econo-Filter Covers improve animal production, protect long-term experiments





Improved breeding rates; greater protection for long-term experiments; generally healthier animals. These are some of the benefits you get by using Econo-Filter Covers on your animal cages. Molded in one piece from nonwoven spun polyester, they are the simplest, most effective way to protect animals against airborne infection, cross contamination and environmental stress. Econo-Filter Covers meet all published standards for porosity, air-permeability, and filtration of air-borne organisms, dust and other contaminants. They are available for all standard Econo-Cages and are reusable.

Positive Filtration. Econo-Filter Covers effectively remove air-borne contaminants without inhibiting the proper exchange of air. They can measureably reduce the incidence of contamination and diseases such as infantile diarrhea. This means that now both short-term and long-term programs can maintain a "clean" cage environment without instituting new lab procedures.

Environmental Control. Environmental stability promotes animal health. Econo-Filter Covers reduce fluctuations in temperature and humidity, eliminate drafts and minimize CO_2 and ammonia buildup.

Increased Animal Production. Healthier animals produce stronger litters and show greater fertility. Econo-Filter Covers can make a profitable difference in production by promoting more successful breeding while, at the same time, reducing infant mortality.

Economy and Efficiency. Few filter systems of equal efficiency are as economical as Econo-Filter Covers. They are reuseable; withstanding normal sterilization cycles in both steam and gas autoclaves. One-piece Econo-Filter Covers can be installed without special attachments or adapters.

What do you want? Healthier animals; increased animal production; or more protection for long-term experiments. You get them all with Econo-Filter Covers. For all the facts, contact your Econo-Cage/Econo-Filter Distributor or write the Scientific Division, Maryland Plastics, Inc., 9 East 37th Street, New York, New York 10016.

MP

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Here are Some New (and old) Problem Solvers from Varian, the Multi-Product, Quality Instrument Company.

Varian instruments are helping life scientists shed light on a variety of problems in their research — instruments with the well-known brand names Cary®, Aerograph®, Anaspect, MAT, Techtron, and Varian®.

From UV-Vis through GC and LC to NMR, EPR or AA — you have a wide selection from which to choose the tools best suited to your needs. And a Varian expert will help you pick the best possible combination of instruments plus back-up assistance so you can focus on life science problems, not hardware problems.

Here are some of the kinds of problems in which Varian instruments can help the life science lab. There are others. Ask us about them.

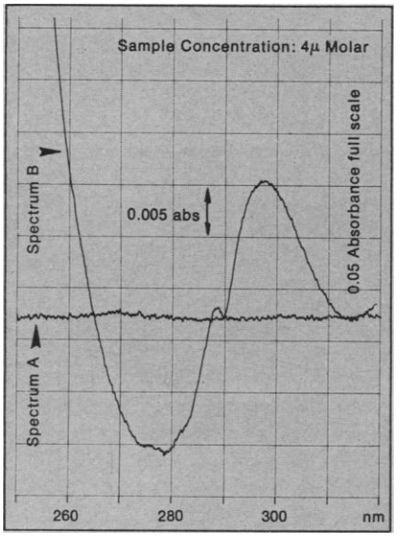
Protein difference spectroscopy needs the Cary 118's accuracy

With difference spectroscopy the life scientist has a valuable probe for investigating the structure of protein macromolecules. It is a very sensitive method for detecting small, discrete changes in a sample which could not be observed with standard absorption procedures, where strong overlapping bands obscure many weaker peaks. To measure these small absorbance changes, the scientist must have a good spectrophotometer.

Because of its unmatched photometric accuracy, the Cary 118 Spectrophotometer is the ideal instrument for difference measurements (at 0.1 abs the accuracy is 0.00035 abs). Such performance is necessary, since even

very small errors can sometimes lead to incorrect interpretation of the spectrum.

In practical terms the 118's exceptional performance frees the scientist from concern about the quality of the data. He knows that any peaks recorded on the spectrum result from sample absorption, and not from an instrument artifact.

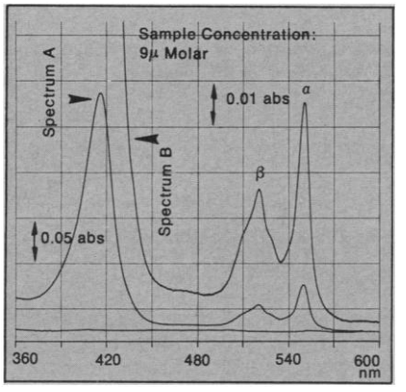


These spectra of oxidized cytochrome C, recorded on the Cary 118, illustrate one effect of pH on this protein. Spectrum A was recorded with identical sample and reference solutions (both pH 7). For Spectrum B the sample was increased to pH 11, while the reference was unchanged. Perturbation of the tyrosine residues becomes readily apparent.

To obtain further information about the Cary 118's capabilities for difference spectroscopy, kinetics, determining concentration in small-volume samples, quantitative analyses, or even recording derivative spectra, circle Reader Service No. 12.

With the Cary 17 changing absorbance ranges makes a mountain out of a mole hill

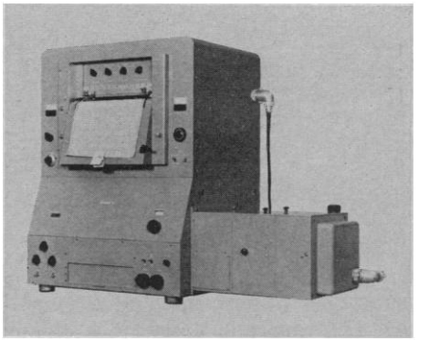
Often when recording a UV-Vis spectrum, a particular wavelength region of interest may produce only a small hump on the spectrum, because the sample's absorption is not very great in that area. In such a situation, changing the absorbance range expands the chart scale and makes it possible to see more spectral detail.



To demonstrate the advantages of changing absorbance ranges, these spectra of cytochrome C reduced with ascorbic acid were recorded on the Cary 17. Spectrum A (0-0.5 abs range) fully resolves the Soret band at 415 nm, but shows little detail on the peaks at the longer wavelengths. The expanded presentation in Spectrum B (0-0.1 abs range) gives better detail of the α and β bands at 550 and 520 nm.

With the Cary 17 Spectrophotometer, switching absorbance ranges is convenient and rapid. The instrument is equipped with a universal absorbance/%T slidewire so that any of eight absorbance ranges or a 0-100 %T range may be selected. This feature, along with the coupled wavelength scan and chart drive, makes it easy to back up the chart and rescan a particular area using expanded scale to increase the sensitivity of the recording. A small, smooth hump becomes a detailed peak.

A second advantage of the range change capability is that absorbance bands with widely divergent molar absorptivities can be recorded on the same chart, a more convenient presentation for most purposes. Too, it requires less sample preparation because no sample dilution is necessary to bring absorbance values on scale.



Circle Reader Service No. 13 for more information on the Cary 17.

The Techtron 635 Spectrophotometer simplifies kinetics

Enzyme kinetics involve a lot of sample handling problems. They're a major concern in this type of measurement. With the Varian Techtron 635K Spectrophotometer we've solved many of them.

To do this we designed the instrument on a modular concept so the scientist can select the system best suited to his work, and purchase it at a moderate cost.

For analyzing numerous samples, for instance, an Auto-5 cell programmer with dual sample/reference turrets can be included in the system. Also, there are thermostattable cell holders, a temperature readout module, wavelength programmer, and other accessories, all designed to make kinetics studies easier.

Another step we've taken to simplify kinetics is to incorporate push-button controls on the instrument. You just punch a button to set operating parameters.

To obtain more information, circle Reader Service No. 14.

varian instruments

Spin labeling biological membranes: What For and What With

First, the What For.

Here's a list of literature references, all of which deal with the use of nitroxide spin labels and EPR (ESR) to study biological membranes:

Biosynthetically spin labeled mitochondria subjected to EPR analysis contained at least two incorporated spin labels with different degrees of constraint.
A. Kieth, A. Waggoner, and O. Griffith, Proc. Nat'l Acad. Sci., **61**, *819 (1968).*

Incorporation of spin-labeled compounds into membranes by using a protein carrier or, for experiments with micelles or liposomes, by agitation or sonication of the aqueous suspension should prove to be more valuable in the future as a probe of the membranes of living cells.
A. Waggoner, T. Kingzett, S. Rottschaefer, and O. Griffith, Chem. Phys Lipids, **3**, *245 (1969).*
M. Barratt, D. Green, and D. Chapman, Chem. Phys. Lipids, **3**, *140 (1969).*

The orientation properties of spin labels were used to show that the phospholipid regions of both nerve and erythocyte membranes strongly resemble lipid bilayers with phospholipids being more tightly packed in erythrocytes than in nerve fibers.
W. Hubbell and H. McConnell, Proc. Nat'l Acad. Sci., **63**, *16 (1969).*

The spin label attached to cytochrome *C* in submitochondrial membranes underwent reversible changes in mobility when the metabolic state of the submitochondrial particles was altered.
C. Lee, H. Drott, B. Johansson, T. Yonetani, and B. Chance in Probes of Structure and Function of Macromolecules and Membranes, *B. Chance, C.-P. Lee, and T. Yonetani, Eds., Academic, New York (1971).*

They're all available in your local technical library.

Now, the What With.

Varian EPR systems, of course. The EM-500, E-4, E-Line—the finest EPR systems available anywhere. For literature, write on your letterhead indicating the systems of interest.

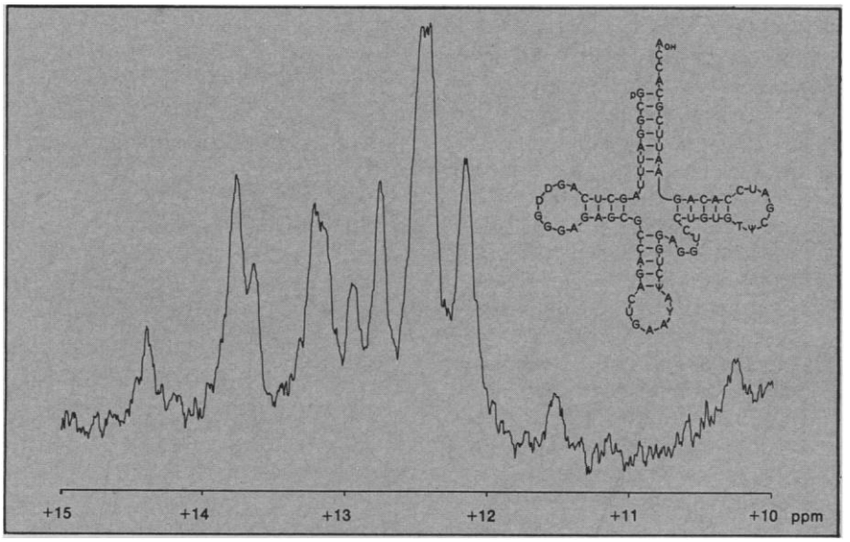
For E-Line information only, circle Reader Service No. 15.

The high field NMR analysis of living cell components

Transfer RNA plays a vital role in protein synthesis in the living cell, selecting a specific amino acid and attaching it to the growing protein amino acid sequence at the point specified by the genetic code of the ribosomal DNA. Now, high field NMR, by helping to provide detailed knowledge about t-RNA's conformation in aqueous solution, offers a promise of better understanding the exact way in which t-RNA accomplishes its function.

Recent work[1] involving a Varian superconducting NMR system has shown that high field proton NMR studies in H_2O allow observation of the number and type of hydrogen bonds involved in Watson-Crick base pairing in yeast phenylalanine t-RNA.

In this 300-MHz spectrum, obtained using the most powerful NMR spectrometer available, Varian's HR-300, the region between +15 and +10 ppm from DSS[2] shows a number of peaks whose integrated intensity can be interpreted in terms of the *number* of base pairs, and whose shift values reflect the *type* of bases paired. These data have now been used to confirm the clover-leaf model for the secondary structure of t-RNA and may even throw additional light on the tertiary structure believed to be responsible for the specificity of action of these vitally important molecules.



The renowned and well-established HR-220 series of Superconducting NMR Spectrometers has been upgraded to the HR-300, the instrument that provided this data. Now an improved version of the HR-300 is available, Varian's SC-300.

For more detailed information, circle Reader Service No. 16.

REFERENCES:

1. Y. P. Wong, D. R. Kearns, B. R. Reid and R. G. Shulman, *M. Mol. Biol.*, in press.
   D. R. Lightfoot, K. L. Wong, D. R. Kearns, B. R. Reid, R. G. Shulman and L. Cary, *Ann. N.Y. Acad. Sci.*, in press.
2. 2,2-dimethyl-2-silapentane-5-sulfonate.

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This outstanding gas chromatograph can really help you operate easily and efficiently with the most difficult samples. Samples like you encounter in drug, toxicology, pesticides, steroids, lipids, pharmaceuticals, and other metal-sensitive compounds. Here's why.

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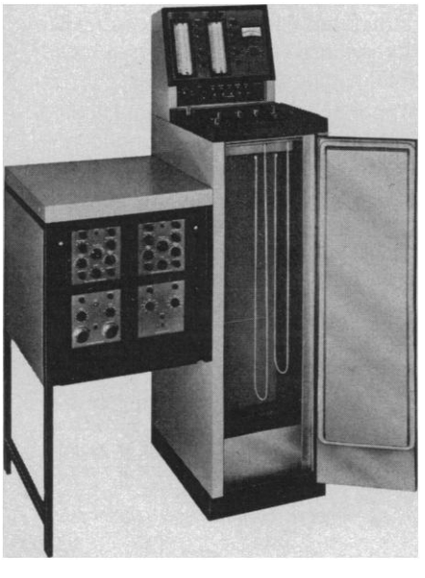
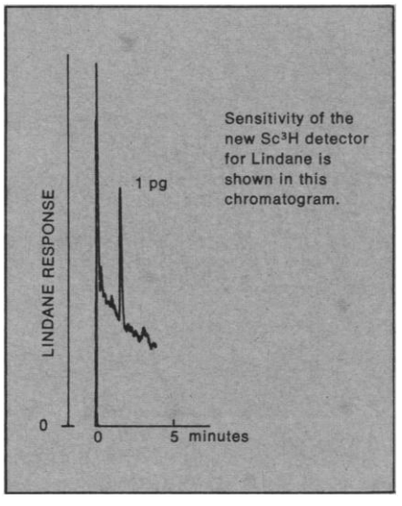
For Model 2100 literature only, just circle Reader Service No. 17.



New rare earth ^{3}H detector improves GC sensitivity for pesticides

Varian's new EC detector both provides and exceeds the best performance characteristics of present ^{3}H and ^{63}Ni detectors. And perhaps best of all, they can be removed, cleaned,

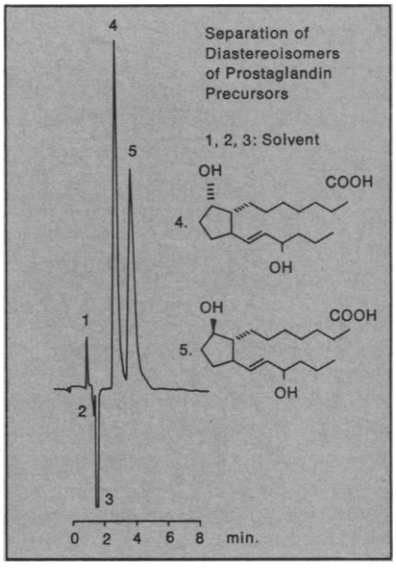


and returned to the GC in less than 30 minutes! Since they can be heated to 325°C, contamination is minimized. Sensitivity for Lindane is better than 0.2 picograms of Lindane when eluted in 5 minutes or less, and dynamic range exceeds 1000:1. The unit fits the standard universal detector base on most Varian Aerograph gas chromatographs.

For details circle Reader Service No. 18.

Steroids separation, one of many performed easily and precisely with Aerograph Liquid Chromatographs

Whether your separations involve steroids or other biochemicals, you'll have no concerns about being equipment-limited with Varian Aerograph liquid chromatograph systems; they provide capability to perform any LC separation with precision and speed. Our UV and RI detectors are second to none in sensitivity; our pumps deliver flowrates that are easily set, precisely regulated, and reproducible to ±0.1%; columns and related hardware offer state-of-the-art efficiency and capacity. All these let you perform rapid separations, even with diastereomers of heat labile biochemicals.



Conditions: Varian MicroPak® SI-10 column, 50 cm x 2.1 mm i.d.; mobile phase, heptane (70), THF (30), acetic acid (1); sample 0.5 mg; flowrate 126 ml/hr; pressure 950 psi; RI detector; attenuation 16. Chromatogram courtesy Dr. R.P. Lanzilotta, Syntex Research.

If you have questions about an LC system to meet your specific needs, we'd like to help. Outline your requirements to us and our experts will offer recommendations promptly.

If it's just descriptive literature you want now, circle Reader Service No. 19.

And Varian Back-Up Adds Extra Value.

Good back-up is that invisible specification that's necessary to bring out the best from your analytical tools. Here are the extras you get with every Varian product.

Applications

Chemists in our Field Applications Laboratories can help you select the right instrument and the most feasible method of solving your analytical problems.

U.S. Field Application Laboratories are located in Houston, Texas; Springfield, New Jersey; Park Ridge, Illinois; and Los Altos, California — as well as in key locations in Europe, the Far East, and other parts of the world.

Also, applications chemists in our Palo Alto headquarters are working constantly to improve and develop analytical methodology in areas of wide scientific interest.

Local Instrument Division sales offices have available a supply of printed technical information from the laboratories: applications notes, methodology books, reprints — all aimed toward increasing the utility of your Varian instrument.

R and D

Behind closed doors scientists and engineers are working on developments leading to the new generations of instruments and accessories. In fact, in just the past year, Varian has introduced a number of new instruments and accessories, and Varian Instrument Division scientists and engineers have been awarded over three dozen new patents. The Instrument Division has a commitment to continual R and D in the area of analytical instrumentation.

Workshops, Seminars, Scientific Meetings, Customer Training Courses

Varian has a long history of sponsoring and participating in scientific gatherings throughout the world. Regular programs of GC, LC, NMR, EPR, AA, and Raman workshops have reached thousands of scientists in recent years — and are continuing to do so. Here's a recent schedule of activities with, where appropriate, contacts for more information for those interested in attending.

Calendar of Events

For more information, contact your local Varian Instrument Division sales office unless otherwise indicated.

UV-Vis Life Science Seminars

Special life science training seminars entitled "How to Get the Best Answers from *Your* Spectroprotometer" will be held during the month of May in Boston, New York City, Washington DC, Atlanta, Houston, Chicago, Seattle, San Francisco, Los Angeles. Watch for announcements of specific dates.

Circle Reader Service No. 20 for more information.

Gas Chromatography Courses

April 16-18, 1973: Houston, Texas

May 16-18, 1973: Springfield, N.J.

Liquid Chromatography Courses

February 14-16, 1973: Chicago, Illinois

April 9-11, 1973: San Francisco, Calif.

May 9-11, 1973: Houston, Texas

Mass Spectrometer Meetings

May 15-16, 1973: Varian MAT Instrument Owners Meeting, Springfield, New Jersey

May 18-19, 1973: Varian MAT Instrument Owners Meeting, Palo Alto, California

May 20-25, 1973: American Society for Mass Spectrometry Meeting, San Francisco, California

NMR Workshops

April 4-6, 1973: One-day T-60A Workshops, Springfield, New Jersey

Exhibits/Scientific Meetings

Varian instruments on exhibit

February 20-23, 1973: Forensic Science Meeting, Las Vegas, Nevada.

March 5-8, 1973: Pittsburgh Conference, Cleveland, Ohio, USA

March 6-10, 1973: Medex 73, Basel, Switzerland

March 11-20, 1973: Leipzig Spring Fair, Leipzig, Germany

March 27-30, 1973: Labex International 73, London, England

April 4-15, 1973: Electro Mash 73, Moscow, USSR

April 11-18, 1973: Mesucora/Exp. de Physique, Paris, France

April 16-20, 1973: FASEB, Atlantic City, New Jersey, USA

May 7-12, 1973: Interlabor, Zagreb, Yugoslavia

May 18-24, 1973: TV-Symposium, Montreux, Switzerland

Service

The best service is no service at all. Since there's no such thing as a perfect instrument, we do the next best thing: design instruments for the most reliability at a given price tag, then back that up with trained Service Engineers in 15 locations in the U.S. plus many additional locations throughout the rest of the world.

Your orders for spare parts and supplies are shipped on either a normal or emergency basis, depending on need. And we're improving our turnaround time continually.

On those occasions when you have instrument difficulty, you can call your local Varian Service Engineer and perhaps even get the help you want over the telephone — all part of the responsive service that we're making even better.

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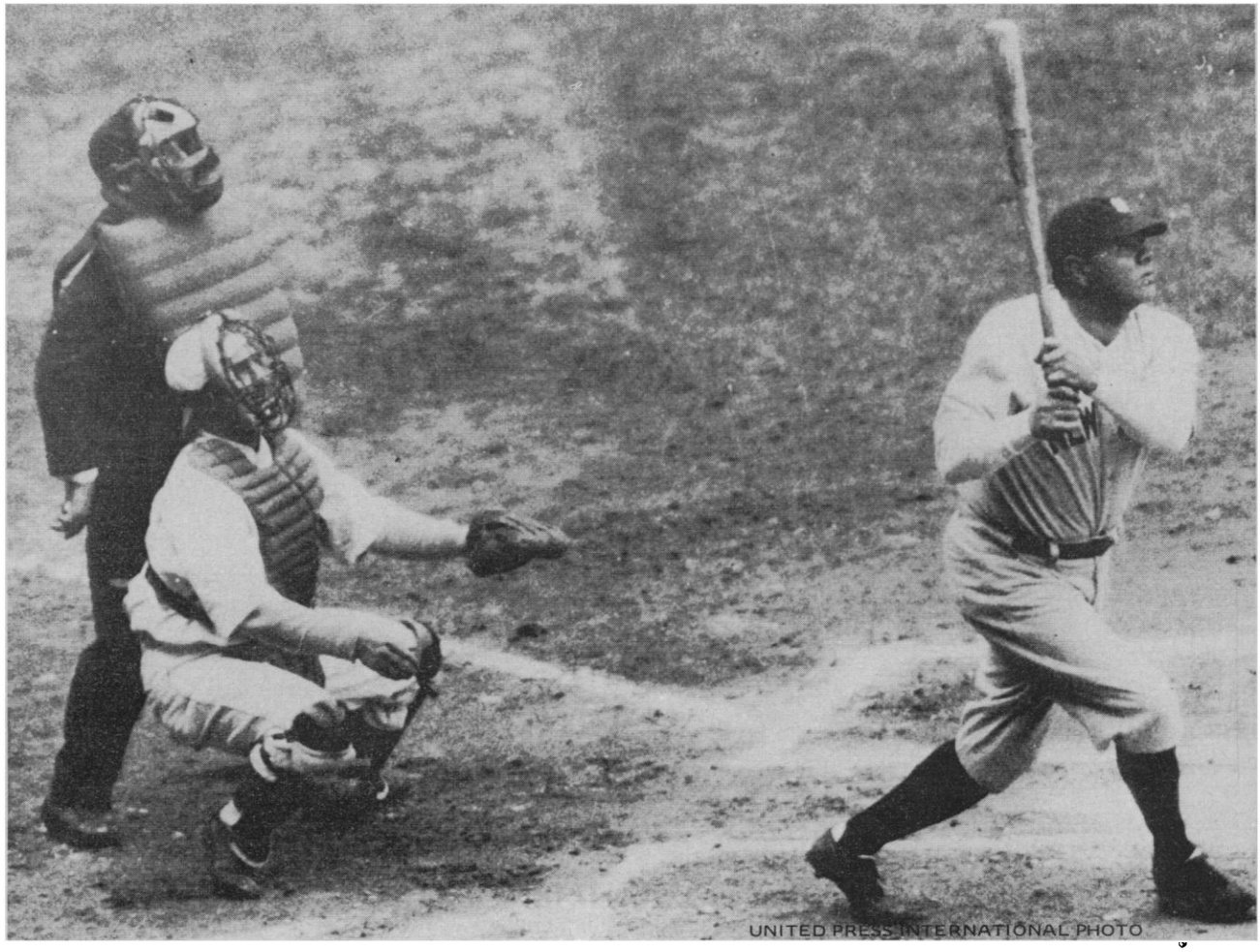
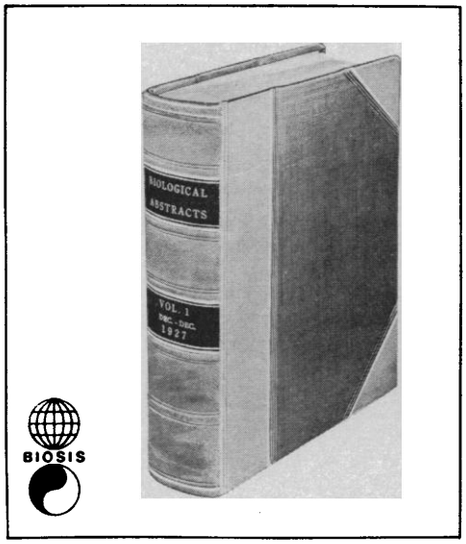


"Babe" had a great year in 1927..... so did biology.

Volume 1 of **BIOLOGICAL ABSTRACTS**, in 1927, was quite an achievement. It contained 14,506 abstracts of biological literature and represented the start of what would become the greatest information service in the life sciences.

Last year **BIOLOGICAL ABSTRACTS** (and its companion publication **BIO-RESEARCH INDEX**) reported on more than one-quarter million papers from publications originating in over 90 countries. An excess of 680 subject sections covering the wide diversity of the life sciences, comprise each issue.

In sharp contrast to the modest beginning of Volume 1, in 1972 **BIOLOGICAL ABSTRACT**'s new microfilm edition offered 20,000 abstracts on just one 4" microfilm cartridge! Now more than 2.5 million abstracts are in the microfilm collection.



The broad spectrum of coverage and service for the life sciences has grown to include semi-annual indexes of abstracted and bibliographic material, a preview on magnetic tape of forthcoming issues, specialized custom search services based on computerized storage of current and past materials, and a whole new series reaching highly specialized disciplines such as mycology, entomology, pollution, cancer, ecology, and drug addiction.

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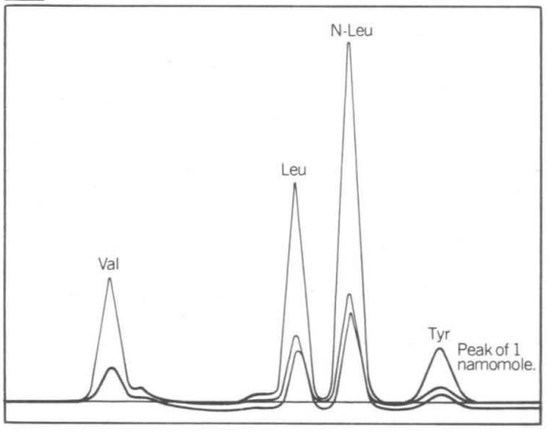
Peak performance.

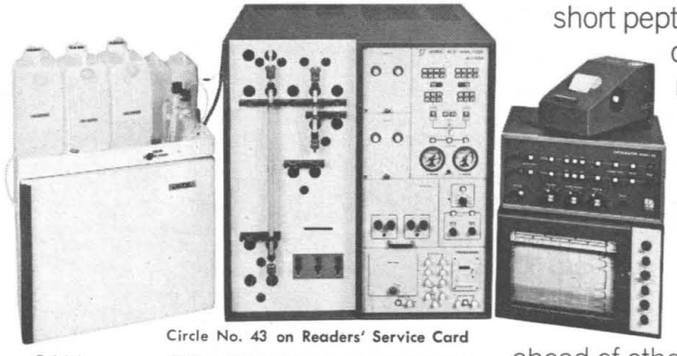


This is an Insulin A-Chain after a 12 step degradation. The instrument that provided the analysis was our 6AH Amino Acid Analyzer. Peaks like this are just part of the performance on the 6AH and our 47K Sequence Analyzer.

Highest sensitivity. The 6AH matches unmatched sensitivity and automatic operation. It's rated at 5 nanomoles/2 mm and 1 nanomole/10 mm. It automatically accommodates 12 samples or 36 with accessories. You can employ either single or dual column methodology for protein hydrolyzate research and for work with physiological fluids. And like the 6AH, the integrator we feature is a product of JEOL design and manufacture. ☐

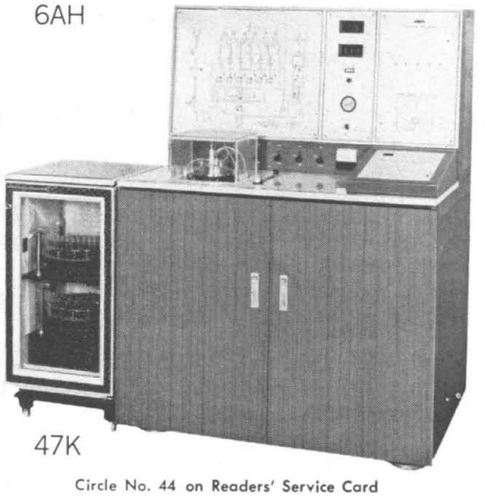
Our 47K should be part of your work if your work includes short peptide or long protein analysis. The patented design of the overflow reaction cup system makes this research possible. The automatic fractionation of residual peptides and dual fraction collectors make both Edman and Dansyl subtractive methods routine.

Top support. More than routine is JEOL service that comes with every instrument. It's the equal of the instruments in refinement, speed and accuracy. Our service stands ahead of others and behind our 47K and 6AH. All are at the top of their field, individually or working together. ☐ Learn more from the Automated Analyzer Division, JEOL, 235 Birchwood Ave., Cranford, N.J. 07016. Tel. (201) 272-8820.



6AH

Circle No. 43 on Readers' Service Card



47K

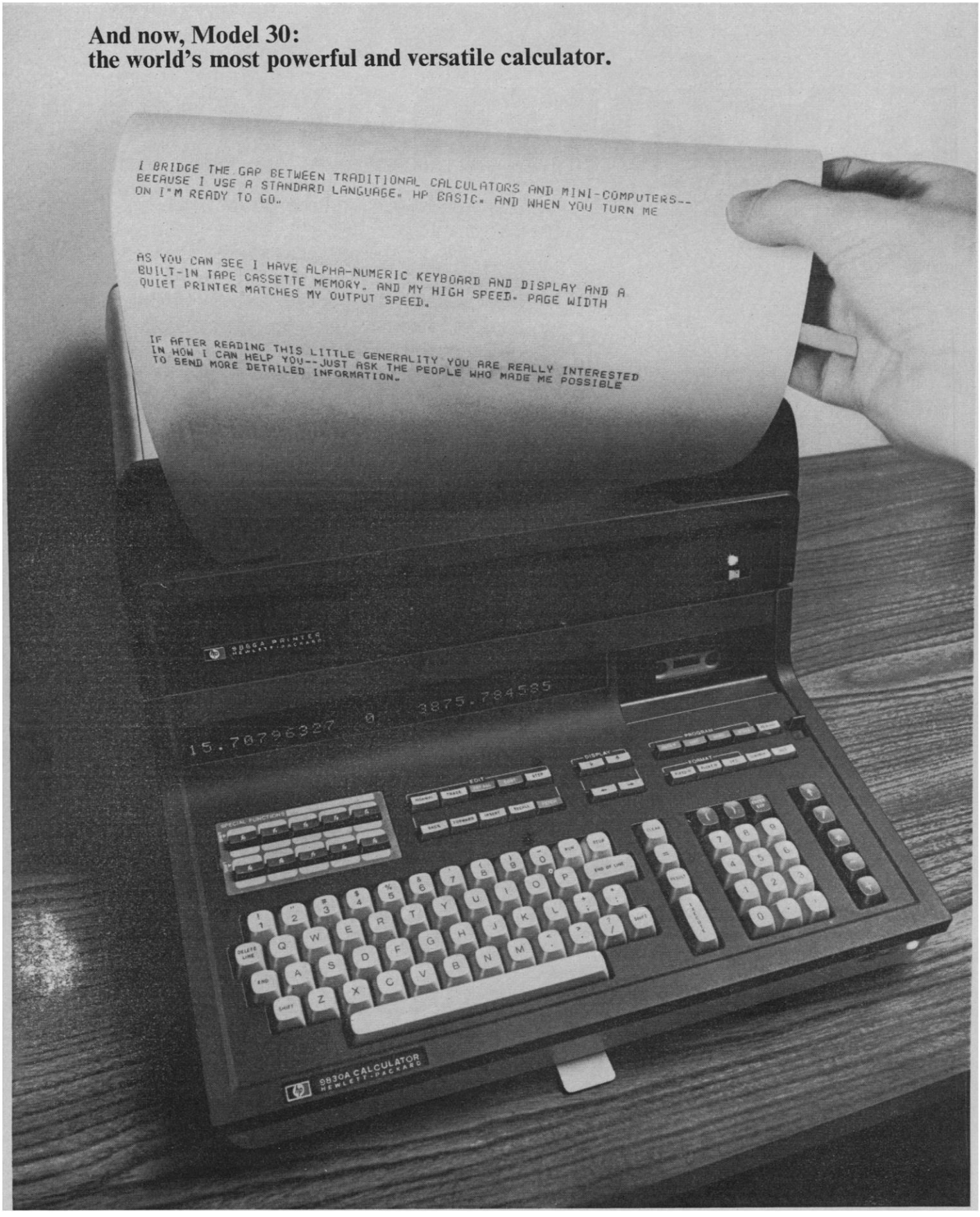
Circle No. 44 on Readers' Service Card

JEOL

INSTRUMENTATION: Scanning Electron Microscopes / Electron Microscopes / X-ray Microprobes / NMR Spectrometers / Mass Spectrometers / ESR Spectrometers / Laser Raman Spectrophotometers / Gas Chromatographs / Laboratory Computers / X-ray Diffractometers / Amino Acid Analyzers / Sequence Analyzers / Electron Beam Apparatus.

WORLDWIDE: 16, Avenue de Colmar, 92 Rueil-Malmaison **(Paris)** / Grove Park, Edgware Road, Colindale, **London** N.W.9 / 3-3-1 Marunouchi, Chiyoda-ku, **Tokyo** 100 / 477 Riverside Avenue, Medford, **(Boston)** Massachusetts 02155 / Australia and New Zealand, Austria, Benelux, Brazil, Canada, Colombia, Germany, Italy, Scandinavia and Finland, South Africa, Spain and Portugal, Switzerland, Venezuela.

Some things are changing for the better.



Many people know us as an instrument manufacturer: we make more than 2,000 products for measurement, test and analysis. Others know us as a computer company: more than 10,000 own our calculators and computers. We prefer to think that our business is to serve your measurement and computation needs.

A way to manage airport noise.

Aircraft engine noise — from more and bigger planes taking off and landing more frequently — is now a bona fide environmental problem. As the volume of air traffic grows and our population expands to surround previously remote airport areas, the need for effective noise control is essential.

The ideal solution is to stop this noise at its source by designing quieter engines, or by retrofitting the world's current fleets with noise-suppressing engine nacelles, but this will take time to implement.

Until then, many airports are finding an interim solution by developing noise abatement techniques for landing and take-off operations. To help establish and validate these techniques, some major airports with acute noise problems are using HP Aircraft Noise Monitoring systems.

These systems operate automatically and around the clock. Special microphones monitor noise from different locations in the airport vicinity. This information is relayed to a central location where the data is continuously analyzed and reported so that airport operations can immediately advise pilots of noise irregularities and violations.

HP noise monitoring systems are now operating at international airports in Los Angeles, Sydney, Geneva, Zurich and Stuttgart (and soon, in London and Manchester).

If you have any relationship to this issue of airport noise, we'd be happy to send you information on our system. The noise won't go away, but our system will help make it more manageable.

A typical noise violation report generated by HP's noise monitoring system.

SINGLE EVENT NOISE VIOLATIONS

DATE	TIME	NMS	RANGE	SETNL	MNL	LIMIT	SENEL	COMMENT
1:23:72	0:13:25	4	60	85	102.5	105	114.7	Flight KL 147
1:23:72	0:13:54	7	80	85	104.8	105	113.2	
1:23:72	0:14: 8	10	60	85	97.7	100	104.3	
1:23:72	0:17:45	12	80	85	121.8	105	116.9	
*								
/C								
1:23:72	0:18: 0	1	80	90	84.9	110	96.3	CAL
1:23:72	0:18:12	14	60	85	99.6	100	107.0	
1:23:72	0:18:55	11	80	85	104.7	105	112.7	
1:23:72	0:19:25	2	80	90	85.3	110	96.8	CAL
1:23:72	0:20: 0	8	40	70	92.0	95	100.5	

NMS: microphone location by number.

RANGE: indicates the lowest value in dB of the dynamic range at microphone location.

SETNL: the threshold noise dB level. If a noise event occurs at or above this level, a report is generated.

MNL: the maximum dB which occurred during the noise event.

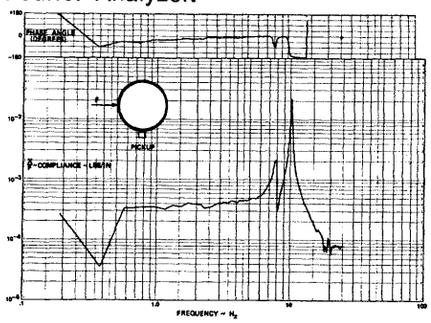
LIMIT: when this dB noise level is exceeded in a single event, audible and visual alarms are initiated.

SENEL: noise exposure level for the event: a time period/dB relationship.

You can detect the real cause and true effect of vibrations and noise.

A trained ear can pinpoint the pitch of a pure note within a few cycles per second. But, given a complex mixture of sounds or other types of signals — like an automobile vibration, or an underwater sound — it takes more than a trained ear to identify the basic frequencies that make up the mixture. Scientists and engineers find it highly useful, and sometimes essential, to trace or identify a low frequency signal through a mechanical structure. And they often need this information on the spot — in real-time as an event is taking place.

It is now possible to bring real-time signal analysis to the lower frequencies of vibration and sound with computers and the fast Fourier transform: HP's Fourier Analyzer.



Send a vibration through a pump with a known force (such as a hammer equipped with a load cell); obtain the output (from an accelerometer); display the transfer function on an HP Fourier Analyzer and you immediately learn the natural resonant frequencies of the pump, (see the above diagram). With this information, you can redesign to avoid resonance (vibrations) problems which might loosen connections or cause failure.

Here are a few practical examples of how it can be used.

- Testing mechanical components such as axles, differentials, and motors to assure their quality.
- Monitoring machines (power turbines, pumps, power tools) to determine when maintenance work should be done — before a breakdown.
- Analyzing structures, i.e., buildings, bridges, vehicle frames, airplane wings for improvement in design and resistance to failure.

If you think you have a problem that might yield to the HP Fourier Analyzer, ask for a free brochure.

For more information on the products described in these pages, fill out the coupon or write to: Hewlett-Packard, 1507 Page Mill Road, Palo Alto, California 94304.

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HP sales, service and support in 172 cities in 65 countries.

Please send me information on the following:
( ) HP Model 30 Calculator
( ) HP Aircraft Noise Monitoring System
( ) HP Fourier Analyzer

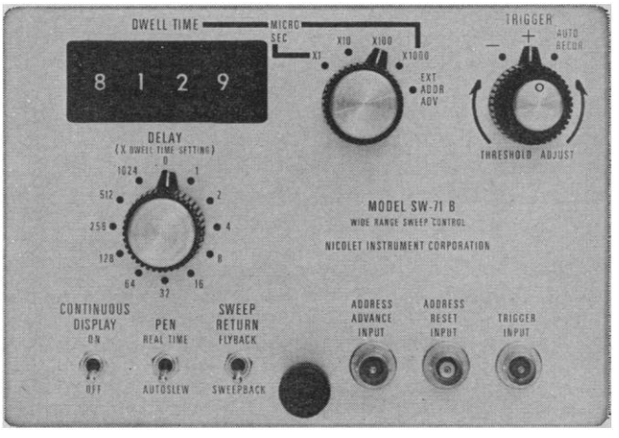
Name_____

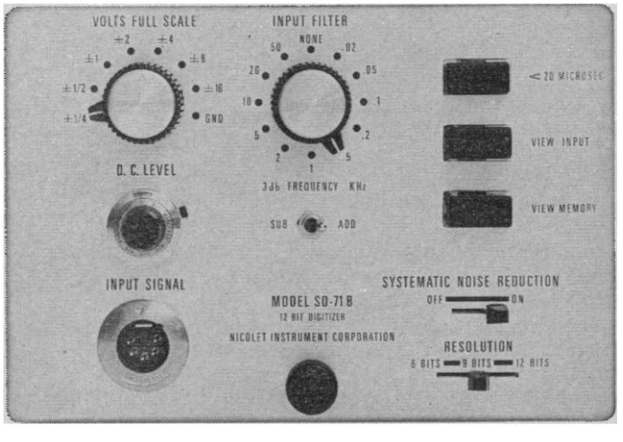
Title_____

Company_____

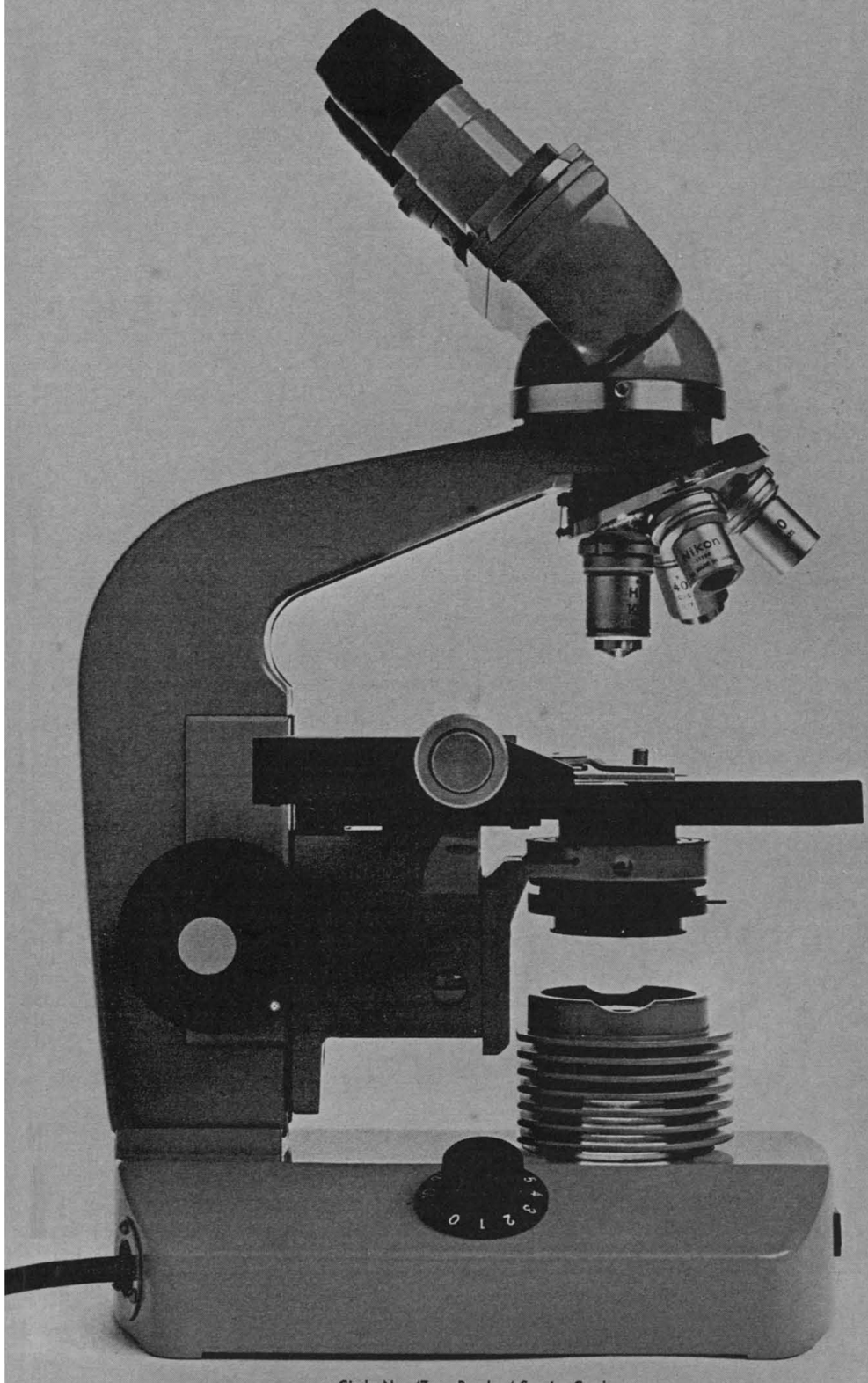
Address_____

City_____ State_____ Zip_____


DWELL TIME
MICRO SEC
8 1 2 9
X1
X10
X100
X1000
EXT ADDR ADV
TRIGGER
AUTO RECOR
THRESHOLD ADJUST
DELAY
(X DWELL TIME SETTING)
0
1
2
4
8
16
32
64
128
256
512
1024
MODEL SW-71 B
WIDE RANGE SWEEP CONTROL
NICOLET INSTRUMENT CORPORATION
CONTINUOUS DISPLAY ON
OFF
PEN REAL TIME
AUTOSLEW
SWEEP RETURN FLYBACK
SWEEPBACK
ADDRESS ADVANCE INPUT
ADDRESS RESET INPUT
TRIGGER INPUT


VOLTS FULL SCALE
±1
±2
±4
±8
±1/2
±1/4
±16
GND
INPUT FILTER
NONE
50
.02
26
.05
10
.1
5
.2
2
1
.5
D. C. LEVEL
386 FREQUENCY KHz
SUB
ADD
< 20 MICROSEC
VIEW INPUT
VIEW MEMORY
INPUT SIGNAL
MODEL SD-71 B
12 BIT DIGITIZER
NICOLET INSTRUMENT CORPORATION
SYSTEMATIC NOISE REDUCTION
OFF
ON
RESOLUTION
6 BITS
9 BITS
12 BITS

The Nikon CL Classic Everything a student microscope should be.



A student microscope should be rugged, durable, tamper-proof, and optically flawless. The Nikon CL Classic is all of that, and more.

From top to bottom, it's designed for classroom use. Furthermore, the emphasis is on simplicity. Widefield 10x eyepieces, easily manipulated high-resolution objectives, bright even illumination and built-in solid state light intensity control — all guarantee trouble-free, simple operation for the student microscopist.

It's priced right, too — without any sacrifice of optical quality or workmanship. You'll find it fits easily into the institution budget. What's more, the CL Classic will accept a variety of accessories, giving you the versatility of an advanced microscope when you need it.

It's optically exceptional.
The high quality, high resolution optics meet the matchless standards that Nikon requires of all its microscopes. Comes with four achromat, color coded objectives, mounted on a four-place multiple ball-bearing nosepiece, 4x, 10x and retractable 40x and 100x (oil immersion.) Also has an n.a. 1.25 condenser in rack and pinion focusing mount.

It's tamper-proof.
Nikon designers have solved the problem of tampering, pilferage and accidental loss by locking in the eyepieces, body tube, condenser and objectives in a special way and giving you the key.

It's damage-proof.
Damage to specimens, slides and objectives is virtually impossible because of the jam-proof, slip-clutch safety feature in the harmonic drive focusing mechanism. The unusually smooth and sensitive, pre-set focusing controls will not break down even when forced.

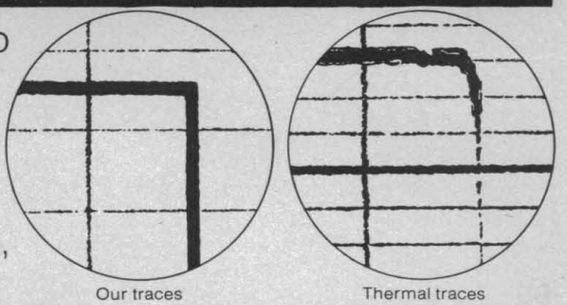
It's rugged and durable.
The stand is full-sized, broad-based, sturdy and resistant to chemicals. This makes for maximum stability and protection against the rigors of daily classroom use.

Student or teacher, the Nikon CL Classic is the ideal classroom microscope. Prove it to yourself. Arrange for a free demonstration. Call or write: Nikon, Inc., Instrument Division, Ehrenreich Photo-Optical Industries, Inc. 623 Stewart Avenue, Garden City, N.Y. 11530.

Circle No. 47 on Readers' Service Card

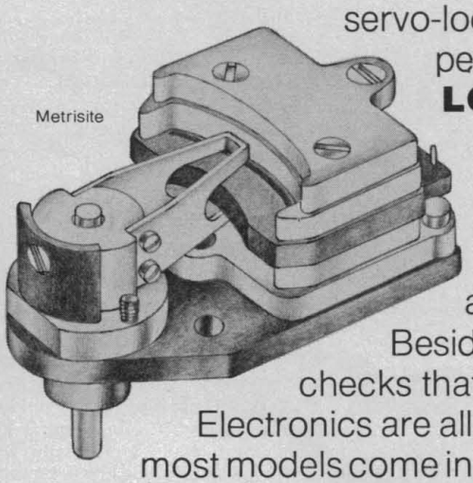
Why we think Brush recorders are your best choices.

CLEANEST TRACES. When you say hello to your Brush Recorder, you say good-bye to smudging, smearing, skipping and puddling traces. The reason: pressurized inking that forces a crisp, clean trace not just onto, but into the paper. Our pens never need priming, even after long periods of not being used.



Our traces Thermal traces

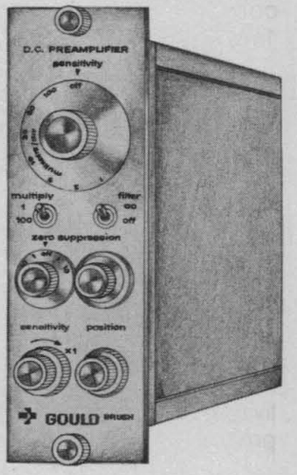
ACCURACY. Another plus for the Brush Recorders is our Metrisite® non-contact servo-loop feedback device. A system so accurate it enforces pen positioning at better than 99½% linearity.



Metrisite

LOW MAINTENANCE. We've carefully designed each instrument to require minimal care. For example, our Metrisite system eliminates bothersome maintenance problems. Like dirty pots, wear, cleaning. The Metrisite also eliminates slide wires and all the maintenance problems that go with them. Besides, we put every instrument through quality control checks that simply don't forgive mistakes.

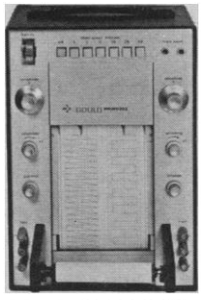
Electronics are all solid-state in the recorders. And most models come in either portable or rack-mounted versions. All of them are compatible with our wide range of signal conditioners, so you can get the exact signal conditioners to suit your requirements.



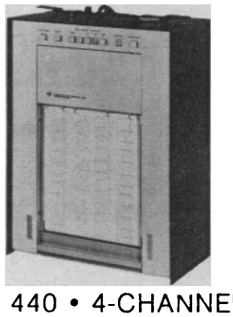
If you'd like to know more about Brush Recorders, contact your nearest Gould Sales Engineer or Representative. Or write for detailed performance information and specifications. Gould Inc., Instrument Systems Division, 3631 Perkins Avenue, Cleveland, Ohio 44114 or Rue Van Boeckel 38, Brussels 1140, Belgium.

BRUSH INSTRUMENTS

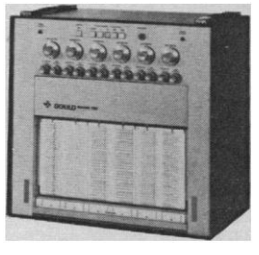
GENERAL PURPOSE



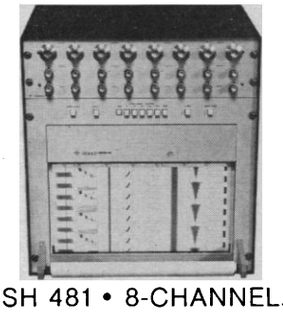
BRUSH 222 • 2-CHANNEL. Portable battery operated version of popular Brush 220 recorder. Internal recharger. 30Hz frequency response. Sensitivity 1mV/div. to 500V f.s.



BRUSH 440 • 4-CHANNEL. Designed for maximum versatility at low cost per channel. 40Hz frequency response.

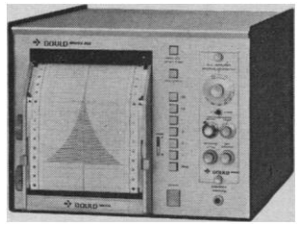


BRUSH 260 • 6-CHANNEL. High precision and maximum operator convenience. Built-in preamps. 1mV/div. to 500V f.s. sensitivity.

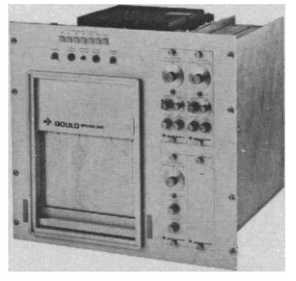


BRUSH 481 • 8-CHANNEL. Our newest 1mV/div. to 500 V f.s. sensitivity. Model 480 available without preamps.

HIGH PERFORMANCE

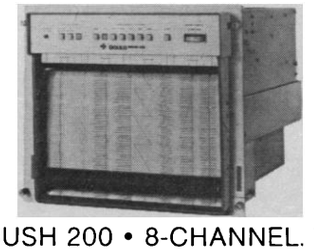


BRUSH 250 SINGLE CHANNEL. Fastest, most versatile strip-chart recorder anywhere. Useful response to 100Hz. Detachable chart paper magazine.



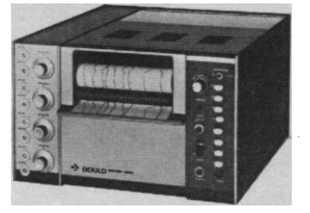
BRUSH 240 • 4-CHANNEL. Frequency response to 55Hz on 40mm and 35Hz on 80mm channels.

BRUSH 280 • 2-CHANNEL. Double width 80mm channels. Built-in preamps. 35Hz frequency response.

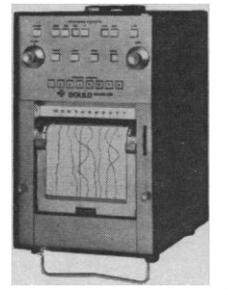


BRUSH 200 • 8-CHANNEL. The world's standard for high performance recorders. Tailored to your specific requirements.

SPECIAL PURPOSE



BRUSH 2300 LIGHTBEAM OSCILLOGRAPH. Dual tungsten filament optical oscillograph. From 1 to 16 channels. To 1000Hz response.



BRUSH 816 • 8-CHANNEL HI-SPEED MULTIPOINT Scans and displays up to 8 channels. Data is recorded at a rate adjustable from 2 seconds per point to 16 points per second.

BRUSH 511 DIGITAL PLOTTER. Absolute coordinate plotter. Non-cumulative errors. No permanent offsets due to transmission line disturbances. 99.85% linearity.

BRUSH 500 X-Y RECORDER. A rugged, low-priced recorder. 99.85% linearity. Pressurized ink writing. Electrostatic hold-down. Built-in preamps.

Circle No. 5 on Readers' Service Card

GOULD

Worthington's high-purity blood fractions.

Human blood has several fractions of intense interest to immunologists and clinical researchers. Responding to this interest, we turned certain of our more sophisticated purification techniques to the problem and came up with a selected group of products obtained from human blood. Six of these – Alpha-1-antitrypsin, Carbonic anhydrase B and C, Gamma globulin G heavy and light chains, and Plasminogen – are offered commercially for the first time. Others, Gamma globulin G and Albumin, are offered in purities and homogeneities surpassing all other preparations previously available. Pictured above are crystalline Fc fragments from pooled human gamma globulin.

Such purification is achieved through the use of such advanced techniques as ion exchange gel permeation and affinity chromatography, expertise we have gained through years of preparing high-purity research enzymes.

The blood fractions are fully characterized through disc gel electrophoresis, ultra-centrifugation, and amino acid and immunochemical analysis. Together, they provide the researcher with new tools for investigations in such dynamic fields as immunology and blood component therapy.

Prices and specifications are listed in the current Worthington Research Products catalog, available on request.

WORTHINGTON

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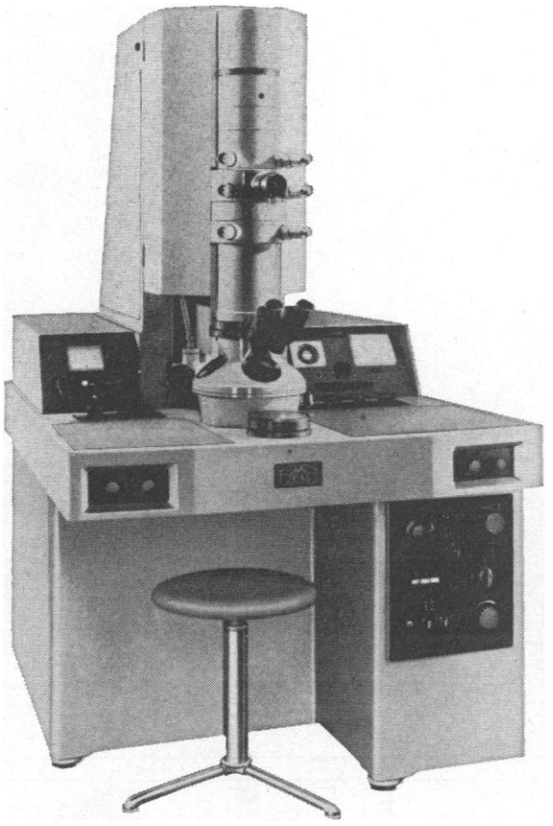
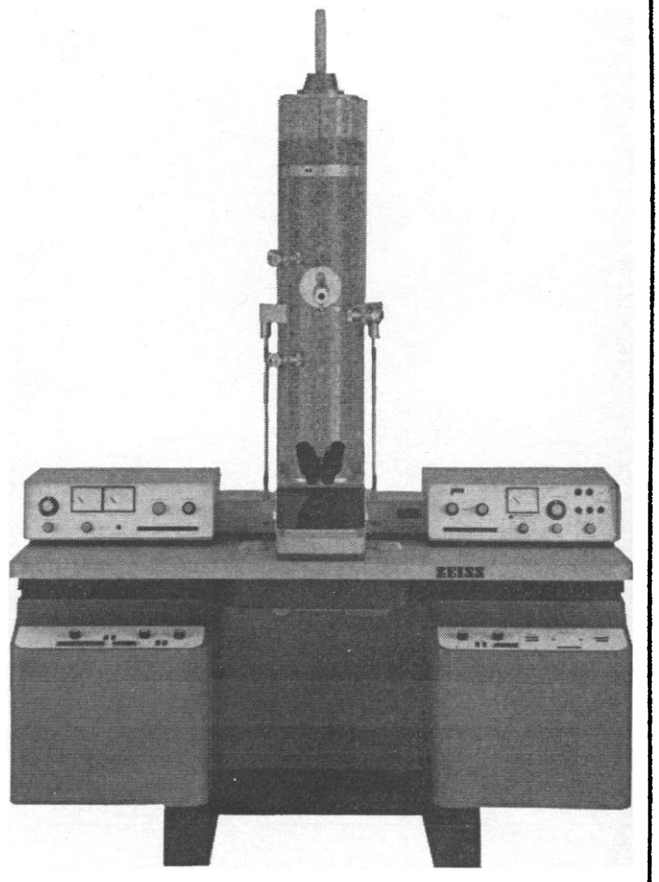
Worthington Biochemical Corporation Freehold, New Jersey 07728 U.S.A.

ZEISS instruments for the researcher and the laboratory



EM 9 S-2 Electron Microscope
7Å point-to-point resolution. Fully automatic camera system. Extremely simple to operate. Small size. Big performance. Low price. Zoom or fixed-step magnifications from 30x to 60,000x—distortion free. Multiple (21 openings) thin-metal film aperture. Specimen exchange through foolproof airlock in 8 secs; stereo tilt. Circle **21** on Reader Service Card.



New EM 10 High-Resolution Electron Microscope
3.5Å point-to-point resolution. All solid-state circuitry. Compact, foolproof. New unique focusing aid for entire range of 100x-200,000x. Multiple specimen holder and universal specimen handling facilities. Fully automatic 3¼x4", 70mm, and 35mm camera systems. Unique 5-character automatic data imprint. Full X-ray protection for operator under *all* conditions. Circle **22** on Reader Service Card.

Particle Size Analyzer TGZ 3A for Automatic Data Analysis
Measures and counts particles directly from electron micrograph or photomicrograph. Of great value in air pollution studies. Provision for on-line or off-line computer analysis. Shown here is the automatic model. Circle 23 on Reader Service Card.

Zoom Stereomicroscope IV
(Shown with optional beam splitter, 35mm camera attachment and auxiliary viewing tube.) Compact. Stable. Precision-engineered. Unique parfocal zoom system. For reflected and transmitted light. Koehler illumination. Drawing attachment available. Circle **24** on Reader Service Card.

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NEW YORK, N. Y. 10018
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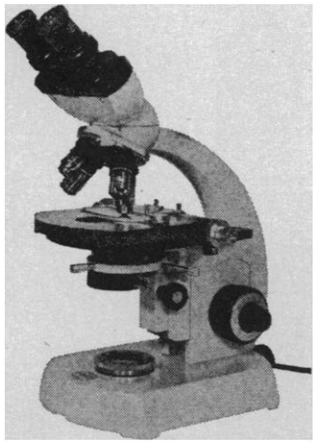
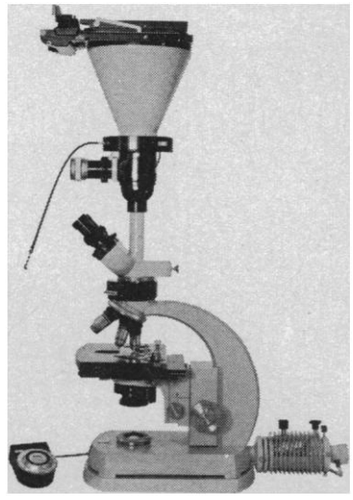
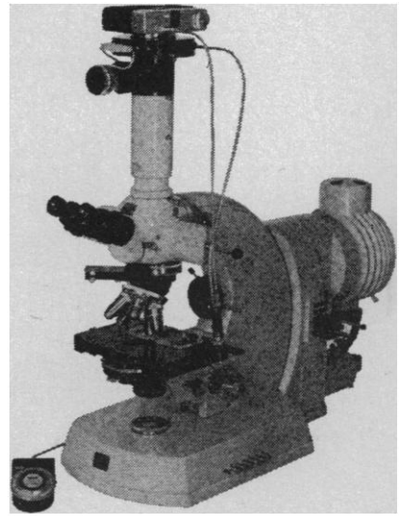


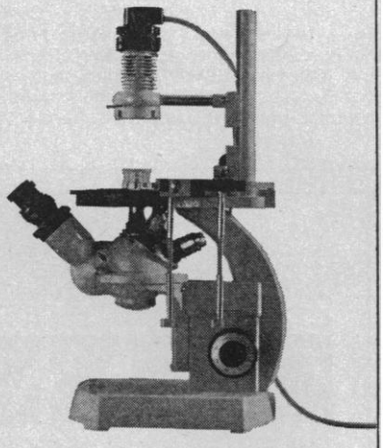
Standard RA Routine and Research Microscope
Great versatility and Zeiss quality at low price. Features include: integral low-voltage illuminator; centerable condenser carrier; permanent or interchangeable nosepiece; selection of stages; combined coarse-fine focusing drives. Accessories for all microscope techniques, including fluorescence and Nomarski. Same wide line of photographic attachments as for the WL. Circle 25 on Reader Service Card.



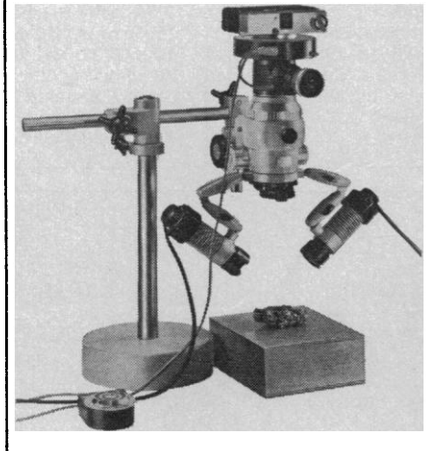
Standard WL Research Microscope
(Shown with 4"x 5"Polaroid®.) Accepts also 35mm manual and automatic cameras, and 3¼" x 4¼". Features include all those of the RA Microscope, plus an independent fine-focus for critical work, interchangeable stages and condenser holders for the researcher with frequent need to change modes. Circle 26 on Reader Service Card.



Universal Microscope
(Shown with Automatic 35mm Camera and Fluorescence attachments.) Recognized as "the closest approach to a universal microscope." Fully interchangeable optics and components for transmitted and reflected-light, bright-field and dark-field, Nomarski interference contrast, phase contrast, polarization, fluorescence, Epi-fluorescence, and U.V. Circle 27 on Reader Service Card.



Standard UPL Inverted Microscope
Ideal for tissue culture work. Features include: high stability; Koehler illumination; easy viewing and adjustment; rapid tube-changing; minute-displacement mechanical stage. Magnifications cover the range from 50X to 1000X. Circle 31 on Reader Service Card.



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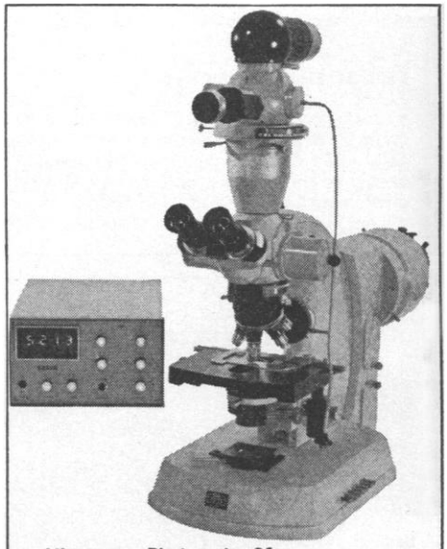
(With type C-35 CS-matic camera on C. stand, two 6-V, 15-W epi-illuminators.) A unique instrument for photomacrography. Zoom optics instead of bulky bellows. Continuous magnifications from 0.8X to 12.8X at 3 fixed working distances. Flat-field optics. Camera backs available for 35mm, Polaroid®, 3¼" x 4¼" and larger formats, manual or automatic. Many other stands and options available. Circle 32 on Reader Service Card.



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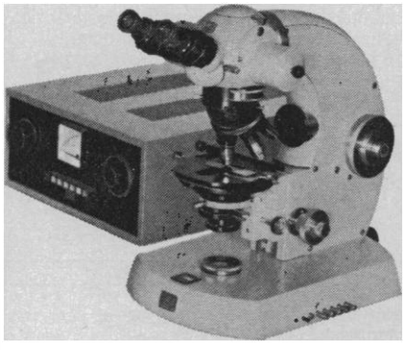

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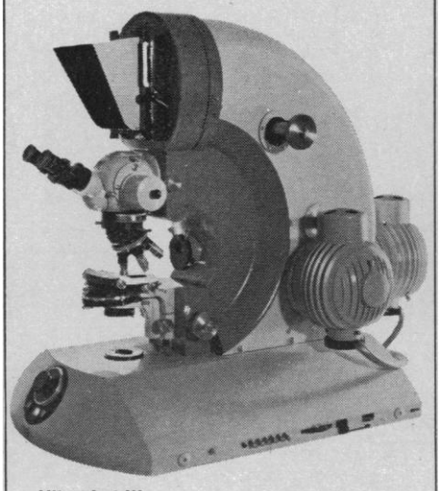

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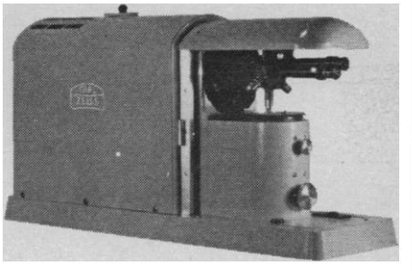

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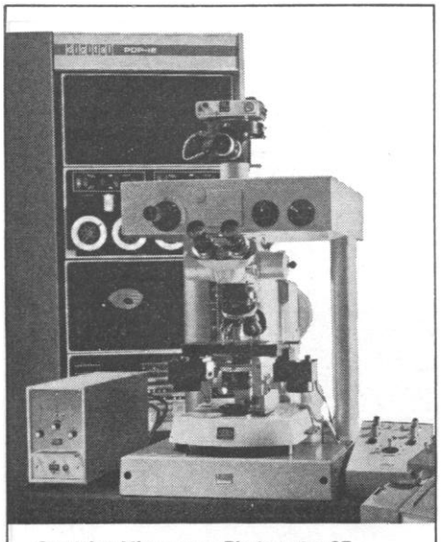

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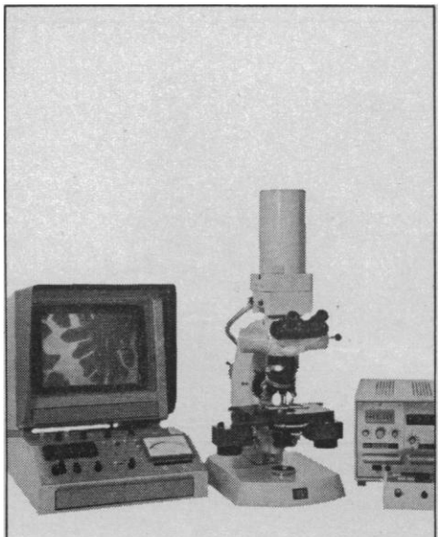

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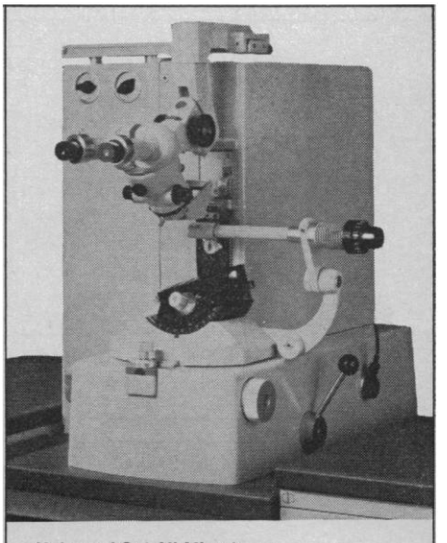

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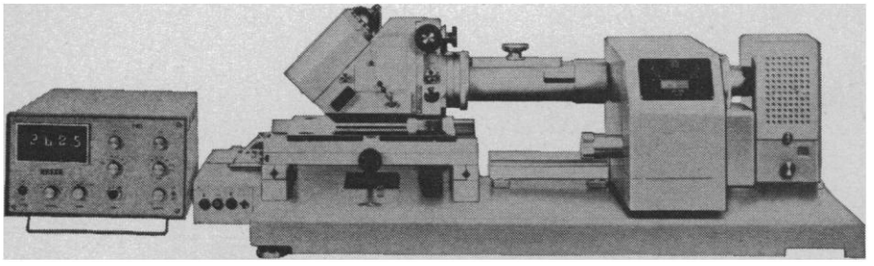

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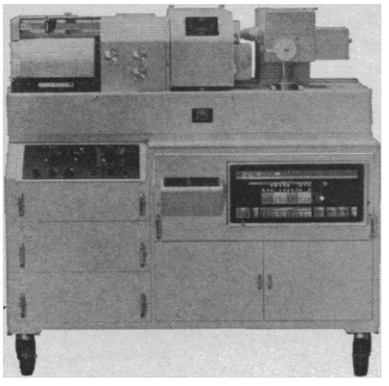

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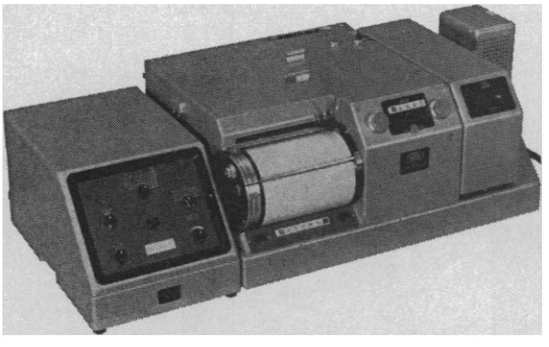

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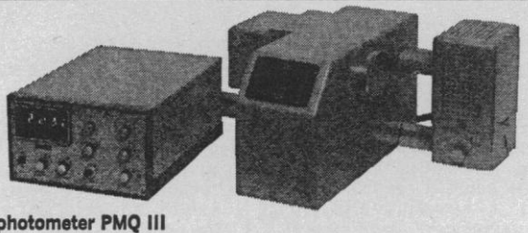

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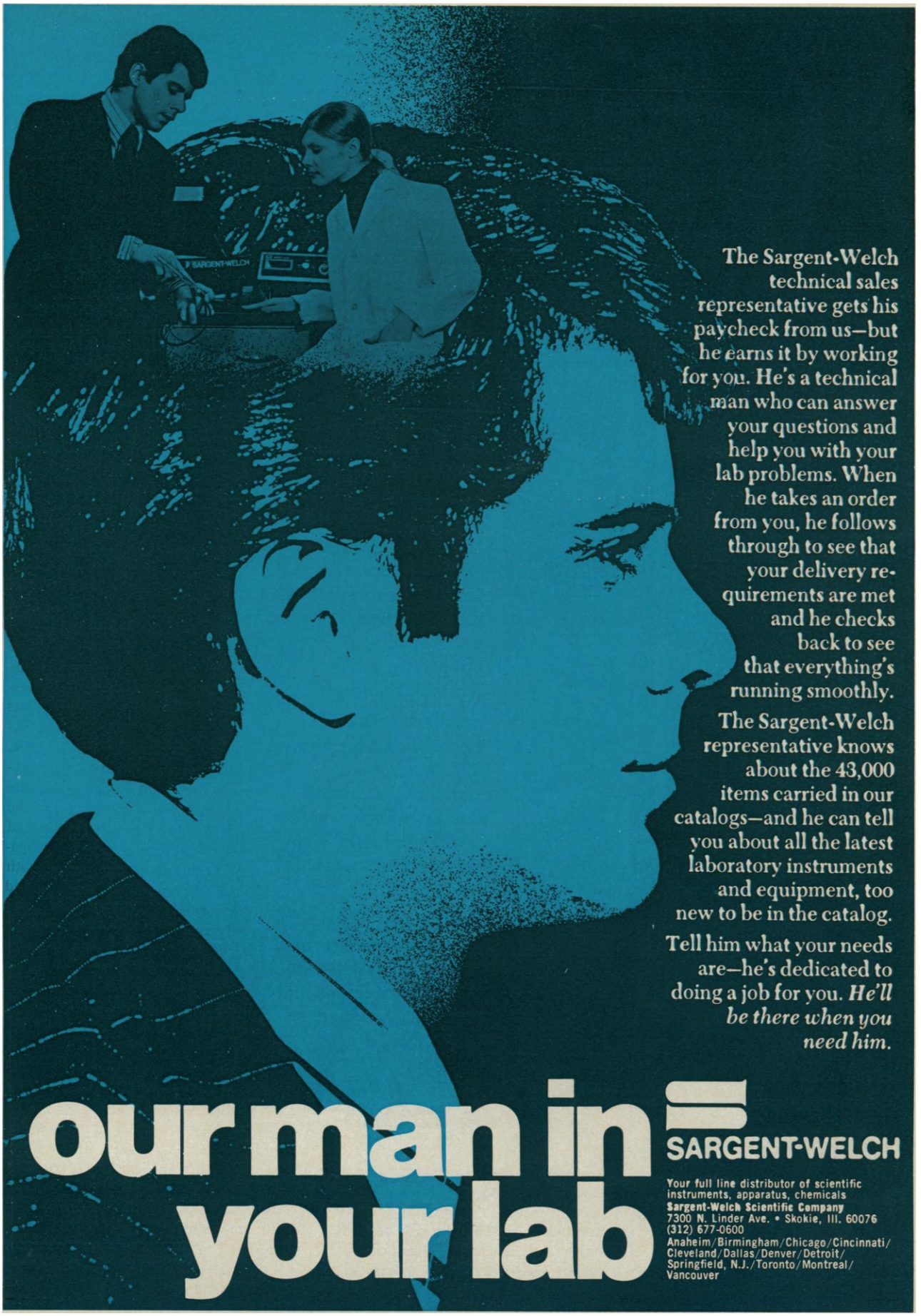

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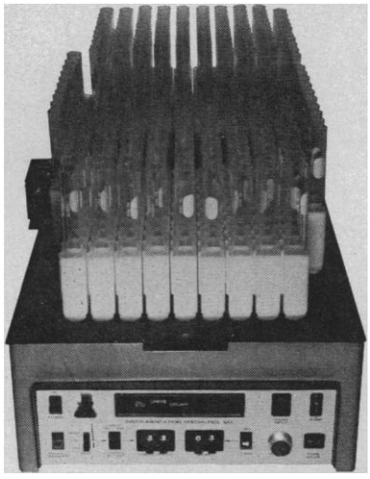

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p. 1216; 21 July, p. 239; 1 Sept., p. 776; 13 Oct., p. 145) concerning the massive use of environmental modification, including weather control, in Southeast Asia to consider that the experience gained in peaceful geophysical modification can be quickly turned to other purposes less helpful to mankind.

To the extent that any one of these hypotheses is valid, the social scientist committed both to rational analysis and to responsibility for his or her actions is in a dilemma. If the limits of the analysis or its possible misuse are great, would society be better off without it? I think in some cases the answer must be yes, as much in social science as in new technology. Indeed to the extent that social science becomes important (that is, people really take it seriously) social scientists must be as self-critical and responsible about their methods and their possible abuse and misuse as technologists should be about their inventions. In some cases where uncertainty is very great, it may be as irresponsible to advocate a decision-making methodology that does nothing to really reduce the uncertainty or to control its use as it is to build an SST. At the very least, until we can take into account both the limits and unintended use of decision analysis, we should be cautious in its advocacy. And in areas of great scientific unknowns, such as weather modification, where heavy pressure exists for its "arational" use and some pressure for its amoral use, extreme caution is indicated.

ROBERT W. KATES

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Worcester, Massachusetts 01610

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1. R. W. Kates and W. R. D. Sewell, *Human Dimensions of Weather Modification* (Department of Geography Research Paper No. 105, University of Chicago, Chicago, 1966), pp. 347–362.
2. P. R. Julian, R. W. Kates, W. R. D. Sewell, *Water Resour. Res.* 5, 215 (1969).
3. L. M. Hartman, D. Hilland, M. Giddings, *ibid.*, p. 555.
4. Taskforce on Federal Flood Control Policy, *A Unified National Program for Managing Flood Losses*, House Document 465, 89th Congr., 2nd sess. (Government Printing Office, Washington, D.C., 1966).
5. G. F. White, in *Water Research*, A. V. Kneese and S. C. Smith, Eds. (Johns Hopkins Press, Baltimore, Md., 1966), pp. 251–273.

Power is correct in suggesting that rainfall and steering effects are important issues in hurricane seeding. Another important factor is storm tide, which can be affected significantly by coastal geography. These effects might be of critical importance in the tactical decision to seed a particular hurricane. As the full report referenced in our article shows, present knowledge concerning these factors is consistent with our strategic recommendation to permit, as an emergency measure, the seeding of some hurricanes threatening a coastal area.

It is possible to conduct a decision analysis to determine the value of research on hurricane steering. However, our discussions with meteorologists have indicated that while the ability to steer hurricanes would be valuable, this ability is unlikely to result from a research program. Consequently, it is not clear that the decision analysis of steering research would demonstrate that the research has a high value.

On the question of loss of life, we found that, given the effective hurricane warnings provided by the U.S. Weather Service, the expected number of lives lost in a present-day hurricane is relatively small. If these lives are valued for decision-making purposes in a range from $100,000 to $300,000 each, they constitute an expected loss of only about one-tenth the expected property damage for the hurricane. Furthermore, since storms that damage less property also tend to kill fewer people, the case for removing the prohibition against seeding is only strengthened by including human loss.

We direct our commentary on Kates's letter to the three hypotheses he suggests for the nature of decision analysis.

Hypothesis H_1 is that decision analysis systematically excludes significant aspects of the problem because they are uncertain or improbable. Anyone familiar with decision analysis knows that its procedures involve not excluding, but discovering and emphasizing, significant aspects of the problem. In fact, decision analysis is uniquely concerned with assessing probabilities and their implications. Kates presents no evidence that our recommendations would be changed by additional analysis of any of the factors he mentions.

Hypothesis H_2 is that decision analysis might be misused. We agree that anything from hammers to medicine may be misused, but we find no logical argument that they should be unused. Moreover, Kates presents no evidence that our hurricane analysis has been or will be misused.

Hypothesis H_3 is that decision analysis might be used for amoral purposes. Presuming that amoral means immoral, we can only reiterate that the fact that hammers and medicine can be instruments of crime is no argument for

discontinuing their production. Kates presents no evidence that our analysis has been or will be used for immoral purposes.

But Kates's hypotheses do not form a collectively exhaustive set. We would like to include a fourth hypothesis, H_4: Decision analysis is a rational method for displaying and balancing the important uncertain, complex, and dynamic factors that surround a decision. We leave it to others to judge whether this hypothesis is supported by our work.

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Department of Engineering–Economic Systems, Stanford University, Stanford, California 94301
JAMES E. MATHESON
D. WARNER NORTH
Decision Analysis Group, Stanford Research Institute, Menlo Park, California 94025

Thermodynamics and Information

Witold Brostow, in his discussion of information theory and thermodynamics (13 Oct., p. 123), says that "It took some years after Jaynes's paper . . . until books of statistical mechanics based on information theory began to appear." He thus overlooks the pioneering textbook by Myron Tribus entitled *Thermostatics and Thermodynamics* (*1*), which was published in 1961.

ROBERT LEMLICH
Department of Chemical and Nuclear Engineering, University of Cincinnati, Cincinnati, Ohio 45221

References

1. M. Tribus, *Thermostatics and Thermodynamics* (Van Nostrand, New York, 1961).

I gladly accept Robert Lemlich's correction. I have also learned from Rolf A. Haugan of Pergamon Press that *An Introduction to Equilibrium Thermodynamics* by Bernard Morrill has just been published—with a chapter on Jaynes formalism. Apart from this, Joel H. Hildebrand writes me that, after spending the academic year 1906–07 with Nernst in Berlin, he independently derived the Gibbs-Duhem equation (not mentioned in Nernst's book). He concludes now that, "There is great reward from getting answers out of one's head instead of from a book."

WITOLD BROSTOW
Département de Chimie, Université de Montréal, Montréal 101, Québec, Canada

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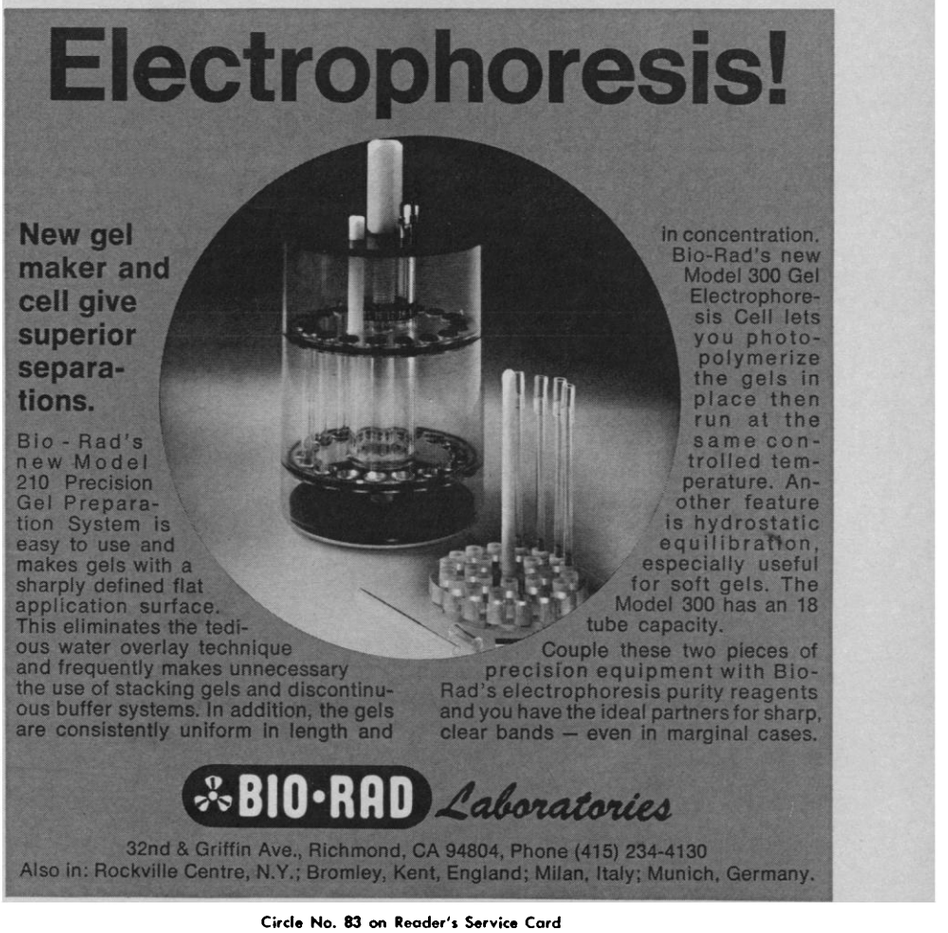

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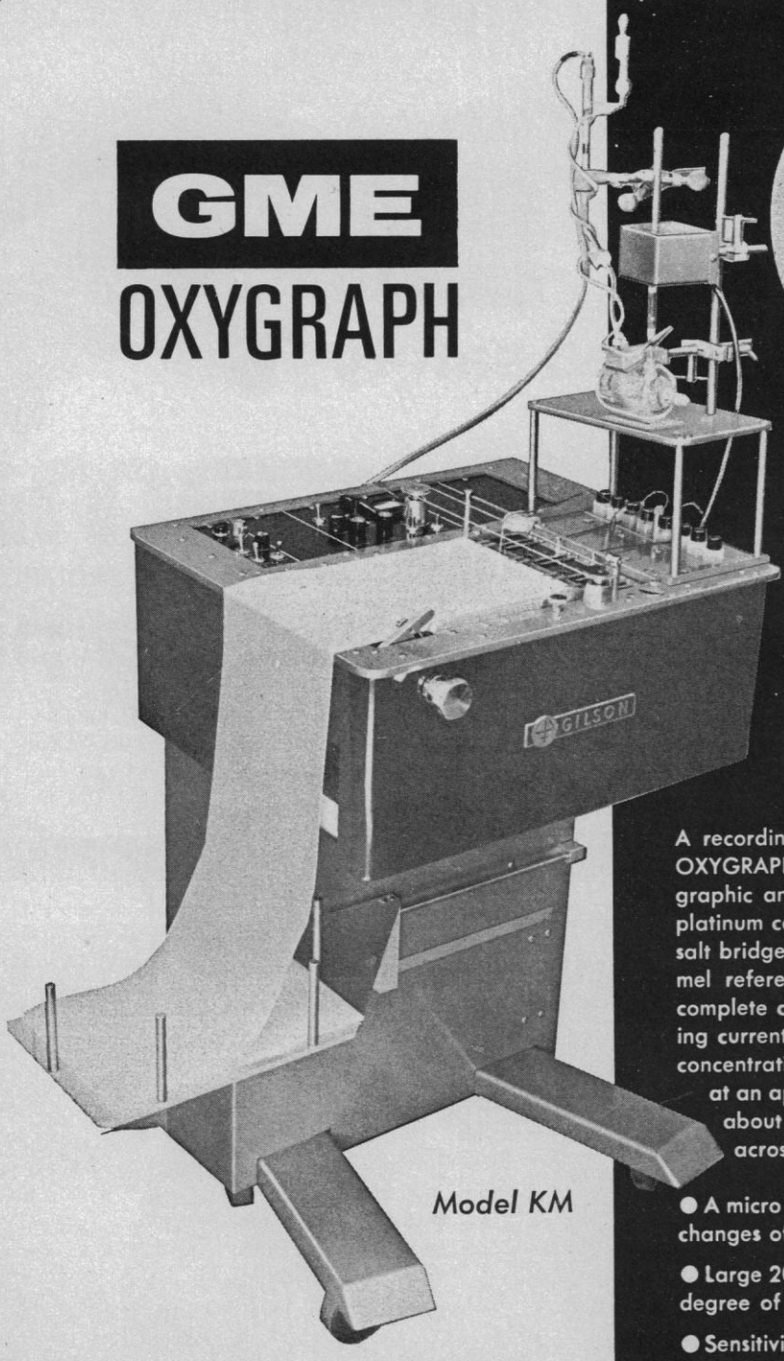
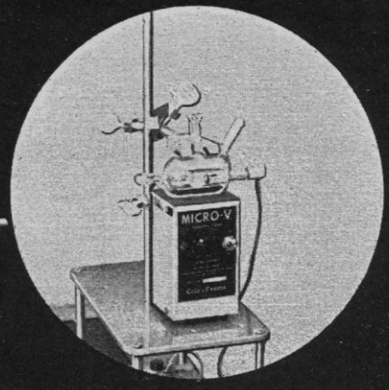


Model KM



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We Are the Government, You and I

This past December, for the first time since 1896, the election of the AAAS's new officers reflected the expressed preference of the Association's members. The election results are given in the report of the 1972 Council meeting contained in this issue of *Science*. That meeting was of historic importance, for the new constitution, approved a year ago and put in force with the adoption of bylaws presented to the 1972 Council, gives rank-and-file members rights they did not even have when the Association was so young and small that its entire membership could meet together in one room and elect officers on the spot.

First, all members are eligible to hold elective positions in the Association.

Second, all members are eligible to participate in the annual election of the President-Elect, members of the Board of Directors, and members of the Committee on Nominations. In addition, they may petition to place names in nomination for any of these positions.

Third, the Council, now to be composed of some 95 members, will be elected by the membership, acting through particular constituencies. Accordingly, the Association will be divided into electorates, each with proportional representation on the Council. The 20 sections of the Association and the new Section X–General, to be established this year, will serve as the electorates.

I have recently written to all members to ask them to designate the section through which they wish to exercise their right of franchise. Let me urge now that each member give this request his prompt and serious attention, for if he is to be eligible for positions to be filled by his electorate and if he is to participate in its election process, his name must appear on its rolls.

Members of each electorate will fill the following positions: Council delegates, members of the electorate's nominating committee, section chairman–elect, and member-at-large of the section committee. As in the case of the general officers, candidates may be nominated by petition.

Fourth, members will have the right—which I hope they shall never have occasion to exercise—of recalling elected members of the Board. A proposal to recall may be initiated by a member of Council during a meeting of the Council. If three-fourths of the members present so vote, the issue will be submitted to the membership by mail ballot.

Finally, to ensure these rights in perpetuity, the new constitution can be amended only by vote of the membership at large. While the bylaws are amendable by the Council, members may also propose amendments by petition.

The new constitution and bylaws were published in the November 1972 *AAAS Bulletin*. A list of changes approved at the 1972 Council meeting is given on pages 823 and 824 of this issue.

The AAAS officers and staff now face the monumental task of developing and instituting the complicated procedures required by the new constitution and bylaws. The election schedule this year will be tight, for we must first convert the present addressing system to computer, as well as ascertain the electorate in which each member wishes to vote. A final reminder: We have mailed each of you who is a member a postcard on which to designate your electorate. By returning it without delay, you can help us keep on schedule and at the same time ensure that you will be able to exercise your full rights as a member.—WILLIAM BEVAN

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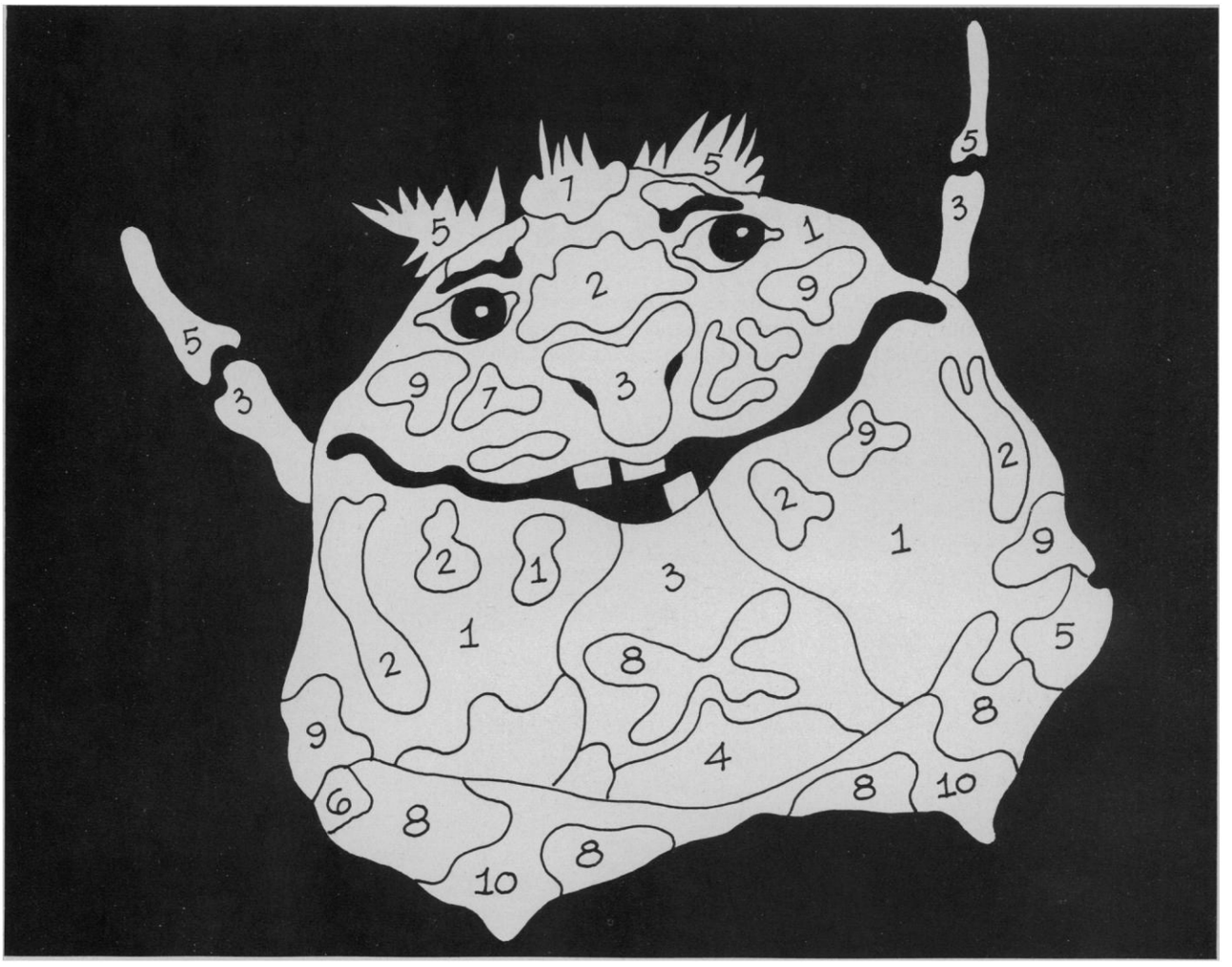

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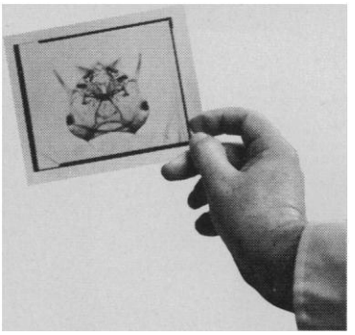

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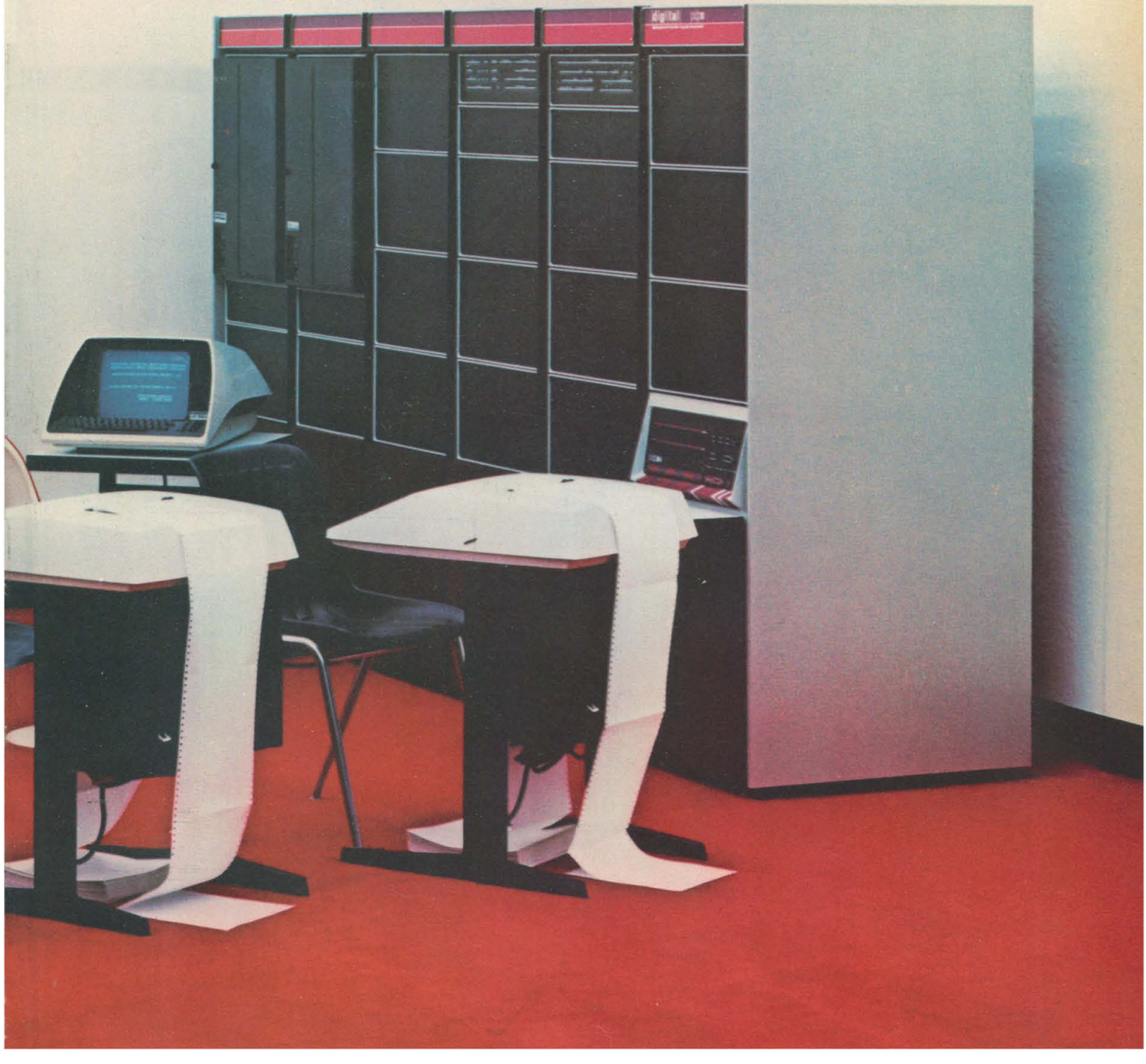

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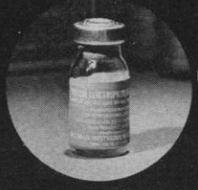

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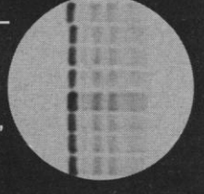

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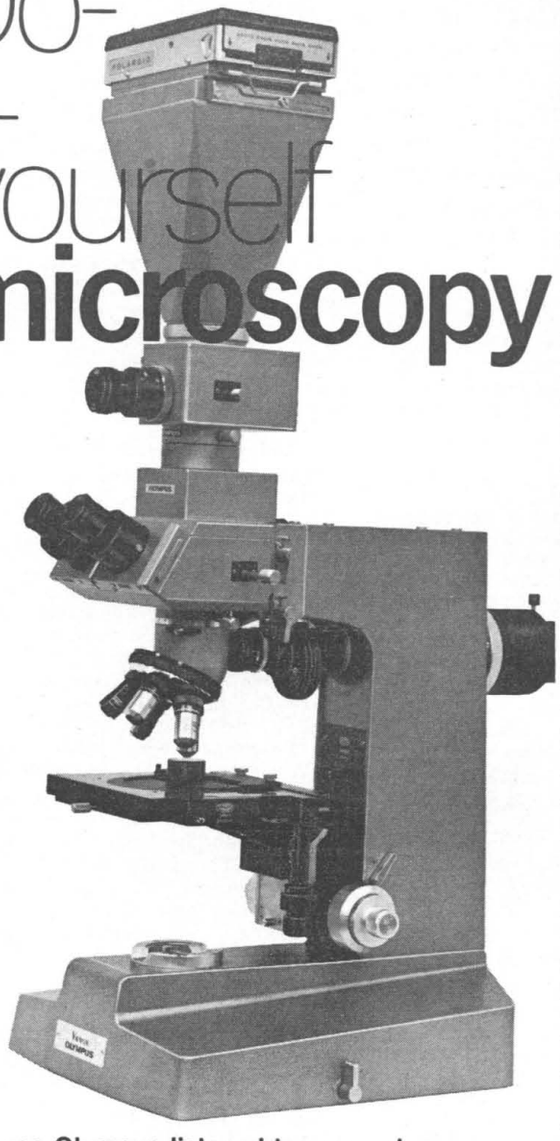

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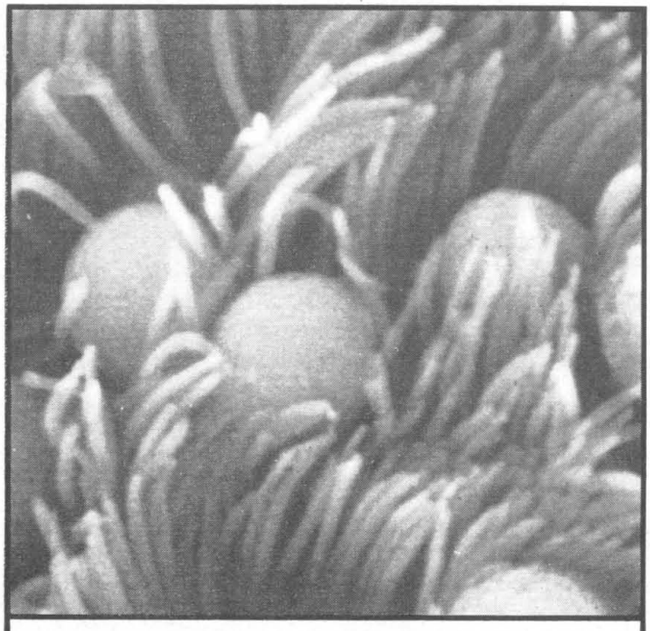

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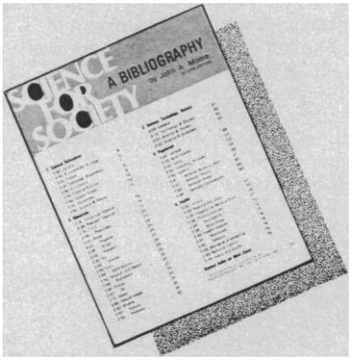

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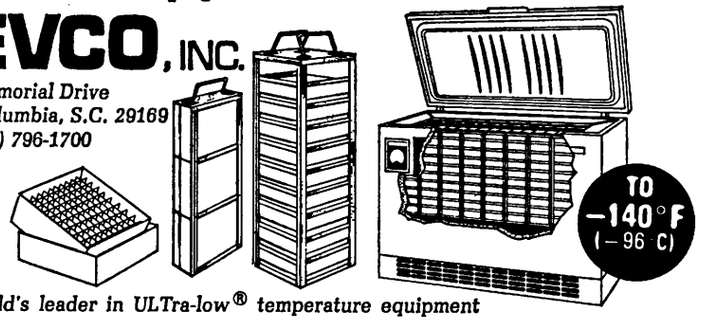

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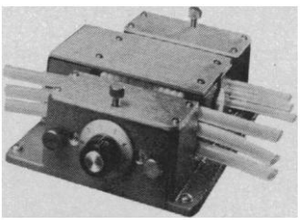

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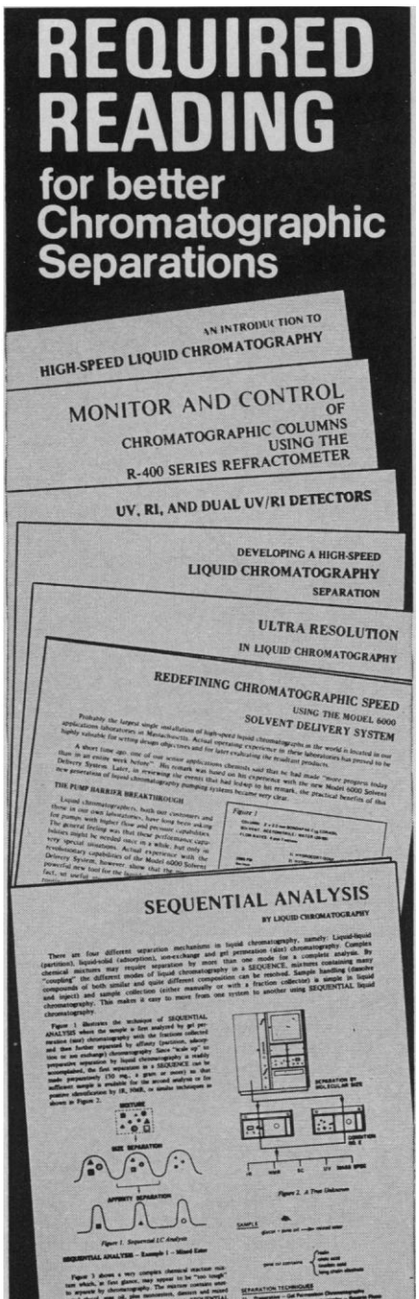

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