SCIENCE

10 August 1962

Vol. 137, No. 3528

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

TRANSISTORIZED SPECTROPHOTOMETER–COLORIMETER

DOES BOTH MICRO and MACRO ANALYSIS

Here's the finest photometric instrument you can buy for routine laboratory use–the Beckman Spectro-Colorimeter

TRANSISTORIZED CIRCUITRY– used for two years in the Spectro-Colorimeter to give this advanced instrument compactness, unusual circuit stability, built-in voltage regulation, and virtual elimination of electrical maintenance.

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All in all, a most versatile colorimeter with unmatched features–an excellent buy for your laboratory.

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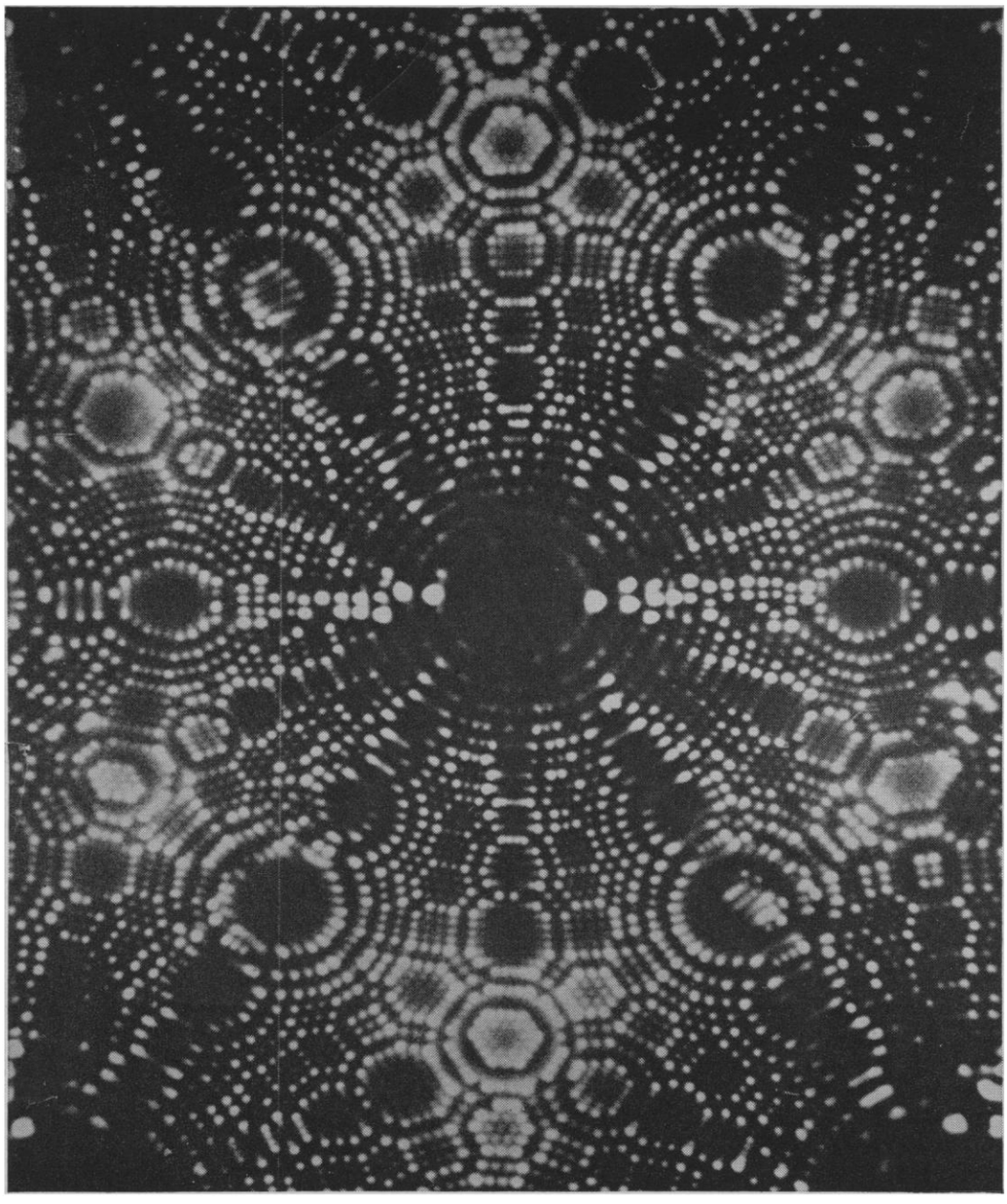

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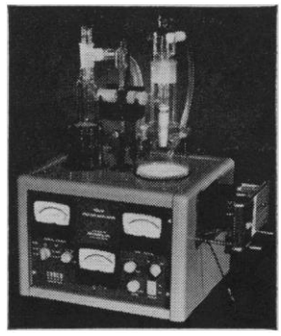
For complete information, write to: Dr. R. G. Picard, Director of Research, Central Scientific Company.



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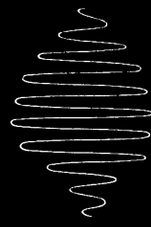

AMPLITUDE 0-5 cm

RATE 75-150 PER MINUTE

- **Quiet Operation**
- **Convenience** — Manometer holders rotate 180° for easy preparation on apparatus. Circular gassing manifold is available for placing on the center casting of apparatus; the manifold can rotate with the manometers as it receives its gas through the bearing. These two factors obviate the need for a separate manometer stand.
- **Accurate Temperature Control** — Provided by means of an electronic relay actuated by a hermetically sealed thermoregulator. Accuracy of control is better than ±.02° Centigrade.
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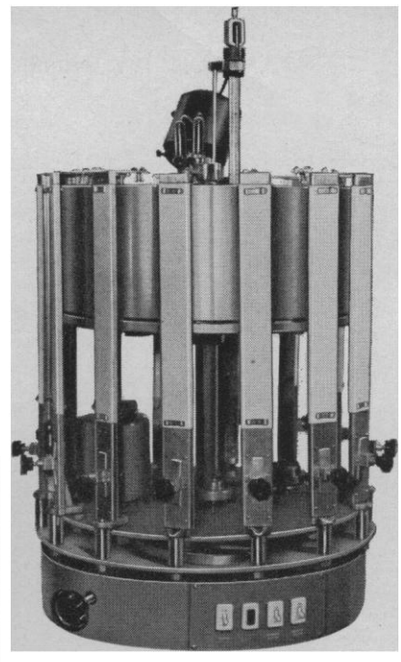
- **Photosynthesis models available** — with a transparent bottom in the water bath. 30-watt lights provide 1000 to 1400 foot-candles on each lighted flask.



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Accommodates 14 manometers
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Temperature range ambient to 50° C.
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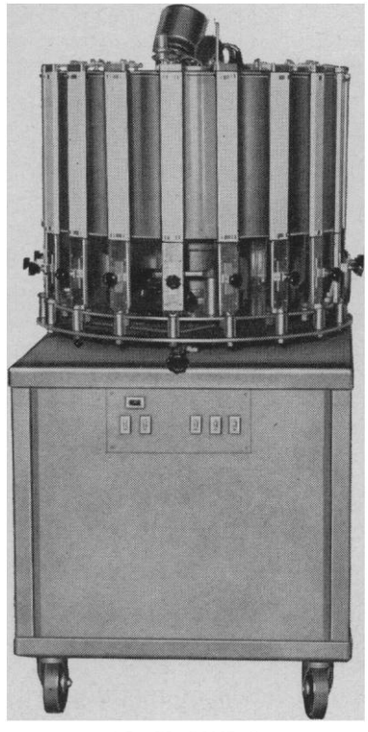

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Apparatus accommodating 20 manometers available on special order. Send for complete glassware list.

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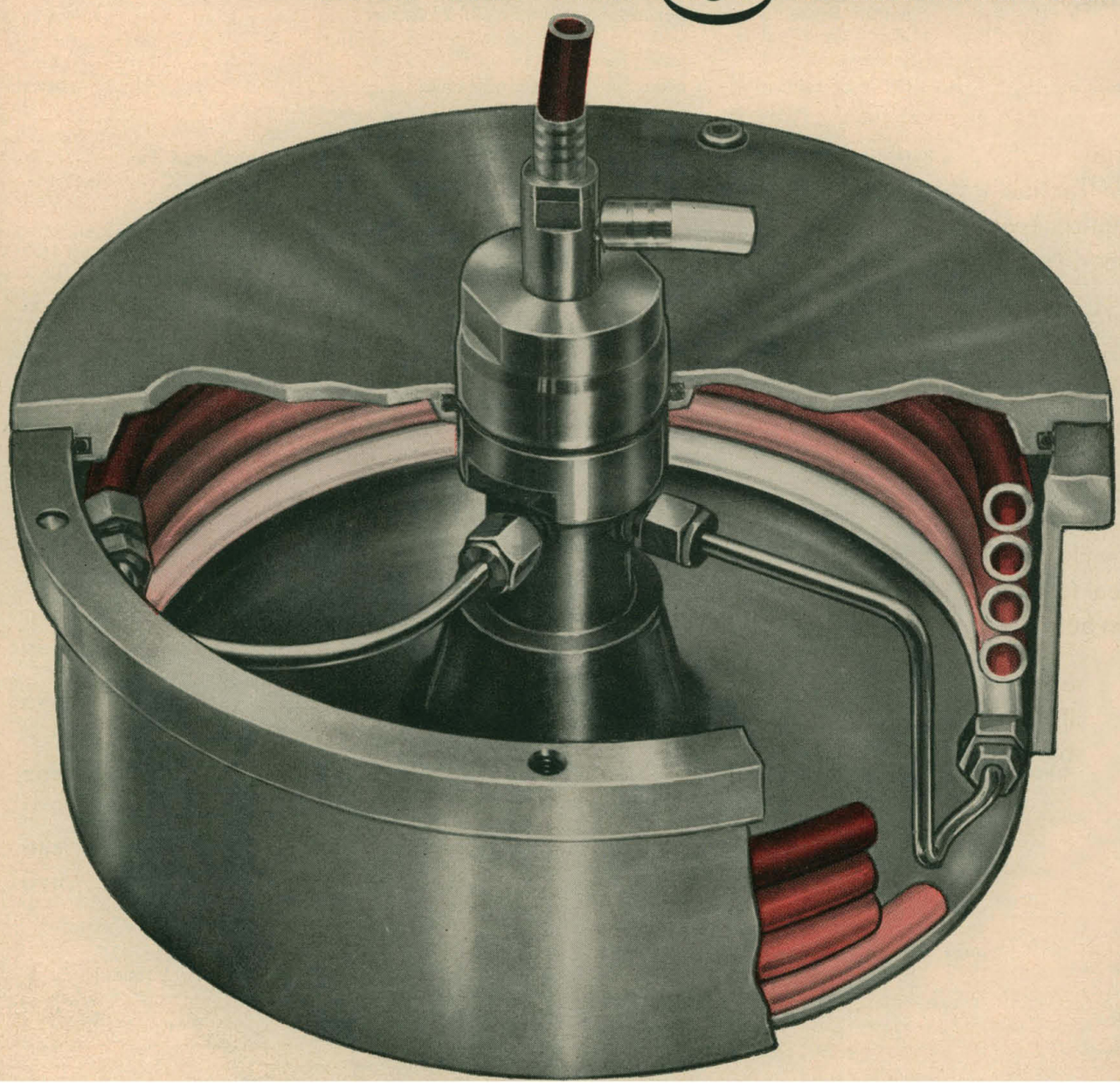
Cover

Braarudosphaera undata Stradner; Lutetian; Donzacq, Landes, France. See page 426. [Kenneth M. Towe, Electron Microscope Laboratory, University of Illinois, Urbana]

NOW... 4 TIMES GREATER SEPARATION EFFICIENCY WITH THE NEW IEC HELIXTRACTOR!



Helical flow continuous centrifugation brings you a new concept in separation efficiency . . .

Now you can separate micro deposits from large volumes of liquids with better results and in a fraction of the time conventional methods require. Tests show that the Helixtractor increases separation efficiency by as much as 400%.

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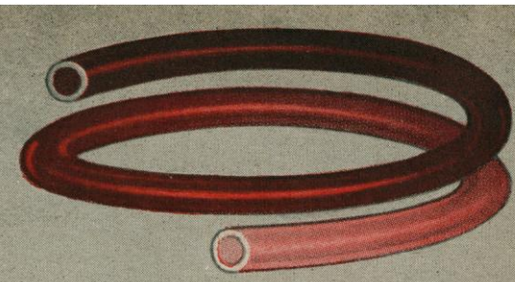
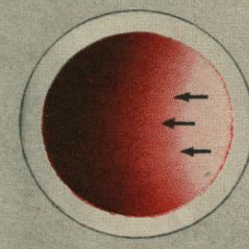
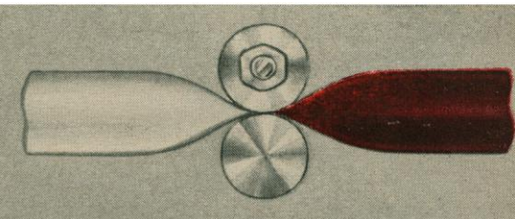


In the Helixtractor, separation takes place in a vertical coil (helix) of polyethylene or Tygon plastic tubing. Material to be centrifuged is introduced into the spinning helix through a central, stationary hub. Solids are collected along the wall of the tubing in the form of a paste. Because the tubing is transparent, different phases of the precipitate may be identified and isolated by simply cutting out a particular section of the tubing.



All material passing through the tubing is subjected to the same G force for the same length of time. The flowing liquid is only a fraction of an inch in thickness; therefore the solid phase separates three to four times more rapidly than by any other method.



Precipitate is easily removed with the roller-type extractor supplied with each IEC Helixtractor unit or flushed with a syringe. Precipitates also can be preserved for future use simply by sealing the ends of the tubing. This forms an air-tight package which lasts indefinitely.

The International Model PR-2 is easily the most versatile refrigerated centrifuge ever developed. It offers hundreds of accessories, 30 interchangeable heads, including horizontal, angle and now, **Helical Continuous Flow.**

Q

What's so different about the Vanguard Model 1000 volumatic fraction collector?

A Only the Vanguard Model 1000 Volumatic Fraction Collector is completely transistorized, completely self-contained. Thanks to transistorization, you're assured of absolute reliability in performance. This reliability even extends to cold-room environments where temperature often causes erratic operation or complete instrument failure.

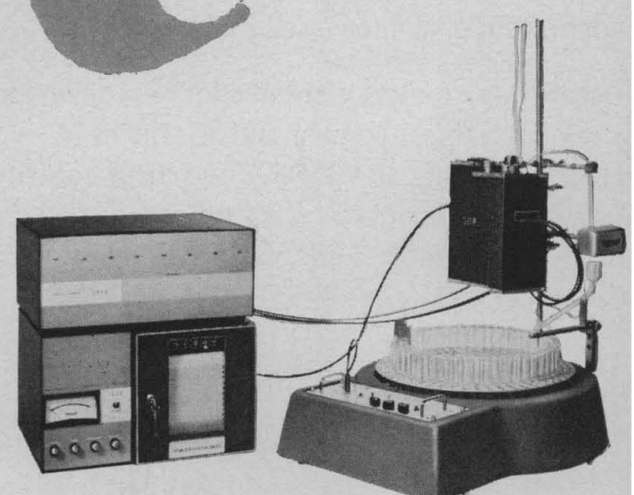
Q. How does the Vanguard Volumatic Fraction Collector affect hold-up and mixing?
A. In volumetrically controlled separations, hold-up and mixing are virtually eliminated between fractions.

Q. How is this reduction possible?
A. The Model 1000 uses a unique system of repetitive cuts for a single sample, in conjunction with a photo-electric sensing device. It actually collects from one to ten times the siphon volume in each test tube. You simply dial the number of times you want the siphon filled and discharged into each test tube.

Q. Is the Model 1000 compact and portable?
A. Vanguard's Model 1000 is highly compact. Specifically: 25″ wide, 30″ long and 6″ high. So, you make maximum use of laboratory and cold-room space. The Volumatic weighs less than 50 lbs. Yet, because the instrument cabinet is cast aluminum, you get the strength and rigidity needed for large columns and ancillary equipment.

Q. Any other facts?
A. Interchangeable turntables for 13mm, 15mm and 18mm test tubes are standard accessories. There's a complete selection of siphons. For increased versatility, a time and drop counting plug-in unit is available.

Q. Where can I get more information?
A. For complete information about the Model 1000, write: Vanguard Instrument Company, Box 244, LaGrange, Illinois.



Shown above are Vanguard's all new Model 1056 Automatic UV Analyzer and Model 1000 Volumatic Fraction Collector.

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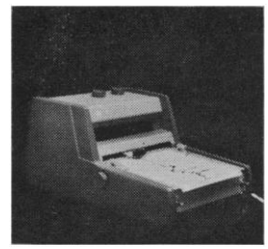

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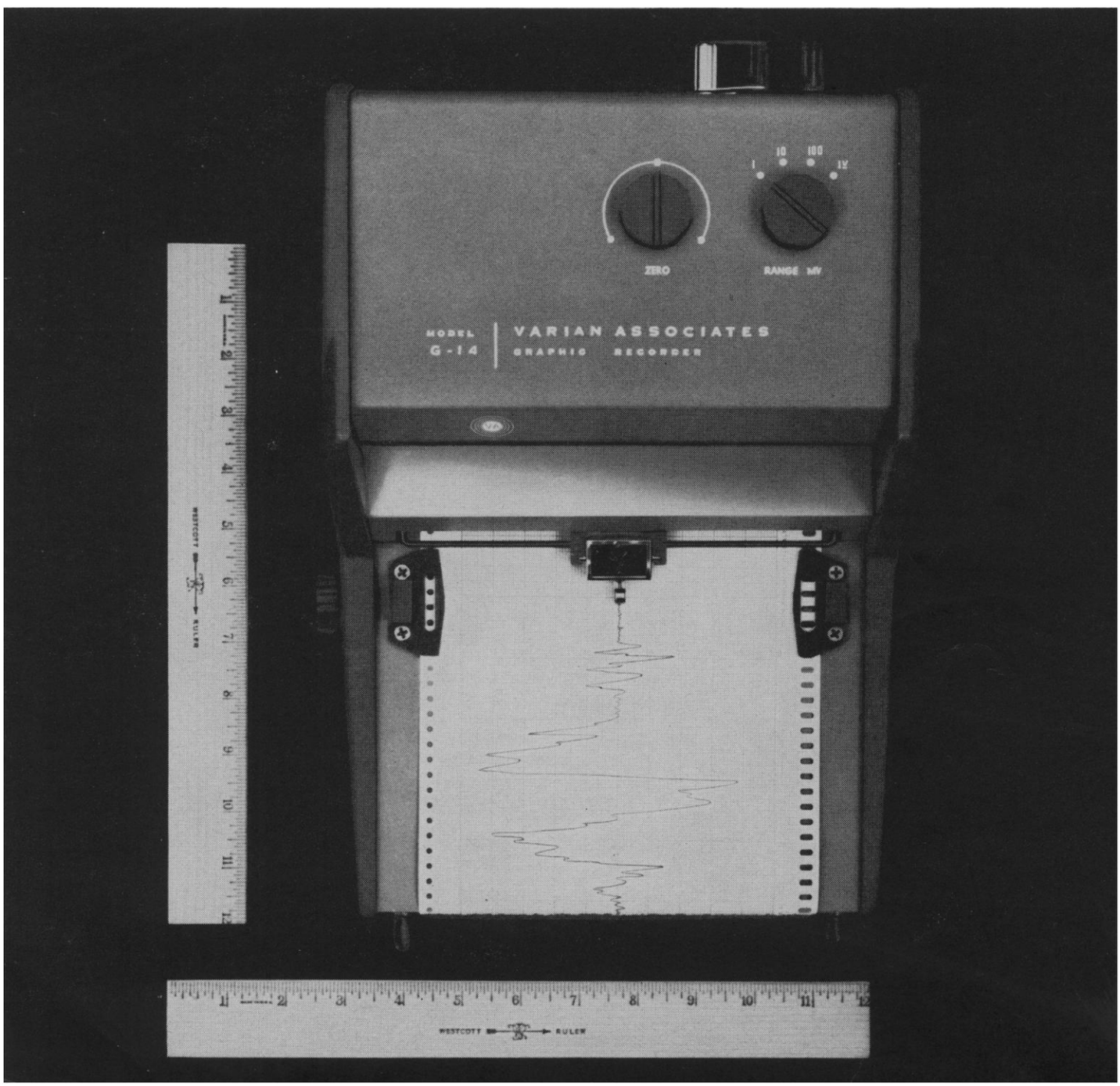

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No. 4

Sephadex notes

SEPHADEX gel particle with immobile water
○ large molecule
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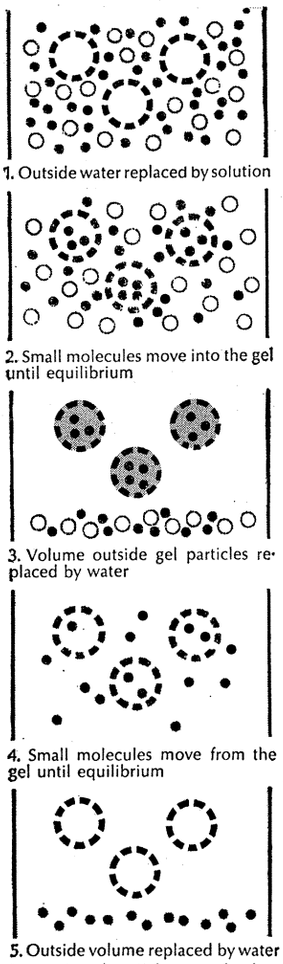

1. Outside water replaced by solution
2. Small molecules move into the gel until equilibrium
3. Volume outside gel particles replaced by water
4. Small molecules move from the gel until equilibrium
5. Outside volume replaced by water to empty gel particles completely

CONCENTRATE LABILE MACROMOLECULES with Sephadex®

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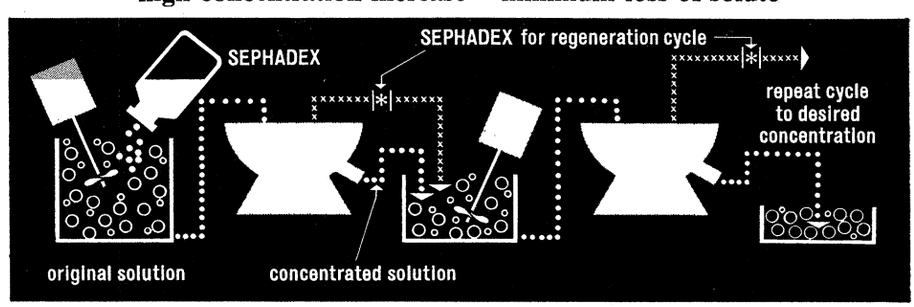

Reference: Flodin, P., Gelotte, B., Porath, J.: A method for concentrating solutes of high molecular weight, Nature, vol. 188, pp. 493-494, 1960.

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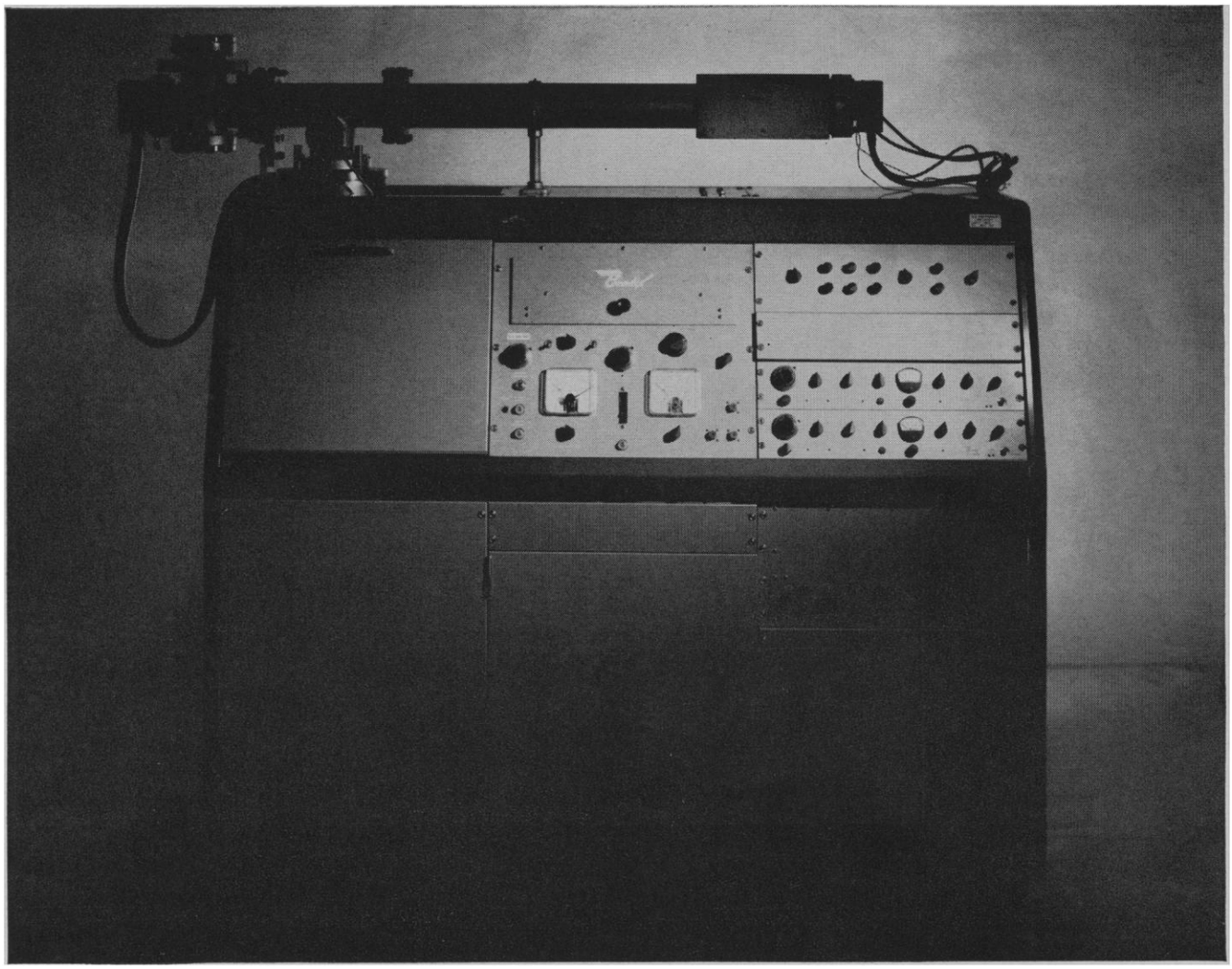

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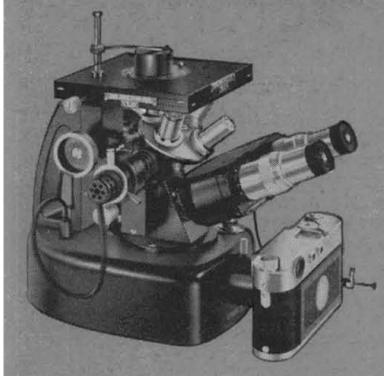

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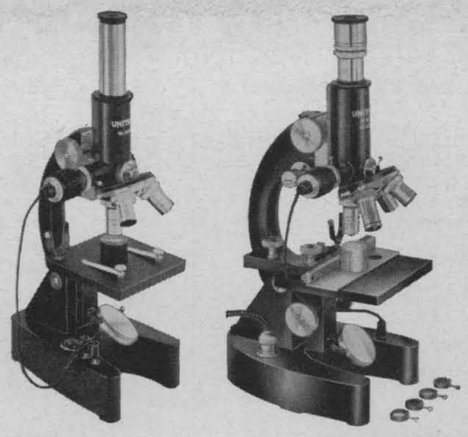

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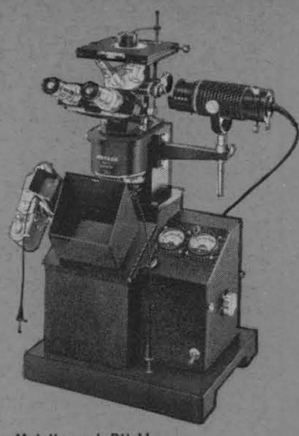

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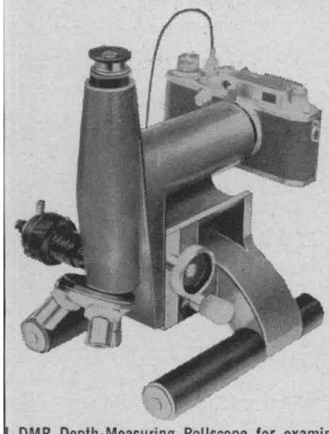

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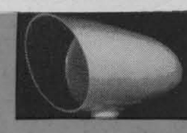

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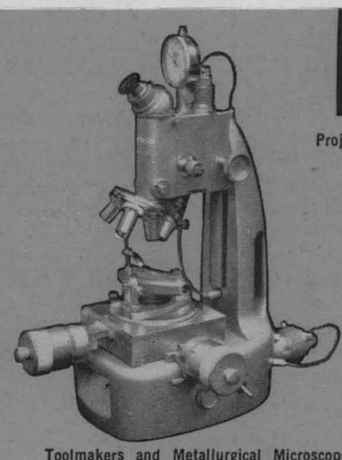

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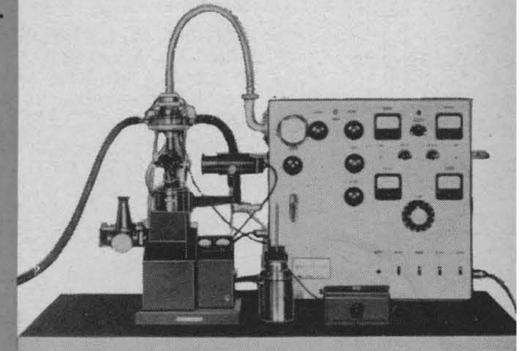

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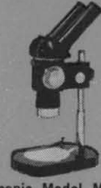

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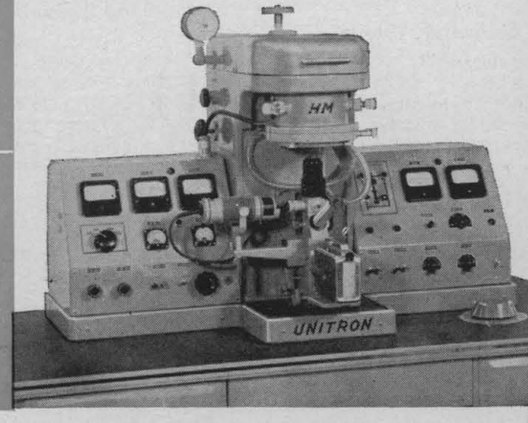

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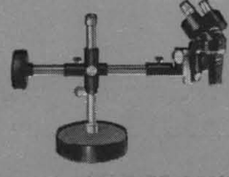

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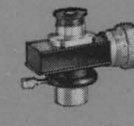

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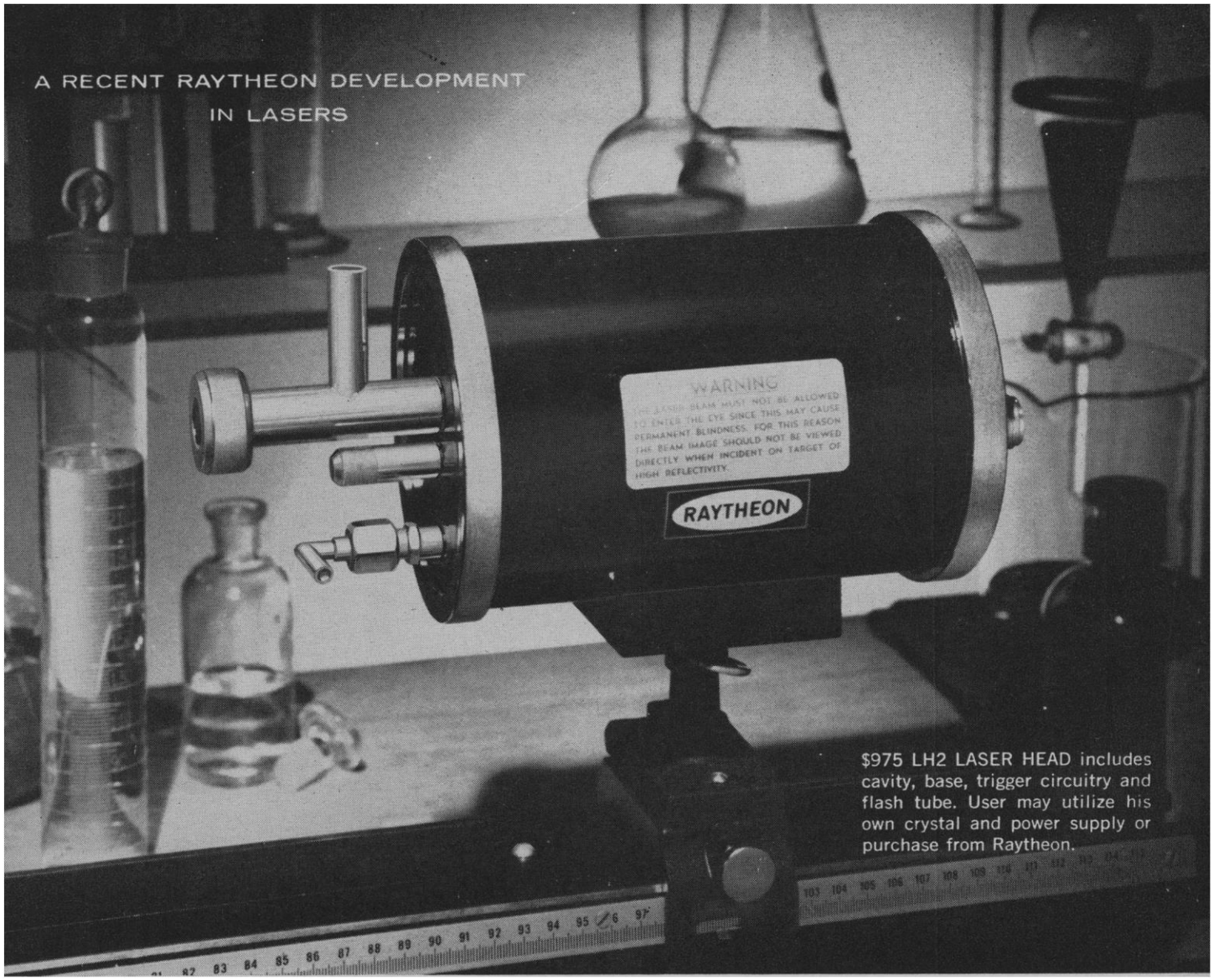

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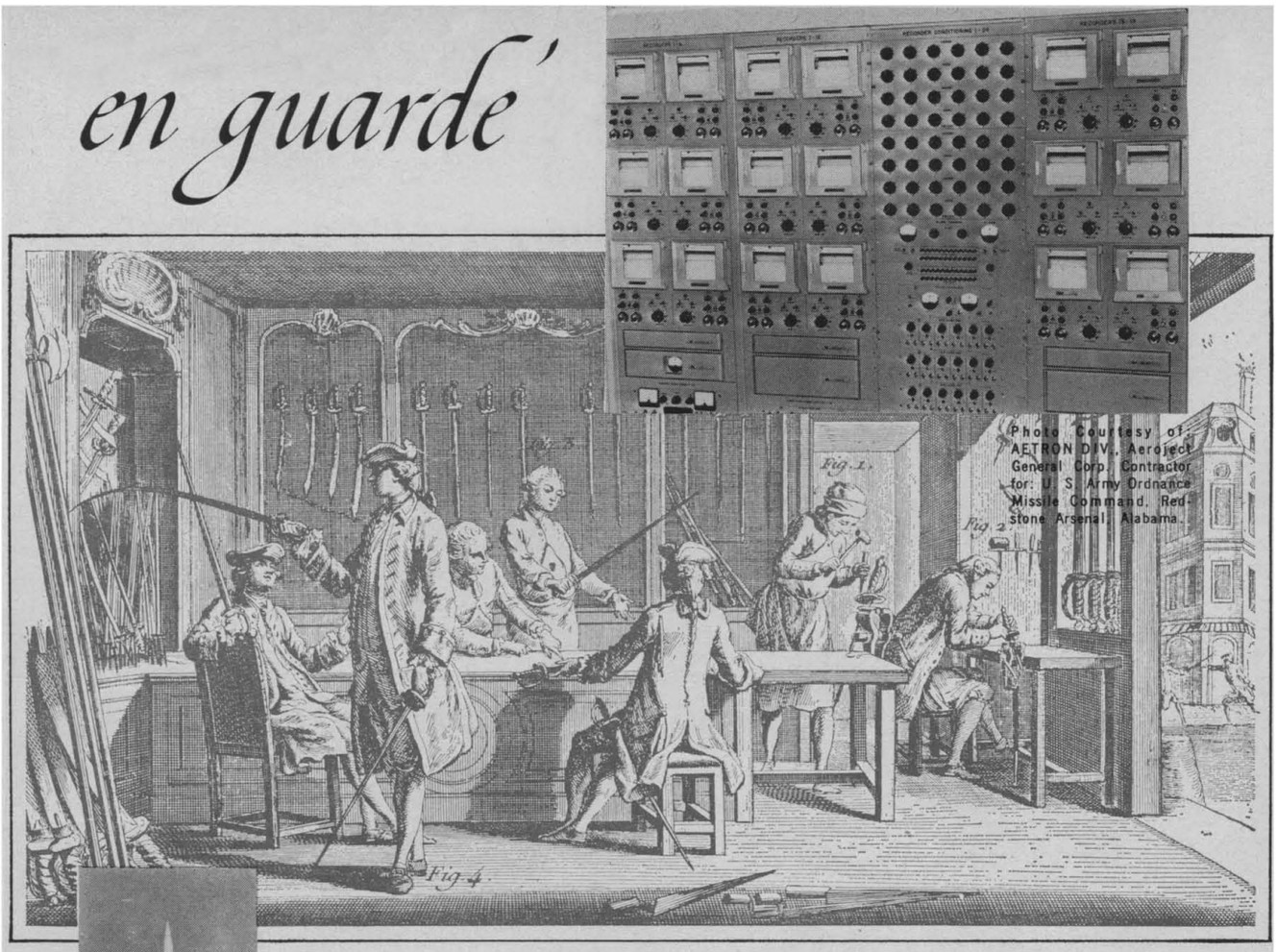

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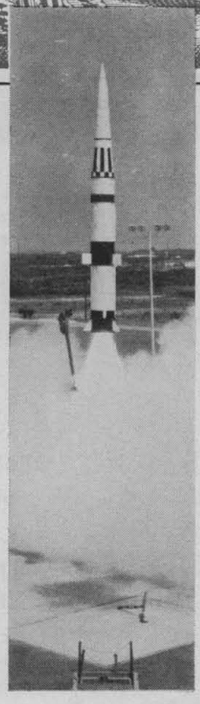

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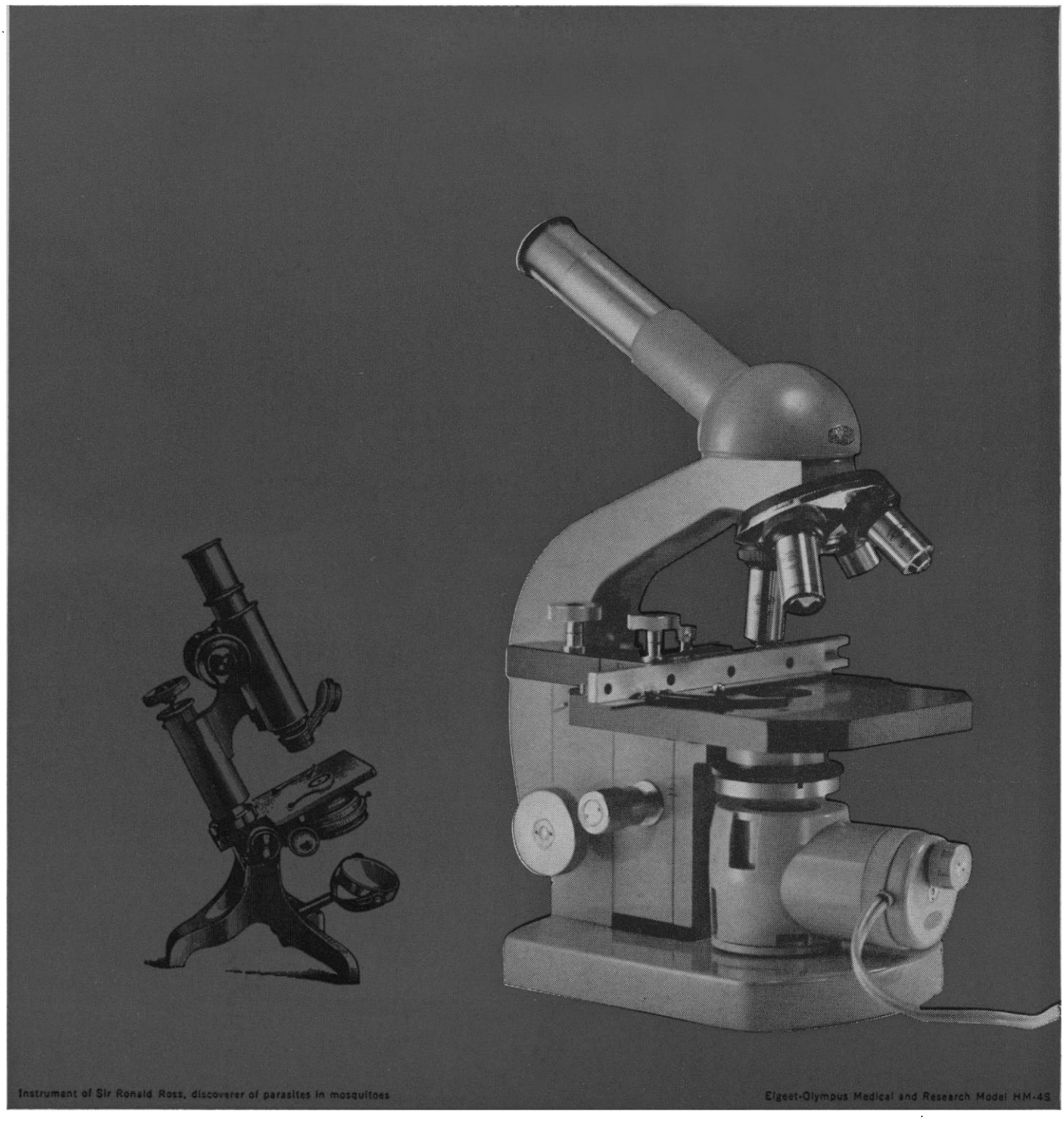

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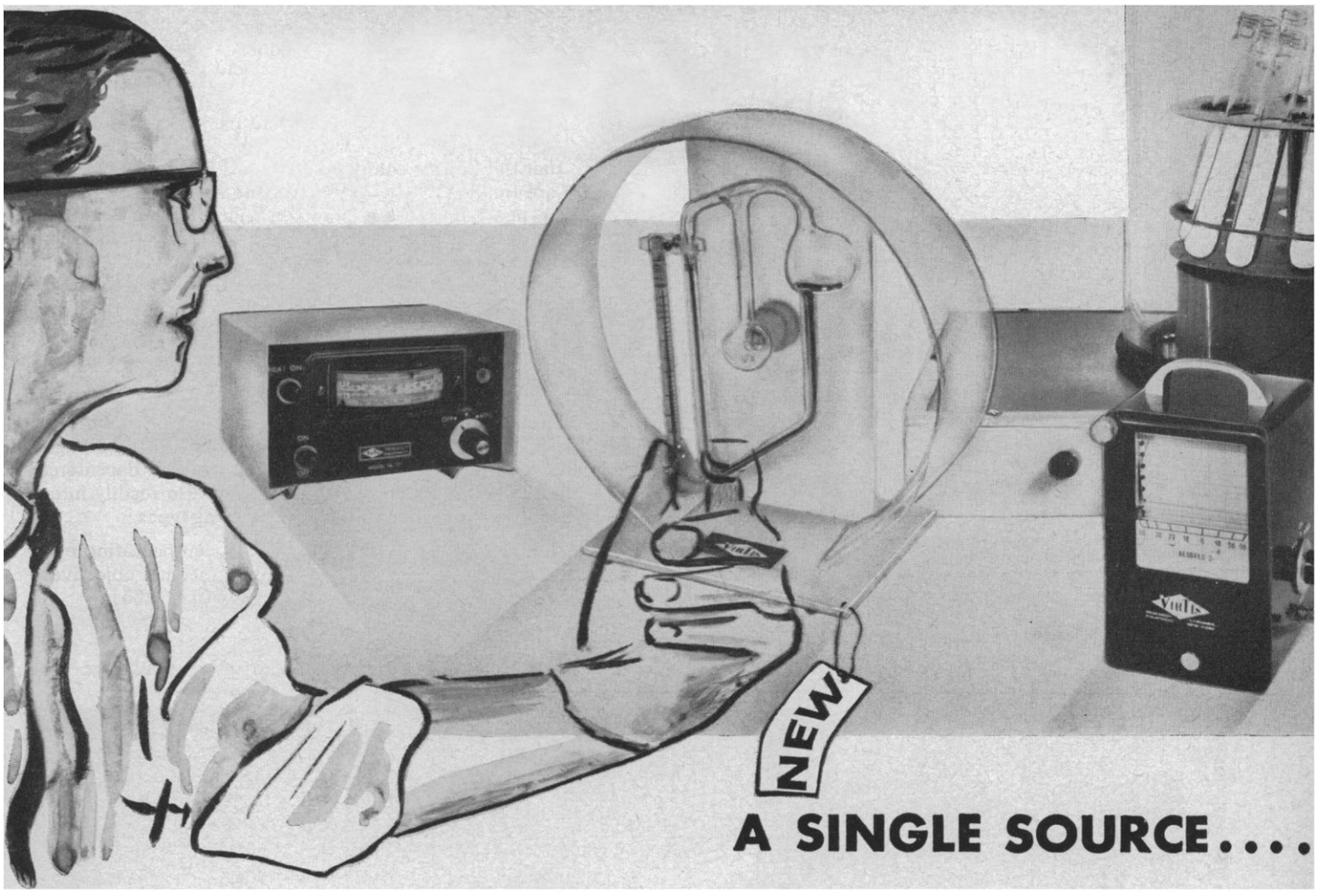

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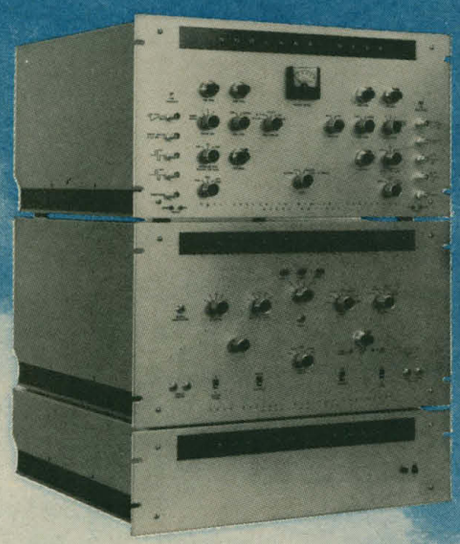

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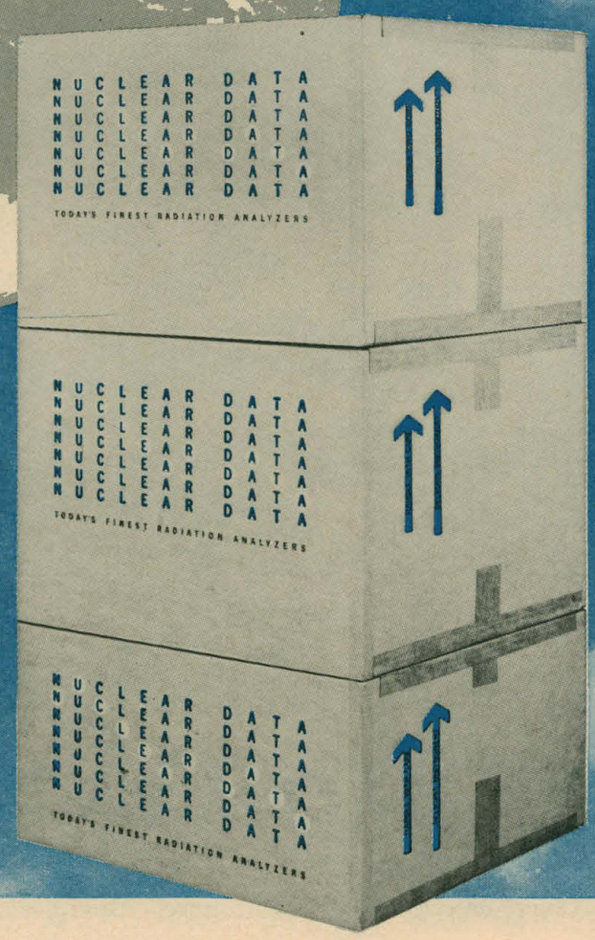

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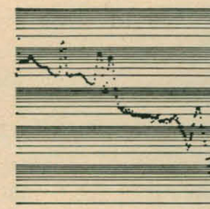

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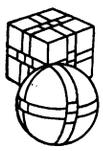

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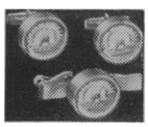

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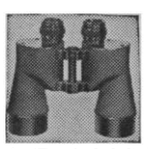

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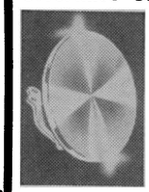

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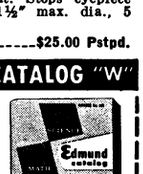

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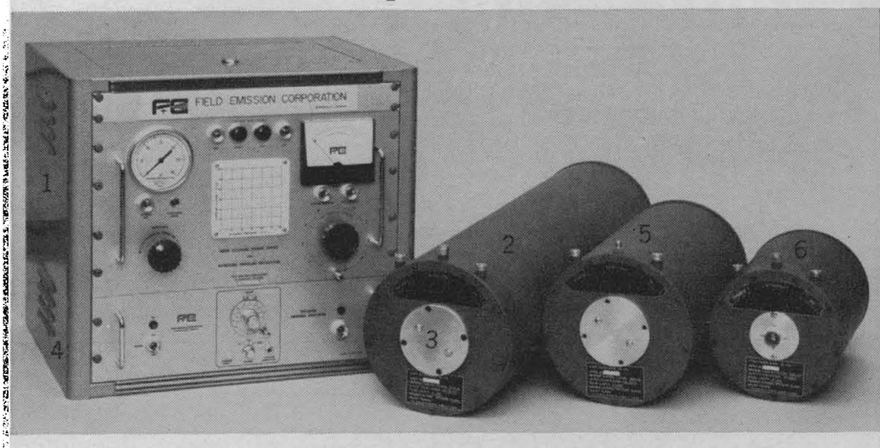

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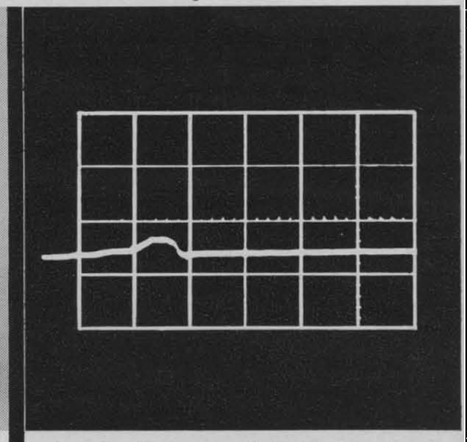

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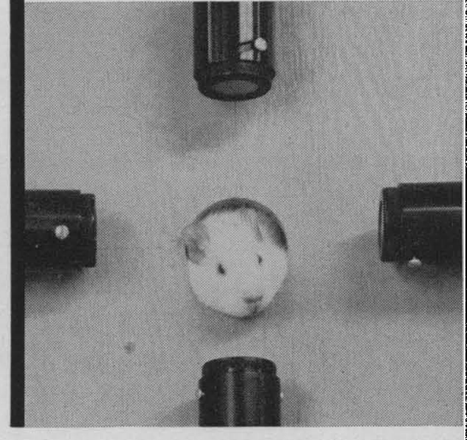

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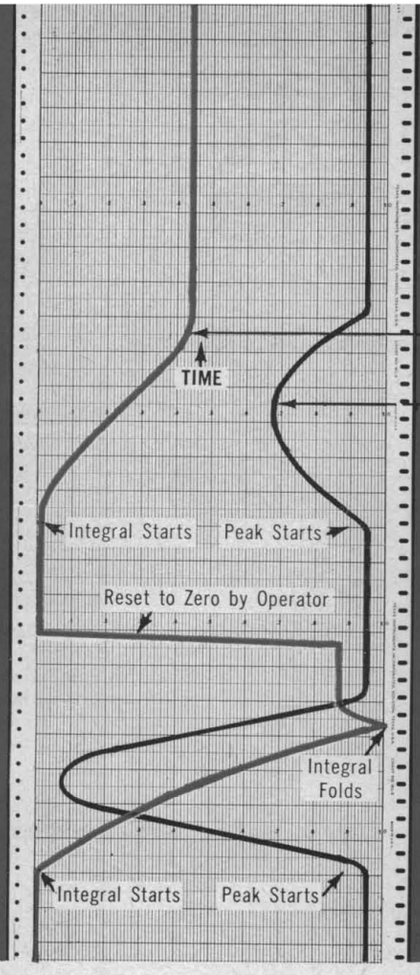
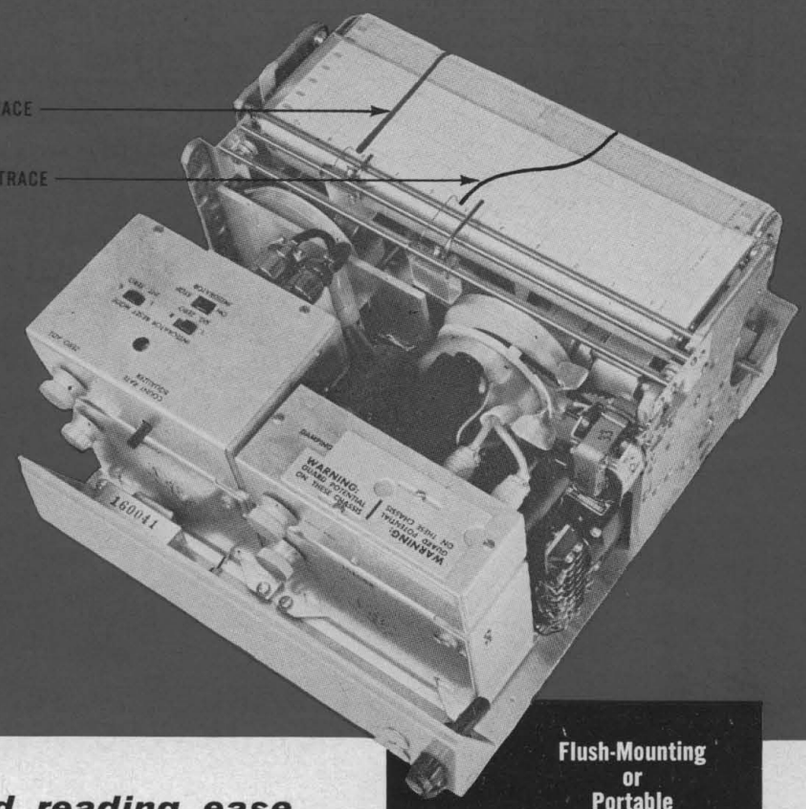


servo/riter*

INTEGRATING RECORDER



More speed, flexibility and reading ease than any other integrating recorder

Accurate, quantitative analysis of *any variable* that depends on the precise measurement and integration of the curve may be obtained with the TI Integrating Recorder. The integrator channel is installed as a second channel in a standard wide-grid, single-channel *servo/riter* recorder. It consists of a special potentiometer-amplifier-servo arrangement and activates an overlapping "area trace" automatically and simultaneously with the signal trace.

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Note that the integrating signal utilizes the full chart scale to provide faster, easier reading. Traverse of the full scale represents 1,000 counts. If the integral exceeds 1,000 counts, the integral "folds" and completes its excursion in the opposite direction. You may reset the pen to either margin between each peak or at the start of each integration for easier interpretation. The integrating circuit may be set to any assumed zero point in the span of the recorder signal.

The Integrator Recorder is offered with either portable or flush-mounting *servo/riter* recorders. Or, the Integrator Unit may be factory installed in your existing wide or dual chart *servo/riter* recorder. In fact, many flexible arrangements are possible . . . let TI's recorder engineers work with you on specific applications.

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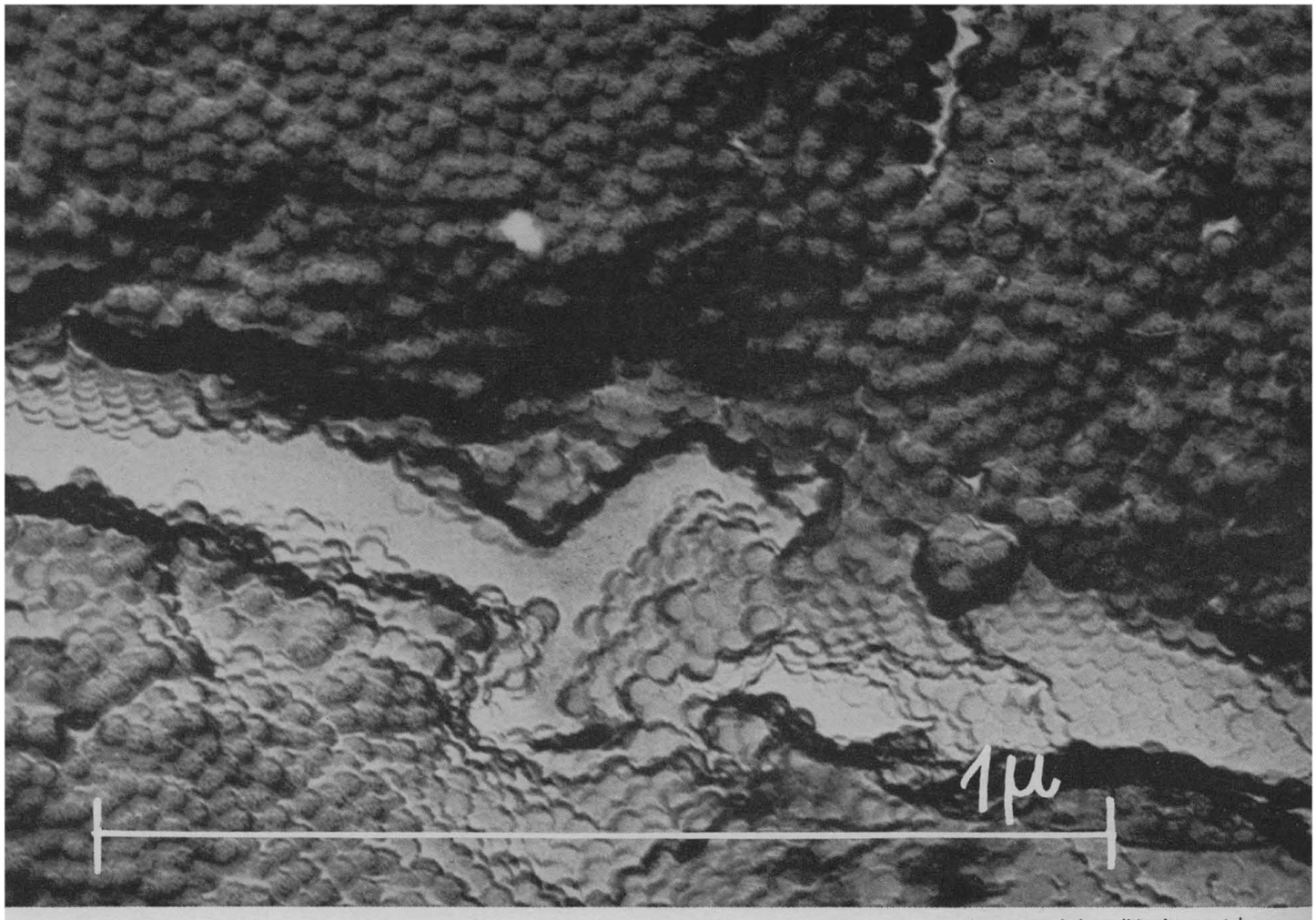


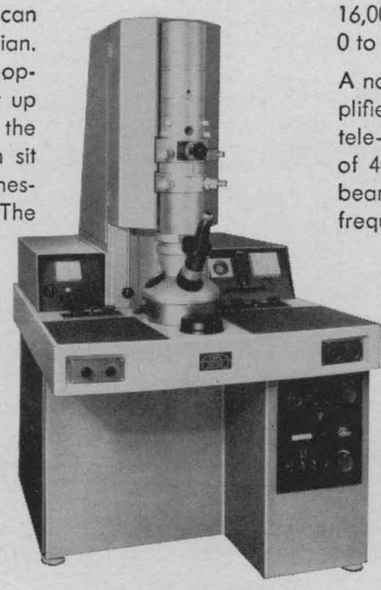
Mouse encephalomyelitis virus crystals.

You can achieve images like this routinely

The new Carl Zeiss Electron Microscope EM-9 can easily be operated by the scientist or the technician. Everything has been done to safeguard against operational errors. The entire control system is set up so that every essential control for manipulating the instrument is right at hand. Two operators can sit comfortably and observe the image on the luminescent screen through any one of three windows. The screen image can also be viewed through a microscope having a magnification of 10x.

In routine operations resolution is better than 20Å, and under optimum conditions—10 to 12Å.

The image-forming system uses three electromagnetic-type electron lenses: the objective, intermediate lens and projector. The objective is equipped with an electrostatic correction system known as the "Stigmator." Distortion-free electron micrographs can be made in four fixed steps. 1500x, 5000x, 16,000x and 35,000x. Continuous magnification from 0 to 35,000x is also possible.



A novel principle for adjusting image brightness simplifies the electronics in the EM-9 considerably. The tele-focus cathode delivers a *constant* beam current of 40μA at a *constant* beam voltage of 60kV. The beam is oscillated across a central aperture at high frequency. Varying the amplitude of frequency varies the length of time the beam remains over the aperture and hence the total energy of the beam.

With the EM-9 it is possible to take stereo electron micrographs by tilting the specimen. Electron diffraction images can be obtained by using the Boersch beam configuration. An automatic exposure timer and an automatic vacuum system are now available for the first time as accessories. Write us for further details. **Complete service facilities available.**

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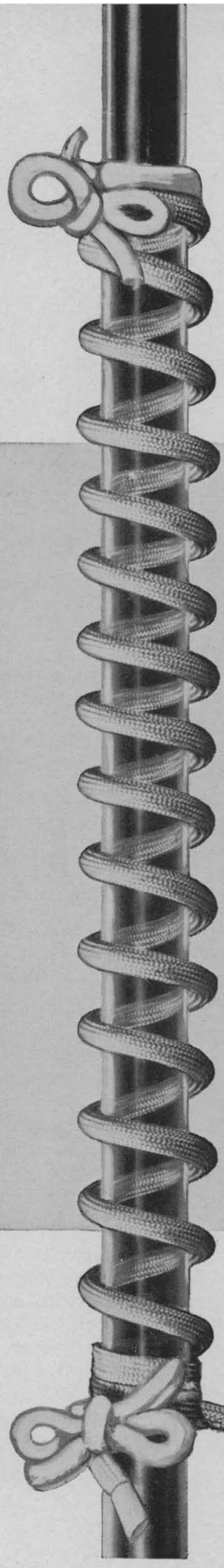

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Just wrap it and plug it in...

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

Cal-Cord Specifications

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

Cal-Cord Temperature Control

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

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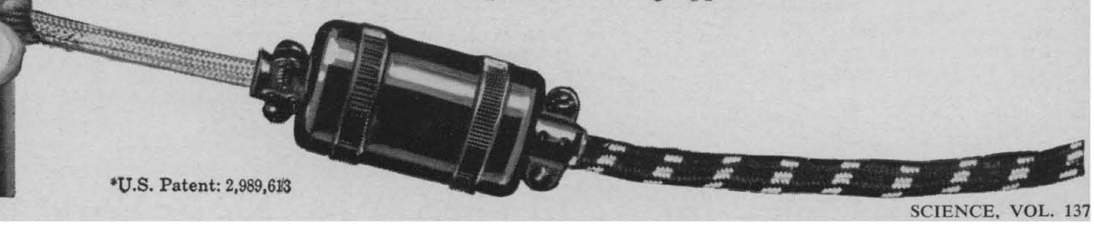


*U.S. Patent: 2,989,613

Linde Cryobiology NEWS

REPORT NO. 2 FROM LINDE COMPANY, DIVISION OF UNION CARBIDE CORPORATION

Achieve maximum recovery of viable tissues, cells and microorganisms with liquid nitrogen

A PRACTICAL TECHNIQUE

Biologists and clinicians in many areas of science can now preserve tissue and cell cultures more efficiently and effectively because of recent advances made in cryobiology.

In fact, new techniques make it possible to preserve successfully many tissues and cell cultures which were formerly thought to be destroyed by the freezing process. Many of the inherent areas of risk in long-term experiments—such as chromosomal change or mutation, contamination of culture with bacteria or viruses or other cell lines, and loss of cultures—have been virtually eliminated.

Basically, best results in freezing and storing of viable specimens have been obtained by:

1) Cooling at a precisely controlled rate (in the range of 1°C. per minute to 15°C. per minute).

2) Using the proper amount of protective additive (usually glycerol or dimethyl sulfoxide).

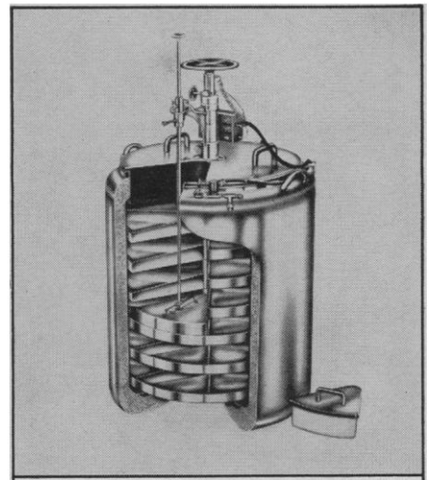
3) Storing at liquid nitrogen temperature (−196°C).

CHOOSE YOUR EQUIPMENT

Linde Company has pioneered in the development of liquid nitrogen equipment for cryobiological purposes. LINDE provides a complete line of LN_2 refrigerators, low-loss liquefied gas containers, and precise controlled-rate freezers, as well as accessories. This is backed by the most experienced technical service available today—through LINDE's own cryobiology laboratories and field representatives.

LINDE liquid nitrogen refrigerators come in a wide range of capacities. These include, for major projects, the new large-capacity LNR-640-C and sophisticated LNR-360 *(see photo)*. Also, there is the new high-accessibility LNR-250, the improved medium-capacity LNR-35, the standard 720-ampule capacity LNR-25 widely used by biologists for many years, and the all-new fully portable, highly compact LNR-10.

NEW LNR-360 REFRIGERATOR



360-liter liquid nitrogen refrigerator developed especially for large-capacity storage of cell and tissue cultures, and microorganisms. 44 in. high, 35 in. outside dia., it has a 6.6 cu. ft. product storage capacity.

Features include:

- Unique semi-automatic tray selector indexing system for easier placement and removal of specimens.
- Large, removable 28.5 in. dia. cover with "pie-shaped" opening for complete accessibility to refrigerator's interior.
- All-welded, stainless steel construction for greater durability.
- Low liquid nitrogen consumption—fully charged refrigerator has a holding time of more than 50 days.
- 6 tray levels containing 37 canisters for greater storage capacity.

Equipment includes two specially developed liquid nitrogen freezers which precisely control the cooling rates of individual specimens from 0.5°C./minute to 19°C./minute. The standard BF-3 holds up to 40 1.2 ml. ampules, has a total volume capacity of 110 cu. in. The new, larger BF-3-2 has a 1600-cu.-in. capacity.

New accessories include special canister conversion kits for LINDE's LD-25 and LD-10 liquefied gas containers, low-heat-loss plastic-handled canisters, and a liquid nitrogen level controller. In addition, LINDE provides the most complete liquid nitrogen distribution service in the country with adequate supply always readily available.

LATEST REPORT...

. . . from LINDE on advanced techniques in cryobiology is a comprehensive review by Dr. S. W. Moline of LINDE's Tonawanda Research Laboratories. Subjects under review (with numbered references to a bibliography of 59 reference works) cover preparation of cells for storing; cooling rates; the use of protective additives; storage at low temperatures; warming rates; and condition of cell or tumor strains after cooling, storage, and warming.

Detailed literature is available on request. Also, LINDE's "Cryobiology Report No. 1" which deals more generally with the all-new method of freezing and storing biologicals. For further information, check your area(s) of interest on the coupon below and send.

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- ☐ *Review:* "The Preservation of Biological Materials with Liquid Nitrogen."
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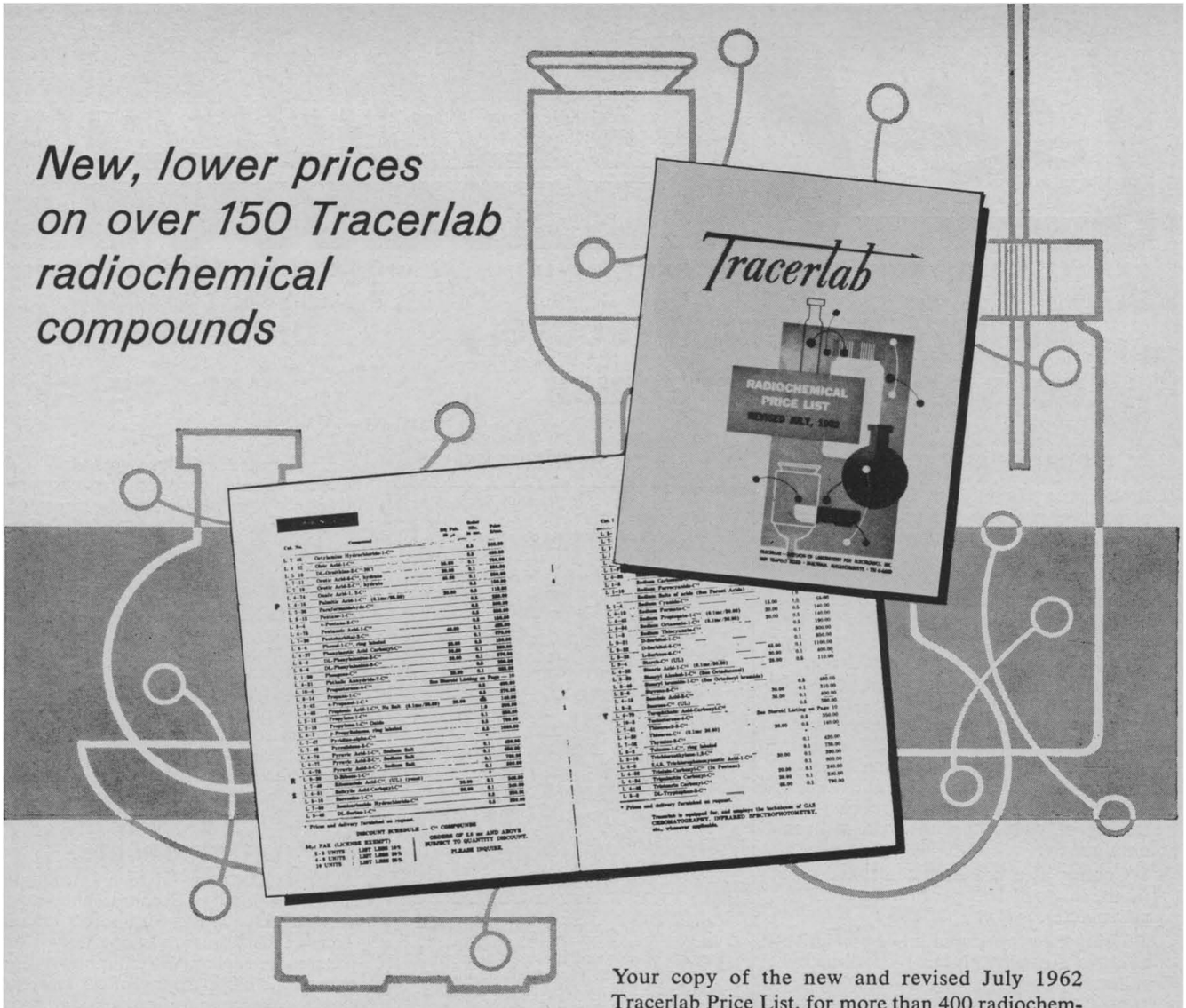

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formerly \$980/mc . . . . . *now \$825/mc*

Your copy of the new and revised July 1962 Tracerlab Price List, for more than 400 radiochemicals, is now available. Effective July 1, 1962, Tracerlab reduced the prices on over 150 radiochemical compounds. All orders received since that date are being filled at the new, lower prices. No prices have been increased.

Tracerlab is now prepared to offer many important radiochemical compounds at prices considerably below any other sources.

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10 August 1962, Volume 137, Number 3528

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Which Yardstick?

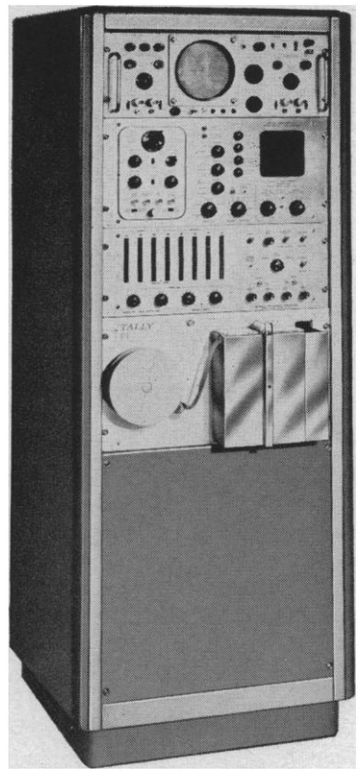
On the campus, or in the foundation or government office, an ever-present problem in budgeting for science is the question of how much money should be devoted to a particular field or purpose. A frequently used technique for trying to persuade budget-makers to allot a larger amount to the speaker's chosen field is to compare its present level of support with national expenditures for beer, popcorn, movie tickets, or something else that the speaker considers frivolous. (It is frequently a speaker who uses this device, for such comparisons sound better in tones of righteous indignation than they look in cold print.) But is the argument persuasive? And if so, is the persuasion based on anything sounder than a passing emotional reaction? We think not, but we admit to having grown tired of these comparisons, for they seem quite irrelevant to any decisions or practical courses of action.

All that they tell us is a little about relative values for the population in the aggregate, and this only in dollar terms. Even though money is the universally used unit of exchange, the number of dollars involved may be a poor guide for judgments concerning unrelated matters unless other information is also available. By almost any standard, the air we breathe freely is more precious than the hair tonic for which we pay good dollars. Or, as another example, how can we use the fact that the nation spends about $1.5 billion a year on motion picture theater tickets in deciding how much we should devote to fundamental research? The decision whether or not to go to a movie and the decision whether or not to increase the national research budget are not effective choices open to the individual citizen, the legislator, or the research administrator.

If the amount spent for some different and irrelevant purpose is not the proper yardstick for determining how much should be devoted to a particular end, how about the amount spent for a similar, related objective? This yardstick also has its limitations. Does the amount spent for cancer research tell us how much should be spent for research on mental diseases? Or the amount for the physical sciences, how much should go to the biological sciences? Which amount should be larger? By how much? Why? And will the proper ratio now still serve as a guide next year?

Only in terms of its own nature, needs, and opportunities can we decide on the right amount of money for education, laboratory refurbishment, research in a particular field, or some similar matter. The number of research workers available; the cost of salaries, equipment, and services; the nature of the problems we have the wit to investigate; the increases in knowledge and sometimes the useful applications that we can foresee—these are the guides that can best help in the planning of ideal budgets. If these considerations seem to be less glamorous than a striking comparison, they have the merits of being honest and relevant, and of helping to educate the budget-makers on the problems involved.

This does not mean that all people will agree upon the proper amounts, or that there will be sufficient money to provide optimal support for all desirable purposes. But in considering either ideal budgets or the distribution of an available total, thinking should be focused on the characteristics and needs of the work to be done. The place for beer and the movies is as diversions after the budget-making is done.—D.W.



1024 channels... 9 plug-in logic units...

in TMC's new CN-1024 pulse analysis system

1024 channels in an all-transistor unit with choice of plug-in logic units to quickly change the system to any of 9 different functions — this is the latest development from TMC. The CN-1024 is the same basic instrument as the time-proven, 256 channel CN-110 analyzer. In fact this new unit employs circuits so similar to the CN-110 that units now in the field can be easily factory-converted to 1024-channel capacity. Most plug-in logic units can be used interchangeably in both instruments.

Plug-in logic units are currently available for 3-dimensional analysis (32 x 32) • 4-input pulse height analysis • Mossbauer studies • Time-of-flight studies • Pulsed neutron analysis • Multiscaler operation • Mass spectrometer operation • Others are being developed.

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Number of channels. . 1024 — with division up to 8 groups of 128 channels each

Storage capacity..... $2^{17}-1$ (131, 071) counts per channel

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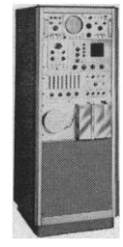

Complete system as shown here is comprised of: 5" Tektronix 'Scope, CN-1024 Digital Computer Unit, Model 220C Data Output Unit, Model 540 Paper Tape Punch Unit.

For complete data contact the TMC Sales office nearest you.

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New Products

Dilatometer (DHT-60) (Fig. 1) measures the difference in dilatation between the specimen and the alumina of specimen support and push rods, the dilatation characteristics of alumina being exactly known. Specimens can be from 10 to 50 mm long, and dilatation may be recorded at amplifications of either 250 or 500 times with changeover from one to the other effected by moving a lever. The instrument is offered for use at temperatures to 1500°C, and models are available for test in ordinary atmospheric conditions or under high-vacuum conditions. Results are pen-recorded on a rotating drum, the pen assembly being actuated by a photoelectric light-spot follower that follows the light reflected from a mirror that moves as the specimen expands and contracts. The drum is motor driven to record against time but may, alternatively, be driven by a recording pyrometer to indicate temperature. On special order, the instrument may be fitted at the factory to record simultaneously both dilatation-time and temperature-time curves. The heating furnace is program controlled, and temperatures are said to be maintained within ±2°C over the entire range.—J.S. (Cooke, Troughton & Simms, Inc., 91 Waite St., Malden 48, Mass.)

Circle 1 on Readers' Service card

New **adsorbent for chromatography**, "Florisil," is a magnesia-silica gel with what are considered outstanding adsorptive characteristics. Its typical uses include: detection of minute amounts of pesticide residues in food; assaying vitamins, alkaloids, nitrogen compounds, and drugs; determining corticosteroids in blood; purification of pharmaceutical products; separation of aromatic compounds in aliphatic/aromatic mixtures; decolorization of fats, oils, and waxes. Florisil's adsorptive characteristics (surface area, 298 m^2/g; voids, 26 percent) give it greater efficiency than conventional silica gel. Many compounds previously thought inseparable have yielded readily to Florisil. Florisil comes in 60-100 mesh and 100-200 mesh. Both ranges must be activated at 1200°F. Its price is $6 per pound, $28.50 for 5 lb. Other ranges, as well as Florisil with lower activity (activated at 500°F), are available on special order. Also available is a 16-page booklet giving chemical and physical properties, adsorptivity data, and a comprehensive bibliography of industrial, biochemical, and medical applications.—R.L.B. (Fisher Scientific Co., 415 Fisher Building, Pittsburgh 19, Pa.)

Circle 2 on Readers' Service card

Zone melting purification apparatus melts a restricted length of sample contained in a 6-inch-long Pyrex glass tube of 3- to 10-mm inside diameter, and moves the tube slowly so that the molten region traverses the length of the tube. As the molten region moves along, impurities that lower the melting point concentrate in the molten zone and are carried to the end of the tube where they may be removed. Applications include purification of a material or concentration of impurities for their identification or recovery. The sample tube is passed through a Nichrome heater coil at 1 in./hr. The system will handle materials melting up to 310°C. The compact apparatus is 9 inches square and 15 inches high.—R.L.B. (Torsion Balance Co., Clifton, N.J.)

Circle 3 on Readers' Service card

Cuvette washer provides a stream of cleaning reagent to flush the interior when the cuvette mouth is inverted in contact with a neoprene gasket around a nozzle in the washer. Flushing and removal of the rinsing agent is powered by suction from vacuum line or water aspirator and waste is collected in a suction filter flask. The device consists of a simple piece of glassware that is inserted into a standard suction flask. One cup fitted with the washing nozzle accommodates gaskets that seal the mouth of the tubes and another cup provided for rinsing agent is connected to a nozzle that

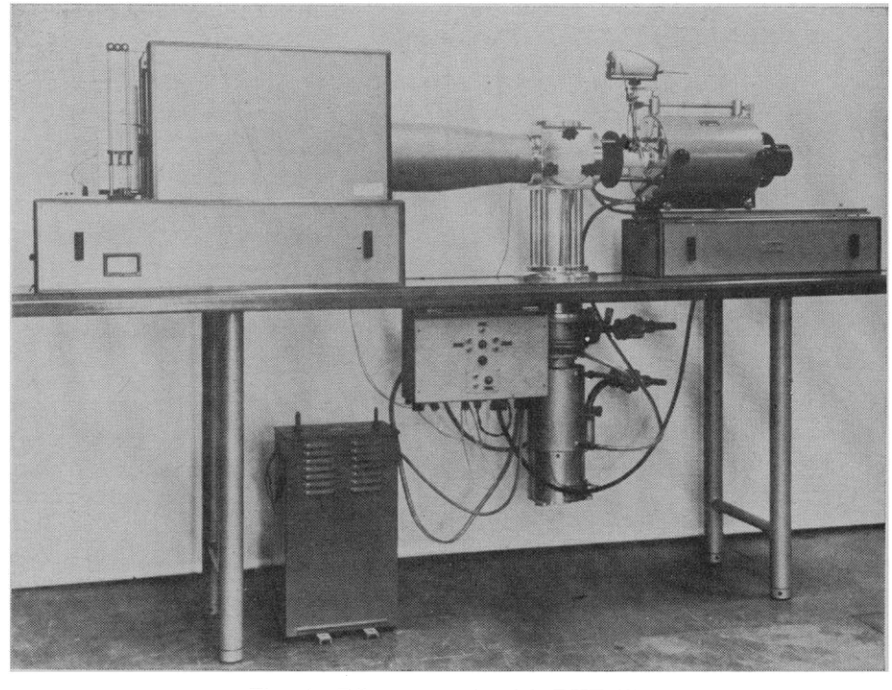

Fig. 1. Dilatometer (model DHT-60).

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

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

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

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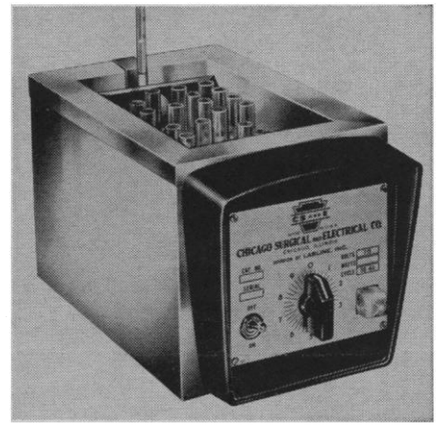
points up into the cuvette. Suction around the nozzle draws rinsing agent into and out of the cuvette only as long as the seal around the cuvette is maintained and low volume open cup allows it to be filled in sequence with cleaning agent, water, sample, and so forth. The washer accommodates square or round cuvettes fitting into 20-mm circle and up to about 80 mm high.—R.L.B. (E. H. Sargent & Co., 4647 W. Foster Ave., Chicago, Ill.)

Circle 4 on Readers' Service card

Small **water bath** designed to handle small-volume serological work. The bath holds one army medical-type rack holding up to 28 test tubes. Temperature range is from slightly above ambient to 60°C. An on-off switch permits turning current off without disturbing the temperature setting. The hydraulic thermostat has sensitivity better than ±0.5°C. A sheathed Thermoplate heater heats the bottom of the bath, which then transfers the heat up the walls, which act like radiant panels to warm the bath fluid evenly from all sides. This method eliminates "hot spots" and provides exceptional temperature uniformity. The chamber is of Monel metal; the exterior is of 18-8 polished stainless steel. The bath is insulated on all four sides and bottom. The interior chamber



measures 4½ in. long by 7½ in. wide by 4⅝ in. deep; overall size is 6½ in. long by 9½ in. wide by 6½ in. high. The control panel has an attractive and utilitarian Bakelite hood to prevent water from dripping on the controls. A neon pilot light indicates when current is on. The bath rests on four Neoprene feet and comes complete with thermometer and thermometer holder. —R.L.B. (Labline, Inc., 3070 W. Grand Ave., Chicago 22, Ill.)

Circle 5 on Readers' Service card

Radiation slide rule—based on the principle of the Planck radiation law—includes scales that are required for calculations that involve spectral radiation flux density and radiant flux density, together with corresponding quantities in photon units. The rule facilitates rapid calculation to obtain quantities such as radiant flux density in a given wavelength region, the spectral radiant flux density at a given wavelength, or the corresponding quantities expressed in photon units for a blackbody over the range $\lambda T = 2 \times 10^{2}$ to $\lambda T = 4 \times 10^{9}$ micron degrees with accuracy said to be about 1 percent. Extension rules can be used for larger values of λT. An instruction manual furnished with each slide rule describes the methods of calculation.—J.S. (International Scientific and Precision Instrument Co., Inc., 910 17 St., NW, Washington, D.C.)

Circle 6 on Readers' Service card

One-meter vacuum ultraviolet monochromator was developed especially for work with high-temperature plasmas. The detector element consists of a system of three multiplier phototubes that are set at various portions of the spectrum. The two side detectors may be set anywhere from 600 to 1000 A from the central image. The instrument is designed to cover the range between 500 and 4500 A but longer wavelength response, to the limit of the phototube cutoff, is said to be possible. An interchangeable grating is available for infrared work. The central multiplier phototube is located at the prime focus of the Seya mounting and is used for scanning monochromator applications. The basic unit is supplied with a 2-inch diffusion pump system; an optional 4-inch pumping system may be attached next to the entrance slits for differential-pumping applications. A daylight loading 16-mm camera attachment is also supplied for time integrating studies.—J.S. (Advanced Kinetics, Inc., 1231 Victoria St., Costa Mesa, Calif.)

Circle 7 on Readers' Service card

Gamma radiography equipment is offered in two series, one of which utilizes iridium-192 and the other cobalt-60. A total of 17 standard machines provide for both panoramic and beam applications. The 192 series, designed to be used with from 10 to 100 c of iridium, includes five panoramic models and two models suitable for both panoramic and beam applications. The 60 series includes seven

models designed for capacities of 1 to 100 c of cobalt-60, and two models, for beam applications only, with capacities of 1000 c of cobalt-60. These latter units have automatic controls. The beam models have 45-deg collimating cones. Various mounting arrangements are provided.—J.S. (Philips Electronics and Pharmaceutical Industries Corp., 750 S. Fulton Ave., Mount Vernon, N.Y.)

Circle 8 on Readers' Service card

A new thermistor-based **indicating-recording temperature controller** (model 73) utilizes a single thermistor probe to provide an input to both a measuring and a control circuit. The d-c error signal indicating a deviation from set point is converted to a-c by a solid-state chopper and is used to control a relay by a phase-sensitive amplifier. A 100-mv signal for recorders is provided. Another feature is a variable sensitivity control which permits adjustment of sensitivity from less than 0.01°C to more than 0.5°C for system optimization. The set point is dialed directly on the front panel with a slotted nylon button which can be turned with coins, keys, or other flat objects but is difficult to change accidentally. The device comes in 17 different ranges covering temperatures from −45°C (−50°F) to +150°C (+300°F). Indication is in both the Fahrenheit and centigrade scales. The double pole, double throw relay handles 10 amps of noninductive load through either 110-volt outlets or an electrically isolated barrier strip. The controller is powered by 110-volt a-c. Thermistor probes are available in glass, stainless steel, and plastic materials for measurement and control of liquids, gases, surfaces, and semi-solids. The devise is of particular value in monitoring, recording, and controlling temperatures of enzyme reactions and similar biological-chemistry phenomena. Another major area of use is in studies on temperature-controlled rooms or environmental chambers.—R.L.B. (Yellow Springs Instrument Co., Inc., P.O. Box 106, Yellow Springs, Ohio)

Circle 9 on Readers' Service card

Spectrum analyzers of the multiple-filter type are designed for continuous real-time, high-resolution analyses of transient and steady-state signals in the frequency range 20 to 100 kcy/sec. The analyzers employ an array of 480 narrow-bandpass magnetostrictive filters. Bandwidth and spacing of individual filters varies in the different models. In operation, a complex signal input is heterodyned to the frequency band of the filter array and separated into 480 components. Rapid commutation and detection of the filter outputs convert the frequency separated input components into a series of time-separated pulses for display. Standard analyzer models provide a synchronized output for oscilloscope presentation. Adaptation to strip-chart and other readout is available on special order. Frequency-to-amplitude linearity is said to be ± 2.5 percent. Dynamic range for any setting of signal attenuators is 42 db and attenuator range is 78 db. Input impedance is 50,000 ohm and minimum detectable signal is 0.25 mv. —J.S. (Spectran Electronics Corp., 146 Main St., Maynard, Mass.)

Circle 10 on Readers' Service card

Cryogenic temperature probe (model S-130) measures temperature from 1 to 50°K. Reproducibility is said to be ±0.017°K during 100 hours continuous cycling from room temperature to liquid-helium temperature. The instrument is stable to vibration up to 15 grav from 20 cy to 2 kcy/sec. The instrument has a resistance change from 0.5 percent at 63°K in liquid nitrogen to 300 percent at 1.6°K in liquid helium. The probe is available in various sensitivities and in various initial room temperature resistance values. Probe length ranges from 1 inch, excluding connector, up to 1 foot, without a change in sensitivity.—J.S. (Gulton Industries, Inc., 212 Durham Ave., Metuchen, N.J.)

Circle 11 on Readers' Service card

CALIBRATED INTERFERENCE FILTERS

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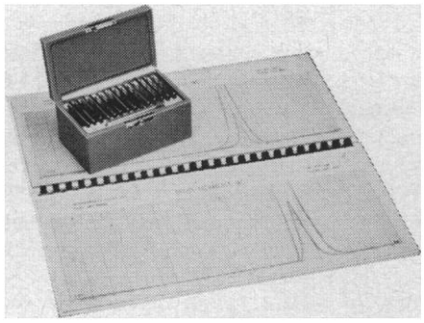

Optics Technology MONOPASS interference filters are designed for precise spectral analysis in the 400 millimicron to 2.7 micron region. MONOPASS filters permit highly sensitive spectral measurements since each filter passes only an extremely narrow band of wavelengths, and rejects all others from X-band to X-ray. Individual calibration curves for each filter assure pinpoint accuracy, with each curve set in laminated plastic and bound in a rugged volume for permanence. MONOPASS filters are available in complete sets, or may be ordered to specification.

VISIBLE SPECTRUM SET 10A includes ten MONOPASS filters to isolate principal lines as K, Ca, Hg, etc., from 706 millimicrons to 404 millimicrons, important in flame chemical analysis. Four neutral density filters and a linear spectral "wedge" filter are included. Price, $325.00.

VISIBLE SPECTRUM SET 12A includes ten MONOPASS filters uniformly spaced from 400 millimicrons to 700 millimicrons, as well as four neutral density filters and a linear spectral "wedge" filter. Price, $325.00.

INFRARED SET 15A includes ten MONOPASS filters spaced at every 0.1 micron between 0.8 micron and 1.75 microns. Price, $450.00.

INFRARED SET 20A includes ten interference filters on 1" diameter substrates spaced at every 0.1 micron between 1.75 microns and 2.75 microns. These filters are blocked out to 3.2 microns on the long end and to X-ray on the short end. Price, $450.00.

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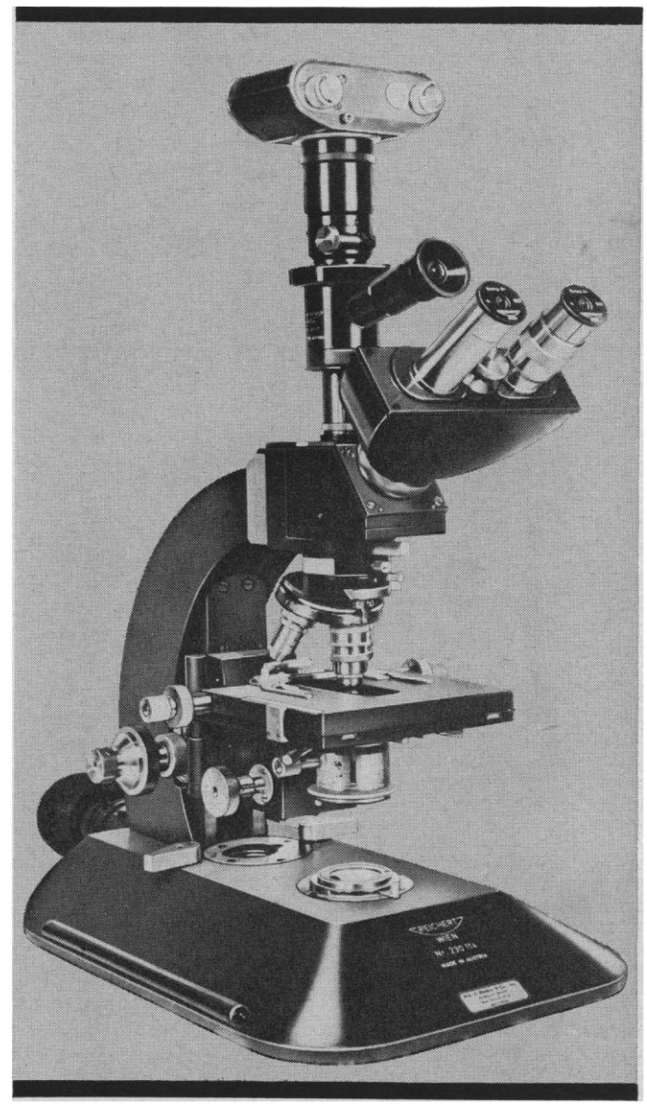

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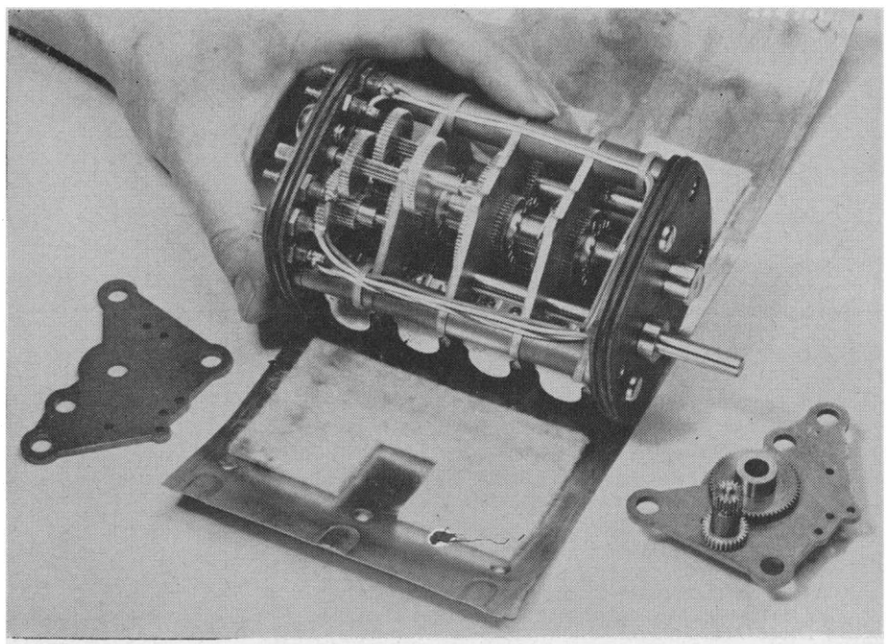
Multi-speed transmissions (Fig. 2) are controlled electrically by remote push-button switches and are of modular construction that provides a wide selection of speed reductions for use with low-inertia loads up to 20 in-oz. The basic transmission consists of four modular stages enclosed in a sealed housing. Each stage can be designed to have any desired gear ratio. To obtain different speed reductions, relays located in each module can be energized in many combinations. In the normal de-energized state the transmission is a straight-through drive with a 1 : 1 ratio between input and output shafts. In the standard 16-speed model, reductions ranging from 1 : 1 to 8000 : 1 can be obtained. Additional stages can be added to extend the range of speeds.—J.S. (Brush Instruments Div. of Clevite Corp., 37th and Perkins Ave., Cleveland, Ohio)

Circle 12 on Readers' Service card

High-speed **digital data recorder** with output rate of 110 characters per second consists of three assemblies: an analog-to-digital converter, a translator, and a tape punch. Encoders employed in the system are a wavelength encoder with a 20-bit binary-coded-decimal (BCD) capacity; a transmittance encoder with a 12-bit BCD capacity; and an external digitizer with a 20-bit BCD parallel entry capacity. The digital translating system accepts binary data from the converter and converts data into proper format for punch output. In a minimum system, only one digitizer is used. The other input is a trigger input supplied by the instrument to which the encoder is attached. Output is a five-character word in which the first and last characters are alpha-numerics triggered by the instrument and the middle characters are the three transmittance digits. An expanded system accepts digital input from all three en-



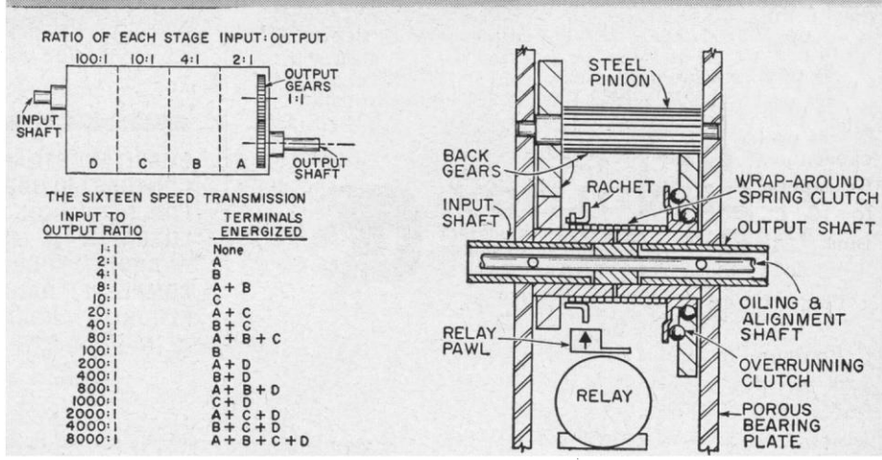


Fig. 2. Multi-speed transmissions.

coders. The punched-paper-tape output may be varied by programming so that it will be suitable for entry into IBM 1620 and 7070, LGP 30, RCP 4000, Burroughs 205 and 220, and other computers.—J.S. (Perkin-Elmer Corp., Norwalk, Conn.)

Circle 13 on Readers' Service card

Random/sequential access **buffer storage unit** (model R/SA-VB-INT) is available in two series, each of which has models with storage capacities of 256, 512, 1024, 2048, and 4096 characters of up to 40 bits per character. The 100 series will read-restore or clear-read in 10 μsec and load or unload in 6 μsec. The 300 series performs these functions in 3.3 and 2.5 μsec respectively. The character access time is nominally 3 μsec for the 100 series and 1.5 μsec for the 300 series. Features of the buffer are three addressing methods, six operating modes, random interlacing of addressing methods and operating modes, high-speed mode switching, and a built-in test program. The information in the memory can be regrouped in any format, stored words can be processed or shifted sequentially forward or backward or blocks of data can be shifted or inverted without destroying the original coherence of the stored information.—J.S. (DI/AN Controls, Inc., 944 Dorchester Ave., Boston 25, Mass.)

Circle 14 on Readers' Service card

Open-circuit detector (type TXE 602) is a six-channel instrument that will detect the presence of an open circuit that persists for 100 μsec or longer. The instrument will monitor from one to six test circuits, each of which will indicate a circuit condition independently of the others and may be reset without affecting the other channel indications. A self-test capability built into the instrument requires no additional equipment, adjustment, or calibration. Leads up to a maximum of 10 ft of single-conductor shielded wire, up to 75 pf/ft maximum, may be used. Lower capacitance permits greater lengths. Resistance range in each circuit is 0 to 10 megohm.—J.S. (Servomechanisms, Inc., 200 N. Aviation Blvd., El Segundo, Calif.)

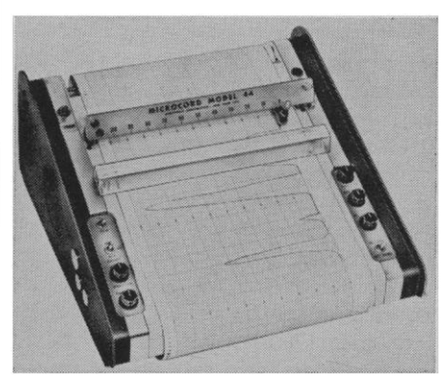
Circle 15 on Readers' Service card

Platinum resistance temperature sensors are discussed in 28-page bulletin 9612. The bulletin compares these temperature sensors with related instruments such as thermocouples, thermis-

tors, carbon resistors, and resistance temperature sensors that use metals other than platinum. Construction features are described and principles of design of bridge circuits are discussed in nonmathematical terms to illustrate how effects such as suppression of lead resistance, control of linearity, high-output voltage, and so forth, may be obtained. Calibration procedures and error analysis are outlined. Representative specification drawings are included to illustrate how various types of sensors may be defined. Appendixes cover a variety of application data. A bibliography of 13 papers on cryogenic and immersion temperature sensors is included.—J.S. (Rosemount Engineering Co., 4900 W. 78th St., Minneapolis 24, Minn.)

Circle 16 on Readers' Service card

Recording potentiometer for laboratory use selects ½-, 1-, and 10-mv ranges by switching and has ⅔-sec ink pen speed across a 10-inch chart. The self-balancing potentiometer uses a mercury battery for voltage reference and a photoelectric chopper in the servo system. Zero position can be adjusted full span in either direction. A 0- to 30-v d-c signal proportional to the pen excursion is provided for operation of integrators, telemetering, or automatic control. A pen vibrator is said to reduce writing friction and eliminate dead-zone. A sloping panel provides a 10-inch grid on 12-inch-wide paper. Two alternately operating chart drive motors are individually interchangeable plug-in units which can be selected from five available units. High or low speed is selected by a panel switch. Sensitivity, linearity, and repeatability are given as 0.25 percent of span and accuracy is claimed to be better than 1 percent on all ranges.—R.L.B. (Photovolt Corp., 1115 Broadway, New York 10)



Circle 17 on Readers' Service card

Wave dropout analyzer (model 900) is designed to determine the quality of magnetic tape by measuring the dropout characteristics of magnetic-tape recording. The analyzer operates over the frequency range 7.5 to 80 kcy/sec. It generates a positive rectangular pulse each time the instantaneous amplitude of the a-c signal drops to or below a predetermined level and remains below that level for a period equal to or longer than some predetermined time interval. Dropout amplitude calibration range is adjustable from 15 to 85 percent by means of a front-panel control. Dropout duration range is adjustable from 380 to 38 μsec; duration should not be less than approximately 3 times the period of the signal frequency to be analyzed. Overall accuracy is said to be ± 3 percent and stability of amplitude and duration measuring circuits to be within $\pm \frac{1}{2}$ percent over an 8-hour period.—J.S. (Acoustronics, Inc., 156 Olive St., Huntington Station, N.Y.)

Circle 18 on Readers' Service card

Peristaltic pump has variable feed for the safe, smooth, continuous transfer of fluids. A new, specially designed throttle permits adjustment of the pump's delivery rate from 4.7 lit./min at 2 lb/in.^{2} (500 rev/min approximately) down to just a few drops per minute. The pump itself never gets wet —never touches the fluid circulated through it. Quick, convenient changeover from one liquid to another is effected simply by changing tubing. There are no cleaning problems, and there is no danger of contamination. The pump handles acids, bases, toxic and sterile liquids, and gases with equally easy efficiency. The cycling pressure of revolving arms against the tubing assures positive suction and delivery at all times. Recommended tubing size is ½ inch (outside diameter) with a 1/16-inch wall—gum rubber, neoprene, Tygon or silicone. Silicone tubing has withstood over 1000 hours of continuous pump operation. The new peristaltic pump is 9 inches by 10½ inches by 8 inches high and comes complete with a 1/16-hp motor for 120-volt 60-cycle a-c operation.—R.L.B. (Greiner Scientific Corp., 22 N. Moore St., New York 13, N.Y.)

Circle 19 on Readers' Service card

Analog-to-digital converters (series 2500) are guaranteed by the manufacturer to maintain a basic accuracy of ± 0.01 percent for 6 months. The in-

struments are solid-state units and are built to standard 19-inch rack dimensions. To prevent external noise from interfering with internal low-level signals, digital input and output lines are isolated from conversion circuits during decision-making intervals. Specifications include a conversion rate of 14,000 per sec for a four-digit, binary-coded-decimal instrument with a maximum drift of 0.0025 percent of full scale. Digital codes available include: binary, to 14 bits and sign; binary-coded decimal, coded either 8421 or 4221; or any restricted range of the two basic codes. Display is in four columns of binary-coded-decimal digits plus sign.—J.S. (Beckman Instruments, Inc., 2400 Harbor Blvd., Fullerton, Calif.)

Circle 20 on Readers' Service card

High-speed oscillograph (model OSD) is a 12-channel instrument incorporating eight galvanometer channels and four cathode-ray-tube channels. It can record from cathode-ray tubes and galvanometers simultaneously without phase displacement between galvanometer and tube traces. The galvanometers can be used for high current sensitivity and for a response to 5 kcy/sec. The cathode-ray-tube elements extend the time response to 200 kcy/sec. Chart speed is continuously adjustable from 50 to 1000 in./sec and writing speed is as high as 5×10^6 in./sec. The instrument consists of separate recording and control units. Input terminals for both the galvanometers and the cathode-ray tubes are mounted on the control-unit panel. Light amplifiers can be plugged into the control-unit panel, four for the cathode-ray tube deflection plates and four for galvanometers. Three types of charts are available: sensitized paper that requires ordinary darkroom processing; print-out paper that requires no processing; high-sensitivity film from which prints can be made.—J.S. (Western Electrodynamics, P.O. Box 98, Colorado Springs, Colo.)

Circle 21 on Readers' Service card

Miniature radiochromatogram scanner (model RSC-293) designed to teach scanning techniques to students or laboratory personnel, is ideal for I^{131} counting and will also count other betas but with lesser efficiency. "Bantam" scanner feeds continuous strips of 1-inch-wide paper past a tiny, ½-inch D. Halogen-quenched, GM detector with a ¼ to 2.0 mg/cm² end window. An "on-off" switch controls an optional "Bantam"

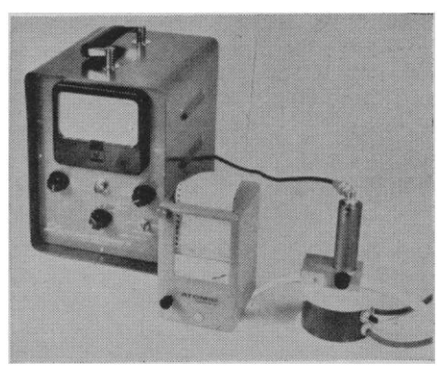


chart recorder. Since the scanner and recorder move at the same speed, the recorder graph gives an exact picture of the location and intensity of activity on the chromatogram The scanner measures only 4 inches in diameter by 4 inches high; it it also available as part of a complete miniaturized scanning system (model RSC-300), which includes a very small chart recorder and ratemeter.—R.L.B. (Atomic Accessories, Inc., 811 West Merrick Rd., Valley Stream, N.Y.)

Circle 22 on Readers' Service card

Pulse-train generator (model 102) generates a four-pulse train with rise time and fall time less than 2.5 nsec. Pulse rates of more than 2×10^8 per second can be simulated with pulse amplitude continuously variable or calibrated in 1-db steps, up to a maximum amplitude of 25 v. Pulse width is continuously adjustable from 0 to 300 nsec and output pulses are available in a train at a common output or at individual outputs. Polarity is individually set for pulses. Pulses in a train are all negative or all positive. Pulses may be combined in any desired train pattern. Train repetition rate is continuously adjustable between 1 and 10,000 per second.—J.S. (Physical Science Corp., 176 Linwood Ave., Fairfield, Conn.)

Circle 23 on Readers' Service card

The series 1110 **x-y recorder** produces an inked plot of two input voltages on either standard 11- by 17-inch or 8.5- by 11-inch graph paper. The plotter uses a controlled-flow inking system with a disposable ink cartridge. It will operate in any position and is suitable for table-top or rack mounting in a standard 19-inch rack. A backlighted surface can be furnished. Two types of hydraulic damping are included: velocity damping for point plotting or lower-speed line plotting; viscous-coupled inertia damping for the most accurate high-speed plotting. Static accuracy is said to be ±0.075 percent of full scale, dynamic accuracy ±0.1 percent of full scale at 10 in./sec-plotting speeds. Repeatability better than 0.05 percent for successive plots is claimed. A variety of plug-in modules are available to adapt the plotter to specific applications.—J.S. (Electronic Associates, Inc., Long Branch, N.J.)

Circle 24 on Readers' Service card

Differential thermoanalyzer measures the difference in temperature between a sample of thermally unstable material and a stable reference material as the temperature of the oven is raised at a predetermined rate. Exothermic or endothermic chemical or physical changes that occur during the temperature cycle increases or decreases the heating of the sample with respect to the reference, and this curve is recorded against the temperature of the sample block. Temperature rise on the standard equipment is 2°, 4°, 8°, and 16°C per minute to a maximum temperature of 1000°C. Flowing controlled atmospheres can be used to determine whether a particular peak is associated with oxidation, reduction, chemical rearrangement, or change in crystal structure and gases evolved can be run into a gas chromatograph for analysis.—R.L.B. (American Instrument Co., 8030 Georgia Ave., Silver Spring, Md.)

Circle 25 on Readers' Service card

Bimetallic stem recording thermometer (model 620) provides a permanent record of temperature from −100° to +1030°F on plastic-coated charts that make one rotation in 24 hours. The stainless-steel stem, 7/16-inch in diameter, may be any length from 1 to 5 ft. The total temperature span is covered in seven ranges. The record is produced by means of a stainless-steel dry stylus that marks the plastic-coated charts. The instrument will function in any position with accuracy said to be ± 2 percent over the entire range. The recording head measures 3-15/16 inches in diameter by 2-7/8 inches high. The chart drive is a mechanical clock.—J. S. (Pacific Transducer Corp., 11836 W. Pico Blvd., Los Angeles 64, Calif.)

Circle 26 on Readers' Service card

mechanism suggested by Hapgood, could have resulted in extreme cold and could have ensured the permanent preservation of the destroyed animals in permafrost.

Whatever the precise mechanism, it is apparent than an unbiased observer must agree with what Baron Cuvier wrote well over a century ago: "[Sudden catastrophes] left, in the northern countries, carcases of large quadrupeds frozen in the ice, . . . preserved down to the present period with their skin, their hair and their flesh. If they had not been frozen as soon as killed, putrefaction would have decomposed them. And besides, this eternal frost did not previously exist in those parts in which they were frozen, for they could not have existed in such a temperature. The same instant that these animals were bereft of life, the country which they inhabited became frozen. This event was sudden, momentary, without gradation."

The extermination of the mammoths is part of a larger picture of geologic change that is impossible to reconcile with orthodox gradualism.

HAROLD E. LIPPMAN
68 Elizabeth Avenue,
Newark, New Jersey

Lippman's letter is typical of several which I have received since the article on frozen mammoths appeared. All these letters indicate that the writers prefer to retain their former ideas about woolly mammoths in spite of abundant evidence to the contrary. I will not reiterate here all the arguments which I have previously presented, but I wish to emphasize certain conclusions once more.

It is surprising to read that "the frozen mammoths are not found in rivers or holes but are often found on the highest points of the tundra." Certainly the best-studied mammoths have come from river banks—on the Berezovka, Mamontova, and Lena rivers. The Lena Delta discovery is the Adams mammoth, which Lippman himself cites.

The botanical evidence speaks for itself. Any treatise on plant ecology and distribution shows that these assemblages (Table 1 in my article) belong in the Tundra and high Boreal zones of northern Siberia, Alaska, and northern Canada. There is absolutely no evidence of forests; all the tree species are dwarf and scrub forms. Only a slight shift, if any, in vegetation zones

is indicated. People who have not been in high arctic areas appear to have little conception of the relatively luxuriant vegetation there—grasses, flowers, shrubs, and dwarf trees. It is amazing what 24 hours of sunshine a day will do!

It is unfortunate that such critics seldom dig back into *original* references. If Lippman had read Tolmachoff's 1929 paper (written in English), instead of reading only Hapgood's interpretation of Tolmachoff's ideas, he would realize that Tolmachoff's ideas on death and preservation are nearly the same as mine.

I would like to say something about Lippman's concept of "gradualism," which he has apparently confused with uniformitarianism. Uniformitarianism ("the present is a key to the past") is the geologist's concept that processes that acted on the earth in the past are the same processes that are operating today, on the same scale and at approximately the same rates. A catastrophe such as a river flood or a tidal wave could have happened in the past just as it does today. Also, the very slow downcutting of streams has always taken place, although the rates have been variable in time and space. It is not logically sound to postulate a major catastrophe on a scale far beyond anything we have experienced to explain geological phenomena which can be adequately explained by the everyday processes which we can observe around us.

Certainly the death (suffocation, in several cases) of the frozen mammoths was catastrophic, and they were frozen in a very short time, geologically speaking—probably in much less than 1 year. Decomposition of the mammoth carcasses was retarded by the cold climate and the very low bacteria count in the Arctic, and by burial of the beasts at the time they died. In at least some cases, decomposition of the flesh had begun before the carcass was completely frozen. Such catastrophes are in accord with the doctrine of uniformitarianism.

Finally, a word about volcanism as a cause of widespread glaciation. The volcanic theory fails on two main counts: it is both quantitatively and chronologically inadequate. The largest volcanic explosions we know—for example, that of Krakatau in 1883—had a very small and short-lived effect on world climate, whereas many decades and centuries of climatic cooling are required to build continental ice sheets.

In addition, the effects of volcanic dust are strongly restricted to areas close to volcanoes. There is little, if any, evidence of world-wide, or hemisphere-wide, volcanism, whereas glaciation *was* world-wide! Moreover, some periods of great volcanic activity, such as that which produced the tremendous lava fields of the Columbia River Plateau in Washington and Oregon in mid-Tertiary time, were not accompanied by glaciation. Many such examples could be cited. Furthermore, it is highly improbable that volcanic holocausts could account for the several fluctuations of the Pleistocene Ice Age: four major and numerous minor advances and retreats of continental ice sheets within the last 1 million years.

WILLIAM R. FARRAND
Department of Geology,
University of Michigan, Ann Arbor

On Planarian Behavior

Recently I have become more than a little interested in the problem of the extent to which learning may be demonstrated in lower invertebrates. As a result, the report of Best and Rubinstein entitled "Environmental familiarity and feeding in a planarian" [*Science* **135**, 916 (1962)] came to my particular attention. I have some doubts about this report and wish to ask whether the authors can resolve them.

The authors compare feeding times in two samples of the animal, one of which they say was "unfamiliarized" with respect to its environment, the other "familiarized." The "familiarized" animals were placed, with no food, for 90 minutes in a plastic test receptacle containing water from their home bowl. They were then removed and put back in their home bowl for 25 minutes. They were then put back into the Lucite test chamber, which now contained liver, and their feeding time was measured. The so-called "unfamiliarized" group were taken from their home bowl and placed in the Lucite test chamber with liver, and their feeding time was measured forthwith.

No doubt the data presented for the feeding times of the two samples, which show that the so-called "familiarized" individuals had a shorter latency period before feeding than the so-called "unfamiliarized" group, were accurately obtained, and the sample of animals, although small in each case, appears to have been adequate to give statistically

significant results. However, the glaring weakness in this technique, which appears to me to render the conclusions completely unfounded, consists in the fact that no effort whatever was made to control the obvious differences in the total exposure to stimuli of the two samples prior to the measuring of feeding time.

No mention whatever is made of the manner in which the samples were manipulated, but it is obvious that the "familiarized" group must have undergone more manipulation in the transfer from container to container and must have received more continued barrages of diverse stimuli immediately prior to testing than the "unfamiliarized" group. How *were* these animals handled? With brushes? With pipets?

It is stated that "planarians of both groups continue moving in the test chamber during their latency period in the food test, encountering the pieces of liver repeatedly during this period. Hence, the differential latency cannot be ascribed to a difference in activity that causes one group to find the food sooner." Granted (even though there are no data on activity to prove it). But is it not perfectly possible that an increase in sensitivity to external stimuli (chemical, and so on) may have resulted from the general activity induced during (the uncontrolled) manipulation? Who is to say that this activity did not make the so-called "familiarized" animals merely "hungrier"?

As I understand it, a scientific control exists *only* when, in two parallel experiments, a single variable factor is altered in one of the two. It is on this basis that I claim that Best and Rubinstein's experiment is uncontrolled. The experiment also illustrates the danger, when dealing with the behavior of simple animals, of using loose "psychological" concepts with little or no physiological foundation. It is of course understandable that such techniques and terminology should be used by psychologists in their dealings with human behavior, which as yet cannot be entirely understood at the physiological level, but they should not be used in experiments on the behavior of invertebrates, which can and should be as strictly controlled as are physiological experiments on isolated systems. Until experiments of this kind are strictly controlled we will never really gain any truths as to the nature of the behavior of lower forms. One tends to feel, after reading this report, that in the midst of the experiment one *Cura* said to

another: "Joe, I'm not gonna eat in this joint; I ain't *familiar* with it!"

In simpler terms, it would appear that the authors are aware neither of the sorts of strictly controlled techniques that can be used in the investigation of the behavior of lower animals nor of the temporal position of vertebrates in the general picture of the evolution of the metazoan nervous system. They state that "these . . . behavior patterns [which they claim to have demonstrated] may predate, and be more universal than, the vertebrate brain." I believe that there is excellent paleontological evidence that highly complicated invertebrate nervous systems (such as the Cephalopod system, in which learning has been so beautifully demonstrated by Young and his colleagues) may have evolved eons before even so primitive a brain as that of a bony fish.

DEMOREST DAVENPORT
Department of Biological Sciences, University of California, Santa Barbara

In spite of Davenport's obvious enjoyment of incensing himself, he has penetrated to the crux of several important matters, and his discussion serves to highlight them.

In deference to Davenport's objection to our designation of the two groups, I will call the subjects (*Cura foremanii*) of the "unfamiliarized" group "Peter" and those of the "familiarized" group, "Paul."

In a strictly logical sense, Davenport's objection to the lack of a handling control for the Peter subjects is legitimate; practically, it is not. To see this, consider the temporal sequence of events for subjects of the two groups. At 115 minutes (90 + 25) before the test period, a Paul subject is transferred (by a pipet with a uniform ¼-inch bore, flame-polished at the end) from its home bowl to the Lucite chamber.

Since *Cura foremanii* (unlike members of the genus *Dugesia*, which adhere tenaciously) cling only very slightly to glass or plastic surfaces, this transfer can be made very gently by an experienced handler. The Paul subject is returned to its home bowl at the end of the "familiarization" period by simply placing the Lucite chamber in the water of the subject's home level and allowing it to crawl out. Thus, the only handling that a Paul subject receives that a Peter subject does not is the single transfer 115 minutes before the onset of the test period.

Furthermore, even if one were to grant that there is a small excitatory effect from such a transfer almost 2 hours prior to the test period, this effect would be completely masked by that of the similar transfer, common to the two groups, that occurs at the beginning of the test period.

"Who is to say that this activity did not make the so-called 'familiarized' animals merely 'hungrier' "? If one places a *Cura* in a maze system similar to the Lucite receptacle used but lacking the rim—that is, with the top 12 millimeters cut off—the planarian will exhibit considerable activity, but it will not eat at all in such a confined space. Other observations strongly suggest that this response to entrapment is aversive and that the activity is directed toward escape. When one feeds planaria in their home bowls in the normal course of maintenance, the probability that an encounter with the food will result in feeding is much greater. According to Davenport's conjecture it should be lower, since the animals have not been previously stimulated into activity.

Davenport's "Joe, I'm not gonna eat in this joint" is somewhat more folksy than we would have put it but is, nevertheless, not too inaccurate. Paraphrasing into computer terminology, one might say that the *Cura* nervous system, in common with the vertebrate nervous system, seems to have a programming instruction to delay feeding in an unfamiliar (and hence potentially dangerous) environment. Our interest in the effect was not, as Davenport seems to think, simply that of demonstrating learning per se in planaria, for this has been done elsewhere (*1*). More interesting is the fact that the planarian seems to have learned something without the introduction of an explicit reinforcement and seems to contain the "Hey Joe . . ." program mentioned above. Studies such as those of K. Von Frisch on the bee language illustrate that the evolution of behavior is a far richer subject than the mere tracing of the capacity for learning.

Davenport apparently feels we are being anthropomorphic about planarian behavior. This is not quite correct. It would be more accurate to accuse us of being planariomorphic in our view of rats and men in the following sense. It has quite commonly been supposed that the more important, or interesting, psychological characteristics of the higher vertebrates had their origin in the hypertrophied neural structures of

the vertebrate brain. What we intended to suggest is that those psychological characteristics are perhaps built of well-formed behavioral bricks already having their origin in the most primitive central nervous systems—for example, that of the planarians.

Being for controlled experiments is like being against sin. It is not, however, entirely clear to us what Davenport means by "controlled experiment," "physiological interpretation," and so on, and since one of us is a physiologist (the other is a psychologist), the communication failure is not entirely due to our lack of familiarity with and appreciation of physiological methods. If he means we should confine ourselves exclusively to notions of "excitation," "inhibition," tropism, and reflex, then I must confess not only a lack of sympathy for such chauvinistic nonsense but a reasonable certainty that the investigators of invertebrate behavior who do have simply not been observant.

Davenport must know that the reports in *Science* are seldom allowed more space than the equivalent of 1200 words for text, figures, everything—a limitation which prohibits review of the literature. Hence the omission of J. Z. Young's important studies, as well as those of Von Frisch and many others.

JAY BOYD BEST

Department of Physiology,
College of Medicine,
University of Illinois, Chicago

Reference

1. J. B. Best and I. Rubinstein, *Federation Proc.* **19**, 24 (1960); ———, *J. Comp. Physiol. Psychol.*, in press; R. Thompson and J. V. McConnell, *ibid.* **48**, 65 (1955); P. van Oye, *Natuurw. Tijdschr. Ghent* **2**, 1 (1920).

Science and Democracy

A recent editorial in *Science* [**136**, 231 (20 Apr. 1962)] raises again the frequently discussed question of whether democracy necessarily provides the best soil for science. A devil's advocate could make a good case for answering "no"; and an impartial jury, faced with the question, would probably bring in the Scottish verdict of "not proven." Indeed, if such a proposition had been put forward a century ago almost any informed person would have answered in the negative. In the development of basic science the democracy of the United States, preoccupied with practical needs, lagged far behind the mon-

archical countries of Europe. As Dupree (*1*) has noted, Asa Gray, for instance, believed that only a monarchical government could effectively support science. "Neither our Congress nor our executive department can be depended on for attending to any such thing wisely or honestly," Gray wrote in a letter to Joseph D. Hooker on 3 June 1866.

American scientists today in general believe that science is good and also that democracy is good. It is an easy jump from that belief to the conclusion that the one is therefore good for the other. Our natural predilections favor such a view; but this very fact should put any critical scientist on his guard against accepting the proposition too readily. A few glimpses at the past might provide strong evidence to the contrary. During most of the 18th century, under the very undemocratic governments of Louis XV and Louis XVI, France led the world in science. Although Lavoisier was executed during the Revolution, French science survived and flourished vigorously under the Napoleonic dictatorship. Napoleon himself gave active encouragement to science and took a group of distinguished scientists and scholars, including Monge and Berthollet, on his Egyptian expedition to carry on researches. Likewise, Imperial Germany from 1870 to 1914 held a position of world leadership in science and learning, yet it was certainly no democracy. One could cite further instances, but these may suffice for illustration.

More important, probably, than any particular form of government was the European tradition that rated intellectual achievement and the advancement of learning as being among the supreme values in the life of man. This tradition was not bounded by national frontiers; it persisted through the upheavals of war and revolution. Harsh governments sometimes imposed rigid limits upon the freedom of inquiry and discussion, when political issues were involved, but the area of intellectual freedom was still very broad. Modern science is primarily a European creation; one need only look at a list of the leading American scientists today, in almost any field, to see how many of them were born and educated in Europe.

Obviously, some kinds of government are inherently inimical to science. German science slowly disintegrated during the frenzied fanaticism of the Nazi regime, which was rooted in a deep irrationalism that was fundamentally hostile to science. Likewise it

is clear that Soviet science, and biology in particular, was heavily damaged by Stalin's assault on genetics. I see no evidence, however, on the basis of the historical record up to this time, that science necessarily flourishes better under a democracy than under an authoritarian regime, provided the latter is reasonable enough to allow investigators to pursue their researches without interference, in the field of their interest. I doubt whether the imagination of Soviet physicists and chemists in attacking scientific problems today is significantly inhibited by the fact that the free play of thought and discussion in the domain of the social sciences is sharply restricted in Russia. The Russian biologists may suffer more than the physicists and chemists, since their field of research is closer to the social sciences, but here the wounds suffered by Soviet biology in the Lysenko controversy have probably been a more important factor.

The spirit of independent inquiry, which is essential for every scientist, sometimes spreads from the particular area of his research interests and becomes embodied in an independent and critical attitude toward the problems of the world in general. Hence, one may cherish the hope that totalitarian governments, which today are compelled to promote the development of science in order to maintain their position as world powers, will eventually become permeated by more liberal thinking on the part of their scientists, who may gradually come to assert their intellectual independence in wider spheres of thought and action. This, however, remains a hope, fostered by our own interests and predilections, not an established fact.

It has indeed been demonstrated in our time that the government of a democracy, such as that of the United States, can effectively foster the development of science on an unprecedented scale. In this sense experience has refuted the gloomy forebodings of Asa Gray, quoted in the first paragraph of this letter; but this is obviously no proof that a democratic society can promote the growth of science more effectively than any other.

The subject deserves more thought and research than has been given to it, and these brief remarks are offered largely in the hope that they may stimulate historians and social scientists to inquire more deeply into the relations between the growth of science and the form of government and society in which the scientists live.

JOHN T. EDSALL
Biological Laboratories,
Harvard University,
Cambridge, Massachusetts

Reference

1. A. H. Dupree, *Science in the Federal Government: A History of Policies and Activities to 1940* (Harvard Univ. Press, Cambridge, Mass., 1957), p. 156.

Proving Grounds in the Behavioral Sciences

Two sentences from a recent issue of *Science* [**135**, 503, 505 (1962)], one from the editorial "Prophecy fulfilled" and one from the article, "A scientific society—the beginnings," by Glenn Seaborg (neither sentence especially germane to the principal theme of either author), plus a sentence from the lead article of a later issue, "Strengthening the behavioral sciences" [**136**, 233 (1962)], places in juxtaposition factors which I believe underlie a major dislocation in the "mix" of American research and development.

The fragment from the editorial is: "the theory-to-practice sequence is not as rigorous as is common in the physical sciences and engineering." The

sentence from Seaborg is: "Today, about 12 percent of the federal funds for research and development are used to support basic research fields." The statement from the later issue is: "large-scale action programs have seldom been accompanied or preceded by pilot studies which evaluated the several alternative actions that appeared equally attractive."

In the physical sciences and in engineering, Seaborg notes, Americans spend some $8 in the "theory-to-practice sequence" for each $1 spent on theory, in contrast to the disregard of this aspect of effort in the behavioral sciences, as noted in the third sentence quoted. No, or few, test facilities or proving grounds in the behavioral sciences can be cited as counterparts of the tens or even hundreds supported in the physical and engineering sciences. Who is to say that if a comparable effort were made, comparable results would not be achieved?

It is a commonly accepted view that the behavioral sciences are not as far advanced as the natural sciences. The conclusion is sometimes drawn that this is the sole or a major cause of the less firm understanding, in practice, of behavioral than of physical phenomena. The "mathematical model" of this argument might run as follows: given curves f and g, where a point A of f is not on g and a point B of g is not on f, then f and g can have no point in common.

It should be clear that neither the conclusion nor the line of argument is espoused in any of the articles cited. Indeed, it appears that they justify, rather, the conclusion that in the "theory-to-practice sequence," as elsewhere, "you get what you pay for."

CLIFFORD J. MALONEY
601 Culler Avenue,
Frederick, Maryland

Genesis of Cancer

Despite its title, "Heritance of acquired characters," the recent article by Frank L. Horsfall, Jr. [*Science* **136**, 472 (1962)], is devoted largely to the relationship between viruses and cancer. I have no professional concern with that subject and no fault to find with factual aspects of the article. The title, the introduction, and some further remarks have, however, misleading implications for a field with which I am concerned —evolutionary theory.

The author states that, "the theme does not carry the implication of refutation or support of any theory of inheritance, certainly not of Lamarckian concepts . . ." but he belies this by adding that if knowledge of the genesis of cancer should not correspond "with Mendelian and Darwinian teachings . . . it may be well to reassess our views." The disclaimer of concern with theories of inheritance further rings false because the whole article is based on the theory of inheritance by DNA coding. The title of the article and the mention of Lamarck and Darwin certainly suggest pertinence to the old controversy as to whether the evolutionary adaptation of organisms is caused by the inheritance of acquired characters or by natural selection. Later, Horsfall argues that the result of introducing foreign DNA into a cell is an acquired character and that, "The evidence that it is in fact heritable appears conclusive." Regardless of Horsfall's intended conclusions, his way of expressing them invites citation as "proof" of the Neo-Lamarckian inheritance of acquired characters.

The apparently conclusive evidence to which Horsfall refers is that additions to the heredity of a cell may be made by the introduction of viral DNA. This is one of the most exciting recent discoveries in biology, but it has nothing whatever to do with the theory of the inheritance of acquired characters, as that expression has always hitherto been used. Put in somewhat more modern terms than usual, that theory claims that individual and purely somatic modifications, or somations, acquired within the reaction range of an inherited genetic code can alter that code (in the gametes, if the individual is sexual and multicellular) by encoding the somation itself. There is no evidence that this ever happens. The incorporation of foreign bits of precoded DNA does not constitute such evidence, and indeed has no bearing on the question. One is tempted to say that this is an example, not of the heritability of acquired characters, but of the acquisition of heritable characters. But that might still be a somewhat misleading statement.

Further, Horsfall's argument that the results of the introduction of new DNA into a cell are acquired characters would logically lead to labeling the results of fertilization of an egg by a sperm as "acquired characters." As Horsfall says in another connection "new information has been acquired too fast for new language to keep abreast of it." The

situation is not improved by misapplication of old language, such as the term "acquired characters."

I trust that both Horsfall and his readers will take this not as a contradiction but as a clarification of his intended meaning.

GEORGE GAYLORD SIMPSON
Museum of Comparative Zoology,
Harvard University,
Cambridge, Massachusetts

Comprehension and Understanding

Webster's Third New International Dictionary gives two rather different definitions for the word *understanding*: "1: the act of grasping mentally . . . (a clear [understanding] of the reasons for his failure)"; and "4a: a friendly or harmonious relationship (working for better [understanding] between nations). . . ." One of the factors that confuses discussion of our relations with Russia is a tendency to mix up these two distinct meanings of the word. Melvin H. Marx's letter [*Science* **136**, 190 (1962)] rather neatly illustrates this confusion. Marx states that the "fundamental disease . . . [is] the almost total ignorance of the problems and intentions of the 'other side' evident on each side." He feels it should be treated "by improving the reciprocal understanding and appreciation of strengths, as well as weaknesses, of the American and Russian societies." It is very clear that study and educative efforts will improve the understanding, in the sense of the comprehension that the two peoples have of the "other side's" system. It is not at all clear that this will lead to a friendly or harmonious relationship.

Khrushchev has said that he hopes to bury us. It is surely possible that he doesn't really mean it, but it is also possible that he does. If Khrushchev does wish to impose his system upon us, then a better understanding of that fact would surely not lead to "resolving the underlying tensions by improving the reciprocal understanding. . . ." The possibility that further comprehension of the Soviet system might lead to even more strained relations between ourselves and the Soviets, or perhaps leave the present situation unchanged, is simply ignored by Marx. The reciprocal possibility, that the Russian value system is such that their esteem for us will not increase as they know more about us, is also ignored.

There is everything to be said for increasing our knowledge about Russia. There is also a good deal to be said for trying, insofar as it is possible, to educate the Russians about us. The bland assumption that the present tensions between the two nations result from mutual ignorance, however, is untenable. In general, in our society the most friendly feelings for Russia are held by people who have not made a special study of the subject. Of those people who have devoted their lives to a study of communism and the new Russian Empire, a high percentage feel that we are, if anything, not sufficiently aware of the danger.

GORDON TULLOCK
Thomas Jefferson Center for Studies in Political Economy, University of Virginia, Charlottesville

Tullock's letter makes certain points that call for comment.

First, I made no assumption, "bland" or otherwise, that the present impasse is a consequence of "mutual ignorance." My remarks were entirely directed toward what can be done, now and in the future, to improve relations and thereby reduce the tensions which most of us deplore.

Second, implicit in Tullock's letter is the assumption that "comprehension of the Soviet system" is the objective that is under discussion. There is at present in this country a sufficient concern with the Soviet "system"; what I am advocating is a greater concern for increased social and cultural relationships with the Russian people—scientists, artists, workers, and the like, as well as politicians. The most serious internal threat we face today is from those radicals, of the right as well as the left, who see *only* the ideological issues. By concentrating our attention solely on these issues they divert us from other, equally important and more long-standing, factors such as the nationalistic impulses involved in both the Russian and the Chinese "empires." Surely one does not need to be "friendly" to communism to see that the ideological interests are not perfectly correlated with the nationalistic interests of the countries in the so-called Communist bloc; the view that they are is no more valid than the view that a common interest in our brand of political freedom automatically unites the Western countries and overrides their respective national interests.

Third, I think it is most unfortunate that more and more in this country

we seem to be equating *liking* and *respect,* or rather, to be making the latter dependent upon the former. It is particularly important that we recognize that different social and cultural and political systems must be at least tolerated, if not fully respected, regardless of whether or not we *like* all the existing systems. It is also important that we appreciate the rapidly changing nature of today's economic and political systems—the Russians' as well as our own. Differences, where they exist, need not be denied, but at the same time the areas of similarity, which are probably increasing as certain of our political leaders have suggested, must also be recognized.

Finally, it is of course perfectly true, as Tullock points out, that we do not automatically like everything with which we become better acquainted. Familiarity may certainly breed contempt. But it is even more certain that ignorance breeds suspicion and distrust. Thus, while there would be some risk incurred in opening up the channels of communication with Soviet Russia, I think there will be infinitely greater risk in continuing our recent course.

In conclusion, I do not see how Tullock's argument negates, or in any way modifies, the fundamental contention of my previous letter. Scientists have a unique opportunity to take the lead in breaking through encrusted political prejudices on both sides, thereby helping to produce both kinds of "understanding."

MELVIN H. MARX
Department of Psychology,
University of Missouri, Columbia

An Atypical Occurrence

May an outside observer add something to D. N. Misra's letter in a recent issue of *Science* [**136**, 199 (1962)]. Anyone who knows Indian laboratories knows that such things are as rare there as in American or British laboratories and that if they should occur, they are treated equally seriously. What everyone may not know, however, is that such an event was also wholly out of keeping with the admirable establishment where it chanced to happen, a laboratory which is worthily living up to a 70-year tradition of fine scientific work and achievement.

H. R. AMBLER
British High Commission,
Chanakyapuri, New Delhi, India

Environmental Factors and Correlation Coefficients

In a report in *Science* [**132**, 34 (1960)], Levengood and Shinkle discuss environmental factors influencing the progeny yields in *Drosophila*. In their Fig. 1 they plot the change in progeny yield and barometric pressure for 17 generations of flies and claim that a correlation cofficient of 0.51 exists between progeny yield and barometric pressure and that this result is significant at the 95-percent confidence level. Looking at their curve, one observes that the peaks and valleys are about parallel in just as many instances as they are nonparallel. Nevertheless, the high correlation coefficient is not unexpected, because during the period of investigation the barometric pressure increased in general, as did the progeny yield.

The increase in progeny yield could have been the result of acclimation to the laboratory environment of the strain used, of improved methods of handling, or even of change in the ventilating and heating system of the laboratory during the months of October and November. The authors would have obtained a similarly good correlation between progeny yield and any other factor which accidentally increased or decreased during the same interval. For example, a good positive correlation would have been found with the fuel-oil consumption, and a good negative correlation with the outdoor activity of children.

The authors seem not to be aware that, when computing correlation between two series of quantities arranged in a time sequence, the correlation between the quantities and time has to be eliminated first. If a linear dependence between time and the other quantities is assumed, this can be done by computing the multiple correlation between time, progeny yield, and barometric pressure and determining the partial correlation coefficient between barometric pressure and progeny yield with the time variant eliminated. Another method would be to determine first the regression lines of each of the two variables relative to the time axis and then take the deviations from the regression lines instead of the deviations from the mean.

The partial correlation coefficient between progeny yield and barometric pressure data given in Fig. 1 of the report is not positive, but negative and negligible as compared to its error—

namely, $r = -0.015 \pm 0.250$. Since obviously the other series, for which no data were published, were treated in the same way, the authors' finding of a correlation between progeny yield of *Drosophila* and barometric pressure is not supported by their results.

Special attention has to be drawn to this type of mistake in computing correlation coefficients between two variables arranged in a time sequence, since, due to the fact that often there are comparatively few cases to which experimenters can look for guidance, other researchers, trusting the claimed high confidence levels, attach undue importance to such findings.

M. F. BARNOTHY
University of Illinois
College of Pharmacy, Chicago

The time ordinate used in Fig. 1 of our report was chosen simply as a convenient means of illustrating the data in graphical form. It was strictly fortuitous that during this period of test the barometric pressure showed a gradual increase, which Barnothy chooses to describe as a "linear dependence." Barometric pressure and time are independent events, and progeny yield and time are independent events; therefore, all that is necessary is to show the interdependence of the pressure and the progeny yield. Since publication of our report we have analyzed over 100 control cultures which represent, on a cumulative basis, a time span of well over 200 weeks, and we have not found a time-dependent relationship. For example, in one 16-generation series, the correlation of barometric pressure with time was essentially zero ($r = 0.06$), whereas the correlation between the barometric pressure and the progeny yield in this same series was high ($r = 0.73$, within the 95-percent confidence limits). Also, the maxima and minima in the progeny curve correspond with those in the barometric pressure curve at 14 out of a possible 14 data points.

In his letter Barnothy concentrates on our Fig. 1 and proceeds to ignore the data in Fig. 2, which extend over approximately a 7-month period and do not show a linear change with time. The progeny data in Fig. 2 disclose remarkably similar variations in curves for two spatially isolated culture bottles, and the peaks and valleys of the progeny curves coincide with those of the barometric-pressure curve at five out of six data points. Even though the partial coefficient is small for the Fig. 1

case and it appears that there is a cross correlation that is dependent on time, it has been shown that the factors of progeny and barometric pressure do not depend on time; therefore the statistics we used were appropriate.

After discussing Fig. 1 Barnothy states that it is obvious that other series mentioned in the report were treated in the "same way." Although the same method of applying the correlation coefficients was used, they were not treated in the same way experimentally. In our report we pointed out, after discussing Fig. 1, that a greater degree of correlation was obtained by using repeated filial generation crosses and the barometric pressure reading for the 72-hour period covering the day before the day of, and the day after the initial mating. Since publication of the report we have continued with this procedure and have repeatedly found the correlation between the progeny yield and the barometric pressure. It was also shown in our report that growth in an electric field reduced the correlation with barometric pressure and produced greater progeny yields than growth of control cultures out of the field. In a later discussion [*Science* **133**, 115 (1961)] it was pointed out that the electric-field effect (35-percent greater yield) may possibly be attributable to variations in air ion densities.

W. C. LEVENGOOD
Institute of Science and Technology, University of Michigan, Ann Arbor

Research Costs

The recent editorial "Wrong question" [*Science* **136**, 291 (27 Apr. 1962)] is of particular interest. It caused me to recall the period in the 1940's when I served on the "Advisory Committee on Research to the Quartermaster Corps" and found that the colleges and universities almost always underbid commercial organizations and either profit-making or nonprofit research groups who submitted proposals for Army research contracts. I have been concerned for a number of years with the costs of doing research, and I had the feeling then that the colleges and universities did not really know how to calculate their research costs, especially in regard to such factors as heat, light, power, rent, depreciation of equipment, library services, machine shop, administrative expense, and other indirect costs.

According to my line of reasoning, this gave the universities more and more to do in the way of government research but at the same time it reduced the number of hours available to the staff for teaching purposes and, since this research was done at an unrealistically low cost, caused the colleges and universities to become financially hard pressed. Consequently, tuition costs have risen drastically over the past 10 to 15 years, and a plea for funds has gone out not only to the college alumni but also to the country at large and to the federal government. On the basis of what I know of the cost of doing research in an industrial organization, I have a feeling that even the 28- or 32-percent burden for indirect costs given in the National Science Foundation study is also far too low. On the other side of the coin, however, is the possibility that fixing the indirect costs of research grants at 15 percent may cause the colleges and universities to become realistic, withdraw from this type of research activity, and return their full professors to the undergraduate classrooms.

HENRY GRINSFELDER
8250 New Second Street, Elkins Park, Pennsylvania

Ethical Issues

May I comment briefly on Haybittle's thoughtful remarks [*Science* **136**, 917 (1962)] concerning my recent letter "Standards of ethical conduct" [*ibid.* **135**, 997 (1962)].

I could not agree more with his statement that "the problem of introducing ethical judgments into the practice of science is by no means simple." But it does not follow, I believe, that this problem should be left entirely to the conscience of the individual scientist. In particular, this would amount to giving a blank check to the unscrupulous. There are other professions, scientific and otherwise, where ethical problems arise, and where Haybittle's remark applies—for instance, medicine, or the practice of law. In those fields, professional associations have long had committees on ethics, of the highest standing, whose task it is to define standards of professional ethics and, when necessary, to pass judgment on their peers. This has powerfully contributed to a continuing awareness, on the part of the members of the professions concerned, that ethical issues are

an inescapable part of their total professional responsibility.

The gist of my letter simply was that it is high time the professional associations in the exact sciences did the same and shed their present tacit assumption that ethical issues are no legitimate concern of, say, a professional association of physicists. The ethical problems they will meet, to be sure, are of the highest complexity. This precisely is an important reason why these should be tackled in the most responsible manner, and at the highest possible level of competence.

Not *all* the issues involved are complex, however. In particular, I believe that they are rather simple in the case of the Russian scientists who conducted the recent tests. The Russian government had assumed a clear international obligation to refrain from further testing. Those scientists therefore made themselves knowing accomplices in a breach of international faith.

Would it really be too much to expect the international scientific community to adopt some such stipulation as this one as part of a code of professional ethics: "A scientist may not knowingly help in a violation, by his own or any other government, of international law or internationally assumed obligations"?

What a rejection of some such principle would mean can best be seen in a hypothetical example: Assume that General Salan had seized power in France and had decided to use atomic bombs for destroying the Algerian Moslem population entirely (instances of attempted genocide are no novelty in the modern world). Should there really be no professional obligation—beyond the call of individual conscience—upon French physicists to reject collaboration in such a project?

This example points to one other important aspect of a code of professional ethics: it is apt to provide powerful professional backing to a scientist bent on resisting immoral claims upon his knowledge. Let us assume that one of the great Russian physicists had wished to resist Khrushchev; would he not have been in a better position to do so if he could have pointed to the discredit his collaboration would bring to himself and to the whole of Russian science than if he had had to be content with opposing his personal ethical judgments to the judgments of the government of his own country?

ALEXANDER WITTENBERG
Laval University, Quebec, Canada

Meetings

Sulfur Isotopes

An international symposium on the biogeochemical cycle of sulfur isotopes was held at Yale University from 12 to 14 April. The symposium, sponsored by the National Science Foundation, was organized by M. L. Jensen (department of geology, Yale). Participating were more than three dozen scientists (including representatives from Canada, England, Japan, New Zealand, and Sweden) who are doing research on the bacteriological, biological, chemical, and geological role of sulfur and the distribution of stable sulfur isotopes.

The meetings offered an opportunity for all investigators (with the exception of the Russians) who have made extensive studies on sulfur isotopes to gather together and agree upon the acceptance of sulfur isotope standards. During the past, troilite from the Cañon Diablo meteorite has been accepted by several investigators as the standard, but its absolute S^{32}/S^{34} composition has been assumed by various groups to be 22.200, 22.210, 22.220, and 22.222!

Even though the precision of sulfur isotope measurements, in comparison to a standard, is at least ± 0.02 percent, the absolute values cannot be measured with a precision better than about 1 percent. It was agreed, therefore, to assume an absolute value of 22.220 for the S^{32}/S^{34} composition of Cañon Diablo troilite. This value will, therefore, be taken to equal zero per mil, and δS^{34} per-mil values from different laboratories will henceforth be strictly comparable.

The present National Bureau of Standards No. 120 standard of native sulfur is apparently not satisfactory, as variations of more than 2 per mil have been obtained by different investigators. Variable preparation techniques and slight oxidation of this native sulfur supply at the Bureau may be causing the discrepancy in values. A small group of the investigators will, therefore, provide the NBS with at least two more satisfactory sulfur isotope standards.

The majority of the papers presented pertained to the role of bacteria in oxidizing or reducing sulfur or sulfur compounds. Sulfate reducers of the *Desulfovibrio desulfuricans* and *Clostridium nigrificans* varieties are apparently capable of producing vast quanti-

ties of hydrogen sulfide appreciably enriched in the lighter isotope. The geological role of this effective reductant in forming ferrous sulfide concentrations along marine coastal margins is certainly becoming more fully understood through the variety of studies by scientists of supposedly quite different interests, such as bacteriologists, biologists, geologists, limnologists, and oceanographers.

The papers presented, and the speakers, were as follows: "Biogenic ore deposits," M. L. Jensen (Yale); "Sulfur isotopes of the gold-quartz deposits of Yellowknife, N.W.T.," R. Wanless (Geological Survey of Canada); "New Zealand sulfur standards in relation to meteoritic sulfur," J. R. Hulston and T. A. Rafter (Wellington); "Sulfur isotope measurements on New Zealand, Australian, and Pacific Island specimens," T. A. Rafter; "Summary of sulfur isotope standards," W. Ault (U.S. Geological Survey, Hawaii); "Sulfur isotope standards—results and recommendations," N. Nakai (Yale, and Nagoya, Japan) and M. L. Jensen; "Diagenesis of sulfur in recent sediments," C. H. Oppenheimer (Miami); "Pyrite spheres in sediments," L. G. Love (Yale, and Sheffield, England); "A chemical study of pyrite spherules isolated from the surface sediments of Little Round Lake, Ontario," J. R. Vallentyne (Cornell); "Observation on microbial association with some mineral sulfides," H. L. Ehrlich (Rensselaer); "Experimental studies of sedimentary iron sulfide formation," R. A. Berner (Harvard); "Chemistry of the shallow water marine mud biological environment," J. W. Kanwisher (Woods Hole); "Some necessary conditions for fractionation of sulfur isotopes by *Desulfovibrio desulfuricans*," G. E. Jones (La Jolla) and R. L. Starkey (New Brunswick, N.J.); "Biogenic oxidation and reduction of sulfur in lake sediments," N. Nakai; "Precipitation of elemental sulfur by *Thiobacillus*," W. Vishniac (Rochester); "Sulfur isotope cycle in fresh water lakes," E. S. Deevey, Jr. (Yale), and N. Nakai; "Sulfur cycle in recent marine muds," I. Kaplan (California Institute of Technology); "Carbon isotope fractionation in bacterial processes," S. R. Silverman and W. D. Rosenfeld (La Habra); "Carbon isotopes of Gas Hills Uranium District, Wyoming," E. S. Cheney (Yale); "C^{13}/C^{12} variations of the fatty acids," P. L. Parker (Geophysical Laboratory, Washington, D.C.).

Other participants in the discussions were Alan M. Bateman (Yale); W. Broecker and F. Fraser (Lamont); H. Dequasie (Millville, N.J.); T. Hoering (Geophysical Laboratory, Washington, D.C.); Shinya Oana (Nagoya, Japan); Göte Ostlund (Stockholm); D. Runnells (Harvard); T. Tatsumi (Tokyo); H. G. Thode (McMaster University); K. K. Turekian (Yale); P. E. Yankwich (Urbana); R. L. Ames, R. L. Armstrong, G. Holland, and R. I. Tilling (Yale); and W. G. Smitheringale (Massachusetts Institute of Technology).

A symposium volume is being prepared. While the supply lasts, copies of this volume will be made available on request to anyone interested in the subject. Requests should be addressed to M. L. Jensen.

M. L. JENSEN
Department of Geology, Yale University, New Haven Connecticut

Plant Tissue and Organ Culture

A symposium on plant tissue and organ culture was held at Delhi jointly by the University of Delhi and the UNESCO South Asia Science Cooperation Office, New Delhi, from 22 through 29 December 1961, with P. Maheshwari as president. Forty-one delegates, representing India, Ceylon, Burma, Singapore, the United Kingdom, France, Germany, and the United States, participated. Most of them came from universities and research institutions of India. Special mention might be made of the following delegates: F. C. Steward (Cornell, United States); H. E. Street (Swansea, Wales); J. P. Nitsch (Gif sur Yvette, France); and J. Reinert (Berlin-Dahlem).

The 35 papers read covered a wide range of subjects, but the majority dealt with the rearing of reproductive organs of phanerogams (such as male cones of pine) and with flowers, anthers, ovaries, ovules, seeds, nucelli, and embryos of angiosperms. It was shown that the number of embryos in *Citrus* and *Dendrophthoe* could be greatly multiplied by chemical control of the nutritive medium. Other papers pertained to the nutrition of roots; the growth of tumors and cells; experimental control of morphogenesis; and the effect of gamma radiation on culture media and naturally occurring growth substances in relation to plant tissue culture. In addition, special

lectures were given by five botanists. One session was devoted entirely to a discussion of progress and prospects in tissue-culture research.

The organizers made every attempt to provide adequate communication both during and in between the official sessions. The proceedings will be published as a separate volume by the International Society of Plant Morphologists, University of Delhi. The advantages of a small, intimate meeting on the university campus were appreciated by all the participants.

H. Y. Mohan Ram
Department of Botany,
University of Delhi, Delhi, India

Forthcoming Events

September

14–16. Society of **Exploration Geophysicists**, annual intern. meeting, Calgary, Alberta, Canada. (N. J. Christie, 209A Sixth Ave., SW, Calgary)

15–17. **Psychology and Pedagogy**, intern. symp., Turin, Italy. (Servizio di Assistenza Psico-Medico Sociale della Provincia di Torino, Via Giovannida Verazzano 4, Turin)

16–19. American Inst. of **Chemical Engineers**, natl. meeting, Denver, Colo. (Secretary, AICE, 25 W. 45 St., New York 36)

16–22. Latin American **Chemistry** Congr., annual, Buenos Aires, Argentina. (Secretary, Congreso Latinoamericano de Quimica, Casilla de Correo 2153, Buenos Aires)

16–22. **Low-Temperature Physics**, intern. conf., London, England. (LT8, Queen Mary College, University of London, Mile End Rd., London, E.1)

16–24. **Military Medicine and Pharmacy**, intern. congr., Caracas, Venezuela. (E. P. Vivas, c/o Ministerio de la Defensa, Caracas)

17–18. **Hydrofoils and Air Cushion Vehicles**, natl. meeting, Washington, D.C. (W. H. Arata, Jr., Manager-Market Planning, Fairchild Stratos, Hagerstown, Md.)

17–18. **Water Protection**, symp., Schaffhausen, Switzerland. (Ligue Suisse pour la Protection des Eaux, Kurbergstrasse 19, Zurich 49, Switzerland)

17–19. **Pharmaceutical Products**, intern. symp., Florence, Italy. (A. Soldi, Società Italiana di Scienze Pharmaceutiche, Via Giorgio Jan 18, Milan, Italy)

17–21. **Hormones and the Kidney**, colloquium, London, England. (P. C. Williams, c/o Imperial Cancer Research Fund, Burtonhole Lane, London, N.W.7)

17–21. **Malacological** Congr., London, England. (H. E. J. Biggs, 19 Siward Rd., Bromley, Kent, England)

17–21. **Vector Control**, symp., Geneva, Switzerland. (World Health Organization, Palais des Nations, Geneva)

17–22. High-Speed **Photography**, intern. congr., The Hague, Netherlands. (Con-

gress Secretariat, 14 Burgemeester de Monchyplein, The Hague)

17–22. International **Brain Research** Organization, central committee meeting, Paris, France. (H. H. Jasper, U.N. Educational, Scientific and Cultural Organization, Place de Fontenoy, Paris 7e)

17–22. International Union Against **Tuberculosis**, annual, Paris, France. (IUAT, 15 rue Pomereau, Paris 16e)

17–24. History of **Medicine**, intern. congr., Warsaw and Krakow, Poland. (Organizing Committee, Chocimska 22, Warsaw)

17–29. Chromatographic Methods for **Lipid Research**, intern. congr., Milan, Italy. (R. Paoletti, Congrès International, V. del Sarto 21, Milan)

18–21. **Food Science** and Technology, intern. congr., London, England. (F. J. Griffin, 14 Belgrave Square, London, S.W.1)

18–22. **Agricultural Aviation**, intern. conf., Grignon, France. (P. Journet, Service de la protection des végétaux, Ministère de l'Agriculture, 78 rue de Varenne, Paris 7e, France)

18–23. International Assoc. of **Geodesy**, Munich, Germany. (J. J. Levallois, IAG, 19 rue Auber, Paris 8e)

18–24. Effects of Use and Disuse of **Neuromuscular Functions**, Prague-Liblice, Czechoslovakia (by invitation). (Czechoslovak Acad. of Sciences, Narodny Tr. 5, Prague I)

18–26. **Equatorial Aeronomy**, intern. symp., Huaychulo, Peru. (A. A. Giesecke, Scientific Program Committee, Apartado 3747, Lima, Peru)

18–28. International **Atomic Energy** Agency, general conf., Vienna, Austria. (IAEA, 11 Kärntner Ring, Vienna I)

19–20. **Industrial Electronics**, annual symp., Chicago, Ill. (E. A. Roberts, Comptometer Corp., 5600 Jarvis Ave., Chicago 48)

19–21. Rocky Mountain **Minerals** Conf., Butte, Mont. (Metallurgical Soc. of AIME, 345 E. 47 St., New York 17)

19–22. **Information Retrieval**, seminar, Minneapolis, Minn. (Director, Center for Continuation Study, Univ. of Minnesota, Minneapolis 14)

19–23. **Air Force** Assoc., convention and aerospace panorama–weapons meet, intern., Las Vegas, Nev. (Air Force Assoc., 1901 Pennsylvania Ave., NW, Washington 6)

20. **Surgery** of the Hand, intern. conf., Paris, France. (L. Gosse, c/o Hôpital de Nanterre, 3 Ave. de la République, Nanterre (Seine), France)

20–22. **Sulphur Therapy**, intern. symp., Innsbruck, Austria. (K. Weithaler, c/o Medizinische Universitäts Klinik, Innsbruck)

20–23. International Soc. for Practical **Applied Medicine**, intern. congr., Salzburg, Austria. (Sekretariat, Internationale Gesellschaft für Praktisch Angewandte Medizin, Lange Str. 21a, Oelde, Westfalen, Germany)

20–23 **Rockets and Space Flight**, symp., Coblenz, Germany. (Deutsche Raketen-Gesellschaft, Fritz-Beindorf-Allee 9, Hanover, Germany)

20–28. Intergovernmental, **Oceanographic** Commission, Paris, France. (U.N. Educational, Scientific and Cultural Organization, Place de Fontenoy, Paris 7e)

20–30. Handling and Lifting Equipment and **Industrial Electricity**, intern. study sessions, Charleroi, Belgium. (Société Coopérative de Gestion, Palais des Expositions, Avenue de l'Europe, Charleroi)

22. **Pharmacy** Assembly, annual, New York, N.Y. (J. Yellin, Hebrew Home for the Aged, Bronx, N.Y.)

22–29. International **Scientific Film** Assoc., congr., Warsaw, Poland. (F. Gazan, ISFA, 38 Avenue des Ternes, Paris 17e, France)

22–4. **Cinematographic** Techniques, intern. congr., Turin, Italy. (Salone Internazionale della Tecnica, Corso Galileo Ferraris 60, Turin)

23–26. Latin American Congr. of **Angiology**, Buenos Aires, Argentina. (E. Sales, Santa Fé 1171, Buenos Aires)

23–26. **Petroleum** Mechanical Engineering, conf., Dallas, Tex. (American Soc. of Mechanical Engineers, Meetings Manager, 29 W. 39 St., New York 18)

23–27. **Electrochemical** Soc., Boston, Mass. (ES, 1860 Broadway, New York 23)

23–27. **Metal**, intern. congr., Vienna, Austria. (Metall-u. Farben A.G., Kärntnerstrasse 7, Vienna I)

23–27. **Microcirculation**, symp., Pavia, Italy. (G. Pellegrini, Inst. of Medical Pathology, Univ. of Pavia, Pavia)

24–26. European Assoc. Against **Poliomyelitis**, symp., Prague, Czechoslovakia. (P. Recht, EAAP, 56 rue Charles Legrelle, Brussels 4, Belgium)

24–26. National **Power** Conf., Baltimore, Md. (American Soc. of Mechanical Engineers, 29 W. 39 St., New York 18)

24–26. World **Veterinary Poultry** Assoc.,

conf., Cambridge, England. (W. M. McKay, Cyanamid of Great Britain, Ltd., Bush House, Aldwych, London, W.C.2, England)

24–28. International **Astronautical** Federation, congr., Sofia, Bulgaria. (J. A. Stemmer, IAF, P.O. Box 37, Baden, Switzerland)

24–28. **Organometallic Derivatives**, intern. colloquium, Paris, France. (H. Normant, Faculté des Sciences, Université de Paris à la Sorbonne, 47 rue des Ecoles, Paris 5e)

24–29. International Committee on Electrochemical **Thermodynamics and Kinetics**, Rome, Italy. (N. Ibl, c/o Laboratory of Physical Chemistry, Federal Polytechnicum, 6 Universitätsstrasse, Zurich, Switzerland)

24–29. **Pharmaceutical** Sciences, intern. congr., Vienna, Austria. (W. Thor, Organizing Committee, Spitalgasse 31, Vienna 9)

24–29. Technical Assoc. of the **Pulp and Paper** Industry, annual conf., Stockholm, Sweden. (I. F. Hendry, Research and Development, Wigging Teape & Co., Ltd., Beaconsfield, Bucks, England)

24–30. European **Seismological** Commission, general assembly, Jena, Germany. (E. Peterschmitt, ESC, 38 Boulevard d'Anvers, Strasbourg, France)

24–30. Vital Substances, **Nutrition, and Civilization Diseases**, intern. convention, Garmisch-Partenkirchen, Germany; and Innsbruck, Austria. (Intern. Soc. for Research on Nutrition and Vital Substances, Bremeroderstr. 61, Hanover-Kirchrode, Germany)

25–28. Association of **Iron and Steel** Engineers, Cleveland, Ohio. (Managing Director, AISE, 1010 Empire Bldg., Pittsburgh 22, Pa.)

25–28. Electric **Power Systems for Space**, conf., Santa Monica, Calif. (American Rocket Soc., 500 Fifth Ave., New York 36)

26–28. Practice of **Gas Chromatography**, meeting, East Lansing, Mich. (C. G. Harriz, Houdry Process & Chemical Co., Box 427, Marcus Hook, Pa.)

26–29. Austrian Soc. of **Biochemistry**, Society for Physiological Chemistry, German Pharmacology Soc., Vienna, Austria. (Secretariat, Vienna Medical Acad., 4 Alserstr, Vienna IX)

26–29. **Neurobiologists** intern. meeting, Kiel, Germany. (W. Bargmann, Neue Universität, Olshausenstrasse 40/60, Kiel)

27–29. **Protection of Plants** and Extermination of Pests, symp., Magdeburg, Germany. (Chemische Gesellschaft in der D.D.R., Unter den Linden 68–70, Berlin W.8, Germany)

27–29. Society for General **Microbiology**, Reading, England. (SGM, c/o Inst. of Biology, 41 Queen's Gate, London, S.W.7, England)

28-29. **Broadcast** Symp., annual, Washington, D.C. (G. C. Wetmore, Collins Radio Co., 1825 Connecticut Ave., NW, Washington 9)

28–30. **Medical Psychology**, intern. colloquium, Brussels and Louvain, Belgium. (P. H. Davost, Société de Psychologie Médicale de Langue Française, 2 rue de Rohan, Rennes, France)

30–5. American Soc. for **Testing Materials**, Pacific area, Los Angeles, Calif.

(Executive Secretary, ASTM, 1916 Race St., Philadelphia 3, Pa.)

30–6. Medical **Hydrology and Climatology**, intern. congr., Baden-Baden, Germany. (M. Fontan, c/o Faculté de Médecine, Lille, France)

October

1–3. Association of **Medical Illustrators**, annual, Detroit and Ann Arbor, Mich. (AMI, 1853 W. Polk St., Chicago 12, Ill.)

1–3. **Communications**, natl. symp., Utica, N.Y. (J. K. Webb, 489 Van Ellis Rd., Utica)

1–3. **Plastics**, intern. congr., Turin, Italy. (Segreteria, Congresso delle Materie Plastiche, Corso Galileo Ferraris 60, Turin)

1–4. American **Oil Chemists** Soc., Toronto, Canada (K. F. Mattil, Swift & Co., Packers and Exchange Aves., Chicago 9, Ill.)

1–4. **Electroencephalographic** Information, Marseilles, France. (R. Naquet, 23 rue de la Loge, Marseilles 2e)

1–4. **Iron and Steel**, intern., Luxembourg. (Secrétariat, c/o Centre National de Recherches Metallurgiques, Abbaye du Val-Benoit, Liége, Belgium)

1–4. **Shell Structures**, intern. conf., San Francisco, Calif. (A. C. Scordelis, Dept. of Civil Engineering, Univ. of California, Berkeley 4)

1–5. American Soc. of **Tool and Manufacturing Engineers**, Los Angeles, Calif. (R. M. Johnson, 3336 Stinson Blvd., Minneapolis 18, Minn.)

1–6. **Food Standards**, conf., Geneva, Switzerland. (Intern. Agency Liaison Branch, Office of the Director General, Food and Agriculture Organization, Viale delle Terme di Caracalla, Rome, Italy)

1–6. International **Astronomical** Union, symp. on site testing, Rome, Italy. (D. H. Sadler, c/o Royal Greenwich Observatory, Herstmonceux Castle, Hailsham, Sussex, England)

1–6. International Soc. of **Photogrammetry**, Milan, Italy. (A. L. Nowicki, c/o Army Map Service, 6009 Massachusetts Ave., N.W., Washington, D.C.)

1–6. **Malaria**, conf., Manila, Philippines. (World Health Organization, Regional Office for the Western Pacific, P.O. Box 2932, Manila)

1–10. International Council for the **Exploration of the Sea**, Copenhagen, Denmark. (ICES, Charlottenlund Slot, Charlottenlund, Denmark)

2–4. Advanced **Propulsion** Concepts, Cincinnati, Ohio. (M. M. Slawsky, Air Force Office of Scientific Research, Washington, 25)

2–4. **Batteries**, intern. symp., Bournemouth, England. (D. H. Collins, Inter-Departmental Committee on Batteries, Admiralty Engineering Laboratory, W. Drayton, Middlesex, England)

2–4. **Fluid Amplification**, symp., Washington, D.C. (by invitation only). (Public Information Officer, Diamond Ordnance Fuze Laboratories, Room 315, Bldg. 83, Washington 25)

2–4. **Physics and Nondestructive Testing**, symp., San Antonio, Tex. (D. L. Black, Southwest Research Inst., Box 2296, San Antonio)

2–4. **Space Electronics and Telemetry**, symp., Miami Beach, Fla. (O. A. Hoberg,

Marshall Space Flight Center, M-ASTR-I, Bldg. 4487-B, Huntsville, Ala.)

2–5. American **Roentgen Ray** Soc., Washington, D.C. (C. A. Good, Mayo Clinic, Rochester, Minn.)

2–5. **Animal Care Panel**, annual, Chicago, Ill. (R. J. Flynn, Argonne National Laboratory, Argonne, Ill.)

2–5. **Human Engineering**. Annual inst., Stamford, Conn. (J. H. Ely, Dunlap and Associates, 429 Atlantic St., Stamford)

2–5. **Prophylactic Medicine and Social Hygiene**, intern. congr., Bad Godesberg, Germany. (Kongressbüro, Postfach 864, Bad Godesberg)

2–8. Committee on **Human Genetics**, World Health Organization, Geneva, Switzerland. (WHO, Palais des Nations, Geneva)

2–9. **Sanitary Engineers**, seminar, Belgium. (World Health Organization, Regional Committee for Europe, 8 Scherfigsvej, Copenhagen Ø, Denmark)

3. **California Acad. of Sciences**, San Francisco. (S. W. Muller, CAS, Golden Gate Park, San Francisco)

3–5. International Union for **Applied Ornithology**, Frankfurt am Main, Germany. (S. Pfeifer, Institut für angewandte Vogelkunde, Steinauer Strasse 44, Frankfurt am Main-Fechenheim)

3–5. New **Respiratory Disease Viruses**, intern. conf., Bethesda, Md. (C. G. Loosli, Univ. of Southern California School of Medicine, 2025 Zonal Ave., Los Angeles 33)

3–6. **Optical** Soc. of America. Rochester, N.Y. (M. E. Warga, Executive Office, OSA, 1155 16 St., NW, Washington, D.C.)

4–5. International Soc. for **Geomechanics**, congr., Salzburg, Austria. (Landesverkehrsamt Salzburg, Mozartplatz 10/1, Salzburg)

4–5. International Soc. of **Rock Mechanics**, colloquium, Salzburg, Austria. (ISRM, Franz-Josef-Str. 3, Salzburg)

4–5. **Solid Fuels**, conf., Pittsburgh, Pa. (Society of Mining Engineers, Coal Div., 345 E. 47 St., New York 17)

5–7. Association of **Cereal Research**, milling conf., Detmold, Germany. (Arbeitsgemeinschaft Getreideforschung, Am Schützenberg 9, Detmold)

5–10. **Moorland Research**, intern. congr., Bremen, Germany. (Internationale Gesellschaft für Moorforschung, Hauptstr. 26, Vaduz, Liechtenstein)

6–7. American Acad. of **Psychotherapists**, annual conf., Chicago, Ill. (A. Ellis, Parc Vendome, 333 W. 56 St., New York 19)

6–7. **Parathyroid Insufficiency** and **Chronic Tetany**, intern. symp., Paris, France. (H. P. Klotz, Hôpital Bichat, 170 Boulevard Ney, Paris 18e)

6–12. **Electronic Computers** in Civil Engineering, symp., Lisbon, Portugal. (M. Rocha, Laboratório Nacional de Engenharia Civil, Av. do Brasil, Lisbon)

7–9. **Neurology** and Neurological Sciences, congr., Tokyo, Japan. (Japanese Organizing Committee, c/o 3rd Dept. of Internal Medicine, Faculty of Medicine, University of Tokyo, Hongo, Tokyo)

7–10. **Process Engineers**, annual, Mainz, Germany. (Verfahrenstechnische Gesellschaft, Verein Deutscher Ingenieure, Rheingau-Allee 25, Frankfurt am Main, Germany)

7–10. Society of **Petroleum Engineers**, Los Angeles, Calif. (SPE, 345 E. 47 St., New York 17)

7–13. **Cardiology**, intern. congr., Mexico City, Mexico. (I. Costero, Instituto Nacional de Cardiologia, Ave. Cuauhtemoc 300, Mexico 7, D.F.)

8–10. **Electronics**, natl. conf., Chicago, Ill. (National Electronics Conf., 228 N. La Salle St., Chicago 1)

8–11. **Allergy**, congr., Basel, Switzerland. (R. Schuppli, c/o Dermatologische Universitäts-Klinik, Basel)

8–11. **Infectious Pathology**, intern. congr., Bucharest, Rumania. (N. Cajal, Str. Dumbrava, Rossie 23, Bucharest)

8–11. **Otorhinolaryngology**, congr., Paris, France. (H. Guillon, French Soc. of Otorhinolaryngology, 6 Avenue MacMahon, Paris 17e)

8–11. **Water Pollution Control** Federation, annual, Toronto, Canada. (R. E. Fuhrman, Executive Secretary, WPCF, 4435 Wisconsin Ave., NW, Washington 16, D.C.)

8–12. American Soc. of **Civil Engineers**, Detroit, Mich. (W. H. Wisely, 345 E. 47 St., New York 17)

8–12. Industrial **Forestry**, seminar, St. Paul, Minn. (Z. W. White, Yale School of Forestry, 205 Prospect St., New Haven 11, Conn.)