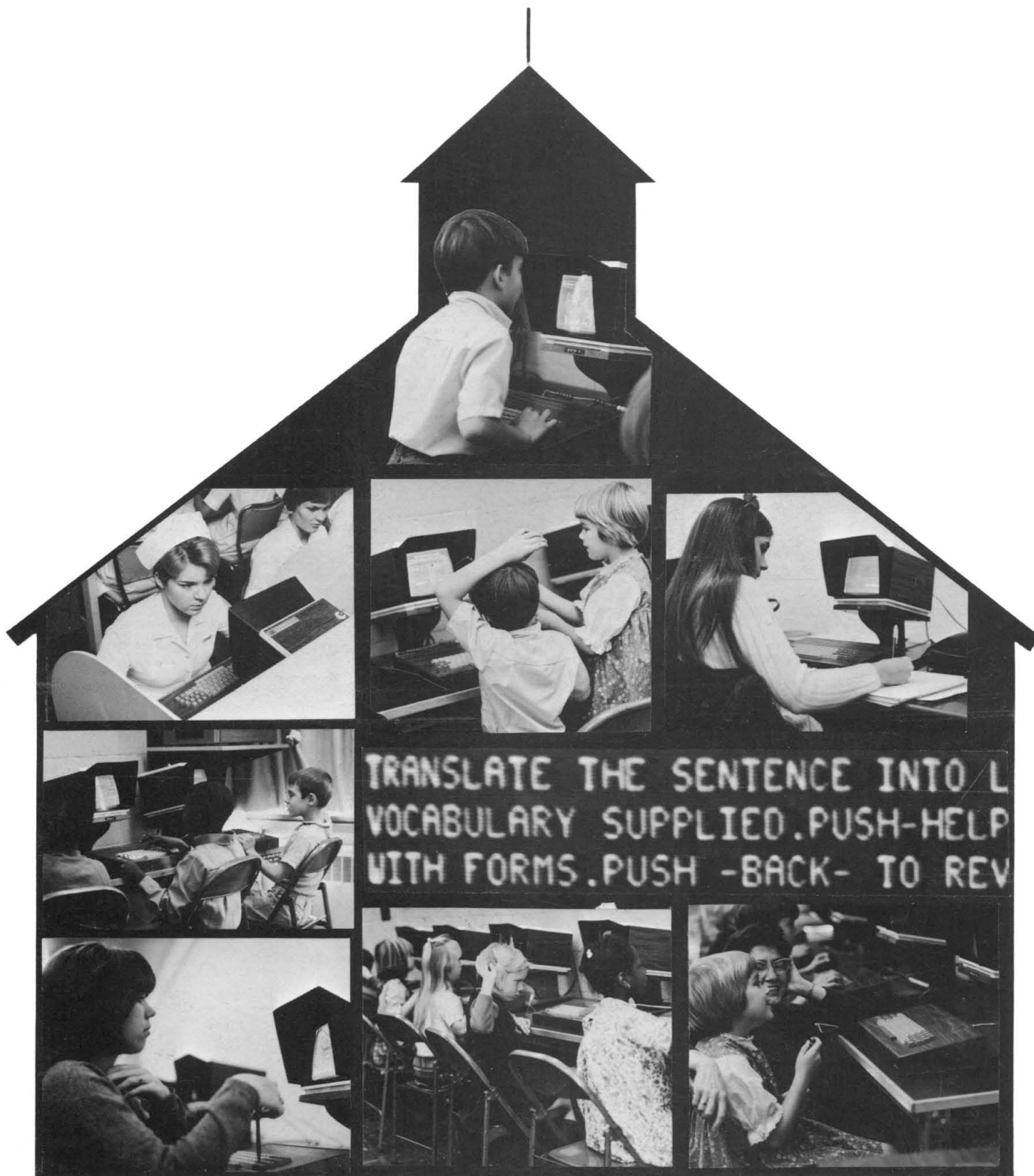


SCIENCE

20 March 1970

Vol. 167, No. 3925

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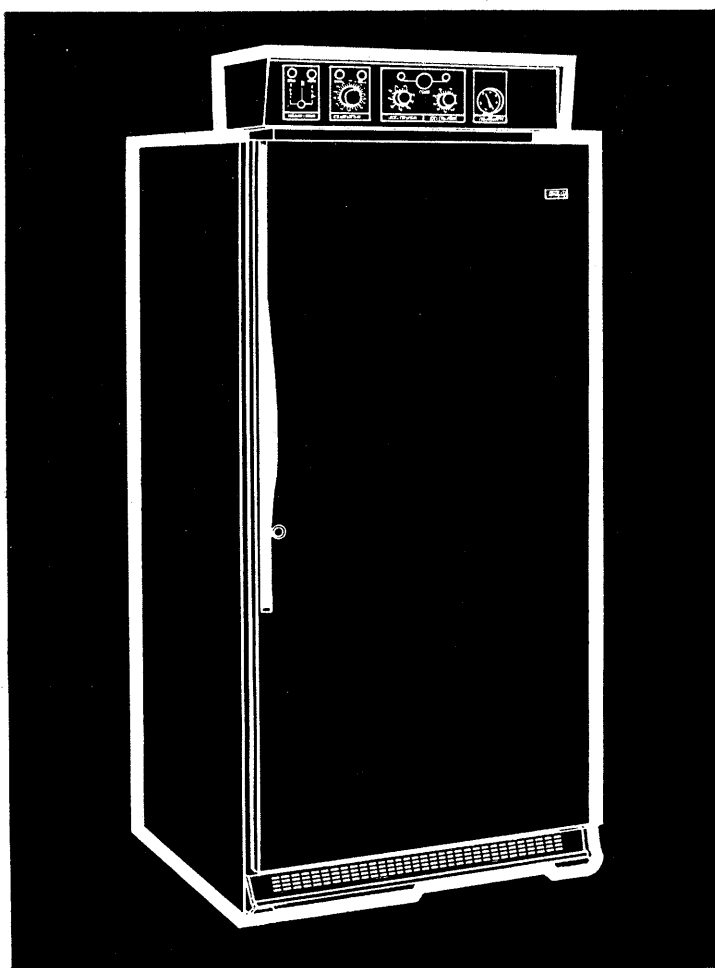
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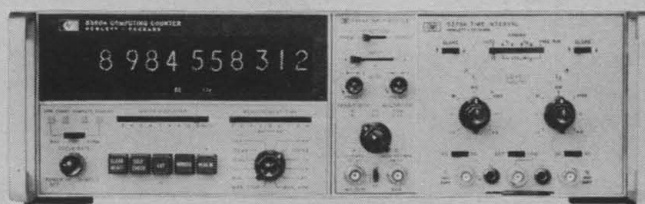


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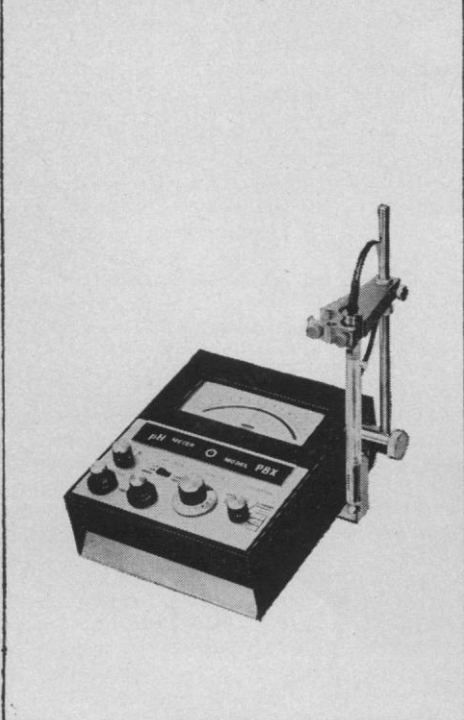
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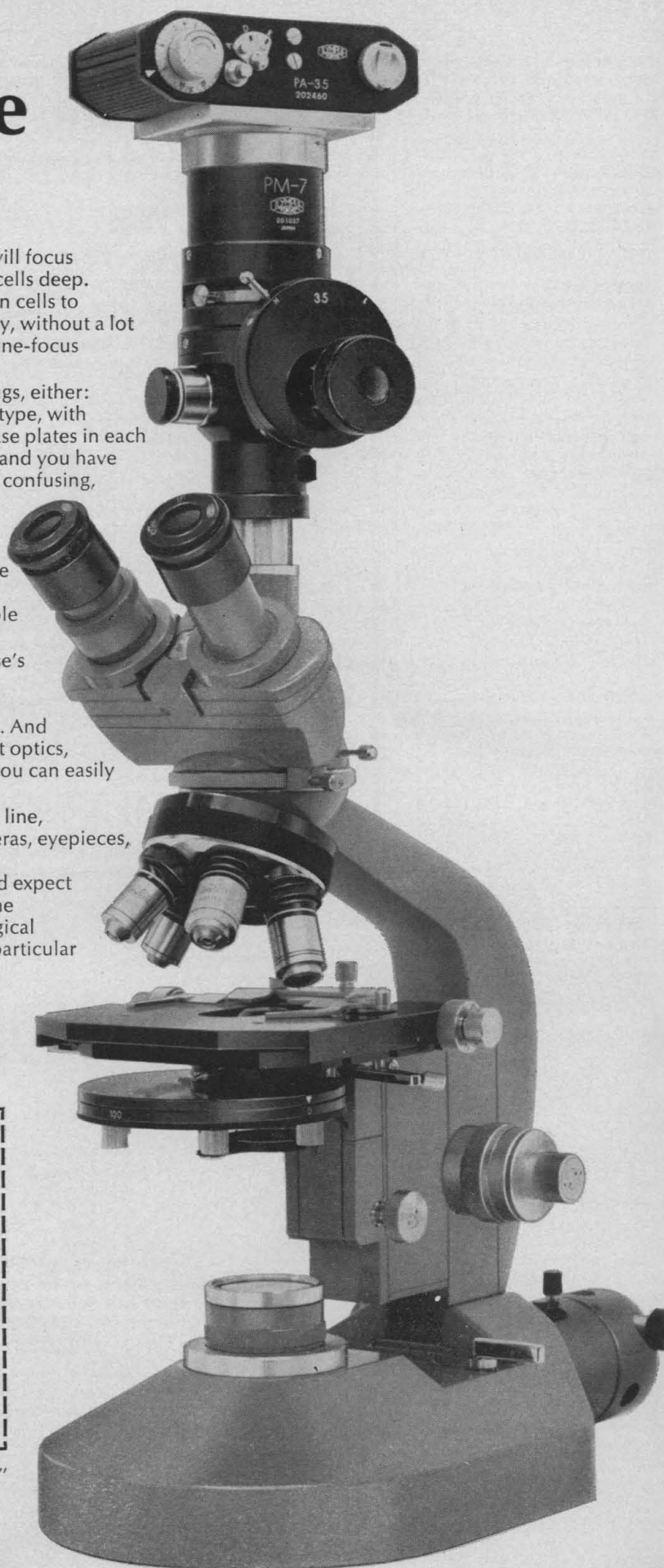


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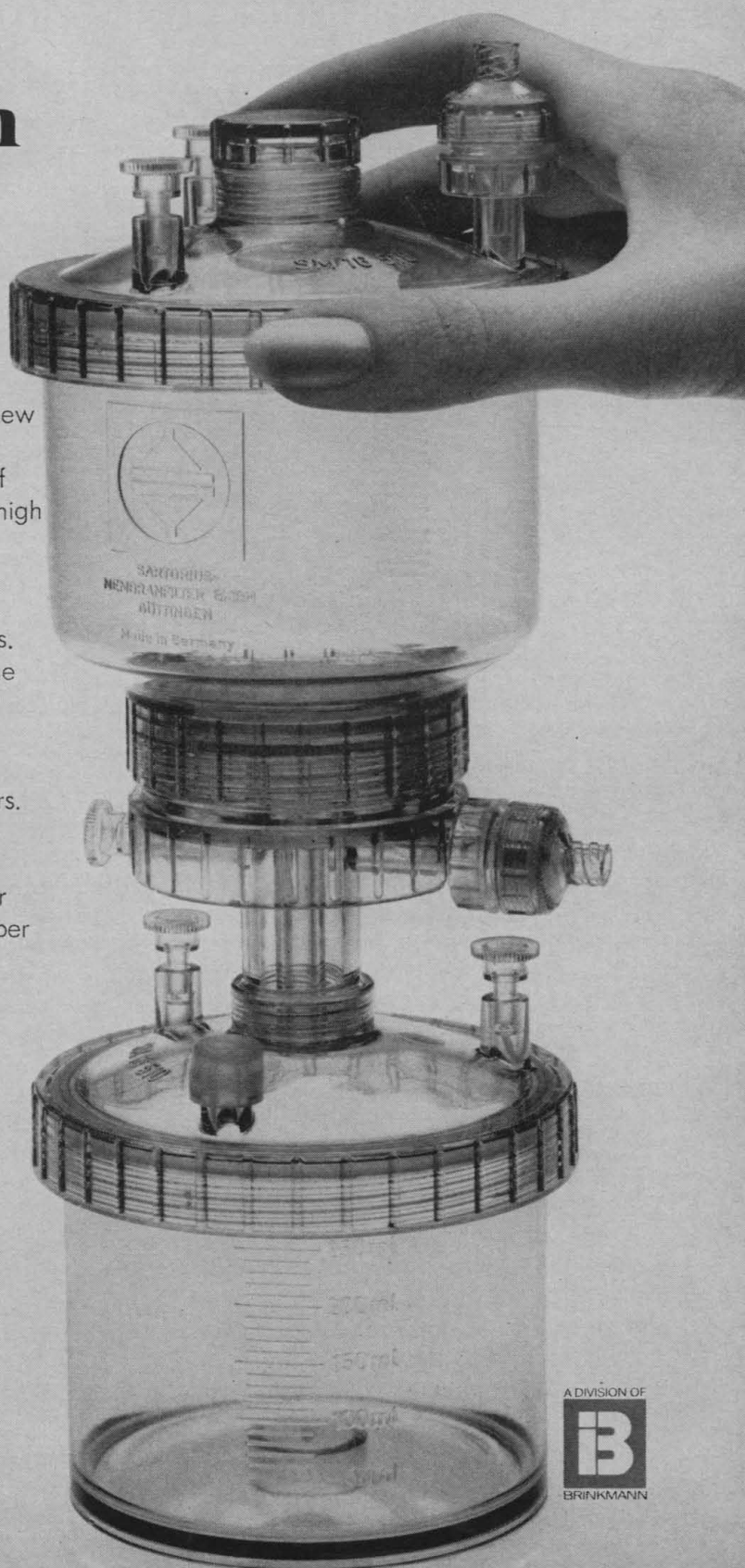
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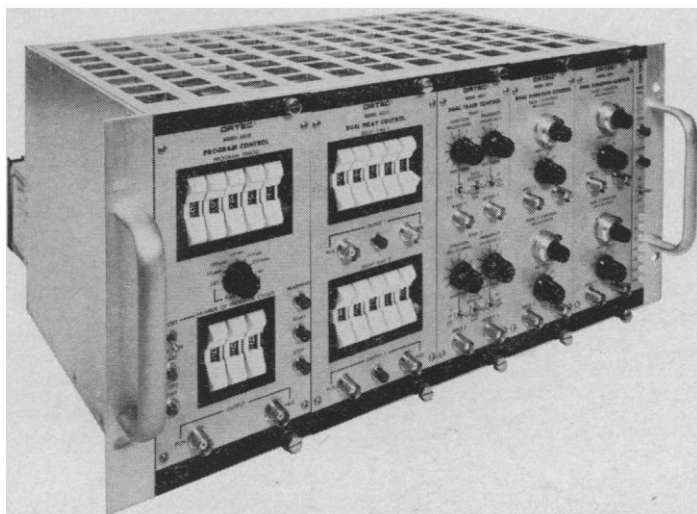
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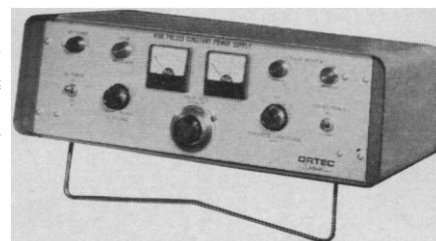
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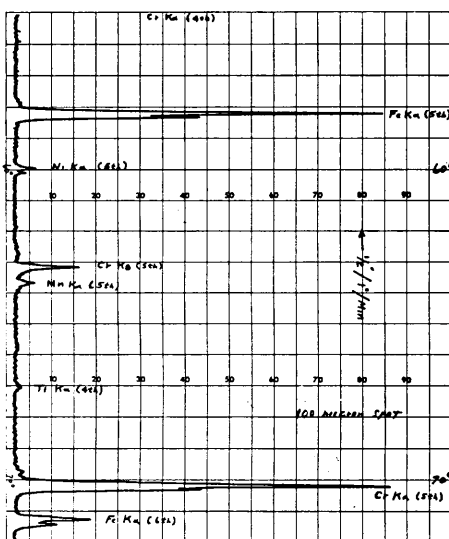
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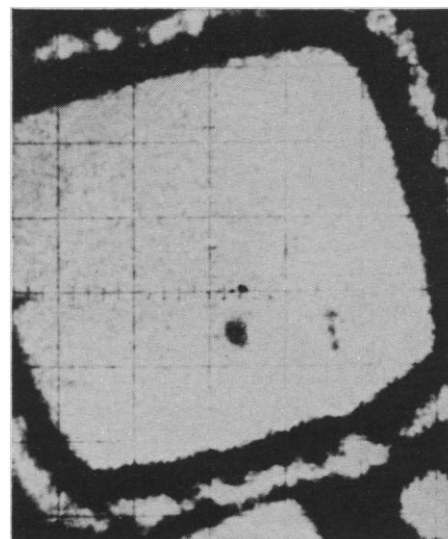
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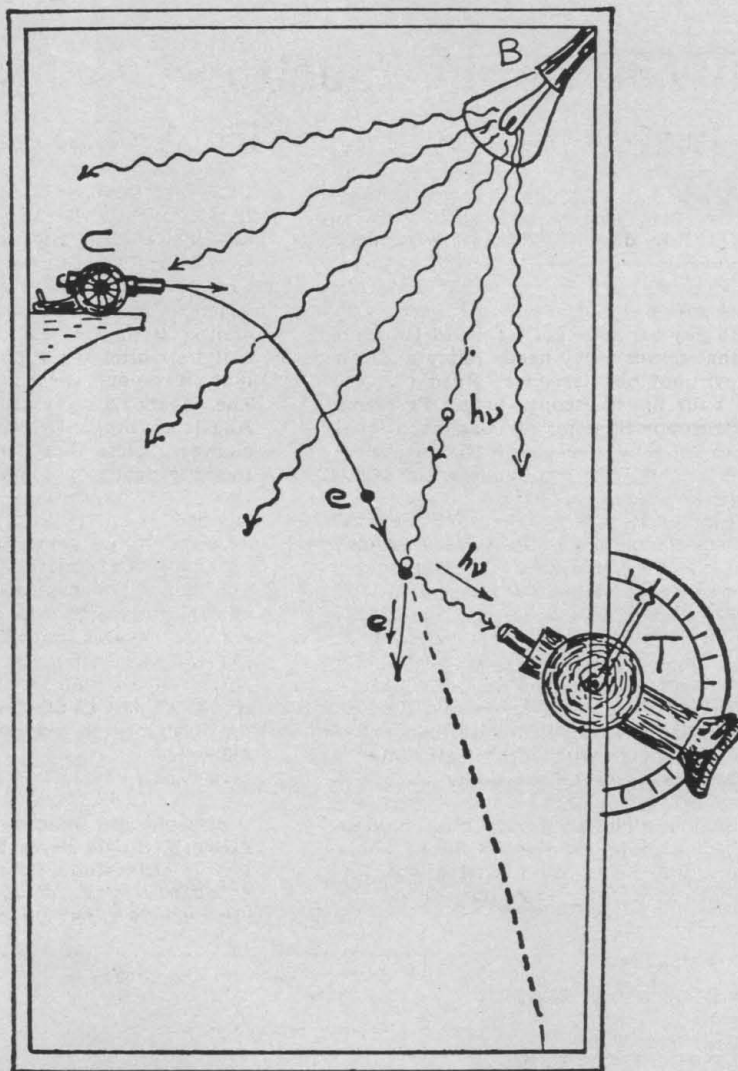
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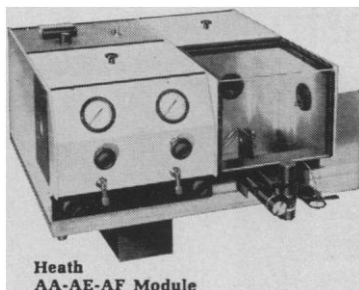


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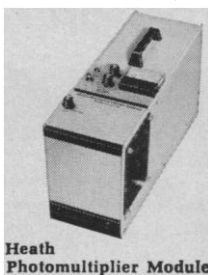
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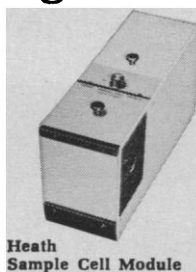
A Spectroscopy System That Comes In Pieces Can Keep Your Budget From Going To Pieces



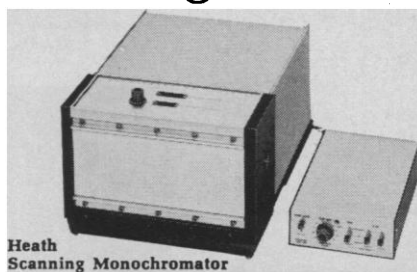
Heath
AA-AE-AF Module



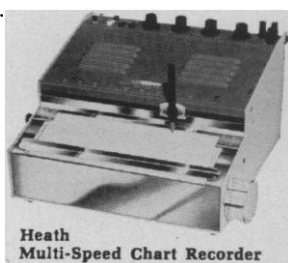
Heath
Photomultiplier Module



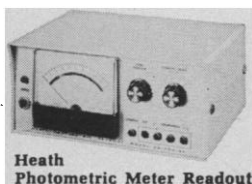
Heath
Sample Cell Module



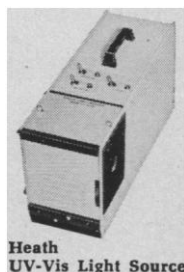
Heath
Scanning Monochromator



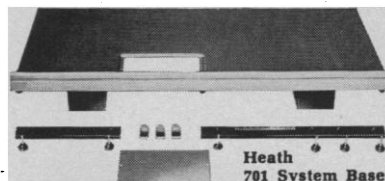
Heath
Multi-Speed Chart Recorder



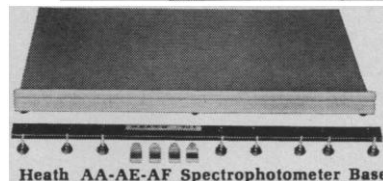
Heath
Photometric Meter Readout



Heath
UV-Vis Light Source



Heath
701 System Base



Heath AA-AE-AF Spectrophotometer Base

Buy Heath 700 Series Spectroscopy Modules... And Get Multi-Instrument Capability At One-Instrument Cost

Budget. Mention the word and even the most hardened manager cringes... he knows what to expect well in advance of seeing the final figures. How do you cope with expanding instrumentation requirements and a static or even reduced equipment budget? Do you delay needed purchases with the hope of "maybe next year"? Play the "numbers" game and borrow from one area to pay for another? Or could you find the kind of equipment that serves many needs today and can be updated tomorrow without obsolescence? Read on...

Heath Can Help Solve Your Spectroscopy Budget Problems... Our 700 Series Spectroscopy Systems are unconventional in both design and price. But they give you precision Molecular Absorption and AA-AE-AF Spectrophotometric capability (and that's just the beginning) all for under \$3900. So, if you're caught between an increasing need for spectrophotometric laboratory equipment and a diminishing amount of money, the 700 Series may be just what you're looking for.

Modular Versatility. Because some functions in spectroscopy are common to many instruments, Heath has put these functions in separate modules that can be interchanged as needed. The Heath 701 high precision Spectrophotometer Single-Beam System, for example, consists of the Scanning Monochromator, UV-Visible Light Source Module, Sample Cell Module and Photomultiplier Module, locked together on the 701 Base. Cost? Only \$2500 with photometric meter readout. To get complete atomic absorption, atomic emission, atomic fluorescence capability you don't have to buy another monochromator and another photomultiplier module... just add the AA-AE-AF Module and the 703 Base... only \$1335 more. Modules to provide many other types of spectrophotometric measurements at equally low cost are on the way.

Choice of Readout. The modular versatility of the Heath 700 Series extends also to readout. The 701 and 703 Systems can be supplied with the Photometric meter Readout, the Multi-speed Chart Recorder or Multispeed Log/Linear Current Recorder. Or combine readout modules to give simultaneous chart recording and direct meter readout. And the Photometric meter Readout can also be used as an interface for a digital voltmeter, such as the Heath 805A. Pick the readout that suits your needs... and your budget.

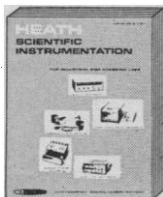
The Heath 701 Spectrophotometer features 1900 to 7000 Angstrom range (which can be extended with PM interchange)... less than 0.05% stray light... ± 1 Å wavelength tracking accuracy... better than 1 Å resolution... ± 0.2 Å wavelength reproducibility... electronic digital-controlled stepped scanning and many other precision features. 701 Systems range from \$2245 (less readout) to \$2785 (with recording readout).

The Heath 703 AA-AE-AF System includes adaptability to all major types of total consumption and laminar flow burners... accurate, repeatably xy, yz burner positioning... a hollow cathode lamp turret that accepts four lamps... lamp power supply stability that's better than 0.1%... high intensity and multi-element lamp capability and built-in chopper. 703 Systems are available from \$2736 (without readout) to \$3278.

Investigate The Heath 700 Series Now... and start conserving your budget while building the most versatile, widely applicable spectroscopy system on the market today.

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EK-262

Continuous-flow zonal ultracentrifugation: A beautiful technique awaiting a practical, non-temperamental research instrument.



(Wait no more: you're looking at it.)

Background

Continuous-flow zonal ultracentrifugation was a major development of Dr. N. G. Anderson and co-workers in the AEC-NIH Molecular Anatomy Program at Oak Ridge National Laboratory. And because this technique combined high resolution, high capacity, and high practicality, a production-scale centrifuge is now being used by major pharmaceutical companies for the production purification of influenza virus vaccine. The high resolution of this device is now providing vaccine up to 10X purer than any previously available commercially. (Electro-Nucleonics, Inc., is the only company making this ultracentrifuge—the Model K—available commercially.)

Now announcing the Model RK: the research and pilot-plant version of the Model K.

The high capacity of the Model K is beyond the requirements of many research and pilot-plant applications. The obvious need, then, has been for a simple, non-temperamental continuous-flow zonal ultracentrifuge as dependable and versatile as the production-oriented Model K, but designed for the smaller volumes of

material typical of the research laboratory and the pilot plant. Enter the Model RK.

The Model RK

Oversimplifying somewhat: the Model RK is a smaller Model K. Accordingly, it too features continuous flow capability over the entire speed range. And, most importantly, the design, engineering, and construction aspects of the Model K—the elements responsible for its simplicity and dependability—are retained by the RK. Example: the RK has the K's unique single-pass rotating seal design and operates to 60,000 RPM completely eliminating fussing with complex temperamental demountable seal systems for loading and unloading the rotor.

Now specifications, briefly. The currently available aluminum and titanium RK rotors provide speeds of 35,000 RPM and gravitational forces in excess of 90,000 g. (Subsequent rotors—fully compatible with the RK system—will provide even higher gravitational fields at the RK's full speed of 60,000 RPM.) The RK rotor volume is typically 1.7 liters and the sample flow rate may be 500 ml/min or higher.

The RK is a safety-oriented instrument with a monitoring system which con-

stantly scans the critical operating conditions and forecasts problem areas in sufficient time to correct them. Result: the RK monitoring system protects both your run and your instrument.

Applications of continuous-flow zonal ultracentrifugation

This technique has been most effectively used to isolate viruses, bacteria, mitochondria, polysomes, ribosomes, ribosomal subunits, macroglobulins, microsomes, and other sub-cellular particles. It has wide application wherever high-resolution separation of such components is desired. (For background information see: "The Development of Zonal Centrifuges and Ancillary Systems for Tissue Fractionation and Analysis," National Cancer Institute Monograph 21, GPO, Washington, D.C. 20402. \$4.75)

For further details

We'll be happy to send further information on the new Model RK and/or the production-scaled Model K. Write Tom Guerin (or call collect 201-227-6700), Electro-Nucleonics, Inc., Fairfield, New Jersey 07006.

ELECTRO-NUCLEONICS

SCIENCE, VOL. 167



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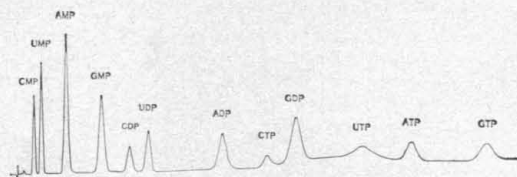
If you're not studying nucleotides with a high pressure, ion-exchange LC, you're not studying nucleotides.

No ion-exchange liquid chromatography analysis would be complete without our new LCS 1000: a self-contained, high pressure, ion-exchange system designed to perform quantitative separations of water soluble, ionizable compounds quickly and accurately.

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Utilizing a unique gradient elution capability, the LCS 1000 is particularly useful in the separations of such complex mixtures as bases, nucleosides, nucleotides, and dinucleotides. Only nanomole sample quantities are required and molecules as similar as 2' and 3' RNA nucleotides can be separated clearly.

The separation of Mono-, Di- and Tri-phosphates of cytidine, uridine, guanosine and adenosine, which typically requires more than a day with other techniques, can be



performed in a couple of hours or less with the LCS 1000.

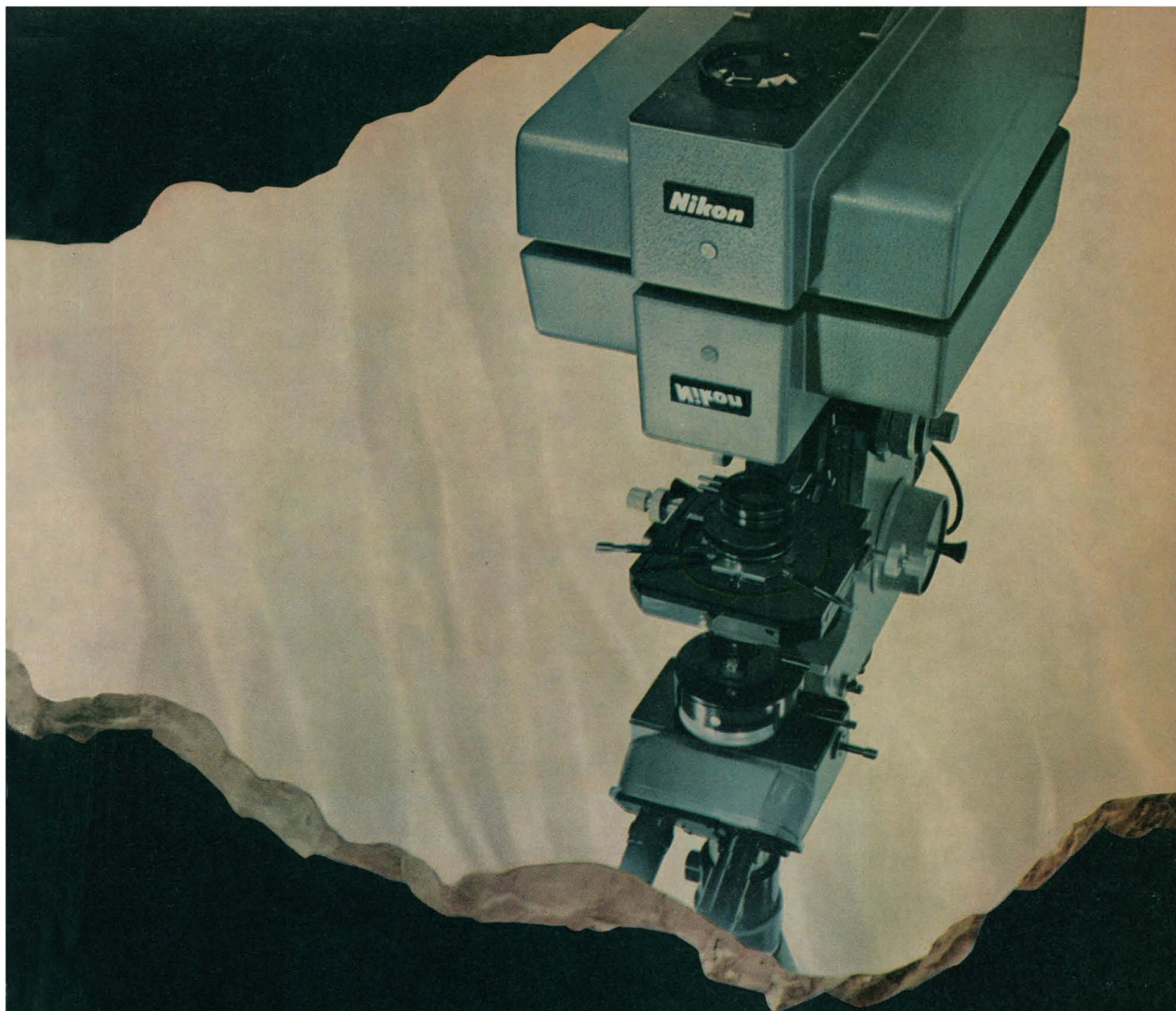
Our new ion-exchange liquid chromatograph is also extremely easy to operate. Just plug it in. No water lines, air tubes or nitrogen feeders. It even has provision for sample collection.

For complete details and a copy of our recently published applications booklet, *Nucleic Acid Constituents by Liquid Chromatography*, write Varian Aerograph, Walnut Creek, California 94598; Tokyo, Japan; Malton, Ontario, Canada; Crows Nest, N.S.W., Australia; or Zug, Switzerland.



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Think of it as a vertical optical bench

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The massive base and vertical column hold dual light sources and their optics in precise alignment. You can equip Apophot with tungsten, high pressure mercury arc, xenon arc, quartz halogen and/or CSI and use reflected and transmitted light simultaneously when you need to. Zoom-Koehler systems for both diascopic and episcopic illumination have pancratic collectors which automatically adjust the image of the light source to the numerical aperture of the objective in use.

The objective turret can be fitted with an optional 1x, 1.25x and 1.5x magnification changer. A focusable Bertrand lens is standard equipment with the Apophot.

The built-in trinocular eyepiece tube permits simultaneous observation and photography. The vertical photo tube is coupled to the interpupillary adjustment to provide automatic tube length compensation. The standard stage measures 76x25mm and has coaxial controls on both sides. The condensers are quickly and securely positioned on the stage with centerable dovetail sliders.

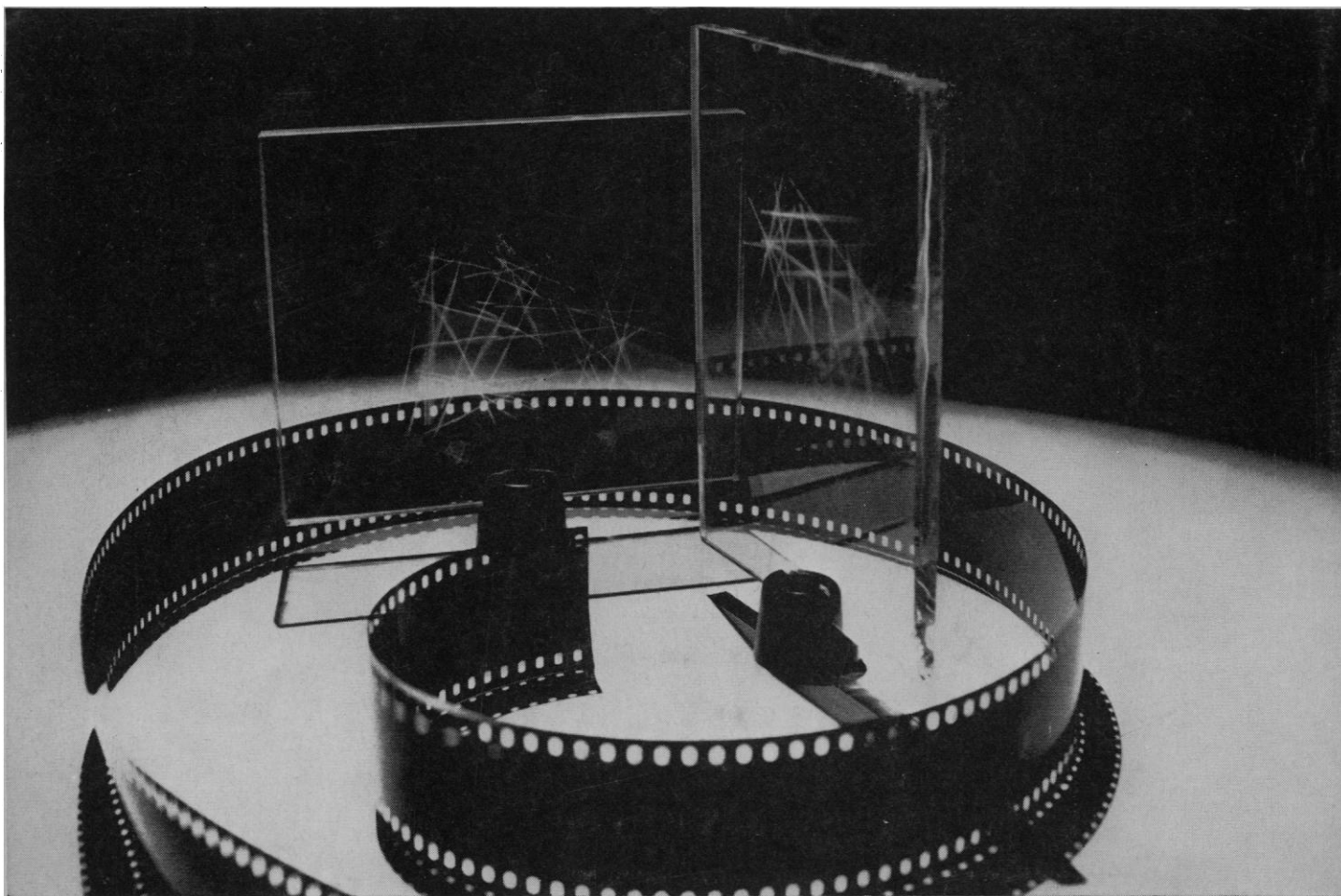
As you might expect, the Apophot accepts a full range of Nikon accessories; phase contrast, interference phase, differential interference, polarizing, fluorescence and others. If you'd like more information on the new Nikon Apophot, write for a free brochure. It's the easiest research you'll ever have to do.



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New Nikon Apophot Research Microscope

Circle No. 9 on Readers' Service Card



Holography—quickly—by computer

One of the most startling things about a hologram is that it produces images with parallax... that the appearance of the image varies according to the angle of view, just as in the real world. That's why we see the subject in 3-D, even though each eye, looking along its axis through a separate small area of the hologram, sees only two dimensions. Bell Labs scientists M. C. King, A. M. Noll, and D. H. Berry took advantage of this to generate holograms of nonexistent objects (such as 3-D mathematical graphs) with a few seconds of computer time.

Normally, a hologram is made by photographically recording wavefronts of laser light reflected from a real object. (Holograms have also been generated by calculating such wavefronts and recording their pattern on a photographic plate, but this takes many hours of computer

time, even for simple subjects.)

A King-Noll-Berry hologram, however, is actually a series of holograms, each about 1mm wide and 100mm high, on a single holographic plate. These individual holograms are made, one by one, from a series of two-dimensional computer-generated pictures (film strip above), showing the hypothetical object from a range of viewing angles, in 0.3° steps. (Because of a hologram's high information capacity, each 1-mm vertical strip can contain—and project—a full-width picture.) And since each of the viewer's eyes looks through a different vertical strip, the viewer sees the object binocularly, in 3-D.

Like most holograms, these should be viewed with a laser; this limits their usefulness for many scientists, engineers, and students. But, because the "strip"-hologram images

are two dimensional, placing a holographic plate with a special emulsion in the plane of the projected real image yields a copy hologram (glass plates above). Viewable under an ordinary incandescent bulb, this hologram can be studied wherever and whenever the user wishes.

This technique is the first way to make "hard copy" holograms of imaginary solid objects with little computer time... a fast and inexpensive way of converting abstract data into three-dimensional pictures and graphs. It opens another avenue of fluent communication between man and machine, for possible use in communications technology, science, finance, architecture, statistics, and other fields in which the computer has become necessary.

**From the Research
and Development Unit
of the Bell System—**



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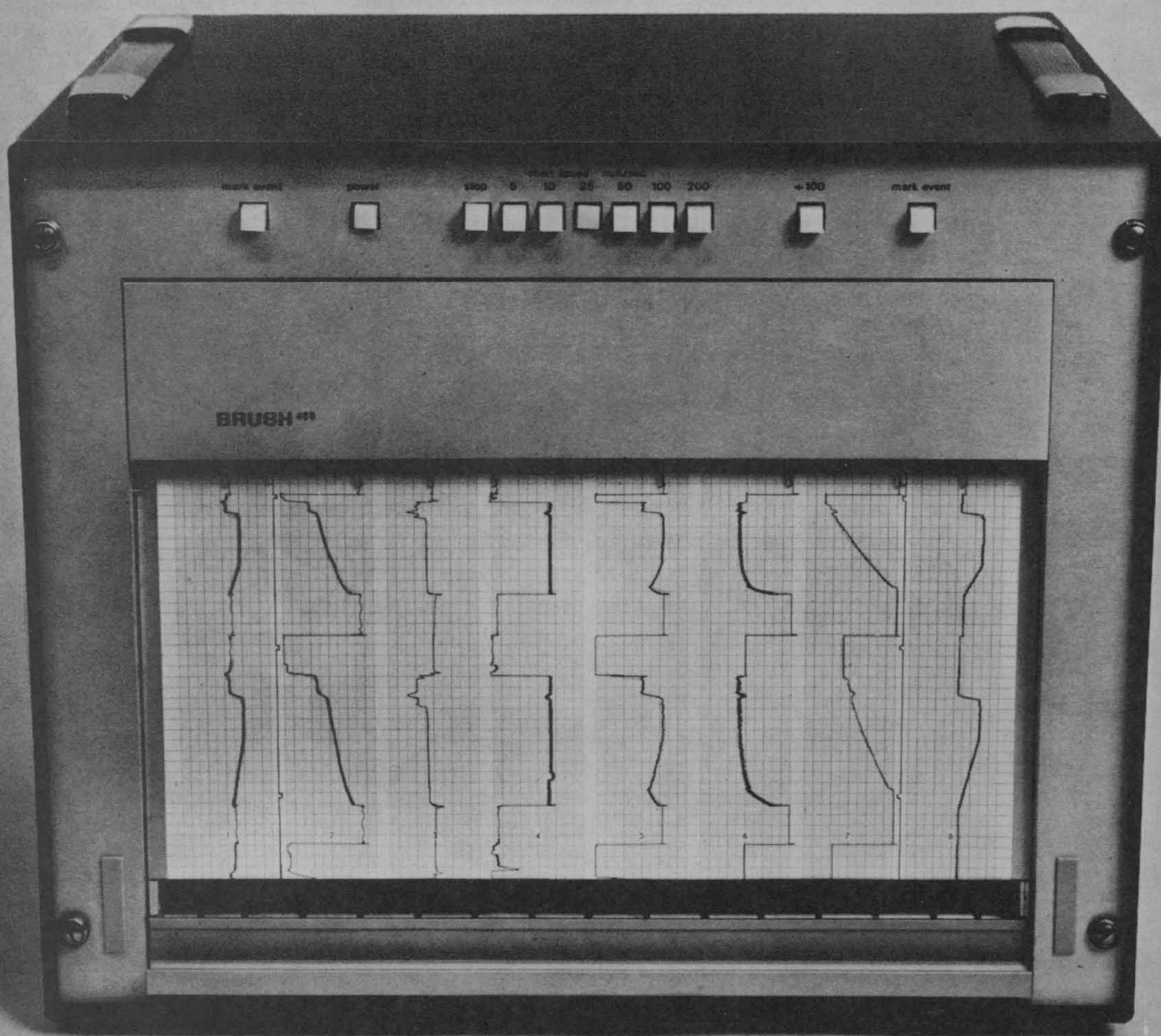
And the Brush 480 is compatible with our multi- and single channel signal conditioners so you can select the conditioning best suited for your measurements, whether it's temperature, pressure, strain, voltage, current, position, velocity or what have you.

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Despite some of the zany places where our top-loaders do their thing, the lab is really their natural habitat.

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For complete details on our family of top-loading balances, request Bulletin P from our headquarters at 20 Nassau Street, Princeton, New Jersey 08540.

THE ANALYTICAL THAT SPEAKS ITS MIND

The Mettler H20E analytical balance does more than just weigh. It converts weighing results into electrical signals which can be fed to compatible instrumentation, such as recorders. To tolerance meters for sorting control. To digital printers, calculating machines, and tape and punchcard equipment via analog-digital converters. And to computers for conducting real-time research and process control.



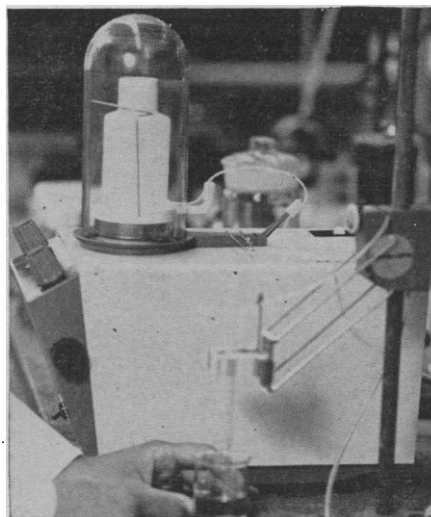
The H20E electronic semi micro has no peer when it comes to making continuous determinations of weight changes. One example is measuring the change in weight of a micro-absorption tube as a function of time. The high repeatability of the instrument's zero point and excellent reproducibility ensure precise results over long experimental runs.

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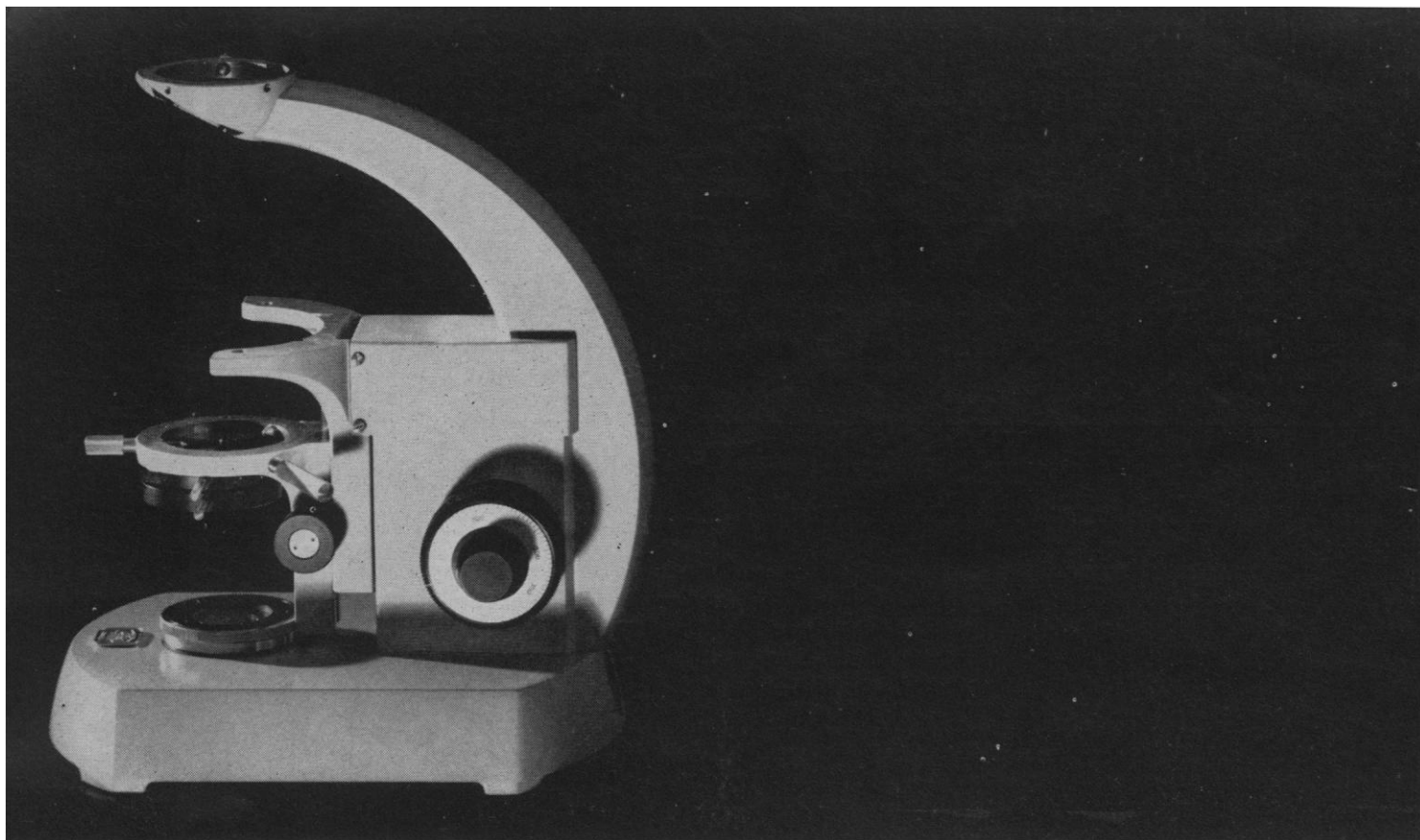
The DP11 is a joy to use. Simply place the burette containing the titrant on the balance pan and carry out your titration. The quantity of titrant you dispense by a remotely controlled pinch valve is continuously displayed on the digital readout panel of the balance.

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Concepts from Union Carbide:

Cryogenic freezing of red blood cells

Probably no single problem has received more attention from cryobiologists than the preservation of the human red cell. And with good reason. Procedures that extend the supply of erythrocytes for transfusion have meaning in terms of human lives.

The prospect of a frozen blood reserve has been a matter of intensive interest to the blood banking agencies for the past twenty years; some have played a major role in the scientific attack on the problem. It has not been easy. It was observed in 1941 that red cells (suitably protected with additive substances) could survive the drastic environmental changes induced by freezing. Since then, processes have been sought for the preservation of blood in the frozen state that would provide a useful and acceptable product for transfusion. As evidenced over the past decade by the successful transfusion of thousands of units of blood preserved in the frozen state, that goal seems to have been reached.

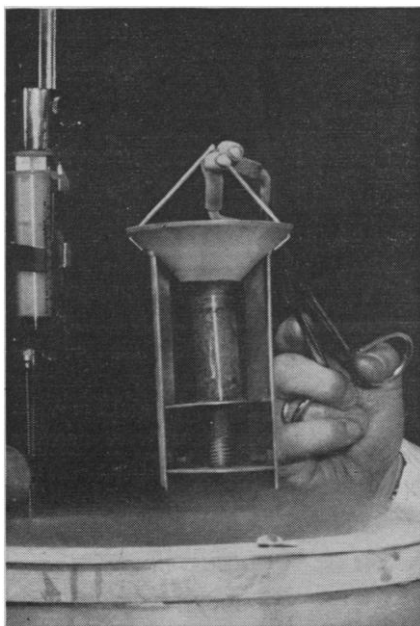
The current limitation of twenty-one to twenty-eight days for blood preserved by conventional methods in the liquid state has often taxed the resources of the organizations that undertake to provide our communities with supplies of this indispensable agent. The relatively short shelf life of the cellular components of blood adds to the problem of coordinating supply with demand. The less common blood types sometimes are difficult to procure, but even the more common types may vary in supply at any given time.

Red cell wastage is an inevitable consequence of the dating period necessarily imposed on blood stored at 4°C. A primary objective of agencies interested in preserving blood at low temperatures is to prevent this wastage. Another, of course, is to assure adequate reserves of all types of blood at all times for each community. Conceivably then, as frozen blood banks become established in various parts of the country, an integrated and computerized inventory system could be developed that would result in an effective national reserve.

Several practical approaches to the preservation of blood at low temperatures have evolved. All have some elements in common. A solution of additives, often called cryoprotective agents—glycerol is the outstanding example—is combined with the red cells from which most of the plasma and much of the other cellular components of blood (leukocytes and thrombocytes) have been removed. This is done in special containers in which the erythrocytes are cooled and placed in long-term storage. When needed, the erythrocytes are withdrawn from storage, warmed, and subjected to a washing procedure to remove the protective agent before transfusion.

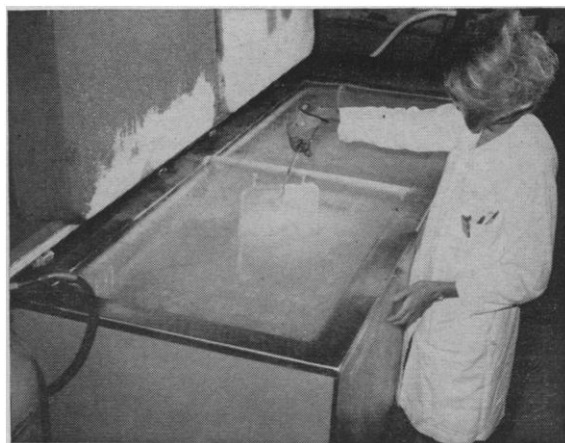
The heart of a frozen blood reserve is the storage facility. Storage equipment is of two general types: cryogenic and noncryogenic. The latter provides temperatures down to about -85°C and depends on electric power. The cryogenic equipment is independent of a power source and provides lower storage temperatures—down

to -196°C—with liquid nitrogen, the most commonly used refrigerant. Associated with such storage equipment are cryogenic shipping units that permit transport of blood in the frozen state without danger of a destructive rise in temperature that might render the blood cells unfit for transfusion.



Small quantities of blood are instantly frozen for long-term storage in the drop-let freezer. A mechanically vibrated syringe releases droplets into a revolving drum of liquid nitrogen. The frozen droplets are collected in the base. Thousands of droplets can be collected from each sample for use as reference specimens.

The banking of frozen blood with longer shelf life should considerably enhance the ability of the blood supply agencies to meet demand and might influence current procurement practices. The use of cryogenic storage equipment would provide a margin of safety for autologous blood banking in which individuals of rare blood type would establish a reserve of their own blood in anticipation of later need. Probably most important in terms of medical need, the availability of banks of frozen red cells would seem likely to lead to the development of banks of the other cellular components of blood. With current liquid state storage procedures, platelets and leukocytes—far less stable than the red cell—are without transfusion value within about three days or less after donation. At present, the only prospect for establishing a large-scale reserve of these invaluable components is to preserve them in the frozen state. Although low temperature preservation procedures for these cells are not technically as far advanced as for the red cell, several blood laboratories are fully aware of the need and are attacking the problem vigorously.



The refrigerator shown here stores red blood cells for transfusions. No other cryogenic refrigerator provides as much storage capacity in as little space as the LINDE LR-1000.

LINDE cryogenic refrigerators come in all shapes and sizes

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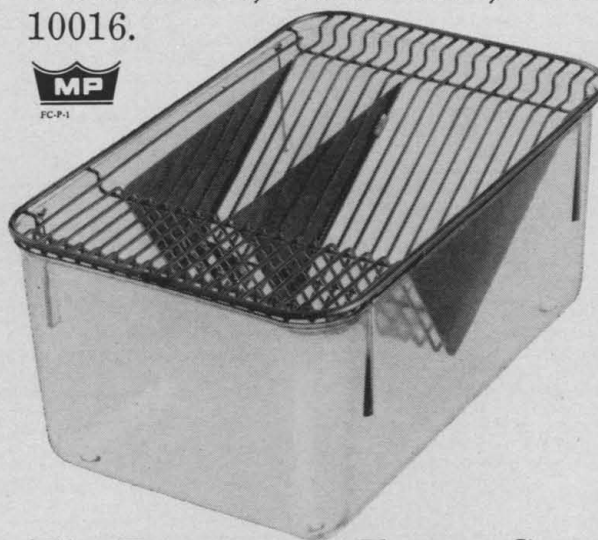
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spray several times, so I requested to see the label on the insecticide bomb. It read: "Airosol Company Inc., G-1152 Aircraft Insecticide Bomb, Neodesha, Kansas. Active Ingredients: Pyrethrins 1.0%, DDT 3.0%, Cyclohexanone 5.0%, Mineral Oil 6.0%. Inert Ingredients: Dichlorodifluoromethane 59.5%, Trichloromonofluoromethane 25.5%." What really caught my eye was not so much the fact that DDT is in truth being sprayed in tightly packed, poorly ventilated aircraft, but the warning at the bottom of the label in bold black letters "*Avoid Inhalation of Aerosol Mist,*" and what I assume must be both the source of the caution notice and the order to spray the aircraft, "U.S. Public Health Service (71.5.3E)."

The aircraft in which I was a passenger was sprayed three separate times before three separate landings, several times while passengers were drinking beverages served by the stewardesses. Although it is a relatively short flight from San José to Miami, it is difficult to hold one's breath that long, and contrary to what Jukes might think, we have learned something about the effects of DDT on human health since 1959 ... or have we?

DAVID K. EVANS

*Department of Anthropology,
Wake Forest University,
Winston-Salem, North Carolina 27109*

Sonic Booms over Cities

It is surprising that F. G. Finger and R. M. McInturff, after giving *quantitative* accounts of many meteorological problems facing the supersonic transport planes ("Meterology and the supersonic transport," 2 Jan., p. 16) discuss the sonic boom in *qualitative* terms only. Why not inform the readers that the sonic boom overpressure will be 2 to 4 pounds per square foot and that this is twice the overpressure used in the 1964 Oklahoma City sonic boom tests—which resulted in damage payments exceeding \$94,000?

WILLIAM A. SHURCLIFF

*Citizens League Against the Sonic Boom, 19 Appleton Street,
Cambridge, Massachusetts 02138*

We were concerned "only with the atmospheric influences on sonic boom propagation, and with the prospects for predicting the location and intensity of the boom." Although, as we pointed out, there are other problems related

to the sonic boom, it seemed to us more appropriate to give a reference to a comprehensive discussion of these problems than to attempt ourselves to delve into an area outside our specialty (1).

In the interest of fairness, we offer the following quotation from a speech by John H. Shaffer, FAA Administrator, on 17 November:

"There will be no sonic boom nuisance or annoyance, because the whole program is based on the President's policy that the plane will not be operated at boom-producing speeds over populated areas."

FREDERICK G. FINGER

RAYMOND M. MCINTURFF

*National Meteorological Center,
ESSA, Silver Spring, Maryland 20910*

Reference

1. K. D. Kryter, *Science* 163, 359 (1969).

Mistaken Identity

The carelessness described by Goldman (Letters, 16 Jan.) is not limited to suppliers of radioactive biochemicals. We recently received nonradioactive samples of epinephrine and norepinephrine from a major supplier of biochemicals; unfortunately, they were in bottles bearing the opposite labels.

We first used the material labeled L-arterenol bitartrate as a substrate for phenethanolamine N-methyl transferase, the enzyme that methylates norepinephrine, and knew something was amiss when we found no activity in an assay used daily in our lab. Thin-layer chromatography showed that the bottle marked L-arterenol bitartrate actually contained epinephrine (in this case, the product of the enzyme). Another bottle from the same supplier was labeled L-epinephrine bitartrate; that bottle contained norepinephrine.

We were lucky that our experimental situation readily revealed the error. Possible scientific disaster awaits others with the same preparations if they happen to be working with one of the many experimental situations in which norepinephrine and epinephrine react qualitatively the same. The pharmacologist studying adrenergic blocking drugs, for example, might obtain results that he would accept, but which would be quite wrong. I therefore feel obliged to provide the name of the supplier and the lot numbers of the erroneously labeled catecholamines to anyone who

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may have doubts as to the identity of his samples.

Goldman suggested that investigators should "report such incidents promptly to their colleagues and forcefully to their suppliers." We have now done both.

RAY W. FULLER

Lilly Research Laboratories,
Indianapolis, Indiana 46206

Nonhuman Primates

A simian virus reference center has been developed at this laboratory to provide assistance for individuals working in biomedical research with non-human primates. With grants from NIH and the World Health Organization [*WHO Chronicle* 23, 112 (1969)] we propose to develop a working repository for simian viruses, provide reagents such as certified reference seed virus strains and specific antisera, furnish diagnostic services and serum survey data on viruses of both human and simian origin, act as an information exchange with other primate centers, and train students in virological laboratory procedures associated with primate investigations.

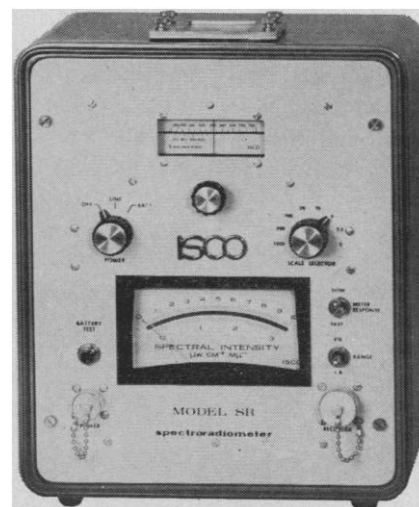
S. S. KALTER

Division of Microbiology and
Infectious Diseases, Southwest
Foundation, P.O. Box 28147,
San Antonio, Texas 78228

Desalination of Cold Seawater

In "Dry lands and desalted water" (23 Jan., p. 339) Young suggests that a maximum cost of about 20 cents per 1000 gallons for desalinated water represents the limit below which irrigation agriculture using this water source can begin to be economical for certain crops. The cost of water from presently operating desalination plants is discouragingly higher. A recent study (1) of water production costs of the 59 largest of these plants, operating around the world, reveals that 57 percent of them cannot produce water below \$3 per 1000 gallons and only 5 percent show costs below \$1. Although Young points to the hoped-for cost reductions expected through engineering advances and the development of atomic reactor powered dual-purpose plants, it will be some time before these improvements can lower the cost of desalinated

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water. Moreover, it is unlikely that these developments, when available, will be of help to the older existing plants.

In recent publications (2, 3) J. L. Worzel and I have suggested an approach to the utilization of the marine environment, where deep ocean water (20°C colder than surface water), pumped to shore installations through large pipes, becomes a valuable resource in sea thermal power generation, atmospheric water recovery, and mariculture. We also pointed out (3) that desalination plants located on shores accessible to deep cold seawater could realize immediate benefits.

The water yield and performance ratio (desalinated water per unit weight of steam) in the typical multistage distillation plant are increased by increasing the difference between the minimum and maximum water temperatures. This flashing range, which is limited on the high side by problems of scale and corrosion and on the low side by the local surface seawater temperatures [tropical and subtropical surface waters are commonly between 24° and 27°C (75° to 80°F)], averages around 55°C (100°F). By using deep water of about 5°C (41°F), available at many sites within a few miles of the shore, the flashing range can be increased by more than 30 percent with a commensurate increase in yield and performance ratio. Additional advantages would accrue in the form of reduced corrosion, reduced requirements for phosphate or acid additives used to remove scale, and reduction of the thermal and brine pollution effects of the outflow water.

To an oceanographer considering the enormous engineering effort that has gone into the design of today's desalination plants, it is remarkable that none has been built with an intake pipe extending offshore to take advantage of colder water. It will be even more remarkable if desalination plants being designed today for tomorrow's increased needs still do not utilize this feature of the marine environment where it is available.

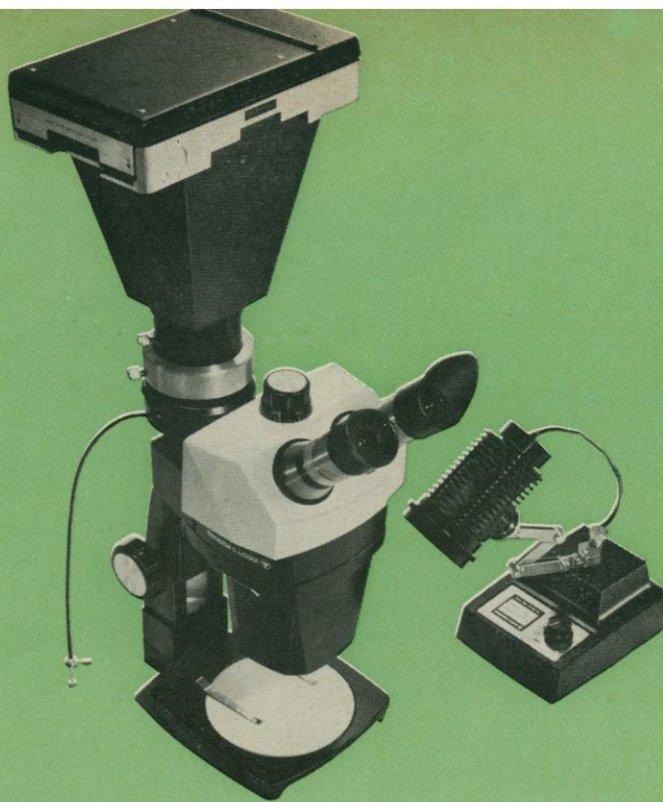
ROBERT D. GERARD

*Lamont-Doherty Geological
Observatory, Columbia University,
Palisades, New York 10964*

References and Notes

1. *First United Nations Desalination Plant Operation Survey* (United Nations Dept. of Economic and Social Affairs, New York, 1969).
2. R. D. Gerard and J. L. Worzel, *Science* **157**, 1300 (1967).
3. R. D. Gerard and J. L. Worzel, 1968 *Proc. Fourth Amer. Water Resources Conf.* (American Water Resources Association, Urbana, Ill., 1969), p. 218.

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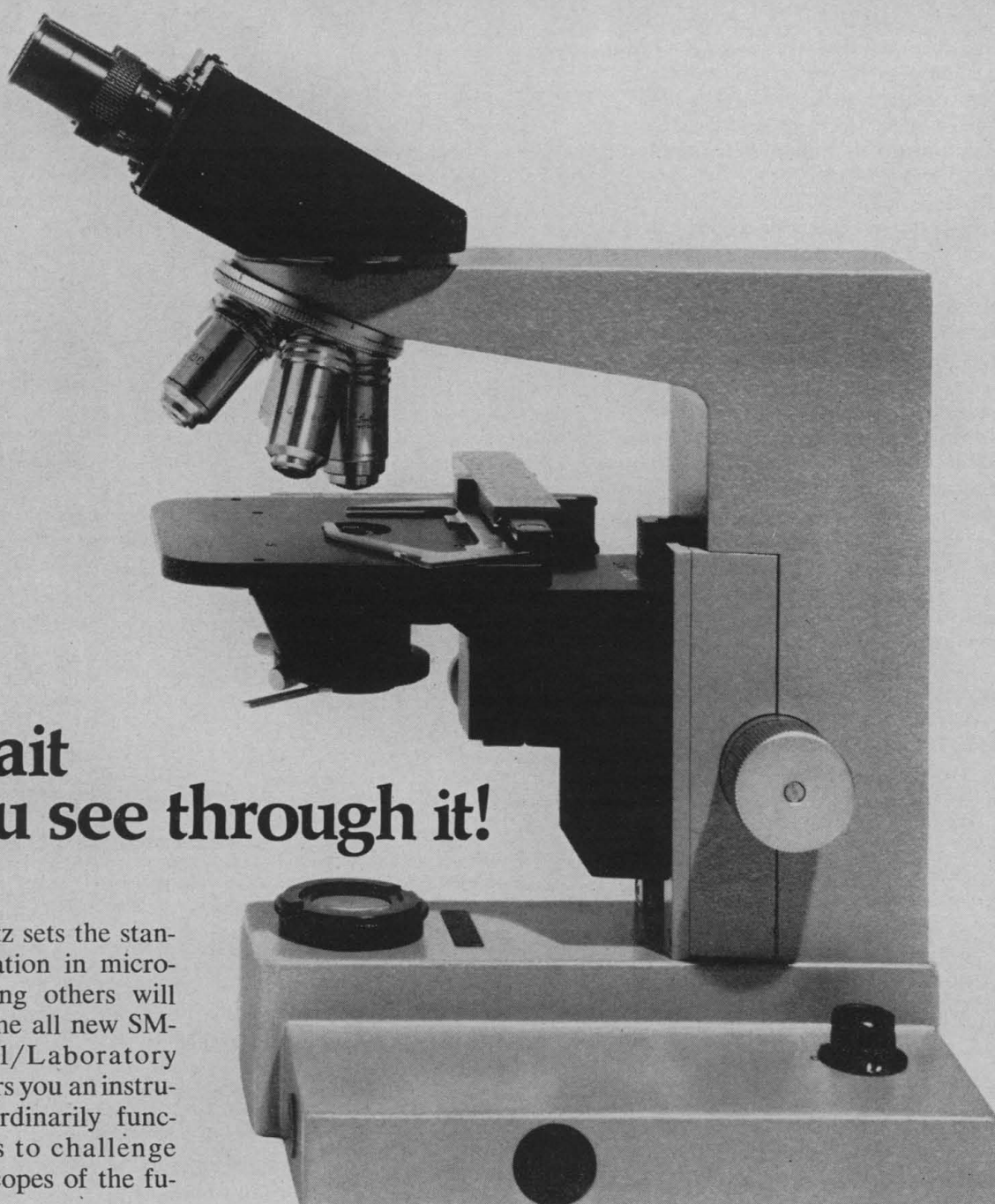
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Progress in Abating Air Pollution

An optimist can at last see signs of progress in overcoming air pollution. The ponderous machinery of government is beginning to move, and segments of industry are behaving as if they realize that they cannot go on increasingly polluting the atmosphere. An important example is the automobile manufacturers who are taking action against the nuisances they were creating. Emission of hydrocarbons by new cars in California this year will be only about 23 percent that of earlier, uncontrolled models. The California standards will apply nationwide in the next model year. General Motors has committed itself "to take the automobile out of the smog problem altogether." The federal government has begun to assume leadership. Recently Secretary Finch issued a schedule for reducing the permissible limits of pollutants from automobiles. By 1975 the emission of hydrocarbons is to drop to about 5 percent of that of uncontrolled vehicles.

Progress has already been made in diminishing the emission of carbon monoxide. Next year's models will emit about a third as much as uncontrolled automobiles. Control of nitrogen oxides has lagged behind, but California standards require a partial abatement in the 1971 model year. The federal standards for 1975 call for a substantial change—a drop to about 15 percent of present levels. A striking feature of the abatement of motor vehicle pollution is its price. The improvements incorporated in the 1971 models will cost no more than \$48 per vehicle.

In terms of tonnage of emitted pollutants, the automobile ranks first. However, in overall damaging effects, sulfur oxides from burning of fuels seem most serious. This is especially true in the area east of the Mississippi and north of the Ohio, where sulfur-bearing coal is a principal fuel. In that region, major metropolitan areas have been gambling with catastrophe. An unusual weather pattern with a persistent inversion could result in many deaths. In November 1966, the New York metropolitan area came close to such an event. The experience caused authorities in the area to issue regulations calling for progressively improved control of sulfur oxides. In abating its air pollution, New York in effect limited the sulfur content of fuel to 1 percent. As a result, the concentration of atmospheric sulfur oxides is now less than half what it was in 1966. During 1971 the permissible sulfur content of fuel for most installations will drop to 0.37 percent. This will reduce pollution further. It will also have substantial economic consequences. Fuel will cost more. It will consist mainly of natural gas, purified residual oil, and clean fuel oil.

The United States cannot afford to import enough low-sulfur oil to meet its energy needs. In many regions it will be necessary to use coal which typically contains 2 to 3 percent of sulfur. Only a small fraction of the reserves contains as little as 1 percent. It is possible to remove some of the sulfur from coal by mechanical means, but most cannot be eliminated except by costly chemical processing. In major installations abatement of pollution arising from the burning of coal will require cleansing of stack gases. At a recent congressional hearing,* four processes were described that have reached the stage of commercial application. They are all capable of sharply reducing the concentrations of sulfur oxides emitted by major electric power generating stations. The consumer, naturally, will have to pay more for his electricity—from 6 to 10 percent more, according to present estimates.

In view of the health hazards and other costs of pollution this seems a small price to pay. With this new technology the major polluters can lower their emissions of sulfur oxides, and they should be required to do so expeditiously.—PHILIP H. ABELSON

* Testimony by James R. Garvey, President, Bituminous Coal Research, Inc., to Joint Committee on Atomic Energy, 25 February 1970.

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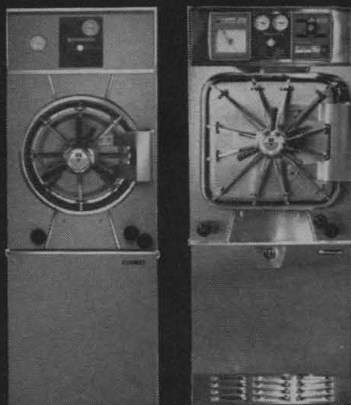
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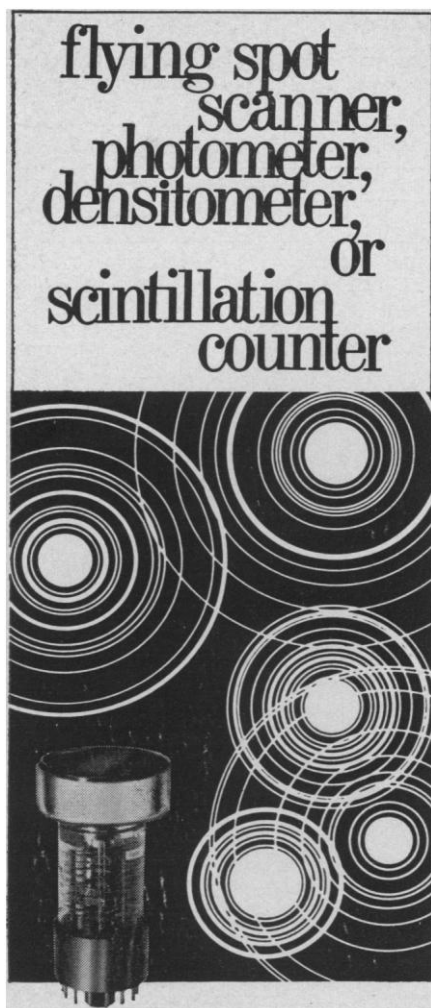
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MEETINGS

Radiation Biology of the Fetal and Juvenile Mammal

In his introductory talk at a symposium on the radiation biology of the fetal and juvenile mammal, T. R. Noonan (University of Tennessee-AEC Agricultural Research Laboratory at Oak Ridge) traced the general development of this subject since 1953, when a major symposium was held in Oak Ridge on the effects of radiation on embryonic development. Research areas that were only beginning to be of interest at that time have since assumed major importance. Changes in approach by investigators became increasingly apparent as the symposium progressed.

The opening session was concerned with cross-placental transfer of radionuclides. There were several reports on quantitative measurements of this transfer, including papers on the dynamics of transfer and the relative ease of passage of related materials. Studies in which the radiation dose to the fetal animals was calculated after administration of radionuclides to the dams were reported. Sufficient information has become available for some nuclides to permit estimates of the radiation dose to the human fetus after exposure of pregnant women. In other studies, it was possible to separate the role of the fetus from that of the placenta.

The metabolism of inorganic elements by the neonatal organism and the changes that occur during maturation were considered. The accumulation of environmental ^{90}Sr in the teeth of children was reported. Some of the factors affecting strontium retention in newborn swine were considered. Several workers reported on the comparative utilization of various alkaline earths and on age-related differences in the metabolism of a number of minerals, including cesium, cerium, and zinc.

Interest in the effects of continuous or fractionated radiation on the perinatal animal was evident in the session on radiation effects in the fetus. Related to this were papers on the effects of the continuous infusion of tritiated thymidine and on the role of dose rate. Studies on the neurological and behavioral effects of prenatal irradiation were reported, as well as effects on the heart, vascular system, gonads, and thyroid.

Papers on the long-term effects of radiation of the intrauterine or neonatal animal were presented at a session on perinatal radiation effects. A number of

the factors that influence the response of the perinatal animal to radiation were discussed. Several reports, based on autoradiography studies, were presented on the effects of radiation on cell proliferation. The relation between age and radiosensitivity was studied by measuring the size and intrinsic sensitivity of the population of stem cells in the bone marrow of animals of various ages. Several groups reported differences in the radiosensitivity of various systems and organs in animals of different ages.

General aspects of the studies on the Marshall Islanders exposed to fallout were described by R. Conard (Brookhaven National Laboratory). More detailed results on the status of the children exposed in this incident were presented in a session in which the results observed in several irradiated human populations were considered. An analysis of the age factors in thyroid carcinogenesis in the Japanese populations exposed to the atomic blasts was presented. Other reports included a review of the progress in follow-up studies of children who received diagnostic x-rays during intrauterine life and a consideration of the importance of the latent period in the interpretation of the epidemiology of radiogenic cancer following exposure of the pre-natal human. Recent changes in the rate of decline in the incidence of neonatal mortality and childhood leukemia were correlated with fallout from atomic weapons testing. A number of investigators took strong exception to the suggested correlation and thereby initiated a vigorous discussion as to the validity of the epidemiological approaches employed and of the interpretations.

In a session devoted to the effect of radiation on the immature central nervous system, the reports included determinations of the differential radiosensitivity of various anatomic and functional loci in the brain and studies of the fine structural changes observable by electron microscopy. Other investigators described the reproductive integrity of cells, as measured by thymidine incorporation, and cellular recovery, as measured by split-dose radiation techniques. A comparison was made of the effects of localized radiation and surgical ablation of localized areas of the cerebellum on the development of motor function. Several groups reported effects of radiation on the biochemistry of the brain, including changes in nucleic acids, enzymes, and lipids.

The final session, on mechanisms, commenced with a review of the molecular events which might be altered by radiation. This was followed by a consideration of the role of the hormonal environment on the radiosensitivity of oocytes and by several papers suggesting alterations of enzymes and of proteins as possible mechanisms for the differential radiosensitivity of the immature organism. The symposium ended with a discussion of the relative importance of radiation damage to inductor and competent tissues in the response of the embryo.

An increasing tendency toward quantitative experimentation and the impact of modern concepts in biology on the study of radiobiologic phenomena was particularly notable. It was evident that there is continuing effort to understand the mechanisms and processes of normal development underlying the many experiments with radiation and radioactive material.

The symposium was held in Richland, Washington, 5 to 8 May, under the sponsorship of the Battelle Memorial Institute Pacific Northwest Laboratories and the U.S. Atomic Energy Commission. Approximately 150 scientists, representing 11 countries, participated in the meeting. Approximately 65 papers were selected from those submitted, to provide a coherent development of the field. The texts and related discussion are available as the *Symposium Proceedings*, from the Clearing House for Federal Science and Technological Information (National Bureau of Standards, Springfield, Va. 22151).

MELVIN R. SIKOV

Biology Department, Battelle Northwest, Richland, Washington 99352

Forthcoming Events

April

16-18. Carnahan Conf. on **Electronic Crime Countermeasures**, 4th annual, Lexington, Ky. (J. S. Jackson, Electrical Engineering Dept., Univ. of Kentucky, Lexington 40506)

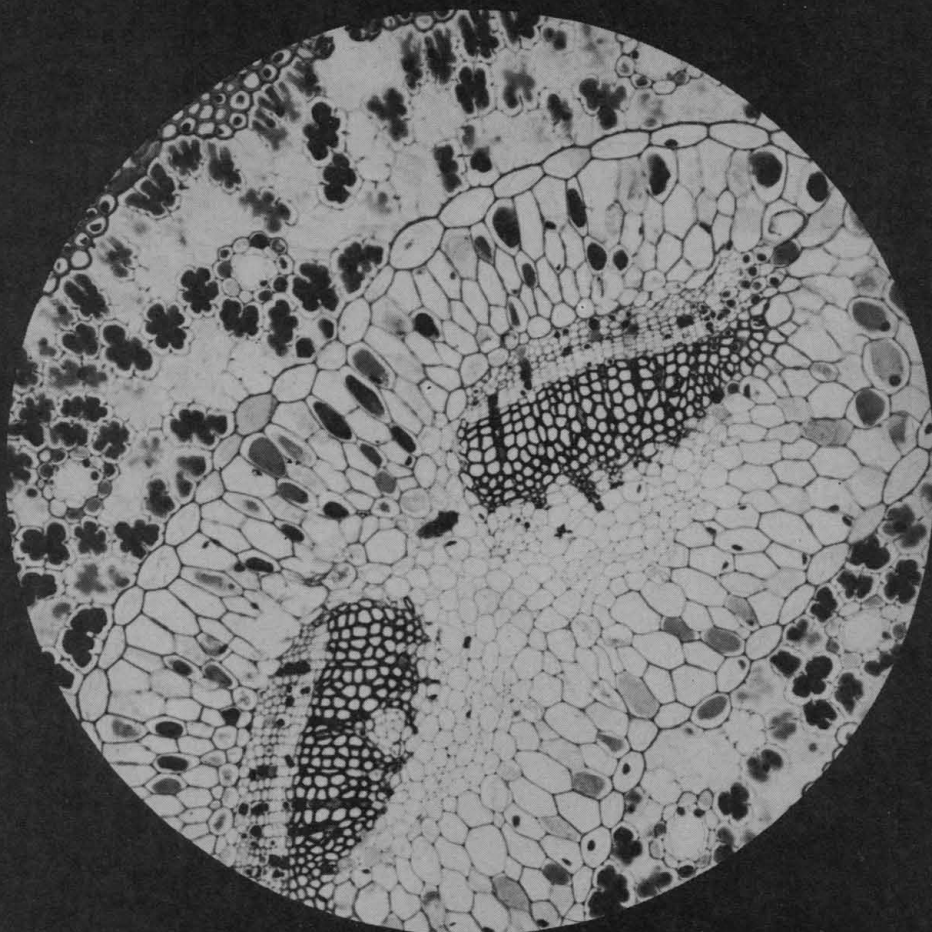
20-23. Southwestern **Surgical Congr.**, Dallas, Tex. (J. A. Barney, 301 Pasteur Medical Bldg., Oklahoma City, Okla. 73103)

20-24. American **Geophysical Union**, Washington, D.C. (W. E. Smith, AGU, 2100 Pennsylvania Ave., NW, Washington, D.C. 20037)

21-23. **Aerospace Nuclear Applications**, Huntsville, Ala. (A. D. Smith, American

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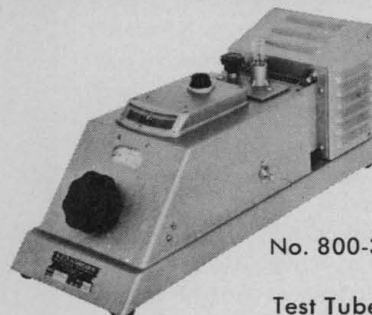
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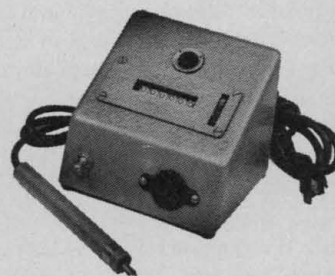


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21-23. Conference on **Stress Corrosion Cracking**, Los Angeles, Calif. (J. A. Fellows, American Soc. for Metals, Metals Park, Ohio 44073)

22-25. American Assoc. for **Child Care in the Hospital**, San Francisco, Calif. (H. H. Glaser, Stanford Children's Convalescent Hospital, Palo Alto, Calif. 94304)

23-25. **Illinois State Acad. of Science**, Chicago, Ill. (K. Harmet, Dept. of Biology, Northern Illinois Univ., De Kalb)

23-26. Association of **Clinical Scientists**, Detroit, Mich. (R. P. MacFate, ACS, 125 N. Rutledge St., Pentwater, Mich. 49449)

24-25. **Mississippi Acad. of Sciences**, Clinton. (C. Q. Sheely, Drawer CQ, State College, Miss. 39762)

24-25. **Nebraska Acad. of Science**, Lincoln. (C. B. Schultz, Univ. of Nebraska, Lincoln 68508)

24-25. **South Carolina Acad. of Science**, Columbia. (L. H. Stevenson, Biology Dept., Univ. of South Carolina, Columbia 29208)

25-30. **American Ceramic Soc., Inc.**, 72nd annual mtg., Philadelphia, Pa. (The Society, 4055 N. High St., Columbus, Ohio 43214)

26-30. **Group Medicine**, 1st intern. congr., Winnipeg, Canada. (R. E. Beamish, Manitoba Clinic, 790 Sherbrook St., Winnipeg 2, Man., Canada)

26-1. **American Soc. for Microbiology**, Boston, Mass. (R. W. Sarber, 1913 I St., NW, Washington, D.C. 20006)

27-29. **Frequency Control Symp.**, 24th annual, Atlantic City, N.J. (J. M. Stanley, Electronics Components Lab., Fort Monmouth, N.J. 07703)

27-29. **American Surgical Assoc.**, White Sulphur Springs, W. Va. (C. G. Shires, 5323 Harry Hines Blvd., Dallas, Tex. 75235)

27-30. **National Telemetry Conf.**, Los Angeles, Calif. (A. V. Balakrishnan, Dept. of Engineering, Univ. of California, Los Angeles 90024)

27-2. **American Acad. of Neurology**, Miami Beach, Fla. (S. A. Nelson, Executive Director, The Academy, 4005 W. 65 St., Minneapolis, Minn. 55435)

28-30. **Blood Coagulation and Hemostasis**, Sherbrooke, P.Q., Canada. (R. Losito, Dept. of Medicine, Univ. of Sherbrooke, Sherbrooke)

28-30. Conference on the **Fatigue Problem**, Los Angeles, Calif. (J. A. Fellows, American Soc. for Metals, Metals Park, Ohio 44073)

28-30. **Pi Gamma Mu**, Denver, Colo. (E. B. Urquhart, 1719 Ames St., Winfield, Kan. 67156)

29-1. **Instrument Soc. of America**, 2nd education symp., Montreal, Canada. (C. M. Skillern, The Foxboro Co., Foxboro, Mass.)

30-1. **Kansas Acad. of Science**, Wichita. (R. J. Robel, Div. of Biology, Kansas State Univ., Manhattan 66502)

May

1. **Missouri Acad. of Science**, Warrensburg. (E. A. McGinnes, Jr., 1-31 Agriculture, Univ. of Missouri, Columbia 65201)

1-2. **North Dakota Acad. of Science**,

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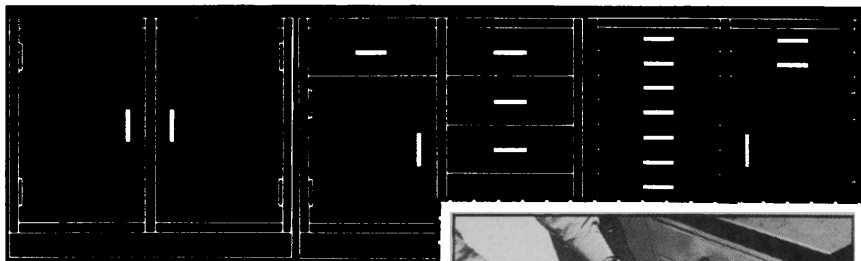
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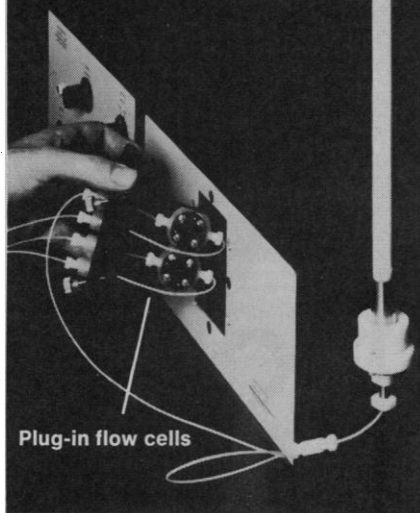
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1-2. Society for Pediatric Research, Atlantic City, N.J. (R. E. Greenberg, Dept. of Pediatrics, Stanford Univ., Stanford, Calif. 94305)

2-3. American Federation of Clinical Research, Atlantic City, N.J. (J. E. Brown, 2011 Eye St., NW, Washington, D.C. 20006)

3-6. European Federation of Chemical Engineering, 93rd, Vienna, Austria. (W. F. De Geest, Lijzenstraat 24 Berchem-Antwerp, Belgium)

3-6. Society of Professional Well Log Analysts, symp., 11th annual, Los Angeles, Calif. (J. D. Clark, 13507 Tosca, Houston, Tex. 77024)

3-8. International Radiation Protection Assoc., 2nd, Brighton, England. (B. Godbold, Central Electricity Generating Board, 20 Newgate St., London, E.C.1, England)

4-5. Industrial Electronics and Control Instrumentation Transducer Conf., 2nd annual, Gaithersburg, Md. (R. B. Spooner, IMPAC Instrument Service, 201 E. Carson St., Pittsburgh, Pa. 15219)

4-6. Instrument Soc. of America, 8th Biomedical Sciences Instrumentation Symp., Denver, Colo. (L. J. Brannick, E. R. Squibb & Sons, Inc., New Brunswick, N.J. 08901)

4-8. American Nurses Assoc., Miami, Fla. (Mrs. A. R. Warner, Dept. 10, Columbus Circle, New York 10019)

4-8. Society of Plastics Engineers, New York, N.Y. (J. H. Hyden, SPE, 656 W. Putnam Ave., Greenwich, Conn. 06830)

4-8. Veterinary Conf. and Wildlife Disease Assoc., joint biennial mtg., Atlanta, Ga. (W. G. Winkler, Program Chairman, Veterinary Science Dept., Univ. of Wisconsin, Madison 53706)

5-6. Institute of Electrical and Electronics Engineers Appliance Technical Conf., 21st annual, Mansfield, Ohio. (W. H. Lynn, Registration Chairman, Tappan Co., 250 Wayne St., Mansfield, Ohio 44906)

5-6. Association of American Physicians, Atlantic City, N.J. (J. B. Hickman, Indiana Univ. Medical Center, 1100 W. Michigan St., Indianapolis 46202)

5-7. Biometric Soc., eastern North American regional, Chapel Hill, N.C. (D. G. Gosslee, P.O. Box 713, Oak Ridge, Tenn. 37830)

5-7. Purdue Industrial Waste Conf., 25th, Lafayette, Ind. (D. E. Bloodgood, School of Civil Engineering, Purdue Univ., Lafayette 47907)

5-7. Institute of Mathematical Statistics, Chapel Hill, N.C. (L. Katz, Statistical Lab., Michigan State Univ., East Lansing 48823)

5-7. Modern Welding Techniques Conf., Los Angeles, Calif. (J. A. Fellows, American Soc. for Metals, Metals Park, Ohio 44073)

5-8. Virginia Acad. of Science, Richmond. (R. C. Berry, The Academy, P.O. Box 9211, Richmond 23227)

6-8. Society of Mining Engineers, Socorro, N.M. (P. H. Johnson, New Mexico State Bureau of Mines and Mineral Resources, Campus Sta., Socorro 87801)

6-9. American Inst. of Industrial Engineers, Cleveland, Ohio. (J. J. Jericho, AIIE, 345 E. 47 St., New York 10017)

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7-8. National **Information Retrieval** Colloquium, 7th annual, Philadelphia, Pa. (P. Bagley, Information Engineering, 3401 Market St., Philadelphia)

7-9. Northeastern **Anthropological** Conf., Ottawa, Ont., Canada. (F. G. Vallee, Carleton Univ., Ottawa)

7-9. International **Communication** Assoc. Conf., 18th annual, Minneapolis, Minn. (R. W. Pace, Communication Program, Univ. of Montana, Missoula 59801)

8-10. Society of **Biological Psychiatry**, San Francisco, Calif. (C. Shagass, Eastern Pennsylvania Psychiatric Institute, Henry Ave. and Abbottsford Rd., Philadelphia 19129)

8-11. American **Psychoanalytic** Assoc., San Francisco, Calif. (H. Fischer, Executive Secretary, APA, 1 E. 57 St., New York 10022)

10. Association for the Advancement of **Psychotherapy**, Inc., 9th natl. conf., San Francisco, Calif. (S. Lesse, 15 W. 81 St., New York 10024)

10-12. American Assoc. of **Plastic Surgeons**, Colorado Springs, Colo. (C. W. Monroe, 715 Lake St., Oak Park, Ill. 60301)

10-14. **Metallurgical** Soc., Las Vegas, Nev. (J. V. Richard, Secretary, The Society, 345 E. 47 St., New York 10017)

10-15. **Chemical Vapour Deposition**, 2nd intern. conf., Los Angeles, Calif. (W. W. Smeltzer, Dept. of Metallurgy and Metallurgical Engineering, McMaster Univ., Hamilton, Ont., Canada)

10-15. **Electrochemical** Soc., Los Angeles, Calif. (E. G. Enck, Executive Secretary, The Society, 30 E. 42 St., New York 10017)

11-12. Council of **Biology Editors**, Ottawa, Ont., Canada. (K. Heumann, 9650 Rockville Pike, Bethesda, Md. 20014)

11-13. Instrument Soc. of America, 16th **Aerospace Instrumentation** Symp., Seattle, Wash. (J. M. Taylor, 3246 116th S.E., Bellevue, Wash. 98004)

11-13. American Soc. for **Quality Control** Technical Conf. and Exhibit, 24th annual, Pittsburgh, Pa. (R. W. Shearman, Administrative Secretary, The Society, 161 W. Wisconsin Ave., Milwaukee, Wis. 53203)

11-13. **Television Measuring Techniques** Conf., London, England. (R. Larry, Institution of Electronic and Radio Engineers, 8-9, Bedford Sq., London, W.C.1, England)

11-14. International **Microwave** Symp., Newport Beach, Calif. (R. H. Duhamel, Granger Assoc., 1601 California Ave., Palo Alto, Calif. 94304)

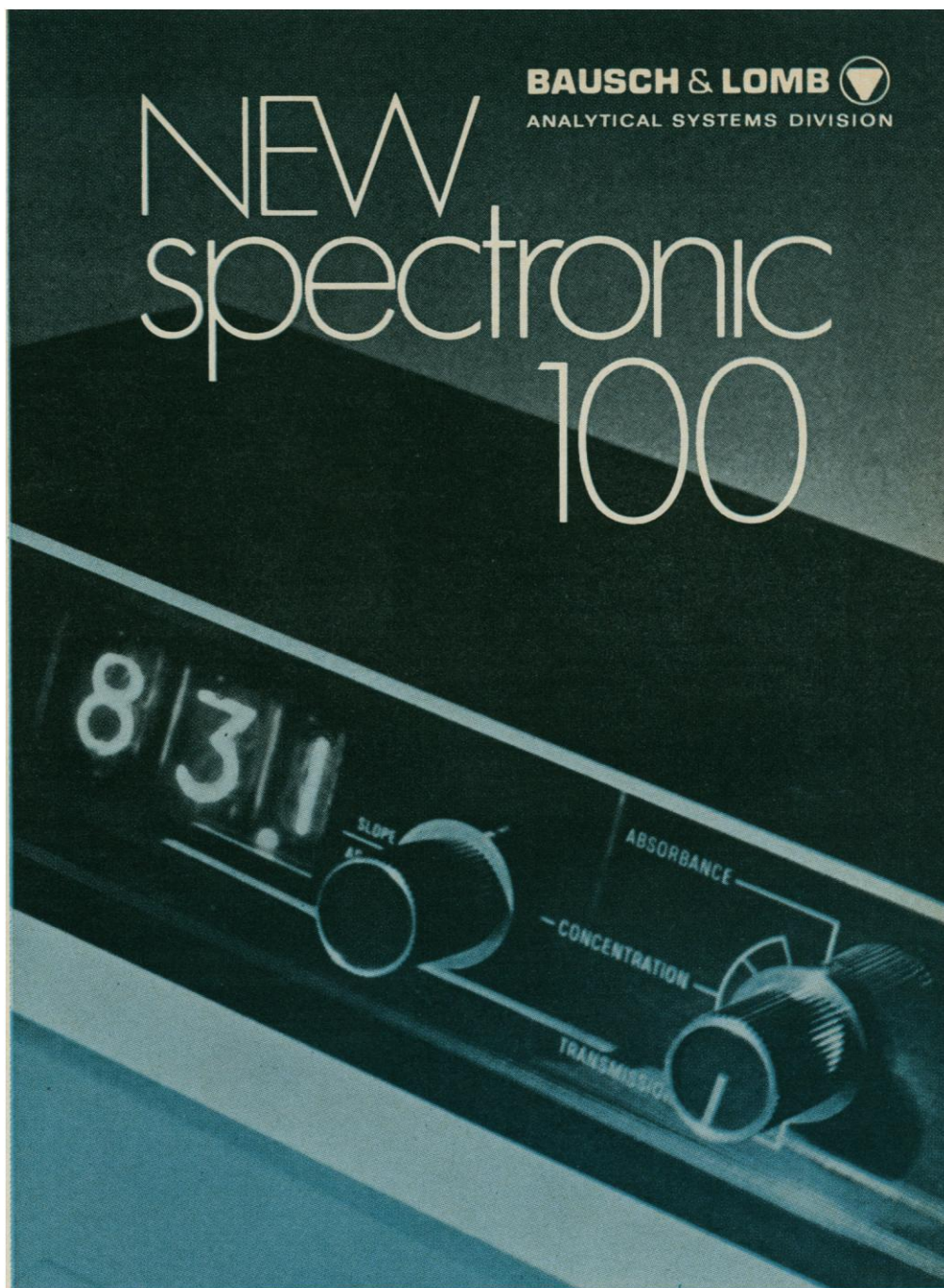
11-15. **High Pressure**, 3rd intern. conf., Aviemore, Invernesshire, Scotland. (J. Schoeffer, Institution of Mechanical Engineers, 1 Birdcage Walk, London, S.W.1, England)

11-15. American **Industrial Hygiene** Assoc., Detroit, Mich. (G. D. Clayton, AIHA, 25711 Southfield Rd., Southfield, Mich. 48075)

11-15. American **Psychiatric** Assoc., San Francisco, Calif. (B. W. Hogan, APA, 1700 18th St., NW, Washington, D.C. 20009)

12-14. **Metal Matrix Composites** Conf., San Francisco, Calif. (J. A. Fellows, American Soc. for Metals, Metals Park, Ohio 44073)

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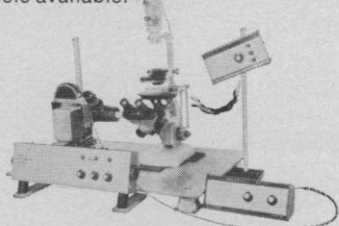
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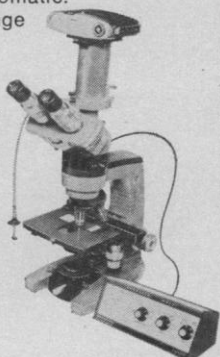
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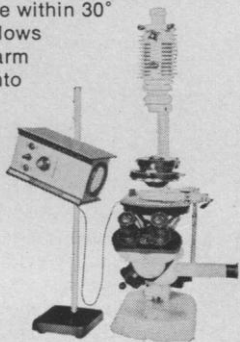
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13-15. **Electronics Components Conf.**, Washington, D.C. (D. Burks, Sprague Electric Co., North Adams, Mass. 01247)

14. **Modern Methods of Analyses of Surfaces Symp.**, Murray Hill, N.J. (J. D. Levine, Symp. Chairman, RCA Labs, Princeton, N.J.)

14-15. **Materials Selection Symp.**, Cleveland, Ohio. (W. M. Mueller, American Soc. for Metals, Metals Park, Ohio 44073)

14-15. **Southern Textile Research Conf.**, 10th annual, Hilton Head Island, S.C. (D. W. Snyder, Crompton Shenandoah Co., Drawer 907, Waynesboro, Va. 22980)

14-16. **Cardiovascular Diseases**, 6th annual symp., Hartford, Conn. (R. M. Jere-saty, Section of Cardiopulmonary Medicine, St. Francis Hospital, Hartford)

14-16. **American Inst. of Chemists**, Pittsburgh, Pa. (P. B. Slawter, 79 Madison Ave., New York 10016)

15-19. **International Assoc. of Professional Numismatists**, 19th general assembly, Scheveningen, The Hague, Netherlands. (A. Cronheim, Director, Holland Organizing Centre, 16 Lange Voorhout, The Hague)

17-18. **Modern Methods of Chemical Separations Symp.**, Buffalo, N.Y. (L. B. Church, Dept. of Chemistry, State Univ. of New York at Buffalo, Buffalo 13214)

17-20. **American Inst. of Chemical Engineers and Puerto Rican Inst. of Chemical Engineers**, 3rd joint mtg., San Juan, Puerto Rico. (P. Santiago, Caribbean Gulf Refining, San Juan)

17-21. **Pulp Bleaching**, 5th intern. conf., Atlanta, Ga. (R. A. Joss, Canadian Pulp and Paper Assoc., 2300 Sun Life Bldg., Montreal, P.Q., Canada)

17-30. **International Electrotechnical Commission**, Washington, D.C. (D. Hogan, U.S.A. Standards Inst., 10 E. 40 St., New York 10016)

18-20. **National Aerospace Electronics Conf.**, Dayton, Ohio. (Inst. of Electrical and Electronics Engineers, Dayton Office, 134 E. Monument St., Dayton 45402)

18-20. **American Gastroenterological Assoc.**, Boston, Mass. (H. D. Janowitz, Mt. Sinai Hospital, 11 E. 100 St., New York 10029)

18-20. **Neonatal Enteric Infections Caused by *Escherichia coli***, Conf., New York, N.Y. (L. R. Neville, New York Acad. of Sciences, 2 E. 63 St., New York 10021)

18-20. **Instrument Soc. of America, Power Instrumentation Symp.**, 13th, Kansas City, Mo. (R. A. Russell, Box 8405, Kansas City 64114)

18-20. **Steels for Dynamic Loading**, Cleveland, Ohio. (W. M. Mueller, American Soc. for Metals, Metals Park, Ohio)

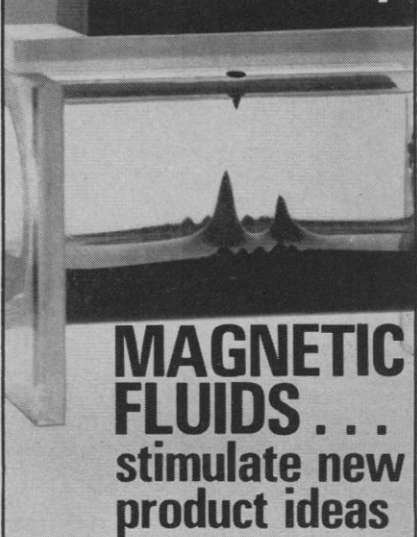
18-21. **Photosynthetic Unit**, intern. conf., Gatlinburg, Tenn. (R. M. Pearlstein, Oak Ridge Natl. Lab., P.O. Box Y, Oak Ridge, Tenn. 37830)

18-22. **Air Force Materials Symp.** '70, Miami Beach, Fla. (J. Shipp, Executive Director, AFMS '70, P.O. Box 38, Dayton, Ohio 45420)

18-22. **Medical Library Assoc.**, New Orleans, La. (H. B. Schmidt, Executive Secretary, MLA, 919 N. Michigan Ave., Chicago, Ill. 60611)

18-22. **Society of Photographic Scientists and Engineers**, 23rd annual conf., New York, N.Y. (F. Brown, Logetronics,

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SCIENCE, VOL. 167

7001 Louisdale Rd., Springfield, Va. 22150)
19-20. International Conf. on **Magnet Technology**, Hamburg, Germany. (W. Jentschke, German Hamburg Electron Synchrotron, Notkeskieg 1, D-2, Hamburg 52)

19-22. Society for **Experimental Stress Analysis**, Huntsville, Ala. (B. E. Rossi, 21 Bridge Sq., Westport, Conn. 06880)

20-22. Conference on **Fracture Control: Theory and Application**, Chicago, Ill. (A. M. Mueller, American Soc. for Metals, Metals Park, Ohio 44073)

20-22. **Teratology Soc.**, 10th annual, Annapolis, Md. (R. W. Miller, 402 Wisconsin Bldg., Bethesda, Md. 20014)

22-29. International **Cancer Congr.**, 10th, Houston, Tex. (M. M. Copeland, Univ. of Texas, P.O. Box 20465, Houston 77025)

24-28. Institute of **Food Technologists**, San Francisco, Calif. (C. L. Willey, IFT, 221 N. LaSalle St., Chicago, Ill. 60601)

24-28. International Congr. of **Social and Preventive Medicine**, 3rd, Venice, Italy. (S. Vanasia, General Secretary, The Congress, 71, via M. Macchi, Milan, Italy)

24-29. Chemical Inst. of Canada/Canadian Soc. for **Chemical Engineering**, Toronto, Ont. (W. M. Campbell, Ontario Research Foundation, Sheridan Park, Ontario, Canada)

24-30. European **Cultural Foundation Congr.**, 7th, Rotterdam, Netherlands. (Secretariat, Holland Organizing Centre, 16, Lange Voorhout, The Hague, Netherlands)

25-26. Symposium on **Biochemistry of Brain and Memory**, Kenosha, Wis. (S. P. Datta, Univ. of Wisconsin-Parkside, Kenosha 53140)

25-26. Progress in **Gas Dynamic Research by Optical Methods**, Syracuse, N.Y. (D. S. Dosanjh, Dept. of Mechanical and Aerospace Engineering, Syracuse Univ., Syracuse 13210)

25-29. European Conf. on **Psychosomatic Research**, 8th, Knokke, Belgium. (M. E. Houben, Universitaire St. Jozeikliniek voor Psychiatrie, 3070 Kortenberg, Belgium)

26-29. **Textile Institute Conf.**, 5th annual, London, England. (Textile Inst., 10 Blackfriars St., Manchester 3, England)

27-29. **Alcohol and Drug Addiction Foundation Symp.**, Toronto, Canada. (R. M. Gilbert, Addiction Research Foundation, 344 Bloor St. W., Toronto 179, Ont.)

30-1. Pan American **Cancer Cytology Congr.**, Jamaica, B.W.I. (J. E. Ayre, Westbury Quadrangle, 113 S. Service Rd., Jericho, N.Y. 11753)

June

1-5. Symposium on Use of **Computers for Automatic Control of Traffic**, Versailles, France. (G. Ruppel, Intern. Federation of Automatic Control, Postfach 1139, Dusseldorf 1, Germany)

1-6. International **Mineral Processing Congr.**, 9th, Prague, Czechoslovakia. (U. P. Vyskub Rud, Modranska 23, Prague 4)

1-6. World **Mining Congr.**, 6th, Madrid, Spain. (A. G. Readett, Natl. Coal Board, Hobart House, Grosvenor Pl., London, S.W.1, England)

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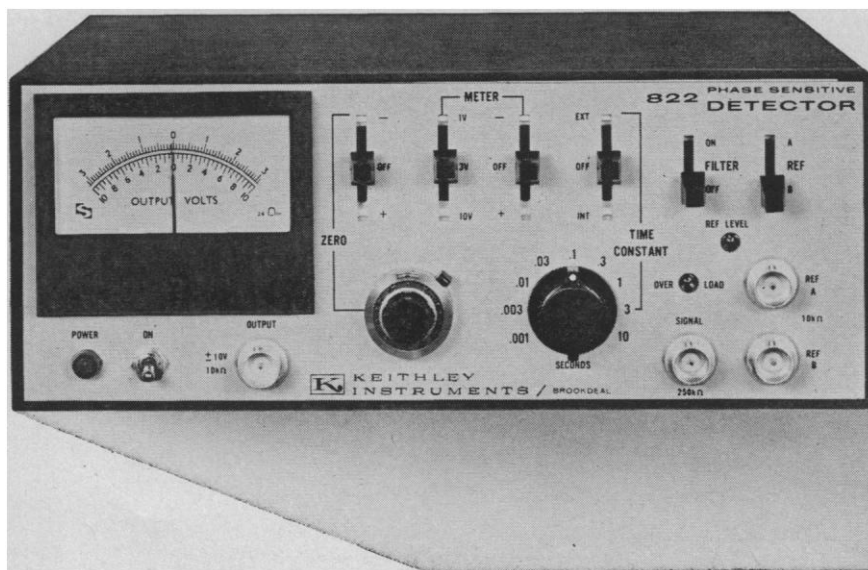
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1-6. World Congr. of **Occupational Therapists**, 5th, Zurich, Switzerland. (G. Stauffer, Kraftstr. 22, 8044, Zurich)

2-4. Conference on **Stress Corrosion Cracking**, New Orleans, La. (J. A. Fellows, American Soc. for Metals, Metals Park, Ohio 44073)

2-5. Mid-American Symp. on **Spectroscopy**, 22nd, Chicago, Ill. (W. A. Loseke, IIT Research Inst., 10 W. 35 St., Chicago 60616)

3-5. American **Chemical Soc.**, Central regional, 2nd, Columbus, Ohio. (R. W. Bird, 2540 Olentangy River Rd., Columbus 43210)

4-5. **Environmental and Water Resources Engineering Conf.**, 9th annual, Nashville, Tenn. (E. L. Thackston, Vanderbilt Univ., Box 133, Sta. B, Nashville 37203)

4-5. **Molecular Biology**, 4th intern. symp., New York, N.Y. (E. G. Bassett, Research Products Div., Miles Laboratories, Inc., Elkhart, Ind. 46514)

7-9. **Computer Applications in the Earth Sciences**, 8th colloquium, Lawrence, Kans. (D. F. Merriam, Kansas Geological Survey, Univ. of Kansas, Lawrence 66044)

7-10. American Soc. of **Mechanical Engineers**, Boston, Mass. (A. B. Conlin, Jr., 345 E. 47 St., New York 10017)

8-9. **Choice Criteria and Management Systems for Estuarine Resources Conf.**, Charleston, S.C. (J. C. Hite, Dept. of Agricultural Economics, Clemson Univ., Clemson, S.C. 29631)

8-10. International Conf. on **Communications**, San Francisco, Calif. (A. M. Peterson, Stanford Research Inst., Menlo Park, Calif. 94025)

8-10. Association for **Gnotobiotics**, Notre Dame, Ind. (M. Pollard, Dept. of Microbiology, Univ. of Notre Dame, Notre Dame 46556)

8-10. Conference on **Powder Metallurgy**, Detroit, Mich. (J. A. Fellows, American Soc. for Metals, Metals Park, Ohio 44073)

8-12. International **Gas Conf.**, 11th, Moscow, U.S.S.R. (R. H. Tonwaide, General Secretary, Intern. Gas Union, 4 Av. Palmerston, Brussels 4, Belgium)

8-12. International Symp. on **Plant Protein: Their Improvement through the Application of Nuclear Techniques**, Vienna, Austria. (J. H. Kane, U.S. Atomic Energy Commission, Washington, D.C. 20545)

9-12. American **Astronomical Soc.**, Boulder, Colo. (H. M. Gurin, 211 Fitz Randolph Rd., Princeton, N.J. 08540)

9-12. Canadian Federation of **Biological Societies**, 13th annual, Montreal. (K. K. Carroll, Dept. of Biochemistry, Univ. of Western Ontario, London 72, Canada)

10-12. **Low Energy X- and Gamma Ray Sources and Applications**, 3rd symp., Boston, Mass. (J. W. Hitch, Div. of Isotopes Development, U.S. Atomic Energy Commission, Washington, D.C. 20545)

11-13. **Endocrine Soc.**, St. Louis, Mo. (N. L. Mattox, Suite 304, 1211 N. Sharel, Oklahoma City, Okla. 73103)

12-14. Society of **Biological Psychiatry**, Atlantic City, N.J. (G. N. Thompson, 2010 Wilshire Blvd., Los Angeles, Calif. 90057)

13-14. American **Diabetes Assoc.**, St. Louis, Mo. (J. R. Connelly, 18 E. 48 St., New York, N.Y. 10017)

14-18. **Botanical Soc. of America**,

northwestern section, New London, Conn. (R. K. Zack, Dept. of Botany, Drew Univ., Madison, N.J. 07940)

14-18. **American Nuclear Soc.**, Los Angeles, Calif. (O. J. Du Temple, 244 E. Ogden Ave., Hinsdale, Ill. 60521)

14-18. **National Plastics Exposition and Conf.**, Cleveland, Ohio. (L. P. Williams, 250 Park Ave., New York 10017)

14-19. **Air Pollution Control Assoc.**, 63rd annual, St. Louis, Mo. (A. Arch, 4400 Fifth Ave., Pittsburgh, Pa. 15213)

14-19. **Mass Spectrometry and Allied Topics**, 18th annual conf., San Francisco, Calif. [J. M. McCrea, Applied Research Lab. (73), U.S. Steel Corp., Monroeville, Pa. 15146]

14-19. **Canadian Assoc. of Pathologists**, Winnipeg, Man. (C. W. Penner, Winnipeg General Hospital, Winnipeg 3)

15-16. **Catalytic Hydrogenation and Analogous Pressure Reactions**, 3rd conf., New York, N.Y. (L. R. Neville, New York Acad. of Sciences, 2 E. 63 St., New York 10021)

15-17. **American Neurological Assoc.**, 95th annual, Atlantic City, N.J. (S. A. Trufant, Cincinnati General Hospital, Cincinnati, Ohio 45229)

15-17. **National Conf. of Standards Laboratories**, Gaithersburg, Md. (R. J. Barra, Westinghouse Defense and Space Center, P.O. 746, Baltimore, Md. 21203)

15-18. **American Soc. for Engineering Education**, Columbus, Ohio. (W. L. Collins, 2100 Pennsylvania Ave., NW, Washington, D.C. 20037)

15-18. **American Meteorological Soc. Symp.**, Boulder, Colo. (J. London, Dept. of Astro-Geophysics, Univ. of Colorado, Boulder 80302)

15-18. **Tissue Culture Assoc.**, 21st annual, Washington, D.C. (V. P. Perry, American Foundation for Biological Research, 11125 Rockville Pike, Rockville, Md. 20853)

15-19. **International Symp. on Information Theory**, Noordwijk, Netherlands. (P. E. Green, Jr., M.I.T. Lincoln Lab., Lexington, Mass. 02173)

15-19. **Nuclear Data for Reactors**, 2nd intern. conf., Helsinki, Finland. (J. H. Kane, Div. of Technical Information, U.S. Atomic Energy Commission, Washington, D.C. 20545)

15-19. **Vacuum Metallurgy**, intern. conf., Anaheim, Calif. (E. L. Foster, Battelle Memorial Inst., 505 King Ave., Columbus, Ohio 43201)

15-19. **American Water Resources Assoc. Conf.**, Milwaukee, Wis. (G. Karadi, Dept. of Applied Sciences and Engineering, Univ. of Wis., Milwaukee 53201)

16-17. **Environmental Variables in Animal Experimentation**, 2nd annual, Metropolitan Branch, American Assoc. for Lab. Animal Science, New Brunswick, N.J. (D. Miller, Smith Kline & French, 1500 Spring Garden St., Philadelphia, Pa.)

16-18. **Conference on Cold Forming of Metal Parts**, Cleveland, Ohio. (J. A. Fellows, American Soc. for Metals, Metals Park, Ohio 44073)

16-18. **American Helicopter Soc.**, 26th annual natl. forum, Washington, D.C. (H. M. Lounsbury, 30 E. 42 St., New York 10017)

16-19. **Canadian Psychiatric Assoc.**,

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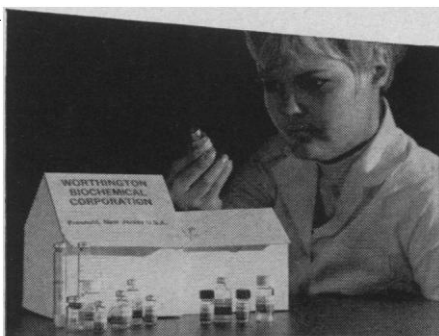
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20th annual, Winnipeg, Man. (W. A. Blair, 225 Lisgar St., Ottawa, Ont., Canada)

17-18. **European Dialysis and Transplant Assoc.**, 7th annual, Barcelona, Spain. (W. Drokker, 75 de Lairessestraat, Amsterdam, Netherlands)

17-19. **Cryogenic Engineering Conf.**, Boulder, Colo. (J. L. Smith, Jr., Rm. 41-204, Massachusetts Inst. of Technology, Cambridge, Mass. 02130)

17-20. **American Rheumatism Assoc.**, Detroit, Mich. (M. M. Walsh, 1212 Ave. of the Americas, New York 10036)

17-21. **American Therapeutic Soc.**, Chicago, Ill. (R. T. Smith, 37 Narbrook Pk., Narberth, Pa. 19072)

17-24. **Chemical Engineering and Congr. of Chemical Engineers**, Frankfurt-am-Main, Germany. (J. Dohent, Natl. Chemical Exposition, 86 E. Randolph St., Chicago, Ill. 60601)

18-19. **Current Concepts of the Histology of the Oral Mucosa Symp.**, Chicago, Ill. (C. A. Squier, College of Dentistry, Univ. of Illinois at the Medical Center, Chicago 60680)

18-20. **Bibliographical Soc. of America**, Philadelphia, Pa. (W. H. Bond, Houghton Library, Harvard Univ., Cambridge, Mass. 02138)

18-20. **American Assoc. of Bioanalysts**, New York, N.Y. (D. Birenbaum, 802 Ambassador Bldg., St. Louis, Mo. 63101)

20-25. **American Soc. of Radiologic Technologists**, Miami Beach, Fla. (G. J. Eilert, 527 S. Main St., Fond du Lac, Wis. 54935)

21-24. **American Dairy Science Assoc.**, 65th annual, Gainesville, Fla. (C. Cruse, 903 Fairview Ave., Urbana, Ill. 61801)

21-24. **American Leather Chemists Assoc.**, Lake Placid, N.Y. (M. T. Roddy, c/o Tanners Council Research Laboratories, Univ. of Cincinnati, Cincinnati, Ohio 45221)

21-25. **American Association for the Advancement of Science**, Pacific Div., Berkeley, Calif. (R. C. Miller, California Acad. of Sciences, Golden Gate Park, San Francisco 94118)

21-25. **American Medical Assoc.**, Chicago, Ill. (W. E. Burmeister, 535 N. Dearborn St., Chicago, Ill. 60610)

21-25. **American Veterinary Medical Assoc.**, Las Vegas, Nev. (D. A. Price, 600 Michigan Ave., Chicago, Ill. 60605)

21-26. **American Soc. for Testing and Materials**, Toronto, Ont., Canada. (T. A. Marshall, Jr., ASTM, 1916 Race St., Philadelphia, Pa. 19103)

22-24. **International Conf. on the Role of Tryptophan Metabolism in Biochemistry and Pathology**, Madison, Wis. (T. C. Meyer, Univ. of Wisconsin, Madison 53706)

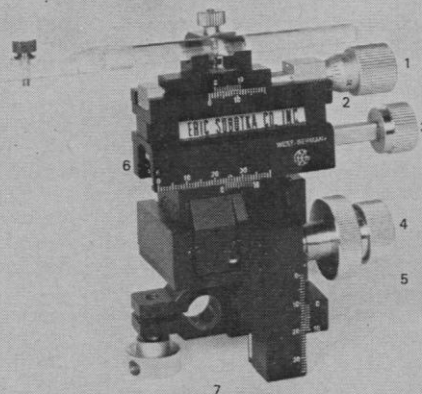
22-25. **Canadian Soc. of Agronomy**, Ottawa, Ont. (R. Loiselle, Ottawa Research Sta., Central Experimental Farm, Ottawa)

22-25. **Symposium on Bioinorganic Chemistry**, Blacksburg, Va. (R. E. Dessy, Dept. of Chemistry, Virginia Polytechnic Inst., Blacksburg 24061)

22-25. **Canadian Soc. of Horticultural Science**, Ottawa, Ont. (E. C. Loughheed, Dept. of Horticulture, Univ. of Guelph, Guelph, Ont.)

22-25. **American Assoc. of Petroleum Geologists**, Calgary, Alta., Canada. (J. M.

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22-25. Canadian Soc. of **Soil Science**, Ottawa, Ont. (A. R. Mack, Central Experimental Farm, Ottawa)

22-25. **Thyroid Conf.**, 6th annual, Vienna, Austria. (R. Hofer, c/o Wiener Medizinische Akademie, Alserstrasse 4, A-1090, Vienna)

22-26. American Assoc. of **Avian Pathologists**, Inc., Las Vegas, Nev. (G. H. Snoeyenbos, Univ. of Massachusetts, Amherst 01002)

22-27. **Mathematical Statistics and Probability**, 6th, Berkeley, Calif. (E. L. Scott, Dept. of Statistics, Univ. of California, Berkeley 94720)

23-26. State of the Art in **Corrosion Testing Methods Symp.**, Toronto, Canada. (W. H. Ailor, American Soc. for Testing and Materials, Reynolds Metals Co., 4th and Canal Sts., Richmond, Va. 23218)

24. **Biometric Soc.**, Western North American regional, Berkeley, Calif. (J. S. Williams, Statistical Lab., Colorado State Univ., Fort Collins 80521)

24-26. National **Aeronautics and Space Administration**, Ames Research Center, Moffett Field, Calif. (M. R. Heinrich, NASA, Ames Research Center, Moffett Field 94035)

24-26. American **Automatic Control Conf.**, Atlanta, Ga. (D. Lyons, Dept. of Textiles, Clemson Univ., Clemson, S.C. 29631)

24-26. Canadian **Wood Chemistry Symp.**, 3rd, Vancouver, B.C. (D. A. I. Goring, Pulp and Paper Research Inst. of Canada, 570 St. John's Rd., Pointe Claire, P.Q.)

24-27. **Drugs and Cerebral Function Symp.**, 2nd annual, Denver, Colo. (M. L. Smith, Suite 1120, 2045 Franklin, Denver 80205)

24-27. **Hydrobiology**, natl. symp., Miami Beach, Fla. (J. C. Warman, Water Resources Research Inst., Auburn Univ., Auburn, Ala. 36830)

24-27. Western Soc. of **Malacologists**, 3rd annual, Stanford, Calif. (C. Skoglund, 3846 E. Highland Ave., Phoenix, Ariz. 85018)

24-1. International Symp. on **Mechanical Properties and Processes of the Mantle**, Flagstaff, Ariz. (L. R. Sykes, Columbia Univ., Palisades, N.Y. 10964)

25-27. Conference of **Immunologists**, San Diego, Calif. (W. O. Weigle, Scripps Clinic and Research Foundation, La Jolla, Calif. 92037)

25-27. **Leukocyte Culture Conf.**, 5th, Ottawa, Canada. (J. Harris, Ottawa General Hospital, Ottawa 2)

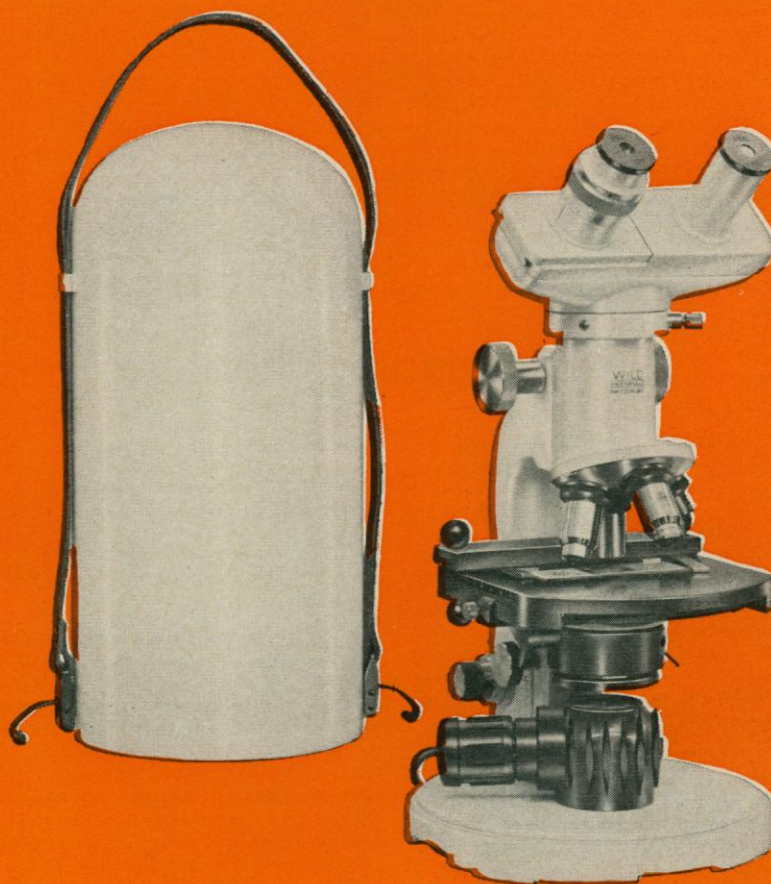
28-2. **Health Physics Soc.**, 15th annual, Chicago, Ill. (W. J. Blair, Biology Dept., Battelle Northwest, Richland, Wash. 99352)

28-4. American **Library Assoc.**, Detroit, Mich. (D. H. Clift, Executive Director, The Association, 50 E. Huron St., Chicago, Ill. 60611)

28-4. American **Optometric Assoc.**, 73rd annual congr., Honolulu, Hawaii. (G. Allen, Jr., 7000 Chippewa St., St. Louis, Mo. 63119)

29-1. **Drug Metabolism in Man**, New York, N.Y. (E. S. Vesell, Pennsylvania State Univ. College of Medicine, Hershey, Pa.)

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NEW BOOKS

(Continued from page 1609)

Quantum Mechanics. George C. Pimentel and Richard D. Spratley. Holden-Day, San Francisco, 1969. viii + 344 pp., illus. Cloth, \$8.50; paper, \$4.50.

Chromosomes Today. Vol. 2, Proceedings of a conference, Oxford, England, September 1967. C. D. Darlington and K. R. Lewis, Eds. Plenum, New York, 1969. x + 286 pp. + plates. \$15. A Supplement to *Heredity*, vol. 24, 1969.

Comprehensive Biochemistry. Marcel Florkin and Elmer H. Stotz, Eds. Vol. 17, Carbohydrate Metabolism. Elsevier, New York, 1969. xvi + 308 pp., illus. \$17.

Developments in the Structural Chemistry of Alloy Phases. Based on a symposium, Cleveland, October 1967. B. C. Gies-sen, Ed. Plenum, New York, 1969. x + 292 pp., illus. \$12.50. A publication of the Metallurgical Society of AIME.

Electronic Circuits for the Behavioral and Biomedical Sciences. A Reference Book of Useful Solid-State Circuits. Mitchell H. Zucker. Freeman, San Francisco, 1969. xii + 244 pp., illus. \$9.75.

Elementary Quantitative Chemistry. Es-march S. Gilreath. Freeman, San Fran-cisco, 1969. viii + 224 pp., illus. Paper, \$3.75.

Environmental Design. Richard P. Dober. Van Nostrand Reinhold, New York, 1969. x + 278 pp., illus. \$18.50.

Evolution and Comparative Morphology of the Lymphatic System. Otto Frederic Kampmeier. Thomas, Springfield, Ill., 1969. xiv + 622 pp., illus. \$29.50.

Excursions in Geometry. C. Stanley Ogilvy. Oxford University Press, New York, 1969. viii + 184 pp., illus. \$6.

Flights into Yesterday. The Story of Aerial Archaeology. Leo Duell. St. Mar-tin's, New York, 1969. xx + 332 pp. + plates. \$8.95.

Francis Bacon. Pioneer of Planned Sci-ence. Benjamin Farrington. Praeger, New York, 1969. vi + 122 pp., illus. \$4.25. Praeger Pathfinder Biographies.

A Geography of Population: World Pat-terns. Glenn T. Trewartha. Wiley, New York, 1969. vi + 186 pp., illus. Cloth, \$6.95; paper, \$3.95.

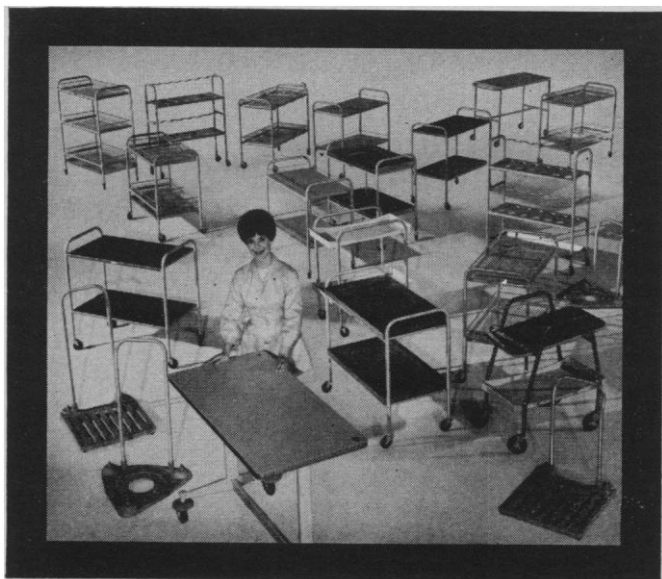
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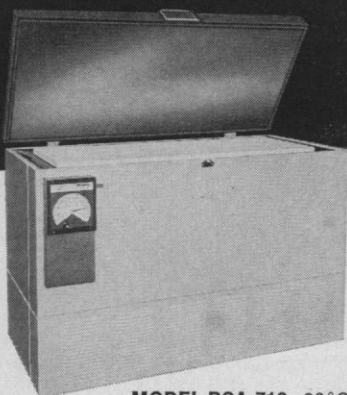
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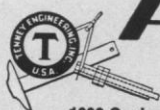


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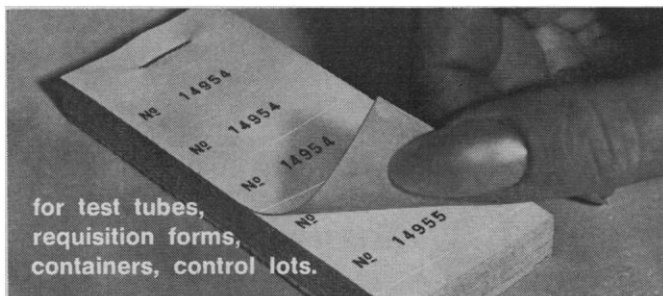
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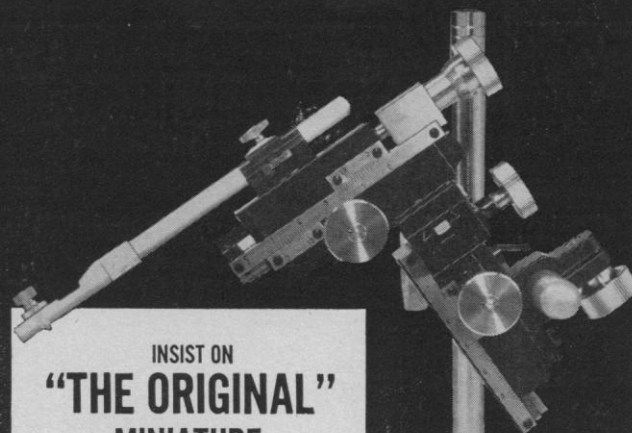


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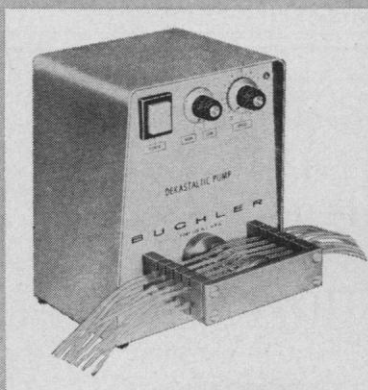
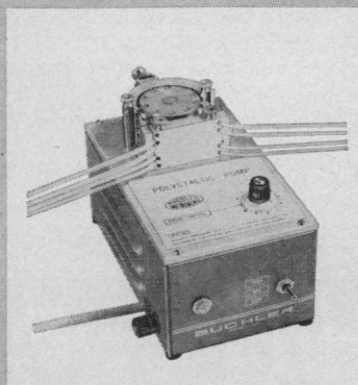
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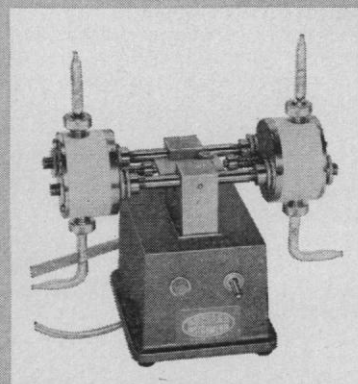


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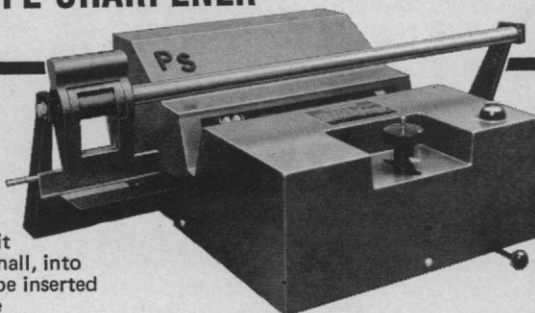
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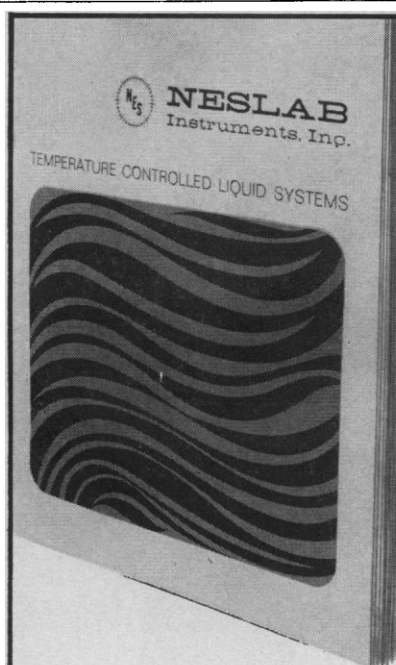
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