

SCIENCE

12 April 1963

Vol. 140, No. 3563

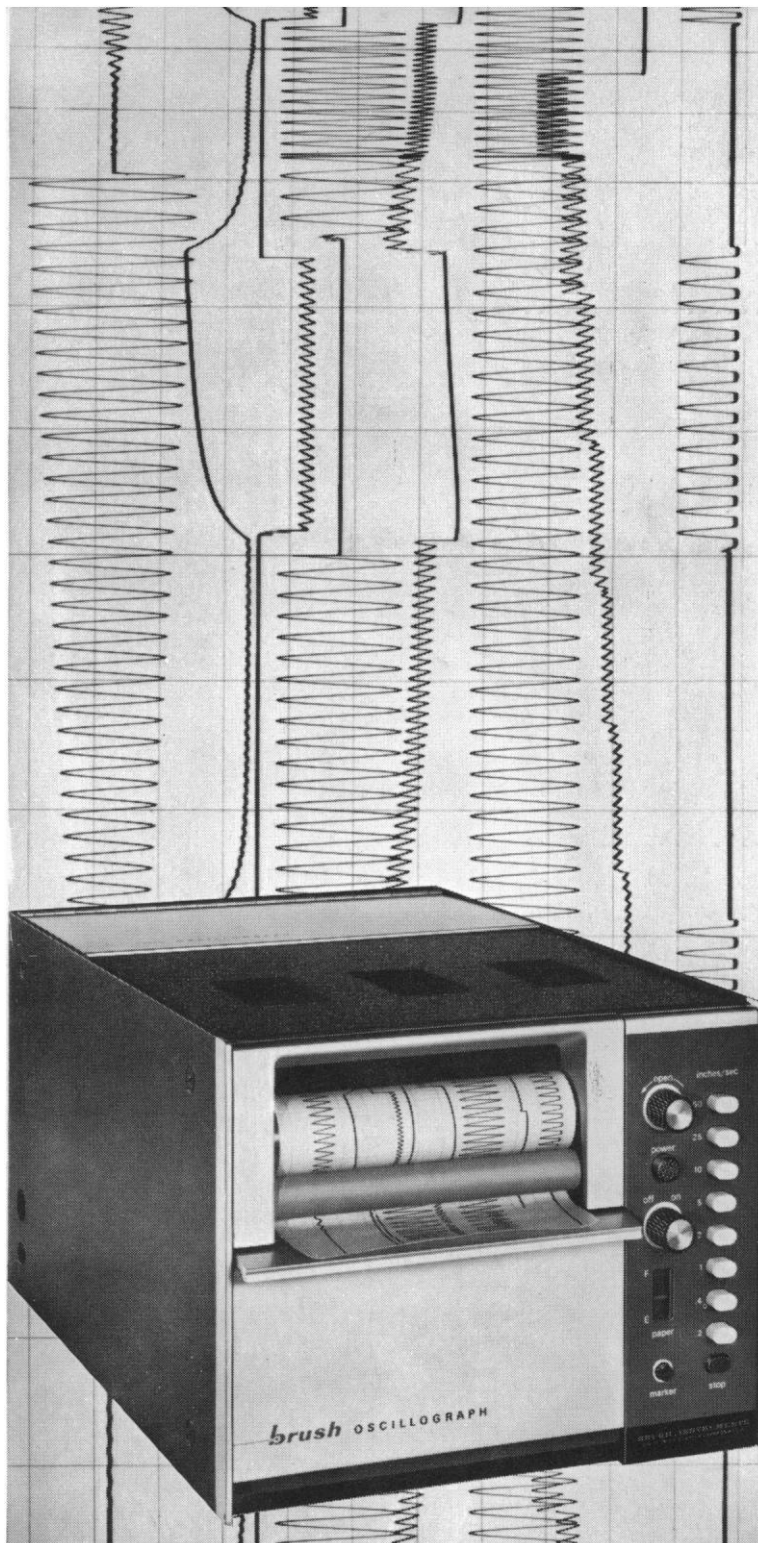
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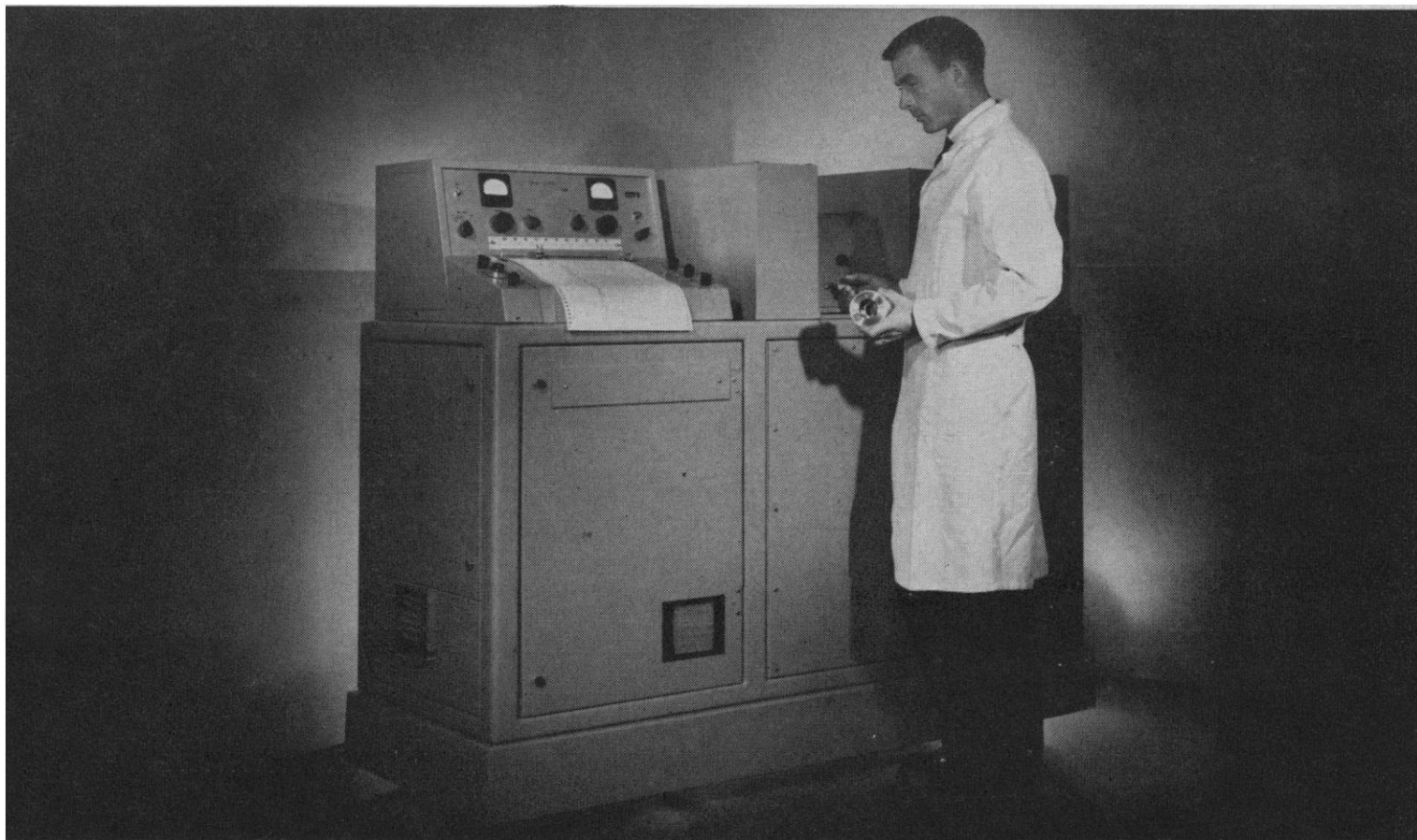
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COVER

The veined gneiss-migmatite shown in the photograph is partially melted and metamorphosed graywacke, originally deposited in a Grenville geosyncline over 1.2 billion years ago. Associated sediments were thick carbonate beds, quartz-rich sandstones, and shales. The entire sedimentary pile has been complexly folded and depressed deeply into the crust. During this orogenic epoch the graywacke was heated to some 600°C, pervasively recrystallized, and partially melted. The partial melt now appears as the light-colored veins, intimately interlayered with the remains of the graywacke sediment. Subsequent rise of the Grenville mountains and deep erosion have exposed rocks of this geosynclinal orogenic epoch. See page 143.

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A mixture of Krypton-85 in air was introduced into the pipe. A portable geiger counter was carried on the ground above the top of the pipe. The difference in radiation indicating where the pipe was blocked became obvious. The crews dug through the ground, opened the pipe, recovered their brush and sealed up the pipe.

Medical Tracing

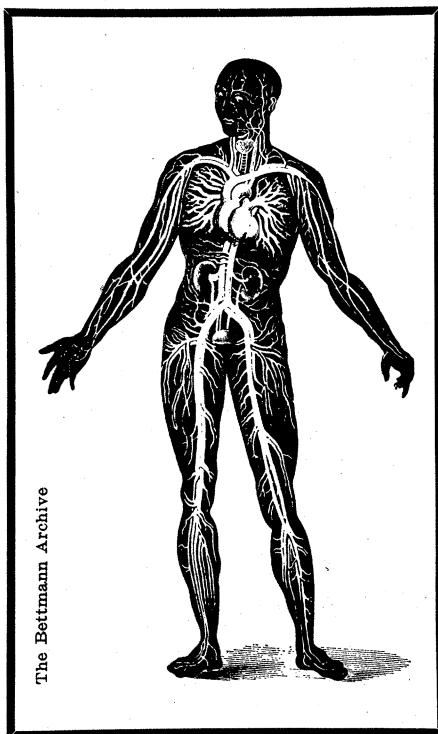
Krypton-85 is principally used in mixtures for tracing operations. Matheson supplies these mixtures in various concentrations, and hundreds of uses suggest themselves. Among the most important are medical uses, to trace blood flow into the cells of the brain, or to determine if a malfunctioning heart has a defective valve.

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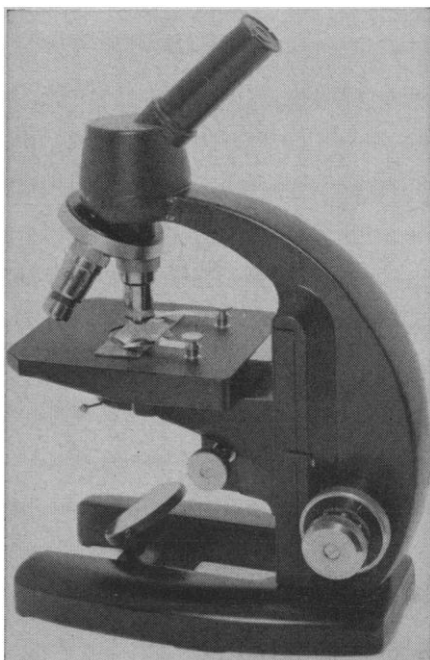
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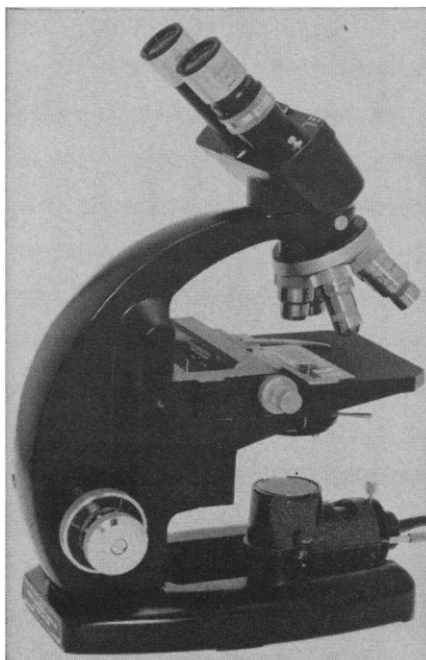
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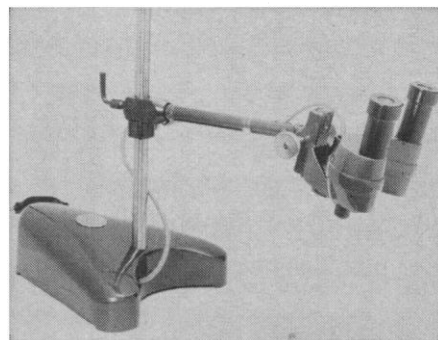


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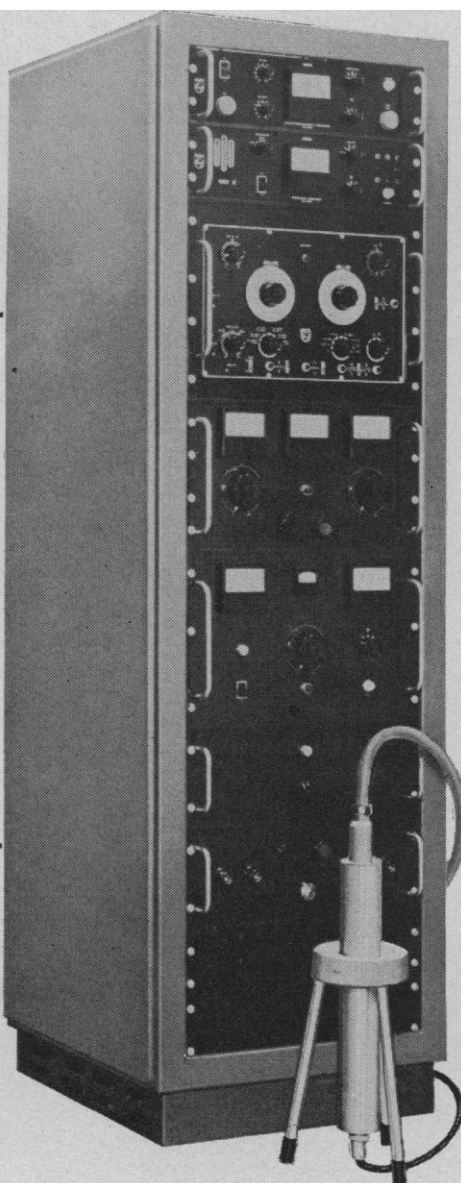
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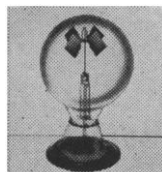
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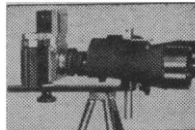


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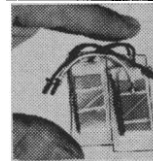
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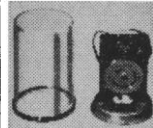
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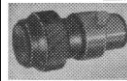
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Current Accuracy: 1/10%

Voltage Accuracy: 1/4%

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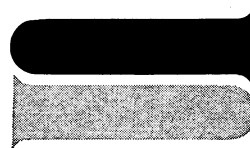
Dimensions: 23 x 17 x 10 inches.

Net Weight: 65 pounds.

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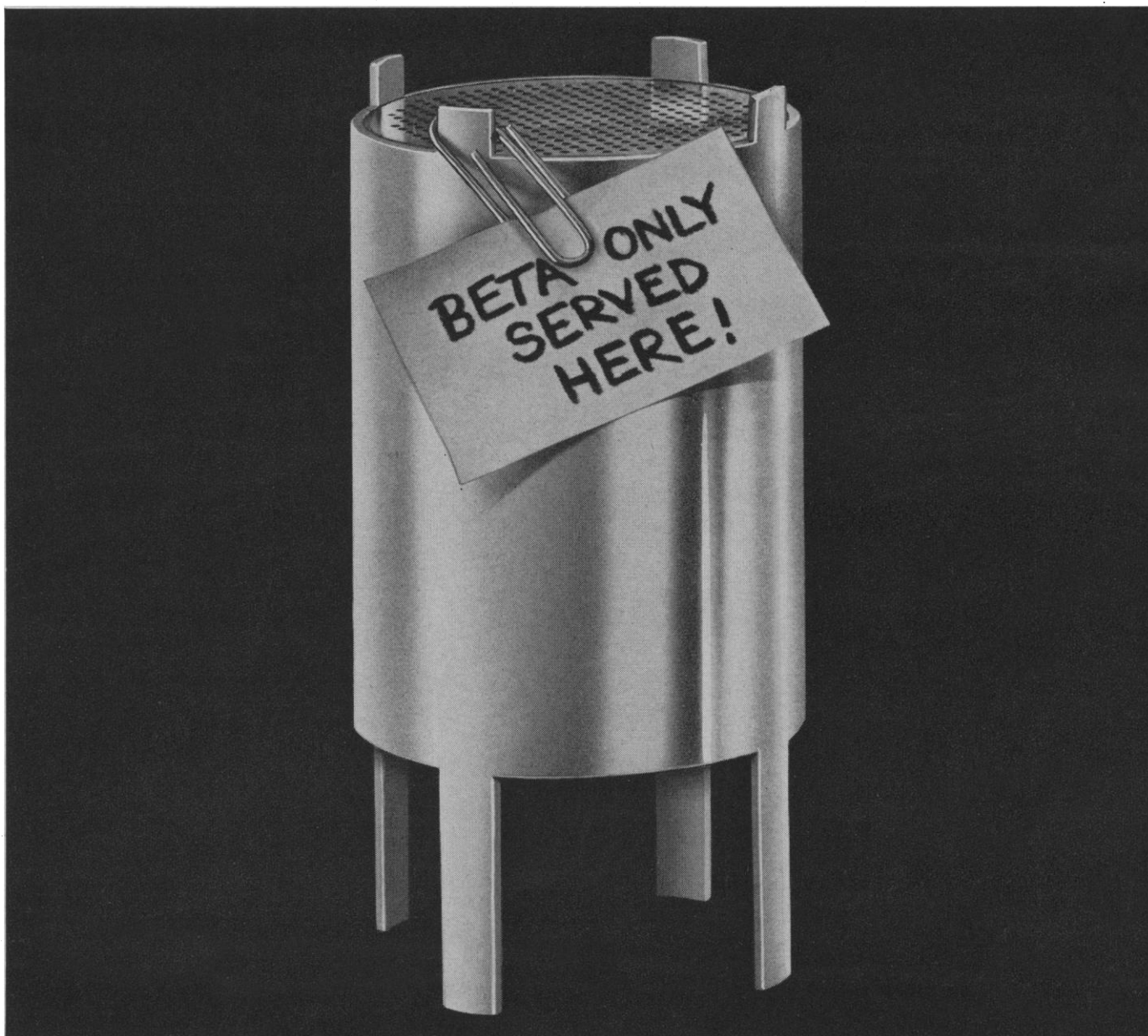
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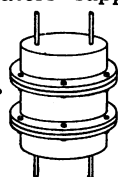
New lab irradiator offers 1000 times the dose rate of Co-60 sources—lasts longer, costs and weighs less!

A tower of beta strength, this new Sr-90 irradiator from 3M Nuclear—created for research into catalytic and other radiation effects on chemical systems. The greater ionizing power of its beta radiation provides 1000 times higher dose rates within a sample than do gamma rays emitted by an equal-strength Co-60 source. The 3M Irradiator may be used with gases, liquids and slurries—produces 10^6 rads per hour from 100 curies of Sr-90 caged in 3M Brand Microspheres.

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Heart of the new irradiator is 3M Microspheres. They cage Sr-90 in tiny ceramic particles that are chemically inert, resistant to heat as high as 2200°F! If an irradiator tube should rupture, the Microspheres can be easily recovered intact, without contamination of the sample. Irradiator core (shown above) is constructed of Inconel X. Other metals, configurations available to meet most tem-

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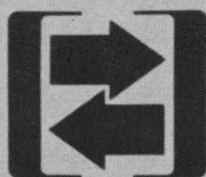
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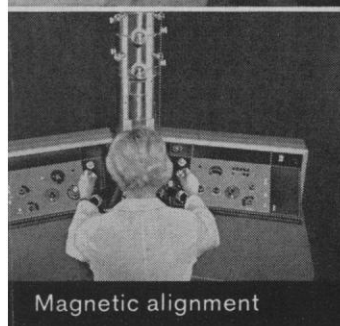
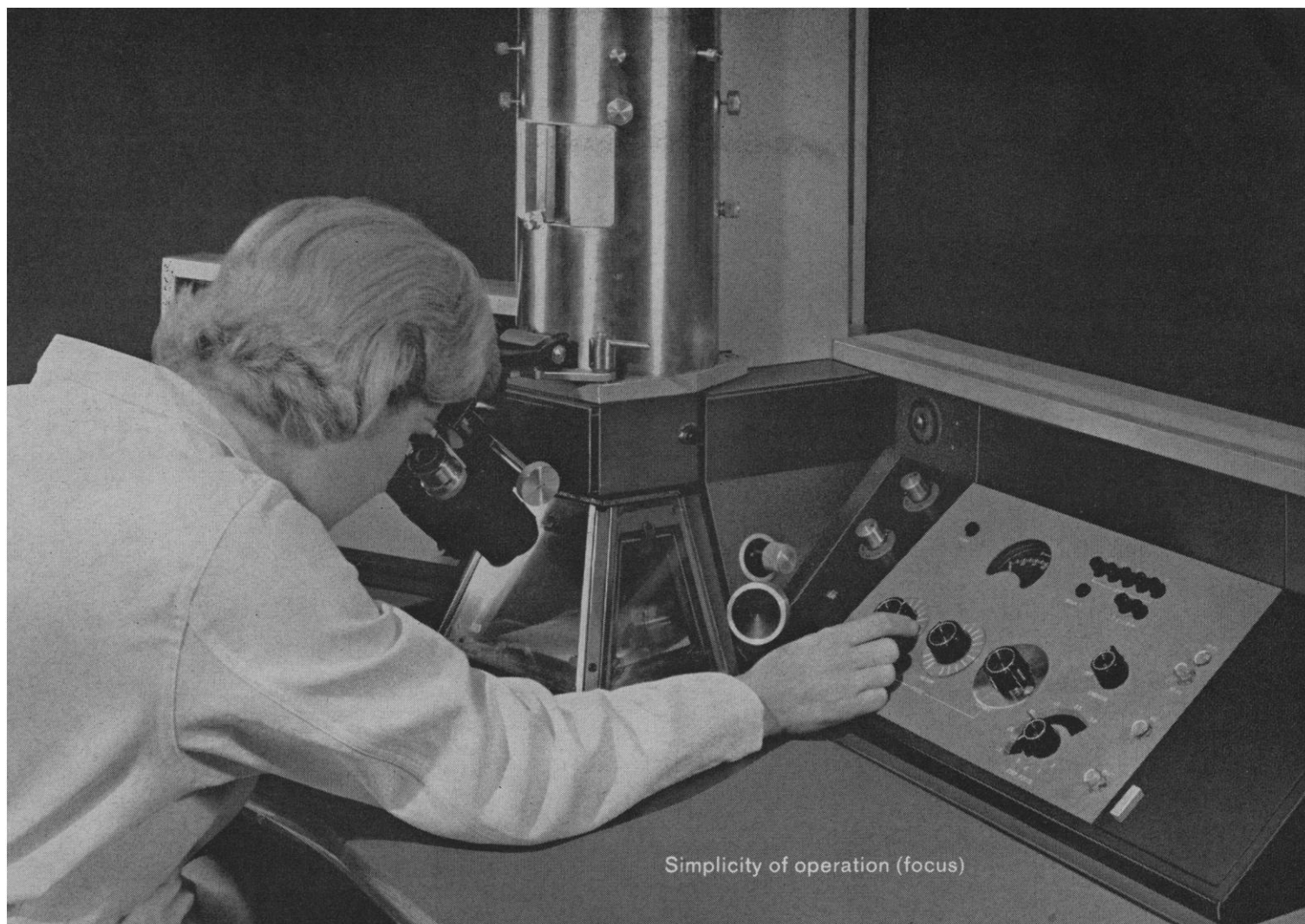
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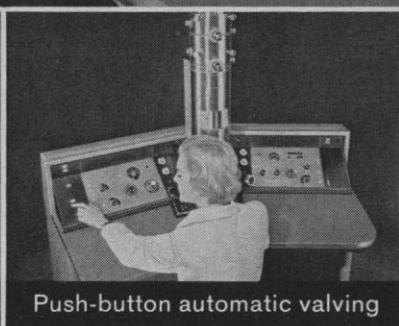
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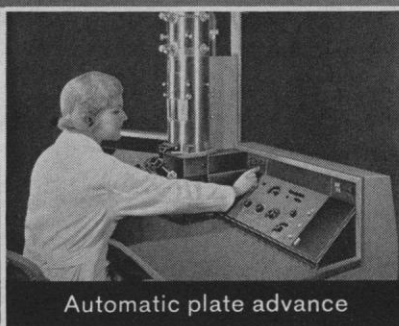
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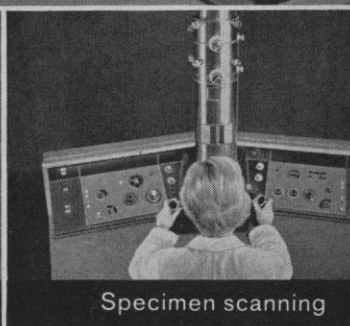
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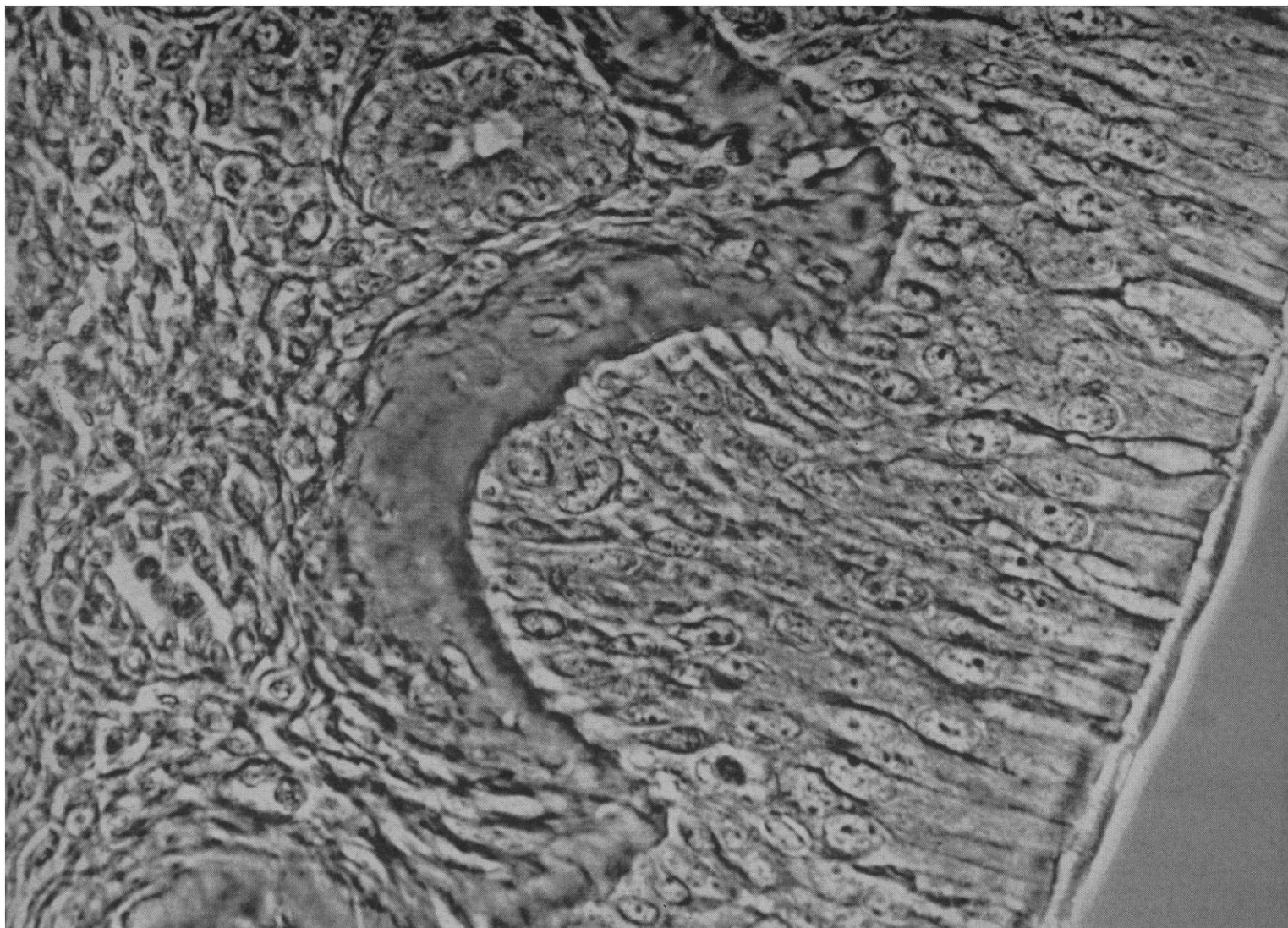
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Phase contrast photomicrograph: unstained section of respiratory epithelium, nasal concha

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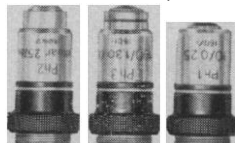
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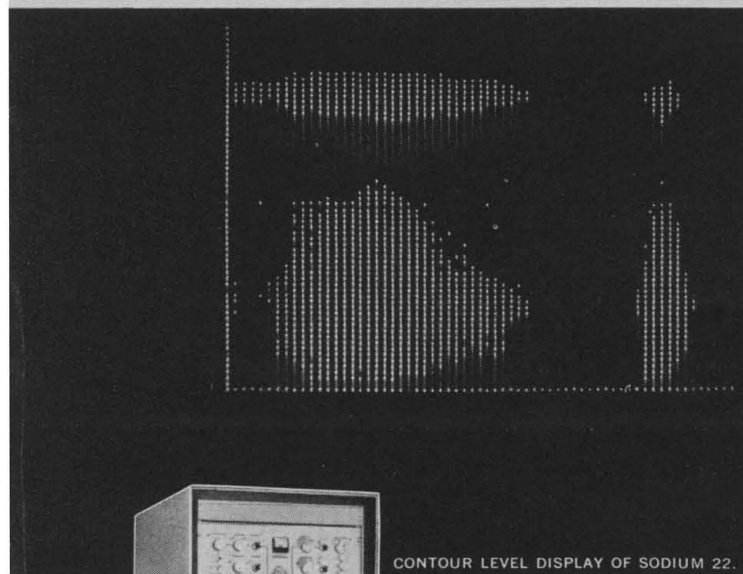
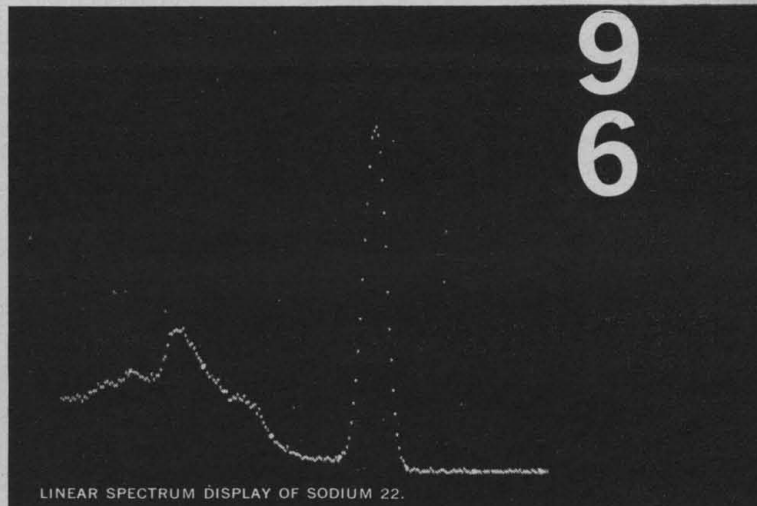
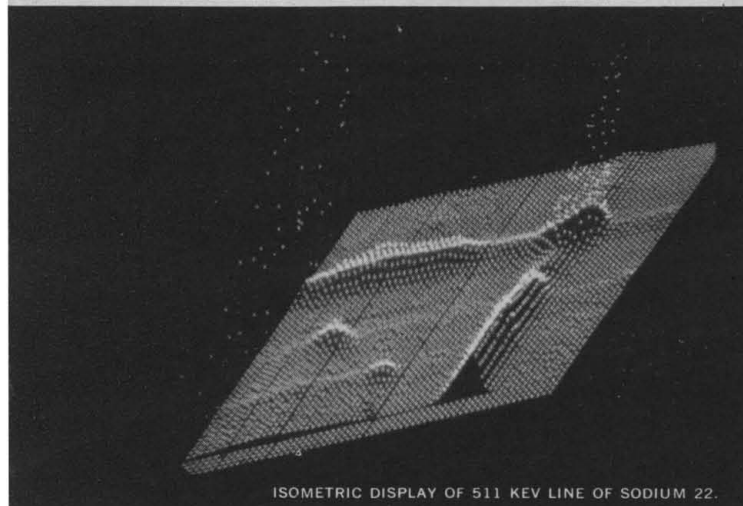
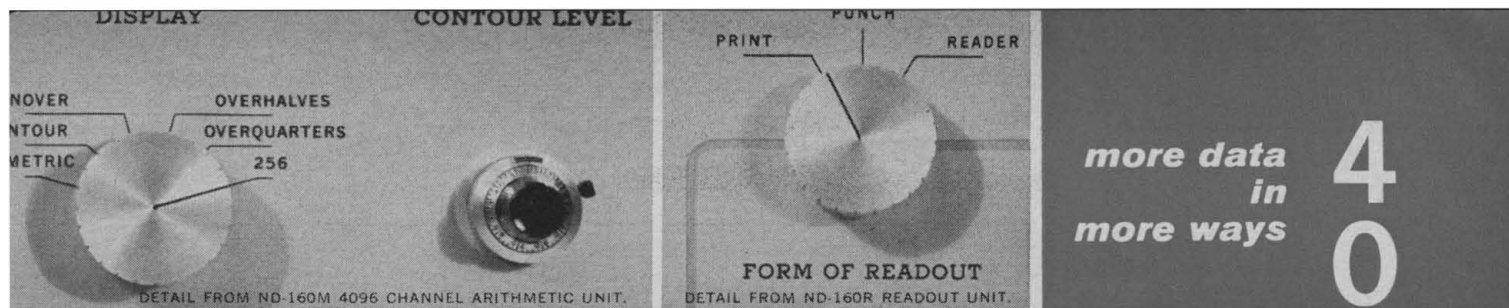


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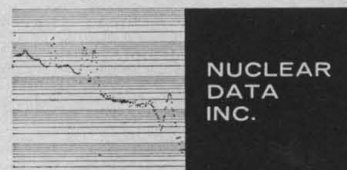
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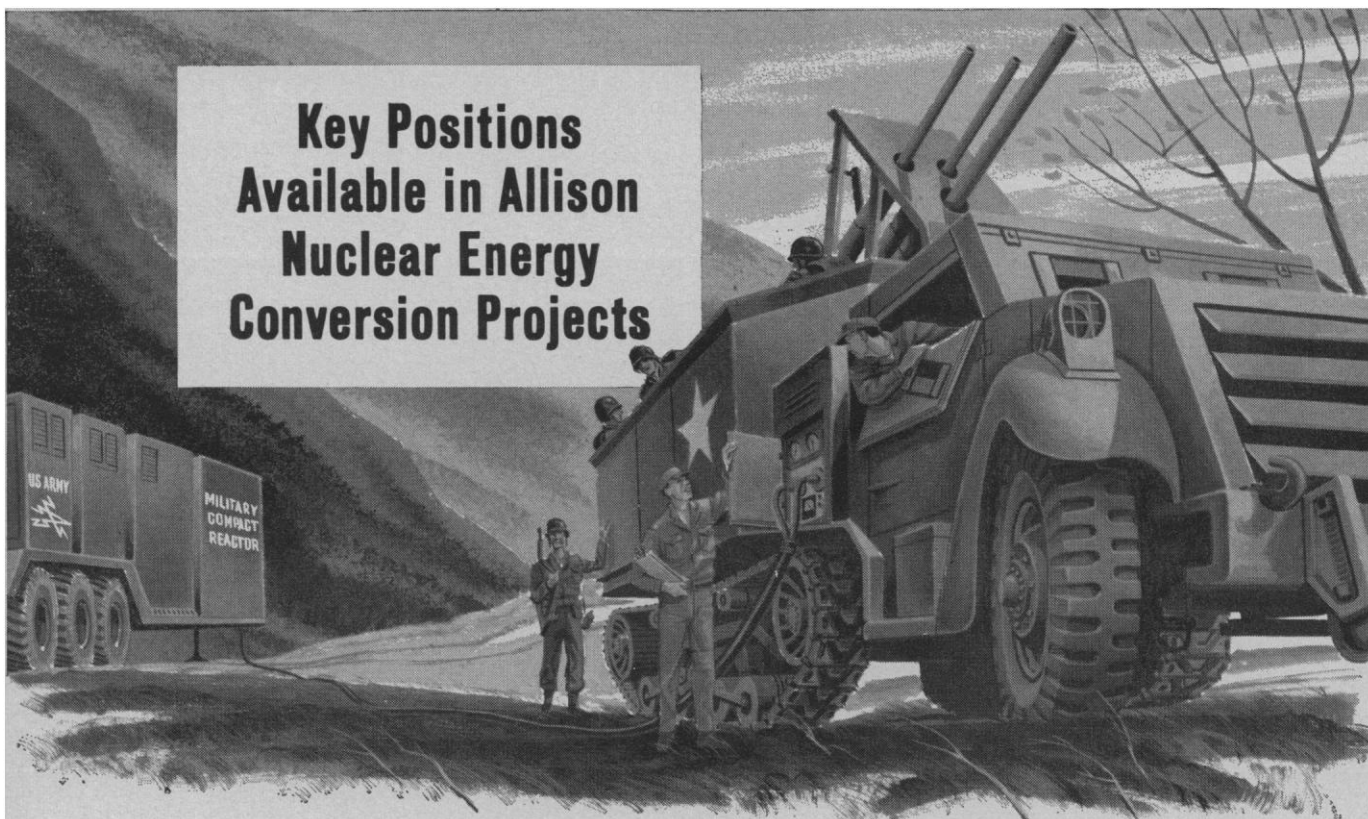
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Linde Cryobiology NEWS

REPORT NO. 3 FROM LINDE COMPANY, DIVISION OF UNION CARBIDE CORPORATION

New preservation techniques using liquid nitrogen

Notes on...preserving human erythrocytes and leucocytes... plans for establishing tumor and tissue banks for cancer research...new cryobiology equipment.

Some interesting new developments have been reported on the use of liquid nitrogen to preserve biological materials. In the storage of human erythrocytes, it was found that "the original hemagglutinating activity of the cell was retained 100% after storage frozen in liquid nitrogen for two years". . . Blood samples frozen and stored in liquid nitrogen yielded excellent recoveries with little evidence of hemolysis.⁽¹⁾

Another research team concluded from their data that . . . "major red cell antigens retain full reactivity when stored in a liquid nitrogen refrigerator for six months." They found that a panel of cells preserved in liquid nitrogen was as satisfactory as fresh cells in defining irregular antibodies encountered in patient sera. Compared to other techniques, erythrocytes frozen and stored in liquid nitrogen had the important advantage of being immediately available for use upon thawing.⁽²⁾

RESEARCH AT LINDE

Linde Company is actively investigating several key areas of cryobiology. Cooperative research is being conducted with Roswell Park Memorial Institute on preserving human chronic lymphocytic leukemic leucocytes in liquid nitrogen. Results of these studies indicate that the use of liquid nitrogen preserved leucocytes for routine clinical testing is feasible.⁽³⁾

LINDE is also assisting Roswell Park Memorial Institute in setting up a tumor bank which will enable scientists to use original specimens at any time in the future. Such tumor and tissue banks will permit researchers to work on the original specimen now, or ten or more years hence.

In chromatographic or electrophoretic separation techniques, LINDE scientists have used liquid nitrogen to maintain stability of biologic materials sensitive to oxygen. In purifying the enzyme, nitrate reductase, they found that freezing the material

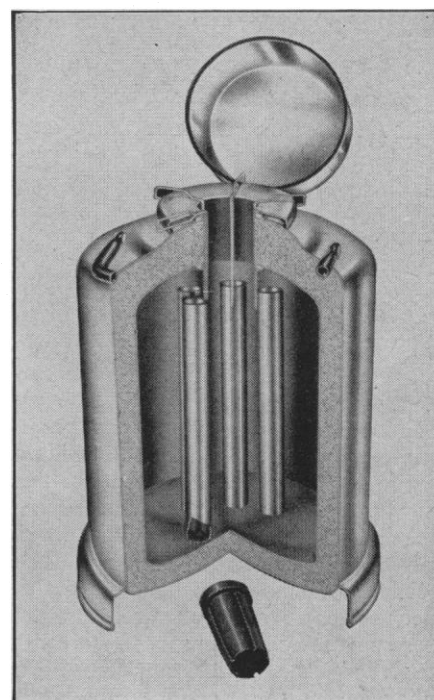
soon after collection, followed by storing in a gaseous nitrogen atmosphere at temperatures below -100°C ., protected its enzymic activity.⁽⁴⁾

NEW EQUIPMENT FROM LINDE

LINDE has developed the most complete assortment of quality cryogenic equipment. Among these are liquid nitrogen refrigerators, controlled rate freezers, special canister conversion kits for 25- and 10-liter liquefied gas containers, low-loss plastic-handled canisters, and an automatic liquid nitrogen level safeguard. Two recent additions in its line of cryogenic equipment are the LR-10-5 and LR-250 Liquid Nitrogen Refrigerators.

The LR-10-5 is a fully portable liquid nitrogen refrigerator designed for the shipment and storage of small quantities of biological materials safely and economically. When fully charged with 10 liters of liquid nitrogen, it weighs only 31 lb. The refrigerator holds 120 ampules of product in 5 easily accessible canisters at a constant temperature of -196°C . LINDE's patented Super Insulation keeps the liquid nitrogen consumption extremely low—0.55 liters per day (max.) with canisters inserted, pro-

(1) Gibbs, M. B., McCord, E. B., Collins, W. S. II, Schrider, C. T. Jr., and Akeroyd, J. H., *TRANSFUSION*, 2:100 (1962). (2) Bronson, W. R., and McGinnis, M. H., *BLOOD*, 20:478 (1962). (3) Cohen, E., and Rowe, A. W., *BLOOD*, (in press). (4) Schreiner, H. R., *J. Chromatog.*, 7:573 (1962).



LR-10-5: A fully portable liquid nitrogen refrigerator.

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- ☐ Reprint: "Chromatography of Unstable Materials of Biological Origin" by H. R. Schreiner⁽⁴⁾
- ☐ Report: "The Preservation of Biological Materials with Liquid Nitrogen," F-1270
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Careful revisions have been made in this exceptional text . . . heightening its value as prime source for the student on the first-year level. The regional organization of the text parallels closely the procedure followed in the majority of laboratory courses. The flow of text follows the natural main subdivisions of the body (Thorax, Upper Limb, Head and Neck, etc.). Each section contains all the material pertinent to the specific body area covered. Systemic considerations have not been excluded; the initial portion of the book covers such topics as the skeleton, the nervous system, development and growth. The most recent advances in knowledge of functional anatomy are included, while surface anatomy and radiographic anatomy are beautifully covered in word and picture. The authors stress living anatomy rather than anatomy of the cadaver, and they emphasize the interrelationship of structure and function. More than 200 illustrations have been revised or replaced for this *New (2nd) Edition*, each selected for clarity in demonstrating highlights.

By ERNEST GARDNER, M.D., Wayne State University; DONALD J. GRAY, Ph.D., Stanford University; and RONAN O'RAHILLY, M.Sc., M.D., St. Louis University. About 1072 pages, 7" x 10", with about 762 illustrations. About \$20.00.
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ATLAS of HUMAN ANATOMY—Anson

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Based on original dissections, presented regionally, this book contains many illustrations in serial sets . . . demonstrating progressively deeper dissections. New in this revision, orienting illustrations precede each section, helping you locate anatomical areas under discussion. Special tables of contents at the head of each section facilitate location of specific illustrations within that section.

By BARRY J. ANSON, Ph.D. (Med. Sc.) Robert Laughlin Rea Professor, Emeritus, Department of Anatomy, Northwestern University Medical School; Research Professor, Department of Otolaryngology and Maxillo-facial Surgery, College of Medicine, State University of Iowa. 632 pages, 7 $\frac{1}{4}$ " x 10 $\frac{3}{4}$ ", with about 1300 illustrations on about 600 figures. \$18.00
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A New Book

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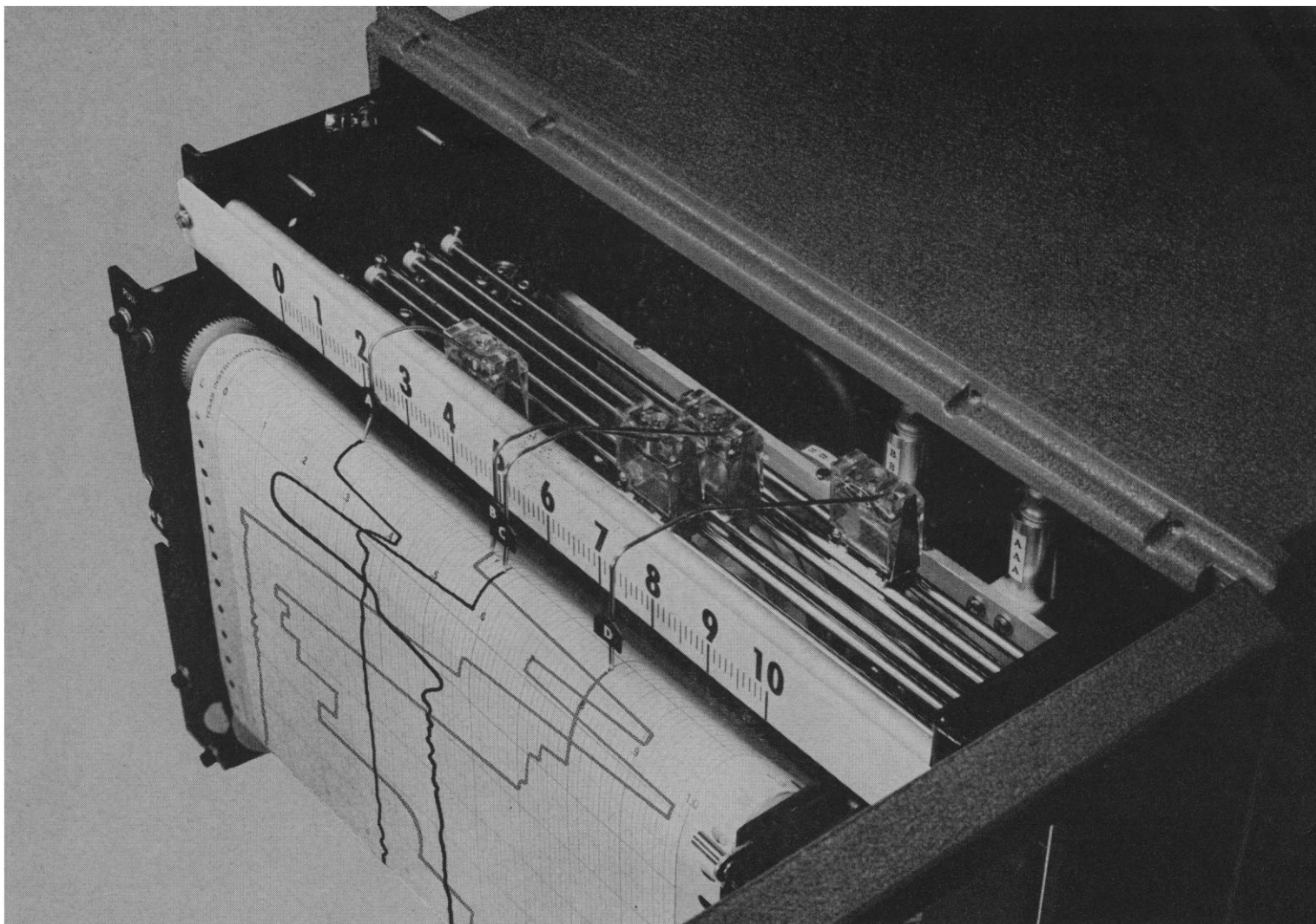
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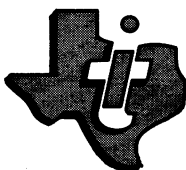
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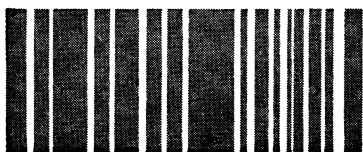
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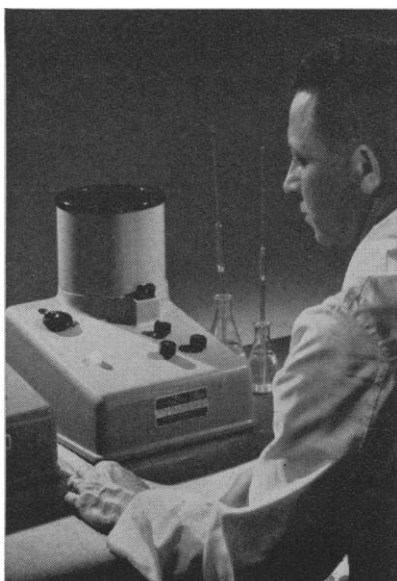
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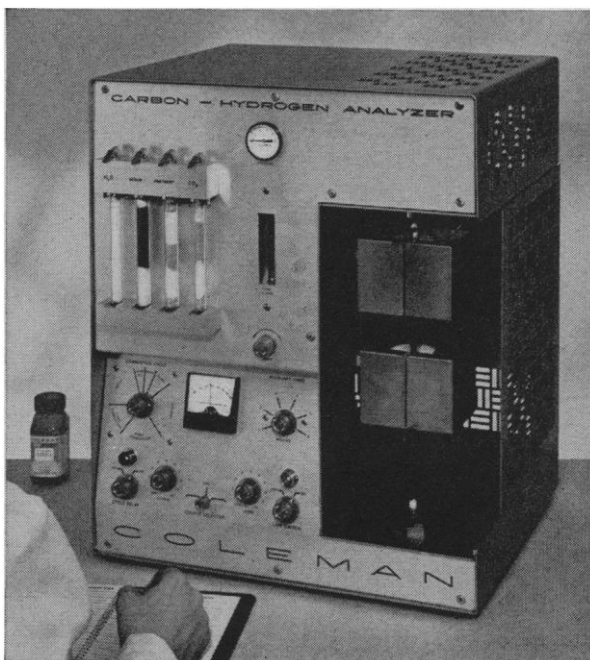
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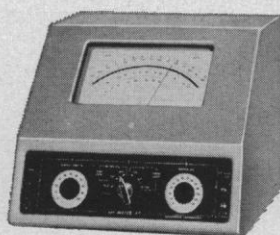
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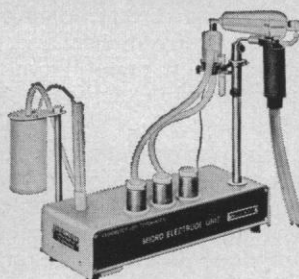
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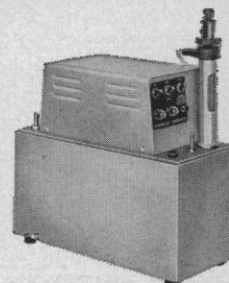
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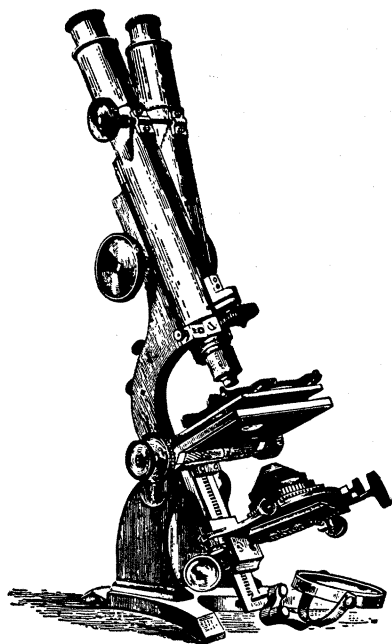


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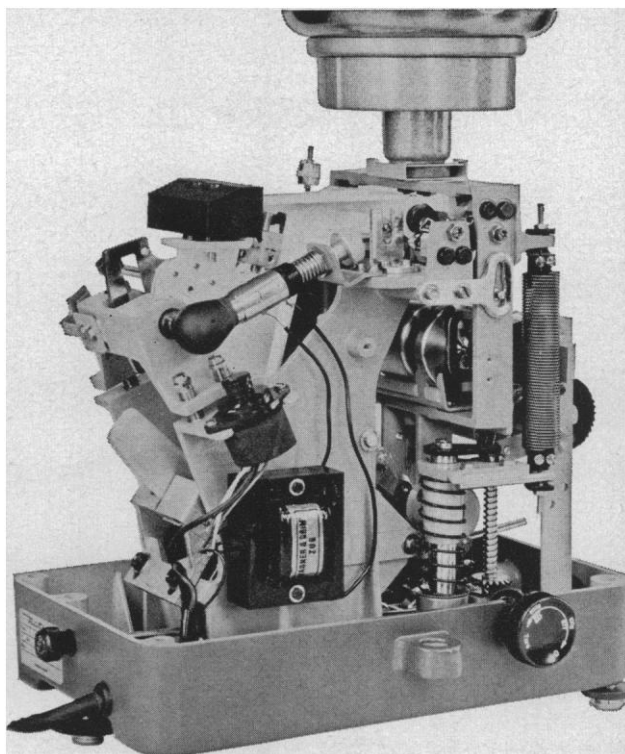
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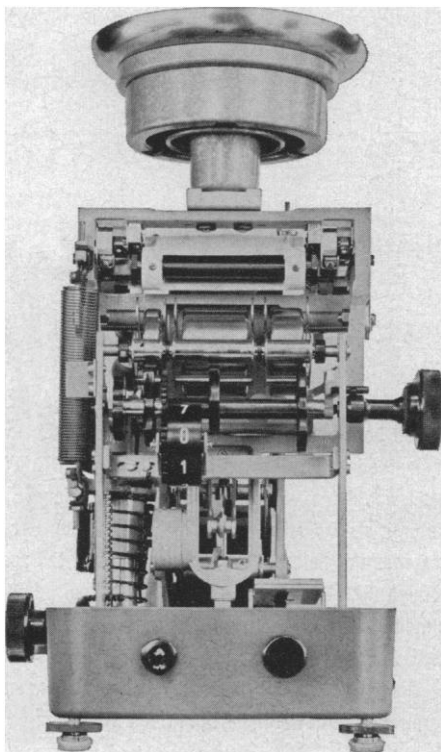
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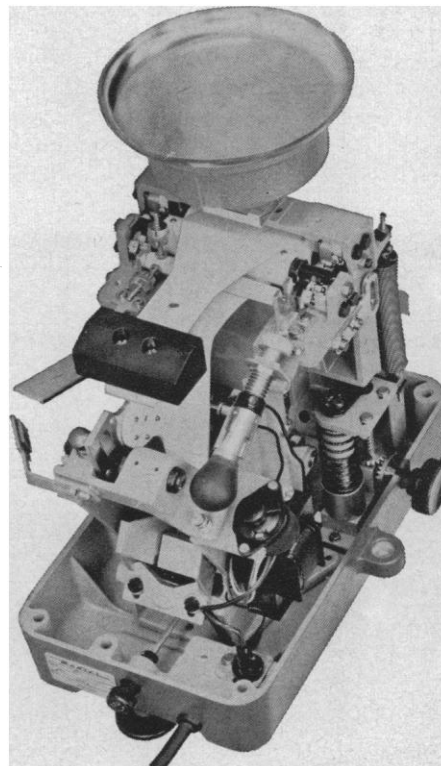
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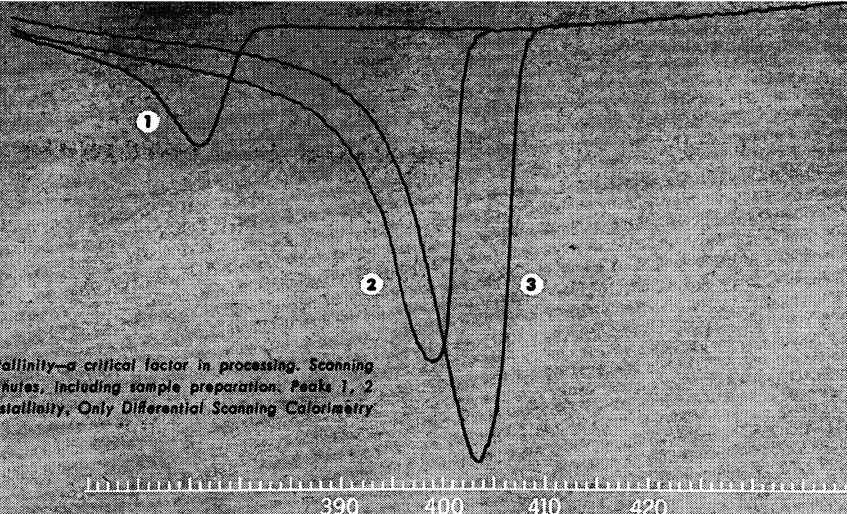
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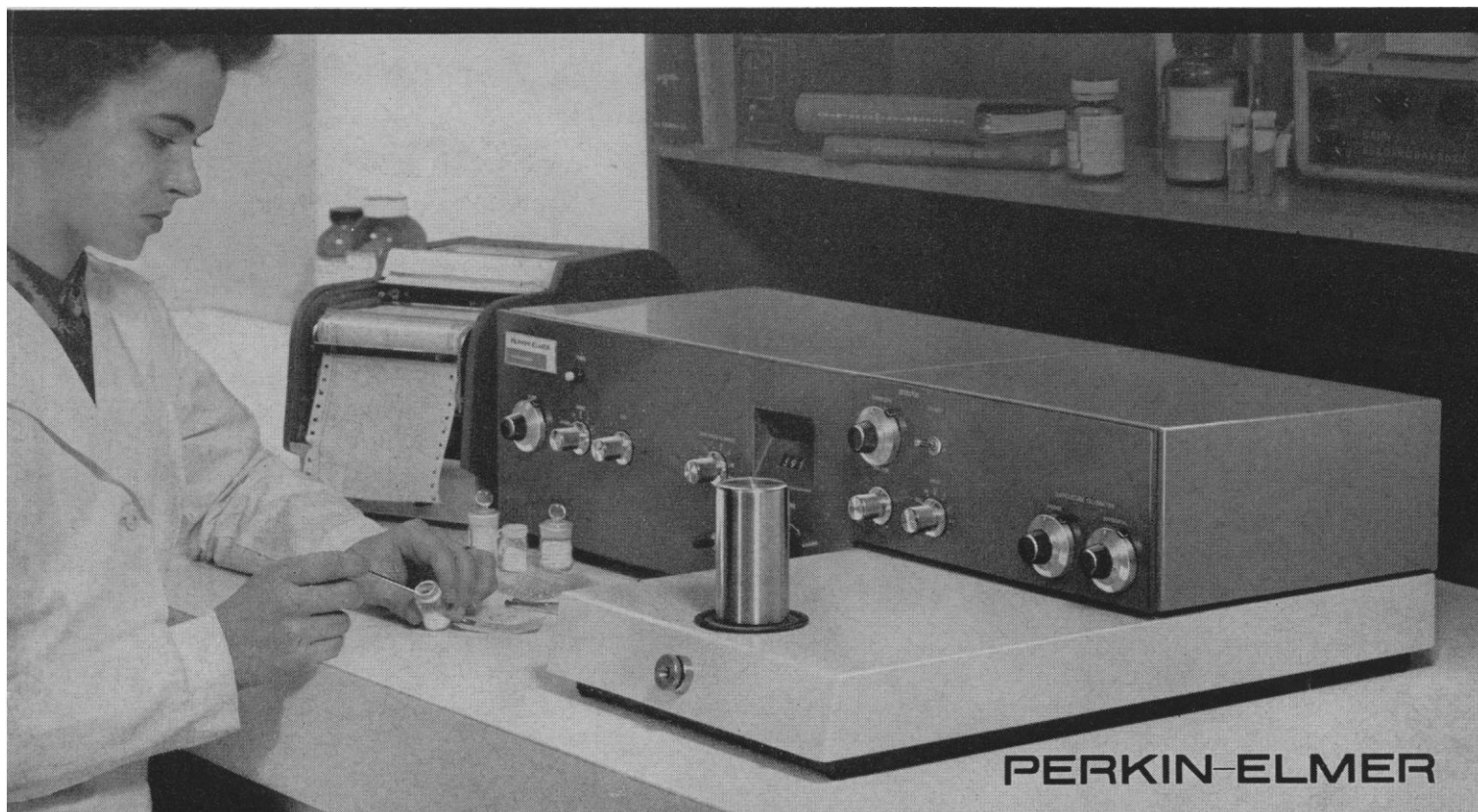
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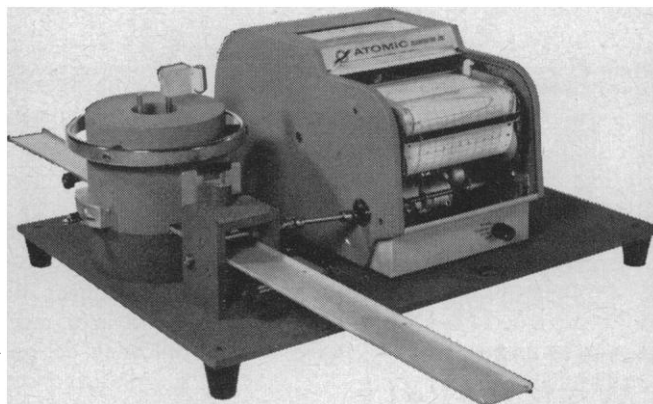
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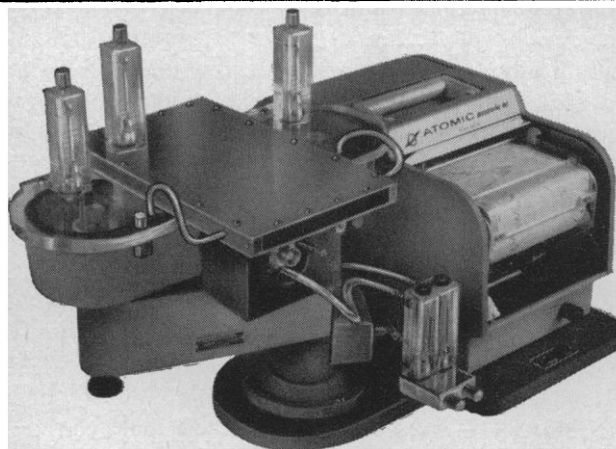
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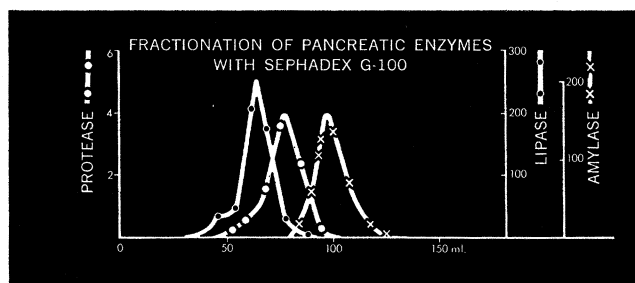
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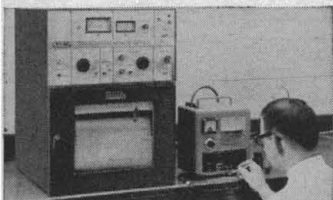
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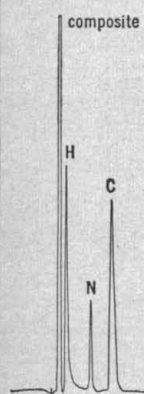
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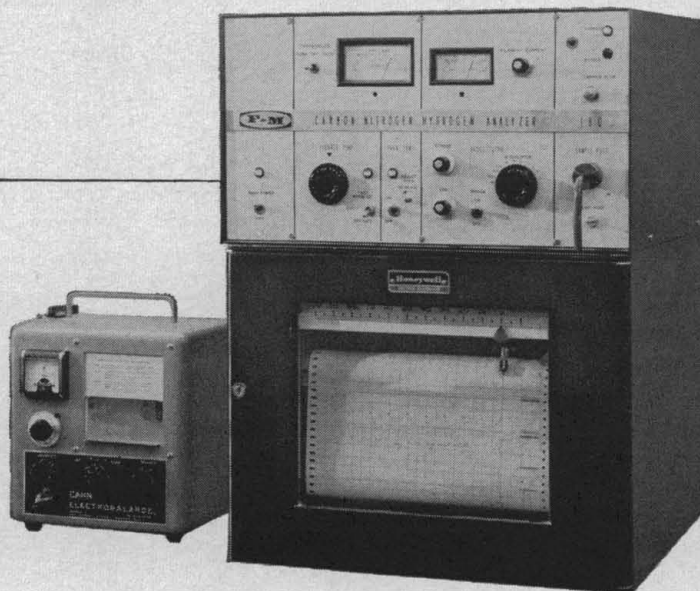
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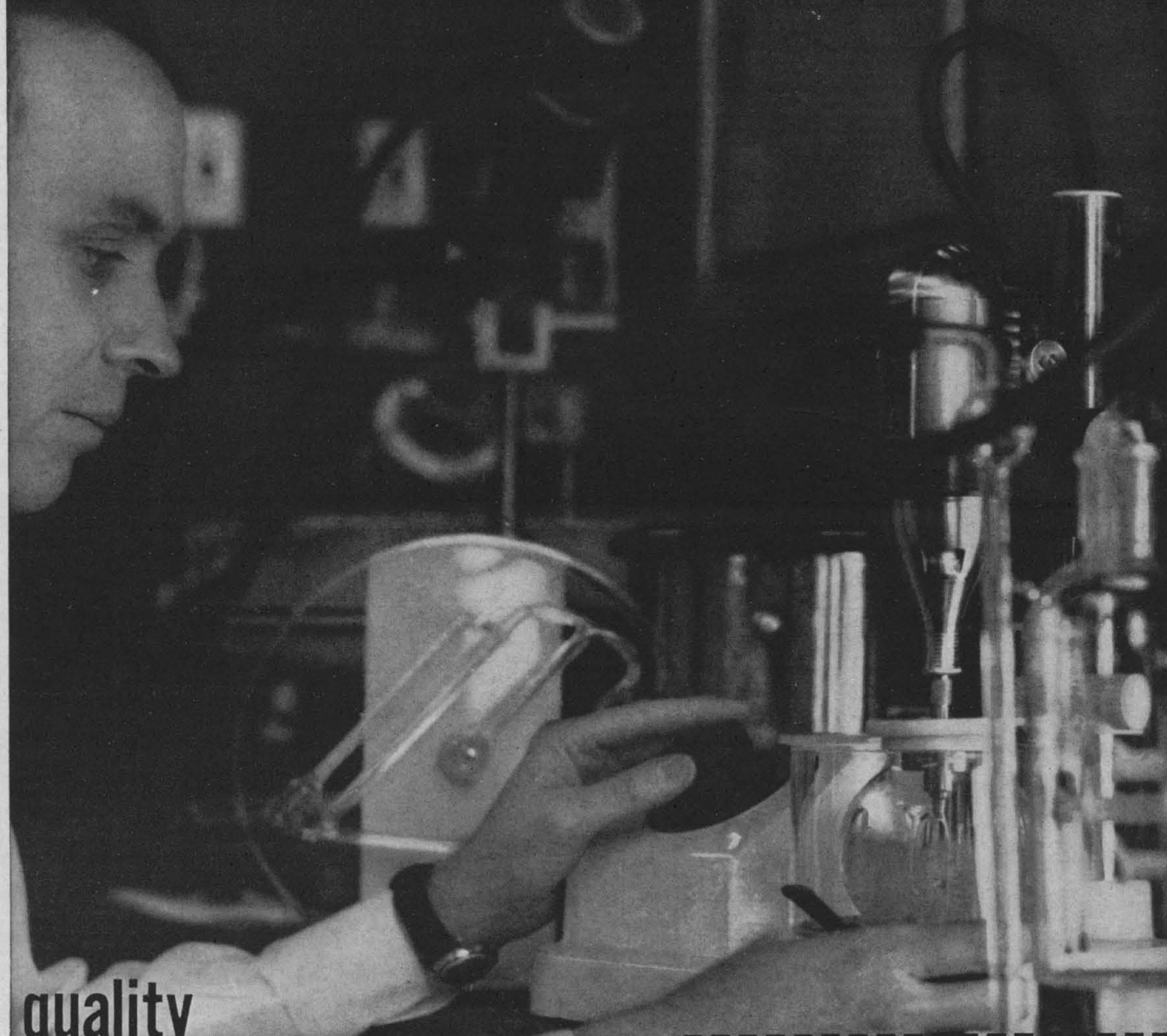
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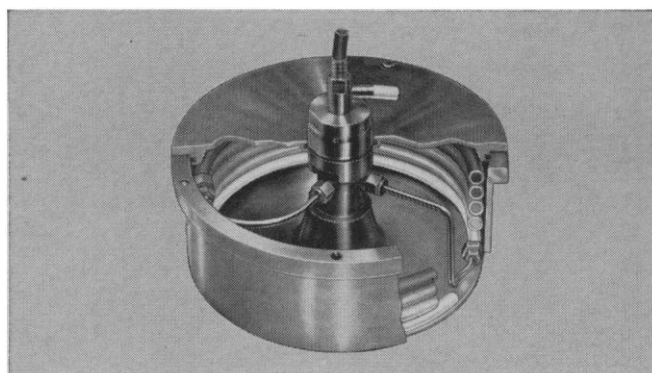
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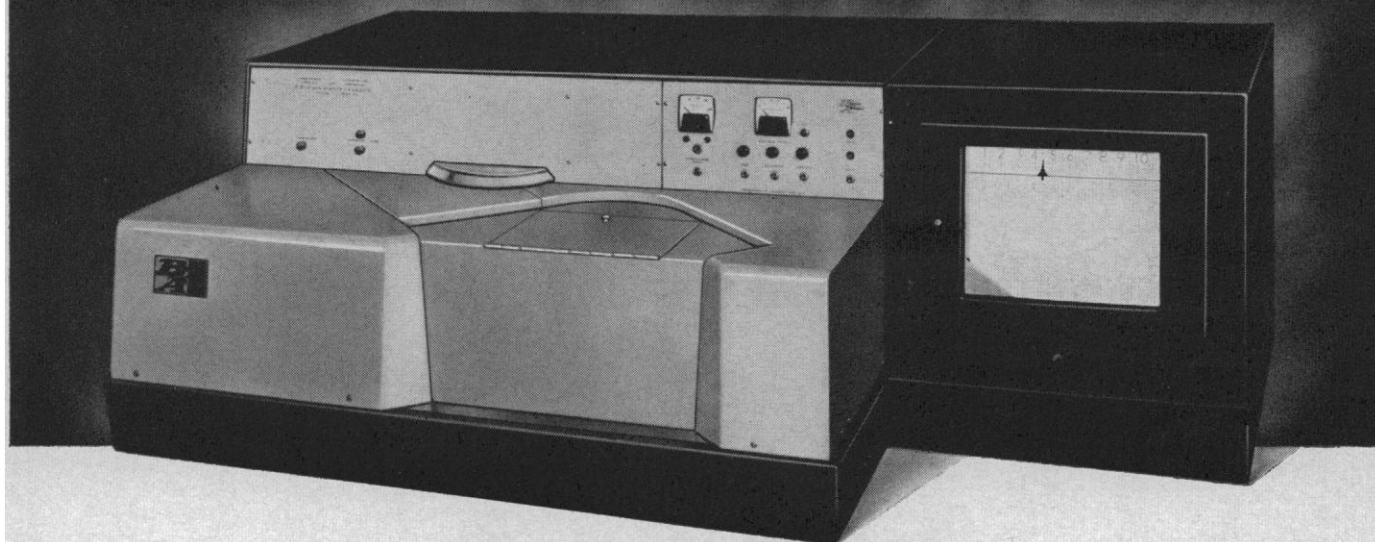
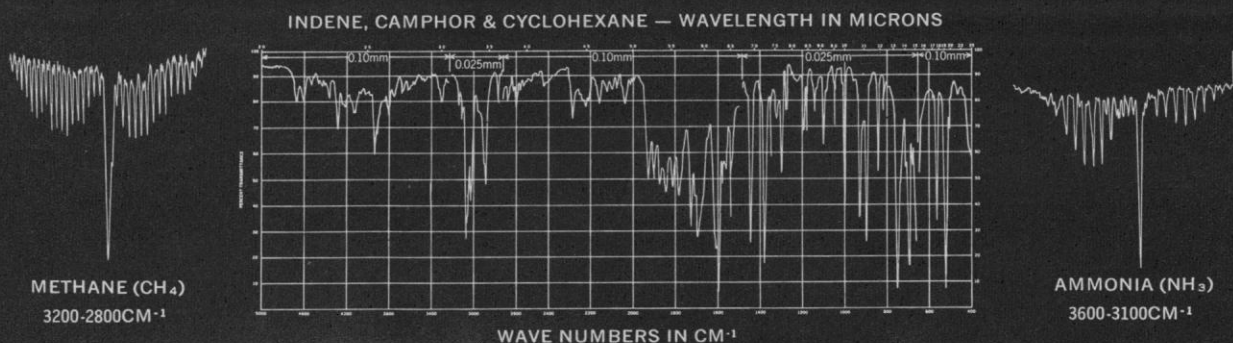
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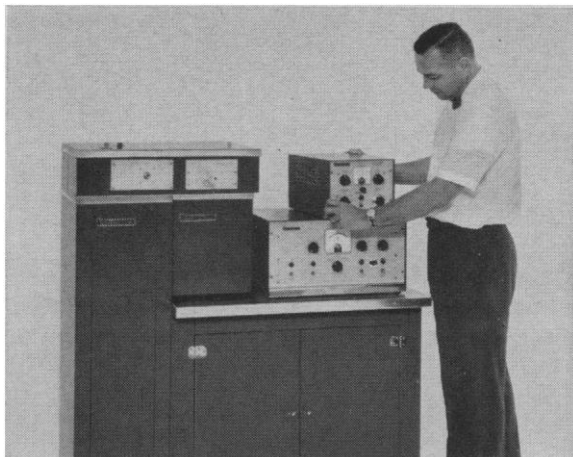
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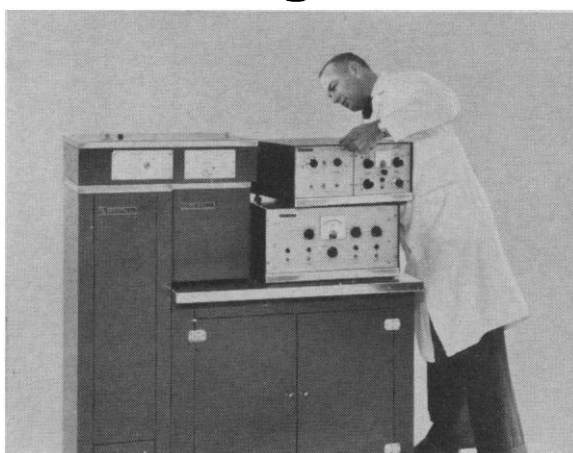
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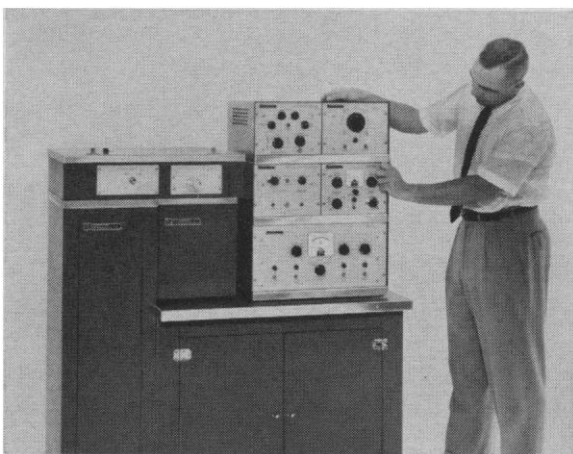
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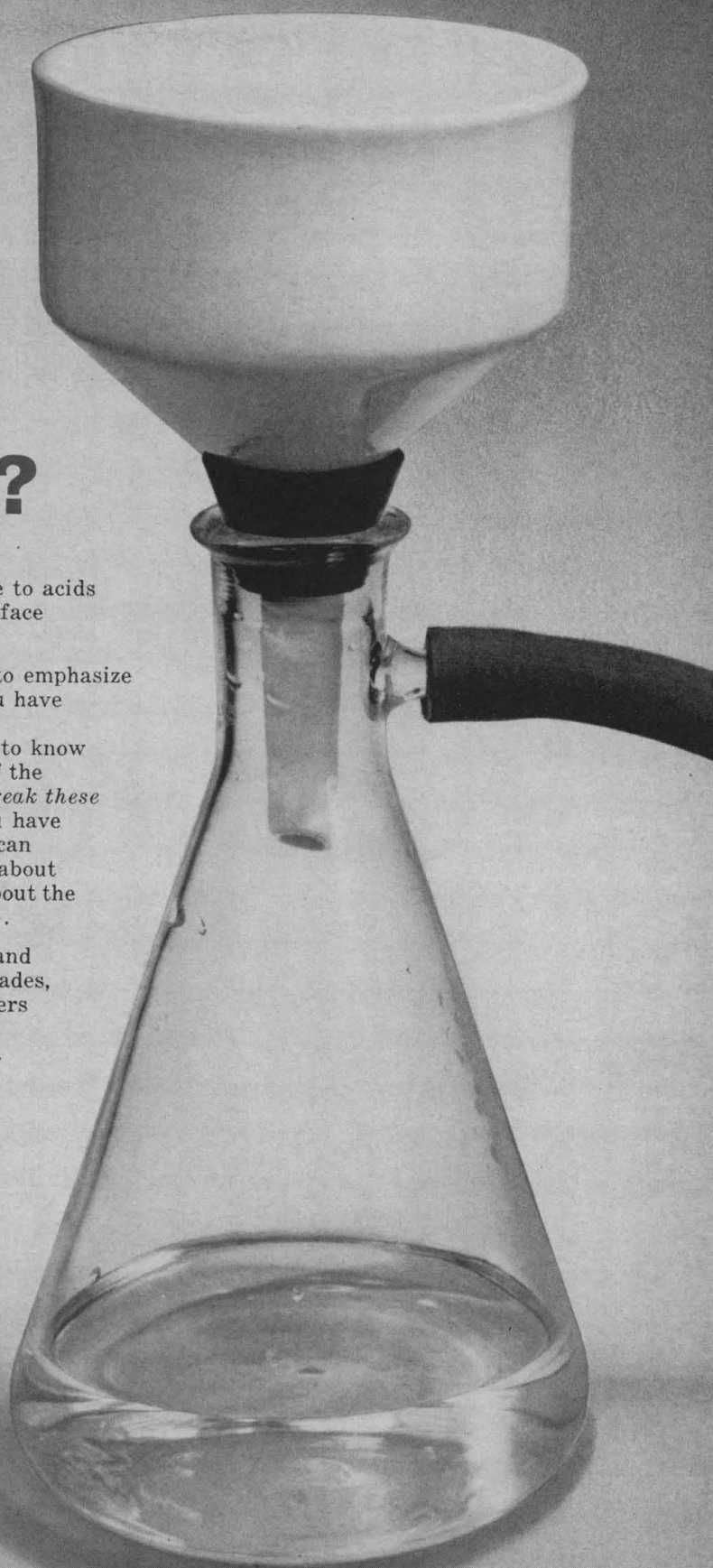
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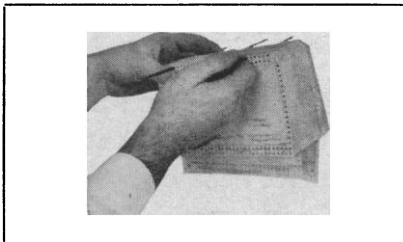
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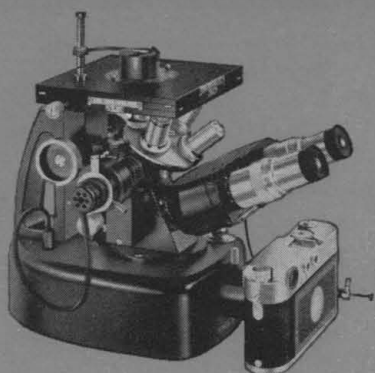
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*Physician in Psychological Medicine, National Hospital,
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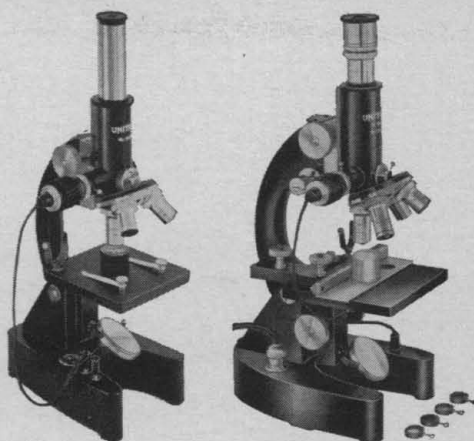
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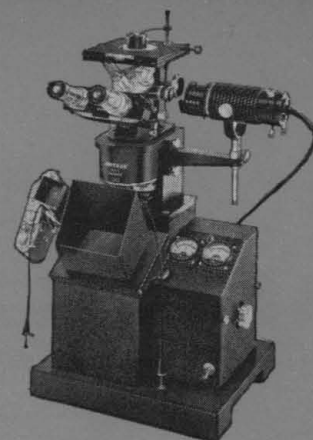
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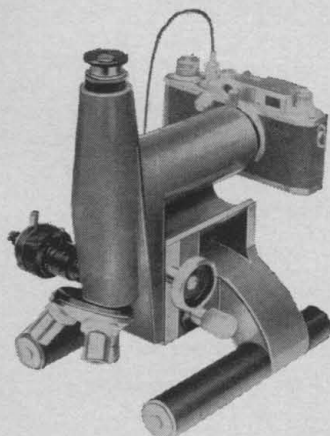
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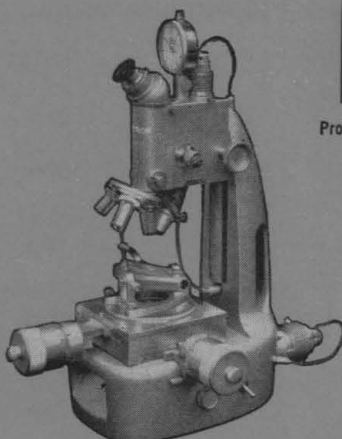
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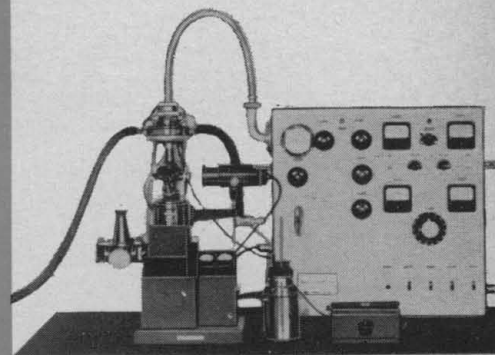
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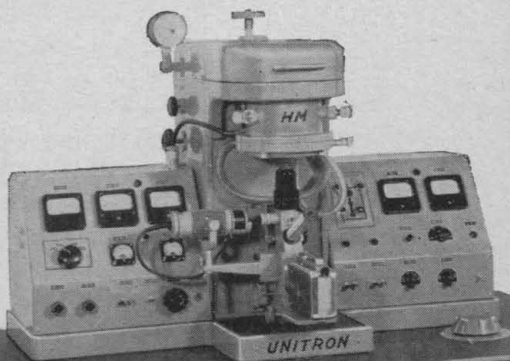


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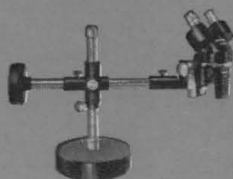
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But lay a heavy book on them and push. The book glides smoothly with no vertical component of motion.

Or measure them with a micrometer caliper. Like a sphere, their "diameters" are everywhere constant.

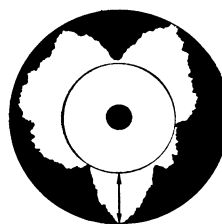
They are members of a family of surfaces having constant width. It's their less brazen cousins that are troublesome, though. Many machined parts, for instance, may be constant in diameter but out of round. Bearing balls. Journals. Holes. You name it. A smidgen of out of roundness would remain invisible to the eye and undetectable by two-point measurements.

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These pioneering studies of roundness and its ramifications are typical of how General Motors engineers are finding a better way—through research in depth.

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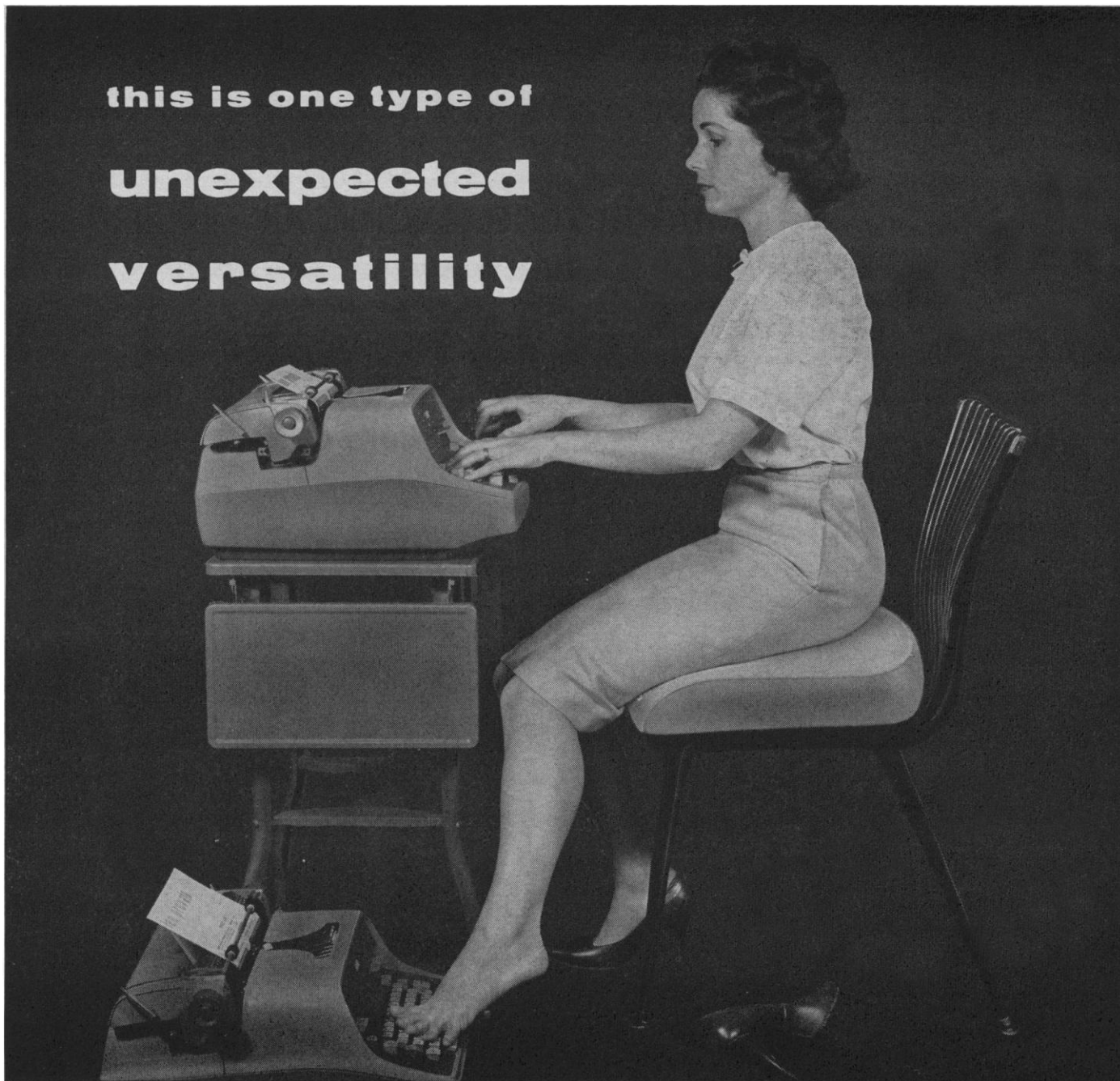
Warren, Michigan



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"Roundicator" chart of a 1-in. standard used to check micrometers. Diameter is constant to within 11 micro-inches, but disc is out of round by 53 microinches.

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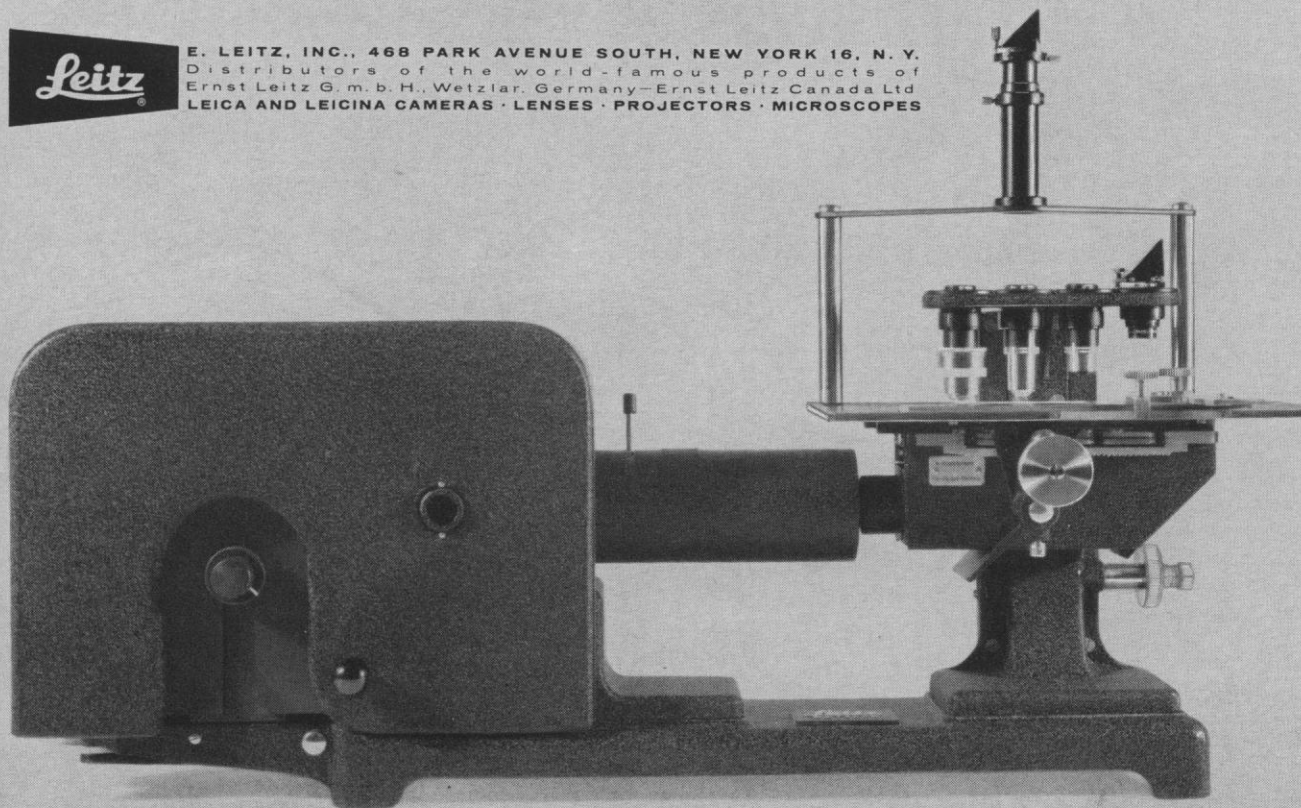
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 N. Russell Hanson
 ENGINEERING (M)
 Clarence E. Davies
 Leroy K. Wheelock
 MEDICAL SCIENCES (N)
 Francis D. Moore
 Oscar Touster
 DENTISTRY (Nd)
 Paul E. Boyle
 S. J. Kreshover
 PHARMACEUTICAL SCIENCES (Np)
 Don E. Francke
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 A. H. Moseman
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The American Association for the Advancement of Science was founded in 1848 and incorporated in 1874. Its objects are to further the work of scientists, to facilitate cooperation among them, to improve the effectiveness of science in the promotion of human welfare, and to increase public understanding and appreciation of the importance and promise of the methods of science in human progress.

How Guard Our Diversity in Science?

Recently Jerome Wiesner testified before the House Committee on Government Appropriations that the government plans to allocate for the coming fiscal year the sum of \$12.3 billion for support of research and development in the nation. Although this sum represents only about 15 percent of the overall federal budget, it amounts to well over one-third that portion not formally committed.

These are awesome figures. Their positive impact is clear enough. But there are cautionary aspects that cannot be stressed too often. They were introduced by the President when he observed that federally financed activities in defense, space, and atomic energy absorb roughly two-thirds of our total supply of physical scientists and engineers. They are further emphasized by a committee headed by J. Herbert Holloman, Assistant Secretary of Commerce for Science and Technology. Such is the stress created by this drain that we are actually falling behind Western Europe, England, and Japan in our resources of scientific talent available to industrial production.

Throughout our national history we have depended on a demand mechanism to distribute human effort and resources in a pattern which, if sometimes wasteful in the short term, in the long term provided proven benefits. This approach has served us well. But it assumed two fundamental premises, among others: that available resources of trained human talent would continue to be great enough to fill all demands, and that their commitments would continue to be highly plural in nature and, moreover, flexible. What do we do when so large a fraction of the reserve is being inflexibly committed to specific enterprises that the bottom of the barrel is visible? What do we do when—as is not yet universally recognized—it is not dollars but unbuyable human gifts that will set the limit?

But there is another dimension to this matter of plural commitment of scientific and engineering talent. In the past, we have owed some of the greatest advances in our understanding of nature—not to mention the greatest leaps in technical exploitation—to the work of individual genius ill-fitted to the kind of specific scientific commitment that faces us on such a colossal scale today. It would be strange if the potential of such individuals in the years to come were less than it has been in the past. Indeed, it ought to be yet greater. For the substrate of scientific knowledge with which it works today is enormously larger. And again, the absolute numbers of such exceptionally gifted individuals among us should increase in the future, provided that conditions for their discovery and development do not deteriorate.

But what part of this priceless resource is annually swept irrevocably into the maw of activities organized about sharply committed goals? What part is annually consigned, at a formative age, to an environment which, while it may produce worthy scientific citizens, may also extinguish the full reach of their potential? These are very serious questions indeed. They ought to be argued and thought about deeply at every level by those concerned for our future scientific welfare and progress.—CARRYL P. HASKINS, *Carnegie Institution of Washington, Washington, D.C.*

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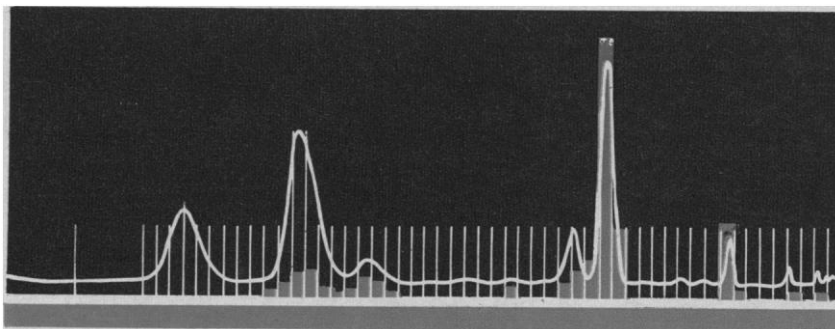
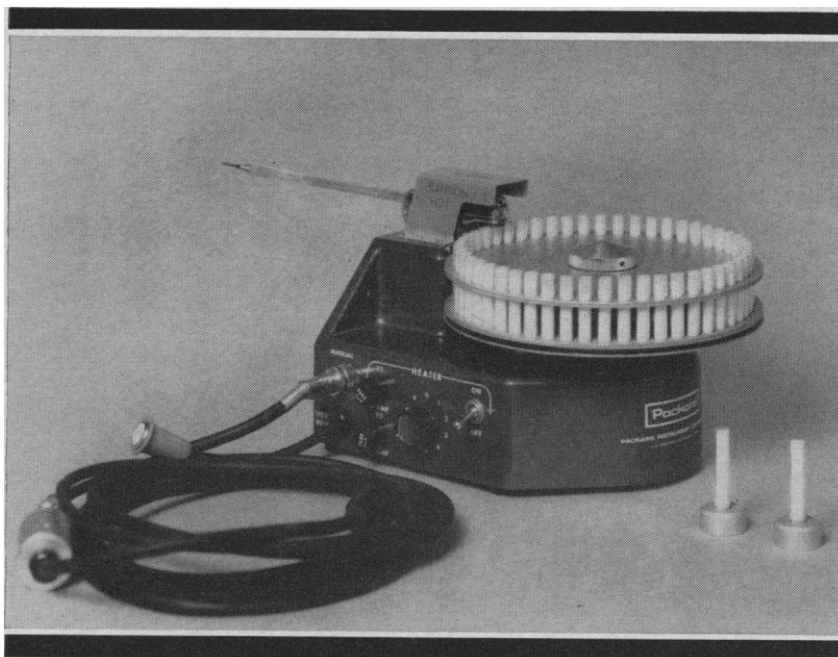
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Analysis of methyl esters labeled with carbon-14. The curves represent the output of a mass detector. The white vertical lines represent the times at which the fraction collector was actuated. The bar graph represents the radioactivity in each fraction in counts per minute, determined by a 10-minute count. (Ref.: *Journal of Lipid Research* 3, No. 1, 44, January, 1962)

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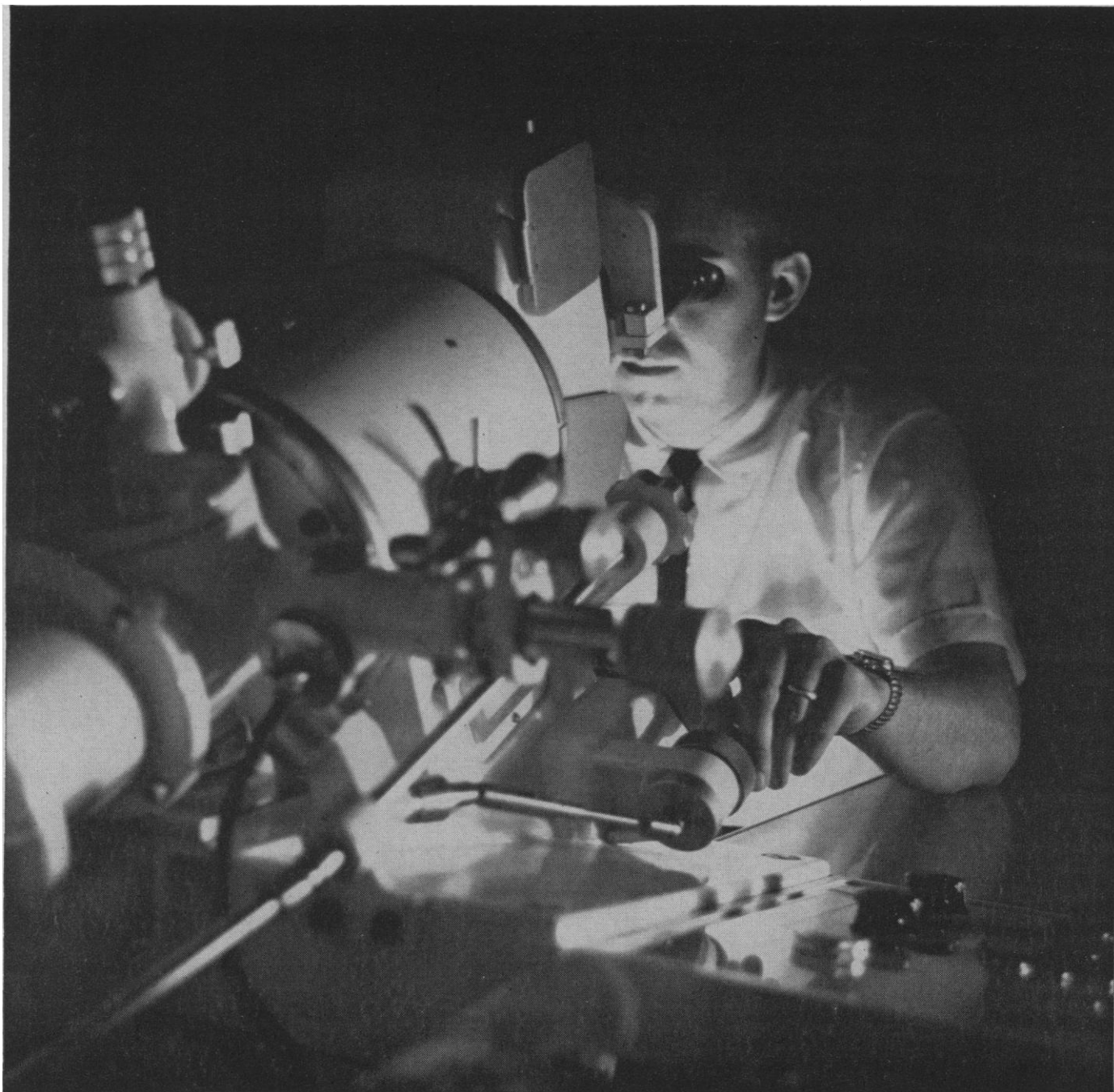
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Meetings

Autoregulation of Blood Flow

The intrinsic ability of an organ to maintain the rate of its own blood flow relatively constant, when the arterial driving pressure for flow is changed, has been a controversial area of research, and recently was the subject of a research workshop involving experimental demonstrations, laboratory discussions, and formalized discussions. During a 5-day period, 26-30 November 1962, 14 representatives from the majority of American laboratories working in this field convened to discuss their findings. The first two days were spent with William Waugh (University of Kentucky); the latter three days were spent with Francis Haddy and Lerner Hinshaw (University of Oklahoma).

Six of the visiting participants brought their own apparatus and demonstrated their experimental techniques and results in the host laboratories. The experiments included ten different preparations which involved the circulation of the dog kidney, brain, intestine, skeletal muscle, and foreleg. In most instances the spectator investigators extended the original experiment to elucidate certain points of particular interest to them, and in many respects this was the most beneficial part of the tour.

Some physiologists have not observed the phenomenon of autoregulation of blood flow; while those who have observed it have not agreed on a probable cause. It seems possible that the wide variability in experimental results is due to the variety of experimental techniques employed.

W. H. Waugh (Kentucky) studied autoregulation in the isolated kidney with blood perfused by a donor animal. Small-vein pressures were measured by a catheter passed retrograde into the venous system. With large changes in arterial pressure, there were only small changes in small-vein pressure. Dissection of the kidney showed the catheter tip had not passed beyond the renal calyces. Data from other experiments in which the catheter tip was found in arcuate or interlobular veins showed similar changes in small-vein pressure. Waugh also reviewed his previous work which suggests that an active myogenic vascular response to the level of transmural pressure is the cause of renal circula-

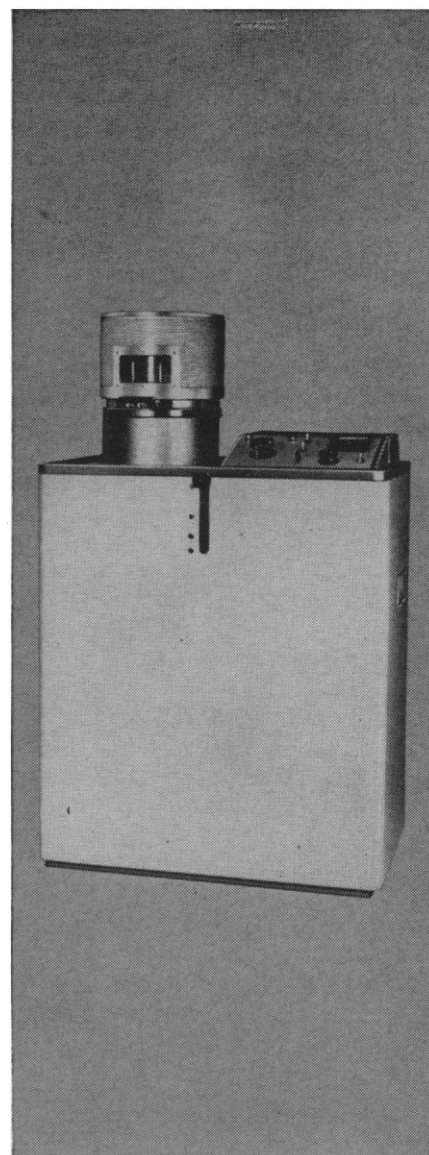
tory autoregulation. G. Grupp (Cincinnati), in addition to Waugh, also stressed the influence of vasoactive agents on autoregulation of renal flow. He reviewed his work (i) on the relatively constant rate of renal oxygen consumption and heat production with changes in renal blood flow and (ii) on the shift from aerobic to anaerobic renal metabolism with short-term vascular occlusion.

H. E. Schmid (Bowman-Gray), using an electromagnetic flowmeter, studied flow regulation with acute changes in arterial pressure in the *in situ*, non-cannulated kidney. He also reported the presence of autoregulation after kidney decapsulation. A blood-perfused, isolated kidney technique was described which showed that the autoregulatory resistance changes can be localized to the specific end-arterial vasculature of arteries in which pressure changes occur (R. B. Harvey, Minnesota). Additional reviews on renal circulatory autoregulation were presented by A. R. Koch (Washington) and F. J. Haddy (Oklahoma). Koch presented an analysis of the effect of varying the tonicity of the arterial blood and of the effect of osmotic diuresis on renal vascular resistance; and Haddy found that elevated arterial CO_2 tension did not abolish autoregulation in the kidney.

Experiments on the isolated kidney perfused from a heart-lung preparation showed changes in renal tissue pressure were largely responsible for the major resistance changes underlying renal autoregulation (L. B. Hinshaw, Oklahoma). Deep-venous pressure rose considerably with large elevations in arterial pressure, thus favoring the tissue-pressure concept. Identical deep-venous pressures were also measured by Waugh, who inserted a venous catheter of much smaller bore into the same preparation.

Recent studies of renal blood flow and glomerular filtration rate showed indirect evidence that the chief resistance changes underlying renal circulatory autoregulation are located in the preglomerular vasculature and that there is no significant redistribution of cortical and medullary blood flow with autoregulation (E. E. Selkurt).

In studies of cerebral blood flow by C. Rapela (Bowman-Gray) a blood pump was interposed in the arterial path and sometimes reduced or abolished cerebral circulatory autoregulation. However, hypercapnia is exceedingly effective in abolishing autoregu-



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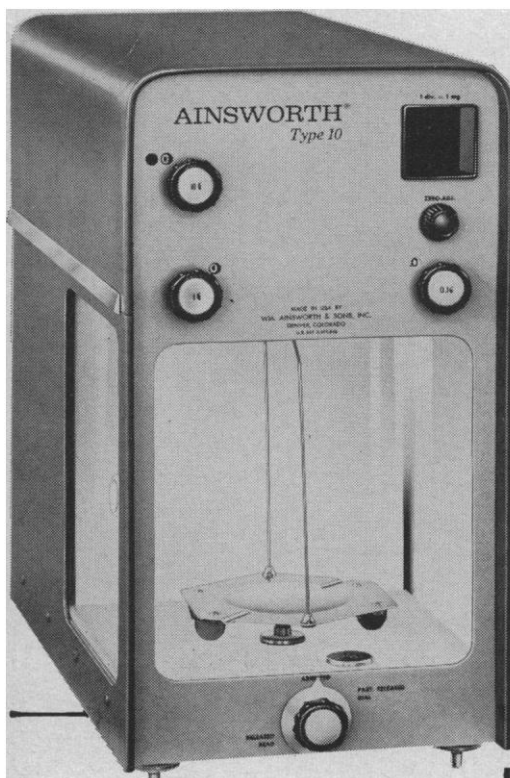
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lation of cerebral blood flow by producing marked dilatation of resistance vessels. Rapela suggested that a very sensitive metabolic feedback mechanism (which perhaps tends to keep cerebral venous CO₂ tension constant) may be responsible for autoregulation of cerebral blood flow upon changes in arterial pressure.

R. M. Berne (Western Reserve) described the autoregulation of coronary blood flow and its absence in the fibrillating heart. He also suggested that such blood flow is controlled locally by myocardial oxygen tension, and this control appears mediated in part by the release of adenosine. R. D. Jones (St. Luke's Hospital, Cleveland) and Berne demonstrated intense circulatory autoregulation in the isolated thigh muscles which is sometimes impaired by incorporation of an arterial blood pump.

Additional demonstrations included preparations of (i) the isolated gastrocnemius-plantaris muscular vascular bed (W. N. Stainsby, Florida), (ii) the heart-lung-foreleg (Hinshaw), and (iii) the isolated intestinal loop (P. C. Johnson and K. M. Hanson, Indiana). The elevation of arterial pressure caused a large increase in blood flow followed by a slow return toward the control level in the isolated gastrocnemius-plantaris muscular bed. In this preparation the steady state vascular resistance decreased with arterial pressure elevation. However, other experiments have shown a direct relation between arterial pressure and vascular resistance. In Hinshaw's heart-lung-foreleg preparation, and in Haddy's dog foreleg preparation no autoregulation of foreleg blood flow was observed. The relative paucity of skeletal muscle vasculature in the dog foreleg, compared to foreleg skin and paw, was pointed out.

The last day of the conference was concerned with three main topics.

1) The group discussed criteria which should be applied to determine whether changes in tissue pressure are responsible for autoregulation. In an organ where the major resistance changes are due to generalized tissue-pressure changes, the greatest resistance changes should be found in those vessels most sensitive to collapse, such as the veins, while the pre-venous resistance will tend to remain constant. This type of autoregulation should be accompanied by sizable changes in interstitial pressure or lateral deep-vein pressure.

2) The group considered the expected behavior of a preparation ex-

hibiting myogenic autoregulation, a type which depends upon vascular transmural pressure. This response should exist only in vessels possessing active smooth muscle tone, or might be evoked in previously atonic vessels if they are sufficiently reactive to the stimulus, and should be abolished by any agent which paralyzes vascular smooth muscle. Such autoregulation may occur in the absence of a parallel change in tissue pressure, venous resistance, or organ weight. When venous pressure is elevated, total vascular resistance should increase except where capillary pressure is high (for example, in the kidney), or where tissue pressure increases substantially.

3) The group considered metabolic autoregulation. Generally, resistance is dependent on blood flow in a manner consistent with maintenance of an adequate nutrient supply. In comparing it to myogenic autoregulation it is similar in that it requires active smooth muscle tone and may be seen in the absence of parallel changes in tissue pressure, venous resistance, or organ weight, and dissimilar in that vascular resistance to blood flow should decrease with elevation of venous pressure.

Finally, the group discussed further experiments which should be performed to determine the nature of autoregulation demonstrated in the various organs.

The workshop was a most useful method to the participants in trying to resolve individual differences and in determining the areas most likely to be fruitful in this research field. It was generously supported by a grant (H-7124) to one of us (P.C.J.) from the National Heart Institute.

PAUL C. JOHNSON

*Department of Physiology,
Indiana University, Indianapolis*

WILLIAM H. WAUGH

*Department of Medicine,
University of Kentucky, Lexington*

LERNER B. HINSHAW

*Department of Physiology,
University of Oklahoma,
Oklahoma City*

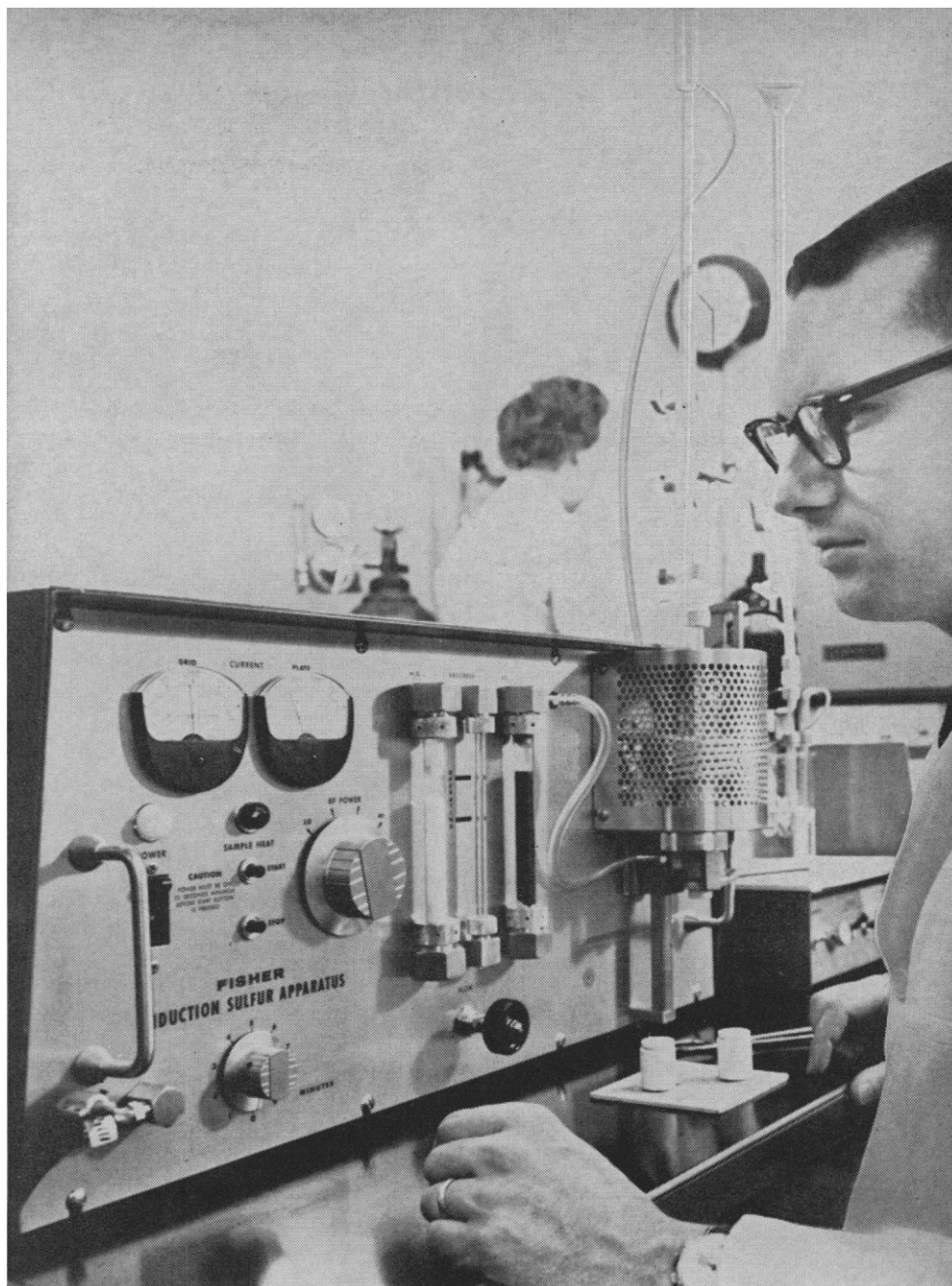
Forthcoming Events

May

12. American Pharmaceutical Assoc., Miami Beach, Fla. (W. S. Apple, 2215 Constitution Ave., NW, Washington, D.C.)

12-13. Biology Colloquium, 24th annual, Oregon State Univ., Corvallis. (F. A.

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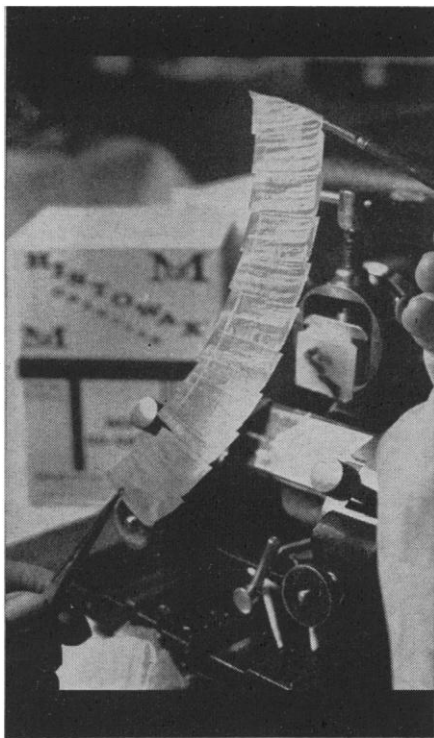


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12-14. **Excerpta Medica** Foundation, Amsterdam, Netherlands. (Headquarters, 111, Kalverstraat, Amsterdam)

12-17. American Soc. of **Hospital Pharmacists**, Miami Beach, Fla. (J. A. Oddis, 2215 Constitution Ave., NW, Washington, D.C.)

13-14. National Assoc. of **Boards of Pharmacy**, Miami Beach, Fla. (F. T. Mahaffey, 77 W. Washington St., Chicago 2, Ill.)

13-16. **Histochemistry**, intern. symp., Warsaw, Poland. (H. G. Godlewski, Inst. of Exptl. Pathology, Polish Acad. of Sciences, Dworkowa 3, Warsaw 12)

13-17. American Soc. of **Civil Engineers**, Milwaukee, Wis. (W. H. Wisely, ASCE, 345 E. 47 St., New York 17)

13-17. National League for **Nursing**, Atlantic City, N.J. (NLN, 10 Columbus Circle, New York 19)

13-18. **Condensation Nuclei**, 5th intern. symp., Clermond-Ferrand and Toulouse, France. (H. Dessens, Laboratoire de Physique du Globe, Faculté des Sciences, Univ. de Toulouse, Toulouse)

14-19. **Mass Spectroscopy**, 11th conf., San Francisco, Calif. (N. D. Coggeshall, Gulf Research and Development Co., P.O. Drawer 2038, Pittsburgh 30, Pa.)

15-17. **Transplutonium Elements**, symp., Argonne, Ill. (D. C. Stewart, Chemistry Div., Argonne Natl. Laboratory, 9700 S. Cass Ave., Argonne)

15-18. **Acoustical Soc. of America**, New York, N.Y. (W. Waterfall, American Inst. of Physics, 335 E. 45 St., New York 17)

16-17. **Aromatic Biosynthesis and Metabolism**, Saskatoon, Canada. (A. J. Finlayson, Prairie Regional Laboratory, National Research Council, Saskatoon)

16-17. **Metallurgical Problems in Electronic Technology**, New England regional conf., Boston, Mass. (Metallurgical Soc. of the American Inst. of Mining, Metallurgical, and Petroleum Engineers, 345 E. 47 St., New York 17)

16-18. International Assoc. for **Bronchology**, 13th congr., Zurich, Switzerland. (E. Steinmann, Tödstr. 36, Zurich 2)

16-18. **Diabetology**, 4th, Paris, France. (M. Rathery, Hotel-Dieu, Place du Parvis Notre Dame, Paris 4)

17-18. **Surface Physics**, symp., Pullman, Wash. (E. E. Donaldson, Dept. of Physics, Washington State Univ., Pullman)

18. Southern California **Academy of Sciences**, Los Angeles. (G. Sibley, Los Angeles County Museum, 900 Exposition Blvd., Los Angeles 7)

19-24. **Mass Spectrometry and Allied Topics**, 11th annual conf., San Francisco, Calif. (N. D. Goggeshall, Gulf Research & Development Co., P.O. Drawer 2038, Pittsburgh 30, Pa.)

20-22. Institute of Radio Engineers, Professional Group on **Microwave Theory and Techniques**, symp., Santa Monica, Calif. (I. Kaufman, Space Technology Laboratories, Inc., 1 Space Park, Redondo Beach, Calif.)

20-23. **Humidity and Moisture—Measurement and Control in Science and Industry**, intern. symp., Washington, D.C. (A. Wexler, National Bureau of Standards, Washington 25)

20-23. **Spectroscopy**, 14th annual mid-



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21-23. **Australian Mathematical Soc.**, Clayton, Victoria, Australia. (G. C. Smith, Dept. of Mathematics, Monash Univ., Clayton)

21-23. **Joint Computer Conf.**, Detroit, Mich. (B. W. Pollard, Burroughs Corp., 6071 Second Ave., Detroit 32)

21-23. **Radioisotopes**, 5th Japanese conf., Tokyo. (J. H. Kane, Div. of Special Projects, U.S. Atomic Energy Commission, Washington 25)

22-25. **Space**, 3rd European symp., Stuttgart, Germany. (U. Seeliger, Verkehrsamst der Stadt Stuttgart)

22-31. **Scientific and Technical Press and Books**, 1st intern. exhibition, Paris, France. (Groupe des Editeurs de Livres de Sciences et de Techniques, Syndicat National des Editeurs, Cercle de la Librairie, 117 Boulevard St. Germain, Paris 6)

23-24. **Radiosensitizers and Radioprotective Drugs**, 1st intern. symp., Milan, Italy. (R. Paoletti, Inst. of Pharmacology, Univ. of Milan, Via A. Sarto 21, Milan)

23-24. **Southern Textile Research**, 3rd conf., Pinehurst, N.C. (M. P. Underwood, P.O. Box A-2, Greensboro, N.C.)

23-25. **American Assoc. for Cancer Research**, Inc., Toronto, Canada. (H. J. Creech, Inst. for Cancer Research, Fox Chase, Philadelphia 11, Pa.)

23-25. **American Soc. for Quality Control**, Chicago, Ill. (C. E. Fisher, Bell Telephone Laboratories, 463 West St., New York 14)

23-26. **Nuclear Fuel Reprocessing**, Eurochemic symp., Brussels, Belgium. (O.E.C.D., European Nuclear Energy Agency, 38 Boulevard Suchet, Paris 16^e, France)

26-27. **Society for Industrial and Applied Mathematics**, Menlo Park, Calif. (R. D. Gaskell, Dept. of Mathematics, Oregon State Univ., Corvallis)

26-29. **Institute of Food Technologists**, Detroit, Mich. (C. L. Willey, Inst. of Food Technologists, 176 W. Adams St., Chicago 3, Ill.)

26-31. **American Physical Therapy Assoc.**, New York, N.Y. (L. Blair, APTA, 1790 Broadway, New York 19)

26-1. **Mineral Processing**, 6th intern. congr., Cannes, France. (D. A. Dahlstrom, Eimco Corp., 301 S. Hicks Rd., Palatine, Ill.)

27. **Operations Research Soc. of America**, Transportation Science Section, Cleveland, Ohio. (L. C. Edie, Port of New York Authority, 111 Eighth Ave., New York 11)

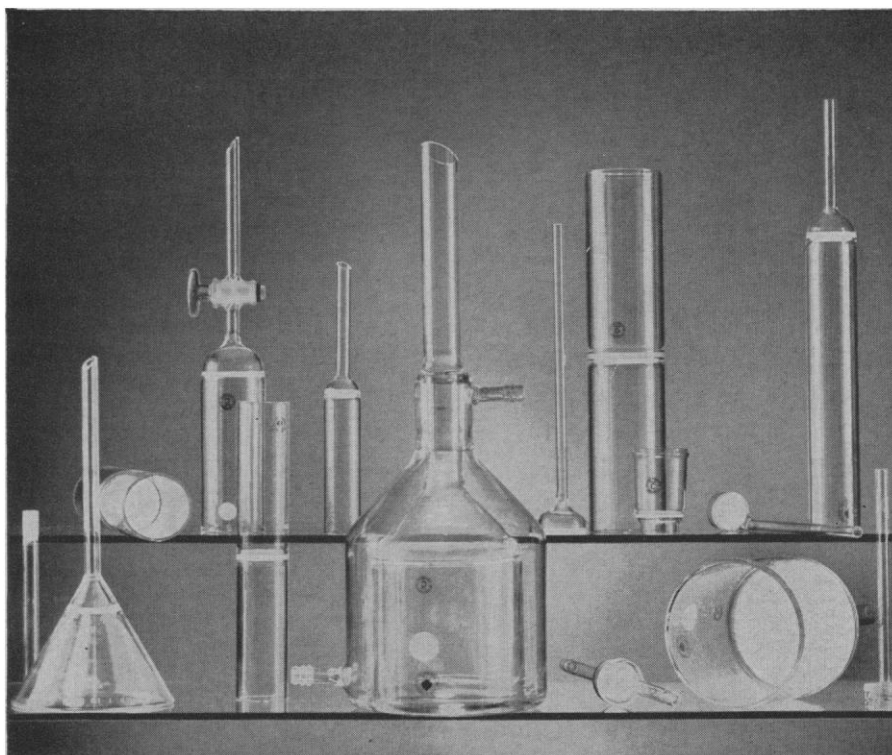
27-29. **Canadian Nuclear Assoc.**, 2nd intern. conf., Montreal, Canada. (CNA, 19 Richmond St., W., Toronto 1, Canada)

27-29. **Frequency Control**, 17th annual symp., Atlantic City, N.J. (Headquarters, U.S. Army Electronics Research and Development Laboratory, Fort Monmouth, N.J.)

27-30. **Tissue Culture Assoc.**, 14th annual, Boston, Mass. (R. L. Sidman, Laboratory of Cellular Neuropathology, Harvard Medical School, 25 Shattuck St., Boston 15)

(See 29 March issue for comprehensive list)

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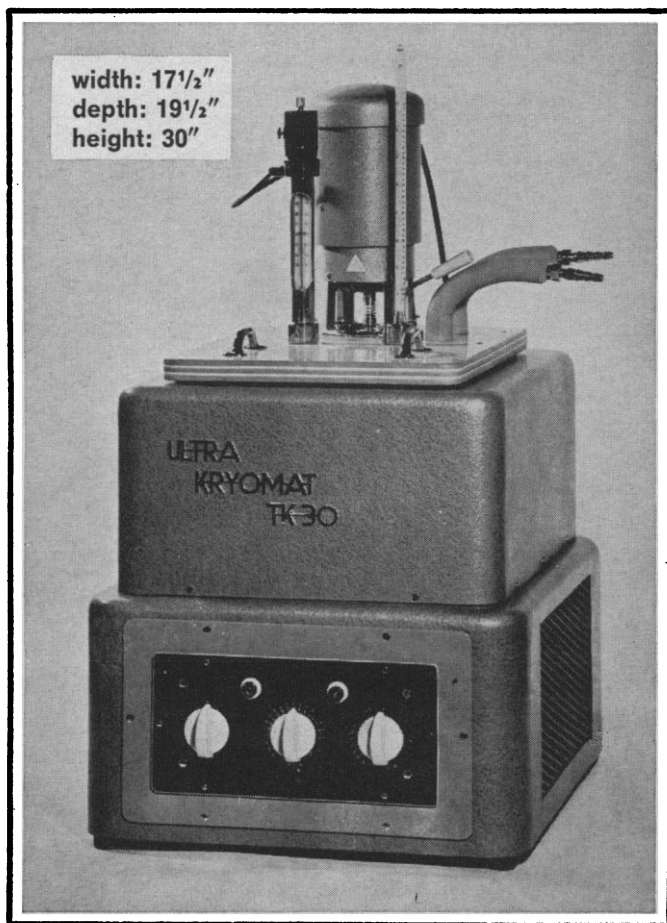
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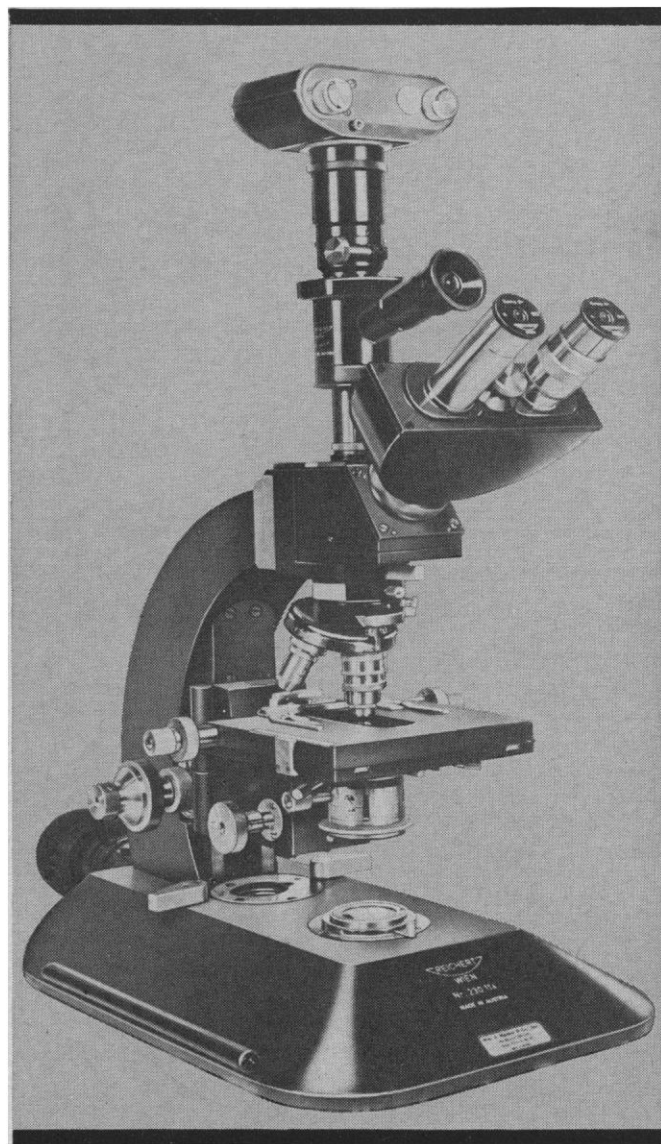
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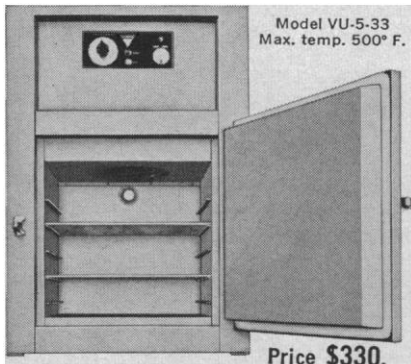


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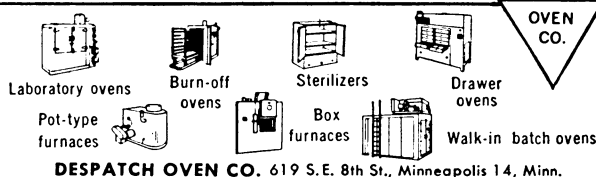
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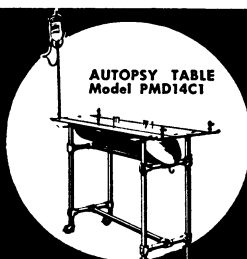
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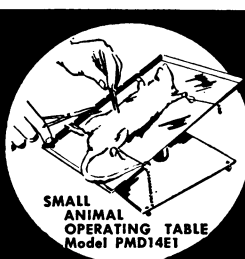
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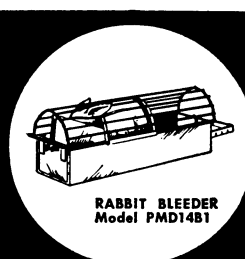
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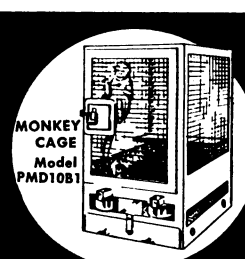
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in the direction of giving a closer scrutiny" implies that the goal is not yet reached. The point of diminishing returns, where the advantages of having funds available for medical research is outweighed by the time consumed in securing and administering them, may be close.

An aspect of the reports quoted by Congressman Fountain that has received inadequate recognition from scientists is the eloquent statements by the leaders of the National Institutes of Health in support of the liberal policies that they have been following. Clearly, NIH cannot support this point of view indefinitely against the desires of Congress, on whom they are, after all, dependent for funds. Scientists outside the government must also help in convincing Congress and the people that there are at least two sides to this question. The issue has come up initially with respect to support of the health sciences, but it may not stop there.

BRIAN MACMAHON

*Department of Epidemiology,
School of Public Health,
Harvard University*

Creativity and the Indigent Student

It is distressing to see . . . [you] give support to the archaic idea that a hungry student is a superior student [*Science* 139, 79 (11 Jan. 1963)]. Some of the penetrating minds of the past and present may have been starved during their formative period, but to assign a cause and effect relationship is absurd. The same reasoning would suggest that we decrease by 50 percent the pay of all present scientists so that they will be twice as creative, thereby eliminating the need for a crash program.

Freed from financial pressure the "man of moderate endowment may show flashes of genius." Why dilute his academic struggles with monetary adversity?

WILTON H. BUNCH

*Crow Indian Hospital,
Crow Agency, Montana*

. . . Not all can be Enrico Fermi, but any reasonably competent Ph.D. can add to the sum of knowledge from which the Enrico Fermis draw. If recent Ph.D. theses are pedestrian, is it the fault of the Ph.D. candidate or of the professor and system under whom the work is done?

Furthermore, poverty at the graduate school level is not an automatic virtue. Probably lack of financial assistance has hindered more scholars, potential and actual, than reasonably adequate stipends could possibly do.

GUY W. MCKEE

*127 Orchard Road,
State College, Pennsylvania*

. . . [the] report [of the President's Science Advisory Committee entitled "Meeting Manpower Needs in Science and Technology"] does not imply "that scientists, like nuts and bolts, are interchangeable and can be mass produced." It does imply that graduate schools will assert their traditional selectivity and accept only those students who are capable of quality academic performance; that science majors are not continuing their education because of financial difficulties; and that they can complete their programs earlier and do more creative work when devoting full time to educational pursuits than when working at odd jobs like cleaning pigeon cages.

The implementation of this document may not produce enough scientists—only because it doesn't start early enough! . . . To really increase the number of graduate students we must identify and encourage gifted youngsters in the secondary school—probably even more effectively in the elementary school. There are many studies to substantiate the fact that interest in science is "killed" or "kindled" early.

GLADYS S. KLEINMAN

*Rutgers University,
New Brunswick, New Jersey*

. . . I have noticed that a relationship exists between the amount of expensive laboratory equipment and the ingenuity with which problems are solved and techniques developed. A laboratory in the early stages of growth, and short of money for equipment, develops a high proportion of new information through improvisation. As the physical plant takes on more elaborate equipment, experimental design more often is set up around the instrumentation than around the problem to be solved.

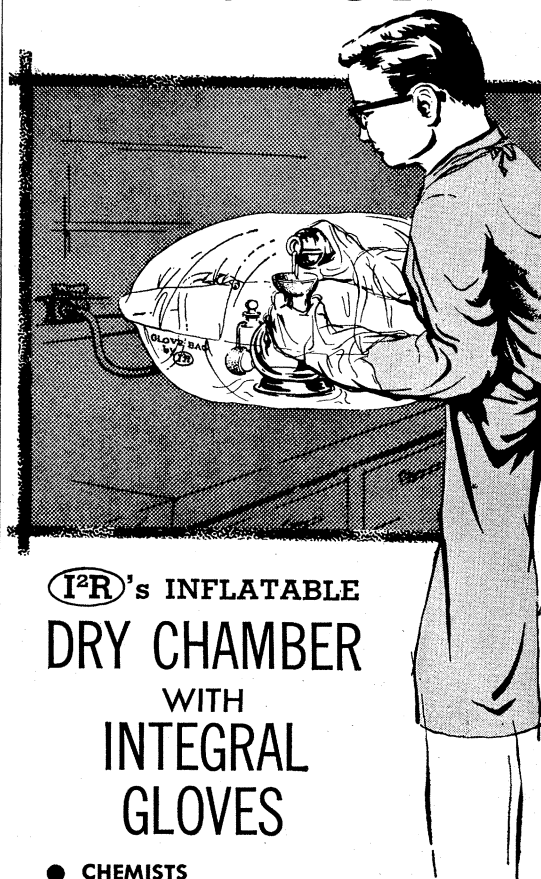
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. . . The increasing formalization of our educational processes stifles that type of creative mind that might be

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classed as "obsessed." Yet I know of nothing which has the motivating power of an obsession to solve a problem or prove a point. Although some educators are beginning to understand and value such unique students, it is too often the case that they are expelled from school, or are at least so frustrated and repressed by the necessity to conform to the established pattern that they grow into neurotic adults and are of little value to their fellow men. . . .

WILLIAM R. WELLS

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Presentation of Papers

All scientists (and indeed nonscientists too) are aware that talks at professional meetings should be concise, lucid, and held to the allotted time. All are equally aware of how short we fall of this goal. Too often talks are rambling, confused, slow in getting underway, and then rushed and garbled as the speaker runs out of time. All this could be avoided if it were required that each speaker present the chairman of his session with a magnetic tape recording of his talk for playback over the hall's public address system. The author would sit on the platform, signal for slides at the right time, and be prepared to field questions at the end. He would have adjusted his talk to the proper length at home (or else the chairman could reject it) and he would have had to listen to it himself, the salutary effect of which would be incalculable.

M. A. VAN DILLA

Los Alamos Scientific Laboratory,
University of California,
Los Alamos, New Mexico

Missing Links in Computer Intelligence

The paper by Ulric Neisser on "The imitation of man by machine" [*Science* 139, 193 (18 Jan. 1963)] describes three characteristics of human thought which are absent from machine programs. I would like to add a fourth characteristic which is, perhaps, the most important one. This is the property of "consciousness," the ability to be aware of the stimuli coming to us from our sense organs, and of the thoughts circulating in our own nerv-

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ous systems—and to be conscious of the fact that we are conscious.

While Neisser touches on this matter in his discussion, I believe that the property of "consciousness" is worth emphasizing.

Conceivably a computer could be programmed to give emotionlike responses, or to operate with a multiplicity of motivations. The central question here is whether a computer could be built which would be aware of its emotions, motivations, and the world around it. While this would appear to be an inconceivable feat (some would say impossible), the fact remains that our own human consciousness is, somehow, the end result of physical interactions taking place within the mechanisms of the body cells. There is no a priori reason for assuming that these operations cannot be performed by man-made circuits (although the complexity may make it impractical).

Present-day computers think unconsciously and compulsively. In the jargon of psychoanalysis, they consist entirely of superego, and are devoid of ego or id. The question of humanlike machines, translated into these terms, becomes: Can we build a computer with an ego?

MILTON A. ROTHMAN

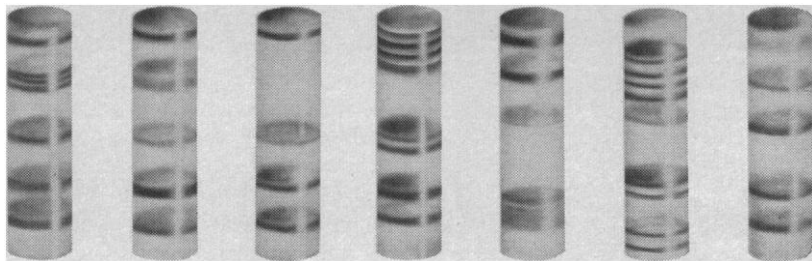
*James Forrestal Research Center,
Princeton, New Jersey*

Neisser seems to believe that popular misconceptions about "thinking" machines (they are not capable of "thinking"—even in quotes) are due to a misunderstanding of the nature of human thought. Indubitably! But it is equally due to a misunderstanding of the very nature of machines and machine operation. Even the most sophisticated computing machine cannot do anything it is not programmed to do, although much of the program is now "built in" into the machine and does not have to be spelled out in detail by the programmer.

If a comma was omitted in the program, then what was intended to mean two small adjacent numbers is not two small adjacent numbers but one large number, and the machine reacts accordingly. Every machine is literal without any sense of discrimination, common sense, or humor. It is the obedient servant of man—like the disastrously obedient slaves in fairy tales of the past—and in its very obedience lies the danger, for men do not always wish as wisely and well as an omnipotent master.

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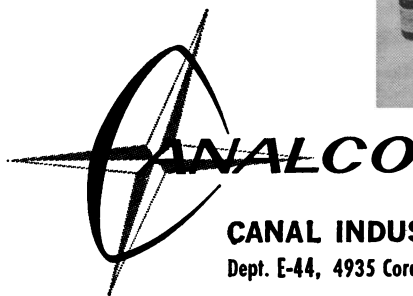
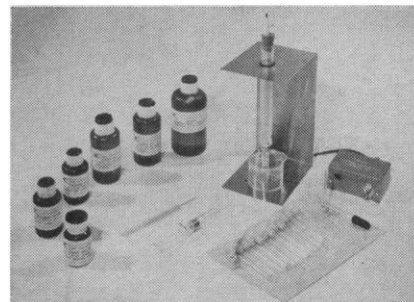
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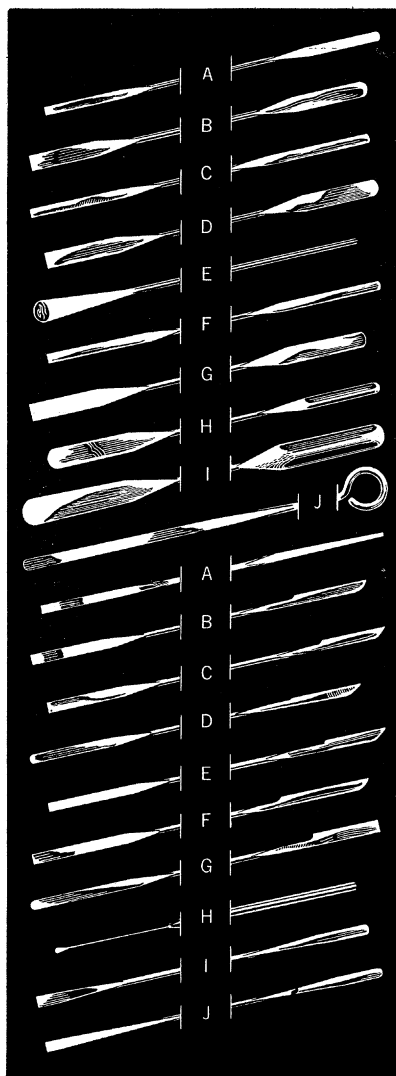


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Most important in Neisser's article is his brief allusion to the use of computing machines to "make social decisions." Again, the very thought of using machines to "answer" questions of human and moral values, or taste, betrays a—widespread, unfortunately—lack of understanding of the very nature of computing machines, of mathematics, and of logic. These machines are eminently suitable to implement the solution of problems in mathematics and logic for the simple reason that they are built in accordance with such laws. Every circuit is the hardware manifestation of a Boolean-algebra equation.

Therefore a machine can solve any problem that can be expressed as a mathematical equation, which means—at least, in theory (in practice, we sometimes lack proper understanding of the problem or mathematical skill to formulate it)—any problem for which a purely rational solution is possible. Social decisions must never be made on purely rational grounds. They are primarily questions of human and moral values and, let us hope, good taste.

ALICE MARY HILTON

New York 21, New York

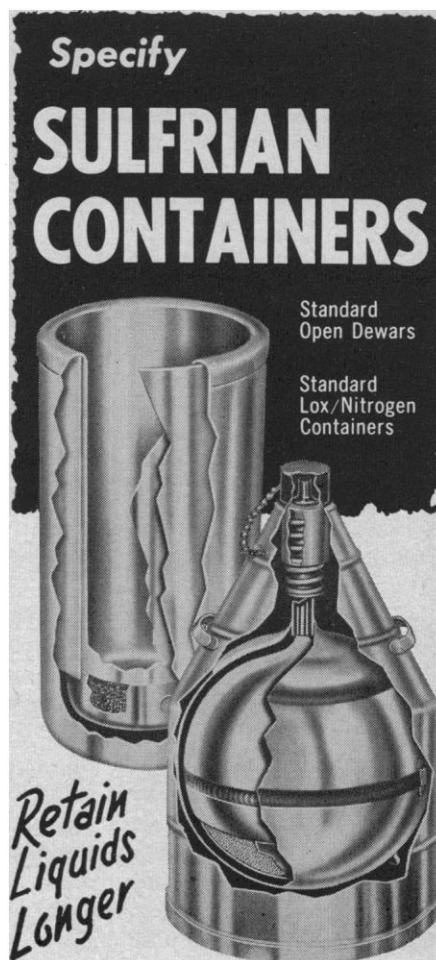
While Neisser avoids explicit statement of the extreme position that differences between human thought and the functional properties of modern computers are insurmountable, he clearly implies support of that position by his subtitle.

Neisser's arguments do not support a mystical or irrational view of the differences between men and machines. Instead of demonstrating any inviolable distinction between the two, he has pointed the way toward making machines more nearly "human" and hence more useful to humans.

The chief differences, Neisser states, arise from the developmental (and, one might add, even the phylogenetic, historical, and ontogenetic) origins of man. Human thinking is inseparable from other human activities and processes. It "takes place in, and contributes to, a cumulative process of growth and development. . . . The cumulation of learning is interwoven at every point with inborn maturational sequences." A machine will continue indefinitely to pursue any goal programmed into it (this is perhaps its most inhuman feature); whereas the motivations which govern human thought are complex, subtle, and

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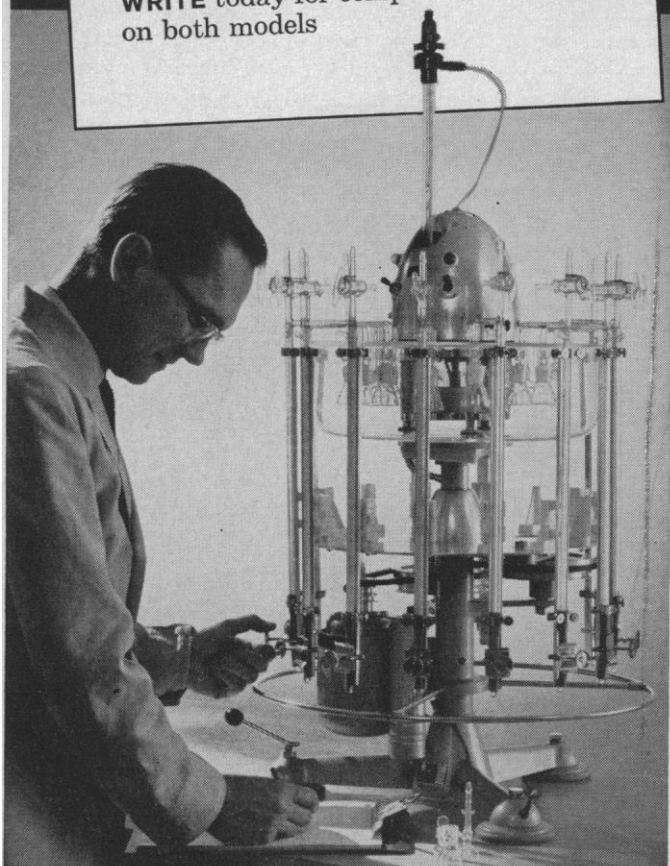
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changing. The computer acquires and retains information in a systematic and controllable fashion; whereas the human thinker "lives willy-nilly in an accumulating context of experiences which he cannot limit even if he would."

The real question is whether or not these differences are so fundamental as to rule out forever the possibility of our building some day a machine that can make rational and useful social decisions. . . .

SAMUEL C. McLAUGHLIN, JR.
*Institute for Psychological Research,
Tufts University, Medford,
Massachusetts*

Ulric Neisser's article brings to mind a remark I was privileged to hear from J. von Neumann during an informal talk on computers given at the Institute for Advanced Study at Princeton, in 1948. A woman in the audience started raising the canonical question, "But, of course, a mere machine can't really think, can it?" For a while he tried to put it off with a good-natured gesture, but she persisted. So he turned to his

tormentor and said: "Look here. You insist that there is something a machine cannot do. If you will tell me precisely what it is that a machine cannot do, then I can always make a machine which will do just that."

The full import of this remark may have been lost on the person to whom it was directed, but to others in the audience it answered, in a sudden flash of understanding, many half-formulated questions. There is no limitation at all inherent in the machine; the only limitations on making "machines which think" are our own limitations in not knowing exactly what "thinking" consists of.

Von Neumann's remark applies equally well to all of the alleged differences pointed out by Neisser. I suggest that his arguments, far from establishing any "deep difference between the thinking of men and machines," describes only the present state of ignorance of psychologists concerning what growth, emotion, motivation, creativity, and so forth really are.

This does not mean, as Neisser implies, that it would be desirable to incorporate all these features into ma-

chines of the future. For most applications of machines, this would amount to a deliberately built-in unreliability. I could hardly disagree more strongly with the implications of the remark, "If machines really thought as men do, there would be no more reason to fear them than to fear men." It is just the fact that machines do not get confused by emotional factors, do not pursue hidden motives opposed to ours, do not get bored with a lengthy problem, that makes them far safer agents than men for carrying out certain tasks. What we have most to fear in the world today is not machines which lack these "human" features, but men who, unfortunately, have them.

E. T. JAYNES
*Department of Physics, Washington
University, St. Louis 30, Missouri*

My paper was not concerned with the inherent limitations, if any, of machines. I attempted to describe the differences between existing or contemplated computer programs on the one hand, and human thinking on the other. It is true that human thought processes are not well understood, but this seems irrelevant to the accuracy of my description. Jaynes' opinion that emotion and growth are deplorable sources of unreliability seems equally irrelevant.

I would like to comment directly on the remark attributed to von Neumann. It is not necessarily true that a program can be written to carry out any well-specified task. The following counterexamples are due to Oliver G. Selfridge:

The speaker may be asked to make a machine to defeat Botvinnik at chess, or to select the painting (from 100 in a contest) which will be awarded first prize by the judges. He will be unable to make such machines at present, and equally unable to give formal proof that he can ever succeed in doing so. (We do have promising leads for the first of these problems, but success cannot be guaranteed.)

If it be replied that these tasks are not specified "precisely," one may enquire what further precision is required. It will probably appear that the underlying idea of a precise definition is rather like a computer program. In that case the assertion reduces to "If you will tell me how to program a task, I can always do so."

Even the last statement may not be right. It is possible that some tasks, including the simulation of human thought, are so complex that the speci-

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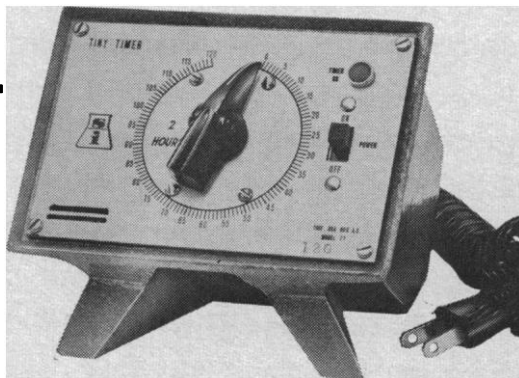
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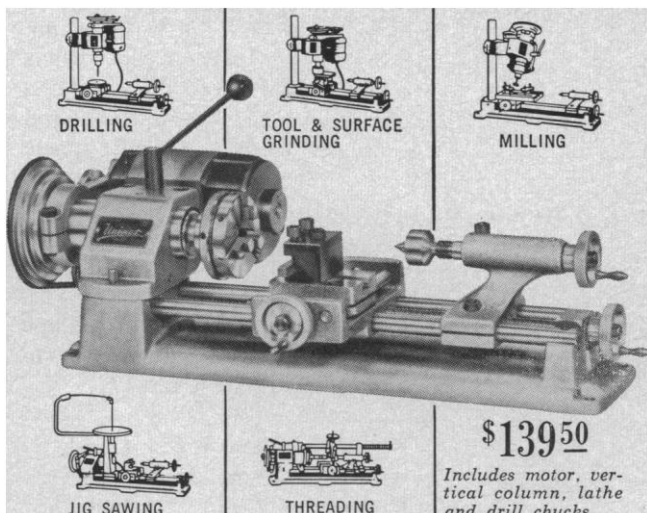
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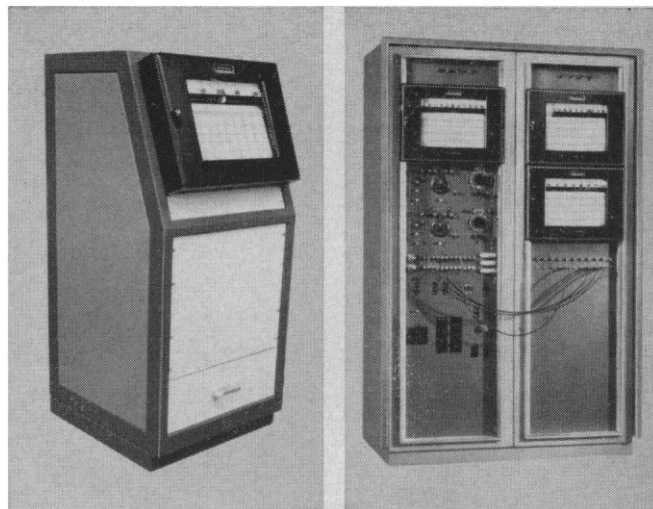
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cation would take a full lifetime to write, and the resulting program 1000 years to de-bug. There is no way of knowing in advance; we must find out by experimenting.

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ULRIC NEISSER

Brandeis University,
Waltham, Massachusetts

Self-Stimulation Experiments

Your publication of papers by Margules and Olds [*Science* 135, 374 (1962)] and by Hoebel and Teitelbaum [*Science* 135, 375 (1962)] leads me to propose the following physiological explanation of the association which they describe between mechanisms for self-stimulation and for feeding in the lateral hypothalamus. It is my opinion that in a self-stimulation experiment the negative feedback loops of normal feeding mechanisms are replaced by an artificially constructed loop having a positive sign.

Under natural conditions, an activation of the lateral hypothalamus induces or facilitates feeding behavior. Included in the many possible varieties of such behavior is bar pressing—one of the responses which lateral hypothalamic activity will induce for feeding. Ordinarily such behavior induced by the lateral hypothalamus leads to ingestion of food, and this leads in turn to a number of physiological changes which inhibit further intake of food and suppress the activity of the lateral hypothalamus. But when, as in a self-stimulation experiment, the bar pressing leads not to food ingestion but to electrical stimulation of the lateral hypothalamus, then that part of the brain can only become still more active. Consequently the animal is that much more likely to press the bar again, and every further press enhances the chances of more presses. Induced to press the bar in the first place by a naturally occurring activation of its lateral hypothalamus, the animal receives for its press only a recurrent stimulation into the region which originated the bar pressing.

This distinction between a normal, negative feedback loop and an artificial, positive loop avoids the paradox mentioned by Olds [*Physiol. Rev.* 42,

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554 (1962)] in these words: "In any event it is clear that stimulation of the same lateral area has two usually dissociated effects . . . the effects of the primary drive itself . . . [and] the effect of the primary reward related to that drive. . . . Therefore the possibility that the electric stimulus constitutes a simple internal surrogate for either is unlikely" (pp. 593-94). It seems more probable that self-stimulation of the lateral hypothalamus is a surrogate for natural stimulation of the lateral hypothalamus—nothing else.

If my interpretation for the relationship between feeding and self-stimulation is correct, then one can predict that any region of the brain where self-stimulation is observed must function as a component of a similar physiological system, in which the animal can be taught to use bar pressing as a part of some normal behavioral sequence.

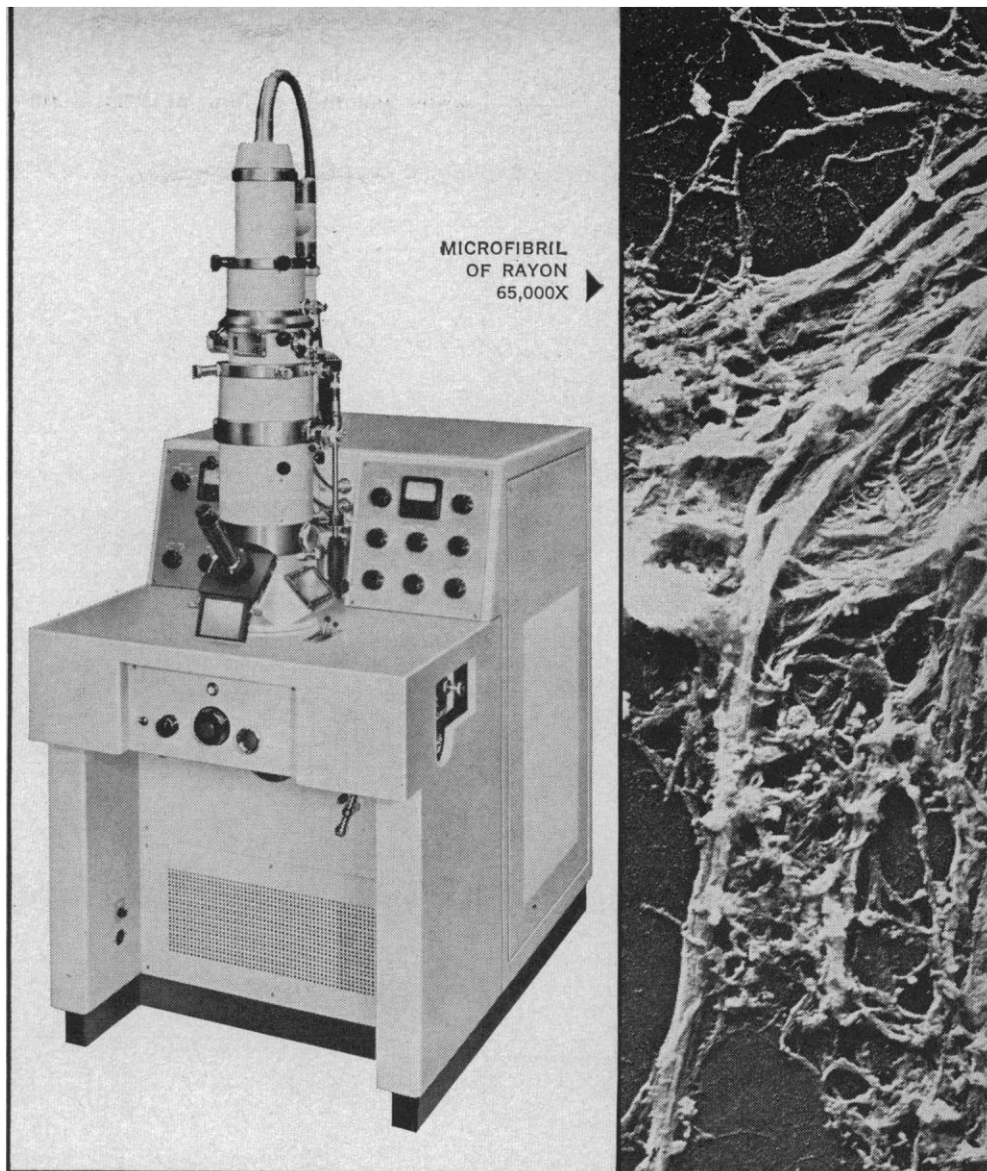
JOHN R. BROBECK

*National Defense Medical Center,
Taipei, Taiwan*

While I find myself in sympathy with Brobeck's view, I find it difficult to agree fully for two reasons:

1) At the beginning of a self-stimulation experiment, bar pressing has never been previously associated with or been instrumental in feeding behavior. It is a random response like ear twitching or tail movement, and it should be kept in mind that any random response may be used to trigger the electric stimulus. The chosen response will quickly rise in frequency, gradually excluding other responses from the immediate repertory, until the chosen response predominates and occurs at a maximum possible rate. It is difficult to understand why this response should be chosen for repetition just because of its temporarily contiguous relationship to the subsequent increment in lateral hypothalamic activity. The increment should make all food-related or other possible responses more likely, but I do not find in Brobeck's explanation any reason why the response emitted just prior to artificial stimulation of the hunger drive should be marked for immediate repetition. We think of a hungry animal trying the habitual responses in an effort to get food, and if these fail, trying others. If some item of the new repertory were followed by a sudden rise in hunger or in any internal activity generator, would that response be repeated? If so, why?

2) If the size of the supra-threshold



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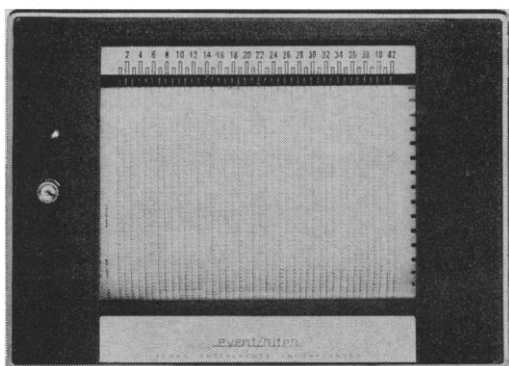


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electric field in a self-stimulation test is approximately a 1-mm sphere, it seems unlikely that the sphere in such a complex structure as the hypothalamus in a small animal like the rat is homogeneous in regard to function. One millimeter is the cross-sectional diameter of the whole medial forebrain bundle which might so far as we know mediate the whole gamut of emotional control. Thus, on anatomical considerations alone it seems that an electric stimulus here must be having more than one effect.

Two possible explanations occur to me; different from Brobeck's, but equally plausible.

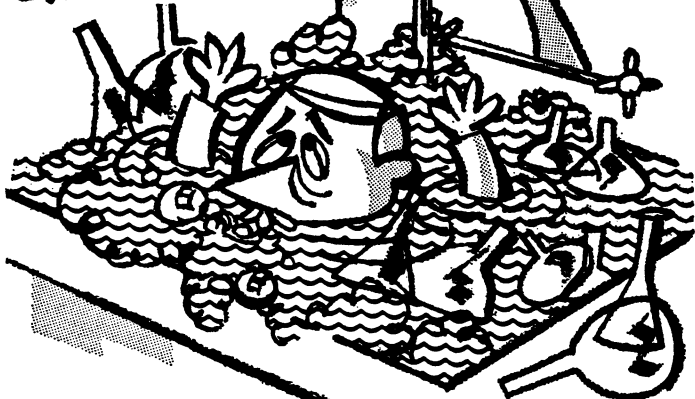
1) The electric stimulus might simply activate two different mechanisms, one yielding eating behavior, the other yielding behavioral reinforcement. The mechanisms might be grouped in anatomical proximity in the lateral hypothalamus so that both could be brought under control of a common deficit-sensor (such as the hypothetical glucose receptor). In such a case, a deficit in nutrients would have two consequences, (i) generating activity directly in the eating behavior system, and (ii) lowering thresholds in a "taste" system so that stimulation by food would "taste better"; that is, it would have more power as a positive reinforcement over antecedent operant behavior patterns. If such an anatomical proximity existed, electric stimulation, acting as something of a bludgeon, would have two effects, evoking directly the eating behavior system and the positive reinforcement mechanism of the "taste" system.

2) The electric stimulus has the same effect as food in the mouth which causes eating and repetition of antecedent behavior. These views are related both to one another and to Brobeck's view, but they emphasize the distinction between drive-caused behavior and reward-caused selection of a particular behavior for repetition. In drive-caused behavior an antecedent condition heightens the activity level of the organism facilitating *all* behaviors, thereby causing an increase in the diversity of behavior. In reward-caused behavior a stimulus subsequent to a random response causes that *particular* response to be repeated at the expense of all other random responses, thereby diminishing the diversity of behavior.

JAMES OLDS

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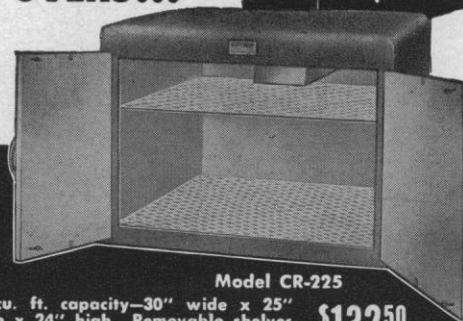


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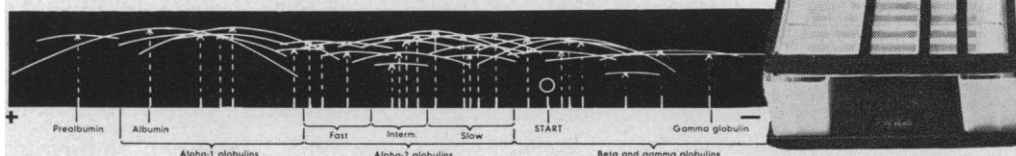
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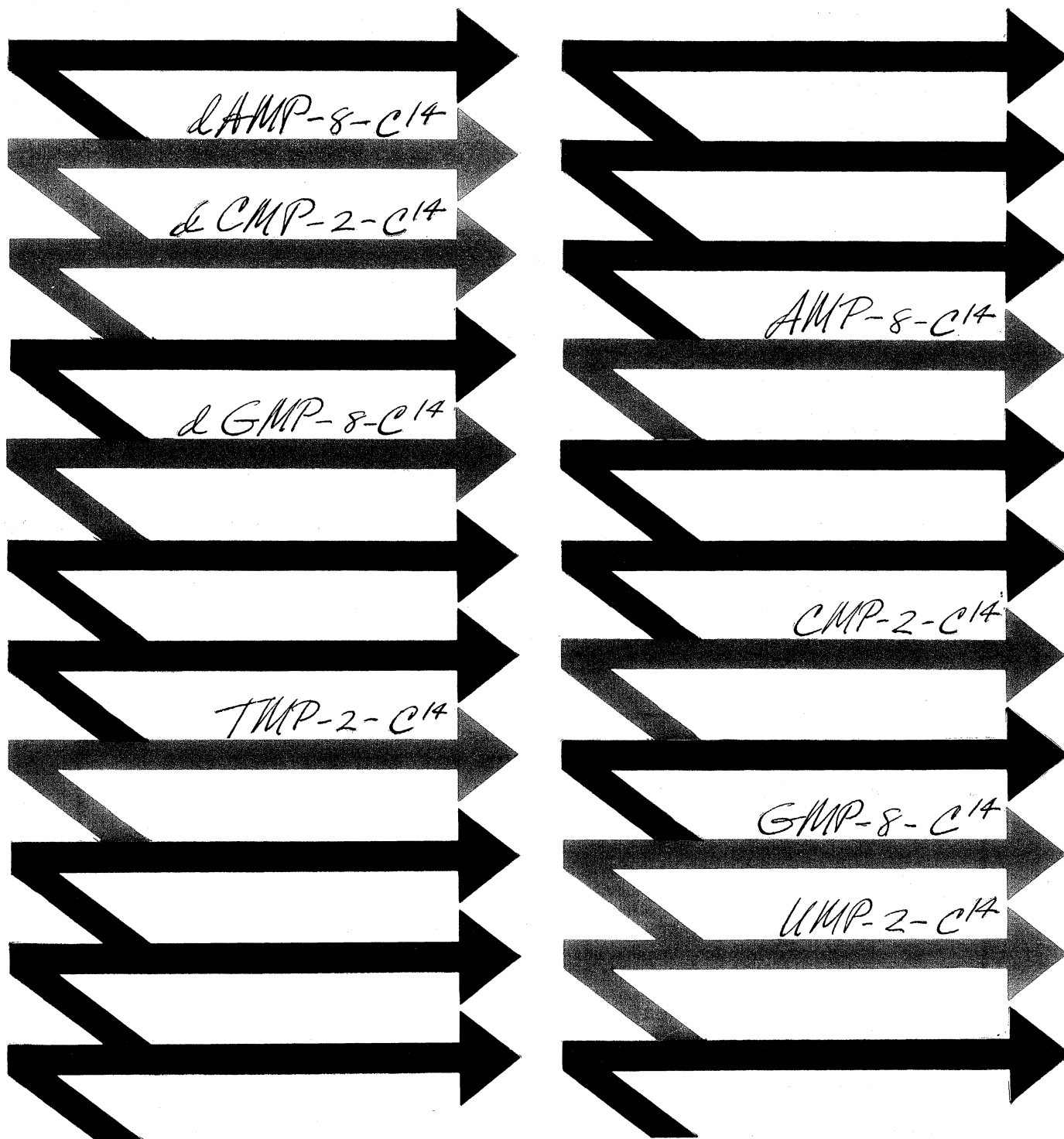
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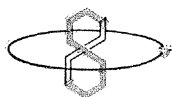
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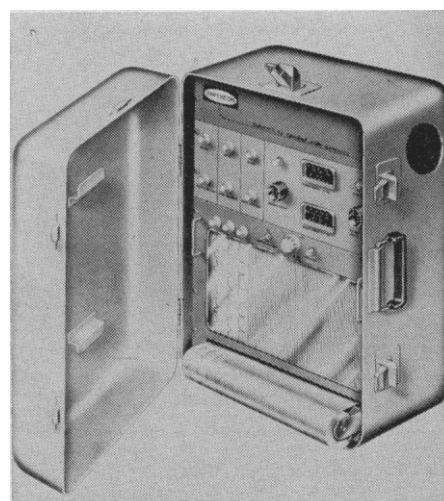
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Joshua Stern (J.S.), Basic Instrumentation Section, National Bureau of Standards, Washington 25, D.C. (physics, computing, electronics, and nuclear equipment).

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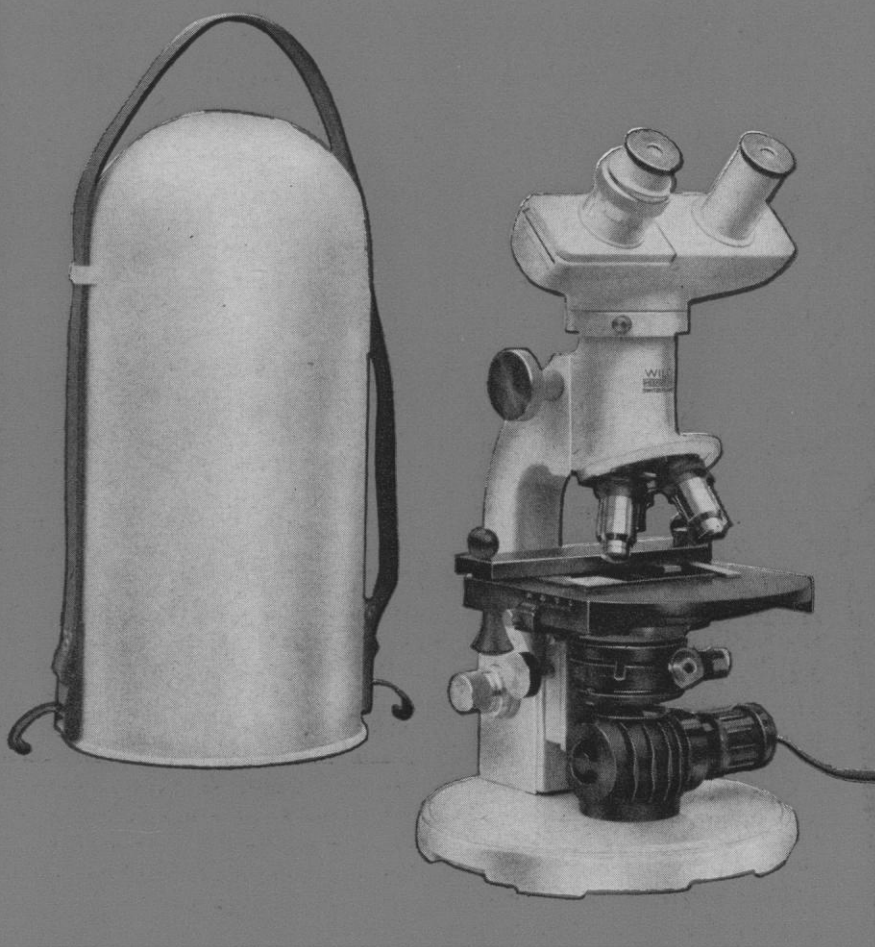
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Thermal-conductivity apparatus (model TCP-200) is designed for the measurement of powders, fibers, and other particulate insulators in vacuum, inert gas, or air. The apparatus uses the radial-flow principle and operates over the range -300° to +3000°F. A central heater 1 inch in diameter, consisting of dense alumina, is wound in

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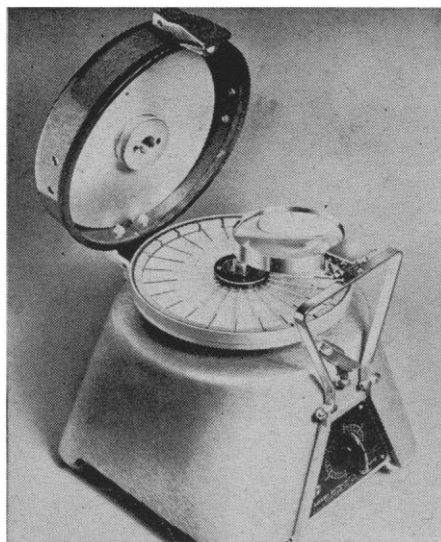
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with platinum-rhodium wire carrying taps to measure the power dissipated in a 3-inch length of its central zone. An auxiliary heater 3 inches in diameter surrounds the sample and allows independent control of heat flux temperature. Immediately surrounding the auxiliary heater is approximately 2.5 inches of insulation contained in a cryogenic-liquid or water-cooled heat sink. Samples are placed in the annulus surrounding the central heater. Measurements of conductivity are made by adjusting power to the heaters to provide the desired heat flux and temperatures. Power dissipation measurements are made with a volt-meter and ammeter accurate to ± 0.5 percent. The vacuum chamber is 18 inches in diameter and 30 inches high and provides an ultimate vacuum of 5×10^{-7} mm-Hg.—J.S. (Dynatech Corp., 17 Tudor St., Cambridge 39, Mass.)

Circle 9 on Readers' Service card

Microhematocrit system reduces microhematocrit procedure to its simplest, most direct form. Utilizing a direct-reading head and a removable tube-carrying tray, the "Autocrit" permits the technologist to collect the



specimen at the bedside or in the laboratory, and to transport, centrifuge, and read the results right in the centrifuge. The tubes are handled only once, thus minimizing the chance of specimen loss or mix-up. Specifically designed to cope with heavy work loads, the Autocrit can process 24 capillary tubes at one time.—R.L.B. (Clay-Adams, Inc., 141 E. 25 St., New York 10, N.Y.)

Circle 10 on Readers' Service card

Illuminated magnifiers have attachments that are compatible with the basic Flash-O-Lens for special applications. Eleven basic components comprise the entire package, and may be purchased together or individually. These components include: the lens-housing ring required on all assemblies; illuminating handle; (optional electric handle may be interchanged with standard battery-operated handle); a 20 or 40 \times tube for extremely close examination; a 4 or 5 \times achromatic or non-achromatic lens set; the textile plate for pick counting; the Battley disk for applications requiring concentric circles; and the required lens housing. This illuminated magnifier has magnification of 4.5 to 40 \times and is a useful laboratory tool where gross examination of macroscopic objects is desirable.—R.L.B. (E. W. Pike & Co., Inc., 577 Pennsylvania Ave., Elizabeth, N.J.)

Circle 11 on Readers' Service card

Dual column gas-liquid chromatograph (model A-110-D) has two 6-foot coiled glass columns mounted in the column oven. One column is wound inside the other. These columns can be operated individually or in series. This dual column unit operates with a radium, strontium, or hydrogen flame detector. Through the use of a new electrometer design, electron capture detection methods can be used without additional electronics or special detectors. This unit can be operated isothermally or by programming temperature; manual or automatic collection systems are available. There are 13 ranges of electrometer sensitivity with a selection of input impedances. The high voltage is supplied in three ranges: 0 to 20, 0 to 200, and 0 to 2000. The unit is 22 inches wide, 16 $\frac{3}{4}$ inches deep, and 15 $\frac{3}{8}$ inches high.—R.L.B. (Glowall Corp., Glenside, Pa.)

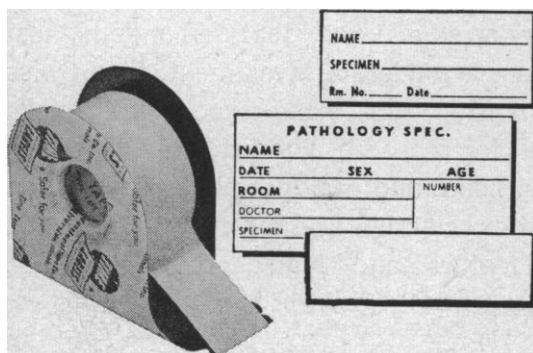
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Frequency-response slide rule provides a direct reading of amplitude ratio and phase versus frequency for all the terms in a complex transfer function. With one setting, the desired information is presented for 20 frequency intervals per decade through six decades. Phase angles are read to ± 0.5 deg; amplitude ratio is read to ± 0.05 db. There are 11 slide channels. One channel has a frequency scale covering six decades from 0.001 to 1000; each of the ten remaining channels has a scale that represents one

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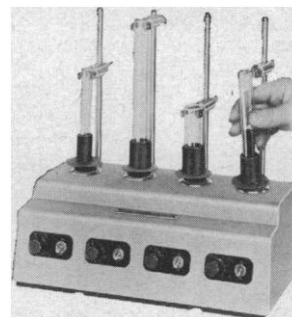
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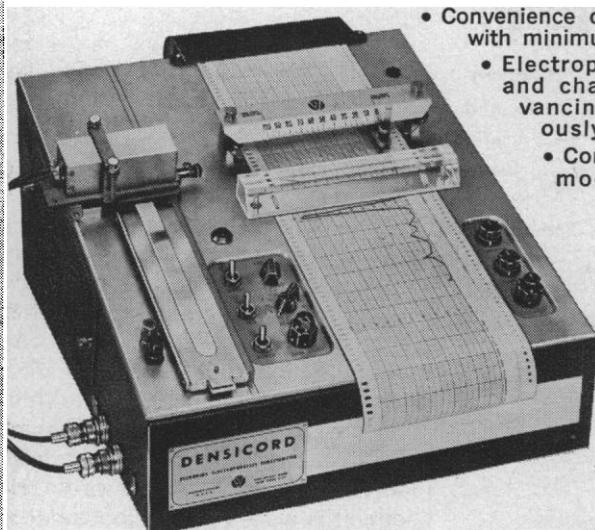


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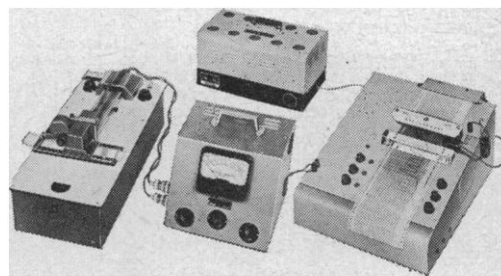
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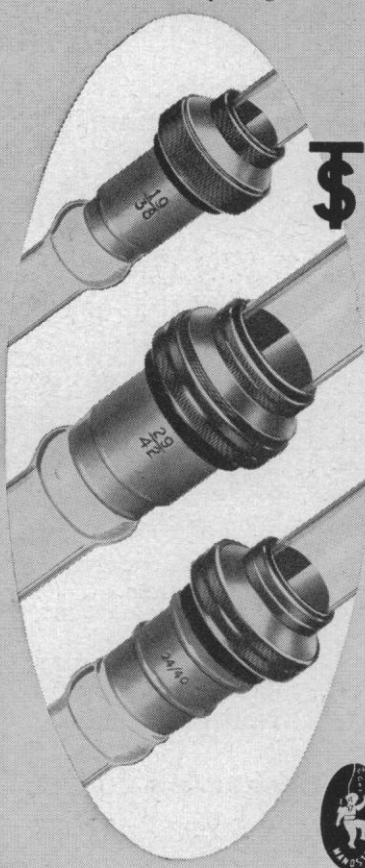
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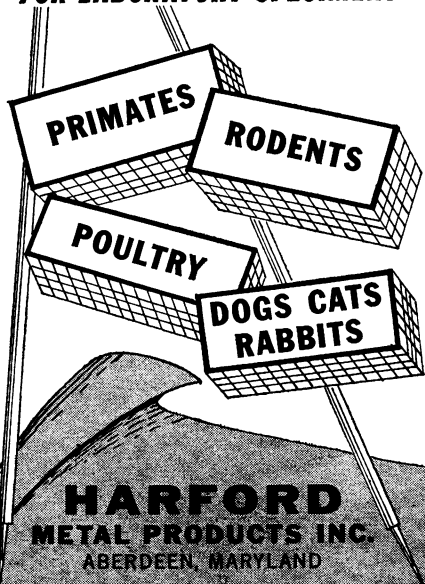
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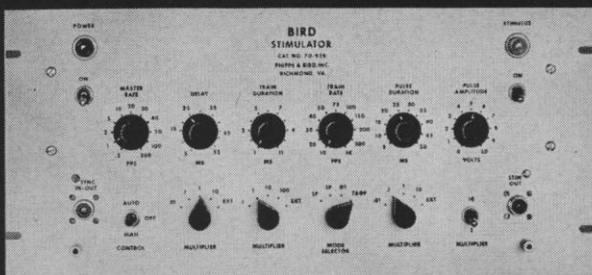
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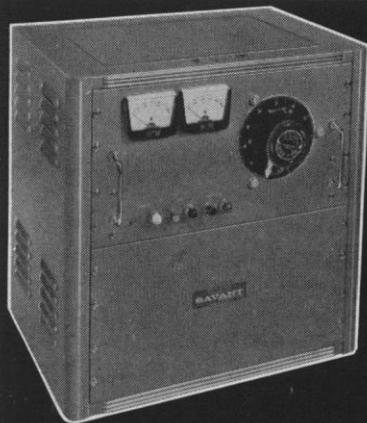
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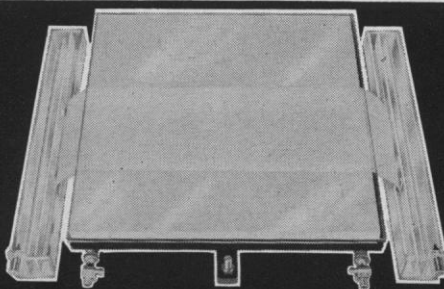
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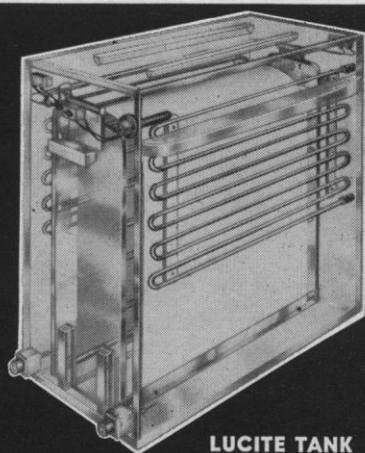
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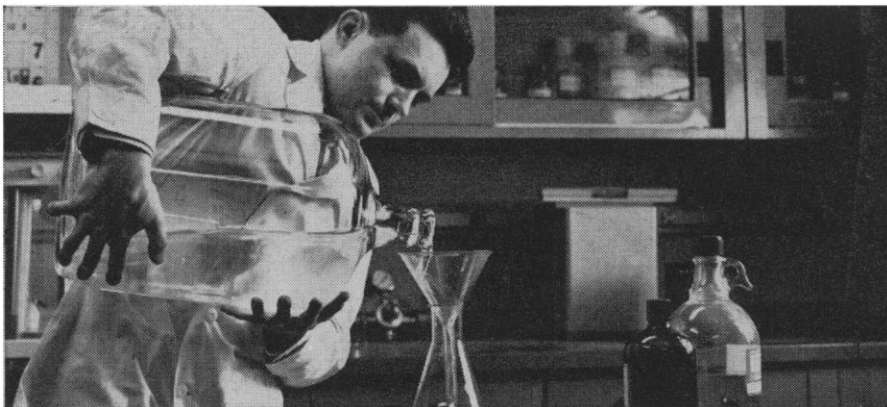
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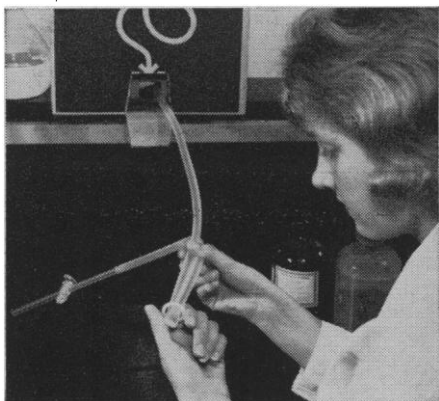
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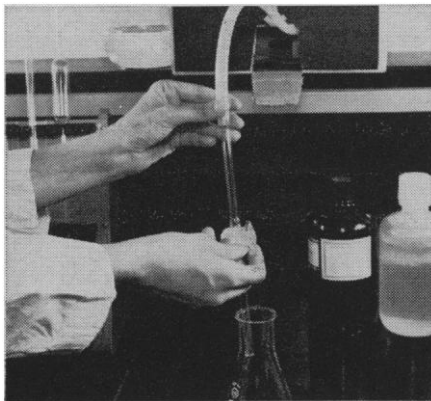
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Statistical digital voltmeter (model SV2) automatically processes data represented by electrical voltages, classifies the measurements, and displays the data in the form of a frequency distribution. The instrument produces a bar graph that reveals the number of items falling within, above, or below tolerance limits; the number of items that have fallen into any of 16 other specified categories above or below a center value; and how these data compare with those of a previous period. The instrument compares each voltage input with a pre-established center value. It then determines in which of 19 deviation classes the voltage lies. The number of signals falling in each class is stored until a pushbutton command causes the data to be plotted on an x - y recorder. Additional voltages can be entered while the graph is being plotted. Voltage is measured with accuracy said to be ± 0.01 percent in the ranges ± 9.999 , 99.99, and 999.9. Signals may be fed to the instrument at a 3-per-second rate.—J.S. (Non-Linear Systems, Inc., P.O. Box 728, Del-Mar, Calif.)

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Admittance bridge (model 33A) is a self-contained instrument including oscillator and detector. Test frequency is selectable from the following: 1, 5, 10, 20, 30, 40, and 50 Mcy/sec. The capacitance range is 0 to 150 pf and the conductance range is 0 to 6000 μ mho. Bias range is -5 to $+100$ volts.

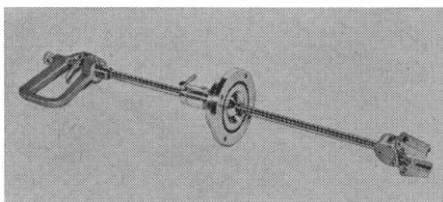
The bridge is supplied with a set of seven work coils, one for each test frequency, to permit zeroing the bridge prior to measurement. All variable elements in the bridge are air capacitors, thus assuring, according to the manufacturer, continuous smooth operation without deterioration of calibration.—J.S. (Boonton Electronics Corp., Morris Plains, N.J.)

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Event-marker galvanometers make it possible to use light-beam oscillographs to record the starting, stopping, duration, and separation of events, as indicated by the presence or absence of a trace on the oscillogram. When the event-marker galvanometer is activated, a standard galvanometer suspension rotates a shutter away from a mirror fixed to the galvanometer front post. Manual adjustment of the post positions the trace horizontally on the oscillogram. When full signal is applied, the mirror is fully exposed. Response time from signal to trace is 10 msec for the type 7-371 galvanometer, 1 msec for the type 7-372, and 0.5 msec for the type 7-373. Sensitivities of the three types are 400 ma, 6.0 ma, and 2.5 ma, respectively, each ± 5 percent.—J.S. (Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif.)

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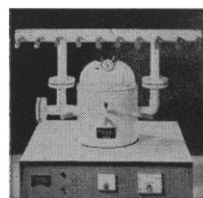
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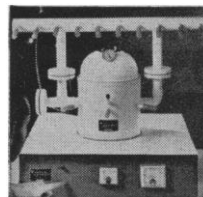
Autofil cell permits the automatic filling and emptying of a special spectrophotometer or colorimeter cell without removing the cell from the instrument. A three-position combined lever and filling tube controls a system of valves. The sample solution is drawn up into the cell under vacuum from a separate pump. When the cell is full, any surplus liquid is automatically removed. When the sample is emptied, less than 1 percent of the sample volume is left in the cell. The cell may also be effectively sealed so that no further sample or air can enter. The sample solution does not pass through the valve system and comes into contact only with fine-bore polythene and stainless-steel tubing. The Autofil cell will save a considerable amount of time in the operation of colorimeters and spectrophotometers, and also will reduce the risk of cell breakage and contamination.—R.L.B. (Unicam Instruments Ltd., York St., Cambridge, England)

Circle 22 on Readers' Service card

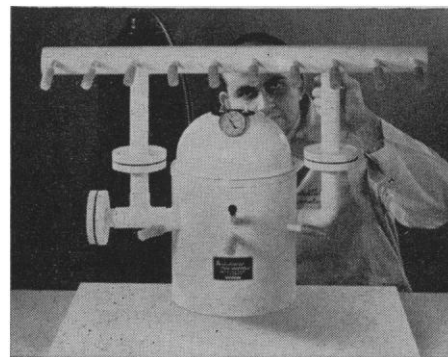
Impedance matching device is a transistor Emitter Follower (type 1-301) for use with high-impedance piezoelectric transducers. The Emitter Follower provides a minimum of 300 megohms impedance and 100 ohms output impedance with no loss in voltage sensitivity (unity gain). High input impedance and flat frequency response (± 5 percent from 2 cy to 10 kcy/sec with a 50,000-ohm load) insures a wide frequency range of measurements. This Emitter Follower is compatible with all types of crystal accelerometers. Operating temperature range of the unit is from -65°F to $+185^{\circ}\text{F}$. Maximum undistorted output voltage is 10



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volts peak-to-peak, linearity is ± 1 percent and reference gain is 1, with a stability of ± 1 percent. An integral four-conductor shielded cable is provided for excitation voltage and output signal. The device is 1.03 inches high by 0.64 inch wide by 0.53 inch deep and weighs 16 g.—R.L.B. (Consolidated Electrodynamics Corp., 360 Sierra Madre Villa, Pasadena, Calif.)

Circle 23 on Readers' Service card

The Dynatrol-10 temperature indicator and controller is a self-contained solid-state instrument that permits control of temperature over the range -100° to $+565^{\circ}\text{C}$ with a single probe. The controller operates at ambient temperatures up to 54°C . Accuracy at 0°C is said to be $\pm 0.3^{\circ}\text{C}$. According to the manufacturer, regulation within $\pm 0.05^{\circ}\text{C}$ can be achieved when a well-balanced system is used. Interchangeable stainless-steel tape scales used in the instrument are available in 15 ranges, with choice of 1°F or 0.5°C graduations. Plug-in bridge components, matched to the scales, simplify range changes. Adjustments are made by means of a 10-turn potentiometer. Fail-safe operation is said to be provided against an open circuit in the probe or lead wires. The unit measures 8 by 8 by 7 inches and weighs 9 lb.—J.S. (Dynatronic Instruments Corp., 3070 W. Grand Ave., Chicago 22, Ill.)

Circle 24 on Readers' Service card

Klystron stabilizer (model KSL) permits closed-loop locking of klystron oscillator frequency to an external cavity. In the unlocked mode of operation, the instrument provides tuning indication. In the locked mode, it automatically adjusts the klystron reflector voltage to maintain the klystron frequency centered on the resonant frequency of the external reference cavity. Features include: front-panel selection and adjustment of phase; front-panel control of gain and reflector modulation levels, selection of locked or unlocked mode of operation, built-in test signal, 40-volt correction range, 100-db gain, and a-c or battery operation.—J.S. (Triconix, Inc., Bear Hill, Waltham, Mass.)

Circle 25 on Readers' Service card

A-c null detector (model 51-A) is a cathode-ray indicating instrument with provision for discriminating against all frequencies except that to which it is tuned. Tuning range is 20 to 200

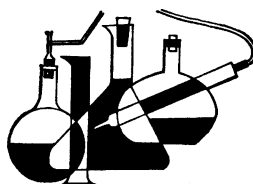
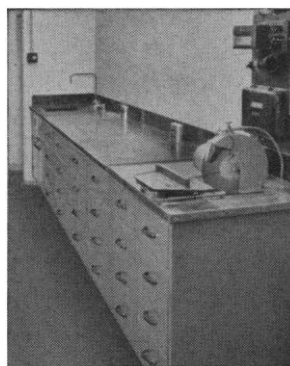
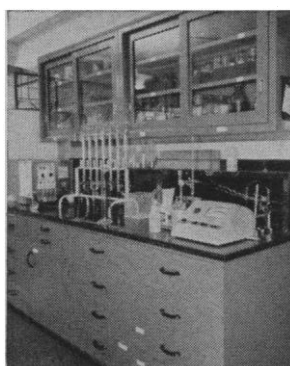
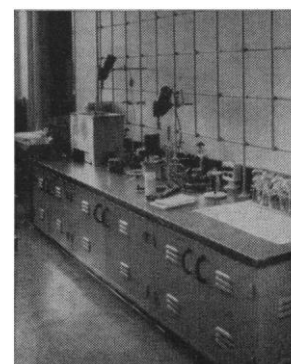
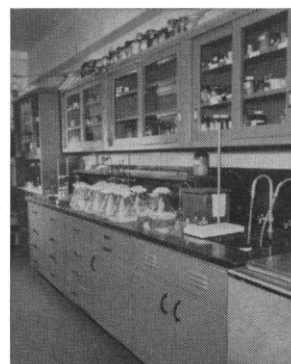
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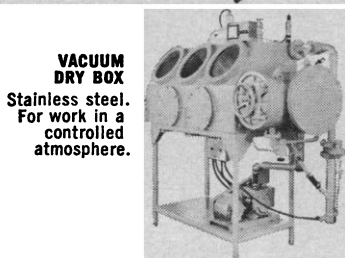
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key/sec. When used as an impedance bridge indicator, it can be adjusted to show resistive and reactive balance separately. External frequency standards can be switched in to check or set the frequency of the generator that is to power the bridge. Range compression permits easy bridge balancing when the value to be measured is unknown. Input impedance is 1 megohm shunted by 100 pf. The instrument can be calibrated for use as a tuned peak-to-peak voltmeter or as a wave analyzer.—J.S. (Boonton Electronics Corp., 738 Speedwell Ave., Morris Plains, N.J.)

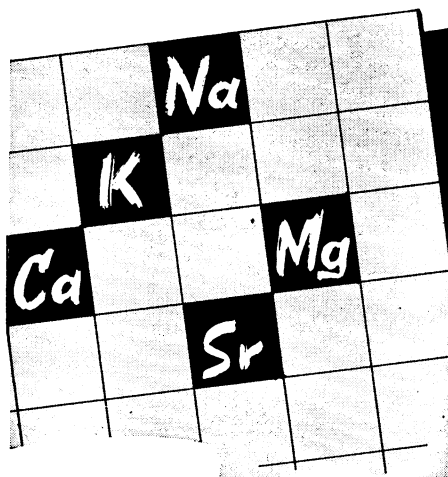
Circle 26 on Readers' Service card

Event recorder with 60-channel capability features a built-in threshold level for each channel. The system monitors up to 60 events simultaneously and records voltage level changes as small as 60 mv on an inkless chart 16 inches wide and 200 ft long. In operation, incoming signals are continuously compared with preset threshold levels and deviations are recorded by deflection of the corresponding channel styli. Response time of the system is said to be better than 10 msec. The threshold level for each of the 60 channels is set by the operator by feeding into the system separate signals ranging between +150 and -160 volts. Input impedance is greater than 1 megohm. Transistorized circuitry is used in the instrument, which is said to be sufficiently rugged for use in the field.—J.S. (Techni-Rite Electronics, Inc., 65 Centerville Rd., Warwick, R.I.)

Circle 27 on Readers' Service card

Calorimeter (model 12) is a double-guarded cold-plate apparatus for measuring the thermal conductivity of insulation materials under in-test controllable conditions of temperature, mechanical pressure, and atmosphere. In the apparatus, a test sample up to 2 inches thick and 12 inches in diameter separates a heated plate from a facing plate that is cooled by a thermally isolated cryogenic fluid. The boil-off rate of the fluid provides data on heat flow through the insulation material. Thickness of the sample can be continuously monitored from 0 to 2 inches during test and can be adjusted during test. Mechanical pressure can be monitored and varied from 0 to 50 lb/in.² Pressure within the sample chamber can be varied between 10⁻⁵ mm-Hg and 50 lb/in.², through the use of any desired

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gas. Cold-plate temperature can range from 4.2° to 220°K and warm-plate temperature from 77° to 500°K.—J.S. (Arthur D. Little, Inc., 25 Acorn Park, Cambridge 40, Mass.)

Circle 28 on Readers' Service card

Multi-channel light-beam oscillographs (series 2300) provide direct recording with incandescent light sources. They are available with 8 or 16 channels and have a basic-system response of ± 5 percent from d-c to 1000 cy/sec. With compensated amplifiers, system response is 2500 cy/sec and signals from 0.2 to 2000 mv/mm can be accommodated. Response to 5 kcy/sec can be obtained with special compensation. System linearity is 2 percent of best straight line. Writing speed is greater than 30,000 in./sec with records visible directly on exposure to ambient room light. Eight chart speeds from 0.2 to 50 in./sec can be adjusted during operation without loss of data. The incandescent light used for recording is harmless to the eye. The lamp reaches full intensity within a few milliseconds and can be restarted instantly without prolonged cooling periods. Available accessories include solid-state galvanometer amplifiers, flash timers, trace interrupters, remote on-off control, and rack-mounting adapters.—J.S. (Brush Instruments Div. of Clevite Corp., 37th and Perkins, Cleveland 14, Ohio)

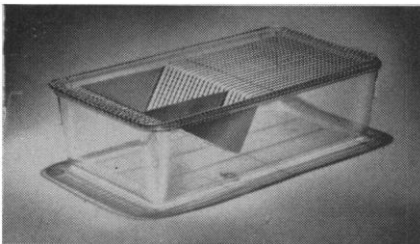
Circle 29 on Readers' Service card

Digitized measuring frame is designed for use with film-viewing tables, projection devices, and light tables, to measure the x and y coordinates of hard-copy or projected images. The frame has a range of 24 inches on each axis. Precision is said to be 1 part in 3600 over the entire range of the device. The digitizer consists of a portable 41-inch-square frame approximately 8 inches deep, with a 24-inch-square opening in the center. Hand wheels adjust the x and y cross wires. The movement of the cross wires is converted to digital form by rotary encoders for punch-card readout. Twenty 10-digit rotary thumb wheels are provided to set in indicative data. These are automatically included with every coordinate measurement readout. Maximum recommended speed of the encoder shafts is 13 rev/min, equivalent to 3 rev/sec of the hand wheels. Non-linearity of the encoder is said to be negligible.—J.S. (Houston Fearless Corp., 2800 7th St., Berkeley, Calif.)

Circle 30 on Readers' Service card

A Mousellany of Animal Care Developments

They Said It Couldn't Be Done



Econo-Cage #37, Lid #32G

The remarkable new Polycarbonate Econo-Cages (Series "20" and "30" for mice, "40" and "50" for rats and hamsters) are clear, autoclavable and unbreakable.

To operate most efficiently, animal colonies must use cages which withstand the rough and tumble of mechanized washing systems and the high temperatures at which these systems and autoclaves operate. Because colonies must be inspected quickly, cages should afford maximum visibility. Until now the cages were either transparent or durable, but none had both characteristics.

The new Polycarbonate resin combines the optical and thermal properties of glass with an impact resistance unmatched by any other clear material. A good example of the degree of impact resistance was furnished when a cage did not break when dropped out of a fourth floor window. Polycarbonate retains this remarkable strength from 275°F to -40°F. It is the first clear plastic which can be autoclaved repeatedly.

This new material, a linear aromatic polyester of carbonic acid, has a very low absorption level. Odor-producing gases are not absorbed; resistance to most acids and basics is very good.

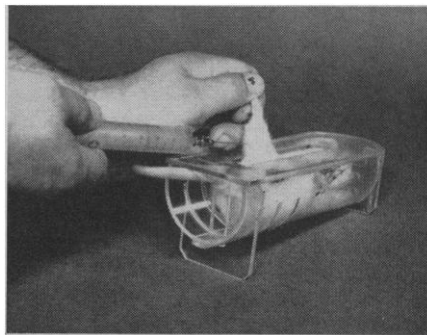
The cages are made to NIH and ILAR Standards. The cage illustrated above is one of the "30 Series" of Econo-Cages, which includes cages of fibre glass, acrylonitrile-styrene-copolymer, polypropylene and polycarbonate. There are three lid styles which are interchangeable on all "30 Series" cages.

CAGE DIMENSIONS

SERIES	LENGTH	WIDTH	DEPTH
"20"	11½"	7½"	5"
"30"	19"	10½"	5½"
"40"	19"	10½"	6½"
"50"	14⅞"	12⅞"	6⅞"

Working With Restraint

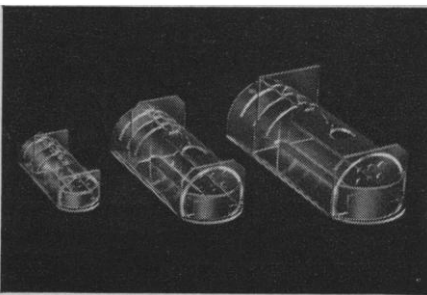
Econo-Cage Restraining Cages are clear acrylic plastic units that afford rapid and safe immobilization of animals, easy access and maximum visibility. There are 3 sizes to accommodate varying sized animals. They prevent unanesthetized animals from attacking tubes, cannulae, and other fixtures; provide extended housing during nutritional studies; restrain animals during intravenous, intraperitoneal, intramuscular, and subcutaneous injections; and are useful for administering intravenous fluid drips and anaesthetic.



#90 Restraining Cage being used for intramuscular injection

All restrainers have an adjustable tailgate which fits into any of three slots to vary cage length, confine the animal and serve as a cage door. Openings at top, bottom, and tail provide easy access to any part of the animal (the bottom slot also permits drainage of animal waste). A hopper permanently attached to the front of the unit includes a trough for granular feeds and a water tube inlet.

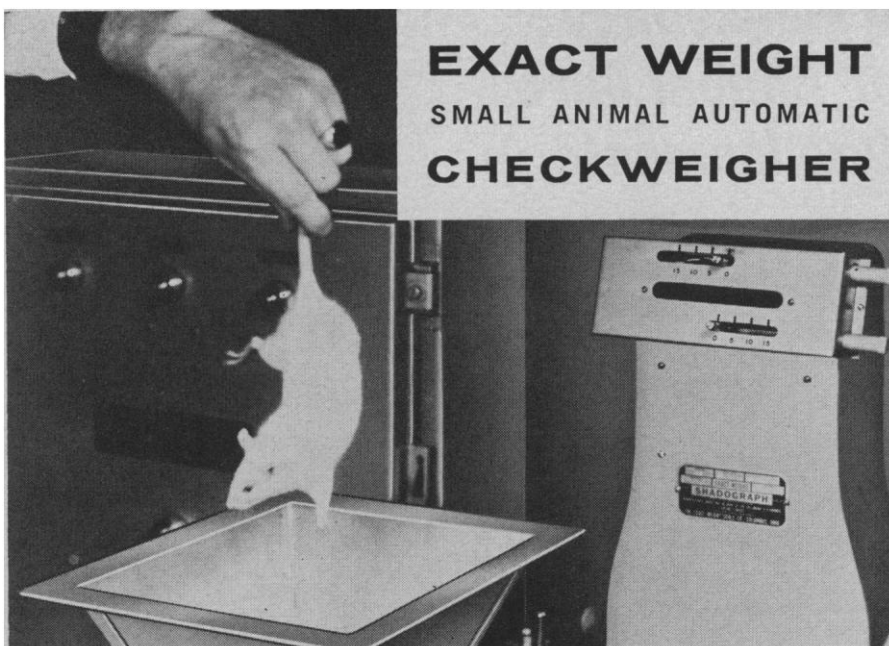
CAGE NO.	CAGE SIZE	ANIMAL WEIGHT
#88	2" to 3½" long; 1½" wide	Mice from 10 to 40 grams
#90	4¼" to 5½" long; 2½" wide	Rats/hamsters from 150 to 285 grams
#91	5" to 7" long; 3¼" wide	Rats/hamsters from 235 to 585 grams



Econo-Cages #88, #90, #91



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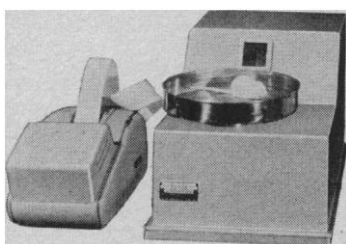
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NEWS AND COMMENT

(Continued from page 165)

port, furthermore, by no means ends at the "on-campus" line. Last year the dollar volume of federally sponsored research on campus amounted to \$21.5 million of the \$45.8 operating budget of the Institute.

Work on the on-campus federally supported research projects is to an increasing extent carried out in interdepartmental laboratories, to which the improvisations of wartime gave strong impetus. The oldest and perhaps best known of these labs is the Research Laboratory of Electronics, which shares the ancestry of the Radiation Lab and continued its working relationship between electrical engineering and physics. The entrée has been broadened until now faculty, graduate students, and undergraduates from 11 departments are on the R.L.E. rolls.

The need for equipment and for more extensive financing and organization has pushed the development of the interdepartmental labs to the higher form of the "center," which School of Science dean George Harrison Russell calls an "attempt to overcome the effects of overspecialization."

M.I.T. president Julius A. Stratton, in describing the new center for materials research, said, "We conceive the center to be a federation of many individual projects, each consisting of a professor or a few closely associated professors, with their graduate students, postdoctoral research workers, and so on. In conformity with university traditions, these individual projects are essentially autonomous, determining their own programs and to a large extent handling their own business, and the center is a coordinating body whose main function is to pass information back and forth, as well as to supply the convenience of central facilities which are too large for any one project to handle itself."

Monuments to the center idea seem to be rising all over the M.I.T. campus. Tech is in the process of raising a minimum of \$66 million for development, and a substantial portion of that is being allocated to the construction of five new interdepartmental centers: Aeronautics and Astronautics, Communications Sciences, Earth Sciences, Life Sciences, and Materials Sciences and Engineering.

The center principle, which has developed great momentum at M.I.T. and has been widely applied elsewhere,

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is not, however, an object of unreserved approval at Tech. Some faculty members regard the center idea as inapplicable in many fields, and one senior professor observed wryly that "a new idea sells better" in getting support money and projects. Some feel that the center threatens departmental divisions, and deeper misgivings are expressed by those who fear that projects may become the main concern at the centers, rather than students.

Concern over the implications of the centers is only one instance of the qualms fairly generally admitted at M.I.T. over the effects of the expansion of research under federal support. M.I.T., moreover, has a history of organizing its self-criticism, and the place abounds with working committees and study groups.

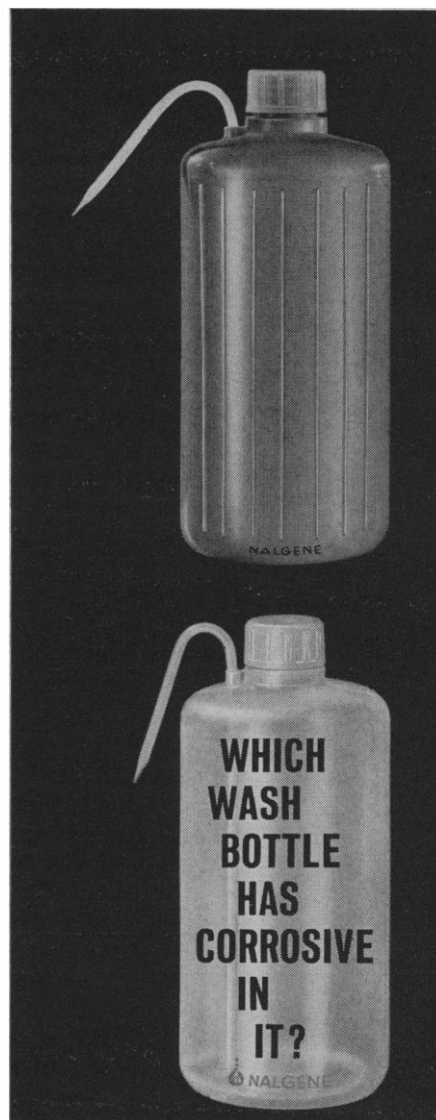
The curriculum is under permanent review, and the relationship of the Defense Laboratories to the Institute proper is apparently another subject of constant consideration. Currently under study is the extremely complicated and touchy matter of faculty conflict of interest. Outside consulting has always been a faculty prerogative, regularized on a 1-day-a-week basis, but the search for standards now focuses on such cases as that of the professor who sits on a government panel making a decision on military hardware, information on which would be useful to a company that the same professor serves as a consultant or an officer.

At M.I.T. and elsewhere the working assumption is that government support of research is here to stay and that such dilemmas will only grow more difficult. In the dynamic area of government-university relations, therefore, M.I.T. is a leader in a changing game for which the old rules will not serve.—JOHN WALSH

A View from the Pork Barrel: Congress, PHS, Haggle Over Proposed Health Center Site

There is at least one way in which Congress, its critics to the contrary, has not failed to keep up with changing times. The old tradition of the federal pork barrel has been reshaped, and Congressmen now haggle over the location of scientific facilities with all the energy once spent in pursuit of rivers and harbors projects for their own districts.

A case in point is the Public Health Service's proposal for a National Cen-



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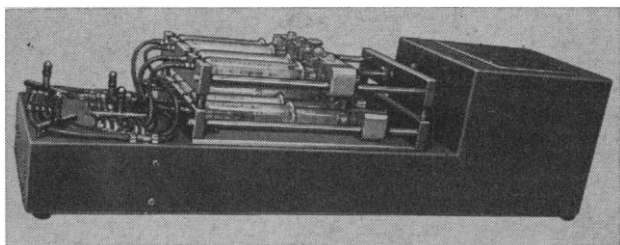
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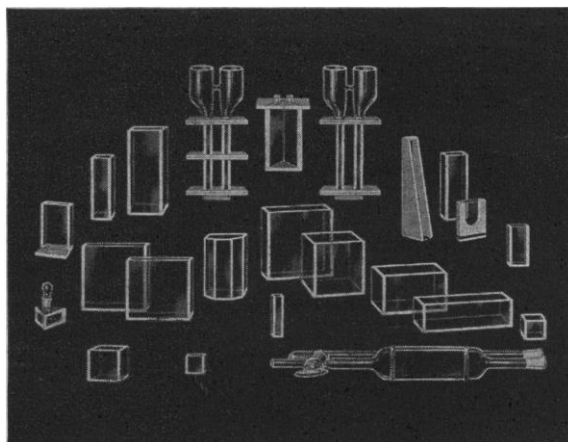
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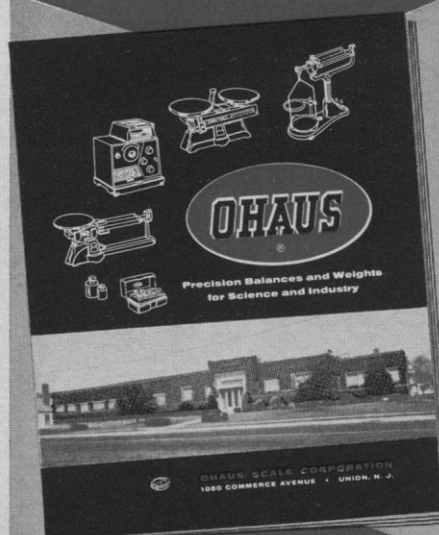
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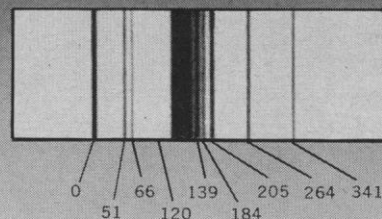
ter for Environmental Health, which the PHS would like to locate in the Washington, D.C., area. For the past 2 years Congress has refused to appropriate the \$2,761,000 requested by the PHS for site acquisition and planning, and from reports filtering out of closed appropriations hearings in the House last month, and from open hearings in the Senate, it appears that the funds may be denied this year as well.

The trouble centers wholly on the location of the proposed Center, not on its merits, for no one denies that it is badly needed. Congressmen are not unaware of the growing public anxiety over environmental contaminants—focused mainly on radioactive fallout, but ranging, too, from concern over foul air and polluted rivers to panic over Thanksgiving cranberries—and they have long recognized that existing Public Health Service programs in these fields are fragmented and inadequate. Congress is willing to support an expansion of PHS programs and the building of an Environmental Health Center somewhere, but it will not be persuaded that the Washington location is crucial.

The Public Health Service believes that it is. Environmental health is a new field, significantly different from disease-centered public health activities, and its focus on protection from the adverse by-products of technological change requires a new kind of organization, for operational programs as well as for research. Responding to the new problems, the Public Health Service has accumulated new divisions, but in a helter-skelter way—Food Protection in the early 1940's, Air Pollution in 1955, Radiological Health in 1958. These, plus divisions on Water Pollution and Occupational Health, and some field facilities—the Taft Sanitary Engineering Center in Cincinnati, three radiological laboratories, and a shellfish laboratory—make up the present PHS effort. It is supplemented by the environmental health activities of other government agencies—the Atomic Energy Commission in radiation, the Food and Drug Administration in food protection, and a half-dozen agencies with interest in water resources.

By seeking to place its Environmental Health Center in Washington, the PHS hopes not only to coordinate its own research and operational activities with these other agencies but to take advantage of Washington's other scientific institutions and resources—the National Institutes of Health, the

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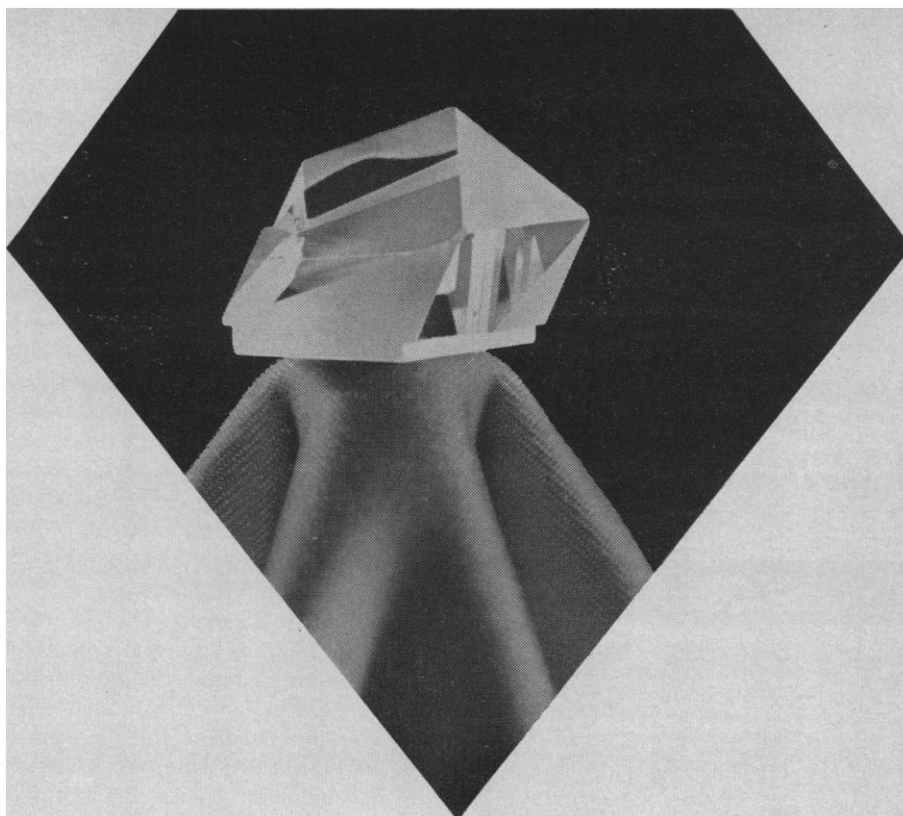
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Bureau of Standards, the National Science Foundation—and to get a voice for itself in policy-making both within its own Department (Health, Education, and Welfare) and in scientific councils generally. PHS officials do not deny that attractive scientific resources exist elsewhere in the country; it is just, as one of them put it, that “Washington and Washington alone has the other government agencies.” The officials also point out that between one-third and two-thirds of the Center’s future personnel are already located in Washington and that relocating them would be costly and inconvenient.

Since its first rejection by Congress in 1961, the PHS proposal has been reviewed by two scientific panels—one, the Gross Committee, appointed by the Surgeon General, the other a panel appointed by the President’s Science Adviser—and both have endorsed the Washington location. And in his health message to Congress last February, President Kennedy specified that the money he had budgeted was for “a central facility in the Washington area which can serve as a focal point for related research, training and technical assistance in environmental health.”

Still, Congress refuses to be convinced and wants to see the Center located elsewhere. The objections are not solely those of the pork barrel—although the Congressmen vie with each other in illuminating the virtues of their own districts as sites—but a compound of other things as well. A financial argument—that land costs in the Washington area are too high—is actually irrelevant, since the Beltsville, Maryland, site the PHS wants is already owned by the government. Another argument has to do with national security—and here the Congressmen are still responding to the directives on decentralization of a few years ago (since quietly shelved), which chased the Atomic Energy Commission about 30 miles into Maryland, the Social Security Administration into Baltimore, and the Central Intelligence Agency somewhat beyond the local suburbs.

A combination of these objections was expressed at last year’s appropriations hearings by Representative Charles R. Jonas, Republican, of North Carolina (whose governor had offered a free site there for the Center). Jonas wondered why, “if you can get a location such as this donated free of charge . . . you should spend \$3000



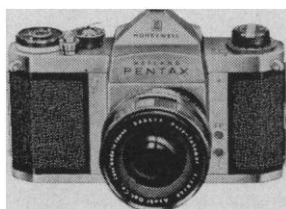
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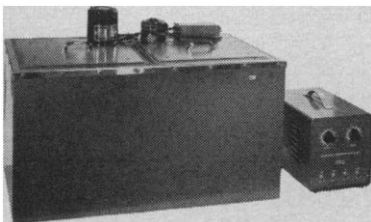
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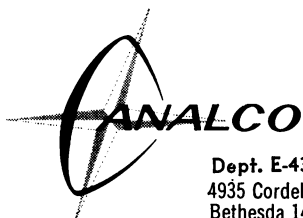


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Other objections grow out of a skeptical view of administrators generally, and a feeling that Congress is being put upon by "experts." Senator Robert Byrd (D. W.VA.), who blocked the appropriation on its first appearance in 1961 and dominated the Senate hearings last month, pointed out that any government agency wanting to expand could demonstrate that Washington was the "focal point" of its activities, and called the process a "vicious circle . . . that must stop somewhere." A good way to begin, he thought, would be to build the Environmental Health Center in West Virginia.

Representative Albert Thomas (D.-Tex.), presiding at last year's hearings in the House, thought the administrators were plain lazy: "You just want to make it convenient for the gentlemen here in town who are going to run it," he said. "They do not like to get outside the District of Columbia." And when the PHS witness justified the Washington site in terms of coordination with other agencies, Thomas said, "You are talking like a bureaucrat. Let's get down on the people's level."

Since the Public Health Service is not about to give up its insistence on Washington and Congress is not likely to appropriate the money unless it does, it appears that, although everybody wants an Environmental Health Center, nobody is going to get it—at least not soon. It is understood that in the House the five-man appropriations subcommittee is split three ways, with its chairman John Fogarty (D.-R.I.), and another member supporting the PHS, two members opposing, and a fifth sitting on the fence. In the Senate the opposition of Senator Byrd alone is probably enough to block the appropriation. And, to further confuse the issue, a new move is now afoot in Congress to take the water pollution control programs out of the Public Health Service altogether. This move, supported by 18 Senators and several Congressmen, stems from the feeling that the health-oriented PHS is not the best agent for enforcing antipollution measures. The possible removal of this large chunk from the operations of the Environmental Health Center raises another question about what form it will take when it finally does go through.—ELINOR LANGER

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