SCIENCE

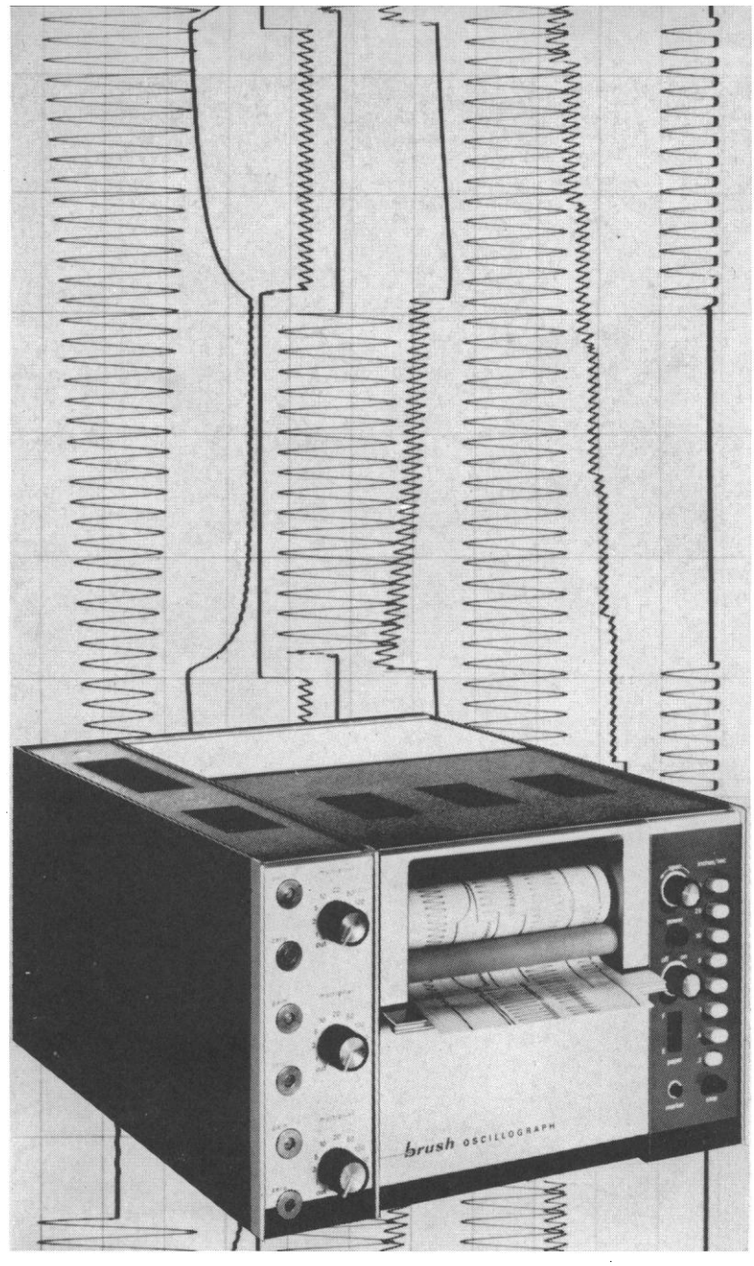
12 July 1963

Vol. 141, No. 3576

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

CONVERSION OF MONTMORILLONITE

Brush lightbeam recorder eliminates RFI with silent light!



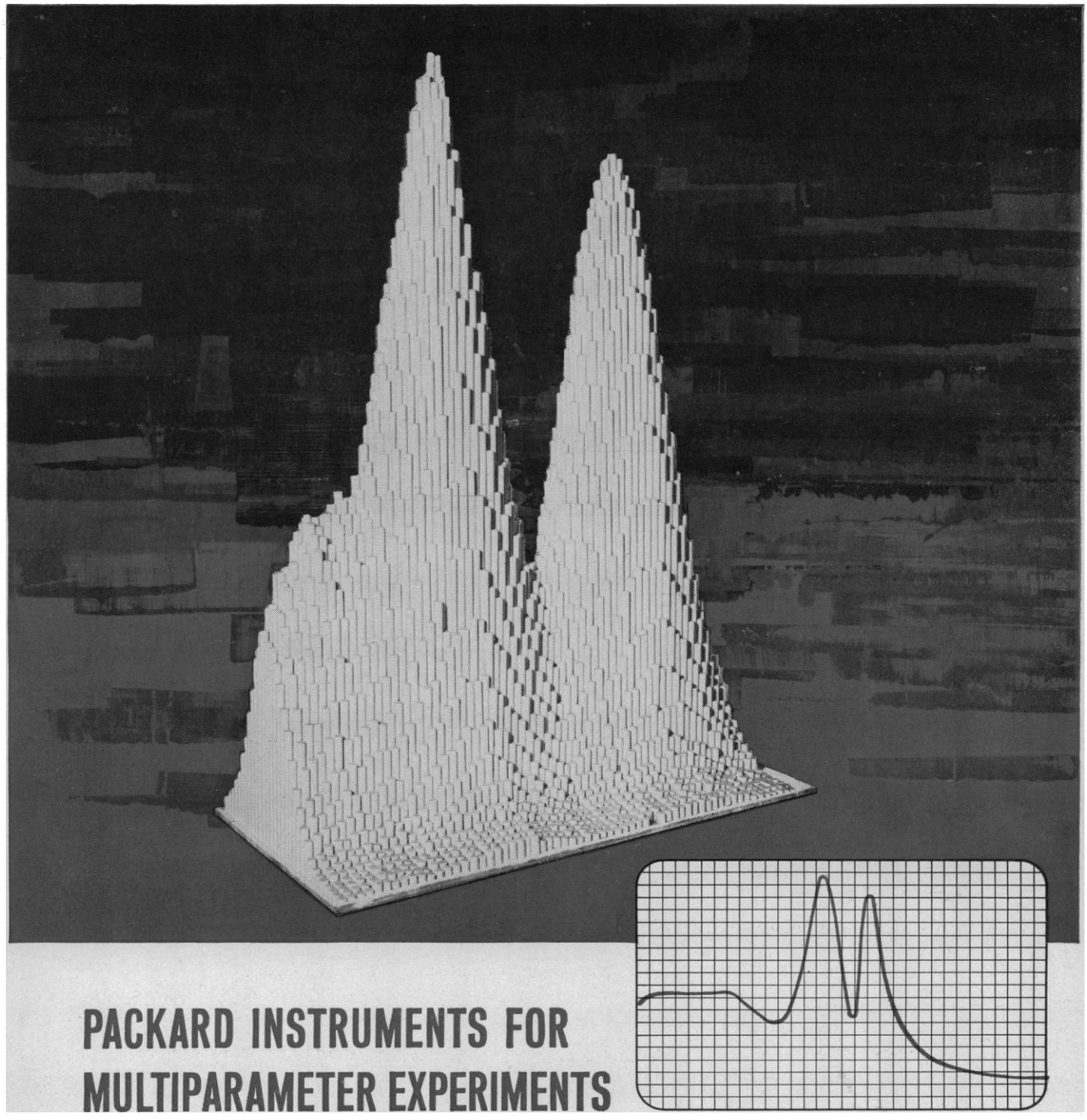
The unique incandescent optical system of this new direct-print oscillograph completely eliminates confused data caused by generation of RF interference into associated equipment. It is the only lightbeam recorder that meets RFI specs . . . MIL-I-26600 and MIL-I-6181D. Whether your application is industrial or aero-space, check out these important facts.

Start and Re-start Recording time . . . 50 milliseconds
Writing Speed . . . Greater than 30,000 in./sec.
Companion Amplifiers . . . Especially Designed
Complete Line of Accessories
8 Pushbutton Record Speeds
Internal Chart Take-up
High Contrast Traces
16 Channels

Now you can record over the whole range of most-used frequencies with Brush systems incorporating all the known refinements in oscillography. Write for full details.

brush INSTRUMENTS
DIVISION OF CLEVITE 37TH AND PERKINS, CLEVELAND 14, OHIO

Circle IFC on Readers' Service Card



PACKARD INSTRUMENTS FOR MULTIPARAMETER EXPERIMENTS

Research workers in high energy physics, and those dealing with complex multidimensional spectrum analysis can now choose—from the most complete system of data analysis, storage and recording instrumentation—the equipment best suited to their experimental requirements.

The capability of Packard multidimensional data handling units to analyze, sort out and store simultaneous or correlated values of parameters defining nuclear events has been demonstrated in advanced research projects. More than fifty multiparameter analyzers of this design are now at work in research laboratories—primarily in Europe. Designed around the modular concept, Packard Analyzers permit complete flexibility in the choice of input, output, data handling and storage capabilities. For more information on Packard Multichannel and Multiparameter Analyzers, call your Packard Field Engineer, or write for Bulletins.

Packard

PACKARD INSTRUMENT COMPANY, INC.

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12 July 1963
Vol. 141, No. 3576

SCIENCE

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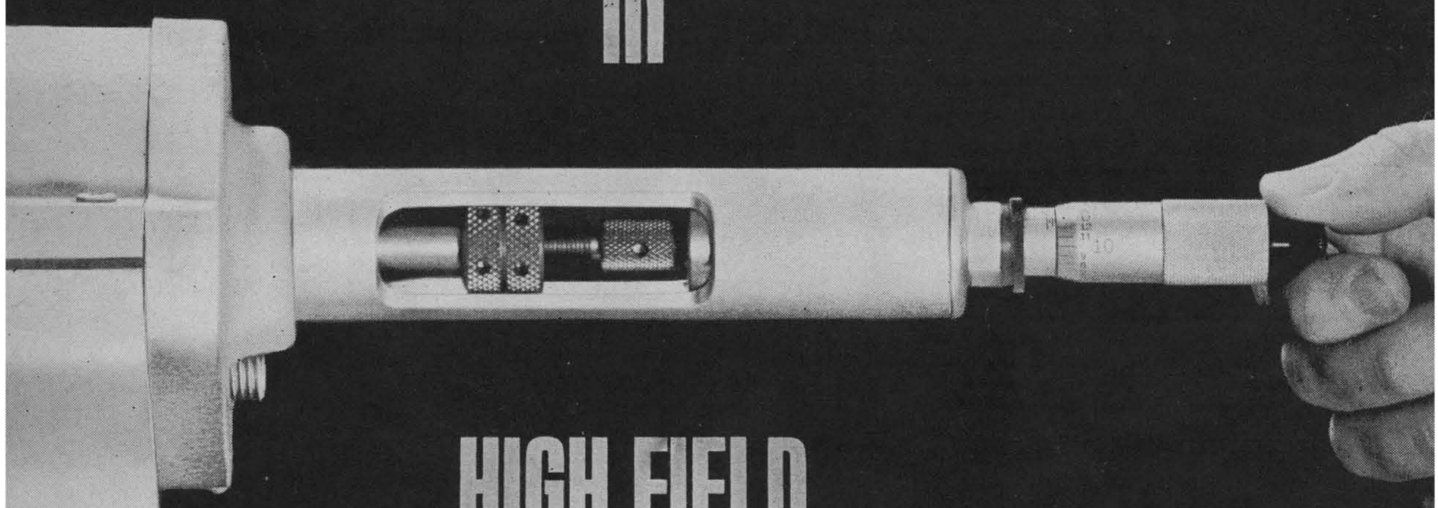
COVER

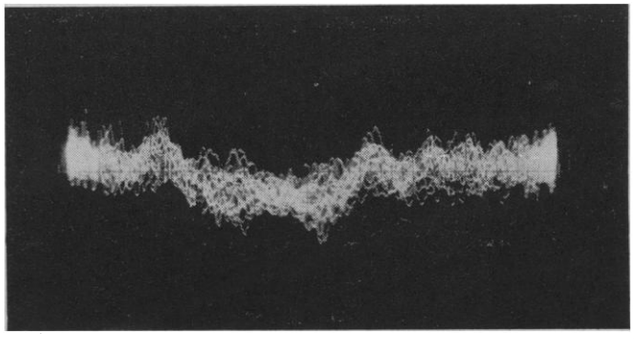
Platinum-shadowed electron micrograph of kaolinized montmorillonite. Hexagonal plates of kaolinite grew by lateral epitaxy from mixed-layer montmorillonite-kaolinite. Tiny rune-shaped crystallites in center of field are a templated growth in morphological orientation to large plate and underlying sheet (× 55,700). See page 148.

NEW JJ-SHIM* MAKES MAJOR ADVANCE IN HIGH FIELD UNIFORMITY

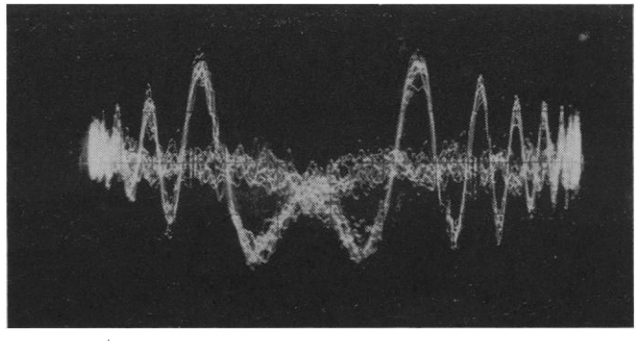


*Patent applied for.

No longer is it necessary to sacrifice field uniformity to achieve required high field strength! The new μ-SHIM by Harvey-Wells makes possible precision research and experimentation at field strength levels unavailable until now in standard size electromagnets. It allows continuous precision adjustment of pole faces to increase the volume of field uniformity, or to increase the degree of homogeneity within a fixed working area.



With optimum pole face alignment, a Deuterium resonance at 25,000 gauss in 1.75 inch gap was only vaguely discernible.

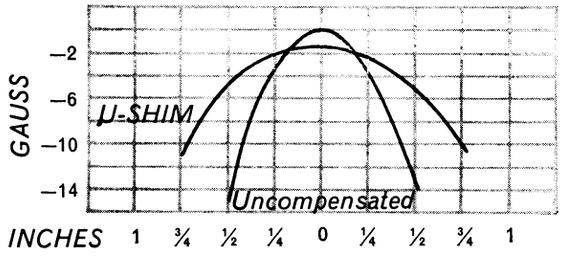


Upon insertion of the μ-SHIM, the signal-to-noise ratio was improved by a factor of four as a result of the improved uniformity.

The μ-SHIM is simply a micro-adjustable, ferromagnetic alloy rod which optimizes homogeneity at any desired field strength setting. It does not protrude into the magnetic gap and does not interfere with placement of Dewars and experimental apparatus. Unlike other shimming techniques, it requires no auxiliary power supply and can be adjusted during operation.

This unique device compensates for field gradients both axially and radially. Although the μ-SHIM is most effective at higher field strengths (17,000 gauss and more) it is also suitable for correction of flux distortion at lower field strength levels.

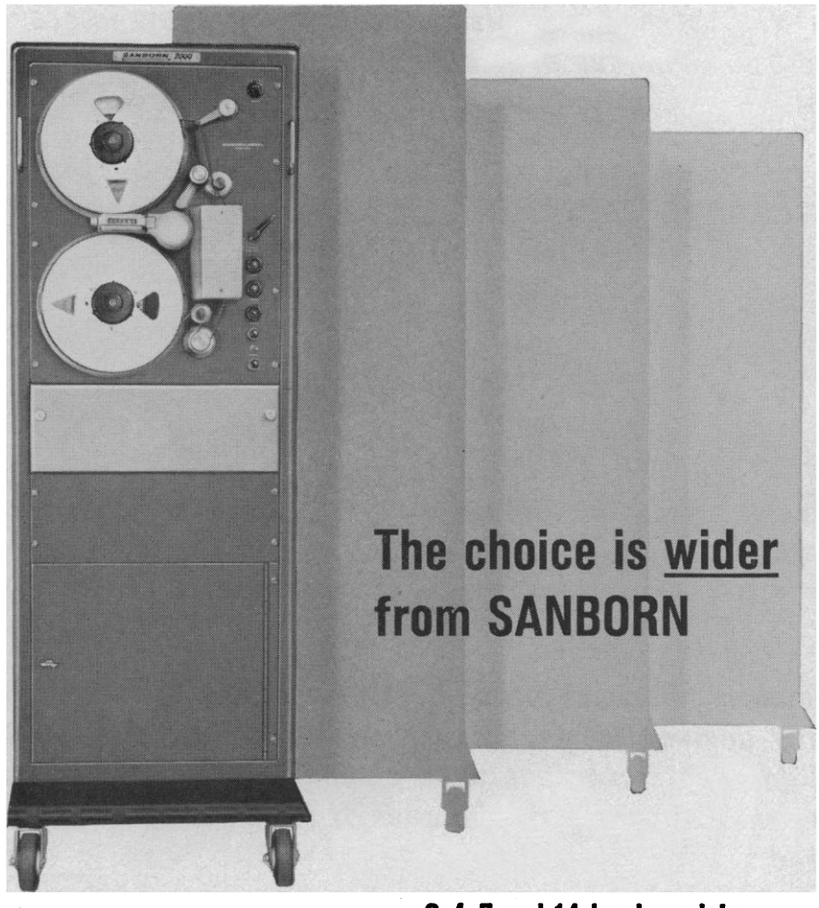
RADIAL FIELD GRADIENTS UNCOMPENSATED POLE FACES VS. μ-SHIM



Magnet.....Harvey-Wells Model L-128A
Magnetic Air Gap.....1.75 inches
Pole Face Diameter at Gap.....6 inches
Field Strength.....17,000 gauss

The μ-SHIM is available for all Model L-128A and Model L-158 Electromagnets.

HARVEY-WELLS CORPORATION FRAMINGHAM, MASS. TELEPHONE (617) 872-4365



2,4,7 and 14 track models . . .

Numerous accessories for greatest recording flexibility

Now you have virtually a "*custom*" choice of magnetic data recording systems — at *standard equipment prices.* Basic Sanborn tape systems now include 4-speed and 7-speed models with 7 tracks and ½" tape, 7-speed model with 14 tracks and 1" tape. All conform to IRIG instrumentation standards for track width, spacing, and FM center carrier frequency and frequency deviation. This feature assures tape compatibility with many other systems. Also, soon to be introduced are new 4-track, 4-speed and 2-track, 2-speed models utilizing ¼" tape. Most of these systems may be equipped with your choice of a wide variety of accessories, such as a precision *true* footage counter to insure complete accessibility of data; push-pull input coupler; voice channel amplifier; loop adapter for repetitive playback; provision for remote control of many functions; mobile console or portable case packaging.

All systems use Sanborn solid-state circuitry of proven dependability for FM and Direct electronics. FM or Direct Record/Reproduce inserts for each channel are interchangeable and use individual plug-ins for recording speed desired. Record and reproduce circuits on the same cards permit monitoring of data from tape as it is recorded. Maximum capability in this family of magnetic data recorders is 100KC for direct mode and 10KC for FM at 60 ips tape speed. FM record/reproduce linearity is ±0.5% using 40% modulation.

Call your Sanborn Branch Office, or the Medical Research Instrument Sales Manager in Waltham, for complete specifications, price data and application assistance.

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

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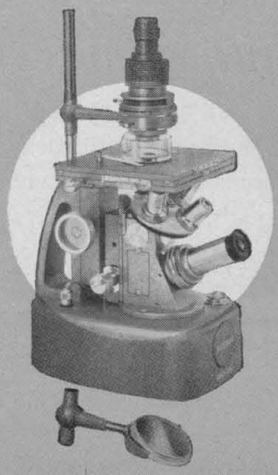
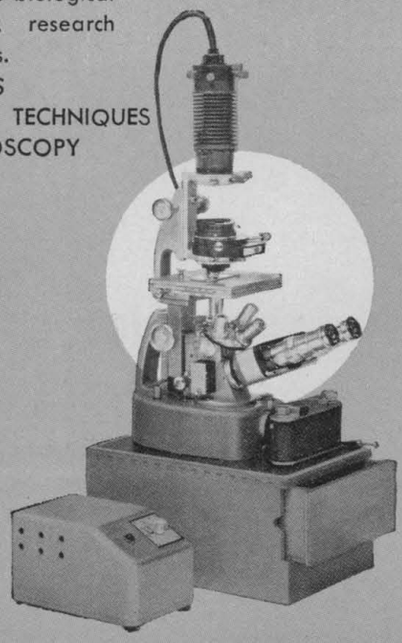
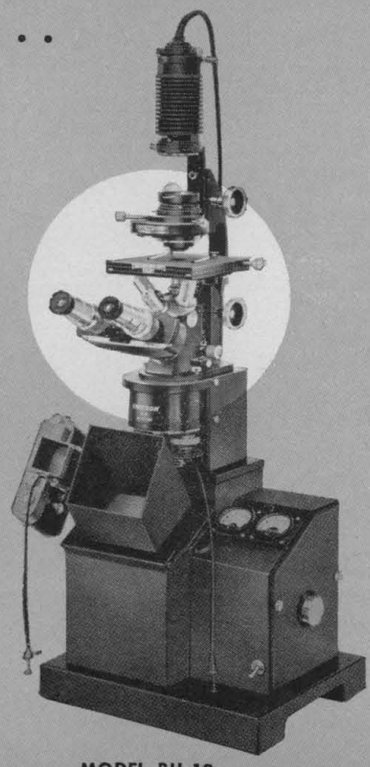


MODEL MIC



MODEL PH-BMIC



MODEL BU-13

INVERTED LABORATORY AND RESEARCH MODELS

Brightfield Laboratory Models:

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

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

Brightfield Research Models:

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

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

Phase Research Models:

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

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

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

CAMERA-MICROSCOPES

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

Brightfield Research Models:

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

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

Phase Research Models:

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

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

Only UNITRON Inverted Microscopes Offer ALL These Advantages

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

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

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new automatic HEMAGGLUTINATION – HEMOLYTIC techniques

...introduce quantitation

with unique decantation principle that "puts a number" on end result. Traditional laborious hemagglutination-hemolytic techniques are so subjective that results may vary considerably from lab to lab. At best, answers are merely *qual*itative.

The AutoAnalyzer method not only standardizes and automates the procedure (in itself a considerable achievement), but it "puts a number" on the end result: expresses answers directly in *% agglutination or % hemolysis.*

The whole procedure is a simple, straightforward chemical method under precise control every step of the way... cell/anti-serum volume, reagent proportioning, mixing, time/temperature, etc. Equipment is rugged and simple, even down to the readout, which is colorimetric rather than cumbersome complicated electronic counting devices.

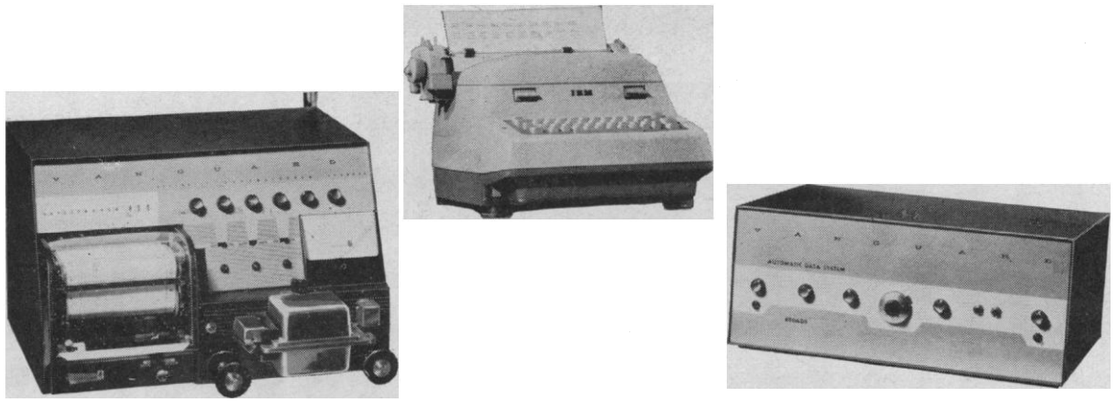
Beyond its use for routine blood typing and assay, the new method promises to open broad avenues of investigation in all fields where antigen-antibody reactions are measured by hemagglutination or hemolytic reactions.

enlarged view of agglutinates being separated by decantation from the analytic stream. Reaction-produced agglutinated cells travel along with the stream: being heavier they drop to the bottom. On arriving at the "T" junction, the heavy agglutinates are drawn off: unreacted cells move on to hemolysis and colorimetry. Where hemolysis is to be measured the cells are decanted off and the hemolyzed material read out.

TECHNICON®
AutoAnalyzer®

Technicon Bulletin H-1 gives details of the technique, with diagrams of instrumentation and flow, examples of the definite recording. Write us at the below address for a copy.

TECHNICON INSTRUMENTS CORPORATION
Research Park • Chauncey, New York

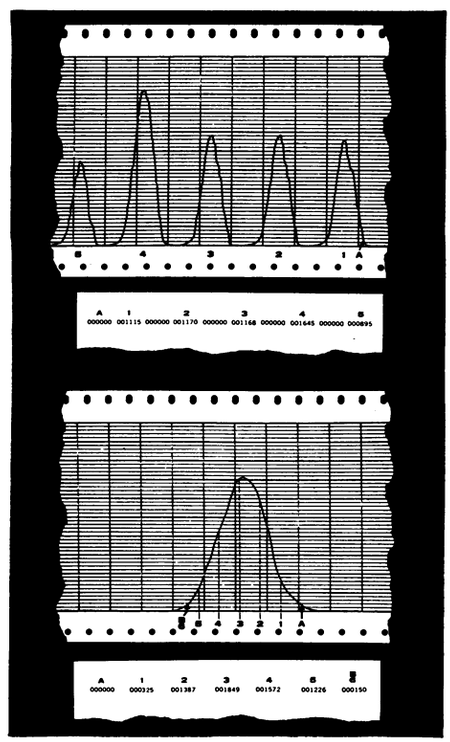


OUTSTANDING PERFORMANCE

IN AUTOMATIC CHROMATOGRAM SCANNING

Outstanding is indeed the word for the performance of Vanguard Model 880ADS Low Background Autoscanner with Automatic Data System. Now you can automatically perform both qualitative and quantitative assays of chromatograms on the intact strip . . . with an accuracy and efficiency never before possible. This exclusive system scans, detects and presents radioactivity in direct digital form. It completely eliminates mechanical integration, planimetry and triangulation. No painstaking cutting, eluting and counting of radioactive zones on strips.

Vanguard's Model 880 Autoscanner is the most sensitive instrument ever designed for scanning tritium, carbon-14, sulphur-35 and other low-energy, beta-emitting radioisotopes. It features windowless, 4 pi detection with a total background of less than 10 cpm. Completely transistorized for long performance, dependable performance. 10 scanning speeds, 5 rate meter time constants, 7 count rate ranges, 5 individual slit width collimations.



Two modes of Data Presentation are available with the Model 880ADS. Digital information obtained in the Peak Print mode (above) and the Interval Print mode (below) is utilized through all phases of the quantitating procedure.

For complete information on the most sensitive scanning system you can buy, write today for this informative brochure.

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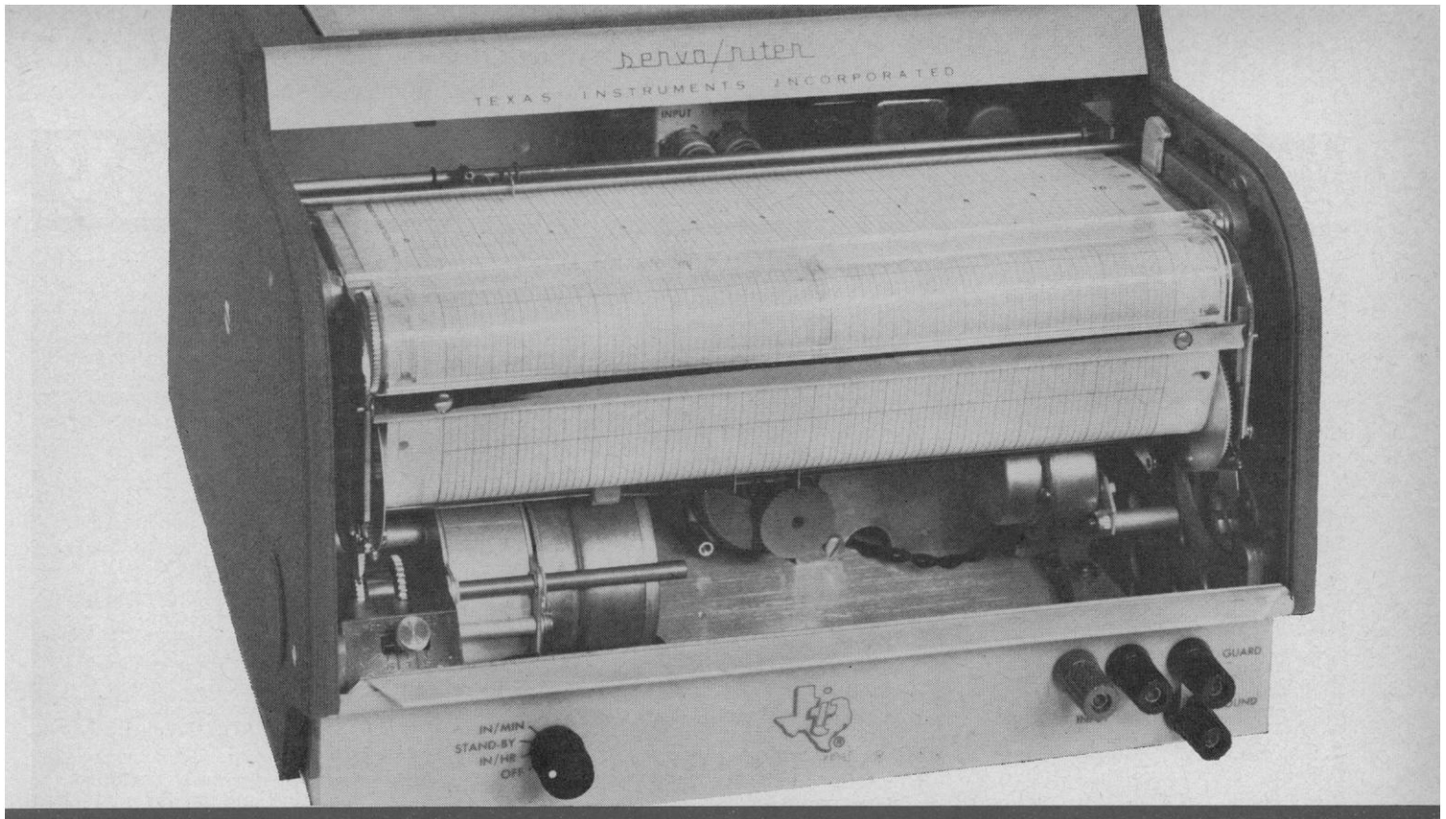


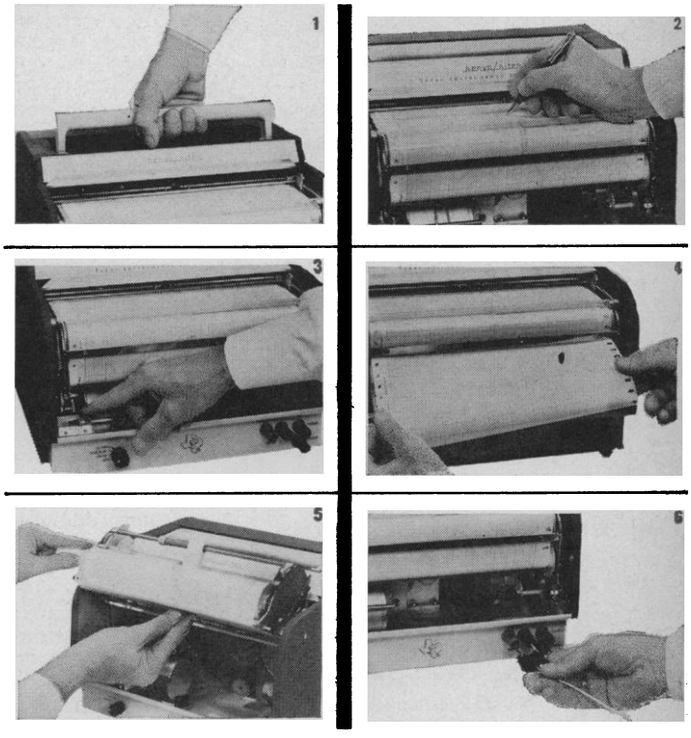
Six reasons servo/riter* recorders are first choice for the laboratory

There are dozens of reasons *servo/riter* recorders are first choice for laboratory applications . . . here are just six.

1. True laboratory style . . . can't tip over, readily carried in one hand. Compact, lightweight, takes up a minimum of space.
2. Writing-desk chart carriage . . . permits jotting data while recording.
3. Finger-tip speed changer . . . front panel selection of ten chart speeds.
4. Automatic chart take-up . . . recorded chart can be pulled out for inspection . . . quickly respools without interruption.
5. Easy chart loading . . . swing-out chart carriage is easiest to reload, saves time.
6. Front terminals . . . readily accessible five-way binding posts . . . guarded, floating or grounded input.

These features plus highest performance specifications, widest selection of ranges, inputs, references and accessories make *servo/riter* recorders the first choice. Write for information.

*A trademark of Texas Instruments Incorporated.



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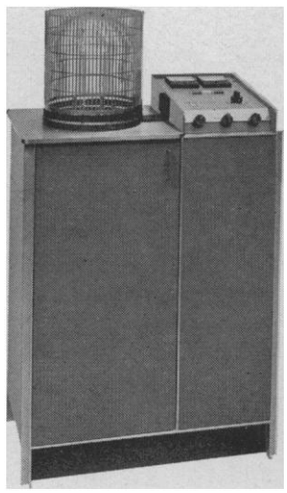
VACUUM SYSTEM CONTROLLERS
MOTOR-DRIVEN VACUUM VALVES



Model VE-10

MODEL VE-10 VACUUM EVAPORATOR

Pushbutton-activated, pressure-programmed, completely automatic. All valve changes occur automatically at the optimum points in the pump operating ranges. Requires no valving decisions by the operator other than depressing the proper pushbutton—no operator attention during pumpdown cycles or the 30-minute shutdown sequence. Typical pumpdown time—3 minutes to 1 x 10^{-4} Torr; ultimate vacuum with optional cold trap better than 2 x 10^{-6} Torr (standard 10″ bell jar). 16″ base plate—four 100 amp feedthroughs, one rotary manipulated from control panel, 10 feedthrough ports, accepts bell jars to 14″. Utilities—117 volt, 60 cps, single phase, 15 amp, NO AIR OR WATER REQUIRED. Completely self-contained, requires only 16″ by 27″ of floor space. Optional Accessories—cold trap baffle, discharge gauge, glow discharge unit, pumping station adaptor, various feedthroughs, thin film deposition accessories.
Price: $2500.00, availability 15 days.

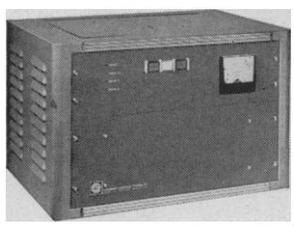
MODEL VE 10A—As above equipped with carbon and evaporation kit for electron microscope preparation. Price: $2560.00, availability 15 days.

MODEL VE-10 PS Pumping Station—Model VE-10 less bell jar, implosion shield, pump plate, feedthroughs and filament current systems.
Price: $2175.00, availability 30 days.

MODEL VE-10 PSB Basic Pumping Station for electron optical systems, beam analyzers, similar applications. Includes motor driven valves, air-cooled diffusion pump, mechanical pump, vacuum meter, three control panel pushbuttons.
Price: $2025.00, availability 30 days.

For additional information, refer to Catalog Sheets C-20, C-100.

NEW! **MODEL VE-20—AUTOMATICALLY CONTROLLED 4″ SYSTEM** expressly designed for semi-conductor, micro circuitry, final frequency crystal plating and similar production and research applications. Consult factory for performance data, prices and delivery.

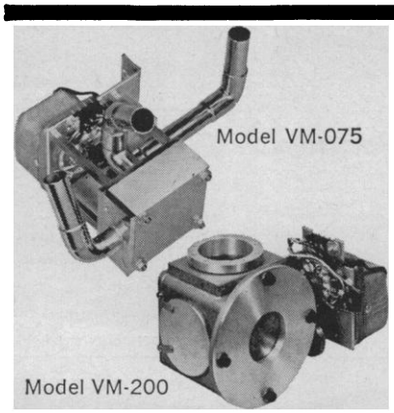


Model AC-1

MODEL AC-1 AUTOMATIC VACUUM SYSTEM CONTROLLER

The basic control system of the Model VE-10. Pressure-programmed, completely automatic. Controls any number or size of pumps—any size or type of power-operated valves. With optional interlocked circuitry can provide automatic control for such additional functions as gas backfilling, water cooling, oven heat. System includes control chassis, control panel with 3 control pushbuttons and vacuum meters, Pirani transducer and wiring harness, mounted on two standard 19″ panels in metal cabinet. Meter panel and controller panel may be remoted from each other up to 100′. Available with optional discharge gauge for extending ranges of vacuum monitoring and control. Price: $600.00, availability 30 days.

For additional information, refer to Catalog Sheet C-21.



MOTOR-DRIVEN VACUUM VALVES

Compact motor-driven valves for use in 2″ vacuum systems. May be controlled by rotary switch, pushbuttons, the Mikros AC-1 automatic controller and other control devices. High torque, unidirectional, direct drive motors. 2 ampere, 115 volts ac. Designed for convenient ease of inspection and maintenance.

MODEL VM-075 Roughing Backing Valve—O-ring sealed, two-way, minimum impedance to flow. Inlet-outlet lines ¾″ OD, nickel plated, silver-soldered to valves. Opens and closes in 1½ seconds. May be used in systems working in the 1 x 10^{-6} Torr range. Dimensions 8″ L x 3½″ H x 5″ W. Weight—9½ lbs.
Price: $150.00, availability 30 days.

MODEL VM-200 High Vacuum Valve—Rapid, full opening flap type. Opens and closes in one second. Motor-driven flap completely out of flow path in open position. Right angle construction provides optical bafflement and maximum conductance. Dimensions: 9″ L x 5½″ H x 4″ W. Weight—12 pounds.
Price: $250.00, availability 30 days.

For additional information, refer to Catalog Sheet C-25.

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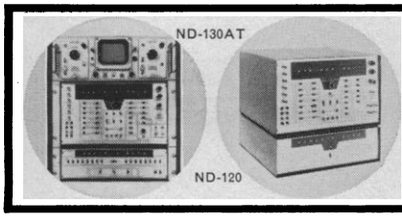
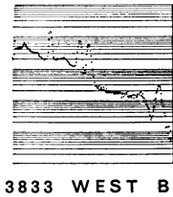
ELECTRON MICROSCOPES/HIGH VOLTAGE GENERATORS / VACUUM EVAPORATORS / VACUUM SPECIALTIES

We have discussed the ND-160 4096 channel analyzer in past ads in terms of its outstanding engineering and design features. (The brochure "More Data in More Ways" which covers this thoroughly is available upon request.) But there are other features of a secondary nature which "complete" the effectiveness of this instrument: ON-TIME DELIVERY, which means that it is *now in production*, ready for delivery; an INSTRUCTION MANUAL, which is clearly informative, helpful in its graphic aids, and attractively presented; EASE OF OPERATION, which is achieved through easily read controls and easy to turn knobs which are positioned wisely; STYLING, which is attractive, yet unobtrusive, permitting the operator to use the controls with a minimum of effort; PORTABILITY, which saw this analyzer travel extensively throughout the United States and Europe, bringing the instrument to the customer instead of the customer to the factory; RUGGED CONSTRUCTION, which proved the dependability of the *same* ND-160 to operate perfectly, without failure, after being "knocked around" literally in numerous trips around the country and abroad during the past six months.

If you wish to see a copy of the Instruction Manual illustrated above, or desire more information on the ND-160 series analyzers, write or phone Nuclear Data.



The Nuclear Data ND-130AT 512 channel pulse height analyzer/computer is the most dependable analyzer of its kind. These important features are *built-in*: Spectrum Resolver, Area Integration, Punch & Reader, and Typewriter Control. *In most analyzers these are added as design afterthoughts, at extra cost.* The ND-120 is also a 512 channel analyzer but without the Area Integration and Spectrum Resolving capabilities of the ND-130 series.



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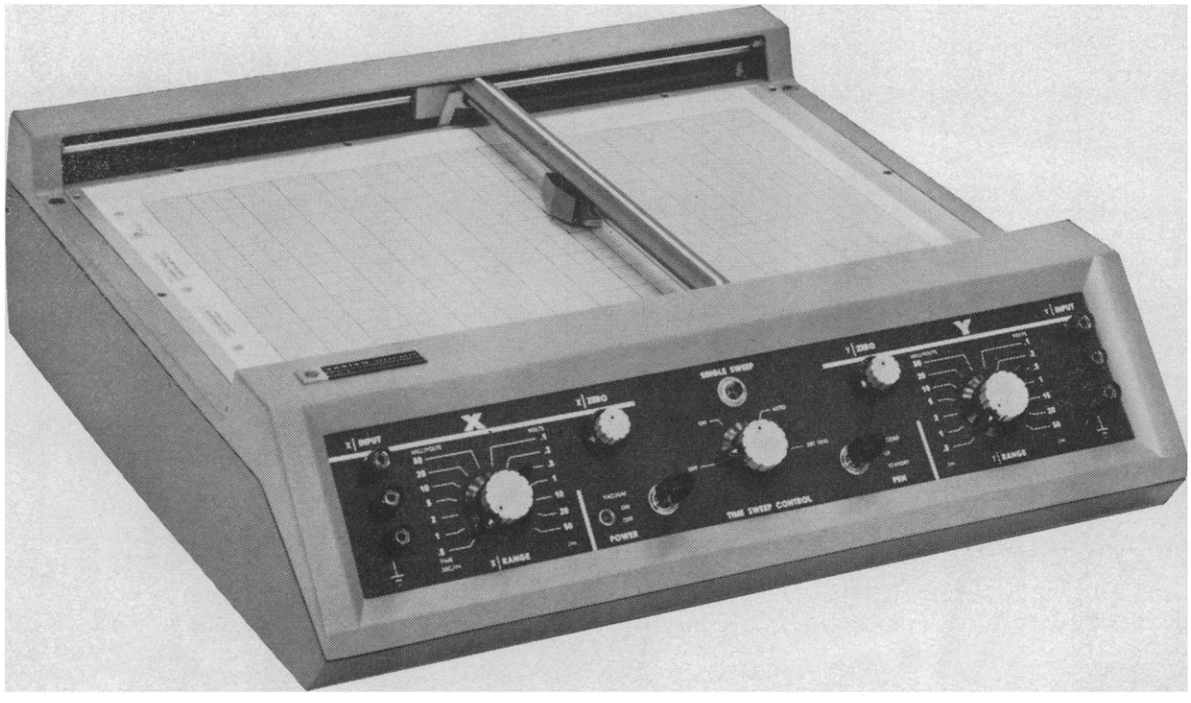

...and here are five reasons why it's really new:

1. Unique paper hold-down grips over entire platen surface. A maintenance-free vacuum hold-down enables you to use any size or shape of paper, from 2″ x 2″ to 11″ x 17″, without masking.

2. Built-in time base has seven fixed ranges from 50 sec/in to 0.5 sec/in, with adjustable margins and manual or automatic cycling.

3. Human engineering gives you new operating conveniences. Control panel is arranged to avoid confusion. Pen is held magnetically for easy servicing and color changing. Chart can be precisely positioned with vacuum on.

4. Rugged reliability is an important contribution to X-Y recording. All moving parts and paper hold-down system are mounted on one sturdy casting.

5. Flexibility for special applications allows operation of the translation and writing system remotely from the entire electronic package and controls. Convenient for building into test consoles, control panels, analytical instruments, etc.

Important features of the new F-80:

- all-transistor circuitry
- accuracy, 0.2%
- reproducibility, 0.1%
- 17″/sec pen speed
- 14 DC voltage ranges, 0.5mv/in to 50v/in
- vernier adjustment between ranges
- full scale zero plus 100% suppression
- exceptionally high input impedance
- zener diode reference
- excellent damping
- independent servo-operated X and Y axes
- weight, 29 pounds

Price: $2,025 in either bench-top or rack-mounting configuration. For further information or a demonstration write RECORDER PRODUCTS. In Europe contact Varian A.G., Zug, Switzerland.

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RADIOMETER

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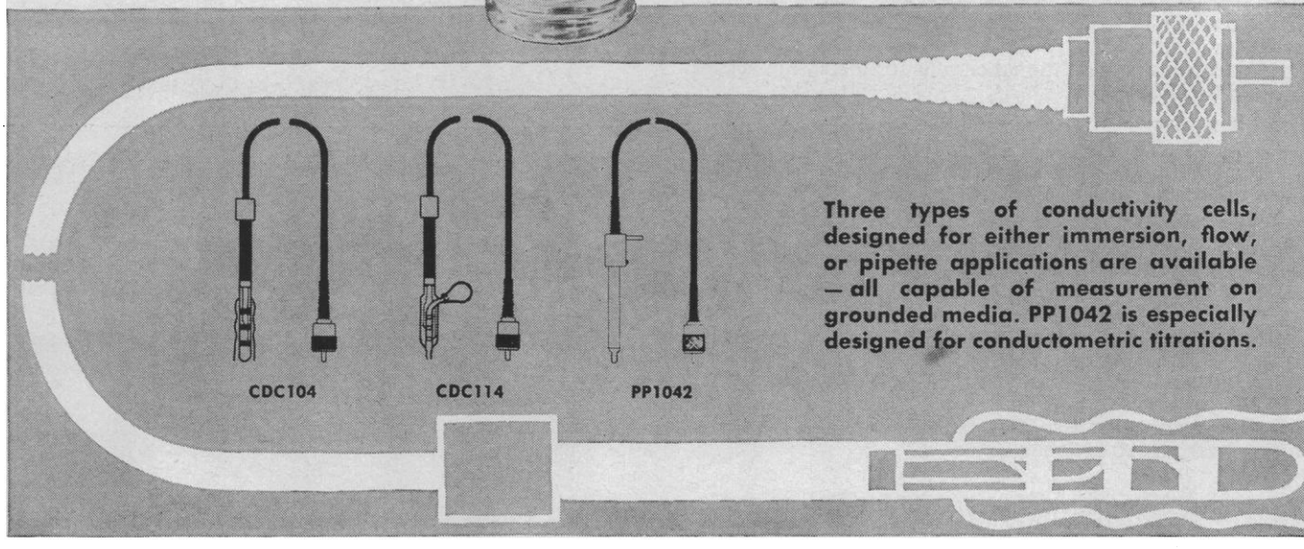
Conductivity Meter

type CDM2



Three types of conductivity cells, designed for either immersion, flow, or pipette applications are available — all capable of measurement on grounded media. PP1042 is especially designed for conductometric titrations.

The Radiometer Direct Reading Conductivity Meter fills a long-felt want in any laboratory. Without any sacrifice in accuracy it has been made more flexible and simple in operation than the ordinary conductivity bridge. Direct reading on all of 12 ranges — accuracies better than 1% to 2% are displayed instantaneously on an illuminated and mirrored scale.

With a choice of conductivity cells, it is ideally suited for all normal laboratory conductivity measurements as well as conductometric titrations. Simple to calibrate and use, it can be operated by untrained personnel if necessary, and can drive a recorder for continuous measurement.

Write for further descriptive literature and prices.

RANGES:

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Low-cost Metrion pH Meter is a line-operated instrument featuring a basic simplicity of design and operation which make it ideal for general-purpose laboratory use. With measurement accuracy to 0.05 pH, the Metr*ion* provides a level of performance far out of proportion to its moderate cost.

Features:

- Stabilized against line voltage fluctuations over 95-125 volt range.
- Easy-to-read duplex scales cover 0-14 pH range.
- Calibration control provides compensation for temperature effect.
- Simplified operation—"push-to-read" pH control.

Cost—only $139.00.

Increased versatility, Metrion II pH Meter offers the same simplicity of design and operation as the basic Metr*ion*. It also features two additional circuits for increasing versatility of the instrument:

...a true temperature-compensating circuit with a control knob conveniently located on instrument's front panel.

...an output jack for use with an automatic titrator such as the Coleman Titr*ion*.

Addition of these two circuits makes the Metr*ion* II valuable for an increased variety of specialized laboratory applications with only a small price increase.

Cost—$160.00.

Fully-versatile Companion pH Meter is a zero-restoring instrument ideal for a broad range of laboratory applications. It provides pH measurement over the 0-14 pH range with a routine accuracy of 0.05 pH and reproducibility within 0.02 pH. The instrument also may be used for millivolt measurements over a 1400 mv span.

Features:

- Zero-restoring circuit for drift-free operation.
- May be used with recorder, automatic titrator, and automatic temperature compensator accessory.
- Simplified control system for easy operation.
- Manual Temperature Compensator control permits accurate measurement over 0-100° C. range.

Cost—$300.00

Complete selection of electrodes—Coleman electrodes cover virtually every practical application of laboratory pH measurement. They are usable with any Coleman pH meter or other instrument of modern manufacture.

- Glass electrodes, shielded against stray electrical fields, permit precise measurement over widely-varying conditions of temperature, viscosity, alkalinity.
- Reference electrodes are available in standard calomel or non-mercurous types.
- Metallic electrodes for electometric titrations.
- Special-purpose electrodes for unusual applications.

Coleman electrodes are priced about one-third less than the closest competitive designs.

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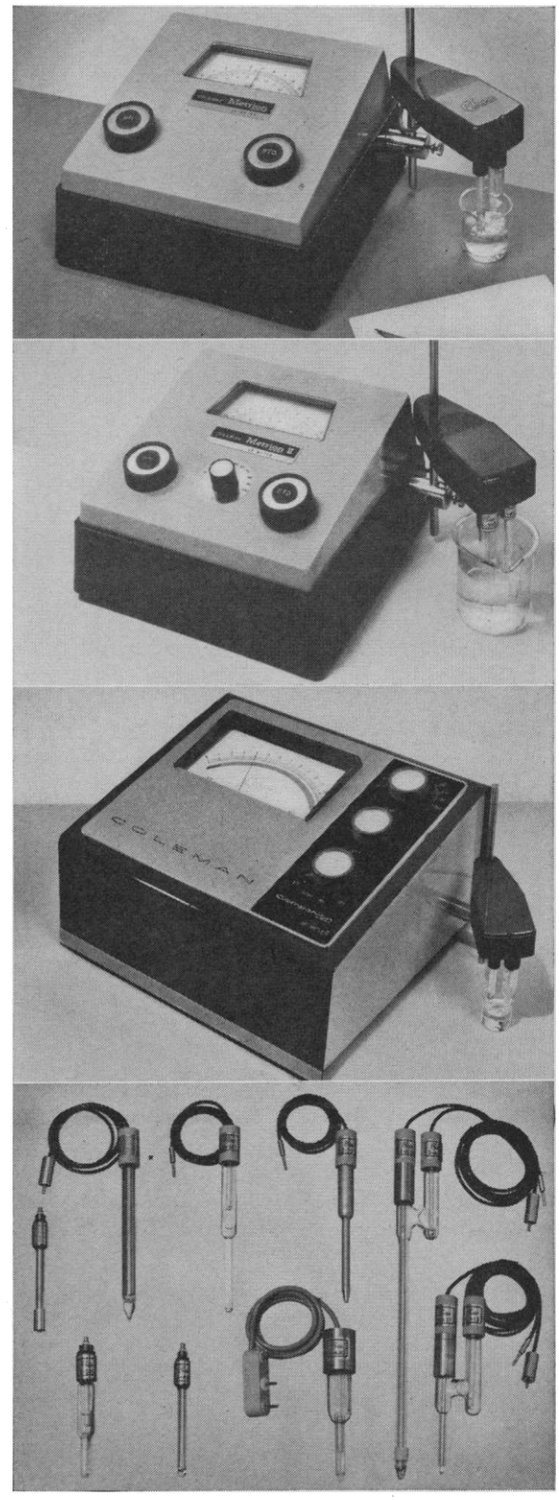

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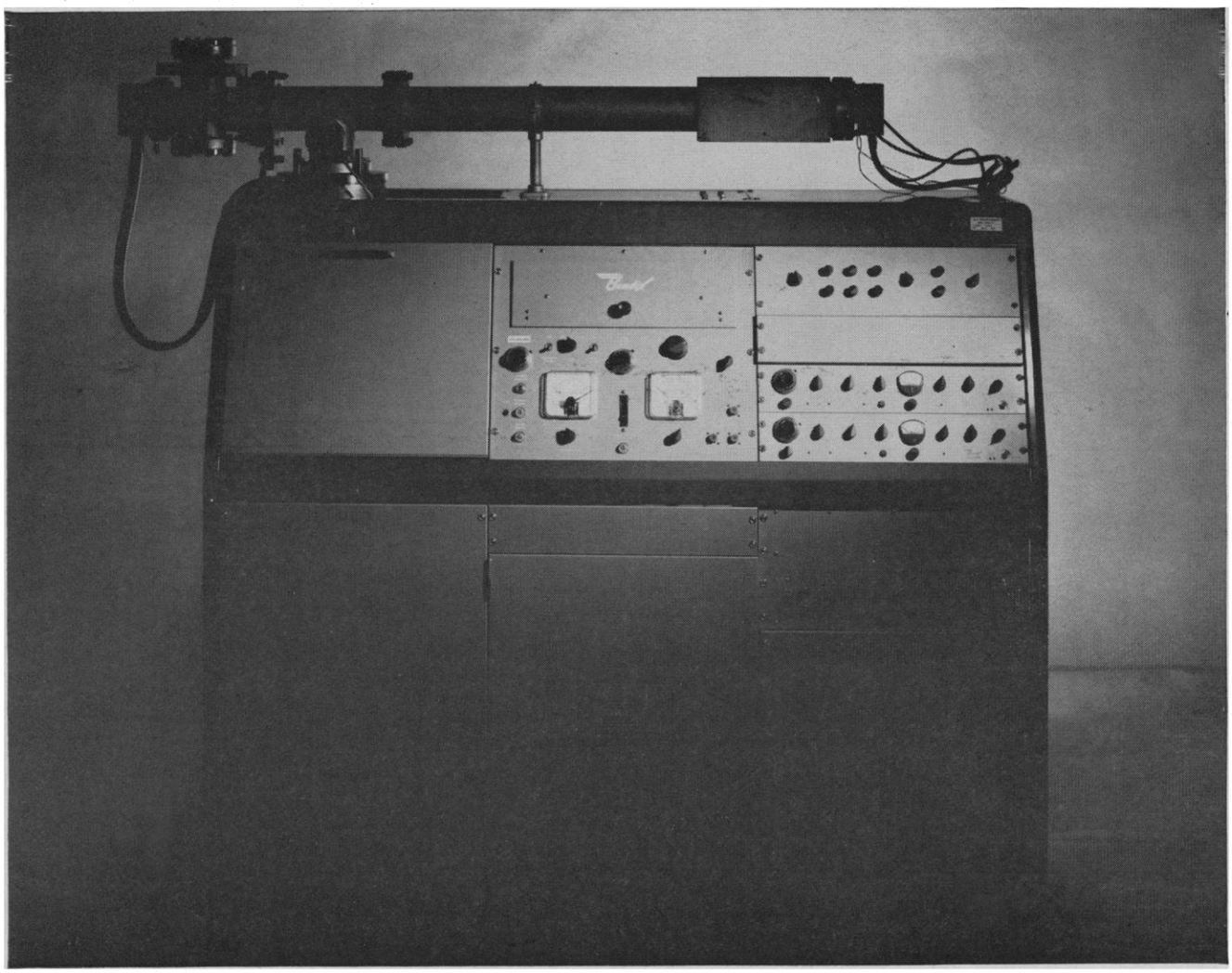

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There is something the Bendix® Time-of-Flight Mass Spectrometer won't analyze. Diamonds! But hand it any other material and you'll get your quantitative-qualitative analysis fast . . . and accurately. Its versatility is unsurpassed for analytical purposes, research projects or industrial process control.

Depending on project needs and equipment, you can get up to 100,000 spectra per second, unit resolution up to mass 350 and a sensitivity of 1 to 5 ppm. With the analog output system you can record both positive and negative ion spectra and can simultaneously record up to six preselected masses.

The unit is compact and easy to move. Maintenance involves little more than knocking the dust off once a week. And the list of things it can do in the way of analyzing won't even give the dust a chance to collect. Models range from $17,000 to $100,000. What would you like to analyze? Dept. B-7, 3625 Hauck Road, Cincinnati 41, Ohio.

Time-of-Flight Mass Spectrometer

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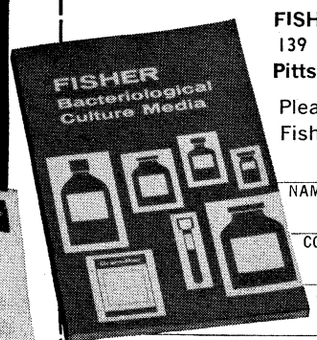

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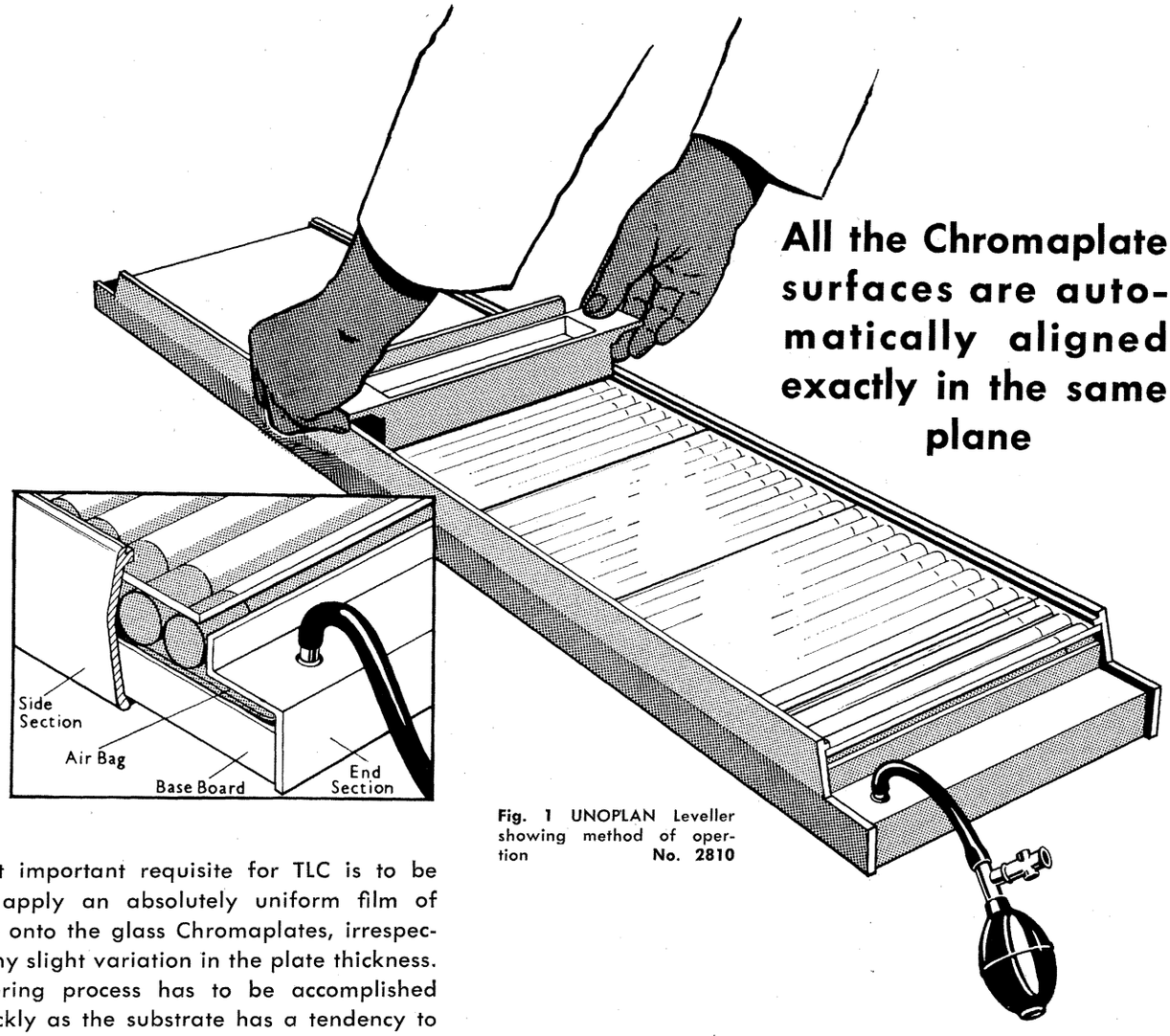

All the Chromaplate surfaces are automatically aligned exactly in the same plane

Fig. 1 UNOPLAN Leveller showing method of operation **No. 2810**

The most important requisite for TLC is to be able to apply an absolutely uniform film of substrate onto the glass Chromaplates, irrespective of any slight variation in the plate thickness. The layering process has to be accomplished very quickly as the substrate has a tendency to set. This problem has been solved completely by the patented Colab Unoplan Leveller No. 2810 (Fig. 1) which will take in one loading five 20 x 20 cm, ten 20 x 10 cm, or twenty 20 x 5 cm Chromaplates. The Chromaplates are simply slid over the rollers until the Unoplan is filled up. A few squeezes of the rubber ball will inflate an air bag beneath the rollers, which press the plates, without straining them, firmly against the machined underside of the two guide rails, ready to be coated with a layer of really uniform thickness.

LITERATURE AVAILABLE UPON REQUEST

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The versatility of the Nikon 6 Optical Comparator has been demonstrated in many ways. In addition to its function as an inspection and measurement instrument, it is also capable of producing pictures or slides of specimens under inspection, in color or black-and-white, or on Polaroid material.

A camera-back attachment is available for this purpose. The attachment interchanges with the comparator viewing screen assembly. It has its own ground glass panel for focusing and selecting the area to be photographed.

The camera-back attachment is utterly simple to use. It utilizes the optical system and illumination of the comparator. No darkened room is required. It is available for standard film and plates in sizes up to 5x7 inches. The 4x5 size can be used with the Polaroid #500 holder.

Essentially the Nikon 6 Optical Comparator is a projection microscope. Any object, substance or specimen placed on its stage appears as a bright, magnified image on its 12″ screen, where it can be studied and observed by several people simultaneously in the comfort of a normally lit room.

The Nikon 6 provides incident as well as transmitted illumination. Opaque as well as translucent substances and specimens can be inspected at magnifications from 10X to 100X — extendable to 500X. The Nikon 6 is being used for measuring and evaluating ultracentrifuge and electrophoresis patterns. It is being used in chromotography, and in the study of electron photomicrographs. It has even been used for examining specimens in petri dishes and in a wide variety of applications requiring fast, accurate inspection of visual data or images. Its measurement accuracy is within 2 microns.

For complete details, write to Dept. S-7.

NIKON INC. • Instrument Division • 111 Fifth Ave. N. Y. 3.
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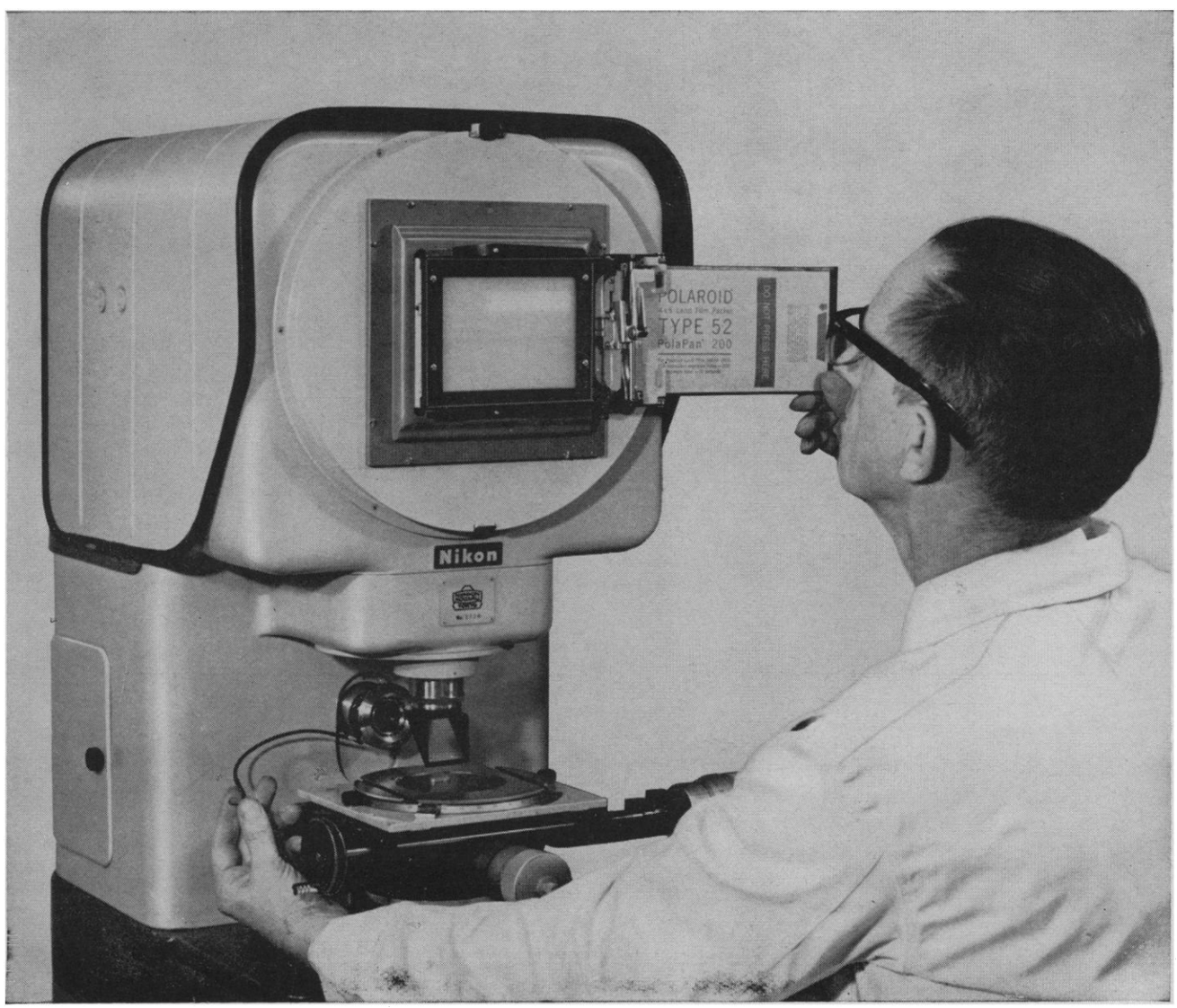
NIKON MODEL 6 OPTICAL COMPARATOR



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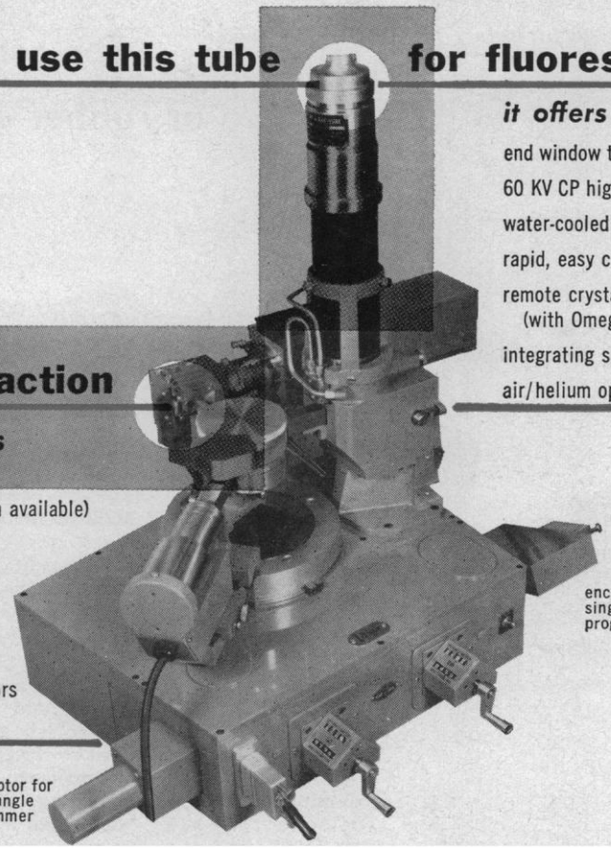

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The attachments seen jutting from the diffractometer base in the picture above are the slew motor and encoder for the Picker Single-Angle Programmer.

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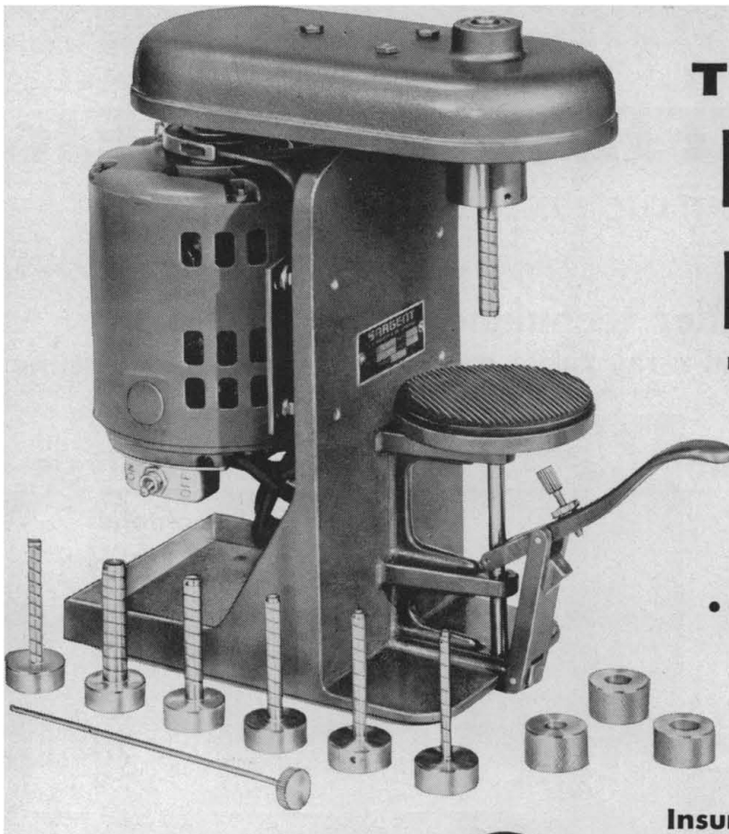

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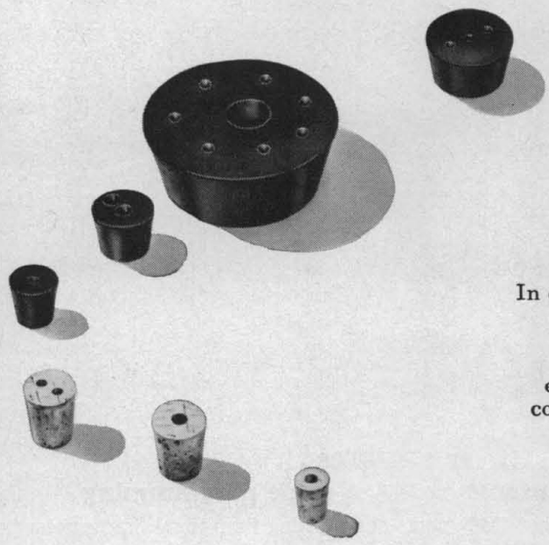

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The apparatus is essentially a condensed drill press with the vertical motion inverted, the drilling platform being elevated with respect to a fixed bearing head by a compound lever mechanism. In operation the spindle which holds the borer is driven at a constant rate of 800 r.p.m. by a V-belt drive. This speed provides clean fast cutting over the entire range of common diameters from 3 to 32 mm. A safety limit adjustment saves cutting borer edges and eliminates frequent sharpening. This adjustable limit stop prevents contact of the cutting borer edge with the metal plate of the drilling platform but still permits penetration through the stopper into the rubber supporting mat and so assures clean breakout.

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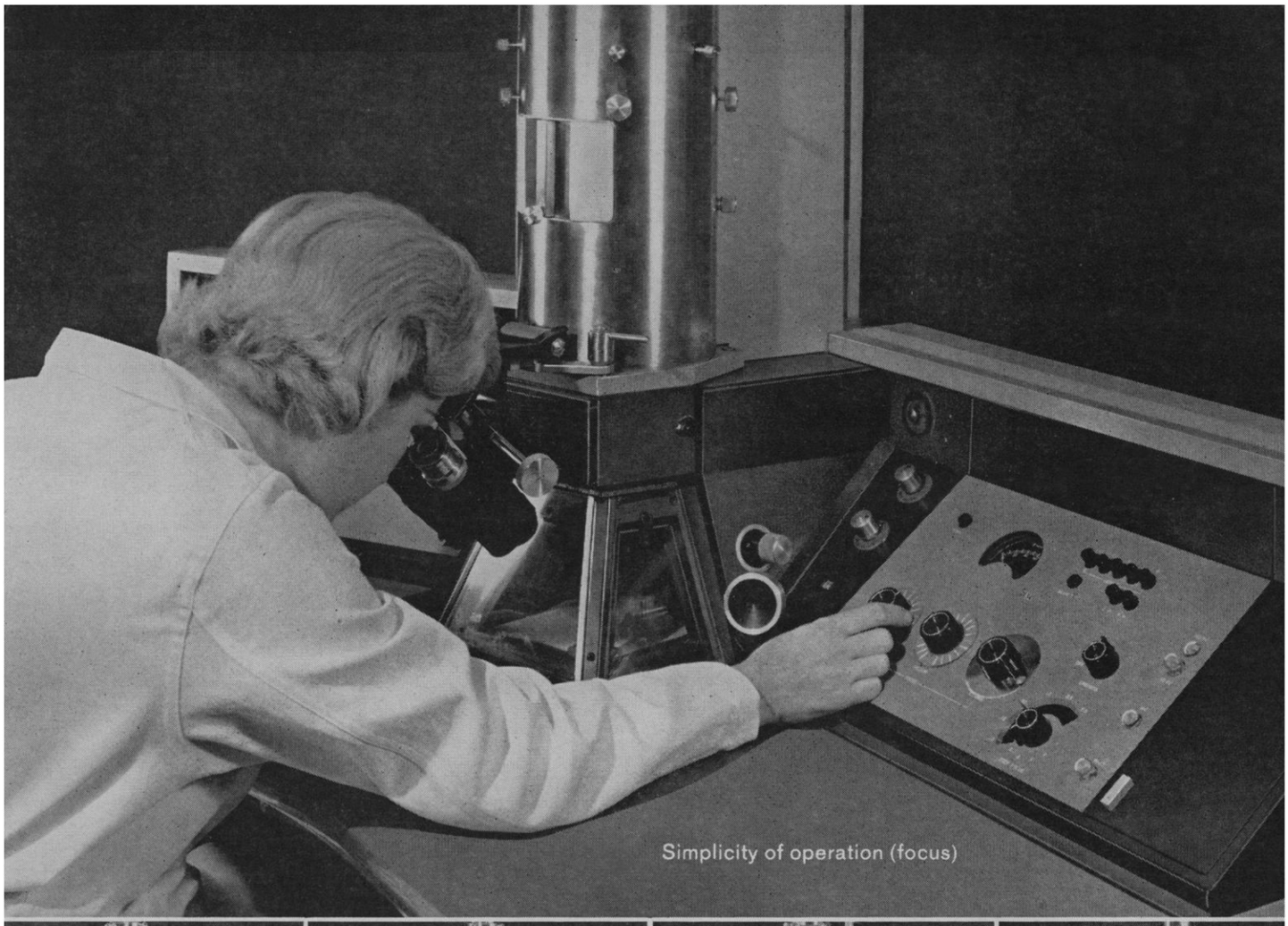
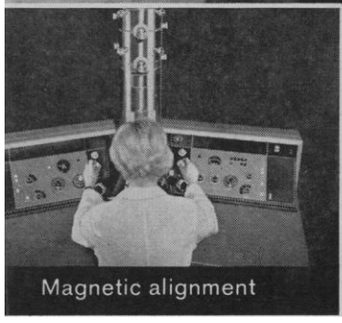
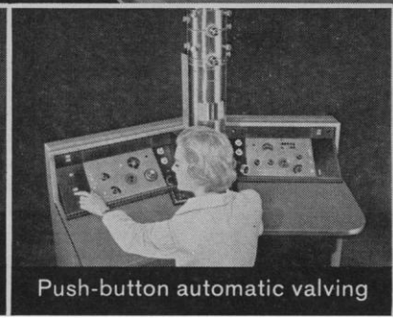



Magnetic alignment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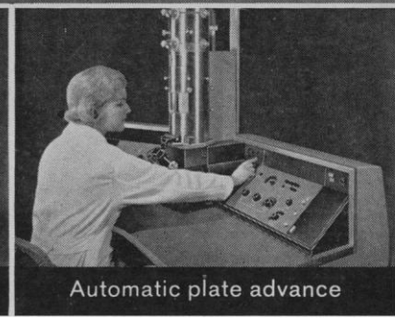
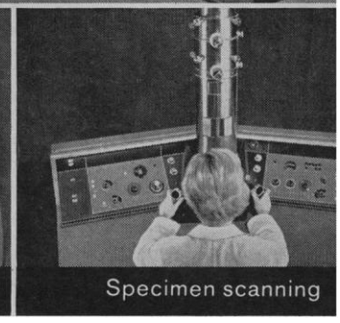

Automatic plate advance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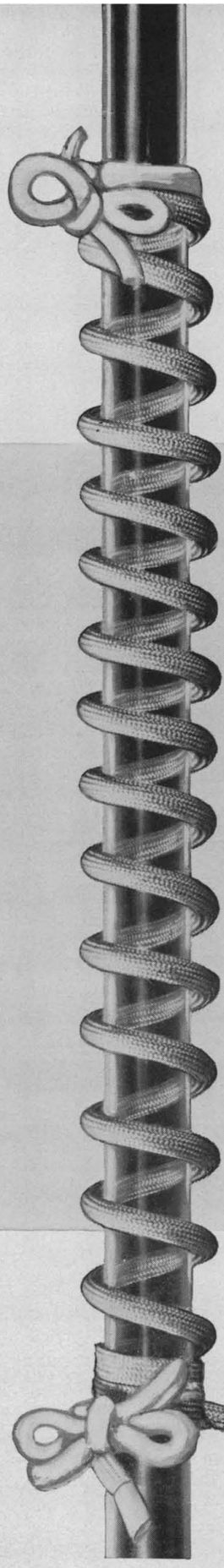

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This reliable, cord-type heating unit was developed specifically for laboratory work. Easy-to-use Cal-Cord is as flexible as an appliance cord. Delivers uniform temperatures up to fabric limits of 400°C for glass fabric, or 600°C for quartz fabric.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

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	Cat. No.	Length	Wattage	Price
400°C Medium Cal-Cord Made of glass fabric material	C-C 2	2 ft.	80W, 115V	$ 6.50
	C-C 3	3 ft.	120W, 115V	9.00
	C-C 4	4 ft.	160W, 115V	11.00
	C-C 6	6 ft.	240W, 115V	15.00
	C-C 8	8 ft.	340W, 115V	19.00
	C-C 10	10 ft.	400W, 120V	23.00
	C-C 12	12 ft.	480W, 220V	27.00
	C-C 14	14 ft.	560W, 220V	31.00
	C-C 16	16 ft.	640W, 220V	35.00
600°C Super Cal-Cord Made of quartz fabric material	**Cat. No.**	**Length**	**Wattage**	**Price**
	SC-C 2	2 ft.	200W, 115V	$ 8.00
	SC-C 3	3 ft.	300W, 115V	13.75
	SC-C 4	4 ft.	400W, 115V	16.75
	SC-C 6	6 ft.	600W, 230V	19.50
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Thermolyne Stepless Type 800 temperature controller is ideally suited for use with any Cal-Cord. Specifications: 1500W, 115V; maximum amps, 13. Price $15.75.

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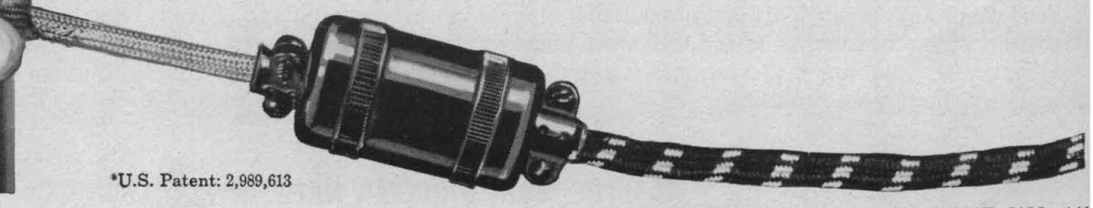

*U.S. Patent: 2,989,613

NUMBER 3 IN A SERIES

Chemists seeking to detect the presence of free radicals in chemical systems will find EPR Spectrometry the most sensitive and rapid technique available. The ability of Varian EPR Spectrometers to detect as low as 2×10^{11} free radicals (10^{-8} molar concentrations), and to respond in times less than 100 microseconds, has rendered all other techniques obsolete.

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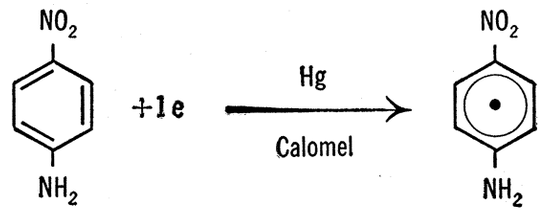
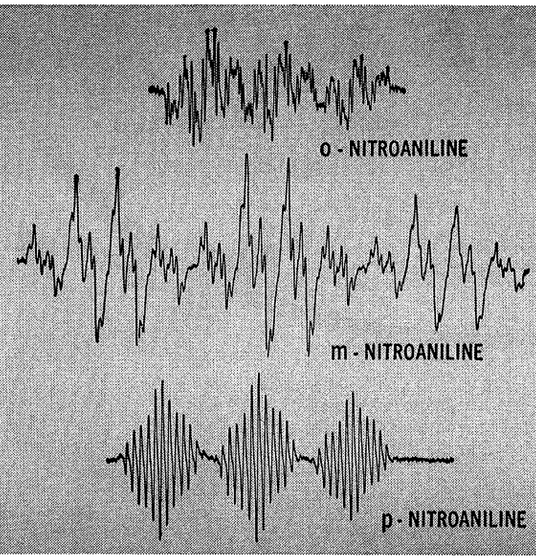
EPR IN THE WORLD OF CHEMISTRY

UNIVALENT OXIDATION-REDUCTION BY ELECTROLYSIS



Cyclic voltammetry can be an effective tool for studying univalent oxidation-reduction reactions of organic molecules, provided one observes a split wave in the typical current-potential curve. Very often these split waves are not resolved and an uncertainty arises as to whether one or multiple electron steps are occurring. EPR has eliminated the necessity of observing split waves in such measurements by direct detection of the one-electron intermediate (free radical ion) resulting from a univalent oxidation-reduction.



In situ generation and detection of univalent intermediates in an EPR cavity allow not only positive detection of intermediates in a complex organic electrode reaction, but also permit direct study of the nature of the intermediate.

Fig. 1 illustrates typical one-electron intermediates as detected by EPR in the **in situ** electrolytic reduction of ortho, meta and para nitroaniline in 0.1M KC1 solutions.

Attention is called to the radically different EPR spectra obtained for these three intermediates whose molecular structures differ only by the position of substitution of the amino group. It is this difference in the number of lines and spacings of lines (hyperfine pattern) that allows positive identification of these intermediates. How to identify free radicals by means of their "EPR hyperfine pattern" will be discussed in a later number of this series.

Detection and identification of free radicals are not the only results obtainable from the EPR spectrum, however. It is also possible to measure the rate of free radical formation for studies of complete reaction kinetics.

Varian EPR Spectrometer systems and accessories are designed for a wide range of applications in the fields of chemistry, biology, medicine and physics. For additional information about the example above and other chemical applications of EPR, please write: INSTRUMENT DIVISION.

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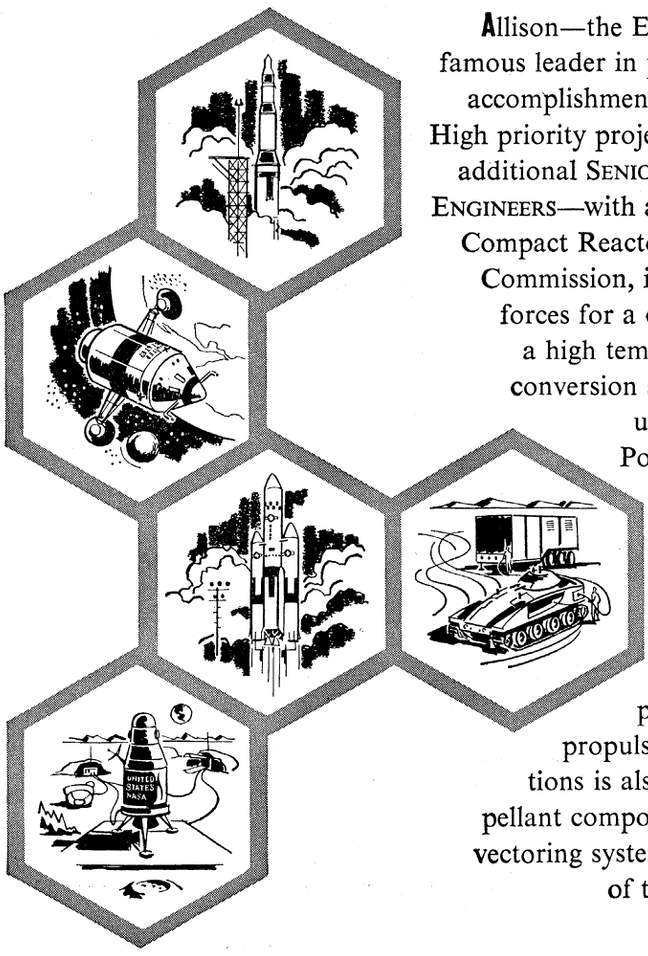
Nuclear Energy Conversion Projects Create New Opportunities for SENIOR SCIENTISTS: PHYSICISTS, CHEMISTS & NUCLEAR ENGINEERS



Allison—the Energy Conversion Division of General Motors and long-famous leader in production of aircraft engines—is chalking up significant accomplishments in nuclear energy conversion and aerospace programs. High priority projects at Allison have created exceptional opportunities for additional SENIOR SCIENTISTS . . . PHYSICISTS . . . CHEMISTS and NUCLEAR ENGINEERS—with advanced degrees and related experience. MCR (Military Compact Reactor) under development by Allison for the Atomic Energy Commission, is designed to meet the urgent requirements of army field forces for a completely mobile nuclear power source. MCR will have a high temperature, liquid metal-cooled reactor coupled to a power conversion system capable of generating 3000 kw of electricity. Also under contract at Allison is the development of a Nuclear Powered Energy Depot which could eliminate cumbersome and vulnerable fuel supply lines by powering military vehicles through nuclear power. In one Energy Depot concept, the reactor system would provide power for synthesizing a fuel from universally available elements, such as air and water. Or, electricity produced by a mobile reactor could be used to charge a combined cell powerplant which would supply electric power for vehicle propulsion. Further development for lunar and satellite applications is also under study. Additional Allison contracts include propellant components for APOLLO; pressure tanks in the TITAN III thrust vectoring system, and rocket motor cases for MINUTEMAN. Acceleration of these—and other—solid programs means exceptional and challenging opportunity for those who can qualify.

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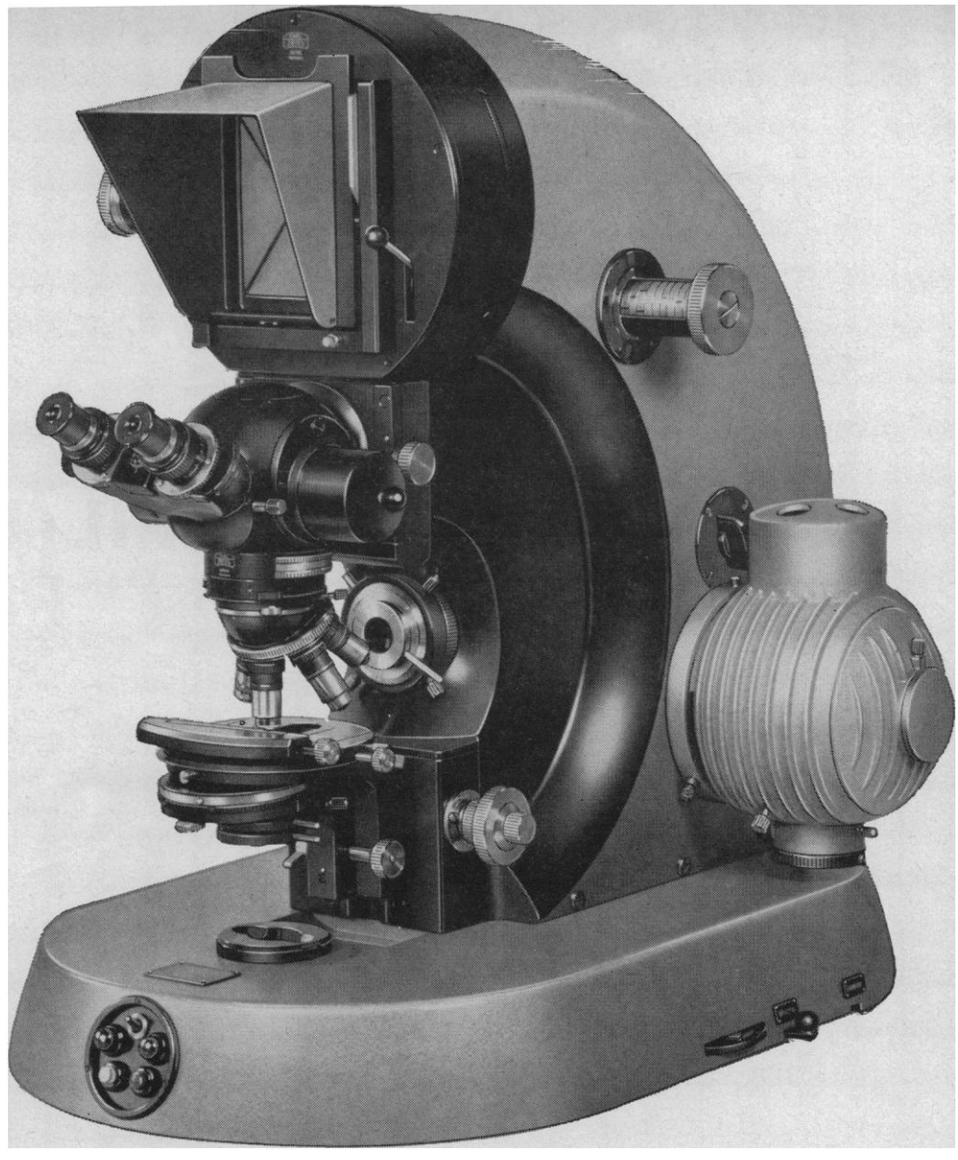

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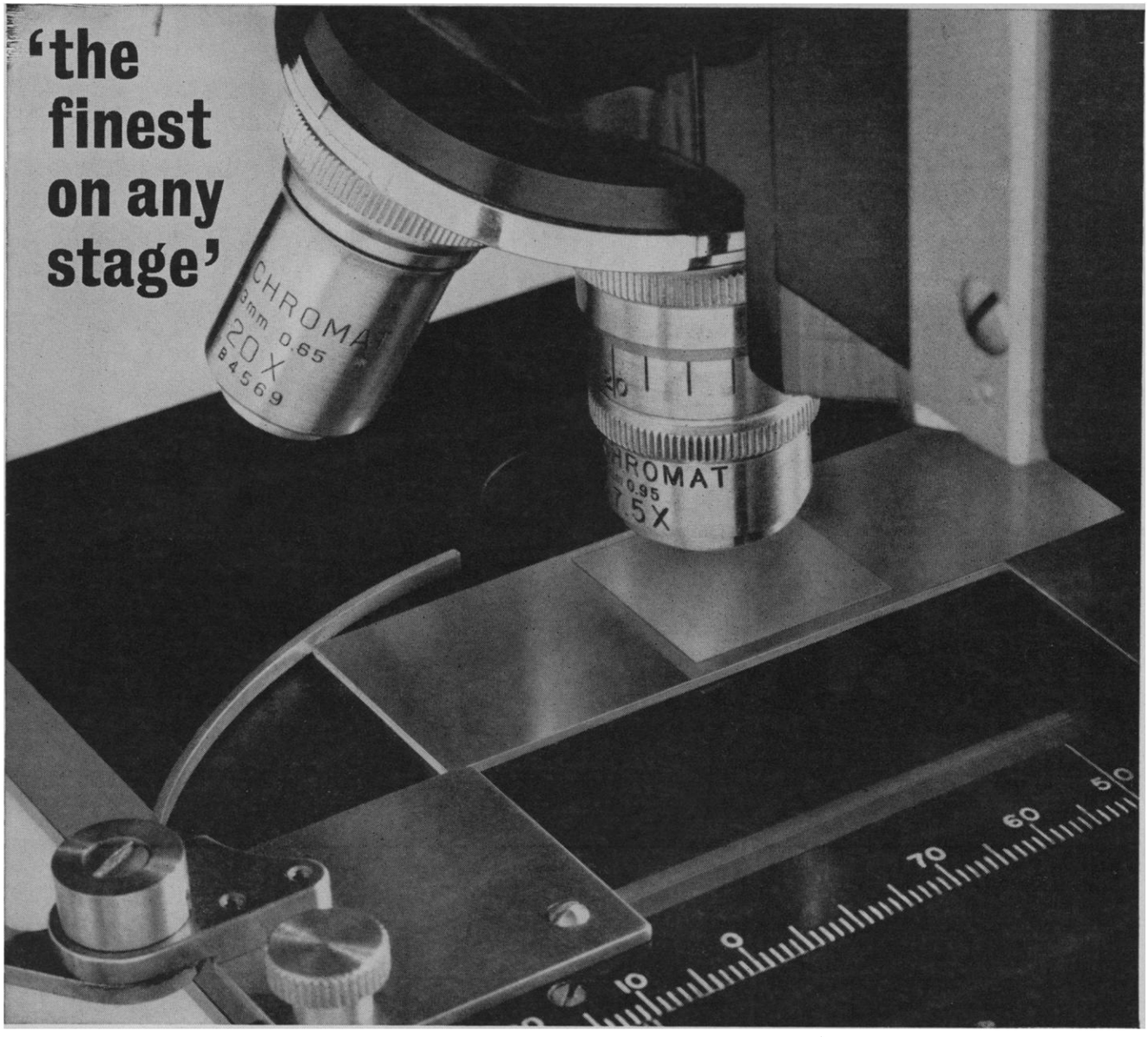

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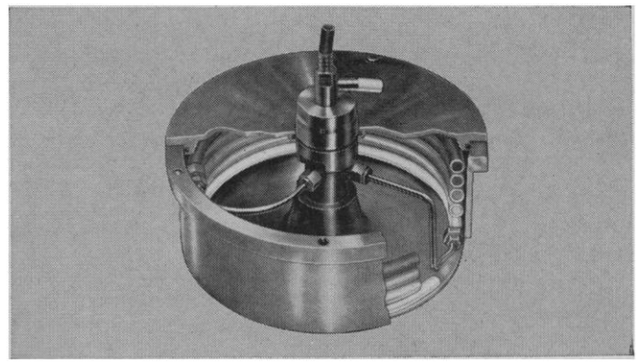

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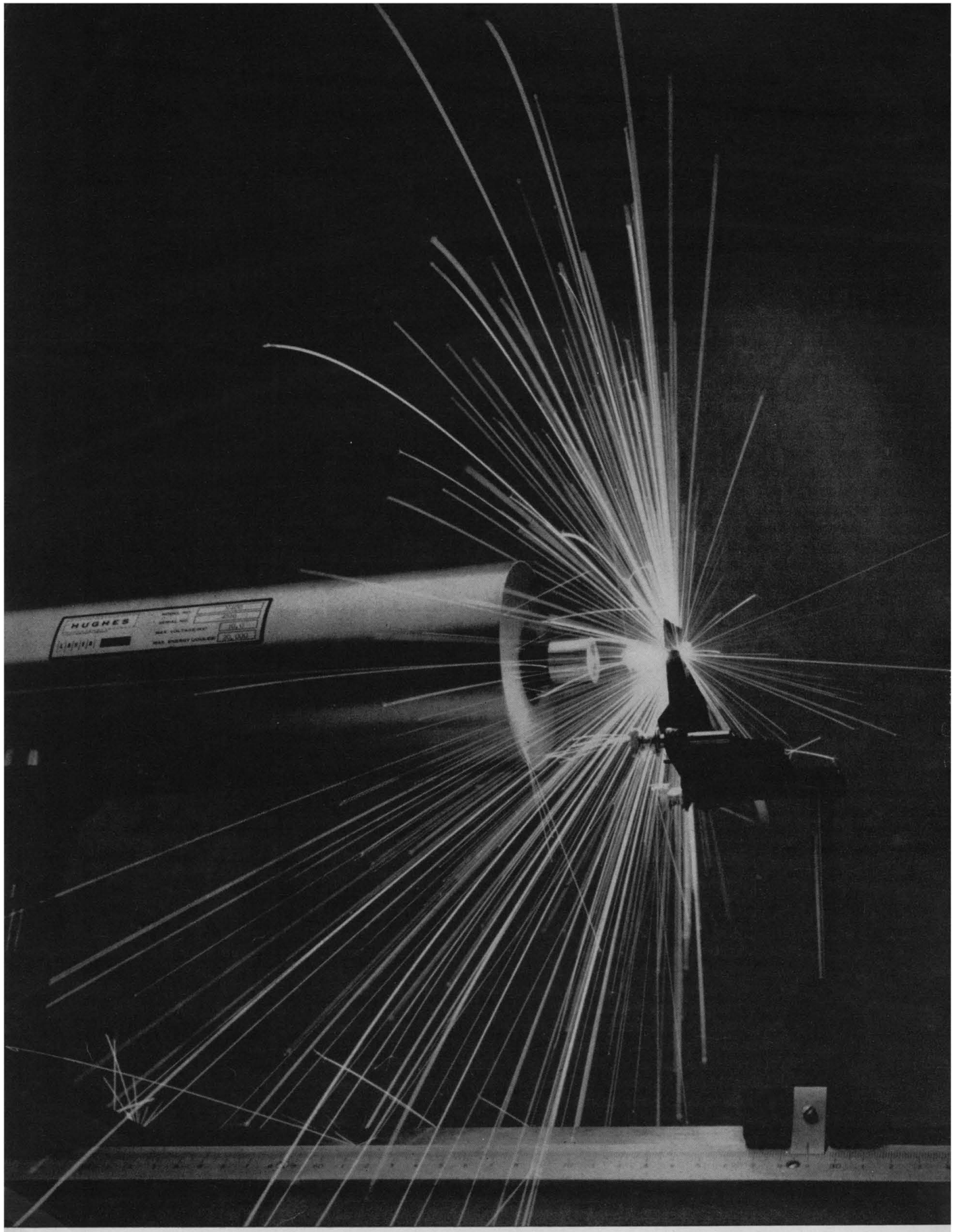

Larry Foster of Hughes Aircraft Company had a fully developed negative and positive just 20 seconds after he took this picture of a laser beam piercing a sheet of tantalum. He used a Graphic view camera and **Polaroid Land 55 P/N 4x5 Film.**

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—seem to be accepted without question from the picture agencies, or dashed off by members of the junior editorial staff who may have had a freshman course in science or who may recall a little science from their high school days.

Isaac Asimov's *Intelligent Man's Guide to Science*, for example, was embellished by sheafs of photographs placed with no reference to the text, and with captions that seemed in some cases to be the result of a layman's misreading misinformation. *Life* generally goes to more trouble than this, with the results Throckmorton describes.

Ideally, perhaps, an author should insist on a contract which gives him the right to approve every detail of *his* book. This is not very practical, however, either for the publisher—who has had bitter experiences with hair-splitters who insist on adding footnotes to footnotes or changing 20th century back to 19th century style—or for the writer. Supermarket illustrations are easier for the publisher to get and use than struggling with the author over the rights to pictures that may illustrate well enough but be copyrighted by a competitor.

If reviewers took extra pains to separate the sins of the author from those of his publisher when it is reasonably evident who is to blame, perhaps publishers would eventually mend their ways.

P. SCHUYLER MILLER

Fisher Scientific Company, Pittsburgh 19, Pennsylvania

Keeping up with Current Research: Science Information Exchange

The Science Information Exchange (formerly Bio-Sciences Information Exchange) was originally established in 1950 to help federal research directors and administrators quickly exchange up-to-date information on their current research activities. This service has expanded so that it now serves the entire scientific community. A staff of more than 30 scientists and specialists in life and physical sciences review, classify, and index the resumés of more than 50,000 projects that are annually registered in the Exchange. To cover the many multi-disciplinary relationships, now so evident in modern research, more than 18,000 reference points are used.

In order to provide comprehensive services to the scientific community, the Exchange receives resumés of current research projects on a voluntary basis from all available sources. Notice of new work comes to hand long before it may appear in normal publication channels, and any research scientist or engineer, who is associated with a research institution, foundation, or laboratory may request and receive, without charge, up-to-date information on who is currently working on a specified topic, problem, or project. Research resumés are accepted and released only under the condition that they will not be used for publication or publication reference without the express permission of the principal investigator.

The Exchange is especially organized to provide reference on detailed technical points. It also provides information covering broader fields and topics of basic and applied research, but it should be borne in mind that broad subject fields are difficult to define, especially in terms of their related and interdisciplinary aspects, and usually result in very large and unwieldy numbers of project records. For instance, all cancer research now in the S.I.E. files would include about 6500 records.

At present, the Exchange collection is fairly comprehensive in the life sciences including almost 90 percent of all the basic and applied research sponsored or conducted by the Federal agencies. In addition, more than 100 non-government foundations, universities, and state and city governments actively cooperate in furnishing records of their programs, and an annual growth rate of about 20 percent is being maintained.

Registration of basic and applied research in physical sciences began this year and is now being developed as fast as current research records can be identified and secured. In such areas as chemistry, materials, electronics, and earth sciences, useful information can be obtained already, even if not complete or comprehensive at this point. However, if the Exchange can furnish even a few records of new research not yet known to the scientist or engineer, it will be an increasingly useful service to the scientific community.

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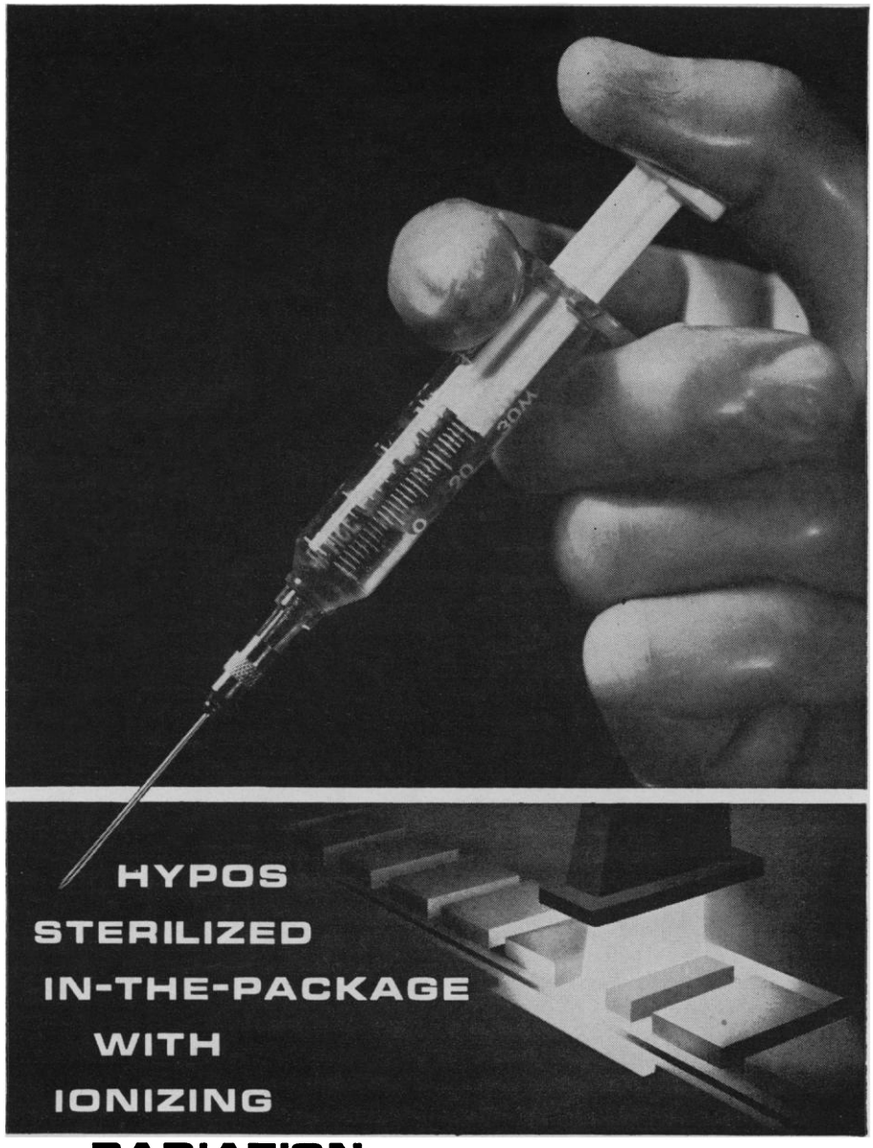

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HIGH VOLTAGE ENGINEERING REPORT

JULY, 1963

A New Industrial Radiation Center

A new, complete production-scale service radiation processing center is now going into operation in Burlington, Mass. Owned and operated by Electronized Chemicals Corporation (a subsidiary of High Voltage Engineering), the new unit will house 3 electron accelerators of varying capacities, bringing together the widest range of radiation processing facilities ever offered under one roof.

The new facility offers anyone interested in radiation processing effects a unique opportunity to carry out development work before making a capital investment in equipment. Determination of parameters such as penetration, radiation dose and dose rate, beam configuration can all be determined on rented equipment. In fact, economics may dictate the use of a rental facility indefinitely. Or you may conclude that an accelerator belongs in your laboratory or plant.

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A New High Voltage D-C Power Supply

A new product line, Series 7 ICT Power Supplies, has been introduced by High Voltage Engineering Corporation. This new entry into the high power, d-c power supply market makes available a complete line of 18 standard power supply models ranging in output from 100,000 volts at 1 ampere, to 1,000,000 volts at 10 milliamperes.

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Potential applications range from research studies in radio interference, corona phenomena, ion propulsion and plasmas to practical applications in high voltage cable, insulation and components testing. High Voltage would like to send you a performance data sheet on the ICT line. Write describing the application you have in mind.

HIGH VOLTAGE ENGINEERING

12 July 1963, Volume 141, Number 3576

SCIENCE

Support for the Humanities

Recent issues of the *Newsletter* of the American Council of Learned Societies indicate growing support for a National Humanities Foundation comparable in function to the National Science Foundation. Laudable as this objective is, and despite endorsement by some members of Congress, a humanities foundation is likely to remain pretty low on the list of congressional priorities for the next few years.

While advocates seek to develop greater support for the idea (remember, it took 5 years to get the NSF legislation approved), a partial approach may also be worthwhile. One particularly timely proposal is now before Congress in the form of a request by the National Historical Publications Commission for an appropriation of $500,000 a year to provide partial support for a program of editing and making generally available some of the nation's major historical documents. The function of the National Historical Publications Commission, which was established by the Federal Records Act of 1950, is to foster the "accumulation, preservation, and accessibility of documentary sources for use by the whole community of scholars, professional and amateur, and by the public at large. . . . [The] documentary sources with which it deals are the foundation on which all efforts to study, interpret, or recreate the past must rest." Examples include the editing and publication of the Adams, Franklin, Hamilton, Jefferson, and Madison papers. Complete and well-edited source materials set a high standard for historical writing, strengthen the graduate education of future historians, and also have a public benefit. The next quarter of a century will witness the bicentennial of "one of the most significant eras of political creativity in the annals of history." The current spate of books on the Civil War forecasts a great deal of popular and semipopular writing on this historic era, the quality of which will depend in large measure on the quality of the available source material. Moreover, the undoctored, unmanipulated story of those years can serve as a rich source of information and inspiration to other nations that are struggling to establish their own political foundations.

What the Commission now wants is a little more money: $5 million to complete work on the Adams, Franklin, Hamilton, Jefferson, and Madison papers and to endow similar work on other collections; and $1 million a year to support smaller and less expensive projects and to encourage the wider use of microfilm reproduction of other source materials that have been carefully prepared for this kind of distribution. Of this total, Congress is being asked to provide $500,000 a year.

Here is a project of easily understood values (recent hearings before a committee of the House of Representatives went quite favorably); the budget is extremely modest; the objective is a worthy one in its own right; and although it is far from being a National Humanities Foundation, it might serve as a step in that direction. The request seems worthy of general support, including support by scientists who agree that in the interest of scholarship generally it is desirable to redress the great imbalance in prestige and support that has developed between the sciences and the humanities.—D.W.

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identified with known molecular species, he pointed out that a number of prominent features remain unidentified.

While Philip Baumeister (Institute of Optics, University of Rochester) is not an astronomer, he has had a very definite effect upon astronomical instrumentation because of his pioneering work in modern techniques of the design of high-efficiency, multiple-layer interference stacks. These devices are rather well known as narrow-band dielectric filters, but Baumeister showed how other applications of this same technique could yield both nonreflecting surfaces and ultrahigh reflecting surfaces with exceptional properties over pass-bands of several thousand angstroms. Since astronomical observations are made with so few quanta available per second, astronomers are always seeking the most efficient systems. Baumeister's paper showed some welcome new techniques that as yet have only been applied to relatively few existing astronomical instruments.

A highlight of the meeting was the report on the recent flight of the 36-inch Princeton University Stratoscope II telescope. R. E. Danielson described the balloon-borne telescope and the actual flight in behalf of his Princeton colleagues, J. E. Gaustad and Martin Schwarzschild. His description of the "cliffhanger" aspects of the entire mission held the audience on the edges of their chairs. H. F. Weaver (University of California, Berkeley) then described the scientific instrumentation for the flight and the scientific results on behalf of himself and his colleague, N. Woolf. It was indeed remarkable that, in spite of the difficulties of this maiden flight, the germanium helium-cooled bolometer and spectrograph functioned so well after the balloon telescope had already well exceeded its maximum operating range. While the scientific results only yielded a maximum value for the water vapor content of the Martian atmosphere, the limit has made a valuable scientific contribution and provides the scientific boundary conditions for later flights.

Following the conclusion of the symposium, G. Munch (Mount Wilson and Palomar Observatories) and H. Spinrad (Jet Propulsion Laboratory) requested time to announce their detection of water vapor in the Martian atmosphere. Their data had been obtained a few days earlier with a new grating installed in the Mount Wilson 100-inch Coude spectrograph. Their spectra clearly showed the presence of

resolved satellite lines, Doppler-shifted away from the much stronger terrestrial water vapor lines. Their preliminary results both confirmed the correctness of the results from Stratoscope II and also demonstrated that perhaps all possible avenues open for the study of this problem had not been fully exhausted.

Co-hosts of this 113th meeting of the American Astronomical Society were the University of Arizona and the Kitt Peak National Observatory. The next meeting will be held at the University of Alaska, College, 22–24 July, immediately following the total solar eclipse which will be visible there on 20 July.

A. B. MEINEL
Steward Observatory,
University of Arizona, Tucson

Plasmas: Wave Interaction and Dynamic Nonlinear Phenomena

The study of wave interaction and nonlinear phenomena in plasmas and ionized media has become in recent years a subject of great importance not only to physicists and engineers, but also to wave propagation theoreticians. Pennsylvania State University, whose Ionosphere Research Laboratory has a traditional interest in ionospheric wave interaction phenomena, arranged a conference on wave interaction and dynamic nonlinear phenomena in plasmas. Outstanding investigators from universities and industrial laboratories attended the meeting (4–6 February). In order to make the sessions more effective a limited number of speakers (about 15) were invited, and no attempt was made to arrange or group papers into areas; instead, papers were randomly arranged since mixing of the workers in vastly differing areas of specialities was one of the objectives of the meeting.

Basic wave interaction and dynamic nonlinear phenomena have much in common and scientists and engineers working in these diverse fields, which range from the high-power klystron studies to the plasma physics of the sun, greatly benefited from being brought together to exchange views and theoretical ideas. The high-power tube engineer, who deals with the "cleanest" of all plasmas, has advanced the analysis of nonlinear phenomena and had valuable information for those scientists who have to work with less

clean plasmas. A comparison with the developments in solid state physics is not out of place in this connection. Without the availability of the basic clean and well understood solid into which impurities gradually were introduced, the entire field of transistor and maser physics and engineering would not have developed to its current state.

Interest in plasma is exhibited in many different areas of research. In astronomy, plasma physics is of importance since stars exist in a highly ionized state. Much work of theoretical importance has evolved from the study of the astrophysicist, and a great deal of this work is of importance in understanding thermonuclear fusion and the high-temperature plasma which results. Aerodynamicists are concerned with high-temperature plasma produced when high velocity vehicles re-enter the earth's atmosphere. In addition, wave propagation theoreticians have been concerned with the plasma sheath which surrounds the vehicle; this sheath can drastically affect radio communications with ground-based stations.

Other research has covered nonlinear phenomena in plasma of two distinct kinds. The first, known as the Luxembourg effect, was discovered about 1939 and consisted of the transferring of the modulation of one high-power radio signal onto the carrier of another radio signal; both were of different radio frequencies but passed through a common region of the ionosphere. This effect, caused by the local heating of the plasma (the ionosphere) by the one signal, perturbs the propagation parameters of the medium at the modulation frequency and transfers this modulation to the second radio signal. This effect has been a very useful tool for studying the ionosphere and for making sensitive measurements of the characteristics of laboratory plasmas.

The second nonlinear process is the modulation of the electron density of a plasma by, for example, a high-power radio signal. It is this spatial perturbation of the density occurring whenever a powerful signal creates significantly large electron excursions that accounts for the nonlinear phenomena. This latter type of nonlinearity, rather than that due to "heating," was the main theme of the conference.

Nonlinear phenomena exhibit certain inhibitory effects; they limit the output of present-day high-power klystrons. High-power plasma amplifiers, which may be serious competitors to high-power klystron devices in the future, will also have their ultimate power output limited by nonlinear effects. The plasma amplifier in its present form makes use of the interactions between electron streams, plasma oscillations, and slow wave plasma modes (so-called "whistler" modes). In principle this device is extremely simple; the plasma replaces the slow wave structure of more "conventional" amplifiers, for example, the traveling wave tube or the klystron with floating cavities. Such plasma amplifiers have already been designed to operate in the millimeter wave range.

As far as wave interaction effects are concerned, they are very similar to those in the plasma amplifier and are likely to take place in the exosphere when streams of charged particles impinge upon the same. This may cause the audio frequency whistler hiss which is recorded during periods of strong geomagnetic activity.

Nonlinear phenomena occurring in the ionosphere include ultrahigh-frequency radiation effects and resonance and parametric amplification effects. Ultrahigh-frequency phenomena take place in the solar corona (the solar ionosphere) during intervals of enhanced solar activity; "second harmonics" of solar radio noise outbursts have been

recorded on several occasions. Since a third harmonic has never been reliably recorded, it is believed that the "fundamental" radiation frequency actually is a subharmonic and that parametric amplification or generation of radio waves takes place in the coronal plasma when the primary radiation is very intense. The exciting agent may be, for example, an ionized stream as in the plasma amplifier, an electromagnetic wave, or a mixture of both.

Nonlinear resonance and parametric amplification occurs for the most part in the top-side region of the ionosphere. "Top-side" ionospheric soundings by the Canadian Alouette Satellite have shown, for example, that it is possible to excite the fundamental electronic cyclotron resonance of the medium by harmonic pumping; actually harmonic (or parametric) pumping has been possible with frequency ratios as high as ten or more. If future "top-side" sounders are equipped also with harmonic receivers, it is most likely that other interesting non-linear phenomena will be observed.

Nonlinear wave and interaction phenomena are very important also in the fields of high-power sound, underwater sound, and in high-power laser physics and engineering, including future laser communication systems. The arranging committee for the conference believes that representatives from these fields of scientific and engineering endeavor should continue the practice of holding symposia similar to this type.

Pennsylvania State University gratefully acknowledges the general support by the National Aeronautics and Space Administration which made the conference possible and will provide support for the publication of the conference transactions that will be available by July 1963.

O. E. H. RYDBECK
Pennsylvania State University, University Park

Transplutonium

In order to mark the near completion of the new hot laboratory of the chemistry division at Argonne National Laboratory about 250 scientists from 12 countries attended a symposium on the transplutonium elements at Argonne, Illinois (15–17 May). Discussions reflected four characteristics of research with the very heavy elements: (i) the

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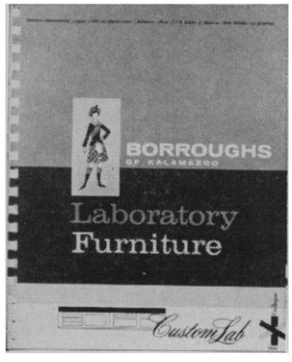

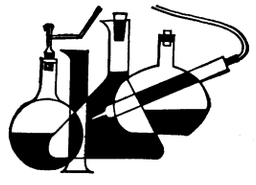

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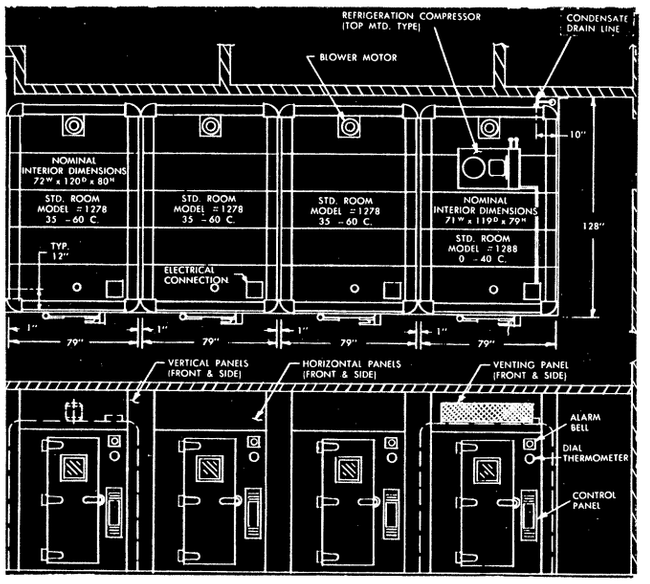

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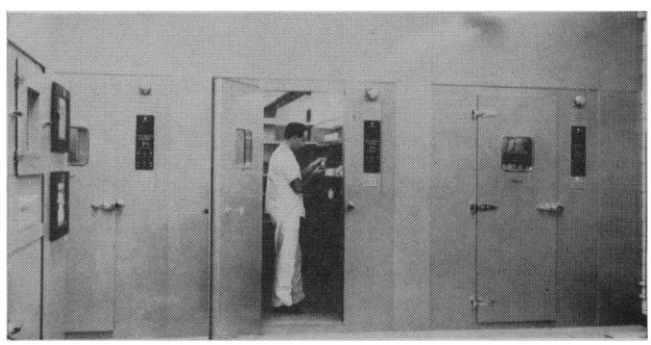

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large installations required to produce, process, and study even modest amounts of material; (ii) the minute amounts of some of the elements now extant; (iii) the highly radioactive nature of the elements; and (iv) the rich insights into the fundamental nuclear and chemical properties of matter afforded by investigations in this region. The transplutonium elements are created by neutron buildup in reactors, by neutron buildup in the interior of a star or in a terrestial thermonuclear device, or by charged particles from an accelerator undergoing reaction with a suitable heavy-element target.

A. R. Van Dyken (U.S. Atomic Energy Commission) described the latest American transplutonium element production program, which has been initiated by the irradiation of 20 kilograms of plutonium-239 in production reactors in order to produce plutonium-242, americium-243, and curium-244. Relatively low fluxes are necessary for this first stage because of the problem of removing fission heat. After separation and purification, the Pu^{242}, Am^{243}, and Cm^{244} will be inserted into the high-flux isotope reactor at Oak Ridge when it is completed late in 1965. This reactor was described by J. R. McWherter and the accompanying process facility ("TRU") by D. E. Ferguson (both of Oak Ridge National Laboratory). The maximum flux in this reactor is expected to be 5×10^{15} n/cm² sec. One of the chief products of interest will be californium-252. Production of this nuclide will rise from a few milligrams in 1966 to a gram per year by 1969. The course of buildup of heavy elements in several reactors was calculated and compared by P. R. Fields (Argonne). Mendelevium-259 may be produced if the decay properties and cross sections of fermium-256, -257, -258, and -259 are consistent with reasonable estimates.

Another, and more intense source of neutrons is a small thermonuclear device. R. W. Hoff (Lawrence Radiation Laboratory, Livermore) described results from a small bomb of this type which was recently exploded deep underground. Isotopes up to americium-246 were found in the debris. The variation of yield with mass number below mass 246 compared favorably with that seen in "Mike," the 1952 thermonuclear device in which elements 99 and 100 were first observed and masses up to 255 were produced. When development of a successful thermonuclear device is completed, it will be detonated in a salt dome so that

large-scale recovery of the products will be simplified.

The very large number of neutrons required to account for the solar system abundances of the heavy elements would imply the rapid collapse of a helium-rich shell into a 10^9-degree stellar interior, according to A. G. W. Cameron (National Aeronautics and Space Administration). Small peaks observed at mass numbers 170 and 104 in the abundances of elements created on a fast time scale were attributed by him to peaks at mass numbers 138 and 56 (arising from earlier processes) being swept upwards by subsequent neutron capture in part of the material.

J. A. Wheeler (Princeton) discussed the theoretical considerations limiting the addition of neutrons to a nucleus in order to increase the mass number. He concluded that the highest nuclide likely to persist for 10^{-4} seconds or longer would be at either mass 650 or 274, depending on the spontaneous half-life systematics applied. However, in very high density stars, a possible state might exist with all of the electrons squeezed out. The entire stellar mass would in effect be one continuous nucleus.

Prediction of the spontaneous fission half-life of unknown isotopes is one of the key unsolved problems in planning the production of even heavier nuclides. G. N. Flerov (U.S.S.R.), in a paper read by S. M. Polikanov (U.S.S.R.), told of a new isotope of element 102 made by E. D. Donets, V. A. Schegolev, and V. A. Ermakov, utilizing the reaction, $U^{238}(Ne^{22},4n)No^{256}$. This nuclide decays by alpha emission with an 8-second half-life. Its spontaneous fission half-life exceeds 50 minutes—far in excess of current predictions. A trend toward larger spontaneous fission half-lives in the heavier elements would be advantageous in producing transfermium elements.

Flerov also considered the cross sections for producing Fm^{250} (plus four neutrons) by three different reactions: $C^{13} + Pu^{241}$, $O^{16} + U^{238}$, and $Ne^{22} + Th^{232}$. The decline in cross section with increasing atomic number of the projectile is greater than would be expected from consideration of coulomb barrier heights. Flerov speculated that this might be due to an increased probability for fission of the compound nucleus as its angular momentum increased, or to the possibility that the greater vibrations brought into the compound nucleus by the impact with heavier ions might induce fission more readily.

R. Vandenbosch (Argonne) in reviewing fission, noted that an increase in distortion energy in a fissioning nucleus would be accompanied by a comparable and opposite decrease in coulombic energy as the centers of charge separate further. Shell structure within a fragment would stiffen it against distortion at the time of scission, with the deformation energy then going to the less constrained complementary fragment. These considerations were related to experimental observations on the variation of ν (neutrons emitted per fragment) with mass number, the variation of total kinetic energy with mass number, and the large ν and low kinetic energy seen in the symmetric fission of U^{235}. Vandenbosch pointed out that much valuable experimental work has been made possible in this area by the availability of the spontaneously-fissioning nuclide Cf^{252}.

The oxidation of $Am(OH)_3$ in $NaHCO_3$ produces a soluble complex of Am(VI), but if $KHCO_3$ is used, an insoluble Am(V) compound results. These reactions were discussed by T. K. Keenan (Los Alamos Scientific Laboratory). The plus four states of Am and Cm, although difficult to obtain, have now been stabilized in aqueous solution by dissolving previously prepared $Am(OH)_4$ or CmF_4 in saturated ammonium or cesium fluoride. The current unsolved problems in americium chemistry include the synthesis of AmF_6, preparation of divalent Am compounds, and the study of the structures of the complex fluorides and carbonates.

W. T. Carnall (Argonne) emphasized the utility of working in a molten $LiNO_3$-KNO_3 eutectic rather than in an aqueous medium for some purposes. Absorption spectra in the fused salt system may be obtained to 2.6 microns. The system is particularly useful with the very heavy elements, since radiation damage to the solvent is reduced.

B. B. Cunningham (Lawrence Radiation Laboratory, Berkeley) noted that the size of the unit cell for actinide dioxides (fluorite structure) decreases with atomic number with the expected actinide contraction; the exception is CmO_2. This lead him to question the literature value given for that compound. He also suggested that the "metallic valences" of the actinides should be related to curium metal with a +3 valence assignment rather than to thorium metal with a +4 as suggested by Zachariasen. Cunningham cited magnetic susceptibility measurements to support his frame of reference.

Talks by D. F. Peppard (Argonne), J. Kooi (Euratom), V. N. Kosyakov (IAEA), and J. Maly (U.S.S.R.) considered various aspects of the solvent extraction of the transplutonium elements. The trialkylamines are most valuable for giving actinide-lanthanide separations, while the alkylphosphoric acids give the best resolution of the actinides from each other. The paper by Maly described an interesting experiment using only 15 atoms of mendelevium to obtain the distribution coefficient of that element between tributyl phosphate and 13.1*M* HNO_3 by a reverse phase chromatographic approach.

D. C. Stewart acted as general chairman of the meeting, while C. H. Youngquist described the new chemistry research hot laboratory and organized the subsequent tour of the facility.

HERBERT DIAMOND
D. C. STEWART
Chemistry Division, Argonne National Laboratory, Argonne, Illinois

Plant Tissue Culture

Thirty years after the initial isolation of tomato roots in vitro by Philip R. White, a group of about 150 tissue culture experts from all over the world met, at White's invitation, under the auspices of the Pennsylvania State University and the NATO Advanced Study Institute at University Park, Pennsylvania (28 May–1 June), to discuss the present problems and future developments of plant tissue culture. Subcultures of the roots originally isolated by White and kept in continuous culture for 30 years were mute testimony to the possibilities of tissue and organ culture.

Although defined synthetic media have been used in plant tissue culture for over a quarter of a century, the nature and the extent of the interactions between the tissue and the medium on which it is grown is still the subject of intensive investigation. The older ideas of the medium playing the role of mechanical support and source of needed growth factors and nutrients has been replaced by the realization that not only does the medium act upon the tissue, but also that the tissue has complex effects upon the medium. Street reported that isolated roots release into the medium as many as 18 amino acids as well as some indolic compounds. Other investigations revealed "exsorption" of iron-chelating agents by callus cultures (Heller); the release of arginase by ginkgo tissues (Tulecke); and the release of peroxidase by sunflower tissues (Lipetz).

The release of some of these substances by roots was reported by Street to be light sensitive. Burstrom reported that the action of light upon the growth of roots of monocotyledons could be divided into two parts, red-light action which stimulates cell division and blue-light action which stimulates cell elongation.

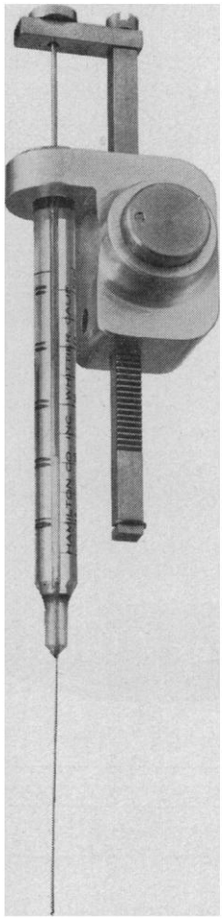
The various enzymes released into the medium not only affect its composition, as shown by Tulecke, but also are released in response to calcium concentrations in the medium (Lipetz). These complex medium-tissue interactions were reported to influence the suitability of certain nitrogen sources (such as ammonium) for growth (Street), the differentiation of tissues (Lipetz), and overall growth (Heller).

Wood also reported on the effects of the medium on tissue growth. High concentrations of certain ions could substitute for growth-factor requirements formerly believed to be specific for the tissues. One of the ions reported necessary in high concentrations was K, which previously could not be entirely replaced by Na.

The observations that single cells and small clumps of cells usually require a medium previously "conditioned" by growing cultures (Muir, Reinert, Jones, and others) can possibly be explained in terms of the above reports. More specifically, Earle has demonstrated that single cells require exogenous kinetin for growth, whereas larger clumps of cells do not. It was also noted that as embryos mature, their requirements for exogenous supplies of certain specific growth substances decrease (Raghaven).

Sussex's report on the growth of various members of cell populations in shake culture also seems to bear out the point that all the cells in a given culture are not identical in size, shape, or growth ability. It is thus possible that the medium may act as a selecting agent.

Tissue culture has become an important tool in the study of morphogenesis. The development of flowers and floral organs on isolated stem fragments, separated from correlative and other influences of the intact organism, were reported by Tepfer, Jacobs, and Vasil. Vasil also described attempts to



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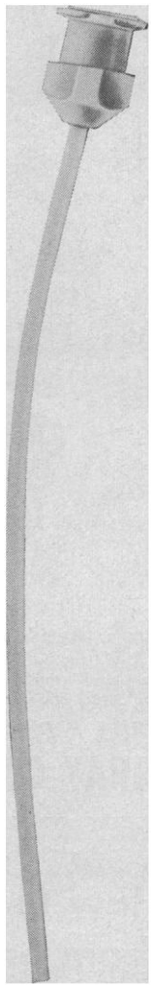

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obtain meiotic divisions in cultures of isolated anthers. Karstens reported on the formation of phloem in tissue cultures and Rier on attempts to influence the reconstruction of stelar patterns in isolated callus tissue. Ball reported on microcinematographical studies of developing isolated meristems. Stonier discussed his attempts to influence meristem formation by the mixing of various cell types and by creating an interdependence between them, thus influencing their organization. Both Hagen and Gunckel reported on studies of abnormal meristem development; the former dealt with hybrid tumors in *Nicotiana* and the latter with neoplasias induced by radiation.

Murashige explored the effects of various gibberellins on the differentiation of callus cultures. He reported that this hormone acts somewhere between the induction of cellular proliferation and the differentiation of the products of the dividing cells. The problem of hormone action on tissues was further discussed by Kulescha who noted that indole acetic acid and 2,4, dichlorophenoxy acetic acid (2,4,D) both led to the appearance of new, as yet unidentified, growth promoters in Jerusalem artichoke tissues.

The increasing use of "fragmented tissue" cultures, single-cell cultures, and the development of cloning techniques has led to new information on cytology, cytogenetics, radiation biology, pathology, biochemistry, physiology, and morphogenesis. Observations on the events leading up to and following cell division in isolated single cells were reported, with the aid of time-lapse cinematography, by Jones, Muir, and Mota. These observations on living material present a new approach to the problems of cell division, wall formation, the role of the phragmoplast, cell senescence, and cell death. Correlations were made of certain aspects of cellular morphology and their future ability or inability to divide. The report of Earle on the reconstruction of entire plants from single cells is further evidence for the multi- or toti-potency of somatic plant cells.

Single-cell and shake cultures were also used to advantage by Dougall who discussed two methods of using these in metabolic studies, and by Eriksson who studied the effects of ultraviolet radiation on these cells.

The kariology of plant tissues was reviewed (D'Amato), and the point that polyploidy is the consequence rather than the cause of differentiation

was emphasized (Partanen). Torrey presented evidence for the chemical selection of polyploid cells in culture and said that in the presence of certain concentrations of kinetin, the total number of cell divisions increases and the total number of diploid cells decreases. These and other observations make it clear that one cannot consider a callus culture as a mass of essentially identical, relatively undifferentiated cells.

Tissue culture as a tool in the study of phylogeny and comparative embryology was discussed by Maekawa, who compared the development of embryos and the differentiation of single-cell and cell-fragment cultures into intact entire plants.

Tissue culture has also been a valuable tool in phytopathology. Riker reviewed developments in these allied fields, and Nakamura discussed attempts to grow obligate parasites and their host in monoxenic culture. Manigault reported on his use of isolated tissue as test material for the virulence of various mutants of the crown gall organism *Agrobacterium tumefaciens*.

Quak and Hirth reported on studies of the growth and infectivity of tobacco mosaic virus in tissue cultures. The former stated that by using C^{14}-labeled virus, she was unable to show a change in cell susceptibility with age. Hirth demonstrated that the classic anti-infection factors in plants, such as polyphenol oxidase and scopoletin, were present in lower concentrations in moderately susceptible tissue cultures than in highly susceptible plants, thus questioning the physiological role of these substances. Other techniques have enabled the rearing of axenic insect vectors for the infection of axenic plants with viruses known to proliferate in both hosts, and bearing a remarkable resemblance to the REO group (Maramorosch).

The synthesis of natural plant products by tissue cultures was explored. Kinetin appears to favor lignin production by shifting metabolism from the Embden-Meyerhoff pathway to the hexose monophosphate shunt and thus increasing the size of the pool of presumptive lignin precursors (Bergmann). A report was made on the chemical analysis of lignins produced by various tissue cultures and their comparison with the lignin produced by the parent organism (Barnoud). Tissue cultures, unlike intact plants, can synthesize tannins in the dark, and various precursors can, depending upon their con-

centration, enhance or inhibit tannin production (Constabel). Also discussed were the isolation and properties of tissues from various medicinal and other commercially valuable plants (Staba).

The roles of light and temperature on the metabolism and growth of plant tissues were discussed by Duranton and by Petru. Duranton found that light has varying effects, depending upon the season, on the arginine metabolism of Jerusalem artichoke. Petru reported on the "sudden death" of tomato roots after temperature shocks, and their seasonal variations of growth rate.

An international committee was formed to plan the next meeting of plant tissue culturists. Elected to the committee were: Ball (U.S.), Constabel (Germany), Hildebrandt (U.S.), Karstens (Netherlands), Maekawa (Japan), Morel (France), Petru (Czechoslovakia), Street (United Kingdom), Vasil (India), and White (U.S.). Ball was elected secretary of this committee. The conference also decided to accept the offer of Lipetz, Stonier, and Tulecke to edit a newsletter "Explants" which would publish a list of tissues presently in culture and compile current bibliographies on plant tissue culture.

JACQUES LIPETZ
Laboratory of Plant Morphogenesis, Manhattan College, Riverdale 71, New York

Radiation Chemistry: Aqueous Media

Basic concepts pertaining to the chemistry of irradiated water and aqueous media were discussed at a conference on radiation chemistry at Gatlinburg, Tennessee (8–10 May). Topics discussed by the 42 invited chemists and biologists covered chemistry of pure water, of dilute solutions, and of complex molecules.

A new impetus was given to radiation chemistry with the general availability of inexpensive and reliable radioactive cobalt-60 gamma-ray sources. On an unprecedented scale, research in this field expanded from national laboratories and a few atomic energy research centers to universities and other chemical, medical, and industrial laboratories throughout the world. As a result, research on a greatly expanded front is now being carried out. No longer is it possible to cover the entire field in any

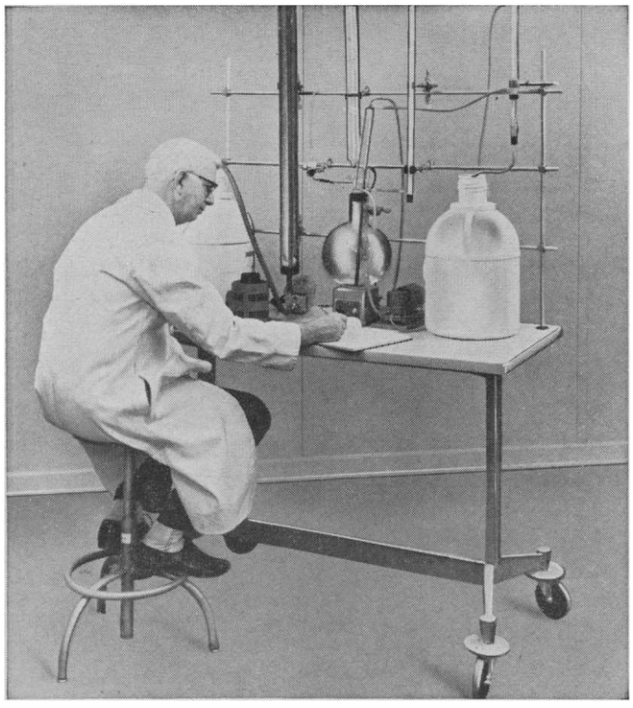
one meeting; and for this reason, the conference at Gatlinburg was restricted to aqueous solutions. Emphasis was placed on primary reactions and chemical changes induced by the primary species in simple ions, organic molecules, and the complex units present in proteins and nucleic acids.

The most impressive advances in aqueous radiation chemistry are: a more complete characterization of the primary species and reactions; measurement of the absolute reaction rate constants of these primary reactions; and determination of chemical yields. Considerable progress has also been made in understanding the mechanisms of some of the simpler reactions induced by radiation.

For many years hydrogen atoms and hydroxyl radicals have been considered the unquestioned primary species in irradiated water. Only recently has it been shown that a second reducing species, the hydrated electron, e_{aq}^-, plays a dominant role in the chemistry of neutral and alkaline solutions. For this reason its reactions are of great significance to biologists as well as to chemists. Other less well substantiated primary species discussed were the oxygen atom and the positive polaron $(H_2O)_n^+$.

Considerable discussion centered about the measurement of relative and absolute rate constants. New techniques in spectroscopy and in the pulsed electron beam are being widely used for these measurements, and reliable absolute rate constants are now emerging from these studies. The rate constants, obtained by the spectroscopic method, of the reaction of the hydrated electron with the primary radicals H, OH, e_{aq}^-, and a host of other electron scavengers and molecules were reported. The usefulness of absolute rate constants of the hydrogen atom, hydroxyl radical, and hydrated electron reactions in simple organic reactions was demonstrated; and the need for extending these studies to the complex units in proteins and nucleic acids was pointed out. It develops that the hydroxyl radical displays a high degree of reactivity with most organic molecules and the hydrogen atom a considerably lower reactivity. The hydrated electron is readily converted to a hydrogen atom by reaction with a hydrogen ion, but it is very selective in its reactions with organic molecules.

As the radiation chemistry of irradiated pure water becomes more completely understood, radiation chemists are turning their attention to the many



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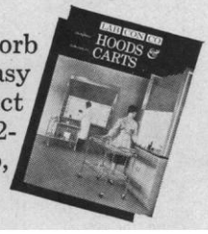

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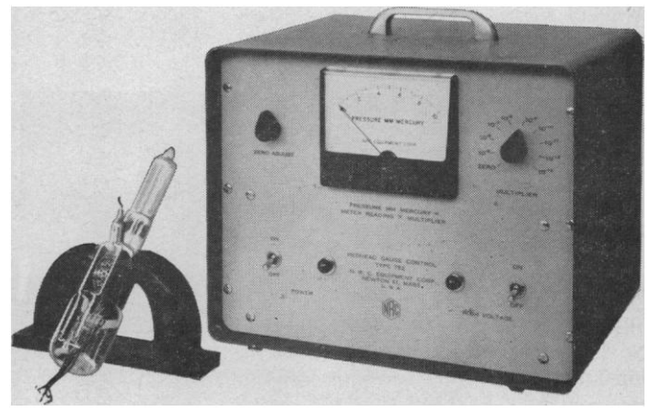

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interesting problems arising in the reaction of the primary species with organic molecules. In this area of research the interests of the chemists and biologists overlap. Of principal interest will be the effect of structure and molecular configuration on the rate constants of the hydroxyl radical and hydrated electron. Pulsed electron beam and spectroscopic techniques are most helpful for the measurement of these rate constants and for the identification of intermediates. The methods of isotopic tracer and chromatographic analysis are also being widely exploited in the separation and analysis of fragments derived from the radiolysis of large molecules. Considerable progress can be expected in understanding the reaction mechanisms of the hydrogen atom, hydrated electron, and hydroxyl radical.

This conference was sponsored by the National Academy of Sciences-National Research Council and supported by the U.S. Atomic Energy Commission.The proceedings of this conference will be published as a supplement to *Radiation Research.*

E. J. HART

Chemistry Division, Argonne National Laboratory, Argonne, Illinois

Forthcoming Events

August

3–7. **Contact Lens**, 2nd world congr., Chicago, Ill. (H. G. Klene, 18 S. Michigan Ave., Chicago 3)

3–10. International **Esperanto** Congr., Sofia, Bulgaria. (R. A. Lewin, Scripps Institution of Oceanography, La Jolla, Calif.)

4–7. **Heat Transfer**, 6th natl. conf., Boston, Mass. (D. Q. Kern, 7016 Euclid Ave., Cleveland 3, Ohio)

4–9. **Aerospace Support**, intern. conf. and exhibit, Washington, D.C. (I.E.E.E., Box 6635, Washington 9)

5–7. Western **Resources** Conf., 5th annual, Fort Collins, Colo. (N. Evans, Dept. of Agricultural Engineering, Colorado State Univ., Fort Collins)

5–9. **Lattice Dynamics**, intern. conf., Copenhagen, Denmark. (S. Lundqvist, Dept. of Mathematical Physics, Chalmers Univ. of Technology, Gibraltargatan 58, Göteborg S, Sweden)

5–23. Relativity in College **Physics**, Ithaca, N.Y. (T. J. Peterson, Jr., Dept. of Physics, Cornell Univ., Ithaca, N.Y.)

5–30. **Engineering Foundation** Research Conf., Andover, N.H. (H. K. Work, Engineering Foundation, 345 E. 47 St., New York 17)

6–9. **Hydraulics**, 12th natl. conf., University Park, Pa. (Continuing Education Conf. Center, Pennsylvania State Univ., University Park)

7–9. **X-Ray Analysis** Applications, 12th annual conf., Denver, Colo. (Metallurgy Div., Denver Research Inst., Univ. of Denver, Denver 10)

9–15. **Nutrition**, 6th intern. congr., Edinburgh, Scotland. (A. B. Meikeljahn, Dept. of Clinical Chemistry, Royal Infirmary, Univ. of Edinburgh, Edinburgh 3)

11–14. American Soc. of **Pharmacology** and Experimental **Therapeutics**, San Francisco, Calif. (H. G. Mandel, Dept. of Pharmacology, George Washington Univ., Washington, D.C.)

11–15. American Soc. of **Animal Science**, Corvallis, Ore. (J. E. Oldfield, Oregon State Univ., Corvallis)

11–16. **Gerontology**, 6th intern. congr., Copenhagen, Denmark. (Danmarks Internationale Studenterkomit, Congr. Service, 19 Sankt Peders Straede, Copenhagen K, Denmark)

11–17. **Industrial** Research, 14th conf., Harriman, N.Y. (R. T. Livingston, School of Engineering and Applied Science, Columbia Univ., New York 27)

12–14. **Electromagnetic Waves** (vlf), Ionospheric Propagation, symp., Boulder, Colo. (Mrs. D. Belsher, Room 3420, Natl. Bureau of Standards, Boulder)

12–15. Care of **Mentally Defective Persons**, intern. congr., Oslo, Norway. (Bestyrelsen for Ostifternes Aandsvageforsog, Fredericksgade 19, 3 sal., Copenhagen K, Denmark)

12–16. Results of **International Geo-**

physical Year, symp., Los Angeles, Calif. (C. Harris, Administration Bldg., Room 1104, Univ. of California, Los Angeles 24)

12–17. American **Ornithologists** Union, Gainesville, Fla. (L. H. Walkinshaw, 1703 Wolverine Federal Tower, Battle Creek, Mich.)

12–30. Canadian **Mathematical** Congr., 2nd seminar, Saskatoon, Sask., Canada. (L. F. S. Ritcey, Sherbrooke Avenue West, Montreal, Que., Canada)

14–16. **Gas Dynamics**, 5th symp., Evanston, Ill. (Gas Dynamics Laboratory, Northwestern Univ., Evanston)

14–17. **Communication** processes, symp., Washington, D.C. (D. Almy, Psychological and Social Science Div., Room 3E 1037, Pentagon, Washington 25)

14–21. **Veterinary** Congr., 17th, Hanover, Germany. (H. Merkt, Tierärztliche Hochschule, Hans-Böckler-Allee 16, Hanover)

15–17. International College of **Surgeons**, European Federation congr., Helsinki, Finland. (ICS, 1516 Lake Shore Dr., Chicago 10, Ill.)

15–30. International Assoc. of **Meteorology and Atmospheric Physics**, 13th general assembly, Berkeley, Calif. W. L. Godson, Meteorological Office, 315 Bloor St. West, Toronto 5, Ont., Canada)

18–22. **Health**, 12th annual conf., University Park, Pa. (E. J. Kusko, Dept. of Health, P.O. Box 90, Harrisburg, Pa.)

19–21. **Cryogenic Engineering** Conf., Boulder, Colo. (K. T. Timmerhaus, Chemical Engineering Dept., Univ. of Colorado, Boulder)

19–23. **Clinical Chemistry**, 5th intern. congr., Detroit, Mich. (D. G. Remp, Henry Ford Hospital, Detroit 2)

19–25. Electrochemical **Thermodynamics and Kinetics**, 14th, Moscow, U.S.S.R. (Secretary General, Swiss Federated Institute of Technology, Dept. of Industrial and Engineering Chemistry, Universitätstr. 6, Zurich 6)

19–30. **Macromolecules**, statistical theory, seminar, Hanover, N.H. (Dean of Summer Programs, P.O. Box 833, Hanover)

19–31. **Geodesy and Geophysics**, 13th general assembly, Berkeley, Calif. (W. E. Smith, AGU, 1515 Massachusetts Ave. NW, Washington 5

20–23. Western **Electronic** Show and Conf., San Francisco, Calif. (J. D. Noe, WESCON, 701 Welch Rd., San Francisco)

20–24. **Poultry Science** Assoc., Stillwater, Okla. (W. E. Shaklee, Cooperative State Experiment Station Service, USDA, Washington 25)

20–26. **Psychology**, 17th intern. congr., Washington, D.C. (American Psychological Assoc., 1333 16th St. NW, Washington 6)

20–26. **Zoological Nomenclature**, intern. committee meeting, Washington, D.C. (W. E. China, British Museum of Natural History, Cromwell Rd., London S.W.1)

20–27. **Zoology**, 16th intern. congr., Washington, D.C. (Secretary of the Congress, Natl. Acad. of Sciences, 2101 Constitution Ave., NW, Washington 25)

21–23. **Biochemical Conf.**, Pacific Slope annual, Honolulu, Hawaii. (P. E. Wilcox, Dept. of Biochemistry, Univ. of Washington, Seattle 5)

21–29. International Conf. on **Population**, Ottawa, Ont., Canada. (B. Benjamin, Intern. Union for the Scientific Study of Population, General Register Office, Somerset House, London W.C.2, England)

22–24. National Council of Teachers of **Mathematics**, Pittsburgh, Pa. (E. G. Begle, Stanford Univ., Stanford, Calif.)

25–28. **Soil Conservation** Soc. of America, Logan, Utah. (H. W. Pritchard, Soil Conservation Soc., 7515 Northeast Ankeny Rd., Ankeny, Iowa)

25–29. **Medical** Correctional Assoc., Portland, Ore. (F. L. Rouke, 14 Studio Arcade, Bronxville, N.Y.)

26–28. Simulation for **Aerospace Flight**, specialists meeting, Columbus, Ohio. (Inst. of the Aerospace Sciences, 2 E. 64 St., New York 21)

26–28. **Superconductivity**, intern conf., Hamilton, N.Y. (R. W. Schmitt, General Electric Research Laboratory, P.O. Box 1088, Schenectady, N.Y.)

26–29. American **Sociological** Assoc., Los Angeles, Calif. (T. Parsons, Dept. of Social Relations, Harvard Univ., Cambridge 38, Mass.)

26–30. American **Mathematical** Soc., 68th summer, Boulder, Colo. (Mrs. R. Drew-Bear, Special Projects Dept., AMS, 190 Hope St., Providence 6, R.I.)

26–30. **Rheology**, 4th intern. congr., Providence, R.I. (R. S. Rivlin, Brown Univ., Providence 12)

26–30. **Solar Spectrum**, intern. symp., Utrecht, Netherlands. (C. de Jager, Theoretical Dept., Sterrewacht, Servaasbolwerk 13, Utrecht)

26–31. **Haematology**, European Soc., 9th congr. Lisbon, Portugal. (Secretary, Haematology Congr., Dept. of Haematology, Inst. of Tropical Medicine, Lisbon, Portugal)

27–30. **Alaskan Science** Conf., Anchorage. (A. H. Mick, Alaska Agricultural Experiment Station, Palmer)

27–30. American **Physiological** Soc., Coral Gables, Fla. (M. Edwards, Physiology Dept., Univ. of Miami School of Medicine, Coral Gables 34)

27–30. **Computing Machinery** Assoc., natl. conf., Denver, Colo. (F. P. Venditti, Univ. of Denver, Denver 10)

27–31. American Inst. of **Biological Sciences**, Amherst, Mass. (R. A. Jester, Dept. of Floriculture, Univ. of Massachusetts, Amherst)

27–4. **Automatic Control**, 2nd intern. congr., Basel, Switzerland. (A. von Schulthess, Wasserwerkstr. 53, Zurich 6, Switzerland)

28–31. **Electron Microscope** Soc. of America, 21st annual, Denver, Colo. (V. L. Van Breemen, Mercy Inst. for Biomedical Research, 2920 E. 16 Ave., Denver 6)

28–4. **British Assoc. for the Advancement of Science**, Aberdeen, Scotland. (Sir G. Allen, Burlington House, Piccadilly House, London, England)

29–30. **Solvation** Phenomena, symp., Calgary, Alberta, Canada. (P. J. Krueger, Dept. of Chemistry, Univ. of Alberta, Calgary)

29–31. **Pollen Physiology** and **Fertilization**, symp., Nijmegen, Netherlands. (H. F. Linskens, Dept. of Botany, Univ. of Nijmegen, Driehuizerweg 200, Nijmegen)

29–4. American **Psychological** Assoc., Philadelphia, Pa. (E. B. Newman, Memorial Hall, Harvard Univ., Cambridge 38, Mass.)