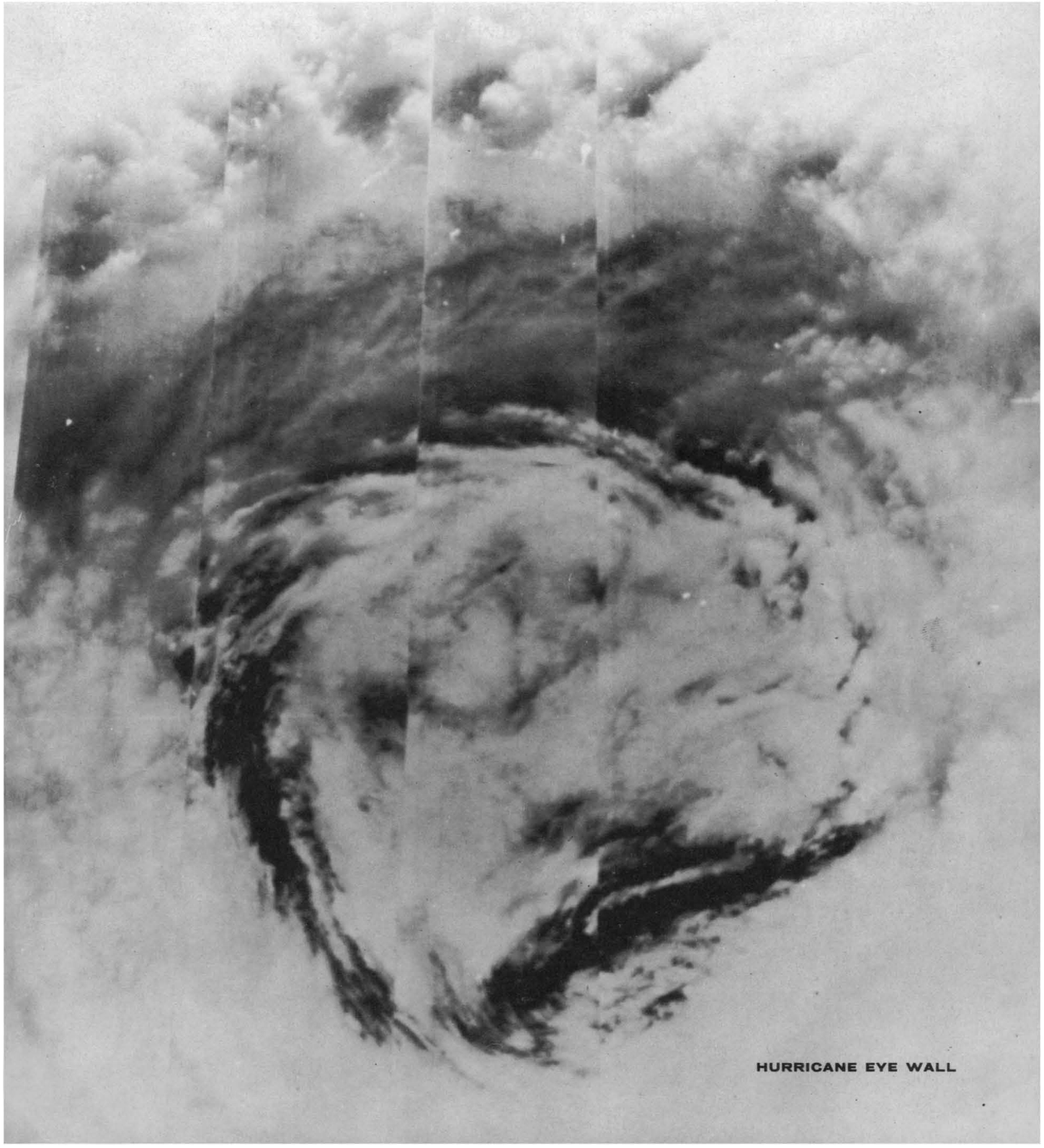
SCIENCE 13 September 1963
Vol. 141, No. 3585
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



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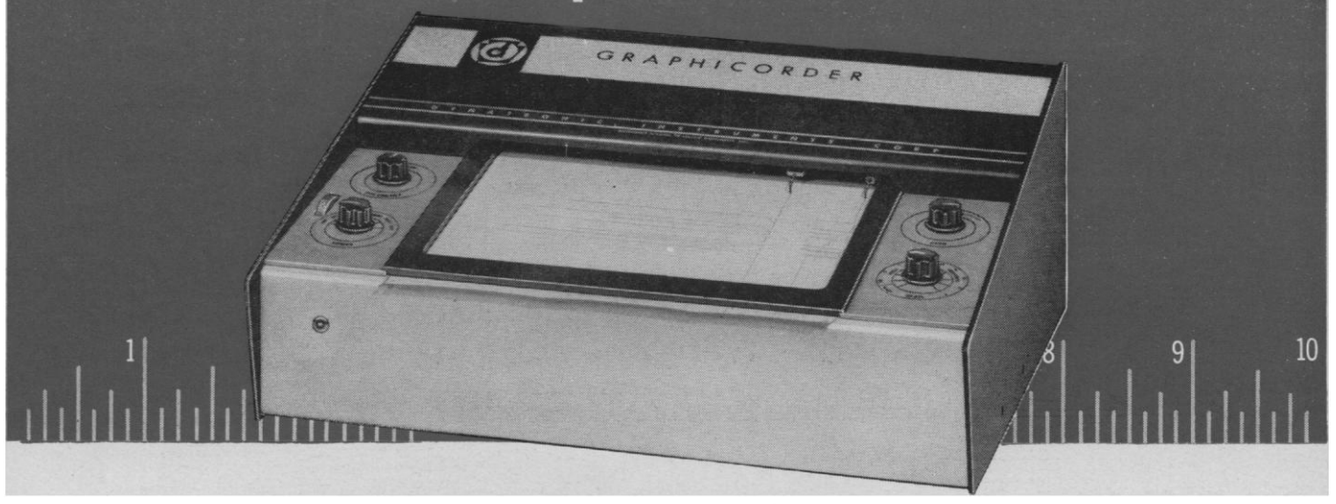

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13 September 1963
Vol. 141, No. 3585

SCIENCE

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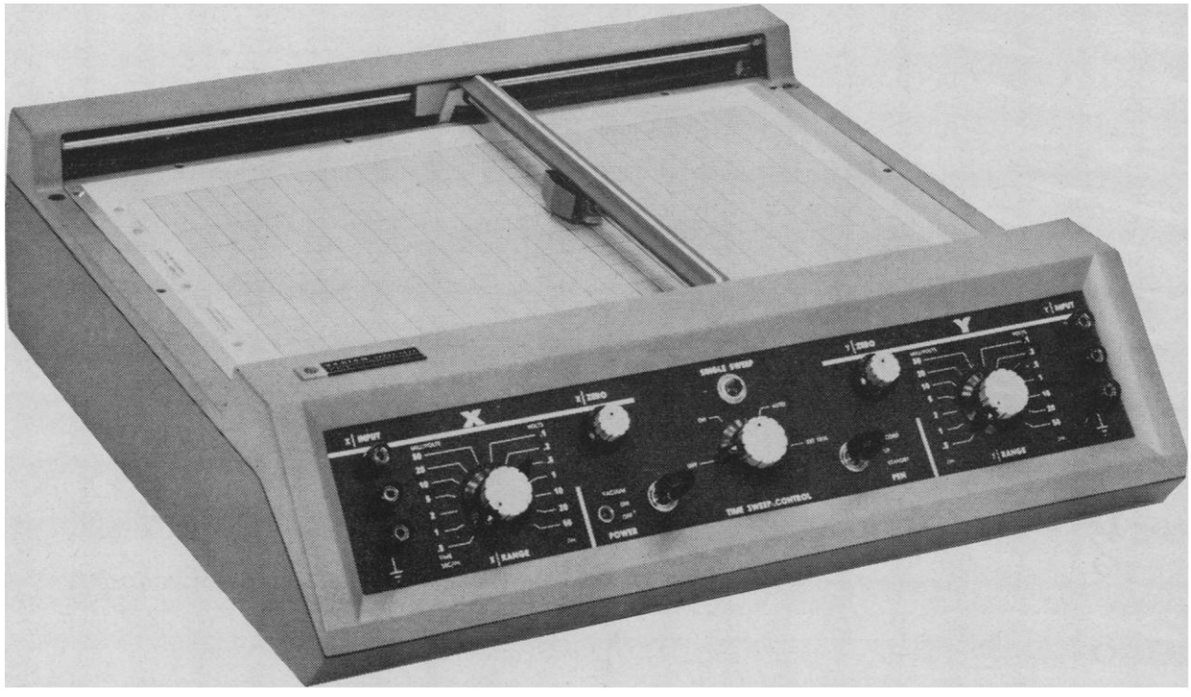
COVER

Eye of hurricane Esther as seen from a U-2 reconnaissance plane flying at an altitude of 20,000 meters on 17 September 1961. The wall cloud is estimated to be about 15,000 meters high and the banded clouds in the eye top extend upward about 2000 meters. See page 1001. [U.S. Air Force]

MEET VARIAN'S NEW X-Y RECORDER!



...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.

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- zener diode reference
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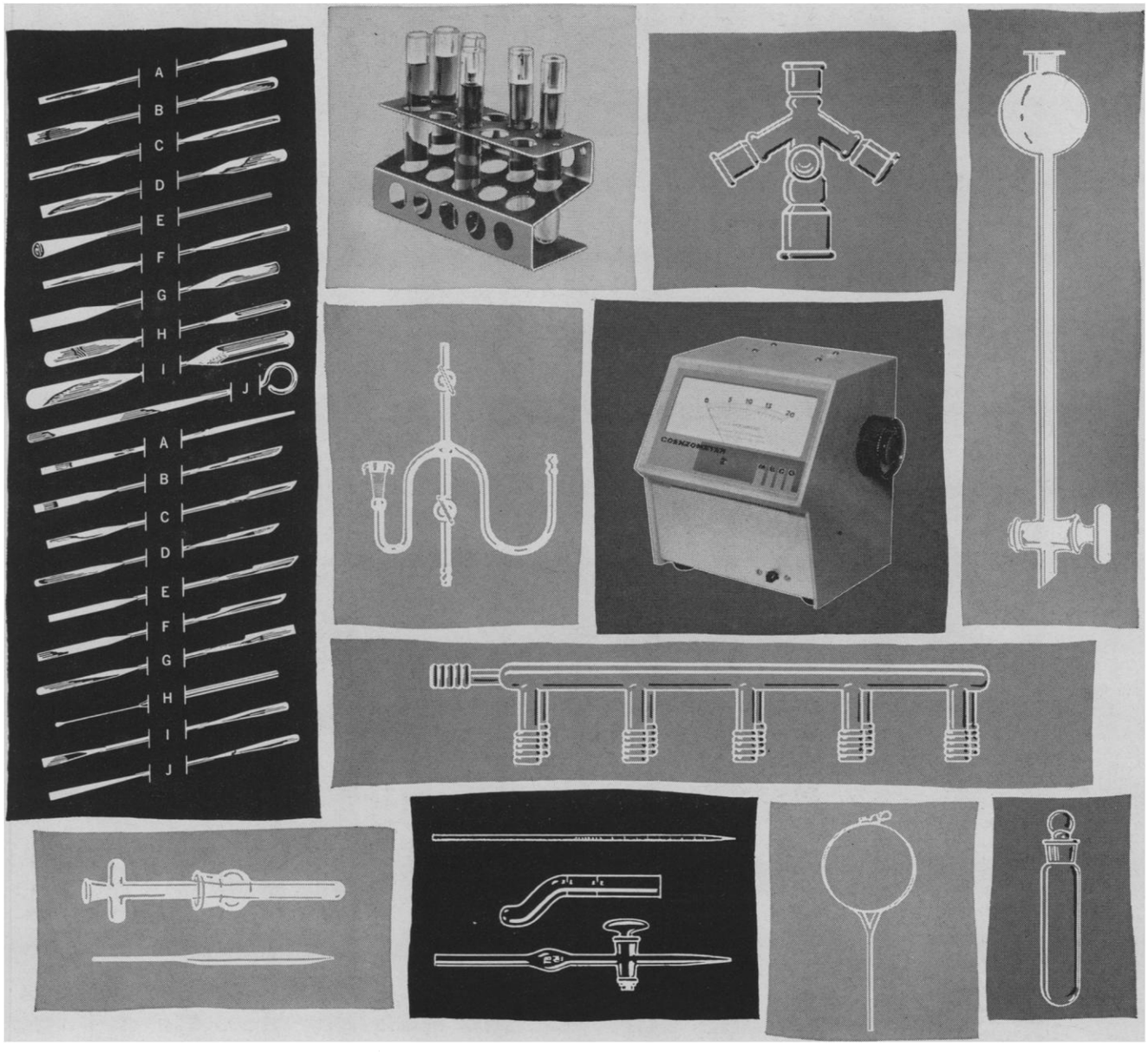

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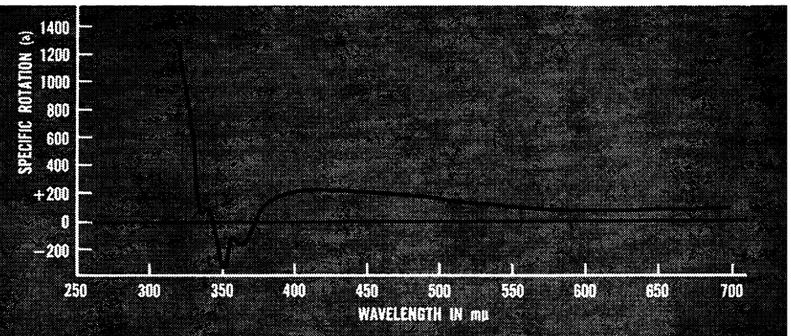

Chart shows spectral analysis by Optical Rotatory Dispersion of 2mg of testosterone in p-dioxane. With identical calcite polarizer-analyzer combinations in each beam, absorption by the sample is canceled out. Rotation of the light by the sample appears as a pen deflection on the chart, whence it is readily convertible to angular units by conversion tables provided with the accessory. The high scale expansions available on the Model 350 can be used to advantage in ORD work.

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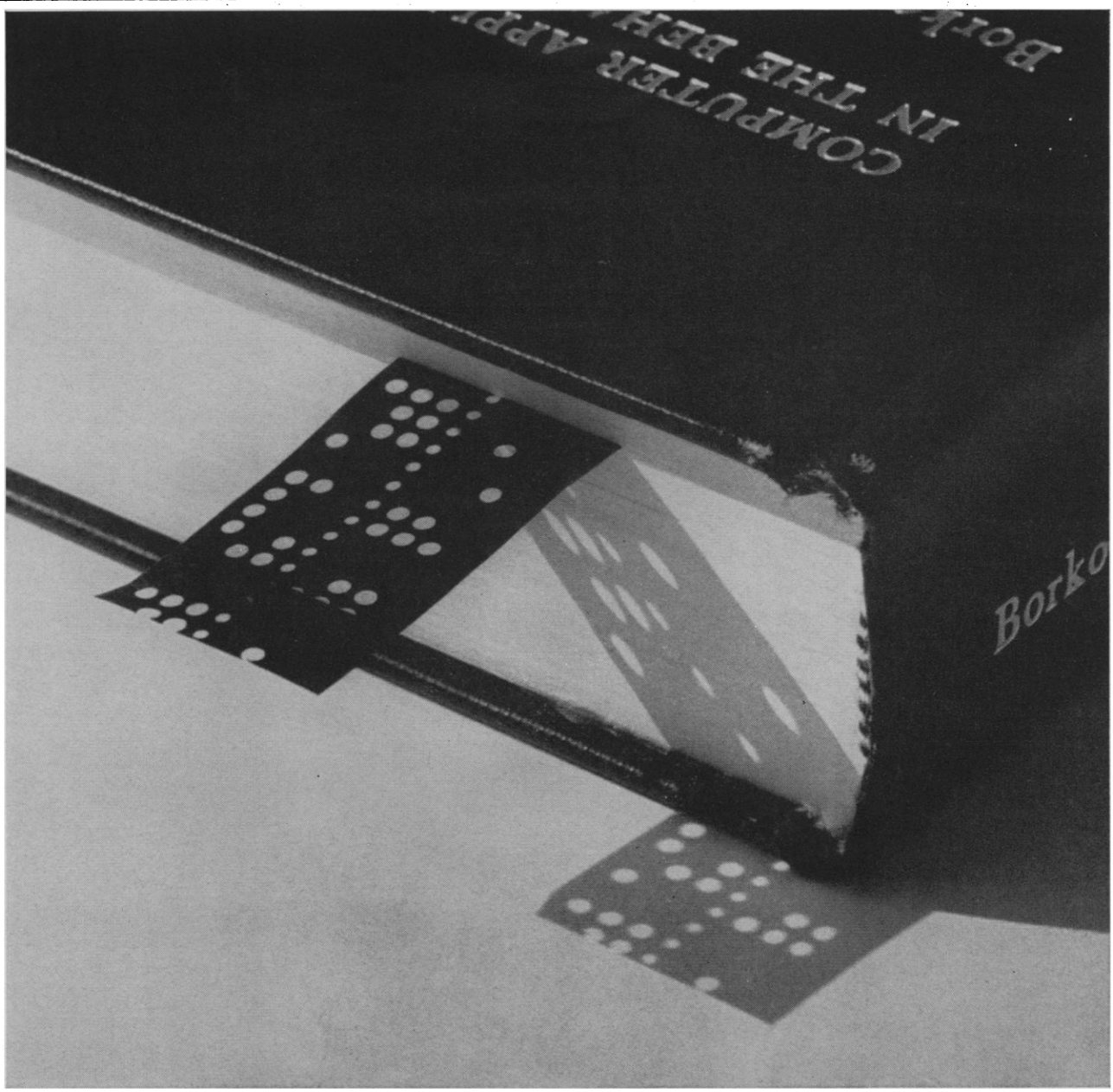
A wide dynamic range of scan speeds and complete selection of recording and sampling accessories enable the Model 350 to meet specialized analytical requirements with ease. For an illustrated brochure with complete description and specifications, write to Instrument Division, Perkin-Elmer Corporation, 910 Main Avenue, Norwalk, Connecticut.



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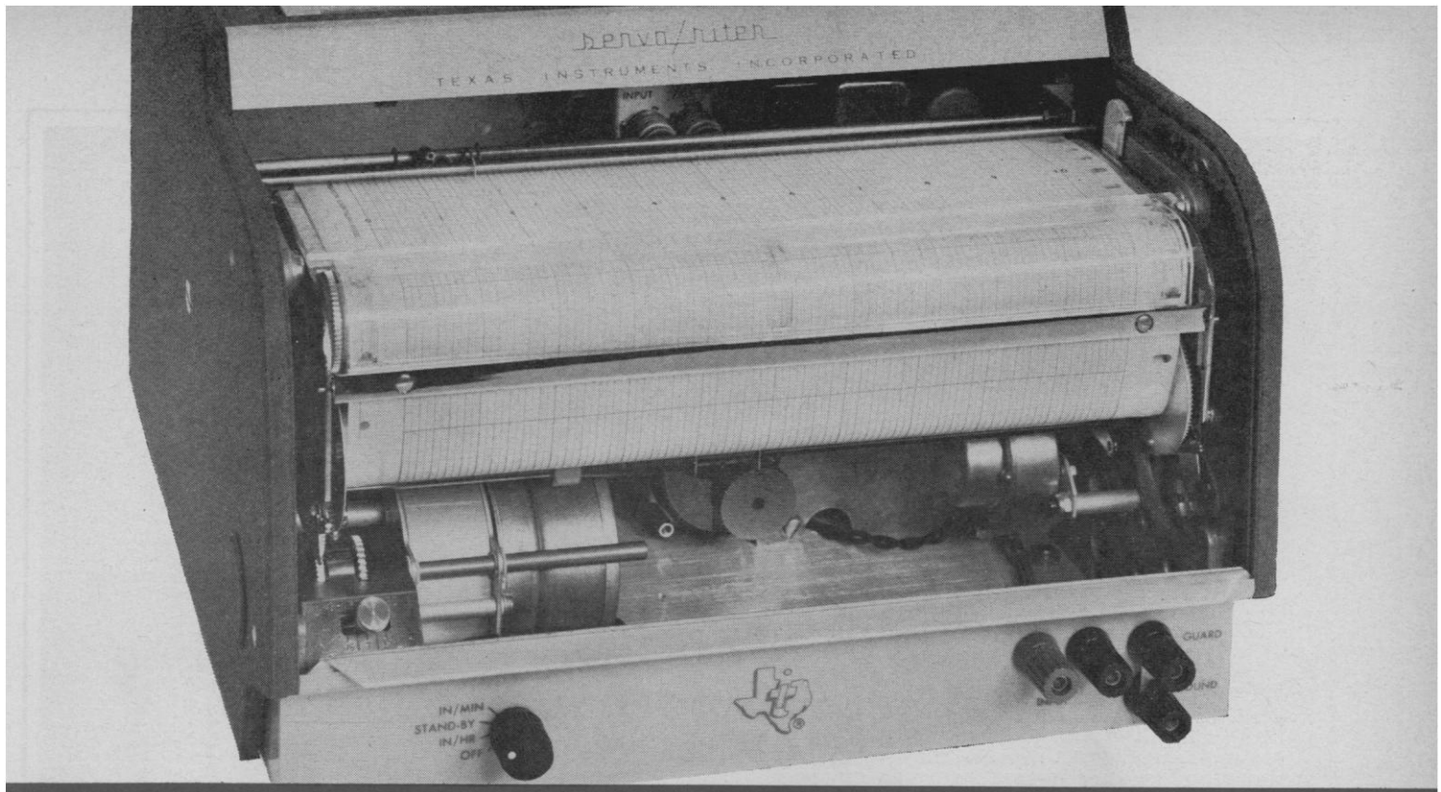

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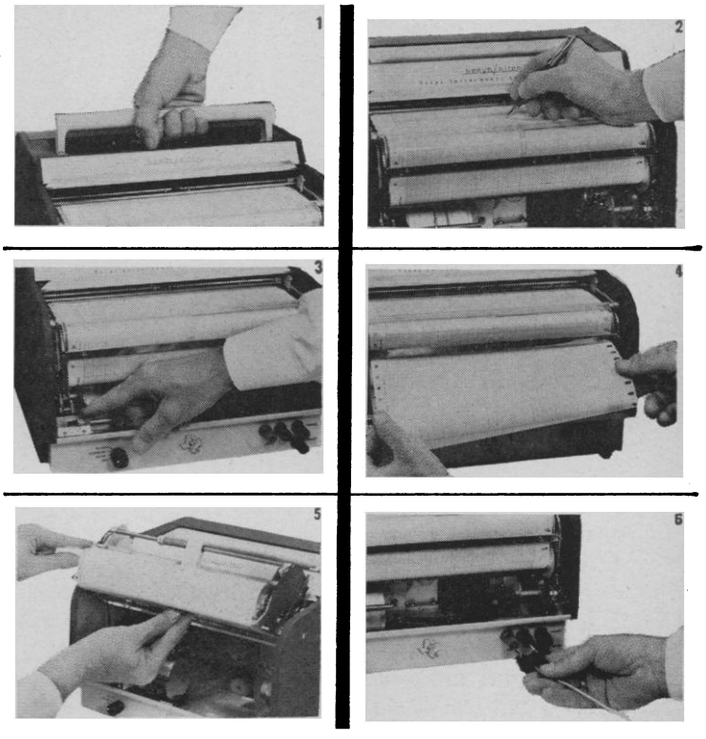

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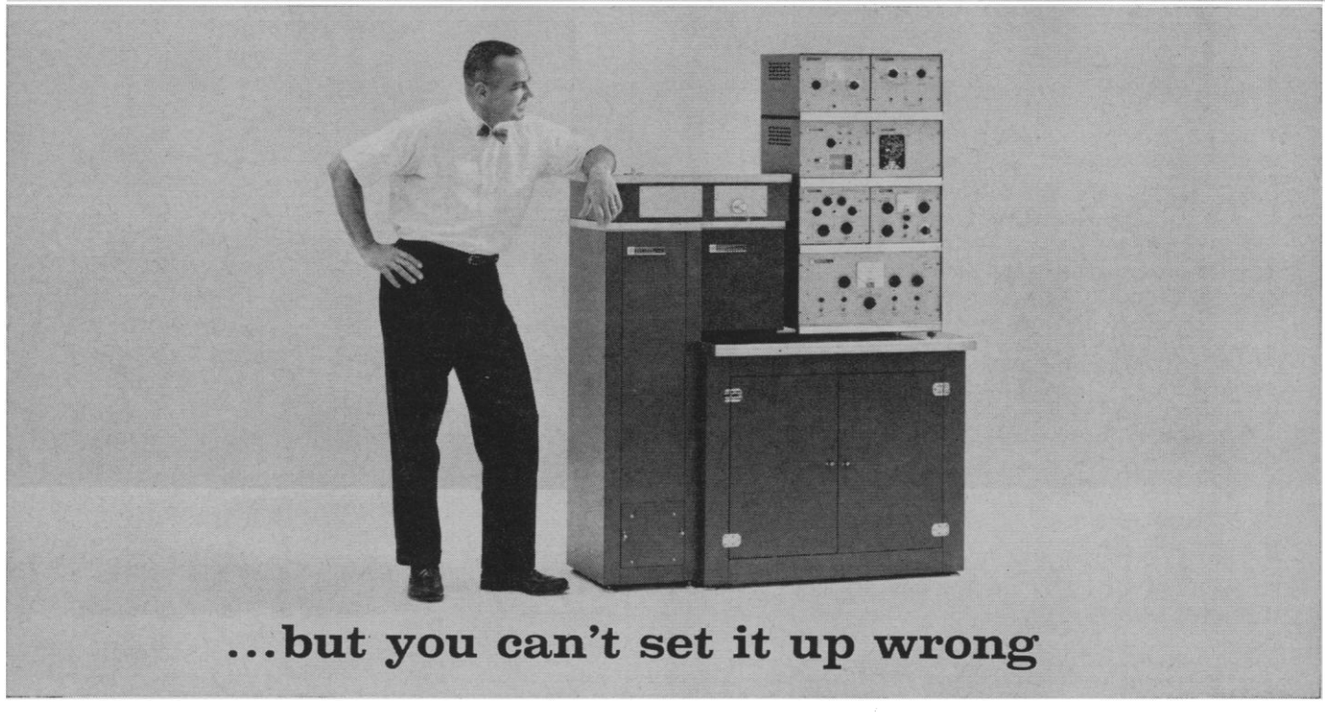

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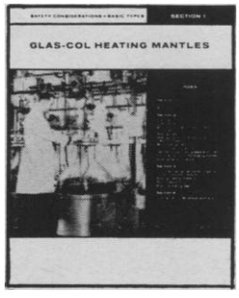
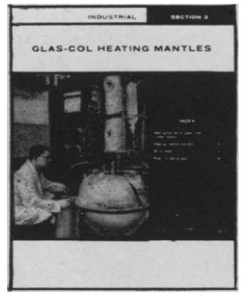


Section 1 Basic types of heating mantles . . . safety considerations . . . how *not* to use heating mantles.



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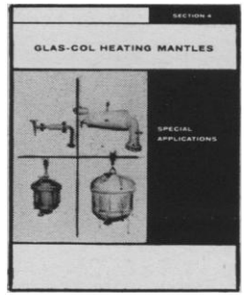

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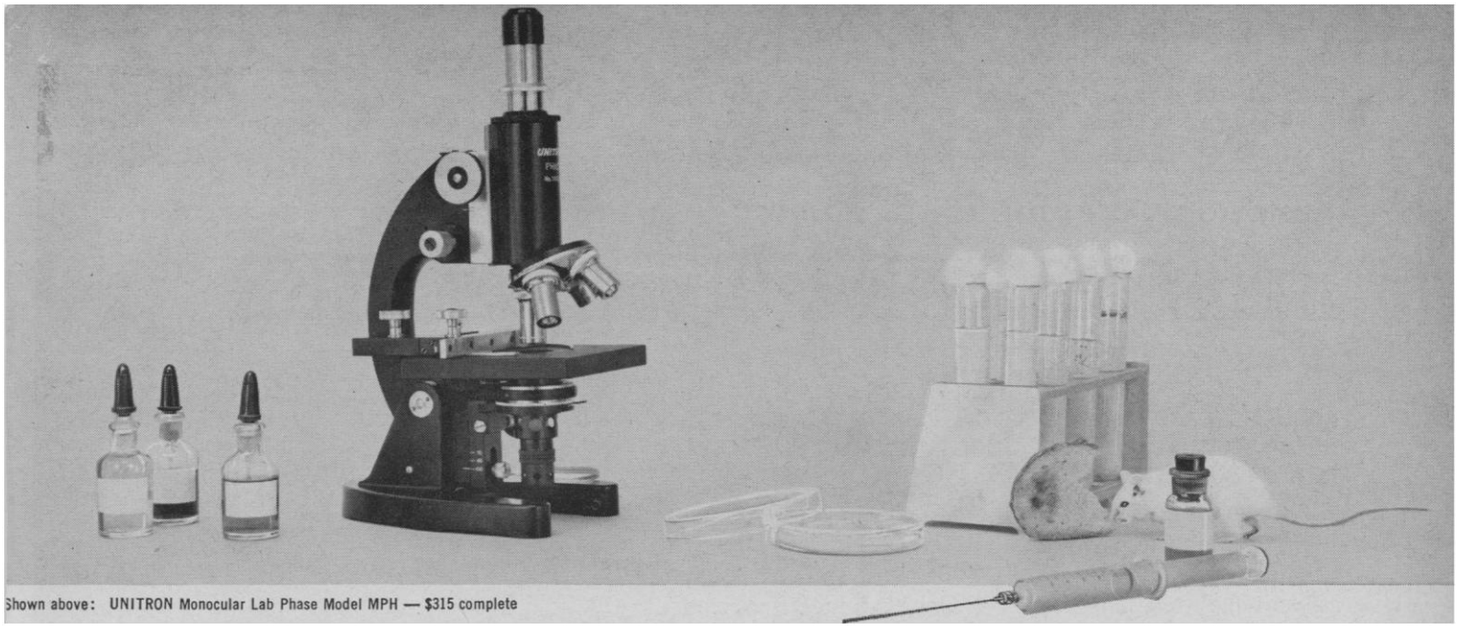

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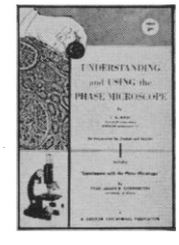

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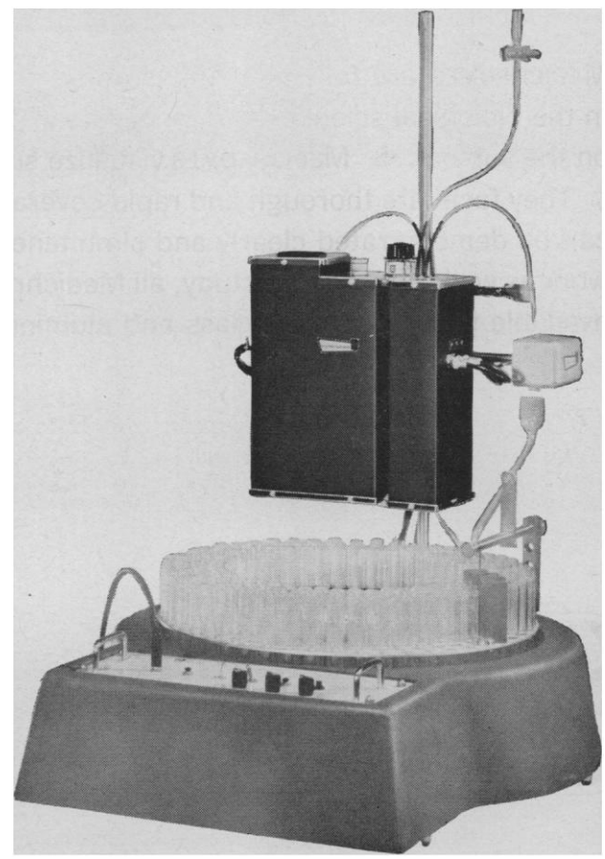

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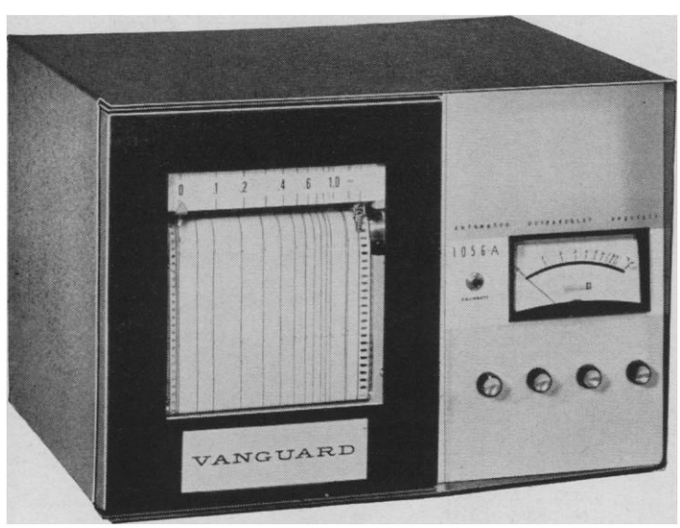

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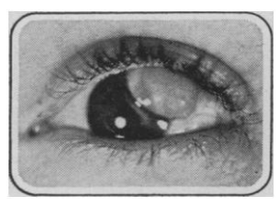
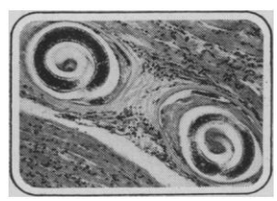
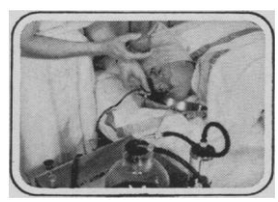
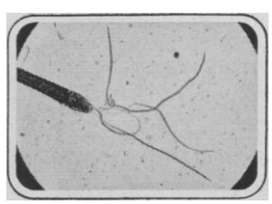

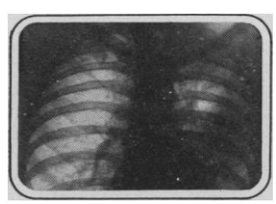
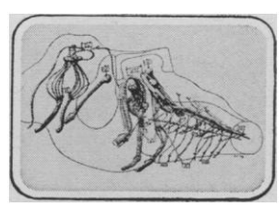

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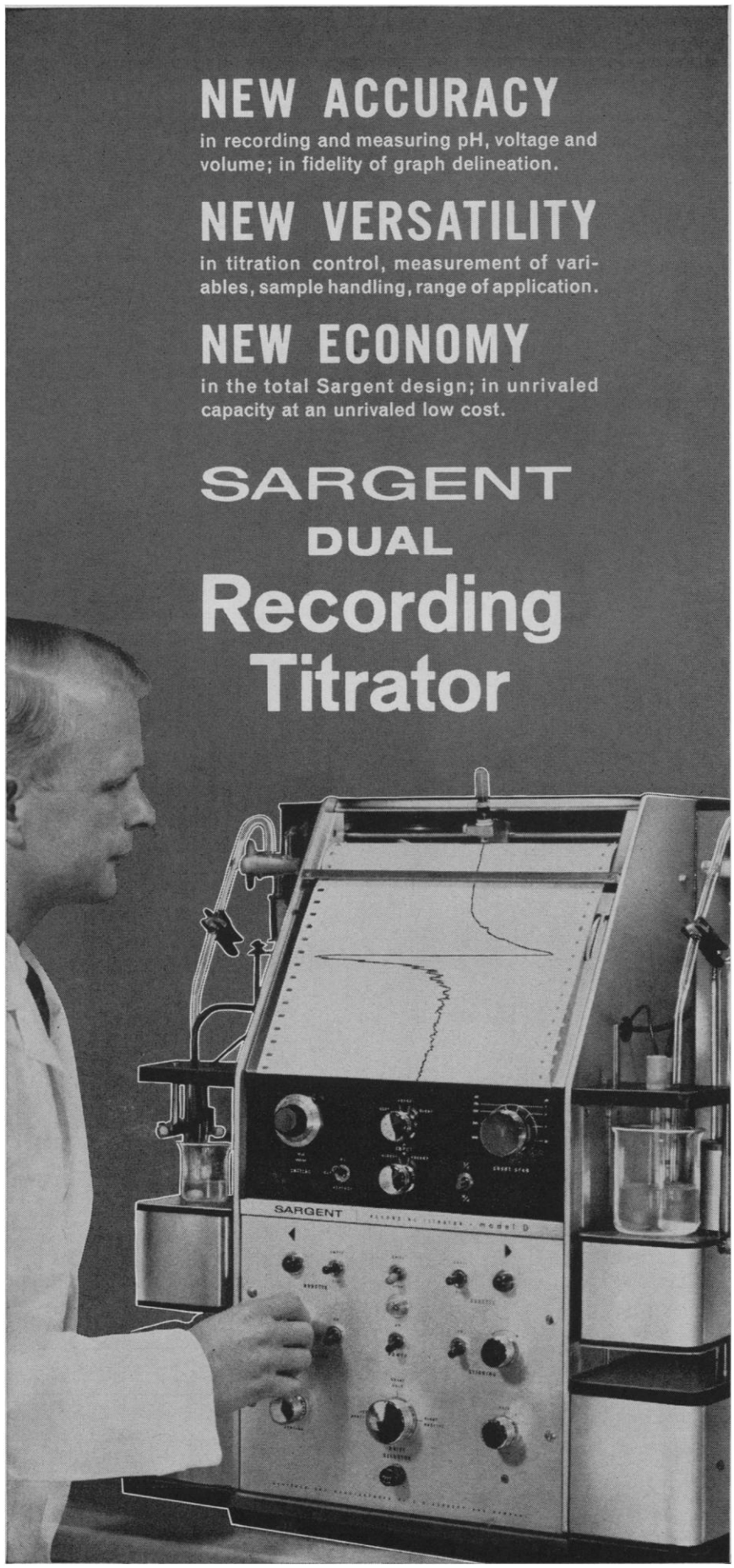

SPECIFICATIONS:

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

Scale accuracy: ¼ percent.

Bridge power: mercury batteries.

Scale width: 240 mm, graduated in 100 units.

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

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

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

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

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

Burette accuracy: 1/10 percent.

Stirring: magnetic variable speed.

Balancing speed: 3⅓ seconds full scale.

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

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

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

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

Recorded functions: fundamental signal or first derivative.

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

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

Net weight: 95 pounds.

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

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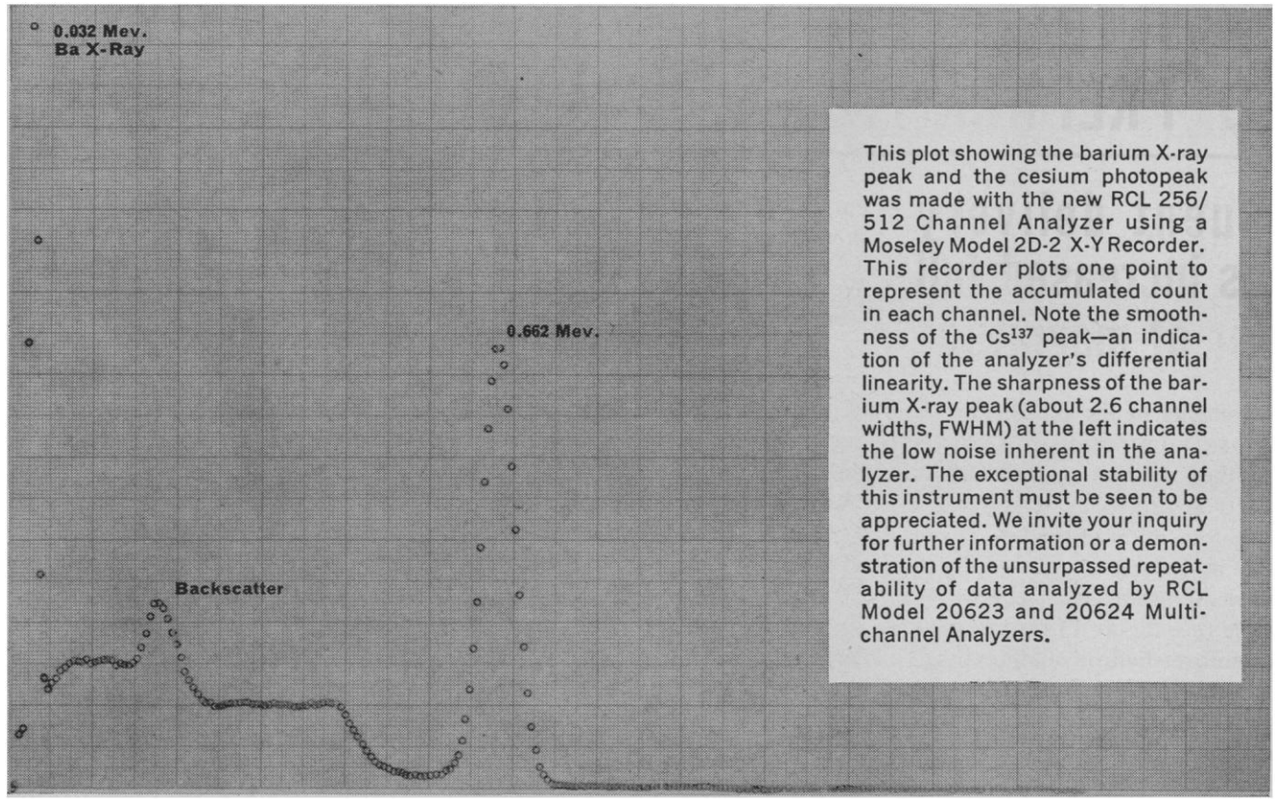

This plot showing the barium X-ray peak and the cesium photopeak was made with the new RCL 256/512 Channel Analyzer using a Moseley Model 2D-2 X-Y Recorder. This recorder plots one point to represent the accumulated count in each channel. Note the smoothness of the Cs^{137} peak—an indication of the analyzer's differential linearity. The sharpness of the barium X-ray peak (about 2.6 channel widths, FWHM) at the left indicates the low noise inherent in the analyzer. The exceptional stability of this instrument must be seen to be appreciated. We invite your inquiry for further information or a demonstration of the unsurpassed repeatability of data analyzed by RCL Model 20623 and 20624 Multichannel Analyzers.

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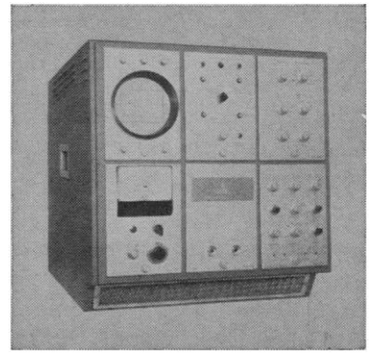

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One of the most significant results of the introduction of the new beads is the extension of SEPHADEX gel filtration to production-scale preparative operations. As can be calculated from the lowest curve in Figure 2, a 10 cm. diameter column of coarse grade SEPHADEX G-25 under a head of 60 cm. of water *can deliver almost 19 liters/hour of effluent.*

We strongly suggest that laboratory workers acquaint their colleagues in semiworks and production engineering with the new beads of SEPHADEX. The use of the spherical particles could open entirely new avenues in unit operations.

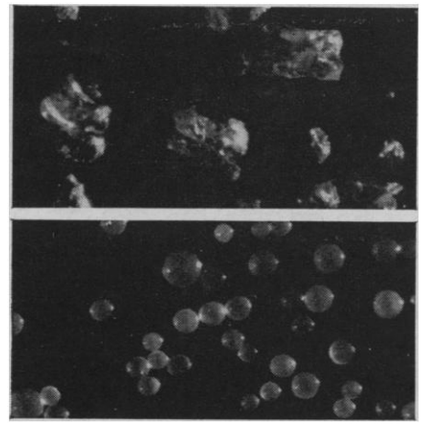

Figure 1. SEPHADEX was formerly supplied in the form of irregularly shaped particles as shown in top photograph. Now available in spherical beads as shown below, SEPHADEX facilitates packing of columns and greatly increases speed of operations.

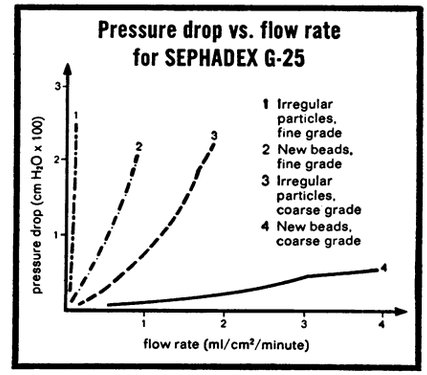

Figure 2. The curves above depict pressure-drop/flow-rate functions for columns using a 50 cm bed of SEPHADEX G-25. For given hydrostatic heads, note that the new spherical beads give up to tenfold greater effluent deliveries. Analytical procedures are hastened and preparative operations are put within economically practical engineering ranges.

Available forms of new SEPHADEX beads

SEPHADEX Type	Exclusion Limit (MW)	Grade	Size (microns)	Bed Volume ml/g
*G-25	5,000	coarse fine	100-300 20-80	5
G-50	10,000	coarse fine	100-300 20-80	10
*G-75	50,000	one grade	40-120	12-15
G-100	100,000	one grade	40-120	15-20
G-200	200,000	one grade	40-120	30-40

*SEPHADEX G-25 (fine) and G-75 will not be available before October, 1963.

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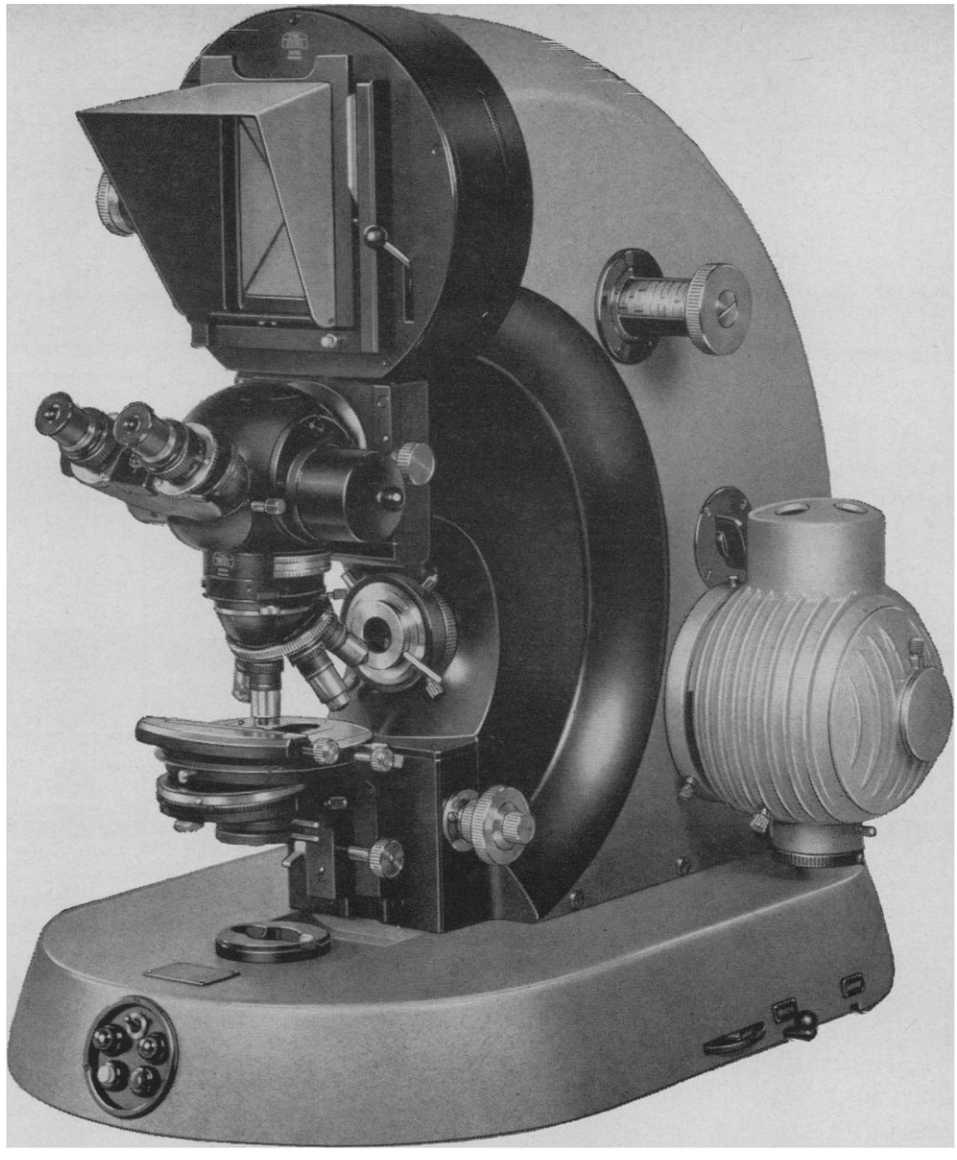

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NUMBER 5 IN A SERIES

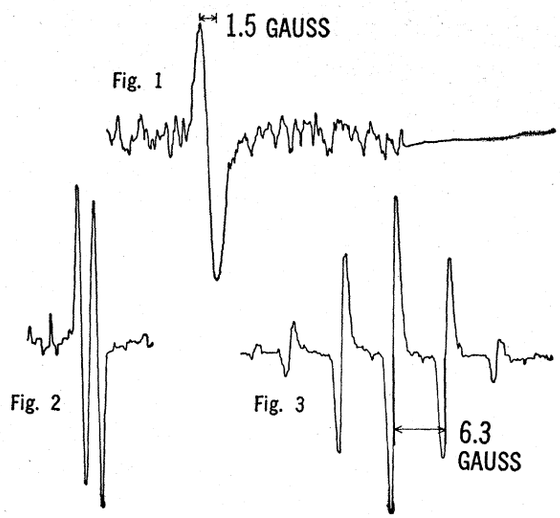
How can Electron Paramagnetic Resonance (EPR) provide a chemist with information about free radical reaction mechanisms?

First, he can detect transient free radicals in the course of a reaction. He can then identify the free radical by obtaining information concerning the molecular environment of the unpaired electron. In addition, he can make a quantitative measurement of the free radical concentration; and finally, measure this concentration as a function of time.

IDENTIFICATION OF FREE RADICALS

Free radicals are known to exist as intermediates in a variety of organic reactions. Numbers 1 through 3 of this series illustrated the effectiveness of EPR in detecting these intermediates in dynamic reactions. The problem for the chemist, however, does not end with mere detection of free radicals—**identification** of the intermediate is equally important.

Number 4 of this series discussed an important aspect of the EPR phenomenon which allows absolute identification of free radical intermediates. This phenomenon is the classical hyperfine interaction involving an unpaired electron interacting with neighboring magnetic nuclei (n) of spin quantum number (I). The interaction results in a splitting of the electron resonance absorption into multiplets, the number of which is equal to $(2 \cdot nI + 1)$ when all nuclei are alike.



To illustrate how such identifications are made possible we can examine EPR spectra obtained during the enzymic oxidation, by peroxidase—H_2O_2 of several substrates.

Fig. 1 is the spectrum of the substrate radical generated from dihydroxyfumaric acid and the single line is consistent with the molecular structure of the intermediate

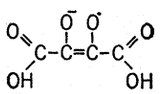


Fig. 2 is the spectrum of the substrate radical from ascorbic acid. The doublet indicates an interaction with a single hydrogen and is consistent with the structure

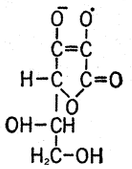
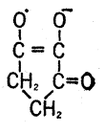
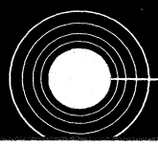


Fig. 3 is the spectrum of the substrate radical from the substrate reductic acid and indicates an interaction with 4 equivalent hydrogens yielding a quintet which is consistent with the structure



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 or other examples in this series, please write: Instrument Division. In Europe: Varian A. G., Zug, Switzerland.



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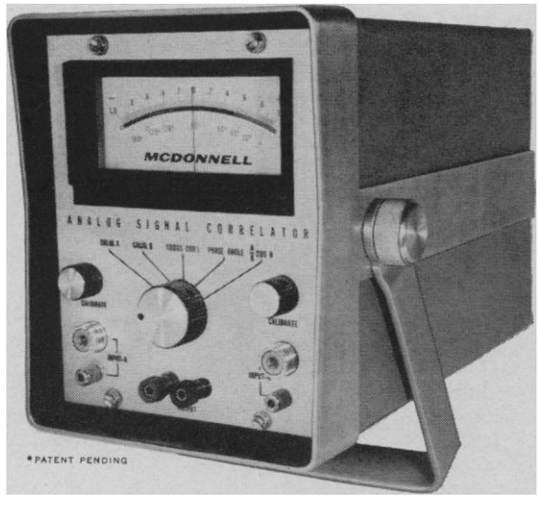
SCHIZOPHRENIA and the AIRPLANE WING

A discussion of a unique instrument we have developed which seems to be useful to the aircraft designer, the medical researcher, the oceanographer, the meteorologist, and in a number of other scientific disciplines . . .

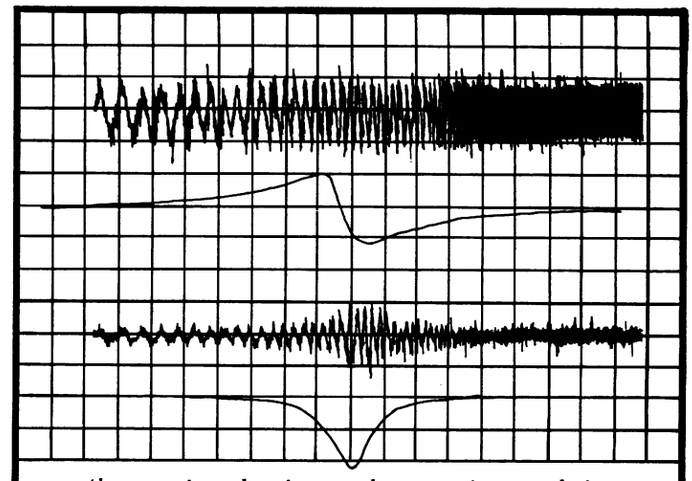
The relationship between the human brain and an aircraft wing seems remote, yet engineers at McDonnell who are working on America's fighter aircraft, and medical researchers in St. Louis, have discovered that study of events in these two unlikely areas involves a common technique called "pattern recognition".

The measurable dynamics of the brain are recorded as variations in voltages, in the same way engineers measure stresses on an aircraft wing during critical flight maneuvers at supersonic speeds.

Recording these dynamic parameters has been possible for several years. Isolating them for immediate interpretation was not. Data engineers at McDonnell have now developed a device called an Analog Signal Correlator, which not only solves the problem for military aircraft designers, but for the medical researcher as well. With this device, medical researchers have been able to establish definite relationships between psychological functioning and the recorded waveform patterns of the brain as they exist in normal and schizophrenic humans.



The McDonnell Analog Signal Correlator* provides, in real time, a dynamic measurement of coherence between any two random signals. The output is visually displayed for immediate interpretation and is simultaneously provided as a voltage output for recording.

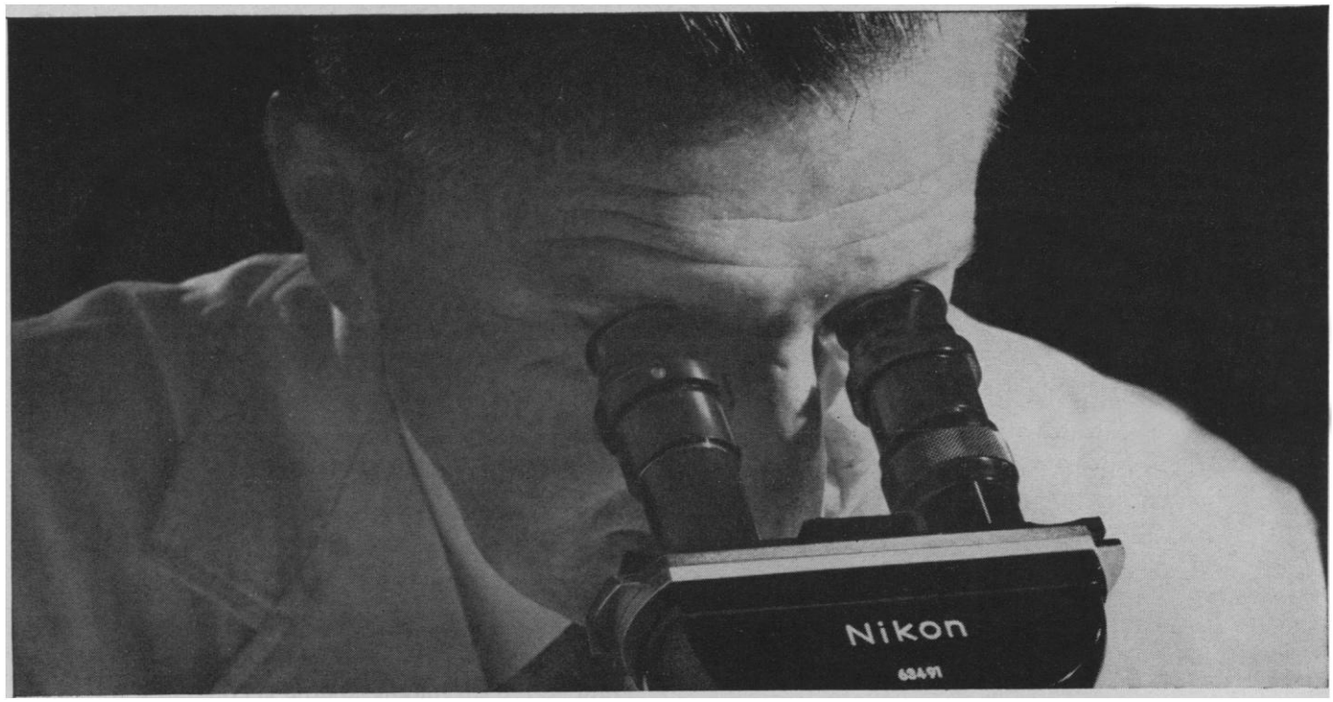


Above tracings show input and output using correlation method for evaluation of system transfer functions.

Data stored on magnetic tape is converted to "hard numbers" at real time rates. Voluminous archives and painstaking visual evaluation with its potential for bias are avoided. Operation of the Analog Signal Correlator "on line" reduces research time by making data results immediately available. Sampling, digitizing-rate and time restrictions are eliminated thus providing thorough and complete data for analysis.

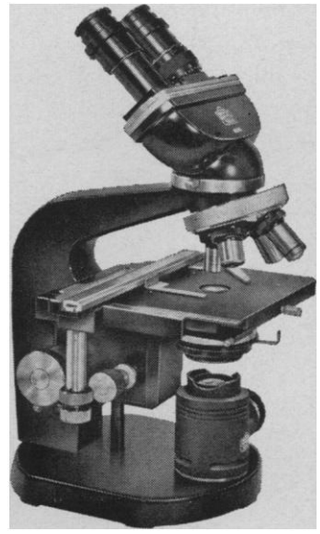
The application of this device is just beginning. Current contract programs include such diverse studies as noise, vibration and flutter onset as they apply to supersonic development-flights and wind-tunnel research. In biomedicine, the Analog Signal Correlator makes possible the study of EEG bilateral phase relationships in humans. It is a significantly useful device for determining human habituation to external stimuli. Other areas which may be studied with this new research tool include pharmacology and fetal electrocardiography as well as aircraft-related research involving pilot proficiency and detection of pilot stress during hyperventilation.

We have already learned that Analog Signal Correlation can be utilized to improve data analysis in Biomedicine, Seismology, Radar, Sonar, Structural Dynamics, Oceanography, Bionics, Automatic Control, Radio Astronomy, Meteorology. Our engineers would be pleased to discuss this device with you and are especially interested in applications you might suggest. Additional information about the design, operational parameters, price and delivery schedule is available. **Write W. W. Toole, McDonnell Electronic Equipment Division, Department 946, Box 516, St. Louis 66, Missouri.**



where ruggedness and reliability are as essential as optical quality

NIKON SBR laboratory microscope



The Nikon SBR is a solidly built, yet incredibly flexible laboratory instrument. A veritable workhorse for routine applications, its ready adaptability, whenever special problems arise, is no less astonishing.

Essentially, the SBR consists of the basic Series S microscope body equipped with dust-proof, quadruple nosepiece, mounted in ball bearings; rotating binocular head; and rotating, rectangular graduated mechanical stage whose coaxial controls can be operated with either hand.

Tension-adjustable, focusing controls are located on both sides of the instrument. And a stage-stop lever can be preset to prevent accidental contact between the slide and objective. All controls are low-positioned.

Whether focusing, or manipulating other controls, the one thing that impresses you about the SBR is its rock-steady mechanical stability. There's nothing finicky about any of the adjustments. Once set, they stay put. There's no loss of time or temper having constantly to reset and readjust them.

But, apart from the ruggedness, versatility and smooth mechanical responsiveness of the Nikon SBR, the quality that commends it above all else is its optics. You will find it difficult to duplicate its performance with any other microscope — for uniformity and brightness of field, image resolution, and for the visual comfort and ease you enjoy even with prolonged use.

Building-block design readies the SBR for any number of special applications. It accepts dark-field and phase-contrast equipment, interference-phase and polarizing attachments, photomicrographic equipment, projection head, and a wide variety of eyepieces, objectives, illuminators, measuring reticles, and other accessories.

For complete details, write to Dept. S-9

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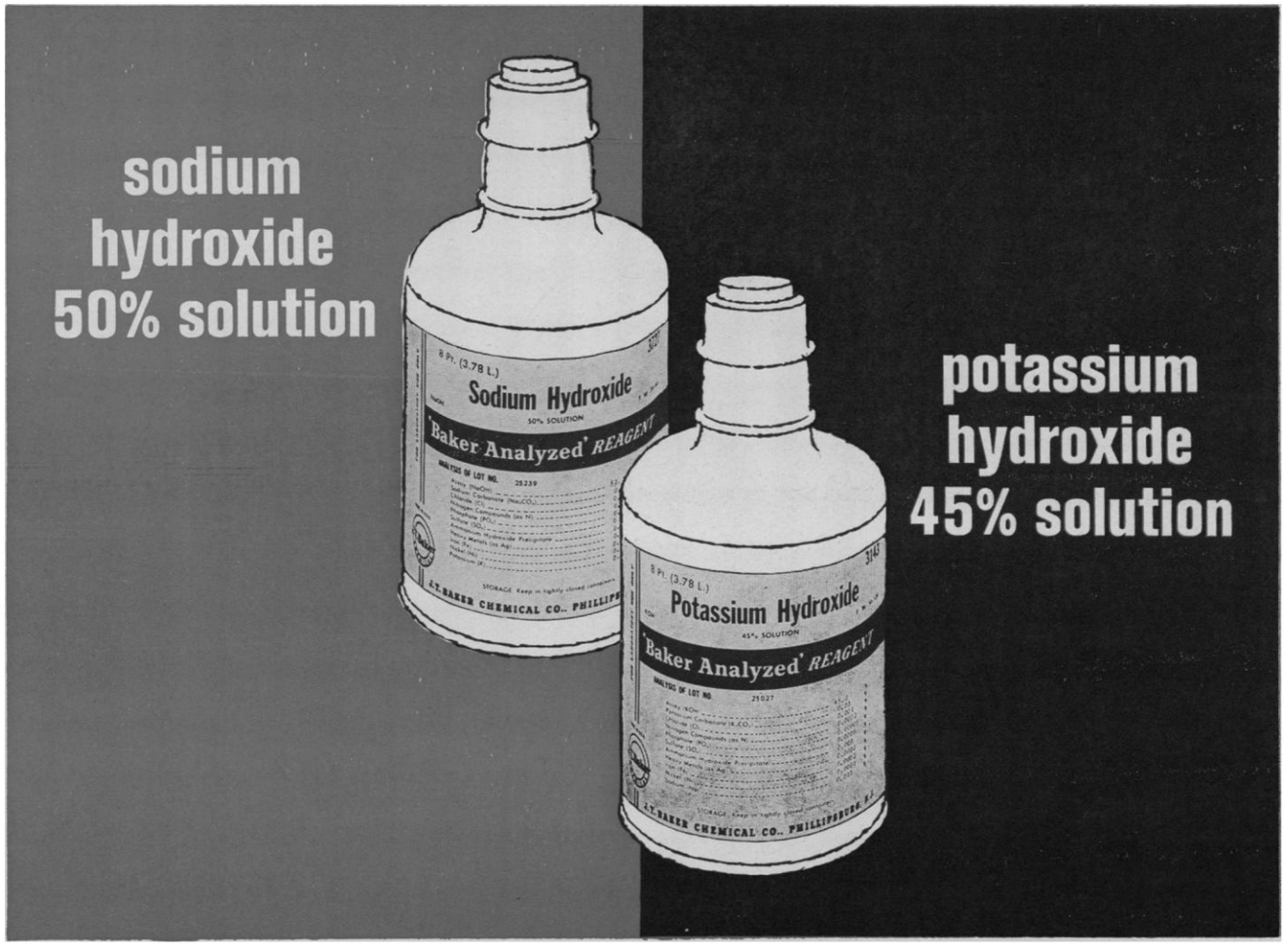

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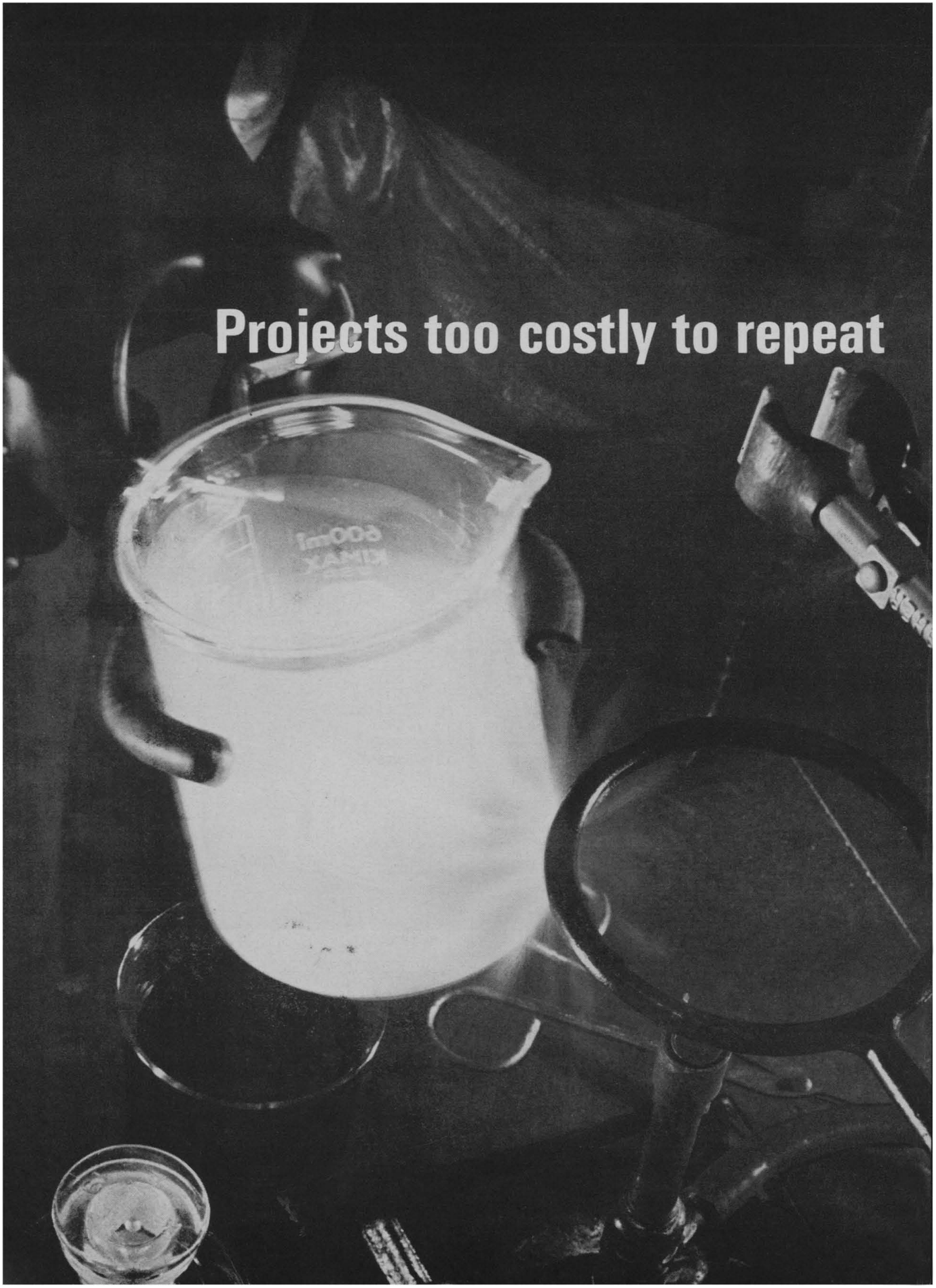

Projects too costly to repeat

UNION CARBIDE **LINDE CRYOBIOLOGY NEWS**

REPORT NO. 4 FROM UNION CARBIDE CORPORATION, LINDE DIVISION

More preservation progress using liquid nitrogen

Notes on preserving parasitic protozoa, tissue cultures...successful applications of new cryogenic cooling systems...latest cryobiology equipment.

Significant achievements were recently reported on the use of liquid nitrogen for freezing and storage of biological specimens. Diamond, et al.[1] successfully applied cryogenic techniques to preserve a selected group of parasitic protozoa for extended periods. Using two- or three-step freezing cycles and storing at liquid nitrogen temperature (-196°C.), this research team was able to preserve *Entamoeba histolytica, Trichomonas gallinae, T. vaginalis, T. foetus, T. hominis, Trypanosoma cruzi,* and *T. ranarum,* for unprecedented times. In evaluating the efficiency of this liquid nitrogen preservation technique, they reported:

"No difference in yields were found between samples of a given species thawed 24 hours after freezing and those thawed after the longest period of storage. This indicated absence of decay during storage . . ."

At dry ice temperature, degradative activity commonly occurs.

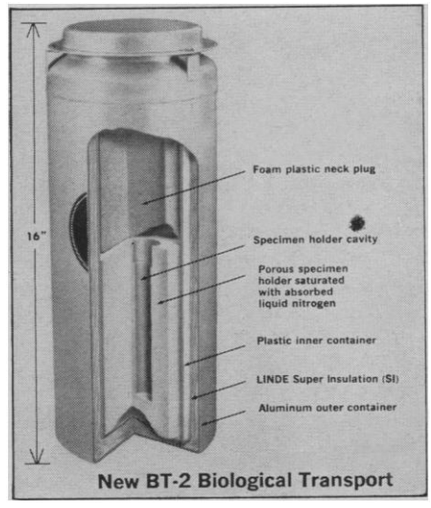
Greaves, et al.[2] designate the two major biological products requiring low temperature storage as: (1) the preservation of cells for tissue culture and (2) the preservation of erythrocytes of rare blood groups. These authors note that the key to very low temperature storage is reliability, and: "The LINDE containers require recharging only once a week as routine and in an emergency (they) will last from 28 to 90 days."

In this paper the authors also describe a modification to the plug of the LINDE LR-25B Refrigerator, which serves as a controlled-rate cooling device.

LATEST EQUIPMENT FROM LINDE

The BF-5 Biological Freezer provides a simple, economical means of freezing small quantities of biological materials with reasonable accuracy. Designed for use with the LINDE LR-35 Refrigerator, this low-cost, plug-type freezer holds nine 1.2 cc. ampules. The refrigerant is cold nitrogen gas, evolving from liquid nitrogen in the refrigerator. Cooling rate, from ½ °C. to 7°C. per minute, depends upon the number and position of ampules.

The BT-2 Biological Transport (see illustration) is a practical, lightweight container that is designed to permit, for the first time, shipment of biological materials at cryogenic temperatures via postal service or common carrier.



New BT-2 Biological Transport

This new container completely eliminates loss of refrigerant by spillage during shipment. The new BT-2 features a porous specimen holder-block, which absorbs liquid nitrogen and retains it as a liquid until heat from the refrigeration load gradually evaporates this liquid as cold gas. Liquid nitrogen lasts up to five days.

The LR-120 Refrigerator combines convenience and space economy. As the first liquid nitrogen refrigerator to offer square exterior and interior geometry, it permits more convenient use of laboratory floor space and more efficient utilization of internal storage space. Completely non-mechanical, the LR-120 features LINDE's exclusive Super Insulation (SI). Storage space, providing a total bulk capacity of four cubic feet, is divided into four compartments. Storage temperature is -196°C. below and -130°C. above liquid level. Access is via a large opening covered by a two-section plastic lid. The LR-120 holds up to 9600 ampules; liquid nitrogen capacity is 120 liters. It is especially recommended for applications requiring frequent handling of stored materials.

LINDE offers a complete line of quality cryogenic equipment – biological refrigerators, freezers, and other cryogenic containers – as well as fast, nation-wide delivery of liquid nitrogen and top-flight technical service. To secure reprints and full information on latest developments in cryobiology, complete and mail the coupon below.

(1) Diamond, L. S., Meryman, H. T., and Kafig, E., CULTURE COLLECTIONS: PERSPECTIVES AND PROBLEMS (Ed. Martin, S. M.): University of Toronto Press (1963). (2) Greaves, R. I. N., Nagington, J., and Kellaway, T. D., *Fed. Proc.,* 22:90 (Jan.-Feb.) 1963.

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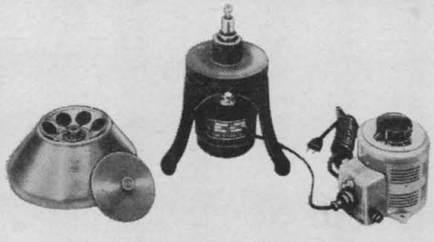

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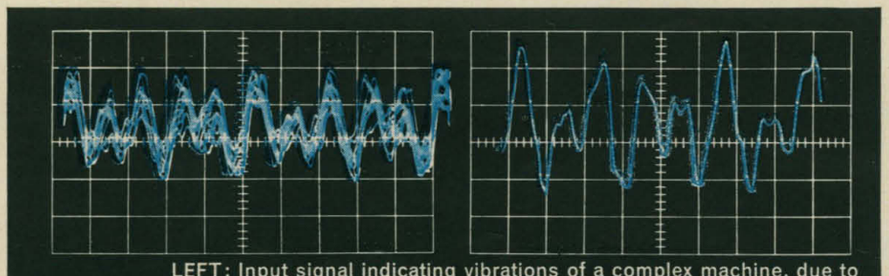
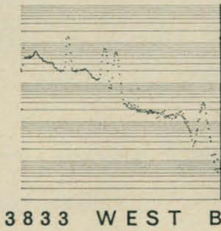
Write or phone Nuclear Data for further information and literature.



LEFT: Input signal indicating vibrations of a complex machine, due to several unrelated forces. RIGHT: Enhancetron 1024 output signal indicating motion due to a single vibration producing member.



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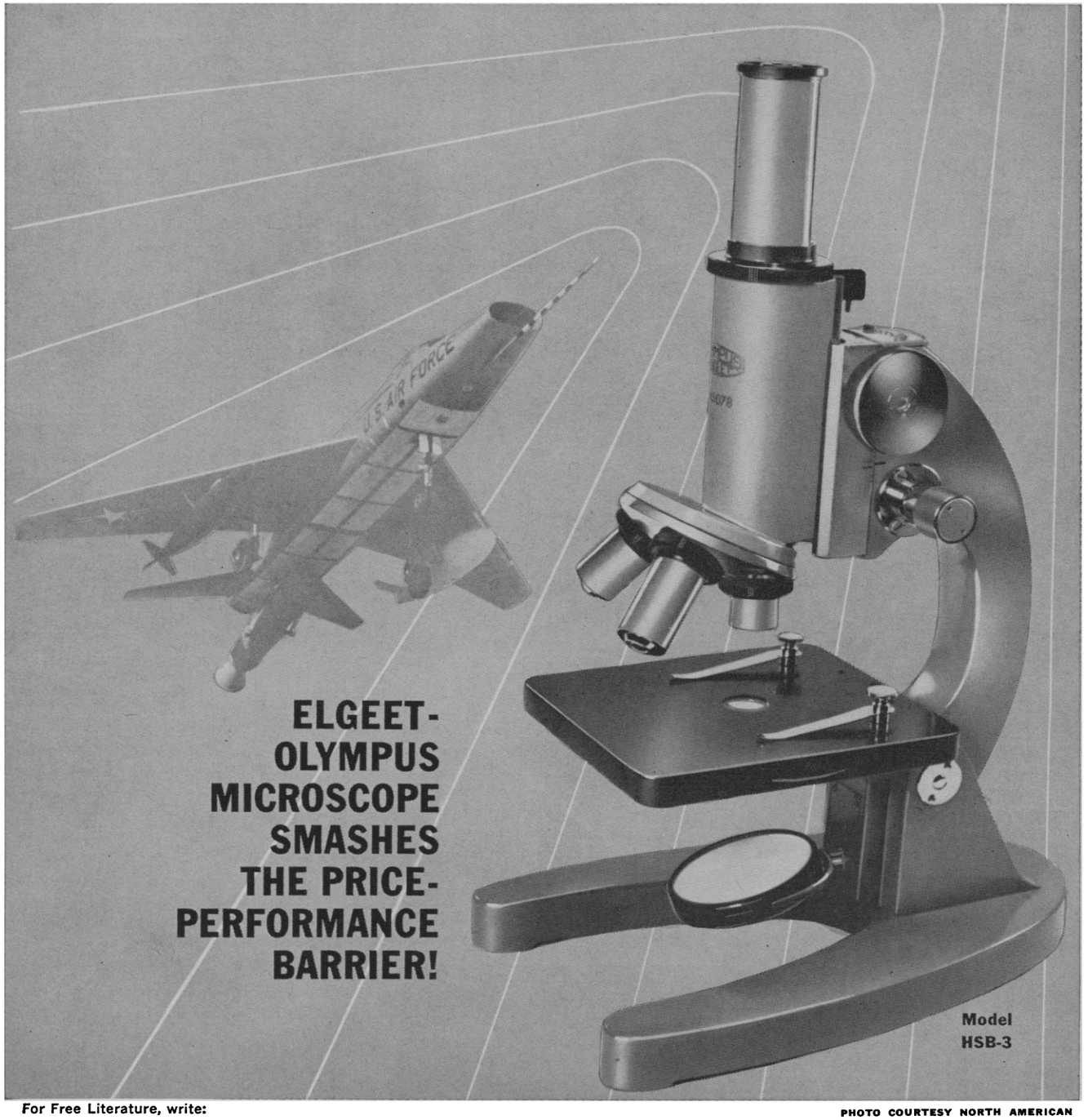

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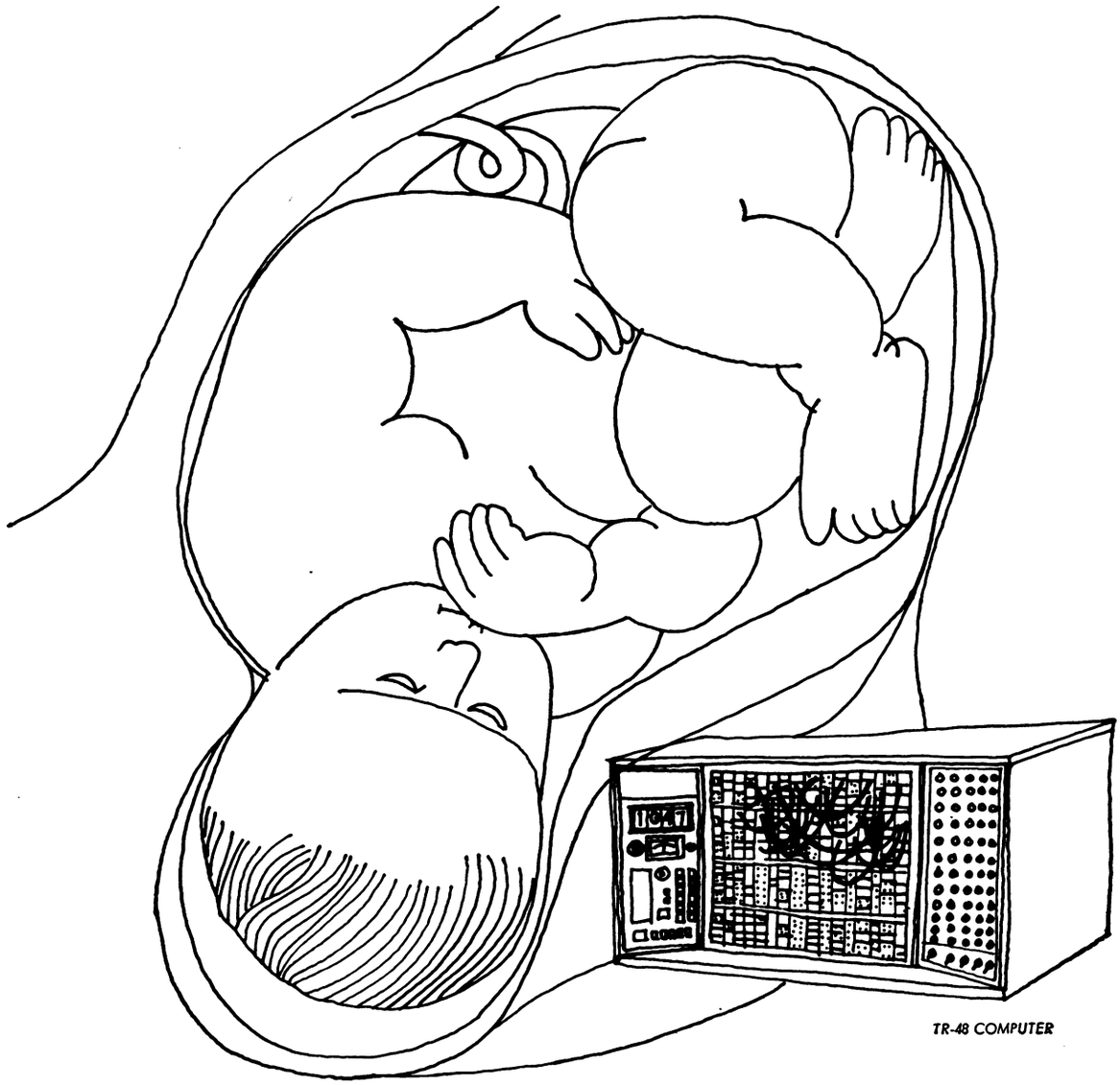

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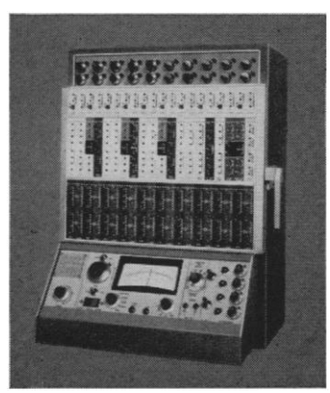

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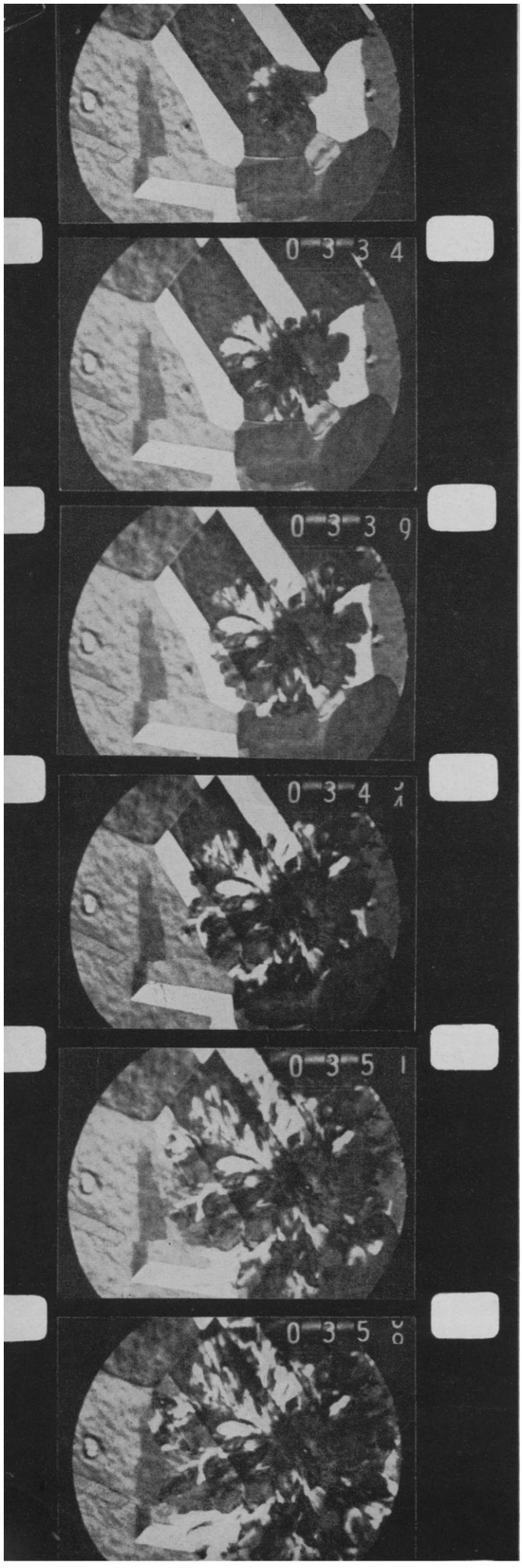

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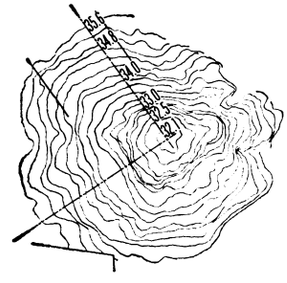
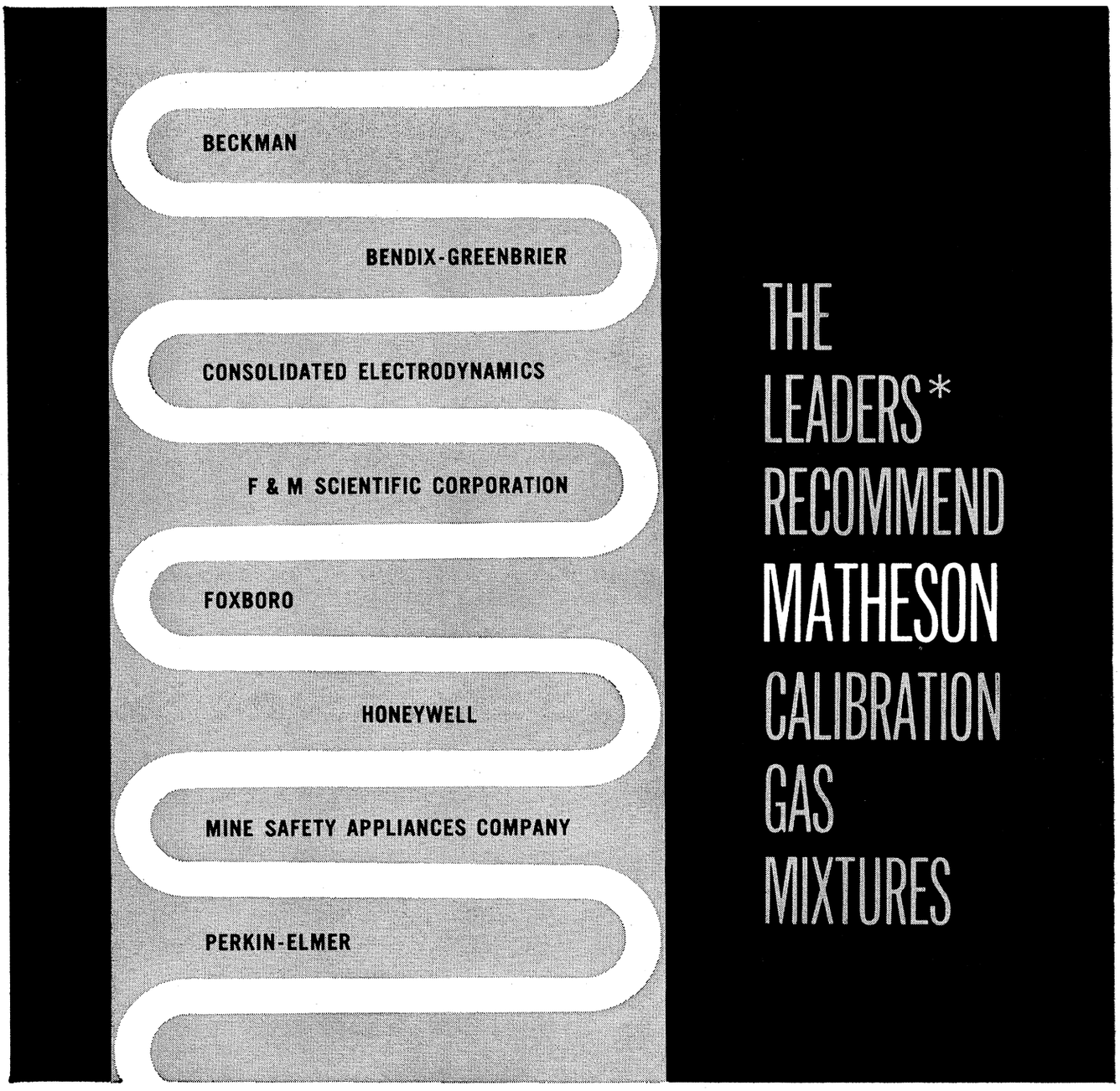


Time-contour map used for growth rate measurements.

Austenite transforming to pearlite in steel over a 3-second interval.



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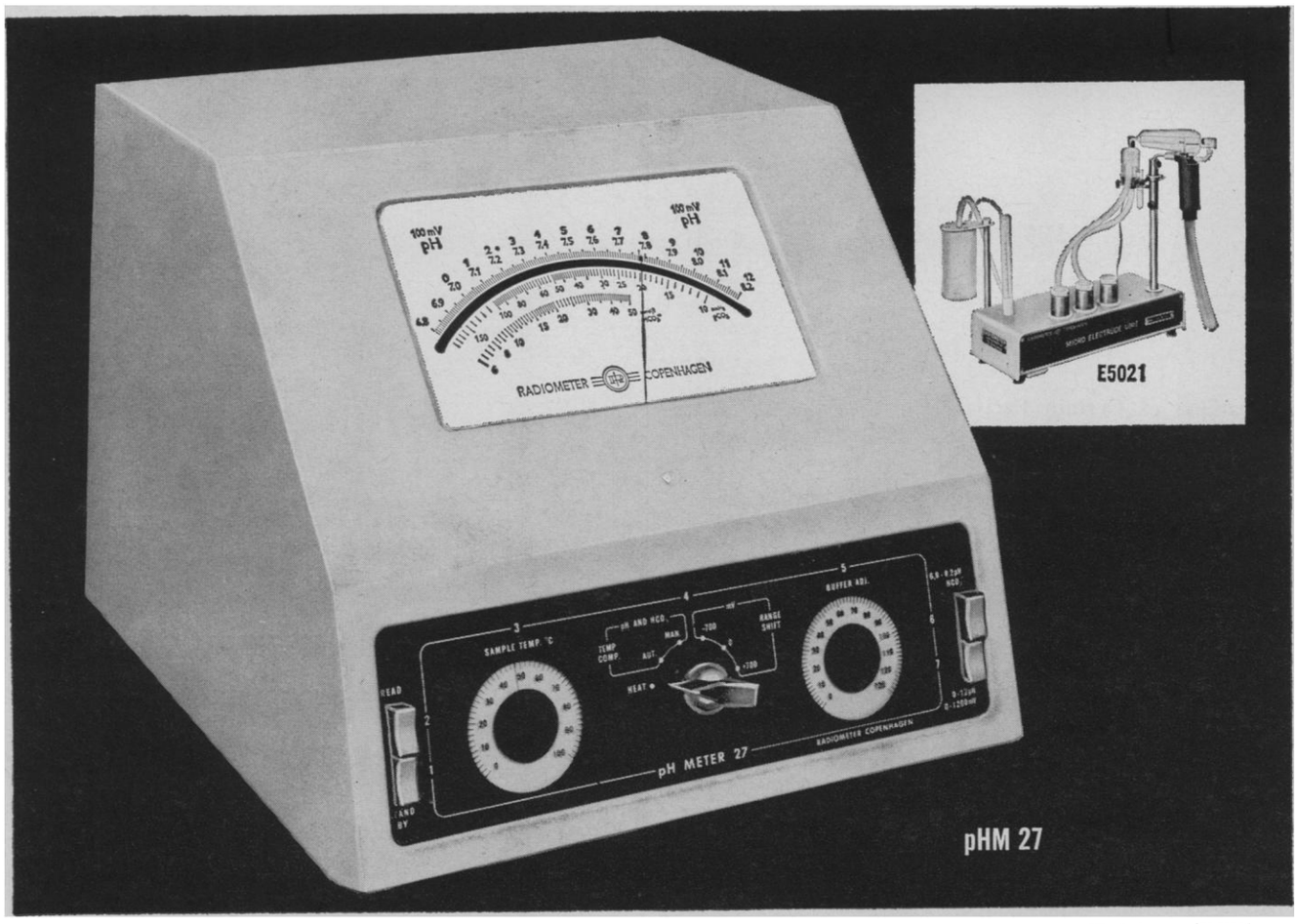

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moved from the medium per formula weight of DPN^+ formed. Each of the following reactions is to be regarded as occurring in neutral, aqueous solution, in vitro, with or without such a catalyst as may be needed for acceleration. The stoichiometry is based on known compositions of the substances. A single arrow designates the dominant direction of change.

Included in Appendix E of the report, but with other symbols, is reaction I.

$$DNPH + TPN^+ \rightleftharpoons DPN^+ + TPNH \quad (I)$$

In the next case the quinone has an ionization constant such that the charge is 1^- at *p*H 7.

$$DPNH + \text{2-hydroxy-1, 4-naphthoquinone}^{1-} + 2H^+ \rightarrow DPN^+ + \text{the neutral hydroquinone} \quad (II)$$

In considering the reaction with a cytochrome *c* I shall be naive in neglecting the evidence that different cytochromes of type *c* appear to differ in their states near *p*H 7 and in neglecting some other complications which recently have come to light. With this confession, one might be permitted, for the present purpose, to consider only the conventional charges allocated to the "iron" in the monomeric oxidant and reductant and to write:

$$DPNH + 2 \text{ cytochrome } c^{3+} \rightarrow DPN^+ + 2 \text{ cytochrome } c^{2+} + H^+ \quad (III)$$

For low concentrations of an alcohol dehydrogenase:

$$DPNH + \text{acetaldehyde} + H^+ \rightarrow DPN^+ + \text{ethanol} \quad (IV)$$

Of these four reactions only the last, IV, conforms with the alleged generality and it must be admitted that perhaps reactions of this type were in mind.

Incidentally in Appendix E (*1*) the reaction with a cytochrome *c* is written:

"$NADH_2$ + oxidized cytochrome *c* = NAD + reduced cytochrome *c*"

Obviously this is wrong on two counts. There are many other errors of stoichiometry in Appendix E.

A suggestion of a reason for expressions (A) and (B) is found in the prefatory remark: "Like the flavin compounds, the coenzymes require two equivalents of hydrogen [*sic*] for their reduction . . . " Incidentally a study of the flavin adenine dinucleotide system (*2*) will show more contrast than likeness to the DPN system. The quoted statement sounds very much like a commitment to the concept of hydrogen transfer. If this was in mind, the expressions (A) and (B) may be related to half-reactions (a) and (b), respectively.

$$NAD + 2H \rightleftarrows NADH_2 \quad (a)$$
$$NAD^+ + 2H \rightleftarrows NADH + H^+ \quad (b)$$

As already noted, half-reaction (a) does not conform with certain facts. Half-reaction (b) is especially interesting when regarded exclusively in terms of stoichiometry. Then a proton may be eliminated from each side to yield the equivalent half-reactions (b′) and (b″).

$$NAD^+ + H^- \rightleftarrows NADH \quad (b')$$
$$NAD^+ + 2e^- + H^+ \rightleftarrows NADH \quad (b'')$$

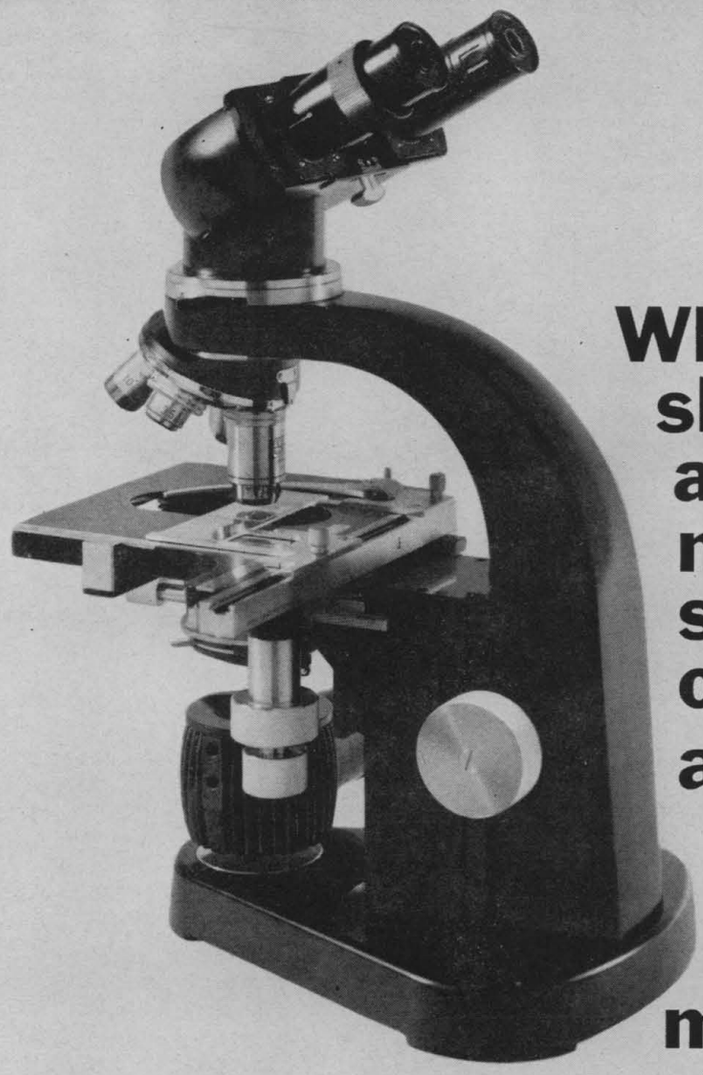
Half-reaction (b′) is preferred by those who regard the reduction, when mediated by a dehydrogenase, to be by the transfer of a hydride ion, H^-, from a substrate such as ethanol.

Of course, half-reactions of the sort under consideration cannot be studied in isolation. They are written with an eye on complete reactions for which it is essential to preserve correct, stoichiometric relations. For this purpose it becomes a convenience to resolve each transferred hydrogen to its proton and electron so that, by the usual rule of combining half-reactions, eliminations can be made as is done in the foregoing treatment of expression (b). Such a treatment need imply no mechanism of the final reaction. With this understood, half-reaction (b″) is by far the more convenient when used with numerous other half-reactions each of which is expressed in the lowest terms. This system leaves open the question of the actual nature of a process until a decision thereon is supported by evidence.

The point of present interest is that the report does not mention the frequently used half-reactions (b′) and (b″), which seems to support my supposition that only hydrogen transfer was considered. This will be disturbing to teachers who instruct their students on important distinctions, especially on what a particular experimental method can and cannot reveal.

Although it may be doubted that any responsible investigator will be misled by the carelessness to which attention is called, the prestige of the International Union of Biochemistry and of its Commission on Enzymes may lead to the teaching of relations here criticized. If so, confusion could result.

(Continued on page 1009)



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13 September 1963, Volume 141, Number 3585

SCIENCE

Responsible Scientific Choice

The scientific community has not responded adequately to the high trust placed in it by the nation. Perhaps if our role were better understood we would search more diligently for ways of discharging our responsibilities. For more than a decade science has been the recipient of repeated congressional votes of confidence as funds for research and development increased from $1.6 billion in 1950 to $14 billion in 1962 (including space). Most of the federal budget goes for fixed purposes, such as interest on the debt, veterans' benefits, salaries of military and civilian personnel, military hardware, and general government housekeeping. The funds for research and development represent a major fraction of the nation's capacity to achieve progress in defense technology, science, and the general welfare.

Most of the funds go for developmental work, including hardware which will be obsolete in a few years. The nation's hopes for substantial long-term progress lie in fundamental research and in a few areas of basic development which receive but a minor fraction of the total amount spent. It is of crucial importance that the best possible judgment be shown in the allocation of funds, and especially of manpower, in these areas. Our present methods do not meet the challenge of the needs.

Government agencies attempt to tap the best minds by appointing advisory panels of experts. Usually these experts are from one limited relevant field. This narrow intellectual base creates an atmosphere which heightens provincial attitudes. Such panels seem only to be able to conclude that their field needs more men and more money.

The basis for a new and sounder approach has been outlined by Alvin M. Weinberg in the 1963 Winter issue of *Minerva*. He points out that criteria for scientific choice can be established. Two of these criteria are internal: "(1) Is the field ready for exploitation? (2) Are the scientists in the field really competent?" But Weinberg considers a group of three external criteria to be more important: "technological merit, scientific merit and social merit. The first is fairly obvious: once we have decided, one way or another, that a certain technological end is worthwhile, we must support the scientific research necessary to achieve that end."

One of Weinberg's arguments on scientific merit is particularly apt: "other things being equal, *that field has the most scientific merit which contributes most heavily to and illuminates most brightly its neighboring scientific disciplines.*"

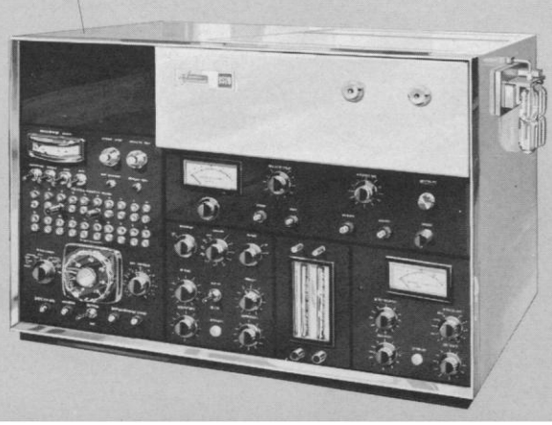
On the basis of these criteria, it is possible to estimate the comparative value of such divergent fields as molecular biology and high-energy physics. This is done in the *Minerva* article with convincing clarity, and high-energy physics comes off badly.

Weinberg suggests that our present system could be improved if representatives not only of the field being judged, but also of neighboring fields sat on panels that are assessing the merits of research proposals. This suggestion should be implemented. It also should be possible to set up a point system, in which various weights are given to the components of internal and external criteria. Weinberg has initiated a very useful line of reasoning, and further thinking along these lines is in order.—P.H.A.

(Reprints of Dr. Weinberg's article, "Criteria for scientific choice," may be obtained from Dr. Alvin M. Weinberg, Director, Oak Ridge National Laboratory, Oak Ridge, Tenn.)

moduline

The 1520



The 202

The Hy-Fl 2

Moduline series

How can you design a gas chromatograph and protect heat-sensitive electronic components from the oven heat? One cumbersome method is to build two separate units.

The new Aerograph Moduline series accomplishes this in a trim, beautiful, single-unit manner. A through-shaft motor drives two fans. One fan circulates column oven air, while the other draws in cool air from the outside and efficiently keeps the electronic components cool.

Three sparkling new basic models were developed in a truly modular concept.

The Hy-FI_2, a big brother to the popular Hy-FI 600-C, is a single-column instrument which adapts perfectly to all of the following detectors: Flame, Electron Capture, Cross-section (available Jan. 1964), Thermal Conductivity, and Flame-Electron Capture combination. Manual or linear temperature programming modules are optional.

The "202"* is a two-column instrument adaptable to both Dual Flame and Thermal Conductivity detectors. Manual or linear temperature programming modules are optional.

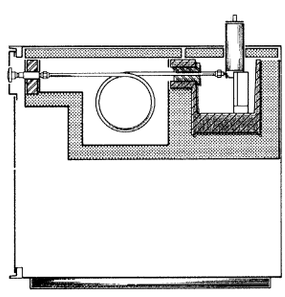
The "1520"* is a deluxe version of the 202 equipped with both Dual Flame and T.C. detectors. It features matrix board temperature programming, automatic cooldown, and automatic reset-to-start temperature.

*For more information, please see page 4.

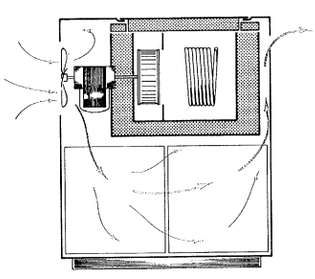
Hy-FI_2 features

- The basic design of the $HyFI_2$ permits easy interchange of the three basic ionization detectors, all used with the standard single-channel electrometer.
- The Hy-FI_2 may also be used with the standard 4-filament thermal conductivity detector cell by interchanging the electrometer with a bridge-power supply module.
- A most interesting and useful combination incorporates both flame and electron capture detectors used with the special two-channel electrometer shown in picture opposite. With this combination the column effluent is divided by a stream splitter to feed both detectors. The signals from both detectors are amplified by the two-channel electrometer which in turn operates a two-pen recorder. A standard peppermint oil sample was analyzed using this unique instrument, and the startling two-pen trace is shown on page 4.
- The temperature of the $HyFI_2$ column oven is controlled by two methods: Standard, with manual temperature programmer module incorporating a constant voltage, solid-state electronic controller. Deluxe, with an all-electronic linear temperature programming module.
- The cast aluminum separate detector oven is controlled at four set temperatures also using the constant voltage, solid-state electronic conroller.

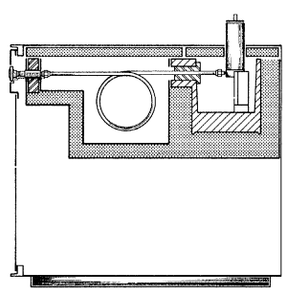
Plan to see the Hy-FI_2, the 202, and the 1520, at the Fall ACS meeting, New York Hilton Hotel, N.Y.C. Booth 801.



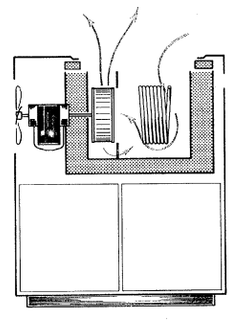
Separate Detector Oven — The temperature of this heavy cast aluminum oven, heated by a 250 watt ring heater, is regulated by a unique solid-state, constant power, electronic controller.



Air-Cooled Cabinet — A 4-blade fan, circulating air at the rate of 70 cubic feet per minute, effectively cools all electronic components. The cabinet temperature is less than 40°C.

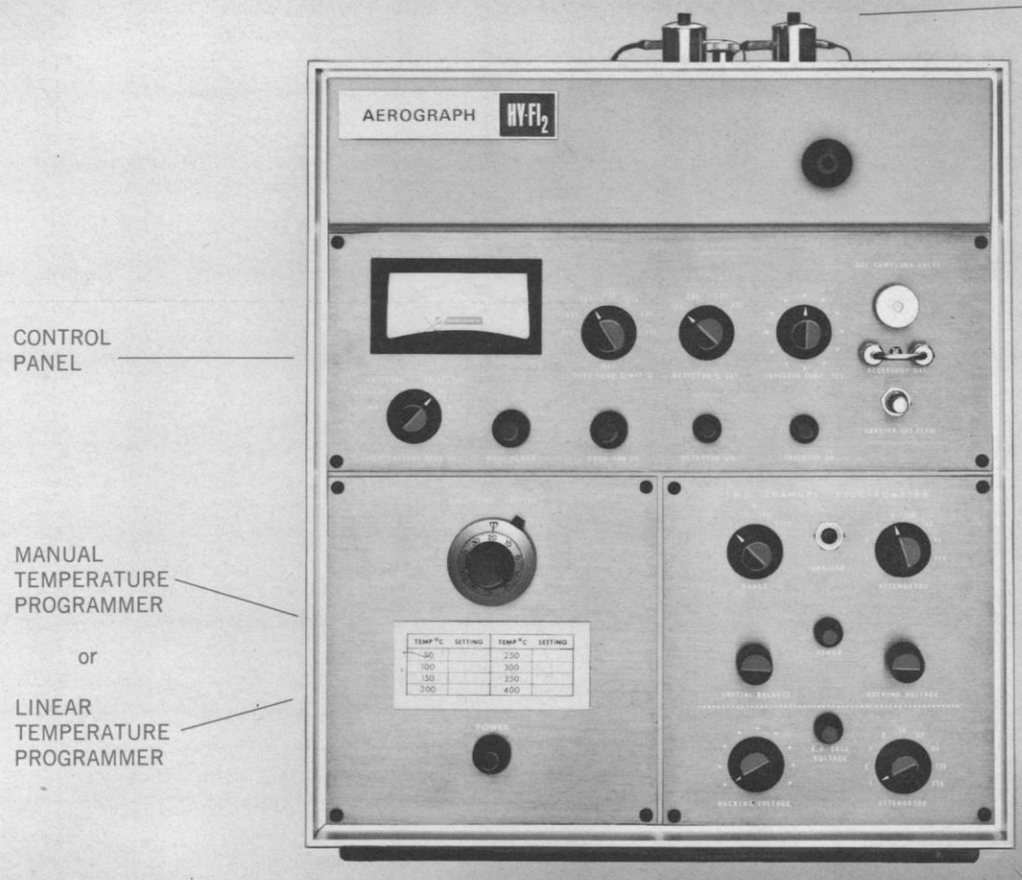


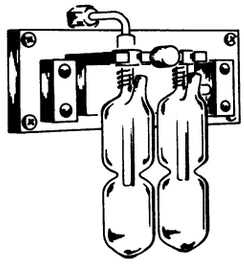
Two-Inch Injector — On-column injection is an important aspect in GC. The 2" injector, standard on all Moduline instruments, permits on-column injection with standard Hamilton syringe.



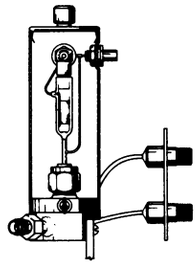
Rapid Oven Cooling — When the column oven door is opened, hot air is exhausted at approximately 200 cubic feet per minute which will cool the column from 400 to 100°C in 3 minutes.

The Hy-Fl$_2$

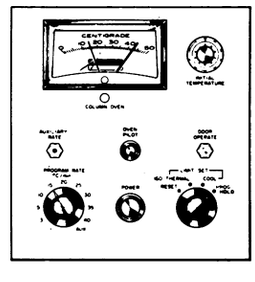




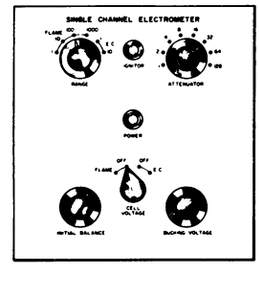
Two-Position Collector—This manual collector, which supports two Autoprep collector bottles, is standard with any Moduline instrument equipped with thermal conductivity detectors.



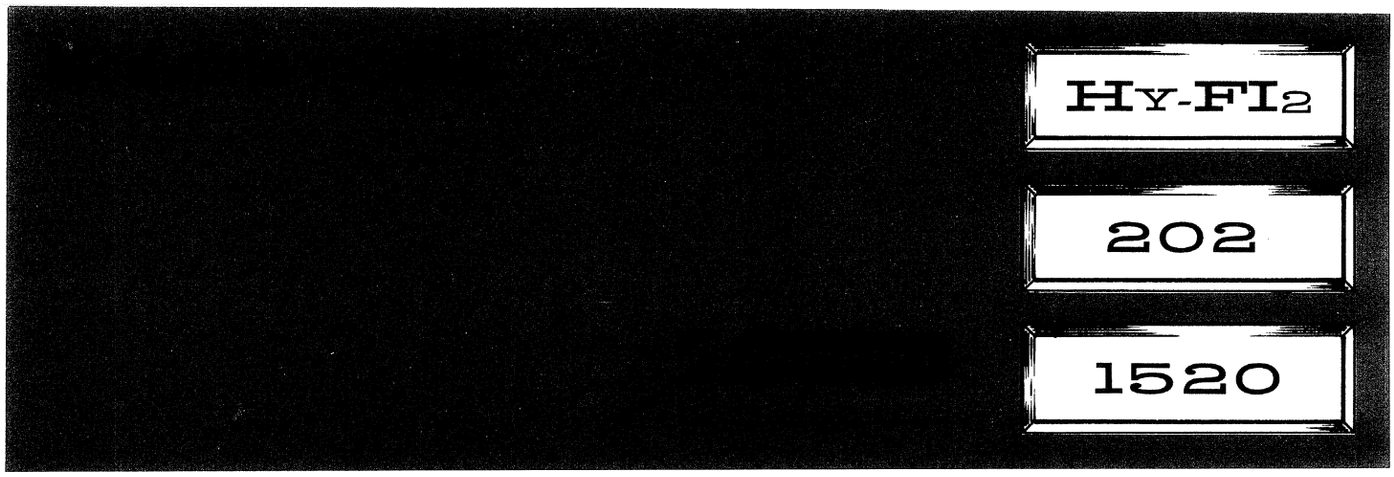
Detectors—Five options are available: 1. Flame; 2. Electron Capture; 3. Cross-Section; 4. Thermal Conductivity; 5. Flame-Electron Capture combination are interchangeable in the Hy-Fl$_2$.



Linear Temperature Programmer — This programmer is completely electronic with no gears, motor or clutch. It programs at 10 precise rates. A matrix plug permits any additonal rates.



Bridge-Power Supply — This 12 or 20 volt solid-state bridge and power supply module is used in conjunction with 4 - filament T.C. detectors. It is interchangeable in the Hy-Fl$_2$, 202 or 1520.



The Module Concept

A true modular design permits the option to use and interchange functional components. This minimizes manufacturing problems and increases versatility to the user. The chemist, in this instance, can order precisely the instrument of choice or he can alter the functionality at a later date by interchanging modules.

The Hy-FI_2, a single-column instrument, can be used with any of the four common detectors or as a combination instrument with flame plus electron capture. Either a manual or a linear temperature programming module may be selected.

The 202, a dual-column instrument can be used with either two flame or thermal conductivity detectors. Again, manual or linear programming is optional. Dual flow controllers, flow meters, and automatic door opener are standard.

The 1520 is like the 202 except it has both dual flame and thermal conductivity detectors. The all-electronic matrix board temperature programmer, standard, not only gives complete flexibility in pre-setting program rates, but automatically closes the oven door after cool-down and re-sets the start temperature.

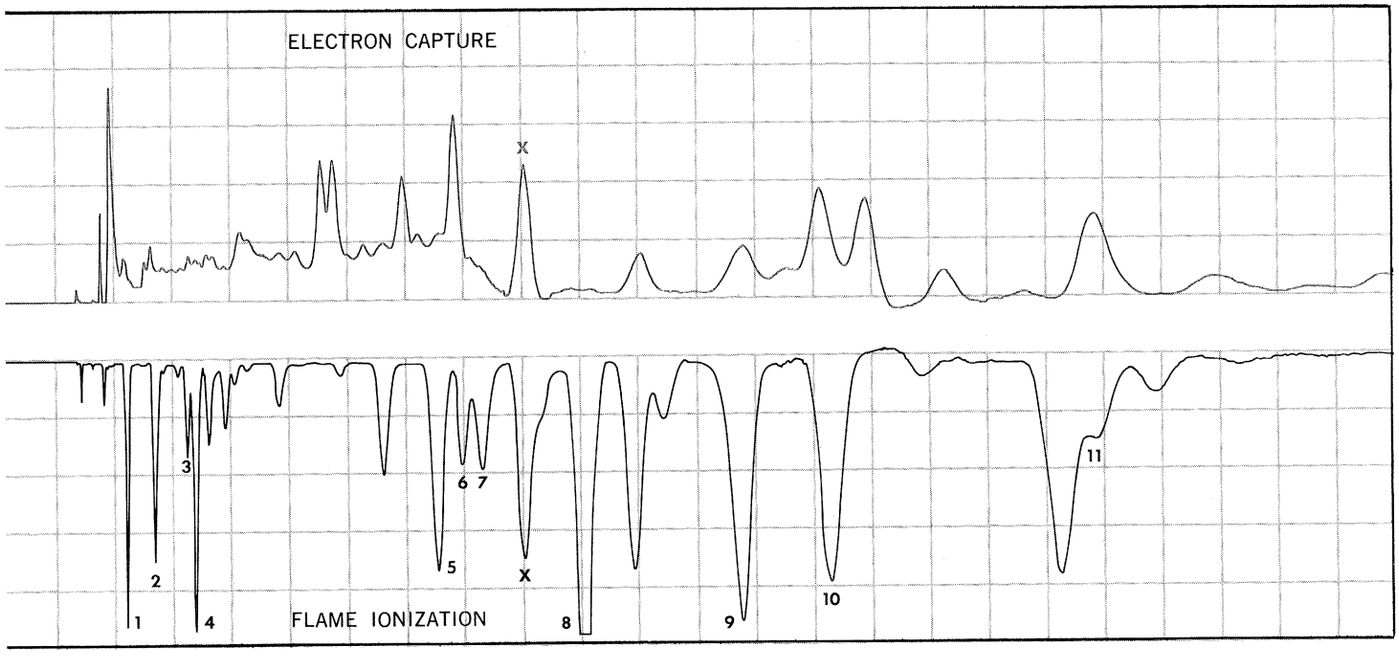
HY-FI_2 Dual-Channel

Dual-channel gas chromatography is very analogous to stereo music. The response of the record (equivalent to the gas chromatograph column) is separated and picked up by two heads (equivalent to the Flame and E.C. detectors). Signals from each head are separately amplified (dual electrometer) and fed to two speakers (the twin pen recorder).

The Flame and E.C. combination seems particularly ideal since the E.C. detector is sensitive to only a few types of molecules as halides, conjugated carbonyls, nitro compounds and certain sulfur-containing compounds.

The E.C. peaks shown in the peppermint trace below were not identified. The one marked "X," an added marker, is benzaldehyde which was known to give about equal response on both detectors. Menthol was the only other component which recorded simultaneous peaks. In short, the E.C. trace shows an entirely new pattern for peppermint oil These components may be most vital to the natural flavor.

Conditions: $HyFI_2$ two-channel; Column, 20′ x ⅛″, 5% Carbowax, 20 M; 143°C. Sample, peppermint oil 0.15 μl • split 1.2:1 FL/EC ■ 1-α Pinene • 2-β Pinene 3-Limonene • 4-Eucalyptol • 5-Menthone • 6-Menthofuran • 7-Isomenthone • X-Benzaldehyde • 8-Menthyl Acetate • 9-Menthol • 10-Pulegone • 11-Piperitone



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The International Federation for Medical Electronics was formed in 1958 to be a federation of societies having an interest or activity in medical electronics. The concept that it should be made up of societies affiliated for mutual advantages has matured with the participation of the Japan Society for Medical Electronics and Biological Engineering with 850 members. Over 70 percent of the membership have medical degrees, in contrast to medical electronics groups in America, where the members are predominantly engineers and physical scientists. An opportunity to become more familiar with the Japanese activities in this field will be available in September 1965 when the 6th International Conference will be held in Tokyo after the International Physiological Congress, scheduled for 1–7 September. This schedule has been arranged to facilitate attendance at both conferences. Further information about the federation and future meetings can be obtained from the secretary, L. E. Flory, 167 Hamilton Ave., Princeton, N.J.

ROBERT L. BOWMAN
National Heart Institute, Bethesda 14, Maryland

Information Systems: Learning, Adaptation, and Control

Approaches in the engineering and physical sciences to learning, adaptation, and control in information systems were the main topics of discussion at the 1963 Computer and Information Science Symposium held 17 and 18 June at the Technological Institute, Northwestern University. Related papers in mathematical techniques, artificial intelligence and learning, computers and control, and pattern identification were presented.

One of the most persistent problems in the theory of brain mechanisms has been the requirement for a model capable of storing and recapitulating the sequence of experience which may occur in the duration of a human life. Reviewing the present state of his research in cognitive systems, Rosenblatt (Cornell) presented a mathematical model for long-term sequential memory, which appears to be of sufficient capacity to record an entire life history of sensory experience with a high probability of permitting correct judgments and decisions to be made in retrospect. His model is also consistent in size and structural organization with the known constraints of the human nervous system. Following an intuitive geometric approach, Charnes (Northwestern) presented new proofs of the fundamental theorems of the perceptron-learning theory of Rosenblatt and Block. His discussions clarified the motivation and restrictiveness of the previous work. Block (Cornell) and Nilsson and Duda (Stanford Research Institute) studied the problem of determining a small number of features for a given set of patterns by considering a pattern on a discrete retina to be the set of active retinal points. They also developed an algorithm for finding features of restricted sets of patterns and considered the mechanization of this algorithm by adaptive neural networks.

Pattern identification plays an important role in the design of learning systems. Viewing pattern identification as a problem in statistical classification wherein an n-dimensional space is partitioned into category regions with decision boundaries, Cooper (Sylvania) discussed the concept of hyperplanes, hyperspheres, and hyperquadrics as decision boundaries. He introduced techniques for determining the actual optimum boundary from known samples and for efficiently reducing the

dimensionability. Learning from experience may be considered as a process of computing estimates of probability measures from sample data during a conditioning phase. Based upon this point of view, Brick and Owen (Sylvania) treated an intelligent pattern recognizer as a learning and classification problem in a multidimensional characteristic, feature, or measurement space. They also introduced the concept of using nonparametric probability estimation techniques and Bayes' risk analysis for the investigation of pattern recognition and self-organization problems.

Leading the session on pattern identification, Gamba (Italy) discussed the concept of establishing probability weights for statistical inference and the principles involved in PAPA (automatic programmer and probability analyzer) and the papister. An interesting character recognition system using adaptive linear decision functions was reported by Griffin, King, and Tunis (I.B.M.) The system is made up of the transducer, processor, and categorizer. Their work emphasized the practical implementation of linear decision functions and their application to the recognition of the ABA E-13B magnetic character font, taking into account realistic component specifications and tolerances. Kamentsky and Liu (I.B.M.) presented a theoretical and experimental study of a model for pattern recognition. They derived some equations for the performance of a recognition system as a function of the type of classifier used and the number and power of the measurements.

An important advancement in modern control theory is the introduction of learning, adaptation, pattern identification, and artificial intelligence into control processes. The theories of automata, threshold logic, and statistical decision have found many important applications in modern synthesis of learning and control systems. Several papers emphasizing this new approach to control system design were presented at the symposium. Tou (Northwestern) and Ivanenko (U.S.S.R.) discussed the design of a learning system for control based upon pattern recognition principles. The design was treated as the problem of decision making on the basis of information obtained from the control process. The observed data was transformed into special types of multidimensional information pattern from which a

proper decision was made. In a survey paper, Widrow and Smith (Stanford) emphasized the use of adaptive logic networks in optimum control and reviewed the applications of pattern classification principles to such control problems as weather forecasting, speech recognition, and vectorcardiogram diagnosis. Fu (Purdue) approached the learning control problems from the point of view of statistical decision and introduced the method of state-space partition for system design. A very interesting model which has the same input-output characteristic as a person solving simple physics problems was reported by Kuck and Krulee (Northwestern). The proposed system is a part of a larger system which accepts inputs in the form of descriptive statements in natural language. Their discussions placed emphasis upon the design of the subsystem which takes a descriptive formalism derived from natural language as its input and proceeds deductively to attempt a solution.

The theory of automata and semigroups appears to provide a useful tool in the synthesis of learning systems and adaptive processes. Weeg (Michigan State) reviewed some general properties of an automaton and the structural properties of Rabin-Scott automata, and discussed the structure-preserving function of automata, input semi-groups associated with strongly connected automata, and divisible semi-groups. Klaczko (Germany) presented an interesting procedure for recognition of normalized, connected patterns by using a threshold-conditioned adaptive template. A software representation of a digital two-dimensional pattern is used as a template for pattern recognitions. Andrew (England) discussed some prerequisites of self-organization and general system properties conducive to self-organization. Mesarovic (Case) proposed a unified approach to learning and information theory in which he introduced the concept of uncertainty sets. In a review paper, Greene (Chicago) considered some problems in designing highly adaptive systems and the problem of identifying the behavioral structures. The interesting idea of simulation of a billion-gate computer by a thousand-gate computer was reported by Ledley (National Biomedical Research Foundation).

Highlights of the meeting were the keynote address "The next ten years," by the noted cybernetician W. Ross

Ashby and a lecture on dynamic programming, learning, and adaptive processes by Richard Bellman (Rand Corporation). Bellman pointed out some of the major problems in the study of learning and adaptation processes and some of the ways in which dynamic programming furnishes a natural bridge between classical and modern theories.

The symposium was cosponsored by the Technological Institute of Northwestern University and the Information Systems Branch of the Office of Naval Research. The co-chairmen were Julius T. Tou (Northwestern) and Richard H. Wilcox (ONR). In order to reach a much wider audience and to provide a source of permanent reference, the proceedings, edited by Tou, will be published in September by the Spartan Book Company.

JULIUS T. TOU
Computer Sciences Laboratory, Technological Institute, Northwestern University, Evanston, Illinois

Forthcoming Events

September

22–25. **Petroleum** Mechanical Engineering Conf., Tulsa, Okla. (A. B. Conlin, Jr., 345 E. 47 St., New York 17)

22–25. National **Power** Conf., Cincinnati, Ohio. (A. C. Hartranft, 1000 Chestnut St., Philadelphia, Pa.)

22–28. Pan American **Child** Congr., 12th, Buenos Aires, Argentina. (Inter-American Children's Inst., 8 de Octubre No. 2882, Montevideo, Uruguay)

23–24. Soc. of **Plastics** Engineers, Worcester, Mass. (C. Campbell, 65 Prospect St., Stamford, Conn.)

23–25. **Tobacco Chemists**, 17th research conf., Montreal, Canada. (N. A. MacRae, Canada Dept. of Agriculture, Central Experimental Farm, Ottawa, Ont.)

23–27. **Aeronautic and Space** Engineering and Manufacturing, meeting and display, Los Angeles, Calif. (Soc. of Automotive Engineers, 485 Lexington Ave., New York 17)

23–27. **Telemetering**, 1st intern. conf., London, England. (F. G. McGavock, Box 5067, Pasadena, Calif.)

24. **Chemical Safety**, 7th workshop, New Orleans, La. (Manufacturing Chemists' Assoc., Inc., 1825 Connecticut Ave., NW, Washington, D.C.)

26–1. **Astronautics**, 14th intern. congr., Paris, France. (International Astronautical Federation, 12 rue de Gramont, Paris 2)

26–27. **Air Pollution Control** Assoc., 3rd technical meeting, West Coast section, Monterey, Calif. (R. L. Weimer, 434 S. San Pedro St., Los Angeles 13, Calif.)

27–28. Western **Industrial Health**, 7th conf., San Francisco, Calif. (W. G. Bogane, Employers Mutual of Wausau, 114 Sansome St., San Francisco)

29–2. American Inst. of **Chemical Engineers**, San Juan, Puerto Rico. (F. J. Van Antwerpen, AICE, 345 E. 47 St., New York 17)

29–3. **Electrochemical** Soc., New York, N.Y. (Electrothermics and Metallurgy Div., 30 E. 42 St., New York 17)

30–1. Canadian **Electronics** Conf., Toronto, Ont. (J. L. Yen, CEC, 1819 Yonge St., Toronto)

30–2. **Neurologic and Electroencephalographic Correlative Studies** in Infancy, intern. conf., Houston, Tex. (P. Kellaway, Dept. of Physiology, Baylor Univ. College of Medicine, Houston)

30–4. **Clay Minerals**, 12th conf., Atlanta, Ga. (W. E. Moody, School of Ceramic Engineering, Georgia Inst. of Technology, Atlanta 13)

30–4. Time of Flight, **Mass Spectrometer** symp., Cincinnati, Ohio. (D. C. Damoth, Bendix Corp., 3625 Hauck Rd., Cincinnati 41)

30–6. International Federation of **Documentation**, 29th conf., Stockholm, Sweden. (7 Hofweg, The Hague, Netherlands)

October

1–3. **Physics and Nondestructive Testing**, symp., San Antonio, Tex. (W. J. McGonnagle, Southwest Research Inst., 8500 Culebra Rd., San Antonio 6)

1–3. **Space Electronics**, 8th annual symp., Miami Beach, Fla. (H. E. Weber, Martin Co., Orlando, Fla.)

1–4. **Animal Care** Panel, Los Angeles, Calif. (A.C.P., Box 1028, Joliet, Ill.)

1–4. **Aerospace Nuclear Safety**, 1st natl. topical meeting, Albuquerque, N.M. (A. J. Smith, Topical Meeting, Box 818, Kirkland Air Force Base, N.M.)

1–4. Electronics Research and Development for **Civil Aviation**, London, England. (Secretary, Inst. of Electrical Engineers, Savoy Pl., London W.C.2)

1–4. American Council of **Independent Laboratories**, Lincoln, Neb. (ACIL, 4302 East-West Highway, Washington, D.C.)

1–5. **Aviation and Cosmonautical Medicine**, 6th intern. congr., Rome, Italy. (Secretariat of the Congress, Centro di Studi e Ricerche di Medicina Aeronautica, Via P. Gobetti 2 a, Rome)

1–6. Microbiology of **Crude Oil**, intern. symp., Greifswald, Germany. (W. Schwartz, Institut für Mikrobiologie, Ludwig-Jahn-Str. 15, Greifswald)

3–4. Physics of **Optical Glass**, conf., Lathom, England. (Inst. of Physics and the Physical Soc., 47 Belgrave Sq., London S.W.1, England)

4–5. **Documentation**, intern. federation, Stockholm, Sweden. [Tekniska Litteratursällskapet (TLS) Ranhaamrsvägen 12, Stokholm-Bromma 11]

4–5. **Muscular Dystrophy**, symp., Houston, Tex. (M. M. Guest, Dept. of Physiology, Univ. of Texas Medical Center, Galveston)

4–6. American Acad. of **Psychotherapists**, New York, N.Y. (H. Rockberger, 44 S. Munn Ave., East Orange, N.J.)

5. **Paleontological Research** Inst., Ithaca, N.Y. (K. Caster, Geology Dept., Univ. of Cincinnati, Cincinnati, Ohio)

7–10. **Instruments and Research Equipment**, symp. and exhibit, 13th annual,

Bethesda, Md. (J. B. Davis, National Institutes of Health, Bethesda 14)

7–11. American Soc. of **Civil Engineers**, annual, San Francisco, Calif. (ASCE, 345 E. 47 St., New York 17)

7–11. Biological Effects of **Neutron Irradiations**, intern. symp., Upton, N.Y. (C. W. Pelzer, Div. of Special Projects, U.S. Atomic Energy Commission, Washington 25)

7–12. **Communication**, 11th intern. congr., Genoa, Italy. (Civico Instituto Colombiano, Palazzo Tursi, Genoa)

8–10. **Analytical Chemistry** in Nuclear Technology, 7th conf., Gatlinburg, Tenn. (C. D. Susano, Oak Ridge Natl. Lab., P.O. Box X, Oak Ridge, Tenn.)

5–6. New England Intercollegiate **Geological Conf.**, Providence, R.I. (J. Rogers, Dept. of Geology, Yale Univ., Box 2161 Yale Station, New Haven, Conn.)

6–9. **Process Engineers**, annual, Hanover, Germany. (German Engineering Assoc., Rheingau Allee 25, Frankfurt-am-Main)

6–10. **Water Pollution** Control Federation, Seattle, Wash. (to be reconvened 13–16 Oct., Honolulu, Hawaii). (R. E. Furman, WPCF, 4435 Wisconsin Ave., NW, Washington, D.C.)

6–12. Clinical **Pathology**, 5th intern. congr., Mexico City, Mexico. (E. Cervera B., Asociacion Mexicana de Laboratorio Clìnico, Durango 213, Mexico 7)

7. **Pediatric Radiology**, Montreal, P.Q., Canada. (R. G. Lester, Box 151, Medical College Station, Richmond, Va.)

8–10. Ciba Foundation Colloquium on **Endocrinology and Aetiology of Diabetes Mellitis** and Its Complications, London, England. (Ciba Foundation, 41 Portland Pl., London W.1)

8–10. **Science and Engineering**, 10th annual symp., U.S. Air Force Academy, Colo. (Maj. J. Shafer, RROND, U.S. Office of Aerospace Research, Washington, D.C.)

8–11. **Electromagnetic Relays**, intern. conf., Sendai, Japan. (C. F. Cameron, School of Electrical Engineering, Oklahoma State Univ., Stillwater)

8–11. American **Roentgen Ray** Soc., Montreal, P.Q., Canada. (American College of Radiology, 20 N. Wacker Dr., Chicago 6, Ill.)

8–12. **Neurological Surgeons**, 13th congr., Denver, Colo. (J. R. Russell, 1815 North Capitol Ave., Indianapolis 2, Ind.)

9. American Acad. of **Arts and Sciences**, Brookline, Mass. (R. W. Burhoe, American Acad. of Arts and Sciences, 280 Newton St., Brookline Station, Boston, Mass.)

9–11. **Aerospace Electronics**, exposition and conf., Los Angeles, Calif. (E. Niles, Aerospace Electrical Soc., 3540 Wilshire Blvd., Los Angeles 5)

9–13. **Cytophotometry** and Interference Microscopy, symp., Giessen, Germany. (W. Sandritter, Pathologisches Institut, Justus Liebig Universität, Giessen)

10–11. Bioassay and Analytical **Chemistry**, 9th conf., San Diego, Calif. (G. Bucolo, General Atomic Div., General Dynamics Corp., P.O. Box 608, San Diego 12)

10–11. **Engineering** conf., Long Beach, Calif. (Natl. Soc. of Professional Engineers, 2029 K St. NW, Washington, D.C. 20006)

10–11. **Kidney**, 15th annual conf., New York, N.Y. (Natl. Kidney Disease Foundation, 342 Madison Ave., New York 17)

10–11. **Lipid Transport**, intern. symp., Nashville, Tenn. (H. C. Meng, Vanderbilt Univ. School of Medicine, Nashville)

10–13. American Soc. of **Clinical Hypnosis**, 6th, San Francisco, Calif. (W. T. Heron, American Soc. of Clinical Hypnosis, 800 Washington Ave., SE, Minneapolis 14, Minn.)

13. American College of **Dentists**, Atlantic City, N.J. (O. W. Brandhorst, 4236 Lindell Blvd., St. Louis, Mo.)

13–17. **Neurosurgery**, 10th Latin American conf., Buenos Aires, Argentina. (R. Morea, Callao 1685, Buenos Aires)

13–18. Society of **Motion Picture and Television Engineers**, 94th technical conf., Boston, Mass. (H. J. Hall, Itek Corp., Lexington, Mass.)

13–18. **Plastic Surgery**, 3rd intern. congr., Washington, D.C. (Capt. Joseph Connelly, Bethesda Naval Hospital, Bethesda 14, Md.)

14–16. **Geological Sciences**, intern. union, Rome, Italy. (T. Sorgenfrei, Tranegaardsvej 20, Hellerup, Denmark)

14–16. **Systems and Procedures** Assoc. of America, intern., Milwaukee, Wis. (R. L. Irwin, 7890 Brookside Dr., Cleveland 38, Ohio)

14–18. **Audio Engineering** Soc., 15th, New York, N.Y. (J. Harvey, Harvey Associates, 580 Fifth Ave., New York 36)

14–17. Association of Official **Agricultural Chemists**, Washington, D.C. (L. G. Ensminger, AOAC, Box 540, Benjamin Franklin Station, Washington 44)

14–18. American **Rocket** Soc., 18th annual, New York, N.Y. (ARS, 500 Fifth Ave., New York 36)

14–19. **Anatomical Pathology**, 4th Latin American congr., San Salvador, El Salvador. (F. K. Mostofi, Armed Forces Inst. of Pathology, Washington 25)

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

15–16. **Reactor Operations**, symp., American Nuclear Soc., Ottawa, Ont., Canada. (ANS, 244 E. Ogden Ave., Hinsdale, Ill.)

15–17. Progress in **Metallography**, seminar, Leoben, Austria. (Eisenhütte Osterreich, Eisenhütteninstitut, Montanistische Hochschule, Leoben)

15–18. American **Dietetic** Assoc., 46th annual, Philadelphia, Pa. (ADA, 620 N. Michigan Ave., Chicago 11, Ill.)

16–18. Ballistic **Missile and Space** Technology, San Diego, Calif. (C. T. Morrow, Aerospace Corp., P.O. Box 95085, Los Angeles, Calif.)

16–18. **Calorimetry**, 19th conf., Bartlesville, Okla. (G. T. Armstrong, Natl. Bureau of Standards, Washington, D.C.)

16–18. **Gaseous Electronics**, 16th annual conf., Pittsburgh, Pa. (G. J. Schulz, Westinghouse Research and Development Center, Pittsburgh 35)

16–18. American **Vacuum** Soc., 10th natl. symp., Boston, Mass. (AVS, Box 1282, Boston 4)

17–18. Industrial **Hydraulics**, natl. conf., Chicago, Ill. (E. Hansen, Illinois Inst. of Technology, Chicago 16)

17–18. American Soc. of **Tool and Manufacturing Engineers**, Pittsburgh, Pa. (H. E. Conrad, 10700 Puritan Ave., Detroit, Mich.)

17–19. Society of **Photographic Scientists and Engineers**, Washington, D.C. (E. Ostroff, SPSE, Box 1609, Main Post Office, Washington, D.C.)

17–20. **British Medical Assoc.**, annual clinical meeting, Stoke on Trent, England. (D. Gullick, BMA, Tavistock Sq., London W.C.2, England)

17–22. Anglo-American **Aeronautical** Conf., Cambridge, Mass., and Montreal, Canada. (American Inst. of Aeronautics and Astronautics, 500 Fifth Ave., New York, N.Y.)

18–19. American Soc. of **Opthalmologic and Otolaryngologic Allergy**, New York, N.Y. (J. Hampsey, Grant Bldg., Pittsburgh 19, Pa.)

18–19. American **Physical** Soc., Chicago, Ill. (K. K. Darrow, American Physical Soc., Columbia Univ., New York 27)

19. Research in Blindness and Severe **Visual Impairment**, symp., New York, N.Y. (Natl. Committee for Research in Ophthalmology and Blindness, 406-C S. Blvd., Evanston, Ill.)

19–23. **Chemical Engineering** conf., Montreal, P.Q., Canada. (N. E. Cooke, P.O. Box 10, Montreal)

20–23. Society of American **Foresters**, Boston, Mass. (H. Clepper, 704 17th St., NW, Washington, D.C. 20006)

20–25. **Exploration Geophysicists**, 33rd intern., New Orleans, La. (J. S. Johnson, California Company Bldg., New Orleans 12)

20–25. Pan American Congress of **Neurology**, Lima, Peru. (J. O. Trelles, Organizing Committee, Apartado 5117, Lima)

21–23. Direct **Aeronomic Measurements** in the Lower Ionosphere, Urbana, Ill. (S. A. Bowhill, Dept. of Electrical Engineering, Univ. of Illinois, Urbana)

21–23. **Aerospace and Navigational Electronics**, 10th East Coast conf., Baltimore, Md. (R. J. Allen, Research and Advanced Technology Dept., Martin Co., Baltimore 3)

21–23. Pathology of **Laboratory Animals**, New York, N.Y. (Office of Medical Education, New York Acad. of Medicine, 2 E. 103 St., New York 29)

21–25. **Beryllium Oxide**, intern. conf., Lucas Heights, New South Wales, Australia. (Secretary, AAEC, Research Establishment, Private Mail Bag, Sutherland, N.S.W., Australia)

21–25. American Soc. for **Metals**, metals and materials show, Cleveland, Ohio. (ASM, Metals Park, Ohio)

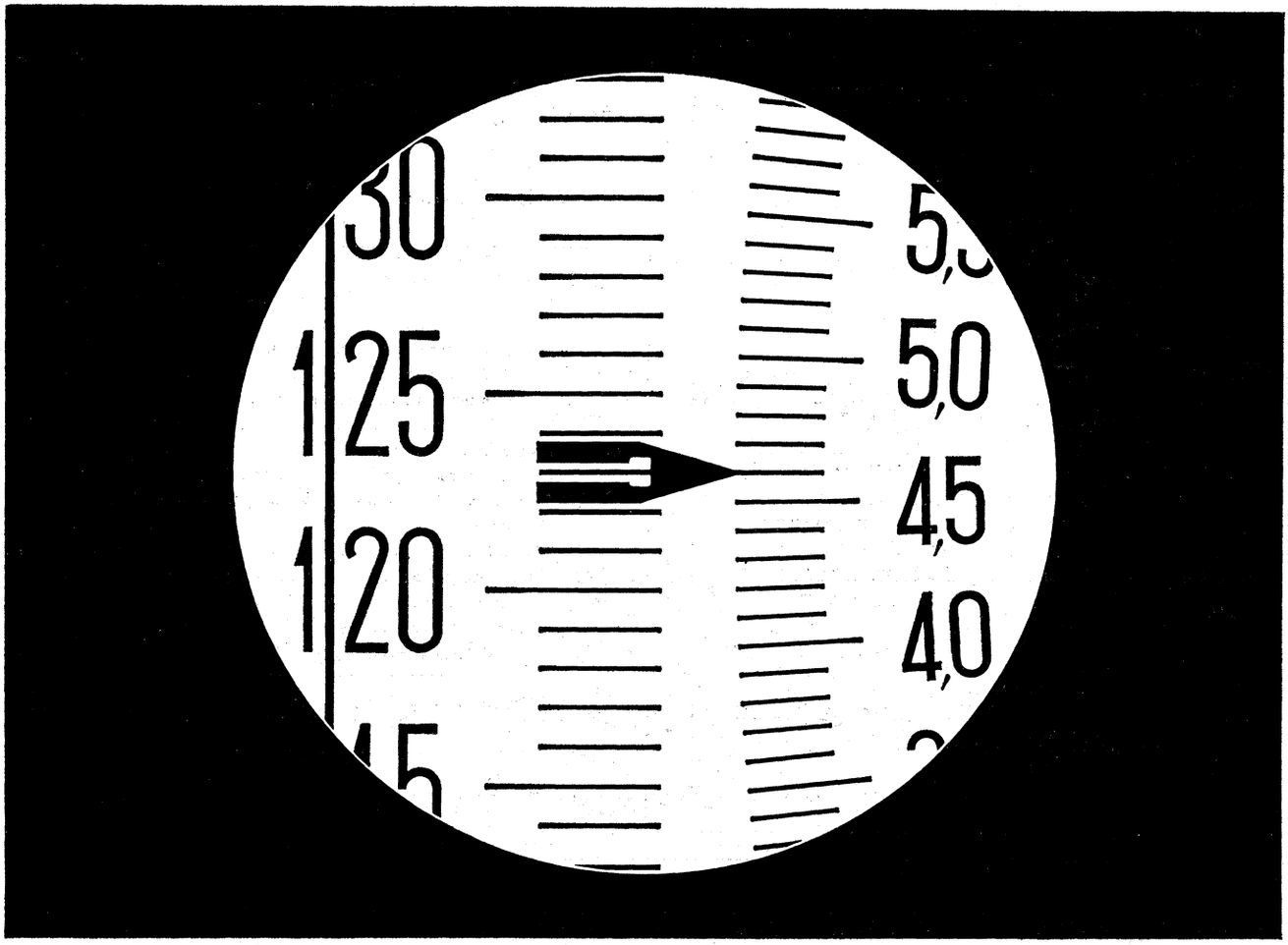
21–25. **Protein Rich Foods** in Developing Areas, intern. conf., Food and Agriculture Organization, United Nations, Rome, Italy. (FAO, Rome)

21–25. Society for **Nondestructive Testing**, 23rd natl., Cleveland, Ohio. (P. D. Johnson, 914 Chicago Ave., Evanston, Ill.)

22–25. Society for **Clinical and Experimental Hypnosis**, New York, N.Y. (SCEH, 200 W. 57 St., New York, N.Y. 10019)

22–28. **Medical Radiation**, seminar, Geneva, Switzerland. (WHO, Palais des Nations, Geneva)

23–24. **Industrial Hygiene** Foundation, 28th annual, Pittsburgh, Pa. (R. T. P. de-Treville, 4400 Fifth Ave., Pittsburgh 13)



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New Products

Fiber optics light wires promise outstanding possibilities in the illumination of small or inaccessible areas. Applications for the light wires are virtually unlimited, since specialized lighting is often a problem in quality assurance, tooling and production, electronics, and detection systems, as well as in military and space programs. Light wires are actually thin glass fibers of exceptionally high optical quality. A single fiber (approximately 15 μ in diameter) resembles a strand of a spider web, yet functions as a tiny "light pipe." Large numbers of these fibers are gathered together in "bundles," and the ends bonded together, ground, and polished. In order to prevent light leakage between fibers, each is insulated by a coating of lower refractive index glass. Light entering the inner "core," or fiber itself, travels the length of the glass "wire" by total internal reflection. Transmission loss is within practical limits, even in a fiber bundle 6 ft long. For maximum flexibility, only the ends of the fiber bundle are fastened together. The glass fibers are designed to withstand dirt, oil, tar, or nearly any other material without adverse effect on light transmission. Outstanding durability of the light wires is largely due to the thinness of each fiber. A "bundle" of thousands of fibers can be flexed, twisted, and threaded through the most devious paths, without breaking. For further protection, the bundle is encased in a flexible tubing, within which the fibers have room to fluff out or slide on one another when the tubing is bent. Additional versatility is provided by the wide temperature range (−65° to +250°F) within which the light wires are used effectively. At present, light wires come in four diameters, from 1/16 to 1/4 inch, and in a series of lengths, ranging from 6 inches to 6 ft.—R.L.B. (Bausch & Lomb Inc., Rochester 2, N.Y.)

Circle 1 on Readers' Service card

Positive displacement infusion pumps with infinitely variable flow rates from 1.5 to 900 ml/hr operate on the kinetic clamp principle. A loop of tubing is held between two disks. The front disk is mounted on an eccentric bearing and presses the tubing flat at one point, forcing liquid around the loop. The volume is controlled by the size of the tubing and the speed of rotation. The speed is controlled by means of a solid-state converter, operating on regular 115-volt a-c line. —R.L.B. (Sigmamotor Inc., 68 Main St., Middleport, N.Y.)

Circle 2 on Readers' Service card

Variable impedance pressure transducer (model K–100) is available in any pressure range from 0 to 0.02, to 0 to 15 lb/in.^{2} The basic design is differential, but absolute measurements may be made by evacuating one side of the transducer; overpressures of at least 15 lb/in.^{2} can be applied without affecting calibration. The transducer uses a stiff, flat, metal diaphragm moving in an air gap between two stationary air-core coils. The nonmagnetic metal diaphragm is clamped in a stainless-steel case that also serves to admit pressure to either side. The transducer is used with the manufacturer's model K-2000 oscillator-demodulator that supplies a 1 Mcy/sec excitation signal and also provides a d-c output proportional to the pressure being measured. The transducer impedance is nominally 50 ohms and the d-c output impedance of the entire system is 150 ohms or less. Hysteresis and repeatability errors are said to be less than 0.1 percent referred to full-range output. Nonlinearity of the system is less than ±0.5 percent and shift with temperature is 0.01 percent per degree Fahrenheit or less. Frequency response is 100 to 3,000 cy/sec, depending on pressure range and related specifications. Operating temperature range is −80° to +250°F. Size of the transducer body, exclusive of pressure and electrical connections, is 3/8 inch thick and 1 inch in diameter. —J.S. (Kaman Aircraft Corp., Garden of the Gods Rd., Colorado Springs, Colo.)

Circle 3 on Readers' Service card

Sweeping oscillator and frequency marker provides continuous high-level sweeps from 100 cy to 470 Mcy/sec by interchange of a number of plug-in heads. Sweep repetition rate is continuously adjustable from 0.2 to 25 cy/sec and can be locked to line frequency at 60 cy/sec. Switched attenuation is provided in 1-db steps to 65 db. Sweep outputs are regular sawtooth synchronized with the sweeping oscillator output. Five plug-in heads are available. The P130 head is a beat-frequency oscillator providing stable wave shapes from 100 cy to 2 Mcy/sec. The P860 head offers wide frequency range coverage, 2 to 220 Mcy/sec, and wide sweep widths. The P867 head covers the frequency range from 200 to 470 Mcy/sec in one continuously tuned band. The PM7631 is a marker head with customer-specified frequencies to identify frequency within the range 5 kcy to 3.0 Mcy/sec. The PM-932 is a marker head offering 30 crystal markers between 2 and 220 Mcy/sec switched in six groups.—J.S. (Kay Electric Co., 14 Maple Ave., Pine Brook, N.J.)

Circle 4 on Readers' Service card

Nucleic acid analyzer (model 3000) automatically controls a liquid chromatography system for analysis of nucleic acids, nucleotides, nucleotide derivatives, peptides, and proteins, and is adaptable to the analysis of amino acids as well as many other materials. The analyzer is completely self-contained in a modern double-bay cabinet and is designed for maximum operational flexibility. Automatic timing controls permit programming of four discrete changes in elution sequences. A variable gradient elution pattern may be employed separately or in combina-

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

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

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

The information reported here is obtained from manufacturers and from other sources considered to be reliable. Neither *Science* nor the writers assume responsibility for the accuracy of the information. A Readers' Service card for use in mailing inquiries concerning the items listed is included on pages 963 and 1097. Circle the department number of the items in which you are interested on this card.

tion with the stepwise procedure through the addition of a gradient producing device, the Phoenix Varigrad. Provisions exist for the installation of five chromatographic columns, the length and diameter of which are optional. A Teflon rotary manifold facilitates selection of effluent from the appropriate column and its direction either to the monitoring portion of the instrument or its diversion to auxiliary equipment prior to monitoring. Recording spectrophotometry provides identification and quantitation of sample constituents. A three-channel recorder plots absorbances of the column effluent at two selected wavelengths, in the ultraviolet range, while the third channel simultaneously records the ratio of the two absorbances.—R.L.B. (Phoenix Precision Instrument Co., Inc., 3803 N. 5th St., Philadelphia 40, Pa.)

Circle 5 on Readers' Service card

Glass manometer originally designed for use by students in introductory organic chemistry is suitable for measuring pressures in the 0- to 140-mm range in any laboratory. The manometer and scale are encased in a heavy-walled test tube, fitted with a two-holed rubber stopper. One end of the U-tube protrudes through one of the openings; the other one contains a small T-shaped length of glass tubing by which the manometer is attached to the evacuated system. This novel construction reduces the possibility of breakage when the system is assembled and disassembled. It also prevents the loss of mercury. Should any mercury escape through the small filling hole, it will be caught in the bottom of the test tube. Approximately 1 oz of mercury is required. A mechanical pump is recommended for evacuating the system. If desired, an infrared lamp may be used for heating. All glassware is hard borosilicate.—R.L.B. (Scientific Glass Apparatus Co., Inc., Bloomfield, N.J.)

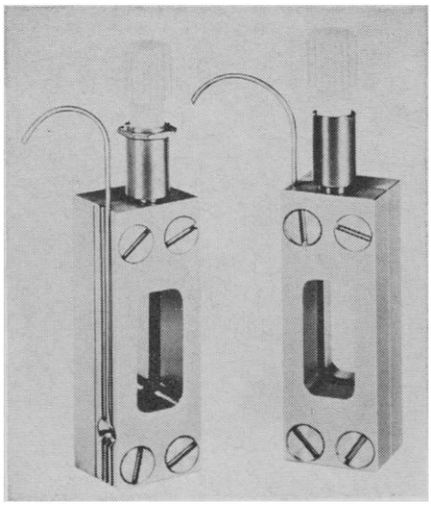
Circle 6 on Readers' Service card

Combustible and toxic gas alarms detect minute leakage of either toxic or explosive gases and vapors wherever the processing, storing, shipping, or use of combustible or toxic liquids or gases are involved. The TOX-EX alarm system features a meter that combines both the explosive scale and the toxic scale calibrated in parts per million. These detection instruments automatically give both audible and

visual warning before hazardous conditions reach the danger point. They also provide automatic control for hazardous processes such as solvent evaporation. An eight-station instrument permits multiple sampling of the atmosphere in various rooms, or at eight stations in sequence, with sampling time of 30 sec per station. Where constant sampling or monitoring is necessary, another model is recommended. The manufacturer guarantees the instruments for 10,000 hours, or more than 1 year between servicings. Pulsed alarm and pilot indicators give the failure mode if malfunction of components should ever occur. Solid-state circuitry and specially designed analysis cells assure accuracy, stability, and long life. Stable and accurate toxic (combustible gases or vapors) or explosive indication is given by audible and visual alarm which is adjustable, pulsed, and local, or remote. The eight-station instrument has explosion-proof construction for wall or rack mounting in hazardous areas, requires a power input of 115 volts, 60 cy, 400 watts, and measures 42 inches high by 30 inches wide by 8 inches deep.—D.J.P. (Erdco Engineering Corp., 136 Official Rd., Addison, Ill.)

Circle 7 on Readers' Service card

Short-path-length ultraviolet microcell permits the analysis of small quantities of highly absorbing samples in the ultraviolet and visible regions of the spectrum. Use of this unique cell obviates the waste of time and sample incurred by repeated dilutions necessary with ordinary cells. By simply changing spacers, the path length of the new cell can be varied between 0 and 2 mm. Either Teflon or lead spacers can be supplied to cover the complete range 0.007 to 2 mm. Cells, however, can be ordered with shorter path lengths down to a fraction of 1 μ. The cell consists of two stainless-steel plates between which two high-quality fused silica windows, separated by a spacer, are sandwiched. Two holes drilled in one of the windows are in juxtaposition with two holes in one of the stainless-steel plates, serving as inlet and outlet. The inlet is connected to a capillary and the outlet to a Luer syringe holder. Both can be closed by means of Teflon plugs. The cell is self-filling by automatic siphoning when the end of the capillary is dipped into the sample. There are two types of the new microcell available. The UV-0-1 is completely in 18/8 stainless steel. The



UV-0-2 incorporates tantalum and platinum so that the sample comes in contact with tantalum, platinum, fused silica, the spacer, and gasket only. If Teflon spacer and gaskets are used, the scope of the cell is greatly increased. The cell is easily flushed through with solvent and when Teflon spacers are used it can readily be taken apart and reassembled. Both types of UV-0 cell fit the standard fused silica cell holders universally used in spectrophotometers. Volume of the cell is small and is in the range of 0.018 to 0.230 ml for the 0.007- to 2-mm path length range. The fused silica windows used in UV-0 cells are transmissive to below 180 mμ.—R.L.B. (Limit Research Corp., P.O. Box 852, Darien, Conn.)

Circle 8 on Readers' Service card

Laboratory microscope is said to provide the best visual and photomicrographic image quality obtainable in this class of instrument through the use of a unique, infinity-corrected optical system. Only the smallest, lightest, most easily moved part of the microscope—the nosepiece assembly which contains the objectives—moves to focus the objective to the specimen. Those familiar with the mechanical aspects of microscopy will recognize the advantage of a focusing adjustment without rack and pinion, and without bearing surfaces to wear and bind. The entire mechanism is enclosed in the arm, is sealed against dirt, and requires no periodic cleaning or lubrication. The stage is fixed rigidly to the stand. Plain, mechanical, and Micro-Glide stages are available. Mechanical stages are research type, graduated or ungraduated. There is a choice of three integral illumination systems, as well as a standard mirror assembly. A high-intensity illuminator has a convenient external lever which controls the built-in neutral density filter. It is supplied with a five-step transformer, for adjusting the intensity, and provides essentially Koehler illumination. Two inexpensive illuminators are also available—one for binocular models, and one for monocular. Both fill the field of all objectives. Daylight filter, condensing lens, and reflector are built-in. Of the wide selection of accessories available, a new type of inexpensive 35-mm camera will be of special interest. Having two different magnifications, the 2.8× covers essentially the field that is seen through the 10× wide field eyepiece, while 5× covers approximately one-half that diameter. A single adapter allows instant changeover from 2.8× to 5×, with the same camera back. A Polaroid camera will also be available. Cameras and visual systems are parfocal, eliminating the need for special focusing eyepieces for photomicrography.—R.L.B. (American Optical Co., Eggert and Sugar Rds., Buffalo 15, N.Y.)

Circle 9 on Readers' Service card

Picoammeter (model 417) is said to provide at least a tenfold increase in speed of response over other available instruments. Ranges extend from 10^{-13} amp full scale to 3×10^{-5} amp. Zero drift is less than 1 percent in 24 hr and calibrated current suppression is provided to 1000 times full scale. Circuitry is all solid state except for the electrometer tube. Accuracy is said to be within 3 percent. A 3-volt, 1-mm output for recorders is available for full-scale signals on any range. Plug-in design of the instrument permits location of the amplifier up to 30 m from the instrument chassis. Accessories are available to facilitate remote operation. When fast response is unnecessary, adjustment of rise time may be made with a front-panel damping control. The current suppression feature of the instrument permits full-scale display of 0.1-percent variation in signals as small as 10^{-10} amp. Four in-line dials provide direct readout of the suppression current. The instrument derives its high speed of response from a high-gain d-c amplifier and a critically damped feedback network. Dimensions are standard for rack mounting but a conversion kit is available for bench mounting.—J.S. (Keithley Instruments, Inc., 12415 Euclid Ave., Cleveland 6, Ohio)

Circle 10 on Readers' Service card

Viscometer which analyzes fluid substances by placing a small sample between a rotating metal cone and a stationary flat plate is now available with four distinct improvements. Viscosity value readings depend on maintenance of a constant rate of shear speed, variable from 2 to 20,000 reciprocal seconds and accurate to 0.2 percent. Rotation speed is precisely controlled, from 10 to 1,000 rev/min. The four improvements claimed are: maximum operating sample temperature has been increased from 30° to 200°C; truncated cones have been provided, to permit the analysis of materials with larger particles in suspension and greatly increase the range of materials the instrument can handle; provision for automatic programming and recording facilities, thus adding to the efficiency and speed of the machine's operation; a precision gap setting arrangement between cone and plate has been introduced with a heating element surrounding the supporting column. Another feature of the viscometer is that it can record viscosity values by using extremely small samples (less than 0.5 ml

in volume). A notable claim of the machine's advantages over conventional types of viscometers is that it is rapid in operation and can measure many samples in a given time, either in the laboratory or in production and processing of fluids and related substances. It is also said to be extremely quick and easy to clean before refilling.—R.L.B. (Ferranti Electric, Inc., Industrial Park No. 1, Plainview, N.Y.)

Circle 11 on Readers' Service card

X-ray tube is designed for operation with the Jarrell-Ash Microfocus X-Ray Generator in applications such as: determination of crystal structures, textures, orientations, and deformations; investigations of low-angle scattering; identification of substances through diffraction pattern comparison; and macroradiography of biological specimens and thin metal sections. The new tube features complete interchangeability of a wide selection of low-cost targets and cathode guns. The interchangeability feature permits the use of spot shapes, sizes, and orientations to assure unlimited application versatility from the single x-ray tube. The tube is said to deliver from 9 to 13 times the intensity of conventional vacuum-sealed tubes, because of greatly increased electron bombardment at the target by means of a unique electrostatic lens system which serves to focus the electrons into a localized target area (1.4 mm by 100 μ, or optionally, to a 40-μ spot). The inexpensive targets last from 600 to 1000 hr and can be replaced, in minutes, to prolong indefinitely the life of the tube itself.—R.L.B. (Jarrell-Ash Co., 26 Farwell St., Newtonville, Mass.)

Circle 12 on Readers' Service card

Low-cost infrared spectrophotometer (model 337) is a grating instrument which covers the broad range of 4000 to 400 cm^{-1}, 2.5 to 25 μ; the range includes longer infrared wavelengths, extending to the carbon-bromine vibrations and out-of-plane aromatic carbon-hydrogen bonds, and also provides useful data on inorganics and metal-oxygen or metal-nitrogen bonds in complexes. Usable with standard accessory equipment, the instrument features an efficient filter-grating monochromator and is available with either linear wavelength or linear wave number presentation. Its total range is divided between two standard 8½ by 11 charts for flexibility of recording, and to give abscissa scales adequate to show

fine structural details clearly. The unit may be used also with auxiliary recording equipment to give data presentation in any format desired. A variable slit programming system is a standard feature of the new model and provides programmed slit widths to fit the needs of any application, from highest-resolution scans to energy-limited analyses where reduction of noise is a primary problem. The unit employs two gratings and four filters to cover its total range, with the gratings used as the primary dispersing elements. Filters of appropriate cut-off characteristics eliminate all but first-order radiation. This principle of construction permits both mechanical simplicity and high optical efficiency. Overall dimensions are 27½ inches long by 17 inches wide by 19½ inches high and weight is 110 lb.—R.L.B. (Perkin-Elmer Corp., Norwalk, Conn.)

Circle 13 on Readers' Service card

Photo-plethysmograph and control unit provides a convenient method of adapting standard electrocardiograph machines, oscillographic recorders, and oscilloscopes to recording or viewing of peripheral pulse wave forms and relative vascular volume changes. It provides a d-c output for studies where relative position and change in position of the base line is of importance, or a low-frequency a-c output should only pulse wave-form measurements be desired. This unit finds its greatest areas of application in the field of psychopharmacological studies to indicate subject response to stimuli, effective drugs, or other conditions. In this use, the equipment is frequently used on the d-c basis, and may be used to compare two areas, for example, temporal artery and finger. It is particularly valuable in use during surgical procedures when it can be used to monitor pulse as a reflection of cardiac output, vascular changes indicating shock, where there is a constriction, or other vascular changes as a result of drugs or surgical procedures. In all instances, it can be readily used as a sensor for heart rate. It is also valuable in determining relative blood flow, and with an occlusive cuff it can be used to determine systolic pressure. The unit will be of interest to surgeons, anesthesiologists, physiologists, pharmacologists, neurophysiologists, psychologists, and so forth, as a means of expanding the capability of instruments already in their possession. The model PCB-AD photo-plethysmograph and control unit is a complete system, consisting of the model PCB-1 photo-plethysmograph pulse transducer, the model PCB-2 control unit, and the model PCB-3 interconnecting cable. The photo-plethysmograph transducer is a photoelectric device. It consists of a grain of wheat light source and a photocell, both contained in a small plastic housing designed to operate from any location on the subject where an artery lies near the surface. A beam of light is directed into the vascular bed and is reflected and picked up by the photocell. As the blood volume changes in the area being observed, the intensity of the reflected light is also changed and is observed by the photocell. This device is sensitive only to relative changes of light intensity. It is not sensitive to pressure changes on the transducer or to motion to the transducer. The control unit converts this observed volume change to a proportional electrical pulse wave form for use directly into EKG and oscillographic recorders or oscilloscopes. The control unit is equipped with a ten-turn calibrated dial which is employed to

adjust the output d-c bias level or the a-c output amplitude, and provides a convenient method for reading the relative volume or amplitude changes. In addition, the control unit is supplied with an "on-off" switch, connector for the pulse transducer, and connector for the interconnecting cable. The interconnecting cable is furnished with leads suitable for connecting to standard recording devices.—R.L.B. (Starling Corp., 2047 Sawtelle Blvd., Los Angeles 25, Calif.)

Circle 14 on Readers' Service card

Portable **direct-reading oxygen gage** is designed for monitoring the oxygen content of inert gases and for measuring the flow of oxygen into a vacuum. For monitoring, the instrument has a range of from 1 to 200,000 parts per million. For measuring oxygen flow into a vacuum, calibration is in partial pressure of oxygen on a scale from 10^{-4} to 10^{-2} mm-Hg. Accuracy of the gage is said to be ± 3 percent and response time is 10^{-3} sec. Power requirement is 25 watts at 120 volts a-c. Response of the instrument is logarithmic. It is not sensitive to the presence of water and carbon dioxide and these constituents of a gas stream do not alter the instrument's sensitivity to oxygen. The test cell of the sensing element consists of solid electrolyte that does not diffuse volatile contaminants into the monitored gas stream or into the vacuum system. The instrument measures 20.3 by 22.9 by 30.5 cm and weighs 6.8 kg.—J.S. (Westinghouse Electric Co., Box 2278, Pittsburgh 30, Pa.)

Circle 15 on Readers' Service card

Vibrating capacitors are available in four series for vacuum-tube drive, transistor oscillator drive, synchronous drive 6.3-volts a-c; and frequency doubling 6.3-volts a-c drive. The first two can be furnished for any specified frequency from 300 to 700 cy/sec, the third for any specified frequency from 60 to 500 cy/sec, and the fourth for any specified frequency from 60 to 250 cy/sec, the output frequency being twice the drive frequency. Specifications for high-performance models include: capacitance, 10 pf static each channel; input voltage, 100 volts maximum; minimum insulation resistance, 10^{15} ohms; maximum contact potential, including drift, 20 mv; maximum contact potential drift at constant temperature ± 0.1 mv/24 hr, noncumulative; temperature coefficient of drift 0.03 mv/°C; conversion

efficiency, defined as a-c voltage output per unit d-c voltage input, 8 percent r.m.s. and 22 percent peak-to-peak; temperature range 0 to 85°C. Specifications for economy models include: minimum insulation resistance 10^{14} ohms, contact potential 30 mv maximum including drift, and contact potential drift ±2 mv/24 hr, noncumulative.—J.S. (Stevens-Arnold, Inc., 7 Elkins St., South Boston 27, Mass.)

Circle 16 on Readers' Service card

Vacuum heating stage for microscopic examination of metals and other materials permits heating of specimens to 1750°C with thermocouple measurement of temperature. The stage is designed for observation by incident light. The vacuum chamber is mounted on a spherical bearing to permit the surface of the sample on the heating stage to be aligned parallel to the surface of the microscope stage. The sample to be observed is placed over the thermocouple like a thimble. As a rule, the sample is heated indirectly by means of low-voltage heating elements of tantalum. Screened plates, also of tantalum, enclose the heating cylinder and concentrate the heat onto the sample. The heating elements and the interior of the chamber are covered by a radiation protection plate. Only the surface of the sample remains visible through a small observation window. A quartz disk arranged eccentrically over the sample and rotatable through 360° closes the chamber so that it is vacuum sealed. If the window space above the sample becomes clouded, it can be renewed up to 25 times by turning the cover to a clear area. The heating stage objectives are corrected for the thickness of the quartz glass window. For examinations at 1750°C the stage is equipped with a platinum-rhodium thermocouple. For observations at temperatures above 1750°C, a micropyrometer can be used for measurement of temperature.—J.S. (E. Leitz, Inc., Scientific Instrument Div., 468 Park Ave., New York)

Circle 17 on Readers' Service card

Micro-flow pump plugs into any 117-volt a-c source and operates by electrolysis. The pump assembly consists of a glass pumping chamber and a piston within which gas is generated to drive fluid at reproducible, uniform rates. The pump offers continuously adjustable flow rates ranging from 1 ml/¼ hr to 1 ml/24 hr. A second model offers eight specific rates within

the same range. In each case, a dial on the control box sets the rate. The pump assembly is connected to the control box by a 6-ft cable, and may be freely moved. Pump assemblies are available in the capacities of 10 ml, 25 ml, and 50 ml, and may be used interchangeably. Major uses are for chemotherapy, intravenous feeding, and slow infusion of all kinds. Any fluid compatible with glass may be handled, and parts in contact with the fluid are autoclavable. Miniature, self-contained, battery-operated models are also available.—D.J.P. (Sage Instruments, Inc., 2 Spring St., White Plains, N.Y.)

Circle 18 on Readers' Service card

Pocket-sized sugar refractometer measures from 0- to 90-percent sucrose. A single drop of the sample is sufficient for a determination. To use, merely place a drop or two of the solution on the prism surface, close cover, and point toward any convenient light source. The percent sucrose or total dissolved solids is clearly shown on a graduated scale. The refractometer incorporates a unique turret that introduces any one of three prisms into the optical path. Each prism covers the range 0 to 43 percent, 42 to 73 percent, and 72 to 90 percent, respectively. A knurled knob provides instant selection of the range desired. Concentrations may be read directly to 0.2 percent. Dense or clear solutions may be checked with equal facility. The refractometer is sturdily constructed for hard use in the plant or field. Supplied complete with top grain, sewn leather case and shoulder strap. —R.L.B. (National Instrument Co., 4119 Fordleigh Road, Baltimore 15, Md.)

Circle 19 on Readers' Service card

Operational amplifier (model 3821) is a transistorized amplifier said to match performance of vacuum-tube amplifiers in voltage range, power, and gain. Output is ±100 volts at 20 ma and ±60 volts at 40 ma. Open-loop gain at d-c is typically 5×10^6 and minimum gain is 2×10^6. Drift, referred to input, is 50 μv in 8 hr at constant temperature; 175 μv/10°C from −20° to +45°C; 200 μv/10°C from −55° to +55°C. Input current is 10^{-10} amp and integrator drift is 150 μv/sec. Noise is 2 mv r.m.s. and typically 25 mv peak-to-peak. Response is down 3 db at 50 kcy/sec. Input impedance is 500 kohms at d-c and 100 kohms at 300 cy/sec. Output imped-

ance is less than 1 ohm with feedback. The amplifier is capable of driving galvanometers, process control elements, and servo control equipment directly without auxiliary circuitry. It is compatible with standard electronic instruments and is interchangeable with vacuum-tube amplifiers.—J.S. (Systron-Donner Corp., 888 Galindo St., Concord, Calif.)

Circle 20 on Readers' Service card

Magnetic tape–paper tape converter (model D427) accepts input records of various sizes and codes them for direct processing by a computer. The device converts magnetic tape to paper tape at a speed of 300 characters per second and converts paper tape to magnetic tape at 1000 characters per second. It accepts 5, 6, 7, or 8 level paper tape, produces tapes compatible with the I.B.M. 1401 or 7090 computers, and produces 5, 6, 7, or 8 level punched paper tape. The converter is equipped with a plugboard that allows 6-bit code translation as well as various fills, inserts, character flagging, and other features necessary to accommodate input records of various sizes. The memory provides 1024 characters of storage. Read-after-write checking is included in the magnetic tape output operation.—J.S. (Digitronics Corp., Albertson, N.Y.)

Circle 21 on Readers' Service card

Infrared laboratory test panel is said to heat evenly across its entire face free of hot-spot effects and to provide data that is readily transferable to process conditions. Test panels can be supplied in three face temperatures: 1200°, 1000°, and 800°F. The panels use a ceramic face as the source of infrared radiation. Formed resistance wire, embedded in an insulation block behind it, brings the ceramic face to emission temperature. Batt and reflective insulation keep the metal shell at safe temperatures. A support grill under the panel is height adjustable. Size of the panel is 0.3 by 0.6 by 0.15 m. Power is 3000 watts. A junction box is provided on the back of the panel.—J.S. (Infrared Systems Inc., Route 23, Riverdale, N.J.)

Circle 22 on Readers' Service card

Plastic separatory funnel in 500 ml Squibb pear-shape design is molded of unbreakable polypropylene featuring unusual clarity. The separation line between even two water-white liquids is easily visible down to the stopcock

housing. The funnel is produced by a new technique that permits molding the funnel and stopcock housing in one sturdy piece. It has no joints to impede liquid flow, and no weak spots where breakage might occur. Even the funnel stem is unbreakable. Designed with a Teflon plug, each funnel stopcock is precision engineered and individually tested for pressure and vacuum at the factory. The low-friction TFE plug works smoothly without lubrication, eliminates any chance of contamination. The Nalgene separatory funnel offers both immediate and long-range economies. It costs less than comparable glass separatory funnels with TFE plugs, and, because it is unbreakable, it cuts replacement costs. In addition, it resists virtually all chemicals, including hydrofluoric acid, and can be autoclaved repeatedly without damage. The funnel is supplied with a polyethylene stopper.—R.L.B. (Nalge Co., Inc., 75 Panorama Creek Dr., Rochester, N.Y.)

Circle 23 on Readers' Service card

Heat dissipating tube shield is said to put no strain on the tube contact pins; require no torque or twisting to lock into place; put no insertion force on the tube bulb; and have no tendency to pull the tube from its socket when it is removed. The tube shield is hinged at the base and opens for insertion and removal. When in place over the tube, the shield is closed and secured by a metal snap ring at the top. The interior of the shield is fitted with a flexible beryllium-copper material that grips the tube and provides heat conduction to the tube shield case. The heat is then dissipated to the component chassis. The shield is said to meet and exceed military specifications that require bulb temperature reduction of 50 percent or greater.—J.S. (Atlee Corp., 2 Lowell St., Winchester, Mass.)

Circle 24 on Readers' Service card

Four-terminal rheostat can set up 893 reference resistance values in two digits in the range 1 to 110,000 ohms. These reference values are obtained by direct transfer from five reference resistors. With the use of the rheostat as a calibrating device, a conventional 0.1-percent bridge can, according to the manufacturer, be operated with 0.01-percent or better accuracy for all discrete resistance values within the rheostat range. In calibrating bridges for 0.01-percent accuracy, any two decades of a five-dial bridge can be calibrated by direct comparison to the four-

terminal rheostat. Construction of the rheostat uses multiple leaf switches, and stabilized 2-watt resistors. Shunting in the 10,000-ohm arm is said to be kept to more than 10^{12} ohms, controlling transfer error at 10^{5} ohms to less than 0.1 ppm. The switch is enclosed and dust-tight with self-cleaning construction. Contact resistance is less than 0.001 ohm; internal emf is less than 1.0 μv; and contact resistance varies less than 0.005 ohm with 10^{6} operations.—J.S. (Angstrohm Precision Inc., 7341 Greenbush Ave., North Hollywood, Calif.)

Circle 25 on Readers' Service card

Automatic **gage-block calibration system** provides a quick comparison of gage block to master block and produces automatically a typewritten record of deviations said to be less than 0.000001 inch. The automatic system consists of electronic gage-block comparator, tolerance-limit control, digital display, and a coupling and scanner unit connected to an automatic electric typewriter. To calibrate gage blocks, the operator places the master block under the gage tip of the comparator, adjusts the instrument to zero, and sets the tolerance-limit control as required. The uncalibrated gage block is then substituted for the master and a foot switch is depressed to actuate the digital display and the automatic typewriter. An asterisk appears on the typewritten record after any reading that exceeds the tolerance limit.—J.S. (Cleveland Instrument Co., 6220 E. Schaaf Rd., Cleveland 31, Ohio)

Circle 26 on Readers' Service card

A **miniaturized air sampler** is designed to be worn by personnel to check their breathing zones for airborne contamination, dusts, and vapors. The device is made of high-impact polystyrene, weighs 283 g, and is slightly larger than a pack of cigarettes. It contains a motor, rechargeable nickel-cadmium battery, built-in charger, and a flow meter calibrated to 3 lit./min. A disposable plastic filter holder uses standard filter paper and protects the sample until it is ready for analysis. The sampler is attached to the user's belt or pocket and is connected by a tube to the filter holder fastened to the user's lapel. The filter holder cover is removed before the motor is turned on.—J.S. (Atomic Accessories Inc., 811 W. Merrick Rd., Valley Stream, N.Y.)

Circle 27 on Readers' Service card

Letters

(Continued from page 996)

I suggest that if the Commission finally decides to have the symbols conform with the widely accepted stoichiometric relation between oxidant and reductant, it will suffice to state that they should be NAD^+ and NADH. By comparison with the currently used DPN^+ and DPNH the meanings will be well understood. Further comment of the sort injected into the 1961 report hardly can be regarded as germane to the principal subject of that report. One may also expect corrections of the errors in Appendix E.

W. MANSFIELD CLARK
Johns Hopkins University, Baltimore, Maryland

References

1. *Report of the Commission on Enzymes of the International Union of Biochemistry* (Pergamon Press, New York, 1961).
2. W. M. Clark, *Oxidation-Reduction Potentials of Organic Systems* (Williams and Wilkins, Baltimore, 1960).

The New Regulations Pertaining to Research Grants of the Public Health Service

During recent weeks, storms of criticism of the newly instituted regulations relating to the management of research grants of the National Institutes of Health (NIH), a division of the Public Health Service (PHS), have arisen among the staffs of many universities, institutes, and scientific societies, and among various individual scientists. Congressional Committees, the General Accounting Office, and the General Counsel of the Department of Health, Education and Welfare, recognizing the occasional lack of adequate responsibility by grantees of the PHS, have made demands that scientists not be treated as especially privileged citizens and that greater fiscal control should be exercised in the expenditure of the hundreds of millions of dollars awarded annually by the various agencies of Congress for the support of scientific research. It is important to note that the funds of the PHS are awarded on the basis of evaluations made by carefully selected scientists, who serve as consultants to the Surgeon General, and who carefully scrutinize each application for a grant, with respect to the objectives, the proposed means of

obtaining them, and the appropriate amount of money needed to support each application that is recommended for approval.

It is unfortunate that some members of the Congress and of the offices mentioned think that scientific research can operate productively when subjected to rigid fiscal controls, as can a variety of industrial or other operations supported by federal funds. It is only too easy for critics to characterize scientists working in areas of fundamental research, particularly in biological and medical fields, for whom "fiscal controls" are necessary—for their own good. Yet experienced investigators know full well that important discoveries simply cannot be made in an atmosphere of restrictive rules, regulations, and bureaucracy.

What has gone wrong? Perhaps it is to a considerable degree a result of unprecedented rapid growth in (i) the number of scientists being trained or supported by federal funds; (ii) the number and size of the grants; and (iii) the almost inevitable differences in opinion as to what constitutes essential freedom to do good research, as compared to what some apparently regard as unfettered license. In any case, although attainment of the desired degree of "fiscal control" can be insured by the development of severely restrictive regulations, the inevitable price to be paid is a reduced overall productivity of science in America. Consequently, the Congress ought to have the collective courage to question the wisdom of those "directives" of its committees and of other groups that have led to the establishment of restrictive regulations by unwilling but apprehensive agencies.

What are some of these newly made regulations that are regarded so unfavorably by scientists?

1) The requirement that grantee-investigators not be allowed to alter their objectives in a major way, except after permission has been recommended by a committee or granted by officials within the agency from which the funds were obtained.

2) The establishment of rules requiring that records be kept concerning the actual percentage of time that grant-supported scientists devote to a research project.

3) The interpretation that full-time employment with funds derived from a research grant should prohibit even a modest and sensible participation of scientists in such regularly scheduled

educational activities in an institution as are conducive to the scholarly development of the individual.

4) Restrictions upon freedom to shift funds within the several budgetary categories of a research grant, even when a grant has been morally committed for several years in advance, with those inevitable changes in orientation that develop and that require a maximal amount of flexibility in the management of research funds.

Let us consider then, each of the above-listed restrictive regulations, and some constructive suggestions for their modification.

1) Scientists reacted vigorously against a most objectionable earlier restriction that prevented any significant modification of an initially approved research objective by a qualified investigator. Their objections led the Surgeon General of the PHS to announce recently a change in this regulation whereby the alteration of research objectives is now limited to "changes in methodology, approach, or other aspects of the project that would expedite achievement of *its* (my italics) research objectives, including changes that grow logically out of the approved project and serve the best scientific strategy." This is a major step forward, but even this statement does not go far enough, for it does not permit an essential change in the orientation of a very competent and established investigator. All that is needed, in this new regulation, is to change the italicized word "*its*" to "*his.*" Such a modification would put the responsibility for quality and objectives where it should be, in the hands of the carefully selected investigator. Furthermore, it would have the very salutary strategic effect of not encouraging the submission of grant applications that are vague with respect to objectives and therefore difficult to evaluate. It would thus be recognized that precision in the delineation of a proposed investigation, although of great value to advisory committees concerned with evaluation, would not restrict an investigator to an area that new research could demonstrate to be unproductive.

2) Perhaps none of the new regulations has caused more irritation among scientists than has this one; not only is it unrealistic and unworkable, but it demands intellectual dishonesty. Good investigation cannot be done under the shadow of a time clock and effective scientists do not work a week of 37.5 or 40 hours. A regulation that requires that either "per cent of time" (or "per cent of effort") or "hours per week" be recorded asks for the impossible. Contributions to research cannot be estimated on the basis of the number of hours at either the bench or the desk, for equally important intellectual contributions actually may occur during conferences with scientific colleagues and students, and, even more, with time for reflection: in the library, while shaving, or in the quiet of one's bed! Let us realize, therefore, that neither time nor effort can be gauged as with clerks, and scientists should not be required to make outwardly plausible but actually untenable estimates of it.

3) There appear to be some curious differences between the kinds of dollars awarded by the PHS in support of research and training and how they may be used; these may be defensible in terms of bookkeeping and "fiscal control," but not in terms of attainment of intellectually desirable goals. Thus, as an example, a PHS research grant that fully supports a scientist permits him to give only an occasional *unscheduled* lecture, but a modest amount of scheduled teaching, desired by the individual for his own intellectual stimulation and growth, the respect of his peers, and the development of his career, is forbidden. On the other hand, the same man might be employed legally, and on a full-time basis, on a PHS-supported research training program and be so overburdened with teaching that time for productive research would be minimal or absent.

Clearly, a much more liberal interpretation is needed of what is reasonable in the way of modest and sensible participation in teaching that is desired by the theoretically full-time research worker, and of what actually is beneficial, not detrimental, to his research. To accomplish this requires only a common-sense definition of reasonableness—and what could be simpler than an *average* participation of up to perhaps 6 hours a week, rather than, let us say, up to 15 percent of his time and effort?

4) Some restrictions upon freedom to shift funds, within the various budgetary categories of a previously approved grant, would seem to be entirely warranted *if* scientists are not to be regarded as the best judges of sensible and productive ways to obtain desired objectives within the framework of the

total amount of money provided for the conduct of their own research. But if the scientists are not to be trusted, who is? As the new rules now stand, it can be predicted that a rapidly expanding army of bureaucratic officials will be drafted to rule upon the multitudinous and laboriously documented appeals for budgetary readjustments that are certain to be presented continually by grantee scientists throughout America. Who can evaluate and rule upon these appeals? Presumably former scientists who, for a variety of reasons, become involved in the regulation of science rather than in contributing to it creatively. Will not the amount of money relegated to the salaries of this new bureaucracy, as well as the amount of time spent by scientists who ought to be working or thinking, be far more wastefully expended than that to be spent, presumably unwisely, each year by a small percentage of less severely controlled grantees? If the fear is that some institutions will use research funds to rehabilitate physical facilities (or in some other *wasteful* manner), presumably with a view to the better accomplishment of the research, will this not be controlled adequately by the well-known activities of the General Accounting Office, which scrutinizes the records of expenditures by institutions and has the power (and exercises it) to enforce restitution? If undue travel by scientists for conferences and the exchange of ideas is a legitimate and really fearful problem, a restriction on alterations of this aspect of research budgets perhaps is defensible. It would seem, however, that in all other categories the best way to foster scientific progress is to delegate authority to the principal investigator (and his administrative associates in an institution) to expend the allocated research funds with maximal freedom. The investigator, as an applicant, has already been judged to be highly qualified for the conduct of research; a reasonable sum of money has already been granted with which to gain the desired objectives, and maximal attainment will occur only with minimal bureaucratic interference in the guise of attaining fiscal responsibility.

In conclusion, it is suggested that the objectives of the Congress to further scientific research and the training of new scientists, as well as the best means of attaining these ends for the public good, hitherto attained with remarkable success by such disbursing

agencies as the National Institutes of Health and the National Science Foundation, need further consideration—carefully and promptly. For this purpose, it has been suggested by others that the National Academy of Sciences be invited to arbitrate in the present controversy. What could be more appropriate in this case?

Specifically, there is need (i) to reduce the present limitations upon modifications of research objectives; (ii) to abolish the keeping of records by research workers of "time and effort"; (iii) to liberalize the interpretation of "full-time" and to permit scientists entirely paid from research grants to participate to a modest degree in teaching; and (iv) to remove restrictions upon the transfer of funds between the different categories of a budget set up to permit an initially desirable research objective to be attained.

It is unthinkable that the errors of a very small proportion of the grantees of the Public Health Service and of other federal agencies should be so exaggerated that, in purging them, serious and lasting harm be done to the progress of science. The people of the world probably have received more permanent benefit from unimpeded scientific research and development than from almost any other application of American intelligence, ingenuity, enterprise, and public money (*1*).

ARNOLD D. WELCH

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Note

1. The substance of this letter, by the chairman of the Department of Pharmacology, Yale University School of Medicine, has received the approval, as well as the constructive criticism, of the other chairmen of the departments and the dean of the School of Medicine, and the provost of Yale University.

Intelligence and Genetic Trends

From time to time students of evolution have urged that adverse changes are probably taking place in the collective pool of human genes and that practical measures may be needed to counter the trend. For geneticists such assertions raise questions, to which there are no simple answers, about their individual and collective responsibilities for the genetic future of man. Some of the more perplexing of these questions do not appear to have been discussed in print.

In his recent book, *Animal Species*

and Evolution (*1*), Ernst Mayr devotes a chapter to the evolution of man in which he supports the view of Julian Huxley that the frequency of superior combinations of alleles in the collective pool of human genes has diminished and is probably continuing to do so. The assertion applies especially to human intelligence and is based on (i) fossil evidence of long-term changes in cranial capacity, indicative of an early period of rapid evolution of mental ability which apparently came to an abrupt halt, and (ii) the much discussed negative correlation between I.Q.'s of school children and family size. As a remedy for this supposed trend, Mayr proposes the introduction of financial changes, involving the manner of taxation and the payment of educational fees, to encourage (rather than to deter as they now do) procreation by, and the education of, gifted people.

Even if the evidence for a decline in the genetic basis of intelligence were generally accepted as adequate (which Mayr recognizes is not the case), many geneticists would still be inclined to wonder just what they personally should do about a problem which can seem at one and the same time terribly important and yet, perhaps, not very urgent.

Probably only a minority, even among geneticists, feel reasonably sure that there is such a downward trend. Experts called upon to advise the British Royal Commission on Population (*2*) have pointed out a number of deficiencies in the evidence, and recent limited data have done little to support the view that a decline is, in fact, in progress (*3*, *4*).

Interpretation of the seemingly unfavorable fertility differential is far from simple. (i) Childless members of the parental generation, who are not ascertained in studies of the I.Q.'s of school children, may be predominantly of lower-than-average intelligence (*4*). (ii) Children with many brothers and sisters may develop more slowly than other children so that they underrepresent their parents' intelligence. (iii) A similar negative correlation has been observed in the Scottish Mental Survey (*5*) between sibship size and height (and also weight) which, by the reasoning applied to intelligence, would seem to indicate a decline in the frequency of superior gene combinations for stature—an interpretation which is difficult to reconcile with the dramatic increase observed in stature. Nevertheless, a continuing attitude of concern

for man's genetic future must be regarded as essentially healthier than one of smugness based on present ignorance.

To hope that the biological aspects of man's evolution will be "duly taken into consideration by those entrusted with the task of planning the future of mankind" (*1*, p. 662)—if by this is meant the elected representatives of the people or the civil servants whom they control—seems either unrealistic or else positively dangerous as long as geneticists themselves are not in some sort of general agreement.

Let us suppose, however, that the reasoning and the inference are correct, although still unproved, and that all that is required in order to achieve unanimity of opinion on the urgency of the matter is adequate evidence. How much effort would be justifiable, under these circumstances, in an attempt to obtain such evidence in spite of known substantial difficulties? A major defect in most studies so far, which will have to be remedied in future undertakings, is that the negative correlation of I.Q. test scores with family size has been investigated in only a single generation of tested individuals—a procedure that must be regarded as inherently unsuitable for distinguishing between a genetic and an environmental component in intelligence. More elaborate studies will, of course, be much more demanding in their requirements.

While it is generally recognized that the first step in detecting the supposed genetic trend would have to be the devising of methods by which mental capacity or performance can be partitioned into a heritable and a non-heritable fraction, the unlikelihood that a strictly psychological test will ever do this has not been especially emphasized. Certainly no physical test is envisioned which would partition stature into a heritable and a non-heritable fraction, and intelligence may well be much the same. The only sound method in either case would seem to be a breeding test. For intelligence, this would have to take into account not only the I.Q.'s (or other measures of performance) of the parents, but also various assessments of the degrees of social adversity against which these I.Q.'s were achieved. To identify a transmissible component, it would then be necessary to observe the I.Q.'s of the children as developed under known degrees of social adversity.

Even this does not represent the ultimate in refinement and must be regarded as just one more step in the quest for discrimination. True, it will distinguish a transmissible component from one conditioned by an environmental factor which has been newly injected into the family history. The further distinction, however, between transmission by genes and that which takes place as a result of family traditions and habits is more difficult, although it must not be regarded as wholly impossible. Curiously, neither the suggested obvious improvements in design, nor possible further refinements, have been explored in any detail, even in discussion. Haldane suggested to the Royal Commission on Population that a two-generation approach was needed, but neither he nor any of the other advisers mentioned details. It would almost seem as if the organizational and financial difficulties in a two-generation study of appropriate design and size have caused the geneticists to renounce their own special kind of test (that is, the breeding test) in favor of something they have hoped the psychologists might devise, but which will probably never materialize. One could probably defend even the extreme opposite view that a very bad test of performance, when used in a suitable two-generation study, is superior to the most refined test of performance when used in any single generation study.

Two generations of I.Q. scores, specific for families, are in fact available from the investigation being carried out at the Dight Institute (*4*) but measures of social adversity are lacking. This project is small in comparison with what would be required to detect correlations of fertility with the heritable component of intelligence, as assessed by a two-generation approach incorporating refinements of the kinds mentioned earlier, although it is considered large by most standards since it includes records of over 80,000 people. Size can be critical where precision is required, and especially where a number of variables are to be considered.

A more appropriate scale might even approach that of the Scottish Mental Survey (in which about 80,000 children, 11 years of age, were tested in a single year), but the test would be repeated annually to build up family histories, including social particulars, spanning two generations. This would be exceedingly laborious unless use were made of the large amounts of data on intelligence that are already being gathered routinely by most schools (as was done to a limited ex-

tent in the Dight Institute study) and of such information on family size and social characteristics as is collected by the vital statistics system.

An undertaking of this kind would become possible only through rapid handling and compact storage of the large quantities of data, and through use of an appropriate technology for linking up successive records relating to the same individuals or families (*6*). Under such conditions, however, it would become less laborious to follow all the families in a geographic region by using the routine records, than to follow a 1-percent sample by personal interview and correspondence. A study involving 50,000 to 100,000 records per year might correctly be regarded as large, but it seems less so when it is pointed out that a central office of the Canadian Pacific Railway receives a similar number of records of freight car movements each night and uses them to update a master file of freight-car histories for accounting purposes.

For any large two-generation study of family histories full-time effort on the part of one or more senior research scientists would be needed, in designing and testing procedures, arranging for use of existing records of I.Q. test scores and family relationships, and ensuring continuity and flexibility in the running of the project over a period of 30 years or more. Other costs might equal the salaries, or be even greater. Nevertheless, I.Q.'s of children are measured by most schools routinely, and family relationships are unambiguously recorded in the vital statistics registration system together with some social data. Thus, we have hardly begun to use the vast amounts of relevant information we already possess and much of it (relating chiefly to the I.Q. scores) is sytematically destroyed after a limited period so that if not used currently it may be irretrievably lost.

Mayr's reasoning, like that of Huxley and others, is largely divorced from questions of detailed design and costs of relevant scientific studies. Perhaps, after all, the effort required would be too great in view of present uncertainties about the extent of the refinement that might be achieved even with the best of planning, difficulties in interpretation that might still remain, and the nature of other important competing demands for funds and scientists. But what, then, is the degree of importance associated with the problem raised by Mayr? He has suggested reapportionment of taxation and educa-

tional costs involving many billions of dollars even in a single lifetime. If the matter is really that important, who should be doing the detailed thinking about the next step towards an ultimate demonstration of the presumed deleterious trend?

Perhaps consideration should also be given to the possible genetic effects of legislative changes of the kinds recommended by Mayr, irrespective of whether the frequencies of "superior" gene combinations are decreasing. Would such measures lead to any substantial increase in their frequencies, and is this desirable? These questions could, presumably, be studied by following appropriate sub-groups within a population, but how much thought and effort are such studies worth?

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That 1953 Fallout

E. J. Sternglass refers to the fallout in 1953 in the Troy-Albany area in his report "Cancer: Relation of Prenatal Radiation to Development of the Disease in Childhood" [*Science* **140**, 1102 (7 June 1963)]. He assumes that there would have been a significant dose to the bone marrow of the human embryo because of radioisotopes ingested by the mother with fresh milk and vegetables.

As I pointed out in a previous comment, upon a report by Ralph Lapp [*Science* **138**, 732 (9 Nov. 1962)], the 1953 fallout in this area occurred on 26 April 1953 and the average date of first pasturing in the area was 12 May, 17 days later. There was a total of 5.36 inches (13.6 cm) of rain during the period between the deposition of the