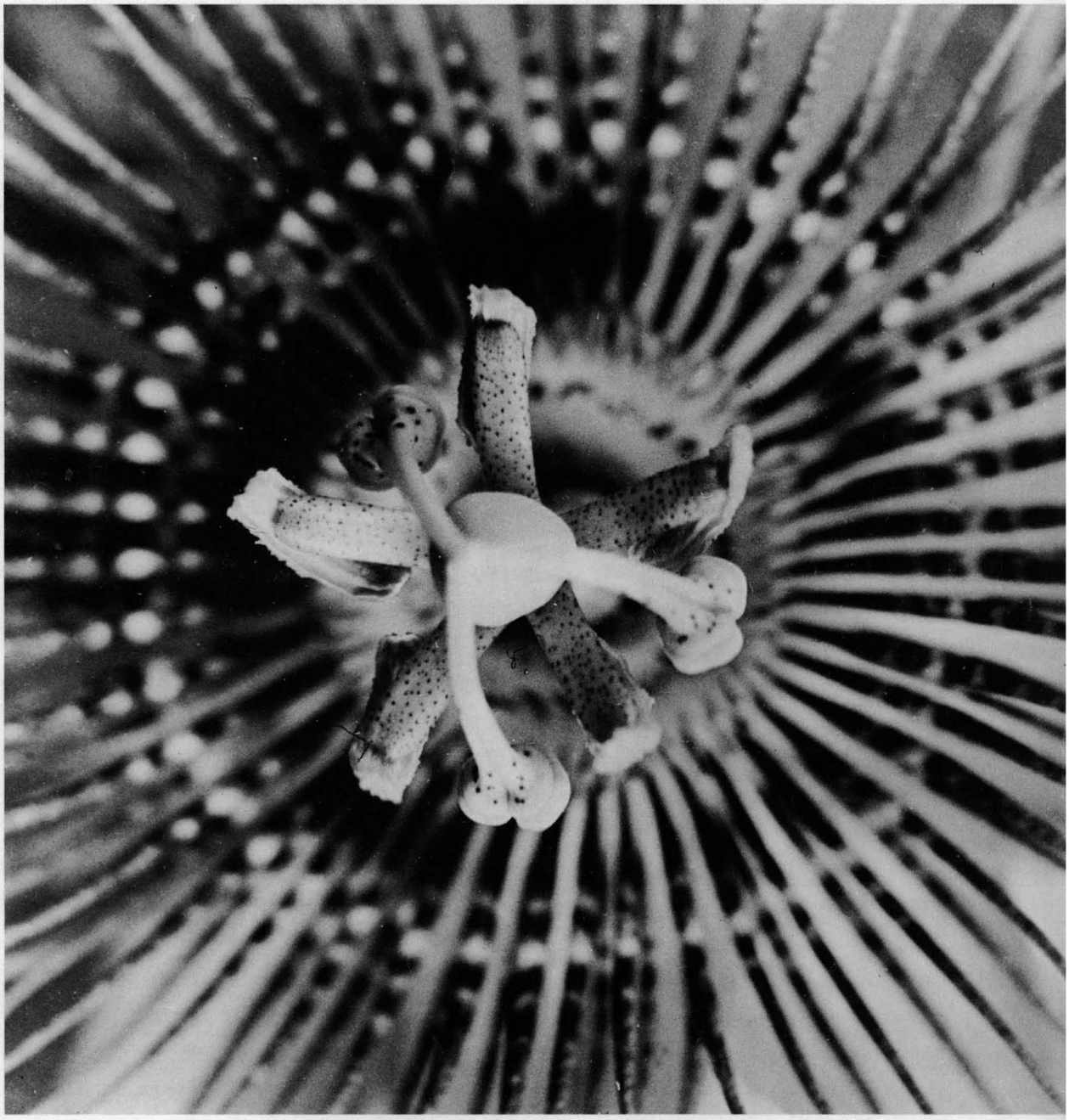
SCIENCE

16 February 1962

Vol. 135, No. 3503

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



Proceedings Issue

New satellite will peel back the sky

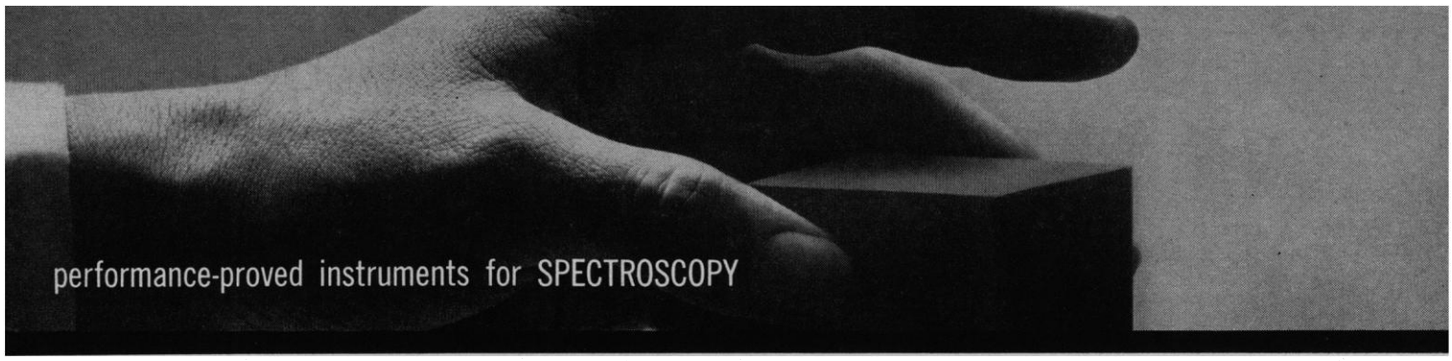
IBM® scientists are now developing an electronic memory system for a satellite that will study the stars from high above the Earth's atmosphere.

While the sky seems transparent enough, it makes a poor window for astronomers. The atmosphere acts as a filter, blocking important information from earth-bound instruments. By putting their telescopes into orbit 500 miles above the atmosphere, astronomers hope to obtain valuable new scientific data about the age and composition of planets, stars and galaxies.

The orbiting observatory is planned for launching in 1963 by the NASA–Goddard Space Flight Center. It will contain a compact, highly reliable IBM system for processing and storing data. This system will receive radio commands from Earth, store them, and tell the observatory where to point its instruments. It will then collect the observations for periodic relay back to Earth.

Seeing the heavens more clearly will help scientists clear up many problems long unsolved. Whether you are a scientist or a businessman, IBM developments can also uncover solutions to your problems.

SCIENCE is published weekly by the AAAS, 1515 Massachusetts Ave., NW, Washington 5, D.C. Second-class postage paid at Washington, D.C., and additional mailing office. Annual subscriptions: $8.50; foreign postage, $1.50; Canadian postage, 75¢.



HIGH-ORDER ACCURACY AND VERSATILITY WITH PERKIN-ELMER BUILDING BLOCKS

If your requirements for physical measurement include unique spectroscopic instrumentation, chances are they can be met with Perkin-Elmer building block components, or with special instruments designed around them. Among the "building blocks" are separate sources, a variety of prism and grating monochromators, detectors, and associated optical and electronic components. They afford maximum versatility in tailoring the instrument to the problem.

Typical of the Perkin-Elmer instruments designed from building blocks are:

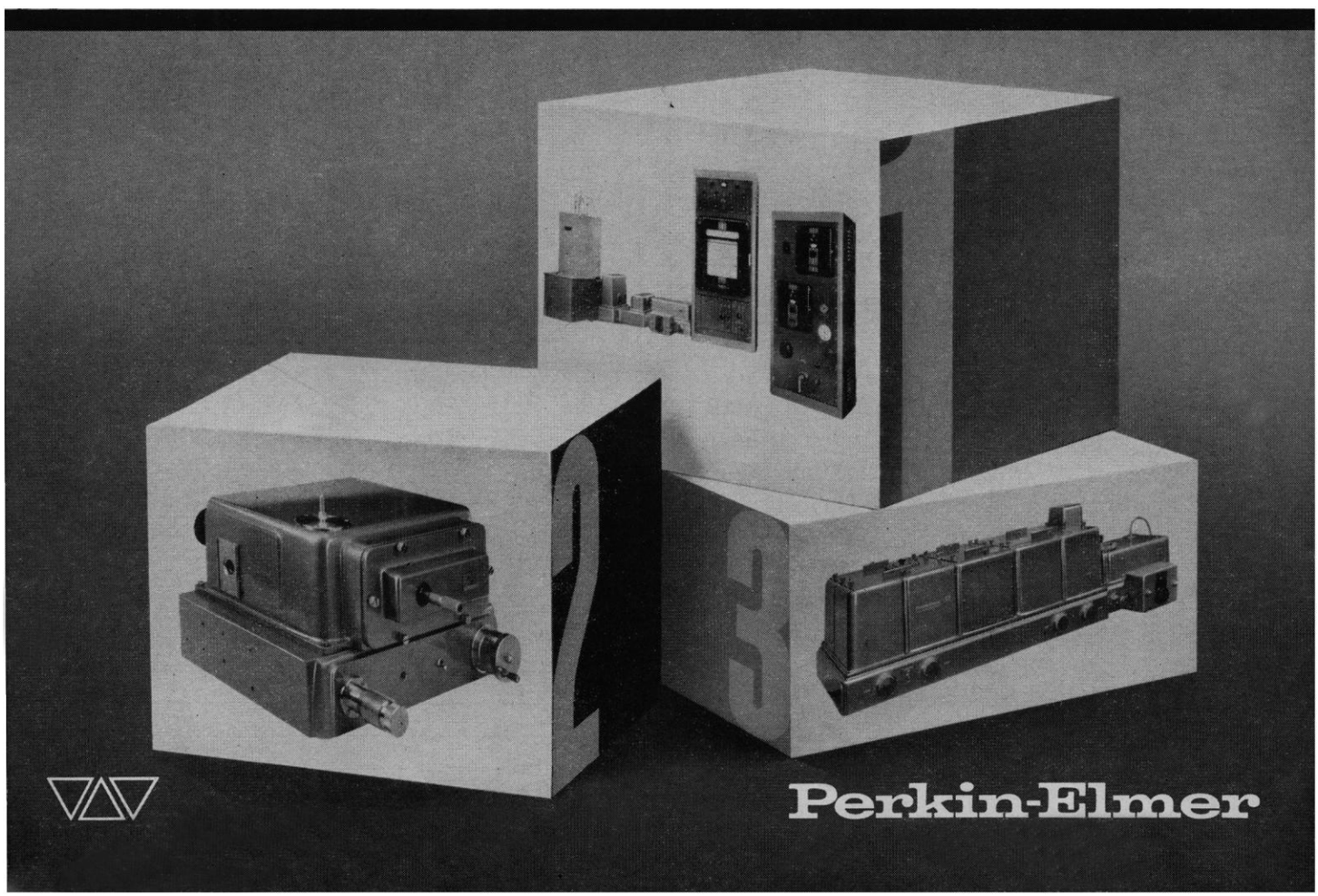
1. Model 205 Infrared Reflectometer, to measure the total diffuse reflectance and emittance of solid materials. Spectral reflectance in the infrared region as well as spectral emissivity as a function of temperature can be measured.

2. Model 108-A Rapid Scan Monochromator, to scan the spectral range of one prism at several discrete frequencies at a rate of 3 to 150 spectra per second, in the study of flame sources, rocket engine exhausts and other transient phenomena.

3. Model 301 Far Infrared Spectrophotometer, a double-beam direct transmittance recording instrument which operates in the region from 15 microns to 180 microns. The linear-in-wavenumber monochromator has a dual grating mount and provides a continuous scan over the first order range of each grating. A complete detector and electronic system with recorder is part of the instrument.

With Perkin-Elmer building block systems, it is possible to compare the spectral response of all types of detectors to a reference thermocouple on a direct recording basis, or to measure the absolute spectral radiance of intense continuous light sources such as solar light simulators.

For details on building blocks and special instruments, contact the Instrument Division, Special Laboratory Instruments, Perkin-Elmer Corporation, 910 Main Avenue, Norwalk, Connecticut.



16 February 1962, Volume 135, Number 3503

SCIENCE

SPECIFICATIONS:

Scale span: 1, 2, 5, 10 pH units and 100, 200, 500, 1000 millivolts.

Scale accuracy: ¼ percent.

Bridge power: mercury batteries.

Scale width: 240 mm, graduated in 100 units.

Displacement: continuously adjustable, direct reading to 10 pH units or 1000 millivolts plus and minus.

Input: direct potentiometric or pre-amp with 1:1 feedback stabilized electrometer.

Drive speeds: controlled automatic, fast constant and slow constant. Charts and burettes synchronized.

Burettes: motorized, precision, glass, displacement type with interchangeable 50 ml and 10 ml plungers and barrels, with fast refilling and flushing motors and automatic safety switches.

Delivery rates: approximately 10 ml per minute maximum, 1/15 ml per minute minimum.

Burette accuracy: 1/10 percent.

Stirring: magnetic variable speed.

Balancing speed: 3⅓ seconds full scale.

Automatic stop: precisely adjustable, cam actuated with ¼ scale overrun, restarting, repeating.

Polarizing adapters: interchangeable, plug in, mercury battery powered.

Burette fittings: interchangeable, duplicate for either flexible tubing or all glass interconnection, the latter with standard taper and ball joint unions and Teflon stopcock plugs.

Speed controller: derivative actuated, proportional to rate of change of signal.

Beaker supports: swinging, height adjustable, with self-contained stirring motors.

Recorded functions: fundamental signal or first derivative.

Structural materials: polished 18-8 stainless steel, aluminum and Bakelite.

Dimensions: height, 26 inches; width, 22 inches; depth, 15 inches.

Net weight: 95 pounds.

Power requirement: 115 volt, 60 cycle A. C.; 150 watts. Available on special order for operation from 50 cycle current.

S-29685 TITRATOR—Dual, Recording, Potentiometric, Automatic Rate Controlling, Glass or Metal Electrode, Sargent, Model D (Pat. No. 2,931,964); with standard equipment, without electrodes Price.....$2,850.00

For complete information, contact your nearest Sargent representative—or write for Bulletin D.

E. H. SARGENT & CO., 4647 W. FOSTER AVE., CHICAGO 30, ILLINOIS
Detroit 4, Mich. · Dallas 35, Texas · Birmingham 4, Ala.
Springfield, New Jersey · Anaheim, California

SARGENT
Scientific Laboratory Instruments
Apparatus · Supplies · Chemicals

LEITZ PANPHOT
FOR RESEARCH AND PHOTOMICROGRAPHY
LARGE OR SMALL FORMAT

Think of any problem in photomicrography requiring any type of microscope . . . illumination . . . or light measurement. Now examine the Leitz Panphot. You'll find it has all the important features and accessories that specialize the Panphot for almost any field of microscopic observation and illumination.

Transmitted light	**Phase contrast**	**Micro-projection**
Incident light	**Polarized light**	**Micro-cinematography**
Bright field	**Fluorescence light**	**Photomicrography**
Dark field	**Micro-drawing**	**Macro-photography**

MAJOR FEATURES OF THE PANPHOT PHOTOMICROGRAPHIC SYSTEM

• 4" x 5" reflex or 35mm Leica with micro-reflex • Front viewing and controls • Rotatable back* to orient negative • Accepts Leitz Orthomat for fully automatic 35mm photomicrography • Instant change from monocular or binocular observation to photomicrography • Instant switchover from filament to arc or Xenon lamp • Permanent centration of illumination

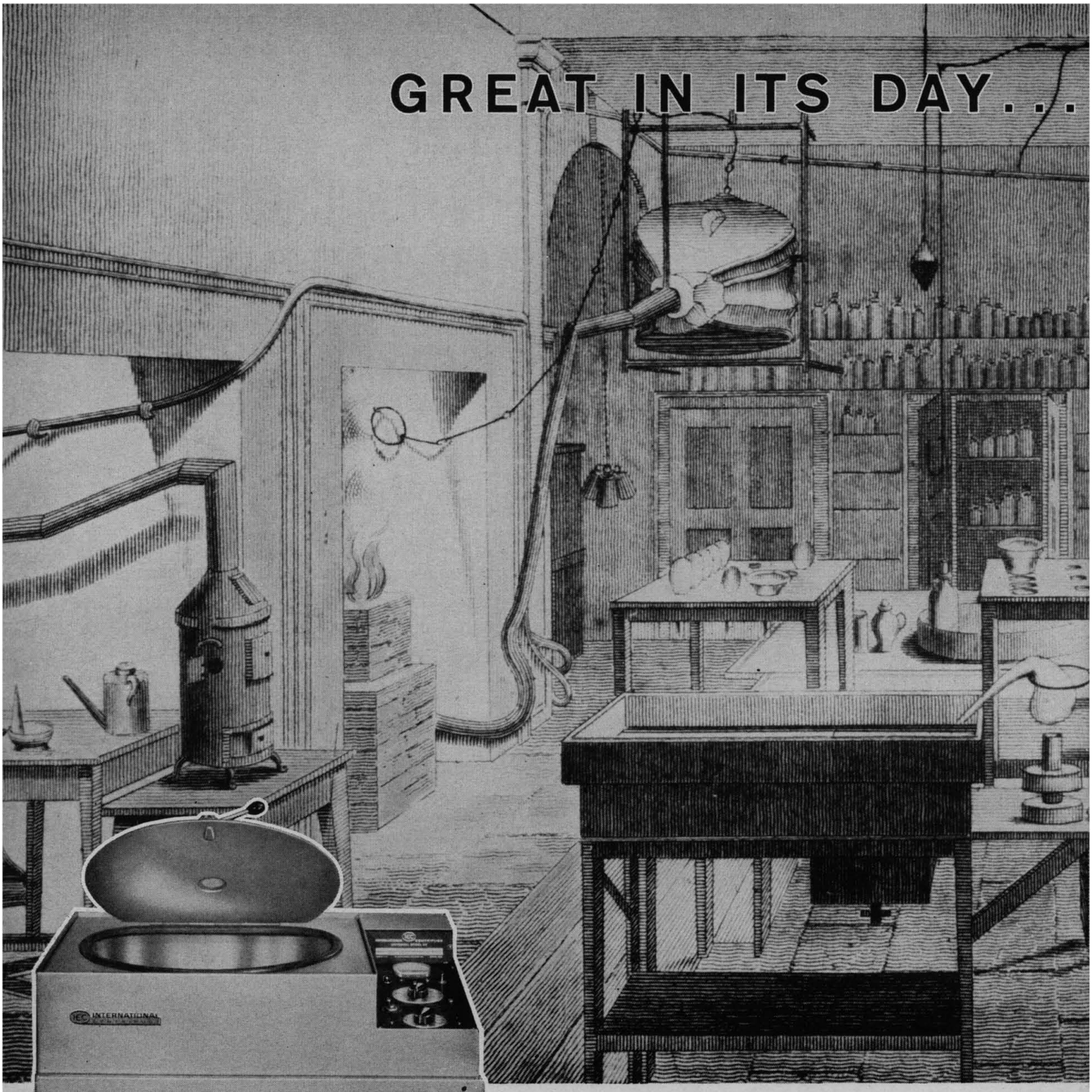
*Optional

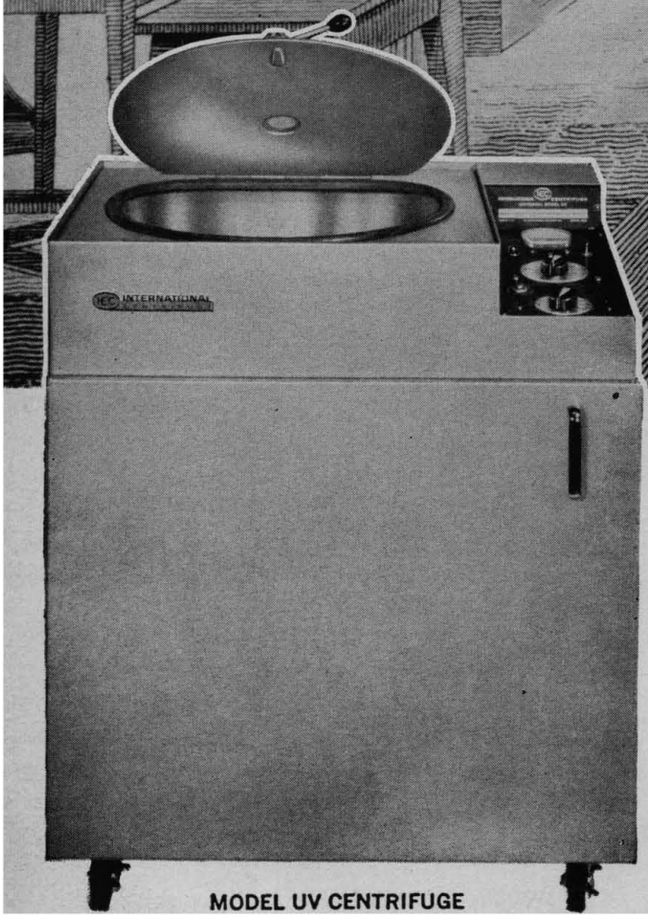
43662

Leitz

E. LEITZ, INC., 468 PARK AVENUE SOUTH, NEW YORK 16, N. Y.
Distributors of the world-famous products of Ernst Leitz G. m. b. H., Wetzlar, Germany—Ernst Leitz Canada Ltd.
LEICA AND LEICINA CAMERAS · LENSES · PROJECTORS · MICROSCOPES

GREAT IN ITS DAY...





MODEL UV CENTRIFUGE

Once the pride of its times, it served Sir Humphrey well but today is hopelessly outmoded.

Centrifuges become obsolete, too... even if still serviceable. But under today's pressures, mere serviceability is insufficient reason for retaining a machine. A laboratory's ability to maintain high standards of quality and service is related directly to its equipment.

That's why there is so much interest in International's modern design CS & UV general purpose centrifuges. They're extremely versatile and convenient, handle a wide range of work easily, efficiently and reliably day after day over a heavy schedule.

Sir Humphrey Davy's Laboratory

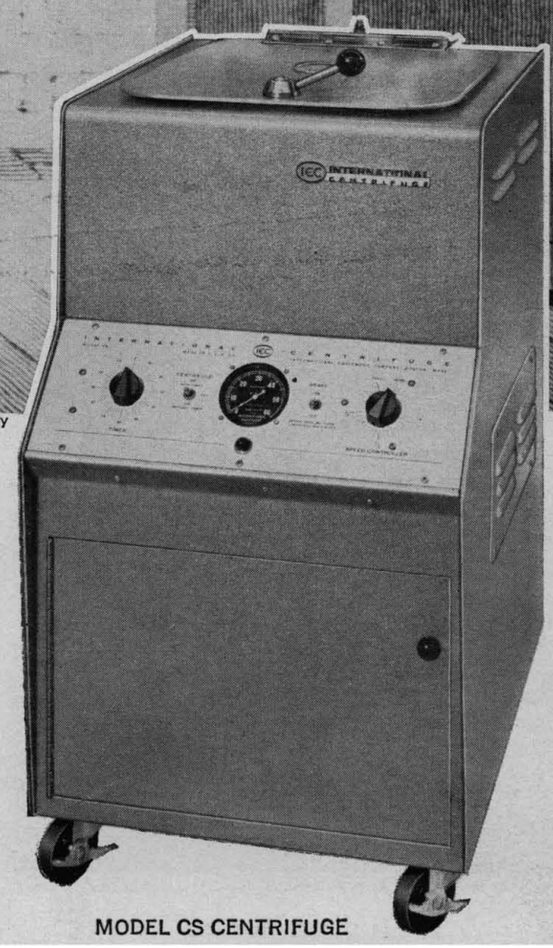
Illustration courtesy Harvard Library

Which to select? It's largely a matter of matching your work with centrifuge characteristics. Both are low cost. The CS takes 75 different accessories. Speeds up to 5600 rpm, has an electric brake, 2 hour timer, stainless steel guard bowl, speed controller, continuous reading tachometer and numerous other features. Excellent for swinging medium size volumes.

The UV has all these features but accepts more accessories, swings larger volumes, and handles a greater variety of work. Send for bulletins FC and I and make your own comparison.

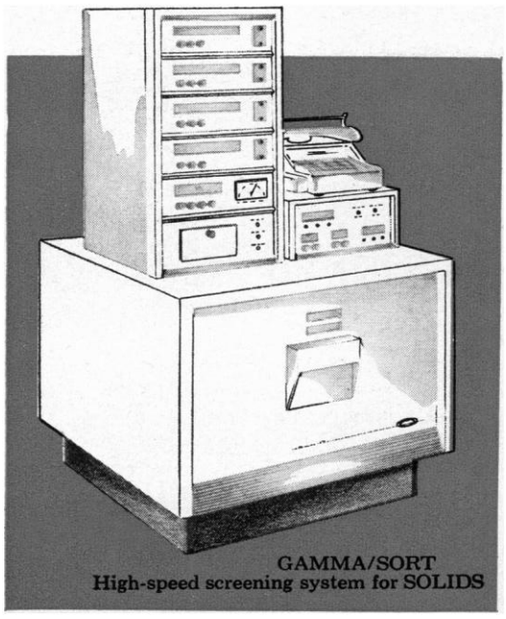
INTERNATIONAL (IEC) EQUIPMENT CO.

1284 SOLDIERS FIELD ROAD • BOSTON, MASSACHUSETTS



MODEL CS CENTRIFUGE

INTRODUCING the LOW GAMMA LINE



GAMMA/SORT
High-speed screening system for SOLIDS

The GAMMA/SORT — GAMMA/FLO Systems are high-speed radioactivity counting systems designed for the specific purpose of rapidly monitoring large quantities of food and water supplies for fallout contamination.

These Systems are sensitive, reliable, and versatile instruments that can be operated by unskilled personnel. They count radioactivity in all types of bulk and packaged foods, as well as liquid, without sample preparation, measure contamination in each item in shorter time periods than any other available monitoring system. They are also equipped for automatic and permanent recording of all measurements taken.

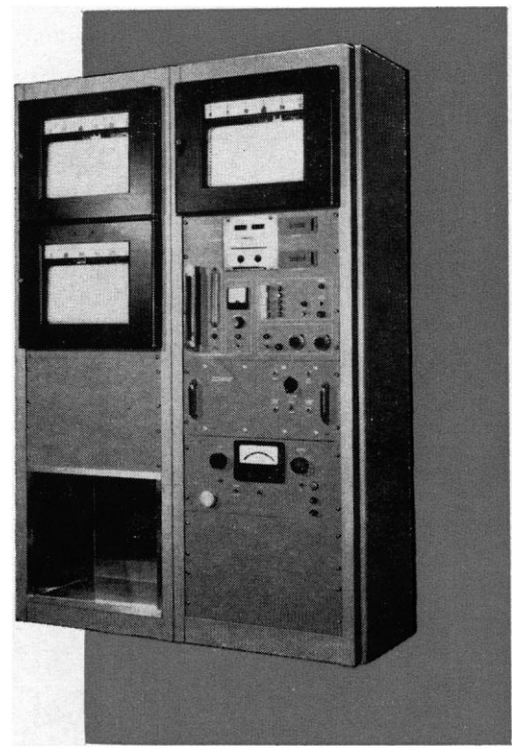
These Systems are available to federal, state, and local governmental agencies which will be responsible for monitoring food supplies and taking regulatory action if hazardous rates of contamination are found. They are also available to commercial food producers, processors, and distributors who wish to establish the safety of their supply sources.

Advantages:

- No sample preparation necessary
- Ultra-high sensitivity (instantaneous reading of fallout concentration)

The GAMMA/SORT and GAMMA/FLO Systems feature:

- Detector geometry better than 3π
- Detector scintillator volume greater than 30 liters
- Unique optical design results in fewer photomultipliers
- Newly designed solid state electronics
- Coincidence and anti-coincidence circuits provide discrimination and cosmic-ray rejection
- Four inches of selected low background lead shielding
- Detect 10 micro-microcuries per liter in less than 3 minutes
- Solid state interrogator, translator, coder and IBM typewriter read-out
- Pre-set alarm system



RESPIRATORY GAS ANALYZERS (4 different models to choose from)

ADVANTAGES:

- Continuous monitoring, measuring, analysis of exhaled respiratory gases
- Detect and measure key gases such as: $C^{14}O_2$, CO_2, O_2, etc.

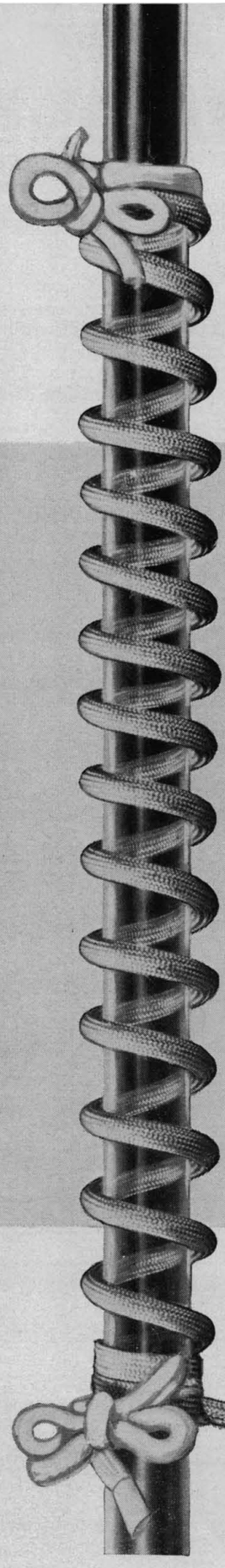
FEATURING

- Data computation, such as: Respiratory quotient, C^{14} specific activity
- All vital data continuously integrated, coded and printed
- Precise control of temperature, flow and pressure.

For detailed information write to:

General Measurements
DIVISION OF PRECISION SCIENTIFIC COMPANY GM

General Measurements
Division of Precision Scientific Company
Garnerville, N. Y.



High temperature in a hurry with CAL-CORD* for the lab

Just wrap it and plug it in...

This reliable, cord-type heating unit was developed specifically for laboratory work. Easy-to-use Cal-Cord is as flexible as an appliance cord. Delivers uniform temperatures up to fabric limits of 400°C for glass fabric, or 600°C for quartz fabric. Paralleled ribbon-type heating elements terminate at one end into a single twistlock connection for joining to supply cord. No troublesome, unsafe loose terminals on the ends. Cal-Cord comes complete with power supply cord and plug. Eight new sizes now available.

Cal-Cord Specifications

	Cat. No.	Length	Wattage	Price
400°C Medium Cal-Cord Made of glass fabric material	C-C 2	2 ft.	80W, 115V	$ 6.50
	C-C 3	3 ft.	120W, 115V	9.00
	C-C 4	4 ft.	160W, 115V	11.00
	C-C 6	6 ft.	240W, 115V	15.00
	C-C 8	8 ft.	340W, 115V	19.00
	C-C 10	10 ft.	400W, 120V	23.00
	C-C 12	12 ft.	480W, 220V	27.00
	C-C 14	14 ft.	560W, 220V	31.00
	C-C 16	16 ft.	640W, 220V	35.00
600°C Super Cal-Cord Made of quartz fabric material	**Cat. No.**	**Length**	**Wattage**	**Price**
	SC-C 2	2 ft.	200W, 115V	$ 8.00
	SC-C 3	3 ft.	300W, 115V	13.75
	SC-C 4	4 ft.	400W, 115V	16.75
	SC-C 6	6 ft.	600W, 230V	19.50
	SC-C 8	8 ft.	800W, 230V	25.50

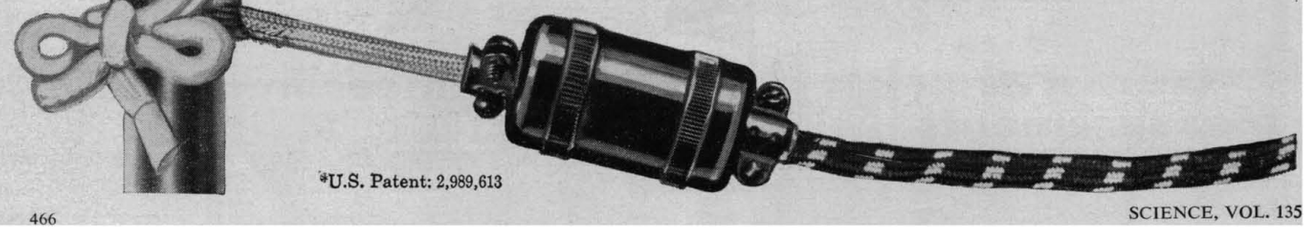
Cal-Cord Temperature Control

Thermolyne Stepless Type 800 temperature controller is ideally suited for use with any Cal-Cord. Specifications: 1500W, 115V; maximum amps, 13. Price $15.75.

For additional information, please write to . . .

Glas-Col Apparatus Company / Dept. SC, 711 Hulman St., Terre Haute, Indiana

World's largest manufacturer of heating mantles for laboratory, pilot plant, and chemical process heating applications



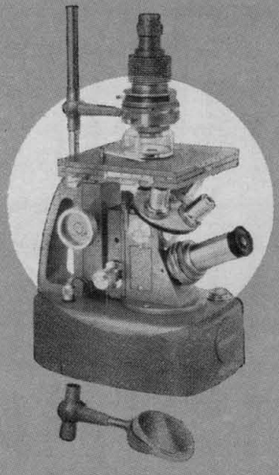
*U.S. Patent: 2,989,613

THE BIO-LOGICAL BUY IN MICROSCOPES

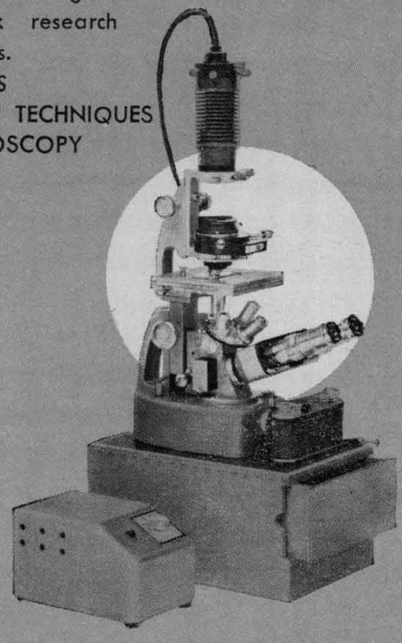
UNITRON INVERTED MODELS...

are proving to be the most logical and versatile design in all fields of the biological sciences, whether for complex research studies or for routine lab analyses.

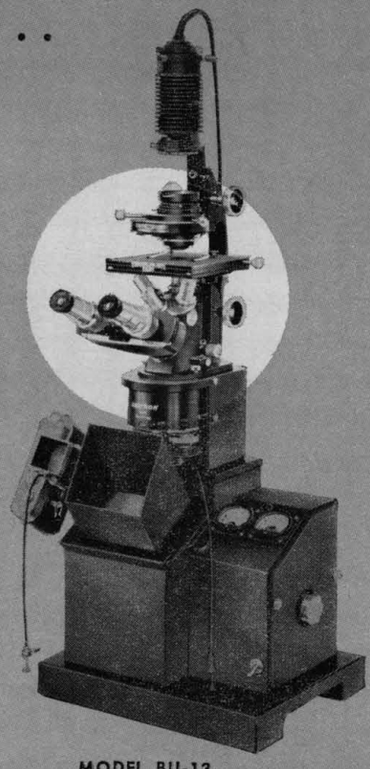
IDEAL FOR
- TISSUE CULTURES
- HANGING-DROP TECHNIQUES
- GENERAL MICROSCOPY



MODEL MIC



MODEL PH-BMIC



MODEL BU-13

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:

MONOCULAR MODEL BR-MIC. Five brightfield objectives 5X, 10X, 20X, 40X, 100X (oil); eyepieces 5X, 10X, 15X; rack and pinion condenser mechanism with individual centering adjustments for condenser and illuminator; elevating compartment provides handy storage for accessories. **$545.**

BINOCULAR MODEL BR-BMIC. Binocular version of Model BR-MIC, with camera mechanism. **$745.**

Phase Research Models:

MONOCULAR MODEL PH-MIC. Eight phase objectives 10X, 20X, 40X, 100X (oil) in both bright and dark-medium contrast; eyepieces 5X, 10X, 15X; high intensity Koehler-type illuminator; five-choice intensity transformer; phase turret condenser with aperture for brightfield; elevating base. **$812.**

BINOCULAR MODEL PH-BMIC. Binocular version of Model PH-MIC plus built-in camera mechanism. **$1012.**

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.

CAMERA-MICROSCOPES

The all-purpose microscope for visual examination, screen viewing and photomicrography. Built-in 3¼" X 4¼" camera with four flat field photo-eyepieces on revolving turret. Accessory attachments for 35mm., Polaroid, and movie cameras. Low-power (5X–40X) accessories available. Needs only 9" x 12" table space.

Brightfield Research Models:

MONOCULAR MODEL U-12. Same objectives and visual eyepieces as Model BR-MIC. **$1195.**

BINOCULAR MODEL BU-12. Binocular version of Model U-12. **$1379.**

Phase Research Models:

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

BINOCULAR MODEL BU-13. Binocular version of Model U-13. **$1580.**

Only UNITRON Inverted Microscopes Offer ALL These Advantages

accommodates slides, wet mounts, special glassware, warming chambers and micro-manipulators ● unobstructed stage for easy access ● built-in, correct intensity illumination ● glare-free coated optics ● special petri dishes for observation of cultures even by highest power oil immersion objective ● graduated mechanical stage ● accessory camera attachments ● long working distance 40X objective and other accessories also available

ASK FOR A FREE 10-DAY TRIAL. You be the judge in your own lab. Select the model you want. Then fill out and mail the coupon. Microscopes sent and returned at our expense. You assume no obligation. Or if you want more data on these and other UNITRON microscopes, use coupon to request our complete catalog.

UNITRON

INSTRUMENT COMPANY • MICROSCOPE SALES DIV.
66 NEEDHAM STREET • NEWTON HIGHLANDS 61, MASS.

☐ I'd like to try UNITRON Model ..... absolutely free for ten days with no obligation. Send details.

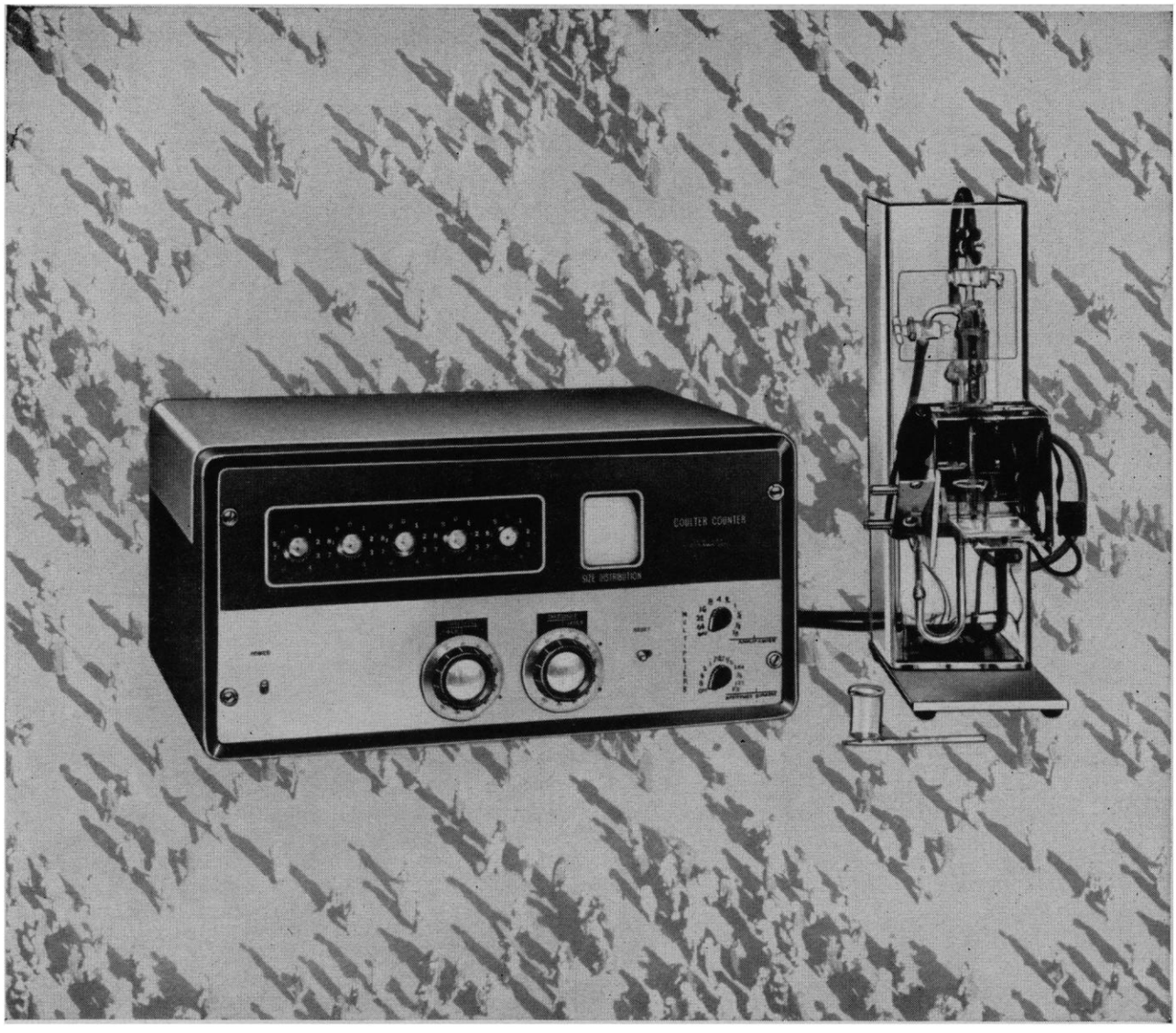
☐ Send me your complete catalog #4Y-3

NAME _____

ORGANIZATION _____ DEPT. _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____



Coulter Biological Particle Counter...

pity the census can't use it

They could count and size the population anytime if the Coulter Counter® counted people. But it's designed for biological populations; counts and sizes such particles as blood cells, bacteria, spores, pollen, plankton, algae, tissue cells, etc.

The Coulter Counter is fast, accurate and convenient. Position the sample, and the instrument does the rest, operating on the principle of electrical conductivity differences between cells and common diluents.

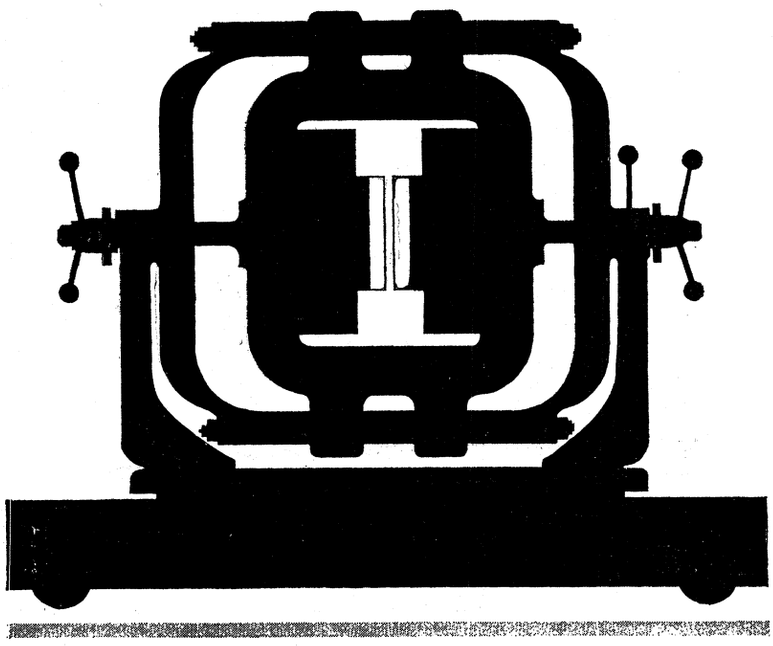
Particle size distribution studies can be made manually with the Model "A" and automatically with the Research Model and Plotter.

B3130-1—Model "A".....**$3550.00**
B3135—Research Model.....**$4850.00**
B3140—Automatic Plotter.....**$1950.00**

If you have biological particles to count,
ask your S/P Representative for complete literature or a demonstration . . . or write . . .

scientific products
DIVISION OF AMERICAN HOSPITAL SUPPLY CORPORATION
GENERAL OFFICES: 1210 LEON PLACE, EVANSTON, ILLINOIS
Regional Offices: Atlanta · Boston · Charlotte · Chicago · Columbus · Dallas · Detroit · Kansas City
Los Angeles · Miami · Minneapolis · New York · San Francisco · Seattle · Washington
Export Department—Flushing 58, L. I., New York. In Canada: Canadian Laboratory Supplies Limited.
In Mexico: Hoffmann-Pinther & Bosworth, S. A.

The NEW Versatility In Magnets



A **completely** versatile electromagnet — the new Model L-76V adjustable gap seven inch magnet by Harvey-Wells.

The Model L-76V, available for immediate delivery, affords the user, in one unit of precision equipment, the variety of electromagnetic properties more usually found only by the use of several magnets, each serving a different application.

Like all Harvey-Wells magnets, the Model L-76V has a cast frame and low impedance tape-wound coils, for highest efficiencies in air gap accessibility and power utilization.

It features full rotation about both the vertical **and** horizontal axes. **Forty-three** different air gap geometries from ¼ inch to 5⅝ inches are obtainable with one set of pole caps by use of precision ground insertion blocks.

The Model L-76V is specifically designed for use with either the Model HS-1050 or Model S-735 magnet power supplies by Harvey-Wells. Current, power and stabilization is thus matched to the specific needs of each user.

Typical performance characteristics are:

Field strength in excess of 16,000 gauss

Homogeneity of 1 part in 100,000 over two cubic centimeters

For information on how this, or other magnet systems by Harvey-Wells can solve your research needs, write to

HARVEY-WELLS CORPORATION

FRAMINGHAM, MASSACHUSETTS

Other magnet systems available: 2½ inch, 7 inch, 12 inch, 15 inch, 23 inch, each with matching regulated power supply. Also NMR gaussmeters and field control units.

VARIAN associates
611 HANSEN WAY, PALO ALTO 18, CALIF.

INSTRUMENT DIVISION

MEMORANDUM

SUBJECT: Pittsburgh Spectroscopy Conference, 1962

Varian's introduction of the revolutionary A-60 spectrometer took the 1961 Pittsburgh Conference by storm. Here's a preview of Varian at Pittsburgh for 1962.

We will show a new variable temperature accessory for the A-60 spectrometer, further extending the versatility of this instrument. The attachment will allow sample temperature to be varied over a range of 0°C to +200°C.

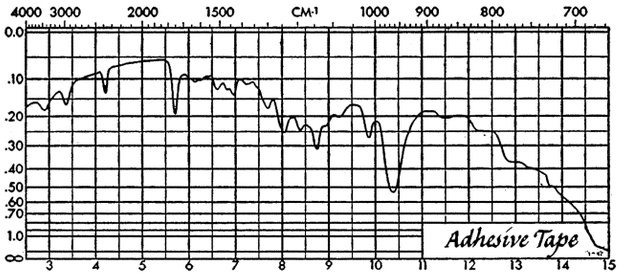
Also featured will be an advanced EPR system, applicable to many chemical disciplines. This system includes a new 9" electromagnet with EPR performance capability equalling that of a 12" magnet; a new transistorized 7 kW power supply; improved switching circuits for ease of operation; and a complete line of research accessories, such as electrolytic cells, superheterodyne detectors, and rapid-flow mixing chambers.

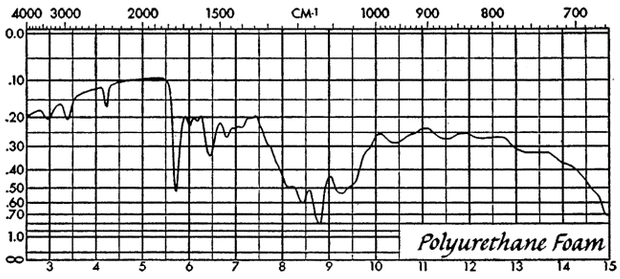
This improved EPR system also includes a double-resonance cavity, providing a new technique for line-width calibration.

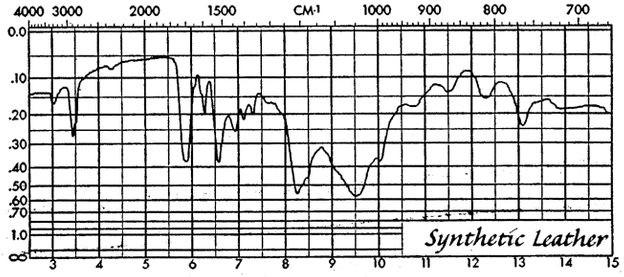
Another Varian contribution to spectroscopy will be a new NMR Spectra Catalog, including 368 spectra. The spectra are pre-calibrated and cross-indexed by chemical shift, functional group, and chemical name.

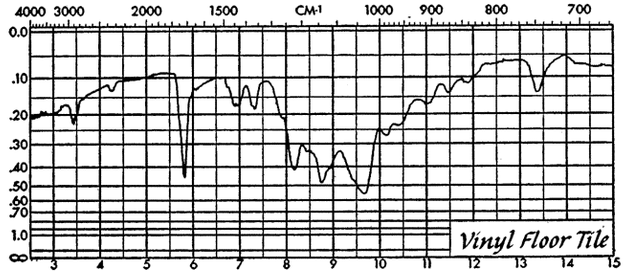
We will demonstrate our new G-14 graphic strip chart recorder, which features instantly-selectable multiple ranges down to 1 mV, ideal for gas chromatography.

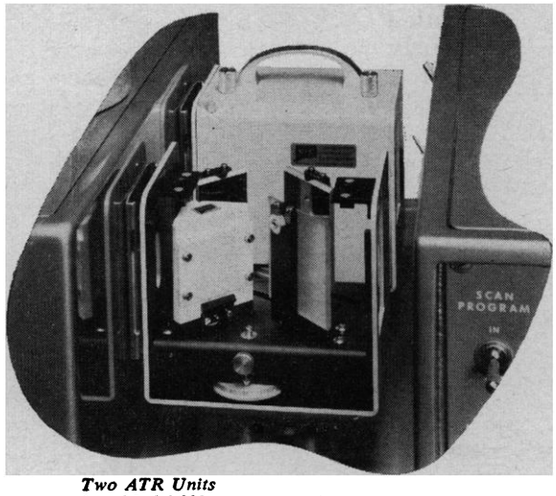
P.S.: Basic research chemists should look for an important andvancement in our HR-60 NMR system — proton high-resolution studies at ??,000 gauss.











Two ATR Units in a Model 221

ATTENUATED TOTAL REFLECTANCE

. . . a new infrared sampling technique of tremendous promise for the analysis of hitherto impossible samples.

Imagine being able to analyze by means of infrared a piece of floor tile, the coating on a paper board, a liquid detergent, the lubricant film on a piece of metal, the plastic bag on a package, a painted surface or a blob of toothpaste — directly, without special sample preparation and without regard to sample thickness. All of these analyses are quite feasible by means of Attenuated Total Reflection, a new infrared sampling technique, exclusively available from CIC. ATR spectra are nearly identical to conventional absorption spectra and are produced quickly and simply with the CIC ATR attachment on most infrared spectrophotometers.

Write for complete information on ATR — or better yet — send us a sample (if it is a solid piece, please cut it to 20 x 30mm) and we will run an ATR curve on it for you.

CIC

CONNECTICUT INSTRUMENT CORPORATION

DANBURY ROAD, WILTON, CONNECTICUT

A SUBSIDIARY OF BARNES ENGINEERING COMPANY

CES tackles one of the toughest sterilization jobs of all time

The problem is to keep our space probe vehicles completely free from earthly contamination—to keep our celestial neighbors pure for biological study. To this end, the National Aeronautics and Space Administration has awarded a research contract to the Castle Company for development of procedures for the sterilization of space craft components.

It's a complex problem. The thousands of components required contain all types of metals, plastics, fibers, synthetics — all different in composition and reaction to sterilization—all presenting different problems of accessibility.

But it's the challenging kind of problem that CES—the Castle Engineered Sterilization program—is uniquely qualified to tackle. Because whatever the product—from catheters to coconuts; whatever the sterilization method—steam, dry heat, gas, radiation, chemical—CES has the experience and the research facilities to provide the practical answer.

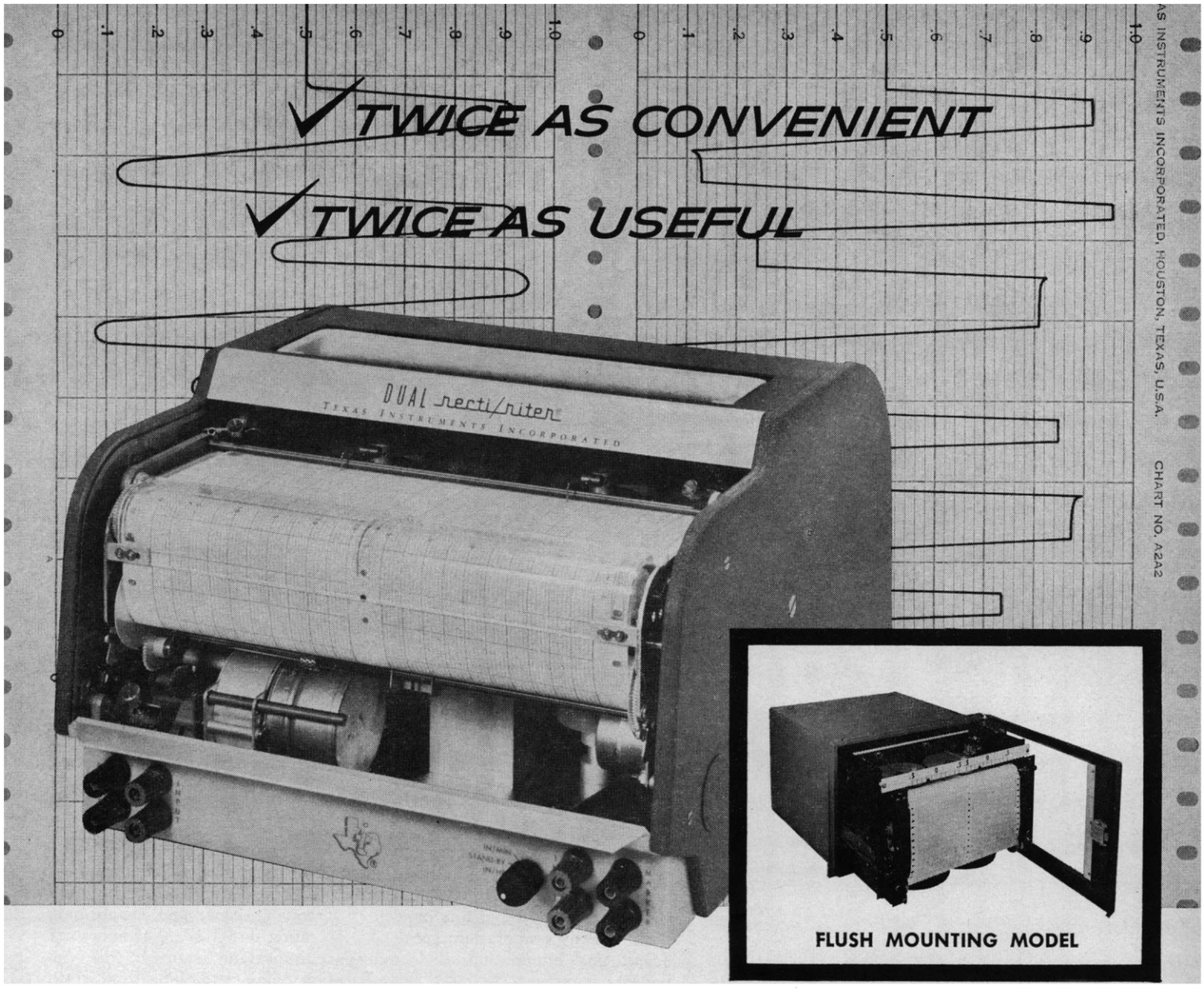
WRITE today for CES literature if yours is a problem of sterilization or disinfection. There's no obligation for preliminary research and planning.

Castle

Castle CES

WILMOT CASTLE COMPANY, 8014 E. Henrietta Rd., Rochester 18, N. Y.

Subsidiary of Ritter Company Inc.



Record Two Variables Side by Side with the DUAL recti/riter® Recorder

The DUAL *recti/riter* recorder combines in one compact instrument two complete galvanometric recorders and a single chart drive . . . enabling you to record two variables simultaneously to a common time base. No chart drive synchronization problems, just one chart roll to handle and data can be interpreted in a glance. Only the DUAL *recti/riter* offers true rectilinear recording on two 4½-inch, side-by-side grids. Whether you use it primarily as a single channel instrument or for the hundreds of applications requiring the direct comparison of two variables, you'll find the DUAL *recti/riter* offers greater convenience and unmatched versatility. Available in either portable or flush-mounting models in the widest selection of standard ranges.

Two-Cycle Pen Response

d-c Milliampere Ranges.....½ ma to 100 ma
a-c Ampere Ranges.....0.25 amp to 25 amp
d-c Ampere Range.....100 mv for use with standard shunts
Expanded Scale a-c Voltage Ranges.....80-130 V, 160-260 V, 320-520 V
a-c and d-c Voltage Ranges.....10 V to 1000 V
Frequency Ranges.....50, 60, 400 cps

Five-Cycle Pen Response

d-c Milliampere Ranges.....2.5 ma to 125 ma

Special options and accessories further expand the usefulness of *recti/riter* recorders. Also available in single channel models.

Write for complete information.

APPARATUS DIVISION
PLANTS IN HOUSTON
AND DALLAS, TEXAS

TEXAS INSTRUMENTS
INCORPORATED
3609 BUFFALO SPEEDWAY
P. O. BOX 66027 HOUSTON 6, TEXAS

SIMPLIFY YOUR LAB WORK...

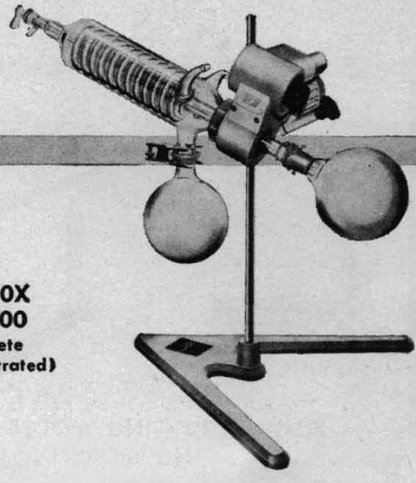
with these new units

TORSION OPTICAL BALANCE...

Projects true weight—even when out of level!

B-1754X . . . $425.00

Because the zero point is unaffected by out-of-level conditions, this new Model PL-2 Torsion Balance projects true weight readings *without* being re-zeroed! It's fast, accurate, convenient—designed to operate under severe environmental and physical conditions. Capacity is 2-kilograms, accuracy 0.1 gram, precision 0.1 gram, readability 0.2 gram. Has unlimited tare range up to full capacity. Projection system operates on 6 cycles 110-115 volts AC (also available for 220). Overall dimensions: 7½" x 12⅝" x 16½" long. *Descriptive brochure sent on request.*

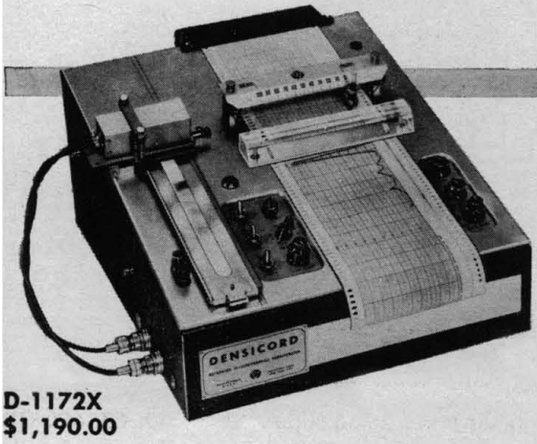


E-5540X
$295.00
(complete as illustrated)

ROTAVAPOR. . a new rotary vacuum evaporator

Extracts substances gently, rapidly, easily, economically!

You can use this solvent evaporator for just about any distillation requirement by merely regulating the temperature of the bath, depth of immersion, speed of rotation, degree of vacuum, and temperature of coolant. It has a built-in condenser, receiving flask, and evaporating flask. Speedy evaporation, gentle concentration under slight temperature drops, and elimination of foaming are important features. All components are readily detachable. Solution touches nothing but glass. *Ask us for bulletin No. 4000.*



D-1172X
$1,190.00

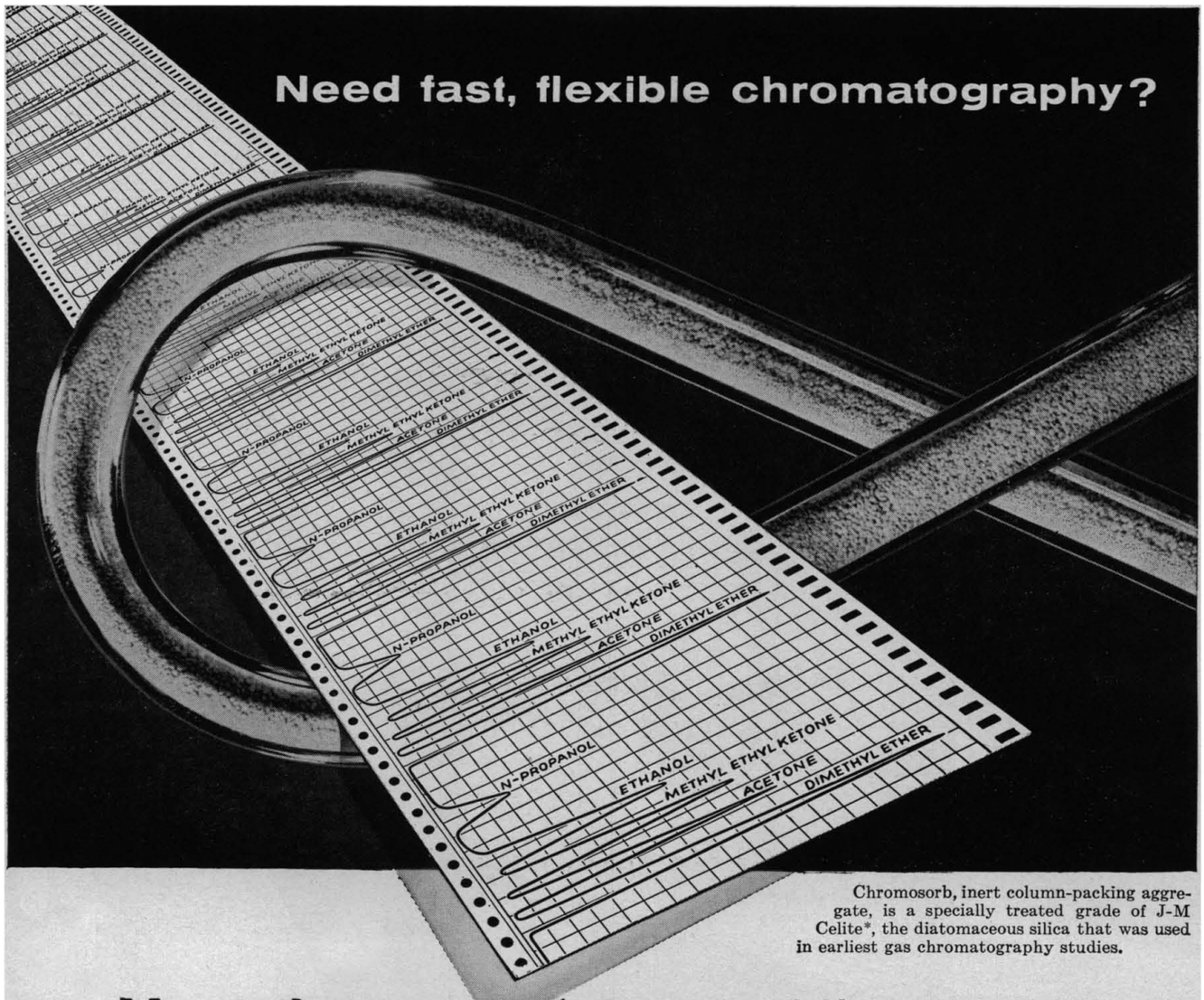
DENSICORD . . . an automatic recording densitometer by Photovolt

This instrument, designed for analyzing paper electrophoresis and chromatography strips, consists of a sensitive electronic photometer, scanner, and variable response recorder—all in a single unit. There are twelve recording functions to choose from . . . selected by means of a switch. High sensitivity, rapid response, ease of operation, flexibility in applications, plus versatility, are highlights of the Model 542 Densicord. Bulletin 800D gives details—sent on request!

SCIENTIFIC GLASS APPARATUS CO., INC.
BLOOMFIELD, NEW JERSEY

LABORATORY . . .
♦ APPARATUS
♦ INSTRUMENTS
♦ CHEMICALS
♦ GLASSWARE

Branch Sales Offices: Albany 5, N. Y. • Boston 16, Mass. • Elk Grove Village, Ill. • Philadelphia 43, Pa. • Silver Spring, Md.



Chromosorb, inert column-packing aggregate, is a specially treated grade of J-M Celite*, the diatomaceous silica that was used in earliest gas chromatography studies.

You always get a good "picture" with Johns-Manville Chromosorb

As an aggregate in gas-liquid partition chromatography, J-M Chromosorb® gives high partitioning effect with maximum number of theoretical plates. Good resolution is obtained because it is chemically inert and won't adsorb components being passed through. You get uniform results, optimum reproducibility, and good flow of carrier gas without excessive pressure drop.

Chromosorb combines optimum surface area with high uniformity. For reduction of fines, all grades are water-screened to close tolerances. Packing is easy. Its physical stability and non-adsorption let you re-use the same column packing again and again. For further information, contact the dealer nearest you.

*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products.

For gas phase chromatography or where inertness is needed . . . Chromosorb

Typical Properties

Calcined diatomaceous earth aggregate.

Color	light pink
Free Fall Density—lbs./cu. ft. (avg.)	20-23
Specific Gravity—true	2.15
Water Absorption—cc./gr. (avg.)	2.4
Moisture—% by weight, maximum	1.0
pH (avg.)	6-7
Surface Area—sq. m./gm. (avg.)	3-5

For chromatographic studies . . . Chromosorb W

Typical Properties

Flux calcined diatomaceous earth aggregate.

Color	white
Free Fall Density—lbs./cu. ft. (avg.)	15-16
Specific Gravity—true	2.30
Water Absorption—cc./gr. (avg.)	4.0-5.0
Moisture—% by weight, maximum	1.0
pH (avg.)	8-10
Surface Area (BET Method)—sq. m./gr. (avg.)	3-4

For fine filtration of liquids in laboratory application . . . Celite Analytical Filter Aid

Quality diatomite, calcined at high temperatures and acid-washed to remove organic and inorganic impurities. Filters out all types of precipitates, including the difficult-to-handle gelatinous and semi-colloidal materials, and produces brilliantly clear filtrates at high flow rates.

JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS

CENTRIFUGAL FREEZE-DRYING

Patent No. 2,907,117
Patent No. 2,907,663

VirTis Mechanically Refrigerated Freeze-mobile with Centrifugal Freeze-Dryer

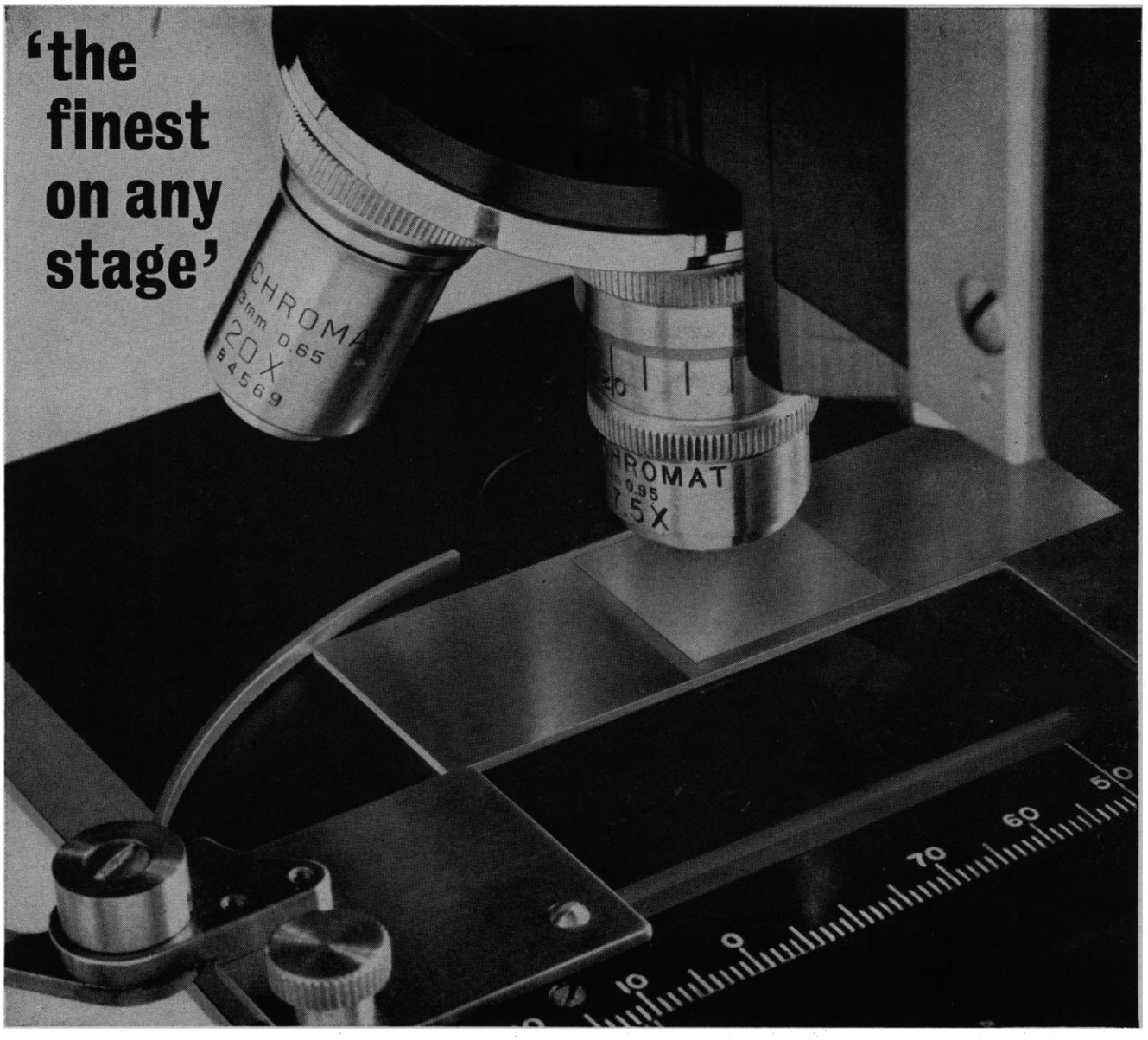
- No Pre-freezing
- Faster Drying Time with Radiant Heating
- Large Volume Dehydrations
- Sample foaming eliminated

Place water in a vacuum and it freezes! This simple classroom demonstration is the basis for centrifugal freeze-drying now available with the **VIRTIS MECHANICALLY REFRIGERATED FREEZE-MOBILE.** The new **CENTRIFUGAL DRYING CHAMBER** attachment is ideal for large volume dehydrations. This Chamber will accommodate seven 250 ml. serum bottles at one time; or it may be obtained with six stations for 500 ml. serum bottles.

High quality results are routinely obtained with centrifugal freeze-drying, making the method suitable for the preservation of most heat sensitive biologicals, such as antibiotics, hormones and enzymes. Two major advantages are inherent in this freeze-drying technique. First, samples are automatically shell-frozen. And second, speed of drying is increased due to uniform radiant heating over the entire ice-shell surface.

Accessory instrumentation includes sample temperature indication, control and recording.

VIRTIS THE VirTis COMPANY, INC. GARDINER, NEW YORK



GOLD SEAL® SLIDES and COVER GLASSES

Microslides and cover glasses bearing the familiar "Gold Seal" label have set standards of quality for many years. They are as perfect as painstaking manufacturing processes can make them. And as a final safeguard, they are individually inspected before being packaged.

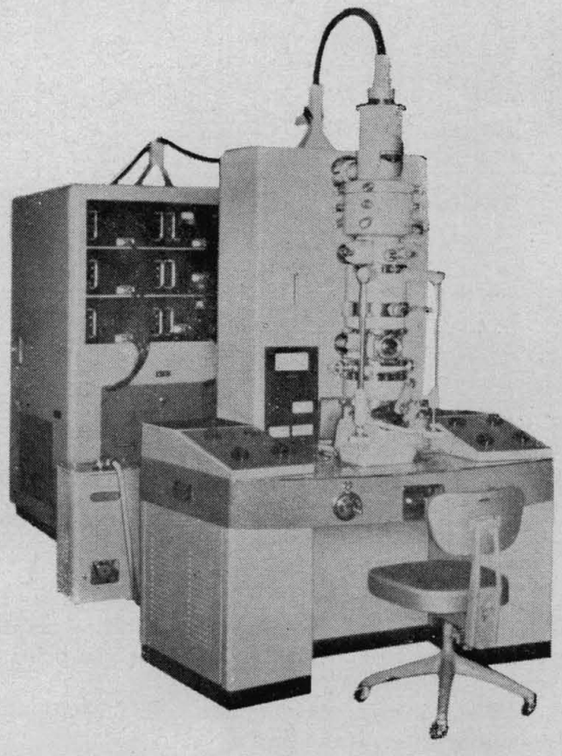
"Gold Seal" microslides are made of flawless, colorless, non-corrosive glass. Each slide is of uniform thickness, length, and width and has ground, polished edges. Each is precleaned and ready for use. A special-edged Stand-Rite dispenser box, used to pack all "Gold Seal" microslides, keeps slides upright, permits finger-tip removal without smearing or fingerprinting.

"Gold Seal" cover glasses are of equal excellence. Carefully selected and guaranteed perfect, they are made of rigidly specified, non-corrosive, nonfogging glass of uniform thinness. Available in every convenient size and thinness, "Gold Seal" cover glasses are dispensed clean from lint-free plastic boxes holding one ounce of glass.

Your dealer carries "Gold Seal" microslides and cover glasses and a large selection of microslide boxes, cabinets, and other accessories. Illustrations and full details of all items may be found in the Clay-Adams catalog No. 106. If you do not have a copy, write today on your institutional letterhead to:

Clay-Adams
New York 10, N. Y.

HITACHI Electron Microscopes



featuring the new HU-11

Hitachi, Ltd. of Japan, in advance of worldwide competition, announces the successful production of the HU-11, the latest in electron microscopes.

The new HU-11 is an enlarged, high efficiency electron microscope, guaranteed 8-10 Angstrom Unit resolution, capable of probing the very basic structure of matter. This is possible in the HU-11 because it is equipped with a chromatic aberration compensating lens system, a development uniquely Hitachi.

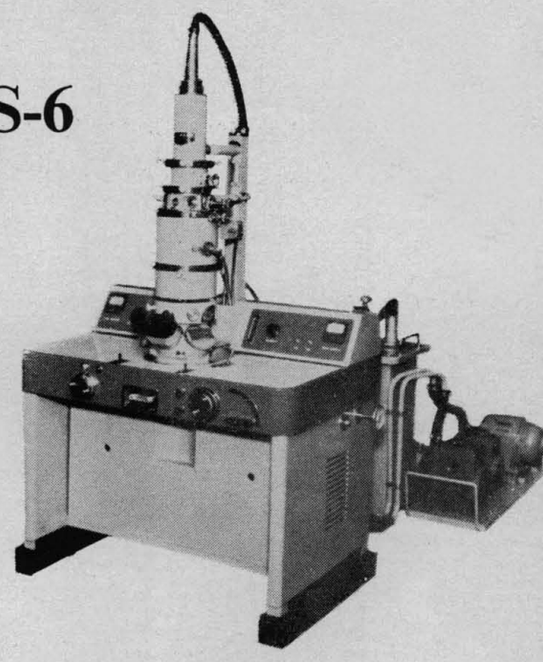
Other improvements include an enlarged specimen chamber facilitating handling of accessories, an exhaust system trap reducing contamination to a minimum (therefore eliminating the need to disassemble the column), increased exposure area of photography permitting recording of high resolution diffraction rays.

...and presenting the HS-6

Hitachi's outstanding HS-6, the permanent magnet electron microscope, is equipped with four lenses (condenser, objective, intermediary, projection) with a resolving power reaching 25 A.U. upwards and ensures an electron optical magnification continuously changeable from 2,000x to 20,000x.

The HS-6 is proving itself doubly invaluable photographically as an electron diffraction camera using an additional specimen stage and as the so-called "selected area" diffraction camera. (Camera chamber is loaded with 18 cassettes permitting 36 successive exposures.)

Simplicity of operation, mechanics and circuitry make the HS-6 the ideal instrument for researchers in the most sensitive medical and biological fields.

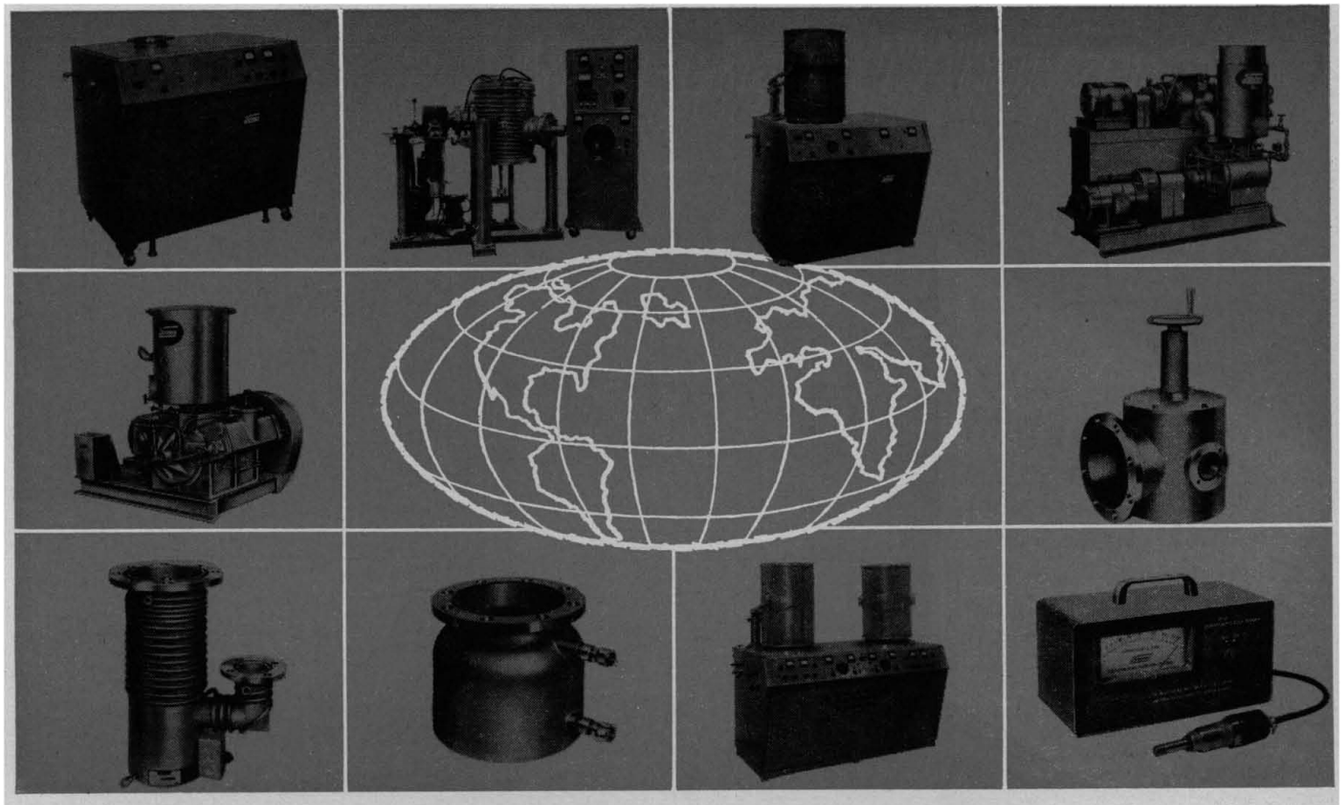


Hitachi, Ltd.
Tokyo Japan
Cable Address: "HITACHY" TOKYO

For more detailed information get in touch with

ERB & GRAY SCIENTIFIC, INC.

854 S. Figueroa St., Los Angeles 17, Calif.
5927 Riverdale Ave., New York 71, N.Y.



LEADERSHIP

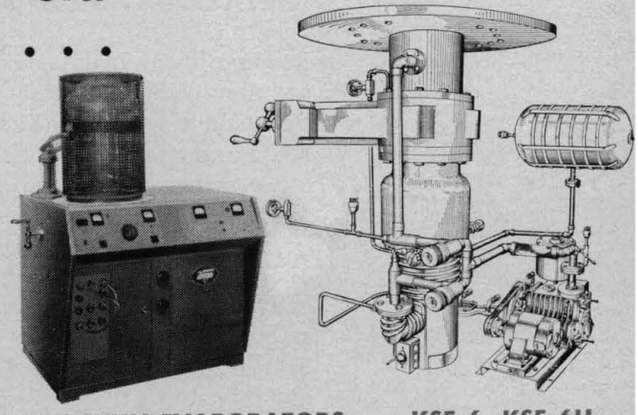
with a forward look in the field of high vacuum equipment . . .

Kinney Vacuum, the accepted leader in the manufacture of vacuum pumps is acknowledged foremost in research and development in the high vacuum industry.

This leadership is carefully guarded by constant and extensive research and development that produces the ultimate in mechanical pumps, diffusion pumps, valves, baffles, gauges, vacuum furnaces, space chambers, and complete vacuum systems.

The resources of the New York Air Brake Company and all of its divisions guarantee every Kinney Vacuum product to be efficient in operation, most modern in design, and constructed to give the maximum in service.

- PROVEN STABILITY
- EXTENSIVE RESOURCES
- DYNAMIC DEVELOPMENT



HIGH VACUUM EVAPORATORS . . . KSE-6, KSE-6H

This attractively packaged system delivers maximum performance, requires minimum floor space. Formica work surfaces, integral control panels with grouped controls for operating convenience. These units are built around flange connected components including new high speed oil diffusion pumps, water cooled baffle (also available with liquid nitrogen cooled baffle). Hydraulic bell jar hoist. Rapid evacuation to below 1 x 10^{-6} torr., ultimate pressure less than 5 x 10^{-7} torr. KSE-6H offers a pot-type base plate (Haas Chamber) to allow more freedom for location of monitoring devices and additional feed-throughs.

KINNEY VACUUM

DIVISION THE NEW YORK AIR BRAKE COMPANY
3529 WASHINGTON STREET • BOSTON 30, MASS.

Tracerlab omni/guard

LOW BACKGROUND BETA COUNTING SYSTEM

BACKGROUND AS LOW AS 0.3 CPM

1″ OR 2″ SAMPLES

MANUAL OR AUTOMATIC SYSTEMS

Leading research and environmental analysis laboratories* are now using Tracerlab Omni/Guard Low Background Beta Counting Systems like the one pictured. In addition to setting new standards of reliability, Omni/Guard Systems are performing counting operations never before possible.

The Omni/Guard can assay 1″ or 2″ solid beta samples. Efficiency is high, even for low energy beta rays, C^{14}, S^{35}, etc. This means that less starting material is needed, lower activity levels can be measured, and counting time is substantially reduced. And the new Tracerlab Omni/Guard System is moderately priced and economical to operate and maintain.

In mentioning these advantages we've merely scratched the surface. Write for the Omni/Guard Bulletin. Tracerlab, 1601 Trapelo Road, Waltham 54, Mass., or 2030 Wright Avenue, Richmond 3, California.

*names on request

LFE *Tracerlab* inc.

A DIVISION OF LABORATORY FOR ELECTRONICS, INC.

The New Brunswick Scientific Company Presents The PsycroTherm(TM)

A CONTROLLED-ENVIRONMENT INCUBATOR-SHAKER

U.S. Patent No. 3,002,895

Gassing facilities provided for circulating gas in the tightly sealed chamber.

For the Growth of Microorganisms under Controlled Conditions of Temperature, Atmosphere, and Agitation

THE PSYCROTHERM is a rigidly controlled environmental incubator with a continuous-duty shaking mechanism. Though it occupies comparatively little floor area, it has 10½ cubic feet of *usable* work space in the incubation chamber, where static and shake cultures can be incubated simultaneously or separately.

A VERSATILE UNIT

With fully integrated heating and refrigeration systems the unit is ideal for work with psycrophilic, mesophilic, and thermophilic systems. Temperatures can be accurately regulated from 0° C to 60° C with a control tolerance and temperature gradient both within ± 0.5° C. In non-refrigerated units, the temperature range is from ambient to 60° C, with the same tolerance and gradient as above.

There are many interchangeable shaker platforms. They have large capacities for flasks, tubes, and other culture and reaction vessels.

CHOICE OF SHAKER MECHANISMS

The degree of agitation can be selected and the temperature controlled for the growth of aerobic and anaerobic organisms. Models are available with either Gyrotory® or reciprocal agitation, and illumination for photosynthesis studies. The PSYCROTHERM can also be used as a BOD incubator.

CONTINUOUS DUTY SHAKING

The shaking mechanisms are precision built for continuous operation, long life, and for smooth, quiet, reproducible agitation. Speed is adjusted mechanically and will never drift nor vary when workloads or voltages change. The rotary shaker mechanism has a range of speeds between 50 rpm and 400 rpm. The reciprocating shaker mechanism has an adjustable stroke from 0 to 3½" and a speed range between 40 and 285 oscillations per minute.

OVERALL DIMENSIONS: Width 40", Depth 29", Height 65"
CHAMBER DIMENSIONS: Width 32½", Depth 21", Height 26"

UNCONDITIONAL ONE-YEAR WARRANTY

Write for Catalog G26S/2162

NEW BRUNSWICK SCIENTIFIC CO., INC.

PRECISION LABORATORY APPARATUS

P.O. BOX 606, NEW BRUNSWICK, NEW JERSEY

The Vanguard Model 1000 VOLUMATIC Fraction Collector

The Vanguard VOLUMATIC is a completely transistorized self-contained unit employing an advanced technique for volumetric collection of chromatographic separations. Hold-up and mixing in volumetrically controlled separations are virtually eliminated when fractionation is performed with the Vanguard VOLUMATIC. Using a unique principle of repetitive cuts for a single separation, in conjunction with a photoelectric sensing device, the VOLUMATIC will collect from one to ten times the siphon volume in each test tube. The operator merely dials the number of times he wishes the siphon to fill and discharge before advancing to the next test tube. Employing this technique for collection of 5 X siphon volume for example, only the hold-up present from the last one-fifth of the first fraction is mixed with the first one-fifth of the second fraction, *an 80% reduction in mixing.*

Transistorization of all components assures absolute reliability of operation and allows continuous cold-room operation without modification.

The cast aluminum instrument cabinet affords the strength and rigidity needed for large columns and ancillary equipment, yet the entire unit weighs less than 50 lbs. Positive indexing of the stainless steel dispensing head to succeeding inner rows is achieved through mechanical gating which assures continued reliability. Compact size (25 in. wide x 30 in. long x 6 in. high) promotes maximum utilization of valuable laboratory and cold-room space. Heavy gauge, large capacity aluminum turntable (245 samples in 13mm. or 15mm. size) is supplied with handle and base-mounted rubber feet for easy removal and use as test tube tray.

Interchangeable turntables for 13mm., 15mm. and 18mm. test tubes are offered as standard accessories. To meet varying requirements a complete selection of siphons is also available. To increase the versatility of the Vanguard VOLUMATIC, transistorized time and drop counting plug-in units are also available.

Complete unit including siphon and turntable of choice with 4 ft. column support rod priced at $695.00, F.O.B. LaGrange, Illinois.

P.O. Box 244
La Grange, Illinois
FLeetwood 4-5656

VANGUARD INSTRUMENT COMPANY

AN INTEGRATED DATA PROCESSING SYSTEM IN YOUR LAB

MNEMOTRON MULTI-PURPOSE DIGITAL COMPUTER FOR RESEARCH

CAT*

model 400

*COMPUTER OF AVERAGE TRANSIENTS

CAT 400 is a *multi-purpose* digital *on-line* computer for the study of biological and other variables. One of its uses is the on-line calculation of average evoked responses of four different variables simultaneously. By accumulating the average responses, the CAT 400 is able to extract the precise response pattern from the "noise" which generally masks biological responses to stimuli.

In addition to averaging, the CAT 400 multi-purpose computer offers the research scientist a whole range of computing functions. Here are a few:

- Analog To Digital Conversion Up To 4 Channels Simultaneously.
- Recording Fast Waveforms.
- Automatic Plotting Of Digital Data.*
- Statistical Distribution Of Analog Data – Amplitude Histograms.*
- Statistical Distribution Of Pulse Data – Time Histograms.*
- Function Generation.

**In conjunction with CAT accessories.*

As a Computer Of Average Transients, the CAT 400 is ideal for the simultaneous measurement of average evoked brain potentials from four different regions of the brain – and for averaging nerve potentials, retinograms, cardiological data, phonocardiograms, autonomic functions, pupil responses, and many other biologic variables, as well as astronomical, sonar and seismic data. Its multi-purpose features extend its applications manyfold to digitizing of fast waveforms such as cardiograms, or the analysis of random behavior in terms of amplitude spectrum, or the automatic plotting of numbers, to list a few examples.

Analog output is provided for graphic readout on strip chart and XY recorders. The CAT 400 also has a digital output which enables it to "talk" to other computers. Digital printer, electric typewriter, or paper tape punch is available for direct digital readout.

Fully transisterized, small in size, and truly portable (it weighs only 36 pounds), CAT 400 brings the flexibility and accuracy of the digital computer to the scientist with the simplicity of a laboratory instrument.

PRICE: $10,950 (rental plan available)

MNEMOTRON MULTI-CHANNEL ANALOG DATA RECORDERS...

0.2% ACCURACY AT LOW COST

Ideal companion to the CAT 400... precise, versatile additions to any research facility. Available with up to 14 channels.

TYPICAL SYSTEM: MODEL M204

Completely self-contained 4 channel record/reproduce system. Fully transisterized. • Tape speeds up to 30 inches/sec. • Frequency response dc-4KC. • Noise less than 50 db below full scale. • Crosstalk below 70 db. • 10½" reel capacity. • Superb tape handling characteristics. • Unique pulse FM principle. Price from $4340 Complete.

2-CHANNEL PORTABLE SYSTEM from $1450

MNEMOTRON CORPORATION

45 S. Main St., Pearl River, N.Y.
PEarl River 5-4015 (914)
Cable: MNEMOTRON

A Subsidiary Of Technical Measurement Corporation

Send For Complete Technical Literature

NAME_____
TITLE_____
ORGANIZATION_____
ADDRESS_____
CITY_____ STATE_____
APPLICATION_____

Up-to-date information on micro-methodology . . .

Van Slyke & Plazin: MICROMANOMETRIC ANALYSES

Micro-methods, the principles behind them, and the apparatus required with them, are the subjects under concentrated study in this new book. The authors have strategically interspersed clear and useful illustrations and tables throughout the comprehensive, detailed, and well-referenced text.

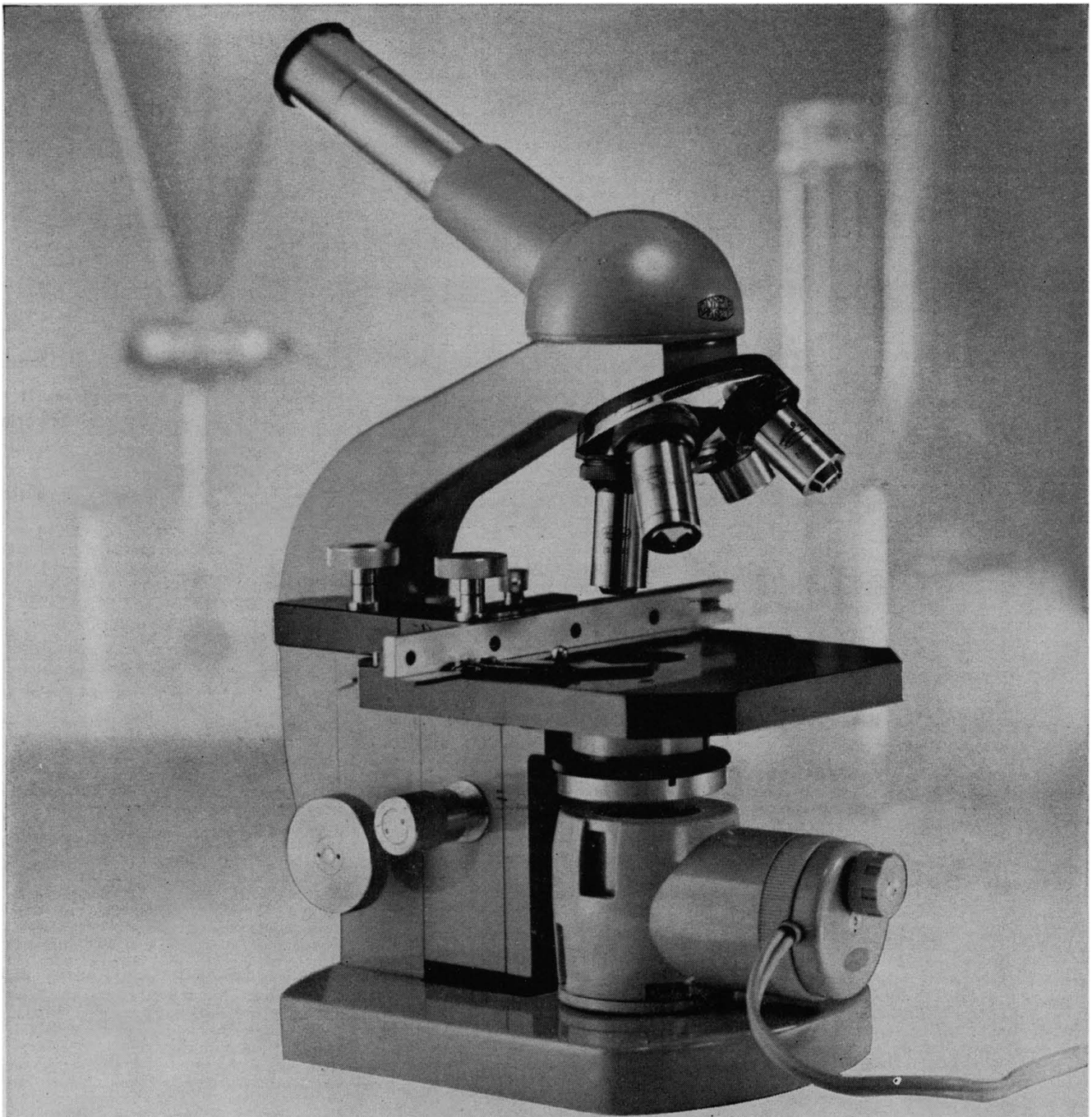
The 10-ml. gas extraction chamber and the micropipets used with it, described in this volume, enable one to make manometric analyses with accuracy fully equal to that of the standard Van Slyke-Neill methods, and with 1/20 as much material.

CONTENTS: *Construction and Handling of Micromanometric Chamber and Needle-Tipped Pipets:* Construction of the 10-ml. chamber. Connections of the chamber. Manometer, mercury cock, and connections. Supporting structure and attachments of chamber and manometer. Alternative arrangement of the 10-ml. chamber for use with a magnetic stirrer. Lubrication of cocks. Testing the cocks. Needle-tipped stopcock pipet. Automatic serum CO_2 pipet. Extraction and measurement of gases. Choice of volume of solution to extract. Shaking speed and extraction rate of gases. Precision of pressure measurements. Cleaning the chamber between analyses. Preliminary practice and test of apparatus. *Calculations and Calibrations:* Calculations. Gasometric calibration of chamber and stopcock pipet together with standard iodate solution. Calculation of the *a* volume of the chamber from the gasometric calibration with iodate. Calibration of serum CO_2 pipet and chamber together with standard carbonate solutions . . . of stopcock pipet by weight of water or mercury delivered . . . of serum CO_2 pipet by weight of water delivered . . . of chamber by weight of water delivered. *Determination of Carbon Dioxide and Oxygen In Blood:* Carbon Dioxide. Oxygen. Determination of O_2 and CO_2 in a single sample of 50 *u*l. of blood. *Determination of Blood Carbon Monoxide and of Total and Active Hemoglobin by Carbon Monoxide Capacity:* Determination of carbon monoxide in blood . . . of total hemoglobin, including methemoglobin, by carbon monoxide-binding capacity . . . of active hemoglobin, capable of binding oxygen and carbon monoxide. Methemoglobin. *Determination of Nitrogen Gas, Nitrous Oxide, Cyclopropane, and Ethylene in Blood:* Drawing and handling blood for analysis. Method A—Determination of nitrogen gas, nitrous oxide, cyclopropane, or ethylene, without determination of oxygen. Method B—Determination of nitrous oxide, cyclopropane, or ethylene, together with oxygen, in one sample of blood. Solubility correction factor for unextracted gas. Determination of the reabsorption correction, *i.* Experiment showing that the $Na_2S_2O_4$-NaOH-blood mixture in method A completely retains carbon monoxide present in the blood. Example of determination of N_2 in blood . . . of nitrous oxide in blood, with and without determination of oxygen. *Determination of Urea in Blood by the Hypobromate Reaction:* Preparation of blood filtrates. Manometric determination. *Determination of Free Amino Acids by the Ninhydrin-CO_2 Method:* Reactions of amino acids with ninhydrin. Determination of free amino acids in aqueous solutions . . . in blood plasma.

By DONALD D. VAN SLYKE *and* JOHN PLAZIN, *Medical Research Center, Brookhaven National Laboratory, Upton, New York.*

1961 • 99 pp., 22 figs., paper cover • $4.50

BALTIMORE 2, MARYLAND, U.S.A.



NOW...A DISTINGUISHED MEDICAL AND RESEARCH MICROSCOPE
ELGEET MODEL HM with all features for advanced microscopy
AT A VALUE-PACKED PRICE

The performance...the precision...the perfection you demand from quality optics...yours in this new system of modular-styled microscopes from America's newest scientific instrument leader. Write for Booklet HM561 for complete information on the Model HM series.

Model HM-4 with quadruple nosepiece including 4X, 10X, 40X and 100X (oil immersion) objectives. 10X eyepiece. $193.45.

Model HM-4S with accessory mechanical stage (as illustrated)...$218.45.

Elgeet OPTICAL CO., SCIENTIFIC INSTRUMENT DIV., 838 Smith St., Rochester 6, N.Y.

EL-77

nuclear DATA

THE NEW NUCLEAR DATA SERIES ND 140 COUNTING SYSTEM

In measurements requiring the use of large arrays of radiation detectors, problems in count accumulation arise, partly because the cost of an array of discriminators, scalers, and counting registers is high, and partly because readout is difficult. Transistorized scalers of high quality which provide accurate discrimination levels, coincidence gating circuits, automatic readout provisions and electrical reset capability cost in the vicinity of a thousand dollars per channel. If many channels are needed, the cost can become prohibitive.

To solve this problem, it is natural to consider marrying an array of discriminator circuits to an ordinary pulse height analyzer memory, for the cost per channel of such a system would be reasonable. The multichannel analyzer is a sufficiently useful tool in its own right, particularly in setting-up procedures preceding a measurement, that its cost is not offensive.

Such a marriage, however, would have serious limitations, unless special methods were used to combine the discriminators with the analyzer. One limitation, for example, would be that of speed. The analyzer requires some ten microseconds to accept and store a count, once the address scaler has been properly set to correspond to the correct counting channel. During this time the system would be 'dead' in all channels, so overall counting rates would have to be limited to a few thousand counts per second to avoid severe losses.

The process of properly setting the analyzer address scaler is in itself difficult, and the difficulty increases in a non-linear fashion as the number of channels increases. Especially awkward is the fact that signals appearing almost coincidentally on two or more signal lines tend to cause confusion that can be eliminated only by complicated circuitry.

In the Nuclear Data system, these problems have been avoided by using an entirely new method of combining the discriminators and the analyzer. Figure 1 shows the general arrangement. Counts received in a particular channel cause a one-decade scaler to advance. When it overflows, it sets the flip-flop associated with that channel. In the meantime, the analyzer address is periodically advancing, at a relatively high rate. When the address corresponds to the channel of interest, the recognition circuit and associated gates cause the periodic advance to be discontinued momentarily, and a count is stored in the corresponding memory channel. If the flip-flop for that channel had not been 'on', the storage cycle would not have occurred. After the storage cycle the flip-flop is reset.

Two important characteristics of the system are apparent. One is that the entire system need not be paralyzed merely because one or more of the scaler overflow flip-flops is set. Other channels may continue counting undisturbed by this situation. As a matter of fact, even the channel which has just received its tenth count may continue counting. Only if ten counts are received following the setting of the flip-flop will there be a loss. The other characteristic is that there is no possibility of confusion due to nearly coincident pulses in two or more channels.

These characteristics permit average system counting rates, under the worst condition (all counts falling into a single channel) of well over 10,000 counts per second with losses entirely negligible except those due to the approximately 1.5 microsecond dead time of the discriminator circuits. Where counting rates are more evenly distributed among the channels, rates of well over 100,000 per second can be handled without losses except due to the discriminators. For pulsed beam particle accelerators, operating at repetition rates of 1 kc/s or slower, the average, not peak, counting rates govern the count losses, except for discriminator dead time effects.

The discriminators are of high quality, with input pulse amplitude ranges of from 0.1 volt to 3 volts negative. Discriminator stability is one millivolt per day. The circuits are arranged in groups of 32 channels with a maximum limited only by the analyzer memory capacity. It is possible to operate individual counting channels with both upper and lower level discrimination. All channels may be slow coincidence gated, with approximately one microsecond resolving time.

Although not shown in figure 1, circuits are included to provide for acceptance of counts residing in the decade scalers after completion of a measurement. It would be undesirable to ignore those counts, for in some channels it may be that just a few counts are of significance. The analyzer memory will contain actual counts received, after the measurement, without scale factor changes or round-off error.

The system is designed for use with Nuclear Data models ND120, ND130A, and the monitor analyzer for the new ND2000 "Acquisition Series" analysis system soon to be formally announced. For ease and precision of set-up there are provisions for viewing the pulse height spectrum of any channel, with positive markers indicating the exact thresholds of the upper and lower level discriminators of that channel. Since millivolt stability is available, combined with means for rapid and accurate discriminator adjustments, counts may be restricted to even very narrow individual spectral lines in each channel.

The system has been constructed in such a manner that the discriminator boards may be replaced with different "front ends" in anticipation of the need for special characteristics, such as higher coincidence resolution. Only one "front end" model is now available, with characteristics as described above.

The cost of the system not including the pulse height analyzer is $305 per channel for the unit described, and $210 per channel for a lower speed system designed for such applications as area monitoring, mapping of radioactivity concentrations in the human body, and the like. In such applications, where no accurate shaping of signal pulses is required to prevent pulse pile-up, the output of photomultipliers is sufficient, without voltage amplification, to operate the discriminators properly.

APPLICATION TO DISCRIMINATOR TYPE MULTICHANNEL ANALYSIS

An interesting application of the method is in multichannel discriminator type pulse height analysis. Instruments of that type ordinarily require a considerable number of counting channels, but because of the expense and readout problems there are rarely many channels provided. Nevertheless, because of the high speed of such analyzers, (typically only two or three microseconds is required for the analysis of each pulse) they are still in use despite their disadvantages.

The Nuclear Data model ND141 Discriminator Analyzer, which is very similar to the ND140 Counting System described above except for discriminator interconnections, utilizes the same models 120, 130A or 150 analyzers for count storage and readout. As a matter of fact, one or more model ND141 analyzers and one or more model ND140 analyzers can be operated simultaneously using the same count accumulation analyzer.

The model ND141 analyzer has a dead time of approximately 1.5 microseconds per event, may be slow coincidence gated, and may be operated as four seven channel analyzers, two fifteen channel analyzers or one thirty channel analyzer. One channel is used for timing pulses; after a preselected number of these timing pulses have been received, the count accumulating analyzer automatically terminates the analysis. Readout is by means of typewriter or paper tape punch. Four consecutive measurements may be made without intervening readout, merely by switching to different groups of memory channels. The overall high operating speed allows measurements of energy spectra of short lived nuclides.

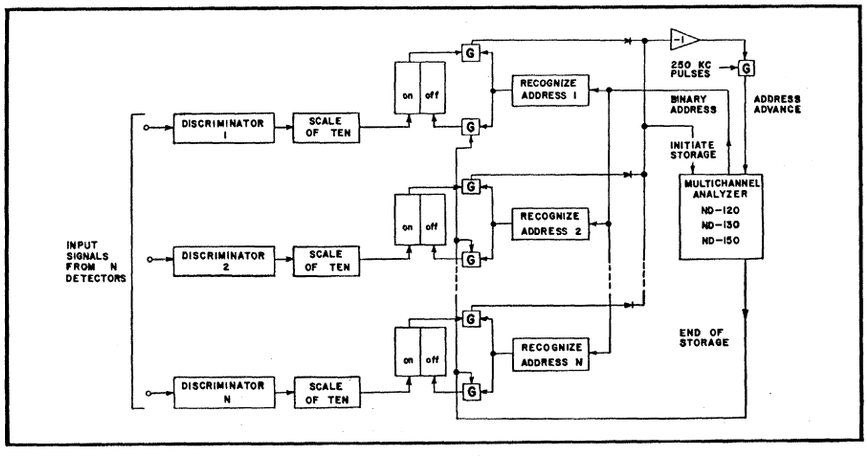
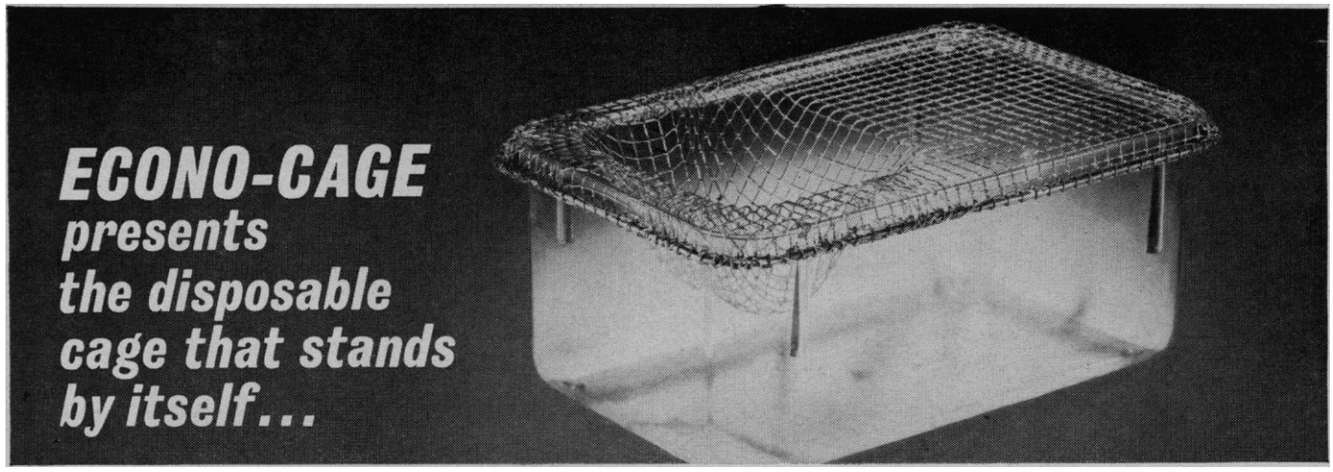
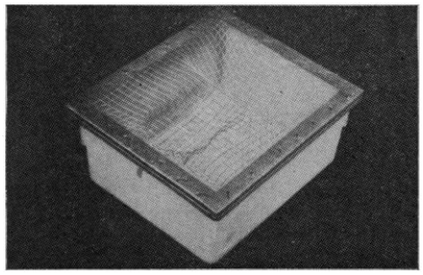


Fig. 1 Counting System, Nuclear Data Model ND140. Residual-count-interrogation circuit not shown.



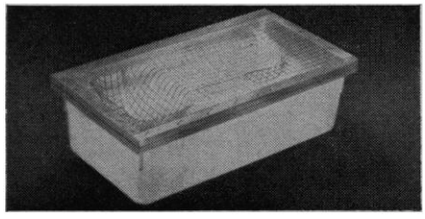
added to the line that stands by itself

The New Disposable Econo-Cage #21, Pictured Above, Brings To Animal Care A Rigid Plastic Disposable Cage That Spells Real Economy. It Stands By Itself Requiring No Expensive Supports That Prevent Full Visibility. Designed Primarily For Mice, The Cage Is 11½" X 7½" X 5" Deep. The Floor Area Of 84 Square Inches Will Adequately House Up To 12 Mice. All 20 Series Lids Fit The New Disposable Econo-Cage #21.



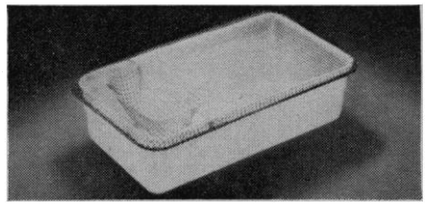
ECONO-CAGE #50 SERIES

The new 50 Series Econo-Cages and lids are designed for Hamsters or rats. Dimensions are 12⅞" X 14⅞" X 6⅝" deep with room for 11 adult Hamsters per cage. The cages are available in clear Acrylonitrile-Styrene Copolymer—Econo-Cage #53, Linear Polyethylene—Econo-Cage #54 and Polypropylene—Econo-Cage #55. All 50 Series lids fit interchangeably on 50 Series cages.



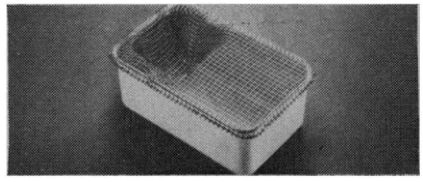
ECONO-CAGE #40 SERIES

Number 40 Series cages can be used interchangeably for Hamsters and/or rats. #43 is made of clear Acrilonitrile-Styrene-Copolymer, #44 of Linear Polyethylene and #45 of translucent Polypropylene. All 40 Series lids are standard ½" mesh designed for rat housing and fit interchangeably on all 40 Series cages. All 30 Series lids also fit all 40 Series cages but have the $\frac{5}{16}$" for mice.



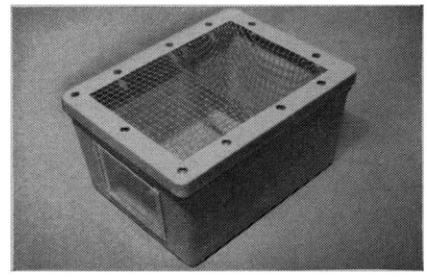
ECONO-CAGE #30 SERIES

Number 30 Series cages are designed as breeding and holding cages for mice. The over-all dimensions are 19" X 10½" X 5⅛" deep. Cage #32 is made of fiberglass, reinforced by plastic. Cage #33 is made of clear Acrylonitrile-Styrene Copolymer. Cage #34 is made of linear high density Polyethylene. Cage #35 is made of Polypropylene. All 30 Series lids are interchangeable on 30 Series cages.



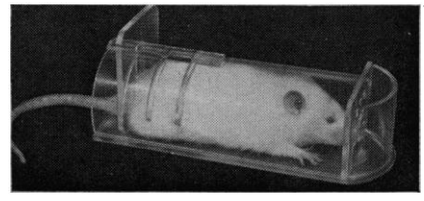
ECONO-CAGE #20 SERIES

Econo-Cages in the 20 Series are designed primarily for mice. Over-all dimensions of the cages are 11½" X 7½" X 5". This cage is used for housing animals during experimentation and also as a one-to-one and two-to-one breeding cage. The cages are available in Polystyrene — new disposable Econo-Cage #21, Fiberglass, reinforced plastic — Econo-Cage #22, clear Styrene-Acrylonitrile Copolymer — Econo-Cage #23, transculent Linear Polyethylene—Econo-Cage #24, autoclavable Polypropylene—Econo-Cage #25 and Polycarbonate Resin—Econo-Cage #27. All 20 Series lids are interchangeable on 20 Series cages.



GENERAL PURPOSE ECONO-CAGE #12

Over-all dimensions of the Econo-Cage general purpose unit are 11½" X 8" X 6" deep. This cage is designed especially for laboratories with changing animal use requirements. It can be used to house mice, Hamsters, rats and guinea pigs. Because of its versatility, it is ideal in teaching situations. The cage is available with or without windows. It is made of fiberglass reinforced polyester plastic. All #12 lids can be used on General Purpose Cage #12.



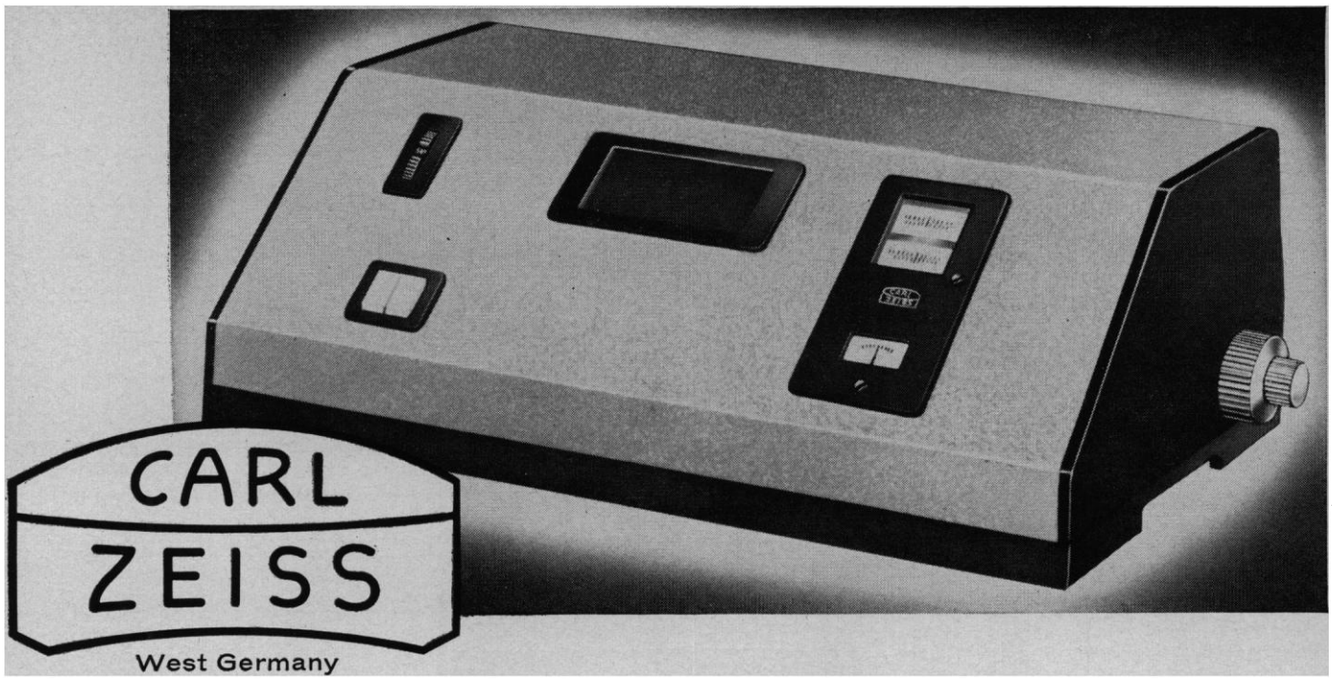
ECONO-RESTRAINING CAGES #90 SERIES

The small Restraining Cage #88 can be varied from 2" to 3½" in length and is 1¼" wide. Econo-Cage #90 can be varied from 4½" to 6" in length and is 2½" wide. Econo-Cage #91 can be varied from 5" to 7" in length and is 3" wide. All these units can be cleaned chemically or with hot water. They are not autoclavable.

FOR MORE INFORMATION ABOUT THE LINE THAT STANDS BY ITSELF, write:

econo-cage

ECONO-CAGE DIVISION
MARYLAND PLASTICS, INC.
9 East 37th Street,
New York 16, N. Y.



Photoelectric Precision Polarimeter

0.005°

Supreme accuracy and speed in measurement

The unique photoelectric principle used in this polarimeter results in a measuring accuracy of 0.0025° as well as the elimination of subjective-setting and correction of errors. It is remarkably easy to operate.

The polarimeter tubes, with a path length of 10, 20, 50 and 100mm, are automatically lowered into the housing and brought into the path of rays. The electric indicator instrument is set to zero by conveniently located knobs for coarse and fine adjustment, and the angle of rotation can be immediately read off on two projected scales representing diametrically opposed sections at 20x magnification. This projection of the scales permits use of the instrument in undarkened rooms. Reading is direct to 0.005° and by estimation to 0.0025°.

Automatic control maintains full measuring accuracy even for strongly absorbent samples.

Five double-band interference filters for wave lengths 365, 405, 436, 546 and 578 mμ of the light of a built-in mercury lamp permit measuring of optical rotatory dispersion.

•

Write for booklet which gives full details.

•

CARL ZEISS, INC.

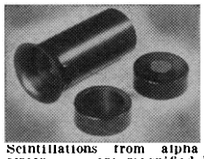
485 FIFTH AVENUE, NEW YORK 17, N. Y.

COMPLETE SERVICE FACILITIES

GET READY FOR THE SPACE and SCIENCE ERA! SEE SATELLITES, MOON ROCKETS CLOSE-UP

AMAZING SCIENCE BUYS for FUN, STUDY or PROFIT

New Alpha Counter Safely Demonstrates Radioactivity in the Classroom!



Many science classes and every junior and senior physics class will find this device a fascinating means of studying radioactivity. Counter provides visual indications—instantly detects radioactivity in self-luminescent paints, uranium-and-thorium-bearing ores. Scintillations from alpha particles (rays) appear on screen . . . are magnified by novel lens system . . . and viewed through eyepiece. Operates with all uranium minerals. Also recommended for prospectors, assayers, experimenters, and for general laboratory use. 100% safe. Must be used in darkened room. Unit includes Alpha Counter (2½" long by ⅝" visible diameter), red filter and safe alpha source.

Stock No. 60,259-W ----------**$9.25 Postpaid**

BUILD A SOLAR ENERGY FURNACE

A fascinating new field. Build your own Solar Furnace for experimentation—many practical uses. Easy! Inexpensive! Use scrap-wood! We furnish instructions. This sun powered furnace will generate terrific heat—2000° to 3000°. Fuses enamel to metal. Set paper aflame in seconds. Use our Fresnel Lens—14" diameter . . . f.l. 14°.

Stock No. 70,130-W, Fresnel Lens -------**$6.00 Postpaid**
11" Sq. Fresnel Lens F.L. 19"
Stock No. 70,533-W ----------**$4.75 Ppd.**

MINIATURE WATER PUMP

Wonderful for experiments, miniature waterfalls, fountains, HO gage railroad backdrops, etc. Tiny (2⅝" x 1¾") electric motor and pump ideal for hobbyists, labs, schools. Pumps continuous flow of water at rate of one pint per minute at a 12" head. With 2 D Batteries in series will pump to 24" high. Runs 48 hrs. on battery. Works in either direction. Self-priming.

Stock No. 50,345-W ----------**$2.25 Postpaid**

THERMOMETER TIE BAR AND CUFF LINKS REGISTER AS HOT CONVERSATION PIECE

Ruggedly precise new style item in matched set of cuff links and tie bar—featuring non-breakable, accurately calibrated thermometers. Sensitive to a tolerance of 1 degree (although some wearers have noted violent fluctuations when worn in close proximity to certain blondes and redheads of the warmer sex"). Easy to read. Indicia range from 20 (degrees) to (plus) 120 (degrees) Fahrenheit on circular dial. Silver plated, gift boxed—Tie Bar and Cuff Links also available separately.

Stock No. 1700-W Tie Clasp -------**$3.25 Ppd. tax incl.**
Stock No. 1701-W Cuff Links ------**$6.55 Ppd. tax incl.**
Stock No. 1702-W Set of Clasp & Links, **$8.75 Ppd. tax incl.**

SCIENCE TREASURE CHESTS

For Boys—Girls—Adults!

Science Treasure Chest — Extra-powerful magnets, polarizing filters, compass, one-way-mirror film, prism, diffraction grating, and lots of other items for hundreds of thrilling experiments, plus a Ten-Lens Kit for making telescopes, microscopes, etc. Full instructions included.

Stock No. 70,342-W ----------**$5.00 Postpaid**
DeLuxe Chest . . . Stock No. 70,343-W -**$10.00 Postpaid**

SPECIAL REDUCED PRICE FOR '62!
LIFE SIZE VISIBLE HUMAN HEAD

Precise, Full Color, Take-apart Model

Study the most complex organ easily, inexpensively. Ideal for student, hobbyist, professional. You will be amazed at the detail. Molded from actual human skull. Eyes, ears, and teeth easily removed and disassembled for complete study. Entire brain, spinal cord and organs of mouth and throat presented in vivid detail. Amazingly low priced—conforms to rigid laboratory standards. 16-page fully illustrated medical handbook included.

Stock No. 70,447-W ----------**$8.95 Postpaid**

OTHER VISIBLE TAKE-APART MODELS

Stock No. 70,470-W Heart ----------**$3.00 Pstpd.**
Stock No. 70,228-W Man ----------**$4.98 Pstpd.**
Stock No. 70,283-W Woman ----------**$4.98 Pstpd.**

Photographers! This is an actual photograph of the moon taken through our Astronomical Telescope by a 17-year-old student.

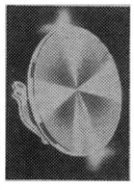
See the Stars, Moon, Planets Close Up!
3" ASTRONOMICAL REFLECTING TELESCOPE

60 to 180 Power. An unusual Buy! Famous Mt. Palomar Type

You'll see the Rings of Saturn, the fascinating planet Mars, huge craters on the Moon, Star Clusters, Moons of Jupiter in detail. Galaxies! Equatorial mount with lock on both axes. Aluminized and over-coated 3" diameter high-speed f/10 mirror. Telescope comes equipped with a 60X eyepiece and a mounted Barlow Lens, giving you 60 to 180 power. An Optical Finder Telescope, always so essential, is also included. Sturdy, hardwood, portable tripod—**FREE with Scope:—Valuable STAR CHART plus 272 page "HANDBOOK OF HEAVENS" plus "HOW TO USE YOUR TELESCOPE" BOOK.**

Stock No. 85,050-W ----------**$29.95 Postpaid**

OFFSPRING OF SCIENCE...REALLY BEAUTIFUL!
CIRCULAR DIFFRACTION-GRATING JEWELRY
1" diameter



Shimmering rainbows of gemlike color in jewelry of exquisite beauty—made with CIRCULAR DIFFRACTION-GRATING REPLICA. Just as a prism breaks up light into its full range of individual colors, so does the diffraction grating. Promises to become a rage in current fashion.

Stock No. 30,349-W Earrings ----------**$2.20 Pstpd.**
Stock No. 30,350-W Cuff Links ----------**$2.20 Pstpd.**
Stock No. 30,372-W Pendant ----------**$2.20 Pstpd.**
Stock No. 30,390-W Tie-Clasp ----------**$1.65 Pstpd.**
Stock No. 40,519-W Bracelet (six ¾" Gratings), **$7.70 Pstpd.**

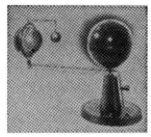
4¼" REFLECTING TELESCOPE! Up to 255X

New vibration-free metal pedestal mount. With this scope you can see with greater power plus will split finer stars. Mirror has twice the light gathering power. Mirror guaranteed to give theoretical limit of resolution. Rack and pinion focusing, real equatorial mounting—only one adjustment follows stars! Aluminum tube. 6 power finder telescope. 2 standard size eyepieces and mounted Barlow lens give you powers of 45X—90X—135X—180X and 255X. Low-cost accessory eyepiece available for higher powers. FREE with Scope:—Valuable **STAR CHART** plus 272 page **"HANDBOOK OF HEAVENS"** plus **"HOW TO USE YOUR TELESCOPE"** Book. Shipping weight 25 lbs.

Stock No. 85,105-W.....**$79.50 f.o.b.**

Same Telescope as above but equipped with Electric Clock Drive—

Stock No. 85,107-W **$109.00 F.O.B. Barrington, N. J.**



THE PLANETARIUM PORTRAYS THE FASCINATING STORY OF EARTH IN ACTION

Here is the story of cosmic motions—how the moon revolves around the earth, and the earth around the sun, with our planet rotating simultaneously. With this instrument, the observer sees a three-dimensional moving demonstration of how seasons, day and night, and moon phases occur. This handsome gear-and-chain-driven unit is supported by a smartly finished wood base. The sun is 6" in diameter, and the earth is 4". Planetarium is 12" high, base 8" wide; arm is 18" long. A completely illustrated, delightfully informative handbook included.

Stock #70,415-W----------**$29.95 ppd.**

STURDY—LOW.COST PRECISE LAB BALANCE

Built for hard, daily use. Weighs materials from 100 milligrams to 100 grams, can be used for proportionate measuring. Has removable plastic pans 60mm in dia. Features base of rugged cast iron and adjustable on piece beam for balancing. Overall ht. 5½" x 7" long. Comes complete with set of 12 weights ranging from 100mg to 50g and pr. of tweezers in wooden box. Imported.

Stock No. 70,443-W----------**$15.00 Postpaid**

Experiment in Plastics with New PLASTICS ENGINEERING SET

Keep pace with advances in plastics technology. Innumerable profit opportunities. Designed for working knowledge for non-plastics technicians, etc. Teaches how to identify and shows unusual properties and behavior of different plastics. Demonstrates heat forming, heat sealing, cementing. Depicts methods of foam casting, solid casting, rotational casting, slush molding. Make plastic products by injection molding and blow molding. Kit 15" x 6" x 11¾". Incl. non-tech. instr. manual.

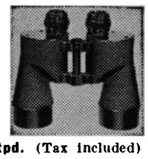
Stock No. 70,456-W ----------**$25.00 Postpaid**

EXCITING NEW LOW-COST MOON MODEL—AN OUTER-SPACE CONVERSATION PIECE

Exact replica in relief with 30,000 formations for study—peaks, craters, the 2-million-square-mile Oceans of Storms, etc. Formations scaled to size. Distance relationships help to narrow margins—valuable teaching aid and outer-space display for museums and institutions. With proper rotation and lighting it snows Moon Phases, and with "black light" . . . spectacular effects! Made of tough, washable plastic in three colors, can be marked without damage. Reverse side blank to provide room for present and future space data. Wonderful gift for amateur astronomers—space enthusiasts. Exciting "conversation piece" for living room or den. Diam. 12". Wt. ¾ lbs. Priced remarkably low.

Stock No. 70,515-W ----------**$12.50 Postpaid**

War Surplus American-Made 7x50 Binoculars



Big savings! Brand new! Crystal clear viewing—7 power. Every optical element is coated. An excellent night glass—the size recommended for satellite viewing. Individual eye focus. Exit pupil 7mm. Approx. field at 1,000 yds. is 376 ft. Carrying case included. American 7 x 50's normally cost $274.50. Our war surplus price saves you real money.

Stock No. 1544-W --**Only $74.80 postpd.** (Tax included)

6 x 30 Binocular—similar to above, a terrific bargain.
Stock No. 963-W --------**$33.00 Pstpd. (Tax included)**

NEW LOW PRICE FLASHLIGHT POINTER

. . . Point It Out With Arrow Projected

Ideal for pointing out interesting features on movie and slide projection screens. Excellent lecture tool. For teacher use on maps, etc. Flashlight focuses an arrow where you point it.

Stock No. 60,117-W ----------**$5.95 Postpaid**

MAIL COUPON for FREE CATALOG "W"

160 Pages!
Over 1000 Bargains!

EDMUND SCIENTIFIC CO.,
Barrington, New Jersey

Please rush Free Giant Catalog-W

Name .....

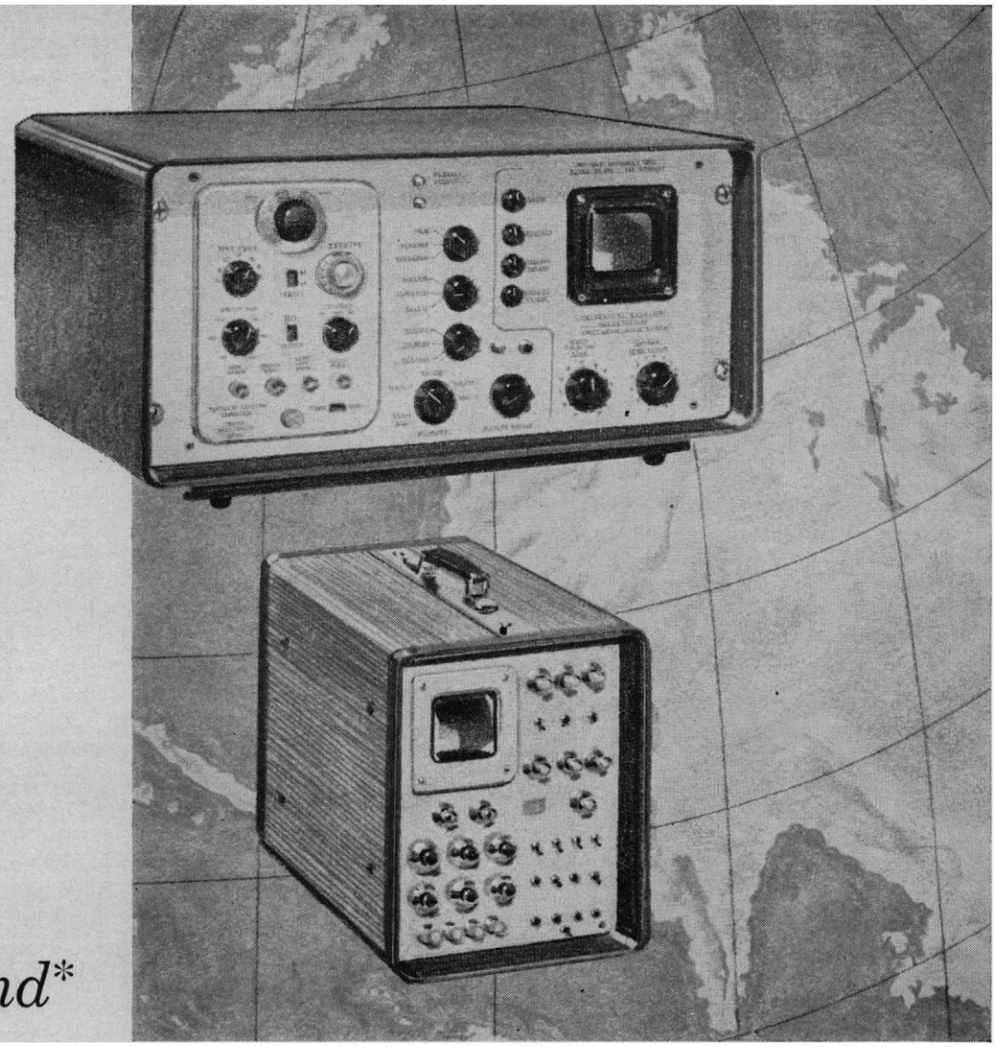
Address .....

City .....Zone.....State.....

ORDER BY STOCK NUMBER . . . SEND CHECK OR MONEY ORDER . . . SATISFACTION GUARANTEED!

EDMUND SCIENTIFIC CO. BARRINGTON, NEW JERSEY

*What's good for nuclides in New Haven is good for those in New Zealand**



We think the reason people all over the world buy TMC pulse analyzers is pretty much the same reason they're widely purchased and used here: competently designed, bug-free circuits . . . straightforward operation with the same performance and stability today as yesterday . . . easy access to sub-assemblies and uncomplicated servicing if needed. Another way of putting it is the instruments give the user the information he wants in *his* work — with predictable behavior—regardless of where his site, lab or plant may be located. Here are two current examples:

The TMC CN-110 256 channel analyzer offers 7 interchangeable plug-in logics, including pulse height, time of flight, pulsed neutron, multiscaler, mass spectrometer, and coincidence pair. This widely used and thoroughly proven analyzer (over 100 units have been delivered) employs all-transistorized circuitry. Analog, binary, octal and decimal readout may be used. Data can be recorded on strip chart or X-Y recorders, printed paper tape, punched paper tape, or punched cards.

The Model 404 is a compact, 400-channel analyzer you can use anywhere there's a wall outlet and one square foot to put it down. It has a magnetic core memory that can be used in sub groups of two or four; four separate inputs and associated amplifiers; internal pulse routing circuity; pushbutton data transfer and display overlap; power requirement of *only 25 watts*, and many "system" advantages. While its versatility is a little less than the CN-110's, so are its size, price and purpose quite different from the 110's. Each does its *own* job well.

**Also wherever TMC Pulse Analyzers are used... in Canada, Brazil, Australia, Japan, Yugoslavia, France, Italy, Germany, Belgium, Sweden, Denmark, Switzerland, Israel, Formosa . . . as well as the United States.*

WRITE FOR LITERATURE.

TMC TECHNICAL MEASUREMENT CORPORATION
441 WASHINGTON AVE., NORTH HAVEN, CONN. • CE 9-2501

16 February 1962, Volume 135, Number 3503

SCIENCE

SCIENCE, now combined with THE SCIENTIFIC MONTHLY, is published each Friday by the American Association for the Advancement of Science at National Publishing Company, Washington, D.C. SCIENCE is indexed in the *Reader's Guide to Periodical Literature*.

Editorial correspondence should be addressed to SCIENCE, 1515 Massachusetts Ave., NW, Washington 5, D.C. Manuscripts should be typed with double spacing and submitted in duplicate. The AAAS assumes no responsibility for the safety of manuscripts. Opinions expressed by authors are their own and do not necessarily reflect the opinions of the AAAS or the institutions with which the authors are affiliated. For detailed suggestions on the preparation of manuscripts, see *Science* **125**, 16 (4 Jan. 1957).

Advertising correspondence should be addressed to SCIENCE, Room 1740, 11 West 42 St., New York 36, N.Y.

Change of address notification should be sent to 1515 Massachusetts Ave., NW, Washington 5, D.C., 4 weeks in advance. Furnish an address label from a recent issue. Give both old and new addresses, including zone numbers.

Annual subscriptions: $8.50; foreign postage, $1.50; Canadian postage, 75¢. Single copies, 35¢. School year subscriptions: 9 months, $7.00; 10 months, $7.50. Cable address: Advancesci, Washington.

Prophecy Fulfilled

If, by a miracle of mechanical ingenuity, a book could be so arranged that only to him who had done what was directed on page one would page two become visible, and so on, much that now requires personal instruction could be managed by print.

Edward L. Thorndike, a former AAAS president, wrote these words in 1912. Mechanical ingenuity, theories of learning, and industrial enterprise have now, 50 years later, fulfilled Thorndike's prophecy in the form of some 45 different kinds of commercially available teaching machines. Aware of this headlong rush for production, the National Education Association has just published a survey of the burgeoning young industry that produces teaching machines and the programmed courses of instruction for which the machines are designed.

The devices vary from an inexpensive book that doesn't prevent a student from peeking at page 2 before completing page 1 to machines costing thousands of dollars in which a computer makes the page 2 shown to a student who has muffed page 1 quite different from the page 2 shown to the student who has handled page 1 satisfactorily. The devices use different materials (books, cards, films, and others) and different responses (writing, typing, button pushing), and they are based on different educational and psychological principles. There is as yet but little research evidence to guide one in the choice of a particular device or technique. But there is much theoretical and empirical evidence that the basic idea is sound.

By the end of this year, one will be able to choose among 250 programmed courses in elementary, secondary, and college mathematics, 60 in science, 25 in electronics and engineering, 25 in foreign languages, 120 in social studies, and others in contract bridge, parliamentary procedure, fundamentals of music, and even in chess and etiquette.

The list will grow; techniques will become more standardized; research and experience will bring improvements; emotional reactions against anything called a "teaching machine" will dwindle; and the devices—or, more important, the programmed materials—will come into widespread and effective use.

But in the meantime there will be inept and inadequate programs, exaggeration of both advantages and limitations, and compromise between what is available and what might be achieved with further research and development. Let these processes go on, but let them not kill off the great development around which the confusion swirls, for the potential value is of the order of value of textbooks rather than film projectors or other teaching aids.

There are several reasons for watching this development with continuing interest. It is the first major technological innovation in education since the development of printing. It is based on theories of learning; the theory-to-practice sequence is not as rigorous as is common in the physical sciences and engineering, but a direct connection is nonetheless present. Widespread adoption will not only provide the student with the advantages of proceeding at his own pace and mastering page 1 before he turns to page 2, but will also force teachers to a higher plane of educational endeavor. The teacher who does little that a machine could not do better will obviously be an inferior employee to the one who uses machines to fulfill their functions and devotes his time and knowledge to going on from where the machines leave off. Teaching machines will enable teachers to become better teachers.—D.W.

patibilities leading to graft rejection may relate particularly to white cell antigens. C. L. Markert (Johns Hopkins) then showed that each species and tissue contains its own characteristic pattern of isozymes, the patterns changing systematically during development. In his summarizing remarks on the symposium, Dobzhansky reminded the audience of the succession of primary objects of attention (for example, *Drosophila,* viruses, nucleic acids) of geneticists over the years. He emphasized the advantages offered by the use of man in genetic investigations.

It was widely agreed that the remarkable developments in the study of the nucleic acid control of protein synthesis now lead to difficult problems involving the mechanism of expression of genetic factors in more biological terms—for example, in growth and differentiation. The vice-presidential address of J. B. Youmans (American Medical Association) was highly relevant to the program in that he discussed the increasing importance of medical problems with genetic facets and recommended expansion and improvement in the teaching of genetics in medical schools.

OSCAR TOUSTER, *Secretary*

Dentistry (Section Nd)

Section Nd, in keeping with the general program scheme of recent years, again chose to organize a multidisciplinary symposium on a topic basic to oral health—namely, oral aspects of genetics.

The two-session symposium, held in the Cosmopolitan Hotel on 27 December, was organized under the direction of Albert A. Dahlberg (University of Chicago), with the cosponsorship of Section N (Medicine); the International Association for Dental Research, North American Division; the American Dental Association; and the American College of Dentists.

The morning session covered the following subjects: recent advances in dental genetics (C. J. Witkop, Jr., National Institute of Dental Research); the respective roles of twin, sibling, family, and population methods in dentomedical studies (R. H. Osborne, Sloan-Kettering Institute for Cancer Research and Cornell University Medical College); effects of heredity and environment on the development of the dentition (J. D. Niswander, University of Michigan Medical School); chromosomes, nondisjunctions, and oral anom-

alies (R. Gorlin, University of Minnesota); and the effectiveness of selection in producing laboratory stocks genetically uniform for resistance or susceptibility to dental caries (H. R. Hunt, Michigan State University, and S. Rosen, School of Dentistry, Ohio State University).

The afternoon session covered family studies of the facial complex (B. Hanna, National Institute of Dental Research); clinical aspects of genetic research in dentistry (S. L. Horowitz, Bellevue Medical Center and School of Dental and Oral Surgery, Columbia); third molar polymorphism and dental genetics (S. M. Garn and A. B. Lewis, Fels Research Institute); and the regulative changes in tooth germs grown in tissue culture (S. Glasstone Hughes, Strangeways Research Laboratories, Cambridge, England). The symposium was concluded with a general discussion by the panel and audience.

In addition, Section Nd cosponsored a meeting, on 28 December, on career opportunities in medicine and dentistry, arranged by Alpha Epsilon Delta, which attracted a large audience. After introductory remarks (Norman F. Witt, University of Colorado) two formal reports were presented, on the future needs in medicine (A. N. Taylor, American Medical Association) and in dentistry (R. F. Sognnaes, University of California, Los Angeles, Medical Center, School of Dentistry). There followed two panel discussions, on future challenges for physicians and dentists. The dental panel was moderated by H. B. G. Robinson (School of Dentistry, University of Kansas City), with discussants from several schools: W. C. Fleming (University of California, San Francisco, Medical Center), H. J. Noyes (University of Oregon Dental School), and B. C. McKinney (University of Texas).

After a group luncheon, addressed by Robert J. Glaser (University of Colorado Medical Center), arrangements were made for individual conferences with college admissions officials and for visits to local professional schools.

After these sessions Section Nd cosponsored, with Section N (Medicine), a 2-day symposium on general aspects of genetics.

Ned B. Williams (University of Pennsylvania School of Dentistry) was elected to succeed Harold J. Noyes as vice president and chairman of Section Nd (for 1962); for committeman-at-large (1962–65), S. Wah Leung (Uni-

versity of California, Los Angeles, School of Dentistry) was elected to succeed Thomas Hill, who has completed his 4-year term of office.

REIDAR F. SOGNNAES, *Secretary*

Pharmaceutical Sciences (Section Np)

Section Np held eight sessions, 27 through 29 December. There were 28 contributed papers on various studies, and one symposium was held jointly with sections on the zoological sciences, the botanical sciences, anthropology, psychology, the medical sciences, dentistry, agriculture, and education. Over 350 persons attended one or more of the pharmacy section meetings.

The AAAS Council, the governing body of the association, elected John Autian (School of Pharmacy, University of Texas) a vice president of the association and elected George F. Archambault (chief, Pharmacy Branch, Division of Hospitals, Bureau of Medical Services, U.S. Public Health Service) to serve on the committee-at-large of the section for a 4-year term. Autian will serve as chairman of the section for the coming year and will preside at the Philadelphia meeting in 1962. John E. Christian (head of the bionucleonics department, Purdue) continues to serve as secretary of the section.

Of major interest to the group in attendance was a most interesting and stimulating vice-presidential address entitled "Pharmacy and hospital pharmacy," presented by Joseph A. Oddis. An interdisciplinary symposium in the biological-medical sciences, entitled "Existing levels of radioactivity in man and his environment—measurement and significance," attracted wide attention on the part not only of the pharmaceutical scientists but of many individuals from other scientific disciplines. Over 250 persons attended this session. Christian gave introductory remarks and radioisotope demonstrations, served as presiding officer, and served as moderator of the question and discussion session. Wright H. Langham and Ernest C. Anderson of the Los Alamos Scientific Laboratory discussed, respectively, "Radioactivity levels in man and his environment" and "Application and measurement of the existing radioactivity of people and foods." James R. Arnold (University of California) discussed existing levels of cosmic-ray-produced radioactivity, and P. R. J. Burch (University of Leeds) spoke on the relationship of existing radiation levels to carcinogenesis.

The hospital pharmacy group had a most informative and well-attended full-day session of discussions and contributed papers on the scientific aspects of hospital pharmacy, under the guidance of Oddis, Don E. Francke, and Gloria Francke. The following groups were represented: the American Society of Hospital Pharmacists, the American Pharmaceutical Association, the Colorado Society of Hospital Pharmacists, the American Association of Colleges of Pharmacy, the American Hospital Association, and the American College of Apothecaries. Luncheon, entertainment, and dinner were sponsored by E. R. Squibb and Sons, Wyeth Laboratories, and McKesson and Robbins, Inc., respectively.

Autian opened the session for contributed papers which consisted of presentation of the results of original scientific investigations. Wayne V. Kessler and his coworkers at Purdue presented information on the design and operating characteristics of a large 2-pi-liquid scintillation counter for large samples, including man and animals. R. S. McCutcheon (Oregon State College) discussed antiarrhythmic actions of primaquine and amodiquin compounds with quinidine. The effects of reserpine pretreatment on drug responses were explained by R. G. Brown (University of Texas). D. B. Meyers (Butler) presented a pharmacological evaluation of six aromatic hydrazides, and D. C. Fitzgerald (Creighton) discussed estrogen levels and personality characteristics in adolescent females. G. H. Hamor described the synthesis and diuretic activity of 2-methyl-6-sulfamoylsaccharin.

Kessler presided over the remainder of the session, in which Autian presented the effect of quaternary ammonium compounds on polyvinyl chloride used in medical practice; L. A. Sciuchetti (Oregon State University) presented studies on the influence of gibberellic acid and kinetin on growth and alkaloid patterns; H. A. Lieberman (Warner-Lambert Research Institute) discussed the drying of tablet granulations in fluidized beds; T. P. Michaels (Merck Sharp and Dohme) presented an assay procedure for residual amounts of acetone in film-coated tablets; and W. W. Stiles (University of California) presented his views on preventive medi-

cine and public health in the pharmaceutical sciences curriculum.

This meeting proved to be one of the most successful of those held in recent years.

JOHN E. CHRISTIAN, *Secretary*

Agriculture (Section O)

The program for Section O, arranged by chairman Wynne Thorne, consisted of a symposium on land and water use, with special reference to the plains and mountain regions. This symposium involved four half-day sessions, for which Section O had prime responsibility. In addition, Section O cosponsored, with the AAAS, a half-day interdisciplinary program on water and climate and two half-day sessions on water improvement, in conjunction with the Committee on Desert and Arid Zones Research of the AAAS Southwestern and Rocky Mountain Division.

The first session (27 December) of the Section O program dealt with the subject of land and water resources (of the plains and mountain regions). Thorne substituted for Roland Renne (president of Montana State College) as presiding officer. There were four papers: "Population demands for land and water resources of the western hinterland," presented by S. C. Smith (University of California); "Land resources and potential use," by R. D. Hockensmith (U.S. Soil Conservation Service); "Water resources, development, and uses," by W. I. Palmer (U.S. Bureau of Reclamation); and "Public grazing lands in the economy of the West," by M. L. Upchurch (U.S. Department of Agriculture).

The second session dealt with optimum uses for resources, with E. L. Frolik (University of Nebraska) presiding. E. N. Castle (Oregon State College) discussed criteria and planning for optimum use; Nathaniel Wollman (University of New Mexico) presented a paper on economic priorities on water use in arid regions; B. D. Gardner (Brigham Young University) reviewed agriculture as a competitive segment of multiple use; and Marion Clawson (Resources for the Future) discussed recreation as a competitive segment of multiple use.

The third session (29 December) followed the AAAS half-day session on water and climate, held on 28 December, continuing the general consideration of the use of land and water resources. This third session dealt with

the impact of public policy on land and water use. W. E. Morgan (Colorado State University) presided. The first paper, on the government's responsibility for land and water, by L. B. Leopold and R. L. Nace of the U.S. Geological Survey, was presented by the associate author. The second paper, by C. R. Gutermuth (Wildlife Management Institute), presented problems associated with wilderness and other reserves of public lands. M. M. Kelso (University of Arizona) discussed problems growing out of the spaciousness of the West. The final paper, by W. E. Folz (University of Idaho), dealt with public and private investment in resource development.

The fourth session of the symposium (29 December) centered on the theme "Projecting management programs," with R. E. Hodgson (U.S. Department of Agriculture) presiding. There were four papers. Of these, the first, "Providing for multiple use in managing land and water," was presented by J. A. Hopkin. The second, "Modifying management and vegetation of watershed areas for improved water yields," was presented by F. H. Kennedy (U.S. Forest Service). The third, "Management associated with complex use for wildlife, livestock, and recreation," was presented by A. L. McComb (University of Arizona). N. K. Roberts (Utah State University) discussed management of private lands in relation to changing uses of public lands, completing the program.

On the following day the special programs on water improvement provided an important treatment of that subject, enlarging upon the themes developed in the Section O symposium. The entire series of programs, from 27 through 30 December, provided a comprehensive and well-balanced treatment of the problems associated with land and water resources and their use in the 17 western states. The information presented, and the analyses of potential programs and decisions, should be very useful to those seeking solutions to the critical problems facing these western regions.

The attendance totaled about 550 for the four half-day sessions of Section O and more than 400 for the three related half-day sessions. The audience included agricultural leaders from the federal and state agencies concerned with land and water use in the West and many leaders from private enterprises. The interdisciplinary nature of these programs was an excellent illustration of the role of science in solving basic

problems of current and long-range significance.

The following actions were taken, or announced, relative to Section O. Thorne, chairman of the section for 1961, was appointed committeeman-at-large for a 4-year term, beginning 1 January 1962. He succeeds L. P. Reitz, who has completed a 4-year term as committeeman-at-large. H. B. Sprague was reappointed secretary of Section O for a 4-year term. The symposium program of Section O for the 1962 meeting of the AAAS in Philadelphia will have as its theme, "Food quality, as influenced by production and processing." George R. Irving, Jr. (deputy administrator, Agricultural Research Service, U.S. Department of Agriculture), was elected chairman of Section O for 1962 and a vice president of the AAAS for that period.

HOWARD B. SPRAGUE, *Secretary*

Land and Water Use

Twenty papers were presented during the 3-day symposium on land and water use, one session being a general society symposium jointly sponsored and arranged with the Southwestern Division's Committee on Desert and Arid Lands Research.

Population increases of 1.6 percent per year, rising living standards, and changing interests and leisure-time activities are increasing the pressures on the nation's land and water resources (Stephen C. Smith, University of California). Higher-than-average population increases in the West, the nearly 400 million acres of public lands, and acute water limitations combine to make this an area of conflicting ideas about the use of resources.

With production on the nation's farms increasing about 2.6 percent per year, the approximately 640 million acres of land suitable for cultivation, plus anticipated developments in science and technology, will provide food and fiber needs for the foreseeable future (R. D. Hockensmith, Soil Conservation Service).

W. I. Palmer (Bureau of Reclamation) pointed out that water needs for the West could only be satisfied through a large public investment for storage, distribution, pollution control, and better measures for reducing losses. F. H. Kennedy (U.S. Forest Service) reported preliminary results of some long-term experiments which indicate that thinning or removing trees and replacing them with grass on many western watersheds could result in larger yields of water. Similar increased water supplies were foreseen from capture and use of underground and surface water (J. Harshbarger, University of Arizona) and from better knowledge of climatic events (P. R. Julian, University of Colorado).

The role of government as a guardian and developer of resources has been accepted, according to L. B. Leopold and R. Nace (U.S. Geological Survey), but they foresaw need for action to guard public interest against government encroachment. Research to determine the consequences of long-term programs is needed, with more consideration of esthetic and social values. M. K. Udall (U.S. congressman, Arizona) concluded that legislative attempts to consolidate agencies concerned with national resources had failed; legislation is being sought to establish uniform criteria among agencies for developing and managing land and water.

Several papers evaluated competitive uses of resources. N. Wollman (University of New Mexico), in an economic appraisal of alternative uses of water

in the Missouri Basin, concluded that returns in productive value of labor strongly favored use of water for manufacturing over use for agriculture. J. Hopkins (Bank of America) challenged the accepted concept of multiple use of resources and proposed the concept of optimum use, with public preference polls used as a supplement to present criteria for programs of public agencies.

M. Clawson (Resources for the Future) proposed precedures for comparing the demand curves and benefits for recreation with those for other uses of land and water. C. R. Gutermuth (Wildlife Management Institute) contended that the purpose of establishing national parks and monuments is to preserve national values rather than to provide public playgrounds. Recreation areas should be administered by the Forest Service and Bureau of Land Management. A. L. McComb (University of Arizona) concluded that multiple use is acceptable for large areas but that in practice use should be defined by a detailed site classification.

Use of public lands for livestock grazing has declined. M. L. Upchurch (U.S. Economic Research Service) estimated that only 1.2 percent of livestock feed comes from the 400 million acres of public lands and that changes in grazing fees would have little influence on the income of federal agencies. K. Roberts (Utah State University) provided data to show that the value of grazing permits on public lands has been capitalized into regular ranch operations.

WYNNE THORNE, *Program Chairman*

Education (Section Q)

The Section Q program consisted of a symposium on factors identified with the early shaping of the scientist, and two sessions of contributed papers. In addition, Section Q cosponsored two sessions with the Council for Exceptional Children, two sessions with the American Educational Research Association, and a special program with the AAAS Cooperative Committee. Section Q also cosponsored one of the AAAS interdisciplinary symposia, "Existing levels of radioactivity in man and his environment." The teaching societies had their usual array of fine programs.

William Bristow gave the vice-presidential address for the section. His subject was "Some imperatives of curriculum research and development." Two meetings were scheduled for the

section committee. Possible program improvements were considered, and greater involvement of section membership was urged. A continuing problem was seen in the relative tenuousness of the ties with various assigned affiliates of Section Q. Few of the representatives of the affiliate organizations attend the AAAS meetings. It would be mutually advantageous if affiliate societies would designate representatives who could and would attend the annual meeting.

There seemed to be general satisfaction with the quality of the programs. Some of them were really outstanding, but the attendance was relatively light. Some very deserving programs were rather poorly attended.

Kenneth E. Anderson (dean of the University of Kansas) was elected vice president and chairman of Section Q. Edgar Martin was elected committeeman-at-large for a 4-year term.

HERBERT A. SMITH, *Secretary*

The Shaping of a Scientist

In setting the focus for the symposium "The shaping of a scientist," Ralph Tyler commented on the role of the scientist in our society. He pointed out the crucial need for an ever-increasing supply of scientists who are broadly educated in terms of the values of our society, as well as highly trained in their professional field of activity. He suggested that we view the life history of a scientist and the development of his career from his preschool days through the entire educational system and on into his postgraduate work.

Patrick Suppes discussed an investigation of the way in which young children learn mathematical concepts. He commented on the incremental, as compared with the all-or-none, learning theories and described some of the experiments he had conducted in teaching mathematical logic in the elementary schools. For example, in one of these experiments, conducted at the 5th-grade level, the boys and girls are learning material usually offered at the college level.

The kinds of students who do, and the kinds who do not, achieve in science at the high school level were discussed by Victor Cline. He characterized the former as persons who are "inner-directed" or psychologically independent. They are those to whom ideas are more important than people, those who have the capacity for self-criticism and self-expression. In the work he has done, Cline sees three factors as making the critical difference between those who

do and those who do not achieve—the student's ability, his family environment, and the subculture in which he lives.

The question of differentiating between the individual who is a generally good scholar and one who excels specifically in science was raised by John Dailey. Tests of creativity offer one means of differentiating, but such tests should be used in combination with other instruments, such as aptitude inventories, to help identify science talent. Dailey reported that a recent nation-wide study of high school students showed a trend away from science careers from the 9th grade to the 12th on the basis of the students' own statements of their future plans.

Howard Gruber discussed educational goals at the university level and and their relationship to self-directed study on the part of the student. He pointed out that science education must have two facets—the assimilation of a body of scientific knowledge and the learning of a scientific way of thinking. The second objective seems to be the more difficult to attain, and to receive much less attention than the first.

There followed a general discussion, under the leadership of Tyler, in which the panel members and the visitors joined. Tyler commented on the factors in the life history and career development of a scientist about which we need more information and pointed out current research which is seeking to provide needed insights. For example, much remains to be learned about early childhood experiences which may influence the individual with regard to science. Among the factors to be studied here are the development of curiosity in the young child, his opportunities for an increasing skill in manipulating objects, the growth of his readiness for new experiences, and the effects of rewards and punishments resulting from such behavior as asking questions. Other factors enter the picture at the high school and college level in the life of the future scientist—the expectations established for the child at home, the expectations of his peer group, the general climate of the school he attends, and the environmental press of the college or university he attends. At all levels of his development an important factor is the student's opportunity to identify himself with some older person who may serve as a model for him—perhaps a doctor, lawyer, or a scientist. Tyler also commented on the education of scientists in Russia, which he

visited recently. He reported that a scientific career there carries the highest prestige. Also, during the development of the individual, much more time is devoted to educational pursuits than in the U.S., and there is therefore a correspondingly greater amount of time available for science education.

The consensus of the discussion on the shaping of a scientist in our educational system was that the mathematical foundations and the beginning of science as a way of thought as well as a body of knowledge should receive attention at the elementary school level. It was agreed that the determination of whether an individual is or is not likely to become a scientist is made well before the end of high school.

ALICE Y. SCATES, *Program Chairman*

The Exceptional Child

Section Q and the Council for Exceptional Children held two meetings in joint session on 26 and 27 December at the Shirley Savoy Hotel. The papers, with emphasis on research and theory, covered a wide range of problems concerned with exceptional children.

James Lent (University of Oregon) compared the attitudes of educable retarded children in special classses and in regular classes with respect to the level of aspiration in arithmetic-type and reading-type tasks. He noted that educable retarded children in special classes were significantly more realistic regarding their ability in arithmetic-type tasks than their counterparts in regular classes. However, no significant differences were found regarding reading-type tasks. To discover the social needs of retarded children, Barbara Edmonson and John de Jung (University of Kansas) reported on a modification of the Syracuse Scales of Social Relations. They stated that the educable retarded can recall a sufficient number of reference names to make the scale feasible for measuring social needs in an intergroup setting.

Marion Philippus (University of Colorado) and Louis Fliegler (University of Denver), in studying the personality, value, and interest patterns of elementary, secondary, and special-education student teachers, found that special educators differed significantly from the other groups on 11 out of 22 scales. Rather interestingly, all three groups rated social service interests above science and computational areas.

The problems of the gifted child were emphasized by Alice Hayden (University of Washington), Edwin Richard-

son (University of Nevada), and Calvin Taylor (University of Utah). Hayden evaluated the qualities and qualifications desired for teachers of the gifted as delineated by school administrators, gifted students, teachers of the gifted, and regular classroom teachers. She found that gifted children desired teachers who make them think, who create an interest in the subject, and who help them make good use of their time. Richardson stressed the fact that it is a mistake to overemphasize the I.Q. in determining the dynamic qualities of intellectualization demonstrated by the gifted. He further contended that the gifted appear to be more concerned with specific abilities than with general ability, are perfectionistic in their ideas, are sensitive to values, and are overcritical in their approach to problems. Taylor reiterated that current measures of intelligence are not identifying the creative individual. There is, he said, a need to define several types of giftedness and to construct adequate assessment procedures to delineate these aspects of giftedness.

Miles Zintz (University of New Mexico) discussed his 3-year research study, which was carried out to identify, define, and describe factors of cultural and environmental difference between Indians and non-Indians; to find ways to alleviate conflicts in classroom teaching-learning situations; and to provide a basis for planning appropriate classroom adjustments. Teachers' middle-class values and life style were contrasted with the values and life style of Pueblo and Navajo Indians and of the traditional Middle Rio Grande Spanish Americans. A pattern of over-age-in-grade status and increasing educational retardation as students move through the school grades was found. There was considerable evidence of a need for a systematic, sequential teaching of English as a second language for all minority ethnic groups in New Mexico.

The body image of stutterers was reported by Joseph Fitzpatrick (University of Denver). He contrasted the differences accentuated by the stutterers in drawing themselves and their ideal image in the process of speaking. Empirical indices suggested that the technique of drawing oneself is important in evaluating progress in therapy.

The way in which researchers use content words and certain causative phrases was challenged by Joseph Spradlin and Gerardeau (University of Kansas). They contended that content words should be defined in terms of ob-

servable objects or events, or of the characteristics of such objects or events. It was also suggested that the term *cause* should be defined, and utilized only where an experimental manipulation had been made.

In summary, the high quality of papers reflected the increased research interest in the exceptional child.

LOUIS A. FLIEGLER, *Program Chairman*

Science Teaching Societies (Q8)

A superb symposium arranged by the affiliated science teaching societies and covering some of the more fundamental areas within the sphere of molecular biology was held and was well attended. The history of ideas leading to the present knowledge of the architecture of cellular components was beautifully developed in a remarkably coherent sequence by Leonard Lerman, Henry Borsook, and Irwin Sizer.

Genetic architecture was treated in some detail by Lerman (University of Colorado Medical School). The empirical evidence for establishing the molecular structure of deoxyribonucleic acid was presented from the standpoint of both chemical analysis and x-ray diffraction detail. A superb metal "mobile" of a few nucleotides attracted considerable attention.

Borsook (California Institute of Technology) focused attention on the molecular structure of proteins and developed the "sentence" structure of the amino acid "alphabet." The exact sequence of some simpler proteins was illustrated by means of simple, clear slides. A description of the various chemical bonds was related to the chemical activity in terms of enzyme attack sites.

The role of enzymes in the molecular architecture of cells was well presented by Sizer (Massachusetts Institute of Technology). The chemical characterization of ribonuclease was shown, and the method for determining the active enzyme site was followed through. Only a very short section of the long chain was pointed up as the active center.

ALFRED NOVAK, *Program Chairman*

Creativity in Science

In the research symposium on creativity in science, arranged by the National Association for Research in Science Teaching and held on 29 December, Calvin Taylor presented a paper which described research techniques, the characteristics of creative scientists, and some of the implications of the research results for the process of educating

science personnel. The results of the research activities to date indicate that the thinking processes involved in acquiring basic knowledge and those involved in producing new ideas and devising new research procedures differ. For full utilization of the creative talents of a scientist, an understanding of the nature of creativity is imperative. School grades and I.Q. scores are inadequate measures of creativity. Characteristics which exemplify creativity are intellectual persistence, a capacity for manipulating ideas, the ability to make intuitive decisions, resourcefulness, and emotional identification with a research problem.

Edward U. Condon (Washington University) was unable to attend the Denver meeting. Instead, Dr. Love (Sacramento State College) presented procedures for selecting the content of a proposed liberal arts biology course for college students.

EDITH M. SELBERG, *Program Arranger*

American Nature Study Society (X3)

The American Nature Study Society, an affiliate of the AAAS since its founding, held its 53rd annual meeting in Denver from 26 to 30 December. The program included seven sessions, a banquet, and an all-day field trip and was unique in its emphasis on interpreting the natural world from viewpoints ranging from local to international.

The society cosponsored, with other teaching societies, the symposium on molecular biology.

In the first session of the society's program, the theme "Nature study around the world" was developed. The papers included one on Iran, by John Wanamaker (Principia College, Elsah, Illinois); one on science teaching in Brazil, by Paul Klinge (Editor, *American Biology Teacher*); one on general science in Pakistan, by Richard L. Weaver (University of Michigan); and one on worldwide interest in nature and conservation, by Mrs. S. Glidden Baldwin (Illinois Nature Conservancy).

Olaus J. Murie, director of the Wilderness Society, presided over the session on outdoor nature interpretation. An appeal was made for more interpretive programs and for more efficient use of the natural areas still to be set aside. Papers on these subjects were presented, by W. H. Woodin (Arizona-Sonora Desert Museum), Ted F. Andrews (Kansas State Teachers College), and Edwin C. Alberts and Wayne W.

Bryant (National Park Service). The symposium on conservation and international resource development, sponsored jointly with the National Association of Biology Teachers, attracted over 100 persons. Walter P. Taylor, Richard L. Weaver, Frank O'Leary, and Robert C. Leestman presented papers.

The Kodachrome Showing by society members and their guests attracted an audience of over 150. Each series of slides presented excellent photography and a natural history story.

At the annual banquet, which was well attended, Ruth E. Hopson (Portland, Oregon), the outgoing president, handed over the gavel and scroll of presidents to the incoming president, S. Glidden Baldwin (Danville, Illinois). Baldwin presented a movie record of "Nature adventures around the world," the highlights of his family's 8-month trip in 1960. Sounds recorded by Mrs. Baldwin accompanied the film.

The all-day field trip by bus to the Garden of the Gods was a pleasant, informative affair arranged by David O. Davis and Sam S. Blanc. The excellent interpretation of the area, by the leaders and particularly by Paul W. Nesbit of Colorado Springs, greatly added to the day's pleasure.

Ruth Hopson presided at a symposium on the natural history of the Rocky Mountains. This included a review of the physical evolution of the Rockies, by S. H. Knight, a panorama of wildlife of the area, by Richard G. Beidleman, a talk on nature in the mountains, by Nesbit, and a study of animals in the Rockies, by Murie. All papers in this and other sessions were interestingly illustrated.

The final session involved a trip to the Denver Museum of Natural History, where director Alfred M. Bailey and his staff reviewed their major activities and the process of preparing new displays.

STANLEY MULAIK, *Program Chairman*

Conference on Scientific Communication (X5)

Chauncey Leake, chairman of the AAAS Board of Directors, announced at a luncheon following the annual meeting of the AAAS Council its formal approval of the new Section on Information and Communication. Recognition was tendered to members of the Conference on Scientific Communication (originally designated the Conference on Scientific Editorial Problems),

both to those who have been members of the steering committee since 1952 and to those who have participated in the conference programs at the annual AAAS meetings.

In opening the program of the Conference on Scientific Communication (the first session of the new section), Leake said, "We know too much and yet we can't find out what we know." He pointed out that a new type of scientist will emerge, one who will be able to synthesize the data other scientists generate.

The new section (see page 535) will deal with problems of communication between scientists and between scientists and the public. The section may play a leading part in correlating information in those fields where scientific boundaries are crossed and in disseminating information on new techniques of publishing and data processing and on abstracting and information storage and retrieval.

Several related papers were presented during the first program. Published information is doubling every 10 years, according to Phyllis Parkins (*Biological Abstracts*) and Ralph Shaw (Rutgers), who discussed the problems of collecting, storing, and retrieving scientific information. Isaac Welt (Institute for the Advancement of Medical Communication) described the techniques and advantages of indexing in depth, and Foster E. Mohrhardt (U.S. Department of Agriculture) presented a paper on solving the problems of interdisciplinary communication in science.

There were two panel discussions, one on interdisciplinary science communication, under the chairmanship of Dale Baker (*Chemical Abstracts*), the other on communicating science to the people, under the chairmanship of Victor Cohn (Minneapolis *Tribune*). Members of the first panel were Miles Conrad (*Biological Abstracts*), Graham DuShane (AAAS), Eugene Garfield (Institute for Scientific Information), Richard Orr (Institute for the Advancement of Medical Communication), George L. Seielstad (Johns Hopkins Laboratory of Applied Physics), and Charles Shilling (AIBS Communication Project).

Members of the second panel were Watson Davis (Science Service), Hillier Krieghbaum (New York University), Edward G. Sherburne, Jr. (AAAS), and John Sherrod (Library of Congress).

GEORGE L. SEIELSTAD,
Program Chairman

Conference on Scientific Manpower (X6)

The program of the conference on scientific manpower featured a paper by Truman H. Kuhn (Colorado School of Mines) on the topic "Engineering and science—a struggle for survival." The session was held on 27 December.

Howard Meyerhoff (Scientific Manpower Commission) served as chairman of the session. In his introductory remarks he noted that recent studies indicate an increasing demand for scientific and engineering personnel, while current enrollments, in engineering schools at least, are declining.

Kuhn noted the close relationship between science and engineering and stated that students in these fields are drawn from a common pool of talent; science's share of this talent is now growing at the expense of engineering's. The solution, according to Kuhn, is to increase the size of this pool of talent rather than struggle to divide the present inadequate pool. Furthermore, well-rounded graduates who can specialize are needed, rather than individuals who are already narrowly specialized.

The conference on scientific manpower was sponsored this year by the Engineering Manpower Commission, the Scientific Manpower Commission, the National Research Council, the National Science Foundation, and AAAS Sections E (Geology and Geography) and M (Engineering).

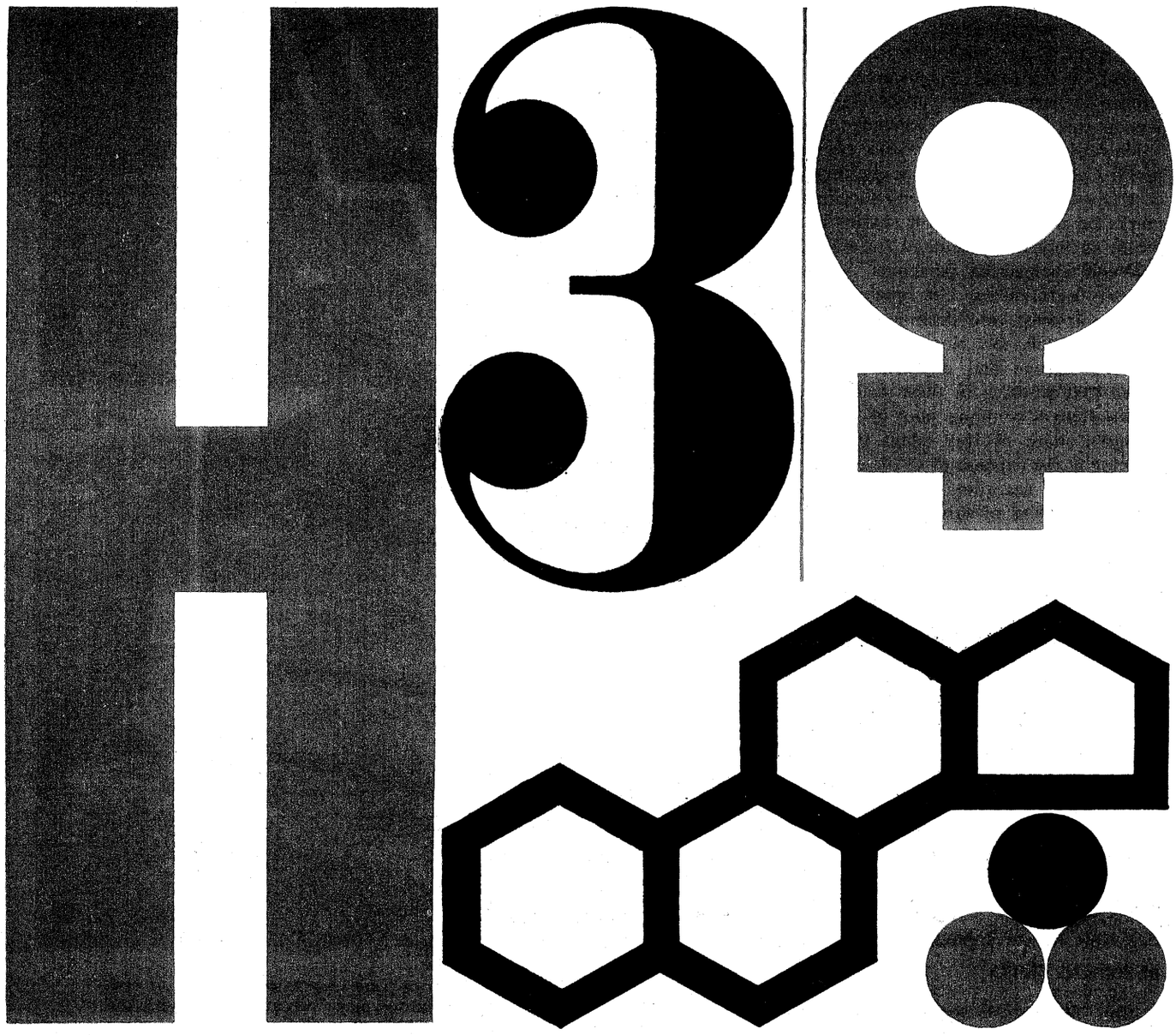
THOMAS J. MILLS, *Program Chairman*

Scientific Research Society of America (X11)

The 13th annual convention of the Scientific Research Society of America (RESA) was held in the Hilton Hotel on 29 December. The board of governors, at its October meeting, had reelected W. J. Coppoc and D. B. Prentice chairman and director-treasurer, respectively, for 1-year terms, to begin 1 July 1962. The convention elected Donald L. Benedict and John W. Copenhaver members of the board of governors for 3-year terms, to begin 1 July 1962. At the RESA-Sigma Xi Luncheon, which followed the meeting, the annual RESA address was given by Edward R. Weidlein, former director of the Mellon Institute. The 1961 Procter prize of $1000 for scientific research was presented to Weidlein by W. J. Coppoc, chairman of RESA.

DONALD B. PRENTICE, *Director*

specifically labeled steroids of high specific activity



tritiated estrogens

17-β-Estradiol-6,7-H^3 (180 mc/mg)
Estrone-6,7-H^3 (110 mc/mg)
Hexestrol-2,3,4,5,7-H^3 (420 mc/mg)

The first three of a series of specifically labeled tritiated steroids and related compounds, prepared and standardized in our own laboratories. Radiochemical purity 98%. Specific activity levels higher than any previously available. Hexestrol, as one of the newest estrogens, may be of special value in exploratory studies in tissue tenderizing and animal feeds—and its unique high specific activity should be of interest to those doing basic metabolic research. Packaged in vials of 250 μc, 500 μc, 1 mc and 5 mc in benzene solution, sealed under nitrogen. Write for complete information on these and other labeled steroids in which you may be interested.

SCHWARZ BIORESEARCH, INC. · Dept. 2B3 · Mountain View Avenue, Orangeburg, New York
BIOCHEMICALS · RADIOCHEMICALS · PHARMACEUTICALS for research, for medicine, for industry

New Products

Desalter for reducing the salt concentration of plasma, urine, spinal fluid, and other biological samples being prepared for chromatographic fractionation operates by electrolytically driving the ions through anion- and cation-exchange membranes into acid and alkali compartments provided with platinum-wire electrodes. The sample compartments of clear Plexiglas offer a choice of using 1, 2, or 3 ml volumes for an optimal ratio of membrane area to sample volume. Direct current is supplied from an integral transformer and rectifier. In operation, a sample is introduced into the proper cell and current is adjusted to 30 to 80 ma, and in 5 to 10 minutes the completion of the process is signaled by a fall in the current to about 30 percent of the initial value. Membranes are said to be inexpensive; they have a useful life of about 1 year. Enough material for four pairs of membranes is provided. In contrast to the devices which use the mercury amalgamation method for removing cations, no mercury or water connections are required. The entire instrument is contained in a 7-by-6-by-4-inch package.—R.L.B. (Torsion Balance Co., Clifton, N.J.)

Circle 1 on Readers' Service card

Liquid-borne-particle monitor provides outputs by means of which alarms can be sounded or displayed either upon occurrence of suspended materials or on the deviation from size or concentration tolerance of desired particulates in suspension. Control circuits can be tied into these outputs. Particle-size readings can be programmed over any desired combination of 15 constant-percentage ranges from 5 to 160 microns in the standard instrument. The time period for the programmed size ranges can be 0.3, 1, 3, or 10 minutes. A built-in dilution system for handling fluids having a high density of particles is available. —J.S. (Royco Instruments Inc., 440 Olive St., Palo Alto, Calif.)

Circle 2 on Readers' Service card

Pulsed laser (Fig. 1) provides zoom lens and transit mounting for convenience in aiming. Built-in Fabry-Perot type end reflectors permit the device to be used as both a coherent light source and laser material tester. The instrument accommodates materials up to 4½ in. long and ½ in. in diameter. Peak power is nominally 1 kw, and pulse width is nominally 0.5 msec with ruby laser materials. End reflectors are ¾-inch multilayer reflectors at ruby wavelength of 6943 A. Absorption and scattering are nominally below 0.2 percent. Transmission is nominally 1 percent. Other reflectors are interchangeable. The laser material is positioned at one focus of an elliptical mirror; a cylindrical flash lamp occupies the other focus. The mounting cradle of the instrument provides azimuth and elevation circles graduated in 1-degree markings with a vernier reading to 5 seconds. The mounting cradle is equipped with leveling screws and may be mounted on a bench or tripod.—J.S. (Optics Technology, Inc., 248 Harbor Blvd., Belmont, Calif.)

Circle 3 on Readers' Service card

A **laboratory illumination source** (type 6500 Lab-Lite) providing a daylight fluorescent lamp and reflector behind a 3-by-11-inch translucent plastic screen can be used for viewing plates, films, slides, or biological specimens in dishes or on slides with the panel horizontal. A convenient feature of the compact stainless steel housing is that it is designed for a 17°C rise above room temperature so that the viewing surface reaches 37° to 42°C for room temperatures of 20° to 25°. This warm surface is ideal for many serological procedures that can be carried out on the illuminated surface. The soft, diffused light can also be used

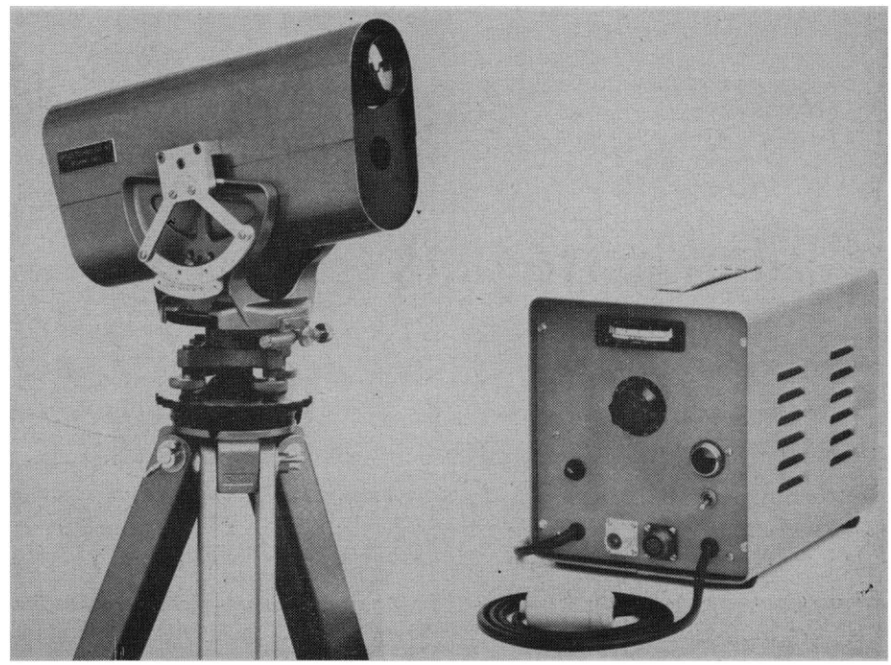


Fig. 1. Pulsed laser.

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

Robert L. Bowman (R.L.B.), 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. A Readers' Service card for use in mailing inquiries concerning the items listed is included on page 489. Circle the department number of the items in which you are interested on this card.

to illuminate titration vessels from under or behind, as well as to provide an under-shelf or cabinet illuminated panel suitable for viewing dental x-rays or small negatives. Compact size of 5 by 12⅜ by 2⅝ inches conserves laboratory space.—R.L.B. (Thermolyne Corp., 465 Huff St., Dubuque, Iowa)

Circle 4 on Readers' Service card

X-Y recorder is a null-seeking, servo-type instrument that plots two d-c input voltages in Cartesian coordinates on 8.5-by-11-inch paper. Two models are available, one with sensitivity of 1 mv/inch and the other with sensitivity of 10 mv/inch. The recorder is a flat-bed type; ink is used for recording.—J.S. (Central Scientific Co., 1700 W. Irving Park Rd., Chicago 13, Ill.)

Circle 5 on Readers' Service card

Voltage-surge protectors are specially processed selenium cells that exhibit a change from high to very-low impedance when the applied voltage exceeds a specified value. Units are available in polarized or nonpolarized configurations, in stacked or cartridge assemblies. Voltage ratings range from 25 to 500 volts (r.m.s.); maximum leakage current is 12 ma; maximum operating temperature is 100°C.—J.S. (International Rectifier Corp., 233 Kansas St., El Segundo, Calif.)

Circle 6 on Readers' Service card

Tester for operational d-c amplifiers (model 1800) is designed for on-the-spot testing of plug-in amplifiers used in analog computer and simulator installations. Amplifier gain, drift, positive and negative voltage swing, and response to an internally generated square wave are measured. The tester which may be rack-mounted, is powered by the manufacturer's model PS/200/3.5 power supply.—J.S. (Embree Electronics Corp., 993 Farmington Ave., West Hartford 7, Conn.)

Circle 7 on Readers' Service card

Polyethylene ball-and-socket joints are molded with tolerances of not more than 32 microinches of surface roughness. They meet all the requirements of conventional, leak-tight laboratory apparatus joints. The new joints eliminate the danger of frequent glass breakage. The two parts are held together firmly with special pinch-type, spring closed clamps. The joints are resistant to radiation and are sufficiently flexible to permit remote manipulation.

They have been tested and evaluated in the assembly of apparatus for handling radioactive materials. The male part of the joint is molded with a guide which facilitates remote assembly by acting as a support until the clamp firmly grips the joint. The joint accommodates either glass, rubber, or plastic tubing of 3/16 inch inside diameter.—R.L.B. (Labline, Inc., 3070-82 W. Grand Ave., Chicago 22, Ill.)

Circle 8 on Readers' Service card

Temperature and thermal-radiation integrating system measures, integrates, and records analog voltage inputs corresponding to differential and absolute temperatures and thermal-radiation levels. System capacity is 36 channels. Input data for each channel are sampled for value and sign, stored, integrated over a 1-hour period, and recorded by a tape punch. The integration period may be changed to suit individual requirements. Sampling rate is 100 per channel per hour. Input voltage range is 0.001 to 0.999 v. A 1000-count, full-scale output is said to be accurate within ±0.2 percent ±1 count. Operating ambient temperature range is −15° to +55°C; the system will operate with relative humidity up to 95 percent. —J.S. (Datex Corp., 1307 S. Myrtle Ave., Monrovia, Calif.)

Circle 9 on Readers' Service card

Twin filament indicator lamp is designed to prevent complete failure of signaling function without warning. One of the two filaments supplies the major portion of the light; the other is designed for long life. When the first filament burns out, the second still provides its signal but also indicates the need for lamp replacement. —J.S. (Chicago Miniature Lamp Works, 1500 N. Ogden Ave., Chicago 10, Ill.)

Circle 10 on Readers' Service card

Phase measurement console for microwave frequencies can be designed for any portion of the microwave spectrum. A system for the 3000-Mcy/sec band is said to be capable of resolution and repeatability to ±0.1 deg. Readout is provided by calibrated meter indication, by swept-oscilloscope display of phase shift versus frequency, or by a recorded plot. Readings are not affected by amplitude of input signals or variations in insertion loss of the device under test.—J.S. (Rantec Corp., Calabasas, Calif.)

Circle 11 on Readers' Service card

Particle accelerator (model S) is capable of producing a wide range of particles and radiations. Both vertical and horizontal models, with or without switching for acceleration of ions or electrons, are available. Components are not enclosed in a pressure vessel and are therefore readily accessible. The accelerator contains a four-lens accelerator tube. The potential of the focusing electrode is supplied by an auxiliary power unit whose voltage can be adjusted from a control console. Other electrode potentials are derived from a resistance divider. The high-frequency ion source is supplied by an alternator and remotely controlled by selsyns. The accelerator comes equipped with a high-speed diffusion pump with necessary accessories. Operating at full power, the unit has a rated power consumption of 10 kva. The high-voltage generator has a maximum voltage of 600 kv and is rated at 4 ma. Either a medium- or high-stability generator can be supplied.—J.S. (S.A.M.E.S., 30 Broad St., New York 4)

Circle 12 on Readers' Service card

Two-dimensional measuring microscope covers a longitudinal range of 20 cm and a cross traverse of 10 cm. The two scales of the instrument are graduated in millimeters, and micrometer heads provide adjustment and indication to 0.01 mm. Accuracy is said to be better than ±0.01 mm when moved over the full range of either motion. A plate-glass platform is fitted to provide a surface upon which objects can be mounted for examination. Open construction permits lighting from above or beneath. The microscope provides magnifications of 5 and 20 interchangeably; other magnifications are available. Graduation in English units is available on special order.—J.S. (W. G. Pye & Co., Ltd., Granta Works, Cambridge, England.)

Circle 13 on Readers' Service card

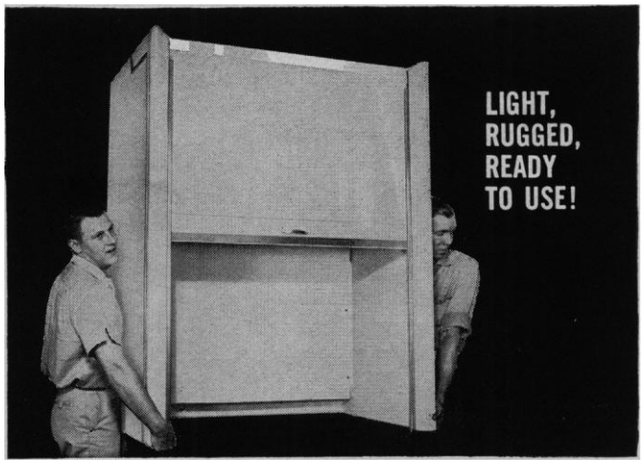
Plant growth rooms provide complete integrated systems of illumination, temperature, and humidity control for growing plants under controlled conditions. Banks of fluorescent lamps supplemented by incandescent lamps provide proper spectral balance. These lamps are controlled by timers for various programs. Four 30-by-70-inch doors provide clear access to the entire usable plant bed (52 by 100 inches). Circulation of the air through the lamps to the cooling coils is said to eliminate the nuisance of maintaining a heat barrier between lamps and bed. —R.L.B. (Sherer-Gillett Co., Marshall, Mich.)

Circle 14 on Readers' Service card

Probability analyzer is used to extract statistical data concerning random inputs. In its primary mode of operation, it calculates the number of cycles of data whose peak-to-peak value lies between 16 pairs of equally spaced thresholds. Provision for measuring the time duration between specified threshold pairs can be embodied. The number of cycles whose value is less than each of the 16 thresholds can similarly be calculated. Also calculated are the total number of cycles of data counted, and the first, second, and higher moments of the distribution. The analyzer consists of an operational amplifier for signal conditioning, an analog-to-digital encoder, logic circuitry, level-occurrence counters, and readout circuitry. The signal to be analyzed is encoded in binary form. Logic circuitry is utilized to determine whether the peak-to-peak value falls between each of the pairs of thresholds. A count is then added to the appropriate level-occurrence counter, and the next signal is encoded. Timing and control circuits permit automatic plotting of an analog voltage proportional to the number of counts in each counter, thus producing the desired histogram on a laboratory recorder.—J.S. (Sierra Research Corp., Dept. S28, P.O. Box 22, Buffalo 25, N.Y.)

Circle 15 on Readers' Service card

Transducer amplifier-indicator (model 311) provides approximately 5 volts at 2400 cy/sec for excitation of differential-transformer or bridge-type transducer elements. A carrier a-c amplifier and phase-sensitive demodulator provides 0 to 200 cy/sec response (within 3 db at 6 volts peak to peak) at output terminals. A large meter responding to 2 or 3 cy/sec indicates output for convenient centering, zero suppression, and calibration. A 250-microvolt signal from the transducer deflects the zero-center meter to the end of the scale and provides a 3-volt signal across 1000 ohms (or higher) for recording. The entire unit is con-



NEW FIBERGLASS "47" FUME HOOD FROM LABCONCO

Here's a brand new, practical idea for your laboratory —an attractive fume hood made of fiberglass! The new Fiberglass "47" Fume Hood from Labconco is light, rugged, easy to install and easy to maintain. It is highly resistant to chemicals and heat. Made of special polyesters, it will not support combustion.

Almost any flat surface will serve as a base for the Fiberglass "47" or it can be purchased with matching base cabinet or table. Colors are white, green and gray.

The cost? . . . only $495 complete with sash, motor and blower. Write today for descriptive brochure.

LABORATORY CONSTRUCTION CO.
8811 Prospect Ave., Kansas City 32, Mo.

DIFCO

ASTO

Difco reagents for the diagnosis of
Group A Streptococcal Infections

- **RHEUMATIC FEVER**
- **GLOMERULONEPHRITIS**

ANTISTREPTOLYSIN *O* TITERS (ASTO) and their relation to pathological conditions in Group A streptococcal infections have established the importance of this determination as a routine clinical test.

Bacto-Streptolysin O Reagent—a dehydrated, standardized and stable reagent requiring only rehydration with distilled water. Antistreptolysin *O* titers have been impractical for routine diagnosis because of the difficulties in preparing the reagent. Bacto-Streptolysin *O* Reagent is a standardized preparation permitting the routine performance of this diagnostic test in all clinical laboratories.

Bacto-ASTO Standard—an antiserum titred in Todd units for use as a control in the determination of antistreptolysin *O* titers.

Descriptive literature sent upon request.

DIFCO LABORATORIES
DETROIT 1, MICHIGAN

FOR IRRADIATION RESEARCH

the famous GAMMACELLS

safe and simple, offer Cobalt 60 GAMMA RADIATION with dose rates up to 2 MILLION R/Hr., without altering your present Laboratory. Chamber sizes up to 6" in diameter and 8" in height. Solids, liquids or gasses can be irradiated. Your choice of 3 standard models or, have a Gammacell custom built for your particular requirements.

Now used by 30 Centers of Research in 12 different countries for basic and applied research in Chemistry, Food, Medicine, Agriculture, Biology, Electronics, Metals, Textiles, Glass, Plastics.

GAMMACELLS are compact, efficient and low in cost — Can be operated by technicians — No special skills required.

Be ready for TOMORROW'S RESEARCH by writing for complete information TODAY.

ATOMIC ENERGY OF CANADA LIMITED
Commercial Products Division • P.O. Box 93 • Ottawa • Canada

Sales and service representation in over 100 countries.

tained in a 8⅛ (h) by 9¼ (w) by 6 inch (d) portable case; it operates on 115 v, 50 to 400 cy/sec current, consuming 7 watts.—R.L.B. (Sanborn Co., Waltham 54, Mass.)

Circle 16 on Readers' Service card

Laboratory electromagnet is an optimized-geometry iron-bound air core solenoid. It is bored to provide both horizontal and vertical access to the gap. Its removable plug-type pole pieces may themselves be bored for axial gap access as well. The gap is adjustable within the limits of the overall dimensions of the magnet. A field up to 12 kgauss can be produced over a working volume 1 in. wide and 2 in. in diameter with plug-type poles installed. Removal of the pole pieces allows operation as an air core solenoid with a 2-in. bore which can produce a field greater than 4 kgauss.—J.S. (Magnion Inc., 195 Albany St., Cambridge 39, Mass.)

Circle 17 on Readers' Service card

Flash lamp pulser (model 110) provides outputs up to 10 million peak candlepower and up to 5 watt-seconds per flash. Flash duration is approximately 1 μsec and repetition rate up to 10,000 flashes per second. Repetition rate and number of flashes in a burst are independently adjustable. Any number of flashes from 1 to 512 may be obtained. The initiating signal may be an electrical pulse or the making of a contact. Auxiliary equipment enables the burst of flashes to be initiated on an adjustable time delay. An accessory divider extends the maximum number of frames to 4096. With an auxiliary power supply, the total energy may be extended to 1500 watt-seconds per burst.—J.S. (Shapiro and Edwards, 1130 Mission St., South Pasadena, Calif.)

Circle 18 on Readers' Service card

Model At-14 **automatic switching thermistor thermometer** is available with 3, 4, 6, or 12 channels. Response time of the instrument is stated to be 0.4 sec/20°C change in temperature, accuracy ± 1 percent of full scale. A direct-reading scale is supplemented by an output for connection to a standard recorder. Each channel operates independently and has its own calibration controls. Automatic sequential switching is provided at 15-, 30-, and 60-second intervals. Manual control is also provided.—J.S. (Waters Corp., P.O. Box 529, Rochester, Minn.)

Circle 19 on Readers' Service card

Infrared radiation test set (model No. 16-110) is designed to test or evaluate optical systems, detectors, or detector elements, and to determine the effects of changes in configuration. The basic test set consists of a motor-chopper assembly, a detector-preamplifier assembly, and a synchronous rectifier amplifier unit. Each can be purchased separately. When used in conjunction with a radiation reference source of known intensity, the test set can be used to obtain absolute values of the parameters for portions of radiometric systems.—J.S. (Barnes Engineering Co., 30 Commerce Rd., Stamford, Conn.)

Circle 20 on Readers' Service card

Breadboarding arrangement permits assembly of circuits without solder. The device consists of a phenolic board carrying 108 gold-plated cells spaced 1 in. apart in nine horizontal rows of 12 cells each. The upper and lower rows are connected into two bus bars. Each cell has an elastic core protruding through it. By pulling up on the core, component pigtails, up to seven in number, may be inserted and held firmly. —J.S. (Circuit Structures Lab, P.O. Box 36, Laguna Beach, Calif.)

Circle 21 on Readers' Service card

Ultrasonic Doppler system, model No. RDL-06, is designed to measure an aircraft's velocity during the last 18 inches of vertical descent. The system features three ultrasonic transducer units mounted on the nose and main landing gear. The transducers transmit a controlled-frequency signal to the runway and receive the reflected signal. The Doppler shift produced is a function of the rate of approach of aircraft and runway. The instrument produces a d-c voltage proportional to the shifted frequency. A correction channel is provided which allows temperature variations to be compensated. Total range of the instrument is 10 ft, and accuracy is said to be 0.2 ft/sec.—J.S. (Gulton Industries, Inc., 212 Durham Ave., Metuchen, N.J.)

Circle 22 on Readers' Service card

Oscilloscope with digital display (model No. 567) presents simultaneously an analog display on a 5-in. cathode-ray tube and a digital presentation on an automatic computing programmer. Features of the programmer include adjustable measurement reference zones, automatic normalization, zone intensity markers, automatic and manual start-timing and stop-timing systems, preset-

limit selector, and provision for external programming. The points on the wave form to be measured are selected on the cathode-ray tube display. The corresponding measurement is read directly up to four digits on the numeral tube display.—J.S. (Tektronix, Inc., P.O. Box 500, Beaverton, Ore.)

Circle 23 on Readers' Service card

Laboratory microphotometer for measuring intensity distribution in optical images is essentially a low-power traveling microscope designed to be used with multiplier-phototube photometers. Positioning micrometers are used to move the microscope itself, permitting the device to be mounted directly on optical benches. The basic model VS 12 microphotometer utilizes a scanning slit 12 microns wide and 12 mm long. With the standard objective (10 × 0.25 numerical aperture), measurements can be made over intervals as small as 1.2 microns. All mountings are standard, permitting the use of other objectives of higher or lower power. The device can also be used without optics, and slits can be provided to allow observation in the deep ultraviolet.—J.S. (Intectron, Inc., 2300 Washington St., Newton 62, Mass.)

Circle 24 on Readers' Service card

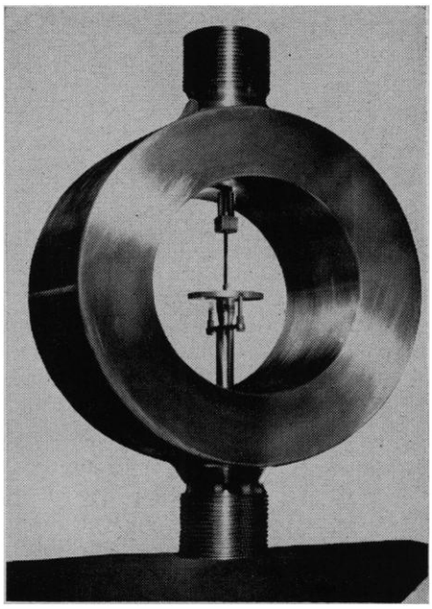
Pressure transducer converts mechanical pressure to voltage output by virtue of the change of permeability of magnetic materials caused by applied pressure. Electrically the device is similar to a differential transformer, but with moving parts eliminated. The transducer has primary and secondary windings coupled by a core. The two secondary coils form a half-bridge circuit balanced for zero-pressure condition. The primary coil is excited by a source of alternating current whose frequency can be as high as 10 kcy/sec. When pressure is applied to one side, the magnetic coupling between the primary and the corresponding secondary winding is changed and the bridge balance is upset. Output voltage is 0.5 v into 10 kohm at 400 cy/sec. Hysteresis is said to be less than 0.1 percent, and repeatability better than ±0.1 percent. Prototype quantities are available for pressure ranges from 100 to 5000 lb/in^2.—J.S. (Control Components Division, International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.)

Circle 25 on Readers' Service card

Publication titled **Technical Information for the Engineer—Servo Motors, Motor Generators, Synchros,** describes the theory, performance, application, construction, and testing of such rotary-wound components as motors, precision tachometers, rate generators, damping tachometers, mechanical filters, integrating motor generators, and types of high-performance synchros and resolvers. The 60-page booklet includes tabulations of the operating characteristics of more than 250 components used in servo systems, computers, and other applications.—J.S. (Kearfott Div., General Precision, Inc., 1150 McBride Ave., Little Falls, N.J.)

Circle 26 on Readers' Service card

Proving ring, the largest ever made to meet National Bureau of Standards specifications is capable of measuring compression forces up to 1,200,000 lb with accuracy said to be well within 0.1 percent of applied load. The ring has the standard deflection-measuring apparatus consisting of micrometer screw and vibrating reed. It was cali-



brated by the National Bureau of Standards with the use of four 300,000-lb proving rings loaded in parallel. The bosses of the ring are threaded in anticipation of availability of equipment for calibration of the ring in tension. The ring, measuring 32.5 in. high and weighing 625 lb. will be available on a rental basis or will be manufactured to order.—J.S. (Morehouse Machine Co., 1742 Sixth Ave., York, Pa.)

Circle 27 on Readers' Service card

Gamma analyzer (model No. GSS-1B) operates automatically without adjustment to scan, record, and analyze emitters with energies varying from 0.003 kev to 3 Mev. The system consists of a universal shield, a combination linear count-rate meter and spectrometer, a slave scaler, and a graphic recorder. An equal percentage of each peak is automatically analyzed, and absolute peak comparisons are made directly, regardless of energy differences. Readout is provided in three forms: count for a preset time period, continuous counting rate, and a graphic record calibrated in units of million electron volts.—J.S. (Nuclear Measurements Corp., 2460 N. Arlington Avenue, Indianapolis 18, Ind.)

Circle 28 on Readers' Service card

Low-level transistorized multiplexer is capable of commutating differential or single-ended input signals from 0 to ±15 volts, with resolution of 1 μv. The basic system consists of 15 solid-state switches, a sequencer, solid-state clock, and filter. The sequencer assures that two switches will not be gated simultaneously even when one of the components fails. For source-impedance variations of 0 to 10 kohm and temperature range −20° to +85°C, offset voltage is said not to exceed 50 μv, and saturation resistance is said to be less than 40 ohms. The differential input-switch capacitance to ground is 1.5 pf.—J.S. (Alpha-Tronics Corp., 1033 Engracia, Torrance, Calif.)

Circle 29 on Readers' Service card

Clip-on d-c ammeter measures current from 0.3 ma to 10 amp without interrupting or loading the circuits involved. The meter (model No. 428A) features a probe that clamps around the current-carrying wire. To measure currents below 0.3 ma, several loops may be put through the probe increasing sensitivity by a factor equal to the number of loops. The instrument will measure d-c in the presence of a-c and will also measure the sums and differences of currents in separate wires. An output voltage is available for driving recorders.—J.S. (Hewlett Packard Co., 1501 Page Mill Rd., Palo Alto, Calif.)

Circle 30 on Readers' Service card

Parallel data communication system, developed for use with the Bell System parallel Data-Phone service, provides one-way or bidirectional transmission of perforated-tape data at speeds to 60 characters per second or 600 words per minute. Tape format or code structure is unrestricted. Three versions are available. The Mark 1 consists of simple data transmission and reception. The Mark 2 and 3 are combination transmit-and-receive systems with error correction and additional editing features.—J.S. (Tally Register Corp., 1310 Mercer St., Seattle, Wash.)

Circle 31 on Readers' Service card

Humidity indicator is designed to sample the atmosphere in closed areas or containers. One outlet of the instrument is connected to the volume to be sampled, and a vacuum line is used to draw the sample into the instrument. The sample in the instrument is brought to a predetermined temperature for measurement, by means of a coil through which liquid at the proper temperature may be circulated. Fluctuations caused by external conditions are retarded by the double-wall insulated construction of the unit.—J.S. (Serdex, Inc., Boston, Mass.)

Circle 32 on Readers' Service card

Automatic calibration system for transducers that measure temperature, pressure, and voltage incorporates the manufacturer's standard digital components interconnected to provide the desired functions. A low-level multiplexer samples signals from 12 transducers and a reference channel. These signals are amplified and converted to digital representation for on-line processing by a PB 250 computer that provides gage factor, linearity, repeatability, and the influence of reference-vol-

tage shift. Accuracy of ±0.01 percent is said to be achieved with system noise less than 2 μv.—J.S. (Packard Bell Computer, 1905 Armacost Ave., Los Angeles 25, Calif.)

Circle 33 on Readers' Service card

Temperature sensor attaches to a surface by tapping a ⅛-in.-deep hole. The tungsten- or platinum-wound element is contained within a silver (or other alloy) housing that is a standard screw ⅛-in. long. Screw sizes range from No. 2-56 to 1/4-20. Accuracy is said to be ±0.1 percent of full range from −425° to 1750°F. Standard models have resistance ranges from 20 to 600 ohms at 32°F. Models with integral leads or with connectors are available.—J.S. (Temtro, Inc., 3016-C S. Halladay, Santa Ana, Calif.)

Circle 34 on Readers' Service card

Piezoelectric ceramic element can move loads of up to 30 g a distance of 1/64 inch in one direction. If polarity is reversed, a net motion amplitude of 1/32 inch can be produced. These displacements, suitable for switches, valves and other electrical devices, are provided with excitation voltages of approximately 125 v d-c. Oscillating motion can be obtained by using a-c excitation.—J.S. (Gulton Industries, Inc., 212 Durham Ave., Metuchen, N.J.)

Circle 35 on Readers' Service card

Power supply is said to provide 0.0001-percent regulation and stability of ±0.001 percent over an 8-hour period. Temperature stability between 0° and 50°C is better than 10 ppm per degree centigrade. Output impedance is less than 10 μohm, and combined ripple and noise are less than 50 μv (r.m.s.). Operating range is 0 to 60 volts, 0 to 2 amp.—J.S. (Princeton Applied Research Corp., P.O. Box 565, Princeton, N.J.)

Circle 36 on Readers' Service card

Magnetic characteristics tracer is designed to measure the B-H hysteresis loop of small samples of material. Magnetic films as thin as 10 μin may be evaluated as well as wire and other bulk materials. The standard model 750T is capable of developing magnetic fields up to 1000 oer. Higher ranges are available upon request. The instrument is supplied with or without an oscilloscope.—J.S. (Halex, Inc., 310 E. Imperial Highway, El Segundo, Calif.)

Circle 37 on Readers' Service card

cruel to animals again. This little account has another point as well; it brings out a distinction between suffering and pain. Obviously the lady suffered, although presumably she felt no physical pain; what the lobsters felt is, unfortunately, beyond the realm of human knowledge.

I am therefore not much concerned about Gunter's anthropomorphic statement, "anyone who watches the violent actions of crabs being scalded to death can see that they suffer extreme pain." Of course, we know nothing about the extent of suffering in a lobster or crab. The violent movements last for a few seconds, but who will tell us whether the lobster stops suffering when he cannot flip his tail any more? Or whether he felt any pain at all? We do know that sometimes little or no pain is felt by human beings in a serious accident until well after the event.

More seriously, I am concerned about some of Gunter's other suggestions. He wants to place the animals in cool fresh water and raise the temperature steadily to about 40°C. How can we find out whether the lobster suffers from being placed in fresh water? Of course, we have no possible way to define suffering in a nonhuman species, but I would suggest that a lobster may not like to be in fresh water. The lobster lives in ocean water and does not have physiological mechanisms of osmoregulation to counteract the effects of fresh water. The fact that his nervous system deteriorates and his reactions get slower in fresh water proves nothing about whether or not there is anesthesia, such as Gunter claims, or about when the hypothetical anesthesia sets in. How much "discomfort" does the lobster experience up to the point when the breakdown of nerve conduction is sufficient for "anesthesia"? If he could feel and speak like a human being, the lobster would probably tell us that he is extremely uncomfortable in a pot of fresh water.

The next step is to heat him slowly. The lobster prefers cool water, and as Gunter says, his tolerance for temperature increase is limited. Gunter certainly knows how uncomfortable he can be on a hot summer day in Texas. I myself shudder at the thought of a hypothetical Texas day with the temperature continuing to rise and rise, and I find no comfort in Gunter's statement that "death from heat occurs long before coagulation of the protein." It seems logical that the more slowly we heat the lobster, the more time we give him in which to suffer, but since we have such inadequate means for communicating with lobsters about suffering and pain, I propose that we use some common sense in deciding whether to kill him slowly or quickly.

KNUT SCHMIDT-NIELSEN
Duke University,
Durham, North Carolina

Criticisms pro and con of my idea on how to kill crustaceans have come by letter and from the newspapers at a surprising rate. Adverse criticisms state that the whole affair is a tempest in a crab pot, scalded crabs die instantaneously without suffering and are of better flavor, slow heating of crabs causes slow, torturous death, and the assumption that crabs suffer pain is based on specious reasoning and cannot be proved. One gentleman says the low-heat method gives more relief to the cook than to the crab.

Stephen Carlill has pointed out, in a letter to me, that experiments on the low-heat method were quoted by Andre

Simon, president of the Wine and Food Society (British), in his *A Concise Encyclopaedia of Gastronomy* (1940). Bertrand Couch has stated that several older American cookbooks recommend placing live crabs in cold water and slowly raising the temperature, but that recent recipes generally recommend killing by boiling water. The latter is the common American practice, but I am glad to learn from the notes of Benarde and Baker that methods are different in northern Europe. Humane ways of killing crustaceans are certainly not well known in this country, as is shown by the widespread comment my brief note created in the newspapers and by the request received from a government official for a popular article for the benefit of the "thousands" of American housewives who will not now purchase live crustaceans for home cooking.

In reply to the criticisms which have come to me, I should like to add the following statements to my previous remarks.

Physiological and ecological studies on the effects of high temperature are scientific matters, and they also have something to do with cookery and the technology of seafood preparation, with which numbers of people are seriously concerned. Restaurateurs complain that some people force them to cut up live crabs and lobsters before cooking. This results in the loss of juice, and it may be no less painful than scalding. Destroying the crab's nervous center by stabbing also results in the loss of juices, and it cannot be done with facility by the ordinary cook. The low-heat method seems to be easier and surer.

With regard to sudden death, not everybody drops live crabs into boiling water. Instead, boiling water is sometimes poured on the crabs, and this prolongs the killing process by several seconds. Furthermore, larger animals such as lobsters do not die immediately in boiling water.

Critics who are concerned about the "slow, torturous death" of crustaceans in slowly heated water are not properly impressed with the relatively low temperatures required, which are of the order of temperatures that sometimes occur in natural waters in cool temperate climates. There is an extensive literature on heat death of aquatic organisms under natural conditions, which I cannot document here, and I call attention only to the following: "Heat stroke in Canadian Maritime stream fishes" (*1*) and "Differential mortality from high temperature in a mixed

population of fishes in southern Michigan" (*2*).

All physiological processes of aquatic invertebrates which have been studied increase in rate with temperature right up to the point of heat death at around 40° to 44°C. Presumably the reaction rate of the enzyme system increases with temperature, but as the temperature rises, the enzymes are destroyed faster than they are produced and the system breaks down. In any case, death ensues with no overt signs of distress.

Crustaceans subjected to the low heat are certainly not paralyzed. They stir about vigorously if touched, and their gills work increasingly fast up to the moment of death. There is no sign of pain or distress, and it is reasonable to assume that an organism showing such reactions is much less likely to be distressed than one which goes into a violent spasm and throws off or cracks its own claws. There is no physiological basis for assuming that boiling water is not painful to various invertebrates, and there is ancillary and indirect evidence that it is painful. The question as to whether or not crabs suffer pain cannot be rigorously proved one way or the other, but there is no known reason why the pain sense should be correlated with intelligence, and all animals show some degree of sensitivity. Crabs certainly show a violent reaction to hot water, comparable to what would be considered evidence of extreme distress if exhibited by human beings or other mammals, and it has every appearance of a reaction to pain. I believe that the sensation we call pain is of enormous survival value, that it is unrealistic to hold the view that a similar situation does not exist in lower animals, and that it is proper to conduct ourselves, in the manner of Brooks, whom I cited in my report, as if all living things have a sensitivity somewhat akin to our own.

In connection with these matters, I should like to quote parts of a letter from William R. Catlow, Jr., in which he said he had been using the low-heat method for 30 years but was influenced by motives different from those I mentioned: "These are: *a*. With a full kettle of crabs there is likely to be a distressing amount of slopping about as the last of the lot go into the boiling pot. *b*. I am convinced that the northern lobster and the southern spring lobster (crawfish or langusta) when plunged into boiling water die under tension which promotes toughness. In your method, they appear to go to sleep, relax, and die quietly."

Regarding Schmidt-Nielsen's remarks, one misconception needs correcting. I never intended to recommend or advocate the placing of marine crustaceans in fresh water as a method of killing. In this part of his argument, Schmidt-Nielsen is charging a windmill. I merely mentioned the matter as an example of what some people do in an attempt to minimize the distress of the animals they kill, and I stated further that "only one more thing is needed"—namely, the application of low heat.

The largest American lobster ever reported weighed 36 pounds. Such animals are not cooked in private homes, but even much smaller ones, weighing only a few pounds, are relatively formidable creatures in the kitchen. The application of Schmidt-Nielsen's "common-sense" method for killing these crustaceans has often resulted in a half-scalded animal flopping vigorously around the kitchen floor, to the dismay of the cook. Such episodes have disturbed the peace of some fairly large neighborhoods. Actually, the housewife usually has no adequate facilities for handling large lobsters.

I assume that the lower animals suffer pain for the same reason that some of the physicians who have written me assume that human beings suffer pain—that is to say, I have set up an arbitrary criterion as proof of pain. These criteria are assumptions and inferences only, because there is no known way that we can measure pain in terms of physics or chemistry. We cannot prove basically that several states of feeling exist in another human being. We assume that they do, but these assumptions remain inferences, and this is the reason for the old medical aphorism, "The physician is at the mercy of the man who says he suffers pain." For these gentlemen to hold me to account for not being able to prove pain finally and absolutely in an invertebrate animal, while they cannot prove or even define pain in human beings except in terms of itself, is, in their terms, anthropocentric.

In summary, crabs and the larger crustaceans are of various sizes and species, and of different shapes, and they have different locations of the brain, all of which factors virtually preclude the use of the stabbing method of killing except at the hands of an expert. In addition, most housewives will not handle individual live crustaceans. People who cannot use the stabbing method would do better to heat water containing the animals very slow-

ly to temperatures near 100°F. If this process is properly carried out, the animals die with no signs of distress, but the process carries no automatic safeguard against misapplication and ranks as another cooking art which must be executed with finesse. No valid physiological objections have been raised to this method of killing crustaceans, and it should be employed by those people who assume that lower animals feel pain and who are revolted by their violent reactions to boiling water.

GORDON GUNTER
Gulf Coast Research Laboratory, Ocean Springs, Mississippi

References

1. A. G. Huntsman, *J. Fisheries Research Board Can.* **6**, 476 (1946).
2. R. M. Bailey, *Ecology* **36**, 526 (1955).

Studies of the Cuna Religion

Those who witnessed the "burning" of myself and my book *Apples of Immortality from the Cuna Tree of Life* [*Science* **134**, 278 (1961)] will wonder why Stout wasted 73 lines of type rather than tell the editor that my little 68-page essay was so bad that it did not merit review. Possibly Stout was defending his 5 months' San Blas study (1940–41) against my eight trips to the Cuna tribe from 1950 to 1959.

Stout failed to mention that *Apples of Immortality* was merely a postscript to a 352-page study of the Cuna religion as compared with other primitive religions of the world, called *Secrets of the Cuna Earthmother,* in which striking parallels of sacred symbol, belief, and ritual are discussed.

There are those who do not take Stout's dim view of these studies.

CLYDE KEELER
Milledgeville, Georgia

Support for Medical Research

While I appreciated the lively journalistic style of Robert Toth in "Science and the news" [*Science* **134**, 822 (22 Sept. 1961)], the news item relative to the appropriations for the National Institutes of Health is so obviously slanted that I cannot help but feel it will give a false impression of the attitude of scientists in general toward the attempted solution of problems of illness.

The growth in funds for the National

Institutes of Health has been carefully considered, and the Consultants' Committee headed by Boisfeuillet Jones referred to in the article is made up of men whose scientific integrity and objectivity is beyond question. It would be difficult, because of the Public Health Service's wise policy of wide consultation, to obtain as consultants men who had not already been consulted or who were not engaged in the solution of problems supported in part by the Public Health Service. Whether money for health comes from public sources or private sources, the essential point is that research looking toward better health is being supported.

In Toth's last paragraph he seems to imply that there have been no results from the research done. Many of the results of research available today or in the future will not be immediately applicable; some are already applicable, as witness vaccination against infantile paralysis, the promise of an effective vaccine against mumps, the thousands of people now living useful lives because of better understanding of the control of diabetes or the management of heart disease. Shall we say to the inmates of our many mental institutions that advances in mental health can be made only at a rate to be determined by some arbitrary figure?

Scientists all realize the grave responsibility that their fellow citizens place upon them by giving them funds with which to work.

SHIELDS WARREN
Cancer Research Institute,
Boston, Massachusetts

The article "Congress presses funds on the National Institutes of Health" is a rather distorted and somewhat misleading interpretation of the background of increased federal support for medical research.

Toth makes quite a point of the percentage increases in contrasting this year's appropriations for the National Institutes of Health with appropriations a few years ago. He neglects to point out that federal support for medical research was practically nonexistent 15 years ago; all increases above a rock-bottom level naturally produce handsome growth percentages.

He fails to relate increases in federal medical research support to comparable programs in other areas of national concern. Support of our space program, for example, has jumped from practically zero a few years ago to close to $2 billion in the current fiscal year, with predictions from our physical scientists that a few years from now Congress will be asked to appropriate $6 billion annually for this program alone. If Toth applied his slide rule to these space appropriations, he would obtain astronomic percentage increases.

Furthermore, Toth does not relate expenditures for medical research to the total federal budget. Not only is medical research support far less than 1 percent of total appropriations but it is a small segment indeed of the $9 billion which the federal government currently spends for research of all types.

It is also charged that there is a good deal of "force feeding" of medical research by Congress with a consequent "regurgitation." The exact contrary is true. In each year that Congress increased the monies for medical research over the Administration budget, the critics cried out that the money could not, and would not, be spent properly. The record shows, however, that at the end of each of these fiscal years there was always a sizeable backlog of *scientifically approved* research and training projects which could not be supported because of lack of funds. Furthermore, the present rate of rejection of research grants denies support to more than half of all applications submitted to Bethesda.

Concluding his article, Toth asks us to produce "a golden egg or two." I will resist the obvious temptation to dwell on some of the less-than-golden eggs produced in the research programs of the Department of Defense and elsewhere in our government. We have spent hundreds of millions of dollars in developing planes which never flew and additional hundreds of millions for missiles which were later abandoned.

With a much smaller federal investment, medical research has produced many golden eggs over the last 15 years. Space does not permit a listing of most of these accomplishments, but a few should be cited here.

1) In the field of cancer, one of every three Americans is saved today as against one in every four a few years ago. This gain has been achieved largely through the national cancer chemotherapy program supported by the Congress. We now have 5-year cures against three types of cancer. This is the first time in history that this has occurred. Through the remarkable cancer compound screening program, we have produced more than a score of chemical agents which are effective in some degree against various forms of cancer.

2) In the field of cardiovascular diseases, which account for more deaths in our country than all other diseases combined, more progress has been made in the past decade alone than in all the previous years of recorded history. This has been achieved largely through research supported by congressional appropriations. Heart disease is no longer regarded as a sentence of death. In less than a decade the prognosis in most forms of congenital heart disease has been converted from "hopeless" to "surgically curable." Similarly, aneurysms and occlusive lesions of the aorta and major arteries which were previously considered inevitably disabling or fatal conditions are now amenable to corrective surgical treatment. In the majority of patients hypertension can now be well controlled or cured. Over the past decade an impressive body of scientific knowledge has been developed concerning the etiology and treatment of arteriosclerosis.

3) In the field of psychiatry, the Psychopharmacology Service Center of the National Institute of Mental Health is the prime source of support for research scientists who are developing more effective drugs against the various forms of mental illness. The remarkable reduction in the number of patients

resident in our public mental hospitals is a direct consequence of this accelerated research.

4) In the field of neurology, research work at the National Institute of Neurological Diseases and Blindness led to the discovery of the cause of retrolental fibroplasia, the prime cause of blindness in infants for many years. It has been stated that the cost of the care for the thousands of children already blinded will be 100,000 times the cost of the medical research which led to successful prevention of the disease.

Day in and day out, week in and week out, there are reports of additional advances against many baffling diseases.

On 27 September, a few days after Toth's article appeared, the Surgeon General of the Public Health Service announced that isoniazid, a drug widely used to treat tuberculosis, was 80-percent effective in preventing the disease among more than 12,000 people directly exposed to newly discovered cases of tuberculosis. In man's ancient fight against tuberculosis no one ever before dared hope for this degree of prevention.

While Toth's article is heavy on statistics and percentages, it strangely omits any discussion of the truly staggering human disability resulting from unchecked disease. In World War II, for example, 5 million Americans in the prime of life were unable to join the fight to preserve this democracy because of pronounced physical and mental defects. Two diseases alone, heart disease and cancer, killed more Americans in 6 months of last year than were slain in all 4 years of World War II. Every minute at least two persons die from heart disease and cancer in the United States, and two-thirds of all Americans now living will eventually have these diseases.

It really gets down to a very simple question: What price human life? What price do we put upon a drug which arrests leukemia in a child and gives him, and his parents, a few more years of hope and happiness? What price do we put upon the discovery of a research breakthrough which prevents blindness in a child? What price do we put upon the heart surgery which restores a victim to productivity and to usefulness in our society?

We who are involved in medical research would be the first to admit that ours is a long-time effort with many heartbreaks and many disappointments

along the way, but we are not defeatists —we gain strength from the support we have received, and we will persevere until we have unraveled the mysteries of the major illnesses of our time.

MICHAEL E. DE BAKEY
College of Medicine,
Baylor University, Houston, Texas

Congratulations to Toth for a succinct commentary dealing with Congress and the National Institutes of Health. I hope it will be read widely, both in and outside of Washington. Indeed, at least on one important count, Terry must have a unique bureaucratic responsibility.

One must agree that such governmental outlays to the Institutes of Health are in a very real sense "investments in human capital," and one must therefore appreciate the obvious zeal Congress manifests in supporting such expenditures. However, a serious difficulty evolves here when one realizes that the United States is apparently handicapped by a shortage of "brains" at the moment (hence, the scourge of cancer and problems in space technology), rather than by inability to use what is available. Naturally, it is gratifying that we seemingly have few medical research projects of merit wanting for financial support, but our greatest need is for more highly trained scientists. For those who have run the gamut of a Ph.D. program, it is abundantly clear that more talent is not developed simply as a result of increased monetary outlay—the time element plays a vital role. In short, it appears most incongruous that these public-spirited representatives will consistently add to NIH appropriations in excess of budget requests (presumably made in terms of known need), while in the same hallowed halls essentially refusing to make more direct "investment" in people. How about a *large* sum for postgraduate *grants* (not loans) to pursue scientific studies? In light of some speculation it will pay off handsomely.

Finally, to carry examination of these inconsistencies a step further, one is compelled to comment on the utter folly of cutting down an already grossly inadequate Food and Drug Administration appropriation. If public health is of genuine concern in this "age of food additives, etc.," such an unenlightened maneuver is patent nonsense.

J. D. DEFOREST
Department of Economics,
Denison University, Granville, Ohio

In an article purporting to review and criticize the budget history of the National Institutes of Health, Toth sees fit to refer to Representative John Fogarty as "a former bricklayer from Rhode Island" and to Senator Lister Hill as "son of a small-town doctor from Alabama." These otherwise irrelevant biographical details might have been introduced to reveal that in this land of opportunity modest origins need not preclude attainment of high position. It appears from the context of the article, however, that such was not Toth's intent. Rather have these facts been included to discredit the two eminent legislators and to disqualify them from holding valid opinions on matters of the federal support of biomedical research.

I believe that character assault such as this is entirely out of place in a scientific journal, whatever the practice of the New York *Herald Tribune*, which normally employs Toth, may be. It happens that Representative Fogarty and Senator Hill, as a result of many years' study of the problem, have become among the best informed nonscientists in matters of biomedical research. They have thought and acted creatively in this area, and whereas one may argue with the numbers in their budgets, no one can question their high motivation or the magnitude of the contribution which they have made to scientific research in this country. One wonders when Toth will become as well informed and whether he will ever make a like contribution. Perhaps he is not so fortunate as to have been a skilled bricklayer and was not blessed with a father who was a small-town doctor.

Editorial scrutiny of contributions to scientific journals is always irksome to authors. Editorial boards are not devoid of responsibilities, and among these is the obligation to delete irrelevant polemic. I believe that in the present instance the editors of *Science* have been remiss in their duty.

DEWITT STETTEN, JR.
7504 Maple Avenue,
Chevy Chase, Maryland

None of the letters of criticism challenge the facts in my news article. They were the basis of my conclusions. Others can draw their own.

Stetten's incredible charge of "character assault" requires more response. Certainly it was not my intent to "discredit" the legislators by those descrip-

tions to which he so violently objects. I wanted only to add some dimension to the men within the context of portions of the article. Similar descriptions were included in profiles on the men in recent issues of *Medical World News*, profiles with which, I understand, both men were quite pleased. That on Fogarty (18 Aug. 1961) was headlined: "One-time bricklayer becomes a key force behind the $4 billion federal medicine and research programs." As science relies more and more on government money, the politicians themselves become factors in federal appropriations for science. In this respect it is noteworthy that De Bakey's letter to *Science* was released to the press by Fogarty's office shortly after it was written.

I wish to again credit the pioneering study of NIH appropriations made last year by Robert P. Clark of the Louisville *Courier Journal* while he was a Nieman fellow at Harvard University.

ROBERT C. TOTH
Washington Bureau, New York
Herald Tribune, *Washington, D.C.*

Shelter and Survival

Please allow me to offer a brief rebuttal of the editorial on President Kennedy's fallout shelter program, an editorial titled "Better nothing than something?" [*Science* **134**, 1955 (1961)].

The editorial discusses the President's contention that the proposed shelter program is meant to serve solely as survival insurance in case of an irrational or accidental nuclear attack on this nation and is not to be construed as an added element of our military deterrent power.

I personally support the President with some enthusiasm, but the fact that he said the words and himself believes the words does not make them true. He is flatly disputed by one of his most ardent supporters, who, insofar as the subject of civil defense is concerned, is much more knowledgeable than he is himself—Chet Holifield, congressman from California. Holifield heads the subcommittee which has been riding close herd on civil defense for the past decade, as recorded in volume after volume of expert testimony.

It is Holifield's well-buttressed judgment that shelters will definitely contribute very substantially to both the credibility and the actuality of weapons deterrence. And it is on this basis that he is pressing for an eventual expenditure of $20 billion on a nationwide shelter system. The Kennedy proposal simply gets our feet in the water, and once that happens the logic of being committed to "survival by shelter" will soon take us into the deeper water of "more shelters, more survival," "bigger bombs? deeper digging!" "faster weapon-delivery time? full-time safety by full-time living, working, and sleeping underground!"

I do not say the President himself will push us into this deeper water, or will even approve of it. My feeling is that he would do just the opposite. But the Pentagon hasn't opened with the Herman Kahn civil-defense gambit with any intention of stopping short of a checkmate to stifle the opponents of more arms and more bellicosity.

So the people of America have no simple choice between insurance and deterrence, as the editorial implies they have when it asks, "Is the distinction between insurance and deterrence really so hard to grasp?" The question can be answered easily and directly with a "No."

But this is the wrong question, and it is a misleading question because it carries the implication that civil defense really makes sense if people will just stop being confused about it. For my part, I do not blame anybody for con-

cluding that civil defense is not only a useless but a dangerously diversionary activity when it is directed against the threat of destructive forces as overwhelming as those of thermonuclear war. And my attitude is the outgrowth of 7 years of full-time professional service for civil defense in the field of public information.

ARNOLD B. LARSON
1457 5th Street,
Manhattan Beach, California

As civil defense seems inevitable whether we believe in it or not, one may indeed join the writer of the *Science* editorial in the hope that the Kennedy Administration's ambitious civil defense program "may make . . . people look squarely for the first time at the consequences of atomic war." Some of us entertained a similar hope 20 months ago when Tucson was selected to be ringed with Titan missiles and thus turned into a high-priority target likely to receive intense local fallout after an attack on the upwind missile installations (*1*).

From their actions it appears that economic self-interest continues foremost in the minds of community leaders and that contemplation of the outcome of nuclear war is considered irrelevant or even unpatriotic. Fear of economic reprisal, in the form of withdrawal of the local SAC air base and location of the costly Titan silos elsewhere, persuaded community leaders to accept, over the protest of local scientists, a pattern of Titan base encirclement which presents the greatest possible civil defense hazard (*2*).

Local civil defense leaders have also demonstrated that if their intimate association with the program has led them to look closely at the consequences of atomic war, the result has not led them to consider alternatives. In a public statement, State Civil Defense Director Ralph R. Redburn proposed that the United States consider going to war against Russia now, when there is a fifty-fifty chance of our winning (*3*).

Admittedly Tucson may present a special case; furthermore, in the absence of a careful attitude survey it is impossible to evaluate the impact of intimate association with advanced defense installations on the mind of the average citizen. Future experience may show that the shelter construction program beginning here did finally impress people with the danger of atomic war. For the moment there is little in the Tucson case to demonstrate that serious

confrontation with matters of civil defense brings the result the *Science* editorial hopes for.

Regarding President Kennedy's request that patriotic citizens construct their own fallout shelters, some individuals, who have come to believe that continued civilian participation in the defense program is a dangerous means of bringing home to one's neighbors the insanity and immorality of atomic war, may prefer an alternative. In protest against both the folly and the selfishness of building a private fallout shelter in a world where hundreds of millions of people lack any form of decent housing, many Americans may choose to contribute instead to a recently announced program of the Fellowship of Reconciliation, "Shelters for the Shelterless."

PAUL S. MARTIN
Geochronology Laboratories, University of Arizona, Tucson

References

1. J. E. McDonald, *J. Arizona Acad. Sci.* **2**, 18 (1961).
2. ———, *Arizona Frontiers* (Nov. 1961); P. S. Martin and C. Steelink, *Bull. Atomic Scientists* **17**, No. 4 (1961).
3. Tucson *Daily Citizen* (16 Nov. 1961).

I concur 100 percent with your editorial of 15 December concerning our national civil defense program. I have been taking this position for many months now and have been reproached by almost all my scientific colleagues. Apparently these people feel that the "don't look at it and maybe it'll go away" attitude will solve the problem.

I just can't understand how the usually sound rational thinking of competent technical workers can fail to lead them to the conclusion expressed in your editorial. Somehow the usual "brotherhood of man" attitude which prevails internationally among scientific men continues to becloud their thinking in the political areas. For example, I heard Harrison Brown express this "let's not have shelters" sentiment in a recent national TV broadcast, where he took a position opposite to Kahn's very realistic point of view.

I hope that enough of your readers who believe that Khrushchev and his colleagues are not rational leaders read your statement and see through to the kernel of the matter—that insurance is essential.

DAVID BALBER
Advanced Product Development, General Precision, Incorporated, Tarrytown, New York

Allow me to commend, as well as criticize, your excellent editorial, "Better nothing than something?"

I am in complete agreement with the underlying major premise of the editorial, that it is absolutely imperative that the likelihood of atomic war be eliminated. Whether the building of shelters under private or public auspices would contribute to the general awareness of the utter destructiveness of such a war is a delicate question. As one of the 285 faculty members of the Chicago area who signed an open letter protesting against the shelter program on the ground that it created a false sense of security and predisposed the public to underestimate the tragic futility of nuclear warfare, I took a position different from that of your editorial. If your editorial has left me unconvinced that I was wrong (one can never be sure that one is right in such matters), it was mainly for the following reason.

The editorial cited the President's distinction between deterrence and insurance and then proceeded to argue as if the two were entirely independent, as if insurance never weakened caution against risk-taking. Simply because the shelter program, like accident policies, may spell out the dangers and enumerate excluded risks, is there any good reason to expect that this will predispose the public to discountenance adventures in "brinkmanship"? Do not accident policies frequently undermine the motorist's sense of personal responsibility, a sense that would otherwise deter him from driving recklessly? The very analogy your editorial drew, leads, I should say, to the conclusion (the very opposite of your own) that the shelter program would not preclude taking fearful risks.

Forgive me if I write less as a fellow of the AAAS than as a grandfather of five pretty babes and as a teacher of more than 30 years' standing, who rebels at the thought of exposing the youth of the world to annihilation or to the prospect of begetting generations of crippled progeny.

WILLIAM JAFFE
College of Liberal Arts, Northwestern University, Evanston, Illinois

Isosceles Triangles and the Center of Population

Walter Crosby Eell, in a recent letter [*Science* **134**, 797 (1961)], pointed out that the center of population is not necessarily the point at which the population can convene with minimum travel mileage, and he proceeded to show this with two simple examples.

While there can be no doubt about the soundness of his basic contention, we would like to point out that his second example of three persons living at the vertices of an isosceles triangle is not entirely correct. Speaking of the distance from the base AB of the triangle to the vertex C, he states, "regardless of that distance, the point of minimum travel for the three [people] to convene will be a fixed point, the center of the equilateral triangle of which AB is one side."

This is true whenever the distance from the vertex C to the base AB of the isosceles triangle is greater than the distance from the center of the equilateral triangle to the base AB. But if we have a "short" isosceles triangle, the point of minimum travel is the vertex C itself.

CURTIS E. MILLER
JOHN B. OPFELL
Dynamic Science Corporation, South Pasadena, California

AADS, 840 N. Lake Shore Dr., Chicago 11, Ill.)

18–22. Bilharziasis, symp., Cairo, Egypt. (A. H. Mousa, Ciba Foundation, 41 Portland Pl., London, W.1, England)

18–22. International Anesthesia Research Soc., Bal Harbour, Fla. (Scientific Liaison Office, Natl. Research Council, Sussex Dr., Ottawa, Ont., Canada)

19–23. International Conf. on Equatorial Geophysics, Lima, Peru. (J. A. Broggi, Instituto Geofisico de Huancayo, Apdo. 46, Huancayo, Peru)

19–23. National Assoc. of Corrosion Engineers, Kansas City, Mo. (T. J. Hull, NACE, 1061 M&M Bldg., Houston, Tex.)

20–21. Hypervelocity Techniques, symp., Denver, Colo. (A. M. Krill, Mechanics Div., Univ. of Denver Research Inst., Denver 10)

20–23. American Assoc. of Anatomists, annual, Minneapolis, Minn. (C. B. Heggestad, Dept. of Anatomy, Univ. of Minnesota, Minneapolis 14)

20–23. High-Temperature Solution Chemistry, symp., Washington, D.C. (J. W. Cobble, Purdue Univ., Lafayette, Ind.)

20–23. Institute of Metals, London, England. (R. E. Moore, 17 Belgrave Sq., London, S.W.1)

20–29. American Chemical Soc., natl., Washington, D.C. (A. T. Winstead, ACS, 1155 16 St., NW, Washington 6)

21–23. Audio Engineering Soc., Los Angeles, Calif. (AES, P.O. Box 12, Old Chelsea Station, New York 11)

21–24. American Orthopsychiatric Assoc., annual, Los Angeles, Calif. (AOA, 1790 Broadway, New York 19)

21–24. Neurosurgical Soc. of America, Biloxi, Miss. (Scientific Liaison Office, Natl. Research Council, Sussex Dr., Ottawa, Ont., Canada)

22–24. Michigan Acad. of Science, Arts, and Letters, Ann Arbor. (F. C. Bald, 160 Rackham Bldg., Univ. of Michigan, Ann Arbor)

24–31. Symbolic Languages in Data Processing, symp., Rome, Italy. (Secretary, Provisional Intern. Computation Center, Palazzo degli Uffici, Zona dell'-EUR, Rome)

25. American Pharmaceutical Assoc., Las Vegas, Nev. (W. S. Apple, APA, 2215 Constitution Ave., NW, Washington, D.C.)

25–27. American Assoc. of Colleges of Pharmacy, Las Vegas, Nev. (C. W. Bliven, 2128 H St., NW, Washington 5)

25–30. American Soc. of Hospital Pharmacists, Las Vegas, Nev. (J. A. Oddis, ASHP, 2215 Constitution Ave., NW, Washington 7)

25–30. National Education Assoc., Dept. of Audio-Visual Education, Kansas City, Mo. (Chief of Information, Dept. of the Army, Washington 25)

26–27. High Energy Nuclear Physics, symp., London, England. (C. C. Butler, physics Dept., Imperial College, London, S.W.7)

26–29. Circum-Pacific Petroleum Exploration, Amer. Assoc. of Petroleum Geologists–Soc. of Economic Paleontologists and Mineralogists, annual, San Francisco, Calif. (G. B. Oakeshott, State Div. of Mines and Geology, Ferry Bldg., San Francisco 11)

26–29. Institute of Radio Engineers, intern., New York, N.Y. (E. K. Gannett, IRE, 1 E. 79 St., New York 21)

26–29. Recent Advances in Acarology, symp., Ithaca, N.Y. (J. Naegele, Dept. of Entomology, Cornell Univ., Ithaca)

26–20. World Meteorological Organization, Commission for Synoptic Meteorology, Washington, D.C. (WMO, 41, Avenue Giuseppe Motta, Geneva, Switzerland)

27–29. American Physical Soc., Div. of High-Polymer Physics, Baltimore, Md. (H. D. Keith, Bell Telephone Laboratories, Murray Hill, N.J.)

27–29. American Power Conf., American Soc. of Mechanical Engineers, Chicago, Ill. (A. B. Conlin, Jr., ASME, 29 W. 39 St., New York 18)

27–30. Cellular Basis and Aetiology of the Late Somatic Effects of Ionizing Radiations, symp., London, England. (P. Alexander, Chester Beatty Inst., Inst. of Cancer Research, Royal Cancer Hospital, Fulham Rd., London, S.W.3)

28–12. International Conf. on the Prevention of Pollution of the Sea by Oil, London, England (Intergovernmental Maritime Consultative Organization, Chancery House, Chancery Lane, London, W.C.2)

28–29. Engineering Aspects of Magneto-

hydrodynamics, symp., Rochester, N.Y. (G. W. Sutton, Massachusetts Inst. of Technology, Room 3-254, Cambridge 39)

29–30. Electron Beam Symp., annual, Boston, Mass. (Dr. Bakish, c/o Alloyd Electronics Corp., 35 Cambridge Pkwy., Cambridge 42, Mass.)

29–31. Kappa Delta Pi, Lafayette, Ind. (E. I. F. Williams, 238 E. Perry St., Tiffin, Ohio)

30–1. American Psychosomatic Soc., annual, Rochester, N.Y. (S. Wolf, APS, 265 Nassau Rd., Roosevelt, N.Y.)

30–1. American Soc. for the Study of Sterility, annual, Chicago, Ill. (Scientific Liaison Office, Natl. Research Council, Sussex Dr., Ottawa, Ont., Canada)

April

1–3. International College of Surgeons, Las Vegas, Nev. (Secretary, ICS, 1516 Lake Shore Dr., Chicago 10, Ill.)

1–4. American Radium Soc., annual, New York, N.Y. (C. G. Stetson, Dept. of Radiology, Englewood Hospital, Englewood, N.J.)

1–6. American Soc. of Abdominal Surgeons, clinical congr., Chicago, Ill. (B. F. Alfano, ASAS, 663 Main St., Melrose 76, Mass.)

2–5. American College of Obstetricians and Gynecologists, Chicago, Ill. (Chief of Information, Dept. of the Army, Washington 25)

2–5. Instrument Soc. of America, instrument-automation conf. and exhibit, Pittsburgh, Pa. (W. H. Kushnick, ISA, 313 Sixth Ave., Pittsburgh 22)

2–13. Photogrammetry Week, Munich, Germany. (H. Bischoff, Zeiss–Aerotopograph G.M.P.H., Ismaniger Str. 57, Munich 27)

3–5. Organic, Inorganic, and Physical Chemistry, symp., annual, Chemical Soc., Sheffield, England. (General Secretary, Burlington House, London, W.1, England)

3–5. Plasma Sheath, symp., Boston, Mass. (C. Ellis, Air Force Electronics Research Directorate (CRRD), L. G. Hanscom Field, Mass.)

3–6. Society of Automotive Engineers, natl. aeronautic, production forum and engineering display, New York, N.Y. (R. W. Crory, SAE, 485 Lexington Ave., New York 17)

3–7. Inter-American Nuclear Energy Commission, Mexico City, Mexico. (IANEC, Pan American Union, Washington 6)

4–6. Institute on Rehabilitation of the Mentally Ill, New York, N.Y. (B. J. Black, Altro Health and Rehabilitation Services, Inc., New York)

4–6. Physics of Graphite-Moderated Reactors, symp., Bournemouth, England. (Inst. of Physics and the Physical Soc., 47 Belgrave Sq., London, S.W.1, England)

5–7. Pacific Sociological Assoc., annual, Sacramento, Calif. (R. Nisbet, Univ. of California, Riverside)

6–8. American Soc. of Internal Medicine, annual, Philadelphia, Pa. (S. O. Krasnoff, ASIM, 3410 Geary Blvd., San Francisco 18, Calif.)

6–8. Association of Clinical Scientists, Chicago, Ill. (R. P. MacFate, 323 Northwood Rd., Riverside, Ill.)

6–8. Biological Photographic Assoc., midwestern sectional, Des Moines, Iowa. (BPA, 551 W. Grant Pl., Chicago 14, Ill.)

7. New Jersey Acad. of Science, annual, West Long Branch. (H. L. Silverman, NJAS, 361 Highland Ave., Newark 4, N.J.)

7. New Mexico Acad. of Science, Socorro. (K. G. Melgaard, P.O. Box 546, Mesilla Park, N.M.)

7. Paleontological Research Institution, Ithaca, N.Y. (R. Harris, PRI, 109 Dearborn Pl., Ithaca)

7–9. Impact of Physical Metallurgy on Technology, symp., San Carlos de Bariloche, Argentina. (J. A. Sabato, National Atomic Energy Commission, Avda. Libertador General San Martin 8250, Buenos Aires, Argentina)

9–10. Chemical and Petroleum Instrumentation Symp., natl., Instrument Soc. of America, Wilmington, Del. (C. W. Sanders, E. I. du Pont de Nemours & Co., Louviers Bldg., Newark, Del.)

9–12. Aerospace Medical Assoc., annual, Atlantic City, N.J. (W. J. Kennard, c/o Washington National Airport, Washington, D.C.)

9–12. American Acad. of General Practice, annual, Las Vegas, Nev. (AAGP, Volker Blvd., Kansas City 12, Mo.)

9–12. International Feigl Symp. on Analytical Chemistry, Birmingham, England. (M. L. Richardson, c/o John & E. Sturge Ltd., Lifford Chemical Works, Kings Norton, Birmingham 30)

9–13. American College of Physicians, Philadelphia, Pa. (Chief of Information, Dept. of the Army, Washington 25, D.C.)

9–13. American Welding Soc., annual, Cleveland, Ohio. (F. L. Plummer, AWS, 33 W. 39 St., New York 18)

9–13. Inter-American Symp. on the Peaceful Application of Nuclear Energy, Mexico City, Mexico. (J. D. Perkinson, Jr., Inter-American Nuclear Energy Commission, c/o Pan American Union, Washington 6)

9–13. International Soc. for Fat Research, London, England. (Soc. of Chemical Industry, 14 Belgrave Sq., London, S.W.1)

9–13. Physiology, Behavior, and Ecology of Orthoptera in Relation to Metamorphosis, intern. colloquium, Paris, France. (F. O. Albrecht, Laboratory of Natural Evolution, Natl. Scientific Research Center, 16, rue Pierre Curie, Paris 5e)

9–14. Nutritional Absorption in Vegetables, intern. symp., Pisa, Italy. (Instituto di Chimica Agraria, Università degli Studi di Pisa, Via S. Michele degli Scalzi, 2, Pisa)

10–13. European Symp. on Size Reduction, European Federation of Chemical Engineering–Processing Technology Soc., Frankfurt am Main, Germany. (Verfahrentechnische Gesellschaft im V.D.I., Rheingau-Allee 25, Frankfurt am Main 7)

10–14. International Conf. on Stress Analysis, Paris, France. (Secretary, 10, rue Vauquelin, Paris 5e)

11–13. Institute of Environmental Sciences, annual meeting and equipment exposition, Chicago, Ill. (J. P. Monroe, Lear, Inc., Grand Rapids, Mich.)

11–13. Institute of Radio Engineers, southwest conf. and electronic show, Houston, Tex. (IRE, 1 E. 79 St., New York 21)

12. Symposium on Non-Conventional Nuclear-Engineering Lubricants and Bearing Materials, symp., London, England. (Institution of Mechanical Engineers, 1 Birdcage Walk, London, S.W.1)

12–13. Histochemical Soc., annual, Atlantic City, N.J. (M. Wachstein, St. Catherine's Hospital, Bushwick Ave., Brooklyn 6, N.Y.)

12–13. International Assoc. for Dental Research, British Div., annual, Sheffield, England. (C. H. Tonge, c/o Dept. of Anatomy, King's College Medical School, Newcastle-upon-Tyne, England)

12–14. Association of Southeastern Biologists, Wake Forest, N.C. (H. J. Bennett, Dept. of Zoology, Louisiana State Univ., Baton Rouge 3)

12–14. Experimental Arithmetic, symp., American Mathematical Soc., Chicago, Ill. (N. C. Metropolis, Inst. for Computer Research, Univ. of Chicago, Chicago)

13–14. American Soc. for Artificial Internal Organs, annual, Atlantic City, N.J. (E. C. Peirce, II, ASAIO, 514 W. Church Ave., Knoxville 1, Tenn.)

13–14. Iowa Acad. of Science, Waverly. (P. F. Romberg, Iowa State Univ., Ames)

13–14. Nebraska Acad. of Sciences, Lincoln. (C. B. Schultz, Univ. of Nebraska, Lincoln 8)

13–15. Alabama Acad. of Science, Inc., Troy. (W. B. DeVall, Forestry Dept., Auburn Univ., Auburn, Ala.)

13–15. American Assoc. for Cancer Research, annual, Atlantic City, N.J. (H. J. Creech, Inst. for Cancer Research, Fox Chase, Philadelphia 11, Pa.)

13–19. Federation of American Societies for Experimental Biology, Atlantic City, N.J. (M. O. Lee, 9650 Wisconsin Ave., Washington 14)

14–16. Kinetics, Equilibria, and Performance of High Temperature Systems, 2nd conf., Los Angeles, Calif. (G. S. Bahn, 16902 Bollinger Dr., Pacific Palisades, Calif.)

14–19. American Inst. of Nutrition, Atlantic City, N.J. (A. E. Schaefer, Bldg. 16-A, Natl. Institutes of Health, Bethesda 14, Md.)

14–19. American Soc. of Biological Chemists, Inc., Atlantic City, N.J. (F. W. Putnam, Dept. of Biochemistry, Univ. of Florida College of Medicine, Gainesville)

15–18. American College Personnel Assoc., Chicago, Ill. (B. A. Kirk, Counseling Center, Univ. of California, Berkeley 4)

15–18. National Education Assoc., Council of Mathematics Teachers, San Francisco, Calif. (Chief of Information, Dept. of the Army, Washington 25)

16–17. Diseases in Nature Transmissible to Man, conf., annual, Dallas, Tex. (M. B. Starnes, Univ. of Texas Southwestern Medical School, 5323 Harry Hines Blvd., Dallas 35)

16–18. Flight Test Instrument Symp., intern., Cranfield, England. (College of Aeronautics, Cranfield)

16–18. Reactor Safety and Hazards Evaluation Techniques, symp., Vienna, Austria. (Intern. Atomic Energy Agency, 11 Kaerntnerring, Vienna 1)

16–18. Spins and Phonons, conf., Bristol, England. (P. M. Llewellyn, H. H. Sills Physics Laboratory, Royal Fort, Bristol 8)

16–19. American Personnel and Guidance Assoc., annual, Chicago, Ill. (J. Fishbein, Science Research Associates, 259 E. Erie St., Chicago 11)

16–19. Interactions between Mathematical Research and High-Speed Computing, symp., American Mathematical Soc.–Assoc. for Computing Machinery, Atlantic City, N.J. (E. Pitcher, AMS, 190 Hope St., Providence 6, R.I.)

16–19. Paleoclimatology and Paleopedology, symp., International Soc. for Plant Geography and Ecology, Stolzenau, Germany. [R. Tüxen, Intern. Vereinigung für Vegetationskunde, Stolzenau (Weser)]

16–19. Vacuum Ultraviolet Radiation Physics, intern. conf., Los Angeles, Calif. (G. L. Weissler, Univ. of Southern California, Los Angeles 7)

16–20. American Physiological Soc., Atlantic City, N.J. (R. G. Daggs, APS, 9650 Wisconsin Ave., Washington 14)

16–20. American Soc. for Pharmacology and Experimental Therapeutics, Atlantic City, N.J. (H. G. Mandel, George Washington Univ. School of Medicine, 1337 H St., NW, Washington 5)

17–20. International Mineralogical Assoc., Washington, D.C. (D. J. Fisher, Dept. of Geology, Univ. of Chicago, Chicago 37, Ill.)

17–20. Sector-Focused Cyclotrons, conf., Los Angeles, Calif. (B. T. Wright, Dept. of Physics, Univ. of California, Los Angeles 24)

18–20. American Inst. of Electrical Engineers, Fort Wayne, Ind. (R. S. Gardner, AIEE, 33 W. 39 St., New York 18)

18–20. Information Retrieval in Action, conf., Cleveland, Ohio. (Center for Documentation and Communication, Western