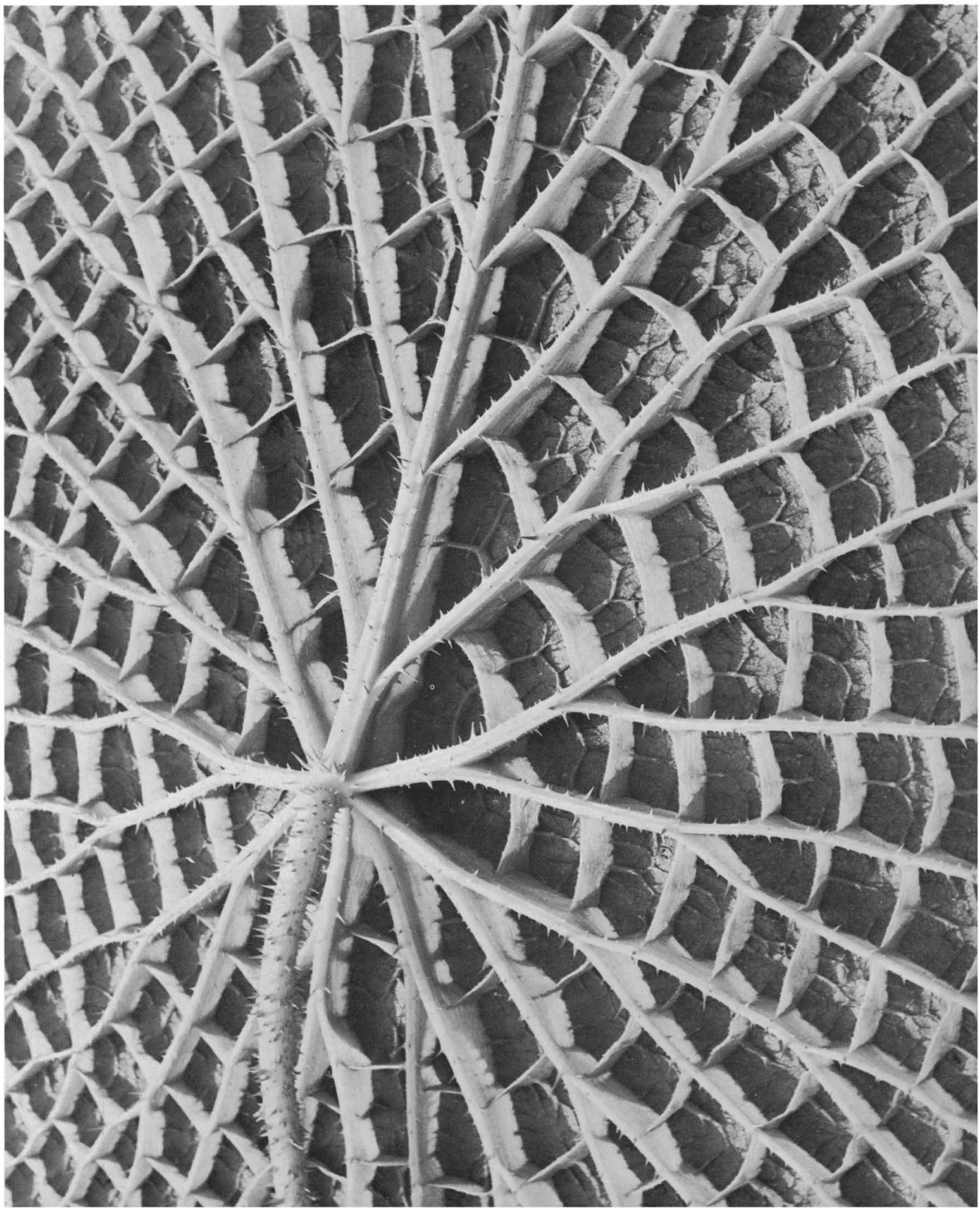
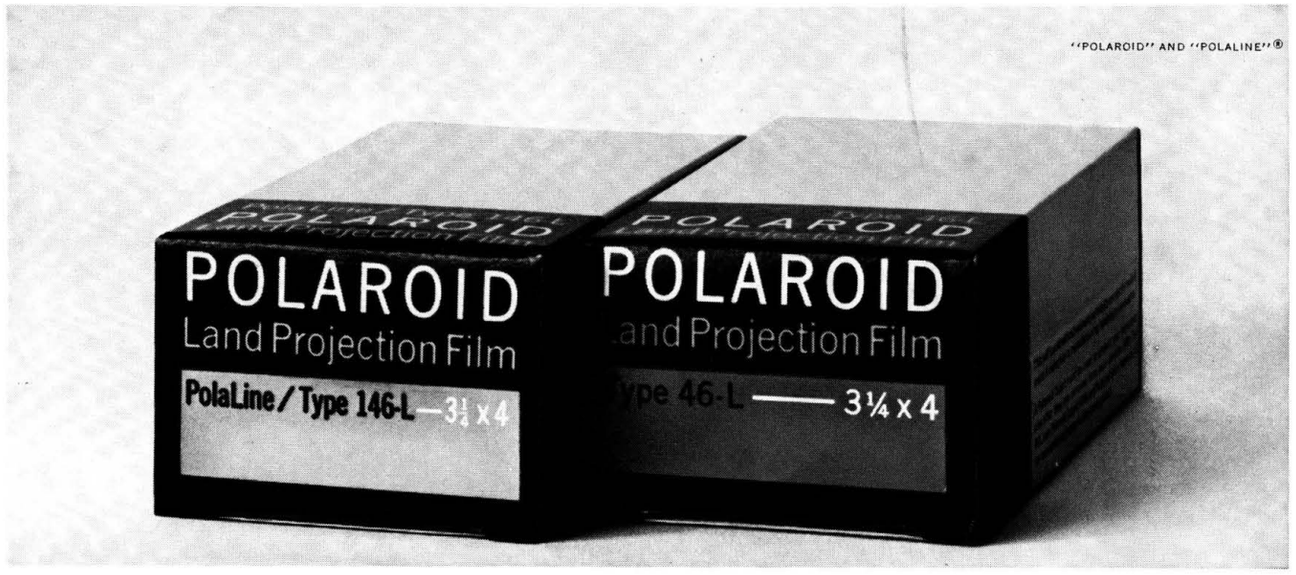
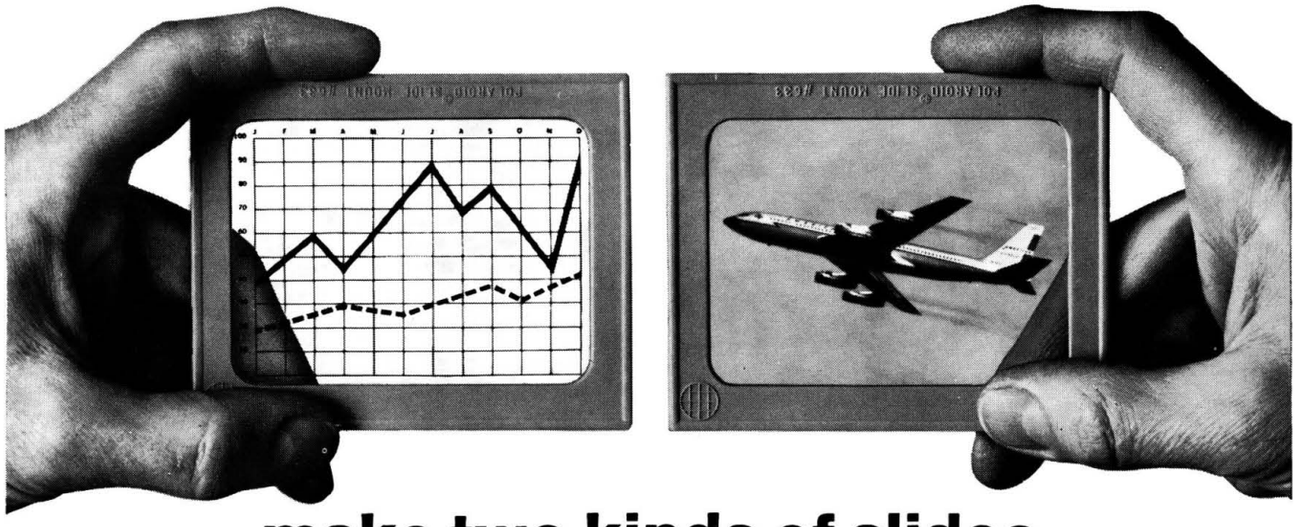
SCIENCE 14 September 1962
Vol. 137, No. 3533
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE






# Two kinds of film



# make two kinds of slides with a Polaroid Land Camera

Two special transparency films turn a Polaroid Land Camera into an easy, instant slide maker. And the cost is about ⅓ of the average conventional black and white slide.

For line copy work such as charts and printed material, Polaroid PolaLine Land film gives you a fully developed transparency in just ten seconds. It's a very high contrast material specifically designed to make slides from line originals. The blacks are really black, the clear areas really clear.

For continuous tone work, another Polaroid Land transparency film (Type 46-L) produces slides unsurpassed in sharpness, brilliance and full tonal range. It develops in 2 minutes.

You load and shoot the transparency films the same way as standard Polaroid Land film. Push a button, pull a tab, wait a moment and remove the transparency. After a quick hardening you put it in a snap-together frame and it's ready to project with a standard 3¼ x 4 lantern slide projector. You can use both films in any Land Camera that takes 40-series film except the J-66.

Doesn't this make other kinds of slide making kind of old-fashioned?

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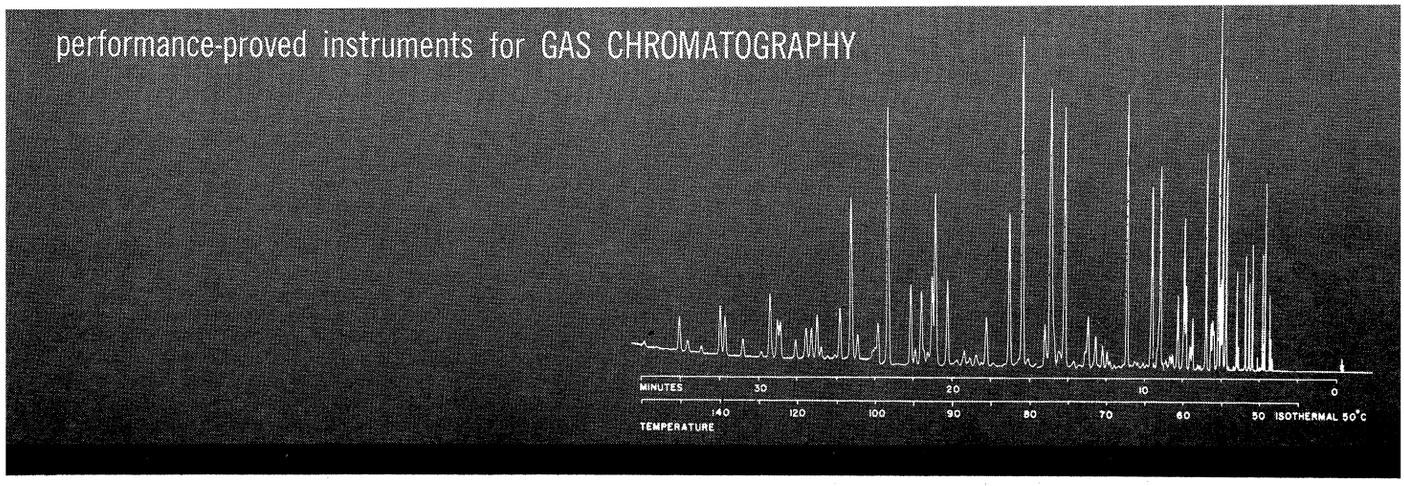


# FIRST HIGH-PRECISION CHROMATOGRAPH SEES, MEASURES ALL COMPONENTS

The new Perkin-Elmer Model 226 Gas Chromatograph is the world's first high-precision chromatographic instrumental system.

It employs the most advanced electronic, pneumatic and thermal control components and subsystems to optimize the performance of high resolution Golay and packed columns, the flame ionization detector, and the first automatic, truly linear, temperature programming system. Its unmatched speed, resolution, reproducibility, and quantitative precision facilitate automatic analysis of virtually any organic mixture amenable to gas chromatographic separation.

For the petroleum chemist who wishes to resolve all of the components in a gasoline or gas-oil.

For the biochemist who wishes to analyze steroids, lipids, amino acids or saccharides precisely and rapidly.

For the food chemist who must sense and measure the marginal traces of components which contribute to flavor or aroma.

For all chemists who require the finest performance, precision and convenience in gas chromatographic analysis.

Golay chromatogram above shows separation of 103 components of reformed gasoline in 55 minutes. Note: iso and normal butanes completely resolved at start, naphthalenes at end of run.

For complete information, write Instrument Division, Perkin-Elmer Corporation, 910 Main Avenue, Norwalk, Connecticut.

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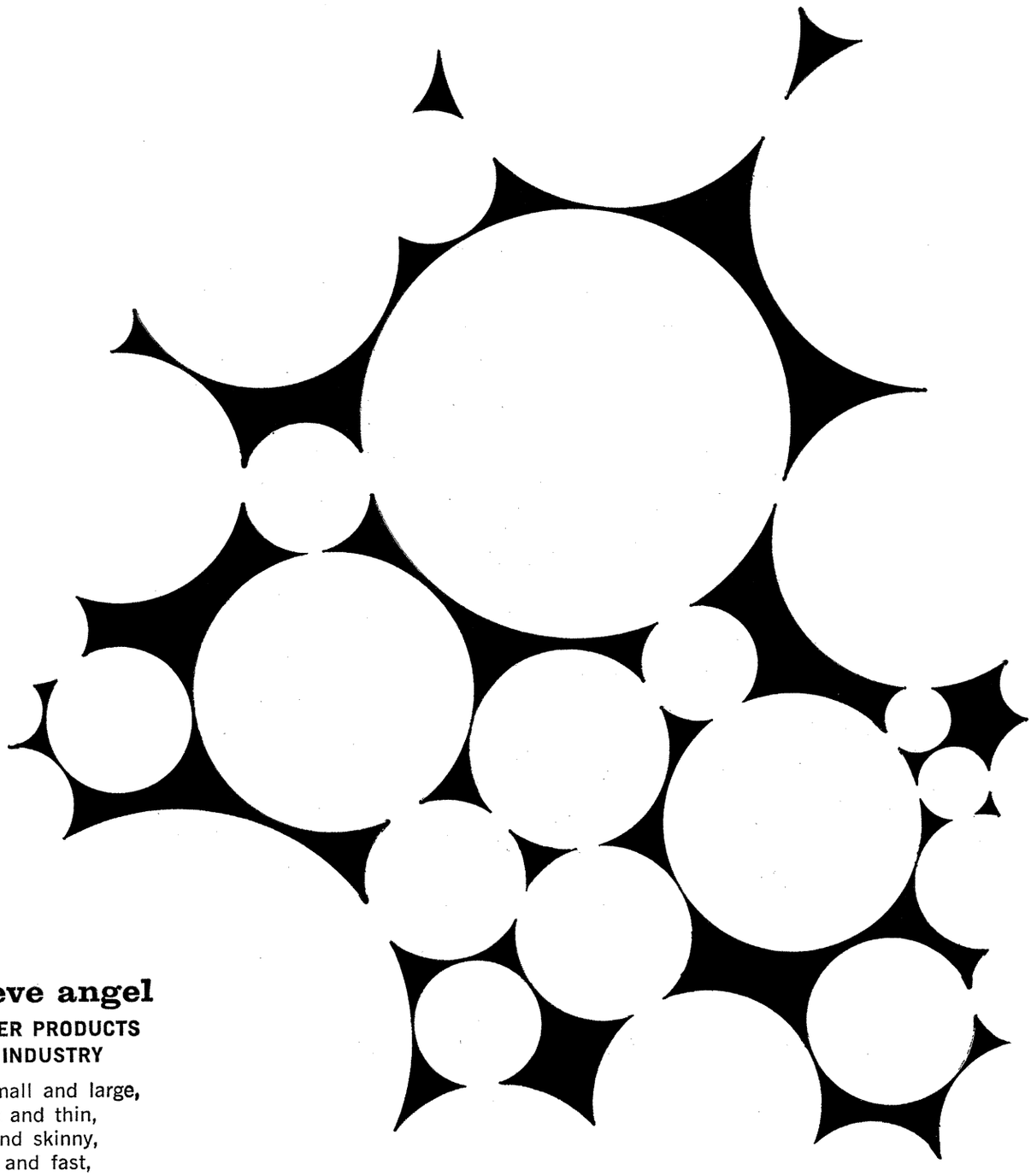
# SCIENCE



**Cover**

The underside of the giant water lily, *Victoria amazonica*, with its beautiful pattern of anastomosing veins. These veins enable the water lily to support its great weight. [Walter H. Hodge, 5413 Center St., Chevy Chase, Md.]

# SAMPLES



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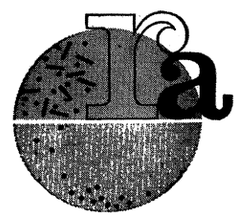

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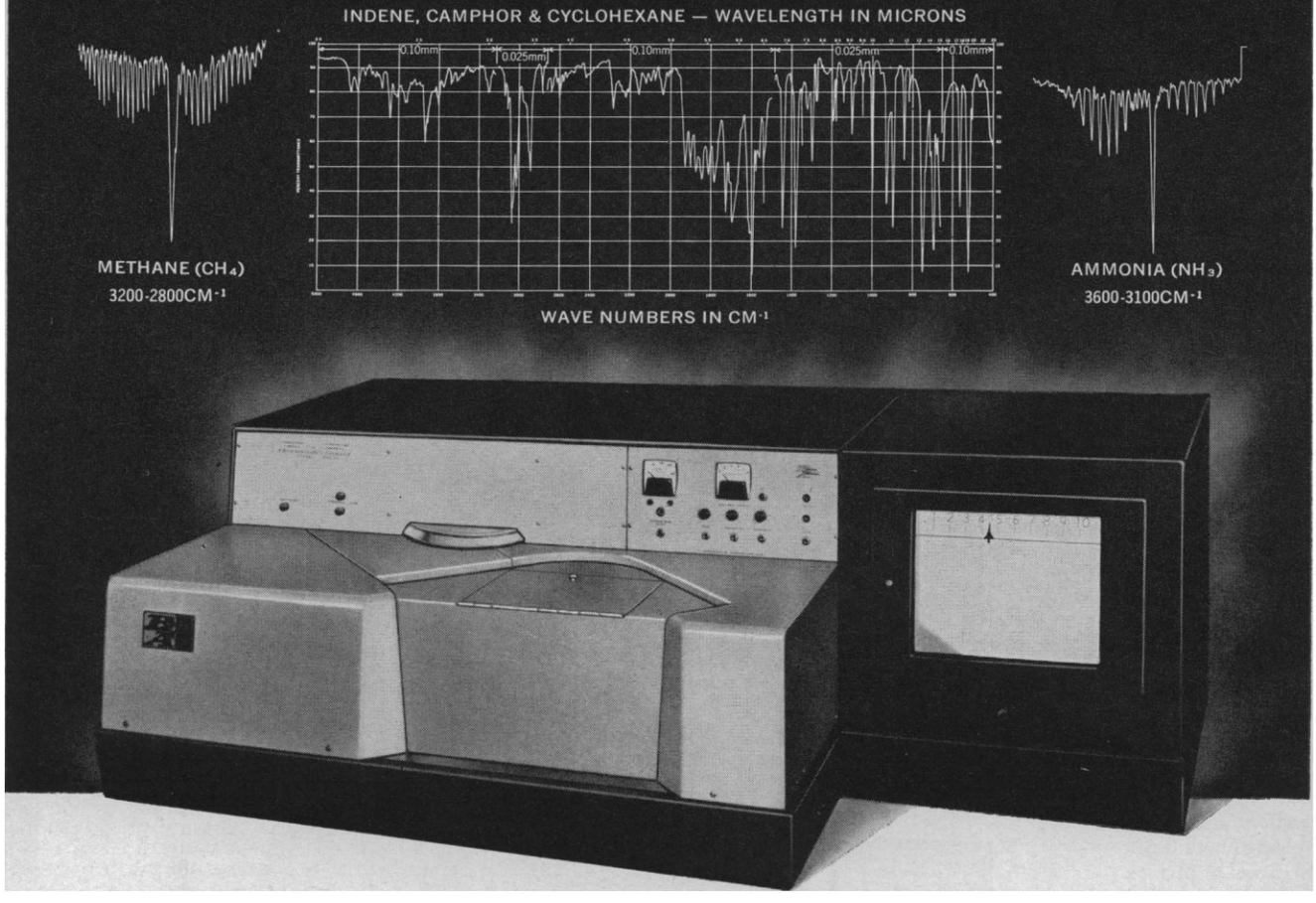
*The highest energy, most versatile IR grating instrument available*

# B/A NK-3 spectrophotometer




The NK-3 Prism/Grating Spectrophotometer makes possible readings of extreme accuracy over a broader range than any other commercial infrared system. Highest resolution for fast, reliable analysis is attained at optimum scan speeds. And these results are achieved economically.

In the NK-3, a Baird-Atomic Globar source, photometer, and prism monochromator are matched with a modified Czerny-Turner grating monochromator to achieve new standards of performance. Spectra are recorded on an 11″ strip format chart, or on expanded abscissa, with frequency marker pen for high resolution studies. Exclusive indexing mechanism, precision slit and frequency cams, insure accurate frequency reproducibility and constant energy throughout scan. An accessory for single beam operation is standard equipment.

The NK-3 records an uninterrupted spectrum from 5000cm$^{-1}$ to 400cm$^{-1}$, in 7 minutes, with resolution of approx. 1cm$^{-1}$ at all frequencies, using automatic scan control. Linear absorbance and ordinate scale expansion are available as well.

Full information, spelling out the unique advantages of the Baird-Atomic NK-3 is available. Write today to Advertising Dept. for Brochure SC-300.

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# MATHESON

*Compressed Gas Notes*

# Gas Sterilization with Ethylene Oxide Mixtures

The science of sterilization has been changing over the past few years. Gone is the necessity of lengthy exposures to high heat to insure effective sterilization.

Heat and moisture-sensitive items, often ruined by long exposures to steam, can now be effectively and completely sterilized by the turn of a valve. The valve is on a cylinder of sterilizing gas called by different proprietary names, but consisting of Ethylene Oxide plus an inerting non-toxic, non-flammable gas to render the total mixture either non, or less flammable. For most sterilizing purposes, Ethylene Oxide concentrations of 450 to 1000 milligrams per liter of chamber space will be sufficient to provide a 100% kill.

## Mixtures

The sterilizing mixture can be compounded in a number of ways to render the mixture more or less concentrated in Ethylene Oxide, or to have higher or lower cylinder pressure to suit the needs of the sterilizer function and design. The Matheson Compressed Gas Catalog lists sterilizing gas mixtures available from stock from all 3 Matheson plants. Special mixtures of any concentration of Ethylene Oxide are available from Matheson.

Fig. 1 illustrates the type of cylinder used to package sterilizing gas mixtures. The picture represents the sterilizing gas in two phases—liquid and gas. An eductor tube extends into the liquid phase of the mixture. When the cylinder valve is opened, the vapor pressure of the mixture forces the liquid out of the cylinder, through the eductor tube and valve. From there, the mixture may be piped directly to a sterilizer where the mixture will vaporize and do its job. Another method of dispensing the mixture to a sterilizer, is by first discharging the liquid into an expansion tank where it is allowed to completely vaporize. The mixture is then automatically fed from the expansion tank to the sterilizer as a completely mixed and vaporized gas, insuring a homogeneous mixture throughout the sterilizer.

## Advantages

Here are some of the advantages gained by the use of gas sterilization:
*Rapid action. All forms of organisms destroyed at ordinary temperatures. All types of substances and many packaging materials can be penetrated, allowing completely packaged items to be sterilized. (Even the pages of a closed book can be effectively sterilized.) Low toxicity to humans and animals. Can be rendered non-flammable. Convenient to handle. Easy storage. Gas completely removed by aeration; no residue. Non-corrosive.*

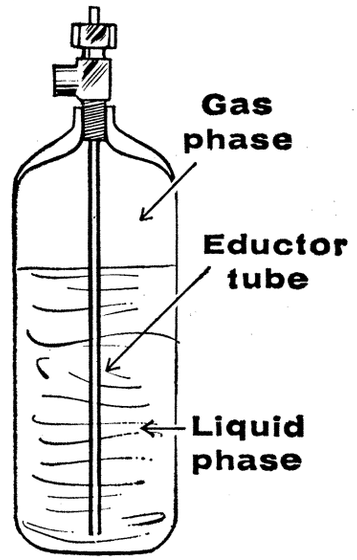


Fig. 1

## Typical Applications

Here are a few of the items that have been effectively sterilized with sterilizing gas containing Ethylene Oxide: Plastic bandages, polyethylene bottles, packaged catheters, penicillin, surgical sutures, blankets, leather, wool, cotton, nylon, paper, plastics, foodstuffs, glassware, airplane cabins, railroad cars and buses.

We are equipped to supply sterilizing gases in regular or special formulations, in a variety of cylinder sizes. Our Sales Engineering Department will be glad to furnish further details and quotations concerning your needs. We will welcome your inquiries on gas sterilization.

## BENVICIDE

Matheson is the exclusive producer, in cylinders, of BENVICIDE, a registered trade mark of Ben Venue Laboratories. This is a mixture of 11% Ethylene Oxide in halogenated hydrocarbons. This type of mixture has the added advantage of giving a higher volume percent of Ethylene Oxide in the gas phase (while still remaining non-flammable), compared with Carbon Dioxide mixtures of similar weight percent, thus offering more rapid sterilization at low chamber pressures.

## Sterilizing Bulletin Offered

Check and mail coupon for our 8 page bulletin and price list on sterilizing mixtures, giving references, procedures, handling, etc. Our general catalog, listing all our gases, gas mixtures and equipment is also offered.

The Matheson Company, Inc., P.O. Box 85, E. Rutherford, N.J.

Please send the following:

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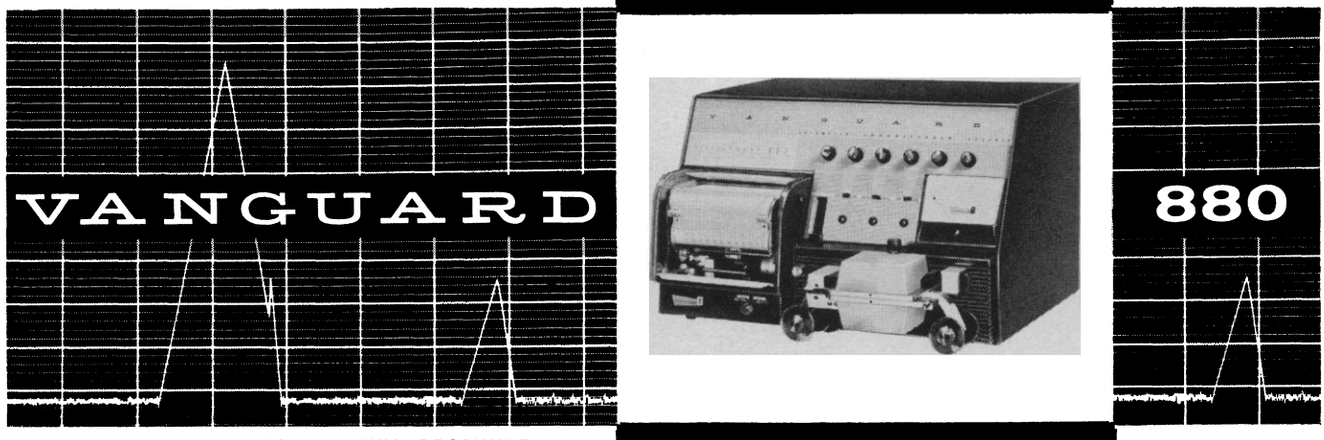
# NEW SENSITIVITY IN CHROMATOGRAM SCANNING....

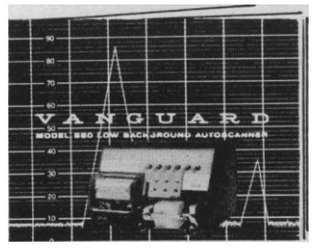
**Vanguard 4 pi AUTOSCANNER reduces background to less than 10 c pm., revolutionizes counting of $H^3$, $C^{14}$, and $S^{35}$**

Vanguard's new, completely transistorized Model 880 Low Background AUTOSCANNER revolutionizes chromatogram scanning of low-energy, beta-emitting radioisotopes. Specially designed to meet the exacting requirements of medical, agricultural and pharmaceutical research, the AUTOSCANNER utilizes the most advanced electronic and mechanical design, integrated into a compact, one-piece console. With the Model 880, analyses can be performed with the highest possible degree of sensitivity—even when counting tritium, carbon-14 and sulphur-35.

**NEW STANDARD ACCESSORY, TOO!** Also available is the new, exclusive Vanguard Model 880ADS, a completely automatic system for quantitative integration and digital presentation of radioactive zones. For complete details concerning either the Model 880 or Model 880ADS, please write or call.




**REQUEST THIS BROCHURE—** See how you can achieve the highest detection efficiency available for chromatogram scanning. Booklet outlines distinctive features and lists all operational characteristics of the Model 880 AUTOSCANNER.




- Features 4 pi scanning—counts radiation on both sides of strip simultaneously
- Reduces background to less than 10 cpm.
- Completely transistorized for longer, more reliable performance
- Handles chromatograms 1½ to 4 cm. wide in lengths to 100 ft.
- Gas and power shut off automatically at end of scanning period
- 10 scanning speeds, 5 rate meter time constants, 7 count rate ranges, 3 individual slit width collimations
- Automatically marks solvent fronts, leading and trailing edges of strips
- Windowless gas-flow, geiger detection
- Accuracy of better than 2% of count rate on all ranges
- Compact, completely integrated, one piece unit

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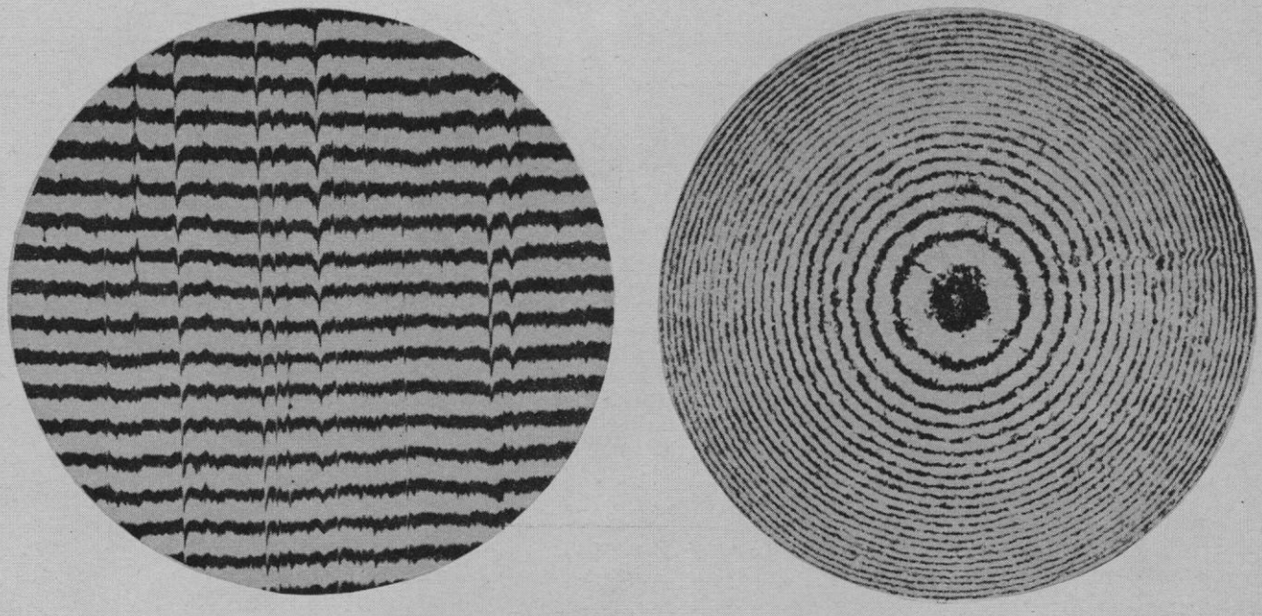
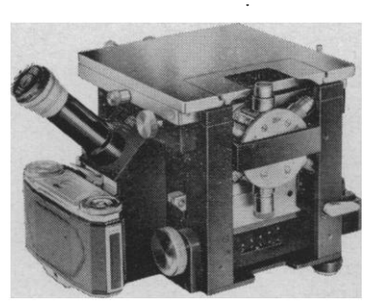


CARL ZEISS INTERFERENCE MICROSCOPE shows surface flaws by deviations in interference bands, at left. (Right) Circular interference bands produced by a sphere.

# Measure surface roughness from 1.2 to 80 millionths of an inch

Determine roughness of a super finished surface with the Carl Zeiss Interference Microscope. Check for imperfections in curved and flat surfaces. Set up production standards. See whether finishes fall within pre-set roughness tolerances. Measure thickness of transparent films, coatings and anodized surfaces. Test, for instance, the inside of a ball race either directly or by means of a replica method. A photographic attachment is available to keep records of the examined material. These are some of the things you can do with this instrument.

The objectives of the Interference Microscope are mounted on a revolving nosepiece and can quickly be changed to provide total magnifications of 80x, 200x, and 480x. The surface structure can be viewed as a regular reflected microscope image or as an interference image. Both white light and monochromatic (green) thallium light sources are available. The stage on which the test piece is placed is tiltable for proper alignment of surface to be tested. During operation the number of interference bands used for the measurement can be varied.



The Interference Microscope is a compact instrument: only 6 x 6 x 9½ in. Operators are easily trained in its use. Each instrument is equipped with 35mm film carrier.

For a description of the instrument, send for our literature. Upon request, we will be glad to arrange for a demonstration. **Complete service facilities available.**

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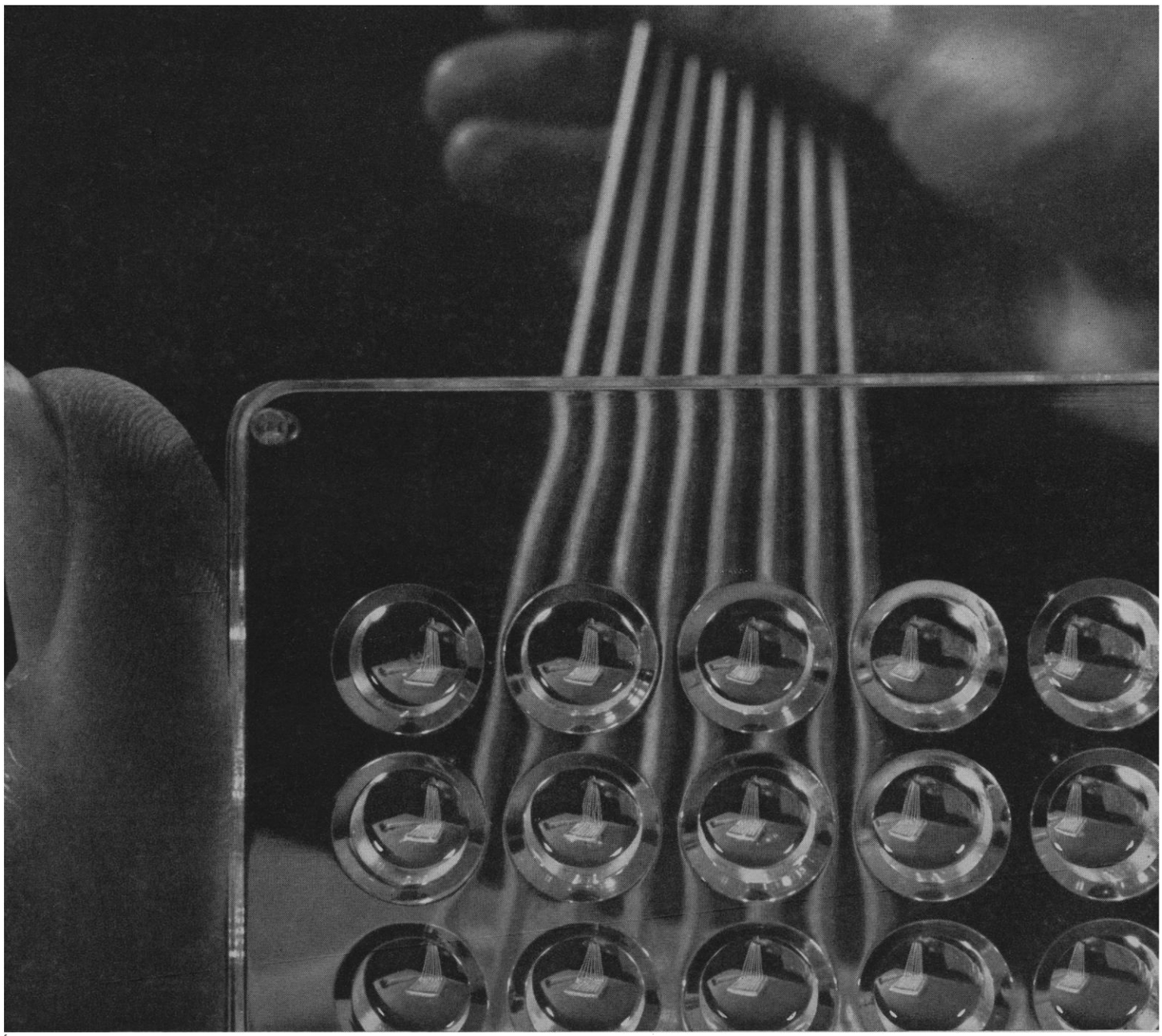

S/P Microtiter System takes less reagent, less space to do

# 8 serial dilutions simultaneously

Compare the Microtiter System* to traditional test tube technics and you'll see that you use not only less reagent and space, but less sample and glassware, too! You need as little as 0.025 ml of sample and reagent, and far less time—eight complete 12-step serial dilutions take just 60 seconds. Reproductibility and reliability are comparable to macro technics.

The Microtitering Plate takes the place of 96 test tubes. Sample and diluent are introduced with pre-calibrated Pipette Droppers. Serial dilutions are performed with pre-calibrated Stainless Loops. Although there is much more to be said about this complete system, we think that a brief demonstration by your S/P Representative will be more conclusive. Ask him today, or, for a detailed pamphlet, write to our General Offices. On second thought, why not order an Introductory Set today.

**No. B1190**—S/P Microtiter System, consists of Storage Case, 16 Plates, 6 Pipettes, 36 Loops, Loop and Pipette stand and Loop rack. . . . **$330.00**
**No. B1195**—Introductory Set, consists of 2 Plates, 2 Pipettes and 4 Loops . . . . . **$49.50**

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# Now!

## Double-element laboratory type Glas-Col heating tapes

This heating tape is especially designed for laboratory use . . where the tape must be applied and removed frequently. BOTH of the parallel leads of heating elements terminate at the SAME end of the tape so that a heater cord can be attached easily.

The heating elements in these tapes consist of two Nichrome ribbons running parallel to each other with an insulated space between them . . each ribbon is covered with glass braid and then with a tough, pliable silicone rubber. The tape can be attached to steel pipe by small magnets, or tied to glass tubes.

**Waterproof:** If water is spilled on Glas-Col heating tapes, the possibility of shorts and electrical shock to laboratory personnel is eliminated.

**Flexible:** Glas-Col heating tapes are extremely flexible. They're only 1/16" thick, yet are very tough and durable.

**Uniform heating:** Glas-Col laboratory type double-element heating tapes* produce a uniform heating pattern.

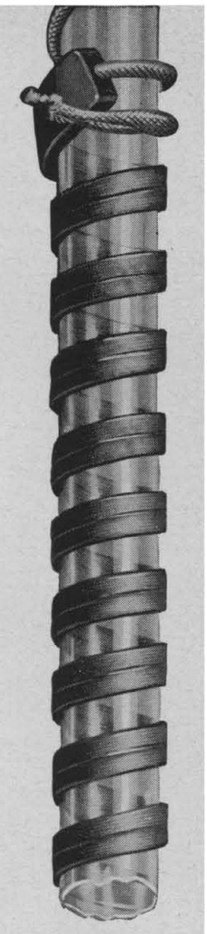
**No burnouts:** Nichrome heating elements will not burn out even when used far beyond assigned wattages. Glas-Col tapes are tested at 1000 volts for electrical breakthrough. They'll give years of service when used below 480°F which is the temperature limit of the tape's silicone rubber covering.

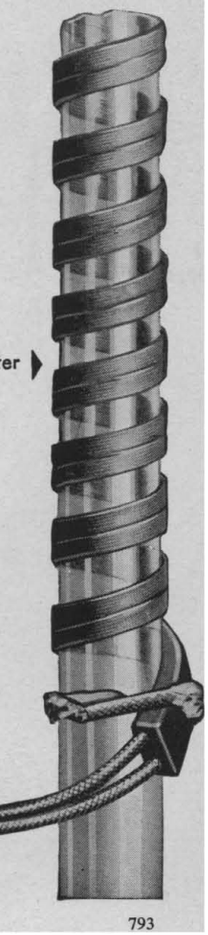
Available in ½" and 1" widths, in standard lengths from 4 to 40 ft with plug and cord, or in any special length.

**Single-element tapes for production applications.**

Single-element tapes are ideal for installations requiring extremely long lengths . . . 300 feet or more. Example: for heating pipe lines, or large production, or pilot plant receptacles.

*Patents Pending





Heater tape ½" wide with twistlock and heater cord, shown on 1" glass tube.

**Send for Bulletin 4-B-1**

**GLAS-COL Heating Tapes**

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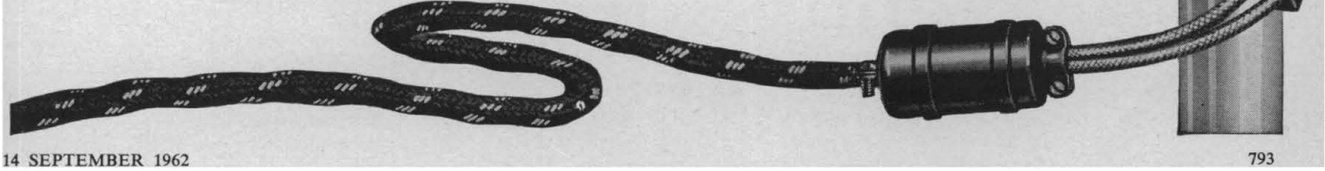
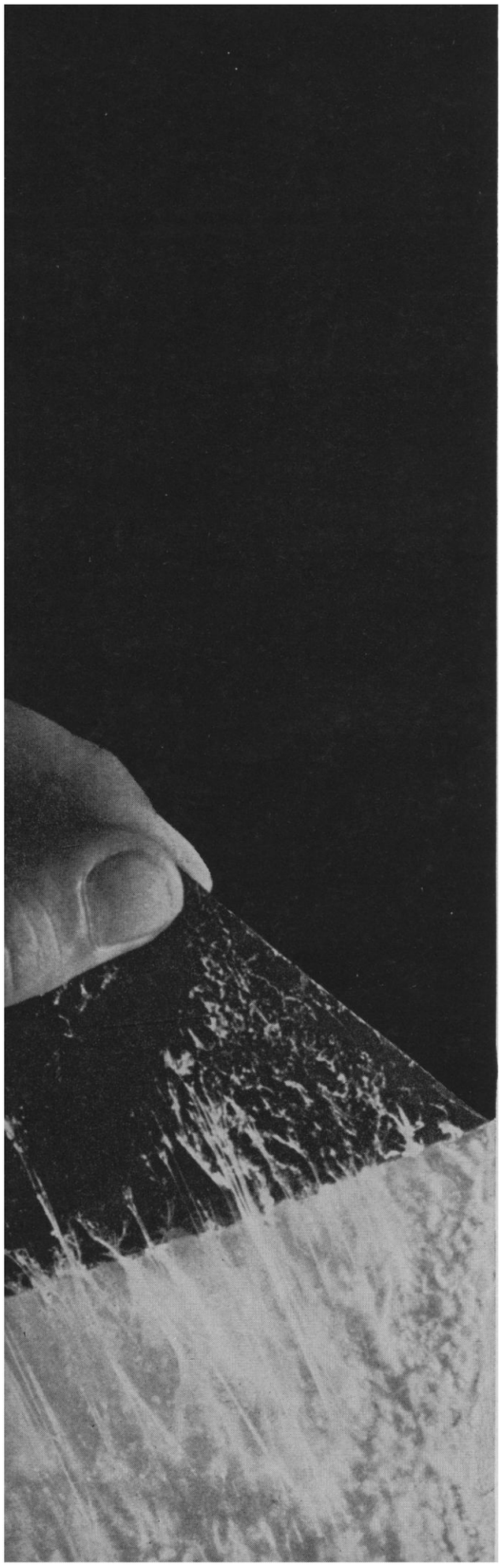
711 Hulman Street, Terre Haute, Indiana

Glas-Col is the world's largest manufacturer of heating mantles . . and produces a complete line for laboratory, pilot plant, and chemical process heating applications.





*One of a series briefly describing GM's research in depth*

# Adhesion: describing an elephant of science

Adhesion has certain similarities to the elephant the blind men were asked to describe. This interdisciplinary subject has occupied the talents of the physicist, chemist, mathematician, metallurgist, and polymer scientist. But still, what adhesion is—its mechanisms and principles —seems to have eluded an overall scientific theory. Perhaps not for long.

Food for inductive thought is being gathered from fundamental research studies around the world. At the General Motors Research Laboratories, for example, recent experimental work by our polymer scientists has supported the idea that adhesion is dependent on:

(1) specific chemical groups in the adhesive film

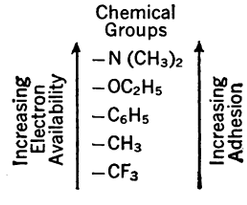
(2) surface roughness of the metal substrate to which the polymeric film adheres.

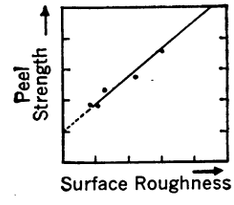
Particularly, through a range of polymers synthesized in the lab, they have found that the more available the electrons in the chemical groups, the stronger the adhesion. Similarly, the rougher the metal surface, the more force required to break the adhesive bonds between the polymeric coating and the substrate.

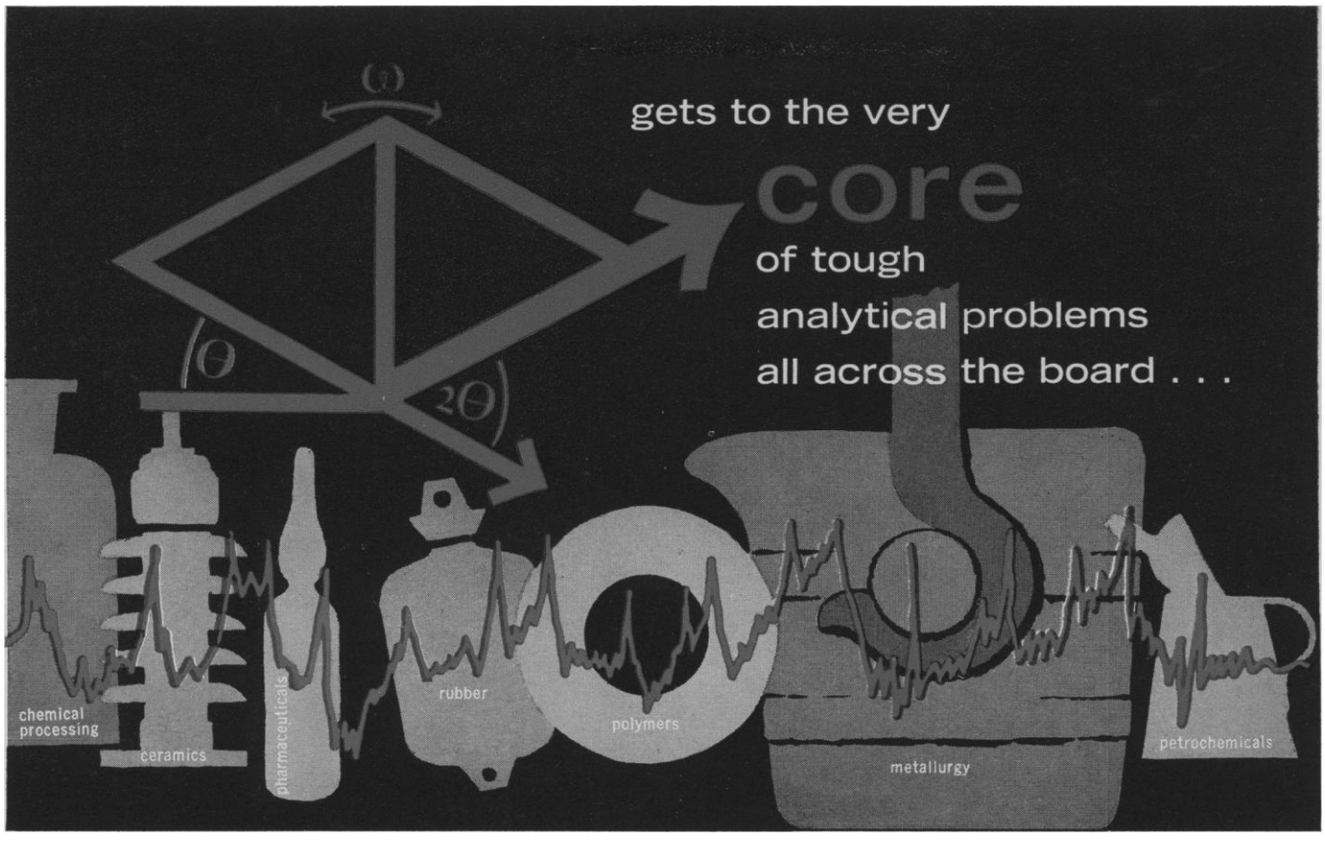
This experimental approach is enriching our understanding of some of the fundamentals affecting adhesion. It is also finding practical use in General Motors, helping in improving the adhesion of paint, rubber, plastics, and metals to each other. It's another example of GM's continual quest for—A BETTER WAY.

## General Motors Research Laboratories

Warren, Michigan



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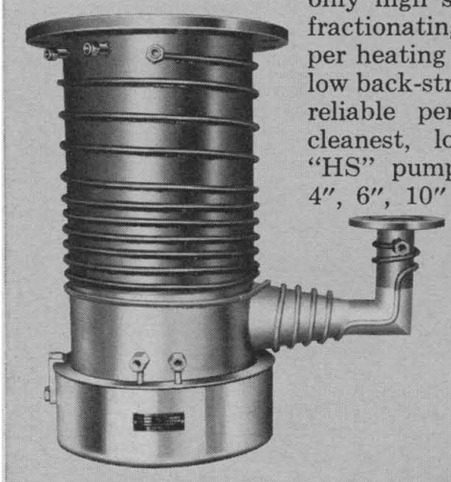
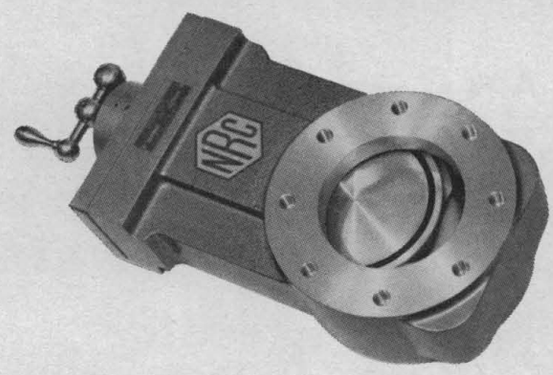
## DIFFUSION PUMPS



NRC's new "HS" Series Diffusion Pumps is the only high speed line with fractionating design, no super heating necessary, and low back-streaming for top, reliable performance and cleanest, lowest vacuum. "HS" pumps available in 4″, 6″, 10″ and 32″ sizes.

## SLIDE VALVES



The new NRC Slide Valves are the best by comparative tests. The "HC" Series valves now provide valved systems with very high and ultrahigh vacuums ($10^{-8}$ torr and lower) at *conventional* prices. Available in 4″ and 6″ sizes.

## CRYO AND MOLECULAR BAFFLES

NRC's Circular Chevron Cryo Baffles provide exceptionally high conductance for maximum *useful* pumping speed.

NRC's new Molecular Sorbent Baffles provide truly *clean* vacuums by use of three full trays of sorbent material (Zeolite) and built-in heater for regenerating easily.

## VACUUM GAUGES

From 1 x $10^{-3}$ to $10^{-10}$ torr range, the most accurate, reliable gauge in NRC's improved Bayard-Alpert type, the Model 751.

At pressures *below* 1 x $10^{-9}$ torr, "there is only one really satisfactory gauge commercially available, the Redhead Gauge, NRC's Model 752." The 752 is *not* "X-Ray limited", is magnitudes less "gassy" because there is *no* hot filament, is 50 times more sensitive than typical Bayard-Alpert gauges. The result is more accuracy below $10^{-9}$ torr than any other gauge. If you really want accurate, reproducible measurements in the ultrahigh vacuum range, use the Model 752.

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**Economy in original equipment cost plus rapid drying rates are inherent in the Sublimator design. Condensing coils are built into the chamber containing the materials to be freeze-dried Result — water vapor traverses an extremely short path before being condensed. And the space conserved by eliminating a remotely located condenser is effectively utilized to house the complete equipment in a remarkably compact, mobile cabinet.**

**Ultra-high quality production is routinely achieved in the fully automatic Sublimators. Usable tray areas are available from 4.5 sq. ft. to 166 sq. ft. Sublimator features include— sterile operation — stoppering under original vacuum — front panel mounted controls — reverse cycle defrosting. The large, glass-clear Lucite® vacuum chamber closure provides an unobstructed view of all shelves and the condensing coils. No plumbing connections are required — simply plug the single electric cord into a suitable outlet.**

For full details on the modern, economical Sublimator freeze-drying method, write

**RePP INDUSTRIES, INC.**
GARDINER, NEW YORK

# UNEXCELLED OPTICS, MECHANICAL RUGGEDNESS AND A VERSATILITY AS FLEXIBLE AS YOUR NEEDS

These things will impress you about the Nikon S:

First, *as you look at it,* its physical appearance; its rugged, substantial construction; its rigidity; and its obvious ability to stand up to constant use and handling.

Second, *as you try the controls,* the smooth responsive 'feel'; the positive action; the complete absence of vibration or chatter — not the slightest trace of 'play' or 'back-lash'.

And third, *as you look through the eyepiece,* the clear delineation of field; the brightness and definition of image; the visual ease; and the almost incredible resolution characteristic of Nikon optical quality.

The Nikon S Microscope is a basic, practical instrument whose capabilities are as varied as your changing needs. A veritable 'workhorse' for routine applications, you can rely on the same Nikon S to qualify as a 'specialist' whenever special needs arise. The Nikon S handles dark-field as well as bright-field microscopy — phase-contrast, polarizing, incident light, and transmitted light interference microscopy. And with the Nikon Microflex, the S is equipped for high quality photomicrographs using famous Nikon 35mm cameras.

Note that the various component parts of the Nikon S microscope are freely interchangeable to suit virtually any preference or need. There are plain, circular floating and rectangular mechanical stages; 45° eyepiece tubes: monocular, binocular and trinocular; fixed substage lamp and external adjustable illuminator; and a variety of measuring accessories.

The rectangular mechanical stage provides cross-wise slide movement, and is equipped with calibrated coaxial controls. One of its unique features is that it can be rotated 180° for either right-hand or left-hand operation.

The standard Abbe (n.a. 1.25) condenser, supplied with the Nikon S, is equipped with a variable aperture diaphragm which can be easily centered for normal work, or decentered for oblique illumination. This consenser is also readily interchangeable for dark-field and other special types.

Available optics include Huygenian and compensating eyepieces, and a full range of dry and oil-immersion objectives, including a 'no-cover-glass-corrected' 40x (n.a. 0.65).

Write for complete details to Dept. S9

**NIKON INCORPORATED • Instrument Division • 111 Fifth Avenue, New York 3, N. Y. • Subsidiary of Ehrenreich Photo-Optical Industries, Inc.**

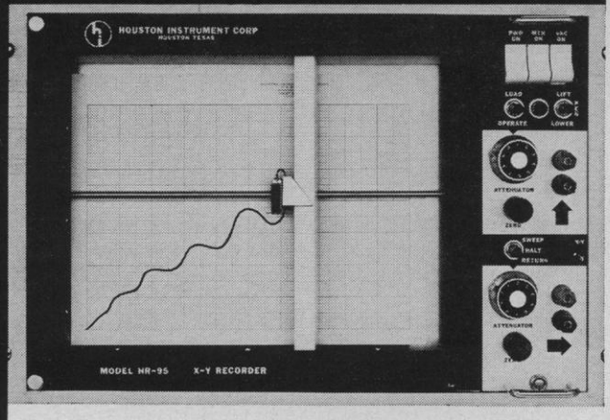
optical inspection instruments, scientific and industrial microscopes, surveying instruments, cameras, telescopes, binoculars and other precision optical equipment.

**NIKON LABORATORY MICROSCOPE Series S**

## VISIT BOOTH 21 AT THE NIH EXHIBIT

# X-Y RECORDERS

**for automatically recording any variable vs. any other variable on linear or logarithmic scales**




## SPECIAL PLUG-IN CONTROL MODULE

- 0.25% accuracy
- High dynamic performance (15 inch per second pen speed)
- 1 MV per inch sensitivity
- Vacuum paper hold down system
- Snap-on cartridge pen assembly
- Precision 10 turn attenuators permit recording of wide range of input signals
- Zener reference supply

Model HR-95T-1 illustrated features Built-In X-axis Time Base. Wide variety of AC or DC signals can be handled using selection of available plug in control modules.

**MODEL HR-95T from $1150**

Optional C-1 case and D-1 cart extend usefulness of basic HR-95T X-Y Recorder. Write for other available accessories.

## X-Y RECORDER MODEL HR-92

**Rugged** *All Purpose*

**8½ x 11"**

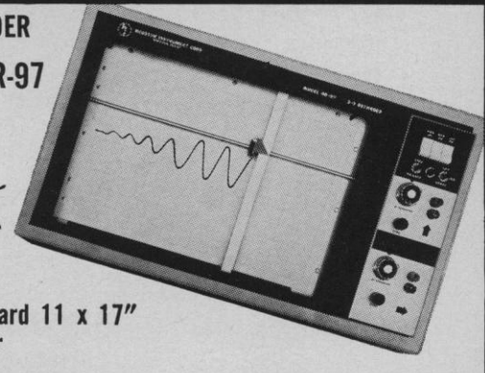
**X-Y Recorder**

- ½% accuracy
- Critically Damped Response
- 7½ Inch per second pen speed
- 10 MV per inch sensitivity (1 MV per inch sensitivity optional)
- Clip on pen—interchangeable for multi-color traces

**$595**

## X-Y RECORDER MODEL HR-97

**NEW in '62**



**Uses standard 11 x 17" Graph Paper**

- 0.25% accuracy
- 15 inch per second pen speed
- 1 MV per inch sensitivity
- Vacuum paper hold down system
- Precision 10 turn attenuators permit recording of wide range of input signals
- Zener reference supply
- Optional time base

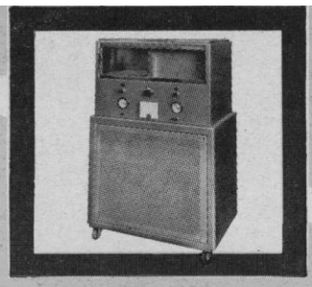
**$1250**

Literature Available Upon Request

**houston instrument** corporation

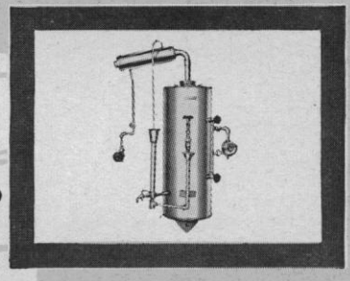
Box 22234 M Houston 27, Texas MO 7-7403

# AMSCO Microbiological Equipment



*FREEZE DRY EQUIPMENT*

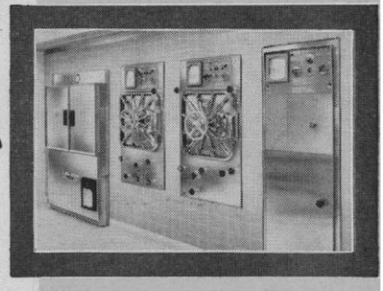
Models for laboratories and pilot plants. Used for the preservation and concentration of labile substances.



*WATER STILLS and DEIONIZERS*

STILL capacities from ½ to 500 gal./hr. Steam, Electric or Gas heat. Automatic or manual controls.

DEIONIZERS — Complete line ranging from 2 to 1000 gal./hr.

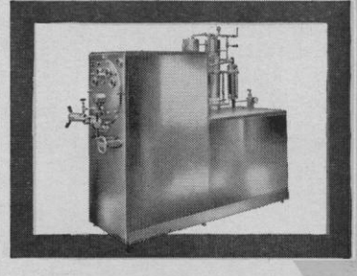


*STERILIZERS*

Pressure Steam, Ethylene Oxide and Combination Gas-Steam models. Chambers 16″ x 16″ x 24″ to 60″ x 66″ x 120″

*CONTINUOUS CULTURE APPARATUS*

"Biogen" Continuous Culture Apparatus produces microbial cells and/or their byproducts on a continuous or batch basis under precisely controlled conditions.

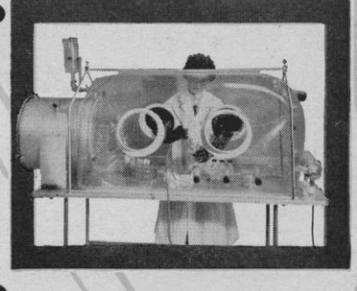


*DRY BOXES*

Flexible Film disposable chamber. Economical, efficient and easy to use. Ideal for laboratory and production.

*GERM-FREE LIFE APPARATUS*

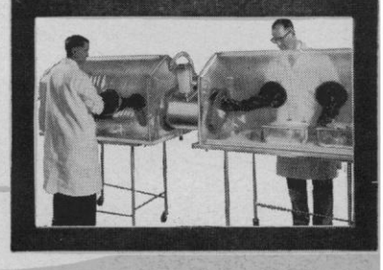
Flexible Film Isolators for operating, rearing and transfer of germ-free animals. Economical, disposable chamber.



For good reason more and more universities, pharmaceuticals and industrials confidently specify AMSCO Freeze Dryers, Sterilizers, Water Stills and other specialized microbiological equipment. Each is designed and built to accomplish a specific job better . . . more dependably . . . and with less time and attention from the staff.

If you have a problem in the area of technical microbiological equipment, a letter to our Scientific and Industrial Department may lead to its economical resolution.

Meanwhile we'll be happy to send along literature on any of the equipment illustrated.



SCIENTIFIC AND INDUSTRIAL DEPARTMENT

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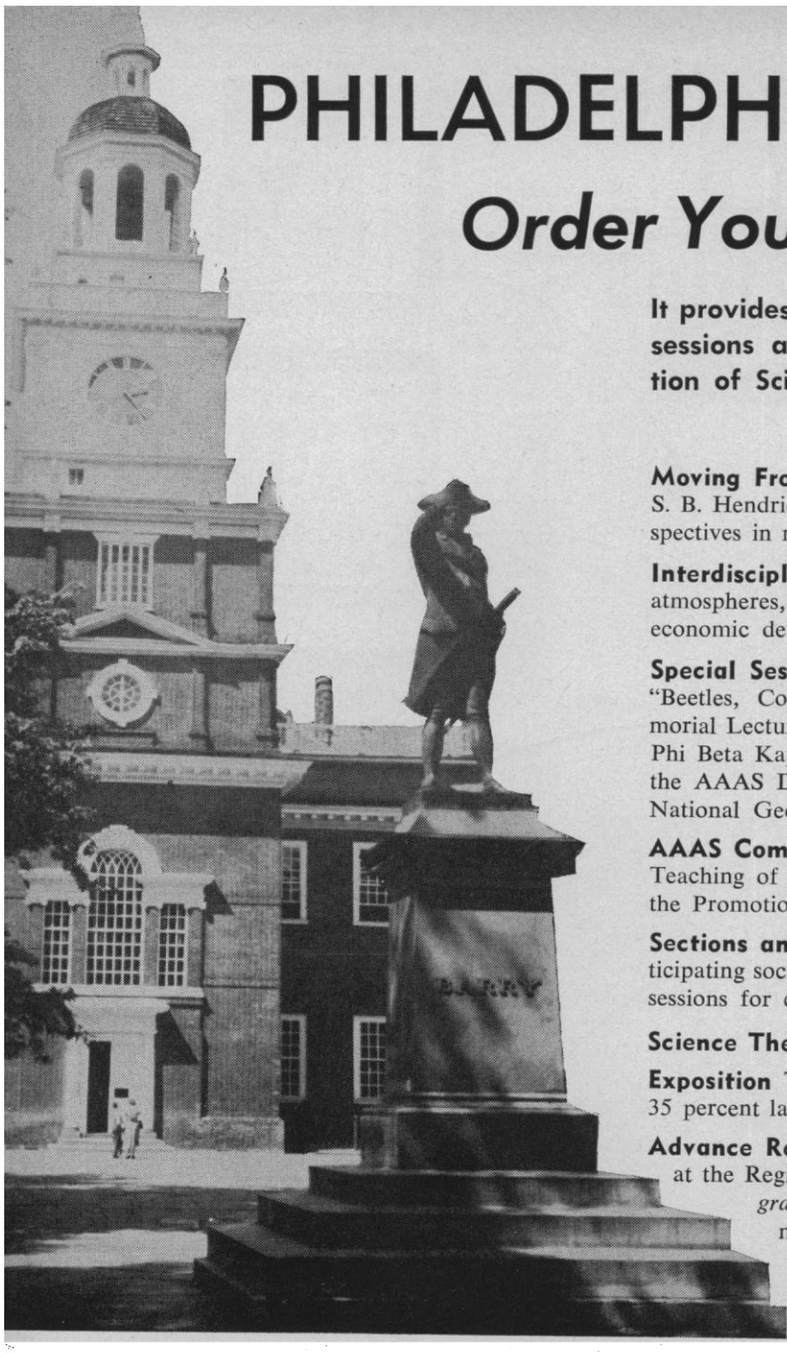

# PHILADELPHIA • 129th AAAS

## *Order Your General Program*

**It provides complete, detailed information about all the sessions and symposia scheduled, the Annual Exposition of Science and Industry, and the Science Theatre.**

### Program Highlights

**Moving Frontiers of Science** H. E. Newell on space science, S. B. Hendricks on biological timing mechanisms, S. Brenner on perspectives in molecular biology, W. O. Baker on industrial research.

**Interdisciplinary Symposia** AAAS day: Dynamics of planetary atmospheres, the spread of technical knowledge as an instrument of economic development, biochemistry of genetic transcription.

**Special Sessions** AAAS Presidential Address by Thomas Park on "Beetles, Competition, and Population"; the George Sarton Memorial Lecture by Gerald Holton; the Joint Address of Sigma Xi and Phi Beta Kappa by Loren C. Eiseley on "Man: The Lethal Factor"; the AAAS Distinguished Lecture, the Tau Beta Pi address; and the National Geographic Society Illustrated Lecture.

**AAAS Committees** Sessions of the Cooperative Committee on the Teaching of Science and Mathematics, the Committee on Science in the Promotion of Human Welfare, and others.

**Sections and Societies** The 20 AAAS Sections and some 50 participating societies are scheduling specialized symposia, and many have sessions for contributed papers.

**Science Theatre** The latest foreign and domestic films.

**Exposition** The Annual Exposition of Science and Industry will be 35 percent larger than it was last year.

**Advance Registration** By registering in advance, you avoid delay at the Registration Center on arrival, you receive the *General Program* in time to plan your days at the meeting, and you permit your name to be posted in the Visible Directory of Registrants when the meeting opens.

Use the coupon below for advance registration or to order your advance copy of the *General Program*.

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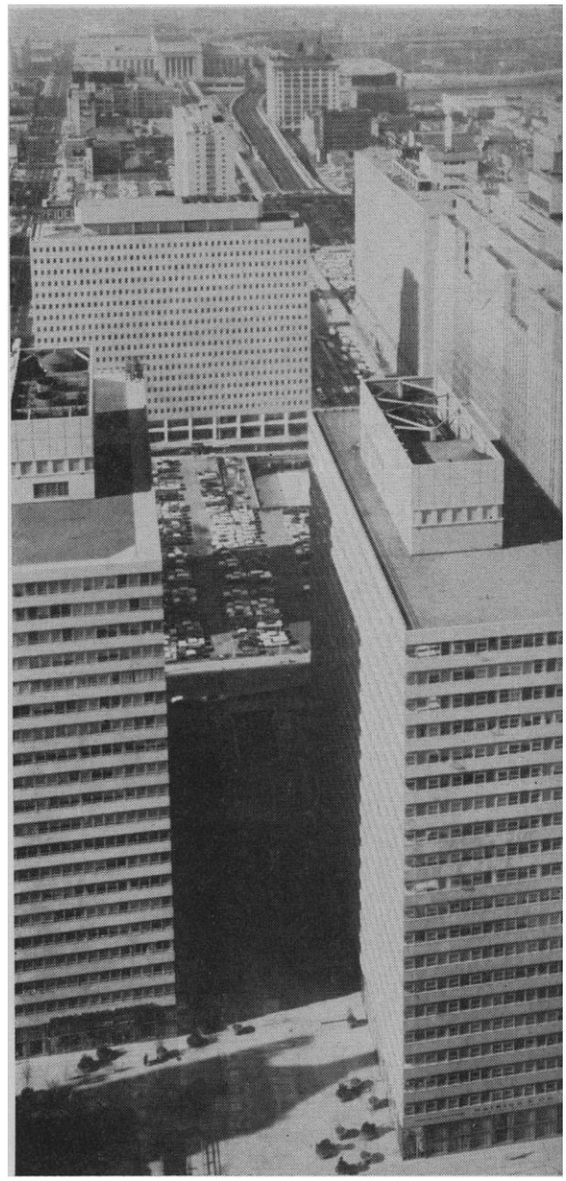
**Please mail this coupon and your check or money order for the total amount to the AAAS.**

# MEETING • 26-30 DECEMBER

## *Reserve Your Hotel Room*

**Make sure you have the accommodations you prefer. A list of headquarters hotels of participating societies appears on page 235, SCIENCE, 20 July. The AAAS headquarters is the Sheraton.**



The hotels for the AAAS Philadelphia meeting have established special, low flat rates and have reserved large blocks of rooms for the meeting.

Use the coupon below to make your hotel reservation in Philadelphia. Send your application to the AAAS Housing Bureau in Philadelphia, not to any hotel. Give a definite date and estimated hour of arrival, and also probable date of departure. The Housing Bureau will make the assignment and send you a confirmation in two weeks or less.

A rollaway bed can be added to any room at $3.00 per night. Mail your application now to secure your first choice of accommodations.

### HOTEL RATES*
### AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

For a list of the headquarters of each participating society and section, see page 235, *Science*, 20 July.

| Hotel | Single Bed | Double Bed | Twin Beds | Suites |
|---|---|---|---|---|
| Sheraton** | $8.50 | | $14.00 | $35.00—$45.00 |
| Bellevue Stratford** | 8.50 | | 14.00 | 32.00— 60.00 |
| Warwick** | 8.50 | | 14.00 | 30.00— 65.00 |
| Franklin Motor Inn | 8.50 | | 14.00 | |
| Robert Morris | 5.50—7.50 | $9.00—$11.00 | 10.00—11.00 | |
| Sylvania | 7.50 | 11.00 | 12.00 | |
| Adelphia | 7.50 | 11.00 | 12.00 | |
| Benjamin Franklin | 8.50 | 12.00 | 14.00 | 32.00— 60.00 |

* All rooms are subject to a 4% Pennsylvania state sales tax.
** Hotels with sessions.

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**AAAS Housing Bureau, Hospitality Center.**
**16th Street and Pennsylvania Boulevard**
**Philadelphia 2, Pa.**

Date of Application .....

Please reserve the following accommodations for the 129th Meeting of the AAAS in Philadelphia, 26—30 December, 1962

**First Choice Hotel** ..... **Second Choice Hotel** ..... **Third Choice Hotel** .....

Type of room: Single ☐ Double ☐ Double, twin beds ☐ Suite ☐ Rates: Desired ..... Maximum .....

Number in party..... Sharing this room will be: .....

**(List name and address of each person, including yourself. Attach list if space is insufficient.)**

.....

.....

DATES: ARRIVAL ..... A.M. .....P.M.....DEPARTURE .....
(These must be indicated—add approximate hour, A.M. or P.M.)

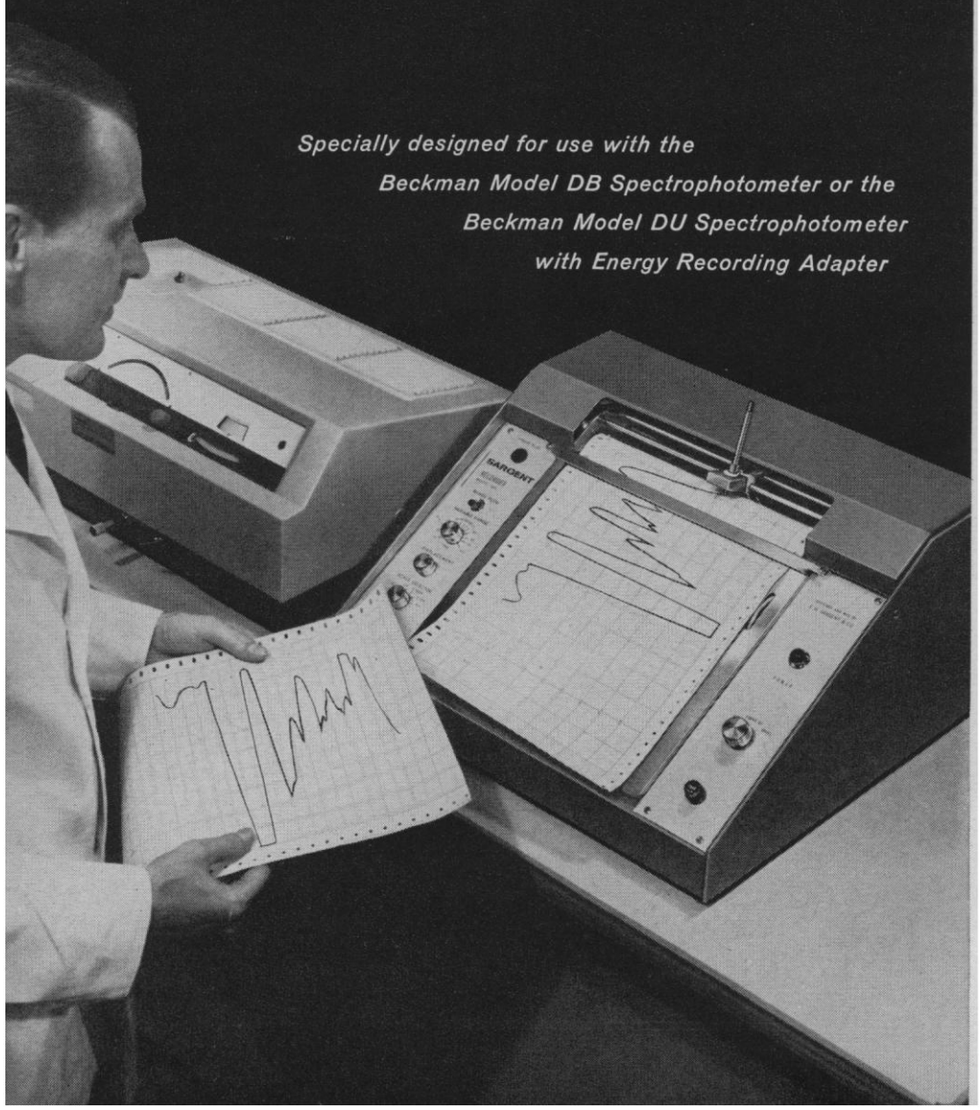
NAME .....
(Individual requesting reservation) (Please print or type)

ADDRESS .....
(Street) (City and Zone) (State)

**Mail this coupon now to the Housing Bureau. Rooms will be assigned and confirmed in order of receipt of reservation.**

# FOR RECORDING LINEAR ABSORBANCE

## The Sargent Model SRL Linear-Log Recorder



*Specially designed for use with the Beckman Model DB Spectrophotometer or the Beckman Model DU Spectrophotometer with Energy Recording Adapter*

### The SRL offers these advantages:

TRANSMITTANCE OR LINEAR ABSORBANCE RECORDING—simple conversion by interchanging logarithmic and linear gears. Log gears—precision generated—produce ultimate accuracy of log function.

FAST RESPONSE—less than one second required for full scale pen travel, for faithful transcription of peaks and valleys in the curve.

ACCURACY—¼% or 20 microvolts, which, coupled with the wide chart, provides more than sufficient reading accuracy—especially important when considering alternative applications.

REPRODUCIBILITY—to a fraction of a millimeter, ensuring that the accuracy of analytical measurement is not limited by the measuring instrument.

SPECIAL CHART—wide 240 mm scale (0 to 100) for best reading accuracy. Zero point is at left for logical presentation of wavelength axis.

VARIABLE LINEAR RANGE—permits full scale presentation of any %T range from 0-10 to 0-100.

LOG RANGE SELECTION—permits full scale presentation of either 0-1 or 1-2 absorbance ranges.

SYNCHRONOUS SWITCHING—for convenient, simultaneous engagement of scan and chart drive from one switch position. (Scanning with DU requires SERA attachment.)

TRUE POTENTIOMETRIC RECORDING—variable range accomplished by adjustment of potentiometric bridge network—independent of input circuit resistance.

VERSATILITY—useable for all other laboratory recording applications through use of standard accessories.

**S-72180-50 RECORDER**—POTENTIOMETRIC, LINEAR-LOG RECORDING, SARGENT MODEL SRL (PAT. NO. 2,931,964). With integral panel control to adjust range from 0-10 to 0-100 millivolts and with alternate logarithmic recording of 0-1 or 1-2 orders by interchange of precision generated linear and log gears in the pen drive system, for highest accuracy. Ranges from 0-10 to 0-100%T and 0-1 or 1-2 absorbance are provided. Complete with 1 roll of S-72167 chart paper and with cables for connection to the spectrophotometer.....**$970.00**

# SARGENT

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**E. H. SARGENT & CO., 4647 W. FOSTER AVE., CHICAGO 30, ILLINOIS**
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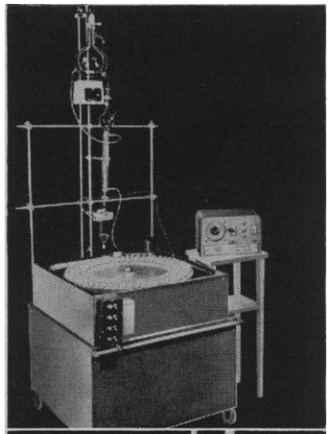
**Write for bulletin SRL**

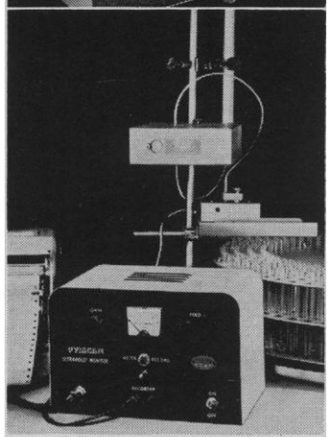


# FRACTION COLLECTORS

**REFRIGERATED . . . THE MOBILE COLDROOM, REFRIGERATED FROM COLUMN TO COLLECTING TUBES . . . ON CASTERS . . . GLASSWARE AND TURNTABLE TEMPERATURE-CONTROLLED.**

OTHER MODELS (for every program and budget) include CONTINUOUS (for long-term or overnight use) and SECTIONAL (for processing during fraction collecting).

Send for Bulletin S-3-4000 for complete information.

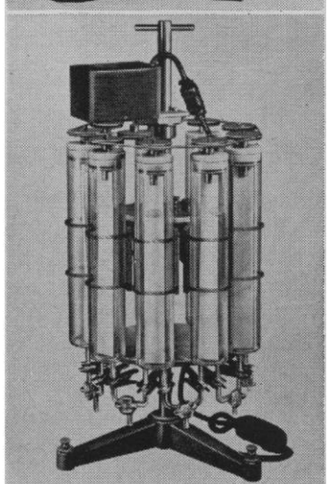


# UVISCAN

**FOR AUTOMATIC ULTRAVIOLET MONITORING OF CHROMATOGRAPHIC ELUENTS WITH CONTINUOUS FLOW UV MONITOR. For use with all Fraction Collectors.**

UVISCAN makes possible speedier identification of compounds with great accuracy and automatically indicates, on a recorded chart, the test-tube in which the desired compound is contained. • Amplifier yields signal from 0.05 to 4 Optical Density. Easily accessible Flow Cell with adjustable lightpath from 1 to 10 mm. • Minimum volume 0.125 ml. • High Stability. During 24 hours the baseline will remain constant within 0.5 mv. • Wave Length from 220 to 280 millimicrons. • Linear or Logarithmic Recorders available.

Send for Bulletin S-3-5000 for complete information.



# VARIGRAD

**VARIABLE GRADIENT MIXER FOR CHROMATOGRAPHY. A UNIQUE APPARATUS FOR PRODUCING PRECISELY-CONTROLLED AND REPRODUCIBLE GRADIENTS.**

Developed at the National Institutes of Health

- Makes small changes in specific portions of an elution gradient to improve resolution in certain regions of chromatograms.
- Presents gradient data for duplication in any laboratory.
- Single apparatus can be used to supply identical gradients simultaneously to several columns.
- Any number of independent gradients of different molecular or ionic species can be produced simultaneously.

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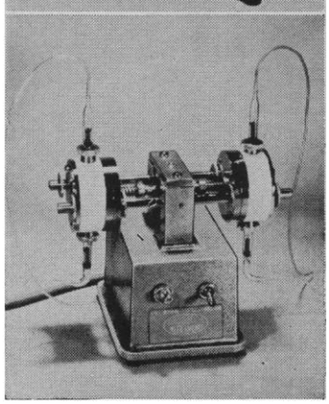

# MICROPUMP

**REGULATES FLOW OF SOLVENTS THROUGH CHROMATOGRAPHIC COLUMNS AT A PRE-SET CONSTANT VOLUME.**

Features:

- CONSTANT FLOW RATE of buffer solution
- ADJUSTABLE VOLUME from 25 ml to 950 ml/hour
- ALL COMPONENTS, which are in contact with the solvent, are made of teflon or glass
- Designed for CONTINUOUS DUTY
- EXCEPTIONALLY LOW COST

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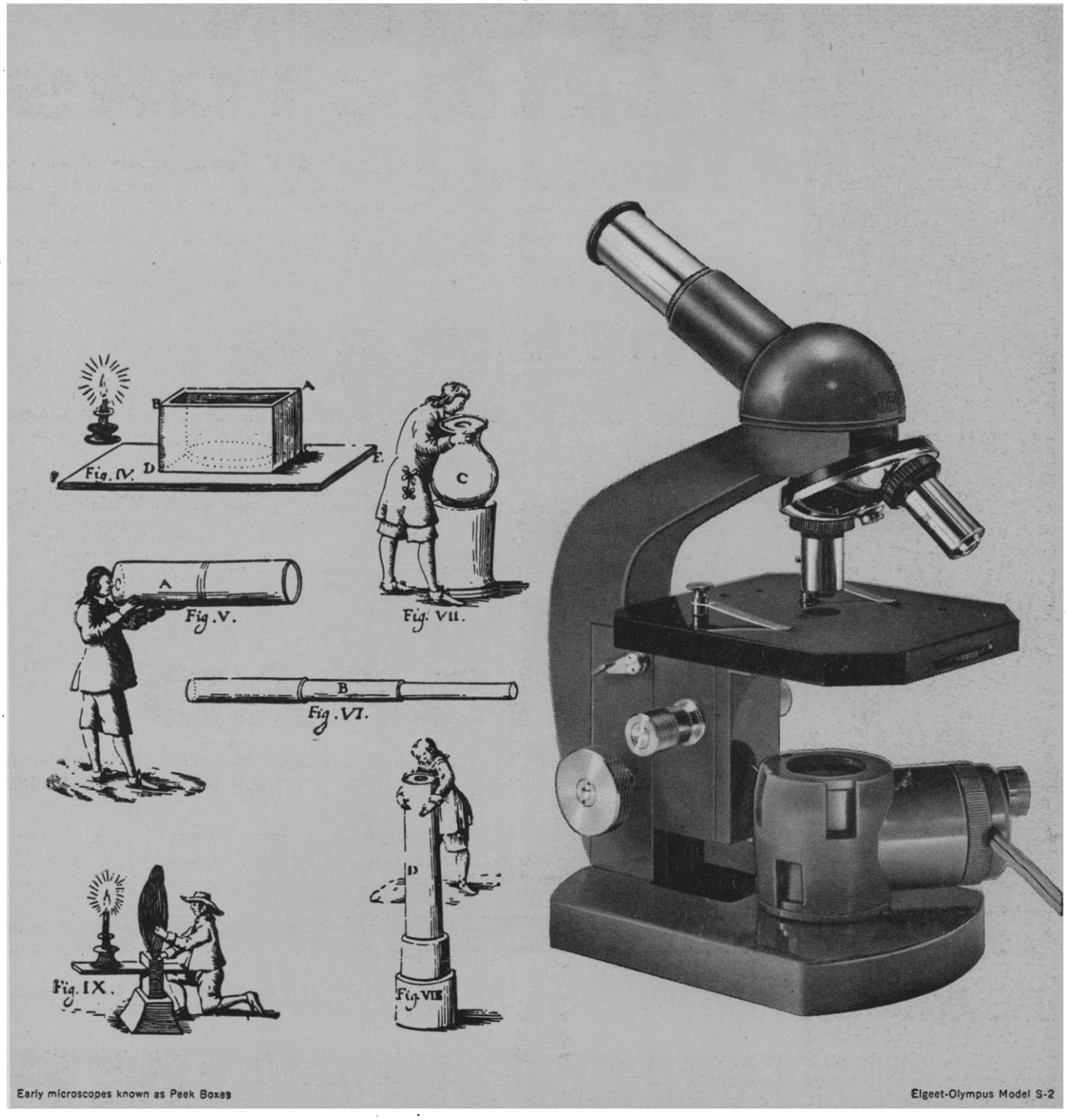



Early microscopes known as Peek Boxes

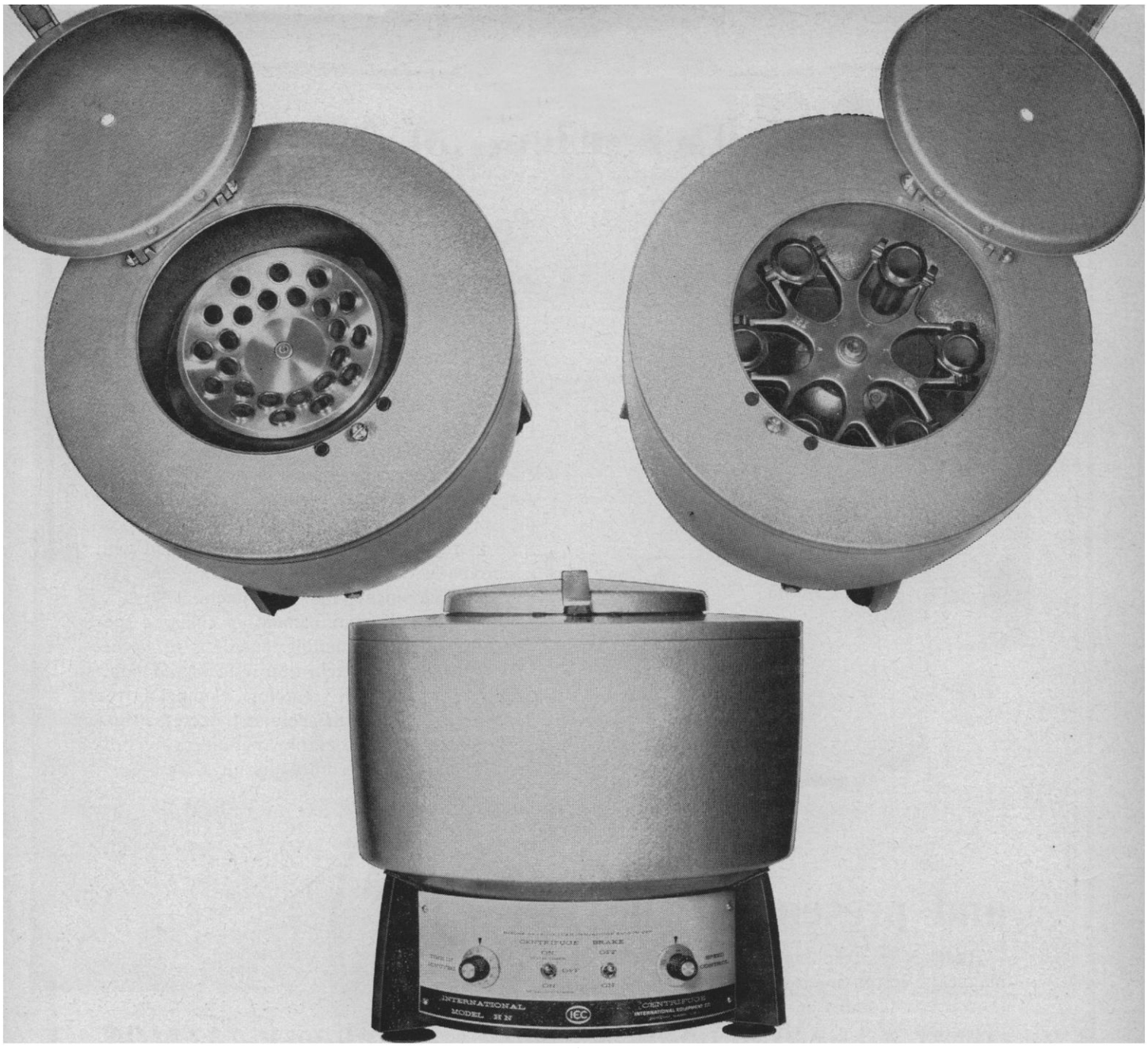
Elgeet-Olympus Model S-2

# IMAGINE IF...

**ENSTACHIUS DIVINIUS, the early Roman scientific investigator and the other pre-Renaissance students of optical phenomena which inevitably led up to today's fine instruments...imagine if ENSTACHIUS had enjoyed ownership of this fine ELGEET-OLYMPUS Model S-2 microscope. This new rugged and versatile student-teaching microscope with its inclined eyepiece is typical of the many new models extending to students the benefits of unsurpassed convenience, ease of operation, and efficiency combined with working comfort, resulting in maximum learning possibilities even over prolonged periods of close concentration. Standard Model S-2 with double revolving nosepiece hard-coated parfocal, achromatic interchangeable 10X (N.A. .25) and 40X (N.A. .65) objectives. Choice of concave mirror or interchangeable 15-watt illuminator. $99.45 in lots of 5. Write for booklet.** **ELGEET**

EL-90

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




# YOU REALLY OUGHT TO LOOK INTO THE NEW IEC HN ...A "COMPACT" WITH BIG CENTRIFUGE VERSATILITY

Examine this superb new instrument. You'll see that IEC has built extraordinary **versatility** into this modern, compact, quiet-running centrifuge.

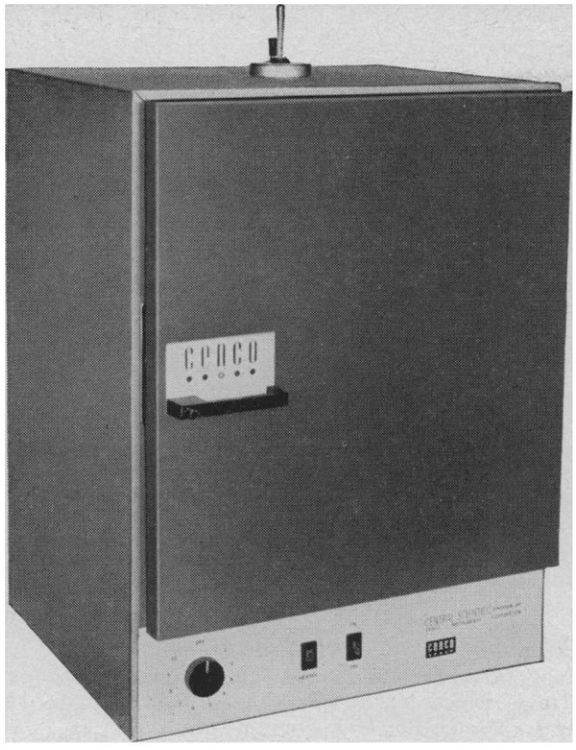
Look at the angle head in the upper left picture, for example. It swings **twenty-four** 15 ml tubes at 3800 rpm — 2100 X G. Look at the horizontal head at the upper right. It swings **six** 50 ml tubes at 2670 rpm — 1120 X G. These are just samples. You can acquire over **fifty** heads and accessories which can be interchanged in hundreds of combinations to perform an exceptional variety of work.

You'll find the new model HN centrifuge convenient and efficient, too. It has an automatic timer; smooth, stepless speed controller; an electric brake and a heavy gauge steel guard bowl. In fact, you'll find the features and versatility of the HN put it well into the work range of larger, more expensive centrifuges. It fills a universal need for an intermediate centrifuge with capacities formerly available only in larger centrifuges. It is priced well within the most conservative budget. Would you like complete literature? Write for 12-page Bulletin HN.

**INTERNATIONAL (IEC) EQUIPMENT CO.**

**1284 SOLDIERS FIELD ROAD • BOSTON 35, MASSACHUSETTS**

# THE NEW SERIES 16 CENCO OVENS



Smartly designed cabinets blend with modern lab interiors.

Announcing 16 new Cenco double wall ovens from which you can choose the interior capacity and lining, line voltage and mode of circulation that exactly meets your needs—whether it be in the lab or on the production line. Every model offers these Cenco extras:

- two light weight, adjustable shelves
- fully shielded Incoloy heater elements
- temperature uniformity within 1.5° C
- completely grounded by 3-wire line cord
- choice of gravity or forced air circulation
- available with corrosion resistant aluminum liner

Pick the model that fits your needs from this chart—

| | CENCO NO. | INTERIOR | DIMENSIONS (W" x D" x H") INSIDE | DIMENSIONS (W" x D" x H") OUTSIDE | ELECTRICAL VOLTAGE | ELECTRICAL CURRENT | ELECTRICAL WATTAGE | PRICE EACH |
|---|---|---|---|---|---|---|---|---|
| **Gravity** These ovens have a temperature to 200°C with a material uniformity of ±1.5°C. | 95077-16 | LACQUERED STEEL | 14 x 14 x 14 | 18 x 17½ x 26 | 115 | 50/60 AC | 750 | $185.00 |
| | 95077-17 | | 14 x 14 x 14 | 18 x 17½ x 26 | 230 | 50/60 AC | 750 | 197.00 |
| | 95078-16 | ALUMINUM | 14 x 14 x 14 | 18 x 17½ x 26 | 115 | 50/60 AC | 750 | 195.00 |
| | 95078-17 | | 14 x 14 x 14 | 18 x 17½ x 26 | 230 | 50/60 AC | 750 | 207.00 |
| | 95085-16 | LACQUERED STEEL | 19 x 17 x 20 | 23 x 21 x 32 | 115 | 50/60 AC | 1200 | 245.00 |
| | 95085-17 | | 19 x 17 x 20 | 23 x 21 x 32 | 230 | 50/60 AC | 1200 | 257.00 |
| | 95086-16 | ALUMINUM | 19 x 17 x 20 | 23 x 21 x 32 | 115 | 50/60 AC | 1200 | 250.00 |
| | 95086-17 | | 19 x 17 x 20 | 23 x 21 x 32 | 230 | 50/60 AC | 1200 | 262.50 |
| **Forced Draft** These ovens have a temperature to 200°C with a material uniformity of ±1°C. | 95377-16 | LACQUERED STEEL | 13 x 13½ x 14 | 18 x 17½ x 25¼ | 115 | 50/60 AC | 750 | $235.00 |
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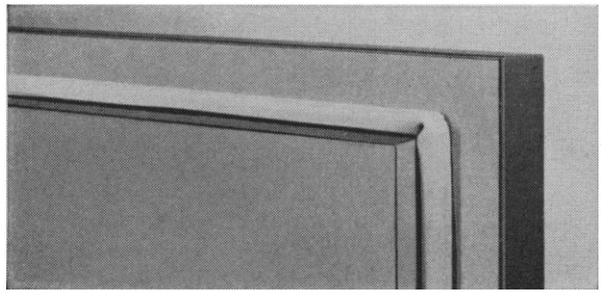
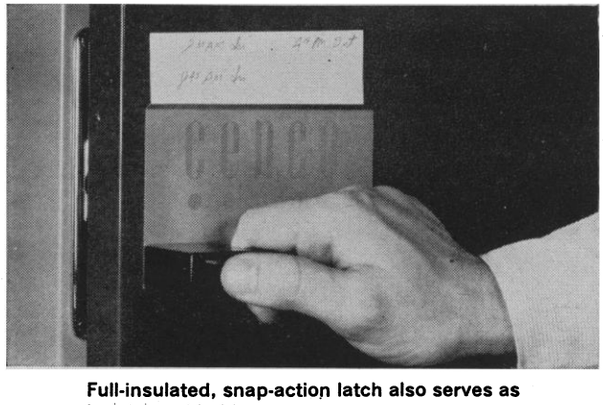
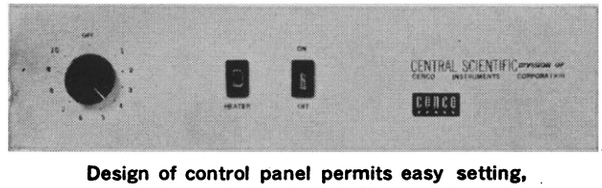
| | 95378-16 | ALUMINUM | 13 x 14 x 14 | 18 x 17½ x 26 | 115 | 50/60 AC | 750 | 245.00 |
| | 95378-17 | | 13 x 14 x 14 | 18 x 17½ x 26 | 230 | 50/60 AC | 750 | 260.00 |
| | 95395-16 | LACQUERED STEEL | 18 x 16½ x 20 | 23 x 21 x 32 | 115 | 50/60 AC | 1200 | 315.00 |
| | 95395-17 | | 18 x 16½ x 20 | 23 x 21 x 32 | 230 | 50/60 AC | 1200 | 332.50 |
| | 95396-16 | ALUMINUM | 18 x 17 x 20 | 23 x 21 x 32 | 115 | 50/60 AC | 1200 | 325.00 |
| | 95396-17 | | 18 x 17 x 20 | 23 x 21 x 32 | 230 | 50/60 AC | 1200 | 337.50 |



Long-lasting silicon rubber door gasket insures positive seal.



Full-insulated, snap-action latch also serves as handy card holder.




Design of control panel permits easy setting, monitoring and adjustment of temperatures.

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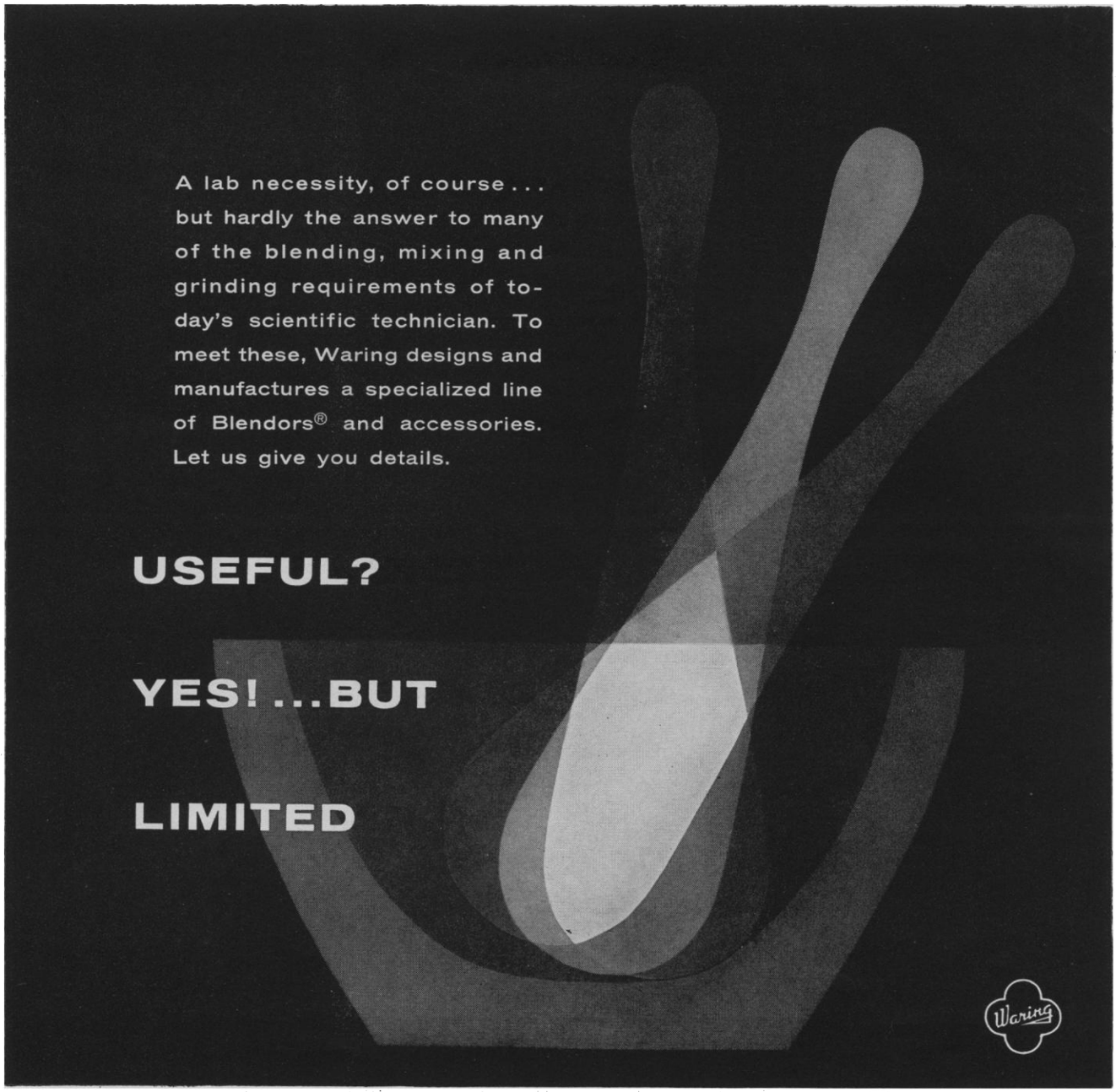


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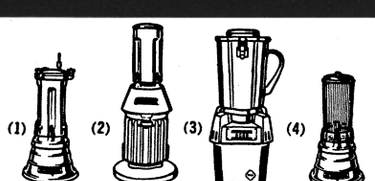


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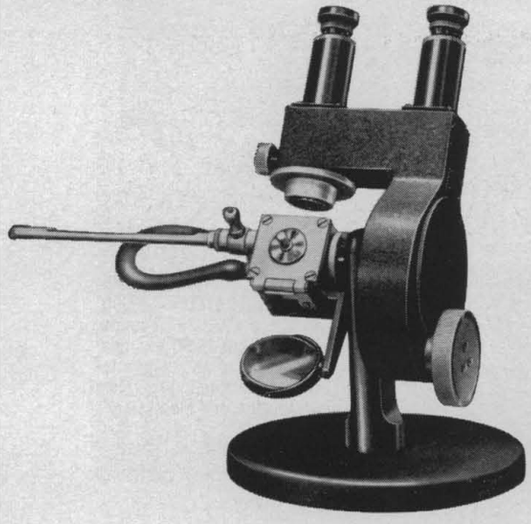

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Dry substance $\pm 0.1$ to 0.2%

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### TECHNICAL DATA

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**Limit of error —**
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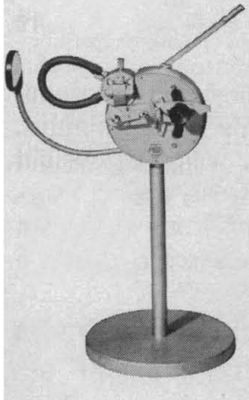
Refractive index $\pm 1$ to 2 units of the fourth decimal



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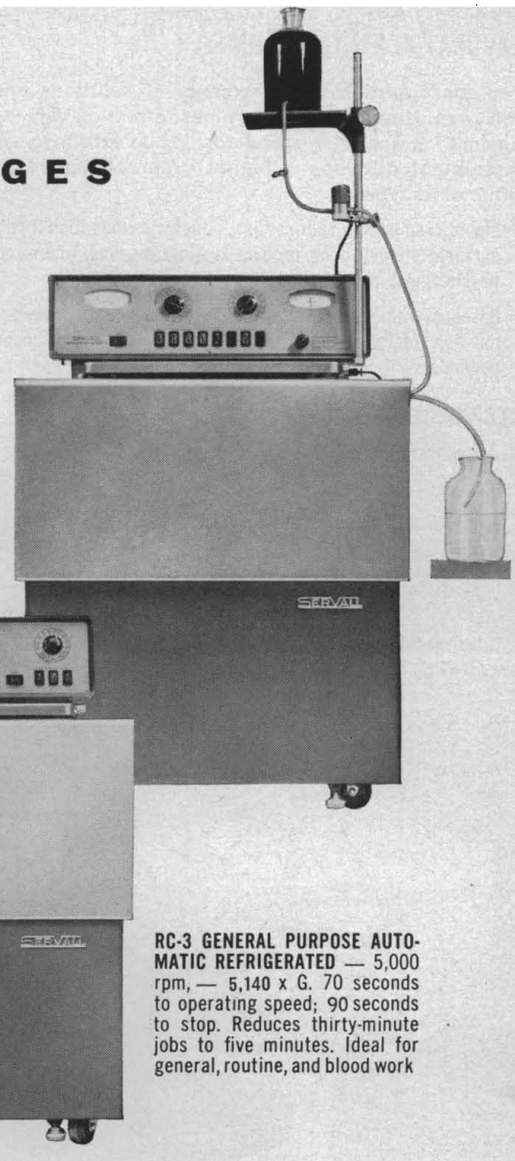

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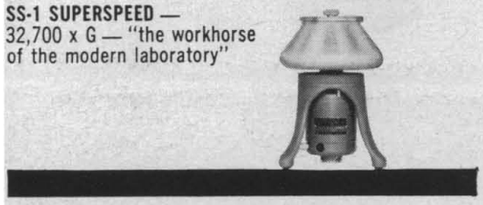

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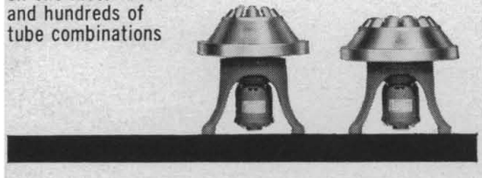

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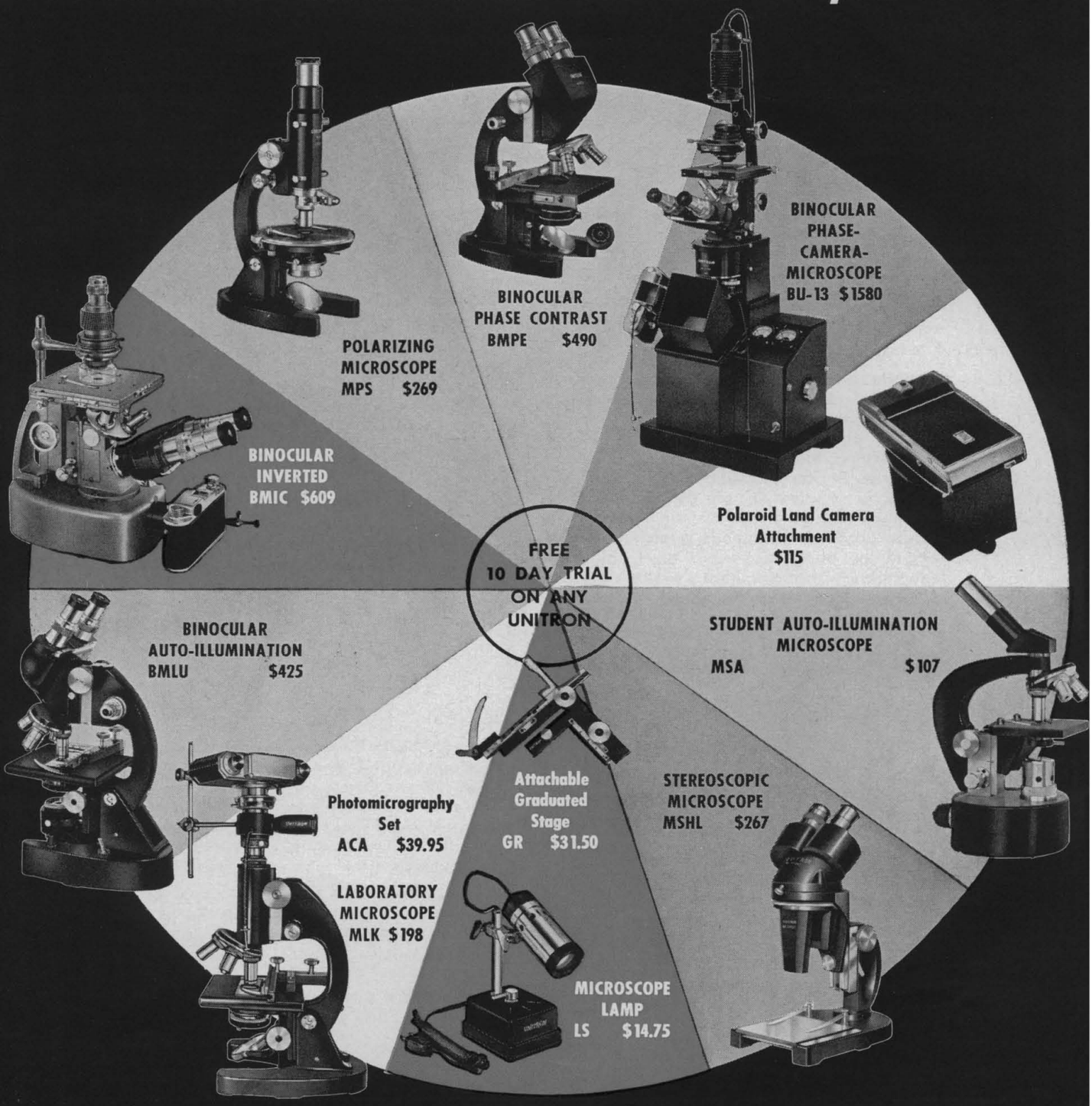


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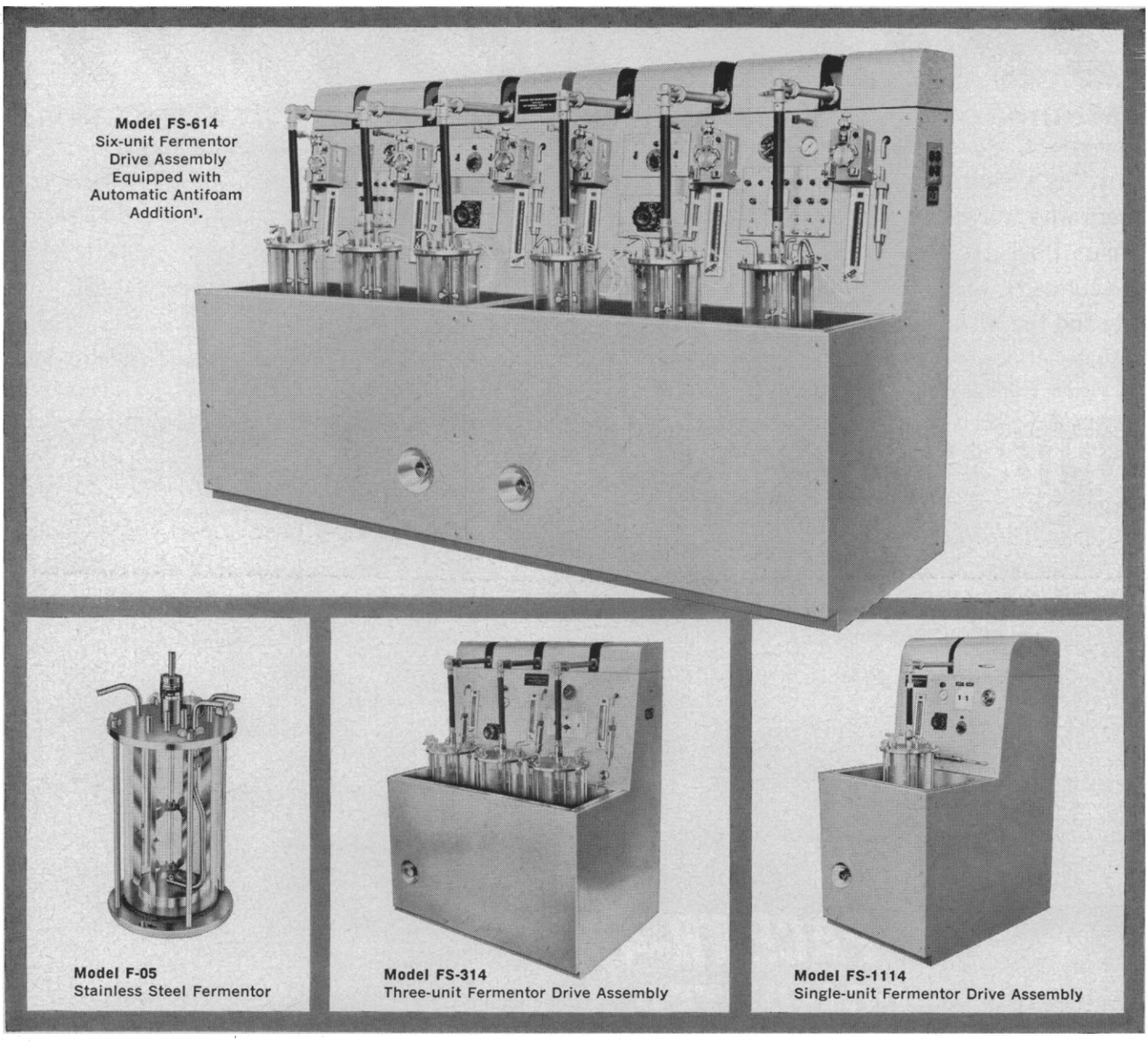

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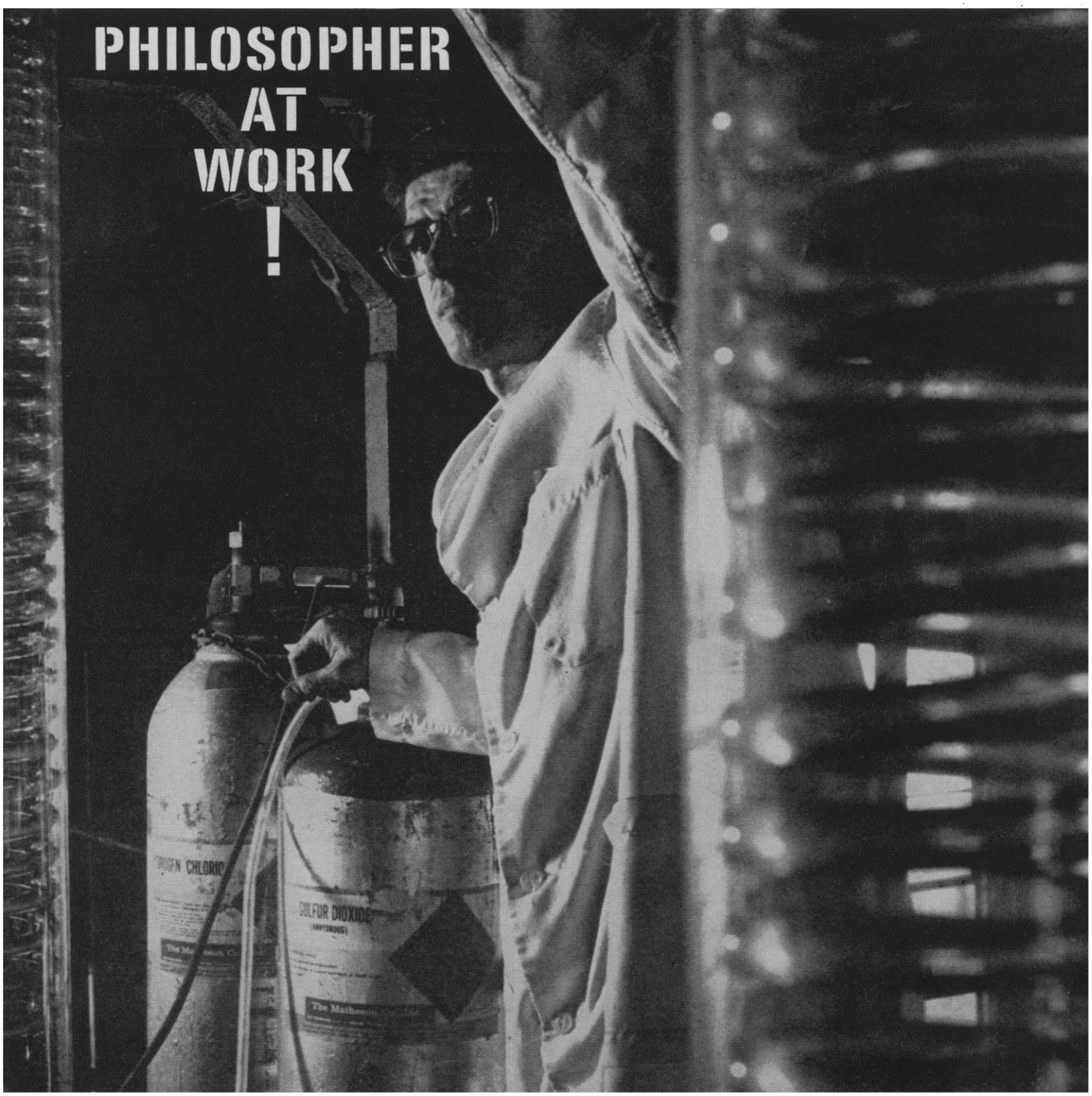

14 September 1962, Volume 137, Number 3533 **SCIENCE**



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# Admission Charges

The feet of countless tourists have partially obliterated a chessboard wantonly inscribed on the floor of the west portico of the Parthenon. Volunteers from the Sierra Club go into the mountains to clean up after careless campers. Some timber companies log selectively and then reseed. Thus erosion, repairs, and new growth conceal some of man's damage to natural and man-made monuments.

But not all. Even if ax, knife, and beer can were outlawed, man would destroy nature and his own earlier constructions. The Parthenon has suffered more from what at the time seemed reasons of state than it has from indifference to classic beauty. Parts of the wild Sierras have given way to railroads, highways, and reservoirs. Agriculture and industry have permanently destroyed much of the primeval forest. Much as one may regret the passing of great monuments of the past, they cannot all be saved. But some must be. We owe to our successors the opportunity to see a range of samples of the work of their ancestors and a range of samples of what the earth was like before those ancestors drastically altered its character.

The natural samples should be of three kinds, and they can be treated quite differently. Recreational areas must be easy of access. If intensive use and man-made improvements alter their topography and ecology, no matter. Their purpose is to provide good camping, fishing, swimming, and boating facilities. For such of these areas as are on federal land, Congress and Secretary Udall now propose an admission charge so that their number may be increased and their maintenance improved.

National parks preserve more distinctive parts of our heritage, and preserve them in more nearly their original form. Because they serve recreational and educational purposes, they require good roads and good accommodations, and an admission fee for those who enjoy their beauty is accepted and appropriate. But they must be expected to change. Yellowstone Park cannot serve millions of visitors and also retain unchanged the wild, natural character it displayed when Washburn and Langford conducted the survey that led to its designation as the first national park.

True wilderness areas are also needed. How best to preserve them has been the topic of many an article and debate. Without here considering the merits of the single-use and multiple-use doctrines or the other issues that have stalled federal legislation, we offer the small suggestion that the admission charge idea should be extended. But a simple money charge is not enough; if wilderness areas are to be protected from human damage, a different kind of admission fee is called for: access must be difficult. There can be no landing fields or highways or large tourist accommodations. (Perhaps signs reading "Rough Trail," "Mosquito Lake," and the like would also help.) The difficulty of access that protects may also be a source of pleasure. Anyone who has, with pack on back, explored such a primitive area as the interior of the Olympic Peninsula has earned a kind of permanent ownership. He may never return, but he wants it left so that other hardy souls can duplicate his joy of discovery. And if he has scientific interests, he wants some samples of the earth and its living communities preserved as they were without human interference. For these privileges, substantial admissions requirements are appropriate.—D.W.

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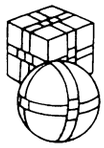

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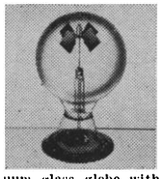

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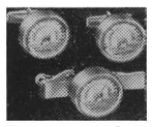

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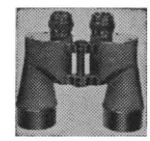

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6 x 30 Binocular—similar to above, a terrific bargain.
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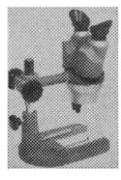

Years in development. Precision American made. Used for checking, inspecting, small assembly work. Up to 3" working distance. Clear, sharp, erect image. Wide, 3 dimensional field. 2 sets of objectives on rotating turret. 23X and 40X. 10 Days Free Trial.

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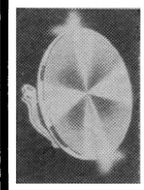

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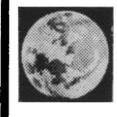

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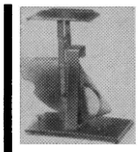

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Calibrated in ounces from 0 to 16—and in grams from 0 to 450 this inexpensive gram-ounce scale is surprisingly accurate, particularly valuable in lab and production line use. Made of polished stainless steel and aluminum. Weighing pan 3" x 2¼"—stands 5¾" high.

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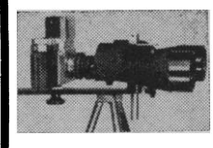
**Will Fit Any Camera**



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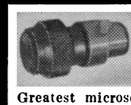

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**Stereochemistry**, seminar, Bratislava, Czechoslovakia. (Slovak Group of the Czechoslovak Chemical Society, Palackeho 32, Bratislava)

Practical Methods of High-Frequency **Titration**, seminar, Bratislava, Czechoslovakia. (Slovak Group of the Czechoslovak Chemical Society, Palackeho 32, Bratislava)

Automation and Column **Chromatography**, seminar, Prague, Czechoslovakia. (K. Macek, Specialized Group for Chromatography of the Czechoslovak Chemical Society, Kourismka 17, Prague 3, Vinihrady, Czechoslovakia)

Technical **Microphotography**, seminar, Kosice, Czechoslovakia. (Czechoslovak Academy of Sciences, Národní Tr. 3, Prague 1)

**January 1963**

**Embryologists**, 4th all-union conf., Leningrad, U.S.S.R. (Laboratory of Embryology, Institute of Botany of the Academy of Sciences U.S.S.R., ul. Prof. Popova, 2, Leningrad, P-22)

**April 1963**

Use of **Electronic Computers** in the Structural Analysis of Crystals, 3rd conf., Novosibirsk, U.S.S.R. (Academy of Sciences of the U.S.S.R., Lenin Prospekt, Moscow)

**Public Health** Information, 2nd natl. scientific conf., Prague, Czechoslovakia. (Central Institute for Public Health Information, Prague 2, Sokolska 54, Czechoslovakia)

**April–May 1963**

Methods of Preparing Information for **Program-Control Machines**, 2nd inter-departmental conf., Kiev, Ukrainian S.S.R. (Academy of Sciences of the Ukrainian S.S.R., Kiev)

**May 1963**

Oscillographic **Polarography** with Alternating Current, 2nd intern. colloquium, Bratislava, Czechoslovakia. (Czechoslovak Academy of Sciences, Národní Tr. 3, Prague 1)

**August–September 1963**

Question of **Micro-elements** of the Far East, 2nd coordination conf., Vladivostok, U.S.S.R. (Academy of Sciences of the U.S.S.R., Lenin Prospekt, Moscow)

**October 1963**

Microwire and Resistance **Measuring Instruments**. Kishinev, Moldavian S.S.R. (Moldavian Academy, Kishinev)

**Labor Medicine**, 8th natl. congr., Mariancke Lazne, Czechoslovakia. (F. Huzl, Division of Occupational Diseases and Industrial Toxicology, SFN Plzen, Marxova 13)

**Autumn 1963 (no dates given)**

**Radiation Chemistry**, 3rd all-union, U.S.S.R. (Academy of Sciences of the U.S.S.R., Lenin Prospekt, Moscow)

**1963 (no dates given)**

**Inorganic Chemistry**, 5th Ukrainian Republic conf., U.S.S.R.

**Lithological** Conference, 6th all-union, U.S.S.R.

**Medicinal Plant** Resources, all-union congr., U.S.S.R.

**Manufacturing** Methods, Physical Properties, and Electron Structure of Refractory Metals, Their Compounds and Alloys, 5th all-union, U.S.S.R.

Physics of **Fission**, conf., U.S.S.R.

Theory and Practice of **Rectification**, all-union inter-institute conf., U.S.S.R.

Analysis of Noble **Metals**, 6th all-union conf., Krasnoyarks, U.S.S.R.

(Inquiries on the preceding seven meetings should be directed to the Academy of Sciences of the U.S.S.R., Lenin Prospekt, Moscow.)

Problem of Postmagmatic **Ore** Formation, conf., Czechoslovakia. (M. Shtemprok, Tsentralnyy Geologicheskiy Institut ChSSR, Malostranske namesti, 19, Prague 1)

**September 1964**

15–20. Yugoslav **Pharmacists**, 4th congr. Opatija, Yugoslavia. (Yugoslav Academy of Sciences and Arts, Zrinski trg 11, Zagreb 1)

**1964 (no dates given)**

Microelements and Natural **Radioactivity of Soils**, 4th inter-VUZ scientific conf., U.S.S.R.

Geology of **Diamond Deposits**, all-union conf., Yakutsk, U.S.S.R.

(Inquiries on the preceding two meetings should be directed to the Academy of Sciences of the U.S.S.R., Lenin Prospekt, Moscow.)

**1965 (no dates given)**

**Physico-Chemical** Analysis, 5th all-union conf., Moscow, U.S.S.R. (Academy of Sciences of the U.S.S.R, Lenin Prospekt, Moscow)

## Forthcoming Events

### October

*14–17.* **Electrical Insulation,** conf., Hershey, Pa. (L. J. Frisco, Div. of Engineering and Industrial Research, Natl. Acad. of Sciences, 2101 Constitution Ave., Washington 25)

*14–19.* **Dentistry Teaching,** seminar, Bogota, Colombia. (Pan American Sanitary Bureau, Washington 6)

*14–19.* **Pulp and Paper Engineering,** conf., Montreal, Canada. (Technical Assoc. of the Pulp and Paper Industry, 360 Lexington Ave., New York 17)

*15–17.* Association of Official **Agricultural Chemists,** annual, Washington, D.C. (W. Horwitz, Box 540, Benjamin Franklin Station, Washington 4)

*15–17.* **Materials Handling,** conf., Cincinnati, Ohio. (American Soc. of Mechanical Engineers, 29 W. 39 St., New York 18)

*15–17.* Selection Problems in **Plastics,** Amsterdam, Netherlands. (Secretariate, Tesselschadestraat 5, Amsterdam W.)

*15–17.* Specialists on **Antisubmarine Warfare,** natl. symp., Boston, Mass. (classified secret). (T. Nussdorfer, Geophysics Corp. of America, Bedford, Mass., or Institute of the Aerospace Sciences, 2 E. 64 St., New York 21)

*15–18.* American **Meteorological** Soc., natl., New York, N.Y. (AMS, 45 Beacon St., Boston 8, Mass.)

*15–18.* **Danube Research,** intern. symp., Bratislava, Czechoslovakia. (L. Kneppo, Slovak Acad. of Sciences, Ul. Obrancov Mieru 41, Bratislava)

*15–18.* **Instrument-Automation,** conf. and exhibit, New York, N.Y. (Meetings Manager, Instrument Soc. of America, Penn-Sheraton Hotel, Pittsburgh 19, Pa.)

*15–18.* **Space** Phenomena and Measurement, intern. symp., Detroit, Mich. (H. E. DeBolt, AVCO Corp., 201 Lowell St., Wilmington, Mass.)

*15–19.* American College of **Surgeons,** annual clinical congr., Atlantic City, N.J. (ACS, 40 Erie St., Chicago 11, Ill.)

*15–19.* American **Public Health** Assoc., annual, Miami Beach, Fla. (APHA, 1790 Broadway, New York, N.Y.)

*15–19.* Diagnosis and Treatment of **Radioactive Poisoning,** Vienna, Austria. (World Health Organization, Palais des Nations, Geneva, Switzerland)

*15–20.* **Laboratory, Measurement, and Automation Techniques in Chemistry,** intern. congr. and exhibit, Basel, Switzerland. (Sekretariat, ILMAS, Clarastr. 61, Basel)

*15–26.* **Statistics,** Inter-American conf., Washington, D.C. (Inter-American Statistical Inst., Pan American Union, Washington 6)

*16.* Oak Ridge Inst. of **Nuclear Studies,** Oak Ridge, Tenn. (W. G. Pollard, ORINS, Oak Ridge)

*16–18.* **Lubrication,** conf., Pittsburgh, Pa. (American Soc. of Mechanical Engineers, 29 W. 39 St., New York 18)

*16–18.* Noise in **Electronic Systems,** seminar, Rochester, N.Y. (H. Kentner, Extended Services Div., Rochester Inst. of Technology, Rochester 8)

*16–19.* **Textile Materials,** New York, N.Y. (American Soc. for Testing and Materials, 1916 Race St., Philadelphia 3, Pa.)

*17–20.* **Insect Pathology and Microbial Control,** intern. colloquium, Paris, France. [Secretariat, Intern. Committee for Biological Control, c/o Laboratoire du Lutte Biologique, La Minière (Seine-et-Oise), France]

*18.* **Bibliographical** Soc. of America, Cambridge, Mass. (F. R. Goff, Rare Book Div., Library of Congress, Washington 3)

*18–19.* **Applied Spectroscopy** and **Analytical Chemistry,** annual Pacific regional meeting, Pasadena, Calif. (W. F. Ulrich, Scientific and Process Instruments Div., Beckman Instruments, Fullerton, Calif.)

*18–19.* **Cellulose,** conf., Syracuse, N.Y. (Cellulose Research Inst., State Univ. College of Forestry at Syracuse Univ., Syracuse 10)

*18–19.* German Soc. for **Operations Research,** annual, Bonn, Germany. W. Krelle, GSOR, c/o Universität, Liebfrauenweg 5, Bonn)

*18–20.* **Indiana Acad. of Science,** Evansville. (W. W. Bloom, Valparaiso Univ., Valparaiso, Ind.)

*18–21.* Central Assoc. of **Electroencephalographers,** annual, Rochester, Minn. (D. W. Klass, Mayo Clinic, Rochester)

*19–20.* **Aging,** symp., San Francisco, Calif. (M. A. Shearn, Kaiser Foundation Hospital, Oakland, Calif.)

*19–20.* **Quantitative Systematics,** symp.,

St. Louis, Mo. (R. L. Dressler, Missouri Botanical Garden, 2315 Tower Grove Ave., St. Louis 10)

*21–24.* **Fundamental Research**, symp., Chicopee, Mass. (Technical Assoc. of the Pulp and Paper Industry, 360 Lexington Ave., New York 17)

*21–24.* Society of American **Foresters**, Atlanta, Ga. (H. Clepper, 425 Mills Bldg., 704 17 St., NW, Washington 6)

*22–24.* **Aerospace and Navigational Electronics**, conf., Baltimore, Md. (Inst. of Radio Engineers, Office of the Technical Secretary, 1 E. 79 St., New York 21)

*22–26.* Advances in **Radioisotope Scanning**, symp., Oak Ridge, Tenn. (R. M. Kniseley, Oak Ridge Inst. of Nuclear Studies, Oak Ridge)

*22–26.* **Diabetes**, Buenos Aires, Argentina. (C. A. Campos, Sociedad Argentina de Diabetes, Santa Fe 1171, Buenos Aires)

*22–26.* Society of **Motion Picture and Television Engineers**, convention, Chicago, Ill. (C. S. Stodter, 55 W. 42 St., New York 35)

*23–25.* **Occupational Therapists**, intern. congr., Philadelphia, Pa. (M. T. Cardwell, 963 Avenue Rd., Toronto 7, Ont., Canada)

*23–27.* American Soc. of **Oral Surgeons**, New Orleans, La. (L. W. Peterson, 117 N. Meramec St., Clayton 5, Mo.)

*23–1.* **Care of Children in Institutions**, Geneva, Switzerland. (World Health Organization, Palais des Nations, Geneva)

*24–25.* **Computer** Applications, symp., Chicago, Ill. (R. S. Hollitch, Armour Research Foundation, Illinois Inst. of Technology, 35 W. 33 St., Chicago 16)

*24–26.* Design of Experiments in **Army Research**, Development, and Testing, Washington, D.C. (by invitation only). (F. G. Dressel, Army Research Office, Box CM, Duke Station, Durham, N.C.)

*24–26.* Society for **Experimental Stress Analysis**, annual, Milwaukee, Wis. (B. E. Rossi, 21 Bridge Square, Westport, Conn.)

*24–27.* International Assoc. of **Milk and Food Sanitarians**, annual, Philadelphia, Pa. (H. L. Thomasson, Box 437, Shelbyville, Ind.)

*24–28.* **Angiology**, intern. conf., Darmstadt, Germany. (Sekretariat, c/o Medizinische Klinik, Bismarckstr. 28, Darmstadt)

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

*25–27.* **Electron Devices**, Washington, D.C. (Inst. of Radio Engineers. Office of the Technical Secretary, 1 E. 79 St., New York 21)

*25–27.* International Assoc. of **Milk and Food Sanitarians**, Inc., Philadelphia, Pa. (K. K. Jones, Food & Drug Div., Indiana State Board of Health, Indianapolis)

*26.* Reliability in **Space Vehicles**, Los Angeles, Calif. (Inst. of Radio Engineers, 1435 La Cienga Blvd., Los Angeles)

*26–27.* Association of **Clinical Scientists**, applied seminar, Washington, D.C. (F. W. Sunderman, 1025 Walnut St., Philadelphia 7, Pa.)

*26–27.* Society for the Scientific Study of **Religion**, annual, New York, N.Y. (J. E. Dittes, 409 Prospect St., New Haven 11, Conn.)

*26–28.* American **Heart** Assoc., scientific sessions, Cleveland, Ohio. (AHA, 44 E. 23 St., New York 10)

*27.* American **Mathematical** Soc., Hanover, N.H. (AMS, 190 Hope St., Providence 6, R.I.)

*27–28.* International College of **Dentists**, Miami Beach, Fla. (H. O. Westerdahl, 4829 Minnetonka Blvd., Minneapolis 16, Minn.)

*27–28.* Science and Technology in **Israel and the Middle East**, conf., New York, N.Y. (B. Dibner, American Technion Soc., 1000 Fifth Ave., New York 28)

*27–30.* American Soc. of **Safety Engineers**, Chicago, Ill. (A. C. Blackman, ASSE, 5 N. Wabash Ave., Chicago 2)

*27–1.* **Metallurgical** Soc., New York, N.Y. (MS, 345 47 St., New York 17)

*28.* American College of **Dentists**, Miami Beach, Fla. (O. W. Brandhorst, 4236 Lindell Blvd., St. Louis, Mo.)

*28.* International **Dairy** Soc., annual, Atlantic City, N.J. (G. W. Weigold, 1145 19th St., NW, Washington 6)

*28–31.* **Systems and Procedures** Assoc. of America, intern. meeting, Boston, Mass. (D. E. Tisdale, 817 Penobscot Blvd., Detroit 26, Mich.)

*28–2.* **Dairy Industries Supply** Assoc., trade show, Atlantic City, N.J. (T. L. Jones, 1145 19 St., NW, Washington 6)

*28–2.* **Mushroom**, intern. congr., Philadelphia, Pa. (Organizing Committee Secretary, Box 373, Kennett Square, Philadelphia)

*29.* **Vacuum Microbalance** Techniques,

symp., Los Angeles, Calif. (Cahn Instrument Co., 15505 Minnesota Ave., Paramount, Calif.)

*29–30.* **Large Rockets**, natl., Sacramento, Calif. (Inst. of the Aerospace Sciences, 2 E. 64 St., New York 21)

*29–31.* Domestic and Industrial **Water Supply**, conf., Klagenfurt, Austria. (Österreichischer Wasserwirtschaftsverband, Graven 17, Vienna I, Austria)

*29–31.* Dynamics of **Manned Lifting Planetary Entry**, symp., Philadelphia, Pa. (A. C. Harrison, Room 1308M, General Electric Co., Valley Forge Space Technology Center, Box 8555, Philadelphia 1)

*29–31.* **Entomological** Soc. of Canada —Entomological Soc. of Manitoba, annual, Winnipeg, Manitoba. (L. L. Reed, K. W. Neatby Bldg., Carling Ave., Ottawa, Ont., Canada)

*29–31.* Society of **Rheology**, Baltimore, Md. (J. C. Miller, Union Carbide Plastics Co., Bound Brook, N.J.)

*29–1.* American **Dental** Assoc., Miami Beach, Fla. (H. Hillenbrand, 222 E. Superior St., Chicago 11, Ill.)

*29–2.* American Soc. for **Metals**, natl. congr. and intern. exposition, New York, N.Y. (M. A. Scheil, A. O. Smith Corp., Milwaukee, Wis.)

*29–2.* Basic **Environmental Problems of Man in Space**, symp., Paris, France. (A. R. Weiller, Intern. Acad. of Astronautics, 12 rue de Gramont, Paris 2e)

*29–2.* National **Safety** Council, annual congr., Chicago, Ill. (R. L. Forney, NSC, 425 N. Michigan Ave., Chicago 11)

*29–19.* International North Pacific **Fisheries** Commission, Seattle, Wash. (INPFC, 209 Wesbrook Bldg., Univ. of British Columbia, Vancouver 8, B.C., Canada)

*30–31.* **Spaceborne Computer** Engineering Technology, natl. conf., Anaheim, Calif. (W. C. Chambliss, California Computer Products, Inc., 8714 E. Cleta St., Downey, Calif.)

*31–2.* **Antimicrobial Agents and Chemotherapy**, interscience conf., Chicago, Ill. (American Soc. for Microbiology, 19875 Mack Ave., Detroit 36, Mich.)

*31–3.* American **Vacuum** Soc., annual symp., Los Angeles, Calif. (G. H. Bancroft, Consolidated Vacuum Corp., 1775 Mt. Read Blvd., Rochester 3, N.Y.)

*31–3.* **Neurological Surgeons,** congr., Houston, Tex. (E. Weiford, 4706 Broadway, Kansas City 12, Mo.)

*31–3.* Non-Proprietary Names for **Pharmaceutical Preparations**, Geneva, Switzerland. (World Health Organization, Palais des Nations, Geneva)

### November

*1–2.* Alkaline **Pulping** Conf., Savannah, Ga. (Technical Assoc. of the Pulp and Paper Industry, 360 Lexington Ave., New York 17)

*1–2.* **Chemtronics**, conf., New York, N.Y. (E. C. Torkelson, Bell Telephone Laboratory, 463 West St., New York)

*1–2.* **Educational** Conf., annual, New York, N.Y. (A E. Traxler, Educational Records Bureau, 21 Audubon Ave., New York 32)

*1–2.* **Kidney**, annual conf., Princeton, N.J. (National Kidney Disease Foundation, 145 E. 35 St., New York 16)

*1–2.* **Medical Practice** Management, 1st annual conf., Las Vegas, Nev. (Soc. of Professional Business Consultants, 420 Madison Theatre Bldg., Detroit 26, Mich.)

*1–2.* **Product Engineering** and **Production,** natl. conf., San Francisco, Calif. (H. R. Traver, Hewlett-Packard Co., 1501 Page Mill Rd., Palo Alto, Calif.)

*1–3.* American **Chemical** Soc., annual southeastern regional meeting, Gatlinburg, Tenn. (F. A. Griffitts, Maryville College, Maryville, Tenn.)

*1–3.* Delayed Effects of **Captivity,** intern. medical congr., Brussels, Belgium. (R. Laumond, Intern. Confederation of Former Prisoners of War, 46 rue Copernic, Paris 16e, France)

*2–3.* American **Geophysical** Union, regional meeting, Seattle, Wash. (F. A. Richards, Dept. of Oceanography, University of Washington, Seattle)

*2–3.* **Fat** as a Tissue, intern. research conf., Philadelphia, Pa. (Division of Research, Medical Science Bldg., Lankenau Hospital, Philadelphia 51)

*4–7.* **Engineering in Biology and Medicine,** annual conf., Chicago, Ill. (Program Committee, P.O. Box 1475, Evanston, Ill.)

*4–9.* American Acad. of **Ophthalmology** and **Otolaryngology,** Las Vegas, Nev. (W. L. Benedict, 15 Second St., SW, Rochester, Minn.)

*4–10.* Interamerican **Red Cross** Conf., San Juan, Puerto Rico. (American Natl. Red Cross, 17 St. between D and E Sts., NW, Washington, D.C.)

*5–7.* American Soc. for **Cell Biology,** annual, San Francisco, Calif. (ASCB, Box 2982, Duke Univ. Medical Center, Durham, N.C.)

*5–7.* Protection against **Radiation** Hazards in Space, symp., Gatlinburg, Tenn. (E. P. Blizard, Oak Ridge Natl. Laboratory, P.O. Box X, Oak Ridge, Tenn.)

*5–9.* American Inst. of Mining, Metallurgical, and Petroleum **Engineers,** fall meeting, Chicago, Ill. (Executive Secretary, AIME, 345 E. 47 St., New York 17)

*5–9.* German **Ceramics** Soc., annual, Baden-Baden. (Deutsche Keramische Gesellschaft, Menzenbergerstr. 47, Bad Honnef am Rhein, Germany)

*5–9.* **Metallurgical** Congr., intern., Chicago, Ill. (C. Wells, American Soc. for Metals, 7301 Euclid Ave., Cleveland 3, Ohio)

*5–9.* Practical Applications of Short-Lived **Radioisotopes** Produced in Small Research Reactors, seminar, Vienna, Austria. (Intern. Atomic Energy Agency, 11 Kärntner Ring, Vienna 1)

*5–17.* World **Meteorological** Organization, South-West Pacific Regional Assoc., Noumea, New Caledonia. (Secretariat, WMO, Geneva, Switzerland)

*7–10.* **Acoustical** Soc. of America, Seattle, Wash. (W. Waterfall, Amer. Inst. of Physics, 335 E. 45 St., New York 17)

*7–10.* **Corrosion** of Metals, symp., Kanpur, India. (Defense Research Laboratory, Kanpur)

*7–10.* Fetal and Infant **Liver** Function and Structure, conf., New York, N.Y. (E. T. Minor, New York Acad. of Sciences, 2 E. 63 St., New York 21)

*7–10.* **Geological** Soc. of America, Houston, Tex. (F. Betz, Jr., GSA, 419 W. 117 St., New York, N.Y.)

*8–9.* **Operations** Research Soc. of America, Philadelphia, Pa. (G. D. Shellard, New York Life Insurance Co., 51 Madison Ave., New York 10)

*8–10.* American Soc. of **Cytology** (formerly Inter-Soc. Cytology Council), annual, St. Louis, Mo. (P. A. Younge, 1101 Beacon St., Brookline 46, Mass.)

*8–10.* **Gerontological** Soc., Miami Beach, Fla. (R. W. Kleemeier, Dept. of Psychology, Washington Univ., St. Louis, Mo.)

*8–13.* International Office of **Epizootics,** American regional conf., Mexico City, Mexico. (R. Vittoz, 12 rue du Prony, Paris 17e, France)

*9–8. Dec.* United Nations **Educational, Scientific, and Cultural** Organization, general conf., Paris, France. (UNESCO, Place de Fontenoy, Paris 7e)

*11–16.* World **Medical** Assoc., general assembly, New Delhi, India. (L. H. Bauer, 10 Columbus Circle, New York 19)

*11–17.* **Veterinary** Medicine, Pan American congr., Mexico City, Mexico. (J. Santivanez, P.O.B. 1697, Coral Gables 34, Fla.)

*11–22.* **Plastics,** intern. fair and convention, Göteborg, Sweden. (Interfair, Inc. AB, Intern. Trade Fair, S. Tullgatan 4, Malmö C, Sweden)

*12–13.* **Genetics** Symp., Columbia, Mo. (Director, Postgraduate Medical Education, M176 Medical Center, Univ. of Missouri, Columbia)

*12–14.* **Paleontological** Soc., Houston, Tex. (H. B. Whittington, MCZ, Harvard Univ., Cambridge 38, Mass.)

*12–15.* **Magnetism** and Magnetic Materials, conf., Pittsburgh, Pa. (Inst. of Radio Engineers, Office of the Professional Groups Secretary, 1 E. 79 St., New York 21)

*12–16.* Australasian **Corrosion** Assoc., annual conf., Auckland, New Zealand. (Conference Secty., ACA, Box 995, Auckland)

*12–16.* Conservation and Management of Temperate **Marshes and Wetlands,** conf., Arles or Saintes-Maries-de-la-Mer, France. (L. Hoffman, Station Biologique de la Tour de Valat, Par Le Sambuc, (B. du Rh.), France)

*12–16.* Problems of Methodology of **Agricultural** Problems, conf., U.N. Economic Commission for Europe, Geneva, Switzerland. (UNECE, Palais des Nations, Geneva)

*12–17.* Czechoslovak **Medical** Congress, Prague. (K. Räska. Czechoslovak Medical Soc. J. E. Purkyně, Sokolská 31, Prague)

*12–24.* Aeronautical Fixed **Telecommunications** Network, European-Mediterranean regional meeting, Paris, France. (Intern. Civil Aviation Organization, Intern. Aviation Bldg., 1080 University St., Montreal 3, P.Q., Canada)

*13–15.* **Birth Defects,** science writers' seminar, Ann Arbor, Mich. (Science Information Div., National Foundation, 800 Second Ave., New York 17)

*13–15.* Institute of Radio **Engineers,** Northeast research and engineering meeting, Boston, Mass. (L. G. Cumming, IRE, 1 E. 79 St., New York 21)

*13–18.* American **Rocket** Soc., annual meeting and space flight exposition, Los Angeles, Calif. (ARS, 500 Fifth Ave., New York 36)

*13–22.* **Soil**, intern. conf., Wellington, New Zealand. (ISC, Secretary General, P.O. Box 8001, Wellington)

*14–17.* Society of **Naval Architects** and **Marine Engineers**, annual, New York, N.Y. (Secretary, SNAME, 74 Trinity Place, New York 6)

*15–17.* Cold **Metal** Working, intern. conf., Budapest, Hungary. (Hungarian Soc. of Mechanical Engineers, Szabadság tér 17, Budapest 5)

*15–18.* American **Anthropological** Assoc., Chicago, Ill. (S. T. Boggs, 1530 P St., NW, Washington 5)

*15–18.* International Federation of **Blood Donors'** Organizations, congr., Monaco. (V. Formentano, Largo Volontari del Sangue 1, Milan, Italy)

*16–17.* American **Mathematical** Soc., Tallahassee, Fla. (AMS, 190 Hope St., Providence 6, R.I.)

*16–17.* **Communications**, symp., Montreal, P.Q., Canada. (A. B. Oxley, Canadian IRE Symp. on Communications, Box 802, Station B, Montreal)

*17.* American **Mathematical** Soc., Los Angeles, Calif. (AMS, 190 Hope St., Providence 6, R.I.)

*18–21.* American **Speech and Hearing** Assoc., New York, N.Y. (K. O. Johnson, 1001 Connecticut Ave., NW, Washington 6)

*18–21.* **Brain** Mechanisms for External Inhibition (closed meeting), Los Angeles, Calif. (Air Force Office of Scientific Research (attention: SRL), Washington, D.C.)

*19–20.* Mid-America **Electronics** Conf., Kansas City, Mo. (J. Warfield, Dept. of Electrical Engineering, Univ. of Kansas, Lawrence)

*19–21.* European **Packaging** Federation, congr., Paris, France. (EPF, 3 rue La Boétie, Paris 8°)

*19–23.* **Radioactive Dating**, intern. symp., Greece. (Intern. Atomic Energy Agency, 11 Kärntner Ring, Vienna 1)

*19–26.* Paris Intern. **Dental** Sessions, Paris, France. (G. Delbart, 3 place de la Gare, Mantes, S.-et-O., France)

20. Manufacturing **Chemists'** Assoc., mid-year conf., New York, N.Y. (MCA, 1825 Connecticut Ave., NW, Washington 9)

*20–24.* **Fish Diseases**, intern. symp., Turin, Italy. (R. Vittoz, Intern. Office of Epizootics, 12 rue de Prony, Paris 17°, France)

*22–23.* International Waste **Rubber** and **Plastics** Federation, conf., Antwerp, Belgium. (R. G. Kirkpatrick, Moorgate Hall, Moorgate, London, E.C.2, England)

*22–24.* Central Assoc. of **Science and Mathematics Teachers**, St. Louis, Mo. (J. Kennedy, Indiana State College, Terre Haute)

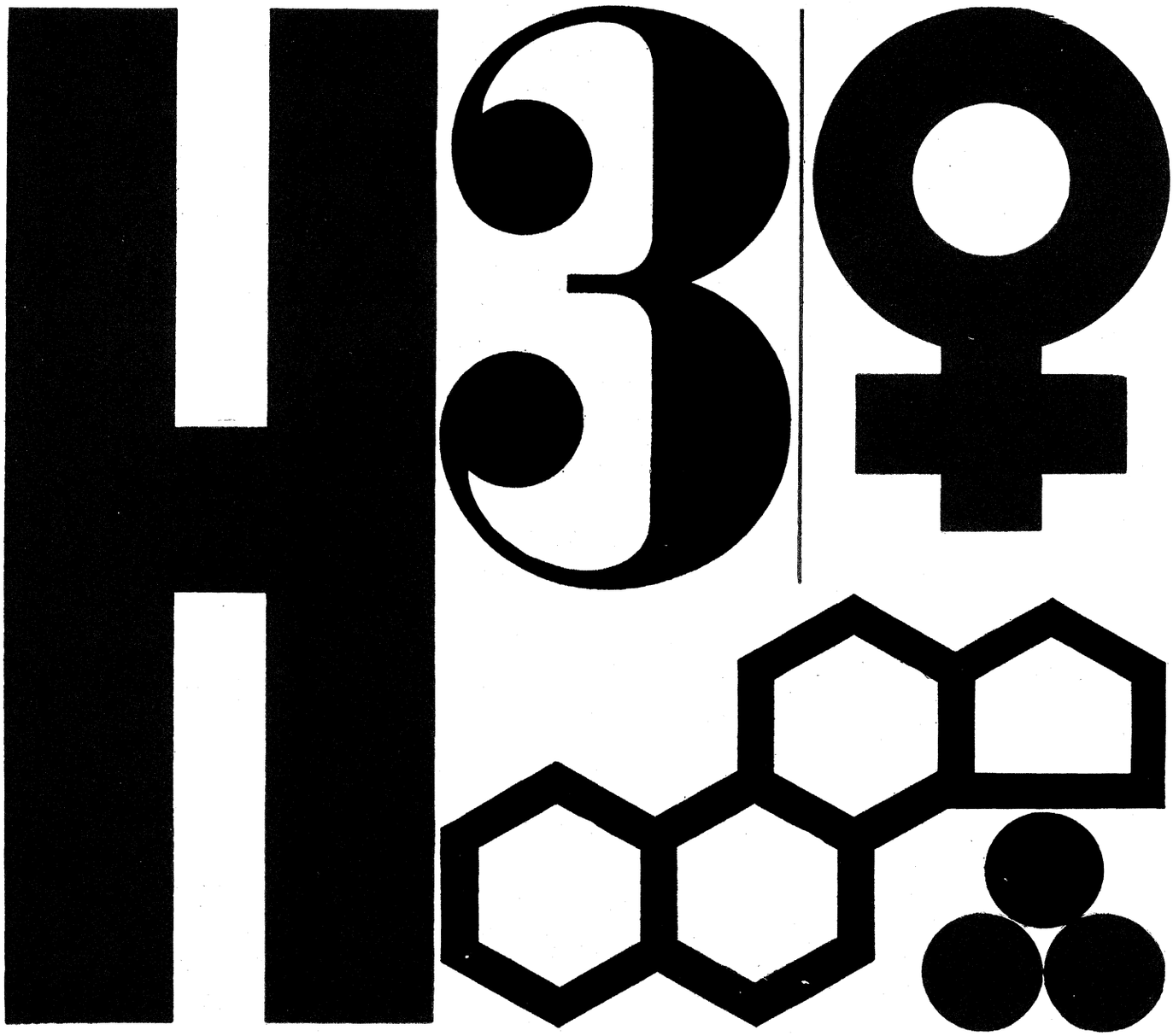
*22–24.* National Council for **Geographic Education**, Chicago, Ill. (L. Kennamer, Univ. of Texas, Austin)

*22–27.* **Automation** and **Instrumentation**, congr., Milan, Italy. (Federazione delle Associazioni Scientifiche e Techniche di Milano, Via del Politecnico 10, Milan)

*22–27.* **Thermotechnology**, intern. conf., Milan, Italy. (A Barbieri, Via Marcona 15, Milan)

*22–3.* Latin American **Forestry** Commission, Santiago, Chile. (U.N. Food and Agriculture Organization, Regional Office, Casilla 10095, Santiago)

*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.** · Mountain View Avenue, Orangeburg, New York
BIOCHEMICALS • RADIOCHEMICALS • PHARMACEUTICALS for research, for medicine, for industry

# New Products

An automatic apparatus for performing analytical **density gradient electrophoresis** provides clinical medicine with a research tool which delivers analytical results rapidly and reproducibly. Without human intervention it provides electrophoretograms at the rate of one every 20 minutes as contrasted to one every 24 hours achieved by conventional techniques. Company scientists report that with the system an electrophoretogram can be run off in 10 minutes. Some specific clinical uses include the diagnosis of nephrosis, certain liver diseases, and the malignant process of bone marrow known as multiple myeloma. The apparatus develops the electrophoretic diagram of a patient's blood plasma or serum by separating it into six fractions—including pre-albumen, albumen, alpha 2 globulin, beta globulin, gamma globulin, and a sixth fraction called alpha 3 globulin. A novel technique, by which the sample is pumped and mixed with sugar to a given density, forms a short, steep density gradient in the electrophoresis cell in 3 minutes. The cell, with quartz windows, is separated from top and bottom chambers by a cellophane membrane. When electric current is applied to the platinum electrode on the top and bottom chambers, it causes the electrophoretic separation of the serum proteins in 17 minutes. The separated components in the cell are scanned by ultraviolet light at 280 $m\mu$ and the resulting pattern is traced on a stripchart recorder. A ball-and-disk integrator automatically integrates the fractions during the tracing. A factor related to the color response of the various fractions at 280 $m\mu$ is then applied to the recorded integration. $A/G$ ratios are obtainable from these results. Further information can be obtained by writing Technicon.—R.L.B. (Technicon Instruments, Inc., Chauncey, N.Y.)

**Circle 1 on Readers' Service card**

**New high vacuum grease** Apiezon H is a soft grease having a vapor pressure of $10^{-9}$ mm of Hg at room temperature and $10^{-3}$ at 200 to 250°C with a melting point over 250°C. This new material was developed for those applications requiring a seal or lubricant with a high melting point. It promotes good adhesion when in contact with glass or metal surfaces. An informative bulletin on properties and applications of "Apiezon Greases and Oils" is available as 43–38.—R.L.B. (James G. Biddle Co., 1316 Arch St., Philadelphia 7, Pa.)

**Circle 2 on Readers' Service card**

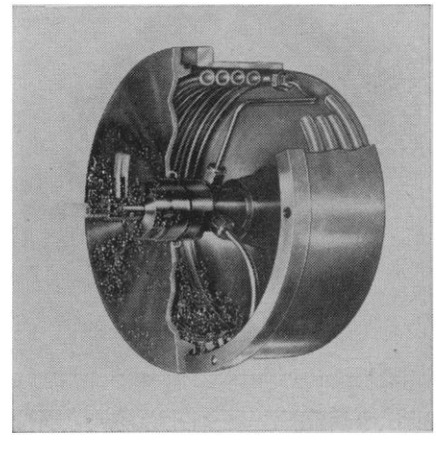
**Physiological monitor oscilloscope** displays conventional ECG, EEG, and fetal ECG. Various plug-in adapters allow inputs to be connected to the Monitor Scope either directly, through the a-c power lines, or by means of wireless radio telemetry. All patient-connecting adapters are separately powered by batteries, eliminating the danger of shock hazard to the patient and/or operator. An output on the Monitor Scope makes possible the simultaneous recording on a direct writer, any wave form that is monitored by the scope. In addition, a built-in modulator-demodulator permits any phenomena observed on the Monitor Scope to be recorded on any standard tape recorder, and then be replayed through the scope with the output being monitored on the scope and also recorded on a direct writer, if desired.—R.L.B. (Medtronic, Inc., 3055 Highway 8, Minneapolis 18, Minn.)

**Circle 3 on Readers' Service card**

The Bell **electronic stethoscope** enables the physician to eliminate by advanced electronic techniques all unwanted portions of the heartbeat cycle and brings into focus only the heart sounds he wants to hear. The device permits three means of studying the heartbeat cycle or any portion of it. Output from the device can be fed into conventional earphones or a loudspeaker for audio analysis; it can be connected to an oscilloscope for visual display or it can be recorded on an electrocardiograph to provide a permanent record of the heart sounds. All three outputs can be employed simultaneously, thus enabling the doctor to hear, watch, and record the patient's heart sounds at the same time. The instrument also has considerable value as a teaching aid for medical students studying auscultation of the heart. Fully transistorized, the stethoscope is lightweight (only 20 ounces) and compact (8 by 3½ by 1½ inches). It is powered by self-contained long-life mercury batteries.—R.L.B. (Bell Aerosystems Co., Buffalo 5, N.Y.)

**Circle 4 on Readers' Service card**

Continuous flow **centrifugation system**, *"Helixtractor,"* adaptable to all IEC PR-1 and PR-2 centrifuges, increases separation efficiency three to four times over angle centrifugation. The system is ideal for harvesting micro deposits from gallon quantities where the increased efficiency obtained with this unit is desirable. The entire system is aerosol free making it ideal for use with infectious materials, and the unit is autoclavable. The Helixtractor utilizes a helix of plastic tubing coiled on the inside wall of a basket type head. Material to be centrifuged is fed through a stationary hub into the coil of tubing where separation takes place. Because of the small diameter of the tubing, separation is extremely rapid.



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 920a. Circle the department number of the items in which you are interested on this card.

The clear supernate is expelled through the hub leaving the precipitate packed along the walls of the tubing. The precipitate may then either be removed through the use of a roller extractor or stored in the tubing for future use.—R.L.B. (International Equipment Co., Boston, Mass.)

**Circle 5 on Readers' Service card**

**Volumetric respirometry,** a constant-pressure variable-volume technique, eliminates the vessel calibrations and thermobarometric corrections of conventional manometric methods. Changes in the volume of the gas phase in the respiration chamber cause a change in the liquid level of a totally enclosed manometer. Readjustment of the liquid level to an index mark by adjustment of a precision-diameter steel rod, and measurement of the distance the rod is moved, provide direct measurement of the gas-volume change. The rod is factory-calibrated to provide volume changes of 7.87 ± .015 $\mu$l per millimeter of rod travel. Readings are precise to ± 0.6 $\mu$l, and stability is ±1 $\mu$l/hr. An agitation frame with ten stations is available in a 17-gallon constant-temperature bath with heater and circulator, and thermal regulation to ± 0.03°C without insulation. Agitation is concentric with the steel rod so that readings may be taken without stopping the agitation. Volume-compensated injection permits addition or removal of gas or liquid samples during a run. Radioactive $CO_2$ emitted during respiration can be recovered. Any size or shape of respiration vessel can be used without calibration and without loss of accuracy.—R.L.B. (Mark Company, 31 West St., Randolph, Mass.)

**Circle 6 on Readers' Service card**

**Recording computer systems** perform a variety of analog computing functions while recording variables or computed values. Computing functions are performed by various combinations of standard modules and components housed within the case of a miniature multipen recorder. The key component is a rotary pick-off transformer that is positioned by a pen-drive torque motor in response to one of the variables. The device performs multiplication, square-root extraction, division, summing, and ratio functions. Additional data can be recorded by increasing the number of recorders. In most cases, a d-c current or voltage-signal output proportional to any of the computed values is available and can be

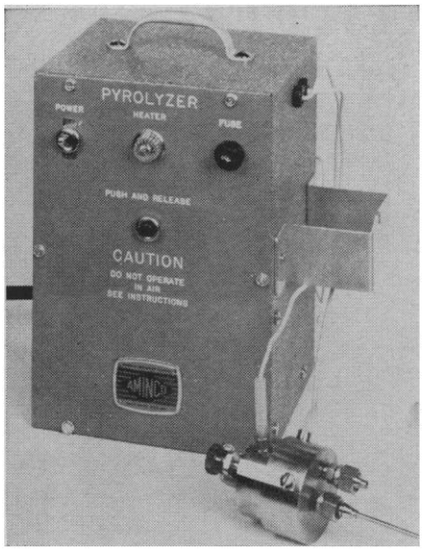
used by an integrator to provide a running total of that value. Input of the recorders is continuously adjustable over a wide range starting at 0 to 5 mv d-c. Voltage excitation modules and alarm modules that can be mounted within the recorder case are available. Battery reserve provides continuous operation during emergencies.—J.S. (De-Var-Kinetics Div., Consolidated Electrodynamics Corp., Glenbrook, Conn.)

**Circle 7 on Readers' Service card**

**Adjustable parameter power supply** permits adjustable deliberate deterioration of the regulation and ripple characteristics to provide a method of determining the performance characteristics required by a specific application. Regulation may be smoothly adjusted between ±0.005 and ±10 percent. Ripple is adjustable between 3 and 200 mv peak-to-peak. By checking the load at various levels of regulation and ripple, the degree of each required to power the load adequately is determined. The final power-supply specification is then determined by adding an appropriate safety factor.—J.S. (NJE Corporation, 20 Boright Ave., Kenilworth, N.J.)

**Circle 8 on Readers' Service card**

**Small pyrolysis unit** makes possible fast, accurate chromatographic separations of many difficult-to-handle substances. Now such diverse samples as polymers, hydrocarbons and soils, heretofore identified only after arduous, time-consuming separations, can be quickly and easily investigated by gas chromatography. The Pyrolyzer consists of a control unit and separate flash heater; the flash heater attaches easily in a matter of seconds to most models of commercial chromatographs without requiring special tools or adaptors. A push-button switch on the control unit automatically controls on-off time of the flash heater; cams inside the control unit permit varying the heater on-off cycle. Provision is made for plugging a variable autotransformer into the control unit to permit adjustment of vaporization temperature from a few degrees above ambient to 1100°C. Liquid or gaseous samples are injected directly by syringe into a septum on the flash heater; solid samples are encased in a quartz tube and inserted into the heater. Flash-vaporized samples are swept directly into the carrier gas stream eliminating danger of sample contamination. After pyrolysis, solid sample residues may be analyzed by other chemical




means (titration, and so on). All stainless-steel construction of the flash heater and tubing eliminates sample contamination and permits effortless, thorough cleaning after pyrolysis. Bulletin 2382. —R.L.B. (American Instrument Company, Inc., 8030 Georgia Ave., Silver Spring, Md.)

**Circle 9 on Readers' Service card**

**Cryostat and microtome** is designed to improve efficiency and precision for both fresh-frozen tissues and preparation of sections from paraffin-embedded tissues. The recessed front of the inclined cabinet allows the operator to sit while working. The temperature gauge, thermostat, and sterilizing cycle dials are clearly visible at all times on a rear panel. In addition to a full-length freeze bar, an unusual anti-roll control is featured in this cryostat. Sections are flattened with a gentle stream of cold air eliminating mechanical contact. A dual-function foot switch activates the anti-roll device while simultaneously shutting off the freezer compressor to achieve maximum stability. Defrosting and cleaning have been reduced to a minimal task. The stainless-steel interior of the cryostat is funnel-shaped and has a built-in draining system. In addition, a special heating cycle converts the refrigeration system to a heating chamber to permit hot-vapor sterilization of mechanical parts that may become contaminated with pathogenic organisms during sectioning of fresh-frozen tissue. After cleaning, a dehydration system eliminates all water vapor to assure optimal function of mechanical equipment free from frozen moisture. The unit is unusually compact in size and is made entirely of rustproof stainless-steel and bronze components. Designed for the 2- to 20-$\mu$ range, it is adjustable in 2-$\mu$ increments. To improve efficiency in adjustment, the blade holder pivots from the top; that is, the pivot point is at the same position as the cutting edge; the cutting angle can be changed without affecting the critical position of the cutting edge.—R.L.B. (Lab-Tek Instruments Co., Westmont, Ill.)

**Circle 10 on Readers' Service card**

**Planimeter** provides means for integrating records of linear or square-root charts of a variety of widths. Accuracy of the unit is said to be better than $\pm$ ½ percent on linear planimeters and this accuracy can also be obtained on the upper half of the scale on square-root charts, while accuracy of $\pm$ 1 percent is said to be attainable at the lower end of the scale. The chart is fed through the planimeter by a variable-speed electric motor, controlled by foot rheostat. As the chart is being run through the planimeter, an index is made to follow the curve by positioning a large control knob. Output of the instrument is read on a five-digit counter provided with reset mechanism.—J.S. (Royson Engineering Co., Hatboro, Pa.)

**Circle 11 on Readers' Service card**

**Electronic fish collecting device** may be used to collect fish for population studies, stream management investigations, or fish farm harvesting. Collecting fish by means of the "Fishocker" is achieved by putting its adjustable aluminum anode-paddle into the water where it emits square-wave (d-c) pulses. The "on-off-on" character of the pulses causes an alternating contraction of fish back muscles—first on one side, then the other. Fish always point their heads in an anode's direction and, therefore, involuntarily swim to the paddle where a net awaits them. The amplitude of the pulses may be varied according to expected conditions; 400 volts is normal, 220 is for highly conductive lakes and river banks, 600 is for water with extremely low conductivity such as melting snow. The Fishocker's power is supplied by a self-contained storage battery and converted by a dynamotor before reaching a pulse generator. (A transistorized version of the Fishocker is currently under development.) The

pulse repetition rate may be varied with a mercury reed switch from 4 to 80 pulses per second, and the ratio of "on-time" to "off-time" is selectable as either 10 or 90 percent. The pulse generator and anode paddle are connected by a 20-foot cable reel. The last portion of the cable is encased in a vinyl sleeved aluminum handle (safer than wood) containing a tape safety switch which operates a relay to turn the Fishocker off upon hand release. Ground for the unit is supplied by a cable leading from the frame and connected to a metal boat or floating metal fish collection container. A galvanized wash tub works well. A battery charger is an integral part of the Fishocker. The apparatus is mounted on a high-quality, light-weight, mountain back-pack.—R.L.B. (Oceanic Instruments, Inc., Houghton, Wash.)

**Circle 12 on Readers' Service card**

A series of even-sided **optical polygons** provides a range of up to 72 sides; standard models are available with 6, 8, 12, 24, 36, or 72 sides. With each polygon a certificate of calibration is furnished showing angle deviation to an accuracy of ±0.2 second. The reflecting or target elements are made of highly reflective hard chrome carbide said to be lapped optically flat to an accuracy of 2 $\mu$in. Both the base and top are hardened steel and are parallel and flat. The polygons are designed for use with autocollimators.—J.S. (Webber Gage Co., 12900 Triskett Rd., Cleveland 11, Ohio)

**Circle 13 on Readers' Service card**

**Electronic timer** is a highly compact completely transistorized device. A typical unit occupies a volume of 15 in.$^3$ Microminiature techniques are employed in its design, and a quartz crystal is utilized as the time-base generator. Accuracy is said to be better than ±0.1 percent. The output pulse amplitude is 2 amp and duration 100 msec. The device is capable of being preset to several hours in increments of minutes and/or seconds.—J.S. (International Telephone and Telegraph Corp., 320 Park Ave., New York 22, N.Y.)

**Circle 14 on Readers' Service card**

**Cryogenic chamber and biological freezer** (Nitro-Freeze) provides a controlled freezing program for viable biological materials, as well as a controlled-temperature atmospheric chamber to −150°C for industrial purposes. The standard model programs the sam-

ple atmosphere at a cooling rate of 1°C/min, according to the accepted Parkes-Polge-Smith technique, affording preservation of marrow, tissue, semen, and cultured cells for high-percentage recovery of most types. It also offers a constant-temperature cold atmosphere at any level between ambient and −60°C. Optional accessories permit experimentation for unusual special purposes at freezing rates from ¼° to 12°C/min, as well as automatic unattended elimination of the "freezing-point" jump, thermal recording, and constant-temperature cold-atmosphere control to −150°C. Control is entirely automatic by feed-back from a resistance sensing element through a bridge circuit, with cold nitrogen gas pumped into the freezing chamber and circulated therein by a blower. Capacity is 1200 cubic inches (1000 1.2-ml ampoules or equivalent), either for freeze-processing in the upper cold chamber or for subsequent storage in liquid nitrogen in the lower source tank. Programming is entirely automatic, with no manual attention required.—R.L.B. (Canal Industrial Corporation, 4935 Cordell Ave., Bethesda 14, Md.)

**Circle 15 on Readers' Service card**

Strong **guar gels** that remain stable under both acid and alkaline conditions, to be known as Jaguar 315 CM and Jaguar 315-FC-2, self-complex and gel automatically in a one-step operation that needs no additional catalyst. This new series is extremely efficient, requires only about 1 percent based on the weight of the water, and it was stated that the gels produced are strong, water resistant, and non-bleeding. Gelation time may be controlled from minutes to hours through the selection of the proper member of the series: Jaguar 315 CM will gel in about 15 minutes; Jaguar 315-FC-2 requires about 30 minutes. In addition, it is understood that the gels formed are reversible: the '315-FC-2' series may be liquefied by alkalizing; the '315 CM' groups by acidizing. Gels may be reformed by restoring initial conditions, and this process may be continued indefinitely. According to the manufacturer, exceptionally high viscosities as well as gelation at low concentrations is now possible through the use of the new series of self-complexing Jaguars. The viscosity development and gelation take place entirely automatically after initially dispersing the powder in water, using only a minimum of agitation. Many self-complexing Jaguar types differing

in gelation rates as well as gel strength are available, and the proper type can be selected to best suit the individual application. The strong gelation properties of self-complexing Jaguar at extremely low concentrations suggests its application wherever unusually high water holding or water absorbing power is required. Further information may be obtained without obligation by writing Dept. PR 565.—R.L.B. (Jaguar, Stein, Hall & Co., Inc., 285 Madison Ave., New York 17, N.Y.)

**Circle 16 on Readers' Service card**

**Steam generator for gas chromatography** permits the separation of highly polar materials with minimum tailing and provides a system that will accept samples in aqueous solution without indicating a large and tailing water peak. A stainless-steel boiler contains an immersion heater regulated by a variable thermal switch to control the steam pressure. Temperature and pressure gauges are provided on the front panel. When the steam valve is shut off the temperature switch maintains the steam under pressure ready for immediate use. Heated exit pipe and provision for mixing with other gases are provided to reduce the dew point and maintain dry steam operation for a variety of column conditions. In operation 700 ml of water provides 250 hours of continuous operation at 50 ml/min without replenishing the water. The hydrogen flame detector is ideal for use with steam as a carrier gas as it is insensitive to the water molecules and does not appear to lose any sensitivity. The Aerograph hydrogen generator which produces hydrogen by the electrolysis of water can be used with the steam generator to do gas chromatography without any tank gas requirements.—R.L.B. (Wilkens Instrument and Research, Inc., P.O. Box 313, Walnut Creek, Calif.)

**Circle 17 on Readers' Service card**



**Radiating microspheres** are spherical ceramic particles capable of retaining high concentrations of most of the known radioisotopes even when subjected to corrosive environments and elevated temperatures. Size of the spheres for most applications is 60 $\pm$ 25 $\mu$, but they are available in graded sizes from 10 to 100 $\mu$. Density of the particles is 3.0 g/cm$^3$ and density of the bulk material about 2.0 g/cm$^3$. Softening point is about 1500°C. The particles are insoluble in all common reagents except 57-percent hydrofluoric acid. Stability to radiation is said to be greater than $10^9$ rad; no color change or decrease in isotope retention occurs at this dose. The material is said to yield a high percentage of the available radiation from soft beta and alpha emitters.—J.S. (Minnesota Mining & Manufacturing Co., St. Paul, Minn.)

**Circle 18 on Readers' Service card**

**Pulse propagation meter** measures the transit time of a longitudinal mechanical pulse traveling between two piezoelectric transducers coupled to a test sample. Sonic velocity and Young's Modulus are obtained for the material under test. Films, filaments, tubes, and other shapes may be measured against environmental and mechanical conditions. Moving filaments or sheets can be measured while they travel over the transducers. This testing technique can provide information that indicates the degree of orientation of the molecular structures and other properties that produce changes in sonic velocity. Observation of the pulse shape is claimed to be useful in determining visco elastic properties as well. In operation the

sample material is placed in contact with two piezoelectric transducers and the transit time of a damped 10-kcy/sec pulse is measured 195 times per second. Transit times of 5 to 400 μsec corresponding to 0.5 to 40 inches of acetate rayon can be measured to within 1 percent under favorable conditions. While the instrument finds ready application in the synthetic fibers and films field, it also promises to be a useful tool for measurement of the properties of living membranes and fibers.—R.L.B. (KLH Research and Development Corp., 30 Cross St., Cambridge 39, Mass.)

**Circle 19 on Readers' Service card**

**Rubidium-vapor station magnetometer** (model X-4936) monitors the earth's magnetic field to provide a continuous high-sensitivity measure of the total magnetic field intensity. The magnetometer system is based on optical pumping, utilizing the interaction of the magnetic moment and the angular momentum of the valence electron of rubidium with the ambient magnetic field. As a spin-precession type of magnetometer, the sensor contains no moving parts. The narrow spectral line is monitored by a self-oscillation circuit that allows instantaneous response even to large field changes. The instrument is comprised of three units: the sensing head; an electronic console to which the sensor connects and that contains a multipurpose power supply and a frequency-to-voltage converter; and a solid-state potentiometer-type recorder. Total weight of the instrument is 110 lb; operating power is 300 watts.—J.S. (Varian Associates, 611 Hansen Way, Palo Alto, Calif.)

**Circle 20 on Readers' Service card**

**Frequency comparator** (model 100) uses frequency difference multiplication to reduce the time required to make accurate frequency comparisons. It can be used with the manufacturer's model 100A indicator-recorder unit to provide a continuous record of the magnitude and sense of the difference frequency. The instrument accepts either 0.1- or 1-Mcy/sec test and reference signals. The reference input is either directly multiplied or divided and multiplied to provide a 900-kcy/sec internal reference. The test input is converted to 100 kcy/sec for processing by multiplier-mixer modules. Each of these modules multiplies the test input —including the error—by 10 and reconverts it to 100 kcy/sec by mixing

it with the 900-kcy/sec internal reference. Each successive module provides a 10-times increase in the difference frequency while maintaining the 100-kcy/sec center frequency. A front-panel control selects the number of modules through which the test signal is processed providing a choice of difference frequency multiplication of 1, 10, 100, or 1000 times. Input modules for frequencies other than 100 kcy/sec and 1 Mcy/sec are available on special order. The instrument is said to be capable of making a comparison to one part in $10^{11}$ in a few minutes. Measurements are relative to the reference input. With the manufacturers model 200 synchronized frequency standard as reference, accuracy is said to be a few parts in $10^{10}$.—J.S. (Montronics Inc., 1212 West Main, P.O. Box 135, Bozeman, Mont.)

**Circle 21 on Readers' Service card**

**Preparative gas chromatograph**, Prepkro II, has a temperature range to 500°C, and uses hot wire thermal conductivity detection cell. In addition to large scale preparative work, the instrument converts in 5 minutes to a highly sensitive analytical unit. This feature is said to permit installation where funds or space would normally limit the number of chromatographs which could be purchased. For preparative work, the instrument incorporates the new Nester/Faust "biwall" (patent pending) column. Prepkro II may be operated isothermally, manually or automatically programmed to 500°C. The injection block, column, and cell are independently controlled. Proportional temperature controllers are incorporated for both the column and detection cell, resulting in excellent baseline stability. The instrument may be operated at an attenuation of 1 on a 0- to 1-mv recorder. A large column compartment is used which allows up to 24-feet of ¾-inch-diameter preparative columns. Cabinet dimensions are 18 by 22 by 48 inches.—R.L.B. (Nester and Faust, 2401 Ogletown Rd., Newark, Del.)

**Circle 22 on Readers' Service card**

The **impedance pneumograph** measures respiration using two standard electrocardiogram electrodes attached on either side of the chest. This procedure eliminates the need for face masks and/or thermistor beads, thereby providing a convenient and easily attached method for monitoring an astronaut's respiratory volume as well as rate. The impedance change detected by this sig-

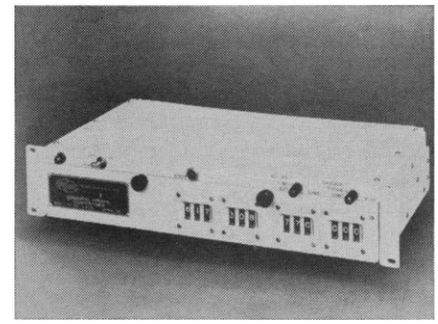

nal conditioner may be equated to the respiratory tidal volume and cyclic occurrence used to compute respiratory rate. Lightweight and compact, it measures .46 by 2.14 by 3.77 inches and weighs 4.2 ounces, including its hard anodized aluminum casing. The single-ended, low-impedance output (less than 1 kohm) of this amplifier makes it ideal for telemetry or direct reading applications. The model 130 impedence pneumograph, a Biotel System Component, is part of a family of interchangeable physiological amplifiers.—R.L.B. (Spacelabs, Inc., 15521 Lanark St., Van Nuys, Calif.)

**Circle 23 on Readers' Service card**

**Notes on microwave measurements** is a 23-page booklet that is a guide to methods and techniques of microwave measurements. The booklet covers general procedures for the use of various principal categories of microwave test equipment—spectrum analyzers, signal generators, microwave receivers, and microwave power meters. Information for each of these classes of instruments is presented first by a statement of general function of each instrument. This is followed by a detailed explanation of the various types of microwave measurements that can be made with the instruments. These explanations include test set ups, calibration charts, formulas, and tables useful to the engineer and technician.—J.S. (Polarad Electronics Corp., 43–20 34 St., Long Island City 1, N.Y.)

**Circle 24 on Readers' Service card**

**Sequential interval counter/timer** (model S.I.C.-4/3-25) provides outputs that mark the ends of four successive counting cycles. Each cycle is adjustable by decade thumb switches from 0 to 999 counts. An external asynchronous count rate may be used with a



maximum limit of 25 kcy/sec. An internal 5-kcy/sec oscillator is provided as well as a 60-cy/sec input so that either of these frequencies may be used as the base frequency to transform the unit into a timer. In "single" operating mode, an external starting signal causes the unit to count through its four cycles and come to a stop ready to be started by the succeeding start signal. In "continuous" mode, the four cycles repeat until commanded to stop, upon which the instrument completes the current four cycles and stops. In "cascade" mode, it counts through four cycles and provides an output that can start the sequence of another unit of

the same type. The instrument uses magnetic logic elements. It will operate over the temperature range −20° to +55°C and in 100-percent relative humidity.—J.S. (DI/AN Controls, Inc., 944 Dorchester Ave., Boston, Mass.)

**Circle 25 on Readers' Service card**

**Electron microscope**, JEM T-1, a compact, relatively low priced instrument produced by Japan Electron Optics Laboratory, Ltd., is ideal for teaching the principles and techniques of electron microscopy, can be used in any research situation where .50 A resolution and 5000 × magnification (or 50,000 × with photographic enlargement) will suffice. The T-1 is a two-lens instrument whose electron-optical column consists of a self-biased electron gun operated at 50-kv accelerating voltage, a specimen chamber with the identical convenient specimen-shifting mechanism used in higher-priced instruments, an objective lens, a projector lens, and a fluorescent viewing screen observed through three large windows at the base of the column (one window has a 2 × magnifier as well). The built-in plate-camera takes a single cassette that holds two standard 65- by 90-mm (2½ by 3½ inches) plates. Both can be exposed without breaking the vacuum to remove the cassette. (However, even when the column's vacuum is broken to remove plates or exchange specimens, it is restored in 3 minutes by the efficient high-vacuum system.) Advantages include a noteworthy stability in the presence of vibration, permitting set-up in many places where it would be impossible to operate the big electron microscopes with maximum resolution. In addition, the high-voltage circuits are fully shielded; the operator is always completely safe, and all vulnerable parts of the T-1 are protected against atmospheric moisture. All controls are within easy reach of a seated operator. —R.L.B. (Fisher Scientific Co., 415 Fisher Building, Pittsburgh 19, Pa.)

**Circle 26 on Readers' Service card**

Portable **dissolved oxygen and temperature recorder** for use in streams and other bodies of water also monitors ambient air temperature by means of two sensing probes with attached cables —one containing an oxygen electrode and water temperature thermister, the other an air sensing thermister. A compact, dual-channel, strip-chart recorder monitors the oxygen content and temperature. Water temperature may be

recorded for approximately 15 minutes, then air temperature for a like period and finally water temperature may be recorded again, repeating this cycle indefinitely. Longer periods may be selected by changing a cam in the chart-drive mechanism. Normal range for both water and air temperature is −10° to +90°F. An expanded range of 32° to 72°F may be selected for water temperature. The water temperature trace is deflected to 90-percent scale reading at regular intervals to identify the trace and to provide a check on instrument calibration. The air temperature trace is deflected to zero scale reading. With fresh batteries it should be possible to operate the recorder continuously for 3 or 4 days. A built-in interval timer may be used to limit recorder operation to 20 minutes out of each 2 hours and thus permit 30 days of continuous operation. Shortly before the interval timer shuts off the recorder drive, the oxygen and temperature traces return to zero scale, providing an indication of the "dead" periods on the chart record.—R.L.B. (Oceanic Instruments, Inc., Houghton, Wash.)

**Circle 27 on Readers' Service card**

**Color-coded Kimax culture tubes** have fused on ceramic colored marking spots in either plain or screw-capped tops. Marking spots are in matte finishes, making it easier to write on and easier to clean. These color-coding marking spots are carefully applied to withstand repeated detergent cleaning by the user.—R.L.B. (Owens-Illinois, Kimble Glass Co., Toledo 1, Ohio)

**Circle 28 on Readers' Service card**

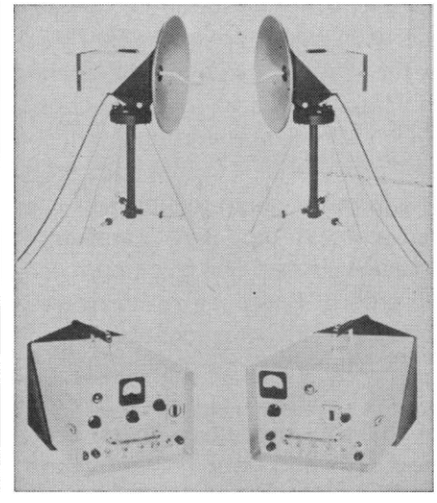
An **absolute-pressure meter** (model 311-1) is an all-electronic, continuous, vacuum measuring device for the moderate vacuum region. Two basic ranges, 0 to 3 and 0 to 30 mm-Hg full scale, are available. Dynamic response is said to be 100 cy/sec or better. Output voltage for full-scale deflection is 10 v d-c, with resolving power 1 part in 1000, allowing measurements of vacuum down to 0.003 mm-Hg. Overpressure capability exceeding 2 atm without damage to the sensing element is provided. Other features include a built-in getter for periodic outgassing; insensitivity to gas composition; stainless-steel construction for application to corrosive-gas measurements; portability; and outputs for operation of recorders or oscillographic instruments.—J.S. (Decker Corp., Bala-Cynwyd, Pa.)

**Circle 29 on Readers' Service card**

**A signal generator** (model G110C) provides 21 discrete crystal-controlled signals in the range 5000 to 6000 Mcy/sec in 25-Mcy/sec increments. Frequency accuracy is said to be ±0.0001 percent and power output 1 mw minimum. Spurious responses are said to be at least 60 db below the desired-signal level. A separate crystal oscillator is used as a check on operating frequency. The difference frequency is monitored and displayed on a front-panel meter. Signals are derived from a standard crystal oscillator by miltiplication and mixing circuits followed by a high-selectivity gang-tuned filter to eliminate all but the desired signal.—J.S. (Frequency Engineering Laboratories, P.O. Box 504, Asbury Park, N.J.)

**Circle 30 on Readers' Service card**

**Microwave relay link** operates in the 10,500 to 13,200 Mcy/sec range for point-to-point FM data transmission. The link is a 0.1-watt, 7-Mcy/sec bandwidth system. Transmitter and receiver are self-contained units weighing approximately 30 lb each. A common type of klystron has been used for convenience of service and replacement. A built-in meter and selector switch on each unit provides voltage checks and all mixer and radiation indications necessary for normal system tune-up and



operation. A built-in 60-cy/sec signal provides a deviation reference and test signal. A separate cavity-type wavemeter is supplied as a means for adjusting the equipment to the assigned operating frequency. The meter is a continuously tunable cavity with calibrated micrometer control.—J.S. (Micro-Link Corp., Akron St., Copiague, N.Y.)

**Circle 31 on Readers' Service card**

**Zoom microscope eyepiece** changes its magnification from 10× to 20× through continuous variation of power by means of a simple mechanical adjustment. A twist of the dial selects the desired magnification without additional focusing. The coated optical elements are housed in a structure 2¾ inches long and 1½ inches maximum diameter. Attachment is simple and rapid, and mechanical construction is described as high quality. Price, $25.—R.L.B. (Edmund Scientific Co., Barrington, N.J.)

**Circle 32 on Readers' Service card**

**Recording storage-tube system** (model 206) operates at standard television scanning rates and stores a single television frame for repeated display. Resolution of 1000 television lines across the diameter and gray-scale fidelity of five to six shades are said to be achieved. Readout is nondestructive, and the stored picture may be continuously displayed on a television monitor for 10 minutes or longer. The system connects directly into a video line to receive composite television signals. Upon manual or electrical command, the unit stops and stores a single frame. The system requires a composite video input amplitude of 0.7 to 2.0 volts, black negative. Its composite video output amplitude is adjustable from 0.5 to 1.5 volts. Input and output impedances are 75 ohms, resistive. Input and output bandwidth is greater than 8 Mcy/sec.—J.S. (Image Instruments, Inc., 2300 Washington St., Newton Lower Falls, Mass.)

**Circle 33 on Readers' Service card**

**Portable salinometer** is based upon the principle that a direct proportionality exists between the magnitude of an induced electric current and the electrical conductivity of the medium in which it is induced. This instrument, designated Model RS-5 Electrodeless Induction Salinometer (U.S. Patent 2,542,057), completely eliminates the need for both sample bottles and electrode maintenance. Salinity, temperature and conductivity may be measured to depths of 300 feet simply by lowering an electrodeless cell to the desired depth and reading the instrument. Salinity and temperature gradients are easily determined and any change in salinity or temperature quickly detected. The electrodeless inductive conductivity cell consists of two toroidally wound coils arranged around a thick-walled epoxy tube. The first coil, driven by an

oscillator, induces an a-c current which flows in a closed loop through the cell bore and the surrounding water. The second coil is used to measure the magnitude of this induced current. Moreover, although the cell bore is large, it offers a much greater resistance to the passage of the induced current than the surrounding sea water. This allows the cell to be operated as close as 6 inches to obstructing surfaces which otherwise might affect the measurements by reducing the induced current. The instrument itself contains the batteries, transistorized oscillator and amplifier, bridge circuits, selector switch, readout dials, and meter all in a small 5 by 6 by 8 inches covered and gasketed carrying case. For measuring, a selector switch is set for the desired function and the proper dial adjusted to give a meter null. The reading is taken directly from the dial setting. All three measurements —salinity, temperature, and conductivity—may be taken in less than 1 minute by a single operator.—R.L.B. (Industrial Instruments Inc., 89 Commerce Rd., Cedar Grove, N.J.)

**Circle 34 on Readers' Service card**

The model ND-150-FM **1024-channel radiation analyzer** is designed to provide both the high-stability and resolution required for day-long, part-in-a-thousand measurements, and very-high-speed, low- or medium-resolution measurements when speed is important. Parameters can be represented by amplitude modulated pulses, time modulated pulses, or d-c voltages. Two analog-to-digital converters are provided, each with independent address registers, to provide multiplex operation. Multiplexing may be used for either unrelated or time-coincident events. Dead-time corrected timing is provided by use of either internal timing oscillator or accelerator beam current integrating capacitor discharge pulses. Dead times range from 10 $\mu$sec per event in low-resolution measurements to average times of 150 $\mu$sec for high-resolution measurements. Measurements can be made with 32 $\times$ 32, 64 $\times$ 16, or 128 $\times$ 8 configurations. Readout by contour-map point display and by digital field-of-data points is provided for interpretation of two-parameter data. Either parameter may be pulse amplitude, steady voltage level, or time-modulated pulses.—J.S. (Nuclear Data Inc., 3833 W. Beltline Ave., Madison, Wis.)

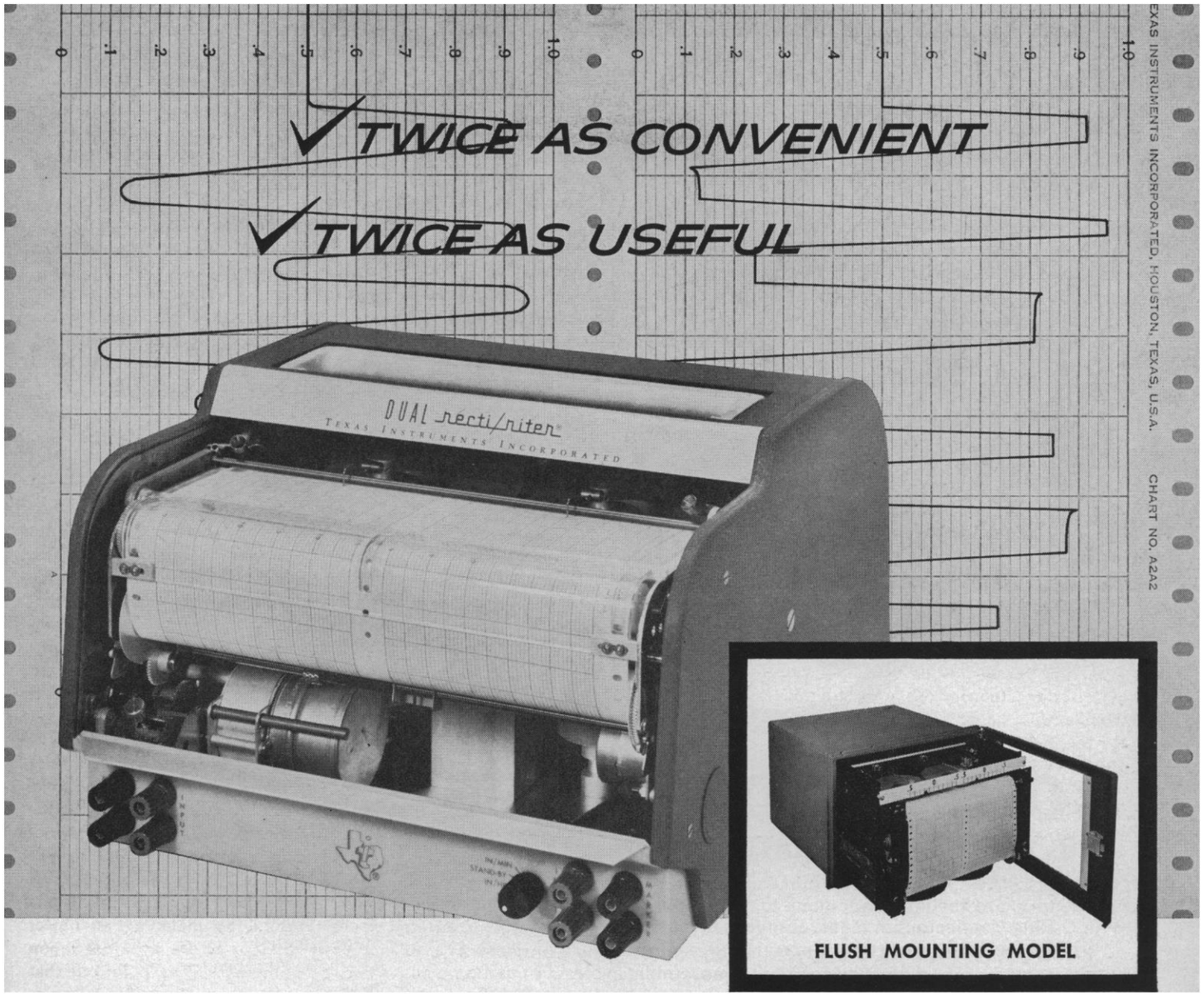
**Circle 35 on Readers' Service card**

**Event recording system** (series 360) records 120 channels of on-off information on a 16-inch dry, electrically sensitive chart. Response to events of duration as brief as 1.3 msec is made possible by a writing control that is connected to the recorder by four cables. A pulsed writing technique prolongs stylus life. Each bank of 30 styli may be pulled out, and an individual stylus replaced by plugging in a new one; 18 chart speeds are provided.—J.S. (Sanborn Co., Wyman St., Waltham 54, Mass.)

**Circle 36 on Readers' Service card**

**Humidity meter** "Humid-I-Meter" is an all-electronic transistorized instrument that indicates relative humidity at temperatures of 50° to 100°F by measuring what the maker describes as "dipole moment concentration." The sensitive element is a bead about 1/16 inch in diameter and readings are made in 5 seconds. The presence of gases with high dipole moments or contact of the bead with conducting electrolytes will interfere with the readings. A large, easily read meter and a probe on the end of a wire bead provide convenient operation and accuracy to $\pm$ 2 percent RH within the specified temperature range.—R.L.B. (Telostat Corp., 1003 First St., South, Hopkins, Minn.)

**Circle 37 on Readers' Service card**

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Working with two projected disks of light, one in horizontal direction and the other above the observer and at the same distance from him, Schur found a size difference in favor of the horizontal disk which increased steadily with increasing distance of the two disks from the observer. The distances were varied in six steps from 3 to 33 meters. For the distance of 3 meters the mean illusion ratio amounted to 1.16, and at distances of 22 and 33 meters, to 1.71 and 1.87. Today these findings are supported by the result of Hermans' whose illusion ratio of 1.06 for distances of 4 feet fits well with Schur's data (and does not refute them, as Rock and Kaufman claim), and by the results of Leibowitz and Hartman; only Rock and Kaufman's planetarium experiment is in disagreement.

I see Schur's size-elevation illusion as a thing apart from the terrain effect. Rock and Kaufman surmise that there was enough stray light in the rooms used by Schur to illuminate the floors. I don't think that this explanation is tenable. Schur's report shows that a great deal of attention was paid to the task of keeping walls and floors invisible; the projectors were completely enclosed, and the subjects were not allowed to become dark-adapted. Besides, if Schur's results were really due to a vestige of a terrain effect, one would expect her illusion ratios to be smaller than those obtained by Rock and Kaufman with good terrain visibility. The opposite is the case; for the 33-meter distance Schur's illusion ratios show an effect almost twice as large, and with much less variability. Since Schur also found her effects to be partly independent of the angle-of-regard illusion—she did obtain an angle-of-regard effect with disks of light at distances of 5.2 meters which, when set against the ordinary size-elevation effect, would diminish but not overcome it—it looks as if we have here a third condition which can produce a moon illusion.

I want only to set the record straight, not to advocate more discussion or research on the ordinary moon illusion. As is the case with many phenomena of our daily lives, its causes are probably too complex to warrant detailed unraveling. But I don't like to see the angle-of-regard illusion and the size-elevation illusion neglected as unimportant. These facts are of genuine scientific interest, having relevance to perception independent of the moon illusion.

HANS WALLACH
*Department of Psychology and Education, Swarthmore College, Swarthmore, Pennsylvania*

Kaufman and Rock's thorough investigation of the dependence of the moon illusion on the presence or absence of a visible, uninverted, intervening terrain makes important reading and seems to me, the surviving member of the Holway and Boring team and Kaufman and Rock's most clearly defined target, to lend strong support to Ptolemy's theory and the effectiveness of Emmert's law in this situation. It can be said, of course, that Ptolemy's theory *is* Emmert's law, and that everyone knows that Emmert's law works. Emmert's law is the principle that the size of a perceived object increases with its perceived distance in those unusual cases, such as a visual afterimage, when the size of the retinal image remains

constant as actual distance varies. If visually filled distance looks greater than empty distance, then the horizon moon, separated from the observer by a filling of terrain, should look further off and, subtending always the same visual angle, should appear larger. The difficulty here is that the preponderance of evidence, against which Kaufman and Rock cannot do better than set up their fiat, is that the horizon moon looks nearer than the moon in elevation. Of course, say the subjects, it looks nearer because it looks bigger, and that leaves us with a paradox.

Neither Holway and I nor Kaufman and Rock made any well-designed study of the perceived distances of the moon, although Holway and I did ask questions about perceived distance of a good many observers. If one is studying the effect of apparent distance on apparent size, one would do well to measure the relative apparent distances as well as the relative apparent sizes, would one not?

Kaufman and Rock say that the size of the elevated moon is indeterminate. Now surely that is nonsense. All size is relativistic, and, when not under comparison, size is necessarily indeterminate. You spend an hour watching a puppet show on a lighted stage surrounded by the dark, the curtain falls, the general lights go on, and the actors themselves who make the little figures work appear to take their bow. A gasp of astonishment goes through the audience when these apparent giants appear. Actually, the puppets lost apparent size when they lost their standard of comparison. No perceived object has determinate size except as its size is fixed in a comparison.

Then Kaufman and Rock object to the fact that Holway and I used heterotelic comparisons of size (*heterotelic* is from *tele*, afar, as in *telescope*, not from *telos*, end, as in *teleology*). Abstractive comparisons, such as the heterochromatic equating of visual brightnesses, are more difficult to make than judgments of identity, but they are not invalid. The measure of difficulty lies in the large size of the interval of uncertainty about the point of subjective equality and in the longer decision times for the more uncertain judgments. Given a difference somewhat larger than the interval of uncertainty, be that interval large or small, the judgment is immediate. Holway and I found, for our extreme heterotelic comparisons, that the judgments were certain and instant. Conversely, even identity judgments near the critical point are slow

and unsure. There is nothing wrong with the heterotelic method except that it is less precise than homotelic comparisons of size, or, one might say, the heterotelic method is as accurate as the homotelic but in respect of larger units.

Now let us raise the question as to how much we must stretch credulity to believe that Emmert's law, set up by the filled distance of the terrain, can account for the moon illusion. I have read Wallach's letter about these researches with assent. He notes that there is probably no single correct theory of the moon illusion, and even Kaufman and Rock admit in a note that more than one principle may be operating synchronously. Emmert's law is consistent with the principle of size constancy: that the receding object maintains the same apparent size as its retinal image shrinks, and thus that a receding object whose retinal image does not shrink (an after image) grows in apparent size. Another law, incompatible with this one, might be called Euclid's: a receding object appears to shrink in size as its retinal image shrinks; and conversely, *mutatis mutandis*. The observers in the Holway and Boring studies were appealing to Euclid's principle when they said that the horizon moon looked near because it looked so large. Certainly this principle often works, and then, of course, size constancy fails.

Now, Kaufman and Rock are arguing that these two principles operate simultaneously, each of them effectively, though in opposite directions. They adopt Woodworth and Schlosberg's word *register*, which means that a perceptual cue operates below the level of consciousness. A distance may be great as registered while being small as perceived. Let me extend this argument and suggest its treachery by being explicit. The visible terrain is effective as a cue. It operates below the level of consciousness to register the moon as far away. Under Emmert's law the moon is thus, because of its remote registry, perceived as large. Looking large, it seems, under Euclid's principle, near. And might one not then add that, under Emmert's law appearing near, it looks small? That would be the whole circle of logic of these two principles: the horizon moon, being far, is big; being big, is near; being near, is small. Obviously, still more research and more thinking are needed on this matter.

Kaufman and Rock could have aided their readers by being more precise in

their terminology. Again and again they speak of "the greater apparent distance" of the horizon moon. Only occasionally do they use the word *register*, introducing it in connection with a half-hearted admission that the apparent distance to the horizon moon may be small although the registered distance is great. They speak of "phenomenal size" and seem to mean by that term the consciously apparent distance. They speak occasionally of "report" as if it could be expected to contradict the character of the phenomenon reported upon. The situation described and the theory based upon it need careful explication, and it would help were these five words defined and used with rigor: *apparent, perceived, registered, phenomenal,* and *reported.* Then the paradox outlined earlier would become clear —or so I think.


EDWIN G. BORING
*Psychological Laboratories,*
*Harvard University,*
*Cambridge, Massachusetts*


Wallach and Boring make a number of interesting points concerning our work on the moon illusion. On the whole they raise different arguments, except for one on which they agree. They both defend the method used by Boring and his colleagues (and Pozdena) to measure the moon illusion (in fact, Wallach believes it preferable to the method we have developed). We still disagree. The disk projected on the nearby screen in Boring's method appears to be of a definite linear size. But the moon does not; we believe it is correct to say that the moon is indeterminate as far as an impression of linear size is concerned. How, therefore, can we rely on a comparison object which appears to be of a definite linear size to tell us about the apparent size of the moon? Wallach implies that such a comparison is desirable because at least the size of the comparison object is stable and definite. How, then, does he explain the fact reported by Boring that, if the observer backs away from the screen, the disk he has just selected no longer appears to match the moon? Obviously the moon's size would not be affected by these few additional feet and the disk's size would not change, because size constancy would obtain. Apparently the observer is, at least in part, comparing the moon and the disk in terms of their visual angles. Where is the stability of the comparison object Wallach hints at? (It is surprising

to find Wallach arguing for Boring's method when he has recently published a paper, with McKenna, the main conclusion of which is that comparison of an indeterminate object at an indeterminate distance with a determinate object at a determinate distance is essentially not possible!)

Boring's statement that all size is necessarily relativistic obscures the important difference between determinate and indeterminate linear size. An apple at some definite distance has determinate size, whether or not one is comparing it to anything. Of course, by "determinate size" we mean a size that has meaning in the whole scale of sizes in our world (for example, smaller than the hand but bigger than a grape), and this is no doubt what Boring means by "relative." But the size of the moon, particularly when it is at the zenith, is none of these. One cannot rank it anywhere on the scale of linear sizes we deal with. It is not even necessarily very large, linearly speaking. Unlike the apple, it is indeterminate, and for a very good reason. Its distance is more or less indeterminate. That it is indeterminate is an empirical fact. Subjects cannot decide or agree on its linear size. Of course, the moon does have a size relative to other astronomical objects—for example, to the distance between two stars, or to itself in other positions. But this is not a matter of relative linear size. Our method is based on such a nonlinear comparison.

Wallach seems to forget that our focus was the moon illusion as it exists in daily life. Are we to believe that that illusion requires comparison of the moon with some nearby object and that it is the cross-comparison with that object that mediates the moon illusion? That is, are we to believe that the illusion is based on the observer's first comparing, say, the zenith moon with some nearby object and, on some other occasion, comparing the horizon moon with that object? When we say the horizon moon seems large to us, don't we mean large in comparison to the size we remember the zenith moon to be? That is why we strove to use a method wherein the observer could compare one moon with the other, as he does in daily life. Even if such a comparison is not reliable for the reason Wallach suggests (although we don't agree that this is the case), the plain fact is that that comparison *is* the moon illusion. Boring himself said in 1943 that the illusion "is a comparison of the moon with itself seen previously."

Wallach's defense of the eye-elevation hypothesis is that eye elevation affects convergence and convergence could not influence the illusion unless "the distance of at least one of the two objects to be compared is within the effective range of convergence." Hence, a method such as Boring's is required to produce the effect. Our question, again, is: Does the illusion in daily life require mediation by way of some nearby comparison object? If so, no one seems to be aware of it. Hence, if Wallach's reasoning is correct, eye elevation could not possibly explain the moon illusion, although it could explain Boring's findings. However, a point we made in our paper is worth repeating—namely, that in spite of the quantitative results based on eye elevation, the observers in the Holway and Boring studies were impressed with the large size of the (geographical) horizon moon and the smaller size of the (geographical) zenith moon.

The supine observer says the zenith moon "does not appear large to him, yet he equated it to an artificial moon to which, when erect, he had already equated the horizon moon." As Patrick Rizzo recently pointed out in the bulletin of the Amateur Astronomer's Association, the moon illusion is a "seeming," an impression of size. Boring's subjects reported this impression while giving quantitative data of a different kind. In such a case of contradiction it is the method employed that must be questioned. One final point about Wallach's argument: we do not understand why convergence with respect to the nearby *comparison* object is required before eye elevation in viewing the zenith moon can emerge as a cause. The convergence is the same for the comparison object whether the standard is the horizon or the zenith moon. Does Wallach mean to suggest that what is crucial is the *transition* from eyes level to convergence on a nearby object or from eyes elevated to convergence on a nearby object? What evidence is there for such an effect, and what is its rationale? Suppose the observer rests his eyes a moment after looking at the moon before focusing on the comparison object. Would Wallach now predict no moon illusion?

There is another curious fact. Both Wallach and Boring seem to admit that our evidence for the role of the terrain is convincing (although this hypothesis had been discarded ever since Boring's research was published 20 years ago). If apparent or registered distance does affect the illusion as strongly as our evidence shows, and if Boring's method is indeed a good one, why is it that his data show no influence of the terrain? For example, Holway and Boring obtained an illusion ratio of 1.0 when observers viewed a horizon moon normally and a zenith moon with head elevated and eyes level.

We turn now to a second point. Boring still seems reluctant to subscribe to the apparent-distance hypothesis (in spite of his opening sentence) because of what he calls "the preponderance of evidence . . . that the horizon moon looks *nearer* than the moon in elevation." The preponderance of evidence to which he refers is presumably the reports of observers that, of the two, the horizon moon is *nearer*. We will not repeat here all our reasons for not being greatly concerned with this report. We thought we had done more "than set up a fiat" when we suggested that such reports were probably based on judgmental reactions to the difference in *phenomenal* sizes of the two moons (which difference *is* the moon illusion) and when we backed up this suggestion by two experiments. One showed that subjects do use the apparent relative size of the moon as a basis for answering the question, Which moon seems nearer? The other showed that, with moons absent, observers do report the horizon sky to be farther away than the zenith sky.

Boring tries to reduce our argument to an absurdity by the following deduction: if the horizon moon is indeed judged nearer because it seems larger, it now ought to seem smaller because

it is judged nearer. We would answer that a judgment of this kind (which in this case is perhaps only elicited by a question) does not influence perceived size. A judgment or inference is not to be equated with a sensory cue to distance. Perception is rarely if ever influenced by knowledge about the situation—if it were there would be no moon illusion.

Wallach believes we have not obtained the full moon illusion, citing earlier work by Pozdena in which an illusion ratio of 2.5 was obtained. This argument has little force when the method used by Pozdena (being like that of Boring) is itself in question. We wonder, however, what Wallach's explanation is for the fact that Boring and his colleagues did not obtain an illusion of that magnitude with the same method. Their illusion was closer to the values we obtained.

Finally we come to Wallach's reference to the earlier experiments of Schur in dark rooms of various sizes, and to the recent work of Hermans and of Liebowitz and Hartman. Common to all these experiments is the finding of an illusion when equidistant horizon and zenith objects are compared in a dark field at a finite distance. First, we would point out that this method is different from that of Boring's. It is in fact similar to ours in that both objects are now at the *same* distance. To the extent that distance perception is diminished in the dark, the method is even closer to ours. Hence, Wallach has shifted his position insofar as preferred methodology is concerned (for example, convergence could have little effect if both objects are at 33 meters). Second, the question arises as to why the effect increases with distance (it is quite small at 3 meters, for example) if convergence is what is crucial. Boring answered this question long ago by saying the moon illusion is greatest when distance is indeterminate. Third, if the previous point is correct, is not the ideal experiment one in which distance increases to a maximum? (Extrapolation from Schur's curves leads to this prediction, and Hermans made the same prediction.) In that case, our indoor experiment in a dark field with the two disks at optical infinity is ideal. Yet we obtained only a negligible effect. Our planetarium dark-field experiment yielded a similar result.

This leaves us with the problem of explaining Schur's results and those of Liebowitz and Hartman. Perhaps Wallach is right in stating that our specu-

lation that they are based on stray light is not tenable. A more promising lead is a recent finding of Gruber, King, and Link to the effect that an illusion indoors depends on the observer's first gaining some impression of the distances involved in the room prior to the darkening of the room—on a kind of memory effect which may itself be a function of (remembered) apparent distance.

We agree with Boring that there is a tendency toward imprecision in our use of certain terms. We believe this is largely due to the fact that we sought to derive the moon illusion from certain already known facts and principles in the area of size perception. Unfortunately, that area is itself still beset with theoretical difficulties.

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## Battle Not Won

The item entitled, "Congress shrugs at proposals on laboratory animal welfare" [*Science* **126**, 863 (1962)], could easily give the impression that all is well and that those interested in animal research have little cause for concern.

It is true that Congress will not have time in the few remaining weeks of this session to consider proposals to regulate research and teaching involving the use of animals. It probably is true also that most members of Congress do not at this time favor such legislation. Further, it is true that there are only about 6 million antivivisectionists in the United States—a small minority of the population.

But this is where the good news ends. Members of Congress report that mail on the Moulder, Griffiths, and Clark bills is running approximately 20 to 1 in favor of regulation. Experience in legislative bodies around the nation shows that politicians will, in the end, do what they believe the voters want, regardless of their own convictions. Experience further shows that a tiny minority of antivivisectionists can, by writing letters day in and day out, create an illusion of public sentiment that is very difficult to ignore. Thus, the antivivisectionists won in the states of Illi-

nois and Connecticut and the cities of Kalamazoo, Palo Alto, and Duluth last year. Thus, the antivivisectionists might, with the largest flood of mail ever received by Congress, get favorable action on a bill that would encumber research on animals with a tangle of restrictions and red tape.

The author of your report was correct in assessing our present strength. He simply failed to mention that our Achilles' heel is apathy. Congress ultimately will act on the basis of apparent public opinion.


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## Adjusting Data

It appears to me, a casual reader with no special competence in the field, that the manipulation of the data in reference *11* of Astin's article " 'Productivity' of undergraduate institutions" [*Science* **136**, 129 (1962)] requires considerable justification.

As I understand the situation, data were available on the I.Q. distribution of recipients of bachelor's and doctor's degrees from which the variation with I.Q. of the probability that a recipient of a bachelor's degree would attain the doctorate could be computed. The original data gave the anomalous result that the probability for students with I.Q.'s in excess of 160 was less than that for students with I.Q.'s between 150 and 160. Astin therefore considered various adjustments of the I.Q. distribution of baccalaureate recipients. Changing the standard deviation of the distribution shifted the anomaly to a different I.Q. range, but lowering the estimate of the average I.Q. resulted in a monotone increase with I.Q. of the probability of obtaining the doctorate.

Now, while it is plausible that the probability should be a monotone increasing function of the I.Q. it is far from being such a self-evident requirement as to warrant the altering of measurements, however crude. It could, for example, be argued that a monotone probability is a characteristic of a rational educational system, and that an anomaly thus indicates an organizational defect. (Of course, one cannot conclude the converse—that if the distribution is monotone the system is rational, or that changes which would make the distribution monotone are necessarily improvements.) From this

point of view, Astin has glossed over an extremely significant result by his treatment of the data.

It is, of course, possible that the data were erroneous, but revision should be made on the basis of a more extensive investigation, not to secure agreement with preconceived ideas of plausibility.

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If I correctly understand his comment, Squire feels that changing the estimate of the mean I.Q. score for college graduates from 121 to 115 was not justified merely in order "to secure agreement with preconceived ideas of plausibility." I would be inclined to agree with him if this were the only basis on which I made the change. But my principal authority for this decision was L. R. Harmon [*Science* **133**, 679 (1961)], who found a monotonic function in the general population. I felt that my function should conform to Harmon's, not merely that it should be "plausible." I specifically refer to Harmon's findings in the reference in question (reference *11*).

It might also be added that, in our longitudinal studies of Merit Finalists (who represent these extremely high levels of aptitude) we have never observed such reversals—that is, the relationships between aptitude and the probabilities of entering college, completing college, and entering graduate school have consistently turned out to be positive and monotonic.

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## Fact and Fashion in Scientific Nomenclature

Needless to say, the debate over biological terminology between Soulides and Buchanan [*Science* **136**, 947 (1962)] is not so much an argument over fact as an argument over fashion.

Generally speaking, 19th-century scholars preferred to latinize scientific terms of Greek origin, while 20th-century scholars prefer to preserve the Hellenic spelling of these terms.

Nonetheless, some peripheral questions of fact raised by the two disputants do merit comment. Though I think Buchanan generally stands on firmer factual ground than does Soulides, Soulides correctly insists that the

stem of the Greek word for sulfur—from which the generic term *Thioploca* derives—is *theio-* (latinized *thio-*). The root, to be sure, is *thei-* (latinized *thi-*), while the word is *theion* (latinized *thium*); but a stem is at once more than a root and less than a word. Buchanan errs in asserting that *all* intranominal *o*'s in such compounds are "connecting vowels." Most of them are; but where the first noun is a Greek *o-* stem (as it is in *theio-/thio-*), the *-o-* is an integral part of that noun rather than a neutral compound-formative.

However, Soulides errs in declaring flatly that Greek *deiktikos*, "indicative," and Greek *dēktikos*, "mordant," must be "pronounced the same." In modern Greek, *ei* and *ē* (as well as *i* and *u*) are identically pronounced; but in classical Greek (from which technical terms are preferably derived) they were differently pronounced, in non-Attic as well as in Attic dialects.

What is most needed in such questions, it seems to me, is not pontification but consensus. Yet, until the various international biological congresses make some sort of collective pronouncement on the merits and demerits of latinization as a general nomenclatural principle, such consensus will continue to be no more than a pious hope, and acrimonious debate will go on, to the edification of few and the enlightment of none.

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## Genetic Composition and Cultural Structure

I would like to take issue with the passage in G. G. Simpson's review of T. Dobzhansky's *Mankind Evolving* [*Science* **136**, 142 (13 Apr. 1962)] in which Simpson asserts, "Many ethnologists follow Leslie White to the opposite extreme [from the position of C. D. Darlington], maintaining that genetic differences and changes in mankind can be completely ignored, that all normal individuals of our species are biologically identical as far as present status and future possibilities are concerned."

This statement appears to me thoroughly to misrepresent White and certainly corresponds to no opinion held by any ethnologist known to me. It is certainly contrary to what any anthropologist, ethnologist or otherwise,

learns when, in his graduate training or in his subsequent reading in physical anthropology, he studies the biology of man. All of us who are primarily ethnologists know perfectly well that there is individual genetic variability of great scope in any given human population, the more so if the population has been composed of strains hailing from quite dispersed geographical areas, as in the case of the population of the United States.

Rather, the argument is that culture involves relations, especially normative ones, which disregard the biological variations, genetic or otherwise, of *individuals*. Culture involves symbols whose form and content are independent of individual genetics and can be transferred from one individual to another regardless of their individual genetic constitution. Further, it involves symbol *systems*, or higher orderings of symbols which are still more remote from the genetic foundations of biological individuals. In short, there appears to be no evidence whatever linking *individual* genetic composition to cultural structure.

The argument, however, goes further. It is asserted that the processes by which culture is transmitted and generated are independent of the relatively minor intraspecies variations of gene pool distributions which may be called races. The fundamental position was clearly set forth by Diamond and Steward in letters to *Science* [**135**, 961 (16 Mar. 1962)]. The history of culture traits, indeed of whole cultures, is such as to prove again and again the independence of cultural traditions from any definable population, distinguished on genetic grounds alone. There is no satisfactory evidence that the dynamics of the gene pools of *populations* are linked with cultural structure or dynamics in any significant way.

I do not know of an ethnologist, Leslie White included, who would assert that there were *no* connections between genetical factors in humans and their cultures, but I think there would be fair consensus in the following assertions.

1) Genetic peculiarities of populations may (or may not) be adaptive, but if they are adaptive it is in the sense that they adapt man as a biological organism to the environment in which he lives. Though his living in any environment is done through the intermediacy of culture, the genetic feature is irrelevant to the content or structure of the culture, both of which are pri-

marily derived by diffusion, acculturation, or other means from populations other than the one under examination.

2) Culture may affect the distribution of genes in a gene pool. If gentlemen indeed, and persistently, prefer blonds and forbear, as a consequence, to mate as frequently with brunettes, the population will tend toward blondism. If, as is asserted to be the case in the Brazilian population, gentlemen prefer *morenas*, or darker-skinned, black-haired beauties, and mate with *morenas* at the reproductive expense of still darker and blonder persons of the population, the more extreme colorations will tend to decrease. If, by cultural means, malaria is removed from the environment of a group which has the gene for sickle-cell anemia in its gene pool, which proves nonadaptive in the absence of malaria, or even negatively adaptive, then persons with that gene will be reproductively at a disadvantage, the proportion of the gene will decrease, and the gene pool composition will in consequence change. Insofar as culture contributes to mixing or isolating groups through such phenomena as exogamy and endogamy, slave trade, and racist barriers, all of which are cultural phenomena, it will affect the processes of genetic change which are connected with geographic isolation or openness. Cultural effects, however, are relatively minor.

3) The direction is almost entirely one-way—from culture to gene pool.

4) The independence of genetic constitution, individual or populational, from cultural organization is further made indubitable by the entirely discordant rates of change of biological and cultural evolution. Though in the 40,000 or so years since the first appearance of *Homo sapiens*, biological variation has been at most subspecific, cultural variation has cumulatively evolved through several qualitatively different "stages." The rate of the change appears to have been quite independent of the rate of change in the biological population. The nature of the change is apparently also quite different, particularly with respect to the continual emergence of ever-larger geographical units, overarching local adaptational systems. There is no parallel to this in biological evolution. I refer of course to ever-expanding politically bounded systems for whose territories, despite local ecological variation, there are uniform institutional arrangements. Again, the "cumulative" character of culture has often been

pointed out as being characteristically different from biological development—that is, the transformation of the gene content of gene pools. Although I can define "cumulation" for culture, I have some difficulty in defining "noncumulation" for biological systems, for gene pools. In general, however, one feels intuitively that the two processes are different.

Taken together, these assertions or propositions imply that, for virtually all propositions in the analysis of culture or culture history, genetic constitutions of individuals or of populations can be taken as constants, and this is the position that Leslie White *has* taken. Whether this position is justifiable for the entire sweep of the history of culture is quite another matter. If the origins of culture indeed lie back a million and a half or two million years, as recent African discoveries seem to suggest (if the dating is correct), then, since the culture sequences from that time forward appear to be associated (even if not directly in archeological sites) with several quite different types of hominids, it may well be necessary to look toward the genetic effects on culture for those periods, insofar as they may be researchable at all. There is an interesting suggestion, however, that the rate of cultural development in those far-off times was even slower than the rate of genetic development. This would again suggest independence of the two, and the connection of cultural development with factors other than the genetic.

In conclusion, I should like to say that these remarks are addressed not merely to the very faulty statement made by Simpson but to the wider confusions which appear to be becoming all too prevalent of late as to biology and culture and what the anthropologists' position on the relationship between the two is.

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It is a bugbear of some ethnologists that someone might maintain the existence of a genetic component in the capacity for different cultures or even suggest this as a hypothesis worthy of consideration. That is evident in Leeds's long and strong reaction to a single sentence in my review of Dobzhansky's excellent book.

The only issue really pertinent to my review is whether my necessarily ex-

tremely brief mention of White's position was "very faulty." If fault there is, it is only in my failure to specify culture; I thought this sufficiently implicit when *ethnologists* were specified. Leeds affirms that "for virtually all propositions in the analysis of culture or culture history, genetic constitutions of individuals . . . can be taken as constants." The difference between that and the view I ascribed to White is subtle, to say the least. In fact White has also maintained that current biological evolution in man is insignificant. Even if unduly succinct, my statement is an inescapable conclusion from White's two propositions. (Nothing was ascribed to White about human evolution in the past.)

The greater part of Leeds's long communication is devoted not to my alleged sin of misstatement but to defense of White's position. That is quite irrelevant to the review that Leeds is ostensibly discussing. I was reviewing Dobzhansky, not White, and extended discussion of my own views on White or other ethnologists did not belong in the review. Even less does it belong in this letter. The points that Leeds here raises are discussed, judiciously and at length, in Dobzhansky's book, to which I urgently refer both Leeds and the readers of *Science*. If Leeds's polemic has made anyone curious as to opinions apparently imputed to me but *not* expressed in the review, I might add that I agree substantially with Dobzhansky.

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## Conversion of Pyruvate to Lactate in Tumors

In their article on the pathways of intracellular hydrogen transport (*1*), Boxer and Devlin mention the observations of Busch (*2*) that injected labeled pyruvate was primarily converted to lactate by tumor tissues, in contrast to findings in a number of normal tissues, and that, in experiments with tissue slices, the percentage of added pyruvate that was converted to lactate increased in the presence of added glucose in tumors but not in normal tissues. The explanation was offered that increased flow through the glycolytic pathway requires increased oxidation of reduced diphosphopyridine nucleotide. However, Jedekein and Weinhouse (*3*) and

Glock and McLean (*4*) failed to find any increase in the DPNH/DPN ratio in malignant tissues. The reason for this is clear when it is recalled that for every molecule of diphosphopyridine nucleotide that is being reduced, one molecule of pyruvate is formed concurrently.

A different explanation for this discrepancy could be based on the findings of Bloch-Frankenthal and Ram (*5*) that the oxidation of lactate and pyruvate in tissue slices is inhibited by the addition of glucose. In the opinion of these authors this inhibition occurred at the level of the oxidative decarboxylation of pyruvate.

It may be of interest to relate these observations to the theory of Burk and his co-workers (*6*) that the primary biochemical lesion in cancer cells—or, more correctly, the proximal cause of the aerobic glycolysis of these—is at the site of glucose absorption rather than, as has long been maintained (notably by Warburg), at the oxidative phase of cell respiration. Two different findings are also in accord with this theory: (i) the finding that a lesser degree of malignancy in a chrysoidin induced hepatoma (*7*) that exhibited normal glucose-6-phosphatase activity and was thus able to discard any excess glucose, and (ii) the observation (*8*) that the total incidence of cancer in diabetics is half the incidence in nondiabetic patients.

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**References**

1. G. E. Boxer and T. M. Devlin, *Science* **134**, 1495 (1961).
2. H. Busch, *Cancer Res.* **15**, 365 (1955).
3. L. A. Jedekein and S. Weinhouse, *J. Biol. Chem.* **213**, 271 (1955).
4. G. E. Glock and P. McLean, *Biochem. J.* **61**, 388 (1955).
5. L. Bloch-Frankenthal and D. Ram, *Cancer Res.* **19**, 835 (1959).
6. D. Burk, J. Laszlo, J. Hunter, K. Wight, M. Woods, *J. Natl. Cancer Inst.* **24**, 57 (1960).
7. Z. Albert and M. Orlowski, *ibid.* **25**, 455 (1960).
8. E. T. Bell, *Am. J. Pathol.* **33**, 499 (1957).

Rakitzis suggests that a discrepancy exists between the extensive conversion of pyruvate to lactate and the observation of essentially normal DPNH/DPN ratios in malignant cells. Hohorst *et al.* (*1*), however, have demonstrated that the ratio of DPNH/DPN is apparently affected by the oxidation-reduction state of the cell and is only one of a number of possible oxidation-reduction pairs. Thus, the rate of glycolysis and of the conversion of pyruvate to lactate does not necessarily control this ratio.

Bloch-Frankenthal and Ram (*2*) sug-

gested that the glucose inhibition of pyruvate utilization in ascites cells was caused by a combination of substrate competition and inhibition of respiration (the Crabtree effect); they proposed that the latter effect of glucose was on the decarboxylation of pyruvate. More recent studies indicate that the mechanism of the Crabtree effect which occurs in malignant tissues as well as in some normal tissues, involves the availability of adenosine di- or triphosphate or inorganic phosphate (*3*), and that the effect is not primarily due to a specific inhibition by glucose.

Rakitzis supports the concept that the cause of the aerobic glycolysis of malignant tissues is at the site of glucose absorption, and he cites the low incidence of cancer in diabetics (*4*) as evidence. In regard to this suggestion a quotation from Bell's paper deserves attention: "It appears that the total incidence of cancer in males over 40 years of age is about twice as large in non-diabetic as in diabetic cases, and in females there is an even greater preponderance in the non-diabetic cases. This is to be expected since every disease which shortens life shows a decreased incidence of malignant disease. The total incidence of cancer is likewise greatly reduced in tuberculosis, heart disease, and cirrhosis of the liver."

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**References**

1. H. J. Hohorst, F. H. Kreutz, M. Reim, *Biochem. Biophys. Res. Commun.* **4**, 159 (1961).
2. L. Bloch-Frankenthal and D. Ram, *Cancer Res.* **19**, 835 (1959).
3. A. C. Aisenberg, *The Glycolysis and Respiration of Tumors* (Academic Press, New York, 1961).
4. E. T. Bell, *Am. J. Pathol.* **33**, 499 (1957).

## Probability Learning

In a report in *Science* (*1*), S. H. Revusky criticizes certain procedures ("forced trials" and "correction") which have been used to control the distribution of reinforcement in experiments on probability learning. With rats trained by Revusky's own ("nonreinforced trials") procedure choosing the more frequently reinforced side of a T-maze on 67.2 percent of trials in what may seem to be a conventional 67:33 probability-learning experiment, the casual reader is apt to gain the impression (i) that probability matching has been demonstrated in the rat, and (ii) that previous failures to demonstrate it may be attributed simply to faulty procedures. Neither of these conclusions would be justified.

Has Revusky demonstrated "probability matching" in the rat? Not in the usual sense of the term (*2*). Nor has he even given us an experiment on "probability learning" in the original (*3*) and still current (*4*) sense of *that* term, which implies a random or quasi-random schedule of reinforcement. The schedule used by Revusky is far from random, and a corresponding nonrandomness appears in the behavior of his animals. Examination of the protocols (*5*) shows, not the gradual emergence of a stable 67-percent preference for the more frequently reinforced alternative (as Revusky's mean values suggest), but a considerable amount of perseveration in one or the other choice—long runs of the preferred response *m* separated by somewhat shorter runs of the alternative response *l*. The tendency toward perseveration may be seen in the choices of one of the animals on the

last 50 trials (certainly not the most extreme instance): *mmmmmmlmmmmmllllllmmmmmmmmmmmlllmmmmmmmmllmmmmmmmlllm*. For the group as a whole, the one-sample runs test (see *6*) makes it possible to reject the hypothesis of randomness at the 0.001 level.

We do not wish to quarrel about definitions, but if control of the relative frequency of reinforcement in a choice situation is all that is necessary to constitute an experiment on "probability learning," and if a choice ratio approximating the reinforcement ratio is all that we are to mean by "probability matching," then matching in the rat was demonstrated long ago. For example, the single-alternation experiment (in which one of two alternative responses is reinforced on odd trials and the other on even trials) may be treated as a 50:50 problem, and the adaptive alternation of choices which the rat displays under such conditions may be taken as evidence of matching.

Are procedures which involve forcing or correction inadequate to produce matching? Not at all. Two experiments reported in 1958 (*7*) yielded some quite close approximations to matching in the fish *Tilapia macrocephala* (the African mouthbreeder), despite the use of forced correction ("guidance") in 70:30 problems. Without guidance, the animals "maximized"—that is to say, they tended to choose the higher-probability alternative on about 100 percent of the trials. These findings have since been confirmed in some further experiments with mouthbreeders in 80:20, 60:40, and 50:50 problems as well as in 70:30 problems (*8*), and like results have been obtained with pigeons (*9*). Trained under conditions analogous to those which have yielded matching in mouthbreeders and pigeons—that is, with guidance—rats (*7*) and monkeys (*10*) "maximize." We seem to be dealing here with a phylogenetic difference. The difference *may* lie in the way in which the various species are affected by guidance, or other factors may be responsible; but it would be unwise, in the light of the results in submammals, to discount previous failures to demonstrate matching in rats and monkeys on the basis of a priori criticisms of procedures which involve forcing or correction.

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**References and Notes**

1. S. H. Revusky, *Science* **134**, 328 (1961).
2. Although the term *matching* nowhere appears in Revusky's report, the implication that it has been demonstrated is clear, and he asserts in personal correspondence that "the rats were matching in the usual sense."
3. E. Brunswik, *J. Exptl. Psychol.* **25**, 175 (1939).
4. W. K. Estes, in *Psychology: A Study of a Science*, S. Koch, Ed. (McGraw-Hill, New York, 1959), vol. 1, pp. 410 ff.
5. We are indebted to Revusky for lending us his records.
6. S. Siegel, *Nonparametric Statistics* (McGraw-Hill, New York, 1956), pp. 52–58.
7. M. E. Bitterman, J. Wodinsky, D. K. Candland, *Am. J. Psychol.* **71**, 94 (1958).
8. E. R. Behrend and M. E. Bitterman, *ibid.* **74**, 542 (1961).
9. D. H. Bullock and M. E. Bitterman, *ibid.*, in press.
10. W. A. Wilson, Jr., *J. Exptl. Psychol.* **59**, 207 (1960).


From Behrend and Bitterman's criticisms of my report (*1*), the reader may suppose that I claimed that the forced trial and correction procedures are "inadequate to produce matching" and that the nonreinforced trial procedure does not share these inadequacies. In fact, not a word of my report was concerned with whether earlier procedures produced matching or are capable of producing it. My report stated that "much probability learning experimentation has been devoted to the development" of certain theories, and that conventional probability learning procedures "involve the introduction of factors not considered in these theories," which factors should affect the experimental results. Furthermore, the report concluded on the basis of the experimental results that "the present experiment, like previous probability learning experiments with animals, cannot decisively confirm or reject theories about the effect of reinforcement on response probability" (*1*). Thus, what seems to me to be the principal criticism of my report is based on a misconstruction of it.

Behrend and Bitterman cite two descriptions of Brunswik's procedure as evidence that probability learning implies a random schedule of reinforcement. These descriptions were not meant as definitions, and I know of no authoritative definition of probability learning. Since the nonreinforced trial procedure was labeled "a new procedure" (*1*), it should not have been expected to be identical with older procedures. My report describes the characteristics of the nonreinforced trial procedure which make it a probability learning procedure; the lack of random reinforcement is not of great importance because neither Estes (*2*, p. 612), Spence (*3*), nor Brunswik (*4*, p. 258)

require that reinforcement be random for their theories to hold (*5*). Moreover, my definition of probability learning was explicit, and a parenthetical caution was inserted in the first sentence of my report so that my definition would not be confused with other possible definitions.

Behrend and Bitterman's demonstration (*6*) that the sequence of responses was nonrandom is unnecessary, because my use of the statistics *Prr*, *Prrn*, and *Prrnn* (*1*) demonstrated the same thing; had it been random, these three statistics should not have been significantly different. The nonrandomness of the reinforcement schedule I used may well have contributed to deviations from randomness in responding (although this has not been proved), but the relevance of such deviations is not clear. Deviations from randomness do not prove that the rats were not matching in the usual sense of the term. The mathematical learning theories which supply the contexts in which that term is usually used predict matching only for *mean* response probability; they also predict that the sequence of responses at asymptote will *not* be random. Furthermore, in no published demonstration of matching that I know of has it been demonstrated that the sequence of responses is random, so that if randomness is to be considered part of its definition, matching has not yet been demonstrated (*7*). Finally, if any reader held the belief that matching presupposes randomness, he should not have been misled by my report, which did not use the term *matching* and did not indicate that a random sequence of responses was obtained (*8*).

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### References and Notes

1. S. H. Revusky, *Science* **134**, 328 (1961).
2. W. K. Estes, *Am. Psychologist* **12**, 609 (1957).
3. K. Spence, *Behavior Theory and Conditioning* (Yale Univ. Press, New Haven, 1956).
4. E. Brunswik, *Psychol. Rev.* **50**, 255 (1943).
5. As for alternation experiments of the type mentioned by Behrend and Bitterman, their purpose is to show how the outcome of one trial can be a discriminative stimulus for the following trial. This has not been the usual purpose of probability learning experiments, and I eliminated such stimulation in my experiment by spacing the trials a day apart.
6. Among my 19 rats, there was one instance more extreme than that cited by Behrend and Bitterman at the end of their paragraph 2.
7. If randomness is part of the definition of matching, the binominal theorem can be used to assess whether or not matching occurred, with the outcome of each trial used as a statistically independent item. By this criterion, most of the demonstrations of matching cited in paragraph 4 of the note by Behrend and Bitterman are invalid. By con-

ventional standards, these demonstrations are acceptable (except for the second Bitterman, Wodinsky, and Candland experiment, in which conventional use of the *t*-distribution reveals a probability significantly higher than matching), but if Behrend and Bitterman wish to establish new standards, they should adhere to them.

8. I will take this opportunity to correct an error of transcription which appeared in my report. The Kendall *W* had 2 degrees of freedom, not 18.

## Tobacco and Health

The report on the formation of the Tobacco Advisory Committee [*Science* **136**, 972 (1962)] raises some questions concerning the role of this committee.

As stated by the Surgeon General, the mission of the committee is to "make whatever recommendations may be appropriate" regarding the tobacco-health problem. The practical effect of such vague and general instructions may be to insure a long period of delay before the committee can tackle its main job. The unofficial goal, as reported in *Science*, is "to move the government off center on the tobacco issue without delivering too severe a jolt to the tobacco industry." While this implies an interest in protecting the American public against the health hazards of tobacco, it suggests as great or even greater concern for the welfare of the tobacco industry.

What useful purpose can be served by another committee to "study" the tobacco and health issue? The subject has already been studied by at least ten official and voluntary research and health agencies. Studies have been made in the United States, Canada, Great Britain, and the Netherlands, and by the World Health Organization. In 1959 the U.S. Public Health Service reviewed the matter. All these studies came to similar conclusions: tobacco (particularly cigarettes) constitutes a serious health hazard for its users. In addition to its role in lung cancer, tobacco plays a role in cardiovascular and other diseases. It is doubtful if a Tobacco Advisory Committee review could add much to the excellent summaries already available—particularly the most recent one by the Royal College of Physicians of London [*Smoking and Health* (Pitman, New York, 1962)].

Since the evidence concerning smoking as a health hazard has been assembled, summarized, and presented so often in the past, there is little excuse for a long delay in answering the question: Is there sufficient health hazard from smoking to justify doing some-

thing about it? Allowing at most a month or two for preparation, if this committee means business it should be able to reach a decision on this question in a 3-day meeting. But *Science* reports that at his news conference President Kennedy stated that the study would "take some months or go into 1963."

The new committee was set up in response to the pressures generated by public health action abroad—especially in England—and by newspapers and magazine articles at home. The reawakened public interest in the tobacco and health problem will diminish and die down if the committee stalls for 6 months or a year. The composition of the committee seems ideal for such delay. The Surgeon General has announced that "previously uncommitted scientists" would be appointed to the committee. This "sounds good," but its practical effect is to eliminate the scientists who have had first-hand experience with the major surveys and studies on tobacco and health. Indeed, the controversy has dragged on so long and the evidence presented has been so voluminous that there are very few experts in this area who have been unable to make up their minds about the matter. But while the scientists are supposed to be "uncommitted," the tobacco industry, according to the *Science* report, is to be directly represented on this committee.

Although the first major papers on cigarette smoking and lung cancer appeared in 1950, little public action to control the health hazards of tobacco has been taken in the United States. A conservative estimate of the price of this delay is a quarter of a million unnecessary deaths (and the accompanying suffering and economic loss). This delay is *not* happenstance. The tobacco industry has mounted a well-organized and well-financed public relations campaign. The industry experts have developed obfuscation and special pleading into a fine art. A good example of the use of irrelevant and incompetent material to confuse the issues can be found in the industry publication, *Tobacco and Health*. This propaganda bulletin is a very clever imitation of a scientific publication. If given an opportunity, the industry public relations experts could stall the Tobacco Advisory Committee "into 1963" or indefinitely.

In view of the ambiguities and questions concerning the role of the committee, the scientists serving on the committee will bear a double burden. Apart from their official responsibilities they must see to it that the committee is not used merely as a device to cushion the industry against "too severe a jolt." If the committee is unwilling or unable to reach a prompt decision on the health hazards of tobacco—a decision that can lead to effective public health action on this issue—then those scientists who put the public welfare before political or personal considerations should either vote to dissolve the committee or resign from it.

There is an important role that the Tobacco Advisory Committee *could* play—one which would not merely duplicate the activities of the previous committees and commissions. The new committee could move on to the crucial question: What measures are likely to be effective and feasible for reducing the harmful effects of smoking (of cigarettes, in particular) on our population? The question of preventive measures broadens the area of inquiry. In addition to the material relevant to hazard, it brings in the viewpoints and findings of various medical and behav-

ioral disciplines related to public health (for example, epidemiology, sociology, psychology, and public health education). We hope the committee will include in its membership persons competent to advise in these areas, and that the committee will devote its major efforts to considering what can be done to meet the complex problem of minimizing the health hazards of tobacco.

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## Martian Antifreeze

Reading Frank R. Salisbury's highly stimulating "Martian biology" [*Science* **136**, 17 (6 Apr. 1962)] made me feel again the importance of interdisciplinary communication. Although Salisbury did not mention it, glycerol may well be an extremely important element in the metabolism of living things on Mars, where the temperature alternates between freezing and thawing each night and day. Glycerol is a product of glucose metabolism and is formed in large amounts by certain microorganisms and even by some insects. Its ability to protect cells, tissues, and protozoa against damage from freezing to low temperatures is well known, and indeed it is used routinely in the preservation of spermatozoa and red blood cells [see, for instance, A. U. Smith, in *Biological Applications of Freezing and Drying*, R. J. C. Harris, Ed. (Academic Press, New York, 1954), pp. 1–62]. It is tempting to speculate that glycerol, ethylene glycol, or some similarly acting compound may protect the Martian organisms during their nightly freeze to −100°C and leave them free to metabolize when they warm up in the daytime.

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The interesting suggestion by Levine that glycerol might provide the necessary protoplasmic antifreeze for survival during the Martian night is certainly a good one. I have often thought in terms of such protoplasmic antifreezes but lacked the specific information cited by Levine. Because of this it had seemed more likely to me that Martian "plants" might simply freeze and survive the freezing, but at this

stage of the game I am completely open-minded concerning anything which may be encountered when we finally arrive on the surface of Mars. It is quite reasonable to expect that many of our sciences, interdisciplinary and otherwise, will bloom forth in an almost unprecedented manner after this momentous event.

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## Questions and Answers

A recent editorial [*Science* **136**, 231 (20 Apr. 1962)] offers some almost irresistible questions.

1) (Are scientists unfeeling or passionate?) Of course they have their feelings in perfect balance. You will probably get letters declaring this in passionate terms.

2) (Are political and scientific freedom related?) Scientists see red whenever freedom is mentioned, any kind. But don't let public opinion polls be used to demonstrate truth. Cupidity, curiosity, and/or love of power are more common than debates over freedom, in and out of science.

3) (What do laymen do when scientists disagree?) They decide. They have to. It occurs daily. Politicians disagree, so laymen select presidents. Doctors disagree, so laymen choose the path to follow. Scientists disagree, and laymen put their bets on one or the other. Players disagree, and a layman, the umpire, decides. Lawyers disagree, and jurists and juries declare answers.

4) (What is different about what a scientist does?) Not a thing, except that he polishes the brass "SCIENTIST" on his door before going to work. The idea that a scientist is something apart, or something to which to aspire, is a carefully nurtured illusion.

5) (Are scientists unusually moral?) Faking experiments is rare, but the facts around us cannot be faked. The test tube never lies; the experiment is never wrong. Errors arise occasionally in observations but commonly in interpretations and deductions. Except for a degree of wariness or special familiarity with his subject, the scientist is no better than anyone else in moral outlook. In effect, he may well be worse, because of the well-fostered notion that he is faultless, or that objective attitudes lead always to truths.

Whether scientists are the ones to decide about scientists might be debated. On the whole, perhaps this form of gossip should be discouraged, if only because discovery of the truth might injure their status as recipients of hero worship.

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## Programmed Instruction and the Arts

With reference to the editorial "But you have premises to keep" [*Science* **136**, 837 (1962)], while the objections to the technique of programming evident in *Poetry 230* are well taken, it does not necessarily follow that the type of subject matter treated in this text is inherently unsuited for programming.

The editorial did not make clear to me whether its author considered poetry in general, or Frost's short poem in particular, unsuitable. However, the main question appears to me to be: What does one want from an analysis of a work of art (literary, musical, or other)? It seems to me that no analysis —whether by text, college professor, or teaching "machine"—can make a student like, or even appreciate, art. What can be done—and perhaps the only thing that can be done—is to instill in him an understanding of the ideas of the artist and of the materials and techniques which the artist uses in his attempt to communicate these ideas. Clearly, if a sensitive student can understand and appreciate Frost on first reading, then for him it makes no difference how a supplementary analysis is presented, for he will be able to see these techniques in the light of feelings which the poem has already evoked in him.

For the student who cannot appreciate a particular work of art, it is necessary to prepare a background and an analysis. While all that may be necessary to comprehend a Frost poem is careful rereading, there is a wealth of fairly subtle constructive techniques employed in each one. To direct the student's attention to these, and to get him into the habit of looking for such techniques, may be just the stimulus needed to evoke genuine interest and appreciation.

We are, therefore, led to ask: Can a well-programmed text help the student to acquire the sensitivity and background necessary for the development of appreciation? To this I think the answer is yes. In fact, I should think the programming techniques come as close as possible to a serious classroom discussion headed by an inspired professor. Unlike a textbook, a good program demands that the student be continuously thinking and applying what he has learned to new situations. I have noticed that many students whom I have tested on various programs show a marked increase in reading sensitivity. The good programs capture a certain acuteness and sense of discovery which are extremely important factors in learning to appreciate poetry, music, and literature.

Programmed learning is a relatively new technique, one that, unfortunately, has been used by many who have failed to master it. In particular, its application to the arts has been, so far, rather clumsy. Eventually some sensitive artist, musician, or poet with a gift for writing will come along and show us how it *should* be done. Just as programming in the hands of some mathematicians has taken much of the boredom from math and replaced it with insight and excitement, so may programming yet serve the other branches of the arts and sciences.

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The most inexperienced programmers realize the danger of analyzing a single frame (item) out of sequence and context. Yet the writer of the editorial "But you have premises to keep" attempts to do exactly this, selecting the following frame for his excursion into literary criticism: "Even Frost would probably not have forced so much rhyme on himself if he had planned a long poem. Since he doubtless had a hunch that this was to be a _____ rather than a long poem, he decided to increase the difficulties of his rhyme game still more."

The primary objection given is that "the basis for a hint is supposed to be something more than the redundancy of a sentence made redundant for no other purpose."

The only redundant portion of this frame is the phrase "rather than a long." The purpose of this phrase, as any programmer will recognize, is to provide a thematic prompt (by introducing contrast) for the correct response, "short." A rereading of the article

"Teaching machines" [*Science* **128**, 969 (1958)] will show that redundance didn't seem to bother B. F. Skinner. Indeed, his sample frames on the spelling of the word *manufacture*, are most redundant, by the standards of the editorial.

Incidentally, concern over redundance is not reflected in one of the sentences of the editorial: "the basis for a hint is supposed to be something more than the redundancy of a sentence made redundant for no other purpose."

The fourth paragraph sets forth this interesting non sequitur: "A little programmed learning is a dangerous thing. But better understanding would not mean doing a better job; it would mean not attempting the job in the first place."

Isn't the criterion for the presentation of learning material via programmed instruction to be found in the teacher's ability to specify what verbal behavior the student is to have in his repertoire after completing the course? If this "desired terminal behavior" can be explicitly verbalized, the material can be effectively programmed, often as an enriching adjunct to the total classroom scene.

The last sentence of the editorial poses some interesting questions. It reads, "There should be warning enough in the contrast between the pretentiousness of this exercise and Frost's poem itself, 16 short lines of simple narrative." Do we take this to mean that analysis of any "simple narrative" is wrong, since the length of the analysis must exceed that of the narrative? (In his 1958 article in *Science* Skinner outlines a method of studying poetry at the high school or college level, spending "20 or 24 frames on four lines of poetry.") Such thinking smacks of the unscientific and anti-intellectual views of the 19th-century Romantics—that to analyze a work of art is to strip it of its beauty and meaning.

To be sure, there are gifted students who have learned to read such "simple narratives" critically and in depth without help from teachers or others. But for most students, this form of verbal behavior, like most others, is arrived at by imitation—that is, with the help of one whose repertoire of experience is worth sharing and whose ability to point out latent, symbolic, and secondary meanings will enhance enjoyment of the learning process in general and of the reading of poetry in particular.


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