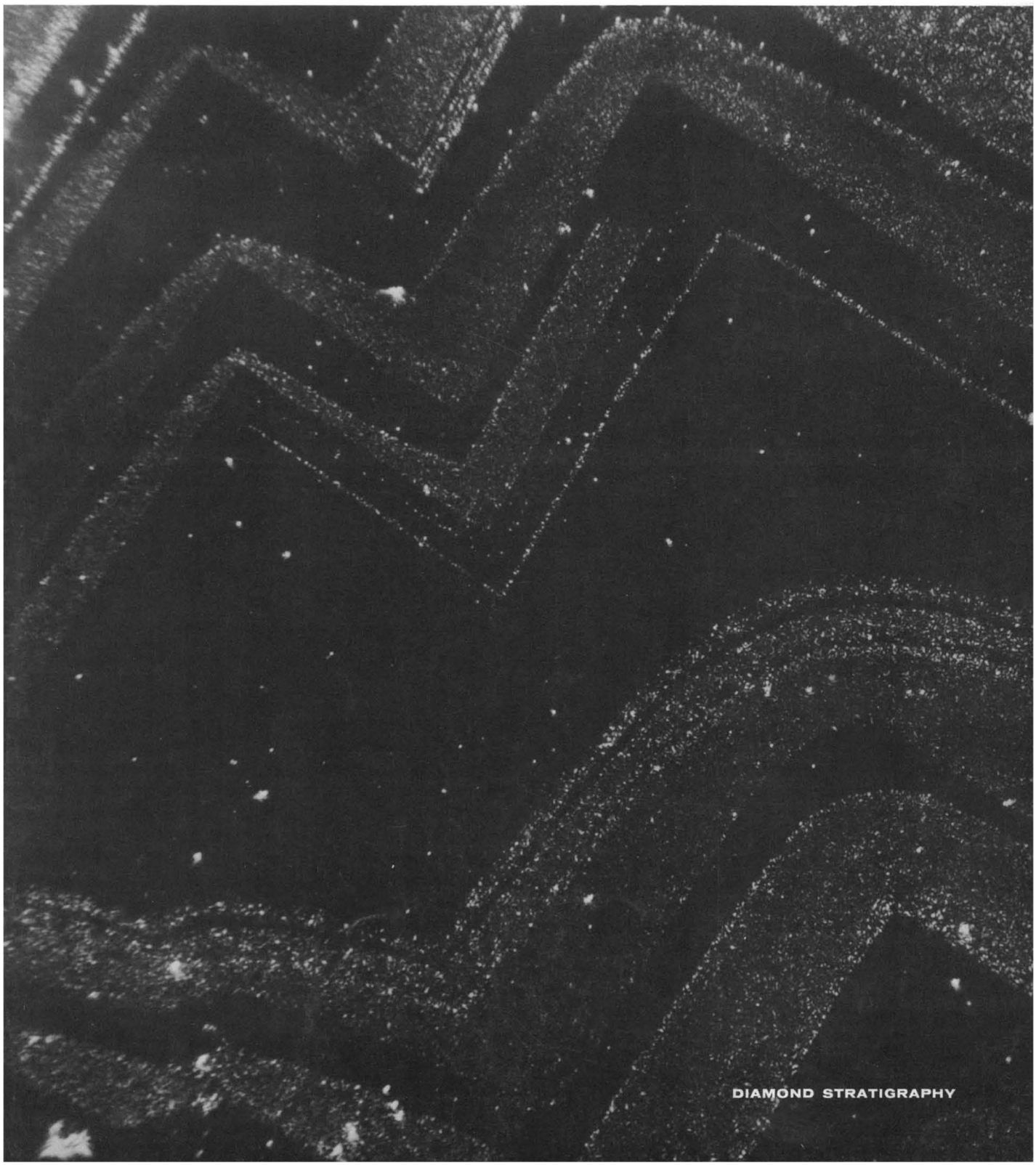
SCIENCE 8 September 1967
Vol. 157, No. 3793
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE



DIAMOND STRATIGRAPHY

In initial tests using a rhesus monkey, two members of the research team at Stanford control the blue-green beam from a Model 140 continuous wave argon laser by means of a shutter mechanism and an optics aiming device.

Laser medical researchers get green light

The first laser retinal "spot-welding" was done with a red light, from a ruby laser. The technique was successful, but it was only a beginning. In new research — aimed at a more fundamental understanding of the effects of laser energy on ocular tissue — a team of ophthalmologists and scientists at Stanford Medical School and Stanford Research Institute is exploring many new directions. In the process the team is using a new gas laser which can emit light of varying colors.

In laser photocoagulation, for example, one of the problems has been that the red light of the ruby is not well absorbed by the red color of hemoglobin, thus limiting its effectiveness in treating blood vessel diseases of the retina. Now the researchers have the use of green light from Spectra-Physics' Model 140 argon laser, light which is absorbed more completely than the red, and which perhaps will prove useful in treating these blood vessel problems.

In other tasks, the researchers hope to (1) determine if any particular laser beams or wavelengths have advantages over others in treating eye diseases with light; (2) photograph — with cameras capable of exposing up to 9,000 frames per second — the actual impact of the laser beam on ocular tissues; and (3) create a hologram of the inside of the human eye, to provide a 3-D image they can then study at leisure.

For medical applications, as well as for other scientific, industrial, geodetic, and military uses of laser energy, Spectra-Physics gas lasers have illuminated nearly every significant advance. Perhaps a look at our product line will suggest some of the reasons why. Write or call us at 1255 Terra Bella, Mountain View, California 94040; (415) 961-2550. In Europe, Spectra-Physics, S.A., Mellingerstrasse 6, 5401 Baden, Switzerland.

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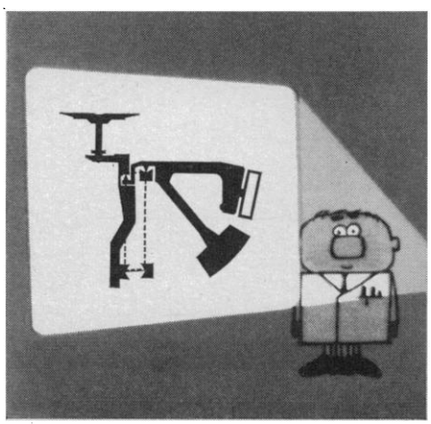

Mettler P-type balances, this film helps you convey the complete story in minimum time and with maximum impact. This film is particularly timely, now that the top-loader is gaining ever wider acceptance in research, industrial and academic fields.

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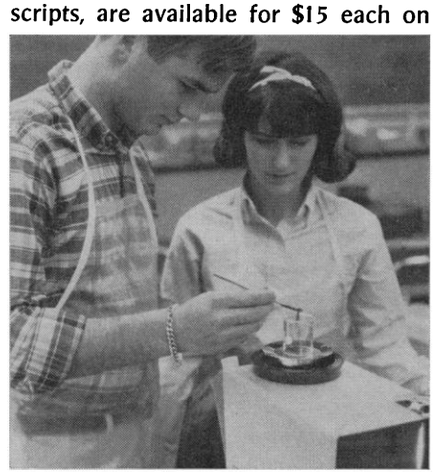
Filmstrips, accompanied by records and scripts, are available for $15 each on



the following subjects: how to use Mettler P120, P1000, or P1200 top-loading balances; how to use Mettler H6 Digital or H15 analytical balances; top-loading balance theory; analytical balance theory; and sources of weighing errors. These permit individual students or small groups to cover a single topic in only eight minutes.

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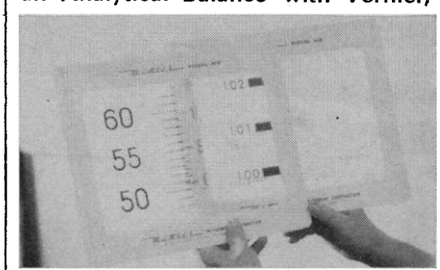

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COVER

Diamonds, when sectioned and etched lightly in hot potassium nitrate, produce a stratigraphy of etch pits. When illuminated obliquely, the etched diffusing regions appear bright; the nonetched regions appear dark. Etched regions, presumably rich in dislocations, are type I regions; the dark areas are type II. Clearly, the crystal has grown in alternating layers of the two types (about × 650). See page 1173. [S. Tolansky, Royal Holloway College, University of London]

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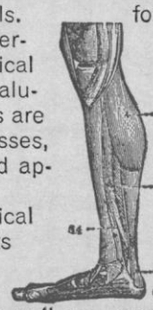

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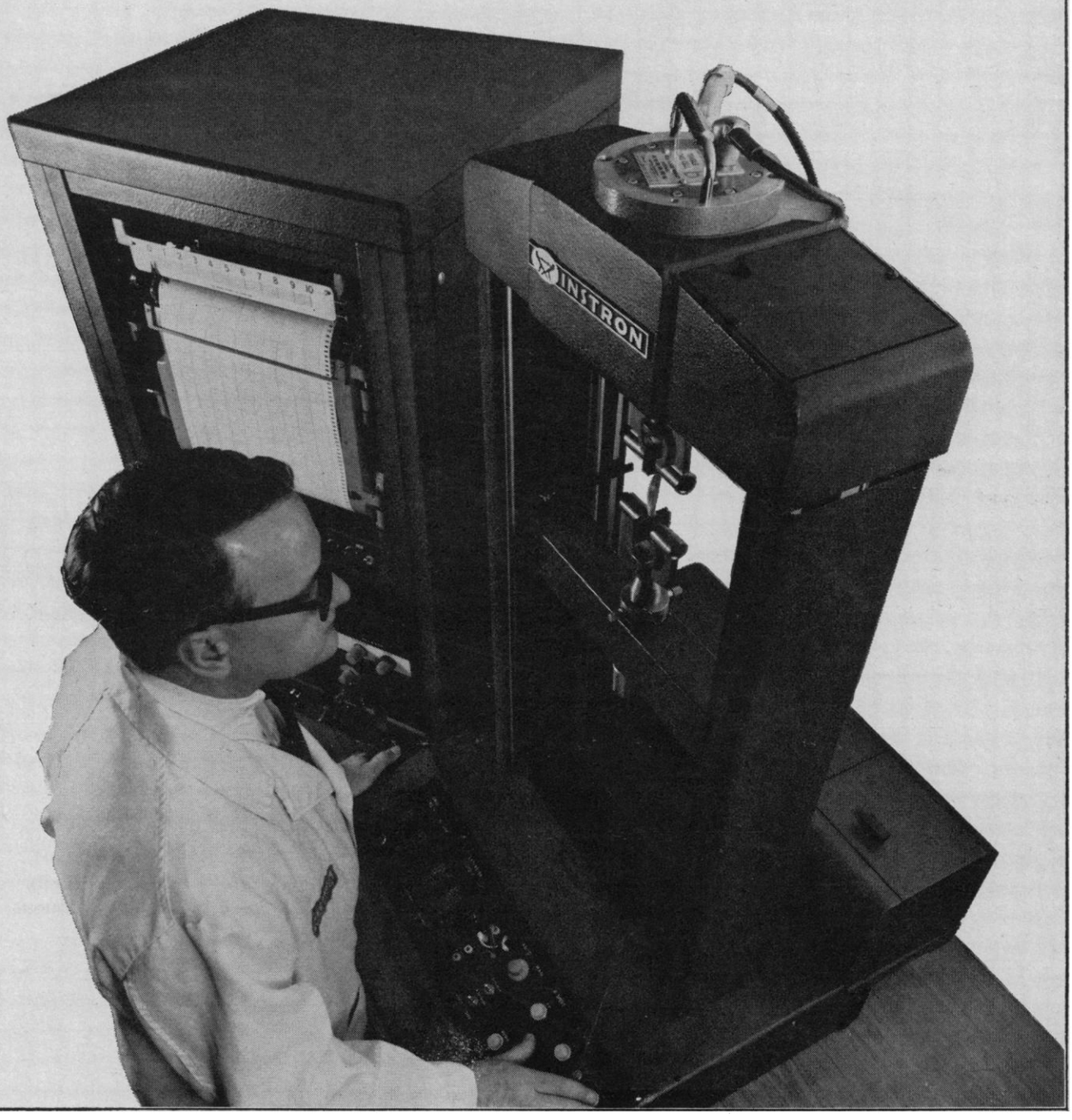

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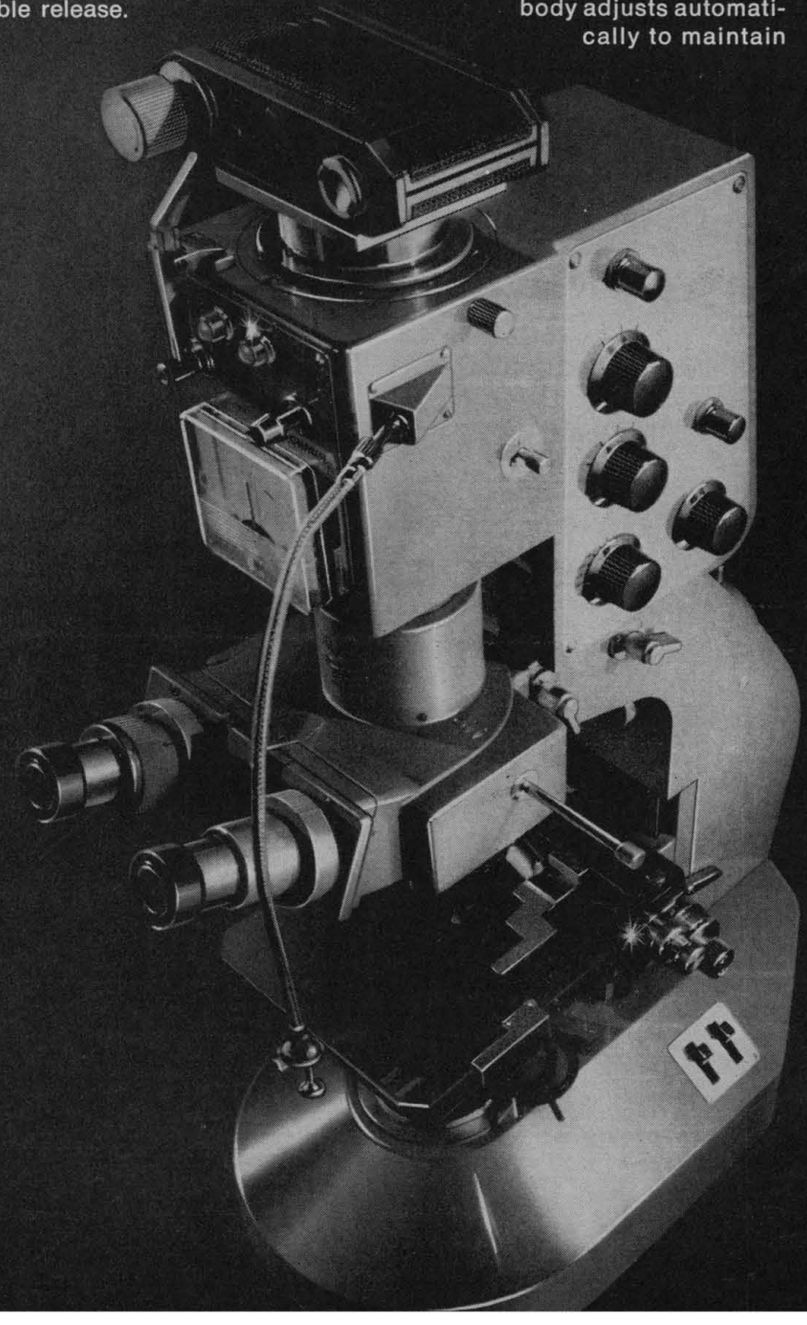

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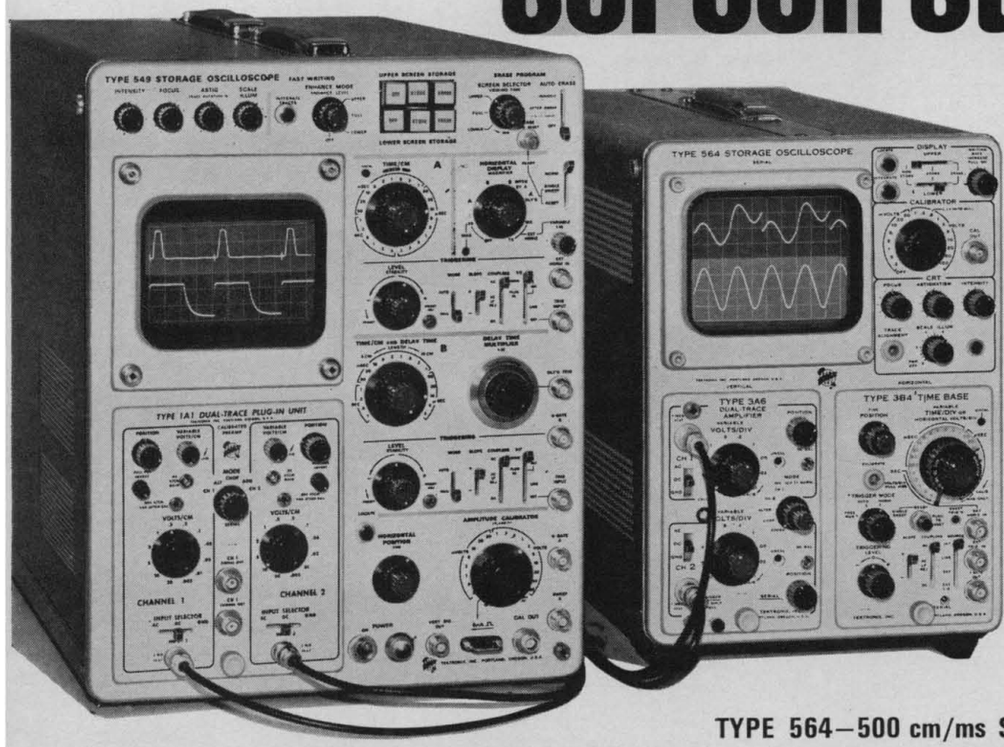

with either of these Tektronix oscilloscopes

TYPE 549—5000 cm/ms STORED WRITING SPEED

The exclusive Tektronix split-screen storage feature is available in two oscilloscopes, the Type 549 and the Type 564.

You can use these oscilloscopes for storage or conventional operation—simultaneously—through use of their unique split-screen display capabilities. Either half of the screen can be used for up to one hour of continuous visual storage, the other half for nonstored displays, or the entire area can be used for conventional or storage displays. Each half of the screen can be independently controlled. Erase time is less than one-quarter of a second.

Variable viewing time — an outstanding feature of the Type 549 — allows you to automatically store displays, view them for a selected time, then automatically erase them on either or both halves of the screen. Two modes of operation are possible. In the After-Sweep Automatic Erase Mode, the selectable viewing time of 0.5 s to 5 s begins at the end of each complete sweep. After the viewing time, the display is automatically erased and the cycle begins again when the next sweep is triggered by a signal.

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The Type 549 uses letter and 1-series plug-ins for vertical deflection. Bandwidth in nonstored operation extends from DC to 30 MHz, depending upon the plug-in used. Two integral time bases provide calibrated delayed-sweep operation.

TYPE 564—500 cm/ms STORED WRITING SPEED

With bistable storage oscilloscopes, such as the Type 564 and Type 549, the contrast ratio and brightness of stored displays are constant and independent of the viewing time, writing and sweep speeds, or signal repetition rates. This also simplifies waveform photography. Once initial camera settings are made for photographs of one stored display, no further adjustments are needed for photographs of subsequent stored displays.

Tektronix bistable storage cathode ray tubes are not inherently susceptible to burn-damage and require only the ordinary precautions taken in operating conventional oscilloscopes.

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Similar electrical specifications to Type 564.

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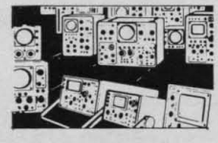

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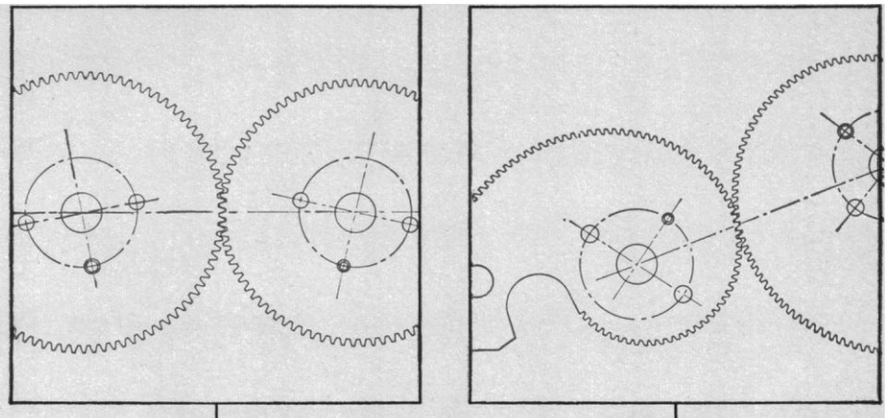
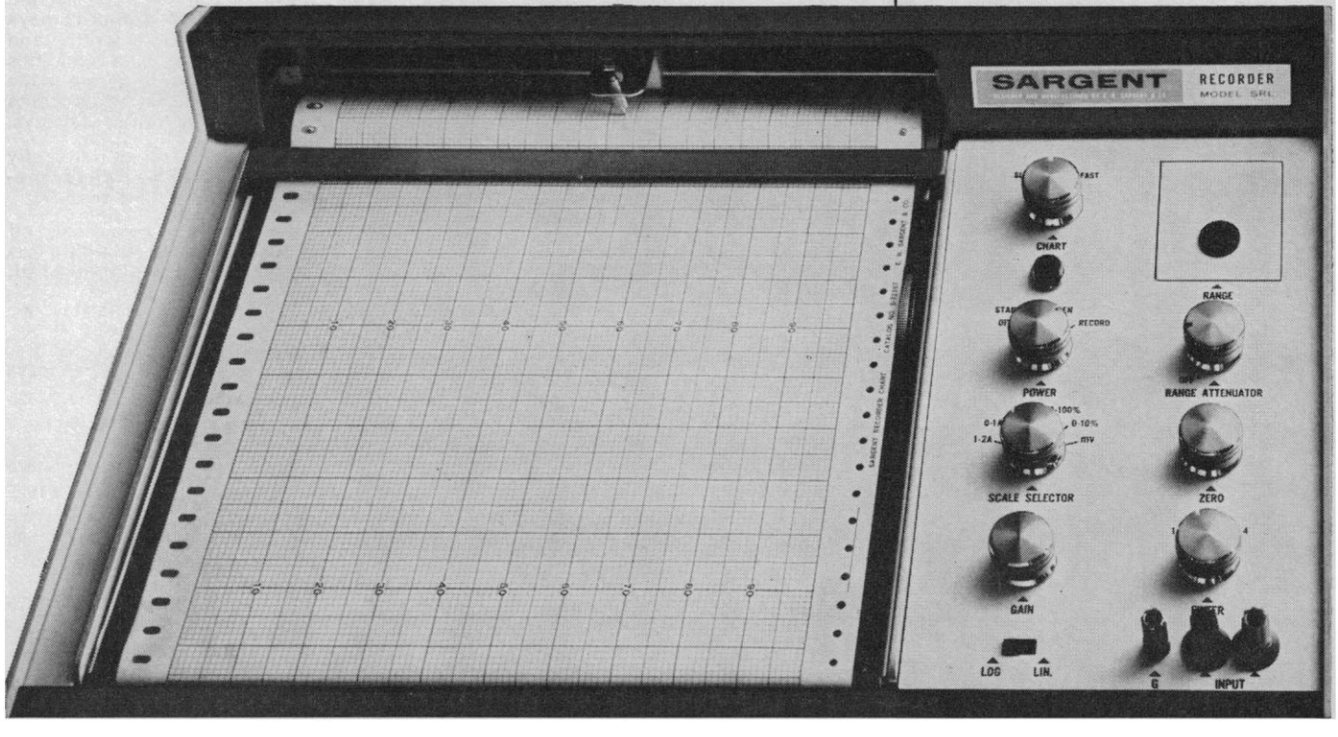
Please call your Sargent man or write to us to arrange for a demonstration of the SRL Recorder.

7-215

X vs. time or log X vs. time. Just change gears on Sargent's SRL recorder to plot either.





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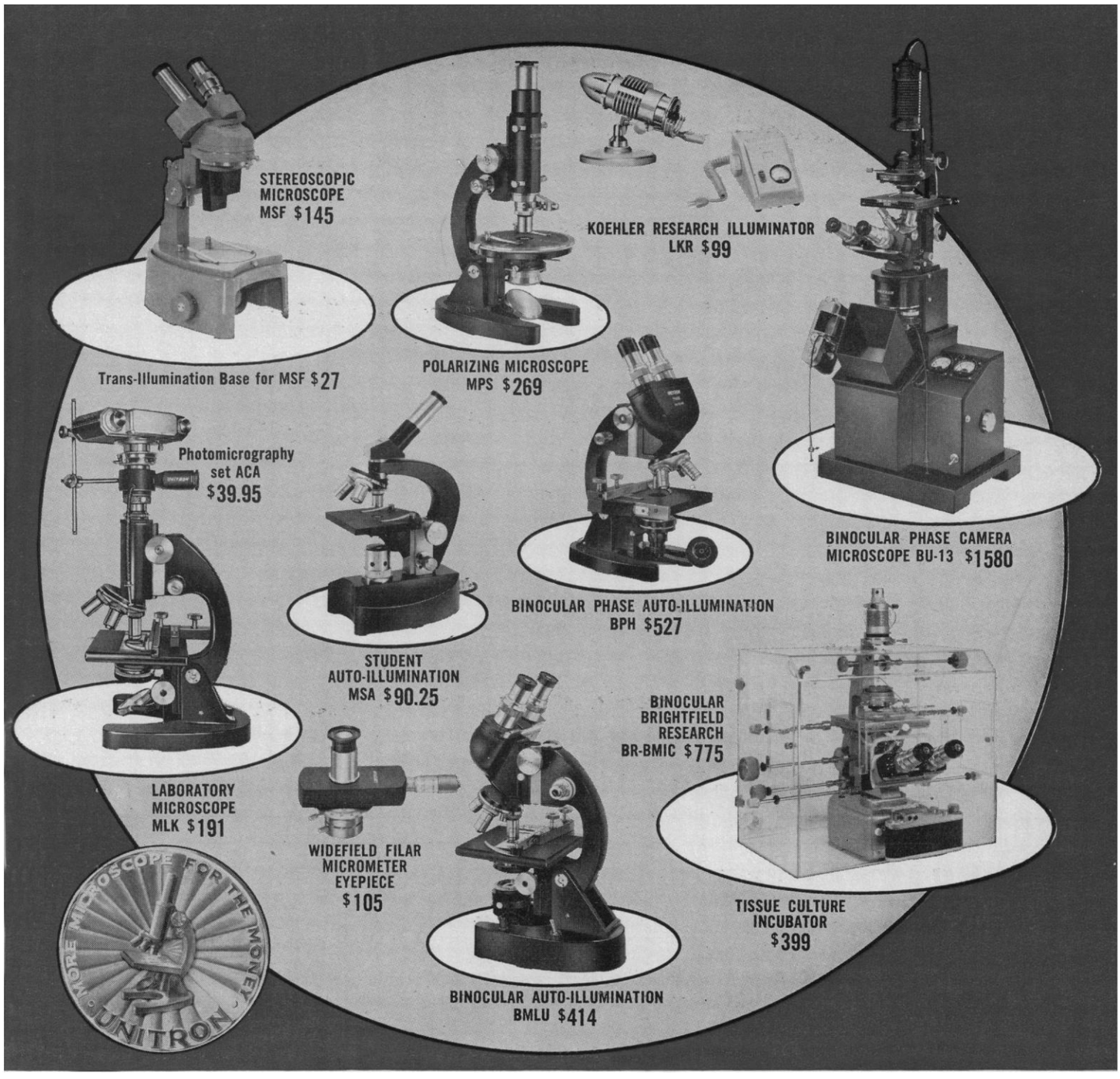

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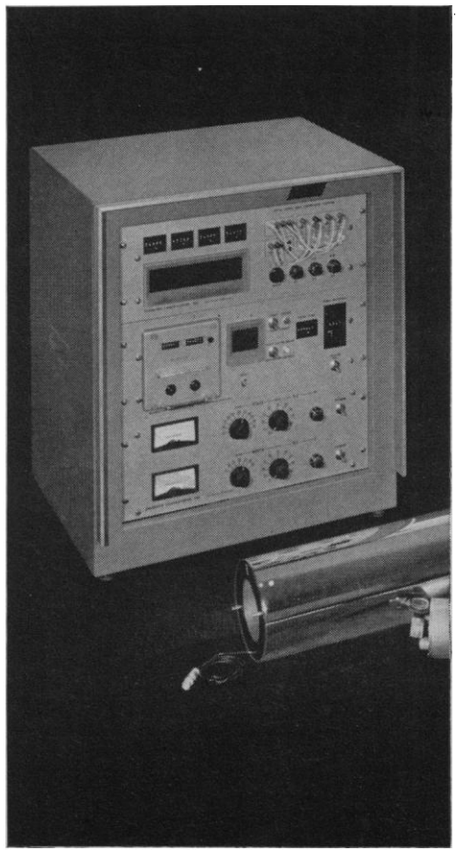

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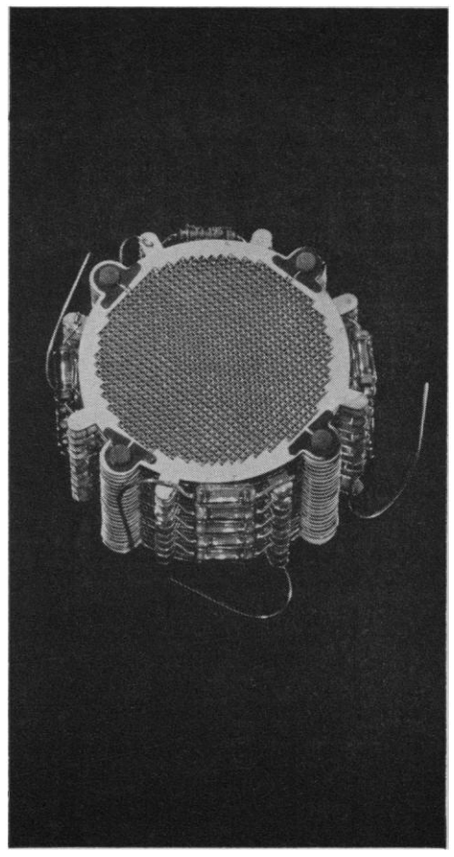

A particle multiplier that can be reactivated.

This is a particle multiplier for the pulse counting or current measurement of electrons, ions, and UV and x-ray photons. In addition to its remarkable resistance to gain degradation, this unit can actually be reactivated over and over again. We guarantee at delivery a gain better than 10^6 at 3KV (*and*, at a slightly higher voltage, 10^8 electrons per electron in pulse counting — with low noise). If the gain drops below 10^6 at 3.5KV under normal operation within one year of purchase, the first reactivation will be gratis. (Subsequent reactivations at a small charge.) This twenty-stage focused mesh particle multiplier is significantly smaller than typical multipliers (2″ dia. by 1¼″ long). Bakeable (max. 400°C in vacuum), lightweight, rugged, has a fast output rise time, and comes complete with an integral voltage divider chain. The MM-1 forms a surprisingly compact, *complete system* when combined with our PAD-1 Fast Precision Preamplifier-Amplifier-Discriminator and our HV-2 or HV-4 High Voltage Power Supplies.

For more information, request GC10-S.
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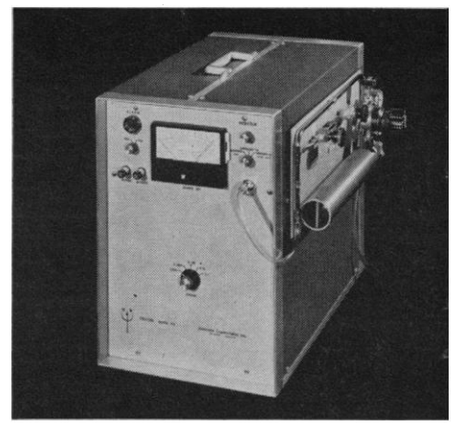
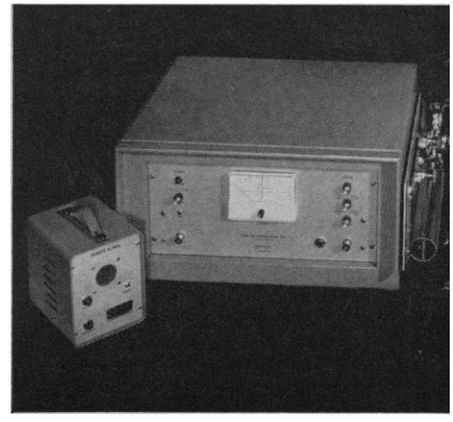




Tritium air and gamma area monitoring systems.

These unique systems are the only ones that combine tritium air and gamma area monitors with calibrators and remote alarm stations. They can also monitor argon-41, carbon-14, chlorine-36, fluorine-18, krypton-85, radon-222, sulfur-35, xenon-133 and xenon-135. Advanced design provides primary gamma compensation and insensitivity to cigarette smoke and airborne dust. The accuracy and reliability of these instruments provide maximum confidence when monitoring: nuclear reactors, neutron generators, stack gas, isotope laboratories, etc.

Triton 755 B System (lower photo): accurately monitors airborne tritium or ambient low-level gamma radiation or beta-emitting isotopes. Exceptional stability and sensitivity also permit analytical applications.

Triton 855 (not shown) and 955 Systems (upper photo): more sensitive than the 755 and ideal where monitoring of extremely small amounts of gaseous radioactive contamination is a necessity. The 955 System is portable and weighs less than 50 lbs.

For more information, request GC10-S.
Circle No. 12 on Readers' Service Card

Low-level radon systems: for information on our low-level radon collection and transfer system, counter, counting system and accessories, request RC-S.

JOHNSTON LABORATORIES, INC.,
3617 Woodland Avenue, Baltimore, Maryland 21215

Let us Show You —

What these new microscopic techniques

Can do for You

INTERFERENCE CONTRAST (NOMARSKI)

This new contrast technique reveals specimen details not obtainable by any other contrast method. It shows images in colors or black and white in a pronounced halo free relief. This phenomenon is characteristic for interference contrast produced by birefringent optical elements, in this case, a special turret condenser in combination with Wollaston prisms, rotatable filter polarizer and analyzer.

CONTRAST FLUORESCENCE MICROSCOPY

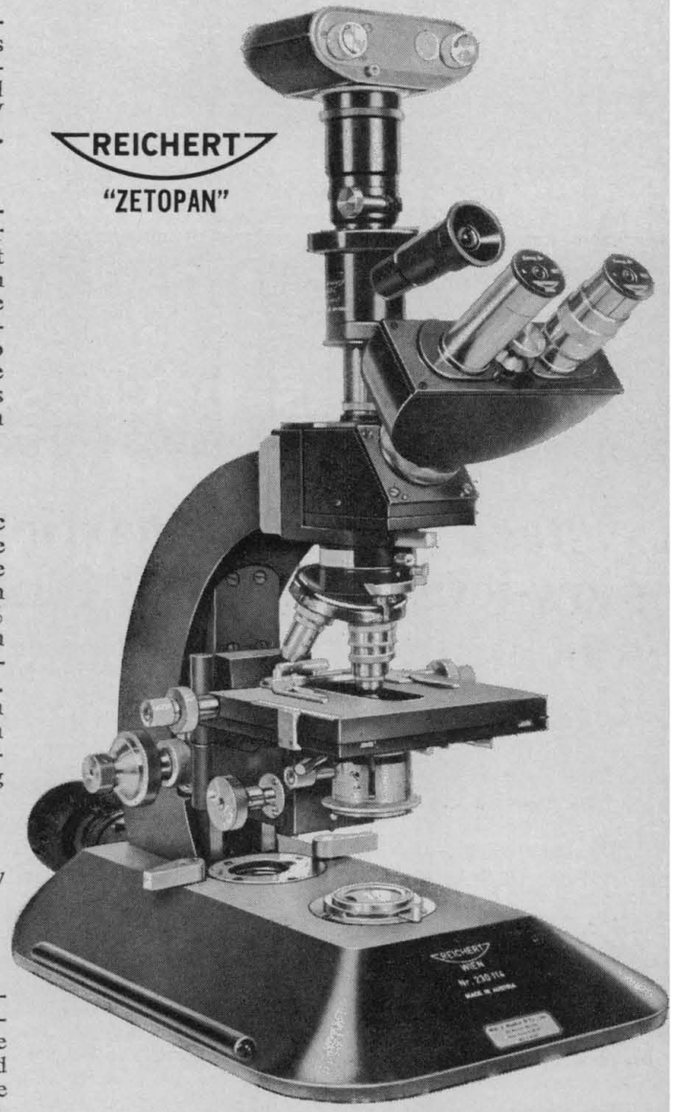
This technique enables examination of fluorescent specimens in positive and negative phase contrast (simultaneous contrast fluorescence) by superimposing a bright fluorescence image on the phase contrast image. It is accomplished by simultaneous application of visible (white) and UV illumination and a unique fluorescence-contrast condenser.

MICROPHOTOMETRIC MEASUREMENTS

For the quantitative determination of reflectivity, absorptivity and extinction or fluorescence intensity and their variation with wave length by means of the new Reichert microphotometer (spectrophotometer) in combination with the "Zetopan". Specimen and measuring diaphragm are viewed simultaneously for infinitely reliable specimen detail location at all objective powers. An integrated photo multiplier assures linearity of indication far exceeding the measuring accuracy of 0.5%. This sensitivity permits measurements of the smallest structural constituents down to 0.5 micron.

AUTOMATIC PHOTOMICROGRAPHY

The new Reichert "Photo Automatic" is a fully automatic photomicrographic camera. It indicates the exposure time *prior* to actual exposure enabling the operator to decide whether the indicated exposure time is reasonable. A beam splitter directs 80% of the light to the camera and 20% to the focusing telescope. The frame size is 24 x 36 mm with readily interchangeable cassettes. A vibration-free magnetic shutter provides for exposures starting at 1/250 sec. with a range to any exposure time necessitated by film and specimen. The film speed setting can be varied between ASA 6 and 1600. The magnification of the built-in photographic eyepiece is variable from 6.3x to 10x eliminating the need for changing objectives.



These and other advanced techniques in optical microscopy are available to you with the . . .

REICHERT RESEARCH MICROSCOPE "ZETOPAN"

The "ZETOPAN" has built-in illuminating systems for reflected, transmitted and mixed light . . . Brightfield, Darkfield and Oblique Illumination. Separate independent tube for convenient photomicrography, including new Polaroid Land Camera Back for instant color or black and white pictures. Automatic and semi-automatic exposuremeters. Light sources include high intensity, xenon and mercury arc, iodine quartz and monochromatic lamps.

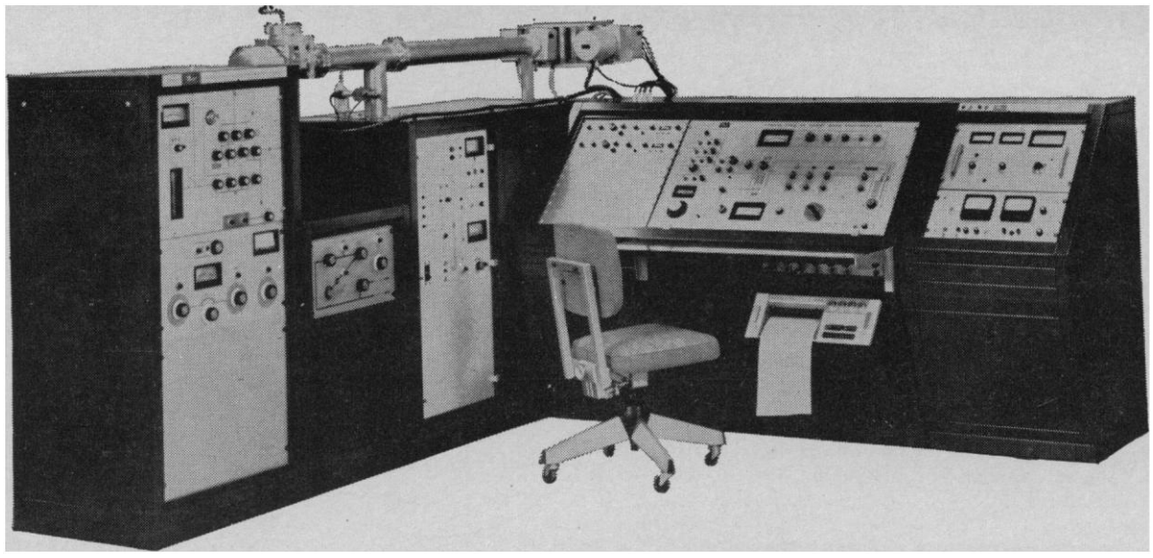
SEE FOR YOURSELF WHAT THESE MODERN TECHNIQUES CAN DO FOR YOU!

Request literature and demonstration of the "ZETOPAN" Write to:

William J. Hacker & Co., Inc.

Box 646, West Caldwell, New Jersey 07006 (201) 226-8450

Hacker



Just because this is the world's fastest Mass Spectrometer doesn't mean you can't use it in general analytical labs.

The Bendix® Time-of-Flight Mass Spectrometer is a versatile analytical instrument that can be used in over 25 different research and analysis areas. *Now with unit mass resolution of 700* ($M/\Delta M$), it's accurate enough to use in general applications for both organic and inorganic work. Use it, for example, in monitoring chromatograph output. Laser vaporization. Organic structure analysis and identification. Thermodynamic studies. Shock tube research, combustion analysis and fast reaction studies, too.

Through it all, you'll see unequalled speed—10,000 to 100,000 measurements per second. Mass range up to 5,000 amu. Detectability of 1 to 5 ppm. and sensitivity to 10^{-13} torr or better. And thanks to the exclusive magnetic electron multiplier, you can have oscilloscope and analog/recorder readout simultaneously.

In addition to measuring positive or negative ions, you can have up to six analog/recorder channels. With each one scanning a separate peak or group of peaks with the oscilloscope viewing the full spectrum—all at the same time. You can also add the total output integrator to integrate the spectrum or any part of it.

Ease of operation? The Bendix TOF Mass Spectrometer wins hands down here, too. No difficult alignment or stringent geometric conditions are required. Ion source, flight tube and high-gain magnetic electron multiplier detector are all in a single, straight tube. Almost any kind of inlet system is easily adapted. Laser microprobe, molecular leak, direct inlet, ion molecule source, fast reaction, hot filament, Knudsen cell and gas chromatograph manifold included.

It's all been proven in hundreds of installations in major universities and private industry throughout the world. Isn't now the time to let a Bendix TOF Mass Spectrometer prove itself to you?

Bendix scientific instruments—including mass spectrometers, atomic absorption and flame spectrophotometers, polarimeters, polarographic systems and electron multipliers—are used in over 100 areas of research and analysis. For more information on any of our instruments, write: **The Bendix Corporation, Scientific Instruments Division, 3625 Hauck Road, Cincinnati, Ohio 45241. Or phone (513) 772-1600.**

Bendix

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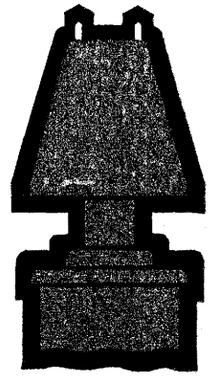
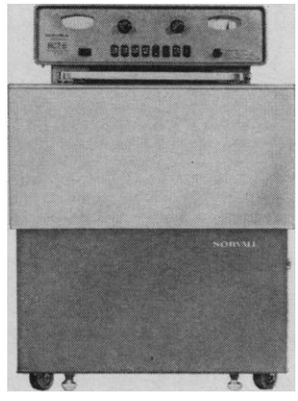
...ON GYRO-ACTION DIRECT DRIVE



Patented, Gyro-Action Direct Drive is one of the main reasons so many researchers and technologists specify SORVALL centrifuges. This drive permits the rotor maximum freedom of action, and gives smoother acceleration run, and deceleration, than any other drive in the low-speed to superspeed range. Precipitate resuspension problems during braking are eliminated. This drive allows for a certain margin of rotor load imbalance. Many rotor loads need only visual equalization prior to centrifugation. Rotors are merely set down onto this drive and a positive "coupling" is obtained without use of any tools. Illustrated here is the RC2-B Superspeed Automatic Refrigerated Centrifuge (49,500 x G). Other SORVALL centrifuges with this exclusive feature are SS-3 Automatic and the SS-4 Manual (34,800 x G), the RC-3 Automatic Refrigerated (6,975 x G), and the GLC-1 General-Laboratory Automatic (4,950 x G). For the many other advantages, just write: Ivan Sorvall, Inc., Norwalk, Connecticut 06852.

SORVALL®



For additional information, ask for Bulletin Sc-9GRC-2

A laboratory that needs a computer always needs more than a computer... unless it's a LINC-8

A laboratory needs ways to get data into the computer, for example. Ways to look at the results. Ways to store masses of data. Ways to get at that data, easily. Ways to communicate with the machine easily, so that it could do things that need doing. If you add up the basic computer and all the needed attachments, you have exceeded the price of the LINC-8 — and you still haven't got what the LINC-8 uniquely offers.

For LINC-8 is more than a general purpose digital computer. It is, in fact, two digital computers (the PDP-8 and the LINC) with built-in A to D converter, oscilloscope display, automatic tape loader, dual magnetic tape unit for mass storage, relay buffer, buffered input-output lines, teletype-writer and two complete software packages, one with FORTRAN compiler. $38,500.

And this is what you can't buy when you do it by separate attachments.

To put a LINC-8 into full operation, you put your tape on the tape rolls, hit the "Load" switch, the "Do" switch, the "Start" switch and you're on the air. 5 seconds. The display scope is reading "Which Program?" You go to the typewriter and tell it.

And this, too. LINC-8 is not only the easiest computer system to operate — it is also the easiest computer in the world to communicate with. Some scopes and some scientists have spoken to each other so often, you could almost call them friends.

Write for a free copy of the "Small Computer Handbook". LINC-8 is described therein.

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The H-P Auto-Viscometer System pays for itself by eliminating time-consuming manual methods while improving precision at least 20 times

The Auto-Viscometer System makes two important contributions to capillary viscometry.

First it automates the method by making influxing, efflux time measurement and digital readout all automatic.

Secondly, a new optional module, the Model 5903A Programmer-Printer, repeats or sequences any combination of the 5901B's four channels, and prints out the results digitally . . . while completely unattended. Thus the Auto-Viscometer System can easily pay for itself entirely in terms of the way it releases the chemist for more creative and productive work.

A more important advantage of the Auto-Viscometer System—especially to the polymer chemist whose ultimate concern is the determination of viscosity-average molecular weight—is an improvement in precision of at least 20 times over manual methods. In a series of tests, two operators using manual methods were pitted against the Model 5901B. A comparison of the results shows that the Auto-Viscometer was 20 to 80 times more precise.

Sample (unfiltered toluene)	Standard Deviation (Rel. %)		
	Manual Method*		Auto-Viscometer** (5901B and 5910A)
	Operator A	Operator B	
Viscometer #1 (efflux: 38 sec)	0.53%	0.61%	0.007%
Viscometer #2 (efflux: 178 sec)	0.13%	0.14%	0.007%
*Based on 12 replicates **Based on 30 replicates			

You can find out how the H-P Auto-Viscometer produces such a dramatic improvement in precision by writing for Data Sheet 5900. Or call the nearest H-P sales office. Price for the 5901B Auto-Viscometer is $2650.00. The optional 5903A Programmer-Printer is $3600.00, and the 5910A Constant-Temperature Bath is $1650.00.

Hewlett-Packard, Route 41, Avondale, Pa. 19311. In Europe: 54 Route des Acacias, Geneva, Switzerland. Elsewhere: 1501 Page Mill Road, Palo Alto, California 94304.

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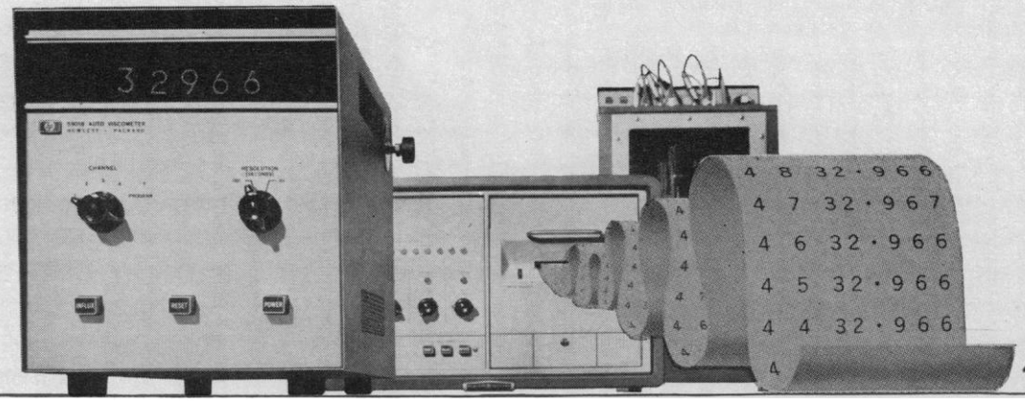
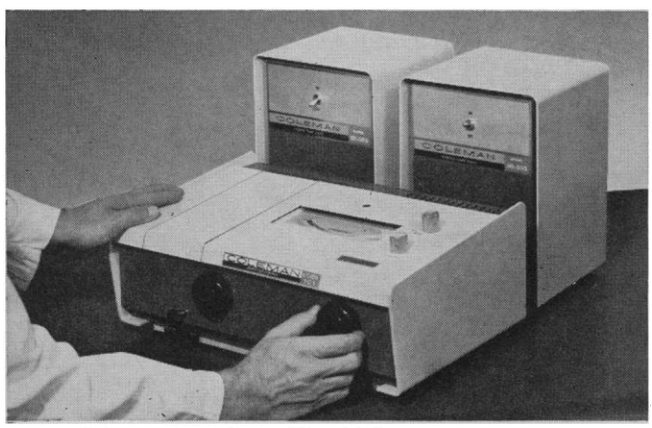
ANALYTICAL INSTRUMENTS

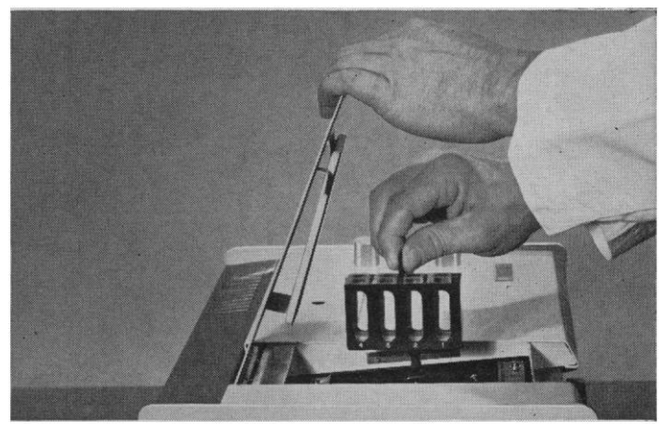


Fast, new UV-Visible spectrophotometer under $1700

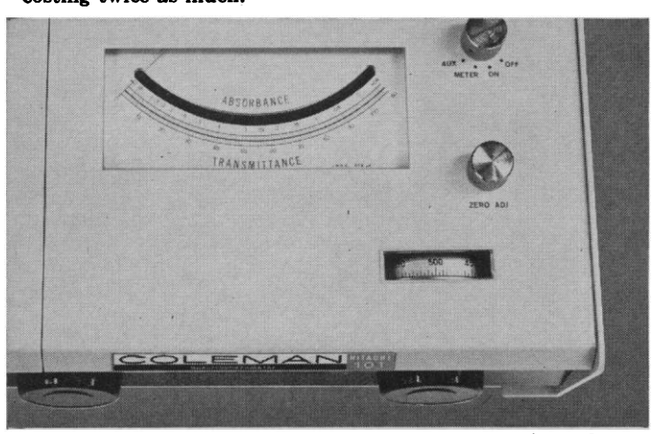
Coleman demonstrates an excellent instrument for barbiturate detection, enzyme analysis and a wide range of additional clinical and pharmaceutical applications.



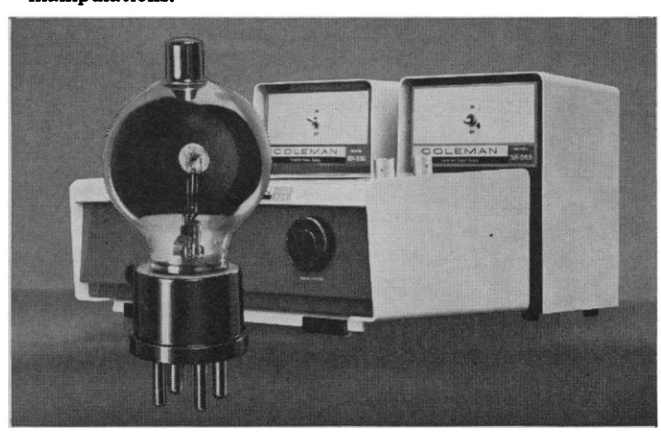
New Coleman Model 101 Hitachi Spectrophotometer covers the range from 220 to 900 mμ, where 95% of all analytical spectrophotometric data is obtained. Its photometric accuracy and stray light characteristics are the equal of instruments costing twice as much.



Operation is simple. When you open the sample compartment, an interlock mechanism automatically protects the optical system. You insert the cell holder, containing reference and three sample cells, and adjust for zero without any further manipulations.



Then shut the compartment, set 100% T and run three determinations in rapid sequence without re-opening the sample compartment. Wavelength scale is linear. The digital wavelength readout is located right next to the transmittance/absorbance meter.



And there's no detector switching. This exclusive Hitachi dual-range phototube covers the complete UV-Visible range of Model 101, eliminates time-consuming stops in the middle of an operation. It prevents errors due to faulty tube positioning.

Coleman Model 101 will fit handily on your workbench. Its largest dimension is only 16". The monochromator weighs just 28 lbs. Call your Coleman distributor. He'll be glad to tuck one under his arm and bring it in for a demonstration.

Other interesting features: Accommodates four, 5, 10, or 20 mm light path cells, available from Coleman; 10 mv recorder output jack. *Can be purchased three ways:* For UV work only, for Visible work only, or complete for full-range operation.

Send for brochure S-305

COLEMAN

The Hasselblad system... and a few reasons why the scientific and industrial photographer needs it.

The applications of photography in science and industry are numerous and undisputed. It would require many volumes rather than this single page just to list, let alone discuss, these applications. Both as a research tool and a recording device, photography has certainly proved not only convenient, but in many cases of sophisticated scientific and industrial research, invaluable.

Obviously, the single most important feature of photography is its ability to produce a permanent record of a visual happening. Something that may or may not be visible to the human eye. That may occur at a speed which would not make it visible to the human eye or that may occur in a place where it would not be convenient or even safe for a human observer to be.

It has long been acknowledged that the single most superior camera for most research purposes is the single lens reflex camera. Because all viewing and focusing is through the lens and is completely free from parallax error, then regardless of the combination of supplementary lenses, extension tubes and bellows extensions used, the image seen on the viewing screen is identical with the final picture.

Unfortunately, most of the single lens reflex cameras available to the researcher use the 35mm format and consequently suffer from lack of image quality when the negative is enlarged to any degree. This problem is overcome by the use of the 2¼ square format as in the Hasselblad system.

The simple fact is that there is not one camera system available today which offers the scientific or industrial photographer the choice of camera bodies, interchangeable film magazines, accessories and attachments, plus the superb optics of Carl Zeiss lenses with built in Synchro Compur shutters allowing the use of both flash and strobe at all speeds, that the Hasselblad system does.

Here's what the Hasselblad System consists of. Firstly, the 500C, the standard camera in the system[A]. It accepts all seven lenses available for the Hasselblad, and is a single lens reflex viewing camera. The 500C always shows you exactly how your final picture will turn out on the ground glass screen, in the same way a view camera does. This allows you to concentrate on the setting up and composition of your picture, no matter what lens or accessories you are using on the camera.

The lens, magazine, focusing hood and winding knob of the 500C are all instantly interchangeable.

Next is the Hasselblad Super Wide C. The camera that caused a breakthrough in 2¼ square photography. Equipped with a 38mm, 90° angle of view Zeiss Biogon f/4.5 lens, this camera allows you to take pictures previously considered impossible. The superb optics of the lens assures perfect distortion-free horizontal and vertical delineation, with sharpness of image from corner to corner of the negative area, even at full aperture. Depth of field at an aperture of f/22 is from 26 inches to infinity.

The newest camera in the Hasselblad System is the electrically driven Hasselblad 500EL. This camera automatically advances the film and cocks the shutter, allowing a rapid series of exposures to be made, either by use of the camera release or long release cords, timer or remote radio control. The 500EL accepts all the lenses and most accessories available for the 500C. Obviously one of the advantages of this camera is that the photographer is freed from the actual mechanics of picture taking and can therefore, devote himself completely to the subject.

The use of the 500EL with the Hasselblad 70mm film magazine, (up to 70 exposures on cassette loaded 70mm film) allows the photographer, working on a job where a large number of exposures are required, to handle his work load much more quickly and efficiently.

There are seven Carl Zeiss lenses in the Hasselblad System, 40, 50[B], 80, 120, 150, 250[C] and 500mm. Each lens has a built in Synchro Compur shutter, with automatic stopping down at the moment of exposure and manual preview for depth of field checks. Every lens has both M and X synchronization allowing the use of flash and strobe at all speeds up to 1/500th of a second.

Five different instantly interchangeable film magazines are available. These magazines allow the photographer to make 12 or 16 exposures on 120 film[D], 24 exposures on 220 film[E] and 70 exposures on 70mm film. The magazines also allow the choice of 3 formats, (2¼ square, 2¼ X 1⅝, 1⅝ X 1⅝). This allows not only for speed of operation, but the convenience of being able to change either film type or format in mid-roll.

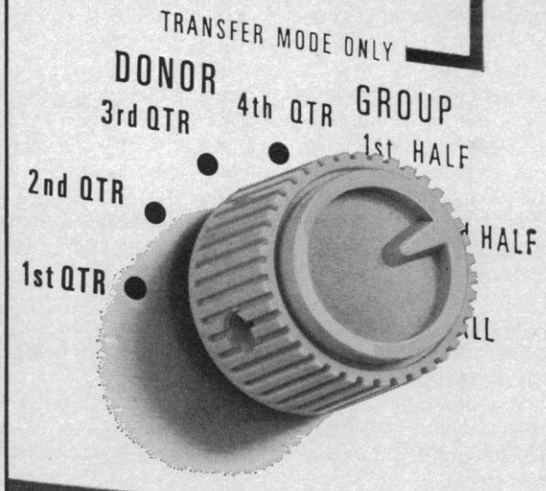
Completing the system is a huge range of accessories that includes extension tubes and bellows extensions for close up work, filters, transparency copy holders, cut film backs, eye level prism finders[G], sports view finders, sun shades, rapid winding crank[I], quick focusing handles[J], grips[K], underwater housings, ring lights, tripod quick coupling[L], microscope attachments and carrying cases.

We have purposely avoided discussing specific applications to which the Hasselblad system might be applied. Not only because of the limitations of the space available, but because the number of applications is almost infinite.

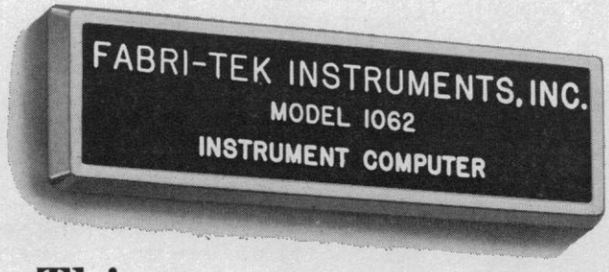
Hasselblad systems are being used today in many branches of science and industry. And are even a part of the NASA space program. Shown below are just a few parts of the system that seem to have become particularly popular with many people engaged in some aspect of science or industry.

This description of the Hasselblad system has been necessarily brief. If you would like a Hasselblad catalogue or further literature or if you have a specific technical inquiry write to Paillard Inc., 1900 Lower Rd., Linden, New Jersey 07036.

HASSELBLAD



What's in a name?



This one means unequalled efficiency and precision in many kinds of measurements.

The Fabri-Tek Series 1060 Instrument Computers were conceived to fill the wide gap between wired program, special purpose digital computers (signal averagers, pulse height analyzers) and programmable, general purpose digital computers.

The 1060 Instrument Computers consist of a "main frame" and a group of highly advanced plug-in modules. The main frame contains the computer basic circuits and memory, with several wired readout and data reduction programs. The modules plug into the main frame to provide programming and experiment interface for signal averaging, high speed digitizing, pulse height analysis, time-of-flight analysis, multichannel scaling, voltage distribution analysis, and other important measurements.

The concept of multi-purpose instrumentation is not new. However, Fabri-Tek Instrument Computers are unique because they perform a great variety of different measurements, each with the finest efficiency and precision. Other multi-purpose instruments usually do only one job well.

The advanced design structure of these computers, made possible by the availability of integrated circuits, is the reason for their versatility. Some structural features include: four full registers, two with shift capabilities; whole number addition rather than add-one arithmetic; one microsecond memory access time; and wired programs with up to 70 steps, that include conditional jumps. These features contribute to instrument flexibility and ease of operation.

Data manipulation includes: additive transfer wherein a set of numbers in one memory section may be multiplied by a constant and added to another set in another memory section, data integration, and addition of a constant to all data points. Readout includes standard cathode ray tube display and pen recorder outputs which may be linear or logarithmic. Digital tape and fast decimal printer readout are optional.

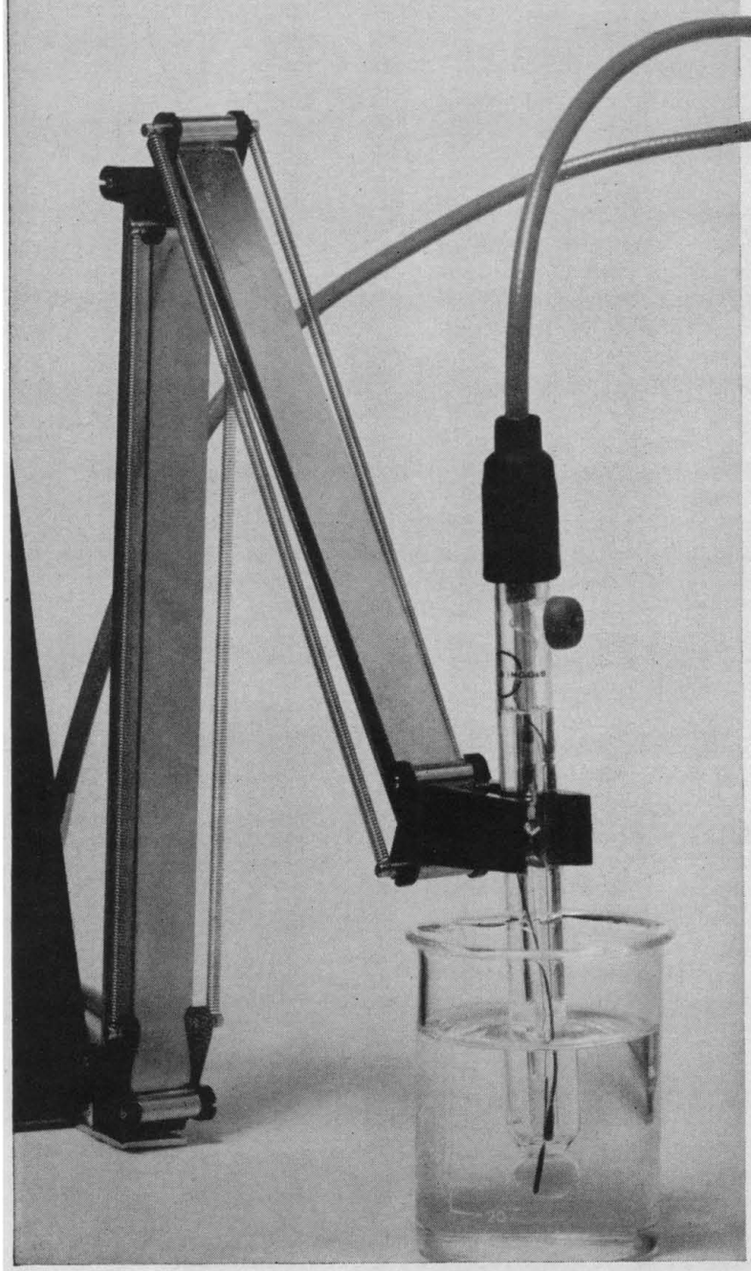
The utility of an advanced design main frame, including a two microsecond memory, and the versatility of adding inexpensive new plug-in modules as needs and state-of-the-art change, make the 1060 Series Instrument Computers defy obsolescence.

Fabri-Tek Instruments warranties each instrument and backs the warranty with both field and factory service.

A 32 page brochure which defines basic measurement types and describes the structure of the 1060 Series Instrument Computers in detail is now available. Write **Fabri-Tek Instruments, Inc., 5225 Verona Road, Madison, Wisconsin 53711. Phone (608) 238-8476.**

the IL MULTI-flex® pH electrode arm

The NEW . . . IL MULTI-flex Electrode Arm . . . a better way for fast, smooth electrode handling. A touch of your fingertips positions the electrode precisely where you want it . . . in the beaker . . . up in the air for cleaning . . . or at any level in the sample. This sturdy flexible holder stops exactly where you want it to . . . anywhere within a 270° radius and as far as 15″ from the meter . . . a convenience that serves to protect against electrode breakage and enables you to work more quickly. Constructed entirely of durable plastic and stainless steel, it can be connected to the electrode support bar of any pH meter with the simple thumb-screw adaptor. The IL MULTI-flex Electrode Arm can be used with combination pH electrodes, glass/reference pairs, or metallic electrodes. The price of the 83020 MULTI-flex Electrode Arm complete with adaptor, is $29.95. Add this new dimension of convenience to your laboratory . . . and look to IL for "innovations in pH" and other scientific instrumentation.



special offer

To acquaint you with the convenience of using an IL MULTI-flex Electrode Arm — and to introduce you to IL precision pH Electrodes — for a limited time the electrode holder will be offered at a reduced price **when purchased with any one of three popular IL Combination Electrodes.** You have your choice . . . the 14023, a rugged polyethylene-protected combination electrode for general laboratory or school use wherever a great deal of abuse can be expected; the 14063, a widely used, high alkaline, general purpose 0-14 pH combination electrode; or the 14043, a slim combination electrode for measuring samples as small as 10 microliters, or for pH measurements on flat, wet surfaces. For further information about this offer fill in and mail the coupon below today or contact your nearest authorized IL dealer representative — Aloe Scientific, Division of Brunswick, or Scientific Products, Division of American Hospital Supply.

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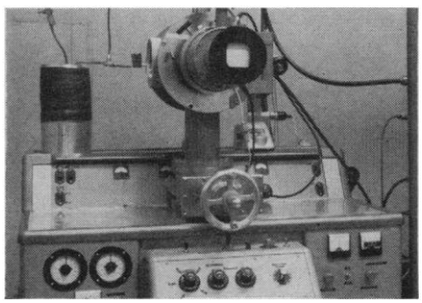
Ford Motor Company research leads to breakthroughs in materials development

ADVANCED THERMIONIC EMISSION MICROSCOPE

In order to eliminate the mechanical problem associated with thermionic emission microscopy, our Scientific Research Staff designed and built a new thermionic emission microscope. This instrument has two lenses, a combination electro-static-electromagnetic objective lens and a magnetic projector lens. It is capable of magnifications of from 78 to 6000 diameters with a resolution in the order of 300A over the entire magnification range, and can be used to study reactions in the temperature range of from 450° to 2300°C.



View of the thermionic emission microscope. Console contains the microscope chamber, vacuum system lens power supplies and the high voltage power supply.

The vacuum system has an ion-getter type of high vacuum pump and is capable of operating at 10^{-8}torr with the specimen at room temperature and at 10^{-7}torr with the specimen at 1600°C. Also available is a temperature measurement and control system capable of measuring specimen temperature to better than ±5°C. The specimen at a potential of 50 KV required designing a system which is floating and isolated at this voltage. Specimen movement is controlled electronically and a measuring system devised so that the exact area of the specimen which is being viewed on the microscope can be determined.

With an instrument of this kind, it is possible to study phase transformations, recrystallization and sintering mechanisms, as well as fundamental studies of electron emission.

Studies made with this microscope should lead to a better understanding of the mechanism of the allotropic transformation in steel and should eventually lead to production of better alloys.

DEVELOPMENT OF NEW TYPE SOLID STATE SPECTROMETER

Physicists from the Scientific Research Staff recently developed a device to demonstrate a new phenomenon in solid state physics.

The device, called a Solid State Spectrometer represents a significant development in our ability to detect microscopic amounts of chemical materials.

The phenomenon, known as inelastic electron tunneling, is capable of seeing minute amounts of molecular material which are in the adsorbed state.

In the experiment, a spectrum was obtained that was characteristic of the particular molecular species. The spectra reflect the internal molecular vibrations.

Traditional methods of obtaining this information have used infrared light of varying wave length to probe the sample. In this new method, electrons take the place of light waves and the voltage applied to drive current through the insulating film takes the place of wave length.

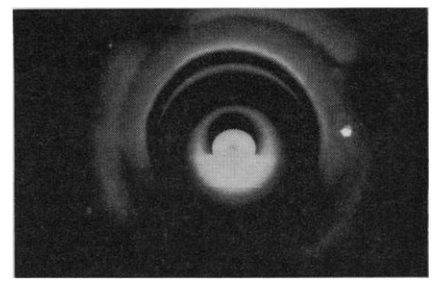
Compared to infrared absorption, electrons are effected more than a thousand times more efficiently in this method, which accounts for its high sensitivity.

Besides providing a new analytical tool, the Solid State Spectrometer permits experimentation on molecules in the adsorbed state, which will be of importance to the field of surface chemistry. It also represents an advance in understanding the basic processes related to electron tunneling in the solid state.

NEW CUTTING TOOLS WITH 10 TIMES LONGER LIFE

The problem of forming a strong bond between dissimilar materials such as metals and ceramics, led to extensive study of the wettability in liquid-solid systems.

In the case of metal-ceramic composites, wetting is studied at Ford Research by placing a piece of metal on a flat ceramic and heating the combination until the metal melts. When molten, the metal forms a specific drop shape, governed by gravitational and surface forces. The extent to which the liquid will wet the solid is a measure of the adhesion between the two materials.



Bright central area is metal melting on a ceramic base in Sessile Drop Furnace. Photo taken at Ford Research Laboratories.

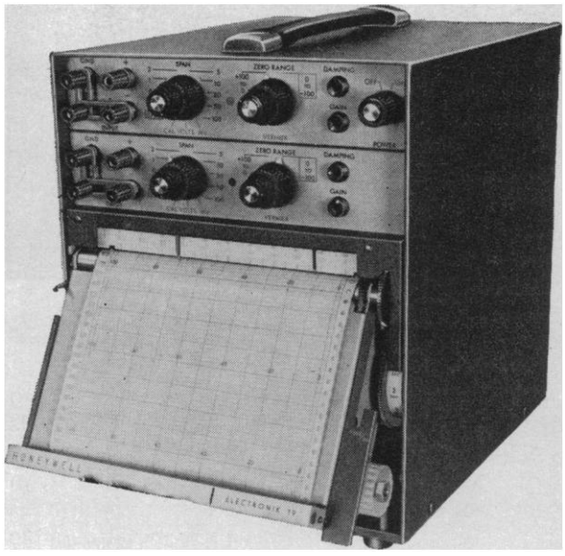
Working with many metals and ceramics in the course of these wettability studies, Ford scientists developed an exceptional material. This synthetic composite consisted of titanium carbide bonded with nickel and molybdenum.

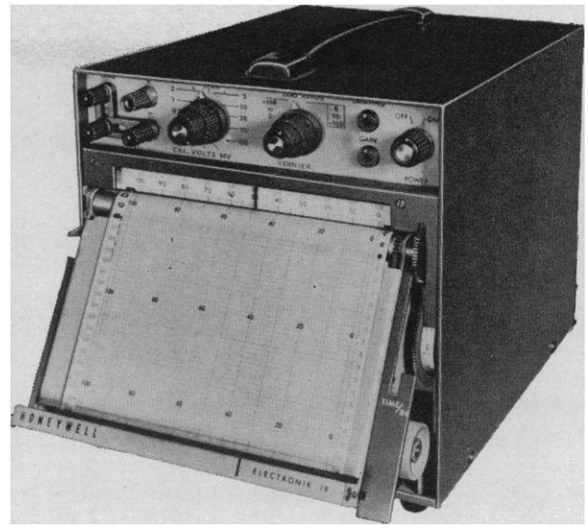
Further testing and studies showed that this material had a high hardness and strength which seemed very well adapted to use as tool bits for metal cutting.

In comparison with the hardest tool bits previously developed, this new material offered a service life approximately 10 times longer.

PROBING DEEPER FOR BETTER IDEAS

Ford





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- *10-Speed Chart Drive System* gives speeds from 1 sec./in. to 10 min./in. with a 1, 2, 5 relationship and "standby" position. Chart transport permits chart reroll or positive drive out across table top, and chart platen tilts to 30° and 45° from vertical.
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- *High Accuracy:* Span = ± 0.25% of span or 1 microvolt, whichever is greater. Zero Position: ± (0.25 + 0.1 x suppression ratio) % of span or 1 microvolt.
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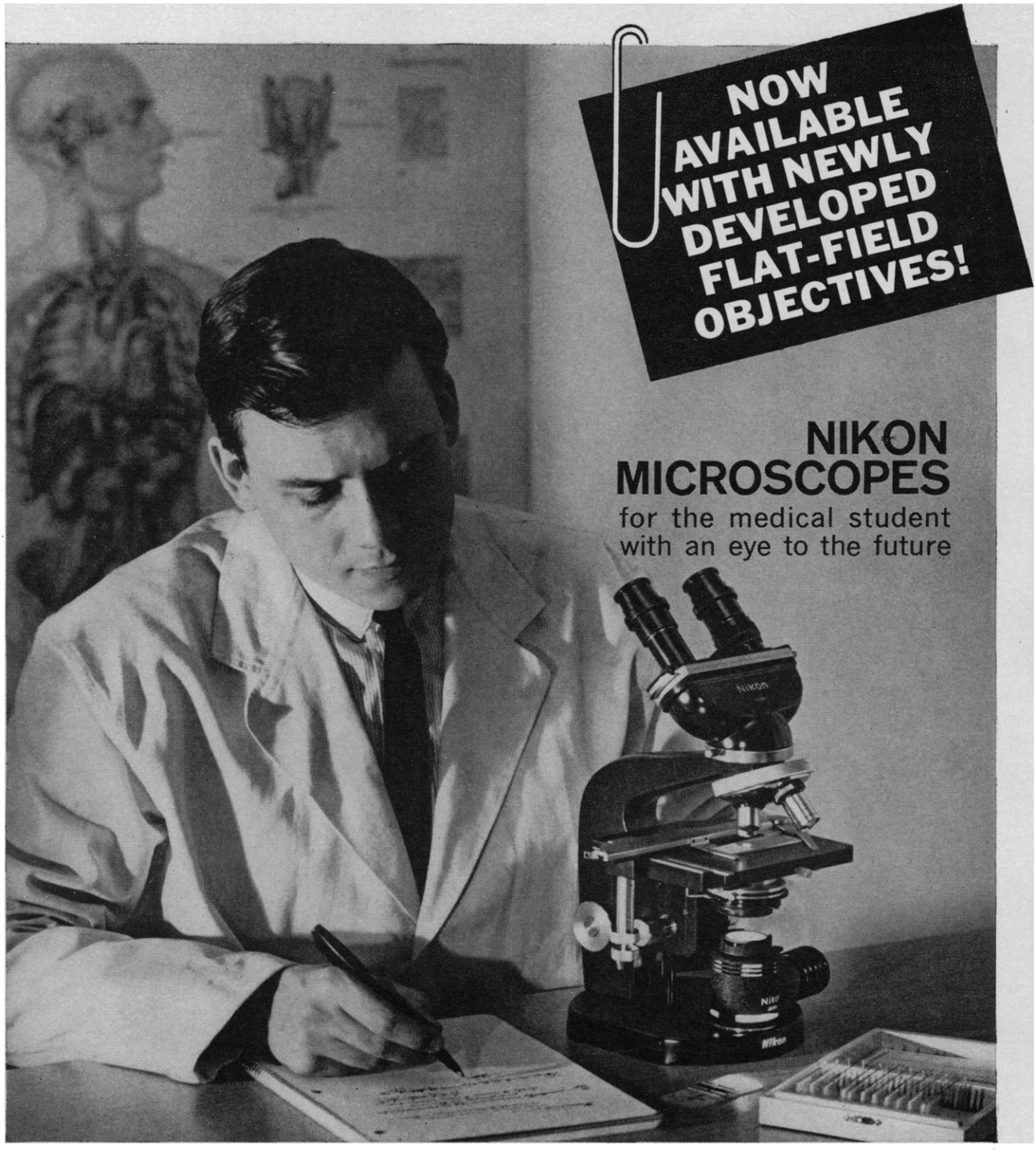

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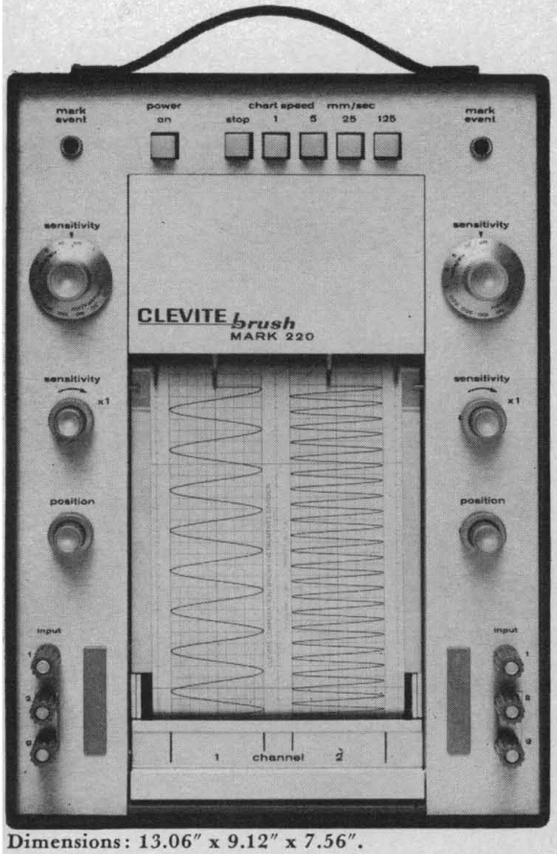
The end of the non-portable portable



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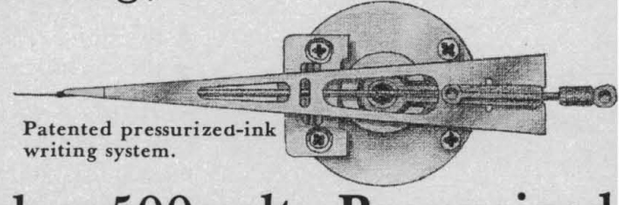

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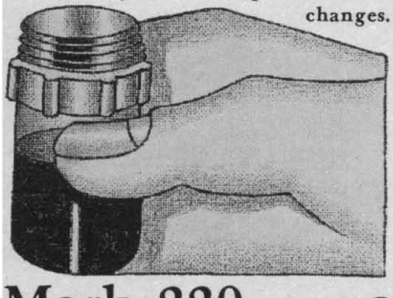

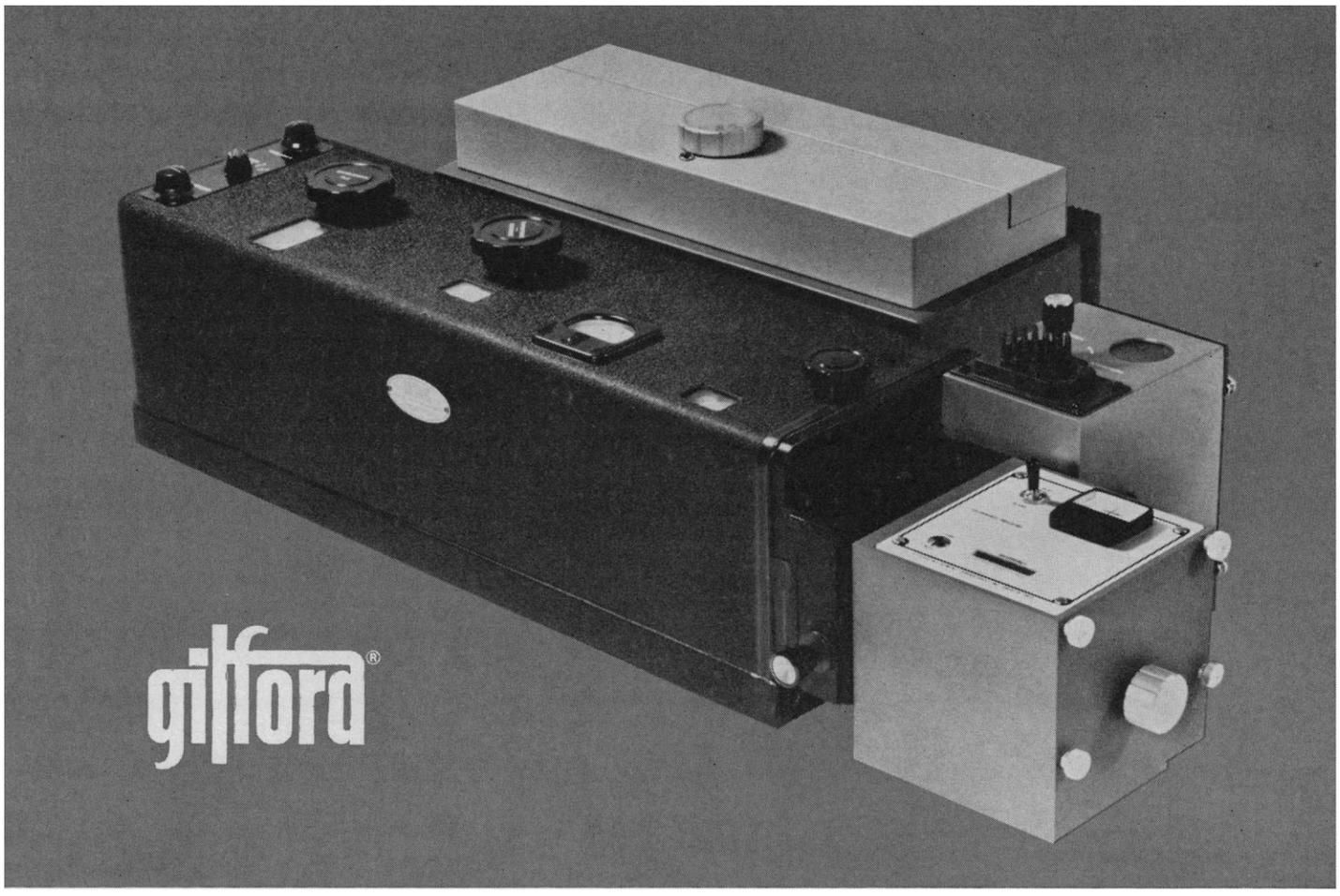

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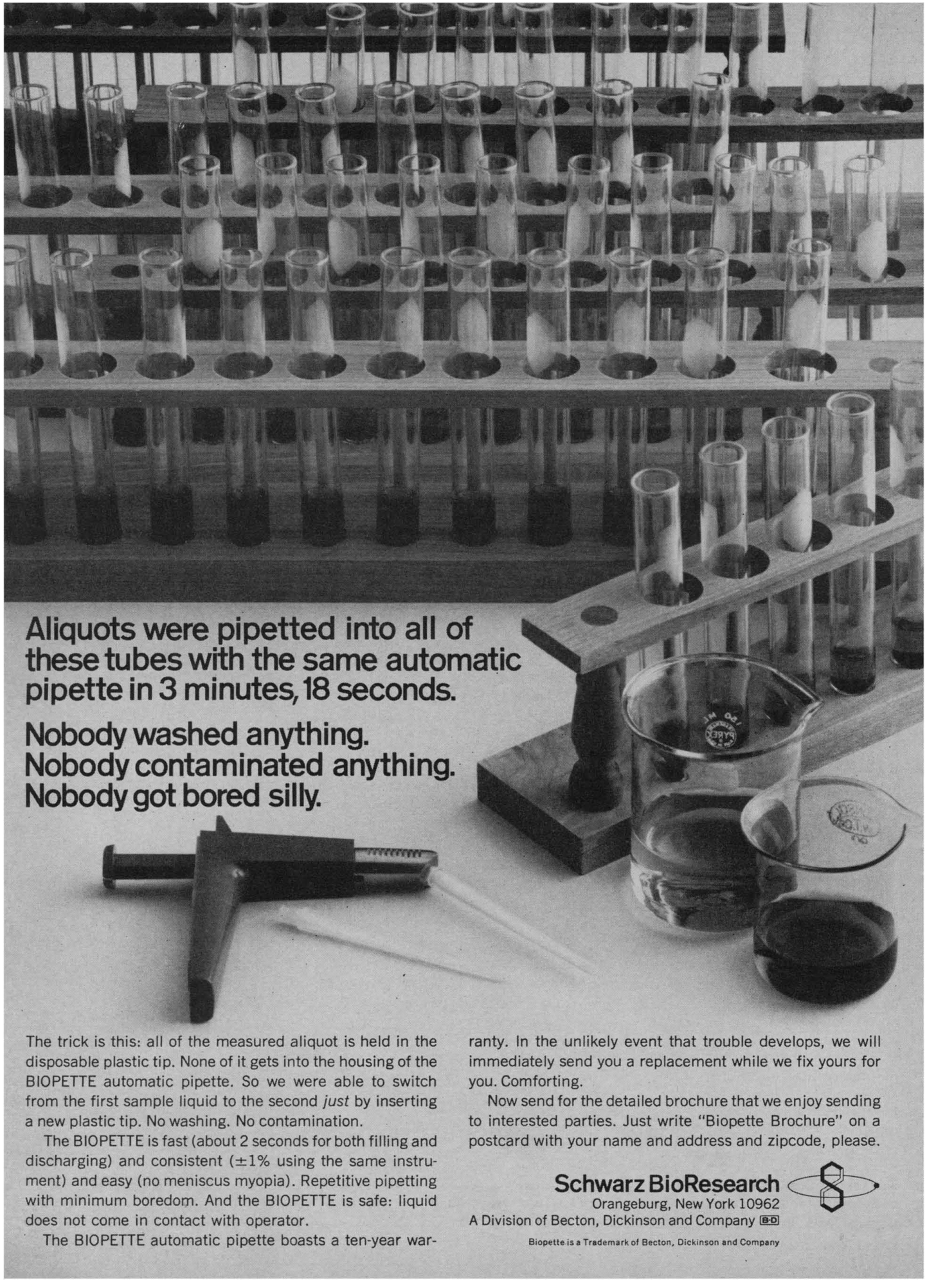

Aliquots were pipetted into all of these tubes with the same automatic pipette in 3 minutes, 18 seconds.

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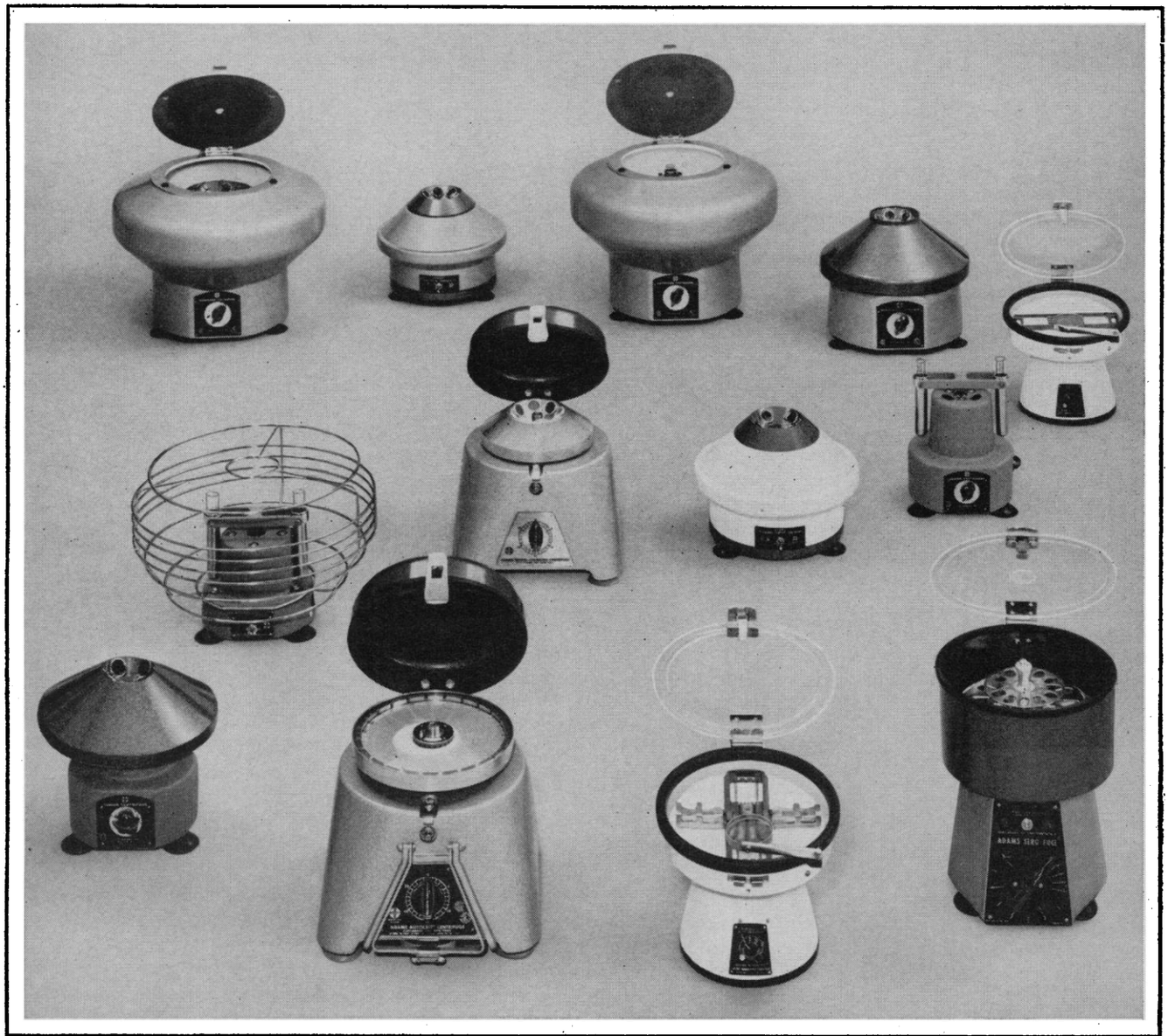

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Mendel's Memorabilia

Dobzhansky's interesting review "Looking Back at Mendel's Discovery" (Book Reviews, 23 June, p. 1588) covers six different books. Five of these are treated in some detail but one, *Iconographia Mendeliana*, is only mentioned and the reader is not made aware of its unusual nature and value. I should like to call further attention to this volume, which was published in 1965 by the Moravian Museum, Brno, Czechoslovakia. It consists of reproductions in black and white and in colors of a great variety of "pictorial and written documents characterizing the life and work of Gregor Johann Mendel," with explanatory notes in English and Czech.

The volume begins with a page of the birth registry at Heinzendorf in which Mendel's birth and baptism are entered and ends with a modern aerial view of the former Augustinian monastery in Old Brno. It includes pictures of the educational institutions which Mendel attended, of his sisters, of the members of the monastery, and of its refectory, library, and other general rooms. It shows the letter by Abbott Napp to his superior bishop in which he states that Mendel has been appointed substitute teacher at the Znaim High School and that, while he lives a virtuous religious life, he is not too well suited for churchly duties. It reproduces the remarkable group photograph of 1862 in front of the Grand Hotel in Paris with Mendel's broad forehead standing out among the many others. There are facsimiles of manuscript and of printed pages from his publications, of his only remaining experimental record page, of his first letter to Nägeli, and of part of a letter by Nägeli to Mendel, and pictures of Mendel's microscopes, his eyeglasses, his portable sundial, a fancy tablecloth with his embroidered initials, his bee house, the obituary notice, and the death certificate.

The 120 items of the *Iconographia* will give pleasure and insight to all interested in genetics and the history of science in general. This book deserves a place in many libraries, public and personal.

CURT STERN
Departments of Zoology and Genetics, University of California, Berkeley

It seems worth noting that in November 1966, there appeared the first number of *Folia Mendeliana*, a serial publication which is dedicated to the dissemination of new facts about the founder of genetics. The editor is V. Orel, chairman of the Gregor Mendel department of genetics in the Moravian Museum in Brno, Czechoslovakia. Eight countries are represented on the publication committee and three of its 13 members are in the United States.

In their introduction of the new journal, the editor and J. Jelinek, director of the Moravian Museum, say:

> The systematic activities of the staff of the newly established Grégor Mendel Department of Genetics in the Moravian Museum enable us to throw some new light upon Mendel's life and work. We are now convinced that with the support of foreign scientific workers we shall find some new documents and add to our knowledge of Mendel.

Apart from an account of the centennial celebrations in Brno in 1965, the first issue of *Folia Mendeliana* carries four articles about Mendel, three in German, one in English. One deals with his efforts to write poetry during his student years. Another tells of his meeting with a famous breeder of bees, and a third tells of his effort to find mathematical laws in the derivation of names. The fourth discusses the extent to which Mendel's work was known before its rediscovery in 1900.

Orel has informed me that, with the help of Weiling of Bonn, new documents were found in 1966, and that reports on these, along with other material, will appear in the second issue of *Folia Mendeliana*, which is to appear in 1967.

F. B. HUTT
Department of Poultry Science, Cornell University, Ithaca, New York 14850

Biochemists' Job Information

Several months ago I offered to serve as a one-man clearing house for job information in biochemistry (Letters, 28 Oct. 1966). I offered to provide, free of charge, a list of available positions I had compiled to anyone who sent me descriptive information on one or more positions he knew about but did not want. That way my original list could grow and remain fairly current. Every contributor would receive more than he gave, thus increasing his opportunities for rational choice. I can report on the outcome of this experiment with "job hunting by chain let-

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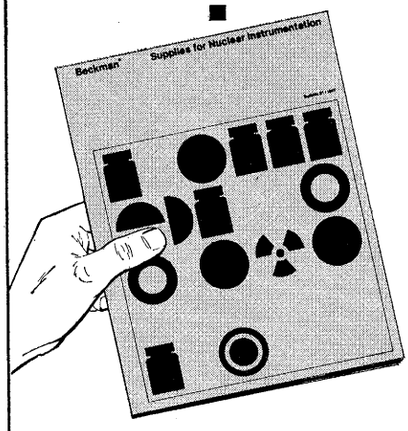

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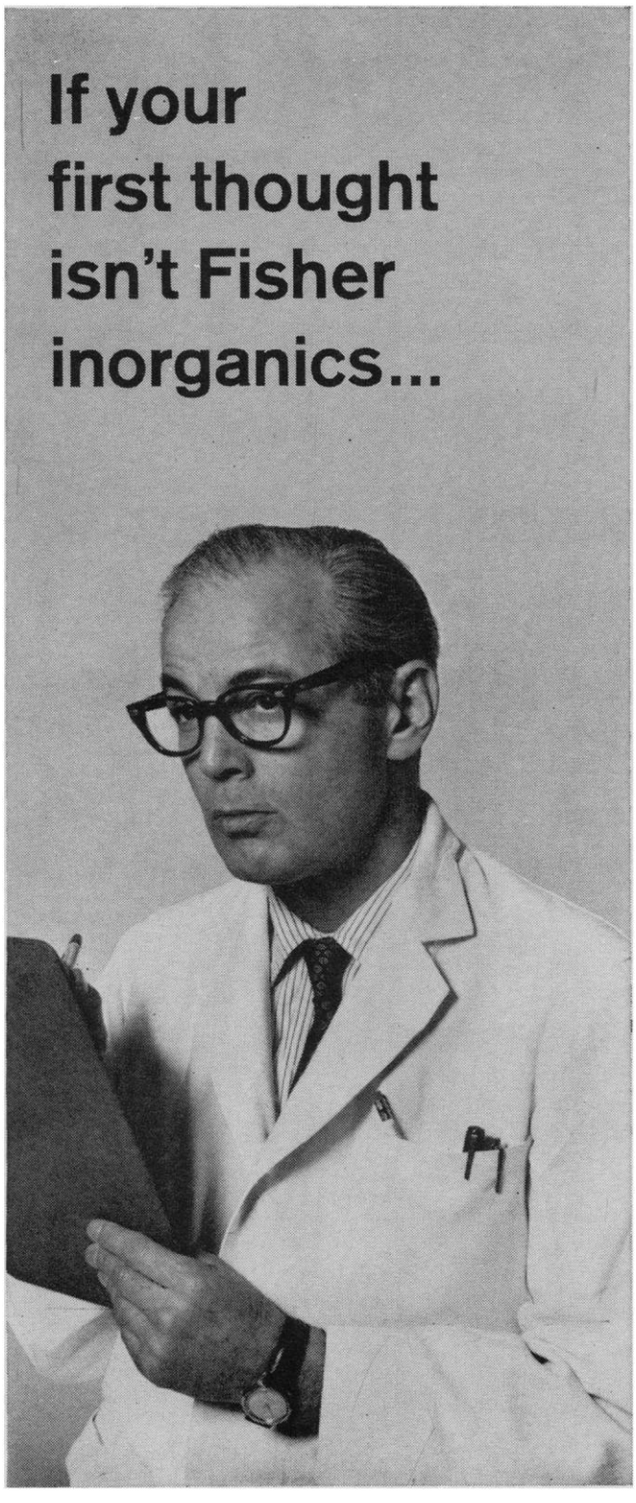

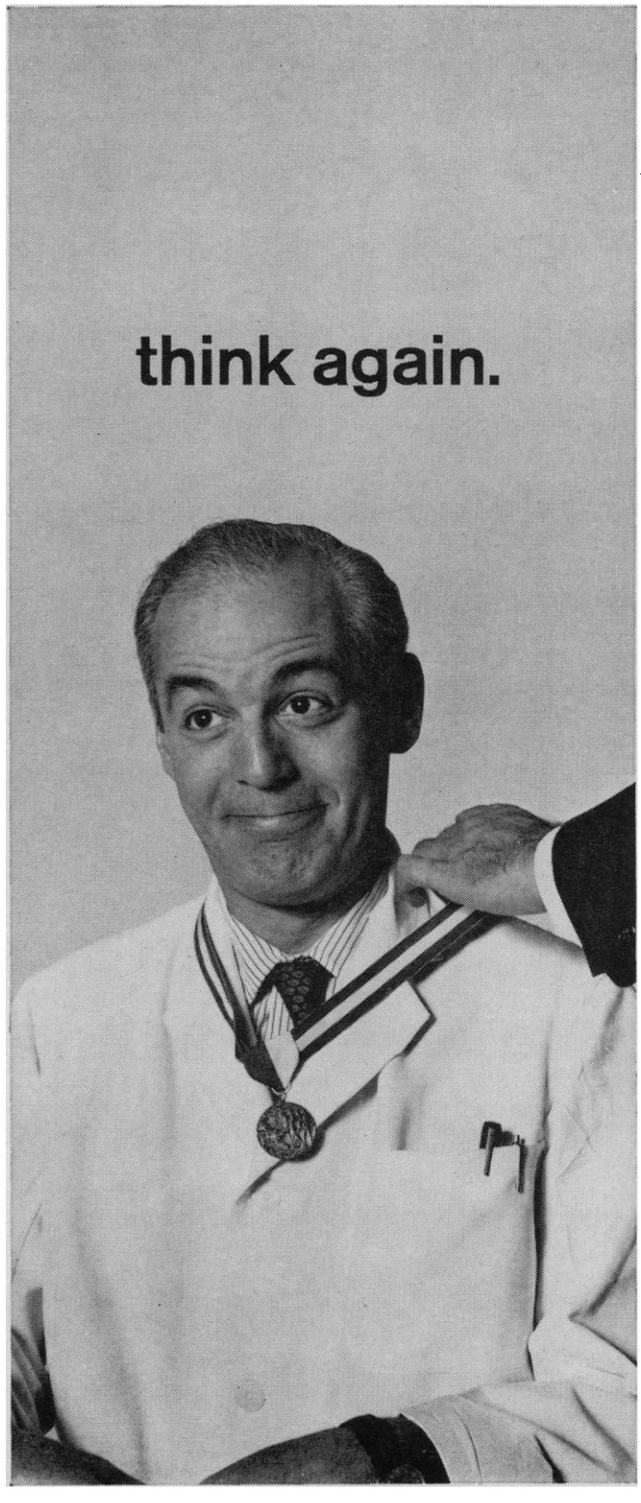

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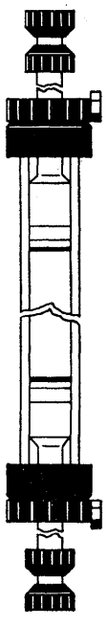

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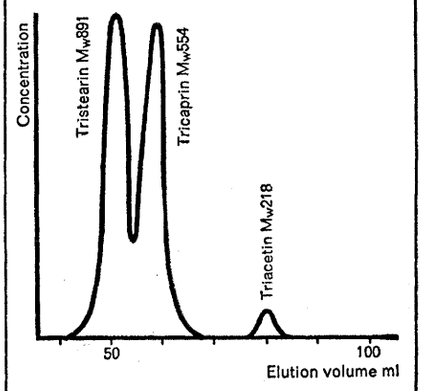
Ethanol	1.8	3.0-3.5
Chloroform*	1.8	3.0-3.5
n-butanol	1.6	3
Dioxane	1.4	2.5-3.0
Tetrahydrofuran	1.4	2.5-3.0
Acetone	0.8	1.5

*Containing 1% ethanol. Particle size: 25-100 μ

EXAMPLE OF SPECIFIC APPLICATION



Separation of glycerol esters in chloroform. Bed dimensions: 2.5x32 cm. Sample: 2 ml containing 4 mg of each substance. Flow rate: 0.6 ml/min.

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ter," lately known as the Biochemists' Job Information Pool.

Nearly 200 positions were sent in. Several were contributed by employers. Contributions came from nearly all academic levels, from graduate students to deans, but most were from people at the postdoctoral level. Probably no more than 75 people participated directly, but I feel certain the lists were seen and used by many more. I judge the experiment a qualified success. I observed that the system needs constant promotion and explanation. Advertising space in scientific journals would insure its smooth operation.

I have tried to interest graduate students in taking over the service, since it is mostly for their benefit and because I have had my fun with it, but most seem to prefer to rely heavily on patronage. It may be that they consider the quality of the leads given them by their sponsor at graduation as a sort of final grade, and grades are important if one has few other criteria for judging his worth.

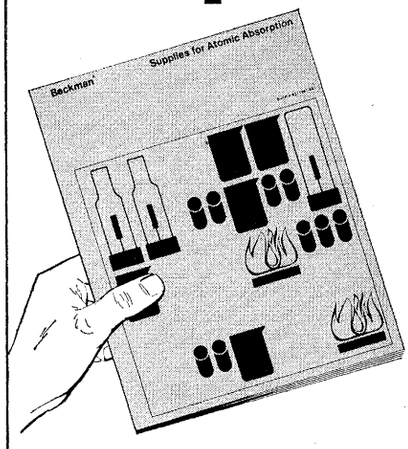
Still, I commend this service to any group of graduate students or postdocs who want to take it over, perfect it, and make it permanent in their department. All it takes is a small amount of time, access to the departmental copying machine, and a cooperative spirit. I would hate to see employers in control of it. The idea is to advertise their positions in writing whether they want them advertised or not. I am ending my part in this venture because I do not believe it should remain in the control of one person. I only wanted to see if it works, which it does.

PETER L. PETRAKIS
Division of Clinical Pathology and Laboratory Medicine, University of California, San Francisco 94122

Worthiness of Wit

In contrast to Bowne (Letters, 7 July) I am encouraged and heartened to see the human touch, emotion, in a scientific journal. Of course, there are places from which emotion must be edited, but I have yet to see any misplaced emotion in *Science*. The monotonous format of customary scientific literature should not be that of *Science*, for it is a magazine as well as a journal, and a magazine must have some wit to spark its readership. Allowing a little fun in

AA supplies ?



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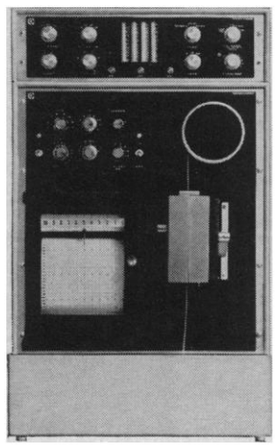

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the letters columns is in the interest of science and scientists, as well as of the few fuddy-duddies, in spite of what they say. Further, the humor in Bowne's letter is a definite step forward.

CONARD M. SWARTZ
Department of Chemical Engineering, California Institute of Technology, Pasadena 91109

Surely Bowne is aware that brains and bowels are as potently inter-influential in scientists as in other complete men.

JAMES D. SKEAN
Department of Biology, Western Kentucky University, Bowling Green

Conflict in Medical Ethics?

Despite Levy's objections to the ethics of his military assignment, the oath taken by military officers does not conflict with the ethics of the medical profession. (News and Comment, 9 June, p. 1346).

The statement adopted by the American Medical Association's House of Delegates in June 1967 stated that the "oath, applicable to medical and other officers, provides that all officers shall support and defend the Constitution of the United States against all enemies, foreign and domestic, that they will bear true faith and allegiance to the Constitution of the United States and that they take such obligation freely and without any mental reservation or purpose of evasion. There is nothing in this oath which conflicts in any way with the ethics of the medical profession."

VINCENT A. JOY
460 Park Avenue, New York 10022

Tenacious Jargon

In "The fuzziness of 'fuzz'" J. F. A. McManus wittily criticizes a new expression used in electron microscopy and electron microscopical jargon in general (Letters, 4 Aug.). I wonder, first, if it is of any use to attempt to eradicate jargon and, second, how reasonable McManus' criticism is.

With regard to my first question, it is interesting to note that there is almost no human activity—in science, technology, or sports—in which a particular jargon is not used. This is not necessarily an evil, as one example may

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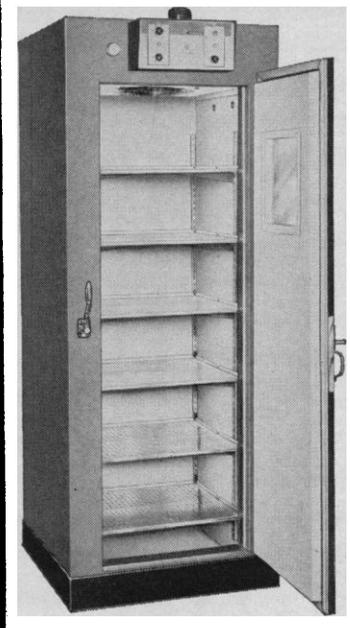

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show: Some kinds of electrical terminals, the "banana" type are described as "male" and "female." However, if you read that two of these connectors had been plugged together, would you believe that a sexual act between two friendly bananas had been committed?

The second question arises by applying McManus' criterion to the word "cell," which was just plain jargon when used by Hooke three centuries ago. As Webster says, "cell" comes from the Latin "cella," meaning small room. It is obvious that to compare the cell (even cork cell walls) with a little room " . . . should be discouraged by editors because of the inappropriate application of a word describing something seen with the naked eye to structures visible only with the . . . microscope," to use McManus' words.

MANUEL P. DEL CERRO
Center for Brain Research,
University of Rochester,
Rochester, New York 14627

Math: Erratum

In my letter, "College math for 11-year-olds" (28 July), I stated that "it was apparent after a while that parabolas and hyperbolas could sometimes fall into circles and ellipses or vice versa." This is not true! Under any nonsingular linear transformation parabolas become parabolas, hyperbolas become hyperbolas, and ellipses become ellipses (or circles).

EUGENE H. LEHMAN, JR.
Department of Mathematics,
Northern Michigan University,
Marquette 49855

Reprint Philosophy

It is time to bring up a relatively neglected aspect of the reprint problem, mentioned by Clark in her letter, "Reprints unlimited" (17 Feb.) but not acknowledged by Mota, "Economics of reprints" (12 May).

As grant support (foundation or government) of university research approaches 100 percent, it is well to remember that papers are still being published by authors with no such support. Being numbered among the grantless, I like to believe that some of us publish meritorious papers for which there will be reprint demand. I cannot follow Mota's suggestion and "have [my] institution pay for as many reprints as [I] consider necessary." My institution, being small and underfunded, does not pay for *any* reprints of papers published in outside journals. The printer's bill for my reprints is paid with my personal check.

The "convenient number" to which Mota alludes, therefore, cannot always be the total number that *might* be of use to somebody, but sometimes (even in 1967) must be the number the author can afford. Also, many papers in great demand predate the era of subsidized research. Of my own publications, the one that has been most frequently requested appeared in 1951. I was a graduate student at the time, and $14 for 100 reprints made a large impact in my budget. If I had been able to afford them, I would now be well into the third hundred, sending reprints only when requested and not on the scattergun principle advocated by Mota.

I am well acquainted with the additional problem described by Clark—the influx of reprint requests after a paper has been listed in an abstracting journal. I have also noticed that I get clusters of requests on identical postcards from single university departments, indicating that a professor has asked his students to read the paper, and perhaps suggested that they write me for reprints. I sometimes suspect that students do this as the easy way out, rather than take the trouble of going to the library and finding the paper in the original journal.

My usual procedure is to send reprints in response to any request, as long as I have a reasonably good stock left (say one-fourth of the original printing). After that I am more cautious. If, like Clark, I am concerned about the reprints being sent only to those who have a real need for them, I invest a few minutes in typing out a postcard, stating that I have only a few copies left and asking the requester to explain more fully his interest in obtaining the paper. If he really wants it, he'll write again. In fact, by learning in this way the specific interests of my correspondent, I am sometimes able to send him other papers of mine that had not come to his attention, and direct him to additional pertinent literature. In a few instances, this has developed into a long-lasting and mutually profitable correspondence.

KENNETH C. PARKES
Carnegie Museum,
Pittsburgh, Pennsylvania 15213

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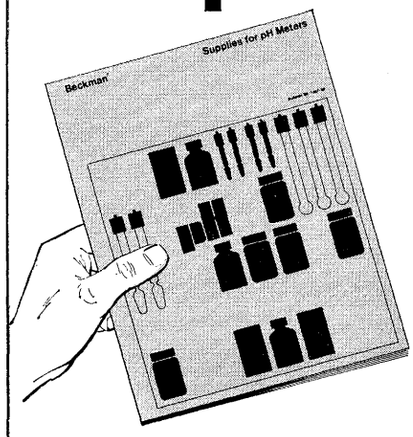

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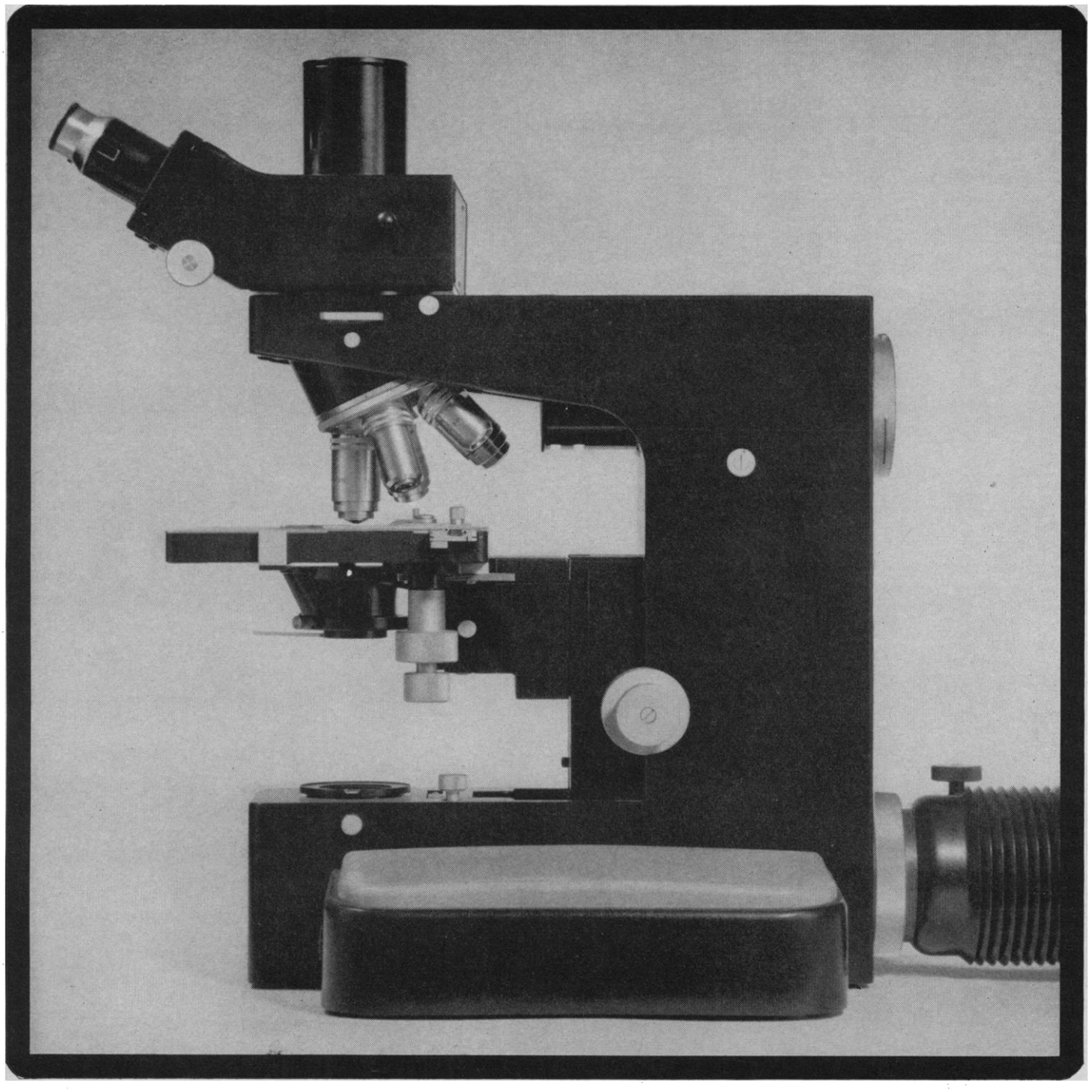

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Faculty Recruitment

A recent National Science Foundation report* projects an easier period of recruiting new members for science and engineering faculties. The students' view of the same projections is that new Ph.D.'s who want academic positions will probably not have as many offers to choose from as recent Ph.D.'s have had. Specifically, the NSF projections indicate that, in order to keep up with enrollment growth and avoid diminishing the percentage of faculty members holding the doctor's degree, colleges and universities needed to add 28,000 Ph.D.'s to their faculties in engineering and in the biological, physical, and social sciences in the 2 years 1965–66 and 1966–67. The 12,000 new Ph.D.'s in science and engineering available for faculty appointments in those years left a gap of 16,000 positions unfilled or filled by non-Ph.D.'s. In contrast, in the 8 years from 1967–68 through 1974–75, the colleges and universities will need 81,000 additional Ph.D.'s, and there will be 79,000 new ones seeking academic appointments.

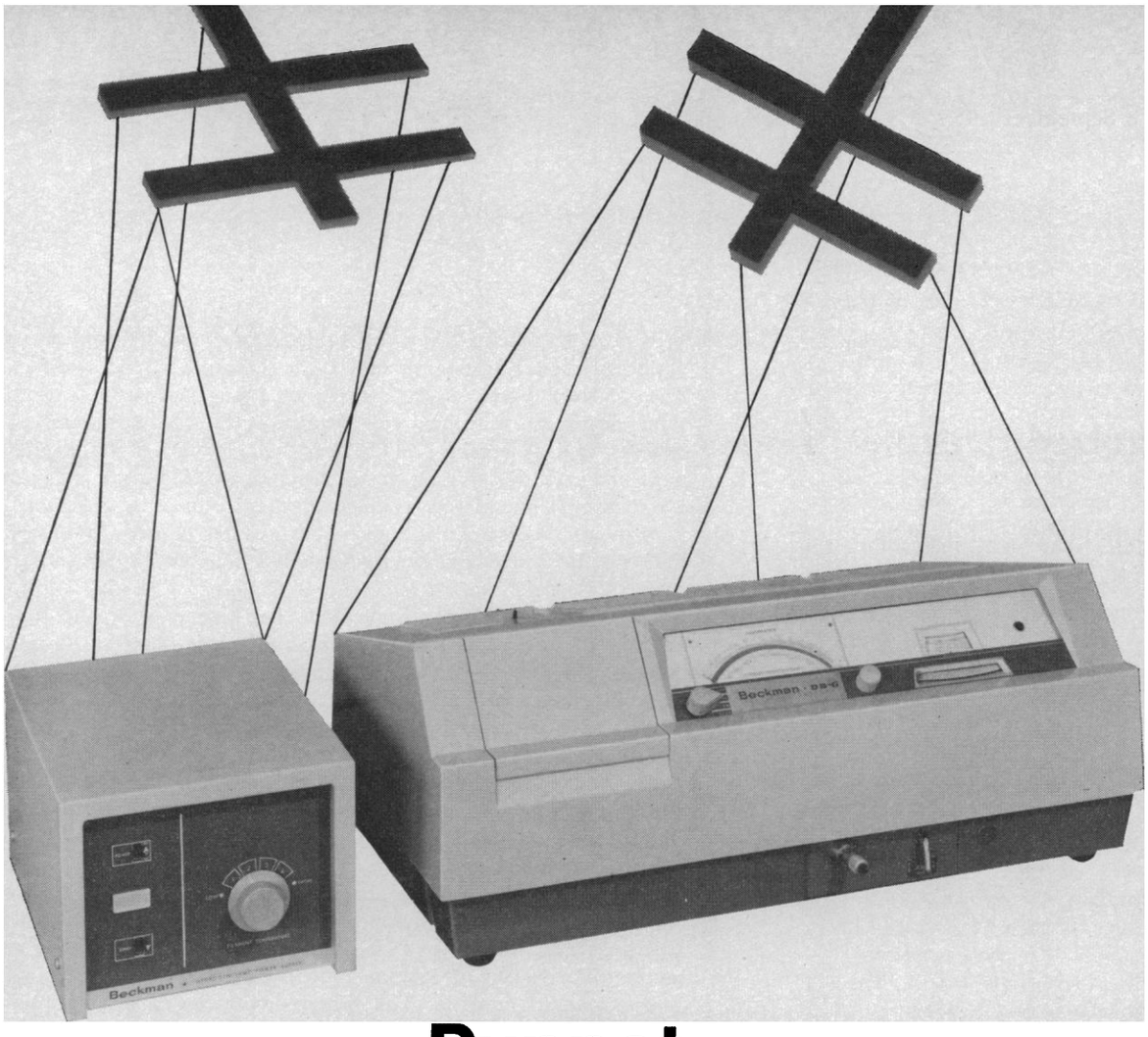
Projections of this nature are always based upon certain assumptions. A major one in this case is that about half of all new Ph.D.'s in science and engineering will want academic appointments. Another is that existing enrollment trends will require doubling the number of teachers of science and engineering between 1964–65 and 1974–75. The additional numbers required for research (both full-time and part-time) were projected on the assumption that the 1965 ratio of faculty research time to teaching time would continue through 1975; NSF chose to make this assumption instead of making independent projections of how research budgets would increase. The third component of total requirements is the need for administrative staff. This need was projected to continue at the 1965 level of 12 percent of teaching and research needs.

One of the uses of projections is to focus attention on the feasibility or desirability of making the underlying assumptions come true. An interesting example is the research projection. Translated into dollar terms, it means that funds for academic research (exclusive of contract research centers) will have to increase from $1.9 billion in 1965 to $4.9 billion in 1975 if the ratio of research time to teaching time is as high in 1975 as it was in 1965. If the actual increase is less rapid, the demand for new Ph.D.'s is likely to fall below the projected figures.

Various factors might make the projections inaccurate. For example, Selective Service policies concerning induction of graduate students after the summer of 1968 are still unknown. They could diminish both the need for additional graduate faculty and the number of new Ph.D.'s conferred.

After 1975, the rate of increase of undergraduate enrollment will slow down, and so will the need for faculty expansion. These trends, which are supported by studies of the Department of Labor and the Commission on Human Resources and Advanced Education, make it appear that after 1975 the number of new Ph.D.'s available for faculty appointment is likely to exceed the number required by major employers. The sellers' market of recent years will not, however, suddenly become a buyers' market, for junior colleges and small undergraduate institutions should have an opportunity to improve the quality of their faculties, and nonacademic needs are expanding. New Ph.D.'s in science and engineering are too valuable to become a surplus commodity, but the federal and other arrangements that have increased graduate enrollment now offer universities hope for a little easier recruiting than they have experienced in recent years.—DAEL WOLFLE

* "Science and Engineering Staff in Universities and Colleges," *National Science Foundation Publication NSF 67-11* (Government Printing Office, Washington, D.C., 1967), 30¢.



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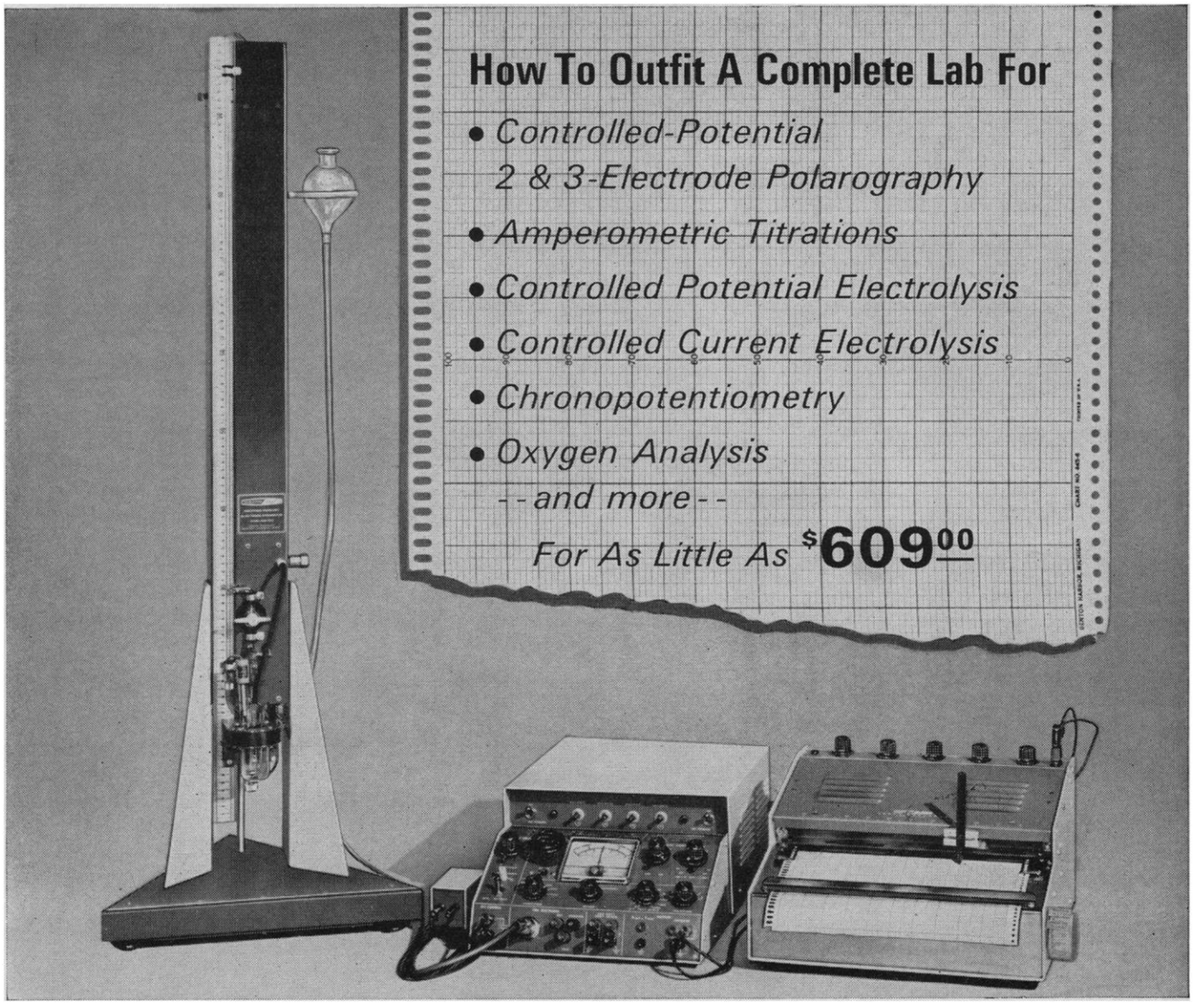

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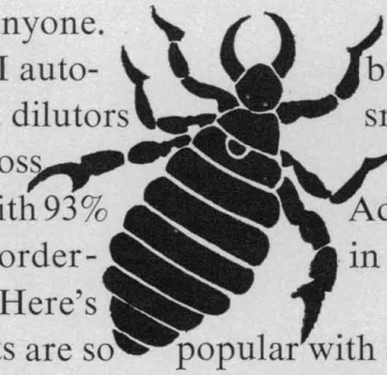

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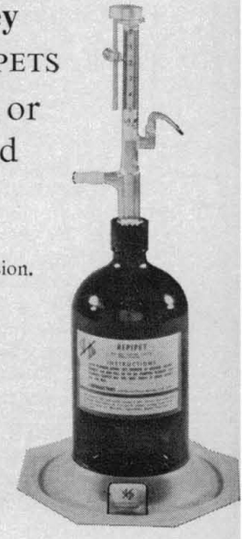

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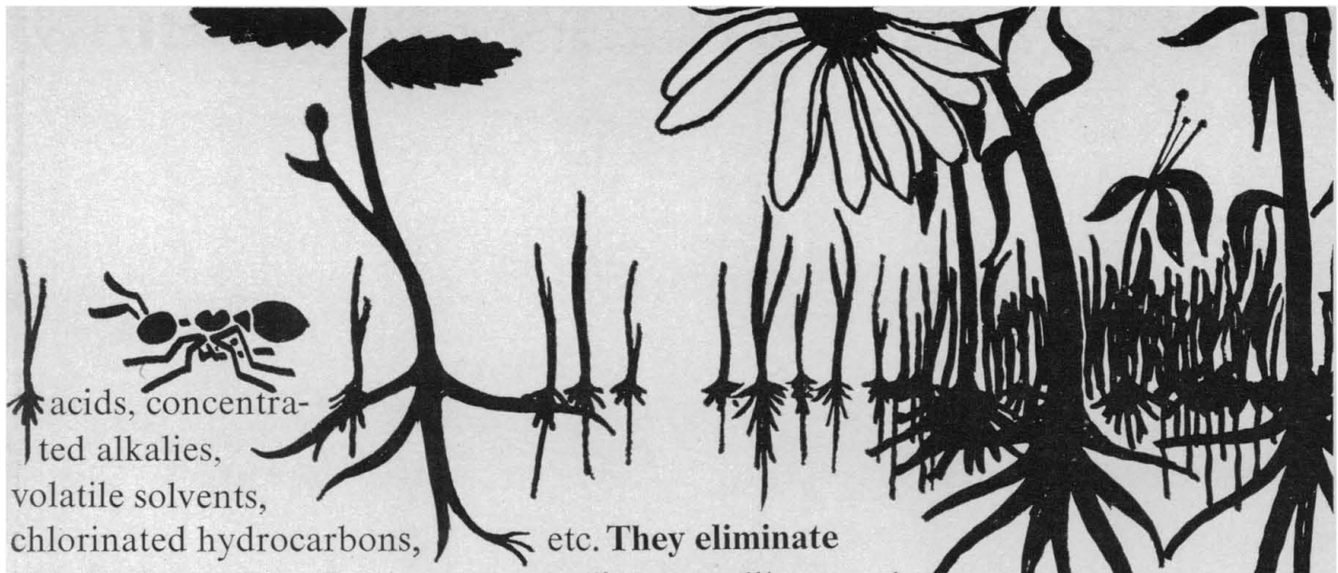

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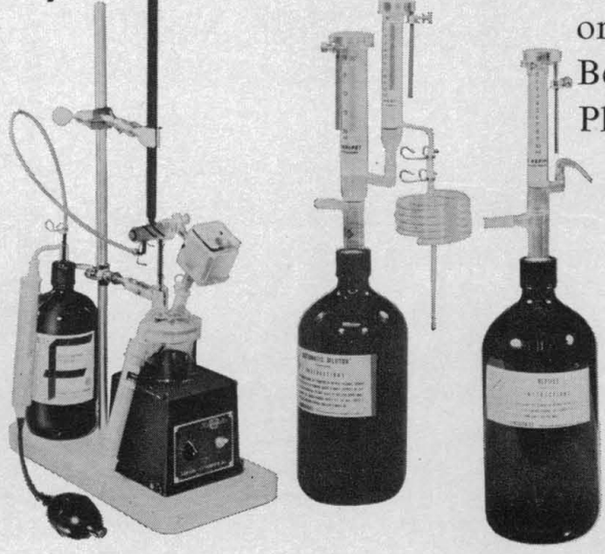

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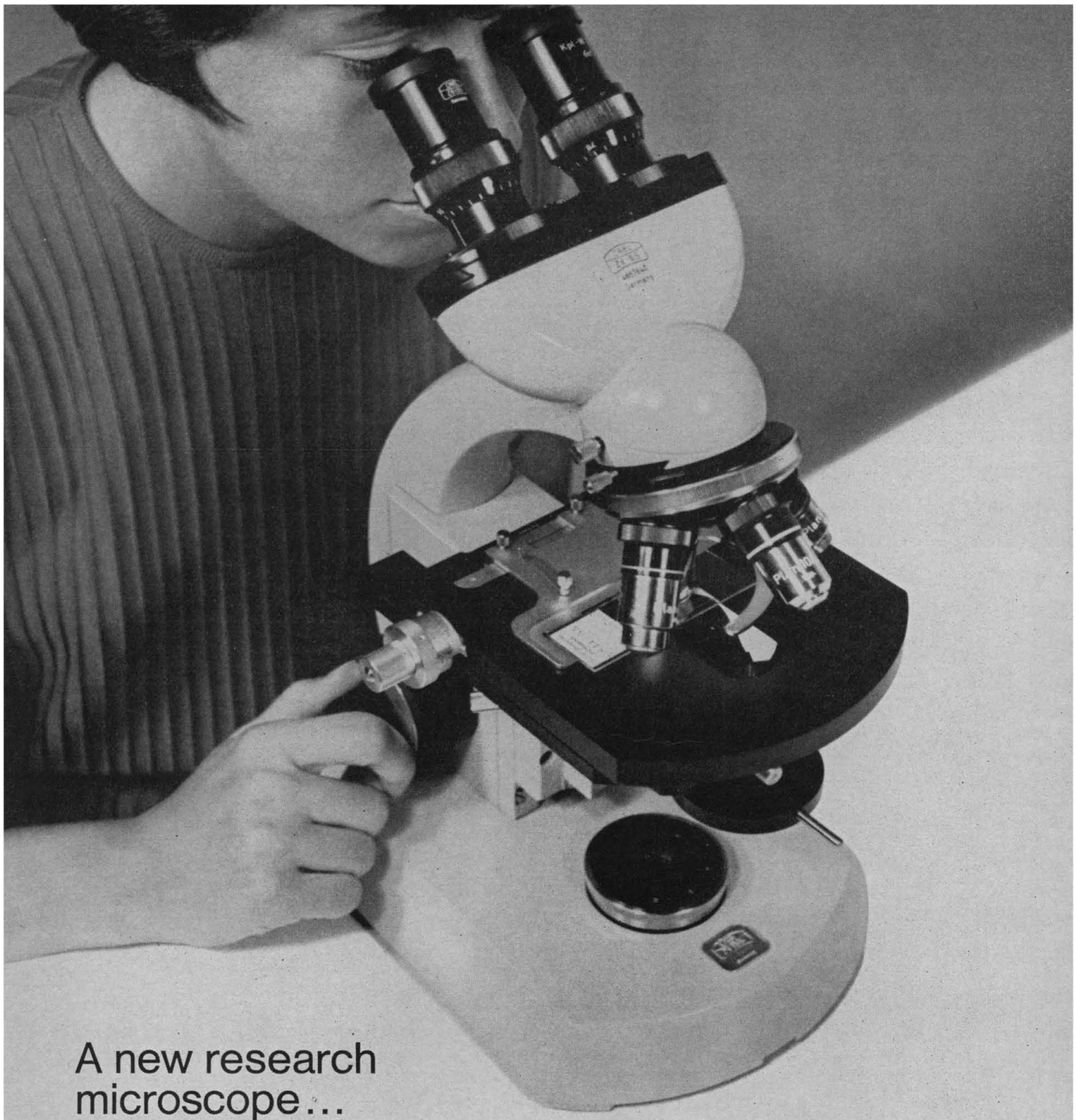

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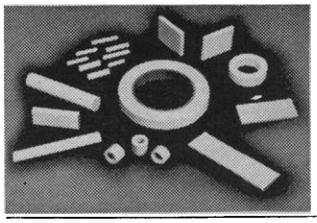

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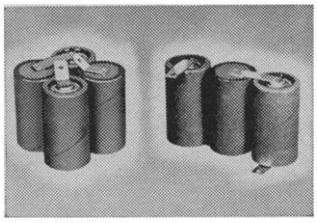

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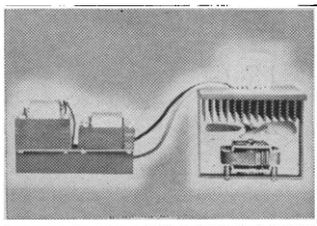

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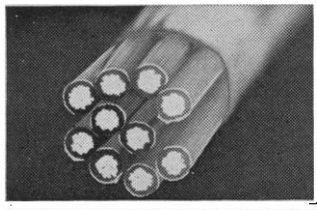

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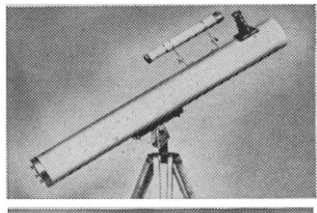

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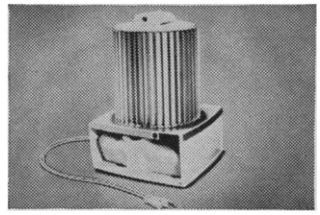

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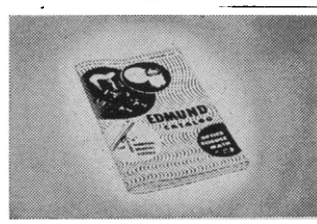

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York at Buffalo, 31 May–1 June 1967, for purposes of comparing these three-dimensional structures and assessing the chemical properties of the enzyme and its mechanism of action in light of the new structural information.

There were three crystallographic contributions: by D. Harker and G. Kartha of Roswell Park Memorial Institute (RPMI), by H. W. Wyckoff and F. M. Richards (Yale), and by C. H. Carlisle (Birkbeck College, London). Harker and Kartha described their crystallization and x-ray diffraction analysis of ribonuclease A; described the isomorphous replacements with heavy atoms used at RPMI for phasing; and presented their model of the enzyme at a resolution of 2 angstroms. C. H. Carlisle, using the same system but a different set of heavy atom derivatives of the protein, briefly compared his lower resolution map with that of Harker *et al.* Carlisle showed several electron density diagrams which differed from those of the RPMI group. These differences were attributed to the lower resolution of the London map; Carlisle explained that these small differences should disappear when their map is at a 2-angstrom resolution. The Yale group described a unique approach to the three-dimensional structure of ribonuclease. Treatment of ribonuclease A with a protease, subtilisin, yields ribonuclease S-protein + S-peptide (the 21 amino acids from the NH_2-terminus). This is crystallized from 75 percent saturated $(NH_4)_2SO_4$ and placed in a diffractometer flow cell where small molecule and heavy atom replacements can occur, thus allowing for the needed phasing atoms and for assay of the ribonuclease S which is enzymatically active, without disturbing the crystal structure. This work has yielded a 3-angstrom resolution model.

In all three x-ray diffraction analyses, the peptide backbone appeared quite similar. A hydrophilic region was connected, by three partial chains, to a hydrophobic region, containing a cystine isolated octapeptide loop; these two regions surround a cleft for substrate. In the Yale model, the S-peptide, not covalently linked to the remaining enzyme, is slightly displaced from its position in ribonuclease A. There is very little α-helix either in ribonuclease A or S crystals. Neither the RPMI group nor the Yale group have sufficient resolution to identify all amino acids. The planar aromatic amino acids, cystine, and methionine are readily identified, but other R groups are more blurred. There are a few differences between the models of Yale and RPMI regarding the exact positions of side chains though there is no difference in identification of side chains since the primary structure is known. Higher resolution x-ray maps were suggested to solve these few discrepancies, but Richards made the point that unconstrained side chains, for example at the periphery of the molecule, would appear blurred even at a 1-angstrom resolution. One important problem that higher resolution maps might solve, however, is the nature and position of atoms in amino acid side chains which interact with pyrimidines and confer specificity to ribonuclease. The crystallographers were unable to tell what changes occurred in enzyme conformation on binding of substrate since all the x-ray work had been done with $H_2PO_4^-$, or nucleotides, or SO_4^{2-} bound to ribonuclease. The answer is important to the mechanism of ribonuclease action. Such a conformational change could provide the needed activation energy for the catalytic reaction. However, the answer may be difficult to obtain since crystallization of anion-free ribonuclease has not been achieved and such powerful approaches to isomorphous replacement as those used by the Yale group would not be directly applicable in x-ray diffractometry of substrate-free ribonuclease.

As a bridge between the crystallography and work on the mechanism of ribonuclease action, H. A. Scheraga described his current work on computing of most probable structures of macromolecules based on the assumption of minimum total energy in the molecule of interest with approximations of the contributions from different types of interaction. Results of these calculations are reflected in bond angles.

A plot of the H-C^{α}-C^1 bond angles versus H-C^{α}-N bond angles gives an energy contour map which can be used in defining the total energy of a conformation as well as the handedness of the macromolecule. Random access to the entire energy map is employed for the purpose of avoiding determination of incorrect energy minima among the many inflections. Such calculations of most probable conformation have been carried out on gramicidin-S, on oxytocin, on ribonuclease S-peptide, and the octapeptide loop of ribonuclease A. Results on S-peptide showed considerable similarity to the crystallographic models. At present, en-

zymes of known sequence, such as lysozyme, are being calculated.

If calculated conformations generated by the computer agree well with those determined by diffractometry, then the computer approach will enable relatively rapid synthesis of three-dimensional structures of macromolecules whose monomer sequences are known. However, a healthy skepticism seems warranted, as noted in discussion of this paper by G. H. Ramachandran, until Scheraga is able to solve the known structures of a number of large heteropolymers. On the other hand, if the minimal energy computations do have predictive value, a major advance will have been made in determining heteropolymer structure and in making correlations between structure and function.

The greatest number of contributions to the symposium concerned studies of ribonuclease chemistry and mechanism of action. J. Bello correlated a large body of chemical evidence with the RPMI model. Thus, the involvement of histidines-12, and -119, and lysine-41 in the active center was confirmed in the model by the close proximity of these residues to the $H_2PO_4^-$ in the substrate cleft; the participation of these residues in ribonuclease A binding and catalysis was discussed by a number of contributors. The dimerization of the enzyme by looping of two S-peptide moieties to two adjacent enzyme molecules is seen to be feasible from the model; A. M. Crestfield presented detailed analysis of his active center work based on hybrid dimers. The presence and identification of easily titratable and buried tyrosines in ribonuclease could also be explained in terms of the model. Finally, the anionic stabilization of the enzyme to urea denaturation was correlated with the model where a number of cationic sites from various parts of the polypeptide chain occur near the substrate cleft.

Another approach to the chemical study of the active center as well as the first systematic study of amino acid replacement in an enzyme was reported by F. Finn and K. Hofmann. These workers have synthesized the S-peptide and a number of S-peptide analogs and have tested enzymic activity after mixing with S-protein. The first 13 amino acids in the S-peptide (S-peptide-1-13), when mixed with S-protein in a ratio of 200 to 1, results in full enzyme activity. A ratio of 1 to 1 of S-peptide-1-14 and S-protein is fully active. Addition of amino acids 15-21, in order, to the S-peptide did not increase activity, thus indicating that these amino acids are not involved either in the binding of S-peptide to S-protein or in the catalytic activity of the complex. Methionine-13 is involved in one or both of these functions since conversion of this residue to sulfone or sulfoxide reduces enzyme activity toward RNA but not toward pyrimidine-2′,3′-cyclic phosphate substrate. All changes in histidine-12 abolish enzyme activity, thus confirming results of others. Replacement of arginine-10 with ornithine or lysine does not affect activity nor does replacement of glutamic-9 with lysine (bovine versus rat ribonuclease). Phenylalanine-8 can be replaced with tyrosine without affecting activity, but the enzyme is inactive when this residue is replaced by nonaromatic amino acids. This type of systematic study of a synthetically accessible polypeptide essential to enzyme activity is a highly informative and powerful approach in investigating enzyme mechanisms. Its general utility remains in doubt until other enzymes are found which can be converted into two reversibly dissociable pieces, each of which is essential for enzyme activity and one of which is small enough to be synthesized chemically.

G. G. Hammes described his work on perturbation analysis of ribonuclease reactions with methods involving temperature-jump and stopped-flow-temperature-jump. With very rapid perturbation and spectroscopic analysis of relaxation to a steady state, enzymic reactions as short as 1 microsecond can be analyzed and the number of intermediates in the reaction observed. Hammes has found five different relaxation times between pyrimidine-2′,3′-cyclic phosphate and the 3′-phosphomonoester, indicating at least five intermediate enzyme-substrate and enzyme-product complexes. Also, studying relaxation times as a function of *p*H, three ionizable groups at, or at least influencing, the active center were identified with *pK*'s of 5, 6, and 6.7, probably corresponding to three histidines.

From the known chemical reactivity of ribonuclease, the kinetic studies, and the enzyme model, it was possible for Hammes to deduce a plausible, if highly tentative, molecular mechanism for transesterification and -2′,3′-cyclic phosphate hydrolysis. Binding was the first step, followed by two separable enzyme conformational changes, and then

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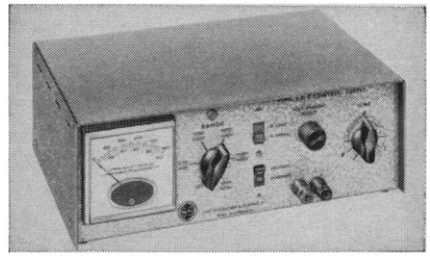

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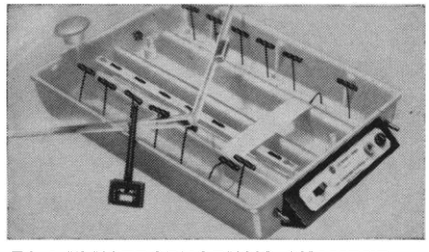

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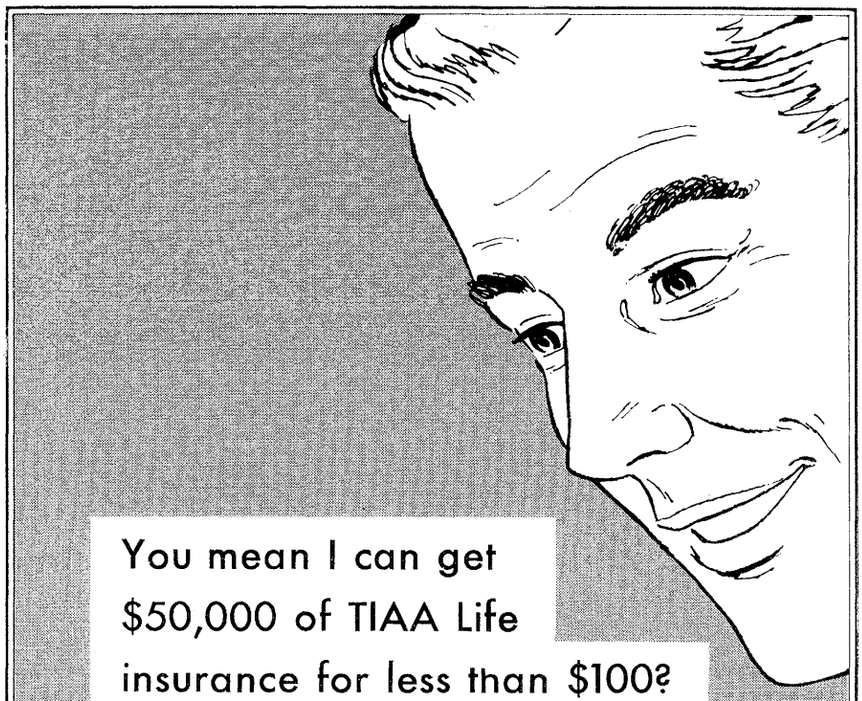

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by dissociation. After binding, protonation of two enzyme bases, histidines -12, and -119, occurs in the transesterification step. A reversal of the process follows, water replacing the expelled 5′-OH with polynucleotides, thus hydrolyzing the -2′3′-cyclic phosphate in the overall general acid-base catalysis. B. R. Rabin presented a similar hypothesis, based on the same general information. His theory differed only in that one of the two histidines is protonated and the other unprotonated at the beginning with the sequential transesterification and hydrolysis involving deprotonation of the first histidine and protonation of the second, followed by a direct reversal. The other amino acid residues known to be involved in the active center are presumably involved in the binding of substrate. There seemed little to choose between these two similar alternative mechanisms except, as noted by Hammes, that the former was esthetically more pleasing and presented no difficulty of low rate constants due to particular histidines being protonated or unprotonated initially. Rabin countered with the observation that the Hammes mechanism did not involve water binding or activation which are thought, by some, to occur in ribonuclease.

A third alternative mechanism was presented by H. Witzel based on his studies of the binding and hydrolysis of a large number of base analog nucleoside-2′,3′-cyclic phosphates. The pyrimidine $-N^3-C^2=O$ appears to be required and Witzel hypothesized that the carbonyl functions as the general base regenerated by exchange with water. The major function of the enzyme in this mechanism is to stabilize transition-state pentacovalent phosphorus dianion at all stages of the reaction, with the pyrimidine ring supplying all reactive requirements. Though no evidence against this mechanism was presented, it did not appear to explain the need for all the known amino acid residues of the active center region.

E. A. Barnard showed that bromoacetate alkylation of one methionine (apparently methionine-29) occurs sharply at *p*H 6.2. Since the methionine-29 side-chain is buried in the ribonuclease A (but not S) model, this increased reactivity was suggested as being associated with a histidine ionization and conformational change. Barnard felt that the latter might be responsible for the *p*H 6 relaxation time observed by Hammes. This conformational change and the changed methionine reactivity

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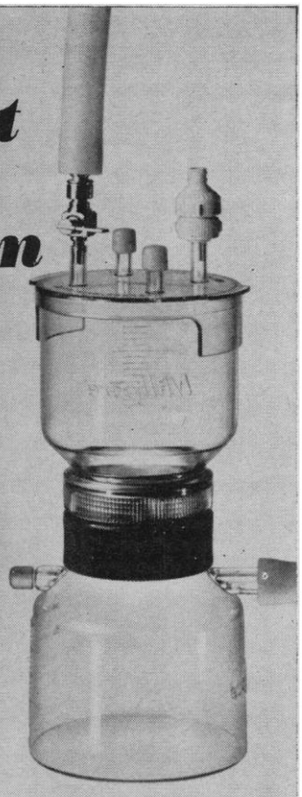

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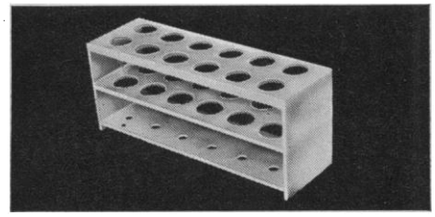

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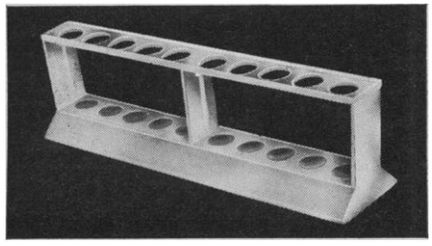

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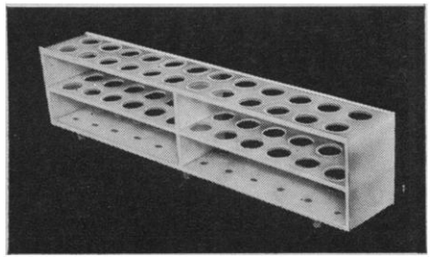

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could be explained by movement of the S-peptide region.

There was much discussion of the mechanisms of ribonuclease A but no general consensus on which, if any, of those presented was most consistent with the model. Further work with close correlation to the three-dimensional structure will be required to resolve this problem.

Several papers were presented concerning derivatives of ribonuclease A and ribonucleases isolated from other sources. S. Beychok presented a study of the circular dichroic (CD) spectra of normal, reduced, and reoxidized ribonuclease A. The original work of Anfinsen on spontaneous recovery of enzyme activity after air reoxidation of inactive, reduced ribonuclease A appeared to represent spontaneous recovery of native conformation, and further suggested that all higher structural orders were completely dependent on the primary structure. The near-ultraviolet CD spectrum of ribonuclease A contains two bands (λ_{max} 240 mμ and 275 mμ) initially assigned to tyrosine. Further work showed the 275-mμ band to be complex, possibly including cystine disulfide bonds which may have two screw senses differentiated by CD. On reduction of the disulfides, the 275-mμ band is markedly changed. After air reoxidation, when about 90 percent of initial enzyme activity is recovered, the CD spectrum is still different from the native enzyme unless the reoxidation is carried out in the presence of 2-mercaptoethanol. This evidence for a different conformation in reoxidized ribonuclease suggests that proteins do not necessarily assume a unique lowest-energy state and, further, that a single unique conformation may not be a necessary attribute of an active enzyme. These conclusions were sharply contested by H. A. Scheraga and by R. F. Goldberger. These findings may have important theoretical implications.

E. A. Barnard, M. Gold, and E. N. Zendzian have isolated and partially purified exocrine ribonucleases from a large number of vertebrates. They have assessed the activity per unit weight of pancreas and some chemical properties of these enzymes. Surprisingly, only certain groups, for example ruminants, had much pancreatic ribonuclease. As a result of this work, a hypothesis was presented concerning the biological significance of pancreatic ribonucleases. Reactivity and substrate specificity studies of ribonucleases from the main vertebrate classes showed the

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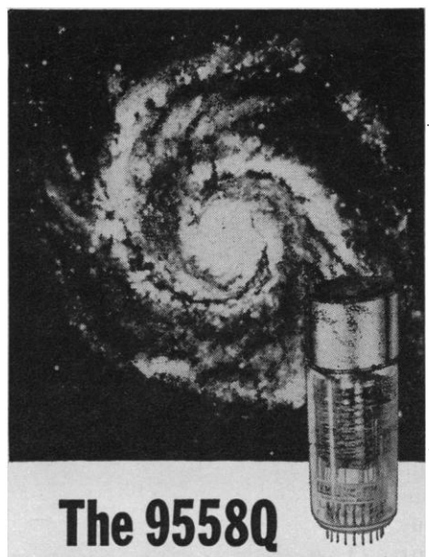

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enzymes to have a number of active center similarities, thus suggesting that pancreatic enzymes are homologous.

Studies of porcine pancreatic ribonuclease were presented by C. H. W. Hirs and V. N. Reinhold. They have purified the enzyme but have found that it is molecularly inhomogeneous. These ribonucleases are glycoproteins and the inhomogeneity arises from a variable amount of polysaccharide around a constant protein core. All these enzymes contain 125 amino acids and have eight half-cystines. The protein core has other compositional similarities to bovine ribonuclease A.

K. Takahashi contrasted the primary structure and early mechanistic studies of ribonuclease T_1 with A. There is little analogy between primary structures despite highly analogous transesterification and -2′,3′-cyclic phosphate hydrolysis (of guanosine-3′-phosphodiesters). The single lysine in T_1 is not required for activity. Reaction with bromoacetate did inactivate the enzyme, but histidine was not alkylated; only esterification of glutamate-58 occurred. Thus, present evidence suggests that the two ribonucleases may have different catalytic mechanisms. It appeared that, despite the recent major advances in knowledge of the structure of ribonuclease A and the mechanistic implications of these findings, there is still a great deal of work to be done on the structure and mechanism of other ribonucleases and considerable informative work to be done on ribonuclease A as well.

The symposium was sponsored by the Department of Biochemistry, Schools of Medicine, Dentistry and Pharmacy, State University of New York at Buffalo, and the Graduate Division of the Roswell Park Memorial Institute, Buffalo, New York.

DAVID B. STRAUS
Department of Biochemistry, State University of New York at Buffalo

Cell Synchrony

Recent advances in the synchronization of cell division was the topic at the 2nd International Conference on Cell Synchrony, held 27–29 April 1967, in Oak Ridge, Tennessee. The program was divided into five sessions: (i) Genetic studies in cell synchrony (H. O. Halvorson, University of Wisconsin, chairman); (ii) Developmental aspects of cell synchrony (D. T. Lindsay, Uni-

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versity of Georgia, chairman); (iii) Regulation and control in synchronized cells (T. W. James, University of California at Los Angeles, chairman); (iv) Biochemistry and physiology of synchronized cells (G. G. Holz, Jr., State University of New York at Syracuse, chairman); and (v) Macromolecular aspects of cell division synchrony (I. L. Cameron, State University of New York at Syracuse, chairman).

A number of contributors examined the proposal that the bacterial chromosome has a single fixed site from which replication proceeds in one direction. Since somewhat conflicting results were reported for cells artifically synchronized by different methods, a study of the replication of the bacterial chromosome during normal, steady-state growth was of particular interest. T. Nagata (Harvard University) analyzed *Escherichia coli* cells pulse-labeled with ^{3}H-thymidine during exponential growth and then transferred to an isotopically heavy medium. He found that the density of ^{3}H-labeled DNA shifted from that of light DNA to hybrid DNA after 0.8 to 1.1 generations and that a similar shift occurred in the second and third generations. Thus the chromosome has a fixed point and direction of replication for several generations during normal, steady-state growth.

Another means of studying cells during normal, steady-state growth was presented by C. E. Helmstetter (Roswell Park Memorial Institute). *Escherichia coli* cells were labeled during exponential growth, and "young" cells were collected by detachment from the surface of a membrane. His results indicated that (i) replication of the entire chromosome took 40 minutes, (ii) completion of chromosome replication preceded cell division by 20 minutes, and (iii) replication of one chromosome could begin and end in different cell-division cycles.

A somewhat different approach for studying the control of cell division in bacteria was reported by W. D. Fisher (Oak Ridge National Laboratory) on mutants of *E. coli*. A short film showed three different cell-division mutants of *E. coli* K-12 isolated by H. I. Adler (ORNL). Cytokinesis in one of these strains is blocked by x-rays, and is reversed by addition of extracts from normal cells.

Another group of participants examined ordered enzyme synthesis in synchronized cells. P. Tauro, from Halvorson's laboratory (University of Wisconsin), reported on the analysis of ordered enzyme synthesis in synchronized budding yeast cells and showed that each structural gene has a defined period of enzyme synthesis. He brought up the interesting question of the relation of the position of structural genes to the time of their expression during the cell cycle and also of whether the yeast genome is transcribed in a sequential manner. J. M. Mitchison (University of Edinburgh) elaborated further on enzyme synthesis in synchronized fission yeast. He emphasized that while certain structural genes showed a defined period of enzyme synthesis others showed a constant rate of synthesis with a doubling at some time in the cell cycle. To account for the second pattern of synthesis, Mitchison proposed a model in which there is a delay between the replication and transcription of the yeast genome. W. D. Donachie (Hammersmith Hospital, London) presented data showing that several induced enzymes in synchronized bacteria show a doubling in rate of synthesis at a given time during the cell division cycle. The time of rate-

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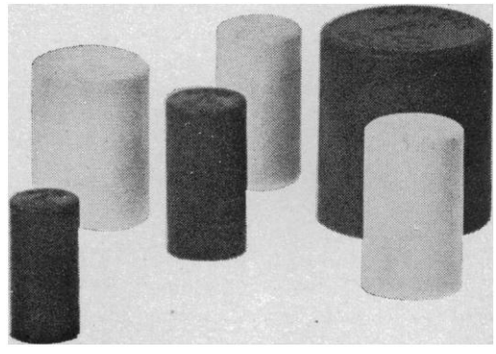

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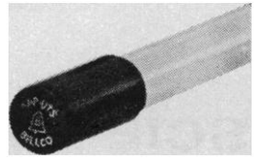

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1967, 468 pp., $14.00

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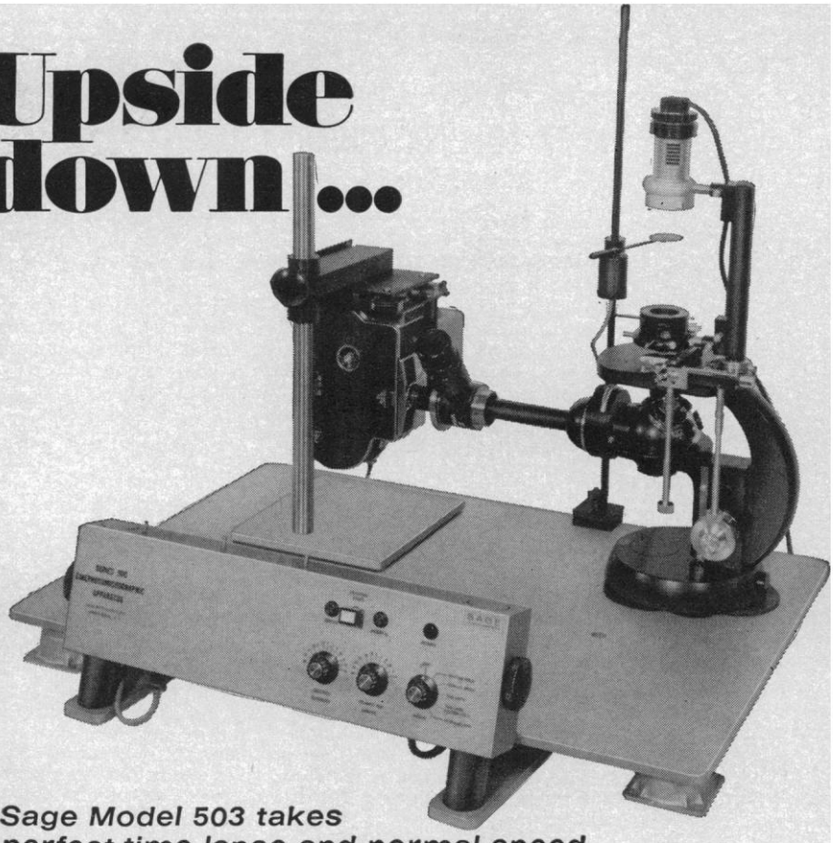

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synthesis doubling was more or less correlated with the map position of genes coding for each enzyme.

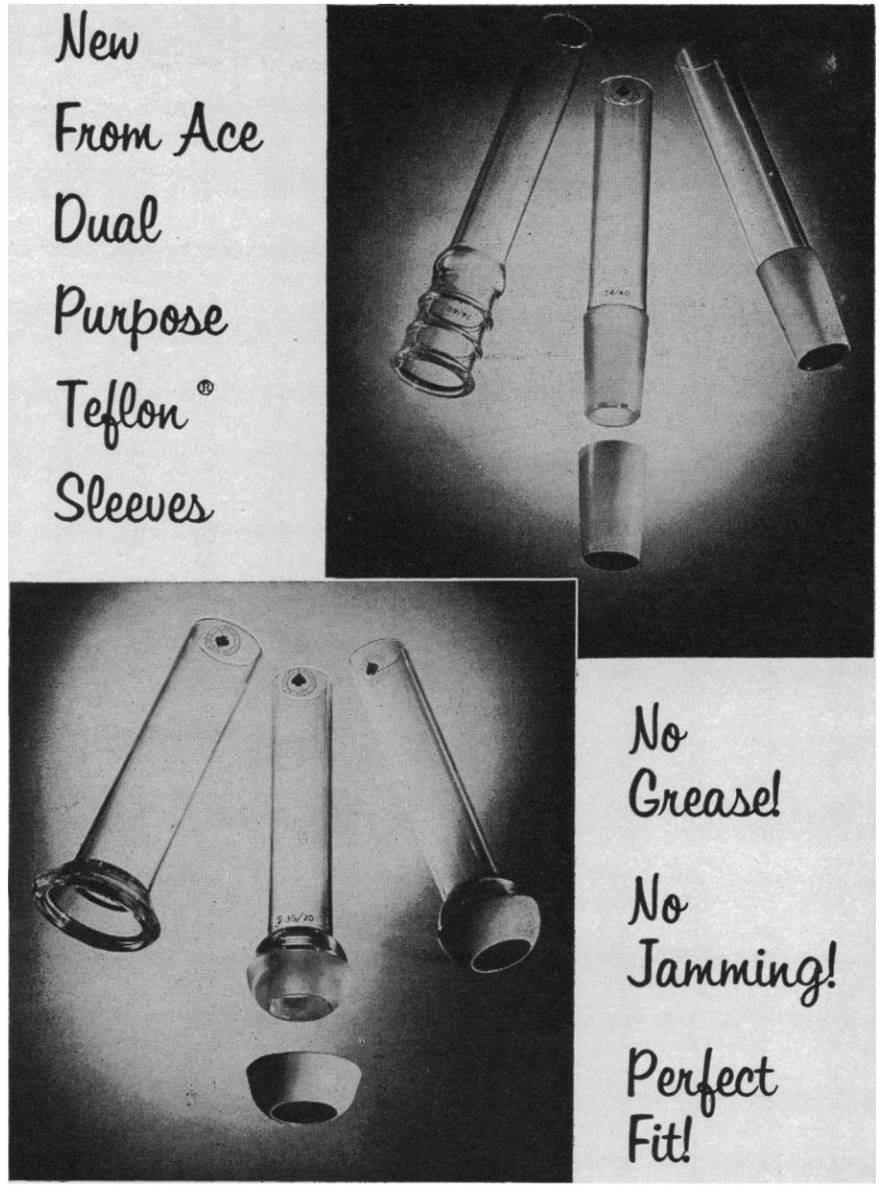
The possible role of macromolecular synthesis in regulation and control mechanisms in cells was examined extensively. H. Senger (Oregon State University) discussed light-dependent formation of nucleic acids and their relation to induction of cell division in *Chlorella.* He indicated that light of certain wavelengths influences both the formation of RNA and protein synthesis, which in turn controls the burst of cell division. R. R. Schmidt (Virginia Polytechnic Institute) reported on the enzymatic control of nucleic acid synthesis in synchronized *Chlorella.* He noted fluctuations in the levels of enzymes involved in nucleic acid synthesis. In particular, he produced enzymatic evidence that ribonucleotides in *Chlorella* are reduced to deoxyribonucleotides at the diphosphate level. A simultaneous synthesis of DNA and histone was shown in widely separated cell types: by Scharff (Albert Einstein College of Medicine) in mammalian cells (HeLa cells) and by Lindsay (University of Georgia) in the protozoan cell, *Tetrahymena.* In HeLa cells, histones were produced on specific localizable polyribosomes in the cytoplasm; the production of histones was blocked by the inhibition of DNA synthesis. Simultaneous synthesis of histone is, however, not required for DNA synthesis since G. C. Mueller (University of Wisconsin) reported that isolated HeLa cell nuclei from synchronized or logarithmically growing cells are active in DNA synthesis. A. M. Zimmerman (University of Toronto) discussed the effects of high pressure on cell division and certain cell macromolecules in *Tetrahymena.* He was unable to demonstrate any differences in protein content of dividing and nondividing cells, that is, no indication of a "division protein." However, he found differences in ribosomal patterns between pressurized and nonpressurized cells. J. Byfield (University of California at Los Angeles) suggested that the synchronizing effect of temperature shock in *Tetrahymena* may involve messenger RNA in that temperature shifts drastically reduce the half-life of already labeled RNA.

Several papers examined the biochemical events associated with cell division and differentiation. P. R. Gross (Massachusetts Institute of Technology) reported on controls of rate of protein synthesis during early development of sea urchin eggs, and gave evidence that

mRNA is stored in eggs and renewed mRNA synthesis occurs only after several successive cell divisions. Data presented by R. M. Iverson (University of Miami at Coral Gables) supported the idea of an increase in protein synthesis and in polysomes after fertilization in sea urchin eggs in the absence of mRNA synthesis. This was further evidence that mRNA is stored in eggs. David Epel (Hopkins Marine Station, Stanford University) reported on "early" structural and respiratory changes occurring within seconds after fertilization and "late" initiation of protein synthesis occurring about 10 minutes after fertilization. This increase in protein synthesis was attributed to an increased rate of translation of preexisting mRNA.

The induction of synchrony in mammalian cells by various inhibitors of macromolecular synthesis received considerable attention. W. K. Sinclair (Argonne National Laboratory) demonstrated that the toxicity of various drugs is related to the stage of the cell cycle. For instance, cycloheximide (an inhibitor of protein synthesis) is more toxic to G_1 cells, less toxic to cells in S phase, and even less toxic to G_2 cells. D. F. Petersen (Los Alamos Scientific Laboratory) also reported on various inhibitors of biosynthesis of macromolecules in Chinese hamster cells. He was able to show specifically that cells removed from cycloheximide after varying intervals still have the capacity to divide, indicating indirectly that mRNA which directs the synthesis of proteins is relatively stable over long periods of time. Furthermore, he has shown that synthesis of essential RNA is inhibited when protein synthesis is shut off. P. N. Rao (University of Kentucky) reported on synchrony in HeLa cells by means of reversal of thymidine and colcemide blocks. While reversal of colcemide blocks could be obtained in HeLa cells, he showed that this was true only when the drug was added in low concentrations and within specific time limits after prolonged treatment.

In summarizing the conference J. M. Mitchison (University of Edinburgh) stressed the need of understanding the events in the early stages of the cell cycle which play important roles in the control of cell division. He mentioned the more recent interest in the study of the relations of biochemical events to physiological events involved in the study of cell division. In particular, he stressed the need of a better understanding of the end products of



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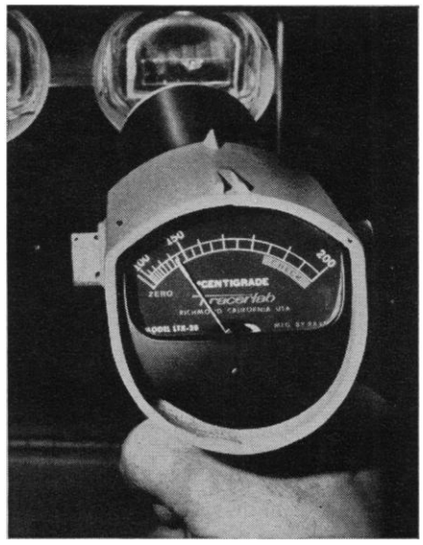

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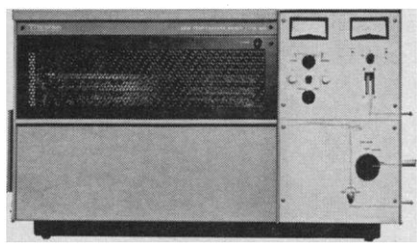

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genetic translation in cells. He further pointed out the need for new morphological or biochemical markers, or both, associated with the different metabolic states, especially during interphase. He contrasted natural synchrony with induced synchrony and pointed out some of the problems associated with the different methods of synchrony.

The conference was held under the joint sponsorship of the Biology Division of the Oak Ridge National Laboratory and Duke University. It was attended by 130 investigators from Canada, England, Scotland, Germany, Japan, Russia, and the United States and dealt with recent advances in the synchronization of cell division. Fifty-one papers were presented, and discussions were interspersed throughout the entire program.

G. L. WHITSON
W. D. FISHER
Biology Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee*
G. M. PADILLA
Department of Physiology, Duke University, Durham, North Carolina, and *Wrightsville Marine Biomedical Laboratory, Wilmington, North Carolina*
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Department of Anatomy, Upstate Medical Center, State University of New York, Syracuse

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Calendar of Events

Courses

Hydrospace: State of the Art, Hopatcong, N.J., 25–29 Sept. Fee: $200. (B. Nierenberg, Oceanics Workshop, Saul Gordon Associates, Center for Professional Advancement, P.O. Box 66, Hopatcong, 07843)

Cardiopulmonary Problems in Children, Chicago, Ill., 21–23 Sept. (American College of Chest Physicians, 112 E. Chestnut St., Chicago 60611)

Cancer Chemotherapy, Houston, Tex., 18–29 Sept. The chemistry, pharmacology, and clinical application of the antimetabolites, hormones and miscellaneous newer drugs will be reviewed. (E. Frei, 6723 Bertner Ave., Houston 77025)

Modern Aspects of Communication Theory, Austin, Tex., 25–29 Sept. Fee: $175. (D. E. Griffith, College of Engineering, University of Texas, Austin 78712)

Water Utility Management, Urbana, Ill., 29 Oct.–2 Nov. Is intended to aid the water commissioner, manager, and supervisors to increase their management skills. (E. Lyons, 116e Illini Hall, Champaign, Ill. 61820)

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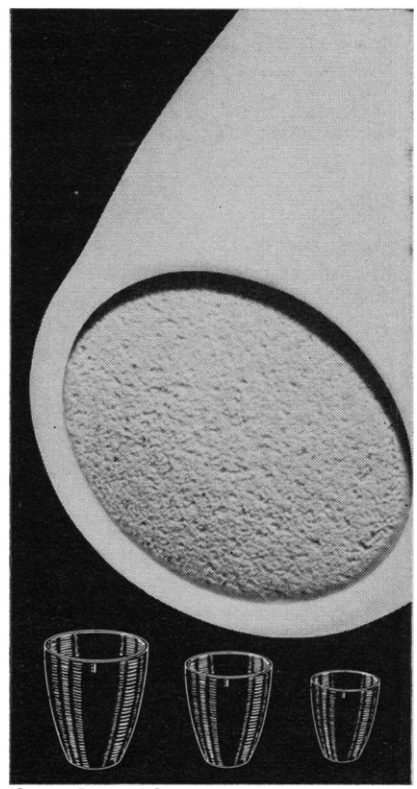

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Analysis of Atmospheric Inorganics, Cincinnati, Ohio, 25–29 Sept. (Chief, Training Program, National Center for Air Pollution Control, 4676 Columbia Parkway, Cincinnati 45226)

Modern Approaches to Drug Discovery and Development, Hopatcong, N.J., 23–27 Oct. Fee: $200. (W. Oroshnik, Saul Gordon Associates, P.O. Box 66, Hopatcong 07843)

September

National Meetings

17–20. **Petroleum Mechanical Engineering**, conf., Philadelphia, Pa. (A. B. Conlin, Jr., ASME, 345 E. 47 St., New York 10017)

18–20. **Electrical Insulation** and **Dielectric Phenomena**, conf., Pocono Manor, Pa. (Col. R. A. Cliffe, Conf. on EIDP, National Acad. of Sciences, 2101 Constitution Ave., NW, Washington, D.C.)

18–20. Society of **Logistics Engineers**, 2nd annual conv., Washington, D.C. (J. L. Carpenter, Jr., Martin-Marietta, Friendship Intern. Airport, Baltimore, Md.

18–20. **Standards Engineers Soc.**, 16th annual mtg., Detroit, Mich. (B. J. Powell, Bendix Corp., Res. Lab. Div., Southfield, Mich. 48076)

18–21. **Marine Corrosion**, seminar, Wrightsville Beach, N.C. (T. P. May, Box 656, Wrightsville Beach)

18–21. **Pulp and Paper**, 22nd engineering conf., Atlanta, Ga. (H. B. Harris, Jr., Union Camp Corp., Savannah, Ga.)

18–22. Localized **Excitations in Solids**, Los Angeles, Calif. (A. A. Maradudin, Dept. of Physics, Univ. of California, Irvine 92664)

19–22. Pulsed **High-Density Plasmas**, conf., Los Alamos, N.M. (F. L. Ribe, Los Alamos Scientific Lab., Box 1663, Los Alamos 87544)

21–24. American **Medical Writers'** Assoc., annual mtg., Chicago, Ill. (E. G. Dailey, AMWA, Box 267, Arlington, Va.

22–30. American Soc. of **Clinical Pathologists** and College of American Pathologists, joint annual mtg., Chicago, Ill. (M. Damron, ASCP, 445 N. Lake Shore Dr., Chicago 60611)

25–27. **Environmental Effects on Aircraft and Propulsion Systems**, 7th annual conf., Princeton, N.J. (H. F. Sander, IES, 940 E. Northwest Highway, Mount Prospect, Ill.)

25–28. Association of **Iron and Steel Engineers**, annual conv., Chicago, Ill. (T. J. Ess, AISE, 1010 Empire Bldg., Pittsburgh, Pa. 15222)

25–28. **Human Factors Soc.**, 11th annual mtg., Boston, Mass. (P. G. Ronco, Systems Bldg., Tufts Univ., Medford, Mass.)

26–28. **Survival and Flight Equipment** Assoc., 5th natl. symp., San Diego, Calif. (J. Dolan, 939 Nolan Way, Chula Vista, Calif.)

26–29. American **Roentgen Ray** Soc., annual mtg., Washington, D.C. (T. F. Leigh, ARRS, Emory Univ. Clinic, Atlanta, Ga. 30322)

27–29. American Assoc. of **Petroleum Geologists**, mid-continent section mtg., Wichita, Kan. (R. J. Gutru, Beardmore Drilling Co., 700 One Twenty Bldg., Wichita 67202)

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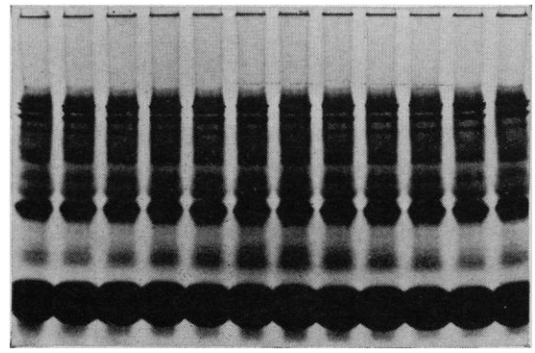

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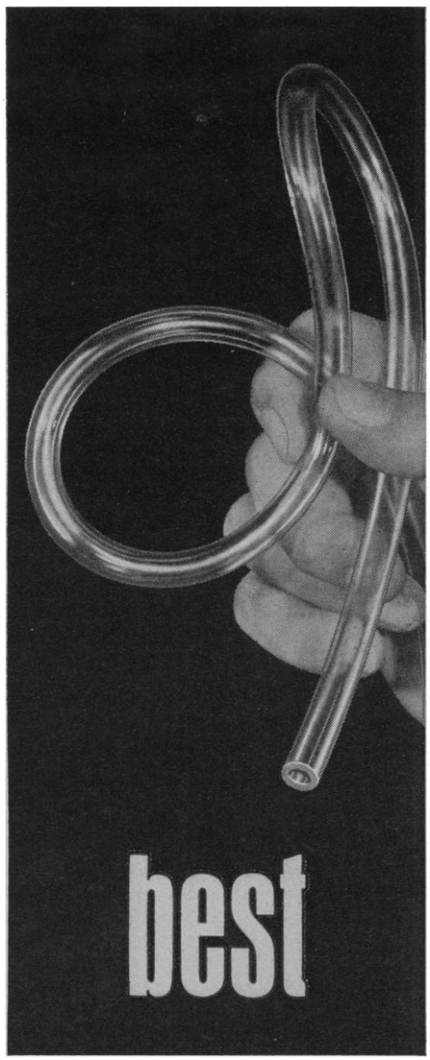

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28–30. **Surgery of Trauma**, mtg., Chicago, Ill. (S. B. Gaston, AAST, 80 Fort Washington Ave., New York 10032)

28–30. **Cervix Uteri**, symp., Miami, Fla. (J. W. Scott, 701 du Pont Bldg., Miami 33131)

29–3. American Soc. of **Anesthesiologists**, annual mtg., Las Vegas, Nev. (W. S. Marinko, ASA, 515 Busse Hwy, Park Ridge, Ill. 60608)

International and Foreign Meetings

7–9. **Analytical Chemistry**, symp., Sackville, Canada. (T. H. G. Michael, Chemical Inst. of Canada, 151 Slater St., Ottawa 4)

10–14. American Soc. of **Psychosomatic Dentistry and Medicine**, 18th annual mtg., Mont Gabriel, Canada. (L. Wollman, ASPDM, 2177½ Seneca St., Buffalo, N.Y.)

10–15. **Illuminating Engineering** Soc., conf., Montreal, Canada. (A. D. Hinckley, IES, 345 E. 47 St., New York 10017)

11–15. **Cybernetics**, 5th intern. congr., Namur, Belgium. (International Assoc. for Cybernetics, 13 Rue Basse-Marcelle, Namur)

11–15. **High Energy Accelerators**, 6th intern. conf., Cambridge, Mass. (W. A. Shurcliff, Cambridge Electron Accelerator, 42 Oxford St., Cambridge 02138)

11–15. **Information Theory**, Inst. of Electrical and Electronic Engineers, intern. symp., San Remo, Italy. (D. Schilling, Polytechnic Inst. of Brooklyn, 333 Jay St., Brooklyn, N.Y.)

13–15. American **Fisheries** Soc., 97th annual mtg., Toronto, Canada. (R. F. Hutton, AFS, Suite 1040, Washington Bldg., 15th and New York Ave., NW, Washington, D.C.)

17–20. **High Temperature**, 3rd intern. symp., Asilomar, Calif. (Dept. 366, Stanford Research Inst., 333 Ravenwood Ave., Menlo Park, Calif. 94025)

17–23. **Neuro-Genetics and Neuro-ophthalmology**, 2nd intern. congr., Montreal, P.Q., Canada. (A. Barbeau, Section de Neurologie, Univ. of Montreal, Montreal)

18–19. American Assoc. of **Botanical Gardens and Arboretums**, Hamilton, Ontario, Canada. (F. Widmoyer, Dept. of Horticulture, New Mexico State Univ., University Park)

18–20. **Buoy Technology**, 2nd intern. symp., Washington, D.C. (M. H. Simons, MTS, 1030 15th St., NW, Washington, D.C. 20005)

20–23. Use of **Radioactive Isotopes in Pharmacology**, intern. conf., Geneva, Switzerland. (B. Glasson, School of Medicine, Univ. of Geneva, 1211 Geneva 4)

24–27. American Inst. of **Chemical Engineers** and Mexican Inst. of Chemical Engineers, joint mtg., Mexico City. (J. Henry, AICE, 345 E. 47 St., New York.

24–30. International **Astronautical** Federation, 18th annual congr., Belgrade, Yugoslavia. (American Inst. of Aeronautics and Astronautics, 1920 Sixth Ave., New York 10019)

25–29. **Mass Spectrometry**, intern. conf., West Berlin, Germany. (Geschaftsstelle der Gesellschaft Deutscher Chemiker, z Hd von Herrn Dr. W. Fritsche, 6 Frankfurt/Main, Postfach 9075, Germany)

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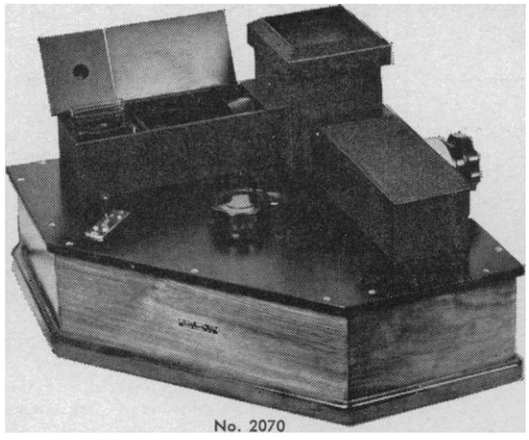

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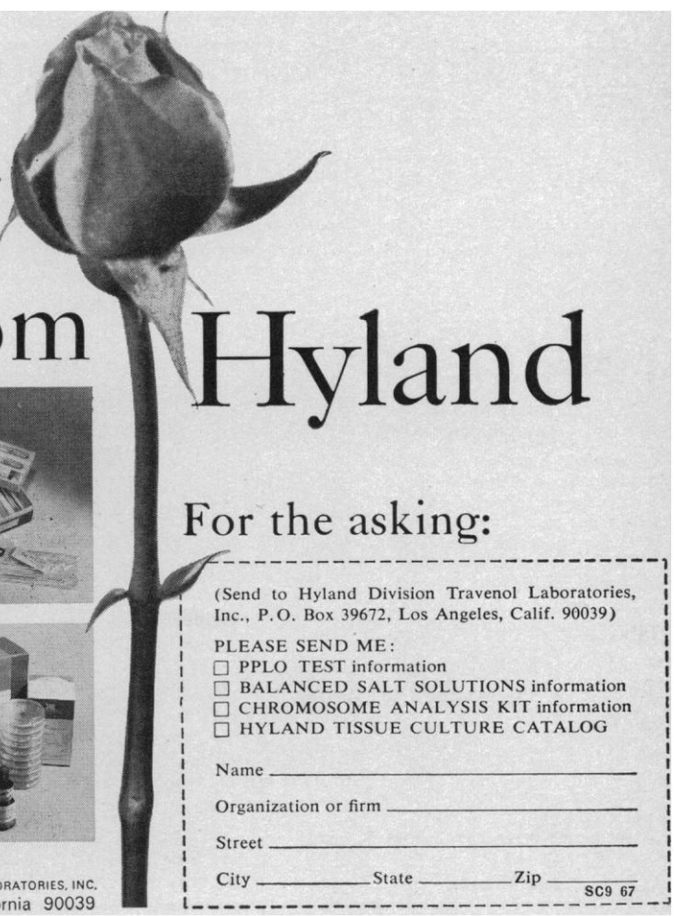

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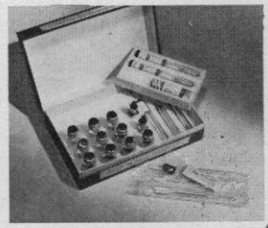

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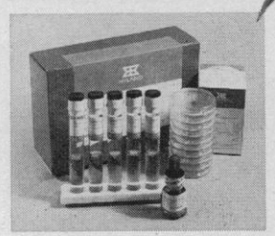

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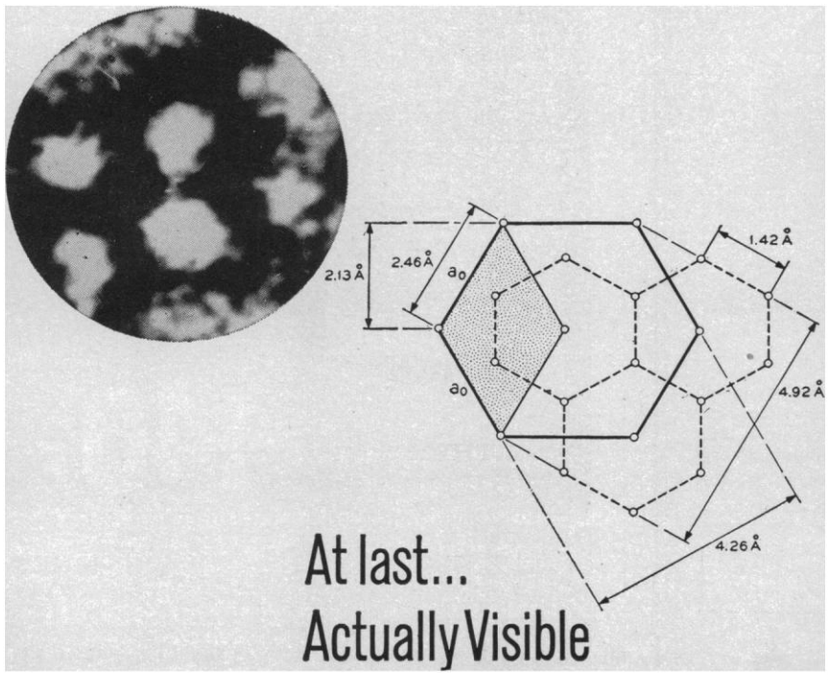

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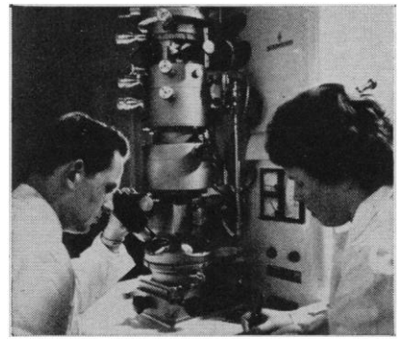

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1967. 640 pp. Illus. $27.50. Twelve papers.

Book of ASTM Standards: With Related Material. pt. 5, *Copper and Copper Alloys (Including Electrical Conductors)* (814 pp. $12); pt. 9, *Cement; Lime; Gypsum* (520 pp. $8); pt. 16, *Structural Sandwich Constructions; Wood; Adhesives* (916 pp. $14); pt. 28, *Rubber; Carbon Black; Gaskets* (1168 pp. $20); pt. 30, *General Testing Methods; Radioisotopes and Radiation Effects; Statistical Methods; Appearance of Materials; Emission, Molecular, and Mass Spectroscopy; Sensory Evaluation of Materials and Products; Gas Chromatography; Temperature Measurement; Space Simulation; Microscopy* (1124 pp. $18); pt. 31, *Physical and Mechanical Testing of Metals—Metallography, Nondestructive Testing, Fatigue, Effect of Temperature* (990 pp. $6); pt. 32, *Chemical Analysis of Metals; Sampling and Analysis of Metal Bearing Ores* (932 pp. $16). American Soc. for Testing and Materials, Philadelphia, 1967. Illus.

Botany: A Textbook for Colleges. J. Ben Hill, Henry W. Popp, and Alvin R. Grove, Jr. McGraw-Hill, New York, ed. 4, 1967. 644 pp. Illus. $9.95.

Casebook in Production Management. Louis J. Rago. International Textbook Company, Scranton, Pa., 1967. 552 pp. Illus. Paper.

Characteristics of Sea Reverberation. V. V. Ol'shevskii. Translated from the Russian (Moscow, 1966). Consultants Bureau, New York, 1967. 171 pp. Illus. Paper, $19.50. Forty-five papers.

Chemical Reactions at High Pressures. K. E. Weale. Spon, London; Barnes and Noble, New York, 1967. 365 pp. Illus. $12.50.

Chemical Thermodynamics: A Problems Approach. Norman O. Smith. Reinhold, New York, 1967. 288 pp. Illus. $8.50.

The Chemistry of Non-Aqueous Solvents. vol. 2, *Acidic and Basic Solvents*. J. J. Lagowski, Ed. Academic Press, New York, 1967. 414 pp. Illus. $18.50. Seven papers.

Comprehensive Biochemistry. vol. 22, *Bioenergetics*. Marcel Florkin and Elmer H. Stotz, Eds. Elsevier, New York, 1967. 226 pp. Illus. $12.75. Four papers.

Computer Solution of Linear Algebraic Systems. George E. Forsythe and Cleve B. Moler. Prentice-Hall, Englewood Cliffs, N.J., 1967. 160 pp. Illus. $6.75.

Digital Computer User's Handbook. Melvin Klerer and Granino A. Korn, Eds. McGraw-Hill, New York, 1967. Unpaged. Illus. $27.50.

Dissection of the Frog. Warren F. Walker, Jr. Freeman, San Francisco, 1967. Illus. Seven loose-leaf exercises, 20¢ each.

Electrochemistry of Molten and Solid Electrolytes. *vol. 5, Physicochemical Properties of Electrolytes and Electrode Processes*. A. N. Baraboshkin, Ed. Translated from the Russian (Sverdlovsk, 1966) by Halina Wroblowa. Consultants Bureau, New York, 1967. 166 pp. Illus. Paper, $19.50. Twenty papers.

Elements of Nonparametric Statistics. Gottfried E. Noether. Wiley, New York, 1967. 116 pp. Illus. $7.95. SIAM Series in Applied Mathematics.

Energy, Organization and Life. R. Rodrigo Panares. Educational Methods. Chicago, 1967. 143 pp. Illus. Paper, $2.95.

Engineering Properties of Roofing Systems. A symposium (Atlantic City, N.J.), June–July 1966. American Soc. for Testing and Materials, Philadelphia, 1967. 214 pp. Illus. $14. Twelve papers.

Erosion by Cavitation or Impingement. A symposium (Atlantic City, N.J.), June–July 1966. American Soc. for Testing and Materials, Philadelphia, 1967. 289 pp. Illus. $20. Ten papers.

Etude biocoenotique d'un milieu "naturel": la prairie permanente pâturée. Germaine Ricou. Institut National de la Recherche Agronomique, Paris, 1967. 148 pp. Illus. Paper, 21 F.

Experimental Organic Chemistry. Charles A. MacKenzie. Prentice-Hall, Englewood Cliffs, N.J., ed. 3, 1967. 336 pp. Illus. Paper, $5.95.

The Explosion of Science: The Physical Universe. Sir Bernard Lovell and Tom Margerison, Eds. Meredith Press, New York, 1967. 216 pp. Illus. $19.95 until 31 December 1967; thereafter $24.95.

Facts on the Major Killing and Crippling Diseases in the United States Today. Compiled by the National Health Education Committee. National Health Education Committee, New York, 1967. Unpaged. Illus. Paper, $5.25.

Fondements de la physique atomique. J. Leite Lopes. Hermann, Paris, 1967. 363 pp. Illus. 66 F.

Foundations of Fluid Mechanics. S. W. Yuan. Prentice-Hall, Englewood Cliffs, N.J., 1967. 630 pp. Illus. $12.95.

Fourth Symposium (International) on Detonation. Proceedings (White Oak, Md.), October 1965. Sponsored by the U.S. Naval Ordnance Laboratory and Office of Naval Research, Sigmund J. Jacobs, Chairman. Department of the Navy, Washington, D.C., 1967 (available from Superintendent of Documents, Washington, D.C.). 668 pp. Illus. $5. Sixty-nine papers and 11 abstracts.

From Raindrops to Volcanoes: Adventures with Sea Surface Meteorology. Duncan C. Blanchard. Doubleday, Garden City, N.Y., 1967. 192 pp. Illus. $4.95.

Functional Bandaging: Including Splints and Protective Dressings. Seymour W. Meyer. Elsevier, New York, 1967. 304 pp. Illus. $9.50.

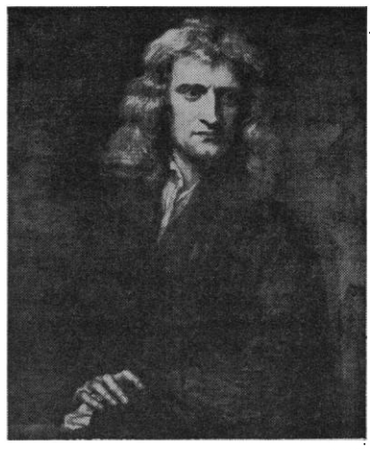
Fundamental Aspects of Petroleum Geochemistry. Bartholomew Nagy and Umberto Colombo, Eds. Elsevier, New York, 1967. 396 pp. Illus. $23. Eight papers.

Fundamental Principles of Bacteriology. A. J. Salle. McGraw-Hill, New York, ed. 6, 1967. 832 pp. Illus. $12.50.

Fundamentals of Metal Deposition. E. Raub and K. Müller. Translated from the German. Elsevier, New York, 1967. 276 pp. Illus. $21.50.

The Genera of Flowering Plants (Angiospermae). vol. 2, *Dicotyledones.* J. Hutchinson. Oxford Univ. Press, New York, 1967. 669 pp. $30.40.

General Chemistry. William A. Nevill.



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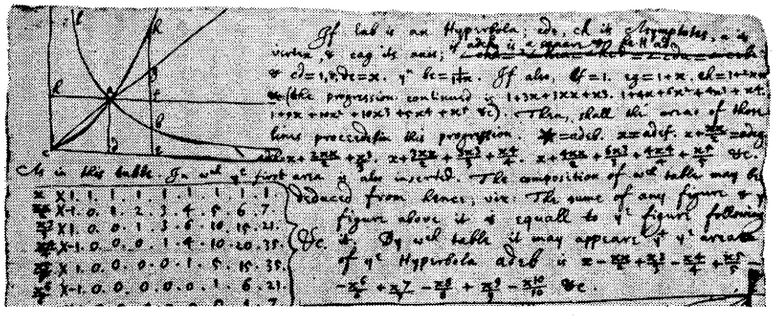

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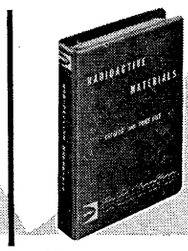

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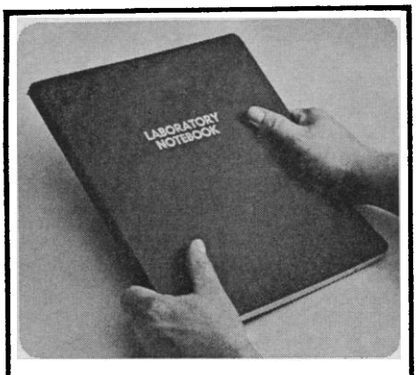

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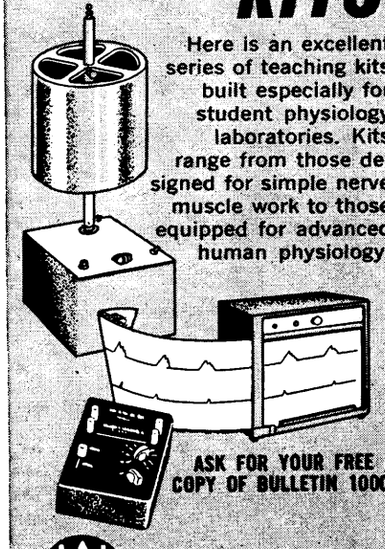

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Genetic Elements: Properties and Function. A symposium (Warsaw), April 1966. D. Shugar, Ed. PWN-Polish Scientific Publishers, Warsaw; Academic Press, New York, 1967. 371 pp. Illus. $15. Fifteen papers.

Historic Derivations of Modern Psychiatry. Iago Galdston, Ed. McGraw-Hill, New York, 1967. 255 pp. Illus. $12.50.

Historical Aspects of Microscopy. A conference (Oxford, England), March 1966. S. Bradbury and G. L'E. Turner, Eds. Published for the Royal Microscopical Society. Heffer, Cambridge, England, 1967. 235 pp. Illus. 42s.

The History of Four-Footed Beasts and Serpents and Insects. vol. 1, *The History of Four-Footed Beasts*, Edward Topsell (620 pp.); vol. 2, *The History of Serpents*, Edward Topsell (246 pp.); vol. 3, *The Theater of Insects*, T. Muffet (270 pp.). Da Capo Press, New York, 1967. Illus. $65 per set. Reprint, 1658 edition, with a new introduction by Willy Ley.

Husbandry of Laboratory Animals. Proceedings of the Third International Symposium (Ireland), September 1965. M. L. Conalty, Ed. Academic Press, New York, 1967. 666 pp. Illus. $28. Thirty-seven papers.

Imprinting and Early Learning. W. Sluckin. Aldine, Chicago, 1967. 159 pp. Illus. Paper, $2.45. Reprint, 1965 edition.

The Industrial Chemistry of the Lanthanons, Yttrium, Thorium and Uranium. R. J. Callow, Pergamon, New York, 1967. 256 pp. Illus. $9.50.

Industrial Electrical Systems: Energy Systems Engineering. Editors of *Power*. McGraw-Hill, New York, 1967. 359 pp. Illus. $12.50.

Industrial Furnaces. vol. 2. W. Trinks and M. H. Mawhinney. Wiley, New York, ed. 4, 1967. 374 pp. Illus. $19.95.

Inorganic Chemistry: A Guide to Advanced Study. R. B. Heslop and P. L. Robinson. Elsevier, New York, ed. 3, 1967. 782 pp. Illus. $11.

Inorganic Glass-Forming Systems. H. Rawson. Academic Press, New York, 1967. 329 pp. Illus. $15. Non-Metallic Solids Series.

Introduction to Research in Ultraviolet Photobiology. John Jagger. Prentice-Hall, Englewood Cliffs, N.J., 1967. 176 pp. Illus. Paper, $3.95.

Instruments in Clinical Medicine. F. D. Stott. Davis, Philadelphia, 1967. 152 pp. Illus. $7.

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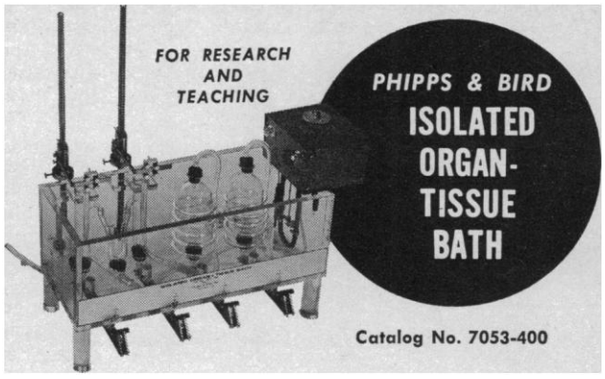

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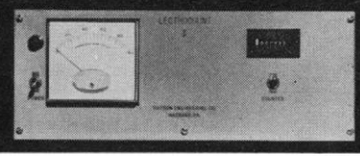

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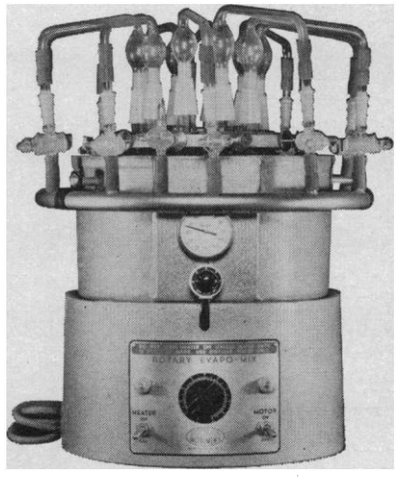

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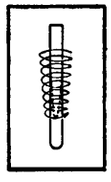

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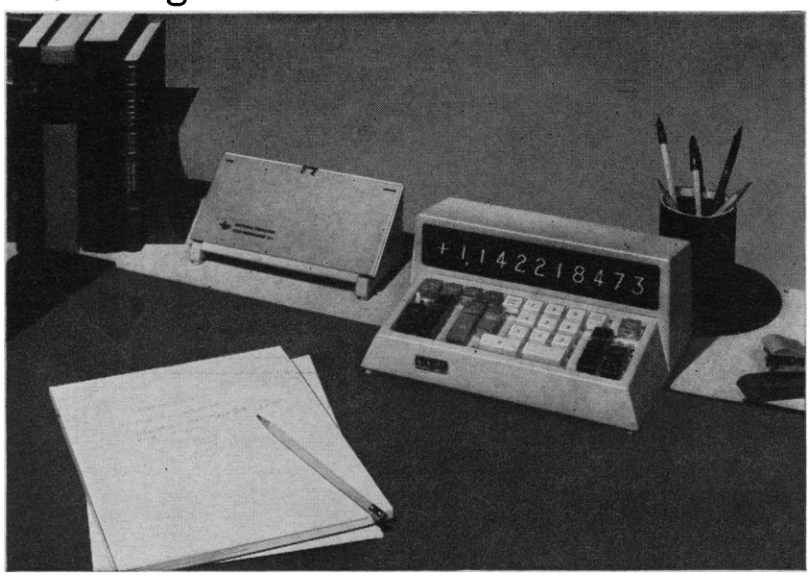

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James B. Vernon. Wiley, New York, 1967. 295 pp. Illus. $14.95.

Lizard Ecology: A Symposium (Kansas City, Mo.), June 1965. William W. Milstead, Ed. Univ. of Missouri Press, Columbia, 1967. 312 pp. Illus. $7.50. Nine papers.

Macro-Economic Theory: A Mathematical Treatment. R. G. D. Allen. Macmillan, London; St. Martin's Press, New York, 1967. 432 pp. Illus. $10.

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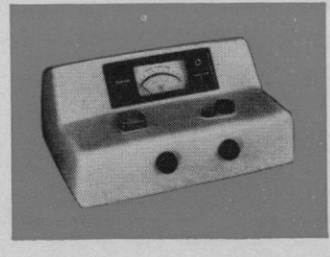

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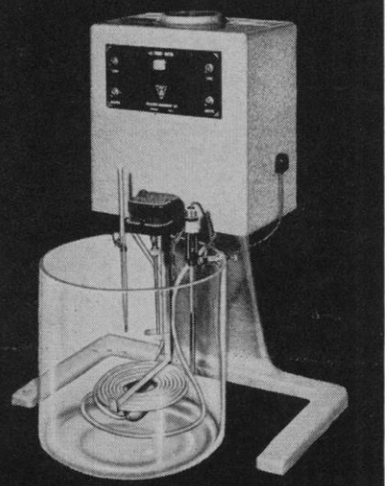

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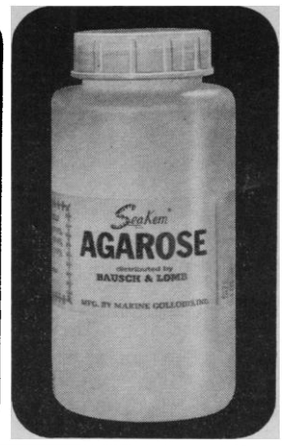

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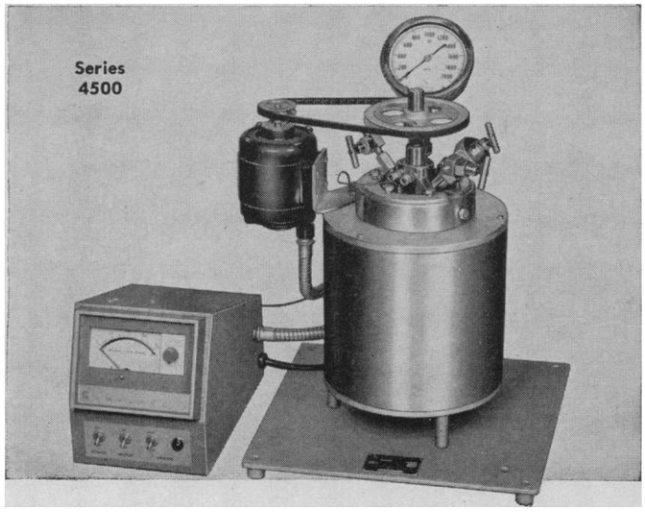

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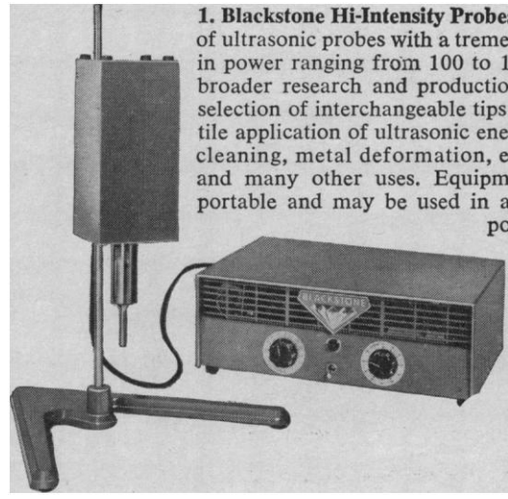

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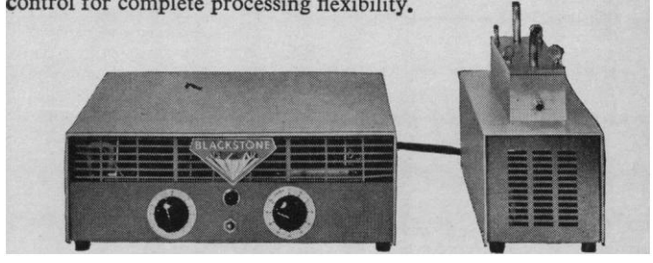

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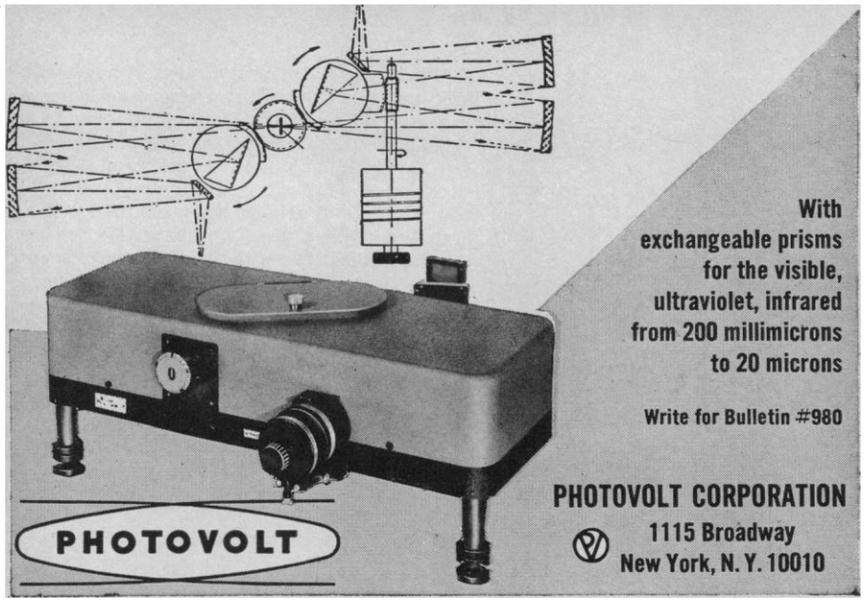

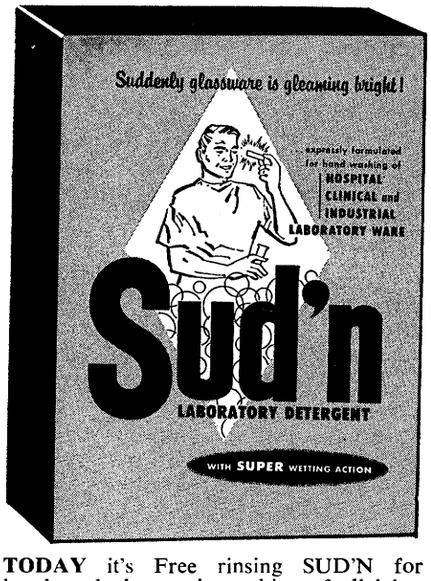

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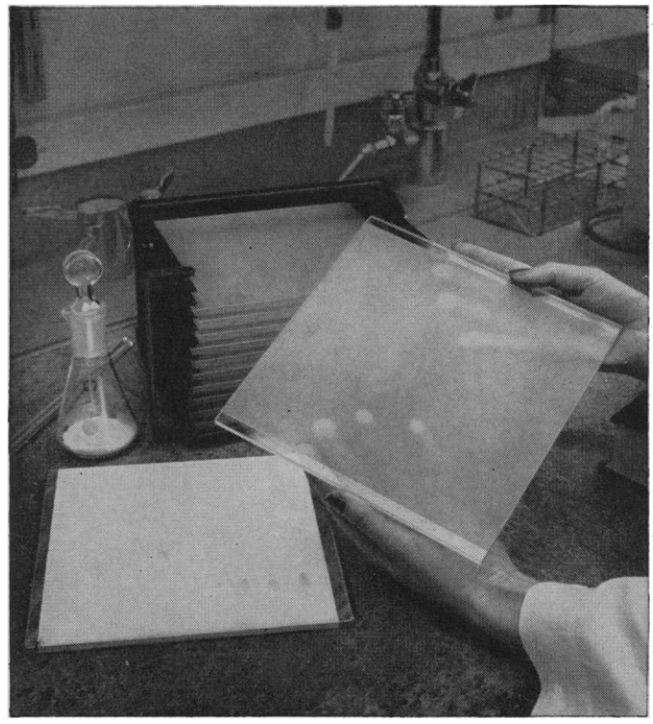

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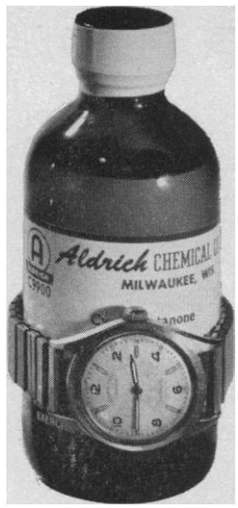

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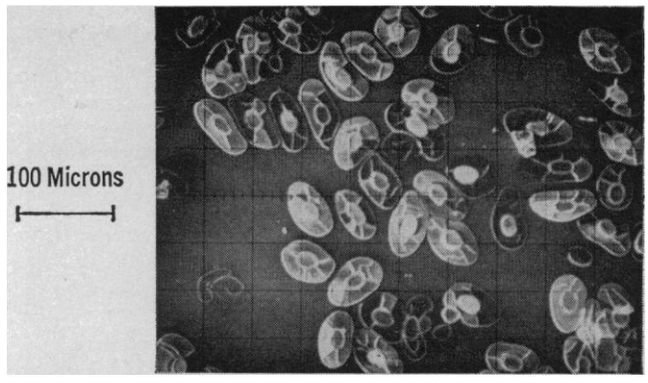

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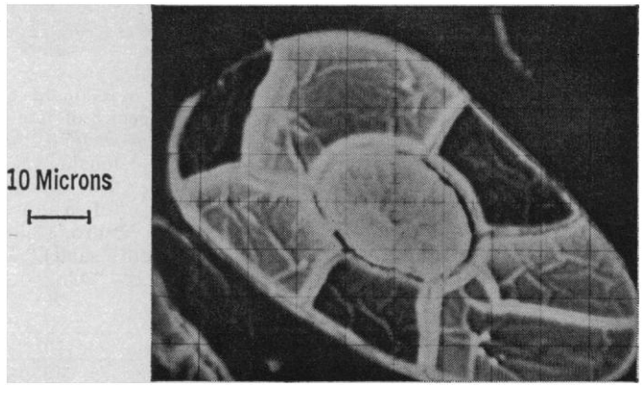

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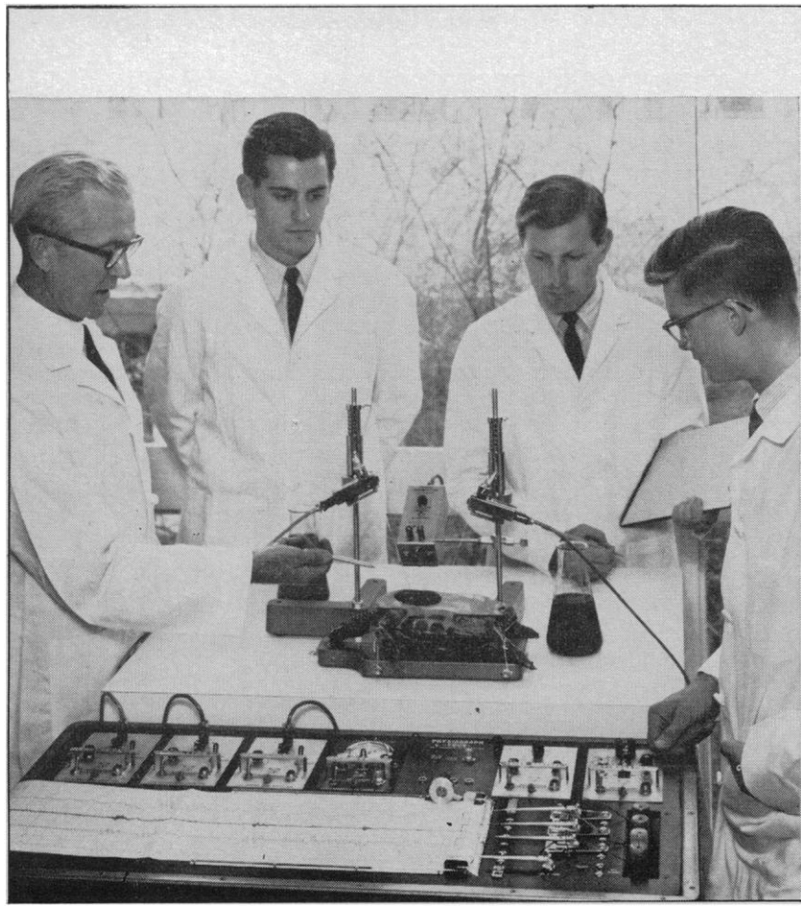

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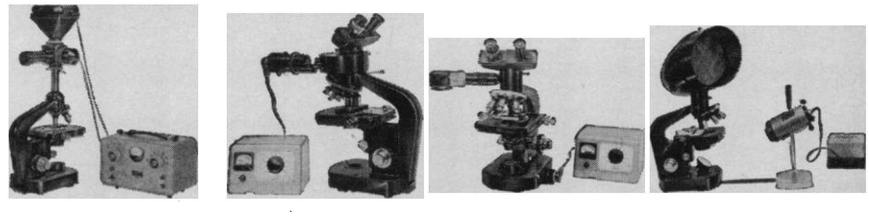

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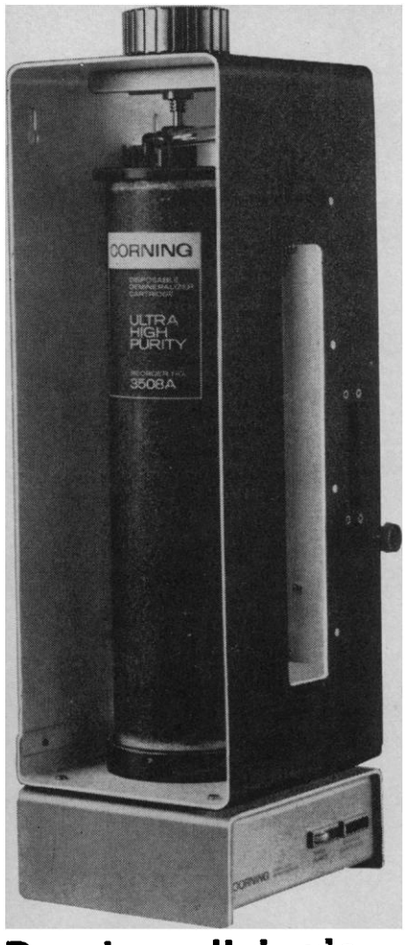

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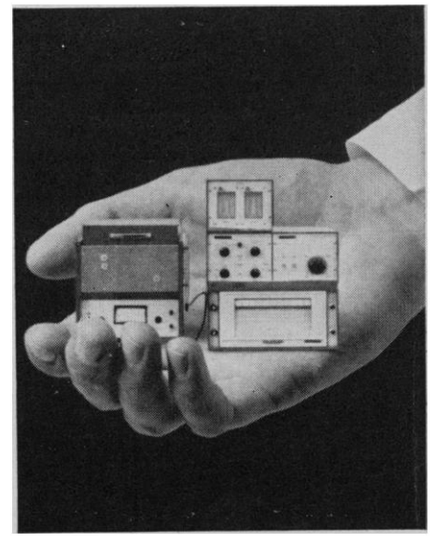

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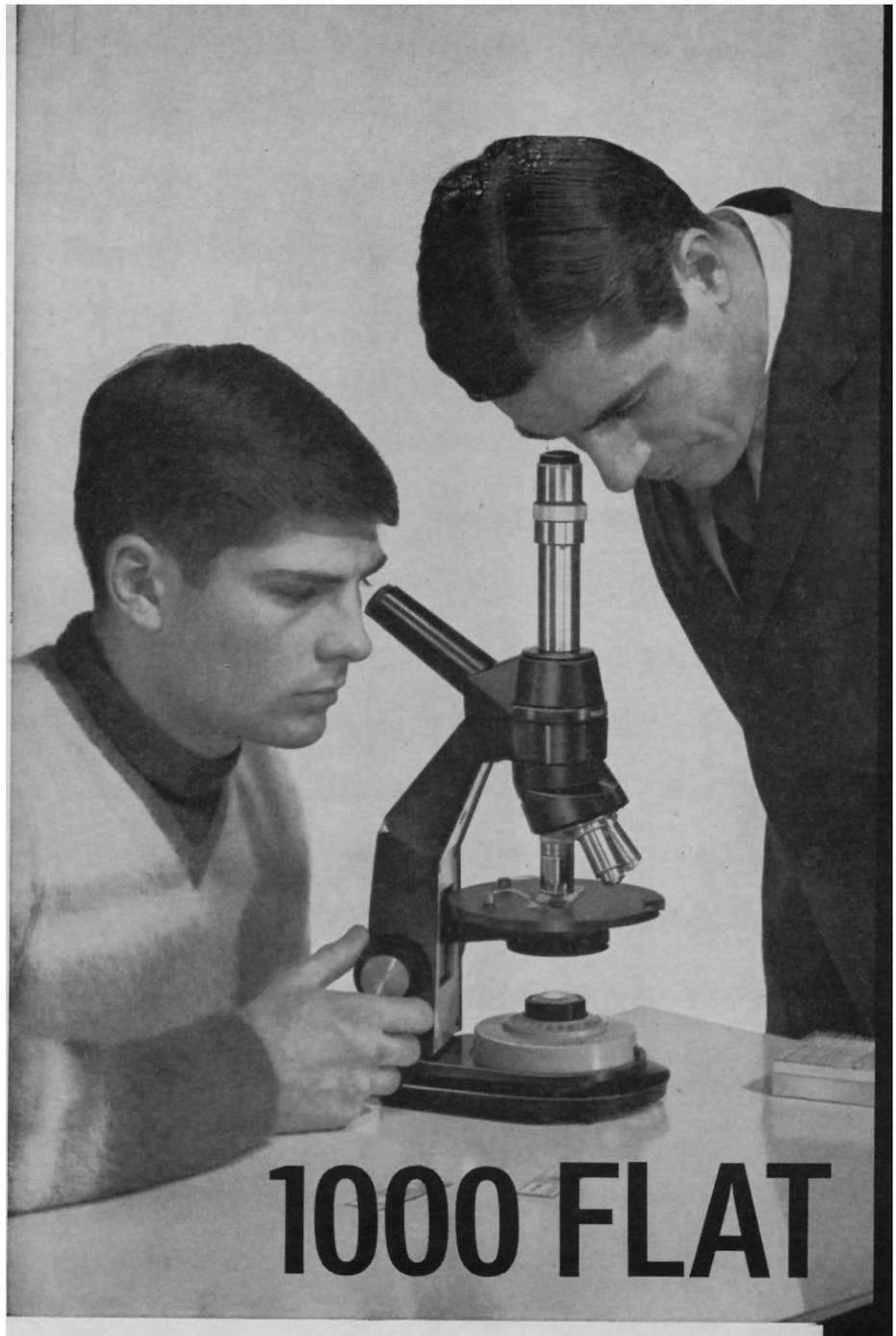

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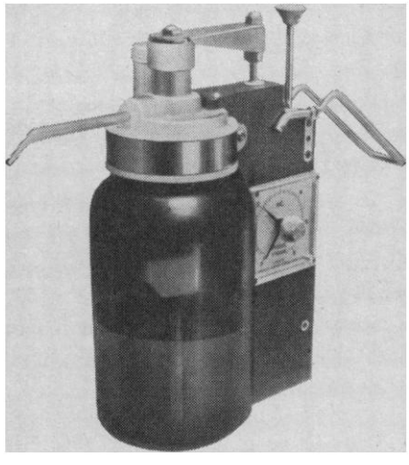

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