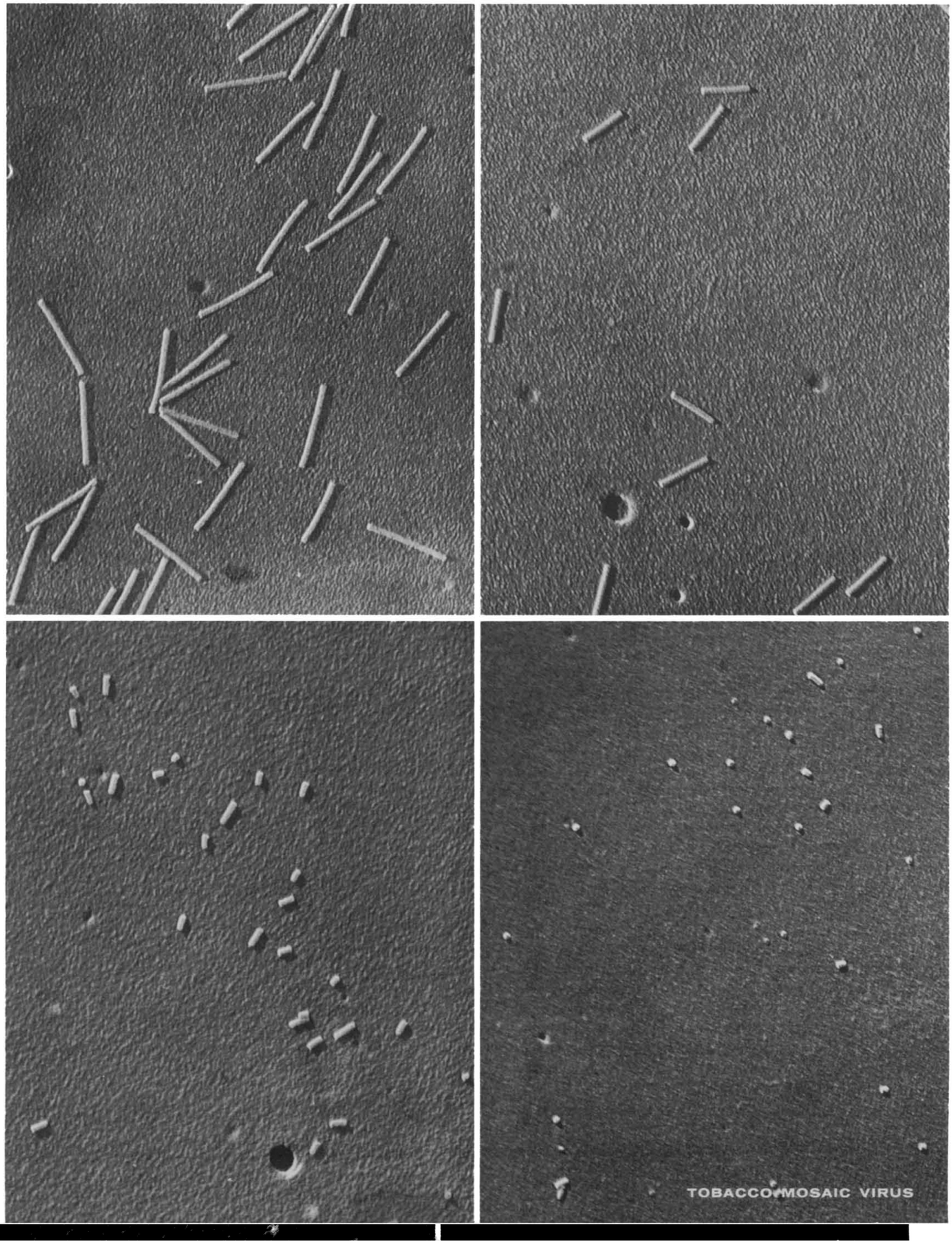
SCIENCE

7 June 1963

Vol. 140, No. 3571

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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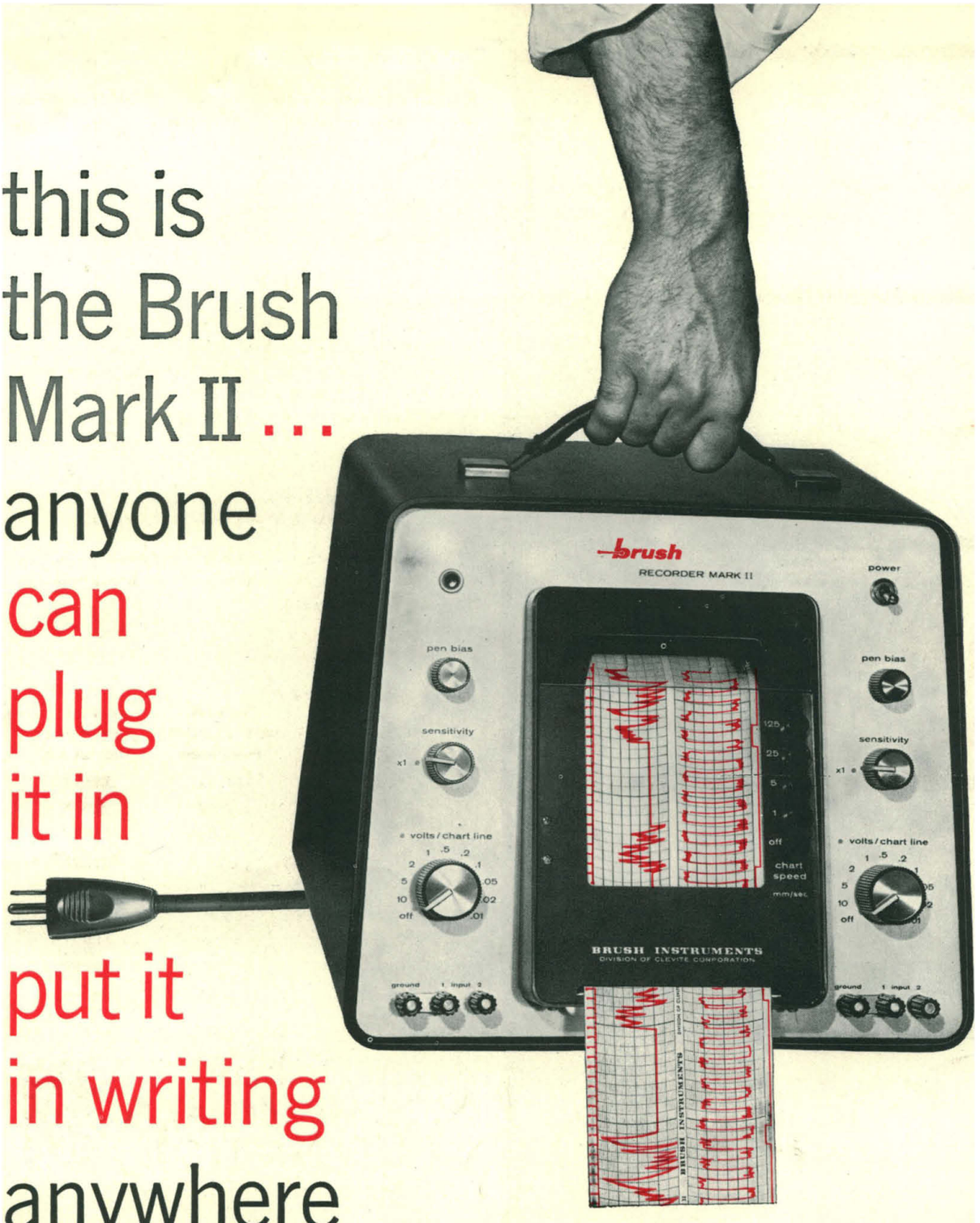

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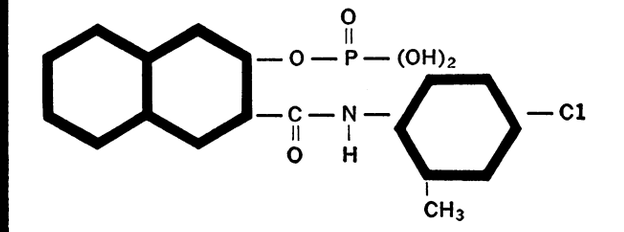
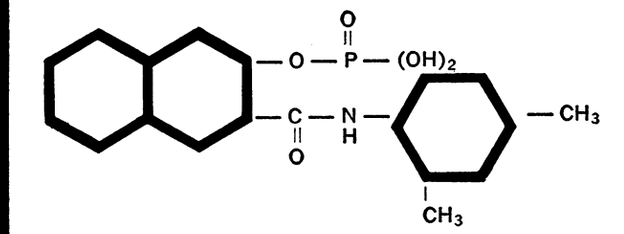
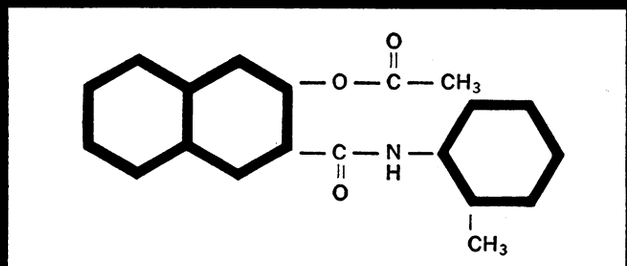
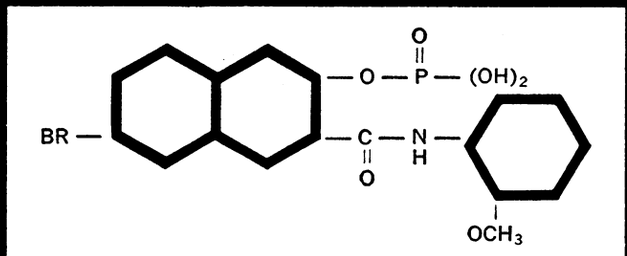
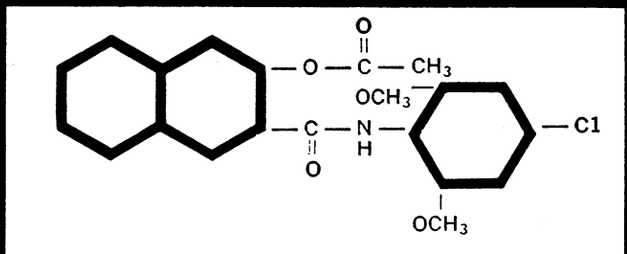




N·B·C® Kit Aids Study of Leukocytes in Blood Film!







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*M. S. Burstone, J. Histochem & Cytochem, 9, 146 (1961)

**M. S. Burstone, J. Nat. Cancer Inst. 21, 523 (1958) and J. Histochem. & Cytochem, 6, 322 (1958)

The literature references should not be interpreted as either an endorsement or disapproval of the biochemical by the cited investigator.

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COVER

Electron micrographs of tobacco mosaic virus and associated particles sorted on the basis of particle length by agar-gel chromatography. Infectious 300 mμ rods (upper left) and noninfectious 200 mμ rods (upper right) separated from each other and from shorter rods by two passages through 1 percent granulated agar-gel. Noninfectious short rods (lower left) and spheres (lower right) incompletely sorted by one passage through a 5 percent granulated agar-gel column (× 47,000). See page 1089.

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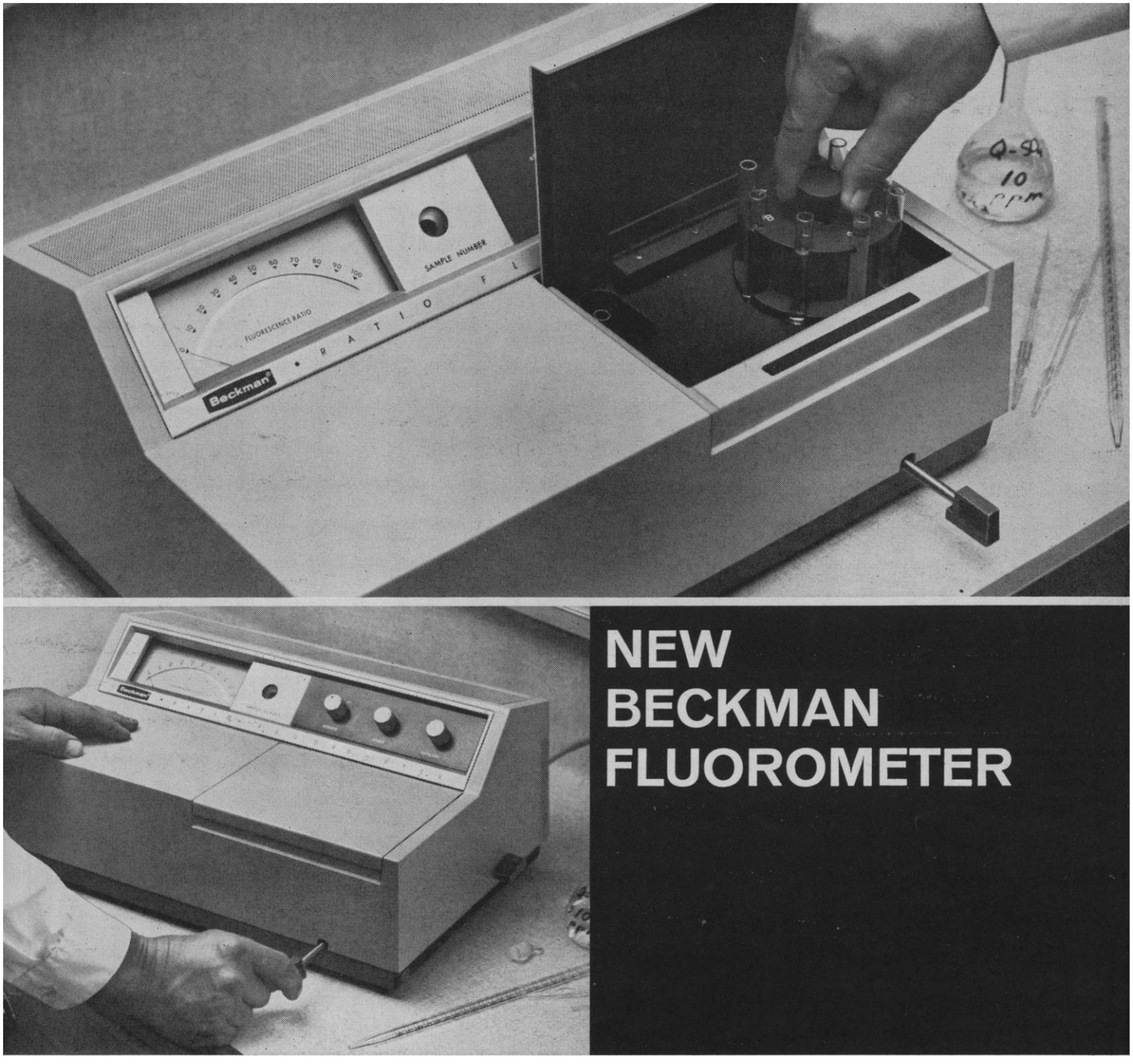

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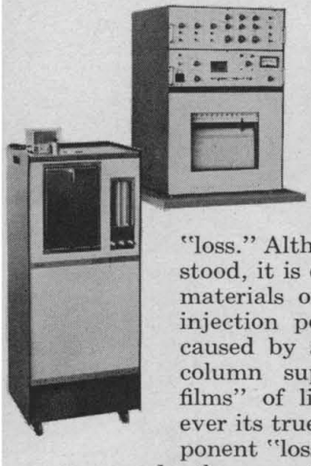
eliminate component "loss" in steroid analysis . . . even at **nanogram** levels



The quantitative analysis by gas chromatography of many biological compounds such as steroids and other substances with polar functional groups has not been entirely satisfactory. Of the several factors which may be involved, one of the most critical is the phenomenon of component "loss." Although this is not completely understood, it is due in part to adsorption of polar materials on metal or glass surfaces in the injection port or detector. It may also be caused by adsorption on active sites of the column support, particularly when "thin films" of liquid phase are employed. Whatever its true cause and its correct name, component "loss" is a very real problem that has made the quantitative analysis of very small amounts of such compounds difficult, thus limiting the usefulness of gas chromatography in certain biochemical and medical investigations . . . until now.

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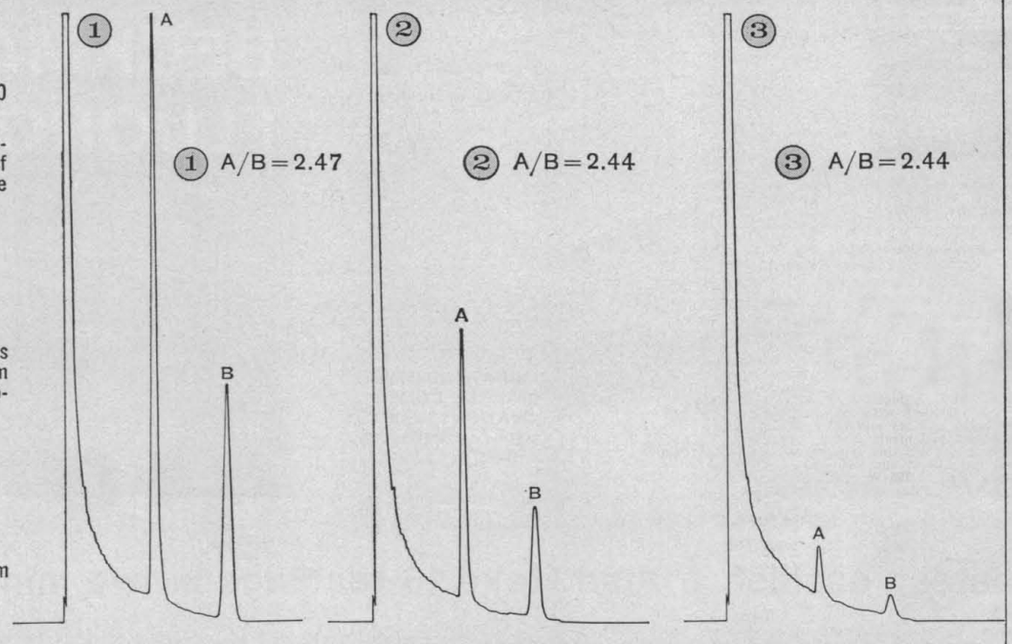
For complete information about the Model 400 Gas Chromatograph or for a demonstration of the separation and quantitative analysis of other types of biological compounds, contact the Applications Laboratory, F & M Scientific Corporation, Route 41 and Starr Road, Avondale, Pennsylvania, 215 COlony 8-2281. *European subsidiary: F & M Scientific Europa N.V., Leidsestraat 67, Amsterdam, The Netherlands.*

INSTRUMENT: F & M Model 400
DETECTOR: Flame Ionization
SAMPLE: 1.0 microliter of successive dilutions of a mixture of testosterone (A) and cholestane (B) in chloroform:
#1: A=0.1 microgram/ul
B=0.05 microgram/ul
#2: A=0.05 microgram/ul
B=0.025 microgram/ul
#3: A=0.01 microgram/ul
B=0.005 microgram/ul
COLUMN: 4′ x ¼″ OD, glass U-tube, 2% SE-30 silicone gum rubber on 80-100 mesh Diatoport S
TEMPERATURES:
Column—230°C
Injection port—300°C
Detector—250°C
CARRIER GAS:
Helium at 60 ml/min
SENSITIVITY: 1/32 of maximum



In this series of chromatograms, successive dilutions of a mixture of testosterone (a highly polar, easily "lost" steroid) and cholestane (a saturated, non-polar hydrocarbon that is readily chromatographed without "loss") were injected into the Model 400. If testosterone "loss" were occurring, the peak height ratio of testosterone to cholestane would decrease as the amount of sample injected decreased (because the amount "lost" would be a larger percentage of the smaller sample.) But this ratio (A/B) remains constant through all three injections, even the most dilute run #3 where only 0.01 microgram of testosterone was injected. Note also the almost perfect symmetry of all the peaks, including the cholestane peak in run #3, which represents only 5 nanograms of sample. In all cases, the detector was operated at 1/32 of full sensitivity.

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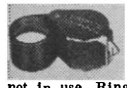

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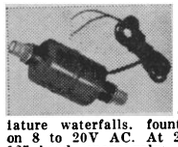

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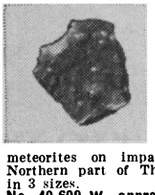

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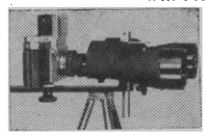

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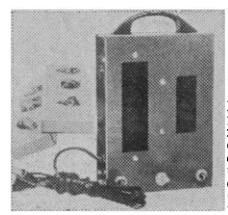

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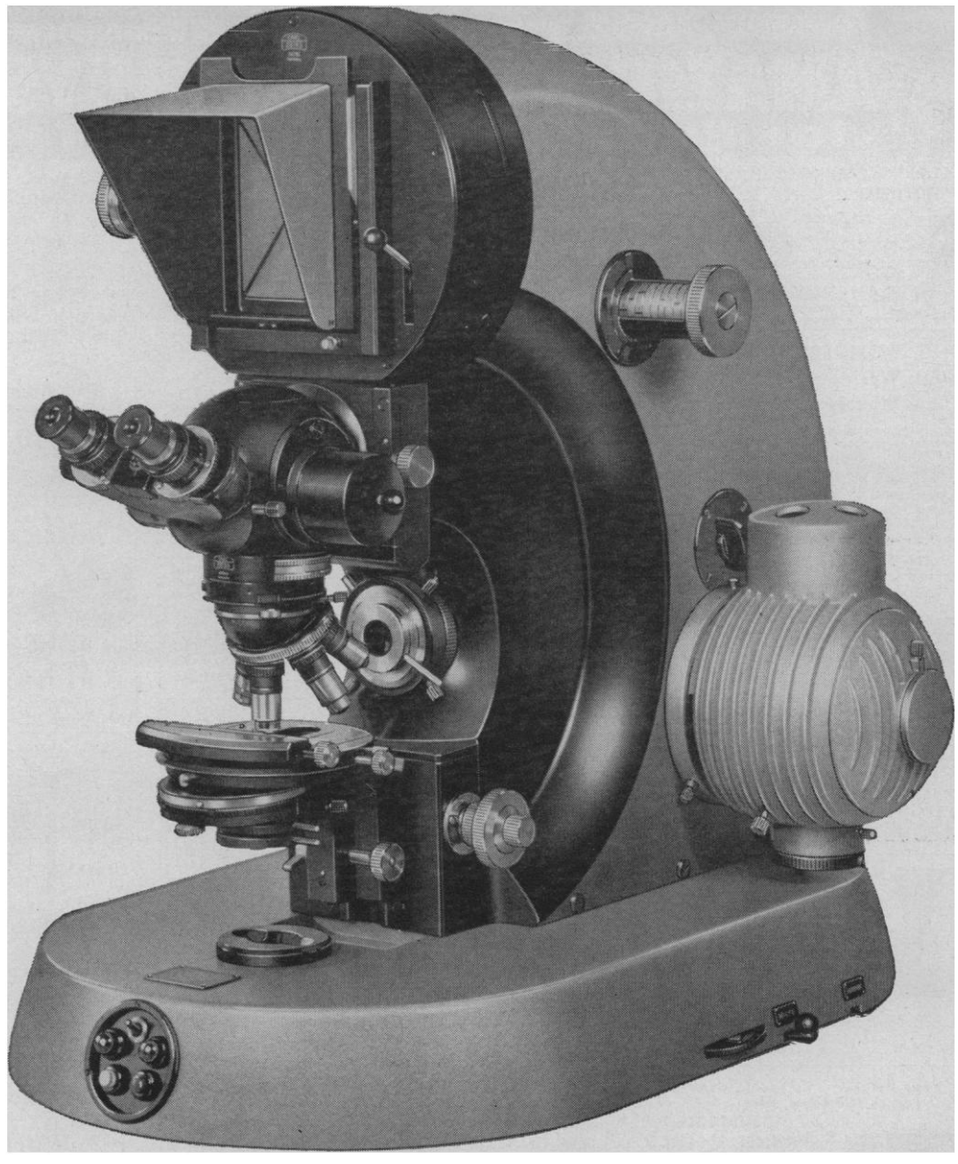

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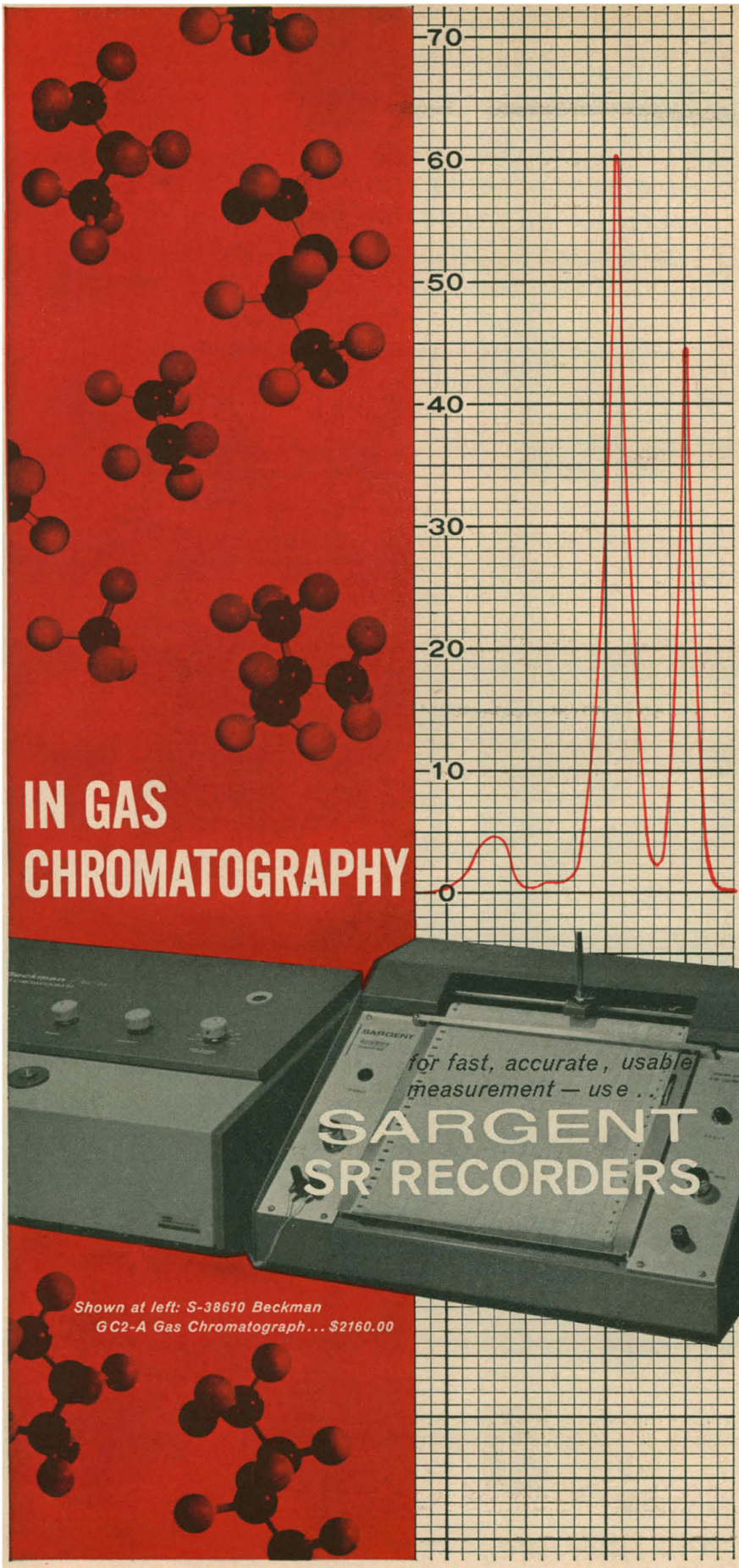

IN GAS CHROMATOGRAPHY

for fast, accurate, usable measurement — use . . .

SARGENT SR RECORDERS

Shown at left: S-38610 Beckman GC2-A Gas Chromatograph . . . $2160.00

Sargent SR Recorders have input circuits, ranges, charts, and other characteristics specifically engineered for application with Beckman GC Gas Chromatographs, Precision Chronofrac, and custom-made experimental chromatographs. They offer you these important advantages:

FAST PEN RESPONSE. Less than one second is required for full scale travel, ensuring faithful reproduction of the sharp slopes and peaks of the chromatogram.

SENSITIVITY. Four microvolts per millimeter (1 millivolt per full 240 mm scale) permits full realization of the potential of the gas chromatograph and chromatographic method.

REPRODUCIBILITY— to a fraction of a millimeter—ensures that the accuracy of analytical measurement is not limited by the measuring instrument, which is accurate to within 20 microvolts.

SPECIAL CHART. Wide 240 mm scale is graduated from 0 to 100 to simplify calculations. Zero point is offset from mechanical zero to show negative signals and simplify adjustment—and is at the right for a logical, conventional presentation of the chromatogram.

VERSATILITY. A variety of accessories permit selection of chart speeds, charts, voltage ranges, pens, etc. for other applications—with true potentiometric measuring (no input dividers to distort the measured circuit).

INTEGRATING UNIT is available, as a component part of the recorder or as an accessory unit, to provide continuous integration of chromatogram record for quantitative analysis.

Besides their use in gas chromatography, Sargent SR Recorders have vital applications in spectrophotometry . . . in pH titration—in recording measurements by any analytical device, from simple cells to the more complex instrument, that provides a D.C. voltage output.

PRICES

S-72180-20 RECORDER—Potentiometric, 1 mv, Gas Chromatograph, Sargent Model SR (Pat. No. 2,931,964). With input circuit adapted for optimum performance with gas chromatographs..... **$720.00**

S-72180-30 RECORDER—Potentiometric, 1 mv, Gas Chromatograph, Integrating, Sargent Model SR (Pat. No. 2,931,964). Identical with S-72180-20 but with S-72170 Disc integrator installed for continuous integration of chromatogram. **$1305.00**

For complete information on SR Recorders, write for Bulletin SR-GC.

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nomy in original equipment cost plus rapid drying rates are inher- in the Sublimator design. Condensing coils are built into the mber containing the materials to be freeze-dried, Result—water or traverses an extremely short path before being condensed. l the space conserved by eliminating a remotely located condenser ffectively utilized to house the complete equipment in a remarkably npact, mobile cabinet.

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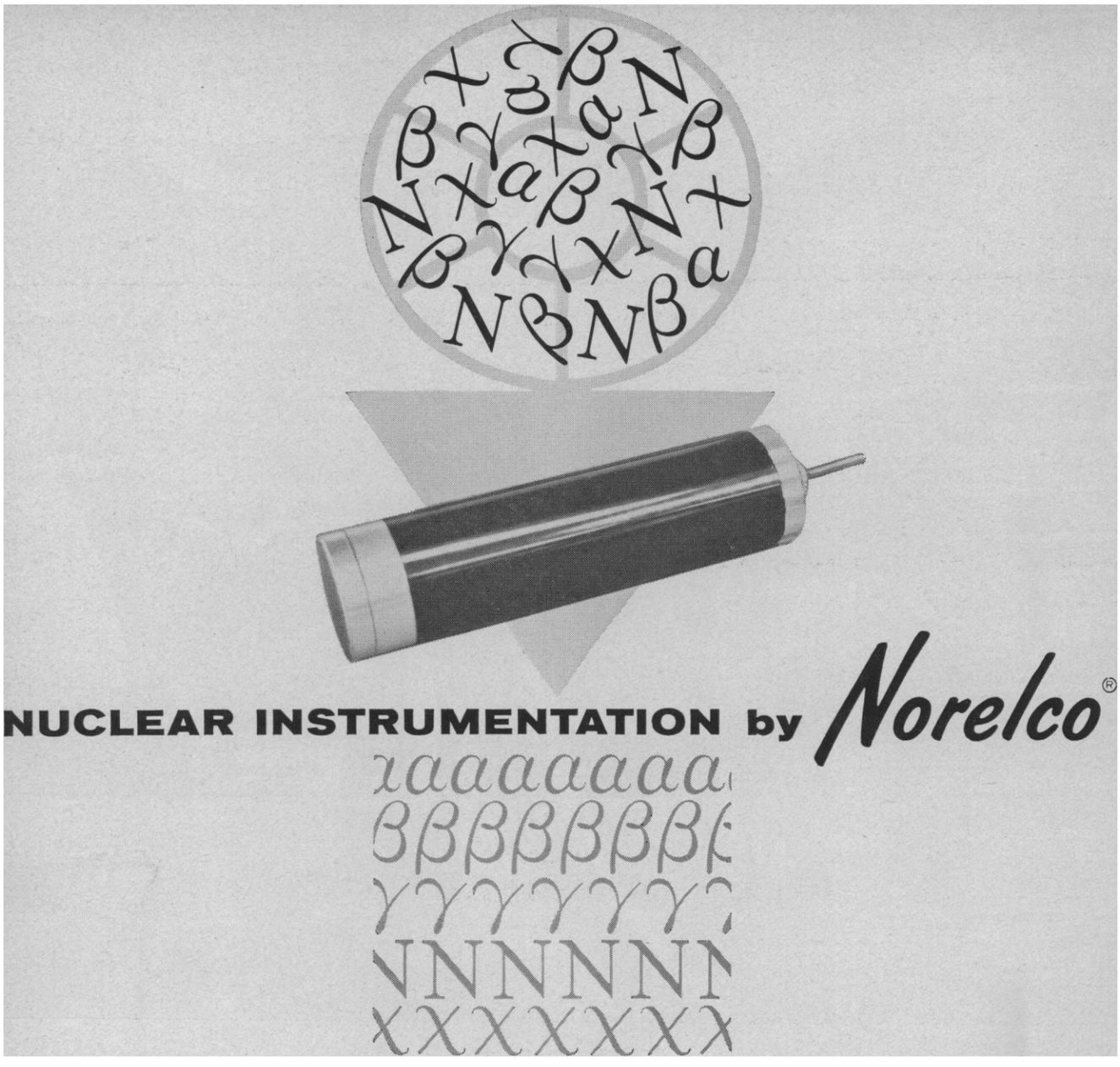

For Quantitative Spectrum Analysis of Radioactive Samples

Conceived, developed and introduced almost ten years ago — the flexibility and versatility of our instrumentation reflects the leadership, the technical ability and the experience that lies behind the production of all Norelco equipment.

The Automatic Counting Asembly, whose function is pictorially represented above, guarantees the user: *analysis of radioactive samples • unexcelled reproducibility • optimized counting geometry • proper sample distribution, which results in minimum background variation • and fully unattended operation with Digital Printout of sample number, count and time.*

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For detailed information in full line catalog write:

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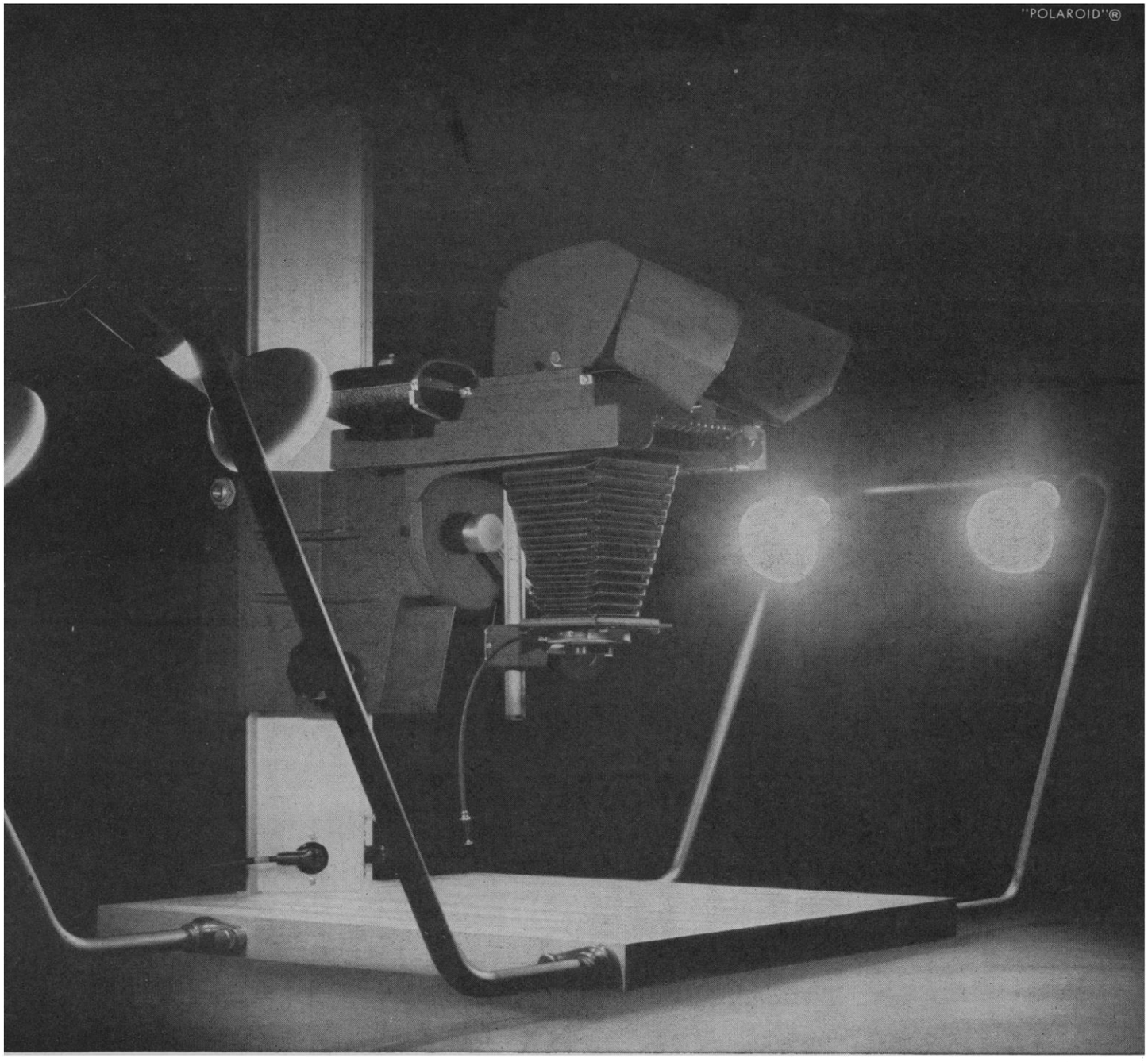

The MP-3 is virtually an industrial studio in itself.

If you need a picture of an assembly, for instance, you can put it on the lighted base, click the shutter and peel out a finished picture 10 seconds later. If you need a macrophotograph of a small part you can make a 4 x 5 print in 10 seconds. If you need a photomicrograph put a microscope under the camera. If you need any of these in *color*, you can get them in 50 seconds. If you want to make a black and white slide of a wall chart, you can swing the camera head 90°, and with transparency film, get one in 90 seconds. If you want a negative you can make one in 20 seconds. If you need multiple records, make multiple originals. And finally, if you aren't in a hurry, use any conventional roll or sheet film.

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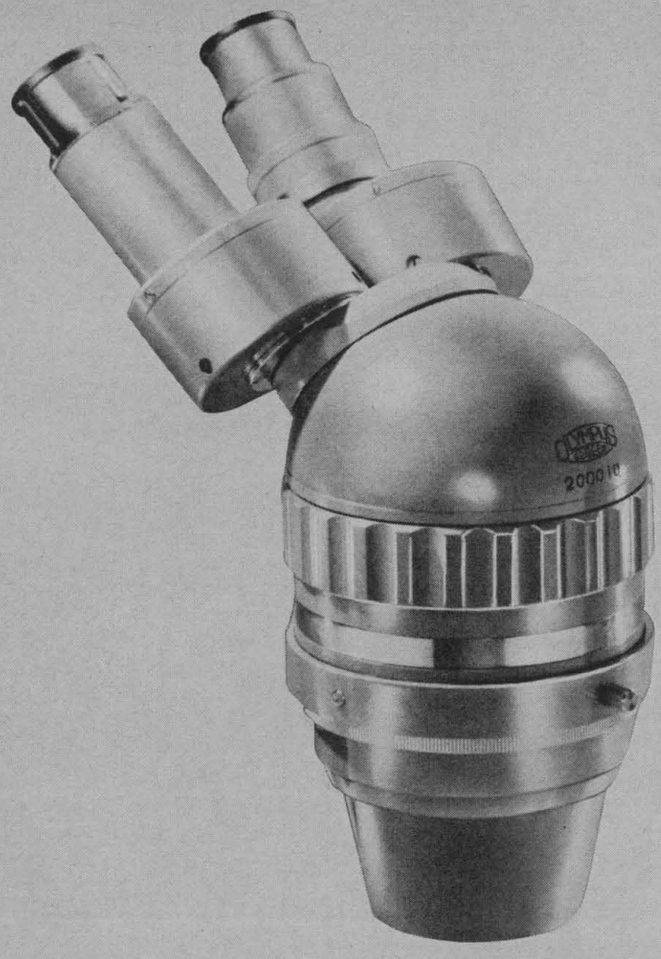

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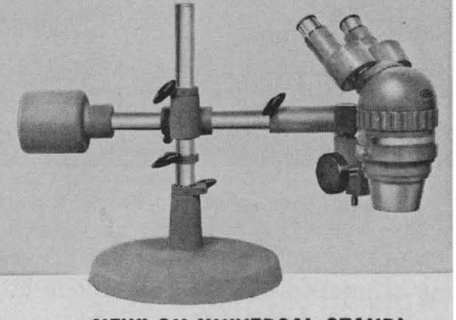
Ideal laboratory or education model provides for inspection of pathology specimens, materials for fixation and sectioning, cultured organisms, or botany, biology or zoology specimens. With mirror beneath the glass stage and a versatile light source above, the full potential of this zoom stereo instrument is readily achieved. Bases may be purchased individually. On base with mirror, $418.00.



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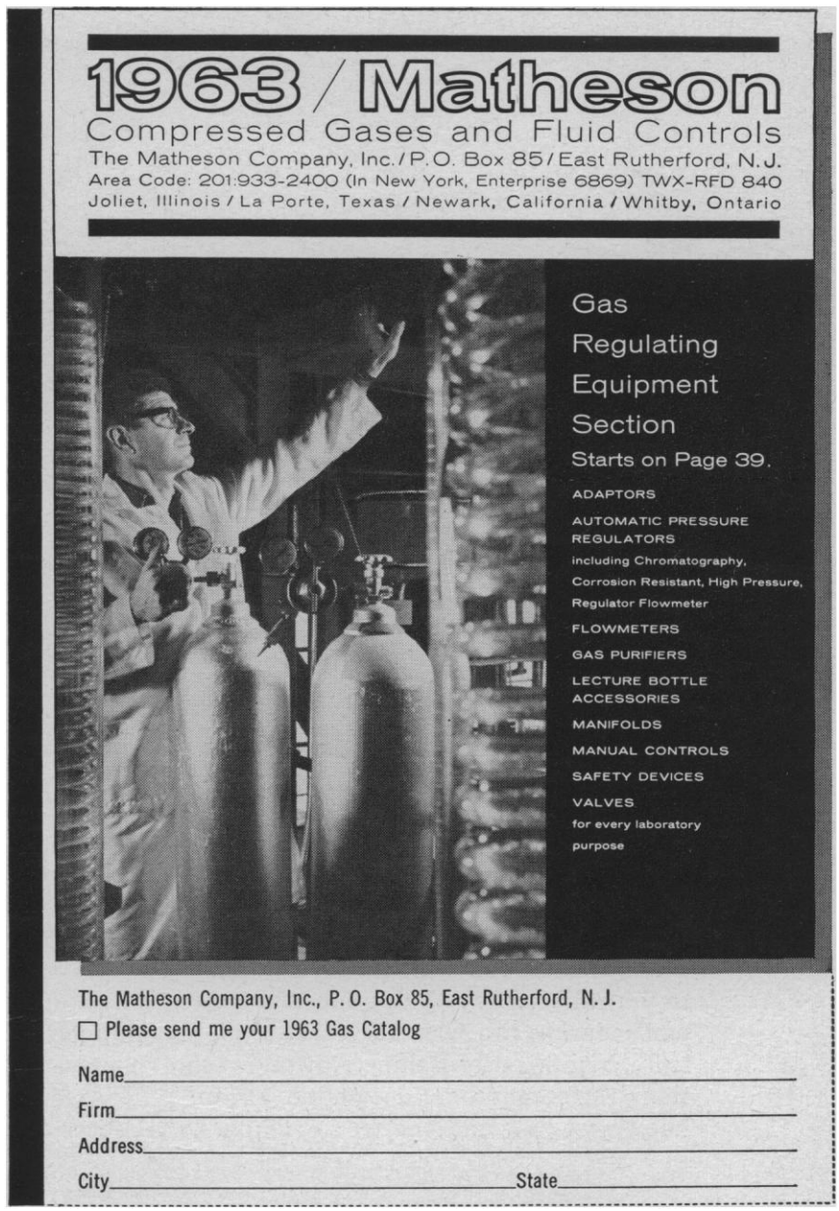

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Incomparable

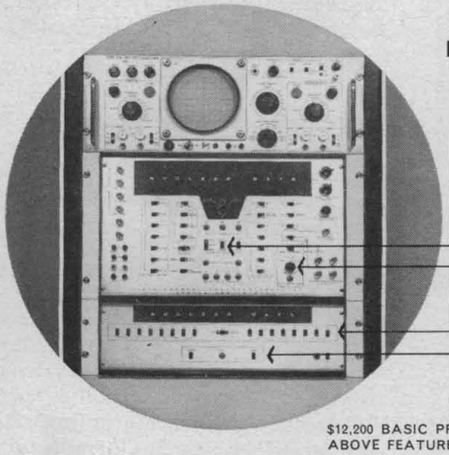
...in reliability, precision, price and capabilities

In the Nuclear Data ND-130AT 512 channel pulse-height analyzers, these important features are ***built-in:*** Spectrum Resolver, Area Integration, Punch & Reader Control and Typewriter Control. *In most analyzers these are added as design afterthoughts, at extra cost.*

And there's more to the story. The last two years have shown this to be by far the most dependable analyzer of its kind ever produced.

It has the highest overall analysis precision of any similar analyzer. It and its companion, the ND-120, are the only analyzers which provide logarithmic spectrum display with internally generated, drift free, plotted decade lines. It has 28% more channels than its most respectable competitor. And a million count capacity per channel.

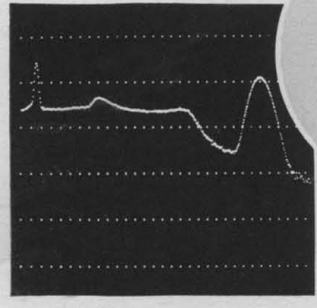
There simply is no better pulse height analyzer available today. Delivery? Two to three weeks.



ND-130AT
BUILT-IN FEATURES

- TYPEWRITER CONTROL
- SPECTRUM RESOLVER
- AREA INTEGRATION
- PUNCH & READER CONTROL

$12,200 BASIC PRICE, INCLUDING ALL OF THE ABOVE FEATURES.



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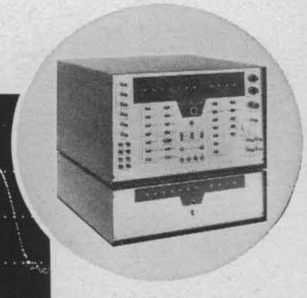

THE ND-120 512 CHANNEL ANALYZER, LIKE THE ND-130AT, MAY BE RACK-MOUNTED. BASIC PRICE, $8,400.

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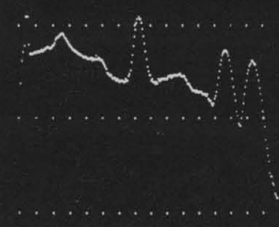
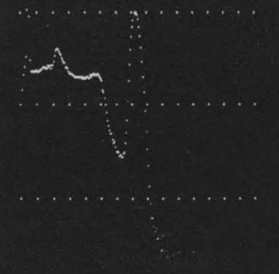
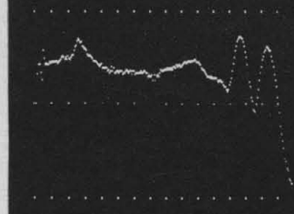
DATA REDUCTION



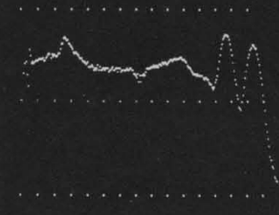
Step 1. Measurement of mixture. Data in first memory half.



Step 2. Read-in of standard cesium 137 spectrum into second memory half.



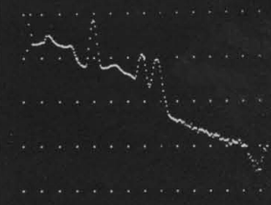
Step 3. Result after subtraction of 1.00 units of standard.



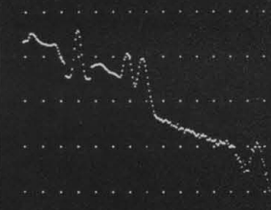
Step 4. Result after subtraction of 1.02 units, showing sensitivity of method.

NOTE: These are unretouched oscilloscope photographs.

INTEGRATION

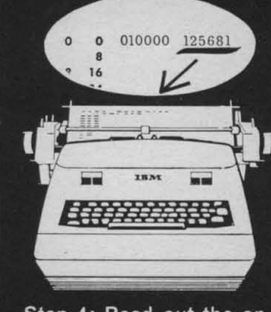


Step 1: Analyze the unknown radiation source. Correct for background counts, if desired, by utilizing the data reduction controls.



Step 2: Select any region of the spectrum by simple switch operations. The selected regions are displayed for instant visual examination. The channel numbers involved are indicated exactly by the switch settings.

Step 3: Depress the "initiate computer cycle" button. The sum of all data points in the selected region, only, is accumulated in a second or two. The sum, divided by ten if desired in order to avoid count overflow, is recorded into analyzer channel number one.



Step 4: Read out the answer in channel one by means of the IBM computer readout typewriter. That's all. No more tedious adding machine opertions. No more adding errors.

NOT JUST BLOOD GAS TENSIONS...

a complete system for blood acid-base measurements

- **FAST**
- **RELIABLE**
- **FIELD PROVEN**
- **ULTRA-MICRO**

In the increasingly important field of acid-base balance in the blood system, *no reliable diagnosis can be made from pH alone, — or from pCO_2 alone.*

Respiratory and Metabolic disturbances are difficult to identify and segregate for therapy, unless *all* the parameters of the acid-base status are known.

The Astrup Technique includes not only an Ultra-Micro arterial blood sampling method, but — with the Radiometer AME1 — a complete system for exposing and evaluating all the separate factors related to both the volatile and fixed acids in the system.

Quick, reliable, and *field proven,* the AME1 requires only a few moments, and a few drops of blood, to accurately define all the values of: pH, CO_2 tension, Bicarbonates (both Actual and Standard), Buffer Base, total CO_2, and a figure of excess acid or base in the system for chemical therapy.

The unit is completely self-contained for both sampling and measurement, and is mounted in a wheeled cabinet for rapid movement from clinical to research laboratory, to surgery, or to intensive care wards.

Write for complete literature and reprints of pertinent scientific papers — and should you wish it, a list of the many distinguished and satisfied users in your area.

(Radiometer also supplies a Modular system of similar instrumentation for fixed installation on a bench top.)

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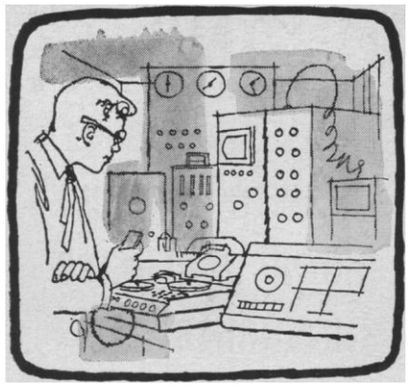
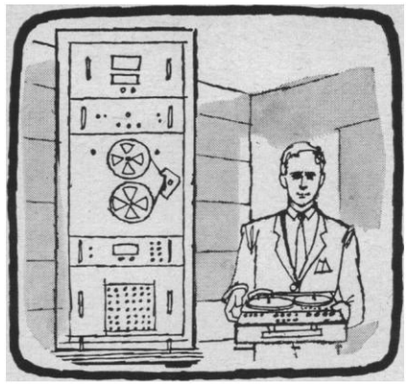


IF YOU ARE RECORDING IN THE LAB...

OR IN THE FIELD, YOU CAN NOW...



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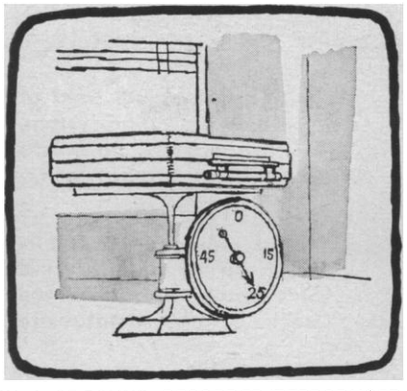
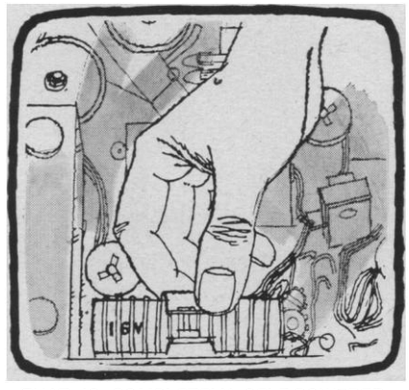


IN A 25-POUND RECORDER/REPRODUCER



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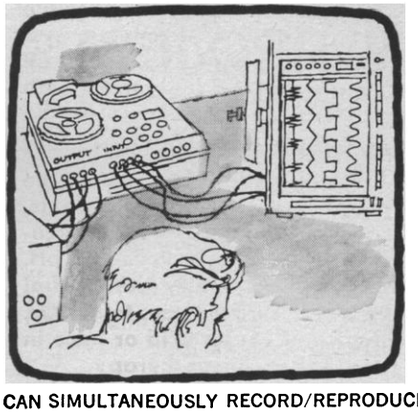
CAN BE HAND-CARRIED ANYWHERE.



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*Tape Speed	Frequency Response ± 3db
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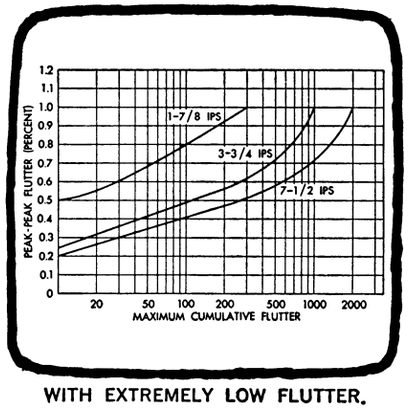
3¾	50—10,000
7½	50—20,000

FM SYSTEM

Tape Speed	Frequency Response ± ½ db
3¾	0—1,000
7½	0—2,000

*optional speeds available

FM OR DIRECT.



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THE NEW LOCKHEED 411 INSTRUMENTATION RECORDER

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Mr. Bernard Mayer: Send me free product specification folders on the Lockheed 411 instrumentation recorder/reproducer.

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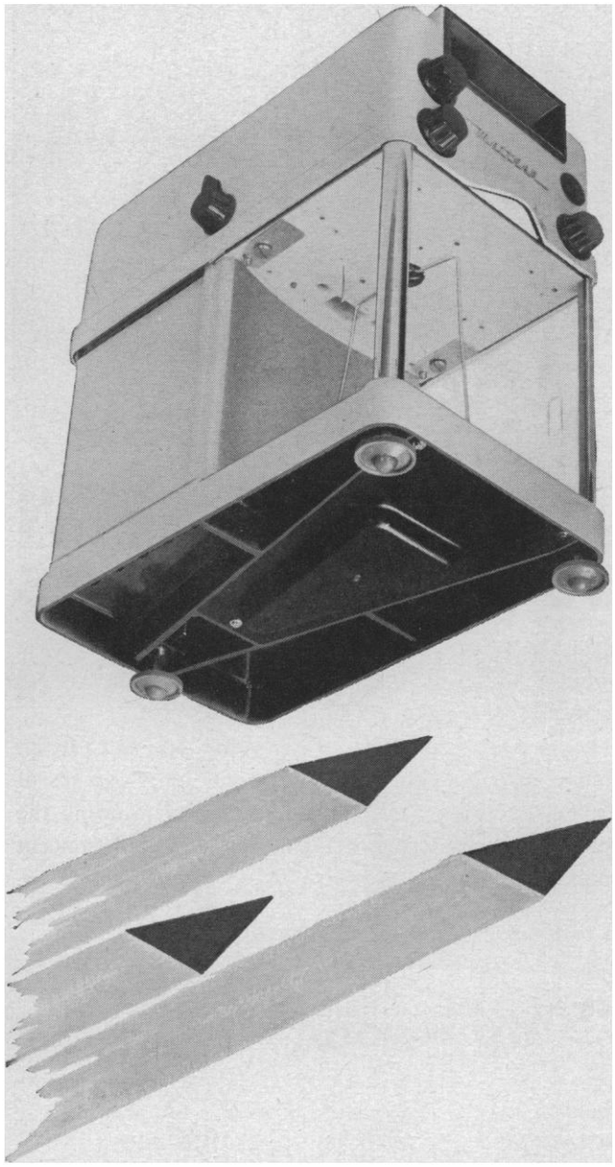
S-6

THE FASTEST THING ON 3 LEGS

A METTLER BALANCE



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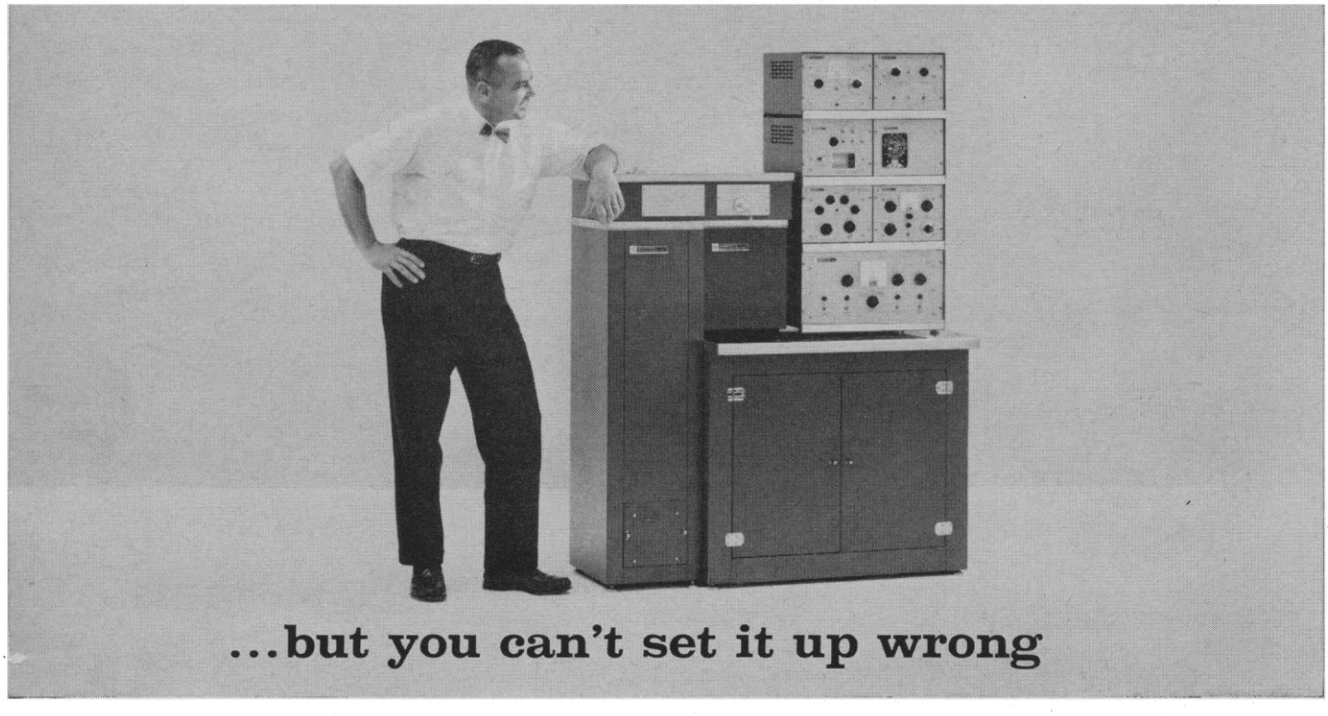

...but you can't set it up wrong

Does your lab have funds for one high quality gas chromatograph, yet need the versatility of many?

Then our RSCo 600 series modular gas chromatography system was designed for you.

Simple interconnections of modules let you set it up for virtually any applications requirement, yet you can't set it up wrong. You can buy the basic unit you need now, assembled and pre-tested, and add to it whenever you wish. It's that easy.

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For a small cost, you can convert your Desiccator into a vacuum drying oven

. . . it assures even heating which minimizes chance of thermal strain to glass vessels.

. . . it provides an effective shield for personnel in the rare instances when glass vessels do collapse.

This new, aluminum-housed electric heating mantle is specifically designed for heating heavy-walled vessels in which vacuums must be created to permit the drying of various samples.

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Glas-Col mantles have been used to heat desiccators for several years . . . with *complete* success.

Glas-Col Desiccator mantles are priced from $45.00 to $57.00

Catalog No.	Desiccator Flange Diameter	Watts (115 Volts)	Price
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. . . the world's largest manufacturer of heating mantles

U.S. Patents
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A complete line for laboratory, pilot plant, and chemical process heating applications.

FOR COLUMN CHROMATOGRAPHY AND OTHER FLOW SYSTEMS

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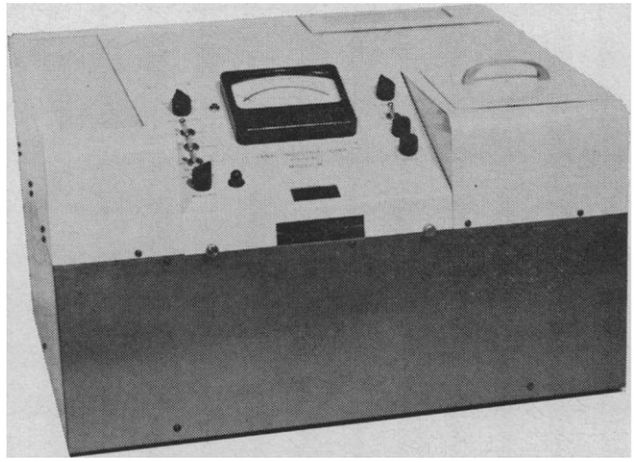

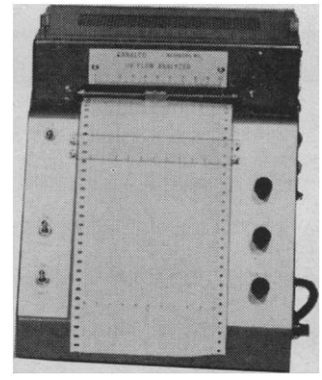

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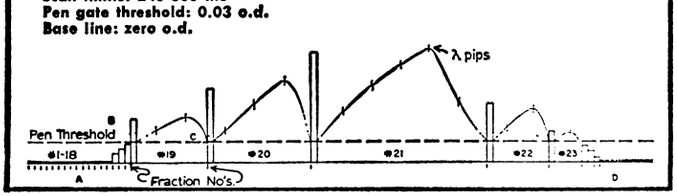
SPECTRAL CURVE ANALYSIS

The new "MODEL M" FLOW ANALYZER by Canalco offers these exclusive benefits:

- UV and visible wavelength range
- 1 mu resolution
- two-wavelength ratios
- spectral curve scans
- manual or automatic control
- timer-controlled repetitive spectra of kinetic reactions
- automatic chart marking for both fraction change and wavelength
- full accuracy and sensitivity in gradient elutions using absorbing solvents
- %T or o.d. readout
- recorded spectra of each fraction over wavelength span of your choice from 200-800 mu

A TYPICAL CHART PRESENTATION

Monitor wavelength: 280 mu
Scan limits: 240-300 mu
Pen gate threshold: 0.03 o.d.
Base line: zero o.d.



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Laboratory Freeze Dryer

Model L-3

Every design element of this all-new Laboratory Freeze Dryer contributes to its unexcelled efficiency as an experimental freeze dryer for university research and food processing laboratories. Never has a freeze dryer offered such versatility . . . precise control over the freeze drying cycle . . . and such superb quality of construction.

This significant advance in laboratory freeze drying equipment is also ideally suited to serving the diverse requirements involved in preserving labile chemical and biological materials. The L-3 permits the accumulation of process data applicable to large scale production models.

Amsco's new L-3 Laboratory Freeze Dryer provides refrigeration and controlled heating of the process shelf. Accessory items permit adjustable radiant heating and manifold drying if desired.

Amsco also offers an extensive line of freeze dry equipment for Pilot Plant operation as well as for Mass Production. If standard equipment does not suit your needs . . . Amsco will construct a freeze dryer to your specifications.

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NEW

Sephadex® G-100

a new "high" for macromolecule separation

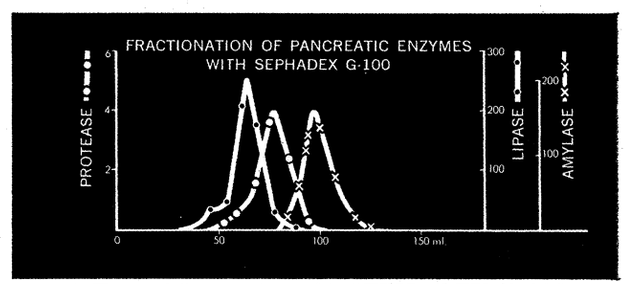
What G-100 Is

SEPHADEX G-100, like its well-known predecessors in the SEPHADEX series of dextran gels,* is produced by cross-linking dextran chains with random ether bonds between glucose residues in the polysaccharide chains. Highly stable mechanically and chemically, G-100 upon swelling produces three-dimensional networks devoid of ionic groups. Prepared in bead form, G-100 offers very low flow resistance, thus permitting the use of fine particles for good resolution of separation.

What G-100 Does

This new SEPHADEX type is an important extension of the gel filtration method into the field of macromolecular fractionation, making possible the separation of substances with molecular weights smaller than about 100,000. Like the other SEPHADEX types,* G-100 acts as a molecular sieve, and molecules of larger dimension do not penetrate the matrices of the swollen gel.

The accompanying chart shows a separation of pancreatic enzymes. Powdered swine pancreas was extracted with a 0.05 M acetate buffer pH 5.3 containing 0.005 M calcium acetate. A 3 ml. sample was introduced in a 2 x 37 cm. (117 ml.) column packed with SEPHADEX G-100.



A Typical Separation with SEPHADEX G-100

Sample: 3 ml. of an extract of powdered swine pancreas in 0.05 M acetate buffer pH 5.3 containing 0.005 M calcium acetate.
Column size: 117 ml. (2 x 37 cm.).
Elution: 0.05 M acetate buffer pH 5.3 containing 0.005 M calcium acetate.

What G-100 Promises

Clearly, the SEPHADEX G-100 field is one of enormous interest, especially for biochemical and medical research. G-100 now makes possible the fractionation and purification of enzymes, polysaccharides, nucleic acids, peptide hormones, and proteins on preparative scale. And it supersedes the earlier, more complicated, and time-consuming methods that were previously required.

*Also available: SEPHADEX G-25, G-50, and G-75.

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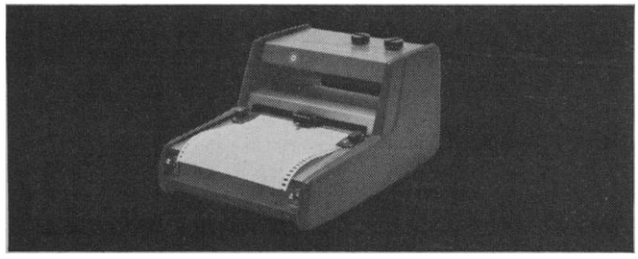
VARIAN MAKES A GOOD RECORDER
(the G-14) EVEN BETTER (by adding an integrator)

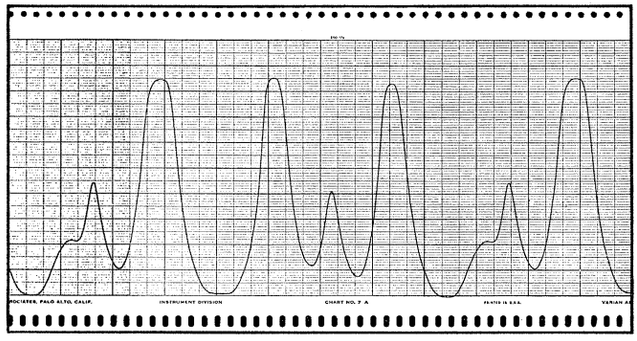


THIS IS THE GOOD RECORDER

Varian's newest graphic recorder, the G-14. It's a versatile, solid-state laboratory unit. It has some significant advancements covering a broad spectrum of recording applications: one-millivolt span, continuous electronic reference voltage, fully transistorized circuitry, excellent accuracy, fast pen speed, and freedom from effects of external transients.

Turn the G-14 on—it's ready to record. The chart may be manually advanced, instantly inspected, and easily marked and torn off. New chart rolls can be installed in 15 seconds. Unique pen design insures smooth performance at all writing speeds.

Dual chart speeds and four input ranges are standard. One full-scale width of true zero suppression is available in addition to the full-scale adjustment of the zero point. Optional equipment includes event markers and spare chart motor assemblies.



This is a sample of a standard five-inch chart from the G-14. Neat, clean, easy to read . . . tells the whole story. Accurately. Graphically. Varian's unique design and standard of excellence make the G-14 the most versatile solid-state recorder in the business. And that's very good.

G-14 SPECIFICATIONS	
Spans:	1, 10, 100 mv and 1v, instantly selectable
Accuracy:	1% on 1 mv span; ½% on other spans
Pen Speed:	0.6 seconds full scale
Chart Drive:	Dual speeds; 15 choices from 1″/hr to 16″/minute
Weight:	13 pounds; 15 pounds with integrator
Bench Space Required:	9⅜″ x 13½″; 13⅜″ x 13½″ with the integrator
INTEGRATOR SPECIFICATIONS	
Accuracy:	± 0.1% of full scale
Count Rate:	1 to 30,000 counts per minute

G-14 Recorder with Disc Model 214 Integrator . . . Base Price.....$1295.00
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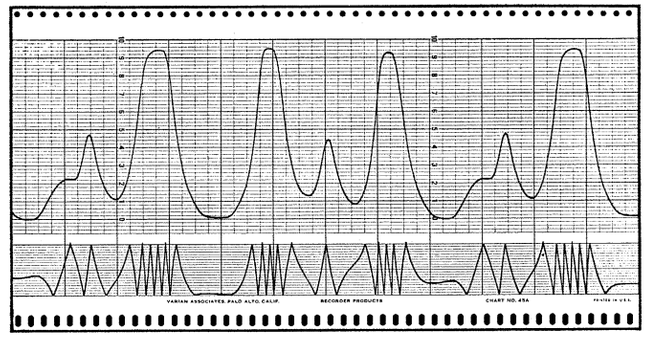
G-14 Recorder alone . . . Base Price.....$ 685.00

NOW FOR THE BETTER PART

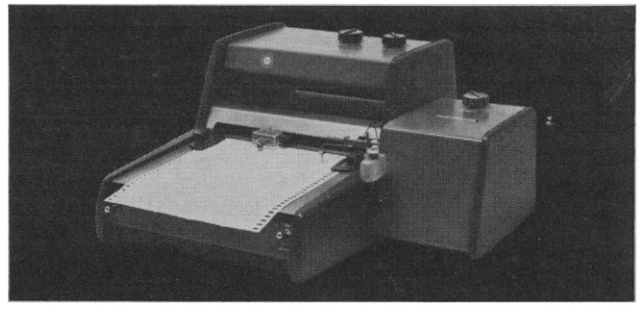
Look at this chart. It's different. It was made on the same model recorder equipped with a mechanical integrator made by Disc Instruments, Inc. and factory-installed by Varian. For accurately interpreting chart curves, this unit provides the important difference between a good close guess and the good measureable facts. With integrator, the G-14 automatically computes the area under a strip chart curve and presents this information continuously on the same chart. This means the G-14 can produce quantitative as well as qualitative records.



USEFUL APPLICATIONS: Gas Chromatography analysis • X-ray diffraction work • Flow measurement and integration • Temperature, sun radiation averaging • Averaging electric power • Weighing materials carried by conveyor belts • Measuring electrical charge (current integration) • Undoubtedly there are other applications unique to your laboratory's experimental work.

The G-14 is modified by externally mounting the integrating attachment on the right-hand side of the recorder. The attachment is housed in a metal cover which matches the G-14 case. The integrator readout pen covers 1″ of the chart width on the right-hand side, with 3.5″ of the chart available for a full-scale deflection of the main recording pen.

The integrator-equipped recorder meets all G-14 performance specifications with one exception: Pen travel is reduced from 5″ to approximately 3.5″ so that recorder range, zero adjustment, and pen response speeds apply to a 3.5″ full scale width. The Disc Model 214 Integrator may be factory-installed on G-14 Recorders now in service. Write Recorder Products for complete specifications.



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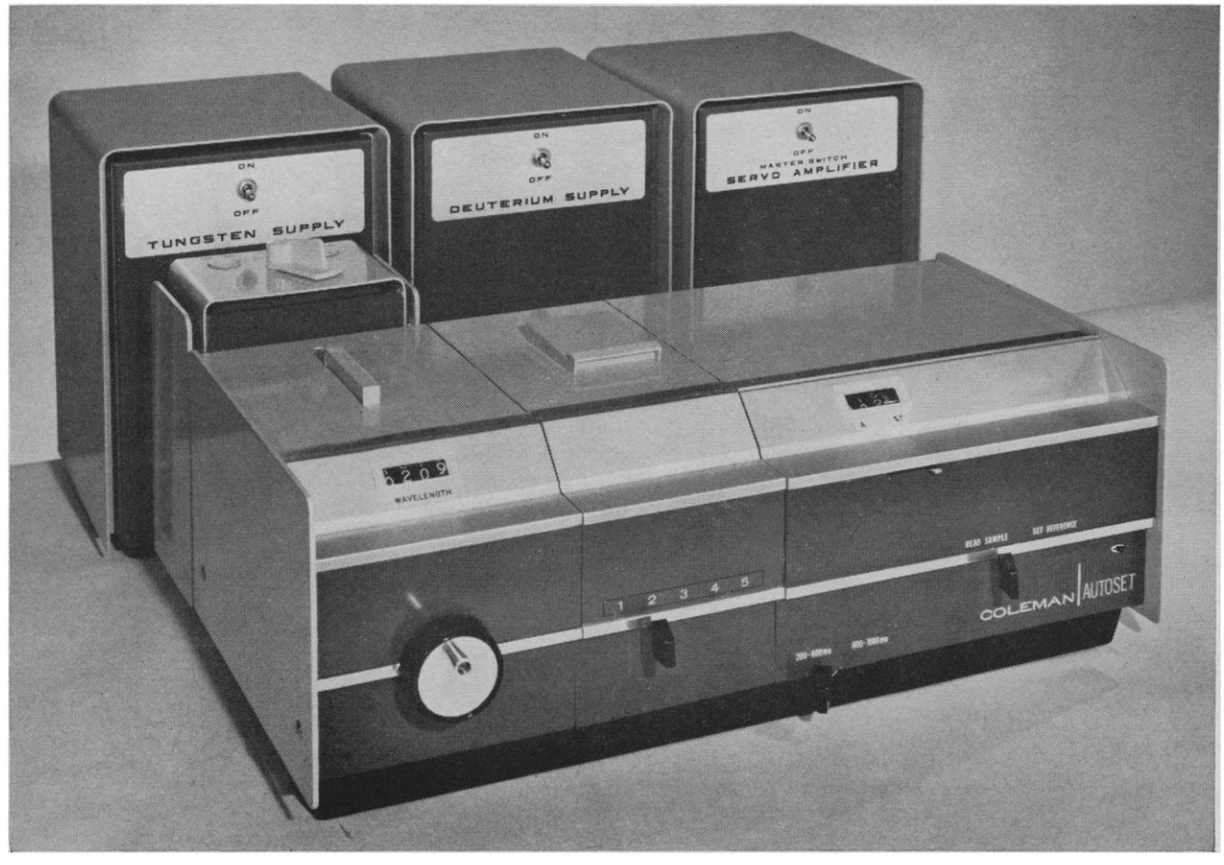
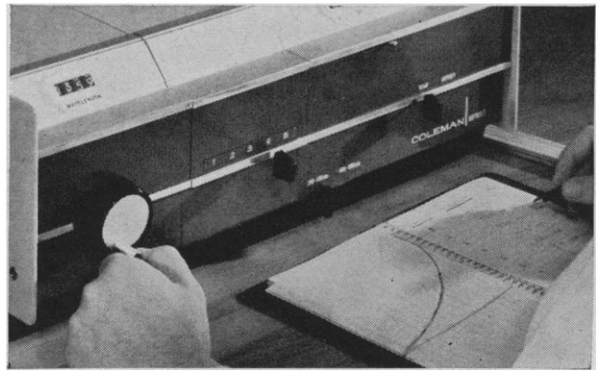
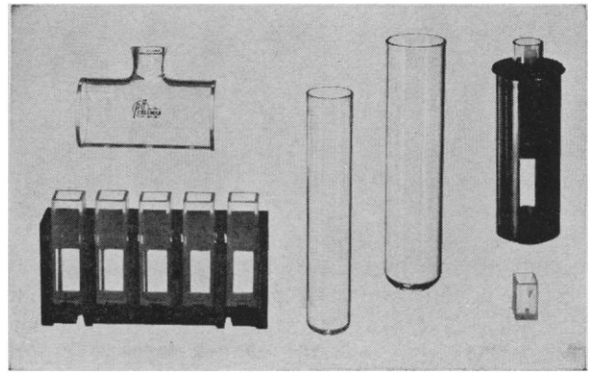
COLEMAN AUTOSET







Unequalled speed and convenience

Automated reference setting, the AUTOSET provision, ends the need for multiple manipulations ordinarily required for making a spectrophotometer reference setting. With AUTOSET, the value is achieved in seconds—*automatically*—by positioning a single control.

For sample analysis, the operator merely repositions the control and selects the sample . . . the sample value is quickly and clearly displayed in the instrument's readout window. The entire operation takes but a few seconds.

Simplified controls and AUTOSET eliminate critical, time-consuming adjustments and the need for nulling meters.

Sample versatility

General purpose and special cuvettes extend the scope of the instrument to meet widely-varying sample requirements. The instrument's sample compartment is designed for efficient use of a full range of cuvettes—ultramicro, long light path, and round test tube types as well as the highly-accurate standard square cuvettes with parallel optical faces.

The sample compartment provides adequate room for such special equipment as magnetic mixers, thermostatted components, and special cells with 100 mm light path.

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★ ***the working spectrophotometer for the ultraviolet-visible range***

★ ***automated reference setting***

★ ***direct reading, numerical data display***

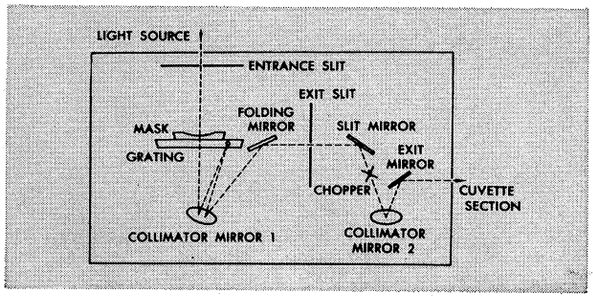
★ ***bipartite diffraction grating optics***

CONDENSED SPECIFICATIONS

Monochromator
Bipartite reflection diffraction grating.
2 millimicron standard bandwidth; 1 and 5 millimicron bandwidths also available for special work.
Wavelength range 200-1000 millimicrons.

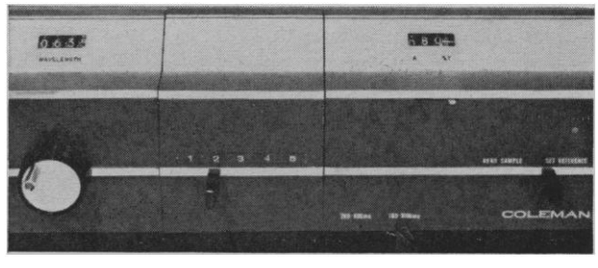
Photometer
Self-balancing null system.
Photometric accuracy: ±0.05%T, ±0.005A at 0.4A.

Sample range
120 microliters to 25 milliliters.
1 to 100 millimeter light path.



Bipartite diffraction grating optics

The Coleman AUTOSET Spectrophotometer provides the laboratory with the practical advantage of a working instrument with the analytical range of a specialized research equipment. A bipartite diffraction grating, dual light source, and dual phototubes provide high levels of energy throughout the 200-1000mμ spectrum. The bipartite grating produces a straight and linear spectrum which provides constant band width at all wavelengths, with fixed optical slits. Constant band width insures maximum reproducibility.



Error elimination

Reading information in numerical form is twice as fast and three times as accurate as reading the same information from dials. In the AUTOSET Spectrophotometer, all data is presented in unmistakable numerical form.

Wavelength data is presented directly in millimicrons—there are no non-linear scales to interpolate or micrometer screws to adjust.

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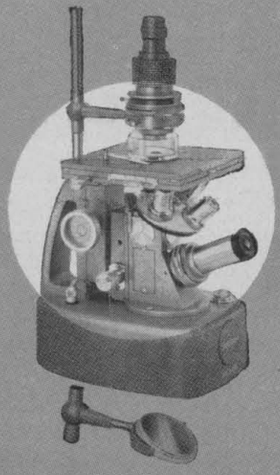
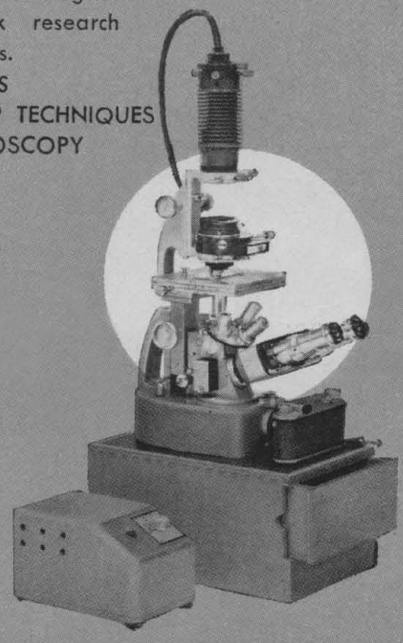
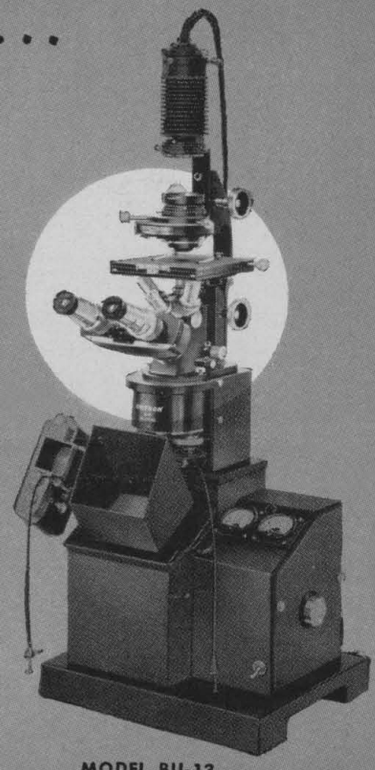


MODEL MIC



MODEL PH-BMIC



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INVERTED LABORATORY AND RESEARCH MODELS

Brightfield Laboratory Models:

MONOCULAR MODEL MIC. Four brightfield objectives 5X, 10X, 40X, 100X (oil); eyepieces 5X, 10X, 15X; ample height adjustment of condenser-illuminator for even large culture bottles; built-in base transformer. **$409.**

BINOCULAR MODEL BMIC. Binocular version of Model MIC, with camera mechanism. **$609.**

Brightfield Research Models:

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Prices include optics, cabinets, filters, special slides, petri dishes, and basic accessories. The built-in camera mechanism is standard with binocular models and available as an accessory for monoculars. Accommodates 35mm. camera back or Polaroid Land Camera Attachment. Both available at extra cost.

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Phase Research Models:

MONOCULAR MODEL U-13. Same phase objectives, turret condenser, and visual eyepieces as Model PH-MIC. **$1390.**

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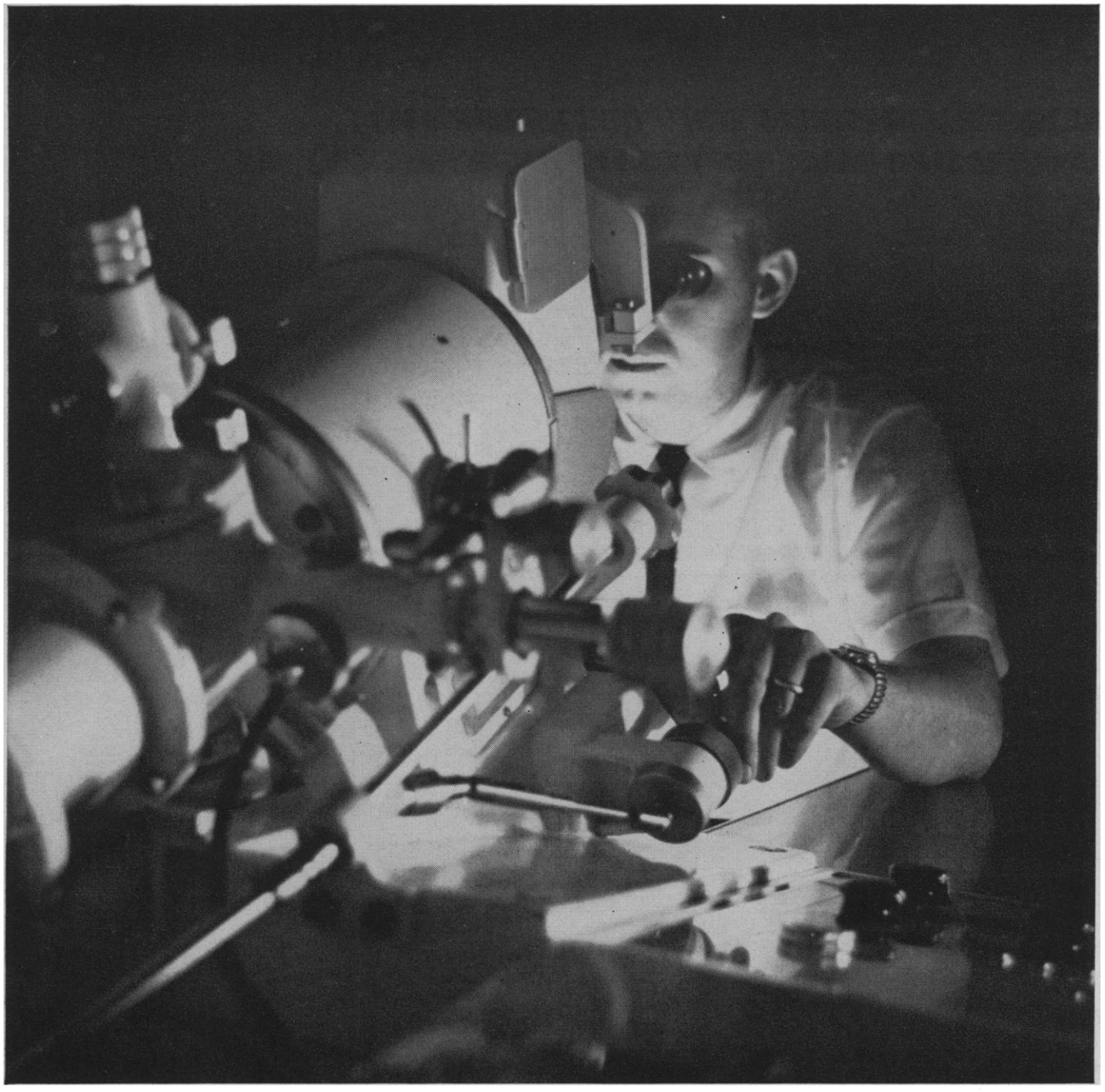

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This defines the Tronscope™ 80 electron microscope; an entirely different type of electron microscope. Bendix/Akashi engineers realized that the productivity of conventional electron microscopes could not be further improved without basic changes in concept. And improvement was necessary! Conventional microscopes had to be operated by a patient, skilled microscopist. Resolution was a function of his ability. Instrument preparation, lens alignment and other adjustments required a great deal of valuable operating time.

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Cincinnati Division

THE Bendix CORPORATION

2) *Requirements for advance specification of equipment*: On the surface, the new requirement that the investigator request authorization, in the original application, for the purchase of all equipment costing in excess of $1000 appears reasonable. After all, an investigator ought to know what equipment will be needed for the experiments that he plans to do. However, it has been widely recognized that basic scientific research gains much of its strength from the pursuit of new leads and new problems as fast as they arise. This has been thoroughly appreciated by federal granting agencies, for the grantee has always been permitted to make rather large alterations in his plan of work without requesting permission. Under previous rules, the investigator was not only free to determine the course of experimentation, but could usually purchase the equipment needed for any unforeseen work, so long as the overall division of the budget between salaries, equipment, and supplies was not altered. Thus, the granting agencies not only permitted the freedom of choice essential for the pursuit of basic research, but adopted an administrative procedure that made it possible to put this freedom into practice.

The new regulations retain, in theory, the investigator's freedom to determine the course of his research, but they place a serious restriction on his ability to make any effective use of this freedom. An investigator who is bound in advance to the purchase of a particular set of equipment loses a good deal of flexibility in research. The new procedures do permit the investigator to alter the approved list of equipment—but this requires a new justification for each new item, and the delays and extra paper work involved in this procedure are certain to vitiate most of the flexibility which this provision is supposed to provide.

Of course, those investigations which *can* be delineated in detail in a grant application will not suffer from this new requirement. It should surprise no one, then, if in the course of time, investigations of a more predictable course become increasingly prevalent in grant-supported research. When this happens, we will have reaped the fruit of this administrative change—the encouragement of research so predictable in its outcome as to become relatively remote from the free inquiry into nature that is the foundation of basic research. That *all* aspects of science, including the most practical development work, will in the not-so-long run suffer from such an erosion of the strength of basic research hardly needs to be argued here.

3) *Restriction of peripheral expenditures*: The arguments in favor of this provision are well known and are superficially reasonable. An institution's basic facilities, such as power lines, plumbing, and typewriters are essential to its *overall* purpose and ought not, it would seem, be charged against a research grant with a specific purpose. With some justification, Congress might regard the use of research funds for the purchase of office equipment and for laboratory maintenance as a flagrant case of "sponging" on government funds, strongly to be forbidden.

A deeper examination of this problem will show, I believe, that it lies close to the heart of a fundamental unresolved issue concerning government support of science and education, and that the difficulty is as much a reflection on Congress as it is on the academic community.

In many institutions there are simply insufficient general funds to provide for the extra burden in typewriters and power lines resulting from the initiation of research grants. In most universities it will be found that the grantless departments, such as English or Romance languages, are notably less well equipped, let us say, with electric typewriters, than the science departments. Often enough the science department's *regular* budget is simply too skimpy to warrant even the cost of annual maintenance of such equipment. The fact that the science departments *are* so equipped is usually due to the fact that, in the past, such charges have been permitted against research grants, which made partial use of general equipment of this kind.

This situation reflects a basic fact about the support of scientific research in the United States: All but a very few affluent institutions lack the general financial strength to accommodate the extra cost in peripheral expenditures resulting from the establishment of scientific research programs to the full capacity of the institution's laboratory facilities and of the intellectual capabilities of its staff. If government granting agencies had not, in the past, permitted these peripheral expenditures, many institutions would have been unable to accomplish the remarkable ex-

pansion in scientific research that we have witnessed in the last generation.

This state of affairs has been well known to grant adminstrators and to the academic community. In effect we have until now operated under a tacit agreement that a certain amount of general support for a university is to take place through the support for scientific research. That this is the actual situation is obvious from the relative magnitude of research support in the total budget of many universities. Grant funds often represent one-third to one-half of an institution's total budget. It is a truism in administrative art that no institution can possibly double its burden of activity without a considerable expansion in its *general* financial strength, and only a few institutions have been able to find this general support from independent sources. It should be clear as well that without the general support derived from research grants, the overall status of most of our universities as educational institutions would suffer a disastrous decline.

One often hears the argument that since Congress will not tolerate the idea of providing substantial federal support for higher education as a whole, the "realist" will accept general support for the university through the expedient of support for science. There has always been the danger that sooner or later the hypnotic glow which surrounds science would fade and that Congress would demand an accounting to show that funds for science are in fact rigorously restricted to the narrow purpose of the particular research program for which they were awarded. It would appear that this time has come.

I believe that the givers and receivers must now face the basic fact which has for so long been evaded by both: If this nation wishes to develop a strong program of research and education in science, it will have to understand that such strength cannot successfully be grafted onto our presently impoverished system of education. If Congress is willing to pay for the fruits of scientific research, it will have to pay the full price—which includes support for education in general. If the academic community wishes to be true to its mission of serving the truth, whether this takes the form of a nuclear pile, or a poem, it will have to accept the duty of making a principled demand for equal support for all aspects of education.

My own experience with both the earlier administrative procedures and the new ones convinces me that the foregoing difficulties are fully appreciated by the granting agencies themselves. Indeed, I believe that the new regulations have been put forward by these agencies with a considerable effort to avoid unnecessary demands on the investigator's time. But even with all the understanding and good will in the world, the new regulations—which appear to have been forced on the agencies by their congressional critics—will do serious harm to the progress of scientific research in the United States. For this reason I believe that the new rules should be strongly opposed by scientists and citizens generally.

Many scientists have accepted a responsibility to educate their fellow citizens about the scientific problems which must be understood if citizens are to help our lawmakers and administrators avoid a catastrophic end to the accelerating power which science has placed in their hands. I believe that scientists should also undertake to educate their fellow citizens about the principles which are essential to the growth of science: conditions of work which foster a free inquiry into nature; a search for truth which acknowledges the equal importance of all the forms that the truth can take, from physics to philosophy.

BARRY COMMONER
Washington University,
St. Louis 30, Missouri

The correspondence following your editorial "More paper work, less research" brings to mind the old adage of the surprise maternal visit to the larder when the young man just happens to have his hands in the confiture.

It has been my privilege to serve on the research grants committee of both national and state organizations for several years. One of the signatories of the 13-barreled letter starting on page 728 of *Science* is a gentleman more than adept at securing grants and then not using them for the purpose for which they were secured. This of course is often justified on the basis of "research," "education," and "serendipity." The cold fact remains that power corrupts and large amounts of funds spell power. Eternal vigilance remains the price of liberty and, to say the least, honesty.

L. H. GARLAND
450 Sutter Street,
San Francisco 8, California

(Continued on page 1136)

7 June 1963, Volume 140, Number 3571 **SCIENCE**

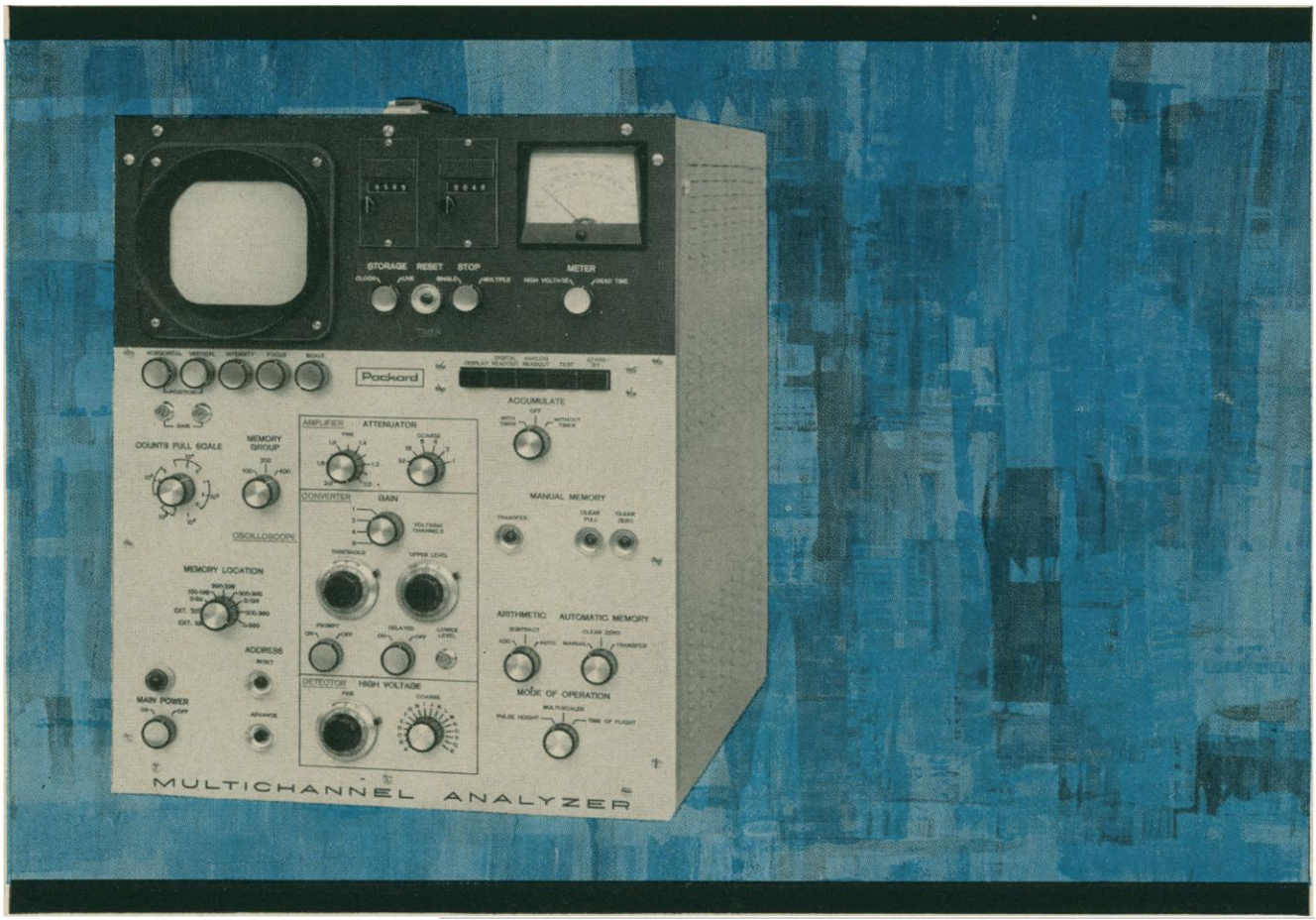
Science Fairs

It is good experience for a student to formulate a problem, design his approach, make the necessary observations, and then attempt to draw the conclusions that are justified by his work. Putting a number of such projects on display recognizes intellectual achievement and gives parents and other visitors an appreciation of the nature of scientific work. And so we have science fairs.

But, the judges report, this is not the whole story. Sponsors—and not all fairs are sponsored by educational organizations—sometimes have a keener eye for publicity than they do for science. Some teachers make participation mandatory instead of voluntary. Children who are too young are encouraged to enter. A high grade in class may depend upon participation or be given as a reward for a winning entry. From these situations other faults flow. Gadgetry gets overemphasized, and showmanship replaces scientific interest in the selection of projects. We have heard more than one student say, "I'm really interested in ——, but this makes a better exhibit." Emphasis on competition fosters a kind of intellectual dishonesty, the custom of having exhibits built by a parent or a scientist friend instead of by the student. A few years ago a Washington, D.C., newspaper quoted a junior high school teacher as telling a student, "You must go there and watch it being made; last semester some of the children didn't even get to see their projects until the week they were due." Perhaps the teacher was not quoted with perfect accuracy, but science fairs do sometimes invite sponging on scientists. One scientist recently sent us a mimeographed letter he uses to avoid writing individual replies to the requests he receives from students, in particularly large numbers at science-fair time. In brief it says, "No, I can't tell you all I know about marine biology; go to the library. No, I can't send you a collection of books and pamphlets or any specimens. No, I can't tell you how to design a project; that is up to you."

Last month the Southwestern and Rocky Mountain Division of the AAAS adopted a resolution criticizing the less desirable aspects of science fairs and calling for reform. Perhaps this action seemed slightly ungracious when Albuquerque, the site of the meeting, was preparing to entertain the International Science Fair sponsored by the Association's good friend and associate, Science Service. But the action may serve as a starting point for an attempt to rescue science fairs from some of their faults.

We have a few suggestions. Participation should be voluntary. Course grades should be divorced from competitive participation and prize winning. Individual projects, not to be entered in a fair, may be valuable in the earlier grades, but school, city, and state competition should be limited to more advanced students. (We learned something about sonnets from being required to write one in the 10th grade, but only a patient teacher had to read the distressing product.) Greater emphasis upon science instead of gadgetry and showmanship is clearly desirable, but largely dependent upon the wisdom and knowledge of the science teacher. Children are plastic and quite responsive to the rewards offered them; let us therefore give careful attention to the prizes, the release from other activities, the laudatory attention, and the other rewards involved. Rewards can be used to encourage attainment of the excellent objectives of science fairs and to discourage the objectionable features.—D.W.



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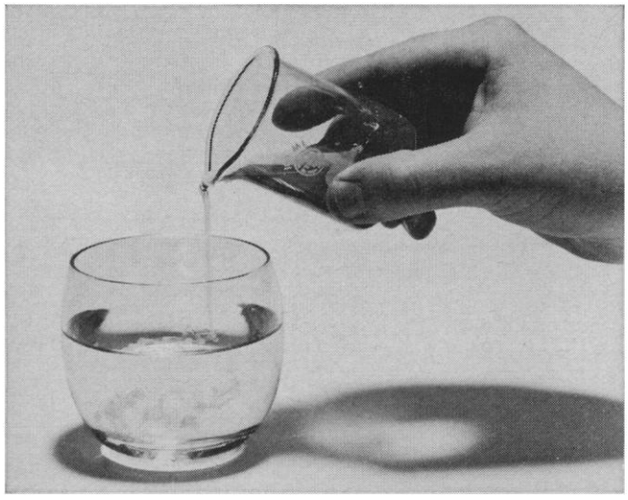
Kodak reports on:

a wrong that makes a right... microfilming computer printout... how to minify

Aqueous vitamin E



This is vitamin E dissolving in water. Most teachers would mark a student wrong for placing vitamin E among the water-soluble vitamins, and rightly so; but we find that when the acid group of crystalline *d*-alpha tocopheryl acid succinate is esterified with poly(ethylene glycol) of average molecular weight 1000, we obtain a waxy solid that melts at about 40°C and dissolves in water to 20% by weight, which provides 70 International Units of Vitamin E per gram. We supply this material in bulk only, to pharmaceutical manufacturers for use in oral multivitamin preparations. Investigators prepared to furnish a brief statement of professional background and proposed research are invited to apply for samples of *d*-Alpha Tocopheryl Polyethylene Glycol 1000 Succinate to Research Laboratories, Distillation Products Industries, Rochester 3, N. Y. (Division of Eastman Kodak Company).

The 29-minute mile

The new RECORDAK ROTOMATIC Microfilmer we believe to be the world's fastest off-the-shelf microfilmer. To keep the shelf stocked we find it necessary to scramble. The customers are in desperate need. Their computers keep pouring out computations. They signed up for the computer when impressed with how fast a mile of computation could be pushed out. When the mile shoots out as promised, the question arises of what to do with it. To feed the printout through a chute directly to the paper shredder and baler in the basement would represent ingenuity masking a pathetic failure to understand ultimate purposes.

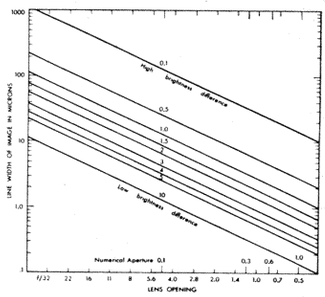
Between generation and shredding, the computations should be microfilmed for possible future reference. An interposed RECORDAK ROTOMATIC Microfilmer photographs the mile in 29 minutes on 220 feet of 16mm film. Acreage from paper to film shrinks by a 500 factor, which is desirable in the high-rent district. The paper can then safely move to the shredder, which usually returns a small but steady cash income.

You ask: why, with the electronic art in its present sophisticated state, bother with the paper at all instead of impressing the output signal from the computer directly on microfilm? We have been over *that* route before. We know exactly how to do it. The only trouble is that we also know how to build this little microfilmer for a tiny fraction of the price that a decently sophisticated device to accomplish the same end-result has to cost!

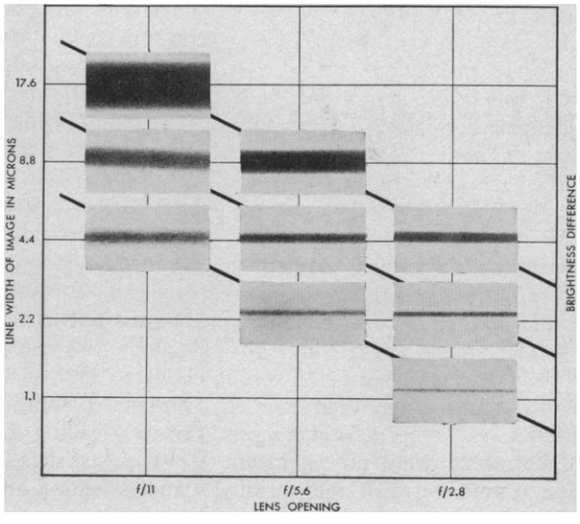
In case interested, address is Recordak Corporation (Subsidiary of Eastman Kodak Company), 770 Broadway, New York 3.

Microphotography for microelectronics

The optics of microscopy, the fabrication of electronic circuitry, and the techniques of the graphic arts are now all entwined. To manufacture a thin-film circuit or a micromodule, one carefully draws it all up (perhaps 200 times actual size) and then converts the drawing into the thing drawn. Incredible to the incredulous. Very difficult. Requires an understanding of → which tells how wide a lens opening is required at the very least when photographically reducing a white line on a black background down to the width represented on the ordinate. Each diagonal plot represents a quality level.* "1.0" indicates quality so good that for practical purposes you'd never need it any better; "0.1" is ten times as good and "10" is ten times as bad. This scale is arbitrary and is for the benefit of those who have to know things like this but who are too tired in the evening to study the literature on modulation transfer concepts in photography and therefore send for a how-to-do-it booklet entitled "Techniques of Microphotography" to Eastman Kodak Company, Special Sensitized Products Division, Rochester 4, N. Y. It covers much more than what lens apertures to use. But remember: microphotography is the opposite of photomicrography. This booklet deals with minification, not magnification.



*Perhaps this will help show what the oblique lines connect:



This is another advertisement where Eastman Kodak Company probes at random for mutual interests and occasionally a little revenue from those whose work has something to do with science

visible by sigmoidoscope and 96 patients in whom the tumor could not be seen. Of the former, 79 percent yielded positive smears, while in cancer which could not be reached by the sigmoidoscope only 5 percent positive smears were obtained. The accuracy of the colonic mucosal smear depended therefore on actually seeing the tumor and so the method was of little value in the diagnosis of cancer of the colon.

S. B. Gusberg, the only gynecologist on the program, reported on his results of cervical biopsy. Punch biopsy missed carcinoma (after positive smear) in 14 percent, while conization failed only in 3.4 percent. Gusberg performs, instead of the conventional complete conization, a narrow ring biopsy at the squamocolumnar junction. Sixty percent of the patients with final diagnosis of carcinoma *in situ* were asymptomatic. During the last few years he has performed 224 total hysterectomies for carcinoma *in situ*. In 52 percent of the uteri removed after conization, carcinoma *in situ* was still present. The recurrence rate after hysterectomy was 1.9 percent.

The accuracy obtained by W. Kaufman after using colpomicroscopy in almost 1500 cases was 84 percent in early carcinoma. He feels this method is so superior that it can often replace biopsy. However, from his photomicrographs this opinion appeared to me somewhat optimistic.

As routine office procedure, King and his associates performed cytological smears on urine for the purpose of detecting unsuspected bladder tumors. The method involved triple strength methylene blue on dry, fixed urine sediment. The results of this simple staining method compared well with preparations made by Papanicolaou's method or by the millipore filter technique.

The final session of the symposium was a cytology seminar moderated by von Haam. The panelists stressed that the purpose of cytology was not only to make a diagnosis of "positive" or "negative" smears, but to use the cytological findings to supplement clinical data and physical findings and to arrive at a final clinical diagnosis of the whole case. The comparison of tissue sections with the cytological findings demonstrated the value of the cytological method, if used as a preliminary screening test or adjunct, but never as a substitute for histological study and thorough clinical evaluation.

C. ALEXANDER HELLWIG
Hertzler Clinic, Halstead, Kansas

Drugs and Behavior

The Behavioral Pharmacology Society, an organization of psychologists and pharmacologists interested in advancing behavioral pharmacology as a scientific discipline, met at Columbia University on 19 January to discuss behavior and the effects of drugs on behavior. The direction taken by the papers and informal discussions makes it clear that progress in behavioral pharmacology can only be achieved by accelerating progress in behavioral science itself.

Useful estimates of relative potency among drugs can sometimes be obtained by administering multiple doses of a drug within a single experimental session. Ordinarily, to compare five different dose levels of five drugs would require 25 experimental sessions. However, administering cumulative doses during a single session reduces this requirement to only five sessions, and for many drugs this technique yields relative potencies that do not appear to be radically different from those obtained by conventional methods (Harley Hanson, Merck Institute for Therapeutic Research). A series of experiments on the comparative effects of methamphetamine and methylphenidate showed that both drugs increased shock avoidance response rate in *Macaca mulatta* and decreased the response rate for food reinforcements on a fixed-ratio schedule when the two schedules were part of a multiple schedule. Further studies with a variety of other reinforcement schedules also showed that these drugs reduced response rate when food rewards were used. These data conflict with other data in the literature, but mainly in the cases where rats were the subjects (Dom Finocchio, Ciba, Inc.).

The interactions resulting from variation in single components of multiple reinforcement schedules were described by Marcus Waller (University of North Carolina). On multiple fixed-interval, fixed-ratio schedules with pigeons as subjects, high ratio requirements may cause two different response rates within a single ratio run. Chlorpromazine produces, in this instance, a single intermediate rate, however, it also eliminates the temporally correlated characteristics of fixed interval behavior. Hypotheses accounting for avoidance behavior in the absence of a warning signal (Sidman avoidance) were presented by Douglas Anger (Upjohn Co.), who proposed that condi-

tioned aversive temporal stimuli play an important role in such behavior. The aversiveness of these stimuli fall to a minimum directly after an avoidance response and then rise as the occasion for the next shock approaches.

John Nevin (Columbia University) described experiments conducted in collaboration with Robert Berryman and William Cumming on matching-to-sample behavior in the pigeon. Several procedural variations were described, and some data on the effects of pentobarbital on delayed matching behavior were presented.

BERNARD WEISS
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Manpower Problems: Training of Mathematicians

A conference on "Manpower Problems in the Training of Mathematicians" was held in Washington on 16–17 April under the auspices of the Conference Board of the Mathematical Sciences (CBMS) with support from the National Science Foundation. It was held in response to a report on *Graduate Training in Engineering, Mathematics, and Physical Sciences* (EMP) prepared by the Gilliland Panel of the President's Science Advisory Committee and issued by the White House, 12 December 1962. The panel summarized the national requirements for EMP scientists at the Ph.D. level and considered various factors affecting the supply. The report concluded that the supply of graduate students could result in the production of 7500 doctorates in 1970, as compared with 3000 in 1960. In mathematics the report presented two alternative goals for 1970: 2200 or 1320, which are increases by factors 7 and 4, respectively, over the output of 303 Ph.D.'s in 1960.

The conference received detailed information on the supply of graduate students, the existing means for their support, and the currently available supply of mathematicians for their training from representatives of government agencies, the constituent organizations of CBMS, and the National Research Council. The effects of industry and of the proposed increase in the training program in engineering and physical

sciences on the supply and demand for mathematicians was discussed by representatives of the Bell Telephone Laboratories, RIAS, American Chemical Society, American Institute of Physics, and the American Society for Engineering Education. About 70 people participated.

The conference report will include the following recommendations:

1) Young Ph.D.'s should be used earlier and more effectively as thesis advisers.

2) NSF support of summer institutes for intensive research training of advanced graduate students should be extended and strengthened.

3) A program of training grants to departments of mathematics should be established which will facilitate the matching of competent graduate students with qualified thesis advisers.

4) Pre- and post-doctoral fellows should be encouraged to do a moderate amount of teaching.

5) Existing national policy which provides funds for the construction and equipment of scientific laboratories should be broadened to provide for the construction and equipment of buildings for offices, seminar rooms, libraries, and computing facilities, which serve the same purpose in the production of Ph.D's in mathematics as experimental laboratories do in engineering and the physical sciences.

6) Promising secondary centers of Ph.D. production should be given support to increase their output of doctorates while maintaining and even increasing their level of excellence.

7) Due consideration should be given to the high level of demand for Ph.D.'s in applied fields: statistics, computer science, applied mathematics.

8) Steps should be taken to provide undergraduate departments of mathematics with competent staffs in order to raise the level as well as the quantity of students entering graduate study.

9) Suitable arrangements should be made so that the substantial number of mathematicians in industry and government who are qualified to direct thesis preparation may serve the universities in Ph.D. production.

10) New centers of excellence for Ph.D. production should be created where suitable pools of students and a nucleus of qualified mathematicians exist.

The constituent organizations of CBMS are: American Mathematical Society, Association for Computing Machinery, Association for Symbolic

Logic, Institute of Mathematical Statistics, Mathematical Association of America, National Council of Teachers of Mathematics, and Society for Industrial and Applied Mathematics. Dr. J. Barkley Rosser, chairman of the CBMS council presided at the conference.

LEON W. COHEN

Conference Board of the Mathematical Sciences
Washington 6, D.C.

International Congress of Zoology, 20–27 August 1963

The 16th International Congress of Zoology will be held in Washington on 20–27 August 1963. In contrast to many congresses, which consist mainly of individually contributed papers plus a number of specialized symposia, a high degree of organization is planned for this meeting. Individual papers have been, to be sure, welcomed, and a large number of "special" symposia have been organized. Many of these symposia are designed to cut across the lines between two or more subdisciplines. Individual papers and special symposia will occupy the afternoons. The unique feature of the congress is that the morning sessions will be devoted exclusively to a series of plenary symposia, in which our current knowledge of some six broad areas of animal biology will be presented to the participants as a whole by experts in each field.

The reasons for this planning lie in the present state of the science of zoology. Half a century or so ago, like every other major scientific discipline, zoology was essentially a discrete unit structure, well-demarcated for the most part from other sciences, and with a considerable degree of mutual intelligibility between workers in its subfields. Today this is no longer the case. Happily, the boundaries between animal biology and the physical sciences have been in great measure broken down. Less happily, with increase in breadth and depth of research interests, there has been a strong trend toward fragmentation—a disintegration of the field into a number of minor disciplines, between which communication is often poor. The major aim of zoology should be an understanding of the animal as a whole. Currently we are rapidly advancing our knowledge of various fractions of the field; but our concept of the total organism has all but vanished.

So far has zoological fragmentation gone that when the organizing committee for the present congress first met, the question was posed as to whether this process had not proceeded so far that it was futile to hold a further congress in this field. The committee's reaction to this was a vigorous affirmation of its belief that the holding of the proposed congress was not only possible but highly desirable; that it was high time that disintegration be counteracted by synthesis; that better channels of communication be set up between workers in the discrete areas of the subject; and that the congress should be a step toward reunion of the zoological sciences into a coherent discipline, making a broadly based attack on the problems of animal life.

It is with this ambition for a rebirth of zoology that the committee chose as the symbol of the congress the phoenix, reborn from its ashes.

The plenary symposia, with participants, are as follows: Genetic Continuity, Benzer (Purdue), Meselson (Harvard), Spiegelman (Illinois); Cell Biology, DeRobertis (Buenos Aires), Ingram (M.I.T.), Lehninger (Hopkins); Development, Oppenheimer (Bryn Mawr), Markert (Hopkins), Abercrombie (London); Evolution, Rendel (Sydney), Lewontin (Rochester), Mayr (Harvard), Kurten (Helsingfors); Phylogeny, Prosser (Illinois), Schmidt-Neilsen (Duke), Carter (Cambridge); Behavior, Bullock (U.C.L.A.), Thorpe (Cambridge), and others.

Special symposia include: North American fauna, endocrine mediation in social adjustments, chromosome structure and function, the deep scattering layer, simian malaria, neuroanatomy, evolution of endocrine systems, regulation of numbers in natural populations, biological productivity at heterotrophic levels, inhibitory control of growth and differentiation, biology of abyssal animals, evolution of higher levels of organization, invertebrate chemoreception, evolution of man, ontology of basic response patterns, nucleocytoplasmic interrelations, evolution at population and interpopulation levels, principles and problems of functional anatomy, nomenclature, new techniques for systematics, biology of gnotobiotic animals, animal navigation, mimicry, scientific use of natural areas, ecological and evolutionary aspects of "biological clocks," mammalian evolution on the southern continents, insect development and endocrinology, physiology of Echinodermata, biology of blood protozoa, and behavioral adaptations of mammals to their environments.

On the more general and less technical side, there will be a series of evening symposia on "Science and Man," the topics including protection of vanishing species, population growth in man and its consequences; man's ability to control his biological destiny; nature, man, and pesticides; and "Our Plundered Planet."

The week's sessions will be broken on Saturday, 24 August, for a day of rest or excursions, of which a number are planned. In addition to scientific events, a number of social occasions are planned, including receptions at the National Zoological Park and the U.S. National Musuem, and a special evening opening of the National Gallery. A "Science Theatre" will show an extensive and carefully selected series of biological films, brought together by R. A. Boolootian. Washington weather in August tends to be very much on the warm and humid side; however, all meetings will be in the air-conditioned Sheraton-Park and Shoreham hotels.

An extensive program of publication of the proceedings of the congress is planned. Abstracts of all contributed papers, in bound form, will be in the hands of all participants at the time of the congress, as will be rather longer summaries of all papers given at the

special symposia. Subsequent to the congress all participants will receive a volume containing the full text of all papers included in the special symposia.

The congress is under the presidency of Alfred S. Romer, with Gairdner B. Moment as secretary-general, Alexander Wetmore as treasurer, John A. Moore as program chairman, and Gerard Piel as finance chairman. It is sponsored by the National Academy of Sciences with the cooperation of the American Society of Zoologists, the American Institute of Biological Sciences, and societies of animal biology generally.

ALFRED S. ROMER

National Academy of Sciences, Washington 25, D.C.

Forthcoming Events

July

5–9. Pure and Applied **Chemistry**, 22nd conf., London, England. (Div. of Chemistry and Chemical Technology, Natl. Research Council, 2101 Constitution Ave., Washington 25)

7–11. **Testing and Research** Laboratories for Materials and Structures, intern. union, symp., Budapest, Hungary. (Hungarian Scientific Inst. for Structural Engineering, Dioxzegi ut 37, Budapest 11)

7–14. American **Dental** Soc. of Europe, annual, Barcelona, Spain. (A. Sturridge, 30 Welbeck St., London, W.1, England)

7–17. **Aerospace Education**, 7th natl. conf., Miami Beach, Fla. (Natl. Aerospace Education Council, 1025 Connecticut Ave., NW, Washington 6)

8–13. **Ionization Phenomena** in Gases, 6th intern. conf., Orsay, France. (P. Hubert, CENFAR, P.O. Box 6, Fontenay-aux Roses (Seine), France)

9–11. **Space Telecommunications**, intern. symp., Boulder, Colo. (Boulder Laboratory, Natl. Bureau of Standards, Boulder)

10–12. Meteorological Support for **Aerospace Testing and Operation**, Fort Collins, Colo. (Inst. of Aerospace Sciences, 2 E. 64 St., New York 21)

10–12. High **Magnetic Fields**, production and applications, conf., Oxford, England. (N. Kurti, Clarendon Laboratory, Parks Rd., Oxford)

10–17. Pure and Applied **Chemistry**, 19th intern. congr., London, England. (Div. of Chemistry and Chemical Technology, Natl. Research Council, 2101 Constitution Ave., Washington 25)

11–14. Fluorine and **Dental Caries** Prevention, 10th congr., Geneva, Switzerland. (Inst. de Médecine Dentaire de l'Université, 30 rue Lombard, Geneva)

12–13. **Renal Hypertension**, intern. conf., Columbus, Ohio. (J. A. Prior, Center for Postgraduate Medical Education, Ohio State Univ., 113 Hamilton Hall, 1645 Neil Ave., Columbus 10)

14–19. **Congenital Malformations**, 2nd intern. conf., New York, N.Y. (Science Information Div., The National Foundation, 800 Second Ave., New York 17)

15–17. **Data Acquisition and Processing** in Medicine and Biology, Rochester, N.Y. (K. Enslein, 42 East Ave., Rochester 4)

15–17. **Newcastle Disease** Virus as an Evolving Pathogen, intern. symp., Madison, Wis. (R. P. Hanson, Veterinary Science Bldg., Univ. of Wisconsin, Madison)

15–19. **Radiochemistry**, 1st Inter-American conf., Montevideo, Uruguay. (Pan American Union, Washington 6)

15–19. **Nuclidic Masses**, intern. conf., Vienna, Austria. (H. E. Duckworth, Commission on Nuclidic Masses, McMaster Univ., Hamilton, Ont., Canada)

15–20. Instrumental Analytical **Chemistry**, 2nd symp., Bethlehem, Pa. (A. J. Diefenderfer, Dept. of Chemistry, Lehigh Univ., Bethlehem, Pa.)

17–23. **Pesticides**, 5th intern. congr., London, England. (Div. of Chemistry and Chemical Technology, Natl. Research Council, 2101 Constitution Ave., Washington 25)

18–23. **Thermodynamics and Thermochemistry**, symp., Lund, Sweden. (S. Sunner, Thermochemistry Laboratory, Univ. of Lund, Lund)

19–20. **Biochemical** Soc., intern. meeting, Oxford, England. (R. W. Whelan, Intern. Section, Biochemical Soc., 20 Park Crescent, London, W.1, England)

19–21. American Soc. of **Human Genetics**, New York, N.Y. (K. Hirschhorn, New York Univ. Medical Center, 550 First Ave., New York 16)

21–24. American **Astronomical** Soc., College, Alaska (P. M. Routley, 265 Fitz Randolph Rd., Princeton, N.J.)

22–25. **Embryology**, 6th intern conf., Helsinki, Finland. (L. Brent, Natl. Inst. for Medical Research, The Ridgeway, Mill Hill, London, N.W.7, England)

22–26. **Academic Administration**, 5th inst. on college self study, Berkeley, Calif. (T. F. Lunsford, Fleming Law Bldg., Boulder, Colo.)

22–26. **Medical Electronics**, 5th intern. conf., Liége, Belgium. (F. Bostem, 23 Blvd. Frère Orban, Liége)

22–26. **Mental Health**, world federation, 16th annual, Amsterdam, Netherlands. (Secretary General, 19 Manchester St., London, W.1, England)

22–26. Psychosomatic Aspects of **Neoplastic Disease**, Cambridge, England. (L. L. LeShan, Intern. Psychosomatic Cancer Study Group, 144 E. 90 St., New York 28)

22–26. **Microscopy** Symp., Brighton, England. (E. C. Bitoy, McCrone Research Inst., 451 E. 31 St., Chicago 16, Ill.)

22–27. **Molecular Spectroscopy**, intern. congr., Budapest, Hungary. (Hungarian Travel Information, 595 Madison Ave., New York 22)

23–27. **Chemotherapy**, 3rd intern. symp., Stuttgart, Germany. (C. A. Hackethal, 13th and Harrison Ave., VA Hospital, Oakland, Calif.)

24–27. **Nucleon Structures**, intern. conf., Stanford, Calif. (R. Hofstadter, Dept. of Physics, Stanford Univ., Stanford, Calif.)

25. **Chemotherapy**, 1st intern. meeting, Stuttgart, Germany. (H. P. Kuemmerle, Postfach 3030, Stuttgart 1)

27–3. Institute of **Religion in an Age of Science**, 10th conf., Portsmouth, N.H. (Dept. A., Inst. of Religion in an Age of Science, 280 Newton St., Brookline 46, Mass.)

New Products

Precision pH meter is claimed to be reproducible to ± 0.0005 *p*H. The voltage from the *p*H electrode is balanced out by a potentiometer circuit and the null read on a sensitive voltmeter. A coarse knob of fixed resistors sets the nearest whole *p*H unit and a fine ten-turn potentiometer is set for the final balance. The *p*H reading is digital to the second decimal place with the smallest division 0.002 *p*H and easy reproducibility to ± 0.001 *p*H. The accuracy of the balance potential is assured by a chopper stabilized amplifier, and this potential can be checked against a standard Weston cell. A temperature compensation knob allows continuous adjustment from 0° to 50°C and the selector switch has a fixed resistor for 37°C compensation. The model E388 by Metrohm is line operated and may be used with a variety of *p*H electrodes.—R.L.B. (Brinkmann Instruments, Inc., 115 Cutter Mill Rd., Great Neck, N.Y.)

Circle 1 on Readers' Service card

A series of **nuclear-radiation probes** as slender as 0.012 inch in diameter is designed for measurement of wall thickness of extremely small and complex internal passages. Used with standard scintillation detectors and analyzers, the gamma-ray probes are said to provide radiation suitable for measurement of any homogeneous material from 0.002 to 1.500 inches. The radioactive source at the tip of the probe is plated on a piece of 0.004-inch platinum wire, 1/16 inch long, that is inserted into the steel probe and enclosed with silver solder. The probes are available in any required length. Various radioactive isotopes may be used. The scintillation detector and analyzer are also available from the manufacturer.—J.S. (Franklin Systems, Inc., P.O. Box 3250, West Palm Beach, Fla.)

Circle 2 on Readers' Service card

Vacuum-gage calibration system (model 964-008) is said to provide accuracy of calibration within ±4 percent between 10^{-3} and 2×10^{-6} torr, and ±6 percent from 2×10^{-6} to 5×10^{-7} torr. Eight ionization gages may be mounted externally on the calibration chamber by making use of the manufacturer's flanges. Internal gage mounting is also possible. The calibration system utilizes the manufacturer's 125-lit./sec ionization pump that can be valved off before the system is opened to air. Either a sorption or a mechanical roughing pump can be used to reduce pressure from atmospheric to 10^{-2} torr, at which point the ionization pump comes into operation. The calibration system depends upon an accurately known pumping speed and a measurement of flow. The pumping speed is determined by the physical dimension of an orifice located between the calibration chamber and the vacuum pump. The gas flow into the calibration chamber is measured by a flowmeter developed by the manufacturer. The system operates within a temperature range 15° to 35°C and a humidity range 0 to 95 percent. Set-up time is approximately 1.5 hr for eight gages; conditioning time is 8 hr; measurement time is approximately 20 min for each point of calibrated pressure. A nude ionization gage and supply unit are supplied with the system. Controls and instruments are mounted in a desk console.—J.S. (Varian Associates, 611 Hansen Way, Palo Alto, Calif.)

Circle 3 on Readers' Service card

Fluorescence, phosphorescence, turbidity, and absorption measurements can be made with a compact versatile new instrument called the Fluoro-Microspectrometer. The standard Aminco Photomultiplier-Microphotometer, containing the regulated power supply and control and measuring circuits for a photomultiplier tube, is used as a base. The light sources, cuvette holders, filters, shutters, and the photomultiplier are housed in an assembly that fits over the basic instrument. High sensitivity, efficiency, and economy are attained through the use of low-power, mercury-vapor resonance lamps, either plain or fluorescent, to provide a choice of four spectral regions of high output. For higher output an 85-watt high-pressure mercury lamp in a Corex envelope is available. Simple filter optics, cuvette and sample holders adapt for a wide choice of conditions. For measurement of phosphorescence at liquid-nitrogen temperatures the sample is placed in contact with a copper rod that connects the sample chamber with liquid nitrogen in a dewar. Nitrogen evaporating from the dewar vents into the sample compartment to prevent moist air from condensing inside the instrument. A rotating shutter assembly is used to measure phosphorescence. Nephelometry, turbidimetry, and titrating accessories are also available.—R.L.B. (American Instrument Co., Inc., 8030 Georgia Ave., Silver Spring, Md.)

Circle 4 on Readers' Service card

Miniature cryogenic machine, "Cryomite," reaches 75°K in 15 min, using a single-stage, modified Stirling cycle. A sealed-in volume of helium is compressed, transferred through a regenerator, expanded, transferred back through a regenerator, and compressed again. Two reciprocating pistons 90° out of phase, driven by an electric motor, approximate the required function. The compression liberates heat to an air-cooled heat sink and the expansion absorbs heat from a block which may be used to cool infrared detectors, condense vapors, freeze specimens, or be provided with an insulated flexible conductor for remote cooling. Cooling capacity at 80°K is 3 watts with an input power of 100 watts, with greater capacity at higher temperatures. Motor speed is used to control the amount of cooling. The entire package, including the electric motor and a vacuum-jacketed cold block, is 14 inches long, 5 inches in diameter, and weighs 14 lb. In a second model the motor shaft en-

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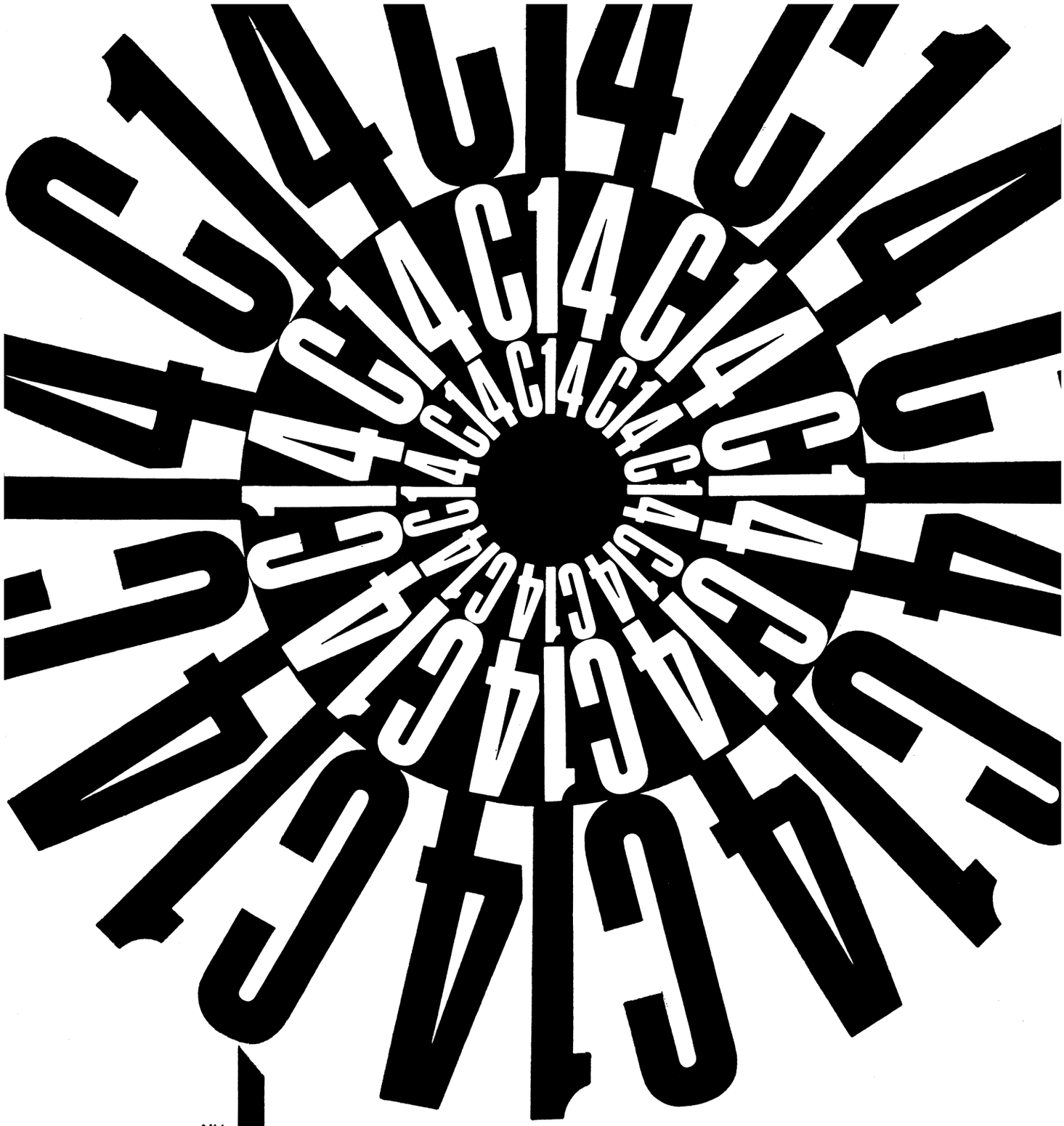
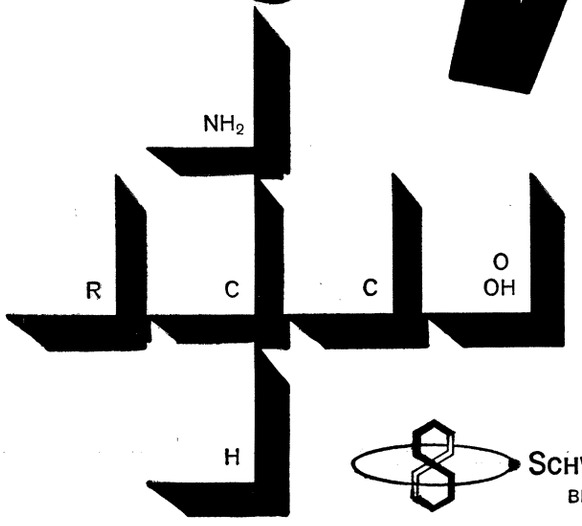
The material in this section is prepared by the following contributing writers:

Robert L. Bowman (R.L.B.), with the assistance of Denis J. Prager, Laboratory of Technical Development, National Heart Institute, Bethesda 14, Md. (medical electronics and biomedical laboratory equipment).

Joshua Stern (J.S.), Basic Instrumentation Section, National Bureau of Standards, Washington 25, D.C. (physics, computing, electronics, and nuclear equipment).

The information reported here is obtained from manufacturers and from other sources considered to be reliable. Neither *Science* nor the writers assume responsibility for the accuracy of the information. Readers' Service cards for use in mailing inquiries concerning the items listed are included on pages 1029 and 1143. Circle the department number of the items in which you are interested on this card.





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ters from the side to achieve a more compact design.—R.L.B. (Malaker Labs., Inc., West Main St., High Bridge, N.J.)

Circle 5 on Readers' Service card

Capacitor analyzer (model BF-71) tests capacitors with voltage ratings from 1 to 500 without causing damage or change of characteristics, according to the manufacturer. Capacitance range is 10 pf to 2000 μf; resistance measurement range is 2.5 ohms to 25 megohms; current measurement range is 2 μa to 100 ma. Accuracy of all measurements is said to be ± 3 percent. The analyzer is also capable of measuring power factor up to 50 percent. An internal power supply provides 0 to 500 volts at 35 ma for making capacitor leakage tests. Leakage current can be measured on tantalum capacitors as well as on aluminum foil types. Operation is at 115 volts, 50 or 60 cy/sec.—J.S. (Federal Pacific Electric Co., 50 Paris St., Newark 1, N.J.)

Circle 6 on Readers' Service card

Paper chromatography cabinet of lightweight fiber glass is for use in ascending or descending paper chromatography. It accommodates four pyrex solvent troughs which hold papers up to 12 inches wide. A transparent Lucite cover with four capped filling holes locks down on a replaceable sponge neoprene gasket for a constant atmosphere. A replaceable glass side window allows observation of the chromatographic separation during a sample run. This basic unit, model 101, measures 25 by 15 by 14 inches and weighs 9 lb. A deluxe unit, model 105, accommodates five 25-inch-wide chromatograph papers and features thermopane windows on the top and side, a removable front panel, a condensation tray, bottom drain, and adjustable leveling casters with two oil-bubble levels for standardized operation. This unit measures 33 by 32 by 22 inches.—R.L.B. (Esco Products, Inc., 267 Plain St., Providence, R.I.)

Circle 7 on Readers' Service card

Sapphire-clad ruby rod is said to more than double the efficiency of conventional laser systems. The ruby rod is 2.5 inches long and has a diameter of 0.25 inch at the ruby core, which is increased to 0.44 inch by the sapphire overlay grown on the outside. According to the manufacturer, the composite rod is a single homogeneous crystal with no interface between the ruby

and the sapphire overlay. Two advantages claimed for the elimination of the interface are the improvement in heat transfer from the ruby to the outer surface and the elimination of off-axis spurious modes that are not reflected back into the ruby. The ratio of the cylinder radius to the core radius is such that all of the pumping light that penetrates the overlay passes through the core. The rods, with polished outer surface, are available with end faces finished to 0.1 wavelength flatness and parallel within 2 sec of arc. Chromium concentration is 0.05 percent and crystallographic orientation is 90°.—J.S. (Valpey Crystal Corp., Highland St., Holliston, Mass.)

Circle 8 on Readers' Service card

Aerosol generator can produce a mist in which the particles are from 5 to 20 $m\mu$ in diameter. A compact instrument, 2-3/16 inches in diameter by 7½ inches high, the Schoeffel aerosol generator will atomize 1 cm^3 of medium into a homogeneous aerosol within 4 to 8 min, depending on its viscosity. The air compressor unit contains a 115 V.A.C. motor and an oil-free diaphragm pump with an output of about six lit./min. All parts are made of stainless steel, chrome-plated brass, and nontoxic plastic, and may be sterilized in temperatures up to 130°C. Although designed essentially for healing and prophylactic inhalation in patient care, this instrument should find use in research laboratories where a convenient source of fine particles and mist is required.—R.L.B. (Schoeffel Instrument Co., 355 Hillsdale Ave., Hillsdale, N.J.)

Circle 9 on Readers' Service card

Variable-area flowmeter (series 5000A) uses a slot of varying width ground into the side of a precision-bore tube, instead of a tapered tube, to provide variation of area. According to the manufacturer, the area of the tapered slot, which varies as the float is lifted by the flow, gives greater accuracy than a comparable meter with a tapered tube. Full-scale accuracy is said to approach ±1 percent. Flow ranges from 0.007 to 30 gal/min of water and 0.05 to 120 standard ft^3/min of air are covered by standard units. Operating pressures range from 300 lb/$in.^2$ for a ¼-inch tube to 75 lb/$in.^2$ for a 1.5-inch tube. The tube and jacket are made of borosilicate glass with an acrylic outer shield. Floats are available in a variety of materials including brass,

glass, stainless steel, aluminum, lead, nickel, Monel, Hastelloy, or Teflon. O-ring seals are used to assemble the flow tube to its connections.—J.S. (C. Mar Instrument Corp., 35 Euclid Ave., Manasqual, N.J.)

Circle 10 on Readers' Service card

Laser equipment includes the model L-100-01 laser head, the L-100-21 power supply, and a variety of accessories. The laser head utilizes a high-pressure mercury lamp cooled by a continuous flow of water. The elliptical cavity containing the lamp and laser material is water cooled and is contained in a shield. Connections are provided for liquid-oxygen and filter solutions. The laser material is easily removed. The power supply will provide from 0 to 2000 volts at current up to 1.4 amp. An interlock with coolant-water supply prevents operation of the lamp when the flow drops below an acceptable level. The L-100-41 closed coolant system, available as an accessory, is designed to prevent corrosion by the water coolant. The L-100-71 liquid-oxygen coolant system provides the means for cooling liquid oxygen to liquid-nitrogen temperature before passing the liquid over the laser rod. The model L-100-81 liquid filter system provides a chemical filter system to the cavity to reduce heating of the laser rod by radiation during operation. The L-100-51 optical bench provides a lathe-bed-type support for the cavity and other measuring or testing devices. The standard bench is 43 inches long.—J.S. (Astromarine Products Corp., 1733 N. 33rd Ave., Melrose Park, Ill.)

Circle 11 on Readers' Service card

Germanium bolometer system for infrared measurements uses doped germanium operating at cryogenic temperatures, normally approximating 2° to 4°K. The complete bolometer system consists of a Dewar-flask cooling system, a bolometer assembly with cooled filter and associated windows and optical elements, and a high impedance, low-noise preamplifier. Windows and electrical feedthrough arrangements are located as specified by the user on the side or bottom of the Dewar flask. Size of the germanium bolometer and its mounting may be designed for optimum sensitivity and thermal time constant. Frequency response of the system for infrared measurements permits coverage of the infrared spectrum from 1 μ to 10 mm. In the 1- to 40-μ region, bolometer

efficiency is said to be better than 95 percent. At longer wavelengths, from 200 μ to 1.3 mm, efficiencies greater than 50 percent are said to have been achieved. A typical system using a 2-by-2-mm detector area and operating at 2°K with 10- to 35-cy/sec chopping rate, produces 5×10^{-13} watt noise equivalent power. Chopping rate may range from 10 to 200 cy/sec, or higher with sacrifice of noise equivalent power. The system is completely calibrated before shipment and may be supplied with radiation baffle and optical elements to meet specific application requirements.—J.S. (Texas Instruments Inc., 3609 Buffalo Speedway, Houston 6, Tex.)

Circle 12 on Readers' Service card

Centrifuge (model PR-B) specifically designed for rapid processing of blood in plastic bags develops 5500*g* and cuts centrifuging to one-third of that normally required for separating plasma from whole blood. It comes equipped with a four-place streamlined angle head designed to accept standard 600-ml blood bags. With the PR-B the complete centrifugation cycle, including acceleration, separation of red cells and buffy coat from plasma, and deceleration, takes less than 10 minutes. After loading the four removable cups with standard 600-ml blood bags, the operator sets the timer for the desired length of run and presses a button. The head automatically accelerates to 5000 rev/min in 90 seconds or less. When the timer returns to zero the centrifuge automatically brakes to a smooth stop in 90 seconds or less. The PR-B is a special purpose model of the standard International Model PR-2 Centrifuge. The PR-B will accept 29 other interchangeable heads, including horizontal, angle, and continuous flow.—R.L.B. (International Equipment Co., 300 Second Ave., Needham Heights, Mass.)

Circle 13 on Readers' Service card

Optical calorimeter (model 600) is a self-contained instrument for measuring the output energy and power of pulsed and continuous-wave lasers as well as flash tubes, lamps, and other light sources. It is said to cover broad dynamic power and energy ranges at any wavelength from the near infrared to the near ultraviolet. The measuring element, contained in an evacuated cell, exhibits absorption and emission characteristics that approach those of a black body. A photocell is provided for peak-power determination. The instru-

ment includes an amplifier, output meter, and power supply. Output connections are provided for input to an oscilloscope for observing power, or for the simultaneous observation of energy and power on a dual-channel oscilloscope. A portion of the light being measured passes through the instrument, thus permitting optical alignment.—J.S. (Optics Technology, Inc., 248 Harbor Blvd., Belmont, Calif.)

Circle 14 on Readers' Service card

Portable cardiac sensor is designed for field or hospital work where there is a need to monitor the cardiac rate and rhythm or to make a differential diagnosis between ventricular fibrillation and cardiac asystole. Measuring 4½ by 2½ by 1 inches, and powered by a mercury battery, the Cardio-Sensor monitors the cardiac rate and rhythm and produces an auditory note and visual meter deflection. Both signals are designed to respond to the "r" wave of the electrocardiogram. The apparatus is attached to the patient's arms by means of two flat electrodes and electrode jelly. Not meant to replace the electrocardiogram, this transistorized device is meant to be a convenient, portable method for determining definite ventricular fibrillation and asystole, and for monitoring portable pacemakers and defibrillation.—R.L.B. (Mastercraft Medical and Industrial Corp., 94–21 150 St., Jamaica, N.Y.)

Circle 15 on Readers' Service card

Solar-radiation simulator provides both Earth- and Venus-orbit intensities, the former 130 watt/ft² and the latter 275 watt/ft². All models feature collimated beams with continuous operation to 1000 hours. The light source combines xenon and mercury-xenon lamps with infrared fill-in. It may be used with a space chamber without additional optical equipment. Models are available to irradiate an area 12 or 18 inches in diameter with collimation within 1°. Uniformity is said to be within 10 percent over the working diameter, measured 6 ft from the exit port of the simulator. Instrumentation includes an intensity monitor, running-time meter, and lamp start-up counter. Intensity recorders can be supplied. Cooling systems and safety interlocks are integrally mounted and the unit is complete with power supplies and lamp igniters.—J.S. (Tenney Engineering, Inc., 1090 Springfield Rd., Union, N.J.)

Circle 16 on Readers' Service card

High-temperature metallic alloy in sheet form is designed to operate at temperatures that melt or materially weaken common metals and even super alloys. The material, thoria dispersed nickel sheet, is said to have exceptional strength and corrosion resistance in a temperature range from 1800° to 2400°F. The sheet material is ductile and can be formed into complex shapes at room temperature. It can be brazed and fusion welding techniques are under development. The high-temperature strength and corrosion resistance are the result of the uniform dispersion of insoluble ultrafine particles of thorium oxide, approximately 1 microinch in diameter, in a matrix of pure nickel. At no time in the process from raw material to finished sheet does the alloy reach a molten state. Nickel-thoria powder is produced by chemical co-deposition rather than by smelting or electrolysis. The resulting metal powders are squeezed into a solid billet and end products are extruded from the solid metal billets. The sheet is cold rolled after extrusion.—J.S. (E. I. DuPont de Nemours & Co., Wilmington, Del.)

Circle 17 on Readers' Service card

Vapor-pressure osmometer with extend range operates at 100° or 130°C for determining molecular weights of polymers by using high-boiling solvents. The determination is made as in the standard 37°C instrument where solutions on thermistor probes unbalance a resistance bridge in proportion to their vapor pressures in the solvent saturated atmosphere. As the resistance change

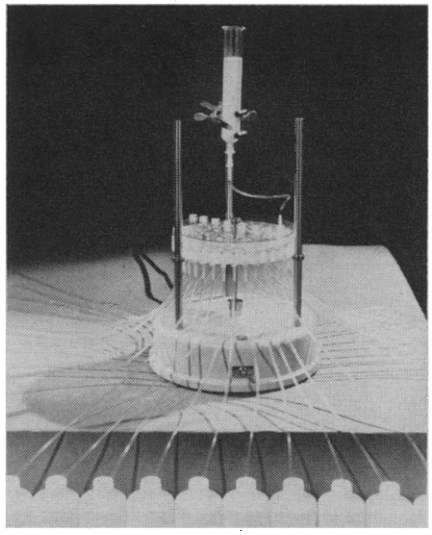
due to cooling is related to vapor pressure, solvent and known compounds can be used to calibrate the resistance change in terms of vapor pressure which is related to molal concentration. If the weight concentration is known, the molecular weight can be computed. Once the instrument is calibrated for a system, readings can be obtained in just a few minutes per sample.—R.L.B. (Mechrolab, Inc., 1062 Linda Vista Ave., Mountain View 3, Calif.)

Circle 18 on Readers' Service card

X-ray sensitive vidicon camera tube (MI-589) is available in a standard 1-inch size. It uses an x-ray–sensitive layer as its sensor element instead of the light-sensitive photoconductive layer found in conventional vidicons. The sensitive layer is placed behind a beryllium face plate that is highly transparent to x-rays. Approximately 2-percent penetrameter sensitivity is obtainable through ¼-inch-thick aluminum. Resolution of details is said to be better than 0.001 inch and image quality to be comparable to fine-grain, high-contrast radiographic film. The 6-inch-long tube is suitable for magnifications to ×50.—J.S. (Machlett Laboratories, Inc., 1063 Hope St., Springdale, Conn.)

Circle 19 on Readers' Service card

Preparative fraction collector and liquid distributor permits column effluents or other fluid flows to be divided into fractions on a precision time base. A stationary distribution plate gives a choice of 4, 8, 16, or 32 fractions per revolution of the upper rotating feed plate. The feed plate provides two sets of inlets leading to each of the concentric dividing circles associated with the flow cuts listed, thus permitting multiple input operation. Accuracy of the time-base fraction system is achieved by combination of the precision geometry of the distribution plate and the use of a synchronous motor drive. Three interchangeable driving motors (one mounted in position and two stored in the base of the collector) provide cycles of 8, 12, and 24 hours—thus producing one fraction in 6 hours, 3 hours, 90 minutes, 45 minutes, 22.5 minutes, or 11.25 minutes, depending on the cycle time and radius selected. Designed specifically to meet the problems of handling effluents from chromatographic columns, the fraction collector has three extensible uprights suitable for supporting columns and capable of having a shelf



attached to the top for the location of various types of column-feed containers. This arrangement produces a compact unit requiring a minimum of bench space. Interchangeable distribution plates with other arrangements, as well as drive motors of other speeds, can be supplied to provide other fraction relationships for special needs. Design is such that no metal parts contact the fluid at any time, nor can fluids enter the area of the driving mechanism. Plastic tubing provided with plug-in adapters leads samples to any desired container. Exposed parts are stainless-steel, plastic, or have a corrosion-resistant epoxy finish. The instrument operates from 115-volt, 50- to 60-cy/sec power.—R.L.B. (Durrum Instrument Corp., 841 Woodside Rd., Redwood City 2, Calif.)

Circle 20 on Readers' Service card

High-energy storage system is capable of delivering up to 100,000 joules. The system consists of the following elements: banks of capacitors, load switches, expandable collector, trigger power supply, pulse generator, trigger switch, trigger capacitor, bank power supply, and charging and dumping resistors. Capacitors are low-inductance units rated at 15 μf and 20 kv. Inductance is less than 0.06 mhy. They are designed for 50,000 operations. Each capacitor is equipped with a load switch with jitter time 2 nsec. The trigger power supply is capable of charging the trigger capacitor fully within 20 sec. The latter discharges in the range of 5 Mcy/sec and contains sufficient energy to trigger up to 30 capacitors. A standard 22-kv, 160-ma power unit charges the capacitor bank in 20 sec. Power supplies are available

to charge the bank in shorter time. The complete system is assembled according to purchaser specifications.—J.S. (Federal Pacific Electric Co., 50 Paris St., Newark 1, N.J.)

Circle 21 on Readers' Service card

Gas chromatograph construction kit includes the Gow-Mac 9285 pretzel detector with four tungsten filaments, heated injection block and materials for construction and packing of chromatograph columns, and text and instructor's manual. All parts necessary for electrical and flow system are included, and only a 12-volt storage battery and 10-mv fast-pen potentiometer recorder are required in addition. The laboratory manual details 12 student-tested experiments directed to organic, inorganic, and physical chemistry applications at college and technical school level. Text is by J. M. Miller of Drew University.—R.L.B. (Gow-Mac Instrument Co., 100 Kings Rd., Madison, N.J.)

Circle 22 on Readers' Service card

Binary-to-digital converter (model S44) provides high-speed conversion of binary numbers to a visual display in the decimal number system. Versions with auxiliary electrical outputs in decimal or 8-4-2-1 binary-coded-decimal form are available on special order. Speed of operation is 6000 1-bit conversions per second (a decimal number range of $\pm$ 1023). Up to 14-bit capacity can be supplied. All bits of the binary input signal must be available simultaneously. Control modes are continuous scan and external synchronization. When set at the former mode, the instrument automatically recycles and performs new conversions every 400 μsec. In the latter mode, conversion is started by an external-start trigger pulse.—J.S. (Non-Linear Systems, Inc., Del Mar, Calif.)

Circle 23 on Readers' Service card

Variable frequency synthesizer (model 5100A) provides precise frequency signals from 50 cy to 50 Mcy/sec in increments as small as 0.01 cy/sec. The instrument has ten columns of pushbuttons arranged in standard decimal form for rapid frequency selection. These permit changing output by steps as large as 10 Mcy/sec and as small as 0.01 cy/sec. Output frequency may also be remotely programmed by contact closure. The range of frequencies represented by any of the eight pushbutton columns can be varied with

either an internal search oscillator or an external voltage. The output voltage is 1 volt ±2 db from 50 cy to 100 kcy/sec and 1 volt ±1 db from 100 kcy to 50 Mcy/sec into a 50-ohm resistive load. Nominal output impedance is 50 ohms. The base frequencies required by the instrument are supplied by a companion **fixed-frequency synthesizer** (model 5110A). Stability is said to be ±3 parts in 10^9 per day.—J.S. (Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, Calif.)

Circle 24 on Readers' Service card

Battery monitor (series ET-250) serves as a device for providing an alarm on low voltage, for shedding the load, and resetting itself when battery voltage returns to its normal level. The device monitors 48-, 125-, and 250-volt d-c station batteries. The series ET-230 **emergency power transfer switch** provides the capability of setting a precise low-voltage trip point in order to transfer electrical equipment from a primary or normal source of power to a secondary or emergency power supply. The device continues to monitor the normal supply, and will automatically transfer the load back to the primary source when service is restored. Input to this series is 0 to 140 volts, 50 to 60 cy/sec.—J.S. (Rochester Instrument Systems, Inc., 275 N. Union St., Rochester 5, N.Y.)

Circle 25 on Readers' Service card

Aerosol photometer (model 230) measures and indicates total average logarithm of light scattered by a large number of particles in sample stream. It thus provides a reading of relative aerosol concentration in monodisperse aerosols or in aerosols having constant spectra of sizes present. As a consequence of this kind of operation, the photometer is a low-cost instrument compared to airborne-particle monitors of the individual-particle type. It is suitable for application in area-monitoring functions, as a general laboratory instrument, or as a go/no-go quality-assurance tool in such activities as filter manufacturing, industrial and chemical processing, and so forth. Functionally, it contains an airflow system that pumps a continuous sample of specimen air through an optical sensor comprising a light-scattering system that measures the luminous intensity in the moving air stream. This is followed by amplifiers that average the phototube output, take the logarithm of this magnitude, and present this value on a two-

scale panel instrument. This provides a moving average of light intensity over a 10,000 to 1 dynamic range. Both galvanometer and potentiometer recording outputs appear on the front panel. An accessory unit permits observation of readings and establishment of alarm conditions from a remote location. Complete powerline regulation for the entire instrument is built in and covers the range 105 to 125 volts. An internal calibrator with front-panel control permits adjusting the overall sensitivity of the instrument to compensate for changes in lamp output. A sensitivity chart accompanies each instrument for convenience in correlation of readings against actual concentration of various monodisperse aerosols. Available in both cabinet and rack-mount types, the aerosol photometer has dimensions of 8¾ by 19 by 16 inches and weighs approximately 25 lb.—R.L.B. (Royco Instruments, Inc., 440 Olive St., Palo Alto 6, Calif.)

Circle 26 on Readers' Service card

Sound-level meter (type ELTZ) indicates airborne sound level from 30 to 120 db referred to 0.0002 bar. Frequency range is up to 500 cy/sec. Accuracy of measurement is said to equal or exceed IEC standards. A slide switch selects eight overlapping sensitivity ranges. Frequency weighting may be selected in conformance with ISO curves A, B, and C. Either fast or slow meter time constant is selected by push-botton. Calibration is provided by an internally contained standard. Audio outputs are provided for external monitors, spectrum analyzers, or recorders. The instrument is housed in a case designed so that in its normal operating position the acoustic field is not distorted by the body of the operator.—J.S. (Rohde & Schwartz Co., Inc., 111 Lexington Ave., Passaic, N.J.)

Circle 27 on Readers' Service card

Lead compensator for voltage dividers (model LC875B) is designed to compensate for lead- and contact-resistance differences between generator and divider traps when two dividers are connected for comparison. The accessory is designed to remove these effects by feeding the dividers through low-resistance tapped dividers so that the output taps can be made to agree at the zero and full-scale settings. The unit consists of the two auxiliary low-resistance dividers with all terminals for connecting them to the dividers being compared and to a generator and null de-

tector. Resolution better than 0.1 megohm is said to be provided so that dividers with input resistance as low as 1 kohm can be set to agree at the two extremes to within 0.1 part per million.—J.S. (Electro Scientific Industries, Inc., 7524 S. W. Macadam Ave., Portland 19, Ore.)

Circle 28 on Readers' Service card

Introductory **kit for thin-layer chromatography** permits application of the TLC technique on an inexpensive trial basis to determine need for additional equipment. Minimal equipment is provided to produce and develop thin-layer chromatograms, and 14 different adsorbents are supplied in sufficient quantity for several trials with each. This enables selection of an appropriate adsorbent for separating substances that the user wants to analyze. Determination of an optimum formulation for developing solvent is also aided by the numerous tests that can be made with the large supply of Silica Gel in the kit. An extensive up-to-date TLC bibliography is included (over 300 references), as well as a catalog of the company's complete line of Chromatofilm equipment for TLC. The user may incorporate the kit into his expanded TLC laboratory, as its components are standard, reusable items.—R.L.B. (Research Specialties Co., 200 S. Garrard Blvd., Richmond, Calif.)

Circle 29 on Readers' Service card

Bellows valves designed for soldered or brazed vacuum manifolds has a bronze body with a flanged cover, brass bellows and nonrising stem. The complete stem assembly can be removed while the body is being soldered in place and can be removed for servicing. Disk seals and O-rings are of Buna N, which allows operating temperatures to 107°C (225°F). While intended for vacuum service, these valves may have application in respiratory gas systems.—R.L.B. (Kinney Vacuum Div., New York Air Brake Co., 3529 Washington St., Boston 30, Mass.)

Circle 30 on Readers' Service card

High-speed electronic comparator (model CS 1050F) is a completely solid-state unit that produces an output voltage when the sum of two input voltages is zero. Sensitivity of switching is within 5 mv for any input voltage to ±100 v. Sensitivity is adjustable to overcome the effects of external noise. The output consists of a voltage pulse of 50 μsec duration and a continuous voltage of

12 v. Switching rate is 200 kcy/sec and comparison time is 5 μsec. The comparator is mounted on a printed-circuit board for incorporation in the purchaser's equipment and it is also available in assemblies of six cards mounted on a 19-inch rack package with switches, mode indicators, and input-output connectors.—J.S. (GPS Instrument Co., Inc., 180 Needham St., Newton 64, Mass.)

Circle 31 on Readers' Service card

Hermetically-sealed platinum element resistance thermometers offer a repeatability variance of less than 100 parts per million. The new devices are available in five standard body and lead syles, and with 0°C element resistances of 50, 100, or 470 ohms. Included are probes with axial and radial leads, and 10/32 threaded-body screw-in models for closed-vessel or probe use. The useful temperature range is from −100°C to +204°C (−148°F to +400°F). These elements of the S-31 series have three leads to permit accurate remote sensing independent of lead effects. Typical applications include missile, gyro, and accelerometer temperature sensing; laboratory, biological, and pathological use; and chemical process control. Models with element resistance of 470 ohms at 0°C are available from stock. Resistance versus temperature curves, tables, and measured 0°C resistance are included with each unit.—R.L.B. (Minco Products, Inc., 740 Washington Ave., North, Minneapolis, Minn.)

Circle 32 on Readers' Service card

Portable **refrigerating device** (model TK-1) is designed to convert a laboratory bath into a refrigerating or cooling unit. In use, a cooling head flexibly attached to the device is inserted into the area to be cooled. Temperature range is +15° to −20°C. Accuracy of temperature control is said to be routinely ±0.1°C with accuracy of ±0.01°C achievable by following special instructions. Temperature regulation is controlled by two independent systems: an adjustable stabilizing pressure valve regulates the evaporation temperature of the material being cooled and an electronically controlled relay regulates the compressor through an on-off arrangement effected by means of a contact thermometer or similar instrument. Cooling rate is 500 kcal/hr. Cooling head hose length is 4 ft but lengths up to 16 ft can be supplied. Weight of the unit is 69 lb and

dimensions are 15.75 by 15 by 12.25 inches. Power requirement is 550 watts, 110 volts, 60 cy/sec.—J.S. (Schueler & Co., 250 W. 18 St., New York 11)

Circle 33 on Readers' Service card

Regulated voltage and current power supplies are solid-state units said to provide regulation within one part in 10^5. Current capabilities are 100 and 200 amp and voltage ranges are 45 and 100 volts in standard units. Operation as either a regulated-current or regulated-voltage source is selectable by means of a switch. The current and/or voltage level is continuously adjustable and may be set to any desired value. Motorized automatic current or voltage sweep units are optional. Other voltages than the standard ones are available on special order. Operating line voltage may be 115 or 220. Ripple is said to be below the regulation tolerance.—J.S. (Alpha Scientific Laboratories, P.O. Box 333, Berkeley 1, Calif.)

Circle 34 on Readers' Service card

Complex-impedance-admittance meter (model 100A) is a portable, completely transistorized, self-contained device for direct reading of equivalent series resistence and reactance or equivalent parallel conductance and susceptance. Capacitance is measured from 10 pf to 50 μf and inductance from 10 μhy to 50 hy full scale. Ranges depend on frequency and applied voltage. Frequency range is 100 cy to 200 kcy/sec. Impedance is measured in 12 ranges from 10 to 50,000 ohms. Admittance is measured from 10 to 50,000 μmho. Accuracy is said to be ± 2 percent amplitude, and ± 2.5 deg phase, up to 150 kcy/sec. Readings are presented on meters; d-c outputs are provided for operation of recorders. The instrument is available with or without internal transistorized oscillator.—J.S. (Dranetz Engineering Laboratories, Inc., Scotch Plains, N.J.)

Circle 35 on Readers' Service card

Variable-time-base frequency counter (model 702A) is an all-transistorized instrument that permits direct readout of variables by translating one function of time representing the variable into another function of time. This is accomplished through the use of the variable time base that provides the proper division ratio, enabling the input frequency to be read directly in desired units. A wide range of selectable gate times is provided and the instrument can be programmed remotely. Output

is provided for actuation of digital printers. Frequency range is 1 cy to 300 kcy/sec. Input impedance is 100 kohms shunted by 50 pf. Input sensitivity is 5 mv r.m.s. from 10 cy to 30 kcy/sec and 100 mv r.m.s. over the complete range. Accuracy is ±1 count ± oscillator error.—J.S. (Computer Measurements Co., 12790 Bradley Ave., San Fernando, Calif.)

Circle 36 on Readers' Service card

Gas-filled laser tube (model LT-40) operates in the visible-light region at a wavelength of 6328 Å, or in the infrared region at a wavelength of 11,530 Å, with suitable mirrors and radiofrequency excitation equipment. The all-quartz tube is supplied with quartz windows at the Brewster angle. Window flatness is 0.1 wavelength. The tube contains a gas mixture of 0.9 mm-Hg of helium and 0.09 mm-Hg of neon. Other mixtures may be obtained on special order. Inside diameter of the envelope is 0.25 inch and length is 40 inches. A feature of the tube is its small-perimeter quartz flat seal area that permits maintenance of a high degree of window flatness and a small maximum outside diameter of 0.8 inch. The tubes are processed above 420°C to assure cleanliness and are pretested for laser action.—J.S. (Litton Industries, San Carlos, Calif.)

Circle 37 on Readers' Service card

Single-brush absolute-position shaft **encoder** (model SD3) uses a lightweight wiper with very low torque and low moment of inertia. The wiper can be repositioned to a new wiping track at least four times during the life of the encoder to extend its useful operating life. According to the manufacturer, this results in a life greater than 6 million shaft rotations. The output signals of the encoder are generated in a solid-state flip-flop register associated with the wiper, and not at the wiper directly. This is said to eliminate all brush contact noise. The output from the encoder is fed to the solid-state logic circuitry through a system of multiple leads. Resolution of the encoder is 1000 counts (binary-coded decimal) in 360° of rotation, and accuracy is ± 1 count. Starting torque is 0.25 in.-oz. Diameter of the 1000-count model is 4 inches.—J.S. (Perkin-Elmer, Norwalk, Conn.)

Circle 38 on Readers' Service card

Time programmer (Model TCP–122) is a solid-state device that delivers a 0 to 2048 straight binary count, 11 bits, in parallel format at the output terminals. The user may select any combination of bits to obtain his desired programming time. Accuracy and stability are said to be ±0.01 percent in the standard instrument when operated in the temperature range −55° to +125°C. The binary zero is represented by a d-c signal between 0 and 0.1 volt. The binary 1 is represented by a 5-volt d-c signal ±10 percent. Maximum pulse rise and decay times are 5 μsec and 100 μsec, respectively, measured across a 5-kohm resistive load. The instrument operates on 25- to 31-volt d-c and draws 60 ma. It is protected against transient power pulses as high as 5 volts, lasting up to 5 msec, and repeating as often as 1 per sec. The device uses a shock-mounted crystal as clock source. The 1 pulse/sec signal resulting from magnetic countdown circuits is used to drive flip-flop counters connected for binary output. The output impedance is 500 ohms.—J.S. (Logtek, Inc., 54 Rome St., Farmingdale, N.Y.)

Circle 39 on Readers' Service card

LETTERS

(Continued from page 1053)

Pseudopregnancy in Rats

Several years ago we completed a project similar to that reported by Doyle and Margolis [*Science* **139**, 833 (1963)] with opposite results. Using the Holtzman modification of Sprague-Dawley rats, we studied the effects on ensuing pregnancy of a preceding deciduoma associated with pseudopregnancy. This was an attempt to find the physiological and anatomical reasons for human infertility associated with the use of a Graffenburg ring.

The pseudopregnancy was produced and deciduomata followed traumatization of one horn and the leaving in of a loop of silk or cotton thread. When these animals recycled, pregnancy occurred only in the untreated horn although blastocysts were seen in the treated one. Our technique was then modified, and the deciduoma was produced only at the ovarian end of the uterine horn through a flank incision. The same loop of thread was used, and this was associated with pseudopregnancy. Operations were performed on the 15th day of the pseudopregnancy to verify the deciduoma, but the horns were not handled.

In the ensuing pregnancy approximately half the animals had implantations in both horns, and the treated horn usually had the least. Our interest being primarily in the absence of pregnancy, we discontinued the study when it became evident that pregnancy would occur if we did not manipulate the horn excessively. Pregnancies have been reported in patients using the Graffenburg ring. Thus, the factor producing infertility has not been identified.

EDUARD EICHNER

10605 Chester Avenue, Cleveland, Ohio

The experiments described by Eichner seem similar to those reported by Nichaman [*Am. J. Physiol.* **186**, 6 (1956)] which differed from ours in that deciduomata were produced in pseudopregnant animals which were subsequently bred.

Apparently we did not make it clear that our sutures were placed in cycling animals prior to the time they were bred, and that at no time did we find decidual changes in the sutured horn. These facts would seem to rule out excessive manipulation as a possible cause of nonpregnancy.

Eichner describes neither his original nor modified technique in detail, and he does not state if the presence of the suture was verified in the horns of the 50 percent of animals that were implanted in his second series. Therefore we are unable to compare our data with his.

Additional animals have now been added to the series reported in *Science*, and we have observed no pregnancies or decidual changes. We have also shown recently that, in sutured animals littered and rebred on the postpartum estrus, pregnancy is again unilateral if the suture is still present and bilateral if it is not.

L. L. DOYLE
A. J. MARGOLIS
Department of Obstetrics and Gynecology, University of California School of Medicine, San Francisco

Metric System of Measurement

The world trend toward adoption of the metric and Celsius systems seems unmistakable, and advanced science courses and graduate schools in the United States have long used them. The adoption by the British of the Celsius system as an alternative to Fahrenheit, the adoption of the metric system by India, and the use of this system in cartography by the 12 Antarctic treaty nations are recent illustrations. However, up to the present time some college biology courses have retained the use of inches, feet, miles, acres, and such units of measurement although they generally use the metric system for objects of small size. They may also use the Fahrenheit system of temperature as well as the Celsius. Some recent botany and zoology texts for college students use a mixture of measurements. If students can think in terms of the metric system for small units, only little encouragement is needed for them to think in terms of meters and kilometers.

When a text in entomology from a western university with many foreign students consistently uses terms like 1/16 or 1/4 inch for lengths, and the Fahrenheit system for temperatures, one wonders why those students are needlessly confused. Proportions here are sometimes in milligrams per kilogram (poison) and sometimes pounds per gallon (insecticides). In this example part of the explanation may be the orientation towards practical United

States agriculture. Advanced biological texts on the whole, however, are consistent in using the metric and Celsius systems. Chemistry texts are similar in this respect, and beginning physics texts are partly oriented towards the engineering student, where industry will force them to use nonmetric systems for an indefinitely long time.

It is suggested that authors and publishers of all college scientific texts be consistent in this respect and use the metric and Celsius systems of measurements in the interests of convenience, uniformity, and what appears to be a world trend. It might also be considered that these growing systems be adopted in secondary school texts since they are tending more towards the college level and clearly designed in many cases for students who enter the science field.

Publishers may also find it to their advantage to use a system already in general use throughout the Common Market, Latin America, and much of Asia, and one might anticipate that the new African countries, like the former French colonies, will use the metric system exclusively.

NEAL A. WEBER

Swarthmore College, Swarthmore, Pennsylvania

The United States president who successfully sponsors full conversion to the metric system will take a mighty step toward global understanding and communication between peoples and nations. Decimal currency, an American innovation in 1792, is understood by all. This largely explains why the dollar is the basic exchange unit of the Common Market, even though none of the member countries use the dollar internally. Just as the invention of zero extended man's comprehension of numbers and improved his ability to count, so decimal systems save his time and extend his grasp.

In 1902 and in 1926, bills to make the metric system mandatory were narrowly defeated in Congress. Lincoln favored metric standardization as a step in reconstruction following the Civil War and there were strong movements afoot at the end of World Wars I and II. The penalty for not going metric grows each year, as do the problems to convert.

Ideally, the British Commonwealth and the United States will set common deadlines for step-wise conversion. England is already well on its way to use of the Celsius temperature scale. Once committed to the decimal monetary

system, Commonwealth countries have begun to calculate what it costs to remain on the old system. Now that Australia has "cast the die," a Sydney paper recently estimated that by cutting man-hours among monetary workers alone, the decimal system will save the country 11,000,000 pounds.

The United States conversion to metric would soon stimulate both U.S. and world economy. Once accomplished, there would develop a more facile relationship between science and industry, also between scientists and nonscientists. For example, the English-speaking public finds it quite impossible to place very small things, such as pesticide residues, in proper perspective. Quantitation of traces is not even attempted by the English system. Comprehension of many problems dealing with traces of biologically active materials is now in the public domain. Understanding the metric system enhances one's sense of measurement from the smallest to the largest, all in multiples of 10, and public understanding is an absolute necessity to progress through the maze of socio-technological problems now before us.

The metric system is either obligatory or permissive in every civilized country and none have abandoned it. Russia, China, Poland, Hungary, and all other Communist countries, including Cuba, converted long ago. Metric conversion will, of course, present more problems to the U.S. than to most other nations who have already changed, but it will confer proportionately more benefits to us. Doctors, pharmacists, and pharmaceutical companies already use the system as much as they can. This is because of its simplicity and nonambiguity in designation of small quantities. The U.S. Army has adopted the meter for linear distances and will, by 1966, use the metric system in all weaponry.

The American Institute of Nutrition last year specified metric system measurement and Celsius temperature scale for the *Journal of Nutrition*. Similar action is under consideration by the Poultry Science Association and the Society of Animal Science. The American Veterinary Medical Association recently adopted the Celsius temperature scale. A resolution favoring the metric system was adopted in 1962 by the Agricultural Research Institute for consideration by the Agricultural Board and the National Research Council, National Academy of Sciences.

A step forward occurs when each

scientific society takes similar action. Trade associations representing entire industries should at least tacitly support this movement. The Nutrition Council of the American Feed Manufacturer's Association voted in favor of the metric system in November 1962. Indeed, such a ground swell among scientists and engineers could conceivably influence Congress to implement conversion by law.

It was estimated in the 1961 hearings on the two metric system bills then before Congress that full conversion would take at least 33 years. The important thing then is to start. But H.R. 269 and H.R. 2049, both to appropriate funds to study the desirability and practicability of conversion, were summarily rejected.

Representative Miller of California, chairman of the House Committee on Science and Astronautics, is expected to introduce a similar bill in Congress this year, but the best way to gain a hearing is to substitute something more satisfying. One way which suggests itself is for educators to stress the metric system, largely excluding the English system and the use of fractions in grade and high school mathematics. The U.S. would soon have a generation, better oriented to science than any heretofore.

This is a national problem which scientists can help to solve by their united action in the adoption of the metric system which would hasten universal acceptance.

DOUGLAS V. FROST
Abbott Laboratories,
North Chicago, Illinois

Devaluation of the Dollar

I enjoyed the lucid account of our modern monetary system in James W. Angell's recent article [*Science* **138**, 1071 (7 Dec. 1962)] but I found the author's discussion of how the U.S. should deal with the stubborn payments problem far from persuasive.

Angell is of the opinion that our payments deficit, which in recent times has aggregated 3 or 4 billion dollars per year, can be eliminated by getting our European allies to assume an appropriate fraction of current U.S. expenditures for defense of Europe and aid to underdeveloped countries. Unfortunately, he presents no evidence to suggest that our allies will, in fact, assume this large burden. It is known that they have little sympathy with the

detailed structure of our present program of military and economic foreign aid, so it may be assumed that they would hardly agree to contribute such large sums without insisting on a drastic revision or abandonment of a great portion of that program.

I believe that a substantial devaluation of the dollar would permit the U.S. to balance its payments without abandoning its foreign commitments. Angell, in discussing this possibility, takes a rather negative view of the probable consequences of devaluation. In my judgment, he gives too little weight to the following points which appear to me to be in favor of devaluation:

1) U.S. price levels are generally too low by the internal test of profitability of business and industry, while they are at the same time too high in comparison with competitive world market prices. Devaluation of the dollar is the most direct means to bring the two kinds of price levels into a more healthy relationship.

2) A devaluation of the dollar large enough so that, loosely speaking, the purchasing power of dollars spent in the U.S. would somewhat exceed the purchasing power of dollars converted into some other hard currency and spent abroad, would define an important incentive for spending existing foreign-held dollar credits in the U.S., and would also weaken the existing trend to invest abroad preferentially.

3) Dollar devaluation would have a favorable effect on the trade balances of countries producing raw materials, since these countries would need to earn fewer dollars to pay for the required American manufactured goods. Thus devaluation could take the place of some of our present aid to such countries. At the same time, it would bring American and foreign commodity prices into a better relationship and permit a great simplification in the jerrybuild of tariffs, controls, and subsidies which is currently required as a buffer between the U.S. and world markets.

4) Provided the U.S. adopts a suitable mechanism of devaluation, there is small danger of other nations counteracting the effects of dollar devaluation by devaluating in turn their own currencies. The U.S. could, for example, suspend convertibility of dollars into gold, convert instead into other hard currencies at a new rate of exchange, and maintain this limited form of convertibility until a new equilibrium of

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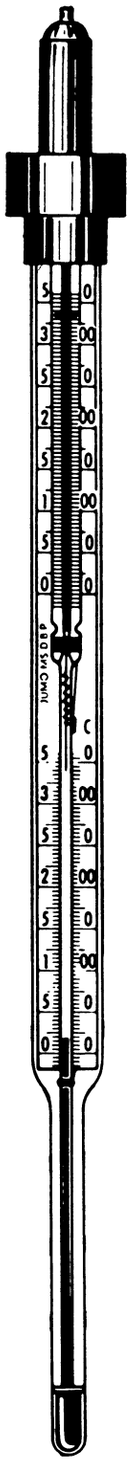

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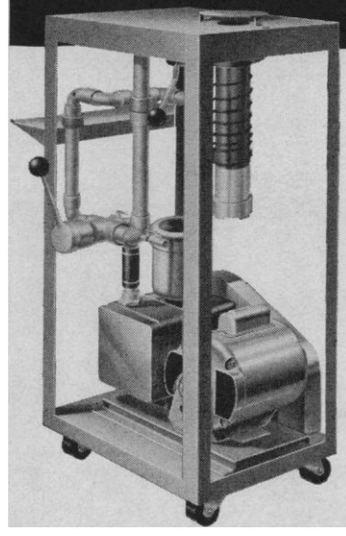

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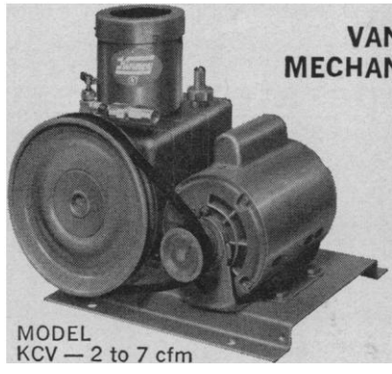

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the international monetary system was negotiated. In these circumstances foreign nations would have to accept the U.S. exchange rate since the great sum of dollar credits already held abroad could only be redeemed at that rate.

5) There is no obvious reason to be concerned about speculative pressure on a vast currency like the dollar in the absence of some compelling reason—like a large, continuing trade deficit—to doubt that the dollar will remain sound. It should further be recognized that mechanisms to relieve short-term pressure are actually an unfavorable factor in solving the long-term payments problem. Such mechanisms make it possible for our government to delay essential domestic reforms while things get worse.

E. N. ADAMS

Thomas J. Watson Research Center, P.O. Box 218, Yorktown Heights, New York

A not insubstantial volume of opinion among professional economists supports the general position that E. N. Adams advances in criticizing my article. I disagree for the following reasons:

1) To the extent that our internal product prices and costs rise in consequence of devaluation, or that our export prices, in dollars, are raised to capture the devaluation "profit," the gains that Adams foresees would be wiped out. His first paragraph, in considering U.S. profits, seems to require just such internal price increases. We have no formal price-control machinery in this country now, and I believe that internal price rises would soon offset all or most of the admitted initial benefit from devaluation. Much, though not all, previous experience supports this belief.

2) Our overall balance-of-payments deficit arises not from our merchandise trade but from our large net capital exports, especially of governmental capital. Adams does not and could not show that devaluation would relieve the latter pressure.

3) If we devalue once, we might easily devalue again. This prospect could well induce a flight from the dollar—even at the new lower exchange rate, after devaluation—that would actually intensify our present acute difficulties.

4) I do not share Adams' optimistic opinion that most of the other nations would quietly accept a substantial de-

valuation of the dollar, instead of devaluing themselves in partial or even complete reprisal. If they take the latter action, we will at best be left about where we started—and with international confidence in our currency badly shaken. If confidence is shaken, continued movements out of the dollar will again ensue—initiated both by foreigners and by Americans—and again our balance-of-payments pressures will be intensified, not reduced.

JAMES W. ANGELL
Department of Economics,
Columbia University, New York 27

Trap Water as well as Tap Solar Energy

The report "Weather control: use of asphalt coatings to tap solar energy" [*Science* **139**, 226 (18 Jan. 1963)] was of great interest. Assuming that the theory advanced has real potential, I should like to suggest that the black coating applied to earth surfaces be upgraded so that it provides a reasonably tough watertight covering. This being done, the black surface—in addition to tapping solar energy—could then be used to trap water.

If all the water that falls on an area were intercepted and conveyed to a storage structure, large quantities of high-quality water could be collected, even in arid regions. For example, in an area where the annual rainfall is 8 inches there are 217,800 gallons per acre; for 12 inches there are 326,700 gallons and for 18 inches, 490,050 gallons.

It has been demonstrated that by covering the ground with watertight materials (asphalt-coated fabrics, butyl rubber sheeting, and so forth) essentially all the precipitation in an area can be intercepted and collected (*1*). If the water collected is to be useful, it must be stored. Through the use of membrane-lined reservoirs and bags this can be accomplished at a lower cost than by the conventional methods of the past.

Should a study be undertaken to test the projected theory for tapping solar energy, water development should be considered as well. Research underway at the U.S. Water Conservation Laboratory, Tempe, Arizona, has shown that cationic asphalt emulsions are potentially useful for stabilizing and waterproofing soil for water development or harvest (*2*, *3*). The ground cover

method of developing water where unproductive land areas are available can be more economical than desalinization of ocean water, particularly for small isolated water needs. The unit cost of water thus developed is not predicated on multimillion dollar facilities or low-cost energy sources, as with desalinization methods, and is relatively the same for large or small developments.

C. W. LAURITZEN

Soil and Water Conservation Research Division, U.S. Agricultural Research Service, Logan, Utah

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Bench vs. Desk:
Dilemma for the Creative Scientist

There is a growing dilemma facing the scientific investigator who creates with his own head and produces with his own hands. The measure of a research scientist should be, as for any creative individual, based on creative output. But science is becoming big business and, in the process, is acquiring some business standards. One of these is an inclination to base the measure of a man's success more on leadership or executive ability than on creativity.

The recent Flemming awards are a good example of equating success with administrative responsibility and distorting the definition of a scientist. These awards are given to federal government employees under 40 years of age for outstanding achievements. The sponsors stipulate that five awards will go to administrators and the other five to scientists. This year, all the scientists receiving the award were directors or administrators and even included a contracting officer whose award was based on the scientific achievements of one of his contractees.

Has the time come when it is more rewarding to direct research than to do it? Can a scientist achieve recognition only as he acquires status in an administrative hierarchy and handles large sums of money? Does success depend on leaving the laboratory before the age of 40? The Flemming award is no isolated symptom. The administra-

tive magnitude of large programs, particularly in engineering, is obscuring the nature and importance of the working scientist.

Project directors, laboratory chiefs, and research directors are obviously important and they deserve their recognition. But the inference is strong that their functions are more important, rather than just different, and that such positions should be the ultimate ambition of every scientist. This social pressure to "advance" can become overwhelming.

True creativity in research demands an intuitive insight of uncommon quality, perhaps more characteristic of the artist than the executive. Where this has been highly developed, it should be nurtured and honored as a worthy achievement in itself, not merely as a rung on the administrative ladder.

Perhaps the givers of awards and the setters of salaries should take a second look at the criteria they are encouraging. If the laboratory becomes merely a way station to executive rewards, quality will suffer and the cause of science and society will not be served.

H. T. MERYMAN

Biophysics Division,
Naval Medical Research Institute,
Bethesda 14, Maryland

Effects of Penicillin

. . . In his discourse on the older history of observations concerning effects of penicillin on bacteria [*Science* **139**, 682 (1963)] Robertson Pratt appears concerned that one of our recent articles on the antimicrobal action of penicillin [*Science* **137**, 982 (1962)] does not refer to certain papers that were published nearly 20 years ago.

In our paper, "Concurrent morphological and chemical events in *Staphylococcus aureus* exposed to penicillin," we emphasized not the individual effects of the antibiotic, each of which has been observed individually and previously by others, but the contemporaneous nature of all these effects when recorded on a common time scale. Our statement, "lysis of *S. aureus* under the influence of penicillin has rarely been mentioned," represents a correct assessment of the state of the field even if one takes into account the early publications of Bonét-Maury and Pérault [*Nature* **155**, 701 (1945)] and of Nitti *et al.* [*Ann. Inst.*

Pasteur **70**, 80 (1944)] in addition to the two references we cited.

We are familiar with the papers by Dufrenoy and Pratt on cytochemical mechanisms of penicillin action [*J. Bacteriol.* **53**, 657 (1947); **54**, 127 (1947)], but their relationship to our own work seems to be peripheral mention of bacteriolysis. We wish to observe that neither Pratt nor ourselves have claimed to be original discoverers of the lysis phenomenon. . . .

FRED E. HAHN
JENNIE CIAK
Department of Molecular Biology, Walter Reed Army Institute of Research, Washington 12, D.C.

How Can Science Teaching Be Improved

High-level planning for improvement in science teaching has progressed to the point where scientists and educators are concerned about the programs in the elementary and high schools. More school administrators are becoming aware of the role science must play in the lives of our students and are ready to look in and work with the science teacher to up-date the local program. Industrial leaders, long the kidnappers of our best science teachers, are now loaning capable scientists to the classroom for brief periods to present new concepts with excellent equipment.

Each of these efforts is worthy of much discussion and exploration, but we can improve science teaching best by improving the teacher of science. Teachers are part-time employees. A position for 36 weeks with 16 weeks of unemployment each year is not a profession. A salary based on part-time employment is not the economic status of a professional.

A program providing 48 weeks of employment for our teachers each year—36 weeks in the classroom to educate the students, and 12 weeks of advanced training in a program for educating the teacher—would permit each teacher to keep up with the rapid expansion of knowledge and the best ways for transmitting it.

The salary for teaching 36 weeks would continue to be provided by the school district under the present financial structure. Then the national community could assume the financial responsibility of employing the teacher for the twelve weeks of advanced study. The dividends to the nation would far

exceed the financial participation of the federal government.

The usual objections to federal aid on the grounds of control of state and local schools, religion, and private organizations cannot apply here. The proposed federal aid would be directed to individuals for providing a staff of qualified science teachers to serve the children in *all* the nation's schools.

It is not too late to start improving teachers of science, math, English and other subjects by improving their educational proficiency and economic status. To attract the best young minds into the teaching profession and to meet the challenge of new and better programs of instruction for American schools, we must get down to counting time, money, and people.

OTIS W. ALLEN
Leflore County Schools, Greenwood, Mississippi

Manpower or Mindpower

Among the letters elicited by the editorial, "Manpower or Mind Power" (11 January 1963), were two expressing opposing viewpoints that seemed to represent the opinions of graduate students and graduate faculty respectively [*Science* **139**, 798 (1 March 1963)]. I would like to present impressions gained from association with recruitment activities in an industrial research laboratory.

Today's knowledgeable undergraduate knows that a graduate degree does not confer scientific prowess or creativity. He also knows that the Ph.D. is a prestige symbol, and he can estimate almost to the dollar his potential earnings both with and without this degree.

While graduate school administrators and professors respect the acquisition of research philosophy, techniques, and personal development as well as textbook knowledge, few students share this respect. They know that the top students get the top jobs, but with demand exceeding supply, almost every Ph.D. is assured of several job offers at salaries only slightly lower than those offered to the top men.

It is a paradox that while industry would like to hire more Ph.D.'s, it does not have enough research posts requiring their special training to utilize all the degree men it does hire. Therefore we see Ph.D.'s working as highly skilled laboratory technicians, doing routine analyses, or helping to commer-

cialize a process. It should come as no surprise then that many of these men become disillusioned and bored and decide to concentrate their efforts, not on research, but on the administration of research, especially when they discover the monetary rewards of a career devoted to keeping other Ph.D.'s happy at their non-research jobs.

The personnel departments know they do not have research jobs for all the Ph.D.'s they hire, but they also know that almost all the best B.S. students go on to graduate school. Thus, with company officials attaching so much importance to having a large number of Ph.D.'s on the staff it is now necessary to get Ph.D.'s for jobs once filled by outstanding B.S. graduates. Personnel policies of 20 years ago may have created this situation, but we cannot blame the personnel men of today who must staff their organization, get men wherever they can, and pay the going price.

These factors have already resulted in some B.S. students undertaking graduate studies even though they have neither outstanding ability nor a good undergraduate record and even though they have not developed a real interest in, or understanding for, research. Offering more financial support without some drastic changes in our school system will only dilute our graduate program with unqualified candidates. This will add to the faculties' problems and present examining committees with the thankless task of deciding whether they can refuse to grant a degree without achieving the reputation of being a "difficult" school and placing their graduate program in jeopardy.

J. R. McKLVEEN
6018 Rio Vista Drive,
Corpus Christi, Texas

Fish Flour

It is very disturbing to me to read in a journal of such high standing as *Science* a news article [*Science* **139**, 891 (8 March 1963)] advocating adulteration of our food supply and holding the Food and Drug Administration blameworthy for their very proper refusal to approve a food which frankly contains filth.

Let me make only this comment. Fresh horse feces commonly contain much undigested food material which, when strained out from a slurry of the feces with water and then sterilized

by heat, will provide wholesome and nourishing food. But I do not want any of that introduced into my food supply; neither does news writer Greenberg want it in his.

One could not permit the filth in whole fish flour without destroying all enforcement of laws against whatever filth any producer might incorporate in food if he sterilizes that filthy food.

LEO B. ROBERTS
Alabama Department of Agriculture and Industries, Montgomery

Since there is no compelling reason for converting horse feces into human foodstuffs, I share Roberts' opposition to such a venture. But what does that have to do with fish flour? There is a compelling need for a cheap, nonperishable protein concentrate to improve the well-being of vast numbers of persons in this hungry world. Fish flour shows promise of filling this need, and it therefore deserves an appraisal unclouded by emotionally loaded words. Properly processed fish flour is wholesome and beneficial. The minimal amounts of undesirable materials that go into its manufacture are almost entirely removed in the production process. The National Academy of Sciences has concluded that the final product is biologically acceptable for human consumption. It might be pointed out that the U.S. government sets maximum tolerances for rat feces in wheat. It does not say there should be none; it says there should be no more than a certain amount. Perhaps Roberts and I can discuss this some day over sardine sandwiches, though, here again, we are dealing with the whole fish.

—D. S. GREENBERG

What Machines Cannot Do

Surely the answer to von Neumann —"If you will tell me precisely what it is that a machine cannot do, then I can always make a machine which will do just that" [*Science* **139**, 216 (12 April 1963)]—is: to encapsulate umpteen hundred million years of evolution and reproduce it in nine months; also, to inherit and, after a few years education, draw upon umpteen hundred thousand years accumulation of material, culture, and knowledge.

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